DRAFT

US 97 High Bridge to Madras Safety Study

TM#5 – Concept Development

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1. Introduction

This memorandum summarizes potential solutions identified for the US 97 High Bridge to Madras Safety Study project limits. These solutions were developed to address the issues summarized in Technical Memorandum 3 and to expound upon the countermeasure lists in Technical Memorandum #4. The project team developed the draft solutions based on a comprehensive review of the following project items:

- Participant Advisory Committee Feedback
- Open House and Online Open House feedback
- Technical Memorandum #3 Roadway Characteristics and Safety Analysis
- Technical Memorandum #4 Crash Countermeasure Toolbox – Application Summary

The team has grouped the potential solutions into three categories:

- Corridor Wide (Systemic) Solutions
- Non-Engineering Solutions
- Location Specific Solutions

Concept Development

Solutions are presented for each location or corridor-wide issue below, with details regarding cost estimates, anticipated safety benefits, description of challenges or considerations, and sample photos provided. The ODOT Crash Reduction Factor (CRF) manual was used to explain safety countermeasures and benefits. For additional information, readers should refer to TM #3: Roadway Characteristics and Safety Analysis and TM #4: Crash Countermeasure Toolbox – Application Summary.

The corridor-wide solutions are general solutions that can be applied at multiple locations or across the entire corridor. These potential solutions can provide solutions to issues that affect the whole corridor. Engineering manuals and past project memorandums refer to these as systemic solutions, these two terms may be used interchangeably in future project development. Systemic solutions often include only one or two countermeasures as listed in the countermeasure toolbox of TM#4.

Non-engineering solutions were identified primarily through members of the Participant Advisory Committee and the ODOT Transportation Safety Office. Recommendations for funding, materials, and staff were provided by the Jefferson County Sherrif's Office and Jefferson County Fire and EMS. ODOT's Transportation Safety Office provided recommendations for campaigns in TM#4 and are also included in this memorandum.

The location-specific solutions are intended to address specific locations where safety issues were identified at each Area of Safety Concern in TM#3. Some areas of safety concern were combined to demonstrate corridor functionality and to better visualize traffic operations to the public. Many of these location-specific solutions include the implementation of one or more countermeasures from TM#4 crash countermeasure toolbox.

Concepts were developed based on the language in the Jefferson County TSP (2021) and project goals were developed by the PAC to guide decision making and next steps. Jefferson County TSP goals are copied below and project goals are listed in section 5 of this document.

Jefferson County TSP Goals for US 97:

- Facilitating turning movements at key intersections
- Closing or modifying turning movements/accesses
- Identifying county roadway projects
- Reducing crash frequency, severity and risk
- Encouraging appropriate speeds and behavior
- Accommodating freight
- Improving shoulders

Cost Estimating Approach

The memorandum provides estimated costs for some of the potential solutions. These estimated costs are meant to be planning-level estimates and are intended to be used to understand the order of magnitude to implement the various potential solutions. Planning level costs are meant to be a starting point for cost assumption and may not accurately capture issues such as right of way, environmental, or other disciplines that would require more in-depth review. Additionally, planning level cost estimates may not be indexed to inflation at the time of implementation, especially if projects are funded years from the time of the study (2024). Funding managers, ODOT, Jefferson County, and the Oregon Legislature should plan accordingly when funding projects in the future. Coordination with ODOT Region 4 at the time of programming will result in the most accurate project cost.

Corridor-wide cost estimates were developed for potential systemic solutions that could be implemented in various locations or throughout the entire corridor. Historical Statewide Transportation Improvement (STIP) data and bid pricing was used to create planning-level cost estimates. These potential solutions are likely to be implemented in combination with one another. For example, rumble strips, pavement markers, and signage may be installed as one safety-related systemic project. Corridor wide solutions may also be implemented in conjunction with larger location-specific projects.

Non-engineering solutions cost estimates were provided by Jefferson County Sherriff and Jefferson County Fire and EMS. Coordination with these agencies would result in the most accurate cost

estimate during implementation. Costs of transportation safety campaigns would vary significantly depending on scope and scale.

Location specific solutions utilized historical STIP data, bid pricing and known assumptions to provide planning-level costs. For projects where a conceptual layout was developed, concept linework was used to develop estimated quantities for some construction items. Professional Engineering (PE) costs were also incorporated into the overall cost estimate. During implementation, it is best to consult with ODOT Region 4 to receive the most updated cost estimate per defined scope.

2. Corridor-Wide Solutions

The following tables discuss corridor wide solutions that are applicable to the US 97 High Bridge to Madras Study Area. TM#4 Crash Countermeasure Toolbox provides a larger list of systemic countermeasures for reference in case future crash trends change or asset conditions deteriorate.

Solution ID **01**	Shoulder and Centerline Rumble Strips
Description: Install rumble strips along the outside of the trave lane and centerline to inform drivers if they leave the travel lane.	
Implementation Suggestion: Near-term	
Considerations: Rumble strips currently exist for the shoulder and centerline in sections of the corridor but are missing in some areas. This project would revisit locations and design. No anticipated right-of-way, geotechnical, or environmental impacts. Road noise and proximity to residents should be considered **Benefits:** CRF for run-off-the-road crashes (22%) and head on crashes (12%) (RD16, 17, 18 from ODOT CRF list)	 *Photo/Image Credit: safety.fhwa.dot.gov* **Cost:** $12k per Mile (both sides of the road) **Assumptions:** Does not include any required paving with installation

Solution ID 02	Widen Shoulders by 3 feet

Description: Widen shoulder by and up to 3 feet throughout the corridor.

Implementation Suggestion: mid-term

Considerations:
Shoulder width varies throughout the corridor and needed improvements may vary by 1 to 3 feet. Shoulder widening has previously been scoped by ODOT.

Right of way impacts are possible and environmental impacts are minimal.

Benefits: CRF for all crashes 6-18% (RD20 from ODOT CRF list)

Photo/Image Credit: Google

Cost: $12,240,000.00
Assumptions: $816K per mile from MP 97.32 to 112.57. Drainage will need adjusted.

Solution ID 03	Increase Distance to Rural Roadside Obstacle

Description: Increase distance to roadside obstacle by 3 to 16 feet by improving the clear zone.

Implementation Suggestion: Mid-term

Considerations:
Obstacles could include fences, trees, utility poles, and any other fixed object that would increase likelihood of injury in a roadway departure crash.

Removing objects can be costly and easements may be needed to remove objects outside of the right of way.

Right of way impacts are likely.

Photo/Image Credit: Google

Benefits: CRF for all crashes is 22-44% (RD1,RD2)	**Cost:** $1,750,000 **Assumptions:** $350,000 per mile, assumes 5 mile segments to start

Solution ID **04**	Median Treatments

Description: Install a traversable median or median barrier throughout section of the corridor

Implementation Suggestion: Mid to Long-term

Considerations:

Median barrier can address head-on crashes which result in the largest portion of fatal and serious injury crashes in the corridor.

A traversable median may be installed as a first phasing effort to reduce crashes in the corridor.

Median barrier requires widening of roadway and can affect out of direction travel. RCUTs and roundabouts can aid corridor directional access.

Right of way impacts are likely.

Emergency services and incident management should be involved in future project design.

Potential Reduction in Vehicle Carrying Capacity (ORS 366.215)

Benefits: CRF for all crash types and all injury crashes 12% (H40) for a traversable median. CRF for all crash types and all injury crashes of 30% (RD25) for median barrier.

Photo/Image Credit: ODOT

Cost: $1.5 Million per mile
Assumptions: Cost varies heavily, this would cover portions of corridor not included in Area of Safety Concern. RCUTs would aid out of direction travel in rural sections of corridor.

Solution ID 05	Restricted Crossing U-Turn

Description: Install Restricted Crossing U Turn (RCUT)when barrier or turn restrictions are installed

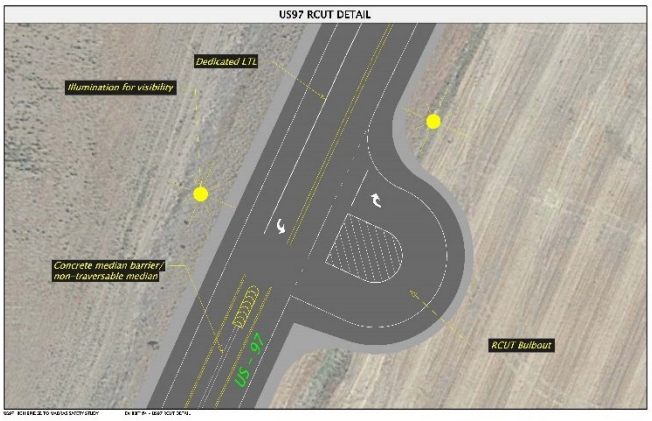
Implementation Suggestion: Long-term

Considerations:

RCUTs, also known as J-turns, are a useful tool to limit out of direction travel when combined with median barrier or turning restrictions.

Right of way and environmental impacts are likely, as well as drainage modifications.

Benefits: No CRF but aids in implementation of median barrier (RD 25)



Cost: $1.7 million per location

Assumptions: RCUT designed to accommodate freight and farm equipment.

Solution ID 06	Close Passing Across Intersections

Description: Close passing opportunities across intersections with striping changes.

Implementation Suggestion: Near-term

Considerations:

Recommendation would change striping and close passing across the following intersections:

- MP 100.81 SW Glide Ln (Private)
- MP 102.59 SW Highland Ln (passing allowed NB)
- MP 104.93 SW Jericho Ln
- MP 108.74 SW Norris Ln
- MP 109.74 SW Opal Ln
- MP110.73 SW Park Ln
- MP 111.72 SW Quincy Ln (Private)

Right of way and environmental impacts are not likely.

Benefits: No CRF but is consistent with state law.

Photo Credit: Google, US 97 at Park Lane

Cost: $63,0000 to remove and re-install no passing striping at intersections

Assumptions: Assumes Re-Stripe and Remove cost at $3k per mile.

Solution ID **07**	**Consistent Signage:** Advance Intersection Warning Signs

Description: Install advance intersection warning signage to notify drivers of upcoming locations and potential for vehicle slowdowns or turning movements.

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as signs are added to the corridor.
- Future project should evaluate where existing signs are missing or substandard

Photo/Image Credit: FHWA Manual on Uniform Traffic Control Devices (W2-1)

Benefits: CRF of 20% for all crashes (I21 from ODOT CRF list). If setup includes flashing beacons (not coordinated with signal timing: CRF of 13% for all crashes (I15 from ODOT CRF list)

Cost: $20k per Sign
Assumptions: Included with larger project, either systemic or in corridor specific locations

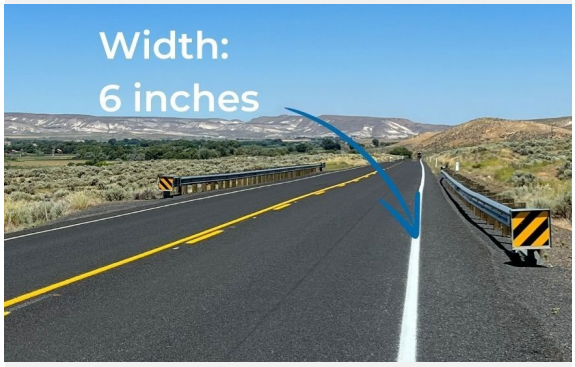
Solution ID 08	Install Wider Edge lines

Description: Install wider edge lines to better delineate the travel lane from the shoulder. Increase from 4" to 6"

Implementation Suggestion: Near-term

Considerations:

- No anticipated right-of-way, geotechnical, or environmental impacts.
- Additional maintenance costs will be incurred as edge lines are wider than current.



Photo/Image Credit: SWARCO engineering

Benefits: CRF of 14% for all crashes (RD24 from ODOT CRF list).

Cost: $825,000
Assumptions: $55k per mile, Included with larger project.

Solution ID **09**	**Driver Feedback Signs**
Description: Install driver speed back signs to indicate to drivers that they are entering communities and encourage slower speeds. When possible, consider opportunities to re-evaluate speed limits in conjunction with engineering treatments.	
Implementation Suggestion: Near-term	
Considerations: No anticipated right-of-way, geotechnical, or environmental impacts. Additional maintenance costs will be incurred as signs are added to the corridor. Existing speed feedback signs exist in Terrebonne and Madras. Sign locations should be re-evaluated in future projects.	*Photo/Image Credit: FHWA*
Benefits: CRF of 20% for all crashes (I21 from ODOT CRF list).	**Cost:** $75k per Sign **Assumptions:** Included with larger project, either systemic or in corridor specific locations

3. Non-Engineering Solutions

Solution ID	Safe Driving Media Campaign
10	

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

Implementation Suggestion: Near-term

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

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

Photo/Image Credit: Oregon Department of Transportation

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

Solution ID **11**	Evaluate Funding Opportunities for Increased Enforcement

Description: Evaluate funding opportunities to support increased state, county, and local enforcement. Jefferson County Sherriff office is supportive and included funding costsfor additional patrol deputies.
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Implementation Suggestion: Near-term

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

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

Photo/Image Credit: Jefferson County Sherrif

Cost: Jefferson County Sherrif has included a $1.25 million annual ask to patrol the corridor. **Assumption:** Could vary based on scope and longevity.

Solution ID **12**	Evaluate Funding Opportunities for Increased Fire & EMS

Description: Evaluate funding opportunities to support increased funding for Jefferson County Fire and EMS.

Implementation Suggestion: Near-term

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

Benefits: No CRF available. The benefits include a reduced response time to crashes and incidents, as well as better equipment for rescue operations.

Photo/Image Credit: Jefferson County Fire and EMS

Cost: Jefferson County Fire & EMS has included the following funding needs:

- Medium duty rescue unit - $400k to $600k
- Medic Crash Unit - $375k
- Additional Staffing: $120k Annually
- Extrication Tool Upgrade - $35k
- Ambulance extrication tool - $54k

Solution ID **13**	Increase ODOT Maintenance funding

Description: Increase ODOT Maintenance funding so that corridor assets and conditions are maintained at optimal levels. This could include sign/delineator replacements, guardrail repair, frequency of winter maintenance, and improved crew response times.

Implementation Suggestion: Near-term

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

Benefits: No CRF available. The primary benefit is that the corridor would be maintained to an appropriate level and depending on funding, a higher level of maintenance response.

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

4. Location Specific Concepts

This section presents the location-specific solutions for the Areas of Safety Concern mentioned in Technical Memorandum #4: Crash Countermeasure Toolbox. Some areas of safety concern were combined to demonstrate corridor functionality and to better visualize traffic operations to the public. Many of these location-specific solutions include the implementation of one or more countermeasures from TM#4. Solutions were separated into mid-term and long term improvements where applicable.

US 97/US 26/Colfax Lane Intersection

The project team and the PAC identified the US 97/US 26/Colfax Lane intersection as an area of safety concern. The location has been a historical Safety Priority Index (SPIS) location and presents several risks to drivers on the US 26 or Colfax Lane approach that turn left/right or continue across US 97. The US 97 South Madras Facility Plan has a long-term preferred alternative which includes median barrier and intersection improvements. Future implementation of this project would require an Intersection Control Evaluation (ICE) and would determine the final intersection configuration. Potential solutions to reduce crashes and crash risk are presented below.

Solution ID #14: Install Roundabout and Illumination

The preferred option would install a roundabout at US 97/US 26/ Colfax Lane. Figure 1 shows an example layout of the roundabout configuration. A roundabout would improve safety by reducing conflicts from left turning and through movements. This project would improve access to US 26 and Colfax Lane, as well as improve overall corridor circulation in the north part of the corridor. Turning movement and angle crashes were noted in TM#3 and the PAC feedback indicated that turning movements were difficult at the US 26 and Colfax Lane approaches on the intersection. The roundabout would include updated illumination which was also identified as a countermeasure in TM#4.

Implementation Suggestion: Mid to long term, depends on local development and safety performance.

Considerations

Roundabouts have shown to be effective at accommodating all modes of traffic safely, including freight. This intersection has frequent heavy dimension use from the north of US 97 to US 26. Additional outreach by the Mobility Advisory Committee will be considered.

Project will have minor right of way impacts and minor environmental impacts.

The roundabout would have a secondary benefit of improving overall corridor access in the north portion of the corridor. The roundabout would also accommodate out of direction travel if median

barrier is installed north or south of the roundabout. The roundabout would also decrease side street delay which was shown to be significant in TM#3.

A speed zone evaluation, a possible countermeasure to reduce corridor speeds in TM#4, could be implemented post construction to evaluate speeds and determine if a reduction in corridor speed is appropriate.

This location may have reimbursable utilities which would need to be captured in the cost.

Safety Benefits

Converting a stop-controlled intersection to a roundabout is estimated to reduce injury crashes by 82 percent (H18 from ODOT CRF list). Roundabouts also help to slow speeds, which may create additional safety benefits along the highway. Illumination is expected to reduce night time injury crashes by 38% (H29 from ODOT CRF List).

Cost Estimate

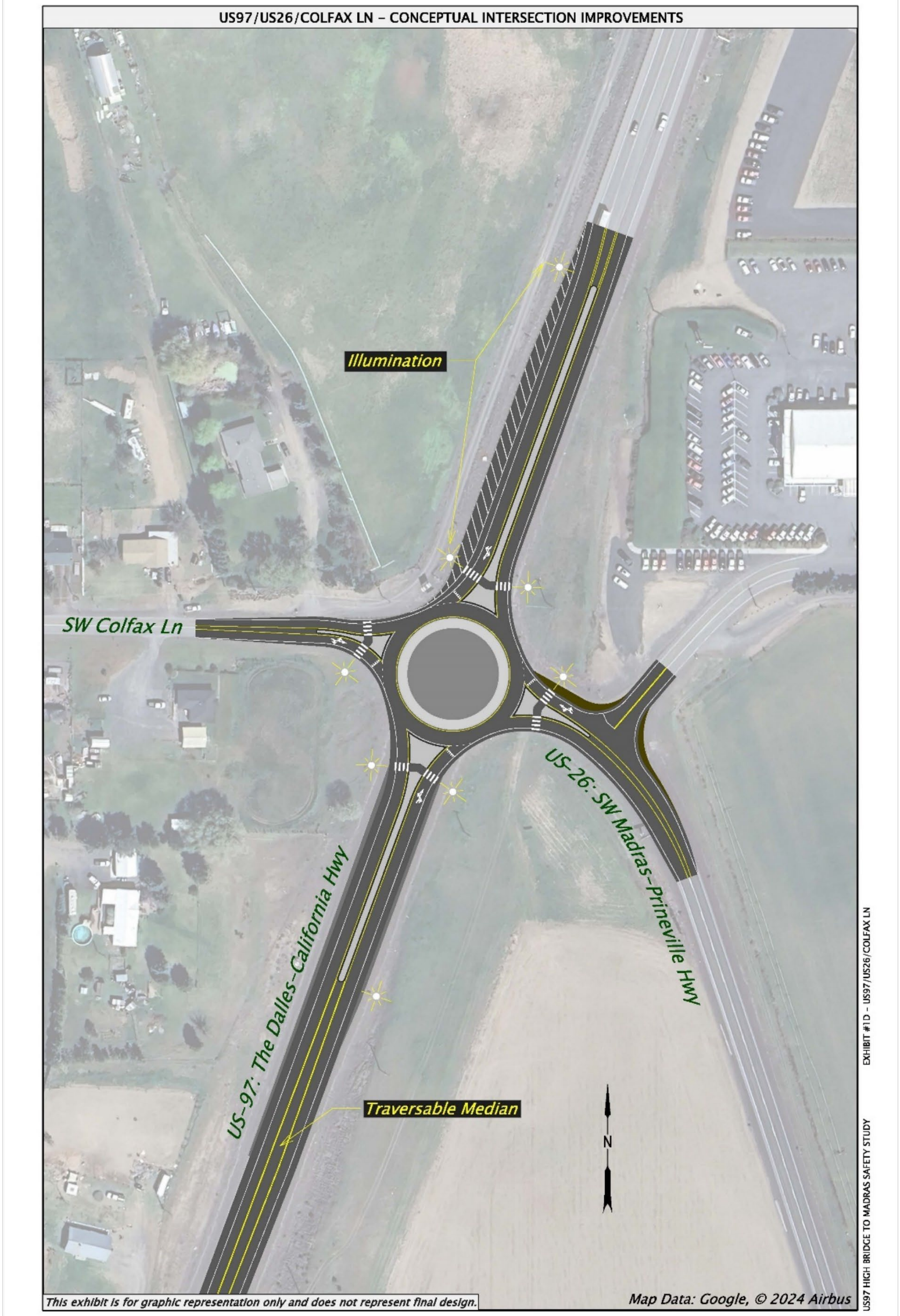
This project is estimated to cost $7.9 million.

Countermeasures not recommended

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

- Simplify and reduce size of intersection – While this improvement could have positive safety benefits, the benefits are likely minimal and the cost to adjust pavement, signage, and drainage would be significant.

Figure 1: US 97/US 26/Colfax Lane



US 97 Waldorf to Dover and US 97/Dover Lane Intersection.

Solution ID #15A:
This solution combines two areas of safety concern: The Waldorf to Dover section of US97 (MP 97.7 to 98.3) and the US 97/Dover Lane intersection. The project team and the PAC identified these locations as areas of safety concern in the project. The proposed solution would install a traversable median from the terminus of the proposed roundabout project to the intersection of US 97/Dover Lane. Left turn and through movement restrictions on the Dover approach are proposed as well. The concept continues south in subsequent solutions identified in this memo.

Implementation Suggestion: Mid term

Considerations
The project would have considerable R/W impacts. Drainage would need to be addressed as well. Environmental impacts would need to be assessed and mitigated as part of the project, although no known extensive impacts exist.

The US 97/Dover Lane intersection improvement project was completed in 2022 and may mitigate some issues at the intersection. However, the crash types at the intersection indicate that additional improvements are needed to improve safety at US 97/Dover Lane.

The US 97/US 26/Colfax Lane intersection is included in the graphic to demonstrate how the proposed roundabout would accommodate left turning movements if left turns were restricted at Dover Lane.

Safety Benefits
A traversable median (H40 in ODOT CRF manual) provides separation between opposing flows of traffic. It is estimated to reduce all crashes at all severities by 12%. Turn restrictions at Dover do not have a CRF but would eliminate the left turning movement and through movement crashes from the minor (Dover) approach. Rural roadside obstacles may be addressed in this potential project or in a systemic project; if so, this countermeasure (RD1.RD2) would reduce all crashes by 22-44%. The Waldorf to Dover section of US 97 is above the critical crash rate and the US 97/Dover intersection is one of the top three crash locations in the corridor. Roadway departure, angle crashes, and head on crashes were the primary crash types in this section.

Cost Estimate
This project is estimated to cost $8.8 million.

Countermeasures not recommended
Additional countermeasures from TM#4 are included in Solution ID #15B.


Shoulder
8 ft
Travel Lane
12 ft
Traversable Median
14 - 16 ft
Travel Lane
12 ft
Shoulder
8 ft

Figure 2: US 97 Waldorf to Dover and US 97/Dover Lane

Solution ID #15B:

The goal of solution #15b is to move local trips to the surrounding transportation system, reduce access points to US 97, and enhance key locations on US 97 for improved safety. Center median barrier is proposed to continue throughout the corridor and Restricted Crossing U-Turns (RCUTS) would assist out of direction travel. Additional local county road connections are proposed for safer access to residences and businesses. This proposed project includes both safety and operational improvements; median barrier has shown to reduce the crash types that occur in the corridor and the proposed access road would provide better vehicular circulation. The proposed solution adds greater system connectivity options for property owners in the corridor and provides a higher level of safety countermeasures. Median barrier is proposed to continue throughout the corridor and Restricted Crossing U-Turns (RCUTS) would assist out of direction travel. Additional local county road connections are proposed for safer access to residences and businesses, consistent with the Jefferson County TSP (2021).

Implementation Suggestion: Long term

Considerations

The project would have greater R/W impacts than those identified in solution #15A. A new frontage road built to county road standards would provide operational benefits but would require a new alignment, as well as significant property impacts. A frontage road is not required for the median barrier to function as intended. Cost for a new county road alignment is expected to be significant as well. Environmental impacts would need to be assessed and mitigated as part of the project, although no known extensive impacts exist. A noise analysis would need to occur if the access road was constructed if federal highway funding is used. Utility impacts, specifically at the proposed RCUT, would occur and would be reimbursable utilities.

Installation of median barrier will require outreach with the Mobility Advisory Committee per ORS366.215 Reduction of Vehicle Carrying Capacity.

This solution could be constructed in phases, with solution #15A installed first. Median barrier could be installed if the safety issues still persist based on crash type. The roundabout at US 97/US 26/Colfax would aid out of direction travel for the proposed concept as well.

Some concepts such as the access road would not likely be great candidates for federal safety funding.

Safety Benefits

Median barrier (RD25 and H31 in the ODOT CRF Manual) are used to separate opposing directions of traffic on divided highways with high speeds or on divided highways with a high frequency of fatal or serious injury crossover crashes. Median barrier has a 30% reduction in all crashes at all injury severities.

Restricted Crossing U-Turns (RCUTS) are not a proven safety countermeasure in the ODOT CRF Manual but do provide operational and safety benefits when paired with median barrier. FHWA has shown RCUTS to be an effective tool for improving safety at intersections with turn restrictions.

The proposed access road from Dover Lane on the west side of US 97 does not have an expected crash reduction alone but would provide safer access to the road network for residences and businesses on the west side of US 97.

Cost Estimate

The project without the access road, is $2.4 million.

To add the access backage road would add $1.4 million.

Countermeasures not recommended

- Additional countermeasures from TM#4 are included in Solution ID #15A.
- Construct a roundabout: Steep grades at the intersection present constructability issues and make a roundabout cost-prohibitive.


Shoulder
8 ft
Travel Lane
12 ft
Median
14 - 16 ft
Travel Lane
12 ft
Shoulder
8 ft

Figure 3 US 97 Waldorf to Dover and US 97/Dover Lane


US97: DOVER LN CONCEPTUAL SAFETY IMPROVEMENTS (LONG TERM)
Potential Access Road
Concrete Median Barrier
SW Dover Ln
RIRO Configuration w/ Concrete Islands
US-97: The Dalles - California Hwy
Potential R-CUT Location
N
This exhibit is for graphic representation only and does not represent final design.
Map Data: Google, © 2024 Airbus
US97 HIGH BRIDGE TO MADRAS SAFETY STUDY
MAC EXHIBIT - US97: DOVER LN (LONG TERM)

US 97 Passing Lanes MP 98.7 to 99.6

Solution ID #16:
The proposed solution for US 97 MP 98.7 to 99.6 is to add median barrier and eliminate the conflict with the existing passing lane at the Auction Yard approach. This section of the corridor had both observed safety issues and was supported by public feedback by the PAC and open house.

Implementation Suggestion: Mid to long term

Considerations
PAC feedback indicated a strong preference to retain the passing lane in this section. Additional R/W would be needed to widen US 97 and install median barrier. Drainage would need to be re-designed for the wider pavement width. Environmental impacts would be assessed at project development but are expected to be minimal.

Installation of median barrier will require outreach with the Mobility Advisory Committee per ORS366.215 Reduction of Vehicle Carrying Capacity.

The existing passing lane is sufficiently long enough to meet ODOT Highway Design Manual standards. A shorter passing would not be sub-standard in length and is not expected to impact corridor travel time.

Left turn lane warrants would need to be evaluated to support the overall intersection configuration at the Auction Yard access.

This project could be phased to only include a traversable median and reduce cost of a median barrier. A median barrier could be installed at a later date if safety issues persist. However, the median barrier provides greater separation from oncoming vehicles and better addresses the crash types in this section.

Safety Benefits
Median barrier (RD25 and H31 in the ODOT CRF Manual) are used to separate opposing directions of traffic on divided highways with high speeds or on divided highways with a high frequency of fatal or serious injury crossover crashes. Median barrier has a 30% reduction in all crashes at all injury severities. This section of the corridor has a history of high-speed rear end crashes, sideswipe/passing crashes, and head on collisions.

Cost Estimate
This project is estimated to cost $9.5 million.

Countermeasures not recommended
The following countermeasures from TM#4 were not recommended for the following reasons:

- Remove passing lane, install median: The PAC feedback strongly indicated that the passing lane should remain.

Figure 4 US 97 Passing Lanes

US 97 – Falcon to Jericho

Solution ID #17:
US 97 from Falcon Lane to Jericho presents unique challenges in concept development: high frequency of public and private approaches, a history of sideswipe/passing crashes, and an adjacent farm industry that utilizes US 97. Near term solutions include striping changes and mid-term solutions include a traversable median, turn restrictions at US 97/Jericho, county road access consolidation, and long-term intersection improvements at US 97/Iris Lane.

Implementation Suggestion: Near term/Long term

Considerations

The near term improvements are relatively inexpensive and low impact. Striping changes could be coupled with other corridor wide improvements. Striping changes would evaluate passing at intersections/accesses

Long term improvements are expected to have significant right of way impacts. The traversable median would require widening and would impact adjacent drainage facilities, as well as intersections and private approaches.

Access consolidation at key locations will provide improved traffic control. The recommendation to consolidate two accesses in the corridor has been left vague so as to retain flexibility in the future. Accesses are very frequent in this section and while consolidating county road approaches would be an improvement, it still would not make the corridor meet our access spacing standards.

An intersection control evaluation would need to occur at US 97/Iris Lane for any future intersection improvements. A roundabout should be considered in the future at this intersection and is subject to approval from the Mobility Advisory Committee in accordance Highway Directive DES-02.

Median barrier installation could be considered in the long term should farm ownership change in the corridor. Currently, large agricultural machinery crosses the highway and median barrier would present challenges with directing that machinery onto the highway. In addition, installation of median barrier will require outreach with the Mobility Advisory Committee per ORS366.215 Reduction of Vehicle Carrying Capacity.

ODOT should work with Jefferson County to re-evaluate emergency/detour routes at implementation.

Safety Benefits

Striping adjustments do not have an ODOT CRF but would make the passing zones consistent with state law (no passing across intersections).

A traversable median (H40 in ODOT CRF manual) provides separation between opposing flows of traffic. It is estimated to reduce all crashes at all severities by 12%. Sections of this corridor are close to the critical crash rate and increased travel lane separation would address the crash types.

Turn restrictions at Jericho do not have a CRF but would eliminate the left turning movement and through movement crashes from the minor (Jericho) approach. Future intersection improvements at US 97/Iris Lane could better accommodate left turns at the intersection

Cost Estimate

Short term improvements would cost less than $200,000.

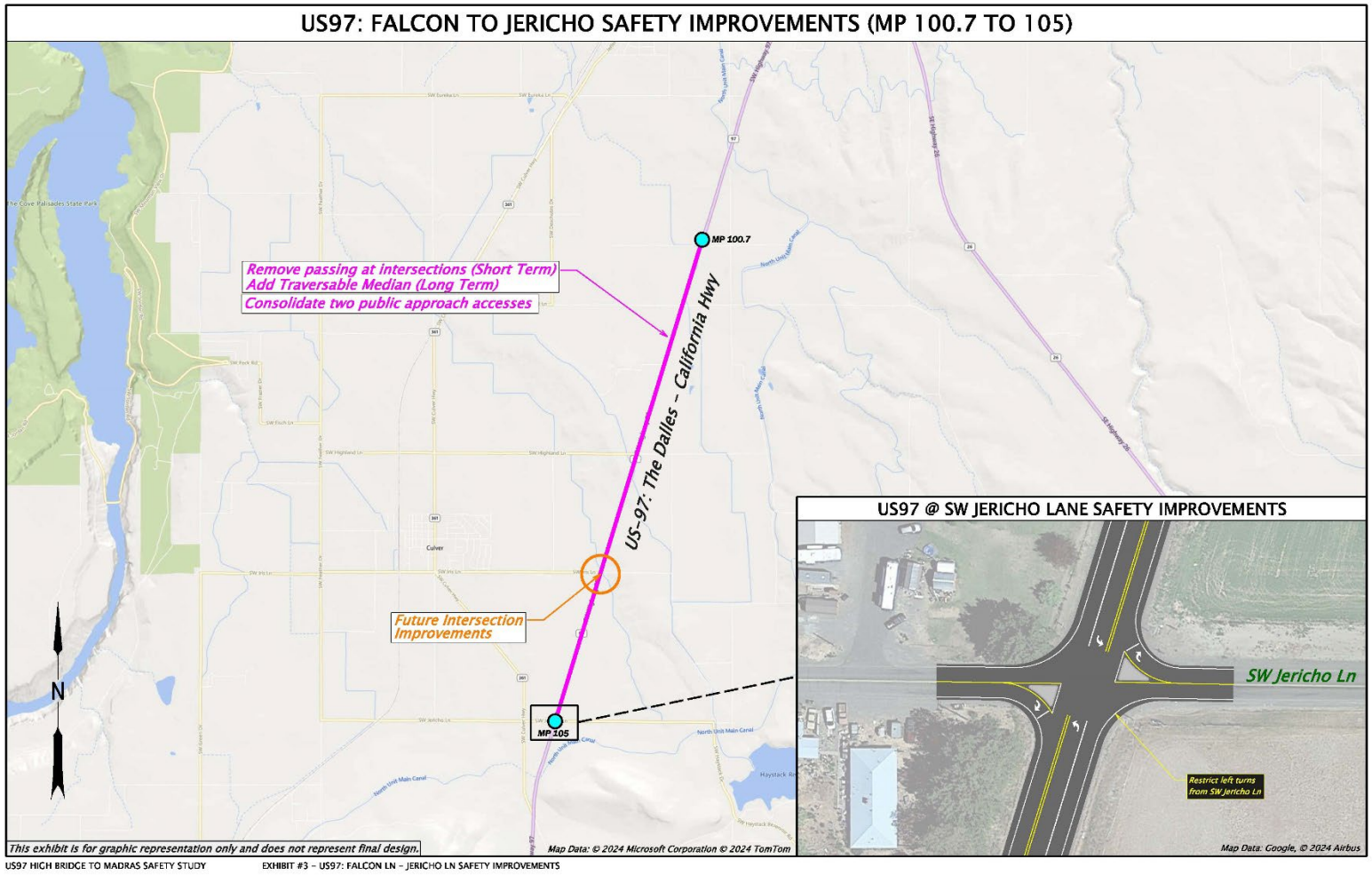
Mid-term costs for installing a 10' wide traversable median are expected to be $20.3 million.

Long term - $7 million for a rural roundabout at the Iris Intersection.

Countermeasures not recommended

- Median Barrier: Median barrier could be recommended in the future but a review of private farm approaches and access needs with the agricultural community would need to occur.

Figure 5US 97 Passing Lanes Falcon to Jericho



US 97/ SW Culver Highway Intersection

Solution ID #18:
Solutions for the US 97/SW Culver Highway intersection include an intersection realignment that reduces existing sight distance, intersection skew, and operations issues. A review of the most recent 5 years of crash data showed this intersection to be one of the top three crash locations in the corridor. Safety concerns from the PAC and public feedback showed that this intersection was also a concern to the public. The intersection realignment would provide better sight distance and appropriate turn lane capacity while also removing conflicts from thru traffic by eliminating the eastern Culver Highway approach.

The Jefferson County TSP identifies a need to provide safe bicycle travel parallel to Juniper Butte on US 97. A concept for bicycle and pedestrian connections across the US 97/Culver Highway intersection and a concept to connect to the Peter Skene Ogden state scenic viewpoint is included.

Implementation Suggestion: Long term

Considerations:
The project would have significant R/W impacts.

The existing Culver Highway approach could be used as an acceleration lane to southbound US 97. The existing acceleration lane does not meet ODOT design standards. The proposed changes would bring the acceleration lane to meet those design standards.

The multi-use path connects under US 97. This would be accomplished easiest if the canal is piped but a design exception for path vertical clearance under US97 could also be evaluated. Additional coordination with the canal operator would need to occur for the project to be successful.
Additional improvements to the US 97/Iris Lane intersection are proposed in Solution #17. There is the potential to phase out the eastbound to northbound connection if improved access is made to the north on US 97.

The multi use path connection to Peter Skene Ogden would require coordination with Oregon Parks and Recreation Department. The concept assumes minimal impacts to the existing US 97 bridge structure.

Illumination may be considered if utility hookups are present.

Safety Benefits
A reduction of intersection skew angle (H601 from ODOT CRF) would have expected safety benefits at the intersection. A closure of the east approach would have a 100% reduction in crashes that involve the eastern approach..

Cost Estimate
$5 Million

Countermeasures not recommended

Below are the countermeasures from TM#4 that are not recommended:

- Install Roundabout – A roundabout was not a preferred intersection treatment due to the high speeds from Juniper Butte and concerns from truck acceleration/deceleration.
- Offset T intersection – This intersection configuration did not address all of the crash types that are currently occurring.

Figure 6 US 97 Culver Highway

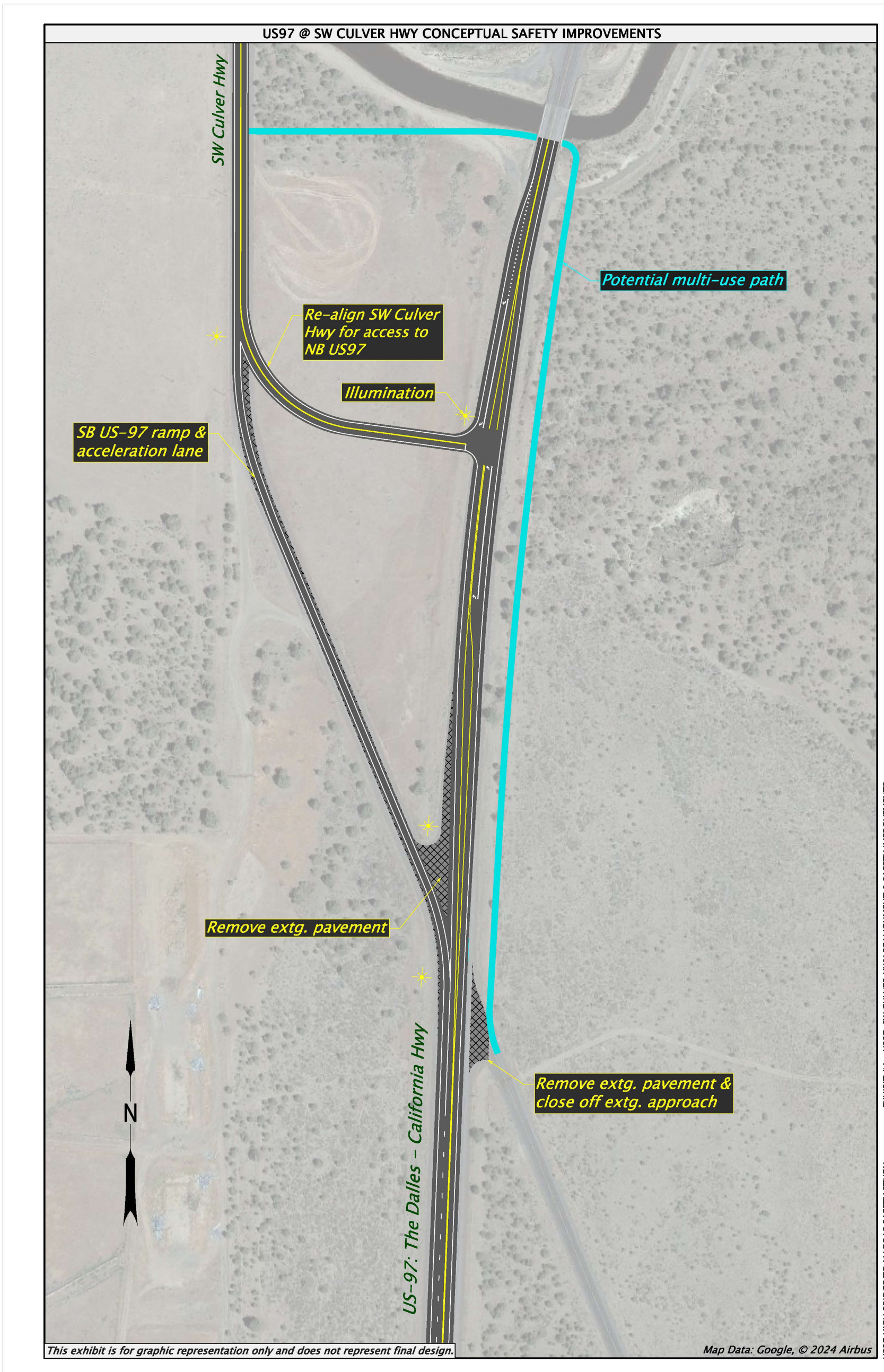


Figure 7 US 97/Culver Highway Peter Skene Ogden

US 97 – Juniper Butte Area

Solution ID #19:
The Juniper Butte section of US 97 includes recommendations for ITS solutions, median treatments, and shoulder/merge lane improvements. US 97 over Juniper butte presents unique corridor issues: the elevation change can lead to snow/ice accumulation before other parts of the corridor, the four lane cross section allows for excessive driver speeds, and crossover crashes force closures on the corridor where existing parallel routes are not ideal. Public feedback, PAC comments, and discussions with ODOT maintenance helped determine appropriate corridor treatments. The following treatments are recommended:

- Median barrier installation
- ITS improvements: Advisory speed signs and variable message boards, Road Weather Information Stations (RWIS)
- Shoulder widening
- Lengthen merge lane for truck scales on northbound/southbound merges

Implementation Suggestion: Mid to Long term, depending on solution.

Considerations
R/W and environmental impacts are to be expected. Widening to support median barrier installation and shoulder width would have impacts to adjacent properties. Most of the land use surrounding Juniper Butte is federal range land so the impact to personal property is expected to be minimal.

ITS improvements would need to be coordinated and supported by a Con-Ops study, which would include regional US 97 ITS equipment and proposed solution ID#20. The proposal would also need to be consistent with statewide ITS documents.

Installation of median barrier and if any ITS devices over roadway will require outreach with the Mobility Advisory Committee per ORS366.215 Reduction of Vehicle Carrying Capacity.

Shoulder widening cost is included in a Systemic package, solution ID 02.

When constructed, updated emergency roue and detour route planning should occur post project between ODOT and Jefferson County.

Safety Benefits
This section of US 97 has historically had weather related, sideswipe, and crossover (head on) crashes that have involved fatalities and occasional roadway closures. The following countermeasures are meant to reduce both the frequency and severity of instances.

- Median barrier (RD25 and H31 in the ODOT CRF Manual) are used to separate opposing directions of traffic on divided highways with high speeds or on divided highways with a high frequency of fatal or serious injury crossover crashes. Median barrier has a 30% reduction in all crashes at all injury severities.

- ITS Improvements: Rural variable speed limit signs (H52 in ODOT CRF Manual) have a reduction in crash type and severity by 20%. Road Weather Information Stations (RWIS) do not have a countermeasure but can aid ODOT in communicating road conditions to drivers.
- Shoulder widening: CRF for all crashes 6-18% (RD20 from ODOT CRF list)
- Merge Lane improvements: While there is not a CRF for improved merge lanes, operational benefits are to be expected. Visibility from mainline vehicles and merging trucks as a result of a longer merge lane will allow drivers to have increased response and reaction times to merging trucks.

Cost Estimate *$14.7 Million*

Countermeasures not recommended

Below are the countermeasures from TM#4 that are not recommended:

- Roadside clearing: Roadside clearing is included in a systemic project and may be included in a project when funded. The majority of the historical crashes are better supported by the countermeasures above in this location.
- Traversable Median: Median barrier would be more effective at addressing the crash types and severity of crashes.

Figure 8 US 97 Juniper Butte


SPEED
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TRUCKS
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US-97
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Google

US 97 – Railroad Overcrossing

Solution ID #20:
Installation of intelligent transportation systems (ITS) technology increases driver awareness and expectations of driver conditions on the corridor. Variable Message signs are proposed at the US 97 overcrossing. A Road Weather Information System (RWIS) would support message signs and provide information through Tripcheck. General benefits of installing ITS equipment are the coordinated operations of the system, allowing ODOT staff to efficiently monitor the corridor, manage and change messaging to drivers as needed, and remotely manage equipment. Feedback from the PAC and the public indicated that issues arise on the railroad overpass primarily in winter.

Implementation Suggestion: Mid term

Considerations
A Con-Ops study is needed so that the seamless installation of ITS equipment can occur on the corridor. There are options for ice warning systems that could be implemented. Final determination is based on State Traffic Engineer approval on the design requirements identified by ODOT.

R/W impacts and environmental impacts are minimal.

If any ITS devices installed over roadway will require outreach with the Mobility Advisory Committee per ORS366.215 Reduction of Vehicle Carrying Capacity.

Safety Benefits
A driver feedback sign is not a listed countermeasure in the ODOT CRF Manual. However, ITS equipment can have positive safety benefits by alerting drivers of road conditions and upcoming changes in traffic or weather patterns.

Cost Estimate
$2 Million for both reader boards and installation.

Countermeasures not recommended
The following countermeasures from TM#4 were not considered:

- Consider guardrail extension: Guardrail may be installed if found deficient in the future. The primary countermeasure at this location based on public feedback, feedback from ODOT maintenance, and crash review led the team to pursue the variable message signs over the guardrail.


CAUTION
ICY
ROADS


CAUTION
ICY
ROADS

5. Project Goals

Project goals were developed by the participant advisory committee at the start of the project and reflect goals from the Jefferson County TSP (2021) for US 97. Project goal criteria in TM#4 were then scored for each of the location specific concepts and are included below the scoring table. Corridor wide solutions and non-engineering solutions were not compared to the project goals.

Each project was evaluated and the results are indicated using the following symbols in the table below:

- ● Project meets or fully addresses the criterion.
- ◖ Project partially meets or addresses the criterion.
- ○ Project does not meet or has negative impacts with respect to the criterion.
- N/A Not applicable.

Project ID	Project Location	Project Description	Multi-modal safety	Safety – Reduces Fatal/Injury	Safety - Practical Design	TSP Consistency	Prioritizes access consolidation	Considers Private Property Impact	Notes
14	US 97/ US 26/ Colfax	Install Roundabout and illumination	●	●	◖	●	N/A	●	Roundabouts can have significant design challenges but perform better from a safety and operational standpoint than a signal
15A	US 97 Waldorf to Dover	Install traversable median, restrict turning movements	●	◖	●	●	◖	●	Traversable median provides adequate CRF but median barrier more greatly reduces crashes.
15B	US 97 Waldorf to Dover	Install median barrier, restrict turning movements	●	●	◖	●	●	◖	Access road has significant private impacts and would not be funded with safety funds.
16	US 97 Passing lanes	Install median barrier	●	●	◖	●	○	◖	A more practical design would be to eliminate the passing lane and utilize the roadway space available for median barrier. Accesses largely remain in current configuration
17	US 97 Falcon to Jericho	Adjust striping, consider traversable median.	●	◖	●	◖	◖	●	Project weighed impacts to farm access heavily and prioritized a more mid term solution that balanced safety benefits with access.
18	US 97 Culver Highway	Realign intersection, include bike/ped connection	●	●	◖	●	●	●	Solution complies with all goals in the project and the Jefferson Co. TSP. Project will be costly and does not have CRFs for all aspects.
19	US 97 Juniper Butte	Median barrier, ITS, shoulder widening, merge lane improvements	●	●	●	●	◖	◖	The solutions address crash types but will have significant private property impacts.

20	US 97 Railroad Crossing	ITS improvements	◖	◖	●	●	○	N/A	ITS improvements provide valuable information to motorists but are limited in their safety effectiveness

US 97 High Bridge to Madras Project Goals				
Goal Category	**Goal**	**Criteria 1**	**Criteria 2**	**Notes**
Multi Modal Safety	Ensure that the US 97 corridor is safe for everyone using the highway, including drivers, freight, and people who use active transportation or take transit.	Alternative does not disproportionately affect safety of one mode over another.		Planning and engineering judgement, best practices via qualitive assessment
Safety	Reduce fatal and serious injury crashes on the US 97 corridor.	Addresses known safety issues and crash type in the corridor.	Provides greatest benefit for reasonable cost, consider most practical design solution.	Utilize CRF's and HSIP manual - Some operational fixes may not be prioritized as high so we would need to capture some kind of perceived safety benefit.
Access	Balance the need for access with safety improvements and corridor through movement.	Aligns with two or more goals of the 2021 Jefferson County TSP.*	Prioritizes access consolidation while considering improvements at primary access location(s).	Qualitative assessment of whether the alternative meets the goals of the TSP, i.e. yes or no
Protect	Protect the natural and built environments with practical design solutions.	Consider environmental impacts.*	Consider private/personal property impact.	Environmental impacts summarized at high level by Enviro resource. R/W impacts would be generally summarized (high=homes or business, medium =farms, yards or open space, low=small R/W needs or barren federal land).

*Environmental impact was considered under each solution.

6. Major Capacity Discussion

The primary benefit of widening a highway from a two-lane highway to a four-lane highway is highway capacity. Highway capacity of a highway is defined based on Level of Service (LOS)—a methodology that scores highway operation on a A-F system. Rural highways are generally designed to a LOS C operation, which represents a well-utilized system where posted speeds are maintained and flow is stable. LOS E represents when highway operation is near capacity and some congestion may be experienced. LOS F represents when highway demand has exceeded capacity, resulting in significantly lower speeds than the posted speed. Highway operations are generally considered acceptable in the LOS A-D range; it is not until operations degrade to LOS E conditions that capacity increasing measures would be considered. As described in the Existing Conditions section, this section of US 97 operates acceptably at LOS C conditions at peak times during peak summer travel. Therefore, highway widening is not justified based on operational needs.

Highway safety is another consideration when evaluating number of lanes. The primary safety benefit of widening US 97 from two lanes to four lanes would be to address sideswipe-overtaking crashes (passing maneuvers) and head-on crashes resulting from passing maneuvers. As described in the crash data and analysis section of the existing conditions section, there were three sideswipe-overtaking crashes where passing zones were present. However, there were seven sideswipe-overtaking crashes where passing lanes were present (two lanes per direction). Therefore, the crash data suggests that providing passing lanes or widening the entire highway from two lanes to four lanes would not remedy sideswipe-overtaking crashes. Furthermore, there are two primary safety concerns when widening a highway from two lanes to four: 1) highway speeds increase and 2) intersections and driveways become less safe. Speed is one of the primary factors in collision severity outcomes; facilitating higher speeds with a four-lane highway is expected to result in more severe crash outcomes. There were 52 intersection/driveway crashes, including 7 fatal and severe injury crashes; widening the highway to a four-lane highway without removing intersections and driveways would exacerbate this safety issue. Overall, widening US 97 from two to four lanes is expected to worsen safety on the corridor.

Another consideration of widening US 97 to provide a four-lane highway are property and access impacts. There are a number of properties along the highway with homes close to the existing right-of-way boundary; widening the highway would require significant right-of-way takes and possibly even fully taking houses Additionally, widening the highway would also need to consider access points to/from the highway through either removal of accesses or restriction accesses to right-in/right-out in order to maintain safety.

Given there is no demonstrated operational or safety need to widen the highway from two lanes to four, the safety concerns of widening the highway to four lanes, the right-of-way and access impacts, and the incredibly high and potentially unrealistic cost of widening the highway to four lanes, a four-lane highway cross-section is not being considered as part of this safety planning effort.

The countermeasures listed in the safety study are forward-compatible should funding for four-lane capacity improvements become available. Additionally, all of the safety countermeasures included in the study would be necessary in order to have a safe four-lane section of US 97; additional intersection and roadway safety improvements would be necessary as well, including large numbers of public and private road approach closures. Funding for large capacity improvements are not anticipated in the 20 year planning horizon.

7. Next Steps

Next steps for the project include a discussion with the Participant Advisory Committee and to incorporate public feedback from the upcoming Open House. Mobility Advisory Committee coordination will follow as well. Following this public involvement phase, the project will move forward with developing a draft US 97 High Bridge to Madras Safety Study.