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Date: October 4, 2022

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SUBJECT: **Hwy OR 99W South Corvallis Facility Plan**
Future Alternatives Motor Vehicle Conditions Intersection Analysis, Task 9.1, DRAFT Technical Memorandum #15B

EXECUTIVE SUMMARY

This memorandum documents the 2040 future alternatives for the OR 99W South Corvallis Facility Plan, including the methodology and key modeling assumptions used in the operational analysis. This memorandum expands upon Technical Memorandum #15A: Multimodal Alternatives Analysis (TM #15A) by providing the motor vehicle analysis. Additionally, updates are included to the future no-build alternative presented in Technical Memorandum #12 in July 2021. The analysis outputs are updated and included in this memorandum, as the model network was updated to include additional local streets and programmed projects.

There are two no-build alternatives and three build alternatives.

2040 Future No-Build Alternatives:
- No-Build Clean
- No-Build Enhanced

2040 Future Build Alternatives:
- Alternative A
- Alternative B
- Alternative C

Background

The study area is 3.6 miles long and encompasses the OR 99W highway corridor from SW Western Boulevard at the northern limit to the City of Corvallis southern urban growth boundary (see Figure 1). The character of the corridor changes significantly from a central business district at the north, through a mixed commercial/residential area, ending at the south project limit in a general rural context.

For consistency with previous memorandums, the corridor is divided into three segments (depicted in Figure 1) from north to south. The alternatives are shown in those three segments throughout this technical memorandum.

Segment 1: Western Boulevard to SE Crystal Lake Drive

Segment 2: SE Crystal Lake Drive to SE Goodnight Avenue

Segment 3: SE Goodnight Avenue to the Southern Urban Growth Boundary (UGB)

Figure 1: Study Area

2040 Future No-Build Alternative Overview

The 2040 No-Build was broken down into two alternatives to capture a financially constrained no-build as well as no-build that includes probable and/or desired improvements (illustrative TSP projects) throughout the corridor that were considered likely to be added to the TSP.

No-Build (Clean)
The clean no-build represents 2040 traffic conditions and includes TSP projects that have known or likely funding for construction in the next 20 years.

Key Points/Takeaways:

- Lacks desired multi-modal improvements
- Overcapacity intersections (10)
- Approximately 80% overcapacity at SW 15th Street and OR 34/ US 20.
- High delays on side streets.
- Higher potential diverted demand that Enhanced No-Build or Alternative A.
- Lacking eastbound OR 34/US 20 off-ramp so Avery Park is the de-facto connection to southbound OR 99W.

No-Build (Enhanced)
The 2040 No-Build Enhanced is the 'Clean' No-Build plus the illustrative TSP projects. This has been used as a baseline to compare the 'Build' alternatives to. Allowing the key differences between each alternative to be highlighted and their resulting performance/impact throughout the corridor.

Key Points:

- Enhanced pedestrian crossings impact corridor performance
- Overcapacity intersections (11)
- Approximately 30% overcapacity at SW 15th Street and OR 34/ US 20.
- High delays on side streets.
- Average corridor travel time increases by two minutes (17%).
- Latent demand shows up as diverted demand and peak hour spreading (note that the diverted demand is an improvement from the Clean No-Build).
- Lacking eastbound OR 34/US 20 off-ramp so Avery Park is the de-facto connection to southbound OR 99W.
- The additional illustrative TSP projects add an estimated $82 million to the project cost, See Appendix B.

2040 Future Build Alternative Overview
The future build alternatives (Alternative A, B and C) are derived from the 2040 No-Build (Enhanced). There are a few factors that distinguish the build alternatives from each other as well as the no-build alternatives. The primary differences are where OR 99W transitions from five-lanes to three-lanes and what local network modifications or additions were needed to optimize the alternative or resolve an identified safety issue.

Elements that apply to all build alternatives include:

- SW Western Boulevard and SW 4th Street through lane reduction providing notable safety benefits; however, there is a trade off in traffic operations discussed below.
- OR 34 WB Off-Ramp terminal realignment and signalization to improve multi-modal safety and connectivity aligning with the current pedestrian travel patterns today.

- The added ramp and roundabout from eastbound OR 34/US 20 to OR 99W shifts traffic to OR 34/ US 20 (away from the downtown couplet). This shift in travel patterns adds more trips through the 15th Street intersection.
- SW 15th Street / SW Avery Park Road and OR 34 / US 20 intersection modifications.
- Left turn restrictions at SW Twin Oaks Circle and SE Chapman Place, Right-In, Right-Out only.
- Left turn restrictions at SE Viewmont Avenue and SW Tunison Avenue, Right-In, Right-Out, plus Left-In.
- There were many elements, or alternatives, considered but ultimately dismissed or not included in the alternatives for various reasons. There are a few elements that performed similarly and could be included if desired. These options are detailed in Appendix A and include elements such as:
    - Signals rather than enhanced pedestrian crossings at SW B Ave and SW 3rd and 4th Streets.
    - Signals rather than roundabouts at SW Goodnight and SW Rivergreen Avenues.

Alternative A

The three-lane cross-section on OR 99W begins just south of SW Goodnight Avenue (rather than where it is today, which is just south of SW Kiger Island Drive). SW Alexander Avenue is extended west to connect to SW Butterfield Drive. This connection is needed when the SE Viewmont Avenue and SW Tunison Avenue turn restrictions are applied and in Appendix F.

Key Points:

- Alternative A also extends SW Alexander Avenue west to connect to SW Butterfield Drive, a connection needed to resolve a known safety issue at Viewmont and Tunison.
- Increased congestion approaching the new eastbound OR 34/US 20 off-ramp because new ramp pulls traffic onto OR 99W (away from Avery Park Road) and changes traffic patterns on the north end.
- Near capacity condition at the intersection of Western Boulevard and SW 4th Street. Mitigation strategies have been applied but the near capacity condition, while improved, remains.
- Mitigating congestion at SW Western Boulevard and SW 4th Street increases the volume reaching the new off-ramp roundabout terminal at the interchange. A meter was added to the SB approach in Alternative A to mitigate the shifted congestion.
- Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.
- Alternative A has more congestion through the interchange as the west parallel route is lacking.
- Long delays at Park Avenue and Wake Robin Avenue continue.
- Latent demand shows up as diverted demand and peak hour spreading
    - Diverted demand in Alternative A is the lowest of all alternatives including no-builds.

- Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

Alternative B

The three-lane cross-section on OR 99W begins just south of SW Cummings Avenue in the southbound direction and at SE Bridgeway Avenue in the northbound direction. New roadway segments are included to complete the parallel route connection between SW Avery Avenue to SW Goodnight Avenue.

Key Points:

- The system-to-system movement from eastbound US-20/OR-34 to southbound OR 99W achieved in Alternative A shifts to a more undesirable path on the local street system within and surrounding Avery Park in Alternative B. The complete western parallel network draws trips through the park.
- Alternative B would likely require a more in depth and expanded study area and analysis to include more detail on the local network and the intersections within Avery Park as well as the intersection of SW 15th Street with US-20/OR-34.
- The complete west side parallel network draws trips through the park
- Shifting the three-lane section further north than Goodnight makes alternatives dependent on the parallel network. Alternative B's performance is entirely dependent on the local network.
- Highest average corridor travel time of all alternatives with an increase of four minutes (33%).
- Latent demand shows up as diverted demand and peak hour spreading
  - Diverted demand in Alternative B is the highest of all alternatives.
  - Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

Alternative C

The three-lane cross-section on OR 99W begins just south of SW Prairie Drive. A partial connection is included between SW Avery Avenue and SW Goodnight Avenue with a break in the parallel route; it does not cross over the Mill Race. Alternative C also adds an east/west route by extending both Prairie Avenue and Powell Avenue, creating a new four-legged intersection at OR 99W.

Key Points:

- Increased congestion approaching the new eastbound OR 34/US 20 off-ramp because the added ramp pulls traffic onto OR 99W (away from Avery Park Road) and changes traffic patterns on the north end.
- Near capacity condition at the intersection of Western Boulevard and SW 4th Street. Mitigation strategies have been applied but the near capacity condition, while improved, remains.

- For Alternatives B and C, it is important to consider that the analysis output is dependent upon the assumption that a relatively high level of traffic will be re-routed to the new east and west parallel routes which require an arterial level of treatment north of Rivergreen Avenue and a major collector level of treatment south of Rivergreen Avenue.
- The Prairie/Powell connection is desirable for anticipated local trips.
- Highest average corridor travel time of all alternatives with an increase of three minutes (or 25%).
- Transitioning to three lanes north of Goodnight Avenue increases latent demand. Latent demand shows up as diverted demand and peak hour spreading
    - Only Alternative B has a higher level of daily diverted demand.
    - Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

As briefly described above there are nuances to each alternative that are graphically represented in Figures X through X.

Summary of Key Takeaways

- Latent demand shows up as diverted demand and peak hour spreading
- Generally, when the transition from 5 lanes to 3 lanes shifts north the local diverted demand increases
- 100% of the diverted traffic is local trips
- The added ramp pulls traffic onto OR 99W (away from SW Avery Park Road) however this does result in changing traffic patterns on the north end
- Roundabouts or signals could be applied at Goodnight and Rivergreen Avenues. Either intersection control performs sufficiently.
- VanBuren Bridge effects how trips are made in the project corridor, particularly how the interchange is used
- Shifting the five lane section north makes alternatives dependent on a robust local roadway network
- Additional enhanced pedestrian crossings impact corridor performance
- The addition of eleven new enhanced pedestrian crosswalks along the corridor contribute to some of the congestion and queuing issues. The location and quantity of these crossings should be analyzed more closely.
- The analyzed alternatives have over-capacity conditions SW 15th Street and OR 34
- At SW Western Boulevard and SW 4th Street, the reduction in through lanes provides notable safety benefits; however, there is a trade off in traffic operations at the already over-capacity intersection. There are also impacts on the new eastbound OR 34/US 20 off-ramp roundabout terminal.
- Mitigating congestion at SW Western Boulevard and SW 4th Street increases the volume reaching the new off-ramp roundabout terminal at the interchange. Metering the SB approach in Alternative A mitigates congestion.

- While Alternative B performs fairly well considering how far north the lane transitions occur, it is important to consider that the analysis output is dependent upon the assumption that a relatively high level of traffic will be re-routed to the new east and west parallel routes that aren't currently equipped to handle the additional anticipated trips.
- Alternative B would likely require an expanded study area and analysis to include the intersections within Avery Park as well as the intersection of SW 15th Street with US-20/OR-34.
- It is likely the corridor will see PM congestion in the southbound direction extending between three and eight hours depending on the alternative.
- VMT (coming soon)
- Mode shift (coming soon)

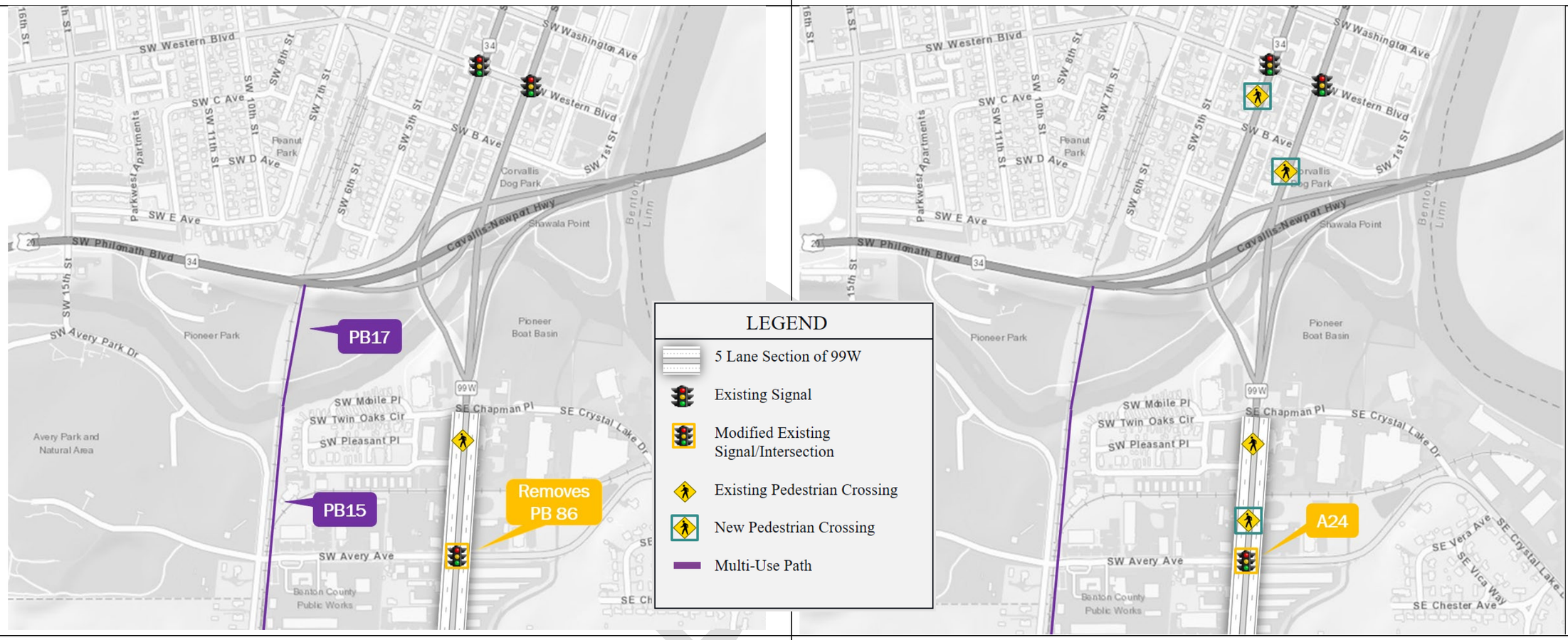
Next Steps

It is likely based on TAC/SAG and PMT input to date the preferred alternative will be a hybrid of these alternatives.

Ranking, scoring, open house/public comment will be completed working toward a preferred alternative for draft plan development.

Segment 1: Western Blvd to Crystal Lake Dr

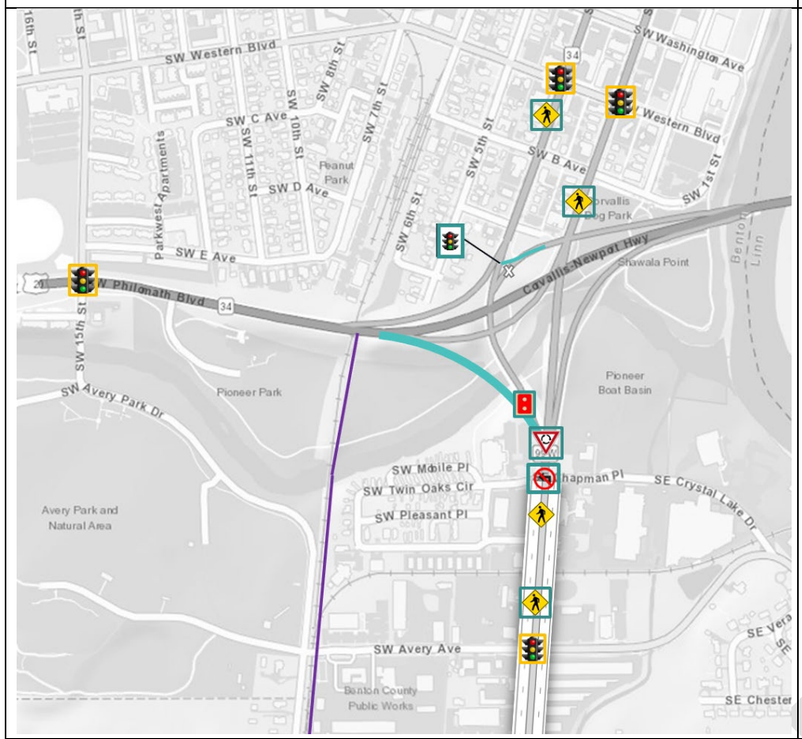
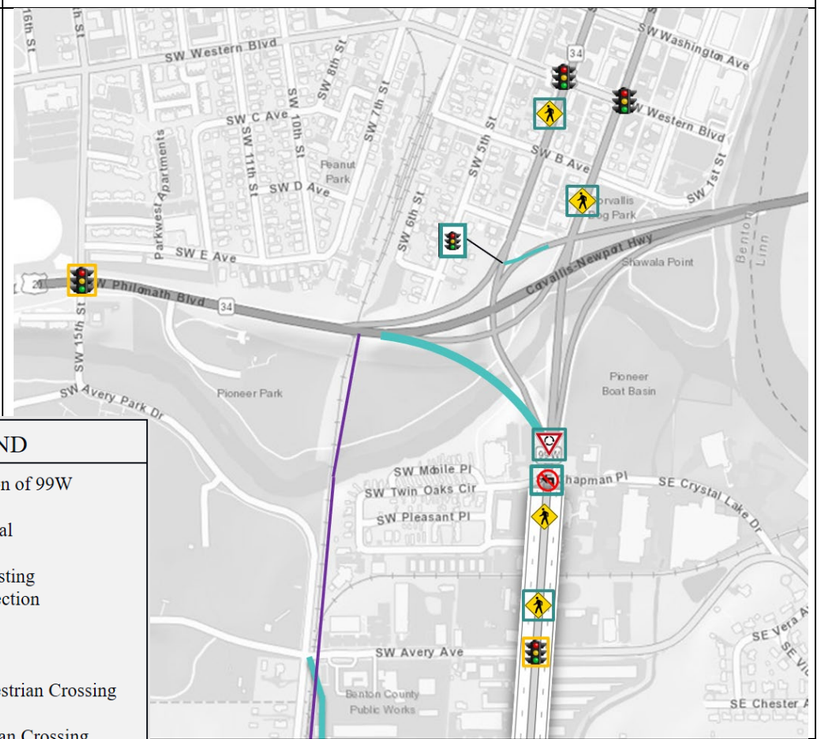
Figure 2: 2040 Future No-Build Alternative Descriptions

2040 No-Build (Clean)	2040 No-Build (Enhanced)
	

2040 No-Build (Clean)
This alternative projects the 2040 traffic conditions and includes Fiscally Constrained TSP projects which means projects that are
• funded and likely to be constructed in the next 5 years and projects with
• known funding likely to be available in the next 20 years, these are projects on the financially constrained project list (more on why this is important for funding options on page 11 of the TSP)
  • Segment 1 includes TSP projects PB15 & PB17, an multi-use path east of OR99W connecting the Pioneer Park Trail network to Airport Avenue.
  • With the addition of the parallel multi-use path, the exiting temporary solution for bicycle connectivity can be removed (PB 86 added a diagonal bicycle phase to the Avery/Crystal Lake intersection).
	2040 No-Build (Enhanced)
	The CLEAN No-Build plus:
	• New enhanced pedestrian crossings
	• Roadway/intersection improvement projects both fiscally constrained and illustrative projects
	  • Segment 1 includes TSP A24, an illustrative TSP project that improves intersection capacity by adding a WB RT Lane, a 2nd SB LT Lane and the associated 2nd receiving lane on the eastern leg of the intersection.

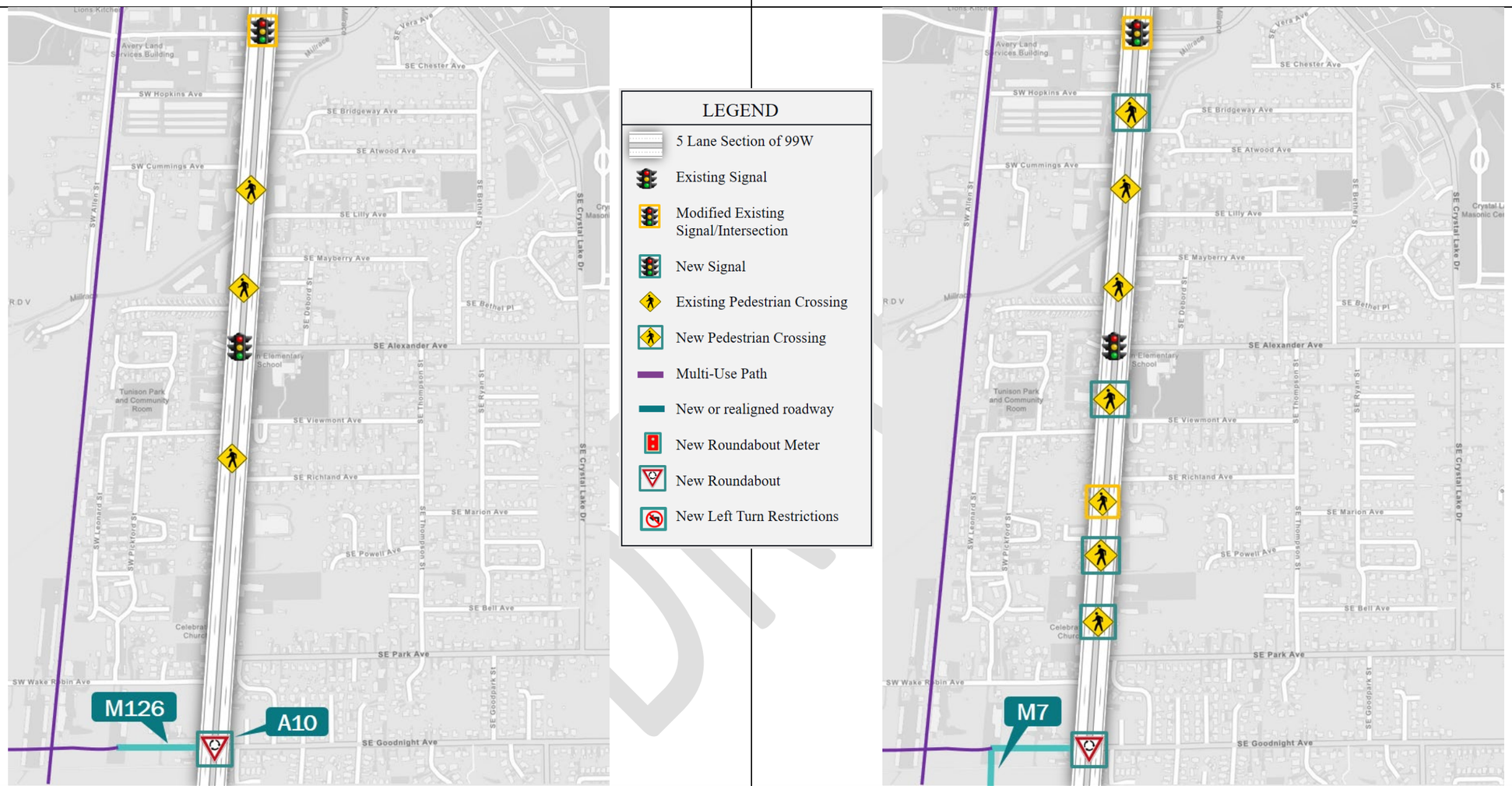
Segment 1: Western Blvd to Crystal Lake Dr

Figure X: 2040 Future Build Alternative Descriptions

Alternative A (Goodnight)	Alternative B (Bridgeway/Cummings)	Alternative C (Prairie/Powell)
		
Alternative A (Goodnight) Building on the No-Build ENHANCED, Alternative A includes • Intersection modifications at 4th & Western, 3rd & Western, 15th & OR34 to improve safety and/or capacity deficiencies. • WB OR34 Ramp terminal modification and signalization • New ramp from EB OR34/US20 to OR 99W • New roundabout at ramp junction with 99W • Roundabout meter • Left Turn Restrictions at Twin Oaks & Chapman	**Alternative B (Bridgeway/Cummings)** Alternative B includes the same items described in Alternative A except: • The roundabout meter is not needed to address capacity in this alternative • The western parallel route begins at the intersection of Avery Park Dr and Avery Ave, continuing south Wake Robin Ave/Goodnight Ave	**Alternative C (Prairie/Powell)** Alternative C includes the same items described in Alternative B except: • Only some portions of the new western parallel route are included. In this segment, the western parallel route is the same, beginning at the intersection of Avery Park Dr and Avery Ave but only extends south to Cummings Ave.

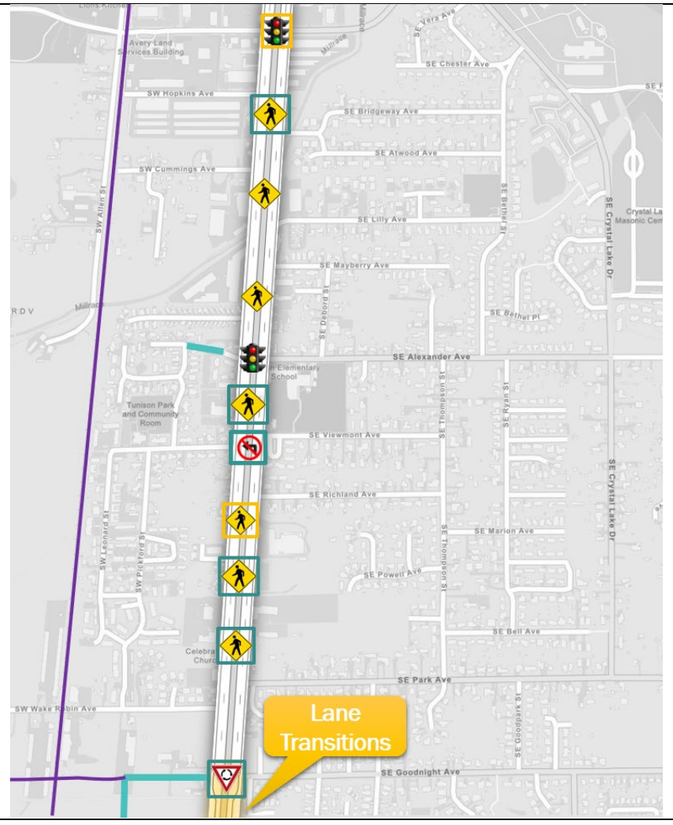
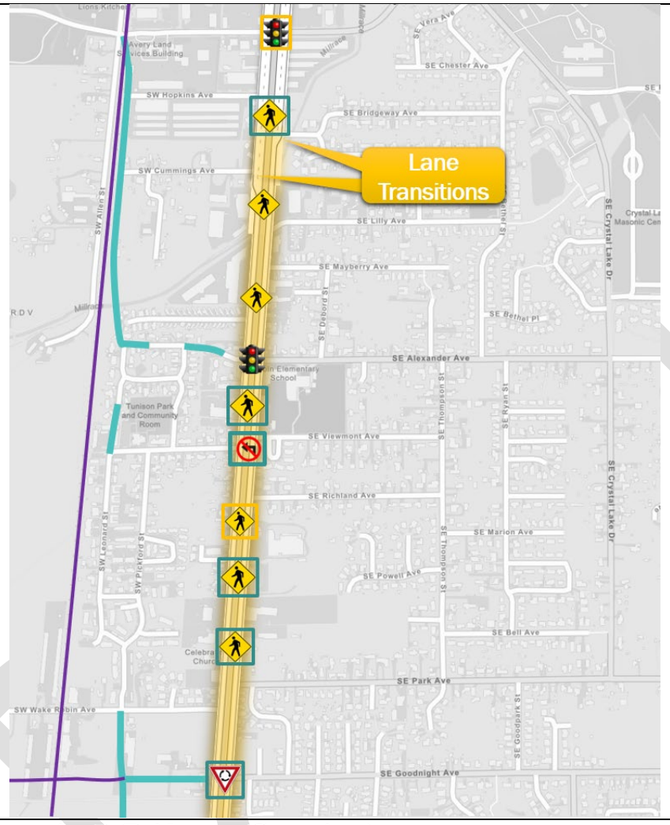
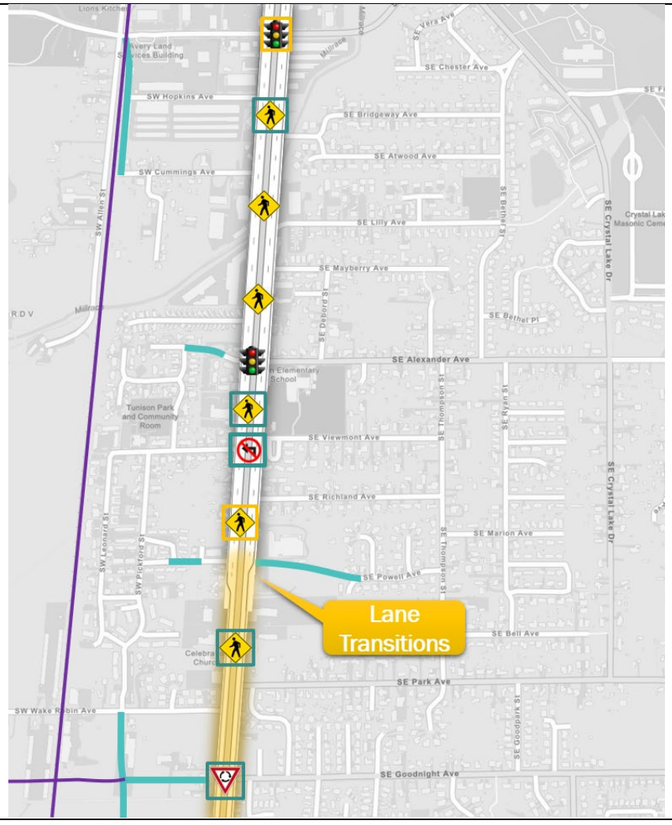
Segment 2: SE Crystal Lake Drive to SE Goodnight Avenue

Figure X: 2040 Future No-Build Alternative Descriptions

2040 No-Build (Clean)	2040 No-Build (Enhanced)
	
2040 No-Build (Clean) As a reminder only funded (or likely to be funded) TSP projects are included in the Clean No-Build. Differences from existing include: • Roundabout at Goodnight Ave (TSP A10, and the associated intersection realignment M126). A signal was evaluated and could be installed in lieu of a roundabout but that did not align with corridor preferences established by the PMT and stakeholders.	**2040 No-Build (Enhanced)** All items in the clean no-build apply to the enhanced. Additional elements for the enhanced no-build in Segment 2 include: • Three additional enhanced pedestrian crossings • One shifted pedestrian crossing from the north side of Richland to the south side. • Western parallel route (M7) that connects the western leg of the realigned Goodnight Ave down to Airport Ave.

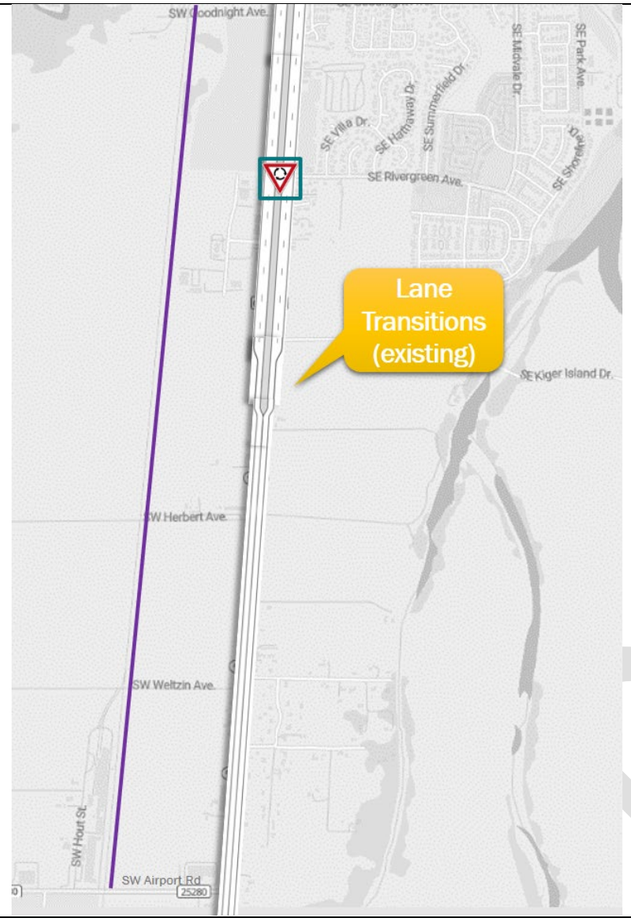
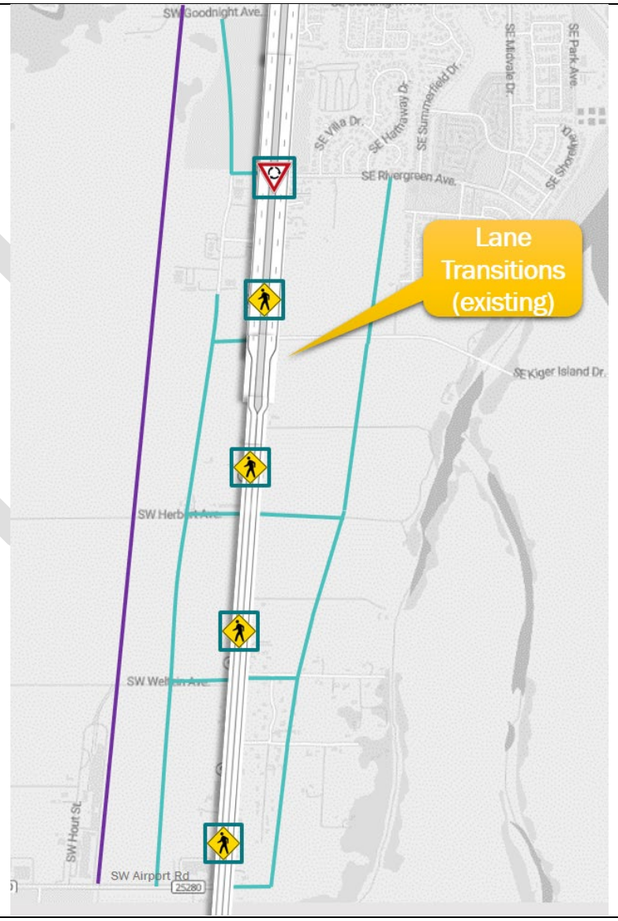
Segment 2: SE Crystal Lake Drive to SE Goodnight Avenue

Figure X: 2040 Future Build Alternative Descriptions

Alternative A (Goodnight)	**Alternative B (Bridgeway/Cummings)**	**Alternative C (Prairie/Powell)**
		
Alternative A (Goodnight) Alternative A is most similar to the No-Build Enhanced. Building on the No-Build ENHANCED, Alternative A includes • Modifying the traffic movement of vehicles turning onto 99W from either Viewmont or Tunison. A Right In, Right Out, plus Left In (RIRO+LI) application is applied in all Build scenarios to improve safety and functionality. The intersections could also be reconfigured to make one - 4 legged intersection. • Extending the western leg of Alexander, connecting to Butterfield. This connection is needed when the RIRO+LI is applied to Viewmont and Tunison to create an adequate parallel network for local access. • The five lane transition to three lanes is shifted north, now transitioning just south of the Goodnight intersection.	**Alternative B (Bridgeway/Cummings)** Building on the No-Build ENHANCED, Alternative B includes • Additional roadway segments to create a full western parallel route, connecting Avery Ave (as shown in Segment 1) to Goodnight Ave (shown in Segment 3). • The five lane transition to three lanes occurs at Bridgeway in the NB direction and Cummings in the SB direction. • RIRO+LI at Viewmont and Tunison	**Alternative C (Prairie/Powell)** Building on the No-Build ENHANCED, Alternative C includes • Portions of the new western parallel route, the primary difference between the parallel routes in Alt B and Alt C is the western parallel route in Alt C do not cross Mill Race. • Both Prairie and Powell are extended toward OR 99W and create a new 4 legged intersection that provides connectivity to parallel routes on both the east and west sides of OR 99W. • The five lane transition to three lanes occurs just south of the new Prairie/Powell intersection. • The enhanced pedestrian crossing at Prairie that was introduced with the enhanced no-build is replaced by the new intersection.

Segment 3: SE Goodnight Avenue to the Southern Urban Growth Boundary (UGB)

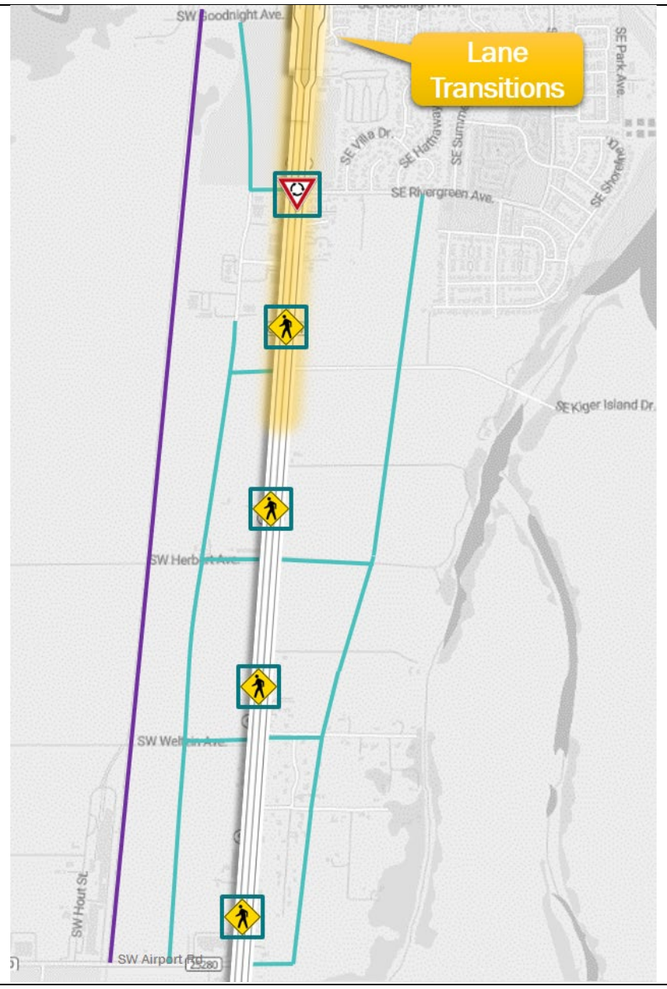
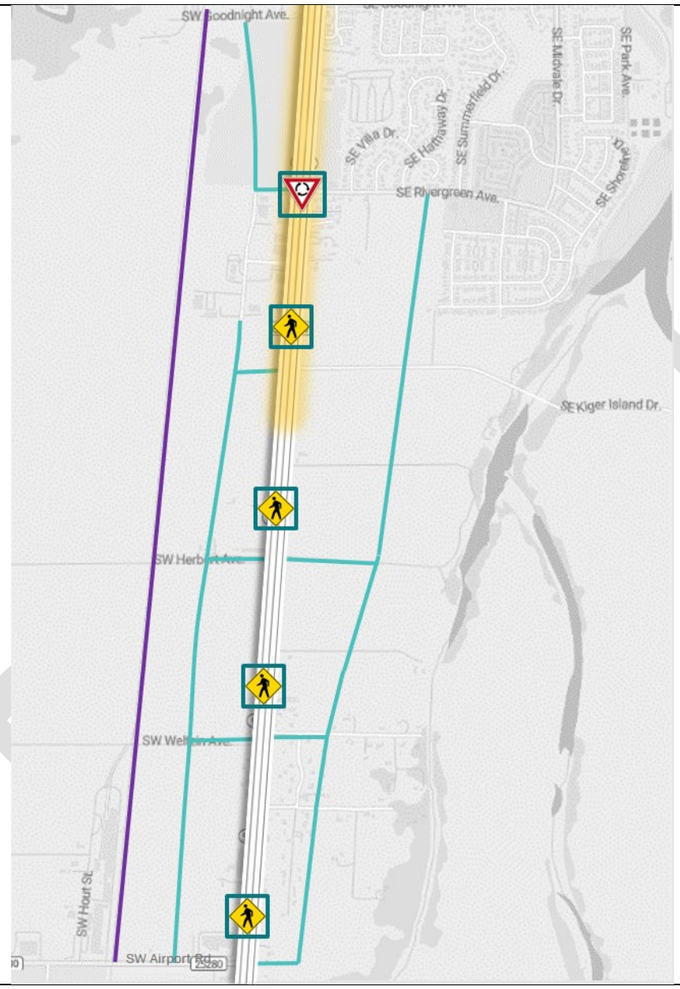
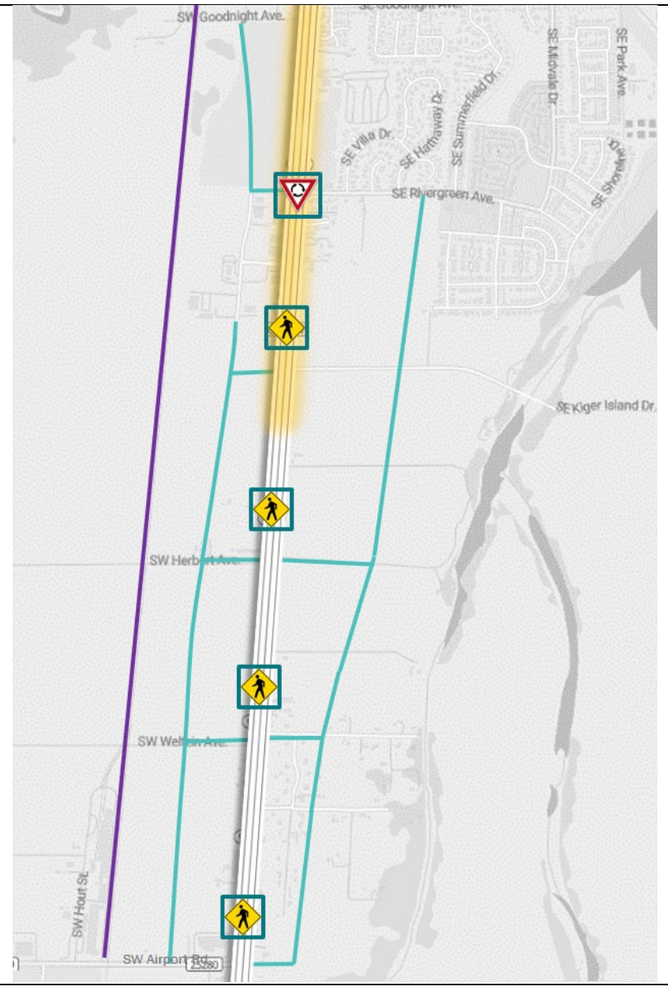
Figure X: 2040 Future No-Build Alternative Descriptions

2040 No-Build (Clean)	**2040 No-Build (Enhanced)**
	

2040 No-Build (Clean)
The Clean No-Build includes:
• Roundabout at Rivergreen Ave (TSP A11). Similar to the roundabout shown at Goodnight Ave, this does not mean a signal could not be installed. It just means roundabouts were preferred by stakeholders (see Appendix A for more information).
• The five lane transition to three lanes remains where it is today (just south of Kiger Island Dr)
	2040 No-Build (Enhanced)
	All items in the clean no-build apply to the enhanced. Additional elements for this segment of the enhanced no-build include:
	• Four enhanced pedestrian crossings
	• Additional roadway segments creating and connecting to the western and eastern parallel routes that link the western leg of the realigned Goodnight Ave and the eastern leg of Rivergreen Ave down to Airport Ave. The TSP projects included are:
	  • West side = M7 + M74, M110, M135, M123
	  • East side = M98 + M99, M100 & M111
	• The five lane transition to three lanes remains where it is today.

Segment 3: SE Goodnight Avenue to the Southern Urban Growth Boundary (UGB)

Figure X: 2040 Future Build Alternative Descriptions

Alternative A (Goodnight)	**Alternative B (Bridgeway/Cummings)**	**Alternative C (Prairie/Powell)**
		
Alternative A (Goodnight) Building on the No-Build ENHANCED, the only difference in Alternative A for Segment 3 is: • The five lane transition to three lanes is shifted north, now transitioning just south of the Goodnight intersection.	**Alternative B (Bridgeway/Cummings)** Building on the No-Build ENHANCED, the only difference in Alternative B for Segment 3 is: • The five lane transition to three lanes occurred in Segment 2 at Bridgeway & Cummings. Throughout Segment 3, OR 99W is three lanes.	**Alternative C (Prairie/Powell)** Building on the No-Build ENHANCED, the only difference in Alternative C for this segment is: • The five lane transition to three lanes occurred in Segment 2 at the re-envisioned Prairie/Powell intersection. In Segment 3, OR 99W is three lanes.

INTRODUCTION & BACKGROUND

This memorandum documents the 2040 future alternatives for the OR 99W South Corvallis Facility Plan, including the methodology and key modeling assumptions used in the operational analysis. This memorandum expands upon Technical Memorandum #15A: Multimodal Alternatives Analysis (TM #15A) by providing the motor vehicle analysis. Additionally, updates are included to the future no-build alternative presented in Technical Memorandum #12 in July 2021. The analysis outputs are updated and included in this memorandum, as the model network was updated to include additional local streets and programmed projects.

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For consistency with previous memorandums, the corridor is divided into three segments (depicted in Figure 1) from north to south. The alternatives are shown in those three segments throughout this technical memorandum.

Segment 1: Western Boulevard to SE Crystal Lake Drive

Segment 2: SE Crystal Lake Drive to SE Goodnight Avenue

Segment 3: SE Goodnight Avenue to the Southern Urban Growth Boundary (UGB)

Figure 1: Study Area

ALTERNATIVE DEVELOPMENT

This section summarizes the factors that went into determining the future no-build and future build alternatives. This section also provides a summary description and comparison of all alternatives. For more information about the alternatives considered but ultimately dismissed, please see Appendix A.

TSP Projects

As identified in TM #14, several Corvallis Transportation System Plan (TSP) projects are assumed to be included in No-Build and Build alternatives. These projects are identified in Appendix B.

Tech Memo Updates since TM#14 and TM#15A

It is important to note that the alternatives analyzed in this memorandum are slightly different than those defined in Technical Memorandum 14: Corridor Alternatives (TM #14) and analyzed in TM #15A. Most notably, the number of alternatives being analyzed has increased; there are now two future no-build alternatives and three future build alternatives. The Alternative Development section below provides more information on this change. The updates summarized below provide more accurate future conditions as well as the ability to more clearly identify the nuances of each alternative.

Model/Network Refinement:
The Corvallis-Albany-Lebanon Travel Demand Model (CALM) network was modified to include additional local street connections to better represent actual trip routing. All future no-build and build alternatives are based on the modified network.

Why was the model network refined:

There were concerns that the previous Transportation Analysis Zone (TAZ) structure and centroid connectors precluded the ability to clearly understand the potential effect of enhancing/relying on parallel facilities to capture/attract/carry traffic.

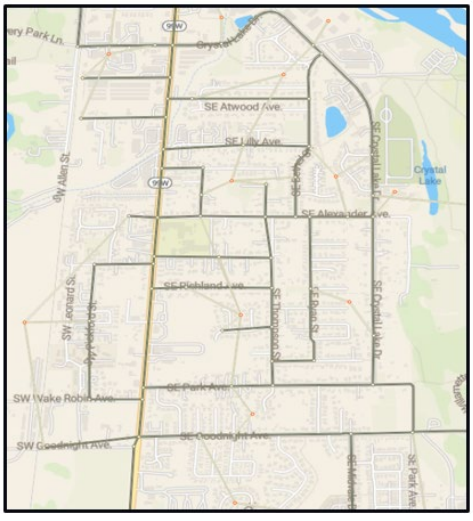
What was done:

A number of centroid connectors were changed into streets to better represent the actual trip routing from land uses. Also, more local roadways were added like SE Lily Avenue and SE Richland Avenue, see Figure 2 below.

Figure 2: Model Network Updates

Previous Version

Updated Version



Van Buren Bridge Project:
The Van Buren Bridge project is outside of the OR 99W Facility Plan project study area and was originally not included in the CALM network. One aspect of the project is to widen the one-way eastbound bridge from a one-lane cross section to a two-lane cross section. As a test, the project was added to the CALM network to investigate the magnitude of impacts within the study area.

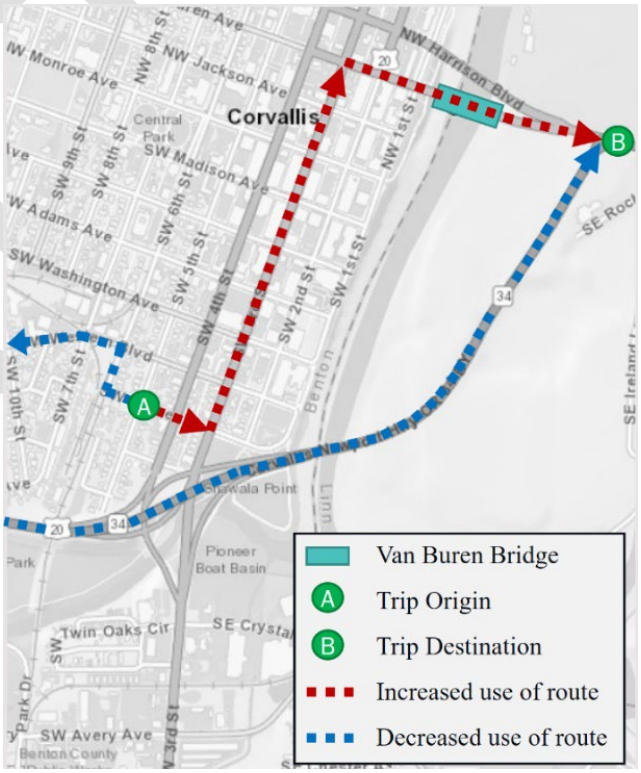
Why was the project included in the update:

It was determined that the additional lane on the bridge did have impacts within the study area significant enough to warrant inclusion in the CALM network

What was the result of including the Van Buren Bridge project in the CALM network:

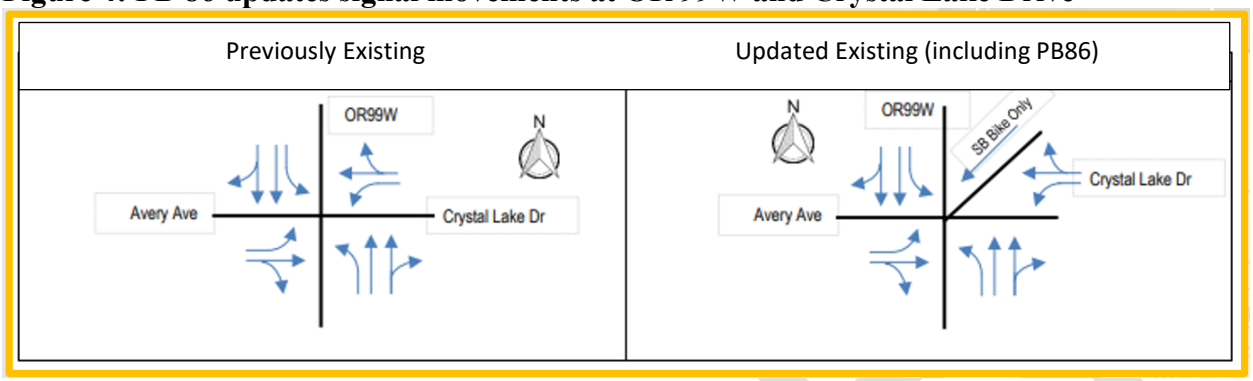
In the no-build alternatives, more trips used the widened bridge due to the reduced congestion and avoided the interchange within the study area, see Figure 3 for an example of this change. In the build alternatives, the bottleneck demonstrated with the existing one lane cross section on the Van Buren Bridge caused trips traveling through the south end of downtown Corvallis to use the new off-ramp roundabout terminal to make a u-turn and use the OR 34/US 20 bypass ramp. Once the bottleneck was removed and the bridge was two lanes, trips were using the more direct route across the Van Buren Bridge. See Appendix C for further information. Figure 3 shows an example of the change seen when a trip originates within the project area (point A) and desires to travel east on OR34/US20 (point B) in the future no-build alternative. When the bridge is not improved, more trips go quite a bit out of their way to avoid the bottleneck that occurs (blue line). When the bridge is widened, a more direct route is utilized to cross the new bridge and continue east (red line).

Figure 3: Example of trip change in NO-BUILD alternatives



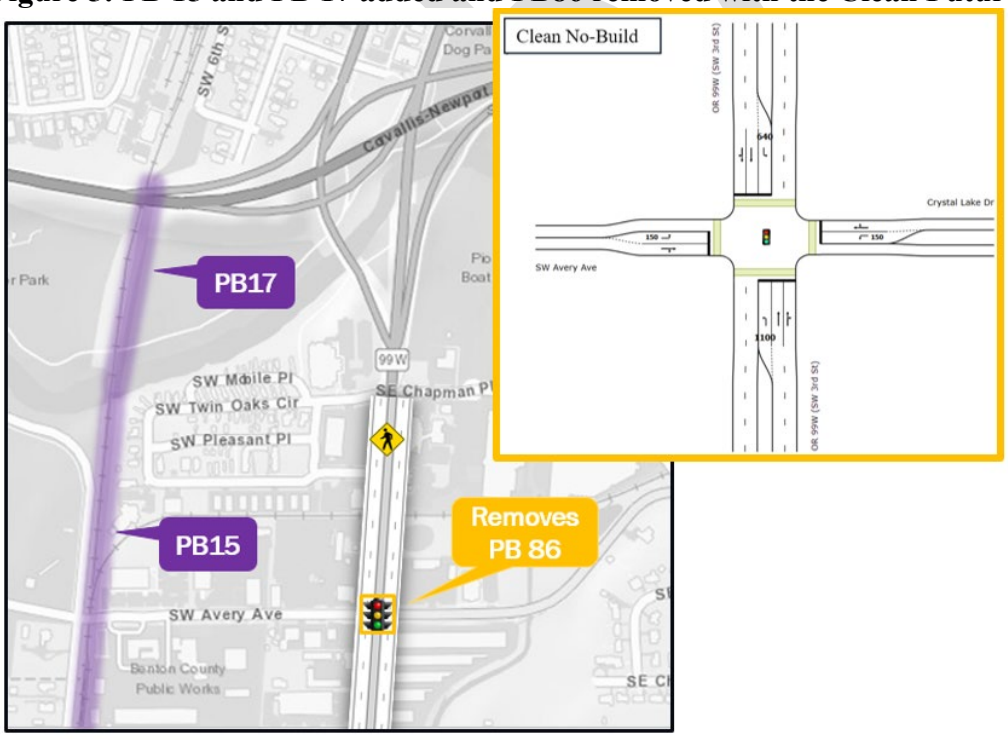
OR 99W & Avery/Crystal Lake Drive Intersection Improvements:
The existing signal at OR 99W and Avery Avenue/Crystal Lake Drive is currently getting a bike safety improvement in the form of an added diagonal bike phase (TSP project PB86). This benefits bicycles traveling from the northeast to the southwest (traveling from Crystal Lake Drive and turning south onto OR 99W) to help prevent right hook conflicts between bicycles and vehicles. PB86 is considered an existing interim solution and is not included in the future scenarios. The previous signal configuration and the updated existing signal configuration are shown in Figure 4 below.

Figure 4: PB 86 updates signal movements at OR 99W and Crystal Lake Drive



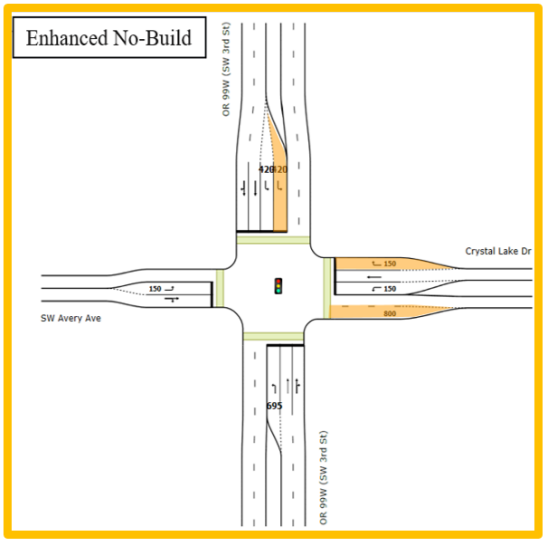
It is assumed this signal phasing will no longer be necessary when TSP projects are added with the future scenarios. An eastern parallel bike route will be constructed with PB15 and PB17 and is first introduced with the Clean Future No-Build, as shown in Figure 5 below. The addition of the parallel route eliminates the need for the diagonal signal phase as most of the trips will shift to the new parallel route, completely avoiding OR 99W.

Figure 5: PB 15 and PB 17 added and PB86 removed with the Clean Future No-Build Alternative



Beginning with the Enhanced Future No-Build alternative, TSP project A24 is added and improves intersection capacity by adding a westbound right turn lane, a second southbound left turn lane and the associated second receiving lane on the eastern leg of the intersection, as represented with the highlighted lanes in Figure 6.

Figure 6: TSP project A24 included with the Enhanced Future No-Build Alternative



Intersection Modifications

A variety of combinations of geometries and intersection controls were analyzed to optimize network operations. The following section describes the modifications made to specific locations and presents the analysis results as well as the assumptions implicit in the results reported.

Modifications at 4th Street and Western Boulevard:

Why was a change needed:

- Safety and comfort improvements needed for non-motorized modes

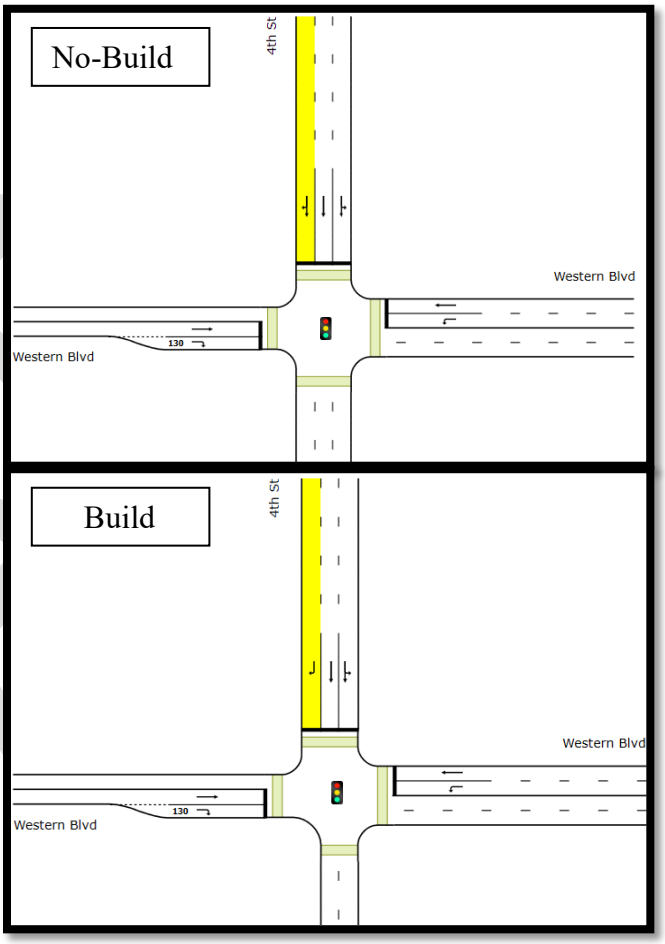
Note: 4th Street is overcapacity in No-Build alternatives

What was changed in the build alternatives:

- The Southbound through-right-turn lane on SW 4th Street was converted to a right-turn only lane.
- The cross-section was reduced to two through lanes south of intersection on SW 4th Street between SW Western Boulevard and the westbound OR34/US 20 on-ramp.

Impact of that change:

- improved safety and comfort for non-auto modes
- overcapacity condition worse as mainline lanes are reduced
- downstream improvements needed to accommodate capacity concerns, these resulting impacts are described in the next update



Key Takeaway: While the reduction in through lanes provides notable safety benefits, there is a trade off in traffic operations at the already over-capacity intersection of SW Western Boulevard and SW 4th Street. There are also impacts on the new eastbound OR 34/US 20 off-ramp roundabout terminal

Modifications at 3rd Street and Western Boulevard:

Why was a change made:

- To mitigate the operations at the intersection of SW Western Boulevard and SW 4th Street, discussed above.

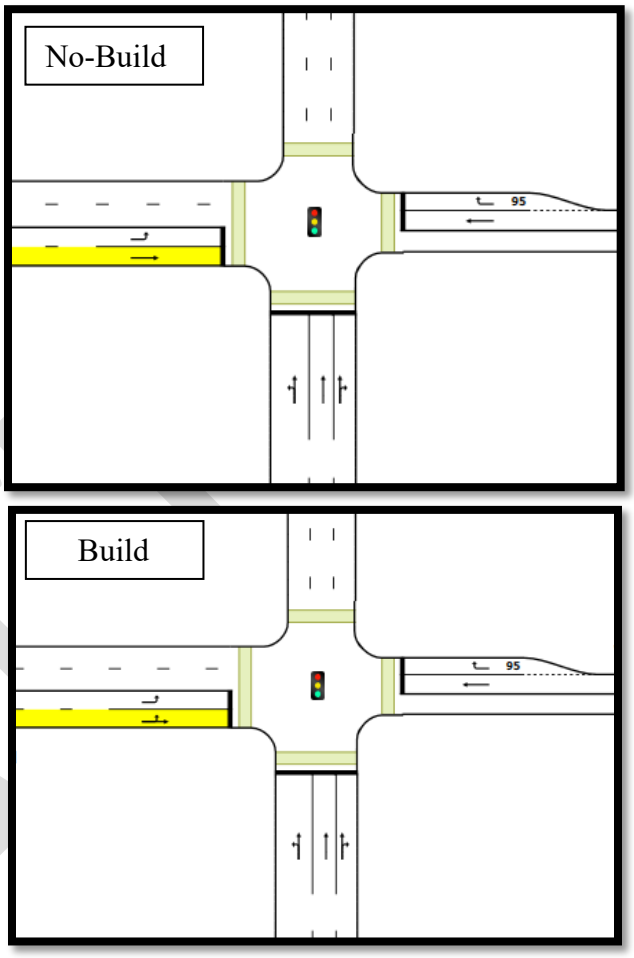
What was changed in build alternatives:

- Added a dual eastbound left turn lane at the intersection of SW Western Boulevard with SW 3rd Street

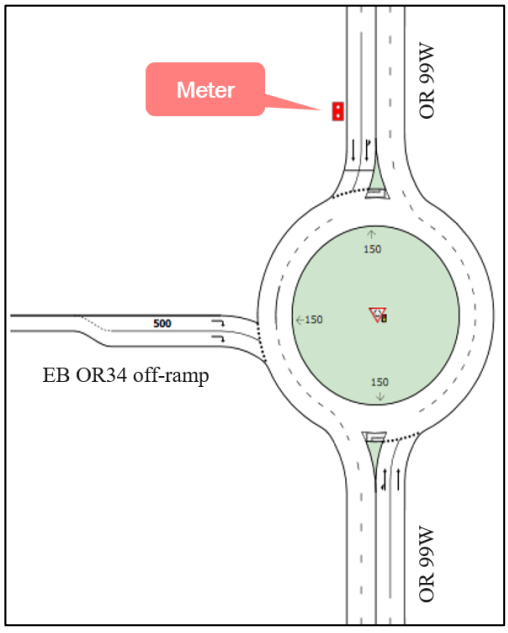
Impact of that change:

- Mitigating problems at the SW Western Boulevard intersections allows more trips to reach the interchange (and the new roundabout analyzed in the build alternatives).
- Because Alternative A, see alternatives section, does not have the additional parallel network (alternate route) on the west side of OR 99W, more trips are traveling through the interchange instead of through Avery Park. While this is desirable in many ways, this causes the roundabout v/c to be >0.90, which is slightly above the acceptable threshold for roundabout operations.
- This additional volume will require the roundabout to be metered on the southbound approach in Alternative A. A detailed discussion of the preliminary results that led to this analysis can be found in Appendix E.

Key Takeaway: Mitigating congestion at SW Western Boulevard and SW 4th Street increases the volume reaching the new off-ramp roundabout terminal at the interchange. Metering the SB approach in Alternative A mitigates congestion.

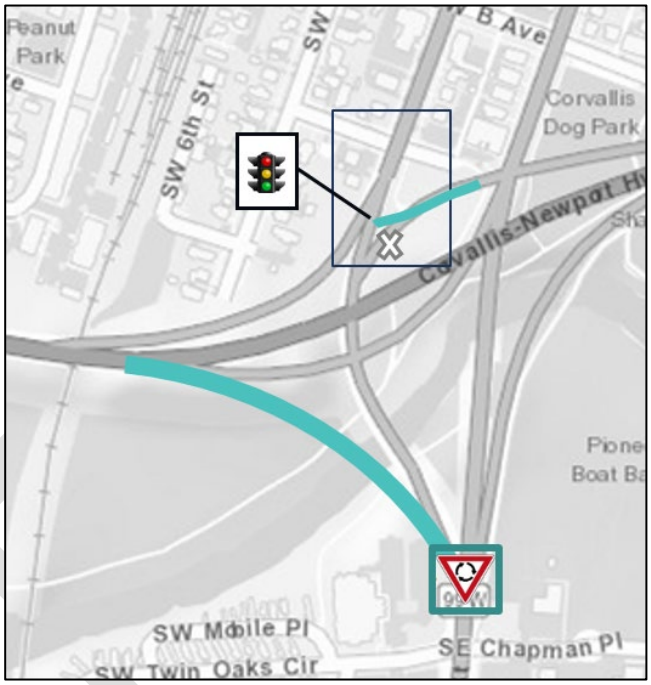


Metered Roundabout at Off-Ramp Terminal in Alternative A



OR 34 WB Off-Ramp Modifications:

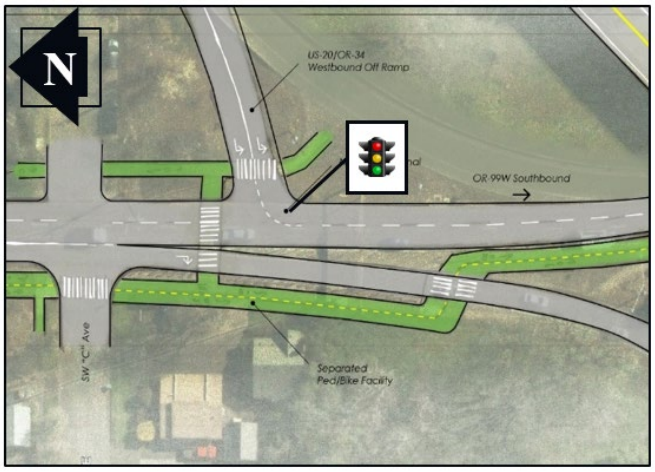
Southbound, the section from Western to Crystal Lake currently has no bicycle facilities, creating a gap in the network and significant out of direction travel for those intending to bike from northwest of the interchange to southwest of the interchange. Motor vehicle speeds are not well-managed through this section of the corridor, which is also true of the westbound off-ramp from OR-34/US-20 that merges with OR 99W at the interchange.



To solve these issues, OR-99W would be reorganized south of Western Boulevard to be two through travel lanes southbound and the sidewalk and additional space available from the road reorganization would be combined to provide a bidirectional raised shared use path on the west side of the road. This facility would extend from Western Boulevard, across the Marys River, to the new roundabout ramp terminal north of SE Chapman Place, described below.

Why was a change needed:

- There is a need for non-auto connectivity and safety improvements



What was changed in build alternatives:

- As depicted in TM #14, the westbound ramp terminal from OR-34/US-20 is slightly realigned to form more of a 'T' intersection.
- A ramp signal was added at the OR-34/US-20 westbound ramp terminal.

Impact of that change:

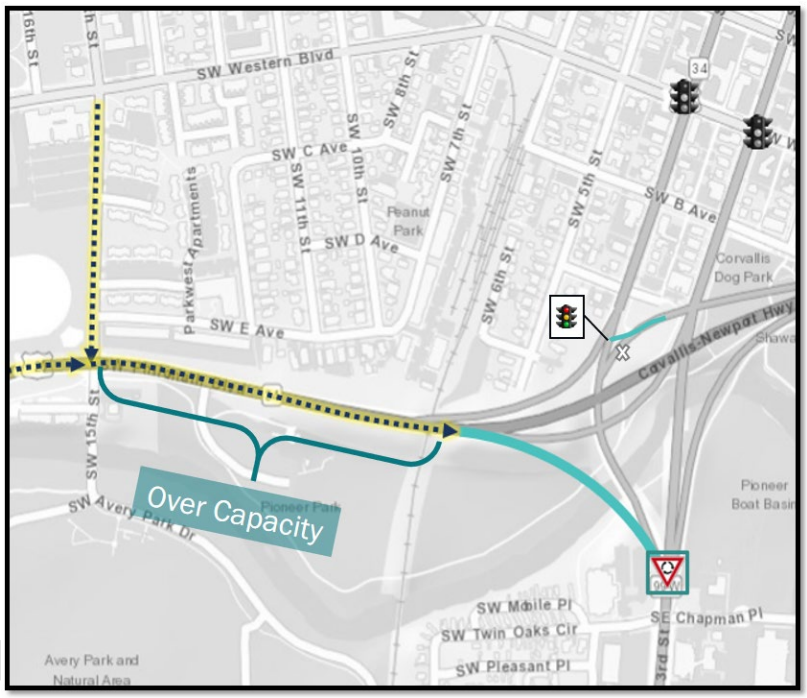
- A signalized intersection better accommodates pedestrian crossings and slows or stops vehicles coming from OR-34/US-20. An actuated crossing at the ramp entrance for OR-34/US-20 westbound from OR 99W is included for people walking and biking.
- The figure to the right illustrates these proposed modifications.

Key Takeaway: Ramp modification and signal were included to improve multi-modal safety and connectivity to align with the current use of pedestrian travel patterns today.

Roadway updates from 15th Street / Avery Park Road to OR 34 / US 20 needed:

Why will a change be needed:

- The new eastbound OR 34/US 20 to OR 99W off-ramp attracts additional trips originating from the northwest
- This increases the already overcapacity conditions by up to 50% on the section of eastbound OR 34/US 20 between SW 15th Street and the new off-ramp.



What would be needed in build alternatives:

- A potential solution is to make this section of eastbound OR 34/US 20 two lanes instead of only one. This would also mirror the westbound section of this highway which has two lanes along this section with one of the lanes terminating with a westbound right at SW 15th Street. See Appendix D for detailed description/discussion.

Impact of that change:

- This solution would require this second eastbound lane to be added to the list of financially constrained projects in the Regional Transportation Plan (RTP).

Key Takeaway: The new ramp draws a significant amount of traffic out of downtown and through the new ramp connection. While this is a good thing, it does affect congestion on the highway.

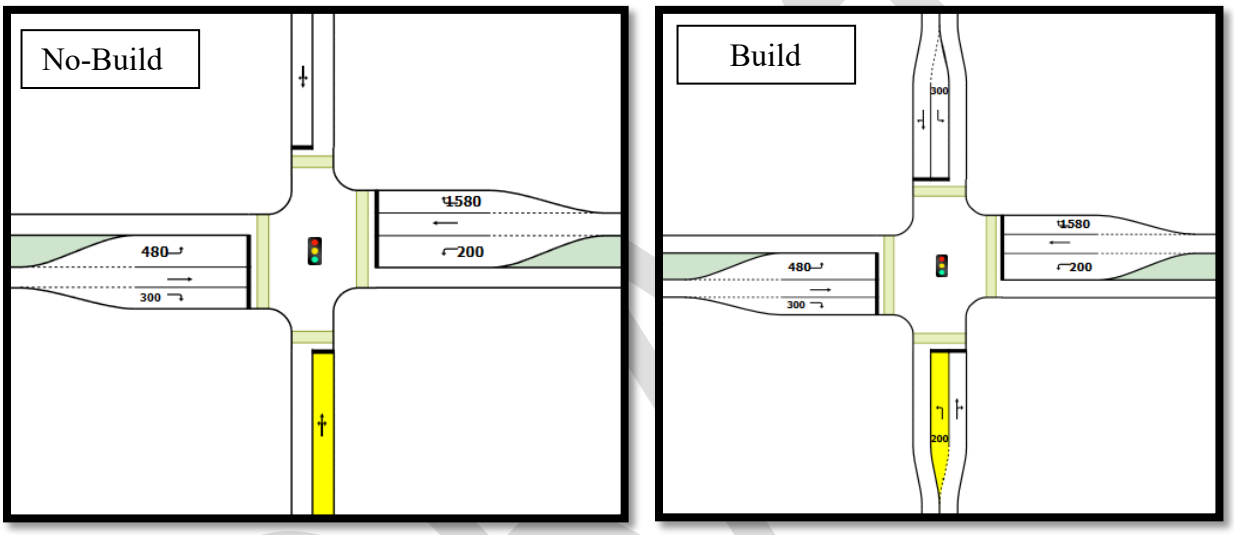
Intersection updates from 15th Street / Avery Park Road and OR 34 / US 20:

Why was a change needed:

- In the 2040 future Enhanced No-Build, which is described in the next section, the intersection of SW 15th Street and OR 34/US 20 is overcapacity with a v/c of 1.32.
- The traffic pattern shifts seen in the build alternatives (described in the issue above) cause the v/c to increase significantly over capacity conditions.
- The added ramp from eastbound OR 34/US 20 to OR 99W shifts traffic to OR 34/ US 20 (away from the downtown couplet). This shift in travel patterns adds more trips through the 15th Street intersection.

What was changed in <u>build</u> alternatives:

- Added a left turn storage lane on the north and south legs of the intersection. See Appendix D for more description/discussion.



Impact of that change:

- Improved the v/c to less over-capacity (improving to approximately 1.05 to 1.19 depending upon alternative).
- Note, further improvements made to reduce v/c would likely need a second lane eastbound from 15th Street to the new ramp as described above.
- There is a need to further study this and adjacent sections in a separate refinement study.

Key Takeaway: As discussed above the ramp draws significant traffic and the intersection v/c's while improved, by adding dedicated left turn lanes at this intersection, are still over capacity. This intersection should be looked at in greater detail along with the ramp.

2040 Future No-Build Alternative Development

Further analysis was essential to develop a future no-build alternative that could adequately be compared with the future build alternatives. Therefore, it was deemed necessary to document two Future 2040 No-Build alternatives and these two no-build alternatives are summarized below. For more information regarding the need for two no-build alternatives as well as specific projects included, please see Appendix B.

2040 No-Build (Clean)

This alternative analyzes the 2040 traffic conditions and includes fiscally constrained TSP projects which means projects are either

- funded and likely to be constructed in the next 5 years or
- have known funding likely to be available in the next 20 years, these are projects on the financially constrained project list (more on why this is important for funding options on page 11 of the TSP)

The 2040 No-Build (Clean) documents a fiscally constrained alternative for consistency with agency procedures (and potential funding sources and requirements). This clean no-build is important for evaluating the overall corridor travel performance and the effects of traffic growth on things like v/c (intersection capacity), queueing, average travel time, average travel speed, VMT/capita and mode shift.

The effects of adding enhanced pedestrian crossings and adding to the city street network with the illustrative TSP projects needs to be understood. Additionally, the effects roundabouts have versus signals on the corridor need to be clearly identifiable. The clean no-build provides a clear comparison for some of the base assumptions that apply to the build alternatives. Once the effects of those 'base' assumptions are identified the differences in each alternative can be better understood.

2040 No-Build (Enhanced)

Utilizing the No-Build (Clean) as the base comparison, the No-Build (Enhanced) adds in 11 new enhanced pedestrian crossings and the illustrative TSP projects outlined in Appendix B.

Crossing enhancements could include lighting, pedestrian activated flashing beacons, pedestrian refuge islands, extra signage, or high visibility striping. For the purposes of this analysis, the enhanced crossings were assumed to include Rectangular Rapid-Flashing Beacons (RRFB). These new enhanced crossings are not in the TSP but are guided by new ODOT urban design guidance (including the number and location of the crossings).

After extensive technical analysis, there were some modifications to the geometry and/or location of treatments described in TM #14 in order to optimize the motor vehicle operations as well as to follow required regulations (such as MUTCD guidance for signal spacing, etc.). For example, ODOT does not permit Pedestrian Hybrid Beacons (PHB) at intersections because they are considered a half-signal configuration. Additionally, any red device (including PHB's and full pedestrian signals) would require signal warrant thresholds to be met. There would need to be a separate engineering investigation by ODOT Region 2 prior to any approvals by the state traffic engineer before these could be considered to be installed. Additionally, there is insufficient pedestrian volume data to determine if intersections meet pedestrian signal warrants. Therefore, only Rectangular Rapid-Flashing Beacons (RRFB) were considered in the analysis.

Signals were also evaluated as an alternative to mid-block crossings where appropriate, in particular the two new enhanced mid-block crossings near B Avenue. These signals were not carried forward into the analysis in this scenario; however, they could be considered in the future (see Appendix A)

The illustrative TSP projects create more network connections on local city streets, specifically adding a parallel route and appropriate connections on the west side of OR 99W connecting SW Goodnight Avenue to SW Airport Avenue.

2040 Future Build Alternative Development

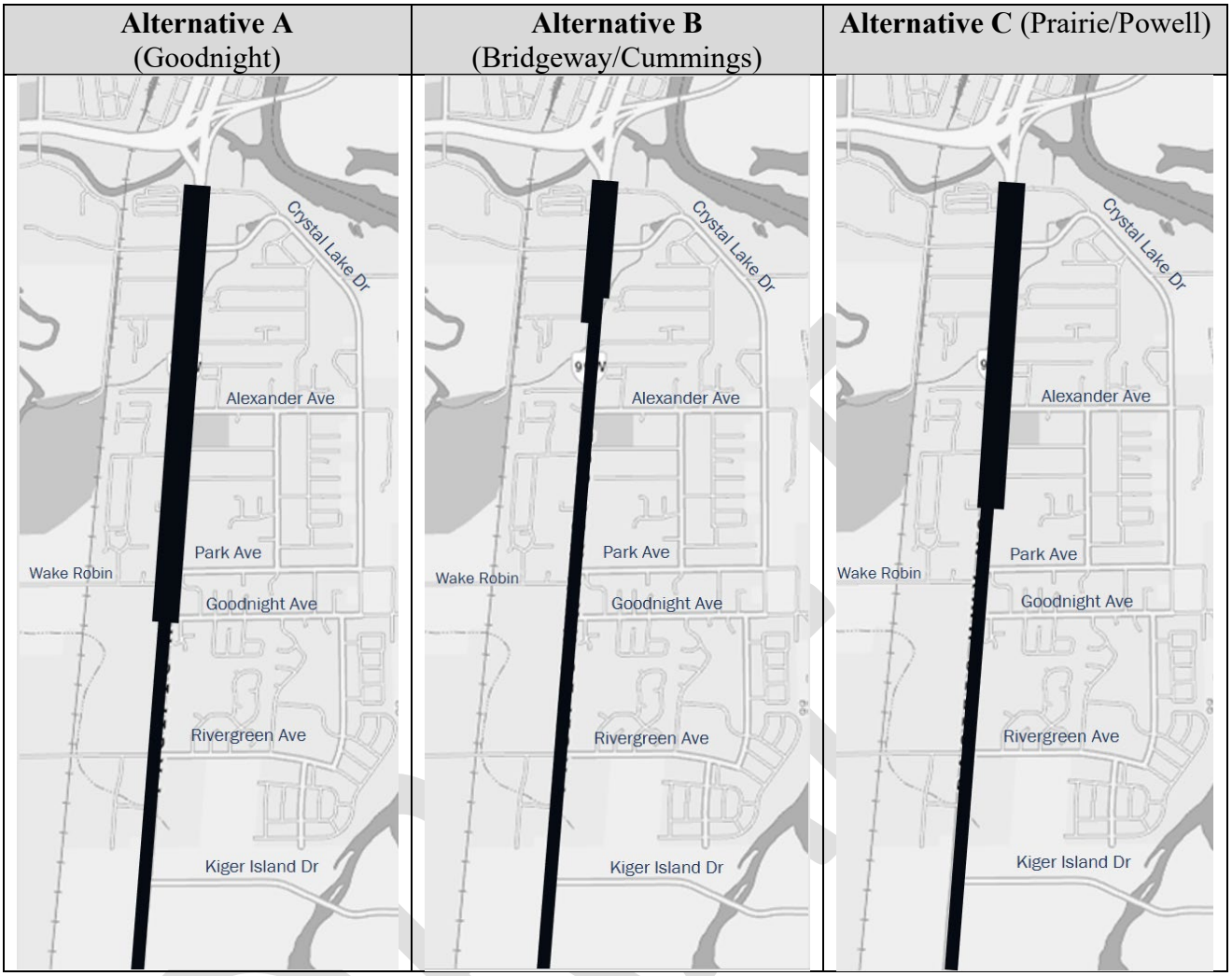
The future build alternatives (Alternative A, B and C) are derived from the 2040 No-Build (Enhanced). There are a few factors that distinguish the build alternatives from each other as well as the no-build alternatives. These differences are described in the following section.

Three-lane cross section:

One of the primary project objectives is to evaluate how far north a three-lane cross-section on OR 99W could be achieved. The intent is to utilize the 'extra' roadway width for multi-modal enhancements to the extent possible. Modifications to the roadway network are also identified based on the impacts of reducing the cross-section of OR 99W to accommodate local traffic needs. The main differences between the three build alternatives stem from this concept and are primarily located in Segment 2 of the project area. Where the three-lane cross section begins or ends in each build alternative is summarized below and graphically shown in Segment 2 in Figure 7.

Multiple iterations were considered, primarily for Alternatives B and C, to determine the ideal location for transitioning from five lanes to three. Ultimately, the location of the transition was selected to meet the project objective and minimize localized and corridor wide impacts, while also providing different elements that conclusions can be made from. For additional information about the multiple iterations of the alternatives see Appendix A.

Figure 7: Transition locations from five-lanes to three-lanes



Alternative A
The three-lane cross-section on OR 99W begins just south of SW Goodnight Avenue (rather than where it is today, which is just south of SW Kiger Island Drive).

Alternative B
The three-lane cross-section on OR 99W begins just south of SW Cummings Avenue in the southbound direction and at SE Bridgeway Avenue in the northbound direction.

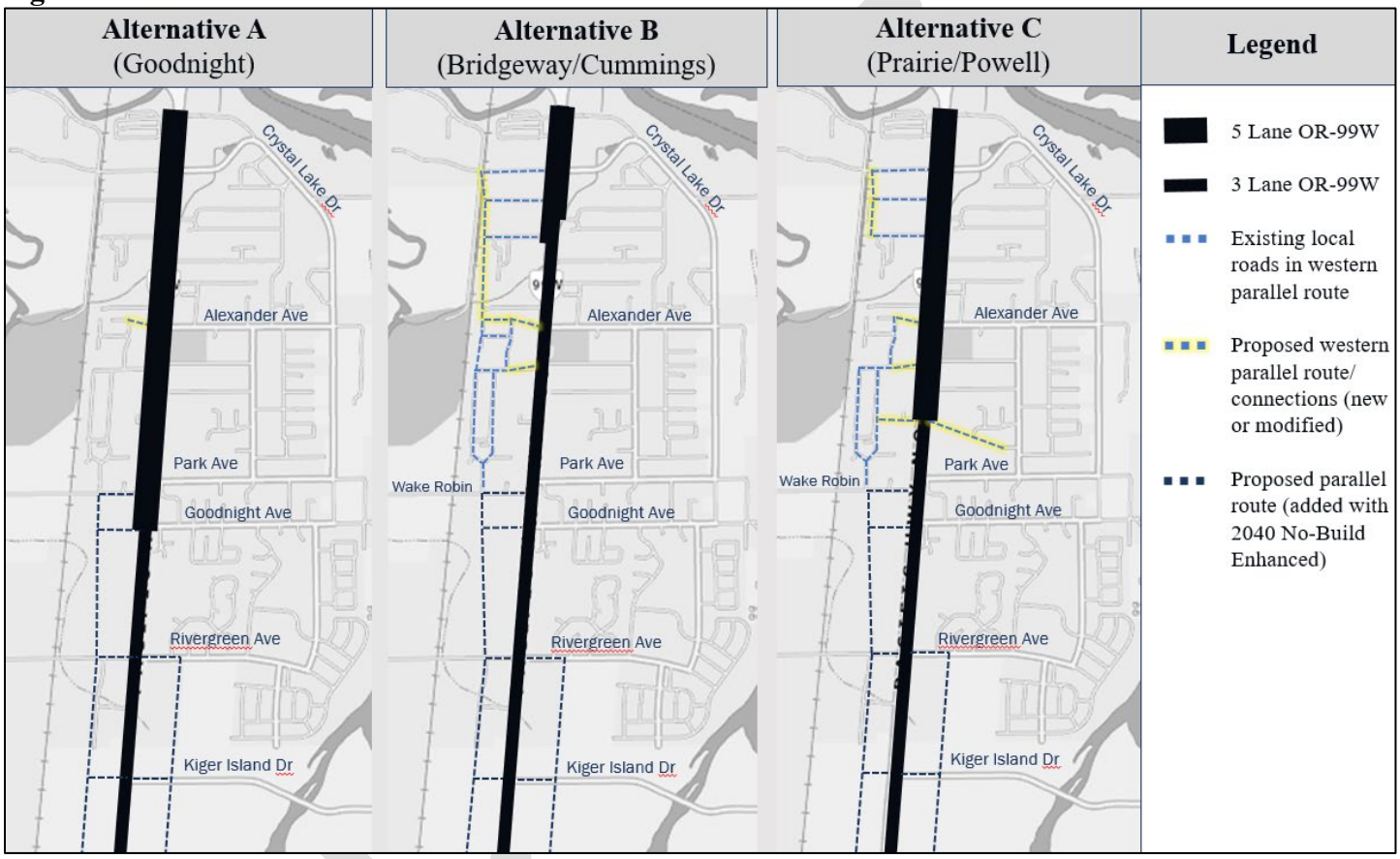
Alternative C
The three-lane cross-section on OR 99W begins just south of SW Prairie Drive.

Local network additions or modifications:
The enhanced no-build and the three build alternatives assume an enhanced parallel network from SW Goodnight Avenue south to SW Airport Avenue, in alignment with the illustrative TSP projects. There are a few additional projects identified for each build alternative that are needed to either optimize the alternative or resolve an identified safety issue. These projects are another key difference between each build alternative.

Modifications and/or additions to local street segments accommodate the local traffic that is getting off of OR 99W and choosing to use a different route. For more on why routes other than OR 99W are being used for local trips refer to Appendix I. The modifications are often extending or connecting existing roadways to create a connected parallel route on the west side of OR 99W for trips (or parts of trips) to be made off OR 99W.

It has been identified that *all trips utilizing these local network connections are local trips,* meaning no through trips (i.e. regional freight movements or long distance travelers) are utilizing these local streets to avoid OR 99W congestion.. The variations in where the local network has been modified are summarized below and graphically shown in the Segment 2 graphics in Figure 8.

Figure 8: Local street network modifications



Alternative A (three-lane cross section beginning at Goodnight Avenue)
Extends SW Alexander Avenue west to connect to SW Butterfield Drive. This connection is needed when the SE Viewmont Avenue and SW Tunison Avenue turn restrictions are applied and in Appendix F.

Alternative B (three-lane cross section beginning at Bridgeway & Cummings Avenues)
Includes new roadway to complete the connection between SW Avery Avenue to SW Goodnight Avenue.

Alternative C (three-lane cross section beginning at Prairie & Powell Avenues)
Includes a partial connection between SW Avery Avenue and SW Goodnight Avenue with a break in the parallel route; it does not cross over the Mill Race. Alternative C also adds an east/west route by extending both Prairie Avenue and Powell Avenue, creating a new four-legged intersection at OR 99W.

INTERSECTION TRAFFIC CONTROL DEVELOPMENT

This section outlines the methods used to determine the most effective intersection traffic control to use for each alternative. There are many aspects to balance along the corridor where it is important to review not only the individual intersection operation, but also how that intersection affects the corridor overall. The optimal combination of signals and roundabouts were assessed as discussed in this section and accompanying appendices.

Roundabouts

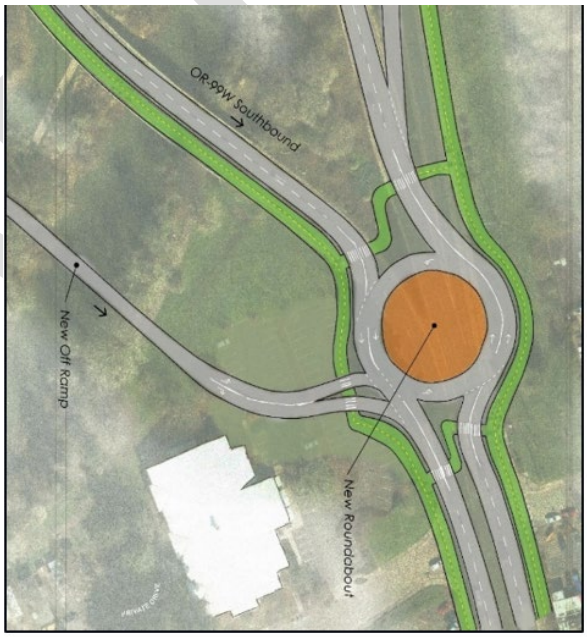
The Project Management Team (PMT) emphasized the use of roundabouts where possible in alignment with the corridor goals set by the City and other stakeholders. Roundabouts were considered at a number of intersections. The final analysis for each alternative evaluated roundabouts at the intersections with OR 99W including:

- At the junction of the new off-ramp from eastbound US20/OR34 to OR 99W
- Goodnight Avenue
- Rivergreen Avenue

Ramp and Roundabout from EB US20/OR34 to 99W:

In both no-build alternatives, the interchange is incomplete and lacks a connection between eastbound OR 34/US 20 and southbound OR 99W. This leaves drivers with two options:

1. Drivers unfamiliar with the area will generally follow signs to travel out-of-direction north on US20. They can then use westbound SW Western Boulevard (or SW B Avenue) to reach southbound OR 99W.
2. Drivers familiar with the area often travel through Avery Park to reach southbound OR 99W more directly. This causes SW Avery Park Road to be the defacto eastbound to southbound off-ramp which is an undesirable facility to facility connection.



In an effort to mitigate this connection, the three build alternatives include a new eastbound OR 34/US 20 to OR 99W off-ramp with a roundabout terminal (see Figure at right). A signal was evaluated at this location and while it was a viable option is was not advanced further for this analysis (see Appendix A).

Goodnight and Rivergreen Avenues:

Analysis is included for both signals and roundabouts at Goodnight Avenue and Rivergreen Avenue as these projects are included in the TSP, see Appendix L for signalized results. While both of these locations were evaluated, only Rivergreen Avenue meets Preliminary Signal Warrants (Appendix B). The ability to meet the preliminary signal warrant for Goodnight Avenue is development driven. Either intersection control could be used however signals cause longer queues on OR 99W than roundabouts and based on feedback from the PMT, where possible, roundabouts were included in the alternatives summarized in this memo. All intersection analysis results are included in Appendix L.

Intersection Turn Restrictions

There are two/three locations where turn movements onto or off of OR 99W were evaluated and it was determined that by restricting certain movements, intersection and corridor performance notably improved. The locations and treatments applied in this analysis are described below. The analysis results include these turn movement modifications in the build alternatives.

Twin Oaks & Chapman Right-In, Right-Out (RIRO):
At the intersections of OR 99W and Twin Oaks Circle and Chapman Place, due to the proximity of the interchange to the north and neighboring intersections to the south, left turns are not allowed onto nor off of OR 99W in the build alternatives. Travelers can turn right from Twin Oaks Circle or Chapman Place onto OR 99W and they can also turn right off OR 99W onto Twin Oaks Circle or Chapman Place. However, if a left movement is needed, travelers can utilize the nearest intersections to the south and use local streets or the new roundabout at the interchange to the north can be used to essentially make a u-turn.

Viewmont & Tunison Right-In, Right-Out, plus Left-In (RIRO+LI):
The Viewmont and Tunison Avenue intersections with OR 99W were identified as safety concerns in TM#12. Each build alternative has addressed this safety concern. One option could be realigning these intersections to create one four-legged intersection, this was evaluated (results shown in Appendix F). However, a better cost-effective option modifies the turning movements to be Right-In, Right-Out and Left-In (RIRO+LI), meaning traffic on OR 99W can turn right and left onto these side streets (no-change here) but coming from the side streets traffic can only turn right onto OR 99W. This traffic control change improves safety by removing direct conflicts with both other vehicles and pedestrians. For more information on this turning movement modification and the analysis of a realigned four-legged intersection see Appendix F.

ALTERNATIVES

Each alternative was developed through a thoughtful collaborative effort to capture the goals of the facility plan and facilitate a comparison of the primary differences between each alternative. The alternatives analyzed are graphically shown below. For more information about the many iterations and various alternatives considered throughout this process see Appendix A.

Graphics of each segment are included in Figures X through X to summarize each alternative.

VOLUME DEVELOPMENT

The volumes were post-processed from CALM outputs starting with the 2019 existing volumes for each of the no-build and build alternatives. The volume development spreadsheets are not conducive to be included in the appendices, but are available upon request. The post-processed peak period Design Hour Volumes are available in Appendix G.

Average Daily Traffic (ADT) volumes are generally straightforward to calculate, the 30 HVs (or design hour volumes (DHV)) are divided by the K factors to obtain the ADT on each directional link. However calculating ADTs at all of the locations of interest for this Project was complicated because there were limited traffic counts available and there was more than one link that was either new or had an unknown volume across the screenline used to calculate the ADT.

ADTs along OR 99W were developed using standard methodology. However, where ADTs were needed along the proposed new roadways or on the local network, an alternative approach was required. For this purpose, ODOT Research's Report SPR-804: "A Method to Estimate Annual Average Daily Traffic for Minor Facilities for MAP-21 Reporting and Statewide Safety Analysis" was used. SPR-804 methodology allowed ADTs to be developed for the local network. A screenline analysis could then be performed with the only unknown north/south link ADT being on the proposed new roadway. The SPR-804 methodology will be discussed in the following sections. Additional discussion about ADT volume development can be found in Appendix H.

ANALYSIS RESULTS

Each alternative was assessed to determine its *overall effect throughout the corridor*. This section summarizes the analysis results. There are many variations and possible solutions at each intersection however, what is summarized here are the results of optimizing each intersection for each alternative to provide the best result for the corridor as a whole while meeting the project goals. For more information about the alternatives considered but dismissed or other solutions that were evaluated but not included in the final alternatives analysis, please see Appendix A.

SIDRA was used to analyze intersections and the overall network of this corridor. Several analysis methodologies are available, for this Project HCM 6 was used. With SIDRA, vehicles can be restricted on roadways or by lane or vehicle type (e.g., bridge weight limit, truck lanes, etc.) and/or allow integration with most on-street modes. With its network and separate lane analysis/vehicle path capabilities (essentially a mesoscopic analysis), it can analyze urban facilities for the full capacity, delay and queuing impacts in the system without the need for micro-simulation. SIDRA fully accounts for queuing spillbacks on the system and will meter flow into adjacent intersections and reduce corresponding capacities. These capacity reductions are incorporated into all of the results including, v/c ratio, LOS, delay, queuing, etc.

Performance Measures

There are a number of performance measures used to gauge the operations of a facility. In this analysis the following were evaluated:

- Intersection volume to capacity (v/c) ratio
- Level of Service (LOS)
- Delay
- Corridor Travel Performance (Travel Time and Travel Speed)
- Queuing
- Latent Demand (Diverted Demand and Peak Spreading)
- Vehicles-Miles Traveled (VMT)
- Mode Share

Intersection Operational Standards (v/c ratio)

The study area falls within the Corvallis Area MPO (CAMPO) boundaries and the state jurisdiction operational standards used for the future no-build conditions will be guided by Table 6 of the Amended 2019 Oregon Highway Plan (OHP). The three future build alternatives are compared to the Highway Design Manual (HDM) v/c design standards. The study area is within the Corvallis Urban Growth Boundary (UGB) and also within the CAMPO boundary on a regional highway freight route. The applicable v/c targets for No-Build alternatives and standards for Build alternatives are provided in Table 1.

Table 1: State v/c Ratio Targets

Roadway	v/c Targets for No-Build Alternatives	v/c Standard for Build Alternatives
	OHP	HDM
Freight Route on a regional or District Highway (MPO)	0.90	0.85
District/Local Interest Roads (MPO)	0.95	0.85

The mobility standard for facilities under City jurisdiction is a maximum v/c ratio of 0.85, per the City of Corvallis 2018 TSP, Chapter 6. For signalized intersections, the overall intersection v/c ratio (not individual legs) must comply with the standard. For unsignalized intersections, all movements serving 20 vehicles per hour or more must comply with the standard. The Benton County 2018 TSP, Chapter 4 indicates that two-way stop and yield controlled intersections under County jurisdiction must operate with a v/c ratio not higher than 0.90. These mobility standards are the same for the no-build and the build alternatives (see Table 2). A v/c ratio of 1.0 represents an intersection at capacity.

Table 2: City and County v/c Ratio Standards

Roadway	v/c
City of Corvallis	
SW Western Blvd	0.85
SW B Ave	
SW Twin Oaks Cir/SE Chapman Pl	
SW Avery Ave/Crystal Lake Dr	
SE Alexander Ave	
SE Viewmont Ave	
SW Tunison Ave	
SE Richland Ave	
SE Park Ave	
SW Wake Robin Ave	
SE Goodnight Ave	
SW Goodnight Ave	
SE Rivergreen Ave	
Benton County	
OR 99W at Kiger Island Dr	0.90
OR 99W at Airport Ave	

INTERSECTION ANALYSIS RESULTS

Unsignalized Intersection Analysis and Results

The v/c, LOS, and delay for the unsignalized intersections in the two no-build alternatives as well as the three build alternatives are presented in Tables 3 and 4. Appendix L contains the Sidra intersection analysis results. The results for the updated no-build alternatives are very similar to those seen in the original no-build analysis found in TM #12, Future No-Build Motor Vehicle Conditions Intersection Analysis.

Table 3: Unsignalized Intersection Delay and LOS

		Intersection Delay (seconds) and LOS (A-F)				
	Intersection[1,2]	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
Segment 1	B Ave & 4th St	3 (A) / **106 (F)**	3 (A) / **>120 (F)**	4 (A) / 39 (E)	4 (A) / 33 (D)	4 (A) / 34 (D)
	B Ave & 3rd St	6 (A) / **>120 (F)**	6 (A) / **>120 (F)**	5 (A) / **88 (F)**	6 (A) / **>120 (F)**	6 (A) / **105(F)**
	Twin Oaks/ Chapman Pl[3]	13(B) / **>120(F)**	15 (B) / **>120 (F)**	5 (A) / 9 (A)	6 (A) / 9 (A)	7 (A) / 9 (A)
Segment 2	Viewmont Ave[3]	7 (A) / **>120 (F)**	8 (A) / **>120 (F)**	8 (A) / 16 (C)	6 (A) / 18 (C)	7 (A) / 16 (C)
	Tunison Ave[3]	8 (A) / **>120 (F)**	9 (A) / **>120 (F)**	7 (A) / 14 (B)	4 (A) / 14 (B)	5 (A) / 11 (B)
	Richland Ave	8 (A) / 42 (E)	8 (A) / **>120 (F)**	8 (A) / 37 (E)	6 (A) / **66 (F)**	8 (A) / 36 (E)
	Park Ave	8 (A) / **>120 (F)**	8 (A) / **>120 (F)**	8 (A) / **>120 (F)**	7 (A) / **53 (F)**	8 (A) / 32 (D)
	Wake Robin Ave	6 (A) / **>120 (F)**	7 (A) / **>120 (F)**	6 (A) / **>120 (F)**	4 (A) / 48 (E)	5 (A) / **>120 (F)**
Segment 3	Kiger Island Dr	6 (A) / **52 (F)**	5 (A) / **>120 (F)**	5 (A) / 43 (E)	5 (A) / 33 (D)	5 (A) / 39 (E)
	Airport Ave	2 (A) / 21 (C)	2 (A) / 22 (C)	2 (A) / 18 (C)	2 (A) / 18 (C)	2 (A) / 18 (C)

[1]Values for intersection are listed by the controlling movement (higher value). In all locations, the MINOR movement controls the intersection performance results.
[2]**Bold** text indicates the delay exceeds 50 seconds and LOS of F
[3]Left Turn restrictions apply to build alternatives, see Right-In, Right-Out Analysis section.

Table 4: Unsignalized Intersection v/c

		Intersection v/c				
	Intersection[1,2]	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
Segment 1	B Ave & 4th St	0.38 / **1.06**	0.38 / **1.11**	0.48 / 0.77	0.47 / 0.72	0.46 / 0.74
	B Ave & 3rd St	0.45 / **1.28**	0.44 / **1.26**	0.36 / 0.59	0.44 / 0.73	0.41 / 0.46
	Twin Oaks/ Chapman Pl[3]	0.55 / **>2.0**	0.58 / **>2.0**	0.54 / 0.10	0.58 / 0.16	0.66 / 0.12
Segment 2	Viewmont Ave[3]	0.39 / **>2.0**	0.36 / **>2.0**	0.36 / 0.18	0.57 / 0.01	0.35 / 0.23
	Tunison Ave[3]	0.36 / **>2.0**	0.39 / **>2.0**	0.36 / 0.01	0.57 / 0.05	0.34 / 0.01
	Richland Ave	0.39 / 0.35	0.38 / **1.01**	0.38 / 0.31	0.62 / 0.47	0.41 / 0.29
	Park Ave	0.37 / **1.55**	0.38 / **1.60**	0.36 / **1.21**	0.63 / 0.38	0.67 / 0.28
	Wake Robin Ave	0.33 / **>2.0**	0.35 / **>2.0**	0.33 / **1.99**	0.55 / 0.69	0.61 / 0.83
Segment 3	Kiger Island Dr	0.33 / 0.46	0.35 / 0.71	0.42 / 0.15	0.41 / 0.12	0.42 / 0.11
	Airport Ave	0.21 / 0.43	0.21 / 0.31	0.20 / 0.22	0.20 / 0.19	0.20 / 0.21

[1]Values for intersection are listed by MAJOR movement / MINOR movement.
[2]**Bold** text indicates the OHP v/c target of 0.90 or City standard v/c of 0.85 has been exceeded. The no-builds are compared to the OHP standard.
[3]Left Turn restrictions apply to build alternatives, see Right-In, Right-Out Analysis section.

Segment 1 - Summary of Unsignalized Intersection Analysis and Results:

- The results represent a dual eastbound left at 3rd and Western and a metered off-ramp roundabout terminal in Alternative A.

- The new eastbound OR-34/US-20 off-ramp and roundabout create a more complete interchange providing a connection for traffic to head southbound without using SW B Avenue as a turnaround. This new connection creates an improvement in v/c and delay at both of the SW B Avenue intersections. A more significant improvement is seen at the intersection of SW B Avenue with SW 4th Street because this is where it was difficult to find a gap to make a westbound left movement to proceed southbound on OR 99W.
    - The new off-ramp moves traffic from traveling through downtown to using SW 15th Street and/or SW 26th Street to head south on 99W. This improves the v/c's at the intersections of SW B Avenue in all build alternatives.

- Converting the intersection of OR 99W with Twin Oaks Circle/Chapman Place to RIRO only in all build alternatives significantly improved v/c and delay. This removes the issue of the difficulty in finding an acceptable gap to turn left onto the mainline.
    - RIRO at Twin Oaks significantly improves intersection performance

- Long delays on the side streets in the no-builds, but the v/c's improve in the build alternatives. Delay remains high for all build alternatives at B Avenue and 3rd Street. B Avenue and 4th Street is improved in all build alternatives due to the presence of the new eastbound off ramp.

Segment 2 - Summary of Unsignalized Intersection Analysis and Results:

- The v/c's demonstrate acceptable operations for all locations in Alternatives B and C considering the mainline lane reductions in this segment.

- Long delays on the side streets in the no-builds

- v/c's are acceptable in all locations in Alternatives B and C, and most locations in Alternative A. While the v/c's are acceptable, what's not clearly shown when looking at v/c alone is the effect of queuing and latent demand. Latent demand effects caused by upstream bottlenecks and demands exceeding capacity are present so the v/c's are likely lower than what will be experienced. For more information on this see the Latent Demand section below and for even more in depth discussion, see Appendices I and J.

- Alternatives B and C improve delay and v/c on Park Avenue and Wake Robin Avenue because the lane reductions for each occur further north and traffic has already diverted to the added parallel routes. Alternative A continues to experience high delay and v/c on Park Avenue and Wake Robin Avenue.

- Alternatives A and C do not have the full parallel network added on the west side of OR 99W connecting Avery Avenue to Goodnight Avenue. Before the RIRO+LI modification to SE Viewmont Avenue and SW Tunison Avenue this resulted in longer delays at Viewmont, Tunison and SE Richland Avenues in Alternative A than in Alternative B because a large portion of the volume is still present on OR 99W making it more difficult to find an acceptable gap to make a left turn on to the mainline. With the RIRO+LI applied to Viewmont and Tunison in the build alternatives the performance of Viewmont and Tunison is significantly improved.

- Due to the CALM model update including more of the existing local network, some re-routing of traffic occurred within the local grid. For example, this can be seen in the shift from Richland Avenue originally being over capacity to Park Avenue having the worse v/c.

- In general, the Richland intersection has been unstable in the sense that very few trips need to be added to 'push' the intersection over the performance targets. In addition to improving how the model reflects the existing roadway network, the mid-block crossing north of Richland was evaluated south of the intersection and this modification improves the overall performance of the intersection. This change is reflected in the ENHANCED No-Build and all three build alternatives.

- Alternative A and C see high v/c's north of the transition from five-lanes to three-lanes (which occurs just south of SW Goodnight Ave and SW Prairie Ave / SW Powell Ave respectively). The lane reduction reduces the capacity of OR 99W and potentially creates a bottleneck as traffic merges.

Segment 3 - Summary of Unsignalized Intersection Analysis and Results:

- The difference between Enhanced No-Build and Alternative A in segment 3 is a lane reduction from 5 to 3 at Goodnight instead of at Kiger Island as it is today.

- Delay and v/c's are similar for all three build alternatives and make improvements on the enhanced no-build.

- Increased delay is observed on Kiger Island Drive in the enhanced no-build only. The difference between the clean and enhanced no-build is the added parallel network and Kiger Island Drive becomes a 4-way intersection. This added leg to the intersection adds overall delay to the side street movements.

- In the build alternatives the lane reduction occurs north of Kiger Island Drive and that combined with the full parallel network in this segment reduces delay through the intersection at OR 99W by rerouting trips to the parallel route before they arrive at Kiger Island Drive.

Signalized Intersection Analysis and Results

Table 5 shows the signalized intersection results.

Table 5: Signalized Intersection v/c, LOS, & Delay

		Intersection v/c Delay (seconds) and LOS (A-F)				
	Intersection[1]	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
Segment 1	Western & 3rd	0.71	0.69	0.70	0.82	0.76
		25 (C)	29 (C)	29 (C)	39 (D)	35 (C)
	Western & 4th	**1.06**	**1.05**	**0.98**	**0.93**	**0.98**
		68 (E)	**71** (E)	**66** (E)	**63** (E)	**69** (E)
	15th St & OR34[2]	**1.84**	**1.32**	**1.19**	**1.05**	**1.15**
		35 (D)	33 (C)	**107 (F)**	**94 (F)**	**91 (F)**
	WB OR34 Off-Ramp	N/A	N/A	0.72	0.66	0.67
		N/A	N/A	1 (A)	18 (B)	17 (B)
	Avery/Crystal Lake	**1.10**	**1.07**	0.84	**1.08**	**0.95**
		>120 (F)	**>120 (F)**	**112 (F)**	**>120 (F)**	**>120 (F)**
Segment 2	Alexander	0.71	0.68	0.71	0.83	0.71
		22 (C)	23 (C)	35 (D)	**66** (E)	26 (C)

[1]**Bold** text indicates the OHP v/c target of 0.90 or City standard v/c of 0.85 has been exceeded
Bold also indicates delay over 50

[2]The build alternatives include modifications to optimize intersection performance, see the previous Intersection Modification section and Appendices B, D, E, and F for more information.

Segment 1 - Summary of Signalized Intersection Analysis and Results:

- At Western Boulevard and 4th Street the build alternatives improve v/c's (below 1.0). This improvement was achieved by optimizing performance at this and nearby intersections
    - The existing southbound through-right-turn lane on SW 4th Street was converted to a right-turn only lane at the PMT's request, resulting in two through lanes south of the intersection. This initially worsened operations. After testing many different combinations of signal timing and lane geometries at Western Boulevard and 4th Street as well as nearby intersections, the performance was optimized. See Appendix E for a thorough discussion of this analysis.

- 15th St & OR34, putting turn storage on the north and south leg improves capacity significantly. For more information see the section above for Intersection modifications and Appendix D.

- The new eastbound OR 34/US 20 off-ramp improves conditions at Avery Avenue/Crystal Lake Drive in Alternative A and Alternative C.

    - Alternative A performs better (improved v/c and delay) because the roundabout is metered north of here.
    - Alternative B does not see the same level of improvement because the transition to three lanes is furthest north in this alternative and more trips are using Crystal Lake Drive to avoid the additional congestion on OR 99W. An increase of approximately 50% westbound on Crystal Lake Drive is seen in Alternative B relative to the other two build alternatives.

Segment 2 - Summary of Signalized Intersection Analysis and Results:

- All intersections perform similarly in all alternatives.
- A signal at Goodnight Avenue was also considered but ultimately a roundabout was included in each alternative, see results in the roundabout section below.

Segment 3 - Summary of Signalized Intersection Analysis and Results:

- A signal at Rivergreen Avenue was also considered but ultimately a roundabout was included in each alternative, see results in the roundabout section below.

Roundabout Analysis and Results

As mentioned previously, a roundabout was tested at three intersections along the OR 99W corridor: the new eastbound OR 34/US 20 off-Ramp Terminal, Goodnight Avenue, and Rivergreen Avenue. The results (provided in Table 6) suggest that roundabouts can be used at these intersections as described below.

Table 6: Roundabout Intersection v/c, LOS and delay

		Intersection v/c Delay (seconds) and LOS (A-F)				
	Intersection[1]	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
Segment 1	EB OR34/US20 Off Ramp	N/A	N/A	0.83	0.69	**0.87**
		N/A	N/A	9 (A)	10 (A)	13 (B)
Segment 3	Goodnight Ave[2]	0.50	0.50	0.56	0.83	**0.90**
		8 (A)	8 (A)	9 (A)	16 (C)	22 (C)
	Rivergreen Ave[2]	0.53	0.53	0.75	0.71	0.70
		9 (A)	8 (A)	15 (B)	13 (B)	13 (B)

[1]**Bold** text indicates the HDM v/c target (0.85) has been exceeded.

[2]For these intersections a roundabout was included for final analysis. Signals were also evaluated, see Appendix L for those results.

Segment 1 - Summary of Roundabout Analysis and Results:

- In Alternatives A and C, the ramp terminal roundabout v/c is nearly 0.90. This is the point at which operations are expected to significantly deteriorate.
- For Alternative A there is a queue detector on the ramp and a roundabout meter on the north leg heading southbound approaching the roundabout. This setup meters traffic entering the roundabout which allows it to function below the 0.85 HDM v/c, for more detail about this see Appendix E.
- Alternative B has a lower v/c of 0.69; however, it is important to note that a large portion of traffic is using the lower functionally classified facilities and traveling through Avery Park to access the west side parallel route thereby avoiding this ramp terminal roundabout.

Segment 2 - Summary of Roundabout Analysis and Results:

- The Goodnight roundabout performs best in Alternative A because it is still a 5-lane cross section through the intersection. This alternative has a multi-lane roundabout.
- For Alternative A, the v/c reported at Goodnight is with the lane reduction occurring approximately 200 ft. south of the intersection. When a lane reduction occurs at the intersection v/c becomes 0.95. For more information about alternatives considered but dismissed, see Appendix A.
- Alterative B has a single lane roundabout (lane transition occurs further north). The v/c is increased (compared to the no-builds and Alternative A) however, the full western parallel route enables traffic to divert further north and remain on the parallel route while OR 99W is congested.
- Similarly Alternative C has a single lane roundabout; however, because there is not a fully connected western parallel route, less trips are diverting and remain on OR 99W causing a higher v/c.

Segment 3 - Summary of Roundabout Analysis and Results:

- The roundabout at Rivergreen Avenue performs similarly and acceptably in all three build alternatives.
- Both no-builds include a multi-lane roundabout and all three no-builds have single lane roundabouts.

Intersection Control Summary

Table 7 shows the intersection traffic control selected for each alternative to optimize performance of the intersection and of the corridor as a whole. For additional information about the alternatives considered, please see Appendix A.

Table 7: Final Intersection Traffic Control

	Intersection	CLEAN No-Build	ENHANCED No-Build	Alternative A (Goodnight)	Alternative B (Bridgeway)	Alternative C (Prairie/Powell)
Segment 1	Western & 4th	Signal	Signal	Signal	Signal	Signal
	Western & 3rd	Signal	Signal	Signal	Signal	Signal
	B Ave & 4th St	TWSC	TWSC	TWSC	TWSC	TWSC
	B Ave & 3rd St	TWSC	TWSC	TWSC	TWSC	TWSC
	EB OR34/US20 Off-Ramp	N/A	N/A	Roundabout	Roundabout	Roundabout
	WB OR34 Off-Ramp	N/A	N/A	Signal	Signal	Signal
	Twin Oaks/ Chapman Pl	TWSC	TWSC	RIRO	RIRO	RIRO
	Avery/Crystal Lake	Signal	Signal	Signal	Signal	Signal
Segment 2	Alexander Ave	Signal	Signal	Signal	Signal	Signal
	Viewmont Ave	TWSC	TWSC	RIRO+LI	RIRO+LI	RIRO+LI
	Tunison Ave	TWSC	TWSC	RIRO+LI	RIRO+LI	RIRO+LI
	Richland Ave	TWSC	TWSC	TWSC	TWSC	TWSC
	Prairie/Powell[1]	N/A	N/A	N/A	N/A	N/A
	Park Ave	TWSC	TWSC	TWSC	TWSC	TWSC
	Wake Robin Ave	TWSC	TWSC	TWSC	TWSC	TWSC
	Goodnight Ave	Roundabout	Roundabout	Roundabout	Roundabout	Roundabout
Segment 3	Rivergreen Ave	Roundabout	Roundabout	Roundabout	Roundabout	Roundabout
	Kiger Island Dr	TWSC	TWSC	TWSC	TWSC	TWSC
	Airport Ave	TWSC	TWSC	TWSC	TWSC	TWSC

[1]Lack of data available to analyze this location.

95th Percentile Traffic Queuing

The 95th percentile queues were obtained from the Sidra Intersection output. These are a calculated statistical measure based off of the average of the maximum queues. The queue figures can be found in Appendix M. A summary of the queue figures and key takeaways can be found in the Segment Re Summary Graphics on page xx.

Segment 1 Queuing Key Takeaways:

- Extensive queuing on Western Boulevard and southbound on 4th Street, this persists with each alternative (builds and no-builds).
- Queuing through the interchange is pretty consistent between the three build alternatives. They all improve over both no-builds because of the addition of the EB OR34/US20 Off-Ramp.
- There is some queuing near the new signalized off-ramp and also adjacent to the newly added pedestrian crossings.
- Queuing and/or turbulent zones around enhanced crossings often spills back into the nearest intersection.
- SW Crystal Lake Drive has extensive southbound queuing which impacts the two enhanced pedestrian crossings.

Segment 2 Queuing Key Takeaways:

- SW Crystal Lake Drive is a bottleneck in all five alternatives. In Segment 2, in the northbound direction the queues spillback through at least the pedestrian crossing north of SE Bridgeway Avenue.
- There are some slowdowns (turbulent zones) near the enhanced crossings.
- In the three build alternatives the queues are improved on the side streets due to the parallel route connections. Alternative A also benefits from the added western leg to the SE Alexander Avenue intersection by connecting to SW Butterfield Drive.

Segment 3 Queuing Key Takeaways:

- No significant queuing issues in Segment 3.
- Minor slowdowns in the northbound direction near the new enhanced pedestrian crossings.

Corridor Travel Performance

This section summarizes the corridor travel performance of each alternative in terms of how long it's expected to take to get from one end of the corridor to the next and approximately how fast traffic will be moving on the mainline (OR 99W). *Information regarding the travel times and other operational analysis elements on the local parallel network are not currently available. This data would be vital to ascertain a holistic understanding of operations in the area.* The average travel time and average travel speed along OR 99W from Western Boulevard to Airport Avenue are shown in Table 8 and Table 9 below.

Table 8: Route Travel Time Comparison

	Average Travel Time (minutes)				
Corridor Direction	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
NB	11	12	13	14	13
SB	13	16	14	18	17
NB/SB Average	12	14	13	16	15

Table 9: Route Travel Speed Comparison

	Average Travel Speed (mph)				
Corridor Direction	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
NB	22	22	21	19	20
SB	17	17	17	14	15
NB/SB Average	20	19	19	16	17

The CLEAN No-Build has the fastest average travel speed and the lowest average travel time through the corridor. The differences between CLEAN and ENHANCED No-Builds can be attributed to the added pedestrian crossings. As these are accounted for in each build alternative, all other performance measures can be traced back to the other key differences such as parallel route links (or lack thereof) and where the three-lane cross section of OR 99W begins.

Alternative A improves the travel time through the corridor over the Enhanced No-Build. Transitioning from the five-lane to three-lane section near Goodnight Avenue does not significantly impact corridor performance. The improved performance in Alternative A can be attributed to the new off-ramp (roundabout and meter).

Although the parallel route connections in Alternatives B and C remove a significant amount of trips from OR 99W, the congestion and the effect of reducing the number of lanes is still reflected in the travel times. Without the parallel route connections Alternatives B and C would have even higher travel times and slower speeds.

Overall, the relatively minor differences in travel time indicate highway traffic is drawn into the adjacent neighborhoods as there are routes that could potentially shorten the travel time. The highest change in travel time is an increase of five minutes southbound in Alternative B.

Key Takeaways:
The differences between CLEAN and ENHANCED No-Builds can be attributed to the added pedestrian crossings.

The addition of the EB OR 34/ US 20 Off-Ramp improves travel time by reducing congestion through the interchange.

The reduction in capacity in Alternative B causes it to have the longest travel time. Without parallel route connections Alternatives B and C would have higher travel times and slower speeds.

Latent Demand

Latent demand is essentially demand that exceeds the capacity of the system and users make choices to avoid congestion. Latent demand responses are typically associated with network limitations, such as capacity constraints, incomplete networks for non-auto modes, sub-optimal operational performance, travel time costs and reliability on a specific route. When users can't afford the 'cost' of travel they typically respond by:

- Using a different route (diverted demand),
- Traveling at a different time (peak spreading), or
- Changing the mode of travel (mode shift),

Some users that have the ability to alter their destination or cancel their trip altogether. Whereas other users have to travel through the congestion, with a significantly higher realized travel time.

Analysis tools are not always able to fully capture additional details related to the complex effects of congestion that causes traffic to alter an aspect of their trip. The latent demand effect in this corridor has been analyzed by looking at the three aspects mentioned above (diverted demand, peak spreading, and mode shift) and the results are summarized in this section.

Key Note: It's important to note that the results described below serve as book ends demonstrating the greatest potential effects of each aspect of latent demand (assuming the other aspects are not also occurring). In reality, there would be a combination of daily diversion, peak hour spreading, and mode shifting.

Diverted Demand

The South Corvallis OR 99W Facility Plan demonstrates a specific aspect of latent demand defined as **diverted demand**. Diverted demand is when "existing system demand divert(s) from typical patterns related to routes and time of day, and day of week" (APM, Chapter 6, p.6-75). This is particularly important in the analysis of this Plan because of the goal of a lane reduction on OR 99W. The congestion created on OR 99W caused by the removal of through lanes makes the travel time through the south Corvallis neighborhoods more competitive. For a comprehensive discussion of latent demand and diverted demand definitions, please see Appendix I. Also available in Appendix I is a detailed description of the methodology applied in this analysis.
The analysis results may show optimal operations on OR 99W while demand diverted to the local network is missed. It is critical to capture the demand being diverted to the local network in order to make informed decisions. A few important notes to highlight:

- Trips choosing to use the local network are not regional through trips, but rather are local trips.
- These results serve as a book end demonstrating the **greatest potential daily diversion** with **no peak spreading effects**. In reality, there would be a combination of daily diversion and peak hour spreading.
- There is diversion present in both of the future build alternatives due simply to local development. In some cases, the diversion seen in a build alternative is actually an improvement over the no-builds.

In the study area delineated for the Project (see Figure 1), the southbound direction has the larger volume in the PM peak hour. Therefore, this is the direction of travel that had the diverted demand issues and was subsequently analyzed.

The total southbound diversion from the north end of the network was determined. The estimate volumes of diverted trips are shown in Table 10 below for five locations along the corridor. In other words, Table X is showing the number of trips that want to be on OR 99W at these locations along the corridor but cannot be served, primarily because there are upstream bottlenecks creating a higher 'cost' than this volume of drivers wants to 'pay'. These trips are then moved to routes other than OR 99W to complete their trips.

Table 10- Total Southbound Diversion Moving South Through the Corridor (Daily Volume)

Segment	Location	CLEAN No-Build	ENHANCED No-Build	Alternative A	Alternative B	Alternative C
1	South of Crystal Lake	3,700	2,700	1,400	9,300	7,800
	North of Alexander	3,300	2,400	1,200	6,300	7,100
	South of Alexander	2,800	2,000	1,000	5,500	6,000
2	Between Wake Robin & Goodnight	2,300	1,700	800	5,500	4,500
3	South of Rivergreen	1,400	900	400	2,800	2,200

Key Takeaways:
The further north the lane reduction occurs the larger the southbound diversion to the local network is because the capacity is reduced sooner.

Each build alternative has characteristics which impact the diversion volume.

Next, the volume that then diverts to either the west or east side of OR 99W was estimated and distributed throughout the local network. It is difficult to predict exactly how trips will route through the local network, however, these results are based upon extensive analyses applying multiple methodologies to provide the most robust output possible.

Diverted trips were added to the modeled volumes for each route to create a new 'bookend' volume for daily trips southbound accounting for the diverted demand aspect of latent demand.

Each roadway is intended for a certain amount of use or range in volume. For example, OR 99W is expected to see higher volumes of traffic then Western Boulevard or Crystal Lake Drive. The volume threshold guidance provided in the Corvallis TSP is summarized in Table 11. Note that 50% of two-way volume thresholds

described in the TSP are calculated in order to use an appropriate one-way threshold for just the southbound direction used in this analysis.

Table 11- Corvallis TSP Roadway Volume Threshold Ranges

Two-Way Volume Threshold	One-Way Volume Threshold	Example Roadway	
5,000 to 10,000	2,500 to 5,000	SW Western Blvd	
1,200 to 5,000	600 to 2,500	SE Crystal Lake Dr	
1,200 to 2,500	600 to 1,250	SE Alexander Ave	
<2,000	<1,000	SE Bethel St	

The analysis identified locations where the volume range thresholds are estimated to be surpassed given those identified for roadways in the City TSP. These estimated differences in volume range thresholds are presented in the graphics in Figure 9 for the no-build alternatives and Figure 10 for the build alternatives

Figure 9- Corvallis TSP Volume Threshold Ranges and Volume Threshold Range Changes Due to Potential Volume Diversion for No-Build Alternatives

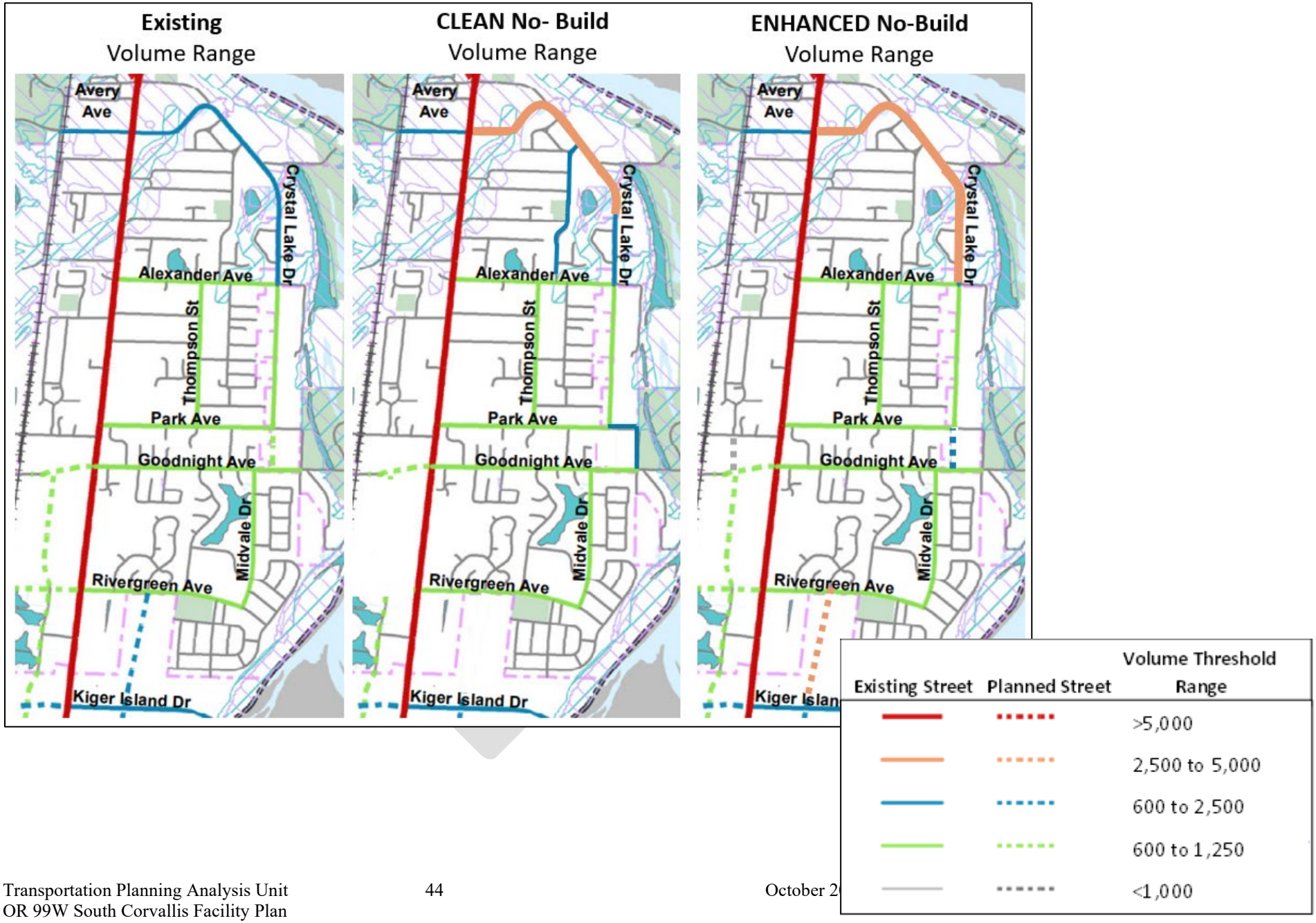


Figure 10- Volume Threshold Ranges Due to Potential Volume Diversion for Build Alternatives

Key Takeaways:
The Clean No-Build Alternative (based exclusively upon future growth and local development) saw a maximum daily southbound diversion potential that would cause:

- SE Bethel Street to increase to a daily southbound volume range of 600 to 2,500;
- the north end of Crystal Lake Drive to increase to a volume range of 2,500 to 5,000;
- the north/south roadways between SE Park Avenue and SE Goodnight Avenue to increase to a volume range of 600 to 1,250.

The additional network added to the Enhanced No-Build Alternative causes lower diversion rates at some locations.

There is diversion present in both the no-build and the future build alternatives due simply to future growth and local development. In some cases, the diversion seen in a build alternative is actually an improvement over that seen in the no-builds.

Additionally, Alternative A saw the lowest volume threshold ranges of the three build alternatives and also was an improvement over the two no-build alternatives at some locations.

Peak Spreading

Another aspect of latent demand occurs when users choose a different time to travel to avoid congestion. This is called peak spreading and occurs when demand exceeds capacity and the resulting excess traffic volumes are served over a longer peak duration. This can typically be observed in the afternoon and evening hours when 'rush hour' extends beyond just one hour. And if familiar with the area, users might choose to make their trip a few minutes earlier or later to avoid the most congestion. These shifts in the timing of trips extends the overall duration of congestion. This is representative of the pent-up or excess demand for the roadway that just cannot accommodate all the trips on one segment at the same time. This section summarizes the peak spreading methodology used and resulting estimates to illuminate the potential for an increased duration of congestion.

The intersection of OR 99W and Avery Avenue / Crystal Lake Drive is a key decision point in the corridor and peak spreading analysis was completed at this location. First the demand capacity volumes for the site specifically were assessed. The site volumes represent the full demand regardless of queuing downstream or bottleneck upstream of that location. Next the demand and capacity were compared when network conditions were applied, such as upstream bottlenecks that essentially meter traffic prior to arriving at that location or queueing affects from downstream intersections or pedestrian crossings that extend into neighboring intersections. Having analysis complete for both scenarios provides bookends for peak spreading. It is likely, actual observed peak spreading would fall somewhere between the 'site' and the 'network' peak spreading estimates.

Below is a summary of the peak spreading analysis results. The site specific analysis resulted in higher levels of peak spreading than the network analysis, which is expected. As observed with the diverted demand analysis, some intersections have higher demand than capacity, metering the volumes that arrive at downstream intersections. For more detailed information on the development of peak spreading estimates, see Appendix J.

Peak Spreading Results North of Avery Avenue / Crystal Lake Drive

As shown in Table 12 below, peak spreading is higher using the site volumes. Actual peak spreading in the southbound direction would likely fall somewhere between these two rows. For example, today the southbound PM peak between SW Twin Oaks Avenue/SE Chapman Place and SW Avery Avenue/SE Crystal Lake Drive likely experiences approximately one full hour of significant congestion which is right in between the estimated peak spreading shown in the table.

Table 12: Peak Spreading Duration North of SW Avery Ave / SW Crystal Lake Dr

	Hours of Peak Spreading Anticipated					
Method	**EXISTING 2020**	**CLEAN No-Build**	**ENHANCED No-Build**	**Alternative A (Goodnight)**	**Alternative B (Bridgeway)**	**Alternative C (Prairie/Powell)**
Site	1 to 2	3+	6	11	10	11
Network	0	2	4 to 5	1 to 3	6	4 to 5
Average	1	2+	5	6	8	8

Key Takeaways:

Network conditions clearly impact the traffic arriving at this location due to a combination of factors such as upstream 'metering', downstream queueing, and alternate route options. It will be important to consider the tradeoffs of congestion on the mainline (OR 99W) versus added trips on local routes.

Alternative A:

- Alternatives A and C show the highest duration of congestion. This is not unexpected as neither of these alternatives has a complete parallel route.
- More traffic is drawn through this location with the added ramp terminal and while this is adding congestion in this location it is drawing trips away from the downtown routes that were not intended to carry those trips.
- The western parallel route is not complete in either Alternative A or C pushing all traffic through this location.
- When the network affects are taken into account, bottlenecks north of SW Avery Avenue/SE Crystal Lake Drive reduce the volume arriving at the intersection (Alternative A has a peak hour demand volume of 1890 for the network versus 4337 for the site).

Key Takeaways, continued:

Alternative B:

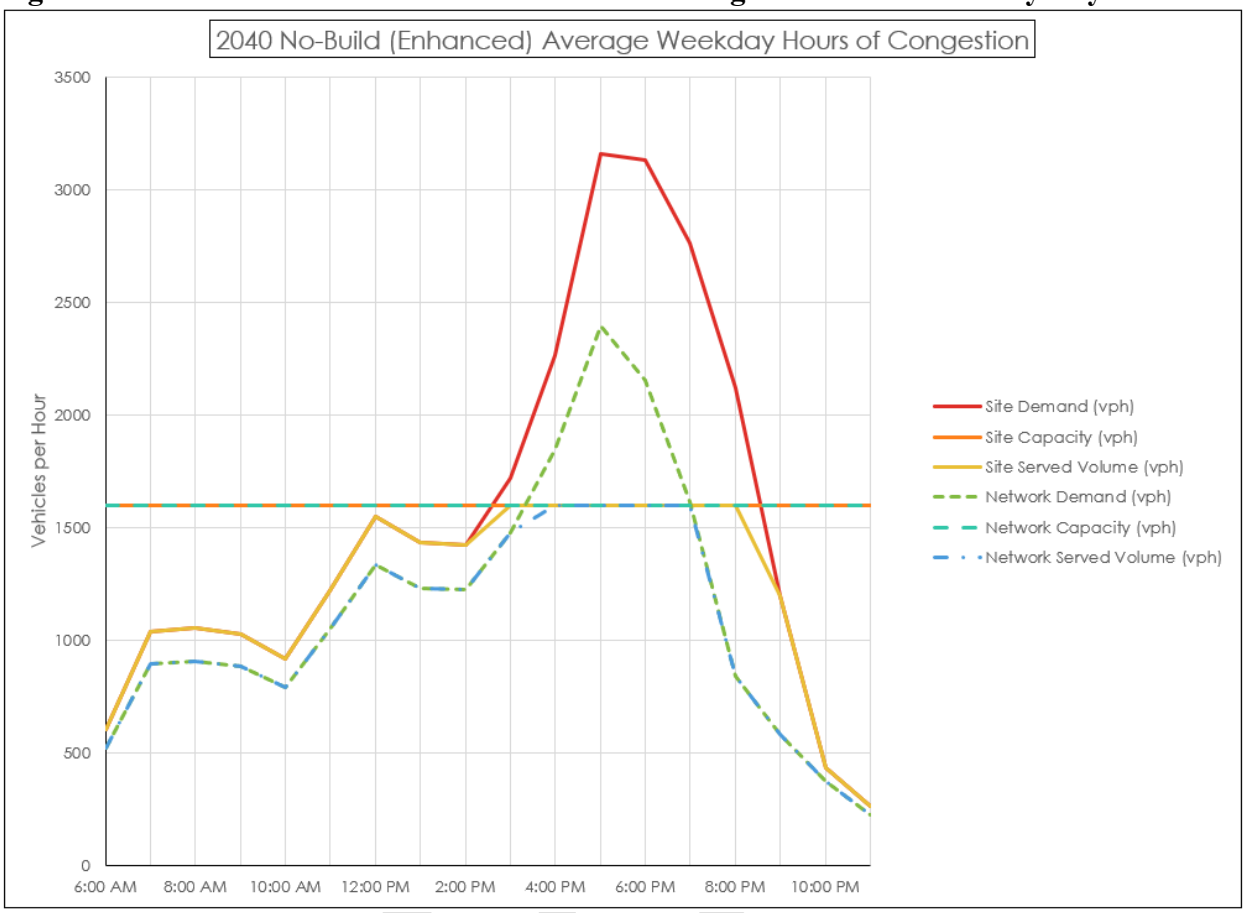
- The parallel route connections for Alternative B account for the lower peak spreading with the site volumes. More trips are taking the park route and down the western parallel route to avoid the congestion on OR 99W. This shows the power of the parallel route and that having a connected network makes system more resilient. However, the network volumes are assuming a higher rate of travel through the park than would probably occur.
- The same level of congestion reduction was not observed in Alternative B when the network affects were applied. It is possible the parallel route connection is drawing enough trips through the park and the new western parallel route that there are now enough fewer trips on OR 99W to reduce the blockage that was 'metering' flow to the intersection.

Alternative C:

- The results of this alternative presented much like Alternative A. Alternative C also does not have a full western parallel route.
- Likely the most realistic results of all the alternatives, showing slightly more congestion than Alternative A but it is representing the most realistic diversion estimates. This also indicates not a lot of bottlenecking is occurring upstream.

To help visualize the peak spreading affect, using the Enhanced No-Build alternative as an example, Figure 11 below shows the site demand in red and the site capacity in orange. As soon as the red (demand) line crosses the orange (capacity) line the demand to use this location is higher than the facility capacity and that location will experience congestion. When the red line stays above the orange line for more than one hour (the peak hour) peak spreading is occurring. Similarly, the network demand and capacity are the green dashed line and teal dashed line respectively. The network graph shows a similar excess demand just with fewer hours of congestion. Now, this graph assumes all excess demand will be shifting travel time to complete their trip. It is more realistic that some of the excess demand will choose to complete their trip at a different time and some might choose to use a different route and some might choose another mode and a few may choose to cancel the trip altogether. There are many factors that will affect the actual amount of congestion that occurs. The peak spreading analysis is a useful tool to quantify that excess demand and potential for significant congestion if other options are not available.

Figure 11: 2040 Enhanced No-Build SB Hours of Congestion North of Avery/Crystal Lake



Graphs for each alternative can be found in Appendix J.

VMT per Capita

The CALM model was used in order to calculate three different versions of vehicle-miles traveled (VMT) per capita. The three versions of VMT per capita are defined as follows:

1. **On-Road**: This is the total VMT for all trips and all vehicles on the roadway in the study area; it is essentially the ADT multiplied by the length of the roadway link in CALM.
2. **Internal-Internal**: This is the previous Transportation Planning Rule (TPR) definition of VMT per capita; it is auto trips only which begin and end within the study area.

3. **Household-based (HH)**: This is meant to align with the new Transportation Planning Rule definition of VMT per capita (as of July 2022) as closely as possible which is: "Vehicle Miles Traveled (VMT)" means all jurisdiction household-based light vehicle regardless of where the travel occurs." What is provided in Table 13 below is all of the trips that begin in the study area and end anywhere outside of the study area. Essentially the trips included are:
    a. Trips that enter the study area but originate from a household outside of the study area.
    b. Commercial trips which are "generated" by a household's actions (e.g., garbage trucks, UPS/FedEx, food delivery, cleaning services, etc.). Although these trips do not originate at the household level, the household is the reason these trips are made. These are limited to trips which begin and end within the study area.
    c. Non-home-based trips that were originally generated by a household. An example of this would be a trip that started from a household and then went to work. The next leg of the trip went from work to lunch and back to work. This work to lunch part of the trip is included.

The results are depicted in Table 13. Although there is not a large change in any of the VMT/capita measures between the five alternatives, the effect of the added parallel networks and connections are evident. This can be seen in the drop in all three versions of VMT per capita for both daily and PM peak between the CLEAN No-Build and the ENHANCED No-Build (where the parallel network at the south end of the study area is added). Additionally, Alternative B and Alternative C have lower values than Alternative A for all of the VMT per capita measures except for the PM peak HH (where it is equal to the other alternatives). Again, this is caused by the greater extent of connectivity provided in the west parallel route in Alternative B and Alternative C. Also noteworthy, for the Internal-Internal version Alternative A is approximately equal to ENHANCED No-Build. This could potentially be due to the more incomplete parallel network in Alternative A (it is very similar to the ENHANCED No-Build). This may cause more re-routing as drivers choose the routes with the shortest travel time.

Table 13: VMT per Capita: Three Versions for All Build and No-Build Alternatives

	DAILY			PM Peak		
Alternative	**On-Road**	**Internal-Internal**	**HH**	**On-Road**	**Internal-Internal**	**HH**
CLEAN No-Build	12.04	1.77	12.68	1.08	0.16	1.32
ENHANCED No-Build	11.74	1.64	12.40	1.05	0.15	1.29
Alternative A	11.68	1.64	12.37	1.04	0.16	1.28
Alternative B	11.55	1.61	12.24	1.02	0.15	1.28
Alternative C	11.61	1.63	12.33	1.03	0.15	1.28

The percent change in VMT per capita relative to the CLEAN No-Build can be seen in Table 14

Table 14: VMT per Capita: Percent Change Relative to CLEAN No-Build

	DAILY			PM Peak		
Alternative	**On-Road**	**Internal-Internal**	**HH**	**On-Road**	**Internal-Internal**	**HH**
CLEAN No-Build	n/a	n/a	n/a	n/a	n/a	n/a
ENHANCED No-Build	-2%	-7%	-2%	-2%	-6%	-3%
Alternative A	-3%	-7%	-2%	-3%	-5%	-3%
Alternative B	-4%	-9%	-3%	-5%	-7%	-3%
Alternative C	-4%	-8%	-3%	-4%	-6%	-3%

Mode Share

Coming Soon

ALTERNATIVES SUMMARY & COMPARISON

The performance of each alternative is summarized in this section in an effort to facilitate comparison. The results represent alternatives and intersections that were modified to meet the multi-modal goals of the plan, ease access off of side streets and optimize corridor performance.

Table 15: Summary of Alternatives

Comparison Criteria:	No-Build (Clean)	No-Build (Enhanced)	Alternative A (Goodnight)	Alternative B (Bridgeway)	Alternative C (Prairie/Powell)
Number of intersections meeting v/c targets	7	6	15	16	16
Number of intersections exceeding capacity	10	11	3	2	1
Number of intersections with Delay >50 seconds	10	11	6	7	5
Number of study intersections/crossings blocked by queues)[1]	3	3	3	4	3
Average NB&SB Travel Speed (Percent change from the Clean No-Build)	N/A	-3%	-5%	-17%	-12%
Average NB&SB Travel Time (Percent change from the Clean No-Build)	N/A	17%	12%	33%	25%
Diverted Demand (Total volume diverted)	3,700	2,700	1,400	9,300	7,800
Peak Spreading (Average estimated hours)	2+	5	6	8	8
Modal Splits relative to Clean (Total non-auto shift)					
Daily On-Road VMT per Capita Relative to Clean No-Build[2]	N/A	-2%	-3%	-4%	-4%

[1]This is only counting study area intersection that are directly blocked by queuing. This does not include intersections that are not study intersections and it does not include intersections effected by the turbulence or conflict zones. Please reference the Queue Diagrams in Appendix M to see the full impact.

[2]This version of VMT per capita was chosen to report here for two reasons. 1.Daily is more comprehensive than PM peak. 2.The On-Road measure seems like the version that is most easily understood by the largest variety of stakeholders.

The build alternatives show improvements in intersection capacity and delay. However, these are somewhat misleading results. The arrival flow has a metered effect before it arrives at many intersections. The demand at many intersections is greater than the arrival flow, indicating an upstream bottleneck. It is critical to capture where that unmet demand is going.

Alternative A shows improved travel time and less diverted demand than the enhanced no-build. It can then be inferred that transitioning from the five-lane to three-lane section south of Goodnight Avenue does not significantly impact corridor performance.

Overall corridor performance travel time increases and travel speed decreases in the enhanced no-build and build alternatives. This can be attributed to

- additional enhanced pedestrian crossings,
- the new ramp pulling traffic onto OR 99W (away from Avery Park Road) and changing traffic patterns on the north end, and
- congestion due to lane reductions on OR 99W (in build alternatives)

Alternative B had the highest travel time (added 4 minutes compared to the clean no-build) and the lowest travel speed (reduced 4 mph compared to the clean no-build).

The highest amounts of diversion and peak spreading are observed in Alternatives B and C, with the highest diversion observed in Alternative B. These results are in alignment with what would be expected by reducing lanes in higher volume areas in the corridor.

- When the transition from five to three shifts north the local diverted demand increases as does peak spreading and
- More complete and connected parallel networks draw more trips off the mainline.

Diversion onto local streets is 100% local trips (no thru trips are getting off OR 99W and utilizing local streets then getting back on OR 99W to complete their trip).

What is not easily observed in this table are the optimizations made in each alternative that address the latent demand prevalent today and the out-of-way routing to avoid congestion. The modifications and assumptions included in the build alternatives shift trips to their intended routes (ramps and state routes) and out of downtown local streets. Additionally, the added network connections benefit local trips on local roads.

FUTURE ALTERNATIVES KEY POINT SUMMARY

The following is a summary of deficiencies for the future year no-build and build alternatives based on the analysis findings. A summary graphic is also provided with Figures X through X.

Clean No-Build

- Lacking desired multi-modal improvements
- Overcapacity intersections (10)
- Approximately 80% overcapacity at SW 15th Street and OR 34/ US 20.
- High delays on side streets.
- Higher potential diverted demand that Enhanced No-Build or Alternative A.
- Lacking eastbound OR 34/US 20 off-ramp so Avery Park is the de-facto connection to southbound OR 99W.

Enhanced No-Build

- Enhanced pedestrian crossings impact corridor performance
- Overcapacity intersections (11)
- Approximately 30% overcapacity at SW 15th Street and OR 34/ US 20.
- High delays on side streets.
- Average corridor travel time increases by two minutes (17%).
- Latent demand shows up as diverted demand and peak hour spreading (note that the diverted demand is an improvement from the Clean No-Build).
- Lacking eastbound OR 34/US 20 off-ramp so Avery Park is the de-facto connection to southbound OR 99W.
- The additional illustrative TSP projects add an estimated $82 million to the project cost, See Appendix B.

Alternative A (Goodnight)

- Increased congestion approaching the new eastbound OR 34/US 20 off-ramp because new ramp pulls traffic onto OR 99W (away from Avery Park Road) and changes traffic patterns on the north end.
- Near capacity condition at the intersection of Western Boulevard and SW 4th Street. Mitigation strategies have been applied but the near capacity condition, while improved, remains.
- Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.
- Alternative A has more congestion through the interchange as the west parallel route is lacking.
- Long delays at Park Avenue and Wake Robin Avenue continue.
- Latent demand shows up as diverted demand and peak hour spreading
    - Diverted demand in Alternative A is the lowest of all alternatives including no-builds.
    - Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

Alternative B (Bridgeway/Cummings)

- The system-to-system movement from eastbound US-20/OR-34 to southbound OR 99W achieved in Alternative A shifts to a more undesirable path on the local street system within and surrounding Avery Park in Alternative B. The complete western parallel network draws trips through the park.
- Alternative B would likely require a more in depth and expanded study area and analysis to include more detail on the local network and the intersections within Avery Park as well as the intersection of SW 15th Street with US-20/OR-34.
- The complete west side parallel network draws trips through the park
- Shifting the three-lane section further north than Goodnight makes alternatives dependent on the parallel network. Alternative B's performance is entirely dependent on the local network.
- Highest average corridor travel time of all alternatives with an increase of four minutes (33%).
- Latent demand shows up as diverted demand and peak hour spreading
    - Diverted demand in Alternative B is the highest of all alternatives.
    - Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

Alternative C (Prairie/Powell)

- Increased congestion approaching the new eastbound OR 34/US 20 off-ramp because the added ramp pulls traffic onto OR 99W (away from Avery Park Road) and changes traffic patterns on the north end.
- Near capacity condition at the intersection of Western Boulevard and SW 4th Street. Mitigation strategies have been applied but the near capacity condition, while improved, remains.
- For Alternatives B and C, it is important to consider that the analysis output is dependent upon the assumption that a relatively high level of traffic will be re-routed to the new east and west parallel routes which require an arterial level of treatment north of Rivergreen Avenue and a major collector level of treatment south of Rivergreen Avenue.
- Highest average corridor travel time of all alternatives with an increase of three minutes (or 25%).
- Transitioning to three lanes north of Goodnight Avenue increases latent demand. Latent demand shows up as diverted demand and peak hour spreading
    - Only Alternative B has a higher level of daily diverted demand.
    - Peak spreading estimates increase with the build scenarios, partially because mitigation strategies have enabled more traffic to arrive in the corridor and partially due to the impacts of enhanced crossings and lane reductions.

NEXT STEPS

It is likely based on TAC/SAG and PMT input to date the preferred alternative will be a hybrid of these alternatives.

Ranking, scoring, open house/public comment will be completed working toward a preferred alternative for draft plan development.