ADOT

US 180 Corridor Master Plan

Working Paper #2 - Tier 2 & Tier 3 Analysis

METROPLAN GREATER FLAGSTAFF | MOUNTAIN LINE | CITY OF FLAGSTAFF ESTABLISHED 1876 | DEPARTMENT OF TRANSPORTATION UNITED STATES GOVERNMENT | NORTHERN ARIZONA UNIVERSITY | BNSF

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1.0 INTRODUCTION

1.1 Corridor Master Plan Purpose & Need

The purpose of the US 180 Corridor Master Plan (CMP) is to identify a 20-year vision for the US 180 corridor that addresses the seven goals (expressed in Figure 1-1 below) by evaluating a mixture of previously recommended and newly introduced System Alternatives. These System Alternatives include a mix of alternatives that utilize and maintain the existing US 180 right-of-way, alternatives that would require an expanded right-of-way, and alternative routes separate and in addition to the US 180 corridor itself.

The System Alternatives are also complemented by a series of Base Build Spot Improvements – which constitute targeted, near term low investment mitigation measures that support mid and long-term System Alternatives.

The US 180 CMP process has included, and will continue to include public and stakeholder involvement that consists of a thorough and community-vetted, quantitative evaluation criteria exercise for the evaluation of the System Alternatives to ultimately reach a set of preferred System Alternative(s) and achieve an informed consensus by the Project Partners, stakeholders and citizens.

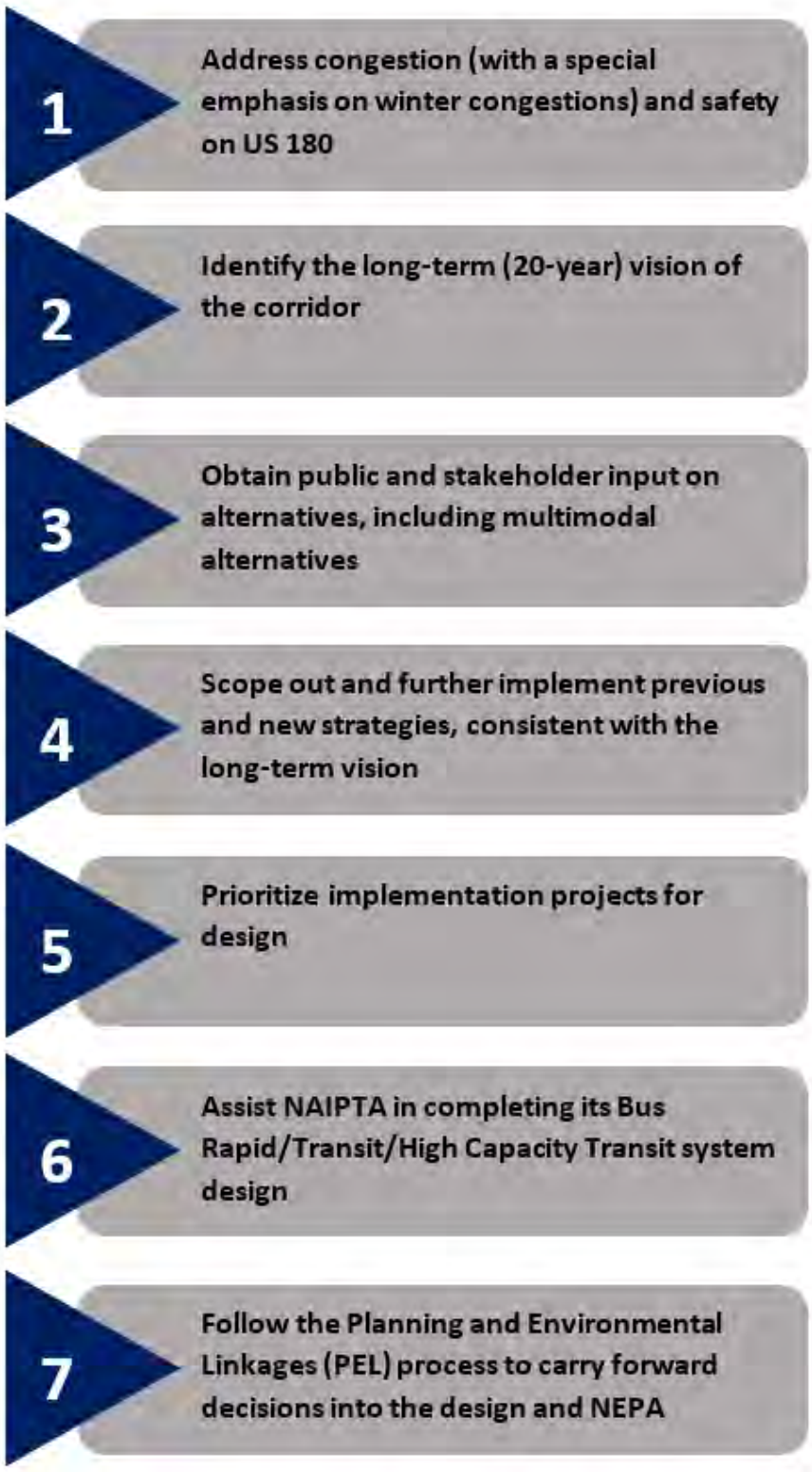
1.2 Project Partner Goals & Objectives

As part of the CMP Process, a team of Project Partners was assembled by representatives from the following agencies:

- Arizona Department of Transportation (ADOT);
- Flagstaff Metropolitan Planning Organization (FMPO) (AKA MetroPlan);
- Northern Arizona Intergovernmental Public Transportation Authority (NAIPTA) (AKA Mountain Line);
- City of Flagstaff;
- Coconino County;
- US Forest Service (USFS);
- Federal Highways Administration (FHWA);
- Northern Arizona University (NAU); and,
- BNSF.

The Project Partners are established to guide the success of the US 180 CMP planning process by maintaining a positive and supportive working relationship with all partnering agencies, communicating regularly, and staying committed to the project's core values. The Project Partners met early in the planning process to agree upon and create a Charter (Appendix A) to establish a set of fundamental principles for the Partners to abide by. The Project Partners also established the following seven goals (**Figure 1-1**) for the US 180 CMP which are not prioritized in any particular order.

Figure 1-1: US 180 CMP Goals

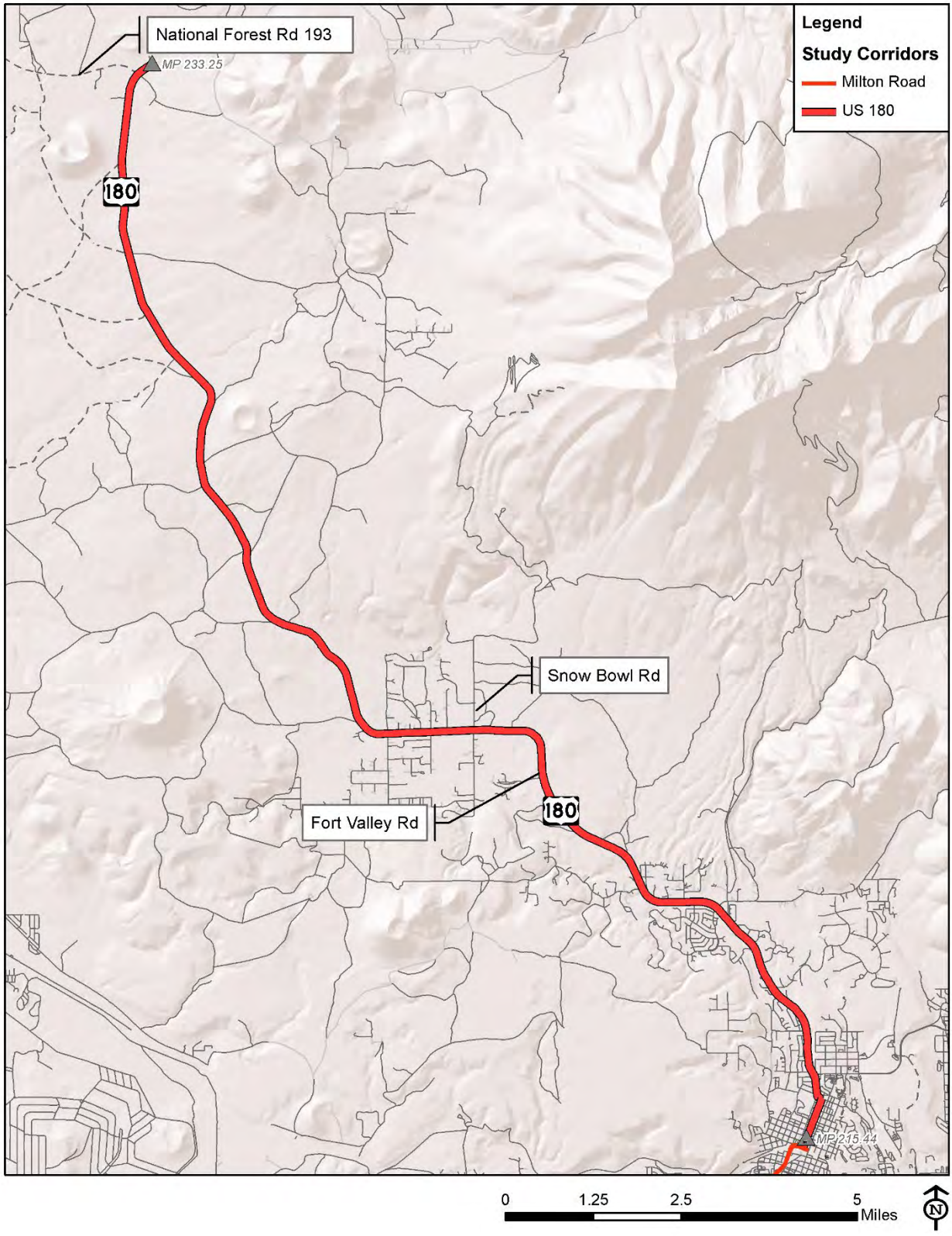


1.3 US 180 Corridor Overview

US Highway 180 (US 180) is primarily an east-west running highway that travels through Texas, New Mexico and Arizona. Arizona's portion is about 170 disconnected miles as it has been re-routed over the last several decades. In Arizona, US 180 goes through lightly populated areas between St. Johns and Holbrook, and then shares alignment with Interstate 40 (I-40) for approximately 85 miles to the City of Flagstaff. From Flagstaff, US 180 traverses northwest to its western terminus in Valle, Arizona. Illustrated in **Figure 1-2,** the US 180 Corridor Master Plan evaluates a 17.4-mile section of the highway northwest of the City of Flagstaff from the intersection of Historic Route 66 and Humphreys Street (Mile Post 215.44) to the Crowley Pit Snow Play Area (Mile Post 233.25).

This segment of US 180 is also known as the Fort Valley Highway 180 Scenic Corridor and is designated by the State of Arizona as a Scenic Road for its rural character and mountainous setting around the San Francisco Peaks. US 180 is the primary arterial thoroughfare for the surrounding rural residents and is suitable for low volume residential traffic. However, visitors seeking access to the Grand Canyon, Arizona Snowbowl, and other recreational sites within Coconino National Forest are dependent on US 180. The winter season is particularly challenging for traffic circulation on US 180, and at peak times the corridor is congested in a gridlock fashion, affecting local traffic while also posing a tremendous threat to emergency vehicle's ability to effectively traverse the corridor. While the congestion problems are often viewed as the key issue, considering the challenges regarding bicyclists and pedestrians is essential. Addressing the traffic congestion while also implementing safe and efficient travel by all modes of transportation is the priority for US 180 CMP.

Figure 1-2: US 180 CMP Study Corridor



2.0 THREE TIER ALTERNATIVE EVALUATION PROCESS OVERVIEW

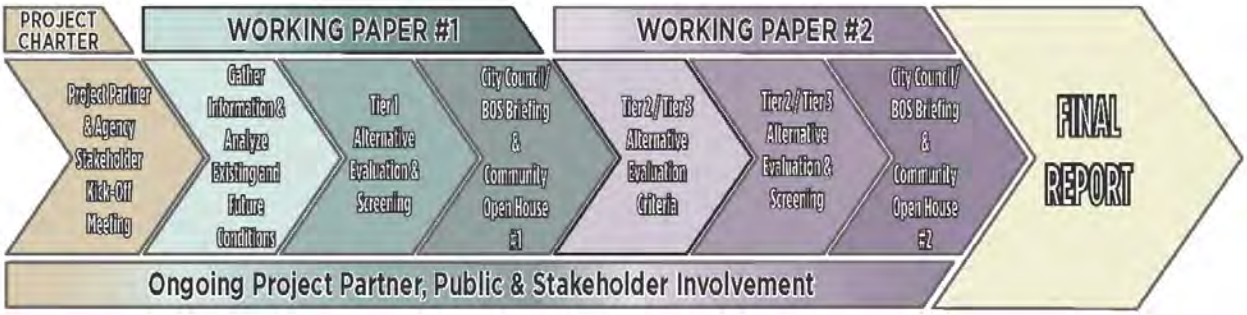
2.1 Working Paper #2 Objectives

The objective of *Working Paper #2 – Alternatives Analysis* is to describe the Tier 1, Tier 2, and Tier 3 Alternative Evaluation/Screening processes. *Working Paper #1 – Existing & Future Conditions* (Appendix B) and the Public Open House Meeting #1 were the foundation of Tier 1 Alternative Evaluation/Screening (refer to *Section 3.0 - Tier 1 Alternative Evaluation* for more information on Tier 1 Alternative Evaluation/Screening). However, this working paper will primarily focus on Tier 2 and Tier 3 Alternative Evaluation/Screening analysis and results. See *Section 4.0 - Tier 2 Alternative Evaluation & Selection* of this working paper for details regarding Tier 2 Evaluation/Screening analysis and results, and see *Section 5.0 - Tier 3 Alternative Evaluation* of this working paper for details regarding Tier 3 Evaluation/Screening analysis and results.

The results of Working Paper #2 will be presented to the City of Flagstaff City Council, the Coconino County Board of Supervisors, and the community through Virtual Public Open House Meeting/Survey #2 prior to the development of the Final Report, which will include a recommended alternative(s).

Figure 2-1 illustrates the progression of the US180 Road CMP process.

Figure 2-1: US 180 CMP Study Process



2.2 Three Tier Approach

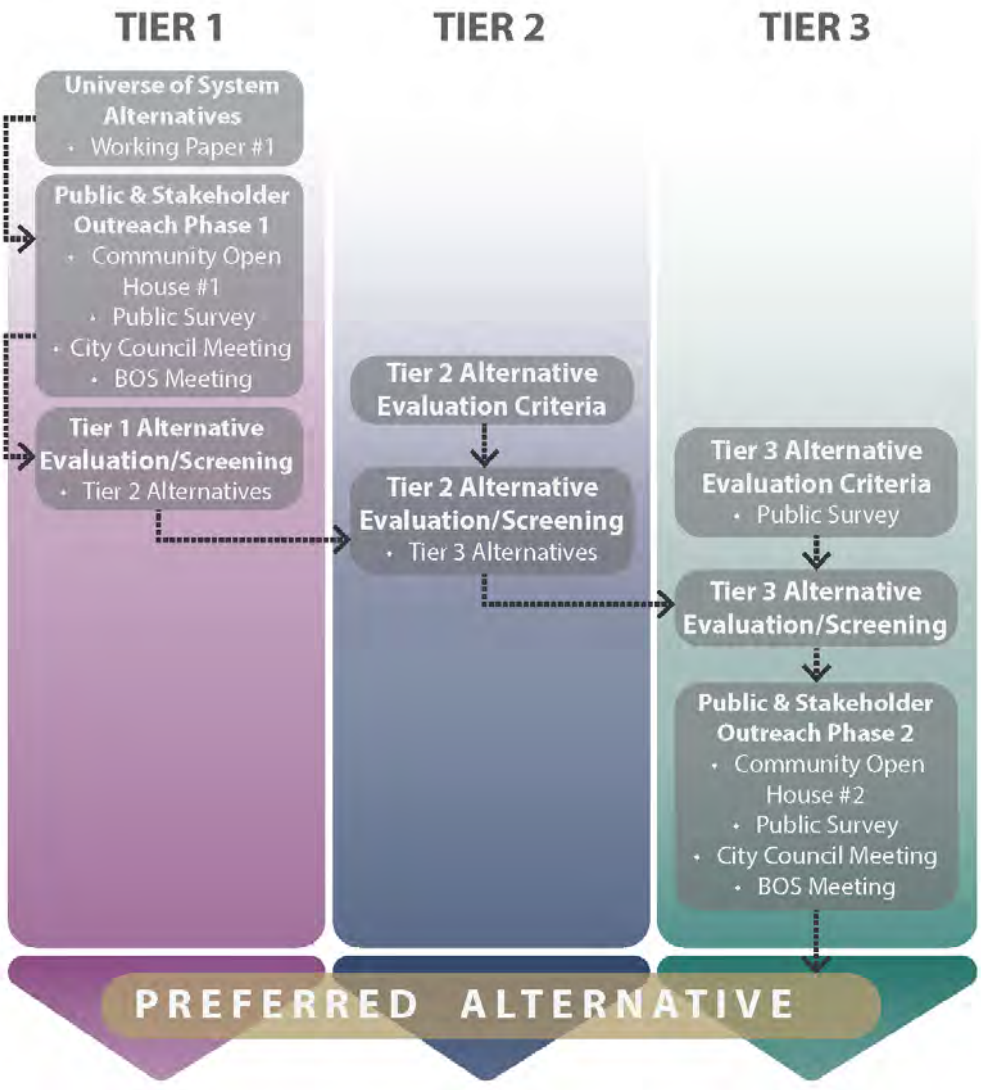
The US 180 CMP alternative evaluation and screening process includes a Three Tier approach (**Figure 2-2**) that is discussed in detail in throughout this working paper. Each of the Three Tier Alternative Evaluation and Screening processes have been conducted under the guidance and advice of the Project Partners with updates and meetings at major milestones during the process. The Three Tiers are described below.

- **Tier 1 Alternative Evaluation** was based on public and stakeholder feedback on the Preliminary System Alternatives developed through the initial phases of the study

presented in *Working Paper #1 – Existing & Future Condition* (Appendix B) for the first screening of alternatives.

- **Tier 2 Alternative Evaluation** focused on the development of qualitative and quantitative evaluation criteria to analyze and measure the performance of the Tier 2 Alternatives.
- **Tier 3 Alternative Evaluation** expanded upon efforts conducted in the Tier 2 Alternative Evaluation phase to further analyze the remaining alternatives through a further refined series of diverse evaluation criteria focusing on quantitative measures to complement qualitative traffic modeling outputs to assess the overall performance of the Tier 3 Alternatives.

Figure 2-2: Three Tier Alternative Evaluation Process Flowchart



3.0 TIER 1 ALTERNATIVE EVALUATION

The foundation of Tier 1 Alternative Evaluation was based on public and stakeholder feedback on the Preliminary System Alternatives presented in *Working Paper #1 – Existing & Future Conditions* (Appendix B). The majority of the feedback was received at Public Open House Meeting #1 held at Flagstaff High School on May 3, 2018 in which 186 community members attended.

The primary objective of Public Open House Meeting #1 was to present the Preliminary System Alternatives for the US 180 CMP study corridor and seek public input to help the Project Partners determine which Preliminary System Alternatives should move forward into Tier 2 Alternative Evaluation. A simple sticky-dot prioritization exercise (just one of many sources of data captured at this meeting) was utilized on the display boards at four stations to capture which preliminary system alternatives were preferred - or not preferred - by meeting community members who attended the meeting. Each participant was given one sticky-dot for each alternative and then asked to place a sticker based on whether they believed each Preliminary System Alternative should either *Move Forward for Further Study*, *Be Eliminated from Further Study,* or *Move Forward for Further Study with Adjustment*. **Table 3-1** shows and summarizes the results of the sticky-dot prioritization exercise for each System Alternative with the total number of dots for each category. Refer to Appendix C for the *US 180 CMP Public Open House Meeting #1 Summary Report*

Photo of public participation at the Public Open House Meeting #1

Table 3-1: Preliminary System Alternative Sticky-Dot Prioritization Exercise Results from Public Open House #1

Station/Preliminary System Alternative	Move Forward for Further Study	Be Eliminated from Further Study	Move Forward for Further Study with Adjustment
Station 2: System Alternatives Utilizing Existing Right-of-Way			
Preliminary System Alternative 1: No Build (Maintain as Is)	Not Applicable		
Base Build Spot improvements	**See Base Build Spot Improvement Results**		
Preliminary System Alternative 2: Humphreys St Southbound PM Peak Managed Lane	**45**	35	0
Station 3: System Alternatives that May Require Expanded Right-of-Way			
Preliminary System Alternative 3: Four General Purpose Lanes, Center Median, Bike Lanes and Shoulders on both Sides	51	**52**	0
Preliminary System Alternative 4: US 180 AM and PM Peak Managed Lane from Meade Street south to Downtown	**48**	36	0
Preliminary System Alternative 5: Humphrey's Street One Way Northbound for AM Peak & One Way Southbound for PM Peak, and right turn capacity at Beaver Street and Columbus, and Humphrey's Street and SR 40B	17	**69**	1
Preliminary System Alternative 6: Dynamic Southbound Shoulder	**50**	28	1
Station 4: Alternative Routes to US 180			
Preliminary System Alternative 7: Columbus Avenue to Switzer Canyon Drive to Route 66	23	**36**	0
Preliminary System Alternative 8: Columbus Avenue to Beaver Street to Butler Avenue (Southbound One Way) & Butler Avenue to San Francisco Street to Columbus Drive	4	**48**	0
Preliminary System Alternative 9: Forest Ave to Turquoise Dr to Switzer Canyon Dr to Rte 66	8	**43**	0
Preliminary System Alternative 10: Cable Propelled Gondola	Previously Removed by Project Partners		
Preliminary System Alternative 11: Milton Road to West Route 66 to Flagstaff Ranch Rd to I-40	4	**48**	0
Preliminary System Alternative 12: Lone Tree Road	**65**	19	0
Preliminary System Alternative 13: Mike's Pike St/Future Overpass/Humphrey's St one way NB & Kendrick Street/Sitgreaves Street/existing underpass to Milton Road SB	10	**65**	0
Preliminary System Alternative 14: Milton Road to West Route 66 to Woodland's Village Boulevard to Beulah Boulevard to John Wesley Powell Boulevard to I-17 South	10	**36**	0
Preliminary System Alternative 15: Bader Road to FS 518 to A-1 Mountain Road to I-40	67	**92**	0
Preliminary System Alternative 16: Snow Bowl Road to A-1 Mountain Road to I-40	56	**78**	0
Preliminary System Alternative 17: Wing Mountain Road to FS Road 222b to FS Road 171	**113**	28	0
Preliminary System Alternative 18: Hidden Hollow Road to FS 506 to I-40	**57**	56	0

4.0 TIER 2 ALTERNATIVE EVALUATION & SELECTION

4.1 Tier 2 Alternative Evaluation

Subsequent to Public Open House Meeting #1 of May 3, 2018, the Project Partners deliberated over a series of meetings to discuss and select which US 180 alternatives that would proceed to the Tier 2 analysis stage. Utilizing the technical inputs and analysis presented in *Working Paper #1 Existing & Future Conditions* as well as drawing from the public and stakeholder inputs received from the public open house meeting and survey, the Project Partners evaluated the public feedback and technical findings to recommend Tier 1 alternatives for Tier 2 consideration.

The Project Partners were presented with the summary results of Public Open House Meeting #1. Based upon the information presented, as well as the previous technical considerations contained in Working Paper #1, the Project Partners agreed to move forward with the following system alternatives for Tier 2 consideration:

- No-Build;
- Alternative 2;
- Alternative 3;
- Alternative 4;
- Alternative 6;
- Alternative 7;
- Alternative 12
- Alternative 17; and
- Alternative 18.

Table 4-1 shows which of the Tier 1 Preliminary System Alternatives were elected to move forward into Tier 2 Alternative Evaluation by the Project Partners.

4.2 Refinement of the Tier 2 Recommended Alternatives

Once the initial selection of the Tier 2 alternatives was established, the next series of Project Partner meetings began to focus on a refinement of the Tier 2 alternatives as previously presented. It was recognized by the Project Partners that, while the Tier 1 alternatives selected for Tier 2 analysis generally captured the range and functionality of facility types being sought/preferred, those roadway cross sections needed to reflect the possibility of what modernized improvements, particularly for multiple modes of travel, would look like for the Build alternative types. One newly introduced transit-specific alternative was also introduced by Mountain Line for Project Partner consideration in line with the project goals.

Table 4-1: Preliminary System Alternatives Elected to Move Forward into and Removed from Tier 2 Alternative Evaluation

Station/Preliminary System Alternative	Move Forward for Further Study	Be Eliminated from Further Study	Move Forward for Further Study with Adjustment
Station 2: System Alternatives Utilizing Existing Right-of-Way			
Preliminary System Alternative 1: No Build (Maintain as Is)	Not Applicable		
Base Build Spot improvements	**See Base Build Spot Improvement Results**		
Preliminary System Alternative 2: Humphreys St Southbound PM Peak Managed Lane	**45**	35	0
Station 3: System Alternatives that May Require Expanded Right-of-Way			
Preliminary System Alternative 3: Four General Purpose Lanes, Center Median, Bike Lanes and Shoulders on both Sides	51	**52**	0
Preliminary System Alternative 4: US 180 AM and PM Peak Managed Lane from Meade Street south to Downtown	**48**	36	0
~~**Preliminary System Alternative 5**: Humphrey's Street One Way Northbound for AM Peak & One Way Southbound for PM Peak, and right turn capacity at Beaver Street and Columbus, and Humphrey's Street and SR 40B~~	~~17~~	~~**69**~~	~~1~~
Preliminary System Alternative 6: Dynamic Southbound Shoulder	**50**	28	1
Station 4: Alternative Routes to US 180			
Preliminary System Alternative 7: Columbus Avenue to Switzer Canyon Drive to Route 66	23	**36**	0
~~**Preliminary System Alternative 8:** Columbus Avenue to Beaver Street to Butler Avenue (Southbound One Way) & Butler Avenue to San Francisco Street to Columbus Drive~~	~~4~~	~~**48**~~	~~0~~
~~**Preliminary System Alternative 9:** Forest Ave to Turquoise Dr to Switzer Canyon Dr to Rte 66~~	~~8~~	~~**43**~~	~~0~~
~~**Preliminary System Alternative 10:** Cable Propelled Gondola~~	~~Previously Removed by Project Partners~~		
~~**Preliminary System Alternative 11:** Milton Road to West Route 66 to Flagstaff Ranch Rd to I-40~~	~~4~~	~~**48**~~	~~0~~
Preliminary System Alternative 12: Lone Tree Road	**65**	19	0
~~**Preliminary System Alternative 13:** Mike's Pike St/Future Overpass/Humphrey's St one way NB & Kendrick Street/Sitgreaves Street/existing underpass to Milton Road SB~~	~~10~~	~~**65**~~	~~0~~
~~**Preliminary System Alternative 14:** Milton Road to West Route 66 to Woodland's Village Boulevard to Beulah Boulevard to John Wesley Powell Boulevard to I-17 South~~	~~10~~	~~**36**~~	~~0~~
~~**Preliminary System Alternative 15:** Bader Road to FS 518 to A-1 Mountain Road to I-40~~	~~67~~	~~**92**~~	~~0~~
~~**Preliminary System Alternative 16:** Snow Bowl Road to A-1 Mountain Road to I-40~~	~~56~~	~~**78**~~	~~0~~
Preliminary System Alternative 17: Wing Mountain Road to FS Road 222b to FS Road 171	**113**	28	0
Preliminary System Alternative 18: Hidden Hollow Road to FS 506 to I-40	**57**	56	0
Alternatives displayed with a strikethrough were eliminated from further study during the Tier 2 Alternative Evaluation			

4.2a Controlling Design Criteria

Borne out of Project Partner discussions and desire to refine the newly selected Tier 2 alternatives, it was determined that a set of Controlling Design Criteria were going to be collectively developed by the Project Partners to guide Tier 2 Alternative Evaluation.

The Controlling Design Criteria were created to:

1. To identify and compare identified FHWA, ADOT, and Flagstaff/MetroPlan/Mountain Line agency standards for the various roadway features in the Milton Road corridor and ensure that ADOT/FHWA standards are met.
2. Acknowledge that once ADOT/FHWA minimum standards are met, which City of Flagstaff/MetroPlan/Mountain Line standard(s) is preferred for inclusion in any refined Tier 2 Alternative.
3. To ensure if any variances or design exceptions would require FHWA approval.
4. Use this comparison to recognize that different agencies may have different views on preferred roadway feature dimensions during the Tier 2 Analysis. As such, it was felt to be important to the planning process to document the similarities and differences between agencies, while also aiding in helping assign potential construction cost obligations between agencies (if the need should arise based on the nature of any preferred alternative that may be identified in this study process).
5. In recognition of possible different preferences between agencies, it was discussed and confirmed what type and size of roadway features ADOT would/could contribute possible construction dollars towards (should a particular alternative be recommended through this study process), versus those roadway feature types above and beyond the ADOT standards that other agencies would be required to contribute construction cost (should the need arise).
6. Flagstaff/MetroPlan/Mountain Line collectively expressed that the current adopted Flagstaff minimum standards for roadway features were a bit dated and didn't necessarily represent current policies that reflect city preferences for certain roadway features. This resulted in identifying Flagstaff/MetroPlan/Mountain Line "current standards" and "preferred standards" separately.
7. The Controlling Design Criteria information would help inform and apply the Tier 2 evaluation criteria to quantify thresholds of scoring for bicycle and pedestrian oriented features across the various alternatives.

Over the course of several meetings, the Project Partners discussed and confirmed the series of Controlling Design Criteria shown in **Table 4-2**.

Table 4-2: Controlling Design Criteria

Roadway Feature	FHWA Standard	ADOT Standard	Flagstaff/FMPO/NAIPTA Standard	Flagstaff/FMPO/NAIPTA Preferred Standard	Notes
General Purpose Lane Width	**Urban:** • *Arterial Minimum - 10' with low truck and bus volumes • Arterial desired – 12' (AASHTO 7.3 Urban Arterials) * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban:** • *Through lane Min – 11' • Through lane Max – 16' **Rural:** • Through lane Min – 12' Through lane Max – 12' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 12'	**Urban Milton & US 180:** • 11' **Suburban Milton & US 180:** • 11' **Rural US 180:** • 12'	**For these categories, the preferred widths are less than the minimums, in contexts where the City/NAIPTA/FMPO have allowed for narrower lanes to improve multimodal functionality. In urban areas in particular, the Regional Plan supports this strategy based on a case by case assessment.
Left Turn Lane	**Urban:** • *Auxiliary lane Min. – 10' • Auxiliary lane Max. – 16' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban:** • *Auxiliary (turn) lane Min – 10' • Auxiliary lane Max = none **Rural:** • Auxiliary lane Min – 12' • Auxiliary lane Max – 12' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban Milton & US 180:** • 12 **Suburban Milton & US 180:** • 12' **Rural US 180:** • 11'	**Urban Milton:** • 11' **Urban US 180:** • 10' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 11'	**
Right Turn Lane	**Urban:** • *Auxiliary lane Min. – 10' • Auxiliary lane Max. – 16' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban:** • *Auxiliary (turn) lane Min – 10' • Auxiliary lane Max = none **Rural:** • Auxiliary lane Min – 12' • Auxiliary lane Max – 12' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 11'	**Urban Milton & US 180:** • 11' - Regional Plan policy supports no RT lanes, except at major intersections **Suburban Milton & US 180:** • 12' **Rural US 180:** • 11'	**
Median Width	**Urban:** • Arterial minimum Median Width – 4' • Arterial minimum Median Width for pedestrian refuge – 6' • *Auxiliary lane Min. – 10' • Auxiliary lane Max. – 16' **Rural:** Not applicable on US 180 cross sections * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	**Urban:** • **Raised** - 16' Through lane - 4' with a turn lane **Rural:** Not applicable on US 180 cross sections	**Urban Milton & US 180:** • 4' **Suburban Milton & US 180:** • 4' **Rural US 180:** Not Applicable	**Urban Milton & US 180:** • 4' **Suburban Milton & US 180:** • 4' **Rural US 180:** Not Applicable	

Roadway Feature	FHWA Standard	ADOT Standard	Flagstaff/FMPO/NAIPTA Standard	Flagstaff/FMPO/NAIPTA Preferred Standard	Notes
Median Width (With Plantings)			**Urban Milton & US 180:** • 8' **Suburban Milton & US 180:** • 8' **Rural US 180:** Not Applicable	**Urban Milton:** • 12' **Urban US 180:** • 11' **Suburban Milton & US 180:** • 12' **Rural US 180:** Not Applicable	Same as left turn lane - would be wider when combined with a median separating the turn lane from oncoming traffic
Median Width (With Turn Lane)			**Urban Milton & US 180:** • 15' **Suburban Milton & US 180:** • 15' **Rural US 180:** Not Applicable	**Urban Milton & US 180:** • 15' **Suburban Milton & US 180:** • 16' **Rural US 180:** Not Applicable	This assumes 4-foot median with no plantings. Can be narrowed up to 1 foot.
Two Way Left Turn Lane	• **Raised Max –** - *TWLT Min – 10' - TWLT Max – 12' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	• **Raised Max –** - *TWLT Min – 10' - TWLT Max – 12' * Anything below 12' has to obtain an variance from the Assistant State Engineer over Roadway Engineering Group.	• 11'	• 11' (12' for Suburban US 180)	Urban contexts have narrower turn lanes to slow truck/bus traffic and because they are not preferred in this context for loading and unloading
Landscape Buffer/Parkway	Desired - 6' Minimum - 3' if a 5' sidewalk is provided	Desired = 5' Minimum = back of curb The location of the sidewalk should be coordinated with the local government and with the Roadside Development Section when the highway project involves landscaping.	**Urban Milton & US 180:** • 5' **Suburban Milton & US 180:** • 5' **Rural US 180:** Not applicable	**Urban Milton & US 180:** • 7' **Suburban Milton & US 180:** • 8' **Rural US 180:** Not applicable	Furnishing strips and tree grates are preferred for the urban context associated with Milton and US 180 because it is consistent with the existing urban design
Utility Setback			**Urban Milton & US 180:** • 1' **Suburban Milton & US 180:** • 2' **Rural US 180:** Not applicable	**Urban Milton & US 180:** • 1' **Suburban Milton & US 180:** • 2' **Rural US 180:** Not applicable	Used for poles, signage, utilities, etc. Used for sidewalk stabilization
Shoulder	**Rural Shoulder:** Desirable – 8' Minimum - 4'	**Rural Shoulder:** Desirable – 8' DHV > 200 vph Minimum - 6' DHV<200 vph	**Rural US 180:** Not applicable within Flagstaff City Limits	**Rural US 180:** Not applicable within Flagstaff City Limits	

Roadway Feature	FHWA Standard	ADOT Standard	Flagstaff/FMPO/NAIPTA Standard	Flagstaff/FMPO/NAIPTA Preferred Standard	Notes
Bike Lane	**Urban:** Desirable – 5' Minimum - 4' **Rural Shoulder:** Desirable – 8' Minimum - 4'	**Urban:** **See ADOT Bicycle Policy –** (1.f) incremental costs for construction and maintenance are funded by a local agency AND 2) the bicycle lane is included as a part of a bicycle facilities plan adopted by a local agency.) Desirable – 5' Minimum - 4' **Rural Shoulder:** Desirable – 8' DHV > 200 vph Minimum - 6' DHV<200 vph	*Measurements do not include gutter pan* **Urban Milton & US 180:** • 4.5' **Suburban Milton & US 180:** • 4.5' **Rural US 180:** • 4'	*Measurements do not include gutter pan* **Urban Milton & US 180:** • 6' with Buffer **Suburban Milton & US 180:** • 6' with Buffer **Rural US 180:** • 8'	buffer is a double stripe with crosshatch 1.5 foot wide
Sidewalk	Desired – 8' Minimum – 4' with a 5' passing section every 200'.	5' (unless local standards require greater and locals agree to pay additional cost of design, construction and agree to maintain the sidewalks.)	**Urban Milton & US 180:** • 10' **Suburban Milton:** • 10' **Suburban US 180:** • 6' (one-side - if paired with FUTs on other side) **Rural US 180:** Not applicable on US 180 cross sections	**Urban Milton & US 180:** • 10' **Suburban Milton:** • 10' **Suburban US 180:** • 6' (one-side - if paired with FUTs on other side) **Rural US 180:** Not applicable on US 180 cross sections	A sidewalk is preferred over a multi-use path on Milton Road.
Multi-Use Path/ Offset (parkway)			**Urban Milton & US 180:** Not applicable **Suburban Milton:** Not applicable **Suburban US 180:** • 20' **Rural US 180:** • 15'	**Urban Milton & US 180:** Not applicable **Suburban Milton:** Not applicable **Suburban US 180:** • 20' **Rural US 180:** • 15'	Dimension includes the parkway/buffer
Pedestrian Island Refuge (Pedestrian Islands at a Right Turn must meet ADA std)	6' (info from NACTO), when 6 ft cannot be attained, narrower raised median is preferred, refuge is ideally 40 ft in length	ADOT does not have a standard for this so minimum would be AASHTO	**Urban Milton & US 180:** • 6' **Suburban Milton & US 180:** • 6' **Rural US 180:** • 6'	**Urban Milton:** • 11' **Urban US 180:** • 10' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 11'	For preferred, a pedestrian island refuge can be as wide as the center lane, if one is present.

November 2, 2018

Roadway Feature	FHWA Standard	ADOT Standard	Flagstaff/FMPO/NAIPTA Standard	Flagstaff/FMPO/NAIPTA Preferred Standard	Notes
Bus Bay/Pullouts		Bus pullouts may be required under any one of the following conditions: 1) Posted speed limit is 35 mph or higher; and 2) There are less than three through-travel lanes in the direction that the bus is traveling 3) There is an identified bicycle facility adjacent to the travel lane. If a bus stop is to be located at an intersection where the traffic on the State highway is controlled by a traffic signal or stop sign, the bus stop must be located on the far side of the intersection. A bus stop sign, denoting the front of the location of a stopped bus, must be located 85 feet from the intersection's radius return ADOT construction detail C-05.50 has dimensions for a bus pullout.	**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** Not applicable	**Urban Milton & US 180:** • 12' (NAIPTA does not prefer in this context, very site specific) **Suburban Milton & US 180:** • 12' **Rural US 180:** • 12'	NAIPTA will not stop in ROW in a rural context, only stop will be Snowbowl lower parking lot. Bus Bays will not be used in BRT Alternatives.
Side running shared bus bike lane (SBBL) (with right turns)			**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 12'	**Urban Milton & US 180:** • 16' **Suburban Milton & US 180:** • 16' **Rural US 180:** • 16'	Based on NACTO standards
Side running bus lane (with right turns)			**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 12'	**Urban Milton & US 180:** • 12' **Suburban Milton & US 180:** • 12' **Rural US 180:** • 12'	Based on NACTO standards
Bus Stop (Back of Curb)			**Urban Milton & US 180:** • 8' **Suburban Milton & US 180:** • 8' **Rural US 180:** • 8'	**Urban Milton & US 180:** • 10' **Suburban Milton & US 180:** • 10' **Rural US 180:** • 8'	This standard can vary when topography is in play due to ADA standards
Center Running transit - 2 lanes + buffer			**Urban & Suburban Milton:** • 25' (2, 11' lanes with 2, 1.5' buffers) **Urban, Suburban, & Rural US 180:** Not Applicable	**Urban & Suburban Milton:** • 28' (2, 12' lanes with 2, 2' buffers) **Urban, Suburban, & Rural US 180:** Not Applicable	See Assumptions for details

Roadway Feature	FHWA Standard	ADOT Standard	Flagstaff/FMPO/NAIPTA Standard	Flagstaff/FMPO/NAIPTA Preferred Standard	Notes
Center Running Transit - Intersection Transit Station			**Urban & Suburban Milton:** • 33' (2, 11' lanes with 2, 1.5' buffers and an 8' Platform) **Urban, Suburban, & Rural US 180:** Not Applicable	**Urban & Suburban Milton:** • 34' (2, 11' lanes with 2, 2' buffers and an 8' Platform) **Urban, Suburban, & Rural US 180:** Not Applicable	See Assumptions for details Option A: Scissors Platforms Options B: Offset Platforms
Center Running Transit - Mid-Block Transit Station			**Urban & Suburban Milton:** • 33' (2, 11' lanes with 2, 1.5' buffers and an 8' Platform) **Urban, Suburban, & Rural US 180:** Not Applicable	**Urban & Suburban Milton:** • 34' (2, 11' lanes with 2, 2' buffers and an 8' Platform) **Urban, Suburban, & Rural US 180:** Not Applicable	See Assumptions for details Option A: Scissors Platforms Options B: Offset Platforms
Clear Recovery Zone	**Urban:** 4' - 6' **Rural:** 14' - 18'	14' – 18'. Can be adjusted for right of way constraints in urban areas.			

The Controlling Design Criteria would be used as a reference for each Alternative to ensure:

a. Minimum ADOT/FHWA standards are being met
b. If any variances or design exceptions would require FHWA approval
c. Once min standards are met, which FMPO/City/NAIPTA standard is preferred
d. Understanding that if max ADOT standards are exceeded, it would be the local agency's responsibility to fund such enhancements
e. Ensure that we do not recommend enhancements that exceed FMPO/City/NAIPTA policy/standards
f. Prior to Tier 2 Analysis, we could review each alternative to ensure and reach consensus on a spec that meets the Controlling Design Criteria

FMPO/City/NAIPTA Assumptions:

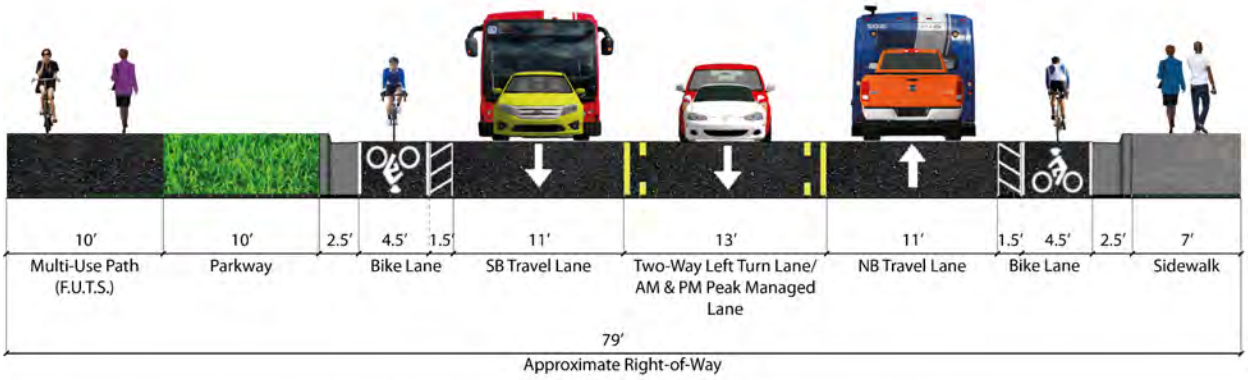
- Widths include the curb to its face
- Assumptions about widths of BRT center running features
- Center lane breakdown
- Side running lane
- Buffers could be added at for safety/ landscape + beautification – approximate 2' each side (4' total)
- Some of the Preferred Minimum and Maximum Standards do not meet the City of Flagstaff's current engineering standards. The City of Flagstaff is in the process of updating its engineering standards and requested that the Preferred Minimum/Maximum standards, as shown in the Controlling Design Criteria be utilized.

In addition to the application of the Controlling Design Criteria to refine the Tier 2 alternatives, three additional alternatives were evaluated and added by the Project Partners. These are; 1) the refinement of Alternative 6 into Alternative 6a and 6b; 2) conversion of Alternative 9 into the No Build Alternative, and 3) introduction and review of newly introduced Bus-Rapid Transit (BRT) alternatives.

4.2b Refinement of Alternative 4 to hybrid Alternative 4a and Alternative 4b

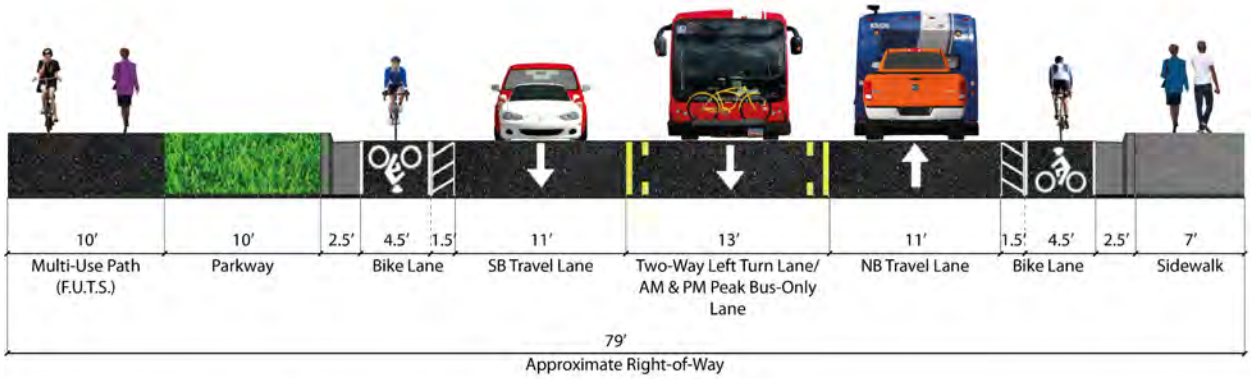
While the public sentiment obtained from public open house meeting #1 (and survey) generally did not widely support the managed lane System Alternative 4 (as presented at the public open house meeting #1), the Project Partners respected the public's feedback, yet also desired to maintain a diversity of options in order to allow for a full range of alternatives for public consideration and traffic operation analysis in Tier 2 analysis. The result of this discussion and analysis yielded two hybrid alternatives for Tier 2 analysis that had not been previously contemplated. These became System Alternative 4a and Alternative 4b, as shown in **Figure 4-1** and **Figure 4-2**:

Figure 4-1: System Alternative 4a Mid-Block Cross Section



*An ADOT design exception and FHWA approval would be required for the application of 11' travel lanes.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

Figure 4-2: System Alternative 4b Mid-Block Cross Section



*A design variance or exception would be required for 11' travel lanes which would need FHWA approval.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

4.2c Alternative 12 Converts into the No-Build Alternative

Recognizing that the Lone Tree Overpass funding was now approved by Flagstaff voters via Proposition 420, System Alternative 9 – already closely resembling the No Build alternative, became redundant to the No Build alternative and not necessary for Tier 2 analysis. The important new distinction however was that, now that voter funding was approved for the Lone Tree Overpass, the Tier 2 analysis could now include the projected benefit of the Lone Tree Overpass into the Tier 2 traffic modeling exercise for the No-Build option and all other Tier 2 Alternatives.

4.3 Final Tier 2 Alternatives Presented

The Project Partners reached consensus on the nine Tier 2 alternatives that are introduced and described in the following sub-sections.

4.3a No-Build

The No-Build option favors maintaining the existing US 180 right of way and facilities "as is", which generally includes one travel lane in each direction with a center two-way left turn lane (TWTL) along the suburban character segments of US 180 (within the city limits), transitioning to (generally) one travel lane in each direction for the more rural segments of US 180 north and west of Schultz Pass Rd. The No-Build alternative is important for public and stakeholder consideration. It also meets FHWA and ADOT Planning and Environmental Linkages (PEL) guidance for certain planning studies and helps facilitate environmental studies should future implementation projects present themselves for consideration.

4.3b System Alternative 2

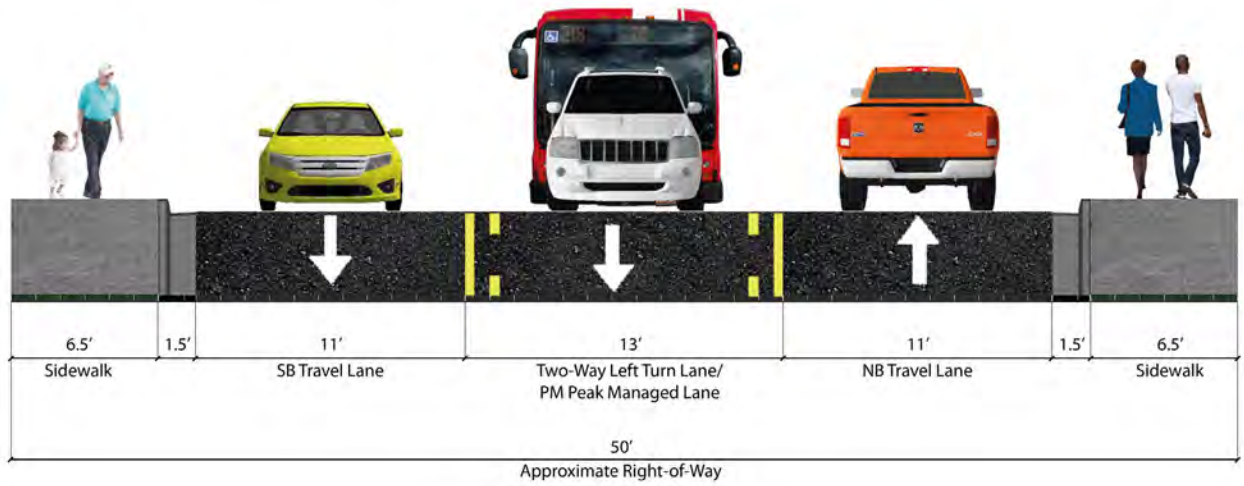
System Alternative 2 incorporates a managed center lane on Humphrey's Street in the southbound direction during the PM peak period to accommodate the influx of southbound traffic generated from winter congestion. A managed lane, as the name implies, is a concept in which the center traffic lane (turn lane) may travel in either direction (however just southbound traffic only in this System Alternative), depending upon the time, day and/or operation sign/signal displayed. Reversible traffic lanes add capacity to a road and decrease congestion by borrowing capacity from the other (off-peak) direction. This holds especially true in situations where options for expanding the existing right-of-way are limited (existing right-of-way on Humphrey's Street is 50 feet) or when traffic in the corridor is heavily imbalanced for a short period of time such as leading to/from a special event (snow play). This alternative is illustrated in **Figure 4-3**. It is important to note that this alternative would only be implemented on high volume snow play weekends along the US 180 corridor on Humphrey's Street between Columbus Avenue and Historic Route 66.

The concept is often referred to by FHWA and transportation professionals, as "managed lanes" in that high demand on existing facilities, such as US 180/Humphrey's Street, especially at peak demands are placed on the roadway, it necessitates the efficient management of those facilities.

There are a wide variety and combination of approaches to managed lane operations. These have typically encompassed such methods as:

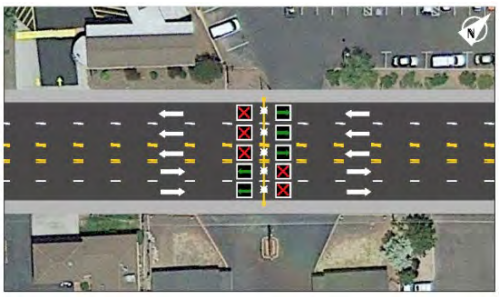
- Static signing and striping;
- Changeable message signs;
- Lane control signals;
- Temporary traffic control devices;
- Law enforcement / legal restrictions; and
- Economic incentives / disincentives.

Figure 4-3: System Alternative 2 Mid-Block Cross Section

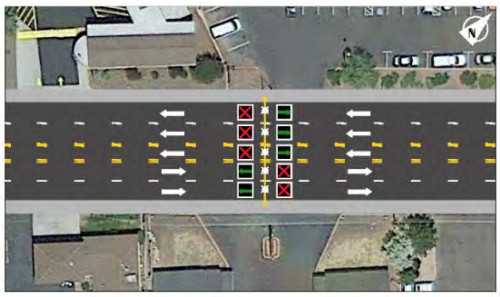


*An ADOT design exception and FHWA approval would be required for the application of 11' travel lanes.

Standard Traffic Designation



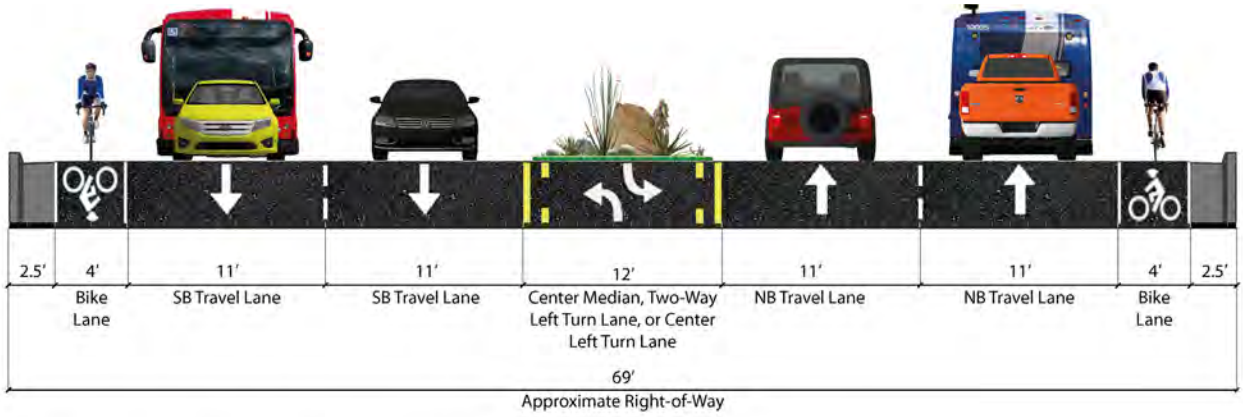
PM peak Period Traffic Designation



4.3c System Alternative 3

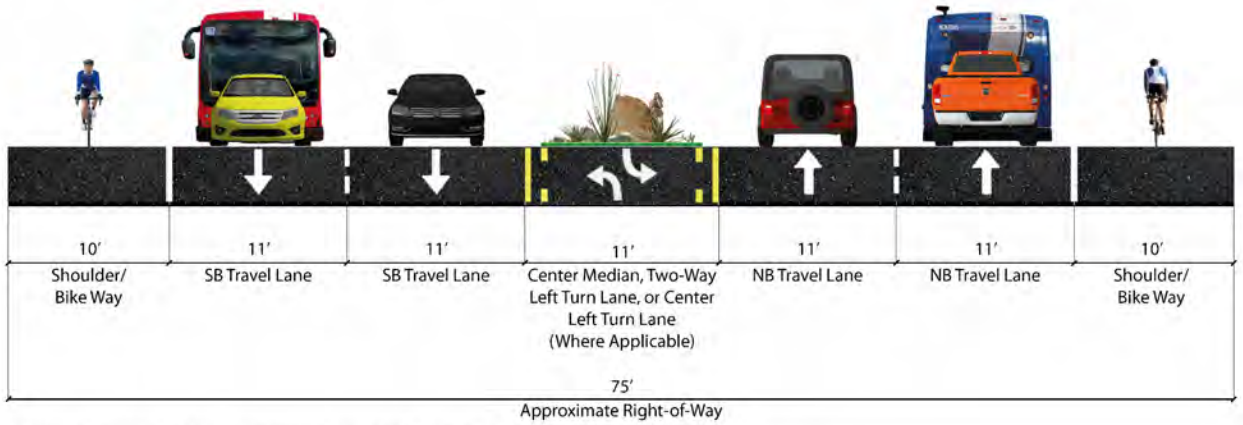
As illustrated in **Figure 4-4** and **Figure 4-5**, this System Alternative calls for four (4), 11-foot general purpose travel lanes, a 12-foot center turn lane (two-way left turn lane) and two, 10-foot shoulders that also may be utilized as bikeways. Each of the outside general purpose lanes would accommodate buses, vehicles and right turning movements. Landscaping setbacks are not included in this alternative. This alternative adds vehicular capacity to existing US 180 by adding two additional general purpose lanes (one south-bound, one north-bound) that do not currently exist. It is suggested that sidewalks be maintained where they currently exist today on both sides of US 180 (generally) from Beal Road to Columbus Avenue. The FUTS would also be maintained on the south side of US 180 as a protected (by the guard rail) shared use path.

Figure 4-4: System Alternative 3 – Suburban Section Mid-Block Cross Section



*An ADOT design exception and FHWA approval would be required for the application of 11' travel lanes.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

Figure 4-5: System Alternative 3 – Rural Section Mid-Block Cross Section

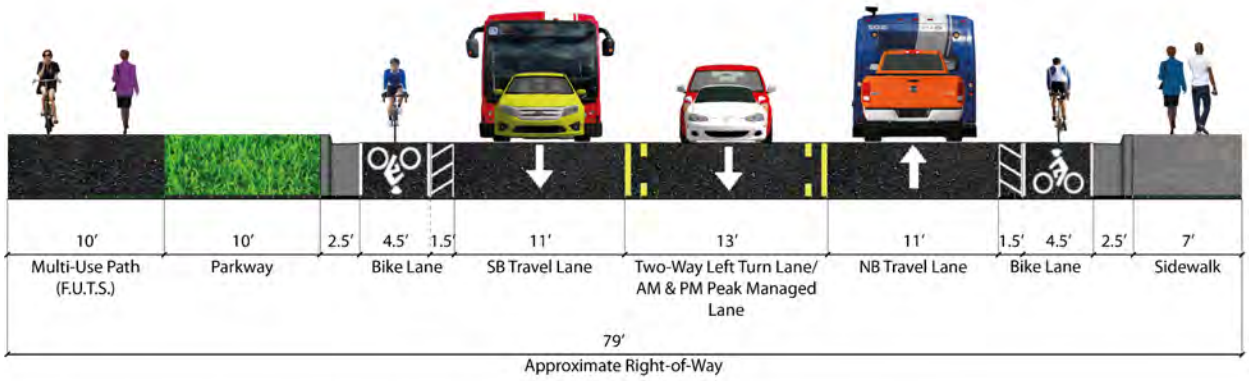


*An ADOT design exception and FHWA approval would be required for the application of 11' travel lanes.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

4.3d System Alternative 4a

This System Alternative that proposes a managed lane for the US 180 roadway segment that experiences congestion issues in the most "urban" segments of US 180 adjacent to residential neighborhoods at the gateway to downtown Flagstaff. From Meade Lane to Anderson Avenue, 90 feet of right-of-way currently exists. From Anderson Avenue to Forest Avenue, 65 feet of right-of-way exists. As a proposed "urban roadway section", this System Alternative proposes to include sidewalks on both sides, bike lanes on both sides and maintain the FUTS on the south side of the roadway. In some locations, some or all of these facilities exist (for this roadway segment), in some cases they do not. For purposes of this System Alternative, a "complete street" that provides for all modes is identified.

Figure 4-6: System Alternative 4a Mid-Block Cross Section



*An ADOT design exception and FHWA approval would be required for the application of 11' travel lanes.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

4.3e System Alternative 4b

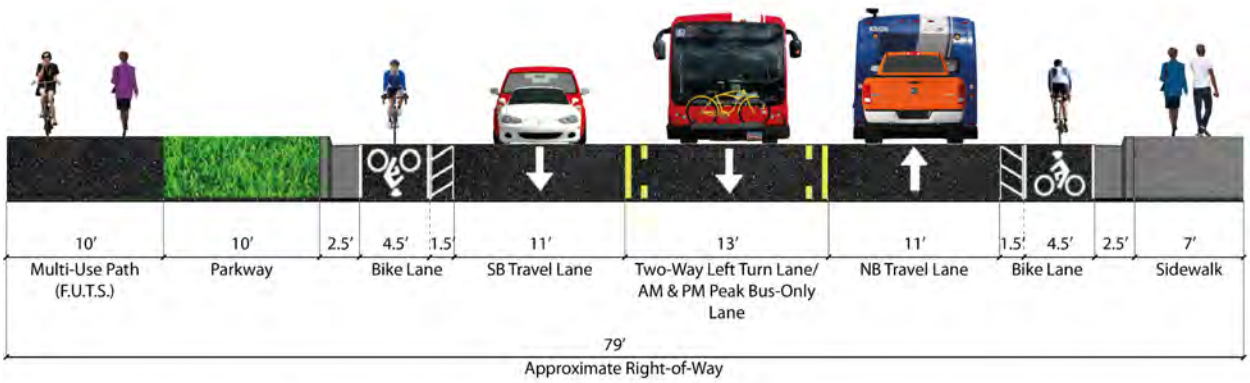
System Alternative 4b is similar to System Alternative 4a that proposes a managed lane for the US 180 roadway segment that experiences congestion issues in the most "urban" segments of US 180. However, the managed center lane would accommodate southbound buses only – a transit only managed lane. From Meade Lane to Anderson Avenue, 90 feet of right-of-way currently exists. From Anderson Avenue to Forest Avenue, 65 feet of right-of-way exists. As a proposed "urban roadway section", this System Alternative proposes to include sidewalks on both sides, bike lanes on both sides and maintain the FUTS on the south side of the roadway. In some locations, some or all of these facilities exist (for this roadway segment), in some cases they do not. For purposes of this System Alternative, a "complete street" that provides for all modes is identified.

A transit only managed lane as the name implies, is a concept in which the middle traffic lane may travel in either direction, depending upon the time, day and/or operation sign/signal displayed. The transit only managed lane adds capacity to a road and decrease congestion by borrowing capacity from the other (off-peak) direction, or in this case, utilizing the two-way center turn lane as a transit-only lane.

There are a wide variety and combination of approaches to managed lane operations. These have typically encompassed such methods as:

- Static signing and striping;
- Changeable message signs;
- Lane control signals;
- Temporary traffic control devices;
- Law enforcement / legal restrictions; and
- Economic incentives / disincentives.

Figure 4-7: System Alternative 4b Mid-Block Cross Section

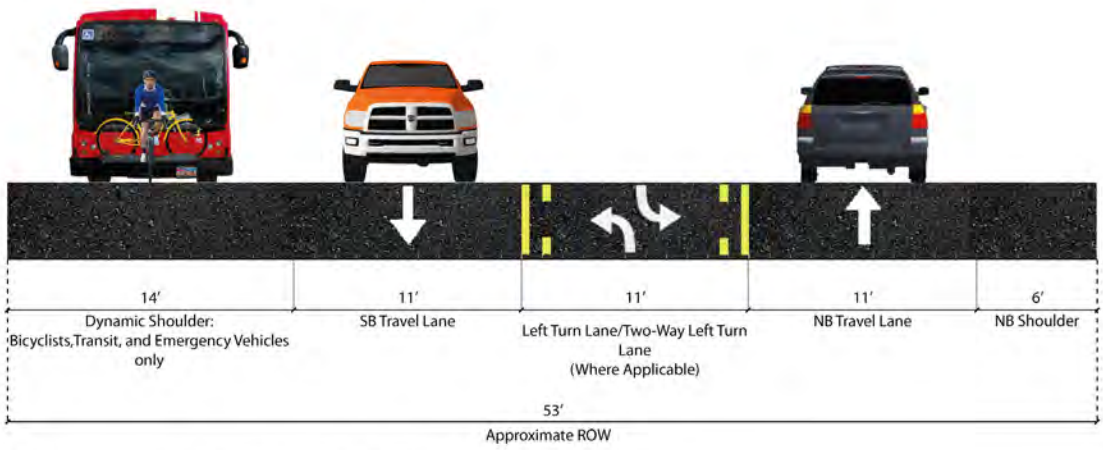


*A design variance or exception would be required for 11' travel lanes which would need FHWA approval.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

4.3f System Alternative 6

System Alternative 6 would generally have minimal physical impact that does not require substantial amounts of additional right-of-way. Similar to a typical roadway shoulder, the "dynamic shoulder" proposed in System Alternative 6 would allow the use of pedestrians and bicyclists; but what separates the dynamic shoulder from a standard shoulder is during winter peak traffic congestion, the dynamic shoulder could support the use of transit and emergency vehicles to bypass vehicle congestion on US 180 general purpose lanes. However, pedestrians and bicyclists traversing on the shoulder would have to yield to both emergency and transit vehicles. Signage would need to be placed at appropriate intervals that would indicate the south bound shoulder is only permitted to non-motorized travel, and emergency and transit vehicles during winter peak traffic congestion. **Figure 4-8** is a graphic representation of System Alternative 6 during winter peak traffic.

Figure 4-8: System Alternative 6 Mid-Block Cross Section



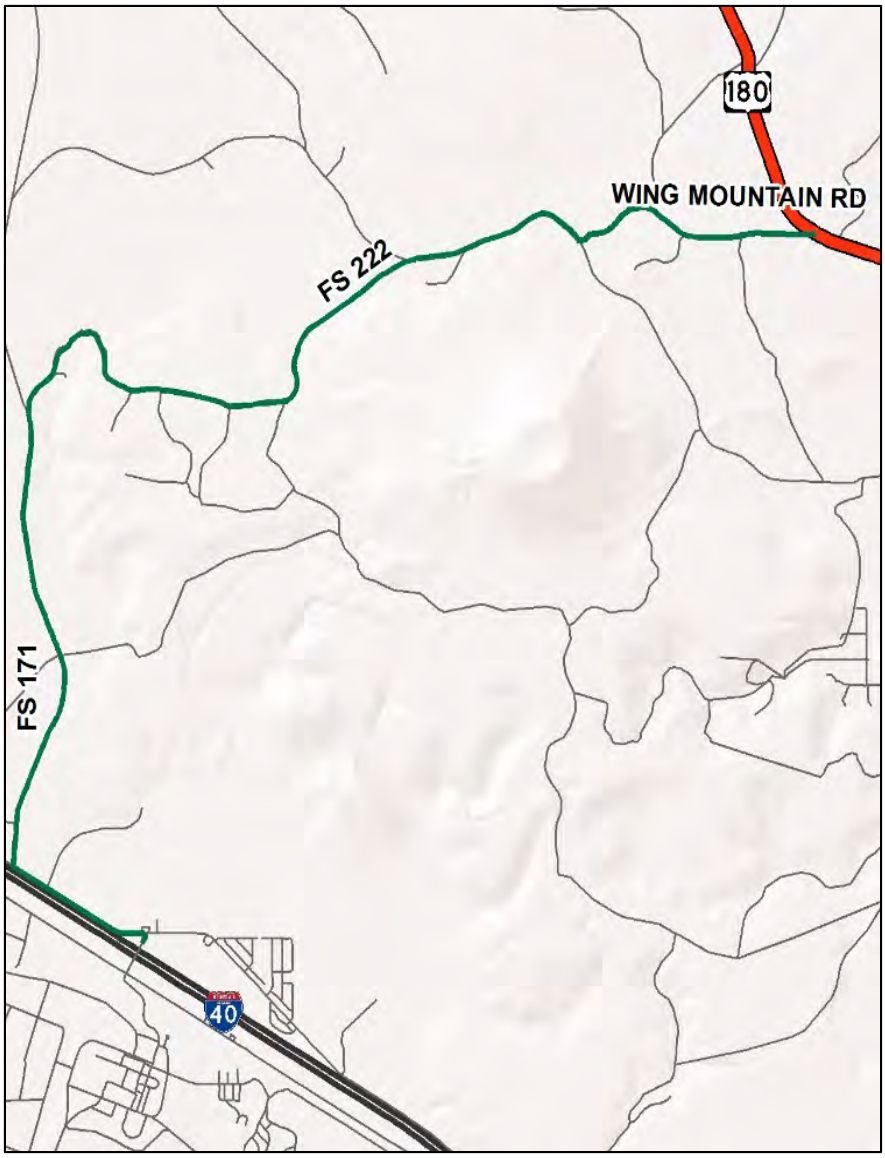
*A design variance or exception would be required for 11' travel lanes which would need FHWA approval.
**Represents F.U.T.S. and sidewalks where present today, and assumes future sidewalks will be constructed with potential forthcoming development.

4.3g System Alternative 17

System Alternatives 17 is an alternative route previously proposed by the US 180 Winter Traffic Study to bypass downtown Flagstaff by directly connecting US 180 to I-40. Local resident concerns regarding their proximity to rural residential properties off Bader Road and Snow Bowl Road prompted the need to explore other viable alternative routes.

Figure 4-9 illustrates the System Alternative 17 route, which is approximately 3.7 miles west of Snow Bowl Road. System Alternative 17 in total is a 10.3-mile connection to I-40 through Bellemont, AZ utilizing the Wing Mountain access road (FS 222B) to Forest Service Roads 222 and 171. This is a long-term solution that would require extensive coordination with Coconino County and the Coconino National Forest and would require federal environmental clearance.

Figure 4-9: System Alternative 17 Alignment

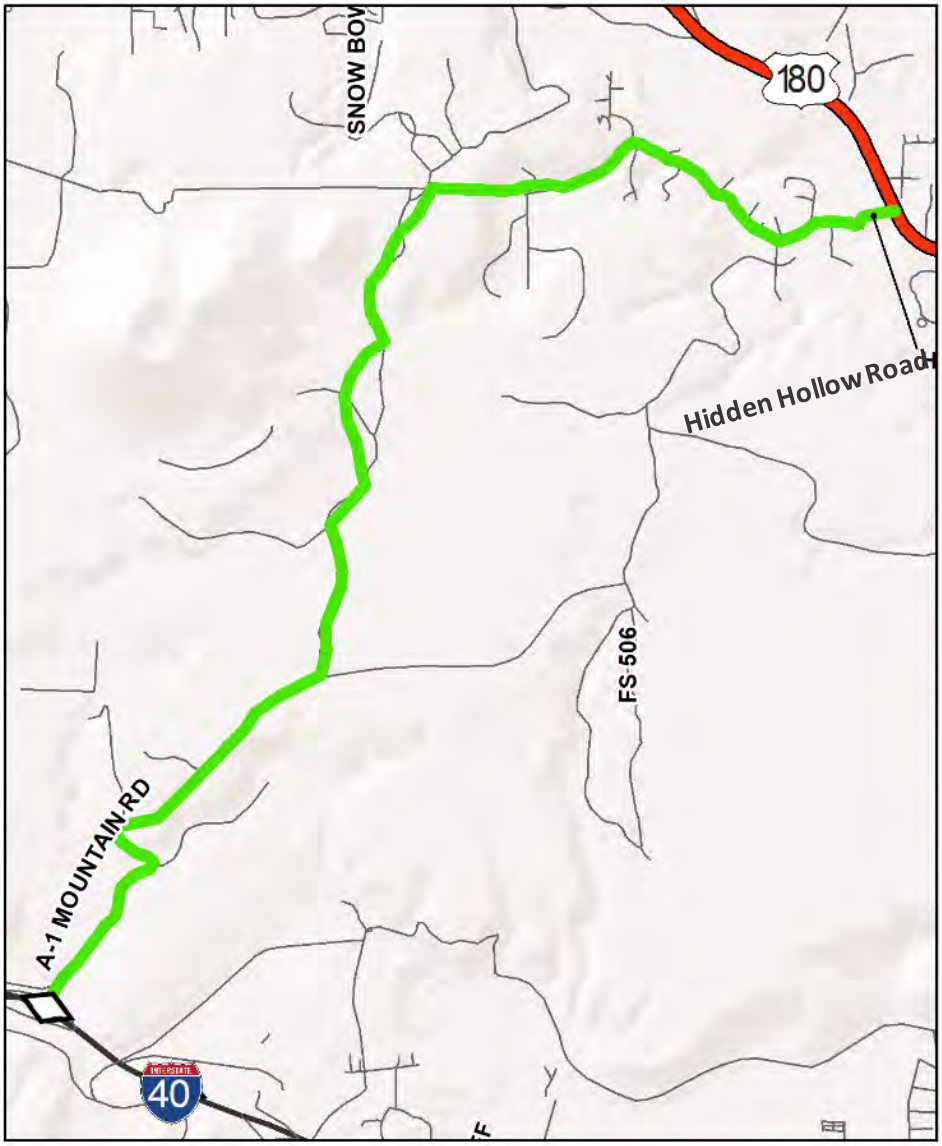


4.3h System Alternative 18

System Alternatives 18 is an alternative route also previously proposed by the US 180 Winter Traffic Study to bypass downtown Flagstaff by directly connecting US 180 to I-40. Local resident concerns regarding their proximity to rural residential properties off Bader Road and Snow Bowl Road prompted the need to explore other viable alternative routes.

As shown in **Figure 4-10**, System Alternative 18 is a 6.9 mile alternative route that utilizes existing Forest Service roads. Travelers leaving Snow Bowl would head towards Flagstaff on US 180 and make a right turn onto FS 6149 for approximately ½ a mile to access Hidden Hollow Road (FS 668D) and then FS 506/518 for the remainder of the alignment. A southbound right turn deceleration lane on US 180 approaching Hidden Hollow Road will be necessary.

Figure 4-10: System Alternative 18 Alignment



4.4 Tier 2 Evaluation Criteria

A series of Tier 2 evaluation criteria and weightings were developed to evaluate and measure the performance of the seven Tier 2 Alternatives. The Tier 2 evaluation criteria were crafted to be diverse in nature through the combination of quantitative and qualitative measurements specific to features of each Tier 2 Alternative.

The first step in developing the evaluation criteria was to identify general categories of roadway performance to measure the operational and environmental qualities of the corridor. The Consultant Team worked with the Project Partners and agreed to use the following categories – in no particular order of importance – on to measure and compare the Tier 2 Alternatives:

- Traffic Operations;
- Safety;
- Expand Travel Mode Choices;
- Public Acceptance;
- Construction/Implementation;
- Project Economics; and
- Environmental Impacts.

Once the categories were selected, the Consultant Team and the Project Partners created a preliminary list of evaluation criteria metrics for each category. The process included researching regulatory mandates across the state and with ADOT; understanding what issues were of highest importance for the ADOT Districts; communicating with ADOT and the Project Partners to understand strategic safety initiatives of the highest value within the various organizations and agencies; investigating measures to evaluate the level of difficulty of implementation through assessment of the costs and right-of-way impacts; and the publics acceptance of each alternative.

As a result, 16 different evaluation criteria were initially developed over the seven categories to use in Tier 2 Alternative evaluation process. **Table 4-3** describes the different evaluation criteria for each category and the following sections go into more detail.

Table 4-3: Initial Tier 2 Evaluation Criteria

Initial Tier 2 Evaluation Criteria		
Category	**Evaluation Criteria**	**Description**
Reduction in Vehicular Congestion	Improved Congestion – Volume/Capacity	ADOT's Congestion Needs Score Tool is the source that calculates the results for the Improves Congetion criterion that essentially rates the prefomance of an alterative through a volume to capacity ratio.
	Travel Speed as Percentage of Base Free Flow Speed	This metric that measures reduction in vehicular congestion by comparing the 2040 travel speed in relative to the base free flow speed of the Milton Road corridor.
	Intersection Level-of-Service (LOS)	The Intersection LOS metric measures reduction in vehicular congestion by identifying the number of operationally failing intersections (LOS grade E or F) under the 2040 condition.
	Travel Time	The Travel Time criterion is a metric that measures reduction in vehicular congestion by calculating the amount of time it takes to travel the corridor from one end to the other.

Initial Tier 2 Evaluation Criteria		
Category	**Evaluation Criteria**	**Description**
Safety	Reduction in All Crashes	The Reduction in All Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives through the use Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs).
	Reduction in All Injury-Related Crashes	The Reduction in All Injury-Related Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives through the use Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs) for crashes only involving injuries.
	Reduction in Bicycle-Related Only Crashes	The Reduction in Bicycle-Related Only Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives through the use Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs) for crashes only involving injuries.
Expand Travel Mode Choices	Improved Pedestrian Facilities	The Improved Pedestrian Facilities criterion is a qualitative metric that measures how pedestrian facilities are improved utilizing the Controlling Design Criteria to see if pedestrian facilities meet or exceed minimum and preferred design standards of ADOT and the various Project Partner agencies.
	Improved Bicycle Facilities	The Improved Pedestrian Facilities criterion is a qualitative metric that measures how pedestrian facilities are improved utilizing the Controlling Design Criteria to see if pedestrian facilities meet or exceed minimum and preferred design standards of ADOT and the various Project Partner agencies.
	Transit Travel Time	The Improved Transit criterion is a metric that measures transit improvement by calculating the amount of time it takes for transit vehicles to travel the corridor from one end to the other.
Public Acceptance	Public Support	The Public Support metric measures the No-Build and Tier 2 Alternatives based on the percentage of support received by the public.
Construction/ Implementation	Project Cost	The Project Cost criterion is a metric that measures the ease of construction/implementation by evaluating the total project cost to implement through detailed cost estimates.
	Right-of-Way Impact	The Right-of-Way Impact criterion is a metric that measures the ease of construction/implementation by evaluating the impact to the adjacent properties by calculating the impact by finding the amount land - in square feet - required for right-of-way acquisition.
Project Economics	Cost-Benefit (C-B) Analysis	The C-B Analysis metric measures the alternatives by calculating total Project cost by the performance of the Reduction in Congestion Criterion to compare costs vs. benefits.

Initial Tier 2 Evaluation Criteria		
Category	**Evaluation Criteria**	**Description**
Environmental Impacts	Environmental Impacts	The Environmental Impacts metric scores the No-Build and Tier 2 Alternatives on whether not they can be completed within existing right-of-way or not.

4.5 Project Partner Weighting of the Tier 2 Evaluation Criteria

Once consensus on the Tier 2 Alternative Evaluation Criteria was reached among the Project Partners, the next step was to formulate and assign a weighting value to each criterion. The weight of the criterion is a numeric value that represents the level of importance of each criterion. The weights are then used to calculate the results of the evaluation of each criterion – the higher the weight results in a higher score for that criterion.

In order to determine a weight for each criterion, the Project Team developed an excel-based survey to distribute to each of the Project Partner agencies. The survey included in-depth instructions on how to populate the excel-based tool. The Project Partners were asked to provide two responses per agency that assigned each criterion a numeric value on a scale of 100 based on their perceived level of importance. For example, a completely balanced weight among the criterion would be 7.14 – the value of equilibrium.

100	**/**	**14**	**=**	**7.14**
Weighted total		*# of Criterion*		*Value of Equilibrium*

The Project Team was asked in the survey to adjust the value of equilibrium, by increasing or decreasing the number, based on their respective agency's perception of the relative importance of each criterion. The two responses provided from each Project Partner agency were averaged to arrive at a final weight for each evaluation criteria.

The results of the criteria weighting survey show that the Project Partners shared some commonalities in their perceptions of which criterion were more important, while also some groups assigned a large portion of the points to the criteria that specifically align with their agency goals and objectives. For instance, ADOT had a fairly equal distribution with somewhat of an emphasis in Safety and Project Economics. On the other hand, Mountain Line (AKA NAIPTA) assigned the majority of their points into Expand Travel Mode Choices and Public Acceptance. The City of Flagstaff and the USFS both had a fairly equal distribution of points neat the value of equilibrium. Coconino County had a balanced distribution on points across all categories with the exception of Project Economics and Expand Travel Mode Choices by putting a lot of emphasis on Project Economics and a very little focus on Travel Mode Choices.

FHWA and BNSF decided to opt out of the Project Partner Weighting Survey of the Tier 2 Evaluation Criteria and thus their voided responses were not included in the Tier 2 Evaluation Criteria Weighting process.

Table 4-4 captures the results of the Project Partner weighting survey and the assigned averages for each category based upon the survey inputs received.

Table 4-4: Project Partner Weighting Survey Results of the Tier 2 Evaluation Criteria

Category	Criteria	ADOT		NAIPTA		Coconino County		FMPO		USFS		Flagstaff		NAU		Average Response
		Response 1	Response 2	Response 1	Response 2	Response 1	Response 2	Response 1	Response 2	Response 1	Response 2	Response 1	Response 2	Response 1	Response 2	
Reduction in Vehicular Congestion	Improved Congestion Need Score (Volume/Capacity)	1	2	0	0	6	6	2.5	1.5	6	6	6.25	6.25	15	15	5.25
	Travel Speed as % of Base Free Flow Speed	4	3	0	0	6	6	2.5	1.5	6	5	6.25	6.25	0	0	3.32
	Improved Intersection LOS	8	5	7.5	7.5	6	6	2.5	1.5	6	6	6.25	6.25	8	8	6.04
	Signal/Stop Control Delay	4	3	0	0	6	6	2.5	1.5	6	6	5.55	5.55	0	0	3.29
	Travel Time	8	5	7.5	7.5	6	6	2.5	1.5	6	6	5.55	5.55	0	0	4.79
Safety	Reduction in Total Crashes	5	5	7.5	7.5	8.33	8.33	7.1	5.9	7	7	5.55	5.55	10	10	7.13
	Reduction in All Injury-Related Crashes	5	3	7.5	7.5	8.33	8.33	8.9	5.9	7	7	8	8	15	15	8.18
	Reduction in Bicycle-Related Only Crashes	15	10	7.5	7.5	8.33	8.33	1.8	5.9	7	7	5.55	5.55	5	5	7.10
Expand Travel Mode Choices	Improved Pedestrian Facilities	6	5	13.5	13.5	1.67	1.67	4.1	7.3	6	5	8	8	10	10	7.12
	Improved Bicycle Facilities	7	9	13	13	1.67	1.67	4.1	7.3	6	6	8	8	10	10	7.48
	Transit Travel Time	7	5	10	10	1.67	1.67	5.4	6.5	6	6	6.25	6.25	8	8	6.27
Public Acceptance	Public Support	4	10	10	10	5	5	16.2	16	6	7	6.25	6.25	7	7	8.26
Construction/ Implementation	Project Cost	4	8	4	4	5	5	6.7	6.8	6	6	5	5	0	0	4.68
	ROW Impact	5	7	4	4	5	5	6.7	6.8	6	6	5	5	2	2	4.96
Project Economics	Cost-Benefit Analysis (Total Project Cost vs. reduction in congestion)	14	15	4	4	20	20	13.8	11.9	6	6	7	7	5	5	9.91
Environmental Impacts	Environmental Impacts	3	5	4	4	5	5	12.7	12.2	7	8	5.55	5.55	5	5	6.21
TOTAL VALUE		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

4.6 Final Tier 2 Evaluation Criteria

After the weighting of the Tier 2 Evaluation Criteria was determined, a series of meetings were conducted between the Consultant Team and the Project Partners to refine the Tier 2 Evaluation Criteria and develop a scoring methodology.

4.6a Refinement of Tier 2 Alternative Evaluation Criteria

As the Project Partners and the Consultant Team met to review the Tier 2 Evaluation Criteria, it became evident that some of the criteria had duplicative measures making the potential for an unequitable emphasis on some elements of the Tier 2 Evaluation Criteria. For instance, the Environmental Impacts Criterion and Right-of-Way Impacts Criterion both use right-of-way as the unit of measure putting extra emphasis on the application of right-of-way in the scoring of the Tier 2 Alternatives and the No-Build. This duplicative measure in right-of-way would seem to favor the No-Build and alternatives with a smaller right-of-way footprint while creating a disadvantage on alternatives with a wider footprint. As a result, the Consultant Team and the Project Partners determined this created an advantageous edge for some alternatives and decided to remove the Environmental Impacts Criterion from the Tier 2 Evaluation Criteria.

The Project Partners also discussed potential drawbacks of the Project Economics/Cost-Benefit (C-B) Analyses Criterion. Although this evaluative method is relatively straight forward, and versatile, the Project Partners decided against using a C-B analysis as a decision-making tool. Project Partners were mainly concerned with the potential subjectivity in identifying and quantifying costs and benefits. As a result, the Project Partners decided to remove the Project Economics/C-B Analyses Criterion from the Tier 2 Evaluation Criteria.

Table 4-5 shows the final set of Tier 2 Evaluation Criteria used in the Tier 2 Alternative Evaluation process.

Table 4-5: Final Tier 2 Alternative Evaluation Criteria & Weightings

Evaluation Criteria				Weight
Category	**Criteria / Measure**	**Threshold / Formula**	**Modifier**	
Reduction in Vehicular Congestion	Improves Congestion	Formula = (Best Result / Alternative Result) * Weight * 100 Ex - Alt 4: (6.25/11.03) * 5.25% * 100 = 2.97	N/A	5.25%
	Travel Speed as % of Base Free Flow Speed	Formula = ((Alternative Result * 100) / Best Result) * Weight * 100 / 2 Ex - Alt 4: ((46.1%*100)/62)* 3.32% * 100 /2 = 1.24	N/A	3.32%
	AM			(1.66%)
	PM			(1.66%)
	Improved Intersection LOS	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (2/3) * 6.04% * 100 /2 = 3.02	N/A	6.04%
	AM			(3.02%)
	PM			(3.02%)
	Signal/Stop Control Delay	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (29.5/41.6) * 3.29% * 100 /2 = 1.17	N/A	3.29%
	AM			(1.645%)
	PM			(1.645%)
	Travel Time:	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (339/560) * 4.79% * 100 /2 = 1.45	N/A	4.79%
	AM			(2.395%)
	PM			(2.395%)
Safety	Reduction in Total Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 4: (19.4/28.98) * 7.13% * 100 = 4.77	N/A	7.13%
	Reduced Injury Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 5: (21.78/28.78) * 8.18% * 100 = 6.19	N/A	8.18%
	Reduced Bicycle Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 5: (14/14) * 7.10% * 100 = 7.10	N/A	7.10%
Expand Travel Mode Choices	Pedestrian	Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's (PP) preferred standards	1	7.12%
		Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's (PP) preferred standards, but not both	0.5	
		Maintains Existing Condition	0	
	Bicycle	Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's preferred standards	1	7.48%
		Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's preferred standards, but not both	0.5	
		Maintains Existing Condition	0	
	Transit	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (250/371) * 6.27% * 100 /2 = 2.11	N/A	6.27%
	AM			(3.135%)
	PM			(3.135%)
Public Acceptance	Public Support	*TBD*	*TBD*	8.26%
Construction/ Implementation	Project Cost[#+-]	Formula = (Best Result / (Alternative Result/10M)) * Weight * 100 Ex - Alt 4: (1/(40.542M/10M)) * 4.68% * 100 = 1.15	N/A	4.68%
	ROW Impact[+-] (Square Feet)	Formula = (Best Result / (Alternative Result/10K)) * Weight * 100 Ex - Alt 4: (1/(26,326/10K)) * 4.98% * 100 = 1.89	N/A	4.96%
			Aggregate Score	**83.88%**
				Rank

4.6b Tier 2 Evaluation Criteria Scoring Thresholds and Methodology

The Project Partners and the Consultant Team worked collaboratively to develop uniform scoring methodologies to be applied across all the Tier 2 Evaluation Criteria. The Project Partners and Consultant Team recognized the fact that the metrics used within the evaluation criteria fell into one of two categories – quantitative or qualitative – and determined a scoring methodology would have to be developed to complement the quantitative or qualitative nature of the evaluation criteria. The following sub-sections describe the Tier 2 Evaluation Criteria Scoring Methodology for the quantitative and qualitative evaluation criteria.

Quantitative Scoring Methodology

The quantitative Tier 2 Evaluation Criteria use inputs measured in the form of numbers with numerical values associated with each alternative. Given the numerical values-based nature of these criteria, the Consultant Team worked with ADOT to develop a scoring formula that compliments the quantitative complexion of the criteria. The formula developed for the quantitative evaluation criteria was derived from uses within ADOT's Planning-to-Programming (P2P) process which is used to prioritize projects on the state's highway system. The formula used to calculate the technical score for each of the quantitative Tier 2 Evaluation Criteria is as follows:

Quantitative Tier 2 Evaluation Criteria Scoring Formula

*Technical Score = ((Alternative Result / Best Result) * Evaluation Criteria Weight)*

Results Ratio **Application of the Weight**

The quantitative Tier 2 Evaluation Criteria Scoring Formula has two fundamental steps or sub-calculations – the "Results Ratio" and the "Application of the Weight". The first step or sub-calculation is the results ratio that divides an alternative's result by the best result within a specific evaluation criterion. This step is formulated to reach a value of between one and zero relative to the result of best performing alternative within that specific evaluation criterion. The value of this ratio scales relative to the difference between the alternative result and the best result. Certain evaluation criteria have numeric metrics where the smaller values reflect a higher performing alternative. For example, the Travel Time Criterion is one of the "reverse ranked" criterion since the lesser travel time duration represents a higher performance. In order to preserve the functionality of the results ratio, the following formula is used for quantitative criteria with reverse ranked results:

Reverse Ranking Quantitative Tier 2 Evaluation Criteria Scoring Formula

*Technical Score = ((Best Result / Alternative Result) * Evaluation Criteria Weight)*

Results Ratio **Application of the Weight**

The second step or sub-calculation of the formula is the application of the weight for a specific evaluation criteria determined through the weighing process described in *Section 4.5 - Project Partner Weighting of the Tier 2 Evaluation Criteria*. This calculation is simply applying the weight to the value of the results ratio that falls within the value of one and zero. The weight is applied through a simple multiplication of the weight percentage.

The Quantitative Tier 2 Evaluation Criteria Scoring Formula ensures the highest performing alternative receives the full amount of possible points which is determined by the evaluation criteria weight. For instance, if the Travel Time Criterion has an assigned weight of 2.40%, the most possible points an alternative can receive for the Travel Time Criterion is 2.40 points.

The following example for the application of the scoring formula illustrates how the quantitative scoring works through the numerical scaling relative to the results of the best performing alternative:

In the purpose of the example, three hypothetical alternatives have the following travel times:

- Alternative A: 339 seconds of travel time;
- Alternative B: 400 seconds of travel time; and
- Alternative C: 560 seconds travel time.

Since travel time is a reverse ranked measurement, the following formula is used to calculate the technical score:

*Technical Score = (Best Result / Alternative Result) * Weight * 100*

Table 4-6 illustrates how the technical scores are calculated for each of the example alternatives for their respective travel time results.

Table 4-6: Example Application of the Quantitative Scoring Formula

Alternative	Travel Time Results	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alternative A	339 seconds	((339/339)	* 2.40%) * 100	2.40
Alternative B	400 seconds	((339/400)	* 2.40%) * 100	2.03
Alternative C	560 seconds	((339/560)	* 2.40%) * 100	1.45

Alternative A has the best travel time and as a result of the formula Alternative A is awarded full possible points of 2.40 points. On the other hand, Alternative B and Alternative C receive a lower score relative to their difference in travel time compared to Alternative A – the alterative with the best result. In essence, the scoring formula is structured to assign points based on the difference between an alternative result and the best result, and the greater the difference will result in a lower score relative to the magnitude of the difference.

The following Tier 2 Evaluation Criteria use the Quantitative Scoring Methodology:

- Improved Congestion – Volume/Capacity;
- Travel Speed as Percentage of Base Free Flow Speed;
- Intersection Level-of-Service (LOS);
- Travel Time;
- Reduction in All Crashes;
- Reduction in Injury-Related Crashes;
- Reduction in Bicycle-Related Only Crashes;
- Transit Travel Time;

- Project Cost; and
- Right-of-Way Impact.

Qualitative Scoring Methodology

The subjectivity inherently infused within the qualitative evaluation criteria require a different scoring methodology than the quantitative evaluation criteria. The two qualitative Tier 2 Evaluation Criteria are Improved Pedestrian Facilities and Improved Bicycle Facilities which reference the Controlling Design Criteria discussed in *Section 4.2a - Controlling Design Criteria*. The Consultant Team and ADOT developed three thresholds to ensure compliance of the Controlling Design Criteria while simultaneously instill an advantage for alternatives that meet and exceed the design standards imbedded in the Controlling Design Criteria. The following three thresholds described in **Table 4-7** were developed with a corresponding modifier to be multiplied by the weight to calculate a score for the alternative.

Table 4-7: Example Application of the Qualitative Scoring Formula

	Qualitative Threshold	Modifier	Weight	Score
1	Meets or exceeds both ADOT's minimum standard and the Project Partner preferred standards*	1	7.12	7.12
2	Meets or exceeds ADOT's minimum standard OR the Project Partners preferred standards, but not both*	0.5		3.56
3	Maintains existing condition/does not meet any standards*	0		0
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*				

This scoring methodology ensures that alternatives with facilities that meet or exceed both ADOT's minimum design standard and the Project Partner preferred design standard in the Controlling Design Criteria are awarded full possible points; while also permitting alternatives with facilities that meet or exceed ADOT's minimum design standard OR the Project Partners preferred standards, but not both, to receive half of the possible points; and finally, confirm that all alternatives with facilities that maintain existing condition and/or does not meet any design standards receive zero points.

4.7 Alternative Packaging

Recognizing that the Tier 2 Alternatives were initially developed for specific segments of the US 180 Corridor, a process of "packaging" the alternatives was necessary in order to create a complete and seamless corridor for traffic modeling purposes. The packaging process then included a merging and matching of each Alternative together with the varying character changes and intersection geometry of each roadway segment type (rural/suburban/urban). As depicted in **Figure 4-11** and **Table 4-8** , The US 180 corridor is split into four segments relative to the varying roadway and land character of each segment of US 180. The following three segments were derived through Project Partner discussion:

1. **Urban:** Humphrey's Street from Route 66 to Columbus Avenue
2. **Suburban:** Fort Valley Road from Columbus Avenue to Peak View Street
3. **Rural Fringe:** Fort Valley Road from Peak View Street to Snowbowl Road
4. **Rural:** Fort Valley Road from Snow Bowl Road to MP 233.25

Table 4-8: US 190 Tier 2 Alternative Packaging

Segment		Alternative Packages					
		No-Build	A	B	C	D	E*	F*
1	Urban		Alt 2	Alt 2	Alt 2	Alt 2	Alt 17 Wing Mountain Bypass	Alt 18 Hidden Hollow Bypass
2	Suburban		Alt 3 Suburban	Alt 4a	Alt 4b	Alt 6		
3	Rural Fringe		Alt 3 Rural	Alt 6	Alt6	Alt 6		
4	Rural		Alt 3 Rural	No-Build	No-Build	No-Build		
**The US 180 is considered under the No-Build condition under Alternative Package E and Alternative Package F*								

The following pages provide graphical representation of the six alternative packages.

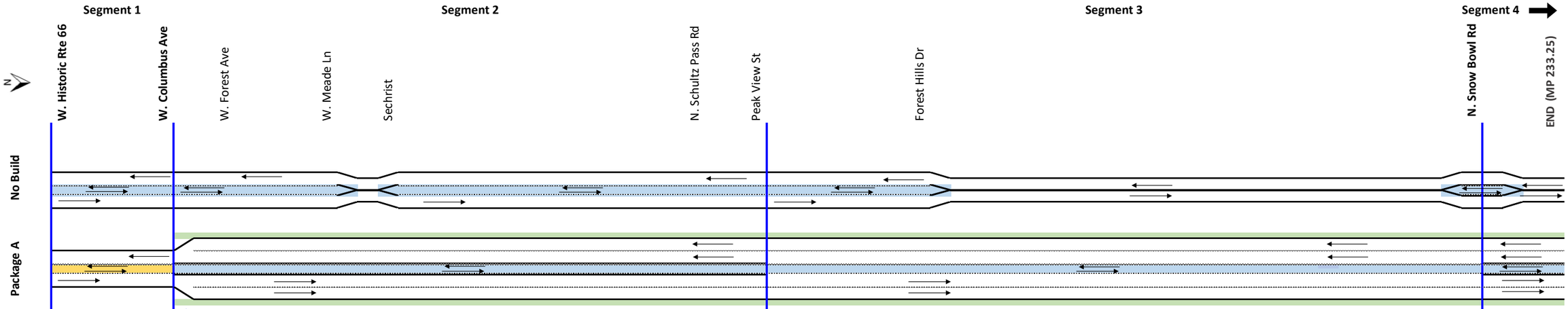
Figure 4-11: US 180 Study Corridor Segmentation

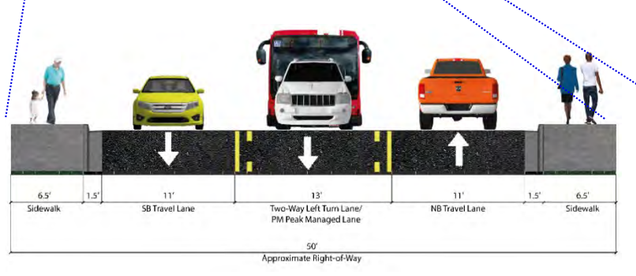
Alternative Package A

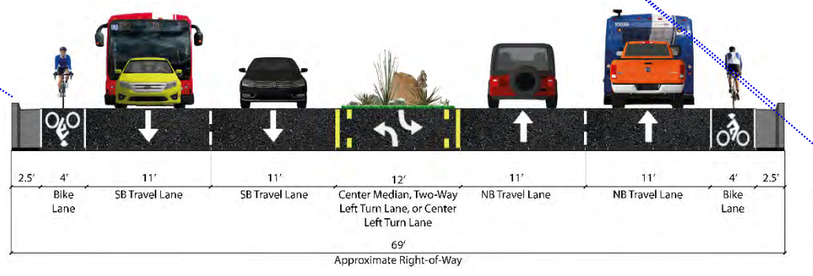
LEGEND

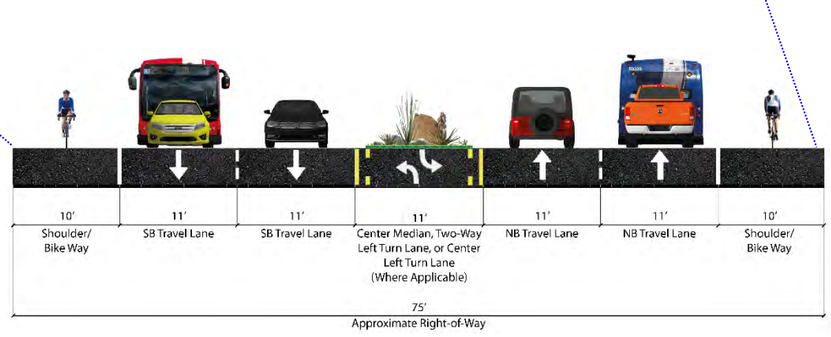
- = General Purpose Lane
- = Bike Lane/Bikeway
- = Dynamic Shoulder
- = Two-way Left Turn Lane (TWLTL)
- = TWLTL or Peak Hour Managed Lane - All Traffic
- = TWLTL or Peak Hour Managed Lane - Transit Only

Segment		Alternative Package						
		No Build	A	B	C	D	E (Alt 17 -Wing Mtn Rd)	F (Alt 18 - Hidden Hollow)
1	Route 66 to Columbus (Urban)		Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	No Build	No Build
2	Columbus to Peak View (Suburban)		Alt 3 Suburban	Alt 4A - AM managed lane NB - PM managed lane SB	Alt 4B (Transit) - AM Bus NB - PM Bus SB	Alt 6 (Transit) - SB bus lane	No Build	No Build
3	Peak View to Snowbowl Rd (Rural)		Alt 3 Rural	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	No Build	No Build
4	Snowbowl Rd to MP 233.55 (Rural)		Alt 3 Rural	No Build	No Build	No Build	No Build	No Build





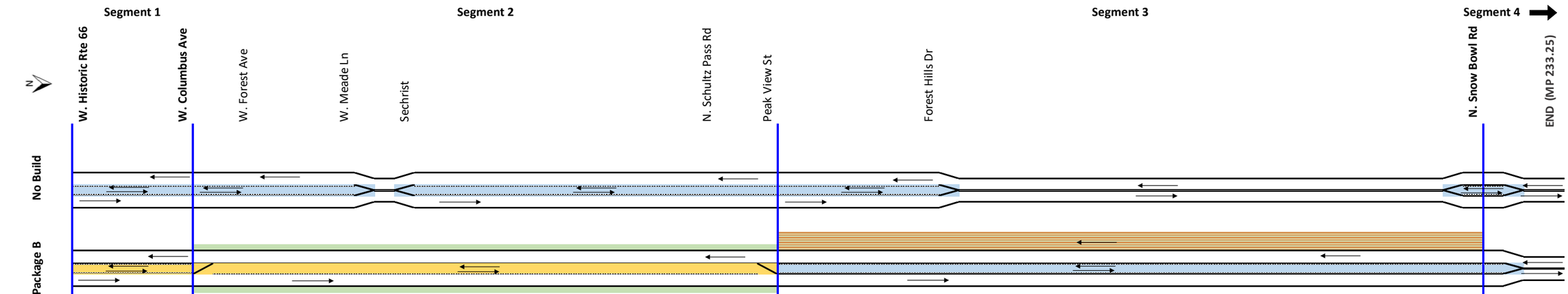


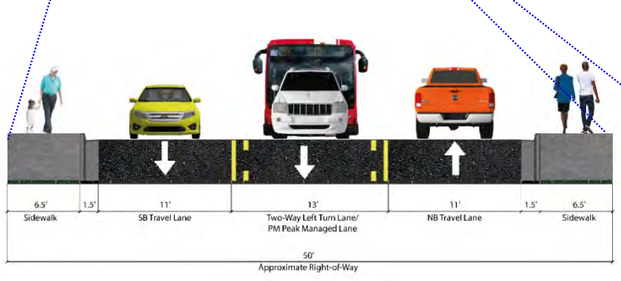


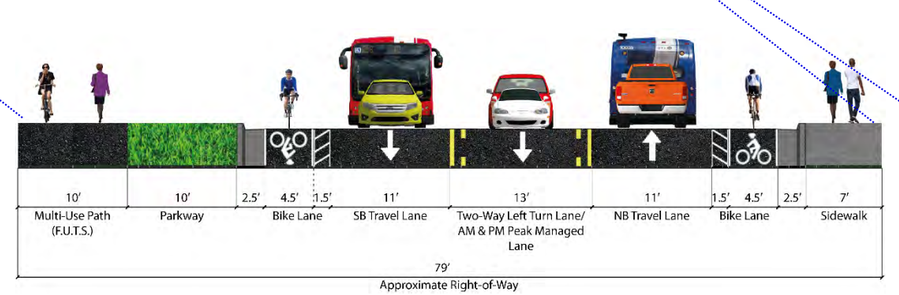
Alternative Package B

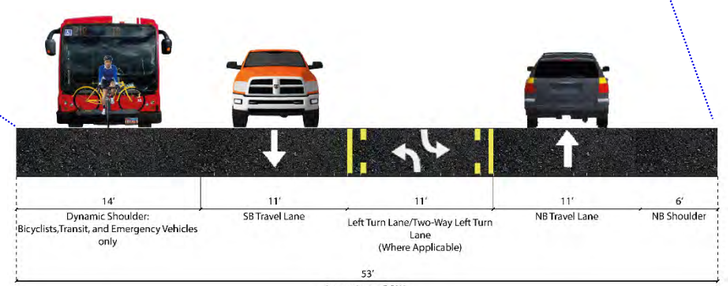
LEGEND
- = General Purpose Lane
- = Bike Lane/Bikeway
- = Dynamic Shoulder
- = Two-way Left Turn Lane (TWLTL)
- = TWLTL or Peak Hour Managed Lane - All Traffic
- = TWLTL or Peak Hour Managed Lane - Transit Only

Segment		Alternative Package						
		No Build	A	B	C	D	E (Alt 17 -Wing Mtn Rd)	F (Alt 18 - Hidden Hollow)
1	Route 66 to Columbus (Urban)		Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	No Build	No Build
2	Columbus to Peak View (Suburban)		Alt 3 Suburban	Alt 4A - AM managed lane NB - PM managed lane SB	Alt 4B (Transit) - AM Bus NB - PM Bus SB	Alt 6 (Transit) - SB bus lane	No Build	No Build
3	Peak View to Snowbowl Rd (Rural)		Alt 3 Rural	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	No Build	No Build
4	Snowbowl Rd to MP 233.55 (Rural)		Alt 3 Rural	No Build	No Build	No Build	No Build	No Build







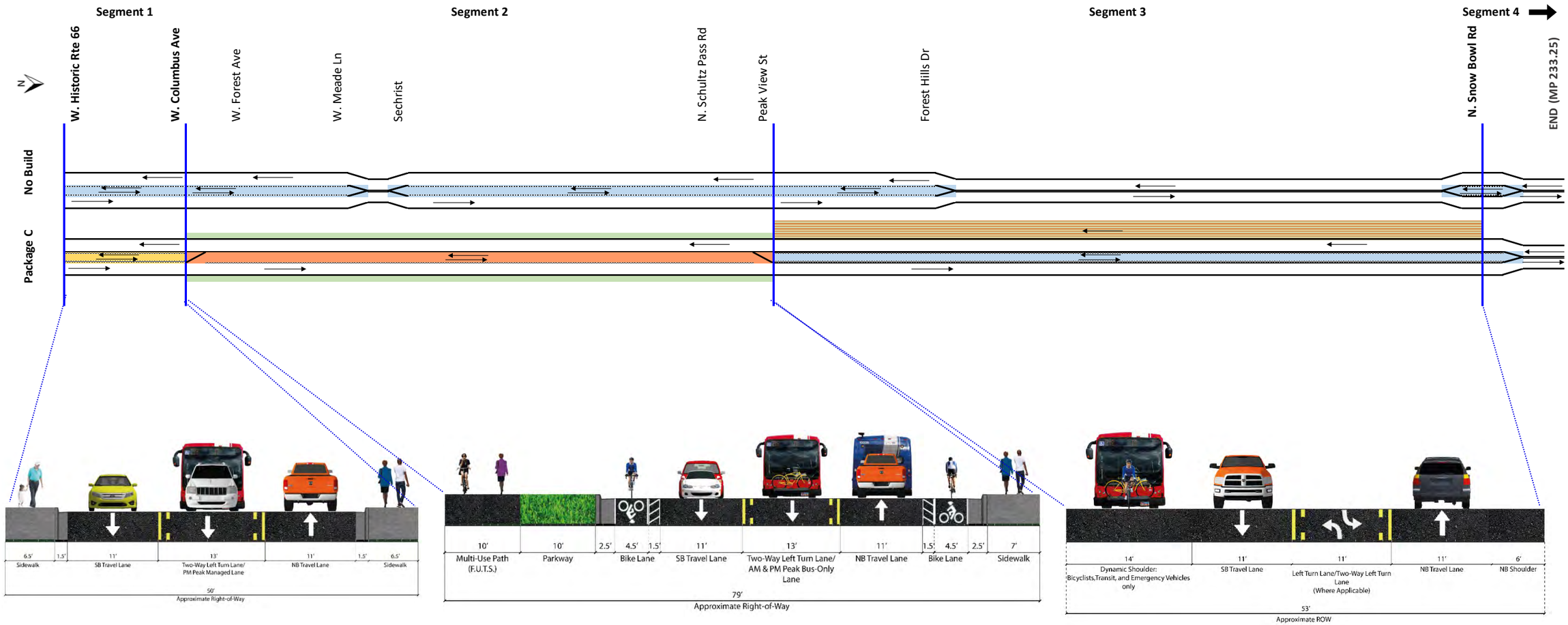


Alternative Package C

LEGEND

- = General Purpose Lane
- = Bike Lane/Bikeway
- = Dynamic Shoulder
- = Two-way Left Turn Lane (TWLTL)
- = TWLTL or Peak Hour Managed Lane - All Traffic
- = TWLTL or Peak Hour Managed Lane - Transit Only

Segment		Alternative Package						
		No Build	A	B	C	D	E (Alt 17 -Wing Mtn Rd)	F (Alt 18 - Hidden Hollow)
1	Route 66 to Columbus (Urban)		Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	No Build	No Build
2	Columbus to Peak View (Suburban)		Alt 3 Suburban	Alt 4A - AM managed lane NB - PM managed lane SB	Alt 4B (Transit) - AM Bus NB - PM Bus SB	Alt 6 (Transit) - SB bus lane	No Build	No Build
3	Peak View to Snowbowl Rd (Rural)		Alt 3 Rural	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	No Build	No Build
4	Snowbowl Rd to MP 233.55 (Rural)		Alt 3 Rural	No Build	No Build	No Build	No Build	No Build

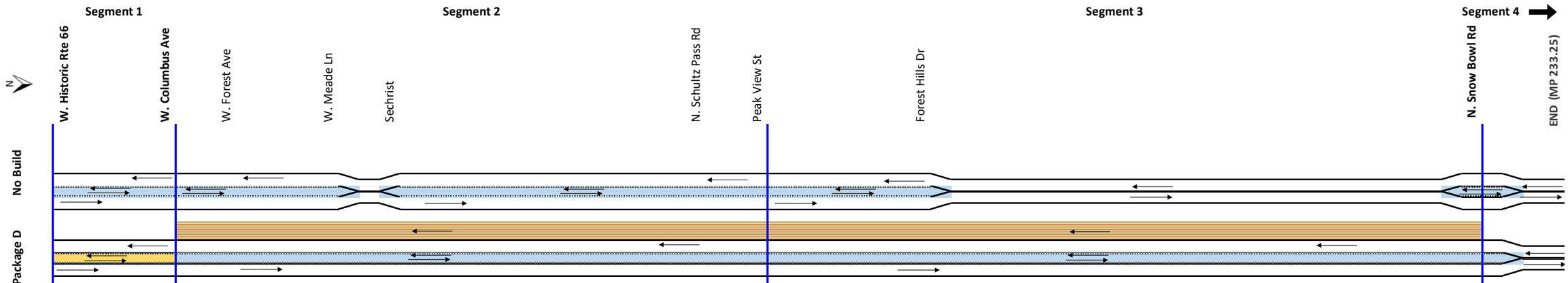


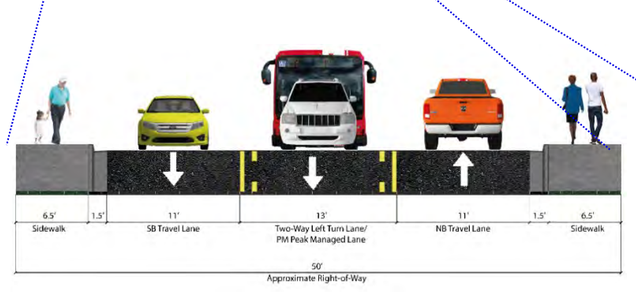
Alternative Package D

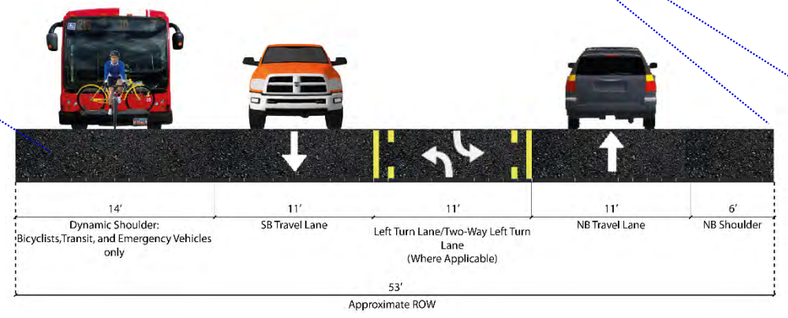
LEGEND

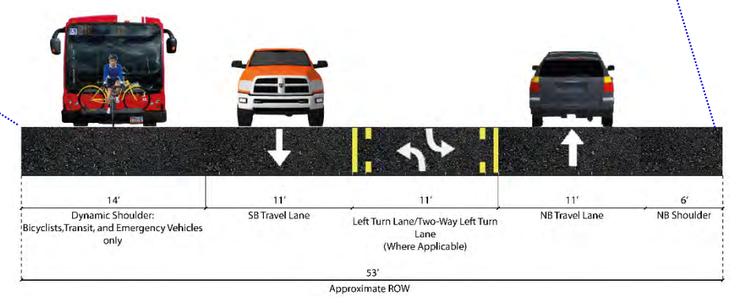
- = General Purpose Lane
- = Bike Lane/Bikeway
- = Dynamic Shoulder
- = Two-way Left Turn Lane (TWLTL)
- = TWLTL or Peak Hour Managed Lane - All Traffic
- = TWLTL or Peak Hour Managed Lane - Transit Only

Segment		Alternative Package						
		No Build	A	B	C	D	E (Alt 17 -Wing Mtn Rd)	F (Alt 18 - Hidden Hollow)
1	Route 66 to Columbus (Urban)		Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	No Build	No Build
2	Columbus to Peak View (Suburban)		Alt 3 Suburban	Alt 4A - AM managed lane NB - PM managed lane SB	Alt 4B (Transit) - AM Bus NB - PM Bus SB	Alt 6 (Transit) - SB bus lane	No Build	No Build
3	Peak View to Snowbowl Rd (Rural)		Alt 3 Rural	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	No Build	No Build
4	Snowbowl Rd to MP 233.55 (Rural)		Alt 3 Rural	No Build	No Build	No Build	No Build	No Build







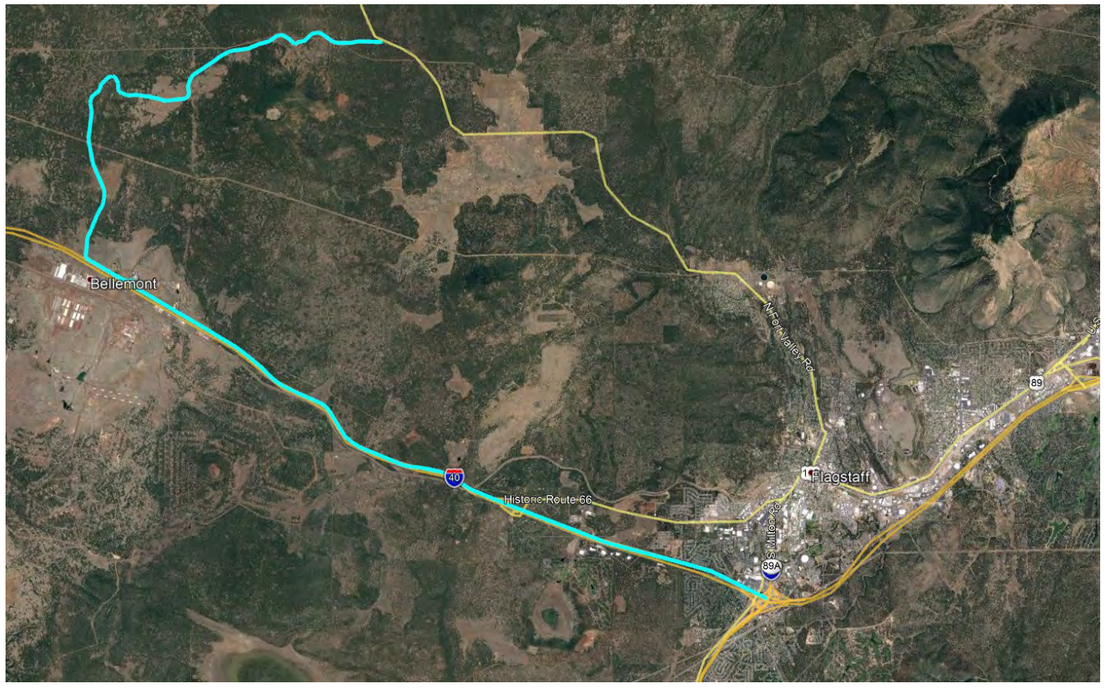


Alternative Routes

Segment		Alternative Package						
		No Build	A	B	C	D	E (Alt 17 -Wing Mtn Rd)	F (Alt 18 - Hidden Hollow)
1	Route 66 to Columbus (Urban)		Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	Alt 2 - AM no change - PM SB managed lane	No Build	No Build
2	Columbus to Peak View (Suburban)		Alt 3 Suburban	Alt 4A - AM managed lane NB - PM managed lane SB	Alt 4B (Transit) - AM Bus NB - PM Bus SB	Alt 6 (Transit) - SB bus lane	No Build	No Build
3	Peak View to Snowbowl Rd (Rural)		Alt 3 Rural	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	Alt 6 (Transit) - SB bus lane	No Build	No Build
4	Snowbowl Rd to MP 233.55 (Rural)		Alt 3 Rural	No Build	No Build	No Build	No Build	No Build

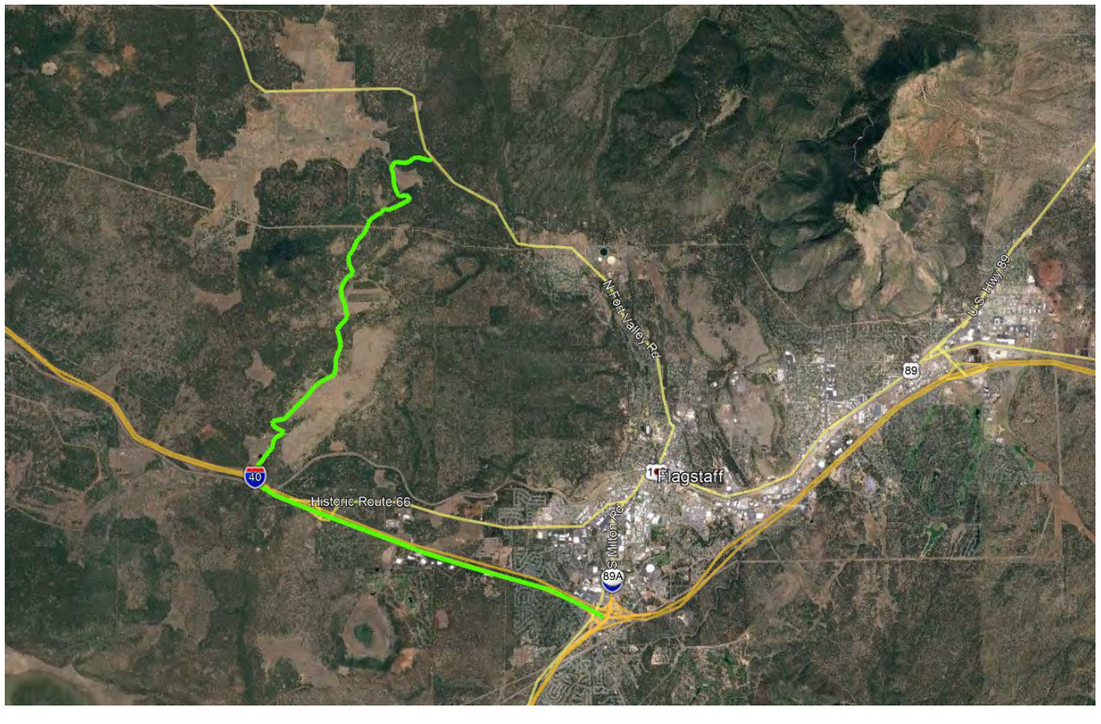
Alternative Package E

Wing Mountain Road Route



Alternative Package F

Hidden Hollow Road Route



4.8 Summary of Tier 2 Evaluation Criteria Results and Analysis Findings

This section describes a brief summary of the results for the Tier 2 Alternative Evaluation process of the seven Tier 2 Alternatives through the application of the Tier 2 Evaluation Criteria. Immediately following this summary, *Section 4.9* - Tier 2 Evaluation Criteria Detailed Results includes more detailed results and a systematic synopsis for each of the Tier 2 Evaluation Criteria.

The US 180 CMP Tier 2 Alternatives range in performance rating based on the score of the Tier 2 Alternative Evaluation Criteria. The highest performing alternative received a score of 58.42 points while the lowest performing alternative received a score of 27.50 points – over a 30-point difference. **Table 4-9** ranks the alternatives from highest scoring to lowest scoring alternative.

Table 4-9: Tier 2 Alternative Rankings Based on Tier 2 Evaluation Criteria Results

Rank	Tier 2 Alternative	Score
1	Alternative A	58.42
2	Alternative D	41.38
3	No-Build	34.06
4	Alternative B	30.67
5	Alternative C	30.19
6	Alternative F	27.51
7	Alternative E	27.50

As demonstrated in **Table 4-9**, Alternative A received the highest score of 58.42 points followed by Alternative D with 41.38 points, No-Build with 34.06 points, Alternative B with 30.67 points, Alternative C with 30.19 points, Alternative F with 27.51 points, and Alternative E with 27.50 points.

The results of the Tier 2 Alternative Evaluation process appear to be aligned with the visual representation of the benefits and trade-offs associated with each of the alternatives. For instance, Alternative A intuitively could be expected to be the best performing alternative because the alternative includes a benefit for all modes of transportation by increasing vehicular capacity through the addition of two travel lanes and improving the corridor for bicyclist.

Conversely, Alternative F and Alternative E (alternative routes) did not perform as well as the other alternatives because these two alternatives do not significantly improve travel times and/or other vehicular operations of the US 180 corridor in an impactful manner. These two alternatives also have the significantly higher costs and right-of-way impacts compared to the other alternatives.

The reason why the No-Build option ranks third of all seven Tier 2 Alternatives could be primarily due to the zero cost and right-of-way impact, but also correlated with the fact that the No-Build condition performs operationally at a relatively high enough level when compared to the lower scoring alternatives across the other evaluation criteria. In theory, the No-Build option ranking third could provide a baseline for a hypothetical cost-benefit ratio where the alternatives that rank below the No-Build have a cost/impacts that outweigh the overall benefits, while the alternatives that rank above the No-Build have overall benefits that outweigh to the cost/impacts.

Table 4-10 provides a summary of the results for Tier 2 Alternative Evaluation process.

Table 4-10: Detailed Results of the Tier 2 Evaluation Criteria

Evaluation Criteria				Weight	No Build		Package A		Package B		Package C		Package D		Package E (Alt 17)		Package F (Alt 18)	
Category	Criteria / Measure	Threshold / Formula	Modifier		Result	Weighted Score	Result	Weighted Score	Result	Weighted Score	Result	Weighted Score	Result	Weighted Score	Result	Weighted Score	Result	Weighted Score
Reduction in Vehicular Congestion	Improves Congestion (Average of existing and future volumes)	Formula = (Best Result / Alternative Result) * Weight * 100 Ex - Pkg C: (6.23/9.09) * 5.25% * 100 = 3.60	N/A	5.25%	9.23	3.54	6.23	5.25	8.88	3.68	9.09	3.60	9.09	3.60	8.05	4.06	7.75	4.22
	Travel Speed as % of Base Free Flow Speed	Formula = ((Alternative Result * 100) / Best Result) * Weight * 100 / 2 Ex - Pkg C: ((74.5%*100)/84.9)* 3.32% * 100 /2 = 1.46	N/A	3.32%														
	AM			(1.66%)	84.8%	1.61	87.4%	1.66	82.4%	1.57	84.4%	1.60	82.6%	1.57	86.9%	1.65	86.0%	1.63
	PM			(1.66%)	83.4%	1.63	84.9%	1.66	76.6%	1.50	74.5%	1.46	75.3%	1.47	84.7%	1.66	84.9%	1.66
	Improved Intersection LOS	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Pkg C: (6/6) * 6.04% * 100 /2 = 3.02	N/A	6.04%														
	AM			(3.02%)	6	3.02	6	3.02	6	3.02	6	3.02	6	3.02	6	3.02	6	3.02
	PM			(3.02%)	7	2.59	7	2.59	6	3.02	6	3.02	6	3.02	7	2.59	7	2.59
	Signal/Stop Control Delay	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Pkg C: (71.2/222.3) * 3.29% * 100 /2 = 0.53	N/A	3.29%														
	AM			(1.645%)	164.8	0.71	162	0.72	195.6	0.60	222.3	0.53	290.5	0.40	71.2	1.65	80.2	1.46
	PM			(1.645%)	85.3	0.92	47.5	1.65	63.8	1.23	63.1	1.24	55.5	1.41	63.2	1.24	55.1	1.42
	Travel Time:	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Pkg C: (931/965) * 4.79% * 100 /2 = 2.31	N/A	4.79%														
	AM			(2.395%)	959	2.33	931	2.40	986	2.26	965	2.31	987	2.26	935	2.39	945	2.36
	PM			(2.395%)	984	2.33	958	2.39	1073	2.14	1105	2.08	1092	2.10	959	2.39	957	2.40
Safety	Reduction in Total Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Pkg C: (11.55/37.13) * 7.13% * 100 = 2.22	N/A	7.13%	0	0*	37.13	7.12	11.55	2.22	11.55	2.22	25.60	4.91	0	0*	0	0*
	Reduced Injury Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Pkg C: (11.50/46.12) * 8.18% * 100 = 2.04	N/A	8.18%	0	0*	46.41	8.18	14.63	2.58	11.50	2.03	23.75	4.18	0	0*	0	0*
	Reduced Bicycle Crashes	Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Pkg C: (-5.31/3.5) * 7.10% * 100 = -10.78	N/A	7.10%	0	0*	3.50	7.10	-5.31	-7.10	-5.31	-7.10	0	0*	0	0*	0	0*
Expand Travel Mode Choices	Pedestrian	Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's (PP) preferred standards	1	7.12%	-	0.00	Varries	3.56	Varries	3.56	Varries	3.56	Varries	3.56	-	0.00	-	0.00
		Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's (PP) preferred standards, but not both	0.5															
		Maintains Existing Condition	0															
	Bicycle	Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's preferred standards	1	7.48%	-	0.00	Varries	4.68	Varries	2.81	Varries	2.81	Varries	1.87	-	0.00	-	0.00
		Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's preferred standards, but not both	0.5															
		Maintains Existing Condition	0															
	Transit	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Pkg C: (755/893) * 6.27% * 100 /2 = 2.65	N/A	6.27%														
	AM			(3.135%)	834	2.84	862	2.74	895	2.64	893	2.65	1075	2.20	755	3.13	790	3.00
	PM			(3.135%)	894	2.90	866	3.00	1031	2.52	949	2.74	964	2.70	829	3.13	873	2.98

Results continued on the following page

Evaluation Criteria				Weight	No Build		Package A		Package B		Package C		Package D		Package E (Alt 17)		Package F (Alt 18)	
Category	**Criteria / Measure**	**Threshold / Formula**	**Modifier**		**Result**	**Weighted Score**	**Result**	**Weighted Score**	**Result**	**Weighted Score**	**Result**	**Weighted Score**	**Result**	**Weighted Score**	**Result**	**Weighted Score**	**Result**	**Weighted Score**
Public Acceptance	Public Support	*TBD*	*TBD*	8.26%	*TBD*		*TBD*		*TBD*		*TBD*		*TBD*		*TBD*		*TBD*	
Construction/ Implementation	Project Cost[#+-]	Formula = (Best Result / (Alternative Result/10M)) * Weight * 100 Ex - Pkg C: (1/(24.576M/10M)) * 4.68% * 100 = 1.90	N/A	4.68%	$0.00	4.68	$87,291,544	0.54	$24,576,648	1.90	$24,576,648	1.90	$20,652,488	2.27	$80,265,491	0.58	$62,352,890	0.75
	ROW Impact[+-] (Square Feet)	Formula = (Best Result / (Alternative Result/10K)) * Weight * 100 Ex - Pkg C: (1/(91,728/10K)) * 4.98% * 100 = 0.54	N/A	4.96%	0	4.96	303,909	0.16	91,728	0.54	91,728	0.54	58,968	0.84	2,557,843	0.02	1,993,306	0.02
			Aggregate Score	**83.88%**	**34.06**		**58.42**		**30.67**		**30.19**		**41.38**		**27.50**		**27.51**	
				Rank	**3**		**1**		**4**		**5**		**2**		**7**		**6**	

Notes:
*If no bicycle lane is recommended as a component of the alternative (Alt. 2,3 rural, and 6) bicycle crash modification factors are not provided by the Clearinghouse, resulting in a score of zero. # Project Costs for managed lane alternatives do not include costs for permanant or variable message signing.
+A common denominator has been added to the formula the normalize the relationship between the best result and the other results due to the large disparity between the two. -ROW impact/cost does not include any costs that may be associated with a potential impact to an existing building.
Project Economics and Environmental Impacts criterion will be included in Tier 3 Alternative Evaluation Analysis.

4.9 Tier 2 Evaluation Criteria Detailed Results

This section describes the detailed results for the Tier 2 Alternative evaluation process of the seven Tier 2 Alternatives using the Evaluation Criteria, Scoring Thresholds and Scoring Thresholds discussed in the previous sections. Refer back to **Table 4-10** for the results presented in the following sub-sections.

4.9a Reduction in Vehicular Congestion - *Improves Congestion Criterion Results*

ADOT's Congestion Needs Score (CNS) Tool is the source that calculates the results for the Improves Congestion criterion. The results of the CNS for each Tier 2 Alternative are displayed below in **Table 4-11**.

Table 4-11: Improves Congestion Criterion Results

ID #	Route	Future AADT (2040)	Capacity Threshold (2040)	Percent of Threshold (2040)	Future Congestion Need Score*	Future Congestion Need Score Average*	Fnctl Class
No-Build	Route 66 to Columbus	21,010	30,000	70.0%	14.01	9.23	2-lanes, Urban, Minor Arterial
	Columbus to Peak View	18,514	33,600	55.1%	11.02		2-lanes, Suburban, Minor Arterial
	Peak View to Snowbowl Rd	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
	Snowbowl to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
Alt A	Route 66 to Columbus	21,010	31,250	67.2%	13.45	6.23	2-lanes, Urban, Minor Arterial except in the PM Peak. PM Peak (2 hours) - 3-lanes, Urban, Minor Arterial
	Columbus to Peak View	18,514	67,200	27.6%	5.51		4-lanes, Suburban, Minor Arterial
	Peak View to Snowbowl Rd	8,568	57,600	14.9%	2.97		4-lanes, Rural, Major Collector
	Snowbowl to MP 233.55	8,568	57,600	14.9%	2.97		4-lanes, Rural, Major Collector
Alt B	Route 66 to Columbus	21,010	31,250	67.2%	13.45	8.88	2-lanes, Urban, Minor Arterial except in the PM Peak. PM Peak (2 hours) - 3-lanes, Urban, Minor Arterial
	Columbus to Peak View	18,514	36,400	50.9%	10.17		2-lanes, Suburban, Minor Arterial except during peak hours. Peak hours (4 hours) - 3-lanes, Suburban, Minor Arterial (AM-NB, PM-SB managed lar
	Peak View to Snowbowl Rd	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector + Transit lane in the SB direction
	Snowbowl to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
Alt C	Route 66 to Columbus	21,010	31,250	67.2%	13.45	9.09	2-lanes, Urban, Minor Arterial except in the PM Peak. PM Peak (2 hours) - 3-lanes, Urban, Minor Arterial
	Columbus to Peak View	18,514	33,600	55.1%	11.02		2-lanes, Suburban, Minor Arterial + Transit lane during peak hours
	Peak View to Snowbowl Rd	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector + Transit lane in the SB direction
	Snowbowl to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
Alt D	Route 66 to Columbus	21,010	31,250	67.2%	13.45	9.09	2-lanes, Urban, Minor Arterial except in the PM Peak. PM Peak (2 hours) - 3-lanes, Urban, Minor Arterial
	Columbus to Peak View	18,514	33,600	55.1%	11.02		2-lanes, Suburban, Minor Arterial + Transit lane in the SB direction
	Peak View to Snowbowl Rd	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector + Transit lane in the SB direction
	Snowbowl to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
Alt 17	Route 66 to Columbus	18,909	30,000	63.0%	12.61	8.05	2-lanes, Urban, Minor Arterial
	Columbus to Peak View	16,414	33,600	48.9%	9.77		2-lanes, Suburban, Minor Arterial
	Peak View to Snowbowl Rd	6,468	28,800	22.5%	4.49		2-lanes, Rural, Major Collector
	Snowbowl to Alt 17 Intersection	10,668	28,800	37.0%	7.41		2-lanes, Rural, Major Collector
	Alt 17 Intersection to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
Alt 18	Route 66 to Columbus	18,909	30,000	63.0%	12.61	7.75	2-lanes, Urban, Minor Arterial
	Columbus to Peak View	16,414	33,600	48.9%	9.77		2-lanes, Suburban, Minor Arterial
	Peak View to Alt 18 Intersection	6,468	28,800	22.5%	4.49		2-lanes, Rural, Major Collector
	Alt 18 Intersection to Snowbowl	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector
	Snowbowl to MP 233.55	8,568	28,800	29.7%	5.95		2-lanes, Rural, Major Collector

The CNS results are "reversed ranked" whereby the lowest numbers represent the higher performing alternatives. Thus, Alternative A is the highest performing alterntive with a CNS of 6.23, where the No-Build is the lowest performing alternative with a CNS of 9.23. The Tier 2 Alternatives are ranked below from highest to lowest in regards to CNS – the Improves Congestion criterion.

1. Alternative Package A – 6.23 CNS
2. Alternative Package F – 7.75 CNS
3. Alternative Package E – 8.05 CNS
4. Alternative Package B – 8.88 CNS
5. Alternative Package C – 9.09 CNS
5. Alternative Package D – 9.09 CNS
7. No-Build – 9.23 CNS

The CNS was calculated with the followng four steps:

1. Identified the future AADTs from the FMPO Regional TDM Model traffic volumes.
2. Identified the Capacity Threshold through the multiplication of the number of vehicular lanes for each alternative by the capacity in accordance of facility type as noted **Table 4-12**. Milton Road is identfied as an urban major arterial facility with an hourly maximum capacity of 800 vehicles per lane. Then Multiply by 24 hours to calculate the alternatives' capacity threshold.

Table 4-12: ADOT's Hourly Capacity Threshold Per Hour by Facility Type

facility_code	facility_type	1-CBD	2-Urban	3-Suburban	4-Rural	5-SmTownCBD	6-OutOfState
0	HOV	2000	2000	2000	2000	2000	99999
1	Freeway	2000	2000	2000	2000	2000	99999
2	Major Arterial	700	800	900	1000	900	99999
3	Minor Arterial	550	625	700	800	700	99999
4	Major Collector	400	450	500	600	500	99999
5	Minor Collector	300	350	400	500	400	99999
7	Ramp	1000	1100	1200	1200	1200	99999
8	Metered Ramp	1000	1100	1200	1200	1200	99999
9	Centroid Connector	99999	99999	99999	99999	99999	99999

The formula below is an example of how the capacity threshold is calculated:

800	*	**6**	*	**24**	**115,200**
*Hourly lane capacity for an urban arterial**		*Number of vehicular lanes*		*Hours of roadway operation*	*Calculated Capacity Threshold*

3. Divide the furture AADT by the Capacity Threshold, then multiply the result by 100 to obtain a percentage.

(42,366	**/**	**115,200)**	*** 100**	**=**	**36.8%**
2040 AADT		*2040 Capacity Threshold*			*Percent of Threshold*

4. Multiply the future AADT percentage by the maximum points possible (20) to obtain the Future CNS.

   One assumption was used in the calculation of the CNS:

   - 10% of the total traffic (in the vicinity of Route 66 and Columbus, which is approximately 2,100 daily trips in 2040) are diverted to the alternative routes

Application of the Improves Congestion Results to Calculate the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Improves Congestion criterion. Refer back to *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* for the background behind the development of the formula. The following formula was used to calculate the scores:

*Technical Score = (Best Result / Alternative Result) * Weight * 100*

Table 4-13 shows how the scores were calculated for the No-Build option and the six Tier 2 Alternatives relative to the results of the Improves Congestion creation in order of highest to lowest scoring.

Table 4-13: Improves Congestion Criterion Results in the Calculation of the Technical Score

Alternative	Improves Congestion Result	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	6.23 CNS	((6.23/6.23)	* 5.25%) * 100	5.25
Alt Package F	7.75 CNS	((6.23/7.75)	* 5.25%) * 100	4.22
Alt Package E	8.05 CNS	((6.23/8.05)	* 5.25%) * 100	4.06
Alt Package B	8.88 CNS	((6.23/8.88)	* 5.25%) * 100	3.68
Alt Package C	9.09 CNS	((6.23/9.09)	* 5.25%) * 100	3.60
Alt Package D	9.09 CNS	((6.23/9.09)	* 5.25%) * 100	3.60
No-Build	9.23 CNS	((6.23/9.23)	* 5.25%) * 100	3.54

4.9b Reduction in Vehicular Congestion - *Travel Speed as a Percentage of Base Free Flow Speed Criterion Results*

The Travel Speed as a Percentage of Base Free Flow Speed criterion is a metric that measures reduction in vehicular congestion by comparing the year 2040 travel speed in miles per hour (MPH) relative to the base free flow speed of 49.8 MPH. The results of the year 2040 travel speed for the No-Build option and the six Tier 2 Alternatives is output from the Vissim Model.

In order to reach a comprehensive measure, travel speeds during both the AM and PM time periods were used to measure the overall performance. The travel speeds in each direction of US 180 – eastbound and westbound – were averaged to reach combined travel speed for the AM and PM timeframes.

The results of the of the Travel Speed as a Percentage of Base Free Flow Speed criterion are shown below in **Table 4-14** for the No-Build option and other six Tier 2 Alternatives. Refer to Appendix D

for detailed Vissim model output results of the AM and PM Travel Speed as a Percentage of Base Free Flow Speed.

Table 4-14: AM and PM Travel Speed as a % of Base Free Flow Speed Criterion Results

AM - Average Speed		No Build AM	Package A AM		Package B AM		Package C AM		Package D AM		Package E AM		Package F AM	
Corridor	Segment	Average Speed (mph)	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change
US-180 WB	1	11.9	12.5	4.7%	10.9	-8.6%	11.6	-2.9%	9.9	-17.0%	15.5	30.1%	14.5	21.1%
US-180 WB	2	36.0	39.3	9.1%	38.1	5.8%	37.3	3.7%	35.9	-0.1%	36.7	1.9%	35.9	-0.4%
US-180 WB	3	48.4	50.8	4.9%	49.8	3.0%	48.8	0.9%	48.4	-0.1%	48.7	0.6%	48.5	0.3%
US-180 WB	4	56.0	53.1	-5.3%	52.7	-6.0%	52.5	-6.3%	52.4	-6.5%	55.9	-0.3%	55.9	-0.2%
Entire Corridor		41.0	42.1	2.9%	40.5	-1.0%	40.5	-1.2%	38.8	-5.2%	42.9	4.7%	42.2	3.0%
US-180 EB	4	56.2	56.3	0.2%	56.2	0.0%	56.2	0.0%	56.2	0.0%	55.9	-0.5%	56.2	0.0%
US-180 EB	3	51.1	52.0	1.9%	50.6	-0.8%	50.6	-0.8%	51.2	0.2%	51.1	0.0%	51.1	0.0%
US-180 EB	2	35.2	39.0	10.7%	34.1	-3.1%	35.3	0.3%	35.2	0.1%	36.0	2.3%	35.2	0.0%
US-180 EB	1	17.0	16.8	-1.1%	13.5	-20.5%	17.4	2.1%	16.9	-1.0%	17.0	-0.3%	17.1	0.5%
Entire Corridor		43.5	44.9	3.3%	41.6	-4.4%	43.5	0.1%	43.5	-0.1%	43.7	0.4%	43.5	0.1%
Average Speed of US-180 EB/WB - AM		42.2	43.5		41.1		42.0		41.1		43.3		42.8	
Travel Speed as %of Base Free Flow Speed		84.8%	87.4%		82.4%		84.4%		82.6%		86.9%		86.0%	

PM - Average Speed		No Build PM	Package A PM		Package B PM		Package C PM		Package D PM		Package E PM		Package F PM	
Corridor		Average Speed (mph)	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change	Average Speed (mph)	Average Speed Percent Change
Milton Rd NB		7.0	5.5	-21.9%	6.1	-12.7%	5.5	-21.9%	6.1	-12.7%	6.3	-10.6%	6.1	-13.2%
Milton Rd SB		12.5	11.9	-4.4%	11.6	-7.4%	11.9	-4.4%	11.6	-7.4%	11.6	-6.7%	12.0	-3.9%
US-180 WB	1	15.3	16.9	10.9%	17.3	13.6%	16.7	9.4%	16.5	8.2%	16.6	9.0%	16.4	7.8%
US-180 WB	2	33.5	35.8	6.9%	34.3	2.2%	32.9	-1.9%	34.0	1.3%	33.7	0.4%	33.7	0.5%
US-180 WB	3	50.0	51.2	2.3%	50.0	-0.1%	49.3	-1.5%	49.1	-1.8%	50.4	0.7%	50.1	0.2%
US-180 WB	4	55.7	52.9	-4.9%	50.9	-8.6%	50.9	-8.6%	50.8	-8.8%	55.2	-0.9%	55.2	-0.9%
Entire Corridor		42.8	43.0	0.6%	41.8	-2.2%	41.0	-4.2%	41.3	-3.6%	42.5	-0.7%	42.4	-0.9%
US-180 EB	4	55.3	55.9	1.1%	55.3	0.0%	55.3	0.1%	55.3	0.1%	55.4	0.2%	55.2	-0.2%
US-180 EB	3	49.6	51.6	4.2%	49.3	-0.6%	49.0	-1.2%	49.0	-1.1%	49.8	0.4%	49.5	-0.1%
US-180 EB	2	31.0	34.2	10.5%	24.3	-21.7%	21.0	-32.2%	21.3	-31.2%	33.1	6.6%	33.7	8.6%
US-180 EB	1	14.1	12.9	-8.2%	8.9	-36.6%	9.6	-31.7%	10.2	-27.4%	16.1	14.0%	16.6	17.7%
Entire Corridor		40.3	41.5	3.0%	34.4	-14.6%	33.2	-17.6%	33.7	-16.3%	41.9	4.0%	42.2	4.8%
Average Speed of US-180 NB/SB - PM		41.5	42.3		38.1		37.1		37.5		42.2		42.3	
avel Speed as Percent of Base Free Flow Spe		83.4%	84.9%		76.6%		74.5%		75.3%		84.7%		84.9%	

As noted in the bottom row for the AM and PM time periods, the higher percentage of base free flow speed results in a higher performing alternative when evaluating the reduction of vehicular congestion. Alternative Package A has the fastest average travel speed in both time periods with an average travel speed of 43.5 MPH in the AM and an average travel speed of 42.3 MPH in the PM. As a result, Alternative Package A will also have the highest travel speed as a percent of base free flow speed in both the AM and PM time periods – receiving 87.4% and 84.9% respectively.

Conversely, Alternative Package C has the slowest average travel speed in the PM period at 37.1 MPH and has the third slowest travel speed by small margin in the AM time period at 42.0 MPH. As a result, Alternative Package C has the lowest percent of base flow speed in the PM at 74.5% and the third lowest in the AM at 84.4%.

The No-Build option and the Tier 2 Alternatives are ranked below for each time frame based on the results of the Travel Speed as a Percentage of Base Free Flow Speed criterion.

AM

1. Alternative Package A – 87.4% of base free flow speed (43.5 MPH)
2. Alternative Package E – 86.9% of base free flow speed (43.3 MPH)
3. Alternative Package F – 86.0% of base free flow speed (42.8 MPH)
4. No-Build – 84.8% of base free flow speed (42.2 MPH)
5. Alternative Package C – 84.4% of base free flow speed (42.0 MPH)
6. Alternative Package D – 82.6% of base free flow speed (41.1 MPH)
7. Alternative Package B – 82.4% of base free flow speed (41.1 MPH)

PM

1. Alternative Package A – 84.9% of base free flow speed (42.3 MPH)
1. Alternative Package F – 84.9% of base free flow speed (42.3 MPH)
3. Alternative Package E – 84.7% of base free flow speed (42.2 MPH)
4. No-Build – 83.4% of base free flow speed (41.5 MPH)
5. Alternative Package B – 76.6% of base free flow speed (38.1 MPH)
6. Alternative Package D – 75.3% of base free flow speed (37.5 MPH)
7. Alternative Package C – 74.5% of base free flow speed (37.1 MPH)

Application of the Travel Speed as a Percentage of Base Free Flow Speed Criterion Results to Calculate the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Travel Speed as a Percentage Base Free Flow Speed criterion. The following formula was used to calculate the scores:

*Technical Score = (Alternative Result / Best Result) * Weight * 100*

Since Travel Speed as a Percentage of Base Free Flow Speed was measured in both the AM and PM time periods - two values were produced each receiving half of the value of the 3.32% weight – or 1.66%.

Table 4-15 and **Table 4-16** show how the AM and PM scores were calculated for the No-Build option and the other six Tier 2 Alternatives relative to the results of the Travel Speed as a Percentage of Base Free Flow Speed criterion in order of highest to lowest scoring.

Table 4-15: AM Travel Speed as a % Base Free Flow Speed Criterion Results in the Calculation of the Technical Score

Alternative	AM Travel Speed Result*	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	87.4%	((87.4/87.4)	* 1.66%) * 100	1.66
Alt Package E	86.9%	((86.9/87.4)	* 1.66%) * 100	1.65
Alt Package F	86.0%	((86.0/87.4)	* 1.66%) * 100	
No-Build	84.8%	((84.8/87.4)	* 1.66%) * 100	1.61
Alt Package C	84.4%	((84.4/87.4)	* 1.66%) * 100	1.60

Alt Package D	82.6%	((82.6/87.4)	* 1.66%) * 100	1.57
Alt Package B	82.4%	((82.4/87.4)	* 1.66%) * 100	1.57
**The Travel Speed as A Percentage of Base Free Flow Speed was converted to a whole value prior to the formula which is not shown in this table*				

Table 4-16: AM Travel Speed as a % Base Free Flow Speed Criterion Results in the Calculation of the Technical Score

Alternative	PM Travel Speed Result*	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	84.9%	((53.6/53.6)	* 1.66%) * 100	1.66
Alt Package F	84.9%	((52.6/53.6)	* 1.66%) * 100	1.66
Alt Package E	84.7%	((52.4/53.6)	* 1.66%) * 100	1.65
No-Build	83.4%	((51.2/53.6)	* 1.66%) * 100	1.63
Alt Package B	76.6%	((49.7/53.6)	* 1.66%) * 100	1.50
Alt Package D	75.3%	((39.8/53.6)	* 1.66%) * 100	1.47
Alt Package C	74.5%		* 1.66%) * 100	1.46
**The Travel Speed as A Percentage of Base Free Flow Speed was converted to a whole value prior to the formula which is not shown in this table*				

4.9c Reduction in Vehicular Congestion – *Intersection Level-of-Service (LOS) Criterion Results*

The Intersection LOS criterion measures reduction in vehicular congestion by identifying the number of operationally failing intersections (LOS grade E or F) under the 2040 condition within the No-Build option the six other Tier 2 Alternatives. The intersection LOS results are an output from the Vissim Model.

The US 180 study corridor has 14 intersections that were evaluated under this LOS criterion, including:

- Humphreys Street & Route 66 (signalized);
- Humphreys Street & Aspen Avenue (signalized);
- Humphreys Street & Birch Avenue (signalized);
- Humphreys Street & Cherry Avenue (two-way stop-controlled);
- Humphreys Street & Dale Avenue (two-way stop-controlled);
- Humphreys Street & Elm Avenue (two-way stop-controlled);
- Humphreys Street & Fine Avenue (two-way stop-controlled);
- Humphreys Street & Hunt Avenue (two-way stop-controlled);
- Humphreys Street & Sullivan Avenue (two-way stop-controlled);
- Humphreys Street & Columbus Avenue (signalized);
- US-180 & Forest Avenue (signalized);
- US-180 & Shultz Pass Road (signalized);
- US-180 & Snow Bowl Road (two-way stop-controlled) and
- US-180 & Roundtree Road/Bader Road (two-way stop-controlled).

The LOS grades for each intersection were collected during both the AM and PM time periods in order to capture a comprehensive intersection performance – each receiving half of the 6.04% weight assigned to this criterion. **Table 4-17** shows the number of intersections within each LOS grade for the No-Build option and each of the Tier 2 Alternatives.

Table 4-17: AM and PM Intersection Level-of-Service (LOS) Criterion Results

	AM							PM						
	LOS Grade						Failing Intersections	LOS Grade						Failing Intersections
Alternative	A	B	C	D	E	F		A	B	C	D	E	F	
No-Build	4	3	1	0	0	6	**6**	2	3	2	0	0	7	**7**
Alt Package A	5	2	1	0	0	6	**6**	3	0	4	0	0	7	**7**
Alt Package B	4	3	0	1	0	6	**6**	2	2	3	1	0	6	**6**
Alt Package C	4	3	1	0	0	6	**6**	3	0	4	1	0	6	**6**
Alt Package D	3	4	1	0	0	6	**6**	3	0	3	2	0	6	**6**
Alt Package E	6	1	1	0	0	6	**6**	3	3	1	0	0	7	**7**
Alt Package F	5	2	1	0	0	6	**6**	4	2	1	0	0	7	**7**

As noted in **Table 4-17**, there is little to no variation in the number of failing intersections among the No-Build option and the six Tier 2 Alternatives in both the AM and PM time periods. The six or seven failing intersections are constant among the No-Build option and the Tier 2 Alternatives, where the two-way stop-controlled intersections on Humphrey's Street are the only failing intersections. Refer to Appendix D for a more detailed result reflecting the intersection LOS output from the Vissim Model.

Application of the Intersection LOS Results Criterion Results to Calculate the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Intersection LOS criterion. The following formula was used to calculate the scores:

*Technical Score = (Best Result/ Alternative Result) * Weight * 100*

Since Intersection LOS was measured in both the AM and PM time periods, two values were produced - each receiving half of the 6.04% weight, or 3.02%.

Table 4-18 and **Table 4-19** below show how the AM and PM scores were calculated for the No-Build option and the other six Tier 2 Alternatives relative to the results of the Intersection LOS criterion in order of highest to lowest scoring.

Table 4-18: AM Intersection LOS Criterion Results in the Calculation of the Technical Score

Alternative	AM LOS Result	Scoring Formula		Score
		Results Ratio	Applying the Weight	
No-Build	6	((6/6)	* 3.02%) * 100	3.02
Alt Package A	6	((6/6)	* 3.02%) * 100	3.02
Alt Package B	6	((6/6)	* 3.02%) * 100	3.02
Alt Package C	6	((6/6)	* 3.02%) * 100	3.02
Alt Package D	6	((6/6)	* 3.02%) * 100	3.02
Alt Package E	6	((6/6)	* 3.02%) * 100	3.02
Alt Package F	6	((6/6)	* 3.02%) * 100	3.02

Table 4-19: PM Intersection LOS Criterion Results in the Calculation of the Technical Score

Alternative	PM LOS Result	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package B	6	((6/6)	* 3.02%) * 100	3.02
Alt Package C	6	((6/6)	* 3.02%) * 100	3.02
Alt Package D	6	((6/6)	* 3.02%) * 100	3.02
No-Build	7	((6/7)	* 3.02%) * 100	2.59
Alt Package A	7	((6/7)	* 3.02%) * 100	2.59
Alt Package E	7	((6/7)	* 3.02%) * 100	2.59
Alt Package F	7	((6/7)	* 3.02%) * 100	2.59

4.9d Reduction in Vehicular Congestion – *Intersection Delay* Criterion *Results*

The Intersection Delay criterion measures reduction in vehicular congestion by evaluating the duration of delay at intersections under the year 2040 condition for the No-Build option as compared to the six other Tier 2 Alternatives. The intersection delay is calculated under seconds and is an output from the Vissim Model.

The 14 intersections evaluated under this criterion include:

- Humphreys Street & Route 66 (signalized);
- Humphreys Street & Aspen Avenue (signalized);
- Humphreys Street & Birch Avenue (signalized);
- Humphreys Street & Cherry Avenue (two-way stop-controlled);
- Humphreys Street & Dale Avenue (two-way stop-controlled);
- Humphreys Street & Elm Avenue (two-way stop-controlled);
- Humphreys Street & Fine Avenue (two-way stop-controlled);
- Humphreys Street & Hunt Avenue (two-way stop-controlled);
- Humphreys Street & Sullivan Avenue (two-way stop-controlled);
- Humphreys Street & Columbus Avenue (signalized);
- US-180 & Forest Avenue (signalized);
- US-180 & Shultz Pass Road (signalized);
- US-180 & Snow Bowl Road (two-way stop-controlled) and

- US-180 & Roundtree Road/Bader Road (two-way stop-controlled).

The intersection delay for each intersection were collected during both the AM and PM time periods in order to capture a comprehensive intersection performance – each receiving half of the 6.04% weight assigned to this criterion. **Table 4-20** and **Table 4-21** show the seconds of delay at each intersection for the No-Build option and the six Tier 2 Alternatives. Note the average delay among all intersections in both AM and PM time periods is the value used to measure performance.

Table 4-20: AM Intersection Delay Criterion Results

Intersection Volume, Delay, & LOS		No Build - AM		Package A - AM		Package B - AM		Package C - AM		Package D - AM		Package E - AM		Package F - AM	
Intersection	Control	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Humphreys St & Rte 66	Signal	17.6	B	16.8	B	19.8	B	17.3	B	19.5	B	14.5	B	15.5	B
Humphreys St & Aspen Ave	Signal	8.6	A	8.2	A	9.8	A	8.8	A	10.7	B	7.0	A	8.0	A
Humphreys St & Birch Ave	Signal	12.7	B	12.1	B	15.4	B	14.1	B	19.8	B	7.3	A	9.1	A
Humphreys St & Cherry Ave	Two-Way Stop-Control	440.4	F	394.7	F	489.6	F	437.4	F	523.8	F	211.7	F	230.0	F
Humphreys St & Dale Ave	Two-Way Stop-Control	486.2	F	394.6	F	382.3	F	512.7	F	693.0	F	77.9	F	132.5	F
Humphreys St & Elm Ave	Two-Way Stop-Control	488.7	F	410.4	F	730.3	F	523.3	F	566.0	F	224.9	F	295.7	F
Humphreys St & Fine Ave	Two-Way Stop-Control	241.4	F	343.1	F	359.3	F	353.6	F	577.7	F	144.7	F	113.5	F
Humphreys St & Hunt Ave	Two-Way Stop-Control	409.7	F	385.2	F	488.9	F	601.8	F	736.6	F	170.4	F	161.3	F
Humphreys St & Sullivan Ave	Two-Way Stop-Control	146.7	F	246.3	F	179.9	F	590.0	F	862.0	F	84.3	F	104.3	F
Humphreys St & Columbus Ave	Signal	30.3	C	27.9	C	36.0	D	28.9	C	29.9	C	28.7	C	28.0	C
US-180 & Forest Ave	Signal	11.2	B	7.2	A	14.0	B	11.2	B	16.4	B	9.7	A	10.9	B
US-180 & Shultz Pass Rd	Signal	5.4	A	4.6	A	6.8	A	7.0	A	5.5	A	5.6	A	5.5	A
US-180 & Snow Bowl Rd	Two-Way Stop-Control	8.6	A	8.3	A	5.2	A	5.2	A	5.2	A	9.5	A	8.4	A
US-180 & Roundtree Rd/Bader Rd	Two-Way Stop-Control	0.5	A	8.1	A	0.9	A	0.6	A	0.5	A	0.7	A	0.5	A
	Average Delay	**164.8**		**162.0**		**195.6**		**222.3**		**290.5**		**71.2**		**80.2**	

Table 4-21: PM Intersection Delay Criterion Results

Intersection Volume, Delay, & LOS		No Build - PM		Package A - PM		Package B - PM		Package C - PM		Package D - PM		Package E - PM		Package F - PM		
Intersection	Control	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Volun	Delay	LOS
Humphreys St & Rte 66	Signal	23.0	C	25.91	C	28.41	C	27.34	C	28.28	C	16.43	B	2563	18.87	B
Humphreys St & Aspen Ave	Signal	10.6	B	20.37	C	25.68	C	25.26	C	24.71	C	8.76	A	1657	8.55	A
Humphreys St & Birch Ave	Signal	16.7	B	21.09	C	33.64	C	33.18	C	29.02	C	13.16	B	1616	12.41	B
Humphreys St & Cherry Ave	Two-Way Stop-Control	304.3	F	129.11	F	189.96	F	223.09	F	161.72	F	171.17	F	1614	122.12	F
Humphreys St & Dale Ave	Two-Way Stop-Control	83.0	F	52.57	F	149.08	F	91.42	F	114.57	F	73.55	F	1545	101.84	F
Humphreys St & Elm Ave	Two-Way Stop-Control	219.7	F	74.36	F	152.15	F	119.64	F	92.23	F	117.98	F	1631	88.03	F
Humphreys St & Fine Ave	Two-Way Stop-Control	82.8	F	52.49	F	71.02	F	86.48	F	63.26	F	62.32	F	1525	54.23	F
Humphreys St & Hunt Ave	Two-Way Stop-Control	201.0	F	72.8	F	79.45	F	101.17	F	71.32	F	83.01	F	1611	131.67	F
Humphreys St & Sullivan Ave	Two-Way Stop-Control	88.9	F	59.8	F	84.58	F	81.71	F	91.43	F	186.02	F	1635	84.61	F
Humphreys St & Columbus Ave	Signal	32.3	C	31.7	C	38.06	D	39.17	D	39.41	D	27.21	C	2365	25.54	C
US-180 & Forest Ave	Signal	14.9	B	6.17	A	18.78	B	33.25	C	40.71	D	11	B	781	9.54	A
US-180 & Shultz Pass Rd	Signal	5.2	A	4.05	A	4.51	A	5.06	A	4.92	A	4.86	A	1176	4.67	A
US-180 & Snow Bowl Rd	Two-Way Stop-Control	110.1	F	106.78	F	10.85	B	9.9	A	8.78	A	107.97	F	754	108.34	F
US-180 & Roundtree Rd/Bader Rd	Two-Way Stop-Control	0.9	A	8.09	A	6.5	A	6.66	A	6.5	A	0.74	A	275	0.78	A
	Average Delay	**85.3**		**47.5**		**63.8**		**63.1**		**55.5**		**63.2**			**55.1**	

Interestingly, the duration of the average delay among the No-Build option and the other six Tier 2 Alternatives are shorter in the PM time period compared to the AM time period, which is different from the trends experienced in the other Reduction in Vehicular Congestion criteria where the traffic operations or worse in the PM. The difference between the best performing alternative and the worst performing alternative in the PM is 37.7 seconds while the difference between the best and worst performing alternative in the AM is nearly 219 seconds. This is due to the fact that the Alternative Package D has an unusually long average delay of 290.5 seconds in the AM time period compared to the six Tier 2 Alternatives.

The No-Build and the Tier 2 Alternatives are ranked below for each time duration based on the results of the Intersection Delay criterion.

AM

1. Alternative Package E – 71.2 seconds of average delay
2. Alternative Package F – 80.2 seconds of average delay
3. Alternative Package A – 162.0 seconds of average delay
4. No-Build – 164.8 seconds of average delay
5. Alternative Package B – 195.6 seconds of average delay
6. Alternative Package C – 222.3 seconds of average delay
7. Alternative Package D – 290.5 seconds of average delay

PM

1. Alternative Package A – 47.5 seconds of average delay
2. Alternative Package F – 55.1 seconds of average delay
3. Alternative Package D – 55.5 seconds of average delay
4. Alternative Package C – 63.1 seconds of average delay
5. Alternative Package E – 63.2 seconds of average delay
6. Alternative Package B – 63.8 seconds of average delay
7. No-Build – 85.3 seconds of average delay

Application of the Intersection Delay Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Intersection Delay criterion. The following formula was used to calculate the scores:

*Technical Score = (Best Result/ Alternative Result) * Weight * 100*

Since Intersection Delay was measured in both the AM and PM time periods, two values were produced - each receiving half of the 3.29% weight, or 1.645%.

Table 4-22 and **Table 4-23** show how the AM and PM scores were calculated for the No-Build option and the six Tier 2 Alternatives relative to the results of the Intersection Delay criterion in order of highest to lowest scoring.

Table 4-22: AM Intersection Delay Criterion Results in the Calculation of the Technical Score

Alternative	AM Delay Result	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package E	71.2 seconds	((71.2/71.2)	* 1.645%) * 100	1.65
Alt Package F	80.2 seconds	((71.2/80.2)	* 1.645%) * 100	1.46
Alt Package A	162.0 seconds	((71.2/162.0)	* 1.645%) * 100	0.72
No-Build	164.8 seconds	((71.2/164.8)	* 1.645%) * 100	0.71
Alt Package B	195.6 seconds	((71.2/195.6)	* 1.645%) * 100	0.60
Alt Package C	222.3 seconds	((71.2/222.3)	* 1.645%) * 100	0.53
Alt Package D	290.5 seconds	((71.2/290.5)	* 1.645%) * 100	0.40

Table 4-23: PM Intersection Delay Criterion Results in the Calculation of the Technical Score

Alternative	PM Delay Result	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	47.5 seconds	((47.5/47.5)	* 1.645%) * 100	1.65
Alt Package F	55.1 seconds	((47.5/55.1)	* 1.645%) * 100	1.42
Alt Package D	55.5 seconds	((47.5/55.5)	* 1.645%) * 100	1.41
Alt Package C	63.1 seconds	((47.5/63.1)	* 1.645%) * 100	1.24
Alt Package E	63.2 seconds	((47.5/63.2)	* 1.645%) * 100	1.24
Alt Package B	63.8 seconds	((47.5/63.8)	* 1.645%) * 100	1.23
No-Build	85.3 seconds	((47.5/85.3)	* 1.645%) * 100	0.92

4.9e Reduction in Vehicular Congestion – *Travel Time Criterion Results*

The Travel Time criterion is a metric that measures reduction in vehicular congestion by calculating the amount of time it takes to travel the corridor from one end to the other. The results of the year 2040 travel time for the No-Build option and six other Tier 2 Alternatives is an output from the Vissim Model.

In order to reach a comprehensive measure, travel times during both the AM and PM time periods were used to measure the overall performance of this criterion – each receiving half of the 4.79% weight assigned to this criterion. The travel times in each direction of US 180 – eastbound and westbound – were also averaged to reach a combined travel time for each the AM and PM timeframes.

The results of the of the Travel Time are shown below in **Table 4-24** for the No-Build option and the six Tier 2 Alternatives.

Table 4-24: AM Travel Time Criterion Results

Alternative	AM Peak Hour				PM Peak Hour			
	Westbound		Eastbound		Westbound		Eastbound	
	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change
No Build	979	-	939	-	955	-	1,014	-
A	952	2.8%	909	3.2%	932	2.4%	985	2.9%
B	990	-1.1%	983	-4.7%	959	-0.4%	1,187	-17.1%
C	991	-1.2%	938	0.1%	979	-2.5%	1,230	-21.3%
D	1,033	-5.5%	940	-0.1%	972	-1.8%	1,211	-19.4%
E Wing Mntn bypass	935	4.5%	935	0.4%	944	1.2%	975	3.8%
F Hidden Hollow bypass	951	2.9%	939	0.0%	946	0.9%	968	4.5%

Average Travel Time	AM		PM	
No Build	959	-	985	-
A	931	2.9%	959	2.7%
B	987	-2.8%	1,073	-9.0%
C	965	-0.6%	1,105	-12.3%
D	987	-2.8%	1,092	-10.9%
E Wing Mntn bypass	935	2.5%	960	2.6%
F Hidden Hollow bypass	945	1.4%	957	2.8%

The average travel time between the westbound and eastbound direction for the No-Build option is 959 seconds (15.9 minutes) in the AM and 985 seconds (16.4 minutes) in the PM – approximately a 30 second difference in average travel time between the AM and PM time periods. The No-Build travel time results is the baseline condition for calculating the travel time percent change for each of the Tier 2 Alternatives.

Alternative Package A is the only alternative that has an improved travel time condition compared to the No-Build option in both the AM and PM time periods, while the two alternative routes (Alternative Package E and Alternative Package F) also have an improved travel time. However, the decrease in travel times for Alternative Package A, Alternative Package E, and Alternative Package F are all minimal/negligible.

The No-Build option and the Tier 2 Alternatives are ranked below for each time duration based on the Vissim model results of the Travel Time criterion.

AM

1. Alternative Package A – 931 seconds of average travel time
2. Alternative Package E – 935 seconds of average travel time
3. Alternative Package F – 945 seconds of average travel time
4. No-Build – 959 seconds of average travel time
5. Alternative Package C – 965 seconds of average travel time
6. Alternative Package B – 987 seconds of average travel time
6. Alternative Package D – 987 seconds of average travel time

PM

1. Alternative Package F – 957 seconds of average travel time
2. Alternative Package A – 959 seconds of average travel time
3. Alternative Package E – 960 seconds of average travel time
4. No-Build – 985 seconds of average travel time
5. Alternative Package B – 1,073 seconds of average travel time
6. Alternative Package D – 1,092 seconds of average travel time
7. Alternative Package C – 1,105 seconds of average travel time

Application of the Travel Time Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Travel Time criterion. The following formula was used to calculate the scores:

*Technical Score = (Best Result / Alternative Result) * Weight * 100*

Since Travel Time was measured in both the AM and PM time periods, two values were produced - each receiving half the value of the 4.79% weight, or 2.395%.

Table 4-25 and **Table 4-26** below show how the AM and PM scores were calculated for the No-Build option and six other Tier 2 Alternatives relative to the results of the Travel Time criterion in order of highest to lowest scoring.

Table 4-25: AM Travel Time Results in the Calculation of the Technical Score

Alternative	AM Travel Time Results	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	931 seconds	((931/931)	* 2.395%) * 100	2.40
Alt Package E	935 seconds	((931/931)	* 2.395%) * 100	2.39
Alt Package F	945 seconds	((931/931)	* 2.395%) * 100	2.36
No-Build	959 seconds	((931/931)	* 2.395%) * 100	2.33
Alt Package C	965 seconds	((931/931)	* 2.395%) * 100	2.31
Alt Package B	987 seconds	((931/931)	* 2.395%) * 100	2.26
Alt Package D	987 seconds	((931/931)	* 2.395%) * 100	2.26

Table 4-26: PM Travel Time Results in the Calculation of the Technical Score

Alternative	PM Travel Time Results	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package F	957 seconds	((957/957)	* 2.395%) * 100	2.40
Alt Package A	959 seconds	((957/959)	* 2.395%) * 100	2.39
Alt Package E	960 seconds	((957/960)	* 2.395%) * 100	2.39
No-Build	985 seconds	((957/985)	* 2.395%) * 100	2.33
Alt Package B	1,073 seconds	((957/1,073)	* 2.395%) * 100	2.14
Alt Package D	1,092 seconds	((957/1,092)	* 2.395%) * 100	2.10
Alt Package C	1,105 seconds	((957/1,105)	* 2.395%) * 100	2.08

4.9f Safety - *Reduction in All Crashes Criterion Results*

The Reduction in All Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives through the use Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs). The Crash Modification Factor Clearinghouse is the source of all CMFs and CRFs, and according to the Clearinghouse, a CMF is a multiplicative factor that indicates the proportion of crashes that would be expected after implementing a countermeasure. Examples of countermeasures include installing a traffic signal, increasing the width of edgelines, and installing a median barrier. CMFs with a value less than 1.0 indicate an expected decrease in crashes. CMFs greater than 1.0 indicate an expected increase in crashes. The Clearinghouse also identifies a CRF as another way of representing the expected effect of a countermeasure in terms of the percentage decrease in crashes. The formula to convert a CMF to a CRF is as follows:

CRF = 100*(1-CMF)

For example, the application of adding one traffic lane in each direction has a CMF of 0.807 for all crashes according to the Clearinghouse, so the CRF for adding a lane in each direction is 19.3% as shown in the formula below:

(1	**/**	**0.807)**	*** 100**	**=**	**19.3%**	
		CMF of adding one lane in each direction			*CRF of adding one lane in each direction*	

The Reduction in All Crashes Criterion used an approach to combine the CMFs of the different countermeasure included in each of the Tier 2 Alternatives to reach a combined CRF for each alternative. As a result, the alternatives with higher CRFs – greater potential in reduction in all crashes - were the alternatives that scored higher within this criterion. The combined CRF for this criterion includes all crash types (injury and non-injury related crashes). **Table 4-27** shows the combined CRF for all crashes for the six Tier 2 Alternatives. The No-Build condition receives no CRFs since no countermeasures would be implemented. Refer to Appendix E for the detailed methodology on how the CRFs were calculated.

Table 4-27: Reduction in All Crashes Criterion Results

Alternative	CRF for All Crashes
No-Build	No CRF
Alternative Package A	37.13% CRF for all crashes
Alternative Package B	11.55% CRF for all crashes
Alternative Package C	11.55% CRF for all crashes
Alternative Package D	25.60% CRF for all crashes
Alternative Package E*	0
Alternative Package F*	0
**No infrastructure changes made to the mainline US 180 corridor automatically receiving a 0% CRF*	

Application of the Reduction in All Crashes Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Reduction in All Crashes Criterion. The following formula was used to calculate the scores:

*Technical Score = (Alternative Result / Best Result) * Weight * 100*

Table 4-28 shows how the scores were calculated for combined CRFs for all crashes for the No-Build option and the six Tier 2 Alternatives relative to the results of the Reduction in All Crashes Criterion in order of highest scoring to lowest scoring.

Table 4-28: Reduction in All Crashes Criterion Results in the Calculation of the Technical Score

Alternative	CRF for All Crashes*	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	37.13%	((37.13/37.13)	* 7.13%) * 100	7.13
Alt Package D	25.60%	((25.60/37.13)	* 7.13%) * 100	4.91
Alt Package B	11.55%	((11.55/37.13)	* 7.13%) * 100	2.22
Alt Package C	11.55%	((11.55/37.13)	* 7.13%) * 100	2.22
Alt Package E	No CRF and no formula used – automatically received a score of 0			0
Alt Package F	No CRF and no formula used – automatically received a score of 0			0
No-Build	No CRF and no formula used – automatically received a score of 0			0
**The CRF was converted to a whole value prior to the formula which is not shown in this table*				

4.9g Safety - *Reduction in Injury-Related Crashes Criterion Results*

The Reduction in Injury-Related Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives through the use Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs). The Crash Modification Factor Clearinghouse is the source of all CMFs and CRFs, and according to the clearinghouse, a CMF is a multiplicative factor that indicates the proportion of crashes that would be expected after implementing a countermeasure. Examples of countermeasures include installing a traffic signal, increasing the width of edgelines, and installing a median barrier. CMFs with a value less than 1.0 indicate an expected decrease in crashes. CMFs greater than 1.0 indicate an expected increase in crashes. The Clearinghouse also identifies a CRF as another way of representing the expected effect of a countermeasure in terms of the percentage decrease in crashes. The formula to convert a CMF to a CRF is as follows:

CRF = 100*(1-CMF)

For example, the application of adding one traffic lane in each direction has a CMF of 0.807 for all crashes according to the Clearinghouse, so the CRF for adding a lane in each direction is 19.3% as shown in the formula below:

(1	**/**	**0.807)**	*** 100**	**=**	**19.3%**	
		CMF of adding one lane in each direction			*CRF of adding one lane in each direction*	

The Reduction in Injury-Related Crashes Criterion used an approach to combine the CMFs of the different countermeasure included in each of the Tier 2 Alternatives to reach a combined CRF for each alternative. As a result, the alternatives with higher CRFs – greater potential in reduction in injury-related crashes only - were the alternatives that scored higher within this criterion. The combined CRF for this criterion includes injury-related crashes only. **Table 4-29** shows the combined CRF for the injury-related crashes for the six Tier 2 Alternatives. The No-Build condition receives no CRFs since no countermeasures would be implemented. Refer to Appendix E for the detailed methodology on how CRFs were calculated.

Table 4-29: Reduction in Injury-Related Crashes Criterion Results

Alternative	CRF for Injury Crashes
No-Build	No CRF
Alternative Package A	46.41% CRF for injury crashes
Alternative Package B	14.63% CRF for injury crashes
Alternative Package C	11.50% CRF for injury crashes
Alternative Package D	23.75%% CRF for injury crashes
Alternative Package E*	0% CRF for injury crashes
Alternative Package F*	0% CRF for injury crashes
**No infrastructure changes made to the mainline US 180 corridor automatically receiving a 0% CRF*	

Application of the Reduction in Injury-Related Crashes Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Reduction in Injury-Related Crashes Criterion. The following formula was used to calculate the scores:

*Technical Score = (Alternative Result / Best Result) * Weight * 100*

Table 4-30 shows how the scores were calculated for combined CRFs for injury-related crashes for the No-Build option and the six Tier 2 Alternatives relative to the results of the Reduction in Injury-Related Crashes Criterion in order of highest scoring to lowest scoring.

Table 4-30: Reduction in Injury-Related Crashes Criterion Results in the Calculation of the Technical Score

Alternative	CRF for Injury Crashes*	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	46.41%	((46.41/46.41)	* 8.18%) * 100	8.18
Alt Package D	23.75%	((23.75/46.41)	* 8.18%) * 100	4.18
Alt Package B	14.63%	((14.63/46.41)	* 8.18%) * 100	2.58
Alt Package C	11.50%	((11.50/46.41)	* 8.18%) * 100	2.03
Alt Package E	No CRF and no formula used – automatically received a score of 0			0
Alt Package F	No CRF and no formula used – automatically received a score of 0			0
No-Build	No CRF and no formula used – automatically received a score of 0			0
**The CRF was converted to a whole value prior to the formula which is not shown in this table*				

4.9h Safety - *Reduction in Bicycle-Related Only Crashes Criterion Results*

The Reduction in Bicycle-Related Crashes metric measures safety performance of the No-Build option and the six Tier 2 Alternatives also using Crash Modification Factors (CMFs) and Crash Reduction Factors (CRFs). **Table 4-31** shows the combined CRF for the injury-related crashes for the six Tier 2 Alternatives. The No-Build condition receives no CRFs since no countermeasures would be implemented. Refer to Appendix E for the detailed methodology on how CRFs were calculated.

Table 4-31: Reduction in Bicycle-Related Only Crashes Criterion Results

Alternative	CRF for Bicycle Crashes
No-Build	0% CRF for bicycle crashes
Alternative Package A	3.50% CRF for bicycle crashes
Alternative Package B	-5.31% CRF for bicycle crashes
Alternative Package C	-5.31% CRF for bicycle crashes
Alternative Package D	0% CRF for bicycle crashes
Alternative Package E	0% CRF for bicycle crashes
Alternative Package F	0% CRF for bicycle crashes
**If no bicycle lane is recommended as a component of the alternative (Alt. 3, 4, 6A, 6b) bicycle crash modification factors are not provided by the Clearinghouse, resulting in a score of zero.*	

Application of the Reduction in Bicycle-Related Crashes Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described was used to calculate the scores:

*Technical Score = (Alternative Result / Best Result) * Weight * 100*

Table 4-32 shows how the scores were calculated for combined CRFs for bicycle-related crashes for the No-Build option and the six Tier 2 Alternatives relative to the results of the Reduction in Bicycle-Related Crashes Criterion in order of highest scoring to lowest scoring.

Table 4-32: Reduction in Bicycle-Related Crashes Criterion Results in the Calculation of the Technical Score

Alternative	CRF for Bicycle Crashes	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package A	3.50%	((3.50/3.50)	* 7.10%) * 100	7.10
Alt Package D*	0%	((0/3.50)	* 7.10%) * 100	7.10
Alt Package E*	0%	((0/3.50)	* 7.10%) * 100	0
Alt Package F*	0%	((0/3.50)	* 7.10%) * 100	0
No-Build*	0%	((0/3.50)	* 7.10%) * 100	0
Alt Package B	-5.31%	No formula was used and automatically received negative 7.1 for an increase in crashes		-7.1
Alt Package C	-5.31%	No formula was used and automatically received negative 7.1 for an increase in crashes		-7.1
**If no bicycle lane is recommended as a component of the alternative (Alt. 3, 4, 6A, 6b) bicycle crash modification factors are not provided by the Clearinghouse, resulting in a score of zero.*				

4.9i Expand Travel Mode Choices - *Improved Pedestrian Facilities Criterion Results*

The Improved Pedestrian Facilities criterion is one of the qualitative metrics of the Tier 2 Evaluation Criteria. This criterion qualitatively measures how pedestrian facilities are improved utilizing the Controlling Design Criteria previously discussed in *Section 4.2a - Controlling Design Criteria.* The width of the sidewalk is the determining factor used in the calculation of the score.

Given the qualitative nature of this criterion, a series of thresholds were developed to measure the magnitude of improvement over the baseline condition (No-Build) and a modifier was assigned to each threshold to calculate the weighted score. **Table 4-33** below shows the thresholds and the modifier used to calculate the score for the Improved Pedestrian Facilities criterion.

Table 4-33: Qualitative Scoring Measures of the Pedestrian Facilities Criterion

Sidewalk Width Threshold Rank		Modifier	Weight	Score
1	Meets or exceeds both ADOT's minimum standard and the Project Partner preferred standards*	1	7.12	7.12
2	Meets or exceeds ADOT's minimum standard OR the Project Partners preferred standards, but not both*	0.5		3.56
3	Maintains existing condition/does not meet any standards	0		0
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*				

The various sidewalk widths excerpted from the Controlling Design Criteria are shown in **Table 4-34.**

Table 4-34: Improved Pedestrian Facilities Criterion Results

Alternative	Result/Threshold
No-Build	Maintains existing condition/does not meet any standards*
Alternative Package A	Meets or exceeds both ADOT and Project Partner Standards, but not both*
Alternative Package B	Meets or exceeds both ADOT and Project Partner Standards, but not both*
Alternative Package C	Meets or exceeds both ADOT and Project Partner Standards, but not both*
Alternative Package D	Meets or exceeds both ADOT and Project Partner Standards, but not both*
Alternative Package E	Maintains existing condition/does not meet any standards*
Alternative Package F	Maintains existing condition/does not meet any standards*
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*	

Application of the Improved Pedestrian Facilities Criterion Results in the Calculation of the Technical Score

The Improved Pedestrian Facilities criterion results are illustrated in **Table 4-35**.

Table 4-35: Improved Pedestrian Facility Criterion Technical Score

Alternative	Result/Threshold	Score
No-Build	Maintains existing condition/does not meet any standards*	0
Alternative Package A	Meets or exceeds both ADOT and Project Partner Standards, but not both*	3.56
Alternative Package B	Meets or exceeds both ADOT and Project Partner Standards, but not both*	3.56
Alternative Package C	Meets or exceeds both ADOT and Project Partner Standards, but not both*	3.56
Alternative Package D	Meets or exceeds both ADOT and Project Partner Standards, but not both*	3.56
Alternative Package E	Maintains existing condition/does not meet any standards*	0
Alternative Package F	Maintains existing condition/does not meet any standards*	0
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*		

4.9j Expand Travel Mode Choices - *Improved Bicycle Facilities Criterion Results*

The Improved Bicycle Facilities criterion is another one of the qualitative metrics. This criterion qualitatively measures how bicycle facilities are improved utilizing the Controlling Design Criteria previously discussed in *Section 4.2a - Controlling Design Criteria.* The width of the bike lane and buffer, or SBBL and buffer are two key determining factors used in the calculation of the Improved Bicycle Facilities score.

Similar to the Improved Pedestrian Facilities criterion, the qualitative nature of this criterion resulted in the development of a series of thresholds to measure the magnitude of improvement and a modifier was assigned to each threshold to calculate the weighted score. **Table 4-36** below shows the thresholds and the modifier used to calculate the score for the Improved Bicycle Facilities criterion.

Table 4-36: Qualitative Scoring Measures of the Bike Facilities Criterion

Bike Facility Width Threshold Rank		Modifier	Weight	Score
1	Meets or exceeds both ADOT's minimum standard and the Project Partner preferred standards*	1	7.48	7..48
2	Meets or exceeds ADOT's minimum standard OR the Project Partners preferred standards, but not both*	0.5		3.74
3	Maintains existing condition/does not meet any standards*	0		0
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*				

The various bicycle facility widths excerpted from the Controlling Design Criteria are shown in **Table 4-37**. The No-Build, Alternative E, and Alternate F maintain the existing condition while the other alternatives have a varying condition of the bicycle facility which resulted in a partial score.

Table 4-37: Improved Bicycle Facilities Criterion Results

Alternative	Result/Threshold
No-Build	Maintains existing condition/does not meet any standards*
Alternative Package A	The condition of the bicycle facility varies across the corridor resulting in a partial score*
Alternative Package B	The condition of the bicycle facility varies across the corridor resulting in a partial score*
Alternative Package C	The condition of the bicycle facility varies across the corridor resulting in a partial score*
Alternative Package D	The condition of the bicycle facility varies across the corridor resulting in a partial score*
Alternative Package E	Maintains existing condition/does not meet any standards*
Alternative Package F	Meets or exceeds both ADOT and Project Partner Standards*
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*	

Application of the Improved Bicycle Facilities Criterion Results in the Calculation of the Technical Score

The Improved Bicycle Facilities criterion results are illustrated in **Table 4-38**.

Table 4-38: Improved Bicycle Faculties Criterion Technical Score

Alternative	Result/Threshold	Score
No-Build	Maintains existing condition/does not meet any standards*	0
Alternative Package A	The condition of the bicycle facility varies across the corridor resulting in a partial score*	4.68
Alternative Package B	The condition of the bicycle facility varies across the corridor resulting in a partial score*	2.81
Alternative Package C	The condition of the bicycle facility varies across the corridor resulting in a partial score*	2.81
Alternative Package D	The condition of the bicycle facility varies across the corridor resulting in a partial score*	1.87
Alternative Package E	Maintains existing condition/does not meet any standards*	0
Alternative Package F	Meets or exceeds both ADOT and Project Partner Standards*	7.12
**Per the minimum and preferred standards outlined in the Controlling Design Criteria*		

4.9k Expand Travel Mode Choices - *Transit Travel Time Criterion Results*

The Transit Travel Time criterion is a metric that measures transit improvement by calculating the amount of time it takes for transit vehicles to travel the corridor from one end to the other – or in other words calculating transit travel time. The results of the transit travel time for the No-Build option and six other Tier 2 Alternatives is under the year 2040 condition and is an output from the Vissim Model.

In order to reach a comprehensive measure, transit travel times during both the AM and PM time periods were used to measure the overall performance of this criterion – each receiving half the value of the 6.27% weight assigned to this criterion, or 3.135% per time duration. The transit

travel speeds in each direction of US 180 – eastbound and westbound – were also averaged to reach a combined travel speed for each of the AM and PM durations.

The results of the of the Transit Travel Time are shown below in **Table 4-39** for the No-Build option and six other Tier 2 Alternatives.

Table 4-39: Transit Travel Time Criterion Results*

Alternative	AM Peak Hour				PM Peak Hour			
	Westbound		Eastbound		Westbound		Eastbound	
	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change	Travel Time (sec)	Travel Time % Change
No Build	1,096	-	572	-	990	-	798	-
A	1,176	-7.3%	548	4.2%	883	10.8%	848	-6.3%
B	1,212	-10.6%	578	-1.0%	919	7.2%	1,144	-43.4%
C	1,217	-11.0%	569	0.5%	947	4.3%	951	-19.2%
D	1,599	-45.9%	551	3.7%	933	5.8%	994	-24.6%
E Wing Mntn bypass	946	13.7%	564	1.4%	879	11.2%	779	2.4%
F Hidden Hollow bypass	1,018	7.1%	562	1.7%	987	0.3%	758	5.0%

Average Travel Time	AM		PM	
No Build	834	-	894	-
A	862	-2.6%	866	2.6%
B	895	-5.6%	1,032	-12.5%
C	893	-5.4%	949	-5.0%
D	1,075	-22.0%	964	-6.3%
E Wing Mntn bypass	755	7.2%	829	5.9%
F Hidden Hollow bypass	790	4.0%	873	2.0%

The average transit travel time between the eastbound and westbound direction for the No-Build option is 834 seconds (13.9 minutes) in the AM and 894 seconds (14.9 minutes) in the PM – a one-minute difference in transit travel time between AM and PM. The No-Build travel time results is the baseline condition for calculating the travel time percent change for each of the Tier 2 Alternatives.

Only the alternative routes – Alternative E and Alternative F - have an improved transit travel time compared to the No-Build option in the AM and in the PM. However, the improvement is somewhat negligible. Each of the other alternatives have an overall increase in transit travel time. The No-Build option and the Tier 2 Alternatives are ranked below for each time duration based on the Vissim model results of the Transit Travel Time criterion.

AM

1. Alternative Package E – 755 seconds of average transit travel time
2. Alternative Package F – 790 seconds of average transit travel time
3. No-Build – 834 seconds of average transit travel time
4. Alternative Package A – 862 seconds of average transit travel time

5. Alternative Package C – 893 seconds of average transit travel time
6. Alternative Package B – 895 seconds of average transit travel time
7. Alternative Package D – 1,075 seconds of average transit travel time

PM

1. Alternative Package E – 829 seconds of average transit travel time
2. Alternative Package F – 873 seconds of average transit travel time
3. Alternative Package A – 866 seconds of average transit travel time
4. No-Build – 894 seconds of average transit travel time
5. Alternative Package C – 949 seconds of average transit travel time
6. Alternative Package D – 964 seconds of average transit travel time
7. Alternative Package B – 1,032 seconds of average transit travel time

Application of the Transit Travel Time Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Transit Travel Time criterion. The following formula was used to calculate the scores:

*Technical Score = (Best Result/ Alternative Result) * Weight * 100*

Since Transit travel time was measured in both the AM and PM time periods, two values were produced - each receiving half the value of the 6.27% weight, or 3.135%.

Table 4-40 and **Table 4-41** below show how the AM and PM scores were calculated for the No-Build option and the six other Tier 2 Alternatives relative to the results of the Travel Time criterion in order of highest to lowest scoring.

Table 4-40: AM Transit Travel Time Criterion Results in the Calculation of the Technical Score

Alternative	AM Travel Time Results	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package E	755 seconds	((755/755)	* 3.135%) * 100	3.13
Alt Package F	790 seconds	((755/790)	* 3.135%) * 100	3.00
No-Build	834 seconds	((755/834)	* 3.135%) * 100	2.84
Alt Package A	862 seconds	((755/862)	* 3.135%) * 100	2.74
Alt Package C	893 seconds	((755/893)	* 3.135%) * 100	2.65
Alt Package B	895 seconds	((755/895)	* 3.135%) * 100	2.64
Alt Package D	1,075 seconds	((755/1,075)	* 3.135%) * 100	2.20

Table 4-41: PM Transit Travel Time Criterion Results in the Calculation of the Technical Score

Alternative	PM Travel Time Results	Scoring Formula		Score
		Results Ratio	Applying the Weight	
Alt Package E	829 seconds	((829/829)	* 3.135%) * 100	3.13
Alt Package F	873 seconds	((829/873)	* 3.135%) * 100	2.98
Alt Package A	866 seconds	((829/866)	* 3.135%) * 100	3.00
No-Build	894 seconds	((829/894)	* 3.135%) * 100	2.90
Alt Package C	949 seconds	((829/949)	* 3.135%) * 100	2.74
Alt Package D	964 seconds	((829/964)	* 3.135%) * 100	2.70
Alt Package B	1,032 seconds	((829/1,032)	* 3.135%) * 100	2.52

4.9l Construction/Implementation – *Project Cost Criterion Results*

The Project Cost Criterion is a metric that measures the ease of construction/implementation by evaluating the total project cost to implement the No-Build option and six other Tier 2 Alternatives. This criterion is intended to reflect the fact that more expensive alternatives are generally more difficult to implement than a less expensive alternatives, and thus alternatives with lower projected costs would score higher than alternatives with more expensive cost estimates.

The No-Build option assumes no cost in order to implement while a detailed planning-level cost estimate was developed for each of the other Tier 2 Alternatives. **Table 4-42** below shows the total project cost for implementation of each Alternative.

Table 4-42: Project Cost Criterion Results

Alternative	Project Cost Estimate[1]
No-Build	No Cost
Alternative Package A	$87,291,544
Alternative Package B	$24,576,648
Alternative Package C	$24,576,648
Alternative Package D	$20,652,488
Alternative Package E	$80,265,491
Alternative Package F	$62,352,890
1 ROW impact/cost does not include any costs that may be associated with a potential impact to an existing building	

As anticipated, the more expansive build alternatives have higher project costs than the narrower build alternatives. Alternative A has the highest project cost estimate of $87,291,544 while Alternative D has the lowest project cost estimates of $20,652,488. Refer to Appendix F to see the detailed cost estimates for each alternative.

Application of the Project Cost Criterion Results Criterion Results in the Calculation of the Technical Score

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Project Cost criterion. One

unique element of the formula used for the Project Cost criterion is that a common denominator of $10,000,000 was added to the formula to normalize the ratio between the best result and the other results due to the large disparity between the zero cost for the No-Build option compared to the costs of the other six Tier 2 Alternatives. In addition, the value of $1 was also used in the formula for the cost of the No-Build option since inputting a zero would make all scores result in a zero).

The following formula was used to calculate the scores:

*Technical Score = (Best Result / (Alternative Result/10M)) * Weight * 100*

Table 4-43 below shows how the scores were calculated for each alternative relative to the results of the Cost of Implementation creation in order of highest scoring alternative to the lowest scoring alternative.

Table 4-43: Project Cost Criterion Results in the Calculation of the Technical Score

Alternative	Project Cost[123]	Scoring Formula		Score
		Results Ratio	Applying the Weight	
No-Build	No Cost	No formula used, automatically received full weighted points		4.68
Alt Package D	$20,652,488	(1/57.695M(/10M))	* 4.68% *100))	2.27
Alt Package B	$24,576,648	(1/40.542M(/10M))	* 4.68% *100))	1.90
Alt Package C	$24,576,648	(1/55.137M(/10M))	* 4.68%) *100))	1.90
Alt Package F	$62,352,890	(1/73.667M(/10M))	* 4.68% *100))	0.75
Alt Package E	$80,265,491	(1/60.994M(/10M))	*4.68% *100))	0.58
Alt Package A	$87,291,544	(1/40.514M(/10M))	* 4.68% *100))	0.54

1 Project Costs for managed lane alternatives do not include costs for permanent or variable message signing.
2 A common denominator has been added to the formula the normalize the relationship between the best result and the other results due to the large disparity between the two.
3 ROW impact/cost does not include any costs that may be associated with a potential impact to an existing building.

4.9m Construction/Implementation - *Right-of-Way Impact Criterion Results*

The right-of-way impact criterion is a metric that measures the amount of right-of-way that will be necessary to implement each alternative. The method to calculate the impact was produced by estimating the amount of land - in square feet - required for right-of-way acquisition to build the alternatives. The No-Build option assumes no right-of-way impact to implement while a detailed process to map and calculate the potential right-of-way impact was conducted for each of the other six Tier 2 Alternatives. **Table 4-44** below shows the total right-of-way impact for the implementation of each Tier 2 Alternative.

Table 4-44: Right-of-Way Impact Criterion Results

Alternative	Right-of-Way Impact*
No-Build	*No Impact*
Alternative Package A	303,909 ft^2
Alternative Package B	91,728 ft^2
Alternative Package C	91,728 ft^2
Alternative Package D	58,968 ft^2
Alternative Package E	2,557,843 ft^2
Alternative Package F	1,993,306 ft^2
**Does not include intersection configurations and thus the right-of-way impact only includes the mid-block width over the length of the study corridor*	

The more expansive build alternatives will naturally have a larger right-of-way footprint than the narrower alternatives. However, Alternative Package's B and Alternative C have the same right-of-way width of 100 feet and have a substantially smaller right-of-way footprint than Alternative Package A. Alternative Package D has the smallest right-of-way impact while the two alternative route have the largest impact because they consist of a newly introduced facility through Coconino National Forest.

Application of the Right-of-Way Impact Results

The quantitative approach previously described in *Section 4.6b - Tier 2 Evaluation Criteria Scoring Thresholds and Methodology* was used to calculate the score for the Right-of-Way Impact criterion. One unique element of the formula used for the Right-of-Way Impact criterion is that a common denominator of 10,000 ft^2 was added to the formula to normalize the ratio between the best result and the other results due to the large disparity between the zero impact for the No-Build option compared to the costs of the other six Tier 2 Alternatives. In addition, the value of 1 ft^2 was also used in the formula for the cost of the No-Build option since inputting a zero would make all scores result in a zero). The following formula was used to calculate the scores:

The following formula was used to calculate the scores:

Formula = (Best Result / (Alternative Result/10K)) * Weight * 100

Table 4-45 below shows how the scores were calculated for each alternative relative to the results of the Right-of-Way Impact creation in order of highest scoring alternative to the lowest scoring alternative.

Table 4-45: Right-of-Way Impact Criterion Results in the Calculation of the Technical Score

Alternative	Right-of-Way Impact*	Scoring Formula		Score
		Results Ratio	Applying the Weight	
No-Build	*No Impact*	No formula used, automatically received full points		4.96
Alt Package D	58,968 ft²	(1/(58,968/10K))	* 4.96% *100))	0.84
Alt Package B	91,728 ft²	(1/(91,728/10K))	* 4.96% *100))	0.54
Alt Package C	91,728 ft²	(1/(91,728/10K))	* 4.96% *100))	0.54
Alt Package A	303,909 ft²	(1/(303,909/10K))	* 4.96% *100))	0.16
Alt Package F	1,993,306 ft²	(1/1,993,306/10K))	* 4.96% *100))	0.02
Alt Package E	2,557,843 ft²	(1/(2,557,843/10K))	* 4.96% *100))	0.02
**Does not include intersection configurations and thus the right-of-way impact only includes the mid-block width over the length of the corridor*				

4.10 Tier 2 Alternatives Recommended for Tier 3 Analysis

Based on the Tier 2 Modeling results and Evaluation Criteria results, the Project Partners agreed to eliminate Alternative Packages E (aka Alternative 17 - Wing Mountain bypass) and F (aka Alternative 18 - Hidden Hollow bypass) from further analysis in Tier 3), however, the group agreed that the alternative routes are being eliminated for Tier 3 analysis, but that we may still want to use the alternate route modeling findings to compare/contrast future US 180 alternative findings and that the future public presentation on US 180 alternatives needs to include the rationale as to why these alternatives were eliminated. Ultimately, the Project Partners felt that the significantly higher construction costs of the alternate bypass routes could not be supported/justified by the minimal/negligible improvements to traffic operations on US 180.

Without improvements to Milton Road or the application of select spot improvements, the US 180 Alternative Packages provide a negligible improvement to vehicle travel time, transit travel times, or signal LOS/delay. As a result, the Project Partners decided Alternative Packages A, B, C, and D require further discussion with the following two options to consider moving forward:

- **Option 1**- Delay US 180 Tier 3 analysis until a Recommended Alternative is identified on Milton Rd. Then, add the Milton Recommended Alt + Spot Improvements to model and re-run together with US 180 Alternative Packages.
- **Option 2**: Eliminate poor-performing US 180 Alternative Packages from further analysis.

The Project Partners also agreed to add a No Build Plus Spot Improvements alternative (No-Build Plus) for Tier 3 analysis.

5.0 TIER 3 ALTERNATIVE EVALUATION

Based on the recommendations from the Project Partners, the following alternatives are included in the Tier 3 Alternative Evaluation:

- No-Build;
- No-Build Plus Spot Improvements (No-Build Plus);
- Alternative A;
- Alternative B;
- Alternative C; and
- Alternative D.

5.1a Spot Improvements

As previously introduced, one component that separates the Tier 3 Alternative Evaluation process from the Tier 2 Alternative Evaluation process is the inclusion of spot improvements. The Tier 2 traffic modeling analysis focused on a comparison of the alternatives by largely comparing various aspects of travel lane operations only.

Through a progression of meetings between the Consultant Team and the Project Partners, a series of spot improvements were developed to be integrated into all the Tier 3 Alternatives, except the No-Build alternative. Spot improvements were recognized by the Project Partners as being desired to potentially inventory which type of low investment enhancements could/should be included as part of the No Build Plus alternative (newly introduced to the Tier 3 process), but also recognize the desire and value of incorporating and measuring the effectiveness (or not) of other desired enhancements such as pedestrian, bicycle, transit, safety and traffic operations along the US 180 corridor.

The spot improvements are concentrated at intersections since the alternative's cross section address the mid-block applications. Spot improvements were also characterized in one of the following categories:

- Roadway Geometry;
- Roadway Operations;
- Vehicular Safety;
- Access Management;
- Pedestrian;
- Bicycle; and
- Transit.

Once the spot improvement inventory was completed, the Project Partners collaborated and recognized the variation in the spot improvement applications and identified the need to assign specific improvements to certain Tier 3 Alternatives. Spot improvements are assigned to the Tier 3 Alternatives by one of the three applications:

- No Build + Alternative Only;
- Build Alternatives Only; or
- All Alternatives.

Project Partners discussed and confirmed the Tier 3 Alternative Spot Improvement Inventory as shown in **Table 5-1**.

Table 5-1: Tier 3 Alternative Spot Improvement Inventory

Spot Improvement Alternative Applicability Key
[1] No Build + Alternative Only
[2] Build Alternatives Only
[3] All Alternatives

Corridor Intersections	Roadway Geometry	Roadway Operations	Vehicular Safety	Access Management	Pedestrian	Bicycle	Transit
Humphrey's Street (signalized)		• Dual Left turn on SB Humphrey's St to EB Milton Rd.[2] • Dual Left Turn on Milton Rd to NB Humphrey's St (requires two NB travel lanes on Humphrey's St)[2] • Florida T Concept, in conjunction with the appropriate signal phasing adjustments[2] •		• Restrict U-Turns[3]	• Ladder/High-Visibility Cross walks[3] • ADA-compliant curb ramps[3] • Pedestrian crossing improvements[3]	• Bicycle signal detection and actuation[3] • Combined Bike Lane/Right Turn Lane[2]	• Transit signal prioritization[3]
Columbus Street (signalized)	• Roundabout[2]	• Dual left turn lanes (NB Humphrey's to WB US 180)[2] • Dedicated right and left turn phase for vehicles (EB US 180 to SB Humphrey's)[2] • Longer left turn phases (NB Humphrey's to WB US 180)[2] • Overlap EB right turn phase with NB left Turn phase[2]			• Ladder/High-Visibility Cross walks[3] • ADA-compliant curb ramps[3] • Sidewalk widening[2] • • Angle ramps on the SE corner with a pork chop[3]	• Bicycle signal detection and actuation[3] • Combined Bike Lane/Right Turn Lane[2]	• Transit signal prioritization[3]
Forest Avenue (stop controlled)		• Restrict WB left turn[3]		• Two raised medians in existing turn lanes (south and east legs). Keep the raised medians for the pedestrian refuge and for the center running lane alts, the center lane will have to merge into the other lane at these segments[3]	• Pedestrian signal[3] • Ladder/High-Visibility Cross walks[3] • ADA-compliant curb ramps[3] • Sidewalk widening[2]	• Combined Bike Lane/Right Turn Lane for WB Forest Ave. to NB US 180 with sharrow[3] • Continue WB bike lane through intersection[3]	

Spot Improvement Alternative Applicability Key
[1] No Build + Alternative Only
[2] Build Alternatives Only
[3] All Alternatives

Corridor Intersections	Roadway Geometry	Roadway Operations	Vehicular Safety	Access Management	Pedestrian	Bicycle	Transit
Sechrist Drive (stop controlled)		• NB right turn lane extension[3]			• Pedestrian signal (RRFB) • Ladder/High-Visibility Cross walks[3] • ADA-compliant curb ramps[3] • Sidewalk widening[2] • Grade separated crossing[2] • Pedestrian warning signage[3]		• Existing bus stop on the NB side (east side)[3]
Schultz Pass Drive (signalized)					• Ladder/High-Visibility Cross walks[3] • ADA-compliant curb ramps[3]	• Bicycle signal detection and actuation[3] • Combined Bike Lane/Right Turn Lane[3]	• Transit signal prioritization[3]
Snow Bowl Road (Stop Controlled)	• Roundabout[2] • Traffic signal[2]	• Additional right turn lane (WB US180)[2] • Additional left turn lane (SB Snow Bowl Rd)[3] • • Enhance pavement striping of existing pavement section to create an additional NB receiving lane on Snow Bowl Road[3]			• Ladder/High-Visibility Cross walks[3] • Pedestrian signal[3]	• Bicycle signal detection and actuation (if traffic signal is installed)[2]	
Other Spot Improvements		• Right turn deceleration lanes[2] • Left turn lanes[2] • DMS Signage[3] • Traffic/pedestrian signal at Elm Street[2]	• Rumble strips[3] • Safety edges[3] • High visibility edge line striping[3] • Raised pavement markers[3] • Delineators[3] • Guard rails[3] • High visibility signage[3] • Wildlife crossings (AZGFD guidance -MP 224.8, 228.8, and 218)[2] • Turn lane extensions[3] • Speed feedback signage[3]	• Raised Medians with left turn lanes[2] • Restrict U-Turns[3] • Right turn restrictions[3]	• Pedestrian mid-block crossings/signals • Mid-block sidewalk widening • Enhanced crosswalks • Pedestrian scale lighting (FUTS) • Pedestrian warning signage • Pedestrian crossing at Meade, Anderson St, and near the Museum	• Bike Lane[2] • Buffered Bike Lane[2] • Multi-use path[2] • Bicycle mid-block crossings/signals[3] • Bicycle signage[3]	• Enhanced Transit Shelters[3] • Planned bus stop on the NB side of Anderson Road (east side)[3]

Spot Improvement Alternative Applicability Key
[1] No Build + Alternative Only
[2] Build Alternatives Only
[3] All Alternatives

Corridor Intersections	Roadway Geometry	Roadway Operations	Vehicular Safety	Access Management	Pedestrian	Bicycle	Transit
			• Shoulder widening between Magdalena Rd (MP 219.16) and Hidden Hollow Rd (MP 219.65) – this spot improvement could cost more than just the cost of additional pavement due to the steep slope.[3]				

5.2 Tier 3 Evaluation Criteria

Similar to the Tier 2 Alternative Evaluation process, a series of Tier 3 Evaluation Criteria and Weightings were developed to evaluate and measure the performance of the six Tier 3 Alternatives. The Tier 3 evaluation criteria were crafted to be diverse in nature, although the Tier 3 Evaluation Criteria tend to focus more on quantitative measurements and remove any qualitative metrics carried over from Tier 2 Alternative Evaluation process.

The Project Partners held a series of meetings to determine which of the Tier 2 Evaluation Criteria would carry over to the Tier 3 Evaluation Criteria; which Tier 2 Evaluation Criteria should be eliminated from the Tier 3 Evaluation Criteria; which of the Tier 2 Evaluation Criteria need to be revised in order to move into the Tier 3 Evaluation Criteria; and finally, consider potential new evaluation criteria to the Tier 3 Evaluation process. Any newly introduced or revised criteria had to comply with three criteria considerations to in order to be included in the Tier 3 Evaluation Criteria.

1. Cannot be duplicative with any other criteria
2. Needs to be objective and data-driven in nature
3. Feasible/reasonable to evaluate

A few members of the Project Partners were elected to participate in a separate small working group assigned to determine and develop the Tier 3 Evaluation Criteria under the criteria considerations.

These meetings of the Consultant Team and the Tier 3 Evaluation Criteria Task Force produced a new set of more refined group of evaluation metrics to be included in the Tier 3 Evaluation Criteria. Detailed notes were collected and distributed during the progression of meetings and can be referenced in Appendix G.

As a result of the small work group meetings, 17 different evaluation criteria were developed to apply in Tier 3 Alternative Evaluation process, 11 of which were newly introduced evaluation criteria. The newly introduced alternative evaluation criteria include:

- Network Delay;
- Conflict Points;
- Bicycle Comfort Index;
- Pedestrian Comfort Index;
- Transit Ridership;
- Title VI Impacts;
- Neighborhood Impacts;
- Air Quality;
- Wildlife Mitigation; and
- Community Character.

Table 5-2 illustrates the evolution from the Tier 2 Evaluation Criteria to the Tier 3 Evaluation Criteria, while **Table 5-3** shows the final set of Tier 3 Evaluation Criteria .

Table 5-2: Evolution of the Tier 3 Evaluation Criteria

Final T3 Evaluation Criteria					Criteria Considerations: 1) Is it duplicative? 2) Is it objective (data-driven)? 3) Feasible/reasonable to evaluate?	Result
Category	Criteria / Measure	Scoring Formula	Acceptance Threshold	Weight (TBD)	Notes	Notes
Traffic Operations	Level of Service (Volume / Capacity Ratio)	Formula = (Best Result / Alternative Result) * Weight * 100 Ex - Alt 4: (6.25/11.03) * 5.25% * 100 = 2.97	N/A	TBD	Project Partners agreed to keep this criterion and that a separate Task Force would verify the data and metrics for this criterion.	Keep
	~~Travel Speed as % of Base Free Flow Speed (AM)~~ ~~Travel Speed as % of Base Free Flow Speed (PM)~~	~~Formula = ((Alternative Result * 100) / Best Result) * Weight * 100 / 2~~ ~~Ex - Alt 4: ((46.1%*100)/62)* 3.33% * 100 /2 = 1.24~~	~~N/A~~	~~TBD~~	See meeting notes for details.	Remove
	~~Improved Intersection LOS (AM)~~ ~~Improved Intersection LOS (PM)~~	~~Formula = (Best Result / Alternative Result) * Weight * 100 / 2~~ ~~Ex - Alt 4: (2/3) * 6.04% * 100 /2 = 3.02~~	~~N/A~~	~~TBD~~	See meeting notes for details.	Remove
	~~Signal/Stop Control Delay (AM)~~ ~~Signal/Stop Control Delay (PM)~~	~~Formula = (Best Result / Alternative Result) * Weight * 100 / 2~~ ~~Ex - Alt 4: (29.5/41.6) * 3.29% * 100 /2 = 1.17~~	~~N/A~~	~~TBD~~ ~~TBD~~	Model output to be documented in final report, but Project Partners agred to remove. See meeting notes for details.	Remove
	Travel Time (AM/PM, both directions)	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (339/560) * 4.79% * 100 /2 = 1.45	Average of NB (AM/PM) & SB (AM/PM) must be positive. No direction / timeframe may exceed -5% of existing.	TBD	See meeting notes for details.	Keep
	NEW: Network Delay	Model output of VISSIM	TBD - After review model output	TBD	See meeting notes for details.	Keep
Safety	~~Reduction in Total Crashes (Based on CMFs)~~	~~Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 4: (19.4/28.98) * 7.13% * 100 = 4.77~~	~~TBD~~	~~TBD~~	See meeting notes for details.	Remove
	~~Reduced Injury Crashes (Based on CMFs)~~	~~Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 5: (21.78/28.78) * 8.18% * 100 = 6.19~~	~~TBD~~	~~TBD~~	See meeting notes for details.	Remove
	~~Reduced Bicycle Crashes (Based on CMFs)~~	~~Formula = (Alternative Result / Best Result) * Weight * 100 Ex - Alt 5: (14/14) * 7.10% * 100 = 7.10~~	~~TBD~~	~~TBD~~	See meeting notes for details.	Remove
	~~NEW: HSM or FMPO Safety Tool(s)?~~			~~TBD~~	See meeting notes for details.	Remove
	NEW: Reduction in Conflict Points	Formula: (Alternative Result / Best Result) * Weight * 100	N/A	TBD	See meeting notes for details.	Keep
Expand Travel Mode Choices	~~Pedestrian - Sidewalk Conditions~~	~~Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's (PP) preferred standards~~ ~~Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's (PP) preferred standards, but not both~~ ~~Maintains Existing Condition~~		~~TBD~~	See meeting notes for details.	Remove
	~~NEW: Bike & Pedestrian - Average Crossing Distance~~	~~Formula = (Best Result / Alternative Result) * Weight * 100~~	~~N/A~~	~~TBD~~	See meeting notes for details.	Remove
	Bicycle Environmental Quality Index	Subtotal Score from index	N/A	TBD	Keep with minor revision. Refer to Bike & Pedestrian Index and meeting notes for details.	Keep
	Pedestrian Environmental Quality Index	Subtotal Score from index	N/A	TBD	Keep with minor revision. Refer to Bike & Pedestrian Index and meeting notes for details.	Keep
	~~Bicycle~~	~~Meets or Exceeds both ADOT's minimum standard and the City/FMPO/NAIPTA's preferred standards~~ ~~Meets or Exceeds ADOT's minimum standard OR the City/FMPO/NAIPTA's preferred standards, but not both~~ ~~Maintains Existing Condition~~		~~TBD~~	See meeting notes for details.	Remove
	Transit Travel Time (AM/PM, both directions)	Formula = (Best Result / Alternative Result) * Weight * 100 / 2 Ex - Alt 4: (250/371) * 6.27% * 100 /2 = 2.11	Average of NB (AM/PM) & SB (AM/PM) must be positive. No direction / timeframe may exceed -5% of existing.	TBD	See meeting notes for details.	Keep
	NEW: Transit Ridership	Formula = (Best Result / Alternative Result) * Weight * 100	N/A	TBD	See meeting notes for details.	Keep
Public Acceptance	Public Support	# of Public Support Formula = (Best Result / Alternative Result) * Weight * 100	Majority of public support (>51%)	TBD	Keep as a placeholder. See meeting notes for details.	Keep
Cost / Implementation	Construction Cost	Formula = (Best Result / (Alternative Result/10M)) * Weight * 100 Ex - Alt 4: (1/(40.542M/10M)) * 4.68% * 100 = 1.15	N/A	TBD	See meeting notes for details.	Keep
	ROW Impact (Square Feet)	Formula = (Best Result / (Alternative Result/10K)) * Weight * 100 Ex - Alt 4: (1/(26,326/10K)) * 4.98% * 100 = 1.89	N/A	TBD	See meeting notes for details.	Keep
	~~NEW: Maintenance Cost~~	~~(Cost to Maintain 1 mile of road X 20 years X # of lanes) + (Sq. ft cost of landscaping)~~ ~~Formula = Best Result / Alternative Result * Weight * 100~~	~~N/A~~	~~TBD~~	See meeting notes for details.	Remove
	NEW: Implementation Opportunities	Formula = Best Result / Alternative Result	N/A	TBD	Project Partners agreed to keep, but consensus on a measure/metric is pending. See meeting notes for details.	Keep
	~~NEW: Cost / Benefit Analysis~~	~~TBD~~	~~TBD~~	~~TBD~~	See meeting notes for details.	Remove
Environmental Impacts	NEW: Neighborhood Impacts	FMPO Model	TBD	TBD	Project Partners agreed to keep. Sara Dechter proposed to consider additional metrics. Consensus on additional metrics pending. See meeting notes for details.	Keep
	NEW: Title VI Impacts	FMPO Model	TBD	TBD	Project Partners agreed to keep. Sara Dechter proposed to consider additional metrics. Consensus on additional metrics pending. See meeting notes for details.	
	NEW: Air Quality	Same output as Network Delay	TBD	TBD	See meeting notes for details.	Keep
	~~NEW: Stormwater Impacts~~		~~TBD~~	~~TBD~~	See meeting notes for details.	Remove
	NEW (US180 only): Wildlife Mitigation	TBD - Will compare AGFD recommended mitigation sites with animal crash data	TBD	TBD	See meeting notes for details.	Keep
	~~Others (not recommended)~~	~~See Notes~~	~~N/A~~	~~N/A~~	See meeting notes for details.	Remove
Community Character	Great Street	50% - Meets *City 2030 Regional Plan Policy 50% - Public Survey Output *Formula for City 2030 Policy: % of corridor able to accommodate trees + % of corridor with "wide" sidewalks	TBD	TBD	See meeting notes for details.	Keep

The sub-criteria in calculating the Pedestrian Comfort Index and the Bicycle Comfort Index are on the following Page

Bicycle Comfort Index Evaluation Criteria

Bicycle Evaluation Criteria	Thresholds	Score
Bicycle Facility Type	No bike facility	0.0
	Shared-lane facility	0.5
	Bike lane	1.0
	Buffered bike lane	2.0
Number of Total Vehicle Though Lanes	8	0.0
	6	1.0
	4	1.5
	2	2.0
Traffic Volume: (Curb Lane)	> 12,000	0
	9,000 - 12,000	0.5
	6,000 - 9,000	1
	3,000 - 6,000	1.5
	< 3,000	2.0
Presence of Median:	No median	0.0
	TWLTL / Left Turn Lane (no median)	1.0
	Left turn Lane with median	1.5
	Left turn Lane with planted median	2.0
		/8

Pedestrian Comfort Index Evaluation Criteria

Pedestrian Evaluation Criteria	Thresholds	Score
Sidewalk Width	6' wide or less	0.0
	6' – 7' wide	1.0
	7' – 9' wide	1.5
	Greater than 9' wide	2.0
Horizontal Buffer Width (select all):	No buffer	0.0
	0' – 3' buffer	0.5
	3' – 6' buffer	1.0
	6' - 9' buffer	1.5
	Greater than 9' buffer	2.0
Number of Total Vehicle Though Lanes	8	0.0
	6	1.0
	4	1.5
	2	2.0
Traffic Volume: (Curb Lane)	> 12,000	0
	9,000 - 12,000	0.5
	6,000 - 9,000	1
	3,000 - 6,000	1.5
	< 3,000	2
Presence of Median:	No median	0.0
	TWLTL / Left Turn Lane (no median)	1.0
	Left turn Lane with median (>5)	1.5
	Left turn Lane with planted median (<5)	2.0
		/10

Table 5-3: Final Tier 3 Evaluation Criteria

Final T3 Evaluation Criteria		
Category	**Metrics**	**Scoring Formula**
Traffic Operations	Level of Service (Volume / Capacity Ratio)	Result = (Alternative Result/ Best Result) * Weight * 100
	Travel Time (AM) - minutes	Result = (Best Result / Alternative Result) * Weight * 100
	Travel Time (PM) - minutes	
	Network Delay (AM) - hours	Result = (Best Result / Alternative Result) * Weight * 100
	Network Delay (PM) - hours	
Vehicular Safety	Reduction in Conflict Points	Result = (Best Result / Alternative Result) * Weight * 100
Expand Travel Mode Choices	Bicycle Comfort Quality Index	Result = (Alternative Result/ Best Result) * Weight * 100
	Pedestrian Comfort Index	Result = (Alternative Result/ Best Result) * Weight * 100
	Transit Travel Time (AM) - minutes	Result = (Best Result / Alternative Result) * Weight * 100
	Transit Travel Time (PM) - minutes	
	Transit Ridership	Result = (Alternative Result/ Best Result) * Weight * 100
Public Acceptance	Public Support	# of Public Support Result = (Best Result / Alternative Result) * Weight * 100
Cost / Implementation	Construction Cost	Result = (Best Result / (Alternative Result/10M)) * Weight * 100
	ROW Impact (Square Feet)	Result= (Best Result / (Alternative Result/10K)) * Weight * 100
	Implementation Opportunities	Result = (Alternative Result/ Best Result) * Weight * 100
Environmental Impacts	Neighborhood Impacts	Result = (Best Result/Alternative Result) * Weight * 100
	Title VI Impacts	Result = (Best Result/Alternative Result) * Weight * 100
	Air Quality	Result = (Best Result/Alternative Result) * Weight * 100
Community Character	Great Street	50% - Meets *City 2030 Regional Plan Policy 50% - Public Survey Output *Formula for City 2030 Policy: % of corridor able to accommodate trees + % of corridor with "wide" sidewalks

5.3 Weighting of the Tier 3 Evaluation Criteria

Tier 3 Evaluation Criteria weights were developed after the Project Partner reached consensus and the Tier 3 Evaluation Criteria were finalized. The Tier 3 Evaluation Criteria Weights were determined through the combined results of a Project Partner and a community-based survey.

5.3a Project Partner Tier 3 Evaluation Criteria Weighting Survey

Similar to the exercise conducted in Tier 2, the Project Partners were provided a survey to populate their desired weight (level of importance/preference) for each of the Tier 3 Evaluation Category and Criteria. This survey used a pair-wise comparison mathematical analysis; allowing each respondent to systematically evaluate each Evaluation Criteria Category against each other two at a time and set their relative impact in achieving the project goals. This exercise was repeated for the criteria under each category. Each Project Partner Agency was afforded two responses. Each and all responses from the Project Partners were averaged together to create the weightings. Refer to Appendix H for more information regarding the Project Partner Tier 3 Evaluation Criteria Weighting Survey.

5.3b Community Tier 3 Evaluation Criteria Weighting Survey

The Project Partners desired the public's perspective and input be integrated into the Tier 3 Evaluation Criteria Weighting process. As a result, a Public Survey created by a separate subcommittee of Project Partners was launched on August 10, 2020 within the City of Flagstaff's Online Community Forum. The public only evaluated the criteria categories and not the individual criteria underneath each. The survey was live for two weeks and had 813 attendees and 562 responses. A full detailed report of the Public Survey can be referenced in Appendix I.

5.3c Final Tier 3 Evaluation Criteria Weights

A meeting was held amongst the Project Partners and the Consultant Team to review the results of the Project Partner and Public Tier 3 Evaluation Criteria Weighting Surveys to develop an equitable approach in aggregating the results of each survey to ultimately finalize the Tier 3 Evaluation Criteria Weighting. The Project Partners reached consensus on one of the approaches and decided to used Option 3 as the approach to combine the results of the Project Partner and Public Tier 3 Evaluation Criteria Weighting Surveys. Reference the meeting notes in Appendix J for more information about the four approaches discussed for aggregating the results of the two surveys.

Table 5-4 shows the finalized Tier 3 Evaluation Category and Criteria Weighting results used in the Tier 3 Alternative Evaluation process.

Table 5-4: Final Tier 3 Evaluation Criteria Weighting

Tier 3 Evaluation Criteria Categories	Public & Project Partner Weighting Survey Results (Option 3)	Tier 3 Evaluation Criteria	Project Partner Criteria Weighting Survey Results	Final Tier 3 Weighting
Traffic Operations	12.4	Level of Service	16.2%	2.0%
		Travel Time	54.9%	6.8%
		Network Delay	29.0%	3.6%
Safety	15.1	Conflict Points	N/A	15.1%
Expand Travel Mode	17.4	Bicycle Comfort Index	33.6%	5.8%
		Pedestrian Comfort Index	28.4%	4.9%
		Transit Travel Time	18.0%	3.1%
		Transit Ridership	20.0%	3.48%
Public Acceptance	12.5	Public Acceptance	N/A	12.5%
Cost / Implementation	12.3	Construction Cost	35.8%	4.4%
		ROW Impact	37.1%	4.6%
		Implementation Opportunities	27.1%	3.3%
Environmental Impacts	15.7	Neighborhood Impacts	25.5%	4.0%
		Title VI Impacts	21.2%	3.3%
		Air Quality	23.1%	3.6%
		Wildlife Mitigation	30.2%	4.7%
Community Character	14.6	Great Street	N/A	14.6%

5.4 Tier 3 Analysis & No Build Plus Alternative Recommendation

Following the confirmation of the Tier 3 Evaluation Criteria, the Project Partners met on August 25, 2020 to review the US 180 CMP Tier 3 model results and discuss the correlation of the Milton Road CMP Tier 3 results to the US 180 CMP Tier 2 Evaluation Criteria results and the Tier 3 Alternative Evaluation and Screening process. Refer to Appendix J for the US 180 model results and meeting summary.

As noted in *Section 4.9 - Tier 2 Evaluation Criteria Detailed Results*, the increase in travel time and poor performance of the operational metrics of the various Tier 2 alternative packages have a significant correlation to the operations on Milton Road – particularly in the southbound direction. Thus, since there are no significant travel time improvements on Milton Road resulting from the Milton Road Tier 3 Alternative Evaluation process (Appendix K), the opportunity or likelihood for operational improvements on US 180 is nearly non-existent.

In other words, Milton Road operations are a significant influence on the impacts to operations on US 180 (particularly for southbound PM movements) and US 180 travel performance cannot be improved without first addressing the congestion issues on Milton Road. It was also noted that Mountain Line completed a US 180 Implementation Plan in 2018, finding that winter weekend congestion delays were typically in the 25- to 30-minute range. Specifically, peak travel time analyzed during the winter season from 2014-2018 showed that for 58% of the winter days, drivers experienced delay of 15 minutes or less, 19% of the winter days drivers experienced delays of 16-20 minutes, 10% of the winter days had delay of 21-30 minutes, and 13% of the days drivers experienced delays longer than 30 minutes. Recent enhancements such as increased transit headways, the enforcement of no parking along the US 180 roadway, and snow play area closures (Wing Mountain) have contributed to overall improvements on US 180 during winter weekends.

Recognizing the combination of these multiple factors, the Project Partners discussed the following approach to the US 180 Tier 3 Alternative Evaluation Process:

1. Identify the No-Build Plus as the recommended alternative for US 180; and
2. If the public agrees, the other US 180 Tier 3 Alternates would not to go through the Tier 3 Alternative Evaluation and Screening process.

The No-Build Plus alternative on US 180 offers improvements without expanding the right-of-way including bike, pedestrian, wildlife, and intersection safety improvements on US 180 per the previously identified spot improvement inventory in *Section 5.1a - Spot Improvements*.

The Project Partners noted that not all bicycle and pedestrian infrastructure gaps are addressed within the currently defined spot improvement inventory and expressed shared interest in introducing a new Tier 3 Alterative - the "No-Build Enhanced". The No Build Enhanced would expand on the US 180 No-Build Plus to also include a select number of additional spot improvements, such as closing sidewalk gaps (not requiring additional right-of-way) that were not previously identified in the former No Build Plus alternative.

The Project Partners will evaluate and select a refined set of spot improvements for US 180 once the Milton Road preferred alternative is identified. This future exercise will, in essence, generate

a new No-Build Hybrid recommended alternative for the US 180 corridor. As a result, the remaining alternatives will not undergo the Tier 3 Alternative Evaluation process.