Prepared for

CITY OF Salem AT YOUR SERVICE

Winter Maple Bikeway

Bicycle and Pedestrian Plan

Prepared by

DKS

December 2017

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December 12, 2017

City of Salem
555 Liberty St SE, Room 325
Salem, Oregon 97301

Subject: Winter Maple Bikeway Bicycle and Pedestrian Plan

Dear City of Salem,

DKS Associates is pleased to submit the Bicycle and Pedestrian Plan for the Winter Maple Bikeway in Salem, Oregon. Please feel free to call if you have any questions or comments regarding this study.

Sincerely,
DKS Associates

Scott Mansur, P.E., PTOE
Transportation Engineer

Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 PROJECT OVERVIEW

This section provides an overview of the project motivation and background information for the Winter-Maple Bikeway in Salem, OR. This project was a joint effort between the City of Salem and the Oregon Department of Transportation (ODOT). This project is partially funded by a grant from the Transportation Growth Management (TGM) Program, a joint program of ODOT and the Oregon Department of Land Conservation and Development. This TGM grant is financed, in part, by federal Fixing America's Surface Transportation Act (FAST-Act), local government, and the State of Oregon funds. The contents of this document do not necessarily reflect views or policies of the State of Oregon.

INTRODUCTION

The City of Salem's Transportation System Plan (TSP) Bicycle Element (adopted in 2014) identifies the Winter-Maple Bikeway (WMB) as a Tier 1–High Priority project for implementation. The approved alignment, shown on Figure 1 on the following page, follows Winter Street north from the Capitol Mall. After approximately one mile, the route shifts one block west to Cottage Street, then shifts west again to Maple Avenue. Near the northern end of alignment, Maple Avenue becomes Auto Group Avenue. The route follows Auto Group Avenue to the east, and then continues north on Cherry Avenue to Salem Parkway, where it connects with the existing multi-use path that parallels the north side of Salem Parkway. The approved alignment is approximately 2.5 miles long.

While the general alignment has been identified, specific physical, operational, and signage improvements are necessary. The primary objective of this project is to develop a streetscape to better accommodate multimodal circulation, improve safety for all modes, encourage a healthy lifestyle, and support uses adjacent to the WMB.

Project Motivation

The WMB, once constructed, will serve as the first complete family-friendly bikeway in the City. Family friendly bikeways are intended to prioritize bicycle circulation while discouraging non-local cut-through vehicle traffic. They are located on low-volume and low-speed streets that have been optimized for bicycle travel by using traffic calming and traffic reduction devices, signage and pavement markings, and specialized intersection crossing treatments. Family-friendly bikeways are an important component of providing a balanced, interconnected, and safe transportation system in Salem that supports a variety of transportation options. The WMB will support safe and convenient biking and walking to employment, schools, parking, shopping and parks. Elements that benefit bicycle travel are also beneficial to safe, comfortable pedestrian travel. It should also be noted that the WMB alignment follows a portion of the 134-mile Willamette Valley Scenic Bikeway.

<Insert PDF>

Figure 1: Study Area and Proposed WMB Alignment

Many people, estimated to be between 55 and 60 percent of the population, are interested in bicycling but are dissuaded by stressful interactions with motor vehicles. In 2005, the City of Portland first categorized cyclists by their level of comfort with automobile traffic based on professional judgement and familiarity with the bicycling public.[1] These initial numbers have been vetted over time and are widely agreed upon in the bicycle planning community. More recently, Dr. Jennifer Dill of Portland State University conducted a larger regional phone survey to validate the percentages of the population that associate with each comfort category.[2] The "Regional" results below are likely similar to rider characteristics in Salem.

Table 1: Cycling Comfort Level of Portland and Portland Region Respondents[2]

Cyclist Comfort Level	Description	City of Portland	Regional	All
Strong and Fearless	Very comfortable without bike lanes	6%	2%	4%
Enthused and Confident	Very comfortable with bike lanes	9%	9%	9%
Interested but Concerned	• Not very comfortable, interested in biking more • Not very comfortable, currently cycling for transportation but not interested in cycling more	60%	53%	56%
No Way, No How	• Physically unable • Very uncomfortable on paths • Not very comfortable, not interested, not currently cycling for transportation	25%	37%	31%
Total Number of Respondents		**436**	**479**	**915**

This "Interested but Concerned" slice of the population would consider riding a bicycle if more facilities within their comfort range existed. For example, these potential riders are more comfortable riding on a low-volume, low-speed street like Maple Avenue as opposed to a higher-volume, higher-speed street with bike lanes such as Cherry Avenue. Crossing improvements that serve to connect existing comfortable streets may attract this new group of bicyclists to riding in Salem.

In addition to attracting different types of cyclists, the proposed WMB would also provide safe mobility choices for underserved communities. The Salem-Keizer Area Transportation Study 2012 Geographic Profile of Transportation Disadvantaged Populations indicates that the census tracts surrounding WMB have a higher than average concentration of persons living in poverty and persons without access to a motor vehicle. Additionally, two of the three census tracts surrounding the route have higher than average rates of non-white and Hispanic populations. The treatments envisioned will support neighborhood livability and increase active transportation options for people of all ages.

[1] https://www.portlandoregon.gov/transportation/article/264746
[2] http://web.pdx.edu/~jdill/Types_of_Cyclists_PSUWorkingPaper.pdf

BACKGROUND INFORMATION

This section presents the key findings of a review of previously conducted studies and plans that were considered as part of the WMB evaluation and design process.

Previously Considered Bikeway Alternatives

A bicycle and pedestrian connection between Keizer and downtown Salem has been a discussion point for nearly 40 years. The 1980 Salem Bike Plan[3] included three alignment alternatives for a bikeway connecting downtown Salem with the residential neighborhoods north of Salem Parkway. One alignment followed Front Street, another followed 4th Street, and a third followed Winter Street, Laurel Avenue, the railroad tracks, and Cherry Avenue. Over the years, the desire for a bicycle and pedestrian connection has not waivered but the potential alignments have shifted.

In 2009, ODOT developed a bike shed map and a map of potential bikeway alignments.[4] The documentation included a proposed alignment connecting downtown to Salem Parkway that follows Winter Street, Myrtle Avenue, and Cherry Street.

In 2008, the City of Salem applied for an ODOT grant for the proposed North Salem Bicycle Boulevard project which included bike lane striping, pedestrian crossing improvements, railroad crossing improvements, and traffic calming following the Winter Street, Myrtle Avenue, and Cherry Street alignment described in the preceding paragraph. The city was not awarded the grant. However, in 2010, an element of the original application was considered for funding through the Streets and Bridges General Obligation Bond, pedestrian crossing safety project (City Council, April 12, 2010, Agenda Item 8(c)). This potential project would have constructed a median island at Fairgrounds Road at Winter Street. Feedback from the Grant Neighborhood Association resulted in this project not receiving funding and shifting the alignment of the route to avoid this complicated, six-leg, intersection.

[3] Salem Area Bicycle Plan, Adopted SATS Coordinating Committee, et al., March 28, 1980
[4] Map Created by ODOT, May 2009

2.0 EXISTING CONDITIONS

The WMB travels through 32 intersections that include four major arterials, three minor arterials, six collectors and 19 local streets. Several high-volume intersections create challenging crossings for people walking and biking. The following sections provide detailed descriptions of the existing infrastructure as well as operational and safety performance for all road users.

EXISTING INFRASTRUCTURE

Along the proposed WMB alignment, Winter Street, Norway Street, Cottage Street, Maple Avenue, and Auto Group Avenue are all two-way, two-lane local roadways. The study section of Cherry Avenue, classified as a major arterial in the Salem TSP, transitions from a three-lane roadway to a four-lane roadway between Auto Group Avenue and Salem Parkway. Table 2 summarizes the number of lanes, posted speed, and classification for each of the study roadway segments.

Table 2. Study Roadway Characteristics

Roadway (Segment)	Number of Through Lanes	Posted Speed (mph)	Salem TSP Classification
Winter Street (Court Street to Norway Street)	2	25	Local Roadway
Norway Street (Winter Street to Cottage Street)	2	25	Local Roadway
Cottage Street (Norway Street to South Street)	2	25	Local Roadway
Maple Avenue (South Street to Bliler Avenue)	2	25	Local Roadway
Auto Group Avenue (Culdesac to Cherry Avenue)	2	25	Local Roadway
Cherry Avenue (Auto Group Avenue to Salem Parkway)	3-4	35	Major Arterial

Bicycle and Pedestrian Facilities

The existing bicycle and pedestrian facilities along the proposed WMB alignment are shown on Figure 2 on the following page. Sidewalks are currently provided on at least one side of the street along the majority of the proposed WMB alignment, except for the segment of Maple Street north of Locust Street. Within the study area, Cherry Avenue is the only roadway segment with dedicated bicycle lanes. More detailed information regarding the existing bicycle and pedestrian infrastructure is presented later in this memorandum as part of the Bicycle and Pedestrian Level of Stress evaluation. Figure 3 shows how the proposed WMB would tie in to other existing and proposed bicycle facilities in the area.

LEGEND

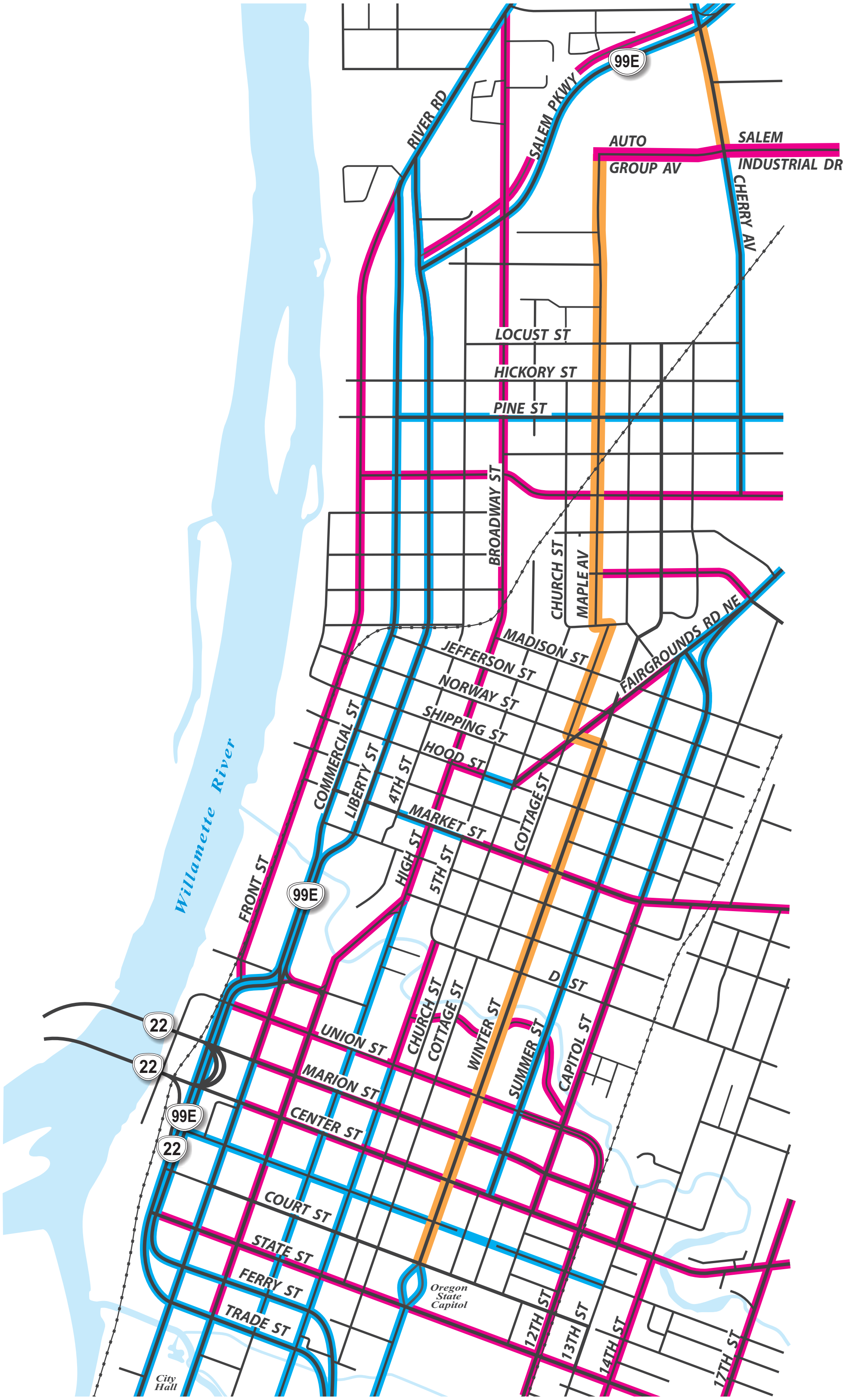
- Existing Sidewalks
- Existing Bicycle Lanes
- Existing Multi-use Path

DKS

No Scale

Figure 2

Existing Bicycle & Pedestrian Facilities along WMB Alignment



LEGEND

- Proposed Bikeway Alignment
- Existing Bicycle Facilities
- Proposed Bicycle Facilities

DKS

No Scale

Figure 3

Proposed WMB Alignment with Connecting Bicycle Facilities

Parking Facilities

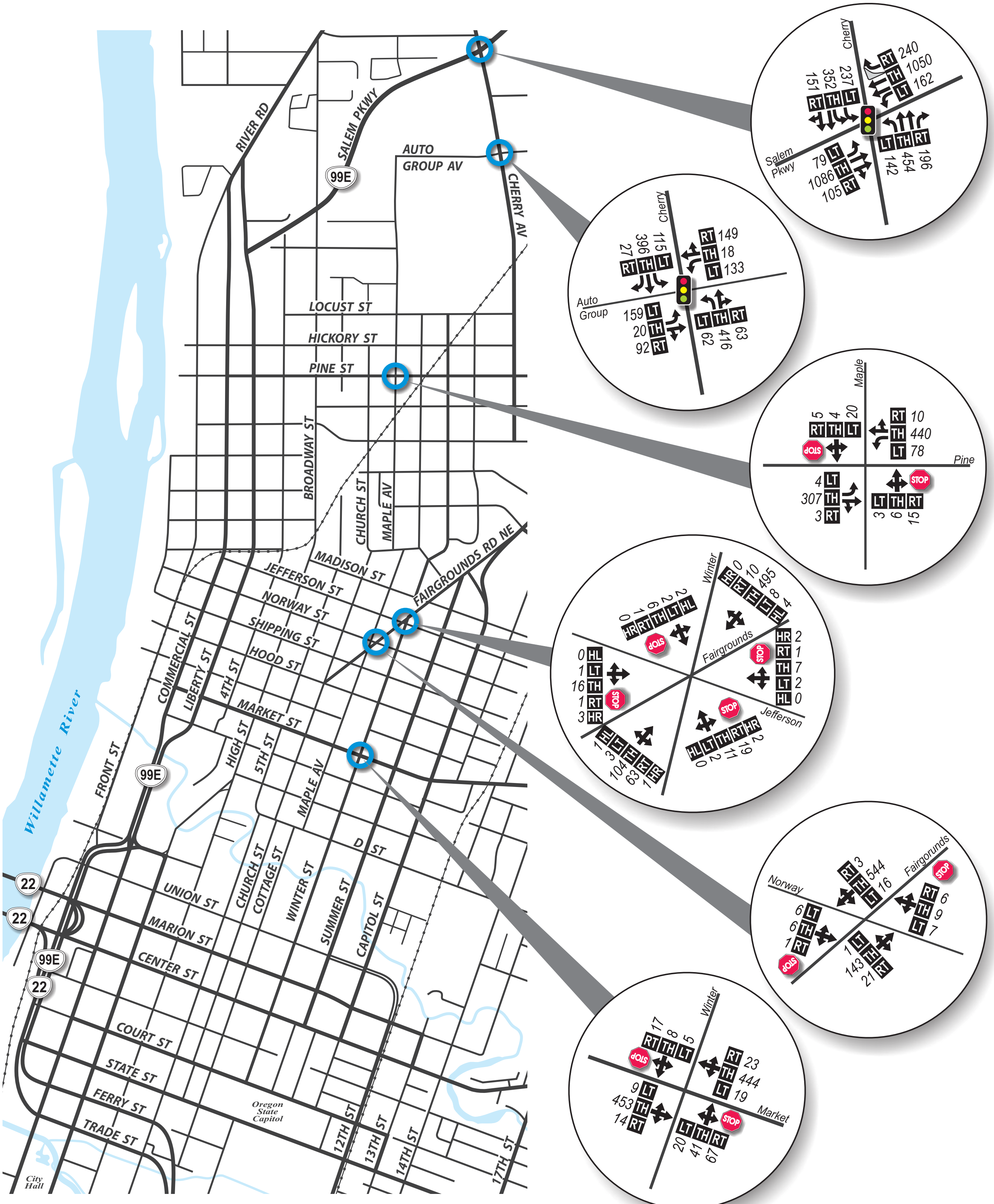
On-street angled parking is provided on Winter Street between Court Street and D Street. On-street parallel parking is permitted on the remainder of the study alignment, with the exception of Cherry Avenue and a small portion of Auto Group Avenue.

Transit Facilities

The local transit service, Cherriots, operates one bus route within the proposed WMB alignment. Route 2 runs on Winter Street between Chemeketa Street and Market Street with stops near Belmont Street, D Street, Union Street, and Chemeketa Street. Route 2 is a frequent route with service every 15 minutes during peak periods.

TRAFFIC VOLUMES AND INTERSECTION OPERATIONS

Evening (4:00 p.m. - 6:00 p.m.) peak hour intersection turning movement counts (including bicycle and pedestrian counts) and daily roadway segment vehicle counts were collected at key locations along the proposed WMB alignment. All traffic counts were collected by ODOT on typical weekdays in June 2016 prior to the end of the school year. The evening peak hour intersection turning movement volumes are shown on Figure 4, the average daily traffic (ADT) volumes are shown on Figure 5, and the evening peak hour pedestrian and bicycle volumes are shown on Figure 6.



LEGEND

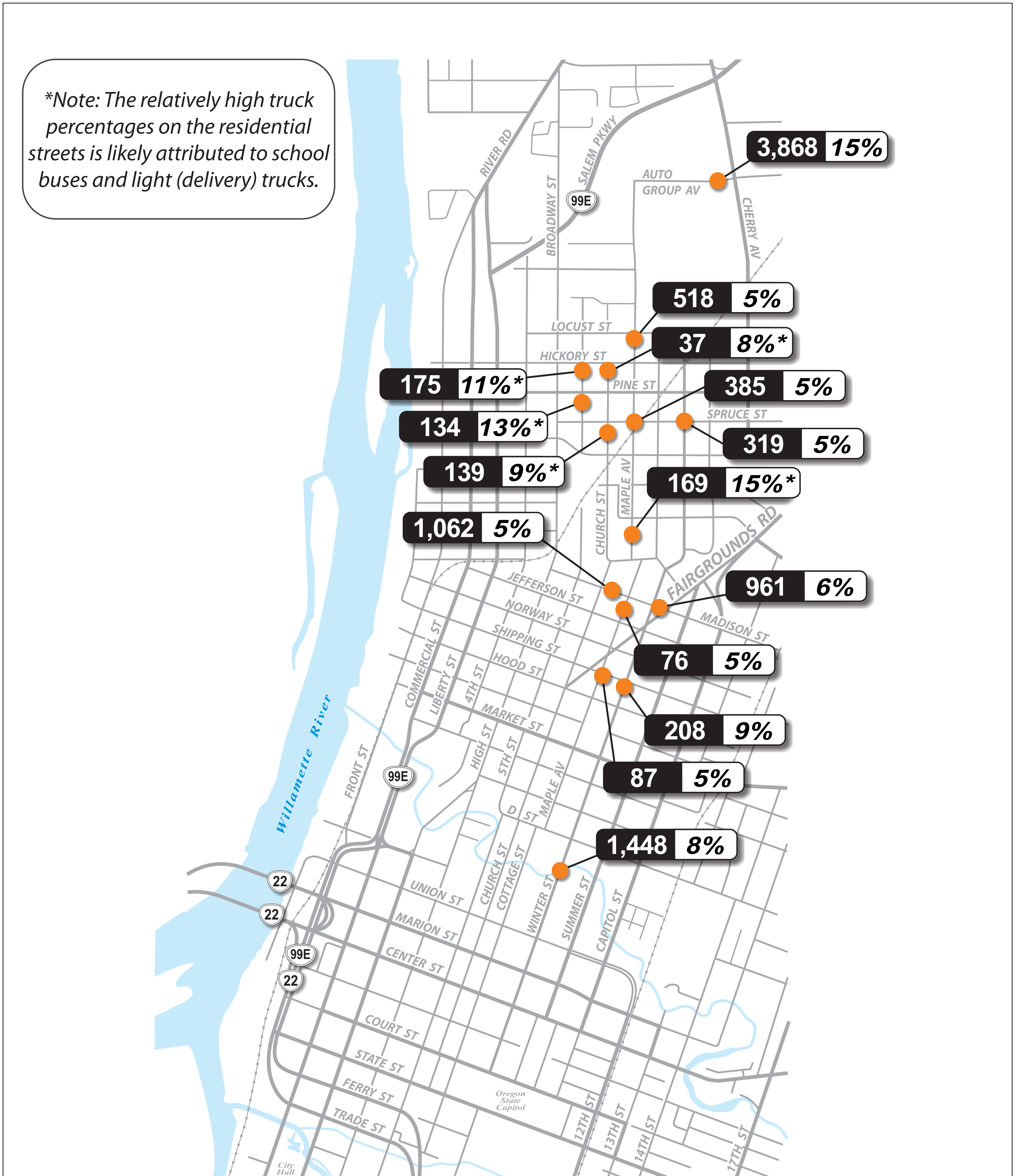
- Study Intersection
- Traffic Signal
- Stop Sign
- Lane Configuration
000 - PM Peak Hour Traffic Volumes
HL Hard Left, LT•TH•RT Left•Thru•Right, HR Hard Right - Volume Turn Movement

DKS

No Scale

Figure 4

2016 Existing Peak Hour Traffic Volumes



LEGEND

- Traffic Count Location

ADT — Truck Percentage

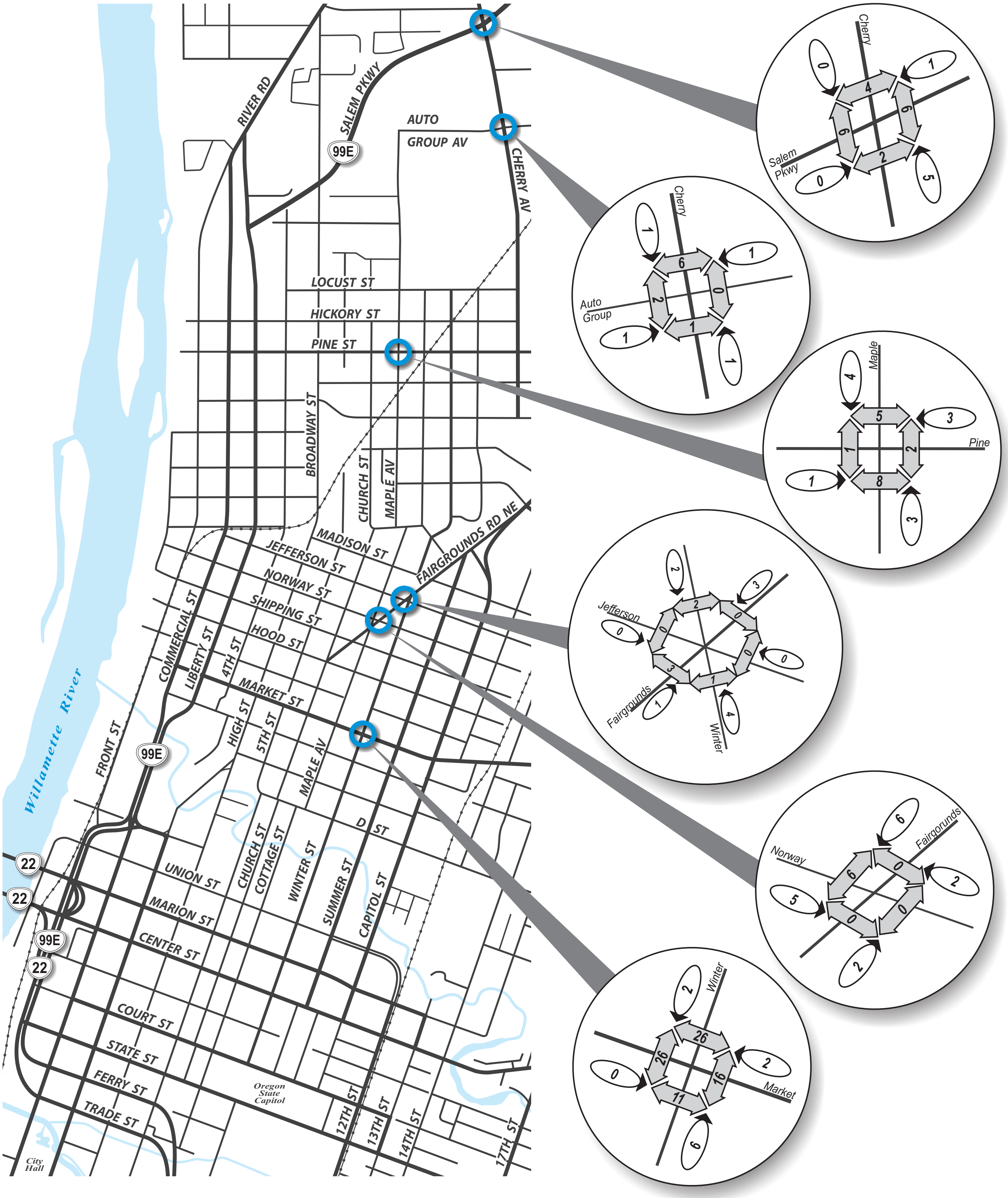
0,000 00%

DKS

No Scale

Figure 5

2016 Existing Average Daily Traffic Volumes



LEGEND

- Study Intersection

00 - Pedestrian Volume

00 - Bicycle Volume

DKS

No Scale

Figure 6

2016 Existing Pedestrian and Bicycle Volumes

Mobility Standards

Agency mobility standards often require intersections to meet level of service (LOS) or volume-to-capacity (V/C) intersection operation thresholds.

The **intersection LOS** is similar to a "report card" rating based upon average vehicle delay. Level of service A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. Level of service D and E are progressively worse operating conditions. Level of service F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity. This condition is typically evident in long queues and delays.

The **volume-to-capacity (V/C)** ratio represents the level of saturation of the intersection or individual movement. It is determined by dividing the peak hour traffic volume by the maximum hourly capacity of an intersection or turn movement. When the V/C ratio approaches 0.95, operations become unstable and small disruptions can cause the traffic flow to break down, as seen by the formation of excessive queues.

According to the City of Salem Level of Service Standards, mobility standards are given as LOS, delay, and V/C ratios and are based on intersection traffic control devices.[5] The mobility standards for signalized and unsignalized intersections are shown in Table 3.

Table 3. City of Salem Mobility Standards

Jurisdiction	Traffic Control	Mobility Standard		
		LOS	Delay	V/C Ratio
City of Salem	Signalized	E	< 80 seconds	0.90
	Unsignalized	E	< 50 seconds	-

Existing Intersection Operations

The existing traffic operations at the study intersections were determined for the PM peak hours using 2000 Highway Capacity Manual methodology[6] for signalized intersections and 2010 Highway Capacity Manual methodology[7] for unsignalized intersections. The estimated operating conditions of each study intersection are shown in Table 4 on the following page.

[5] Division 6 of the City of Salem Department Public Works Design Standards Administrative Rules.
[6] *2000 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.
[7] *2010 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2010.

Table 4. Existing PM Peak Hour Intersection Operations

Intersection	Operating Standard			Existing PM Peak Hour		
	LOS	Delay (s)	v/c	LOS	Delay (s)	v/c
Unsignalized Intersections						
Winter Street/ Market Street	E	< 50	-	A/E	35.2	0.56
Fairgrounds Road/Norway Street	E	< 50	-	A/C	17.2	0.06
Fairgrounds Road /Jefferson Street/Winter Street[1]	E	< 50	-	A/C	15.4	0.06
Maple Avenue/Pine Street	E	< 50	-	A/D	32.9	0.86
Signalized Intersections						
Auto Group Avenue/Cherry Avenue	E	< 80	0.90	B	14.1	0.57
Salem Parkway/Cherry Avenue	E	< 80	0.90	D	43.8	0.80

[1]Although the proposed WMB alignment does not include the intersection of Fairgrounds Road/Jefferson Street/Winter Street, the alignment is still preliminary. This additional analysis was included for informational purposes that can be used during any future refinement of the bikeway alignment.

As shown in Table 4, all study intersections meet the City of Salem's operating standards during the existing PM peak period. The Salem Parkway/Cherry Avenue intersection is approaching capacity which limits future opportunities for special bicycle signal phases.

ROADWAY AND INTERSECTION SAFETY PERFORMANCE

The safety performance of the roadway segments and intersections that comprise the proposed bikeway alignment was evaluated using the most recent five years of crash data available in the ODOT crash database (2011-2015). During that time period, there were a total of 118 crashes within the study area. Of those, three were bicycle-related and two were pedestrian-related. The following sections provide detailed descriptions of the observed crash patterns and safety concerns along the WMB proposed alignment.

Bicycle and Pedestrian Crashes

During the study period (2011-2015), there were two fatal crashes in the vicinity of the WMB proposed alignment, both of which were pedestrian crashes. There were also three crashes involving bicyclists, all resulting in injuries. The locations of the bicycle and pedestrian crashes are shown on Figure 7.

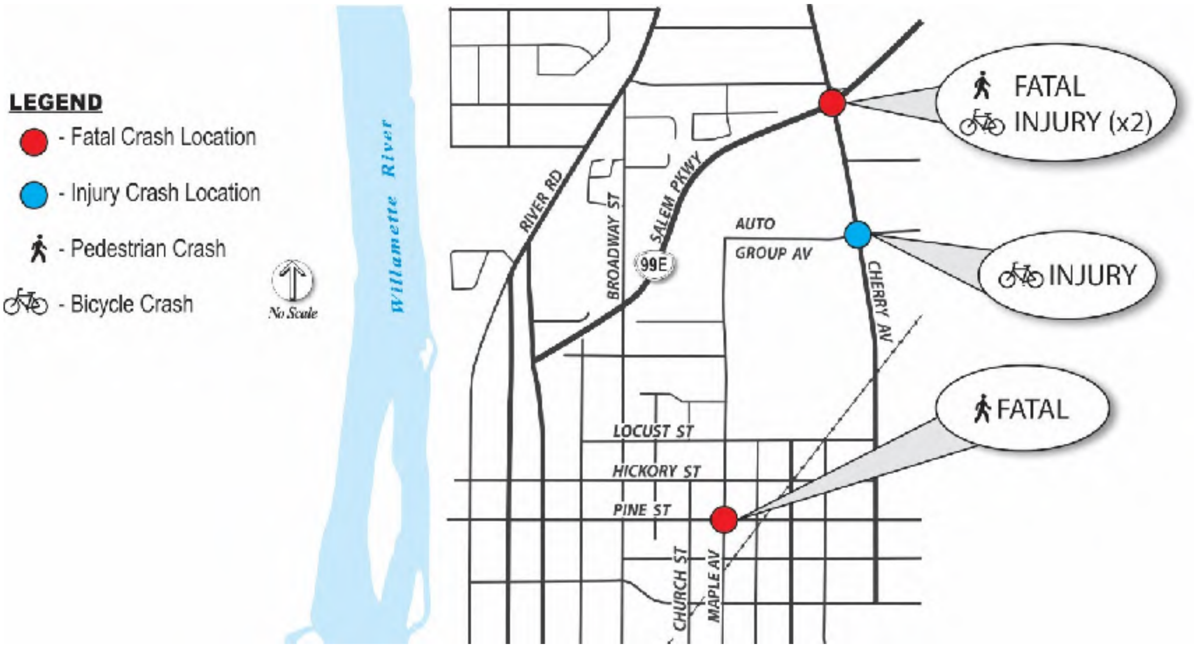


Figure 7. Bicycle and Pedestrian Crash Locations and Severities

Both pedestrian crashes occurred at night, and the reported contributing factors were both attributed to the driver (reckless driving in one case and failure to yield to a pedestrian in the other). Weather was not considered a factor in either case.

All three bicycle crashes occurred during daylight conditions on clear, dry days. According to the ODOT crash database, the primary contributing factors were a bicyclist illegally in the roadway and a bicyclist failing to yield to the traffic signal. No primary contributing factors were reported in the third crash.

Overall Crash Trends

Table 5 presents the number of crashes that occurred along the proposed WMB alignment by crash type and crash severity. The majority of crashes are intersection-related, as evidenced by the large proportion of rear-end (37%) and angle or turning (32%) crashes. At non-intersection locations, the most prevalent recorded crash types were sideswipe (10%), parking-related (7%), and fixed-object (5%). As shown in Table 5, nearly half of the reported crashes were property damage only (PDO). The majority of the remaining crashes resulted in injuries or possible injuries. There were two crashes that resulted in fatalities, both involving a pedestrian.

Table 5. WMB Alignment Crashes by Type and Severity, 2011-2015

Crash Type	Fatal	Serious Injury	Injury	Possible Injury	Property Damage Only	Total
Rear End	0	0	4	20	20	44 (37%)
Angle/Turning	0	0	6	16	15	37 (31%)
Sideswipe	0	0	0	2	10	12 (10%)
Parking Related	0	0	0	3	5	8 (7%)
Fixed Object	0	0	1	2	3	6 (5%)
Bicycle	0	0	3	0	0	3 (3%)
Pedestrian	2	0	0	0	0	2 (2%)
Other [a]	0	0	1	0	5	6 (5%)
Total	2 (2%)	0 (0%)	15 (13%)	43 (36%)	58 (49%)	118 (100%)

[a] "Other" category includes backing, non-collision, and unknown crash types.

Weather Conditions

Approximately 20% of the reported crashes occurred during rainy or wet conditions. The remaining 80% of crashes occurred during clear or cloudy conditions. On average, Salem experiences 140 rainy days per year (39% of the year), which suggests that there is not an overrepresentation of weather-related crashes along the WMB alignment.

Time of Day

The highest frequency of crashes occurred during peak travel times for businesses and schools along the corridor, including the hours of 9:00 a.m., noon, 3:00 p.m., and 5:00 p.m..

Lighting Conditions

The majority of crashes reported on the WMB alignment occurred during daylight conditions (77%). Of the nighttime crashes reported, approximately 24% occurred at locations with street lighting, while approximately 76% occurred at locations with no (or non-working) street lighting.

Critical Crash Rate Analysis

In addition to general crash trend investigations, an analysis of critical crash rates can aid in identifying locations with higher than expected crash frequencies. The total number of crashes experienced at a specific location is related to the volume of traffic present. A crash rate, which represents the observed annual crash frequency per unit of traffic volume (one million entering vehicles for intersections, or 100 million vehicle miles for roadway segments), allows for relative safety comparisons between locations with differing levels of traffic volume. Furthermore, the Oregon Department of Transportation publishes critical crash rates, which present the expected crash rate (90^{th} percentile) for intersections and roadway segments across the state. An observed crash rate that is higher than the corresponding critical crash rate indicates a potential safety issue and warrants further investigation. The intersection and roadway segment crash rates (observed and critical) are presented in Table 6 and Table 7, respectively.

Table 6. Intersection Crash Rate Analysis Results

Intersection	Entering ADT	Observed Crash Frequency (2011-2015)			Observed Crash Rate [a]	Critical Crash Rate [a]
		Fatal	*Injury*	*PDO*		
Winter Street/ Market Street	10,720	0	3	1	0.204	0.408
Fairgrounds Road/Norway Street	7,320	0	2	2	0.299	0.408
Fairgrounds Road / Jefferson Street/Winter Street	7,380	0	3	2	0.371	n/a [b]
Maple Avenue/Pine Street	8,580	1	0	0	0.064	0.408
Auto Group Avenue/Cherry Avenue	15,780	0	2	4	0.208	0.860
Salem Parkway/Cherry Avenue	38,500	1	23	24	0.692	0.860

[a] Intersection Crash Rate = Average Annual Crashes/Million Entering Vehicles

[b] Unique intersection configuration; no comparable critical crash rate available.

Table 7. Roadway Segment Crash Rate Analysis Results

Roadway Segment	ADT	Length (mi)	Observed Crash Frequency (2011-2015)			Observed Crash Rate [a, b]	Critical Crash Rate [a, c]
			Fatal	*Injury*	*PDO*		
Winter Street: Court St. to Union St.	4,000	0.321	0	6	7	178.1	325.6
Winter Street: Union St. to Market St.	1,450	0.441	0	7	1	302.3	325.6
Winter Street: Market St. to Norway St.	350	0.253	0	0	3	**469.7**	325.6
Norway Street: Winter St. to Cottage St.	2,000	0.066	0	0	0	0.0	325.6
Cottage Street: Norway St. to South St.	160	0.219	0	1	1	**684.9**	325.6
Maple Avenue: South St. to Pine St.	390	0.394	0	0	2	281.0	325.6
Maple Avenue: Pine St. to Bliler St.	520	0.348	0	1	2	316.1	325.6
Auto Group Avenue: Bliler St. to Cherry Ave.	3,870	0.327	0	0	0	0.0	325.6
Cherry Avenue: Auto Group Ave. to Salem Pkwy.	10,430	0.241	0	1	2	15.8	331.2

[a] Segment Crash Rate = Average Annual Crashes/100 Million Vehicle Miles Traveled, normalized to 1.0 mi segment length. Segment crash rates exclude any intersection-related crashes included in Table 4.
[b] **Bold** text indicates the observed crash rate exceeds the critical crash rate.
[c] Critical crash rate is the average critical rate for minor arterials and collectors in urban cities.

As shown in Table 6 and Table 7, there are two roadway segments that exceed the critical crash rate, while the remaining intersections have a typical safety performance. The two roadway segments that exceed the critical crash rate (Winter Street between Market Street and Norway Street, and Cottage Street between Norway Street and South Street) have a very low volume of traffic and short segment lengths, both of which can contribute to very high calculated crash rates that do not necessarily represent a safety concern. Both observed crash rates are significantly higher than the critical crash rate even though the crash frequency is relatively low. There is no apparent pattern in crash type, crash location, or crash cause on either segment that would suggest specific safety issues.

BICYCLE AND PEDESTRIAN LEVEL OF TRAFFIC STRESS (LTS)

The proposed WMB alignment was evaluated for level of bicyclist and pedestrian comfort under existing conditions. The Bicycle Level of Traffic Stress (LTS) and Pedestrian Level of Traffic Stress (PLTS) from the ODOT Analysis Performance Manual methodologies were applied in scoring segments and intersections along the corridor.[8] This type of evaluation provides planners and engineers an understanding where infrastructure changes are needed to improve the comfort of bicyclists and

[8] Level of Traffic Stress methodologies and application examples appear on pages 14-8 through 14-50 of the Analysis Procedures Manual. The APM is available online at https://www.oregon.gov/ODOT/TD/TP/pages/apm.aspx.

pedestrians traveling along a roadway and through intersections. For the WMB, this analysis helped guide the types of treatments and their priority for implementation.

LTS and PLTS is scored on a scale of 1 to 4 with 4 being the most stressful. Intersections and segments are scored separately.

Overall, the LTS results suggest that the WMB alignment is relatively comfortable for bicyclists and pedestrians aside from a few key crossings and segments. These key locations are summarized below, while full details on the level of traffic stress evaluation methodology and results can be found in Appendix A.

Bicycle Level of Traffic Stress

Generally, segment conditions along the WMB proposed alignment are comfortable for biking today. Nearly all segments rate LTS 1 or 2 with the exception of Cherry Avenue where higher traffic speeds and conflicts between bicyclists and turning vehicles create more stressful conditions.

Intersections also rate mostly in the LTS 1 and 2 range. Signalized intersections are given a default rating of LTS 1, but some latitude is afforded to the evaluator in these situations. Stop-controlled and uncontrolled intersections along the corridor all rated LTS 1 or 2 as a result of relatively low speeds and fewer number of lanes on the cross streets.

The results of LTS analysis are largely reflective of bicyclists' experience along the proposed WMB alignment today with two exceptions: the crossings at Fairgrounds Road and Pine Street. Both of these intersections rate LTS 1 using the ODOT methodology because of the lower speed limit (30 mph) on the cross-street and number of lanes (two and three lanes, respectively). At the intersection of Fairgrounds Road/Norway Street, the rating does not consider the highly skewed approaches, the actual width of the street (approx. 46 feet consisting of two 23-foot lanes), or unmarked crosswalks and parking lanes. All of these factors contribute to making this a higher stress crossing.

At Pine Street, automobile volumes, the width of the street and lack of crosswalks, signage and lighting contribute to a higher level of stress for bicyclists. Both of these intersections are likely candidates for treatments to improve the safety and comfort of crossing bicyclists.

Pedestrian Level of Traffic Stress

Under the ODOT methodology, the majority of the corridor scores PLTS 3 or 4 for segment ratings and PLTS 1 or 2 for crossings. Though land uses create a comfortable pedestrian environment, automobile speeds and volumes are relatively slow along the corridor and most segments have sidewalks with large, landscaped buffers, these factors are overridden by the relatively poor quality of sidewalks. Most block faces were rated in the poor or very poor categories because of the presence of cracking, faulting and rough conditions.

Most intersections along the corridor rate PLTS 1 or 2. These ratings can be attributed to the low speed and number of lanes on cross streets, presence of signals at larger streets, and the provision of adequate curb ramps and lighting. Unsignalized collector and local street intersections are evaluated on those criteria alone, while unsignalized arterial crossings also consider the ADT of the cross street.[9]

Four intersections rate as PLTS 3:

- Cherry Avenue at Salem Parkway
- Maple Avenue at Pine Street
- Maple Avenue/Cottage Street at South Street
- Norway Street at Fairgrounds Road

These intersections are generally made more stressful because of the speed, width, and traffic volume of cross streets.

SUMMARY OF EXISTING TRANSPORTATION ANALYSIS

The proposed alignment for the WMB was evaluated based on intersection operations, intersection and roadway segment safety performance, and bicycle and pedestrian level of stress. The following list summarizes the key findings of the existing transportation analysis:

- All study intersections currently operate at acceptable levels and meet the City of Salem's operating standards. The Salem Parkway/Cherry Avenue intersection is approaching capacity which limits future opportunities for special bicycle signal phases.
- In terms of safety performance, there are two roadway segments that have an observed crash rate greater than what is expected for similar facility types: the segment of Winter Street between Market Street and Norway Street, and the segment of Cottage Street between Norway Street and South Street. These segments have a very low volume of traffic and short segment lengths, both of which can result in high calculated crash rates that are not necessarily indicative of underlying safety concerns.
- An evaluation of the level of traffic stress currently experienced by bicyclists and pedestrians along the proposed WMB alignment indicated the highest stress locations are at the northern end of the alignment (Auto Group Avenue, Cherry Avenue, and Salem Parkway). Additionally, intersections along Fairgrounds Road and Pine Street present higher stress conditions for both modes and will likely need to be addressed through design treatments.
- The high stress locations for bicyclists are a result of higher traffic speeds, turning movement conflicts between bicycles and automobiles, lack of provision for movements onto/off of the multiuse path at the Salem Parkway/Cherry Avenue intersection, narrow streets and lack of crosswalks, and poor signage and lighting along bicycle routes.
- The high stress locations for pedestrians are a result of higher traffic speeds, width of the roadways, traffic volumes on the minor streets, lack of curb ramps, and diagonal curb cuts.

[9] The method also considers the presence of a refuge median, but there are none along this corridor.

3.0 NEEDS, OPPORTUNITIES, AND CONSTRAINTS

This chapter summarizes the existing roadway characteristics that influenced the design recommendations. These factors are presented in terms of needs, opportunities, and constraints for each of the three segments of the WMB alignment, shown on Figure 8.

DOWNTOWN AREA

This segment of the WMB is surrounded by businesses and state offices. It is a two-way, two-lane roadway with on-street parking and a high density of public and private access points.

Needs

- Dedicated space for bicyclists that are currently sharing the roadway with a higher volume of vehicles.
- Shorter pedestrian crossing distances at wide intersections (example: Center Street and Marion Street).

Opportunities

- With parking reconfiguration, the existing cross-section can accommodate buffered bike lanes.
- Parking garages and large surface lots may be able to serve parking demand if on-street parking is reduced.

Constraints

- High demand for on-street parking for adjacent business and the weekly Saturday Farmer's Market.
- Cherriots Bus Route utilizes this corridor.

Figure 8: WMB Key Segments

WINTER-MAPLE NEIGHBORHOOD

This segment of the WMB is primarily surrounded by residential land uses as well as Grant Community School. It is a two-way, two-lane roadway with on-street parking and a high density of public and private access points.

Needs

- Safe crossings of major streets for bicyclists and pedestrians, especially at Pine Street and Fairgrounds Road.

Opportunities

- Traffic volumes and speeds are relatively low with only two major unsignalized crossings.
- Sidewalks are separated from the street with landscape buffers and mature trees.
- Major intersections (at Pine Street and Fairgrounds Road) have adequate space for the addition of median refuge islands or diverters.
- Some traffic calming already exists in the form of traffic circles.

Constraints

- Cherriots Bus Route utilizes this segment (south of Market Street).
- Student pick-up and drop-off activities for Grant Community School occur on Winter Street.
- Bus parking on Winter Street

NORTHERN SCHOOL/COMMERCIAL AREA

This segment of the WMB is surrounded by a mix of residential, commercial, industrial, and school land uses, including the Oregon School for the Deaf (OSD) and JGEMS Charter School. Along Maple Avenue and Auto Group Avenue, the roadway is a two-way, two-lane street with on-street parking. Cherry Avenue transitions from a two to four lane section in the study area, with no on-street parking and existing bicycle lanes.

Needs

- Pedestrian facilities between Hickory Street and Bliler Avenue. South of Locust Street, sidewalks are present only on the east side of the street. Between Locust Street and Bliler Avenue, there are no sidewalk facilities. The lack of sidewalks combined with heavy school-related traffic during the morning and afternoon hours creates an uncomfortable environment for bicyclists and pedestrians.
- Pedestrian facilities on the south side of Auto Group Avenue and the east side of Cherry Avenue where no sidewalks are present.
- Improved safety and comfort for bicyclists and pedestrians crossing Salem Parkway.
- A more comfortable bicycle facility along Cherry Avenue, such as an off-street path, to provide separation of higher traffic volumes and speeds.

Opportunities

- The existing right of way is sufficient to construct sidewalks where needed.
- The parcel just south of Auto Group Avenue is planned for redevelopment, which may present an opportunity to construct a sidewalk or shared use path along the property frontage.
- The existing multi-use path between Bliler Avenue and Auto Group Avenue provides a connection for pedestrians and bicyclists.
- The signalized intersection at Auto Group Avenue/Cherry Avenue has sufficient capacity which may allow for a dedicated bicycle signal phase to improve the safety and comfort of bicyclists navigating this intersection.

Constraints

- South of the schools, it appears that adjacent homeowners have placed landscaping and fencing within the right of way.
- Utilities on the east side of Cherry Avenue would need to be relocated for installation of a sidewalk or multi-use path.
- Parking in front of Wiltse's Towing and their two access points present potential conflicts for pedestrians and bicyclists.
- The Home Depot access point on the north side of Auto Group Avenue is high volume and presents potential conflicts for pedestrians and bicyclists.
- The traffic signal at the intersection of Cherry Avenue and Salem Parkway is operating near capacity which limits opportunities for bicycle and pedestrian signal adjustments.

4.0 PUBLIC ENGAGEMENT

Throughout the development of this Bicycle and Pedestrian Plan, the project team involved the local community through a variety of meetings and workshops. The project team met with the Project Advisory Committee and Technical Advisory Committee to solicit feedback at various stages of the project. Additionally, the project team held two community workshops where citizens were invited to review project materials, ask questions, and provide feedback regarding their concerns and desires for Salem's first family-friendly bikeway. The project team incorporated this feedback into the selection, placement, and design of treatments along the WMB corridor. The public engagement details for this project are briefly summarized below.

Project Advisory Committee (PAC)

- Salem Bike Boulevard Advocates
- Salem Boys & Girls Club
- Salem Planning Commission
- Highland Neighborhood Association
- Grant Neighborhood Association
- Central Area Neighborhood Development Corporation
- Local Businesses and Organizations

Figure 9: TAC and PAC Members Touring the WMB Route

Technical Advisory Committee (TAC)

- City of Salem
- Oregon Department of Transportation
- Mid-Willamette Valley Council of Governments
- Cherriots
- Oregon Parks and Recreation Department
- City of Keizer

Public Engagement Meetings and Events

Meeting Type	Agenda Items	Date
Joint PAC/TAC Meeting	Driving and Walking Tour of WMB Alignment	October 2016
PAC/TAC Meetings	Summary of Existing Conditions, Needs, Opportunities, and Constraints	January 2017
Community Workshop #1	Project Overview & Existing Conditions, Needs, Opportunities, and Constraints (180 attendees)	March 2017
PAC/TAC Meetings	Preliminary Recommendations and Conceptual Designs	May 2017
Community Workshop #2	Preliminary Recommendations and Conceptual Designs (90 attendees)	May 2017
PAC/TAC Meetings	Final Bicycle and Pedestrian Plan	October 2017

5.0 MAJOR DESIGN FEATURES

This chapter provides an overview of the key design features recommended for the WMB. Full conceptual designs and scaled engineering drawings of all recommended improvements can be found in Appendix B.

DOWNTOWN AREA

In the segment of the WMB that is within the downtown area of Salem, improvements include buffered bicycle lanes in both directions, curb extensions, and improvements to the intersections of Winter Street/Court Street and Winter Street/Union Street.

Buffered Bike Lanes with Parallel Parking

Currently, bicycles and vehicles share the roadway along Winter Street within the downtown area of Salem. This is a less comfortable environment for cyclists due to higher traffic volumes and the movements of vehicles entering and leaving parking spaces. In particular, traffic backing out of the angled parking spaces creates a conflict between bicyclists and vehicles.

To improve the safety and level of comfort for cyclists while maintaining the vehicle operations, it is recommended that buffered bike lanes with parallel parking be installed along Winter Street from Court Street to Mill Creek, just south of D Street (where the existing angled parking ends). As shown in Figure 10, the cross-section of this corridor would consist of eight-foot parallel parking lanes, eight-foot buffered bike lanes (two-foot buffer with a six-foot bike lane), and two eleven-foot travel lanes. Current best practices for signing and striping should be implemented during the design of the buffered bicycle lanes.

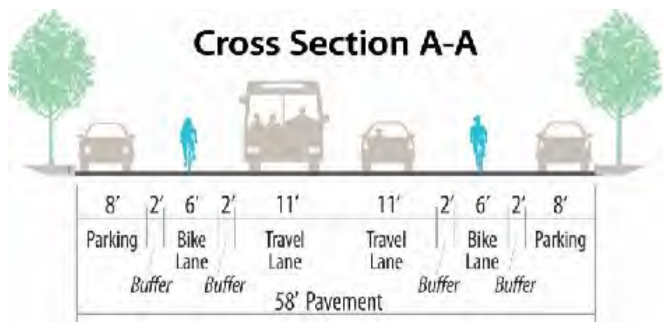


Figure 10: Downtown Cross-section of Buffered Bike Lanes with Parallel Parking

Preliminary estimates suggest that the total number of on-street parking stalls on Winter Street between Court Street and D Street will be reduced from 270 to 153 if parking is converted from angled stalls to parallel stalls.

Curb Extensions

In the downtown segment of the WMB, there are several intersections where pedestrian safety could be improved with the construction curb extensions, similar to those at the Winter Street/Court Street intersection. Curb extensions shorten the crossing distances and make pedestrians more visible to drivers. Curb extensions are recommended at the intersections of Winter Street/Chemeketa Street, Winter Street/Marion Street, and Winter Street/Center Street.

Court Street Improvements

The Winter Street/Court Street intersection is the southernmost end point of the WMB and connects to the Walk of Flags monument of the Oregon State Capital and continues to Willamette University, Salem Hospital, and Bush's Pasture Park. As shown in Figure 11, the improvements would include removing the four parking spaces on the south curb and extending the existing curb.

The curb extension would then provide separate ramps for pedestrians and bicyclists to cross Court Street, where the bicycle ramps would direct cyclists into the buffered bicycle lanes. This design reduces the number of conflicts between bicyclists, pedestrians, and vehicles.

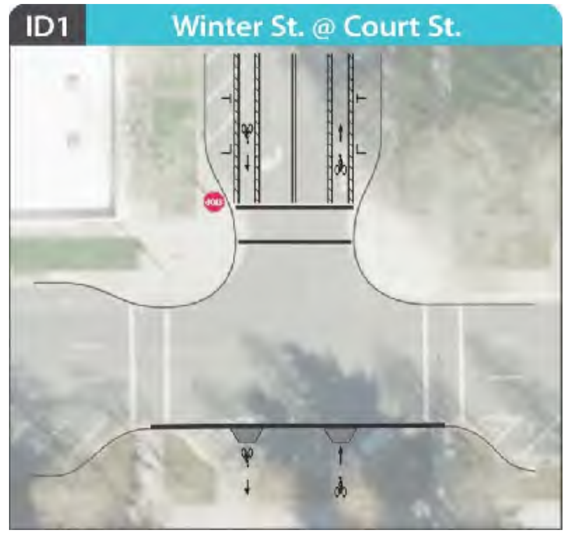


Figure 11: Winter Street/Court Street Intersection Improvements

Union Street Mini-Roundabout

The Winter Street/Union Street intersection presents a unique opportunity as it will serve both the WMB and the proposed Union Street Bikeway. In order to not prioritize one bikeway over the other, it is recommended that a mini-roundabout, with yield-control on all approaches, be constructed.

Figure 12: Winter Street / Union Street Mini-roundabout

The design aspects of the mini-roundabout would include splitter islands to provide pedestrians with a safe location to cross. The outer ring of the center island would be flush with the pavement to allow buses to navigate the roundabout without any elevation change. The middle ring would be a mountable curb to allow heavy vehicles to use the roundabout as needed. The very center of the island would be raised with landscaping. Preliminary evaluations indicate that this design will fit in the existing right of way with little impact on the existing sidewalk.

On all approaches, the proposed bike lanes would end in advance of the mini roundabout. Bicyclists would traverse the intersection in shared lanes, and then re-enter dedicated bicycle lanes just downstream of the mini-roundabout.

Prior to construction, a mock roundabout should be laid out according to design details and tested with city buses to ensure it operates as expected.

WINTER-MAPLE NEIGHBORHOOD

In the segment of the WMB from the downtown area of Salem to Pine Street, improvements include shared lane markings, reorienting stop signs, installing traffic circles, and crossing improvements at Market Street, Gaines Street, Fairgrounds Road, and Pine Street.

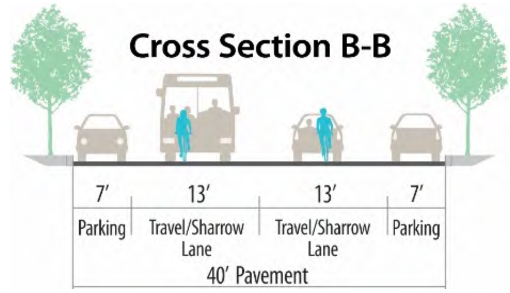


Figure 13: Winter Street Cross-section of Unmarked Parking and Sharrows

Shared Lane Markings

Currently, bicyclists share the roadway along Winter Street in the neighborhood area north of D Street.

It is recommended that the unmarked on-street parking remain along Winter Street from D Street to Fairgrounds Road. As shown in Figure 13, the cross-section of this corridor would consist of seven-foot unmarked on-street parking by each curb and two thirteen-foot travel/sharrow lanes. To improve comfort and safety for bicyclists, pavement maintenance and repair should be a priority along the bikeway route.

Figure 14: Winter Street/E Street Improvements

Reorienting Stop Signs

In the Winter Street segment of the WMB, there are several intersections that could improve bicycle safety and comfort by reorienting the stop signs. Currently, at the Winter Street/Hood Street intersection, the stop signs are located on the north-south movements on Winter Street. By reorienting the stop signs to the east-west movement on Hood Street, the bicyclists on WMB are given priority. Reorienting the stop signs at E Street to the east-west movement will also allow the bicyclists to move unimpeded on Winter Street (Figure 14).

E Street Traffic Circle

At the Winter Street/E Street intersection, improvements to the intersection will include a traffic circle (Figure 14). Traffic circles reduce vehicle speeds by forcing motorists to maneuver around them and have been proved to reduce motor vehicle collisions. It is also recommended that the stop signs be reoriented to allow cyclists to continue on the WMB without stopping.

Market Street Improvements

The Winter Street/Market Street intersection is located at the southeast corner of Grant Elementary School. As shown in Figure 15, the improvements would include extending the existing curbs, adding school warning signs, adding a marked crosswalk on the south leg, and adding “STOP” and sharrow pavement markings to the north and south legs. A pedestrian signal should be installed once the volume of through traffic warrants one, at which time the additional marked crosswalk should also be installed. Prior to a pedestrian signal being warranted, additional pedestrian warning signs such as in-street crosswalk warning signs (paddles) should be considered.

Figure 15: Winter Street/Market Street Improvements

Figure 16: Sample Raised Crosswalk

Raised Crosswalk at Gaines Street

A raised crosswalk at Gaines Street just east of Grant Elementary School will provide a safe crossing for pedestrians traveling to and from the school as well as the Boys and Girls Club. An example of a raised crosswalk is shown in Figure 16.

Fairgrounds Road Crossing Location

The intersection of Fairground Road/Norway Street/Cottage Street is where the WMB will divert from Winter Street and continue onto Cottage Street going north. At this intersection, shown in Figure 17, medians along Fairgrounds Road will allow bicyclists to make a two-stage crossing from Norway Street to Cottage Street.

Figure 17: Fairground Road/Norway Street/Cottage Street Improvements

The westbound approach of Norway Street/Fairgrounds Road intersection will become a right in, right out only. An added stop sign on the eastbound approach of the Cottage Street/Norway Street intersection will only allow left or right turns. Turning restrictions can increase bicyclist (and pedestrian) safety and decrease crashes with turning motor vehicles. These turning restrictions will allow the Norway Street connection between Fairgrounds Road and Cottage Street to become a bike only area. New marked crosswalks will be added to the intersections and pedestrian crosswalk warning signs will also be added to the Fairgrounds Road/Norway Street intersection. Ultimately, this intersection area will provide a safe crossing for bicyclists and pedestrians across Fairgrounds Road to Cottage Street where the WMB will continue north.

Shared Lane Markings

Currently, bicyclists share the roadway along Cottage Street and Maple Avenue where the proposed WMB will be located. These will be installed at various points along WMB.

Reorienting Stop Signs

In the Maple Street Neighborhood segment of the WMB, there are several intersections where bicycle safety and comfort could be improved by reorienting the stop signs. Currently, at the Cottage Street/Jefferson Street intersection, the stop signs are located on the north-south movements on Cottage Street. By reorienting the stop signs to the east-west movement on Jefferson Street, the bicyclists on WMB are given priority. Reorienting the stop signs is also suggested at the Cottage Street/Madison Street intersection.

Speed Humps

Speed humps will be installed along Cottage Street, starting 200 feet north of Jefferson Street. They will continue north and terminate just south of Academy Street on Maple Avenue. This will help reduce the vehicle speeds along this stretch of the WMB.

Shared Lane Markings on South Street

Shared lane markings will be added to the South Street connection on the WMB (Figure 18). Warning signs will also be installed to warn drivers of bicycles on the road.

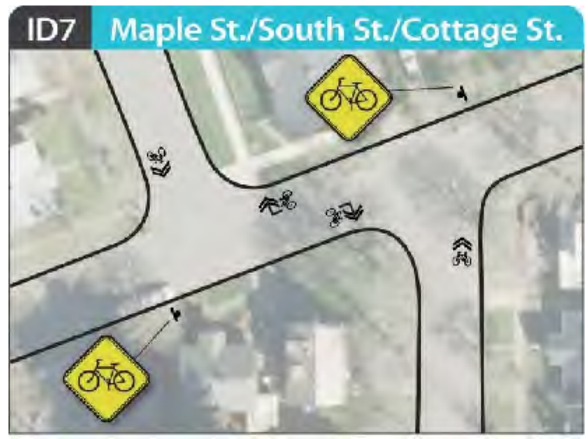


Figure 18: Shared Lane Markings at South Street

Columbia Street Traffic Circle

At the Maple Avenue/Columbia Street intersection, improvements to intersection will include a traffic circle, similar to what is proposed at Winter Street/E Street.

Railroad Crossing Path Diversions

The railroad crosses Maple Avenue south of Spruce Street. The current angle of the crossing makes it difficult for bicyclists to navigate along Maple Avenue without their bicycle tires getting caught in the railroad tracks. The proposed path will be constructed so that it crosses the railroad tracks close to a 90-degree angle (Figure 19). Approval from the railroad will be required prior to construction of this project.

Figure 19: Maple Avenue at Railroad Crossing

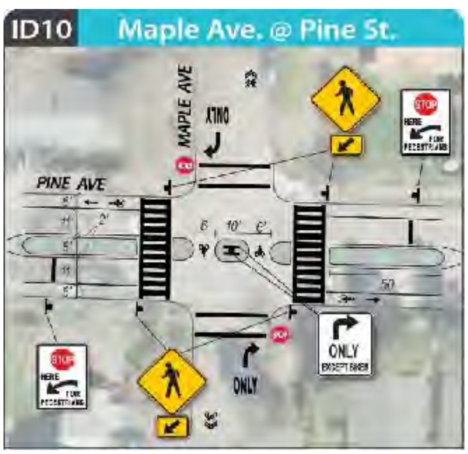


Figure 20: Pine Street Improvements

Pine Street Improvements

The improvements at the Pine Street/Maple Avenue intersection are similar to the improvements at the Fairground Road intersection. As shown in Figure 20, the northbound and southbound approaches of the intersection will become right in, right out only for motor vehicles. Turning restrictions can increase bicycle and pedestrian safety and decrease crashes with turning motor vehicles. Bicyclists and pedestrians will be able to continue traveling north and south along the WMB. Medians on Pine Street will also accommodate two-stage crossing opportunities for both bicyclists and pedestrians. New marked crosswalks will be added and pedestrian warning signs will be added to the east and west crosswalks.

NORTHERN SCHOOL/COMMERCIAL AREA

In the segment of the WMB near the Oregon School for the Deaf/JGEMS Charter Middle School, improvements include reoriented stop signs, wide sidewalks, a school loading area, additions to the existing multi-use path, and improvements at the school entrance.

Reoriented Stop Signs

Currently, at the Maple Avenue/Locust Street intersection, the stop signs are located on the north-south movements on Maple Avenue. By reorienting the stop signs to the east-west movement on Locust Street, the bicyclists on WMB are given priority.

School Frontage and Access

As shown in Figure 21, a cross-section with one fifteen-foot travel lane and one ten-foot travel lane, an eight-foot school loading area, and a twelve-foot multi-use path is proposed. This cross-section will begin at the existing multi-use path on the east side of Maple Avenue. The proposed multi-use path will be a continuation of the existing path and the school loading area will provide a convenient and safe way to drop off and pick up children at the schools. It should be noted that the 15 foot travel lane is wide enough to accommodate on-street parking.

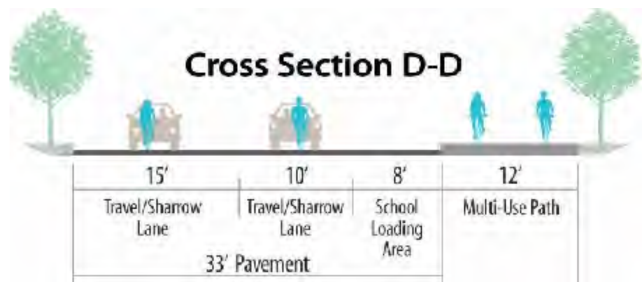
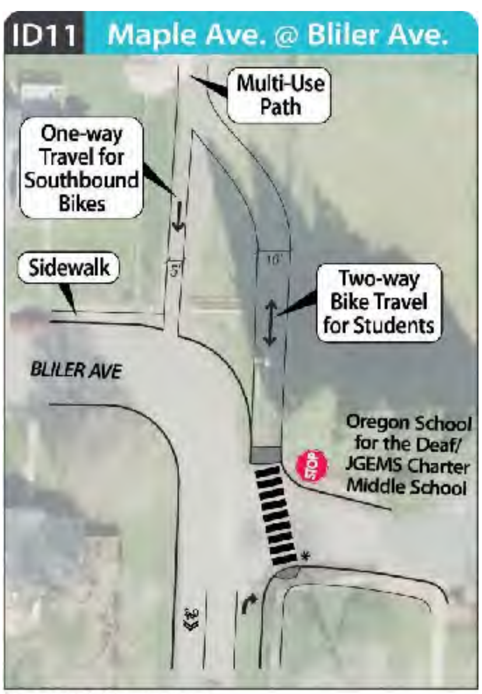


Figure 21: School Loading Area Cross-Section



*New raised driveway apron

Figure 22: School Access and Multi-Use Path Improvements

The access to the Oregon School for the Deaf/JGEMS Charter School is located near the intersection of Maple Avenue and Bliler Avenue. As shown in Figure 22, a marked crosswalk will be added to the new raised driveway apron. A two-way path for bicyclists and pedestrians will connect the WMB on Maple Avenue to the multi-use path north of Bliler Avenue. Southbound bicyclists can either continue on the multi-use path and sidewalk system in front of the school or enter the shared lane on Maple Avenue.

Multi-Use Path Extension

North of the school, a separated multi-use path currently extends from Bliler Avenue to the culdesac of Maple Avenue (Auto Group Avenue). It is recommended that this multi-use path be extended to connect to the existing multi-use path north of Salem Parkway. This portion of the WMB multi-use path will be located on the east side of Maple Avenue, the south side of Auto Group Avenue, and the east side of Cherry Avenue. It is recommended that any future driveways crossing the multi-use path be designed to maximize visibility of bicyclists and pedestrians traveling on the path.

Cherry Avenue Bicycle Traffic Signal Phase

The WMB path will cross the Cherry Avenue/Auto Group Avenue intersection as shown in Figure 23. A bicycle phase will be added to the traffic signal and will include camera detectors and push buttons for the bicyclists. The crossing will cross diagonally through the intersection. Once on the north side of Auto Group Avenue, the WMB will continue north along the east side of Cherry Avenue.

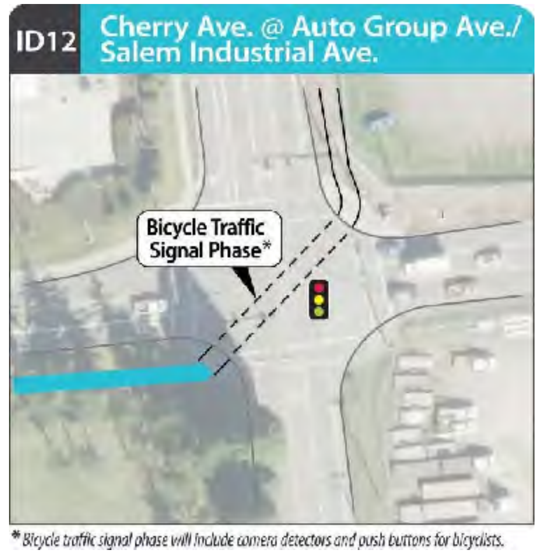


Figure 23: Bicycle Signal Phase at Cherry Avenue/Auto Group Avenue Intersection

Salem Parkway Improvements

At the Salem Parkway/Cherry Avenue intersection, improvements will be made to make the intersection safer for bicyclists and pedestrians wanting to access the multi-use path on the north side of Salem Parkway. The recommended improvements include the installation of “pork chop” islands (triangular raised median islands) on the southwest and southeast corners of the intersection. These islands will provide refuge and allow bicyclists and pedestrians to cross the intersection in two phases, resulting in a more comfortable environment for all users while also minimizing the impacts to traffic operations.

CORRIDOR WIDE IMPROVEMENTS

In addition to the location-specific design features described above, the following general improvements should be implemented along the WMB corridor where appropriate.

- **Improved Lighting** – Lighting infill and/or upgrades should be considered along roadway segments and at intersections where it currently does not meet standards. Supplemental lighting should also be considered at all new or improved crossing locations.
- **Signage** – Wayfinding, branding, and warning signs should be strategically placed along the corridor to inform all road users of the WMB route and anticipated interactions between user types.
- **Green Infrastructure** – Several of the recommended improvements (e.g., curb extensions and multi-use paths) provide opportunities to introduce green infrastructure into the roadway environment. Stormwater planters and bioswales are cost-effective stormwater management techniques that also beautify the streetscape. Permeable pavements can also be used on multi-use paths as a more environmentally-friendly alternative to traditional non-permeable pavements.
- **Pavement Condition** - To improve comfort and safety for bicyclists, pavement maintenance and repair should be a priority along the bikeway route.

DKS

BIKEWAY DESIGN TOOKIT

Because the WMB will be the first family-friendly bikeway in Salem, a goal of this project was to create a template for the design of future bikeways in the City. The bikeway design toolkit, included in Appendix C, served as the basis for treatment selection for the WMB and can also aid the City in selecting the appropriate treatments for future bikeways throughout the City.

EXPECTED FUTURE CONDITIONS

The recommended improvements described in this chapter were incorporated into a revised evaluation of the expected level of traffic stress for bicyclists and pedestrians. Maps showing the changes in expected comfort level for bicyclists and pedestrians is included at the end of Appendix A.

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6.0 PROJECT IMPLEMENTATION

This chapter presents information aimed at guiding the City of Salem and ODOT through the project implementation process. The following sections summarize preliminary cost estimates for key recommended improvements, potential sources of funding, and suggested phasing of the full project implementation.

COST ESTIMATES

Table 8 presents planning level cost estimates for key treatment options that are recommended for the WMB. These planning level cost estimates do not include other costs such as right-of-way acquisition and environmental impacts, which can significantly impact overall costs. Additional costs for individual improvements are included in the bikeway design toolkit in Appendix C.

Table 8. Preliminary Cost Estimates for Key Treatment Types

Treatment	Unit	Estimated Cost
Curb Extensions	Each Crossing (2 extensions)	$30,000 - $35,000
Traffic Circle (Mini Circle)	Each	$25,000 - $50,000
Mini Roundabout	Each	$75,000 - $150,000
Speed Hump	Each	$3,000 - $5,000
High Visibility Crosswalk	Each	$3,000 - $5,000
Raised Crosswalk	Each	$10,000 - $15,000
Pedestrian Signal	Each	$150,000 - $250,000
Median Island	Each	$50,000 - $75,000
Median Diverter with Bicycle Cut-Throughs	Each	$50,000 - $80,000
Bicycle Detection at Signalized Intersections	Each Approach	$7,000 - $10,000
Shared Lane Markings (Sharrows)	Per Mile	$4,000 - $5,000
Buffered Bicycle Lanes	Per Mile	$40,000 - $50,000
Shared Use Path	Per Mile	$300,000 - $500,000

POTENTIAL FUNDING SOURCES

There are a variety of funding sources that are available for implementation of recommended projects along the WMB alignment. Individual projects should be strategically implemented to make the best use of available funding which may include (but are not limited to) the sources outlined in Table 9.

Table 9. Potential Funding Sources

Funding Source	Details
Connect Oregon	State program that allocates funds to non-highway transportation projects which promote economic development; Applicable to bicycle and pedestrian connections (not on the state highway system).
Recreational Trails Program (RTP)	State grant program administered by the Oregon Parks and Recreation Department; Applicable to off-street multi-use paths.
Statewide Transportation Improvement Program (STIP) Allocation	State program that allocates funding for a wide array of transportation projects
Highway Safety Improvement Program (HSIP) / All Roads Transportation Safety (ARTS)	State program that allocates federal and state funding to safety improvement projects on roadways throughout Oregon.
Enhance	State program that is focused on enhancing Oregon's multi-modal transportation system.
Safe Routes to School (SRTS)	State program that allocates federal and state funding to make it safer for students to walk and bike to school. This program is currently being finalized, but funds are expected to be available through ODOT and local jurisdictions in the near future.
Sidewalk Improvement Program (SWIP)/Quick Fix	State program that allocates funding for pedestrian and bicycle improvements; Applicable only to state highway facilities.
Local Funding Sources	City gas tax, other local taxes/bonds, public-private partnerships when development occurs[1], City stormwater treatment funds[2]

[1] Consider for the proposed multi-use path along Auto Group Avenue
[2] For "green" infrastructure like permeable pavement and bioswales

PROJECT PHASING

There is a wide variety of treatments recommended along the WMB corridor, some of which are relatively easy and inexpensive to implement, while others will require supplementary design and planning efforts. Additionally, several of the recommended improvements already have funding secured or identified, while grants or other funding will need to be obtained for the remaining projects. Table 10 and Table 11 present the suggested phasing for the recommended projects, making the most efficient use of the funding that is currently available or is expected to be available in the near term. Low-cost, easily implemented projects, those in the vicinity of schools that could qualify for Safe Routes to School funding, and those with funding already identified are included in the short-term category. Larger scale, complex projects and those without a clear funding source are in the long-term category. This phasing approach is only intended to provide an approximate order for pursuing and constructing projects and should be refined over time to capture the priorities of the community and funding availability.

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Table 10. Short-Term Projects (To be completed in 0-4 years)

Project (From South to North)
Winter Street, Norway Street, Cottage Street, South Street, and Maple Street (where applicable) – Install shared lane pavement markings
Winter Street at Gaines Street – Install raised crosswalk
Norway Street at Fairgrounds Road at Cottage Street[1] – Install marked crosswalks, median diverter, refuge islands, and restrict vehicle access between Cottage Street and Fairgrounds Road
Cottage Street and Maple Avenue (where appropriate) – install speed humps
Maple Avenue at Pine Street – Install median diverter and marked crosswalks
Maple Avenue from Locust Street to Bliler Avenue – Construct sidewalk infill, construct multi-use path and vehicle loading area, connect to existing multi-use path north of Bliler Avenue
Corridor-Wide – Install WMB branding and wayfinding signing; Upgrade street and intersection lighting

[1]Partial funding is available but may not be enough to complete all recommended improvements

Table 11. Long-Term Projects (To be completed in 5+ years)

Project (From South to North)
Winter Street at Court Street – Improvements/changes to parking, bike and pedestrian ramps, crosswalks, and markings
Winter Street from Court Street to Mill Creek - Downtown Salem cross-section change to include buffered bike lanes and parallel parking
Winter Street at Union Street – Construct mini-roundabout
Winter Street at E Street – Construct traffic circle
Winter Street at Market Street – School crossing upgrades and future pedestrian signal (when warranted)
Winter Street, Cottage Street, and Maple Avenue (where appropriate) – Reorient stop signs[1]
Maple Avenue at Columbia Street – Construct traffic circle
Maple Avenue at Railroad Crossing – Realign bicycle path
Maple Avenue and Auto Group Avenue – Construct multi-use path
Auto Group Avenue at Cherry Avenue – Upgrade traffic signal to include diagonal bicycle-only phase
Cherry Avenue from Auto Group Avenue to Salem Parkway – Construct multi-use path
Salem Parkway at Cherry Avenue – Install corner refuge islands

[1]Reorienting stop signs should only be completed once supporting traffic calming measures (traffic circles and speed humps) have been installed.

Appendix A – Bicycle and Pedestrian LTS Methodology and Results

A
December 2017
WMB Bicycle Pedestrian Plan
City of Salem

LEVEL OF TRAFFIC STRESS ANALYSIS METHODOLOGY

Bicycle Level of Traffic Stress

ODOT's Bicycle Level of Traffic Stress is based on a methodology developed by researchers at the Mineta Transportation Institute at San Jose State University and first published in a 2012 report.10 The stated methodology assesses street segments, intersections, and intersection approaches for the level of stress incurred by bicyclists riding there. LTS is scored on a scale of 1 to 4 with 4 being the most stressful. The segment assessment is based on roadway and traffic characteristics including:

- number of lanes,
- traffic speed,
- presence and width of on-street parking, and
- presence and width of bike lanes.

Segments with separated bike lanes[11] are automatically assigned the lowest stress score, LTS 1.

The intersection assessment is based on:

- signalization,
- number of lanes on the cross street, and
- presence of median on the cross street.[12]

The intersection approach assessment is based on:

- presence of turn lanes,
- number of lanes crossed by left-turning bicyclist,
- speed limit, and
- interaction of the right turn lane and bike lane.[13]

The core idea of this methodology is that one factor (speed, number of lanes, type of bicycle facility, etc.) can sway the way in which a bicyclist experiences the roadway. For instance, a street with a bike lane may rate more stressful than one without if the bike lane street has higher speed traffic.

The methodology also relies upon the concept that a bicyclist's choice of route (or decision whether to ride for a given trip) is influenced by the most stressful condition experienced. In practice, this means that a low-stress street ceases to be a comfortable route for most bicyclists if there is an unsignalized

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[10] Maaza C. Mekuria, Ph.D., P.E., PTOE, Peter G. Furth, Ph.D. and Hilary Nixon, Ph.D. Low-Stress Bicycling and Network Connectivity. 2012. Available at: http://transweb.sjsu.edu/project/1005.html

[11] Separated bike lanes refer to a space for bicyclists within or adjacent to the roadway that is separated from automobile traffic by some type of vertical barrier and is not shared with pedestrians.

[12] The original methodology essentially uses number of lanes as a proxy for traffic volume. This often works well in practice, but LTS scores tend to skew higher than actual bicyclist experience in locations where streets are overbuilt.

[13] Consideration of left turn movements and interaction with automobile left turn lanes is an addition to the Mineta Institute methodology by ODOT.

crossing of a wide, high-speed street. This concept is particularly pertinent for family-friendly bikeways whose alignment is often chosen to take advantage of existing low-volume, low-speed streets that may cross arterials at unsignalized locations.

Generally, LTS 1 and 2 segments and intersections are considered “low-stress.” These facilities are comfortable to a large segment of bicyclists. Table A1Table presents a summary of the bicycle LTS scoring criteria described in the ODOT APM.

Table A1. Description of Bicycle LTS Scoring Criteria (from the ODOT APM)

LTS Score	Description
1	Suitable for all bicyclists, including children who are trained to safely cross intersections. Low traffic speeds, no more than one lane in either direction.
2	Suitable for teen and adult bicyclists. Speeds slightly higher, but still with low differential between bicycles and automobiles. Streets can be up to three lanes. Intersections are not difficult to cross.
3	Moderately stressful and suitable for some adult bicyclists comfortable with moderate speeds, up to 35 mph where bike lanes are present or 30 mph in shared lane situations. Streets may be up to five lanes wide.
4	Highly stressful conditions for most riders and suitable only for experienced bicyclists comfortable with proximity to/sharing road with high-speed automobile traffic. Streets may be two to five lanes wide, but with higher speeds. Intersections are wide or high-speed and are likely difficult to cross.

Pedestrian Level of Traffic Stress

ODOT developed the Pedestrian Level of Traffic Stress measure as a complement to the bicycle measure. It operates on a similar principle whereby a single characteristic of the pedestrian realm can sway the way in which a pedestrian experiences the roadway segment or intersection. Ratings reflect the experience both of able-bodied pedestrians and those using wheeled mobility devices.

Segments are evaluated with the following criteria:

- sidewalk condition and width
- buffer type and width
- bike lane width
- parking width
- number of lanes and posted speed
- illumination presence
- general land use

The factor pairs of total buffer width and number of lanes, and posted speed and buffer type are interacted in a matrix to come up with a PLTS score. For example, a segment with a buffer width of 12 feet on a four-lane street is PLTS 2, but is PLTS 3 on a six-lane street. Similarly, a more robust buffer type—landscaped with trees versus paved—mitigates the impact of higher speeds on PLTS.

Intersection crossings are evaluated with the following criteria:

- functional class
- number of lanes and posted speeds
- roadway average daily traffic (ADT) [optional]
- sidewalk ramps
- median refuge and illumination presence
- signalized general intersection features

Table A2 presents a summary of the ODOT APM characterizations of each PLTS rating.[14]

Table A2. Description of Pedestrian LTS Scoring Criteria (from the ODOT APM)

PLTS Score	Description
1	Little to no traffic stress on a sidewalk or shared-use path with a buffer between the facility and automobile traffic. Suitable for all users including children under 10 and those using wheeled mobility devices.
2	Little traffic stress but requires more attention to traffic than may be expected of younger children. Some factors may limit use for those in wheeled mobility devices. Adjacent roadway may have higher speed/volume, but facility is buffered.
3	Moderate stress. Able-bodied adults feel uncomfortable, but safe using facility. Can be higher speed roadway with small buffers. Wheeled mobility device users may find parts impassable.
4	High traffic stress. Route unsuitable and only used by able-bodied adults with no other routing choices. No/narrow buffer for facility on higher speed street, or lack of sidewalk.

[14] Summarized from page 14-30 of the Analysis Procedures Manual.

LEVEL OF TRAFFIC STRESS ANALYSIS RESULTS

Existing Bicycle Level of Traffic Stress

Generally, segment conditions along the WMB proposed alignment are comfortable for biking today. The bicycle LTS scoring results are shown on Figure A1 and Figure A2 on the following pages. Nearly all segments rate LTS 1 or 2 except for northern end of the alignment where higher traffic speeds and bike lane/right turn lane conflicts create more stressful conditions.

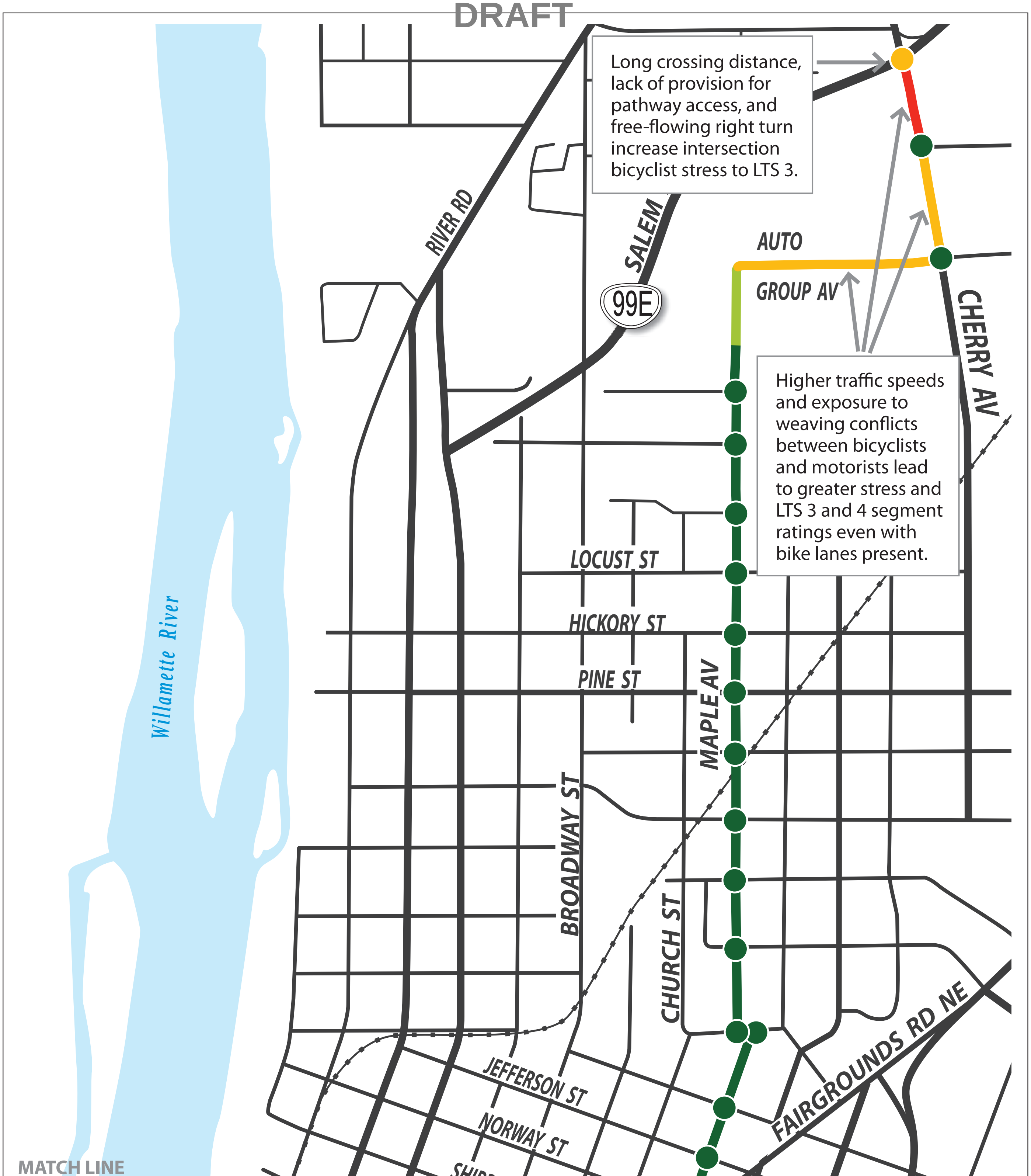
Intersections also rate mostly in the LTS 1 and 2 range. Signalized intersections are given a default rating of LTS 1, but some latitude is afforded the evaluator in these situations. Stop-controlled and uncontrolled intersections along the corridor all rated LTS 1 or 2 owing to relatively low speeds and fewer number of lanes on the cross streets.

The results of LTS analysis are largely reflective of bicyclists' experience along the proposed WMB alignment today with two exceptions: the crossings at Fairgrounds Road and Pine Street. Both of these intersections rate LTS 1 using the ODOT methodology because of the lower speed limit (30 mph) on the cross-street and number of lanes (two and three lanes, respectively). At the intersection of Fairgrounds Road/Norway Street, the rating does not consider the highly skewed approaches, the actual width of the street (approx. 46 feet consisting of two 23-foot lanes), or unmarked crosswalks and parking lanes. All of these factors contribute to making this a higher stress crossing.

At Pine Street, automobile volumes, the width of the street and lack of crosswalks, signage and lighting contribute to a higher level of stress for bicyclists. Both of these intersections are likely candidates for treatments to improve the safety and comfort of crossing bicyclists.

Future Bicycle Level of Traffic Stress

Figure A3 and Figure A4 depict the expected level of traffic stress for bicyclists after all recommended improvements have been implemented. As shown, the LTS scores are expected to improve at several of the key crossings and through the entire downtown area.



LEGEND

Intersection Level of Traffic Stress

- 1
- 2
- 3
- 4

Street Segment Level of Traffic Stress

- 1
- 2
- 3
- 4

DKS

Toole Design Group

No Scale

Figure A1

Bicycle Level of Traffic Stress, North Alignment

DRAFT

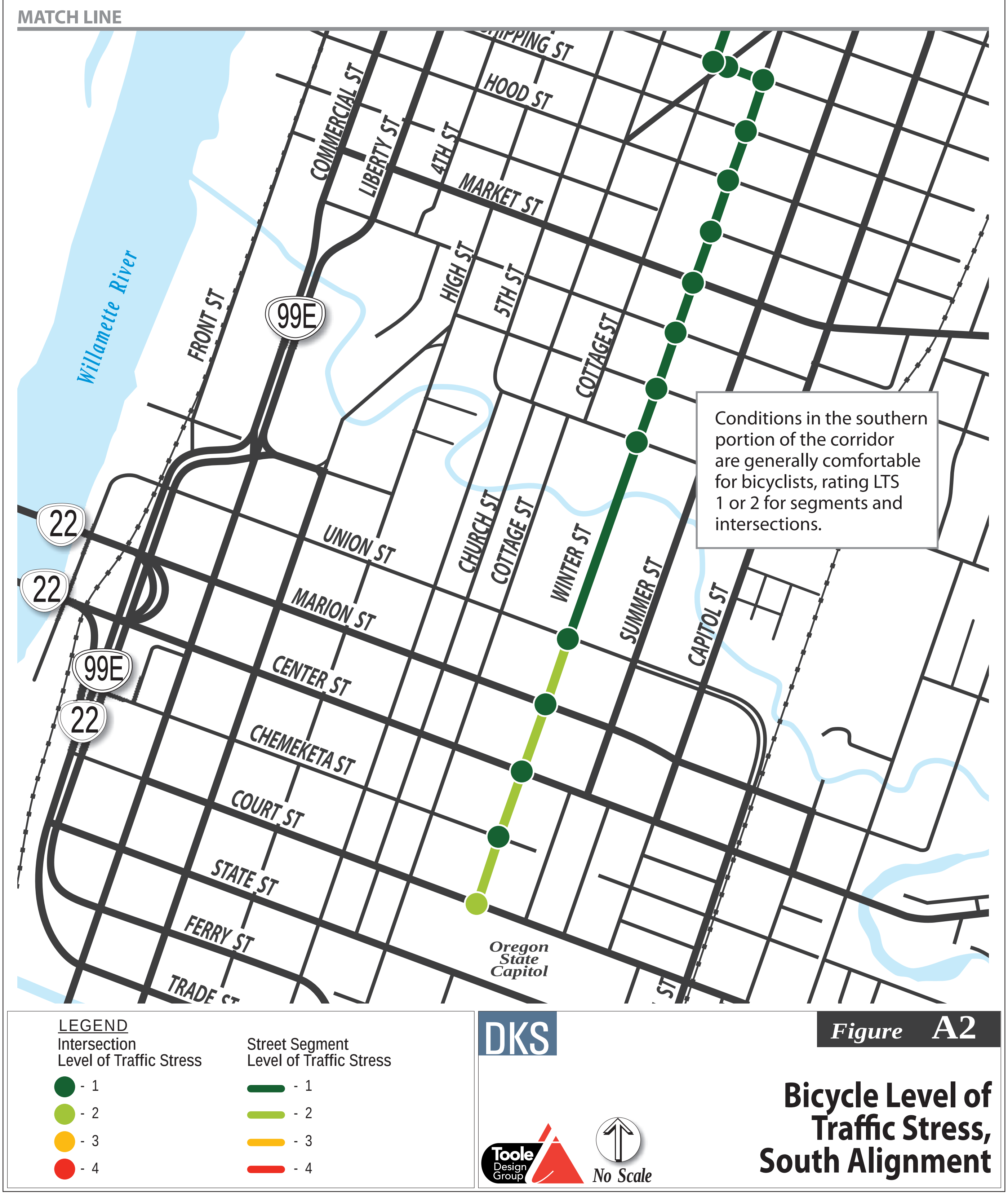


Figure A2

Bicycle Level of Traffic Stress, South Alignment

DRAFT

LEGEND

Intersection Level of Traffic Stress
- 1
- 2
- 3
- 4

Street Segment Level of Traffic Stress
- 1
- 2
- 3
- 4

DKS

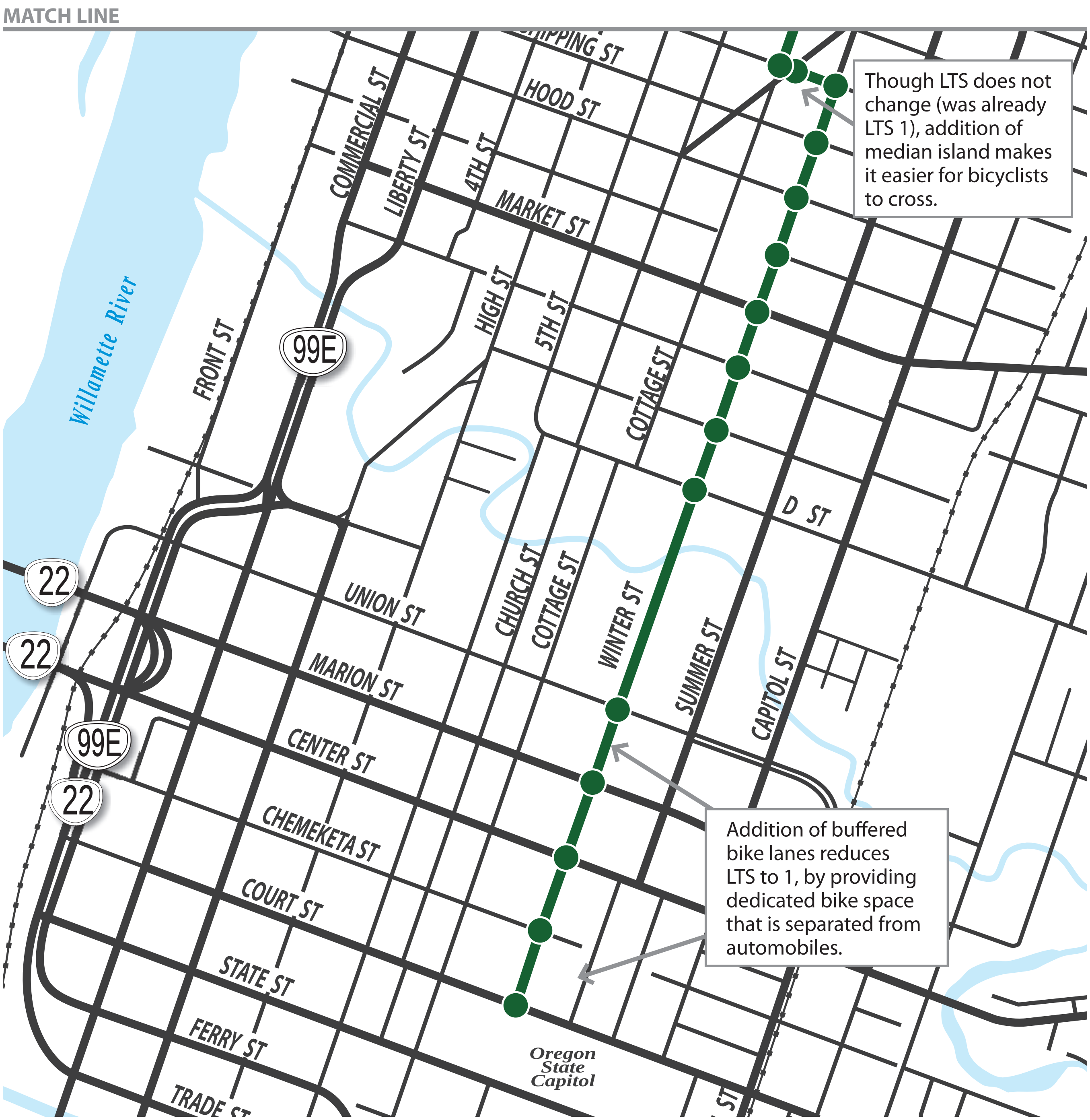
Toole Design Group

No Scale

Figure A3

Bicycle Level of Traffic Stress, post-Implementation North Alignment

DRAFT



LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

DKS

Toole Design Group

No Scale

Figure **A4**

Bicycle Level of Traffic Stress, post-Impelemtnation South Alignment

Existing Pedestrian Level of Traffic Stress

The PLTS methodology scores each side of the street independently, so data were gathered pertaining to the sidewalk, or lack thereof, for both sides of the street along the WMB alignment. Intersections are scored as a single entity, so one score appears for each. Additionally, ODOT's guidance instructs the reviewer to consider one major fault along an otherwise fair condition sidewalk as grounds for scoring that block very poor (PLTS 4).[15] Thus, the resulting PLTS is more reflective of sidewalk condition and the impact it has on wheeled mobility device users than the overall pedestrian environment as experienced by an able-bodied pedestrian. The PLTS analysis was completed with and without consideration of sidewalk condition, as shown on Figure A5 through Figure A8 on the following pages.

Under the ODOT methodology, the majority of the corridor scores PLTS 3 or 4 for segment ratings and PLTS 1 or 2 for crossings. Though land uses create a comfortable pedestrian environment, automobile speeds and volumes are relatively slow along the corridor and most segments have sidewalks with large, landscaped buffers, these factors are overridden by the relatively poor quality of sidewalks. Most block faces were rated in the poor or very poor categories because of the presence of cracking, faulting and rough conditions.

Most intersections along the corridor rate PLTS 1 or 2. These ratings can be attributed to the low speed and number of lanes on cross streets, presence of signals at larger streets, and the provision of adequate curb ramps and lighting. Unsignalized collector and local street intersections are evaluated on those criteria alone, while unsignalized arterial crossings also consider the ADT of the cross street.[16]

Four intersections rate as PLTS 3:

- Cherry Avenue at Salem Parkway
- Maple Avenue at Pine Street
- Maple/Cottage at South Street
- Norway Street at Fairgrounds Road

These intersections are generally made more stressful because of the speed, width, and traffic volume of cross streets.

Future Pedestrian Level of Traffic Stress

Figure A9 through Figure A12 depict the expected level of traffic stress for pedestrians after all recommended improvements have been implemented. As shown, the LTS scores are expected to improve at several of the key crossings and segments where multi-use paths are recommended.

[15] See page 14-32 through 14-34 of the Analysis Procedures Manual for sidewalk condition guidance.
[16] The method also considers the presence of a refuge median, but there are none along this corridor.

DRAFT

LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

DKS

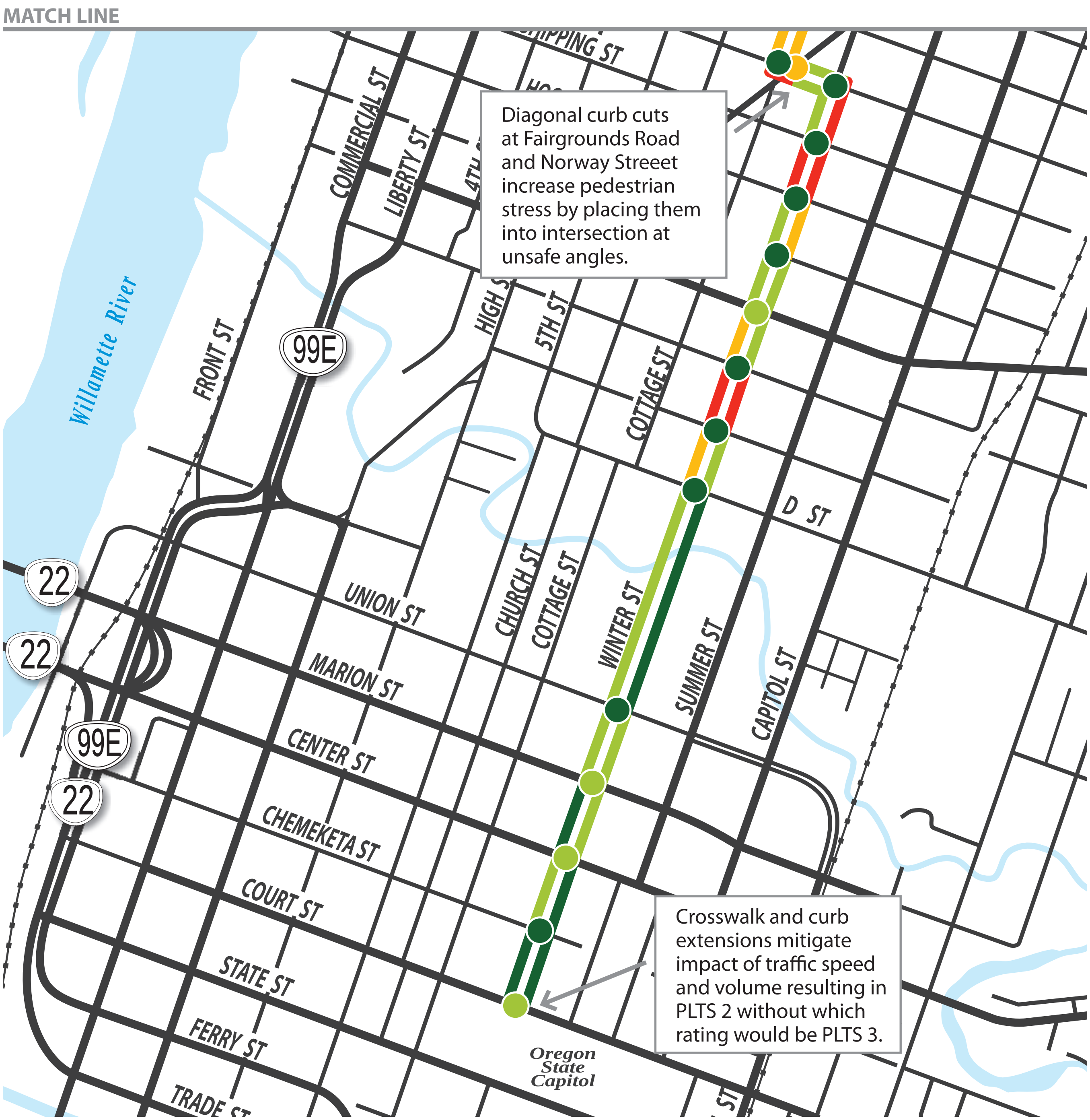
Toole Design Group

No Scale

Figure A5

Pedestrian Level of Traffic Stress, North Alignment

DRAFT



LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

DKS

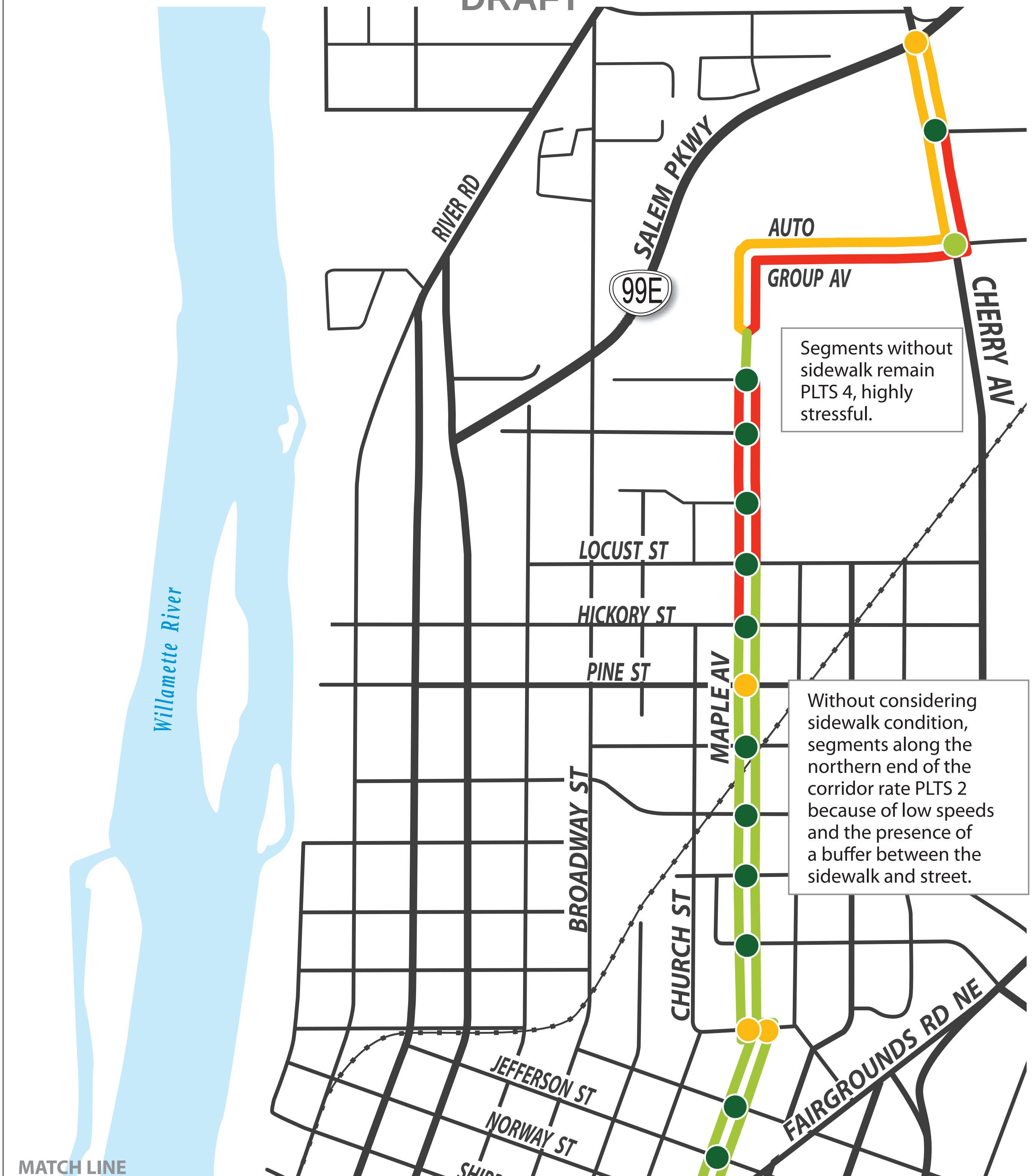
Toole Design Group

No Scale

Figure A6

Pedestrian Level of Traffic Stress, South Alignment

DRAFT



LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

DKS

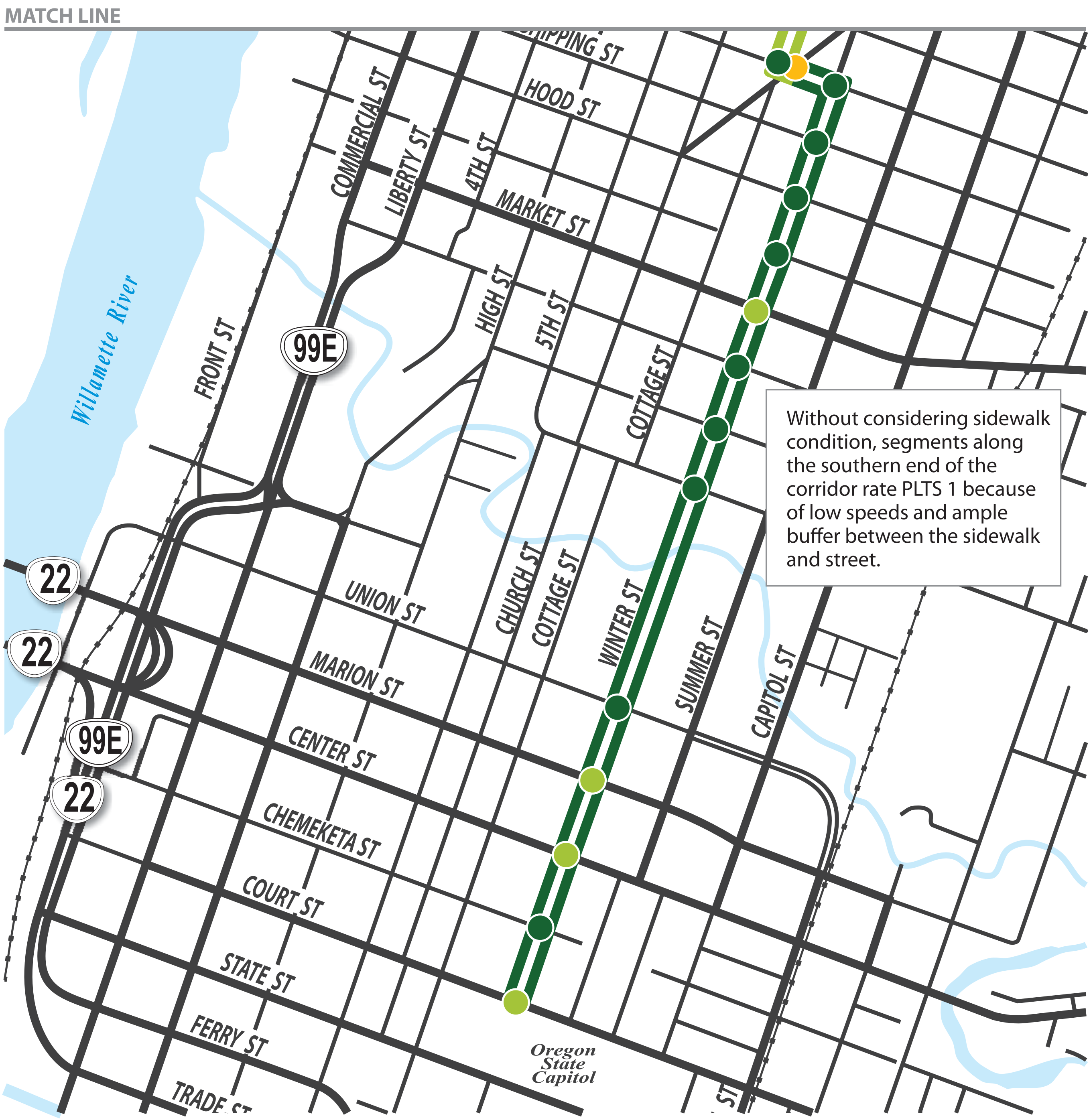
Toole Design Group

No Scale

Figure A7

Pedestrian Level of Traffic Stress - Excluding Sidewalk Condition, North Alignment

DRAFT



LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

No Scale

Figure A8

Pedestrian Level of Traffic Stress - Excluding Sidewalk Condition, South Alignment

DRAFT

LEGEND

Intersection Level of Traffic Stress	Street Segment Level of Traffic Stress
- 1	- 1
- 2	- 2
- 3	- 3
- 4	- 4

DKS

Figure **A9**

Pedestrian Level of Traffic Stress, post-Implementation, North Alignment

Toole Design Group

No Scale

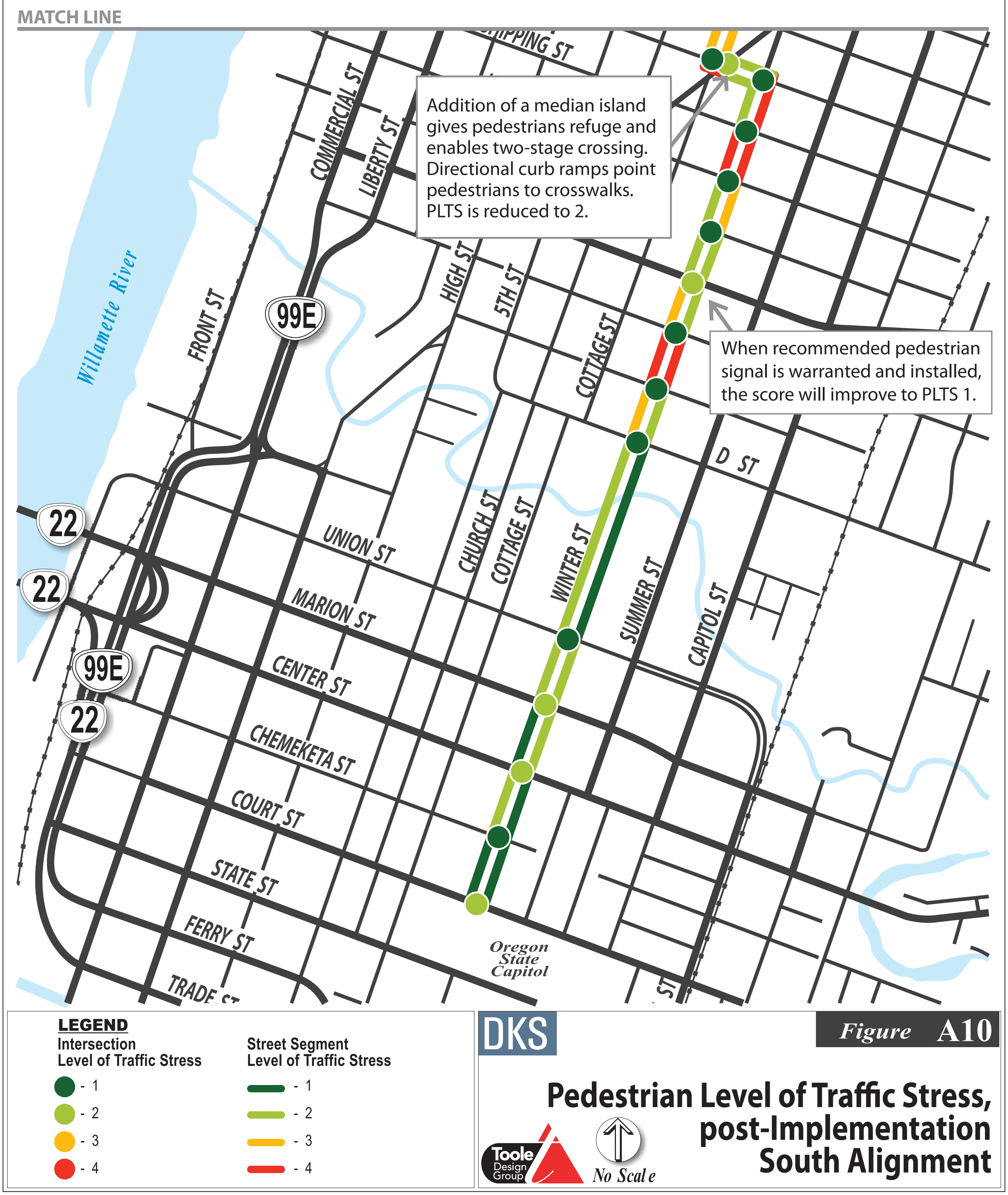


Figure A10

Pedestrian Level of Traffic Stress, post-Implementation South Alignment

DRAFT

LEGEND

Intersection Level of Traffic Stress
- 1
- 2
- 3
- 4

Street Segment Level of Traffic Stress
- 1
- 2
- 3
- 4

DKS

Figure A11

Pedestrian Level of Traffic Stress, excluding sidewalk condition post-Implementation, North Alignment

Toole Design Group

No Scale

DRAFT

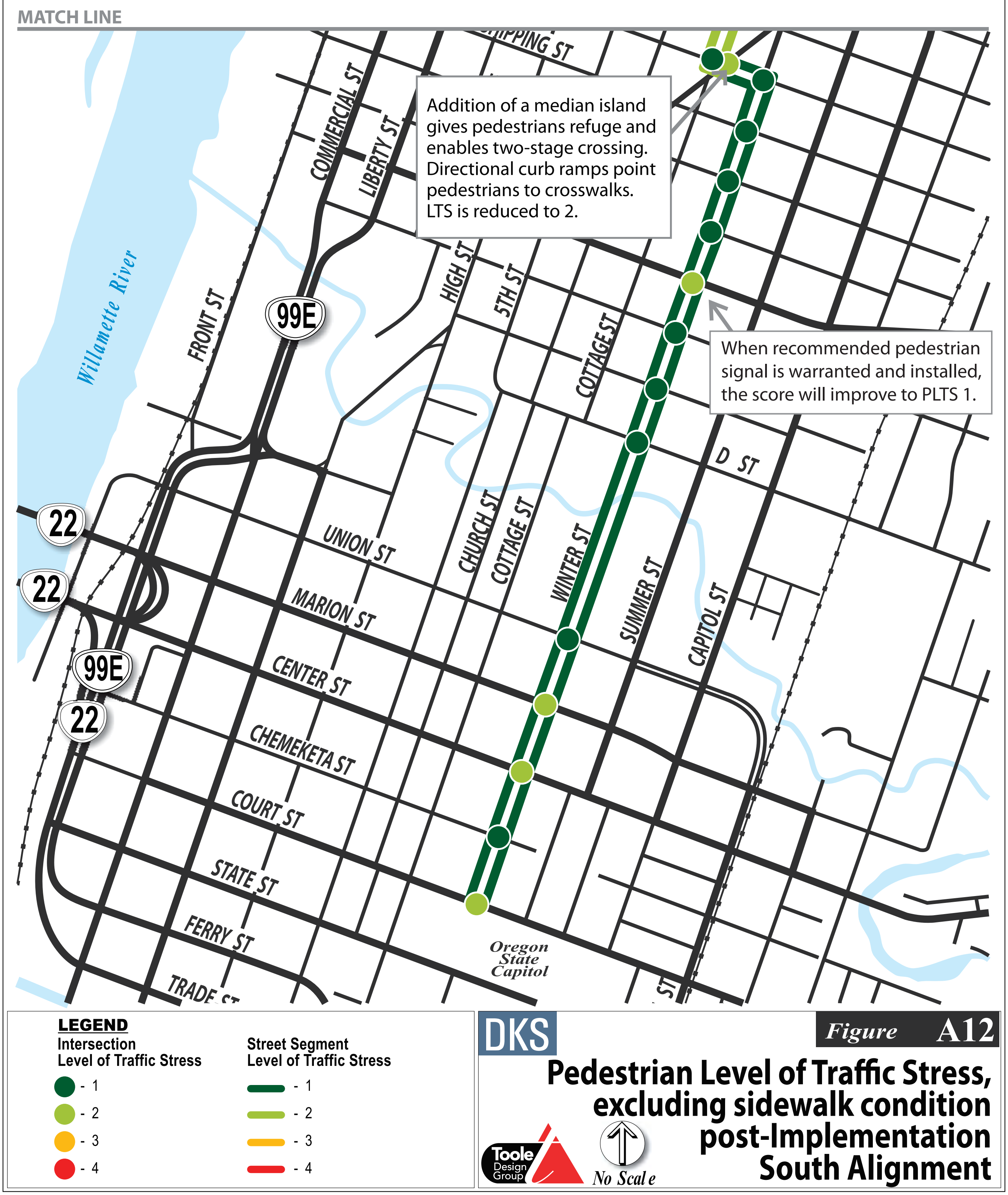


Figure A12

Pedestrian Level of Traffic Stress, excluding sidewalk condition post-Implementation South Alignment

Appendix B – Conceptual Designs and Drawings

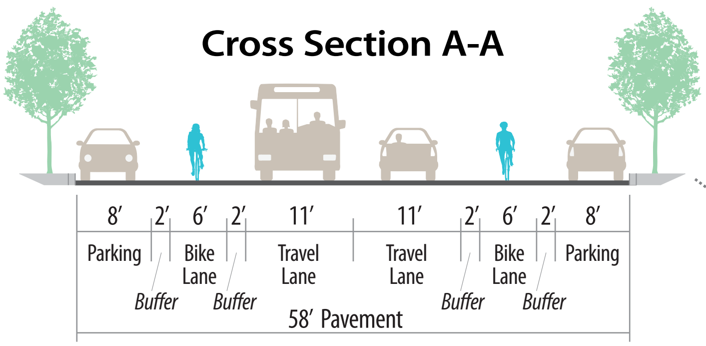
CITY OF Salem AT YOUR SERVICE

Winter-Maple Bikeway
CONCEPT

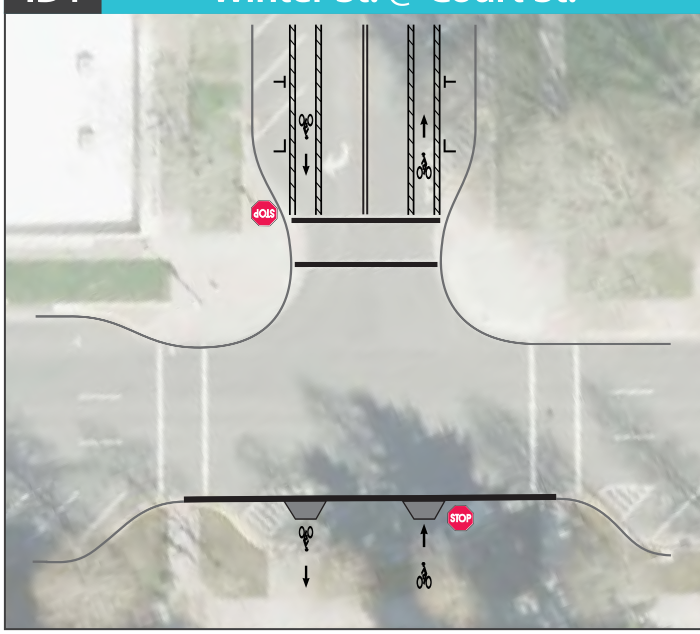
Parking Summary *(Court St. to Marion St.)*

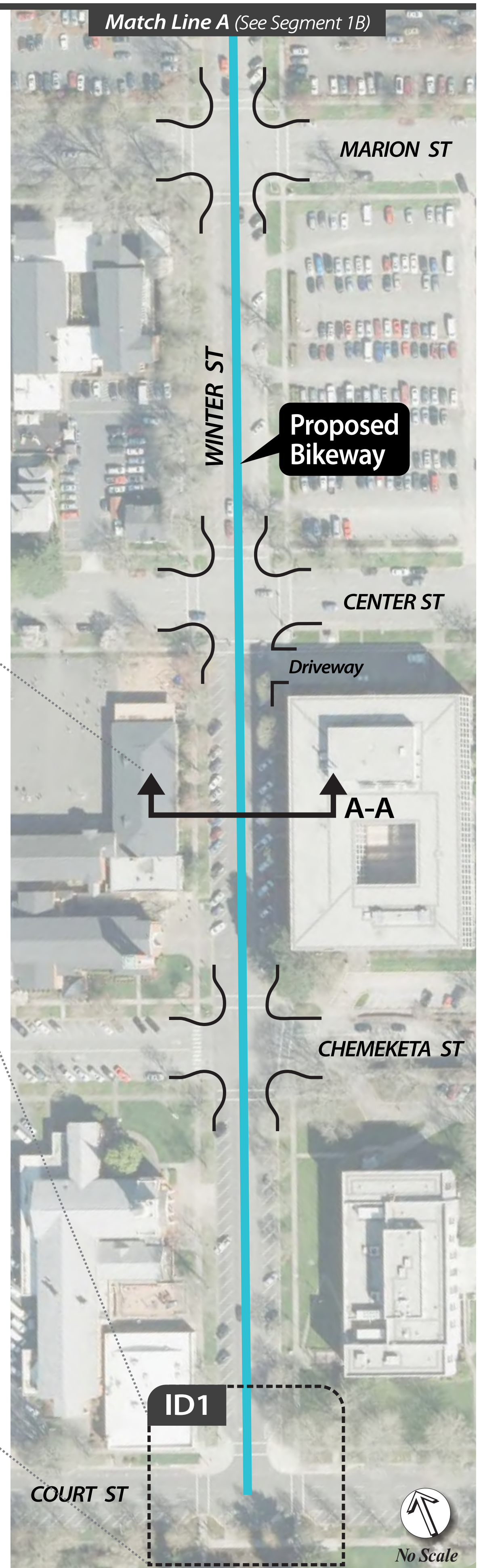
Existing: 113 Angled Parking Spots
Proposed: 66 Parallel Parking Spots

Cross Section A-A



ID1 Winter St. @ Court St.





DKS

Segment 1A - Winter Street
(Court Street to Marion Street)

Note: Aerial segments may contain various overlaps at match line locations.

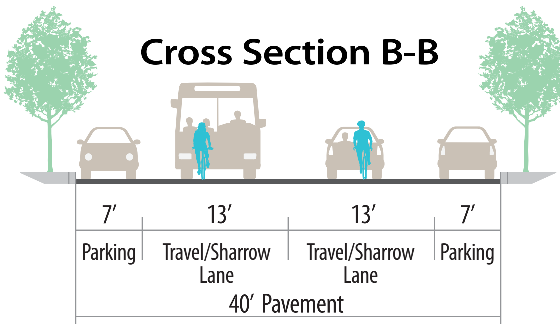
City of Salem — At Your Service

Winter-Maple Bikeway CONCEPT

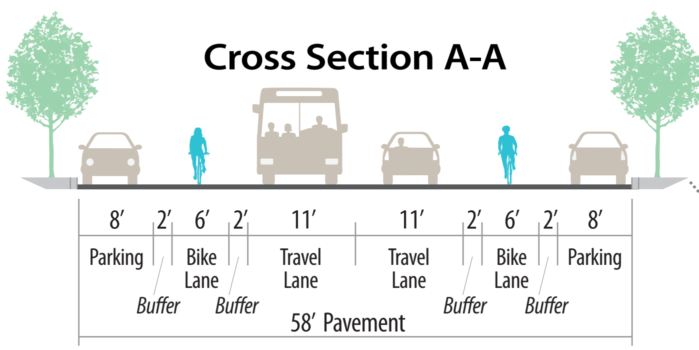
Parking Summary *(Marion St. to D St.)*

Existing: 157 Angled Parking Spots
Proposed: 81 Parallel Parking Spots

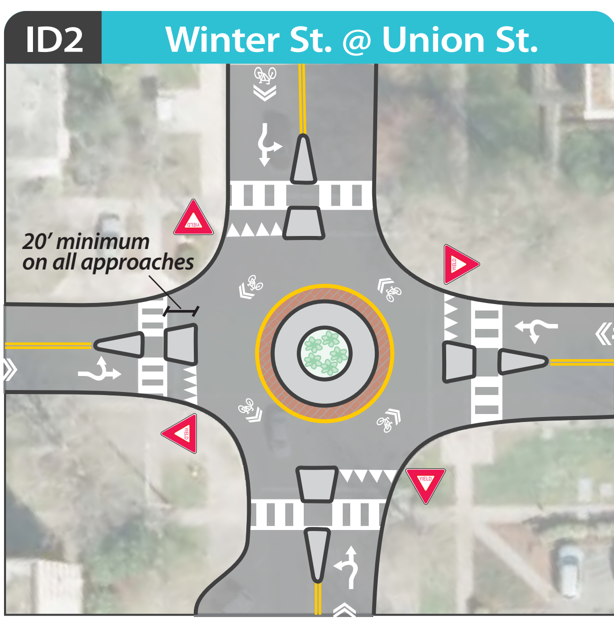
Cross Section B-B

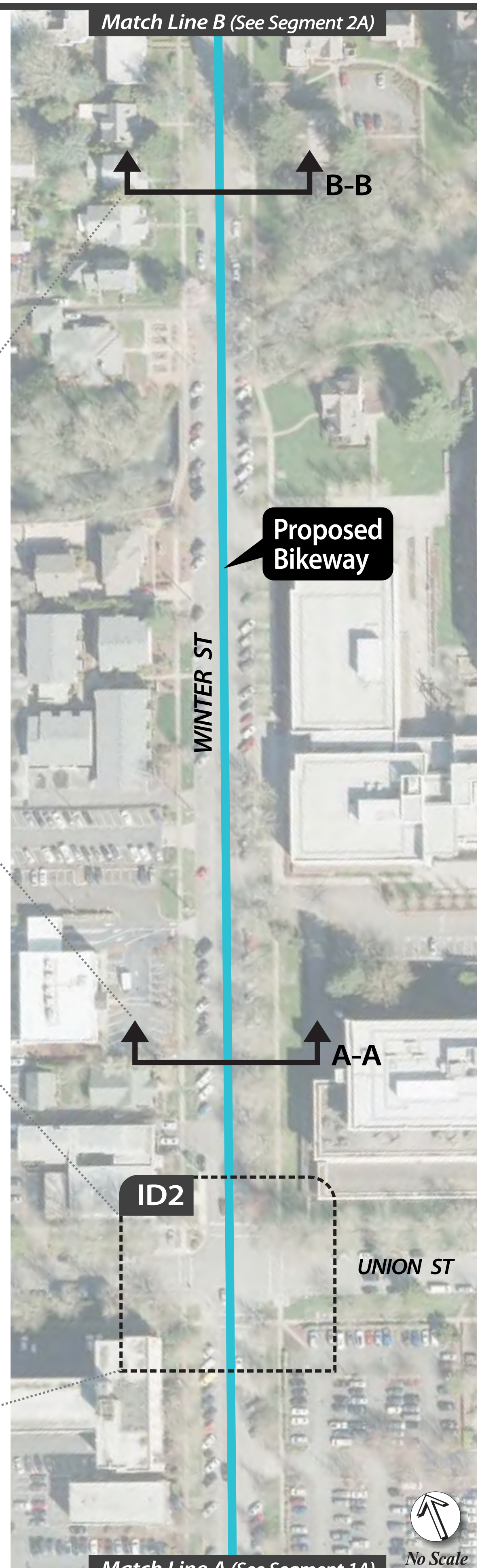


Cross Section A-A



ID2 Winter St. @ Union St.





Segment 1B - Winter Street

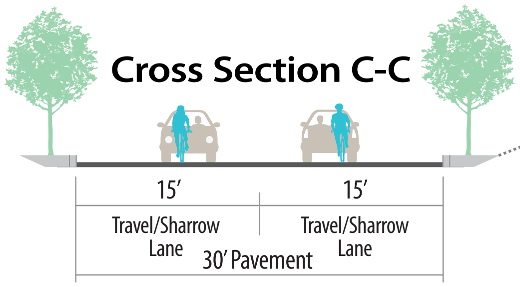
(Union Street to South of D Street)

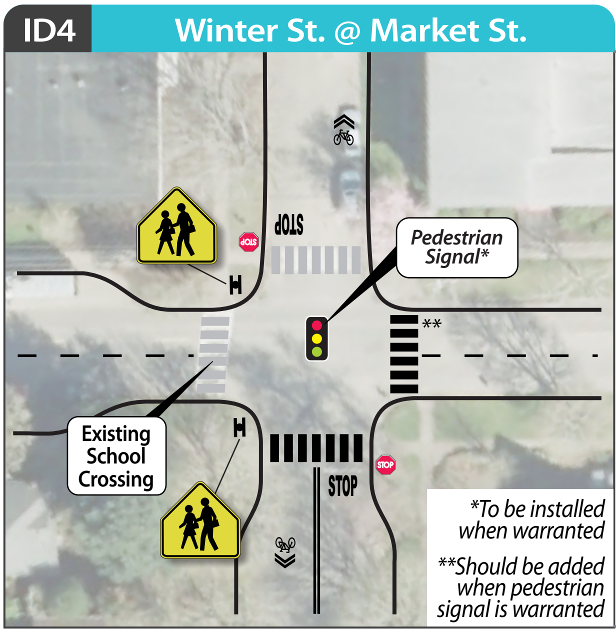
DKS

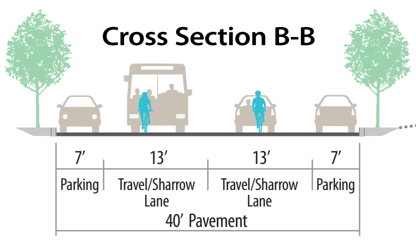
Note: Aerial segments may contain various overlaps at match line locations.

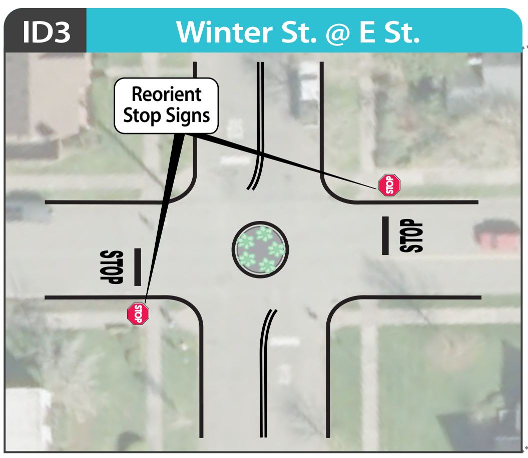
CITY OF Salem AT YOUR SERVICE

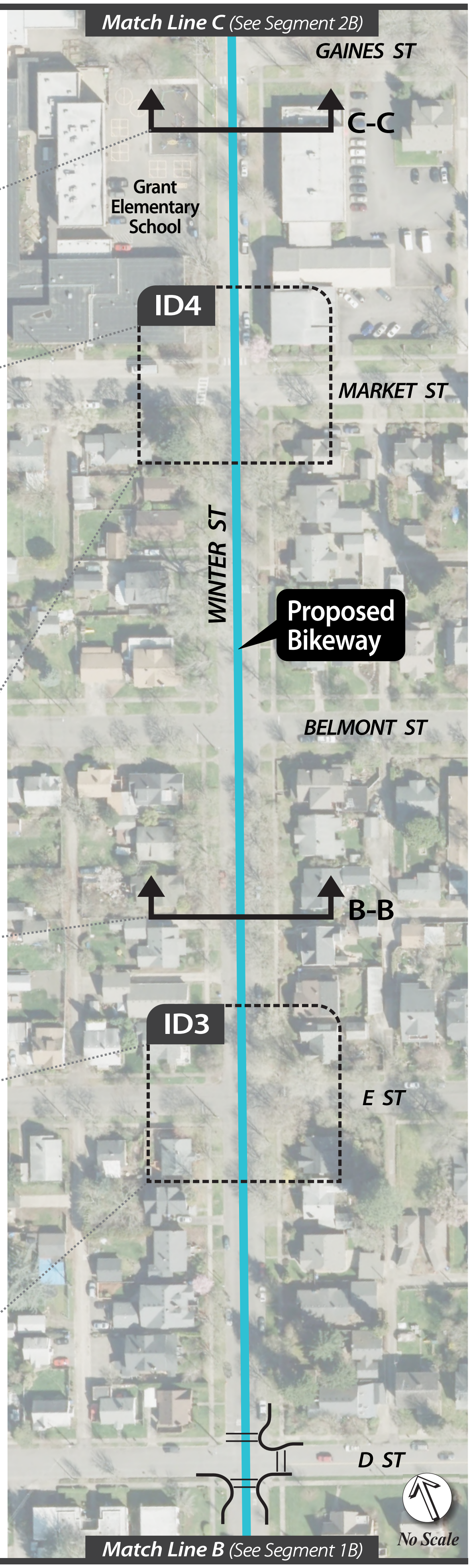
Winter-Maple Bikeway CONCEPT











DKS

Segment 2A - Winter Street

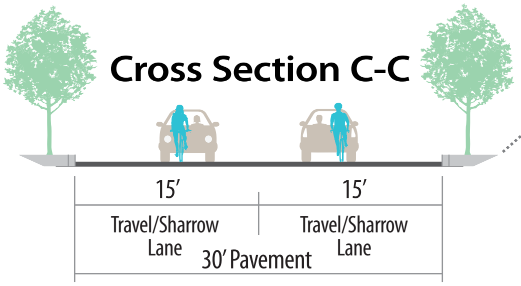
(D Street to Gaines Street)

Note: Aerial segments may contain various overlaps at match line locations.

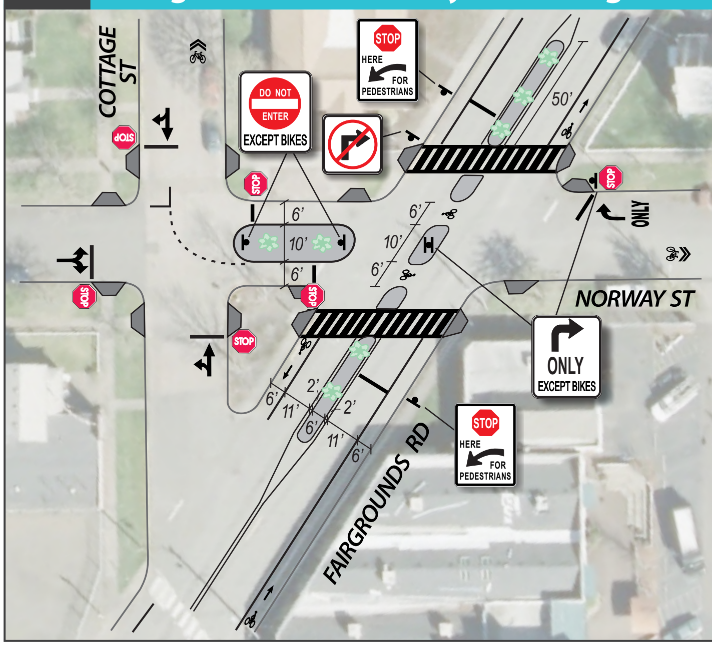
CITY OF Salem AT YOUR SERVICE

Winter-Maple Bikeway CONCEPT

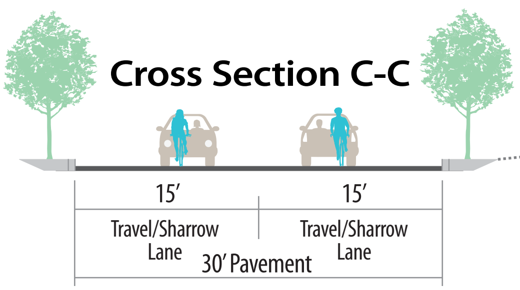
Cross Section C-C



ID6 Fairground Rd./Norway St./Cottage St.



Cross Section C-C



ID5 Winter St. @ Gaines St.

DKS

Segment 2B - Winter Street/Cottage Street

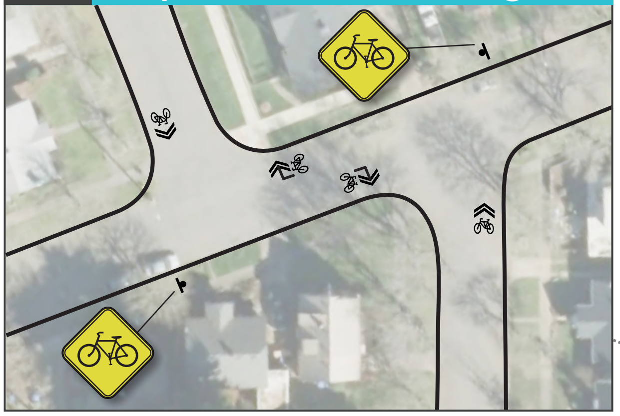
(Gaines Street to Norway Street)

Note: Aerial segments may contain various overlaps at match line locations.

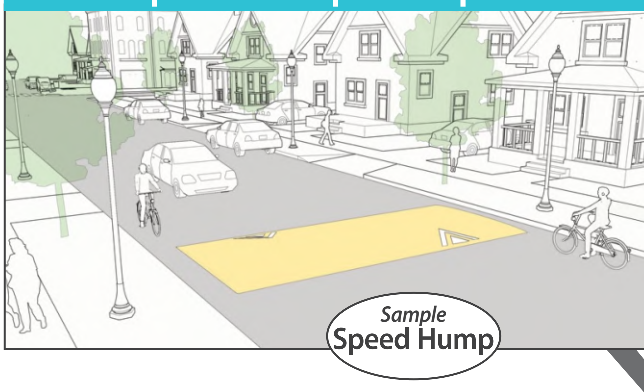
CITY OF Salem AT YOUR SERVICE

Winter-Maple Bikeway CONCEPT

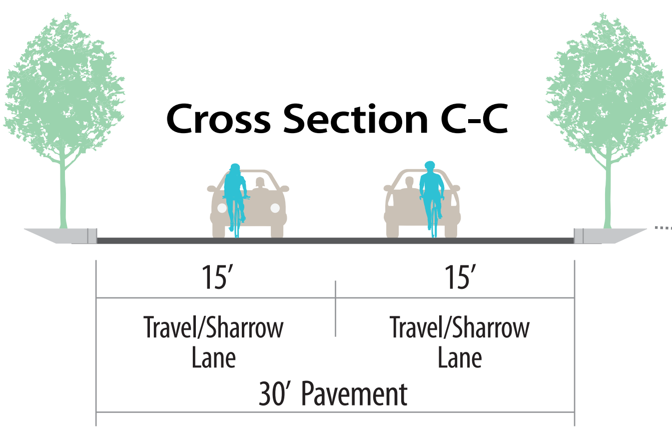
ID7 Maple St./South St./Cottage St.

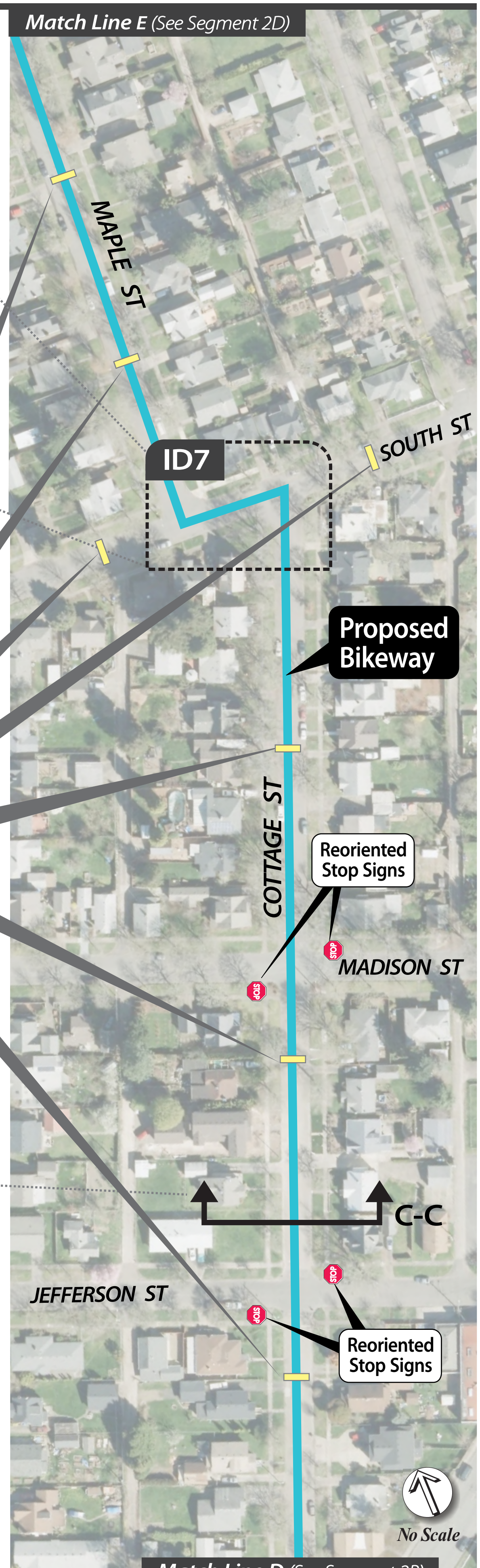


Speed Hump Examples



Cross Section C-C





DKS

Segment 2C - Cottage Street/Maple Street

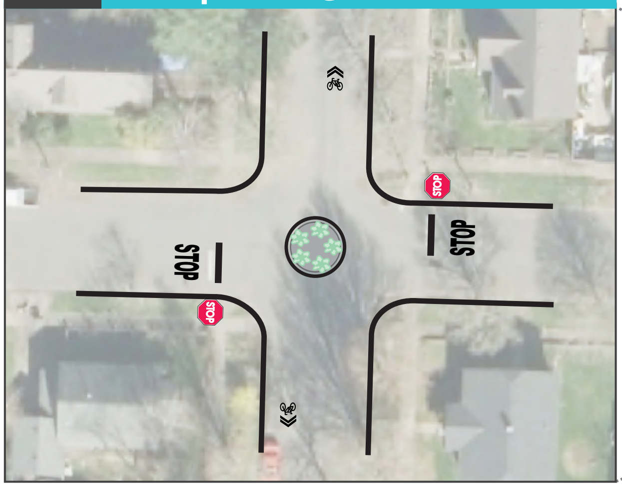
(Jefferson Street to South Street at Maple Street)

Note: Aerial segments may contain various overlaps at match line locations.

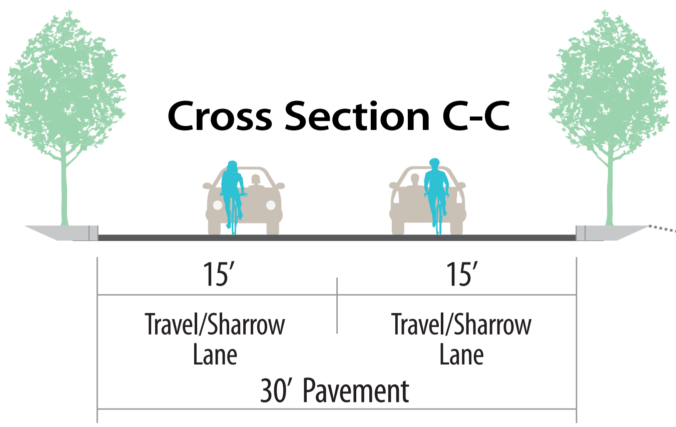
CITY OF Salem AT YOUR SERVICE

Winter-Maple Bikeway CONCEPT

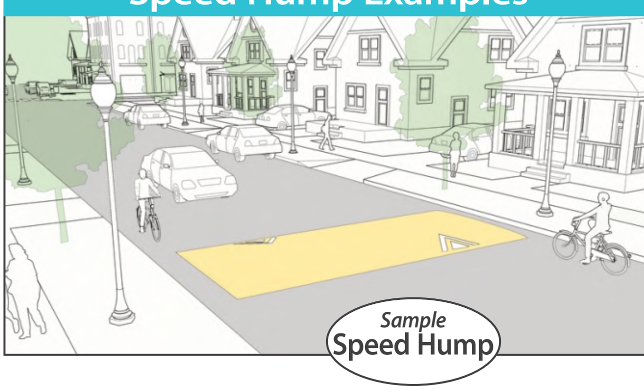
ID8 Maple St. @ Columbia St.

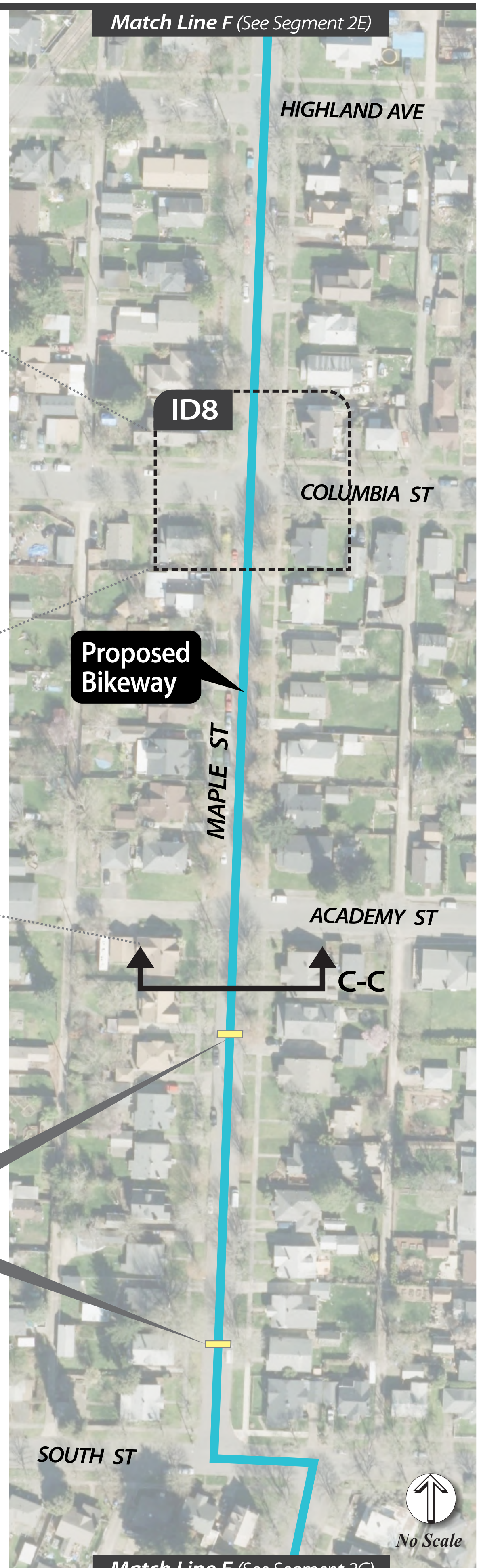


Cross Section C-C



Speed Hump Examples





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Segment 2D - Maple Street

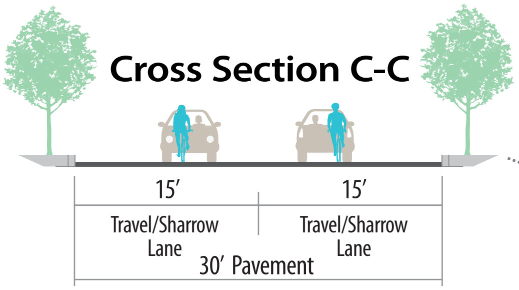
(South Street to Highland Avenue)

Note: Aerial segments may contain various overlaps at match line locations.

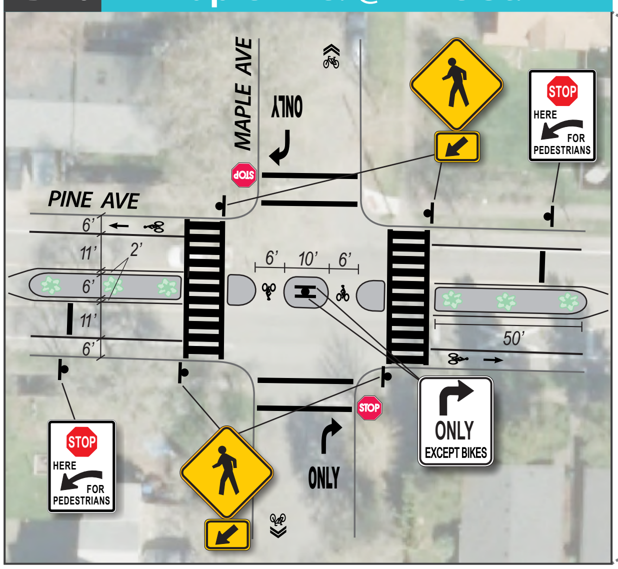
CITY OF Salem AT YOUR SERVICE

Winter-Maple Bikeway CONCEPT

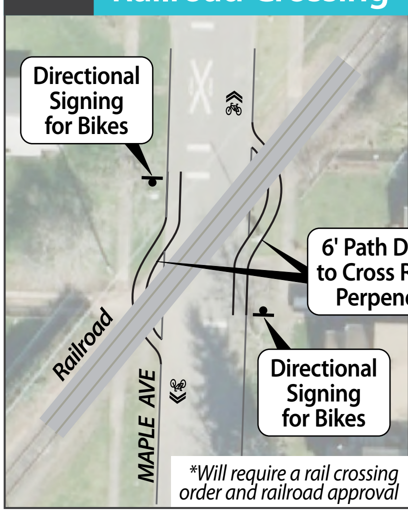
Cross Section C-C

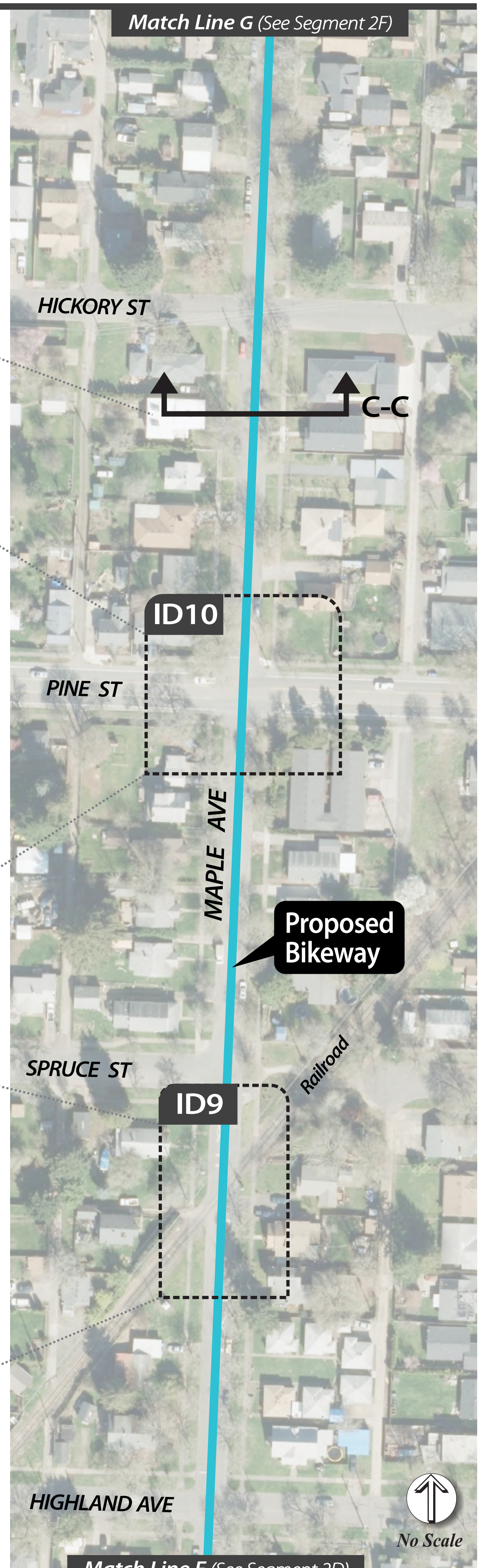


ID10 Maple Ave. @ Pine St.



ID9 Maple Ave. @ Railroad Crossing





DKS

Segment 2E - Maple Avenue

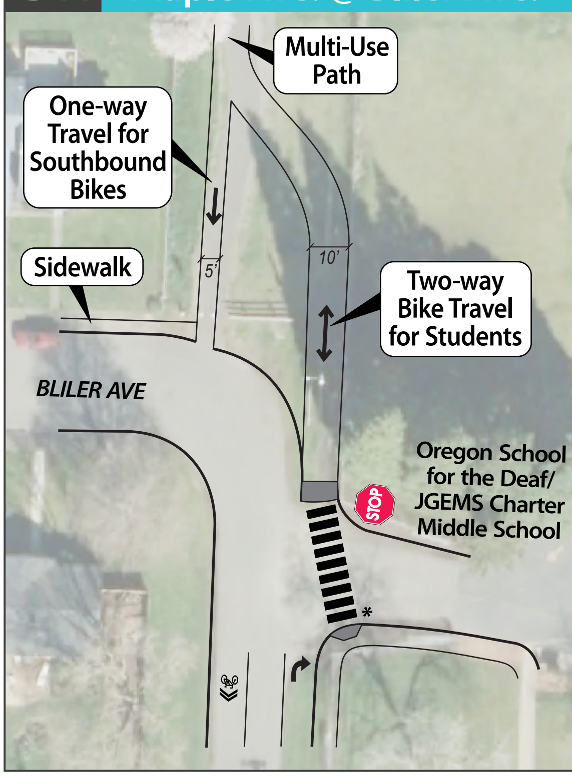
(Highland Avenue to Hickory Street)

Note: Aerial segments may contain various overlaps at match line locations.

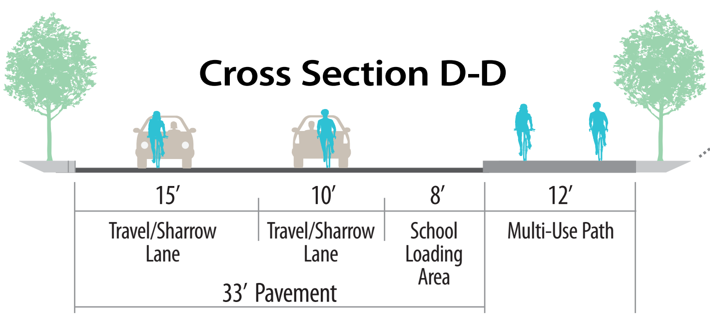
CITY OF Salem AT YOUR SERVICE

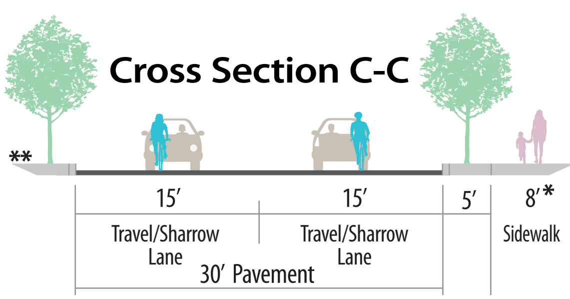
Winter-Maple Bikeway CONCEPT

ID11 Maple Ave. @ Bliler Ave.



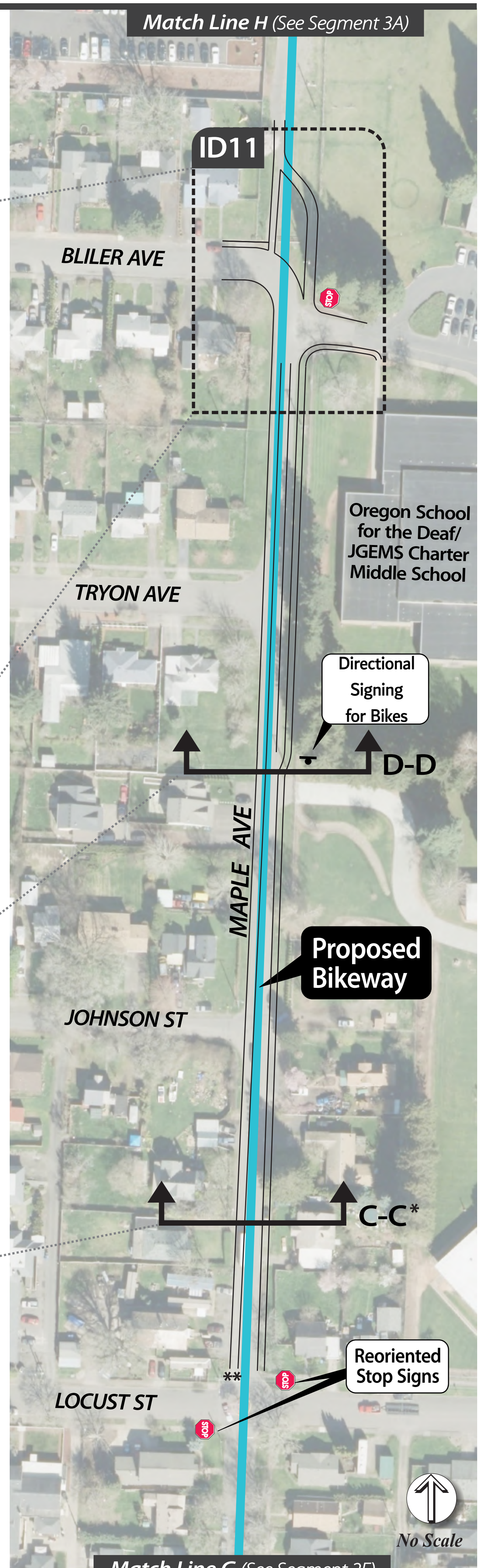
*New raised driveway apron





*Include a 8' sidewalk connecting Locust St. to the Multi-Use Path on the eastside of Maple Ave.

** To install sidewalk on west side for future project.

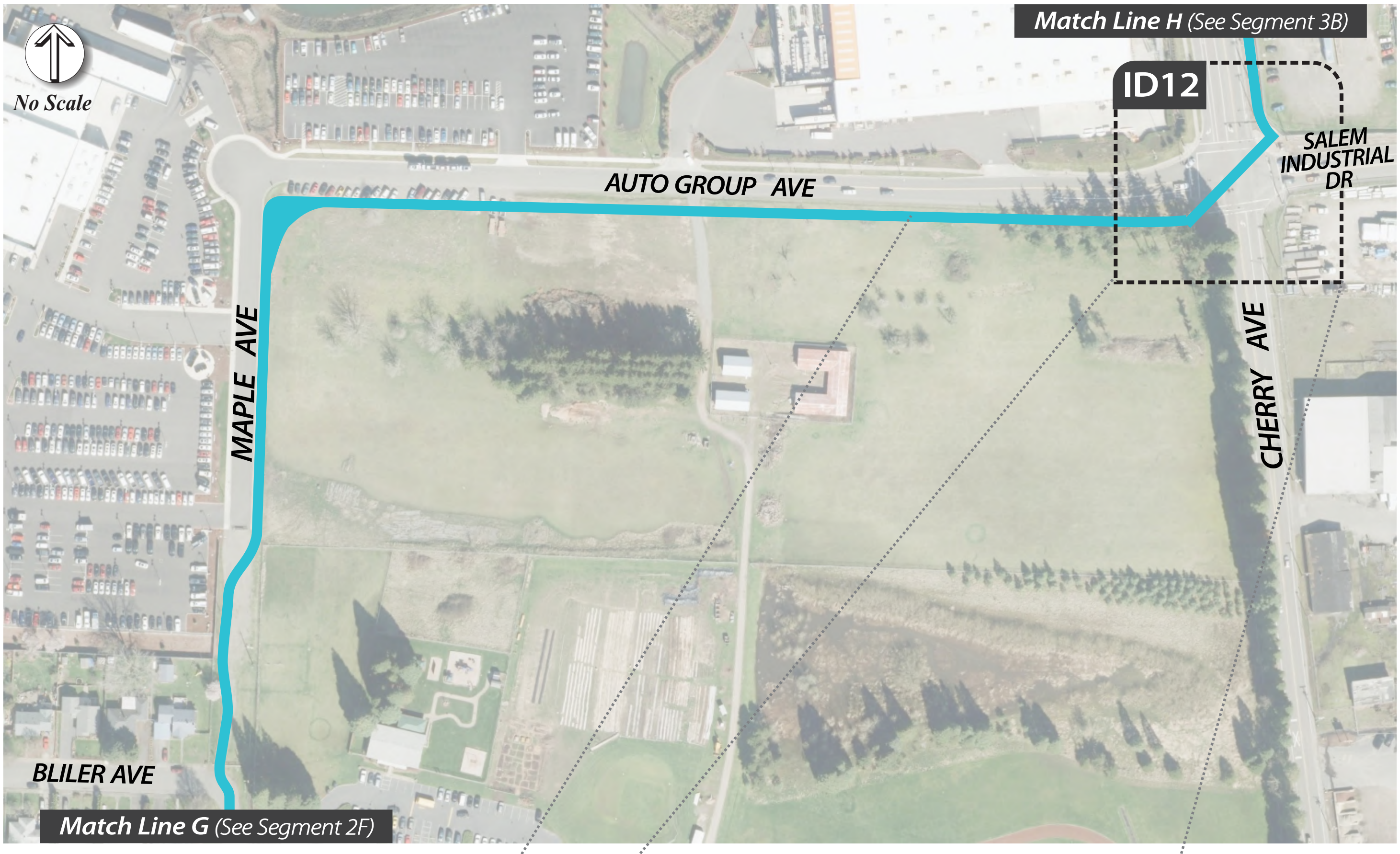


Segment 2F - Maple Avenue

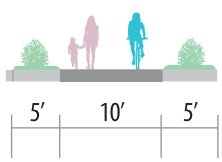
(Locust Street to Bliler Avenue)

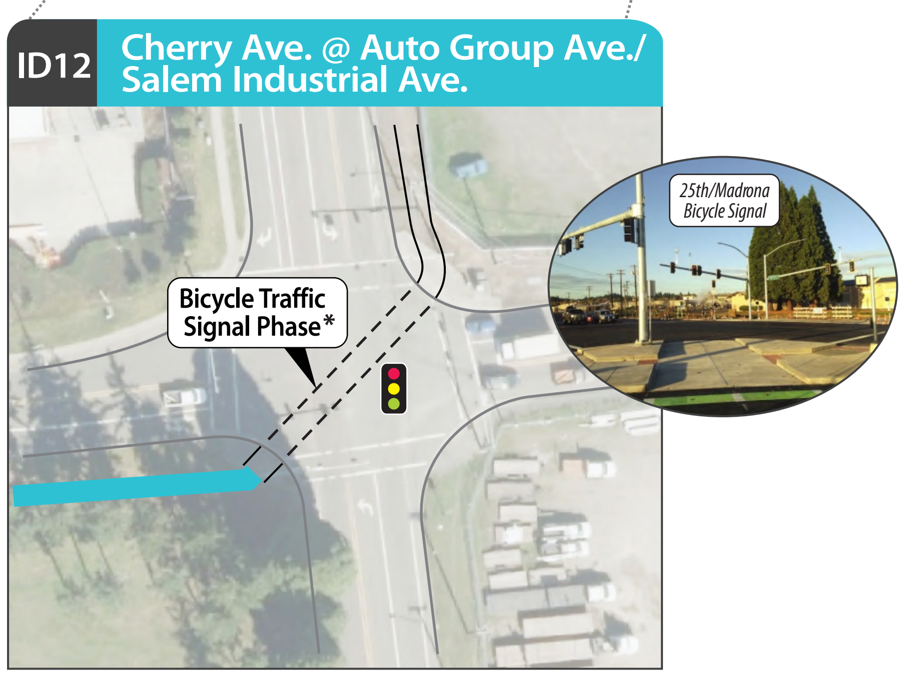
Note: Aerial segments may contain various overlaps at match line locations.

DKS



Multi-use Path



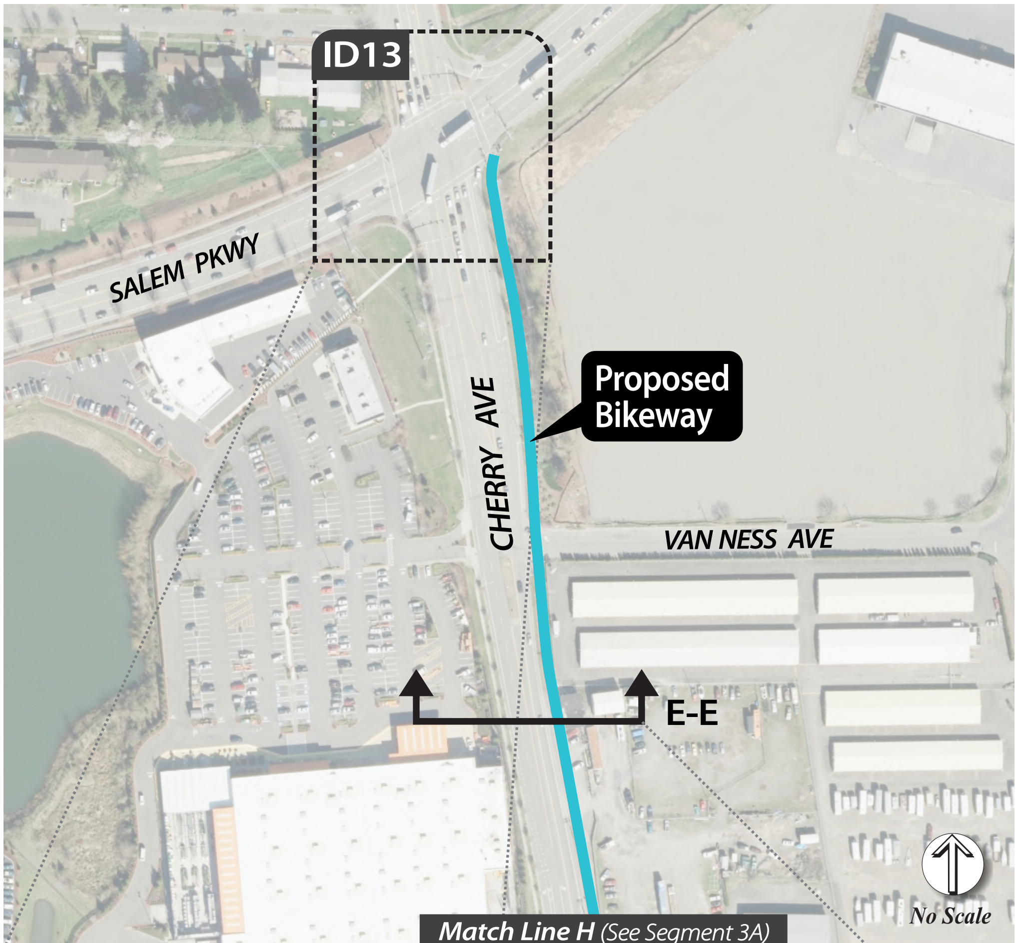


*Bicycle traffic signal phase will include camera detectors and push buttons for bicyclists.

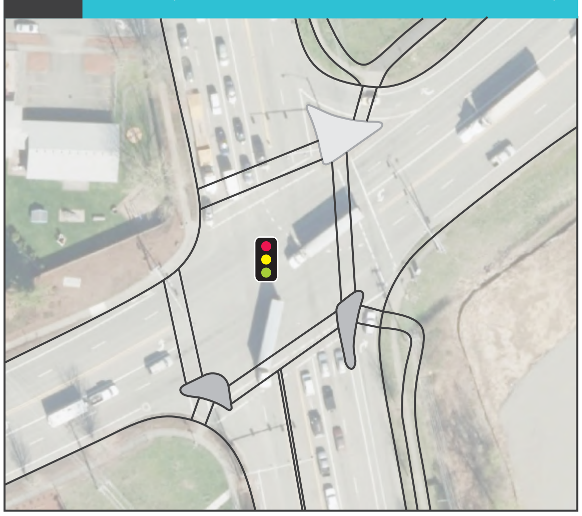
Segment 3A - Maple Avenue to Cherry Avenue

(Bliler Avenue to Auto Group Avenue)

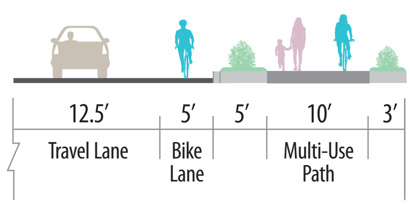
Note: Aerial segments may contain various overlaps at match line locations.



ID13 Cherry Avenue @ Salem Parkway



Cross Section E-E



CITY OF Salem AT YOUR SERVICE

ENGINEERING DIVISION

SALEM PUBLIC WORKS DEPARTMENT

OREGON DEPARTMENT OF TRANSPORTATION

DKS

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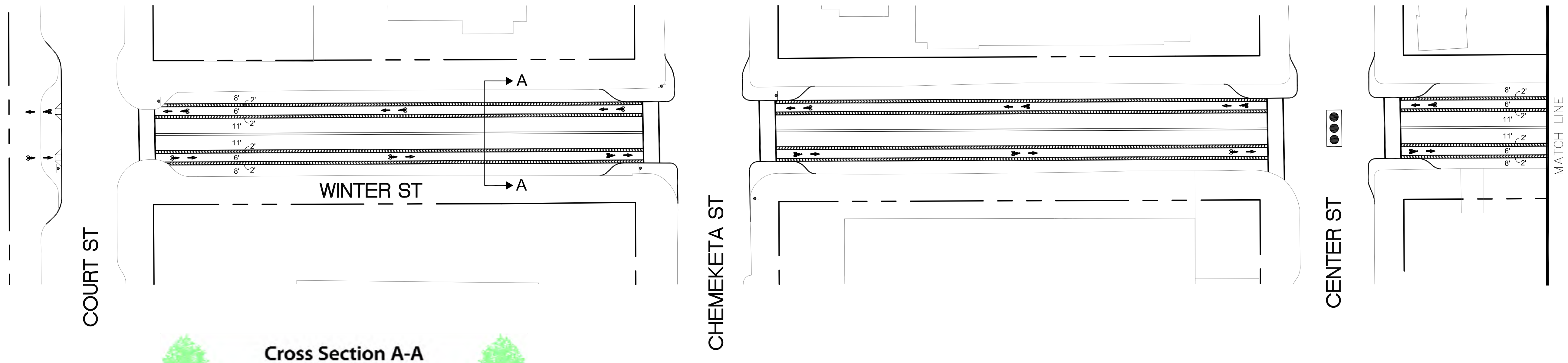
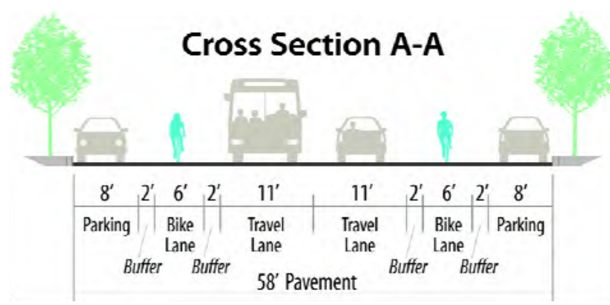
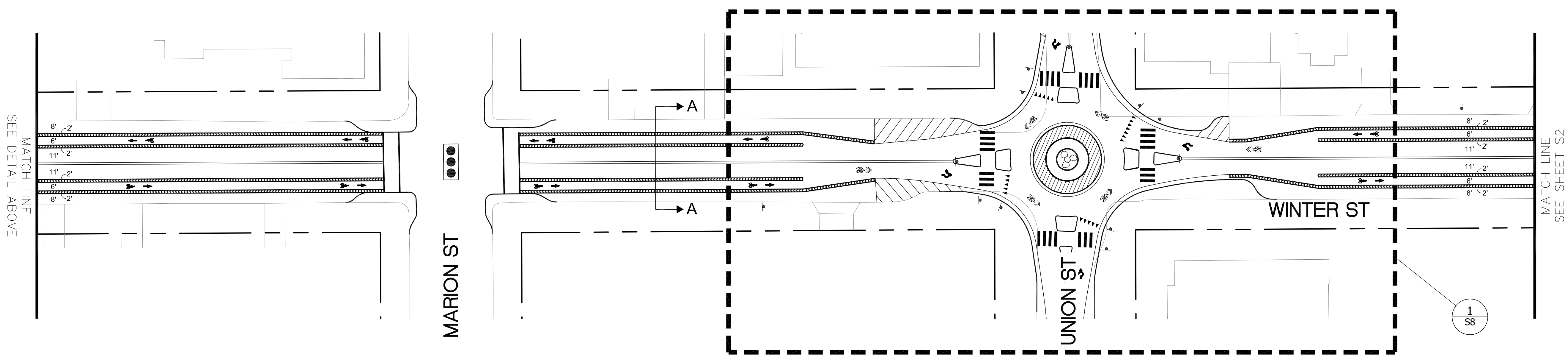
Salem, Oregon 97301
(503) 391-8773
www.dksassociates.com





1 **WINTER STREET**
COURT STREET TO CENTER STREET



2 **WINTER STREET**
CENTER STREET TO UNION STREET

WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 1A & 1B
COURT ST TO UNION ST

S1

SHEET 1 OF 10

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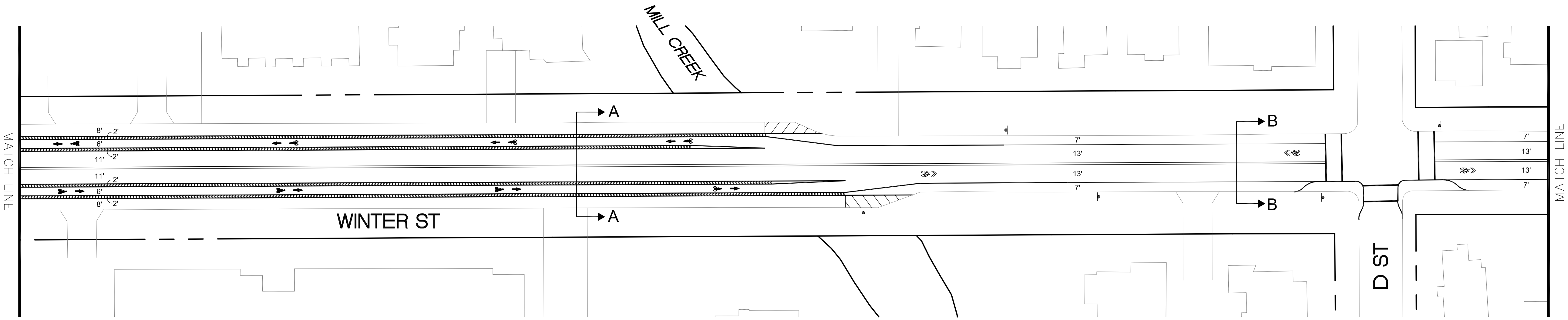

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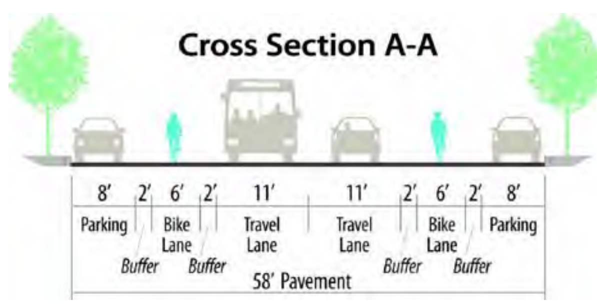
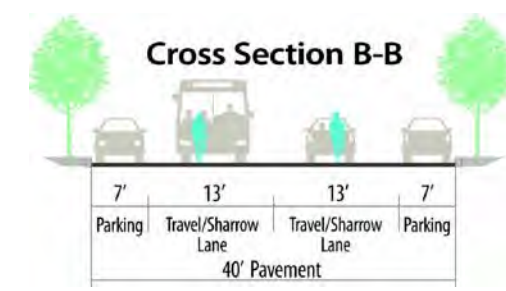
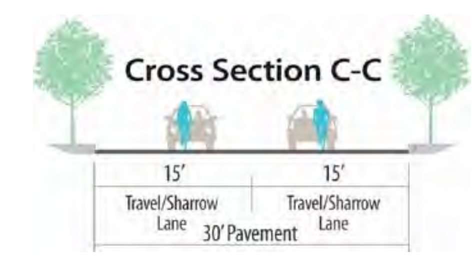
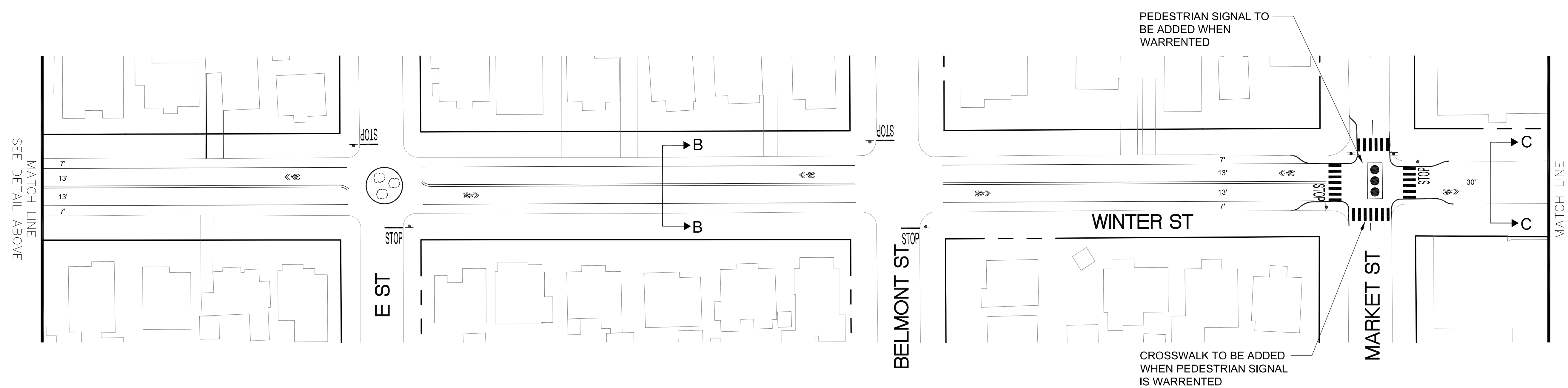
UNION STREET TO "D" STREET







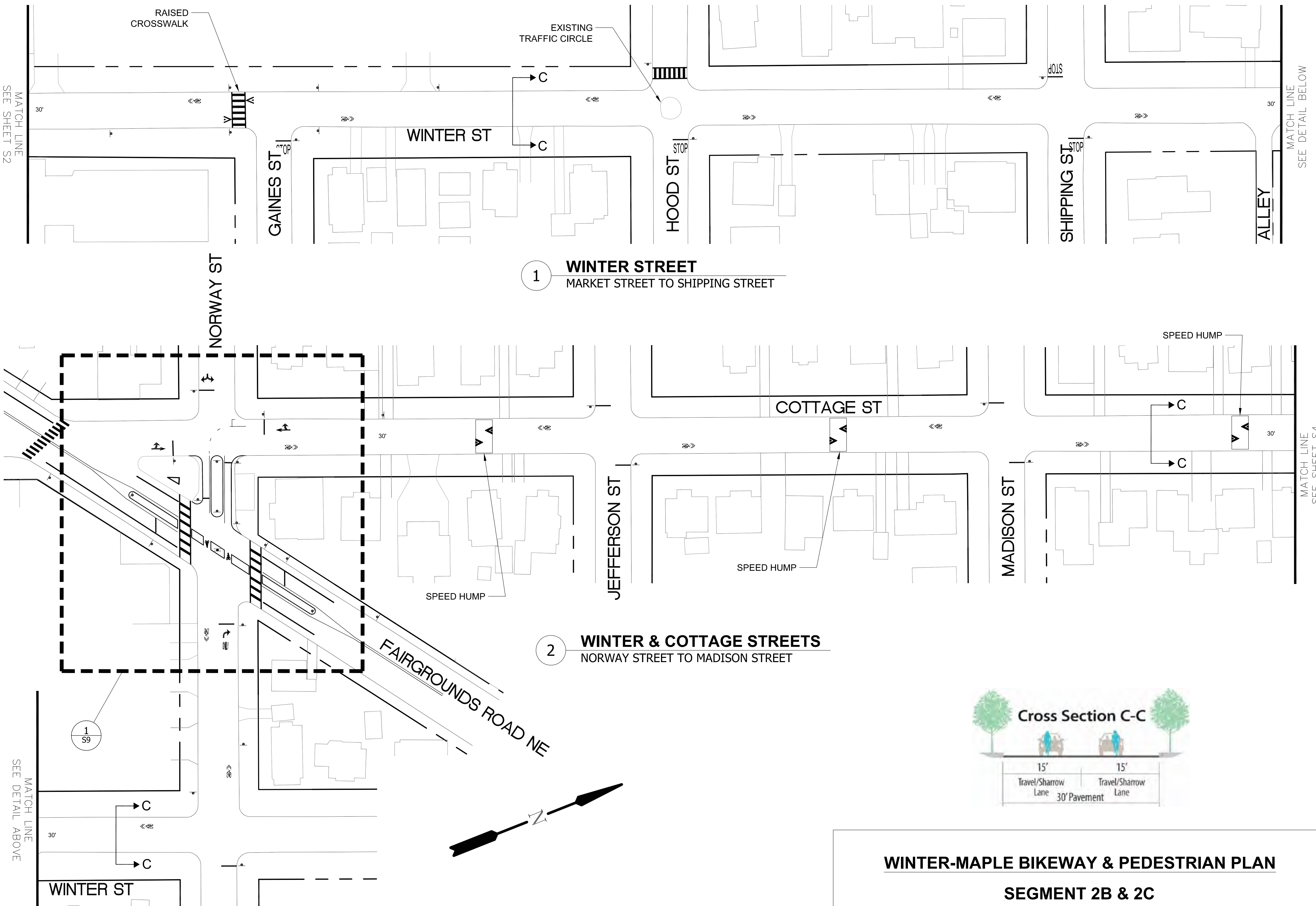


2 WINTER STREET
"D" STREET TO MARKET STREET

WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 1B & 2A
UNION ST TO MARKET ST

S2



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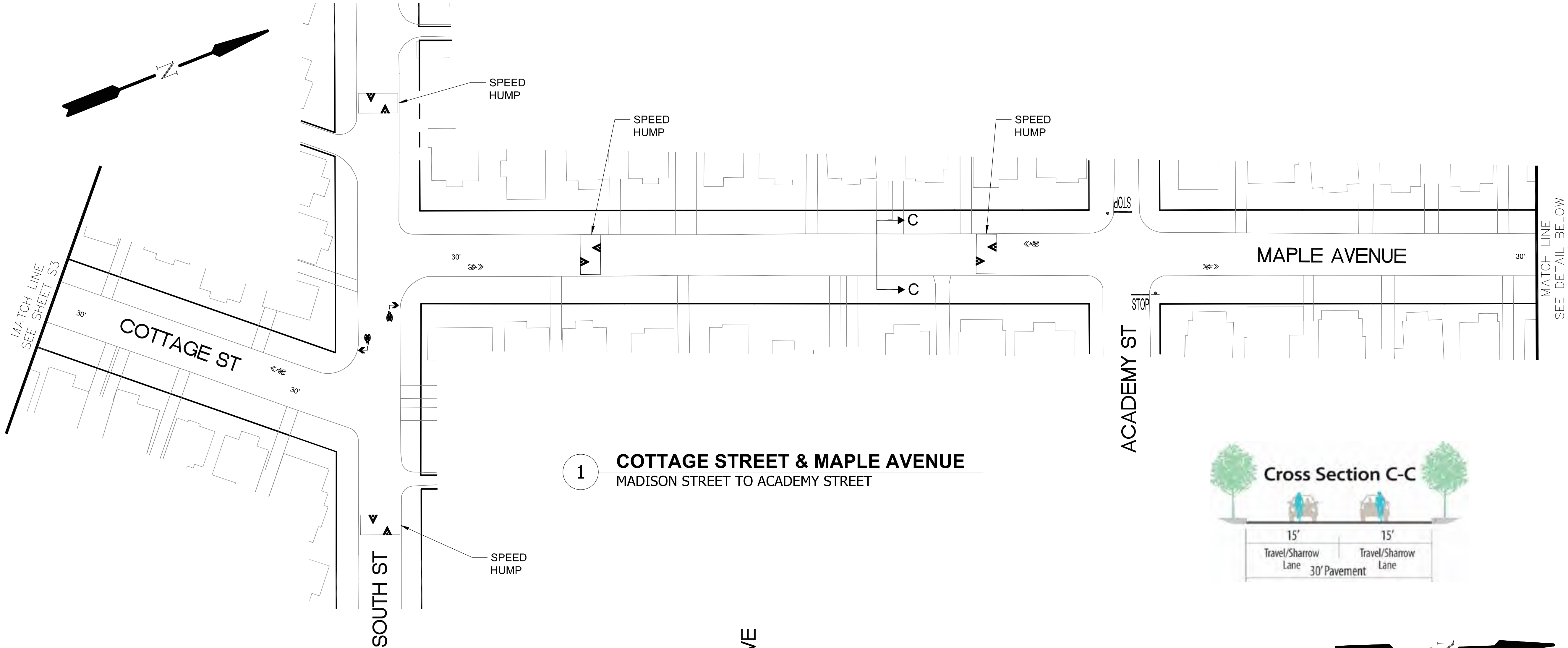
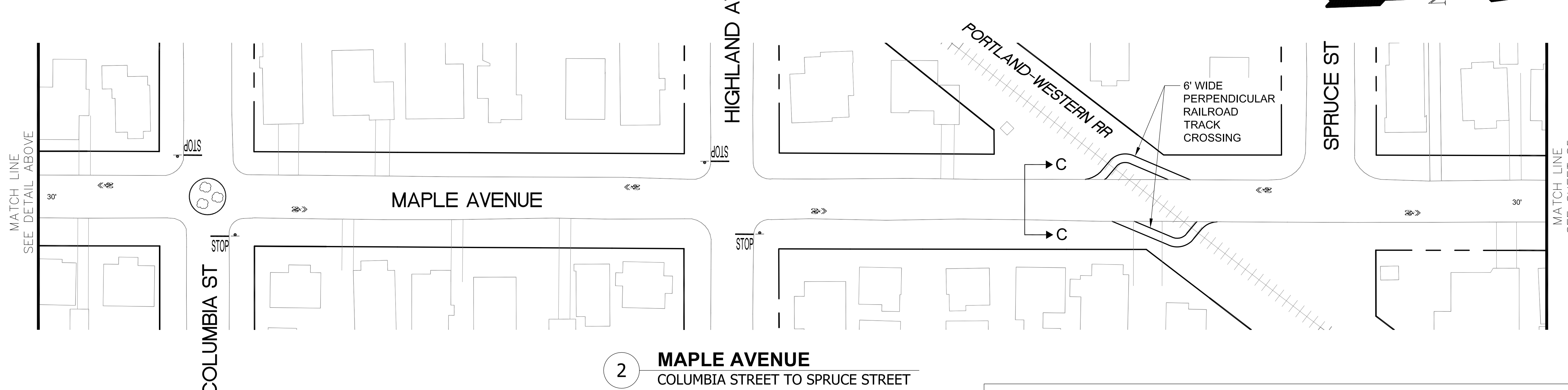
WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 2B & 2C
GAINES ST TO MADISON ST

S3

SHEET 3 OF 10





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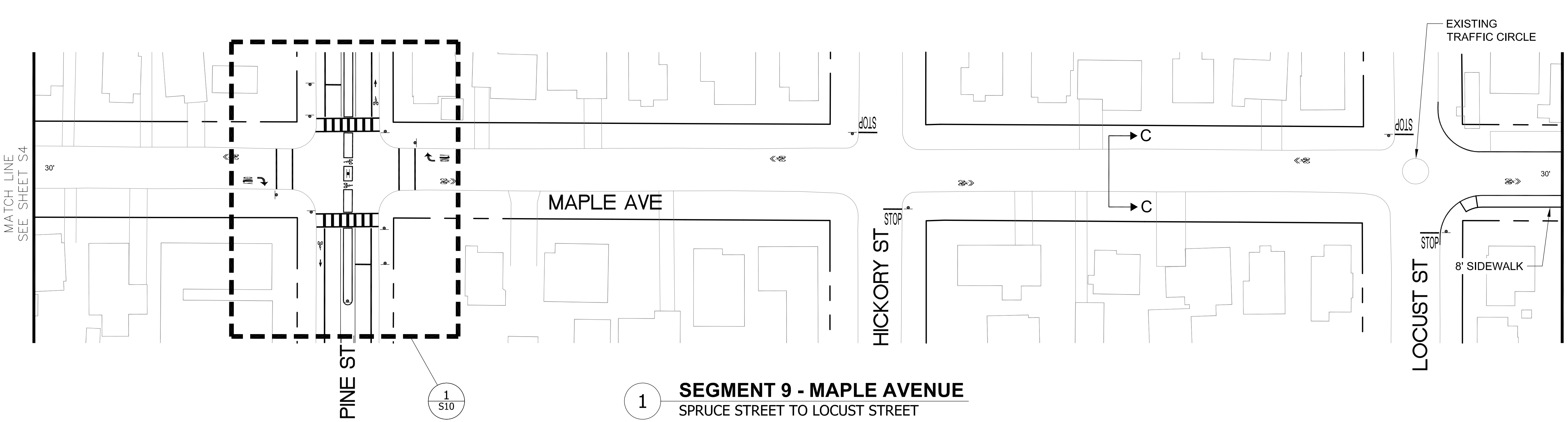
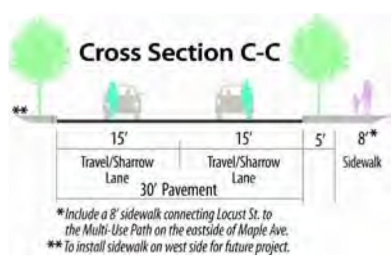
WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

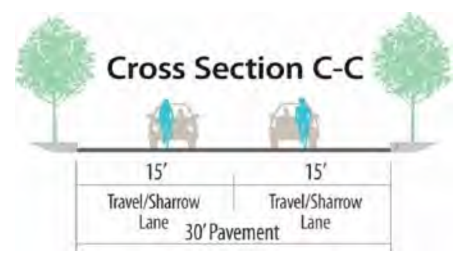
SEGMENT 2C & 2D
SOUTH ST TO SPRUCE ST

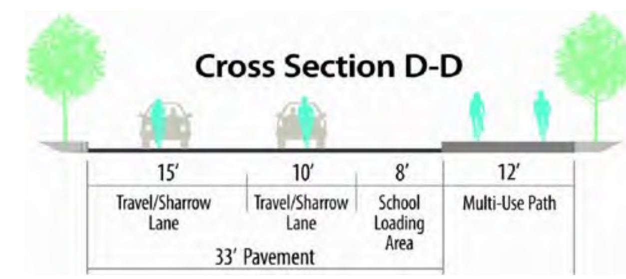
S4

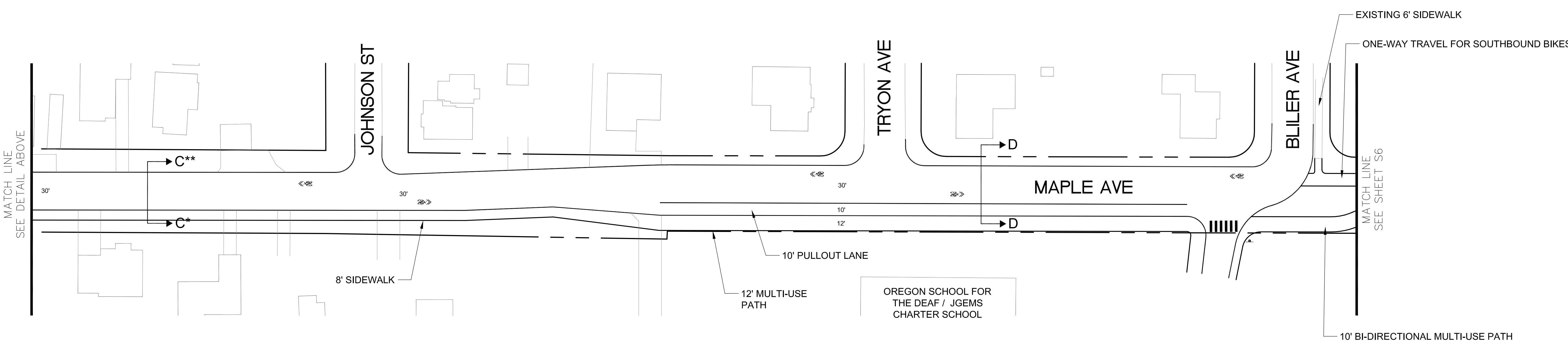


1 **SEGMENT 9 - MAPLE AVENUE**
SPRUCE STREET TO LOCUST STREET









2 **SEGMENT 10 - MAPLE AVENUE**
LOCUST STREET TO BLILER AVENUE

N.T.S.

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WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 2E & 2F
PINE ST TO BLILER AVE

S5

SHEET 5 OF 10

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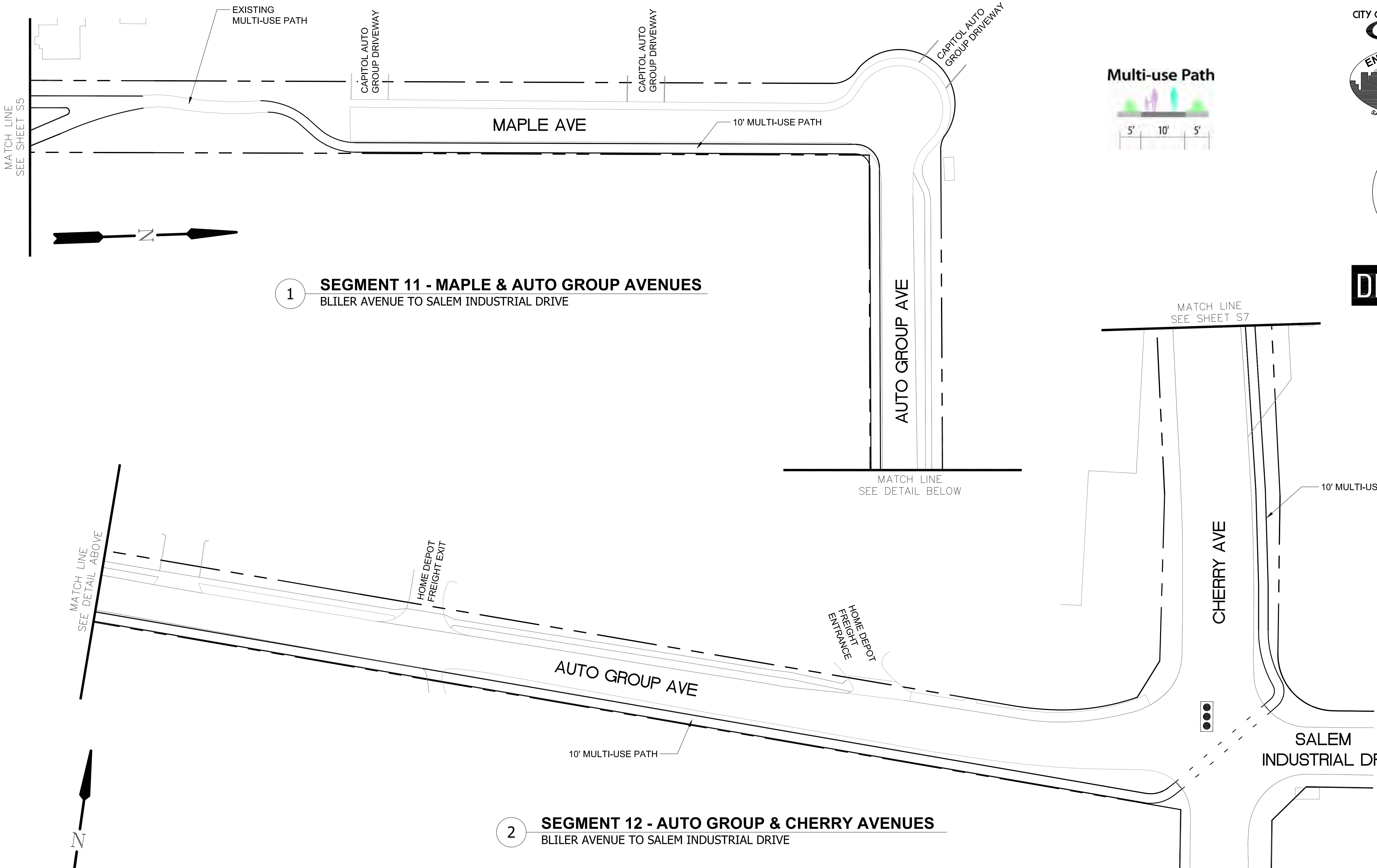

1 **SEGMENT 11 - MAPLE & AUTO GROUP AVENUES**
BLILER AVENUE TO SALEM INDUSTRIAL DRIVE

2 **SEGMENT 12 - AUTO GROUP & CHERRY AVENUES**
BLILER AVENUE TO SALEM INDUSTRIAL DRIVE

WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 3A
SEPERATED MULTI-USE PATH ALONG AUTO GROUP AVE

S6

SHEET 6 OF 10

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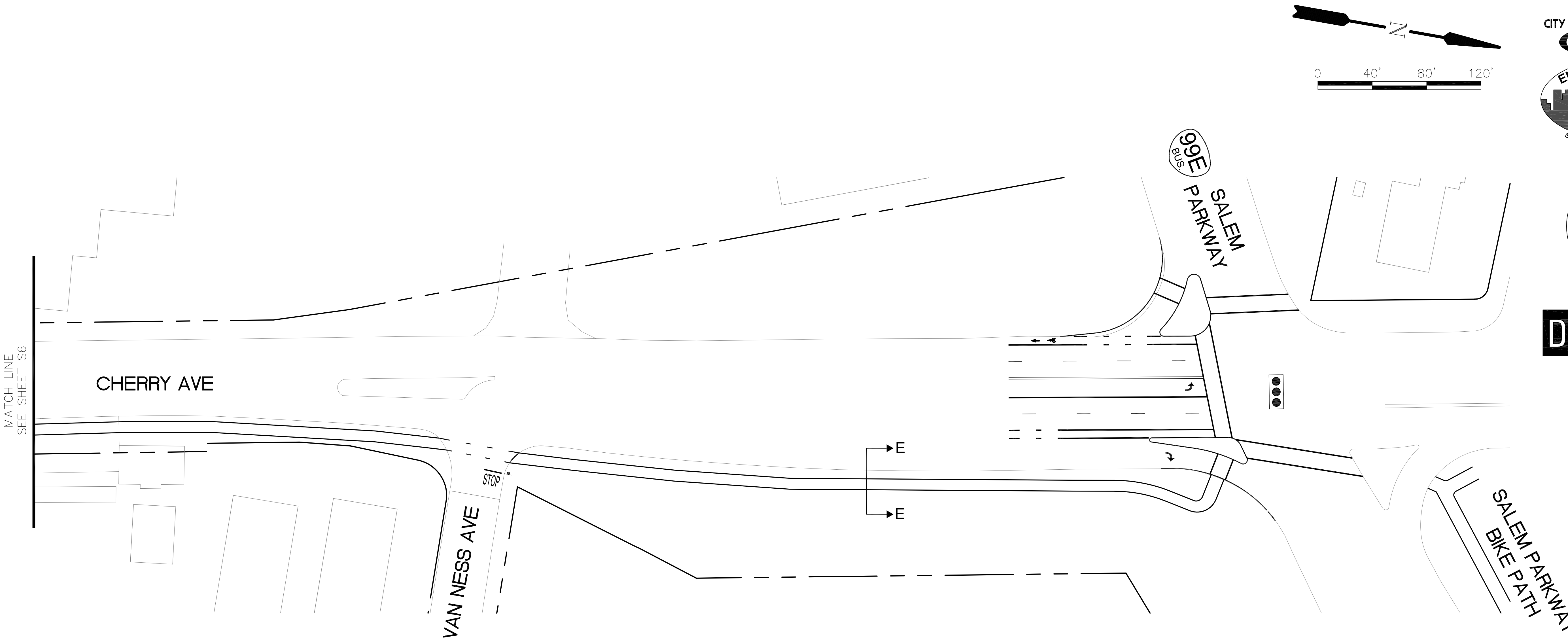
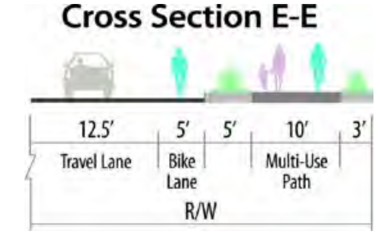


1 **SEGMENT 13 - CHERRY AVENUE**
SALEM INDUSTRIAL DRIVE TO SALEM PARKWAY

Cross Section E-E



WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

SEGMENT 3B
SEPERATED MULTI-USE PATH ALONG CHERRY AVE

S7

SHEET 7 OF 10

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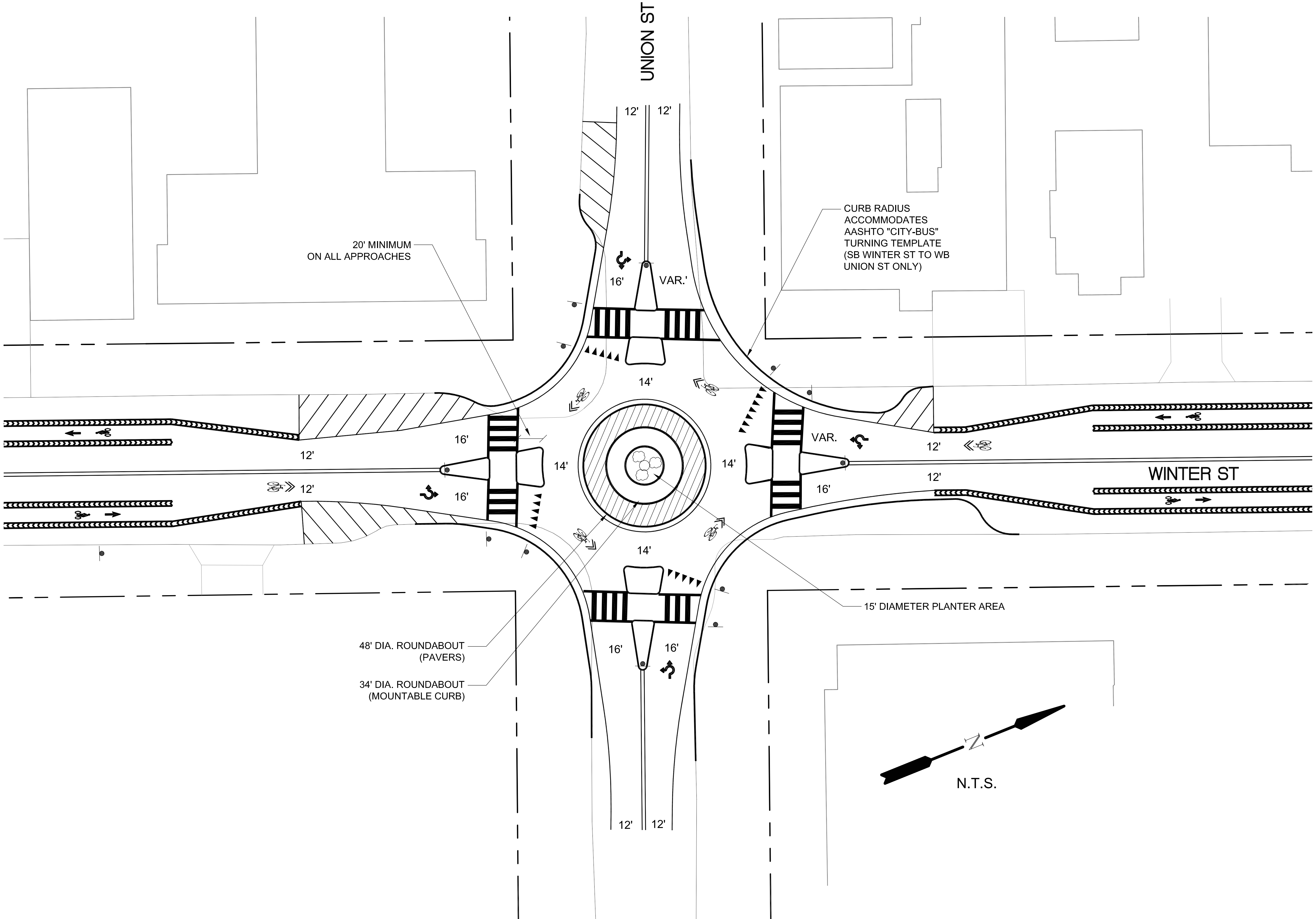

1 WINTER STREET @ UNION STREET
INTERSECTION DETAIL

WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

INTERSECTION DETAILS
WINTER ST / UNION ST

S8

SHEET 8 OF 10

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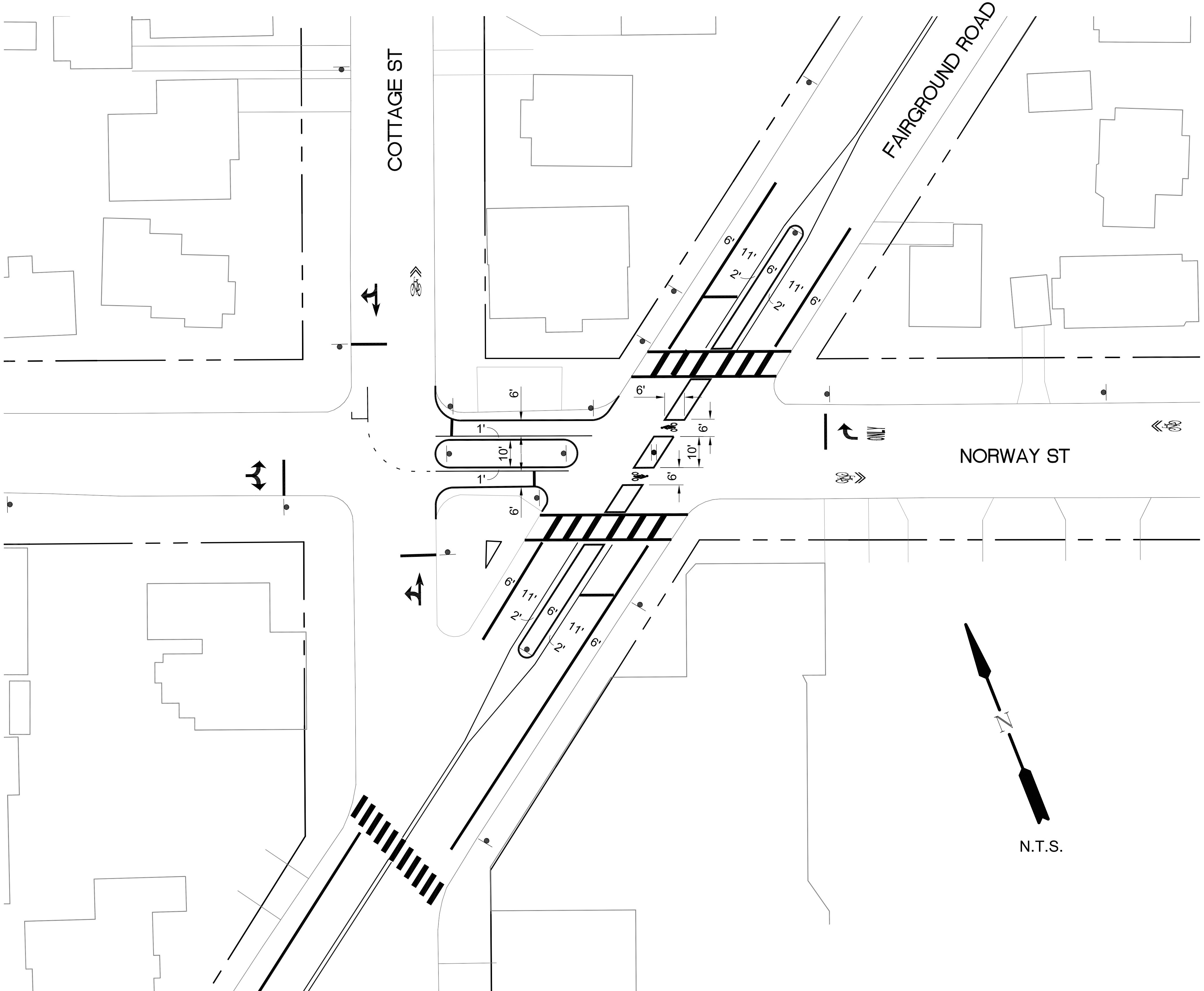

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1 NORWAY STREET @ FAIRGROUNDS / COTTAGE
INTERSECTION DETAIL

WINTER-MAPLE BIKEWAY & PEDESTRIAN PLAN

INTERSECTION DETAILS
FAIRGROUNDS ROAD

S9

SHEET 9 OF 10

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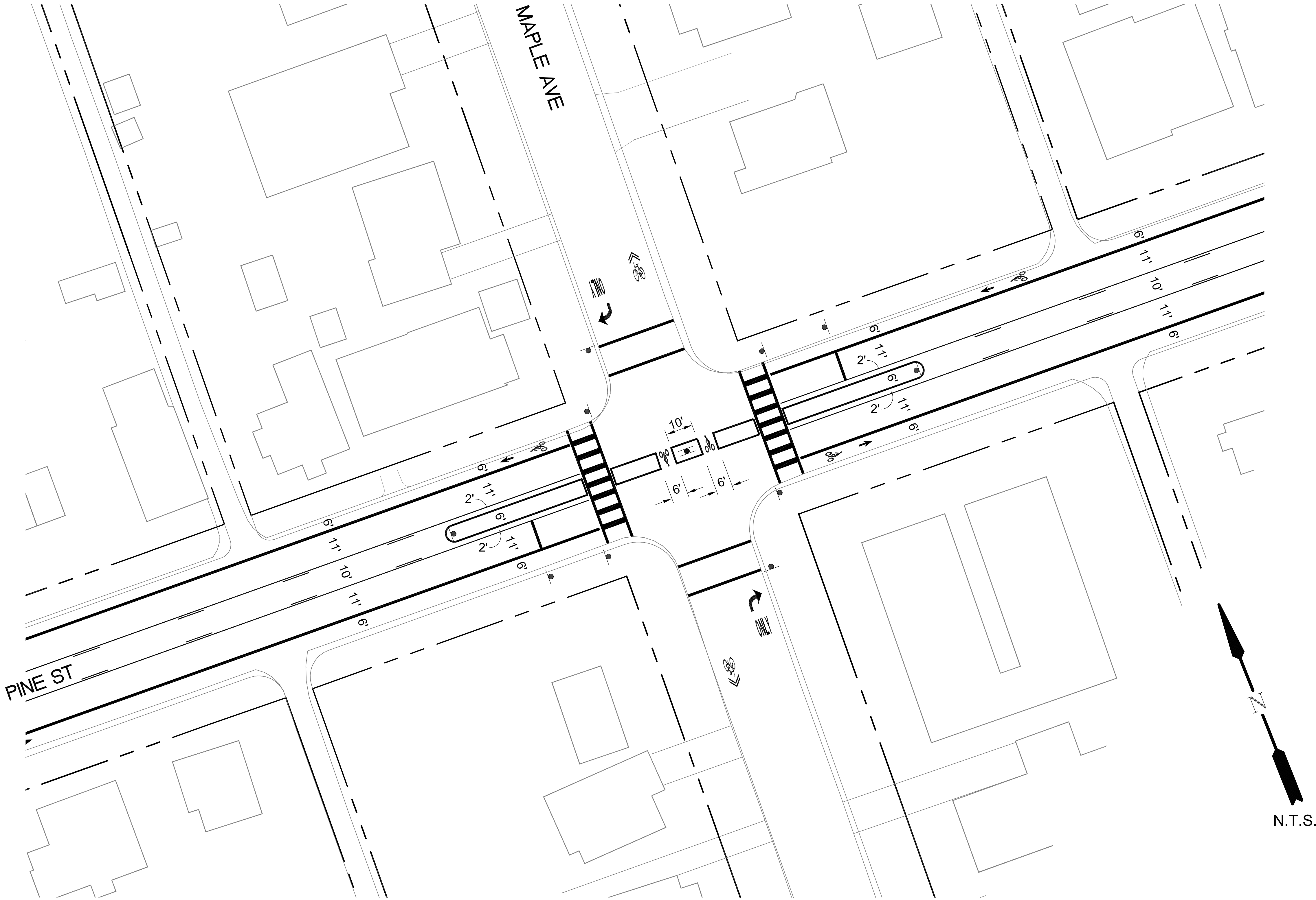

1 MAPLE AVENUE @ PINE STREET
INTERSECTION DETAIL

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INTERSECTION DETAILS
MAPLE AVE / PINE ST

S10

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Appendix C – Family Friendly Bikeway Toolkit

C
December 2017
WMB Bicycle Pedestrian Plan
City of Salem

Design Toolkit

The following pages outline a toolkit of design treatments for this and future family friendly bikeway projects in Salem. This toolkit covers both facility types used in the Winter-Maple possible treatments, and facility types that will be appropriate in other contexts.

It includes 2 design treatments in the following general categories:

- Horizontal traffic calming
- Vertical traffic calming
- Intersection treatments
- Signage
- Linear bicycle facilities
- Green infrastructure

Each treatment is described along with general benefits, considerations, and costs. Costs are highly variable depending on context and design decisions; assumptions are given where possible.

Design Toolkit References

AASHTO. Guide to the Development of Bicycle Facilities, 2012.

FHWA. Pedestrian Safety Improvements Library.

FHWA Pedestrian and Bicycle Safety Guide and Countermeasure Selection System. www.pedbikesafe.org

IPBI, Alta Planning + Design, Portland State University. Bicycle Boulevard Planning and Design Guidebook. 2009.

NACTO. Urban Bikeway Design Guide. 2nd Edition.

NACTO. Urban Street Design Guide.

Portland Bureau of Transportation. Neighborhood Greenway Assessment Report. 2015.

SF Better Streets. Permeable Paving. 2015.

Toole Design Group. Montgomery County Bicycle Master Plan Design Toolkit. 2016.

HORIZONTAL TRAFFIC CALMING

Horizontal traffic calming reduces speeds by narrowing lanes and/or requiring horizontal deflection, which creates a sense of enclosure and additional friction between passing vehicles. Narrower conditions require more careful maneuvering around fixed objects and when passing bicyclists or oncoming automobile traffic. Some treatments may slow traffic by requiring motorists to yield to oncoming traffic.

CURB EXTENSION

Curb extensions are sections of the sidewalk that extend into the parking lane. They are located at intersections and mid-block crossings and may include pedestrian curb ramps.

Use in street segments or intersections where street width contributes to higher motor vehicle speeds, especially where on-street parking has a low rate of occupancy during most times of day.

BENEFITS

- Visually narrows the roadway.
- Reduces the width of the crosswalk, and bike and pedestrian crossing distances.
- Can be used to reduce or eliminate strop control at intersections.
- Extended sidewalk space can be used for plantings, street furniture, bicycle parking, artwork, or green stormwater infrastructure.

CONSIDERATIONS

- Must be designed to deflect motor vehicle traffic without forcing the bicycle path of travel to be directed into a merging motorist.
- Consider the turning radii of larger vehicles as appropriate, depending on design context.
- Landscaped curb extensions should use low growing shrubs to preserve sight distances.
- Incorporating changes to stormwater design may increase costs.

COSTS

- $30,000 - $35,000 for 1 crossing (2 extensions, 6' wide): curb work, detectable warnings, concrete only (no plantings).

CHICANE

Chicanes are raised curbs located mid-block that create small horizontal shifts in the roadway.

Use in street segments where street width contributes to higher motor vehicle speeds, especially where on-street parking has a low rate of occupancy during most times of the day, and where long straightaways allow motor vehicles to pick up speed.

BENEFITS

- Visually narrows the roadway.
- Forces vehicles to shift laterally, slowing traffic.
- Many possible designs and configurations depending on context.
- May be used as planters or for green stormwater infrastructure.

CONSIDERATIONS

- Consider use where long straight stretches of roadway allow vehicles to pick up speed.
- May be used in the parking lane (see photo above) or to narrow a wide travel lane.
- May be separated from the curb either to let bicycles pass or allow stormwater passage.
- Chicanes are often used in pairs on alternating sides of the street.

COSTS

- $10,000 for 1 pair of chicanes, 10' x 20' each; assume no drainage impact (separate from curb).

MINI-CIRCLE

Mini-circles are similar to roundabouts, and are typically constructed as a curb-level landscaped circular island.

Used at local intersections where street width contributes to higher motor vehicle speeds, or where an alternative to a stop- or yield-controlled intersection is desired.

BENEFITS

- Visually narrows the roadway.
- Cars must maneuver around the center circle, slowing traffic slightly.
- Can reduce bicycle delay.
- Opportunity for neighborhood greening.

CONSIDERATIONS

- Should be considered at local street intersections to prioritize the through movement of bicyclists without increasing motorists speeds.
- Unlike mini-roundabouts, mini-circles may use stop control if necessary.
- Mini-circles only slow traffic within about 100 feet of the intersection.
- If landscaped, on-going maintenance is necessary.

COSTS

- $25,000 - $50,000 for 1 curbed, planted, 16' diameter circle.

VERTICAL TRAFFIC CALMING

Vertical traffic calming forces motorists to drive at slower speeds. This lowers the speed differential between bicyclists and cars, increasing bicyclist comfort. These treatments are typically used where traffic controls are less frequent, for instance along a segment where stop signs may have been removed to ease bicyclist travel.

SPEED HUMPS

Speed humps are sections of roadway raised several inches above grade. They can be made from many materials but are most commonly made from asphalt. Speed humps are often used in a series typically spaced several hundred feet apart or less.

Speed humps can be designed with a variety of vertical profiles. Consider on roads with measured or observed speeding issues.

BENEFITS

- Highly effective method of slowing motor vehicles.
- Relatively inexpensive and easy to maintain.
- Minimal slowing for cyclists.

CONSIDERATIONS

- Speed humps impact bicyclist comfort and should be designed with flat-topped approach profiles.
- Speed humps can slow emergency vehicles substantially. Consider speed cushions where emergency vehicle passage is a priority.
- Speed humps are typically designed with space between the hump and the curb for drainage.
- Precludes use of snow plow on street.

COSTS

- $3,000 - $5,000 each (14' wide, includes chevron markings).

RAISED CROSSWALKS

Raised crosswalks are similar to speed humps, but are located at a crosswalk, have flat tops, and typically meet the curb. They can be raised to sidewalk height or slightly below.

Consider raised crosswalks at mid-block crossings with measured or observed speeding issues or where vehicles fail to yield to pedestrians; or at intersections to slow traffic turning on to the neighborhood greenway from a major street.

BENEFITS

- Highly effective method of slowing motor vehicles.
- In addition to the benefits of speed humps, raised crosswalks provide slowing and increased driver attention at conflict points with pedestrians.
- Can provide slowing where motor vehicles tend to take turns at high speeds.

CONSIDERATIONS

- Raised crosswalks impact bicyclist comfort and should be designed with flat-topped approach profiles.
- Precludes use of snow plow on street.

COSTS

- $10,000 - $15,000 each (includes high visibility crosswalk, will necessitate drainage and curbside work).

RAISED INTERSECTION

Entire intersections can be raised to be flush with the sidewalk, to create safer, slow-speed crossings. The raised portion of the intersection includes the crosswalk.

Consider at minor intersections with measured or observed speeding issues, or where motor vehicles fail to yield to crossing pedestrians.

BENEFITS

- Highly effective method of reducing speeds at major conflict points.
- Enhances the pedestrian environment and encourages motor vehicles to yield to pedestrians.
- Can have urban design and placemaking benefits.

CONSIDERATIONS

- Raised intersections must be designed with attention to cyclist comfort, emergency vehicle access, and drainage.
- Bollards or other vertical separation should be used to separate motor vehicle from pedestrian space on the corners.
- Precludes use of snow plow on street.

COSTS

- Up to $200,000; Varies greatly depending on intersection configuration and materials used

INTERSECTIONS

Intersections are the areas of neighborhood greenways that introduce the greatest levels of conflict between cyclists, pedestrians, and motor vehicles, as well as the greatest delay. Major street crossings must be addressed to provide safe, convenient and comfortable travel along the entire route. Treatments provide safe crossings for pedestrians and cyclists, waiting space for bicyclists, control cross traffic, or ease bicyclist use by removing traffic control for travel along the neighborhood greenway route.

MEDIAN ISLAND

Median islands divide road crossings into two halves, providing a protected refuge in the middle of the roadway for pedestrians and cyclists to pause and wait for gaps in traffic. Median islands are typically raised concrete islands at curb level.

Consider use on wide roadways with multiple traffic lanes, especially ones with high traffic speeds.

BENEFITS

- Allows cyclists and pedestrians to cross wide roadways in multiple stages, shortening crossing distances.
- Visually narrows the roadway, providing traffic calming.
- Restricts left-turn movements by motor vehicles, reducing conflicts.

CONSIDERATIONS

- Provide sufficient space for multiple users and their bicycles at high-volume crossings. At least 8’ - 10’ width is preferred.
- The median may be located on just one side of the crosswalk, or may enclose the user on both sides.
- Consider angling the refuge so that the user faces towards oncoming traffic before crossing.

COSTS

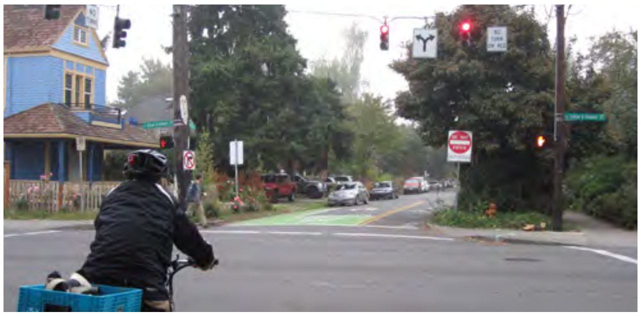
- $50,000 - $75,000 each (6’ wide, 8’ long).

DIVERTERS

Traffic diversion strategies are used to reroute traffic from a neighborhood greenway onto adjacent streets by installing design treatments that restrict motorized traffic from passing through, while allowing gaps or pathways for 2-way bicycle traffic.

Diverters can be designed to create partial or full roadway closures, or force a right or left turn. Diverters can be designed for uncontrolled, stop controlled and signal controlled intersections.

Diverters can be constructed from many different materials, including median islands, curb extensions, planters, bollards, and other barriers.



Partial closure - permanent, signalized

Partial closure - interim, stop-control

Full closure

Diagonal diverter

BENEFITS

- Maintain bicycle and pedestrian connectivity while substantially decreasing motorized traffic on neighborhood greenways.
- Can be designed with plantings or green stormwater infrastructure.
- Temporary materials may be used to test diversion impacts before permanent, curbed diverters are installed.

CONSIDERATIONS

- Diversion is most applicable in areas with a grid of streets to disperse traffic.
- Diversion shifts trips from the neighborhood greenway onto adjacent streets. This change in traffic volume on other local streets must be identified and addressed during the planning, design and evaluation process.
- Consultation with emergency services will be necessary to understand their routing needs.
- Clear signage and/or pavement markings help bicycles and motorized vehicles know where they are and aren't allowed.

COSTS

- $10,000 for single curb extension similar to partial closure photo above;
- $50,000 - $80,000 for a median with cut throughs similar to the full closure photo above.

RECTANGULAR RAPID FLASHING BEACON (RRFB)

RRFBs use a sign and flashing yellow lights to alert drivers to a marked pedestrian crossing. State law requires driver yielding to pedestrians at these locations, but RRFBs do not constitute a regulatory traffic control device. The beacons are activated through push buttons or automated pedestrian detection, and are dark when no pedestrian is present.

Consider use at unsignalized intersections and mid-block locations.

BENEFITS

- Have been shown to significantly increase driver yielding to pedestrians.
- Lower cost than traffic signals or PHBs.
- Typically solar powered, independent of power grid.
- Minimal disruption to motorized traffic flow.
- Minimizes driver habituation to signal, since it is dark when pedestrians aren't present.

CONSIDERATIONS

- Where there is more than one traffic lane in either direction, advance stop bars or yield markings are recommended.
- RRFBs are often paired with median islands. The island should contain a second RRFB installation.
- May require a traffic study.

COSTS

- $25,000 each (assumes two RRFBs with warning signage per location).

BIKE DETECTION

Typical roadway signal activation loops may not detect cyclists waiting at red lights, which can lead to long delays and encourage cyclists to run red lights. Signal activation loops can be calibrated and located in the pavement in such a way that cyclists will activate them, calling up the green light.

Consider use where green lights require vehicle detection loops and motor vehicle volumes are low.

BENEFITS

- Reduces cyclist delay.
- Discourages cyclists from running red lights, especially with implementation of indicator light that tells cyclist they have been detected.

CONSIDERATIONS

- Detection loops are often marked with a bicycle detector symbol to alert cyclists to the bike detection and show them where to optimally position themselves to trigger it.
- Consider installing activation loops in advance of the intersection so that cyclists trigger it as they approach, further reducing delay.
- Left turn pockets may need their own detection.

COSTS

- $7,000 - $10,000 per approach (additional detector and modifications to signal box).

PUSH BUTTONS

Push buttons are similar to bike detection, except that cyclists must manually push a button located near the intersection in lieu of automatic detection.

Many intersections already have push buttons for pedestrians, but these are inconveniently located for cyclists. Bicycle push buttons should be located at the edge of the roadway so that cyclists can press the button without dismounting their bicycles.

BENEFITS

- Reduces cyclist delay.
- Discourages cyclists from running red lights.

CONSIDERATIONS

- Left turn pockets may need their own push buttons.
- At many intersections it may be appropriate to have both pedestrian and cyclist push buttons to serve both groups.

COSTS

- $1,000 per push button.

RE-ORIENTING STOP SIGNS

Cyclists are highly sensitive to delay. To reduce delay and create greater continuity for cyclists on neighborhood greenways, stop signs should be minimized. In locations where there is a two-way stop that gives right-of-way to the cross street, consider re-orienting the stop signs so that the greenway has right-of-way instead.

BENEFITS

- Reduces cyclist delay and provide more continuous route
- Reduces cyclist incentive to run stop signs

CONSIDERATIONS

- Re-orienting stop signs may increase motor vehicle speeds and volumes on neighborhood greenways. Where this is observed, consider using speed humps, and diverters for full or partial road closures.
- May require a traffic study

COSTS

- $300 per sign.

MINI-ROUNDABOUTS

Mini-roundabouts are small mountable circular islands placed at the center of low-volume intersections. They operate under yield control and slow traffic while eliminating the need for stop signs. They are typically hardscaped.

Consider at minor local intersections where street width contributes to higher motor vehicle speeds, especially where there is a desire to remove or decrease stop control.

BENEFITS

- Prioritize through-movement of cyclists without increasing motorist speeds.
- Reduce turning conflicts at intersections.
- Large vehicles can drive over the mountable surface.
- Can be alternatives to stop- or yield-controlled intersections.

CONSIDERATIONS

- Must be designed to deflect motor vehicle traffic without forcing the bicycle path of travel to be directed into a merging motorist.
- Speed reduction for motor vehicles limited to within about 100 feet of the intersection.
- Add modest delay for emergency vehicles.
- Consider using at constrained local intersections where truck or bus access is to be maintained.

COSTS

- $50,000 - $100,000 for one roundabout (16' diameter, stamped or stained concrete construction).

TWO-STAGE QUEUE BOXES

Two-stage queue boxes help cyclists comfortably make a left from a right-side facility in two stages, by providing a designated area to wait for a gap in traffic.

Queue boxes are most commonly used at signalized intersections, but can be used in any context where bicycle left turns are common, or would benefit from greater clarity or safety. Two-stage queue boxes are often used for left turns onto neighborhood greenways.

BENEFITS

- Increases cyclist left turn comfort, safety, and visibility.
- Cyclists can make left turns without merging into traffic; reduces turning conflicts with motor vehicles.
- Orient bicycles correctly for safe crossing.
- Separates turning from through cyclists, reducing conflicts.

COSTS

- $600 per box.

CONSIDERATIONS

- Can also be used for right turns from a left-hand bicycle facility.
- Place box outside motor vehicle travelways and turning paths.
- At signalized intersections, right turns on red must be prohibited for motor vehicles.
- The use of a two-stage turn queue box requires FHWA permission to experiment.

CROSSWALKS

Standard (transverse) marked crosswalks consists of two painted white lines, located along the two side edges of the crosswalk to mark its boundaries. High visibility crosswalks add thick painted horizontal stripes through the entire crosswalk (see photo at left).

Every intersection crossing is a legal crosswalk, whether or not it is marked. Pedestrians are granted the right-of-way when they step into a marked or unmarked crosswalk; cyclists must dismount to be given the right-of-way.

Crosswalks should be marked at all signal-controlled crossings and at RRFBs. Consider marking unsignalized crossings with higher vehicle volumes or multiple lanes. Consider mid-block crosswalks where there are long stretches between crossings, or where trails cross busy roadways, marking them in conjunction with other improvements such as medians or curb extensions. Also consider marking crosswalks near schools, parks, plazas, senior centers, transit stops, hospitals, campuses, and major public buildings.

BENEFITS

- Increase pedestrian visibility, particularly in the case of high visibility crosswalks.
- Alert pedestrians, cyclists, and motorists to an area of conflict.
- Reinforce pedestrian priority at crossings.

CONSIDERATIONS

- Crosswalk marking decisions should be made with care, to avoid driver habituation through over-saturation.
- Crosswalks may need to be used together with other crossing safety tools such as median islands or RRFBs, or traffic calming, especially where pedestrians cross multiple lanes traveling in the same direction (called the multiple-threat crash problem).

COSTS

- $3,000 - $5,000 (one leg of high visibility crosswalk, cost varies by width).

SIGNAGE

Traffic calming and well designed facilities are important parts of creating a safe, functional, continuous neighborhood greenway. A successful greenway also requires appropriate and thoughtful signage to provide information to cyclists and motor vehicles and increase legibility. Signage also offers opportunities for neighborhood greenway branding and identity.

WARNING

Warning signs alert cyclists and drivers alike to notable or changing conditions such as upcoming traffic calming features and traffic control devices. Warning signs also alert drivers to bike and pedestrian crossings.

BENEFITS

- Alert drivers to the presence of cyclists and pedestrians, and encourage slowing, especially at crossings.
- Give advanced warning to roadway users when traffic calming or traffic control devices are present.

CONSIDERATIONS

- Warning signs are a standard or even required component of many traffic calming and crossing safety features.
- Even where not required, research suggests that warning signs make traffic calming and crossing safety features more effective.
- The MUTCD, AASHTO, NACTO, and other guides give guidance on when to use warning signs.

COSTS

- $300 each for diamond warning signs.

BRANDING

Many cities give their bikeways special identities through branding signage with distinctive symbols or colors. Signage is often as simple as specially designed Neighborhood Greenway signs placed along the route.

Branding signage can also be used at entrances to neighborhood greenways or on wayfinding signs

BENEFITS

- Placemaking benefits: branding lets residents and visitors know that neighborhood greenways are special, distinctive places.
- Encourages drivers to slow down and be alert, particularly if signage underscores the family-friendly nature of greenways.
- Strong identity helps users instantly know when they are using a greenway.

CONSIDERATIONS

- Emphasizing the family-friendly nature of neighborhood greenways encourages drivers to go slow and remain alert.
- Branding isn't limited to signage. Neighborhood greenways can also incorporate distinctive bike racks, seating, lighting, public art, or street signs.
- Avoid using colors reserved by the MUTCD for regulatory and warning signs; green and purple are common colors for greenway signs.

COSTS

- Approximately $300 per sign. Additional cost for pavement markings and development of brand.

WAYFINDING

A clear wayfinding system is essential to a successful neighborhood greenway. The wayfinding system should use signage (as well as pavement parkings) to clearly alert cyclists to turns so that they can stay on the route.

Wayfinding signage also gives directions to major destinations such as neighborhoods, schools and universities, parks, commercial districts, transit hubs, and other bike routes, and directs cyclists from other routes to the greenway.

BENEFITS

- Helps cyclists stay on the greenway route.
- Makes cyclist navigation and connecting between bike routes in different parts of town simple and easy.
- Play roles in placemaking, branding and identity.

CONSIDERATIONS

- Install signage far enough in advance of turns that cyclists have time to consider the information, make a decision, and safely turn.
- In addition to direction, wayfinding signs to other routes or neighborhoods should give distance and/or estimated travel time to destinations.
- Too many signs can create clutter and reduce effectiveness.

COSTS

- $500 per sign (single green panel with destination information).

GREEN INFRASTRUCTURE

Bikeways offer numerous opportunities to introduce green infrastructure for effectively and sustainably managing stormwater runoff. Green stormwater infrastructure on sewer systems.

STORMWATER PLANTERS

Stormwater planters replace impervious surfaces with green catchbasins that capture stormwater and let it slowly seep into the ground, being filtered by plants and soil.

Planters can be installed in many traffic calming features such as curb extensions and chicanes.

BENEFITS

- Replaces impervious surface with stormwater filtration or infiltration.
- Can be placed in existing underutilized spaces such as curb extensions.
- Beautification, placemaking and neighborhood greening.
- Cost-effective stormwater management.

COSTS

- Ranges widely based on installation.

CONSIDERATIONS

- Planters must be designed with appropriate soils and plantings,and appropriately sized to meet drainage objectives; see local stormwater guidelines.
- There is great deal of design flexibility and planters can be designed to meet almost any constraints and can fit into many conditions.
- Like all plantings, stormwater planters require on-going maintenance.

PERMEABLE PAVEMENT

Permeable pavement looks like ordinary pavement, but allows stormwater to filter through and into the soil below. Permeable pavements are generally made of systems that include a surface layer, a bedding layer, a transition layer, and a storage layer of permeable base rock.

Shared use paths are an opportunity for using permeable paving materials on bikeways.

BENEFITS

- Replaces impermeable surface with permeable surfaces.

CONSIDERATIONS

- There are a variety of possible permeable pavement materials, including permeable asphalts and concretes.
- Effective permeable pavement depends on the conditions of the soils on which it is installed.
- Permeable pavement typically have higher maintenance requirements than traditional paving materials.

COSTS

- ~$190,000 per mile (surface materials only)

LINEAR BICYCLE FACILITIES

The range of facility types presented here are appropriate on a range of street types to accommodate comfortable bicycle travel. With increased traffic volume and speed, bicyclists need increased separation from automobiles to remain comfortable.

PAVEMENT MARKINGS

Pavement markings are an important part of neighborhood greenway wayfinding and legibility. Markings identify the route and indicate turns in the route and connections to other greenways or bike routes.

Different cities use different markings. Precedents include shared lane markings, medallions, or other bike-related pavement markings with directional arrows.

BENEFITS

- Alerts drivers to presence of bicyclists sharing the road.
- Alerts bicyclists to turns in the route or connections to other bicycling routes.
- Encourages bicyclists to ride in the travelway instead of near parked cars.

COSTS

- $4,000 - $5,000 per mile for shared lane markings spaced at 250'.

CONSIDERATIONS

- Place markings after each intersection, and near high volume driveways and other conflict points.
- Markings should be spaced at no greater than 250' after the locations identified above.
- Use on streets with existing lower traffic volume and speed or where traffic calming measures are implemented concurrently.

BIKE LANES

A conventional bike lane is a portion of a street designated for the exclusive use of bicycles distinguished from traffic lanes by striping, signing and pavement markings.

Bike lanes are a comfortable facility for most riders when they are located on streets with three or fewer lanes and speed limits of 30 mph or less. Bike lanes are typically implemented through road or lane diets when added through retrofit.

BENEFITS

- Provides exclusive space for bicyclists to travel along roads instead of sharing a lane with automobiles.

CONSIDERATIONS

- When located next to a narrow (7-foot) or high turnover parking lane, a wider bike lane of 6 to 7 feet should be considered so as to allow bicyclists to ride outside the reach of opening card doors, but within the bike lane.
- Lanes should be continued all the way to intersections.
- Dashed markings through intersections can help mitigate conflicts.

COSTS

- Approximately $20,000 per mile

BUFFERED BIKE LANES

Buffered bike lanes are conventional bike lanes paired with a designated buffer space separating the bike lane from the adjacent motor vehicle travel lane and/or parking lane to increase the comfort of bicyclists.

While buffers provide greater horizontal separation from automobile traffic, some bicyclists may still not be comfortable in them adjacent to higher speed traffic. Striped buffers still allow automobiles to enter or cross the buffered bike lane.

BENEFITS

- Further separates bicyclists from adjacent automobile traffic.
- When buffer is located next to parking, encourages bicyclists to ride outside the reach of an opening car door.

CONSIDERATIONS

- Buffers can be striped on either the travel lane or parking lane side depdending upon which poses a greater risk to bicyclists. Buffers on the parking side are recommended in areas of high parking turnover.
- When implemented by removing an entire travel lane, consider buffering on both sides to reinforce lane is no longer for automobiles.

COSTS

- $40,000 - $50,000 per mile

SEPARATED BIKE LANES

Separated bike lanes (SBLs) are an exclusive bikeway that combines the user experience of a sidepath with the on-street infrastructure of a conventional bike lane. They are physically separated from motor vehicle traffic and distinct from the sidewalk.

SBLs are comfortable for nearly all bicyclists to use. The vertical separation from automobile traffic provides perceived and actual safety from adjacent vehicles.

BENEFITS

- Nearly all bicyclists are comfortable in an SBL.
- Provide opportunity to continue high-comfort bike routes onto streets with higher traffic volumes and speeds.
- Can be implemented in phases with lower-cost pilot materials (striping , flexposts) transitioning to higher-quality (curbs, planted medians) over time.

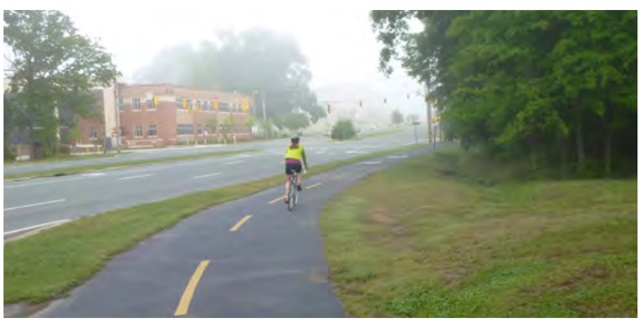
CONSIDERATIONS

- Directional one-way SBLs located adjacent to travel lanes in the same direction are preferred to a two-way SBLs. The one-way situation provides more rational traffic patterns.
- Sight lines for bicyclists and drivers must be kept clear at driveways and intersections where automobile traffic crosses the SBLs.

COSTS

- Varies widely based on separation type.

SHARED USE PATH



A shared use path is a path for use by pedestrians, bicyclists and other non-motorized users that is separated from the roadway. They may run in their own alignment, such as along a utility or natural corridor, or they may run within the right-of-way adjacent to the road. In this latter case, the facility is referred to as a sidepath.

Shared use paths are generally comfortable for all types of bicyclists.

BENEFITS

- Nearly all bicyclists are comfortable on a shared use path.
- Provide opportunity to continue high-comfort bike routes onto streets with higher traffic volumes and speeds.
- Provide pedestrian accommodation where sidewalk is lacking.

CONSIDERATIONS

- Path width should consider anticipated user volume, and wider paths should be provided where volumes are higher and where pedestrians are anticipated to represent a large percentage of users.
- Sidepaths should be designed with the same intersection considerations as separated bike lanes.

COSTS

- $300,000 to 500,000 per mile depending upon materials and right-of-way costs

OTHER

LIGHTING

Street lighting is an important safety feature on neighborhood greenways, increasing pedestrian and cyclist visibility and creating comfortable and safe spaces for travel after dark.

BENEFITS

- Increases cyclist and pedestrian visibility, and visibility of signs, obstacles, and traffic calming features.
- Increases cyclist and pedestrian safety and comfort.

CONSIDERATIONS

- Pedestrian-scale lighting is particularly desirable, and has placemaking benefits as well as providing identity branding opportunities.
- It is particularly important that traffic calming features be well lit, since they require cars and cyclists to maneuver around them.

COSTS

- $5,000 per Salem standard street light.