APPENDIX A1

ALTERNATIVES EVALUATION SUMMARY TECHNICAL MEMORANDUM

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By David Evans and Associates, Inc.

INTRODUCTION AND BACKGROUND

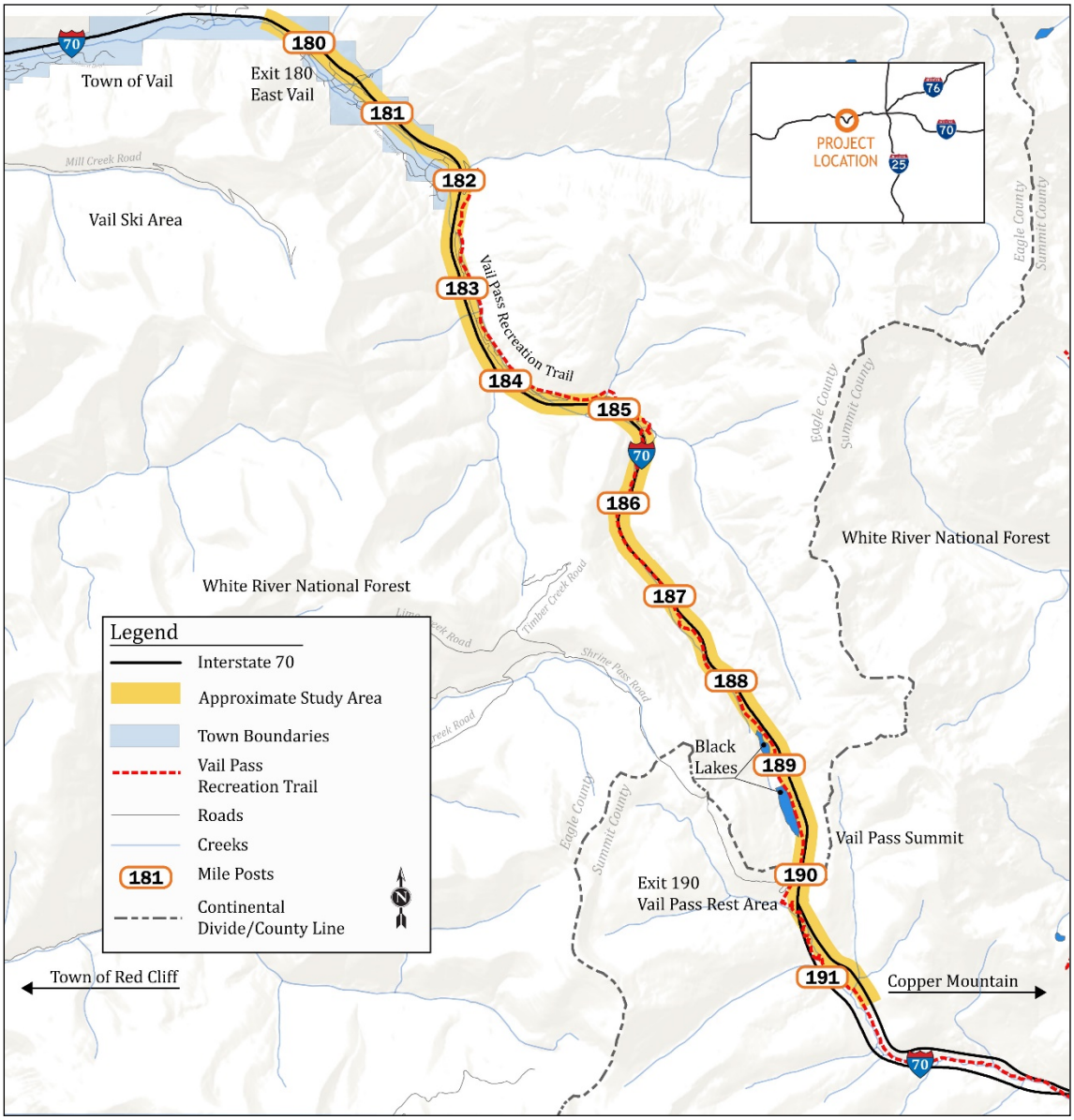
The I-70 West Vail Pass Auxiliary Lanes project is located in Eagle and Summit Counties, with the eastern terminus just east of the Vail Pass Rest Area and the western terminus in the Town of Vail. The project study limits include eastbound (EB) and westbound (WB) I-70 from mile post (MP) 179.5 to MP 191.5. The study area is shown in **Figure 1**.

As part of the initial National Environmental Policy Act (NEPA) analysis, a Tier 1 Environmental Impact Statement (EIS) for the I-70 Mountain Corridor (C-470 to Glenwood Springs) was completed in 2011. This EIS, the *I-70 Mountain Corridor Programmatic Final Environmental Impact Statement* (PEIS), recommended the addition of auxiliary lanes EB and WB on the west side of Vail Pass from MP 180 to MP 190 as part of the Preferred Alternative's Minimum Program of Improvements. The PEIS also identified the potential for an elevated Advanced Guideway System (AGS) for transit along the I-70 corridor, including the West Vail Pass project corridor. A follow-up AGS Feasibility Study in 2014 analyzed potential alignments and costs for an AGS system and determined there were three feasible alignments for future AGS. While AGS is not part of the West Vail Pass Auxiliary Lanes project, the AGS Feasibility Study was used to ensure the project did not preclude the favored alignment of the three, which would be partially within CDOT right-of-way (ROW).

A Tier 2 NEPA analysis is the next step required to move these highway improvements forward. The project is following the Colorado Department of Transportation (CDOT) and Federal Highway Administration (FHWA) NEPA process to confirm the needs for improvements to West Vail Pass, identify a Preferred Alternative, investigate the anticipated benefits and impacts of the proposed improvements (through an Environmental Assessment), produce conceptual design plans, and develop funding, scheduling, and phasing recommendations.

This memorandum describes the alternatives evaluation completed to identify the Preferred Alternative for I-70 in the I-70 West Vail Auxiliary Lanes Environmental Assessment (EA) and the associated design option considerations. For purposes of this project, alternatives are defined as high-level alignment options that are uniquely different. Design options that may be considered within each alternative, such as location-specific variations in lane and shoulder widths, trail location, wildlife mitigation, and sedimentation Best Management Practices (BMPs), will be evaluated and incorporated into the Preferred Alternative.

Figure 1. Project Location and Study Area



Source: DEA Project Team

Public and Agency Stakeholder Involvement

A Technical Team (TT) serves as the focal point for the project's Context Sensitive Solutions (CSS) process. In addition to CDOT staff, representatives from the following governments and groups are included as members of the TT:

- Bicycle Colorado
- Colorado Parks and Wildlife
- Colorado Snowmobile Association
- Colorado State Patrol
- Colorado Motor Carriers Association
- Eagle County
- Eagle River Water and Sanitation District
- ECO Trails
- FHWA

- Northwest Colorado Council of Governments
- Summit County
- Town of Vail
- United States (US) Army Corps of Engineers
- US Forest Service
- Vail Chamber and Business Association

During the alternatives development and screening process, the TT met four times. These meetings were focused on receiving feedback on the draft screening criteria, draft alternatives, screening process and results, and refinement of the Preferred Alternative and associated design options.

In addition, Issue Task Forces (ITFs) were created to discuss specific topics as they relate to the development and screening of alternatives and potential impacts, benefits, and mitigation for the Preferred Alternative following the requirements of the ROD. The ITFs were focused around wetlands and water quality, wildlife, recreation, emergency services, and historic resources.

Two public meetings were held in the Town of Vail during the project initiation and alternatives development and screening phases. The first meeting was held on February 22, 2018 and provided project background, area conditions, and project process information. The second meeting was held on December 13, 2018 and provided information on the draft alternatives, screening process and results, design options, and next steps for the EA.

Purpose and Need

The I-70 PEIS identified safety and mobility issues on West Vail Pass related to speed differentials due to slow-moving vehicles.

Purpose of the Project

The purpose of the project is to improve safety and traffic operations on EB and WB I-70 on West Vail Pass.

Definition of the Problem

This project is needed to address safety concerns and operational issues due to geometric conditions (steep grades and tight curves) and slow-moving vehicle and passenger vehicle interactions that result in inconsistent and slow travel times along the corridor.

Safety Concerns: A high number of crashes occur along the corridor related to speed, tight curves, narrow roadway area, and inclement weather/poor road conditions. Speed differentials between passenger vehicles and slow-moving vehicles cause erratic lane changes and braking maneuvers resulting in crashes and spin outs. Emergency response is hampered by vehicular speeds and lack of roadway width to provide room for incident response and for emergency vehicles to pass.

Operational Issues: The steep grades and resulting speed differentials causes slow and unreliable travel times through the corridor. Tight curves also cause drivers to slow down. The corridor is frequently closed by vehicle incidents, due to lack of width to maintain a single lane of traffic adjacent to emergency responders, resulting in substantial traffic backups and delays. During winter months, the travel lanes and shoulders are severely impacted by snow accumulation, impacting the overall capacity of the corridor.

Alternatives Screening

The purpose of the alternatives evaluation was to determine if each alternative meets the Purpose and Need, to compare how well each alternative meets the Purpose and Need, compare how well each alternative would perform, and identify what potential impacts each alternative would have in order to identify a Preferred Alternative. In addition to the PEIS recommendation of adding EB and WB auxiliary lanes, additional alternatives were developed based on purpose and need data, such as high crash rates on curves, and stakeholder input.

The following five alternatives were evaluated:

- No Action
- Existing Two Lanes with Curve Modifications and Intelligent Transportation System (ITS) Improvements
- Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements
- Existing Two Lanes and Operational Lanes with Curve Modifications and ITS Improvements
- Auxiliary Lanes with WB I-70 Realignment, Curve Modifications, and ITS Improvements

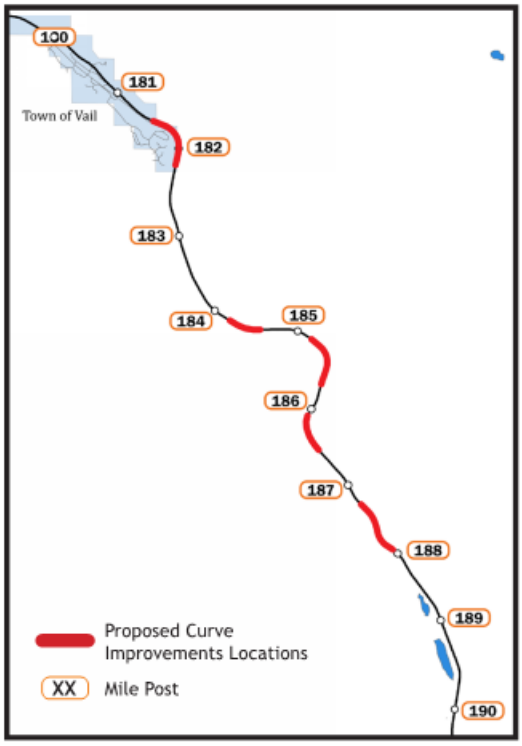
The descriptions and cross sections, where applicable, for the four action alternatives are shown on the following pages. The alternatives' conceptual designs were developed using the applicable CDOT and AASHTO design standards.

No Action Alternative

The No Action alternative is included as a baseline for comparison to the action alternatives. Under the No Action alternative, only programmed projects that are planned and funded by CDOT or other entities would be completed. Currently, there are no large-scale transportation projects to add safety improvements, operational improvements, vehicular capacity, and multimodal facilities along I-70 within the project area. Current maintenance (e.g. resurfacing and plowing) would be maintained.

Existing Two Lanes with Curve Modifications and Intelligent Transportation System (ITS) Improvements

This alternative was considered because it may address safety issues related to the corridor curve geometry and emergency response while avoiding the physical impacts due to widening I-70. The alternative consists of geometric modifications in both the EB and WB directions to flatten the curves with design deficiencies and the highest identified crash patterns, located in the areas of MP 182, 184.5, 185 – 186, and 188. Roadway modifications would be limited to those curve areas. The Vail Pass Recreation Trail would remain where it is currently located.

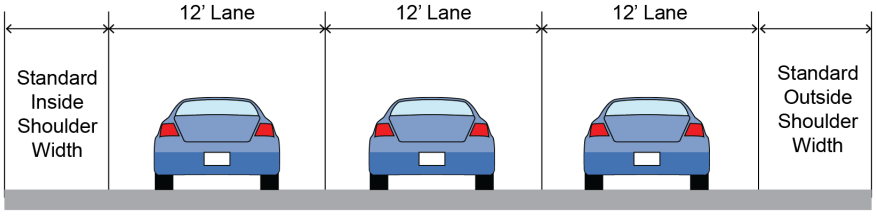


Alternative curve modification locations

ITS equipment would also be installed along the I-70 project corridor, consistent with recent study recommendations. Additional variable message signs (VMSs) would be installed at key locations to warn drivers of upcoming curves, grades, and incidents. Power and communications would be upgraded for the existing and new ITS equipment along the corridor. Additional variable speed limit signs would be installed to better manage driver speeds to conditions. Lane closure signage would be installed to quickly and efficiently close lanes and improve safety for emergency responders.

Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements

This alternative was considered because it may address safety and operational issues along the corridor. The alternative consists of widening I-70 in both the EB and WB directions to provide three lanes between the East Vail and Vail Pass Rest Area interchanges with standard shoulder widths. Potential exceptions to the standard shoulder width may be assessed with final design to avoid areas of impacts, such as sensitive environmental areas, rock cuts, historical impacts, and landslides or other geologic hazards.

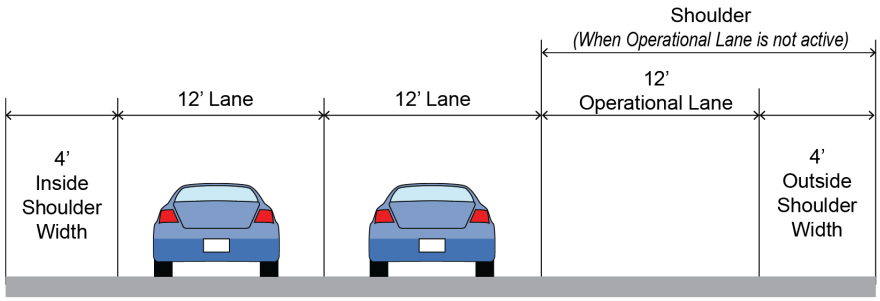


Cross-section: Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements

The alternative also includes geometric modifications in both the EB and WB directions to flatten the curves with design deficiencies and the highest identified crash patterns, located in the areas of MP 182, 184.5, 185 – 186, and 188. The Vail Pass Recreation Trail would be relocated where impacted. ITS improvements would also be installed along the I-70 project corridor, including upgraded power and communications, additional VMSs, variable speed limit signs, and lane closure signage, to enhance the safety and operations of the corridor alternative.

Existing Two Lanes and Operational Lanes with Curve Modifications and ITS Improvements

This alternative was considered because it may address safety and operational issues along the corridor while minimizing the physical impacts due to widening I-70. The alternative consists of widening I-70 in both the EB and WB directions between the East Vail and Vail Pass Rest Area interchanges to provide a wide outside shoulder that can be opened for an additional travel lane (an "operational lane") when needed due to an incident, emergency response, or unusually high traffic volumes. Overhead automated signage would control the opening and closure of the operational lane. When the operational lane is open, the cross-section consists of a four-foot inside shoulder, three 12-foot lanes, and a four-foot outside shoulder.



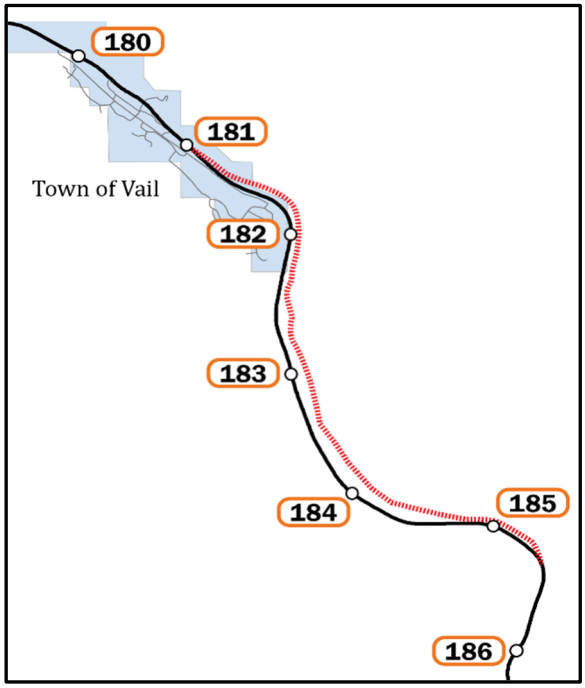
Cross-section: Existing Two Lanes and Operational Lanes with Curve Modifications, and ITS Improvements

The alternative also includes geometric modifications in both the EB and WB directions to flatten the curves with design deficiencies and the highest identified crash patterns, located in the areas of MP 182, 184.5, 185 – 186, and 188. The Vail Pass Recreation Trail would be relocated where impacted. ITS improvements would also be installed along the I-70 project corridor, including upgraded power and communications, additional VMSs, variable speed limit signs, and lane closure signage, to enhance the safety and operations of the corridor alternative.

Auxiliary Lanes with WB I-70 Realignment, Curve Modifications, and ITS Improvements

This alternative was considered because it may address safety and operational issues along the corridor while minimizing impacts to the traveling public during construction. The alternative consists of widening I-70 in both the EB and WB directions to provide three lanes between the East Vail and Vail Pass Rest Area interchanges with standard shoulder widths. WB I-70 would be realigned to the location of the Vail Pass Recreation Trail (the old US 6 highway alignment) between MP 182 and MP 185.4, which would avoid the challenges of maintaining traffic during the reconstruction of most of the I-70 bridges. The Vail Pass Recreation Trail would be relocated due to impacts from the addition of the EB auxiliary lane.

EB I-70 may be widened in the current location or shifted to the current WB I-70 alignment with geometric modifications to flatten the curves with design deficiencies and the highest identified crash patterns. The proposed cross-section of both EB and WB I-70 consists of three 12-foot lanes and standard shoulder widths. Potential exceptions to the standard shoulder width may be assessed with final design to avoid areas of impacts, such as sensitive environmental areas, rock cuts, historical impacts, and landslides or other geologic hazards.



Alternative re-alignment of WB I-70

ITS improvements would also be installed along the I-70 project corridor, including upgraded power and communications, additional VMSs, variable speed limit signs, and lane closure signage, to enhance the safety and operations of the corridor alternative.

Screening Criteria

The project team developed screening criteria for the alternatives screening. The purpose of the first level of screening was to eliminate fatally flawed or unreasonable alternatives and alternatives that do not meet the project Purpose and Need. In addition to criteria based on the Purpose and Need, the project team identified screening criteria based on the project's Core Values and Success Factors that could be assessed based on the limited amount of design available during the screening process.

The alternatives screening was supported by the baseline data collected for the study. The evaluation process was conducted by the project team, composed of CDOT, FWHA, and consultant staff with expertise relevant to the various resource categories. These evaluations were based upon the best available information at the time of the screening. The draft results of the screening were presented to the TT for feedback and discussion.

The corridor alternatives were evaluated with a "Yes" or "No" answer to the following questions to demonstrate each alternative's ability to meet the individual project needs.

- Purpose and Need Criteria
  - Safety
    - Does the alternative reduce crashes?
  - Operations
    - Does the alternative improve traffic flow?
    - Does the alternative maintain or improve access for emergency response?
    - Does the alternative reduce number of full closures?
- Additional Core Values Criteria
  - Enhanced Environment
    - Does the alternative maintain existing terrestrial wildlife connectivity?
    - Does the alternative include trail relocation away from directly adjacent to I-70?
  - Collaborative Decision-making
    - Is the alternative consistent with the Record of Decision?

In addition, detailed comparative screening criteria based on the Purpose and Need and Core Values was developed, should an additional level of screening have been required to identify a preferred alternative.

Screening Evaluation

The five alternatives were evaluated to identify if the alternative met the Purpose and Need and additional Core Values Criteria. The alternatives screening with each criterion is shown in **Table 1**.

Safety and Operations

All of the alternatives, with the exception of the No Action, would reduce crashes on West Vail Pass through the inclusion of curve modifications and ITS improvements. The additional lane and shoulder width of some of the alternatives would further reduce crashes and also decrease the number of full closures on West Vail Pass.

The Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements alternative and the Auxiliary Lanes with WB I-70 Realignment, Curve Modifications, and ITS Improvements alternative were the only two alternatives that would improve traffic flow, since the addition of a third lane would reduce traffic flow turbulence and would provide area for incidents while maintaining two lanes of traffic. The Auxiliary Lanes with WB I-70 Realignment, Curve Modifications, and ITS Improvements alternative was the only alternative that would not maintain or improve existing emergency response as the existing emergency turnarounds from EB to WB travel lanes would be eliminated in places.

Table 1. I-70 West Vail Pass Auxiliary Lanes Alternatives Screening Results- UPDATED October 2019

Screening Criteria			No Action	Existing Two Lanes with Curve Modifications and ITS Improvements	Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements	Existing Two Lanes and Operational Lanes with Curve Modifications and ITS Improvements	Auxiliary Lanes with WB I-70 Realignment, Curve Modifications, and ITS Improvements
Purpose and Need	**Safety**	Does the alternative reduce crashes?	**NO** No change in roadway conditions or traffic disruptions	**YES** Curve modifications reduce crashes related to curve geometry	**YES** Auxiliary lanes, curve modifications, and full shoulders address safety issues	**YES** Curve modifications and wide outside shoulder for majority of time address safety issues	**YES** Auxiliary lanes, curve modifications, and full shoulders address safety issues
	Operations	Does the alternative improve traffic flow?	**NO** No change in roadway characteristics or conditions that create disruptions in traffic flow	**NO** No change in other roadway characteristics or conditions that create disruptions in traffic flow	**YES** Three travel lanes reduce traffic flow turbulence and provide area for incidents while maintaining two lanes of traffic	**NO** Majority of time only two travel lanes, which does not reduce disruptions in traffic flow	**YES** Three travel lanes reduce traffic flow turbulence and provide area for incidents while maintaining two lanes of traffic
		Does the alternative maintain or improve access for emergency response?	**YES** Existing levels of emergency access maintained, but no improvements	**YES** Lane closure system with ITS signage improves access for emergency response	**YES** Full shoulders maintained and lane closure system with ITS signage improves access for emergency response	**YES** Wide outside shoulder for majority of time and lane closure system with ITS signage improves access for emergency response outside of travel lanes	**NO** While lane closure system improves access for emergency response, the loss of emergency turnarounds does not maintain or improve current emergency response access
		Does the alternative reduce number of full closures?	**NO** No reduction in crashes or change in roadway characteristics that contribute to full closures	**YES** Slight reduction in full closures with reduced crashes related to curve geometry	**YES** Reduction in full closures with reduced crashes	**YES** Reduction in full closures with reduced crashes	**YES** Reduction in full closures with reduced crashes
Additional Core Values*	**Enhanced Environment**	Does the alternative maintain existing terrestrial wildlife connectivity?	**YES** Existing terrestrial wildlife connectivity maintained	**YES** Existing terrestrial wildlife connectivity maintained	**NO** Existing terrestrial wildlife connectivity maintained in the lower half of the corridor; the addition of a third lane increases the barrier effect in the upper half of the corridor.	**NO** Existing terrestrial wildlife connectivity maintained in the lower half of the corridor; the addition of a third lane increases the barrier effect in the upper half of the corridor.	**NO** Change in WB I-70 alignment does not maintain existing terrestrial wildlife connectivity as the WB bridges on the lower half of the corridor would be removed.
		Does the alternative include trail relocation away from directly adjacent to I-70?	**NO** Trail remains in existing location directly adjacent to I-70	**NO** Trail remains in existing location directly adjacent to I-70	**YES** Widening I-70 requires trail relocation	**YES** Widening I-70 requires trail relocation	**YES** Widening I-70 requires trail relocation
	Collaborative Decision-making	Is the alternative consistent with the ROD?	**NO** ROD includes recommendation for auxiliary lanes	**NO** ROD includes recommendation for auxiliary lanes	**YES** ROD includes recommendation for auxiliary lanes	**NO** ROD includes recommendation for auxiliary lanes	**YES** ROD includes recommendation for auxiliary lanes
SUMMARY OF RESULTS			**Retained:** Baseline Comparison	**Eliminated**	**Retained**	**Eliminated**	**Eliminated**
NOTES				Does not meet Purpose and Need because it does not address I-70 operational issues and does not address Core Values because it is inconsistent with the ROD	The addition of a third lane increases the distance for wildlife to cross and mitigation for this impact will be included in the refinements of the alternative.	Does not meet Purpose and Need because it does not address I-70 operational issues with only two travel lanes open majority of the time and does not address Core Values because it is inconsistent with the ROD	Does not meet Purpose and Need because it does not maintain existing emergency access and does not address Core Values because it does not maintain existing terrestrial connectivity.

*Not fatal flaw criteria. No alternatives were eliminated based on these criteria.

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Core Values

The No Action and Existing Two Lanes with Curve Modifications and ITS Improvements alternatives were the only two alternatives shown to maintain existing wildlife connectivity. The Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements alternative and Existing Two Lanes and Operational Lanes with Curve Modifications and ITS Improvements alternative maintain the wildlife connectivity under the bridges on the lower portion of I-70, but the additional roadway width adds to the barrier effect in the upper five miles of I-70.

Since the No Action and Existing Two Lanes with Curve Modifications and ITS Improvements alternatives do not include widening of the existing roadway, the Vail Pass Recreation Trail would not be directly impacted and would therefore not be relocated away from directly adjacent to I-70.

The only alternative that is consistent with the I-70 Mountain Corridor Record of Decision is the Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements.

Screening Results

After the first level of screening, it was determined that only one of the five alternatives fully met the Purpose and Need, based on the applied screening criteria. The additional Core Values criteria were not considered fatal flaws and did not prevent any alternatives from potentially moving forward into further evaluation. The Auxiliary Lanes with Full Shoulders, Curve Modifications, and ITS Improvements alternative was recommended as the Preferred Alternative, since the screening showed that it is the only alternative that will improve safety and operations based on the Purpose and Need screening criteria. Further alternative screening was not needed to identify the Preferred Alternative.

The Preferred Alternative underwent minor design refinements to shift the alignment slightly in places to minimize impacts and maximize crossover locations. Additional substandard curve modification locations were also added, in addition to the modifications at highest crash curve locations. The shoulders were defined as described below, instead of "standard" as included in the original alternative description. The No Action alternative will also be carried forward into the EA analysis for a baseline comparison.

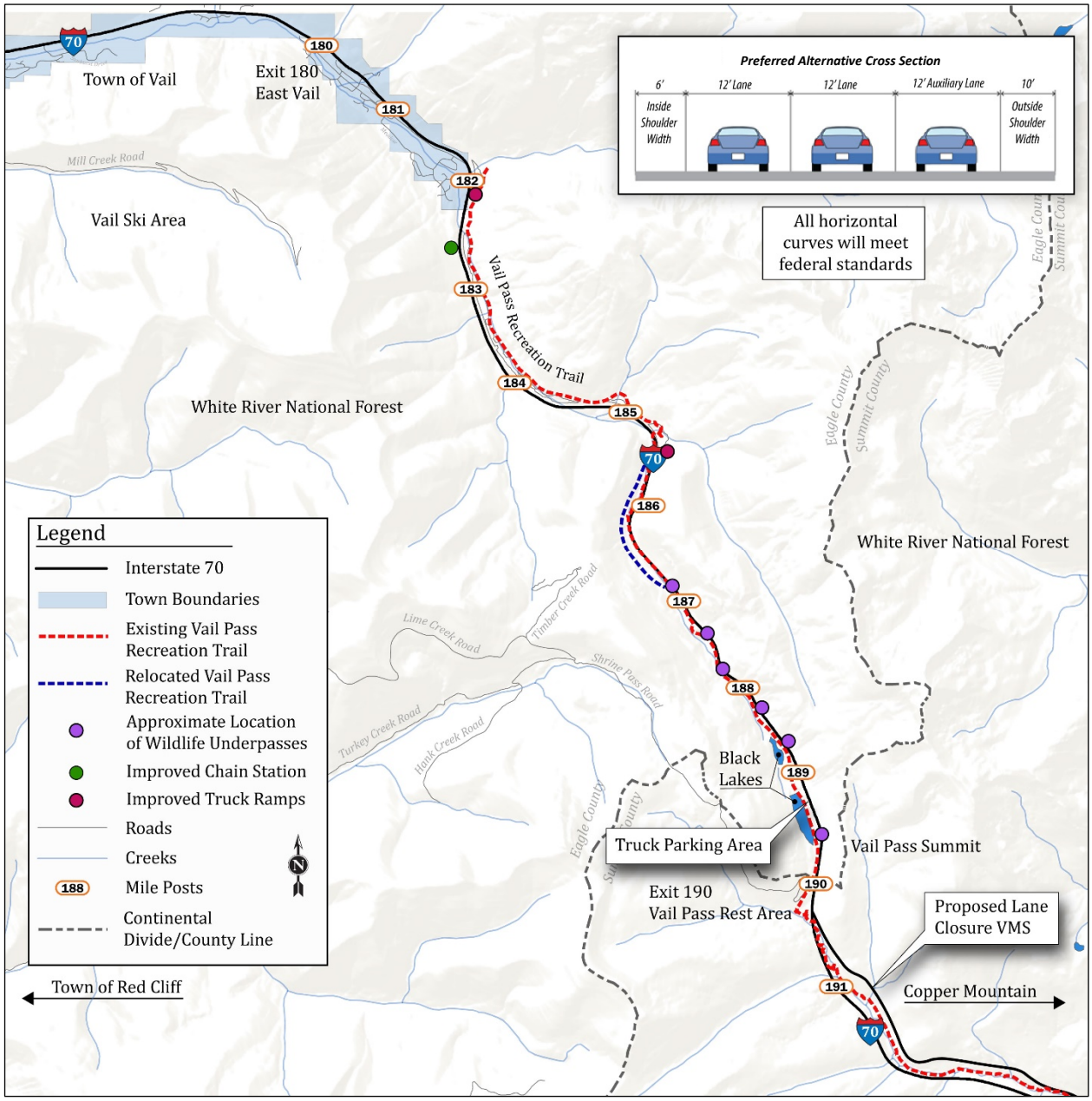
Preferred Alternative Description

The Preferred Alternative (**Figure 2**) will add a 12-foot auxiliary lane, both EB and WB, for 10 miles from approximately the East Vail exit (MP 180) to the Vail Pass Rest Area exit (MP 190). Existing lanes will be maintained at 12 feet and the shoulders will be widened to a minimum of 6 feet for inside shoulders and maintained at 10 feet for outside shoulders. All existing curves will be modified as needed to meet current federal design standards.

ITS equipment will also be installed along the I-70 project corridor, consistent with recent study recommendations. Additional VMSs will be installed at key locations to warn drivers of upcoming curves, grades, and incidents. Additional variable speed limit signs will be installed to manage driver speeds to conditions. Automated lane closure signage will be installed approaching the East Vail exit on EB I-70 and approaching the WB I-70 Vail Pass Rest Area exit to quickly and efficiently close lanes when needed.

The three feasible AGS alignments identified in the 2014 AGS Feasibility Report are conceptual and two of them are completely located outside of I-70 ROW and one is located outside of I-70 ROW where there are steep grades and curves (Hybrid Alignment), such as on West Vail Pass. The Hybrid Alignment was determined to be the most favorable of the three. The Preferred Alternative does not preclude any of the feasible AGS alignments on West Vail Pass, including the favored Hybrid Alignment, as the existing highway alignment and median of I-70 are not substantially changed and the option to operate AGS solely in I-70 ROW was determined to be infeasible, therefore not precluding the Hybrid Alignment.

Figure 2. Preferred Alternative Elements



Source: DEA Project Team

Design Options Considerations

Once the Preferred Alternative was selected, the project team evaluated numerous design options for incorporation into the Preferred Alternative based on the project's Core Values. Design options relating to chain-up stations, emergency truck ramps, emergency turnarounds, truck parking, pull-off areas, water quality, wildlife crossings, and trail relocation were developed and discussed at two of the TT meetings and at the appropriate ITF meetings.

The Core Values and associated considerations used to evaluate and determine the design options, as applicable, were as follows:

- Safety
  - Chain stations
  - Emergency truck ramps
  - Year-round emergency access
  - Avalanche mitigation
- Operations
  - Traveler information systems
- Corridor Character and Aesthetics
  - Impacts to traveling public during construction
  - I-70 Mountain Corridor Aesthetic Guidance
  - Original I-70 Vail Pass design and construction context (i.e. integration of the road with the surrounding landscape)
  - Impacts to historic properties
- Enhanced Environment
  - Water quality impacts sand collection methods and BMPs
  - Protection of Black Gore Creek and Gore Creek
  - Terrestrial and aquatic habitat connectivity and enhancements
- Recreation
  - Capacity and safety of trail
  - Trail location in relation to I-70
  - Closures to recreational facilities during construction
- Sustainability
  - Maintenance and operational financial feasibility

The design options that will be incorporated into the Preferred Alternative are described in **Table 2**.

Table 2. Design Option Descriptions

DESIGN OPTION	DESCRIPTION
Chain Station	Chain station at approximately MP 183 will be improved with additional parking, signage, lighting, and separation from the I-70 mainline.
Emergency Truck Ramps	Two existing truck ramps, located at approximately MP 182.2 and 185.5, will be upgraded to current design standards.
Emergency Turnarounds	Improved median emergency turnaround locations included to accommodate emergency and maintenance vehicle turnaround maneuvers.
Truck Parking	Additional capacity added to the existing commercial truck parking area at the top of Vail Pass.
Pull-Off Areas	Widened shoulders (minimum of eight feet of additional width beyond the 10' shoulder) included at multiple locations to accommodate emergency pull-offs, emergency truck parking, and staging for tow trucks.
Water Quality	Conveyance and treatment water quality BMPs will implemented and determined during final design.
Wildlife Crossings	Six wildlife underpasses and wildlife fencing will be constructed throughout the corridor.
Trail Relocation	Vail Pass Recreation Trail will be relocated for approximately two miles from MP 185 to MP 187 due to direct impacts from the addition of the I-70 auxiliary lane.
Avalanche Protection	Avalanche protection will be installed on the inside of the curve located near MP 186.