GREENWOOD AVENUE WEST SEGMENT

ALTERNATIVES EVALUATION SUMMARY REPORT

JANUARY 2022

PREPARED FOR:

OREGON DEPARTMENT OF TRANSPORTATION

CITY OF BEND

DKS

720 SW WASHINGTON STREET, SUITE 500, PORTLAND, OR 97205 • 503.243.3500 • DKSASSOCIATES.COM

City of Bend

Allison Platt

Janet Hruby, PE

Robin Lewis, PE

Oregon Department of Transportation

Dan Serpico, PE

David Hirsch, PE

DKS Associates

John Bosket, PE

Kayla Fleskes, PE

Amanda Riley, EI

HDR Inc.

Jose Banuelos, PE

PREPARED BY DKS ASSOCIATES

TABLE OF CONTENTS

PROJECT BACKGROUND

Greenwood Avenue serves as a key east-west route through the City of Bend, crossing underneath US 97 and the Burlington Northern Santa Fe (BNSF) railroad and across the Deschutes River to connect the west side, downtown, and the core of Bend. The ODOT All Roads Transportation Safety (ARTS) program evaluated Greenwood Avenue and identified it as a corridor in need of safety improvements.

Greenwood Avenue between Wall Street and 3rd Street (US 20) today has two travel lanes in each direction, although it is fed from the west by a single lane across the Newport Avenue bridge. There are no bicycle lanes, on-street parking stalls are narrow, and sidewalk designs (e.g., widths and buffer space from traffic) vary. The underpass under US97 and the BNSF railroad presents a pinch point where sidewalks become very narrow.

Greenwood Avenue is designated as a Connected Grid street in the Core Area Project report.[1] The purpose of Connected Grid streets are to:

> *"form the connective tissue for promising redevelopment districts, with a full network of sidewalks and safe crosswalks, as well as low-stress bike networks and stormwater treatment. These streets complement and intersect with the east-*

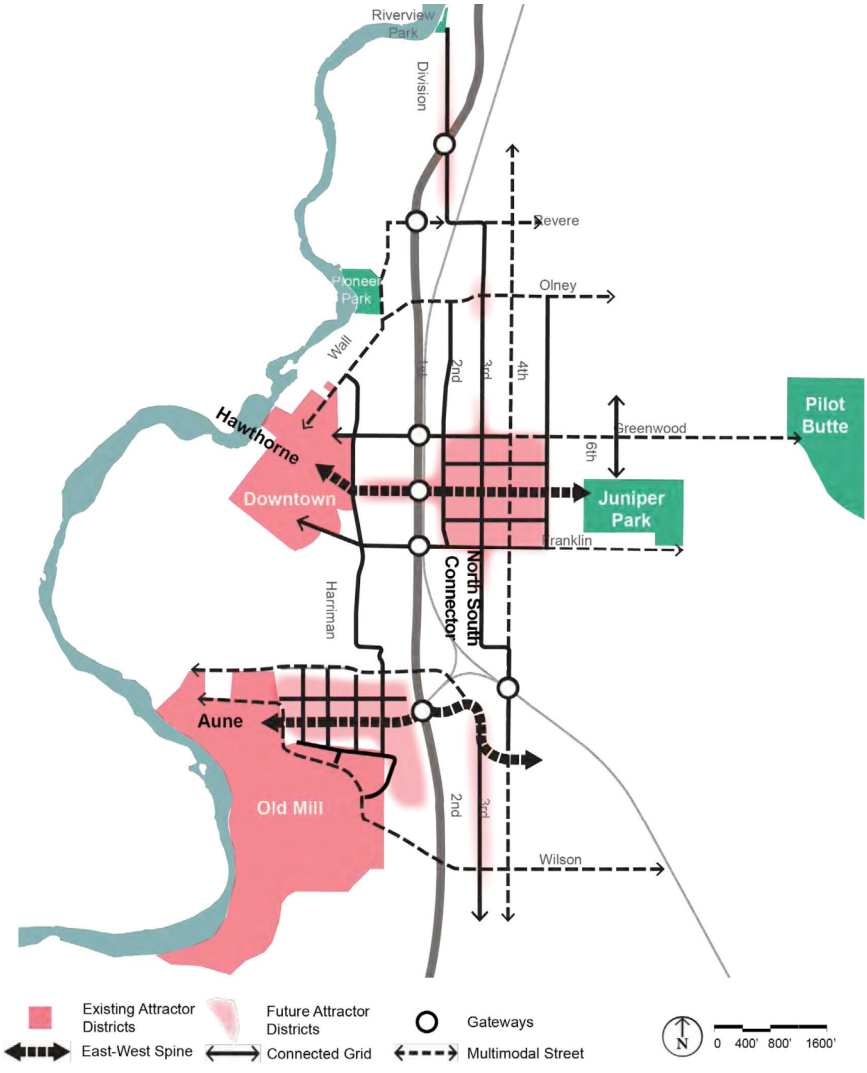


FIGURE 1. CORE AREA OF BEND

Source: Core Area Report

[1] City of Bend. *Core Area Project Report*. Approved by Bend City Council on May 20, 2020.

west spine and provide opportunities to explore roadway reconfiguration."

In addition, the Core Area Project's vision for Greenwood Avenue is:

> *"Greenwood will serve as the vehicular and pedestrian gateway into Downtown from Highway 20. The street will include pedestrian scaled street amenities, landscaped buffers and opportunities to reconfigure lanes through a corridor analysis."*

Therefore, the purpose of this study is to identify potential multimodal enhancements for Greenwood Avenue and explore opportunities to reconfigure the roadway to support its function as a Connected Grid street connecting the Bend Central District to Downtown as shown in the City's Core Area Urban Design Framework. This study evaluates four preliminary concepts for Greenwood Avenue and helps identify elements that may be funded through the ODOT ARTS program. It is anticipated that the upcoming Midtown Crossing Study will further refine concepts through additional analysis and community outreach.

SUMMARY OF OPPORTUNITY AND CONSTRAINTS

The following summarizes the key opportunities and constraints along Greenwood Avenue, as documented in the *Greenwood Avenue West Segment Opportunities and Constraints Memo* in Attachment A.

CONDITIONS FOR PEOPLE WALKING

Conditions for people walking vary along the corridor, primarily:

- Sidewalks are provided on both sides of Greenwood Avenue and typically vary between five and 12 feet wide.
- A narrow section of sidewalk exists at the US 97/BNSF railroad undercrossing. This section was measured at 3.8 feet (46 inches) wide on the south side (and is a similar width on the north side).
- Signalized pedestrian crossings are provided at Wall Street, Bond Street and 3rd Street.
- Unsignalized pedestrian crossings on Greenwood Avenue are typically unmarked (except at Harriman Street) and require high-stress crossings of four lanes of traffic with no pedestrian refuges.
- The highest pedestrian activity was observed near Wall Street and Bond Street, with a total of approximately 75 pedestrians crossing either Greenwood Avenue or the side streets during the peak hour. Few pedestrians cross Greenwood Avenue at unsignalized crossings today (five or fewer on any crossing during the weekday p.m. peak hour).
- Three crashes over the last five years of available data (2015-2019) involved people walking on Greenwood Avenue, including two crashes at Bond Street and one crash at 3rd Street.

CONDITIONS FOR PEOPLE BIKING

The following summarizes key opportunities and constraints for people biking:

- There are currently no bicycle facilities on Greenwood Avenue between Wall Street and 3rd Street (US 20), although bicycle facilities exist to the east and west of this segment.
- Even with no bicycle facilities on Greenwood Avenue, there is still demand, with nine to 17 people counted biking on the roadway through each intersection during the weekday p.m. peak hour. This is also consistent with data previously collected by the City (2017-2020), which showed approximately 80 to 120 people biking east-west along Greenwood Avenue during the summer and five to 30 people during the winter. Data collected by Zagster through Bend's bike share system (2017-2018) showed Greenwood Avenue being utilized to access Downtown Bend.
- While Greenwood Avenue is not part of the City's Low Stress Bicycle Network (LSN), it is identified as a key connection and urban gateway to connect the Bend Central District to Downtown in the Core Area Project. As part of the Connected Grid in the Core Area Project, Greenwood Avenue will be expected to provide safe bike travel and complete walkable streets, prioritizing safe pedestrian crossings where the grid intersects with busy streets.
- Greenwood Avenue intersects the City's LSN at Harriman Street and 2nd Street.
- Connectivity between Downtown/Core Area and the Box Factory area is generally limited to Wall Street and Bond Street as Hill Street/Harriman Street do not connect to Colorado Avenue due to proximity to the US 97 interchange. Therefore, there is a need for broader connectivity for people walking and biking.
- Seven crashes over the last five years of available data (2015-2019) involved people biking on Greenwood Avenue, including one crash at Harriman Street.

CONDITIONS FOR PEOPLE RIDING BUSES

The following summarizes key opportunities and constraints for people taking transit:

- Cascade East Transit (CET) Route 3 serves from Mount Washington Drive to 3rd Street utilizing Greenwood Avenue, and connects to the Hawthorne Station, North Downtown, Portland Avenue, and Central Oregon Community College (COCC).
- Service on the route is at a 30-minute frequency but the 2040 Transit Master Plan identifies increased service to allow 15 to 20-minute headways during peak periods to serve future higher demand.
- Two transit stops are located near 2nd Street and two transit stops are located near Harriman Street (one in each direction).
- There are no enhanced crossings near the transit stops and in particular, there is a raised median barrier near 2nd Street. This barrier limits the ability for people taking transit to easily cross Greenwood Avenue, especially those using mobility devices.

CONDITIONS FOR PEOPLE DRIVING

The following summarizes key opportunities and constraints for people driving:

- Greenwood Avenue between Wall Street and 3rd Street (US 20) today has two travel lanes in each direction, with no turn lanes provided at the unsignalized intersections between Bond Street and 3rd Street.
- Long vehicle queues (extending past 6th Street westbound and past Hill Street eastbound) can build up at the Greenwood Avenue/3rd Street (US 20) intersection, especially during the summer p.m. peak periods.
- Connectivity between the Core Area and Downtown is limited by the US 97/BNSF railroad. Greenwood Avenue is one of the few corridors that connects across the barriers, through an underpass.
- Rear-end crashes (40 percent) were the most common crash type along Greenwood Avenue, followed by turning movement crashes (24 percent), which could be influenced by the lack of left turn lanes on Greenwood Avenue.
- No fatalities were reported along Greenwood Avenue between 2015 and 2019.
- Figure 1 shows hot-spot safety locations along Greenwood Avenue.

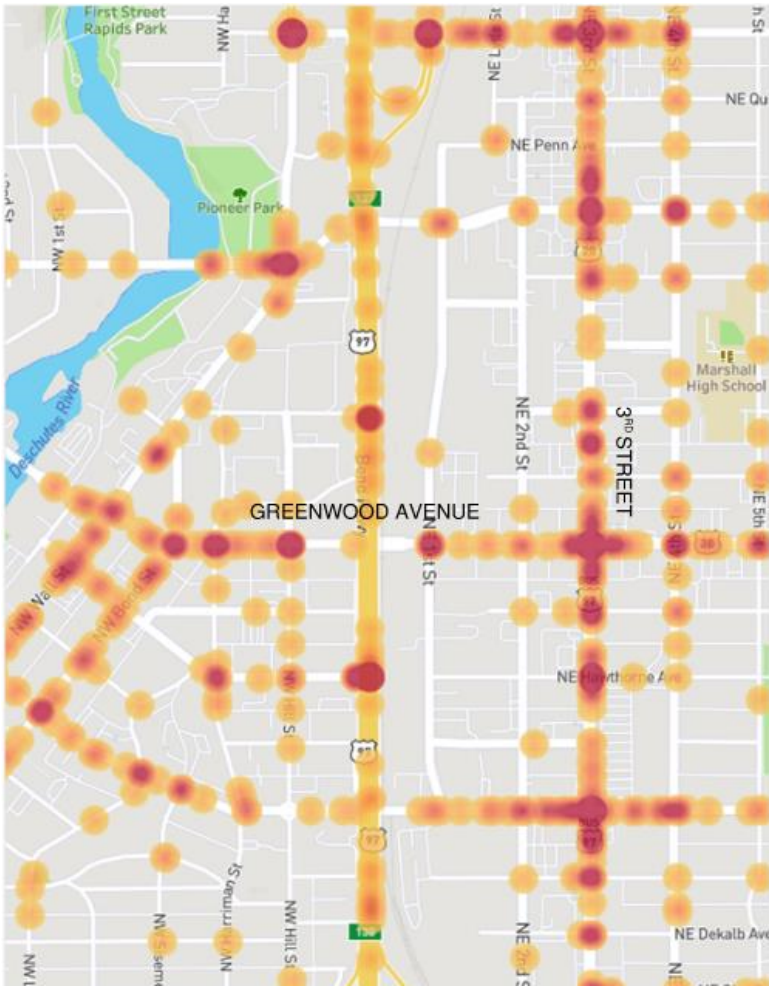


FIGURE 1. ODOT ARTS HEAT MAP OF CRASHES IN BEND, 2015-2019

ALTERNATIVE CONCEPTS CONSIDERED

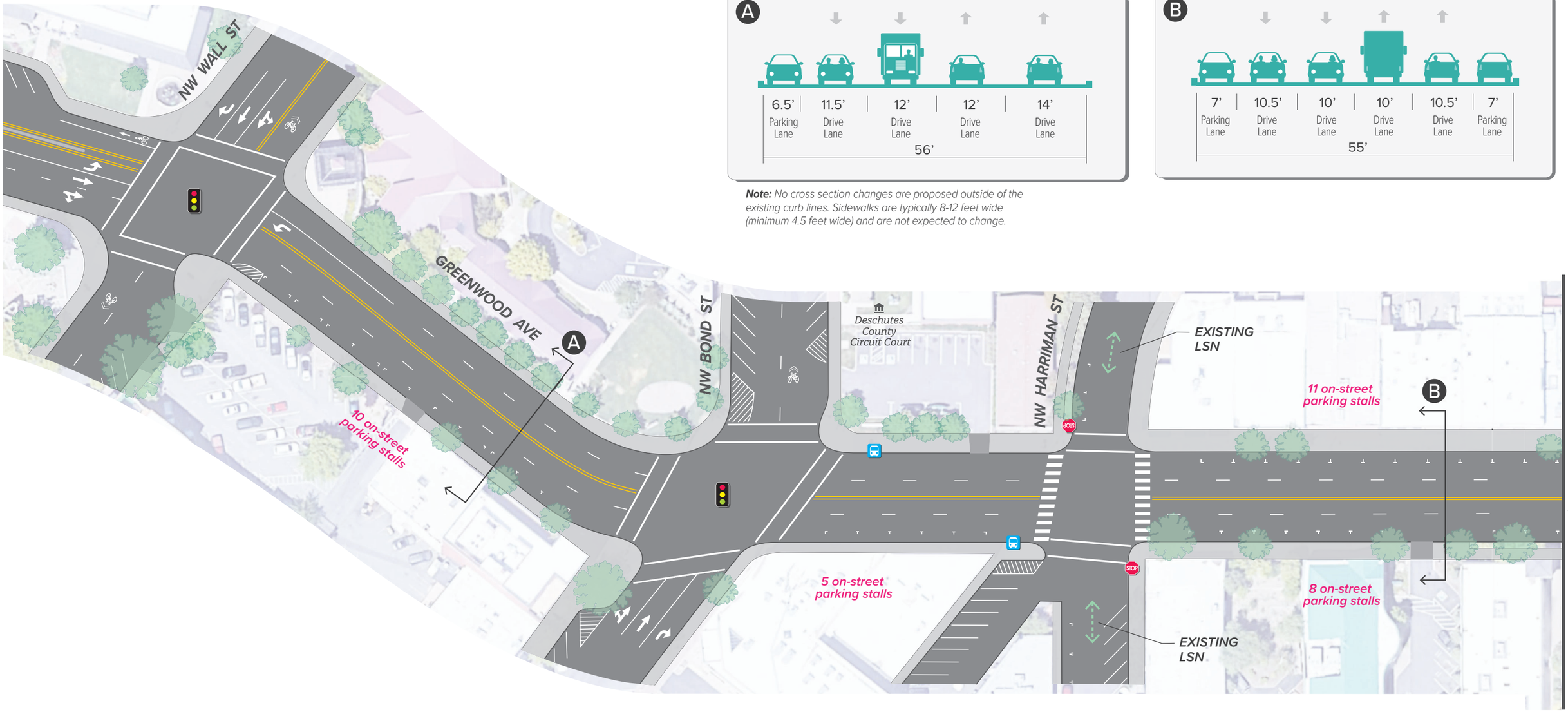
Four alternative concepts were created by the project team to represent a range of potential solutions that could improve multimodal travel and safety on Greenwood Avenue. Each of the alternatives, along with the existing street configuration, are depicted in the following figures on pages 6-20. Table 1 summarizes elements included in each of the four alternatives and under existing conditions, while the following sections briefly describe each alternative in more detail.

TABLE 1. KEY ELEMENTS OF ALTERNATIVES CONSIDERED

ELEMENTS	NO-BUILD	ALT 1	ALT 2	ALT 3	ALT 4
CROSS SECTION	4-lanes (2-lanes in each direction)	3-lanes (1-lane each direction with a center left turn lane) from Hill St to 1st St	3-lanes (1-lane each direction with a center left turn lane) from Wall St to 1st St, widening to two eastbound lanes east of 1st St	3-lanes (1-lane each direction with a center left turn lane) from Wall Street to 2nd St, widening to two eastbound lanes at 2nd St	3-lanes (1-lane each direction with a center left turn lane) from Wall St to 1st St, widening to two eastbound east of 1st St
CENTER TURN LANE WIDTH	NA	12 feet	11 feet	11 feet	11 feet
BICYCLE FACILITIES (TYPICAL)	None	Shared lanes	Buffered bicycle lanes	Buffered bicycle lane; parking buffered bicycle lane	Buffered bicycle lanes
BICYCLE LEVEL OF TRAFFIC STRESS (TYPICAL)	3	1 / 3	1	1	1 / 2
BICYCLE FACILITIES (UNDER US 97/RAILROAD BRIDGES)	None	Separated (plastic bollards) facility for people walking and biking	Separated (plastic bollards) facility for people walking and biking	Separated (plastic bollards) facility for people biking	Separated (plastic bollards) facility for people walking and biking
IMPROVED CROSSINGS FOR PEOPLE BIKING	-	2	2	2	2

TABLE 2. KEY ELEMENTS OF ALTERNATIVES CONSIDERED (CONTINUED)

ELEMENTS	NO-BUILD	ALT 1	ALT 2	ALT 3	ALT 4
SIDEWALKS (TYPICAL)	8-12 feet	8-12 feet	8-12 feet	8-12 feet	8-12 feet
IMPROVED CROSSINGS FOR PEOPLE WALKING	-	2 pedestrian refuge islands; 13 new curb extensions	5 pedestrian refuge islands; 2 new curb extensions	5 pedestrian refuge islands; No new curb extensions	4 pedestrian refuge islands; 13 new curb extensions
TRANSIT STOPS	4 (near Harriman St and 2nd St)	4 (near Harriman St and 2nd St)	4 (near Harriman St and 2nd St)	4 (near Harriman St and 2nd St)	4 (near Harriman St and 2nd St)
BUS BULB-OUTS	0	3	0	0	1
ON-STREET PARKING STALLS	68	59	41	44	48



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

figure **a**

EXISTING CORRIDOR — **Greenwood Avenue**

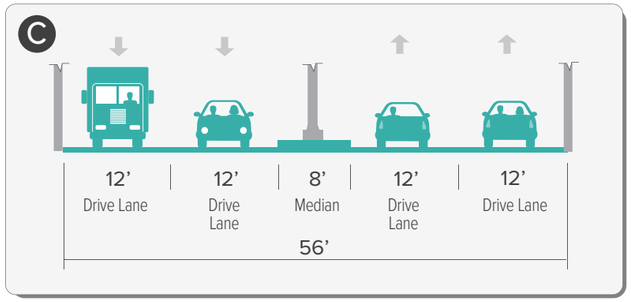
NW Wall Street to East of NW Harriman Street *(this sheet)*

January 28, 2022

N

0 60 120

1 inch = 60 feet



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

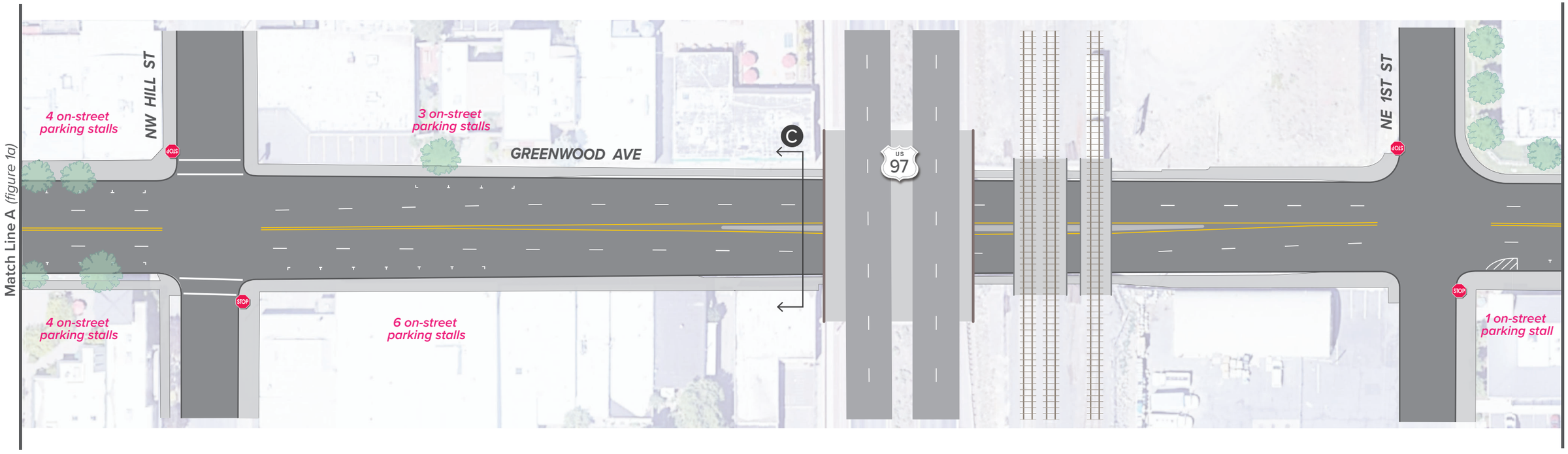


figure **b**

EXISTING CORRIDOR — **Greenwood Avenue**

NW Hill Street to NE First Street *(this sheet)*

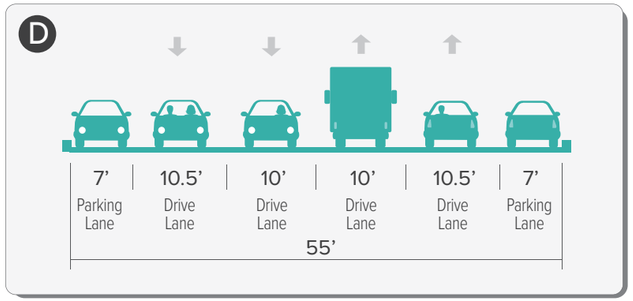
January 28, 2022

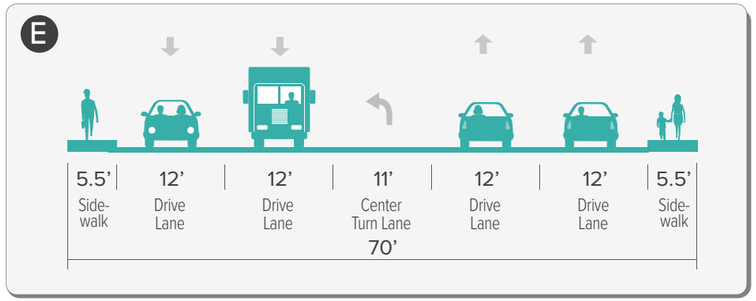
N

0 60 120

1 inch = 60 feet

Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*





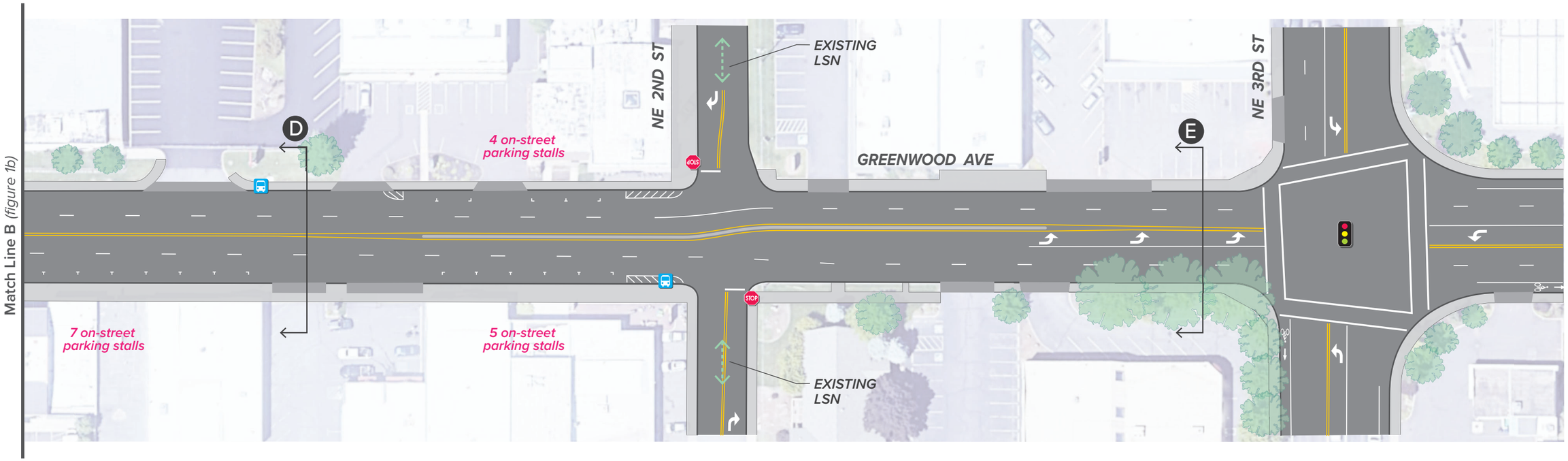


figure **C**

EXISTING CORRIDOR — **Greenwood Avenue**

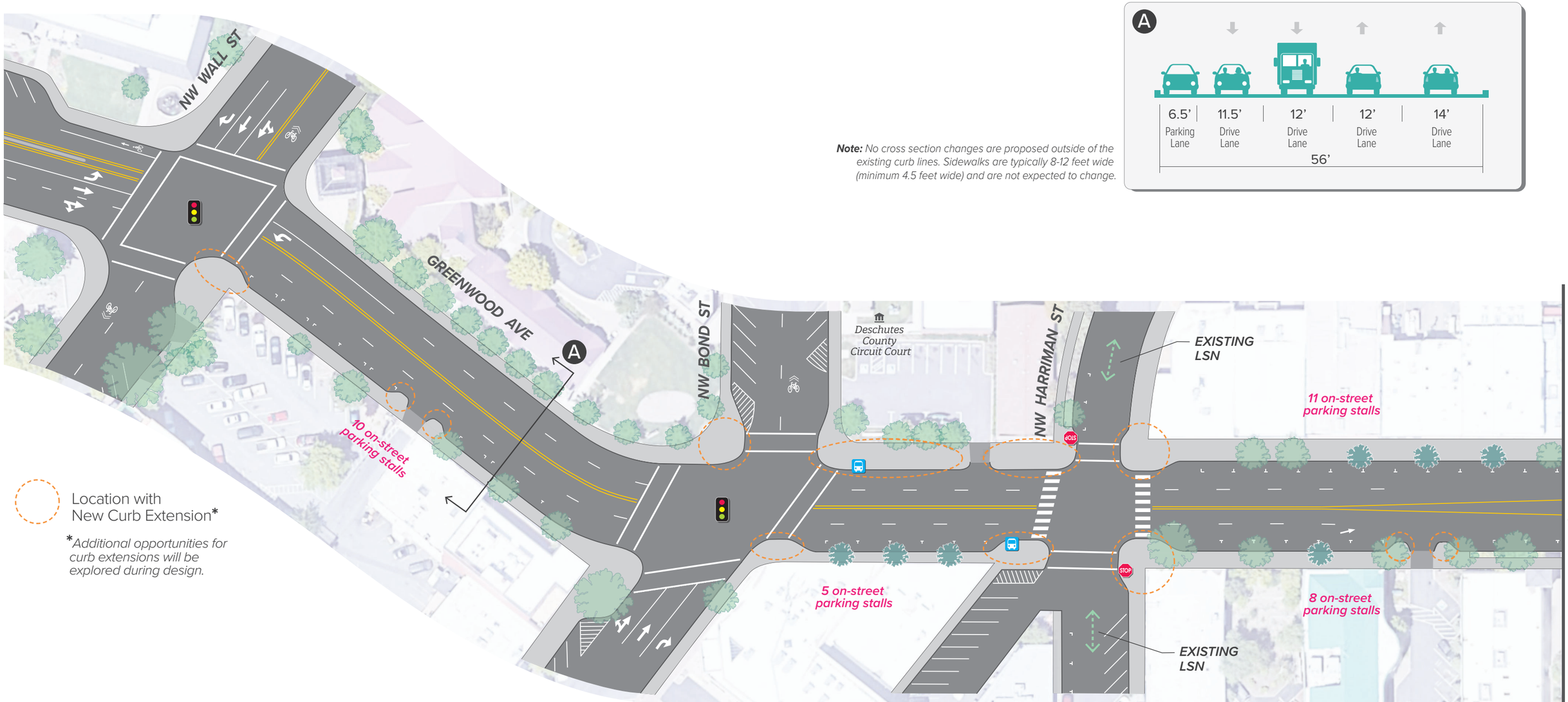
West of NE 2nd Street to NE 3rd Street *(this sheet)*

January 28, 2022

N

0 60 120

1 inch = 60 feet



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

figure **1a**

Alternative 1

ENHANCED PEDESTRIAN ENVIRONMENT – MAXIMIZE PARKING

Greenwood Avenue – NW Wall Street to East of NW Harriman Street *(this sheet)*

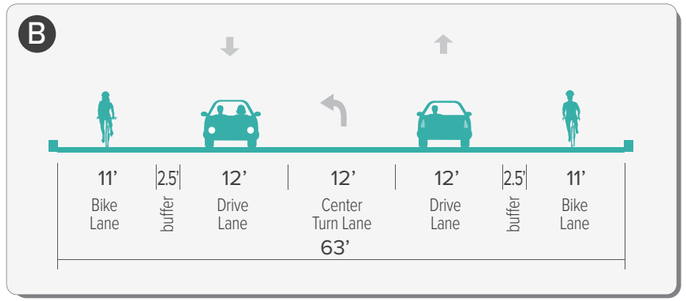
January 28, 2022

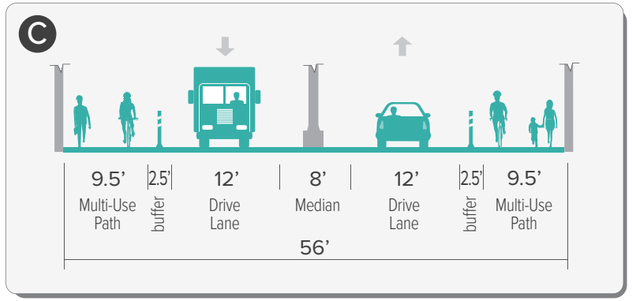
N

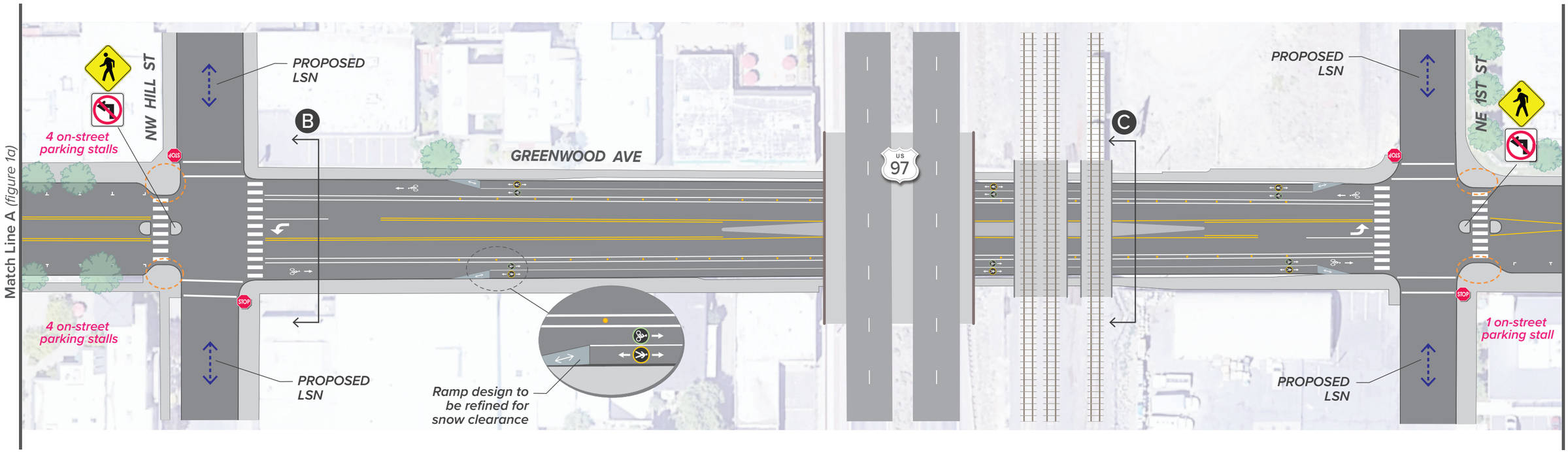
0 60 120

1 inch = 60 feet (approx.)

Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*







Location with New Curb Extension*

*Additional opportunities for curb extensions will be explored during design.

figure **1b**

Alternative 1

ENHANCED PEDESTRIAN ENVIRONMENT – MAXIMIZE PARKING

Greenwood Avenue – NW Hill Street to NE 1st Street *(this sheet)*

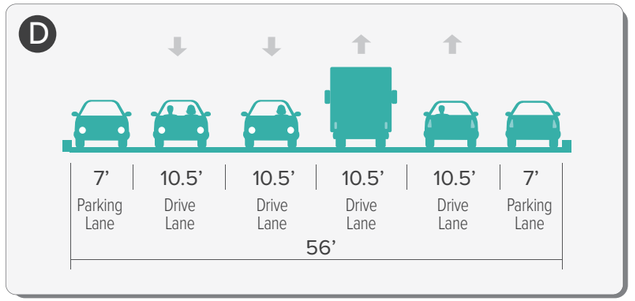
January 28, 2022

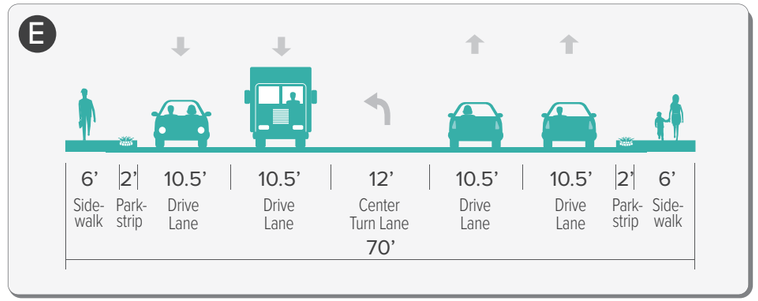
N

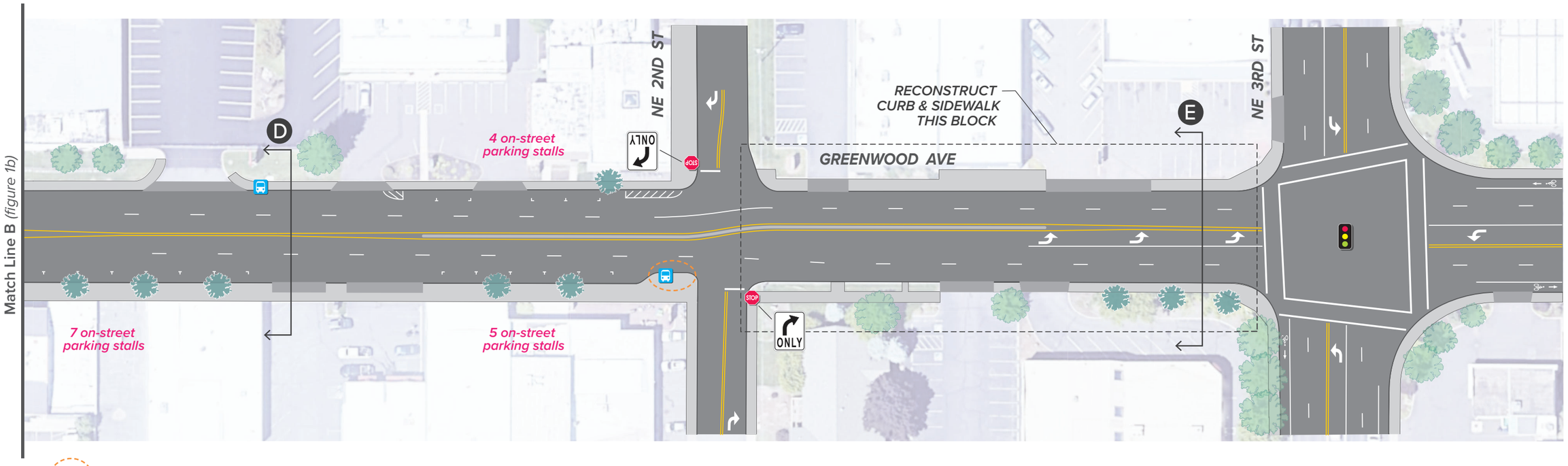
0 60 120

1 inch = 60 feet (approx.)

Note: *For Cross Section D, no cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change. (Does not apply to Cross Section E.)*







Location with New Curb Extension*

**Additional opportunities for curb extensions will be explored during design.*

figure **1c**

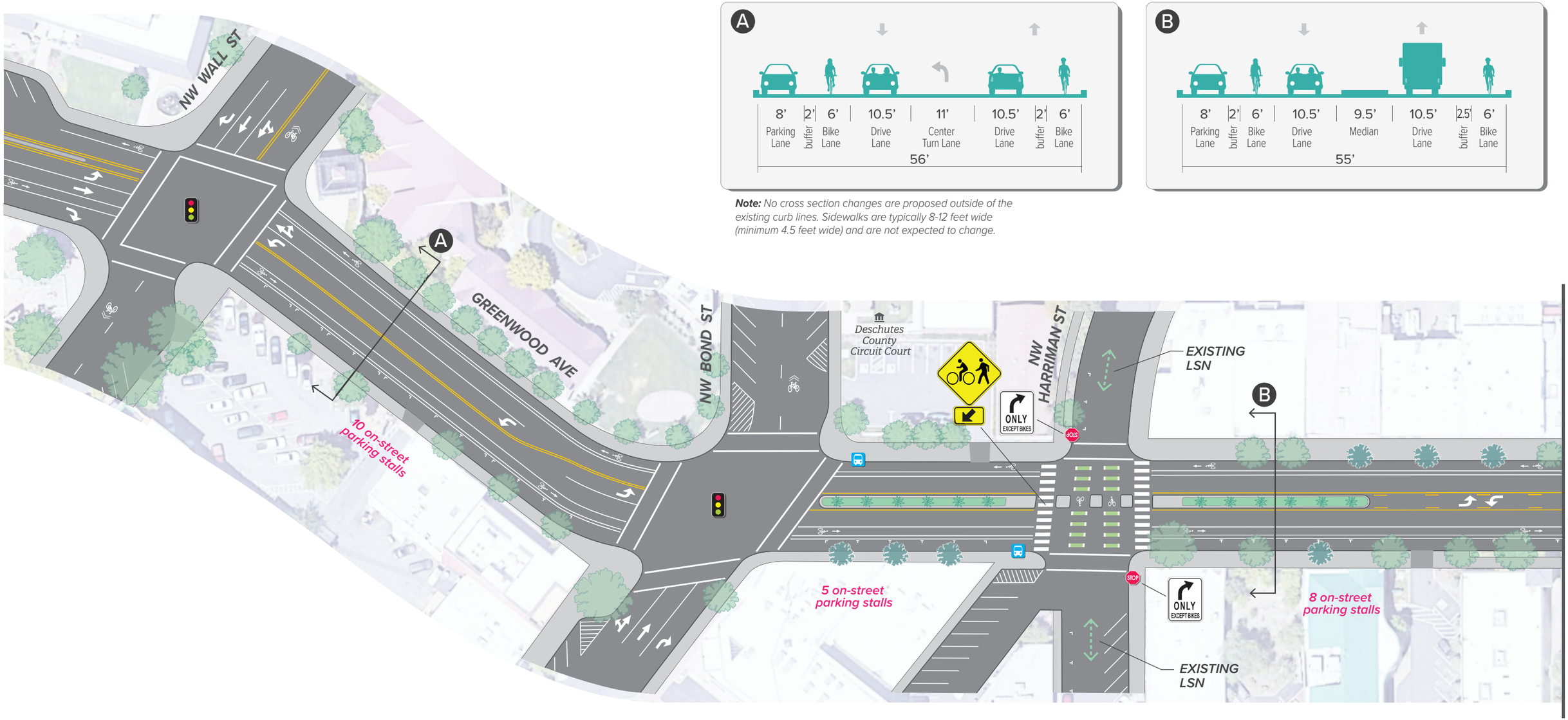
Alternative 1
ENHANCED PEDESTRIAN ENVIRONMENT – MAXIMIZE PARKING

Greenwood Avenue – West of NE 2nd Street to NE 3rd Street *(this sheet)*
January 28, 2022

N

0 60 120

1 inch = 60 feet (approx.)



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

figure **2a**

Alternative 2
ENHANCED BICYCLE ENVIRONMENT

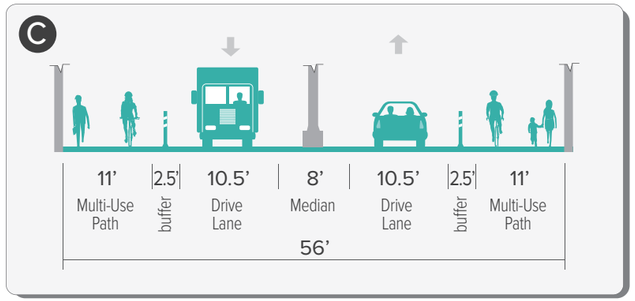
Greenwood Avenue – NW Wall Street to East of NW Harriman Street *(this sheet)*
January 28, 2022

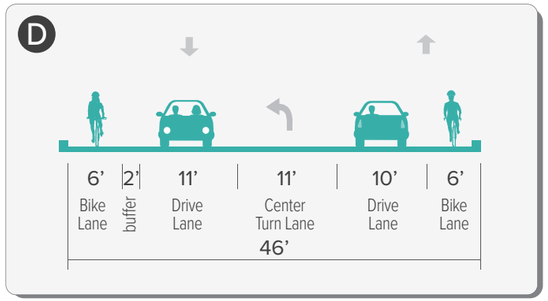
N

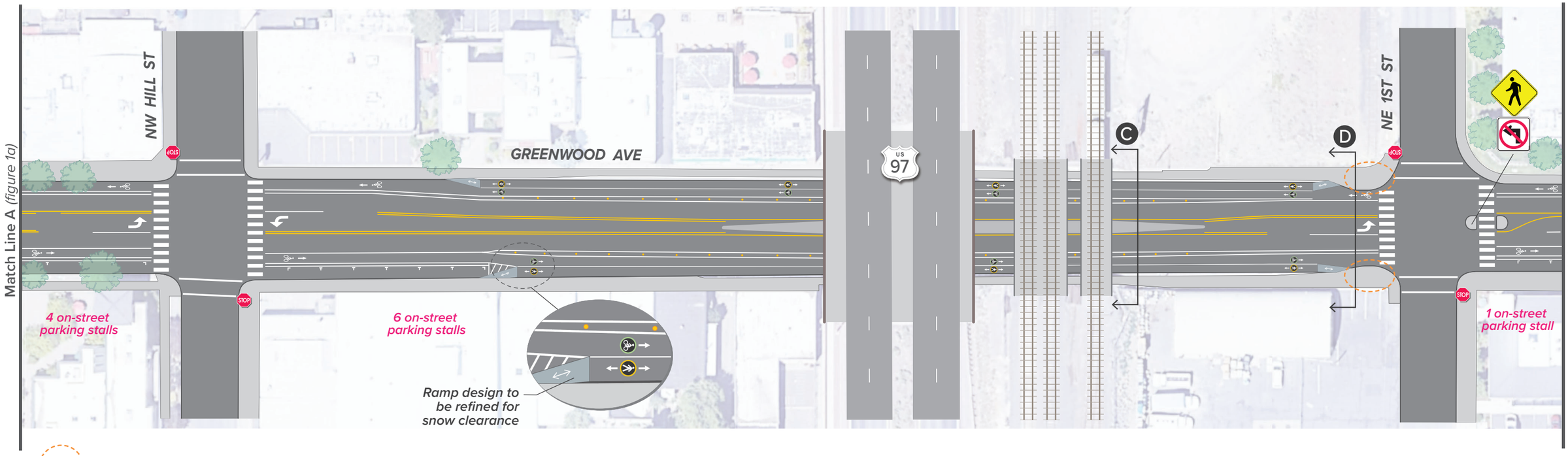
0 60 120

1 inch = 60 feet (approx.)

Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*







Location with New Curb Extension*

*Additional opportunities for curb extensions will be explored during design.

figure **2b**

Alternative 2
ENHANCED BICYCLE ENVIRONMENT

Greenwood Avenue – NW Hill Street to NE 1st Street *(this sheet)*
January 28, 2022

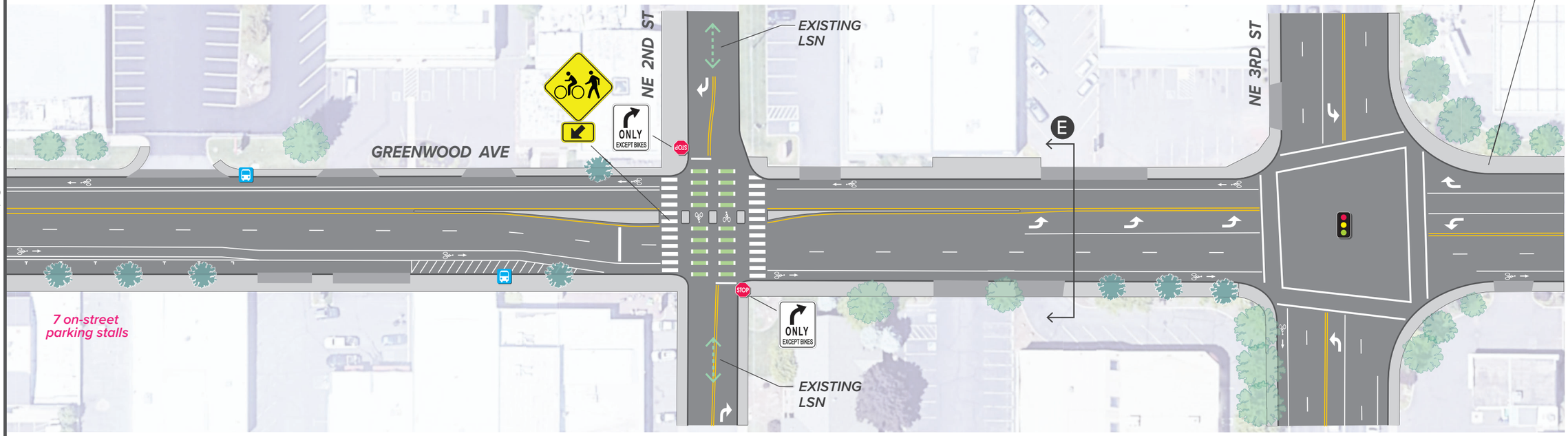
N

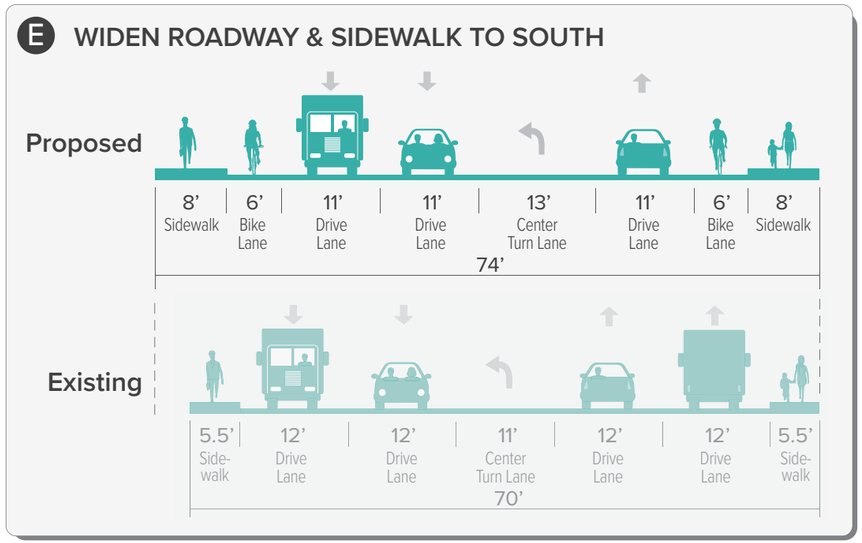
0 60 120

1 inch = 60 feet (approx.)

Match Line B *(figure 1b)*

Widen sidewalk to create SUP in front of Arco with bike ramp. Coordinate driveway location, landscaping, and right-of-way purchase.





N

0 60 120

1 inch = 60 feet (approx.)

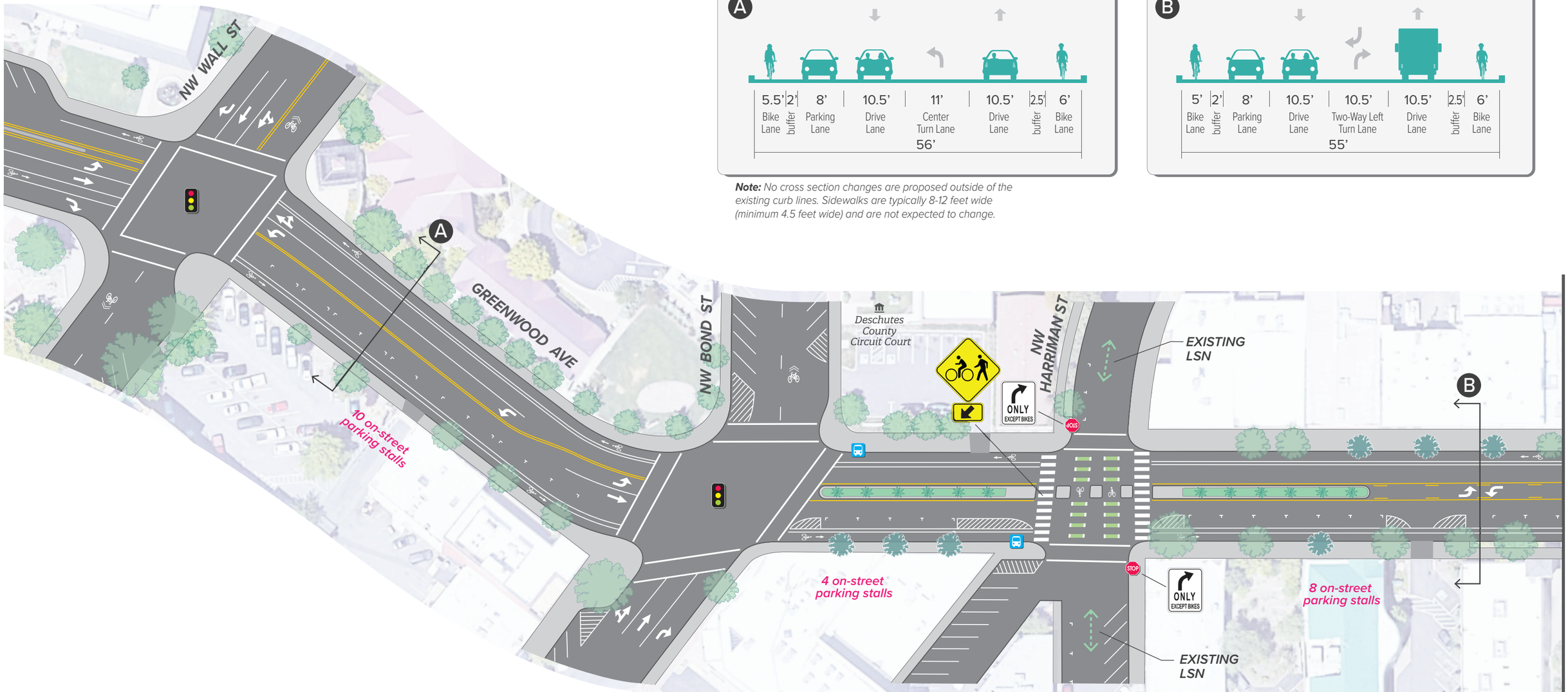
figure **2c**

Alternative 2

ENHANCED BICYCLE ENVIRONMENT

Greenwood Avenue – West of NE 2nd Street to NE 3rd Street *(this sheet)*

January 28, 2022



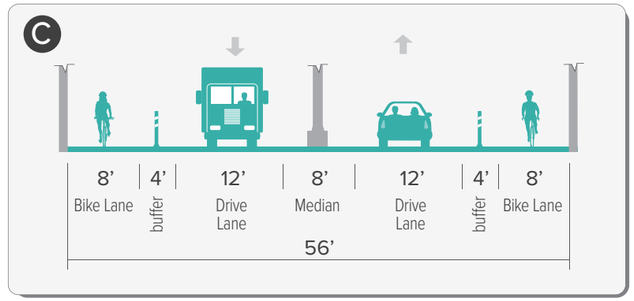
Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

figure **3a**

Alternative 3
PARKING PROTECTED BICYCLE ENVIRONMENT

Greenwood Avenue – NW Wall Street to East of NW Harriman Street *(this sheet)*

January 28, 2022



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

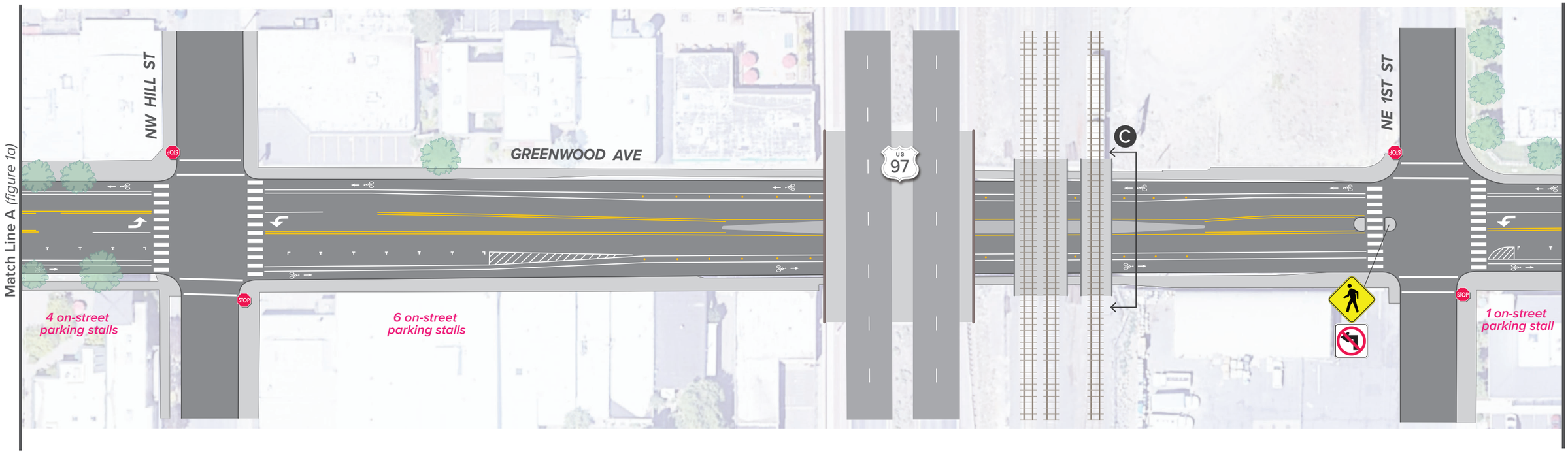


figure **3b**

Alternative 3

PARKING PROTECTED BICYCLE ENVIRONMENT

Greenwood Avenue – NW Hill Street to NE 1st Street *(this sheet)*

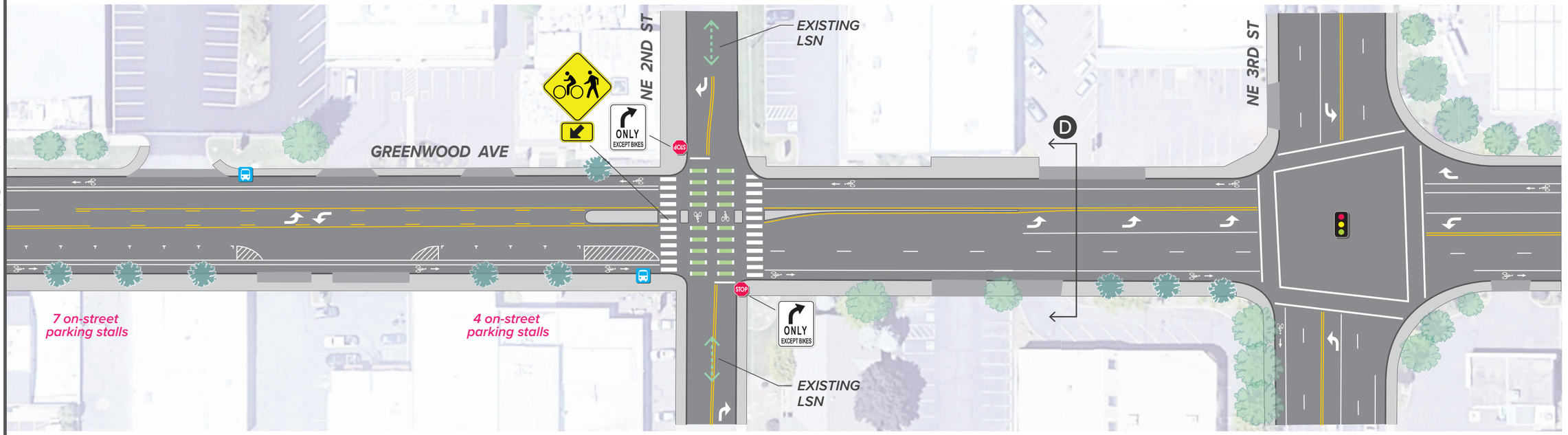
January 28, 2022

N

0 60 120

1 inch = 60 feet (approx.)

Match Line B *(figure 1b)*



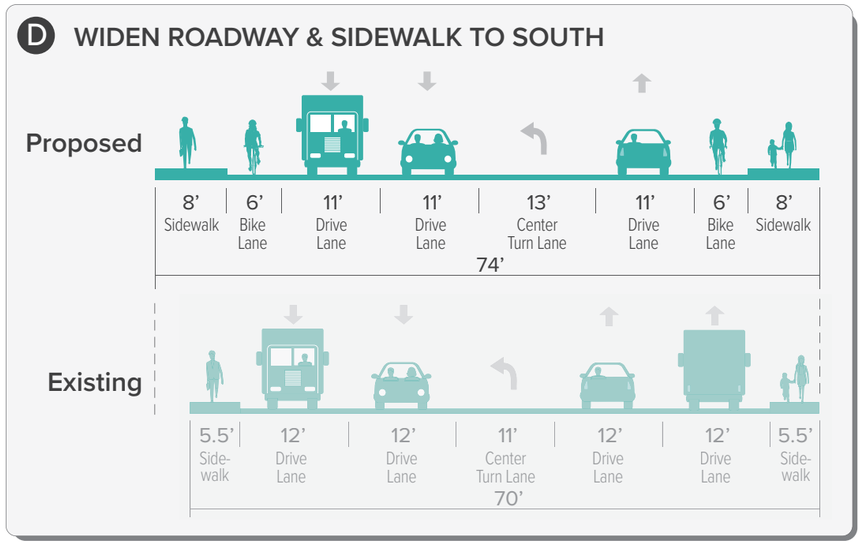


figure **3c**

Alternative 3

PARKING PROTECTED BICYCLE ENVIRONMENT

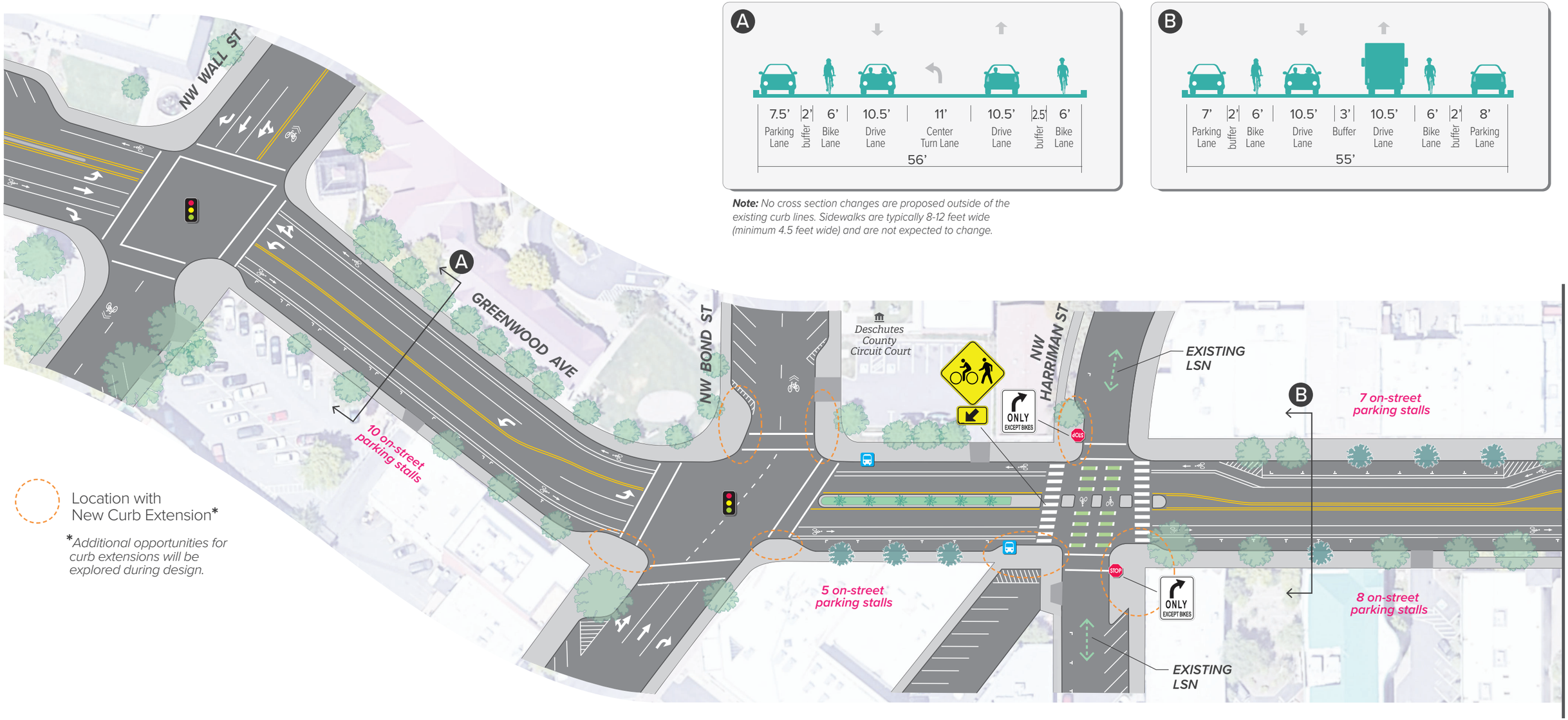
Greenwood Avenue – West of NE 2nd Street to NE 3rd Street *(this sheet)*

January 28, 2022

N

0 60 120

1 inch = 60 feet (approx.)



Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*

figure **4a**

Alternative 4
BALANCED TRAVEL MODE ENVIRONMENT

Greenwood Avenue – NW Wall Street to East of NW Harriman Street *(this sheet)*

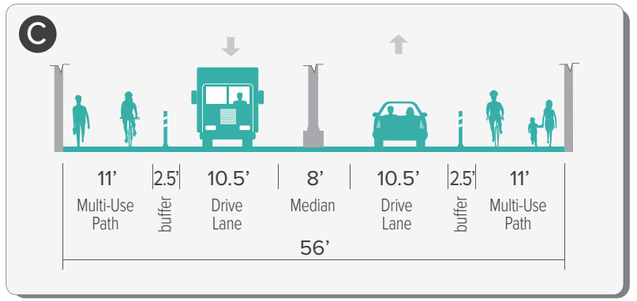
January 28, 2022

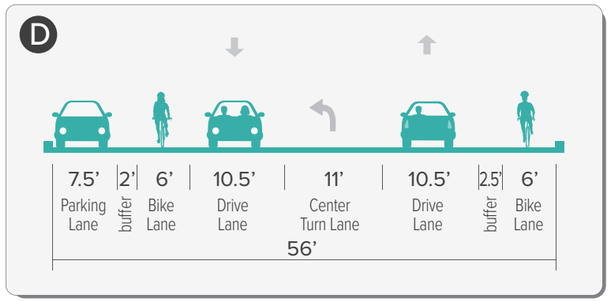
N

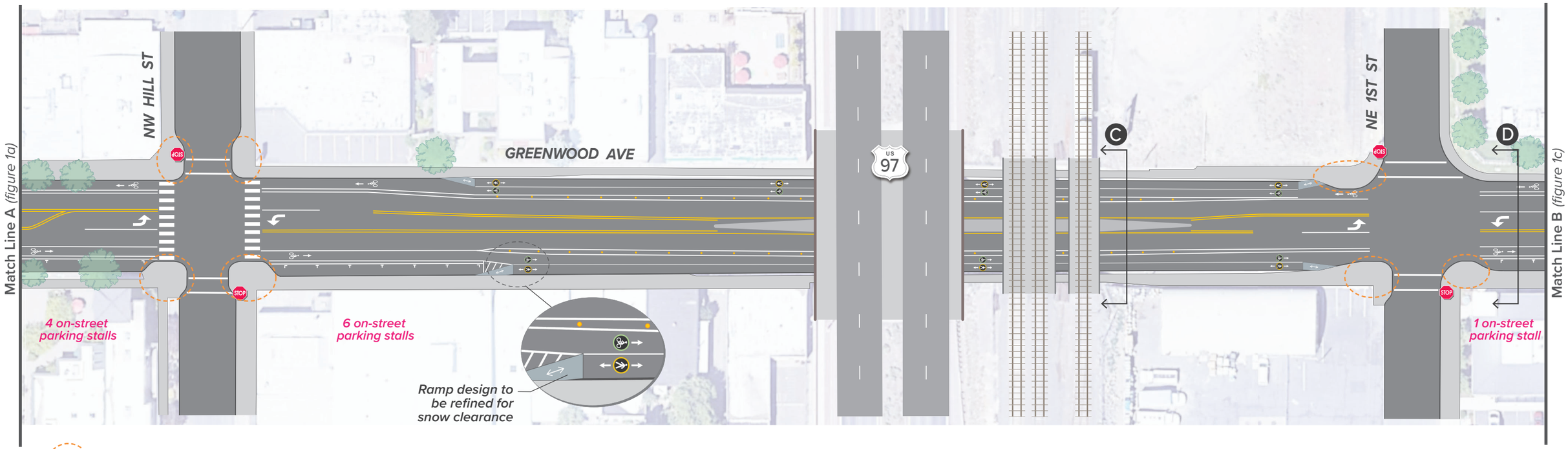
0 60 120

1 inch = 60 feet (approx.)

Note: *No cross section changes are proposed outside of the existing curb lines. Sidewalks are typically 8-12 feet wide (minimum 4.5 feet wide) and are not expected to change.*







Location with New Curb Extension*

**Additional opportunities for curb extensions will be explored during design.*

figure **4b**

Alternative 4

BALANCED TRAVEL MODE ENVIRONMENT

Greenwood Avenue – NW Hill Street to NE 1st Street *(this sheet)*

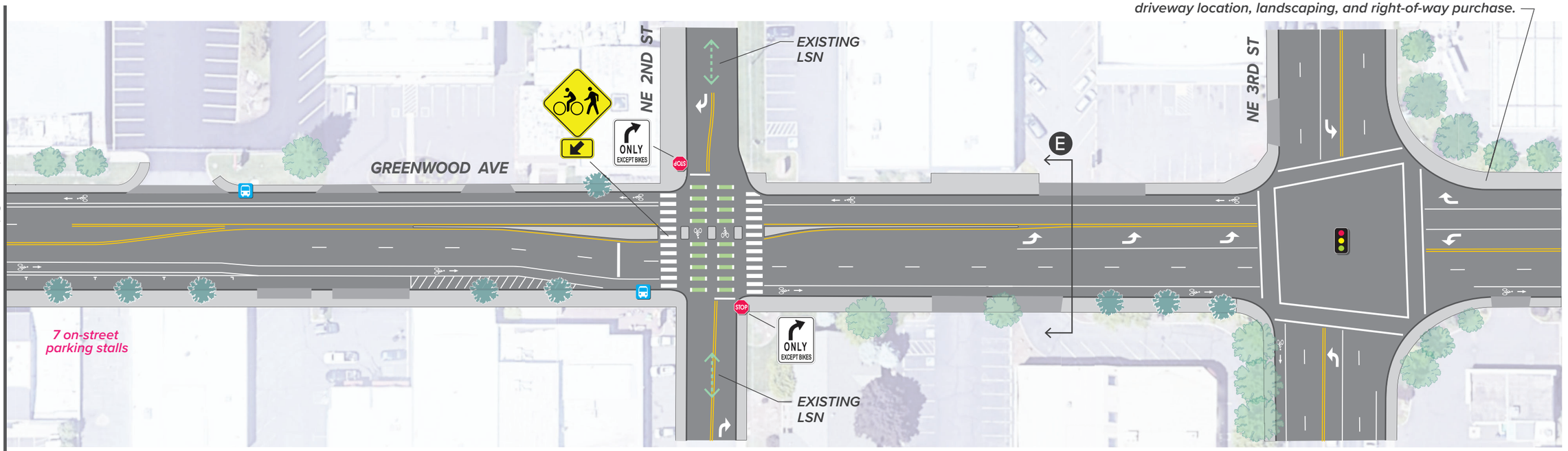
January 28, 2022

N

0 60 120

1 inch = 60 feet (approx.)

Match Line B *(figure 1b)*



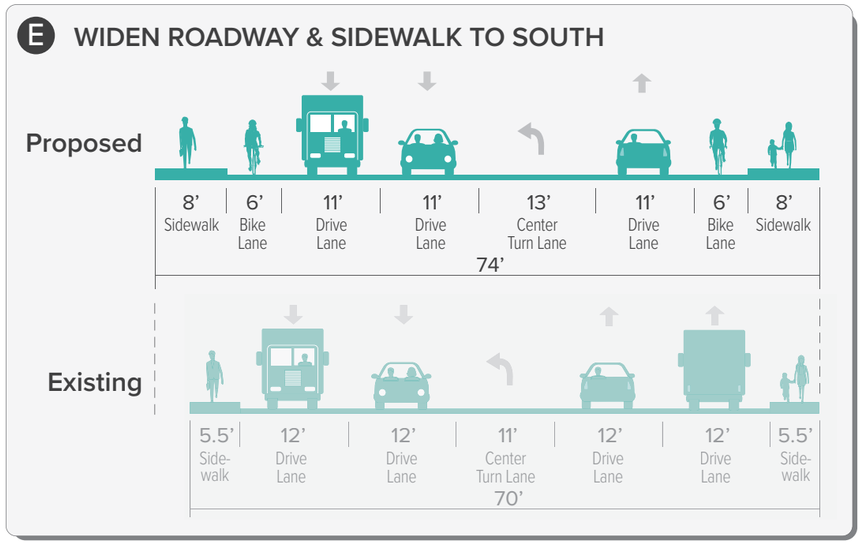


figure **4c**

Alternative 4

BALANCED TRAVEL MODE ENVIRONMENT

Greenwood Avenue – West of NE 2nd Street to NE 3rd Street *(this sheet)*

January 28, 2022

N

0 60 120

1 inch = 60 feet (approx.)

ALTERNATIVE 1: ENHANCED PEDESTRIAN ENVIRONMENT – MAXIMIZE PARKING

Alternative 1 places an emphasis on enhancing the pedestrian environment while maximizing parking.

- **Driving:** Alternative 1 maintains four travel lanes approaching each of the traffic signals and reduces to a three-lane section between Hill Street and 1st Street. West of US 97, left turns are allowed onto Harriman Street from the through lane but the eastbound left turn at Hill Street is restricted with the addition of a median refuge island. East of US 97, westbound left turns are restricted at 1st Street with the addition of a median refuge island and all left turns continue to be prohibited at 2nd Street. Therefore, westbound left turn access east of US 97 is only provided via 3rd Street. Alternative 1 maintains 59 of the existing 68 on-street parking stalls. The safety and comfort of on-street parking remains an issue as entering and exiting from the driver's side will be from the travel lane, leaving no room for opening the car door safely.
- **Biking:** Bicycle facilities would shift from dedicated Bicycle lanes to shared lanes several times along the corridor, which would not meet the City's Transportation System Plan's (TSP) Complete Street goal. Under the US 97 and railroad bridges, vertical delineation (such as plastic bollards, raised curbs, bike rail, etc.) is provided between the travel lane and a multi-use path (directional bicycle facility but bi-directional pedestrian facility). This alternative would alter the City's Low Stress Bicycle Network by moving the existing routes from Harriman Street and 2nd Street to Hill Street and 1st Street. For example, this would require shifting bicycle traffic on Harriman Street to Hill Street between Kearney Avenue and Hawthorne Avenue and shifting bicycle traffic on 2nd Street between Hawthorne Avenue and Norton Avenue (or shifting the low-stress route entirely to 1st Street between Franklin Avenue and Olney Avenue). It should be noted that there is generally higher motor vehicle traffic volumes on Hill Street than Harriman Street, which would make it a less desirable low-stress bicycle route. Shifting the low-stress network may also require a TSP amendment.
- **Walking:** Throughout Greenwood Avenue, curb extensions are added to enhance pedestrian visibility and shorten pedestrian crossing distances. Enhanced pedestrian crossings are provided at Hill Street and 1st Street that include median refuge islands. With the median refuge islands, westbound left turns at 1st Street and eastbound left turns at Hill Street are restricted. The existing raised sidewalk under US 97 would remain but people walking would have the option to travel along the multi-use path.
- **Transit:** Where possible, bus bulb-outs (curb extensions that are typically 20-40 feet in length) are added to reduce transit delay, allowing transit vehicles to stop in-lane instead of pulling to the side of the road to unload and load passengers before merging back into the travel lane. However, no enhanced pedestrian crossings are added near transit stops.

ALTERNATIVE 2: ENHANCED BICYCLE ENVIRONMENT

Alternative 2 places an emphasis on improving the connectivity of the bicycle network by adding buffered bicycle lanes.

- **Driving:** In general, Greenwood Avenue is converted to a three-lane cross section (one lane in each direction with a center turn lane), except approaching 3rd Street (US 20). The cross section is modified to two eastbound travel lanes east of 1st Street. West of US 97, all left turns are restricted at Harriman Street with the addition of median refuge islands, but full left turn access is allowed at Hill Street. East of US 97, westbound left turns at 1st Street are restricted with the addition of a median refuge island and all left turns continue to be prohibited at 2nd Street.

Therefore, westbound left turn access east of US 97 is only provided via 3rd Street. This alternative removes on-street parking stalls on the north side of Greenwood Avenue, maintaining 41 of the existing 68 on-street parking stalls. On-street parking is more functional as people exit and enter their vehicle from a buffered space adjacent to the bicycle lane rather than directly into a moving traffic lane.

- **Biking:** The bicycle network connectivity is improved by adding a standard bicycle lane in the eastbound direction and a buffered bicycle lane in the westbound direction on Greenwood Avenue. Under the US 97 and railroad bridges, vertical delineation (such as plastic bollards, raised curbs, bike rail, etc.) is provided between the travel lane and a multi-use path (directional bicycle facility but bi-directional pedestrian facility). This alternative would maintain the City's Low-Stress Bicycle Network on Harriman Street and 2nd Street and includes raised median island crossing improvements at those intersections.

  Walking: Few curb extensions are included in this alternative, although more could be added if desired. Enhanced pedestrian and bicycle crossings with median refuge islands are added at Harriman Street and 2nd Street, while pedestrian median refuge islands are added on the east leg of Bond Street and the east leg of 1st Street. With the median refuge islands, westbound left turns at 1st Street and all left turns at Harriman Street are restricted. The existing raised sidewalk under US 97 would remain but people walking would have the option to travel along the multi-use path.

- **Transit:** Transit vehicles stop in the bike lane and must pull out of the travel lane to load and unload passengers before merging back into the travel lane. Enhanced crossings are added near transit stops at 2nd Street and Harriman Street.

ALTERNATIVE 3: PARKING PROTECTED BICYCLE ENVIRONMENT

Similar to Alternative 2, Alternative 3 also places an emphasis on improving the connectivity of the bicycle network, but by adding parking protected bicycle lanes in some areas.

- **Driving:** In general, Greenwood Avenue is converted to a three-lane cross section (one lane in each direction with a center turn lane) except approaching 3rd Street (US 20). The cross section is modified to two eastbound travel lanes at 2nd Street. West of US 97, all left turns are restricted at Harriman Street with the addition of median refuge islands, but full left turn access is allowed at Hill Street. East of US 97, eastbound left turns are restricted at 1st Street with the addition of a median refuge island and all left turns continue to be prohibited at 2nd Street. Therefore, westbound left turn access east of US 97 is only provided via 3rd Street. This alternative removes on-street parking stalls on the north side of Greenwood Avenue and maintains 44 of the existing 68 on-street parking stalls. The safety and comfort of on-street parking remains an issue as entering and exiting from the driver's side will be from the travel lane, leaving no room for opening the car door safely.
- **Biking:** This alternative adds buffered bicycle lanes along the north side of Greenwood Avenue, with parking protected buffered bicycle lanes along much of the south side. Under the US 97 and railroad bridges, vertical delineation (such as plastic bollards, raised curbs, bike rail, etc.) is provided between the travel lane and a wide bicycle lane. This alternative would maintain the City's Low-Stress Bicycle Network on Harriman Street and 2nd Street and includes raised median island crossing improvements at those intersections.
- **Walking:** No curb extensions are included in this alternative as they would conflict with the parking protected bicycle lane. Enhanced pedestrian and bicycle crossings with median refuge islands are added at Harriman Street and 2nd Street, while pedestrian median refuge islands are added on the east leg of Bond Street and the west leg of 1st Street. With the median refuge

islands, eastbound left turns at 1st Street and all left turns at Harriman Street are restricted. This alternative would not improve conditions for people walking under the US 97 bridge, which would not meet the City's TSP Complete Streets goal.

- **Transit:** Transit vehicles must pull out of the travel lane to load and unload passengers before merging back into the travel lane. Enhanced crossings are added near transit stops at 2nd Street and Harriman Street. A transit vehicle may block eastbound traffic near 2nd Street.

ALTERNATIVE 4: BALANCED TRAVEL MODE ENVIRONMENT

Alternative 4 tries to balance conditions for all modes of travel.

- **Driving:** In general, Greenwood Avenue is converted to a three-lane cross section (one lane in each direction with a center turn lane) except approaching 3rd Street (US 20). The cross section is modified to two eastbound travel lanes east of 1st Street. West of US 97, all left turns are restricted at Harriman Street with the addition of median refuge islands, but full left turn access is allowed at Hill Street. East of US 97, full left turn access is provided at 1st Street and all left turns continue to be prohibited at 2nd Street. This alternative maintains some parking on the north side of Greenwood Avenue between Harriman Street and Hill Street, maintaining 48 of the existing 68 on-street parking stalls. On-street parking is more functional as people exit and enter their vehicle from a buffered space adjacent to the bicycle lane rather than directly into a moving traffic lane.
- **Biking:** The bicycle network connectivity is improved by adding buffered bicycle lanes on both sides of Greenwood Avenue. Under the US 97 and railroad bridges, vertical delineation (such as plastic bollards, raised curbs, bike rail, etc.) is provided between the travel lane and a multi-use path (directional bicycle facility but bi-directional pedestrian facility). This alternative would maintain the City's Low-Stress Bicycle Network on Harriman Street and 2nd Street and includes raised median island crossing improvements at those intersections.
- **Walking:** Throughout Greenwood Avenue and along the side streets, curb extensions are added to enhance pedestrian visibility and shorten pedestrian crossing distances. Enhanced pedestrian and bicycle crossings with median refuge islands are added at Harriman Street and 2nd Street, while a pedestrian median refuge is added on the east leg of Bond Street. The existing raised sidewalk under US 97 would remain but people walking would have the option to travel along the multi-use path.
- **Transit:** A bus bulb-out (curb extensions that are typically 20-40 feet in length) is added near Harriman Street. However, transit vehicles will still need to pull to the side of the road to unload and load passengers before merging back into the travel lane. Enhanced crossings are added near transit stops at 2nd Street and Harriman Street.

ALTERNATIVE EVALUATIONS KEY FINDINGS

A set of evaluation criteria[2] were developed by the project team with consideration to key opportunities and constraints within this corridor, as well as City Council's transportation-related goals expressed in Bend's TSP. The evaluation criteria were used to guide the development of solutions for Greenwood Avenue and have been used to qualitatively rate each alternative to

[2] See *Greenwood Avenue West Segment Evaluation Matrix*

support continued conversations about how best to balance conditions for people walking, biking, taking transit, and driving, while taking into consideration conditions for business vitality and implementation. No weighting was applied to the scoring and the order that the evaluation criteria are presented is not an indication of relative importance.

Table 3 summarizes key findings from the evaluation. Note the summary considers multiple evaluation criteria for each category. Safety was evaluated under conditions for people driving but impacts all modes of travel and is therefore shown separately in the table. The detailed scoring for each evaluation criteria is shown in Attachment C. Alternatives 2, 3, and 4 all perform similarly well, however, Alternative 4 performs slightly better than the others. Alternative 4 maintains some parking on the north side of Greenwood Avenue, particularly between Harriman Street and Hill Street, while the other alternatives do not. In addition, travel lanes are generally wider in Alternative 4, which could improve freight and bus accessibility.

TABLE 3. SUMMARY OF ALTERNATIVES EVALUATION

CATEGORY [A]		NO BUILD	ALT 1	ALT 2	ALT 3	ALT 4
CONDITIONS FOR PEOPLE WALKING		Poor	Excellent	Excellent	Excellent	Excellent
CONDITIONS FOR PEOPLE BIKING		Very Poor	Fair	Excellent	Excellent	Excellent
CONDITIONS FOR PEOPLE RIDING BUSES		Poor	Good	Fair	Fair	Fair
CONDITIONS FOR PEOPLE DRIVING	All Criterion	Fair	Fair	Fair	Fair	Fair
	Safety Criterion	Fair	Good	Excellent	Excellent	Excellent
CONDITIONS FOR BUSINESS VITALITY		Fair	Good	Fair	Fair	Good
IMPLEMENTATION		NA	Fair	Good	Good	Good

Excellent; Good; Fair; Poor; Very Poor

Other key findings from the evaluation and analysis include:

- Converting from a four-lane section on Greenwood Avenue to a three-lane section can significantly improve safety without a major impact on motor vehicle capacity.
- Curb extensions are an effective approach to improve safety for people walking and there are numerous opportunities throughout Greenwood Avenue to implement them. While not noted in the initial scope of all alternatives, additional curb extensions could be added to many of the alternatives but would increase the cost of implementation.
- Buffered bicycle lanes and parking protected bicycle lanes can both provide low-stress opportunities for bicycle connectivity on Greenwood Avenue, however, parking protected bicycle

lanes limit the opportunities for adding curb extensions across Greenwood Avenue (although floating median refuge islands in the shadow of on-street parking can reduce pedestrian crossing distances). Buffered bicycle lanes also provide separation between the travel lane and people entering and exiting their parked vehicle.

- It is possible to consider incorporating additional on-street parking stalls and bicycle parking on several cross streets in the area to optimize parking availability in the study area.
- Each of the alternatives contain various motor vehicle turn restrictions. A broader evaluation of turn restrictions should be coordinated through the future Midtown Crossing Study, which will look at broader motor vehicle circulation patterns on Greenwood Avenue, Franklin Avenue and Hawthorne Avenue.

The following sections describe some of the key features of each alternative that contribute to the scoring summarized in Table 3. For more details on the evaluation and scoring of alternatives and elements within each alternative, see the *Greenwood Avenue West Segment Alternatives Evaluation Comparison Memorandum* included in Attachment C.

CONDITIONS FOR PEOPLE WALKING

Key features of each alternative that contribute to improved conditions for people walking include:

- Curb extensions are included in all alternatives but Alternative 1 and Alternative 4 add the most curb extensions, reducing pedestrian crossing distance and increasing pedestrian visibility at unsignalized crossings. Curb extensions at the Wall Street and Bond Street signals for these alternatives also reduce pedestrian crossing distance.
- Multiple pedestrian median refuge islands for each alternative reduce the pedestrian crossing distance and increase pedestrian visibility at unsignalized crossings, while allowing for two-stage crossings
- Widening Greenwood Avenue near 3rd Street increases pedestrian exposure for Alternatives 2, 3, and 4.
- Alternative 1 maintains existing unsignalized pedestrian crossings on a four-lane section, which could lead to an increased risk for "double threat" crashes where a stopped vehicle blocks a crossing pedestrian from view of the adjacent travel lane.
- Low-stress crossings are more consistently distributed along Greenwood Avenue for Alternative 1 (with enhanced crossings at Bond Street, Hill Street, 1st Street and 3rd Street). An additional low-stress crossing under Alternative 2 and 3 at 1st Street also improves crossing spacing and minimizes out-of-direction travel for pedestrians.
- All alternatives provide opportunities to include streetscape elements. Large curb extensions or bus bulb-outs under Alternatives 1 and 4 further increase opportunities to incorporate streetscape elements such as landscaping or benches.

CONDITIONS FOR PEOPLE BIKING

Key features of each alternative that contribute to improved conditions for people biking include:

- Parking protected buffered bicycle lanes (Alternative 3) provide the greatest degree of separation between vehicle traffic and people biking, although all alternatives include comfortable facilities for people biking. Note that comfortable bicycle facilities are only included

in Alternative 1 between Hill Street and 1st Street, to connect the two north-south proposed Low Stress Bicycle Network routes, and do not connect the entire Greenwood Avenue corridor.

- Alternatives 2, 3, and 4 include standard, 6-foot bicycle lanes approaching 3rd Street to provide a connection to the existing bicycle lanes east of the study corridor. These alternatives also include buffered bicycle lanes to provide a comfortable connection to the existing bicycle lanes west of the study corridor.
- Median refuge islands provided for each alternative can be used by people biking to support safer crossings. Full medians in Alternatives 2, 3, and 4 physically restrict vehicles to right-in/right-out turns only to reduce potential for conflicts between people biking and driving. These crossings would be LTS 1 or LTS 2, indicating lower stress.
- Alternatives 2, 3, and 4 increase the length of low-stress bicycle facilities on Greenwood Avenue and better meet the TSP's Complete Streets Goal. Alternative 1 requires shared bicycle facilities for portions of Greenwood Avenue, which are considered high stress (LTS 3).

CONDITIONS FOR PEOPLE RIDING BUSES

Key features of each alternative that contribute to improved conditions for people taking transit include:

- Travel times are similar under Alternative 1 compared to No Build conditions, as motor vehicle through traffic diverts to other routes or travel during different time periods or using other modes of travel. Westbound travel times and queues increase for Alternatives 2, 3, and 4 as the through traffic at 3rd Street (US 20) utilizes a single westbound lane. Currently, the westbound through movement shares the second westbound lane with a heavy right turn movement.
- Low-stress crossings are located immediately adjacent to eastbound transit stops and within half a block of westbound transit stops for Alternatives 2, 3, and 4. Increased crossing frequency in Alternative 3 further reduces out-of-direction travel for pedestrians accessing transit.
- High-stress crossings are located immediately adjacent to all transit stops in Alternative 1, although low-stress crossings are available within one and a half blocks of all stops.
- Three bus bulb-outs in Alternative 1 allow transit to stop in-lane at most stops on the corridor and increases the available right-of-way to accommodate transit stop amenities. Alternative 4 also includes one bus bulb-out, but all stops still require the bus to merge with traffic, limiting on-time reliability.
- In Alternative 3, an enhanced bus stop design located in line with on-street parking could be considered near Harriman Street, to allow a bus to stop in-lane while accommodating the parking protected bicycle lane. This would enhance transit access but would block the only lane of motor vehicle traffic and would reduce the curb-to-curb distance to less than 12 feet at the transit stop.

CONDITIONS FOR PEOPLE DRIVING

Key features of each alternative that contribute to improved conditions for people driving include:

- More queue storage space is provided approaching 3rd Street in Alternative 1 compared to the other alternatives.
- No significant change in delay is expected by converting from two travel lanes in each direction to one travel lane in each direction with a center turn lane.
- Each of the alternatives provide 20 feet between curb faces to allow emergency vehicles to bypass a vehicle stalled in the roadway, except under the pinch point of the US 97/railroad undercrossing.
- Consideration should be given to intersections where truck turning needs are more common when designing and locating curb extensions.
- All the alternatives narrow the travel lanes on Greenwood Avenue. However Alternative 3 narrows the center turn lane the most of all alternatives, with 10.5-foot travel lanes next to 10.5-foot travel lanes, which is less desirable for truck accessibility.
- Alternatives 2, 3, and 4 convert the entire corridor from a four-lane to three-lane cross section, which could help address some of the past crash trends. In particular, converting from a four-lane cross section to a three-lane cross section with a center turn lane has the potential to reduce crashes by 29 percent[3]. Alternative 4 shortens the left turn bay at Hill Street.
- Converting to a three-lane cross section also reduces the potential for "double threat" crashes where a stopped vehicle blocks a crossing pedestrian from view of the adjacent travel lane.
- Other elements that are included in the alternatives that could positively influence safety on Greenwood Avenue (as measured by ODOT ARTS Crash Reduction Factors) include: installing bicycle lanes, installing buffered bicycle lanes, installing curb extensions, installing pedestrian refuge islands, and installing street lighting.
- Alternative 1 maintains the most parking (86 percent) as there are only bicycle lanes added on Greenwood Avenue between Hill Street and 1st Street.
- Alternative 4 also maintains a significant amount (70 percent) of on-street parking by narrowing the cross section between Harriman Street and Hill Street to maintain parking on the north side of Greenwood Avenue while maintaining parking throughout the south side of Greenwood Avenue.

CONDITIONS FOR BUSINESS VITALITY

Key features of each alternative that contribute to improved conditions for business vitality include:

- Alternative 1 maintains the most parking (86 percent) as there are only bicycle lanes added on Greenwood Avenue between Hill Street and 1st Street.
- Alternative 4 maintains the second-most on-street parking (70 percent) by narrowing the cross section between Harriman Street and Hill Street to maintain parking on the north side of Greenwood Avenue while maintaining parking throughout the south side of Greenwood Avenue.

[3] ODOT ARTS Crash Reduction Factor List, Countermeasure Number H53.

- There may be opportunities to increase people trips by adding a micromobility hub to offset parking space loss by providing a dedicated space for micromobility device parking.
- Alternatives 2, 3, and 4 have the most ability to incorporate landscaping, as there is an opportunity for a raised median along Greenwood Avenue between Bond Street and Harriman Street, which can incorporate landscaping.
- Additional landscaping can also be provided with each of the alternatives outside of the existing curb lines.
- In general, each of the alternatives include a similar right-of-way impact, with each of the alternatives maintaining the existing curb-to-curb lines between Wall Street and 2nd Street.
- Alternatives 2, 3, and 4 connect more people to businesses by maintaining motor vehicle capacity, adding left-turn lanes, and facilitating walking, biking and transit modes to connect people to core area businesses and services.

IMPLEMENTATION

- Several elements may require modifications and additional resources to maintain, including curb extensions and the type of bicycle facility under US 97 and the railroad bridges.
- Each of the alternatives include a similar magnitude of cost, ranging from $2.5 million to $4.2 million as listed in Table 3 below.

TABLE 4. PLANNING LEVEL COST ESTIMATES

ALTERNATIVE	PLANNING LEVEL COST ESTIMATE (2021 DOLLARS)
ALTERNATIVE 1	$2.5 million
ALTERNATIVE 2	$3.5 million
ALTERNATIVE 3	$3.5 million
ALTERNATIVE 4	$4.2 million

NEXT STEPS

This study presents and evaluates initial alternatives for improving multimodal travel on Greenwood Avenue. The City has initiated the Midtown Crossing Study to holistically investigate improvements on Greenwood Avenue, Hawthorne Avenue, and Franklin Avenue. During the Midtown Crossing Study, the four alternatives may be refined through additional analysis and will be presented for community input before selecting a preferred alternative. Elements from each of the alternatives may be combined to create a preferred alternative.

Given the ability to combine various elements in each of these alternatives, there is opportunity for flexibility in the phasing of these improvements. While the cost of each of the alternatives exceeds the $700,000 ARTS funding available for construction, specific elements could be constructed first, with additional improvements to follow based on additional funding availability. Additional funding opportunities may include the Core Area URA, and Midtown Crossings Study. Synergy with General Obligation Bond and transit improvement projects could also be explored. Examples of ways improvements could be phased to fit within the funding constraints are listed below. By phasing improvements based on the recommendations below, the cost of the alternatives could be reduced from $2.5-4.2 million to approximately $1 million.

- **Reconfigure Greenwood Avenue to three lanes between Wall Street and 1st Street only:** This would create a westbound merge prior to the intersection of 1st Street, but it would limit any impacts to the traffic signal at 3rd Street, which adds cost to the improvements. This would also reduce costs by waiting to reconstruct the roadway between 2nd Street and 3rd Street.
- **Construct fewer permanent curb extensions:** Curb extensions make up a large portion of the cost of the improvements included in the alternatives. By constructing permanent curb extensions at only a handful of crossings or optimizing for more temporary, quick build curb extensions at most crossings, the overall cost of the project can be reduced by $0.25-1 million dollars.
- **Quick build improvements:** Depending on the timing and coordination with the upcoming Midtown Crossing Study, the City may create a plan for quick build improvements specifically targeting crosswalk installation and temporary raised curb ramp installation as an initial phase of improvements. Additional coordination will be needed to determine how restriping is accomplished.

An additional consideration for the phasing of any improvements will be the need for the City to purchase any specialized equipment to plow snow or remove snow, particularly if protected bicycle facilities are implemented. Snow storage areas and treatment options will need to be identified with the implementation of any improvements along Greenwood Avenue.