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The contents of this document do not necessarily reflect views or policies of the State of Oregon.
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INTRODUCTION

As Washington County’s urban area develops and urbanizes, the County has continually sought to serve the transportation needs of its residents, workers, and visitors. Washington County identified the SW 170th Avenue / SW Merlo Road corridor as an area of needed improvement in order to better serve its diversity of users. The SW 170th Avenue / SW Merlo Road Conceptual Design Plan project has developed a conceptual design for these two connecting arterial roadways, based on:

• An analysis of existing conditions, opportunities and constraints;
• A broader look at surrounding neighborhood context;
• An evaluation of best practices and innovative designs; and
• An inclusive public involvement process.

This conceptual design provides Washington County and corridor stakeholders with a higher level of certainty as to how the corridor will look and function in the future and prepares the County for the upcoming phases of designing, engineering and constructing improvements in the corridor.

This report presents the project purpose and background, the planning process, the preferred design including a cost estimate for a potential first phase along 170th Avenue from Merlo Road to Alexander Street, and design options that may be considered during the design phases.

The preferred design is subject to refinement and modification when the project is funded and moves into more detailed design and engineering phases.
CHAPTER 01 | PROJECT PURPOSE AND CONTEXT

The SW 170th Avenue/SW Merlo Road corridor is a critical north-south connection between residential neighborhoods, major employment hubs, transit lines, schools and park facilities; however, it currently faces major challenges for various modes of travel. The corridor is in a high-growth area of Washington County that is experiencing major development and redevelopment activity in both commercial and residential sectors. Neighborhoods to the west and south host communities of concern, including lower income, minority and English language-learning residents. The corridor currently does not serve the needs of people walking, bicycling and accessing transit, and it is projected to have increased vehicular congestion in the future.

Figure 1 shows the study area of the corridor. The corridor is broken into three distinct segments:

- Segment 1 is SW 170th Avenue north of SW Merlo Road to W Baseline Road;
- Segment 2 is SW 170th Avenue south of SW Merlo Road to SW Tualatin Valley Highway, and
- Segment 3 is SW Merlo Road between SW 170th Avenue and SW Jenkins Road.

**Figure 1:** Base Map and Study Area
Project Goal and Objectives

The overarching goal of this Project is to develop a conceptual plan for street design treatments along SW 170th Avenue between W Baseline Road and SW Tualatin Valley Highway (OR8) and along SW Merlo Road between SW Jenkins Road and SW 170th Avenue to provide facilities for multi-modal circulation, to support adjacent land use and development, and to conceptually address a number of environmental constraints including riparian, floodplain, wetland, forest and wildlife habitat resources.

Specific objectives during the development of the concept plan were to:

• Create a corridor that will encourage and support the use of active transportation modes and reduce reliance on the automobile.

• Create a corridor that better links Aloha neighborhoods with nearby destinations including two schools, two Metropolitan Area Express (MAX) light rail stations, Tualatin Hills Nature Park, and a major employment hub anchored by Nike to the northeast of the study area.

• Identify at a planning level means to address potential environmental impacts including stormwater runoff from additional impervious surfaces, construction within floodplain, wetland and/or riparian areas, and impacts on mature trees, considering green street treatments and more conventional measures.

• Address right-of-way and access management needs.

• For the purpose of bicycle and pedestrian mobility, examine the local street and trail network to address safety and connectivity, including connections necessary to link adjacent development to any alternative parallel bicycle or pedestrian facilities.

• Explore the application of innovative bikeway treatments for 170th Avenue and Merlo Road, potentially including a two-way cycle track, one-way cycle tracks, or buffered bicycle lanes.

• Explore opportunities to accommodate bus stops, including improved pedestrian access, along and across 170th Avenue and Merlo Road in anticipation of a TriMet-proposed bus line.

• Provide safe routes and crossings for bicyclists and pedestrians to area destinations such as Beaver Acres Elementary School, Merlo Station High School and Tualatin Hills Nature Park.

• Explore project phasing options that could deliver pedestrian/bicycle facilities in advance of roadway widening to the ultimate number of lanes designated in the Transportation System Plan.

• Engage a broad range of public and stakeholders in designing concepts for 170th Avenue and Merlo Road, ensuring compliance with Title VI regulations regarding outreach to disadvantaged and minority citizens.
Project Context | Land Use

The SW 170th Avenue/ SW Merlo Road corridor is the crossroads of a growing and evolving area in Washington County. Washington County and the City of Beaverton have adopted zoning designations that allow for increased densities and mixes of use surrounding the MAX station areas in the corridor, as well as a community business district zone at the southern end of the corridor, allowing for some of the highest levels of density found in unincorporated Washington County. Recently, several different new multi-family housing developments have been constructed in the north end of the corridor, bringing many new residents into the area. The study area is adjacent to the Nike World Headquarters, which is expanding, and there are two schools located on the corridor.

Figures 2 and 3 show the zoning and existing land uses in the corridor.

Figure 2: Zoning

Figure 3: Existing Land Use
**Project Context | Transportation**

In the County’s adopted Transportation System Plan (2014), 170th Avenue north of Merlo Road (segment 1) is designated as an arterial with two to three vehicle travel lanes. Merlo Road and the southern section of 170th Avenue (segments 2 and 3) are designated as arterials, with future configurations of four to five vehicle travel lanes. Segments 2 and 3 are also planned for future bus service in TriMet’s Westside Service Enhancement Plan and identified as top-level gaps in the pedestrian and bicycle system through the County’s Bicycle and Pedestrian Improvement Prioritization Project and the Aloha-Reedville Study and Livable Community Plan. All segments of the corridor are designated in the Transportation System Plan as Enhanced Major Street Bikeways and the northern and southern extremes of the project corridor have a Streetscape Overlay, a designation intended to enhance the pedestrian realm.

Figures 4 through 7 show the existing and planned transportation systems in the study area.

**Appendix A** includes the complete Existing Conditions Report, including a more detailed look at existing transportation, land use, natural features, utilities, and existing right-of-way in the corridor. The Existing Conditions Report also includes a complete review of applicable design guidance and standards that were referenced and employed in the development of the conceptual design plan.

**Corridor Segments**

- **Segment 1**: Merlo Road
- **Segment 2**: 170th Avenue at Beaverton Creek
- **Segment 3**: 170th Avenue at Beaverton Creek

**Figure 4: Roadway Features**

- **2013**
  - 85th Percentile: 39 mph
  - ADT: 11,723
  - Existing Lanes: 3

- **2013**
  - 85th Percentile: 45 mph
  - ADT: 16,227
  - Existing Lanes: 2

**Functional Roadway Classifications**

- Arterial
- Collector
- Neighborhood Route
- Proposed Collector
- Proposed Neighborhood Route
- 2/3 Proposed Lanes
- 4.5 Proposed Lanes
PROJECT PURPOSE AND CONTEXT

Figure 5: Pedestrian Facilities
Figure 6: Bicycle Facilities
Figure 7: Existing and Planned Transit
Washington County initiated the SW 170th Avenue / SW Merlo Road Conceptual Design Plan in early 2014 after being awarded a Transportation and Growth Management grant to conduct the planning study. The planning process kicked off in June 2014 and was designed to enable a thorough consideration of the existing context in the corridor, consideration of a variety of potential solutions, opportunities for public and stakeholder input and feedback, and development of a preferred alternative for the corridor. A core project management team (PMT), including planning and engineering staff from Washington County, an ODOT grant manager, and the consultant project manager, led the development of the plan. This team was guided by a Project Advisory Committee (PAC), made up of local public representatives and other corridor stakeholders. The project management team also sought input from members of the general public and surrounding communities in two public workshops over the course of the project.

Figure 8 shows a roadmap of the planning process.
Initial Research and Development of Potential Solutions

In preparation for the first PAC meeting and public workshop, the project team thoroughly analyzed the existing conditions in the corridor; including transportation and immediately adjacent land use characteristics as well as the broader transportation network connectivity surrounding the corridor. Appendix A includes the complete Existing Conditions Report and Appendix B includes the Connectivity Report.

Findings from this work can be summarized in a number of key opportunities and constraints.

Opportunities and Constraints

Implementation of the designations included in the recent update to the Transportation System Plan will face some challenges in the study corridor, due to physical and, to some extent, policy constraints. However, improvements in the corridor present an opportunity to improve connections for various modes in the study area. This section outlines the opportunities and constraints that were considered in the development of the conceptual plan:

Urban / Suburban tension:
The corridor lies in an area in transition from a suburban/rural character to a more urban one. There is a tension between creating more urban-type facilities in the station areas, residential areas, and near schools on one hand and providing a high-capacity arterial for vehicles and freight on the other. This tension is also apparent in the different sources of roadway design guidance, including American Association of State Highway and Transportation Officials' (AASHTO) Green Book, North American City Transportation Official's (NACTO) Urban Streets Design Guide, and Washington County's Roadway Design & Construction Standards. However, this tension and transitioning character of the study corridor provide an opportunity to build on the County’s growing multi-modal system and provide an example of designing facilities that fulfill multiple purposes.

Conceptual Plan Approach

The conceptual plan ultimately opted to address this tension by using a lower design speed for vehicles than is typically used on County arterials. This will encourage lower vehicle speeds to enhance the environment for bicycling and walking. The plan also includes high quality pedestrian and bicycle facilities with substantial buffers throughout the corridors to allow for increased use of these modes.

Transportation System Plan designations and the design standards:
The Transportation System Plan designates all three segments of the corridor as enhanced major street bikeways, recommending a buffered bicycle lane or cycle track on each. For segments 2 and 3, it also designates the facilities as 4-5 lane arterials. In order to fulfill both of these designations, the roadways would either require additional right-of-way beyond the 98 feet indicated in the Standards, or they would need to consider using narrower travel lane widths than those shown in the standards. However, the design standards currently offer flexibility in design with the design exception process.

Conceptual Plan Approach

The conceptual plan implements all the Transportation System Plan designated facilities, including cycle tracks on segments 2 and 3, bicycle lanes on segment 1, five-lane cross sections on segments 2 and 3, and a three-lane cross section on segment 1. To allow the proposed cross sections to fit within the 98 feet, the conceptual plan proposes narrower lane widths.
Narrow available right-of-way:
One of the primary challenges in the 170th Avenue/Merlo Road corridor is related to the available right-of-way, which ranges throughout the corridor and the three segments (maps showing existing right-of-way can be found in Appendix A). None of the three segments has sufficient right-of-way to implement the designations of the Transportation System Plan, and obtaining additional right-of-way poses a challenge in terms of cost. As noted in the Washington County Bicycle Facility Toolkit, in order to implement the enhanced facilities as indicated in the Transportation System Plan, one of three options will need to be selected:

- Increase the overall width of the right-of-way beyond the current cross sections in the Washington County Roadway Design & Construction Standards (standards outlined in Appendix A)
- Decrease automobile travel lane widths.
- Reduce the number of automobile travel lanes.

Conceptual Plan Approach
While right-of-way acquisition will be necessary to construct the facilities, the conceptual design uses 11-foot inside vehicle travel lanes and a 13-foot center turn lane/median to achieve a cross section that fits within the total width of the current design standards. This cross section is consistent with most of the right-of-way dedications that have already been made along the corridor and doesn’t change future right-of-way dedication requirements along the majority of the corridor.

Natural water features:
Segment 2 currently has a two-lane bridge crossing Beaverton Creek that runs through Tualatin Hills Nature Park, with a number of utility pipes also crossing alongside the bridge. In order to make any improvements to segment 2, including widening or adding bicycle or pedestrian facilities, the bridge will need to be replaced and utilities relocated. Improving the bridge in segment 2, however, will provide the opportunity to enhance the riparian corridor connection of Beaverton Creek between the Tualatin Hills Nature Park and the greenway to the west. Segment 1 also has a wetland area abutting the corridor near the MAX crossing that may complicate the addition of right-of-way at this pinch-point.

Conceptual Plan Approach
The conceptual design includes replacing the bridge and utilities. While the proposed conceptual design does not go to the level of detail that determines treatment of natural features surrounding this natural area, it does allow for the enhancement and preservation of this natural corridor. The design anticipates repairs and upgrades of the stormwater conveyance system, with detention and treatment for all runoff, and designates four locations for detention facilities. Furthermore, the envisioned new bridge provides the potential for a wider under-crossing to enhance the riparian corridor and potentially provide a future trail under-crossing of 170th Avenue. The detention locations and facilities are described in Appendix C.

Rail crossings:
The MAX line crosses the corridor in two places – on segment 1 and segment 3. On segment 1, this crossing represents the narrowest point in the right-of-way for segment 1, and currently has no bicycle facilities. There is a mid-block crossing with a rectangular rapid flashing beacon (RRFB) that was recently constructed to the south of the light rail tracks. However, the presence of the MAX line and the stations within the study area provide an immense opportunity to increase multi-modal movement in the study corridor. People traveling to and from the MAX stations can already do so via bicycle or on foot; with enhanced multi-modal facilities, even more will be encouraged to do so. In addition, bus service is ultimately planned to run on segments 2 and 3, and this will expand transit service coverage in the neighborhood to further enable residents to make non-single-occupant-vehicle mode choices.

Conceptual Plan Approach
The conceptual plan provides high-quality bicycle and pedestrian facilities and connections throughout the corridor, increasing the ability of people to access the MAX stations safely using these modes of travel. The plan also designates potential future enhanced crossing locations, particularly at bus stops, to facilitate the safe access and use of the bus transit service in the corridor.
Tualatin Hills Nature Park:
Currently the park has many old trees growing adjacent to the property line, with branches overhanging the side of the road (on segment 2), creating an appealing aesthetic, which may make it difficult to widen the roadway to include the facilities designated in the Transportation System Plan. Also, the park is bounded by a tall fence, with only two entrances on the western side of the park, and no marked crossing areas to access the park from neighborhoods to the west, decreasing its accessibility to the residents. However, a redesign of the walking and bicycling facilities along the study corridor has the potential to substantially enhance community access to the park, already an immense asset in the community.

Conceptual Plan Approach
The conceptual plan does not require right-of-way acquisition from Tualatin Hills Park and Recreation District (THPRD); however, the natural features of the park currently extend into the County’s right-of-way. It is anticipated that some trees will be impacted by the roadway widening.

The conceptual plan provides complete pedestrian and bicycle facilities as well as potential crossing locations that will increase ease of access to the park.

On-street bicycle and pedestrian facility connections with regional trail network:
The study area is surrounded by Washington County’s existing and planned network of paved multi-use trails, including the Waterhouse Trail, Vine Maple Trail, Beaverton Creek Trail, and Westside Trail. The redesign of the study corridor presents an opportunity to provide added connectivity to these trails and enhance access to adjacent land uses through protected on-street bicycle and pedestrian facilities.

Conceptual Plan Approach
The bicycle and pedestrian facilities in the conceptual plan are designed to offer the level of comfort and protection that will welcome users of varying levels, similar to the multi-use trail network that surrounds the study area. The facilities proposed on 170th Avenue and Merlo Road will add connectivity to this network.

SW 170th Avenue/SW Merlo Road Intersection:
The SW 170th Avenue/SW Merlo Road intersection represents a future challenge and an opportunity. Existing and forecast vehicular traffic patterns and plans indicate that the segment 2 and segment 3 portions of the study corridor will carry much of the north/south demand. In addition, pedestrian and bicyclist demand is likely to increase moving through the intersection in all directions, especially considering the increasing levels of development in the vicinity. The 170th Avenue/Merlo Road intersection will need to be thoughtfully designed to provide enhanced safety and comfortable movement of all modes through the intersection. The intersection presents the opportunity to consider innovative bicycle crossing treatments, a roundabout, or other potential design ideas.

Conceptual Plan Approach
The conceptual plan includes two potential future intersection designs. The preferred design is a roundabout at the 170th Avenue/Merlo Road intersection, designed with full multi-modal facilities. An alternate intersection design is also included for a signalized intersection at 170th Avenue/Merlo Road that includes innovative treatments for the movement of bicyclists.
Development of Solution Alternatives

Drawing on this knowledge, the project team developed a set of possible solutions for design of the multi-modal transportation facilities in the corridor. Each of the possible solutions relied on the Transportation System Plan designations for functional classification and number of lanes. Therefore, all of the potential solutions assumed one vehicle travel lane in each direction along with a center turn lane for the northern segment of 170th Avenue, and each assumed two vehicle travel lanes in each direction (and a center turn lane or median) for the southern segment of 170th Avenue and Merlo Road.

The primary difference between the three potential solutions is in how they provide facilities for bicyclists and pedestrians. Washington County and other jurisdictions within the Portland metropolitan region have relatively high levels of walking and bicycling compared to other regions in the United States, and this region has been at the forefront of providing innovative facilities that allow safe and comfortable travel for these modes. Washington County has a Bicycle Facility Design Toolkit that provides guidance on bicycle facility types for different context, and the project team drew on this guide and others in considering design solutions for the 170th Avenue and Merlo Road corridors. A number of potential design solutions for pedestrian and bicycle facilities are shown in the following pages:

Other treatments considered, such as crossing treatments, transit stop treatments, and green streets/stormwater treatments, are outlined in Appendix D the Solution Alternatives Memorandum. The three solution alternatives are shown in the following pages.

Facilities Serving Pedestrians

Standard Sidewalk (5 feet)

Sidewalks are the fundamental building block enabling comfortable, convenient and safe walking access from place to place. They also provide an important means of mobility for people with disabilities, families with strollers, and others who may not be able to travel on an unimproved roadside surface. An unobstructed five-foot sidewalk provides the minimum width necessary to provide this functionality.

Wider Sidewalk (6-20 feet)

Already in use along parts of the corridor, a wider sidewalk allows for comfortable side-by-side walking, would allow two people in wheelchairs to pass each other, and provides space for other elements to enhance the pedestrian realm, such as street furniture, signage, art installations, building frontage elements, and bicycle parking. Wider sidewalks are particularly appropriate in areas of high pedestrian traffic, commercial, or mixed use areas.

Multi-Use Trail

In some locations, a paved, bi-directional multi-use trail can serve both pedestrians and bicyclists for a lower cost and using less right-of-way. A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 feet or greater should be considered in areas with moderate to high levels of bicycle and pedestrian traffic due to the potential for conflicts between these modes. In these cases, pavement markings can be used to separate trail users.

Other treatments considered, such as crossing treatments, transit stop treatments, and green streets/stormwater treatments, are outlined in Appendix D the Solution Alternatives Memorandum. The three solution alternatives are shown in the following pages.
Facilities Serving Bicyclists

Standard bicycle lane (6 feet)
Bicycle lanes are on-street facilities that provide designated spaces for bicycles, separated from vehicles by pavement markings. Bicycle lanes are generally used on collector and arterial streets with vehicular travel volumes and speeds that make it difficult for drivers and bicyclists to share the road. A bicycle lane can consist of 8-inch white striping with a bicycle symbol, and it can be filled with a solid paint color, typically green to emphasize conflict zones.

One-way Cycle Tracks
Cycle tracks, also known as separated bicycle lanes or protected bicycle lanes, are exclusive bikeways located within or directly adjacent to the roadway, but physically separated from motor vehicle traffic, parking lanes and sidewalks. Physical separation can be provided by a variety of design elements, including parked cars, bollards, curbs, surface mounted tubular markers, or planters. Cycle tracks can be constructed at street-level, sidewalk-level, or between the two.

Buffered Bicycle Lane
Buffered bicycle lanes are on-street lanes that include an additional striped width of typically 2-3 feet ("buffer") between the bicycle lane and the vehicle travel lane and/or the vehicle parking lane. Buffered bicycle lanes can be particularly appropriate on streets with high vehicle speeds, high vehicle volumes, or relatively frequent parking turnover. A buffer between parking and the bicycle lane can help decrease the risk of bicyclists being “doored” when drivers open their doors to exit parked vehicles.

Two-way Cycle Track
Two-way cycle tracks, similar to one-way cycle tracks, are also physically separated from vehicle lanes, parking lanes, and sidewalks. However, they carry bi-directional bicycle travel, and therefore are generally installed on only one side of the roadway. Two-way cycle tracks are applicable in situations when right-of-way is limited, driveways and accesses are infrequent, and/or when connecting to an off-street multi-use trail.

Multi-Use Trail
In some locations, a paved, bi-directional multi-use trail can serve both pedestrians and bicyclists for a lower cost and using less right-of-way. A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 feet or greater should be considered in areas with moderate to high levels of bicycle and pedestrian traffic due to the potential for conflicts between these modes. In these cases, pavement markings can be used to separate trail users.

Interim Shoulder (6 feet)
A paved 6-foot shoulder is often used in rural areas to provide a space for pedestrians and bicyclists. In Washington County, design standards specify that a 6-foot shoulder is appropriate as an interim treatment on urban streets prior to full construction of the roadway.
SEGMENT 1 - ALTERNATIVE 1

SEGMENT 2 - ALTERNATIVE 1

SEGMENT 3 - ALTERNATIVE 1

Alternative 1 is focused on building and connecting the multi-use path network to serve bicycle and pedestrian needs. This alternative includes multi-use paths on both sides of segment 3 (Merlo Road), enabling pedestrians and bicyclists to choose the side of the road that best connects their trip based on their origin and destination. The path on the south side of Merlo Road would minimize crossings for people traveling on 158th Avenue / Merlo Road / 170th Avenue. Likewise, users would be able to easily connect their trip from the Waterhouse Trail to the planned Beaverton Creek Trail using the multi-use path on the north side of Merlo Road. This option takes advantage of the existing crossing location at the 158th Avenue MAX station to connect the multi-use paths, and provides a high level of separation for bicyclists of various levels. On segment 2, Alternative 1 includes a multi-use path connection on the east side of the roadway as well as standard or buffered on-street bicycle lanes to serve bicyclists more comfortable riding adjacent to motor vehicle traffic. Segment 1 includes on-street bicycle lanes. Alternative 1 would require a multi-use path crossing at 170th Avenue/Augusta Lane to connect to the Beaverton Creek Trail and crossings of the north and west legs of the 170th Avenue/Merlo Road intersection.
Alternative 2 provides one-way cycle tracks and sidewalks on both sides along each of the corridor segments. The full separation of facilities (between motorized vehicles, bicycles, and pedestrians) provides each user type with clear dedicated space. Depending on the type of separation from motor vehicle traffic, one-way cycle tracks can provide a level of comfort that attracts a wide range of bicycle users. This alternative provides bicycle operation similar to standard bicycle lanes, and results in a configuration that meets driver and bicyclist expectation. In the one-way cycle track configuration, the 170th Avenue/Merlo Road intersection could include two-stage left-turn bicycle boxes to facilitate bicycle left-turn movements. The Merlo Road/Jenkins Road intersection would need to be designed to allow southbound bicyclists on the Westside Trail (on the east side of 158th Avenue) to cross over to the trail, or southbound cycle track, on the west and north side of Merlo Road. Alternative 2 would also require the design of a crossing or left turn treatment at 170th Avenue/Augusta Lane for northbound bicyclists to connect to the future Beaverton Creek Trail.
ALTERNATIVE 3: Two-Way Cycle Tracks

Alternative 3 proposes two-way cycle tracks and sidewalks to connect the planned and existing multi-use path network. 170th Avenue south of Merlo Road (segment 2) has a two-way cycle track on its east side adjacent to the Tualatin Hills Nature Park. This cycle track connects with another two-way cycle track on the south side of Merlo Road, which provides connections to the Westside and Waterhouse Trails. This two-way cycle track would provide a protected on-street connection for the Westside Trail that would allow users to avoid crossing the Merlo Road/158th Avenue intersection twice. Alternative 3 includes standard or buffered bicycle lanes on the opposite side of the roadway to serve bicyclists riding at a higher speed and who are more comfortable riding adjacent to motor vehicle traffic. The bicycle-specific design elements of the 170th Avenue/Merlo Road intersection will vary depending on the intersection configuration selected, but could include bicycle signals or two-stage left-turn bicycle boxes. In addition, Alternative 3 would require a bicycle crossing at the 170th Avenue/Augusta Lane intersection in order to provide a connection to the planned Beaverton Creek Trail.
Solution Alternatives Comparison

<table>
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<tr>
<th>Solution Alternative 1</th>
<th>Solution Alternative 2</th>
<th>Solution Alternative 3</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>Provides high level of connectivity for existing and planned multi-use path system in vicinity, both north and south of Merlo Road.</td>
<td>Does not provide separate dedicated facilities for pedestrians and bicyclists, but combines them on multi-use paths. At moderate-to-high volumes, potential conflicts and delay for users may result.</td>
<td>Offers the potential to connect planned and existing multi-use paths via an on-street protected two-way facility.</td>
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<td>Provides high level of separation between bicycles and motor vehicles, which can attract bicyclists of various levels.</td>
<td>More confident commuter cyclists may prefer on-street facilities, where they can travel at higher speeds and have the option to make turning movements as motor vehicles do (as opposed to a two-stage turn, which introduces more delay).</td>
<td>May require less right-of-way width than one-way cycle tracks, due to the need for only one buffer between the cycle track and motor vehicle travel lanes.</td>
</tr>
<tr>
<td>Provides a facility on the west side of 170th Avenue in front of Beaver Acres Elementary School.</td>
<td>May require the most width, due to providing a buffer from motor vehicle traffic on both sides of the roadway.</td>
<td>Two-way cycle tracks require one direction of bicycle travel in a direction counter to motor vehicle traffic, which motorists may not expect (at least initially). Intersection turning movements must be carefully controlled to ensure safe crossings for both directions of travel.</td>
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<tr>
<th>Multi-use Trail System (Alternative 1)</th>
<th>One-way Cycle Tracks along Both Sides (Alternative 2)</th>
<th>Two-Way Cycle Tracks (Alternative 3)</th>
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<tbody>
<tr>
<td>Provides high level of connectivity for existing and planned multi-use path system in vicinity, both north and south of Merlo Road.</td>
<td>• Separate space for each user type (pedestrian, bicycle, motor vehicle), which can provide a high level of comfort for a range of both bicyclists and pedestrians.</td>
<td>• Offers the potential to connect planned and existing multi-use paths via an on-street protected two-way facility.</td>
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<tr>
<td>Provides high level of separation between bicycles and motor vehicles, which can attract bicyclists of various levels.</td>
<td>Operationally similar to standard bicycle lanes, meeting driver expectations.</td>
<td>• May require less right-of-way width than one-way cycle tracks, due to the need for only one buffer between the cycle track and motor vehicle travel lanes.</td>
</tr>
<tr>
<td>Provides a facility on the west side of 170th Avenue in front of Beaver Acres Elementary School.</td>
<td>Intersection design can provide option for two-stage turning movements and/or for “early exit” of the cycle track to position for turns.</td>
<td>Two-way cycle tracks require one direction of bicycle travel in a direction counter to motor vehicle traffic, which motorists may not expect (at least initially). Intersection turning movements must be carefully controlled to ensure safe crossings for both directions of travel.</td>
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<tr>
<th>North 170th Avenue (Segment 1) Considerations</th>
<th>South 170th Avenue (Segment 2) Considerations</th>
<th>Merlo Road (Segment 3) Considerations</th>
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</thead>
<tbody>
<tr>
<td>A multi-use trail could be considered for segment 1, but is not proposed for several reasons. North of Baseline, 170th has bicycle lanes on both sides of the road, so the multi-use path would need to transition. A multi-use path on segment 1 would not substantially enhance connectivity of the trails network. Instead, standard or buffered bicycle lanes are included for segment 1, with crossing treatments provided at 170th Avenue/Merlo Road to transition from multi-use paths to the bicycle lanes.</td>
<td>One-way cycle tracks would need to be designed to provide sufficient opportunities for bicyclists to cross 170th Avenue or make left turn movements (e.g., turns into the neighborhoods for northbound bicyclists).</td>
<td>A two-way cycle track could be considered for segment 1, but is not proposed for several reasons. North of Baseline, 170th Avenue has bicycle lanes on both sides of the road, so the two-way cycle track would need to transition to facilities on each side of the road. A two-way cycle track on segment 1 would not provide a connection between existing or planned multi-use paths (as it would in segment 3). Instead, standard or buffered bicycle lanes are included for segment 1, with crossing treatments provided at 170th Avenue/Merlo Road to transition from the two-way cycle tracks to the bicycle lanes.</td>
</tr>
<tr>
<td>On segment 1, which has lower traffic volumes than segments 2 and 3, one-way cycle tracks could be designed with a vertical separation from travel lanes (at least between sidewalk and roadway level) to provide separation without adding the width of a horizontal buffer.</td>
<td>Alternative 3 could also be designed with the two-way cycle track on the west side of segment 2, adjacent to the residential neighborhoods to provide a connection from the neighborhoods to the Beaver Creek Elementary School without crossing 170th Avenue. However, a multi-use path on the east side would introduce numerous side-street crossings. Aligning the path on the east side provides a connection to the Tualatin Hills Nature Park and has a limited number of side-street crossings. The addition or one or two standard bicycle lanes could provide an option for more confident cyclists seeking to travel faster than would be safe on a multi-use path.</td>
<td>A two-way cycle track in segment 3 could provide a continuous connection between the multi-use paths on the east end of the segment and the planned multi-use path connection to the west of 170th Avenue. The addition of a standard bicycle lane on the other side of the street would allow more confident westbound cyclists to minimize their need to cross Merlo Road to access the facility.</td>
</tr>
<tr>
<td>• Provides high level of connectivity for various levels of bicyclists between the planned and existing multi-use paths, one-way cycle tracks on Merlo Road would need to be designed with a substantial level of separation from motor vehicle traffic.</td>
<td>• Intersection design can provide option for two-stage turning movements and/or for “early exit” of the cycle track to position for turns.</td>
<td>A two-way cycle track in segment 3 could provide a continuous connection between the multi-use paths on the east end of the segment and the planned multi-use path connection to the west of 170th Avenue. The addition of a standard bicycle lane on the other side of the street would allow more confident westbound cyclists to minimize their need to cross Merlo Road to access the facility.</td>
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<tr>
<th>Phasing Options</th>
<th>Multi-use Trail System (Alternative 1)</th>
<th>One-way Cycle Tracks along Both Sides (Alternative 2)</th>
<th>Two-Way Cycle Tracks (Alternative 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing bicycle facilities on one side of the roadway creates phasing options in which one side of the road could be initially constructed, with two travel lanes added to the other side in the ultimate phase.</td>
<td>With one-way cycle tracks, phasing would be more difficult, since the ultimate location of the facilities would need to accommodate the full width of the 5-lane roadway between them. In an interim phase, both cycle tracks could be provided, with one later removed when the roadway is widened; or, one cycle track could be constructed on one side, with an interim 6-foot shoulder provided on the other side.</td>
<td>Providing bicycle facilities on one side of the roadway creates phasing options in which one side of the road could be initially constructed, with two travel lanes added to the other side in the ultimate phase.</td>
<td></td>
</tr>
</tbody>
</table>
First Round of Meetings and Public Outreach

In November 2014, the project team met with the PAC and held a public workshop to get input and feedback on the various facility types and solution alternatives. PAC members and attendees of the public workshop considered a variety of bicycle and pedestrian facility types for each of the three corridor segments.

Summary of Input

Pedestrians
As shown in the table (at right), responses indicate strong consensus that the entire corridor warrants more than standard width sidewalks and that segment 2 has the most need for buffer for pedestrians from the vehicle travel lanes.

Bicycles
The strongest support for multi-use trails was for application on segment 2.

Multi-use trails had equal support to buffered bicycle lanes and one-way cycle tracks combined for segments 1 and 3, indicating a split for these segments between an on-street or off-street (multi-use trail) facility.

Segment 1 was the only segment with more than one vote for a standard bicycle lane, indicating that some people feel standard bicycle lanes (largely existing in this segment) are adequate.

<table>
<thead>
<tr>
<th>Corridor Segments</th>
</tr>
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<tbody>
<tr>
<td>1</td>
</tr>
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<td>3</td>
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<table>
<thead>
<tr>
<th>PAC Meeting #1 Facility Type Exercise Results</th>
<th>Segment 1 (170th Ave North)</th>
<th>Segment 2 (170th Ave South)</th>
<th>Segment 3 (Merlo Rd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Sidewalk</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wider Sidewalk</td>
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<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Multi-Use Trail</td>
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<td>7</td>
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</tr>
<tr>
<td>Interim Shoulder</td>
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<td>1</td>
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<tr>
<td>Bicycles</td>
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<td></td>
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<tr>
<td>Standard Bicycle Lane</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Buffered Bicycle Lane</td>
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<td>2</td>
</tr>
<tr>
<td>One-way Cycle Track</td>
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<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Two-way Cycle Track</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Multi-Use Trail</td>
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<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Interim Shoulder</td>
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<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Public Workshop #1 Facility Type Exercise Results

<table>
<thead>
<tr>
<th></th>
<th>Segment 1 (170th Ave North)</th>
<th>Segment 2 (170th Ave South)</th>
<th>Segment 3 (Merlo Rd)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pedestrians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>Wider Sidewalk</td>
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<tr>
<td>Multi-Use Trail</td>
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<td>15</td>
<td>6</td>
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<tr>
<td>Interim Shoulder</td>
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<td>1</td>
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</tr>
<tr>
<td><strong>Bicycles</strong></td>
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<tr>
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<td>Buffered Bicycle Lane</td>
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<tr>
<td>Two-way Cycle Track</td>
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<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Multi-Use Trail</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Summary of Input

Pedestrians
As shown in the table (at left), more votes were cast for facility types in segment 2 than other segments. This indicates that some people only voted for segment 2, which may indicate it is their main concern in the corridor. Some participants would like to have multi-use trails on all segments.

Because multi-use trail was not a strong preference for bicycling treatments (see below), the pedestrian results for multi-use trail may indicate a desire for pedestrians to have separation from traffic.

Bicycles
More votes were cast for facility types in segment 2 than other segments. This indicates that some participants only voted for segment 2, which may indicate it is their main concern in the corridor.

Segment 3 responders had a strong preference for buffered bicycle lanes. Responses on segment 2 also showed a strong preference for buffered bicycle lanes along with some support for one-way cycle tracks and multi-use trails. The combination of responses for buffered bicycle lanes and one-way cycle tracks shows a strong preference for facilities separate from pedestrians and not set-back from the roadway.
Members of the public also provided input on the three solution alternatives. People were able to indicate their preferred alternative and provide comments and ideas for refinement. Appendix E includes a summary of the PAC and Public Workshop #1.

Public Workshop #1 Corridor Alternative Exercise Results

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1 (Expanded Multi-Use System)</th>
<th>Alternative 2 (One-way Cycle Tracks)</th>
<th>Alternative 3 (Two-Way Cycle Tracks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Choice Votes</td>
<td>6</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>2nd Choice Votes</td>
<td>7</td>
<td>15</td>
<td>5</td>
</tr>
</tbody>
</table>

Summary of Input

Alternative 2 had more 1st Choice votes than Alternative 1 and 3 combined.

The 1st Choice votes for Alternatives 1 and 3 may have split the vote of people interested in a two-way facility, with about half preferring separation from pedestrians that the two-way cycle track in Alternative 3 offers.
Development of Preferred Alternative

Following the initial round of meetings the project team worked to incorporate the feedback from the PAC and the public to develop a preferred conceptual design. Based on this feedback and the information gathered in the initial research and assessment of the corridor, the PMT made the decision to move toward a preferred concept design that includes buffered bicycle lanes or one-way cycle tracks throughout the corridor with a wide, landscape-buffered sidewalk or path on one side of the corridor and a standard-width buffered sidewalk on the opposite side. The PMT determined that the buffer widths and facility widths may vary slightly in different parts of the corridor to minimize impacts where right-of-way is limited, but provide more generous facility widths where right-of-way allows.
**Second Round of Meetings and Public Outreach**

In the second round of outreach, the project team presented an initial draft layout of the preferred conceptual design and requested more detailed input and feedback along the corridor. This allowed the project team to benefit from the detailed local knowledge of the stakeholders and community members that live or work in the areas surrounding the corridor and regularly travel on the facilities in the study area. The project team also sought input on potential future design options for the intersection of 170th Avenue and Merlo Road.

This intersection presents unique design challenges in the future for a number of reasons:

- Future traffic volumes are projected to grow, with a higher portion of vehicular traffic traveling between Merlo Road and the southern segment of 170th Avenue (segments 2 and 3) than there is today.
- With the widening of Merlo Road and the southern segment of 170th Avenue to five lanes, the intersection will be the transition point from one travel lane in each direction on the north and west legs to two travel lanes in each direction on the south and east legs.
- Beaver Acres Elementary School is immediately adjacent to the intersection, necessitating careful consideration of crossings and travel of children via walking and biking modes surrounding the intersection.
- There is a need to provide safe and comfortable intersection design for bicyclists, given that the enhanced bicycle facilities will likely serve riders of varying levels of comfort and abilities.
- The intersection of Augusta Lane and 170th Avenue may need a signal or enhanced pedestrian crossing in the future, and the close proximity of this intersection and 170th Avenue/Merlo Road can create operational challenges.
- 170th Avenue has a number of accesses on the east side south of the 170th Avenue/Merlo Road intersection, some of which may be reconfigured in the near future.

The project team presented a set of potential intersection design solutions, including a redesigned signalized intersection and a roundabout and gathered input on these two configurations. Members of the PAC and participants in the public workshop were fairly evenly split in their preferences for a roundabout versus a signalized intersection at this location. Many people expressed a desire for a signal at Augusta Lane and 170th Avenue.

*Appendix F contains the Community Outreach Summary Report, including a summary of the comments received at the PAC Meeting and Public Workshop #2.*

**Revisions to Preferred Conceptual Design and Additional Options**

In consideration of the second round of input from the public and members of the PAC, the project team conducted a more detailed round of analysis with a focus on the area surrounding the intersection of 170th Avenue/Merlo Road. The analysis included:

- An assessment of potential additional pedestrian crossing locations along the corridor, to enable people to safely cross to bus stops and to travel between destinations and access points on opposite sides of the corridor.
- An assessment of other intersections along the corridor to determine whether additional traffic signals are likely to be warranted in the future.
- An assessment of traffic operations, including vehicular delay and queuing, at 170th Avenue/Merlo Road and 170th Avenue/Augusta Lane for both the roundabout and for a signalized intersection.

Based on the previous analysis, the input from the PAC and public, and results of the additional operational analysis, the project team determined that the preferred conceptual design would include a roundabout. However, a signalized intersection would also fulfill the objectives of the corridor and could be considered in future design phases.

**Final Conceptual Design and Next Steps**

The last phase of the planning process produced the final conceptual design, as presented in Chapter 3. Chapter 4 includes other design options that can be considered in the upcoming design phases for the corridor.

The full analysis is available in Appendix G, the Transportation Analysis Memorandum.
The proposed conceptual design presented in the following pages is the result of a thorough planning process over the course of the past year, including an assessment of existing conditions, development of potential alternatives, public involvement, and technical analysis. The conceptual design meets the project objectives by:

- Providing separated, comfortable facilities for walking and bicycling along the corridor to encourage use of these modes by people of all ages and skill levels and reduce reliance on the automobile for local travel.
- Recommending locations for providing designated crossings for pedestrians and bicyclists in order to improve connectivity to the surrounding trail system and land uses and improve access to bus transit along the corridor.
- Proposing adjustments to vehicle lane widths to minimize right-of-way impacts while providing adequate vehicular capacity for future travel demands.
- Using a design speed of 35 mph, lower than the 45 mph typical design speed for County arterials.
- Creating the opportunity to enhance the natural features along the corridor and the riparian corridor that intersects 170th Avenue.
- Providing enhanced access to the MAX light rail stations and offers design solutions for bus stops along the corridor that are comfortable for bus drivers, bus riders, and bicyclists.

One of the objectives of the project was to explore project phasing options that could deliver pedestrian/bicycle facilities in advance of planned roadway widening. Phasing was considered in the development of the alternatives and the preferred alternative; however, the placement of one-way cycle tracks on each side of the roadway makes phasing difficult and does not offer the possibility to construct a two-way bicycle facility on one side of the roadway prior to the full widening. However, the proposed design does offer other phasing opportunities for incrementally enhancing the pedestrian and bicycle facilities:

- Improvements can be done by segment, without having to fund the full corridor improvements at the same time. Segment 1 requires relatively minor changes and improvements compared to its existing condition. Segment 2 would be the most costly to construct, due to the need to replace the bridge. Segment 3 (Merlo Road) could be done at a different time than the other segments.
- There is a possibility of constructing a sidewalk and cycle track on one side of the roadway prior to full widening to improve pedestrian access. However, the provision of a bicycle facility on only one side of the roadway could invite two-way bicycle travel on a facility not designed for two-way travel, and may result in crossing movements not anticipated under the full design.

- Segment 3 currently has one travel lane in each direction and a two-way left turn lane in the center. Five foot bicycle lanes could be added to this segment in the near term through re-striping, without moving the existing curbs. Re-striping would result in a cross section with 5-foot bicycle lanes, 11-foot travel lanes, and a 12-foot two-way left turn lane or center median.

Appendix H contains a planning-level cost estimate for implementing the preferred conceptual design on Segment 2.
### Proposed Conceptual Design

**Washington County, Oregon**

Three lane cross section with bicycle lanes/buffered bicycle lanes and sidewalks.

Five lane cross section with cycle tracks and sidewalks.

The proposed design enhances pedestrian and bicycle access to MAX stations.

A water quality/detention pond is necessary in this area to treat the impervious surface on 170th Avenue between Merlo Road and Baseline Road. Because it is located in a wetland area, the facility will need to be under the roadway or the wetlands will need to be mitigated.

On-street parking is proposed on the west side of 170th Avenue in this area to support a potential future mixed-use redevelopment with storefront retail.

While a signal is not currently warranted at this location, signal warrants should be monitored as volumes change.

Crossing location needs to be monitored to assess need for enhancements.

It is likely that enhanced crossing treatments will be needed at this location as pedestrian volumes increase.

While a signal is not currently warranted at this location, signal warrants should be monitored as volumes change.

The proposed roundabout at the intersection of 170th Avenue/Merlo Road is a multi-lane roundabout that will accommodate traffic volume forecasts and is designed to reduce approaching vehicle speeds to less than 25 miles per hour. The roundabout design has a lower maintenance cost than a traffic signal and has fewer conflict points for vehicles. The proposed roundabout design also offers benefits for pedestrians and bicyclists. Bicyclists can choose to enter the widened sidewalk approaching the intersection and use the pedestrian crossings. The crossings are split with refuge islands, so pedestrians or bicyclists using the sidewalks only need to cross one direction of traffic at a time. Each leg of the roundabout has a designated crossing. More confident bicyclists can also choose to enter the vehicle travel lane approaching the roundabout and navigate through the intersection as a vehicle would. Because vehicular speeds are slowed coming into the roundabout, this option can be comfortable for some bicyclists.

It is likely that enhanced crossing treatments will be needed at this location as pedestrian volumes increase.
A water quality/detention pond is necessary in this area to treat the impervious surface on 170th Avenue corridor between Alexander Street and Merlo Road.

Converting Vendla Park Lane to a right-in right-out access could allow for reduction of the median for a greater distance, resulting in reduced costs and right-of-way needs.

The proposed design does have impacts to some of the mature trees lining the Tualatin Hills Nature Park that are currently located within the right-of-way. The design in these locations can consider pervious sidewalk or bicycle facility treatments to ensure the health of trees that remain in close proximity to the street.

The 2013 Tualatin Valley Highway Corridor Plan calls for additional turn lanes at this intersection. These features are not included in the conceptual design and require further study.

The proposed design ties in with the existing cross section of 170th Avenue just north of Alexander Street.

Crossing to nature park trail needs to be monitored to assess need for enhancements.

Reconstruction of the bridge could allow for the potential of a pedestrian under-crossing and enhancements to the existing riparian corridor along Beaverton Creek, which is also a crossing area for animals.

It is likely that enhanced crossing treatments will be needed at this location as pedestrian volumes increase due to the nature park trail and potential future bus stop.

Five lane cross section with cycle tracks and sidewalks.

The proposed design does have impacts to some of the mature trees lining the Tualatin Hills Nature Park that are currently located within the right-of-way. The design in these locations can consider pervious sidewalk or bicycle facility treatments to ensure the health of trees that remain in close proximity to the street.

Converting Vendla Park Lane to a right-in right-out access could allow for reduction of the median for a greater distance, resulting in reduced costs and right-of-way needs.

The proposed design ties in with the existing cross section of 170th Avenue just north of Alexander Street.
Washington County, Oregon

**Five lane cross section with cycle tracks and sidewalks**

A water quality/detention pond is necessary in this area to treat the impervious surface on Merlo Road corridor between 170th Avenue and approximately 1200 feet north of Merlo Court (crest point of Merlo Road).

Crossing location needs to be monitored to assess need for enhancements.

Median could be reduced between Merlo Court and the bus garage to save costs, reduce right-of-way needs, and minimize tree impacts.

Proposed design provides a connection to and from 170th Avenue to the regional trail network.

A water quality/detention pond is necessary in this area to treat the impervious surface on Merlo Road corridor between the street crest point and Jenkins Road.

The proposed design ties in with the current 158th Avenue County improvement project.

While a signal is not currently warranted at this location, signal warrants should be monitored as volumes change.

The proposed design enhances pedestrian and bicycle access to MAX station.

Retaining wall may be needed in this area.

A water quality/detention pond is necessary in this area to treat the impervious surface on Merlo Road corridor between 170th Avenue and approximately 1200 feet north of Merlo Court (crest point of Merlo Road).
The conceptual design presented in Chapter 3 represents the preferred alternative resulting from the planning process. However, additional details and considerations are often uncovered in the more detailed design phase.

The project team did consider alternative configurations for the 170th Avenue/Merlo Road intersection, in addition to the roundabout shown in the proposed conceptual design. These alternatives include a signalized intersection, shown here, and a different potential roundabout alignment, shown in Appendix I.

The proposed lane configuration for the signalized alternative has the outside lane on the northbound approach becoming a right-turn trap lane. The standard way to stripe a bicycle lane through an intersection is to position the bicycle lane between the through and right-turning vehicle lanes. However, the need for the bicyclist to merge across a full lane of vehicular traffic prior to the intersection creates a “Level of Traffic Stress” higher than most people feel comfortable navigating. In order to maintain a high level of comfort for bicyclists and minimize conflicts for various modes, the signalized intersection takes a different approach for bicyclist travel through this intersection.

The signalized intersection concept design provides a curb tight bicycle lane at the intersection, bicycle box pavement markings, and bicycle signal to allow bicyclists passage through the intersection on their own green phase, resulting in no vehicle conflicts with bicyclists. Furthermore, a right-turn on-red (RTOR) restriction should be considered – this restriction could be an “active” restriction, in which the RTOR restriction is only activated when cyclists are detected/present. This RTOR treatment has been used at several locations in the Portland metro area, such as at the NE Broadway and N Williams Ave in Portland and N Rosa Parks Way/I-5 Southbound Ramp Intersections. The intersection design also allows bicyclists to make a “two-stage left turn” or elect to make a vehicular left turn from the travel lanes.