South Stage Road
Extension Plan

Technical Memorandum

August 30, 2024 Project# 27003.014

To: Lisa Cornutt, Oregon Department of Transportation (ODOT)

Karl MacNair, City of Medford

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RE: Task 5.2.2.1B: Transportation Analysis Appendix

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INTRODUCTION

This memorandum summarizes the transportation system performance under potential Year 2045 No-Build and the Overpass/Underpass and Interchange alternatives[1] in the study area (see Figure 1) for the South Stage Road Extension Plan. Figure 2 illustrates the alternatives development and recommendation process.

This analysis builds on the analysis conducted as part of Technical Memorandum (TM) *#5.1.3.1: Transportation Analysis Screening* to support the refined alternatives analysis documented in *TM #5.2.2: Refined (Most Promising) Alternative Summary*. This includes refinement of the intersection operations analysis and project sheets for other system needs; evaluation of freeway, mainline, merge, and diverge operations; and identification of projects to address gaps in the pedestrian and bicycle network.

This planning document may be adopted in a subsequent environmental review process in accordance with 23 USC 168, Integration of Planning and Environmental Review,[2] and 23 CFR 450, Planning Assistance and Standards.[3]

[1] The Overpass/Underpass (O-1 through O-4) and Interchange (I-1 through I-4) alternatives have nearly identical horizontal geometrics and operations, and therefore are evaluated as "Overpass/Underpass Alternatives" and "Interchange Alternatives" groups in this memorandum.
[2] https://www.govinfo.gov/app/details/USCODE-2022-title23/USCODE-2022-title23-chap1-sec168/summary
[3] https://www.govinfo.gov/app/details/CFR-2022-title23-vol1/CFR-2022-title23-vol1-part450

Figure 1. Study Area

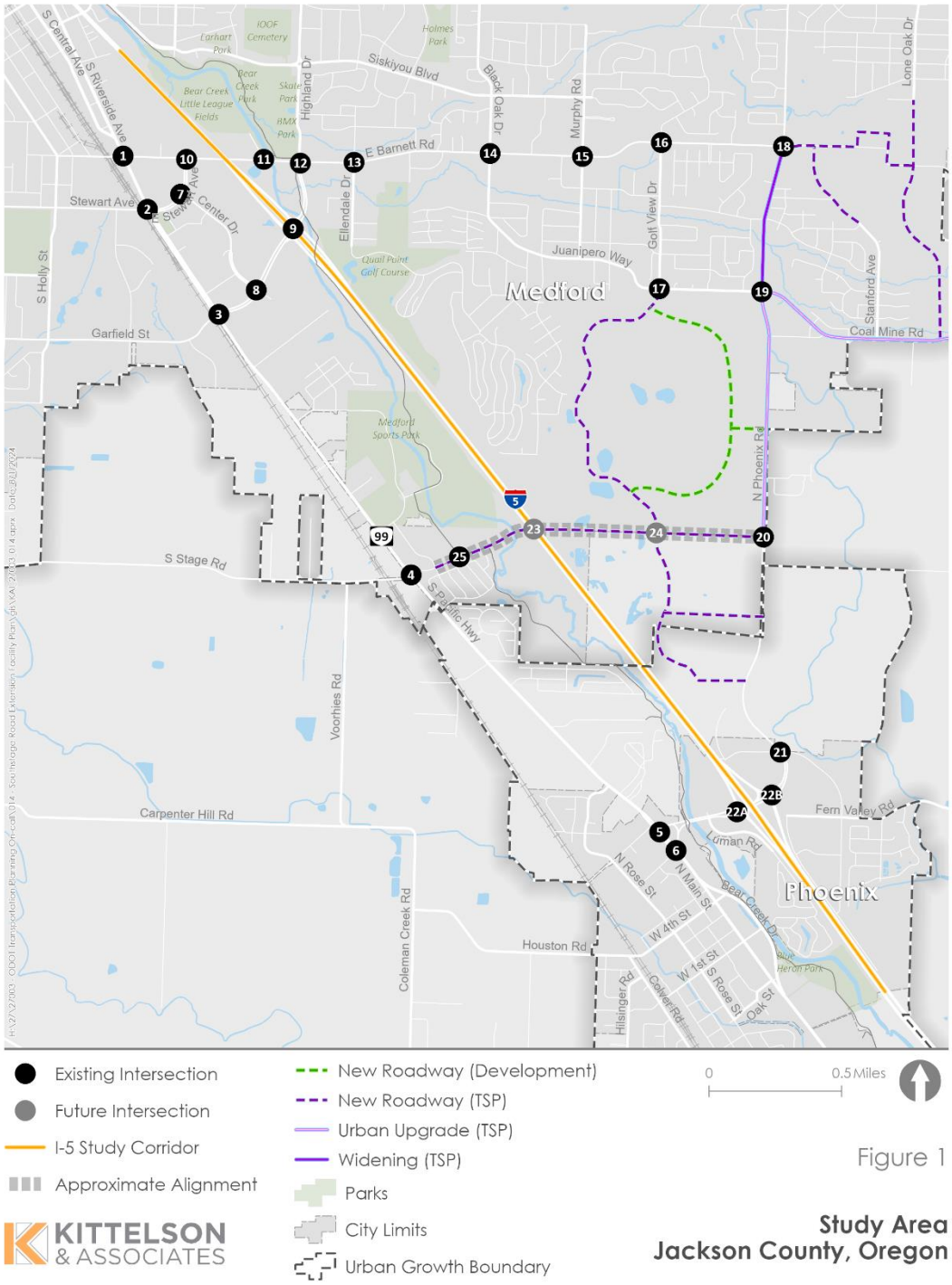
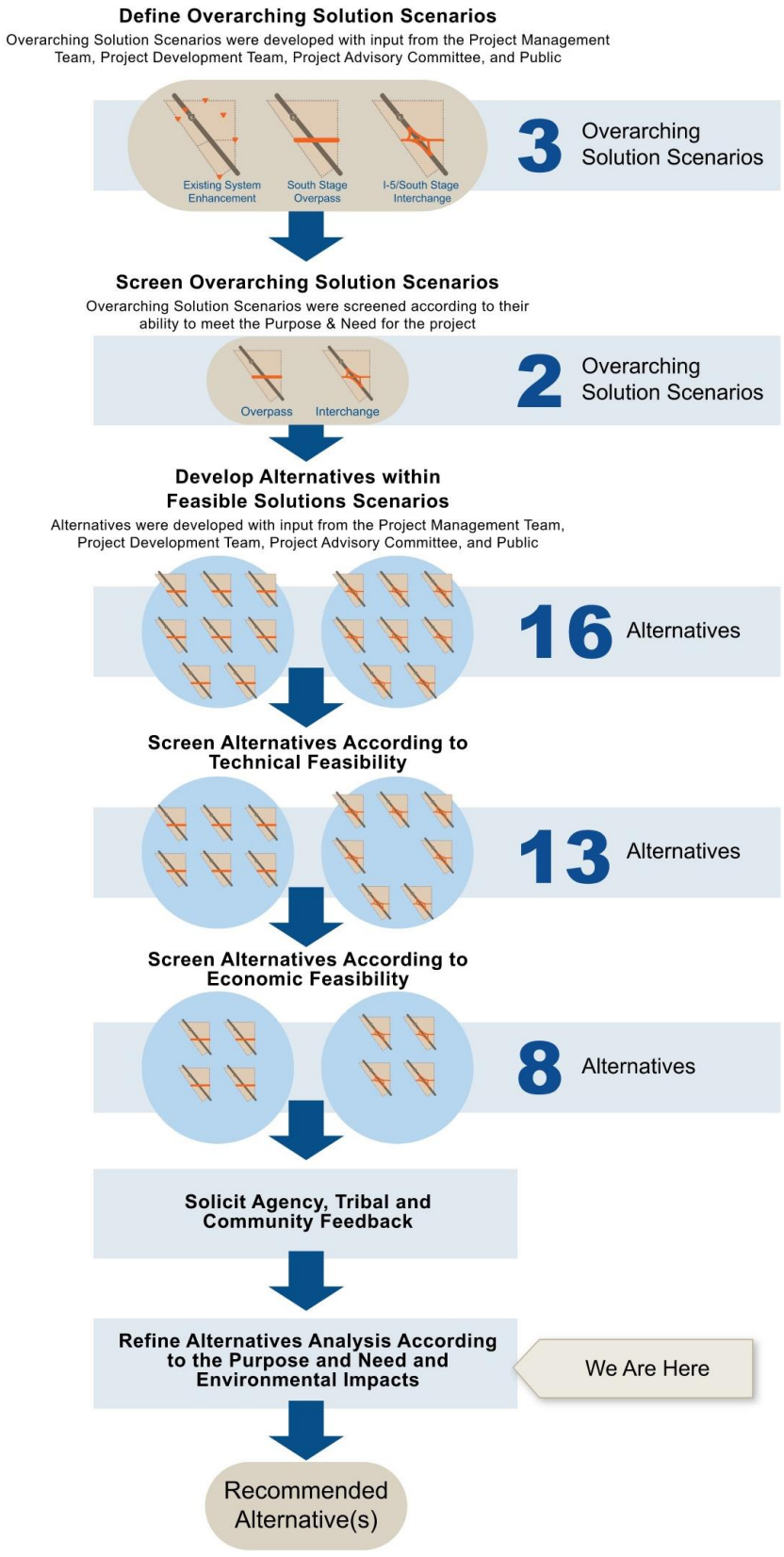


Figure 2. Alternatives Development and Recommendation Process



ALTERNATIVES

The Overpass/Underpass Alternatives create a connection across (over or under) I-5 and Bear Creek between the South Medford and Phoenix interchange. The Interchange Alternatives create a connection across I-5 and Bear Creek and add a new I-5 interchange between the South Medford and Phoenix interchange.

The following system intersection projects are included with the Overpass/Underpass and Interchange Alternatives to address the deficiencies identified in the project Purpose and Need. This list of projects extends beyond what is already included in the Transportation System Plan (TSP) as TSP projects were assumed to be completed in the Year 2045 No-Build Analysis[4]:

- **I-5/South Medford Interchange:** Implement the transportation projects identified in the Exit 27 Interchange Area Management Plan (IAMP), including widening the southbound off-ramp to allow 1,000-foot dual left-turn lanes and extending the ramp to 3,000 feet to accommodate queuing, widening the northbound off-ramp to accommodate a 1,000-foot left-turn lane, and installing ramp metering.
- **OR99/Garfield Street**: Adopt an alternative mobility standard.
- **OR99/N Phoenix-Bolz Road**: Construct separated right- and left-turn lanes on the west leg of the intersection.
  - The Overpass/Underpass Alternatives also include a second northbound right-turn lane.
- **Juanipero Way/Golf View Drive**: Convert the intersection from two-way to all-way stop control.
- **Future South Stage Road/N Phoenix Road**: Convert the intersection to a roundabout.
- **Golf View Drive/Future South Stage Road**: Convert the intersection from a two-way stop control to a roundabout.
- **OR99/South Stage Road**: Construct a separate westbound right-turn lane and sidewalk on the southside of the east leg of the intersection.
- **South Stage Road/Samike Drive–Devonshire Lane**: Convert the intersection to a traffic signal when warranted.[5]

Additional details of these improvements and the differences between the Overpass/Underpass and Interchange Alternatives according to the Purpose and Need are documented herein. Project sheets providing details about each of these improvements are included in Attachment A. After this operations analysis, an additional project intended to improve safety was added to the intersection of Golf View Drive & Barnett Road to remove the unprotected left signal and install a left turn signal. This project is included in the project sheets but was not included in the traffic operations analysis.

[4] TM #4.1.2: Future Year Background Traffic Analysis documents the motor vehicle system planned improvements included in the future year traffic analysis.
[5] Signal warrants are included in Attachment B.

YEAR 2045 TRAFFIC OPERATIONS

This section discusses the potential benefits each alternative provides under Year 2045 traffic operations. As discussed below, all alternatives involve similar improvements to intersections and queuing, with the need for alternate mobility targets at certain intersections. Additionally, mainline, merge, and diverge locations in the vicinity of the South Medford Interchange should continue to be monitored for the potential need for future auxiliary lanes and dual off-ramps. This evaluation focuses on intersections that did not meet mobility standards and freeway merge/diverge analyses under the Year 2045 No-Build conditions documented in *TM #5.1.3.1B: Transportation Analysis Screening*. It also includes additional analysis at the intersection of South Stage Road/Samike Drive–Devonshire Lane.

Additional details on the Vistro model and volume development are included in *TM #5.1.3.1B: Transportation Analysis Screening* and *TM #3.1.3: Transportation Methodology and Assumptions*.

Intersection Operations

Table 1 documents the operations for intersections not meeting mobility targets under Year 2045 No-Build Conditions and for intersections that need additional improvements to accommodate new demand under the Overpass/Underpass and Interchange Alternatives. Operations exceeding targets are identified in **bold red text**. The projects included in the operations analysis are included in Attachment A. Queuing was adopted as an alternate mobility standard for the South Medford Interchange, which is evaluated under the weekday AM and PM peak hours and summarized in Table 2. Operations worksheets are included in Attachment C.

Table 1. Intersection Operations, Year 2045 Weekday PM Peak Hour

#	Intersection	Operating Target	No-Build			Overpass/Underpass Alternatives			Interchange Alternatives		
			LOS[1]	Del[2]	v/c[3]	LOS[1]	Del[2]	v/c[3]	LOS[1]	Del[2]	v/c[3]
3	OR99/Garfield Street	v/c ≤ 0.85[4]	D	51.3	**0.97**	D	49.2	**0.96**	D	43.8	**0.94**
4	OR99/South Stage Road	v/c ≤ 0.85	C	29.5	0.84	C	33.0	0.85	C	30.1	0.81
6	OR99/Phoenix Road-Bolz Road	v/c ≤ 0.85[4]	E	66.1	**0.98**	C	20.0	0.85	C	20.2	0.85
14	Barnett Road/Black Oak Drive	LOS D	**E**	59.7	0.98	D	48.1	0.90	D	41.2	0.82
17	Juanipero Way/Golf View Drive	LOS D	**F**	130.2	1.07	D	27.5	0.93	B	13.4	0.62
20	Phoenix Road/South Stage Road	LOS D	**E**	43.6	0.03	A	8.2	0.79	A	9.4	0.85
24	Golf View Drive/Future South Stage Road	LOS D	B	10.9	0.03	A	7.5	0.53	A	7.3	0.57
25	South Stage Road/Samike Drive-Devonshire Lane	LOS D	A	9.7	0.01	B	13.3	0.43	B	10.8	0.54

[1] Intersection LOS (signal, AWSC, roundabout), CM LOS (TWSC).
[2] Intersection average vehicle delay (signal, roundabout), CM vehicle delay (TWSC).
[3] Intersection v/c (signal, AWSC), CM v/c (TWSC, roundabout)
[4] The operating target under Year 2045 No-Build is v/c ≤ 0.90 for OR99/Garfield Street and OR99/Phoenix Road-Bolz Road.
AWSC = all-way stop control; CM = critical movement; Del = delay; LOS = level of service; TWSC = two-way stop control; v/c = volume to capacity.
Bold red text indicates measurements not meeting targets.

Alternative mobility standards should be sought at OR99/Garfield Street given the existing buildings and rail line constraints.

Queues Exceeding Storage (Interchange Ramps)

TM #5.1.3.1B: Transportation Analysis Screening documents the queuing evaluation at the South Medford Interchange. The 95th percentile queue lengths at the South Medford Interchange with the IAMP projects are summarized in Table 2. Queuing is the identified mobility target in the IAMP, and the queuing for all alternatives is accommodated within the maximum ramp queue length identified within this alternative mobility target. As shown in Table 2, the queue storage and projects identified in the IAMP can accommodate the queues for all alternatives. Queues under the South Stage Interchange scenario could be accommodated without the IAMP ramp extension.

Table 2. 95th Percentile Queue Lengths at the South Medford Interchange (with IAMP projects), Year 2045 No-Build Weekday AM and PM Peak Hours[1]

Approach	Max Allowable Queue (ft)[2]	No-Build		Overpass/Underpass Alternatives		Interchange Alternatives	
		Weekday AM[3]	Weekday PM[3]	Weekday AM[3]	Weekday PM[3]	Weekday AM[3]	Weekday PM[3]
Southbound	2,360 with IAMP ramp extension[1]; 1,070 without IAMP ramp extension	1,525	1,325	1,425	1,300	1,025	875
Northbound	730 (830 with speed reduction)[4]	200	350	225	150	200	175
Eastbound	1,225	300	850	325	275	275	475
Westbound	1,210	575	275	375	250	500	225

[1] Queues highlighted in green could be accommodated without the ramp extension identified in the IAMP. The IAMP ramp extension is a project to extend the I-5 southbound off-ramp at the South Medford Interchange to 3,000 feet to accommodate queues and deceleration.
[2] Ramp length includes both queue storage and deceleration length. IAMP assumes a deceleration length of 640 feet for the southbound off-ramp and 740 feet for the northbound off-ramp.
[3] Queues rounded to the nearest 25 feet.
[4] The City of Medford will continue to work with the ODOT Region 3 Traffic Section to facilitate lowering the speed limit on the I-5 mainline to 55 miles per hour just south of the northbound off-ramp. This lower speed limit will reduce the deceleration length required to 640 feet.

Freeway Mainline, Merge, and Diverge Operations

Figure 3 illustrates differences in trips according to the ODOT Southern Oregon Activity-Based Model between the Overpass/Underpass and Interchange Alternatives compared to the Year 2045 No-Build conditions. Overpass/Underpass Alternatives create a slight increase of the number of trips that use the southbound off-ramp at the South Medford Interchange, even though there is a greater projected overall decrease in the number of vehicles using the South Medford Interchange for Overpass/Underpass Alternatives than for Interchange Alternatives. Interchange Alternatives slightly increase the number of trips along the I-5 mainline, whereas Overpass/Underpass Alternatives shift some demand to OR99.

Operations were assessed on the I-5 mainline, at merge location (e.g. on-ramps), and at diverge locations (e.g. off-ramps) under Overpass/Underpass and Interchange Alternatives and compared to Year 2045 No-Build conditions from *TM #4.1.2: Future Year Background Traffic Analysis* as shown in Table 3 and Table 4. According to the ODOT 20-Year Design-Mobility Standards, the operating standard at these locations has a volume-to-capacity (v/c) ratio less than or equal to 0.75. Locations with v/c ratio greater than 0.75 are identified in **bold red text**.

Consistent with the methodology from *TM #4.1.2: Future Year Background Traffic Analysis*, volumes on the I-5 mainline and at merge/diverge locations were developed by applying the National Cooperative Highway Research Program (NCHRP) Report 765 methodology to the I-5 mainline volume between the interchanges and developing the remaining mainline, merge, and diverge volumes by balancing I-5 mainline volumes with the interchange ramp terminals. The Highway Capacity Software (HCS) analysis conservatively assumes existing peak hour factors and truck percentages where available[6]. The South Stage Interchange ramps assume default HCS values.[7]

[6] Locations exceeding v/c of 0.75 were checked to verify whether increasing the peak hour factor to the default value of 0.94 would reduce the v/c to meet the mobility target. Each of these locations continues to exceed the mobility target with the increased peak hour factor.
[7] Default values utilized include level ramp terrain type, acceleration/deceleration lanes of 800 feet, peak hour factor of 0.94, and Free-Flow Speed of 0.35.

Figure 3. ODOT Southern Oregon Activity-Based Model Results at the South Medford Interchange Southbound Off-Ramp

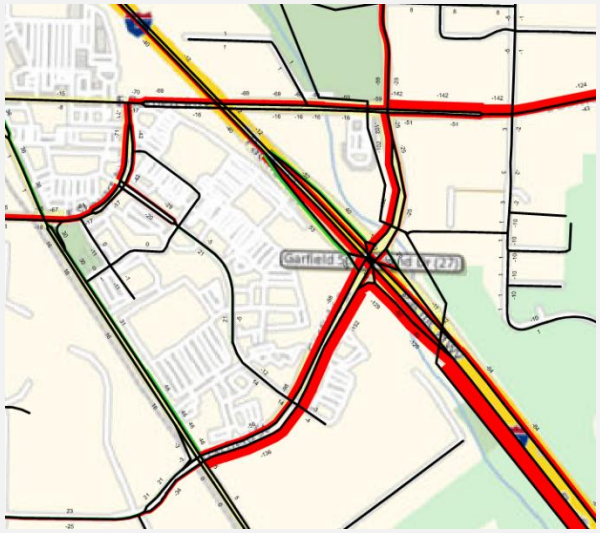
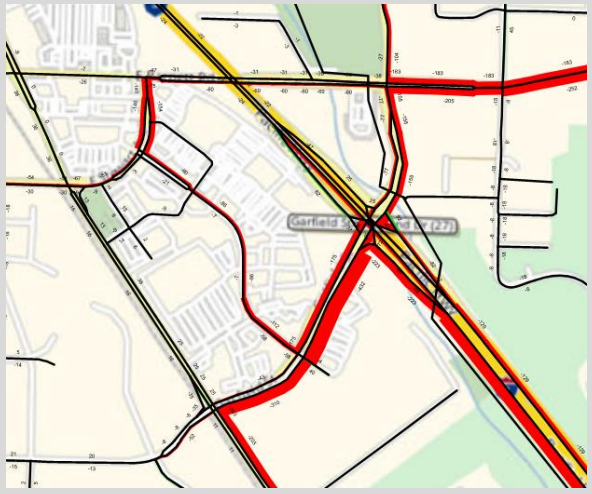
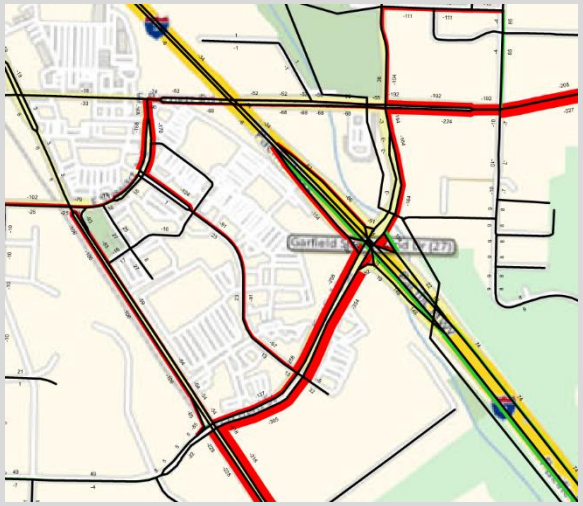
Peak Hour	Overpass/Underpass Alternatives Compared to 2045 No-Build Conditions	Interchange Alternatives Compared to 2045 No-Build Conditions
Weekday AM		
Weekday PM		

Table 3. Mainline, Merge, and Diverge Operations for I-5 Southbound

Segment	Type	No-Build		Overpass/Underpass Alternatives		Interchange Alternatives	
		Weekday AM	Weekday PM	Weekday AM	Weekday PM	Weekday AM	Weekday PM
		v/c	v/c	v/c	v/c	v/c	v/c
North of South Medford Interchange	Mainline	**0.81**	**0.77**	**0.80**	**0.76**	**0.82**	**0.77**
Garfield Street/I-5 SB Off-Ramp	Diverge	**0.88**	**0.78**	**0.90**	**0.77**	**0.86**	**0.77**
Between Garfield Street Ramps	Mainline	0.40	0.41	0.37	0.39	0.41	0.44
Garfield Street/I-5 SB On-Ramp	Merge	0.54	0.57	0.49	0.51	0.54	0.59
Garfield Street to S Stage Road[1]	Mainline	0.53	0.58	0.48	0.52	0.54	0.61
S Stage Road /I-5 SB Off-Ramp	Diverge	-	-	-	-	0.56	0.64
Between S Stage Road Ramps	Mainline	-	-	-	-	0.47	0.52
S Stage Road /I-5 SB On-Ramp	Merge	-	-	-	-	0.53	0.60
S Stage Road to Phoenix Road	Mainline	-	-	-	-	0.53	0.60
Phoenix Road /I-5 SB Off-Ramp	Diverge	0.54	0.58	0.49	0.53	0.53	0.61
Between Phoenix Road Ramps	Mainline	0.43	0.41	0.37	0.40	0.42	0.46
Phoenix Road /I-5 SB On-Ramp	Merge	0.61	0.56	0.57	0.55	0.59	0.57
South of Phoenix Road Interchange	Mainline	0.56	0.54	0.52	0.53	0.55	0.56

[1]Garfield Street to Phoenix Road under No-Build and Overpass/Underpass Alternatives.
For merge/diverge segments, the reported v/c indicates the worst case scenario for either the ramp or mainline facility.
SB = southbound; v/c = volume-to-capacity.
Bold red text indicates measurements not meeting targets.

Table 4. Mainline, Merge, and Diverge Operations for I-5 Northbound

Segment	Type	No-Build		Overpass/Underpass Alternatives		Interchange Alternatives	
		Weekday AM	Weekday PM	Weekday AM	Weekday PM	Weekday AM	Weekday PM
		v/c	v/c	v/c	v/c	v/c	v/c
South of Phoenix Interchange	Mainline	0.44	0.64	0.45	0.63	0.46	0.68
Phoenix Road /I-5 NB Off-Ramp	Diverge	0.44	0.64	0.46	0.64	0.47	0.68
Between Phoenix Road Ramps	Mainline	0.31	0.46	0.34	0.43	0.36	0.54
Phoenix Road /I-5 NB On-Ramp	Merge	0.53	0.70	0.51	0.67	0.52	0.73
Phoenix Road to S Stage Road	Mainline	-	-	-	-	0.51	0.72
S Stage Road /I-5 NB Off-Ramp	Diverge	-	-	-	-	0.51	0.73
Between S Stage Road Ramps	Mainline	-	-	-	-	0.45	0.63
S Stage Road /I-5 NB On-Ramp	Merge	-	-	-	-	0.54	0.73
S Stage Road to Garfield Street[1]	Mainline	0.50	0.69	0.49	0.66	0.53	0.71
Garfield Street/I-5 NB Off-Ramp	Diverge	0.48	0.70	0.50	0.67	0.53	0.71
Between Garfield Street Ramps	Mainline	0.35	0.52	0.33	0.51	0.37	0.53
Garfield Street/I-5 NB On-Ramp	Merge	0.73	**0.84**	0.75	**0.83**	0.67	**0.83**
North of South Medford Interchange	Mainline	0.67	**0.84**	0.66	**0.83**	0.67	**0.84**

[1]Phoenix Road to Garfield Street under No-Build and Overpass/Underpass Alternatives.
For merge/diverge segments, the reported v/c indicates the worst case for either the ramp or mainline facility.
NB = northbound; v/c = volume-to-capacity.
Bold red text indicates measurements not meeting targets.

As shown in Table 3, all merge and diverge movements are projected to meet mobility standards except for the locations listed below. At each of these locations, Overpass/Underpass and Interchange Alternative v/c values are within 0.02 of the No-Build v/c. ODOT should continue to monitor these locations for the potential need to install auxiliary lanes on the I-5 mainline north of the South Medford Interchange and dual exit lanes on the off-ramps.

- I-5 southbound mainline north of the South Medford Interchange
- Garfield Street/I-5 southbound off-ramp

- I-5 northbound mainline north of the South Medford Interchange
- Garfield Street/I-5 northbound on-ramp

The ODOT Analysis Procedures Manual identifies that "where the distance between an entrance terminal and an exit terminal is 2,500 feet or less, the interim space generally becomes a weaving section and must be analyzed for required length and design by the Transportation Planning Analysis Unit, Regional Traffic staff, or others designated to do the appropriate analysis." Since the distance between the South Stage and South Medford Interchange ramps is greater than 2,500 feet and the HCS analysis shows that the South Stage Interchange merge, diverge, and mainline v/c is below the v/c threshold of 0.75, an auxiliary lane between the South Stage and South Medford Interchange ramps is not needed to accommodate Year 2045 traffic volumes.

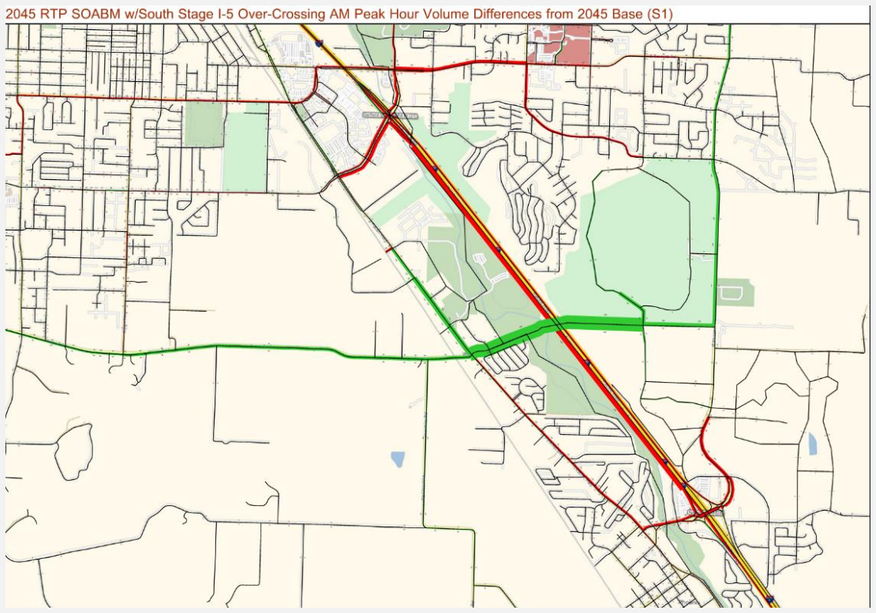
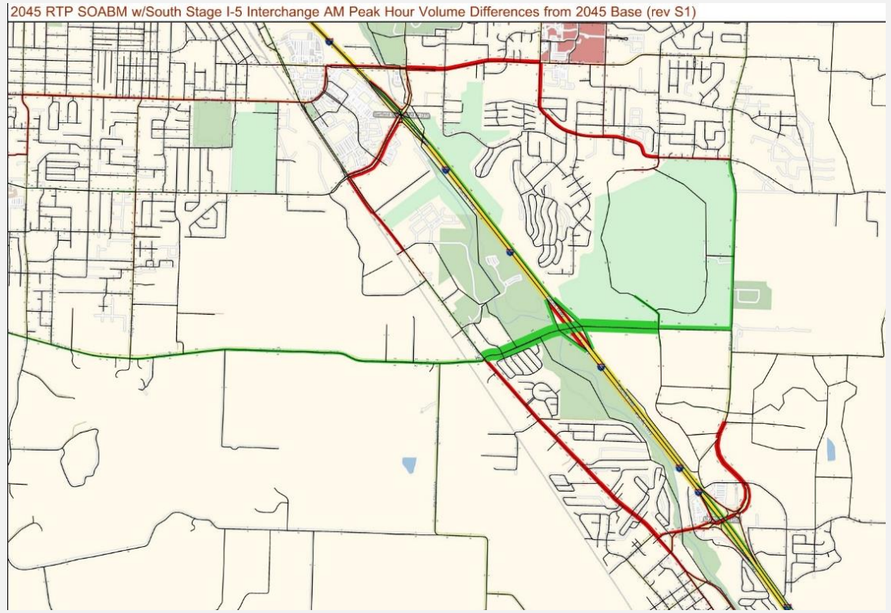
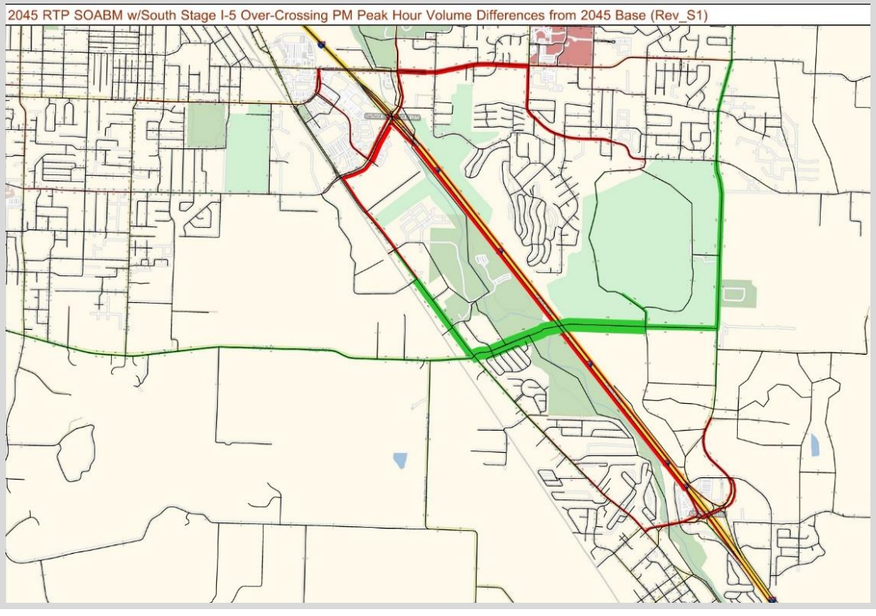
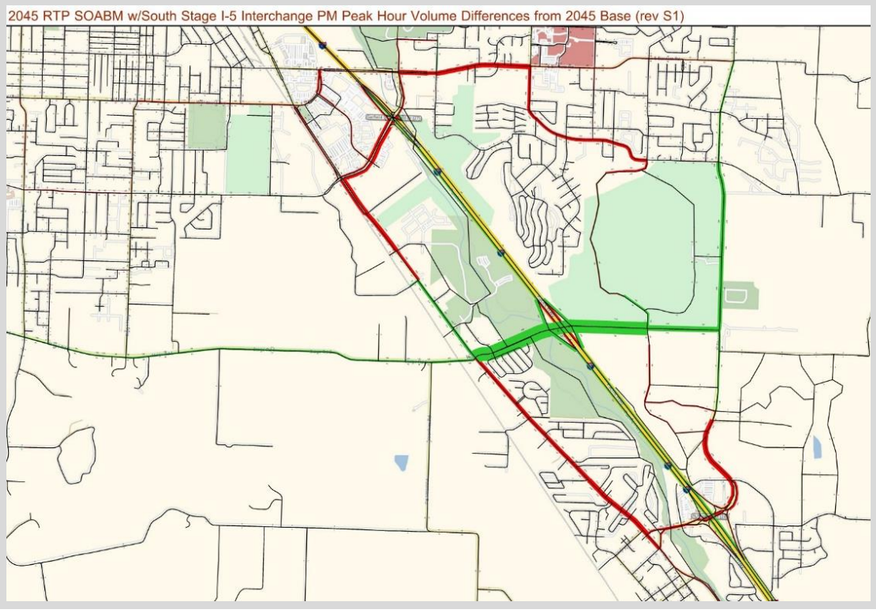
Attachment D of this memorandum contains the freeway operations analysis worksheets under the build alternatives. Freeway operations analysis worksheets for the No-Build scenario are included in *TM #4.1.2: Future Year Background Traffic Analysis*.

Connectivity

Improved east-west arterial connectivity is needed to support planned growth in the Medford and Phoenix urban growth reserves. South Stage Road has long been planned as a primary east-west route across the Rogue Valley and is the only arterial between the South Medford and North Phoenix Road Interchanges that provides east-west connectivity from the City of Jacksonville and other areas within Jackson County to OR99. Local adopted land use and transportation system plans identify the need for an extension of South Stage Road to support future residential and regional employment land development in the South Medford and North Phoenix areas east of I-5. Figure 4 compares the Southern Oregon Activity-Based Model for weekday AM and PM peak hours under the Overpass/Underpass and Interchange Alternatives relative to the model under No-Build conditions.

The Overpass/Underpass Alternatives and Interchange Alternatives provide similar improvements to east-west connectivity. Overpass/Underpass Alternatives draw more traffic onto OR99 and reduce demand on I-5 mainline between the South Medford and Phoenix interchanges. Interchange alternatives induce local demand on I-5 mainline between the South Medford and Phoenix interchanges. Both alternatives support connectivity for future housing and employment in southeast Medford and northeast Phoenix.

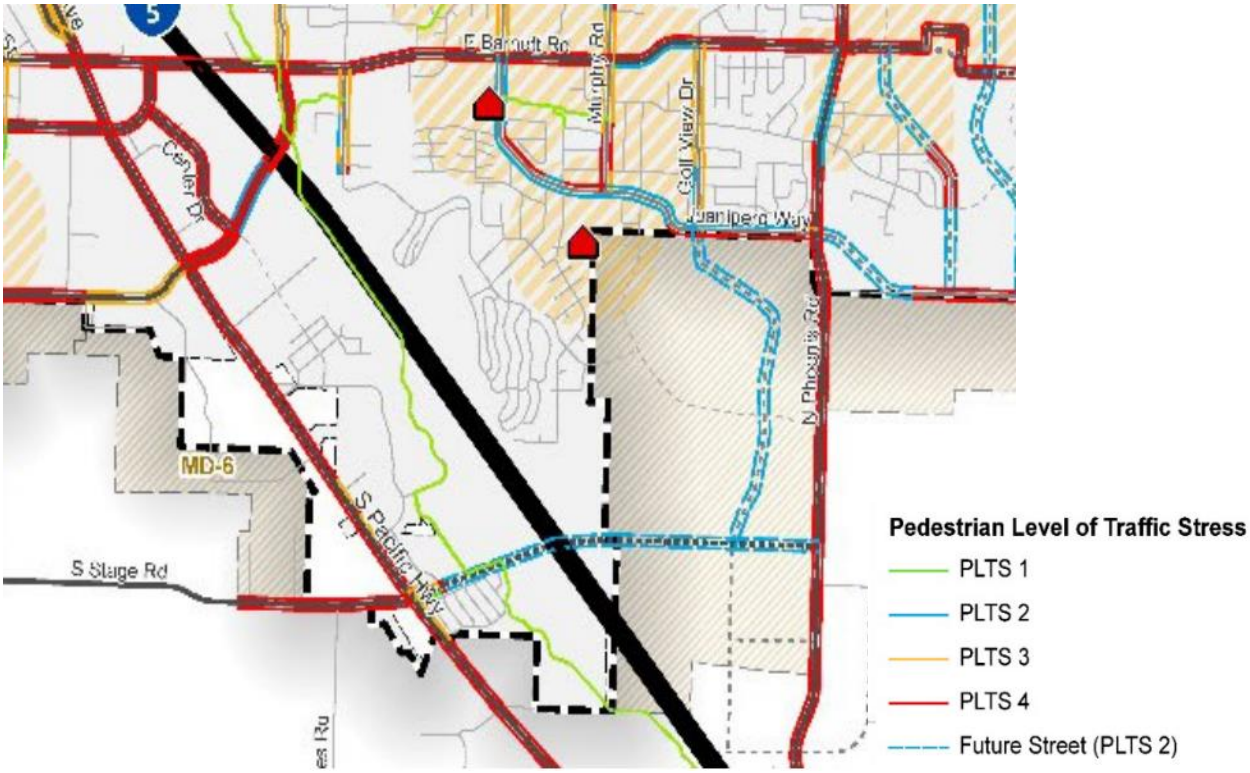
Figure 4. Southern Oregon Activity-Based Model Comparison

Peak Hour	Overpass/Underpass Alternatives Compared to 2045 No-Build Conditions	Interchange Alternatives Compared to 2045 No-Build Conditions
Weekday AM		
Weekday PM		

PEDESTRIAN, BICYCLE, AND TRANSIT CONNECTIVITY

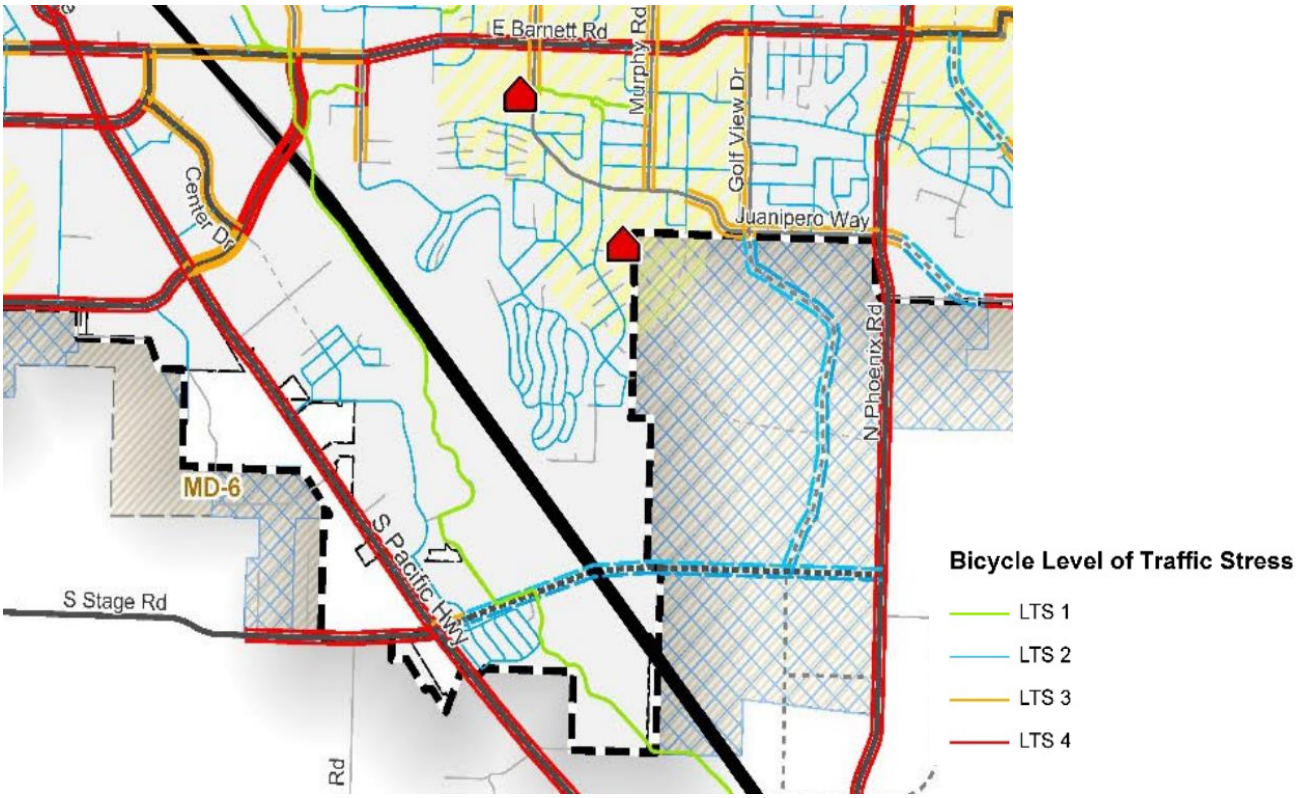
This section discusses the potential benefits each alternative provides for increased pedestrian, bicycle, and transit connectivity. Figure 5 and Figure 6 illustrate the level of traffic stress according to the *City of Medford Transportation System Plan*. Figure 7 illustrates the existing and planned transit facilities in the study area. A majority of the study area has a level of traffic stress of 3-4, which indicates that there is a lack of comfortable access for people walking and biking.

Figure 5. Pedestrian Level of Traffic Stress



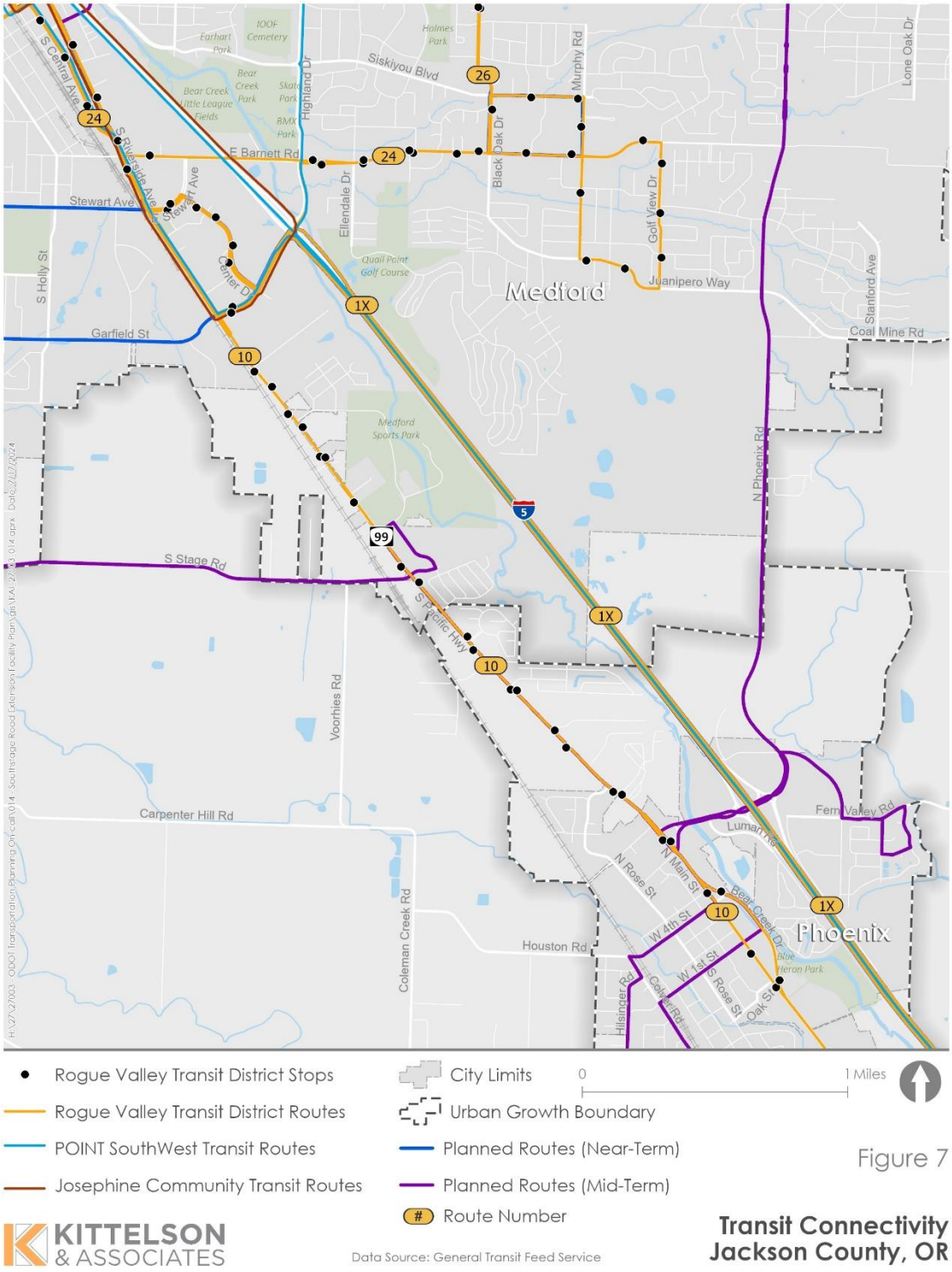
Source: City of Medford Transportation System Plan

Figure 6. Bicycle Level of Traffic Stress



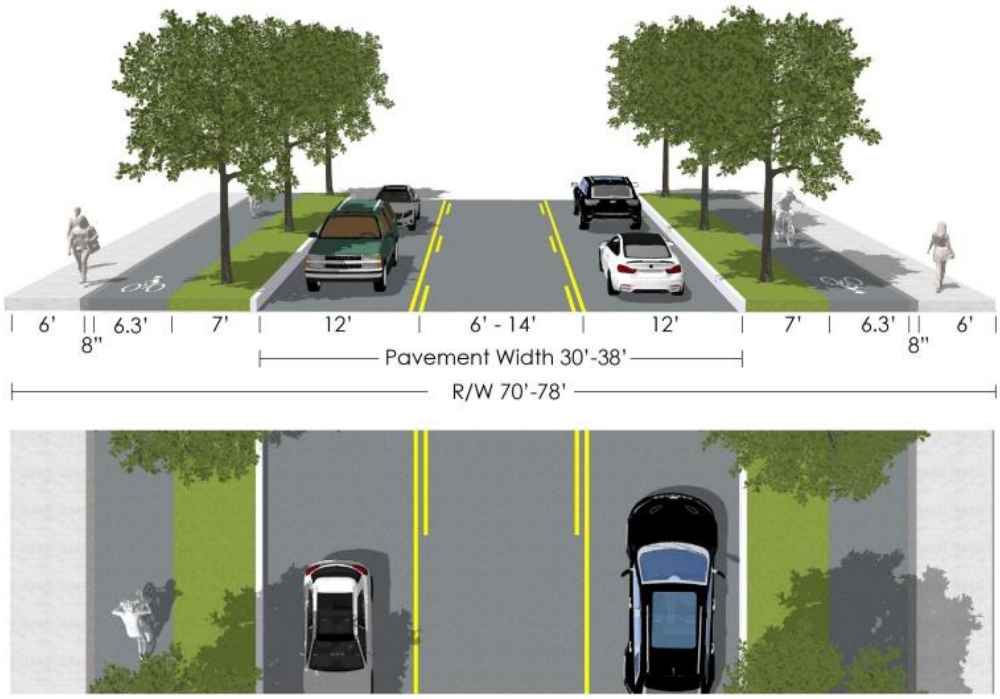
Source: City of Medford Transportation System Plan

Figure 7. Existing and Planned Transit Facilities



The Overpass/Underpass and Interchange Alternatives include separated bicycle lanes and sidewalks with landscape buffers on both sides of the roadway, as illustrated in Figure 8. This creates a low-stress route for people walking and biking of all ages and abilities. These facilities will connect into the Bear Creek Greenway, which a multiuse path that spans 20 miles and connects Medford Phoenix, Talent, Central Point, and Ashland.

Figure 8. Assumed Pedestrian and Bicycle Facilities



Source: City of Medford Transportation System Plan

Both the Overpass/Underpass and Interchange Alternatives provide increased access to the planned transit facilities along South Stage Road and Phoenix Road. The Overpass/Underpass and Interchange Alternatives create additional opportunities for transit routes across I-5 and Bear Creek. The Interchange Alternatives also create the opportunity for an additional stop along the Medford Ashland Express Route on I-5 (1X).

Broader planning efforts are needed to create a complete low-stress network for people walking, biking, and taking transit in the study area.

ANALYSIS FINDINGS

Table 5 summarizes analysis findings. The Overpass/Underpass and Interchange Alternatives require similar improvements throughout the study area and have similar overall performance under the 2045 forecast year.

Table 5. Summary of Analysis Findings

Intersection/Segment	Overpass/Underpass Alternatives	Interchange Alternatives	Part of Adopted Planning Documents
I-5/South Medford Interchange	Implement the transportation projects identified in the South Medford Interchange Area Management Plan (IAMP), including widening the southbound off-ramp to allow 1,000-foot dual left-turn lanes and extending the ramp to 3,000 feet to accommodate queuing, widening the northbound off-ramp to accommodate a 1,000-foot left-turn lane, and installing ramp metering. No additional projects are included as part of the Overpass/Underpass Alternatives beyond what the IAMP documented.	Implement the transportation projects identified in the IAMP, including widening the southbound off-ramp to allow 1,000-foot dual left-turn lanes and extending the ramp to 3,000 feet to accommodate queuing, widening the northbound off-ramp to accommodate a 1,000-foot left-turn lane, and installing ramp metering. **Note: The South Stage Interchange scenario could be accommodated without the IAMP ramp extension.** No additional projects are included as part of the Interchange Alternatives beyond what the IAMP documented.	These improvements are part of the Exit 27 IAMP.
OR99/Garfield (See Attachment A Exhibit 1)	Alternative Mobility Standard of 0.96.	Alternative Mobility Standard of 0.94.	The Alternative Mobility Standard is not part of existing planning documents; however, the intersection exceeds the operating target of 0.85 under No-Build conditions.
OR99/N Phoenix-Bolz Road (See Attachment A Exhibits 2A and 2B)	Construct separated eastbound right- and left-turn lanes on the west leg of the intersection and **a secondary northbound right-turn lane on the south leg of the intersection**.	Construct separated eastbound right- and left-turn lanes on the west leg of the intersection.	This project is not included in adopted planning documents; however, the intersection exceeds the operating target under No-Build conditions.
Barnett Road/Black Oak Drive	No improvements are needed under the Overpass/Underpass Alternatives.	No improvements are needed under the Interchange Alternatives.	The intersection exceeds the operating target only under No-Build conditions. Improvements to this intersection are not identified as part of adopted planning documents.
Juanipero Way/Golf View Drive (See Attachment A Exhibit 3)	Convert the intersection from two-way to all-way stop control.	Convert the intersection from two-way to all-way stop control.	This project is not included in adopted planning documents; however, the intersection exceeds the operating target under No-Build conditions.
Phoenix Road/South Stage Road (See Attachment A Exhibit 4)	Construct a single lane roundabout.	Construct a single lane roundabout.	This project is not included in adopted planning documents; however, the intersection exceeds the operating target under No-Build conditions.
Golf View Drive/future South Stage Road (See Attachment A Exhibit 5)	Construct a single lane roundabout.	Construct a single lane roundabout.	This project is not included in adopted planning documents, and the intersection improvements are needed as a result in additional demand along South Stage Road as part of the Overpass/Underpass and Interchange Alternatives.
OR99/South Stage Road (See Attachment A Exhibit 6)	Construct a separate westbound right-turn lane.	Construct a separate westbound right-turn lane.	This project is not included in adopted planning documents, and the intersection improvements are needed as a result in additional demand along South Stage Road as part of the Overpass/Underpass and Interchange Alternatives.
South Stage Road/Samike Drive-Devonshire Lane (See Attachment A Exhibit 7)	Construct a traffic signal when warranted.	Construct a traffic signal when warranted.	This project is not included in adopted planning documents, and the intersection improvements are needed as a result in additional demand along South Stage Road as part of the Overpass/Underpass and Interchange Alternatives.
Golf View Drive/Barnett Road (See Attachment A Exhibit 8)	Construct separate eastbound and westbound left-turn lanes.	Construct separate eastbound and westbound left-turn lanes.	This project is not included in adopted planning documents, however the intersection exceeds the average crash rate and critical crash rate under no-build conditions.
South Stage – I-5	Construct an overpass/underpass across I-5 at South Stage Road: - Underpasses require raising of I-5 lanes.	Construct an interchange on I-5 at South Stage Road: - Diamond southbound ramps with separate through/left-turn and right-turn lanes at the signalized ramp terminal. - Partial Cloverleaf (Parclo) A northbound ramps with separate left-turn and right-turn lanes at the signalized ramp terminal.	The Overpass/Underpass or interchange is part of the *Medford Transportation System Plan,* which does not specify improvements.
South Stage Road (OR99 to N Phoenix Road)	Construct sidewalk and protected bicycle lanes.	Construct sidewalk and protected bicycle lanes.	Constructing a new minor arterial roadway, including bike facilities and sidewalks, is part of the *Medford Transportation System Plan*.

Table 6 summarizes the alternative evaluation according to the criteria documented in *TM #2.1.3: Goals, Objectives, Evaluation Criteria, and Performance Measures*. The Overpass/Underpass and Interchange Alternatives both meet the project purpose and need. The Interchange Alternatives do not provide substantial benefits over the Overpass/Underpass Alternatives based on the Year 2045 analysis; however, there may be a need for the Interchange Alternatives beyond the horizon year. As such, the Overpass/Underpass Alternatives should be developed with forward compatibility.

Table 6. Existing and Future Needs Summary

Related Need/Objective	Evaluation Criteria	Performance Measure	Year 2045 No-Build	Year 2045 Build – South Stage Overpass/Underpass Alternatives	Year 2045 Build – I-5/South Stage Interchange Alternatives
Purpose 1. Reduce out of direction travel by improving east-west multimodal connectivity across Interstate-5					
Need 1A. I-5 creates a barrier to local east-west travel that limits local road connectivity.	For scenario screening: Does the alternative reduce the ADT on Barnett, Garfield, and Phoenix Roads crossing I-5? For evaluation and narrowing: If so, by how much?	ADT on bridge for each overcrossing/ interchange[1] (Phoenix Road, potential new location, Garfield, and Barnett) of I-5	South Medford Interchange Bridge: 37,610[1]	South Medford Interchange: 33,460 (11% decrease)[1]	South Medford Interchange: 33,380 (11% decrease)[1]
			Phoenix Interchange: 20,555[1]	Phoenix Interchange: 18,515 (10% decrease)[1]	Phoenix Interchange: 16,625 (19% decrease)[1]
			Barnett Road: 21,690[1]	Barnett Road: 20,655 (5% decrease)[1]	Barnett Road: 20,320 (6% decrease)[1]
			New location: N/A	New location (overpass/underpass): 12,060[1]	New location (interchange): 14,440[1]
Need 1B. Out-of-direction travel.	For scenario screening: Does the alternative reduce the travel distance and out-of-direction travel? For evaluation and narrowing: If so, by how much? For scenario screening: Does the alternative reduce the 2.65-mile gap for pedestrians and bicycles crossing I-5 and Bear Creek? For evaluation and narrowing: If so, by how much?	Travel distance: – OR99/Barnett to South Stage/ Phoenix – OR99/South Stage to South Stage/ Phoenix Average I-5 crossing spacing	Travel distance: – OR99/Barnett Road to South Stage Road/Phoenix Road: 4.0 miles – OR99/South Stage Road to N Phoenix Road/South Stage Road: 3.0 miles (south route) Average I-5 crossing spacing between Barnett to Phoenix Road: 1.6 miles	Travel distance: – OR99/Barnett Road to South Stage Road/Phoenix Road: 3.2 miles – OR99/South Stage Road to N Phoenix Road/South Stage Road: 1.4 miles Average I-5 crossing spacing between S Stage Road to Barnett Road: 1.0 miles	Travel distance: – OR99/Barnett Road to South Stage Road/Phoenix Road: 3.2 miles – OR99/South Stage Road to N Phoenix Road/South Stage Road: 1.4 miles Average I-5 crossing spacing between S Stage Road to Barnett Road: 1.0 miles
Need 1C. Poor east-west travel times.	For scenario screening: Does the alternative reduce travel times? For evaluation and narrowing: If so, by how much?	Travel time (vehicle/pedestrian[2]/ bicycle[2]): – OR99/Barnett to South Stage/Phoenix – OR99/South Stage to South Stage/Phoenix	Travel times for OR99/Barnett Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 11 min – Pedestrian: 85 min – Bicycle: 25 min Travel times for OR99/South Stage Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 7 min – Pedestrian: 61 min – Bicycle: 17 min	Travel times for OR99/Barnett Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 8 min – Pedestrian: 69 min – Bicycle: 20 min Travel times for OR99/South Stage Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 3 min – Pedestrian: 29 min – Bicycle: 8 min	Travel times for OR99/Barnett Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 8 min – Pedestrian: 70 min – Bicycle: 20 min Travel times for OR99/South Stage Road to South Stage Road/Phoenix Road (PM peak hour): – Vehicle: 3 min – Pedestrian: 30 min – Bicycle: 9 min
Purpose 2. Reduce existing and projected congestion and related traffic safety issues in the vicinity of the Interstate-5 interchanges with Garfield St. and N. Phoenix Rd. and the adjacent local street network					
Need 2A. Congestion at the existing interchanges and the local roads accessing the interchanges in Year 2045.	For scenario screening: Does the alternative allow the intersection, interchange, and freeway merge/diverge points to meet the mobility target or stay under capacity in the direction of the mobility targets (potential for an alternative mobility target)? For evaluation and narrowing: If so, by how much?	v/c ratio and LOS	Most study intersections meet mobility targets, with the following exceptions: AM peak period	Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes. AM peak period	Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes. AM peak period

Related Need/Objective	Evaluation Criteria	Performance Measure	Year 2045 No-Build	Year 2045 Build – South Stage Overpass/Underpass Alternatives	Year 2045 Build – I-5/South Stage Interchange Alternatives
			– Southbound mainline north of the South Medford Interchange: v/c=**0.81** – I-5/South Medford southbound off-ramp diverge: v/c=**0.88** PM peak period – OR99/Garfield Street: v/c=**0.97** – OR99/Phoenix Road-Bolz Road: v/c=**0.98** – Barnett Road/Black Oak Drive: LOS=**E** – Juanipero Way/Golf View Drive: LOS=**F** – Phoenix Road/future South Stage Road: LOS=**E** – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.78** – Northbound mainline north of the South Medford Interchange: v/c=**0.84** – I-5/South Medford northbound on-ramp merge: v/c=**0.84**	– Southbound mainline north of the South Medford Interchange: v/c=**0.80** – I-5 South Medford southbound off-ramp diverge: v/c=**0.90** PM peak period – OR99/Garfield Street: v/c=**0.96** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=D – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.76** – I-5/South Medford southbound off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford northbound on-ramp merge: v/c=**0.83**	– Southbound mainline north of the South Medford Interchange: v/c=**0.82** – I-5 South Medford SB off-ramp diverge: v/c=**0.86** PM peak period – OR99/Garfield Street: v/c=**0.94** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=B – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford northbound on-ramp merge: v/c=**0.84**
Need 2B. Reduce traffic volumes at intersections with high crash rates.	For scenario screening: Does the alternative maintain or reduce traffic demand at identified high-crash locations? For evaluation and narrowing: If so, by how much? For scenario screening: Does the alternative modify the intersection and/or segment to reduce the identified crash types? For evaluation and narrowing: If so, by how much?	Total entering traffic (TET) Crash modification factor (CMF)	The following intersections are identified as having safety deficiencies. PM peak hour TET is provided in parenthesis: – Barnett Road/Golf View Drive (1,500) – Garfield Street/Center Drive (4,317) – OR99/Stewart Avenue (4,387) – OR99/Garfield Street (4,444) – I-5/South Medford Interchange (5,294)	TET decreases for all intersections with identified safety deficiencies: – Barnett Road/Golf View Drive (1,393; 7% decrease) – Garfield Street/Center Drive (4,018; 7% decrease) – OR99/Stewart Avenue (4,345; 1% decrease) – OR99/Garfield Street (4,256; 4% decrease) – I-5/South Medford Interchange (4,943; 7% decrease) CMF: – Ramp metering at the I-5/South Medford Interchange has a CMF of 0.59 – Constructing a separate left-and right-turn lane at OR99/N Phoenix-Bolz Road has a CMF of 0.90 and 0.96, respectively – Converting the Juanipero Way/Golf View Drive intersection to an all-way stop has a CMF of 0.25 – Converting the intersection of Golf View Drive/future South Stage Road to a roundabout has a CMF of 0.18 – Converting the future South Stage Road/N Phoenix Road intersection to a roundabout has a CMF of 0.18 – Constructing a separate right-turn lane at OR99/South Stage Road has a CMF of 0.96 – Converting the intersection of South Stage Road/Samike Drive-Devonshire Lane has a CMF of 0.33	TET decreases for all intersections with identified safety deficiencies: – Barnett Road/Golf View Drive (1,371; 9% decrease) – Garfield Street/Center Drive (4,004; 7% decrease) – OR99/Stewart Avenue (4,231; 4% decrease) – OR99/Garfield Street (4,020; 10% decrease) – I-5/South Medford Interchange (4,952; 6% decrease) CMF: – Ramp metering at the I-5/South Medford Interchange has a CMF of 0.59 – Constructing a separate left-and right-turn lane at OR99/N Phoenix-Bolz Road has a CMF of 0.90 and 0.96, respectively – Converting the Juanipero Way/Golf View Drive intersection to an all-way stop has a CMF of 0.25 – Converting the intersection of Golf View Drive/future South Stage Road to a roundabout has a CMF of 0.18 – Converting the future South Stage Road/N Phoenix Road intersection to a roundabout has a CMF of 0.18 – Constructing a separate right- turn lane at OR99/South Stage Road has a CMF of 0.96 – Converting the intersection of South Stage Road/Samike Drive-Devonshire Lane has a CMF of 0.33

Related Need/Objective	Evaluation Criteria	Performance Measure	Year 2045 No-Build	Year 2045 Build – South Stage Overpass/Underpass Alternatives	Year 2045 Build – I-5/South Stage Interchange Alternatives
				– Installing left-turn lanes on both major road approaches at Golf View Drive / Barnett Road has a CMF of 0.81	– Installing left-turn lanes on both major road approaches at Golf View Drive / Barnett Road has a CMF of 0.81
Need 2C. At the South Medford interchange, congestion is causing a bottleneck with southbound queues spilling back onto the I-5 mainline, which is not just a congestion issue, but also a safety concern for potential high-speed, rear-end collisions.	For scenario screening: Does the alternative avoid potential spillback onto I-5? For evaluation and narrowing: If so, by how much?	Queue length	Queues can be accommodated with IAMP improvements, including the IAMP ramp extension. The Weekday AM queue at the southbound approach is the constraining queue (approximately 1,525 feet).	These alternatives, paired with other IAMP improvements, can reduce queues by a small amount. The Weekday AM queue at the southbound approach is approximately 1,425 feet. The additional queue storage identified in the IAMP is still needed to accommodate queues.	These alternatives, paired with other IAMP improvements, can reduce queues by a moderate amount. The Weekday AM queue at the southbound approach is approximately 1,025 feet. Queues are anticipated to be accommodated without the IAMP ramp extension.
Purpose 3. Support local system improvements associated with current and planned land uses as well as improved emergency preparedness in the rapidly urbanizing area of south Medford, Oregon, and north Phoenix, Oregon					
Need 3A. Local, adopted land use and transportation system plans identify South Stage Road as being needed to support future land development in the south Medford and north Phoenix areas.	For scenario screening: Does the alternative allow the intersection, interchange, and freeway merge/diverge points to meet the mobility target or stay under capacity in the direction of the mobility targets (potential for an alternative mobility target)? For evaluation and narrowing: If so, by how much?	v/c ratio and LOS	Most study intersections meet mobility targets, with the following exceptions: AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.81** – I-5/South Medford SB off-ramp diverge: v/c=**0.88** PM peak period – OR99/Garfield Street: v/c=**0.97** – OR99/Phoenix Road-Bolz Road: v/c=**0.98** – Barnett Road/Black Oak Drive: LOS=**E** – Juanipero Way/Golf View Drive: LOS=**F** – Phoenix Road/future South Stage Road: LOS=**E** – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.78** – Northbound mainline north of the South Medford Interchange: v/c=**0.84** – I-5/South Medford NB on-ramp merge: v/c=**0.84**	Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes. AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.80** – I-5 South Medford SB off-ramp diverge: v/c=**0.90** PM peak period – OR99/Garfield Street: v/c=**0.96** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=D – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.76** – I-5/South Medford SB off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford NB on-ramp merge: v/c=**0.83**	Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes. AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.82** – I-5 South Medford SB off-ramp diverge: v/c=**0.86** PM peak period – OR99/Garfield Street: v/c=**0.94** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=B – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford NB on-ramp merge: v/c=**0.84**
Need 3B. Without improved connectivity across and/or access to/from I-5, future congestion, safety conditions, emergency response times (for wildfire, medical, etc.) and travel times will worsen for all modes.	For scenario screening: Does the alternative allow the intersection, interchange, and freeway merge/diverge points to meet the mobility target or stay under capacity in the direction of the mobility targets (potential for an alternative mobility target)? For evaluation and narrowing: If so, by how much?	Average I-5 crossing spacing v/c ratio and LOS	Average I-5 crossing spacing between Barnett Road and Phoenix Road: 1.6 miles Most study intersections meet mobility targets, with the following exceptions:	Average I-5 crossing spacing between Barnett Road and Phoenix Road: 1.0 miles Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions	Average I-5 crossing spacing between Barnett Road and Phoenix Road: 1.0 miles Intersections that meet mobility standards under the No-Build scenario continue to meet mobility targets with identified enhancements. The remaining intersections meet mobility targets, with the exceptions

Related Need/Objective	Evaluation Criteria	Performance Measure	Year 2045 No-Build	Year 2045 Build – South Stage Overpass/Underpass Alternatives	Year 2045 Build – I-5/South Stage Interchange Alternatives
				identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes.	identified in **red** below. The intersection of OR99/Garfield Street will need an alternate mobility target. The mainline, merge, and diverge locations in the vicinity of the South Medford Interchange will require continued monitoring for the need for an auxiliary lane and dual exit lanes.
			AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.81** – I-5/South Medford SB off-ramp diverge: v/c=**0.88** PM peak period – OR99/Garfield Street: v/c=**0.97** – OR99/Phoenix Road-Bolz Road: v/c=**0.98** – Barnett Road/Black Oak Drive: LOS=**E** – Juanipero Way/Golf View Drive: LOS=**F** – Phoenix Road/future South Stage Road: LOS=**E** – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.78** – Northbound mainline north of the South Medford Interchange: v/c=**0.84** – I-5/South Medford NB on-ramp merge: v/c=**0.84**	AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.80** – I-5 South Medford SB off-ramp diverge: v/c=**0.90** PM peak period – OR99/Garfield Street: v/c=**0.96** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=D – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.76** – I-5/South Medford SB off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford NB on-ramp merge: v/c=**0.83**	AM peak period – Southbound mainline north of the South Medford Interchange: v/c=**0.82** – I-5 South Medford SB off-ramp diverge: v/c=**0.86** PM peak period – OR99/Garfield Street: v/c=**0.94** – OR99/Phoenix Road-Bolz Road: v/c=0.85 – Barnett Road/Black Oak Drive: LOS=D – Juanipero Way/Golf View Drive: LOS=B – Phoenix Road/future South Stage Road: LOS=A – Southbound mainline north of the South Medford Interchange: v/c=**0.77** – I-5/South Medford SB off-ramp diverge: v/c=**0.77** – Northbound mainline north of the South Medford Interchange: v/c=**0.83** – I-5/South Medford NB on-ramp merge: v/c=**0.84**
Need 3C. Improve emergency response times via the existing interchanges and local street network accessing those interchanges.	For scenario screening: Does the alternative reduce the travel time for emergency vehicles? For evaluation and narrowing: If so, by how much?	Travel time (vehicle) – OR99/Barnett to South Stage/Phoenix – OR99/South Stage to South Stage/Phoenix	Travel time for OR99/Barnett Road to South Stage Road/Phoenix Road (PM peak hour): 11 min Travel time for OR99/South Stage Road to South Stage Road /Phoenix Road (PM peak hour): 7 min	Travel time for OR99/Barnett to South Stage/Phoenix Road (PM peak hour): 8 min Travel time for OR99/South Stage Road to South Stage Road/Phoenix Road (PM peak hour): 3 min	Travel time for OR99/Barnett to South Stage/Phoenix Road (PM peak hour): 8 min Travel time for OR99/South Stage Road to South Stage Road/Phoenix Road (PM peak hour): 3 min

[1]ADT is estimated by multiplying the PM peak hour volume by 10. Bridge PM peak hour volumes are estimated by counting entering/exiting vehicles on the west leg of the intersection for the South Medford Interchange and as an average at the point between the ramps for the Phoenix and South Stage Interchanges. Barnett Road volumes were measured as an average of the entering/exiting volumes between the east leg of Intersection 10 and west leg of Intersection 11.

[2] Pedestrians are estimated to travel at an average speed of 3 mph, and bicyclists are assumed to travel at an average speed of 12 mph.

ADT = average daily traffic; CMF = crash modification factor; LOS = level of service; NB = northbound; SB = southbound; TET = total entering traffic; v/c = volume to capacity.