FHWA-AZ-EIS-19-01-D

TIER 1 ENVIRONMENTAL IMPACT STATEMENT

Draft Tier 1 Environmental Impact Statement and Preliminary Section 4(f) Evaluation

Chapter 2, Alternatives Considered

March 2019

U.S. Department of Transportation Federal Highway Administration

ADOT

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2 ALTERNATIVES CONSIDERED

This chapter discusses the alternatives development and screening process conducted to arrive at alternatives to be evaluated in detail in this Tier I Environmental Impact Statement (EIS).

For More Information On:

- Alternatives Selection Report
- Purpose and Need
- Intermountain West Corridor Study

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2.1 Recommendations from Prior Plans and Studies

Recommendations for major transportation corridors in prior plans and studies were a primary input into the initial alternatives for the Interstate 11 (I-11) Corridor. In addition to the 2014 *I-11 and Intermountain West Corridor Study* (IWCS) described in **Chapter 1** (Purpose and Need), new major (high-capacity) transportation facilities have been identified as a critical need in various statewide plans, regional transportation plans, and municipal planning documents. **Figure 2-1** (Related Planning Recommendations in I-11 Corridor Study Area) is a composite of potential freeway corridors, passenger rail corridors, and freight focus areas that are identified in various planning documents. Key plans and documents that relate to I-11 Corridor planning include:

- ***Statewide Transportation Planning Framework Program*** (Arizona Department of Transportation [ADOT] 2010) was Arizona's first multimodal vision for 2050. It considered all surface modes and fully integrated principles of Smart Growth, environmental stewardship, responsible economic growth, and Tribal participation to address projected population growth and collaboratively identify priorities and strategies for meeting infrastructure needs as part of a comprehensive 2050 vision. A new interstate corridor (I-11) is shown extending from Pinal County to the Arizona-Nevada state line, traversing the Phoenix metropolitan area to the south and west and utilizing the United States (US) 93 corridor to the Hoover Dam Bypass. The potential to accommodate express bus (or other high-capacity transit) is illustrated along this corridor, as well as potential future high-speed rail.
- ***Arizona's Key Commerce Corridors Report*** (ADOT 2014) supports transportation improvements to enhance economic development. The report outlines six key transportation corridors "…where improvements to the transportation infrastructure support the greatest potential commercial and economic benefits." Three of the Key Commerce Corridors are located in the I-11 Corridor Study Area (Study Area) (ADOT 2014):
  - I-19 from Nogales to Tucson
  - I-10 from Tucson to Phoenix
  - I-11 from Phoenix to Las Vegas
- ***Arizona State Freight Plan*** (ADOT 2017b) is Arizona's 5-year State Freight Plan. This plan fulfills the federal requirements for state freight plans embodied in the Fixing America's Surface Transportation Act. One of the key strategies is to implement freight transportation system improvements to bolster the performance of Key Commerce Corridors, which include I-19, I-10, and I-11. In addition, improvements are intended to address the transportation performance needs of the freight sectors that drive the state's long-term economic competitiveness.

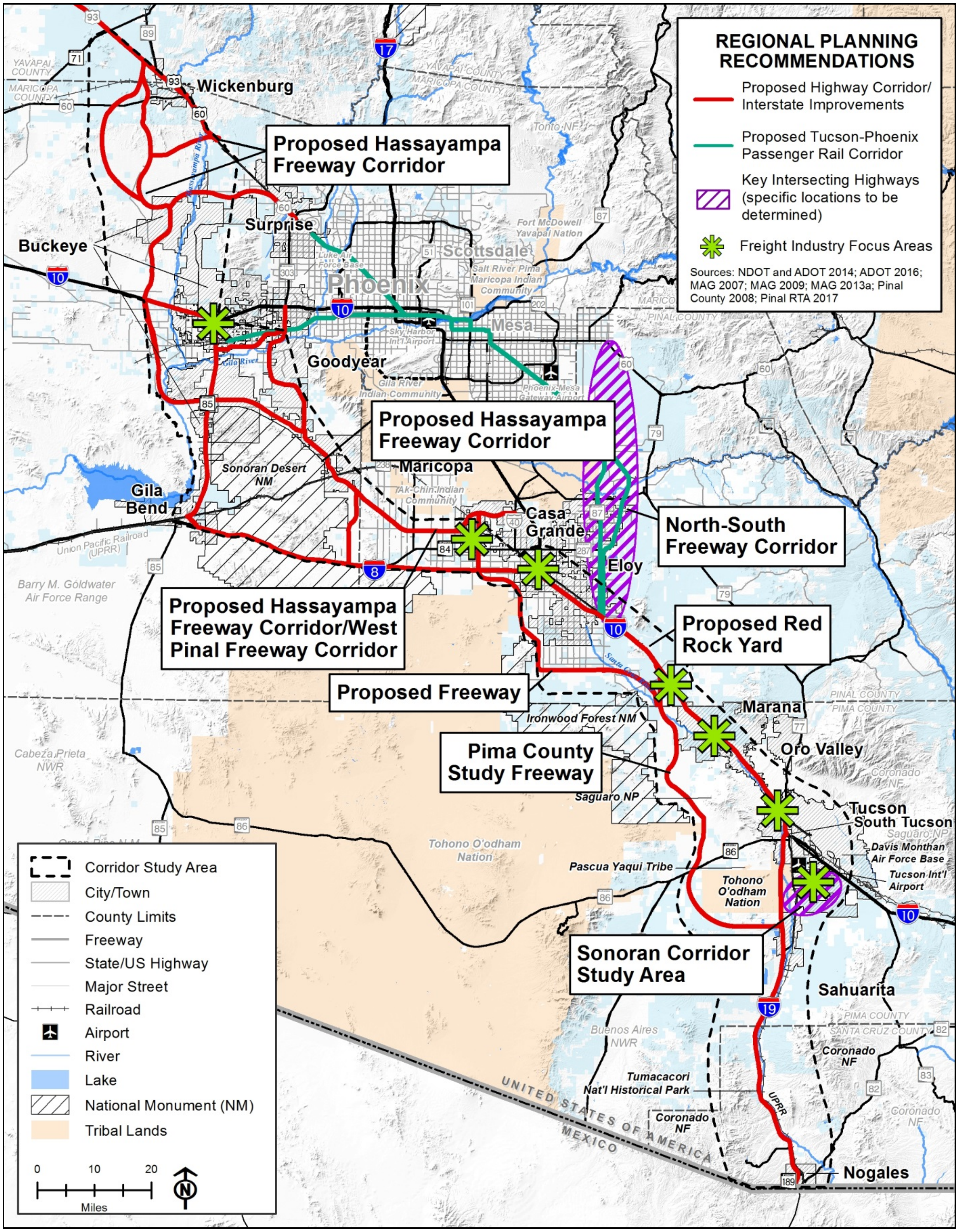


Figure 2-1 Related Planning Recommendations in I-11 Corridor Study Area

- ***Pima Association of Governments (PAG) Regionally Significant Corridors Study*** (2014) is a technical assessment of existing, planned, and proposed major transportation corridors in and around the PAG region that would achieve broad regional objectives. A regionally significant corridor is identified within the Study Area, but no specific alignment has been determined in Pima County (PAG 2014).
- ***Pinal Regional Transportation Plan*** (2017) includes a high-capacity route between the Pinal-Maricopa county line and I-8 to promote freight movement, link communities, and strengthen economic development and job growth countywide (Pinal Regional Transportation Authority 2017). This proposed West Pinal Freeway corridor has been supported as a potential I-11 route by resolutions of the cities of Maricopa and Eloy, Pinal County, and the Sun Corridor Metropolitan Planning Organization.
- ***Pinal County Regionally Significant Routes for Safety and Mobility*** (2008) provides a system of higher-capacity routes to improve safety, access, and mobility throughout the county, as well as connections to adjacent counties. These routes were formed through a partnership with federal, state, county, local, Tribal, and private stakeholders. An alternate route to I-10, which is designated as a "new corridor" and "under analysis," generally runs from I-8 to I-10 on the west, connecting Arica Road and Baumgartner Road. A map update to the *Pinal County Regionally Significant Routes for Safety and Mobility* was completed in 2017 (Pinal County 2008).
- ***Maricopa Association of Government's (MAG's) Regional Framework Studies*** established a network of freeways, parkways, and arterial streets in high-growth areas. The *I-10/Hassayampa Valley Regional Transportation Framework Study* (MAG 2007) and the *I-8 and I-10/Hidden Valley Regional Transportation Framework Study* (MAG 2009) established the Hassayampa Freeway corridor from Casa Grande to Wickenburg, which provided an alternate route to bypass the congested Phoenix metropolitan core. The Hassayampa Freeway corridor in Maricopa County would connect with the West Pinal Freeway corridor in Pinal County, as shown on **Figure 2-1** (Related Planning Recommendations in I-11 Corridor Study Area).
- ***MAG Freight Transportation Framework Study*** (MAG 2013a) described the I-11 Corridor as the "cornerstone for seamless and efficient transportation of goods, services, people, and information between Canada, Mexico, and the United States." This was a joint effort conducted on behalf of the metropolitan planning organizations spanning the Tucson to Phoenix corridor, also known as the Sun Corridor. The goal was to plan the appropriate transportation infrastructure to attract freight-related economic development by taking advantage of the Sun Corridor's prime location to serve the West Coast, Intermountain West, and Mexican deep-water ports within a day's truck drive. **Figure 2-1** (Related Planning Recommendations in I-11 Corridor Study Area) shows the freight industry focus areas that were identified in the study (MAG 2013a).
- ***ADOT and Federal Railroad Association (FRA) Passenger Rail Study*** (ADOT 2016) establishes a need for increased capacity in transportation infrastructure between Tucson and Phoenix, the two largest metropolitan areas in Arizona. The study discusses how the only existing route between Phoenix and Tucson, the I-10, experiences "severe congestion" and "traffic jams of increasing frequency and duration." A Tier 1 EIS process resulted in a Record of Decision that selected a rail corridor for passenger service to help meet the anticipated increase in demand for trips between the two urban areas (ADOT 2016).

- ***I-11 and Intermountain West Corridor Study*** **(IWCS) (2014)** was a multimodal planning effort that involved ADOT, Nevada Department of Transportation (NDOT), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), Maricopa Association of Governments (MAG), the Regional Transportation Commission of Southern Nevada (RTC), and other key stakeholders. As discussed in detail in **Chapter 1**, the IWCS evaluated likely potential routes for a new high-priority, high-capacity transportation corridor.

Additional discussion of relevant plans and projects is provided in the *Purpose and Need Memorandum* (ADOT 2017a), which can be found on the project website at i11study.com.

2.2 Alternatives Development Process

This section summarizes the alternatives development process, which narrowed down a range of suggested options to a reasonable range to carry forward for detailed evaluation in this Draft Tier 1 EIS.

2.2.1 Development of Corridor Options

The Project Team, composed of FHWA, ADOT, and their consultant team, developed a range of corridor options within the Study Area. The range of options was based on:

- **Prior Studies:** The prior studies listed above informed the study area and options. Specifically, the IWCS encompassed a broad Study Area for the Intermountain West region from Mexico to Canada and identified likely potential routes, focusing on connections within Arizona and Nevada. The IWCS evaluated a wide range of corridors from Casa Grande to Wickenburg, including options through central Phoenix. The most feasible candidates were located west of the Phoenix metropolitan area and were recommended for further study. These corridors formed the initial Corridor Options of this study. The study analyzed connection points to Mexico, including ports of entry from San Luis to Douglas, and concluded that Nogales was the best point of entry due to a reciprocal interstate-level highway and freight rail corridor in Mexico.
- **Agency Scoping Input:** The 2016 scoping process and comments are documented in the *Scoping Summary Report* (see **Appendix G**). Agencies commented on the potential Build Corridor Alternatives, opportunities or concerns, and constraint areas (ADOT 2017c). Preferences for Corridor Options were made both to advocate for staying on existing freeways (I-19, I-10, I-8, and State Route [SR] 85) as well as for supplementing the existing network with the following new proposed corridors (**Figure 2-2** [Agency Scoping Feedback on Build Corridor Alternative Preferences, 2016]):
  - Pima County west Tucson route
  - Eloy/Pinal County route west of I-10
  - West Pinal route north of I-8
  - Hassayampa Freeway route
  - SR 303L south extension west of Vulture Mountains route

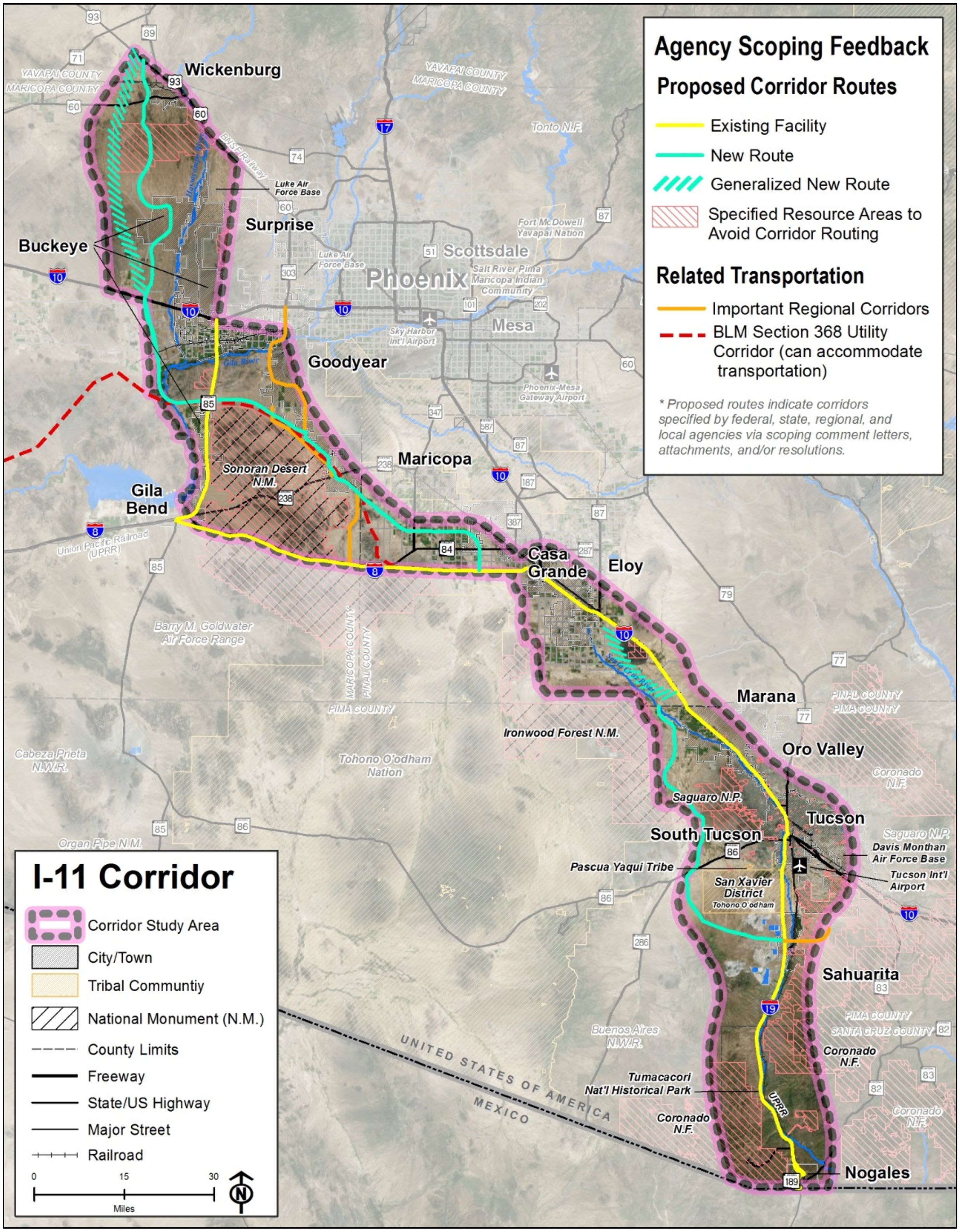


Figure 2-2 Agency Scoping Feedback on Build Corridor Alternative Preferences, 2016

Common feedback themes included:

- Ensure consistency with existing and proposed local and regional plans, environmental documents, and master-planned community plans
- Study opportunities to foster economic development
- Protect environmentally sensitive resources
- Consider wildlife connectivity between public lands and other protected open space
- Consider co-locating I-11 with existing transportation routes
- Consider supplementing the regional transportation network with new routes

- **Public Input:** During the 2016 scoping period, the public commented on potential corridors, opportunities or concerns, and constraint areas (ADOT 2017c). **Figure 2-3** (Public Scoping Feedback on Build Corridor Alternative Preferences, 2016) illustrates common themes. Red areas indicate positive support to study corridors. Red areas do not reflect exact alignments or routing; for example, the large red swath surrounding I-19 reflects a high interest in co-locating I-11 with I-19. Common feedback themes included:
  - Preferences for both improving existing freeways and interstates and constructing I-11 as a separate/new facility; desire to co-locate I-11 with other existing linear infrastructure corridors (e.g., transmission lines).
  - Concern regarding impacts to the Sonoran Desert environment.
  - Concern regarding impacts to rural communities.
  - Desire to avoid parks and conservation management areas (maintain habitat and open space), while still preserving opportunities for recreational visitor use (e.g., hiking, hunting, camping).
  - Consideration of emergency access, such as the effect of dust storms and crashes on interstate mobility.
  - Desire for economic benefits to the surrounding communities.
- **Tribal Coordination:** FHWA and ADOT met regularly with Tribal Nations who expressed interest in the project. FHWA and ADOT convened project-specific meetings with Tribal government representatives and also presented at established district or Tribal meetings. Tribal input factored into the development and evaluation of the Build Corridor Alternatives. Section 3.7 (Archeological, Historical, Architectural, Cultural Resources) provides more information on consultation under Section 106 of the National Historic Preservation Act (NHPA), and **Chapter 5** (Coordination and Outreach) provides additional details on Tribal coordination.
- **Technical Analysis:** A software tool was used to develop potential routes based on engineering design criteria, sensitive environmental resources, and topographical constraints, such as:
  - Engineering geometry should accommodate 75 miles per hour (mph) design speed; grade and other geometry inputs to meet ADOT design criteria for an interstate freeway.
  - Should be able to co-locate rail facilities in the future.

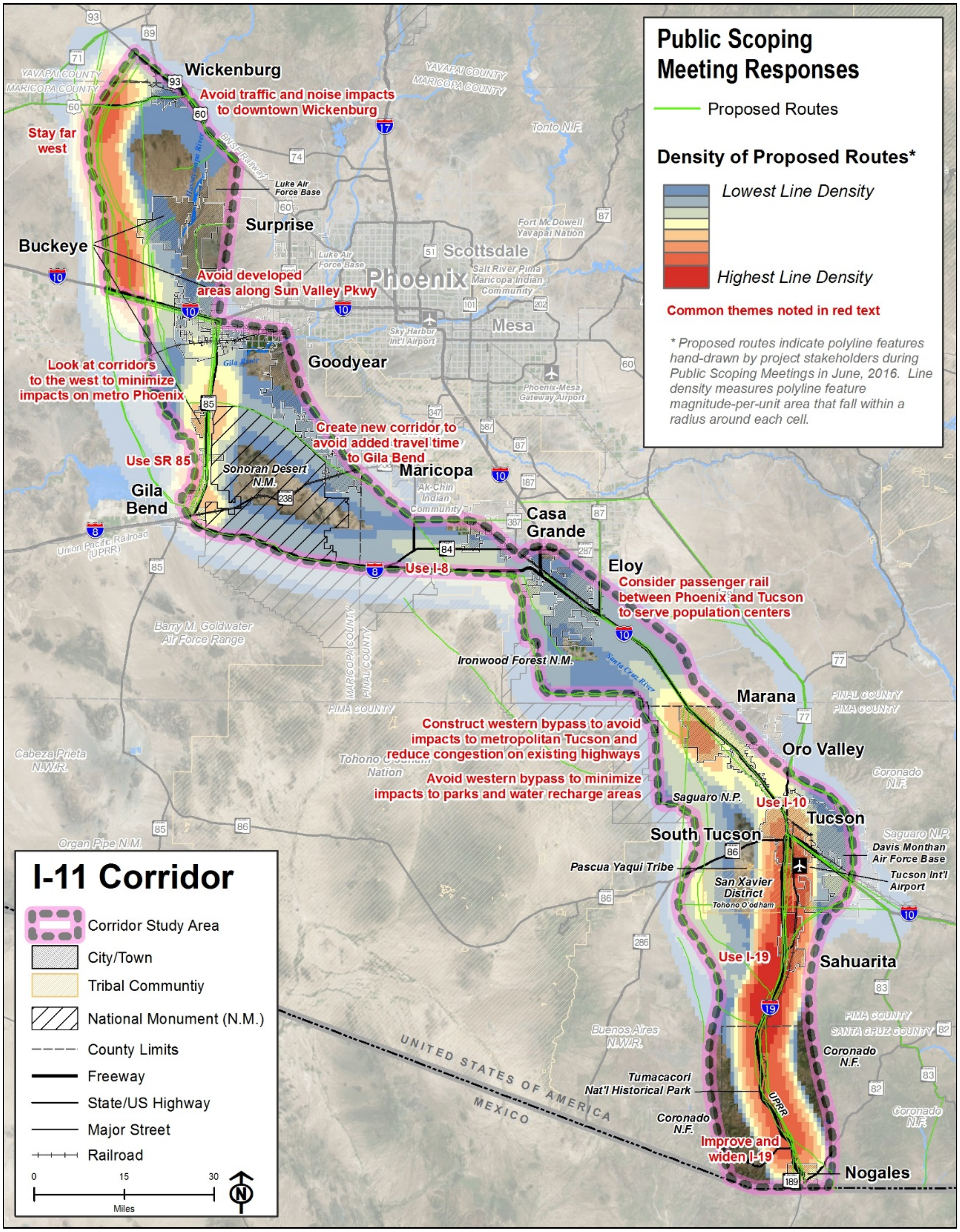


Figure 2-3 Public Scoping Feedback on Build Corridor Alternative Preferences, 2016

- Should avoid direct use of specially designated lands and protected resources, such as national parks, national monuments, wildernesses, areas of critical environmental concern, roadless areas, critical habitat, wetlands, and lakes.
- Should avoid use of Tribal community lands, which are subject to Tribal sovereignty.
- Should avoid or minimize use of Section 4(f) properties, such as publicly owned parks, recreation areas, and wildlife and waterfowl refuges. **Chapter 4** (Preliminary Draft Section 4(f) Evaluation) provides more information on Section 4(f).
- Minimize potential for construction within 100-year floodplains and floodways.
- Minimize potential to impact existing development.

2.2.2 Range of Corridor Options

The range of Corridor Options is shown on **Figure 2-4** (Range of Corridor Options). The Project Team divided the Study Area into three sections for analysis: South, Central, and North. The Project Team evaluated the initial range of Corridor Options for their ability to meet purpose and need (serve population and employment growth, improve system linkages and interstate mobility, serve economic activity centers) and to avoid sensitive environmental resources. Evaluation criteria included: Population and Employment Growth, Traffic Growth and Travel Time Reliability, System Linkages and Regional Mobility, and Homeland Security and National Defense.

In May 2017, FHWA and ADOT presented the preliminary results of the screening process to cooperating and participating agencies, Tribes, and the public at a series of agency and public information meetings. Based on the analysis and input, FHWA and ADOT eliminated certain Corridor Options from further consideration; these are shown in gray on **Figure 2-4** (Range of Corridor Options). All remaining Corridor Options were retained for further evaluation.

The Alternatives Selection Report Evaluation Methodology and Criteria Report are found at i11study.com/Arizona/Documents.asp.

Public meeting materials and the meeting summary report are available on the study website (at i11study.com/Arizona/Meetings.asp and i11study.com/Arizona/Documents.asp, respectively). They also are included in **Appendix G**.

2.2.3 Corridor Options Eliminated from Further Consideration

The following discussion describes the rationale for eliminating Options from further consideration.

Option E – FHWA eliminated Option E because it was largely duplicative of Option F and with greater potential for impacts. Options E and F achieve the same mobility goal; however, Option E has a higher potential for impacts to the Santa Cruz River and its floodplain. Option E is longer than Option F, has greater travel times, and provides no mobility or environmental benefit. Pinal County identified a similar alignment to Option E in their planning documents, and indicated their intent was to have flexibility in the general location of the alignment. FHWA concluded that Options E and F met local planning goals equally; therefore, Option E was eliminated.

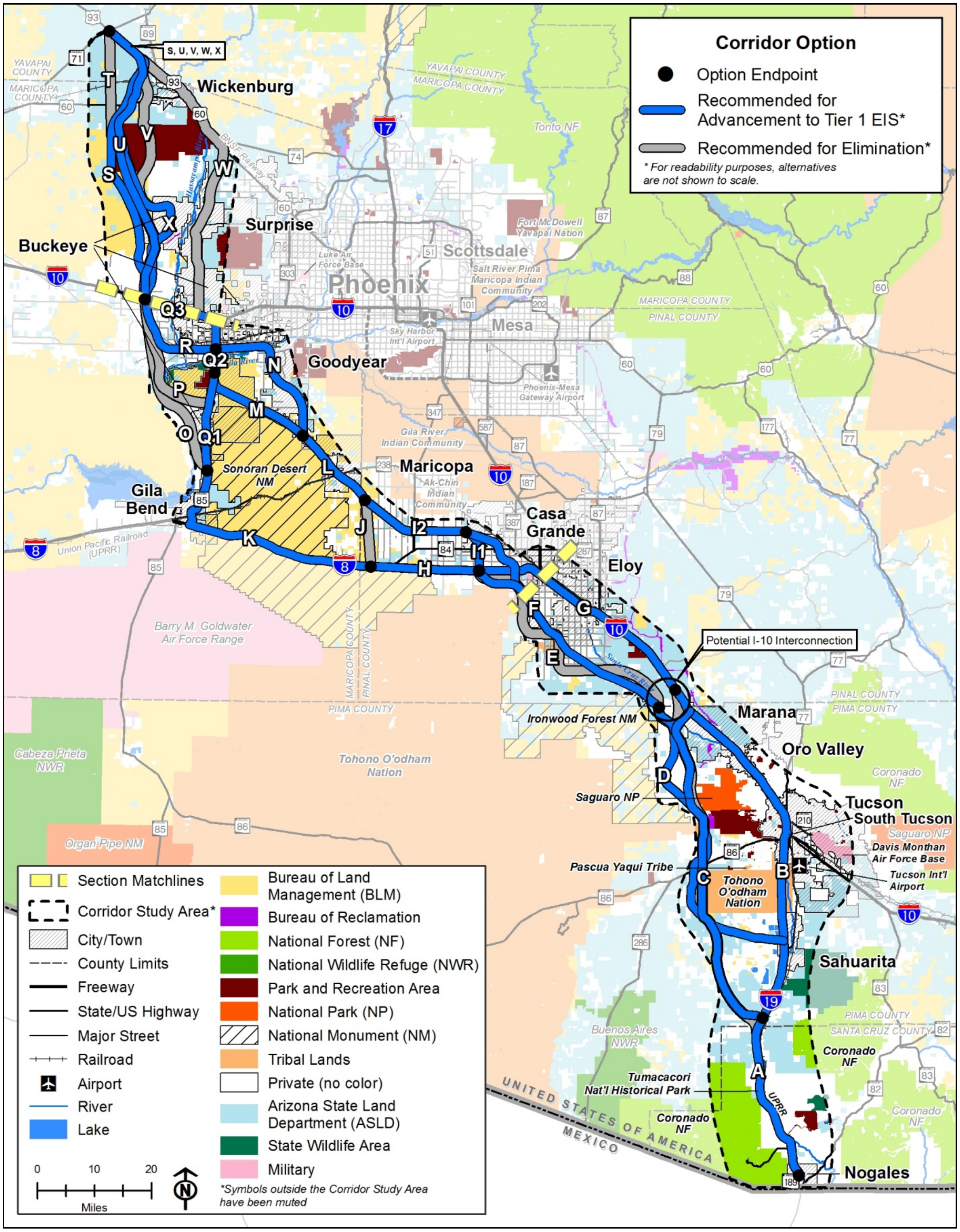


Figure 2-4 Range of Corridor Options

Option J – FHWA eliminated Option J because of its likelihood to impact a Section 4(f) property. Option J provides little mobility benefit and would go through the proposed Palo Verde Regional Park.

Options O and P – FHWA eliminated Options O and P because they are duplicative of other options, but with higher potential for impacts. Both Options O and P have high potential for impacts on sensitive environmental, historic, and cultural resources along the Gila River. The Options also are disfavored by Tribes. Options O and P would have greater potential for impact to critical habitat, an Important Bird Area, Arizona Game and Fish Department (AGFD) state wildlife areas, and the historic Gillespie Dam Bridge. Other reasonable alternatives would have fewer impacts are available that meet the mobility needs served by Options O and P.

Option T – FHWA eliminated Option T because it is largely duplicative of other options, does not perform as well as other options, and has feasibility and practicability concerns. Option T serves the same purpose as Options S and U (to provide system linkage to the northern terminus where none currently exists), but does not meet the criteria as well as other Options. Option T does not meet the Town of Wickenburg's goals of economic vitality and employment growth because it is too far from the town center as compared to Options S and U. Additionally, the terrain would be an impediment to implementation of I-11, calling its feasibility and practicability into question.

Option V – FHWA eliminated Option V because it is infeasible/impracticable. Option V traverses the Vulture Mountains Recreation Area (VMRA), a park protected by Section 4(f), as discussed in **Chapter 4** (Preliminary Draft Section 4(f) Evaluation). The lower portion of Option V was retained, but the northern portion through the VMRA was eliminated from further consideration. The resulting Option X uses the southern portion of Option V and then follows an existing power line corridor through the designated Bureau of Land Management (BLM) multi-use corridor.

Option W – FHWA eliminated Option W due to the potential for community and environmental impacts that would make it impracticable to pursue. Options W would be co-located with Sun Valley Parkway (directly north of I-10) and US 60. Both facilities are non-access controlled arterials (approximately 120 feet in right-of-way width) surrounded by built, under construction, or planned development. Co-location of an access-controlled freeway would cause major disruptions to adjacent urban developments, including the Town of Wickenburg.

Stakeholders voiced environmental concerns, including critical habitat issues along the Hassayampa River; impacts to the Hassayampa River Preserve; and major wash and alluvial floodplain issues between the river and White Tank Mountains. The Flood Control District of Maricopa County voiced concerns regarding the difficulty of crossing their large linear dam, which is located just north of I-10. Additionally, there are topographical issues with co-locating I-11 with US 60.

2.2.4 Modal Alternatives Considered and Eliminated from Further Consideration

Modal alternatives were considered but were not carried forward for detailed evaluation into the Draft Tier 1 EIS. As I-11 is intended to extend from Mexico to Canada, opportunities for highway, rail, and utilities may be located in the same corridor. The analysis in this Draft Tier 1 EIS considers available space, within an assumed typical cross section, that may be used for rail or utility co-location if this infrastructure is implemented in the future.

Rail facilities and services already exist within the Study Area and/or have been studied as part of several statewide planning efforts. In terms of freight rail, Union Pacific Railroad mainline and branch lines span the Study Area from Nogales to Casa Grande, with connections to Gila Bend as well as to Phoenix. A Burlington Northern Santa Fe Railroad (BNSF) branch line parallels US 93/US 60 into Phoenix, connecting at the same downtown Phoenix railyard as the Union Pacific Railroad corridors. MAG studied the opportunity to create a north-south linkage between the Union Pacific Railroad and BNSF corridors in the Hassayampa Valley (MAG 2013b). However, communication with the Class 1 railroads during scoping revealed that major capacity investments are already under way, and upon completion, Arizona freight rail corridors will have adequate rail capacity for the foreseeable future. The *Arizona State Freight Plan* and the *Arizona State Rail Plan* reiterate this and recommend continued coordination with the Class 1 railroads as they complete their capacity improvements.

The *Arizona Passenger Rail Corridor Study* was completed in 2016. A Final Tier 1 EIS and Record of Decision selected a proposed intercity passenger route connecting Tucson and Phoenix, with future opportunities to extend the route south to Nogales. The Selected Corridor Alternative would parallel I-10 to Eloy and then divert north, entering Phoenix from the east (ADOT 2016). With local and regional transit systems in place within the Study Area, additional passenger rail capacity is not warranted at this time. The FRA completed the *Southwest Multi-State Rail Planning Study* in 2014, which evaluated high-speed rail connections within the Intermountain West. The preliminary network vision proposed a high-speed connection from Phoenix to Los Angeles, with connectivity from Los Angeles to Las Vegas and points north in California (FRA 2014).

Major utility companies are participating in this Draft Tier 1 EIS as Participating Agencies. Many have been involved in I-11 planning efforts since the IWCS, which convened a Utility/Energy Focus Group to understand the long-term vision of utility corridor planning in Arizona and Nevada, and the opportunities for connectivity within the I-11 Corridor. Attending agencies communicated that they had no immediate needs, but that a sufficient right-of-way for long-term utility or energy expansion needs could create linear synergies, such as future cost efficiencies and mitigation of potential environmental impacts (NDOT and ADOT 2013).

Appendix E2 provides an inventory of freight, transit, and airport facilities.

2.3 End-to-End Build Corridor Alternatives

The Project Team assembled Corridor Options to create end-to-end alignments from Nogales to Wickenburg and tested different combinations of them, using the Arizona Statewide Travel Demand Model (Arizona Model) to form alternatives that respond best to transportation needs. Corridors were slightly modified to better avoid constraints, such as Tribal land, or to respond to engineering criteria. The Project Team added a connection to I-10 to form a continuous alignment, as shown on **Figure 2-5** (End-to-End Build Corridor Alternatives).

The alternatives development process resulted in three end-to-end Build Corridor Alternatives and a No Build Alternative to be evaluated in detail in the Draft Tier 1 EIS. The end-to-end alternatives include all corridor Options remaining after the screening process, as shown in **Table 2-1** (End-to-End Build Corridor Alternatives). They represent the range of viewpoints voiced during the study to date, from supporting the development of a new corridor to using existing corridors as much as possible.

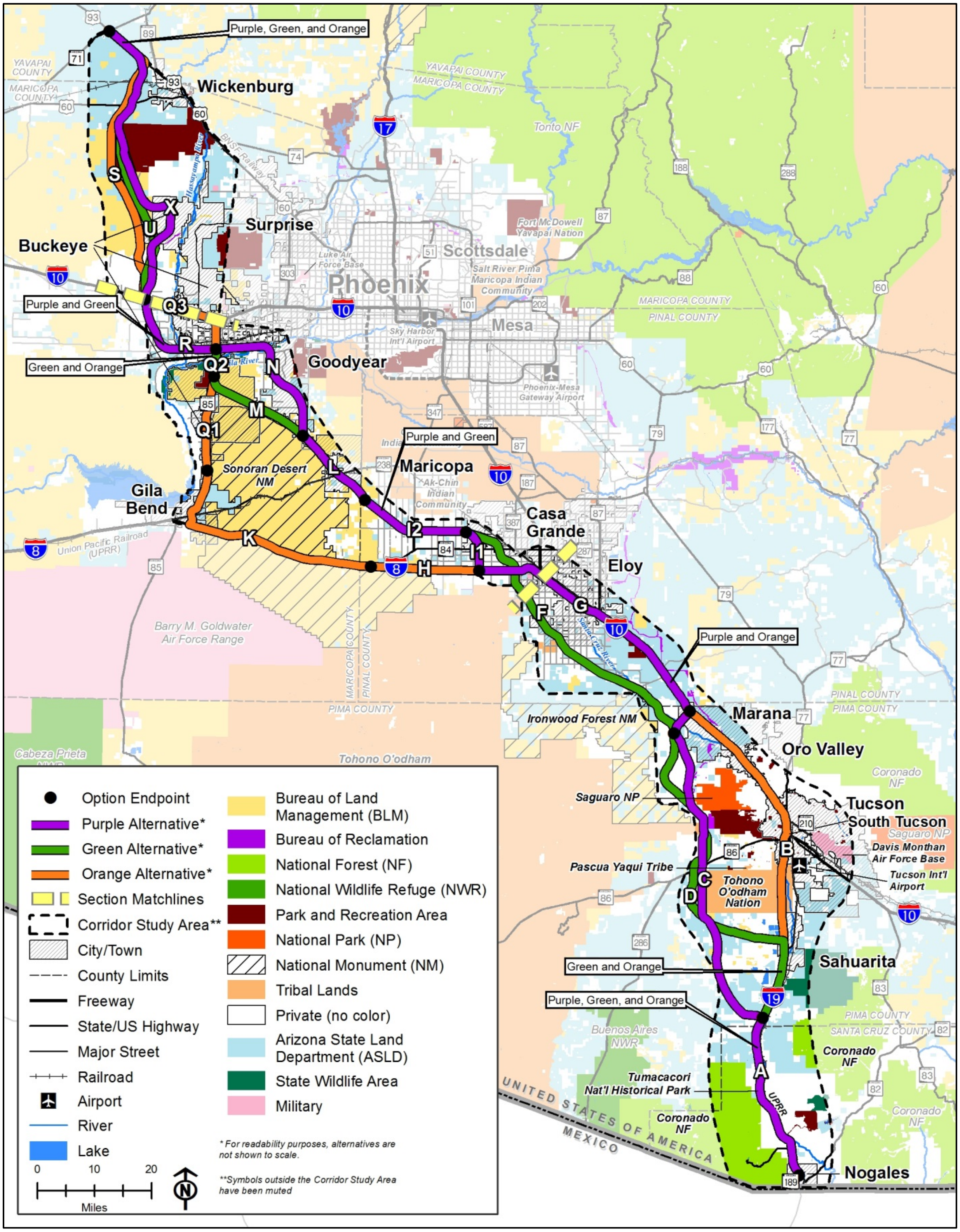


Figure 2-5 End-to-End Build Corridor Alternatives

Table 2-1 End-to-End Build Corridor Alternatives

Corridor Alternative Section	Purple Alternative	Green Alternative	Orange Alternative
South Section	A	A	A
	C	D	B
	G	F	G
Central Section	I1	I2	H
	I2	L	K
	L	M	Q1
	N	Q2	Q2
	R	R	Q3
North Section	X	U	S
Total Alternative Length	271 miles	268 miles	280 miles
New Lane Miles	758	930	415

Figure 2-5 (End-to-End Build Corridor Alternatives) illustrates the three Build Corridor Alternatives. **Chapter 3** (Affected Environment and Environmental Consequences) evaluates these alternatives and the No Build Alternative in detail.

The conclusions from the alternatives development phase did not carry any weight into the EIS, which put all the alternatives on an equal footing.

2.3.1 No Build Alternative

A No Build Alternative is the baseline for comparison to the Build Corridor Alternatives, and is evaluated as a full alternative in the Draft Tier 1 EIS. The No Build Alternative represents the existing transportation system, along with committed improvement projects that are programmed for funding. These improvements are represented in the federally approved *State Transportation Improvement Program*. Projects in this program are consistent with the statewide long-range transportation plan and metropolitan transportation improvement programs.

Under the No Build scenario, travel between Nogales and Wickenburg would use the existing corridors of I-19 and I-10 within the Study Area, along with a connection to Wickenburg via the Phoenix metropolitan area. This connection could take many routes, depending on traveler preference (e.g., SR 101L, SR 202L, SR 303L, I-17, SR 74, US 60). **Table 1-3** (Peak Period Travel Times from Nogales to Wickenburg in Afternoon, 2015 and 2040) in **Chapter 1** (Purpose and Need) provides the various routing options, distances, travel times, and average speeds. This information was generated by the Arizona Statewide Travel Model maintained by ADOT.

The Arizona Model was developed for the ADOT Travel Demand Modeling Group as a trip-based model to estimate the interaction between travel movements (passenger cars and trucks) and the statewide transportation network. The model supports numerous ADOT planning efforts and is updated periodically on a statewide basis to reflect such inputs as revised socioeconomic forecasts or updated transportation system configurations. The Arizona Model is a standard practice used on ADOT projects, and model inputs are not updated on a project basis.

The Arizona Model uses a traditional four-step forecasting approach based on trip generation, trip distribution, mode choice, and trip assignment. The Arizona Model analysis used 2040 socioeconomic forecasts developed by the State Demographer and a four-step modeling process to generate performance measures for the Study Area and broader state of Arizona No Build Alternative conditions. The Arizona Model assumes the current adopted future transportation network, which includes the capacity improvements identified in ADOT's and regional metropolitan planning organizations regional long-range transportation plans.

Socioeconomic projections in the Arizona Model do not incorporate or ensure water availability for future development. The State Demographer builds the statewide projections on the future land uses included in local General or Comprehensive Plans, which are put together before developers must prove a 100-year water supply under the Arizona Department of Water Resources' Assured Water Supply Program. Therefore, the amount and density of proposed residential development throughout the Study Area may not reflect the true availability of water, which in turn, can impact travel patterns, capacity, and needs.

Within the Study Area, the *2018-2022 Five-Year Transportation Facilities Construction Program* identified several capacity improvements programmed and funded for construction by 2022 on the interstate and state highway system within the Study Area. The No Build Alternative includes new capacity (additional lanes) on I-10 between Tucson and Casa Grande, and conversion of US 93 to a four-lane divided highway for a 3-mile segment through Wickenburg, as shown on **Figure 2-6** (No Build Alternative Capacity Improvements).

Under the No Build Alternative, capacity improvements are programmed in the following locations:

- I-10: SR 85 to Verrado Way (Maricopa County)
- I-10: Ina Road to Ruthrauff Road (Pima County)
- I-10: SR 87 to Picacho (Pinal County)
- I-10: Earley Road to I-8 (Pinal County)
- US 93: Tegner Drive to SR 89

The No Build Alternative also assumes the implementation of projects outside of the Study Area that are regionally significant or particularly relevant to the I-11 Corridor, including the following:

- SR 303L: SR 30 to I-10 – The public comment period for the Draft Environmental Assessment and Initial Design Concept Report for the SR 303L extension project (I-10 and SR 30/Tres Rios Corridor) was in June and July of 2018. A Final Environmental Assessment and decision document are pending, as of the publication of this I-11 Corridor Draft Tier I EIS.
- Loop 202 South Mountain Freeway (SR 202L)
- Future SR 30/Tres Rios Corridor (from SR 303L to the South Mountain Freeway)
- I-10 Near-Term Improvements (e.g., Broadway curve improvements)
- SR 189: International Border to Grand Avenue

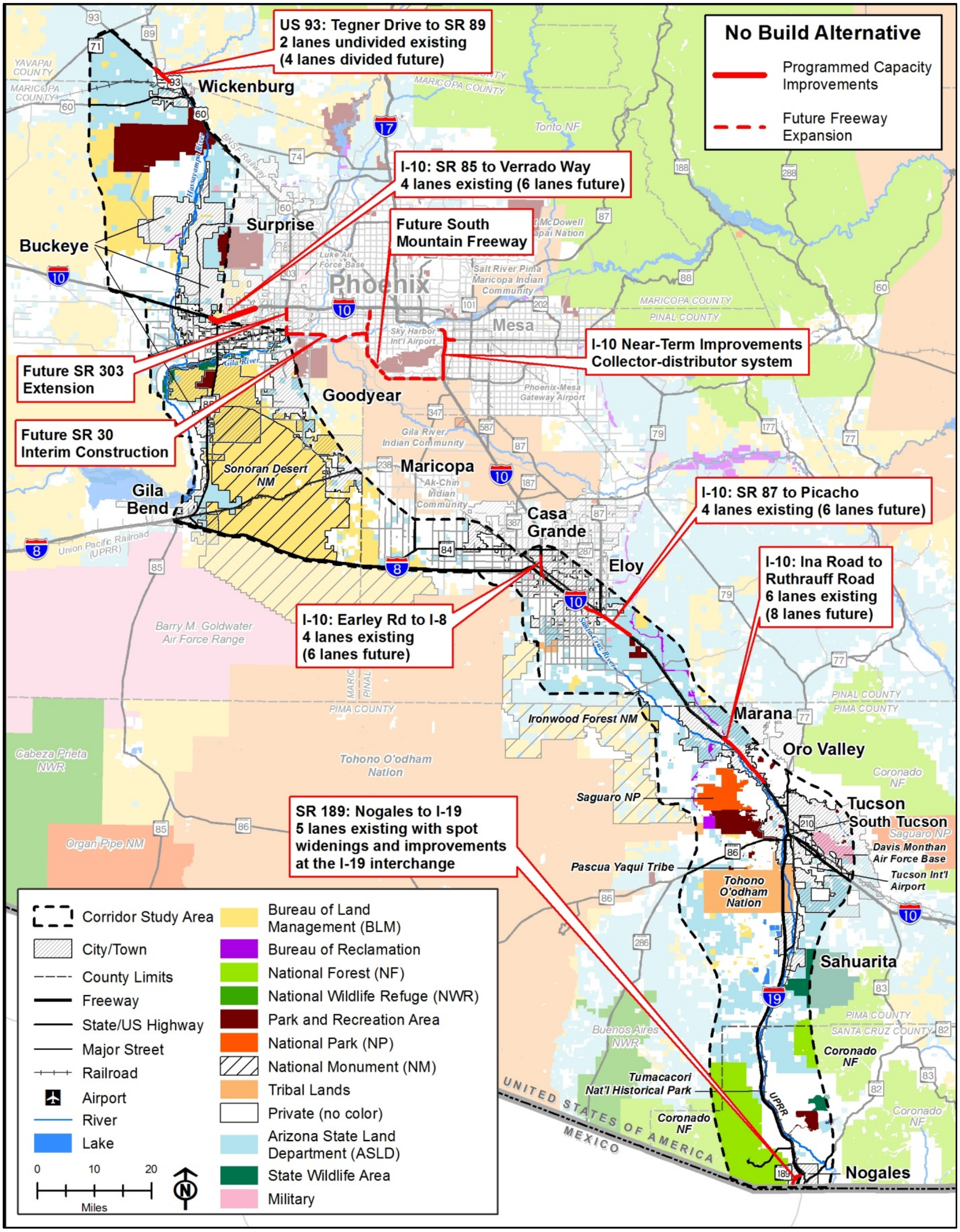


Figure 2-6 No Build Alternative Capacity Improvements

2.3.2 Build Corridor Alternatives

2.3.2.1 Assumptions Common to All Build Corridor Alternatives

The Build Corridor Alternatives have several common features.

- Each Build Corridor Alternative is a 2,000-foot-wide corridor within which a future alignment would be located. Future Tier 2 studies would place the specific alignment of the I-11 facility somewhere within the 2,000-foot-wide corridor. A future I-11 facility is expected to be approximately 400 feet wide. The level of analysis for the Draft Tier 1 EIS is qualitative and programmatic, reflecting the broad definition of the corridor, while the future Tier 2 environmental review would consider specific alignments for more detailed review (**Figure 2-7** [Tier 1 versus Tier 2 Level of Detail]).

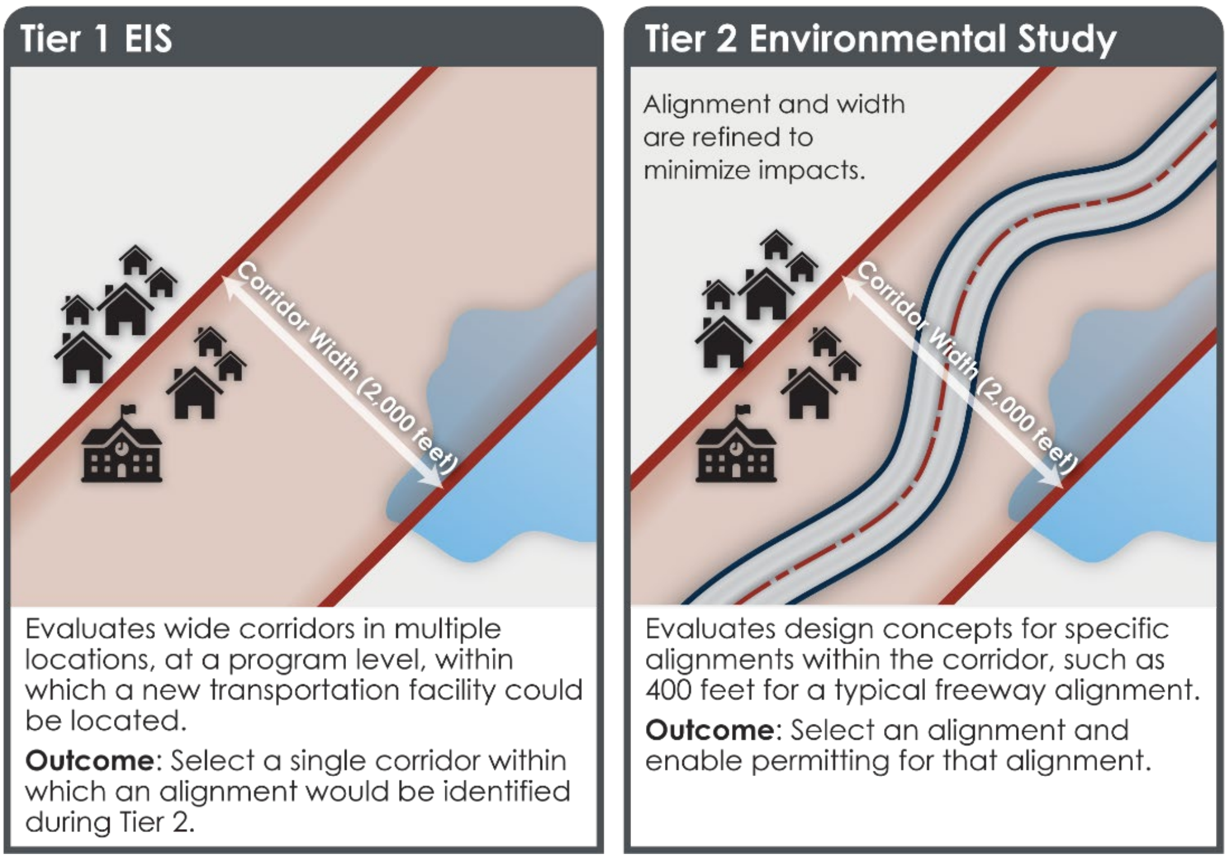


Figure 2-7 Tier 1 versus Tier 2 Level of Detail

- Specific interchange locations are not identified for the Build Corridor Alternatives. However, a set of potential interchange locations were assumed for purposes of this analysis based on the most current available transportation network in the Arizona Model. It is assumed the ultimate footprint of future interchanges would be contained within the 2,000-foot-wide Project Area of each Build Corridor Alternative.

- All Build Corridor Alternatives terminate at the SR 189 and I-19 traffic interchange in Nogales. The programmed improvements at the SR 189/I-19 interchange and improvements on SR 189 to the Mariposa port of entry at the US–Mexico border are assumed to occur prior to the I-11 implementation.
- All Build Corridor Alternatives would be phased, as discussed further in **Chapter 6** (Recommended Alternative).

2.3.2.2 Purple Alternative

The Purple Alternative is illustrated on **Figure 2-8** (Build Corridor Alternative: Purple). This alternative is a mix of existing and new Corridor Options.

This alternative originates at the SR 189/I-19 interchange in Nogales. It includes the following Corridor Options in the South Section:

Option A. Option A is co-located with I-19 from Nogales to the Santa Cruz/Pima County line, near the alignment of Elephant Head Road in Arivaca.

Option C. Option C is a new corridor that would divert west from I-19 near the Santa Cruz/Pima County line, using existing roadway alignments in some locations. A portion of Option C is co-located with the alignment of Sandario Road in the vicinity of the Tucson Mitigation Corridor (TMC), CAVSARP, SAVSARP, and Tohono O'odham Nation (San Xavier and Schuk Toak districts). No part of the Option C is on Tohono O'odham Nation land. Option C would tie back to I-10 in the Marana area.

Option C – Central Arizona Project (CAP) Design Option. The Preliminary Draft Section 4(f) Evaluation triggered consideration of additional Options across the TMC. The CAP Design Option is based on coordination with the Bureau of Reclamation (as the owner with jurisdiction of the Section 4(f) property). It closely parallels the CAP canal on its downslope (western) side across the TMC (see inset detail on **Figure 2-8** [Build Corridor Alternative: Purple]). Placing I-11 next to the CAP canal consolidates these two linear facilities. This would provide the opportunity to place wildlife crossings on I-11 that match up with each of the existing siphon crossings along the CAP canal. This Option could replace 11.3 miles of the original Option C between SR 86 and Mile Wide Road.

Option G. Option G is co-located with I-10 and a short portion of I-8 in Pinal County. The end point of Option G is near Montgomery Road on I-8.

Options I1 and I2. Option I is split into Options I1 and I2 in order to differentiate the portions that are contained in the Purple and the Green Alternatives. The Purple Alternative includes both Option I1 and I2. Option I1 generally follows the alignment of Montgomery Road north from I-8 to Barnes Road. Option I1 is consistent with the West Pinal corridor alignment identified in previous plans, such as the Pinal Regional Transportation Plan. Option I2 extends west along the alignment of Barnes Road, and then heads northwest near SR 347/Maricopa Road towards Goodyear.

Option L. Option L is a new corridor that parallels the east edge of the Sonoran Desert National Monument. This Option is co-located with a portion of the proposed Hassayampa Freeway corridor from the MAG *I-8 and I-10/Hidden Valley Regional Transportation Framework Study*, and is within a multi-use corridor designated by BLM.

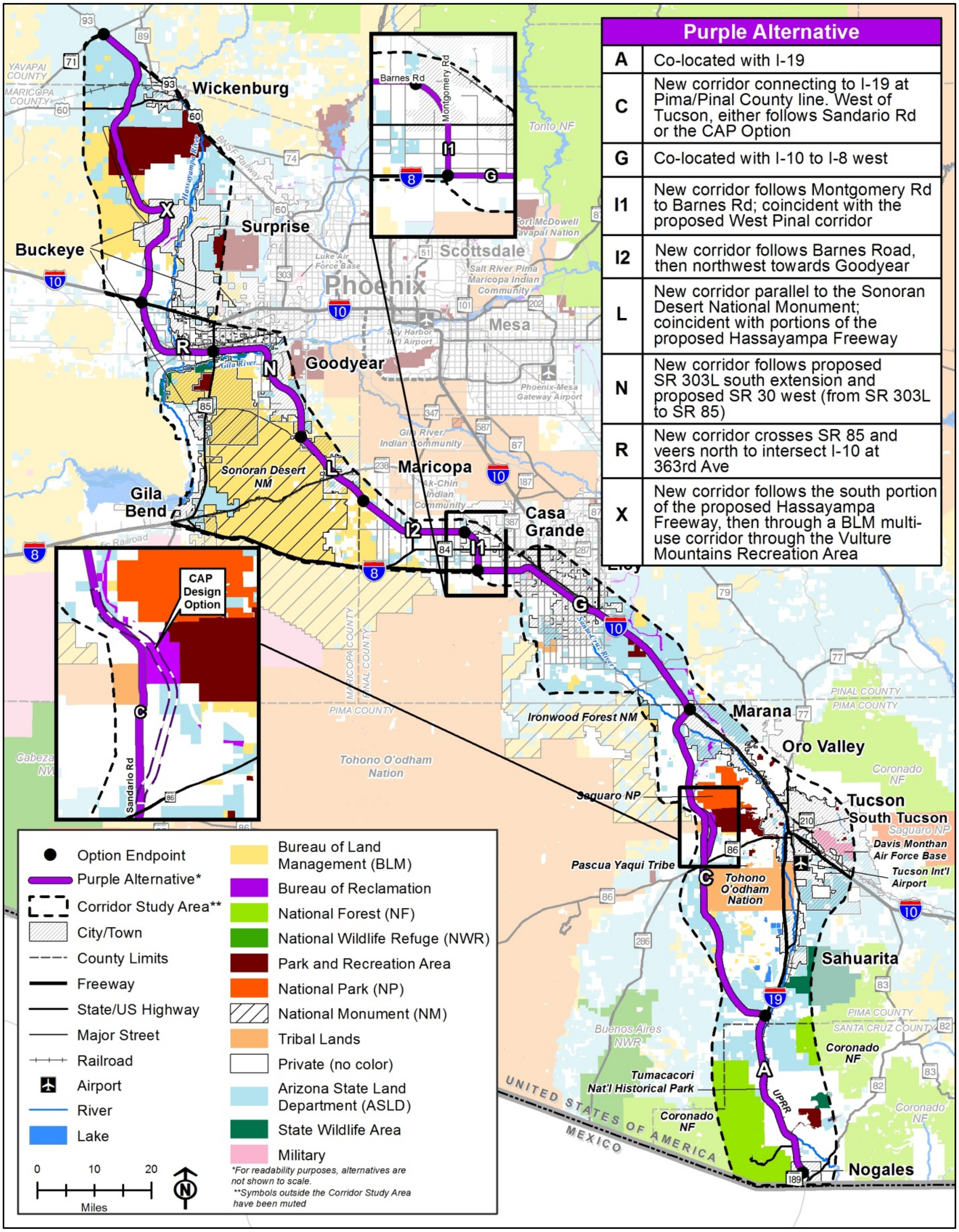


Figure 2-8 Build Corridor Alternative: Purple

Option N. Option N is a new corridor through Goodyear and Buckeye which follows the proposed SR 303L south extension and creates a new crossing the Gila River. The east-west portion of Option N is consistent with the planned alignment of SR 30/Tres Rios Corridor in the ADOT *Loop 303L from State Route 30 to Hassayampa Freeway* study.

Option R. Option R is a new corridor that extends west from SR 85 in south Buckeye and turns north to intersect I-10 at approximately milepost 100 (363rd Avenue).

Option X. North of I-10, Option X would follow the south portion of the proposed Hassayampa Freeway corridor from the MAG *I-10/Hassayampa Valley Regional Transportation Framework Study*. Option X crosses the VMRA through the eastern portion of a designated BLM multi-use utility corridor, parallel to an existing transmission line.

North of the VMRA, Option X connects to US 93 just northwest of Wickenburg. The route of Option X is consistent with the Town of Wickenburg's preferred routing, as identified in its May 2017 resolution. See **Chapter 5** (Coordination and Outreach) for more details on the Town of Wickenburg's May 2017 resolution, the full text of which is attached in **Appendix G**.

2.3.2.3 Green Alternative

The Green Alternative is illustrated on **Figure 2-9** (Build Corridor Alternative: Green). This alternative consists primarily of new Corridor Options (i.e., it is not co-located with existing transportation facilities). The Options for the Green Alternative include the following:

Option A. Option A is co-located with I-19 from Nogales to the Santa Cruz/Pima County line.

Option D. Option D is a new corridor following I-19 from near the Santa Cruz/Pima County line to Sahuarita. It diverts west from I-19 near El Toro Road in Sahuarita. The portion of this Option that crosses the TMC follows the alignment of Sandario Road and is the same as Option C (see inset map for the CAP Design Option on **Figure 2-9** [Build Corridor Alternative: Green]). No part of Option D is on Tohono O'odham Nation land.

Option D - CAP Design Option. The Preliminary Draft Section 4(f) Evaluation triggered consideration of additional Options across the TMC. The CAP Design Option is based on coordination with the Bureau of Reclamation (as the owner with jurisdiction of the Section 4(f) property). It closely parallels the CAP canal on its downslope (western) side across the TMC (see inset detail on **Figure 2-9** [Build Corridor Alternative: Green]). Placing I-11 next to the CAP canal consolidates these two linear facilities. This would provide the opportunity to place wildlife crossings on I-11 that match up with each of the existing siphon crossings along the CAP canal. This Option could replace 11.3 miles of the original Option C between SR 86 and Mile Wide Road.

Option F. Within Pinal County, Option F is a new corridor west of I-10 which crosses I-8 near Chuichu Road. Option F, as presented in the *Alternative Selection Report,* was extended north of I-8 through Casa Grande to connect with Option I2 at Barnes Road.

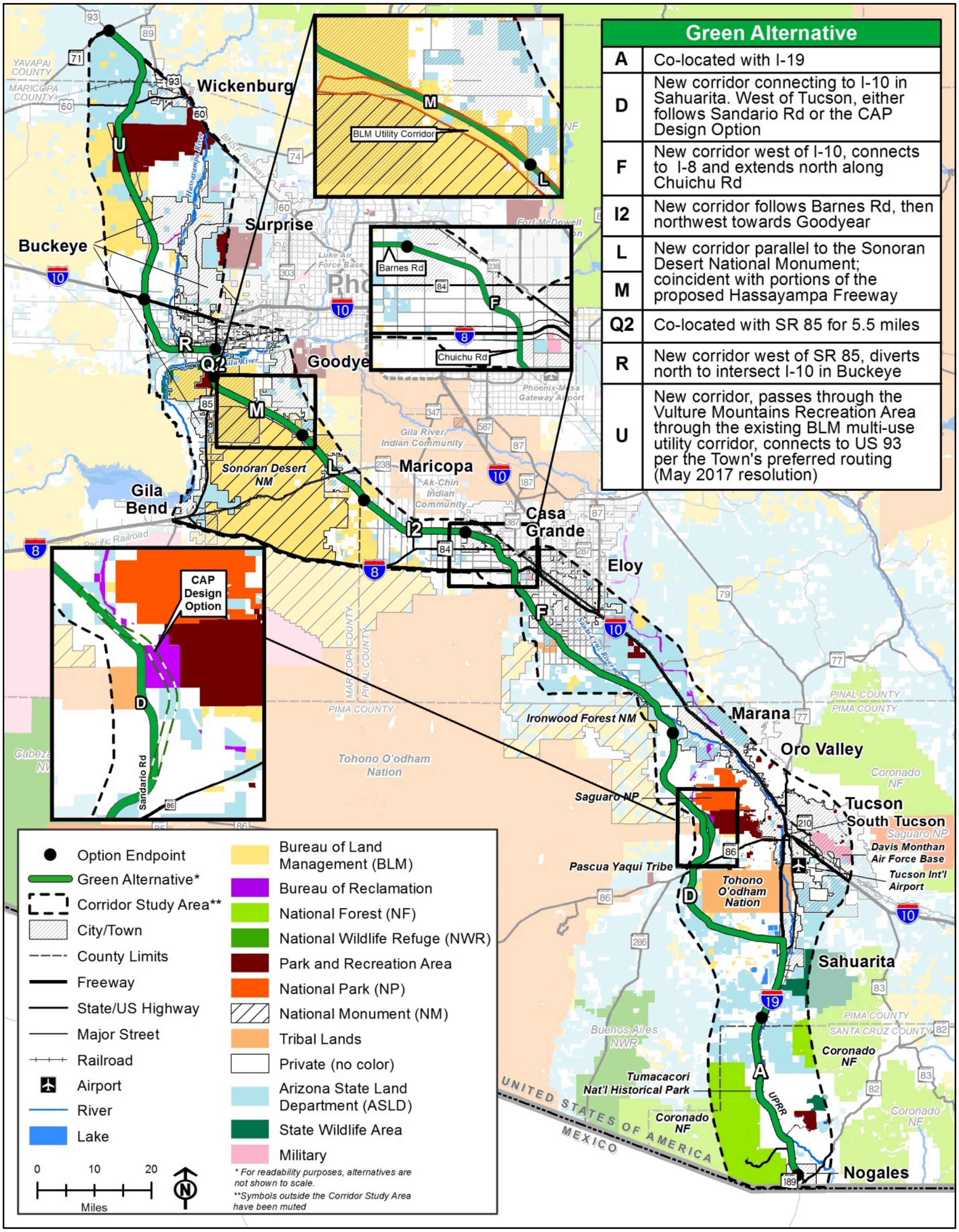


Figure 2-9 Build Corridor Alternative: Green

NOTE: With the extension of Option F north of I-8, connecting with a portion of Option I, Option I is now labeled as I1 and I2 to differentiate this intersection point.

Option I2. Option I2 is a new corridor that extends west along the alignment of Barnes Road, and then heads northwest near SR 347/Maricopa Road towards Goodyear.

Option L. Option L is a new diagonal corridor that parallels the eastern edge of the Sonoran Desert National Monument. This Option is co-located with a portion of the proposed Hassayampa Freeway corridor from the MAG *I-8 and I-10/Hidden Valley Regional Transportation Framework Study* and is within a BLM-designated multi-use corridor.

Option M. Option M is a new corridor that continues west from Option L within a BLM-designated multi-use corridor along the northeastern boundary of the Sonoran Desert National Monument. East of SR 85, Option M moves north to avoid an existing landfill and a power utility substation then connects with Option Q2 at SR 85.

Option Q2. Option Q2 is co-located with SR 85 and includes the existing crossing of the Gila River. Option Q2 would convert SR 85 (a four-lane divided highway) to an interstate facility for approximately 5 miles connecting with Option R approximately 5 miles south of I-10 on SR 85. This corridor is already planned to be a fully access-controlled freeway.

Option R. Option R is a new corridor that extends west from SR 85 in south Buckeye. It diverts north to intersect I-10 near milepost 100 (363rd Avenue).

Option U. Option U is a new corridor extending north of I-10 in western Maricopa County. This Option crosses the VMRA within a BLM-designated multi-use corridor and connects to US 93 just northwest of Wickenburg. The general location of Option U north of the VMRA is consistent with the Town of Wickenburg's preferred routing as identified in its May 2017 resolution. See **Chapter 5** (Coordination and Outreach) for more details on the Town of Wickenburg's May 2017 resolution, the full text of which is attached in **Appendix G**. Option U (Green Alternative) differs from the Purple Alternative (Option X) because it was developed based on the engineering inputs using the technical geographic information system (GIS)-based model.

2.3.2.4 Orange Alternative

The Orange Alternative is illustrated on **Figure 2-10** (Build Corridor Alternative: Orange). This alternative consists mostly of existing interstate and highway corridors and includes the following Options:

Option A. Option A is co-located with I-19 from Nogales to the Santa Cruz/Pima County line.

Option B. Option B is co-located with I-19 and I-10 through Pima County and the Tucson urban area. This section includes a portion of I-19 extending through the San Xavier District of the Tohono O'odham Nation, which is located on a perpetual transportation easement from the Tohono O'odham Nation. **Appendix I** provides the documentation for this easement. I-10 through central Tucson (between I-19 and Prince Road) is mostly elevated, with frontage roads and grade-separated railroad crossings, multiple-level sound walls, and landscaping.

Option G. Option G is co-located with I-10 and a short portion of I-8 in Pinal County, terminating near Montgomery Road on I-8.

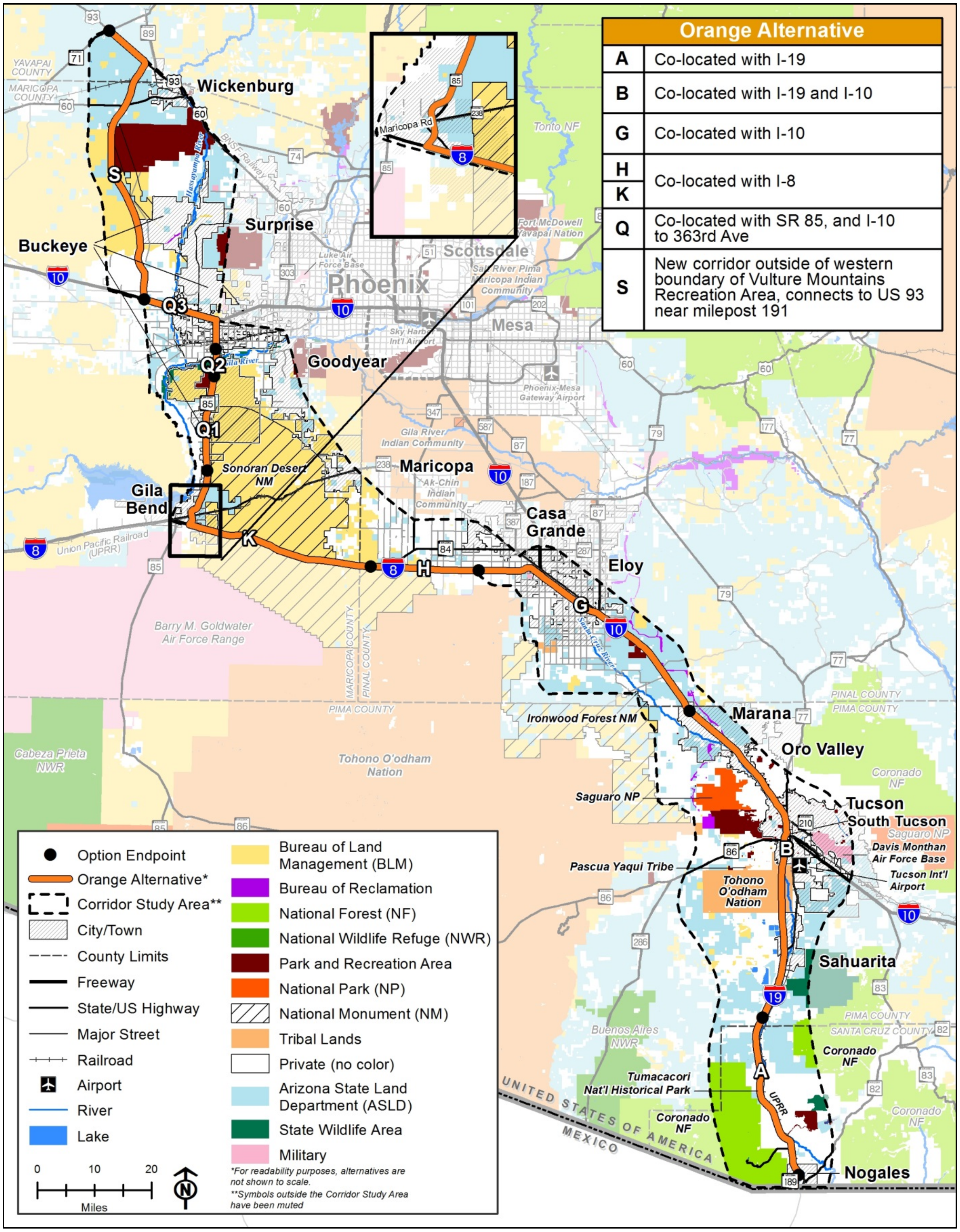


Figure 2-10 Build Corridor Alternative: Orange

Option H. Option H is co-located with I-8 west from Casa Grande (approximately Montgomery Road) to near the Pinal/Maricopa County line.

Option K. Option K is co-located with I-8 (between the Pinal/Maricopa County line and SR 85) and SR 85 (between I-8 and north of Fornes Road).

Option Q1. Option Q1 is co-located with SR 85 for approximately 16 miles, which is already planned for conversion to a fully access-controlled freeway.

Option Q2. Option Q2 is co-located with SR 85 for approximately 5 miles, which is already planned for conversion to a fully access-controlled freeway.

Option Q3. Option Q3 is co-located with SR 85 and I-10. The section of I-10 included in Option Q3 is approximately 12.5 miles long and extends between SR 85 and milepost 100 (363rd Avenue).

Option S. Option S is a new corridor in western Maricopa County extending north from 363rd Avenue on I-10. This Option is located adjacent to the western boundary of the VMRA, providing an Alternative that is outside the recreation area, and connects to US 93 just northwest of Wickenburg. Option S was identified based on the engineering inputs during the GIS-based model analysis.

2.4 Comparison of Alternatives

The following sections compare the alternatives according to how well they meet the I-11 Purpose and Need. **Table 2-2** (Comparison of New Lane Miles and Length) shows the number of new lane miles by Build Corridor Alternative. The Orange Alternative would be co-located with the greatest number of existing freeways and roads. The Green Alternative would create the most new corridors and would include the most new lane miles.

Table 2-2 Comparison of New Lane Miles and Length

Section	No Build Alternative	Purple Alternative	Green Alternative	Orange Alternative
Lane Miles in South Section	0	230	345	71
Lane Miles in Central Section	0	320	385	142
Lane Miles in North Section	0	208	200	202
End-to-End New Lane Miles Assumed in Arizona Travel Demand Model	**0**	**758**	**930**	**415**
Length (miles)	0	271	268	280

SOURCE: ADOT 2018. Travel Forecasting Methods and Analysis Report.

The project team identified the number of lanes needed to achieve the acceptable Level of Service (LOS), discussed further in this chapter. The number of lanes used in the Arizona Travel Demand Model was based on achieving the LOS threshold. Generally, four lanes were needed to meet the LOS threshold for new corridors. The specific number of lanes assumed in the travel demand model is shown on the cross sections in **Appendix E1**.

Potential impacts in this Tier I Draft EIS are based on a 2,000-foot-wide planning corridor, not the actual width of the highway project if it were constructed. The actual number of lanes, design configuration, and specific impacts would be determined in Tier 2 studies.

2.4.1 Population and Employment Growth

Table 2-3 (Comparison of Alternatives and Planned Growth Areas) summarizes how each alternative would serve areas planned for high growth.

Table 2-3 Comparison of Alternatives and Planned Growth Areas

Key Metrics		Alternatives			
Purpose and Need	Metric	No Build	Purple	Green	Orange
Need: Population and Employment Growth: High-growth areas need access to the high-capacity, access-controlled transportation network. **Purpose:** Provide a high-priority, high-capacity, access-controlled transportation corridor to serve population and employment growth.	Provides access to planned growth areas	Does not serve highest growth area (western Maricopa County, within the Study Area)	The greatest areas of population and employment growth within the Study Area are expected in Pinal and western Maricopa counties, which the Purple Alternative serves best (Casa Grande, Goodyear, Buckeye, Wickenburg).	The Green Alternative serves anticipated growth well and provides more access in the Sahuarita area, but does not provide as much access to the Goodyear/State Route 303L area as the Purple Alternative.	The Orange Alternative best responds to continued population and employment growth in the South Section; however, less growth is anticipated in the Tucson urbanized area compared to other portions of the Study Area

Figure **2-11** (Planned Growth Areas and Build Corridor Alternatives) shows the Build Corridor Alternatives in relation to the planned growth areas. The figure shows the areas where local municipalities are planning for high growth in pink. The growth areas were determined based on municipal general and county comprehensive plans, and were supported by interviews with local planning and economic development staff.

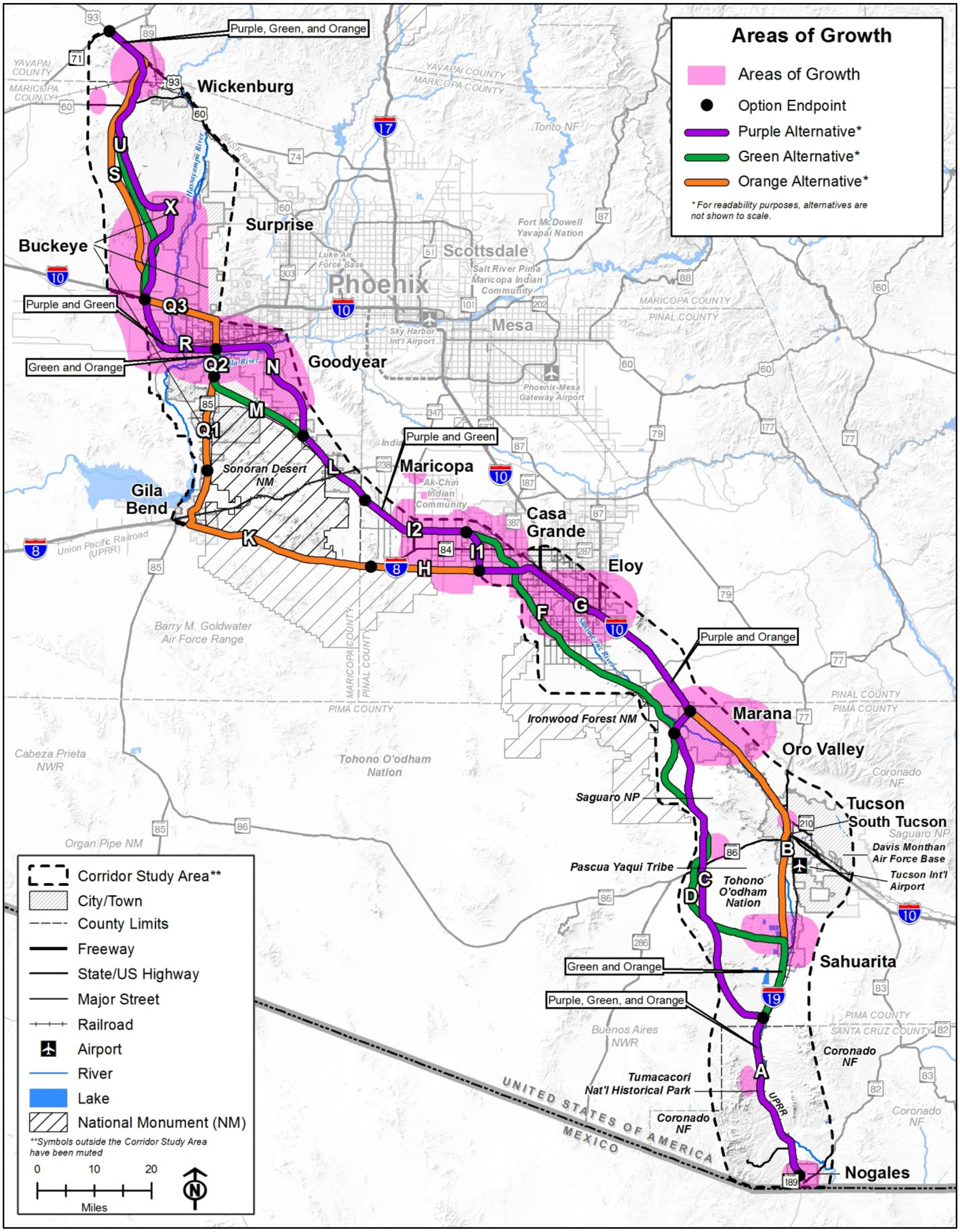


Figure 2-11 Planned Growth Areas and Build Corridor Alternatives

2.4.2 Traffic Growth and Travel Time Reliability

2.4.2.1 Travel Times

Figure 2-12 (2040 Travel Times in Minutes [Afternoon Peak Period]) presents travel times for the No Build Alternative and the Build Corridor Alternatives for 2040 afternoon peak period conditions (3 p.m. to 6 p.m.). All the Build Corridor Alternatives improve travel times. The Green Alternative has the fastest travel time between Nogales and Wickenburg, at 237 minutes, representing a 54-minute savings over No Build conditions. The Purple Alternative has the next fastest travel time, at 243 minutes.

Figure 2-13 (2040 Travel Times in Minutes for City Pairs [Afternoon Peak Period]) presents travel times for key city pairs in the Study Area.

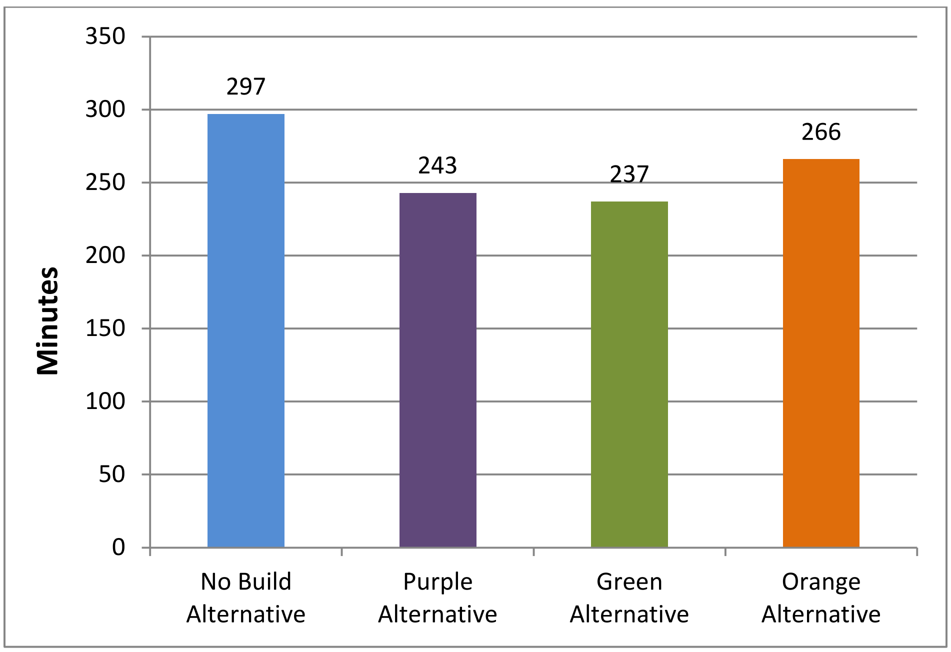


Figure 2-12 2040 Travel Times Nogales to Wickenburg (Afternoon Peak Period)

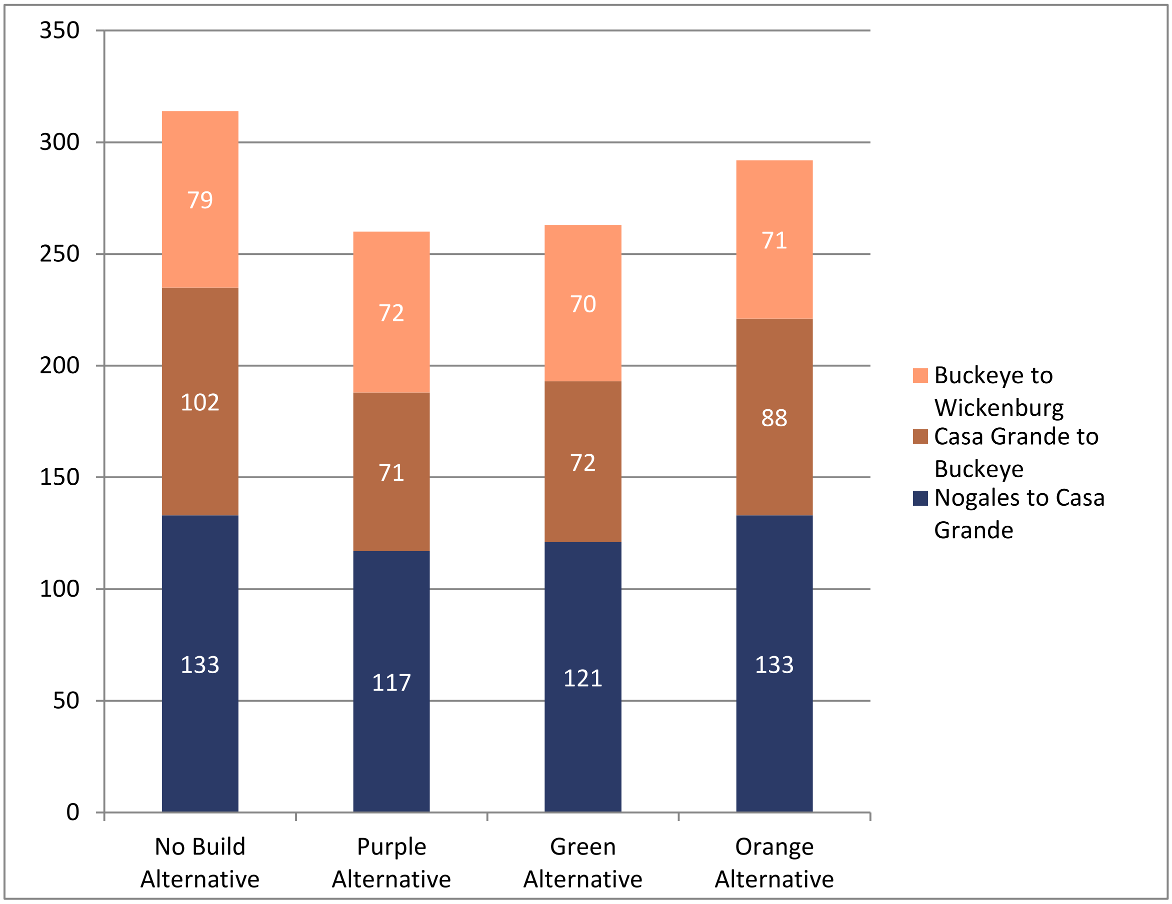


Figure 2-13 2040 Travel Times in Minutes for City Pairs (Afternoon Peak Period)

2.4.2.2 Level of Service

The Project Team defined a threshold for level of service (LOS) on I-11. The LOS threshold informed the number of lanes used for modeling the transportation performance of the Build Corridors in the Arizona Model. Generally, four lanes were determined to meet the need for new corridors. The number of lanes used in the travel demand model is shown on the cross sections in **Appendix E1**.

The LOS criteria are:

- Achieves LOS C or better on I-11 in in rural areas
- Achieves LOS D or better on I-11 in urban areas (Tucson)

The Purple and Green Alternatives achieve LOS C or better on the future I-11 facility. The Orange Alternative achieves LOS C or better except in downtown Tucson where it achieves LOS D. The LOS on existing roads is projected to range from LOS C to LOS F and is discussed in detail in **Chapter 1** (Purpose and Need).

Table 2-4 (Comparison of Travel Time and Level of Service [LOS]) compares the travel time and LOS for the No Build Alternative and the Build Corridor Alternatives.

Table 2-4 Comparison of Travel Time and Level of Service (LOS)

Key Metrics		Alternatives			
Purpose and Need	**Metric**	**No Build**	**Purple**	**Green**	**Orange**
Need: Traffic Growth and Travel Time Reliability: Increased traffic growth reduces travel time reliability due to unpredictable freeway conditions that impede travel flows, hindering the ability to efficiently move people and goods around and between metropolitan areas. **Purpose:** Support improved regional mobility for people and goods to reduce congestion and improve travel efficiency.	Reduces travel time for long-distance traffic (2040 travel time from Nogales to Wickenburg in minutes).	297 minutes	243 minutes (54-minute savings over the No Build Alternative)	237 (60-minute savings over the No Build Alternative)	266 (31-minute savings over the No Build Alternative)
	Achieves LOS C or better in rural areas and LOS D or better in urban areas (Tucson) on I-11.	LOS F on existing roads in some areas	LOS C or better on I-11	LOS C or better on I-11	LOC C or better in rural areas outside of Tucson LOS D on I-11 in Tucson

2.4.3 System Linkages and Regional Mobility

2.4.3.1 Vehicles Miles Traveled

The Project Team used VMT to evaluate utilization of the I-11 Build Corridor Alternatives. Higher system VMT, when compared to the no build, means vehicles are driving further to take advantage of I-11 Corridor travel time savings. The Project Team used the Arizona Statewide Travel Demand Model to model vehicles miles traveled (VMT) in each section of the Study Area. As shown on **Table 2-5** (2040 Vehicle Miles Traveled), **Figure 2-14** (2040 Vehicle Miles Traveled for Passenger Cars and Trucks), and **Figure 2-15** (2040 Vehicle Miles Traveled for Trucks), there would be a negligible increase (less than 1 percent) in VMT in the South Section with the Build Corridor Alternatives. Even with the Build Corridor Alternatives, I-10 will continue to carry a significant amount of traffic through the Tucson area and will continue to be used as a primary connection to downtown Tucson. The Central Section would see the greatest changes in VMT for both passenger cars and trucks. The Purple Alternative would result in the biggest increase in VMT in the Central Section, with a 15 percent increase for passenger cars and a 117 percent increase for trucks. The Green Alternative also would result in substantial increases in VMT in the Central Section (11 percent for passenger cars and 85 percent for trucks). The North Section would see moderate increases in VMT for passenger cars (1 to 5 percent) and moderate to substantial increases in VMT for trucks (3.8 to 21.1 percent).

Table 2-5 2040 Vehicle Miles Traveled

Section	No Build Alternative	Purple Alternative	Green Alternative	Orange Alternative
Passenger Cars and Trucks				
South	30,088,800	30,255,800	30,126,400	30,301,100
Central	6,190,200	8,108,900	7,577,000	6,422,600
North	2,478,100	2,487,800	2,585,000	2,605,200
Total	38,757,100	40,852,500	40,288,400	39,328,900
Trucks				
South	4,175,200	4,196,000	4,177,300	4,211,800
Central	946,000	2,052,500	1,748,200	990,400
North	205,000	211,400	246,700	240,000
Total	5,326,200	6,459,900	6,172,200	5,442,200

SOURCE: ADOT 2018.

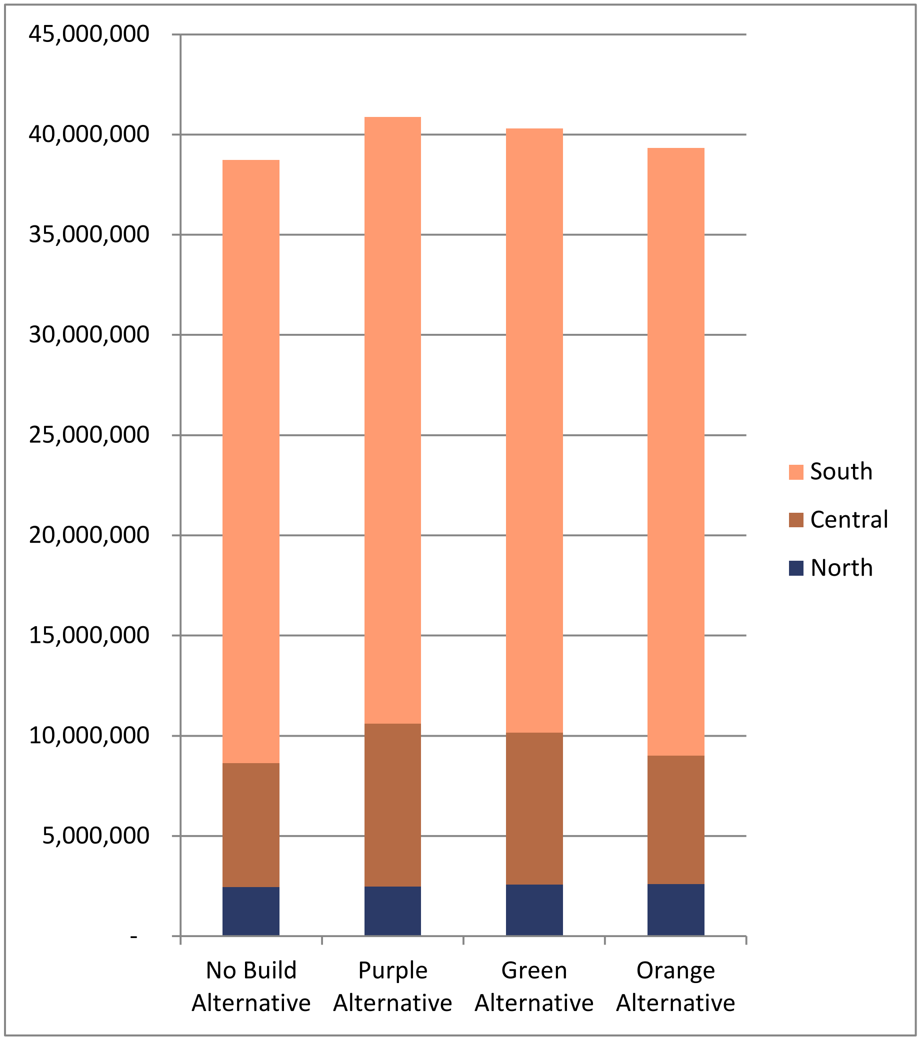


Figure 2-14 2040 Vehicle Miles Traveled for Passenger Cars and Trucks

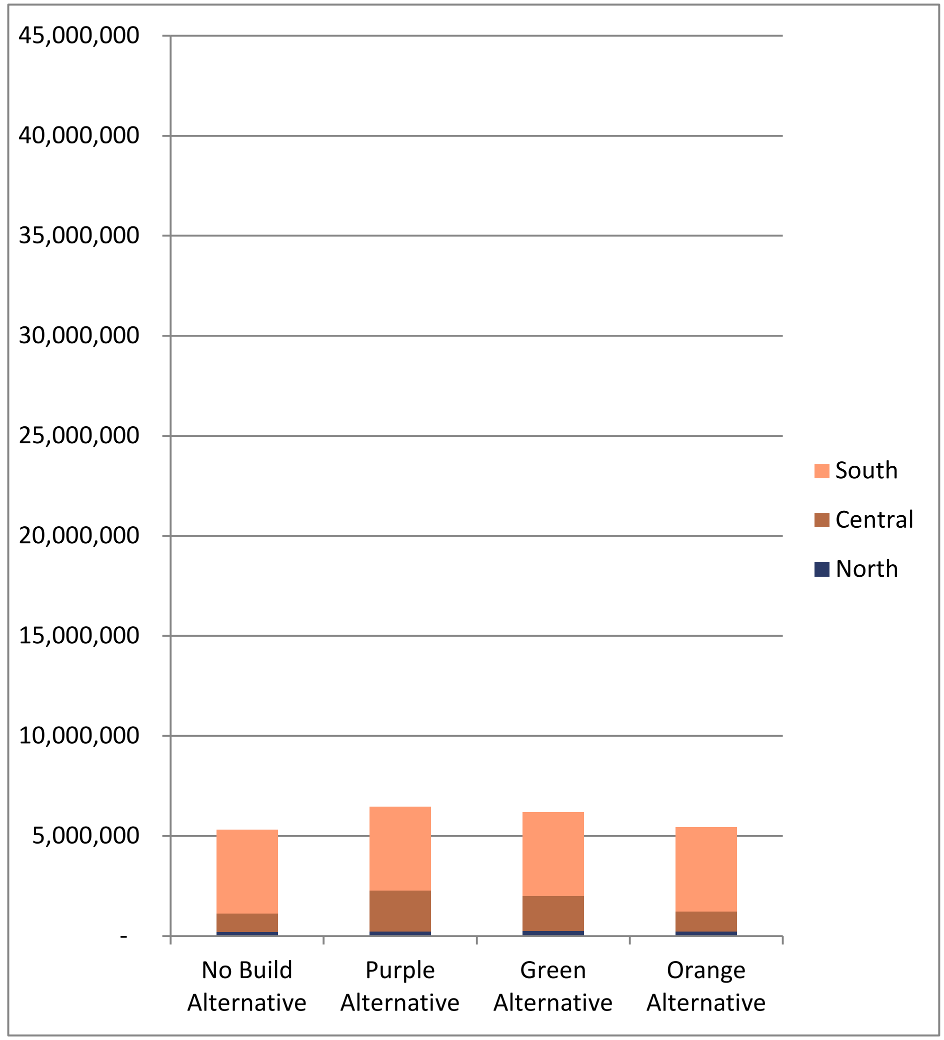


Figure 2-15 2040 Vehicle Miles Traveled for Trucks

2.4.3.2 Freight

The I-11 Corridor has been addressed in federal legislation as well as statewide and regional planning documents in an effort to respond to projected growth and support more robust north-south trade. Freight moving across the US–Mexico border is carried via truck or rail. The I-11 is positioned to take advantage of current developments in international trade, and offers the potential to accommodate new economic activity related to the emerging manufacturing and trade relationship with Mexico. **Appendix E2** provides an inventory of freight, transit, and airport**.**

The Purple Alternative generates the highest increase in truck-related VMT between Nogales and Wickenburg compared to the No Build Alternative (21 percent), followed by the Green Alternative (15 percent). The changes in VMT indicate the Purple and Green Alternatives may be able to attract freight traffic from established freight routes, likely due to the shorter distances and travel times and the increased reliability and speeds. Freight traffic flows are a function of the shortest and fastest path.

Table 2-6 (Comparison of Vehicle Miles Traveled) summarizes how well the alternatives perform in relation to attracting and diverting traffic from existing roadways.

Table 2-6 Comparison of Vehicle Miles Traveled

Key Metrics		Alternatives			
Purpose and Need	Metric	No Build	Purple	Green	Orange
Need: System Linkages and Regional Mobility: The lack of a north-south interstate freeway link in the Intermountain West constrains trade, reduces access for economic development, and inhibits efficient mobility. **Purpose:** Connect metropolitan areas and markets in the Intermountain West with Mexico and Canada through a continuous, high-capacity transportation corridor.	Effectively attracts/diverts traffic from existing roadways as measured by: Percent increase in VMT in the Study Area compared to the No Build Alternative. Percent increase in truck VMT in the Study Area compared to the No Build Alternative.	No diversion of vehicles or trucks.	5% increase in combined passenger vehicles and truck VMT. 21% increase in truck VMT over the No Build Alternative.	4% increase in combined passenger vehicles and truck VMT. 16% increase in truck VMT over the No Build Alternative.	2% increase in combined passenger vehicles and truck VMT. 2% increase in truck VMT over the No Build Alternative.

2.4.4 Access to Economic Activity Centers

Table 2-7 (Access to Economic Activity Centers) summarizes the number of key economic centers for the No Build Alternative and the Build Corridor Alternatives.

Table 2-7 Access to Economic Activity Centers

Key Metrics		Alternatives			
Purpose and Need	**Metrics**	**No Build**	**Purple**	**Green**	**Orange**
Need: Access to Economic Activity Centers: Efficient freeway access and connectivity to major economic activity centers is required to operate in a competitive economic market. **Purpose:** Enhance access to the high-capacity transportation network to support economic vitality.	Serves key economic centers (number of economic activity centers)	9 total - 5 existing centers 4 emerging centers I-10 and I-19	14 total - 7 existing centers primarily near I-10 7 emergency centers	10 total - 6 existing centers primarily near I-10 4 emerging centers	15 total - 8 existing centers primarily near I-10 7 emerging centers

Economic activity centers in relation to the Build Corridor Alternatives are shown on **Figure 2-16** (Economic Centers and Build Corridor Alternatives). The Orange Alternative provides the most access to economic activity centers, followed by the Purple Alternative.

2.4.5 Capital, Operations and Maintenance Costs

Capital costs were developed to compare the alternatives using 2017 dollars, and include ROW acquisition, materials, and construction. In addition, operations and maintenance costs were developed for each Build Corridor Alternative. The Orange Alternative (approximately $3.1 billion) is substantially less costly to build than the Green or Purple Alternatives (approximately $7.2 billion and $7.3 billion, respectively) because the Orange Alternative would use the most existing highway ROW and expand the most linear miles of existing highway infrastructure compared to the Purple and Green Alternatives that would require construction of more new highway infrastructure in new locations. **Table 2-8** (Summary of Capital Costs) provides a summary of the capital costs associated with each of the options that constitute the Purple, Green, and Orange Build Alternatives.

Table 2-8 Summary of Capital Costs

Option	Purple Build Alternative (A,C,G,I1,I2,L,N,R,V)	Green Build Alternative (A,D,F,I2,L,M,Q2,R,U)	Orange Build Alternative (A,B,G,H,K,Q,S)
A	$0	$0	$0
B			$585,899,000
C	$2,371,714,000		
D		$2,082,061,000	
F1		$1,117,072,000	
F2		$799,298,000	
G	$0		$0
H			$0
I1	$425,705,000		
I2	$233,464,000	$233,464,000	
K			$466,842,000
L	$252,613,000	$252,613,000	
M		$568,067,000	
N	$1,186,438,000		
Q1			$263,697,000
Q2a		$67,876,000	$67,876,000
Q2b		$242,124,000	$242,124,000
Q3a			$60,713,000
Q3b			$351,700,000
R	$796,206,000	$796,206,000	
S			$1,097,388,000
U		$1,113,019,000	
X	$1,148,697,000		
TOTAL COST	**$6,414,837,000**	**$7,271,800,000**	**$3,136,239,000**

Annual operations and maintenance (O&M) costs for each Build Corridor Alternative are shown in **Table 2-9** (Preliminary Cost Estimates for Build Corridor Alternatives). O&M costs were estimates using ADOT's latest fiscal year data for interstate highway maintenance cost per lane mile.

Table 2-9 Preliminary Cost Estimates for Build Corridor Alternatives

Alternative	Capital Cost (Billions)	Operations and Maintenance Cost (Millions)
Purple Alternative	$6.4	$23.1
Green Alternative	$7.3	$20.9
Orange Alternative	$3.1	$31.2

2.4.6 Homeland Security and National Defense

Table 2-10 (Alternate Routes to Existing Interstate Freeway) shows where each Build Corridor Alternative provides an alternate route to an existing interstate freeway. The Purple and Green Alternatives provide an alternate route to an existing interstate highway for most of their lengths. The Orange Alternative only provides an alternate route in the North Section.

Table 2-10 Alternate Routes to Existing Interstate Freeway

Key Metrics		Alternatives		
Purpose and Need	**Section**	**Purple Alternate Route to Existing Interstate Freeway?**	**Green Alternate Route to Existing Interstate Freeway?**	**Orange Alternate Route to Existing Interstate Freeway?**
Need: Homeland Security and National Defense: Alternate interstate freeway routes help alleviate congestion and prevent bottlenecks during emergency situations. These routes may be parallel or may generally serve the same major origin and destination points, with local or regional roads connecting the freeway routes in various places. **Purpose:** Provide for alternate regional routes to facilitate efficient mobility for emergency evacuation and defense access.	South Section	**A NO** (co-located with I-19)	**A NO** (co-located with I-19)	**A NO** (co-located with I-19)
		C YES	**D YES**	**B NO** (co-located with I-19/I-10)
		G NO (co-located with I-10)	**F YES**	**G NO** (co-located with I-10)
	Central Section	**I1 YES**	**I2 YES**	**H NO** (co-located with I-8)
		I2 YES (co-located with local arterials)	**L YES (co-located with local arterials)**	**K NO** (co-located with I-8)
		L YES	**M YES**	**Q1 NO** (co-located with SR 85)
		N YES	**Q2 YES** (co-located with SR 85)	**Q2 NO** (co-located with SR 85)
		R YES	**R YES**	**Q3 NO** (co-located with SR 85/I-10)
	North Section	**X YES**	**U YES**	**S YES**
	End-to-End	Yes for 7 out of 9 Options	Yes for 8 out of 9 Options	Yes for 1 out of 9 Options

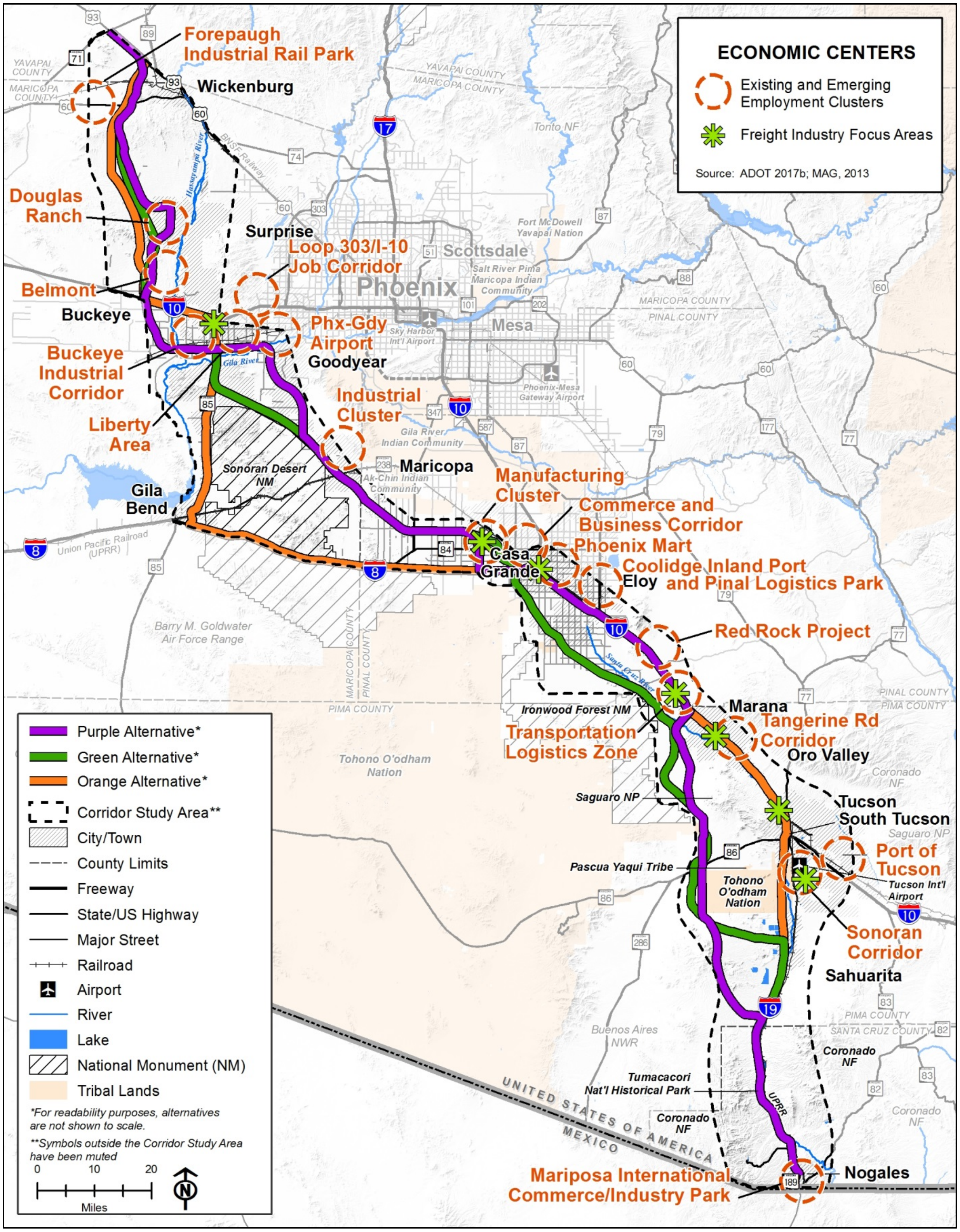


Figure 2-16 Economic Centers and Build Corridor Alternatives

Within the Study Area, there are few continuous north-south facilities. Existing and future congestion levels on I-19, I-10, and other major state roads may inhibit the ability to efficiently and safely move traffic during an incident. Alternate routes are a key response strategy to manage traffic demand during weather incidents or accidents and in cases of natural disasters, they may serve as evacuation routes. Major traffic crashes, emergency access needs, environmental disasters (e.g., dust storms, floods, wildfires), security-related issues, or other events could require full road closures. Alternate routes can strengthen defense movements, international traffic movement, and border security.

2.5 Future Corridor Opportunities

The last few years have seen a breakthrough for emerging transportation technologies, with policy frameworks adopted at both federal and state levels for autonomous vehicles. Emerging technologies can be divided into two categories: (1) technologies that are in fairly advanced stages of development and are likely to be available for mass consumption in the relatively near term (e.g., electric vehicles, autonomous vehicles); and (2) technologies that are in conceptual stages and will need more research and engineering before they become economically viable (e.g., Hyperloop).

These emerging technologies could change the operations of transportation systems globally, and will require advance thought and preparation to begin integrating the required systems into our existing and new infrastructure projects. This section outlines potential emerging transportation technologies that could eventually be integrated into the design of I-11.

The Draft Tier 1 EIS environmental resource analysis will not evaluate technologies that may use the transportation corridor. However, emerging technology trends, such as autonomous/connected vehicles and truck platooning, may impact traffic volumes, travel times, average speeds, and safety, which could impact the corridor footprint or defer some capacity improvements. Over time, statewide and regional travel demand models would need to be recalibrated to account for these travel trends. For example, if one of these emerging technologies becomes a dominant travel trend before I-11 is constructed, the Tier 2 environmental studies would update the approach and data regarding travel demand modeling and travel patterns.

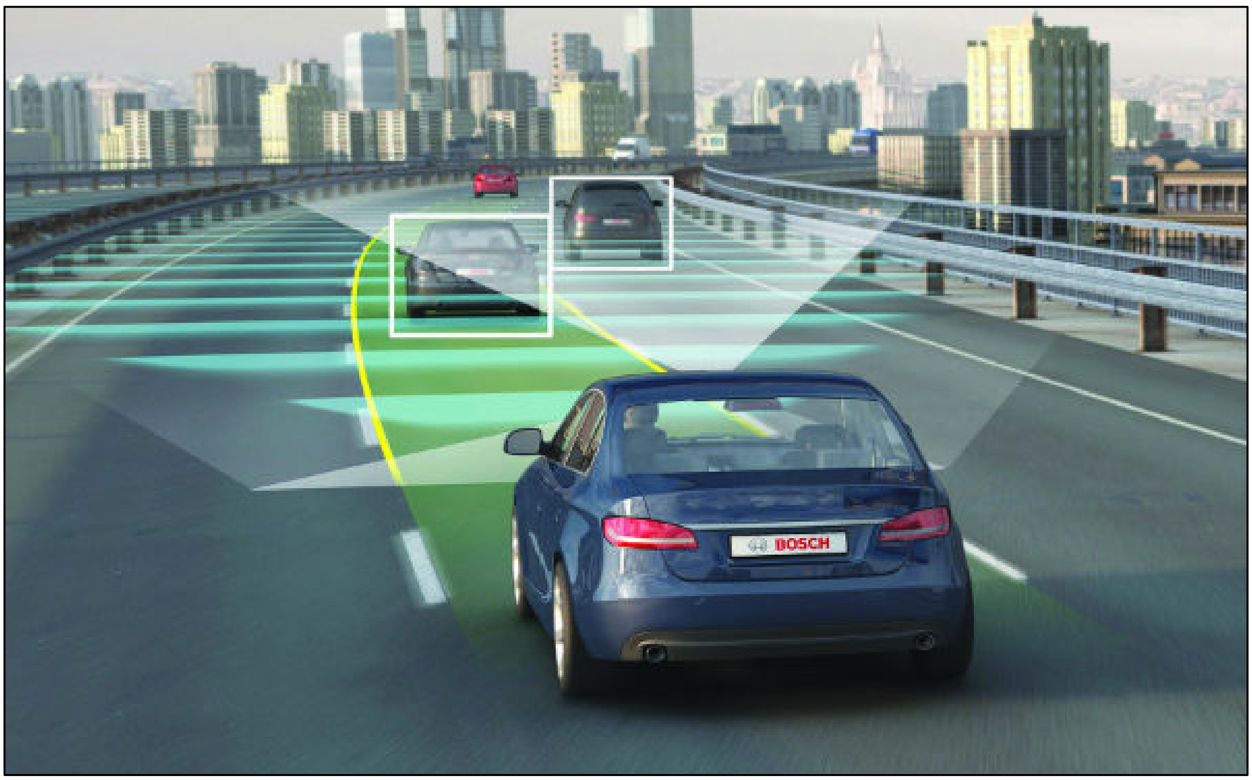
2.5.1 Autonomous Vehicles

Autonomous vehicles are vehicles that have the capability to operate without active physical control or monitoring by a human operator. Autonomous vehicles have the capability to make decisions based on information they are able to gather from the environment around them, either by onboard sensors or other communication devices outside the vehicle. This type of technology is expected to have major implications for safety, convenience, and the planning and design of the physical environment. The National Highway Traffic Safety Administration defines five levels of autonomy for vehicles, where level 0 has no automation and the driver is in complete control: The other levels are described as follows:

- **Levels 1 and 2**: These two levels have driver assist features that can assist with guidance and allow drivers to make better decisions.
- **Level 3**: The vehicle can be in full control for some situations but requires an operator to be able to take control at any time.

- **Levels 4 and 5**: The vehicle is in full control at these levels and can operate with or without occupants.

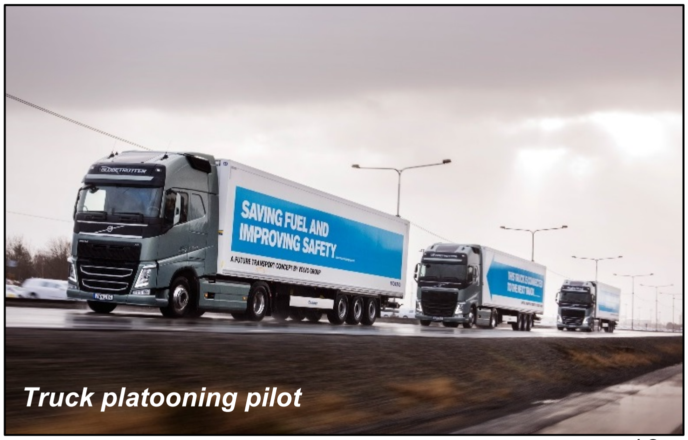
Currently, consumer vehicles have limited automated technologies integrated into their systems and generally operate at levels 1 and 2 of autonomy. Many manufacturers are testing level 3 technologies that allow the vehicle to be in full control in some circumstances, while an operator is available to take control. TuSimple, a company in Tucson, has been testing Level 4 Class 8 autonomous trucks since 2018 and recently began generating revenue hauling freight for commercial carriers in Arizona (Office of the Governor Doug Ducey 2018). Nikola Motor Company announced in 2018 that they will build a $1 billion hydrogen-electric semi-truck manufacturing operation in the central portion of the Study Area, which will manufacture level 5 autonomous trucks. The company plans to break ground in Coolidge, Arizona (Khairalla 2018).



Many of the near-term goals for autonomous vehicles involve improving the safety of our transportation systems. Manufacturers are developing vehicle systems that include automated technologies to better control speed and vehicle positioning, and that also provide drivers with information on their surroundings. Many roadway owners (state departments of transportation) also are investigating improvements to their infrastructure to include devices that can communicate with vehicles to provide better information for driver decisions. This is the case within the Study Area. Recently investors have committed $80 million to build Belmont, a new "smart city," expected to feature accommodations for self-driving cars.

In the long term, autonomous technologies are anticipated to have a much larger impact on safety. The National Highway Traffic Safety Administration conducted a study and found that 94 percent of accidents were caused by human error, where mistakes that drivers made led directly to accidents. The American Automobile Association estimates that autonomous vehicles could reduce accidents by 90 percent and save more than $190 billion in costs related to vehicle accidents by 2050. This is because vehicles will have more information from the onboard sensors as well as external communication devices that many roadway owners are aiming to install now to enable better and faster informed decisions.

2.5.2 Truck Platooning



Truck platooning pilot

Truck platooning refers to a number of trucks equipped with state-of-the-art driving support systems that allow the trucks to safely and closely follow each other. In this "platoon" the trucks communicate and are driven by smart technology.

Truck platooning, which is a variation of self-driving vehicle technology, adds vehicle-to-vehicle communications to enable Cooperative Adaptive Cruise Control, using the forward-looking radar sensors and electronic actuation of the engine and brakes of the conventional Adaptive Cruise Control system, and also adds vehicle-to-vehicle communications (using Dedicated Short Range Communications) that enable the implementation of a smoother, closer following vehicle control system. This system allows trucks to drive safely and smoothly at shorter gaps than they can under conventional manual driving. Potential benefits in efficiency include better utilization of the highway through increased throughput and improved fuel economy (and lower operating costs) due to the aerodynamic effects of closer vehicle spacing. This technology is in advanced stages of development and is being proposed for deployment in a few years. FHWA is currently investigating the technology, the perception of other road users, and the policy implications of truck platooning.

2.5.3 Electric Vehicle Infrastructure

Electric vehicle adoption by consumers has dramatically increased in the last few years, owing to technology advancements and the reduction in the cost of batteries. Forecasts predict an increase in sales of electric vehicles from a record 1.1 million worldwide in 2017 to 11 million in 2025, and then a surge to 30 million in 2030 as they become cheaper to make than internal combustion engine cars. By 2050, 55 percent of all new car sales are predicted to be electric vehicles. Electric vehicle technology is being rapidly adopted in public transportation, with major transit agencies committing to fully electric bus fleets within the next decade.

City governments are already facing the challenge of quickly developing an Electric Vehicle Ecosystem (including facilities for plug-in charging, electric catenary, and other forms of vehicle powering technologies) while partnering with roadway owners, energy utility providers, technology developers, and operators.

FHWA established a national network of alternative fueling and charging infrastructure along national highway system corridors to support expansion of this technology. All interstate corridors in Arizona (including I-8, I-10, and I-19) are included in this national network of alternative fuel corridors.

2.5.4 Electrified Highways

The growth of electric vehicles has been limited by motorists' concerns over vehicle range and charging infrastructure. Inductive charging greatly reduces the need for large-sized batteries by providing a continuous electricity source in the pavement of a roadway. The system sets up an alternating electromagnetic field from which an induction coil harvests power. Technology advancements now make it possible to charge vehicles as they drive along the electric track at highway speeds. Pilot projects along test tracks in France and Israel have tested this technology and found it to be feasible. This technology allows the vehicles to charge the batteries as they drive, making it possible to make do with much smaller and more affordable batteries. Due to the high cost of installation of in-road electric infrastructure, this technology makes the most sense along high-traffic routes through a city.

Electric Highway Concept Drawing

2.5.5 Solar Roadways

Solar highways use the surface of the roadway to generate electricity using solar energy. The roadway is made of a transparent concrete on top, solar panels underneath, and an insulation material as the base. The energy generated from solar highways can be used to keep street lights running, provide power a snow-melting system, or can be fed back into the electricity grid. The solar roadway is prohibitively more expensive (approximately $75 per square foot) than a regular asphalt roadway (approximately $5 per square foot), and has therefore only been experimentally implemented as pilot projects in China and France.

This technology is under development by the US Department of Transportation (USDOT) and could pay for the cost of the solar panels, thereby creating a road that would pay for itself over time. Lights could be added to "paint" the road lines from beneath, lighting up the road for safer nighttime driving and easily allowing changes in striping to respond to construction activities, incidents, or demand-based changes to manage traffic during peak commuting periods. Alternatively, the road could change colors as a warning sign for wildlife crossings or for notification of emergency vehicles. As vehicle-to-infrastructure communication evolves, roadways may "speak" to cars to warn of oncoming obstacles, such as crashes or construction zones.

2.5.6 Hyperloop

Hyperloop operates in a tube with a low-pressure environment, allowing speeds of up to 600 mph. Hyperloop works by loading passenger and cargo into a pod that lifts above a track using magnetic levitation. It then accelerates gently and gradually, using an electric motor, gliding silently inside the low-pressure tube at extremely high speeds. A nearly 1-mile Hyperloop test track for SpaceX is being constructed in California. Hyperloop One in Nevada is developing another test track, focusing on eventually using the technology for long-distance travel (in excess of 300 miles). Arrivo, another company focusing on development of the Hyperloop technology, is developing a Colorado test track for transportation of passengers, vehicles, and freight pallets on pods for shorter regional distances.

The key advantages of the Hyperloop technology are the ability to travel at extremely high speeds, emissions-free transportation, and autonomous travel mode. This is a developing technology that is expected to continue to evolve over the next several years before it is commercially available for implementation along major transportation corridors. Hyperloop includes more stringent horizontal design criteria than roadways (e.g., much wider turning curvature), but also has the opportunity to run at ground level or be elevated on piers to more easily account for vertical grade differences over long distances.