

I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini Stack

Conceptual Alternatives Study

Prepared for



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1.0 Introduction

The Interstate 10 (I-10)/Papago Freeway Tunnel Operations Study (Study) is being conducted by the Maricopa Association of Governments (MAG) to identify potential solutions to accommodate travel demand for this critical segment of the regional freeway system. This Study is technical in nature, future steps will provide opportunity for public input, and recommendations are subject to change.

1.1 Study Overview

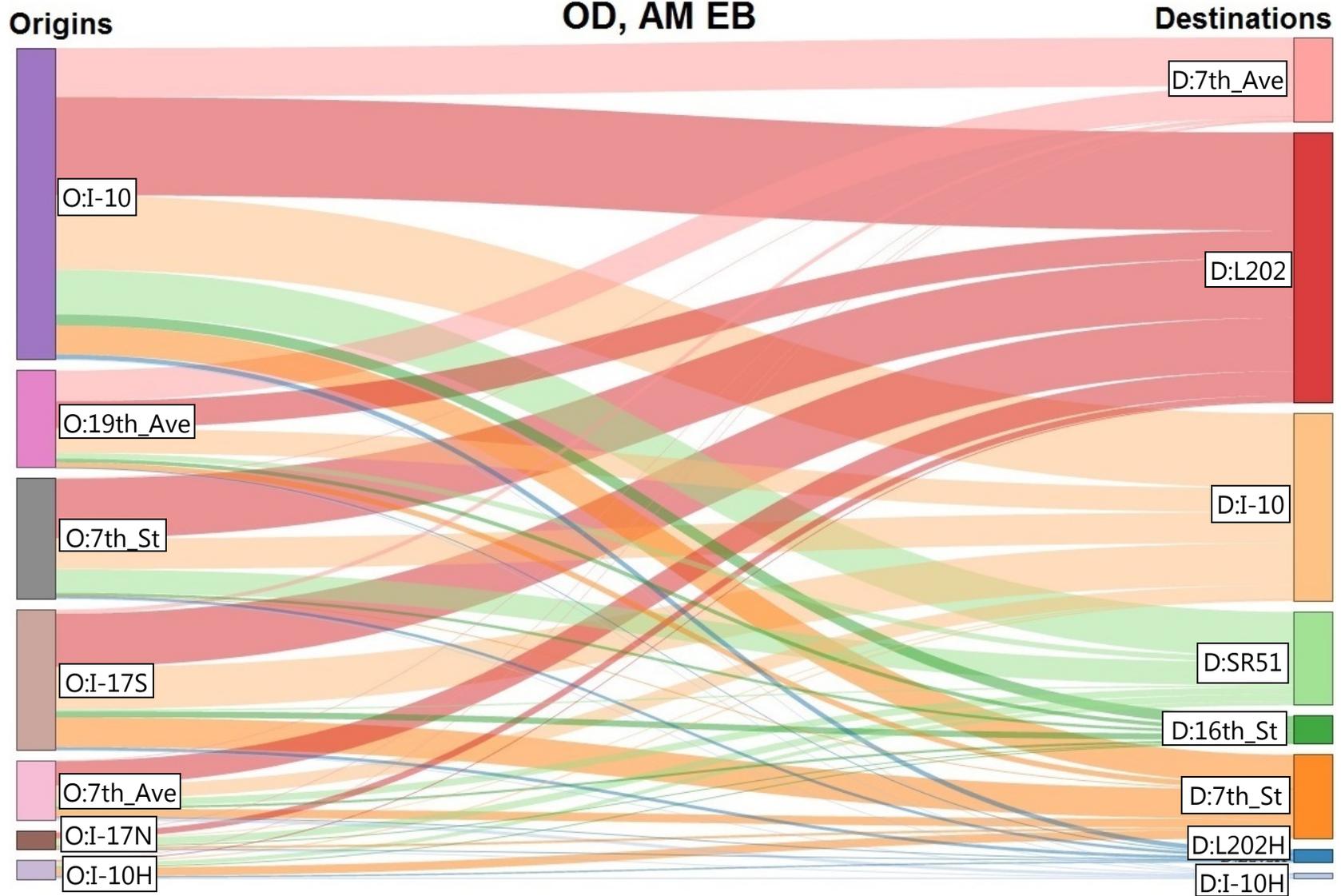
I-10 is an important regional facility that carries almost 300,000 vehicles per day, representing some of the highest travel demand in the Valley. The 6.5-mile long Study Area generally consists of the segment between Interstate 17 (I-17) and State Route 51 (SR-51)/State Route Loop 202 (SR-202L).

In its current state, I-10 experiences numerous traffic operational issues including:

- Travel demand is largely local and directional by peak hour, whereas I-17 (south and west sides of the Inner Loop) handle a larger portion of through travel.
- Weave sections between 7th Street and the SR-51/SR-202L Mini-Stack Traffic Interchange (TI) are failing in both directions.
- Weave sections between the I-17 Stack TI and 7th Avenue are failing in both directions.
- I-10 westbound (WB) off-ramp at 7th Street is short and queues back to the mainline.
- I-10 eastbound (EB) third option lane exit to SR-51 and SR-202L is not functional.

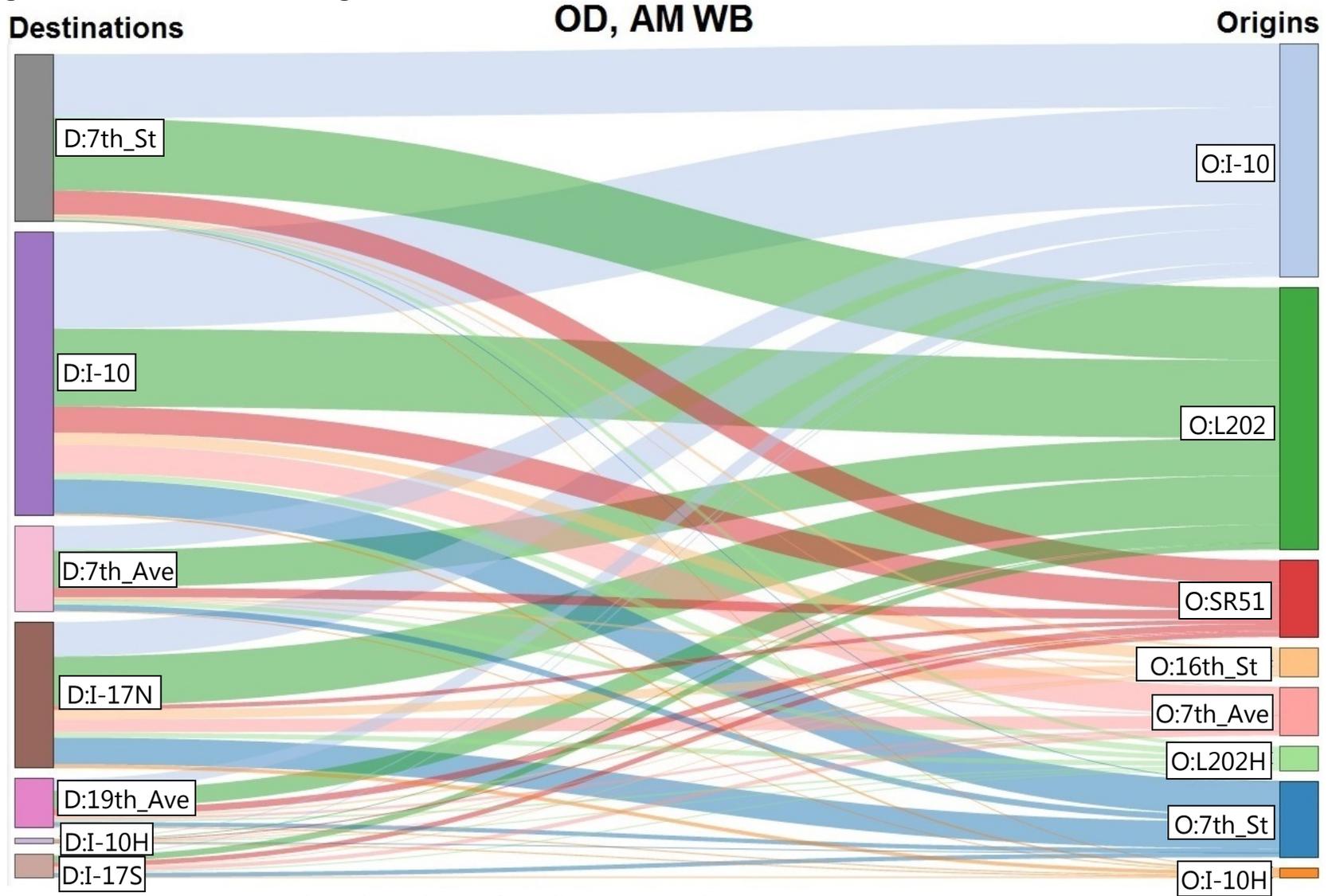
Figure 1 to **Figure 4** display the draft preliminary results for origin-destination patterns within the Study Area from the MAG 2014/2015 Bottleneck Study. Each graphic also illustrates relative volumes by the width of the band. All figures generally support the above list of corridor issues in that I-10 to/from the west and SR-202L to/from the east are the primary routes and that heavy travel demand for local access create substantial weaving concerns along I-10.

Figure 1 – AM Eastbound Origin-Destination Patterns



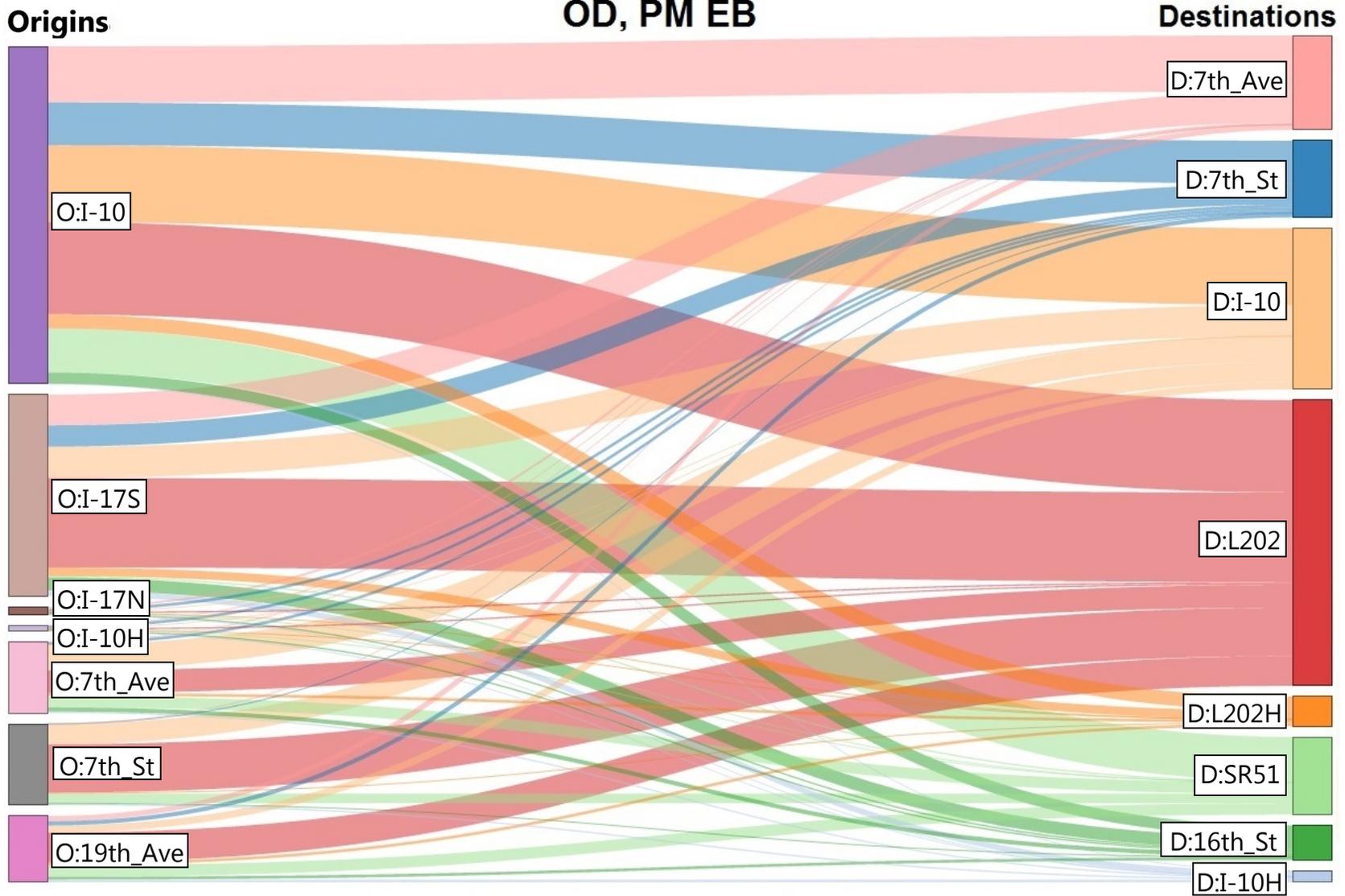
Source: MAG 2014/2015 Bottleneck Study. Draft Preliminary Results

Figure 2 – AM Westbound Origin-Destination Patterns



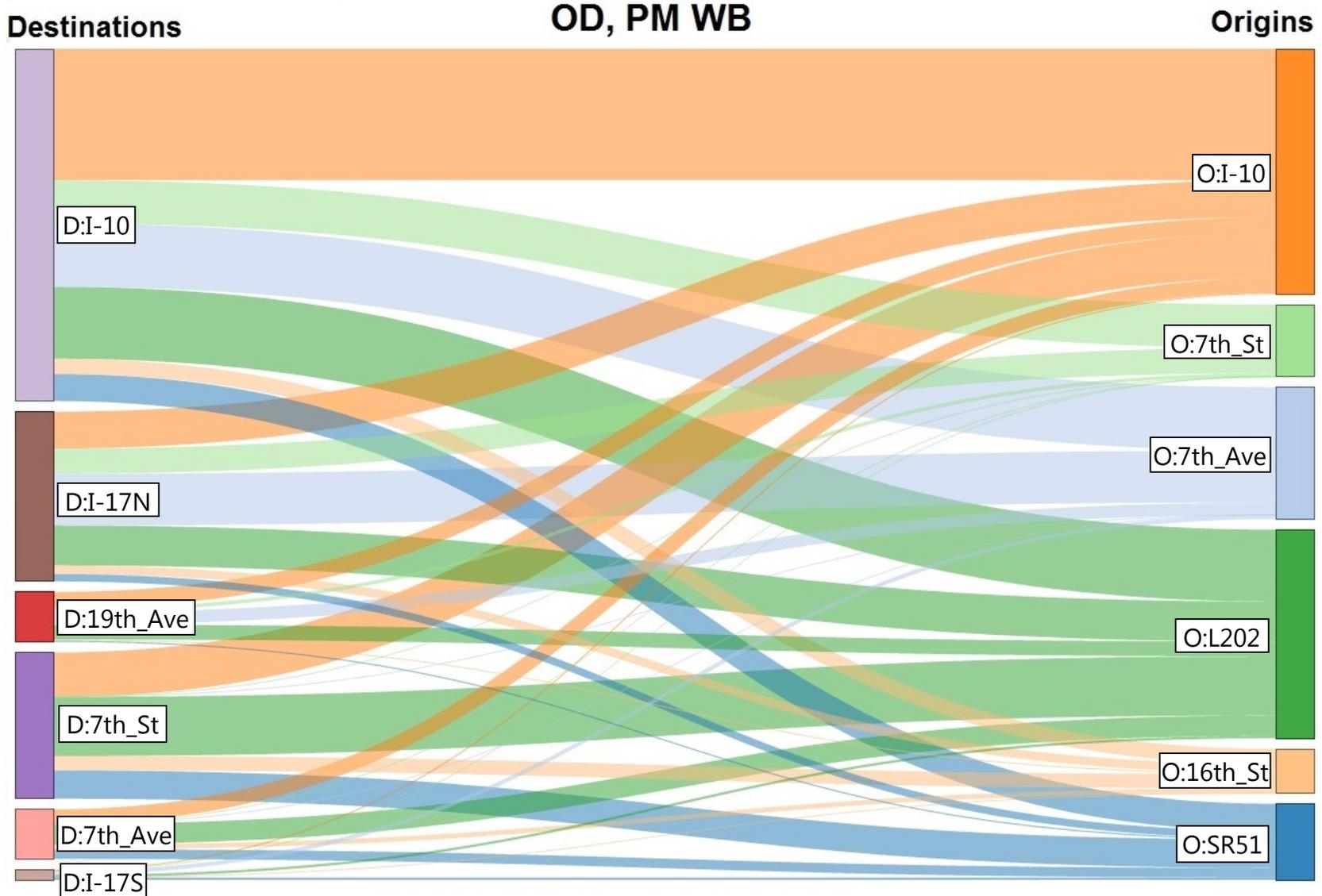
Source: MAG 2014/2015 Bottleneck Study. Draft Preliminary Results

Figure 3 – PM Eastbound Origin-Destination Study



Source: MAG 2014/2015 Bottleneck Study. Draft Preliminary Results

Figure 4 – PM Westbound Origin-Destination Patterns



Source: MAG 2014/2015 Bottleneck Study. Draft Preliminary Results

The purpose of this Study was to develop solutions that address the travel demand issues in the Study Area. The nature of this Study is a high-level investigation seeking to develop potential feasible improvements for future detailed investigation.

The Arizona Department of Transportation (ADOT) recently completed a traffic safety study for the majority of the Study Area. The ADOT safety study identified various low-cost, short term, and operational recommendations for improving the traffic flow based upon the existing geometry of the freeway and its current TIs. These recommendations are considered a basis for potential long-term capital improvements developed. Building upon the recommendations from the safety study, ramp braiding and introducing collector-distributor (C-D) roads were considered in identifying a long-term permanent solution for meeting the existing and future travel demand.

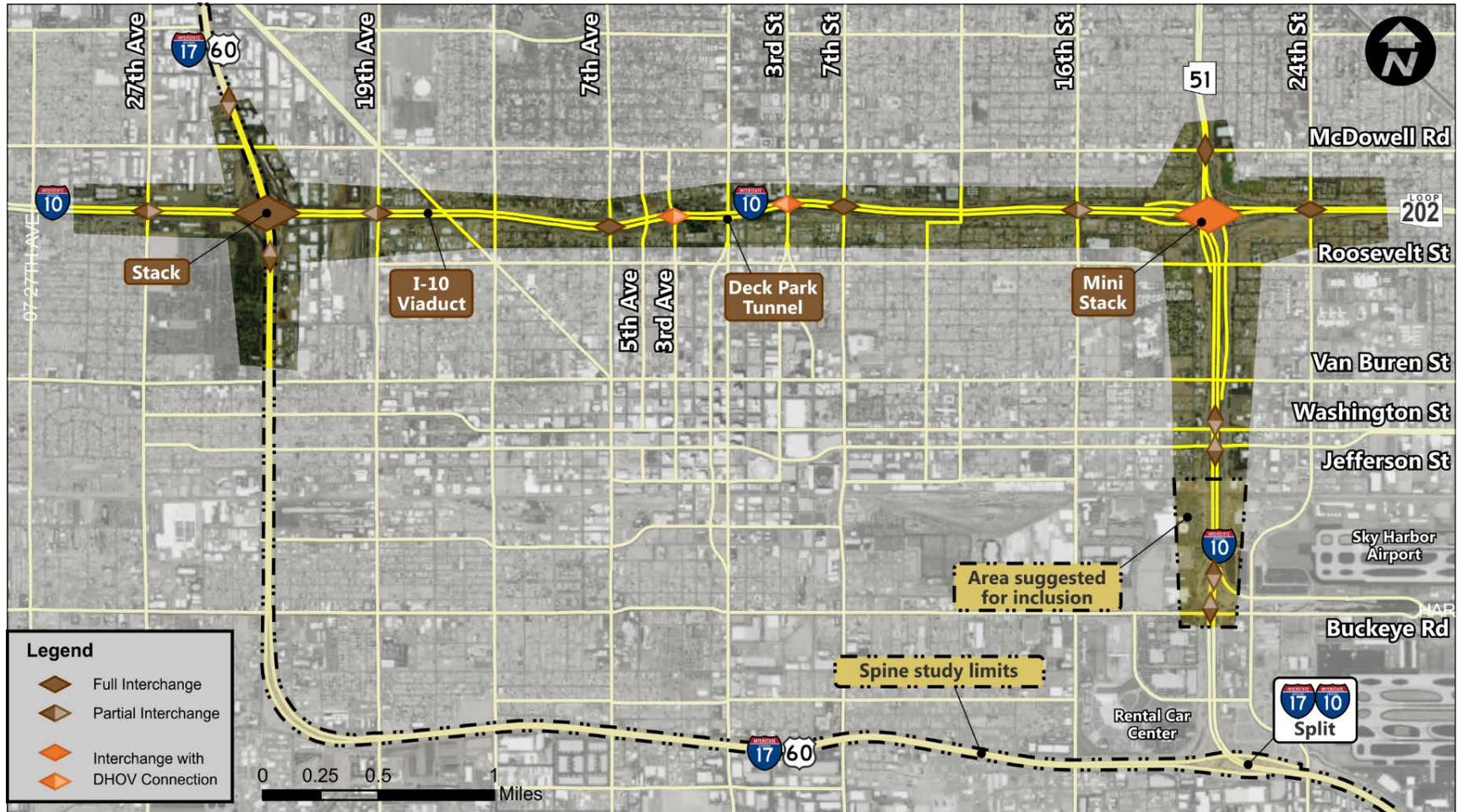
1.2 Study Area

I-10 is part of the downtown City of Phoenix “Inner Loop” system that circles the central business district. This Study is focused on the Inner Loop’s north leg. The project is located along I-10 between milepost 142.14 at the 35th Avenue TI and milepost 148.59 at the Washington Street/Jefferson Street couplet TI. In addition, this Study will consider the influences this segment of the I-10 has for a half-mile north and south of I-17, a half-mile north on State Route 51 (SR-51), and a half-mile east on SR-202L. The Study Area includes:

- System TIs: I-17 Stack and SR-51/SR-202L Mini-Stack;
- General purpose service TIs: 35th Avenue, 27th Avenue (to/from west), 19th Avenue (to/from east), 7th Avenue, 7th Street, 16th Street (to/from west), and Washington Street/Jefferson Street (split diamond TI); and
- Direct High-Occupancy Vehicle (DHOV) TIs and connections: 5th Avenue/3rd Avenue (to/from west), 3rd Street (to/from east), I-10/SR-202L, and I-10/SR-51.

A map of the Study Area is included as **Figure 5**.

Figure 5 – Study Area Map



2.0 Development of Conceptual Alternatives

The development of conceptual alternatives was based on:

- Background information and data developed by others;
- Input from stakeholders at the Kickoff Meeting;
- Collaboration at the Conceptual Alternative Brainstorming Charrette;
- Refinements at the Progress Meeting; and
- Comments from the Planning Partners Meeting.

The nature of this Study is a high-level, feasibility investigation. The intent was to develop potential feasible improvements for future detailed investigation and identify potential fatal flaws in coordination with the Planning Partners.

2.1 Background Information

The project team obtained a variety of relevant documents and recent project data, including:

- I-10, 3rd Street to SR-202L HOV Auxiliary Lanes Feasibility Memo (2015);
- Light rail transit/bus ramps at the I-17 Stack TI (2015);
- I-10, 35th Avenue to Sky Harbor Boulevard Phoenix Corridor Safety Study (2015);
- I-10/Buckeye Road/Sky Harbor Boulevard TI 15% Design (2010);
- I-10 Papago Intermodal Transfer Station Feasibility of Reuse as HOV Lanes and Associated Capacity Improvements Draft (2008); and
- I-10 Origin-Destination Analysis (2008).

2.2 Kickoff Meeting

The Kickoff Meeting was held on July 21, 2016, at MAG. Representatives from MAG, ADOT, City of Phoenix, and the Federal Highway Administration (FHWA) attended the meeting. The meeting purpose was to introduce the Study, provide an overview of the background information, review Study Area issues, and identify qualitative evaluation considerations. Study Area issues included the Deck Park Tunnel as a constraint, weaving (lane changes) between the Stack and Mini-Stack, and reducing impacts to existing structures. During the meeting, the following qualitative evaluation considerations were identified:

- Travel time/reliability;
- Reduction in weaving (reduction in number of lane changes);
- Right-of-way impacts (acreage); and
- Project cost opinion.

Meeting materials for each of the following meetings, including agenda, presentation, and summary, are provided in **Appendix A**.

2.3 Conceptual Alternative Brainstorming Charrette

The Conceptual Alternative Brainstorming Charrette was a four-hour meeting held on August 26, 2016, at Burgess & Niple. Representatives from MAG and the project team attended the charrette. The purpose of this charrette was to develop conceptual alternatives for each quadrant that attempted to reduce conflict points and increase traffic operations. The project team developed two conceptual alternatives per quadrant identifying additional general purpose and High Occupancy Vehicle (HOV) lanes, C-D roads, and TI ramp reconfigurations. Following this meeting, the conceptual alternatives were engineered in MicroStation.

2.4 Progress Meeting

The Progress Meeting was held on December 22, 2016, at Burgess & Niple. Representatives from MAG and the project team attended the meeting. The purpose of the meeting was to present and discuss the engineered conceptual alternatives, including preliminary information on project cost opinions and right-of-way needs. Each conceptual alternative was presented and discussed using Google Earth KMZ files. Refinements and issues, such as right-of-way, constructability, and funding were discussed. Following the meeting, estimates for project cost opinions and right-of-way needs were finalized and the conceptual alternatives were prepared for presentation to the Planning Partners for input.

2.5 Planning Partners Meeting

The Planning Partners Meeting was held on February 22, 2017, at MAG. Representatives from MAG, ADOT, City of Phoenix, and FHWA attended the meeting. The purpose of this meeting was to present the conceptual alternatives to the Planning Partners and obtain input. The conceptual alternatives for each quadrant were presented using Google Earth KMZ files and explained including geometric layout, right-of-way impacts, and project cost opinions. A list of advantages and disadvantages for each conceptual alternative was developed to compare the conceptual alternatives. Conceptual alternatives in the

eastern quadrants were generally accepted with minor drainage and construction concerns. The conceptual alternatives developed for the western quadrants were identified as having fatal flaws by the City of Phoenix due to private property impacts. The conceptual alternatives were revised based on City of Phoenix input and are included herein. Next steps were discussed with the Planning Partners including traffic operations modeling and an implementation study phase prior to the ADOT scoping phase of the project development process (preparing a Design Concept Report).

3.0 Conceptual Alternatives

A total of eight conceptual alternatives for potential improvements to I-10 were developed. It is recognized that the Deck Park Tunnel, located between 5th Avenue/3rd Avenue and 3rd Street DHOV TIs, represents a constraint and that further widening to this portion of I-10 is prohibitive. Due to the Deck Park Tunnel, and considering both directions of travel, there are four quadrants with independent utility and potential solutions. Two conceptual alternative were developed per quadrant in MicroStation using engineering rules of thumb. **Appendix B** includes roll plots depicting each conceptual alternative in their entirety. **Figure 6** through **Figure 21** are excerpts from the conceptual alternative roll plots.

Narratives are provided describing the conceptual alternatives, including advantages and disadvantages that compare the conceptual alternatives within each quadrant. Conceptual alternatives are presented as follow:

- Northeast Quadrant (I-10 WB);
- Northwest Quadrant (I-10 WB);
- Southwest Quadrant (I-10 EB); and
- Southeast Quadrant (I-10 EB).

Cost opinions were developed for each conceptual alternative and are included in **Appendix C**. Unit costs were sourced from the MAG I-10 and I-17 Corridor Master Plan (The Spine Study) to promote consistency between the studies. Major construction items were measured and quantified, such as pavement and structure areas. Contingencies were used where appropriate due to the high-level planning nature of this analysis.

3.1 NORTHEAST QUADRANT: Deck Park Tunnel to SR-51/SR-202L Mini Stack

The northeast (NE) quadrant is located along I-10 WB from the SR-51/SR-202L Mini-Stack system TI to the Deck Park Tunnel. The conceptual alternatives generally propose eliminating the weaving movements along the I-10 WB mainline between the SR-202L DHOV, SR-51 on-ramp, SR-202L on-ramp, 16th Street on-ramp, and 7th Street off-ramp.

A need was identified for a non-motorized route between the Banner Medical Campus on the northeast corner of I-10 and 7th Street and the Universities Medical Campuses on the block from Fillmore to Van Buren and 7th Street to 3rd Street. Maintaining this

connection, which is currently provided by the pedestrian bridge at 10th Street, will be a consideration.

3.1.1 Northeast Option 1

Northeast Option 1 (NE1) includes a two-lane off-ramp from I-10 WB mainline to 7th Street that is braided with the SR-51 and SR-202L system on-ramps. This eliminates weaving from the I-10 WB mainline (**Figure 6**). The SR-51 system on-ramp is barrier separated from the I-10 WB mainline until after the 12th Street bridge where it braids under the 7th Street ramp (**Figure 7**). NE1 adds an HOV lane from the SR-202L DHOV on-ramp and to the 3rd Street DHOV off-ramp.

Figure 6 – NE1 Ramp Braiding East End

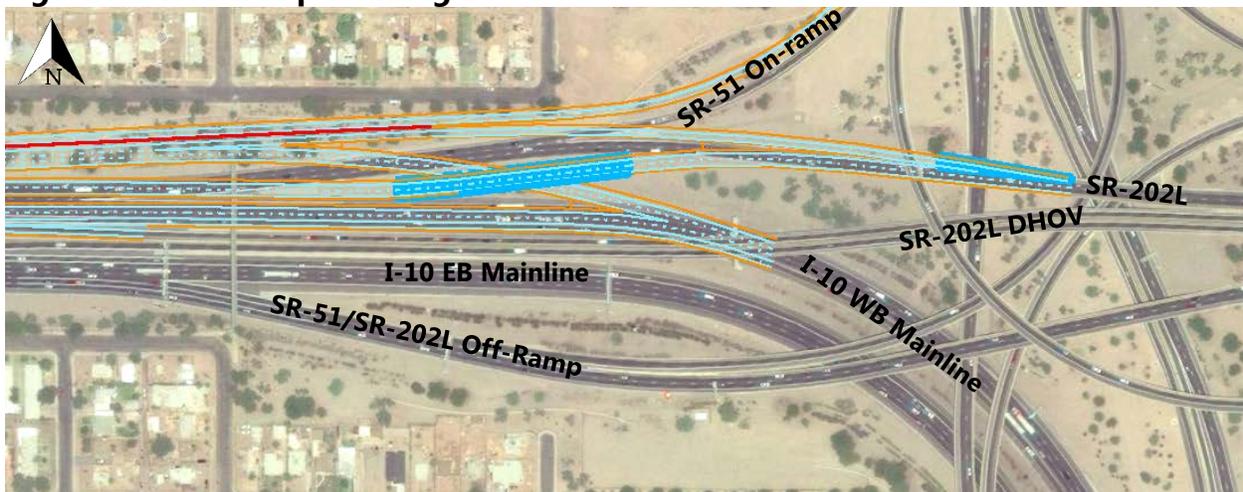
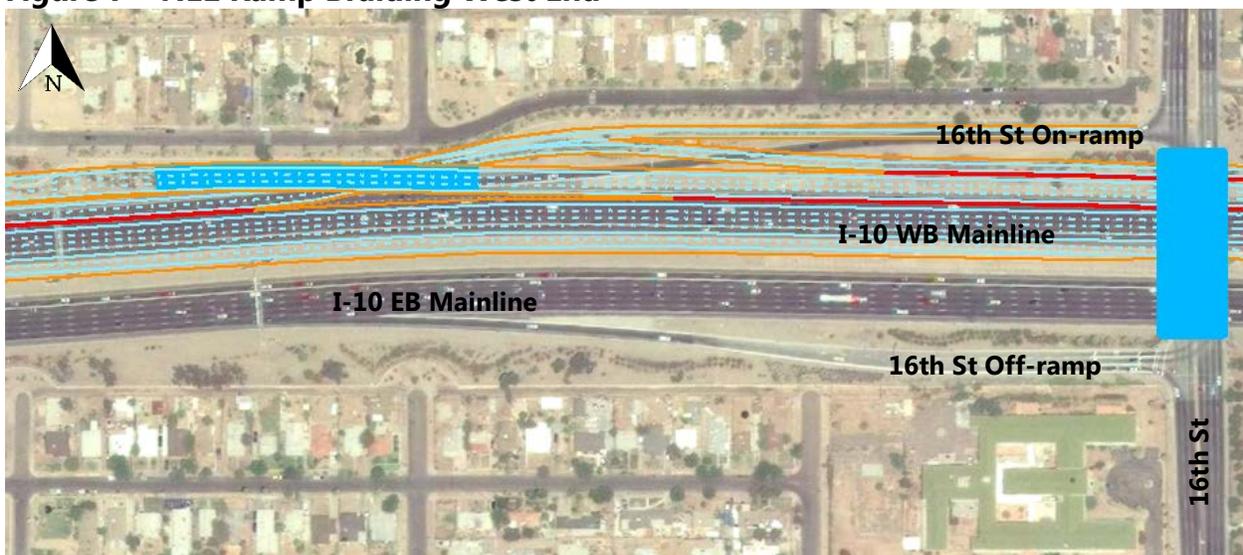


Figure 7 – NE1 Ramp Braiding West End



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing I-10 WB movements are accommodated and I-10 WB mainline weaving is eliminated.
 - The 7th Street off-ramp from I-10 WB mainline and the SR-202L is braided with the I-10 WB on-ramps from SR-51, SR-202L, and 16th Street.
 - The SR-51 on-ramp to I-10 WB merges with the 16th Street on-ramp and is barrier separated from the I-10 WB mainline and the SR-202L on-ramp, preventing traffic from SR-51 and 16th Street from weaving multiple lanes to access the 3rd Street HOV TI.
- An additional HOV lane is provided between the SR-202L and 3rd Street DHOV ramps.
- The SR-202L DHOV on-ramp bridge can be salvaged, including the straddle bent.

Disadvantages:

- SR-51 southbound access to I-10 westbound is maintained; however, SR-51 southbound does not have access to the 7th Street TI via I-10. Vehicles from SR-51 destined for downtown Phoenix via the 7th Street TI will be directed to the SR-51/McDowell Road TI immediately north of the SR-51/SR-202L Mini-Stack. Access to the 7th Street off-ramp from SR-51 is desirable and should be investigated in the future.
- Shoulders widths under the 16th Street bridge will need to be reduced in width.
- The 16th Street bridge and nearby pump station will be impacted.
- The 12th Street bridge will be impacted. Per the City of Phoenix, 12th Street is a complete street corridor that provides a low-stress bus, pedestrian, bicycle, and vehicle north-south corridor in the central City and it also provides access to a regional hospital and employer. The City of Phoenix recommended that 12th Street bridge continues to contain all noted elements.
- New right-of-way will be needed south of Culver Street and Willetta Street for the SR-51 on-ramp.
- Noise barriers may be needed.
- The SR-202L bridge at the SR-51/SR-202L Mini-Stack will need to be widened to accommodate the third lane to the 7th Street TI.
- The SR-51 on-ramp bridge will need to be replaced.
- The extent of the potential improvements may require the replacement/reconstruction of the 10th Street and 18th Street pedestrian bridges; the reconstruction of these bridges was assumed in the cost opinion.

The cost opinion for NE1 is estimated to be approximately \$128 million. NE1 will likely require approximately 2.0 acres of new right-of-way. The largest contributor to this cost is the new bridge area that will need to be constructed and reconstruction of the 16th Street pump station.

3.1.2 Northeast Option 2

Northeast Option 2 (NE2) is similar to NE1 by braiding the I-10 WB and SR-202L ramps to 7th Street with the ramps from SR-51 and SR-202L to I-10 WB. The difference between the conceptual alternatives is that NE2 provides: 1) A one-lane off-ramp from I-10 WB (**Figure 8**); and 2) the SR-202L on-ramp and SR-51 on-ramp are braided differently and connect to I-10 WB separately (**Figure 9**). NE2 adds an HOV lane from the SR-202L DHOV on-ramp and to the 3rd Street DHOV off-ramp.

Figure 8 – NE2 Ramp Braiding East End

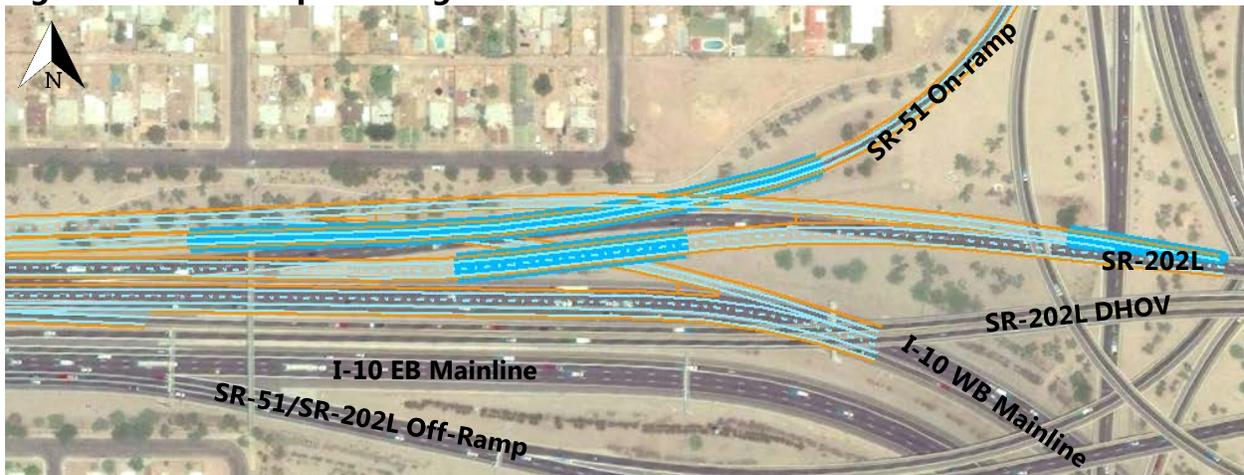
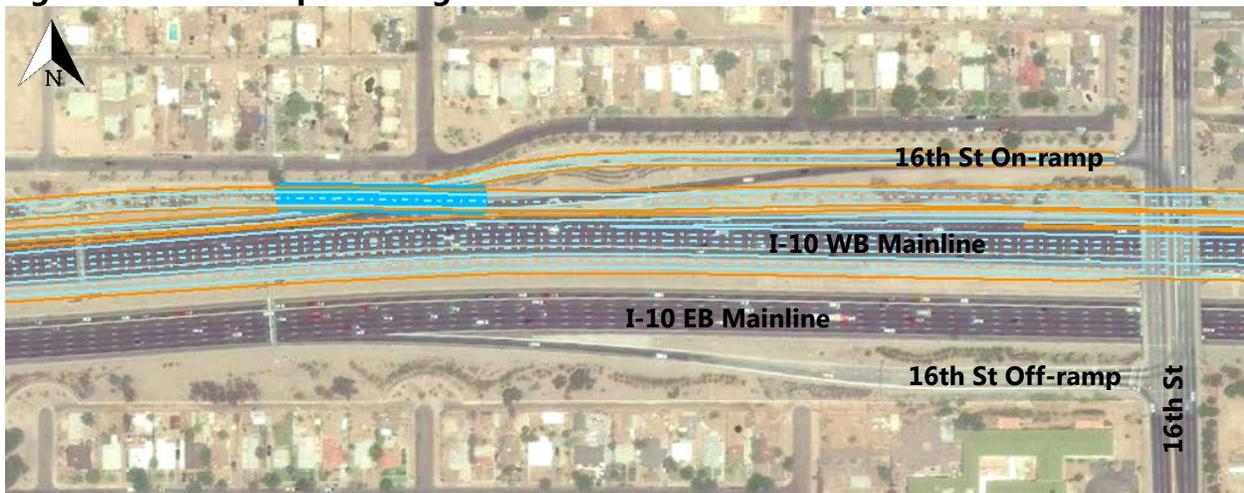


Figure 9 – NE2 Ramp Braiding West End



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing I-10 WB movements are accommodated and I-10 WB mainline weaving is eliminated.
 - The 7th Street off-ramp from I-10 WB mainline and the SR-202L is braided with the I-10 WB on-ramps from SR-51, SR-202L, and 16th Street.
 - The SR-51 on-ramp to I-10 WB connects directly.
- An additional HOV lane is provided between the SR-202L and 3rd Street DHOV ramps.
- There are no/minimal impacts to the 16th Street bridge and pump station.
- The SR-202L DHOV lane can be salvaged, including the straddle bent.
- More of the SR-51 on-ramp can be salvaged.

Disadvantages:

- SR-51 southbound access to I-10 westbound is maintained; however, SR-51 southbound does not have access to the 7th Street TI via I-10. Vehicles from SR-51 destined for downtown Phoenix via the 7th Street TI will be directed to the SR-51/McDowell Road TI immediately north of the SR-51/SR-202L Mini-Stack. Access to the 7th Street off-ramp from SR-51 is desirable and should be investigated in the future.
- SR-51 southbound can still access the 3rd Street DHOV off-ramp (multiple lane weave).
- There is no barrier separation between I-10 mainline, SR-51 on-ramp, 16th Street on-ramp, or 7th Street off-ramp.
- The 12th Street bridge will be impacted. Per the City of Phoenix, 12th Street is a complete street corridor that provides a low-stress bus, pedestrian, bicycle, and vehicle north-south corridor in the central City and it also provides access to a regional hospital and employer. The City of Phoenix recommended that 12th Street bridge continues to contain all noted elements
- New right-of-way will be needed south of Culver Street and Willetta Street for the 7th Street off-ramp.
- Noise barriers may be needed.
- The SR-202L bridge at the SR-51/SR-202L Mini-Stack will need to be widened to accommodate the third lane to the 7th Street TI.
- The extent of the potential improvements may require the replacement/reconstruction of the 10th Street and 18th Street pedestrian bridges; the reconstruction of these bridges was assumed in the cost opinion.

The cost opinion for NE2 is estimated to be approximately \$108 million. NE2 will likely require approximately 0.6 acres of new right-of-way. The largest contributor to this cost are the new bridges that will need to be constructed.

3.2 NORTHWEST QUADRANT: I-17 Stack to Deck Park Tunnel

The northwest (NW) quadrant is located on I-10 WB from the Deck Park Tunnel to the I-17 Stack system TI. The conceptual alternatives generally propose eliminating the weaving moments on the I-10 WB mainline between 7th Avenue WB on-ramp, the 19th Avenue WB off-ramp, and the I-10 WB system off-ramps to I-17.

The initial concepts for the NW quadrant, which are not included in this document, were refined based on input received during the Planning Partners Meeting on February 22, 2017. The revised conceptual alternatives are presented below.

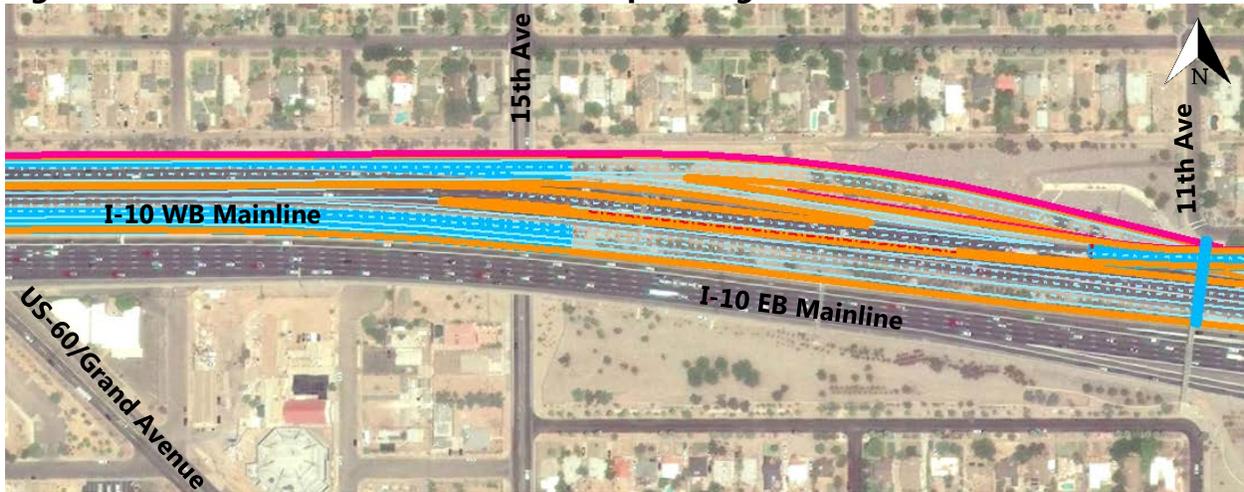
3.2.1 Northwest Option 1

Northwest Option 1 (NW1) includes a two-lane off-ramp from I-10 WB mainline to 19th Avenue and I-17 system on-ramp that is braided with the 7th Avenue on-ramp to I-10 WB mainline (**Figure 10**). The two-lane 7th Avenue on-ramp splits after braiding over the I-10 off-ramp allowing the 7th Avenue on-ramp vehicles to access either the I-17 system on-ramp or I-10 WB mainline (**Figure 11**). NW1 adds a General Purpose (GP) lane from the 7th Avenue WB on-ramp through the I-17 Stack TI.

Figure 10 – NW1 I-17 System Ramp Braiding



Figure 11 – NW1 7th Avenue WB On-Ramp Configuration



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing movements are accommodated.
 - The 7th Avenue on-ramp to the 19th Avenue off-ramp movement (a small movement) is being discouraged with the geometric layout.
 - Vehicles entering I-10 WB on the 3rd Avenue DHOV ramp could no longer cross the I-10 WB mainline to use the 19th Avenue WB off-ramp or the I-17 system off-ramps.
- Barrier separates the I-10 WB mainline and the I-17 off-ramps.
 - Weaving movements for the I-17 system movements, 19th Avenue off-ramp, and the 7th Avenue on-ramp destined for I-17 are contained within the I-17 off-ramp.
- A large percentage of the existing I-10 WB mainline pavement and existing bridges is utilized.
- An additional I-10 WB mainline lane is provided from the 7th Avenue on-ramp through the I-17 Stack bridge, dropping just prior to the on-ramp merges from I-17.
- The existing houses in the historic neighborhood to the north of I-10 will not be directly impacted, except as noted in the last bullet under the disadvantages.

Disadvantages:

- There is a short Type C weave between the 7th Avenue on-ramp and the 19th Avenue off-ramp on the barrier separated I-17 system off-ramp. The desire is to discourage this minor movement completely.

- The I-10 WB mainline bridge viaduct will require median and outside widening. The median widening will have constructability challenges associated with it.
- Additional retaining walls and sound walls will be required at the following locations:
 - 7th Avenue on-ramp / I-17 system off-ramp braid.
 - I-17 system ramp between 7th Avenue and US-60/Grand Avenue in the vicinity of the neighborhood.
 - Almost all of the existing noise barriers between the 11th Avenue and 19th Avenue off-ramp will need to be reconstructed.
- The extent of the potential improvements may require the replacement/reconstruction of the 11th Avenue pedestrian bridge; the reconstruction of this bridge was assumed in the cost opinion.
- The I-17 braided system ramp impacts the existing drainage basin and will require the drainage basin to be reconfigured and reconstructed.
- The new 7th Avenue on-ramp will be elevated to approximately the same elevation as W. Moreland Street in the historic neighborhood. This will likely require a taller sound wall for this neighborhood, and would likely eliminate the existing views of the Phoenix skyline from the homes along the western part of W. Moreland Street.

The cost opinion for NW1 is estimated to be approximately \$100 million. NW1 will not likely require new right-of-way. The largest contributor to this cost is the new bridge area that will need to be constructed.

3.2.2 Northwest Option 2

Northwest Option 2 (NW2) is similar to NW1 in that it includes a two-lane off-ramp from I-10 WB mainline to 19th Avenue and I-17 system on-ramp. The I-10 off-ramp connects, rather than braids like in NW1, with the 7th Avenue on-ramp to I-10 WB mainline creating a three-lane C-D road system. The I-10 C-D road serves the 7th Avenue on-ramp, the 19th Avenue off-ramp, and the I-17 system ramps (**Figure 12**). After the I-17 system ramps, the C-D road merges back onto I-10 mainline in the middle of the I-17 Stack TI from the west-to-north system ramp (**Figure 13**).

Figure 12 – NW2 I-10 Collector-Distributor Road Merge Configuration

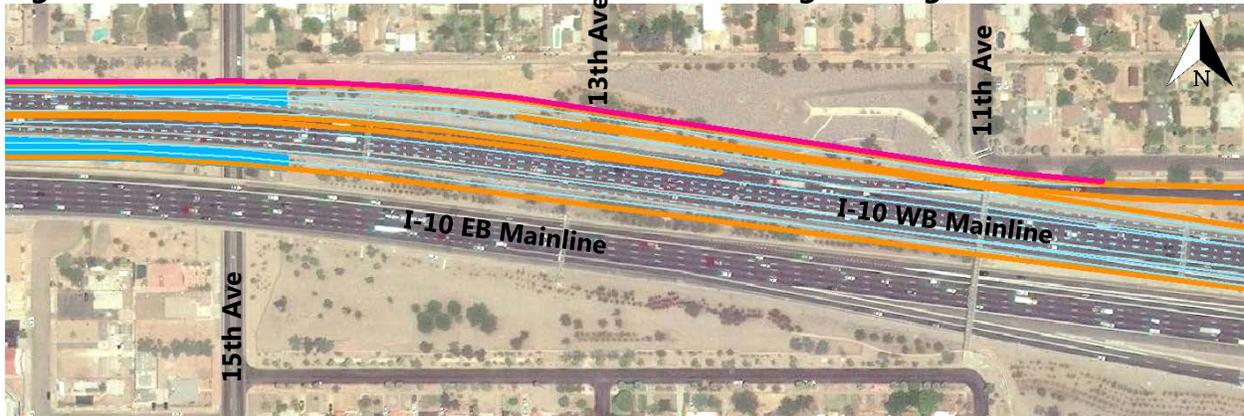
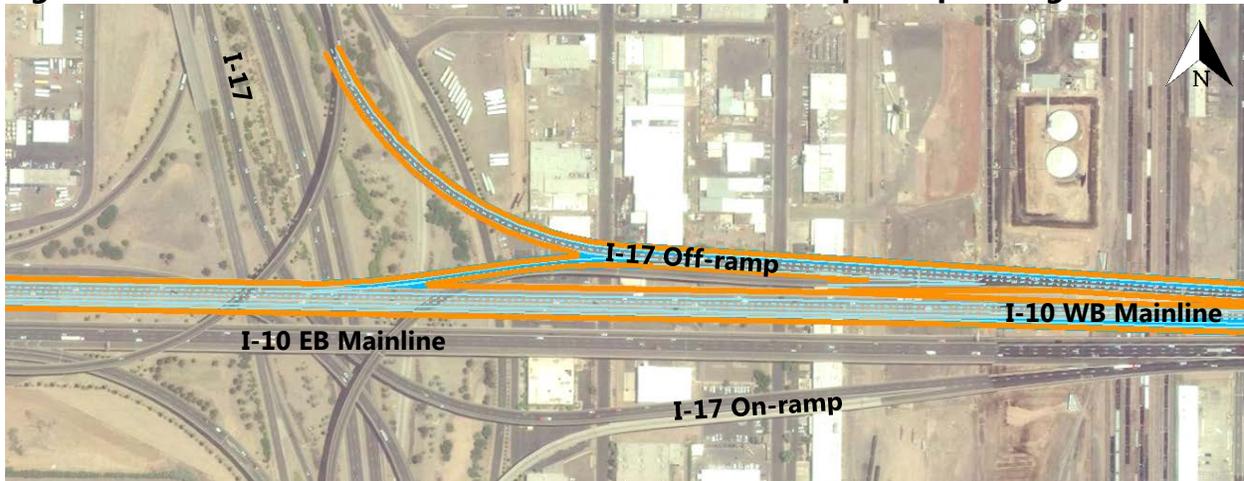


Figure 13 – NW2 I-10 Collector-Distributor Road I-10 Slip Ramp Configuration



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing movements are accommodated.
 - Vehicles entering I-10 WB on the 3rd Avenue DHOV ramp could no longer legally cross the I-10 WB mainline to use the 19th Avenue off-ramp or the I-17 system ramps.
- Barrier separates the I-10 WB mainline and the I-10 C-D road.
 - Weaving movements for the I-17 system movements, 19th Avenue off-ramp, and the 7th Avenue on-ramp destined for I-17 are contained within the I-10 C-D road system.
 - No additional grade separations are required to facilitate the movements in the vicinity of the historical neighborhood.

- The existing I-10 WB lane drop under the 7th Avenue bridge is eliminated, converting it and one other general purpose lane instead to exit only lanes for the I-10 C-D road.
- A large percentage of the existing I-10 WB mainline pavement and existing bridges are utilized.
- The existing houses in the historic neighborhood to the north of I-10 will not be directly impacted.

Disadvantages:

- The operations of the C-D road system may suffer at the expense of improved I-10 WB mainline performance.
- I-10 WB mainline bridge viaduct will require median and outside widening. The median widening will have constructability challenges associated with it.
- Additional retaining walls and sound walls will be required at the following locations:
 - Along the I-10 CD road between 11th Avenue and US-60/Grand Avenue in the vicinity of the neighborhood.
 - A large percentage of the existing noise barriers between the 7th Avenue off-ramp and 19th Avenue off-ramp will need to be reconstructed.
- The extent of the potential improvements may require the replacement/reconstruction of the 11th Avenue pedestrian bridge; the reconstruction of this bridge was assumed in the cost opinion.
- The I-10 C-D road impacts the existing drainage basin and will require the drainage basin to be reconfigured and reconstructed.

The cost opinion for NW2 is estimated to be approximately \$94 million. NW2 will not likely require new right-of-way. The largest contributor to this cost is the new bridge area that will need to be constructed.

3.3 SOUTHWEST QUADRANT: I-17 Stack to Deck Park Tunnel

The southwest (SW) quadrant is located on I-10 EB from the I-17 Stack TI to the Deck Park Tunnel. The conceptual alternatives generally propose eliminating the weaving movements on the I-10 EB mainline between the 19th Avenue on-ramp, the 7th Avenue on-ramp, and the I-17 system ramps onto I-10 EB.

The initial concepts for the NW quadrant, which are not included in this document, were refined based on input received during the Planning Partners Meeting on February 22, 2017. The revised conceptual alternatives are presented below.

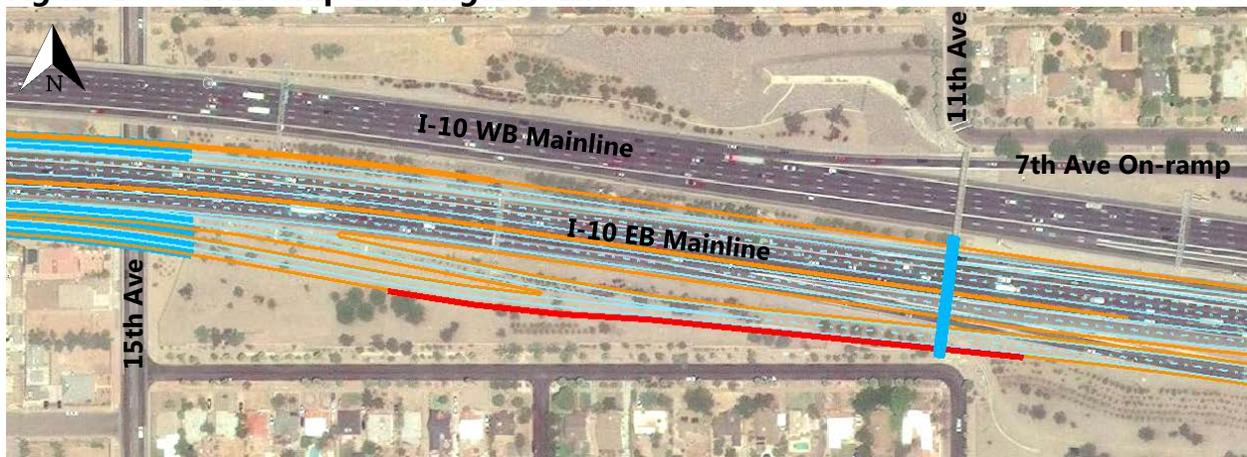
3.3.1 Southwest Option 1

Southwest Option 1 (SW1) includes a one-lane off-ramp from I-10 EB mainline to 7th Avenue braided with the I-17 system off-ramp to I-10 EB mainline (**Figure 14**). The two-lane I-17 system off-ramp is barrier separated from I-10 EB mainline until after the 7th Avenue off-ramp and facilitates the weaving movements between the 19th Avenue on-ramp and the 7th Avenue off-ramp (**Figure 15**).

Figure 14 – SW1 Ramp Braiding West End



Figure 15 – SW1 Ramp Braiding East End



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing movements are accommodated.
 - Vehicles entering I-10 EB from the I-17 system on-ramps and the 19th Avenue on-ramp could no longer cross I-10 EB mainline to use the 3rd Avenue DHOV off-ramp, eliminating a multiple lane weaving movement.

- Utilizes almost all the existing I-10 EB pavement and existing bridges.
- The existing gore configurations for the I-17 system on-ramps are preserved and will not need to be reconstructed.
- I-17 system on-ramps are barrier separated from the I-10 EB mainline and only merged with I-10 EB mainline after the 7th Avenue off-ramp.
 - All weaving movements for the I-17 system on-ramps, the 19th Avenue on-ramp, and the 7th Avenue off-ramp are contained within the extended and barrier separated I-17 system on-ramp.
 - An auxiliary lane is added to facilitate weaving movements between the 19th Avenue on-ramp and the 7th Avenue off-ramp on the I-17 system on-ramp. The weaving length between the gores is 1,100’.
 - An I-10 EB mainline lane drop is required east of the 7th Avenue bridge.

Disadvantages:

- I-10 EB requires viaduct median and outside widening. The median viaduct widening will have constructability challenges associated with it.
- The 7th Avenue off-ramp braid requires right-of-way on the south side of I-17.
- New right-of-way is required.
 - Four properties are impacted east of 19th Avenue including the Iglesia la Luz del Mundo church. The church impacts would not likely require a total take, but may impact the church’s operations. The acquisition of the three other properties may be able to offset the impacts to the church using a land swap.
 - Requires closing Moreland Street.
- New bridges over the I-17 system on-ramp, the existing railroad yard, and 19th Avenue will be required.
- Additional retaining walls and sound walls will be required between 15th Avenue and 7th Avenue.
- Some existing noise barriers will need to be replaced or modified between US-60/Grand Avenue and 7th Avenue. Other minor impacts will also occur around the pedestrian bridge.
- The extent of the potential improvements may require the replacement/reconstruction of the 11th Avenue pedestrian bridge; the reconstruction of this bridge was assumed in the cost opinion.

The cost opinion for SW1 is estimated to be approximately \$122 million. SW1 will likely require approximately 5.5 acres of new right-of-way. The largest contributor to this cost is the new bridge area that will need to be constructed.

3.3.2 Southwest Option 2

Southwest Option 2 (SW2) is similar to SW1 by braiding the 7th Avenue off-ramp from I-10 with the I-17 system on-ramp; however SW2 allows the traffic from the I-17 system on-ramp to enter I-10 EB at the existing location and creates a C-D road for the 19th Avenue on-ramp and the 7th Avenue off-ramp weaving (**Figure 16**). The C-D road is barrier separated from I-10 EB and can be accessed by the I-17 system on-ramp traffic through a slip ramp prior to when the I-17 system on-ramp enters the I-10 EB mainline (**Figure 17**).

Figure 16 – SW2 Ramp Braiding West End

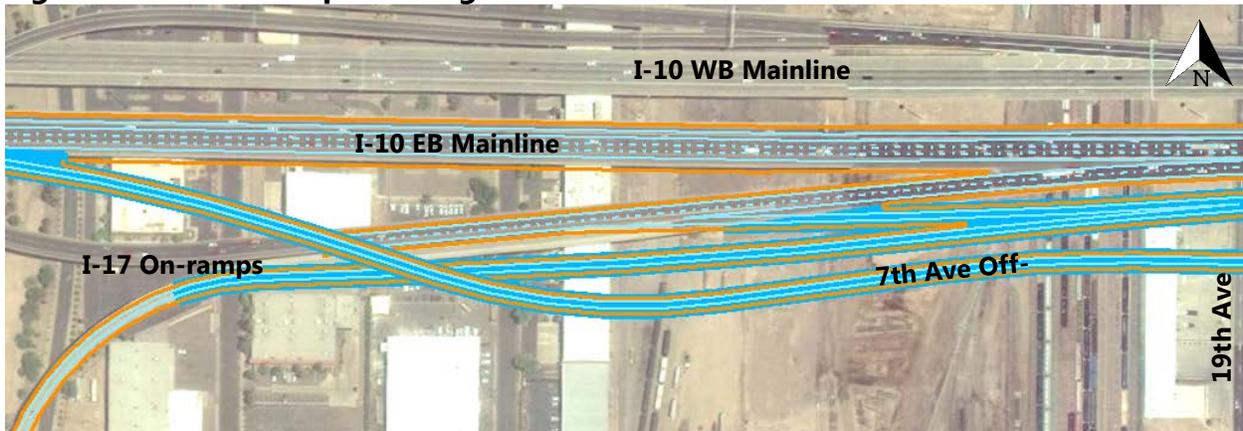
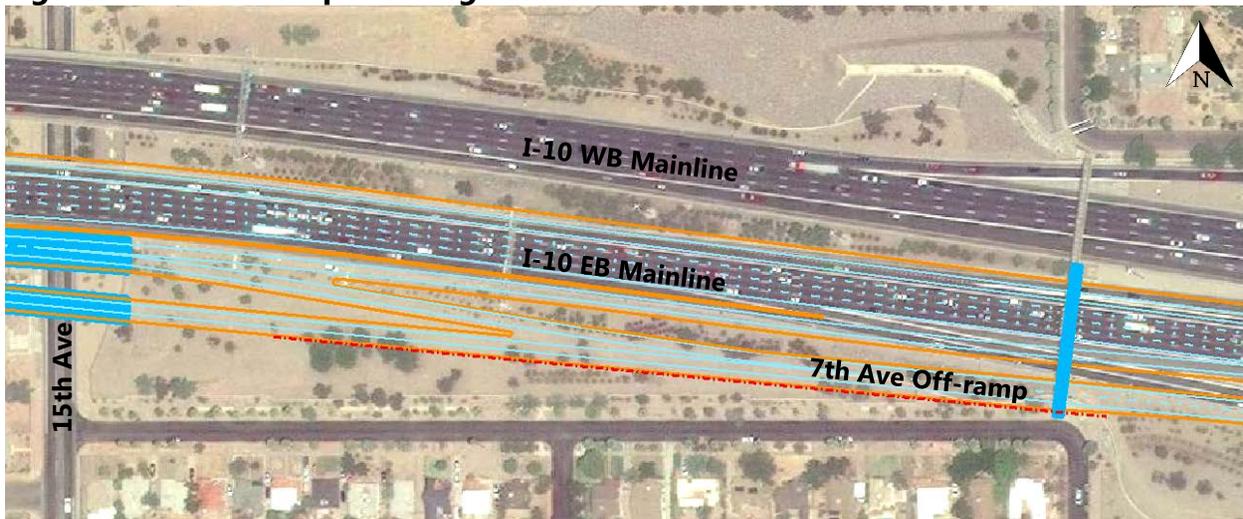


Figure 17 – SW2 Ramp Braiding East End



A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing movements are accommodated.
 - Vehicles entering I-10 EB from the I-17 system on-ramps will be able to weave across I-10 to use the 3rd Avenue DHOV off-ramp; however, vehicles entering from 19th Avenue EB on-ramp will no longer be able to cross I-10 EB mainline to use the 3rd Avenue DHOV off-ramp.
- The barrier separated C-D road merges with I-10 mainline after the 7th Avenue off-ramp.
 - All of the weaving movements between the I-17 system on-ramps, the 19th Avenue on-ramp, and the 7th Avenue off-ramp are contained on the barrier separated C-D road.
 - The existing I-17 system ramp movement is preserved.
- The 7th Avenue off-ramp is braided with the I-17 system on-ramp. The 7th Avenue off-ramp parallels the I-17 system ramp to 7th Avenue.
- No I-10 EB median widening is required. Only outside bridge widening, which simplifies bridge construction.

Disadvantages:

- Generally, more right-of-way on south side of I-10 will be needed when compared to SW1 due to ramp configuration and no median widening.
- New right-of-way is required.
 - Impacts six properties east of 19th Avenue including the Iglesia la Luz del Mundo church. The church impacts would not likely require a total take, but may impact the church's operations. Acquisition of the other properties may be able to offset impacts to the church using a swap.
- A partial reconstruction of the I-17 system on-ramp, which is structure supported, will be required.
- Two I-10 mainline lane drops will be needed: 15th Avenue and east of 7th Avenue Bridge.
- New bridges over the I-17 system on-ramp, the existing railroad yard, and 19th Avenue will be required.
- Additional retaining walls and sound walls will be required between 15th Avenue and 7th Avenue.
- Some existing noise barriers will need to be replaced or modified between US-60/Grand Avenue and 7th Avenue. Other minor impacts will also occur around the pedestrian bridge.
- The extent of the potential improvements may require the replacement/reconstruction of the 11th Avenue pedestrian bridge; the reconstruction of this bridge was assumed in the cost opinion.

The cost opinion for SW2 is estimated to be approximately \$166 million. SW2 will likely require approximately 7.5 acres of new right-of-way. The largest contributor to this cost is the new bridge area that will need to be constructed.

3.4 SOUTHEAST QUADRANT: Deck Park Tunnel to SR-51/SR-202L Mini Stack

The southeast (SE) quadrant is located on I-10 EB from the Deck Park Tunnel to the SR-51/SR-202L Mini-Stack system TI. The conceptual alternatives generally propose eliminating the weaving movements on the I-10 EB mainline between the 7th Street EB on-ramp, the 16th Street EB off-ramp, and the I-10 system off-ramps onto SR-51 NB and SR-202L EB.

A need was identified for a non-motorized route between the Banner Medical Campus on the northeast corner of I-10 and 7th Street and the Universities Medical Campuses on the block from Fillmore to Van Buren and 7th Street to 3rd Street. Maintaining this connection, which is currently provided by the pedestrian bridge at 10th Street, will be a consideration.

3.4.1 Southeast Option 1

Southeast Option 1 (SE1) includes a three-lane off-ramp from I-10 mainline to SR-51/SR-202L EB that is braided with the two-lane 7th Street on-ramp, creating a C-D road system (**Figure 18**). The C-D road runs parallel to I-10 and includes a slip ramp to allow vehicles from the 7th Street on-ramp to access the I-10 EB mainline. The C-D road continues east providing access to the 16th Street off-ramp and SR-51/SR-202L EB system ramps. SE1 adds an HOV lane from the 3rd Street DHOV on-ramp to the SR-202L DHOV off-ramp and a third lane to the SR-202L system ramp toward 24th Street (**Figure 19**).

Figure 18 – SE1 Ramp Braiding West End

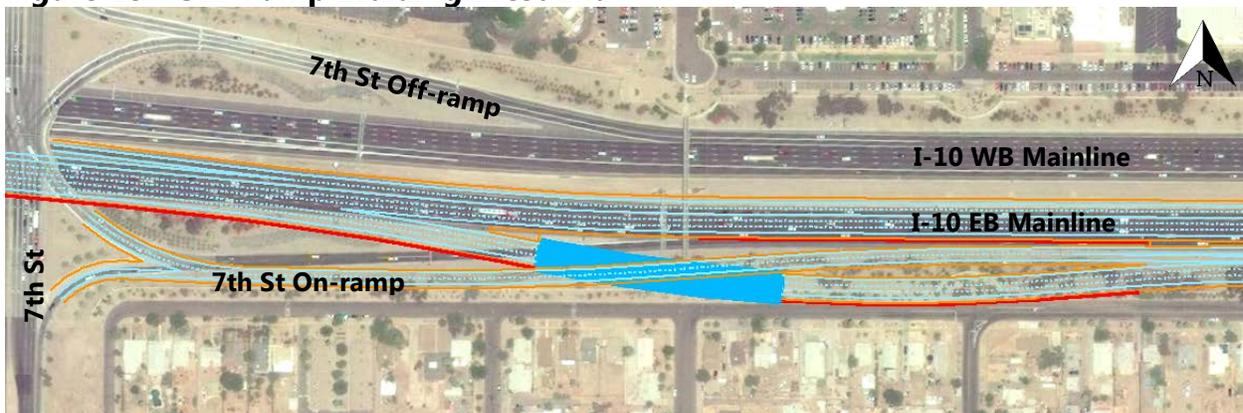


Figure 19 – SE1 Ramps East End



A listing of advantages and disadvantages for the option is provided below.

Advantages

- All existing I-10 EB movements are accommodated and I-10 EB mainline weaving is eliminated.
 - The 7th Street on-ramp is braided with the SR-51/SR-202L off-ramp (C-D road).
 - Vehicles entering I-10 EB from the 7th Street on-ramps will be able to enter I-10 EB via the C-D road or continue to 16th Street or SR-51/SR-202L.
 - A slip ramp is provided for vehicles entering at the 7th Street on-ramp to merge with I-10 EB mainline.
- An additional HOV lane is provided between the 3rd Street and SR-202L DHOV ramps.
- Existing off-ramp gore configurations to SR-51/SR-202L off-ramps do not change.
- The SR-51 system off-ramp is preserved.
- The 12th Street bridge is preserved.

Disadvantages:

- Outside shoulder width under 7th Street will need to be reduced, which will require a design exception.
- The C-D road will need to drop approximately a quarter-level to aid the 7th Street on-ramp profile at their crossing, creating a potential drainage concern.
- The distance between the 7th Street gores from the C-D road to I-10 EB mainline presents an opportunity for an illegal slip movement for vehicles traveling on I-10 EB to access the C-D road. Physically eliminating this movement will require additional width or a variation to the standards.

- The 16th Street bridge will be impacted
- New right-of-way will be needed on Moreland Street between 7th Street and 12th Street for the C-D road.
- Noise barriers may be needed.
- The three-sided box is wide and may have constructability challenges associated with it.
- The SR-202L bridge at the SR-51/SR-202L Mini-Stack will need to be widened to accommodate the third lane to the 7th Street TI.
- The extent of the potential improvements may require the replacement/reconstruction of the 10th Street and 18th Street pedestrian bridges; the reconstruction of these bridges was assumed in the cost opinion.

The cost opinion for SE1 is estimated to be approximately \$112 million. SE1 will likely require approximately 1.1 acres of new right-of-way. The largest contributors to this cost are the bridges that will need to be replaced or widened.

3.4.2 Southeast Option 2

Southeast Option 2 (SE2) is similar to SE1 in that the SR-51/SR-202L EB system off-ramp from I-10 is braided with the 7th Street on-ramp and runs parallel to I-10 creating a C-D road system; however, the SR-51/SR-202L system off-ramp is two lanes rather than three (**Figure 20**). The C-D road runs parallel to I-10 and includes a slip ramp to allow users of the 7th Street on-ramp to access I-10 EB mainline. The C-D road continues east providing access to the 16th Street off-ramp and SR-51/SR-202L EB system ramps. SE2 adds an HOV lane from the 3rd Street DHOV on-ramp to the SR-202L DHOV off-ramp (**Figure 21**).

Figure 20 – SE2 Ramp Braiding West End



Figure 21 – SE2 Ramps East End


A listing of advantages and disadvantages for the option is provided below.

Advantages:

- All existing movements are accommodated.
 - Vehicles entering I-10 EB from the 7th Street on-ramps will be able to enter I-10 EB via the C-D road or continue to 16th Street or SR-51/SR-202L.
- An additional HOV lane is provided between the 3rd Street and SR-202L DHOV ramps.
- All of the weaving movements between 7th Street, 16th Street, and SR-51/SR-202L will be contained within the C-D road.
- Existing off-ramp gore configurations for SR-51/SR-202L system off-ramps do not change.
- The SR-51 and SR-202L system off-ramps are preserved.
- The 12th Street and 16th Street bridges are preserved.

Disadvantages:

- Outside shoulder widths under 7th Street will need to be reduced, which will require a design exception.
- The C-D road will need to drop approximately a quarter-level to aid the 7th Street on-ramp profile at their crossing, creating a potential drainage concern.
- The distance between the 7th Street gores from the C-D road to I-10 EB mainline presents an opportunity for an illegal slip movement for vehicles traveling on I-10 EB to access the C-D road. Physically eliminating this movement will require additional width or a variation to the standards.
 - This will create a large area of pavement to drain, which may need trench drains in gore areas.

- The back of gore width can be reduced to be wider than HOV exits, but not as wide as standard.
- New right-of-way will be needed on Moreland Street between 7th Street and 12th Street for the C-D road.
- Noise barriers may be needed.
- The extent of the potential improvements may require the replacement/reconstruction of the 10th Street and 18th Street pedestrian bridges; the reconstruction of these bridges was assumed in the cost opinion.

The cost opinion for SE2 is estimated to be approximately \$80 million. SE2 will likely require approximately 1.1 acres of new right-of-way. The largest contributors to this cost are the bridges that will need to be replaced or widened.

4.0 Qualitative Evaluation of Conceptual Alternatives

Conceptual alternatives were evaluated qualitatively based on Planning Partner input during the July 2016 Kick-off Meeting. Evaluation considerations include:

- Travel time/reliability;
- Reduction in weaving (reduction in number of lane changes);
- Right-of-way impacts (acreage); and
- Project cost opinion.

The evaluation per quadrant is summarized in **Table 1**. Conceptual alternatives within each quadrant were compared for feasibility and anticipated performance. Ratings include advantage (+); neutral (o); and disadvantage (-).

Table 1 – Conceptual Alternatives Evaluation Matrix

Northeast Quadrant				
	Travel Time/ Reliability	Reduction in Weaving	ROW Impacts	Project Cost Opinion
NE1	-	+	2.0 acres	\$128 million
NE2	+	-	0.6 acres	\$108 million
Northwest Quadrant				
	Travel Time/ Reliability	Reduction in Weaving	ROW Impacts	Project Cost Opinion
NW1	+	+	0.0 acres	\$100 million
NW2	-	-	0.0 acres	\$94 million
Southwest Quadrant				
	Travel Time/ Reliability	Reduction in Weaving	ROW Impacts	Project Cost Opinion
SW1	+	+	5.5 acres	\$122 million
SW2	-	-	7.5 acres	\$166 million
Southeast Quadrant				
	Travel Time/ Reliability	Reduction in Weaving	ROW Impacts	Project Cost Opinion
SE1	+	+	1.1 acres	\$112 million
SE2	-	-	1.1 acres	\$80 million

5.0 Recommendations and Development Considerations

Based on the evaluations presented in **Table 1**, the following conceptual alternatives are recommended for further investigation:

- Northeast Option 1
- Northeast Option 2
- Northwest Option 1
- Southwest Option 1
- Southeast Option 1

The next phase of investigation is recommended to consist of a more in-depth, quantitative analysis. The purpose of the next phase would be to refine the conceptual alternatives, confirm feasibility, and provide the Planning Partners sufficient information in order to identify funding and begin project scoping in the ADOT project development process. Other alternatives may be developed during the formal scoping phase of the ADOT project development process.

The next steps of the Study should include, at a minimum, the following activities and considerations as part of an implementation study prior to the ADOT scoping phase:

- Engagement with:
 - A greater pool of stakeholders, such as Valley Metro, AZDPS, Banner Medical Campus, and business owners; and
 - The general public, including residents of nearby neighborhoods using information from the MAG Title VI and Environmental Justice Annual Report.
- Coordination with nearby project activities, such as the:
 - I-10 and I-17 Corridor Master Plan;
 - I-10 Traffic Interchange West Access with Phoenix Sky Harbor Airport; and
 - Valley Metro improvements in the Study Area.
- Traffic operations analysis and simulation. This may include parallel corridors such as McDowell Road and Thomas Road to investigate changing travel patterns (e.g. southbound SR-51 to 7th Street).
- Safety analysis, including the use of the Highway Safety Manual and recently developed tools (e.g. ISATe), to predict and quantify changes in crash frequency associated with the recommended conceptual alternatives and correlating changes with travel time and travel time reliability. Recommendations from the I-10, 35th Avenue to Sky Harbor Boulevard Phoenix Corridor Safety Study Final

Report, conducted by ADOT and completed in June 2015, should be considered and carried forward in future study.

- Geometric refinements, such as the southbound SR-51 to the I-10 off-ramp at 7th Street.
- Expansion of the study area to investigate the westbound SR-202L ramp to I-10 eastbound and SR-51 northbound movements.
- Environmental overview, including a review of the MAG Title VI and Environmental Justice Annual Report.
- Coordination with the City of Phoenix to maintain major safety features in the pedestrian and bicycle network between major corridors, neighborhoods, and communities. Coordination may also lead to partnering opportunities to address additional needs.
- Drainage overview.
- Signing concept plan.
- Constructability and maintenance considerations.
- ITS infrastructure considerations, such as:
 - Tunnel lighting;
 - Variable speeds;
 - Ramp meters; and
 - Arterial DMS.

6.0 Conclusion

The I-10/Papago Freeway Tunnel Operations Study engaged MAG, ADOT, City of Phoenix, and FHWA to develop feasible solutions for accommodating travel demand along I-10, between the I-17 Stack TI and the SR-51/SR-202L Mini-Stack TI. With traffic volumes reaching almost 300,000 vehicles per day, I-10 is failing in various locations.

The Study Area was divided into four quadrants with potential alternatives in each quadrant having independent utility from alternatives in other quadrants. Two conceptual alternatives per quadrant were developed for a total of eight conceptual alternatives. All conceptual alternatives were evaluated based on travel time/reliability, reduction in weaving, right-of-way impacts, and project cost opinion.

Ultimately, a feasible conceptual alternative was developed for each quadrant of the Study Area. Project costs opinions ranged between \$92 million and \$122 million per quadrant, totaling approximately \$430 million for the Study Area. ***This Study's recommendations are conceptual in nature and other alternatives may be developed in future steps. The formal scoping phase of the ADOT project development process will need to be completed, including required local, state, and federal agencies approvals.***

Study next steps have been identified in order to move the conceptual alternatives towards the ADOT scoping phase. This includes a variety of steps, such as engaging a broader stakeholder pool, seeking public input, performing a traffic operations analysis, and conducting an environmental overview.

A draft version of this document was circulated to the Planning Partners for review. All comments were incorporated into the document as appropriate. Planning Partner comments and comment dispositions are included in Appendix D. Future study activities should review the included comments for scope development and to become familiar with Planning Partner concerns.

APPENDIX A

Meeting Summaries and Materials

I-10/Papago Freeway Tunnel Traffic Operations Study

AGENDA

I-17 Stack to SR-51/SR-202L Mini Stack

Kickoff Meeting

Thursday, July 21, 2016

9:00 a.m.

Maricopa Association of Governments
Cottonwood Room

Meeting Purpose – Kickoff meeting that will engage ADOT, FHWA, MAG, and the City of Phoenix in a discussion about the study’s purpose, study area issues, and evaluation considerations.

1. Introductions
2. Scope of Services and Study Goals
A brief review of the study’s Scope of Services will be provided. A discussion will be facilitated to define the study goals and objectives. 2. For information and discussion.
3. Corridor Past Work Efforts
A review of the study area work efforts that are in progress or completed within the last 10 years will be provided. 3. For information.
4. Study Area Issues
A discussion regarding the study area constraints, operational and safety issues, and Planning Partners concerns will be facilitated. 4. For information and discussion.
5. Evaluation Considerations
Evaluation considerations for use in describing solution advantage and disadvantages will be identified. 5. For information and discussion.
6. Next Steps
Discussion of the next action items. 6. For information



I-10/Papago Freeway Tunnel Traffic Operations Study

Kickoff Meeting
July 21, 2016



Agenda

1. Introductions.
2. Scope of Services and Study Goals.
3. Corridor Past Work Efforts.
4. Study Area Issues.
5. Evaluation Considerations.
6. Next Steps.



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Scope of Services

Agenda Topic 2

Task 1 Project Initiation

- Initiate study;
- Prepare Project Management Plan;
- Conduct kickoff meeting;
- Obtain Planning Partner input; and
- Identify evaluation considerations.

Deliverable: Project Management Plan

Task 2 Develop Alternatives

- Conduct conceptual alternatives brainstorming charrette;
- Develop two conceptual alternatives per freeway segment; and
- Prepare conceptual alternative lane-line diagrams.

Deliverable: Conceptual Alternatives

Scope of Services

Agenda Topic 2

Task 3 Evaluate Alternatives

- Generate Technical Memorandum;
- Prepare planning-level cost estimates; and
- Perform qualitative evaluation.

Deliverable: Technical Memorandum

Task 4 Document Project

- Prepare Project Report;
- Include Planning Partner comments; and
- Identify next steps for investigation and outreach.

Deliverable: Project Report

Scope of Services

Agenda Topic 2

Task	Target Date
Task 1 Project Initiation	July 30, 2016
Task 2 Develop Alternatives	November 30, 2016
Task 3 Evaluate Alternatives	March 31, 2017
Task 4 Document Project	June 30, 2017

Study Goals and Objectives

Agenda Topic 2

- Identify potential solutions to accommodate travel demand.
- Develop practical recommendations that recognize and balance travel patterns, physical constraints, and implementation costs.
- Address safety concerns.

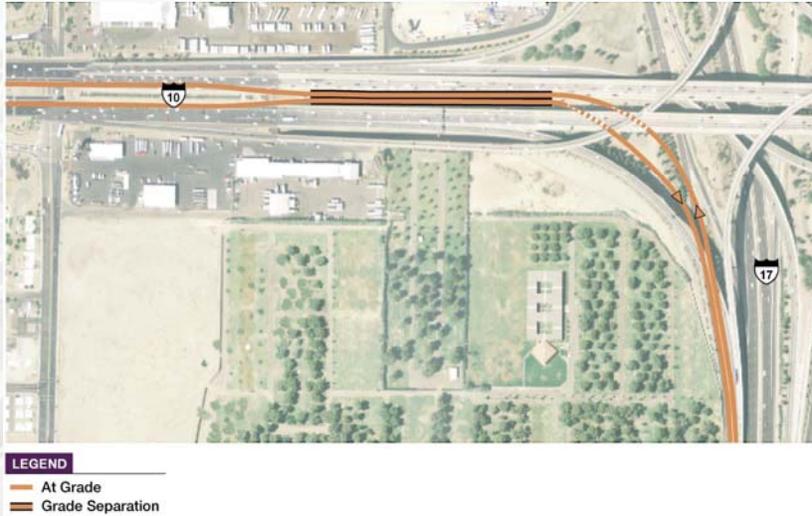


Corridor Past Work Efforts

Agenda Topic 3

LRT / Bus Ramps at the Stack

2014-2015



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Corridor Past Work Efforts

Agenda Topic 3

I-10 HOV Auxiliary Lanes (3rd Street to SR-202L)

March 2015

I-10, 3rd Street to SR 202L
 HOV Auxiliary Lanes
 MP 145.75 to MP 146.85
 Maricopa County, Arizona

FEASIBILITY MEMO

Prepared for:



Arizona Department of Transportation
 Intermodal Transportation Division
 Urban Project Management Section

Prepared by:
HDR Engineering, Inc.
 3200 East Camelback Road, Suite 350
 Phoenix, Arizona 85018

March 2015



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Corridor Past Work Efforts

Agenda Topic 3

I-10 Phoenix Corridor Safety Study

- Completed by Kittleson & Associates
- 2014
- ADOT PM (Mark Poppe)
- Focus on Freeway Crash Prediction Methodologies



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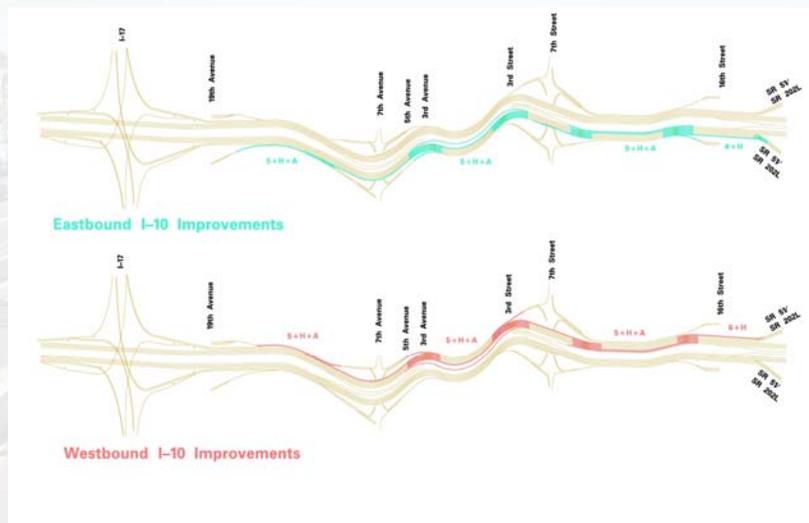
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Corridor Past Work Efforts

Agenda Topic 3

ADOT I-10 Tunnel Study

Early 2008



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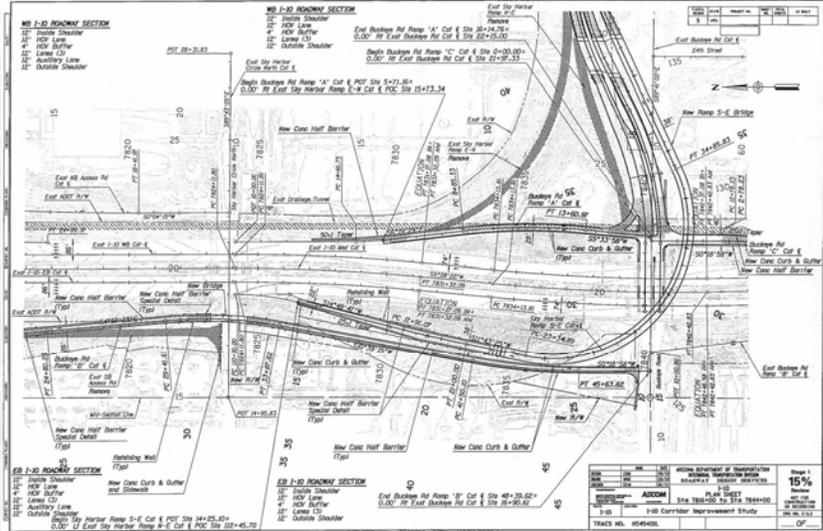
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Corridor Past Work Efforts

Agenda Topic 3

I-10 / Buckeye Road/Sky Harbor Blvd TI

ADOT 15% Design Completed August 2010



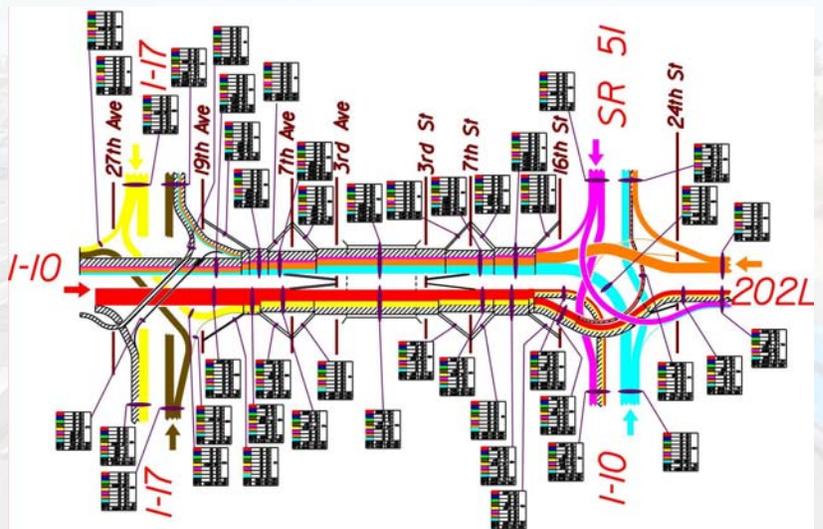
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Corridor Past Work Efforts

Agenda Topic 3

I-10 Origin-Destination Analysis

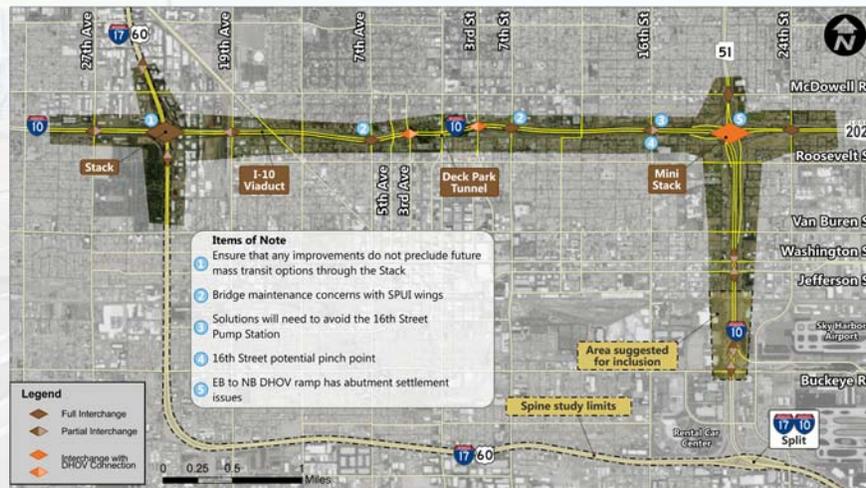
Completed October 2008; (Based on 2030 24-Hr Volumes)



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Study Area Issues

Agenda Topic 4



Study Area Issues

Agenda Topic 4

- Deck Park Tunnel must remain untouched.
- 19th Avenue railroad corridor.
- 11th Avenue, 10th Street, and 18th street pedestrian bridges.
- Architectural semicircular treatments on retaining walls.
- Single-lane ramps at SB SR-51 to WB I-10 and EB SR-202L fail.
- I-10 drainage tunnel.
- Deck Park Tunnel substandard lighting.
- Two system TIs: I-17 Stack and SR-51 Mini-Stack.
- General purpose TIs: 35th Ave, 27th Ave, 19th Ave, 7th Ave, 7th St, 16th St, and Washington St/Jefferson St.
- DHOV access at 5th Ave/3rd Ave, 3rd St, I-10/SR-202L, and I-10/SR-51.

Evaluation Considerations

Agenda Topic 5

- What considerations should be used for qualitative analysis?
- Will be used to compare and contrast the conceptual alternatives.
- Will describe the advantages and disadvantages of the conceptual alternatives.



I-10/Papago Freeway Tunnel Traffic Operations Study

Kickoff Meeting
July 21, 2016



I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini-Stack

Kickoff Meeting

July 21, 2015

ATTENDEES

See attached sign-in sheet.

HANDOUTS

Agenda, PowerPoint presentation, Study Scope, Study Area Issues Map.

Bob Hazlett, MAG Senior Engineering Project Manager, convened the meeting at 9:05 A.M.

1. INTRODUCTIONS

Mr. Hazlett welcomed everyone and asked all participants to introduce themselves. He indicated that Quinn Castro will serve as the MAG project manager. Mr. Hazlett noted that a helicopter origin-destination survey was recently completed by MAG that showed that the majority of traffic flow along I-10 eastbound through the inner loop travels east to SR-202L and the reverse. He stated that the origin-destination study indicated the I-10 through movement at the Mini Stack Traffic Interchange (TI) is the minor travel movement. Mr. Hazlett acknowledged that any improvements within the study area will be costly. Mr. Hazlett stated that the data would be provided to the consultant team when it was ready.

2. SCOPE OF SERVICES AND STUDY GOALS

Mr. Pagnard provided an overview of the study scope and goals. He briefly reviewed the tasks and deliverables and provided expected dates for completion. He explained that the schedule was per the contract and that it is anticipated to be accelerated to approximately four months, with a concept development charrette held in August. Mr. Pagnard indicated the study area has four areas with independent utility: I-10 eastbound and westbound, on both the east and west sides of the Deck Park Tunnel.

3. CORRIDOR PAST WORK EFFORTS

Mr. Bombardier presented an overview of past work efforts along the corridor. He began by explaining plans for light rail transit/bus ramps at the I-10/I-17 Stack TI. The transit route would cross I-17 at Van Buren Street and then continue along the Frontage Road

NOTES

through the I-17 piers of the Stack TI and merge with I-10 in the median, west of the Stack TI. He noted that it will be important to consider plans in the southwest quadrant at the Stack TI for the transit route during development of I-10 alternatives. He also noted that this project has applied twice for TIGER Grant funding.

Mr. Bombardier continued with a review of a feasibility memo for the I-10 HOV Auxiliary Lanes (3rd Street to SR-202L). The study explored the possibility of additional HOV lanes in the existing 50-foot wide median to address operational issues with the westbound merge of SR-202L and I-10. Mr. Bombardier stated that Valley Metro had reserved the median for transit use, but have now indicated that they do not intend to use it and have verbally indicated their willingness to allow ADOT to use the space. He explained that the ADOT District Minor funds were being sought and the project was waiting for approval to be included in the Transportation Improvement Program. The total estimated construction cost for this project is \$3 million; the detailed estimate is provided in the feasibility memo. Group discussion occurred about changing HOV lane access and time of day usage rules. It was stated that any changes to the HOV rules would require an act of legislation.

Mr. Poppe provided an overview of the ADOT I-10, 35th Avenue to Sky Harbor Boulevard, Phoenix Corridor Safety Study. Mr. Poppe stated that the most cost-effective solution identified in the study was to decrease the speed limit from 65 MPH to 55 MPH. This change would create \$200 million in savings over the next 20 years. Mr. Hazlett stated that variable speed limits are also an option and would more easily be accepted by the public. He stated that the current free flow speed is 70 MPH and that variable speed limits would allow the public to continue at this speed during off-peak hours. Mr. Poppe stated that there is a current project to upgrade the street lights in the tunnel because they are deficient based on the current posted speed. The existing street lights were installed when the speed limit was 55 MPH. Then, the speed limit was increased to 65 MPH when speed cameras were installed to help control free flow speeds. After the speed cameras were removed, the speed limit was not readjusted to 55 MPH. He stated that street lighting is design to accommodate a specified speed. Mr. Poppe continued that the current tunnel street light project is investigating three scenarios: 1) constant 55 MPH; 2) constant 65 MPH; and 3) variable speeds. Lee Engineering developed a cost estimate for implementing variable speeds from 16th Street to 19th Avenue, including overhead gantry's, which totaled \$7.5 million. Mr. Poppe also stated that the safety study identified ramp metering as another potential solution. He stated that the biggest problem was with the traffic queues at 7th Avenue and I-10. An investigation would be necessary to evaluate how ramp meters could address the issue at this location and similar issues at other locations including 7th Street and 3rd Street, and corresponding impacts to parallel routes, such as Roosevelt Street. This will require coordination with

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City of Phoenix Streets department. Mr. Poppe stated that DMS signs could help divert traffic away from the I-10 with indicators of travel times along alternative routes such as McDowell Road. Mr. Bombardier stated that a big safety issue is the weaving from 3rd Street, 7th Street and SR-202L for drivers trying to get onto SR-51 and SR-202L.

Mr. Bombardier continued with an overview of the ADOT I-10 Tunnel Study. He indicated that the center bore of the tunnel was originally planned to be a transit center and that there were plans for it to serve for HOV lanes later on. He stated that there are issues with the center bore of the tunnel including vertical clearance as it was designed for low speed transit, and that the existing geometry does not meet current standards. He stated that the center bore is not feasible for transit or HOV. Mr. Poppe stated that ADOT currently uses the center bore area for maintenance and storage. He stated that the center bore could be explored as part of a new emergency evacuation plan but the tunnel would likely not be ADA compliant. Mr. Poppe added that there is no fire suppression system in the tunnel.

Mr. Bombardier provided an overview of the I-10/Buckeye Road/Sky Harbor Boulevard traffic interchange. He stated that while this is not within the study limits, potential improvements could influence the area. He stated there is \$30 million in the Regional Transportation Plan to reconstruct the TI and it is currently being redesigned to address issues from Sky Harbor.

Mr. Bombardier then explained the I-10 Origin-Destination Analysis conducted by HDR. Mr. Hazlett stated that the helicopter survey supports this analysis and that MAG will provide a bandwidth diagram similar to what was developed by HDR.

4. STUDY AREA ISSUES

Mr. Pagnard continued by providing an overview of the study area issues and concerns and asked the study members to identify any issues not already listed. Mr. Pagnard stated that the deck park tunnel would remain untouched with the exception of potential ITS improvements. Ms. Castro stated that if the pedestrian bridges were touched, they may require reconstruction if they are not ADA compliant. Mr. Poppe stated that the tunnel lighting is currently deficient. Mr. Littleton added that the City of Phoenix is looking to enhance the park above the tunnel and include water features and shade structures across Central Avenue. Mr. Poppe noted concerns with wind loads. He also noted that ADOT has a drainage tunnel in the southeast quadrant of the Mini-Stack TI. The group briefly discussed settlement issues at the DHOV ramps between SR-51 and I-10 and at SR-202L. Mr. Poppe noted the pier and pump station wall at 16th Street and pump stations at 3rd Street and 3rd Avenue. He added that the pumps may not have

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the capacity to deal with the additional water runoff associated with increased pavement area.

5. EVALUATION CONSIDERATIONS

Mr. Pagnard asked the study members to identify qualitative evaluation considerations for the alternatives. He stated that the study budget was not large enough for an in-depth quantitative analysis but that it could be done in the future based on the results of this study. The following evaluation considerations were identified:

- Travel time/reliability
- Reduction in weaving (reduction in number of lane changes)
- Right-of-Way Impacts (quantitative)
- Cost

Mr. Pagnard asked the study members to email/call if they identified any other evaluation considerations after the meeting. Mr. Hazlett stated that he estimated the improvements to cost from \$500 million to \$1 billion from a future Proposition 500. He added that the improvements would be completed after 2025. Mr. Poppe stated that minor improvements could be completed in the meantime to relieve traffic. Mr. Hazlett noted that MAG is conducting an Integrated Corridor Management Study on I-10 and Mr. Littleton stated that the City of Phoenix will be adding travel time messages on 7th Avenue and 7th Street by 2019.

6. NEXT STEPS

Mr. Hazlett thanked attendees for their participation and reviewed project next steps:

- MAG will provide the bandwidth diagram from the helicopter survey.
- B&N will prepare the meeting summary notes and distribute to the study members.
- B&N will coordinate with the MAG project manager to set a date and time for the next meeting.

Meeting was adjourned at 10:30 A.M.

**I-10/Papago Freeway Tunnel
Traffic Operations Study**

SIGN-IN SHEET

I-17 Stack to SR-51/SR-202L Mini Stack

Kickoff Meeting

Thursday, July 21, 2016

9:00 a.m.

Maricopa Association of Governments
Cottonwood Room

Present	Name	Agency
<i>MP</i>	Mark Poppe	ADOT
	Jim Windsor	ADOT
	Jennifer Brown	FHWA
<i>EC</i>	Eunice Chan	FHWA
	Tom Deitering	FHWA
<i>ES</i>	<i>Ed Stilling</i>	<i>FHWA</i>
	Ray Dovalina	City of Phoenix
<i>BL</i>	Bruce Littleton	City of Phoenix
	Scott Logan	City of Phoenix
	Mark Melnychenko	City of Phoenix
<i>QC</i>	Quinn Castro	MAG
<i>HB</i>	Bob Hazlett	MAG
<i>CA</i>	Cynthia Alvarez	Burgess & Niple
<i>DL</i>	David Lenzer	Burgess & Niple
<i>JP</i>	Jason Pagnard	Burgess & Niple
<i>BMB</i>	Brian Bombardier	HDR
	Jeremy Neuman	HDR

I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini-Stack

Conceptual Alternative Brainstorming Charrette
August 26, 2016

ATTENDEES

- Bob Hazlett – MAG
- Quinn Castro – MAG
- Ravi Ambadipudi – B&N
- Benjamin Barkan – B&N
- David Lenzer – B&N
- Jason Pagnard – B&N
- Brian Toombs – B&N
- Brian Bombardier – HDR
- Jeremy Neuman – HDR

HANDOUTS

Study Area Issues Map, Study Area Roll Plots, and Origin-Destination Data Map.

Jason Pagnard, Burgess & Niple Project Manager, convened the meeting at 7:30 A.M.

1. INTRODUCTIONS

Mr. Pagnard welcomed everyone. He stated that the purpose of the charrette was to brainstorm potential conceptual alternatives to address Planning Partner identified evaluation considerations for each quadrant of the study area. This includes:

- Travel time/reliability
- Reduction in weaving (reduction in number of lane changes)
- Right-of-Way Impacts (quantitative)
- Cost

Mr. Pagnard reminded the group that the nature of the study is that of a high-level, feasibility investigation with qualitative evaluations. This study is the first phase in the process that should consider feasibility and that a future phase will provide the opportunity for in-depth quantitative analysis depending on the results of this study.

2. CONCEPTUAL ALTERNATIVES

The origin-destination travel pattern map was discussed to identify primary travel patterns for the study area. Mr. Hazlett indicated that one reason there are so many problems in this corridor is because motorists use this freeway system for short trips, which in turn causes excessive weaving. Mr. Hazlett acknowledged that any

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improvements within the study area will be costly, so cost-effective solutions should be a focus.

Mr. Pagnard stated that the Deck Park Tunnel is a constraint leading to essentially four quadrants with independent utility:

- Northeast Quadrant (I-10 Westbound, SR-51/SR202L Mini-Stack to Tunnel)
- Northwest Quadrant (I-10 Westbound, Tunnel to I-17 Stack)
- Southwest Quadrant (I-10 Eastbound, I-17 Stack to Tunnel)
- Southeast Quadrant (I-10 Eastbound, Tunnel to SR-51/SR202L Mini-Stack)

Additional constraints include the existing bridge overpasses, which can create “pinch points” and pump stations that are located in the northeast quadrant. Mr. Hazlett indicated that the existing graded median (approximately 50 feet wide) can be used to develop alternatives. My Bombardier indicated that past potential transit plans for the median have been abandoned and the area can be used for roadway. The group discussed reducing conflict points and aligning vehicles into the desired lane/route as soon as possible.

Mr. Pagnard stated that that the goal of the meeting was to develop two conceptual alternatives for each quadrant.

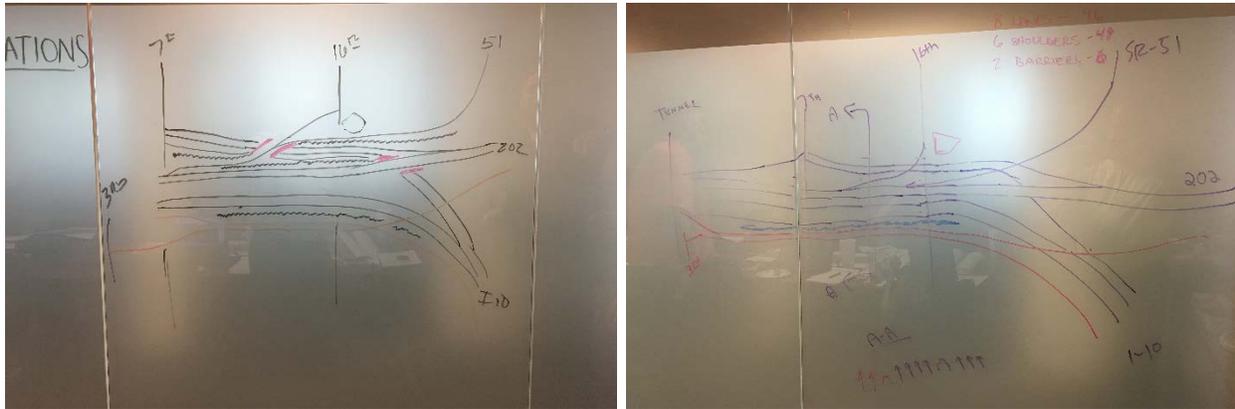
3. NORTHEAST QUADRANT

Various considerations were discussed, including:

- A C-D road system between the SR-51/SR202L Mini-Stack to the I-17 Stack;
- Several braided ramp configurations that minimize impacts to existing SR-51/SR202L Mini-Stack piers;
- Interim, re-striping of the current pavement to allow more traffic coming from the SR-202L;
- Addressing the southbound SR-51 to I-10/3rd Street exit weave;
- Avoiding impacts to the existing pump stations at 7th Street and 16th Street and the pedestrian bridge at 10th Street;
- Including two westbound HOV lanes between the SR-51/SR202L Mini-Stack to the 3rd Street DHOV off-ramp;
- Fully utilizing the space between overpass bridge abutments and median piers; and
- Utilizing parallel routes (e.g. McDowell Road) if movements were eliminated.

The following two conceptual alternatives were ultimately identified:

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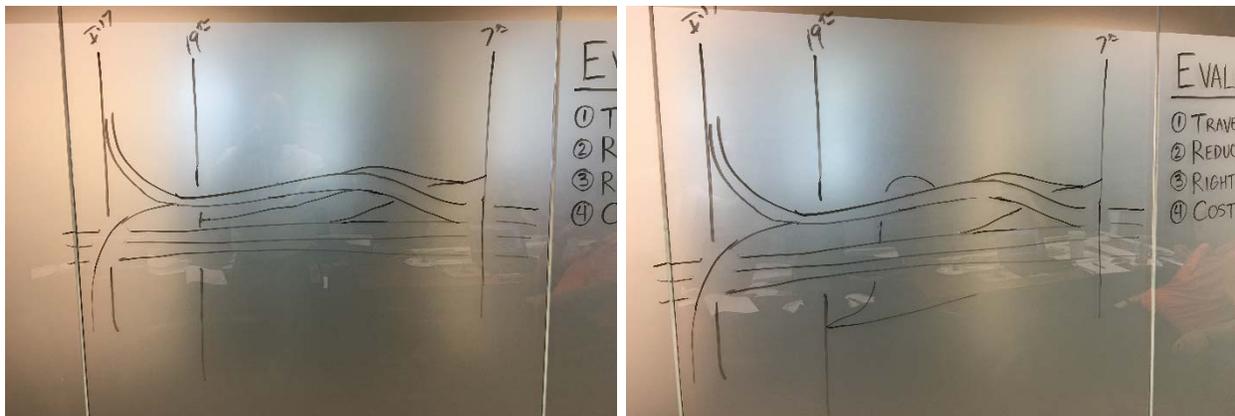


4. NORTHWEST QUADRANT

Various considerations were discussed, including:

- A C-D road that extends from 7th Avenue to the I-17 Stack;
- Minimizing or avoiding neighborhood impacts;
- Minimizing or avoid impacts to drainage facilities long the north side of I-10;
- Braiding ramps;
- Constructing new ramps under the I-10 viaduct through existing piers;
- Reconstructing the 7th Avenue TI; and
- Accommodating traffic from the I-10/19th Avenue eastbound on-ramp U-turn via the 7th Avenue TI destined for I-10 westbound.

The following two conceptual alternatives were ultimately identified:



5. SOUTHWEST QUADRANT

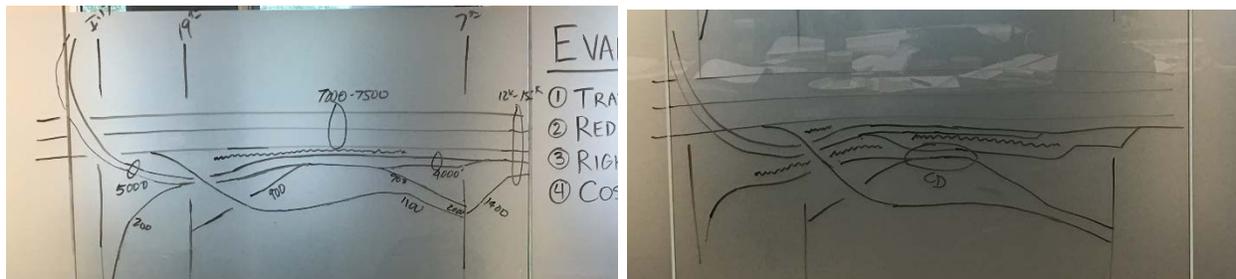
Various considerations were discussed, including:

- An I-17 northbound flyover ramp to I-10 eastbound;

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- Moving the weave to the ramps (C-D Roadway);
- Incorporating variable speeds limits via ITS;
- Understanding that accommodating traffic volumes will likely be the most challenging in this quadrant due to various physical constraints; and
- Considering significant ITS investment to ease peak hour congestion and utilize roadway infrastructure to accommodate substantial off peak traffic.

The following two conceptual alternatives were ultimately identified:

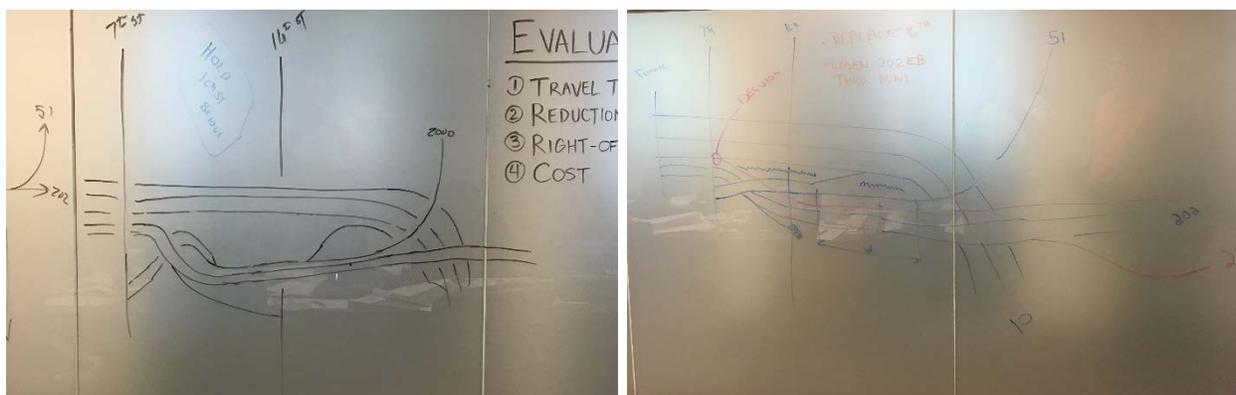


6. SOUTHEAST QUADRANT

Various considerations were discussed, including:

- Consideration that a primary congestion issue is the I-10 eastbound exit to SR-51 and SR-202L through the SR-51/SR-202L Mini Stack TI;
- Including two eastbound HOV lanes between the 3rd Street DHOV on-ramp to the SR-51/SR202L Mini-Stack;
- A C-D road system between; and
- Two braided ramp configurations where one avoids impacting the 16th Street overpass and the other impacts the 16th Street overpass.

The following two conceptual alternatives were ultimately identified:



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7. PRELIMINARY COST OPINIONS

The group discussed the potential cost of the conceptual alternatives. It was thought that approximately \$400 million to \$500 million (rough approximation) would be necessary to implement a conceptual alternative for each quadrant.

8. NEXT STEPS

Mr. Hazlett and Mr. Pagnard thanked attendees for their participation and reviewed project next steps:

- B&N will prepare a meeting summary;
- B&N and HDR will develop the concepts in MicroStation;
- A progress meeting will be conducted with MAG to identify issues and opportunities that are identified once the conceptual alternatives underwent further preliminary engineering.

Meeting was adjourned at 11:45 A.M.

I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini-Stack

Progress Meeting
December 22, 2016

ATTENDEES

- Bob Hazlett – MAG
- Quinn Castro – MAG
- Cynthia Alvarez – B&N
- David Lenzer – B&N
- Jason Pagnard – B&N
- Jeremy Neuman – HDR

HANDOUTS

Google Earth KMZ files.

Jason Pagnard, Burgess & Niple Project Manager, convened the meeting at 9:00AM.

1. INTRODUCTIONS

Mr. Pagnard welcomed everyone. The purpose of the meeting was to review the concepts developed during the August 26 charrette that have now been engineered in MicroStation and discuss refinements and issues, such as right-of-way, constructability, and funding.

2. CONCEPTUAL ALTERNATIVES

The following summarize the key points for each alternative per quadrant.

NORTHEAST QUADRANT

Option 1

- Two lanes from I-10 to 7th Street may not be necessary based on traffic volumes. Regardless of traffic volumes, there may be enough storage length to hold all vehicles in one lane. One lane under the SR-202L DHOV ramp straddle bent on I-10 will reduce impacts to the existing structure.
- There will not be any access to 7th Street for vehicles coming from SR-51.
- This option eliminates the possibility of vehicles travelling across all lanes of I-10 from SR-51 to exit at the 3rd Street DHOV.
- Given right-of-way constraints, barriers were not included between same-direction travel lanes near the Mini-Stack between SR-202L and the I-10 HOV lane.

NOTES

- This option will require reconstruction of the 16th Street bridge and will likely impact the Pump Station in the northeast corner.
- Mr. Hazlett indicated that the City of Phoenix plans to replace the pump station at 16th Street and may want an exit at 12th Street.
- During the next steps, it is desirable to investigate the possibility of a slip ramp onto 7th Street to allow vehicles from SR-51 to exit at this location. A potential solution is to place the off ramp at 7th Street against the wall to obtain more room.
- Signing plans will need to be developed during the next steps to ensure the drivers can read and make decisions in a safe and timely manner. Will need to sign the SR-202L HOV lane east of the Mini-Stack to reflect the exit to 3rd Street.
- There will be a need to consider bus routes during the next steps to ensure they are accommodated.

Option 2

- This option has one lane from I-10 to 7th Street.
- Mr. Lenzer noted that the ramp from SR-202L to I-10 may have a 6 percent downgrade. Ms. Castro stated that DPS has indicated that the high grades cause cars to jump in the air at high speeds. A potential solution for this would be flatten out the ramp and increase the grade of the adjacent ramp if necessary. This would be done in a future study.
- This option does not impact the pump station at 16th Street.
- This option would allow for a SR-51 to 7th Street slip ramp beginning near 12th Street.

Summary

- Option 2 appears to rate well and is the draft preferred option.

NORTHWEST QUADRANT

Option 1

- No impact to 12th Avenue bridge.
- Provides a 2-lane metered ramp at 7th Avenue with a large storage length. Still allows access from 7th Avenue southbound.
- Adds four lanes on I-10 through the I-17 Stack utilizing the extra wide shoulder on the north side.
- Impacts the drainage basin and homes at 15th Avenue. Will need to purchase some of the homes for the ramps and reconfigure access.
- All walls will need to be reconstructed.

NOTES

Option 2

- This option was not desirable due to the right-of-way impacts for the off ramp to 19th Avenue.

Summary

- Option 1 appears to rate well and is the draft preferred option.

SOUTHWEST QUADRANT

Option 1

- All existing movements were accommodated with this option.
- This option keeps 7th Street separate from the mainline.
- This option provides an auxiliary lane between 19th Avenue and 7th Avenue.
- The impacted property and adjacent road at 16th Avenue and US-60/Grand Avenue will need to be closed.
- There is a potential for median widening with this option. Preliminary issues include constructability and right-of-way impacts.
- The pedestrian structures within this quadrant will need to be replaced.
- The biggest issue in this quadrant is the BNSF Railway tracks near 19th Avenue. Piers may need to be placed within BNSF Railway right-of-way. Mr. Pagnard suggested an aerial easement.
- Piers will impact ADOT property, BNSF Railway, and the Phoenix Flooring Outlet company along 19th Avenue among others.

Option 2

- Potential impact to the I-17 Stack which would require rehabilitation of existing piers and bridge reconstruction.
- Spiral on the on ramp from 19th Avenue.
- Provides direct access from southbound I-17 to I-10.
- No median widening with this option.
- Provides only one lane from northbound I-17 to I-10.

Summary

- Option 1 appears to rate well and is the draft preferred option.

SOUTHEAST QUADRANT

Option 1

- Shoulders under the 7th Street bridge will not be standard in order to salvage the bridge.
- There may be constructability issues at the braiding of the 7th Street on ramps and the C-D road. This should be investigated further in a future study.

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- There will be a need to further address drainage concerns at the ramp braiding.
- Potential solutions to discourage weaving from the I-10 to the C-D road at the slip ramp include vertical delineators, rumble strips, or dagmars.
- It is anticipated that there will be trench drains in the gore areas due to the amount of paved area to be drained.
- The required back of gore length of 20 feet per the ADOT RDG at the slip ramp was not achieved in order to reduce right-of-way impacts in the south. Potential solutions include reducing the lanes from their current widths of 12 feet to 11 feet and reducing the shoulder from its current width of 10 feet to 8 feet.
- Signing plans will need to be developed during the next steps to ensure the public can read and make decision in a safe and timely manner.

Option 2

- Shoulders under the 7th Street bridge will not be standard in order to salvage the bridge.
- There may be constructability issues at the braiding of the 7th Street on ramps and the C-D road. This should be investigated further in a future study.
- There will be a need to further address drainage concerns at the ramp braiding.
- Potential solutions to discourage weaving from the I-10 to the C-D road at the slip ramp include vertical delineators, rumble strips, or dagmars.
- It is anticipated that there will be trench drains in the gore areas due to the amount of paved area to be drained.
- Signing plans will need to be developed during the next steps to ensure the public can read and make decision in a safe and timely manner.
- The impacts to right-of-way in the south are minimized because there are only 3 lanes on the C-D road rather than the 4 in Option 1.

Summary

- Option 1 appears to rate well and is the draft preferred option. Traffic volume data will most likely show a need for the third lane from I-10 to the C-D road shown in Option 1.

3. NEXT STEPS

Mr. Hazlett and Mr. Pagnard thanked attendees for their participation and reviewed project next steps:

- B&N will prepare the meeting summary.
- B&N will prepare cost estimates with the template provided from HDR for consistency with The Spine Study (I-10 and I-17 Corridor Master Plan).

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- B&N will coordinate with the MAG project manager to set a date and time for a Planning Partner meeting in February to include the City of Phoenix, ADOT, and FHWA.
- It is anticipated the pre-design activities would begin in FY 2018/FY 2019 including a DCR and Environmental Clearance. This process is expected to last three to four years.

Meeting was adjourned at 11:00 A.M.

I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini Stack

AGENDA

Planning Partners Meeting

Wednesday, February 22, 2017

3:00 PM

Maricopa Association of Governments

Palo Verde Room

Meeting Purpose – Meeting to engage ADOT, FHWA, MAG, and the City of Phoenix in a discussion about the preliminary study findings and recommended next steps.

1. Introductions
 2. Project Overview
A brief overview of the study's purpose and progress will be provided.
 3. Development of Conceptual Alternatives
A review of the conceptual alternatives developed during the project team brainstorming charrette.
 4. Preliminary Evaluation of Conceptual Alternatives
A discussion regarding the evaluation of conceptual alternatives considering the following:
 - Travel time/reliability;
 - Reduction in weaving;
 - Right-of way impacts; and
 - Cost.
 5. Next Steps
Discussion of the next action items.
2. For information
3. For information and discussion.
4. For information and discussion.
5. For information



I-10/Papago Freeway Tunnel Traffic Operations Study

Planning Partners Meeting
February 22, 2017



Agenda

1. Introductions.
2. Project Overview.
3. Development of Conceptual Alternatives.
4. Preliminary Evaluation of Conceptual Alternatives.
5. Next Steps.



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Project Overview

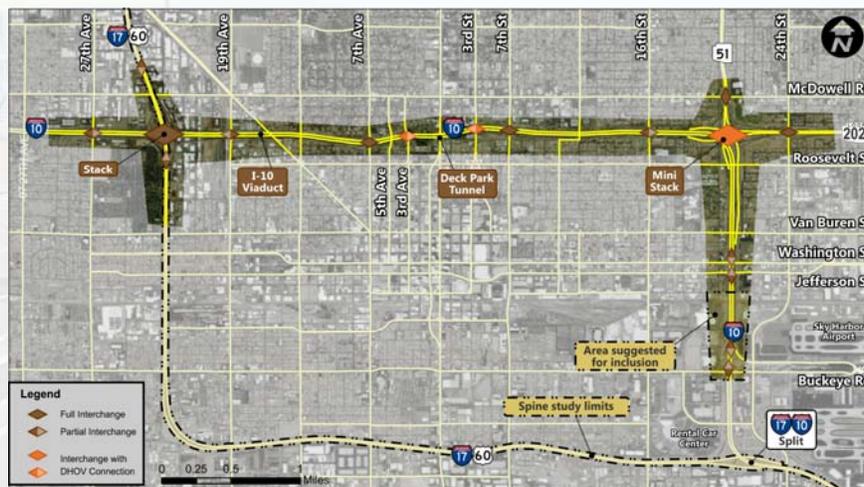
Agenda Topic 2

- Identify potential solutions to accommodate travel demand.
- Develop practical recommendations that recognize and balance travel patterns, physical constraints, and implementation costs.
- Address safety concerns.



Study Area Issues

Agenda Topic 2



Study Area Issues

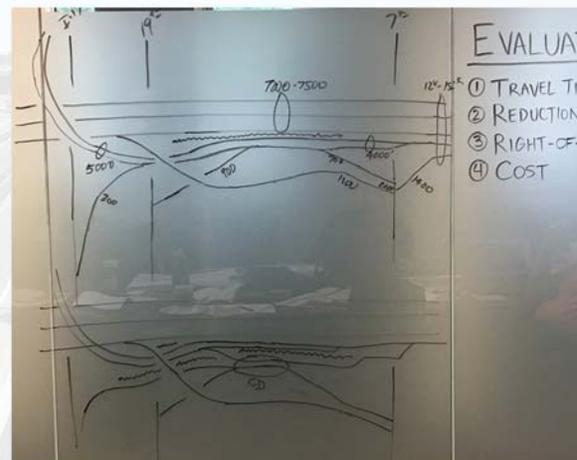
Agenda Topic 2

- Deck Park Tunnel must remain untouched.
- 19th Avenue railroad corridor.
- 11th Avenue, 10th Street, and 18th street pedestrian bridges.
- Architectural semicircular treatments on retaining walls.
- I-10 drainage tunnel.
- Transit along I-17 through I-17 Stack TI and to the west.
- Deck Park Tunnel lighting.
- Two system TIs: I-17 Stack and SR-51 Mini-Stack.
- General purpose TIs: 35th Ave, 27th Ave, 19th Ave, 7th Ave, 7th St, 16th St, and Washington St/Jefferson St.
- DHOV access at 5th Ave/3rd Ave, 3rd St, I-10/SR-202L, and I-10/SR-51.
- I-10, SR-51 Mini-Stack to 3rd Street HOV Auxiliary Lanes (Study).
- I-10 Safety Corridor
- I-10/Sky Harbor access.

Development of Conceptual Alternatives

Agenda Topic 3

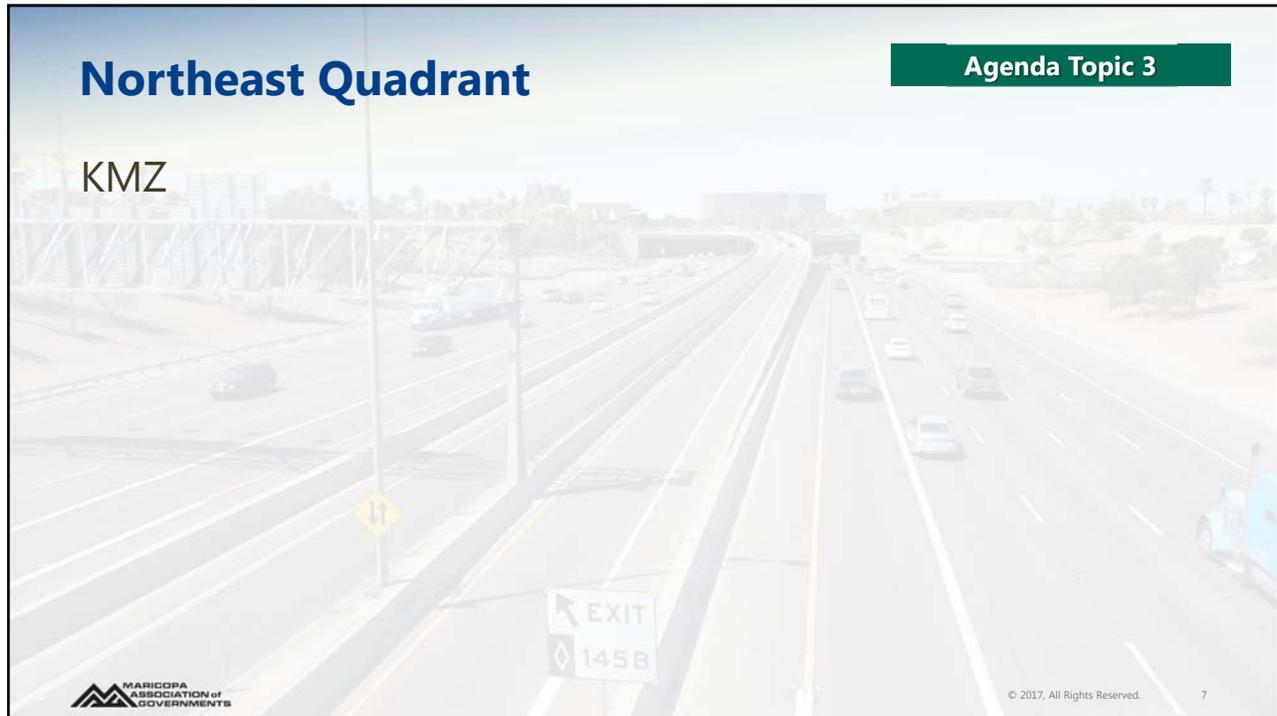
- Deck Park Tunnel was held as a constraint.
 - Tunnel-East (Deck Park Tunnel to the SR-51 Mini-Stack TI).
 - Tunnel-West (I-17 Stack TI to the Deck Park Tunnel).
- Considering both directions, there are four quadrants with independent utility for potential concepts.
- Two conceptual alternatives were developed per quadrant.



Northeast Quadrant

Agenda Topic 3

KMZ



Northeast Quadrant

Agenda Topic 3

Option 1

- Braid WB I-10 exit to 7th Street with ramps from SR-202L and SR-51.
- Additional HOV lane from WB SR-202L DHOV to 3rd Street DHOV.
- Reconstruct the 12th Street, 16th Street, and two pedestrian bridges.
- Reconstruct/impact the pump station.
- Two lane WB I-10 exit to 7th Street.
- SR-51 traffic cannot access 3rd Street or 7th Street.
- 16th Street and SR-51 entrances combine to a single entrance to WB I-10.

Option 2

- Braid WB I-10 exit to 7th Street with ramps from SR-202L and SR-51.
- Additional HOV lane from WB SR-202L DHOV to 3rd Street DHOV.
- Reconstruct the 12th Street and two pedestrian bridges.
- Avoids pump station.
- One lane WB I-10 exit to 7th Street.
- SR-51 traffic cannot access 7th Street.
- 16th Street and SR-51 enter WB I-10 separately.



Southeast Quadrant

Agenda Topic 3

Option 1

- Braid 7th Street entrance to EB I-10 with ramps to 16th Street, SR-202L, and SR-51.
- EB I-10 exit to CD is three lanes.
- Additional HOV lane from 3rd Street DHOV to EB SR-202L DHOV.
- Reconstruct the 12th Street, 16th Street, and two pedestrian bridges.
- Extends three EB SR-202L lanes, with drop to 24th Street

Option 2

- Braid 7th Street entrance to EB I-10 with ramps to 16th Street, SR-202L, and SR-51.
- EB I-10 exit to CD is two lanes.
- Additional HOV lane from 3rd Street DHOV to EB SR-202L DHOV.
- Reconstruct one pedestrian bridge.
- Extends two EB SR-202L lanes, with decision to 24th Street (same as today).

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Southwest Quadrant

Agenda Topic 3

Option 1

- Braid EB I-10 exit to 7th Avenue with ramps from I-17 and 19th Avenue.
- New bridges over the BNSF Railway.
- Iglesia la Luz del Mundo church impact.
- Requires viaduct median and outside widening.
- I-17 traffic cannot access 3rd Avenue DHOV exit.
- NB and SB I-17 entrances combine to a single entrance to EB I-10.

Option 2

- Braid EB I-10 exit to 7th Avenue with ramps from I-17 and 19th Avenue.
- New bridges over the BNSF Railway.
- Iglesia la Luz del Mundo church impact.
- No median widening is required, only outside bridge widening.
- NB I-17 traffic cannot access 3rd Avenue DHOV exit.
- NB and SB I-17 enter EB I-10 separately.

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Northwest Quadrant

Agenda Topic 3

KMZ



Northwest Quadrant

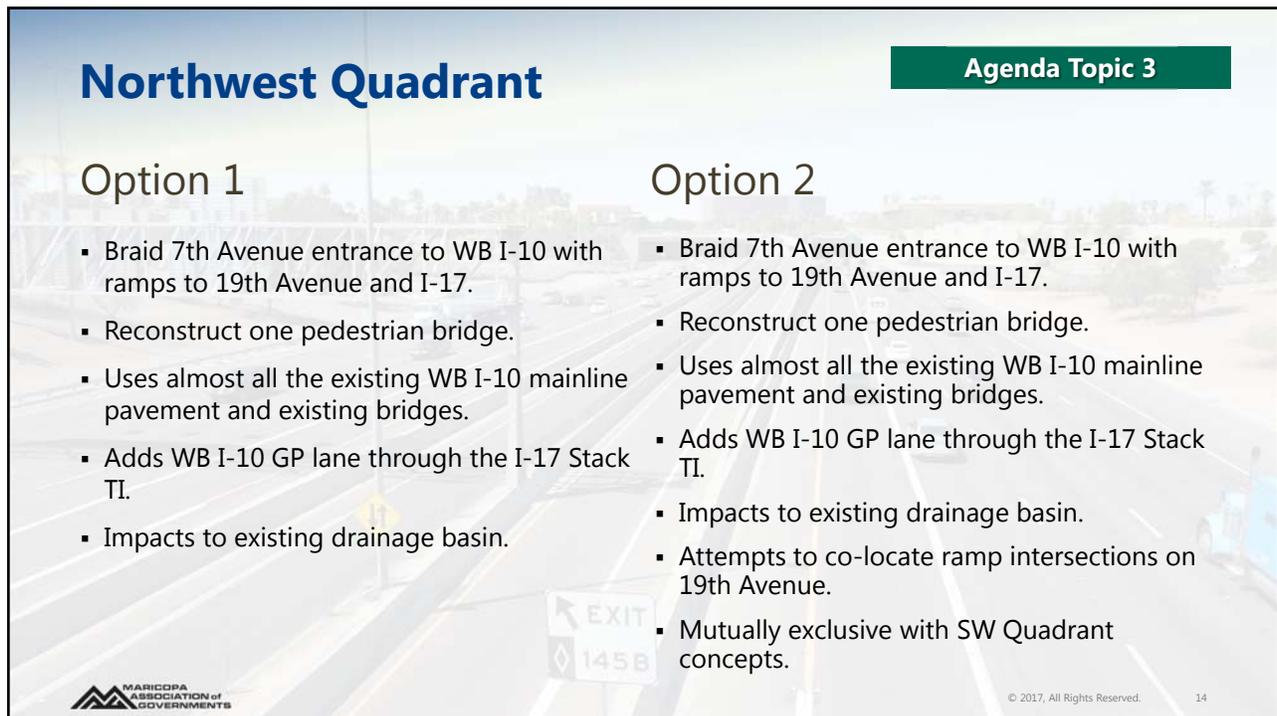
Agenda Topic 3

Option 1

- Braid 7th Avenue entrance to WB I-10 with ramps to 19th Avenue and I-17.
- Reconstruct one pedestrian bridge.
- Uses almost all the existing WB I-10 mainline pavement and existing bridges.
- Adds WB I-10 GP lane through the I-17 Stack TI.
- Impacts to existing drainage basin.

Option 2

- Braid 7th Avenue entrance to WB I-10 with ramps to 19th Avenue and I-17.
- Reconstruct one pedestrian bridge.
- Uses almost all the existing WB I-10 mainline pavement and existing bridges.
- Adds WB I-10 GP lane through the I-17 Stack TI.
- Impacts to existing drainage basin.
- Attempts to co-locate ramp intersections on 19th Avenue.
- Mutually exclusive with SW Quadrant concepts.



Evaluation of Conceptual Alternatives

Agenda Topic 4

- Evaluation considerations were identified during the Kickoff Meeting with Planning Partners including:
 - Travel Time/Reliability;
 - Reduction in Weaving (Reduction in Number of Lane Changes);
 - Right-of-Way Impacts; and
 - Cost.
- These items were used to develop and qualitatively evaluate the concepts.



East Quadrants

Agenda Topic 4

Northeast Quadrant

	Travel Time/Reliability	Reduction in Weaving	Right-of-Way Impacts	Cost
Option 1	-	-	2.0 acres	-
✓ Option 2	+	+	0.6 acres	+

Southeast Quadrant

	Travel Time/Reliability	Reduction in Weaving	Right-of-Way Impacts	Cost
✓ Option 1	+	+	1.1 acres	-
Option 2	-	-	1.1 acres	+

West Quadrants

Agenda Topic 4

Southwest Quadrant						
	Travel Time/ Reliability	Reduction in Weaving	Right-of-Way Impacts		Cost	
✓ Option 1	+	+	5.5 acres	+	\$122 million	+
Option 2	-	-	7.5 acres	-	\$166 million	-

Northwest Quadrant						
	Travel Time/ Reliability	Reduction in Weaving	Right-of-Way Impacts		Cost	
✓ Option 1	+	+	2.9 acres	○	\$95 million	○
Option 2	-	-	2.9 acres	○	\$95 million	○

Additional/Future Considerations

Agenda Topic 4

- Drainage overview to determine the extents of potential impacts.
- Environmental overview to determine potential impacts.
- Signing plan concept.
- Stakeholder and public involvement.
- Transit considerations.
- Maintenance considerations.
- Traffic operations.
- ITS infrastructure considerations, such as:
 - Tunnel lighting;
 - Variable speeds;
 - Ramp meters; and
 - Arterial DMS.
- Geometric refinements.

Next Steps

Agenda Topic 5

- Distribute Report to Planning Partners for review and comment.
- Finalize Report.



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I-10/Papago Freeway Tunnel Traffic Operations Study

Planning Partners Meeting
February 22, 2017



I-10/Papago Freeway Tunnel Traffic Operations Study

I-17 Stack to SR-51/SR-202L Mini-Stack

Planning Partners Meeting
February 22, 2017

ATTENDEES

See attached sign-in sheet.

HANDOUTS

Agenda, PowerPoint presentation

Quinn Castro, MAG Project Manager, convened the meeting at 3:05 P.M.

1. INTRODUCTIONS

Ms. Castro welcomed everyone and introduced the consultant Project Manager, Mr. Pagnard.

2. PROJECT OVERVIEW

Mr. Pagnard provided an overview of the study scope and goals. He briefly reviewed the study area issues including the Deck Park Tunnel, BNSF Railway, reconstruction of structures, the I-17 Stack TI and SR-51/SR-202L Mini-Stack TI, and general purpose TIs.

3. DEVELOPMENT OF CONCEPTUAL ALTERNATIVES

Mr. Pagnard explained that the consultant team met with MAG to develop conceptual alternatives for each quadrant. Quadrants were identified as east and west of the tunnel and north or south of the median. A total of eight conceptual alternatives were developed, two per quadrant. Mr. Pagnard proceeded to utilize Google Earth KMZ files to present the conceptual alternatives.

Mr. Pagnard began with Option 1 for the Northeast Quadrant (NE1). He explained the braiding of SR-202L, I-10, SR-51, and 16th Street and that this option prevents access to the 3rd Street DHOV from vehicles travelling from SR-51. Mr. Pagnard added that this option also prevents access to 7th Street from SR-51. The Planning Partners expressed an interest in providing access to 7th Street from SR-51. Mr. Pagnard stated that the Consultant Team already looked into the issue and suggested that a slip ramp near the 7th Street TI be added to allow this movement. Mr. Bombadier explained that there are approximately 300 vehicles a day that make this movement. The dominant movement is

NOTES

from SR-202L west to merge with I-10 and access 7th Street. Mr. Pagnard continued with Option 2 (NE2) and explained that the major difference was where SR-51 merged with I-10 and the number of lanes that diverged from I-10 mainline to 7th Street; two lanes in NE1 versus one lane in NE2. He noted that the extra lane width is what creates a requirement for replacement of the 16th Street pump station. Mr. Hazlett questioned whether the 16th Street on-ramp should be metered. Mr. Bombadier responded that it would depend on traffic volumes. Mr. Stillings inquired about the median and shoulder widths regarding spacing for emergency vehicles. He added that the Consultant team should consider whether an emergency vehicle has enough roadway width to safely reach a location in case of an incident.

Mr. Pagnard continued with Option 1 of the Southeast Quadrant (SE1). He explained the braiding of SR-202L and 7th Street and the slip ramp for vehicles from 7th Street onto I-10 mainline. Mr. Pagnard added that this option would be easy to sign since lane 1 is the local lane to 16th Street and 24th Street, lanes 2 and 3 are SR-202L off-ramps, and lane 4 is SR-51 off-ramp. Mr. Pagnard continued with SE2 explaining that the primary difference is the number of lanes from I-10 toward SR-51/SR-202L; three lanes in SE1 and two lanes in SE2. Mr. Hazlett mentioned that signing for these options would have to start as far back as the I-17 Stack TI in order to ensure vehicles are able to get in the correct lanes with ample time. He also mentioned that a major issue is that there is not currently a direct lane for SR-51 which causes driver confusion.

Mr. Pagnard then introduced Mr. Neuman to present the remaining alternatives. Mr. Neuman began with Option 1 of the Southwest Quadrant (SW1). He explained the braiding of I-17, 19th Avenue, and 7th Avenue and explained that the I-17 traffic cannot access the 3rd Avenue DHOV. This option requires viaduct widening and joins the northbound and southbound I-17 on-ramps. Mr. Neuman continued by explaining SW2. SW2 does not join the northbound and southbound on-ramps and does not require median widening. Mr. Hazlett mentioned that a major movement was from 19th Avenue eastbound to 7th Avenue for vehicles to be able to u-turn and head westbound on I-10. He also added that pier placement at the BNSF Railway railroad yard would be an issue.

Mr. Neuman continued with Option 1 of the Northwest Quadrant (NW1). NW1 braids 7th Avenue, 19th Avenue, and I-17 and adds a general purpose lane through the I-17 Stack TI. This option also impacts the existing drainage basin. Mr. Pagnard presented NW2 and explained that the only difference was co-locating the 19th Avenue ramp was attempted, but not achieved in NW2. Mr. Remes expressed concern with the impacts to the neighborhood west of 7th Avenue. He explained that these homes are part of the Roosevelt Historic District and that impacts to these would create conflict. Mr. Remes explained that it would be best to have no impact to this neighborhood, including the

NOTES

access road. Based on this information, this design had a fatal flaw and would not be pursued. Mr. Bombadier suggested a third option that bifurcates the movements such as a C-D road that runs parallel to I-10. Mr. Neuman suggested that the Consultant Team could shift the improvements south and stay within the limits of the retaining walls in both the north and south to minimize impact.

4. EVALUATION OF CONCEPTUAL ALTERNATIVES

Mr. Pagnard continued by presenting the evaluation of the conceptual alternatives. He explained that each concept was evaluated based on the following considerations: travel time/reliability, reduction in weaving, right-of-way impacts, and cost. After presenting each concept, Mr. Pagnard stated that the preferred options were as follows:

- Northeast Quadrant: Option 2
- Southeast Quadrant: Option 1
- Southwest Quadrant: Option 1
- Northwest Quadrant: Fatal Flaw (private property impacts)

Mr. Pagnard stated that future considerations during selection of alternatives include items such as signing plan concept, transit, and ITS infrastructure improvements. Mr. Hazlett stated that simulation modeling should also be done to identify how the quadrants interact and how they can be implemented. He added that improvements can be made in each direction, but that it would be important to avoid just changing the location of the bottleneck. Mr. Neuman stated that implementation of improvements should be made by-directional away from the tunnel (e.g. Southwest and northwest quadrants). Ms. Chan questioned whether there would be any design exceptions. The only known design exceptions at this time are for narrowing shoulders at select locations under the bridges east of the Tunnel.

5. NEXT STEPS

Mr. Pagnard indicated that the project team would develop another alternative that avoided impacts to the Roosevelt Historic District neighborhood.

Mr. Pagnard stated that the project summary report would be distributed to the Planning Partners for review and comment. After their review, the report will be finalized incorporating their comments. Mr. Hazlett added that simulation modeling and an implementation study should be completed before developing a DCR.

Mr. Pagnard convened the meeting at 4:15 PM.

**I-10/Papago Freeway Tunnel
Traffic Operations Study**

SIGN-IN SHEET

I-17 Stack to SR-51/SR-202L Mini Stack

Kickoff Meeting

Wednesday, February 22, 2017

3:00 PM

Maricopa Association of Governments

Palo Verde Room

Present	Name	Agency
	Steve Boschen	ADOT
<i>JBW</i>	Jim Windsor	ADOT
<i>[Signature]</i>	Jesse Gutierrez	ADOT
	Scott Beck	ADOT
<i>[Signature]</i>	Eunice Chan	FHWA
	Ed Stillings	FHWA
	Aryan Lirange	FHWA
	Ray Dovalina	City of Phoenix
<i>TR</i>	Thomas Remes	City of Phoenix
<i>[Signature]</i>	Eric Anderson	MAG
<i>[Signature]</i>	Quinn Castro	MAG
<i>[Signature]</i>	Bob Hazlett	MAG
<i>CA</i>	Cynthia Alvarez	Burgess & Niple
	David Lenzer	Burgess & Niple
<i>JT</i>	Jason Pagnard	Burgess & Niple
<i>BMB</i>	Brian Bombardier	HDR
<i>Jm</i>	Jeremy Neuman	HDR

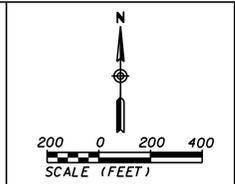
APPENDIX B

Conceptual Alternatives Roll Plots

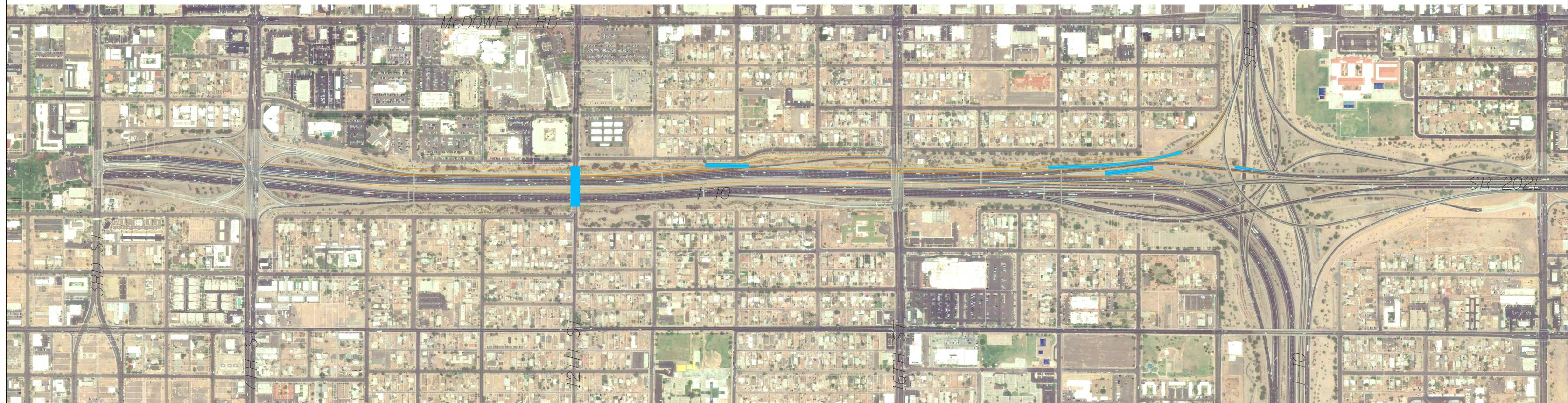


LEGEND

- | | | | |
|--|---|--|---|
|  Edge of Pavement |  Retaining Walls |  Striping |  Barrier |
|  Sound Walls |  Parcel Lines |  Bridges | |

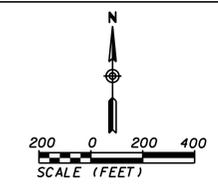


MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
TUNNEL TO MINI-STACK
ALTERNATIVE NE1
BURGESS & NIPLE **05/2017**



LEGEND

- | | | | |
|--|---|--|---|
|  Edge of Pavement |  Retaining Walls |  Striping |  Barrier |
|  Sound Walls |  Parcel Lines |  Bridges | |



**MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
TUNNEL TO MINI-STACK
ALTERNATIVE NE2**

BURGESS & NIPLE **05/2017**



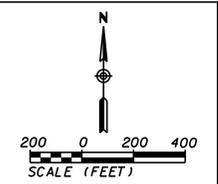
LEGEND

- Edge of Pavement

— Sound Walls
- - - Retaining Walls

— Parcel Lines
- Striping

■ Bridges
- Barrier

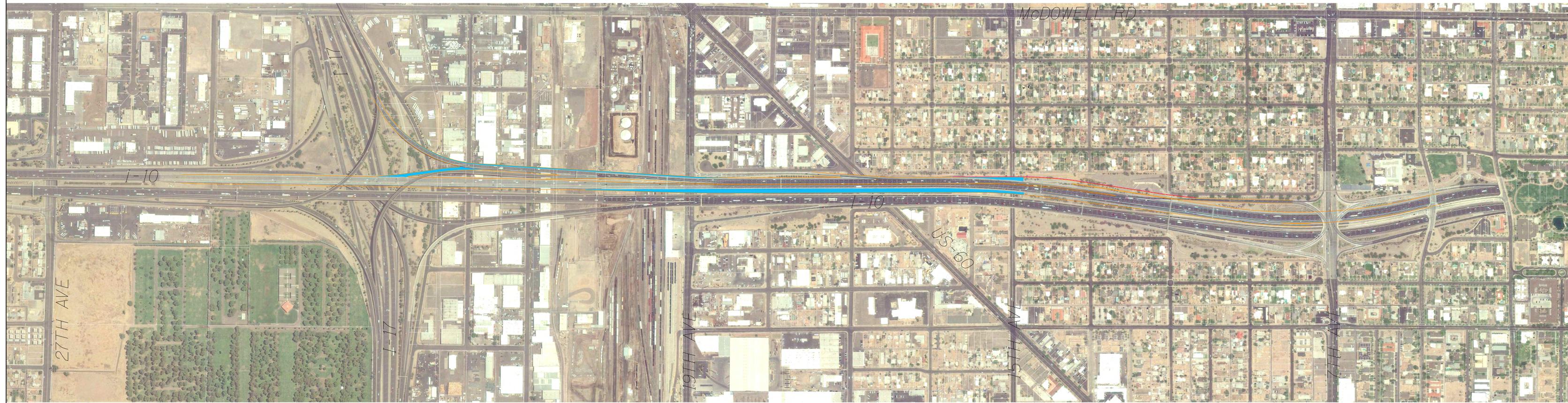


**MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
STACK TO TUNNEL
ALTERNATIVE NW1**



HDR, INC.
3200 E. CAMELBACK ROAD
SUITE 300
PHOENIX, AZ 85018-2311
TEL: (602) 522-7700

05/2017



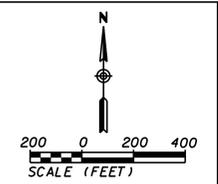
LEGEND

- Edge of Pavement

— Sound Walls
- - - Retaining Walls

— Parcel Lines
- · — Striping

■ Bridges
- Barrier

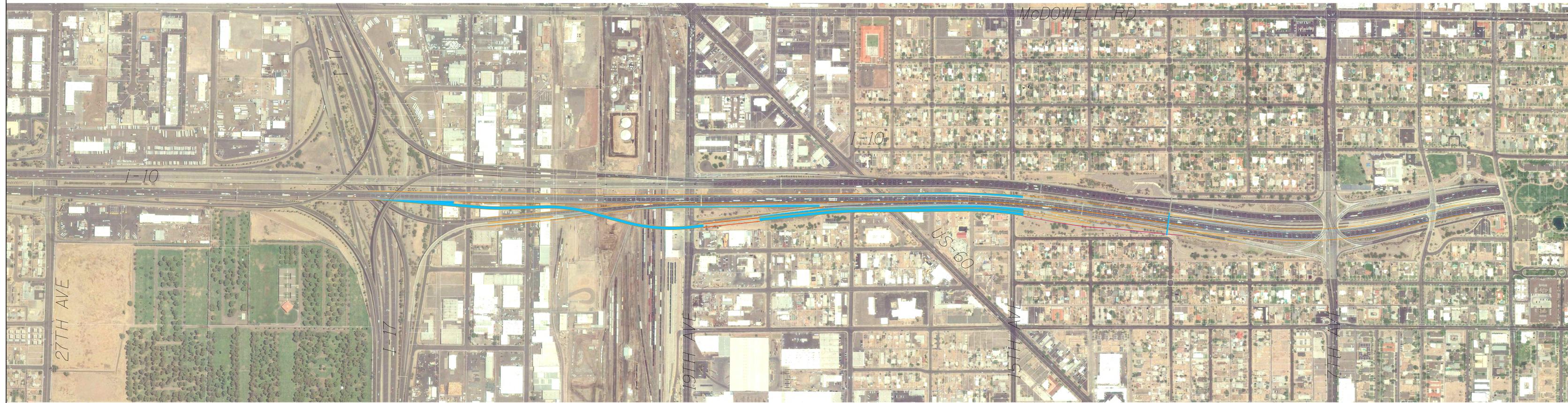


**MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
STACK TO TUNNEL
ALTERNATIVE NW2**

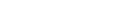


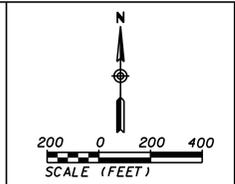
HDR, INC.
3200 E. CAMELBACK ROAD
SUITE 300
PHOENIX, AZ 85018-2311
TEL: (602) 522-7700

05/2017



LEGEND

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|--|---|--|---|
|  Edge of Pavement |  Retaining Walls |  Striping |  Barrier |
|  Sound Walls |  Parcel Lines |  Bridges | |

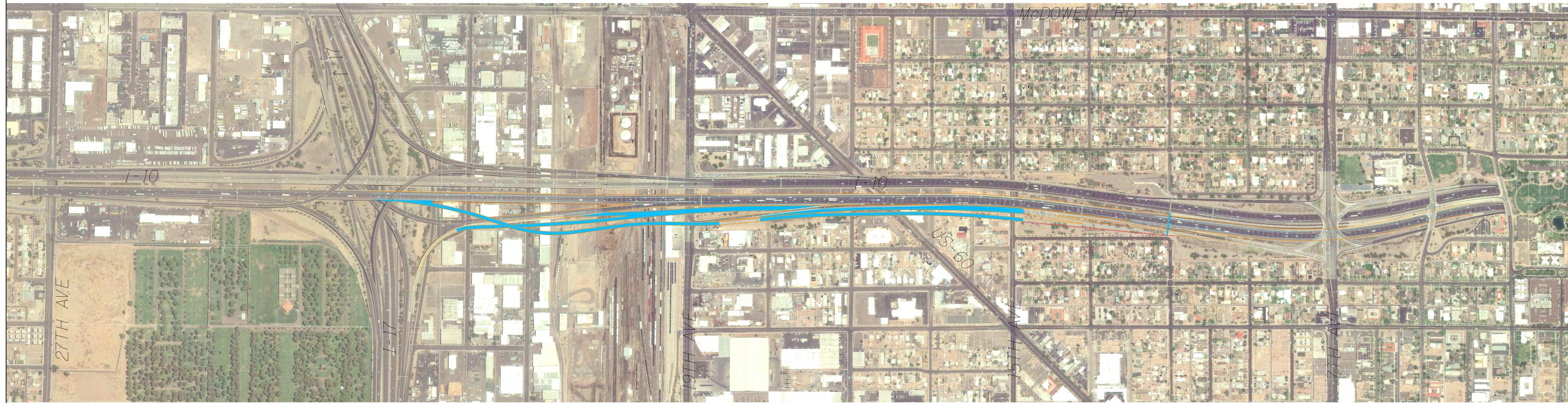


**MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
STACK TO TUNNEL
ALTERNATIVE SW1**



HDR, INC.
3200 E. CAMELBACK ROAD
SUITE 300
PHOENIX, AZ 85018-2311
TEL: (602) 522-7700

05/2017



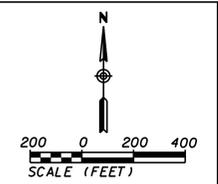
LEGEND

- Edge of Pavement

--- Sound Walls
- Retaining Walls

— Parcel Lines
- Striping

■ Bridges
- Barrier

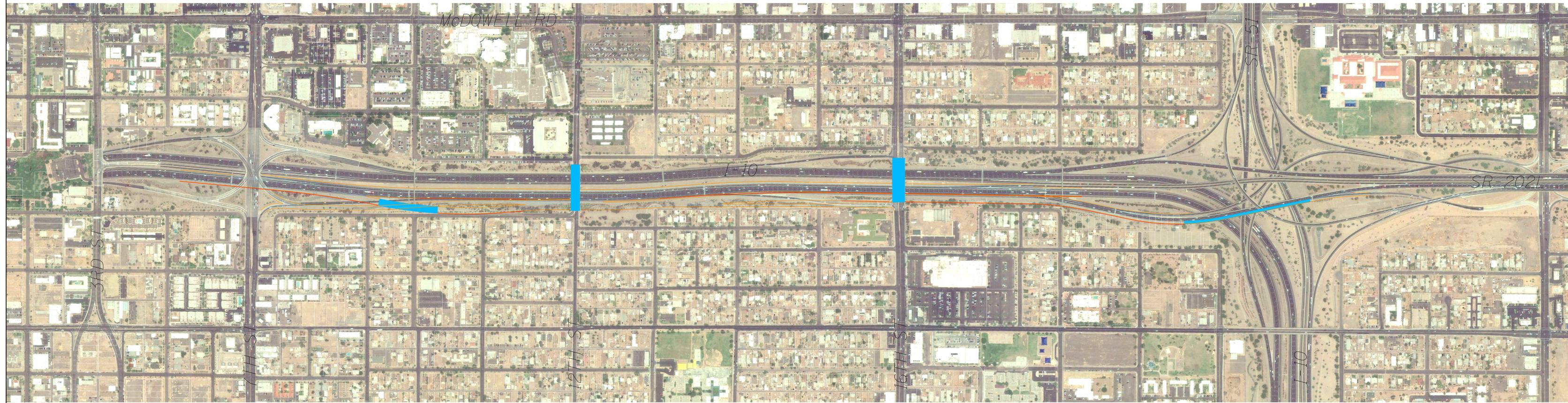


**MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
STACK TO TUNNEL
ALTERNATIVE SW2**



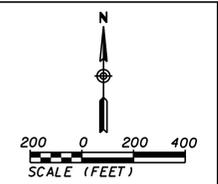
HDR, INC.
3200 E. CAMELBACK ROAD
SUITE 300
PHOENIX, AZ 85018-2311
TEL: (602) 522-7700

05/2017



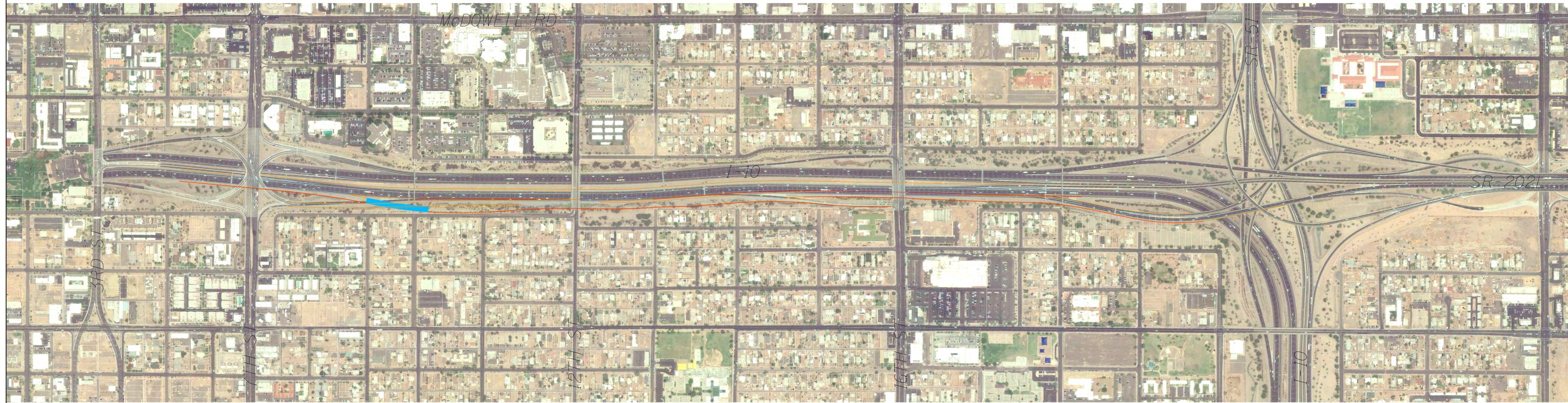
LEGEND

- | | | | | | | | |
|---|-------------------------|---|------------------------|---|-----------------|---|----------------|
|  | Edge of Pavement |  | Retaining Walls |  | Striping |  | Barrier |
|  | Sound Walls |  | Parcel Lines |  | Bridges | | |



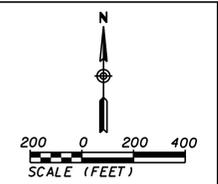
MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
TUNNEL TO MINI-STACK
ALTERNATIVE SE1

BURGESS & NIPLE **05/2017**



LEGEND

- | | | | |
|--|---|--|---|
|  Edge of Pavement |  Retaining Walls |  Striping |  Barrier |
|  Sound Walls |  Parcel Lines |  Bridges | |



MAG I-10 / PAPAGO FREEWAY TUNNEL
TRAFFIC OPERATIONS STUDY
TUNNEL TO MINI-STACK
ALTERNATIVE SE2
BURGESS & NIPLE **05/2017**

APPENDIX C

Conceptual Alternatives Itemized Cost Opinions

I-10/Papago Freeway Tunnel Traffic Operations Study
I-17 Stack to SR-51/SR-202L Mini Stack
Appendix C

Series	Items	Unit	Unit Cost	NW1		NW2		NE1		NE2		SW1		SW2		SE1		SE2	
				Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost	Qty	Segment Cost
200	Bridge Removal	EA	\$ 125,000	0	\$ -	0	\$ -	4	\$ 500,000	3	\$ 375,000	0	\$ -	0	\$ -	4	\$ 500,000	1	\$ 125,000
	Pavement Removal	SY	\$ 15	10,700	\$ 160,500	6,100	\$ 91,500	76,056	\$ 1,140,840	76,056	\$ 1,140,840	6,150	\$ 92,250	7,200	\$ 108,000	83,130	\$ 1,246,950	83,130	\$ 1,246,950
	Earthwork	CY	\$ 10	100,000	\$ 1,000,000	100,000	\$ 1,000,000	200,000	\$ 2,000,000	200,000	\$ 2,000,000	100,000	\$ 1,000,000	100,000	\$ 1,000,000	200,000	\$ 2,000,000	200,000	\$ 2,000,000
	Contingency and Unidentified Items	LS	30%	1	\$ 348,150	1	\$ 327,450		\$ 1,092,252		\$ 1,054,752	1	\$ 327,675	1	\$ 332,400		\$ 1,124,085		\$ 1,011,585
300 / 400	New PCCP w/base & AR	SY	\$ 40	21,400	\$ 856,000	12,200	\$ 488,000	132,829	\$ 5,313,142	122,114	\$ 4,884,556	12,300	\$ 492,000	14,400	\$ 576,000	134,807	\$ 5,392,271	119,884	\$ 4,795,355
	New AC w/ base	SY	\$ 35	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Rehab Pavement	SY	\$ 10	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Contingency and Unidentified Items	LS	15%	1	\$ 128,400	1	\$ 73,200		\$ 796,971		\$ 732,683	1	\$ 73,800	1	\$ 86,400.00		\$ 808,841		\$ 719,303
500	Drainage on-site (Reconstruct)	LS	\$ 1,500,000	0	\$ -	0	\$ -	1	\$ 1,500,000	1	\$ 1,500,000	0	\$ -	0	\$ -	1	\$ 1,500,000	1	\$ 1,500,000
	Drainage on-site (Retrofit)	LS	\$ 500,000	1	\$ 500,000	1	\$ 500,000		\$ -		\$ -	1	\$ 500,000	1	\$ 500,000	0	\$ -	0	\$ -
	Drainage off-site	LS	Varies	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 5,000,000	1	\$ 5,000,000	1	\$ 500,000	1	\$ 500,000	1	\$ 5,000,000	1	\$ 5,000,000
	Pump Station Improvements	LS	Varies	0	\$ -	0	\$ -	1	\$ 8,000,000	1	\$ 1,500,000	0	\$ -	0	\$ -	1	\$ 1,500,000	1	\$ 1,500,000
	Contingency and Unidentified Items	LS	30%		\$ 450,000	1	\$ 450,000	1	\$ 4,350,000	1	\$ 2,400,000	1	\$ 300,000	1	\$ 300,000	1	\$ 2,400,000	1	\$ 2,400,000
600	New/Widen Bridges	SF	\$ 200	173,800	\$ 34,760,000	172,200	\$ 34,440,000	83,259	\$ 16,651,800	79,935	\$ 15,987,000	225,823	\$ 45,164,600	351,368	\$ 70,273,600	88,335	\$ 17,667,000	0	\$ -
	Rehab Bridges	LS	Varies	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Three-Sided Box	SF	\$ 150	0	\$ -	0	\$ -	28,695	\$ 4,304,250	14,555	\$ 2,183,250	0	\$ -	0	\$ -	27,534	\$ 4,130,100	24,014	\$ 3,602,100
	Contingency and Unidentified Items	LS	10%	1	\$ 3,476,000	1	\$ 3,444,000	1	\$ 2,095,605	1	\$ 1,817,025	1	\$ 4,516,460	1	\$ 7,027,360	1	\$ 2,179,710	1	\$ 360,210
700	MOT (high)	LS	\$ 7,000,000	1	\$ 7,000,000	1	\$ 7,000,000	0	\$ -	0	\$ -	1	\$ 7,000,000	1	\$ 7,000,000	0	\$ -	0	\$ -
	MOT (low)	LS	\$ 5,000,000	0	\$ -	0	\$ -	1	\$ 5,000,000	1	\$ 5,000,000	0	\$ -	0	\$ -	1	\$ 5,000,000	1	\$ 5,000,000
	Sign/Stripe/Light (Reconstruct)	LS	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000	1	\$ 1,500,000
	Sign/Stripe/Light (Retrofit)	LS	\$ 500,000	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Existing FMS Modifications	LS	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000	1	\$ 500,000
	New ITS	LS	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000	1	\$ 3,500,000
	Tolling Infrastructure	LS	\$ 600,000	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Contingency and Unidentified Items	LS	30%	1	\$ 3,750,000	1	\$ 3,750,000	1	\$ 3,150,000	1	\$ 3,150,000	1	\$ 3,750,000	1	\$ 3,750,000	1	\$ 3,150,000	1	\$ 3,150,000
800	Landscaping	LS	Varies	1	\$ 250,000	1	\$ 250,000	1	\$ 500,000	1	\$ 500,000	1	\$ 250,000	1	\$ 250,000	1	\$ 500,000	1	\$ 500,000
	Utilities	LS	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000
	Contingency and Unidentified Items	LS	40%	1	\$ 500,000	1	\$ 500,000	1	\$ 600,000	1	\$ 600,000	1	\$ 500,000	1	\$ 500,000	1	\$ 600,000	1	\$ 600,000
900	Retaining Walls (Assume H(avg)=15')	LF	\$ 825	3,348	\$ 2,762,100	1,440	\$ 1,188,000	10,210	\$ 8,423,250	10,282	\$ 8,482,650	1,938	\$ 1,598,850	1,900	\$ 1,567,500	8,030	\$ 6,624,750	7,240	\$ 5,973,000
	Sound Walls (Assume H(avg)=15')	LF	\$ 525	4,095	\$ 2,149,875	2,045	\$ 1,073,625	3,670	\$ 1,926,750	3,670	\$ 1,926,750	1,324	\$ 695,100	1,410	\$ 740,250	3,008	\$ 1,579,200	3,008	\$ 1,579,200
	Roadway Appurtences (High)	LS	\$ 1,000,000	0	\$ -	0	\$ -	1	\$ 1,000,000	1	\$ 1,000,000	0	\$ -	0	\$ -	1	\$ 1,000,000	1	\$ 1,000,000
	Roadway Appurtences (Low)	LS	\$ 500,000	1	\$ 500,000	1	\$ 500,000	0	\$ -	0	\$ -	1	\$ 500,000	1	\$ 500,000	0	\$ -	0	\$ -
	New Bike / Ped Bridges	EA	\$ 1,250,000	1	\$ 1,250,000	1	\$ 1,250,000	2	\$ 2,500,000	2	\$ 2,500,000	1	\$ 1,250,000	1	\$ 1,250,000	2	\$ 2,500,000	2	\$ 2,500,000
	Bike / Ped TI Upgrades	LS	\$ 500,000	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
	Contingency and Unidentified Items	LS	20%	1	\$ 1,332,395	1	\$ 802,325	1	\$ 2,770,000	1	\$ 2,781,880	1	\$ 808,790	1	\$ 811,550	1	\$ 2,340,790	1	\$ 2,210,440
				Subtotal:	\$ 68,673,420	Subtotal:	\$ 64,628,100	Subtotal:	\$ 85,114,861	Subtotal:	\$ 73,016,386	Subtotal:	\$ 75,819,525	Subtotal:	\$ 103,573,060	Subtotal:	\$ 75,243,697	Subtotal:	\$ 53,273,143
Other	Mobilization	LS	8%	1	\$ 5,493,874	1	\$ 5,170,248	1	\$ 6,809,189	1	\$ 5,841,311	1	\$ 6,065,562	1	\$ 8,285,844.80	1	\$ 6,019,496	1	\$ 4,261,851
	Construction Engineering	LS	9%	1	\$ 6,180,608	1	\$ 5,816,529	1	\$ 7,660,337	1	\$ 6,571,475	1	\$ 6,823,757	1	\$ 9,321,575.40	1	\$ 6,771,933	1	\$ 4,794,583
	Contractor Quality/Survey	LS	3%	1	\$ 1,716,836	1	\$ 1,615,703	1	\$ 2,127,872	1	\$ 1,825,410	1	\$ 1,895,488	1	\$ 2,589,326.50	1	\$ 1,881,092	1	\$ 1,331,829
	Construction Contingency	LS	5%	1	\$ 3,433,671	1	\$ 3,231,405	1	\$ 4,255,743	1	\$ 3,650,819	1	\$ 3,790,976	1	\$ 5,178,653.00	1	\$ 3,762,185	1	\$ 2,663,657
	Enviromental Mitigation	LS	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000	1	\$ 1,000,000
	Design	LS	8%	1	\$ 5,493,874	1	\$ 5,170,248	1	\$ 6,809,189	1	\$ 5,841,311	1	\$ 6,065,562	1	\$ 8,285,844.80	1	\$ 6,019,496	1	\$ 4,261,851
	ROW	Acre	\$ 2,000,000	0	\$ -	0	\$ -	2.0	\$ 4,085,675	0.6	\$ 1,244,215	5.5	\$ 11,000,000	7.5	\$ 15,000,000	1.1	\$ 2,132,002	1.1	\$ 2,132,002
				Subtotal:	\$ 91,992,282	Subtotal:	\$ 86,632,233	Subtotal:	\$ 117,862,865	Subtotal:	\$ 98,990,926	Subtotal:	\$ 112,460,871	Subtotal:	\$ 153,234,305	Subtotal:	\$ 102,829,900	Subtotal:	\$ 73,718,917
ICAP		LS	8.36%	1	\$ 7,690,555	1	\$ 7,242,455	1	\$ 9,853,336	1	\$ 8,275,641	1	\$ 9,401,729	1	\$ 12,810,388	1	\$ 8,596,580	1	\$ 6,162,901
				Total:	\$ 99,682,836	Total:	\$ 93,874,687	Total:	\$ 127,716,201	Total:	\$ 107,266,568	Total:	\$ 121,862,599	Total:	\$ 166,044,692	Total:	\$ 111,426,480	Total:	\$ 79,881,818

APPENDIX D

Summary of Comments

REVIEW COMMENT FORM
 I-10/Papago Freeway Tunnel Traffic Operations Study

RE: I-10/Papago Freeway Tunnel Traffic Operations Study	DATE: 6/20/2017
SEGMENT: I-10, I-17 Stack to SR-51/SR-202L Mini Stack	RETURN DATE: 6/27/2017
REVIEWER: Eric Anderson (MAG)	
SUBMITTAL : Draft Conceptual Alternatives Study Report	
MAG PROJECT MANAGER: Quinn Quihui Castro, PE	CONSULTANT: Burgess & Niple, Inc. PROJECT MANAGER: Jason Pagnard, PE

CODES: A = Complied; B = Complied, but Modified; C = Could Not Comply (Response Required); D = Not Applicable

NO.	PAGE	COMMENT	CODE	RESPONSE
1	N/A	One of the issues that we have not addressed is the L202 to SR-51 and L202 to I-10 east which both cause substantial backups and crashes.	A	Comment noted. Section 5.0 Recommendations and Development Considerations was revised to include the investigation of the westbound SR-202L to I-10 eastbound and SR-51 northbound for future study.
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REVIEW COMMENT FORM
I-10/Papago Freeway Tunnel Traffic Operations Study

RE: I-10/Papago Freeway Tunnel Traffic Operations Study	DATE: 6/20/2017
SEGMENT: I-10, I-17 Stack to SR-51/SR-202L Mini Stack	RETURN DATE: 6/27/2017
REVIEWER: Scott Beck (ADOT)	
SUBMITTAL : Draft Conceptual Alternatives Study Report	
MAG PROJECT MANAGER: Quinn Quihui Castro, PE	CONSULTANT: Burgess & Niple, Inc. PROJECT MANAGER: Jason Pagnard, PE

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NO.	PAGE	COMMENT	CODE	RESPONSE
1	General	The study only looked at major roadway reconfiguration. No ITS/technology related options were investigated or discussed in the report.	B	Comment noted. Section 5.0 Recommendations and Development Considerations includes ITS investigation for the next phase of study.
2	General	While the alternatives were developed to address deficiencies along the corridor, recommendations and conclusions within the report were based on perceived benefits rather than analysis. Further study will be needed to factually compare alternatives.	B	Comment noted. Section 5.0 Recommendations and Development Considerations includes detailed, quantitative evaluations for the next phase of study.
3	General	It is recommended that clearer graphics be provided in Figures 1, 2, 3, and 4 for the final copy of the report. Those displays were extremely difficult to read in the copy of the report that was provided.	A	
4	Specific	The TSM&O Operational Traffic and Safety Group concurs with the recommendations make for the following Quadrants: Southeast (Option 1), Northwest (Option 1), and Southwest (Option 1).	A	Comment noted.

NO.	PAGE	COMMENT	CODE	RESPONSE
5	Specific	<p>For the Northeast Quadrant, staff recommends Option 1 from an operations standpoint. The evaluation matrix scores Option 2 higher in the operational categories but Option 2 introduces two merge conditions on mainline 1-10 whereas Option 1 only has one. In addition, Option 1 provides a 2-lane exit for 7th Street which is one of the heaviest movements. Option 1 also reduces the likelihood of SR-51 traffic attempting to merge and exit on the left-hand 3rd St HOV exit. Both options lack a 7th Street connection from SR-51 which is one of the highest destinations based on the O/D graphic.</p>	B	<p>Comment noted. Both NE1 and NE2 will be recommended for additional investigation. The changing of the SR-51 to 7th Street access was identified in the report and recommended for further investigation as potential inclusion through concept geometric refinements (to restore) or via surface streets (alternative route). Section 5.0 Recommendations and Development Considerations recommends a traffic operations analysis to include McDowell Road to account for this movement.</p>
6	Specific	<p>The Study does not address operations within the tunnel. The existing roadway configuration has on- and off-ramps within the tunnel serving 7th Street and 7th Avenue. These ramps and the associated decision-making occur within a tunnel environment in addition to horizontal alignment changes and high volumes. As part of this study, it is suggested that the interchanges of 7th Street and 7th Avenue be reviewed for possible conversion to half interchanges. The elimination of the ramps to/from the tunnel would rely on the local network but would improve the freeway operations. Eliminating the 7th Street WB on-ramp and the 7th Avenue EB on-ramp would benefit the proposed Northeast and Southwest Quadrant options respectively by allowing the SR-51 lanes and 1-17 lanes to be add lanes rather than a significant merge configuration. In addition, the proposed Northwest and Southeast Quadrant options move major decision-making points related to the system interchanges (SR-51/L202, 1-17) closer to the tunnel. More lane changing will likely occur within the tunnel and more signing and information will be needed prior to and within the tunnel. Removing the 7th Street EB off-ramp and the 7th Avenue WB off-ramp would reduce the number of decisions made within the tunnel environment. The remaining 7th Street and 7th Avenue interchange ramps will increase in volume due to the necessary rerouting but most proposed options provide significantly increased ramp capacity and length.</p>	B	<p>Regarding the suggested half/split traffic interchanges at 7th Avenue and 7th Street, comment noted. This can be a point of discussion with the Planning Partners during next study phases at which time more detailed information will be available.</p> <p>Regarding lane changes and signing, Section 5.0 Recommendations and Development Considerations includes geometric refinements and preparing a signing plan for the next phase of study to investigate these concerns.</p>

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RE: I-10/Papago Freeway Tunnel Traffic Operations Study	DATE: 6/20/2017
SEGMENT: I-10, I-17 Stack to SR-51/SR-202L Mini Stack	RETURN DATE: 6/27/2017
REVIEWER: Mark Poppe (ADOT)	
SUBMITTAL : Draft Conceptual Alternatives Study Report	
MAG PROJECT MANAGER: Quinn Quihui Castro, PE	CONSULTANT: Burgess & Niple, Inc. PROJECT MANAGER: Jason Pagnard, PE

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NO.	PAGE	COMMENT	CODE	RESPONSE
1		You may want to reconsider the title of the study. It is not a study of the tunnel and is not, in my view, an traffic operations study. It seems to be a geometric design concept alternatives study. A traffic operations study aims to quantify changes in traffic operations in terms of travel time delay and travel time reliability. In order to assess travel time reliability, the analysis would also need to quantify expected crash frequency - for crashes are a major source of non-recurring delay on I-10, between 35th Ave the Mini Stack.	B	Comment noted. Section 5.0 Recommendations and Development Considerations includes detailed traffic operations analysis for the next phase of study.

NO.	PAGE	COMMENT	CODE	RESPONSE
2	(Page 29 of 29)	<p>It seems that one of the next steps should also be to quantify the expected change in crash frequency associated with the recommended alternative. This could be done by applying the methodology (from Chapter 18 of the Highway Safety Manual) used in the 2015 Safety Study referenced on page 6 of 29. I recommend the existing and projected safety performance for affected ramps and interchanges also be assessed. Ramp and interchange analysis would need to apply the methodology found in Chapter 19 of the Highway Safety Manual. The FHWA developed ISATe or IHSDM programs could be used to perform the analysis. The expected change in crash frequency and severity could then be used to develop a quantitative estimate of expected changes in travel time and travel time reliability. I believe this analysis could be done using the tools developed under the SHRP2 Reliability Research. You may wish to reach out to Christopher Kinzel (HDR) who was involved in some of the Reliability Research – in particular LO7 – “Identification and Evaluation of the Cost-Effectiveness of Highway Design Features to Reduce Nonrecurrent Congestion.” It seems that this type of quantification of safety and mobility will be needed to support any change of access report that may be required. I believe one may be needed. More importantly... As good stewards of tax dollars, it would seem that if we are going to contemplate spending \$430 million to improve the operation of a 3-4 mile stretch of roadway, then we should spend (maybe) one-tenth of one percent of this amount to actually quantify the expected safety and mobility benefits for our ultimate customer - the road user.</p>	A	Comment noted. Section 5.0 Recommendations and Development Considerations was revised to reference the safety analysis.
3				

REVIEW COMMENT FORM
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RE: I-10/Papago Freeway Tunnel Traffic Operations Study	DATE: 6/20/2017
SEGMENT: I-10, I-17 Stack to SR-51/SR-202L Mini Stack	RETURN DATE: 6/27/2017
REVIEWER: Eunice Chan (FHWA)	
SUBMITTAL : Draft Conceptual Alternatives Study Report	
MAG PROJECT MANAGER: Quinn Quihui Castro, PE	CONSULTANT: Burgess & Niple, Inc. PROJECT MANAGER: Jason Pagnard, PE

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NO.	PAGE	COMMENT	CODE	RESPONSE
1	2	Origin/Destination labels are hard to read on these figures. Particularly, when cross referencing with the 8 alternatives.	A	
2	11	New right-of-way is will be needed south of Culver Street and Willetta Street for the SR-51 on-ramp.	A	
3	12	NE24 adds an HOV lane from the SR-202L DHOV on-ramp and to the 3rd Street DHOV off-ramp.	A	
4	14	I-10 EB Off-ramp	A	
5	28	Qualitative methodology may be too simplified to capture the analysis behind which conceptual alternative to recommend for further investigation. Ex. While one option may reduce more weave/movements than another, is the movement the second option eliminates larger/heavier than the movements eliminated by the first?	B	Section 5.0 Recommendations and Development Considerations identifies the need to complete a quantitative analysis to move beyond the feasibility level of analysis that was completed as part of this study. The narrative was revised to include: "Other alternatives may be developed during the formal scoping phase of the ADOT project development process." The narrative in Section 6.0 Conclusion was revised to read: "This Study's recommendations are conceptual in nature and other alternatives may be developed in future steps. The formal scoping phase of the ADOT project development process will need to be completed, including required local, state, and federal agencies approvals."
6	28	How was the +/- determined for this column? Travel Time/Reliability did not appear to be part of the advantage/disadvantage discussion for each option.	B	Travel time/reliability was determined using qualitative engineering judgement based on perceived improvements considering available traffic volume data.

NO.	PAGE	COMMENT	CODE	RESPONSE
7	28	NE1 Reduction in Weaving: How is this a disadvantage? Pg 11 discusses eliminating weave from I-10WB mainline which is the same advantage as NE2.	A	NE1 was marked as an advantage.
8	28	NE2 Reduction in Weaving: One of the disadvantages for NE2 is the multiple lane weave from SR-51 to the 3rd st DHOV off-ramp. This movement is eliminated in NE1.	A	NE2 was marked a disadvantage. See comment response #7.
9	28	NE1 ROW Impacts: Advantage/Disadvantage does not particularly capture quantifiable values such as ROW and cost. Suggest inputting the values directly in this table. Ex. 2.0 ac.	A	
10	28	NE2 ROW Impacts: 0.6 ac	A	
11	28	NE1 Project Cost Opinion: \$128M How is a cost disadvantage determined?	A	Table 1 was revised to show right-of-way and cost values.
12	28	NE1 Project Cost Opinion: 108M	A	
13	28	NW2 Reduction in Weaving: Why is this a disadvantage when it eliminates the existing I-10 WB lane drop under the 7th ave bridge as well as barrier separates the I-10 WB mainline and the I-10 CD road?	B	Conceptual alternative qualitative scoring was based on a comparison of the alternatives within a quadrant. The intent was to identify which alternative is likely to perform better than the other and not an overall indication of how well an alternative performed against the no-build condition. While it might not be a disadvantage, it was labeled as such as a comparison to NW1.
14	28	NW1 ROW Impacts: 0 ac	A	
15	28	NW2 ROW Impacts: 0 ac	A	
16	28	NW1 Project Cost Opinion: \$100M Why are these both labeled as neutral? One is \$8M more than the other. Is there a \$ threshold difference that triggers the +/-?	A	See comment response #11.
17	28	NW2 Project Cost Opinion: \$92M	A	
18	28	SW2 Reduction in Weaving: See pg 20 and 22. Both options address weave.	C	SW1 prohibits the weaves from I-17 and 19th Avenue to the 5th Avenue/3rd Avenue DHOV. SW2 prohibits the weave from 19th Avenue, but does not prohibit the weave from I-17. SW1 was scored as an advantage. See comment response #13.

NO.	PAGE	COMMENT	CODE	RESPONSE
19	28	SW1 ROW Impacts: 5.5 ac	A	
20	28	SW2 ROW Impacts: 7.5 ac	A	
21	28	SW1 Project Cost Opinion: \$122M	A	
22	28	SW2 Project Cost Opinion: \$166M While this option is higher in cost, the largest contributor to cost (construction of new bridge area) is the same for both options.	A	Comment noted. See comment response #13.
23	28	SE2 Reduction in Weaving: SE2 contains all weaving movements between 7th st, 16th st, and SR51/SR202 within the CD road.	B	Both options contain all weaving movements within the C-D road, although SE2 is striped better for direct access to 16th Street and 24th Street. See comment response #13.
24	28	SE1 ROW Impacts: 1.1 ac	A	
25	28	SE1 ROW Impacts: 1.1 ac	A	
26	28	SE1 Project Cost Opinion: 112 M. Largest contributions to cost are the same for both options (replacing or widening bridges).	A	Comment noted. See comment response #13.
27	28	SE1 Project Cost Opinion: \$78 M	A	

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SEGMENT: I-10, I-17 Stack to SR-51/SR-202L Mini Stack	RETURN DATE: 6/27/2017
REVIEWER: Thomas Remes (City of Phoenix)	
SUBMITTAL : Draft Conceptual Alternatives Study Report	
MAG PROJECT MANAGER: Quinn Quihui Castro, PE	CONSULTANT: Burgess & Niple, Inc. PROJECT MANAGER: Jason Pagnard, PE

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NO.	PAGE	COMMENT	CODE	RESPONSE
1	1	Add a sentence indicating that the study is technical in nature, that there will be opportunities for public involvement, and that recommendations are subject to change.	A	Sentence was added to Section 1.0 Introduction.
2	General	For all figures, can the report provide 'keys' for graphics?	B	Figures 6 through 21 are excerpts of the roll plots that are included in Appendix B. Each roll plot has a legend defining the various line styles shown on the figures. The narrative was revised to clarify this point.
3	General	As a side note: Exhibits should be expanded to match the scope of the analysis and presented more clearly for review.	A	Roll plots exhibiting the full extents of the conceptual alternatives are included in Appendix B. See comment response #1.
4	General	Label main line, off ramp approaches, etc.	A	Labels were added.
5	General	Add a legend and improvement call outs. It is very difficult to tell what the map is trying to show and what are new improvements or modifications.	A	See comment response #1 and #2 above.
6	General	All improvement cost estimates in each quadrant should be placed in a table and itemized so a mix and match can be forwarded for implementation if not all improvements are deemed feasible.	A	Itemized cost estimates are included in Appendix C. Table 1 was revised to include the total cost opinion for each conceptual alternative.
7	11 and 13	Vehicles from SR-51 destined for downtown Phoenix will be directed to the SR-51/McDowell Road TI, and I-10/Washington TI. Will the direct connection from SR-51 southbound to the I-10 westbound be eliminated?	A	The SR-51 to I-10 westbound will not be eliminated; the narrative was clarified.

NO.	PAGE	COMMENT	CODE	RESPONSE
8	NE2	<p>Recommendation calls for eliminating access to 7th Street with traffic diverted to McDowell for Downtown access:</p> <p>Comment: McDowell currently operates with 2 westbound lanes. Additional analysis of McDowell corridor and improvements as a result of increased capacity should be considered prior to final comment. Redevelopment activity may play a key role in the future of McDowell Road.</p>	B	<p>Comment noted. The changing of the SR-51 to 7th Street access was identified in the report and recommended for further investigation as potential inclusion through concept geometric refinements (to restore) or via surface streets (alternative route). Section 5.0 Recommendations and Development Considerations recommends a traffic operations analysis to include McDowell Road to account for this movement.</p>
9	NE1	<p>Has modeling been done of the impacts to McDowell Road for this new configuration? This will likely increase congestion in the McDowell corridors and at key intersections considerably causing downtown travel time delay.</p>	B	<p>Comment noted. Section 5.0 Recommendations and Development Considerations includes detailed traffic operations analysis, including modeling, for the next phase of study. See comment response #7.</p>
10	Pedestrian Bridges	<p>Can the report provide additional information on what 'Two pedestrian bridges will be impacted' means?</p>	A	<p>Narrative was revised to indicate which pedestrian bridges may be impacted per alternative. Impacted assumes the replacement/reconstruction of the pedestrian bridge, pending additional investigation and refinements. Bridge replacement/reconstruction was included in the cost estimates.</p>
11	Pedestrian Bridges	<p>The pedestrian bridges on SR-51 @ Oak Street, I-10 @ 11th Avenue, I-10 @ 10th Street are major safety features in the pedestrian and bicycle network for the City of Phoenix. They should not be removed. If it is suggested that they are removed, new bridges should be added with coordination of Phoenix staff to properly locate them so the Title VI neighborhoods are not negatively impacted. Please see Title VI reports from MAG.</p>	B	<p>Comment noted. The study assumes pedestrian bridge replacement/reconstruction. Section 5.0 Recommendations and Development Considerations was revised to include coordination with the City of Phoenix to address potential impacts and accommodations for pedestrian (and bicycle) freeway crossings. See comment response #9.</p>
12	Pedestrian Bridges	<p>Major environmental justice concerns with impacts on churches and property takes in specific communities.</p>	B	<p>Comment noted. Section 5.0 Recommendations and Development Considerations includes conducting an environmental overview to consider potential impacts.</p>
13	Pedestrian Bridges	<p>Does this mean the pedestrian bridges will be removed? Which bridges in particular. Have alternatives for impacted bridge replacement been considered? it is not feasible to remove bridges because they serve as key connective nodes for Bicycle and Pedestrian corridors throughout the City, including existing and proposed programmed improvements.</p>	B	<p>See comment responses #9 and #10.</p>

NO.	PAGE	COMMENT	CODE	RESPONSE
14	Bridges	12th Street is a complete street corridor that provides a low-stress bus, pedestrian, bicycle, and vehicle N/S corridor in the Central City, and it also provides access to a regional hospital and employer. It is recommended that 12th Street bridge continues to contain all elements noted above.	A	Comment noted. The NE1 and NE2 narratives were revised to incorporate this comment.
15	Pedestrian Bridges	Potential to add a bike/pedestrian bridge on 11th Street/I-10 for direct connection from Banner Hospital.	B	Comment noted. See comment response #9 and #10.
16	Pedestrian Bridges	Potential to add a bike/pedestrian bridge on 7th Street/Willetta to create a safe crossing for a ped/bike corridor on Willetta connecting banner with the Downtown Bio-campus.	B	Comment noted. See comment response #9 and #10.
17	Public Transit	No impacts to public transit operations were cited by the Public Transit Department.	A	Comment noted.
18	Next Steps	As part of the next steps with a Traffic Simulation exercise, it is suggested to closely look at the traffic impact to Thomas Road and McDowell. The results need to be taken into consideration when deciding on freeway alternatives.	A	Comment noted. Section 5.0 Recommendations and Development Considerations recommends a traffic operations analysis to include McDowell Road and possibly Thomas Road.
19	Next Steps	For public outreach, specifically related to possible ROW takes and impacts to neighborhoods, please consider using information from the Title VI report, and utilize neighborhood meetings, bi-lingual material, etc. to receive input from potential impacted residents in addition to any online information.	A	Comment noted. Section 5.0 Recommendations and Development Considerations includes an environmental overview was revised to include the MAG Title VI and Environmental Justice Annual Report.
20	Next Steps	Besides reconfiguration of lanes, weaves, ramps, C-D roads, freeway interchanges, etc. was a speed reduction looked at? Can this be added into the simulation?	A	The I-10, 35 th Avenue to Sky Harbor Boulevard Phoenix Corridor Safety Study Final Report, conducted by ADOT and completed in June 2015, investigated speed limits in relation to safety and crashes. It recommended additional investigation for a reduction in speed limit, from 65 mph to 55 mph and the application of a variable speed limit (VSL) system. Section 5.0 Recommendations and Development Considerations was revised to clarify the inclusion of recommendations from the June 2015 study.