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Technical Memorandum #5: Potential Solutions

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RE: OR 6: Wilson River Highway Corridor Study (HB 4053)

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This memorandum summarizes potential solutions identified for the OR 6: Wilson River Highway Corridor Study (HB 4053) (refer to as OR 6 Corridor Study). These solutions were developed to address the issues summarized in Technical Memorandum #4. The issues were identified by the Project Team based on a comprehensive review of the following items together:

- Existing conditions, as summarized in Technical Memorandum #3 (TM#3)
- Public and stakeholder input
- Corridor Issues Summary, as documented in Technical Memorandum #4 (TM#4)

The team has grouped the potential solutions into two categories:

- Corridor-wide solutions
- Location-specific solutions

Solutions are presented for each location or corridor-wide issue below, with details regarding cost estimates, anticipated safety benefits, description of challenges or considerations, and sample photos provided. Where applicable, crash information is provided to describe an issue. For additional information, readers should refer to Technical Memorandum #3: Existing Conditions and Technical Memorandum #4: Corridor Issues Summary.

Contents

MEMO OVERVIEW

The corridor-wide solutions are general solutions that can be applied at multiple locations or across the entire corridor. These potential solutions can provide solutions to issues that affect the whole corridor. The location-specific solutions are intended to address specific locations where safety issues were identified. Many of these location-specific solutions include the implementation of one or more corridor-wide solutions as well.

Crash Reduction Factor Approach

A Crash Reduction Factor (CRF) is the percent reduction in crashes that would be expected if a potential solution is implemented. The CRFs in the memorandum have been taken from the Crash Reduction Factor Appendix that ODOT maintains as a part of the All Roads Transportation Safety (ARTS) program. ODOT provides a fixed set of CRFs allowing all projects to be evaluated consistently and fairly throughout the project selection process. For solutions where no CRFs were available in ODOT's CRF Appendix or where the appendix referenced it, Federal Highway Administration's (FHWA's) Crash Modification Factors (CMF) Clearinghouse was also reviewed for CRFs to include in this memorandum.

Some potential solutions do not have an associated CRF. This means that, while the potential solution may provide safety related benefits, there is not sufficient published research to confidently quantify these benefits.

Cost Estimating Approach

This memorandum provides estimated costs for some of the potential solutions. These estimated costs are meant to be planning-level estimates and are intended to be used to understand the order of magnitude to implement the various potential solutions. There are two categories of cost estimates provided in the memorandum: corridor-wide estimates and project cost estimates. Assumptions for the two estimate types are documented below.

Corridor-Wide Cost Estimate Assumptions

The corridor-wide cost estimates were developed for potential systemic solutions that could be implemented in various locations or throughout the entire corridor. These potential solutions are likely to be implemented in combination with one another. For example, centerline rumble strips, pavement markers, and reflectors may be installed to improve delineation in a curve. The cost estimates provided are for the cost to add the potential solution to a larger project. These estimates do not include overall project costs such as mobilization, traffic control, engineering design, and more. The corridor-wide costs were developed using ODOT historical bid pricing and some basic assumptions, which are documented in Attachment A.

Location Specific Project Cost Estimate Assumptions

The project cost estimates were developed for the location specific solutions using historical ODOT bid pricing. Planning level quantities were used for each project based on the length of the project and the width of the improvements. For projects where a conceptual layout was

developed, the concept linework was used to develop site specific quantities for some construction items. Many bid item costs were developed using an assumed percentage of the overall construction cost based on historical project costs as summarized below:

- Mobilization – 10%
- Traffic Control & Construction Staging – 10%
- Removals of Structures & Obstructions – 2.25%
- Clearing and Grubbing – 2%
- Pavement Markings & Permanent Signs – 3.5%
- Illumination (intersection related projects) – 14%
- Engineering & Construction Management – 35%

The project cost estimates include a 50 percent contingency due to the projects being in a planning-level stage of development. It is recommended that the potential project solutions that are moved forward continue to refine the project scope and cost estimates prior to budgeting for or identifying funding for the respective projects.

CORRIDOR-WIDE SOLUTIONS

The issues and potential solutions summarized in this section are prevalent through much of the corridor. Many of these issues may be best addressed through systemic potential solutions, which would proactively address the issue at all locations where the conditions of risk are present rather than waiting for a crash pattern to occur. Potential solutions are presented in the following categories based on the issue addressed:

- Recreational Destinations and Communities
- Curves
- Passing Opportunities
- Roadway Conditions
- Pavement / Slope Stability Conditions
- Communications
- Risky Driving Behaviors

Recreational Destinations and Communities

The OR 6 Study Corridor provides access to many destinations along the corridor including campgrounds, hiking trails, residences, and small stores. While some of these destinations are marked, others are not well signed. The Project Team identified a correlation between crash patterns at some of these recreational destinations, including several unmarked trail heads that are used informally for hiking. Risk is present due to vehicles slowing to look for their

destination, as well as vehicles unexpectedly pulling out of these locations. Several of these locations are also located near bridges or culverts, which restricts the roadway width and recovery area for vehicles that may leave their lane or need to swerve to avoid another vehicle.

Options to reduce crash risk at destinations and communities along the corridor are summarized below. These treatments primarily focus on increasing visibility and awareness of potential destinations and encouraging slower speeds where appropriate. In locations with more dense development, such as more frequent residential driveways or commercial destinations, treatments that visually indicate drivers are entering a community and encourage slower speeds throughout the community are suggested.

Older Driver Special Rule

Due to the older population overrepresentation along the majority of the corridor, as identified in the 2020 Oregon Bicycle & Pedestrian Safety Implementation Plan, the solutions presented in this memorandum should be viewed and compared against older population representation along the corridor. When moving forward into design and/or implementation of any of the potential solutions, the future project team and/or ODOT staff should ensure consideration is given to the Older Drivers and Pedestrians Special Rule in federal transportation legislation. The rulemaking guidance can be found here: https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf.

The Older Drivers and Pedestrians Special Rule Guidance references FHWA's Handbook for Designing Roadways for the Aging Population to support implementation of the Special Rule, found here: https://safety.fhwa.dot.gov/older_users/handbook/aging_driver_handbook_2014_final%20.pdf.

01 – Delineators to Define Driveways and Intersections

Description: Install delineators at driveways/intersections.

Implementation Suggestion: Near-Term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Consider whether different colored delineators should be in use on the corridor depending on whether defining the curves, driveways, etc.

Benefits: No CRF available. The benefits include increased visibility and awareness for destinations through consistent delineation, minimizing and warning drivers of potential vehicle slow-downs or turns.

Assumptions: 100-foot spacing on approach plus additional delineators at intersection or driveway

This solution is listed in FHWA's Unsignalized Intersection Safety Strategies

Cost: $3,000 per Driveway or $5,000 per Intersection

Photo/Image Credit: City and County of Honolulu

02 – Access Management Principles

Description: Minimize conflict points along the corridor by:

- Defining access points with curb or paint;
- Encouraging appropriate use of parking areas along the side of the road;
- Increasing awareness and visibility of parking areas through signage;
- Partnering with other agencies to encourage defined parking areas near destinations (such as trailheads or retail locations)

Implementation Suggestion:
Near-Term / Long-Term

Considerations: No anticipated right-of-way, geotechnical, or environmental impacts associated with signage.

Constructing new parking areas would have potential right-of-way, environmental, or geotechnical issues.

May be difficult to implement unless the specific location has a crash pattern related to access design.

Benefits: No CRF available. The benefits include minimizing the number of potential conflict points and increasing awareness of potential conflict points.

NCHRP Report 659: Guide for the Geometric Design of Driveways[1] states that wide-open, undefined driveways lack lane definition, allowing vehicles to enter and leave such sites in random positions and are more likely to cross paths. This type of design should be avoided.

Photo/Image Credit: Example Illustrating a Defined Access on US 199

Cost: Varies depending upon length and type of treatment. For example, standard curb installation costs $50 per foot.

[1] https://nap.nationalacademies.org/catalog/14399/guide-for-the-geometric-design-of-driveways

Solution 03: Install *Consistent* Warning Signs

Description: Increase consistent signage to indicate where access locations are located and provide warning when drivers are approaching these access points. When considering additional signage, verify that the area is not oversigned (leading to visual clutter) and verify with maintenance staff their ability to maintain the signs. Specific solutions may include:

- Advance pedestrian warning signs (Solution ID 03a)
- Congestion ahead warning signs (Solution ID 03b)
- Advance intersection warning signs (Solution ID 03c)
- Installing destination signage for recreational areas or trailheads (Solution ID 03d)
- Installing street names on both sides of the road (Solution ID 03e)
- Increasing frequency of milepost signs to make it easier to locate destinations and report incidents when they do occur (Solution ID 03f)

Safety Benefits: General benefits of the increased warning signs are to increase driver awareness and reduce sudden unexpected reactions.

03a – Consistent Signage: Advance Pedestrian Warning Signs

Description: Install warning signage to notify drivers of potential upcoming pedestrian activity.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.

Benefits: CRF of 5% for all pedestrian and bicycle crashes (BP17 from ODOT CRF list)

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W11-2)

03b – Consistent Signage: Congestion Ahead Warning Signs

Description: Install warning signage to notify drivers of potential congestion ahead.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.

Benefits: No CRF available. The benefits include warning drivers of potential vehicle slow-downs in areas where delay and congestion occur often.

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W3-4)

03c – Consistent Signage: Advance Intersection Warning Signs or Advance Street Name Signs

Description: Install advance intersection warning signage or advance street name signage to notify drivers of upcoming locations and potential for vehicle slowdowns or turning movements. The setup could include flashing beacons. For advance intersection warning signage, consider including the supplemental advance street name plaque.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies .[2]

Benefits: CRF of 20% for all crashes (I21 from ODOT CRF list). This solution can be paired with other systemic intersection treatments such as stop ahead pavement markings and additional stop signs, which can increase the benefit up to 30%.

Cost: $1,500 per Sign (for a standard sized warning sign)

Assumptions: Included with larger project. Minimum 2 signs needed per intersection.

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W2-1 with W16-8P supplemental plaque)

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (D3-2 options)

[2] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

03d – Consistent Signage: Destination Signage to Recreational Parking Areas

Description: Install destination signage that points drivers to nearby parking for recreational destinations.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Partner with local stakeholders who have parking available off of OR 6 for recreational destinations.
- Additional maintenance costs will be incurred as signs are added to the corridor.

Benefits: No CRF available. The benefits include encouraging drivers to park off of the corridor and warning drivers to be aware of potential vehicle slow-downs or turning movements in the area.

Cost: $1,500 per Sign (for a typical sized sign)

Assumptions: Include with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (D4-1)

03e – Consistent Signage: Street Name Signs on Both Sides of the Street

Description: Install street name signs on both sides of the street to help inform drivers.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies [3].

Benefits: No CRF available. The benefits include increased visibility of intersections and warning drivers to be aware of potential vehicle slow-downs or turning movements in the area.

Cost: $1,500 per Sign (for a typical sized sign)

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (D3-1)

[3] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

03f – Consistent Signage: Increased Frequency of Milepost Signs

Description: Install milepost signs at a 0.5-mile interval, instead of every one mile.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.

Benefits: No CRF available. The benefits include increased location awareness to help drivers navigate to their destinations on the corridor and to support emergency calls where drivers need to relay their location to responders.

Cost: $600 per Mile

Assumptions: 1 additional sign per mile

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (D10-1a, D10-2a, and D10-3a)

04 – Reinforce Slower Speeds in Communities and Near Areas with More Destination Density

Description: Install gateway signage, speed feedback signage, and cross-section modifications to indicate to drivers that they are entering communities and encourage slower speeds. When possible, consider opportunities to reevaluate speed limits in conjunction with engineering treatments to support the slower speeds.

Implementation Suggestion: Near-term

Considerations:

- Potential right-of-way, geotechnical, or environmental impacts depending on cross-section modifications.
- Unlike a static sign, a speed feedback sign needs power to operate.
- Destinations with large widen open accesses should be evaluated to determine whether access points can be better defined with curb or paint to consolidate potential conflict points and increase awareness at those locations. See Solutions ID 01 and ID 02.
- Per ODOT staff, evaluation of speed zone changes need to occur after a change is implemented, not in anticipation. Evaluation is based on existing conditions.
- Potential locations for implementation:
    - Near MP 8 to 10
    - From Gales Creek to Shell Station

Benefits:

The treatments together support slower speeds through communities, although no CRF is available for the combined impact of treatments.

Speed feedback signs: CRF of 10% for all crashes (RD12 from ODOT CRF list)

Cost: Varies based on treatment used.

See Exhibit 1 below.
Illustration Credit: Kittelson

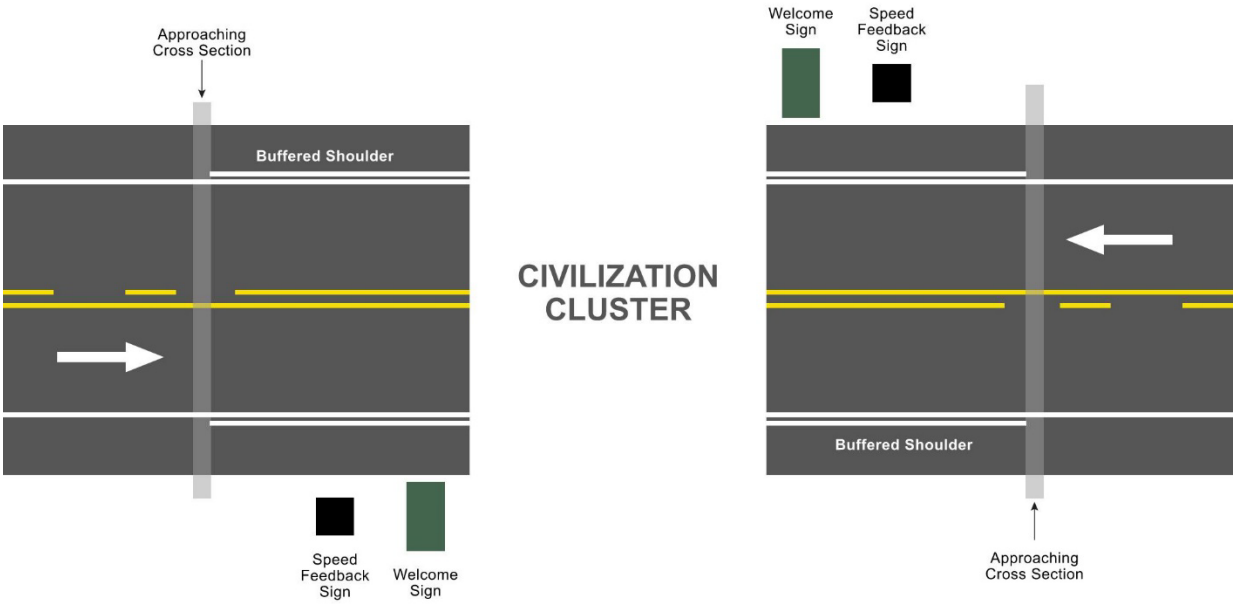


Exhibit 1. Illustration of Concept to Encourage Slower Speeds in Communities

The illustration provides examples of the concept of changing the cross-section to encourage slower speeds within a community: speed feedback signs to provide real time feedback to drivers, gateway signs informing drivers they are entering a community, buffered shoulders to narrow lanes[4] and create space for people walking and biking, and eliminating passing zones to encourage slow speeds and minimize conflicts in these areas. When possible, destinations with large wide open accesses should be evaluated to determine whether access points can be better defined with curb or paint to consolidate potential conflict points and increase awareness of these locations. Modifying accesses may be difficult to implement unless the specific location has a crash pattern related to access design.

[4] OR 6 is a reduction review route. A project reducing lane width may be required to go through the Mobility Advisory Committee (MAC).

05 – Intersection Warning System – Detect Vehicles Waiting on the Mainline

Description: Install an actuated intersection warning system for detecting vehicles waiting on the mainline at higher-volume destinations or driveways. The warning system will let drivers know that there may be a vehicle stopped ahead of them where the mainline does not have a stopped condition.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Maintenance will be costly for this kind of system.

Benefits: CRF of 13% for all crashes when install flashing beacons as advance warning at intersections (I15 from ODOT CRF list)

Cost: $45,000

Assumptions: Included with other improvements in larger project.

Photo/Image Credit: Google Earth (actuated intersection warning system on NW Cornelius Pass Road approaching NW Sheltered Nook Road intersection) (top); MUTCD, 2009 Edition, published by FHWA (bottom)

06 – Intersection Warning System – Detect Vehicles Waiting on the Side Street

Description: Install an actuated intersection warning system for detecting vehicles waiting to turn from the side street at higher-volume destinations, also known as a Through-Route Activated Warning System (TRAWS). The warning system will let drivers know that there may be conflicting turning movements occurring.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Maintenance will be costly for this kind of system.

Benefits: CRF of 27% for all crashes (I26 from ODOT CRF list)

Cost: $95,000

Assumptions: Included with other improvements in larger project.

Photo/Image Credit: fhwa.dot.gov

07 – Improve Intersection Sight Distance

Description: Increase triangle sight distance at intersections to help drivers better see oncoming traffic when turning onto OR 6.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Potential need to work with property owners.
- Additional maintenance cost to visit corridor more times per year.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies [5].

Benefits: CRF of 48% for all injury crashes (I17 from ODOT CRF list)

Cost: Solution cost dependent on specific project. Costs could range from low cost such as trimming trees or relocating minor obstacles to high cost for tree or fence removal or changes in geometry at intersection.

Photo/Image Credit: Google Map. Good Sight Distance at Randle Corner Road and OR6. Street View. Retrieved April 6, 2023.

[5] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

08 – Left Turn Lanes

Description: Install left turns lanes at key locations that meet ODOT guidance.

Implementation Suggestion: Long-term

Considerations:

- Likely right-of-way, geotechnical, and environmental impacts assuming roadway widening would be necessary to install a turn lane.
- Location specific recommendations at Gales Creek Road (see pg. 80) include a left-turn lane.
- One additional potential location for evaluation based on public input is Beaver Dam Road.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies.[6]

Benefits: CRF of 44% for all crashes (install left turn lane on single major road approach of 3-leg unsignalized intersection) (H9 from ODOT CRF list)

Cost: Varies based on scope of project. Solution would require widening which would likely result in significant project cost.

Photo/Image Credit: Google Maps

[6] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

Curves

Horizontal curves are common throughout the corridor. A review of the crash data shows that several sites with high crash frequency and severity are located within horizontal curves. The segment MP 31 to 35 has a high concentration of crashes and is addressed under the location-specific section. Roadway departure crashes were most commonly observed within horizontal curves. In addition to the presence of curves, several other factors that may increase risk are also present in many of these locations including:

- Vertical grade and substandard superelevation
- Snow, ice, and wet pavement conditions
- Passing lanes located within curves
- Pull-outs located within curves with limited sight distance

Potential options to reduce the risk of crashes in horizontal curves are summarized below.

09 – Delineators Along Curves

Description: Install delineators on both sides of the roadway along a curve to better define the roadway during dark conditions. This solution may include adding delineators on existing guardrail.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Curves with existing traffic barriers (e.g., guardrails) may be good initial candidates to add posts to the traffic barriers.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies.[7]

Benefits: CRF of 30% for curve crashes at night (RD14 from ODOT CRF list)

Cost: $9,500 per Curve Location

Assumptions: For 40-foot spacing along the average curve length of 3,650 feet

Photo/Image Credit: safety.fhwa.dot.gov

[7] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

10 – Shoulder Rumble Strips

Description: Install rumble strips along the outside of the trave lane to inform drivers if they leave the roadway.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Shoulder rumble strip locations would need to be reviewed for adequate shoulder width and proximity to residences.

Benefits: CRF of 22% for run-off-the-road crashes (RD18 from ODOT CRF list)

Cost: $4,500 per Mile (both sides of the road)

Assumptions: Does not include any required paving with installation.

Photo/Image Credit: safety.fhwa.dot.gov

11 – Centerline Rumble Strips

Description: Install rumble strips along the centerline of the roadway to inform drivers if they enter the travel lane for opposing traffic. Install along no pass zones as well as curves.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Centerline rumble strip locations would need to be reviewed for proximity to residences.

Benefits: CRF of 12% for all injury crashes in rural areas (RD16 from ODOT CRF list) or CRF of 45% for head on and sideswipe meeting injury crashes in rural areas (RD17 from ODOT CRF list)

Cost: $2,500 per Mile

Assumptions: Does not include any required paving with installation

Photo/Image Credit: fhwa.dot.gov

12 – Modify Roadway Curves

Description: Flatten or modify curves.

Implementation Suggestion: Long-term

Considerations:

- Likely right-of-way, geotechnical, and/or environmental impacts.
- Costs to modify or flatten curves on the OR 6 corridor may be prohibitive, especially due to likely geotechnical impacts in areas of existing slope instability.

Benefits:

CRF of 15-78% for all crashes
(H43 from ODOT CRF list)

CRF of 68.5% for all crashes
(9525 from CMF Clearinghouse)

Cost: Varies based on treatment and scope, but would be on the scale of typical Statewide Transportation Improvements Program (STIP) projects.

This solution would need to be completed at limited locations in conjunction with other projects focusing on addressing slope stability as well.

Photo/Image Credit: Kittelson

Solutions Already Implemented for Curves:

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Install curve warning signs: ODOT recently completed an inventory, conducted a ball-bank assessment, and updated the curve warning signs.
- Install overhead curve warning signs: ODOT recently completed an inventory and updated the curve warning signs.

Passing Opportunities

Passing opportunities (including passing lanes and climbing lanes) are associated with crash risk when short passing or climbing lanes are located in areas with horizontal curves, limited sight distance, and presence of other potential conflicts such as driveways or intersections. This section focuses on solutions that provide a separate space for passing and does not include evaluating passing within 2-lane sections. Passing zones where passing is allowed by using the opposing lane were not evaluated because these are determined by roadway geometrics (horizontal and vertical alignments).

The westbound climbing lane on OR 6 between MP 33.53 and 33.78, which is located on a horizontal curve, is the site of several severe crashes, as shown in Figure 1. The curves on both ends of the passing lanes also have notable crash history. Crash data from this corridor and another similar corridors in Oregon has revealed patterns of crashes near the start and end of some passing lanes, particularly when located in or near curves.

Figure 1. Crashes Near Climbing Lane at MP 33.5

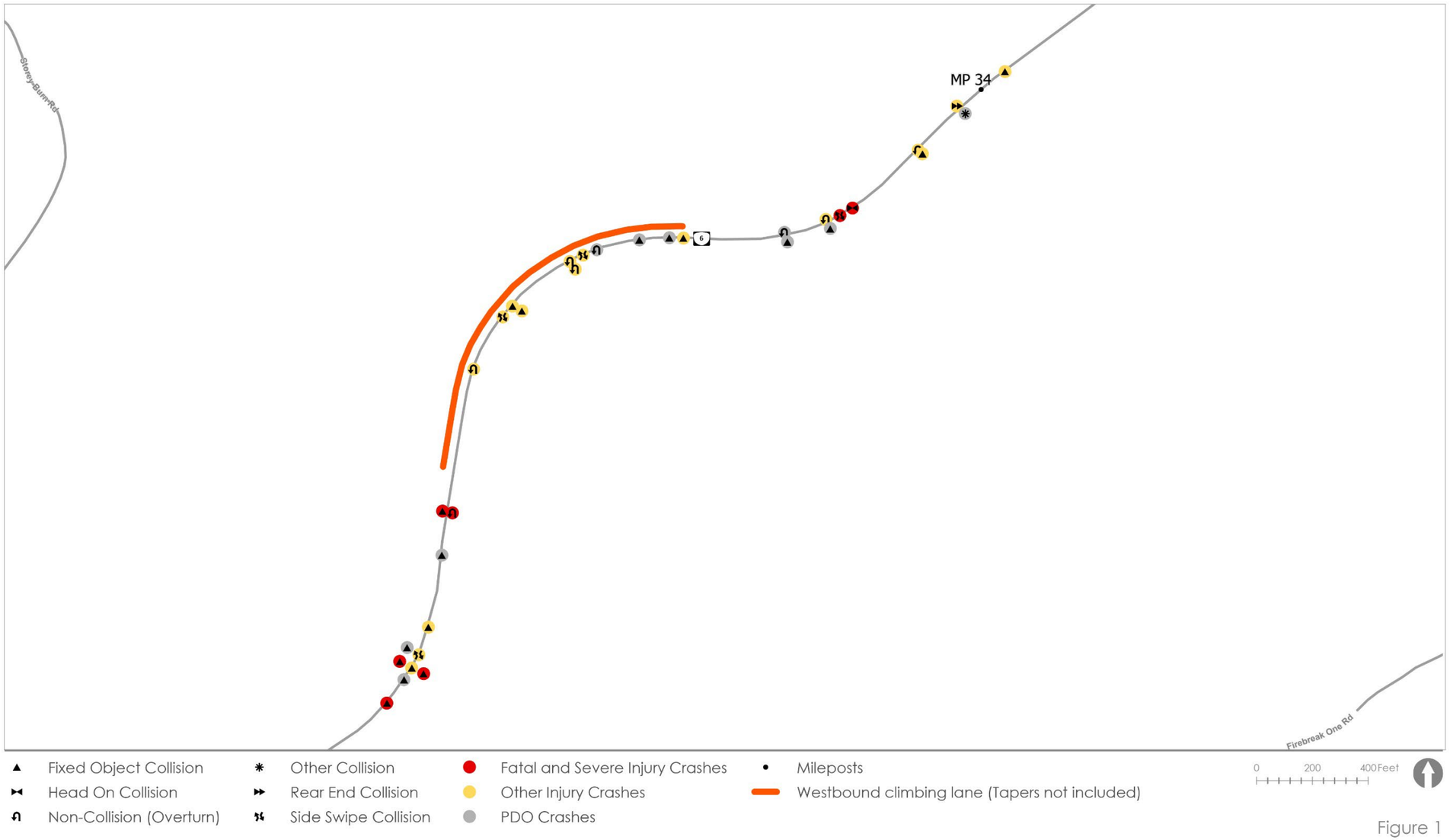


Figure 1

Reported Crashes (2016-Preliminary 2021) Near Climbing Lane at MP 33.5
OR 6 Study Corridor

KITTELSON & ASSOCIATES

Several passing lanes within the OR 6 study corridor do not meet current design guidance for minimum lengths or termination standards. According to the 2023 Highway Design Manual "The ending point and transition section of a passing lane is critical and these specific types of locations need to be avoided for ending the passing lane: the crest of a hill, on a horizontal curve, and locations that have the potential for a left turn." Exhibit 2 below is an example of a passing lane that is shorter (length approximately 850 feet) than the standard length (1,250 feet minimum), requires cars to merge within a horizontal curve, and transitions near a forest road where left turns may occur.

Exhibit 2. Sub-standard Passing Lane at M.P. 34.6. (Photo Source: Oregon Statewide Aerial Imagery Download).

Exhibit 3. Passing Lane with Left-Turning Movements near Merge at M.P. 33.55. (Photo Source: Google Earth Street View).

In addition, recent changes to the striping have effectively shortened the distance available for passing even further. The MUTCD calls for longer distance of unstriped pavement before the physical taper begins when dropping the climbing lane. This required removing skip striping within sections of the passing lane for approximately 745 feet (based on a 55-mph speed) before the taper starts, as illustrated in Exhibit 4, sometimes resulting in an unreasonably short striped climbing lane length. These merges typically occur along tangent sections. Many of the passing lanes in this section are located within horizontal curves. Removing the skip striping in these situations effectively results in an even shorter striped passing lane because vehicles do not have full view of the passing lane ahead due to the curves. Climbing or passing lanes that are too short can lead to risky behaviors with vehicles attempting to complete a passing maneuver, overcorrecting into adjacent lanes, and higher speed differentials because drivers know the passing opportunities are short.

Exhibit 4. Illustration of Existing Passing Lane with Striping According to Latest MUTCD Guidance (Photo Source: Google Earth)

Passing or climbing lanes can be beneficial in locations with greater speed differentials; however, they do result in vehicles traveling at higher speeds. When speed differentials are present and passing or climbing lanes are not provided, drivers may attempt unsafe passing maneuvers using the opposing traffic lane. Therefore, it is important to provide passing opportunities when they can be designed appropriately where speed differentials are greatest.

Based on speed differential, passing opportunities should be prioritized where there are steep climbs. Input from truck drivers has indicated that the climbs in the vicinity of the submit (approximately MP 33) are the sections of the highway at which trucks cannot travel the posted speed limit and experience the greatest speed differentials compared to passenger vehicles.

However, passing opportunities should not be prioritized over safety if physical constraints prohibit the creation of a passing/climbing lane of adequate length and with adequate sight distance. To understand the potential risk, consider an example of a short passing lane (0.25 mile long). A truck traveling 35 miles per hour (mph) would take approximately 25 seconds to travel this distance. For a vehicle to pass this truck, the vehicle must accelerate and pass within this timeframe, while also negotiating the curves in the road and considering the striping which may limit this passing distance even more.

The resulting difference in travel time for vehicles that are able to pass compared to those that cannot pass is relatively small when considering the entire 49-mile corridor trip. The steep portion of the westbound climb on OR 6 is approximately 3.5 miles long. If a vehicle is stuck behind a truck traveling at 35 miles per hour (mph) for the length of this climb, it may take them six minutes to travel this distance. If that vehicle passes the truck and is able to travel at

the speed limit of 55 mph, the vehicle would be able to complete the 3.5-mile long climb in 3 minutes and 49 seconds, resulting in a time savings of 2 minutes and 11 seconds.

Based on public input regarding locations of speed differentials, crash history, and review of passing lane lengths against current standards, several options are proposed to reduce risk associated with the existing climbing lanes. The potential solutions presented in this section are presented based on the crash history and risk associated with the existing passing opportunities.

Corridor wide potential solutions to address passing opportunities focus on adequate marking and signing passing lanes as well as modifying existing passing lanes or installing new ones, all with the following fundamental principles applied:

- Begin passing lanes on a tangent for adequate advance sight distance
- End passing lanes on a tangent for adequate sight distance to complete passing maneuvers and merges
- Prioritize constructing passing lanes in locations with significant speed differentials
- Avoid passing lanes in areas of denser development and more frequent intersections or driveways
- Avoid terminating passing lanes at the following locations:
  - On a crest curve
  - In a horizontal curve
  - In an area where left-turns may occur
- Consider converting passing lanes to turn-outs when minimum passing lane lengths cannot be met and speed differential indicates a need, or remove passing lanes when minimum lengths cannot be met. Per the ODOT Traffic Line Manual, Section 503.0 current ODOT policy does not allow the construction of new slow-moving vehicle turn-outs unless they are allowed by a roadway design exception.

The following are potential solutions presented in this section that include a range of options due to costs:

- Project A: Connect Existing Climbing Lanes
- Project B: Provide Full Climbing Lanes Over the Summit
- Project C: Removing Passing Opportunities and Increase Buffer
- Project D: Covert Climbing Lanes to Slow Moving Vehicle Turnouts

Projects A and B focus on providing ideal lengths and designs for passing opportunities and require significant investments and additional environmental permitting. Projects C and D

focus on lower-cost options within the existing roadway prism and are presented in the event that Projects A and B are determined to be financially infeasible. These projects are potential solutions to reduce the crash risk for the location-specific project, MP 31-35 (page 86).

Several components should be included with each of the options presented below to improve slope stability, improve pavement conditions, and increase the life of the highway. These are capital improvement projects that will require higher costs to implement and therefore should be included with the passing opportunities projects for coordination and efficiency. These components include:

- Modify / flatten curve radius where possible to reduce crash risk
- Address slope stability issues
- Install new pavement to address pavement conditions
- Upgrade bridges when they reach the end of their service life

Potential solutions to addressing passing opportunities are summarized in the following sections.

13 – Consistent Signage and Pavement Markings

Description: Install consistent signage and pavement markings associated with passing lanes and turn-outs on the corridor.

Implementation Suggestion: Near-term

Considerations:

- No right-of-way, geotechnical, and/or environmental impacts.

Benefits: Provides driver with consistent information along the corridor so that they are aware of when passing opportunities are upcoming and when passing lanes will be ending.

Cost: Varies based on extent of modifications needed to provide consistency throughout corridor.

Photo/Image Credit: Example Signage at Climbing Lane Merge (Google Streetview)

14 – Complete Passing Opportunities Evaluation

Description: Evaluate passing lane lengths, taper lengths, and other existing conditions within passing lanes against current standards.

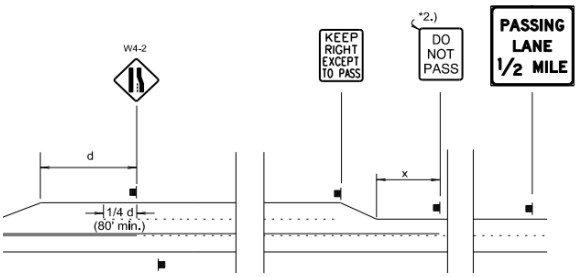
Implementation Suggestion: Near-term

Considerations:

- No right-of-way, geotechnical, and/or environmental impacts associated with study. Recommendations from the study may result in projects with impacts.
- Two locations in particular to consider (outside of the MP 31 – 35 area, which is addressed through the larger projects below, Solution IDs 15, 16, and 17), include:
- MP 43.2 to 43.9 (eastbound): reevaluate entry and exit taper lengths
- MP 16.29 – 16.47 (eastbound): The eastbound turn-out / passing lane is short and should be evaluated for options: define as turn-out; or extend the length along the tangent section to create a 4-lane section.

Benefits: Identify needs and opportunities to provide adequate passing distances to minimize risky passing behaviors.

Cost: Evaluation study estimated to cost <$100,000



Photo/Image Credit: Excerpt from Figure 3 Standard Signing for Passing or Climbing Lanes from the ODOT Traffic Sign Design Manual

15 – Longer Climbing Lanes Near Summit

Description: Modify climbing lanes in both directions to provide longer passing opportunities.

See Descriptions for Project A (connect existing passing lanes) and Project B (extend passing lanes over the summit) below.

Implementation Suggestion: Long-term

Considerations: These projects will have substantial impacts; *see discussion for considerations for Project A and Project B below.*

Benefits: No CRF available. Reduce the risk associated with short passing lanes and limited sight distance.

Cost: $32.2 to $61.9 million (See Project A and Project B below for more information.) In addition to costs above, $40.9 million respectively would be required as additional costs to repair unstable slopes.

A full-page graphic of this potential solution is provided by Figure 2 on page 38.

Project A: Connect Existing Climbing Lanes

Project A includes connecting existing climbing lanes to create one long climb in each direction. The three short westbound climbing lanes are within a segment where trucks are likely to travel slower than typical. This project will reduce the risk associated with short passing opportunities, providing drivers with adequate distance to complete their movements. The climbing lanes should be designed to start and end on tangents to provide adequate sight distance to drivers.

The eastbound climbing lanes for Project A would result in a 1.94-mile climbing lane, extending from approximately MP 30.88 to MP 32.82. This project could be paired with a bridge project to upgrade structure no. 02472 that is currently in Fair condition at MP 32. This project could be paired with slide remediation.

The connected two westbound climbing lanes for Project A would result in a 1.13-mile long climbing lane, extending from approximately MP 33.53 to MP 34.66. This project could be paired with slide remediation.

Safety Benefits

No CRF available. This project will provide longer climbing lanes, reducing the risk associated with short climbing lanes (higher speed differentials, short merges). In addition, the start and end of climbing lanes on tangents will improve sight distance and awareness of the end of passing opportunities.

Cost Estimate

This project is estimated to cost $32.2 million. This cost includes engineering and construction services. The high cost is driven by the bridge reconstruction and earthwork required for the widening. The bridge crosses a very deep ravine over the Devils Lake Fork creek. An additional cost of $40.9 million would be required to repair all of the unstable slopes within the corridor as identified in the ODOT Geotechnical Report.

Considerations

This project would be very impactful to public traffic. Since most of the eastbound direction is on a structure, staging and detour routes would need to be evaluated in detail before moving forward. A seismic retrofit/widening or replacement is likely required given the age of the bridge and seismic vulnerability rating. It is anticipated that significant cuts and fills will be required and potentially retaining walls to accommodate widening west of the bridge and at other locations.

There are environmental considerations that would add to the complexity of this project. The Devils Lake Fork Wilson River is designated critical habitat for coho salmon (O. kisutch) of the Oregon Coast Evolutionarily Significant Unit (ESU), and is ESH for steelhead. The project area around MP 33.78-34.40 is in an area that likely does not have jurisdictional wetlands or waters, and no ESA concerns; permitting requirements for this area will likely be limited to FAHP programmatic BO standards and procedures.

Project B: Provide Full Climbing Lanes Over the Summit

Project B builds upon Project A and extends the climbing lanes over the summit. This allows the eastbound climbing lanes to end on the tangent just past the summit, resulting in an eastbound climbing lane from MP 30.88 to MP 33.32. The westbound climbing lane would also be extended past the summit, resulting in a westbound climbing lane from MP 32.27 to MP 35.70.

Safety Benefits

No CRF available. This project will provide longer climbing lanes, reducing the risk associated with short climbing lanes (higher speed differentials, short merges). Extending the climbing lane over the summit will result in a lower speed differential at the merge on the downhill side of the summit. In addition, the start and end of climbing lanes on tangents will improve sight distance and awareness of the end of passing opportunities. The extension over the summit will provide passing opportunities the full length of the segment with the greatest speed differentials.

Cost Estimate

This project is estimated to cost $61.9 million. This cost includes engineering and construction services. The high cost is driven by the bridge reconstruction and earthwork required for the widening. The bridge crosses a very deep ravine over the Devils Lake Fork creek. There would also be retaining walls required at multiple locations along the project. An additional cost of $40.9 million would be required to repair the unstable slopes within the mile points as identified in the ODOT Geotechnical Report. It makes sense to include all of the required unstable slope repairs with the project so that the widening work has a long service life.

Considerations

In addition to the considerations discussed in Project A, Project B would include a lot of work on unstable slopes. The scope of the unstable slope repairs could be focus on locations identified as high-priority in the ODOT Geotechnical Report, but it would still be a significant cost. The scale and scope of this project would be extremely complex and include a lot of risk through the design and construction phases.

Figure 2. Climbing Lane Projects A and B

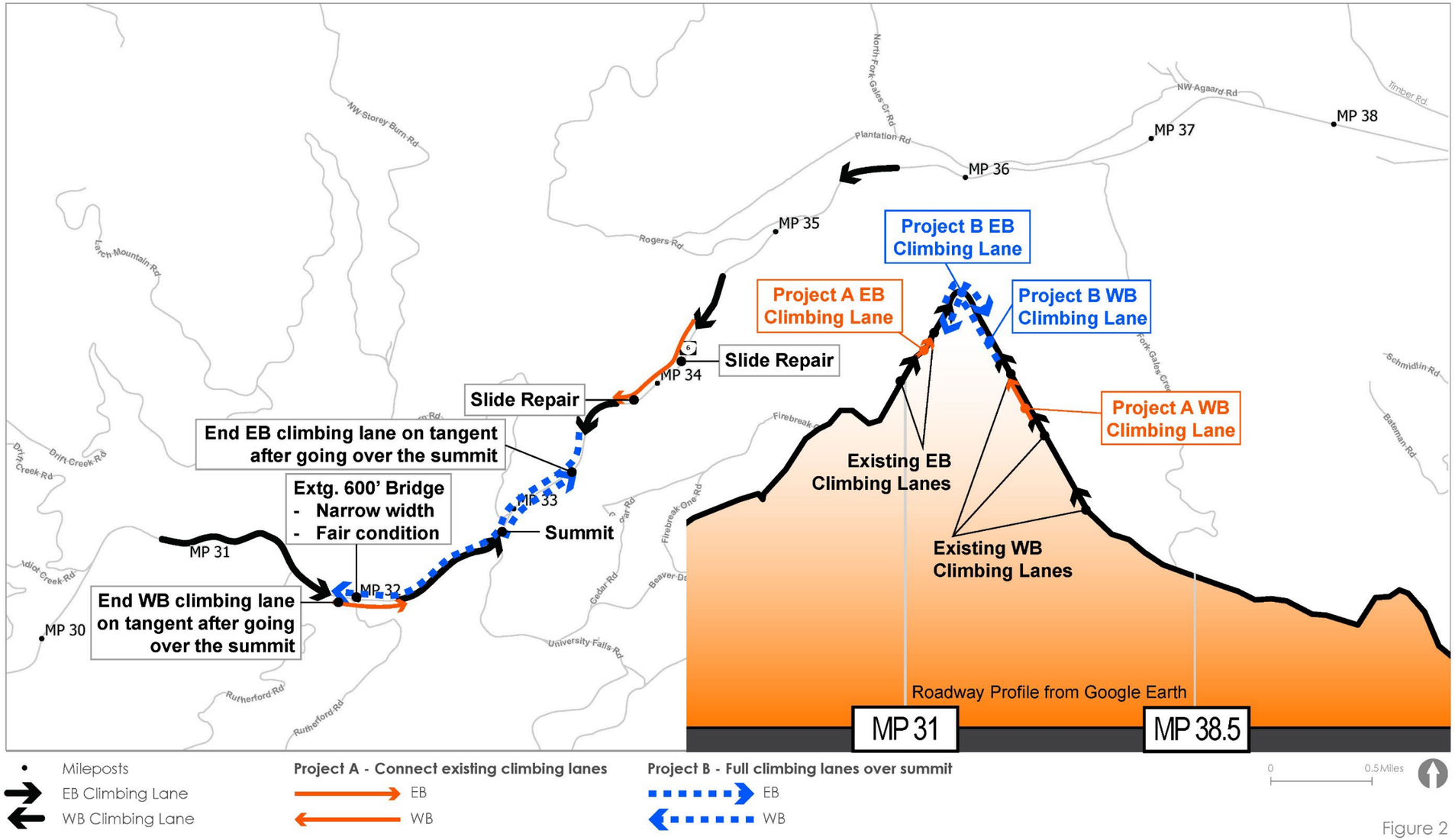


Figure 2

Climbing Lane Projects A and B
OR 6 Study Corridor

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16 – Remove Short Climbing Lanes Near Summit

Description: Remove or reallocate existing short climbing lanes.

See Descriptions for Project C (remove) and Project D (convert to slow moving vehicle turn-outs) below.

Implementation Suggestion: Long-term

Considerations: These projects should be completed in conjunction with a project to evaluate additional passing opportunities outside of MP 31 to 35 as well (See Solution ID 17).

These projects focus on providing an option to reduce the risk associated with short passing opportunities without impacts outside of the existing roadway prism.

Benefits: No CRF available. Reduce the risk associated with short passing lanes and limited sight distance.

The westbound climbing lane at MP 33.5 is one example to illustrate the potential to reduce crash occurrence by removing a short climbing lane. From MP 33.4 to MP 33.8, there were 30 reported crashes from 2016 to 2020. Of those 30, nine crashes involved westbound vehicles. Eight of those nine crashes involved drivers traveling too fast. Five of the crashes were side-swipe, two were fixed-object, and two were overturn. It is difficult to fully discern whether the short entry and exit taper lengths, short passing lane, horizontal curve, or combination of those factors contributed to these crashes. The consistent crash cause of high travel speeds could potentially be linked to vehicles increasing speed to pass others.

Cost: $4.8 million (See Project C and Project D below for more information.) In addition to the costs above, $40.9 million would be required to repair the unstable slopes within the corridor.

A full-page graphic of this potential solution is provided by Figure 3 on page 43.

Project C: Removing Passing Opportunities and Increase Buffer

Projects C is provided as an option that does not require work outside of the existing roadway prism. These options reduce the risk associated with short passing opportunities, including minimizing conflict points and reducing the potential for head-on crashes when passing occurs in narrow three-lane sections.

Project C includes the removal of existing passing opportunities in the westbound direction because these climbing lanes are shorter than current design standards would require and are also located within horizontal curves. The highway would be restriped in these sections to a two-lane highway with a striped median and centerline and edge line rumble strips. The additional width could be used to provide wider centerline striping or a buffer between lanes. The existing eastbound climbing lanes are long enough meeting minimum design guidance. Therefore, these lanes are not recommended for removal. However, where possible, these lanes should be extended to provide a start and end point on tangents, and striping should be updated to extend skip striping until the beginning of the merge, to provide clarity and encourage use of the full length. Although the suggested striping approach does not follow the MUTCD, based on the context and the goal of being able to maintain the existing climbing lanes, it is recommended to consider allowing this exception to help guide motorists through the winding roadway.

If possible, this project should be completed in conjunction with evaluating the possibilities of adding new passing opportunities in other sections of the OR 6 corridor (See the Passing Opportunities section for more discussion on this).

Safety Benefits

This project removes the risk associated with short passing opportunities within curves. By reallocating the existing roadway width, it also provides additional buffer width that can be used for wider centerlines and wider shoulders, helping reduce roadway departure crashes.

Cost Estimate

This project is estimated to cost $4.8 million. This cost includes engineering and construction services. There would be an additional cost of $40.9 million for the unstable slope repairs within the corridor.

Considerations

This project would include a grind and inlay of the sections where passing lane striping is removed and include new pavement markings and permanent signs to provide guidance for the new configuration. This project would include a lower risk engineering and construction phase because most of the work would occur within existing pavement limits.

The unstable slope repairs costs significantly outweigh the construction costs for this project. The unstable slope repairs could be limited to high priority locations to reduce the scope and cost impacts to this potential project.

Project D: Convert Climbing Lanes to Slow Moving Vehicle Turnouts

Project D aims to reduce the risk associated with short climbing lanes by converting the westbound climbing lanes to slow moving vehicle turn-outs. **The three short westbound climbing lanes are within a segment where trucks are likely to travel slower than typical.** Although ODOT does not typically construct these slow-moving vehicle turnouts anymore, the use of the existing pavement for turnouts will continue to provide vehicles with an opportunity to pull over to allow vehicles to pass. The eastbound climbing lanes would be maintained and extended to the extent possible to start/end on tangents.

Project D would primarily involve pavement markings and signage changes, as shown in Exhibit 5 below.

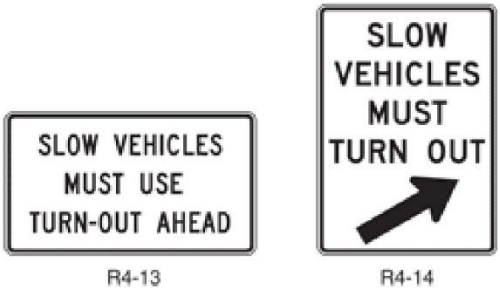

Figure 660: Typical Slow Moving Vehicle Turnout

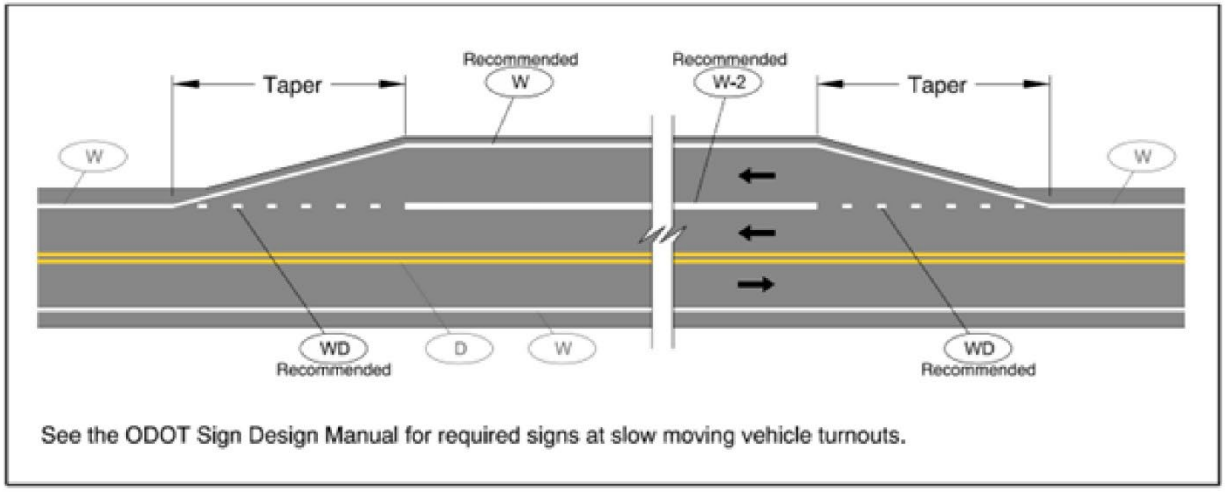

Exhibit 5. Illustration of Signage and Typical Markings for Slow Moving Vehicle Turnouts

Safety Benefits

This project removes the risk associated with short passing opportunities within curves, while still providing an opportunity for vehicles to stop in the event of emergencies.

Cost Estimate

This project is estimated to cost $4.8 million. This cost includes engineering and construction services. There would be an additional cost of $40.9 million for the unstable slope repairs within the corridor.

Considerations

Slow moving vehicle turnouts are typically not installed anymore. This project would require a roadway design exception and would require supporting justification to replace a substandard passing lane with a slow-moving vehicle lane.

Figure 3. Climbing Lane Projects C and D

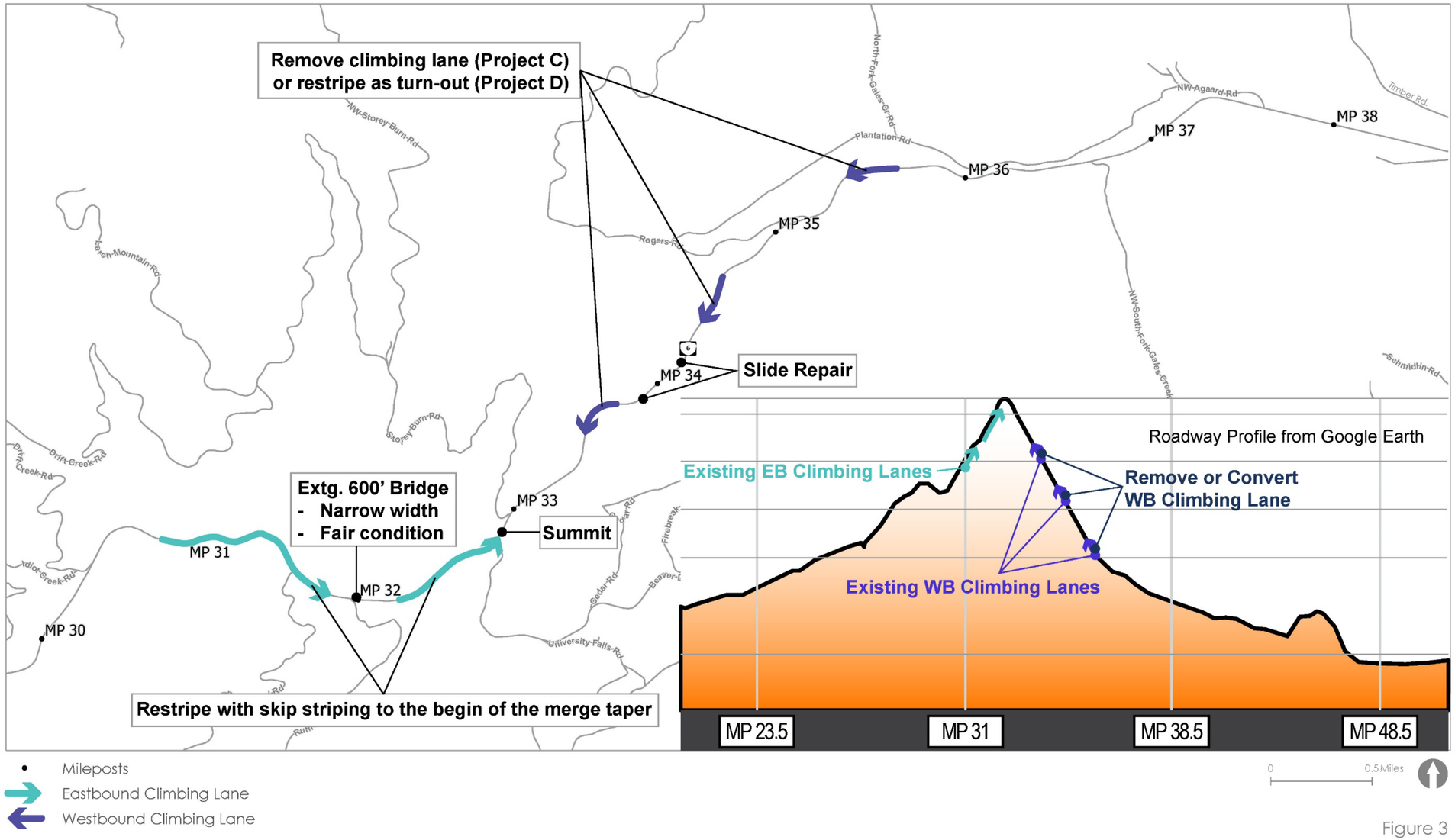

Figure 3

Climbing Lane Projects C and D
OR 6 Study Corridor

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17 – Additional Passing Opportunities within Corridor

Description: Evaluate opportunities to provide additional passing opportunities (in addition to those within Projects A and B (Solution ID 15) discussed in the previous section).

See descriptions below for additional details regarding specific locations to evaluate.

Implementation Suggestion: Long-term

Considerations: These projects would be particularly helpful to provide additional passing opportunities if Projects C or D (Solution ID 16), the removal of existing short climbing lanes, are selected.

Projects will have substantial impacts. *See discussion below for discussion regarding specific locations.*

Benefits: No CRF available. These projects would provide additional passing opportunities, reducing driver impatience throughout the corridor.

Cost: $17.6 to $24.6 million per location (See discussions below.)

A full-page graphic of this potential solution is provided Figure 4 on page 47.

Potential Locations for Additional Passing Opportunities

The project team identified the following locations as candidates to be evaluated for new passing opportunities based on roadway geometry. Figure 4 illustrates the location of these opportunities.

- Additional Passing Lane Opportunity #1 – Westernmost Option
  - Approximately MP 12 – MP 13
  - Estimated Cost = $17.6 million
  - Considerations – Minor retaining walls may be required. No unstable slopes in this section but DOGAMI mapped landslide deposit crosses OR6 between MP 12.1 – MP 12.3.
- Additional Passing Lane Opportunity #2 – Modify Existing Passing Lane Near MP #16
  - Approximately MP 16 – MP 16.4
  - Estimated Cost = <$6 million (estimate requires further refinement)
  - Considerations – Existing slow-moving vehicle turnout would be converted to passing lane and extended to meet standards. Earthwork required and only minor retaining walls anticipated. Project may evaluate opportunity to extend the 4-lane cross-section further west.
- Additional Passing Lane Opportunity #3 – Lee's Camp Store
  - Approximately MP 23.5 – MP 24.5
  - Estimated Cost = $24.6 million
  - Considerations – Significant cuts and fills, and potential retaining walls will be required but no mapped landslides or unstable slopes in this section so do not anticipate significant geotechnical issues.
- Additional Passing Lane Opportunity #4 – Easternmost Option
  - Approximately MP 37.5 – MP 38.5
  - Estimated Cost = $24.4 million
  - Considerations – Significant cuts and fills, and potential retaining walls will be required but no mapped landslides or unstable slopes in this section so do not anticipate significant geotechnical issues.

OR 6 Passing Opportunities Investment Considerations

Implementing passing opportunities along the OR between Banks and Tillamook will require significant investment. Although there are opportunities to improve existing passing/climbing

lanes and introduce new passing opportunities, it may not be possible to build them all. Each option has unique benefits and challenges associated with it. When determining which strategy to implement, ODOT will need to consider which option is likely to have the largest return on investment. The following passing opportunities investments were introduced above:

- Additional Passing Lane, MP 12-13, Opportunity #1 ($17.6 million)
- Additional Passing Lane, MP 16-16.4, Opportunity #2 (<$6 million)
- Additional Passing Lane, MP 23.5-24.5, Opportunity #3 ($24.6 million)
- MP 31-35 (including cost to repair all unstable slopes)
  - Project A (Connect existing climbing lanes), MP 31-35 ($73.1 million)
  - Project B (Connect and extend climbing lanes), MP 31-35 ($102.8 million)
  - Project C (Remove westbound climbing lanes), MP 31-35 ($45.7 million)
  - Project D (Convert westbound lane to turn-out lanes), MP 31-35 ($445.7 million)
- Additional Passing Lane, MP 37.5-38.5, Opportunity #4 ($24.4 million)

When considering implementation scenarios, the return on investment will need to be considered. Two scenarios are presented below as an example of the considerations:

- Scenario #1 could provide desirable climbing lanes over the summit (Project B), for approximately $102.8 million. However, this scenario would not provide any additional passing opportunities on the corridor. Scenario #1 would include fixing all of the unstable slopes within the project area. When the scenario is further developed, the slide repair scope may be reduced based on the recommendation of a geotechnical engineer.
- Scenario #2 could be comprised of a lower-cost improvement at the summit (Project D), as well as two of the new passing opportunities resulting in more passing opportunities along the OR 6 corridor for approximately $69.3 million. Scenario #2 will still require fixing the unstable slopes within the corridor, which is included in the cost estimate for scenario #2. When the scenario is further developed, the slide repair scope may be reduced based on the recommendation of a geotechnical engineer.

Figure 4. Corridor Wide Passing Opportunities

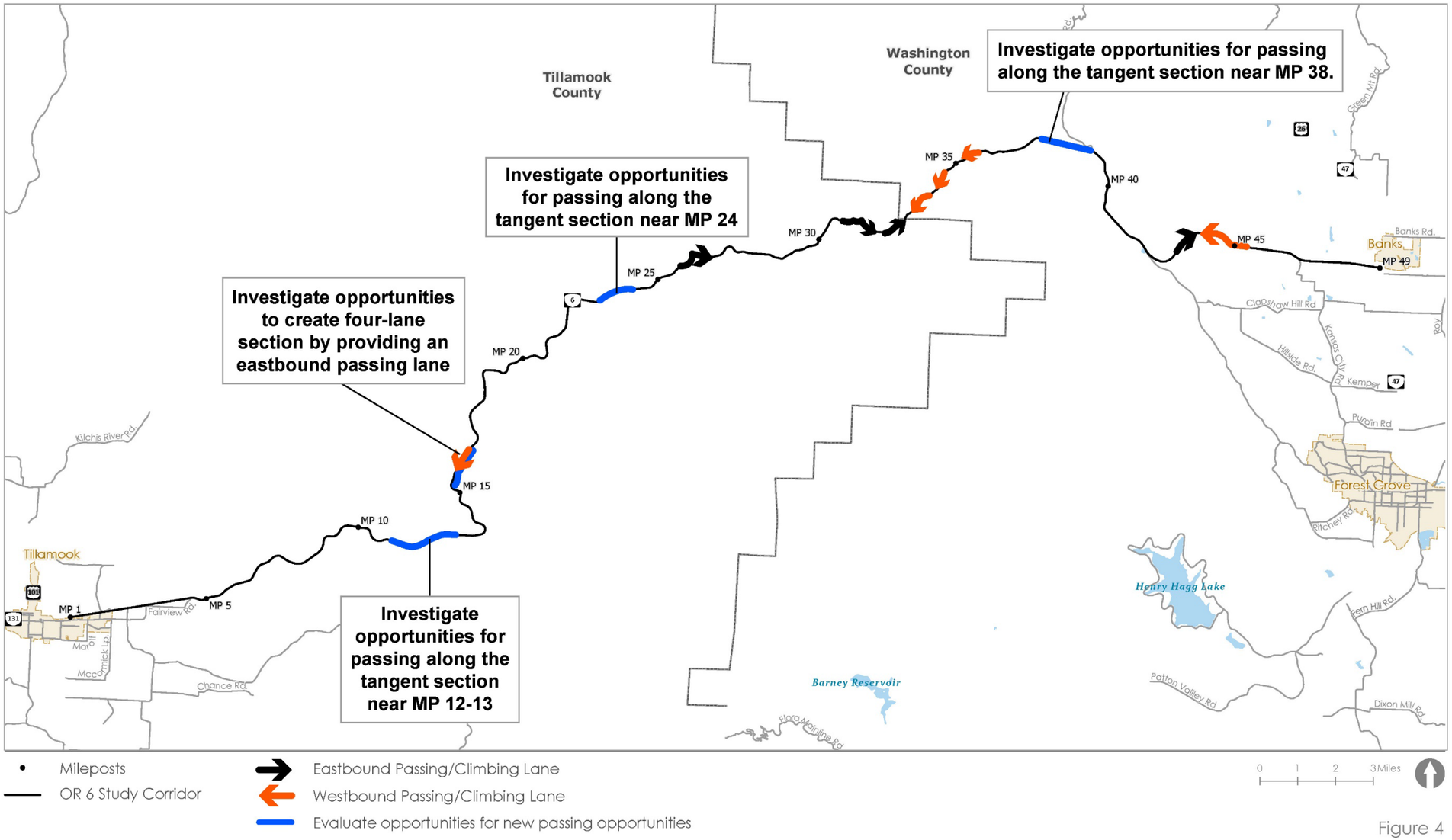


Figure 4

Corridor-Wide Passing Opportunities
OR 6 Study Corridor

KITTELSON & ASSOCIATES

Roadway Conditions (Wet, Snow, Ice)

Some areas of the corridor have concentrations of crashes occurring on snow/ice conditions or wet pavement conditions. In particular, a pattern of snow/ice crashes is observed between approximately MP 31 and MP 38, which correlates with the peak elevation and grades of the corridor as shown by the approximate roadway profile from Google Earth below. Between MP 31 and 35, snow and ice conditions were present in 45 percent of crashes.

Potential solutions to address roadway conditions are summarized below.

18 – Identify Opportunities to Increase Maintenance Funding

Description: With additional maintenance funding, maintenance procedures could be reviewed for wet, snow, and ice conditions to ensure best practices are being followed (salt, deicer, rock, sand, etc.).

Implementation Suggestion: Near-term

Considerations:

No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include verifying best practices in maintenance to fund ODOT staff at appropriate levels to support the travelling public.

Cost: Cost varies, likely a repeating cost in staff time annually or every few years depending on the maintenance activity.

Photo/Image iStockphoto

Solution 19: Update Missing or Old Reflective Markings and Signage

Description: Install new reflective markings and signage to update missing or old inventory that is impacted by weather, age, and/or incidents. This may include:

- Reflective striping
- Reflective signs
- Delineators
- Recessed pavement markers
- Milepost signs

Safety Benefits: General benefits of increased driver awareness and visibility in dark conditions.

19a – Highly Retroreflective Striping

Description: Update and maintain highly retroreflective striping to ensure visibility throughout the year. Dependent on the upcoming updated MUTCD, the national standard for edge-line striping is proposed to increase to six inches. When updating and maintaining striping, this could be considered.

Implementation Suggestion: Near-term

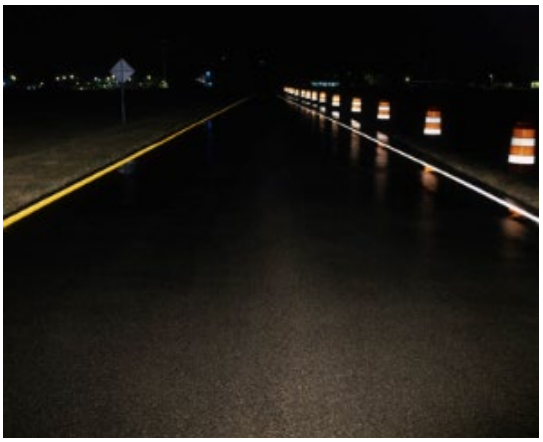
Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Considerations needed about maintenance of the striping to verify it is visible throughout the year.
- Verify if the specific location(s) for implementation is within an area with older population overrepresentation and if the Older Drivers and Pedestrian Special Rule applies.[8]

Benefits: CRF of 14% for wet road crashes when upgrade existing markings to wet-reflective pavement markings (RD23 from ODOT CRF list)

Cost: $64,000 per Mile

Assumptions: Double No-Pass centerline and White continuous fog lines



Photo/Image Credit: fhwa.dot.gov

[8] https://safety.fhwa.dot.gov/hsip/rulemaking/docs/Section148_SpecialRule_Guidance.pdf

19b – Reflective Signs

Description: Update signs to be more reflective. These updates may include updating to have larger signs and adding reflective signs posts.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: CRF of 20% for run-off-the-road crashes (RD8 from ODOT CRF list)

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: Retroreflectivity Material for Increased Visibility. 3M Website. Accessed April 6, 2023.

Photo/Image Credit: Signs & Safety Devices. Accessed April 25, 2023

19c – Update Delineators

Description: Update missing or old delineators as needed to ensure visibility throughout the year. These updates may include adding delineators on existing guardrail.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: For updated delineators on curves, CRF of 30% for curve crashes at night (RD14 from ODOT CRF list)

Cost: $80 per delineator

Assumptions: Included with larger project

Photo/Image Credit: safety.fhwa.dot.gov

19d – Recessed Pavement Markers

Description: Install recessed pavement markers to help drivers see the lane striping, especially during dark, wintery, and/or wet conditions.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: CRF of 15% for night crashes (RD13 from ODOT CRF list)

Cost: $3,000 per Mile

Assumptions: Included with striping project

Photo/Image Credit: umasstransportationcenter.org

03f – [Repeat] Increased Frequency of Milepost Signs

Description: Install milepost signs at a 0.5-mile interval, instead of every one mile.

Implementation Suggestion: Near-term

Benefits: General benefits of the increased frequency of milepost signs are increased location awareness to help drivers navigate to their destinations on the corridor and to support emergency calls where drivers need to relay their location to responders.

See the Recreational Destinations and Communities Section for more information regarding this solution

.

20 – Road Narrowing Warning Signs

Description: Install warning signage to notify drivers of road narrowing.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include warning drivers of potential vehicle slow-downs as lanes narrow and of loss of recovery width if an incident occurs.

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W5-1)

21 – Narrow Bridge Warning Signs

Description: Install warning signage to notify drivers of a narrow bridge ahead.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include warning drivers of potential vehicle slow-downs as lanes narrow and of loss of recovery width if an incident occurs.

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W5-2)

22 – Pavement Rehabilitation (Near-term and Long-term)

Description: Repave areas with rough pavement to improve pavement conditions, install high friction pavement to increase performance in wet conditions, correct settled roadways, and utilize pavement reinforcement opportunities, such as geogrid.

Implementation Suggestion: Near-term and long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Pavement maintenance is already difficult to fund for this corridor.
- Prioritize this solution in and around curves and include for any pavement projects that occur.
- Add geogrid to the pavement as part of a paving project to extend the life of the pavement.
- When larger projects occur, install new pavement to address pavement conditions.
- Superelevation corrections would need to be included in a 3R or a 4R project.

Benefits:

- If install high friction surface treatment on curves:
  - CRF of 72% for run-off-the road crashes (H48 from ODOT CRF list)
  - If install high friction pavement at intersections:
  - CRF of 57% for wet road crashes (I18 from ODOT CRF list)
  - If improve superelevation variance (SV) on rural curves:

H45 from ODOT CRF list:

- If SV between 0.01 and 0.02:
  - CRF - -600*(SV-0.01)

H46 from ODOT CRF list:

- If SV between greater than 0.02:
  - CRF - -300*SV

Cost: Varies based on treatment and scope

Assumptions: No additional area of impervious surface would be added that would modify environmental impacts

Photo/Image Credit: FHWA (dot.gov)

23 – Evaluate OR 6 Against the Safety Corridor Designation Criteria

Description: Review the Safety Corridor designation criteria for the full OR 6 corridor. If the full corridor does not meet the criteria, evaluate if a section of the corridor meets the criteria.

Implementation Suggestion: Near-Term

Considerations:

- There are four areas of safety that ODOT lists as potential actions within safety corridors; Engineering, Education, Enforcement, and Emergency Services. Other solutions presented in this memorandum would reinforce the safety corridor designation.

Benefits: No CRF available. If OR6 is designated a safety corridor then it becomes subject to heightened enforcement and double fines for traffic infractions, if signed. Drivers may also be asked to turn on headlights during the day, reduce speed and refrain from passing.

Cost: $1,500 per safety corridor sign. There would also be a cost associated with reviewing the corridor in comparison to the safety corridor designation criteria.

Photo/Image Credit: ODOT Oregon Safety Corridor Program Guidelines

24 – Weather Warning System

Description: Install temperature gauges, cameras, and variable message signs to allow drivers to look up current conditions and warn drivers when an alternative route is recommended or when conditions are difficult. Variable speed guidance may be included as well. This system should include detection for both temperature and moisture to determine when pavement conditions may be poor.

See Figure 5 for potential locations; at least two signs in each direction are recommended to allow ODOT to activate warnings near the location where conditions change. If activated too soon, drivers may increase speeds again before encountering the snow and ice conditions.

Implementation Suggestion: Long-term

Considerations:

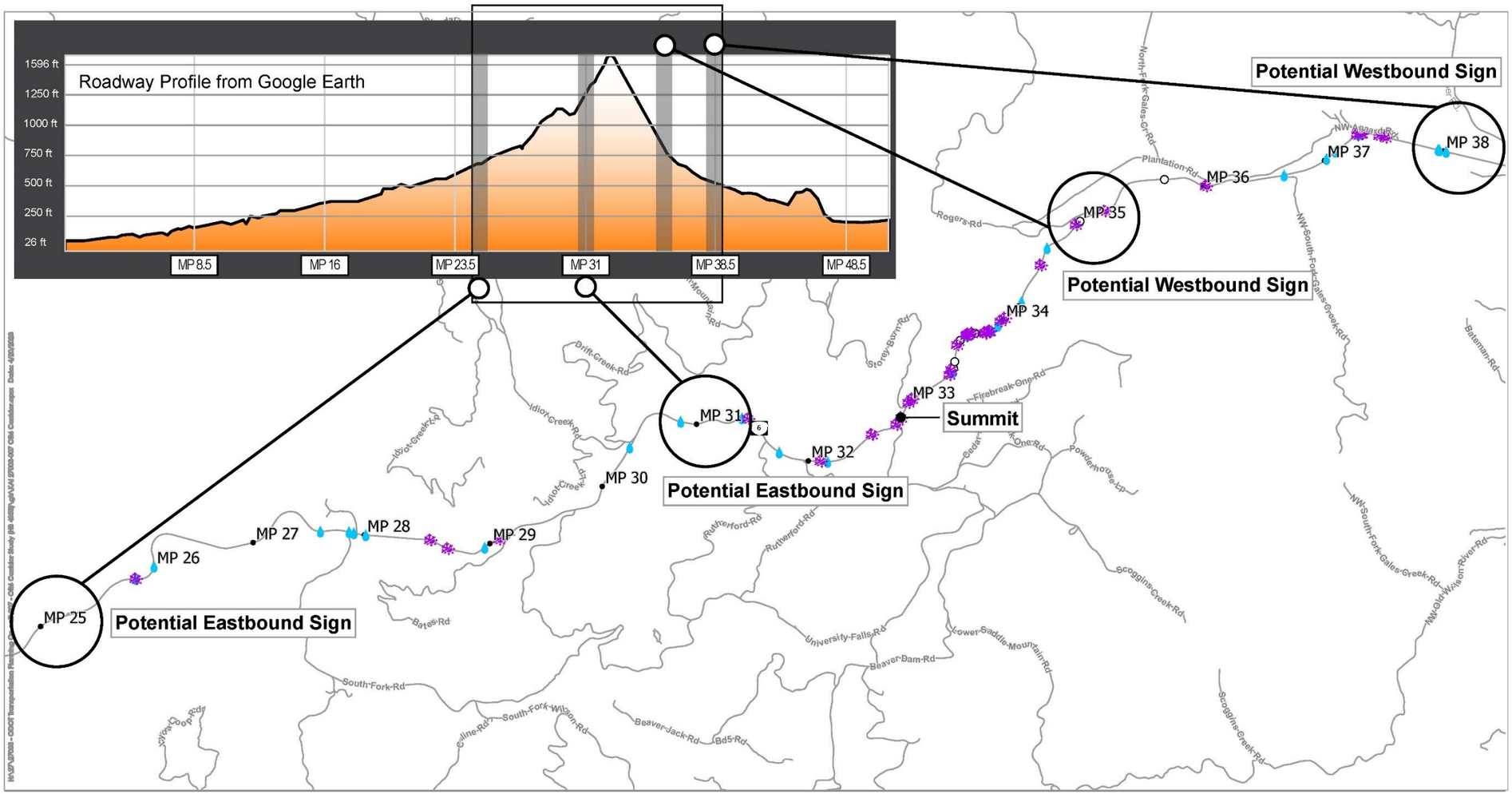
No anticipated right-of-way, geotechnical, or environmental impacts.

Elements of the system would need power and communications to operate. This may be coordinated with the larger Communications projects and be coordinated with Variable Message Signs near Banks and Tillamook to share messages far enough in advance for drivers to choose alternate routes. On-going maintenance will be needed.

Benefits: No CRF available. The benefits include warning drivers to use caution during winter weather events and potential use alternative routes.Cost: The cost would include weather measurement systems, signs on foundations, and connections between all of the system components. The cost varies based on exact scope, but will be a significant cost.

Photo/Image Credit: Kittelson photo on OR 140 illustrating weather warning system.

Figure 5. Potential Weather Warning System Locations



25 – Traffic Cameras

Description: Install additional traffic cameras with temperature gauges to better reflect road conditions in poor weather conditions; connect with TripCheck.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Elements of the system would need power and communications to operate, and maintenance may be costly.

Benefits: No CRF available. The benefits include warning drivers to use caution during winter weather events and potential use alternative routes.

Cost: $55,000 per location

Assumptions: Assumes interconnect or some other internet connection already installed in the area.

Photo/Image Credit: Road Camera from Tallahassee Driver Information System. www.talgov.com

26 – Variable Message Signs

Description: Install variable message signs (VMS) to alert of incidents or condition ahead, provide travel times, or to draw attention and emphasize the message to drive safely.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Unlike a static sign, VMS needs power to operate.
- Potential locations for VMS signs include:
- Just west of the interchange with OR 47 (Westbound direction)
- Just east of Gales Creek Road/OR 8 (Westbound direction)
- Just east of Timber Road (Westbound direction)
- Between Fairview Road and Olsen Road (Eastbound direction)

Benefits: No CRF available. The benefits include warning drivers to use caution during incidents, setting expectations around travel time, and drawing driver attention to reduce risky behaviors.

Cost: $600,000 per location

Assumptions: Assumes installation is included with other roadway improvements.

Photo/Image Credit: WordPress

Photo/Image Credit: ODOT Portable Changeable Message Sign Handbook

27 – Variable Speed Guidance System

Description: Install variable message signs (VMS) to provide updated speed limits based on winter weather. This system could use a friction sensor to determine when friction level is low enough to impact traction on curves.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Elements of the system would need power and communications to operate, and maintenance may be costly.

Benefits: No CRF available. The benefits include warning drivers to use caution during winter conditions. Cost: $600,000 per location

Assumptions: Assumes sign is installed as a part of a larger roadway project.

Photo/Image Credit: ODOT and KTVZ

28 – Chain-up Area

Description: Install chain-up area or convert wide shoulders or non-standard passing lanes to chain-up areas for winter conditions.

Implementation Suggestion: Long-term

Considerations:

- Likely right-of-way, geotechnical, and/or environmental impacts assuming roadway widening would be necessary to install new chain-up areas.

Benefits: No CRF available. The benefits include providing space for drivers to add snow chains to their tires during winter conditions, especially for trucks and large vehicles.

Cost: Varies based on treatment and scope, but widening of roadway would result in high cost.

Photo/Image Credit: Example Chain-up Area Sign (Google Streetview)

29 – Updated Snow Zone Signs

Description: Install snow zone signs that can be remotely activated.

Implementation Suggestion: Long-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Elements of the system would need power and communications to operate, and maintenance may be costly.

Benefits: No CRF available. The benefits include informing the public of roadway conditions without sending staff physically to the corridor.

Cost: Varies based on treatment and scope

Photo/Image Credit: ODOT TripCheck

Solutions Not Recommended for Roadway Conditions (Wet, Snow, Ice):

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Install shoulders: This is not likely feasible in many locations without being part of a larger project; it could be added in the design of large capital improvement projects such as those in the MP 31 to 35 areas.
- Install lighting: This is not feasible for the majority of the corridor. It may be evaluated at specific locations if crash patterns in the future indicate an issue.

Pavement / Slope Stability Conditions

Public input suggested pavement conditions as one of the primary concerns for the corridor. In addition, there are numerous areas of unstable slopes throughout the OR 6 study corridor and areas where unstable slopes have led to pavement condition issues and roadway cross slopes that appear to be in the wrong direction within a curve. Where these unstable slopes overlap with safety issues, there may be an opportunity to address both issues with potential projects or strategies. In addition, understanding areas of unstable slopes will be an important consideration in implementing other projects or potential solutions throughout the corridor.

Areas with unstable ground will require more complex and generally more expensive treatments.

According to ODOT's Geotechnical Report there are currently 85 active inventoried landslides, rockfalls, and debris flows that are impacting the corridor. Based on ODOT's Geotechnical Report and the inventory analyses completed for this project, MP 28-37 is the primary segment of the corridor with unstable slopes. ODOT's Geotechnical Report identifies MP 32 to 37 as the segment with the most slides. ODOT is working on an active slide at MP 34.8. ODOT has created a list of 18 unstable slope sites to prioritize in the corridor, which have a total repair cost of $38 million. ODOT's estimated cost to repair all unstable slopes in the corridor is $114.8 million.

Potential solutions to address pavement / slope stability conditions are summarized below.

30 – Rough Pavement Warning Signs

Description: Install warning signage to notify drivers of rough pavement ahead.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include warning drivers to proceed with caution and be aware of potential vehicle slow-downs as they traverse rough pavement sections.

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W8-8)

22 – [Repeat] Pavement Rehabilitation

Description: Repave areas with rough pavement to improve pavement conditions, install high friction pavement to increase performance in wet conditions, correct settled roadways, and utilize pavement reinforcement opportunities, such as geogrid.

Implementation Suggestion: Near and long-term

Benefits: General benefits of the rehabilitated pavement are to reduce rough conditions that differ from driver expectations along the corridor, increase driver comfort, increase driver visibility of impacted pavement markings, and reduce roadway condition impact on vehicles.

See the Roadway Conditions (Wet, Snow, Ice) Section for more information regarding this solution.

31 – Address Unstable Slopes

Description: When larger projects occur, address unstable slopes per ODOT Geotechnical Report.

Implementation Suggestion: Long-term

Considerations:

- Anticipated large-scale right-of-way, geotechnical, and environmental impacts.

Benefits: No CRF available. The benefits include reduced frequency of landslide and other unstable slope events, less ODOT maintenance staff time needed for these locations, reduced pavement condition and marking impacts, and increased driver comfort.

Cost: Estimated cost to repair 18 highest priority sites: $38.0 million

Estimated cost to repair all unstable slopes: $114.8 million

Photo/Image Credit: Washington State Dept of Transportation Flickr

Communications

Input from the public and stakeholders revealed that the lack of wireless and optical/wired communications available along the corridor creates additional challenges with reporting and responding to crashes when they occur. Drivers have indicated that they do not know where they are along the corridor after crashes. Drivers also have to travel to obtain service to call for help. This creates delays in responding to crashes and additional challenges for emergency vehicles to access crashes with traffic queues and unknown crash locations.

In addition to the lack of cell phone service throughout the corridor, there is also limited communications infrastructure in place.

ODOT has been coordinating with Astound Broadband regarding future plans for communications along this corridor. Astound Broadband has plans to install a new fiber optic cable along OR 6 between Tillamook and Banks. ODOT should continue to coordinate with these efforts to ensure opportunities to connect into this line for new ITS infrastructure is provided.

Potential solutions to improve communications are summarized below.

03f – [Repeat] Increased Frequency of Milepost Signs

Description: Install milepost signs at a 0.5-mile interval, instead of every one mile.

Implementation Suggestion: Near-term

Benefits: General benefits of the increased frequency of milepost signs are increased location awareness to help drivers navigate to their destinations on the corridor and to support emergency calls where drivers need to relay their location to responders.

See the Recreational Destinations and Communities Section for more information regarding this solution.

32 – Fiber Communications

Description: Install fiber communications along the corridor.

Implementation Suggestion: Long-term

Considerations:

- Potential right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include drivers having phone service to report incidents, be able to reach family/friends during an emergency, and navigate the corridor.

Cost: Currently being evaluated.

Photo/Image Credit: ODOT Broadband Strategy & Implementation Plan

Solution 33: Install Intelligent Transportation System (ITS) Equipment and Warning Systems

Description: Once fiber communications are installed along the corridor, it will be more feasible to incorporate many of the ITS and warning system solutions that have been previously described in other sections of the memorandum. Those solutions include the following:

- Solution ID 05: Intersection Warning System – Detect Vehicles Waiting on the Mainline (from Recreational Destinations and Communities Section)
- Solution ID 06: Intersection Warning System – Detect Vehicles Waiting on the Side Street (from Recreational Destinations and Communities Section)
- Solution ID 24: Weather Warning System (from Roadway Conditions Section)
- Solution ID 25: Traffic Cameras (from Roadway Conditions Section)
- Solution ID 26: Variable Message Signs (from Roadway Conditions Section)
- Solution ID 27: Variable Speed Guidance System (from Roadway Conditions Section)
- Solution ID 29: Updated Snow Zone Signs (from Roadway Conditions Section)

Safety Benefits: General benefits of installing ITS equipment and warning systems is the coordinated operations of the system, allowing ODOT staff to efficiently monitor the corridor, manage and change messaging to drivers as needed, and remotely manage equipment in some cases.

Solutions Not Recommended for Communications:

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Extend communications network in from both sides of the corridor.
  - This solution was considered as a way to extend coverage if obtaining full corridor coverage was not possible. However, a full corridor project is underway. This interim step appears to be unnecessary.
- Emergency callboxes were considered but not included because ODOT has found that the usefulness of these boxes is limited due to the spacing, the technology is becoming obsolete, and they have had issues with vandalization. The recommendation to partner with private industry and advance cell service and fiber is preferred.

Risky Driving Behaviors

Input from the public and stakeholders indicated that driving behaviors are also a concern along the corridor. Concerns voiced included: driving too fast, unsafe passing behaviors, and impaired driving.

Potential solutions to reduce risky driving behaviors are summarized below.

34 – Safe Driving Media Campaign

Description: Develop a media campaign for safe driving. Topics covered could include speeding, impaired driving, passing opportunities and behavior, setting expectations for travel time in varying conditions, and winter weather driving. Consider using humor in messages to attract attention.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include increasing driver awareness of their impacts on other drivers and setting appropriate expectations when using the corridor.

Cost: Varies based on scope and longevity of the campaign.

Photo/Image Credit: Maryland Department of Transportation – Be the Driver Campaign (https://zerodeathsmd.gov/how-you-can-help/be-the-driver/)

35 – Evaluate Funding Opportunities for Increased Enforcement

Description: Evaluate funding opportunities to support increased state, county, and local enforcement.

If the corridor meets the criteria for Solution 23 (Evaluate OR 6 Against the Safety Corridor Designation Criteria), use any additional enforcement funding opportunities that become available.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Even with additional funding, the personnel needs for increased enforcement may not be met. Both additional funding and personnel would be required for this solution to be implemented.

Benefits: No CRF available. The benefits include encouraging drivers to travel the speed limit and pass others appropriately. A secondary benefit is that responders are in the proximity if there is an incident.

Per the National Highway Traffic Safety Administration, high-visibility enforcement is an official countermeasure.[9]

Cost: Varies based on scope and longevity of the campaign.

Photo/Image Credit: Oregon State Police

[9] https://www.nhtsa.gov/book/countermeasures/a3-speeding-and-speed-management/22-high-visibility-enforcement#:%7E:text=Overall%2C%20the%20findings%20regarding%20countermeasure,benefits%20or%20even%20negative%20outcomes

Solution 36: Install Engineering Solutions to Encourage Safer Driver Behavior

Description: Install low-cost solutions, such as signage, delineators, and rumble strips, to encourage safer driver behavior. Several of these low-cost solutions have been previously described in other sections of the memorandum and a few are described below. The solutions include:

- Solution ID 01: Delineators to Define Driveways and Intersections (from Recreational Destinations and Communities Section)
- Solution ID 04: Reinforce Slower Speeds in Communities and Near Areas with More Destination Density (from Recreational Destinations and Communities Section)
- Solution ID 11: Centerline Rumble Strips (from Recreational Destinations and Communities Section)
- Solution IDs 13 through 17: Modify passing opportunities within the corridor
- Solution ID 24: Weather Warning System
- Wildlife Warning Signs
- Gateway Signage
- Speed Feedback Signs

Safety Benefits: General benefits of installing these solutions are increasing driver awareness, reducing sudden unexpected driver reactions, and encouraging less risky driver behavior.

36a – Wildlife Warning Signs

Description: Install warning signage to notify drivers of potential wildlife activity on the roadway.

Implementation Suggestion: Near-term

Considerations:

No anticipated right-of-way, geotechnical, or environmental impacts.

Elk and deer crossings were identified as a concern based on feedback from the public.

Benefits: CRF of 26% for all rural crashes (RD27 from ODOT CRF list)

Cost: $1,500 per Sign

Assumptions: Included with larger project

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W11-20 [Elk])

36b – Gateway Signage

Description: Install gateway signage that introduces areas with more access points, businesses, and/or pedestrian/bicycle activity.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.

Benefits: No CRF available. The benefits include warning drivers to be aware of a more urban context. This may include potential vehicle slow-downs or turning movements, increased density of accesses, and increase vehicular, pedestrian, and bicycle activity in the area.

Cost: $1,600 for sign pictured above. Larger, more ornate gateway signs will be more expensive.

Assumptions: Sign installed as a part of a larger project.

Photo/Image Credit: Google Earth

36c – Speed Feedback Signs

Description: Install speed feedback signs that show drivers how fast they are driving compared to the posted speed limit.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Unlike a static sign, a speed feedback sign needs power to operate.

Benefits: CRF of 10% for all crashes (RD12 from ODOT CRF list)

If setup is a dynamic speed feedback sign for curves in a rural area: CRF of 5% for all crashes (RD11 from ODOT CRF list)

Cost: $35,000 per Sign

Assumptions: Pedestal foundation, sign, and solar power with wiring

Photo/Image Credit: Speed Feedback Sign FHWA

Solutions Not Recommended for Risky Driving Behaviors:

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Add markers for where there are fatal crashes and incidents.
  - This suggestion, from the public, requires a broader statewide policy discussion and approach.
- Install flexible delineators along center striping or median barriers
  - Freight industry is unlikely to accept this without additional widening. Centerline rumble strips are proposed instead.

LOCATION-SPECIFIC SOLUTIONS

This section presents the location-specific solutions for three locations identified in Technical Memorandum #4 (Issues Summary). Near-term and long-term options are presented for each location, with discussion regarding anticipated safety benefits, cost estimates, and considerations regarding feasibility and impacts associated with each solution. When a solution is also included in the Corridor-Wide solutions referenced in the previous sections of the memorandum, the corresponding Solution ID is provided for reference.

MP 2.0 - 2.1: Wilson River Loop [East] Intersection

The project team identified the intersection of Wilson River Loop/OR 6 (East) due to safety issues. The reported crash data between 2016 and 2020 at this intersection showed that the majority of crashes were turning crashes, with more than half involving vehicles turning left from Wilson River Loop onto OR 6. Public input and project team site observations indicate that vehicles in the westbound right-turn lane can restrict sight distance for southbound vehicles waiting to turn left or right at the intersection.

This intersection has been flagged through safety analyses in the past and was reconstructed in 2012 to separate the north and south legs of the intersection (creating offset T-intersections) to reduce potential conflict points. However, the crash data analyzed for this study was all obtained after the intersection was reconstructed and indicates that the east intersection (with the north leg) continues to experience crashes associated with southbound left-turning movements.

Potential solutions to reduce crash risk at this intersection are presented below.

Near-Term Options:

Modify Right-Turn Lane

Figure 6 illustrates the near-term option for this intersection, which includes creating a 12-foot buffer between the westbound through travel lane and the right-turn lane. This project will improve sight distance for southbound vehicles and create further clarity regarding westbound right-turning vehicles. This project is currently identified in ODOT's 2021 – 2024 STIP. No design plans have been developed by ODOT.

Safety Benefits

This project will improve sight distance which is estimated to reduce crashes by 48 percent for all injury crashes (I17 from ODOT CRF list).

Currently, there is limited design standards and guidance on what conditions justify adding a buffer to a right-turn lane beyond crash frequency and severity patterns that may indicate a need to provide an improved departure sight distance triangle at an intersection. However, there are upcoming research publications that may provide clearer recommendations for the justification of an offset turn-lane which should be considered as preliminary engineering is completed for the potential solution.

Cost Estimate

This project is estimated to cost $3.8 million. This includes assumptions for construction, engineering, and construction management costs. No right-of-way costs are anticipated because the Wilson River Loop realignment project acquired significant right-of-way widths in this area to account for the wetland mitigation and highway improvement locations.

Considerations

The weigh station is located just east of this intersection, creating a weave section that is currently approximately 900 feet long. This project must balance achieving separation between the right-turn lane and through lane with allowing an adequate length for accelerating trucks to merge back into the through lane. A buffered right-turn lane concept was developed based on Figure 500-18 of the Highway Design Manual. This would reduce the weave section to approximately 720 feet.

There is an existing utility pole that is likely in the clear zone for the offset right turn lane. Guardrail would be required to protect traffic from this object in the clear zone, or it will have to be relocated.

A mitigation wetland was constructed with the Wilson River Loop realignment project. This area is near the headwaters of Hoquarten Slough, as well as wetlands mapped in the Tillamook Local Wetland Inventory and the National Wetland Inventory. In order to avoid wetland impacts minor retaining walls may be required with the project.

Figure 6. Right-Turn Lane Concept at Wilson River Loop Intersection

Long-Term Options:

Complete Intersection Control Evaluation and Install Roundabout

Installing a roundabout at the intersection is proposed as a potential long-term solution to reduce the likelihood of crashes at the intersection. Two options are presented: Figure 7 illustrates the concept that would install a roundabout at the current location, and Figure 8 illustrates the concept that would realign the intersection with the south leg with a roundabout. As discussed below, an Intersection Control Evaluation (ICE) will need to be completed to confirm that a roundabout is the preferred treatment at this location and evaluate the operational performance of the roundabout.

Safety Benefits

Converting a stop-controlled intersection to a roundabout is estimated to reduce injury crashes by 82 percent (H18 from ODOT CRF list). Roundabouts also help to slow speeds, which may create additional safety benefits along the highway.

Cost Estimate

This project is estimated to cost $7.8 million if a 3-leg roundabout (Figure 2) is constructed at the intersection with the north leg of Wilson River Loop and is estimated to cost $9.8 million if a 4-leg roundabout (Figure 3) is constructed at the intersection with the south leg of Wilson River Loop. This includes construction, engineering, and construction management costs. No right-of-way costs are anticipated because the Wilson River Loop realignment project acquired significant right-of-way widths in this area to account for the wetland mitigation and highway improvement locations.

Considerations

A roundabout was considered in the past, but at the time, ODOT had a policy of not installing roundabouts on state highways, primarily due to concerns with moving large freight through them. Since then, extensive outreach and testing has been conducted, including driving oversize loads through temporary roundabouts. After positive results, ODOT removed this restriction several years ago and several roundabouts have been constructed on state highways across the state. These roundabouts have shown to be effective at accommodating traffic including freight while also reducing crashes. Based on these results and the continued crash history at the Wilson River Loop intersection, the project team believes a roundabout should be reconsidered as a long-term solution at this intersection.

If the traffic control is changed at the intersection, then an ICE is required to determine the most appropriate traffic control. In order to complete the ICE, the traffic operations at the intersection

would be analyzed to determine appropriate type and scale of improvements such as the number of lanes required for a roundabout. The project team has not completed an ICE or the supporting traffic analysis at the time of this memorandum. In addition, State Traffic Roadway Engineer (STRE) approval would be required.

In the current configuration, Wilson River Highway has one travel lane in each direction, a left-turn lane, median acceleration lane, buffer widths between lanes and shoulders. At either potential roundabout location, the highway cross section would be able to be reduced to a travel lane in each direction, a center raised median (splitter island), and shoulders. The entrance ramp from the weigh station in both configurations could be realigned to be a standard highway entrance and the weave section would be removed, further increasing safety. In the four-leg alternative, about 1,500 feet of Wilson River Loop could be removed which would reduce impervious area as a part of the project.

A mitigation wetland was constructed with the Wilson River Loop realignment project at both the south and north T- intersections with Wilson River Highway. This area is near the headwaters of Hoquarten Slough, as well as wetlands mapped in the Tillamook Local Wetland Inventory and the National Wetland Inventory. In order to avoid wetland impacts minor retaining walls may be required with the project.

Solutions Not Recommended at Wilson River Loop [East] Intersection:

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Install traffic signal – not recommended due to increase in rear-end crashes that would be expected at this location (rural, higher speed area). An ICE may further explore this option to confirm this assumption.
- Install warning sign about sight distance issues associated with seeing westbound approaching traffic – not recommended because the near-term solution will address the sight distance issues.
- Provide Median U-Turn (MUT)/J-Turn – not recommended because the roundabout is expected to have fewer impacts and better align with driver expectation.

Figure 7. Roundabout Concept at Wilson River Loop (East) Intersection

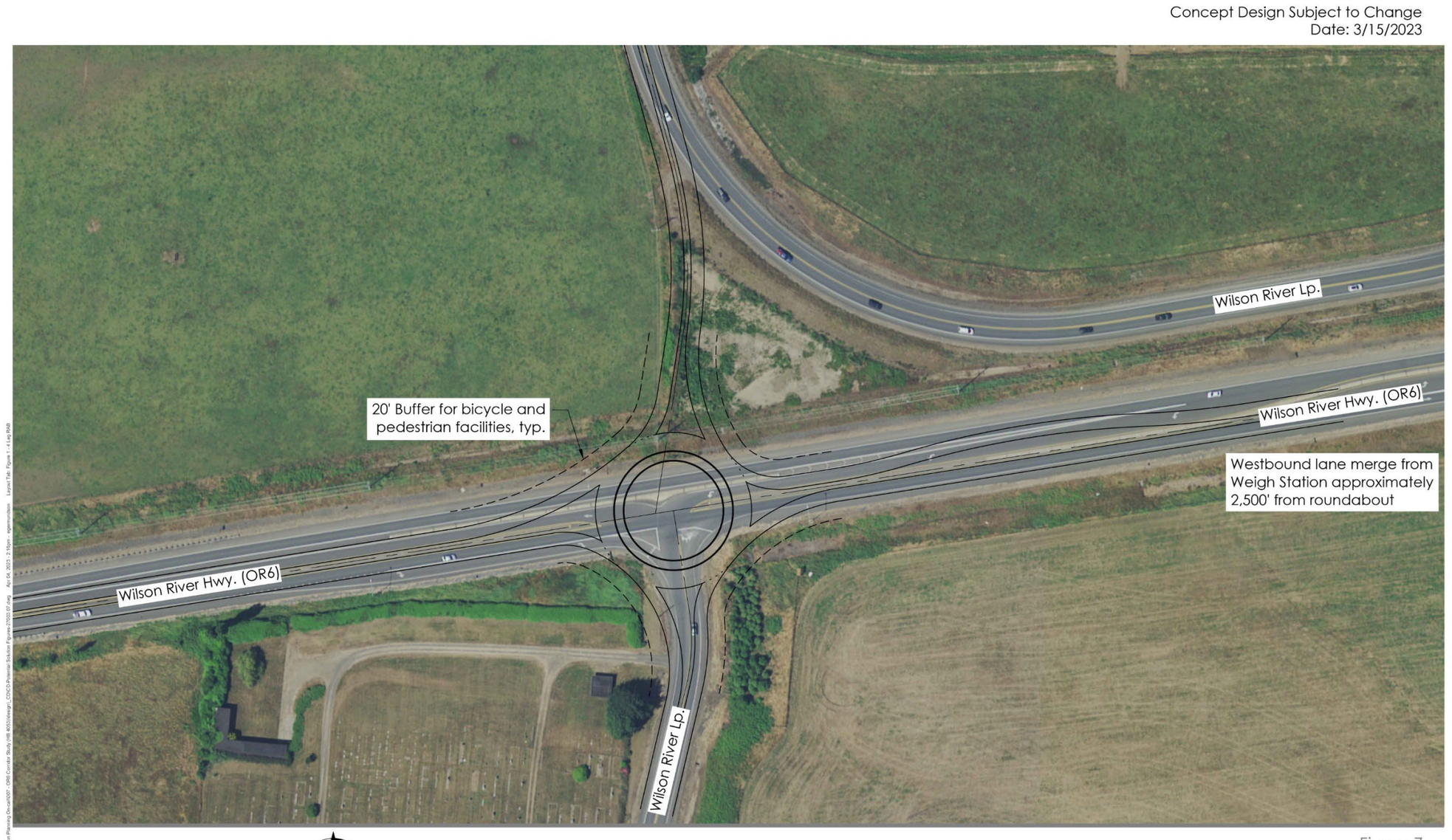
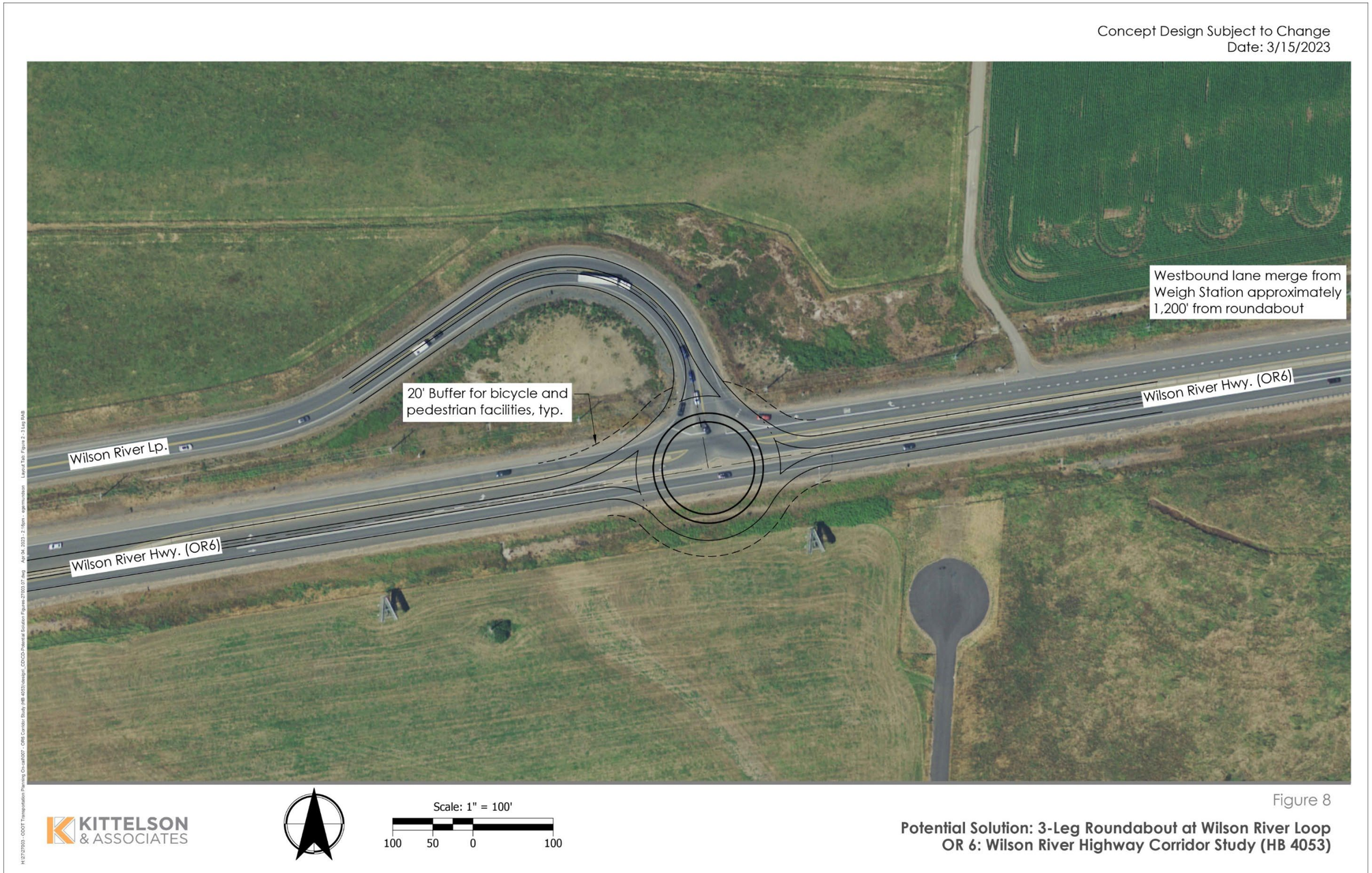


Figure 7

Potential Solution: 4-Leg Roundabout at Wilson River Loop
OR 6: Wilson River Highway Corridor Study (HB 4053)

Figure 8. Roundabout Concept at Wilson River Loop (West) Intersection



MP 42.2 (Gales Creek Intersection)

The OR 6/Gales Creek Road intersection was identified based on the safety analyses and operational analyses. This intersection has a skewed angle and exceeds the expected crash rate for similar intersections statewide. In addition, it meets volume criteria for a westbound left-turn lane on OR 6.

Potential solutions to reduce crash risk at this intersection are presented below.

Near-Term Options:

Install Delineators

Delineators can be used to increase intersection visibility.

(See Solution ID 01)

Improve Intersection Warning Signage and Striping

This recommendation is intended to further increase intersection awareness for drivers by installing double intersection ahead signs and additional road name signs approximately ¼ mile in advance of the intersection. Signs with large font and retroreflective sheeting should be used. Figure 9 illustrates a potential concept with additional warning signage.

In addition to signage enhancements, wider (6") striping should be installed along with recessed pavement markers (RPMs) to increase visibility of the intersection.

(See Solution IDs 01, 03, 19d)

Safety Benefits

These expected benefits of this project vary depending on how many countermeasures are installed together. The CRF indicates an anticipated reduction of 20 percent for projects with one to two countermeasures, 25 percent reduction for projects with 3 to 4 countermeasures, and 30 percent reduction in all crashes for five to seven countermeasures (I21 from ODOT CRF list).

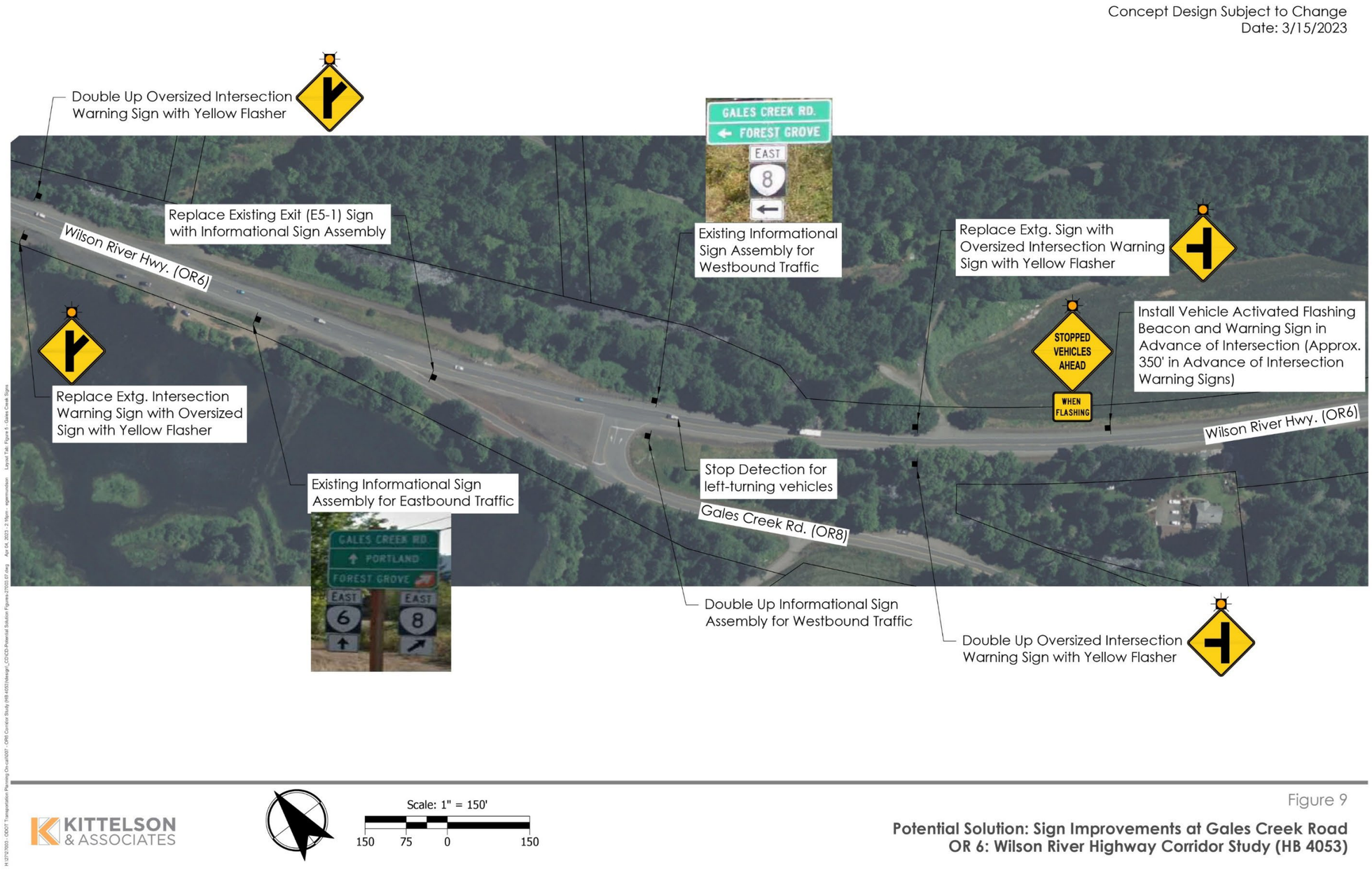
Cost Estimate

The estimated cost to install each additional intersection warning sign is $1,500. The estimated cost to install wider, 6-inch, striping is $95,000 per mile. It is assumed that these costs would be included in a larger work package.

Considerations

This project would include improving existing lane configurations and would have a typical permitting process. All of the signs with flashers are assumed to use solar power in order to reduce impacts and costs from conduit trenching to hardwire flashers.

Figure 9. Signage Enhancements at OR 6/Gales Creek Road



Improve Intersection Sight Distance

Although this intersection meets minimum sight distance for a 55-mph road, the vehicles traveling along this corridor are frequently traveling at higher speeds. The intersection is located just west of a horizontal curve, which can create challenges with sight distance for vehicles attempting to turn onto OR 6. This recommendation includes improving sight distance by clearing vegetation to the extent possible.

(See Solution ID 07)

Long-Term Options:

Install Actuated Intersection Warning System (For Mainline Vehicles)

As shown on Figure 9, another signage option for reducing crash risk is an actuated intersection warning system. This system will detect vehicles stopped and waiting on OR 6 to complete a left-turn onto Gales Creek Road. Because the intersection is located just west of the curve, vehicles approaching from the east may not be expecting a stopped vehicle waiting to turn. This system will provide additional warning time to alert those approaching vehicles to slow down and stop. This system will cost more than standard signage enhancements due to the technology needed, but it will be more cost effective than widening for a left-turn lane.

(See Solution ID 05)

Install Actuated Intersection Warning System (For Side Street Vehicles)

Another application of the actuated intersection warning system is one that detects vehicles on the side street waiting to turn. This system will alert vehicles approaching on OR 6 that there is a vehicle turning ahead, allowing mainline vehicles to slow and look for the turning vehicle.

(See Solution ID 06)

Install Westbound Left-Turn Lane

Figure 10 illustrates the concept of widening to add a westbound left-turn lane at the intersection and the realignment of Gales Creek Road. This concept provides dedicated space for slowing and stopped vehicles waiting to turn onto Gales Creek Road, reducing the risk of rear-end crashes associated with vehicles slowing in the travel lane. In addition, this concept includes the removal of the free flow right-turn lane and installation of a right-turn deceleration lane to encourage slower, turning speeds and reduce potential conflicts with right-turning vehicles.

(See Solution ID 08)

Safety Benefits

This project is estimated to reduce crashes by 44 percent (H9 from ODOT CRF list).

Cost Estimate

The project is estimated to cost $14.2 million. This cost includes construction, engineering, and construction services.

Considerations

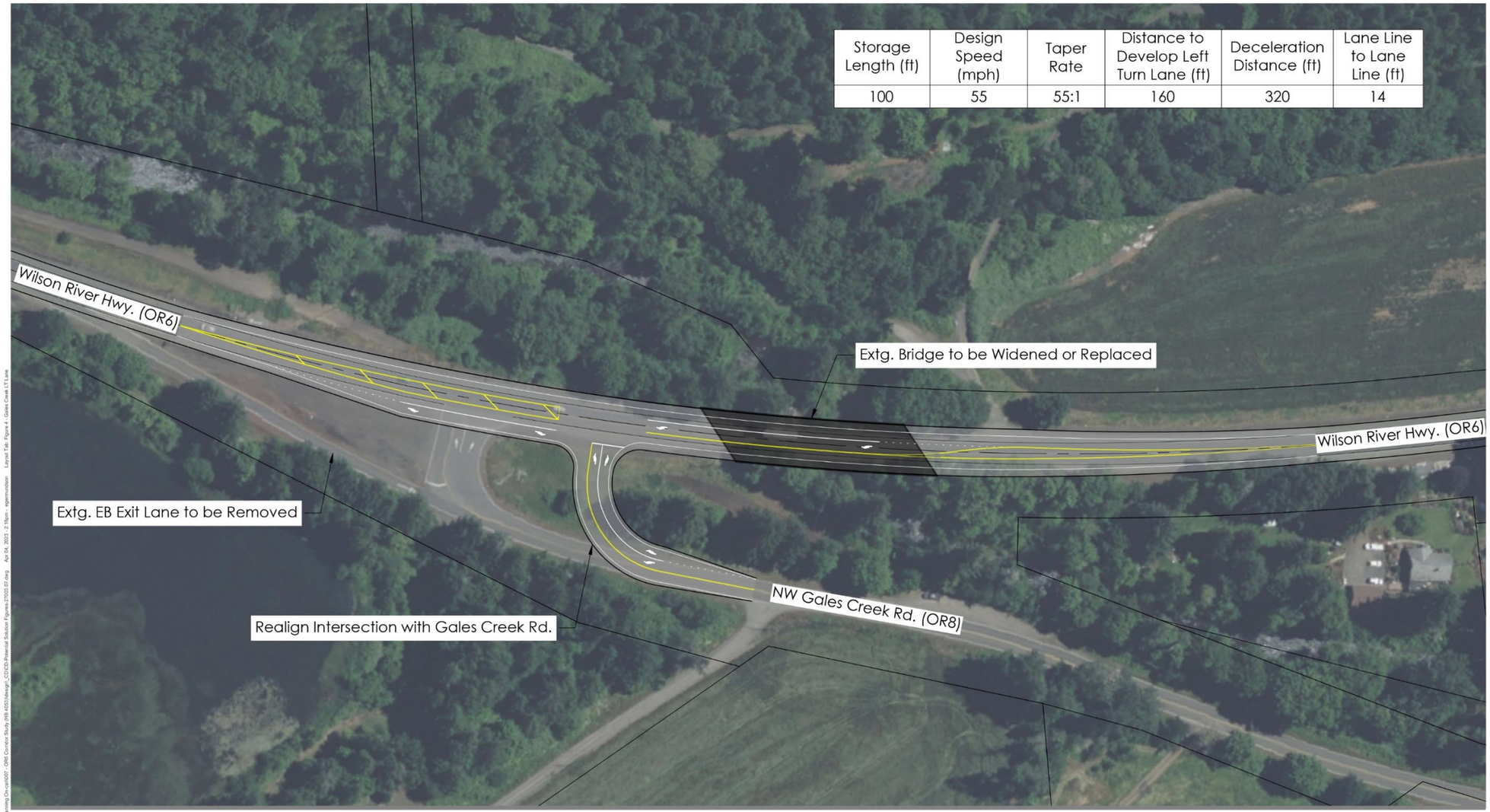
This project will include the widening or reconstruction of bridge no. 07677 which spans Gales Creek. The bridge is in fair condition, but would likely require seismic retrofit and widening, if not a full replacement. Retaining walls are likely to be required at all bridge approaches.

This project would have some environmental considerations because the bridge will be impacted with this project. Gales Creek is designated Essential Salmonid Habitat (ESH) and critical habitat for steelhead (Oncorhynchus mykiss) of the Upper Willamette River Distinct Population Segment (DPS). In addition, there are wetlands and waters around the project that are jurisdictional and so additional permitting processes will need to be followed.

Figure 10. Westbound Left-Turn Lane at Gales Creek Road

Concept Design Subject to Change
Date: 3/15/2023

Storage Length (ft)	Design Speed (mph)	Taper Rate	Distance to Develop Left Turn Lane (ft)	Deceleration Distance (ft)	Lane Line to Lane Line (ft)
100	55	55:1	160	320	14



KITTELSON & ASSOCIATES

Scale: 1" = 100'
100 50 0 100

Figure 10

Potential Solution: Gales Creek Left-Turn Lane & Realignment
OR 6: Wilson River Highway Corridor Study (HB 4053)

Solutions Not Recommended at Gales Creek Intersection:

This section lists solutions that were included in brainstorming sessions or suggested by the public but are not recommended by the project team:

- Roundabout: There is likely not adequate space for a roundabout to fit between the creek and the pond.

MP 31 – 35 (Horizontal Curves and Pull-outs)

The segment from approximately MP 31 to 35 was flagged through the safety analyses, inventory of roadway conditions, and public input. Public input indicated drivers are concerned about safety in this area, feel that the passing opportunities are too short, and noted poor and uneven pavement conditions.

This section of the corridor contains poor pavement conditions, several short climbing lanes, many areas of unstable slopes, horizontal curves, and includes the summit of the pass (the highest elevation of the corridor). As summarized in TM#4, the three westbound climbing lanes between MP 33 and 36 are shorter than guidance suggests for minimum lengths. In addition, recent changes to the striping have effectively shortened the distance available for passing even further.

As documented in TM#4, there were 65 reported crashes between MP 31 and 35 between 2016 and 2020, including seven fatal/severe injury crashes. There were 12 head-on or sideswipe meeting crashes within this area. Forty-five percent of crashes on this segment occurred on snow or ice conditions.

During future project development and design, this site may increase in size based on location of similar conditions in the corridor (curves, poor pavement conditions, location of passing opportunities, crashes, etc.). It is likely that a project for this section may have impacts from approximately MP 30 to MP 37.

Potential solutions to reduce crash risk along this section of the corridor are presented below.

Near-Term Options:

Install Delineators

Delineators can be used to visually guide drivers when they are approaching a curve by decreasing spacing on the approach to and throughout the curve. ODOT's standard drawing TM570 lists maximum delineators spacing based on the degree of curve of a horizontal curve.

The standard drawing also documents the reduced spacing approaching curves to provide the visual indication to drivers. The standard spacings are the maximum values with the minimum spacing at any location being 20 feet. Closer spacing may be used to provide more continuance guidance, but the change in spacing approaching the curves should be maintained.

(See Solution ID 09)

In areas with limited width, alternative installations may be considered such as installing linear delineators on existing guardrail, or adding post delineators on chevrons on curves. There is no design standard for the delineators installed on chevrons, but ODOT considers this a maintenance option.

Recessed Pavement Markers (RPMs)

Similar to post delineators, recessed pavement markers (RPMs) can be installed to provide additional visual guidance through curves. Installation of these pavement markers can supplement existing pavement markings.

(See Solution ID 19d)

Pavement Rehabilitation

This section of the highway includes poor pavement with active landslides. Pavement rehabilitation is suggested to improve pavement conditions, including the installation of high friction pavement, addressing superelevation issues, and extending the life of the pavement by installing geogrid. High friction pavement will increase pavement friction in wet conditions. Due to unstable slopes, some of the pavement has settled, resulting in roadway slopes or superelevation in the wrong direction; this project should address these issues. Geogrid is an option for reinforcing the pavement to better protect against settling and unstable slopes.

(See Solution ID 22)

As part of this project, ODOT should review the roadway drainage performance and needs near milepost 30.5, at the low point of the roadway. Comments indicate a potential drainage issue at this location.

Long-Term Options:

Install Weather Warning System

This section of the highway includes the peak elevation of the corridor, the summit. Snow and ice involved crashes were most prevalent in this section, accounting for 45 percent of crashes between MP 31 and 35. A weather warning system is recommended to help inform drivers

when snow or ice conditions are present and encourage appropriate speeds. The weather warning system is described in Solution ID 24 in the corridor-wide potential solutions.

Modify Passing Opportunities

As described above (Passing Opportunities on pages 26 through 47), this section of the highway contains several short climbing lanes in both directions. The corridor-wide potential solutions for passing opportunities, in particular Longer Climbing Lanes Near the Summit (Solution ID 15) and Remove Short Climbing Lanes (Solution ID 16) are located within this section. Refer to discussion in those sections for more details regarding these projects.

Any large capital improvement projects should also evaluate side street approaches to the highway to determine if wider approaches are needed to better accommodate movements between the highway and side street. For example, public comments indicate a concern regarding side street width being inadequate for two vehicles to pass each other at Drift Creek Road, near MP 30.5.

Solutions Already Implemented Near MP 31 to 35:

This section summarizes recent improvements that ODOT has completed along the corridor. These improvements may not have been in place at the time of the reported crash data, but are not included as potential solutions because they have already been completed.

- Installed curve warning signs where missing based on recent ball bank analysis.
- Reviewed unstable slopes in corridor. Unstable slope locations were assigned a maintenance cost, a repair cost, and a hazard score from which recommendations were developed for which repair location are the highest priority.

NEXT STEPS

The Project Team requests input on this draft Technical Memorandum #5: Potential Solutions from the public and project advisory committees. After gathering put, the project team will revise the suggested solutions and develop the Draft Corridor Study.

ATTACHMENT A

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Technical Appendix A: Cost Estimate Assumptions

May 22, 2023 Project# 27003.003

RE: OR 6: Wilson River Highway Corridor Study (HB 4053)

OR 6: WILSON RIVER HIGHWAY CORRIDOR STUDY (HB 4053)

This technical appendix summarizes the assumptions made when determining estimated costs for various solutions project types. This includes the location specific projects and the corridor wide projects discussed in Technical Memorandum #5.

Specific assumptions are listed in later sections of this appendix. The following general assumptions were made for all estimates that were completed:

- Estimates are in 2023 dollars and do not include inflation or future market changes
- Unit costs determined based on most recent ODOT bid pricing, where available
- Cost estimates may vary based on how final project are bundled and delivered
- Cost Estimates do not include Maintenance and Operations costs
- 50% Contingency added to site-specific project costs
- 50% Contingency added to corridor wide systemic estimates
- All costs rounded up to nearest appropriate significant figures

CORRIDOR-WIDE SOLUTIONS

Delineators

- Cost per delineator - $80 ea.
- Avg cost per intersection or driveway
    - 800 ft. either side of intersection
    - 500 ft. either side of driveway
    - 100 ft. spacing on approach and 50 ft. spacing at intersection per TM576
    - Driveway Cost = (1,000 ft./100 ft.*2 Sides+4 at driveway) * $80 ea. = $1,920
    - Intersection Cost = (1,600 ft./100 ft.*2 Sides+8 at int.) * $80 ea. = $3,200
    - Driveway Cost with 50% Contingency = **$3,000**
    - Intersection Cost with 50% Contingency = **$5,000**
- Avg cost per curve (use ODOT spacing standards… or note if you differ)
    - Average curve length = 3,650 ft.
    - 40 ft. spacing, tapered spacing at ends (below max. listed in TM570)
    - Curve Cost = 6 + (3,650 ft. – 2*(80 ft. + 120 ft. + 240 ft.))/40 ft. * $80 = $6,020
    - Curve Cost with 50% Contingency = **$9,500**

Signage

- Warning signs (multiple identified in technical memorandum)
    - Cost per Sign with 50% Contingency = **$1,500**
        - Cost per Sign = $10/lb. * 2.5 lb./ft. * 10ft. + $40/sq. ft. * 16 sq. ft. = $890 (round up)
        - Unit Price = $10/lb. for PSST and $40/sq. ft. for sheet aluminum sign (Per ODOT historical pricing)
        - Assumed 2 1/2", 10-gauge PSST, 10' length, and typical 48" x 48" sign
- Signs indicating parking areas
- Reflective guide signs
- Street name signs
- Milepost signs
    - 1 Type C (10" x 36") Sign + 1 Milepost Marker Post per Sign
    - Sign = (10 in. x 36 in.) * (1 sq. ft. / 144 sq. in.) * $40/sq. ft. = $100
    - Post = $280 ea. (Per ODOT historical bid pricing)
    - Sign Assembly with 50% Contingency = **$600 ea.**
- Gateway signage
    - Cost Per Sign with 50% Contingency = **$1,600 ea.**
    - Cost per Sign = $10/lb. * 2.5 lb./ft. * 10ft. + $40/sq. ft. * 2.5 ft. * 8 ft. = $890 (round up)

- Unit Price = $10/lb. for PSST and $40/sq. ft. for sheet aluminum sign (Per ODOT historical pricing)
- Assumed 2 1/2", 10-gauge PSST, 10' length

Speed Feedback Signs

- Unintegrated Speed Feedback Assembly with 50% Contingency = **$35,000**
  - Vehicle pedestal and foundation = $4,000 ea. * 2 = $8,000
  - Speed Sign (R2-1) = $500 ea. * 2 = $1,000
  - Speed Feedback Sign with Solar = $4,500 ea. * 2 = $9,000
  - Conduit & Wiring = $5,000 Lump Sum

Rumble Strips

- Shoulder Cost per Mile = **$4,500** (from ODOT historical bid pricing) + 50% Contingency
- Centerline Cost per Mile = **$2,500** (from ODOT historical bid pricing) + 50% Contingency
- Assume included in resurfacing or other project

Defining Access Points

- Curb Cost Per Foot = **$50** (Based on historical bid pricing)

Striping

- Wider Centerlines
  - Assumes Double No-Pass "D" stripe type
  - $2 ft. for 4" equivalent
  - Cost with Contingency = $3/ft. * 5280 ft./mi. * 2 6" stripes * 150% = **$48,000 mi.**
- 6" long lines (required everywhere per new MUTCD)
  - Assumes White 4" "W" stripe for fog lines and Double No-Pass "D" stripe for centerline
  - Unit Cost $3 ft. ($2 ft. for 4" equivalent)
  - Cost with 50% Contingency = $3/ft. * 5280 ft./mi. * 4 stripes * 150% = **$95,000 mi.**
- Restriping or adding striping along with passing lane projects
  - See "Reflective Striping" below.
  - Note, larger quantities will significantly reduce unit price for striping installation.
- Reflective Striping
  - Assumes White 4" "W" stripe for fog lines and Double No-Pass "D" stripe for centerline
  - Unit Cost $2 ft. for 4" reflective
  - Cost with 50% Contingency = $2/ft. * 5280 ft./mi. * 4 stripes * 150% = **$95,000 mi.**

Recessed Pavement Markers

- Cost per Mile with 50% Contingency = **$3,000 per Mile**
    - RPM = $15 ea.
    - 40 ft. spacing for YB/R-40 and D/R-40 (assumed typical spacing)
    - Cost per Mile = 5,280 ft./40 ft.*$15 = $1,980

Mainline Actuated Intersection Warning System

Install actuated intersection warning system for detecting vehicles waiting on the mainline at higher-volume destinations.

- Cost with 50% Contingency = **$95,000**
- Vehicle Pedestal + Foundation = $4,000 * 2 ea. = $8,000
- Amber Flasher = $1,000 ea. * 2 = $2,000
- Permanent Signs = $3,000 ea. * 2 = $6,000
- Conduit + Wiring = $20/ft. * 2,000 ft. = $40,000
- Junction Boxes = $500 ea. * 4 = $2,000
- Loop Detection = $5,000 ea.
- Total = $8,000 + $2,000 + $6,000 + $40,000 + $2,000 + $5000 = $63,000

Side Street Actuated Intersection Warning System

Install actuated intersection warning system for detecting vehicles waiting to turn from the side street at higher-volume destinations. (See cost above)

Install Left-Turn Lane at Key

- See Left-turn at Gales Creek project for example of estimated cost

Modify or Flatten Curve Radii (where possible)

- Due to the impacts and scale of a highway realignment project, the project team is assuming this will not be feasible in the foreseeable future
- Assumed cost would be multi-million dollar

Passing Opportunities

- See previous discussions of passing opportunity projects

High Friction Surface Treatments (HFST)

- High friction surface treatments (HFST) are pavement treatments that dramatically and immediately reduce crashes, injuries, and fatalities associated with friction demand issues, such as:
    - A reduction in pavement friction during wet conditions, and/or
    - A high friction demand due to vehicle speed and/or roadway geometrics.
- 10 year life cycle
- Cost = $50 Sq. Yd. (Per FHWA – Link)

Weather Warning System

- Assuming 4 notification signs (2 in each direction)
- Traffic cameras at summit
    - **Cost with 50% Contingency = $55,000**
    - Camera = $5,000 ea. * 2 (one eastbound, one westbound) = $10,000
    - Battery Back-up = $4,000 ea.
    - Luminaire = $8,000 ea.
    - Power Connection = $2,500 ea.
    - Junction Box = $500 ea.
    - Conduit and Wiring = $20/ft. * 500 ft. = $10,000
- Weather detection system at summit (any other locations?)
    - Temperature gauge
- Install snow zone signs that can be remotely activated

Variable Message System

- 3 potential locations in westbound direction, 1 eastbound (or just give price per sign…)
- Would there be a different cost for dynamic message signs that could be used for wildlife warning throughout the corridor?
- **Cost Per VMS with 50% Contingency = $600,000**
    - Assumes Type 2 (3 - 12 character lines)
    - Monotube Cantilever Sign Structure = $15/lb. * 12,500 lbs. = $187,500 ea.
    - Drilled Shaft Foundation = $3,000/ft. * 20 ft. = $60,000 ea.
    - VMS Display Board = $50,000 ea.
    - Guardrail and roadway improvements = $100,000
    - Cost = $187,500 + $60,000 + $50,000 + $100,000 = $397,500 ea.

LOCATION-SPECIFIC SOLUTIONS

MP 2.0 - 2.1 (Wilson River Loop [East] Intersection)

4 Leg Roundabout at Wilson River Loop

- Removal of realigned Gales Creek Road and impervious area
- Generally flat, no walls assumed
- Impacts to wetland mitigation area constructed with OR6 @ Wilson River Loop Road (C14479)

Geotechnical Considerations

No significant geotechnical issues anticipated

Environmental Considerations

There may be wetlands and/or waters in and around this project area that are jurisdictional to the Oregon Department of State Lands (DSL) and/or the U.S. Army Corps of Engineers (USACE). This area is near the headwaters of Hoquarten Slough, as well as wetlands mapped in the Tillamook Local Wetland Inventory and the National Wetland Inventory. Additionally, there are wetlands that were constructed as part of the previous realignment of Wilson River Loop Road in this area, and they too would be jurisdictional to the DSL if they were developed as mitigation.

The DSL and USACE Removal-Fill permitting processes require all wetlands and waters to first be delineated, described in a wetland delineation report, and then the wetland/waters types and boundaries must be concurred with by the DSL.

- This project would likely require two days (including travel) for two scientists to delineate on-site wetlands and waters. The cost for this effort would be approximately $5,000-7,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort not included in this cost.
- The wetland delineation report would take approximately two weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $6,000-8,000 including expenses.

A Joint Permit Application (JPA) would then need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 Clean Water Act (CWA) permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures General Permit (GP) from DSL, which would take approximately 70 days to process once the completed application is submitted for review. Or, if the project does not meet the criteria for a GP, then it would require an Individual Permit (IP) from the DSL, which takes approximately 120 days for DSL to review and process. The CWA 401-C certification is administered by the Oregon Department of Environmental Quality (DEQ) to authorize water quality impacts on Waters of the U.S. under CWA Section 401-C. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization). The USACE cannot authorize the 404 permit until DEQ provides the 401-C certification. If the project is authorized under an Individual Permit, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require an Oregon Rapid Wetland Assessment Protocol (ORWAP) to be completed. The cost for these efforts would be approximately $11,000-13,000 including expenses.
- A standard post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection and the preparation of a report demonstrating the project was implemented per the requirements of the permit. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $34,000-46,000. This project is in the Wilson Trask Nestucca service area and may also require the purchase of wetland mitigation bank credits to offset impacts to wetlands (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by the Federal Aid Highway Program (FAHP), consultation with the National Marine Fisheries Service (NMFS) and the Unites States Fish and Wildlife Service (collectively referred to as the "Services") per Section 7 of the Endangered Species Act (ESA) would be covered by the FAHP programmatic biological opinion (BO). As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: realign the roadway;

change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct at least two site visits. The cost for these efforts would be approximately $10,0000-12,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$34,000-43,000** including expenses. Again, this does not include the cost of wetland mitigation bank credits or in-kind mitigation to offset impacts to wetlands, if required.

3 Leg Roundabout at Wilson River Loop

- Jurisdictional Hoquarten Slough Headwater Channel at NE quadrant of roundabout adjacent to existing roadway
- Impacts to wetland mitigation area constructed with OR6 @ Wilson River Loop Road (C14479)
- Generally flat, no walls assumed
- This potential project has the same environmental considerations and costs as the 4-leg roundabout discussed above, but it may also require compliance with Oregon's Fish Passage Law [Oregon Administrative Rules (OARs) 635-412-0005 to 635-412-0040].

Geotechnical Considerations

No significant geotechnical issues anticipated

Environmental Considerations

Wetlands/Waters

See summary for the first potential project, "4-Leg Roundabout at Wilson River Loop Road."

Endangered Species

This project would be like the first potential project, "4-Leg Roundabout at Wilson River Loop Road," but it may require additional effort to accommodate the replacement or modification of a culvert.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct at least two site visits. The cost for these efforts would be approximately $11,0000-13,000 including expenses.

Fish Passage Plan

If the Oregon Department of Fish and Wildlife (ODFW) determines that the small headwater tributary to the Hoquarten slough is inhabited, or has been historically inhabited, by native migratory fish (including lamprey species), then the project would require a fish passage plan for any water crossings installed, replaced, repaired, or otherwise modified by the project (this requirement can be exempted or waived in some cases, but this summary assumes that it will be required for this project). All work below the Ordinary High Water Mark (OHWM) would have to occur in an isolated in-water work (IWW) area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to relocate aquatic species from the isolated IWW area (known as 'fish salvage') before work could commence. Lastly, all IWW would have to occur within a specific period approved by ODFW known as the IWW window (IWWW).

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $3,000-5,000 including expenses.
- Fish salvage would require a Scientific Take Permit (STP) application to be created, approved by ODFW and NMFS, and then closed out after salvage is complete with the results. Fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$51,000-69,000** including expenses. This includes the costs associated with wetland/waters and ESA permitting described for the first project and the costs of fish passage and salvage. This does not include the cost of wetland or waters mitigation bank credits or in-kind mitigation, if required. This cost also assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort by the project team not included in this cost.

Buffered Right Turn Lane at Wilson River Loop

- Potential retaining walls needed to avoid impacts to wetland mitigation area and jurisdictional Hoquarten Slough
- Guardrail required to protect existing utility pole in proposed clear zone
- No significant geotechnical issues anticipated. Potential presence of soft soils for retaining wall support however given minimal fill heights, conventional CIP or MSE walls are likely suitable.
- This potential project has the same environmental considerations and costs as the 3-leg roundabout discussed above.

Environmental Considerations

Wetlands/Waters
See summary for the first potential project, "4-Leg Roundabout at Wilson River Loop Road."

Endangered Species
See summary for the second potential project, "3-Leg Roundabout at Wilson River Loop Road."

Fish Passage Plan
See summary for the second potential project, "3-Leg Roundabout at Wilson River Loop Road."

Total Cost of Environmental Permitting For This Potential Project
The total cost of environmental permitting for this potential project would be approximately **$51,000-69,000** including expenses. This includes the costs associated with wetland/waters and ESA permitting described for the first project, and the costs of fish passage and salvage described in the second project. This does not include the cost of wetland or waters mitigation bank credits or in-kind mitigation, if required. This cost also assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort by the project team not included in this cost.

MP 31 – 35 (Horizontal Curves and Pull-outs)

Climbing Lane Project A - Connect Existing Climbing Lanes

- Add EB climbing lane from M.P. 31.85 – M.P. 32.20
- Add WB climbing lane from M.P. 33.78 – M.P. 34.40

Geotechnical Considerations

- Most of this section is existing bridge no. 02472
- Seismic retrofit/widening or replacement likely required given age of bridge and seismic vulnerability rating. If full replacement, will need to consider staging aspects and potential need for temp detour structure.
- Approx. 600' long bridge spanning what appears to be deep canyon. Bridge retrofit/widening or replacement will be very expensive.
- Assume driven piles at end bents and drilled shafts at any interior bents for widening/replacement.
- Anticipate need for significant cuts/fills and potentially retaining walls to accommodate widening west of the bridge.
- No unstable slopes but DOGAMI mapped landslide deposit crosses OR6 between MP 31.85 – MP 31.95 west of the bridge. This is a large dormant landslide that is referenced in

the ODOT OR6 Unstable Slopes memo, dated January 2023. Any earthwork, particularly related to upslope cuts for highway widening in this area will be very risky and require considerable investigation during design, possibly mitigation, and monitoring during construction.

- Low risk area for liquefaction so do not anticipate significant geotechnical issues for bridge widening/replacement.
- Rockfall at MP 32.16 (SL037-0032-16LW1)
- This is upslope of WB travel lanes so may not need to mitigate for EB widening project
- Unstable slopes:
    - Fill failure at MP 33.89 (SL037-0033-89BB1)
        - ODOT indicates yearly maintenance required
        - Appears ~250′ long soldier pile or GSI retaining wall already exists along shoulder of roadway (TransGIS references 2008 GRI Investigation), unclear if retaining wall has stopped slide movement as extensive patching is present in roadway
        - ODOT estimated repair cost = $640k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 300′ slide width x $10,000/lf = $3.0M
    - Fill failure at MP 33.96 (SL037-0033-96BB1)
        - ODOT indicates yearly maintenance required
        - ODOT estimated repair cost = $180k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
    - Fill failure at MP 34.07 (SL037-0034-07LW1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $320k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
    - Fill failure at MP 34.09 (SL037-0034-09LW1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $640k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
    - Fill failure at MP 34.24 (SL037-0034-24BB1)
        - ODOT indicates maintenance 4-5 times per year
        - Appears ~185′ long soldier pile or GSI retaining wall already exists along shoulder of roadway (TransGIS references 2008 GRI Investigation), unclear if retaining wall has stopped slide movement as extensive patching is present in roadway
        - ODOT estimated repair cost = $700k

        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 200' slide width x $10,000/lf = $2.0M
    - Fill failure at MP 34.42 (SL037-0034-42LW1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $640k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 250' slide width x $10,000/lf = $2.5M

Environmental Considerations

This environmental summary assumes that Bridge 02472 would have to be replaced with a multi-span bridge to facilitate an EB climbing lane, and that the replacement bridge meets the fluvial performance standards of the FAHP programmatic BO (i.e., its abutments span at least 2.2 times the active channel width). The Devils Lake Fork Wilson River is designated critical habitat for coho salmon (O. *kisutch*) of the Oregon Coast Evolutionarily Significant Unit (ESU), and is ESH for steelhead. The project area around MP 33.78-34.40 is in an area that likely does not have jurisdictional wetlands or waters, and no ESA concerns; permitting requirements for this area will likely be limited to FAHP programmatic BO standards and procedures.

Wetlands/Waters

There are wetlands and/or waters in and around this project area that are jurisdictional to the DSL and the USACE. This area includes ESH of the Devils Lake Fork Wilson River, so any amount of removal or fill from wetlands adjacent to the river will require a DSL permit. Additionally, the Devils Lake Fork Wilson River and its tributaries, and any ditches with a free and open connection to the River (including culverts) that also contain game fish would be jurisdictional to the DSL. The USACE would likely assume jurisdiction over the Devils Lake Fork Wilson River and any ditch or natural tributary connected to the River with relatively permanent or perennial flow, and any wetlands adjacent to these waters.

The DSL and USACE wetland/waters permitting processes requires all wetlands and waters to first be delineated, described in a wetland delineation report, and then the wetland/waters boundaries must be concurred with by the DSL.

- This project may require up to two days (including travel) for two scientists to delineate on-site wetlands and waters. Access and foot travel below the bridge would be challenging. The cost for this effort would be approximately $5,000-7,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort not included in this cost.
- The wetland delineation report would take approximately two weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and

concurrence. The cost for this effort would be approximately $7,000-9,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require multiple ORWAPs and SFAMs to be completed. The cost for these efforts would be approximately $18,000-20,000 including expenses.
- A post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $42,000-54,000. This project may also require the purchase of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: add a lane and/or widen road shoulder(s); change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Bridge replacement would have to meet FAHP fluvial performance standards and would require additional coordination with NMFS to optimize the bridge design, construction BMPs, and streambed/bank restoration to minimize impacts to salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification (including a bridge supplement), construction, and post-construction documentation; and conduct multiple site visits. The cost for these efforts would be approximately $13,000-15,000 including expenses.

Fish Passage Plan

This project would require a fish passage plan due to the Oregon Fish Passage Law trigger from the bridge replacement. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $5,000-7,000 including expenses.
- Fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$63,000-81,000** including expenses. This does not include the cost of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters, if required.

Climbing Lane Project B – Connect Existing and Complete Climbing Lanes Over Summit

- Add EB climbing lane from:
  - M.P. 31.85 – M.P. 32.20
  - M.P. 32.82 – M.P. 33.32
- Add WB climbing lane from:
  - M.P. 32.27 – M.P. 33.53
  - M.P. 33.78 – M.P. 34.40
  - M.P. 34.66 – M.P. 35.45

Geotechnical Considerations

- Add EB climbing lane from:
  - M.P. 31.85 – M.P. 32.20
    - See write up for Project A

- M.P. 32.82 – M.P. 33.32
  - Unstable slopes:
    - Fill failure at MP 33.21 (SL037-0033-21BB1)
      - ODOT indicates twice yearly maintenance required
      - Appears ~250′ long soldier pile or GSI retaining wall already exists along shoulder of roadway (TransGIS references 2008 GRI Investigation), unclear if retaining wall has stopped slide movement as extensive patching is present in roadway
      - ODOT estimated repair cost = $2.9M
      - Assume widening/mitigation with soldier pile tieback wall
      - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
    - Fill failure at MP 33.26 (SL037-0033-26LW1)
      - ODOT indicates less frequent maintenance (every 5 years or less)
      - ODOT estimated repair cost = $960k
      - Assume widening/mitigation with soldier pile tieback wall
      - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M
    - Fill failure at MP 33.32 (SL037-0033-32LW1)
      - ODOT indicates less frequent maintenance (every 5 years or less)
      - ODOT estimated repair cost = $960k
      - Could get away without mitigation if widening occurs along EB lanes
      - Assume widening/mitigation with soldier pile tieback wall
      - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M
- Add WB climbing lane from:
  - M.P. 32.27 – M.P. 33.53
    - Unstable slopes:
      - Fill failure at MP 32.31 (SL037-0032-31RE1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $320k
        - Could get away without mitigation if widening occurs along WB lanes
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
      - Rockfall at MP 32.31 (SL037-0032-31LW1)
        - ODOT indicates maintenance at least 5 times per year

    - ODOT estimated repair cost = $1.06M
    - Assume widening/mitigation with rock cut and catchment ditch
    - Mitigation cost = 450′ rockfall width x 50′ tall cut x 30′ deep cut x $200/cy = $5.0M
- Fill failure at MP 32.36 (SL037-0032-36RE1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $320k
    - Could get away without mitigation if widening occurs along WB lanes
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
- Fill failure at MP 32.4 (SL037-0032-40BB1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $320k
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
- Rockfall at MP 32.46 (SL037-0032-46RE1)
    - ODOT indicates maintenance 5 or more times per year
    - ODOT estimated repair cost = $800k
    - Assume mitigation with pinned mesh
    - Mitigation cost = 350′ rockfall width x 30′ slope height x $100/sf = $1.1M
- Rockfall at MP 32.46 (SL037-0032-46LW1)
    - ODOT indicates maintenance 5 or more times per year
    - ODOT estimated repair cost = $800k
    - Assume widening/mitigation with rock cut and catchment ditch
    - Mitigation cost = 350′ rockfall width x 50′ tall cut x 30′ deep cut x $200/cy = $3.9M
- Fill failure at MP 32.52 (SL037-0032-52RE1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $320k
    - Could get away without mitigation if widening occurs along WB lanes

    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
- Fill failure at MP 32.58 (SL037-0032-58RE1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $640k
    - Could get away without mitigation if widening occurs along WB lanes
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
- Fill failure at MP 32.68 (SL037-0032-68BB1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $640k
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
- Fill failure at MP 33.21 (SL037-0033-21BB1)
    - ODOT indicates twice yearly maintenance required
    - Appears ~250′ long soldier pile or GSI retaining wall already exists along shoulder of roadway (TransGIS references 2008 GRI Investigation), unclear if retaining wall has stopped slide movement as extensive patching is present in roadway
    - ODOT estimated repair cost = $2.9M
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
- Fill failure at MP 33.26 (SL037-0033-26LW1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $960k
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M
- Fill failure at MP 33.32 (SL037-0033-32LW1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $960k
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M
- Fill failure at MP 33.39 (SL037-0033-39BB1)

        - ODOT indicates yearly maintenance required
        - ODOT estimated repair cost = $2.4M
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 300′ slide width x $10,000/lf = $3.0M
    - Fill failure at MP 33.42 (SL037-0033-42LW1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $320k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
    - Fill failure at MP 33.51 (SL037-0033-51LW1)
        - ODOT indicates less frequent maintenance (every 5 years or less)
        - ODOT estimated repair cost = $320k
        - Assume widening/mitigation with soldier pile tieback wall
        - Mitigation cost = 150′ slide width x $10,000/lf = $1.5M
- M.P. 33.78 – M.P. 34.40
    - See write up for Project A
- M.P. 34.66 – M.P. 35.45
    - Unstable slopes:
        - Rockfall at MP 34.67 (SL037-0034-67RE1)
            - ODOT indicates less frequent maintenance (every 5 years or less)
            - ODOT estimated repair cost = $530k
            - Assume widening/mitigation with pinned mesh
            - Mitigation cost = 250′ rockfall width x 30′ slope height x $100/sf = $750k
        - Fill failure at MP 34.72 (SL037-0034-72LW1)
            - ODOT indicates twice yearly maintenance required
            - ODOT estimated repair cost = $4.4M
            - Corresponds to "West Landslide" in ODOT Advanced Investigation Geotechnical Report for MP 34.8 Landside (June 2022)
            - Assume widening/mitigation with soldier pile tieback wall
            - Mitigation cost = 300′ slide width x $10,000/lf = $3.0M
        - Fill failure at MP 34.81 (SL037-0034-81BB1)
            - ODOT indicates twice yearly maintenance required
            - ODOT estimated repair cost = $6.4M

    - Corresponds to "Main Landslide" in ODOT Advanced Investigation Geotechnical Report for MP 34.8 Landside (June 2022)
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 400′ slide width x $10,000/lf = $4.0M
- Fill failure at MP 34.92 (SL037-0034-92BB1)
    - ODOT indicates twice yearly maintenance required
    - ODOT estimated repair cost = $4.2M
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M
- Fill failure at MP 35.04 (SL037-0035-04LW1)
    - ODOT indicates less frequent maintenance (every 5 years or less)
    - ODOT estimated repair cost = $640k
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 250′ slide width x $10,000/lf = $2.5M
- Fill failure at MP 35.28 (SL037-0035-28LW1)
    - ODOT indicates yearly maintenance required
    - ODOT estimated repair cost = $3.7M
    - Assume widening/mitigation with soldier pile tieback wall
    - Mitigation cost = 350′ slide width x $10,000/lf = $3.5M

Environmental Considerations

This project area consists of many segments of OR6 corridor that are situated along a hillside that is unlikely to contain wetlands and waters. Determining this in the field, however, would take some additional time given the total length of all sections (~3.2 miles). The wetland and waters delineation report for a linear project like this would also require additional time because figures require multiple pages – even if the report is just documenting a lack of jurisdictional features. Also, if any project actions modify or replace culverts, and those culverts convey waters that ODFW determines are inhabited, or have been historically inhabited, by native migratory fish, then the project would require a fish passage plan(s) for those culverts.

Wetlands/Waters

There are likely no wetlands in this project area and only a few waters that may or may not be jurisdictional. A wetland and waters delineation report would be required if there are jurisdictional features, and a wetland and waters determination memo would be required if there are no jurisdictional features. However, both the wetland delineation report and the wetland determination memo would require on-site inspection and delineation.

- This project would likely require two days (including travel) for two scientists to delineate on-site wetlands and waters. Access and foot travel along the shoulder of OR6 would be challenging. The cost for this effort would be approximately $6,000-8,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort not included in this cost.
- The wetland delineation report would take approximately 2 weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $8,000-10,000 including expenses.
- If wetland scientists find that there are no boundaries of wetlands or waters in the project area for the DSL to concur with, then that conclusion would be documented in a wetland determination memo. This would take approximately 1 week to assemble, review, and save to the project record. The cost for this effort would be approximately $4,000-5,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require one SFAM to be completed. The cost for these efforts would be approximately $12,000-14,000 including expenses.
- A post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $38,000-50,000 if a delineation report and JPA are required, or $10,000-13,000 if there are no wetlands/waters impacts (i.e., only a wetland determination memo is needed). This

project may also require the purchase of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: add a lane and/or widen road shoulder(s); change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Bridge replacement would have to meet FAHP fluvial performance standards and would require additional coordination with NMFS to optimize the bridge design, construction BMPs, and streambed/bank restoration to minimize impacts to ESA-listed salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct multiple site visits. The cost for these efforts would be approximately $11,000-13,000 including expenses.

Fish Passage Plan

This project may require a fish passage plan for modifications to or replacement of culverts conveying waters that have or may have had native migratory fish presence. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $3,000-5,000 including expenses.
- This project may require one fish salvage for each IWW area. Each fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Each fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$55,000-73,000** including expenses if a wetland/waters fill permit is needed and fish passage and salvage is necessary. However, if there are no jurisdictional features that would be impacted,

and no fish passage or salvage are required, then the cost of environmental permitting for this potential project would be approximately **$21,000-26,000** including expenses.

MP 42.2 (Gales Creek Intersection)

Left Turn Lane and Realignment at Gales Creek Road

- Existing Bridge No. 07677 is in Fair condition
- Bridge spans Gales Creek which has critical habitat
- Work containment, fish passage, and scour review will need to be included in design
- Realignment of roadway will create additional storage on side street and better intersection geometry.
- Seismic retrofit/widening or replacement likely required given age of bridge and seismic vulnerability rating. If full replacement, will need to consider staging aspects and potential need for temp detour structure.
- Assume driven piles at end bents and drilled shafts at any interior bents for widening/replacement.
- Anticipate need for retaining walls, likely MSE, to accommodate widening at bridge approaches, especially along WB direction.
- Geologic deposits at bridge site are mapped by DOGAMI as highly susceptible to liquefaction. Seismic mitigation such as ground improvement may be required to stabilize bridge approaches.
- This environmental summary assumes that the area of potential impact for this project includes the OR6 bridge over Gales Creek for widening or replacement. Gales Creek is designated Essential Salmonid Habitat (ESH) and critical habitat for steelhead (O*ncorhynchus mykiss*) of the Upper Willamette River Distinct Population Segment (DPS).

Wetlands/Waters

There are wetlands and waters in and around this project area that are jurisdictional to the DSL and the USACE. This area includes ESH of Gales Creek, so any amount of removal or fill from within Gales Creek or wetlands adjacent to Gales Creek will require a DSL permit. Additionally, any ditches with a free and open connection to Gales Creek (including culverts) that also contain game fish would be jurisdictional to the DSL. The USACE would likely assume jurisdiction over Gales Creek and any ditch or natural tributary connected to Gales Creek with relatively permanent (i.e., intermittent/seasonal) or perennial flow, and any wetlands adjacent to these waters.

The DSL and USACE wetland/waters permitting processes requires all wetlands and waters to first be delineated, described in a wetland delineation report, and then the wetland/waters boundaries must be concurred with by the DSL.

- This project would likely require one day (including travel) for two scientists to delineate on-site wetlands and waters. The cost for this effort would be approximately $3,000-5,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors as a separate effort not included in this cost.
- The wetland delineation report would take approximately two weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $6,000-8,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require an ORWAP and an Oregon Stream Functional Assessment Methodology (SFAM) field and reporting efforts to be completed. The cost for these efforts would be approximately $14,000-16,000 including expenses.
- A standard post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection and the preparation of a report demonstrating the project was implemented per the requirements of the permit. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $35,000-47,000. This project may also require the purchase of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: realign the roadway; change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Bridge replacement would have to meet FAHP fluvial performance standards and would require additional coordination with NMFS to optimize the bridge design, construction Best Management Practices (BMPs), and streambed/bank restoration to minimize impacts to salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification (including a bridge supplement), construction, and post-construction documentation; and conduct multiple site visits. The cost for these efforts would be approximately $13,000-15,000 including expenses.

Fish Passage Plan

This project would require a fish passage plan if the bridge were replaced or if at least 50% of the existing bridge structure were repaired. This summary assumes that the replacement bridge would be a single span with a length of at least 1.5 times the active channel width. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $5,000-7,000 including expenses.
- Fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$56,000-74,000** including expenses. This does not include the cost of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters, if required.

Other Passing Lane Opportunities in Corridor

Corridor Passing Lane Opportunity Project #1 – West

- M.P. 12 - M.P. 13

Geotechnical Considerations

Some cuts and fills, and potential retaining walls may be required. No unstable slopes in this section but DOGAMI mapped landslide deposit crosses OR6 between MP 12.1 – MP 12.3.

Environmental Considerations

This environmental summary assumes that there will be no widening, replacement, or other modification of any bridges over the Wilson River (MP 7.75 and MP 11.8). The Wilson River, part of Hatchery Creek, and Hughey Creek are designated critical habitat for ESA-listed coho salmon of the Oregon Coast ESU, and they are ESH for steelhead.

Wetlands/Waters

There are likely wetlands and waters in this project area that would be jurisdictional to the DSL and the USACE. The project area parallels and crosses the Wilson River, and it crosses many tributaries of the Wilson River. The wetland and waters delineation report for a linear project like this would also require additional time because each figure would require multiple pages to prepare.

- This project could take up to four days (including travel) for two scientists to delineate on-site wetlands and waters. Access and foot travel along the shoulder of OR6 would be challenging. The cost for this effort would be approximately $12,000-14,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors on the project team as a separate effort not included in this cost.
- The wetland delineation report would take approximately three weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $12,000-14,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to

DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require multiple ORWAPs and SFAMs to be completed. The cost for these efforts would be approximately $18,000-20,000 including expenses.
- A post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $54,000-66,000. This project may also require the purchase of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: add a lane and/or widen road shoulder(s); change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Any culvert replacement would have to meet FAHP fluvial performance standards and may require additional coordination with NMFS to optimize the design, construction BMPs, and streambed/bank restoration to minimize impacts to salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct multiple site visits. The cost for these efforts would be approximately $14,000-16,000 including expenses.

Fish Passage Plan

This project may require a fish passage plan for modifications to or replacement of culverts conveying streams that have or may have had native migratory fish presence. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $3,000-5,000 including expenses.
- Fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$74,000-92,000** including expenses. This does not include the cost of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters, if required.

Corridor Passing Lane Opportunity Project #2 – Lee's Camp

- M.P. 23.5 - M.P. 24.5

Geotechnical Considerations

- Embankments will likely result in large cuts
- Cuts and fills, and potential retaining walls, will be required but no mapped landslides or unstable slopes in this section so do not anticipate significant geotechnical issues.

Environmental Considerations

This environmental summary assumes that there will be no widening, replacement, or other modification of the OR6 Bridge over the Wilson River at MP 23.6. The Wilson River is designated critical habitat for coho salmon of the Oregon Coast ESU, and it is ESH for steelhead. Additionally, Scotty Creek from its confluence with the Wilson River to its crossing of OR6 is also ESH for steelhead.

Wetlands/Waters

There are likely wetlands and waters in this project area that would be jurisdictional to the DSL and the USACE. The project area parallels and crosses the Wilson River, and it crosses many tributaries of the river.

- This project may require up to two days (including travel) for two scientists to delineate on-site wetlands and waters. Access and foot travel along the shoulder of OR6 would be challenging. The cost for this effort would be approximately $5,000-7,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors on the project team as a separate effort not included in this cost.
- The wetland delineation report would take approximately three weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $8,000-10,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies and may require multiple ORWAPs and SFAMs to be completed. The cost for these efforts would be approximately $15,000-17,000 including expenses.
- A post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $40,000-52,000. This project may also require the purchase of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: add a lane and/or widen road shoulder(s); change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Any culvert replacement would have to meet FAHP fluvial performance standards and may require additional coordination with NMFS to optimize the design, construction BMPs, and streambed/bank restoration to minimize impacts to salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct multiple site visits. The cost for these efforts would be approximately $13,000-15,000 including expenses.

Fish Passage Plan

This project may require a fish passage plan for modifications to or replacement of culverts conveying waters that have or may have had native migratory fish presence. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $3,000-5,000 including expenses.
- This project may require one fish salvage for each IWW area. Each fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Each fish salvage would require two trained biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$59,000-77,000** including expenses. This does not include the cost of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters, if required.

Corridor Passing Lane Opportunity Project #3 – East

- M.P. 37.5 - M.P. 38.5

- Requires widening or replacement of structure at MP 37.6?

Geotechnical Considerations

- Will trigger both significant cut and fill
- Cuts and fills, and potential retaining walls, will be required but no mapped landslides or unstable slopes in this section so do not anticipate significant geotechnical issues.

Environmental Considerations

This environmental summary assumes that there will be no widening, replacement, or other modification of the OR6 Bridge over Gales Creek at MP 37.62. Gales Creek is designated critical habitat and ESH for steelhead of the Upper Willamette River DPS.

Wetlands/Waters

There are likely wetlands and waters in this project area that would be jurisdictional to the DSL and the USACE. The project area parallels and crosses Gales Creek along an area close to the valley bottom.

- This project may require up to two days (including travel) for two scientists to delineate on-site wetlands and waters. Access and foot travel along the shoulder of OR6 would be challenging. The cost for this effort would be approximately $5,000-7,000 including expenses. This cost assumes that locations of all sample plot flags and boundary flagging for wetlands and waters will be recorded by surveyors on the project team as a separate effort not included in this cost.
- The wetland delineation report would take approximately three weeks to assemble, review, and submit to the DSL, and then up to 120 days for DSL review and concurrence. The cost for this effort would be approximately $8,000-10,000 including expenses.

A JPA would need to be submitted to the DSL and USACE to receive the Removal-Fill and Section 404 CWA permits, respectively, authorizing wetland/waters impacts if impacts are necessary to complete the project and the impacts do not meet agency exemption requirements. This project may meet the criteria for a Transportation-Related Structures GP from DSL, which would take approximately 70 days to process once the completed application is submitted to DSL for review. Or, if the project does not meet the criteria for a GP, then it would require an IP from the DSL, which takes approximately 120 days for DSL to review and process. Application for a CWS 401-C Certification from DEQ can be done by submitting the same JPA prepared for DSL and USACE permits. This certification could be processed concurrently with the USACE CWA permit (if coordination between USACE and DEQ occurs prior to USACE authorization), or 35 days after USACE authorization. If the project is authorized under an IP, DEQ has up to 1 year to issue a decision. Construction cannot start until DEQ approval is obtained.

- The JPA for this project would require coordination among many agencies, and may require one ORWAP and SFAM to be completed. The cost for these efforts would be approximately $13,000-15,000 including expenses.
- A post-construction report to close out the DSL Removal-Fill permit would require a one-day site inspection. The cost for these efforts would be approximately $2,000-3,000 including expenses.
- This project may also require up to 5 years of post-construction monitoring and reporting at a cost of $2,000-3,000 per year, for a 5-year total of $10,000-15,000.

Considering all the information above, the total cost for Wetland/Water permitting for this project could be $38,000-50,000. This project may also require the purchase of mitigation bank credits to offset impacts to wetlands and/or waters (this cost is not included).

Endangered Species

Assuming this project is at least partially funded by FAHP, consultation with the Services per Section 7 of the ESA would be covered by the FAHP programmatic BO. As such, the project would have to adhere to FAHP programmatic BO design and construction standards. FAHP water-quality and flow-control stormwater management requirements would be triggered per the FAHP programmatic BO because the project would: add a lane and/or widen road shoulder(s); change the location, type, or size of stormwater conveyance; and discharge to a drainage basin that is less than 100 square miles. Any culvert replacement would have to meet FAHP fluvial performance standards and may require additional coordination with NMFS to optimize the design, construction BMPs, and streambed/bank restoration to minimize impacts to salmonids.

- The project would require a FAHP-certified biologist to coordinate with the Services and ODOT; complete FAHP forms for project notification, construction, and post-construction documentation; and conduct at least two site visits. The cost for these efforts would be approximately $12,000-14,000 including expenses.

Fish Passage Plan

This project may require a fish passage plan for modifications to or replacement of culverts conveying waters that have or may have had native migratory fish presence. All work below the OHWM would have to occur in an isolated IWW area closed off from the stream channel by coffer dams with flow bypassed around it, and biologists would have to acquire an STP and conduct fish salvage before IWW could commence. Lastly, all work below OHWM would have to occur within the ODFW-approved IWWW.

- A fish passage plan requires coordination with ODFW and the design team. The cost for these efforts would be approximately $3,000-5,000 including expenses.
- Fish salvage would require an STP to be created, approved by ODFW and NMFS, and then closed out after salvage is complete. Fish salvage would require two trained

biologists, seine nets, and a backpack electro shocker. The cost for these efforts would be approximately $3,000-5,000 including expenses.

Total Cost of Environmental Permitting For This Potential Project

The total cost of environmental permitting for this potential project would be approximately **$56,000-74,000** including expenses. This does not include the cost of mitigation bank credits or in-kind mitigation to offset impacts to wetlands and/or waters, if required.