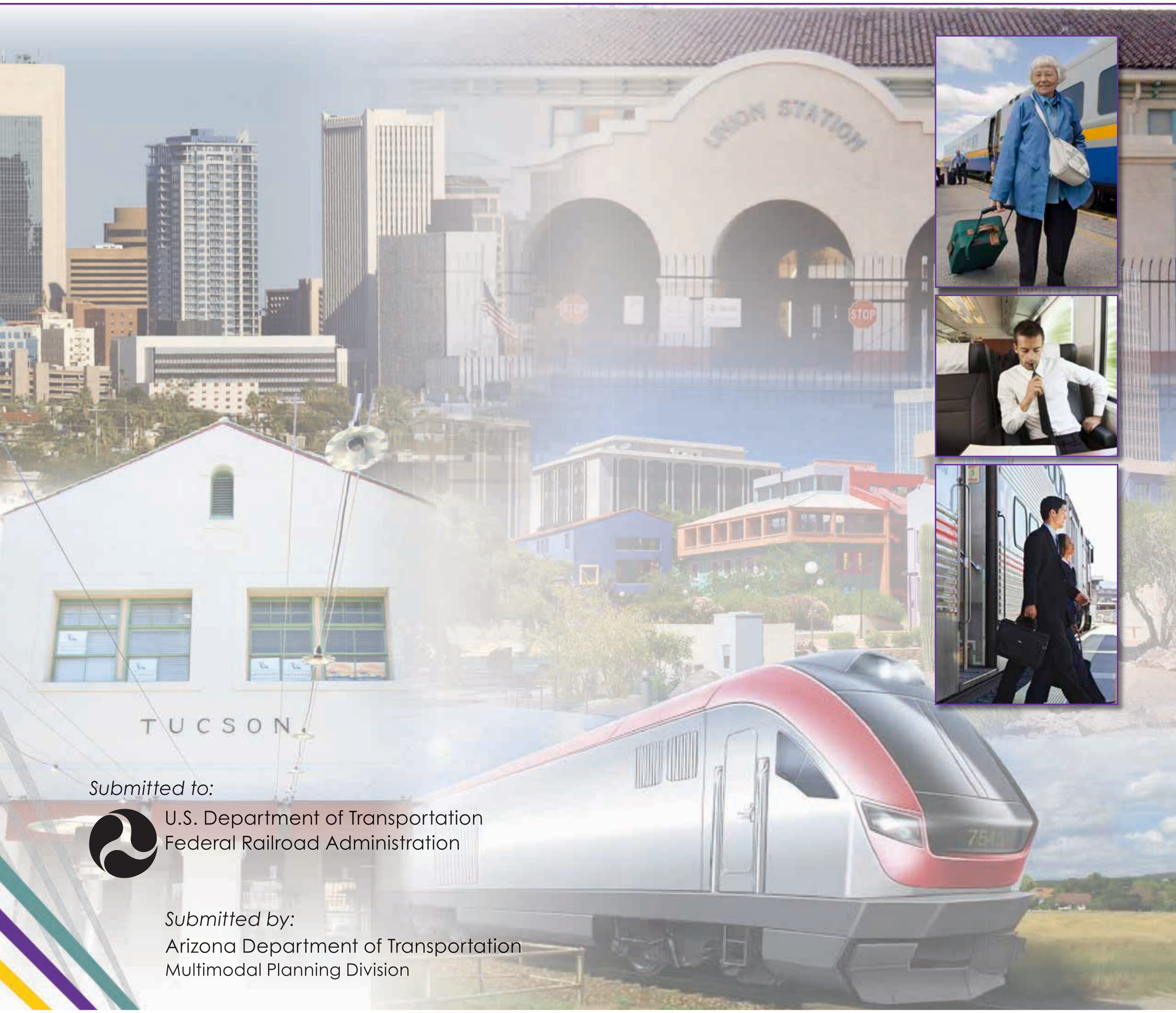
ARIZONA PASSENGER RAIL CORRIDOR STUDY
Tucson to Phoenix

Final Tier 1 Environmental Impact Statement

December 2016



Submitted to:

U.S. Department of Transportation
Federal Railroad Administration

Submitted by:

Arizona Department of Transportation
Multimodal Planning Division

ARIZONA PASSENGER RAIL CORRIDOR STUDY: TUCSON TO PHOENIX

Final Tier 1 Environmental Impact Statement

Submitted pursuant to the National Environmental Policy Act (42 USC 4321 et seq.); Federal Railroad Administration Procedures for Considering Environmental Impacts (64 FR 28545, May 26, 1999); Council on Environmental Quality's regulations implementing NEPA (40 CFR parts 1500-1508); Federal Transit Administration's Environmental Impact and Related Procedures (23 CFR Part 771).

by the
Federal Railroad Administration

Sponsoring Agency
Arizona Department of Transportation

Cooperating Agencies
Federal Transit Administration
Federal Highway Administration

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This Final Tier 1 Environmental Impact Statement (EIS) considers development of a passenger rail system to provide an alternate travel mode that would reduce travel times and improve service reliability between Tucson and Phoenix by providing intercity and commuter rail service. This Final Tier 1 EIS evaluates the potential effects of a passenger rail system within alternative corridors on land use, socioeconomic conditions, environmental justice, public health and safety, parklands, Section 4(f) and Section 6(f) resources, air quality, noise and vibration, hazardous materials, geology and topography, biological resources, water resources, energy use and climate change, visual and scenic resources, and cultural resources.

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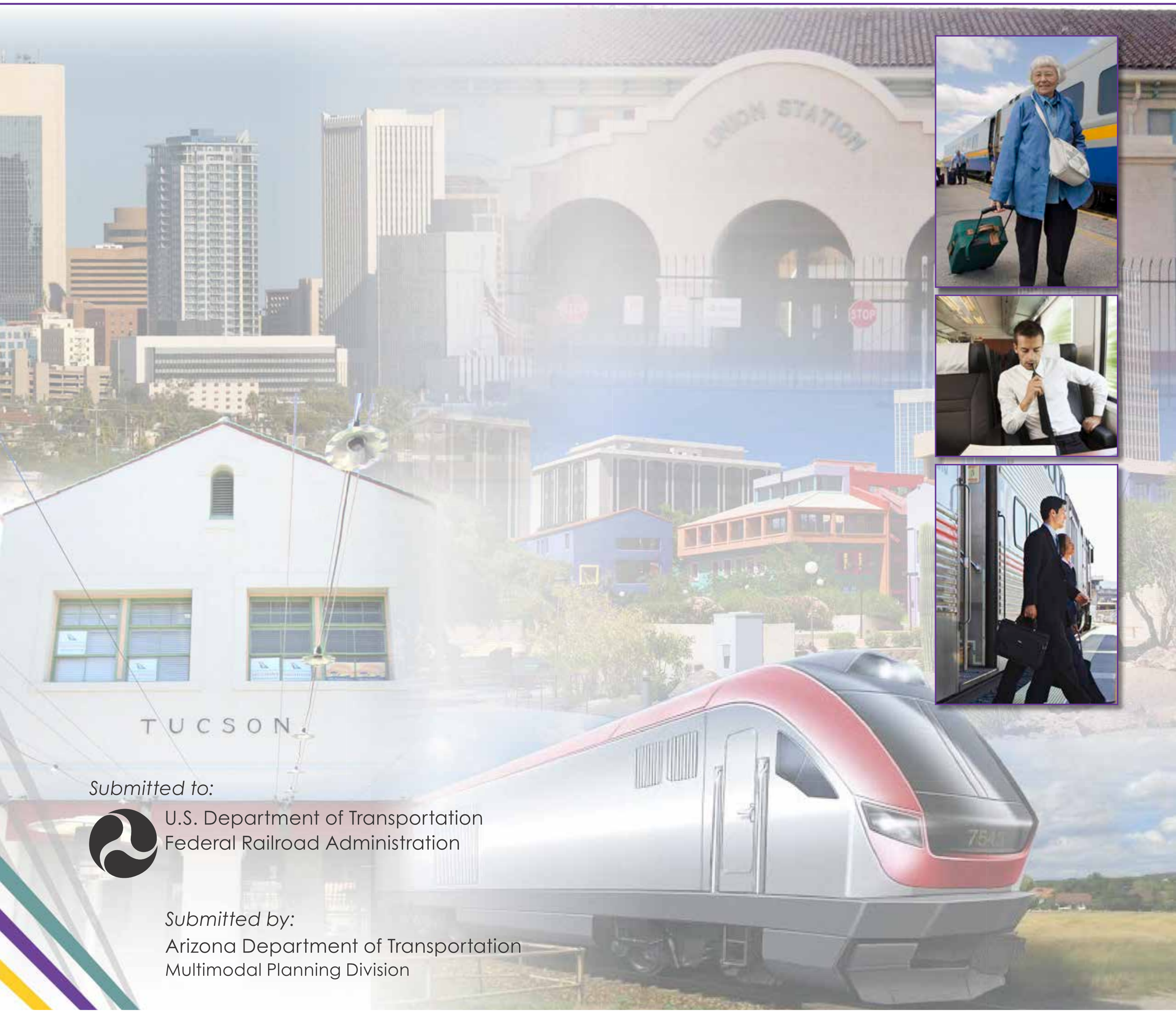

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Tucson to Phoenix

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Abbreviations, Acronyms, and Short Forms

AA	Alternatives Analysis
ACS	American Community Survey
ADA	Americans with Disabilities Act
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
ALRIS	Arizona Land Resource Information System
AMA	Active Management Area
amsl	above mean sea level
APRCS	Arizona Passenger Rail Corridor Study
APTA	American Public Transportation Association
A.R.S.	Arizona Revised Statutes
ASLD	Arizona State Land Department
ASTM	American Society for Testing and Materials
AWLW	Arizona Wildlife Linkages Workgroup
AZGS	Arizona Geological Survey
AZPDES	Arizona Pollutant Discharge Elimination System
AZTDM2	Arizona Statewide Travel Demand Model version 2
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	best management practice
BRT	bus rapid transit
BTU	British thermal unit
C	candidate (ESA)
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CAG	Central Arizona Governments
CAP	Central Arizona Project
CART	Central Arizona Regional Transit
CCA	candidate conservation agreement
CCAA	candidate conservation agreement with assurances
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CH_4	methane

CLS	Conservation Lands System
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
Corps	United States Army Corps of Engineers
Council	Advisory Council on Historic Preservation
CST	Corridor Support Team
CTPP	Census Transportation Planning Package
CWA	Clean Water Act
D	delisted (ESA)
dB	decibel(s)
dBA	A-weighted noise level in decibels
DHHS	Department of Health and Human Services
DMU	diesel multiple unit
DVD	digital video disc
E	endangered (ESA)
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMU	electric multiple unit
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
et seq.	and the following (Latin *et sequentes or et sequentia*)
^{o}F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FPPA	Farmland Protection and Policy Act
FR	Federal Register
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FY	fiscal year
GBN	ground borne nose
GBV	ground borne vibration
GHG	greenhouse gas
GIS	geographic information system
GRIC	Gila River Indian Community

HS	harvest restricted (native plants)
HOV	high occupancy vehicle
I-10	Interstate 10
L1UB	Lacustrine Limnetic Unconsolidated Bottom (wetland)
L2UB	Palustrine Littoral Unconsolidated Bottom (wetland)
L_{dn}	day night noise level
LEP	limited English proficiency
L_{eq}	equivalent noise level
L_{max}	maximum pass by sound level
LQG	large quantity generator
LUST	leaking underground storage tank
LWCF	Land and Water Conservation Fund
MAG	Maricopa Association of Governments
MBTA	Migratory Bird Treaty Act
MF	multi family
MJ	Megajoule
MOA	memorandum of agreement
mpg	miles per gallon
mph	miles per hour
MPO	metropolitan planning organization
MSATs	mobile source air toxics
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRPR	Natural Resources, Parks and Recreation (Pima County)
NWI	National Wetland Inventory
NWP	Nationwide Permit
O_3	ozone
OHWM	ordinary high water mark
OU	operating unit

P&R	Parks and Recreation Department
PA	programmatic agreement
PAG	Pima Association of Governments
Pb	lead (chemical element)
PCAQCD	Pinal County Air Quality Control District
PE	proposed for listing as endangered (ESA)
PEL	Planning and Environmental Linkages
PEM	Palustrine Emergent (wetland)
PFO	Palustrine Forested (wetland)
PHX	Phoenix Sky Harbor International Airport
PKT	passenger kilometer traveled
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns
PM_{10}	particulate matter less than or equal to 10 microns
ppb	parts per billion
ppm	parts per million
PSS	Palustrine Scrub Shrub (wetland)
PUB	Palustrine Unconsolidated Bottom (wetland)
R2UB	Riverine Lower Perennial Unconsolidated Bottom (wetland)
R2US	Riverine Lower Perennial Unconsolidated Shore (wetland)
R4SB	Riverine Intermittent Streambed (wetland)
R4SBAx	Riverine Intermittent Streambed Temporarily Flooded Excavated (wetland)
R4SBJ	Riverine Intermittent Streambed Intermittently Flooded (wetland)
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Condition
ROW	right-of-way
RMS	root-mean-square (velocity of gas particles)
RS	Recreation Services (City of Tempe)
S	sensitive (species)
SAFETEA LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
SCMPO	Sun Corridor Metropolitan Planning Organization
SDCP	Sonoran Desert Conservation Plan
SO_2	sulfur dioxide
SF	single family
SHPO	State Historic Preservation Office
SR	salvage restricted (native plants)
SR	State Route

SRP-MIC	Salt River Pima-Maricopa Indian Community
spp.	species (plural)
ssp.	Subspecies
STOPS	Simplified Trips-on-Project Software
SWPPP	Stormwater Pollution Prevention Plan
T	threatened (ESA)
TCP	traditional cultural property
THPO	Tribal Historic Preservation Office
TIP	Transportation Improvement Program
Title VI	Title VI of the Civil Rights Act of 1964
TMDL	Total Maximum Daily Load
TNW	traditional navigable water(s)
TRI	toxic release inventory
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
TUS	Tucson International Airport
U.S.C.	United States Code
UP	Union Pacific Railroad
US	United States
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
USDOT	United States Department of Transportation
var.	variety
VASR	Visual and Aesthetic Scenic Resources
VdB	vibration decibel(s)
VHT	vehicle hours travelled
VMT	vehicle miles travelled
VOC	volatile organic compounds
Waters	Waters of the United States
WSC	Wildlife of Special Concern (in Arizona)

Preface

The Arizona Department of Transportation, through numerous planning studies, has identified the corridor defined by Phoenix and Tucson, the state's two most populous metropolitan areas, for investigating potential passenger rail service in the state. This Tier 1 Environmental impact Statement (EIS) documents the potential environmental effects of constructing and operating a passenger rail system within alternative corridors considered in the Arizona Passenger Rail Corridor Study (APRCS), which was undertaken to investigate faster and more reliable travel modes between these two cities and intervening points.

The Tier 1 EIS is one of three documents created to satisfy the project planning requirements of the lead and cooperating agencies for the APRCS. The Federal Railroad Administration is the lead agency, and the Federal Transit Administration and Federal Highway Administration are cooperating agencies for the Tier 1 EIS. In accordance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq*., the EIS looks at the effects that constructing and operating a passenger rail system would have on the natural, built, and social environment. It examines several alternative solutions developed to meet a recognized transportation need, so that decision makers can compare the environmental effects of two corridor alternatives and the No Build Alternative. The other deliverables of the APRCS, an Alternatives Analysis (AA) and a Service Development Plan (SDP), examine planning, operational, and funding issues in greater detail than normally reported in an EIS.

This document describes the potential environmental consequences of a passenger rail system within corridors each extending up to 1.0 mile in width. It considers the environmental context of each corridor alternative, relative to the intensity of effects anticipated from construction and operation of the proposed rail system. The EIS discloses both what is known and, to the extent practicable, what is not known about resources in the area, based on readily available data. The analysis discusses benefits as well as potential adverse impacts of implementing a rail system within each corridor alternative, as compared with taking no action.

The Draft Tier 1 EIS was circulated for public review and comment between September 11 and October 30, 2015, and has been updated and finalized as part of the NEPA process in response to comments received. The Final Tier 1 EIS is being published in conjunction with a Record of Decision documenting FRA's selection of a preferred corridor alternative and granting environmental clearance for further project development within the selected corridor.

In later phases, one or more design and construction projects for a passenger rail system will undergo Tier 2 environmental analysis. The Tier 2 NEPA document(s) will identify project-specific impacts and provide requirements for mitigating those impacts, allowing a project to be constructed.

Introduction to the Final Tier 1 Environmental Impact Statement

The Arizona Department of Transportation's (ADOT) current study of methods to move passengers between the cities of Tucson and Phoenix builds on work that ADOT and other agencies have undertaken in recent years. Because any project or projects resulting from this study would likely use federal funds, this Tier 1 Environmental Impact Statement (EIS) was prepared to satisfy the requirements of NEPA. NEPA requires federal agencies to consider the environment in their planning and decision-making through a systematic, interdisciplinary approach. Federal agencies assess the environmental impact of proposed actions and alternatives with the potential for significant effects on the environment.

FRA utilizes a "Tier 1" EIS to examine alternative corridors, rather than specific alignments, to guide decision-making, encourage coordination between agencies and jurisdictions, preserve right-of-way, and identify funding opportunities for future infrastructure projects. Taken together, the combined deliverables from the Arizona Passenger Rail Corridor Study (APRCS) provide the requisite analysis and preliminary engineering to complete an AA for FTA New Starts, along with a Tier 1 EIS and Service Development Plan for FRA.

This Tier 1 EIS was prepared in conjunction with a New Starts-compatible Alternatives Analysis (AA), to satisfy the Federal Transit Administration's (FTA) approach to selecting an alternative for implementation. New Starts is a capital investment grant program administered by FTA for new and expanded rail, bus rapid transit, and ferry systems in key corridors.

Two different transportation needs—intercity connectivity and commuter mobility—have been identified, and two federal agencies are funding the APRCS. FRA is the designated lead agency and FTA and the Federal Highway Administration (FHWA) are cooperating agencies for the EIS, with ADOT serving as the sponsoring agency. Each federal agency has its own process for moving a proposed project from an array of possible alternatives to a single alternative, although both fulfill the environmental evaluation principles stipulated by NEPA. The APRCS follows a process designed to meet both agencies' requirements for identifying a preferred alternative that would provide opportunities for intercity connectivity between Tucson and Phoenix while enhancing commuter mobility within the same study area.

Study Location

Arizona, in the southwestern United States (US), is the sixth largest state in area and fifteenth most populous. Future growth anticipated within Arizona's 114,000 square miles, however, can only take place within private developable land. Seventy (70) percent of Arizona is either public land managed by the Bureau of Land Management or Bureau of Reclamation or protected parkland, tribal land, or military facilities. State Trust land administered by the Arizona State

Land Department (ASLD) makes up another 13 percent and has the potential for future development, leaving only 17 percent of the state as private developable land.

Most of that area where growth could occur lies within a megaregion—a network of metropolitan areas that share environmental characteristics, infrastructure, economic linkages, development patterns, culture, and history—known as the Sun Corridor, where 86 percent of the state's population already resides. This megaregion extends northwest beginning in the south at Nogales, through Tucson and Phoenix, and up to Prescott. Over the last decade it has been one of the fastest growing areas in the country.

At the heart of the Sun Corridor lie three counties—Pima, Pinal, and Maricopa—containing Arizona's two largest cities, Tucson and Phoenix, and the developing region in between. For the APRCS, this most populous area of the state, which also happens to be the area where future growth is most likely to occur, was deemed most appropriate to be selected as the study area. This three county study area is strategic not only on a state level but also on a regional level. Phoenix is the sixth largest city in the US, in both population and land area. It is the only US city with a population above 1 million that is not served directly by an intercity or commuter rail system. Planned increases in vehicle carrying capacity on the study area roadway network are constrained by environmental and jurisdictional issues, while regional growth is projected to outpace and exceed the roadway network's planned optimum capacity.

Final Tier 1 EIS Contents

A detailed description of the transportation problem prompting this Study is contained in **Chapter 1, Purpose and Need.** Additionally, this chapter outlines the revisions made to the Draft Tier 1 EIS (DEIS), subsequent to public and agency review and FRA's selection of the preferred alternative, that resulted in the Final Tier 1 EIS (FEIS).

The corridor alternatives examined in the DEIS were selected from a broad range of alternatives potentially meeting the purpose and need for a high-capacity transportation connection. The extensive process by which these preliminary alternatives were narrowed is described in detail in **Chapter 2, Alternatives Considered**.

Chapter 3, Public Agency Coordination outlines the extensive outreach efforts that ADOT and the federal lead agency have conducted in conjunction with identifying the purpose and need for the study and developing alternative transportation solutions. This coordination included the DEIS being circulated for public and agency review and comment, and public hearings held as part of the NEPA process. A brief summary of comments received is included in this chapter as well.

Train and automobile trip durations, passenger service frequency scenarios, and conceptual rail station locations and their associated impacts on transportation within the region, along with the transportation impacts of the No Build alternative, are explored in **Chapter 4, Transportation Impacts**.

Many aspects of the natural, social, and built environment could be affected, either positively or adversely, both by building and by operating a passenger rail system within the corridor alternatives, and by *not* building one. These are methodically examined in **Chapter 5, Error! Reference source not found.**, following guidance established by both the study's federal lead agency, FRA, as well as guidance from FTA, for implementing NEPA. As stated above, the analysis of potential environmental effects was reported at a corridor-level in this Tier 1 EIS.

Chapter 6, Cost Analysis, provides capital and operation/maintenance cost estimates for a passenger rail system. Costs were estimated at a corridor level to provide decision-makers with order-of-magnitude information on the potential cost of building, operating, and maintaining a passenger rail system within the corridor alternatives.

Information contained in the APRCS AA, as well as in prior chapters of this Tier 1 EIS, is distilled and summarized in **Chapter 7, Comparison of Alternatives**. This chapter compares the three alternatives' potential performance with respect to environmental impacts, financial feasibility, ease of implementation, and operating characteristics. FRA used this information, as well as agency and public comments on the DEIS, to select and approve a preferred alternative for undertaking Tier 2 studies for passenger rail service between Tucson and Phoenix.

Chapter 8, Next Steps, outlines the further steps ADOT and the federal lead agency will need to take to advance the APRCS into design of one or more operable segments of a passenger rail system that could be developed as individual projects. Subsequent Tier 2 NEPA documentation involving more detailed technical analysis of environmental conditions, impacts, and mitigation, would be undertaken at the project level.

The **appendices** of the FEIS contain comments on the DEIS and responses, background data, and technical information. The first two appendices consist of agency and public comments received on the DEIS, along with FRA's responses to those comments. Subsequent appendices are arranged alphabetically, and correspond either to the name of an environmental resource section in **Chapter 5**, or to another EIS chapter. An exception to this is the *Corridor Aerial Atlas Appendix*, consisting of 91 annotated aerial maps of the 1-mile-wide Yellow and Orange corridor alternatives that were studied in detail in the Tier 1 EIS over their entire length.

References in the EIS text to chapters, figures, tables, or sections contained within the EIS appear in bold type, while EIS appendix names are italicized, and EIS appendix table and figure numbers are indicated in plain type.

1 Purpose and Need

As part of its mission to provide a safe, efficient, cost-effective transportation system, the Arizona Department of Transportation (ADOT) wishes to serve commuter and intercity travel needs and enhance travel opportunities within Maricopa, Pima, and Pinal counties. Statewide and regional transportation planning efforts undertaken from 2007 to 2010 ("Building a Quality Arizona," or bqAZ) have recommended implementing passenger rail to add travel capacity to what highways already provide. For this reason, ADOT is studying passenger rail service options between the cities of Tucson and Phoenix to provide more travel choices in this 115-mile-long corridor. Passenger rail service would provide an alternative travel mode and would reduce travel times over highway travel. By providing an alternative to private single-passenger vehicle travel within the study corridor, passenger rail would avoid traveler delays caused by highway congestion, enhance highway safety, and reduce pollutant emissions on Interstate 10 (I-10).

ADOT's 2010 Statewide Rail Framework Study (ADOT 2010) and 2011 State Rail Plan (ADOT 2011) include a passenger rail vision for the state. The first step in the implementation of the plan would be to link Tucson and Phoenix, the state's largest metropolitan areas. Both the State Rail Plan and the 2010 Statewide Rail Framework Study (ADOT 2010) showed that of all possible locations within Arizona, a passenger rail line between the Tucson and Phoenix metropolitan areas would serve the most people. Such a line could connect communities within the region and form the starting point for later rail connections to other regions.

The Federal Railroad Administration (FRA) is leading this Arizona Passenger Rail Corridor Study (APRCS): Tucson to Phoenix (also referred to as "the study" in this document). FRA provides financial and technical assistance for intercity passenger rail systems (focusing on regional trips). FTA, which is serving as a cooperating agency on the APRCS, provides financial and technical assistance to local public transit systems, including commuter rail. Because the APRCS addresses both intercity travel and commuter transit trips, both FRA and FTA have a role in project planning. The Federal Highway Administration (FHWA) provided guidance on the feasibility of using existing highways, such as I-10, as potential rail corridors since agency and public scoping identified existing highways such as I-10 as potential passenger rail corridors. This study examines and evaluates different route corridors between the Tucson and Phoenix areas.

As the federal lead agency, FRA is responsible for compliance with the National Environmental Policy Act of 1969 (NEPA) and determined that a Tier 1 Environmental Impact Statement was an appropriate document for examining the regional context of a future passenger rail system before focusing on the more detailed Tier 2 analysis that considers site-specific effects.

1.1 The Need for Passenger Rail Service

Between 1990 and 2010, the combined population of Maricopa, Pima, and Pinal counties increased by over 78 percent, according to the U.S. Census Bureau, from 2.9 million to nearly 5.2 million, with an over 61 percent increase between 1991 and 2010 in the number of nonfarm jobs. This three-county Study Area forms part of a clustered network of cities—a megaregion—known informally as the “Sun Corridor” (See **Figure 1-1**). Travel patterns, available transit services, and trip times indicate that the need to move people from one place to another is also growing. Based on population and travel forecasts, and the amount of available open land within the corridor, travel markets are expected to continue to grow in the future; however, opportunities to increase the carrying capacity of the region’s roadway network are limited.

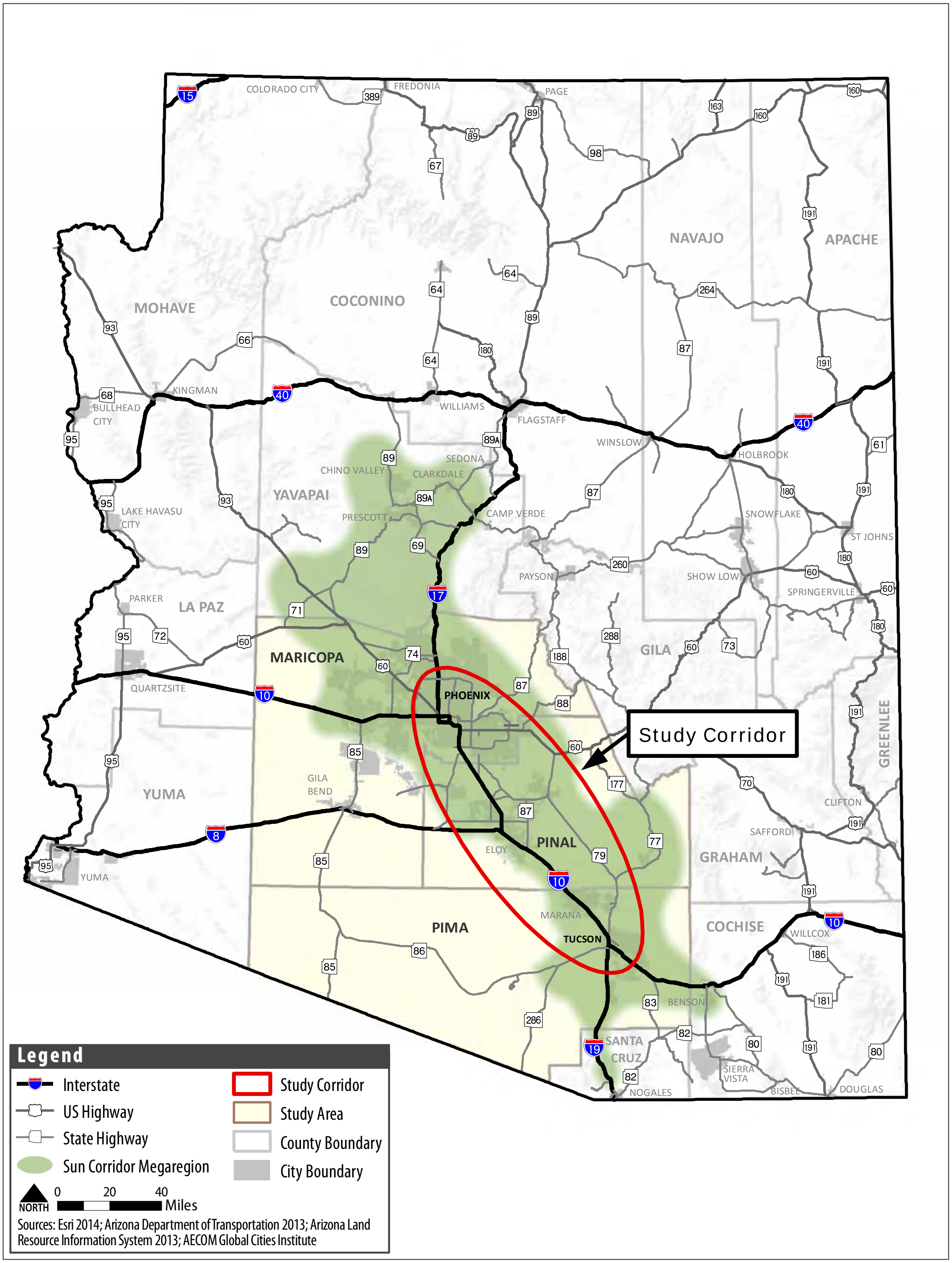
The Tucson and Phoenix metropolitan areas will continue to be major population and employment centers within the region. Most of Arizona’s developable land is situated between these cities, and development of this area is projected to form a continuous urban corridor connecting the metropolitan areas. As a result of recent and projected growth, the City of Casa Grande joined with the Pinal County communities of Eloy and Coolidge to form a new metropolitan planning organization (MPO), the Sun Corridor MPO, in 2013. With Arizona on a steady economic upswing after experiencing a downturn in the second half of the last decade, the increasing development in the corridor is projected to contribute to a need for increased commuter and intercity mobility within the corridor which will have to be addressed.

Travel between Tucson and Phoenix currently takes place almost entirely on I-10, the only high-capacity freeway between the two cities. Increasing congestion along this highway is lengthening travel times. Based on forecasts from studies conducted within this corridor, even a planned widening of the existing interstate to eight lanes and the construction of a planned new North-South Corridor will not provide adequate capacity to meet the expected demand in the year 2035 (ADOT 2007d, 2012).

As western Pinal County continues to develop, traffic congestion on area highways will cause an increase in travel times within the three-county Study Area. Considering the projected population growth and current travel patterns, **Table 1-1** illustrates trip lengths projected using the Arizona Travel Demand Model (version 2). These projected increases in travel time have the potential to discourage mobility of people and cargo, stifle productivity, and increase the cost of goods in the region.

Available transportation choices between Tucson and Phoenix are currently limited to private automobile, common carrier (bus), commercial flights, and ridesharing, with most travelers—commuter, regional, and intercity—using I-10. Despite recent widening of sections of the

Figure 1-1. State Map



interstate within the study corridor, motorists on I-10 experience severe congestion and traffic jams of increasing frequency and duration.

The growing demand placed on I-10 as the primary intercity route in the corridor—and the resulting congestion—will increase the likelihood of traffic collisions, which will further reduce the overall effectiveness and reliability of I-10 to serve commuter and intercity travel needs.

Table 1-1. 2010, 2035, and 2050 Travel Time Comparison for Trips in Study Corridor

Origin and destination (trip distance)	Congested travel time (minutes)[a]				
	2010	2035 baseline	Percent increase over 2010	2050	Percent increase over 2010
Apache Junction to Coolidge via US 60 (37 miles)	54	72	33%	97	80%
Eloy to Phoenix-Mesa Gateway Airport by way of I-10 (56 miles)	62	93	50%	122	97%
Phoenix to Marana (93 miles)	85	106	25%	134	58%
Marana to Tucson (25 miles)	33	43	30%	51	55%
Tucson to Phoenix by way of I-10 (116 miles)	113	142	26%	180	59%

[a] Estimated using Arizona Travel Demand Model, version.2 (AZTDM2).

Increasing capacity by adding lanes to this highway cannot be accomplished in some sections, and adding lanes may not be the best solution to address the anticipated demand. An alternative transportation mode, such as passenger rail, could help meet the demand of existing and future travel markets by providing additional transportation capacity that would help serve the increasing travel demand and not be affected by unpredictable highway conditions.

1.1.1 Commuter Travel Need

Demand for commuter services, where most travelers make a same-day round trip during peak commuting periods, exists within the Tucson and Phoenix metro areas. Ridership on other fixed-route transit systems serving these cities has exceeded projected figures. Demand for this type of service is expected to grow in the future, as population growth in the service area is projected to remain high over the next few decades.

The average trip to work within the study area has grown longer as residential development has spread from the major cities to outlying areas and as population growth has increased traffic congestion. As development in Pinal County proceeds, commuter activity will continue to expand in the areas between Tucson and Phoenix, with major daily commutes taking place between Pinal County and neighboring Maricopa and Pima counties. Emerging travel markets that would benefit from commuter service include:

- Tucson and suburban communities extending into Pinal County
- Phoenix and suburban communities extending into Pinal County
- Activity centers in Pinal County and the Tucson Metropolitan Area
- Activity centers in Pinal County and the Phoenix Metropolitan Area

US Census data indicate that Arizona's population grew by 81 percent between 1990 and 2010, from approximately 3.7 million to over 6.6 million. Projected population and job growth in the Sun Corridor are shown in **Table 1-2**. Only about 17 percent of the state's land is privately owned; because the majority of this private land is located within the Sun Corridor megaregion, population and employment growth are likewise focused in this region.

Table 1-2. Projected Population and Employment Growth within the Sun Corridor

	Maricopa County	Pima County	Pinal County
2010 Population	3,763,853	956,082	349,688
2035 Projected Population	5,684,351	1, 277,301	728,729
Percent Increase from 2010	51.0%	33.6%	108.4%
2010 Jobs	1,597,898	337,218	51,788
2035 Projected Jobs	2,636,798	472,599	244,096
Percent Increase from 2010	65.0%	40.1%	371.3%

Sources: US Census Bureau, Arizona Department of Administration, Office of Employment and Population Statistics 2014, US Bureau of Labor Statistics **(Population); and Maricopa Association of Governments, Pima Association of Governments, and Central Arizona Governments geographic growth forecasts (Jobs)**.

In Pinal County, high-density activity centers are expected to develop to serve the substantial infill of population and employment, in keeping with the region's long-range plans. Within the 2035 planning horizon, daily travel to these Pinal County activity centers from Maricopa and Pima counties will add to the region's total mobility needs. The overall increase in travel demand within the corridor will further tax a transportation system that already exceeds its capacity.

Recent regional travel conditions are represented by the following:

- A 2008 photo license plate survey of highway vehicles conducted by the Maricopa and Pima Associations of Governments (MAG and PAG, respectively), indicated that more than 51,000 daily trips were observed on I-10 and State Route (SR) 79, two primary north-south roads in the study area. Of these trips, 22 percent (11,220) completed a commute-type trip, where the vehicle traveling from one county to the next was observed returning at the same location.
- Data from the Census Transportation Planning Package (CTPP) from 2006-2010 indicate that daily inter-county commute trips within the three counties exceeded 80,000. Daily commute trips from Maricopa County to Pima County (i.e., Phoenix metropolitan area to Tucson metro area) averaged 2,565, and commute trips in the reverse direction numbered 2,375. The commute from Pinal County to Maricopa County represented about 72 percent of all the inter-county commute trips (57,600), with the second most frequent trip (11,570) being in the reverse direction, between Maricopa and Pinal counties, representing about 14 percent of all inter-county commute trips. By 2035, as Pinal County's employment is anticipated to more than double, the trips between Pinal and Maricopa counties could be expected to increase accordingly. About 2.6 percent of commuters in the United States are “super commuters,” travelling at least 50 miles one way (US Department of Transportation, Bureau of Transportation Statistics 2014). In Phoenix, the number of super commuters approaches 8.6 percent; and the most heavily traveled route in the Unites States among super commuters is the trip from Tucson to Phoenix (Nusca 2012). Meanwhile, Phoenix is the only metropolitan area in the United States with a population over 1 million without a commuter or regional passenger rail system.

1.1.2 Intercity Travel Need

Travel between Tucson and Phoenix for non-work purposes also accounts for many trips. As population and travel demand grow, intercity travel by auto and air will suffer from increasing congestion and time delays—especially in metropolitan areas, at and around airports, and on weekends and holidays. This decline in transportation service and the quality of the travel experience adversely affects intercity travelers, other users of the system, commercial carriers, and the general public.

As shown in **Table 1-1**, a statewide demand model indicates the duration of a trip from Phoenix to Tucson will increase by 59 percent by 2050, from under 2 hours to 3 hours, even if I-10 is widened to eight lanes between these cities and the proposed North-South Corridor multimodal facility between East Mesa and Eloy is constructed and opened.

Round-the-clock bus and flight schedules currently offered by private carriers between Tucson and Phoenix show that demand exists for a transportation solution other than the automobile that offers convenient, safe, and reliable intercity travel between these two metropolitan areas.

1.1.3 Need for Improved Connectivity within the Region and Beyond

Several modes of passenger service—both intercity and commuter—are currently available in the Tucson to Phoenix corridor, including conventional intercity rail (Amtrak, which provides limited service in the study area because access to stations is poor and travel schedules include infrequent departure and arrival times that often do not match peak schedule demand), common carrier (private bus), commercial airline, and ridesharing options. Public transit service such as bus and light rail is also available within urban communities. While each mode partially addresses some aspect of the region's travel needs, most operate independently of one another. They could be considered emerging elements of a regional transit network but are missing the unified plan and strong backbone that tie a network together. A reliable Tucson-to-Phoenix rail connection could provide this backbone, close the gap that currently exists for potential commuters and intercity travelers, and create and deliver a robust customer base for a future network of commuter and intercity services.

Described below are the existing non-automobile travel choices within the study corridor, along with their passenger-carrying capacity, where available.

Urban Public Transit Services

The Phoenix (Maricopa County) and Tucson (Pima County) metropolitan areas are both served by local and regional fixed-route bus and commuter express bus service. Additionally, a light rail system in the Phoenix region connects the communities of Mesa, Phoenix, and Tempe. The line is 26 miles long as of spring 2016, with a 2-mile eastward extension in design. In Tucson, service on a 4-mile modern streetcar line linking downtown Tucson with the University of Arizona campus was inaugurated in 2014. Combined, the Tucson and Phoenix metro area fixed-route bus and rail services board over 69 million unlinked passenger trips annually, on a par with Minneapolis and Houston's bus ridership, which rank the 15th and 16th highest in the nation, respectively (American Public Transportation Association 2013).

Commuter express bus service operates in the I-10 corridor in both the Tucson and Phoenix urban areas, with routes extending nearly to their respective borders with Pinal County. In the Phoenix region, a public park-and-ride facility located at 40th Street and Pecos Road is utilized by Pinal County residents, according to a 2005 passenger survey, to access the I-10 East RAPID, a heavily used commuter express bus route with over 166,000 annual riders into Phoenix.

Public transit service in Pinal County is limited but growing. The Cotton Express is a local circulator that operates four routes within Coolidge; and the Central Arizona Regional Transit (CART) travels between Florence, Coolidge, Central Arizona College, and Casa Grande. Currently, CART buses run every 90 minutes. A Tucson-to-Phoenix train with a station located along this 20-mile east-west CART route could extend passenger service beyond the localized connection. This could serve a substantial number of commuters from these established communities and the growing areas surrounding them and may increase ridership on CART.

Passenger Rail

Amtrak's Sunset Limited line, which travels from New Orleans to Los Angeles, stops at two locations within the study area, Tucson and the City of Maricopa (in Pinal County). Trains run three times a week, stopping on Tuesday, Thursday, and Sunday evenings in the westbound direction and Monday, Thursday, and Saturday mornings in the eastbound direction. Although they connect parts of the study area by passenger rail, these Amtrak trains do not provide intercity service between Tucson and Phoenix. Currently no transit connection is available from the City of Maricopa to Phoenix.

Private Intercity Bus

Greyhound Lines makes six intercity trips from Tucson to Phoenix each weekday with a 55-passenger bus. Bus service begins at the Greyhound terminal near Tucson's central business district and ends at the Greyhound terminal near Sky Harbor International Airport. Six trips are operated each weekday between Tucson and Phoenix as well. Some of these trips have intermediate stops in the City of Casa Grande (Pinal County).

Arizona Shuttle is a common carrier that makes 18 daily round-trips between Tucson and Phoenix Sky Harbor International Airport using 29-passenger buses. Three stops are in the Tucson area: Craycroft (east Tucson), University of Arizona Campus (central Tucson), and Ina Road at I-10 (north Tucson).

Based on the total number of trips and vehicle carrying capacity, the daily capacity of these scheduled services between Tucson and Phoenix is approximately 1,000 person-trips in each direction.

Commercial Aviation (Intercity Aviation)

US Airways/American Airlines operates daily nonstop flights between Phoenix Sky Harbor International Airport (PHX) and Tucson International Airport (TUS). Between 7 and 10 weekday trips operate from PHX to TUS depending upon the day of the week, while 6 to 12 weekday trips are operated from TUS to PHX depending upon the day of the week. Most flights use a 90-passenger plane, while one trip each weekday uses a 140-passenger plane. Based on the range of flights offered each weekday and the types of planes operated, the daily passenger capacity between PHX and TUS is 950, while the daily passenger capacity between TUS and PHX is 1,130, depending upon the day of the week. According to the US Bureau of Transportation Statistics (BTS 2014), the 2010 daily average number of passengers on these flights was 545 and 574, respectively.

Ridesharing

Public and private ridesharing options within the study area include vanpooling and carpool ride-matching services. The largest public rideshare operator is Valley Metro in Phoenix, which coordinates vanpools originating in and destined to all three study area counties. In FY 2013, Valley Metro owned 412 vanpool vehicles having an annual ridership of 1,227,297 (Valley Metro 2013).

The preceding information demonstrates the need for both commuter and intercity transportation services to provide connectivity between local and regional routes within and throughout the study corridor. All three needs are addressed in the APRCS.

1.2 Purpose of a Passenger Rail System in Arizona

The need for improved intercity and commuter services and regional connectivity throughout the entire Tucson-to-Phoenix corridor is the driving purpose behind the development of a high-capacity passenger rail system serving the communities between Tucson and Phoenix. The APRCS would help ensure coordination between agencies in defining the project, providing a corridor so that local and regional planning agencies can limit development to preserve rights-of-way, pursuing opportunities for funding, and ensuring plan compatibility with communities along the studied corridor alignment(s). The APRCS also strives to achieve efficiencies by undertaking a single analysis of alternatives and potential environmental consequences and by proposing a single infrastructure investment that would serve both travel markets.

The overall 115-mile corridor between Tucson and Phoenix is being studied to address intercity travel needs in an area where the demand for such travel is growing while opportunities for highway expansion are limited. An intercity connection could serve as a foundation for commuter service overlays in the urban areas, designed with the ability to grow along with commuter travel demand, reaching into and across Pinal County from both ends. Commuter services could span the entire corridor within the forecast timeframe of this study as Pinal County's employment base grows to rival Pima County's and establishes new patterns of daily trip interchanges from Pima and Maricopa counties to daytime destinations in Pinal County and back.

By evaluating both intercity and commuter travel needs simultaneously, the APRCS reports on all aspects of the alternative corridors and addresses the combined requirements of the Federal lead and cooperating agencies. The purpose of proposed passenger rail service in Arizona is to provide high capacity intercity and commuter transit service in the identified study corridor that addresses the identified transportation problems within the larger framework of promoting regional connectivity throughout Arizona and the Southwestern United States. The purpose of proposed passenger rail service in Arizona includes:

- Providing transportation alternatives to the automobile within the Tucson-to-Phoenix travel corridor and reduce the growth in traffic congestion
- Increasing access to existing and planned employment and activity centers within the three-county study area
- Supporting reliable travel times and safe travel within an increasingly congested region that currently affords few transportation alternatives to the private automobile
- Facilitating continued development of a comprehensive, multimodal, and interconnected regional and multiregional transportation network that provides mobility choices for existing and future needs and allows connectivity to systems beyond the Tucson-to-Phoenix corridor

In satisfying these stated purposes, a transportation solution would also achieve the following beneficial outcomes:

- Support economic vitality by providing efficient, dependable, and convenient access to economic activity centers in the Sun Corridor
- Efficiently and predictably accommodate local, regional, commuter, and intercity movement of travelers throughout the corridor
- Enhance system linkages, multimodal connections, and accessibility to major population centers
- Support regional plans and policies that call for a balanced transportation system
- Incur potentially lower capital and operating costs than traditional highway facilities
- Avoid, reduce, minimize, or otherwise mitigate impacts on the environment

1.3 Program Area of Analysis

This Tier 1 Environmental Impact Statement (EIS) complies with NEPA, which requires that Federal agencies analyze a range of reasonable alternatives in an EIS (42 U.S.C. § 4332[c][iii]).

To meet this requirement, this Tier 1 EIS evaluates potential environmental impacts of the alternatives broadly, over 1-mile-wide corridors, rather than along specific alignments within the three-county Study Area shown on **Figure 1-1**. The corridors provide a sufficiently flexible regional context for the best location of a passenger rail system while providing opportunities for alignment alternatives within the corridor to account for engineering and environmental constraints as well as public input when Tier 2 studies examine the corridor in greater detail. As described in **Chapter 5, Existing Conditions and Environmental Consequences**, a future alignment is likely to affect a corridor of 200 feet or less, so the impact analysis also includes a discussion of the representative effects for the narrower corridor.

Additional public input and more refined engineering studies would be undertaken as part of a Tier 2 NEPA review. The Tier 2 NEPA review would identify and analyze the potential impacts of alignment alternatives within the corridor selected at Tier 1.

1.4 Connected Actions

1.4.1 Station Locations

This Tier 1 EIS does not identify specific station locations for analysis. An Alternatives Analysis (AA) undertaken as part of the APRCS included conceptual station locations to provide a basis for corridor definition and ridership forecasting. As part of the AA, various types of stations were developed to provide context for station decision-making and local commitments. However, the exact locations of stations would require more analysis and further agency and community input. These would be part of independent localized studies and a Tier 2 NEPA document for a passenger rail facility.

1.4.2 Airport Connections

Public input throughout the development of the Alternatives Analysis and Draft Tier 1 EIS (DEIS) indicated airport access to be an important consideration as a feature of future passenger rail service. Comments on the DEIS from agencies, jurisdictions, and the public strongly urged that the study corridor extend to Tucson International Airport (TUS). While a connection to TUS was not evaluated in the Tier 1 environmental analysis, the AA included coordination with Tucson, South Tucson, PAG and TUS related to airport connectivity, and public and stakeholder input were gathered regarding how best to connect with TUS. The conceptual ridership analysis developed for the AA includes TUS at the southern end.

Based on public and agency input, ADOT and FRA will commit to evaluating the connection of passenger rail service to TUS in future (Tier 2) studies. As noted elsewhere in this EIS, ADOT anticipates that a Tucson-to-Phoenix passenger rail system would be funded incrementally, and that construction and operations would be implemented in phases. The specific phasing of a future passenger rail system is not known at this time but would be determined as funding is allocated and as part of Tier 2 NEPA review.

1.4.3 Southwest Regional Context

Each alternative rail corridor was assumed to connect in the future to a larger regional western states rail network connecting California, Arizona, and Nevada, including the California High-Speed Rail System. As identified as part of the *Southwest Multi-State Rail Planning Study* (FRA 2014), the western network is envisioned to include a high-speed rail connection between Phoenix, Las Vegas, and Los Angeles. High-level design and system performance assumptions were made to be compatible with the potential future regional network shown in **Figure 1-2**.

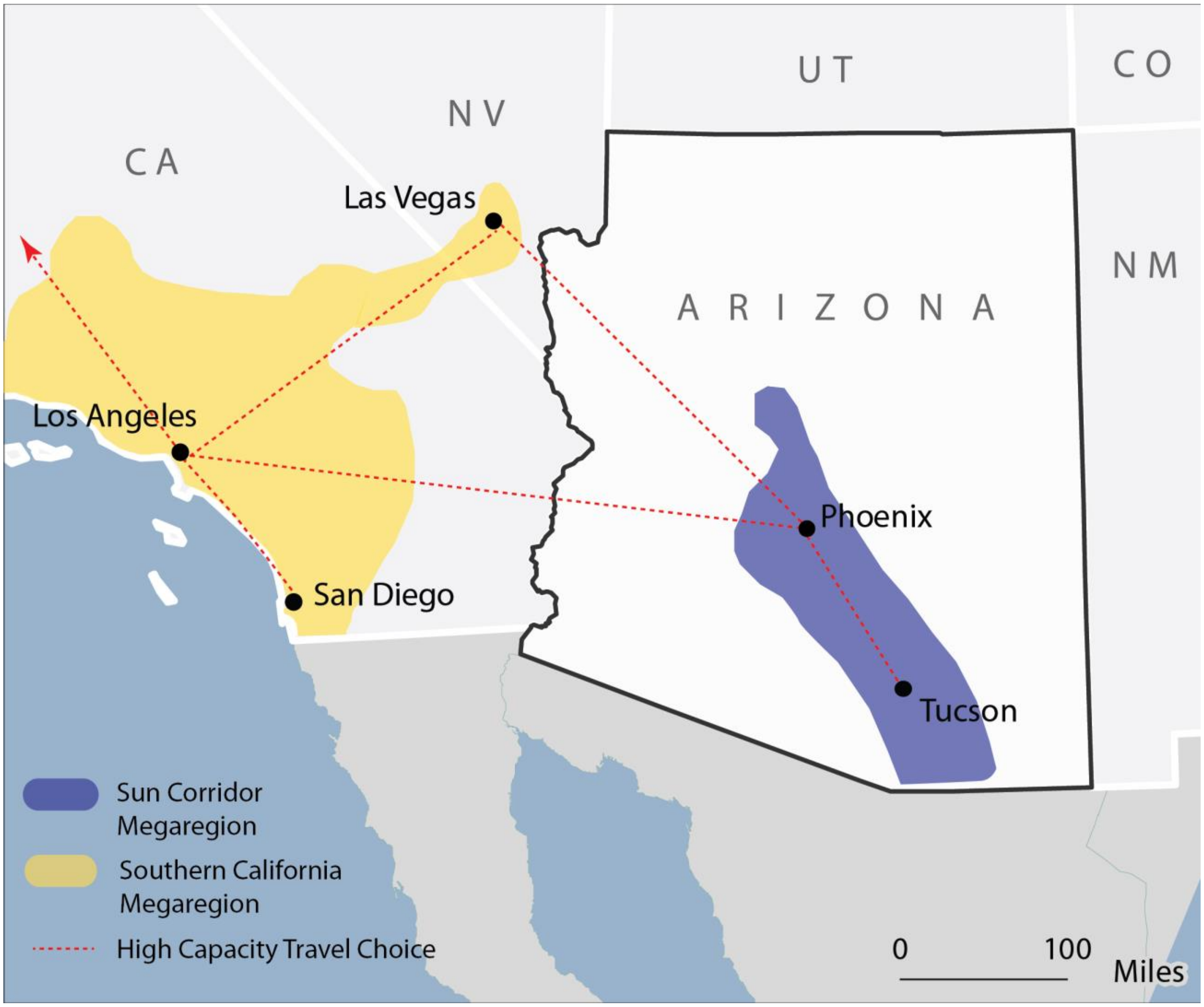
1.5 Final Tier 1 EIS, Preferred Alternative, and FRA Decision

The Tier 1 NEPA process for the corridor study began formally in October 2011 with the publication of the Notice of Intent to prepare an EIS. This and other milestones are shown in **Table 1-3**.

Table 1-3. Milestones in the NEPA Process for the APRCS

Milestone	Date
Notice of Intent published in the Federal Register	October 6, 2011
Public Scoping Meetings	October 7 through November 1, 2011
Public Scoping Comment Period	October 6 through November 14, 2011
Agency Scoping Meeting	October 11, 2011
DEIS Notice of Availability published in the Federal Register	September 11, 2015
Public Hearings on the DEIS	September 15, 16, and 17, 2015
DEIS Comment Period	September 11 through October 30, 2015
ROD/FEIS Notice published in the Federal Register	Winter 2016/2017

Figure 1-2. Future Western Regional Rail Network



Source: *Southwest Multi-State Rail Planning Study* (FRA 2014)

The DEIS presented: the purpose and need for the study; the range of corridor alternatives and the alternative screening process; the existing environmental setting; potential adverse and beneficial effects from implementation of a passenger rail system; and potential measures to avoid, minimize, or mitigate potential adverse environmental effects.

The DEIS also informed resource agencies, decision makers, interested parties, and the public about the differences between the No Build Alternative and the Corridor Alternatives carried forward for evaluation in the DEIS. FRA circulated the DEIS for 50 days for public review and comment (September 11, 2015 through October 30, 2015), and public hearings were held in Phoenix, Tucson, and Coolidge/Casa Grande, Arizona on September 15, 16, and 17, 2015, respectively. In addition, comments were solicited online from September 11 to October 30, 2015, providing opportunities for the public to comment on the DEIS. All comments received on the DEIS are listed in two appendices: *Agency Comments on the Draft Tier 1 EIS* and *Public Comments on the Draft Tier 1 EIS*.

FRA filed the Final Tier 1 EIS (FEIS) with EPA upon signature by ADOT and the FRA.

1.5.1 Modifications to the Tier 1 EIS from Draft to Final

Like the DEIS, the FEIS documents the NEPA process and as such, includes updated information on public and agency outreach and coordination that had not yet occurred at the time of the publication of the DEIS. This information, as well as summary of agency and public comments, has been added to **Chapter 3. Public Agency Coordination**. Substantive additions or text revisions to the FEIS resulting from agency and public comments received on the DEIS during the review and comment period are listed on the following pages and identified in the EIS by the use of underlined type.

Land Use

Subsurface mining rights administered by the Bureau of Land Management (BLM) in areas not mapped as BLM Lands were added as a land use consideration to be analyzed in Tier 2 studies.

Parklands and Recreation Areas

The Juan Bautista de Anza National Historic Trail was included among the potentially affected resources. The Anza Trail corridor was also added to Maps 1-11 and 21-27 of the *Corridor Aerial Atlas Appendix*.

Biological Resources

The Wildlife Linkages figure was modified to disclose all of the linkages that fall within the map boundaries.

Tables listing Species of Greatest Conservation Need and Species of Economic and Recreation Importance were added.

The statement, “a passenger rail system may present opportunities to improve wildlife connectivity” was modified to read: “a passenger rail system may present opportunities to improve wildlife connectivity by siting the corridors to minimize habitat and connectivity fragmentation, identifying current and potential important wildlife movement areas, and designing facilities to provide maximum permeability for safe wildlife movement.”

Mitigation measures were added to provide further protection to the western burrowing owl.

The following Potential Mitigation Measures were added in their respective locations:

- Conduct preconstruction surveys for removal and translocation of Sonoran desert tortoise and western burrowing owl.
- Design sufficient wildlife crossing structures to facilitate movement of large and small species of wildlife across the landscape, including appropriate funnel fencing associated with crossing areas, and appropriate right-of-way (ROW) fencing to allow for, or restrict as necessary, wildlife movement.
- A Habitat Restoration Plan should be developed for all temporary impacts to native vegetation and provided to land management / resource agencies for review prior to project construction.
- Edge effects should be addressed and minimized through: the use of existing infrastructure, monitoring of adjacent habitats, and the development of adaptive management strategies for toxins, invasive species and habitat conversion.
- Conduct special status species and wildlife movement studies/surveys prior to the Tier 2 NEPA analysis, in order for the data to inform the NEPA process. These studies should be identified with the approximate timelines in relation to the preparation of the Tier 2 NEPA.

Visual and Aesthetic Scenic Resources

The Juan de Bautista de Anza National Historic Trail was included among the potentially affected resources, and the trail corridor was added to the Visual Resource map figures. Although not entirely on BLM land, and not subject to BLM Visual Resource Management guidelines, the intent of the Historic Trails designation is to provide experiences similar to those of first-time explorers to the extent possible.

Cultural Resources

The Juan de Bautista de Anza National Historic Trail was included among the potentially affected resources, and the trail corridor was added to the Visual Resource map figures. Although the trail corridor is not a “property” and not protected under Section 106, the Historic Trail designation merits consideration with regard to potential physical, operational, and construction impacts of a passenger rail system.

2 Alternatives Considered

This chapter summarizes the routing alternatives considered for the APRCS. The Alternatives Analysis (AA) Report, available in the *Alternatives Analysis Appendix*, documents the assessment of opportunities in the study corridor that led to the selection of the corridor alternatives evaluated in the Tier 1 EIS. Included as an appendix to this Tier 1 EIS, the AA provides supporting documentation to the information presented in this chapter.

2.1 Rail Alternatives

As discussed and/or illustrated in the *Alternatives Analysis Report and AA Appendix*, each rail alternative is assumed to have similar characteristics, including:

- 150 mph maximum design speed
- 125 mph maximum operating speed with segments of lower speed where required because of design constraints (mostly in urbanized area)
- Blend of intercity and commuter operations
  - Intercity trains provide express service by stopping only at regional stations, such as airports
  - Commuter trains provide local service by stopping at all stations
- Single track system and a 60-foot cross section with dual track at stations and where directional conflicts are identified by operations modeling
- Coordination and collaboration with the freight rail operators within the study area
- Adherence to UP's "*Commuter Rail Principles,*" where applicable
- As identified as part of the FRA *Southwest Multi-State Rail Planning Study,* a future connection to a larger western network that is envisioned to include a high speed rail connection between Phoenix, Las Vegas, and Los Angeles

2.2 Prior Studies

The Sun Corridor megaregion has been evaluated for rail passenger service on a number of occasions in the past several decades. ADOT studied rail options throughout the state in 1993, and a passenger rail feasibility study was conducted in 1994. Those efforts led to an evaluation of high-speed rail in the Tucson-Phoenix Corridor in 1998. MAG completed a Commuter Rail Study in 2010 for the Phoenix metropolitan area, which provides a basis for some of the analysis in the AA related to commuter services. While information from past studies provided a foundation for alternatives criteria and a comparison for study results, the alternative corridors developed for this analysis are based largely on new original work, new data collection, and additional public involvement.

2.3 Alternatives Screening and Selection Process

The AA began with a broad range of possible alternatives designed to identify all reasonable connections between Tucson and Phoenix meeting the Project's purpose and need. All available modes were initially considered, including automobile, air, rail, and bus rapid transit (BRT). Automobile travel has been thoroughly analyzed in the study corridor; a comprehensive implementation plan is in place for expanding capacity, but the projected capacity will not fully satisfy future transportation demand. Therefore, infrastructure to support automobile travel will not meet the purpose and need and was not considered further in this analysis. Air travel was not competitive in terms of time or cost and fails to satisfy the purpose and need because it will not effectively serve destinations between the Tucson and Phoenix hubs. Expanding existing bus service was also found not to be competitive with rail or BRT (operating in a dedicated guideway) alternatives in terms of travel time and would be subject to the same reliability limitations as present roadway operations (e.g., congestion, crashes). This left rail and BRT as the primary modal choices to be evaluated further.

The remaining passenger rail and BRT alternatives were refined through progressive levels of analysis, which are listed below and explained in more detail throughout this section.

- Level 1 Initial Screening: Range of Alternatives
- Level 2 Evaluation: Conceptual Alternatives
- Level 3 Evaluation: Final Alternatives

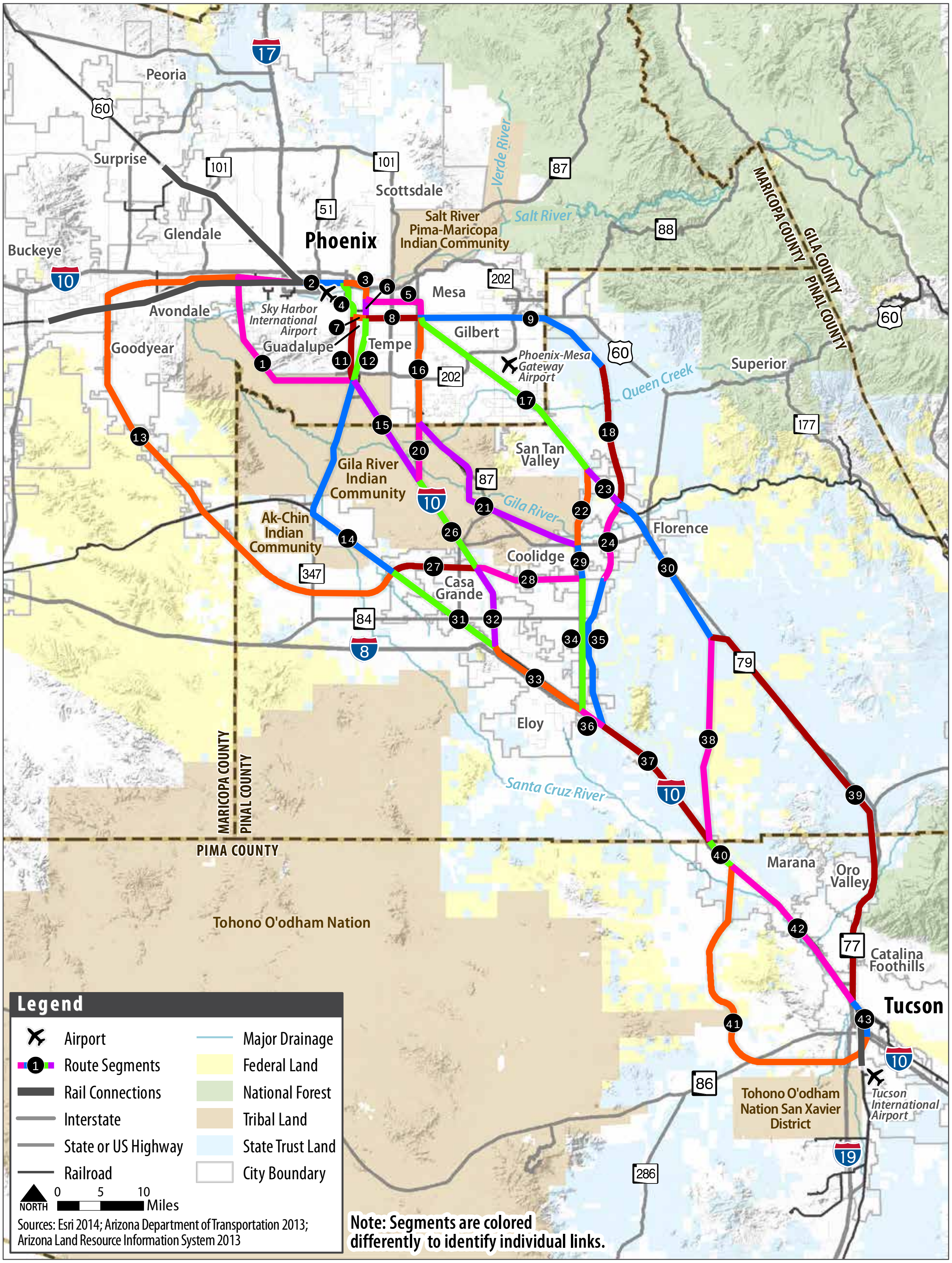
2.3.1 Level 1 Initial Screening

Range of Alternatives

The initial screening evaluated BRT as well as a range of rail alternatives made up of 43 corridor segments linking 38 potential station locations, which produced more than 150 unique corridor alternatives between Tucson and Phoenix. The range of alternatives process introduced all reasonable routes and station locations to be evaluated in the Level 1 initial screening, including those based on public and agency comments. The information from the range of alternatives process was used in the initial screening of corridors and provided a fatal flaw and/or risk assessment to help select routes that best meet the project purpose and need. **Figure 2-1** shows the route segments that were evaluated as part of the initial screening process.

The details of the initial screening process are documented in the Range of Alternatives Report (ADOT Multimodal Planning Division 2012) and Initial Screening Report (ADOT Multimodal Planning Division 2013a), both included in the *Alternatives Analysis Appendix*. The possible route

Figure 2-1. Route Segments That Define the Range of Alternatives



segments and locations served were screened based on broad assessments of land use compatibility, environmental impacts, travel markets, and cost. Throughout the initial screening process, the evaluation methodology established an appropriate level of analysis to identify a set of complete alternatives. The screening criteria relied as much as possible upon qualitative measures, with minimal use of quantitative assessments. Qualitative assessments were made to establish a tiered ranking of the measurements and included the input of the public, agencies, and professionals with pertinent expertise.

A complete alternative, defined for purposes of the initial screening, comprised three elements that were assessed independently: alignment, locations served (including hub stations, regional stations, and local stations), and service type (mode and connections). These details, which are discussed later in this chapter, were developed only for purposes of the analysis in the AA because locations served and service type were necessary components in determining effective and viable routes.

FRA determined that the route of a future passenger rail system must first be considered in its regional context, as it would influence roadway networks, future planning processes, and environmental issues spanning portions of three counties, numerous jurisdictions, and multiple independent planning processes. Given the existing and projected

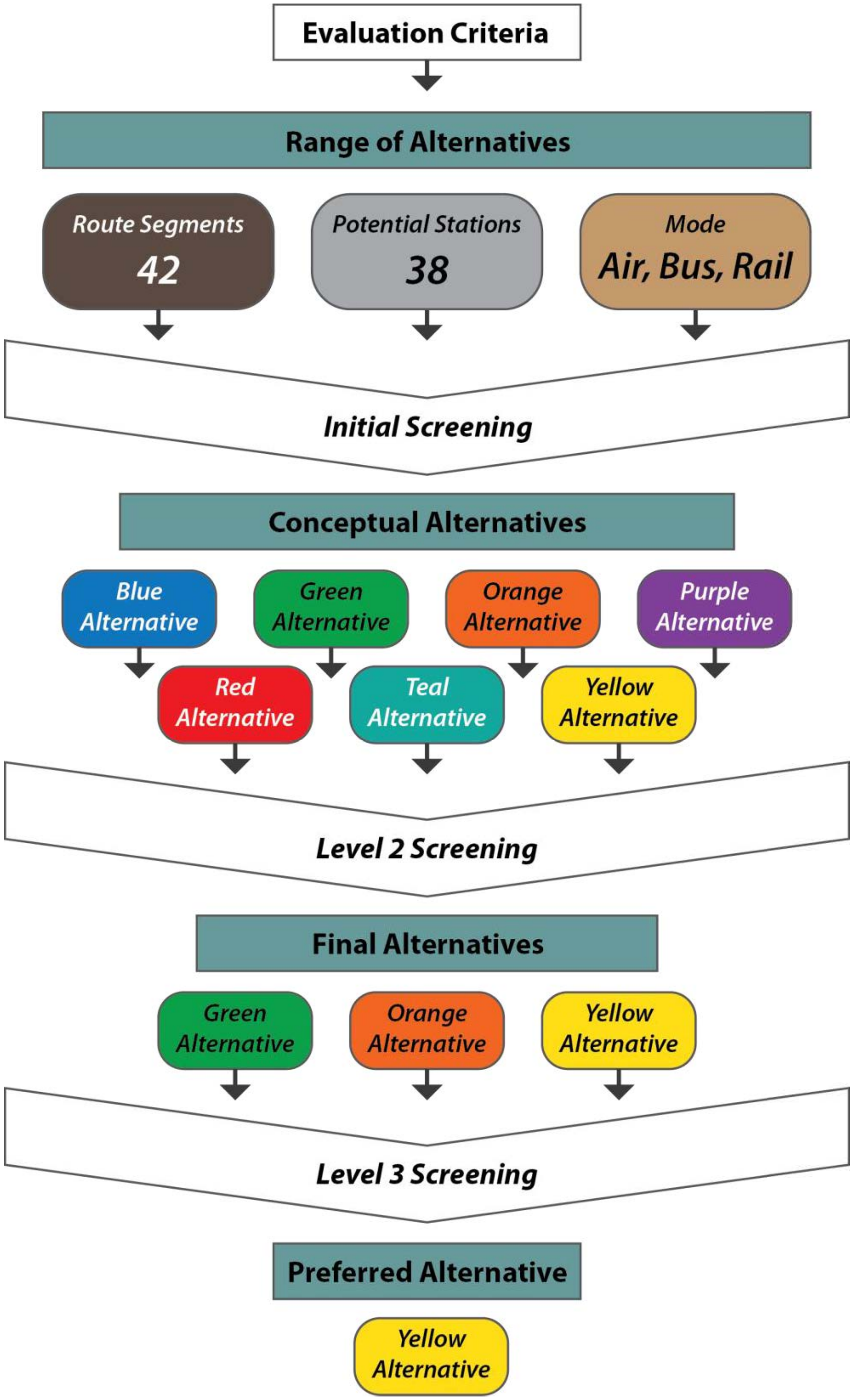
rapid growth in and around the study area, it is vital to identify a preferred corridor alternative as early as feasible, so that planning decisions can consider a future passenger rail system, and before new development reduces alignment options or increases ROW acquisition costs. This Tier 1 EIS evaluates only the corridor alternatives that were identified through the AA's levels of screening and evaluation (**Figure 2-2**). General locations for rail stations were identified in the AA but were used primarily for travel forecasting purposes. Details such as alignment and specific alternative station locations, and the environmental impacts associated with them, would be evaluated in subsequent Tier 2 analyses.

Among the initial list of alternatives that could link the Tucson and Phoenix hub locations, alternatives deemed viable by the initial analysis were those that served population centers between Tucson and Phoenix with a relatively direct route (i.e., minimal or no reverse direction travel). As noted, more than 150 possible 1-mile-wide corridor options were identified that addressed those requirements.

Conceptual Alternatives

After completing the initial screening analysis, the range of reasonable alternatives was refined from the 150 possible alternatives to seven conceptual alternatives and associated station locations. The initial screening found that these seven alternatives would provide the most

Figure 2-2. Screening Process Developed for the Alternatives Analysis



effective movement in terms of service, travel time, generalized cost (based on distance), accessibility, and potential environmental effects.

Public and agency input indicated that impacts to undeveloped land should be minimized by considering routes parallel to other, existing linear transportation corridors. Therefore, all seven conceptual alternatives focused on the use of existing transportation corridors such as I-10, Union Pacific Railroad (UP) freight lines, proposed new freeway alignments, or other existing transportation facilities. **Figure 2-3** shows existing railroads within the study corridor. In general, all seven conceptual alternatives attempted to minimize greenfield (previously undisturbed land) impacts, although one alternative relies on a proposed multimodal corridor in a largely agricultural portion of the three-county Study Area. These seven conceptual alternatives selected for further analysis are described below and shown in **Figure 2-4**. The geographical descriptions in this Tier 1 EIS move from south to north, originating in Tucson and ending in Phoenix. These conceptual alternatives include high-level operating assumptions as described in section 3.2 of *Alternatives Analysis Appendix*.

- **Blue Alternative** – A BRT alternative along I-10 between Tucson and Phoenix in dedicated lanes)
- **Green Alternative** — A rail alternative connecting Tucson and Phoenix along I-10 and the UP Tempe Branch
- **Orange Alternative** — A rail alternative along 1) I-10, 2) the planned North-South Corridor, 3) an exclusive transit corridor planned in the proposed Superstition Vistas development on ASLD lands, and 4) the US 60 Superstition Freeway
- **Teal Alternative** — A rail alternative along 1) I-10, 2) the planned North-South Corridor, 3) the Southeast Branch of the UP Phoenix Subdivision, and 4) Rittenhouse Road. The Teal Alternative represents a combination of the Orange and Yellow Alternatives
- **Yellow Alternative** — A rail alternative along the existing UP corridor, including the Southeast Branch of the UP Phoenix Subdivision and the UP Sunset Route (although the UP Sunset Route was later removed, as discussed in **Section ?** on the evaluation of conceptual alternatives).
- **Purple Alternative** — A rail alternative along I-10 from Tucson, turning north through the Gila River Indian Community (GRIC) north of Casa Grande to join the UP Chandler Branch into Phoenix.

Figure 2-3. Existing Railroads within the Study Corridor

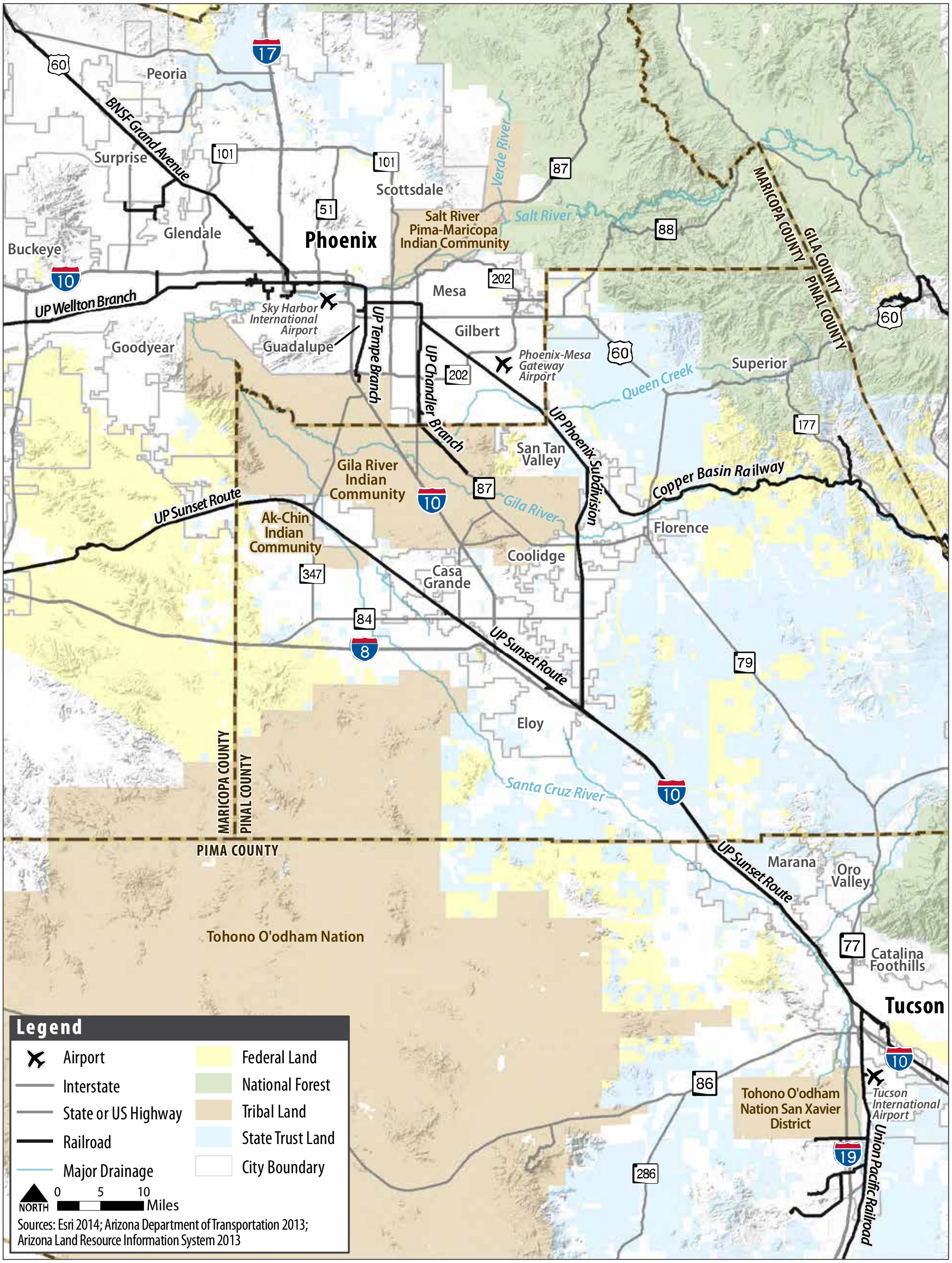
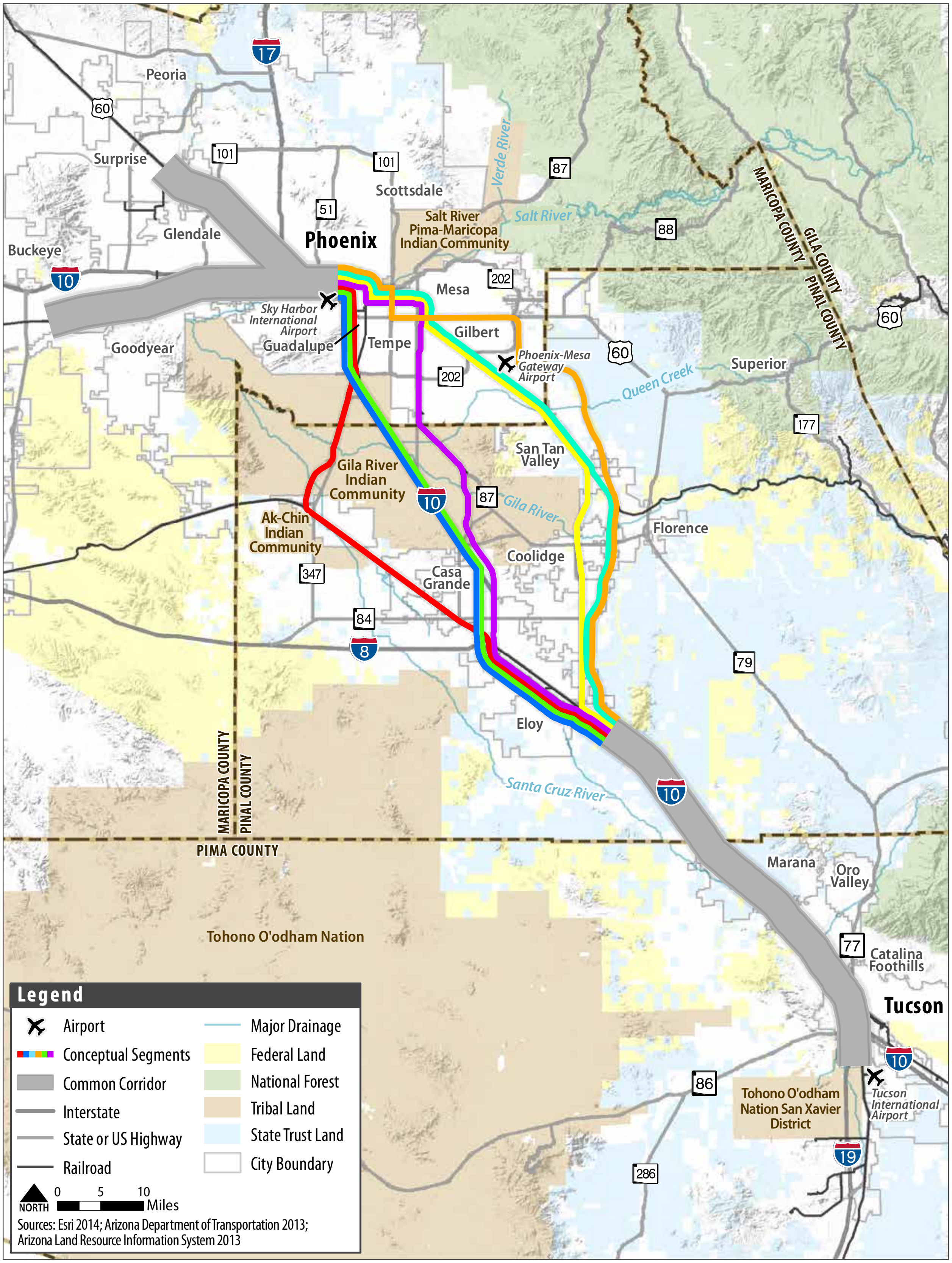


Figure 2-4. Conceptual Alternatives (Level 2)



- **Red Alternative** — A rail alternative running along I-10 from Tucson, continuing along the Maricopa-Casa Grande Highway into the City of Maricopa, then following SR 347 to join the UP Tempe Branch into Phoenix

2.3.2 Level 2 Screening

Evaluation of Conceptual Alternatives

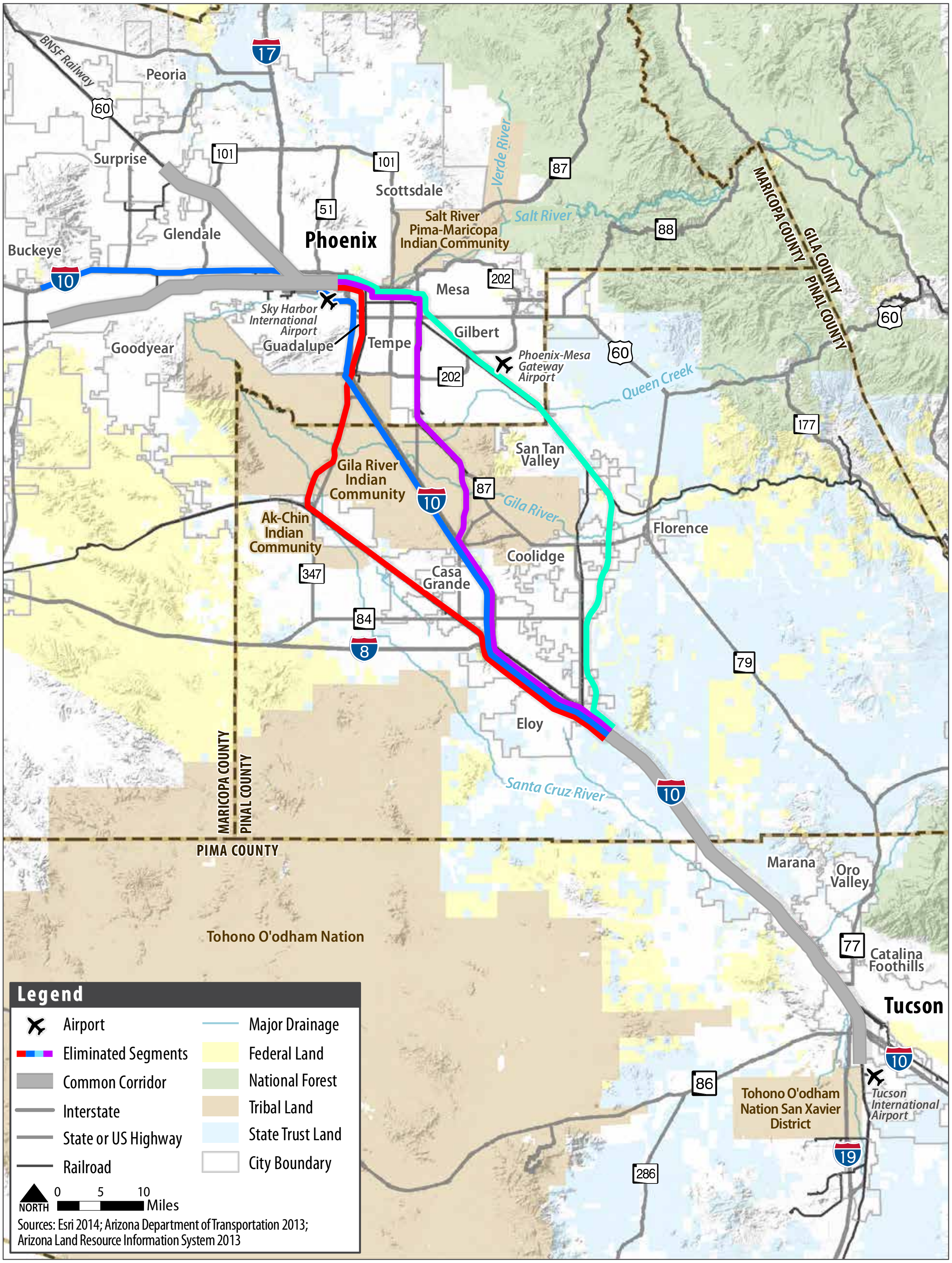
The Level 2 evaluation consisted of a more detailed evaluation of the seven conceptual alternatives identified in the Level 1 initial screening assessment. In Level 2, each alternative was evaluated based on specific information about conditions, including environmental impacts, potential travel performance (predictability and dependability, potential travel market, and travel time), preliminary operating and capital costs, practicality of the proposed project within local government plans, and public input.

The Level 2 screening indicated that the Orange Alternative scored the highest, given a multitude of mobility, environmental, agency/public input, and financial considerations documented in the Level 2 Screening Report (ADOT Multimodal Planning Division 2013b). The Blue (BRT), Green, Purple, and Teal alternatives were determined to have a medium level of feasibility. The Red Alternative was considered one of the least feasible due to a lower performance in the evaluation criteria. Similarly, the Yellow Alternative, based on the goal of sharing the UP Sunset Route in southern Arizona from Tucson to Eloy, was also considered one of the least feasible alternatives. However, subsequent coordination with UP and a reconfiguration of the Yellow Alternative in southern Arizona improved the feasibility.

UP expressed major concerns about shared passenger service on the UP Sunset Route as it is one of UP's busiest and most vital freight routes with plans for over 100 trains per day. This would likely prevent effective shared use as a joint passenger and freight corridor. The southern section of the Yellow Alternative was eliminated due to this conflict, as other viable routes like I-10 exist within the same corridor. The northern portion of the alternative following the UP Phoenix Subdivision remained a viable connection between Eloy and Phoenix and rated favorably in the alternatives screening process.

A separate analysis of major conflicts in the AA determined that three of the seven conceptual alternatives were either fatally flawed or had other characteristics that rendered them noncompetitive, and they were eliminated from further study or development. The eliminated alternatives and a summary of the reasons for the findings are listed below and are shown in **Figure 2-5**.

Figure 2-5. Alternatives Eliminated from Detailed Study in the Tier 1 EIS



Eliminated Conceptual Alternatives

The following conceptual alternatives were eliminated from further consideration during the Level 2 evaluation.

- **Blue Alternative** – The Blue (BRT) Alternative would not meet the project purpose and need, as the alternative would be subject to unpredictable highway conditions on I-10 including increased congestion, traffic accidents, and inclement weather events that would make bus operation, even in a dedicated lane, unsafe or unreliable. In addition, the Blue Alternative was least popular among the public, based on submitted comments and survey results. High-level operating cost estimates also indicated that that long-term operation and maintenance costs for bus service would be much greater than a rail alternative and would have substantially lower passenger capacity.
- **Purple Alternative** – This rail corridor would use I-10 from Tucson north and would establish a new corridor through the GRIC population center at Sacaton, continuing north along the UP Chandler Branch into Phoenix. Coordination with GRIC cultural resources staff and Natural Resources Committee indicated that the portion of the corridor through the GRIC would adversely affect Tribal cultural and historic resources and community cohesion and would have a significant effect on property in allocated lands.

  Red Alternative – The proposed corridor is longer in distance than other alternatives, would attract a relatively low ridership, and would affect the GRIC in a manner similar to the Purple alternative. These limitations were reflected during the second public outreach phase, when the public ranked the alternative the least favorable overall.

After considering the results of the Level 2 screening and the presence of fatal flaws, the Green, Orange, Teal, and Yellow alternatives emerged as potential final alternatives. These alternatives advanced to Level 3 screening, which provided additional analysis and rationale for further refinements to the alternatives and the resulting elimination of additional alternatives from detailed consideration in the Tier 1 EIS.

2.3.3 Level 3 Screening

Analyses of the Teal Alternative were covered under the evaluation of the Yellow and Orange corridor alternatives. As a result, the Teal Alternative was assumed to be part of the Yellow and Orange corridor alternatives, leaving the three final alternatives: Green, Yellow, and Orange. The only area of the Teal Alternative not common to either the Orange or the Yellow alternatives is a 5-mile section along the Copper Basin Railroad corridor.

The Level 3 evaluation analyzed the three remaining final alternatives in greater detail regarding community acceptance and accessibility, environmental impacts, financial feasibility, ease of implementation, operating characteristics, mobility, and safety. Additional screening and ongoing stakeholder coordination resulted in the elimination of the Green Alternative from detailed consideration.

- **Green Alternative** — The shortest alternative between the two hub stations, the Green Alternative received comments of support from many participants in the public outreach process and from some agencies; however, the Green Alternative did not attract ridership comparable to other alternatives, did not effectively serve as many key population centers within the study corridor, and presented a high degree of potential cultural resource impacts.

  The GRIC Tribal Historic Preservation Officer, Transportation Technical Team, Natural Resources Standing Committee, and Tribal Council voiced concerns about potential impacts to cultural and community resources. A passenger rail system paralleling I-10 would require additional easement beyond that of the existing highway. The additional land required from the Community would necessitate the acquisition of a large number of allotted parcels, requiring extensive and lengthy ROW and landowner coordination. Due to cultural resource impacts, ROW challenges, and no advantage in ridership, the Green Alternative was no longer advanced for further study. This was presented to the GRIC Tribal Council, and the Council accepted the removal of the Green Alternative from the study with the understanding that complementary transit connections to the GRIC would be included.

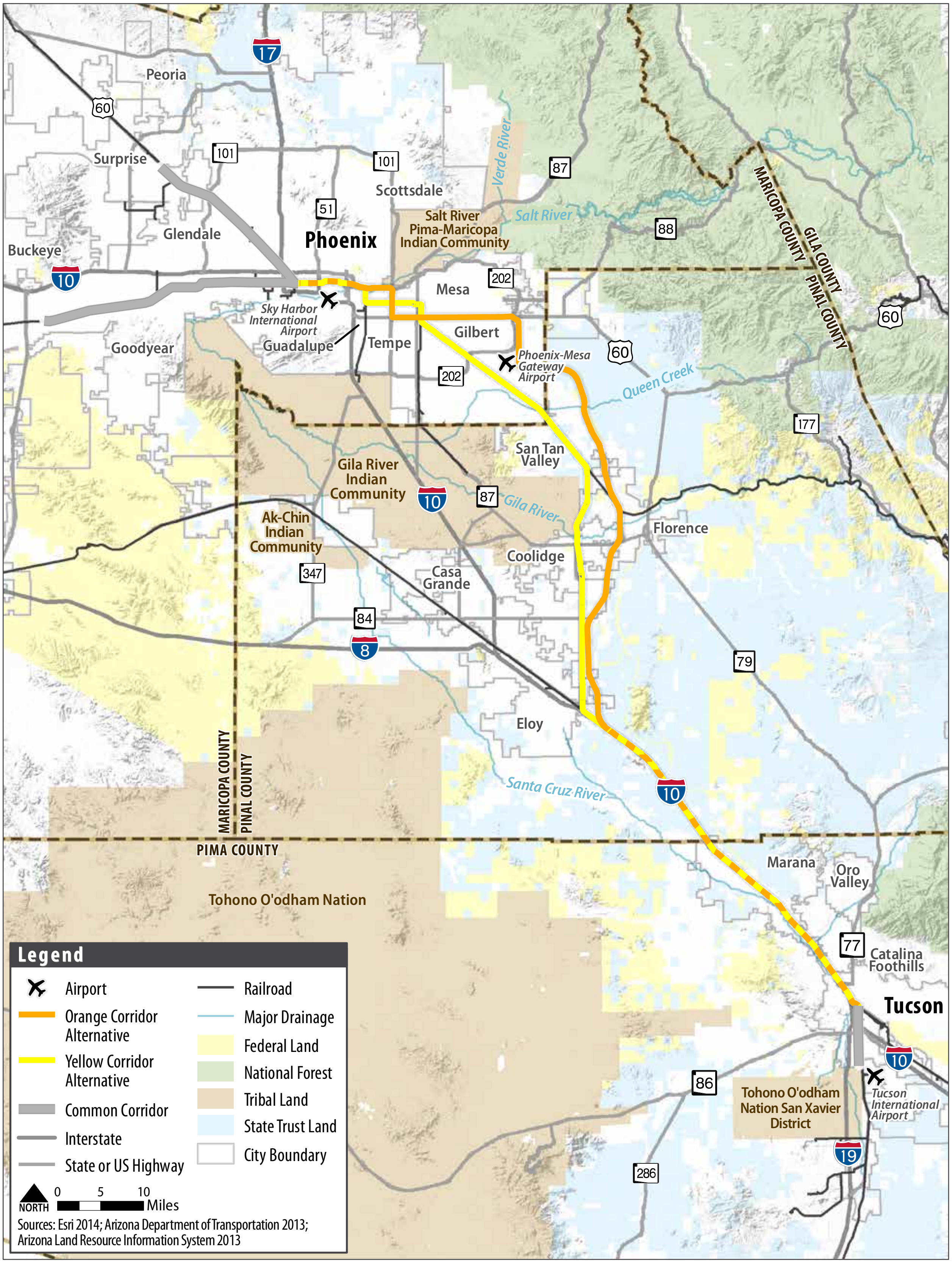
Based on the three levels of alternatives screening, the Orange and Yellow corridor alternatives were carried forward for analysis at a corridor level with the intent of providing a basis for identifying corridor-level impacts and understanding system performance.

2.4 Alternatives Evaluated in the Tier 1 EIS

Based on the findings in the AA and an assessment of fatal flaws or duplication of study segments, two corridor alternatives were carried forward for detailed analysis along with the No Build Alternative in the Tier 1 EIS. These corridor alternatives were evaluated for potential environmental impacts in the Tier 1 EIS extend between downtown Tucson and downtown Phoenix. Connections to TUS and into the Phoenix metropolitan area’s West Valley, as shown in **Figure 2-6**, illustrate the potential for a more comprehensive future rail system. In response to public and agency input, ADOT and FRA commit to include TUS in required future (Tier 2) studies as the southern terminus of a passenger rail system from Tucson to Phoenix.

PASSENGER RAIL CORRIDOR STUDY
Tucson to Phoenix

Figure 2-6. Corridor Alternatives Carried Forward for Detailed Study



FTA requires that the AA be used to inform local officials and community members on the benefits, costs, and impacts of transportation options so that the community can identify a preference. This phase is complete when local and regional decision makers select a locally preferred alternative, and it is adopted by the MPO into the region's long-range transportation plan. A locally preferred alternative, typically the final result of an AA, was identified in the Draft Tier 1 EIS and identified by FRA as the preferred alternative in the Record of Decision and this Final Tier 1 EIS.

2.4.1 Yellow Corridor Alternative

This corridor alternative is a modification of the original Level 2 Yellow Alternative proposed within the existing UP corridor. The Yellow Corridor Alternative is a 1-mile-wide corridor that would follow the I-10 ROW between Tucson and Eloy and then follow the UP corridor between the City of Eloy and downtown Phoenix. It is anticipated that the Yellow Corridor Alternative would adhere to UP guidelines for coordination of services along active UP freight lines. The Yellow Corridor Alternative and its characteristics, as evaluated in the Tier 1 EIS, are shown in **Figure 2-6**. With selection of this corridor alternative, a future alignment could be designed anywhere within the corridor. ADOT would obtain permission from GRIC to study any alignments encroaching on GRIC land.

2.4.2 Orange Corridor Alternative

The Orange Corridor Alternative connects Tucson and Phoenix following existing and planned freeway alignments. The Orange Corridor Alternative extends 0.5 mile on each side of I-10 between Tucson and Eloy, in common with the Yellow Corridor Alternative. From their common point near Eloy to the Phoenix metropolitan area, the Orange Corridor Alternative would follow whichever potential north-south route is ultimately selected for the planned North-South Corridor, which is currently under study as a possible expressway with a high-capacity mode such as rail. From the vicinity of Phoenix-Mesa Gateway Airport into Tempe, the Orange Corridor Alternative follows the existing US 60 (Superstition Freeway), SR Loop 101 (Price Freeway), and SR Loop 202 (Red Mountain Freeway). From Tempe into Phoenix, this corridor alternative follows the UP corridor in the vicinity of Sky Harbor Airport. Should this corridor alternative be selected, a future alignment could be designed anywhere within the 1-mile-wide corridor. ADOT would obtain permission from the Salt River Pima-Maricopa Indian Community (SRP-MIC) to study any alignments encroaching on SRP-MIC land. The Orange Corridor Alternative is shown in **Figure 2-6**.

2.4.3 No Build Alternative

Under the No Build Alternative, no passenger rail system would be developed between Tucson and Phoenix. The No Build Alternative assumes that existing and committed projects within the study corridor would occur. This includes all transportation facilities and services programmed for implementation within the three-county Study Area, including transit, roadway, and highway Improvements identified in the Transportation Improvement Programs (TIPs) of MAG, Central Arizona Association of Governments (CAG), the Sun Corridor Metropolitan Planning Organization (SCMPO) and PAG, including major and minor roadway and transit improvements as well as other significant projects in the planning, design, or construction phases.

Transportation projects programmed or under construction include the following:

- Planned Extensions of Valley Metro Light Rail System:
  - Gilbert Road Extension: 1.9 miles in design from Main Street to Gilbert Road in Mesa
  - Phoenix West Extension: Addition from State Capitol, following I-10 to 79th Avenue
  - Northwest Phase II Extension: 2.0 miles to be added from Dunlap and 19th Avenues to Metrocenter Mall
- Tempe Streetcar Addition
  - Network loop serving downtown Tempe along Rio Salado Parkway, Mill Avenue, Ash Avenue, and University Drive
- North-South Corridor
  - New, approximately 50-mile-long expressway in Pinal County connecting Apache Junction to I-10 south of Eloy
- State Route 202L – South Mountain Freeway
  - Extension of State Route 202L connecting Chandler and West Phoenix, via new route south of the Phoenix South Mountain Park/Preserve
- Interstate 10
  - Construction of local express lanes between 32nd Street and Loop 202
  - Roadway widening from four to six general purpose lanes and the addition of a high occupancy vehicle (HOV) lane from Loop 202 to Riggs Road
  - Roadway widening and lane additions between Florence Boulevard and State Route 87
  - Roadway widening from six to eight lanes between Ina Road and Prince Road

- Widening from four to six general purpose lanes and two HOV lanes across the GRIC between Riggs Road and McCartney Road

- Interstate 19
    - Roadway widening from four to eight lanes between San Xavier Road and Interstate 10
- State Route 77
    - Roadway widening from four to six lanes between Tangerine Road and the Pima County line
- Maricopa-Casa Grande Highway
    - Roadway widening from two to four lanes between State Route 84 and State Route 347

The Tucson Streetcar, Sun Link, began passenger operations on July 25, 2014, and is also a transportation element of the No Build Alternative. This new streetcar system, which connects the Mercado neighborhood, downtown Tucson, and the University of Arizona along Congress Street, 4th Avenue, University Boulevard, and 2nd Street, boarded its millionth rider on May 21, 2015, six weeks ahead of the projected milestone.

The projects listed above are not analyzed in this Tier 1 EIS except as part of the cumulative impact analysis. With any of the alternatives being considered, the programmed projects may be developed regardless of the decision of whether to establish passenger rail service between Tucson and Phoenix. The No Build Alternative provides a baseline analysis so that the anticipated effects from construction and operating a passenger rail system in either the Yellow or Orange corridor alternative may be compared to the effects of not constructing and operating a passenger rail system. In the case of some environmental resource categories, these effects were estimated based on travel demand and ridership estimates provided in **Chapter 4, Transportation Impacts**.

2.5 Conclusion

The Corridor Alternatives evaluated in detail as part of this Tier 1 EIS were selected as a result of analyses carried out as part of the AA and previous studies. The AA includes the development of the original Range of Alternatives, the Initial Screening (Level 1) of unique corridor possibilities, the bundling of alternatives and station locations into Conceptual Alternatives, the Level 2 screening of Conceptual Alternatives and identification of fatal flaws, the selection of Final Corridor Alternatives, and the elimination of the Green Alternative due to lower ridership, right-of-way challenges, and a high degree of potential cultural resource impacts in addition to further coordination with the Gila River Native American Community during the Level 3 screening. The Yellow and Orange corridor alternatives and the No Build Alternative form the basis of this Tier 1 EIS and are evaluated and compared in the following chapters.

3 Public Agency Coordination

Agencies, nongovernmental groups, and the public have been engaged throughout the planning process for the APRCS, as required by federal law and regulation. CEQ's NEPA implementing regulations require agency and public participation in defining and evaluating the impacts of a proposed action and its alternatives (40 CFR §§ 1503.1 and 1506.6). This chapter summarizes the regulations that mandate the need for public involvement, agency and public coordination to date, the scoping process, public outreach associated with the Alternatives Analysis process, and the public hearings held following the release of the Draft Tier 1 EIS. **Section 3.7** addresses the accommodations made for minority and low-income populations, as well as persons with disabilities, to support their involvement in the public involvement process. The final section of this chapter discusses the thorough coordination with local agencies and municipalities undertaken as part of the APRCS.

3.1 Regulatory Requirements

The APRCS public and agency participation and coordination efforts meet the requirements found in NEPA (42 U.S.C. 4321 *et seq*.) and the associated CEQ implementing regulations (40 CFR §§ 1503.1 and 1506.6). The Tier 1 EIS follows both FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and the FTA and FHWA regulations (23 CFR § 771.111) as well as requirements for early coordination with appropriate public agencies, public involvement, and project development.

The APRCS has also followed efficient environmental reviews for project decision-making (23 U.S.C. § 139) requirements when:

- defining the purpose and need (§139 [f][1]), and
- determining the range of alternatives to be considered (§139 [f][4][A]).

In addition, 23 U.S.C. §139 (g)(1)(A) requires the preparation of a coordination plan to ensure public and agency participation in and comment on the environmental review process for a project.

The APRCS has also followed USDOT federal requirements for public participation, including Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000D *et seq*.) and Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994).

Public and agency coordination efforts were initiated during the scoping phase of the study, including during the development and refinement of alternatives. Coordination has continued throughout the process.

3.2 Agency Coordination

3.2.1 Coordination Plan

23 U.S.C. § 139 (g)(1) requires the preparation of a plan for coordinating public and agency participation during the environmental review process. The APRCS Coordination Plan was published on April 5, 2012 and is included in the *Public and Agency Coordination Appendix*. The purpose of the Coordination Plan was to facilitate and document the lead agencies' structured interaction with the public and other agencies as well as to inform the public and other agencies of how that interaction would be accomplished. The Coordination Plan promotes an efficient and streamlined environmental review process and project management through coordination, scheduling, and early resolution of issues. The Coordination Plan includes a Tribal Coordination Plan, which has specific coordination requirements with the various tribes having an interest in the study.

Lead, Cooperating, and Participating Agencies

The Coordination Plan identifies the lead, cooperating, and participating agencies involved in the study and defines their roles and responsibilities during the environmental review process. The Federal Railroad Administration (FRA) has been identified as the lead federal agency, with ADOT serving as the local sponsor and proponent. Several cooperating and participating agencies have also been identified in the coordination plan as well as stakeholders. **Table 3-1** summarizes the roles and responsibilities of the lead, proponent, participating, and cooperating agencies. The Scoping Report located in the *Public and Agency Coordination Appendix* includes agency correspondence.

Table 3-1. Agency Roles and Responsibilities

Agency	Agency Designation	Roles and Responsibilities
FRA	USDOT Lead	Primary responsibilities are to ensure compliance with NEPA and prepare the environmental document. Request participation from other agencies, provide project information, conduct corridor reviews, hold scoping meetings, provide pre-draft and pre-final documents; brief participating agencies prior to issuing Draft Tier 1 EIS, ensure documentation is adequate and legally sufficient for related decisions, and make final decisions on key milestones.

Table 3-1. Agency Roles and Responsibilities

Agency	Agency Designation	Roles and Responsibilities
ADOT	Local Sponsor	Serves as project sponsor. Share in the responsibility to manage the coordination process, prepare the Tier 1 EIS, and provide opportunities for public and participating/cooperating agency involvement.
FHWA and FTA	Cooperating	Participate early in the NEPA process and provide comments and guidance so that the Tier 1 EIS satisfies their agency requirements. Participate in developing the purpose and need and alternatives and in the scoping process. Develop information and analysis/ provide staff support, participate in public involvement activities; review draft environmental documents, and provide comments.
Other Federal, State, Regional and Local Agencies	Participating	Participate in developing the purpose and need and alternatives and identify potential impacts during scoping and the Draft Tier 1 EIS.

Participating agencies include:

Federal Agencies

- Federal Aviation Administration
- National Park Service
- Natural Resource Conservation Service
- US Army Corps of Engineers
- US Bureau of Indian Affairs
- US Bureau of Land Management
- US Bureau of Reclamation
- US Environmental Protection Agency
- US Fish and Wildlife Service
- US Forest Service: Coronado National Forest
- Western Area Power Administration

State Agencies

- Arizona Air National Guard
- Arizona Corporation Commission
- Arizona Department of Corrections
- Arizona Department of Environmental Quality
- Arizona Department of Housing
- Arizona Department of Public Safety
- Arizona Game and Fish Department
- Arizona State Land Department
- Arizona State Parks

Local and Regional Agencies

- Central Arizona Governments
- City of Apache Junction
- City of Avondale
- City of Casa Grande
- City of Chandler
- City of Coolidge
- City of El Mirage
- City of Eloy
- City of Glendale
- City of Litchfield Park
- City of Maricopa
- City of Mesa
- City of Peoria
- City of Phoenix
- City of South Tucson
- City of Surprise
- City of Tempe
- City of Tolleson
- City of Tucson
- Laveen Community Council
- Maricopa Association of Governments
- Maricopa County Department of Transportation
- Maricopa County Flood Control District
- Pima Association of Governments
- Pima County
- Pinal County
- Town of Florence
- Town of Gilbert
- Town of Guadalupe
- Town of Marana
- Town of Oro Valley
- Town of Queen Creek
- Town of Youngtown
- Tucson Department of Transportation
- Valley Metro Regional Public Transportation Authority

Tribes

- Ak-Chin Indian Community
- Gila River Indian Community
- Salt River Pima-Maricopa Indian Community

Transportation and Utilities

- Central Arizona Project
- National Railroad Passenger Corporation (AMTRAK)
- Phoenix-Mesa Gateway Airport Authority
- Salt River Project
- Sun Tran Tucson
- Tucson Airport Authority

Stakeholders such as non-government and private organizations with an interest in the study were also identified in the coordination plan and invited to participate in the process.

The lead, cooperating, and participating agencies have worked cooperatively throughout the study's environmental process. During the process, the main goal has been to ensure that all agency concerns are satisfactorily addressed.

Agencies identified in the coordination plan were invited to participate by providing input to scoping, contributing to development of the purpose and need, providing input into the development and refinement of the alternatives, and identifying potential effects. Official comment periods for the public as well as for participating and cooperating agencies included the scoping period and following issuance of the Draft Tier 1 EIS, which are now complete.

Government and Tribal Coordination

Government agencies throughout the corridor have been actively engaged in the APRCS. These agencies were sent scoping information and requests to become participating and cooperating agencies during the process. Feedback was solicited from the following government and other agencies through direct contact:

- Elected officials
- Governmental agencies and stakeholders
- Interested organizations
- Community groups

Additional participating agencies identified in the Coordination Plan and the Tribal Coordination Plan included various tribal communities in Arizona:

- Chemehuevi Indian Tribe
- Cocopah Tribe
- Colorado River Indian Tribes
- Fort McDowell Yavapai Nation
- Fort Mojave Indian Tribe
- Fort Sill Apache Tribe
- Fort Yuma-Quechan Tribe
- Havasupai Tribe
- Hopi Tribe
- Hualapai Tribe
- Kaibab-Paiute Tribe
- Mescalero Apache Tribe
- Moapa Band of Paiute Indians
- Navajo Nation
- Paiute Indian Tribe of Las Vegas
- Paiute Indian Tribe of Utah
- Pascua Yaqui Tribe
- Pueblo of Zuni

- San Carlos Apache Tribe
- San Juan Southern Paiute Tribe
- Tohono O'odham Nation
- Tonto Apache Indian Community
- Ute Mountain Ute
- White Mountain Apache Tribe
- Yavapai-Apache Nation
- Yavapai-Prescott Tribe

The Scoping Report located in the *Public and Agency Coordination Appendix* includes a list of governments, agencies, and organizations contacted.

3.2.2 Project Kickoff Meeting with Stakeholders

On March 10, 2011, ADOT hosted the ADOT Intercity Rail Study stakeholder kickoff meeting at the Sheraton Wild Horse Pass Conference Center in Chandler, Arizona. The kickoff meeting introduced the study to participating agencies and stakeholders. The meeting was designed as an exposition, with attendees receiving an overview presentation and then participating in information-building activities at booths developed around the following themes:

- Why passenger rail in Arizona?
- Why this project now?
- Different types of rail
- Mobility benefits
- How would I get to my destination?
- Quality of life
- Economic vitality
- Can rail help shape a community?
- What about the environment?
- Stay involved

A summary of the project kickoff meeting is included in the Scoping Report located in the *Public and Agency Coordination Appendix*.

3.2.3 Corridor Support Team Meetings

At key points in the study process, ADOT held Corridor Support Team (CST) meetings to gain input from stakeholders and help guide the study. The CST was composed of all agencies within the corridor, with meetings held in the three study area counties to make project information conveniently accessible. ADOT held three rounds of CST meetings during the project scoping and assessment of the alternatives in the study, as identified in the Public Involvement Plan.

June 2011 CST Meetings

ADOT held the first round of CST meetings in June 2011 on the dates and at the locations listed in **Table 3-2** below.

Table 3-2. Corridor Support Team Meetings, June 2011

Date	Location	Participants
June 21, 2011	Tucson: Tucson Convention Center	31
June 23, 2011	Coolidge: Arizona Central College	24
June 28, 2011	Phoenix: Burton Barr Library	56
	Total:	**111**

ADOT distributed 370 email invitations on June 10, 2011, using Constant Contact, an internet-based email distribution service. The CST invitation list is included in the Scoping Report located in the Public and Agency Coordination Appendix.

The June meetings focused on developing the purpose and need (Purpose and Need Workshop) and offered participants the opportunity to think critically about a potential alignment of a rail line and stations while considering land use and future development throughout the corridor. The meetings offered participants the opportunity to talk about criteria that would be used to narrow the range of alternatives and shape the final recommendation.

The meeting included a brief overview of the study, the schedule, and the purpose of the workshop. Participants then attended three workshops.

The Purpose and Need Workshop was designed to help participants understand the study process and create an appropriate purpose and need statement. Participants were encouraged to discuss passenger rail service in order to effectively identify the need for such a service as well as potential benefits and outcomes.

The Range of Alternatives Workshop offered participants the opportunity to think critically about a potential rail alignment and station locations while considering land use and future development along the corridor. Large maps were used to show corridors of the study, and yarn was used to illustrate route alternatives.

The Evaluation Framework Workshop offered participants the opportunity to talk about criteria that would be used to narrow the range of alternatives and shape the final recommendation.

Five main categories (community acceptance, safety, environment, financial feasibility, and mobility) were offered to help lead the conversation.

Participants evaluated the meeting at the end of each day.

August 2012 CST Meetings

On July 19, 2012, ADOT sent 450 email invitations for the second round of CST meetings to an established list that included staff at local, regional, tribal, and state agencies. Staff included representatives from public works, economic and community development, and engineering departments.

The second round of CST meetings was held on August 15, 16, and 23, 2012, at the locations listed in **Table 3-3**. The objective of the meetings was to review the seven preliminary alternatives, rate the alternatives, and develop a plan for a local and regional system.

Table 3-3. Corridor Support Team Meetings, August 2012

Date	Location	Participants
August 15, 2012	Tucson: University of Arizona University Services Annex	24
August 16, 2012	Casa Grande: City of Casa Grande Council Chambers	15
August 23, 2012	Phoenix: Burton Barr Library	42
	Total:	**81**

The first part of the meeting involved a brief overview of the study, the schedule and purpose of the study, and information about the input received from the public during the 2011 scoping phase. Participants were then given three cards, each with a different question, and asked to deposit the card into a colored ballot box corresponding to the appropriate preliminary alternative. The alternative rating exercise was followed by a Station Area Planning (SAP) exercise. The SAP exercise was designed to inform and educate local community staff on land use, urban form, and transportation decisions that needed to be made in order to “ready” their communities for a potential future commuter/intercity rail transit station. After the meeting, Community Readiness Assessment forms were mailed out to the municipalities to be completed and returned to ADOT. The final step was a one-on-one meeting with each community along the alternative rail corridors to review their self-assessment forms as well as discuss future planning efforts to prepare for potentially hosting a passenger rail station.

April 2013 CST Meeting

One final CST meeting was held April 13, 2013. The meeting started with a review of the study’s progress and a recap of the passenger rail vision, the study process, and the preliminary alternatives being carried forward for further analysis. Three criteria were identified as contributing to the selection of the final alternatives: public input, agency input, and technical evaluation. Following a review of the alternatives, participants were engaged in an exercise designed to shape the final alternatives by identifying areas of concern, modifying alignments that had been identified, and making additional comments.

A complete summary of all CST meetings can be found in the Scoping Report located in the *Public and Agency Coordination Appendix*.

3.3 Public Coordination

3.3.1 ADOT Intercity Rail Study Participation Plan

The ADOT Intercity Rail Study Participation Plan was finalized on October 31, 2011. (The study name was later changed to the Arizona Passenger Rail Corridor Study.) This public involvement plan was developed for the Draft Tier 1 EIS and addresses public involvement strategies to be used throughout the study (see the *Public and Agency Coordination Appendix*).

ADOT's goal was to have a high number of Arizonans participate in the study and provide input to ensure public support and to meet the requirements of the NEPA. To meet this goal, ADOT sought to make participation convenient by offering a variety of opportunities for personal interaction, making the information interesting and meaningful, and soliciting opinions and advice from audiences in order to improve the participation process. As public comments have been received and evaluated, the public involvement plan has been updated to ensure that coordination is timely, thorough, effective, and relevant.

A Corridor Support Team (CST) was originally formed as a direct result of the March 2011 project kickoff meeting with the intent of keeping public agency partners, the business community, and community leaders involved in the study process. The ADOT Intercity Rail Study Participation Plan established the schedule and framework for CST meetings, scoping meetings / outreach, and the alternatives analysis meetings / outreach. The plan also identified participants, values for the participants, opportunities for personal interaction, virtual participation options, publicity requirements, and earned media responsibilities.

The plan also identifies the public meeting notification procedure to follow for the scoping and AA processes. Two widely publicized public meetings were held in each of the three counties through which the corridor alternatives pass. The public meetings were duplicated in virtual format to increase convenience, thereby increasing participation. Those wishing to participate had the opportunity to "attend" a meeting online, viewing the same information presented at the physical meetings, and submitting input directly through the website. ADOT combined the transcripts from the physical meetings and the input received online for the study record. Comments posted to ADOT's Facebook page related to the study during this time frame also were added to the record.

3.3.2 Public Outreach Techniques

To reach as many community members as possible, ADOT used a wide variety of public involvement tools throughout the APRCS. Because of the length of the study corridor, emphasis was placed on electronic communication and on taking advantage of already scheduled events to avoid single-purpose meetings that often limit participation. Informational materials produced on an ongoing basis included public meeting announcements, brochures, media releases, fact sheets, and preference surveys that have helped indicate public preferences throughout the AA and Tier 1 EIS development. ADOT has made these materials public on the ADOT website and distributed them at public events.

ADOT held corridor-wide community status updates at public events and with public and environmental resource agency staffs as the alternatives were refined and less effective options were removed from further study. Since March 2011, over 10,000 project preference surveys have been completed by members of the public, both in person and through the project website. These surveys have led to a better understanding of what individuals within the corridor communities believe is important and which alternatives best meet their expectations.

3.3.3 Identification of Environmental Justice Populations during Public Outreach

Public and agency outreach was undertaken throughout the corridor and communicated widely by a variety of outlets and sources during the study. At a Tier 1 level of analysis, with no specific alignment or project identified and only a broad corridor definition, identifying specific environmental justice populations that could be disproportionately affected was not feasible. Potentially affected minority and low-income populations represent about 45 percent and 16 percent, respectively, of the study corridor, but insufficient information exists to identify how many of them, if any, could be affected. As a result, the Tier 1 EIS relied on broad demographic information for public outreach, as well as the discussion on Title VI and Environmental Justice in **Chapter 5, Existing Conditions and Environmental Consequences**, rather than a targeted localized analysis to identify potentially affected populations. In Tier 2 analyses, with a specific alignment or alignments under consideration, the effects of a project on environmental justice populations would be more thoroughly investigated following FTA's Environmental Justice Policy Guidance (FTA 2012) and incorporated into the public involvement element of the work.

3.4 Scoping for the Draft Tier 1 EIS

Scoping was conducted early in the APRCS process to identify major issues and help establish the scope of the NEPA analysis. The main goals of scoping were to:

- Inform stakeholders and the public about the APRCS and its intent
- Identify key concerns of stakeholders and the public regarding passenger rail service in this region
- Identify environmental issues
- Identify opportunities beyond those already presented in for public input

Scoping meetings were designed for two audiences, resulting in two separate scoping meeting agendas: one for agencies and one for the general public.

Meeting times and locations were advertised through a variety of avenues including but not limited to the *Federal Register*, local newspapers in each affected county, direct invitations, social media, the ADOT website, email, television, and radio.

3.4.1 Notification Techniques

Notice of Intent

FRA published the Notice of Intent (NOI) to prepare a Tier 1 EIS in the October 6, 2011, *Federal Register*.

The NOI alerted interested parties of the EIS process; solicited public and agency input on the scope of a Tier 1 EIS; and provided information on the nature of the analysis to be conducted, the purpose and need for the proposed action, the possible alternatives to be considered in the preparation of the Tier 1 EIS, and potentially significant impacts to the natural and built environment associated with those alternatives. The notice invited public participation in the EIS process. The dates, times, and locations of public scoping meetings were announced in the NOI along with comment submission directions and the comment closing date. All interested parties were invited to submit comments on or before November 4, 2011. The comment period was later extended to November 14, 2011.

The NOI reported the date, time, and location of public scoping meetings to be held in each of the three counties associated with the study:

- Maricopa County - October 11, 2011. Burton Barr Central Library, 1221 North Central Avenue, Phoenix, AZ, from 3 p.m. to 7 p.m.

- Pima County - October 13, 2011. Pima Community College, Northwest Campus, 7600 North Shannon Road, Tucson, AZ, from 3 p.m. to 7 p.m.
- Pinal County - October 19, 2011. Central Arizona College, Signal Peak Campus, 8470 North Overfield Road, Coolidge, AZ from 3 p.m. to 7 p.m.

A copy of the NOI is included in the Scoping Report located in the *Public and Agency Coordination Appendix*.

Legal Advertisements and Additional Scoping Notification

In addition to the advertisement in the *Federal Register*, newspaper legal advertisements were placed in daily newspapers associated with each of the four counties. These advertisements not only alerted the agencies and public to the NOI public hearings but also invited interested parties to attend open houses and events on the same subject on other dates in other locations within the counties.

Paid legal and display advertisements, as listed in the *Public and Agency Coordination Appendix*, announced the public scoping open houses and events in local and regional newspapers between September and October 2011 to comply with NEPA requirements. **Table 3-4** lists the newspapers and dates of publication for these advertisements.

Table 3-4. Public Scoping Open House and Event Newspaper Advertisements

Newspaper	Publication Dates	Advertisement Type
Arizona Daily Star	September 22 and 27, 2011	Legal Ad
Arizona Republic	September 22 and 27, 2011	Legal Ad
TriValley Central	September 21 and 22, 2011	Legal Ad
TriValley Central	October 12, 2011	Display Ad

The legal advertisements alerted the public that FRA, FTA, and ADOT were preparing an AA and EIS to study the proposed development of passenger rail service between Tucson and Phoenix. The notice invited the public to several open houses and events to be held in Pima, Pinal, and Maricopa counties in order to solicit public input on the scope of the project. The legal ads offered special assistance, such as sign language interpretation, and provided a contact person so that special arrangements could be made at the open houses and events. Copies of the legal advertisements are included in the *Public and Agency Coordination Appendix*.

Extensive email list distribution, media releases, social media communication, and earned media resulting from interest in the study were relied upon to make the scoping process known to interested stakeholders and the public. Television, radio, and print/online media also covered the initial meeting and the scoping process. The details of the notification effort are listed in the Scoping Report located in the *Public and Agency Coordination Appendix*.

Additional information regarding publicity and notices is included in the *Public and Agency Coordination Appendix*.

3.4.2 Scoping Activities and Events

Agency Scoping

On October 4, 2011, ADOT distributed 111 scoping meeting invitations to state and local agencies as well as to Tribes. Attachments to the meeting invitations included a meeting agenda, study segment map, description of the segment areas, schedule of study milestones, comment form, and a state map showing the study area. All the identified stakeholders and CST members were invited to participate in the meeting and webinar.

The agency scoping meeting was held at ADOT's downtown Phoenix campus on October 11, 2011. This meeting was also conducted as a webinar to accommodate participants throughout the study area.

The meeting started with a PowerPoint presentation which described the study, the AA/Tier 1 EIS process, and the study objectives. This was followed by a presentation of the environmental issues known to date followed by a discussion of the agency mandate, the agency's decision-making process, and the agency's key interests. The final three segments of the meeting included a presentation of the potential controversial issues associated with the passenger rail study, how to ensure a successful agency coordination process, and specific recommended actions for moving forward. The meeting was then opened for discussion followed by a question and answer period.

A total of 66 agency representatives attended the meeting in person, and 34 participated via webinar. During the meeting, questions were asked about noise modeling, required agreements with the Gila River Indian Community regarding the proposed corridor through their land, ridership projections, whether FTA would allow ADOT to conduct ridership modeling, the point at which changes can be made to the plan, and the time frame for the EIS process.

By the end of the day on November 14, 2011, 14 agencies and stakeholders submitted written comments to ADOT. Eight of the comments were in letter or memo format, four were on the supplied comment forms, and two were email messages.

Most comments were regarding flooding concerns, impacts to wildlife corridors, habitat impacts, and impacts to priority vulnerable species.

The agency scoping meeting summary and examples of the invitation and materials distributed are included in the Scoping Report located in the Public and Agency Coordination Appendix.

Public Scoping Open Houses and Events

ADOT held scoping open houses and events in Pima, Pinal, and Maricopa counties beginning on October 7, 2011, with the final event held on November 1, 2011. A total of 141 people signed in at the scoping open houses, and hundreds more stopped by ADOT booths at community events and spoke with ADOT members.

The scoping process included eight public scoping open houses and four public events. The locations are shown in **Table 3-5** and **Table 3-6**, respectively.

Table 3-5. Public Scoping Open House Locations

Date	City	Location/Address	Attendees
10/11/11	Phoenix	Burton Barr Library: Auditorium 1221 North Central Avenue, Phoenix, AZ	51
10/13/11	Tucson	Pima Community College: Northwest Campus 7600 North Shannon Road, Tucson, AZ	16
10/18/11	Florence	Town of Florence Town Hall 775 North Main Street, Florence AZ	7
10/19/11	Coolidge	Central Arizona College: Signal Peak Campus 8470 North Overfield Road, Coolidge, AZ	6
10/24/11	Chandler	Chandler Downtown Library 22 S. Delaware Street, Chandler, AZ	13
10/25/11	Eloy	City of Eloy Council Chambers 628 North Main Street, Eloy, AZ	9
10/27/11	Casa Grande	City of Casa Grande Council Chambers 510 East Florence Blvd., Casa Grande, AZ	21
11/1/11	Mesa	Mesa Main Library 64 East First Street, Mesa, AZ	18

The scoping open houses provided participants an opportunity to ask the project team questions as well as submit feedback. These open houses featured displays and exhibits detailing the analysis area and AA and NEPA process. Participants were asked to register to receive future communication follow-up and were given an informative booklet and comment form.

A primary element of participation was a video lasting slightly less than 2 minutes. A running video presentation provided an overview of the NEPA and AA process. The video was available online and on a digital video disc (DVD). The video was accompanied by a 12-page booklet and a 12-question survey. The booklet and survey, which contained basic project information as well as the 12 questions, were available in hard copy and online. The online survey was available between October 7 and November 14, 2011. The public scoping booklet, scoping comment form, copies of the scoping event exhibits, and photos of the events are included in the Scoping Report located in the Public and Agency Coordination Appendix.

In addition to traditional public open houses, ADOT sought out and, when possible, attended community events scheduled during the scoping period. To supplement the open houses, exhibits were set up at selected local community events within the study area. Participation in these events maximized ADOT's ability to engage the public in their local surroundings. The table below includes the locations of these public events.

Table 3-6. Public Scoping Events

Date	Location/Address
10/7/11	University of Arizona: Campus Mall 1303 East University Boulevard, Tucson, AZ
10/8/11	Second Saturdays Downtown 44 North Stone Avenue, Tucson, AZ
10/12/11	Arizona State University: Campus Mall Tempe, AZ 85287
10/14/11 through 10/16/11 (3-day event)	Tucson Meet Yourself - Event Exhibitor Booth Pima County Plaza, 130 West Congress Street, Tucson AZ

Additional Scoping Activities

Project Website

The ADOT project website (www.azdot.gov/passengerrail) also served as a primary tool for communication during the scoping process. Stakeholders and members of the public could access additional study information, maps, and meeting materials on this site. The survey distributed at open houses and events was also made available for electronic completion on the website.

The following information is available on the website:

- Previous study overview documents
- Environmental process information
- Information about different types of rail transit and technologies
- Case studies about the impact of passenger rail service
- Stakeholder meeting presentations
- Statement of project need
- Calendar of events
- CST meeting material
- Maps of corridor alternatives
- Do-It-Yourself Participation Kits

To make participation as accessible as possible, and understanding that not all people have Internet access or the ability to attend a meeting or event, ADOT also offered Do-It-Yourself participation kits, which included a DVD of the short project video, copies of the scoping booklet and comment form, and postage-paid envelopes to return the comment form. People were able to request kits for as many people as they would like by calling the project hotline (see below), emailing the project team, faxing ADOT's Community Relations Division, or mailing a written request to ADOT Community Relations. A total of 31 kits were requested and mailed.

Project Hotline

An automated project hotline was established as an additional means of soliciting feedback. Respondents were free to leave comments for the study team on this hotline. All calls received were requests for Do-It-Yourself Participation Kits, which were shipped upon request.

3.4.3 Public Scoping Comments

Between October 7, 2011, and November 14, 2011, ADOT received 3,075 written comment submissions. This includes 2,784 survey responses along with 291 additional comment submissions that did not follow the survey format. The survey results are presented in the Scoping Report located in the *Public and Agency Coordination Appendix*.

Summary of Comments

In general, comments reflected a need for an additional transportation option between Tucson and Phoenix and a preference for rail. Traveling I-10 by car is often not viewed favorably due to heavy truck traffic, dust storms, and crashes, making many people likely to avoid the trip. Respondents indicated that if they had a viable alternative, they would make the trip more frequently.

The primary themes identified from the responses listed in **Table 3-7** helped the APRCS team analyze the data. Many of the 3,075 respondents had multiple comments in their submissions, yielding 14,218 unique public scoping comments that pertained to these six primary categories. Additional unique scoping comments did not fit into these common themes.

For each of the six key comment categories, an individual table of subcategories was prepared. These are included in the Scoping Report located in the *Public and Agency Coordination Appendix*. The information provided a good indication of the issues that need to be addressed in the technical analysis, which is a primary purpose of scoping.

Among the comments received, slightly over 6 percent indicated opposition to some element of passenger rail between Tucson and Phoenix. The majority of the opposed comments cited:

- Concerns about using taxpayer dollars to fund a rail project
- Fixing problems on I-10 before building something that is not an absolute necessity

Table 3-7. Public Scoping Comment Themes

Comment Category	# Unique Comments	% of Total Unique Comments
Mobility	6,858	48%
Environment	1,858	13%
Operational Characteristics	1,841	13%
Safety and Security	1,720	12%
Financial Feasibility	1,199	8%
Economic Development	742	5%
Total Comments in Comment Theme Categories	14,218	

Mobility

Forty-eight percent of the comments received related to mobility. Mobility between Tucson and Phoenix is unreliable because I-10, the only major corridor between the two major urban areas, is congested; and, as such, an alternative transportation option is viewed as an improvement to mobility.

Environment

Thirteen percent of the comments received related to the environment. In general, respondents did not view a new high-capacity travel choice as having a negative impact. The exception to this would be if the facility were located outside an existing transportation corridor. People who favor passenger rail said they would oppose a system that would forge a new corridor and adversely affect the natural environment. Air quality improvements were listed most often in terms of environmental issues, and "green" or "sustainable" were words used to describe a desirable transportation option.

Operational Characteristics

Thirteen percent of the comments received related to operational characteristics. People said they wanted a train with fewer stops that can travel at a higher speed.

In addition, responses frequently mentioned intermodal connections at stations. Although the light rail system in the metropolitan Phoenix area has expanded the Arizona public's view with regard to public transportation, more than 3,500 comments expressed concern about reaching a final destination after alighting a train. People indicated that they would ride the train if connections were available but communicated a sense of skepticism because these connections are not already in place.

Safety and Security

Twelve percent of the comments received related to safety and security. Driving on I-10 is viewed as challenging. Due to high traffic volumes, high truck traffic volumes, accidents, and dust storms, many people said they feel unsafe making the trip by car. A desire for another transportation option was clear in the comments.

Financial Feasibility

Eight percent of the comments received related to financial feasibility. Comments relating to financial feasibility tended to correlate with respondents indicating an opposition to rail, although some (approximately 1 percent) were in favor of or neutral toward rail and mentioned financial feasibility as a factor.

Economic Development

Five percent of the comments received related to the economic development. Respondents expressed the opinion that a link exists between the development of a transportation option and economic development, primarily indicating that such an option would spur global competitiveness and economic growth.

3.5 Alternatives Analysis (AA) Public Outreach

In addition to the extensive scoping outreach conducted, two phases of public participation, which included extensive communication with stakeholders and the public throughout the corridor, were held during the preparation of the AA and leading to the identification of the alternatives to be analyzed in the Tier 1 EIS. The outreach programs were held in Fall 2012 and Spring 2014 at public venues in conjunction with scheduled events in communities within the corridor. These responses helped to reduce the number of alternatives considered during the evaluation process from the approximately 150 possible original corridors to 7, and eventually to the final 2 corridor alternatives evaluated in detail in the Tier 1 EIS.

3.5.1 Notification of Public Outreach

Several strategies were employed to encourage community participation and receive feedback from Arizonans during the AA process. Publicity and notices are detailed below and are included in the Scoping Report located in the *Public and Agency Coordination Appendix*.

Paid display advertisements announced the beginning of the outreach process and directed readers to the study website for dates and locations where information would be available. **Table 3-8**, below, details the publications and dates of these advertisements.

Table 3-8. October 2012 Outreach Newspaper Advertisements

Newspaper	Publication Date
Apache Junction News	October 15, 2012
Arizona Daily Star	October 10, 2012
Arizona Republic	October 14, 2012
Coolidge Examiner	October 10, 2012
East Valley Tribune	October 10, 2012
Eloy Enterprise	October 11, 2012
Florence Reminder/Blade Tribune	October 11, 2012
Maricopa Monitor	October 12, 2012
TriValley Dispatch	October 10, 2012
Tucson Weekly	October 11, 2012

3.5.2 Alternatives Analysis Events

The AA process included ADOT participation in an information booth at 16 community events. As a result of the efforts, ADOT was able to reach out to community members who would not have otherwise participated. Information booklets, reporting what was heard from the public the previous year, maps of all seven alternatives being considered at this stage of the study, a high-level evaluation of the alternatives, a comment form, and self-addressed prepaid envelope were distributed at the events. In total, ADOT passed out 1,909 booklets. Additionally, the events provided participants an opportunity to ask ADOT questions regarding the study as well as submit feedback.

Each information booth was staffed by two to three ADOT representatives, accompanied by the following displays and information:

- 10-foot by 10-foot tent with a 6-foot table
- "Add your voice" branding banner
- Two A-frame display boards of the alternatives
- Detailed table display of all seven alternatives
- Informational takeaway booklet with comment form, postage-paid envelope, and link to the project website/electronic participation materials
- Promotional items printed with project branding such as drink cozies, keychain flashlights, magnetic chip clips, and microfiber eyeglass cleaning wipes

The information booklet and the comment form are included in the Scoping Report located in the *Public and Agency Coordination Appendix*. Photos of the events are also included in the Scoping Report. The locations and dates of events attended by ADOT members are listed in **Table 3-9**.

Table 3-9. Fall 2012-Spring 2013 Outreach Events

Date	City	Location/Address
10/6/12	Coolidge	Coolidge Days San Carlos Park, Coolidge
10/12/12 - 10/14/12	Tucson	Tucson Meet Yourself Downtown Tucson
10/17/12	Phoenix	CityScape Lunch Hour Washington and 1st Avenue in Downtown Phoenix
10/20/12	Maricopa	Stagecoach Days Pacana Park, Maricopa
10/27/12	Gilbert	Gilbert Fall Music and Halloween Festival Freestone Park, Gilbert

Table 3-9. Fall 2012-Spring 2013 Outreach Events

Date	City	Location/Address
10/27/12 – 10/28/12	Phoenix	Arizona State Fair Arizona State Fairgrounds, Phoenix
11/6/12	Casa Grande	Art in the Alley “The Alley” behind the Cook E Jar Restaurant, Casa Grande
11/9/12	Mesa	Mesa 2nd Friday Night Out Main Street, Mesa
11/10/12	Tucson	U of A on the Mall University of Arizona Campus, Tucson
11/10/12	Tucson	Tucson Second Saturday Downtown Tucson, Tucson
11/10/12	Chandler	Rock the Block Dr. A.J. Chandler Park
11/14/12	Tempe	ASU on the Mall Arizona State University Campus
11/16/12	Gilbert	28th Annual Gilbert 5k and 1-Mile Run Freestone Park, Gilbert
11/17/12	Phoenix	Harvest Festival Encanto Park, Phoenix
12/1/12	Marana	Marana Holiday Festival and Tree Lighting Municipal Complex Courtyard, Marana
12/2/12	Phoenix	F.Q. Story Historic District Home Tours Downtown Phoenix
12/8/12-12/9/12	Mesa	Mesa Arts Festival Mesa Arts Center
3/16/13-3/18/13	Sacaton	Mul-Chu-Tha Rodeo and Fair Sacaton Fairgrounds

3.5.3 Project Website

The project website (www.azdot.gov/passengerrail) continued as a primary tool for communication during the Fall 2012 outreach process. Stakeholders and community members could access additional study information, including potential alternatives. Over the course of the two-month outreach process, the website was viewed 23,591 times.

Stakeholders and community members could access additional study information that had been added since the scoping process.

3.5.4 Results of the Fall 2012-Spring 2013 Public Outreach

Community outreach efforts generated a significant amount of data and survey responses between October and December 2012. Public involvement statistics from this period include:

- 1,909 Information booklets were distributed
- 3,599 survey responses were collected, both physically and online
- 543 emails in support of rail were received
- 11 formal letters were submitted
- 922 individuals asked to be included in the study email distribution list

In general, comments reflected strong support for passenger rail between Tucson and Phoenix. Many respondents felt that rail is the future and were happy to see that alternative travel options were being studied. It was clear that a balance between time of travel and serving the most population centers was important, along with financial feasibility. The following pages present the information collected from the survey responses.

Question 1: For each alternative, please indicate your preference for each one using one of the following rankings:

1. Strongly in Favor of
2. In Favor of
3. Neither in Favor of nor Against
4. Against
5. Strongly Against

The main focus of the surveying instrument was to identify which of the seven alternatives from this stage of the study were favored among the community. Below are trends ADOT heard from the community at the events.

Blue Alternative:

- Better than nothing
- Could serve as an interim solution to build ridership

Green Alternative:

- Provides fast travel time and most direct route

Orange Alternative:
- Connects Tucson International, Phoenix-Mesa Gateway, and Phoenix Sky Harbor airports
- Connects universities and the East Valley

Purple Alternative:
- Connects Cities of Casa Grande, Chandler, and Tempe
- Provides an economic development opportunity for the GRIC
- Route provides a balance between the East Valley, I-10, and communities to the west

Red Alternative:
- Provides the best access to Maricopa
- Potential to connect to existing Amtrak station

Teal Alternative:
- Connects population centers, including the East Valley
- Proposes fewer stops than the other routes through the East Valley

Yellow Alternative:
- Recognition that it could use existing UP right-of-way
- Connects population centers in the East Valley

Questions 2 and 3: In what city/town would you most likely get on the train or bus and get off the train or bus?

The survey asked participants their home and work zip codes to identify the locations from which responses were provided. Using only the home zip code data, the team identified that 98 percent of those who provided this information live in Maricopa, Pima, and Pinal counties; and 59 percent live in Tucson, Phoenix, and Mesa.

Table 3-10 and **Table 3-11**, respectively, indicate the number of responses received based on city and county.

Table 3-10. Fall 2012-Spring 2013 Responses by City

City	Responses	Percent of Total	City	Responses	Percent of Total
1. Tucson	904	39.3%	25. Eloy	8	0.3%
2. Phoenix	367	16.0%	26. Laveen	7	0.3%
3. Mesa	119	5.2%	27. Paradise Valley	7	0.3%

Table 3-10. Fall 2012-Spring 2013 Responses by City

City	Responses	Percent of Total	City	Responses	Percent of Total
4. Tempe	96	4.2%	28. Sun City	6	0.3%
5. Chandler	91	4.0%	29. Sahuarita	6	0.3%
6. Gilbert	86	3.7%	30. Gold Canyon	6	0.3%
7. Casa Grande	86	3.7%	31. Cave Creek	5	0.2%
8. Scottsdale	64	2.8%	32. Fountain Hills	5	0.2%
9. Maricopa	61	2.7%	33. Buckeye	4	0.2%
10. San Tan Valley	49	2.1%	34. El Mirage	4	0.2%
11. Glendale	49	2.1%	35. New River	3	0.1%
12. Queen Creek	38	1.7%	36. Tolleson	3	0.1%
13. Surprise	31	1.3%	37. Waddell	3	0.1%
14. Peoria	30	1.3%	38. Oracle	3	0.1%
15. Marana	25	1.1%	39. Sacaton	3	0.1%
16. Vail	22	1.0%	40. Kearny	2	0.1%
17. Goodyear	21	0.9%	41. Unknown	2	0.1%
18. Florence	15	0.7%	42. Luke Air Force Base	1	0.0%
19. Coolidge	12	0.5%	43. Wittman	1	0.0%
20. Avondale	11	0.5%	44. Youngtown	1	0.0%
21. Litchfield Park	11	0.5%	45. Cortaro	1	0.0%
22. Apache Junction	11	0.5%	46. Nogales	1	0.0%
23. Green Valley	9	0.4%	47. Mammoth	1	0.0%
24. Arizona City	8	0.3%			
			TOTAL	**2,299**	

Table 3-11. Fall 2012-Spring 2013 Responses by County

County	Responses	Percent of Total
Maricopa	1,065	45.32%
Pima	968	41.12%
Pinal	266	11.32%
Other	51	2.17%
TOTAL	**2,350**	

Taking a closer look at the responses, ADOT used zip code data to identify the cities and towns from which respondents were commuting back and forth. The top 10 cities and towns of commutes are detailed in **Table 3-12**. The data in **Table 3-12** show that a majority of the respondents live and work in the same city. A total of 19 respondents stated they commute between Tucson and Phoenix (13 originating in Phoenix and 6 originating in Tucson).

Table 3-12. Top Ten Commute Cities

Origin City	Destination City									
	Casa Grande	Chandler	Gilbert	Maricopa	Mesa	Phoenix	San Tan Valley	Scottsdale	Tempe	Tucson
Casa Grande	48	3	0	0	0	5	0	1	3	2
Chandler	1	38	2	1	5	22	0	4	15	2
Gilbert	0	7	33	1	8	14	0	2	9	1
Maricopa	2	4	0	25	2	13	0	1	3	1
Mesa	1	1	5	0	64	24	0	4	12	2
Phoenix	2	5	0	2	4	287	0	20	17	6
San Tan Valley	0	2	3	0	6	7	20	2	3	0
Scottsdale	0	1	0	0	0	19	0	33	7	1
Tempe	1	1	2	1	2	17	0	6	44	2
Tucson	0	0	1	0	4	13	0	4	2	862

Question 4: What ways would you plan on arriving at the rail or bus station to begin your trip?

ADOT asked participants what modes of transportation would be used to access rail or bus stations. **Table 3-13** shows the results.

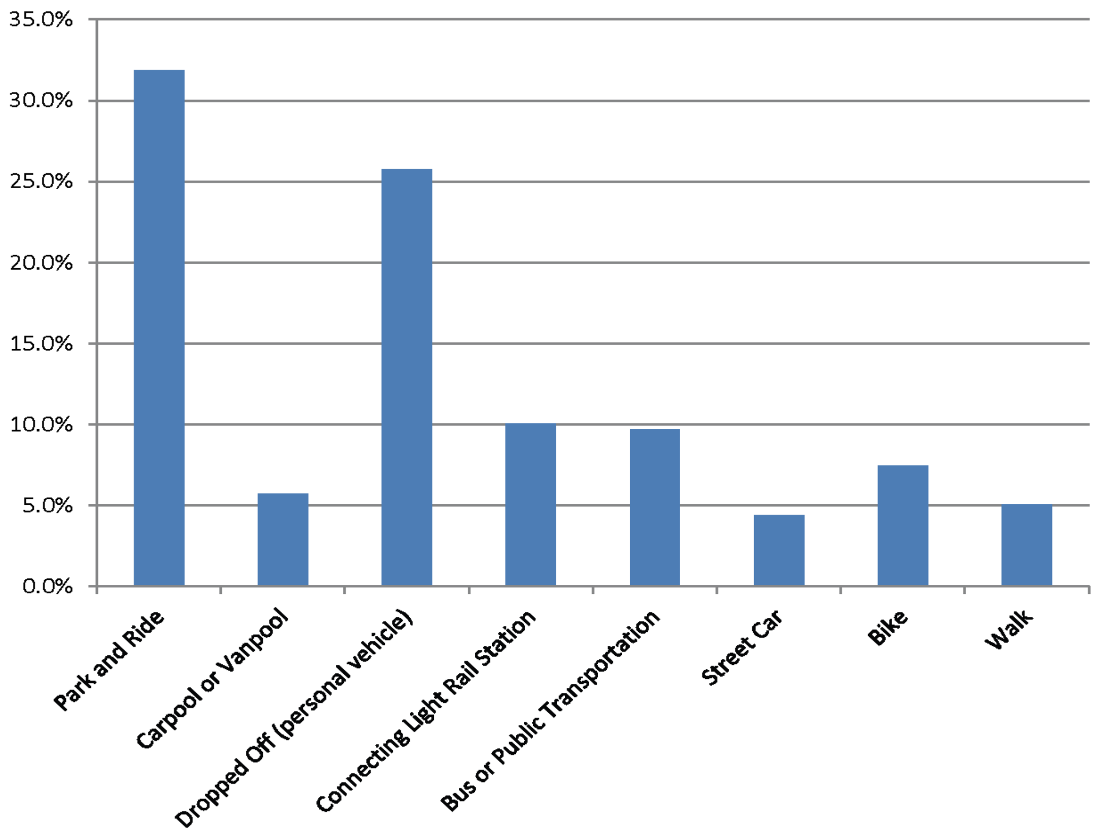
Table 3-13. Responses by Access Mode

Mode	Park and Ride	Carpool or Vanpool	Dropped Off (personal vehicle)	Connecting Light Rail Station	Bus or Public Transportation	Street Car	Bike	Walk
Responses	2,367	426	1,912	746	722	326	553	377
Percentage	31.9%	5.7%	25.7%	10.0%	9.7%	4.4%	7.4%	5.1%

Participants were asked to select their top three choices. Potential user preference by access mode is shown graphically in **Figure 3-1**. The top three modes of arriving at a bus or rail station are:

1. Park and Ride
2. Dropped Off (Personal Vehicle)
3. Connecting Light Rail Station

Figure 3-1. Responses by Access Mode



Question 5: What do you need to have available at the rail or bus station to arrive at your final destination? **Table 3-14** shows the distribution of the departure mode at the destination end of the trip.

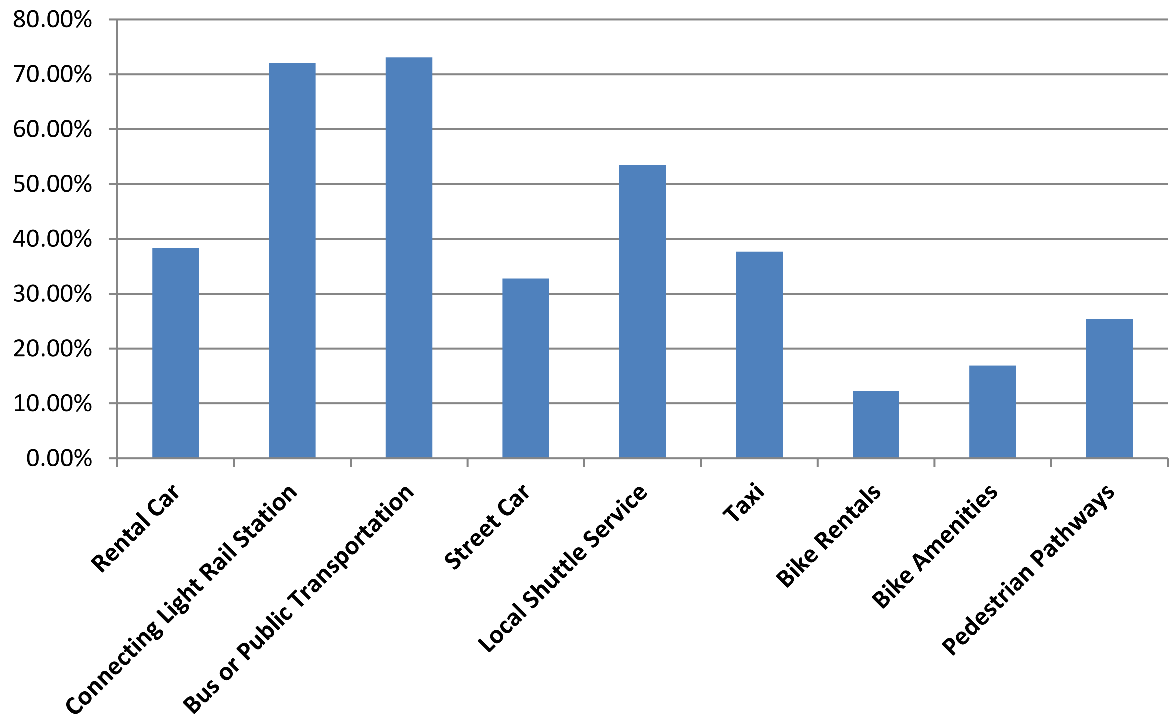
Table 3-14. Responses by Departure Mode

Mode	Rental Car	Connecting Light Rail Station	Bus or Public Transportation	Street Car	Local Shuttle Service	Taxi	Bike Rentals	Bike Amenities	Pedestrian Pathways
Responses	1,041	1,955	1,984	890	1,451	1,023	334	459	690
Percentage	38.4%	72.1%	73.1%	32.8%	53.5%	37.7%	12.3%	16.9%	25.4%

Participants were asked to select their top three choices. Potential user preference by departure mode is shown graphically in **Figure 3-2**. The top three modes of departing from a bus or rail station to complete a trip were:

1. Bus
2. Connecting Light Rail Station
3. Local Shuttle Service

Figure 3-2. Responses by Departure Mode



Question 6: Rank the following criteria that will be used to help evaluate the alternative, with one being the most important and six the least important:

The order in which the priorities were ranked by participants is as follows:

4. Community Acceptance
5. Financial Feasibility
6. Safety
7. Mobility
8. Environment

9. Operating Characteristics

The results of the participant preferences are shown in **Table 3-15**.

Table 3-15. Priority of Evaluation Categories

Ranking Value	1	2	3	4	5	6	Average Ranking
Community Acceptance	723	510	405	359	361	379	3.10
Environment	431	429	495	410	429	576	3.62
Financial Feasibility	625	545	495	418	328	356	3.13
Operating Characteristics	325	413	502	547	496	419	3.64
Mobility	437	502	434	442	505	416	3.48
Safety	568	401	446	467	481	457	3.45

3.5.5 Spring 2014 Alternatives Analysis Public Outreach

The public and agency outreach associated with the final alternatives began in the spring of 2014. During the intervening time, the alternatives and the information to be shared during the public outreach program were further refined to help gain as much public and agency input about the key factors identified in the Level 2 outreach.

Notification of Public Outreach

In the spring of 2014, public comments, stakeholder input, and technical analysis led to the narrowing of seven alternatives in Level 2 to three final alternatives in Level 3. The outreach effort in the spring of 2014 focused on eliciting the public's and agency's preferences among the three remaining options.

News releases were issued by ADOT on March 4, April 2, and May 12, 2014, to encourage participation in the outreach process. These news releases resulted in extensive media coverage in press, radio, and television. At least 24 media sources produced articles on the study and broadcast them throughout communities in the corridor.

Alternatives Analysis Events

As in previous levels of the outreach program, the AA public process included ADOT participation in an information booth at 13 community events throughout the corridor as indicated in **Table 3-16**. An updated information booklet was prepared with the latest information available from the study, including the findings from earlier outreach, maps of the three Final Alternatives with defining characteristics and performance information, a comment form, and self-addressed prepaid envelope. These were distributed at the events and available on the ADOT project website. In total, ADOT distributed 1,400 booklets during the Level 3 Outreach. Additionally, as before, the events provided participants an in-person opportunity to discuss the project with study team members as well as submit feedback.

Table 3-16. Spring 2014 Outreach Events

Date	City	Location/Address
3/7/14 3/8/14	Chandler	Ostrich Festival 2250 S. McQueen Road, Chandler
3/15/14	Gila River	Mul-Chu Tha Sacaton Fairgrounds
3/28/14 3/29/14 3/30/14	Tempe	Tempe Festival of the Arts Mill Avenue, Tempe
4/5/14	Marana	Marana Main Street Festival Main Street and Civic Center Drive, Marana
4/5/14	Peoria	Peoria Arts Festival Osuna Park, 10510 N 83rd, Peoria
4/12/14	Gilbert	Gilbert Global Village Festival Gilbert Civic Center
4/15/14	Mesa	ADOT SR 24 Opening Event State Route 24, Mesa
4/16/14	Tucson	City of Tucson Downtown Stone Avenue and Pennington Street
4/17/14	Tucson	University of Arizona University Blvd. and Tyndall Blvd., Tucson
4/18/14 4/19/14	Tucson	Pima County Fair Old Pueblo Hall, Pima County Fairgrounds, Tucson
4/26/14	Mesa	Celebrate Mesa Pioneer Park, 526 E. Main Street, Mesa
5/15/14	Phoenix	CityScape Washington Street at 1st Street, Phoenix
6/17/14	Florence	Florence Chamber of Commerce Holiday Inn Express, 240 W. Highway 287

Project Website

As with earlier outreach phases, the project website (www.azdot.gov/passengerrail) continued to be a primary tool for communication of project-related information. Interested citizens could access additional study information at any time and could submit project preferences and surveys. Over the course of the four-month outreach process between March and June 2014, 7,873 individuals viewed the website.

Results of the Spring 2014 Outreach Effort

During Level 3 public outreach, 1,400 information booklets were distributed; and 5,085 surveys, plus an additional 43 emails/letters, were received. The comments were generally consistent with previous outreach findings, with strong support for a rail option between Tucson and Phoenix. The public placed a high priority on short travel time, system reliability, and minimizing the cost of the trip for passengers.

Paired Attribute Comparison

For the Level 3 Outreach, an additional technique was used to collect more focused information about project priorities from survey participants. In cooperation with the University of Arizona, the survey instrument used in Level 3 was modified to include a paired comparison of some of the proposed rail alternatives' attributes to assess preferences in more depth than a simple question about preferred alternatives. The surveys distributed included random questions about the critical features or characteristics of the study alternatives compared to each other to test the strength of the preferences when asked in different contexts. For example, a comparison of travel speed to the cost of the trip might assign a higher priority to trip cost, but a comparison of travel speed to reliability of service might suggest travel speed is more important. By comparing the results among select pairings, the priorities for various features among the participants can be expected to emerge. While the survey was not designed to be statistically valid, the large number of responses adds a level of confidence to the results and provides insight into what attributes associated with a passenger rail system are most valued.

On a straight preference basis, among the three Final Alternatives, excluding the No Build Alternative, the Yellow Alternative is supported by 46 percent of the nearly 4,000 participants who responded to that question. The Green was preferred by 32 percent and the Orange by 22 percent. In addition to the overall preference, reviewing the attribute (key decision variable) comparisons produced the results shown in **Table 3-17**.

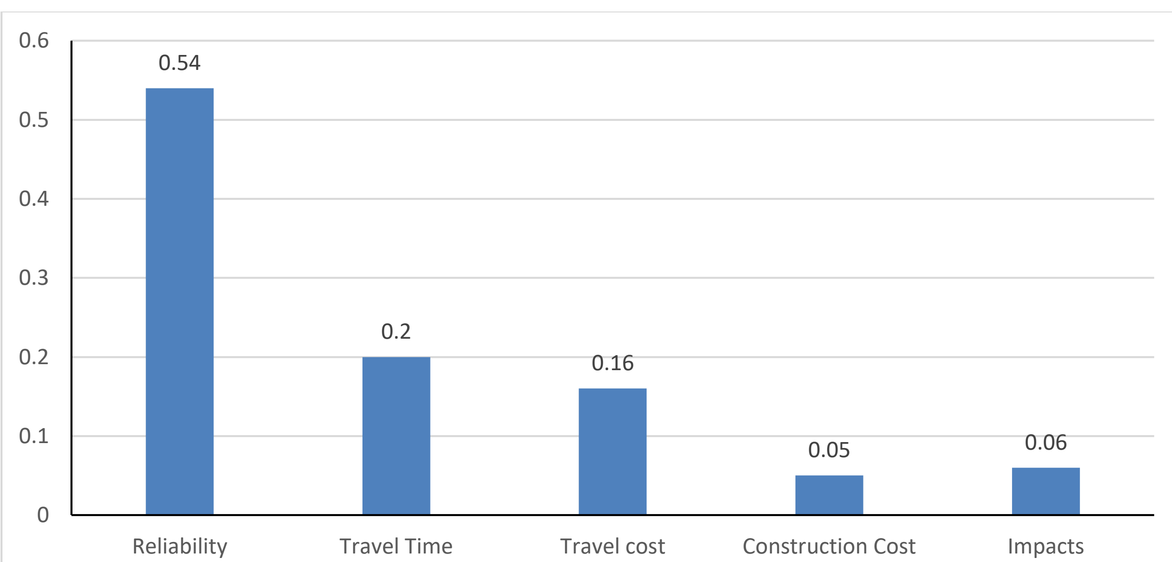
Reliability is the clear priority for those responding to the survey, while construction cost and impacts to private property are less important. More detail about this process can be found in the *Public and Agency Coordination Appendix*.

Table 3-17. Paired Comparisons of Select Features

Features Selected for Comparison	Number	Percent of Total
Policy Q1 – Travel Time vs. Cost of Construction		
Provide fastest overall travel time	1,203	79.20%
Limit cost of construction	316	20.80%
Policy Q2 – Reliability vs. Impacts to Private Property		
Limit service disruptions and maintains schedule reliability	1,208	79.63%
Limit impacts to private property	309	20.37%
Policy Q3 – Cost of Trip vs. Cost of Construction		
Limit the cost of the trip	1,301	78.71%
Limit the cost of construction	352	21.29%
Policy Q4 – Reliability vs. Cost of Trip		
Limit service disruptions and maintains schedule reliability	1,352	81.59%
Limit the cost of a trip	305	18.41%
Policy Q5 – Cost of Construction vs. Impacts to Private Property		
Limit the cost of construction	545	54.12%
Limit impacts to private property	462	45.88%
Policy Q6 – Cost of Trip vs. Travel Time		
Limit cost of trip	425	42.00%
Provide fastest overall travel time	587	58.00%

The results in **Figure 3-3** show the significance of the variables among the respondents.

Figure 3-3. Relative Weights of Key Decision Variables



3.6 Public Hearings

As part of the NEPA process, FRA and ADOT circulated the Draft Tier 1 EIS for a 50-day review and comment period beginning on September 11, 2015. During this period, the document was made available to interested and concerned parties, including residents, property owners, community groups, the business community, elected officials, and public agencies. In addition to being available online on the ADOT, EPA, and FRA websites, copies of the Draft Tier 1 EIS were available at the following locations:

Burton Barr Branch
Phoenix Public Library
1221 North Central Ave.
Phoenix, AZ 85004

Downtown Branch
Chandler Public Library
22 South Delaware Street
Chandler, AZ 85225

ADOT Research Library
206 South 17th Ave.
Phoenix, AZ 85007

Pima Community College
Northwest Campus
Library
7600 North Shannon Road
Tucson, AZ 85709

Central Arizona College
Signal Peak Campus
Library
8470 North Overfield Road
Coolidge, AZ 85128

Southeast Regional
Library – Gilbert
775 North Greenfield Road
Gilbert, AZ 85234

During the review and comment period, FRA and ADOT held a series of formal public hearings on the Draft Tier 1 EIS on September 15, 16, and 17, 2015 from 5:30 p.m. to 7:00 p.m., with video presentations beginning at 5:45 p.m. and 6:20 p.m. FRA and ADOT presented the same information was presented at each of the following locations:

Tuesday, September 15
Burton Barr Branch Phoenix Public Library
First Floor Pulliam Auditorium
1221 North Central Avenue
Phoenix, AZ 85004

Wednesday, September 16
Tucson Convention Center
Leo Rich Theater
260 South Church Avenue
Tucson, AZ 85701

Thursday, September 17
Central Arizona College
Signal Peak Campus, Room M101
8470 North Overfield Road
Coolidge, AZ 85128

The purpose of the hearings was to give interested parties an opportunity to meet the project team and to formally submit comments in person, on comments cards or electronically on the Draft Tier 1 EIS. Attendance at the hearings was not required in order to submit comments. Responses to substantive comments received have been addressed in the Final Tier 1 EIS. All comments and responses are listed in the *Public and Agency Coordination Appendix*.

Additional Public Comment Period Activities

Project Website

The ADOT project website (www.azdot.gov/passengerrail) was also a primary tool for providing updated information during the Draft Tier 1 EIS review and comment period. Using the website, stakeholders and members of the public could:

- View a 13-minute video presentation on the Draft Tier 1 EIS;
- Access and/or download the Draft Tier 1 EIS, appendices, and additional study information; and
- Submit written comments on the Draft Tier 1 EIS.

Project Hotline

ADOT established an automated project hotline as an additional means of soliciting feedback. Callers were given an opportunity to leave spoken comments on the Draft Tier 1 EIS on this hotline.

3.6.1 Comments on the Draft Tier 1 EIS

Between September 3, 2015, and October 30, 2015, ADOT received 499 written comment submissions online. In addition, 13 comment forms were filled out and either handed in, mailed, or faxed. Formal letters were received from 15 government agencies, jurisdictions, utilities, and stakeholder groups.

Commenting Agencies

The following participating agencies and stakeholder groups submitted comments, either online or by letter, on the Draft Tier 1 EIS:

Federal Agencies

- U.S. Environmental Protection Agency
- National Park Service)
- US Bureau of Land Management
  - Arizona State Office
  - Lower Sonoran Field Office
  - Tucson Field Office

State Agencies

- Arizona Corporation Commission
- Arizona Game and Fish Department

Local and Regional Agencies

- City of Coolidge
- City of Eloy
- City of Mesa
- City of Phoenix
- City of Tucson

- Maricopa Association of Governments
- Pima County
- Town of Florence
- Town of Gilbert
- Town of Queen Creek

Tribes

- Gila River Indian Community
- Tohono O'odham Nation

Transportation and Utilities

- Phoenix-Mesa Gateway Airport Authority
- Tucson Airport Authority
- Tucson Electric Power
- Union Pacific Railroad Company

Non-Governmental Organizations

- Pima Community Access Program
- Valley of the Sun United Way

Stakeholder Groups

- Audubon Arizona
- AZ Public Interest Research Group
- Coalition for Sonoran Desert Protection
- Environment Arizona
- Local Initiatives Support Corp.
- Physicians for Social Responsibility
- Sierra Club
- Sky Island Alliance
- Southern Arizona Leadership Council
- Southern Arizona Lodging and Resort Association
- Southwest Energy Efficient Project
- Visit Tucson

Agency and Stakeholder Comments

Public agencies and stakeholder groups generally addressed issues pertaining to their particular geography, interest, or expertise. Agency and stakeholder letters received, as well as agency comments submitted online, are presented, with responses, in the *Public and Agency Coordination Appendix*.

Summary of Federal, State, and Tribal Agency Comments

Many of the comments received by government and regulatory agencies included requests for project-specific data, requests for comprehensive, Study-Area wide inventories of environmental features, or system-wide analyses of impacts. Analysis for this Tier 1 EIS was conducted for one-mile wide corridor alternatives to allow flexibility for avoiding environmentally sensitive areas, reducing costs, and addressing engineering constraints during Tier 2 analysis and design. Detailed analysis of corridor alternatives this wide would have resulted in an overstatement of the potential environmental effects, while analyzing corridors that are too narrow in Tier 1 limits flexibility in future design. For this reason, detailed data and analysis will be addressed in Tier 2 environmental studies. Comments on the Draft Tier 1 EIS from federal, state, and tribal entities included the following:

<u>Federal Agencies</u>

- U.S. Environmental Protection Agency: Requested area-wide inventories and detailed analyses of a broad range of environmental resources, or commitments to coordinate with agencies and perform these studies in Tier 2.

  This type of detailed analysis will be conducted during Tier 2 along with any site-specific consultation with relevant resource agencies.

- U.S. Department of the Interior / National Park Service: NPS requested to become a cooperating agency on this study. Also requested a Section 4(f) Evaluation of potentially affected resources, specifically drawing FRA and ADOT’s attention to the following
  - Casa Grande Ruins National Monument
  - Pueblo Grande Ruin and Irrigation Sites National Historic Landmark
  - San Xavier del Bac Mission National Historic Landmark
  - Ventura Cave National Historic Landmark
  - Air Force Facility Missile Site 8 National Historic Landmark
  - Gatlin Site National Historic Landmark
  - Taliesin West National Historic Landmark
  - Juan Bautista de Anza National Historic Trail designated historic corridor, auto tour route, and recreation retracement route (de Anza Trail)

- Potential impacts to parks and recreation areas, specifically Section 4(f) properties would depend on the alignment within the designated corridor and refined during Tier 2 analysis. Specific types and degrees of impacts on individual resources (such as ROW acquisition and impacts on characteristics of a resource) would not be known until further design of rail facilities takes place. These would be evaluated in Tier 2 NEPA documents. The *Section 4(f) and 6(f) Resources Appendix* includes a table of the public parks and recreational resources located within the mile-wide corridor alternatives, plus a 0.25-mile buffer around them to account for proximity effects such as increased noise.
- U.S. Department of the Interior / US Bureau of Land Management: BLM requested to become a cooperating agency on this study, and identified the de Anza Trail for inclusion in the Tier 1 study, and disclosed prior rights (a recreation and public purposes lease in place until 2028) on a parcel of BLM land along Schnepf Road. Also, based on a review of Master Title Plats for federal mineral estate status within the corridor alternatives, BLM administers subsurface mineral estate of lands within the alternatives.

  The de Anza Trail corridor was added to the *Corridor Aerial Atlas Appendix*. The BLM parcel on Schnepf Road as identified by the BLM comment letter, does not lie within the Yellow or Orange Corridor Alternative.

  <u>The southern portion of both corridor alternatives coincides in places with the Juan Bautista de Anza National Historic Trail designated historic corridor, auto tour route, and recreation retracement route. As defined by the National Trails System Act (16 U.S.C. §§ 1241-1251), a National Historic Trail is an extended trail which follows as closely as possible and practicable the original trail or route of travel of national historical significance. While the historic corridor is not afforded protection under the NHPA, the Historic Trail designation is intended to identify and protect the remains of this overland route for public use and enjoyment. The Anza Trail corridor appears on Maps 1-11 and 21-27 of the *Corridor Aerial Atlas Appendix*.</u>

  Section 4(f) and cultural resources planning, and avoidance alternatives will be considered for appropriate resources during Tier 2 environmental analysis.

  Prior existing rights, including subsurface mineral estate, will be investigated and addressed during Tier 2 environmental studies.

<u>State Agencies</u>

- Arizona Corporation Commission (Commission): Presented an overview of the Draft Tier 1 EIS generally advocating passenger rail service and the Yellow Corridor Alternative in particular. Affirmed the Commission’s role in inspecting all aspects of any new or existing railroad infrastructure, including crossing improvements, to ensure safety in construction, operation, and maintenance.

- Arizona Game and Fish Department: Requested a number of specific changes to the Final Tier 1 EIS to provide more complete available information on wildlife species, movement, and habitat within the Study Area, and measures to mitigate potential effects resulting from implementation of passenger rail service.

  The Final Tier 1 EIS was revised to comply with AGFD's requests to the extent possible, with resolution on the outstanding issues deferred to Tier 2.

Tribes

- Gila River Indian Community
  - Cultural Resources Management Program (GRIC-CRMP): Requested to be a consulting party under Section 106 of the National Historic Preservation Act, and explained the need for FRA and ADOT to directly request GRIC-CRMP to conduct a Class III archaeological survey of the unsurveyed parts of a future passenger rail facility on GRIC lands in Tier 2. Also requested that ADOT identify Traditional Cultural Properties in accordance with documentation protocols for Section 4(f) resources.

    FRA and ADOT sent a letter to GRIC in September 2013 inviting them to participate in Section 106 consultation. Section 106 consultation will continue during the Tier 2 studies. GRIC-CRMP will be consulted to obtain available cultural resource data and discuss requirements for future data collection and analysis of the area of potential effects of proposed alignments that intersect GRIC land.
  - Department of Environmental Quality (GRIC DEQ): Because the Yellow Corridor Alternative intersects GRIC land, FRA and ADOT need to comply with GRIC DEQ ordinances and regulations, including any applicable permits or authorizations required. The Orange Corridor options do not intersect with GRIC land.

    FRA and ADOT will comply with GRIC DEQ environmental regulations in Tier 2 studies and subsequent actions located within GRIC boundaries.
  - Department of Transportation: Requests that FRA and ADOT coordinate with GRIC Department of Transportation in subsequent Tier 2 studies, regarding alternatives, sensitive noise and vibration receptors, socioeconomic impacts, Section 4(f) resources, and farmlands. Requests that FRA and ADOT investigate "last mile" connections between community centers and rail stations once station locations have been determined in Tier 2 studies.

FRA and ADOT will undertake these analyses in Tier 2.

- Tohono O'odham Nation: Requested that a "complete Class III (100%) survey" as well as a Cultural Landscape Survey be completed for both corridor alternatives before selecting a final route. Also requested that presentations on this project be made to the Chairman of the Tohono O'odham Nation, the Tohono O'odham Nation Legislative Council Cultural Preservation Committee, and eventually to the full Legislative Council.

  FRA and ADOT respect the interests of this and other tribal governments. The Yellow Corridor Alternative with Orange corridor options within Tempe and Pinal County was identified as the preferred alternative based on multiple factors; available cultural resource data at the Tier 1 Study level, for the two alternative corridors did not sufficiently differ, in the context of all environmental and non-environmental factors considered, to set one corridor alternative above another as the preferred corridor alternative. There is not enough information at the Tier I Study level to require or perform a Cultural Class III as requested for a Tier 1 document. Section 106 and Tribal consultation for resources will be conducted at Tier 2 when an alignment is known.

Most of the concerns raised by agencies would be addressed in future Tier 2 analyses, which would cover far less than a one-mile wide corridor. Actual construction activities for a passenger rail facility would occur within a railroad ROW ranging from 66 to 400 feet wide, and determined at Tier 2 upon funding. Environmental study boundaries for future Tier 2 analysis would address a much narrower area within and around the ultimate ROW required. More in-depth environmental analysis, as well as coordination and consultation with state and federal agencies (e.g., State Historic Preservation Office, USFWS) on specific resource areas would be undertaken once alignment boundaries were more firmly established and funding was allotted. During Tier 2, input from engineers, transit demand planners, and government agencies, as well as environmental data would be used to develop alignment options.

Summary of Public Comments

Over 500 public comments were submitted on the Draft Tier 1 EIS, as follows:

- 499 written comments submitted online
- 13 written comments submitted on comment cards or faxed
- 28 oral comments taken at public hearings

Most of these expressed either support of (nearly 88 percent of those indicating a preference) or opposition to passenger rail service between Tucson and Phoenix, with the majority of those in support preferring the Yellow Corridor Alternative. Fewer than 4 percent of the public comments mentioned environmental resource categories and none resulted in revisions to the environmental analysis in the Tier 1 EIS. A breakdown of the environment-related comments, as shown in **Table 3-7**, illustrates the topics addressed, followed by a brief description of the comment themes.

Public comments received on the Draft Tier 1 EIS are arranged in a table, with responses to each comment, in the *Public and Agency Coordination Appendix*.

Table 3-18. Public Comment Themes

Comment Category	Number of Comments Expressing Benefits	Number of Comments Expressing Concerns
Air Quality	5	1
Biological Resources	3	2
Cultural Resources	0	1
Economic	1	1
Energy	3	0
Traffic	2	0

Air Quality: Commenters were in favor of improved air quality resulting from reduced traffic volumes and motor vehicle emissions associated with establishing passenger rail service. One commenter expressed opposition to pollution associated with diesel technology. The cost estimate developed for the AA assumed diesel-electric motive power for pricing purposes, and the environmental analysis was conducted assuming diesel locomotives. During Tier 2 studies, additional air quality analysis, including a quantification of MSAT emissions, will be conducted based on the technology chosen by the project sponsor at the time of project implementation. It should be noted that while the cost estimate developed for the AA assumed diesel-electric motive power for pricing purposes and the environmental analysis was conducted for diesel locomotives, an additional air quality analysis will be conducted during the Tier 2 NEPA studies. Additional Tier 2 air quality analysis will quantify MSAT emissions from the technology chosen by the project sponsor at the time of project implementation.

At this time, no specific engine technology has been selected. It is assumed that new technology will be implemented by the project sponsor. EPA has established emission standards for pollutants for newly manufactured and remanufactured locomotives (see 73 FR 25098, Locomotive and Commercial Marine Rule). EPA is projecting that 1 $PM_{2.5}$ and NOx emissions will drop as a result of these standards.

Biological Resources: Comments included support of the preferred alternative as being less environmentally damaging of the two corridor alternatives. Commenters also expressed concerns about interruptions to wildlife connectivity, and questions about the AGFD study.

Cultural Resources: A commenter inquired about potential impacts to historic districts in and around downtown Phoenix.

Economic Impacts: One commenter asked about the potential for adverse impacts to communities located along a passenger rail route where the train does not stop. Another commenter touted the economic benefit passenger rail could bring to station areas, particularly the Tucson and Phoenix hubs, stating that this would mitigate the significant construction cost.

Energy: Commenters favored mass transit over automobile travel.

Traffic: Commenters cited existing and future traffic congestion and advocated passenger rail as one means of providing relief.

3.7 Accommodations for Minority, Low-Income, and Persons with Disabilities

All public meetings were held in accessible facilities in compliance with the Americans with Disabilities Act of 1990. Every effort has been made to respond to members of the public who require a sign language interpreter, an assistive learning system, a translator, or other accommodations to facilitate participation in the planning process. Meetings throughout the corridor were held at different times of day and in all geographic regions and accommodated disabled participants.

EO 12898 requires that, as part of the environmental evaluation of the alternatives, the EIS must address environmental justice issues. To comply with this requirement, community demographics and socioeconomic impacts were considered in analyzing the alternatives. The public participation process ensured “full and fair participation by potentially affected communities” throughout the duration of the study. In addition to traditional public open houses, ADOT sought out and, when possible, attended community events scheduled during the scoping period. To supplement the open houses, exhibits were set up at selected local community events within the study area, including one in the Gila River Indian Community. Participation in these events maximized ADOT’s ability to engage the public in their local surroundings. ADOT also proactively coordinated with the tribes, inviting them to Corridor Study Team and Scoping meetings, and arranging individual meetings to discuss potential impacts of passenger rail through tribal lands.

3.8 Additional Agency Coordination

In addition to the engagement and outreach techniques described previously in this chapter, ADOT held individual meetings with nearly all local municipal participating agencies within the study area throughout the study process. This coordination included briefings to local municipal staff as well as formal presentations to elected municipal boards, committees, and councils. Additionally, throughout the EIS process, multiple meetings were held with the communities located along the three final corridor alternatives (Green, Orange, and Yellow) defined as part of the AA. The purpose of these meetings was to update those particular communities on study progress.

As the corridor alternatives being carried forward in the EIS began to take shape, it was apparent that certain agencies required further coordination to assist with the analysis of potential corridor impacts and identification of fatal flaws. These agencies included the commercial airports (Phoenix Sky Harbor, Phoenix-Mesa Gateway, and the Tucson International Airport), the Arizona Game and Fish Department, UP, major universities in the region, and the GRIC. The project team met with UP multiple times to discuss potential impacts to their freight rail corridors located throughout the study area and within the corridor alternatives.

FRA initiated formal tribal consultation process with GRIC. The project team met with GRIC staff and committees during different stages of the study and ultimately presented on corridor alternative selection decisions to the GRIC Tribal Council. The Agency Coordination Plan at the end of the *Public and Agency Coordination Appendix* (prepared in accordance with Section 6002 of Pub. L. 109-59) outlines tribal outreach activities during the study.

4 Transportation Impacts

This chapter compares the potential transportation impacts associated with the implementation of passenger rail service within the corridor alternatives with the potential impacts of the No Build Alternative. Future ridership projections for passenger rail service are presented for each corridor alternative. In addition to passenger rail service characteristics, impacts to freight rail service, grade crossings, and vehicular traffic are discussed, including potential impacts during construction and long-term changes associated with highway/railroad grade crossings.

Rather than include transportation impacts in **Chapter 5, Existing Conditions and Environmental Consequences** as one facet of the environment, these impacts have their own chapter in this Tier 1 EIS. The impacts speak directly to the purpose and need for the project; and, as a transportation project is being proposed to solve a transportation problem, the transportation impacts of the two corridor alternatives and of the No Build Alternative are of a magnitude that warrants their own chapter in the EIS.

ADOT has coordinated with all local agencies to obtain readily available long-range transportation plans within the study corridor illustrated in **Figure 1-1**. Major existing and planned transportation facilities for each transportation mode have been identified, including locations with substantial existing levels of congestion. A list of these plans and studies is included in the AA.

A separate Service Development Plan (SDP) will be prepared as part of the APRCS following the approval of the Record of Decision (ROD). The SDP will provide more detail of the proposed passenger rail service.

4.1 Service Concept and Travel Forecasting

A primary objective of passenger rail is to deliver a service that can provide an effective alternative mode within the corridor. The success of the system depends on the travel time achievable and the reliability of the service compared to alternative travel modes. This section details the concept for service used for the Yellow and Orange corridor alternatives, assuming a regional higher speed (between 80 and 125 mph) train operation and building upon a blend of intercity and commuter considerations. These service assumptions (i.e., frequency of intercity or commuter trains, times of operation, schedule, stops, etc.) were developed to estimate ridership and capital and operating costs, as well as the effect of changes in vehicle miles traveled (VMT) on safety, noise, vibration, and air quality. The findings in this chapter are approximations based on a passenger rail system built on the alignments used in the AA. A future alignment elsewhere within the corridor alternatives may have different impacts and would be reevaluated in Tier 2 studies.

The FTA-developed Simplified Trips-on-Project Software (STOPS) model was used to provide an estimate of ridership for each of the corridor alternatives. The model replaces the standard "trip generation" and "trip distribution" steps with CTPP tabulations to predict detailed travel patterns, to quantify trips-on-project measure for all travelers and for transit-dependents, and to compute the change in automobile VMT based on the change in overall passenger rail ridership between the No Build and the corridor alternative scenarios.

4.1.1 Yellow Corridor Alternative

For the purposes of this transportation impact analysis, the alignment of the Yellow Corridor Alternative would take advantage of an existing UP ROW. A passenger rail system operating at grade within the corridor would likely affect land uses and crossings along its entire length. At the same time, it could serve major population and activity centers and connect key trip origins and destinations directly. Potential station stops (shown in **Table 4-1**), frequencies, and overall travel times between terminal stations for the Yellow Corridor Alternative are summarized in this section. Documented assumptions include all three modeled Yellow Corridor Alternative service patterns, defined below and shown in **Figure 4-1**. It is possible for the commuter and intercity service patterns to overlap and run concurrently.

- Commuter (Grand Corridor) – TUS to Surprise
- Commuter (Yuma West Corridor) – TUS to Buckeye
- Intercity – Downtown Tucson to Downtown Phoenix

Table 4-1. Yellow Corridor Alternative Conceptual Stations

Station Name	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern
Tucson International Airport	X	X	
Tucson	X	X	X
Orange Grove	X	X	
Tangerine Road	X	X	
Eloy	X	X	X
Coolidge	X	X	
San Tan Valley	X	X	
Queen Creek	X	X	
Cooley	X	X	

Table 4-1. Yellow Corridor Alternative Conceptual Stations

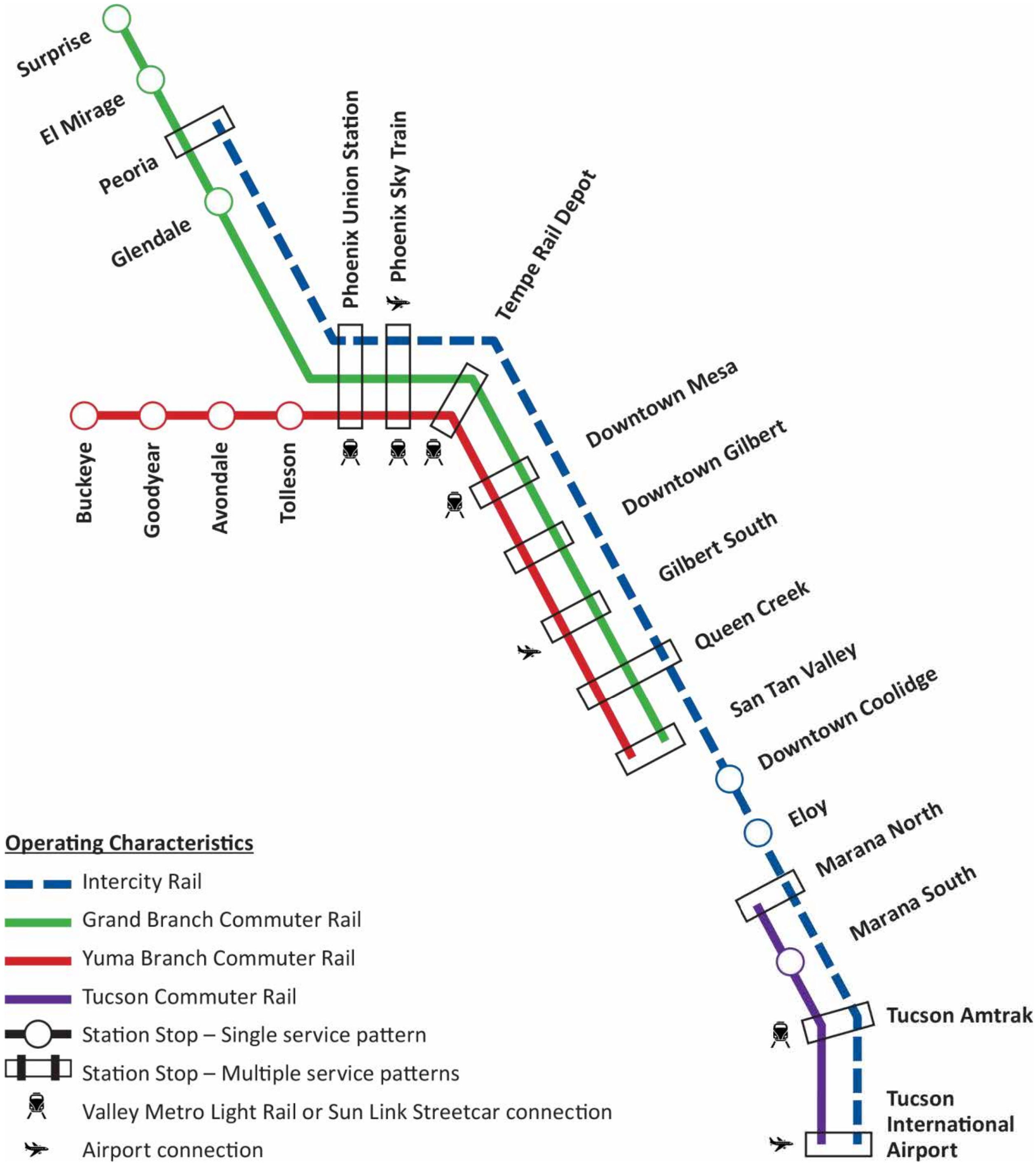
Station Name	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern
Downtown Gilbert	X	X	
Downtown Mesa	X	X	
Tempe	X	X	
PHX	X	X	X
Phoenix	X	X	X
Glendale	X		
Peoria	X		
El Mirage	X		
Surprise	X		
Avondale		X	
Goodyear		X	
Buckeye		X	

Table 4-2 compares the assumptions for the combined frequencies (headways—the interval of time between trains on the same route—in minutes) of the three modeled Yellow Corridor Alternative service patterns.

Table 4-2. Yellow Corridor Alternative Frequencies

		Headways (minutes)			
From Time	To Time	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern	Combined Headway between DT Phoenix & DT Tucson
			Southbound		
5:30:00	9:29:00	30	60	60	15
9:30:00	14:59:00	180	180	---	90
15:00:00	18:59:00	30	60	60	15
			Northbound		
5:30:00	9:29:00	30	60	60	15
9:30:00	14:59:00	180	180	---	90
15:00:00	18:59:00	30	60	60	15

Figure 4-1. Yellow Corridor Alternative Operational Context



Total travel times based on detailed station-to-station travel times used in the AA are displayed in **Table 4-3**.

Table 4-3. Yellow Corridor Alternative Travel Times (Tucson to Phoenix)

Station Name	Commuter Operating Pattern	Intercity Operating Pattern
Northbound	1:35:00	1:23:00
Southbound	1:36:00	1:22:00

4.1.2 Orange Corridor Alternative

For the purposes of this transportation impact analysis, the Orange Corridor Alternative would not make use of the existing rail corridor but would follow existing or proposed highways. Similar to the analysis in the AA, the Orange Corridor Alternative is assumed to be located on a separate alignment within highway corridors and may be grade separated in places (most likely elevated) to eliminate the need for numerous grade crossings and expedite travel within the metropolitan Phoenix area. This alternative would afford opportunities for higher speed rail travel but would include a substantial structural component in the project cost. The use of existing or proposed highway corridors would also impose certain constraints on the potential alignments, some of which do not serve population centers directly. In some cases, this could necessitate the use of a secondary transit service (e.g., bus or light rail) to access destinations. Potential station stops (shown in **Table 4-4**), frequencies, and overall travel times between terminal stations for the Orange Corridor Alternative are summarized in this section. Documented assumptions include all three modeled Orange Corridor Alternative service patterns as described below and shown in **Figure 4-2.**

- Grand Corridor Pattern – TUS to Surprise
- Yuma West Corridor Pattern – TUS to Buckeye
- Intercity Pattern – Downtown Tucson to Downtown Phoenix

Table 4-4. Orange Corridor Alternative Conceptual Stations

Station Name	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern
TUS	X	X	
Tucson	X	X	X
Marana - Orange Grove	X	X	
Marana - Tangerine	X	X	
Eloy	X	X	X

Table 4-4. Orange Corridor Alternative Conceptual Stations

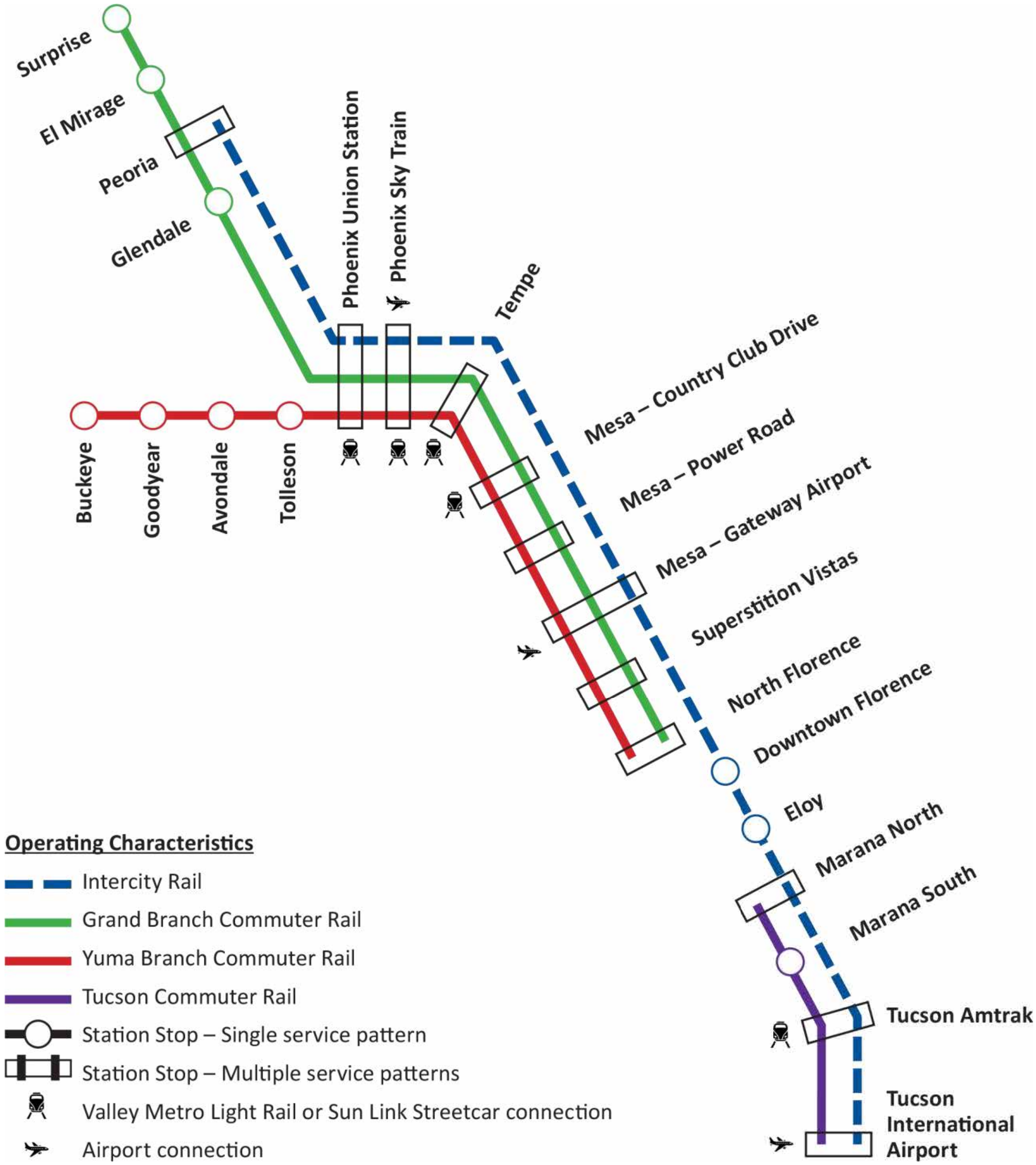
Station Name	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern
Coolidge-Florence	X	X	
North Florence	X	X	
Superstition Vistas	X	X	
Mesa-Gateway Airport	X	X	
Mesa-Power	X	X	
Mesa-Country Club	X	X	
Tempe	X	X	
PHX	X	X	X
Phoenix	X	X	X
Glendale	X		
Peoria	X		
El Mirage	X		
Surprise	X		
Avondale		X	
Goodyear		X	
Buckeye		X	

Table 4-5 compares the assumptions for the combined frequencies (headways—the interval of time between trains on the same route—in minutes) of the three modeled Yellow Corridor Alternative service patterns.

Table 4-5. Orange Corridor Alternative Frequencies

		Headways (minutes)			
From Time	To Time	Grand Corridor Pattern	Yuma Corridor Pattern	Intercity Pattern	Combined Headway between DT Phoenix & DT Tucson
		Southbound			
5:30:00	9:29:00	30	60	60	15
9:30:00	14:59:00	180	180	---	90
15:00:00	18:59:00	30	60	60	15
		Northbound			
5:30:00	9:29:00	30	60	60	15
9:30:00	14:59:00	180	180	---	90
15:00:00	18:59:00	30	60	60	15

Figure 4-2. Orange Corridor Alternative Operational Context



Total travel times based on detailed station-to-station travel times used in the AA are displayed in **Table 4-6**.

Table 4-6. Orange Corridor Alternative Travel Times (Tucson to Phoenix)

Travel Direction	Commuter Operating Pattern	Intercity Operating Pattern
Northbound	1:44:00	1:30:00
Southbound	1:45:30	1:30:00

No passenger rail service currently operates within the Orange Corridor Alternative. UP operates approximately 10-15 freight trains per day on the Phoenix Subdivision line (between Eloy and downtown Phoenix) with speeds ranging between 15 miles per hour (mph) and 60 mph. Conditions would not change with the No Build Alternative.

4.1.3 Travel Demand/Benefits

Chapter 1, Purpose and Need of this Tier 1 EIS identifies the need to provide an effective alternative to automobile travel within the study corridor because conditions on the highway system are expected to deteriorate over time as population and travel in the corridor grow. The corridor alternatives were developed with that intent. The quantification of travel and safety benefits using anticipated changes in travel time, ridership, and VMT for each corridor alternative is the basis for the comparison of those measures in this chapter, as well as air quality and energy consumption (in **Chapter 5, Existing Conditions and Environmental Consequences**), compared with anticipated conditions under the No Build Alternative.

Corridor Alternatives

Travel Time

The SDP will be completed and adopted by ADOT following the publication of the Final EIS and issuance of a FRA Record of Decision. Given the assumed level of rail service outlined in the SDP as it is being developed, the corresponding personal vehicle travel time between the two urbanized areas is detailed in **Table 4-7**. No Build Alternative travel times are based on the Arizona Statewide Travel Demand Model version 2 (AZTDM2).

Table 4-7. Estimated Rail and Auto Travel Times between Tucson and Phoenix

	Yellow Corridor Rail Alternative (Hrs:Min)	Orange Corridor Rail Alternative (Hrs:Min)	No Build Alternative (Auto Travel) (Hrs:Min)
2010			1:53
2035	1:23 (Intercity)	1:30 (Intercity)	2:22
2050	1:23 (Intercity)	1:30 (Intercity)	2:59

Ridership

Ridership forecasts are a measure of the potential success of the proposed service based on the demand for its use. Ridership was estimated using an FTA forecasting model called STOPS. It was designed specifically to estimate ridership on fixed guideway systems. While its original purpose was for travel in urban environments on New Starts and Small Starts (FTA grant programs for funding major infrastructure investments) projects, it generates reasonably high-level forecasts for the Tier 1 EIS analysis of the Tucson to Phoenix corridor.

The development of STOPS evolved directly from the requirement established in FTA's Final Rule on major capital investments: to provide a simplified method that project sponsors can use, at their option, to quantify the trips-on-project measure and the VMT change needed for the environmental effects analysis.

Because the proposed service is a blended concept that includes intercity and commuter trips, the STOPS application was set up to identify trips of less than 40 miles and trips of more than 40 miles. The longer trips are an estimate of the expected intercity travel demand.

The output from STOPS shows both unlinked and linked transit trips in the modeled area. The "unlinked" trips are all the component segments of a transit trip identified separately (i.e., a transfer from one bus route to another represents two unlinked trips), while "linked" trips count the entire trip from beginning to end as a single trip (i.e., the same two unlinked trips in the transfer above represent a single linked trip). This information is shown quantitatively in **Table 4-8**.

Table 4-8. Year 2035 Tucson-Phoenix Commuter and Intercity Trip Demand

	Yellow Corridor Alternative	Orange Corridor Alternative	No Build Alternative
Unlinked transit trips	476,000	475,000	451,000
Linked transit trips	343,000	343,000	324,000
Total Daily Rail Ridership	**20,060**	**18,080**	N/A
Intercity trips (>40 miles)	3,360	4,140	N/A
Commute trips (<40 miles)	16,700	13,940	N/A
Total by Service Type	20,060	18,080	
Daily VMT reduction	566,914	570,268	N/A
Daily VHT reduction	17,522	17,655	N/A
Notes: VHT = Vehicle Hours Traveled			

Safety

Overall passenger safety in the corridor would improve because passenger rail service would divert some automobile trips to an alternate mode of travel. The safety risk to travelers would decrease, as rail travel is statistically safer per passenger mile than automobile travel. The overall potential decrease in automobile traffic that could be realized with implementation of passenger rail service would be expected to reduce potential automobile injuries and fatalities within the corridor. The potential annual reduction in fatalities and injuries within the Yellow and Orange corridor alternatives is estimated as part of FTA STOPS model forecasts and shown in **Table 4-9**.

Table 4-9. Safety Improvement (per 1,000,000 VMT in 2035)

	Yellow Corridor Alternative	Orange Corridor Alternative	No Build Alternative[a]
Annual fatality reduction	2.2	2.2	N/A
Annual injury reduction	33.2	33.4	N/A

Note: Assumes trains run 300 days a year.
[a] Potential increases in fatalities and injuries under the No Build Alternative were not estimated for this Tier 1 analysis.

With additional trains operating within either corridor alternative, the possibility of train collisions is increased as a result of increased activity between freight and passenger services and a higher number of trains at grade crossings; however, the signaling system, such as positive train control as required by the Rail Safety Improvement Act of 2008 (RSIA), would be designed to mitigate this risk.

No Build Alternative

Current travel time between Tucson and Phoenix is approximately 113 minutes and is projected to increase to 179 minutes by 2050, even with the addition of substantial new roadway capacity along I-10 and on the proposed North-South Corridor, based on AZTDM2. No passenger rail service currently exists in the Tucson-to-Phoenix corridor.

4.2 Operational Impacts to Freight Rail Service

4.2.1 Corridor Alternatives

Yellow Corridor Alternative

ADOT has had ongoing discussions with UP, the freight operator in the corridor, related to the proposed Yellow Alternative. Based on the information obtained from UP and analysis of the alternative, the implementation of passenger rail within the Yellow Corridor Alternative is not expected to result in a change in the number of freight trains currently operating in the Tucson to Phoenix corridor, although some freight train scheduling modifications may be required to prevent conflicts with passenger service. Upgrades to the existing UP track were assumed as part of this alternative in addition to projects to accommodate passenger rail operations. These potential improvements include:

- New at-grade single track
- New at-grade siding tracks
- New siding turnouts, where needed
- New roadway-rail grade crossings
- Reconfiguration of UP track where needed
- Centralized train control signal systems
- Positive train control systems where required by FRA regulations.

These projects would allow continued service to freight customers and mitigate potential restrictions to freight movements.

Orange Corridor Alternative

The implementation of passenger rail within the Orange Corridor Alternative would have minimal impact to existing freight rail service. Impacts would be restricted to the portion of the corridor between Tempe and downtown Phoenix/West Valley and downtown Tucson to TUS. Within the portion of the passenger rail corridor which is shared with the freight rail corridor, the following typical projects would be implemented:

- Rehabilitation of single track where necessary
- New at-grade single track
- New at-grade siding tracks
- Centralized train control signal systems
- Positive train control systems where freight and passenger train activity intersect

During operation of the passenger rail system, freight rail service could be maintained with minimal scheduling modifications and limited need for coordination with the passenger rail service.

4.2.2 No Build Alternative

The No Build Alternative consists of current freight rail conditions with no additional track upgrades, capacity increases, or signal projects planned.

4.3 Grade Crossing Impacts

4.3.1 Corridor Alternatives

Yellow Corridor Alternative

Under the Yellow Corridor Alternative, modifications or improvements would be made to all grade crossing signals. Additionally, it is possible that some grade crossings would be converted to grade-separated crossings. All grade crossings would be upgraded to four-quadrant gates. For locations already equipped with four-quadrant gates, construction to accommodate the upgraded service could be required, such as in areas with additional track. Grade-separated crossings can be considered as part of implementing the Yellow Corridor Alternative and require further analysis. Some locations can be determined using safety records maintained by ADOT, but the identification of the exact locations would require further analysis. Vehicular delay at the grade crossings would increase due to the addition of the more frequent passenger rail operations and advanced warning times. This delay would be eliminated at grade separations.

Orange Corridor Alternative

Under the Orange Corridor Alternative, modifications or improvements would be made to all grade crossing signals, which are limited to the areas between Marana and TUS, and between downtown Tempe and downtown Phoenix. Additionally, 15 new grade-separated crossings would be assumed to be installed in the area between Marana and Phoenix-Mesa Gateway Airport as part of the North-South Corridor development and the use of the Superstition Vistas transit corridor. All grade crossings would be upgraded to four-quadrant gates. For locations already equipped with four-quadrant gates, construction to accommodate the upgraded service may be required, such as in areas with additional track. Vehicular delay at existing grade crossings would increase due to the addition of passenger rail service operations and advanced warning times.

4.3.2 No Build Alternative

Under the No Build Alternative, no passenger rail system would be constructed, and no changes to existing roadway-rail grade crossings would be anticipated. No projects are currently planned to upgrade existing grade crossings beyond regular maintenance. The No Build Alternative would have no effect on UP operations.

4.4 Rail Service Impacts during Construction

4.4.1 Corridor Alternatives

In the case of the Yellow Corridor Alternative, ADOT would obtain permission and participation from UP for all construction that would take place within the railroad ROW, including coordination to ensure continued access and maintenance of customer service. In the case of the Orange Corridor Alternative, the corridor has little interaction with the railroad, although permission would be sought for any coordination needs in the short distance between Tempe and Phoenix and in downtown Tucson. In general, corridor construction would affect rail traffic by reducing operating train speeds through construction zones and adding to rail travel time. This may occur when adding new siding tracks, double-tracking, upgrading signals, and modifying grade crossings. The other impact would be schedule adjustments for existing operations to create windows of opportunity for temporary suspension of rail operations on selected track sections, such as when new turnouts are being placed for passing sections and new sidings or if a potential safety risk may occur. During construction, temporary “shoo-fly” trackage may need to be installed for longer disruptions; or brief track outages, which would interrupt freight service temporarily, may be necessary. Minimal construction impacts are associated with the Orange Corridor Alternative as compared to the Yellow Corridor Alternative.

4.4.2 No Build Alternative

Under the No Build Alternative, construction would be limited to regular maintenance activities; therefore, no impacts to rail service would occur.

4.5 Vehicular Traffic Impacts during Construction

4.5.1 Corridor Alternatives

Vehicular traffic would be temporarily affected at locations where grade crossings would be separated or modified. While the exact construction zones have not been determined at this time, temporary lane closures or roadway closures would likely be required to construct a passenger rail system. Grade crossing construction would, at a minimum, slow traffic down as it passes through the construction zone. In some cases, temporary diversion of traffic to adjacent crossings could be required.

Construction of grade-separated crossings would be staged to minimize street closures. This may be accomplished by closing the outside lanes during retaining wall and bridge abutment construction while maintaining traffic on the inside lane. The adjacent parallel streets would be used for detour traffic during street closures. Another option is to construct a temporary detour around the construction site, which would reduce the amount of out-of-direction travel to parallel routes.

Where impacts to vehicular traffic occur, emergency services, schools, businesses, and other activities requiring vehicular access would be affected by potential delays or detours. Construction-related impacts to vehicular traffic would be temporary, however; and ADOT would undertake a public outreach program prior to construction to notify schools, emergency service providers, residents, and businesses.

4.5.2 No Build Alternative

No construction activity associated with a passenger rail system would occur in the No Build Alternative.

4.6 Station Location and Local Parking Impacts

4.6.1 Corridor Alternatives

Concept plans have not been developed for station locations, as specific locations have not yet been determined. Station area concept plans would be developed as the projected ridership forecasts are refined, to allow the determination of required station size, number of parking spaces, transit amenities, and vehicular circulation. It is assumed that the location of new stations would be easily accessible from the highway and arterial system and would also accommodate transit, bicycle, and pedestrian access. Generalized station type concepts (i.e., hub, regional, local, emerging) have been developed as a model for future stations pending the requisite information about demand for services and physical location. These are presented in the *Station Area Planning Guidance for Communities* at the end of the *Alternatives Analysis Appendix*.

Constructing and operating passenger rail stations have the potential to generate impacts that require mitigation. These could be related to:

- property acquisition and displacements,
- changes in land use and economic development potential,
- the need to relocate and/or reconstruct displaced community facilities,
- congestion resulting from intensified travel activity at stations, including parking, facilities, that could require reconfiguration of existing streets or diversion of vehicular traffic, and
- the need to facilitate station access by alternative modes while ensuring pedestrian and bicycle safety as a result of increased congestion.

Any such impacts would be addressed during Tier 2 analysis.

4.6.2 No Build Alternative

No station construction or effects on local parking would take place under the No Build Alternative.

4.7 Corridor Cross Sections

The transportation impact analysis of the Yellow and Orange Corridor Alternatives did not consider detailed design concepts of a passenger rail track alignment. However, in order to better understand the potential impact of an alignment's built condition within a corridor, typical rail cross sections were developed. These cross sections are not meant to distinguish between the Yellow and Orange Alternatives, and are intended only as a means to gauge potential ROW impacts of different possible scenarios. More detailed analysis in the future may bring to light factors or conditions which change these assumptions. **Figure 4-3**, **Figure 4-4**, and **Figure 4-5** show the typical cross sections for single track, double track, and double track with a station platform, respectively. While these cross sections are only an illustration of possible configurations, any elements such as station platforms or other features would be designed and constructed to conform to the requirements of the Americans with Disabilities Act (ADA).

Figure 4-3. Cross Section – Single Track

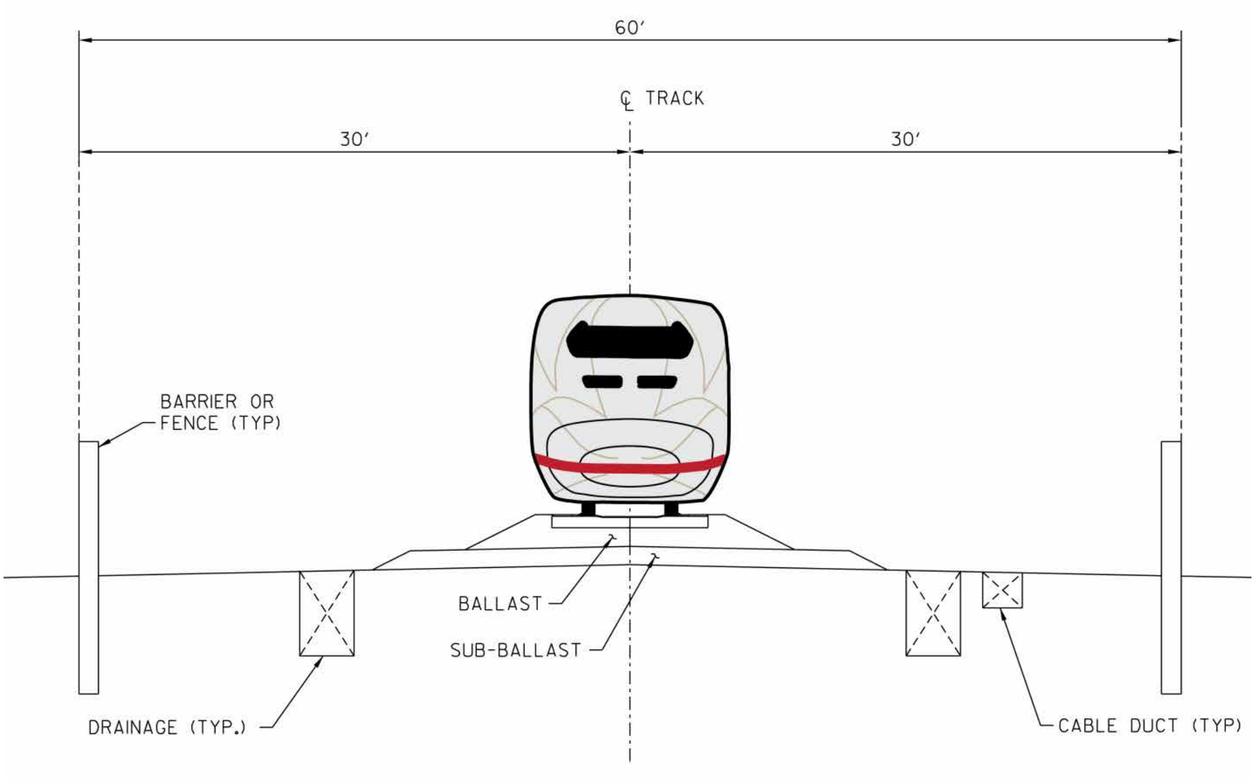


Figure 4-4. Cross Section – Double Track

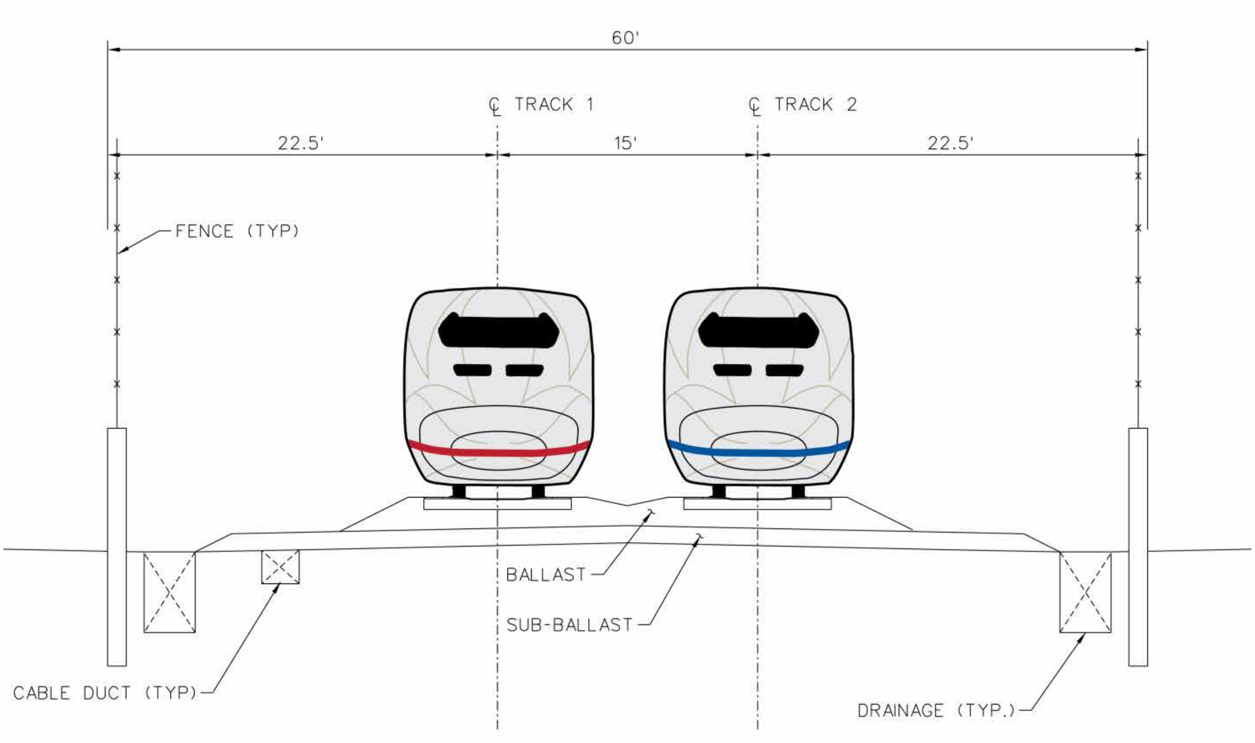
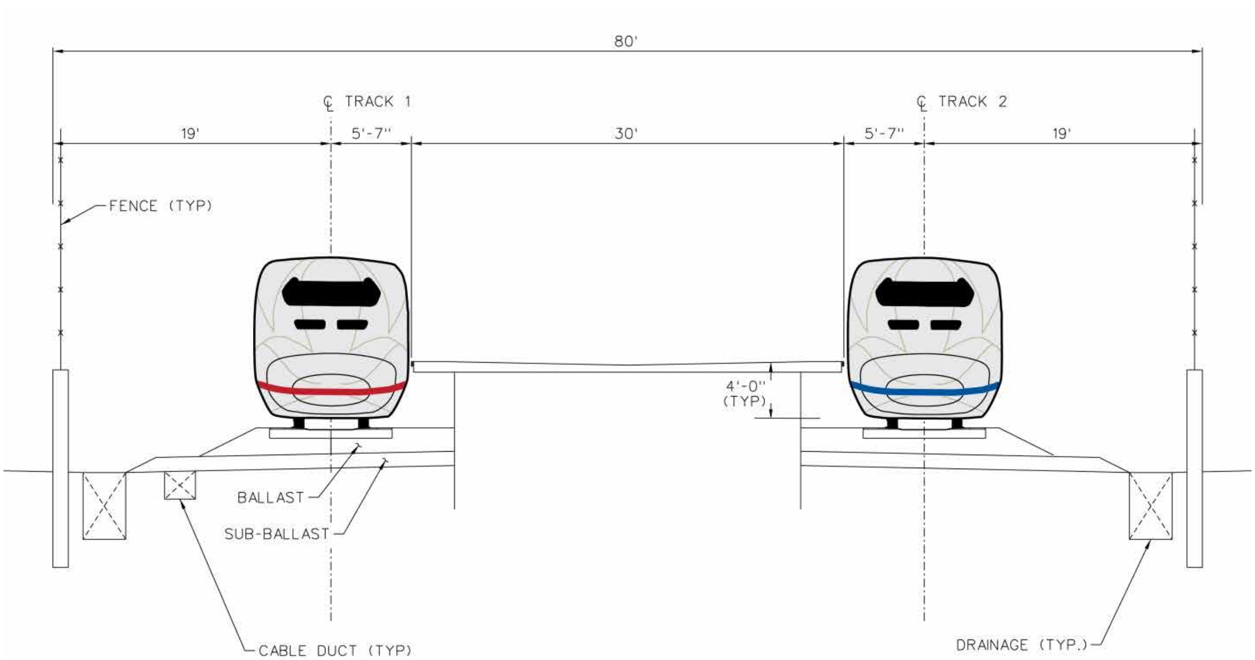


Figure 4-5. Cross Section – Station Platform



5 Existing Conditions and Environmental Consequences

5.1 Introduction

A Tier 1 environmental review was conducted for the APRCS because FRA and FTA determined that the route of a future passenger rail system must first be considered in its regional context, as it would influence roadway networks, future planning processes, and environmental issues spanning portions of three counties, numerous jurisdictions, and multiple independent planning processes. Given the existing and projected rapid growth in and around the study area, it is vital to identify a preferred corridor alternative as early as feasible, so that planning decisions can consider a future passenger rail system, and before new development reduces alignment options or increases ROW acquisition costs. While this Tier 1 EIS examines a conceptual level of design without a specific track alignment, more detail about specific affected areas would be examined in Tier 2 NEPA analyses.

<u>The Final EIS includes revisions made subsequent to the publication of the Draft EIS. Substantive additions or text revisions to this chapter of the EIS resulting from agency and public comments received on the Draft EIS during the review and comment period are identified by the use of underlined type.</u>

Service development planning is also being completed as part of the development of the APRCS and includes the development of FRA-required conceptual site plans for passenger rail, new stations, and maintenance facilities. Detail about the affected areas for stations and maintenance facilities would be examined more closely in future Tier 2 NEPA analyses. ADOT has prepared the Service Development Plan (SDP) for the alternative identified by the FRA. The SDP will be completed and adopted by ADOT following the publication of the Final EIS and issuance of a FRA Record of Decision.

This chapter describes the existing social, economic, and environmental conditions within the two corridor alternatives which serve as a baseline for comparing the potential impacts of a passenger rail system with the No Build Alternative. **Chapter 5, Existing Conditions and Environmental Consequences** also identifies potential environmental consequences that could result from implementation of a passenger rail system, as well as types of mitigation measures that could be used to avoid or minimize some of the potential environmental consequences identified.

5.1.1 Regulatory Requirements

This Tier 1 EIS is being prepared in compliance with NEPA to analyze and disclose the potential effects of a passenger rail system between Tucson and Phoenix. FRA is the lead federal agency for the EIS. ADOT is the local sponsoring agency and in 2009 received $2 million – $1 million plus a $1 million state match – through FRA's Capital Assistance to States – Intercity Passenger Rail Service Program, to prepare a Service Development Plan and the required environmental study. In addition to funding for these two studies, ADOT received $4,331,250 in 2011 through FTA's New Starts program funds ($3,465,000 federal in an 80%-20% state match), to conduct an Alternatives Analysis (See the *Alternatives Analysis Appendix*) to be eligible to proceed with the FTA New Starts Project Development phase.

ADOT could seek future funding opportunities from FTA, which provides financial and technical assistance to local public transit systems, as well as FRA, which provides financial assistance for developing and enhancing intercity rail service. Funding could also be provided by other sources such as other USDOT grant programs, federal loan programs, local bonds, and public-private partnerships.

Cooperating agencies include those agencies with federal, state, or local jurisdiction by law. Cooperating agencies also may have special expertise or information that would assist in development of the analysis in an EIS, even when the agency may not have legal jurisdiction.

FHWA and FTA are both serving as cooperating agencies, which includes responsibilities for sharing data and contributing to the review of the EIS. Approximately 75 parties were invited to serve as participating agencies, including federal, state, and local agencies. In addition, consultation has been initiated with 29 Native American tribes. Numerous stakeholders have participated in the studies and planning process, as described in **Chapter 3, Public Agency Coordination**.

In addition to complying with NEPA (42 U.S.C. § 4321 *et seq.*), this EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999), Council on Environmental Quality's (CEQ) regulations implementing NEPA (40 CFR parts 1500-1508), and FTA's Environmental Impact and Related Procedures (23 CFR Part 771), for compliance with that agency's Alternatives Analysis process.

5.1.2 Chapter Organization

In this Tier 1 EIS, the following general outline is used to summarize the analysis conducted for each resource.

- **Methodology and Regulatory Requirements** – Summarizes the impact analysis methodology and the regulatory requirements for each resource, including the sources for the data collected and the applicable regulatory agencies.
- **Existing Conditions** – Describes the existing social, economic, or environmental conditions for each resource within the study corridor and, in some cases, the area

surrounding the corridor alternatives. Existing data are used to develop the description as a baseline for assessment of effects for the alternatives considered.

- **Environmental Consequences** – Evaluates the potential effects of building, implementing, and operating a passenger rail system within each of the corridor alternatives, beginning at the southern hub in Tucson and ending at the northern hub in Phoenix. This section also evaluates the potential effects of the No Build Alternative.
- **Potential Mitigation Measures** – Reviews potential mitigation measures, including avoidance and minimization appropriate for a Tier 1 EIS and lists more specific mitigation measures that might be identified during preparation of Tier 2 NEPA documents.
- **Tier 2 Considerations** – Identifies some of the additional studies and evaluations that may be required as funding becomes available and specific track alignments and rail station locations are developed.

Tier 2 NEPA analysis could be advanced for logical operable sections of a passenger rail system within the preferred corridor alternative; that is, one or more operable sections of a Tucson-to-Phoenix passenger rail system could be developed as individual projects. Separate Tier 2 NEPA documentation would be prepared for each project identified. Preliminary design and NEPA documentation would be conducted in support of the Tier 2 analyses because more detailed information would be necessary to identify the specific resources that would be affected by construction and to what extent. Any such section would be required to have independent utility, with or without construction of other sections. The sections could be evaluated as logical, independent sections subject to available funding and the source of that funding. Tier 2 sections could also be combined, modified, or revisited in the future based on available funding.

In addition to the No Build Alternative, this Tier 1 EIS analyzes the potential effects of building and operating a passenger rail system within two corridor alternatives that are a mile wide. At this stage in project development, rather than examine specific alignments, the corridor analysis looks at a broader area, allowing future design and construction to avoid potential direct impacts while reducing the potential need to reassess the existing conditions and potential impacts. At the same time, the entire mile-wide corridors described under "Existing Conditions" in this chapter would not be affected by construction of a passenger rail system. Therefore, the potential impacts described in this Final Tier 1 EIS are estimated based on a hypothetical railroad ROW corridor, particularly where potential ground disturbance is a factor in the impacts analysis. The impact area used to estimate potential effects was obtained by adding 60 to 70 feet to either side of the 60 to 80-foot typical sections shown in **Figure 4-3,**

Figure 4-4, and **Figure 4-5**. Thus, a 200-foot wide corridor was used to allow for passenger stations, parking lots, and temporary impacts such as staging areas, access for construction vehicles and equipment, areas for stockpiling topsoil, and nurseries for relocated vegetation that could be used in reclaimed construction areas.

To measure the potential impacts of a hypothetical 200-foot wide corridor within the mile-wide corridor alternatives without a specific alignment identified, the ratio of 200 feet to the one-mile (5,280 foot) corridor width was calculated, and then multiplied by the GIS-derived existing conditions data within the mile-wide corridor alternative, as represented in the following formula:

$$\frac{200' \mathit{impact\ corridor}}{1 - \mathit{mile}\ (5{,}280')\ \mathit{corridor\ alternative}} = 0.0379$$

$$0.0379 \text{ x } \mathit{Existing\ Conditions} = \mathit{Estimated\ Impact}$$

Because the estimated environmental consequences are representative of the mile-wide corridor and not calculated for a predetermined alignment, the Tier 1 analysis preserves flexibility for consideration of multiple alignments within the corridor identified for Tier 2 NEPA studies.

The resources within the natural, built, and social environment have characteristics that vary, and not all of the environmental resource categories in this Tier 1 EIS were analyzed using this method. For resources unrelated to potential ground disturbance, e.g., noise and vibration from train operations, air quality, and energy consumption, federal guidelines and regulations specify the method by which potential impacts are measured, based on established sensitivity distances or effect buffers.

This Tier 1 EIS provides approximate impact quantities for environmental resources in most cases; however in some cases this is not possible. For example, land use data are not available at the same level of detail throughout the approximately 120-mile-long corridor alternatives. Consequently, land use impacts are addressed qualitatively to provide a consistent level of analysis within and between the two corridor alternatives. The individual resource sections describe the area reviewed and discuss whether impacts are evaluated quantitatively or qualitatively in each Methodology and Regulatory Requirements section.

The *Corridor Aerial Atlas Appendix* contains 91 maps of the corridor alternatives, with many environmental resources highlighted. The maps were developed using recent aerial and satellite high-resolution photographic imagery, and the most recent GIS data available for a variety of environmental resources. Resource data were not digitized or field verified for this Tier 1 analysis.

5.1.3 Resources Eliminated from Study in the Tier 1 EIS

Table 5-1 identifies environmental resources traditionally included in environmental studies that are not found within the study corridors and therefore are not analyzed in this Tier 1 EIS. The table includes background information regarding each resource category and provides the sources used to obtain this information.

Table 5-1. Resources Eliminated from Study in the Tier 1 EIS

Resource[a]	Determination	Rationale for Determination
Wild and Scenic Rivers	Not Present	No watercourses in the National Wild and Scenic Rivers System or congressionally approved for study are located within the corridor alternatives (National Wild and Scenic Rivers System 2012).
Navigable Rivers	Not Present	No navigable rivers are located within the corridor alternatives (Arizona Navigable Stream Adjudication Commission 2003).
Outstanding Arizona Waters	Not Present	No outstanding Arizona waters are within the corridor alternatives (Arizona Department of Environmental Quality [ADEQ] 2008).
National Natural Landmarks	Not Present	No National Natural Landmarks are located in the corridor alternatives (National Park Service 2012).

[a] These resource lists are updated periodically. ADOT will review new issues of these lists for relevance to a project until it is constructed.

5.2 Land Use

The following assessment of land use includes a program-level (qualitative) analysis of the impacts of a passenger rail system on existing and future land uses within one of two alternative study corridors (the Yellow and Orange corridor alternatives), as well as the No Build Alternative. A review of the land use, transportation, environmental planning, and conservation elements of the general plans of the cities and counties through which the corridor alternatives pass was undertaken to determine if construction and operation of a passenger rail system would be consistent with these jurisdictions' planned land uses and applicable goals and policies.

5.2.1 Methodology and Regulatory Requirements

As stated earlier, this EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA's Environmental Impact and Related Procedures (23 CFR Part 771). FRA's Environmental Procedures Section 14(n)(15) states that an EIS should assess the impacts of each alternative on local land use controls and comprehensive regional planning as well as on development within the affected environment, including, where applicable, other proposed federal actions in the area.

This Tier 1 assessment of land use impacts focuses on areas where the existing uses would be converted to transportation land use and, specifically, where new facilities would be anticipated. Changes in land use such as induced growth from an expanded transportation system are assessed in the indirect and cumulative effects section later in this chapter. The impacts on local land use controls and comprehensive regional plans would be evaluated during Tier 2 NEPA analysis.

The corridor alternatives are each approximately 120 miles long. While specific track alignments have not been determined, a 200-foot-wide ROW corridor of this length would occupy approximately 2,900 acres. Given the magnitude of the mile-wide corridor alternatives, land use data collection and analysis were accomplished using publicly available electronic GIS land cover and zoning data and corresponding general plans. Field surveys and ground-truthing of existing land uses were not conducted as part of this analysis. Because alignments and station locations could hypothetically be located anywhere within the mile-wide corridor alternatives, zoning, which varies widely within the corridor alternatives, was not addressed in this Tier 1 EIS. For the same reason, land use impacts were not analyzed for any 200-foot ROW corridor, nor were Bureau of Land Management (BLM) subsurface mineral estate mining rights (See the letter from the United States Department of the Interior (DOI) in the *Agency Comments on the Draft Tier 1 EIS* Appendix). BLM administers mineral rights beneath private land within the corridor alternatives. In the Tier 1 analysis, only surface land use was identified within the corridor alternatives. Specific affected areas would be examined in more detail in Tier 2 NEPA analyses to assess project-level impacts on land use, zoning, individual property owners, and mining rights.

For this Tier 1 analysis, land uses are identified relative to the following categories assembled from land use designations defined by PAG, CAG, and MAG; and potential impacts are described qualitatively.

- Agricultural/rangeland
- Commercial

- Designated open space
- Industrial
- Institutional
- Office
- Other/mixed use
- Public
- Residential
- Undevelopable
- Utilities/transportation
- Vacant (also described as undeveloped land)

5.2.2 Existing Conditions

Aerial views of the study corridors are shown in Maps 1 through 91 of the *Corridor Aerial Atlas Appendix*. While the overall Study Area encompasses Pima, Pinal, and Maricopa counties, the corridor alternatives run between the major city destinations of Tucson and Phoenix and intermediately pass through the mid-sized cities of Gilbert, Mesa, and Tempe southeast of Phoenix. Additional communities through which the study corridors pass include small economic centers or suburbs of the larger cities, including Marana, Eloy, Coolidge, Florence, Queen Creek, and the Census-Designated Place of San Tan Valley in Pinal County.

Undeveloped land accounts for 27 percent of the existing land use within the Yellow Corridor Alternative and 33 percent of the Orange Corridor Alternative. Agriculture and rangeland account for 24 percent and 25 percent of the Yellow and Orange corridor alternatives, respectively. Residential use accounts for between 11 and 14 percent of the use for the Yellow and Orange corridor alternatives, respectively. A mix of other uses accounts for the remaining percentage. Table L-1 in the *Land Use Appendix* provides more information on existing uses in the study corridors.

Future land use within the corridor alternatives is overwhelmingly planned for residential use, with approximately 36 percent of each corridor alternative designated for residential development. Designated mixed uses also account for approximately 26 percent of the future land use within each corridor. A mix of other planned uses accounts for the remaining percentage. Table L-2 in the *Land Use Appendix* provides more information on future land use in the corridor alternatives.

Land ownership within the corridor alternatives is dominated by private land, including approximately 63,000 acres of each corridor alternative, constituting 80 percent of the Yellow Corridor Alternative and 76 percent of the Orange Corridor Alternative. The bulk of the remaining land is managed by the Arizona State Land Department, accounting for approximately 13,000 acres, or 17 percent, of the Yellow Corridor Alternative and approximately 17,000 acres, or 20 percent, of the Orange Corridor Alternative. The remaining percentage includes a mix of other land management agencies and owners, including federal, tribal, and local entities. **Figure 5-1** and **Figure 5-2** on the following pages illustrate land ownership and jurisdiction in and around the corridor alternatives. Table L-3 in the *Land Use Appendix* provides more information on land ownership within the study corridors.

A broad description of the land use within the corridor alternatives follows.

Yellow Corridor Alternative

Southern Hub to Eloy

Predominant land uses around the southern terminus near downtown Tucson include transportation (UP and I-10), industrial, commercial, institutional, residential, and vacant/undeveloped. Proceeding northwest along the corridor, land uses within the corridor vary in type and intensity between the east and west sides of I-10 due to the proximity of the Santa Cruz River west of I-10. The eastern side of I-10 is densely developed with residential and industrial uses, while the immediate area on the west side is dominated by undeveloped land and land zoned as open space (typically land set aside for conservation or recreation). Leaving northern Tucson, land uses within the study corridor common to both the Orange and Yellow corridor alternatives transition to predominantly open space to the east of I-10 and agricultural to the west of I-10.

Figure 5-1. Land Ownership and Jurisdiction between Tucson and Eloy

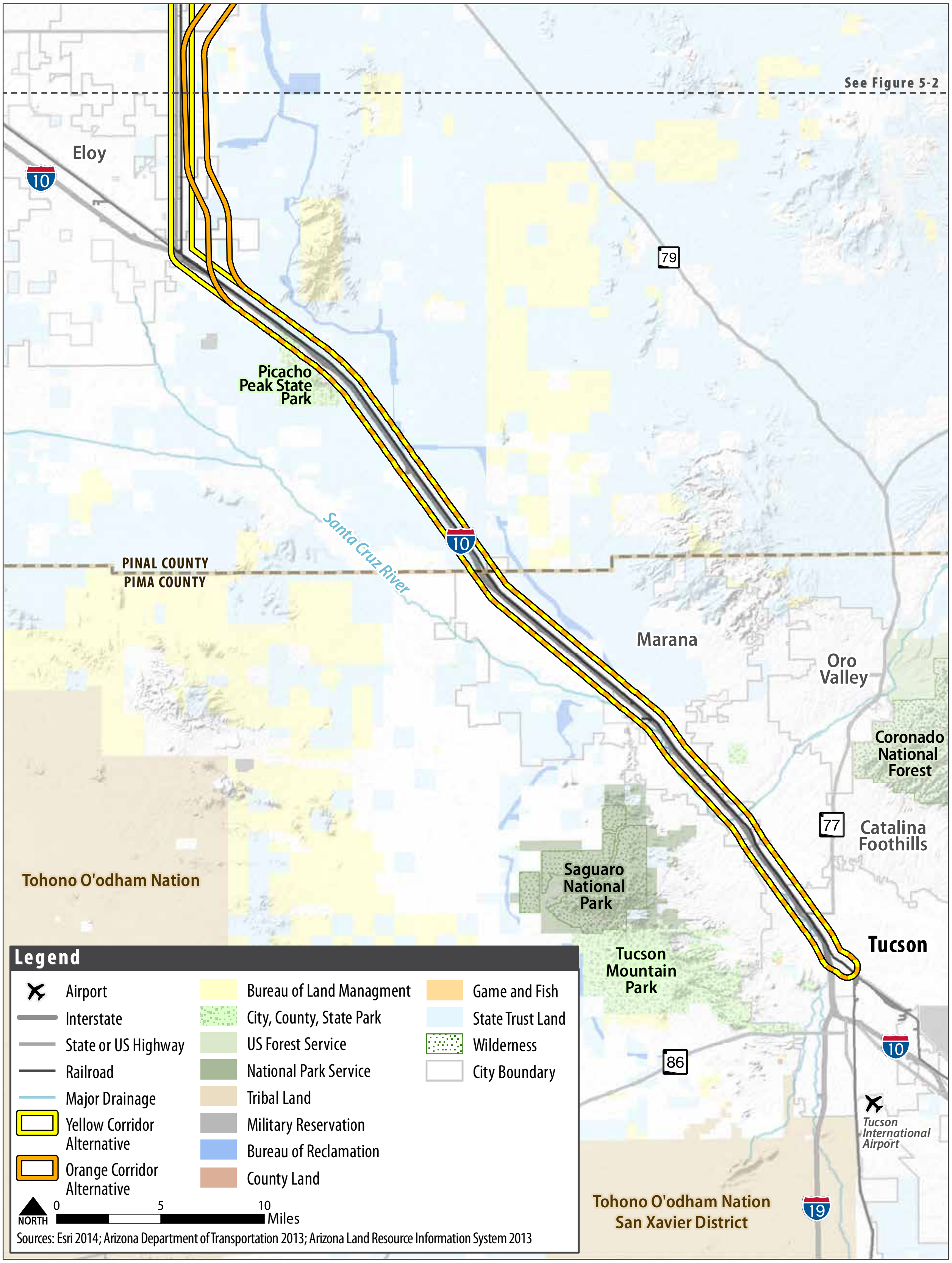
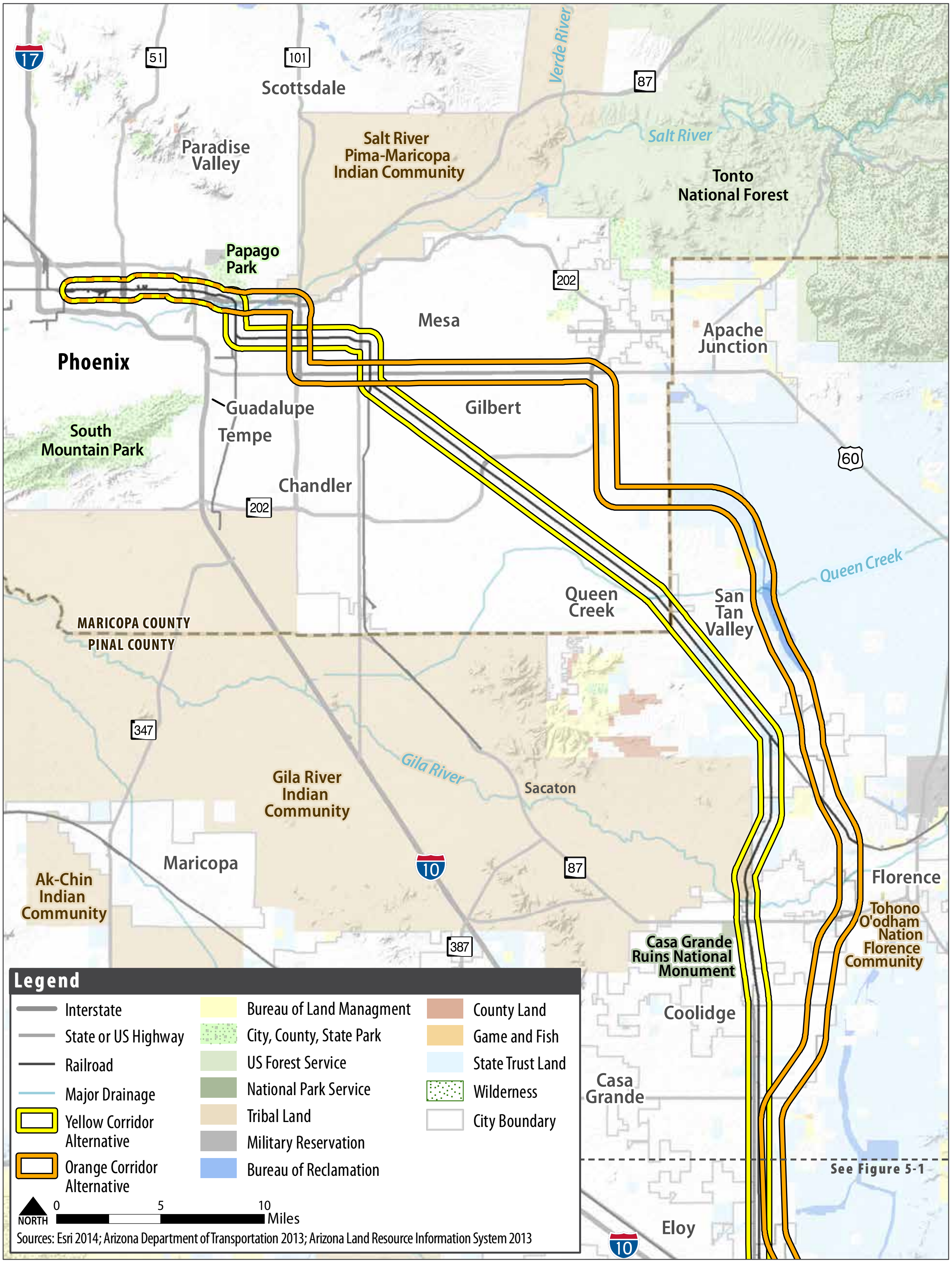


Figure 5-2. Land Ownership and Jurisdiction between Eloy and Phoenix



Sensitive designated land uses are scattered along the study corridor from the southern hub to Eloy. In Tucson, both sides of the I-10 corridor are designated as residential land use. Land designated as open space and small amounts of designated institutional land are scattered within the residential areas. At the boundary of Tucson and Marana, the corridor contains designated open space, transitioning into institutional land uses (i.e., churches, schools). Traveling north through Marana, residential land is scattered throughout the corridor, with open space designated along the southwestern edge. A small amount of agricultural land and rangeland is located in Marana east of I-10, as well as just north of the city boundaries in unincorporated Pinal County. In the community of Picacho, both sides of the I-10 corridor are predominantly undeveloped, with inclusions of agricultural lands near the I-10 and SR 87 interchange. As the study corridor travels through the narrow Picacho Pass, the west side encroaches on Picacho Peak State Park. Small amounts of open space are also designated west of I-10 just north of the city boundary. The common study corridor ends near the City of Eloy.

Residential land dominates the future land use designations from southern Pinal County north to Eloy, with a few scattered open space areas.

Eloy to Northern Hub

Advancing north from Eloy, land use in the Yellow Corridor Alternative consists primarily of agricultural and vacant/undeveloped parcels until approaching the City of Coolidge. Residential subdivisions are located throughout the corridor through Coolidge, with additional subdivisions under development at both the south and north ends of the city. As the corridor proceeds north, it traverses the western portion of the City of Florence and skirts the eastern edge of the Gila River Indian Community. Land uses in this area transition from chiefly residential to agricultural and vacant/undeveloped. The corridor passes near Heritage Park in the northern portion of Florence before crossing the Gila River, where land use returns to primarily agricultural before the corridor alternative turns northwest in the vicinity of the Town of Queen Creek and enters Maricopa County.

Continuing northwest through Queen Creek, land use in the Yellow Corridor Alternative becomes much more developed, consisting primarily of residential land uses, some neighborhood commercial areas, and numerous parks, with areas of vacant/undeveloped and agricultural land north of East Queen Creek Road. As the Yellow Corridor Alternative crosses into the southeastern corner of Mesa and continues heading northwest into the Town of Gilbert, land use patterns intensify. The historic centers of Gilbert and Mesa are within the Yellow Corridor Alternative; these areas are characterized by residential development with inclusions of commercial, industrial, and institutional uses located adjacent to most major intersections, and recreational uses interspersed throughout the residential areas. Turning due west in the vicinity of downtown Mesa, the Yellow Corridor Alternative crosses into the City of Tempe. Residential uses predominate within the corridor alternative while industrial uses and part of the main campus of Arizona State University, a large institutional use, also exist within the corridor. Turning north, the Yellow Corridor Alternative would cross to the north bank of Tempe Town Lake. Here the Yellow and Orange corridor alternatives converge and continue west through primarily industrial and undeveloped areas in the vicinity of Sky Harbor International Airport. The corridor continues west through a predominantly heavy industrial area, approaching a district containing sports venues; nearby warehouses, many of which have been repurposed into mixed uses including restaurants; and residential uses before reaching the northern hub.

Between Eloy and Phoenix, 66 percent of the future land uses allocated within the Yellow Corridor Alternative are for residential and mixed uses. Industrial, transportation, and utility uses account for an additional 15 percent of the uses. No agriculture or rangeland is designated in this corridor.

Orange Corridor Alternative

Southern Hub to Eloy

Land use from the southern hub to Eloy would be the same as described for the Yellow Corridor Alternative.

Eloy to Northern Hub

Between Eloy and San Tan Valley, the Orange Corridor Alternative heads generally north, passing through predominantly agricultural and vacant/undeveloped land before entering Maricopa County near southeast Mesa. Within Pinal County, the northern portion of this segment of the Orange Corridor Alternative passes through the Superstition Vistas Planning Area, a proposed master planned community of approximately 175,000 acres, which at buildout is proposed to expand the Phoenix metropolitan area to the southeast toward Florence.

As the Orange Corridor Alternative enters Maricopa County, land uses north of Queen Creek primarily include vacant/undeveloped and residential categories. As the corridor enters Mesa, it turns sharply north and then west in an area where residential subdivisions and master-planned communities dominate. The Orange Corridor Alternative then continues west toward Tempe. Residential and commercial land uses, as well as some recreational uses, are contained within the corridor in this part of Mesa. The Orange Corridor Alternative then turns sharply north again in the vicinity of the Mesa-Tempe border. Land use remains relatively unchanged for 2 miles but transitions to predominantly light industrial and eventually recreational and undeveloped as the corridor approaches Tempe Town Lake, an impoundment of the Salt River. After the Orange Corridor Alternative crosses to the north bank of Tempe Town Lake it turns west again, paralleling the bed of the Salt River. Open space dominates the land uses in this area, transitioning into industrial just past its convergence with the Yellow Corridor Alternative. The corridor continues west to the northern hub, as described earlier for the Yellow Corridor Alternative.

5.2.3 Environmental Consequences

To accommodate a passenger rail system, areas may need to be rezoned through the local development process. This would depend on the corridor selected, the specific alignment and station locations, current zoning, and the locations and size of layover and maintenance facilities. These would be considerations addressed during the Tier 2 analysis, but rezoning is an effect that can be anticipated in association with either corridor alternative.

Yellow Corridor Alternative

Southern Hub to Eloy

The project horizon date is 2035; therefore, future land use designations were analyzed to quantify potential impacts on land use at the time of buildout. Between Tucson and Eloy, 58 percent of the future land use is projected to consist of residential and mixed uses. Industrial uses account for an additional 15 percent. Due to the width of the study corridor, which land uses could be affected and to what extent cannot be determined at this time. The effects of building and operating a passenger rail system within the Yellow and Orange corridor alternatives are presumed to be similar from the southern hub to Eloy.

Physical Impacts

Physical impacts include potential construction of rail stations, reconfiguration of existing or creation of new rail facilities, and potential ROW acquisition, which may require the conversion of non-transportation land to a transportation use. The specific alignment developed in later project phases would determine the extent to which land use conversions occur. If the alignment is within the ROW of or closely parallel to an existing transportation corridor such as the UP Railroad, the extent of land use conversion may be minimal. The farther an alignment departs from an existing transportation feature, however, the greater the likelihood for land use conversion, ranging from building on vacant/undeveloped land to potential displacement of existing structures.

Construction and operation of a passenger rail system could influence future growth and land values as developments consider the perceived assets and drawbacks of proximity to a rail line.

Because land within the corridor includes residential, commercial, and industrial uses, the potential for displacement exists and would be addressed in Tier 2 analysis, if applicable.

Operational Impacts

Operational impacts of a passenger rail system could include potential incompatibilities with future land uses (i.e., rail facilities adjacent to open space, residences, and/or schools); however, operation of passenger rail may also create opportunities, such as increased business for commercial establishments near rail stations or increased exposure to businesses along the rail facilities.

Construction Impacts

Construction impacts on land use would be temporary in nature, such as those associated with temporary construction easements.

Eloy to Northern Hub

If a passenger rail system is constructed and operated within the UP ROW, relatively few ROW acquisitions would be required; however, the mile wide corridor allows a future alignment to be located beyond the limits of the UP ROW, which would require acquisition of land not designated for transportation. Which land uses would be affected by the future construction and operation of a passenger rail system, and to what extent, cannot be determined at this time. Detailed analysis of ROW acquisition impacts would be completed in a subsequent Tier 2 analysis.

Physical, operational, and construction impacts would be the same as described for the southern hub to Eloy segment of the corridor alternative.

Orange Corridor Alternative

Southern Hub to Eloy

The Orange Corridor Alternative is identical to the Yellow Corridor Alternative from the Tucson hub to just south of Eloy. Therefore, the potential impacts to land uses are considered the same as the Yellow Corridor Alternative in this section.

Eloy to Northern Hub

The Orange Corridor Alternative continues north of Eloy, centered along the proposed future North-South Corridor; however, the proposed highway is not an approved project, and ROW has not been acquired. Therefore, construction of a passenger rail system within the Orange Corridor Alternative could require acquisition of currently undeveloped private lands, possibly conflicting with future land use designations.

Physical, operational, and construction impacts would be similar to those described for the Yellow Corridor Alternative; however, the Orange Corridor Alternative offers fewer opportunities for a future passenger rail alignment to coincide with an existing transportation use. Therefore, the potential for displacing non-transportation land uses would be greater with the Orange Corridor Alternative. In addition, the Orange Corridor Alternative is approximately 8.0 miles longer than the Yellow Corridor Alternative, meaning that more acres of land likely would be allocated to the rail facilities rather than other land uses. The size and location of other rail facilities, such as rail stations, could also influence the total acreage affected the passenger rail system, which would be determined during Tier 2 studies.

Consistency with State, Regional, and Local Plans and Programs

The Yellow and Orange corridor alternatives primarily fall within the jurisdictions of the Arizona State Land Department; Pima, Pinal and Maricopa counties; and the cities/towns of Tucson, Marana, Eloy, Coolidge, Florence, Queen Creek, Gilbert, Mesa, Tempe, and Phoenix. Each jurisdiction's general plan was reviewed at a Tier 1 level for general consistency with land use goals and circulation/transportation goals, as summarized in Table L-4 in the *Land Use Appendix*. As studies advance to a Tier 2 analysis, detailed and specific evaluation of land use compatibility with plans and programs would be completed for one or more project-specific alignments. Based on a Tier 1 level of analysis, the corridor alternatives are consistent with the jurisdictional land use and transportation goals outlined in the general plans, comprehensive plans, and transportation plans listed in Table L-4 of the *Land Use Appendix*. One exception is the Master Plan for Coolidge Municipal Airport, located between East Randolph Road and East Bartlett Road (Coolidge 2010 Coolidge, Arizona 2010. Coolidge Municipal Airport Master Plan). While the Orange Corridor Alternative is located more than 1 mile west of the airport, future development of the airport could limit the alignment options for a passenger rail system in the Orange Corridor Alternative.

Land use elements vary greatly among different jurisdictions' general plans. Typically, land use goals relate to economic growth that promotes alternative transportation methods, infill development, maintaining buffers between urban and rural land use, and sensitivity to the natural environment. In general, the transportation elements include goals relating to improving circulation, enhancing public transit, supporting commuter rail service, and creating alternatives to automobile transportation.

The Bureau of Reclamation, Bureau of Land Management, National Park Service, Arizona Department of Recreation, and the Gila River and Salt River Pima-Maricopa Indian communities have jurisdiction over small amounts of land within the corridor alternatives. Compatibility with agency plans depends on the specific alignment of a passenger rail system within a corridor and cannot be definitively determined at this time.

No Build Alternative

Under the No Build Alternative, passenger rail service between Tucson and Phoenix would not be established, and land would not be allocated for rail facilities. This may prevent potential displacements of existing and planned land uses but would increase the likelihood for displacing land uses adjacent to existing highways such as I-10, which would likely need to be widened to accommodate the projected demand for capacity as population in the region increases. Land uses adjacent to major highway corridors would likely be affected by increased traffic congestion, which may include time delays, and increased exposure to noise and vehicle emissions. Because adding travel lanes for vehicles takes more land than rail facilities to move the same volume of people, more land in the region would need to be allocated to transportation facilities, precluding other land uses.

5.2.4 Potential Mitigation Measures

Future construction and operation of a passenger rail system would result in physical impacts that could require mitigation. At this stage in project development, potential mitigation measures to apply, when the acquisition and conversion of adjacent land within the corridor alternatives cannot be avoided, can only be identified in general terms. For example, if property acquisition is necessary, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and the Civil Rights Act of 1964 would be followed. During the Tier 2 review, specific locations for rail facilities, such as rail stations, would be planned in coordination with local government entities and with public input to minimize the potential for land use conflicts and develop appropriate mitigation specific to each location.

5.2.5 Tier 2 Considerations

The Tier 2 analysis would be conducted once the selected corridor alternative is refined into one or more project segments. The Tier 2 analysis would consider specific effects on land use of a passenger rail corridor and rail stations, the potential need to rezone areas along the rail line, and consistency with established land use plans and policies. During Tier 2 analyses, the extent of land use, zoning, and property acquisition impacts would be analyzed at a project level; and potential mitigation issues and measures would be identified through agency coordination and the public involvement process. Phoenix is currently updating their general plan, and a draft was released for public comment in Fall 2014 (City of Phoenix 2014). In any Tier 2 analysis, the general plan update should be reviewed for changes to the policies and goals applicable to land use within or adjacent to the Phoenix portions of the corridor alternative. Pima County is currently updating their comprehensive plan, and a draft was released for public comment in Fall 2014 (Pima County 2014). In any Tier 2 analysis, the comprehensive plan update should be reviewed for changes to the policies and goals applicable to land use within or adjacent to the Pima County portions of the corridor alternative.

5.3 Socioeconomic Conditions

The evaluation of the social and economic environment considers population; employment; demographic shifts; community disruption and cohesion; effects on commerce; and general state, regional, and local economies. In addition to assessing potential adverse effects from community disruption, the assessment considers likely benefits resulting in any potential increase in economic activity in and near a rail corridor.

5.3.1 Methodology and Regulatory Requirements

This EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA's Environmental Impact and Related Procedures (23 CFR Part 771). Impacts to the socioeconomic and human environment were evaluated in accordance with FRA's Procedures for Considering Environmental Impacts Section 14(n)(16) (FRA 1999a).

Social and economic characteristics were gathered from the US Census Bureau including the 2010 decennial US Census and the 2007-2011 American Community Survey (ACS). Population, households, and employment characteristics were gathered to describe the past, current, and future demographic trends. The description of the socioeconomic environment also includes identification of community services such as schools, emergency services, and utilities as well as communities and economic centers. Major communities and economic centers within each of the corridor alternatives were identified from GIS data.

Demographic data were collected at the county level within rural areas and at the city level within urban areas (that is, communities with population greater than 50,000).

Assessment Area

Two corridor alternatives that would connect the metropolitan areas of Tucson and Phoenix, Arizona, were evaluated for a future passenger rail system. The two alternatives traverse portions of Pima, Pinal, and Maricopa counties and several cities and towns. From south to north, the cities and towns include Tucson, Marana, Eloy, Coolidge, Florence, Queen Creek, Gilbert, Mesa, Tempe, and Phoenix. Due to the regional nature of the study, demographic data were collected for an assessment area that extends beyond the 1-mile-wide alternative corridors. This area includes the above-mentioned counties, cities, and towns traversed by each corridor alternative. The demographic data were used to compare the characteristics of the populations that live and/or work within and near each corridor alternative within potentially affected communities and the region.

Because socioeconomic effects extend beyond the local level, the influence of an action on population, employment, or the tax base would be analyzed at a community scale rather than a corridor scale. Conversely, potential business relocations and displacements and disruptions to community cohesion resulting from the placement of new infrastructure tend to be location specific. The analysis of socioeconomic effects, both at the macroeconomic scale and the microeconomic scale, cannot be quantified until specific alignments are identified. Consequently, existing socioeconomic conditions within the tri-county region surrounding the corridor alternatives are described quantitatively, while potential effects of a passenger rail system within the one-mile-wide corridor alternatives can only be described on a qualitative level in this analysis.

5.3.2 Existing Conditions

Historical and Projected Population

Between 1970 and 2010 the tri-county region of Pima, Pinal, and Maricopa counties (which corresponds to the APRCS Study Area) grew by more than 3.78 million people. In 2010, the region was home to approximately 81 percent of the population in the state of Arizona. The metropolitan area of Phoenix (Maricopa County) is the dominant population center in the tri-county region (accounting for more than 3.8 million people in 2010) followed by Tucson (Pima County), which was home to nearly one million people. Historical growth patterns show that the metropolitan regions surrounding Tucson and Phoenix have sprawled, while population growth in the urban cores has slowed. Between 1970 and 2010, Marana (northwest of Tucson) grew at an average annual rate of 10.7 percent, while Tucson grew by 1.7 percent annually. In the Phoenix area, Queen Creek and Gilbert (southeast of Phoenix) grew at an annual rate of 12.1 percent and 12.4 percent, respectively, while Phoenix grew by 2.3 percent per year. Coolidge and Eloy, communities in Pinal County, are relatively small compared to the other cities in the assessment area and have grown at a slower pace. In 1970, the nearby town of Florence was smaller than these other two Pinal County communities along the corridor alternatives, but it has grown more than 1,000 percent between 1970 and 2010 and is now the largest of the three communities (see Table S-1 in the *Socioeconomic Conditions Appendix*).

According to population projections produced in 2012, the population within the state and tri-county region will continue to grow over the next 40 years; however, the annual growth rate is anticipated to slow (Arizona Department of Administration, Office of Employment and Population Statistics 2012). By 2050, Arizona is projected to be home to more than 11.5 million people; which represents an approximately 78-percent increase over December 2012 estimates and a 1.6 percent annual growth rate. The tri-county region is projected to grow approximately 84 percent overall at a 1.7 percent annual growth rate for almost 9.7 million people in 2050. By then, the tri-county region will account for almost 84 percent of the state population. Between December 2012 and 2050, it is anticipated that Maricopa County and Pima County's share of the total regional population will decrease (from 74 percent to 71 percent and from 19 percent to 16 percent, respectively), and that Pinal County's share will grow (from 7 percent to 13 percent) (see Table S-2 in the *Socioeconomic Conditions Appendix*). These growth trends suggest that the corridor between Tucson and Phoenix will become a megaregion with growing population centers in between these cities.

Employment

According to the US Census Bureau, the largest employment sectors in Arizona in 2012 included education, health care, and social services, followed by retail trade and then professional, scientific, management, administrative, and waste management services. The employment characteristics of the assessment area, particularly in the urban centers of Tucson and Phoenix, mirror those of the state. In the tri-county area, education, health care, and social services account for 21.5 percent of the employment; retail trade accounts for 12.2 percent; and professional, scientific, management, administrative, and waste management services account for 12.1 percent. Some of the economies outside the urban centers differ somewhat from the regional trends. For example, employment in the agriculture, forestry, fishing, hunting, and mining sector; education; and public administration accounts for a larger share in the smaller communities in Pinal County. Relative to other communities along the corridor alternatives, the share of work-aged people in the labor force in Florence and Eloy is substantially less; this economic characteristic is largely due to presence of correctional facilities and the share of unemployed and incarcerated population (see Table S-3 in the *Socioeconomic Conditions Appendix*).

The Census statistics are consistent with the largest employers in each community. Within the educational services, health care, and social assistance sector, major employers in the assessment area include Banner Health (health care), Apollo Group, Inc. (educational services), the University of Arizona and Arizona State University (education), as well as local school districts (education). According to *The Arizona Republic's 2014 Arizona's 100 Largest Employers,* Walmart Stores, Inc. is the largest employer in the state and is a major contributor to the retail employment sector in the assessment area. Several large employers within the state are headquartered in the study corridor. University of Arizona Health Network (health care) is headquartered in Tucson; and Banner Health, Apollo Group, Inc. (educational services), Freeport-McMoRan Copper & Gold Inc. (mining), and the Salt River Project (utility provider) are headquartered in Phoenix (*The Arizona Republic* 2014). In the smaller, more rural communities of Eloy, Coolidge, and Florence, the local economies are driven more by government employment, as well as agriculture and corrections in Eloy and Florence.

The Public Works and Economic Development Act of 1965, as amended, considers an area economically distressed if it has an unemployment rate that is at least 1.0 percent greater than the national unemployment rate. Unemployment statistics for the three-county Study Area are available from the US Census Bureau based on a sample survey from the American Community Survey 2008-2012. The estimated 2012 unemployment rate in the US was 6.0 percent. In comparison, the overall rate was 6.0 percent in Arizona and 5.9 percent in the three-county Study Area (see Table S-3 in the *Socioeconomic Conditions Appendix*). Several communities in the assessment area, however, have an unemployment rate that is higher than the nation, the state, and the three-county Study Area. Eloy had a 2011 unemployment rate of 16.3 percent, and Tucson had a rate of 9.9 percent. Because they exceed the 1.0 percent threshold, these two communities are considered to be economically distressed areas. Tempe had an unemployment rate of 9.2 percent, higher than the national average but not exceeding the threshold. Historical data provided by the US Bureau of Labor Statistics indicate that unemployment in Arizona has been consistently above the national rate since June 2008. The April 2013 assessment showed a decline in unemployment in both the nation and the state (7.5 percent in the US and 7.9 percent in Arizona). While these more recent datasets are not available at the assessment area level, it is likely that unemployment in the tri-county region has generally followed the national and state trend.

Community Facilities

Community facilities, including schools, libraries, places of worship, parks, community centers, hospitals, emergency services, and other public buildings, are located throughout the corridors in proportion to the intensity of development and density of the local population, as shown in Maps 1 through 91 of the *Corridor Aerial Atlas Appendix*. While most community facilities are tailored to serve local neighborhoods, Tucson, Florence, and Phoenix are the county seats of each of the Study Area counties; and Phoenix is the state capital. For this reason, each of these locations houses state and county offices offering additional services to a larger public.

Community facilities such as police, fire department, and ambulance provide emergency services and must share the roadway network with private and commercial vehicles.

Native American Communities

The corridor alternatives intersect two Native American reservations: the Gila River Indian Community and the Salt River Pima-Maricopa Indian Community (see Maps 31, 32, 33, 86, and 87 of the *Corridor Aerial Atlas Appendix*).

Gila River Indian Community

The Gila River Indian Community is just south of the City of Phoenix and extends through parts of Pinal and Maricopa counties. The Yellow Corridor Alternative intersects the eastern extent of the Gila River Indian Community just north of Coolidge where the corridor crosses the Gila River. The seven districts in the community cover approximately 584 square miles and are home to over 11,000 people from the Akimel O'odham (Pima) and Pee Posh (Maricopa) people. Approximately 40,000 acres (10.7 percent) of the reservation is agricultural land. The Community owns and operates several business enterprises including three casino resorts, a resort hotel, an equestrian center, two golf courses, arts and museum centers, and Firebird International Raceway. Valley METRO transit services connect the reservation to Phoenix and other communities in the metropolitan area.

Salt River Pima-Maricopa Indian Community

The Salt River Pima-Maricopa Indian Community is located just east of Scottsdale in the Phoenix metropolitan area. The Orange Corridor Alternative intersects the southwestern corner of the Salt River Pima-Maricopa Indian Community just north of Tempe Marketplace where the corridor crosses the Salt River. The reservation covers approximately 112 square miles and is surrounded by the cities of Scottsdale, Tempe, Mesa, and Fountain Hills. This community is home to a group of over 9,000 Pima and Maricopa people. Almost 12,000 acres of the reservation (16.7 percent) are designated for agricultural use. Numerous commercial uses are located along the western border of the community. Valley METRO transit services connect the reservation to Phoenix and other communities in the metropolitan area.

5.3.3 Environmental Consequences

A passenger rail system's potential impacts on the socioeconomic environment would depend on its specific location and alignment within a corridor alternative. Potential impacts to the socioeconomic environment vary between corridor alternatives and among future alignments but could include business relocations and displacements, disruptions to community cohesion, noise and vibration impacts, concerns of safety and public health, and changes to regional travel patterns.

Because no specific alignment locations have been identified in this Final Tier 1 EIS, ranges of potential socioeconomic impacts are described that could apply throughout the length of the corridor alternatives, with the intensity of the impact at any given location dependent on the existing conditions at that location. For this reason, the environmental consequences for socioeconomic conditions address the Yellow and Orange corridor alternatives in their entirety, rather than separating the impact descriptions into corridor segments.

Yellow Corridor Alternative

Physical Impacts

A passenger rail system within the Yellow Corridor Alternative could have potential impacts on community cohesion, depending on the characteristics of a given community. Some businesses, residential properties, and community facilities within the Yellow Corridor Alternative might be displaced to accommodate passenger rail due to the need for new railroad ROW, stations, and ancillary facilities such as storage and maintenance yards. Unless similar properties can be obtained for relocation, such displacements could result in changes to community character and cohesion and potentially result in job losses. The Yellow Corridor Alternative offers opportunities for a rail alignment adjacent and parallel to existing transportation infrastructure, which could mitigate the potential impacts to community cohesion if such an alignment were considered.

The one-mile-wide Yellow Corridor Alternative intersects Arizona State University's main campus (see Maps 50 and 51 of the *Corridor Aerial Atlas Appendix*). A passenger rail system within this area would be designed to preserve the cohesive nature of this campus. Relocation of any of the university's specialized buildings could be particularly challenging and would interfere with university operations and students' ability to access university facilities.

Phoenix Sky Harbor International Airport's north runway 8/26 is located within the one-mile-wide Yellow Corridor Alternative (see Maps 53 and 54 of the *Corridor Aerial Atlas Appendix*). A passenger rail system within this area would be designed to avoid any potential conflict with airport activities that could result in adverse socioeconomic impacts at both local and regional levels. UP Railroad's Phoenix Yard, also located within the Yellow Corridor Alternative between 7th and 16th Streets (see Maps 54 and 55 of the *Corridor Aerial Atlas Appendix*), would be avoided to preclude the need for any relocations or displacements that could potentially disrupt freight operations.

The conversion of property from taxable commercial or residential uses to a tax-exempt transportation use could potentially decrease local tax revenues. On the other hand, potential new development around future station areas could benefit a community by generating economic activity and creating new sources of tax revenue. The effects on local real estate markets would vary based on availability of comparable properties within existing neighborhoods, zoning, and local planning and economic development objectives. Dynamics such as these would be analyzed in more detail during Tier 2 evaluation.

Automobile, pedestrian, and bicycle access to adjacent neighborhoods and community facilities could be altered by the introduction of new rail infrastructure, thereby affecting community cohesion. Changes in access could also introduce challenges to emergency service providers. Depending on the extent of safety mitigation, potential changes in or additions to highway/rail crossings could also introduce safety risks.

Operational Impacts

Implementation of a passenger rail system within the Yellow Corridor Alternative would likely increase the potential for economic development and land use changes, such as transit-oriented development around future station locations. Transit-oriented development could be designed to support new employment and housing options with associated tax revenue benefits for the communities with passenger rail stations. Other potential impacts to land use within the corridor alternatives, as described in **Section 5.2**, could result in additional socioeconomic impacts.

Jurisdictions within the Yellow Corridor Alternative would experience changes in socioeconomic conditions, as described below, if passenger rail service were implemented within the corridor. A rail system in the Yellow Corridor Alternative would bypass some communities within the three-county Study Area, which would not afford them the direct economic effects experienced by communities with passenger rail stations; however, the bypassed communities may still experience indirect benefits of a regional transit option.

Long-term socioeconomic benefits along the Yellow Corridor Alternative would accrue to the tri-county Study Area as well as communities intersecting the corridor. Passenger rail service within this corridor would provide connections to major economic generators within the assessment area, including downtown Tucson and Phoenix. The improved access would likely result in increased economic activity within cities and towns directly served by the new passenger line, particularly near stations. Connecting urban areas and communities by improving access and mobility would likely expand employment opportunities over the larger geographic area, benefiting both employers (by expanding the labor pool) and employees (by offering more choices regarding where to live and work). Improved access to job and educational opportunities within the region, to cultural and recreational activities and events, and to shops and services adjacent to future station areas would enhance socioeconomic conditions throughout the region.

Passenger rail service within the Yellow Corridor Alternative could offer travel time savings for transit patrons and regional commuters. If the preference for rail transit increased, it could help bolster economic development and housing demand in the areas surrounding stations. Reductions in vehicular traffic could also result from increased ridership on a passenger rail system.

A passenger system within the Yellow Corridor Alternative would bring socioeconomic benefits in terms of improving regional mobility and connections between economic and employment centers, education centers, and other cultural and recreational activity centers. The improved access could increase economic activity in the communities served by the Yellow Corridor Alternative and could expand regional employment opportunities and offer more flexibility in terms of where to live and work.

Construction Impacts

Constructing a passenger rail facility within the Yellow Corridor Alternative would result in temporary disruption of access to existing businesses and community facilities and temporary noise, vibration, and air quality impacts. This may affect businesses if patrons avoided the construction zone because of these disruptions.

Depending on the alignment, construction of a passenger rail facility within the Yellow Corridor Alternative could temporarily disrupt freight rail traffic along the UP line that runs within the corridor. Although passenger rail service would run on a separate track from freight, existing freight customers could experience temporary limits on available service during construction. Construction of a passenger rail system along or adjacent to the UP line could temporarily affect businesses that rely on the UP for shipping or receiving goods.

Constructing a passenger rail system within the Yellow Corridor Alternative would generate short-term economic benefits associated with construction of the rail infrastructure itself, as well as construction activities associated with any associated transit-oriented development, other development near station locations, and services to support the influx of construction workers. If local materials were used during construction, businesses that manufactured and sold the materials would experience positive effects, and the communities would receive an economic boost from the tax revenues.

Orange Corridor Alternative

Physical Impacts

As would be the case with the Yellow Corridor Alternative, a passenger rail system within the Orange Corridor Alternative could require some properties to be displaced, resulting in disruptions to community cohesion and potential loss of employment and taxable property. Potential decreases in local tax revenues from the conversion of taxable property to a tax-exempt transportation use may be offset by the potential creation of new sources of tax revenue through new development around future station areas. Effects on tax revenues, local real estate markets, zoning, and related economic issues would be analyzed in more detail during the Tier 2 evaluation.

The Orange Corridor Alternative parallels and, in some locations, is intersected by the Central Arizona Project (CAP) Canal (see Maps 66 through 72 of the *Corridor Aerial Atlas Appendix*). A passenger rail system would need to avoid any modifications to or displacement of this vital element of Arizona's water supply system.

Where the Orange Corridor Alternative converges with the Yellow Corridor Alternative, it intersects Phoenix Sky Harbor International Airport and UP Railroad's Phoenix Yard in the manner previously described in the Physical Impacts section of the Yellow Corridor Alternative (see Maps 53 through 55 of the *Corridor Aerial Atlas Appendix*). New infrastructure associated with a passenger rail system within the Orange Corridor Alternative could have fewer opportunities to locate along or within an existing transportation corridor than a system within the Yellow Corridor Alternative and would be more likely to affect community cohesion by creating a linear barrier where it intersects established communities, disrupting access from one side of the railroad to the other. This community disruption could be lessened by including highway-railroad grade crossings; however, these would present safety hazards to a community by creating potential accidents involving trains and cross traffic, including pedestrian and bicycle traffic. Additional detail concerning Public Health and Safety can be found in **Section 5.5**.

Grade-separated crossings could minimize impacts to community cohesion by retaining existing vehicle and pedestrian access or providing new overpasses or underpasses; however, grade separation of rail crossings through construction of an overpass or underpass could result in changes in access and possibly community cohesion impacts beyond the specific intersection through disruption of views, new drainage patterns, and other effects.

Operational Impacts

Operation of passenger rail service within the Orange Corridor Alternative would have both beneficial and negative impacts on socioeconomic conditions throughout the corridor similar to those described for the Yellow Corridor Alternative, albeit in different locations where the two corridor alternatives diverge.

Both the Orange and Yellow corridor alternatives would accrue travel time benefits to the respective communities served by each. The anticipated travel time savings of a passenger rail system within the Orange Corridor Alternative between Tucson and Phoenix would provide a larger benefit than that anticipated from a system within the Yellow Corridor Alternative.

Overall, the implementation of passenger rail service would provide an alternative form of transit that would support persons in the corridor alternative communities that do not have a vehicle or the ability to drive. This would be a long-term benefit to community services within the selected corridor alternative.

Construction Impacts

Impacts of construction of a passenger rail system within the Orange Corridor Alternative would be similar to those described for the Yellow Corridor Alternative, including potential disruption and/or detours of vehicular traffic; temporary access changes; and construction-related noise, vibration, and air quality impacts. These impacts are most likely to occur near stations where construction intensity is likely to be greatest, although station locations have not yet been identified and would be assessed further as part of the Tier 2 analysis.

Short-term economic benefits could result from jobs created to support construction of a passenger rail project, as well as the purchase of goods and services.

No Build Alternative

Under the No Build Alternative, no passenger rail system would be constructed or implemented. The Tucson and Phoenix metropolitan areas and the communities between them would continue to grow, which would increase regional transportation demand. The ability to respond to additional stress on the existing transportation system under the No Build Alternative would be limited to the existing transportation infrastructure’s capacity and capacity increases resulting from other approved transportation projects in the region.

The economic drivers of the communities within the three-county Study Area are both synergistic and complementary and are dependent on adequate transportation infrastructure for localized and regional economic growth potential. Under the No Build Alternative, the economies of these communities would experience deficiencies in transportation capacity, thereby affecting socioeconomic conditions.

5.3.4 Potential Mitigation Measures

Short-term construction-related impacts could be mitigated using construction best management practices (BMPs) such as providing clearly marked detour routes for vehicles and pedestrians such that access to adjacent land use is maintained during construction. Other construction BMPs include minimizing fugitive dust; reducing idling of construction vehicles; and communicating the construction schedule to public officials, emergency service providers, and other affected stakeholders.

All displacements would occur in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Relocation Act), as amended (42 U.S.C. § 4601 *et seq*. and implemented by 49 CFR Part 24). Coordination with local job placement agencies would occur to help mitigate the impacts of potential job loss associated with the displacement of places of employment.

New and/or additional rail traffic at existing grade crossings may pose safety hazards for pedestrians and vehicles. Additional safety measures may be needed depending on the projected rail and vehicle traffic at these intersections. Additional cross-access points (e.g., pedestrian bridges or underpasses, or improved vehicle capacity at existing grade crossings) or four-quadrant gate crossings (with gates on both sides of the tracks for both directions of automotive traffic) may be required to mitigate the effects of closing an existing crossing.

Public involvement and agency coordination activities would help inform the identification of potential mitigation strategies. Specific mitigation measures would be identified and discussed during Tier 2 analysis after design details are known and specific impacts are identified.

5.3.5 Tier 2 Considerations

As design details are further defined and delineated in Tier 2 analysis, more details about the potential impacts on socioeconomic conditions would be identified along with strategies to avoid or mitigate these impacts.

The Tier 2 NEPA analysis would include a detailed quantitative analysis of the socioeconomic impacts of the corridor alternatives. The analysis would focus on the elements of the human environment that may be affected by potential actions taken as a result of the development of a passenger rail project. Existing resources that may be studied further include population changes, labor force changes, business establishments, community characteristics, municipal fiscal conditions, and economic development initiatives. Applicable livability principles from the Partnership for Sustainable Communities–a joint initiative from the US Department of Housing and Urban Development, USDOT, and the US Environmental Protection Agency (EPA)–should also be considered. (http://www.sustainablecommunities.gov/)

Design details, such as station locations and need for additional ROW, would be described in the Tier 2 analysis, which would allow a more precise understanding of the socioeconomic impacts and benefits. Specific mitigation measures would be developed, with coordination of local communities and agencies, as part of the Tier 2 analysis.

5.4 Title VI and Environmental Justice

5.4.1 Methodology and Regulatory Requirements

Environmental Justice (EJ) is partially based in Title VI of the Civil Rights Act of 1964 (Title VI), one of the laws integrated into the procedures of NEPA. Title VI prohibits discrimination on the grounds of race, color, or national origin; and it protects these classes of people from being denied the benefits of or being excluded from participation in any program or activity receiving federal assistance (Title VI, 42 U.S.C. § 2000[d]). NEPA requires federal agencies to serve as trustees of the environment for succeeding generations and assure that all Americans have "safe, healthful, productive, and aesthetically and culturally pleasing surroundings" (42 U.S.C. § 4331(b)(2)).

EO 12898, *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations,* was issued by President Clinton on February 4, 1994, and requires each federal agency "to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations" (FR 59, No. 32, 7629-7633, February 16, 1994). In the memorandum to agency department heads that accompanied the EO, President Clinton specifically recognized the importance of NEPA procedures for identifying and addressing environmental justice concerns. The memorandum states, "each federal agency shall analyze the environmental effects, including human health, economic, and social effects, of federal actions including effects on minority and low-income communities, when such analysis is required by NEPA." The memorandum also calls out the importance of NEPA's public participation process, by directing each federal agency to "provide opportunities for community input in the NEPA process" and to "identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices" (CEQ 1997).

On May 2, 2012, USDOT issued Order 5610.2(a), *Order to Address Environmental Justice in Minority Populations and Low-Income Populations* which updates USDOT Order 5610.2 and describes how USDOT operating administrations comply with EO 12898. The update reaffirms USDOT's commitment to EJ's guiding principles:

- To avoid, minimize, and mitigate disproportionately high and adverse effects
- To ensure the full and fair participation by all potentially affected communities

- To prevent the denial of, reduction in, or significant delay in receipt of benefits by minority and low-income populations

The order also directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of agency actions to promote the principles of environmental justice in all USDOT programs, policies and activities. It requires that EJ principles be fully considered throughout planning and decision-making processes using the "principles of NEPA; Title VI; the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970*, as amended; the *Intermodal Surface Transportation Efficiency Act of 1991*; and other USDOT statutes, regulations, and guidance that address or affect infrastructure planning and decision making; social, economic, or environmental matters; public health; and public involvement."

The methodology for conducting the review and evaluation of minority and low-income populations is in accordance with federal regulations and guidelines, including Title VI, FRA's Environmental Procedures Section 14(n)(20) (FRA 1999a), FTA's Environmental Justice Policy Guidance for Federal Transit Administration Recipients (FTA 2012), and CEQ's Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ 1997a).

Population and demographic data are reported in the decennial US Census; income and language proficiency are reported through the American Community Survey (ACS), an ongoing Census Bureau survey that samples a small percentage of the population every year. The area assessed for this EJ analysis includes all Census block groups that intersect each of the corridor alternatives. Demographic data from the 2010 Census and 2008-2012 ACS were gathered at the state, county, and Census block group level and included race, ethnicity, median household income, and ability to speak English. GIS mapping was used to identify where majority EJ populations are located relative to the corridor alternatives.

Because EJ and Title VI impacts are location specific, calculating an estimated effect for a 200-foot-wide corridor within the one-mile-wide corridor alternatives will not yield meaningful information until a specific alignment is identified. The tables used in this analysis disclose percentages of the population within the mile-wide corridor alternatives that fall under various government acts and regulations protecting them from discrimination and exclusion with regard to federally funded projects.

Definition of Terms

This analysis relies on the following definitions of terms.

Minority

Minority and low-income populations are collectively referred herein as EJ populations. Minority is defined by USDOT Order 5610.2 as a person who is:

- Black (a person having origins in any of the black racial groups of Africa)
- Hispanic (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race)
- Asian American (a person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands)
- American Indian and Alaskan Native (a person having origins in any of the original people of the Americas and who maintains cultural identification through tribal affiliation or community recognition)

A minority population is defined as:

- Any readily identifiable group of persons and/or a community who lives in geographic proximity and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who experience common conditions of exposure or impact, and
- One that consists of persons classified by the US Census Bureau as minority, including those persons of two or more races

Low-Income

Low-income refers to a median household income at or below the US Department of Health and Human Services (DHHS) poverty guidelines (USDOT Order 5610.2[a]). The analysis was based on the poverty guidelines issued in January 2013. Median household income data in the 2006-2010 ACS is reported in 2010 dollars. In order to compare the 2013 poverty guidelines with data in 2010 dollars, the 2013 guidelines were adjusted to 2010 dollars using the Consumer Price Index Inflation Calculator provided by the US Department of Labor, Bureau of Labor Statistics. The following steps are necessary to determine low-Income households for an EJ analysis:

1. Determine the average household size for each Census block group in the corridor alternatives; round up to the next whole number to be more inclusive.
2. Select the appropriate DHHS poverty guideline, as adjusted to 2010 dollars.
3. Collect median household income data for the corridor alternatives from the ACS at the

block group level.

4. Determine if any block groups with a median household income less than the adjusted poverty guideline, as identified in Step 2 above, are present in the corridor alternatives.

Limited English Proficiency

Persons with Limited English Proficiency are defined as individuals for whom English is not their primary language and who have a limited ability to read, write, speak, or understand English. It includes people who reported to the US Census Bureau that they speak English less than very well, not well, or not at all.

Assessed Populations

Based on existing CEQ and EPA guidance, a minority population may be present where "either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis" (CEQ 1997a). The 50 percent threshold was applied to the analysis of Census data to identify distinct minority populations. Low-income populations were identified where the median household income of each Census block group was below the poverty guideline, as established by DHHS, for the household size of each respective Census block group.

The purpose of identifying distinct EJ communities is to compare the adverse effects and benefits of developing a passenger rail system within one of the corridor alternatives as well as the mitigation strategies for EJ populations versus non-EJ populations. Population size of EJ communities alone does not determine whether disproportionately high and adverse effects occur. The comparative impact (adverse and beneficial) of an action on EJ populations and non-EJ populations is the determining factor. Disproportionate impacts could occur even in areas with a low statistical concentration of EJ populations. Non-traditional data-gathering techniques are proposed for the Tier 2 NEPA analysis to identify the presence of distinct EJ populations within close proximity of the corridor alternatives or those EJ populations who are dependent upon potentially affected natural resources. Nontraditional data-gathering techniques could include, but are not limited to, conducting informal group meetings, using digital media, developing partnerships with community groups, participating in community-led events, and using direct mail.

Limited English Proficiency

On August 11, 2000, President Clinton issued EO 13166, *Improving Access to Services for Persons with Limited English Proficiency,* to help ensure that all people have access to meaningful communications about and participation in any program or activity receiving federal assistance. It requires federal agencies to examine the services they provide for persons who, because of national origin, have limited English proficiency (LEP). It calls for agencies to identify if LEP populations are in need of their services and to develop and implement a system to provide those services so LEP persons can have meaningful access to them.

The US Census Bureau collects information about the ability of people to speak English, as well as about those living in linguistically isolated households. The Census Bureau defines a linguistically isolated household as one in which no member 14 years of age or older speaks English at least very well. Members of a linguistically isolated household 14 years old and over have at least some difficulty with English. Although they are not considered EJ populations, data on LEP populations within the study corridor are included in this Tier 1 analysis.

The impact analysis for LEP populations is not dependent upon a concentration. Instead, it must consider the most commonly spoken language(s) other than English and locations where residents reported to the US Census Bureau that they speak English “less than very well.” Therefore, the impact analysis is directly related to an analysis of US Census data of LEP populations in the three-county Study Area who are considered “linguistically isolated.”

5.4.2 Existing Conditions

Table 5-2 summarizes the percentage of protected populations in the three-county Study Area as well as within the corridor alternatives, where data are available. Because data for English proficiency and disability are not tabulated at the Census Block level, specific percentages for the Yellow and Orange Corridor Alternatives could not be calculated. More specific information about the protected populations is discussed under the subheadings that follow.

Table 5-2. Protected Populations in the Study Area and Corridor Alternatives

	Minority Population	Low Income Population	Limited English Proficiency Population
Arizona	42.2%	12.1%	10.5%
Three-County Study Area	42.0%[a]	11.2%	10.1%
Yellow Corridor Alternative	46.2%	16.3%	not available
Orange Corridor Alternative	43.5%	16.0%	not available

Source: **US Census Bureau**
Notes:
[a]**As a percentage of the total population.**

Minority Populations

The racial and ethnic composition of the population in the three-county Study Area (Pima, Pinal, and Maricopa counties) is very similar to the state; however, several communities in the three-county Study Area have a larger share of minority population when compared to the region. **Table 5-3** shows the percent minority population for the state, Study Area, Census block groups within the corridor alternatives, and communities with high minority populations.

The corridor alternatives comprise 424 Census block groups. In comparison to Arizona and the three-county Study Area, both corridor alternatives have a slightly larger share of minority populations. **Figure 5-3**, **Figure 5-4**, and **Figure 5-5** highlight the location of the EJ Block Groups based on race and ethnicity in and around the corridor alternatives.

Table 5-3. Percent Minority for Selected Geographies

Location	Non-Hispanic White	Other Races	Hispanic or Latino	American Indian or Alaskan Native	Total Minority
Arizona	57.8%	37.6%	29.6%	4.6%	42.2%
Three-County Study Area	58.0%	40.1%	30.4%	1.9%	42.0%
Yellow Corridor Alternative[a]	53.8%	44.0%	32.3%	2.2%	46.2%
Orange Corridor Alternative[a]	56.5%	41.3%	32.4%	2.0%	43.5%
Coolidge	43.6%	54.5%	42.0%	1.9%	56.4%
Eloy	18.9%	79.9%	58.0%	1.2%	81.1%
Florence	46.6%	53.0%	31.2%	0.4%	53.4%
Phoenix	46.5%	52.9%	40.8%	0.6%	53.5%
Tucson	47.2%	51.8%	41.6%	1.0%	52.8%

Source: US Census 2010
[a] based on Census block groups that intersect with the corridor alternatives

Low-Income Households

The median household income in the state of Arizona was $50,448 in 2010. Of the more than 2.3 million households in the state, 12.1 percent earned a household income less than $15,000 per year. In comparison, the median household incomes in the three-county Study Area ranged between $45,521 and $55,054; and 11.2 percent of the households earned less than $15,000 per year.

Figure 5-3. Threshold Minority Populations in the Study Area

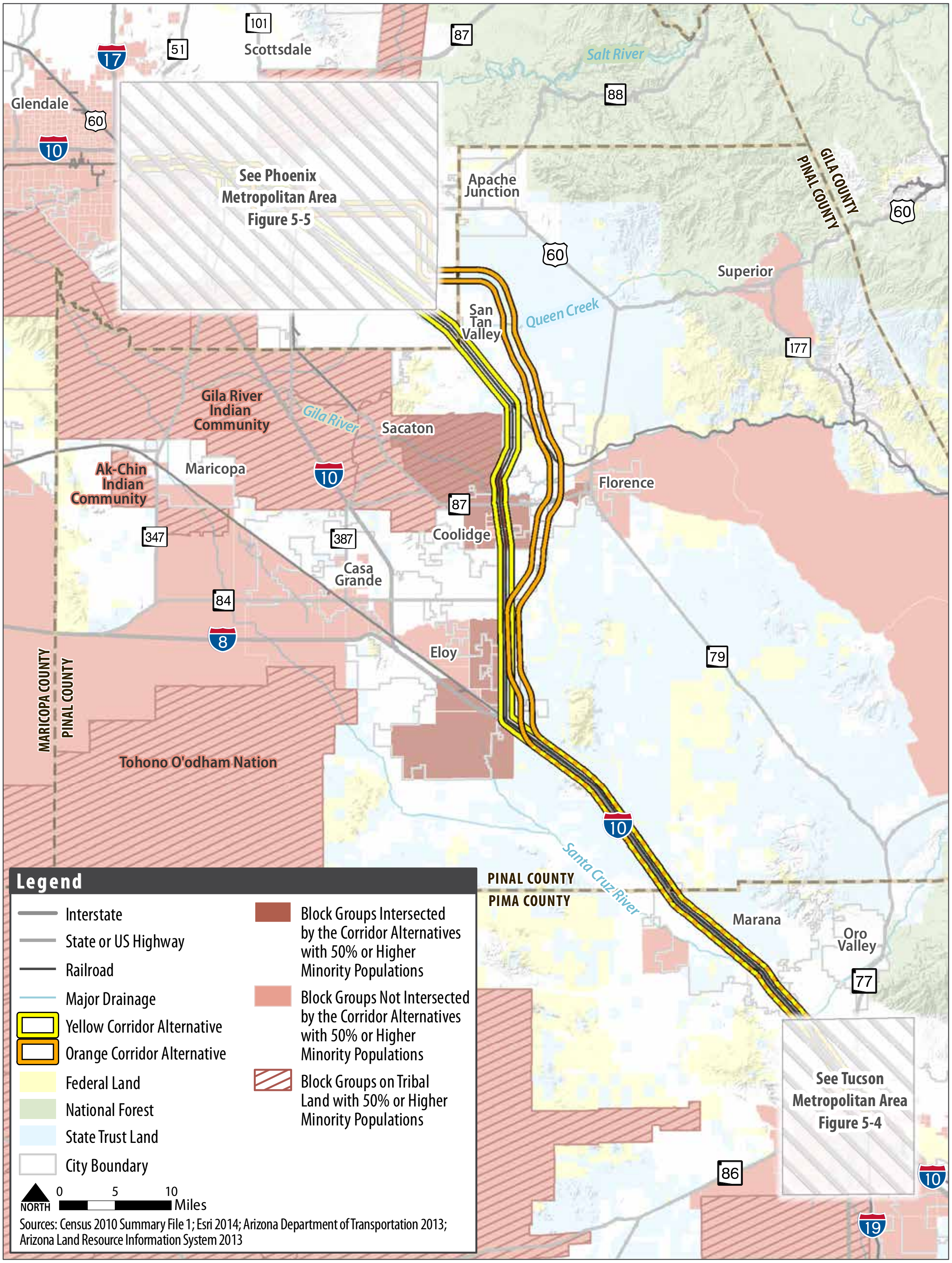


Figure 5-4. Threshold Minority Populations in the Tucson Metropolitan Area

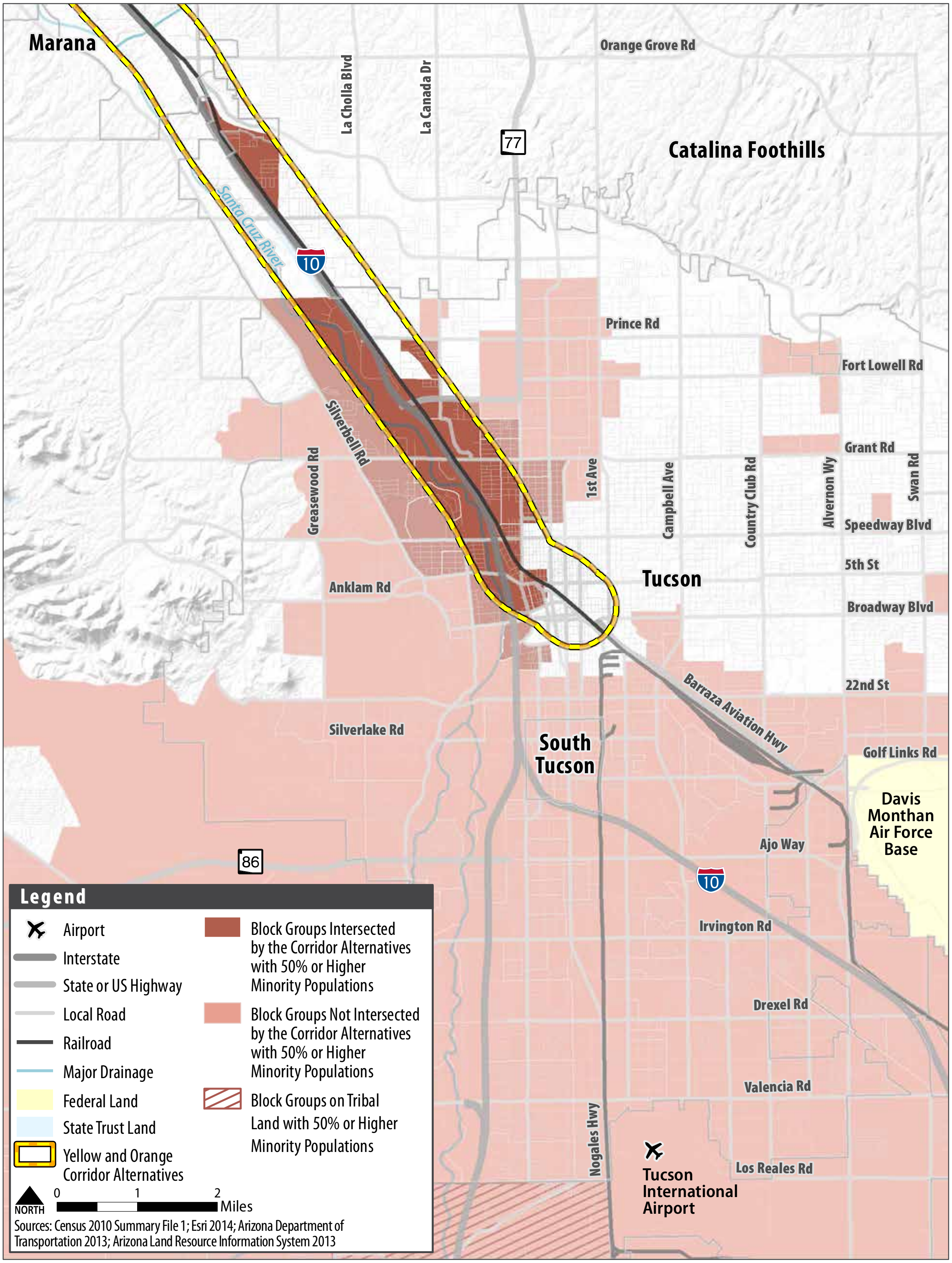
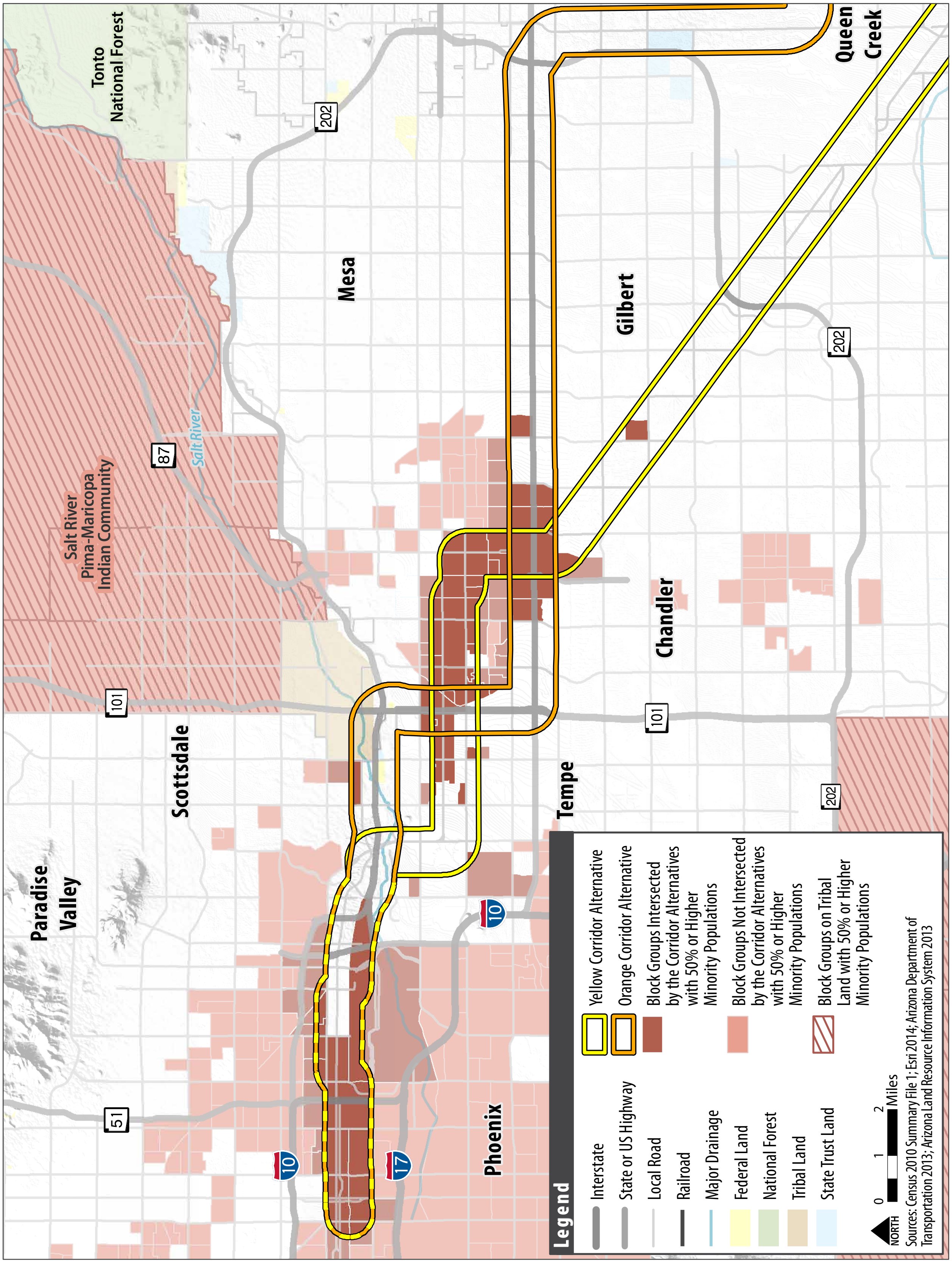


Figure 5-5. Threshold Minority Populations in the Phoenix Metropolitan Area



Several communities had a higher share of households that earn less than $15,000 per year compared to the three-county Study Area, including; Eloy (26.2 percent of all households), Tucson (18.8 percent), Tempe (14.8 percent), Coolidge (14.7 percent), and Phoenix (13.2 percent) (Table T-2 in the *Title VI and Environmental Justice Appendix*). **Figure 5-6**, **Figure 5-7**, and **Figure 5-8** highlight the location of the EJ Block Groups based on income in and around the corridor alternatives.

Limited English Proficiency

According to the 2008-2012 American Community Survey, 73.4 percent of the population aged five years and older living within the corridor alternatives speak English only. Of those that speak a language other than English, almost 1 million people (21.0 percent) speak Spanish; and 8.7 percent speak Spanish and speak English "less than very well." The next most commonly spoken languages in the three-county Study Area include Chinese (0.5 percent), Vietnamese (0.4 percent), and German (0.4 percent). In Pinal County, the most commonly spoken languages are, in descending order, Spanish (19.3 percent), other Native North American languages (0.7 percent), Navajo (0.4 percent), and German (0.4 percent). In Pima County, commonly spoken languages are Spanish (23.5 percent), Chinese (0.6 percent), other Native North American languages (0.5 percent), and German (0.5 percent). In Maricopa County, commonly spoken languages are Spanish (20.6 percent), Chinese (0.5 percent), Tagalog (0.4 percent), and German (0.4 percent). Table T-3 in the *Title VI and Environmental Justice Appendix* highlights the languages spoken in the Study Area and number of people who speak English "less than very well."

In order to provide meaningful communication to the people living in the Study Area, project materials would be made available in the dominant languages spoken (English and Spanish); and interpretation services should be made available for Spanish speakers and speakers of other languages upon request. Different language interpretation may be needed depending on where within the Study Area public outreach activities occur.

Figure 5-6. Concentrations of Low-Income Populations in the Study Area

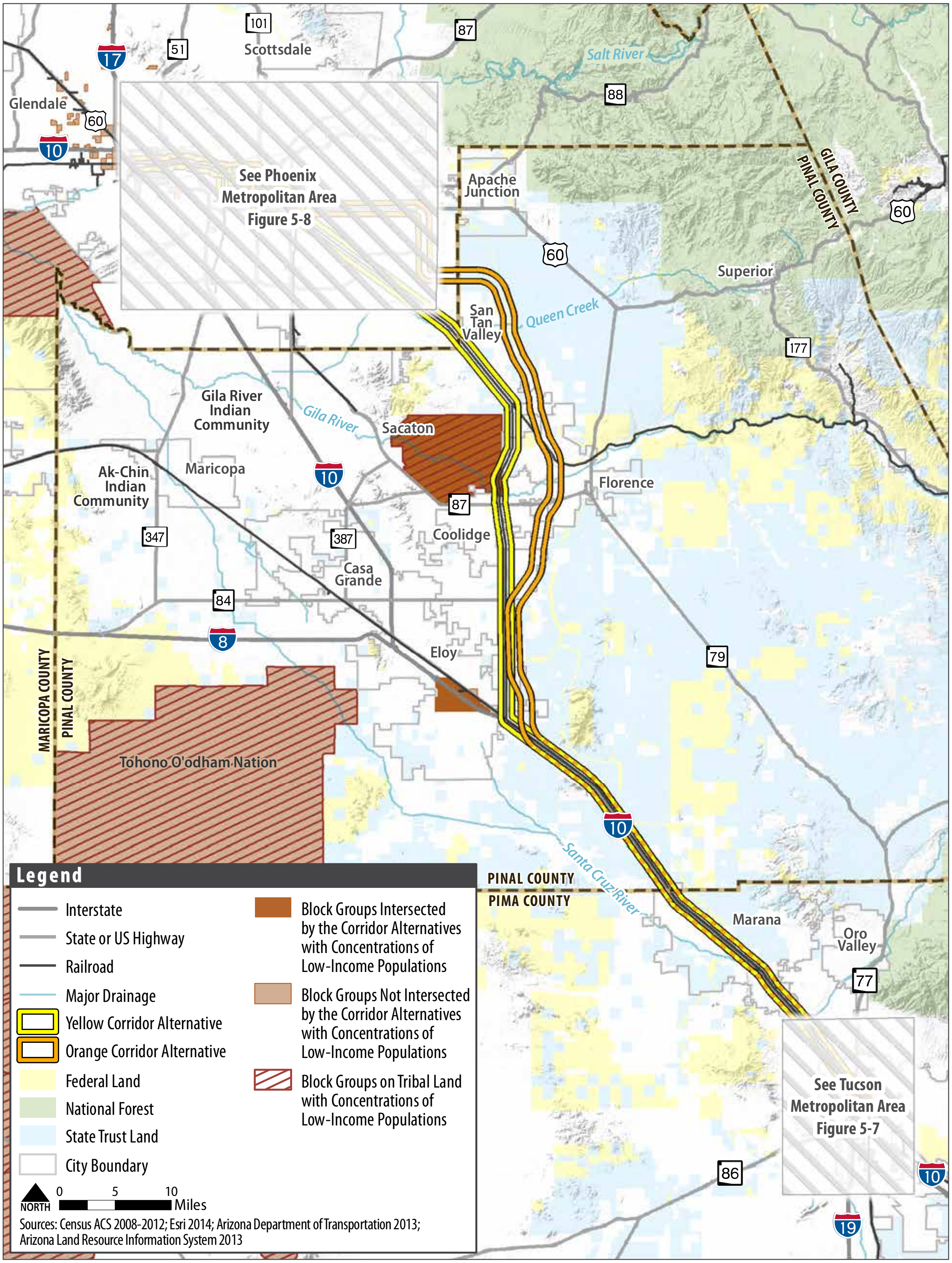


Figure 5-7. Concentrations of Low-Income Populations in the Tucson Metropolitan Area

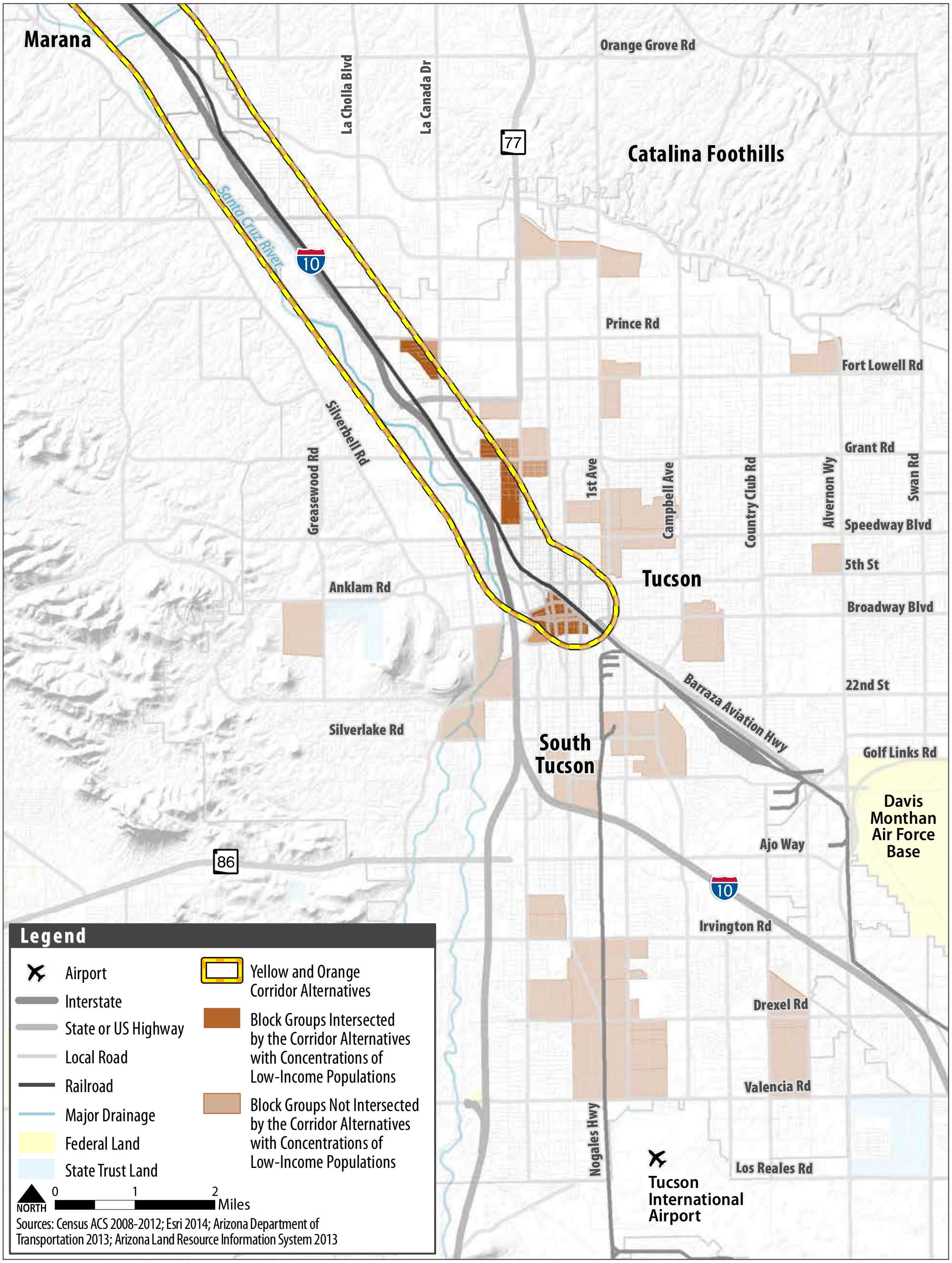
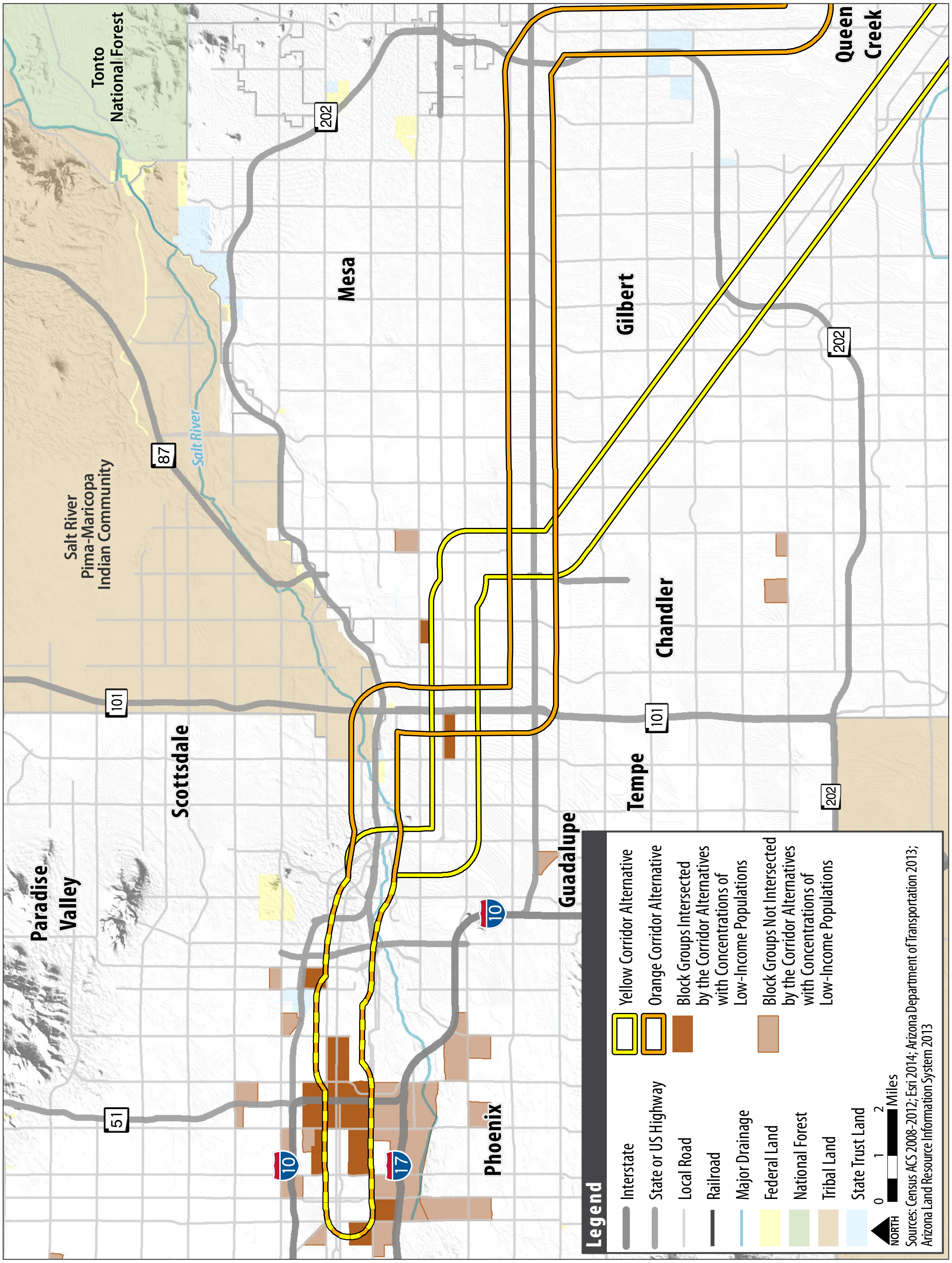


Figure 5-8. Concentrations of Low-Income Populations in the Phoenix Metropolitan Area



5.4.3 Environmental Consequences

As explained in the methodology, Census block groups containing a minority population greater than 50 percent were identified as EJ Block Groups for the purposes of evaluating potential impacts. **Table 5-4** shows the number of Census block groups intersected by the Yellow and Orange corridor alternatives and, of those, the number of block groups with high concentrations of EJ and other protected populations as of the 2010 Census, which is the latest year for which actual counts are available. Effects of a passenger rail system on EJ and vulnerable populations would vary depending on the exact alignment within a corridor alternative; however, for this Tier 1 analysis, corridor-wide percentages of EJ and sensitive population Block Groups represent approximate percentages throughout the corridor.

Table 5-4. Environmental Justice Block Groups Intersected by the Corridor Alternatives

	Total Block Groups	Total EJ Block Groups based on Race & Ethnicity	Total EJ Block Groups based on Household Income
Yellow Corridor Alternative	230	94	16
		40.9%	7.0%
Orange Corridor Alternative	194	72	14
		37.1%	7.2%

Yellow Corridor Alternative

A passenger rail system within the Yellow Corridor Alternative could have direct impacts on minority and low-income populations. Potential property displacements, depending on specific facility locations, would be determined during Tier 2 studies. Additional impacts to protected populations from a passenger rail system within the Yellow Corridor Alternative could include those related to public health and safety and community cohesion, such as tracks creating a barrier to access within a neighborhood, displacing a community center or church, or prompting a change in the demographic composition of a neighborhood near rail stations.

Indirect and temporary impacts on EJ and other protected populations may include increased traffic congestion, delays, noise, and vibrations during construction. Due to the location specific nature of an environmental justice analysis, a determination of the effects on EJ and other protected populations cannot be made until design details are further developed. A full determination of impacts would continue in Tier 2.

Passenger rail would provide economic and quality-of-life benefits to minority and low-income populations through improved mobility and access to alternative transportation modes serving a variety of destinations throughout the region. Benefits would be greatest near station areas, but benefits would also occur where public transit service offers access to rail stations.

If a passenger rail system within the Yellow Corridor Alternative is built within or along an existing railroad alignment, increased traffic within the existing rail ROW could increase noise, as addressed in **Section 5.9**, Noise and Vibration. The potential for additional grade crossings can introduce a greater amount of safety concerns for communities, as addressed in **Section 5.5**, Public Health and Safety.

Minimal temporary impacts on existing public transportation routes could occur as a result of detours and delays during construction. If built along or within an existing railroad ROW, a passenger rail system could provide beneficial impacts by improving or developing highway-railroad grade crossings, potentially with additional safety features.

Potential impacts on EJ populations would be further addressed, along with those for the general population, in the Tier 2 analysis.

Orange Corridor Alternative

Potential impacts of a passenger rail system to EJ and other protected populations within the Orange Corridor Alternative would be the same as those described above for the Yellow Corridor Alternative, albeit in different locations where the two corridor alternatives diverge. Due to the location-specific nature of an environmental justice analysis, a determination of the effects on EJ and other protected populations cannot be made until design details are further developed. A full determination of impacts would continue in the Tier 2 analysis.

Passenger rail could provide economic and quality-of-life benefits to minority and low-income populations through improved mobility and access to alternative transportation modes serving a variety of destinations throughout the region, particularly for populations near rail stations or with access to public transit service connecting to rail stations.

No Build Alternative

Under the No Build Alternative, a new passenger rail system would not be built; and impacts on EJ and sensitive populations are not anticipated beyond those that could occur due to other approved projects. With the No Build Alternative, minority and low-income populations in the assessment area would not realize the mobility and economic benefits provided through access to new passenger rail service.

5.4.4 Potential Mitigation Measures

The potential for disproportionate EJ impacts cannot be determine until Tier 2 analysis on a specific alignment is conducted. However, if the analysis identifies the potential for disproportionate EJ impacts, ADOT would develop an outreach program to engage the protected populations in planning, programming, and implementing alternatives that could affect them. ADOT also would commit to the other requirements outlined in EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*.

5.4.5 Tier 2 Considerations

Tier 2 analysis can result in refinements in design that would minimize potential areas of impact. In compliance with EO 13166, public involvement activities and communications for the study would be conducted to ensure full and fair participation. An LEP investigation would inform the Tier 2 public outreach process to ensure specific approaches are available to provide access to services and for public involvement. Project communication should be made available in Spanish and other languages upon request.

A Tier 2 NEPA document would include a full analysis of the impacts to EJ and sensitive populations from construction and operation of a selected alternative at the project level. Resources that may need to be studied further during Tier 2 would include displacements and relocation; access to employment and business; community characteristics; and affordable housing initiatives for protected populations. The Tier 2 NEPA analysis would include a full determination of the impacts to EJ and other protected populations of a specific passenger rail system. The following strategy, as established by FTA Circular 4703.1 – *Environmental Justice Policy Guidance for Federal Transit Administration Recipients, August 15, 2012*, would be addressed in Tier 2:

- Determine the effects of the activity on the identified EJ populations and compare those effects with the effects on the non-EJ population within the area of the activity
- Determine whether the activity creates an adverse effect and then determine whether that effect is disproportionate and high by comparing the effects experienced by EJ populations and non-EJ populations
- Whether the adverse effects on EJ populations exceed those borne by non-EJ populations
- Whether cumulative or indirect effects would adversely affect an EJ population
- Whether mitigation and enhancement measures would be taken for EJ and non-EJ populations

- Whether there are offsetting benefits to EJ populations as compared to non-EJ populations
- Determine whether it is possible to avoid, minimize, or mitigate any disproportionately high and adverse human health or environmental effects on EJ populations

Design details such as station locations, rail alignments, and the need for additional ROW would be described in the Tier 2 analysis, resulting in a more precise understanding of the specific impacts to EJ populations. Specific mitigation measures would be identified and discussed during the Tier 2 analysis after design details are finalized, recorded in NEPA documents as specific impacts are identified, and implemented prior to construction. Identification of EJ populations would be verified and updated, and public outreach activities would be designed to engage EJ populations. Evaluation of disproportionately high and adverse impacts on EJ populations would require a detailed analysis of impacts as well as input from public outreach to affected communities.

5.5 Public Health and Safety

Public health and safety concerns regarding a potential rail system comprise a number of issues including, but not limited to, vehicular traffic and pedestrian conflicts at highway-railroad grade crossings, safety of rail passengers on trains and at stations, rail worker health and safety during construction and operations, maintaining safe construction zones well separated from public areas, and providing cost-effective as well as adequate warning systems for train operations.

This evaluation assesses the potential effects of a passenger rail system on the health and safety of residents and communities in the Yellow and Orange corridor alternatives, and the types of protection that could be provided during construction and long-term rail operations to help mitigate health and safety concerns.

5.5.1 Methodology and Regulatory Requirements

This EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA’s Environmental Impact and Related Procedures (23 CFR Part 771). The regulatory framework pertaining to public health and safety includes ADA, the Resource Conservation and Recovery Act of 1976 (RCRA) and its amendments, and the Occupational Health and Safety Act of 1970. Public health and safety considerations were evaluated in accordance with FRA Environmental Procedures Section 14(n)(17) and (18) (FRA 1999a).

Publications and resource materials from FRA and other USDOT agencies were also reviewed for general safety requirements including, but not limited to, the ADA, High-Speed Passenger

Rail Safety Strategy (FRA 2009), the Rail Safety Improvement Act of 2008 (Public Law 110-432), and the Federal Railroad Safety Act (FRSA) (49 U.S.C. § 20101 *et seq.*). During Tier 2 NEPA analysis, ADOT, in coordination with FRA and/or FTA, would coordinate with UP to obtain information regarding the level of protection afforded the public concerning health and safety issues.

The potential for collisions between trains and vehicles or pedestrians is greatest at highway/rail and pedestrian/rail crossings. Locations where a roadway, sidewalk, or pedestrian trail/bikeway crosses the track at the same elevation are called “grade” crossings. Crossings where a roadway, sidewalk, or pedestrian trail/bikeway passes over the tracks via an overpass bridge structure or passes under a railroad track via an underpass bridge structure are referred to as “grade separated.” An understanding of the potential number and type of crossings contributes to an understanding of the degree of risk for collisions within each corridor alternative. Because the greatest potential risk to public health and safety is at rail crossings and rail stations, the public health and safety analysis focuses on the number of potential crossings, recognizing that these may change during more detailed design.

Existing roadway/rail grade and grade-separated crossings and existing rail station information was verified against recent aerial photography and ADOT’s rail crossing database. Additional information associated with the UP was collected from the ADOT UP database and recent aerial photography (ADOT 2012). Where existing UP track is located within the Yellow and Orange corridor alternatives, UP crossing information was collected. Existing crossing data were used to formulate a reasonable number of crossings for possible passenger rail alignments within the corridor alternatives. Information regarding potential grade and grade-separated crossings was drawn from aerial photography with inferences based on the ADOT UP crossing database.

Because the number of potential crossings would vary depending on the future alignment within a corridor, densely urbanized areas were assumed to have one grade-separated crossing per mile, while a range of potential crossings was given in other areas where the number of crossings was highly variable depending on the location of a future alignment within a corridor alternative. Aerial photographs illustrating locations where roads are intersected by the corridor alternatives, i.e., potential locations for grade crossings, are shown in the *Corridor Aerial Atlas Appendix*, Maps 1 through 91.

A distinction was made between urban and rural crossings, because different safety elements need to be considered. For example, urban crossings may include higher volumes of cross traffic and warrant the cost of grade-separated crossings and/or additional physical barriers such as railroad crossing gates and signals. Slow-moving vehicles, such as agricultural equipment, may frequently use rural crossings and may need earlier audio warning systems.

Because the analysis estimated crossings for the length of the proposed corridors regardless of the ultimate alignment within each corridor, it was not necessary to apply the ratio for a narrower corridor. The estimated number of railroad crossings used in the analysis is the same regardless of the corridor width.

Future Tier 2 documentation would evaluate a passenger rail system in detail, including site-specific identification of grade crossings and stations and information from additional sources regarding topics such as unusually busy grade crossings or farm crossings. If a future alignment proposes to use existing UP track or rail facilities, ADOT, in coordination with FRA and/or FTA, would coordinate with UP during Tier 2 documentation to obtain information regarding public health and safety issues and associated coordination in protecting the public and rail workers.

5.5.2 Existing Conditions

According to data from the USDOT Bureau of Transportation Statistics, between 2003 and 2012, an annual average of 7 passenger fatalities occurred and 1,172 persons were injured traveling by rail in nearly 100 million passenger train miles traveled (USDOT, Research and Innovative Technology Administration, Bureau of Transportation Statistics 2013). Compared to vehicular highway travel, passenger rail service is statistically safer. According to the National Safety Council data for 2010, based on miles traveled, personal motor vehicle travel was approximately 25 times more likely to result in a fatality than passenger rail travel. In 2010, the passenger death rate in light-duty vehicles was 0.50 per 100 million (1 in 200 million) passenger miles, compared to a passenger death rate in trains of 0.02 per 100 million (1 in 5 billion) passenger miles (National Safety Council 2013).

Numerous public and private roads, state and US highways, and an interstate highway intersect the approximately 120-mile-long Yellow and Orange corridor alternatives.

Table 5-5 summarizes the anticipated number of crossings and stations for the Yellow and Orange corridor alternatives. The locations of these rail system facilities are estimated based on the communities that intersect the corridors. The anticipated number and types of crossings are based on existing UP crossings and aerial photography showing roads that intersect with the corridors. Rural grade-separated crossings are not included because none currently exist, and traffic volumes on rural roads intersecting the corridor alternatives do not likely warrant constructing grade-separated crossings. Actual numbers of crossings and stations would be established during Tier 2 studies in consideration of factors such as more detailed engineering analysis, utility studies, ridership modeling results, and public input.

Table 5-5. Potential At-Grade and Grade-Separated Crossings and Stations by Alternative Segment

Urban At-grade Crossings [a]	Rural At-grade Crossings	Urban Grade-separated Crossings	Urban Stations	Rural Stations	Total Number of Anticipated Crossings and Stations
Southern Hub to Eloy – Yellow and Orange Corridor Alternatives[b]					
16	5	8	8	0	37
Eloy to Northern Hub – Yellow Corridor Alternative[b]					
78	13	23	6	1	121
Eloy to Northern Hub – Orange Corridor Alternative[c]					
29	5	31	4	3	72

Notes:
[a] Urban and rural areas identified by location inside (urban) or outside (rural) city boundaries (ALRIS 2013).
[b] Crossings and stations identified by ADOT UP crossings database and aerial photography.
[c] Crossings and stations identified by aerial photography and inference based on ADOT UP crossings database

The existing UP at-grade crossings have various forms of warning devices ranging from active gates and flashing signals to passive protective lights and bells to simple cross-buck warning signs at rural crossings.

Some communities have established Quiet Zones in which the sounding of train horns is prohibited except in emergencies. In these areas, FRA requires the use of upgraded crossing gates and curbs to prohibit vehicle egress across train tracks from cross streets when a train approaches the crossing.

Assuming the Quiet Zones that apply to the UP are extended to the passenger rail system, two sections of the Yellow Corridor Alternative would be subject to existing Quiet Zones. The UP is currently subject to a Quiet Zone in Tempe, north of Broadway Road from the City of Mesa to the City of Phoenix boundaries. The Yellow Corridor Alternative also may be subject to the Phoenix Downtown Quiet Zone in effect on the UP between 4th Street and 3rd Avenue.

One section of the Orange Corridor Alternative may be subject to the Phoenix Downtown Quiet Zone described above.

5.5.3 Environmental Consequences

At the Tier 1 analysis level, project construction and operations in the Yellow or Orange corridor alternatives do not appear to present major obstacles associated with public health and safety challenges.

Yellow Corridor Alternative

Physical Impacts

A passenger rail system within the Yellow Corridor Alternative would likely have more grade crossings than a system within the Orange Corridor Alternative because the road and street network in the Yellow Corridor Alternative is more robust. The opportunity exists in the Yellow Corridor Alternative to locate part of the passenger rail system within or closely parallel to an existing freight railroad. Where railroad crossings for the freight line coincide with the passenger rail systems, fewer new grade crossings may be needed; and persons who habitually travel across the existing tracks would be accustomed to exercising safety precautions at these crossings. Because the alignment of a passenger rail system within this corridor alternative has not been determined, the extent of physical impacts to public health and safety cannot be fully determined.

Operational Impacts

Operation of passenger rail service within the Yellow Corridor Alternative would introduce train traffic or increase the frequency, number, and average speed of trains along or adjacent to the existing freight railroad. In either case, the change in traffic conditions associated with passenger rail system operations would increase the public's risk of misjudging the time available to cross the tracks. During the operational phase, moving trains and maintenance of the rail facilities would be the primary worker and public health and safety concerns. New passenger service at speeds up to 110 mph may require upgrading of safety systems, in accordance with applicable design standards and FRA safety regulations (49 CFR Parts 200 to 299), to help ensure that the most sophisticated warning devices appropriate for the area are available for the higher-speed service.

Direct effects on public health and safety could arise from passengers interacting with the rail system at stations, on platforms, and within passenger trains. These facilities are susceptible to a range of safety and security threats ranging from personal accidents (e.g., slips or trips) to criminal activity (e.g., theft or terrorism in passenger areas). Platform areas add risks associated with moving trains and train boarding. Passengers on the train are at risk for these same incidents.

An indirect benefit of a passenger rail system would be a relief in some of the volume of vehicular traffic using I-10 and other area roadways. Reduced volumes of vehicular traffic would improve the level of service of the highways, improving traffic flow and thereby reducing the potential for vehicular collisions.

In 2012, 87 fatal crashes occurred in the rural segments of Arizona's interstate highway system and killed 104 persons. In the urban segments of Arizona's interstate highways, 44 fatal crashes accounted for 47 deaths (NHTSA 2015). While the 2012 U.S. fatality rate for motor vehicles is 1.14 per 100 million miles traveled, the Arizona rate during this same year was 1.37 fatalities per 100 million miles traveled; this reflects the historical trends from 2008 through 2011 where Arizona experienced an average of approximately 0.23 more fatalities per 100 million miles traveled than the national average. Additionally, while rural crashes in Arizona accounted for 19.39 percent of all crashes, they accounted for 49.05 percent of all fatal crashes occurring in 2012 (ADOT 2013). With passenger rail statistically resulting in 25 times fewer fatalities per 100 million miles traveled than passenger vehicle (0.02 vs. 0.50), fatality statistics for Arizona may start to align closer to national statistics, which includes states with passenger rail service.

Construction Impacts

Construction of passenger rail system infrastructure and associated safety systems, as well as improvements to adjacent transportation modes, would result in temporary impacts along the rail ROW and at station locations. During the construction phase, health and safety risks could increase. Work crews would be subject to the types of hazards commonly associated with construction sites, including working in an environment with heavy equipment, power tools, open trenches, and other types of potential hazards.

Environmental hazards for work crews could include working in extreme temperatures and potential exposure to venomous insects and wildlife. Workers also may be working with materials that are potentially hazardous if not used, stored, and disposed of properly.

Effects on public health and safety during construction would generally be short-term and temporary. These effects may include localized increases in air pollutants, noise, and vibration, as well as traffic accidents associated with reductions in travel lanes (particularly in urban environments), greater potential exposure to heavy equipment in operation or open trenches, and increases in noise. Soil-disturbing activities associated with construction could increase exposure to dust, which could reduce visibility in nearby travel corridors. Dust may also increase the potential for aggravating pulmonary disorders such as asthma or increasing exposure to the fungi found in some soils that can cause valley fever (Coccidioidomycosis) when inhaled.

Orange Corridor Alternative

Physical Impacts

Direct effects on public health and safety from a passenger rail system within the Orange Corridor Alternative would be similar to those associated with a system in the Yellow Corridor

Alternative. Implementing passenger rail service within the Orange Corridor Alternative would require approximately 120 miles of new track to be built within new ROW or within the ROW of adjacent transportation facilities, including existing and proposed facilities. The introduction of a railroad in a new location would present potential public health and safety hazards to the area. People within the Orange Corridor Alternative unaccustomed to grade railroad crossings and new traffic patterns would need time to become familiar with the presence of these elements in their surroundings and be aware of the safety issues and precautions needed for their protection.

Operational Impacts

Operation of passenger rail service within the Orange Corridor Alternative would introduce public health and safety concerns similar to those associated with a passenger system in the Yellow Corridor Alternative.

Construction Impacts

Impacts from constructing passenger rail system infrastructure and associated safety systems in the Orange Corridor Alternative would be similar to those associated with a system in the Yellow Corridor Alternative.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be constructed or implemented. Traffic volumes on I-10 between Tucson and Phoenix and other area roadways would likely continue to increase, contributing to a likely increase in traffic accidents. In addition, with increases in traffic volume, the potential for crossing conflicts on existing rail lines could increase without the addition of upgraded warning or traffic control devices.

5.5.4 Potential Mitigation Measures

Site-specific mitigation measures would be identified during Tier 2 documentation, based on preliminary design, and implemented with construction of a project. Due to the anticipated maximum train speed, a number of safety measures and strategies would be considered for the rail system being evaluated in this study to protect the health and safety of passengers as well as motorists and pedestrians at existing or new crossings and stations. Several of the following safety measures and strategies are recommendations from FRA guidance in the *High Speed Passenger Rail Safety Strategy* (FRA, Office of Railroad Safety and Office of Railroad Development 2009). While the rail system being evaluated in this study is not included in the FRA's High Speed Intercity Passenger Rail Program (FRA 2013a), the safety measures identified in this program's safety strategy should be considered for implementation, as necessary and practicable.

- Prior to the start of construction, develop a Health, Safety, Security, and Environment Plan to address health and safety risks and requirements, safe work practices, worker training, dust control, use and storage of potentially hazardous materials, emergency response, implementation of safety procedures, incident investigation and reporting, and related topics.
- Where practical, consolidate public and private grade crossings along the route. Eliminate redundant and/or unsafe crossings (due to proximity of exiting road intersections, skewed geometry, etc.) where alternate access can be reasonably provided.
- For at-grade crossings, especially within and on the fringe of populated areas, install the most sophisticated traffic control/warning device appropriate for the location, such as median barriers, special signage, flashing lights, four-quadrant gates, etc. In general, private crossings should be treated the same as public crossings.
- When feasible, close private crossings within industrial developments and rural areas with a prevalence of heavy trucks and farm equipment. If private crossings cannot be closed, consider provision of a locking device when not in use.
- Upgrade existing train traffic control systems to ensure safe interactions between existing rail facilities and traffic and between new rail facilities and traffic.
- Clear trees and brush, as needed, to provide necessary sight distances for safe operation of the rail system.
- Implement measures to suppress fugitive dust during construction.
- Whenever possible, take measures to minimize noise related to construction.
- Use active warning systems for pedestrians where rail lines cross existing sidewalks, trails, and bike routes, particularly when crossings are near parks, schools, and other activity centers.
- Prepare road users for the challenges inherent at future crossings through educational and public outreach programs. Inform the public that passenger trains travel at significantly higher speeds than the freight trains currently operating in portions of the corridor alternatives and that relying exclusively on visual and/or audible cues to judge the arrival of trains can be extremely dangerous.
- Evaluate if Quiet Zones applicable to UP freight operations should be extended to passenger rail operations where the Yellow Corridor Alternative intersects the Tempe

Quiet Zone and where both corridor alternatives pass through the existing Phoenix Downtown Quiet Zone.

- Evaluate the need for and, where warranted, install additional security improvements such as extra lighting, surveillance cameras, and other security measures at train stations.
- Ensure that any future construction, operations, and maintenance of a passenger rail system meet the Occupational Health and Safety Act of 1970, FRA, ADA, RCRA, and other requirements to help protect the safety and health of workers and the public.

5.5.5 Tier 2 Considerations

Temporary and permanent impacts to public health and safety resulting from construction and operation of a rail system would be evaluated in detail during Tier 2 documentation. Project-level analysis under Tier 2 would also evaluate new and existing crossing locations, as needed, to ensure safety issues and standards are addressed. Safety at stations would also be evaluated, with upgrades to existing safety equipment proposed as warranted.

FRA has established train control requirements for train movements above 79 mph (49 CFR Part 236). For train speeds between 80 to 110 mph, the highest speed being considered for this study, FRA recommends the installation of the most sophisticated warning or traffic control devices that fit the location. Examples include dispatcher-controlled electrically locked gates, bells, flashing lights, constant warning time devices, and Positive Train Control systems, which include designs to prevent train-to-train collisions, derailments caused by excessive speed, unauthorized incursion by trains onto sections of track undergoing maintenance, and movement of a train through a track switch left in the wrong position. Sophisticated crossing facilities would be particularly necessary and/or required within Quiet Zones where train horns are not used at crossings unless a hazard is present. Quiet Zones currently exist along certain sections of the UP in Tempe and Phoenix. These would be examined in detail in Tier 2 documentation.

5.6 Parklands and Recreation Areas

Parks are defined as lands that have been officially designated as such by a federal, state, or local agency. Parks may contain recreational resources (such as trails, ball fields, and swimming pools), and recreational resources can also exist independently. For this Tier 1 EIS, federal, state, and local parks and recreational resources were identified and assessed for potential impacts. Publicly owned parks and recreation areas are also addressed in the separate discussion of Section 4(f) and 6(f) resources in **Section 5.7**.

5.6.1 Methodology and Regulatory Requirements

This EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA's Environmental Impact and Related Procedures (23 CFR Part 771). Potential impacts on parks and recreational resources (as defined in the introduction to this section) were evaluated in accordance with CEQ regulations implementing NEPA and FRA's Environmental Procedures (Section 14(n)(19) (FRA 1999a)).

Data from several sources were used to inventory parks and recreational resources within the corridor alternatives and adjacent lands. These sources included federal, state, and county websites and associated GIS data and aerial photography mapping programs such as Google Maps and ArcGIS. A GIS database of parklands and recreation areas was compiled with input from state agencies, local jurisdictions, Councils of Government, and MPOs. The name, location, type, and size of the park, recreational resource, or natural area were identified and are compiled in the *Section 4(f) and 6(f) Resources Appendix*. Federal, state, and local sites were also mapped on the *Corridor Aerial Atlas Appendix*.

Private parks associated with master planned developments and residential subdivisions are also an important resource; however, different local government agencies handle data on location and size of these private parks differently, making data gathering and comparisons among alternatives problematic. For this reason, the analysis of privately owned parks is better suited to be covered in the Tier 2 NEPA analysis. The private parks and recreation areas presented below in **Table 5-6** consist mostly of recreation areas (golf courses).

This Tier 1 EIS focuses on identifying the public parks and recreational resources located within the corridor alternatives and identifying the types of activities having the potential to affect those resources. Because a specific alignment within each alternative has not been determined, the number, rather than the acreage, of potentially affected parklands was estimated. A scan of the 200-foot-wide center swath of each corridor alternative provided a clearer whole-number estimate than applying the 200-foot to one-mile ratio (0.0379) to the total number of parklands obtained from GIS data for each corridor alternative.

5.6.2 Existing Conditions

Public parks, recreational resources, and natural areas within the corridor alternatives are shown in the *Corridor Aerial Atlas Appendix*, Maps 1 through 91. Within the mile wide corridor alternatives, a total of 147 parks (city, county, and state), 67 recreational areas (trails, athletic fields, public and private golf courses, stadiums, and swimming pools), and 26 privately owned parks/recreation areas were identified. The *Section 4(f) and 6(f) Resources Appendix* includes a table of the public parks and recreational resources located within the mile-wide corridor alternatives, plus a 0.25-mile buffer around them to account for proximity effects such as increased noise. **Table 5-6** presents summary data for each corridor alternative, and includes privately owned parks and recreation areas.

Table 5-6. Summary of Parks, Natural Areas, and Recreation Areas in the Study Corridors

Public Parks[a]	Public Recreation Areas[b]	Private Parks and Recreation Areas[b]
Southern Hub to Eloy – Yellow and Orange Corridor Alternatives		
43	12	2
Eloy to Northern Hub – Yellow Corridor Alternative		
56	33	5
Eloy to Northern Hub – Orange Corridor Alternative		
48	22	19

Notes:
[a] Park jurisdictions include city, county, state, and the National Park Service.
[b] Recreation areas include schools, athletic fields, trails, recreation centers, golf courses, stadiums, and swimming pools.

Additionally, the southern portion of both corridor alternatives coincides in places with the Juan Bautista de Anza National Historic Trail designated historic corridor, auto tour route, and recreation retracement route. As defined by the National Trails System Act (16 U.S.C. §§ 1241-1251), a National Historic Trail is an extended trail which follows as closely as possible and practicable the original trail or route of travel of national historical significance. While outside of the Santa Cruz River Park the historic corridor is not within a public park or recreation area, the Historic Trail designation is intended to identify and protect the remains of this overland route for public use and enjoyment. The Anza Trail Corridor appears on Maps 1-11 and 21-27 of the *Corridor Aerial Atlas Appendix*.

5.6.3 Environmental Consequences

Activities having the potential to affect public parks and recreational resources include upgrading existing and building new rail infrastructure, as well as constructing new passenger stations. Impacts could take the form of physical use of and modifications to the land, or the indirect effects of increased noise levels and visibility.

Impacts to parks and recreation areas would depend on the alignment. Parks and recreational resources potentially affected by a future passenger rail system would be further identified in Tier 2. Specific types and degrees of impacts on individual resources (such as ROW acquisition and impacts on characteristics of a resource) would not be known until further design of rail facilities takes place. These would be evaluated in Tier 2 NEPA documents.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Physical impacts to parklands and recreation areas would occur if a resource, or a portion of a resource, were permanently incorporated into the passenger rail system. This mile-wide corridor segment includes 43 public parks and 13 public recreational areas, as listed in Tables F-2 and F-3 of the *Section 4(f) and 6(f) Resources Appendix*, and 2 private recreational areas. Many of these resources are densely clustered in specific areas, including around downtown Tucson, the Santa Cruz River Park, and north into Marana. Multiple trails, river parks, and linear parks also traverse the corridor, increasing the potential for physical impacts. Physical impacts to some resources that serve both a recreational and a flood control purpose (e.g., golf courses) would also be subject to floodplain regulation. As shown on Maps 1 through 22 of the *Corridor Aerial Atlas Appendix*, approximately six parks and recreational areas could potentially be affected within the 200-foot center of this corridor alternative segment. This number could change, depending on the location of a passenger rail system alignment within this segment.

Operational Impacts

Operational impacts to parks and recreation areas could range from temporary or permanent access restrictions to visual, noise, and vibration impacts to nearby resources that would not be permanently incorporated into a future rail line. These impacts would also more likely occur in the Tucson-Marana area, where the parklands within the corridor are concentrated. Baseline noise levels, particularly in areas along Sky Harbor flight paths, should be considered when assessing noise impacts to parks along the Salt River in Mesa and Tempe.

Construction Impacts

Construction impacts to parks or recreation areas would occur if the resources were near a rail line or station being constructed. Impacts of this type might include increases in dust from ground disturbance, views of and noise from construction equipment, access restrictions, and temporary construction staging. These impacts would be short-term and temporary, as they would occur during construction or until ground disturbance is stabilized. Like physical and operational impacts, construction impacts would be more likely around cities and populated areas where parks or other resources are concentrated.

Eloy to Northern Hub

Physical Impacts

Physical impacts to parklands and recreation areas would occur if a resource, or a portion of a resource, were permanently incorporated into the rail line. This corridor segment includes 56 public parks and 33 public recreational areas, as listed in Tables F-2 and F-3 in the *Section 4(f) and 6(f) Resources Appendix.* In addition, five private recreational areas are located within this corridor. Many of these resources are densely clustered in Coolidge, Queen Creek, Gilbert, Mesa, Tempe, and Phoenix; and multiple trails also traverse the corridor alternative, increasing the potential for physical impacts. As shown on Maps 23 through 55 of the *Corridor Aerial Atlas Appendix*, 15 parks and recreational areas could potentially be affected within the 200-foot center of this corridor alternative segment. This number could change depending on the location of a passenger rail system alignment within this segment.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts in this segment of the Orange Corridor Alternative would be the same as those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Eloy to Northern Hub

Physical Impacts

Physical impacts to parklands and recreation areas would occur if a resource, or a portion of a resource, were permanently incorporated into the rail line. This segment includes 48 public parks and 22 public recreational resources, as listed in Tables F-2 and F-3 of the *Section 4(f) and 6(f) Resources Appendix.* An additional 19 private recreational resources were identified within the Orange Corridor Alternative. Many of these resources are densely clustered in Florence, Mesa, Tempe, and Phoenix; and multiple trails also traverse the corridor, increasing the potential for physical impacts. As shown on Maps 21 and 56 through 91 of the *Corridor*

Aerial Atlas Appendix, 14 parks and recreational areas could potentially be affected within the 200-foot center of this corridor alternative segment. This number could change depending on the location of a passenger rail system alignment within this segment.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be constructed, and no impacts to parks or recreation areas would be anticipated beyond those that could occur due to other reasonably foreseeable projects.

5.6.4 Potential Mitigation Measures

Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known and specific impacts are identified and recorded in NEPA documents. Potential mitigation measures would be developed in consultation with the official with jurisdiction over the resource and might include avoiding Section 4(f) and 6(f) resources or minimizing the acreage of a physical take of these properties during alignment planning and design, selecting rail station locations that avoid public parks, moving equipment and facilities to another location within existing parkland, purchasing similar properties, and planting vegetation to offset removed vegetation or to establish visual and auditory screening.

5.6.5 Tier 2 Considerations

Future alignments could be located anywhere within the selected corridor and would need to undergo a Tier 2 analysis for potential impacts on the parks and recreation areas affected by future alignment alternatives. Private parks associated with master planned developments and residential subdivision characteristics are inconsistently documented by various government agencies, so field review may be needed to verify data. This exercise is better suited for the Tier 2 analysis of specific alignments, when the number of private parks likely to be affected could be more readily identified.

5.7 Section 4(f) and 6(f) Resources

Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. § 303[c]) is intended to protect public parks; recreation areas; wildlife/waterfowl refuges of national, state, or local significance; and publicly or privately owned historic sites from being used for a transportation projects. Protected properties must be of national, state, or local significance as determined by the federal, state, or local officials having jurisdiction over the park, recreation area, refuge, or historic site.

Section 6(f) lands are defined as parkland or recreation land that was acquired or developed with funding authorized under Section 6(f) of the Land and Water Conservation Fund (LWCF) Act of 1965 (Public Law 88-578). These lands cannot be converted to a non-park or non-recreational use without the approval of the National Park Service (NPS).

5.7.1 Methodology and Regulatory Requirements

Section 4(f) stipulates that FRA, FTA, and other USDOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historic sites unless there is no feasible and prudent alternative to the use of that land and the proposed action includes all possible planning to minimize harm to the property resulting from such use.

A "use" of a Section 4(f) resource, as defined in 23 CFR 774.17, occurs:

- When land is permanently incorporated into a transportation facility,
- When temporary occupancy of land is adverse in terms of the statute's preservation purpose, or
- When a constructive use of a Section 4(f) property occurs.

A constructive use of a Section 4(f) resource occurs when the transportation project does not incorporate land from the Section 4(f) resource but the project's proximity impacts are so severe that the activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. For example, a constructive use can occur as a result of an increase in noise levels or restrictions in access or from other impacts that substantially impair the aesthetic features or attributes of the resource.

A historic site typically is considered a Section 4(f) resource if it is eligible for the National Register of Historic Places (NRHP) under Criterion A, B, or C as noted in **Section 5.19**, Cultural Resources. Information on determining NRHP-eligible properties can be found on the National Park Service website at www.nps.gov/nr/. Historic properties eligible for the NRHP only under

Criterion D are protected under Section 4(f) if they warrant protection in place or derive significance from being preserved in place.

Section 4(f) allows a direct use of a Section 4(f) resource if it has a *de minimis* impact (23 CFR § 774.3[b]). In determining *de minimis* impacts, FRA considers any avoidance, minimization, and mitigation or enhancement measures included in the proposed project to address the impacts and adverse effects to the Section 4(f) resource. Use of a Section 4(f) resource may be determined to be *de minimis* if it does not adversely affect the activities, features, and attributes that qualify the resource for protection under Section 4(f). This is evidenced by a "no adverse effect" determination during the Section 106 process for historic properties and through coordination with the officials with jurisdiction over parks, recreational areas, or refuges. Use of a Section 4(f) resource is allowed when a *de minimis* impact finding can be supported by FRA with the written concurrence of the officials with jurisdiction over the Section 4(f) resource. Where the resource is a publicly owned park, recreational area, or wildlife and waterfowl refuge, FRA must also provide the public an opportunity review and comment.

Section 6(f) of the LWCF Act is administered by the agency responsible for 6(f) compliance in each state, and NPS. This statute pertains to projects that would affect, or result in the permanent conversion of, outdoor recreational property acquired with LWCF assistance. The LWCF Act established the fund as a matching assistance program to provide grants for the acquisition and development cost of outdoor recreational sites and facilities. Section 6(f) prohibits the conversion of property acquired or developed with these grants to a non-recreational purpose without approval from the applicable state agency and NPS. NPS can approve a land conversion only if replacement lands of equal value, location, and usefulness are provided (16 U.S.C. §§ 4601-4 through 4601-11 and 36 CFR § 59.3).

Potential impacts on Section 4(f) and 6(f) resources have been evaluated in accordance with FRA's Procedures for Considering Environmental Impacts (Section 14[n][19] [FRA 1999a]), the requirements set forth in 49 U.S.C. § 303 for Section 4(f) lands, the requirements set forth in 23 CFR Part 774 (Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites [Section 4(f)]), and 36 CFR 59 (LWCF Program of Assistance to States).

The study area for this Tier 1 Section 4(f) evaluation is defined as the corridor alternatives plus a 0.25-mile buffer around each corridor carried forward for further study. The 0.25-mile buffer is included to account for Section 4(f) resources for the Tier 1 environmental analysis that could be subject to potential constructive use impacts (e.g., noise and visual impacts) that may extend beyond the corridor boundaries. Therefore, data for potential Section 4(f) resources for a 1.5-mile corridor (1.0 mile plus 0.25 mile on each side, or 7,920 feet) were collected for this analysis.

Because the area potentially affected by a 200-foot ROW corridor also includes a 0.25-mile buffer, the total impact width for a Section 4(f) resource analysis is 200 feet + 0.25 mile + 0.25 mile, or 2,840 feet. To estimate the number of resources potentially affected, the ratio of these corridor widths (2,840:7,920, or 0.359) is multiplied by the total number of potentially affected Section 4(f) resources identified for each corridor alternative. The effects on protected resources will be analyzed further during Tier 2 NEPA analysis.

5.7.2 Existing Conditions

Based on a review of readily available data – 2012 aerial photography, GIS data, and municipal planning documents – the study area contains all of the types of Section 4(f) resources: wildlife management areas, preserves, or open space that functions primarily as a refuge, parks, recreation areas, and historic properties. The *Corridor Aerial Atlas Appendix*, Maps 1 through 91 show the refuges, parks, recreational resources, and historic sites of national, state, or local significance that qualify as Section 4(f) protected properties, as well as trails and schools that may potentially qualify for Section 4(f) protection.

The *Section 4(f) and 6(f) Resources Appendix* includes one table listing the Section 6(f) resources and four tables that list the Section 4(f) refuges, parks and recreational resources, historic properties, and potential Section 4(f) schools within the mile-wide corridor alternatives and 0.25-mile buffer.

5.7.3 Environmental Consequences

Identification of potential Section 4(f) resources in this Tier 1 EIS does not constitute a final 4(f) determination. That determination will not be made until Tier 2 project-level analysis, when a specific alignment is under consideration. Impacts to Section 4(f) resources would vary based on the future placement of the rail line within a given corridor. Resources identified within a 0.25-mile buffer around a future alignment would be evaluated for constructive use, while resources directly affected by a future alignment would be evaluated for direct use, constructive use, and temporary occupancy. Avoidance of Section 4(f) resources is required unless there are no feasible and prudent alternatives. Therefore, examining avoidance alternatives, as necessary, would be a key criterion in the identification of Tier 2 alignment alternatives and design options. If a future alignment were to result in the potential use of a Section 4(f) resource, FRA would conduct the appropriate Section 4(f) evaluation.

Consultation with the officials with jurisdiction over potentially affected resources is key to these options.

With respect to potentially affected Section 6(f) resources, coordination would occur during Tier 2 with the administering agencies to confirm which parks and recreation areas were acquired and/or developed with LWCF funding. If any areas are identified as LWCF lands, potential impacts would be addressed during Tier 2.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Physical impacts to Section 4(f) resources would constitute a use if the resource, or a portion of the resource, is permanently incorporated into the passenger rail system. Applying the 0.359 multiplier for a ROW corridor as explained in **Section 5.1.2**, this segment could hypothetically include approximately 6 Section 6(f) resources, 3 refuges, 20 public parks and recreational resources, 17 private and public historic properties, and 7 schools with potentially public recreational resources that would be protected by Section 4(f), based on the resources listed in Tables F-1 through F-5 in the *Section 4(f) and 6(f) Resources Appendix*. Many of these resources are densely clustered across the corridor alternatives around downtown Tucson, the Santa Cruz River Park, and north into Marana; and multiple trails, river parks, and linear parks traverse the corridor alternatives. Spanning some of the linear parks and trails that are perpendicular to the corridor is an option, but other parks are too large to span and therefore avoiding conversion of parkland may not be feasible. Therefore, impacts to Section 4(f) properties are likely to occur for any future alignment in the Yellow Corridor Alternative.

Santa Cruz River Park and Picacho Peak State Park have Section 6(f) status and are expansive enough to intersect with large portions of the corridor width (see the *Corridor Aerial Atlas Appendix)*. If these parks cannot be avoided, the acreage converted for the passenger rail could be substantial compared to some of the smaller parks interspersed through the corridor. Identifying and acquiring replacement properties that would be equally useful to such significant regional and state recreational resources could prove problematic and financially infeasible. Orna Mae Harn District Park in Marana should also be considered for avoidance during Tier 2. While Marana does have other parks, this district park is the primary recreational facility; and its current location helps it to serve as a focal point for the town. Ultimately, given the wide distribution of Section 6(f) resources along this segment, it is likely that a future alignment could result in the conversion of Section 6(f) resources requiring the identification and acquisition of replacement property.

Operational Impacts

Operational impacts to Section 4(f) resources could include permanent access restrictions, visual impacts, and noise and vibration impacts to resources that are in proximity to a future alignment but that would not be permanently incorporated into the passenger rail system.

Nevertheless, because Section 4(f) considers proximity impacts in the determination of constructive use, such operational impacts would be evaluated in concert with the analysis of physical impacts.

Construction Impacts

Depending on the proximity of Section 4(f) resources to construction of the passenger rail system, it is possible that such resources could be subject to temporary occupancy. Temporary occupancy occurs when any part of a Section 4(f) property is required for construction-related activities. The property may not be permanently incorporated into a transportation facility, but the activity might be considered adverse in terms of the preservation purpose of Section 4(f). If the following five requirements are met, then the temporary occupancy would not be considered a use (23 CFR § 774.13[d]):

1. Duration must be temporary and less than the time needed to construct the passenger rail system, with no change in ownership.
2. Changes to the Section 4(f) property must be minimal.
3. Physical impacts cannot be permanent or adverse or interfere with the protected activities, features, or attributes of the property.
4. Land being used must be fully restored.
5. FRA must obtain concurrence from the official(s) with jurisdiction that the first four conditions have been met.

If these requirements cannot be met, then the construction impacts would be considered a use and would be subject to a Section 4(f) evaluation.

Eloy to Northern Hub

Physical Impacts

Physical impacts to Section 4(f) resources would constitute a direct use if the resource or portion of the resource is permanently incorporated into the passenger rail system. Applying the 0.359 multiplier for a ROW corridor as explained in **Section 5.1.2**, this segment could hypothetically include approximately 5 Section 6(f) resources, 2 refuges, 32 public parks and recreational resources, 43 private and public historic properties, and 18 schools with potentially public recreational resources, based on Tables F-1 through F-5 in the *Section 4(f) and 6(f) Resources Appendix*. Many of these resources are densely clustered across the Yellow Corridor Alternative in Coolidge, Queen Creek, Gilbert, Mesa, Tempe, and Phoenix; and multiple trails traverse the corridor alternative. Therefore, substantial impacts to Section 4(f) properties are likely to occur from any future alignment in the Yellow Corridor Alternative.

Casa Grande Ruins National Monument is one of the most prominent Section 4(f) resources within either corridor alternative. Potential impacts include direct conversion of land for passenger rail ROW and constructive use effects from noise, vibrations, or visual intrusions. Tier 2 studies to identify alignment alternatives should focus on avoidance of the monument.

The Riparian Preserve at Neely Ranch is notable as the only bird sanctuary in either study corridor but is not currently accessible to the public; access to the public would be confirmed during Tier 2 to verify the preserve does not qualify for Section 4(f) protection. Woodland Parkway, a linear park in downtown Phoenix, is currently closed; however, its status would also be confirmed during Tier 2.

Papago Park and Papago Municipal Golf Course have Section 6(f) status. Identifying and acquiring replacement properties that would be equally useful to such significant local recreational resources could prove problematic and financially infeasible, so avoidance may be required. Ultimately, given the wide distribution of Section 6(f) resources along this segment it is likely that a future alignment could result in Section 6(f) impacts requiring the identification and acquisition of replacement property.

Operational Impacts

During the agency scoping process, NPS requested consulting party status under Section 106 of the National Historic Preservation Act based on the potential for adverse impacts to Casa Grande National Monument resources (see the letter appended to the Scoping Report in the *Public and Agency Coordination Appendix*). Primary issues of concern for NPS are impacts to cultural and natural resources, viewsheds, and natural soundscapes within the monument boundary. Particularly, NPS is concerned about the potential for vibrations from rail traffic to affect the Great House and impacts to cultural and natural resources in areas considered for expansion of the monument boundary. In June 2013, US Representative Ann Kirkpatrick from Arizona introduced a bill (HR 2497) to expand the monument by 10 acres, based on a 2003 NPS study of additional prehistoric sites in the area. The boundary expansion would likely be a screening criterion for future alternatives, and the boundaries should be confirmed during Tier 2. Close coordination with NPS would continue during Tier 2 to avoid the monument and to determine a sufficient buffer between the rail line and monument boundary.

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis. Baseline noise levels, particularly in areas along Sky Harbor flight paths, should be considered as part of the constructive use evaluation when assessing noise impacts to parks along the Salt River in Mesa and Tempe.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts would be the same as those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Eloy to Northern Hub

Physical Impacts

Physical impacts to Section 4(f) resources would constitute a direct use if the resource or portion of the resource is permanently incorporated into the rail line. Applying the 0.359 multiplier for a ROW corridor as explained in **Section 5.1.2**, this segment could hypothetically include approximately 5 Section 6(f) resources, 1 refuge, 26 public parks and recreational resources, 29 private and public historic properties, and 16 schools with potentially public recreational resources, based on Tables F-1 through F-5 in the *Section 4(f) and 6(f) Resources Appendix*. Many of these resources are densely clustered across the Orange Corridor Alternative in Florence, Mesa, Tempe, and Phoenix; and multiple trails traverse the corridor alternative. Therefore, substantial Section 4(f) impacts can be anticipated from any future alignment in the Orange Corridor Alternative.

Woodland Parkway, a linear park in downtown Phoenix, is currently closed; however, its status would be confirmed during Tier 2 analysis.

Riverview Softball Complex, Papago Park, and Papago Municipal Golf Course would likely require avoidance because of their Section 6(f) status. Identifying and acquiring replacement properties that would be equally useful to such significant local recreational resources could prove problematic and financially infeasible. Ultimately, given the wide distribution of Section 6(f) resources along this segment, it is likely that a future alignment could result in Section 6(f) impacts requiring the identification and acquisition of replacement property.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

No Build Alternative

Under the No Build Alternative, construction would not occur, and no impacts to Section 4(f) and 6(f) resources would be anticipated beyond those that could occur due to other, reasonably foreseeable projects. A passenger rail line would not operate within either of the corridor alternatives.

5.7.4 Potential Mitigation Measures

In conjunction with the Tier 2 NEPA documents, Section 4(f) resources would be confirmed within 0.25 mile of the project footprint. Additionally, the project team would evaluate the design to determine where it is possible and practical to avoid or minimize impacts.

Unless exceptions for *de minimis* impact findings are applicable, a feasible and prudent alternative that avoids resources protected under Section 4(f) must be selected. If two or more alternatives affect Section 4(f) lands, the one causing the least relative harm to Section 4(f) resources must be selected.

Where impacts on Section 4(f) resources cannot be avoided, all possible planning must be completed to minimize impacts. Minimization of harm includes both alternative design that lessens the impact on Section 4(f) resources and mitigation measures that compensate for residual impacts. Minimization and mitigation measures should be determined through consultation with the official(s) having jurisdiction over the resource. Potential mitigation measures for recreational resources could include replacement of equipment and facilities in another location within existing parkland, purchase of similar properties, and/or construction outreach or other public involvement to apprise the public of access changes or temporary use restrictions. Measures to minimize harm to historic resources and cultural resources warranting preservation in place would be identified through the National Historic Preservation Act Section 106 process.

Section 6(f) lands would be avoided to the extent practicable. If LWCF lands cannot be avoided, the land proposed to be taken must be replaced in kind with a replacement property of at least equal fair market value and of reasonably equivalent usefulness for recreation purposes. Any conversion would have to be approved by Arizona State Parks and NPS.

Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known; recorded in NEPA documents as specific impacts are identified; and implemented prior to and, as appropriate for temporary occupancy determinations, during construction.

5.7.5 Tier 2 Considerations

It is important to note that the data limitations of this Tier 1 EIS would require additional confirmation and/or data gathering during subsequent tiers, mostly likely as part of coordinating with the official(s) with jurisdiction over Section 4(f) resources. Because the future alignments could be located anywhere in the corridor alternatives, the specific alignments would need to be reviewed in Tier 2 for potential impacts to Section 4(f) and Section 6(f) resources and potential constructive use to affect properties beyond the alignments.

Potential refuges based on species protection would need to be confirmed during Tier 2. Trails would be protected by Section 4(f) only if they traverse publicly owned property and if they are open to public use; verification of the land ownership of the trails listed in Table F-3, *Parks and Recreation Areas in the Study Corridors,* in the *Section 4(f) and 6(f) Resources Appendix* would be required during Tier 2 studies. Additional elements that would need to be evaluated and/or confirmed in Tier 2 studies include:

- Land ownership of affected trail segments
- Whether affected school recreational facilities meet the criteria for protection under Section 4(f)
- The ownership status and availability for public use of parks in master-planned developments and residential areas
- Whether affected historic properties are eligible for protection under Section 4(f)
- Boundary expansion status of Casa Grande National Monument and, in coordination with NPS, a sufficient buffer between the rail line and monument boundary
- Public availability of the Riparian Preserve at Neely Ranch bird sanctuary
- Closure status of Woodland Parkway, a linear park in downtown Phoenix

Activities having the potential to affect public parks, recreational resources, and natural areas include upgrading existing and building new rail infrastructure and constructing new passenger stations. Impacts could take the form of physical modifications to the land or the effects of increased noise levels and visibility. Specific types and degrees of impacts on individual resources (such as ROW acquisition and impacts on characteristics of a resource) would not be known until further design of rail facilities takes place and would be evaluated in Tier 2 NEPA documents.

5.8 Air Quality

An air quality assessment was conducted to identify potential changes in vehicle emissions as a result of implementing passenger rail service from Tucson to Phoenix, compared to the No Build Alternative. A passenger rail system within the corridor alternatives would primarily be beneficial to air quality and would be expected to contribute to the region's long-term attainment of air quality goals by reducing vehicle miles traveled, which in turn would reduce vehicle emissions. Since this study was conducted at a Tier 1 level and because the passenger rail system would primarily result in beneficial air quality effects, the following analysis is only qualitative and does not include a detailed quantitative evaluation of project-level air quality emissions.

5.8.1 Methodology and Regulatory Requirements

This EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA's Environmental Impact and Related Procedures (23 CFR Part 771). Potential impacts on air quality were evaluated in accordance with FRA's Procedures for Considering Environmental Impacts, Section 14(n)(1) (FRA 1999a).

Federal

The Clean Air Act (CAA) of 1970, which was amended in 1990, is the federal law that governs air quality. EPA is responsible for establishing national ambient air quality standards (NAAQS) for the following six criteria pollutants: carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), coarse and fine particulate matter (less than or equal to 10 microns [PM_{10}] and less than or equal to 2.5 microns [$PM_{2.5}$], respectively), and lead (Pb). The state of Arizona has adopted the NAAQS for these criteria pollutants, which are summarized in **Table 5-7**. Refer to **Section 5.17**, Energy Use and Climate Change, for a discussion on greenhouse gases.

Geographic areas that violate a NAAQS for a particular criteria pollutant are considered "nonattainment" areas for that pollutant. Conversely, areas that are below a criteria pollutant standard are considered "attainment" areas. Maintenance areas are defined as having previously violated the NAAQS for a criteria pollutant (nonattainment) but are currently attaining that standard. Maintenance areas are required to develop a maintenance plan outlining steps for continued attainment over the maintenance period.

In addition to the NAAQS for criteria air pollutants, EPA also regulates air toxics under section 202 of the CAA. Mobile source air toxics (MSATs) are a subset of the 188 air toxics (pollutants known or suspected to cause cancer) defined by the CAA. MSATs denote compounds emitted from on-road mobile sources (vehicles), non-road mobile sources (such as airplanes and locomotives), and stationary sources (such as factories and refineries). In 2001, EPA issued a Final Rule (66 FR 17230) on controlling emissions of hazardous air pollutants. General information regarding emissions of MSATs is included in the *Air Quality Appendix.*

Clean Air Act Conformity

The corridor alternatives would require approval by FRA under the General Conformity requirements; however, if the corridor alternatives were to be funded or require approval under Title 23 U.S.C. or the Federal Transit Act, 49 U.S.C § 1601 *et seq.*, then Transportation Conformity requirements would also apply, requiring an analysis of criteria pollutant concentrations and comparison to the NAAQS.

FRA, as lead agency, in coordination with EPA, must make a determination that a federal action conforms to the applicable state air quality implementation plan to achieve attainment of the NAAQS. In general, conformity rules are designed to ensure that projects using federal funds or requiring federal approval would not:

- Cause or contribute to any new violation of a NAAQS
- Increase the frequency or severity of any existing violation
- Delay the timely attainment of any standard, interim emission reduction, or other milestone

Table 5-7. National Ambient Air Quality Standards for Criteria Pollutants

Pollutant/Averaging Time	Primary Standard[a]	Secondary Standard[a]
Carbon monoxide (CO)		
8-hour	9 ppm[b]	--
1-hour	35ppm	--
Lead (Pb)		
Rolling 3-Month Average[c]	0.15 µg/m^3	0.15 µg/m^3
Nitrogen dioxide (NO_2)		
1-hour	100 ppb	--
Annual Arithmetic Mean[d]	53 ppb	53 ppb
Ozone (O_3)		
8-hour[e]	0.075ppm	0.075ppm
Particulate matter less than 2.5 microns ($PM_{2.5}$)		
Annual	12 µg/m^3	15 µg/m^3
24-hour	35 µg/m^3	35 µg/m^3
Particulate matter less than 10 microns (PM_{10})		
24-hour	150 µg/m^3	150 µg/m^3

Table 5-7. National Ambient Air Quality Standards for Criteria Pollutants

Pollutant/Averaging Time	Primary Standard[a]	Secondary Standard[a]
Sulfur dioxide (SO_2)		
1-hour[f]	75 ppb	--
3-hour	--	0.5 ppm

Source: EPA 2013a.

Notes: ppm = parts per million; µg/m³= micrograms per cubic meter; ppb = parts per billion

[a] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment and damage to animals, crops, vegetation, and buildings.

[b] Due to mathematical rounding, a measured value of 9.5 ppm or greater is necessary to exceed the standard.

[c] Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m³ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, where the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

[d] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

[e] Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

[f] Final rule signed June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking; however, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Under the General Conformity rule (CAA Section 176[c][4]), determinations are made based on *de minimis* levels. These *de minimis* levels can be found in 40 CFR 93.153(b) and vary according to the type of pollutant and severity of the nonattainment area. **Table 5-8** summarizes pollutant *de minimis* levels. These levels were established to focus on those federal actions likely to have a significant effect on air quality. If the emissions of a future passenger rail system within one of the corridor alternatives are projected to be below the *de minimis* levels, then it is assumed the project would not result in any significant air quality impacts and no further analysis would be required. Conversely, if a future passenger rail system's emissions exceeded *de minimis* levels, then the project would require a conformity determination requiring a "hot-spot" analysis of criteria pollutants relative to the NAAQS. The federal lead agency would be able to make changes to the design of the project to reduce emissions below *de minimis* levels to achieve a General Conformity determination required by FRA and, if receiving funding from FTA, meet FTA's Transportation Conformity requirements, i.e., ensure that the project would not cause new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS

Table 5-8. *De Minimis* Levels by Type of Pollutant

Criteria Pollutant	Tons/Year	
	Nonattainment Area	Maintenance Area
Ozone (volatile organic compounds or nitrogen oxides)	50 (serious) 25 (severe) 10 (extreme)	100
Ozone (inside transport region – volatile organic compounds)	50	50
Ozone (inside transport region - nitrogen oxides)	100 (marginal and moderate)	100
Ozone (outside transport region)	100	100
Carbon Monoxide	100	100
PM_{10}	70 (serious) 100 (moderate)	100
$PM_{2.5}$	100	100
Lead (Pb)	25	25
Source: EPA 2015		

State and Local

The corridor alternatives are under the jurisdiction of ADEQ, CAG, PAG, Pima County Department of Environmental Quality, Pinal County Air Quality Control District (PCAQCD), and Maricopa County Air Quality Department. These agencies regulate air pollution and operate air monitors throughout the state.

A transportation project implemented pursuant to this study would need to adhere to the following:

- ADEQ, Title 18. Environmental Quality, Chapter 2 – Air Pollution Control
- Arizona Statutes, Title 49. The Environment, Chapter 3 – Air Quality
- Pima County, Title 17. Air Quality Control
- Pinal County, Article 2. Fugitive Dust
- PCAQCD Code of Regulations
- Maricopa County rules concerning fugitive dust, the federal hazardous air pollutants program, and the Maricopa County hazardous air pollutants program

5.8.2 Existing Conditions

The corridor alternatives are located in portions of Pima, Pinal, and Maricopa counties. With regard to air quality, areas within counties can be classified as nonattainment, attainment, maintenance, or unclassified. **Table 5-9** summarizes the status of those areas traversed by the corridor alternatives.

Table 5-9. Attainment Status within the Corridor Alternatives

Criteria Pollutant	County	Areas	Status
Ozone 8-hr	Pinal	Phoenix-Mesa	Nonattainment
	Maricopa	Phoenix-Mesa	Nonattainment
Carbon Monoxide	Pima	Tucson	Maintenance
	Maricopa	Phoenix	Maintenance
Particulate Matter less than 10 microns in diameter (PM_{10})	Pima	Rillito	Nonattainment
	Pinal	Phoenix, West Pinal	Nonattainment
	Maricopa	Phoenix	Nonattainment
Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$)	Pinal	West Central Pinal	Nonattainment
Source: EPA 2013a			

ADEQ and local air districts maintain a statewide network of monitoring stations that routinely measure pollutant concentrations in the ambient air. These stations provide data to assess compliance with the NAAQS and to evaluate the effectiveness of pollution control strategies. Table A-1 in the *Air Quality Appendix* summarizes the ambient air quality conditions at monitoring stations nearest to the corridor alternatives.

The elevation of the corridor alternatives ranges from approximately 2,500 feet above sea level (amsl) near Tucson to approximately 1,000 feet amsl near Phoenix; and they are located in a desert climate characterized by extremely hot summers, mild winters, and minimal precipitation. Average daily maximum temperatures during the summer in Tucson and Phoenix are in the low 100s (degrees Fahrenheit [°F]). In Phoenix, the average minimum daily temperature during the winter is in the mid 40s (°F); however, Tucson experiences cooler temperatures in the winter, ranging from the high 30s to low 40s (°F). In addition, Tucson receives more precipitation than Phoenix, with an average of 10 inches compared to 6.5 inches per year, respectively. This precipitation is in the form of rain; snowfall is rare. In addition, this precipitation is associated with afternoon showers or thunderstorms during the late summer and storms that originate in the Pacific Ocean in the winter and move eastward through the corridor alternatives.

Fugitive Dust

Fugitive dust is particulate matter from unstable or disturbed soil surfaces that becomes airborne due to mechanical disturbance and has the potential to adversely affect human health or the environment. The most common forms of particulate matter are known as PM_{10} and $PM_{2.5}$. Fugitive dust originates from agricultural, mining, construction, and manufacturing activities, among others. This study is concerned mostly with fugitive dust generated from construction activities such as earth moving, paved road trackout, driving on haul roads, and disturbing surface areas, since such activities would likely be required during construction of a future passenger rail system.

Class I Areas

Rail service contributes to visibility concerns in nonattainment and maintenance areas through primary $PM_{2.5}$, SO_2, and nitrogen oxide diesel emissions, which contribute to the formation of secondary $PM_{2.5}$.

Under the provisions of the CAA, EPA has designated a number of areas in the state of Arizona, including national parks and wilderness areas, as mandatory Class I Areas where visibility is an important value. These mandatory Class I areas are listed in 40 CFR 81.403. Under the EPA Regional Haze Rule, states must establish goals to improve visibility in Class I areas and develop long-term strategies to reduce emissions of air pollutants that cause visibility impairment. These goals are outlined in the state implementation plans.

Of the mandatory Class I areas in Arizona, Saguaro National Park and the Superstition Wilderness are the closest to the corridor alternatives. The nearest boundary of the Saguaro National Park is approximately 1.5 miles west of the Orange and Yellow corridor alternatives near Tucson (see Figure A-1 in the *Air Quality Appendix*). The nearest boundary of the Superstition Wilderness area is approximately 10 miles east to northeast of the Orange Corridor Alternative near Mesa.

5.8.3 Environmental Consequences

Corridor Alternatives

The following assessment would apply to both the Yellow and Orange corridor alternatives.

Physical Impacts

While construction and operation could result in air quality impacts, the tracks, rail stations, and associated infrastructure itself would not result in air emissions Therefore, the physical infrastructure associated with a passenger rail system would not be expected to affect air quality.

Operational Impacts

Local air quality effects of a passenger rail system within either of the corridor alternatives are not expected to be adverse because implementation is expected to increase transit ridership within the corridors, which could reduce vehicle miles traveled (VMT). Because overall automobile congestion and VMT could be reduced, associated emissions could also be reduced. The forecasting model indicates that implementation of a passenger rail system within the corridor alternative with the higher ridership is expected to result in a greater reduction in VMT and air pollutant emissions. A quantitative air quality analysis would be performed during Tier 2 analysis to determine air pollutant effects from a future passenger rail system operating on a specific alignment.

It is possible that locations adjacent to station-related commuter parking lots could experience increases in localized pollutant concentrations, since traffic would now be concentrated in these areas. As a result, a quantitative air quality analysis would be undertaken at representative locations during the Tier 2 NEPA process.

Implementation of a passenger rail system within either of the corridor alternatives is not expected to have any measurable air quality effects on Federal Class I areas, including the Saguaro National Park and Superstition Wilderness; however, since the nearest boundary of the Saguaro National Park is approximately 1.5 miles west of the study corridors near Tucson, further analysis to assess visibility concerns, such as regional haze, may be required during Tier 2.

Construction Impacts

Temporary construction emissions are expected from implementation of a passenger rail system within either the Orange or the Yellow corridor alternatives; however, pollutant emissions would vary daily depending on the level of activity, specific operations, and prevailing weather. These potential effects would be addressed during Tier 2 studies.

Temporary dust emissions would also be expected from construction activities; however, fugitive dust generated from construction activities would be controlled in accordance with the *Arizona Department of Transportation Standard Specifications for Road and Bridge Construction* (2008) and local rules or ordinances. An activity permit for construction in Pima County would be required from the Pima County Department of Environmental Quality under Title 17 of the Pima County Code, and a dust permit would be required from PCAQCD. Any portion of a transportation project implemented pursuant to this study in Maricopa County would also be subject to the Maricopa County Rule 310 (fugitive dust).

No Build Alternative

Under the No Build Alternative, a new passenger rail system would not be built, and impacts on air quality are not anticipated beyond those that could occur due to other approved projects. The No Build Alternative assumes completion of those reasonably foreseeable transportation, development, and infrastructure projects that are already in progress; are programmed; or are included in the fiscally constrained Regional Transportation Plan or State Transportation Improvement Program. Under the No Build Alternative, planned transportation and transit maintenance, modifications, and additions would occur; but a passenger rail system between Tucson and Phoenix would not be built. An increase in traffic and VMT is expected with the No Build Alternative because more cars would be on the roadways compared to what would occur with implementation of passenger rail service along a future alignment. Therefore, traffic congestion is likely to worsen with the No Build Alternative, resulting in adverse air quality impacts.

5.8.4 Potential Mitigation Measures

Air quality modeling may be required for the Tier 2 NEPA document to quantify potential emissions for alternatives studied in detail. Mitigation measures would also be identified at that time for any potential air quality effects. In addition, temporary construction effects may be quantified, and temporary control measures would be recommended. Typical construction mitigation measures include:

- Minimize idling time to save fuel and reduce emissions.
- Use the cleanest fuels available at the time for construction equipment and vehicles to reduce exhaust emissions.
- Keep construction equipment well maintained to ensure that exhaust systems are in good working order.
- Control fugitive dust through a fugitive dust control plan, including watering disturbed areas.
- To minimize wind-blown dust from blasting, particularly near community areas, control blasting and avoid blasting on days with high winds.
- Develop a traffic plan to minimize traffic flow interference from construction equipment movement and activities.

5.8.5 Tier 2 Considerations

If a future passenger rail project receives funding from FTA, it would require a Transportation Conformity analysis due to the nonattainment status of the areas surrounding the corridor alternatives. During Tier 2 NEPA analysis, a detailed air quality analysis would be conducted once a future alignment or alternative alignments have been selected and station layout designs have been advanced for further environmental evaluation. The passenger rail system would need to conform to the NAAQS before it is implemented, requiring an assessment of rail vehicle emissions within the region. Modeling of CO and PM emissions would be conducted during Tier 2 to determine potential local air quality effects from the future construction and operation of a passenger rail system. While general information regarding emissions of MSATs is included in the *Air Quality Appendix*, Tier 2 would likely entail quantifying MSAT emissions.

The potential effects of project-related motor vehicle emissions on local roadways in the vicinity of stations would be assessed at Tier 2. Detailed mitigation measures would also be developed and refined during Tier 2. Emissions of $PM_{2.5}$ and nitrogen oxides (NOx) from diesel locomotive engines currently contribute to the nonattainment of the NAAQS for $PM_{2.5}$ and ozone. EPA has established emission standards for these pollutants for newly manufactured and remanufactured locomotives (see 73 FR 25098, Locomotive and Commercial Marine Rule). EPA is projecting that $PM_{2.5}$ and NOx emissions will drop as a result of these standards. For any future alignment selected, the amount of MSATs emitted would be proportional to the resulting VMTs, assuming that other variables, such as fleet mix, are the same for each corridor.

5.9 Noise and Vibration

Sound is created when an object vibrates and radiates part of its energy as acoustic pressure or waves through a medium, such as air, water, or a solid object. Noise is generally defined as any loud or undesired sound. Noise is measured in terms of sound pressure and is expressed in decibels (dB). Since the human ear does not respond equally to all frequencies (or pitches), measured noise levels (in dB at standard frequency bands) are often adjusted or weighted to correspond to the frequency of human hearing and the human perception of loudness. The weighted noise level is designated as the A-weighted noise level in decibels (dBA).

Noise levels that correlate with human perception are expressed in such descriptors as L_{eq}, L_{dn}, and L_{max}. While sound levels often change over time, L_{eq} (or equivalent noise level) is the "equivalent" constant sound level in dBA, which, in a given situation and time period, has the same sound energy as does the fluctuating sound level over the same time period. One-hour equivalent noise levels measured every hour over a continuous 24-hour period are sometimes used to calculate a composite 24-hour noise exposure measure called the day-night noise level (L_{dn}), which adds 10 dBA to nighttime levels between the hours of 10:00 p.m. and 7:00 a.m. to account for the increased noise-sensitivity of people during sleeping hours. L_{max} is the maximum pass-by sound level.

Use of L_{eq} and L_{dn} is appropriate for transportation noise analysis because these levels are sensitive to both the frequency of occurrence and duration of noise events, including freight and commuter rail operations that may be characterized by infrequent noise. Typical L_{dn} noise levels range from 50 to 80 dBA for non-transit background sources and 55 to 75 dBA for transit sources.

The ability of an average individual to perceive changes in noise levels is well documented. Generally, changes in noise levels of 3 dBA would be barely perceived by most listeners, whereas a 10-dBA change normally is perceived as a doubling of noise levels. Typical sound levels experienced by people range from about 40 dBA, the daytime level in a typical quiet living room, to 85 dBA, the approximate level near the sidewalk adjacent to heavy traffic.

In addition to airborne noise, the operation of transportation facilities is a potential source of ground-borne vibration (GBV). GBV is defined as rapid fluctuating motions through the ground. In contrast to airborne noise, GBV is not a phenomenon experienced by most people on a daily basis. Ground-borne noise (GBN) results from the vibration of the floors, walls, etc. of buildings affected by GBV. Vibration is measured in terms of root-mean-squared velocity levels in decibels, with the abbreviation VdB used to distinguish it from airborne noise. A typical background vibration velocity level in residential areas is 50 VdB or lower, well below the threshold of perception for humans, which is around 65 VdB. Typical outdoor sources of perceptible GBV are construction equipment, steel-wheeled trains, and traffic on rough roads.

This analysis evaluates airborne noise, GBV, and GBN of a passenger rail system consistent with federal guidance for Tier 1 studies. Noise and vibration receptors—or locations potentially affected by airborne noise, GBV, and GBN—include residences, businesses, parks, schools, recreation areas, churches, libraries, and hospitals.

5.9.1 Methodology and Regulatory Requirements

Noise and Vibration Impact Standards

Title 49 CFR Part 210 contains the Railroad Noise Emission Compliance Regulations implemented by FRA to comply with USEPA Noise Emission Standards for Interstate Rail Carriers. FRA has established criteria for noise and vibration impacts that are identical to those established by FTA, which first published the “Transit Noise and Vibration Impact Assessment” guidance document in 1995 with subsequent revisions (FTA 2006).

The FTA/FRA noise criteria are based on a comparison of the noise generated by a transit (or rail) system with the outdoor ambient noise from other sources in the community. They incorporate both absolute criteria, which consider annoyance due to noise generated by the system alone, and relative criteria, which consider annoyance from the change in the surrounding noise environment caused by the system. The criteria are used to evaluate noise impacts on the basis of cumulative, A-weighted noise exposure, in terms of either L_{eq} or L_{dn}. L_{dn} is applied to residences and other buildings where people normally sleep; and L_{eq} is applied to all other noise-sensitive land use categories, such as churches, other institutions, and quiet offices. The FTA/FRA noise impact criteria are established by two curves, representing severe and moderate noise impacts as shown on **Figure 5-9**. In its guidance document, *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, FRA (2012) adopts vibration impact criteria established by FTA (FTA 2006). Impact criteria are defined by three land use categories which vary slightly from those considered for noise impacts. The categories are defined as follows:

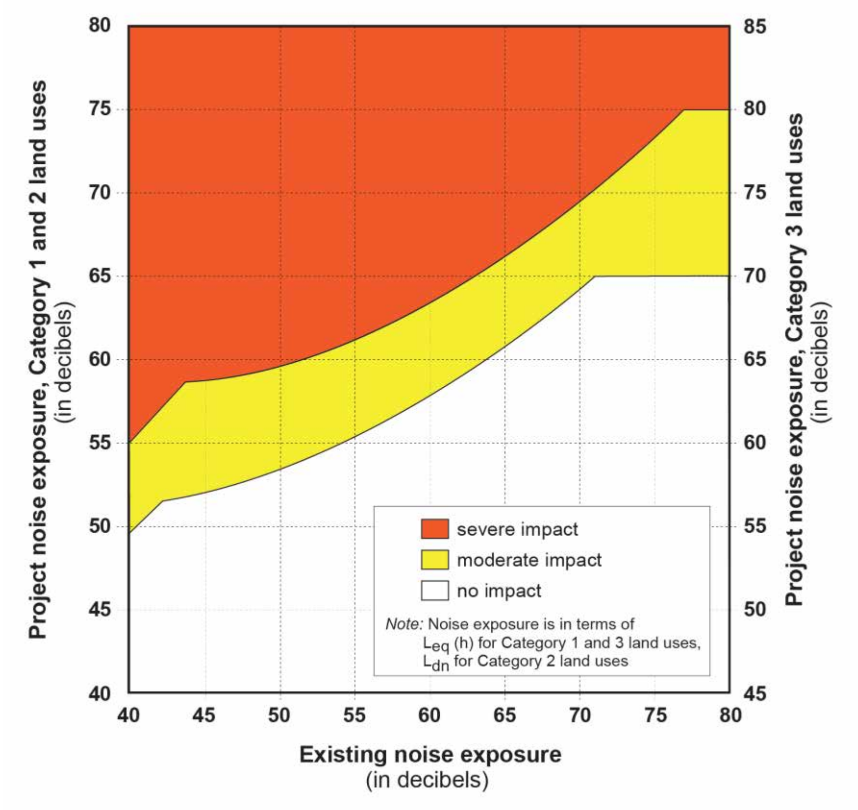
<u>Vibration Category 1 – High Sensitivity</u>: Buildings where vibration would interfere with the operations taking place there, including levels well below those of normal human annoyance. These include vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations.

<u>Moderate Impact</u>: The threshold at which the percentage of people highly annoyed by noise related to the proposed action becomes measurable. The magnitude of the proposed action's impact and need for mitigation depends upon other factors such as existing noise levels, the predicted future increase in noise levels, and the types and number of land uses affected.

<u>Severe Impact</u>: The threshold at which the percentage of people highly annoyed by the proposed action's noise increases substantially. Noise mitigation must be considered if it is not practical to change the location of the proposed project, unless extenuating circumstances prevent the incorporation of mitigation measures into the proposed project (i.e., a practical mitigation method does not exist).

Exposure to potential future project noise impacts is determined by three land use categories identified by the FTA/FRA. Category 3 land uses comprise institutional activities such as schools, libraries, and churches. Category 2 land uses include residential areas; and Category 1 land uses include amphitheaters, concert pavilions, and National Historic Landmarks. Taken from the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (FTA 2006),

Figure 5-9. FTA/FRA Noise Impact Criteria



Source: FTA 2006

Figure 5-9 illustrates the “moderate” and “severe” noise impact criteria curves and their relationship to each land category and existing ambient noise levels (without the potential future project). The figure illustrates that persons in a Category 1 or 2 setting would be affected by the introduction of future project-related noise at a lower day-night average decibel level than persons in a Category 3 setting. Additionally, the figure shows that persons who have habituated to louder background noise levels are more tolerant of increases from an added source of noise.

The criteria for acceptable ground-borne vibration are measured in VdB micro-inches of movement per second, and the criteria for acceptable ground-borne noise are measured in dBA micro Pascals of pressure. **Table 5-10** identifies the relevant impact criteria for each land use category.

Table 5-10. Groundborne Vibration and Groundborne Noise Impact Criteria

Land Use Category	GBV Impact Levels VdB (1 micro-inch/sec)			GBN Impact Levels dBA (20 micro Pascals)		
	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]	Frequent Events[a]	Occasional Events[b]	Infrequent Events[c]
Category 1: Buildings where vibration would interfere with interior operations	65[d]	65[d]	65[d]	N/A[e]	N/A[e]	N/A[e]
Category 2: Residences and buildings where people normally sleep	72	75	80	35	38	43
Category 3: Institutional land uses with primarily daytime use	75	78	83	40	43	48

Source: *Transit Noise and Vibration Impact Assessment* (FTA 2006)

Notes:

[a] "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit (e.g., light rail) projects fall into this category.

[b] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines (e.g., railroads carrying more than one line) have this many operations.

[c] "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines (e.g., shorter distance railroads branching off a trunk line**)**.

[d] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research **activities** would require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

[e] Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

General Assessment Methodology

For this Tier 1 EIS, a general assessment for noise and vibration impacts is an appropriate level of analysis for choosing among corridor alternatives (FRA 2012). Completion of a general noise and vibration assessment per FRA/FTA guidelines requires information more appropriate for a Tier 2 analysis, such as the identification of a rail alignment as well as vehicle types (train engines and number of cars), train schedules and speeds, and the location of future grade crossings, to provide a level of detail for determining potential project impacts. The corridor alternatives for this Tier 1 EIS have been defined without specific alignment, operational, and vehicle parameters; therefore, only the basic noise and vibration screening and impact assessment guidelines have been applied to draw distinctions between the No Build Alternative and corridor alternatives.

The assessment of the affected environment considered the mile-wide corridor alternatives but was based on a hypothetical representative alignment to provide a more valuable and useful result, where propagated noise effects would not extend beyond the corridor; in Tier 2 studies, an analysis area extending beyond the corridor may need to be considered, depending on the position of the alignment within the corridor, to account for rail system noise such as warning horns.

Noise Methodology

The FRA and FTA general noise assessment guidance outlines procedures for establishing study boundaries through a screening process, estimating noise levels within the boundaries under current and future conditions, determining the maximum distance to potential impacts, tabulating the number of noise-sensitive areas affected, and estimating the achievable noise reduction through mitigation measures. For this Tier 1 analysis, only the screening process and estimates of noise levels based on existing facilities and land use density have been applied in the analysis of potential noise impacts associated with each corridor alternative. The noise screening is designed to identify locations where noise impacts may occur, including where horns and warning bells may be heard. The analysis focuses on Category 2 (residential) land uses as defined by FTA/FRA, which include places where people sleep. This approach was approved by FRA for the Chicago to Council Bluffs-Omaha Regional Passenger Rail System Planning Study Tier 1 EIS (FRA 2013b).

The Tier 1 noise analysis examined the Yellow Corridor Alternative, the Orange Corridor Alternative, and a No Build Alternative. In order to conduct a noise analysis within the mile-wide corridor alternatives, hypothetical representative alignments were chosen within each corridor alternative to show a general order of magnitude of noise impacts. The data gathered for these hypothetical alignments, and the findings of this Tier 1 analysis, may not be relevant to a different alignment within the corridor alternatives evaluated during Tier 2.

Potential future commuter and intercity rail operations from the Alternatives Analysis (AA) as required by the FTA, evaluated future UP train operations (where the hypothetical alignments coincide with the UP line) to establish a hypothetical level of train frequency and activity for the noise analysis.

The AA is found in the *Alternatives Analysis Appendix*. Three levels of evaluation and criteria used in the AA were designed to compare alternatives using a common measure and advance the most feasible alternatives for further study at the next level, consistent with the objectives of the FRA Tier 1 EIS process and FTA AA process.

FRA guidance establishes screening distances that are more appropriately applied to trains, which generally operate over longer distances with less frequent stops than a commuter rail line; therefore, FTA guidelines were applied.

For commuter rail, FTA has determined a screening distance of between 375 and 750 feet for the rail mainline (wayside), depending on the presence of intervening buildings, and between 1,200 and 1,600 feet for at-grade crossings where the sounding of a horn per FRA "Horns Rule" (49 CFR 222 and 229) would occur.

Screening distances of 750 feet for potential wayside impacts and 1,800 feet for at-grade crossings were selected as a worst-case scenario based on a hypothetical daily operation of 26 commuter and 10 intercity trains for a passenger rail system within each corridor alternative (Parsons Brinckerhoff 2013). Where portions of the corridor alternatives are in areas with few physical barriers to block train noise, the 1,800-foot screen distance for at-grade crossings was used for a more conservative analysis of potential effects.

The FRA and FTA guidance documents also provide methods for calculating noise impact contours for a general assessment as well as an alternate method of determining contours to define moderate and severe impacts of potential projects using spreadsheet models developed by both agencies. Both methods described in the guidance documents are more appropriate for a Tier 2, project-level analysis. For this Tier 1 analysis, each alternative was evaluated for its potential (with development of a passenger rail system) to substantially increase noise above ambient levels, which were estimated, per FTA guidance, based on land use density and existing noise sources (trains, highways, airports, etc.) within the identified screening distances.

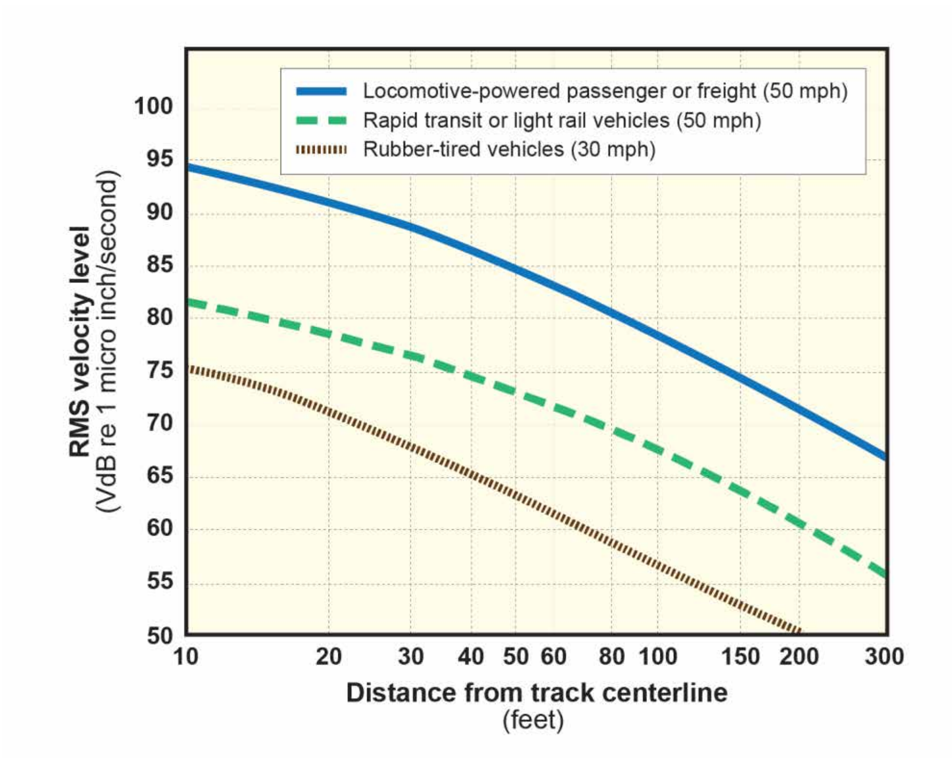
Vibration Methodology

The FRA and FTA guidance documents also outline procedures for conducting a general vibration assessment. A general vibration assessment also begins with screening. Screening distances vary depending on project type and selection of one or more land use categories listed in **Table 5-10** taken from the FTA guidance manual (FTA 2006). For a conventional commuter rail line, an appropriate screening distance for land uses of the type examined in this study, Category 2 (residences, hotels, hospitals), is 200 feet. If vibration-sensitive land uses exist within the screening distance, a general vibration assessment is performed. A screening distance of 320 feet was selected from the representative alignment as a worst-case scenario, based on hypothetical daily commuter and intercity operations used in the AA.

The general level of assessment extends from the screening procedure. FTA and FRA have developed a general curve of vibration level as a function of distance from the track, based on field measurements completed along rail corridors, shown in **Figure 5-10** (FTA 2006; FRA 2012).

Identical to the noise analysis, the vibration analysis examined the Yellow and Orange corridor alternatives and a No Build Alternative. The general vibration assessment focuses on Category 2 land uses, including places where people sleep. For the purposes of the Tier 1 evaluation, the appropriate GBV impact criteria shown in **Table 5-10** were selected for this land use category; and hypothetical train frequencies were taken from the AA (Parsons Brinckerhoff 2013).

Figure 5-10. Vibration Level per Distance from Track Centerline



Source: FTA 2006

As noted in **Table 5-10**, frequent vibration events are defined as 70 or more trains daily, occasionally between 30 and 70 trains daily, and infrequently less than 30 trains daily. Per FTA guidance, GBN levels were estimated assuming a 35-dB correction for typical GBV frequencies from the corresponding impact VdB level. These GBV and GBN levels provide an indication of potential vibration impacts for Category 2 land uses located within the identified screening distance.

Documenting the number and location of each type of sensitive land use is better suited for a Tier 2 analysis, but this Tier 1 analysis uses a representative alignment to estimate an order of magnitude of the potential impacts. Because Category 2 land uses are far more predominant in the corridor alternatives than Category 1 and 3 land uses, the comparison of alternatives for this Tier 1 analysis focuses on existing Category 2 land uses and areas zoned for residences and buildings where people sleep. The number of Category 2 land uses was estimated based on zoned acreage for residential, medical nursing/home, and motel/hotel/resort uses multiplied by the average number of dwelling units per acre reported in the GIS database or estimated from county zoning district guidelines. Zoned acreage was provided by PAG, CAG, and MAG. Category 2 land uses are zoned for different densities of development, as shown in **Table 5-11**. The zoned acreage was weighted to account for the appropriate development density allowed in a given area. The assessment does not account for residences that may be unoccupied or areas less developed than the zoned allowances. The assessment also assumes that zoned residential areas would be developed, which may or may not occur. Consequently, the actual number of potential Category 2 properties (or receptors sensitive to noise or vibrations) may be overestimated but provides for a standard method of comparison. By using the same approach to estimate the number of Category 2 land uses, the number of noise-sensitive and vibration-sensitive land uses within each corridor is the same.

Table 5-11. Zoned Acreage Data for Category 2 Land Uses

Land Use Descriptor	Square Footage Range[1]	Dwelling Units per Acre
Rural residential (SF)	21,7795 to 43,5590	0.13
Estate residential (SF)	43,559 to 217,795	0.33
Large lot residential (SF)	14,500 to 43,559	1.50
Single-family low density	43,559 to 70,000	0.77
Single-family (SF) medium density	10,000 to 43,559	2.00
Medium lot residential (SF)	10,000 to 18,000	3.00
Single-family high density	7,500 to 10,000	5.00
Developing residential	6,000 to 70,000	1.00
Small lot residential (SF)	6,000 to 8,000	6.00
Very small lot residential (SF)	6,000	7.00
Medium density residential (MF)	n/a	8.00
Mixed Use (MF)	n/a	10.00
Multi Family - Apartment/Condo	n/a	20.00
Residential (SF and MF)	n/a	9.00
Medical/Nursing Home	n/a	30.00
Motel/Hotel/Resort	n/a	40.00

Source: Maricopa County Planning and Development Department, *Maricopa County Zoning Ordinance*, July 2013.
Note: Zoned acreages shown are for Maricopa County, but Pima and Pinal counties use similar acreages for zone categories.

5.9.2 Existing Conditions

Land uses representing all three noise and vibration categories of impact are found within both the Yellow and Orange corridor alternatives, and portions of each corridor are undeveloped with no sensitive receptors.

Sensitive Land Uses

The number of Category 2 land uses within the mile-wide corridor alternatives was estimated based on zoned acreage for residential, medical nursing/home, and motel/hotel/resort uses multiplied by the average number of dwelling units per acre reported in the GIS database or estimated from county zoning district guidelines. Zoned acreage was provided by PAG, CAG, and MAG. **Table 5-12** shows the estimated number of FTA/FRA Category 2 land uses for each corridor alternative. To obtain an approximate number of potentially affected Category 2 land uses, an 1,800-foot buffer (the sensitivity distance adopted by FRA/FTA) was added to each side of a hypothetical rail line, and divided into the mile-wide corridor. For this analysis, an impact corridor of 3,600 feet (1,800 feet on each side of the rail line) was used to obtain the ratio for estimating the approximate number of land uses affected by rail noise, as explained on Page 5—3:

$$\frac{3{,}600' - \textit{wide impact corridor}}{5{,}280' - \textit{wide corridor alternative}} = 0.682$$

0.682 *x Land Uses in the mile-wide corridor = Land Uses in the 3,600-foot Sensitivity Area*

The representative numbers for a 3,600-foot corridor are listed in the column next to the GIS-derived totals for the mile-wide corridors:

Table 5-12. Noise and Vibration-Sensitive Land Uses within the Corridor Alternatives

Corridor Alternative	Number of FTA/FRA Category 2 Land Uses[a]	
	Mile-Wide Corridor	1,800-foot Sensitivity Area
Yellow Corridor Alternative	51,260	39,450
Orange Corridor Alternative	50,094	34,155

[a] The number of Category 2 land uses is estimated based on zoned residential densities.

Existing Transportation Facilities

Table 5-13 summarizes conceptual operational characteristics of rail operations based on the AA and information from cooperating agencies. Existing freight operations are a contributing factor to the existing noise and vibration environment. For freight train operations, the number of train trips shown is an average of the range listed in **Table 5-13.** Trips are apportioned between daytime (7 a.m. – 10 p.m.) and nighttime (10 p.m. – 7 a.m.) periods based on a 24-hourly average. These data and details about future commuter and intercity operations would be used to complete the general noise and vibration assessment for the Tier 2 analysis.

Table 5-13. Train Characteristics

Train Description	Assumed Engine Type	No. of Locomotives	No. of Train Cars	Maximum Speeds	Trains per Day	
					Phoenix to Eloy	Eloy to Tucson
Existing Freight[a]	Fossil Fuel	2	10	60 mph	5 - 10	26 - 60
Future Freight[a]	Fossil Fuel	2	10	80 mph	5 - 10	26 - 60
Commuter Rail[b]	Diesel-Electric DMU	1[c]	4	125 mph	26	
Intercity Rail[b]	Diesel-Electric DMU	1[c]	4	125 mph	10	

[a] Train data on existing Union Pacific Railroad provided by Arizona Department of Transportation Multimodal Planning Division.
[b] Commuter and Intercity rail data provided by Parsons Brinckerhoff (2013).
[c] Each passenger rail car has its own power so it can run individually or linked.

Existing Noise and Vibration Levels

As discussed in the methodology, existing noise levels were estimated based on FTA guidance, which imputes ambient noise levels based on development density descriptors and proximity to transportation noise sources such as roads, highways, and trains. **Table 5-14** lists reference ambient noise levels for four development densities and transportation noise sources that exist within the study corridor.

Table 5-14. Estimated Existing Noise Levels within the Corridor Alternatives

<table>
<tr><th>Development Density</th><th>Estimated Ambient Level (dBA)</th><th>UP</th><th>Highway[a]</th><th>Phoenix Sky Harbor Airport[b]</th><th>Phoenix Mesa Gateway Airport[c]</th></tr>
<tr><td>Rural (300-1,000 persons/square mile)</td><td>45</td><td rowspan="3">60 dBA</td><td rowspan="3">62 – 64 dBA</td><td rowspan="3">70 dBA</td><td rowspan="3">50 dBA</td></tr>
<tr><td>Suburban (1,000-3,000 persons/square mile)</td><td>50</td></tr>
<tr><td>Suburban/Urban (3,000-10,000 persons/square mile)</td><td>55</td></tr>
</table>

Table 5-14. Estimated Existing Noise Levels within the Corridor Alternatives

Urban (10,000+ persons/square mile)	60	

[a] Existing noise levels based on typical ambient mitigated noise levels for residential areas located near Arizona Department of Transportation facilities including I-10, US 60, SR 202L, SR 101L, and SR 143.
[b] Existing noise levels are based on noise contours for Phoenix Sky Harbor Airport 2004 Noise Exposure Map (City of Phoenix 2013).
[c] Existing noise levels are based on noise contours for Phoenix Mesa Gateway Airport 2004 Noise Exposure Map (City of Phoenix 2013).

The typical background vibration velocity level for residential areas is 50 VdB or less. For the general vibration assessment, the FTA impact criteria were used to further describe the existing vibration environment. The frequency of existing UP freight operations was referenced to characterize the GBV and GBN environment for Category 2 land uses. For the rail segments between Tucson and Eloy, occasional (30 to 70) trips translate to a reduced tolerance to GBV with the 75-VdB impact criterion being more appropriate at the 320-foot screening distance. Between Eloy and Phoenix, infrequent (fewer than 30) freight train trips result in a greater tolerance to GBV; therefore, the 80-VdB impact criterion is appropriate at the 320-foot screening distance. Appropriate GBN impact criteria at the screening distance are 40 dBA and 45 dBA, respectively, based on the assumption that a 35-dB correction for GBV frequencies is typical.

5.9.3 Environmental Consequences

Corridor Alternatives

Implementation of a passenger rail system would affect the future noise environment within the corridor alternatives. The following assessment would apply to both the Yellow and Orange corridor alternatives except where differences are noted.

Physical Impacts

The physical infrastructure associated with a passenger rail system would not be expected to have notable effects on the noise environment and no effect on the potential for vibrations. Passenger vehicles crossing tracks may generate minor quantities of noise compared with those operating on smooth pavement.

Operational Impacts

Operational effects may include both noise and vibration impacts.

Noise Impacts

Table 5-15 lists the estimated number of Category 2 land uses (existing and zoned) located within the 750- to 1,800-foot screening distance of the hypothetical representative alignment for each corridor alternative. Per FRA/FTA assessment methods, potential impacts are partly a function of existing noise levels. The existing noise level ranges listed for each of the corridor alternatives are a function of typical ambient noise levels by land use density combined with other noise sources that exist within each corridor. For instance, the hypothetical alignment for the Yellow Corridor Alternative generally follows I-10 and the UP, which would increase the upper range of ambient noise levels in rural and suburban areas compared to areas of similar land use density elsewhere within the Yellow Corridor Alternative or within the portions of the Orange Corridor Alternative. Although the hypothetical alignment for the Orange Corridor Alternative encompasses fewer Category 2 land uses within the designated screening distance, the potential noise impact of a passenger rail system in an area that generally experiences lower existing ambient noise levels is greater.

Table 5-15. Potential Noise Impacts within the Corridor Alternatives

	Yellow	Orange
Category 2 Land Uses[a]	**25,350**	**16,925**
Land Use Density	**Existing Noise Levels**[b]	
Rural	45 – 64 dBA	45 – 50 dBA
Suburban	50 – 64 dBA	50 dBA
Suburban/Urban	55 – 64 dBA	55 – 64 dBA
Urban	60 – 70 dBA	60 – 70 dBA
Impact Potential (per FTA/FRA Noise Impact Criteria shown in Figure 5-12)		
None	Low	Medium
Moderate	Medium	High
Severe	High	High

[a] Residential land uses per FTA/FRA guidelines located within 750 to 1,800-foot screening distance.
[b] Based on typical ambient noise levels by land use density. Upper end of range is defined by existing noise sources (e.g., rail, highway, airport, etc.). See **Table 5-15**.

Overall, the highest number of future noise impacts would occur in the vicinity of grade crossings, where locomotives sound their horns as they approach. Notable exceptions are the section of the Yellow Corridor Alternative in Tempe, where train horns would not be used at grade crossings due to the Tempe Quiet Zone ordinance that is in force (City of Tempe 2012), and the section common to both corridor alternatives between 4th Street and 3rd Avenue in Phoenix, which is also a Quiet Zone. Using the hypothetical representative alignments chosen for this Tier 1 noise analysis, a passenger rail system within the Yellow Corridor Alternative would have the potential to affect more Category 2 land uses than a system within the Orange Corridor Alternative near grade crossings, primarily because it would traverse more populous areas and would include more grade crossings, and therefore would produce more horn noise, than the Orange Corridor Alternative.

Vibration Impacts

Table 5-16 lists the estimated number of Category 2 land uses (based on zoned acreage data) that are located within a vibration screening distance of 320 feet on either side of the assumed alignments within the Yellow and Orange corridor alternatives. For high-speed rail traveling between 100 and 150 mph or more, three operational regimes define the potential vibration impacts. At lower speeds (Regime I), propulsion sources that provide motive power to the train are the predominant source of vibration. At higher speeds, mechanical/structural (bridges) and aerodynamic sources (Regimes II and III, respectively) become the dominant source (FRA 2012). Commuter rail lines generally operate at or below 100 mph, or within Regimes I and II; therefore, propulsion and mechanical forces would be the predominant sources of vibration for the Yellow and Orange corridor alternatives.

If a passenger rail system were developed within one of the corridor alternatives, the potential for vibration impacts would largely be a function of the number of sensitive land uses located within the 320-foot screening distance around a future alignment. In comparison to the Yellow Corridor Alternative, the number of potential GBV impacts could potentially be much lower within the Orange Corridor Alternative because zoned development densities are considerably lower within this corridor.

Table 5-16. Potential Vibration Impacts within the Corridor Alternatives

	Yellow	Orange
Category 2 Land Uses[a]	4,925	2,325
	Train Activity	
Frequent Events	Yes	Yes
Occasional Events	No	No
Infrequent Events	No	No
Impact Potential	**GBV/GBN Levels**[b]	
GBV Impact Threshold	72 VdB	72 VdB
GBN[b] at Impact	37 dBA	37 dBA

[a] Residential land uses per FTA/FRA guidelines located within 320-foot screening distance

[b] Represents minimum ground borne noise level (GBN) at impact zone limit to be determined by Tier 2 analysis

The GBN threshold, which is 35 dBA for the planned commuter and intercity rail operations that would be categorized by FTA as "frequent," would be exceeded for the Yellow and Orange corridor alternatives where vibration impacts are predicted to occur. While Quiet Zones would serve to minimize train horn noise, GBN would not be mitigated by this policy.

Construction Impacts

At this stage of the study, the duration, schedule, and specific construction equipment that would be used are unknown. Details about project construction would be more appropriately evaluated during Tier 2. Analysis of construction noise and mitigation would include:

- Duration of construction (overall and at specific locations)
- Equipment expected to be used, e.g., noisiest operations
- Schedule with limits on times of operation, e.g., daytime use only
- Noise monitoring
- Forum for communicating with the public
- Commitments to limit noise to specified levels, including compliance with applicable local ordinances
- Consideration of the application of noise control treatments used successfully in other projects

Similarly, potential impacts from construction vibration would occur only if a passenger rail system were constructed within the Yellow or Orange corridor alternatives. Details about project construction that are more appropriately examined under a Tier 2 analysis of construction vibration and mitigation include the duration and the type of equipment to be used during the construction and an explanation of how the GBV would be maintained at an acceptable level. If the equipment is of the type that generates little or no ground vibration – air compressors, light trucks, hydraulic loaders, etc. – a qualitative explanation would suffice without the need for a quantitative analysis.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be built, and no noise and vibration impacts would occur.

5.9.4 Potential Mitigation Measures

Noise Mitigation

FRA's traditional approach to abatement of noise sources from high-speed train systems is embodied in its Railroad Noise Emission Compliance Regulation (49 CFR § 210). The compliance regulation is intended to enforce the "Noise Emission Standards for Transportation Equipment: Interstate Rail Carriers" to limit the amount of noise emitted from power cars and rail cars under stationary and moving conditions (FRA 2012). FTA's noise analysis guidelines are contained in its Transit Noise and Vibration Impact Assessment (report number FTA-VA-90-1003-06).

The need for noise mitigation is determined based on the magnitude of the impacts and consideration of other factors such as feasibility, cost-effectiveness, and community views. Safety concerns that must be mitigated through project engineering include maintaining sufficient lines-of-sight around noise barriers for pedestrians, cyclists, and motorists and maintaining sufficient warning devices (i.e., audible and visual devices) at grade crossings. Recommended mitigation should be practical, prudent, and safe.

The magnitude of impacts is the first noise abatement consideration. A new passenger rail system with noise impacts predicted to stay within the "No Impact" curve per the FTA/FRA standards defined on **Figure 5-9** would not be considered for mitigation. Severe noise impacts present the strongest case for providing mitigation, and moderate noise impacts may also require consideration for implementing abatement measures. FRA and FTA require that project sponsors prepare a mitigation policy that clearly defines an approach to mitigating moderate and severe noise impacts. The policy should address the following items:

- The number of noise-sensitive sites affected – rows and clusters of homes vs. isolated properties
- The increase over existing noise levels – predicted levels just below the severe impact threshold would take precedence over those just above the moderate threshold
- Noise sensitivity of affected land uses – parks and certain institutional uses vs. residential uses
- Minimum effectiveness of noise abatement measures – can a sufficient reduction in noise be achieved?
- Community views - NEPA provides a framework for seeking public and agency stakeholder input regarding mitigation measures

- Cost benefit analysis – guidelines should be established regarding cost per benefited sensitive land use similar to well-established FHWA guidelines
- Design limitations – limits on engineering design and physical construction of mitigation should be considered
- Wayside mitigation vs. building sound insulation – for second story and above locations, building insulation may be more appropriate than wayside noise barriers
- Indoor land use activities – indoor impact standards such as those established by the US Department of Housing and Urban Development may be more appropriate for multi-story locations such as apartment buildings

The most effective mitigation for noise is to adhere to established design specifications for rail vehicles and infrastructure because the specifications were developed to minimize the potential for added noise. For passenger rail, design parameters and other mitigation measures may include: 1) vehicle and equipment design standards, 2) resilient or damped wheels, 3) wheel truing and rail grinding, 4) track turning radii greater than 1,000 feet, 5) rail lubrication, 6) sound barriers, 7) acquisition of buffer zones, 8) ballast on at-grade and aerial guideways, 9) acquisition of impacted properties, and 10) building insulation, among others.

Vibration Mitigation

Mitigation approaches to GBV are not as well defined because it is not as common a problem as environmental noise, and innovative approaches to control the impact are sometimes necessary. Examples include the floating slab systems that were developed for rail systems in Washington, D.C. and Toronto, Canada, and the use of wheel-flat detectors to identify vehicles in need of maintenance (FRA 2012). Maintenance of wheels and tracks is the single most important consideration for controlling GBV. Rough wheels and rails can increase vibration levels by up to 20 VdB, negating other measures designed to mitigate impacts. Grinding rough rails and truing wheels on a routine basis is often the best vibration mitigation strategy (FRA 2012).

Options to further reduce GBV include: 1) general mechanical maintenance procedures; 2) location and design of special track work such as turnouts and crossovers; 3) vehicle modifications to provide a soft primary suspension, minimum metal-to-metal contact of moving parts, and perfectly round smooth wheels; 4) track support system modifications that soften the connection between tracks and their support structure; 5) modifications to affected buildings to reduce vibration levels; 6) vibration transmission path adjustments such as trenches that act like barriers to environmental noise; and 7) operational changes such as reduced trains speeds, use of lowest vibration equipment at night, and minimizing train operations at night.

5.9.5 Tier 2 Considerations

A Tier 2 NEPA assessment of a specific alignment could include noise and vibration analyses for a location within the selected corridor different from that chosen for this Tier 1 EIS. A general noise assessment would entail the use of more precise project data including a specific alignment for the tracks; curvature of the alignment and potential for wheel squeal noise; details about train types, schedules, grade crossing locations and types, station locations, and maintenance requirements. With the definition of a specific alignment, the Tier 2 analysis would include specific locations of sensitive land use types, including Category 1 and Category 3 uses, where they exist.

Similarly, a general vibration assessment would require analysis of project-specific data gathered for the noise analysis, including land use. In addition, the vibration frequency generated during operation of the passenger rail system would need to be analyzed.

Based on the results of the Tier 2 noise and vibration analyses, mitigation measures could be developed and tested in an iterative process to determine their effectiveness, feasibility, and reasonableness.

5.10 Hazardous Materials

Hazardous materials could be encountered during the construction of a passenger rail system; therefore, it is important to identify properties that may contain contamination before ROW acquisition and construction. Hazardous materials are defined as any waste product that is considered flammable, corrosive, reactive, or toxic (40 CFR § 261.3). Hazardous materials can be found in various forms and can originate from a variety of sources. Examples of potential sites that may contain hazardous waste include landfills, service stations, industrial areas, and railroad corridors. The presence of soil and/or groundwater contamination, or the existence of hazardous materials within existing or proposed ROW, can adversely affect the cost and schedule of completing a passenger rail system. Early identification of potentially contaminated sites provides valuable information for the alternatives analysis, design, ROW acquisition, and engineering because it may be possible to design future alignments to avoid these sites or, if they cannot be avoided, determine the additional work required to remediate these sites before ROW acquisition and the start of construction.

5.10.1 Methodology and Regulatory Requirements

The regulations governing hazardous materials and waste sites include:

- Toxic Substances Control Act (TSCA) (15 U.S.C. §§ 2601-2692)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended (42 U.S.C § 9601 *et seq.*)
- Resource Conservation and Recovery Act (RCRA) (42 U.S.C § 6901 *et seq.*)
- Superfund Amendments and Reauthorization Act (42 U.S.C § 9601 *et seq.*)

USEPA is the federal agency responsible for overseeing hazardous waste management. In addition, under RCRA and state statutes and codes modeled on the federal law, ADEQ has the authority to monitor and direct industries that may generate, transport, or dispose of hazardous waste in Arizona. The following is a list of applicable state statutes and codes:

- Arizona Administrative Code, Title 18 – Environmental Quality, Chapter 8: Hazardous Waste Management, Chapter 12: Underground Storage Tanks, and Chapter 13: Solid Waste Management
- Arizona State Legislature, Title 49 – The Environment, Chapter 4: Solid Waste Management, Chapter 5: Hazardous Waste Disposal, and Chapter 6: Underground Storage Tank Regulation

Title IV of TSCA, as well as other authorities in the Residential Lead-Based Paint Hazard Reduction Act of 1992, directs EPA to regulate lead-based paint hazards.

Under Section 112 of CAA, EPA is responsible for enforcing regulations relating to asbestos and demolition activities. Asbestos is regulated by 40 CFR Part 61, subpart M – National Emission Standards for Hazardous Air Pollutants. The CAA allows EPA to delegate this authority to state and local agencies. The following is a list of National Emission Standards for Hazardous Air Pollutants programs for controlling asbestos within Pima, Pinal, and Maricopa counties:

- Pima County, Title 17, Air Quality Control (Asbestos National Emission Standards for Hazardous Air Pollutants)
- Maricopa County rule 370, section 301.8 – subpart M
- Pinal County Air Quality Control District (PCAQCD) Code of Regulations, Chapter 7, Hazardous Air Pollutant Standards, Article 1. Federal Hazardous Air Pollutant Program

The assessment methodology began with identifying the area of potential effect for regulated materials, which varies depending on the typical extent of exposure. Larger or more contaminated sites, such as Superfund sites, often include a broad area, while hazardous spill sites are usually cleaned up quickly and are more limited in extent.

The data used to identify potential hazardous material and waste sites within the study corridors came from ADEQ and from one of EPA's online databases (EPA 2013b). The data were analyzed by overlaying the study corridors with the identified potential hazardous material and waste sites on an aerial background; however, data from EPA could only be viewed online and could not be overlaid onto the corridor alternatives. Therefore, the number of potential hazardous material and waste sites identified from EPA were estimated. The search distances used to identify potential hazardous material and waste sites were based on the American Society for Testing and Materials (ASTM) E1527-05 Standard Practice for Environmental Site Assessments.

The following federal and state environmental records were reviewed to identify incidents and regulated material sites within the study corridors:

- **Federal brownfield sites.** Brownfields are real property whose expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. FTA supports the use of brownfields in certain circumstances. The US Department of Transportation (USDOT) encourages participation in transportation projects that include the use and redevelopment of contaminated sites, when appropriate (FTA 2015).
- **Federal National Priorities List and Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites**. The National Priorities List includes the known releases or threatened releases of hazardous substances, pollutants, or contaminants that are considered the highest priority hazardous materials sites throughout the US and its territories. CERCLIS sites are also referred to as "Superfund" sites. Superfund is the federal government program to clean up the nation's uncontrolled hazardous waste sites. Arizona's state equivalent to a Superfund site is a Water Quality Assurance Revolving Fund (WQARF) site.
- **Federal RCRA generator sites.** RCRA was established for sites that treat, store, and dispose of hazardous waste.
- **Federal toxic releases to land –** The toxic release inventory (TRI) contains information on toxic chemical releases and waste management activities reported annually by certain industries as well as federal facilities.
- **Federal TSCA sites.** The TSCA authorizes EPA to require reporting, record-keeping, and testing requirements and restrictions relating to chemical substances and/or mixtures. TSCA addresses the production, importing, use, and disposal of specific chemicals including polychlorinated biphenyls, asbestos, radon, and lead-based paint.

- **State landfill sites.** The state holds records of permitted solid waste disposal facilities or landfills in Arizona.
- **State Large Quantity Generator (LQG) sites.** Large quantity generator sites generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste, per month.
- **State Leaking Underground Storage Tank (LUST)/underground storage tank (UST) sites.** The state maintains records for all regulated storage tanks and ensures that tanks meet requirements for release detection, spill and overflow prevention, and corrosion protection and ensures that tanks not meeting these requirements are closed. Leaking USTs are defined as regulated USTs that contain regulated substances including petroleum and hazardous substances, such as those typically found at gasoline stations, fleet fueling facilities, and industrial sites, that are suspected or confirmed of having a leak.
- **State treatment, storage, and disposal facility (TSDF) sites.** This includes treatment, storage, and disposal facilities of hazardous waste.

5.10.2 Existing Conditions

The hazardous materials sites of most concern, in general order of magnitude, are Superfund, Brownfields, and LUST, since they often encompass a broad area compared to other listed sites. **Table 5-17** gives an inventory of Superfund and other hazardous material sites based on ASTM standard search distances, measured from hypothetical centerline alignments within each Corridor Alternative.

Table 5-17. Regulatory Database Summary

Database	Search Distance[a] (mile)	Number of Facilities Identified[b]	
		Yellow Corridor Alternative	Orange Corridor Alternative
ADEQ			
Landfills	1.00	1	1
LQG	0.25	11	24
LUST	0.50	552	428
UST	0.25	276	172
Superfund	0.50	10	7
TSDF	0.50	1	0
EPA			
Brownfields	0.50	95	95

Table 5-17. Regulatory Database Summary

Database	Search Distance[a] (mile)	Number of Facilities Identified[b]	
		Yellow Corridor Alternative	Orange Corridor Alternative
CERCLIS	0.50	22	23
RCRA	0.25	501	358
TRI	0.25	31	23
TSCA	corridor	10	9
Total		**1,511**	**1,142**

[a] Search distances based on ASTM standards.

[b] The number of facilities is only an estimate. The same site could be listed in both databases.

As indicated in **Table 5-17**, a database search for the Yellow Corridor Alternative discloses up to 1,511 hazardous material and waste sites, although some of the same sites may be duplicated on more than one database, so this may be an overestimated count. The database search for the Orange Corridor Alternative indicates almost 25 percent fewer hazardous material and waste sites (a total of 1,142 sites) than that for the Yellow Corridor Alternative. Most of these sites are located within the more urbanized portions of the corridor, where hazardous waste generators are more likely to occur, chiefly in the Eloy to northern hub segment of the corridor alternatives, through parts of Mesa, Tempe, and Phoenix.

Superfund Sites

Figure 5-11, **Figure 5-12**, and **Figure 5-13** depict the location of CERCLIS sites, landfills, LUST sites, TRI sites, and plumes associated with Superfund and WQARF sites in and around the corridor alternatives. The following is a list of Superfund sites intersected by the corridor alternatives that have ongoing monitoring and remediation activities.

EPA National Priority List Sites

- Motorola 52nd Street (OU2 and OU3) – This site is located near the Phoenix Sky Harbor International Airport. This site was divided into three operating units (OU). South Indian Bend Wash – This site represents the southern portion of the Indian Bend Wash Superfund site. The site encompasses approximately 4 square miles in Tempe.
- Williams Air Force Base – This site represents the former Williams Air Force Base, now Phoenix-Mesa Gateway Airport. The site encompasses approximately 4,127 acres (6.45 square miles).

Figure 5-11. Hazardous Waste and Materials Sites in the Study Area

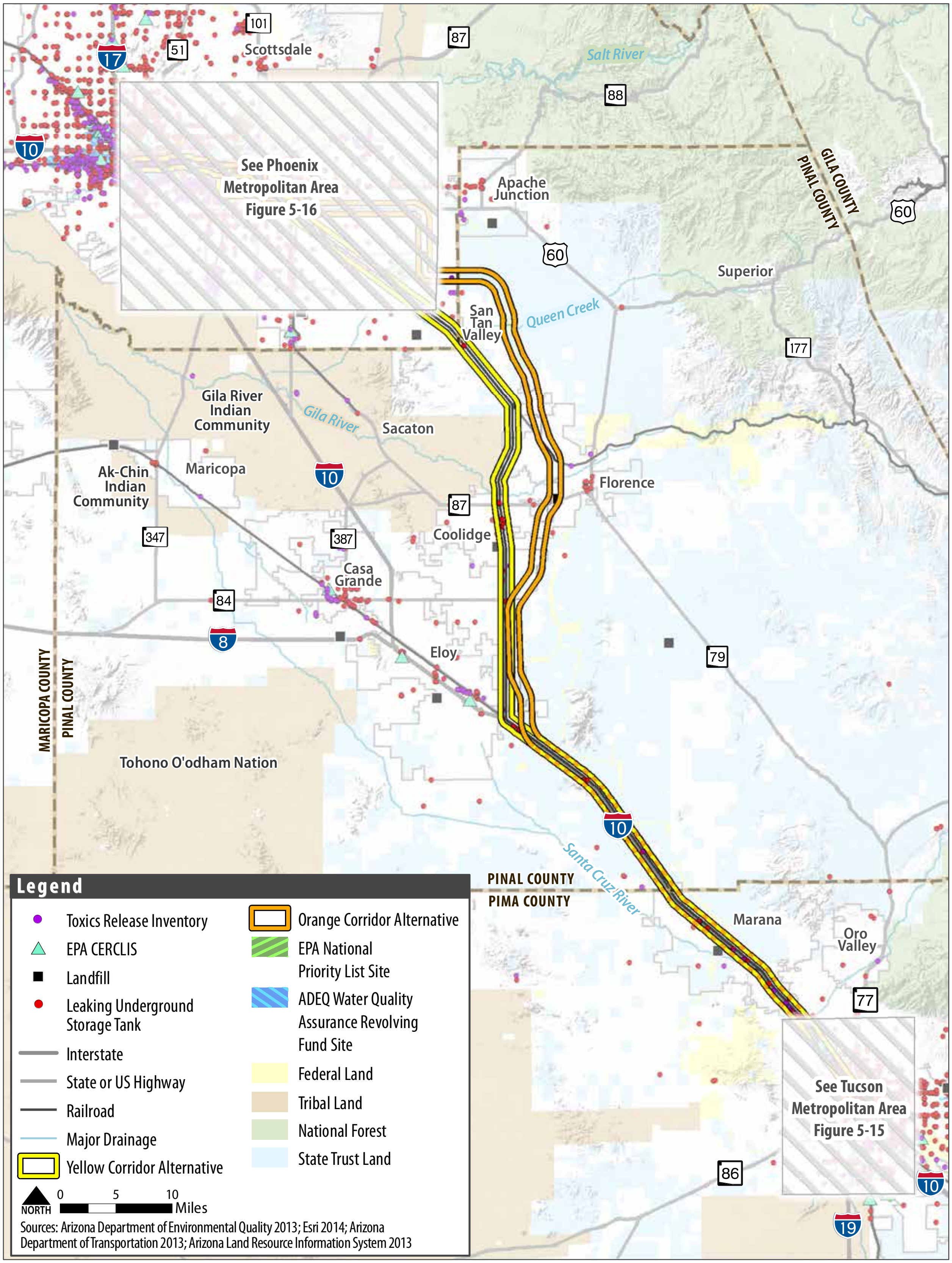


Figure 5-12. Hazardous Waste and Materials Sites in the Tucson Metropolitan Area

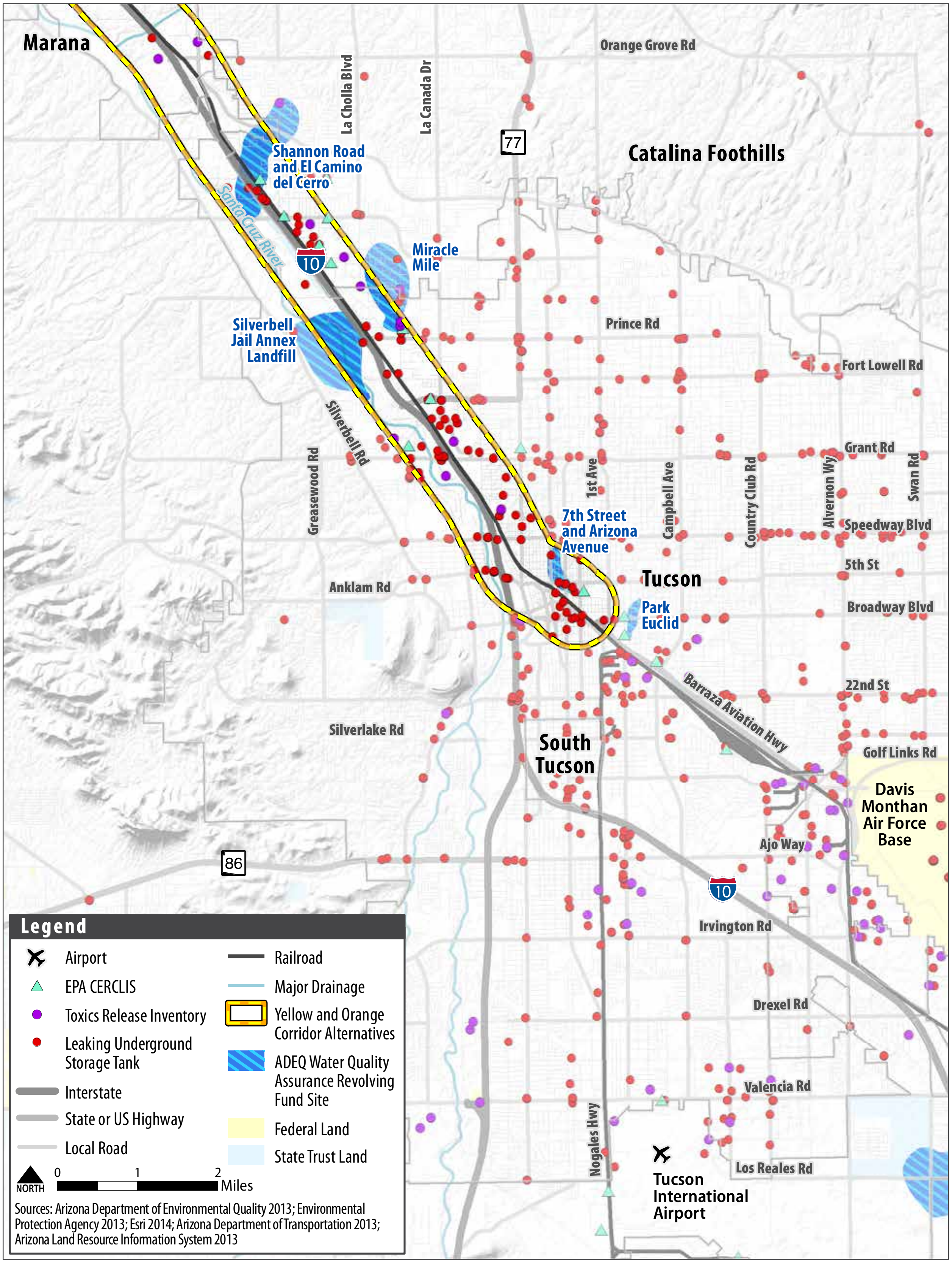
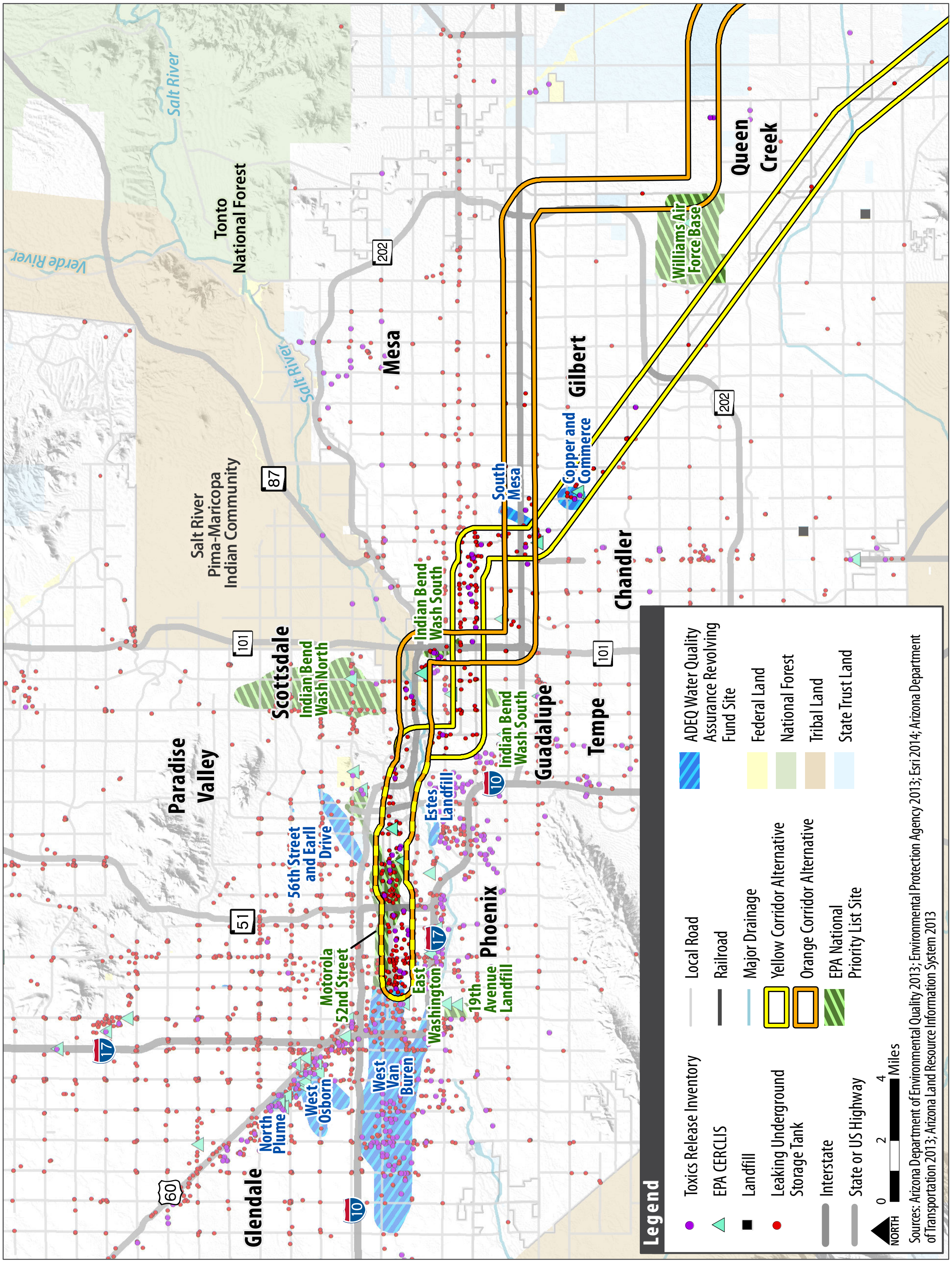


Figure 5-13. Hazardous Waste and Materials Sites in the Phoenix Metropolitan Area



ADEQ Water Quality Assurance Revolving Fund Sites

- 7th Street and Arizona Avenue – A contaminant plume associated with dry cleaning industries lies north of the corridor alternatives' southern hub.
- Cooper and Commerce – This site consists of a contaminated groundwater plume located in the vicinity of Commerce Avenue near Cooper Road in Gilbert.
- Miracle Mile – This contaminated groundwater plume is located in Tucson's Flowing Wells neighborhood north of I-10 between Prince and Wetmore Roads. A portion of the plume falls within the Orange and Yellow corridor alternatives, which run in common in the southern portion of the study area.
- Shannon Road El Camino Del Cerro – This site is located in northwest Tucson.
- Silverbell Landfill – This site is a contaminated groundwater plume in northeast Tucson between Silverbell Road and I-10, originating at a landfill underneath the Silverbell Golf Course.
- South Mesa – This site is located in south Mesa. The plume associated with this site could be directly affected by a rail system in the Orange Corridor Alternative.

Brownfield Sites

A number of known brownfield sites are located in both corridor alternatives. Current and former agricultural land has the potential to be determined a brownfield site due to the presence of pesticides and herbicides in the soil.

UST/LUST Sites

UST and LUST sites are located in both corridor alternatives. Approximately 60 percent more UST and 29 percent more LUST sites occur within the Yellow Corridor Alternative than within the Orange Corridor Alternative, most likely because the Yellow Corridor Alternative covers a greater amount of developed areas than the Orange Corridor Alternative.

5.10.3 Environmental Consequences

In general, a greater potential for hazardous material effects exists within urban areas, where hazardous materials and waste sites are typically located. Both the Yellow and Orange corridor alternatives are centered along the same transportation corridor from Tucson to Eloy; thus, potential hazardous material effects are the same for both corridor alternatives from Tucson to Eloy. From Eloy to Phoenix, the Yellow Corridor Alternative incorporates more developed, urban areas than the Orange Corridor Alternative.

Yellow Corridor Alternative

Physical Impacts

Acquiring ROW within potentially contaminated areas is a concern because contaminated land can be a liability, particularly if the landowner becomes responsible for cleanup costs. Although potentially contaminated sites were identified within the Yellow Corridor Alternative, specific effects at each location were not determined in this Tier 1 analysis; that information would be provided once a future alignment has been determined.

As mentioned above, Superfund sites would be of most concern because their contaminant plumes often encompass a broad area compared to other listed sites. The Cooper and Commerce site contaminant plume in Gilbert would affect or be affected by a passenger rail system within the Yellow Corridor Alternative. The plumes associated with the 7th Street and Arizona Avenue, Miracle Mile, Shannon Road El Camino del Cerro, and Silverbell Landfill are all in Tucson; and Motorola 52nd Street OUs 2 and 3 are in Phoenix.

A passenger rail system within the Yellow Corridor Alternative would likely be affected by more UST and LUST sites than a passenger rail system within the Orange Corridor Alternative, because of the greater number of UST and LUST sites.

Operational Impacts

The potential exists for exposing rail system equipment and passengers to contaminants from hazardous materials sites as well as those generated by the operation of the passenger rail system itself. While petroleum, oils, and lubricants may be used in rail operations or maintenance, proper use, storage, and disposal practices would minimize the potential for accidental releases. In selecting locations for rail stations, avoiding contaminated sites during design could reduce the risk of passenger exposure to contaminants.

Hazardous material sites would have minimal effect on the operations of a passenger rail system. Work within contaminated areas seldom goes beyond maintenance activities, which would be unlikely to increase workers' exposure to contaminants.

Similarly, operating a passenger rail system would not be expected to result in releases of hazardous materials and waste.

Construction Impacts

Construction activities involving excavation increase the likelihood for encountering existing and unknown regulated materials. Hazardous material sites pose a safety risk to workers who might be exposed to contaminated soil, water, and vapors; and it is an additional cost to provide workers with personal protective equipment. Vehicles and equipment used during construction activities, such as fuel storage tanks, have the potential to release hazardous materials, mainly petroleum products. Appropriate construction safety procedures and equipment stockpiling methods would be used to minimize the potential for unintended releases. All releases would be reported and addressed under appropriate regulatory guidance. Heavy truck traffic may also increase with an intensification of construction activities, which has the potential to increase the risk of material spills. Dewatering activities during construction could potentially alter existing groundwater contamination plumes and potentially affect additional properties. Should contamination be encountered, construction activities would be temporarily halted until characterization, storage, disposal, and cleanup requirements were met.

In addition, construction activities would be expected to generate waste material. All construction debris would be recycled or properly disposed of in a permitted landfill or appropriate facility in compliance with federal, state, and local regulations.

Orange Corridor Alternative

Physical, operational, and construction impacts within the Orange Corridor Alternative would be similar to those described for the Yellow Corridor Alternative. A passenger rail system in the Orange Corridor Alternative, however, could have a greater potential to be affected by brownfield sites because the Orange Corridor Alternative has more current and former agricultural land than the Yellow Corridor Alternative. The contaminant plumes associated with the Williams Air Force Base and South Mesa sites could affect or be affected by a rail system within the Orange Corridor Alternative. The contaminant plume associated with the South Indian Bend Wash site would directly affect a rail system in the Orange Corridor Alternative.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not built, and no hazardous materials or hazardous waste sites would be affected. The No Build Alternative would not preclude the potential for ongoing or future releases, as evidenced by the past regulated material releases that have been identified within the corridor alternatives. Cleanup of these conditions would continue under regulatory programs, and some sites may be fully remediated over time.

If a passenger rail system is not developed, vehicle use of the existing and reasonably foreseeable future transportation system would likely increase. The added congestion may cause a higher incidence of accidents than currently occurs. Spills resulting from traffic accidents and crashes could influence the amount of hazardous material exposure in these travel corridors.

5.10.4 Potential Mitigation Measures

This Tier 1 review does not identify the nature and severity of contamination at specific sites; this level of detail would be conducted if the study advances to Tier 2. It is expected, however, that appropriate cleanup of hazardous materials and/or removal of USTs may be required. FRA and FTA would coordinate with the appropriate agencies to ensure proper cleanup of any contaminated sites. In addition, a site management plan would be prepared before construction to address known or potential hazardous material issues, including but not limited to:

- Measures to identify and address potentially contaminated soil and groundwater, as necessary or required
- Measures to identify and address lead-based paint and asbestos-containing materials including handling and disposal, as necessary or required
- A site-specific health and safety plan, including measures to protect construction workers and general public
- Procedures to protect workers and the general public in the event that unknown contamination or buried hazards are encountered

5.10.5 Tier 2 Considerations

During Tier 2, Phase I Environmental Site Assessments would be conducted prior to acquiring property or commencing with construction activities, to identify known or suspected hazardous material and waste sites, and to characterize the extent of possible contamination from all known or suspected sites in accordance with ASTM E 1527-13 standard practice.

More detailed analysis, such as the status of cleanup and remediation activities at Superfund or other sites of concern, would also be more fully evaluated during any Tier 2 analysis.

The identification, handling, and remediation of all known or suspected hazardous or solid wastes, such as asbestos-containing materials and lead-based paint, would be addressed during Tier 2 studies in accordance with applicable local, state, and federal laws and regulations.

5.11 Geology, Topography, Soils, and Prime and Unique Farmlands

This section describes the study corridor's geologic resources, topography, soils, and prime and unique farmlands and evaluates potential effects to these resources resulting from implementing a passenger rail system within each of the corridor alternatives.

Geologic features include rock outcrops, unique rock formations, soils, topography, and mineral and energy resources such as mineral ores, petroleum, natural gas, and sand and gravel. Geologic features that may affect construction include formations and soils that are unstable or erode easily, bedrock outcrops, extreme topography, faults, fissures, and areas of seismic activity. Soil features that may affect construction include soil erodibility, shrink/swell characteristics, and permeability. Furthermore, soils comprising certain chemical and physical properties, in combination with certain current and planned uses, could be subject to regulation under the Farmland Protection and Policy Act (FPPA).

5.11.1 Methodology and Regulatory Requirements

This evaluation assesses the potential effects of a future passenger rail system constructed and operating within the Yellow or Orange corridor alternatives on geology, soils, and prime farmlands. Data sources identifying geology and topography include sources cited under the Land Use (**Section 5.2**) as well as published data from the Arizona Geological Survey (AZGS) and US Geological Survey (USGS). Soils and prime and unique farmlands (as defined under FPPA) within the corridor alternatives were identified using Natural Resources Conservation Service (NRCS) GIS data.

The impact analysis presents a general description of the types of potential effects that could occur in the two corridor alternatives. The effects of the No Build Alternative are also discussed. General mitigation measures to reduce or avoid effects are identified to inform more detailed, future Tier 2 and project-level analyses. No field verification was conducted for this analysis.

Geology and Topography

Geology and topography are discussed in close association because geologic conditions strongly influence topography. The primary issues regarding geology and topography are associated with the potential costs of construction in areas of relatively high topographic relief (i.e., relatively steep slopes), particularly where relatively hard geologic formations (i.e., bedrock) are present. Preliminary information regarding fissures, faults, unstable slopes, and unsuitable soils is also provided because those conditions may present issues for construction.

No state or federal laws were identified that apply specifically to geologic resources in the corridor alternatives, although some local agencies may have restrictions regarding building on certain types of soils, such as expanding soils.

Soils

Soils are identified using NRCS GIS data and data from the NRCS web soil survey (NRCS 2013c).

Prime and Unique Farmlands

Soils comprising certain chemical and physical properties, in combination with certain current and planned uses, are designated as prime and unique farmlands and farmland of unique importance, which may be subject to FPPA. Prime and unique farmlands and farmland of unique importance are identified to provide a preliminary, informal assessment of potential effects on those resources. Areas of current and planned urban land and water bodies are not included and are deducted from mapped areas of prime farmlands and farmland of unique importance.

FPPA was established in 1981 in response to concerns about the declining acreages in the US being actively farmed. The purpose of FPPA is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. FPPA states, "Federal programs shall be administered in a manner that, as practicable, would be compatible with state and local government and private programs and policies to protect farmland."

Prime farmland and agricultural land are not necessarily the same. The agricultural land use designation is a product of local community planning efforts, while the designation of Prime or Unique Farmland is a product of NRCS criteria. Additionally, farmland subject to FPPA requirements does not have to be currently used for cropland. It can be forest land, pastureland, cropland, or other land, but not water or urban built-up land. Definitions of Prime and Unique Farmland, which determine the existing conditions and environmental concerns related to farmlands in the corridor alternatives, are as follows.

- **Prime Farmland** – Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor and without intolerable soil erosion. Prime Farmland includes land that possesses the above characteristics but is being used to produce livestock and timber. It does not include land already in or committed to urban development or water storage (7 CFR 658.2).

- **Unique Farmland** – Land other than Prime Farmland that is used for production of specific high-value food and fiber crops. Its characteristics include the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods. Examples of such crops include citrus, tree nuts, olives, cranberries, fruits, and vegetables (7 CFR 658.2).

The Prime farmland soils are categorized with qualifiers, as follows:

- Prime farmland if irrigated
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season

Farmlands, and areas other than farmlands, are further defined, as follows:

- Farmland of unique importance
- Not prime farmland

Prime farmland and farmland of unique importance are aggregated and are referred to as prime and unique farmlands for the purposes of this evaluation.

5.11.2 Existing Conditions

The study corridor occurs in the Sonoran Desert, one of the largest and hottest deserts in North America. It also lies within the Basin and Range Geologic Province, characterized by generally north-south running mountain ranges (and large, normal faults) separated by broad, relatively flat valley floors (USGS 2004). Soils in the study corridors comprise many units that can be described generally as clay, silt, and/or sand loams and gravels.

Subsidence Areas

Land subsidence in Arizona is generally caused by lowering of the water table resulting from groundwater withdrawals. When land settles evenly, subsidence occurs gradually and is usually imperceptible. Several active land subsidence areas exist within the study corridor, one in the vicinity of Picacho and Coolidge, and one further north in Mesa and Gilbert. The subsidence rate in these areas averages approximately 1 centimeter per year (ADWR 2015).

Fissures and Faults

Fissures and faults are geologic features that may affect infrastructure, including railroads. Fissures are typically associated with land subsidence, a phenomenon that has been identified in several locations in south-central Arizona, including the study corridor (AZGS 1993).

Subsidence can take place when water is removed from underground reservoirs and the weight of the overlying material compresses the underlying, formerly saturated material, causing the land to settle. When the land settles unevenly, cracks in the earth—fissures—may result. Fissures may be more than 1.0 mile in length, up to 15 feet wide, and hundreds of feet deep. During torrential rains, these fissures can erode rapidly and present substantial hazards to people, animals, and infrastructure (Maricopa Association of Governments 2009). According to AZGS, fissures are present between Eloy and Picacho Peak. Because fissures can form and/or increase in size rapidly, available mapping may not identify all fissures within the corridor.

USGS defines faults as "fractures or zones of fractures along which there has been displacement of the adjacent [bedrock] blocks relative to one another" (USGS 2012). Faults are often associated with earthquakes; however, the presence or absence of surface faults is not a reliable indicator of earthquake risk. Earthquake hazard levels are low to moderate in most of Arizona; and the faults that are known to exist throughout southeast and central Arizona, including much of the Phoenix and Tucson areas, have low slip rates, long intervals between rupture, and little historic activity (AZGS 2000). Preliminary information regarding the identified resources in each of the corridor alternatives is summarized in **Table 5-18** and discussed below. Approximate acreages of Subsidence and Prime and Unique Farmlands within 200-foot ROW corridors are shown in parentheses, based on the 200-foot to 1-mile ratio (0.0379) explained in **Section 5.1.2**.

Table 5-18. Geologic, Topographic, and Prime/Unique Farmland Resources in the Corridor Alternatives

Subsidence (acres)	Fissures (number)	Prime and Unique Farmlands (acres)
Southern Hub to Eloy – Yellow and Orange Corridor Alternatives (and 200-foot ROW corridor)		
2,473 (94)	207	28,437 (1,078)
Eloy to Northern Hub – Yellow Corridor Alternative (and 200-foot ROW corridor)		
14,641 (555)	28	48,714 (1,846)
Eloy to Northern Hub – Orange Corridor Alternative (and 200-foot ROW corridor)		
17,820 (675)	39	54,324 (2,059)
Sources: ADWR 2013, AZGS GIS 2013, NRCS 2013 Soil Survey data		

Yellow Corridor Alternative

Southern Hub to Eloy

Geology and Topography

Geologic formations in the southern half of the Yellow Corridor Alternative are characterized by relatively recent deposits of alluvium as well as relatively older deposits of volcanic and sedimentary rocks that comprise the rocky outcrops and mountains (i.e., bedrock) found in the study corridor. The significance of the relatively old volcanic and sedimentary bedrock is that it may be harder, and more resistant to cutting, than the alluvial deposits. The bedrock's higher resistance to erosion generally results in the formation of relatively steep slopes.

Picacho Peak, located approximately 11 miles southeast of Eloy (see **Figure 5-14**), comprises volcanic rock approximately 38 million years old, the oldest deposit in the southern half of the corridor and the only deposit of volcanic rock at the surface in this corridor segment (AZGS 1988). As shown in **Figure 5-14**, no faults are mapped in the southern half of the Yellow Corridor Alternative; however, faults are mapped in four locations in nearby areas.

The topography reflects the geologic characteristics described above, comprising primarily broad, flat, low-lying desert valleys with isolated bedrock outcrops and mountain ranges of relatively low relief. Elevations in the southern half of the Yellow Corridor Alternative range from approximately 2,400 feet amsl at the southern hub in Pima County down to approximately 1,650 feet amsl near Eloy in Pinal County, with the steepest slopes occurring adjacent to Picacho Peak.

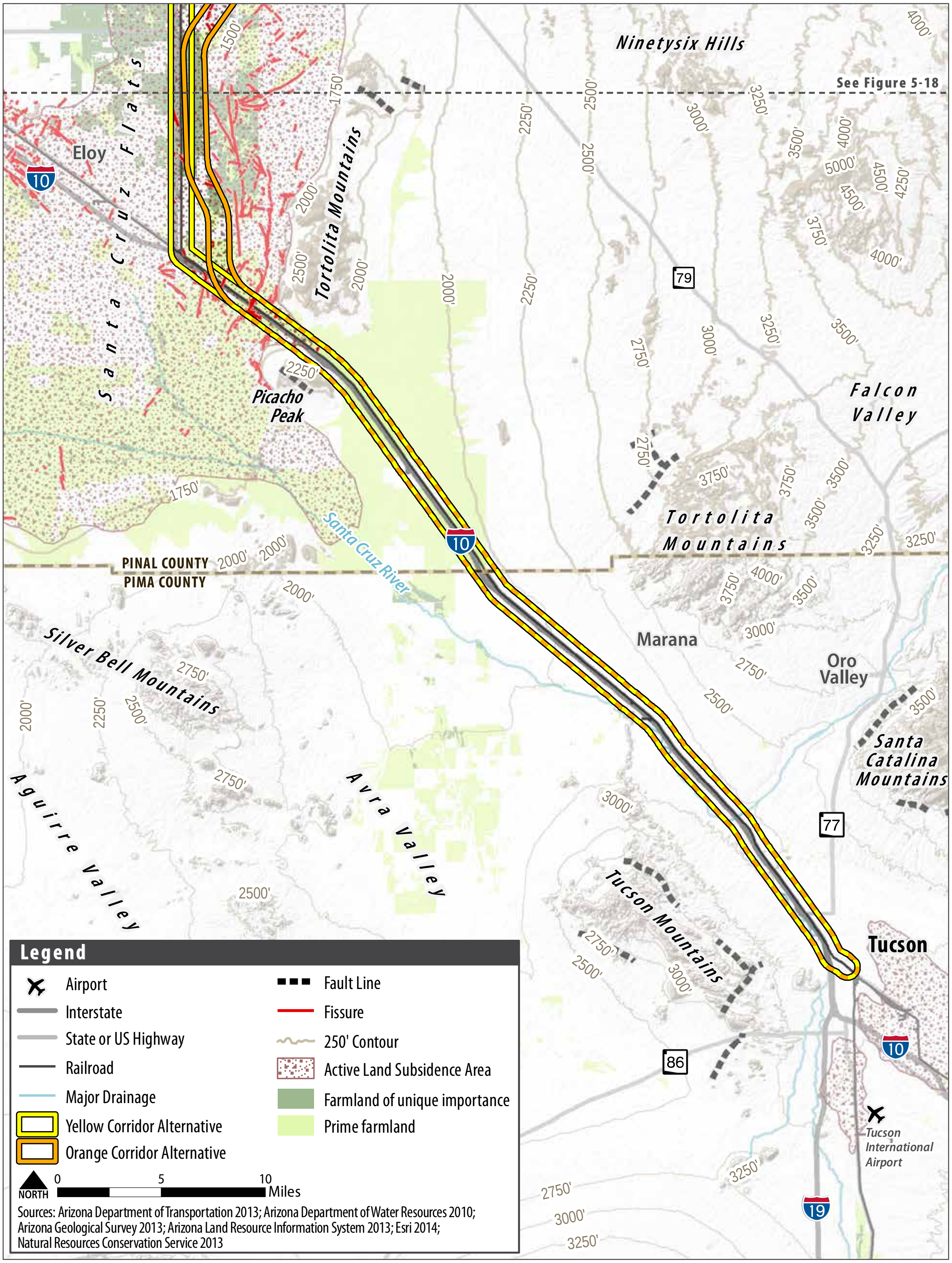
Soils

Soils in the southern half of the Yellow Corridor Alternative comprise many units that can be described generally as clay, silt, and/or sand loams and gravels (NRCS 2013c). The majority of these soil units comprise prime and unique farmland, as discussed below.

Prime and Unique Farmlands

Prime farmlands and farmland of unique importance comprise large segments of the area traversed by the corridor alternatives, particularly in Pinal County. Prime and unique farmland comprises approximately 28 percent of the total area of the southern half of the Yellow Corridor Alternative.

Figure 5-14. Geologic Features and Prime and Unique Farmlands between Tucson and Eloy



Eloy to Northern Hub

Geology and Topography

Geologic formations in the northern half of the Yellow Corridor Alternative are characterized by recent deposits of alluvium as well as older deposits of sedimentary and volcanic bedrock. The oldest deposit in the Yellow Corridor Alternative is approximately 1.1 billion years old, located approximately 9 miles northwest of Florence, adjacent to Twin Buttes, a feature of the Santan Mountains (see **Figure 5-15**). A second deposit of granitoid rock associated with the Santan Mountains is located within the Yellow Corridor Alternative, approximately 7.6 miles west of Florence. Near the northern hub, the Yellow Corridor Alternative comprises approximately 15- to 38-million-year-old volcanic and sedimentary bedrock associated with Hayden Butte (Tempe) and the hills in Papago Park (Phoenix).

Elevations in the northern half of the Yellow Corridor Alternative range from approximately 1,650 feet amsl near Eloy in Pinal County down to approximately 1,100 feet amsl at the northern hub in Maricopa County. The topography of the northern half of the Yellow Corridor Alternative also comprises primarily broad, flat, low-lying desert valleys with isolated mountain ranges of relatively low relief (such as the Santan Mountains, South Mountain, the Superstition Mountains, the hills in Papago Park, and Hayden Butte). The steepest slopes found in the northern half of the Yellow Corridor Alternative are adjacent to the Santan Mountains, where volcanic bedrock is mapped at the surface, and in Phoenix, north of Hayden Butte and south of Papago Park.

According to AZGS, one fault is in the Yellow Corridor Alternative, running roughly northwest to southeast for approximately 1.5 miles, located approximately 0.25 mile southwest of Papago Park in Phoenix. At least six additional faults are located nearby, as shown in **Figure 5-15**. The Yellow Corridor Alternative intersects an active subsidence area from a point just west of Picacho Peak north to the Gila River.

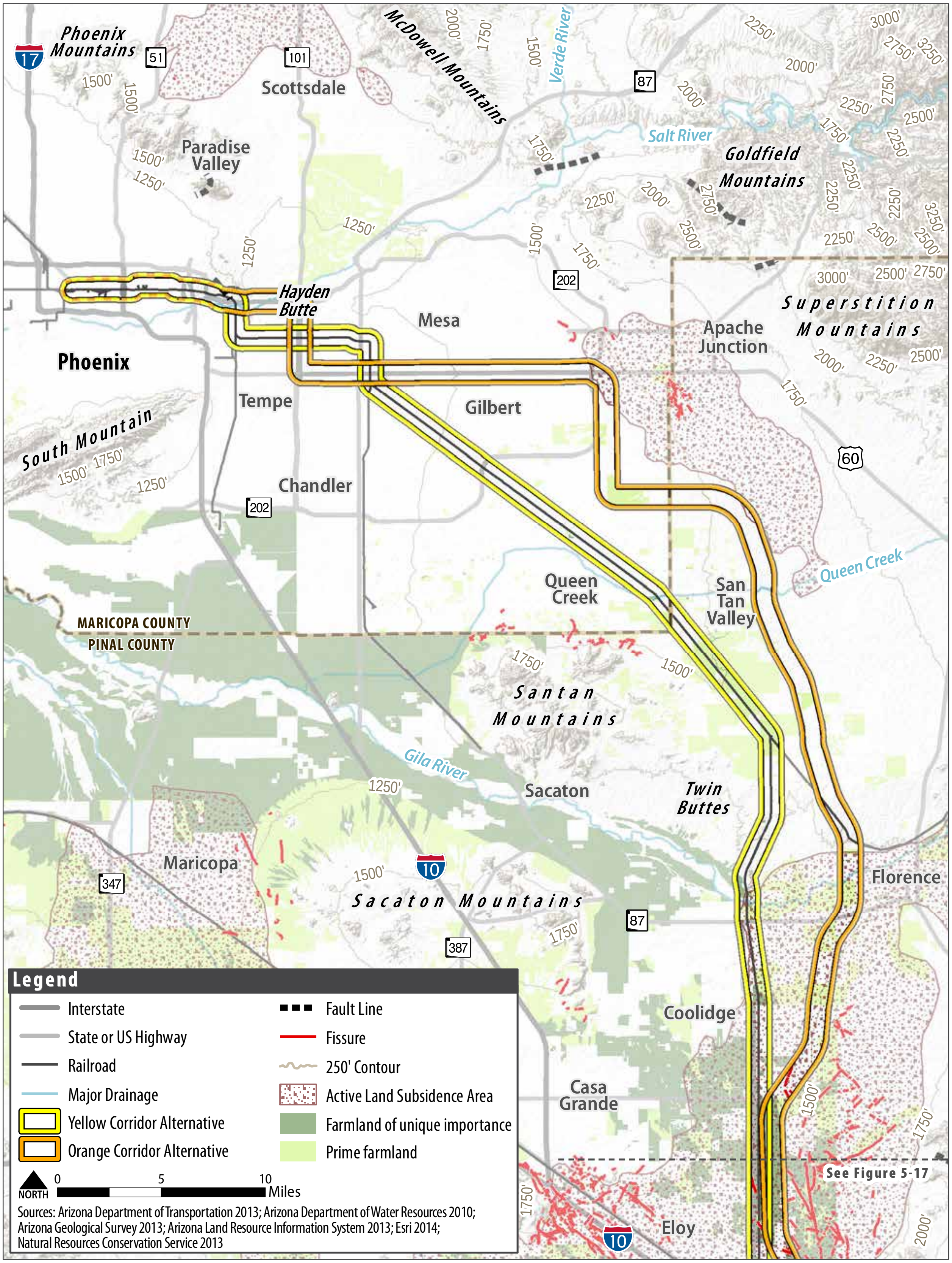
Soils

Soils in the northern half of the Yellow Corridor Alternative comprise many units that can be described generally as clay, silt, and/or sand loams and gravels (NRCS 2013c). The majority of these soil units comprise Prime and Unique Farmland, as discussed below.

Prime and Unique Farmlands

Prime and unique farmland comprises approximately 24 percent of the total area of the northern half of the Yellow Corridor Alternative, primarily in Pinal County between Eloy and Coolidge, and southeast of Queen Creek.

Figure 5-15. Geologic Features and Prime and Unique Farmlands between Eloy and Phoenix



Orange Corridor Alternative

Southern Hub to Eloy

The affected environment for the southern portion of the Orange Corridor Alternative would be the same as that described for the Yellow Corridor Alternative from the southern hub to Eloy.

Eloy to Northern Hub

Geology and Topography

Geologic formations in the northern half of the Orange Corridor Alternative have characteristics similar to those in the northern half of the Yellow Corridor Alternative.

The oldest deposits in the northern half of the Orange Corridor Alternative comprise approximately 15- to 38-million-year-old volcanic and sedimentary rocks associated with Hayden Butte (Tempe) and the hills in Papago Park (Phoenix).

Elevations in the northern half of the Orange Corridor Alternative range from approximately 1,600 feet amsl near Eloy in Pinal County down to approximately 1,100 feet at the northern hub in Maricopa County. The topography of the northern half of the corridor vicinity also comprises primarily broad, flat, low-lying desert valleys with isolated mountain ranges of relatively low relief (such as the Santan Mountains, South Mountain, the Superstition Mountains, the hills in Papago Park, and Hayden Butte). The steepest slopes found in the northern half of the Orange Corridor Alternative occur in Phoenix, north of Hayden Butte and south of Papago Park.

According to AZGS, fissures in the Orange Corridor Alternative are mostly concentrated from Eloy to approximately 11 miles north of Eloy. Because fissures can form and/or increase in size rapidly, current mapping may not identify all fissures within the corridor and nearby areas.

AZGS indicates one fault in the Orange Corridor Alternative, running roughly northwest to southeast for approximately 1.5 miles, located approximately 0.25 mile southwest of Papago Park in Phoenix. At least six additional faults are located in the vicinity of the corridor, as shown in relatively low relief. Elevations in the southern half of the Yellow Corridor Alternative range from approximately 2,400 feet amsl at the southern hub in Pima County down to approximately 1,650 feet amsl near Eloy in Pinal County, with the steepest slopes occurring adjacent to Picacho Peak.

Soils

Soils in the southern half of the Yellow Corridor Alternative comprise many units that can be described generally as clay, silt, and/or sand loams and gravels (NRCS 2013c). The majority of these soil units comprise prime and unique farmland, as discussed below.

Prime and Unique Farmlands

Prime farmlands and farmland of unique importance comprise large segments of the area traversed by the corridor alternatives, particularly in Pinal County. Prime and unique farmland comprises approximately 28 percent of the total area of the southern half of the Yellow Corridor Alternative.

Eloy to Northern Hub

Geology and Topography

Geologic formations in the northern half of the Yellow Corridor Alternative are characterized by recent deposits of alluvium as well as older deposits of sedimentary and volcanic bedrock. The oldest deposit in the Yellow Corridor Alternative is approximately 1.1 billion years old, located approximately 9 miles northwest of Florence, adjacent to Twin Buttes, a feature of the Santan Mountains (see Figure 5 15). A second deposit of granitoid rock associated with the Santan Mountains is located within the Yellow Corridor Alternative, approximately 7.6 miles west of Florence. Near the northern hub, the Yellow Corridor Alternative comprises approximately 15- to 38-million-year-old volcanic and sedimentary bedrock associated with Hayden Butte (Tempe) and the hills in Papago Park (Phoenix).

Elevations in the northern half of the Yellow Corridor Alternative range from approximately 1,650 feet amsl near Eloy in Pinal County down to approximately 1,100 feet amsl at the northern hub in Maricopa County. The topography of the northern half of the Yellow Corridor Alternative also comprises primarily broad, flat, low-lying desert valleys with isolated mountain ranges of relatively low relief (such as the Santan Mountains, South Mountain, the Superstition Mountains, the hills in Papago Park, and Hayden Butte). The steepest slopes found in the northern half of the Yellow Corridor Alternative are adjacent to the Santan Mountains, where volcanic bedrock is mapped at the surface, and in Phoenix, north of Hayden Butte and south of Papago Park.

Soils

Soils in the northern half of the Orange Corridor Alternative comprise many units that can be described generally as clay, silt, and/or sand loams and gravels (NRCS 2013c).

Prime and Unique Farmlands

Prime and unique farmland comprises approximately 21 percent of the total area of the northern half of the Orange Corridor Alternative and is located mostly between Eloy and Florence.

5.11.3 Environmental Consequences

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

An alignment for a passenger rail system within the Yellow Corridor Alternative from the southern hub to Eloy would need to avoid bedrock outcrops and steep slopes to minimize cut and fill areas. Physical impacts of a passenger rail system within the Yellow Corridor Alternative on geologic or topographic resources could be moderated by focusing the design on areas with minimal variation in terrain. Faults existing within the corridor alternative should also be considered in the design and placement of a rail system. Subsidence areas and fissures within the corridor alternative, which are most notable in the vicinity of Eloy, should also be considered during design.

Because areas of prime and unique farmland occupy the entire 1-mile width within this segment of the Yellow Corridor Alternative, they cannot be entirely avoided. The actual acreage of prime and unique farmland that may be affected would depend on track alignment, rail station locations, and proximity to existing ROW that may pass through prime and unique farmland. An alignment within or near existing linear transportation features, or within existing or planned urban areas, may minimize the loss of prime and unique farmlands.

Operational Impacts

Operation and maintenance of a passenger rail system generally within this segment of the Yellow Corridor Alternative would not be expected to affect geology, topography, soils, or prime and unique farmland. Because petroleum, oils, and lubricants would be used to operate and maintain the trains, potential for soil contamination exists; however, best management practices (BMPs) and routine maintenance of trains to prevent spills would minimize the potential risk.

Construction Impacts

Construction of a future passenger rail system in the Yellow Corridor Alternative from the southern hub to Eloy would require ground disturbance to clear construction areas of vegetation, to grade the land to appropriate levels of slope, and to establish staging and storage areas. The extent of ground disturbance would be identified in Tier 2 studies. The potential for soil erosion would increase in areas disturbed for construction from the time soil grading and vegetation removal is initiated until disturbed areas are reclaimed through the installation of long-term stabilizing features (such as building foundations or covering areas with gravel or crushed rock) or reestablishment of vegetation. While construction methods would not be identified until later phases, it is not anticipated that development of a passenger rail system would require pumping of groundwater or other activities that might result in new or expanded subsidence or fissure activity.

The potential for soils to erode by water and wind is influenced by the physical characteristics of the soil, slope gradient, vegetative cover, soil surface roughness, and proximity to shelters such as windbreaks, as well as rainfall or wind intensity. These factors would need to be examined in more detail in Tier 2 studies for a specific rail alignment.

Eloy to Northern Hub

Physical Impacts

Physical impacts of a passenger rail system in the Yellow Corridor Alternative from Eloy to the northern hub would be similar to those described above for the segment from the southern hub to Eloy. Subsidence areas and fissures to be avoided within the corridor alternative are most notable in this segment of the Yellow Corridor Alternative from Eloy to approximately 11 miles north of Eloy.

Operational Impacts

Operational impacts of a passenger rail system in the Yellow Corridor Alternative from Eloy to the northern hub would be similar to those described above for the segment from the southern hub to Eloy.

Construction Impacts

Construction impacts of a passenger rail system in the Yellow Corridor Alternative from Eloy to the northern hub would be similar to those described above for the segment from the southern hub to Eloy.

Orange Corridor Alternative

Southern Hub to Eloy

The physical, operational, and construction impacts of a passenger rail system in the Orange Corridor Alternative from the southern hub to Eloy would be the same as those described above for the Yellow Corridor Alternative from the southern hub to Eloy.

Eloy to Northern Hub

Physical impacts of a passenger rail system in the Orange Corridor Alternative from Eloy to the northern hub would be similar to those described above for the Yellow Corridor Alternative from Eloy to the northern hub. Operational and construction impacts in the Orange Corridor

Alternative from Eloy to the northern hub would be the same as those described above for the Yellow Corridor Alternative from the southern hub to Eloy.

No Build Alternative

Under the No Build Alternative, a new passenger rail system would not be built; and effects to geologic, topographic, soils, or farmland resources would not be anticipated beyond those that could occur due to other projects.

5.11.4 Potential Mitigation Measures

Mitigation for specific effects on geology, topography, soils, and Prime and Unique Farmlands would be identified based on the assessment conducted during Tier 2 analysis; however, a number of BMPs and other measures to mitigate for effects can be anticipated. These include:

- Avoid steep slopes and known bedrock outcrops
- Minimize areas of new ground disturbance for access to construction areas by using existing roads where possible
- Avoid areas of known ground subsidence and fissures, when feasible
- Develop and implement dust control and erosion control strategies
- Stockpile topsoil for use in reclamation
- Develop and implement a reclamation and revegetation plan to minimize soil losses

5.11.5 Tier 2 Considerations

Tier 2 analyses would consider project-level effects on geology, topography, soil, and prime and unique farmland. Design considerations would include the potential to avoid areas with greater degrees of slope, bedrock outcrops, known faults, subsidence areas, fissures, and prime and unique farmland. Environmental considerations would include a more detailed assessment of the amount of ground disturbance required and the erosion potential for disturbed soils. Because portions of the corridor alternatives consist entirely of prime or unique farmlands, a US Department of Agriculture (USDA) Form AD 1006 (Farmland Conversion Impact Rating form) would not be submitted to NRCS until Tier 2 documentation when the specific effects of a proposed project on prime and unique farmland are identified.

5.12 Biological Resources

Biological resources include general wildlife; plant and animal species that have received special designations by a federal, state, or local governmental agency; and the vegetative communities that provide habitat for these species. This chapter is intended to provide an overview of the biological resources in the vicinity of the corridor alternatives for a passenger rail system from Tucson to Phoenix and serves as a foundation for the analysis of potential effects on biological resources.

This EIS complies with FRA's Procedures for Considering Environmental Impacts (Environmental Procedures) (64 FR 28545, May 26, 1999) and FTA's Environmental Impact and Related Procedures (23 CFR Part 771). This evaluation follows FRA's Environmental Procedures Section 14(n)(5) for evaluation of potential impacts to natural ecological systems and Section 14(n)(7) for evaluation of potential impacts to endangered species (FRA 1999a).

5.12.1 Methodology and Regulatory Requirements

Primary jurisdiction for resident wildlife management is implemented on behalf of the State by the Arizona Game and Fish Department (AGFD), except where pre-empted by federal law (e.g., Endangered Species Act [ESA] listed species). Protected species are species of plants or animals that, because of their scarcity or documented declining population numbers in the state or nation, have been designated by a federal, state, or local governmental agency as having special status for protection and/or management. Regulatory compliance requirements vary based on the authorities under which the species has received designation. The regulatory framework pertaining to natural habitats and wildlife includes the following key federal and state statutes, executive orders, and agency and local government policies:

Federal

Endangered Species Act

The Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. § 1531 *et seq.*) provides a means whereby the ecosystems upon which endangered and threatened species depend may be conserved and provides a program for the conservation of such endangered and threatened species (Section 1531[b], Purposes). All federal agencies are to seek to conserve endangered and threatened species and utilize applicable authorities in furtherance of the purposes of the ESA (Section 1531[c][1], Policy). The U.S. Fish and Wildlife Service (USFWS) has primary administrative responsibility under the ESA for terrestrial and freshwater organisms, and is responsible for the listing of plant and animal species under the ESA on the basis of the best scientific and commercial data available on the species' biological status and threats to its existence. Species listed as threatened or endangered, or proposed for such listing, have specific protections under the ESA. All federal agencies are required to consult (or confer) with USFWS (and/or the National Marine Fisheries Service for marine species) in accordance with Section 7 of the ESA if the agency determines that any proposed action may affect a listed species. Each agency must ensure that any federal action or activity is not likely to jeopardize the continued existence of any species listed or proposed to be listed under the ESA, or result in the destruction or adverse modification of designated or proposed critical habitat (Section1536[a], Interagency Cooperation, and 50 CFR 402). Section 9 of the ESA prohibits any "take" (as defined in the ESA: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of a listed species. Section 10 of the ESA allows for exemptions to the take prohibition, based on incidental take statements issued in accordance with Biological Opinions issued under Section 7 consultation or other authorized permits.

Categories of species listed under the ESA are as follows:

- **Endangered:** Species of plants or animals that have been identified by USFWS or NMFS as being in danger of extinction throughout all or a significant portion of its range.
- **Threatened:** Species of plants or animals that have been identified by USFWS or NMFS as being likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
- **Proposed:** Species identified by USFWS under the ESA that are proposed in the Federal Register to be listed as threatened or endangered.
- **Candidate:** Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list them as endangered or threatened.
- **Critical Habitat:** Specific geographic areas (whether occupied by listed species or not) that are determined to be essential for the conservation and management of some threatened or endangered species.
- **Conservation Agreement:** Though not an official listing category, conservation agreement species have special management plans that obligate land and resource management agencies or other entities to certain conservation actions. The implementation of these plans often provides the basis upon which USFWS has precluded listing under the ESA.
- **Petitioned:** Plant or animal species that have been formally requested to be listed by the USFWS or National Marine Fisheries Service under the ESA.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA), as amended (16 U.S.C. § 703-712), is the domestic law that affirms, or implements, the United States' commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource. Each of the conventions protects selected species of birds that occur in both countries at some point during their annual life cycle. The MBTA protects migratory birds and their nests, eggs, young, and parts from possession, sale, purchase, barter, transport, import, export, and take. For purposes of the MBTA, take is defined as “to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect” (50 CFR 10.12). The MBTA applies to migratory birds identified in 50 CFR 10.13. Generally speaking, the MBTA protects all birds occurring in the United States except for several nonnative species (e.g., house sparrow, European starlings, and rock pigeons), and non-migratory upland game birds. The USFWS implements and enforces the MBTA; is the lead federal agency for managing and conserving migratory birds in the United States; regulates the take of migratory birds for educational, scientific, and recreational purposes; and requires that harvests be limited to levels that prevent overutilization. Special Purpose Permits under 50 CFR 2l.27 of the MBTA are required in the event that an action would take, possess, or involve the sale or transport of birds protected by the MBTA.

Executive Order 13186

Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (10 January 2001) directs federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a Memorandum of Understanding with USFWS that promotes the conservation of migratory bird populations within two years of the date of the order. The order outlines specific requirements of the Memorandum of Understanding and 15 conservation measures that agencies are encouraged to immediately begin implementing, as appropriate and practicable.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act of 1940 (BGEPA), and as amended (16 U.S.C. § 668–668d), prohibits anyone without a permit issued by USFWS from “taking” bald or golden eagles including their parts, nests, or eggs. The BGEPA defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” For purposes of these guidelines, “disturb” means “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”

Bureau of Land Management Special Status Species Policy

Under the authorities of the Federal Land Policy Management Act of 1976 (43 U.S.C. § 1701 *et seq*.), the Bureau of Land Management (BLM) manages BLM-administered lands in accordance with the regulatory framework of the “multiple use” mandate. Special status species are managed in accordance with *Manual 6840, Special Status Species Management*. The manual establishes policy to manage species listed or proposed for listing pursuant to the ESA and BLM sensitive species which are found on BLM-administered lands. The BLM special status species policy aims to conserve and/or recover listed species and their habitats and to initiate proactive conservation measures that reduce or eliminate threats to BLM sensitive species to prevent them from requiring listing in the future. The BLM Handbook 6840 defines special status species as: 1) species listed or proposed for listing under the ESA; and 2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA, which are designated as BLM sensitive by the BLM State Director(s).

Executive Order 13112

Executive Order 13112, Invasive Species (64 FR 6183 *et seq*.) requires federal agencies to identify actions that may affect invasive species, use relevant programs to prevent introduction of invasive species; detect, respond, and control such species; monitor invasive species populations; provide for restoration of native species; conduct research on invasive species; and promote public education.

State of Arizona

Title 17 of the Arizona Revised Statutes, Game and Fish

The responsibility for maintenance and management of the state's wildlife resources lies with the Arizona Game and Fish Commission and AGFD. Arizona Revised Statutes (ARS) 17-102 establishes that most wildlife in Arizona is the property of the state. ARS 17-231 establishes that through the Commission, that the AGFD may establish policies and programs for the management, preservation, and harvest of wildlife; establish hunting, trapping, and fishing rules and prescribe the manner and methods which may be used in taking wildlife; enforce laws for the protection of wildlife; and develop and distribute information about wildlife and activities of the AGFD. Under the authority of ARS 17-201 *et seq.*, AGFD establishes detailed rules for licenses and permits, taking and handling of wildlife, possession of live wildlife, heritage grants, and wildlife areas among others.

Based on the authorities granted by ARS 17, AGFD maintains lists of wildlife species of concern (AGFD 1996). The 1996 list of Wildlife of Special Concern in Arizona remains in draft form and is pending approval from the Arizona Game and Fish Commission. This list identifies species in Arizona that may be in jeopardy due to known or perceived threats or population declines. The listing of wildlife as Wildlife of Special Concern in Arizona is intended to indicate to land management agencies those species that should be emphasized in habitat management from AGFD's perspective.

Arizona has developed a proactive State Wildlife Action Plan (comprehensive wildlife action strategy) to assess the health of wildlife and determine strategies to conserve the state's numerous wildlife species, including the full array of wildlife as well as those in greatest need of conservation, and their associated habitats. A component of the State Wildlife Action Plan identified Species of Greatest Conservation Need as well as Species of Economic and Recreation Importance, and the need for strategies to minimize and offset potential impacts to these species.

Arizona Native Plant Law

The Arizona Native Plant Law of 1993 (ARS 7, 3-901 *et seq.*) is administered by the Plant Industries Division of the Arizona Department of Agriculture. The law identifies protected plants belonging to the following four categories:

- **Highly Safeguarded***:* Those Arizona native plants whose prospects for survival in the state are in jeopardy or that are in danger of extinction throughout all or a significant portion of their ranges, or are likely to become so in the foreseeable future, including federally listed species.
- **Salvage Restricted***:* Those Arizona native plants that are not included in the highly safeguarded category but are subject to damage by theft or vandalism.
- **Salvage Assessed***:* Those Arizona native plants that are not included in either the highly safeguarded or salvage restricted category but have a sufficient value if salvaged to support the cost of salvage.
- **Harvest Restricted***:* Those Arizona native plants that are not included in the highly safeguarded category but are subject to excessive harvesting or overcutting because of their intrinsic value.

The most protective category, and the category most directly parallel to the protection afforded wildlife species, is highly safeguarded. Species falling into the salvage restricted, salvage assessed, or harvest restricted categories pertain to the commercial salvage; removal for sale; and harvest of certain plant species that are vulnerable to theft, vandalism, or over-utilization. Protection for these native species is through a process of notification to the Arizona Department of Agriculture prior to destruction of the plants.

Arizona Executive Order 13112

Arizona Invasive Species Executive Order 13112, dated February 3, 1999, establishes that all projects will, "subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: 1) prevent the introduction of invasive species; 2) detect and respond rapidly to, and control, populations of such species in a cost-effective and environmentally sound manner; 3) monitor invasive species populations accurately and reliably; and 4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded." In Arizona, an invasive species is one that is not native to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health (AGFD 2013c).

Pima County

Pima County Native Plant Ordinance

The Pima County Native Plant Ordinance (Pima County Zoning Code §§ 18.72.500-508) establishes that when natural lands are to be developed, a Native Plant Preservation Plan may be required for the conservation of native species and setting aside lands as open space.

Pima County Sonoran Desert Conservation Plan

The Pima County Sonoran Desert Conservation Plan (SDCP), passed in 1998 (Pima County Resolution 1998-250), is part of a land management plan for the County that incorporates conservation and protection of natural and cultural resources with community development. The plan, which entered into an agreement with the Department of the Interior (USFWS), considered the following elements: critical habitats and biological corridors, riparian areas, mountain parks, historical and cultural preservation, and ranch conservation. The land-use policies and conservation principles developed from the SDCP were incorporated into the 2001 Pima County Comprehensive Land Use Plan. A Multi Species Conservation Plan, a component of the SDCP, manages compliance with the ESA. Primary Conservation Areas are established for individual species to maintain sufficient habitat and guide development in those areas. The Conservation Lands System (CLS), also a result of the SDCP, identifies lands for conserving open space and habitat for native species in relation to those lands suitable for development. The CLS established Special Species Management Areas, Multiple Use Management Areas, and Important Riparian Areas with guidelines for maintaining natural open space within these areas. Pima County conservation of native wildlife and plant species and land management are guided by these plans.

Methodology

For the analysis of potential impacts of a passenger rail system to biological resources, GIS-based data were used to evaluate the corridor alternatives from a landscape perspective by overlaying the corridor alternatives with biological resource data, such as vegetation communities, wildlife corridors and habitat linkage zones, special land management designations that preserve natural habitat, unfragmented habitat blocks, riparian and wetland areas, waterways, special status species occurrences, and the degree to which adjacent land uses may have modified natural habitat. Online data sources available from USFWS and AGFD were used to acquire relevant site-specific data. The assessment considered the sensitivity of each of these resource categories and their associated wildlife, wildlife habitat, and each of their special status species to disturbances and habitat loss.

As a result of ADOT's coordination with agency stakeholders, AGFD provided an independent analysis of the corridor alternatives (see the *Natural Habitats and Wildlife Appendix*).

5.12.2 Existing Conditions

The three-county study corridor crosses a large geographic area within the Sonoran Desert region of Arizona, spanning a distance of approximately 115 miles from Tucson north to Phoenix. The corridor alternatives include some lands that are in mostly natural condition, as well as lands that have been highly modified for urban and agricultural purposes. Generally, as the corridor alternatives approach the vicinity of Tucson and Phoenix, natural habitats become increasingly degraded, giving way to agricultural and urban development. Transportation facilities such as an interstate highway, state highways, local roadways, and existing railroads are included within portions of the corridor alternatives. The Central Arizona Project (CAP) canal runs adjacent to segments of the corridor alternatives. This section of the Tier 1 EIS describes in general the biotic communities, wildlife and their associated movement corridors, and habitat for special status plant and animal species expected in the vicinity of the corridor alternatives.

Biotic Communities

The two corridor alternatives being evaluated in this Tier 1 EIS are within the Sonoran Desert, one of the largest and hottest deserts in North America. The corridor alternatives range in elevation from approximately 2,400 feet elevation in Pima County (Tucson area) down to approximately 1,100 feet elevation in Maricopa County (Phoenix area). The topography crossed by the corridor alternatives consists primarily of broad, flat, low-lying desert valleys and bajadas (i.e., alluvial fans) within the general vicinity of various isolated mountain ranges (e.g., the Tortolita Mountains, Picacho Peak, Picacho Mountains, Superstition Mountains, Sierra Estrella

Mountains, and South Mountain) and dry river systems (e.g., Santa Cruz, Gila, and Salt rivers, and Queen Creek Wash).

Natural habitats of the Sonoran Desert biotic community in the vicinity of the corridor alternatives are primarily represented by two major vegetation subdivisions (also referred to as vegetation series): 1) the Lower Colorado River Valley Sonoran Desertscrub; and 2) the Arizona Upland Sonoran Desertscrub (Turner 1982). In addition, Desert Wash Mixed Scrub communities follow wash channels crossing both subdivisions, and remnant stands of Sonoran Riparian Deciduous Forests and mesquite bosques (i.e., woodlands) are scattered along the major drainage systems in the region. Precipitation, though unreliable and uneven, follows a bimodal pattern, with rains primarily in the summer and winter (see **Figure 5-16).**

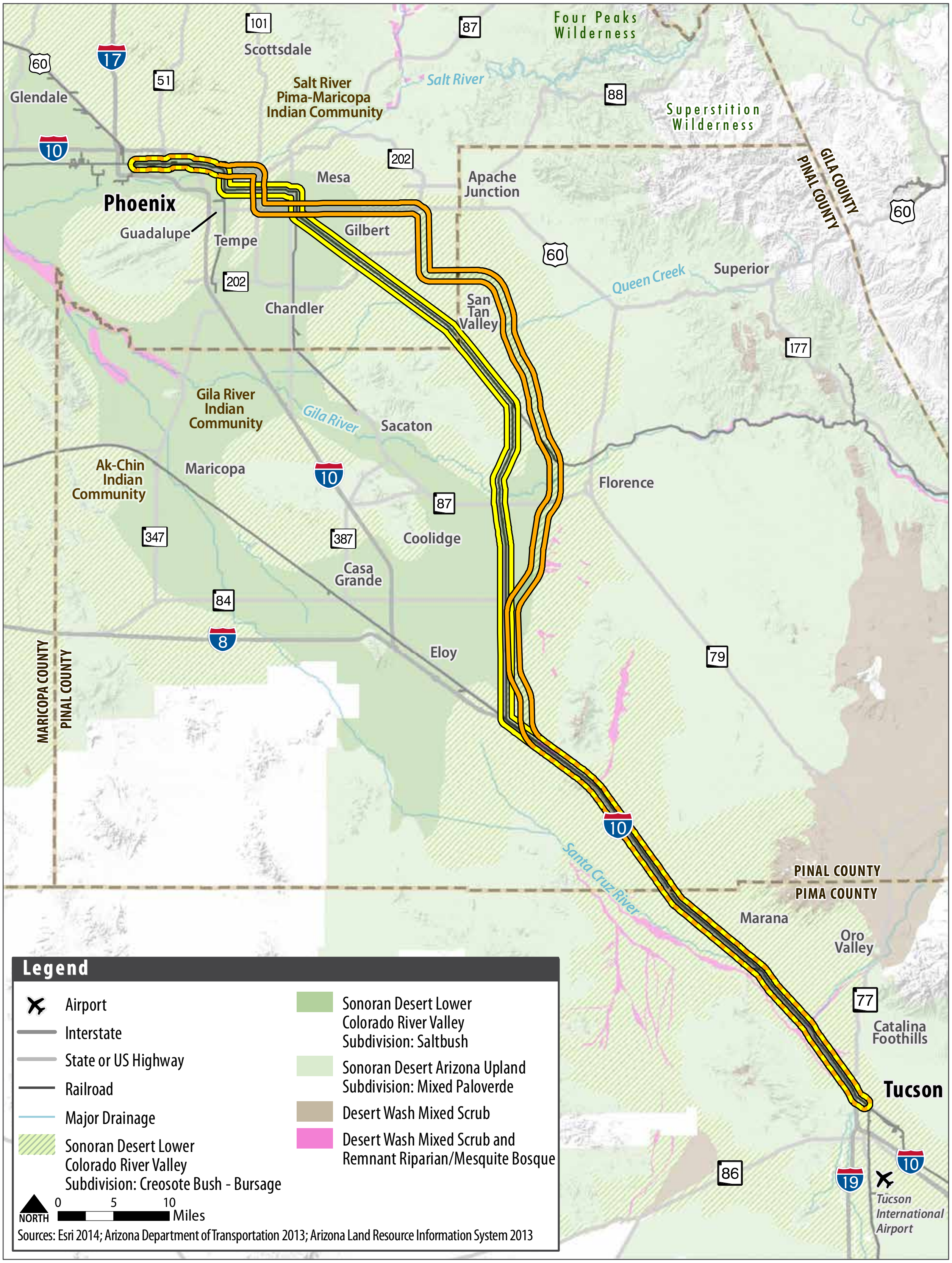
Past and ongoing development activities between Tucson and Phoenix have resulted in the loss of vast areas of native plants and extensive conversion of desert habitats to agricultural fields, irrigation canals, housing developments, golf courses, transportation ROW, and abandoned lands. Roads, railroads, and property and ROW fencing have influenced wildlife movement patterns and denied wildlife access to many areas. High-speed traffic and human activities have resulted in the deaths of many animals.

Sonoran Desert Lower Colorado River Valley Subdivision

The Lower Colorado River Valley Subdivision occurs mostly on the valley floors and is represented by creosote bush and white bursage associations, often with or replaced by several species of saltbush. The various creosote bush desertscrub associations typically occur where soil composition is proportionately high in silt and clay. Other plant species that may be present, often on rocky slopes, in gravelly soils, or along dry washes, include various species of shrubs (e.g., jojoba, cholla, ocotillo, and brittlebush) and scattered trees (e.g., foothill palo verde, mesquite, ironwood, and saguaro) (Turner and Brown 1982).

The presence of wildlife species is often in response to soil conditions that influence vegetative diversity, density, and structure. At the base of plants in creosote bush habitats where the soils are friable (i.e., not compacted or hardpan), many rodent burrows are often found that may also be used by many species of lizards and snakes. In areas where the shrubs provide a relatively dense canopy cover, species such as pocket mice, deer mice, and side-blotched lizards may be found; open areas and where canopy cover is sparse provide habitat for species such as kangaroo rats, burrowing owls, and zebra-tailed lizards. Creosote bush habitats are notably lacking in breeding bird diversity, due in part to the limited vegetative structural diversity (Turner and Brown 1982). Birds commonly breeding in these habitats include black-throated sparrow, common poorwill, and lesser nighthawk. The abundance of rodents inhabiting these

Figure 5-16. Vegetation Communities throughout the Study Area



areas attracts a variety of predators such as coyote, kit fox, American badger, and, seasonally, various avian birds of prey such as red-tail hawk and American kestrel.

The two corridor alternatives intersect four major desert river systems—the Salt, Gila, and Santa Cruz rivers and Queen Creek Wash. These rivers are largely dewatered, have limited flows associated with storm events or effluent runoff (e.g., the Santa Cruz River near Marana), or include managed waters in urban settings (e.g., Tempe Town Lake). Remnant stands of riparian vegetation occur where subsurface flows rise and are available to cottonwood, willow, and salt cedar trees. In addition, mesquite bosques, greatly reduced in extent from historic times, are associated with floodplains of major river systems. No permanent natural aquatic habitats or flowing streams are present within the corridor alternatives.

Sonoran Desert Arizona Upland Subdivision

Arizona Upland Subdivision habitat is characterized by greater diversity of vegetation and more complex vertical structure (Turner and Brown 1982). It is primarily found on mountains, hills, bajadas, and rocky slopes and consists primarily of the palo verde-mixed cacti-mixed scrub associations. The Arizona Upland Subdivision comprises a variety of trees, shrubs, and cacti, as well as those species represented in the Lower Colorado River Valley Subdivision. This community is often dominated by palo verde, saguaro, and various shrubs, including triangle-leaf bursage. Along the two corridor alternatives, the Arizona Upland Subdivision reaches its greatest development on the bajadas in the Picacho Pass vicinity but is still largely transitional with the Lower Colorado River Valley Subdivision.

Arizona Upland habitats support a diverse wildlife community which includes desert bighorn sheep, mule deer, javelina, coyote, black-tailed jackrabbit, desert tortoise, numerous species of lizards and snakes (e.g., western whiptail lizard, collared lizard, common kingsnake, long-nosed snake, and western diamondback rattlesnake) and a variety of desert-adapted amphibians (e.g., Sonoran desert toad, Great Plains toad, and Couch's spadefoot toad). Caves, crevices, abandoned mineshafts found in the nearby mountains, and highway bridges and box culverts associated with transportation corridors provide roosting and nursery colony sites for many bat species. Many species of breeding birds also occur in these habitats including Gambel's quail, turkey vulture, Harris hawk, Gila woodpecker, Say's phoebe, and curved-billed thrasher. Many other bird species commonly migrate through or winter in Arizona Upland habitats. The Arizona Upland community includes most of the species within the Lower Colorado River Valley community but often at higher densities; however, many of the species from the Arizona Upland community are not found within the hotter and drier Lower Colorado River Valley community.

Desert Wash Mixed Scrub and Remnant Riparian Habitats

Often referred to as xeroriparian communities, desert washes generally include many of the same plant species found in upland areas, achieving more lush growth and greater densities due to the increased availability of surface and/or subsurface water. Blue palo verde, ironwood, and mesquite are important trees along these washes. Also, big galleta, a drought-tolerant native grass, is often found along washes and drainage channels. Its dense, clumped growth form captures soils and reduces the potential for soil erosion and provides cover for small mammals, reptiles, and birds.

Desert washes and riparian vegetation provide diverse wildlife habitats. Wildlife, especially birds, large mammals, and invertebrates, make disproportionate use of desert washes and riparian habitat in comparison to surrounding communities. The increased diversity and density of vegetation along the washes provide more seeds and vegetation for herbivores, prey for predators, a variety of nest and perch sites, hiding and thermal cover, movement corridors, and moisture for wildlife than is available in surrounding habitats. Organic material composed of leaf litter and other vegetative debris that is present within the xeroriparian and riparian communities provides an important source of nutrients for plants and animals, as well as providing cover and nesting material for some animals.

Xeroriparian and riparian habitats support a diverse array of nesting bird species and represent an important stop-over habitat for migrating birds. Representative breeding species include western screech-owl, verdin, black-tailed gnatcatcher, and Lucy’s warbler. Where deciduous riparian trees are present, numerous other birds may be found, including summer tanager, kingbirds, and vermillion flycatcher; the larger the stand of riparian trees, the greater the diversity of the bird community. Neotropical migrants such as western tanager, MacGillivray’s warbler, Swainson’s thrush, ruby-crowned kinglet, and tree swallow pass through the Southwest deserts during the flowering periods of palo verde, mesquite, and ironwood. These flowering events support a rich insect fauna which provides forage for a variety of migrating and resident birds and bats.

Large mammalian species, such as mule deer, depend on xeroriparian and riparian habitats for forage, shade, cover, and secluded areas for fawning. Habitat complexity along rivers, washes, and drainage channels due to their associated bordering vegetation represent very important movement corridors for wildlife. Small mammals forage on the seeds and/or other vegetation from the relatively rich flora associated with the xeroriparian and riparian communities. The insectivorous California leaf-nosed bat, which does not hibernate or migrate, forages year-round along these dry washes. Many reptile species also occur in xeroriparian habitats where lizards forage on a diversity of insects, and rodents and lizards are available for snakes.

Wildlife Linkages

Large mammals, such as mule deer, desert bighorn sheep, javelina, bobcat, and mountain lion may range widely across the landscape in search of food and water or in response to changing environmental factors, often following seasonal movement patterns. Drainage channels lined with dense vegetation are often used as corridors for wildlife movement, providing both cover and forage. Natural and man-made barriers to wildlife movement may prevent animals from reaching important resources and/or limit the availability of habitats that may otherwise become occupied.

Man-made features such as highways, fences, railroads, and irrigation canals found throughout the vicinity of the corridor alternatives may become partial or complete barriers to movement of some wildlife species. Major transportation corridors in the vicinity of the corridor alternatives include I-10, SR 87, and the UP railroad. The effect of highways as barriers to large mammal movements may be attributed to ROW fencing, traffic volume, noise, human presence, and possibly the speed of traffic. Additionally, surrounding land uses may reduce wildlife access to traditional movement corridors. Animal movements may be restricted by areas of sparse vegetation cover, especially in areas of human activity. Though most animals would typically move across the landscape using natural corridors such as washes, some individuals are also likely to cross open roadways, increasing the potential for vehicle-wildlife collisions.

The Arizona Wildlife Linkages Workgroup (AWLW) is a cooperative effort among ADOT, USFWS, BLM, AGFD, and other federal and state agencies, academic institutions, and conservation organizations. This workgroup identified 152 potential habitat linkage zones in Arizona that are important to wildlife, 28 of which were recognized as high priority (AWLW 2006). Linkages address habitat fragmentation and connectivity among habitat blocks used by wildlife. The corridor alternatives intersect four wildlife linkage zones; the lengths of these intersections are shown in **Table 5-19**. These numbers are a function of the corridor alternatives' length; changing the corridor width would have no effect on the numbers. None of the linkage zones intersected was ranked as high priority from a statewide perspective. Wildlife linkage zones are continually refined through county-level habitat connectivity assessments and have been expanded to recognize diffuse movement areas for wildlife, riparian corridor movement areas, and landscape level movement areas (**Figure 5-17**). Various wildlife movement corridors intersect with the two corridor alternatives.

Table 5-19. Wildlife Linkage Zones Intersecting the Yellow and Orange Corridor Alternatives

Linkage	Yellow Corridor Alternative (miles)	Orange Corridor Alternative (miles)
Saguaro-Tortolita	55.98	5.98
Ironwood-Tortolita	4.08	4.08
Central Arizona Project Canal	8.15	21.77[a]
Queen Creek-Gila River Indian Community	2.09	1.10
Source: AWLW 2006		
[a]The Orange Corridor Alternative parallels and encompasses more than 20 miles of CAP Canal ROW		

AWLW has also identified habitat fracture zones, which are areas of reduced wildlife movement. Fracture zones occur in Arizona State Trust Land, private holdings, and transportation corridors. Within these zones, roads, railroads, border security operations, and other built features and human activity limit or prevent animal movement or threaten to do so in the foreseeable future. Washes, streams, and rivers in these fracture zones may continue to serve in some capacity as wildlife movement corridors. Certain types of improvements to culverts and bridges can help to promote wildlife movement (AWLW 2006). A passenger rail system may present opportunities to improve wildlife connectivity by siting the corridors to minimize habitat and connectivity fragmentation, identifying current and potential important wildlife movement areas, and designing facilities to provide maximum permeability for safe wildlife movement.

While most lands within the corridor alternatives are privately owned, other land owners in the corridor alternatives include Bureau of Reclamation, BLM, National Park Service, tribal lands (Gila River Indian Reservation and Salt River Pima-Maricopa Indian Reservation), ADOT, Arizona State Parks, and Arizona State Land Department (ASLD) (see Table L-3 in the *Land Use Appendix*). Public lands within the corridor alternatives administered by BLM are managed for multiple use, such as habitat management, grazing by livestock, and recreation. No USFWS-managed national wildlife refuges, national forests managed by the US Forest Service, or designated wilderness areas are located within the corridor alternatives; however, some lands in close proximity to the corridor alternatives are minimally developed and may serve as habitat for wildlife.

Figure 5-17. Wildlife Linkages within the Study Corridor

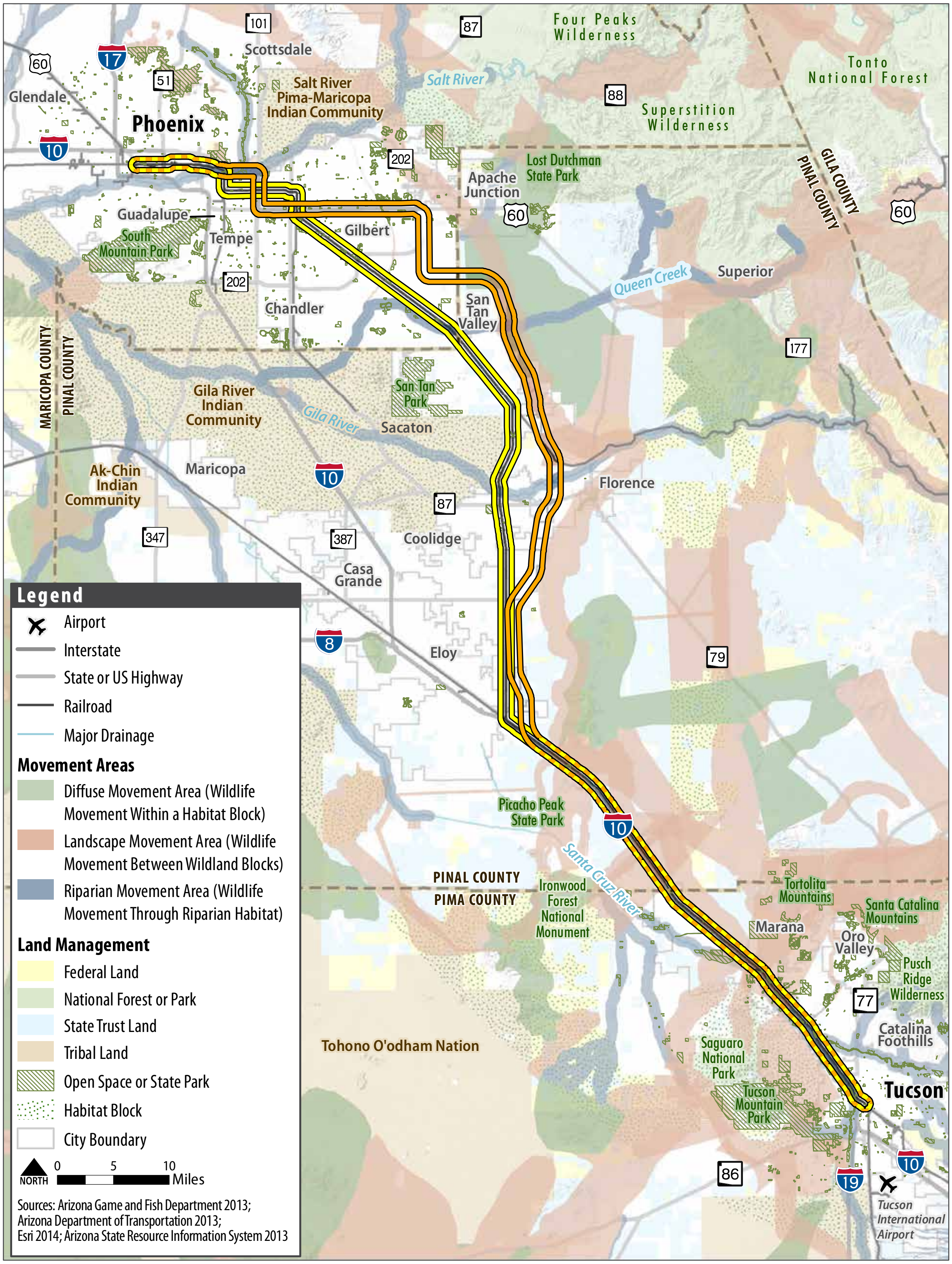


Table 5-20 identifies land ownership and specially designated land management areas near the corridor alternatives and the nearest distance to the identified lands.

Table 5-20. Proximity of the Yellow and Orange Corridor Alternatives to Specially Designated Lands

Special Land Management Designation (listed from south to north)	Nearest Distance to the Yellow Corridor Alternative
Saguaro National Park	1.19 miles
Pusch Ridge Wilderness	5.23 miles
Coronado National Forest	5.14 miles
Ironwood Forest National Monument	4.53 miles
San Tan Mountain Regional Park	2.46 miles
Tonto National Forest	9.96 miles
Papago Park	1.25 miles

The Corridor Alternatives encroach within the borders of Picacho Peak State Park, administered by Arizona State Parks, between Marana and Eloy. The corridor is located along the edge of the park, so that portions of its 1-mile width encroach within the park boundary while other parts of the corridor lie outside the park.

Special Status Species

Special status species include plant and animal species that have received special designations by a federal, state, or local governmental agency due to concerns of rarity and/or a species' sensitivity to perturbations in the environment.

ESA Species

Species lists and information available online from the USFWS Information, Planning, and Conservation system (IPAC) (accessed November 4, 2014; species status designations updated February 2015) on ESA-threatened, endangered, proposed, candidate, petitioned, and conservation agreement species potentially occurring in Pima, Pinal, and Maricopa counties were reviewed to determine if any of these species could potentially occur in the vicinity of the corridor alternatives. Each ESA species included on the USFWS IPAC list is addressed in **Table 5-21**, providing information on habitat and distribution to determine the likelihood that habitat for the species may be present in the vicinity of the corridor alternative.

Table 5-21. Endangered Species Act Species occurring in Pima, Pinal, and Maricopa Counties, Arizona, and Their Potential to Occur in the Vicinity of the Yellow and Orange Corridor Alternatives

Common Name	Scientific Name	Status	Habitat Requirement	Potential to Occur
Birds				
cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Petitioned (Pima)	Areas of desert woodlands with tall canopy cover. Primarily found in Sonoran desertscrub and occasionally in riparian drainages and woodlands within semi-desert grassland communities. Prefers to nest in cavities in saguaro cacti but has been found in low-density suburban developments that include natural open spaces. Elevation less than 4,000 feet	Suitable habitat may occur throughout the vicinity of the corridor alternatives. A special species management area has been identified by Pima County east of I-10 between Tucson north to the county line.
California least tern	*Sterna antillarum browni*	E	Open, bare, or sparsely vegetated sand, sandbars, gravel pits, or exposed flats along shorelines of inland rivers, lakes, reservoirs, or drainage systems. Elevation less than 2,000 feet	If present, most likely to occur as migrants; occasional breeding documented in Arizona. Though not documented in the vicinity of the corridor alternatives, habitat may possibly occur at Picacho Reservoir in some years.
Mexican spotted owl	*Strix occidentalis lucida*	T	Nests in canyons and dense forests with multilayered foliage structure. Elevation ranges between 4,100 and 9,000 feet	No suitable habitat within the vicinity of the corridor alternatives.
southwestern willow flycatcher	*Empidonax trailii extimus*	E (Pima)	Cottonwood/willow and tamarisk vegetation communities along rivers and streams. Elevation less than 8,500 feet	Though not documented along the Salt River, suitable habitat may occur in the vicinity of the corridor alternatives upstream of Tempe Town Lake. A special species management area has been identified by Pima County east of I-10 between Tucson north to the county line.

Table 5-21. Endangered Species Act Species occurring in Pima, Pinal, and Maricopa Counties, Arizona, and Their Potential to Occur in the Vicinity of the Yellow and Orange Corridor Alternatives

Common Name	Scientific Name	Status	Habitat Requirement	Potential to Occur
Sprague's pipit	*Anthus spragueii*	C	Strong preference to native grasslands with vegetation of intermediate height and lacking woody shrubs. Elevation less than 5,000 feet	Species current geographic range is outside the vicinity of the corridor alternatives.
western yellow-billed cuckoo	*Coccyzus americanus*	T PCH (WSC, Pima)	Large blocks of riparian woodlands; cottonwood, willow, or tamarisk galleries. Proposed Critical Habitat includes Picacho Reservoir. Elevation less than 6,500 feet	Proposed critical habitat in the vicinity of the corridor alternatives includes Picacho Reservoir. Additionally, suitable habitat may occur in association with Santa Cruz, Gila, and Salt rivers in the vicinity of the corridor alternative.
Yuma clapper rail	*Rallus longirostris yumanensis*	E	Freshwater and brackish marshes. Elevation less than 4,500 feet	Old occurrence records at Picacho Reservoir, with potentially suitable habitat associated with the Gila and Salt rivers in the vicinity of the corridor alternatives.
Fish				
roundtail chub	*Gila robusta*	C	Cool to warm waters of rivers and streams; occupies deepest pools and eddies of large streams. Elevation ranges between 1,000 and 7,500 feet	Species geographic range is outside the vicinity of the corridor alternatives.
Mammals				
jaguar	*Panthera onca*	E	Found in Sonoran desertscrub up through subalpine conifer forest. Elevation ranges between 1,600 and 9,000 feet	Species current geographic range is outside the vicinity of the corridor alternatives.

Table 5-21. Endangered Species Act Species occurring in Pima, Pinal, and Maricopa Counties, Arizona, and Their Potential to Occur in the Vicinity of the Yellow and Orange Corridor Alternatives

Common Name	Scientific Name	Status	Habitat Requirement	Potential to Occur
lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	E (WSC, Pima)	Desertscrub habitat with agave and columnar cacti present as food plants. Day roosts in caves and abandoned tunnels. Forages at night on nectar, pollen, and fruit of paniculate agaves and columnar cacti. Species is migratory and present in Arizona usually April to September. Elevation ranges between 1,600 and 7,500 feet	Known occurrences within the vicinity of the corridor alternatives south of the Gila River. Foraging habitat may occur in association with stands of saguaro or agave.
Sonoran pronghorn	*Antilocapra americana sonoriensis*	E	Broad intermountain alluvial valleys with creosote-bursage and palo verde-mixed cacti associations. Elevation ranges between 2,000 and 4,000 feet	Species current geographic range is outside the vicinity of the corridor alternatives.
Reptiles				
northern Mexican gartersnake	*Thamnophis eques megalops*	T PCH (WSC)	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests. Elevation ranges between 130 and 8,500 feet	Suitable habitat in Pima County associated with the Santa Cruz River system in the vicinity of the corridor alternatives.
Sonoran desert tortoise	*Gopherus morafkai*	C* (WSC)	Primarily rocky hillsides (often steep) and bajadas of Mohave and Sonoran desertscrub; but may encroach into desert grassland, juniper woodland, interior chaparral habitats, and even pine communities. Washes and valley bottoms may be used in dispersal. Elevation less than 7,800 feet	Suitable habitat exists throughout desert habitats in the vicinity of the corridor alternatives.
Sonoyta mud turtle	*Kinosternon sonoriense longifemorale*	C (WSC)	Ponds and streams. Found only in Quitobaquito Springs in Organ Pipe Cactus National Monument, Arizona. Species also occurs in Rio Sonoyta, Sonora, Mexico. Elevation less than 1,100 feet	Species geographic range is outside the vicinity of the corridor alternatives.

Table 5-21. Endangered Species Act Species occurring in Pima, Pinal, and Maricopa Counties, Arizona, and Their Potential to Occur in the Vicinity of the Yellow and Orange Corridor Alternatives

Common Name	Scientific Name	Status	Habitat Requirement	Potential to Occur
Plants				
Pima pineapple cactus	*Coryphantha scheeri* var. *robustispina*	E (HS, Pima)	Sonoran desertscrub or semidesert grassland communities. Elevation ranges between 2,300 and 5,000 feet	Species geographic range is outside the vicinity of the corridor alternatives.

Source: USFWS IPAC 2014.

E = Listed as Endangered under the ESA;
T = Listed as Threatened;
PT = Proposed for Listing as Threatened;
C = Candidate species for listing;

Petitioned = Petitioned for Listing;
PCH= Proposed Critical Habitat
WSC = Wildlife of Special Concern in Arizona
HS = Highly Safeguarded under Arizona Native Plant Law
Pima = Species of Special Concern in Pima County

*Sonoran desert tortoise was removed from the ESA-listed species, and a Candidate Conservation Agreement was signed between USFWS, ADOT, AGFD, and several federal agencies in May 2015.

State Designated Species of Special Concern and Protected Native Plants; BLM Sensitive Species; and Pima County Species of Special Concern

The AGFD Environmental Review Online Tool was accessed July 2013 (Online Tool receipt AGFD 2013b). **Table 5-22** lists special status species with occurrence records within 3.0 miles of the corridor alternatives as recorded in AGFD's Heritage Data Management System, the most comprehensive listing of rare species data for the state. This table includes AGFD Species of Special Concern in Arizona, plants listed by the Arizona Department of Agriculture as highly safeguarded under the Arizona Native Plant Law, BLM designated sensitive species, and Pima County Species of Special Concern. **Table 5-22** includes information on species habitat and distribution to determine the likelihood that habitat for these species may be present in either of the two corridor alternatives. Species previously noted in **Table 5-21** based on their ESA status that also hold special status on the state or BLM lists are referenced only in **Table 5-21** and not repeated in **Table 5-22**.

State Designated Species of Greatest Conservation Need and Species of Economic and Recreation Importance

The AGFD Environmental Review Online Tool lists species of high conservation need and species of economic importance. Species that the State identified as most in need of conservation actions are evaluated through the distribution and abundance of the species, including low and declining populations that are indicative of the diversity and health of the State's wildlife. These species are ranked based on vulnerability criteria, including whether still present in Arizona, their federal or state status, their numbers and concentration, and their distribution, demographics, and extent of fragmentation. They are then tiered with those that are vulnerable designated a 1A, and those being vulnerable but not falling within other conservation criteria designated a 1B species.

Species that generate revenue, provide spending opportunities, or support jobs within the State's economy include those that are hunted, fished, and/or are valued for watchable wildlife recreation opportunities. **Table 5-23** includes Species of Greatest Conservation Need and Species of Economic and Recreation Importance that would have potential to occur along a passenger rail system within the selected corridor.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Amphibians				
lowland leopard frog	*Rana yavapaiensis*	BLM WSC	Sonoran Desert, grassland, oak and oak-pine woodland in rivers, streams, cienegas, springs, stock tanks, canals, irrigation sloughs, and backyard ponds/pools. Elevation ranges between 480 and 6,200 feet	Suitable habitat is present in the vicinity of the corridor alternatives; frogs may occur where suitable water sources are present.
western narrow-mouthed toad	*Gastrophryne olivacea*	BLM WSC Pima	Mesquite semi-desert grassland to oak woodland near streams, springs, or rain pools. Elevation less than 4,700 feet	Suitable habitat is present in Pima County primarily associated with the Santa Cruz River system; individuals documented from the vicinity of the corridor alternatives.
Birds				
Abert's towhee	*Melozone aberti*	Pima	Associated with brushy understory of cottonwood-willow riparian habitat and mesquite bosques along stream sides in the lower Colorado River and Gila River valleys. Elevation range less than 4,000 feet	Suitable habitat is present in the vicinity of the corridor alternatives in Pima County.
bald eagle	*Haliaeetus leucocephalus*	BLM WSC	Large trees or cliffs near water (reservoirs, rivers, and streams) with abundant prey; varies in elevation.	Species known to nest and forage along Salt River within the vicinity of the corridor alternatives.
Bell's vireo	*Vireo bellii*	Pima	Dense, low, shrubby vegetation associated with willows, streamside thickets, chaparral, woodland edges and riparian areas.	Suitable habitat is present in the vicinity of the corridor alternatives in Pima County primarily associated with riparian areas.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
black-bellied whistling-duck	*Dendrocygna autumnalis*	WSC	Ponds, stock tanks, rivers, marshes; nests in dense thickets, tree cavities, and on the ground near water. Elevation ranges between 985 and 4,200 feet	Suitable habitat is present throughout the vicinity of the corridor alternatives; may occur in association with rivers, stock tanks, and irrigation ponds.
golden eagle	*Aquila chrysaetos*	BGEPA BLM	Mountainous areas; often migrates after breeding in some desert areas. Territories up to 25 square miles. Elevation ranges between 4,000 and 10,000 feet	No suitable nesting habitat occurs within the vicinity of the corridor alternatives.
great egret	*Ardea alba*	WSC	Marshes, streams, lakes, rivers, ponds, fields, and meadows. Elevation less than 1,500 feet	Suitable habitat exists throughout the vicinity of the corridor alternatives.
least bittern	*Ixobrychus exilis*	WSC	Dense cattail/bulrush marshes interspersed with open water. Elevation ranges between 850 and 1,500 feet	Old occurrence records in the vicinity of the corridor alternatives from Picacho Reservoir where suitable habitat may be present in some years.
rufous winged sparrow	*Peucaea carpalis*	Pima	Desert grasslands scattered with thorn bushes, bunch grasses, mesquite, or cholla. Also occurs in washes with sandy bottoms and vegetated slopes, brushy irrigation ditches, and creeks bordered by broad-leaved trees, mesquite, grasses, and weeds.	Suitable habitat is present in the vicinity of the corridor alternatives in Pima County.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Swainson's hawk	*Buteo swainsoni*	Pima	Open habitats for foraging including plains, dry grassland and agricultural lands. Uses scattered stands of trees near agricultural fields and grasslands for nesting sites.	Suitable foraging habitat is present throughout the vicinity of the corridor alternatives in Pima County.
tropical kingbird	*Tyrannus melancholicus*	WSC	Scattered trees, open woodland, residential areas and agricultural lands, and in lowlands near water of southeast Arizona. Elevation ranges between 1,070 and 4,100 feet	Species geographic range is outside the vicinity of the corridor alternatives.
western burrowing owl	*Athene cunicularia hypugaea*	BLM Pima	Open, well-drained grasslands, deserts, agricultural lands, golf courses, and airports; often associated with burrowing mammals. Elevation ranges between 650 and 6,140 feet	Suitable habitat is present, and occurrences have been documented throughout the vicinity of the corridor alternatives, especially associated with agricultural lands north of Eloy.
Fish				
desert sucker	*Catostomus clarkii*	BLM	Found in rapids of flowing streams and rivers, primarily over gravel-rubble with sandy silt substrate. Occurs in the Salt and Gila river drainages. Elevation ranges between 480 and 8,840 feet	Known occurrence along Salt River within the vicinity of the corridor alternatives.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Mammals				
Allen's big-eared bat	*Idionycteris phyllotis*	Pima	Ponderosa pine, pinyon-juniper, pine-oak woodland, and riparian habitats of sycamores, cottonwoods and willows; roosts in mines, caves, and rock shelters. Elevation ranges between 2,600 to 9,800 feet	Species geographic range is outside the vicinity of the corridor alternatives within Pima County.
Arizona shrew	*Sorex arizonae*	WSC, Pima	Found primarily in rocky, narrow canyons with riparian areas bordered by pine-oak forests, usually near surface water. Found in the mountains of southeastern Arizona (Huachuca, Santa Rita, and Chiricahua mountains).	Species geographic range is outside the vicinity of the corridor alternatives within Pima County.
California leaf-nosed bat	*Macrotus californicus*	BLM WSC	Sonoran desertscrub; roosts in mines, caves, and rock shelters. Elevation less than 4,000 feet	Species occurs across desert habitats of Arizona, including the vicinity of the corridor alternatives.
cave myotis	*Myotis velifer*	BLM	Sonoran desertscrub; roosts in caves, tunnels, and mines, as well as under bridges. Elevation ranges between 300 and 5,000 feet	Known occurrences throughout the vicinity of the corridor alternatives.
Merriam's mouse	*Peromyscus merriami*	WSC, Pima	Found in mesquite bosques, and dense brush in the low desert associated with mesquite. The mouse has been found in areas of Organ Pipe National Monument, Sabino Canyon, Arivaca, Baboquivari Mountains, San Xavier, and Fort Lowell.	Suitable habitat is present in the vicinity of the corridor alternatives in Pima County.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Mexican long-tongued bat	*Choeronycteris mexicana*	Pima	Lower edge of oak zone through pine-oak woodland to pine-fir; foraging habitat includes desert areas. Forages on pollen and nectar from columnar cacti and agaves; may eat insects. Roosts in caves, tunnels, and mines, as well as buildings. Generally roost sites are at elevation ranges between 4,000 to 6,000 feet.	Suitable foraging habitat is present in the vicinity of the corridor alternatives in Pima County.
pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Pima	Roost sites restricted to caves, mines, and lava tubes with suitable microclimates. In Pima County, the bat has been recorded from Tucson Mountain Park and Saguaro National Park.	Known occurrences within the vicinity of the corridor alternatives in Pima County.
western red bat	*Lasiurus blossevillii*	WSC, Pima	Riparian areas dominated by cottonwoods, willows, or oaks in the central and southeastern portions of the state. Roosts in tree foliage, 2 to 40 feet above ground. Elevation range between 1,900 to 7,200 feet.	Species occurs across riparian habitats of central and southeastern Arizona, including the vicinity of the corridor alternatives.
western yellow bat	*Lasiurus xanthinus*	WSC Pima	Known from scattered locations across southern Arizona, primarily associated with dense palm tree stands in urban areas; also low- to mid-elevation riparian habitats with broad-leaf trees; roosts in leaf skirts of palm trees. Elevation range less than 6,000 feet	May be found in the vicinity of the corridor alternatives, primarily in the Tucson area where there are stands of palm trees.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Reptiles				
desert box turtle	*Terrapene ornata luteola*	Pima	Sonoran and Chihuahuan desertscrub, semidesert grassland; associated with loose soil for burrowing. Elevation range less than 7,100 feet	Species geographic range is outside the vicinity of the corridor alternatives within Pima County.
giant spotted whiptail	*Aspidoscelis* [*Cnemidophorus*] *burti stictogrammus*	WSC Pima	Occur among dense, shrubby vegetation near the banks of semi-arid permanent streams and intermittent streams. Found in the Santa Cruz River floodplain. In 2001, a population of giant spotted whiptails was found near the west branch of the Santa Cruz River.	Suitable habitat is present in the vicinity of the corridor alternatives between Tucson and Marana in Pima County.
ground snake	*Sonora semiannulata*	Pima	Sagebrush and creosote bush in arid and semiarid lands; desert grasslands; and mesquite and willow thickets. In Pima County, two or more forms of uncertain taxonomy. Elevation range less than 6,000 feet	Suitable habitat is present in the vicinity of the corridor alternatives in Pima County. A population of interest is located near Marana.
Tucson shovel-nosed snake	*Chionactis occipitalis klauberi*	WSC Pima	Sonoran desertscrub; associated with soft, sandy soils having sparse gravel. Elevation ranges between 785 and 1,662 feet	Suitable habitat occurs throughout the vicinity of the corridor alternatives.

Table 5-22. Arizona Species of Special Concern, Highly Safeguarded Native Plants, BLM-Designated Senitive Species, and Pima County-Designated Species of Special Concern Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status	Habitat Requirements	Potential to Occur
Plants				
Pima Indian mallow	*Abutilon parishii*	BLM	Higher elevation Sonoran desertscrub on rocky hillsides, cliff bases, canyon bottoms, lower side slopes, and ledges of canyons among rocks and boulders. Elevation ranges between 1,720 and 4,900 feet	No suitable habitat occurs within the vicinity of the corridor *alternatives*.

Source: Arizona Game and Fish Department Heritage Data Management System, Environmental Online Tool. Accessed July 2013.
BGEPA = Bald and Golden Eagle Protection Act
BLM=Bureau of Land Management Sensitive Species
WSC = Wildlife of Special Concern in Arizona
Pima = Species of Special Concern in Pima County

Table 5-23. Arizona Species of Greatest Conservation Need and Species of Economic and Recreation Importance Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status
Amphibians		
lowland leopard frog	*Lithobates yavapaiensis*	1A
Sonoran desert toad	*Inciliu alvarius*	1B
Birds		
Abert's towhee	*Melozone aberti*	1B
American bittern	*Botaurus lentiginosus*	1B
American peregrine falcon	*Falco perigrinus anatum*	1A
bald eagle	*Haliaeetus leucocephalus*	1A
Bell's vireo	*Vireo bellii arizonae*	1B
broad-billed hummingbird	*Cynanthus latirostris*	1B
desert purple martin	*Progne subis hesperia*	1B
ferruginous hawk	*Buteo regalis*	1B
Gambel's quail	*Callipepla gambelii*	E
Gila woodpecker	*Melanerpes uropygialis*	1B
gilded flicker	*Colaptes chrysoides*	1B
golden eagle	*Aquila chrysaetos*	1B
Le Conte's thrasher	*Toxostoma lecontei*	1B
Lincoln's sparrow	*Melospiza lincolnii*	1B
Pacific wren	*Troglodytes pacificus*	1B
Savannah sparrow	*Passerculus sandwichensis*	1B
Sprague's pipit	*Anthus spragueii*	1A
scaled quail	*Callipepla squamata*	E
western burrowing owl	*Athene cunicularia hypugaea*	1B
white-winged dove	*Zenaida asiatica*	E
wood duck	*Aix sponsa*	1B
yellow-billed cuckoo (Western District Population Segment)	*Coccyzus americanus*	1A
yellow warbler	*Setophaga petechia*	1B
Yuma clapper rail	*Rallus longirostris yumanensis*	1A

Table 5-23. Arizona Species of Greatest Conservation Need and Species of Economic and Recreation Importance Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status
Fish		
bonytail	*Gila elegans*	1A
Colorado pikeminnow	*Ptychocheilus lucius*	1A
desert pupfish	*Cyprinodon macularius*	1A
desert sucker	*Catostomus clarkii*	1B
flannelmouth sucker	*Catostomus latipinnis*	1A
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	1A
little Colorado sucker	*Catostomus* sp. 3	1A
longfin dace	*Agosia chrysogaster*	1B
Quitobaquito pupfish	*Cyprinodon eremus*	1A
razorback sucker	*Xyrauchen texanus*	1A
roundtail chub	*Gila robusta*	1A
Sonora sucker	*Catostomus insignis*	1B
Mammals		
American beaver	*Castor canadensis*	1B
antelope Jackrabbit	*Lepus alleni*	1B
Arizona myotis	*Myotis occultus*	1B
Arizona pocket mouse	*Perognathus amplus*	1B
Brazilian free-tailed bat	*Tadarida brasiliensis*	1B
California leaf-nosed bat	*Macrotus californicus*	1B
cave myotis	*Myotis velifer*	1B
greater western bonneted bat	*Eumops perotis californicus*	1B
Harris's antelope squirrel	*Ammospermophilus harrisii*	1B
jaguar	*Panthera onca*	1A
javelina	*Pecari tajacu*	E
kit fox	*Vulpes macrotis*	1B
lesser long-nosed bat	*Leptonycteris curasoae Yerbabuenae*	1A
mountain lion	*Puma concolor*	E
mule deer	*Odocoileus hemionus*	E
ocelot	*Leopardus pardalis*	1A
pale Townsend’s big-eared bat	*Corynorhinus townsendii pallescens*	1B
pocketed free-tailed bat	*Nyctinomops femorosaccus*	1B

Table 5-23. Arizona Species of Greatest Conservation Need and Species of Economic and Recreation Importance Potentially Occuring in or near the Yellow and Orange Corridor Alternatives.

Common Name	Scientific Name	Status
spotted bat	*Euderma maculatum*	1B
Yuma myotis	*Myotis yumanensis*	1B
western red bat	*Lasiurus blossevillii*	1B
western yellow bat	*Lasiurus xanthinus*	1B
Reptiles		
desert mud turtle	*Kinosternon sonoriense sonoriense*	1B
Gila monster	*Heloderma suspectum*	1A
Goode's horned lizard	*Phrynosoma goodei*	1B
regal horned lizard	*Phrynosoma solare*	1B
saddled leaf-nosed snake	*Phyllorhynchus browni*	1B
Sonoran coralsnake	*Micruroides euryxanthus*	1B
Sonoran desert tortoise	*Gopherus morafkai*	1A
Sonoran whipsnake	*Coluber bilineatus*	1B
tiger rattlesnake	*Crotalus tigris*	1B
Tucson shovel-nosed snake	*Chionactis occipitalis klauberi*	1A
variable sandsnake	*Chilomeniscus stramineus*	1B

Source: Arizona Game and Fish Department Heritage Data Management System, Environmental Online Tool. Accessed January 2016.
1A = vulnerable and also meet any of the following: federally listed as endangered or threatened under the ESA; Candidate species under ESA; is specifically covered under a signed candidate conservation agreement (CCA) or a signed candidate conservation agreement with assurances (CCAA); recently removed from ESA and currently requires post-delisting monitoring; closed season species (i.e., no take permitted) as identified in Arizona Game and Fish Commission Orders 40, 41, 42 or 43
1B= Scored "1" for Vulnerability in at least one of the eight categories, but match none of the above criteria.
E = economic and recreational value associated with the species

Of the 43 special status species evaluated as possibly occurring in the vicinity of the corridor alternatives, suitable habitat may be present for 27 species (**Table 5-24**). Critical habitat has been proposed for the western yellow-billed cuckoo and includes Picacho Reservoir, within approximately 0.1 mile and 0.5 mile of the Yellow and Orange corridor alternatives, respectively.

Table 5-24. Special Status Species with Potentially Suitable Habitat in the Vicinity of the Yellow and Orange Corridor Alternatives

Common Name	Status
bald eagle	BLM, WSC
Bell's vireo	Pima
black-bellied whistling-duck	WSC
cactus ferruginous pygmy-owl	ESA-Petitioned BLM, WSC, Pima
California leaf-nosed bat	BLM, WSC, Pima
California least tern	E
cave myotis	BLM
desert sucker	BLM
giant spotted whiptail	Pima
great egret	WSC
ground snake	Pima
least bittern	WSC
lesser long-nosed bat	E, WSC, Pima
lowland leopard frog	BLM, WSC
northern Mexican gartersnake	T, PCH, WSC
pale Townsend's big-eared bat	Pima
rufous winged sparrow	Pima
Sonoran desert tortoise	CCA, WSC
southwestern willow flycatcher	E, Pima
Swainson's hawk	Pima
Tucson shovel-nosed snake	WSC, Pima
western burrowing owl	BLM, Pima
western narrow-mouthed toad	BLM, WSC, Pima
western red bat	Pima
western yellow bat	WSC, Pima
western yellow-billed cuckoo	T, PCH, WSC, Pima
Yuma clapper rail	E, WSC

Source: USFWS IPaC 2014.
E = Listed as Endangered under the ESA
T = Listed as Threatened
PT = Proposed for Listing as Threatened
C = Candidate species for listing
CCA = Candidate Conservation Agreement
Petitioned = Petitioned for Listing
PCH= Proposed Critical Habitat
WSC = Wildlife of Special Concern in Arizona
HS = Highly Safeguarded under Arizona Native Plant Law
Pima = Species of Special Concern in Pima County

<u>Of the 71 species listed as species of high conservation need and species of economic importance, 16 are also included in **Table 5-24** as special status species. Many of the species,</u>

including bats, birds, and mammals are migratory or could disperse through the area and have the potential to occur in the vicinity of the corridor alternatives. Strategies to minimize and offset potential impacts for these species would be developed in conjunction with AGFD during the Tier 2 analysis.

5.12.3 Environmental Consequences

This section analyzes the potential impacts to plant and wildlife resources of constructing and operating a passenger rail system within the Yellow and Orange corridor alternatives, as well as the No Build alternative. The analysis provides a general overview, as no project specific details are available (e.g., where the passenger rail system would be placed within the 1-mile wide corridor alternatives, where and what type of structures would be used to cross drainage channels, and how wide the construction disturbance zone would be). The direct impacts and indirect impacts (potential project effects that may occur off site or later in time associated with the long-term physical presence and operation of a passenger rail system on the landscape, and the temporary disturbance associated with construction activities) are addressed.

Effects Common to All Corridor Alternatives

Both the Yellow and Orange corridor alternatives include lands that have been fully converted to agricultural and urban uses and generally parallel existing transportation corridors, including portions of I-10 and the UP railroad. Due to the proximity of the corridor alternatives to human development and activities, remaining native habitat within portions of the corridor alternatives has been degraded, and wildlife species diversity and abundance reduced; however, wildlife habitat remains throughout the two corridor alternatives. Wildlife habitat values are generally greater in areas of denser native vegetation, such as along major and minor washes. These washes also provide important corridors for wildlife movement across the landscape. In areas of limited or scattered human development, habitats are used by a wide array of species.

Physical Impacts

In both corridor alternatives, the presence of a passenger rail system would result in the direct loss of native vegetation and wildlife habitats, increase habitat fragmentation, and impede the movement of wildlife across the landscape. Some of these impacts can be reduced by locating the rail system as close as possible to existing transportation corridors and other facilities where habitats are already fragmented. Habitat that may remain between parallel developed corridors would be isolated from larger habitat blocks and would be of less value to wildlife. Animals would be in close proximity to potential disturbances, and the size of the area may limit access to, and the availability of, seasonally variable sources of food, water, and shelter. A loss of species diversity and abundance would occur within these fragmented habitat areas.

A passenger rail system within either corridor alternative would result in a formidable barrier to wildlife movement by both large and small species. Details regarding the elevation of the railroad bed above surrounding terrain and how drainage channels would be crossed are not available. Retaining as much vegetation as possible within and adjacent to the rail ROW and along washes that cross the passenger rail system would reduce the impacts to wildlife. Providing under-crossing structures at as many wash crossings as possible would benefit wildlife, although the location of these structures would need to be coordinated with wildlife crossings in other nearby barriers to wildlife movement.

A passenger rail system in either corridor alternative would bisect large intact habitat blocks. The AGFD wildlife linkages assessment could be used as a guide for locating crossing structures based on current wildlife movement patterns. In addition, crossing structures that are large enough to accommodate mule deer passage, and that include natural bottom surfaces, would facilitate use by a greater variety of species.

Operational Impacts

The corridor alternatives generally parallel existing transportation infrastructure, including I-10 and the UP railroad. Freight trains traveling on existing UP tracks make approximately 43 trips per day through the rural areas between Tucson and Eloy and approximately 8 trips per day from Eloy to Phoenix. Existing freight train traffic does not exceed 80 mph. Wildlife that may be present in the vicinity of the existing highway and rail lines have been exposed, to some extent, to disturbances associated with railroad operations.

While habituation to transportation noise, such as at airports, highways, and urban centers, is commonly seen in some species and individuals of wildlife, the effect of train noise and associated vibration on wildlife is unclear. The passage of a train may not cause habitat degradation; but wildlife, especially larger mammals such as mule deer and bighorn sheep, may have behavioral and physiological responses to this type of disturbance. The magnitude of these effects to wildlife is not always clear and reflects individual animals' experiences and habituation to similar events. Krausman et al. (1986) concluded that desert mule deer habituated to low-flying, fixed-wing, single-engine aircraft, but found that female desert bighorn sheep with lambs were more sensitive to these disturbances (Krausman et al. 1998). Noise may affect different animals in different ways. The roar of a dune-buggy engine was reported by Immel (1995, in Radle 2007) to temporarily disable the reflexive defense of the desert kangaroo rat against the sidewinder rattlesnake by interfering with the rat's defensive hearing. The diversity of effects that noise may have among and between species complicates the interpretation of the effects of noise on wildlife as a whole (Radle 2007). Some animal species that live near active railroad tracks may become accustomed to noise and vibration from trains. Migratory species and species that do not consistently inhabit the rail corridor may be more affected by trains (Hanson 2008). High levels of vibration or repeated exposure to vibrations may cause the collapse of small mammal dens and reptile burrows. The addition of a passenger rail system could further cause wildlife to avoid the expanded transportation corridor, particularly if animals are frightened by faster passenger trains (up to 110 mph). Higher speed trains could also increase mortality rates of animals crossing the tracks. Consequently, with development of a passenger rail system in either corridor alternative, some animal species may become accustomed to train noise and vibration, while others may avoid the rail system.

The number of structural features, such as culverts, bridges, and switchyards, may influence the frequency and nature of maintenance activities, the removal of vegetation from the ROW, and disturbances due to the presence of maintenance crews and heavy equipment. Ground disturbance associated with the maintenance of roadways and tracks provides additional opportunities for establishment and/or spread of nonnative species. Soil erosion, sedimentation, runoff of oils and lubricants from railroad grades, and the potential for spills during maintenance activities, could result in these substances entering adjacent drainage channels and exposing wildlife to toxic chemicals.

Construction Impacts

Construction activities associated with development of a passenger rail system—including vegetation removal; ground clearing; placement of fill material for track; new, replaced, or extended culverts and bridges; and station facility development—could potentially result in disturbance to, and mortality of, local wildlife. Staging areas, access roads, and development of other facilities needed to support construction activities could result in permanent loss of habitat or reduction of habitat values. Disturbance during construction, and later reclamation of such areas, would result in a temporary loss of habitat; although in desert systems, restoration of disturbed sites to previous conditions may take decades. Until disturbed areas are stabilized, the potential exists for increased sediment transport during storm events and an increased potential for the introduction or spread nonnative and invasive species.

In accordance with the Arizona Native Plant Law (A.R.S. §§ 3-901 *et seq.*), the Arizona Department of Agriculture is to be notified at least 60 days prior to ground-clearing activities to determine the disposition of protected native plants.

The removal of vegetation from late winter through spring could result in the loss of active bird nests. Projects with the potential to result in take of birds protected under the MBTA require the issuance of Special Purpose permits from USFWS. Construction activities, such as land clearing or bridge construction during the nesting season could result in a "take" of migratory birds. A wide range of migratory birds are expected to occur within and adjacent to the corridor alternatives; however, the need for a permit may be reduced or eliminated if all vegetation removal were completed during the non-breeding season.

Yellow Corridor Alternative

AGFD, in its independent assessment of the passenger rail corridor alternatives (see the *Biological Resources Appendix*), found that the overall impact of a passenger rail system within the Yellow Corridor Alternative would be medium, indicating a "moderate to significant effect to resources with the potential to minimize or mitigate impacts." A passenger rail system within the Yellow Corridor Alternative would be situated closer to existing development than a passenger rail system within the Orange Corridor Alternative, so it would affect less native habitat for wildlife and generally expand existing barriers rather than create new ones.

Southern Hub to Eloy

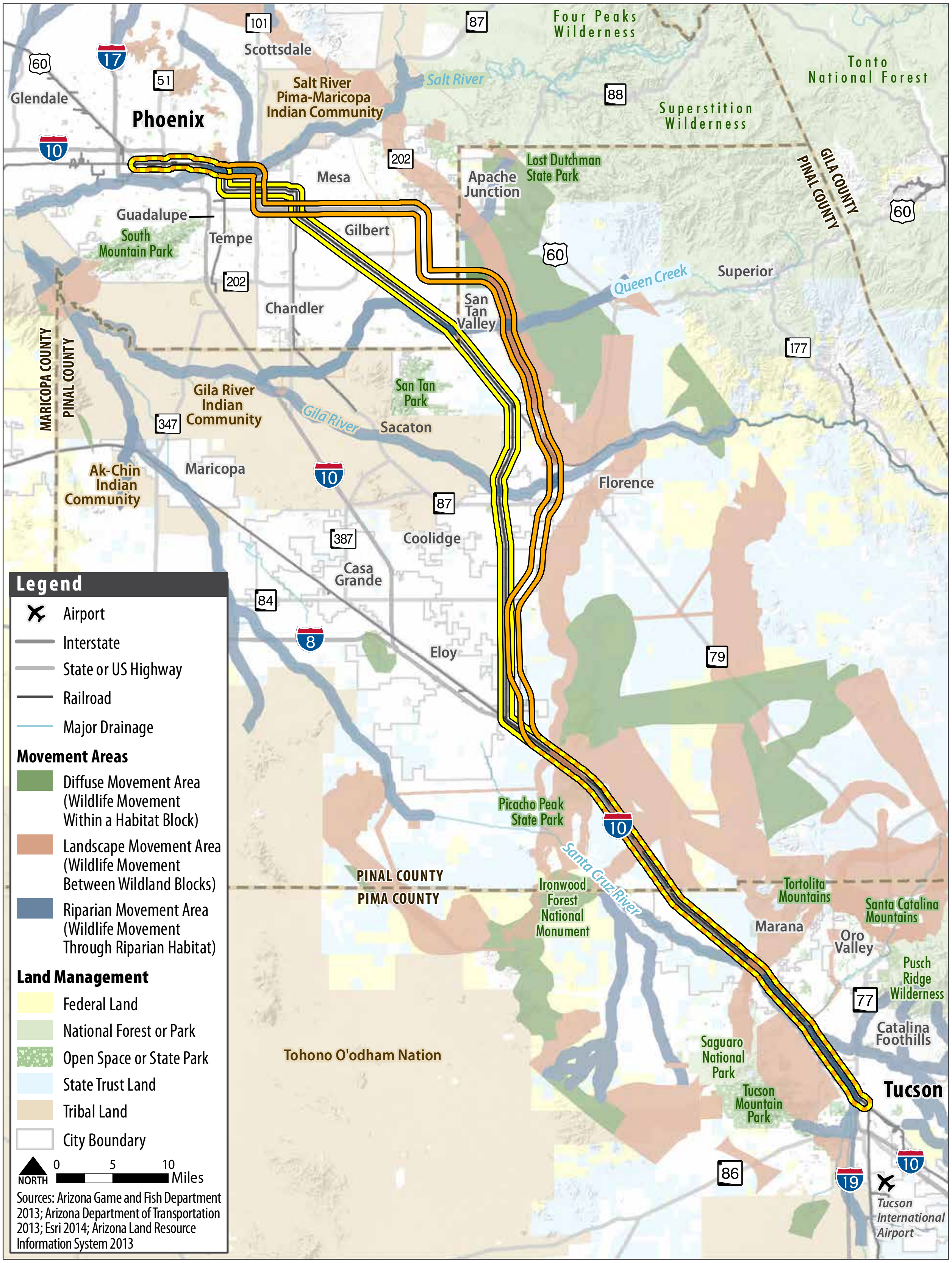
Physical Impacts

The Yellow Corridor Alternative between the southern hub and Eloy generally parallels the existing interstate highway transportation corridor. Within and adjacent to the southernmost segment, the Santa Cruz River runs roughly parallel to I-10 on the west side. This river and its tributary, the Rillito River, are highly degraded and do not provide perennial flow in this area. Scattered patches of riparian vegetation, including deciduous riparian trees, are used by numerous neotropical migrant bird species. In addition, records of ESA-listed threatened Mexican gartersnake and the Pima County Sensitive Species western burrowing owl are associated with the Santa Cruz drainage. The City of Tucson and Pima County have undertaken efforts to restore portions of the river corridor. If a passenger rail system were constructed on the west side of the corridor alternative, to the west of I-10, it could result in the loss of developing riparian habitats along the river and possibly limit opportunities for additional restoration.

North of Tucson, within and adjacent to the corridor alternative, are large expanses of open native habitats with braided washes and high species diversity. The presence of a passenger rail system could result in the direct loss of up to an estimated 10,950 acres of vacant/undeveloped land, much of which would be Arizona Upland Subdivision habitat that includes suitable habitat for the ESA-listed endangered lesser long-nosed bat, Sonoran desert tortoise (candidate conservation agreement [CCA] species), Tucson shovel-nosed snake (AGFD Wildlife of Special Concern, Pima County Sensitive Species), ground snake (Pima County Sensitive Species), western burrowing owl (Pima County Sensitive Species), possibly the cactus ferruginous pygmy-owl (ESA-listed petitioned); and the special management area identified by Pima County. The lesser long-nosed bat feeds on the flowers and fruits of saguaro and agaves. Tortoise habitat is typically associated with rocky slopes and outcrops, and the quality of this habitat increases closer to Picacho Peak and the Picacho Mountains, the location of an AGFD long-term population monitoring plot. The effects of reducing or fragmenting tortoise home ranges and possibly cutting off access of tortoises to important resources (e.g., burrows, water collection sites, and feeding areas) by the presence of a passenger rail system is unknown. ADOT has entered into a conservation partnership with land management agencies and USFWS to address desert tortoise conservation issues. The Tucson shovel-nosed snake is found in sandy washes; the ground snake occupies desert flats, rocky hillsides, and river bottoms with harder substrates; the pygmy-owl is generally associated with dense stands of ironwood, palo verde, and mesquite; and the burrowing owl is found in open, sparsely vegetated areas with mammal burrows for nesting as well as along river/wash banks. Burrowing owls tend to be tolerant of human presence, and will nest in human-modified landscapes, thereby encountering human activity and potential loss to burrows or habitat. This would include clearing habitat and grading banks for a railroad system. In addition, depending on the alignment, protected desert habitat within Picacho Peak State Park could be acquired as ROW for a passenger rail system.

Due to the presence of the existing interstate highway and railroad within the corridor alternative, landscape-level movement corridors for local wildlife have already been affected. I-10 is currently a substantial barrier to wildlife movement and habitat connectivity between the Picacho Mountains and Ironwood Forest National Monument (AGFD 2014); however, three recognized wildlife linkage areas/movement corridors of major (i.e., statewide) importance have been identified along I-10 between Marana and Picacho Pass (see **Table 5-19** and **Figure 5-17**), with various other wildlife movement areas (see **Figure 5-18**). The presence of a passenger rail system would expand the existing barriers rather than create new barriers to animal movements, minimizing habitat fragmentation. In addressing the possibility of a new transportation corridor compounding impacts to wildlife movement, an opportunity exists to improve wildlife movement and habitat connectivity across the I-10 corridor. Improved understanding of the distribution and movement patterns for species like the desert tortoise and Tucson shovel-nosed snake, as well as large mammals like the mule deer and big horn sheep, is necessary to fully assess the potential impacts of a passenger rail system in this area and develop the most effective mitigation measures. The Picacho Peak area is critical to the movement of wildlife across the I-10 corridor and especially important to mule deer and bighorn sheep movements. AGFD considers this habitat linkage area to be of critical concern (AGFD 2014).

Figure 5-18. Wildlife Movement Areas within the Study Corridor



Operational Impacts

Due to the presence of the existing interstate highway and railroad within this segment of the corridor alternative, local wildlife are likely familiar with noise and vibrations associated with existing transportation facilities. The addition of a passenger rail system may further deter wildlife from the area, though it is unclear how wildlife may react to an intensification of an already present stimulus/disturbance.

Construction Impacts

Construction activities would include vegetation removal and ground disturbance by heavy equipment. Potential impacts to nesting behavior of protected bird species, native plants, plants that provide forage for protected bat species, and desert tortoise should be taken into considerations and mitigated, to the extent possible.

Eloy to Northern Hub

Physical Impacts

The Yellow Corridor Alternative from Eloy to the northern hub generally parallels an existing railroad for its entire length. From the Eloy area the corridor alternative proceeds north to Coolidge, passing through agricultural fields interspersed with areas of native habitat consisting primarily of Lower Colorado Subdivision vegetation associations. Development of a passenger rail system in this corridor alternative segment would result in the loss of Sonoran desert tortoise and Tucson shovel-nosed snake habitat. Burrowing owls are also observed throughout this area. The corridor alternative passes adjacent to Picacho Reservoir. When filled with water from agricultural runoff, this reservoir provides habitat for waterfowl and several special status species; past records (over 10 years old) document observations of the ESA-listed endangered Yuma clapper rail at the reservoir. From Coolidge, the corridor alternative crosses the Gila River (an identified wildlife movement corridor), and circles the east side of the San Tan Mountains (desert tortoise habitat), reducing the size of a large, intact block of natural habitat and effectively isolating the mountains. Due to existing development, wildlife movements between the San Tan and Superstition mountains are already impeded; a passenger rail system may present opportunities to improve wildlife connectivity by siting the corridors to minimize habitat and connectivity fragmentation, identifying current and potential important wildlife movement areas, and designing facilities to provide maximum permeability for safe wildlife movement. The corridor alternative continues into the greater Phoenix metropolitan area, crossing Queen Creek and the Salt River, both important wildlife movement corridors within an otherwise urban setting. The Phoenix Mountains-Salt River-Papago Park habitat block could also be affected. Riparian vegetation associated with the Salt and Gila rivers and the Queen Creek Wash, which may include suitable habitat for the ESA-listed threatened western yellow-billed cuckoo, and the dense stands of xeroriparian vegetation in the vicinity of the San Tan Mountains could be lost to provide ROW for a passenger rail system.

Operational Impacts

Due to the presence of existing state highways, local roadways, and the railroad within this segment of the corridor alternative, local wildlife are likely familiar with noise and vibration associated with transportation facilities. The addition of a passenger rail system may further deter wildlife from the area, although it is unclear how wildlife may react to an intensification of an already present stimulus/disturbance. Bald eagles are known to nest along the Salt River upstream of Tempe Town Lake. A passenger rail system through this area could disrupt nesting or foraging eagles, as they are known to be sensitive to human-caused disturbance.

Construction Impacts

The additional noise and human activity associated with construction of a passenger rail system in the vicinity of the Salt River may be a particular concern for disturbance to foraging and nesting bald eagles.

Orange Corridor Alternative

AGFD, in its independent assessment of the corridor alternatives (AGFD 2014), found that the overall impact of a passenger rail system within the Orange Corridor Alternative would be medium through most of the corridor length ("moderate to significant effect to resources with the potential to minimize or mitigate impacts"), but high in the area from a few miles north of Eloy to a few miles south of Apache Junction. A high rating indicates "potential significant impacts to resources." Because the Orange Corridor Alternative deviates from existing transportation corridors and extends into undeveloped native habitats, it would contribute to extensive habitat fragmentation and could create a new barrier to wildlife movement between the San Tan and Superstition mountains, resulting in greater effects to wildlife resources, wildlife habitat, and wildlife-related recreation than a passenger rail system within the Yellow Corridor Alternative.

Southern Hub to Eloy

The physical, operational, and construction impacts of a passenger rail system within the Orange Corridor Alternative for this segment would be the same as those described for this segment of the Yellow Corridor Alternative, as they share the same route over this corridor segment.

Eloy to Northern Hub

Physical Impacts

North of Eloy, the Orange Corridor Alternative closely parallels the Yellow Corridor Alternative until just north of Picacho Reservoir, where the Orange Corridor Alternative begins to veer to the east away from existing transportation corridors, crossing a combination of agricultural fields and natural habitats primarily composed of Lower Colorado River Subdivision vegetation associations. North of the Gila River, the Orange Corridor Alternative follows the CAP canal, which includes dense stands of Desert Wash Mixed Scrub vegetation, mesquite bosque, and some riparian vegetation. AGFD has identified the CAP ROW as a wildlife linkage corridor having regional importance as it provides opportunities for wildlife movements from Tucson north to Phoenix and beyond. The Orange Corridor Alternative crosses the Queen Creek wildlife movement corridor and turns to the west, entering the greater Phoenix metropolitan area. The Orange Corridor Alternative crosses the Salt River, intersecting the Salt River and Indian Bend Wash wildlife movement corridors. Though many of the impacts of a passenger rail system within the Orange Corridor Alternative would be consistent with those of a passenger rail system within the Yellow Corridor Alternative, the Orange Corridor Alternative could result in a greater amount of undeveloped land being acquired to provide ROW. The additional land lost to provide ROW for a passenger rail system with the Orange Corridor Alternative could have impacts on native desert, xeroriparian, and riparian habitats used by a diverse array of plant and animals species, including the Sonoran desert tortoise (a CCA species) and the Tucson shovel-nosed snake. Construction of a passenger rail system within the Orange Corridor Alternative could fragment large blocks of native habitat between Picacho Reservoir and the Town of Queen Creek, disrupt the function of the wildlife linkage corridor associated with the CAP ROW, and effectively isolate the San Tan Mountains from the Superstition Mountains.

Operational Impacts

Effects from operations and maintenance of a passenger rail system within the Orange Corridor Alternative would be generally similar to those described for a passenger rail system within the Yellow Corridor Alternative, including the potential disturbance to nesting and foraging bald eagles along the Salt River upstream of Tempe Town Lake. Because the Orange Corridor Alternative deviates from existing transportation corridors, wildlife in the vicinity of a passenger rail system within the Orange Corridor Alternative would be less habituated to transportation-related noise and vibration.

Construction Impacts

Effects on natural habitats and wildlife from construction of a passenger rail system within the Orange Corridor Alternative would also be similar to the construction impacts described for a passenger rail system within the Yellow Corridor Alternative. Since a passenger rail system within the Orange Corridor Alternative would affect more land of generally better quality native habitat (e.g., dense vegetation farther from human activities) than a passenger rail system within the Yellow Corridor Alternative, ground clearing could result in the short- and long-term loss of many protected native plants and disruption to many wildlife species.

5.12.4 No Build Alternative

Under the No Build Alternative, no passenger rail system would be developed; and impacts to natural habitats and wildlife would not occur beyond those that could occur due to other current and proposed projects. Under the No Build Alternative, potential opportunities to improve wildlife crossings associated with a passenger rail system within the existing transportation corridor would not be realized.

5.12.5 Potential Mitigation Measures

This Tier 1 analysis provides an overview of potential impacts from the development of a passenger rail system within either of the corridor alternatives. Specific project design, construction methods, and corridor alignment have not been determined. Therefore, specific methods to avoid, minimize, or mitigate project-related impacts cannot be developed. However, the general application of these types of measures, consistent with state and federal regulations, is outlined below.

- Avoid impacts, when possible, particularly to protected and sensitive species and their associated habitat, and to wildlife corridors
- Minimize loss of natural habitats
    - Provide construction workers with environmental awareness training, including measures to be taken to minimize impacts to the natural environment
    - Where options are available, align the corridor to maximize the use of disturbed lands and minimize habitat fragmentation
    - Minimize construction impacts by limiting the disturbance zone as much as possible; use previously disturbed areas for staging and equipment storage
    - Flag or fence sensitive habitats such as riparian areas or wetlands to preclude construction impacts from occurring within the area
    - Transplant displaced vegetation to adjacent lands, when feasible
- Replace lost habitat

- Address and minimize edge effects through: the use of existing infrastructure; monitoring of adjacent habitats for change; and the development of adaptive management strategies for toxins, invasive species, and habitat conversion
- Minimize impacts to plant and animal species
    - Provide notification to Arizona Department of Agriculture of the removal of protected native plants so plants may be salvaged
    - Implement seasonal restrictions on the removal of vegetation to protect nesting birds
    - Implement seasonal restrictions on the disturbance of sensitive wildlife areas
    - Conduct preconstruction surveys for nesting birds prior to the removal of vegetation if ground clearing occurs during the nesting season
    - Conduct preconstruction surveys for removal and translocation of Sonoran desert tortoise and western burrowing owl
    - Provide wildlife escape options in open trenches and inspect trenches to remove wildlife prior to filling
    - Check under vehicles for wildlife seeking shade (especially reptiles, including the desert tortoise) before driving
- Minimize impacts to wildlife movement corridors
    - Refine identified wildlife linkage corridors, movement corridors, and habitat blocks to reflect current state of knowledge
    - Support studies to better understand the movement of mule deer and bighorn sheep in association with a passenger rail system within the corridor alternatives
    - Support studies to better understand the movement and habitat use of Sonoran desert tortoise and Tucson shovel-nosed snake in association with a passenger rail system within the corridor alternatives
    - Do not compromise the function of existing wildlife movement corridors or large habitat blocks
    - Design sufficient wildlife crossing structures to facilitate movement of large and small species of wildlife across the landscape, including appropriate funnel fencing associated with crossing areas, and appropriate ROW fencing to allow for, or restrict as necessary, wildlife movement

  - Locate crossing structures to enhance wildlife crossing of the existing transportation corridors associated with a passenger rail system
  - Provide for follow-through studies to assess the effectiveness of the wildlife crossing structures
- Control the spread of nonnative and invasive species
  - Develop a Habitat Restoration Plan for all temporary impacts to native vegetation and provide it to land management/resource agencies for review prior to project construction
  - Address and minimize edge effects through: the use of existing infrastructure; monitoring of adjacent habitats for change; and the development of adaptive management strategies for toxins, invasive species, and habitat conversion
  - Prepare a site restoration plan identifying techniques, timing, and success criteria
  - Wash vehicles and equipment to avoid potential transport of nonnative seed to construction areas
  - Rehabilitate disturbed ground as soon as possible following construction activities to minimize exposure of bare ground susceptible to colonization by nonnative plants
  - Use chemical or mechanical treatments on existing infestation areas within construction zones to prevent additional spread
  - Restore sites with native seed mixes certified as "weed free"

5.12.6 Tier 2 Considerations

For the detailed analyses provided in a Tier 2 NEPA document, site-specific data on biological resources potentially affected by the project would be required including special status species and wildlife movement studies/surveys to inform the NEPA process. Continued coordination with land and resource management agencies may reveal new sources of data as well as identify additional issues to be addressed in the Tier 2 analysis. Technical studies, including field surveys and research programs, can be implemented as part of the Tier 2 analysis. These data can be gathered, analyzed, and applied in an iterative manner with the development of project design and location of project facilities. Additional data may support a more detailed analysis of potential project-specific impacts, including the effects of noise and vibration on various species of wildlife, the effects of interrupting or enhancing specific wildlife movement corridors, and the evaluation of potential adverse effects to ESA-listed and other special status species. The

Sonoran desert tortoise occurs over a large portion of the corridor alternatives. Western burrowing owls also have the potential to occur throughout a large portion of the corridor alternatives, especially inhabiting agricultural lands such as those that occur along both the Yellow and Orange corridor alternatives. Surveys for the owl should be conducted in a timely manner to allow for the proper accommodation or mitigation for owls, including plans for seasonal restrictions to implement in a future construction phase. FRA would coordinate closely with USFWS under the ESA consultation requirements of Section 7 to facilitate meeting regulatory requirements for planning the alignment of a passenger rail system prior to project construction and implementation at Tier 2. The ESA directs all Federal agencies to work to conserve endangered and threatened species as well as habitats, and forms the basis of biodiversity and endangered species protection in the US. In addition, close coordination with AGFD could facilitate resolution of concerns regarding impacts to wildlife, especially wildlife movement corridors and habitat loss.

5.13 Waters of the US

5.13.1 Methodology and Regulatory Requirements

The legal framework pertaining to Waters of the US, also referred to as jurisdictional waters, is the Clean Water Act of 1972 (as amended) (CWA) and its implementing regulations. Waters of the US include traditional navigable waters (TNW), perennial streams, lakes, ponds, and wetlands, as well as intermittent streams and ephemeral washes that have a significant nexus with a jurisdictional water.

The principal goal of the CWA is to establish water quality standards to restore and maintain the chemical, physical, and biological integrity of the nation's jurisdictional waters by preventing pollution sources. The fundamental rationale of the program is that no discharge of dredged or fill material should be permitted if a practicable alternative is available that would be less damaging to aquatic resources or if significant degradation would occur to the nation's waters. Section 404 of the CWA regulates the discharge of earthen fill, concrete, and other construction materials into Waters of the US and authorizes the US Army Corps of Engineers (Corps) to issue permits regulating such discharges. Permit review and issuance follows a sequential process that encourages avoidance of impacts, followed by minimizing impacts, and finally, requiring mitigation for unavoidable impacts to the aquatic environment. More details on the regulatory framework are available in the *Waters of the US Appendix*.

The corridor alternatives are located in the Interior Deserts land resource region, and Clean Water Act investigation and permitting would be conducted in accordance with the Corps' guidance. Refer to **Section 5.14** for more information on wetlands within the corridor alternatives.

In addition to the 404 permit, a future passenger rail system would require a state water quality certification issued by ADEQ to comply with Section 401(a) of the CWA. Impacts to tribal waters would trigger a Section 401 water quality certification from EPA. Section 401 certification, which can cover both construction and operational phases, includes mitigation measures to indicate how a project would comply with surface water quality standards.

Locations of possible Waters of the US were identified through a review of GIS data compiled by the Environmental Systems Research Institute (ESRI) and the Nationwide Rivers Inventory, and a review of USGS maps showing perennial and intermittent streams, lakes, and ponds. A list of possible Waters of the US within the corridor alternatives is included in the *Waters of the US Appendix*.

5.13.2 Existing Conditions

As part of the Basin and Range physiography in the study corridor, ephemeral desert washes carry stormwater flows and can create intricate, braided drainage systems across the valleys between mountains, buttes, and other landforms. The corridor alternatives traverse the Santa Cruz and Middle Gila watersheds, where watercourses generally flow toward the Santa Cruz and Gila rivers. These two primary rivers run south to north and generally east to west, respectively. Named rivers and streams and some of the unnamed washes in the corridor alternatives are shown in the *Corridor Aerial Atlas Appendix*, Maps 1 through 91. No navigable rivers, as adjudicated by the Arizona Navigable Stream Adjudication Commission, intersect or flow through the corridor alternatives (ANSAC 2012).

The Santa Cruz River, 24 named ephemeral washes, and 4 lakes are located within the southern hub to Eloy segment of the Yellow Corridor Alternative. Numerous unnamed ephemeral washes also traverse this segment. The Santa Cruz River flows south to north through this segment for approximately 18 miles, while the ephemeral washes flow predominantly east to west across the corridor toward the Santa Cruz River. A few of the washes flow west to east toward the river. The lakes are associated with golf courses and a park; avoidance is recommended. The Gila River, Queen Creek, East Maricopa Floodway, Salt River, nine lakes, and numerous unnamed washes are located within the Eloy to northern hub portion of the Yellow Corridor Alternative.

One segment of the Santa Cruz River flows perennially from discharges from the Roger Road wastewater treatment plant. The Corps has determined that the Santa Cruz River from the wastewater treatment plant to the Pima County/Pinal County border is a TNW, and this segment flows through the southern portion of the corridor alternatives (Corps 2008) (see the *Corridor Aerial Atlas Appendix*, Maps 3-9). Therefore, tributaries flowing into that segment of the Santa Cruz River have a connection to a TNW and would likely be determined jurisdictional.

The Corps has determined two segments of the Gila River totaling approximately 37 miles as a TNW (Corps 2008). These segments are not located within the corridor alternatives; however, it is reasonable to expect that other segments of the Gila River would also be jurisdictional due to a direct connection to the Colorado River (Arizona's only adjudicated navigable river). The East Maricopa Floodway flows directly into the Salt River and is regulated by the Corps as a jurisdictional water.

Several irrigation canals cross the corridor alternatives and are also shown in the *Corridor Aerial Atlas Appendix*. The Corps typically does not have jurisdiction over irrigation canals unless the water can be shown to come from and return to a Water of the US. Individual jurisdiction determinations would occur during Tier 2, including whether irrigation ditches should be considered Waters of the US.

Several lakes and ponds are also located within the corridor alternatives; most are associated with golf courses or parks. The 43 named watercourses and water bodies in the corridor alternatives are listed in the *Waters of the US Appendix* by corridor segment, with information on the type of resource and, if available, current jurisdictional status. A review of aerial photography indicates numerous other unnamed washes. As discussed above, the jurisdictional status of possible Waters of the US would be determined and confirmed during Tier 2.

5.13.3 Environmental Consequences

5.13.3.1 Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Impacts within Waters of the US would vary based on the placement of a passenger rail system within a given corridor alternative, and would be unavoidable given the number of washes that traverse each corridor alternative. Impacts to waters that run perpendicular to a rail line would likely be less than impacts to waters that parallel a rail line. Perpendicular segments would be affected for the length of the culvert(s) required to allow flows to pass beneath the rail line, plus any erosion or scour control constructed within the ordinary high water mark (OHWM). In some locations, impacts could be further minimized by using a bridge to clear-span the watercourse.

Parallel waters, such as the Santa Cruz River, could be affected by longer stretches of cuts, fills, or diversions required to construct ballast, embankments, drainage slopes, or other railway components. Parallel waters may also be relocated or even truncated to accommodate the new infrastructure, resulting in additional impacts. Finally, the placement of fill required for major structures such as sidings, spurs, yards, and stations could further increase impacts within Waters of the US.

As noted in the Tier 2 considerations discussed later in this section, it is likely that at least a preconstruction notification of the Corps would be required for construction, especially if it results in impacts to the perennial stretch of the Santa Cruz River. Impacts to wetlands would trigger a Section 404 Individual Permit, as discussed in **Section 5.15**.

Operational Impacts

Minimal impacts to Waters of the US would be expected during operation of a rail line. Impacts likely would be limited to maintenance of culverts or bridges, which may be covered by Nationwide Permit No. 3, Maintenance, or possibly the Clean Water Act Section 404 maintenance exemption.

Construction Impacts

Although construction impacts on Waters of the US would occur as a result of soil erosion and potential construction pollutant loading of stormwater runoff, they would be temporary and would cease after construction is completed and disturbed areas become re-stabilized. In addition, requirements associated with the Arizona Pollutant Discharge Elimination System (AZPDES) and Stormwater Pollution Prevention Plan (SWPPP) would minimize impacts from stormwater and associated pollutants.

Eloy to Northern Hub

Physical Impacts

The types of potential physical impacts would be similar to those discussed under the southern hub to Eloy segment of the Yellow Corridor Alternative. It is possible for future alignments to avoid the lakes in the corridor alternative, but a passenger rail system intersecting the four major Waters of the US that cross the corridor alternative (Gila River, Queen Creek, East Mesa Floodway, and Salt River) would likely trigger one of the permitting scenarios presented in **Table 5-25** in the discussion of Tier 2 considerations. The use of bridges is recommended to reduce impacts within the OHWM and simplify permitting requirements.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

5.13.3.2 Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts would be the same as those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Eloy to Northern Hub

Physical Impacts

The types of potential physical impacts would be similar to those discussed under the Eloy to northern hub segment of the Yellow Corridor Alternative. The Gila River, Queen Creek, Salt River, two named washes, 34 lakes, and numerous unnamed washes are located within the Eloy to northern hub portion of the Orange Corridor Alternative. The Superstition Springs Lakes comprise a chain of 21 lakes that stretch across the study corridor. A passenger rail system intersecting the three major Waters of the US that cross the corridor alternative (Gila River, Queen Creek, and Salt River) would likely trigger one of the permitting scenarios presented in **Table 5-25** in the discussion of Tier 2 considerations. The use of bridges is recommended to reduce impacts within the OHWM and simplify permitting requirements.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

5.13.3.3 No Build Alternative

Under the No Build Alternative, construction would not occur; and no impacts to Waters of the US are anticipated beyond those that could occur due to other reasonably foreseeable projects. For example, the Clean Water Act Section 404 maintenance exemption permits maintenance along existing UP lines, such as modifying or replacing culverts or bridges, with the understanding that impacts to the exempt activity would be minimal, in compliance with the requirements of Nationwide Permit (NWP) No. 3 for maintenance. In addition, minor impacts to Waters of the US from potential culvert replacements/extensions and bridge replacements/additions elsewhere in the corridor alternatives may also occur.

5.13.4 Potential Mitigation Measures

In conjunction with the Tier 2 NEPA documents, possible Waters of the US would be evaluated during a jurisdictional delineation. In addition, the project team would evaluate the design to determine where it is possible and practical to avoid or minimize impacts. Continued coordination with the Corps may be necessary to determine the Least Environmentally Damaging Practicable Alternative, if necessary.

Mitigation options available for unavoidable impacts to jurisdictional waters would be discussed in more detail during the Tier 2 NEPA documentation. Mitigation measures could include in-lieu fees and on-site or off-site permittee-responsible mitigation such as vegetation or habitat restoration. During the design process, coordination would take place with the Corps and appropriate state resource agencies to develop mitigation strategies. Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known, recorded in NEPA documents as specific impacts are identified, and implemented prior to construction. In addition, the permit issued by the Corps and their permit verification letter(s) must be included as part of the construction documents.

5.13.5 Tier 2 Considerations

A jurisdictional delineation would be undertaken during Tier 2 to identify which washes would be recommended as Waters of the US and thus subject to Section 404 permitting and Section 401 certification. Quantification of new, permanent impacts to Waters of the US and permit materials would be completed based on final design of the rail line, major structures, utility work, and other associated construction. Any mitigation measures included by the Corps in their permit verification letter(s) must be included in the construction documents. Construction may proceed under the NWP program if impacts conform to the requirements and thresholds set forth in each permit. **Table 5-25** below presents the likely permitting scenarios that may be encountered during Tier 2. The criteria in the first column include triggers and thresholds that construction must meet to proceed under a given permit. For example, construction would not be able to proceed under a non-notifying NWP No. 14 unless all of the criteria listed in the second column are met.

Table 5-25. Likely Clean Water Act Permitting Scenarios During Tier 2

Permit Criteria	Non-notifying NWP No. 14	NWP No. 14 with a Preconstruction Notification	Individual Permit
Acreage of Impacts to Waters of the US	Impacts <0.10 acre	Impacts between 0.10 acre and 0.50 acre	Impacts >0.50 acre
Biology	No adverse impacts to biological resources	Adverse impacts to biological resources with complete Section 7 consultation	Jeopardizes the continued existence of a threatened, endangered, or proposed species
Cultural Resources	No effects to cultural resources	May affect cultural resources with sufficient Section 106 consultation	N/A
Perennial Rivers or Special Aquatic Sites	No impacts to perennial rivers or special aquatic sites	May affect perennial rivers; no impacts to special aquatic sites	Impacts to special aquatic sites
General/Regional Conditions	Complies with all general and regional conditions	Complies with all general and regional conditions	Does not comply with at least one general or regional condition
Threshold for Meeting Permit Requirements	Must meet all the above criteria	Any one of the above criteria triggers a preconstruction notification	Any one of the above criteria triggers an individual permit
Additional Section 404 Permitting Requirement(s)	Would require separate permit for impacts from stations, other non-linear features, or utilities	Would require separate permit for impacts from stations, other non-linear features, or utilities	Could cover all impacts from all construction

5.14 Wetlands

To administer the Corps' Section 404 permit program, the EPA (EPA, May 11, 2012) and the Corps define wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas" (USEPA, 40 CFR 239.2 and Corps, 33 CFR 328.3). For this analysis, this resource includes potential wetland areas as designated on the USFWS National Wetland Inventory (NWI) maps.

5.14.1 Methodology and Regulatory Requirements

The regulatory framework pertaining to wetlands includes Section 404 of the Clean Water Act of 1972 (as amended), and Executive Order 11990, Protection of Wetlands (USDOT Order 5660.1A). For permitting purposes, the corridor alternatives lie within the Corps' Los Angeles regulatory district.

The USFWS NWI database was used to identify locations of potential wetland areas within the corridor alternatives. The NWI maps are based on a classification system known as the Cowardin System, which classifies the types of ecosystems related to water resources (USFWS 1979). Typical wetland classifications in the Arid West include riverine, freshwater pond, and freshwater forested/shrub.

The regulatory definition of wetlands emphasizes that wetlands must possess three essential characteristics before a positive determination of a wetland can be made: hydric soils, a prevalence of hydrophytic vegetation, and a persistent wetland hydrology. Jurisdictional wetlands in Arizona are regulated as special aquatic sites pursuant to 40 CFR Part 230.41, and, per NWP Regional Condition No. 2, very few of the Corps' NWPs can be used to authorize construction that would result in the loss of wetlands in Arizona. Therefore, in Arizona, impacts to a wetland are likely to result in a Section 404 Individual Permit. When impacts to wetlands trigger a Section 404 Individual Permit, a Section 401 Individual Water Quality Certification is also required.

In conjunction with the Tier 2 NEPA documents, a wetland delineation and more detailed impact analysis of potential wetland areas would be conducted, including field surveys, to determine which areas meet the USEPA and Corps regulatory criteria and definition of a wetland, and to determine the types and boundaries of those wetland areas. The potential also exists for additional wetlands to be found in the course of those surveys. Coordination would take place with the Corps to determine which wetland areas are jurisdictional or non-jurisdictional for Section 404 permitting purposes and mitigation requirements.

5.14.2 Existing Conditions

The *Corridor Aerial Atlas Appendix*, Maps 1 through 91, show the NWI-mapped wetlands within and adjacent to the corridor alternatives. **Table 5-26** shows the approximate acreage of different wetland types within the 1-mile-wide Yellow and Orange corridor alternatives, and based on those numbers, the potential acreage of different wetland types within a 200-foot ROW corridor.

Most of the NWI-identified wetlands can be characterized by the following:

- Various channels of the Santa Cruz, Rillito, Gila, and Salt rivers
- Areas within the associated floodplains of the rivers named in the previous bullet (including Sweetwater Wetlands Park)
- Ponding areas in or adjacent to ephemeral washes
- Canals that receive water throughout the year
- Freshwater ponds associated with sand and gravel operations, golf courses, and parks
- Retention basins, stock tanks, or other water storage and management areas for agricultural, industrial, and residential purposes

Table 5-26. Potential Wetland Areas within the Yellow and Orange Corridor Alternatives

Wetland Type	Wetland Abbreviation[a]	Acres (1-Mile Corridor)	Acres (200' ROW)
Yellow and Orange Corridor Alternatives–Southern Hub to Eloy		**465**	**17.6**
Freshwater Emergent Wetland	PEM	0.00	0.00
Freshwater Forested/Shrub Wetland	PFO, PSS	15	0.57
Freshwater Pond	PUB	150	5.69
Lake	L2UB	45	1.71
Riverine	R2UB, R2US, R4SB, R4SBAx, R4SBJ	255	9.66
Associated with river channels and ephemeral washes (percent of total acreage)	-	310 (67%)	11.75 (67%)
Yellow Corridor Alternative–Eloy to Northern Hub		**565**	**21.4**
Freshwater Emergent Wetland	PEM	<1	<0.04
Freshwater Forested/Shrub Wetland	PFO	<1	<0.04
Freshwater Pond	PUB	90	3.41
Lake	L2UB	60	2.27
Riverine	R4SB	415	15.73
Associated with river channels and ephemeral washes (percent of total acreage)	-	290 (51%)	10.99 (51%)
Orange Corridor Alternative–Eloy to Northern Hub		**1,010**	**38.3**
Freshwater Emergent Wetland	PEM	2	0.08

Table 5-26. Potential Wetland Areas within the Yellow and Orange Corridor Alternatives

Wetland Type	Wetland Abbreviation[a]	Acres (1-Mile Corridor)	Acres (200' ROW)
Freshwater Forested/Shrub Wetland	PFO, PSS	20	0.76
Freshwater Pond	PUB	130	4.93
Lake	L1UB, L2UB	50	1.90
Riverine	R4SB	810	30.70
Associated with river channels and ephemeral washes (percent of total acreage)	-	590 (58%)	22.36 (58%)

Source: NWI 2014

[a] L1UB: Lacustrine Limnetic Unconsolidated Bottom
L2UB: Palustrine Littoral Unconsolidated Bottom
PEM: Palustrine Emergent
PFO: Palustrine Forested
PSS: Palustrine Scrub-shrub
PUB: Palustrine Unconsolidated Bottom
R2UB: Riverine Lower Perennial Unconsolidated Bottom
R2US: Riverine Lower Perennial Unconsolidated Shore
R4SB: Riverine Intermittent Streambed
R4SBAx: Riverine Intermittent Streambed Temporarily Flooded Excavated
R4SBJ: Riverine Intermittent Streambed Intermittently Flooded

Based on a review of aerial photos, it is likely that jurisdictional wetlands would only be determined along or near the banks of the named rivers, and potentially in ponding areas along ephemeral washes. These areas represent almost 60 percent of the NWI-identified potential wetlands. As discussed in **Section 5.13,** Waters of the US, the CAP canal, and the various irrigation canals are likely to be considered utilities and determined not jurisdictional. The majority of ponds, retention basins, stock tanks, and other water storage and management areas appear to be isolated waters without an upstream and/or a downstream connection to a possible Water of the US. Therefore, it is likely they would not be considered jurisdictional.

5.14.3 Environmental Consequences

Based on the types of construction typically associated with new rail infrastructure, it is likely that a Section 404 Individual Permit would be required if construction were to result in permanent impacts to jurisdictional wetlands. If preliminary geotechnical activities within jurisdictional wetlands were designed to conform to Nationwide Permit No. 6 (Survey Activities), a preconstruction notification to the Corps would be required rather than an Individual Permit.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Impacts to possible jurisdictional wetlands would vary depending on the placement of the passenger rail system within the corridor. Acquisition of ROW to construct a passenger rail system could have unavoidable impacts to wetlands within the corridor alternative. The majority of wetlands likely to be recommended as jurisdictional (approximately 270 acres) are associated with the Santa Cruz and Rillito rivers between Tucson and Marana; another 40 acres of NWI-identified wetlands are associated with ephemeral washes. Direct physical impacts to wetlands would increase if a passenger rail system is constructed southwest of the existing UP railway, closer to the Santa Cruz River. North of Marana, most of the NWI-identified wetlands are associated with stock tanks and water storage; and, if they are found to lack a direct connection to a designated Water of the US, impacts to them would not require a Section 404 permit. Wetland areas could be affected by cuts, fills, or diversions required to construct ballast, embankments, drainage slopes, or other railway components.

Impacts to jurisdictional wetlands could occur as a result of construction activities including placement of fill material for track and siding, culvert replacement or extensions, and bridge replacement or additions. Some construction impacts, like placement of fill, would be considered permanent and subject to permitting by the Corps.

Operational Impacts

Impacts to jurisdictional wetlands from the operation of a passenger rail system are likely limited to those associated with the maintenance of culverts or bridges. Efforts during the design phase to avoid wetlands would help to minimize potential impacts from maintenance because fewer wetlands may be in close proximity to a future rail line. Currently, a Nationwide Permit No. 3 (Maintenance) cannot be used in jurisdictional wetlands in Arizona. However, ADOT would make an effort to avoid and/or minimize permanent impacts to wetlands, and would work with the Corps to evaluate alternative permitting scenarios.

Construction Impacts

Temporary construction impacts may occur as a result of soil disturbance and potential construction pollutant loading of stormwater runoff; however, they would be temporary and would cease after construction is completed. In addition, the AZPDES and SWPPP requirements would minimize impacts from stormwater and associated pollutants.

Eloy to Northern Hub

Physical Impacts

Impacts on jurisdictional wetlands would vary based on the placement of the passenger rail system within the corridor. Acquisition of ROW to construct new railroad infrastructure could have unavoidable impacts to wetlands within the corridor alternative. The majority of wetlands likely to be recommended as jurisdictional (approximately 280 acres) are associated with the Gila and Salt rivers north of Coolidge and Tempe, respectively. Another 10 acres of NWI-identified wetlands are associated with ephemeral washes. Direct physical impacts to wetlands could be minimized to the Gila River because the passenger rail system would likely be placed perpendicular to the river. Impacts to the Salt River may increase if the passenger rail system is placed south of the SR 202L. The remaining NWI-identified wetlands in this corridor are associated with irrigation canals, water storage, and constructed lakes. If they are found to lack a direct connection to a designated Water of the US, these resources would not require a Section 404 permit. Wetland areas could be affected by impacts to cuts, fills, or diversions required to construct ballast, embankments, drainage slopes, or other railway components.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts would be the same as those described in the Yellow Corridor Alternative southern hub to Eloy analysis.

Eloy to Northern Hub

Physical Impacts

Physical impacts would be similar to those described in the Yellow Corridor Alternative-Eloy to northern hub analysis; however, the acreage of potential wetlands associated with the Gila and Salt rivers (approximately 580 acres) in the Orange Corridor Alternative Eloy to northern hub is more than double the acreage in the Yellow Corridor Alternative Eloy to northern hub because of an additional 315 acres of Salt River-associated potential wetlands. Another 10 acres of NWI-identified wetlands are associated with ephemeral washes. The Gila River-associated wetlands decrease by approximately 10 acres in this study corridor. The additional acreage presents increased challenges for avoiding and minimizing impacts to wetlands as required by the Corps.

Operational Impacts

Operational impacts would be similar to those described in the Yellow Corridor Alternative-southern hub to Eloy analysis.

Construction Impacts

Construction impacts would be similar to those described in the Yellow Corridor Alternative-southern hub to Eloy analysis.

No Build Alternative

Under the No Build Alternative, construction would not occur, and no impacts to wetlands would occur beyond those that could occur due to other reasonably foreseeable projects.

5.14.4 Potential Mitigation Measures

In conjunction with the Tier 2 NEPA documents, wetlands would be reviewed to determine where it is possible and practical to avoid or minimize impacts. If a Section 404 Individual Permit is required, the permit application must include documentation of an alternatives selection process and attempts to avoid and minimize impacts to wetlands. The use of pilings or bridges to minimize fill is one example of how impacts to wetlands could be minimized.

Mitigation options available for unavoidable impacts to jurisdictional wetlands would be discussed in more detail during Tier 2 NEPA documentation and could include in-lieu fees and on-site or off-site permittee-responsible mitigation. Arizona does not have mitigation banking. During the design process, coordination would take place with the Corps and appropriate resource agencies to develop appropriate mitigation strategies. FRA, as the lead agency, would be required to document which alternative would be the Least Environmentally Damaging Practicable Alternative; this would be the Corps' preferred alternative during the Section 404 Individual Permit process. Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known, recorded in NEPA documents as specific impacts are identified, and implemented prior to or during construction.

5.15 Water Quality

This water quality assessment addresses the potential effects of sediment erosion and chemical pollution on surface water resources (e.g., streams, lakes, ponds, wetlands) as well as groundwater.

5.15.1 Methodology and Regulatory Requirements

The CWA is the primary federal statute governing discharge of pollutants into Waters of the US, which, in Arizona, include perennial and ephemeral watercourses and their tributaries and adjacent wetlands. The principal goal of the CWA is to establish water quality standards to restore and maintain the chemical, physical, and biological integrity of the nation's Waters by preventing point (concentrated output) and nonpoint (widely scattered output) pollution sources. While effects on Waters of the US are addressed in **Section 5.13**, CWA compliance is mentioned here for its role in preventing deterioration of water quality.

Section 401 of the CWA requires that the activities covered by the Section 404 permit are certified according to the state's applicable effluent limitations and water quality standards. In Arizona, Section 401 certification is directly related to the Section 404 permit and certification is applied for concurrently with the Section 404 permit approval. Section 401 certification is administered by the Arizona Department of Environmental Quality (ADEQ) if the action is entirely on non-Tribal lands. If any portion of the action occurred within or affected Tribal Waters of the US, the Section 401 certification would be obtained from either the EPA or the respective Tribe.

Section 402 of the CWA formed the National Pollutant Discharge Elimination System (NPDES), which regulates pollutant discharges, including stormwater, into Waters of the US. An NPDES permit sets specific discharge limits for point-source pollutants and outlines special conditions and requirements for a particular project to reduce impacts to water quality. In 2002, the EPA authorized the ADEQ to administer the NPDES program at the state level, called the Arizona Pollutant Discharge Elimination System (AZPDES). AZPDES permits require that projects be designed to protect Waters of the US, that erosion control Best Management Practices (BMP) be implemented, and that a Stormwater Pollution Prevention Plan (SWPPP) be prepared for construction activities exceeding 1.0 acre of ground disturbance.

Other regulatory terms used in describing water quality include impaired waters and not-attaining waters.

Impaired waters are bodies of water that fail to meet water quality standards (based on a bi-annual assessment of surface water chemistry) and are not supporting designated beneficial uses (such as supporting aquatic life, fish consumption, and recreation).

The assessments are submitted to EPA in the Integrated 305(b) Assessment and 303(d) Listing Report, named after the two sections of the CWA that established these requirements. The 303(d) list identifies those waters that are impaired and lists the pollutant causing the impairment. States identify waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards, and establish priorities for development of Total Maximum Daily Load (TMDL) based on the severity of the pollution and the sensitivity of how the water body is used. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards (EPA 2012a). Pollutant loading can originate from either point or non-point sources.

Once a TMDL has been developed, the surface water is removed from the 303(d) list and is classified as "not attaining," which means the TMDL study is complete, but the waterbody is not yet in attainment with water quality standards for the designated uses of the waterbody. Corrective actions are developed in a TMDL Implementation Plan, and timeframes are established to comply with the applicable water quality standards.

Under the Federal Water Pollution Control Act, Section 303(d), each state is required to identify water resources that do not meet the state's water quality standards. In addition to the Water Pollution Control Act and Sections 401 and 402 of the CWA (1972, as amended), other regulations pertaining to water quality include EO 12088, Federal Compliance with Pollution Control Standards (43 FR 47707)(1978).

The sole source aquifer protection program, authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (42 U.S.C. § 300 *et seq*.) is intended to protect drinking water supplies in areas where there are few or no alternatives sources to the groundwater resource and where, if contamination occurred, using an alternative source would be extremely expensive (EPA 2012b).

This evaluation assesses the effects on water quality from a future passenger rail system in one of the corridor alternatives. GIS and other data were obtained to evaluate the existing conditions and potential effects. Data from ADEQ were used to determine the presence of impaired waters and waters not attaining Arizona's water quality standards. Arizona Department of Water Resources data provided information on registered wells. Sole source aquifer data were obtained from EPA, and wetland data were obtained from USFWS. Sub-basin and watershed boundaries were derived from United States Bureau of Reclamation and NRCS data.

5.15.2 Existing Conditions

The Yellow and Orange corridor alternatives are located within the Bureau of Reclamation's Lower Colorado Region and encompass portions of 14 watersheds (USBR 2013; NRCS 2013a, 2013b).

Yellow Corridor Alternative

Southern Hub to Eloy

Water resources in the southern half of the Yellow Corridor Alternative comprise an extensive network of perennial and ephemeral watercourses, wetlands, and other surface water resources that generally flow toward the Santa Cruz River (generally flowing south to north) and Gila River (generally flowing east to west). The largest watercourse in the corridor alternative is the Santa Cruz River, which extends from the City of Tucson, northwest toward the City of Eloy, and on to the Gila River. Most of the ephemeral watercourses in the area, including Rillito River, Cañada del Oro, and Julian Wash, are tributaries to the Santa Cruz River. At least one small lake is in this portion of the Yellow Corridor Alternative; Silverbell Lake is located adjacent to Christopher Columbus Park, at 4600 North Silverbell Road in Tucson. The water resources within the corridor alternative are shown in the *Corridor Aerial Atlas Appendix*.

Due to ammonia content, a portion of the Santa Cruz River in the vicinity of the City of Marana, and apparently within the southern half of the Yellow Corridor Alternative, is identified as an EPA 303(d) not attaining water (ADEQ 2010a, 2013a).

The southern portion of the Yellow Corridor Alternative passes through the Tucson and Pinal Active Management Areas (AMAs), which are areas regulated by Arizona's Groundwater Code to manage the state's finite groundwater resources. The management goal for the Tucson AMA is to establish a safe yield by 2025 so that no more groundwater is being withdrawn than is being annually replaced. In the Pinal AMA, the goal is to preserve the agricultural economy for as long as is feasible while considering the need to preserve groundwater for future non-irrigation uses.

Key features pertinent to water quality in the southern half of the Yellow Corridor Alternative include:

- A designated area of the Upper Santa Cruz & Avra Basin Sole Source Aquifer (EPA 2008a)
- One wastewater treatment plant (Tres Rios Water Reclamation Facility, located near I-10 and Ina Road in Tucson)
- Approximately 24 named ephemeral washes and numerous unnamed ephemeral washes
- Approximately 465 acres of wetlands (see **Section 5.14**)
- Approximately 656 water wells (ADWR 2013)

Eloy to Northern Hub

The northern half of the Yellow Corridor Alternative also comprises ephemeral watercourses, wetlands, and other surface water resources that generally flow from southeast to northwest (draining into the Gila River) in areas south of the Gila River. North of the Gila River, water generally flows from the northeast to southwest and drains into the Salt River. In the Phoenix Metropolitan area, the Yellow Corridor Alternative also includes portions of the Salt River. The flow patterns of natural watercourses are generally less well defined in the Phoenix Metropolitan area than in outlying areas because the watercourses have been disturbed by agricultural activities and development.

The northern portion of the Yellow Corridor Alternative passes through the Pinal and Phoenix AMAs. In the Pinal AMA, the goal is to preserve the agricultural economy for as long as is feasible while considering the need to preserve groundwater for future non-irrigation uses. The management goal for the Phoenix AMA is to establish a safe yield by 2025 so that no more groundwater is being withdrawn than is being annually replaced.

Key features pertinent to water quality in the northern half of the Yellow Corridor Alternative include:

- Tempe Town Lake
- Approximately five canals, all in the Phoenix metropolitan area
- Numerous unnamed washes
- Approximately 565 acres of wetlands (see **Section 5.14**)
- Approximately 1,135 well sites (ADWR 2013)

Orange Corridor Alternative

Southern Hub to Eloy

Water resource features in the Orange Corridor Alternative from the southern hub to Eloy are the same as those described for Yellow Corridor Alternative from the southern hub to Eloy.

Eloy to Northern Hub

The northern half of the Orange Corridor Alternative also comprises ephemeral watercourses, wetlands, and other surface water resources that generally match those described in the Yellow Corridor Alternative study, including the presence of the Salt River.

Like the Yellow Corridor Alternative, the northern portion of the Orange Corridor Alternative also passes through the Pinal and Phoenix AMAs.

Key features pertinent to water quality in the northern half of the Orange Corridor Alternative include:

- Tempe Town Lake
- Approximately five canals, all in the Phoenix metropolitan area
- Approximately 1,010 acres of wetlands (see **Section 5.14**)
- Two named washes and numerous unnamed washes
- Approximately 991 well sites (ADWR 2013)

5.15.3 Environmental Consequences

Yellow and Orange Corridor Alternatives

In general, the potential environmental consequences are similar for all segments of the Yellow and Orange corridor alternatives. While the Yellow Corridor Alternative encompasses more wells and the Orange Corridor Alternative encompasses more wetlands, the specific effects on these resources would not be determined until a Tier 2 analysis is prepared for a specific alignment. Additionally, conditions within the corridor alternatives change over time. Therefore, updated data would need to be obtained when the Tier 2 analysis is undertaken.

Physical Impacts

A passenger rail system has the potential to affect groundwater due to the large number of wells and the presence of the Upper Santa Cruz & Avra Basin Sole Source Aquifer. Wells provide a more direct pathway for runoff to flow to groundwater, so the number of wells contributes to the understanding of the potential for groundwater contamination and the types of mitigation measures that may be required. Additionally, the large number of wells within the study corridors suggests that well relocations would be likely with development of a passenger rail system in either corridor alternative.

New rail infrastructure would increase the amount of impervious surface (pavement), which influences surface water flow and may contribute to flooding because the natural surface is no longer exposed and able to absorb water during a storm; however, the potential increase represents a very minor fraction of the surfaces in the surrounding area, and potential flooding could be mitigated through drainage design. A passenger rail system also could influence drainage patterns, which could potentially affect water resources such as wetlands. The effects could cut off flows to some areas or increase the amount of flows to other areas. Compliance with Section 401 Water Quality Certification and Section 402 AZPDES permit requirements would be necessary, but the permit requirements cannot be fully be determined until Tier 2 studies define a rail alignment and design parameters. Disturbance of 1 contiguous acre or more from construction activity (which is reasonably foreseeable) would require a construction general permit, which in turn requires an SWPPP. In addition, the corridor's proximity to the not-attaining segment of the Santa Cruz River would trigger a water quality monitoring program as part of the SWPPP, and an Individual Section 401 Water Quality Certification.

Operational Impacts

Operational effects on water quality are mainly associated with stormwater runoff and may be influenced by operation and maintenance of the rail facilities, while potentially removing some volume of vehicle traffic from I-10 and other roadways in the area. Operation of a passenger rail system could result in a minor increase the volume of pollutants (e.g., fuel and oils) within the corridor that could potentially enter into surface waterways or groundwater (through well sites) via stormwater runoff. Stormwater runoff may contain sediment, nutrients (e.g., phosphorus and nitrogen), pesticides, petroleum derivatives, solid wastes, or other chemicals and metals.

Construction Impacts

Ground disturbance associated with construction activities would be expected to increase the volume of sediment in stormwater. If soils in construction areas were previously contaminated, such as by agricultural use of pesticides or petroleum derivatives leaked from vehicles, the soil disturbance may potentially increase pollutant loading in the runoff. Construction activities would minimize erosion and sediment discharges to the extent practicable using control measures.

Water for dust control may be required during construction. This short-term use of water would not be expected to affect the goals of the AMAs, but specific water needs and water sources would be identified and analyzed during Tier 2 documentation. The southern segment of both corridor alternatives is within the Upper Santa Cruz & Avra Basin Sole Source Aquifer. Therefore, protection of the aquifer from sources of contamination would be particularly important during construction.

Development of a passenger rail system would result in ground disturbance greater than 1.0 acre and would require an AZPDES permit and the implementation of erosion-control BMPs and a SWPPP to ensure water quality is protected during construction activities. Short-term effects on water quality include those associated with stormwater runoff from construction activities. Most of the effects from construction runoff would remain only for the duration of the construction activities; however, construction activities could potentially result in long-term effects from pollutant discharge into the groundwater system.

No Build Alternative

Under the No Build Alternative, a new passenger rail system would not be built, so no project-related effects on water quality would occur. Operational pollutants such as oils and lubricants would not be generated and would not influence the amount of contaminants in stormwater runoff; however, traffic volumes along I-10 between the cities of Tucson and Phoenix would continue to increase, which would likely raise pollutant levels in stormwater runoff originating on the highway.

5.15.4 Potential Mitigation Measures

An AZPDES Construction General Permit (NPDES permit for tribal or other federal land) would need to be obtained as part of future Tier 2 activities to authorize any stormwater discharges associated with construction of a future passenger rail system.

Specific mitigation measures are anticipated as follows, but future Tier 2 analysis would confirm these measures:

- The contractor will obtain the most current copy of the BMPs for incorporation in the SWPPP.
- Upon completion and ADOT Engineer approval of the SWPPP, the ADOT Engineer and contractor will each file a Notice of Intent to ADEQ. Upon final acceptance of a project by the ADOT Engineer, the ADOT Engineer and the contractor will each file a Notice of Termination for a project to ADEQ. The contractor will provide copies of the completed final SWPPP, Stormwater Monitoring Plan, if needed, and contractor Notice of Intent and Notice of Termination to the ADOT Engineer.
- The ADOT Engineer will submit the contractor's AZPDES Notice of Intent and the Notice of Termination to the ADOT Environmental Coordinator.
- No work shall occur within jurisdictional Waters of the US until the appropriate Clean Water Act Section 401 certification and 404 permits are obtained.
- Consider secondary containment at rail maintenance yards where petroleum-based products may be stored or used and at rail station parking lots to control stormwater runoff to minimize the risk of contaminating surface and groundwater, particularly within the boundaries of the sole source aquifer.

The following standard specifications also may be included as mitigation measures:

- According to ADOT's Standard Specifications for Road and Bridge Construction, Section 104 Scope of Work, Subsection 09 Prevention of Landscape Defacement;

Protection of Streams, Lakes, and Reservoirs (2008 Edition) — The contractor shall take sufficient precautions, considering various conditions, to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumens, calcium chloride, fresh Portland cement, fresh Portland cement concrete, raw sewage, muddy water, chemicals or other harmful materials. None of these materials shall be discharged into any channels leading to such streams, lakes, or reservoirs.

- According to ADOT's Standard Specifications for Road and Bridge Construction, Section 104 Scope of Work, Subsection 09 Prevention of Landscape Defacement; Protection of Streams, Lakes, and Reservoirs (2008 Edition) — The contractor shall give special attention to the effect of its operations upon the landscape and shall take special care to maintain natural surroundings undamaged.

5.15.5 Tier 2 Considerations

The quantities of ephemeral watercourses, wetlands, wells, and other water resources identified in the affected environment are based on 1-mile-wide corridors rather than specific alignments. Many of the resources would be avoided simply by narrowing the width of the affected area, but the specific resources affected by a future alignment would warrant careful analysis during Tier 2 studies because some water resources may be more sensitive than others. Also, because conditions change over time, data would need to be updated when Tier 2 analysis is undertaken.

Water would be needed for construction and operation of a passenger rail facility. Water is typically used to control dust in areas disturbed by construction. Rail stations would require water for passenger drinking water and sanitation. Quantities and sources of water have not yet been defined and would need to be identified and analyzed in Tier 2 documentation, with particular consideration given to the portion of the corridor alternatives within a sole source aquifer.

5.16 Floodplains

The analysis for this resource includes 100-year floodplains (areas with a 1-percent annual chance of flooding) as defined by the Federal Emergency Management Agency (FEMA) in accordance with 44 CFR 59.1. Floodplains are the areas adjoining a river or stream that has been or may be covered by the 100-year flood.

Floodways are the channel of a river or stream and the part of the floodplain adjoining the channel that serve as the natural conduit for floodwaters. Floodways must remain open to allow floodwaters to pass because obstructions in the floodway would result in flooding of an even greater area.

5.16.1 Methodology and Regulatory Requirements

The regulatory framework pertaining to floodplains is EO 11988, Floodplain Management (as amended), which states that federal agencies are required "… to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative."

Flood control districts with jurisdiction within portions of the corridor alternatives include the Pima County Flood Control District, City of Tucson, Pinal County Flood Control District, and the Flood Control District of Maricopa County.

The data collection and analysis for this Tier 1 EIS were undertaken prior to the 2015 adoption of EO 13690, which changed the approach for establishing the flood hazard area. Digital 100-year floodplain data, based on FEMA's Flood Insurance Rate Maps of Special Flood Hazard Areas, were compiled from the FEMA website. Special Flood Hazard Areas (or 100-year floodplains) are the areas subject to flooding by the 1-percent annual chance flood. Special Flood Hazard Area Zone A is designated as having no base flood elevations determined; whereas, in Special Flood Hazard Area Zone AE, base flood elevations have been determined. Zone AH designates areas with a 1-percent chance of shallow flooding with a constant water surface elevation, that is, areas of ponding. Zone AO designates areas with a 1-percent annual chance of flooding that results in sheet flow on sloping terrain.

Areas of flood Zone D were not included in readily available data and would be investigated in Tier 2 studies.

Potential avoidance and minimization of impacts on 100-year floodplains would be further evaluated in the Tier 2 NEPA documents. Per EO 13690, the Tier 2 analysis would either utilize a climate-informed science approach, add 2 to 3 feet of elevation to the mapped 100-year floodplain, or use the 500-year floodplain. Any proposed encroachments in a 100-year floodplain area would require coordination with local floodplain administrators to discuss floodplain development permitting and potential mitigation measures.

5.16.2 Existing Conditions

Flooding is common in the desert Southwest where large amounts of precipitation can fall in a short period of time. Because of the arid climate, vegetation is often sparse, and soils tend to be thin and discontinuous. With little soil to absorb water and little vegetation to hold it back, precipitation runs off quickly and can result in floods. The potential for flooding is higher in urban areas, where most of the land is covered with buildings and pavement.

Major flooding occurred as recently as 1980 in the Phoenix area and 1983 in southern Arizona. The 1980 storm caused severe flooding on the Gila and Salt rivers. The greatest damage occurred along the Salt River, where 11 of 13 bridges were destroyed or damaged (Maricopa County Flood Control District 2013). The UP bridge over the Salt River survived this storm and was even used for a few weeks by a temporary commuter train between Mesa/Tempe and Phoenix, as most other routes were closed (Arizona Rail Passenger Association 2013). The existing railroad bridge has been in use since 1912 on a site where three previous railroad bridges were destroyed by flooding.

In 1983, Tropical Storm Octave brought 10 days of heavy rain to Arizona. The Tucson area was hit especially hard, as the Santa Cruz River, Rillito River, and Pantano Wash all overflowed their banks. Property damage was estimated at $370 million (Maricopa County Flood Control District 2013). The effects of the storm were felt throughout the state; for example, the Santa Fe Railway serving the city of Prescott was washed out in several places and eventually abandoned, leaving Prescott with no rail service.

Floodplains present in the corridor alternatives are associated with:

- Santa Cruz River
- Rillito River
- Gila River
- Queen Creek
- Salt River
- Indian Bend Wash
- Numerous canals (including Eastern, Grand, Roosevelt, and Tempe canals)
- At least 24 named washes and numerous unnamed washes

Most major rivers and washes and some smaller washes within the study corridor have 100-year floodplains mapped by FEMA. Maps 1 through 91 in the *Corridor Aerial Atlas Appendix* show the floodplains near or within the corridor alternatives. Early railroads were located along valley floodplains of rivers and washes wherever possible to take advantage of the level or nearly level terrain and minimize cut and fill construction operations. As such, portions of the corridor alternatives run parallel to several waterways and their adjoining floodplains (Santa Cruz River, Salt River), in addition to crossing several floodplains at a perpendicular or skewed angle (Gila River, Indian Bend Wash, Rillito River).

Approximately 13,344 acres of 100-year floodplains are within the corridor alternatives, as shown in **Table 5-27.** ROW corridors 200 feet in width would incorporate approximately 506 100-year floodplain acres.

Table 5-27. Floodplain Acreage in the Corridor Alternatives

Approximate Acres in the 1-Mile (and 200') Corridor Segment	Acreage within the 100-year Floodplain for 1-Mile (and 200') Corridor	Percent of Total Corridor Acres in the 100-year Floodplain	1-Mile (and 200') Corridor Acres within Floodway
Southern Hub to Eloy – Yellow and Orange Corridor Alternatives			
28,400 (1,076)	5,860 (222)	20.6%	0 (0)
Eloy to Northern Hub – Yellow Corridor Alternative			
48,700 (1,846)	3,470 (132)	7.1%	230 (8.7) [Salt River]
Eloy to Northern Hub – Orange Corridor Alternative			
53,900 (2,043)	4,016 (152)	7.5%	49 (1.9) [Indian Bend Wash] 595 (22.6) [Salt River]

5.16.3 Environmental Consequences

Because some stretches of the corridor alternatives run along and across several 100-year floodplains, it is unlikely that floodplain impacts from constructing a passenger rail system could be avoided. New rail infrastructure would likely cross and permanently encroach on several 100-year floodplains. Depending on how close a passenger rail line might be to the existing UP freight line, this could include adding track and sidings, widening or replacing bridges, and replacing or extending culverts.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Physical impacts to floodplains could occur through dredging within the floodplain; placement of track and sidings; construction of new, widened, or replaced bridges or culverts; or placement of rail stations, if these activities occurred within a 100-year floodplain. The 1-mile-wide Yellow Corridor Alternative from the southern hub to Eloy encompasses approximately 5,860 acres of floodplain, as summarized in **Table 5-27** above. No regulatory floodways are located in this corridor segment. Until Tier 2 studies define alignments within the corridor, the amount of floodplain affected cannot be determined, but the fact that more than 20 percent of the corridor is within the 100-year floodplain suggests there would be effects. Floodplains and floodways that could potentially be affected include the following hydrologic features: Arroyo

Chico Wash, Bronx Wash, Cañada del Oro, El Rio Wash, Flowing Wells Wash, Prospect Wash, Rillito River, Santa Cruz River, as well as unnamed washes.

Operational Impacts

Operation of a passenger rail system within the corridor would have no impacts on floodplains, although maintenance activities could have an effect, depending on the nature of the work.

Construction Impacts

Construction of a passenger rail system could have temporary impacts associated with construction activities in or adjacent to floodplains. This could include parking vehicles or storing equipment or materials in a floodplain or having construction equipment in the floodplain for short periods of time. These temporary impacts would occur only during the construction phase, and would comply with all local, state, and federal floodplain regulations.

Eloy to Northern Hub

Physical Impacts

Physical impacts to floodplains could occur through dredging within the floodplain; placement of track and sidings; construction of new, widened, or replaced bridges or culverts; or placement of rail stations, if these activities occurred within a 100-year floodplain. Approximately 3,470 acres of floodplain are located within this corridor segment; depending on the placement of passenger rail system infrastructure, floodplains and floodways could potentially be affected, Including those associated with the following hydrologic features: Consolidated Canal East Branch, Eastern Canal, Gila River, Grand Canal, Queen Creek, Roosevelt Canal, Salt River, Tempe Canal, as well as unnamed washes.

Operational Impacts

Operation of a passenger rail system within the corridor would be similar to those for the southern hub to Eloy corridor segment.

Construction Impacts

Construction impacts would be similar to those for the southern hub to Eloy corridor segment.

Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts in this segment of the Orange Corridor Alternative would be the same as those in the Yellow Corridor Alternative southern hub to Eloy segment.

Eloy to Northern Hub

Physical Impacts

Physical impacts to floodplains would occur from dredging within the floodplain or the placement of track and sidings, bridges, culverts, or rail stations, if the infrastructure is within a 100-year floodplain. Depending on the placement of the passenger rail and stations, portions of the approximately 4,016 acres of floodplain in this corridor segment could potentially be affected, including those associated with the following hydrologic features: Consolidated Canal East Branch, Eastern Canal, Gila River, Grand Canal, Indian Bend Wash, Queen Creek, Roosevelt Canal, Salt River, Tempe Canal, as well as unnamed washes.

Operational Impacts

Operation of a passenger rail system within the corridor would be similar to those for the Yellow Corridor Alternative southern hub to Eloy corridor segment.

Construction Impacts

Construction impacts would be similar to those described for the Yellow Corridor Alternative southern hub to Eloy corridor segment.

No Build Alternative

Under the No Build Alternative, a passenger rail line would not be constructed within either of the corridor alternatives. No impacts to floodplains would be anticipated beyond those that could occur due to other reasonably foreseeable future projects and the natural forces of deposition and erosion via flows within nearby rivers and washes. Floodplains and floodways would continue to be managed by county and local flood control districts.

5.16.4 Potential Mitigation Measures

If the APRCS advances to a design phase, flood control districts with jurisdiction would be provided the opportunity to review and comment on the design plans for passenger rail system structures within floodplains to ensure flood control district requirements are met and that structures would not cause flood-related erosion hazards or aggravate existing flood hazards.

Once construction activities within a floodplain are complete, all construction sites and fills (such as crane pads, temporary brides, cofferdams, etc.) would be removed in their entirety and the affected areas returned to preconstruction elevations. Structures or other modifications to the floodplain may require the filing of a Letter of Map Change to FEMA to account changes to the area that may be subject to floods.

Other potential mitigation measures may include restoring natural and beneficial floodplain values by seeding with native vegetation and proper design of bridges and culverts so as not to restrict flood flows.

Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known, recorded in NEPA documents as specific impacts are identified, and implemented prior to construction.

5.16.5 Tier 2 Considerations

Impacts on the 100-year floodplains and Zone D areas (where data were not readily available) would be assessed during Tier 2 analysis. Discussions in Tier 2 documents would include potential impacts on floodplain elevation, potential impacts on the natural and beneficial floodplain values, significant changes in flooding risks or damage, and the potential for incompatible floodplain development. Additional hydraulic studies and assessments would be required during the final design process to ensure floodplain encroachments would be minimized to the extent practicable. Coordination with FEMA and local floodplain administrators would be initiated to discuss floodplain development permitting and potential mitigation measures.

5.17 Energy Use and Climate Change

This section describes and compares relative energy use for various modes of transportation. Because greenhouse gas (GHG) emissions are potentially linked to climate change, expected changes in GHG emissions are used to give a general sense of whether impacts to climate change from different modes of transportation are beneficial or detrimental. This section includes:

- an examination of current conditions associated with energy use (fuel consumption) for light vehicles and rail in the nation
- a discussion of GHG emissions associated with light vehicles and rail in the nation
- an explanation of fuel usage as a proxy for energy use and GHG emissions
- a description of relative fuel usage associated with a passenger rail system (including construction and operation of the rail system and expected displacement of vehicles anticipated as a result of implementation)
- a discussion of the relative changes in GHG emissions that could be expected from development of a future passenger rail system within one of the corridor alternatives or from the No Build Alternative

5.17.1 Methodology and Regulatory Requirements

This assessment evaluates potential commitments of energy resources likely to be involved in a passenger rail system and the potential impact that energy usage or conservation may have on GHG emissions and, in turn, climate change.

Under EO 12185, *Conservation of Petroleum and Natural Gas*, agencies are encouraged to conserve petroleum and natural gas whenever financial assistance is contemplated as part of a federal action.

Transportation modeling and energy use data were collected from the *Transportation Energy Data Book,* Edition 31 (Davis, et al. 2012). The FTA publication *Public Transportation's Role in Responding to Climate Change* (FTA 2010) was used for information associated with transportation-related GHG emissions.

Consideration of the effects of GHG emissions in this analysis is intended to be consistent with the CEQ's Revised Draft NEPA Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews (CEQ 2014). This guidance advises that when a proposed federal action analyzed in an Environmental Assessment or an EIS is anticipated to emit GHGs to the atmosphere in quantities that an agency finds may be meaningful, it is appropriate to quantify and disclose an estimate of the expected annual direct and indirect GHG emissions in the document. CEQ's revised draft guidance, issued in December 2014, recommends that the effects of climate change on a proposed project be taken into consideration.

A review of relevant transportation data collected for this study yielded the following general discussion on the relative efficiencies of transportation modes used between Tucson and Phoenix in relation to energy consumption and GHG emissions. A more detailed discussion of transportation analysis factors is provided in **Chapter 4, Transportation Impacts.**

5.17.2 Existing Conditions

Energy

All transportation modes, including passenger vehicles and rail transit, generate their motive power through the use of some form of energy resources. According to the US Department of Energy, transportation accounts for 28 percent of total energy use in the US (Davis et al. 2012). Around 59 percent of total energy associated with transportation is expended by light vehicles, which include passenger cars, motorcycles, and light trucks.

In 2011, over 12 million light trucks and cars were sold in the US (52 percent of these in the light truck category, 48 percent in passenger cars), and over 230 million light vehicles were in use. Average fuel economy of all light vehicles on the road in 2010 was about 23.7 miles per gallon (mpg) for short-wheelbase vehicles and 17.2 mpg for long-wheelbase vehicles. Average new car fuel efficiency for the 2012 model year under Corporate Average Fuel Economy (CAFE) standards show passenger car averages at 35.6 mpg and light trucks at 25.0 mpg. Over time, increasingly stringent CAFE standards would likely result in increased vehicle efficiencies.

Table 5-28 provides an overview of the amount of energy expended per vehicle mile and per passenger mile for selected modes of transportation. Overall, light vehicles on the road today expend an average of approximately 3,600 British thermal units (BTUs) per passenger mile. Depending on the type of train travel, average energy expenditures for rail range from under 2,300 to nearly 2,900 BTUs per passenger mile. Solo drivers of passenger cars and light trucks consume from 5,342 to 7,080 BTUs per passenger mile.

Greenhouse Gas Emissions

GHGs associated with various rail technologies, including heavy rail, light rail, and commuter rail, include primarily carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gas emissions. The transportation sector, and in particular the personal automobile, has been identified as a major and growing contributor to increased GHG emissions. Because they represent the bulk of GHG emissions, and because they are used as a standard in the literature, CO_2 and CO_2 equivalents (CO_2e) are used interchangeably for GHG emissions in this analysis.

Table 5-28. US Passenger Travel and Energy Use, Selected Travel Modes, 2010

Mode	Vehicle Miles (millions)	Energy Expended (BTU/vehicle mile)[a]	Load Factor (passengers / vehicle)	Passenger Miles (millions)	Energy Expended (BTU/ passenger mile)
Light Vehicles	2,494,475			4,127,357	3,607[c]
Passenger cars	1,551,457	5,342	1.55	2,404,758	3,447
Light trucks	924,556	7,225	1.84	1,701,183	3,848
Motorcycles	18,462	2,881	1.16	21,416	2,484
Demand Response[b]	1,529	15,111	1.00	1,477	15,645
Buses	2,425	35,953	8.7	21,172	4,118
Transit Buses	2,425	35,953	8.7	21,172	4,118
Air	5,499	276,329	101.0	555,653	2,735
Certificated Route	5,499	276,329	101.0	555,653	2,735
Passenger Rail	1,400	66,378	25.6	35,874	2,590

Table 5-28. US Passenger Travel and Energy Use, Selected Travel Modes, 2010

Mode	Vehicle Miles (millions)	Energy Expended (BTU/vehicle mile)[a]	Load Factor (passengers / vehicle)	Passenger Miles (millions)	Energy Expended (BTU/ passenger mile)
Intercity Rail	295	49,508	21.8	6,420	2,271
Transit Rail	760	61,740	24.5	18,580	2,520
Commuter Rail	345	91,256	31.5	10,874	2,897

Source: Adapted from Davis, et al. 2012
Notes:
(a) Represents solo vehicle efficiency
(b) Demand response vehicles include dispatched vehicles (e.g., taxis)
(c) Calculated average of light vehicles

5.17.3 Environmental Consequences

Corridor Alternatives

Analysis of relative energy efficiencies and corresponding GHG emission generation associated with different travel modes requires many assumptions. Generally, there is an increase of GHG during construction of a passenger rail system that, over time, results in a net reduction as displacement of vehicle traffic offsets construction-related emissions. Taken from a purely operational perspective, the information presented in **Table 5-28** and **Table 5-29** suggests that displacing ridership from automobiles to rail could potentially produce positive benefits for energy usage and GHG emissions.

These data suggest that reductions in energy use and GHG emissions are achieved when vehicles are taken off the road and drivers put into existing transit. Beneficial effects would result from:

- avoided car trips due to mode shift from automobile to public transit
- relief of traffic congestion and improved operating efficiency of public highways from reduced VMT
- the indirect effect known as the land use multiplier that enables denser land use patterns, which in turn promote shorter trips, walking and cycling, and reduced car use and ownership (American Public Transportation Association 2009)

Table 5-29. Average Greenhouse Gas Emissions from Light Vehicles and Rail

Mode	CO_2 Emissions (average) (lbs. per passenger mile)	CO_2 Emissions (low) (lbs. per passenger mile)	CO_2 Emissions (high) (lbs. per passenger mile)
Light Vehicles			
Single occupancy	0.96[a]	N/A	N/A
Average occupancy (1.55 passengers per vehicle)	0.62[b]	N/A	N/A
4-person carpool	0.24[a]	N/A	N/A
Buses			
Transit Buses	0.64	N/A	N/A
Air			
Airline travel[c]	0.50	0.41	0.61
Passenger Rail			
Heavy rail	0.22[d]	0.085[e]	0.919[f]
Light rail	0.36[d]	0.146[g]	4.266[h]
Commuter rail	0.33[d]	0.013[i]	1.524[j]

Sources: FTA 2010; Davis et al. 2012; and EPA 2008b.

Notes:

[a] National average for single occupancy light vehicle (FTA 2010).

[b] Weighted single occupancy emissions based on 1.55 load factor (from Davis, et al. 2012)

[c] EPA 2008b, Table 4. Represents medium-haul (300-700 miles), long-haul (>700 miles), and short-haul (<300 mile) CO_2 emission rates

[d] FTA 2010. National averages for 14 heavy rail, 29 light rail, and 18 commuter rail systems from across the US

[e] San Francisco Bay Area Rapid Transit (FTA 2010)

[f] Baltimore Metro

[g] San Diego Metropolitan Transit System

[h] Kenosha Transit, Wisconsin

[i] Maryland Transit Authority

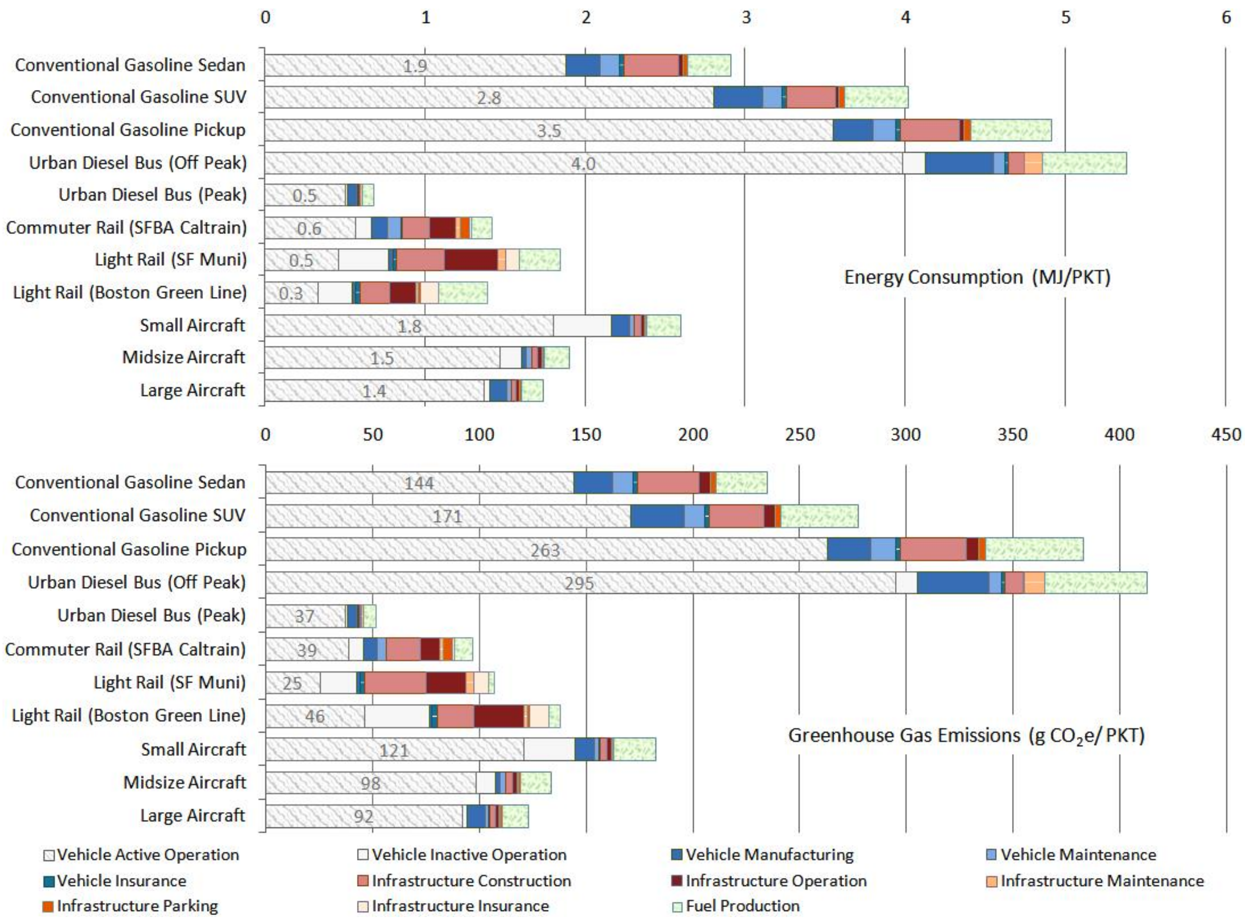
[j] Regional Transportation Authority, Tennessee

N/A = Not Available

Taken in a broader context, rail transit has more mixed results when compared with automobile, bus, or air travel. Researchers have attempted to consider energy used and GHG emissions generated through the life cycle of different travel modes. One such study (Chester and Horvath 2009) posited that analysis of passenger transportation should account for more than just the active operational elements of a given travel mode. The study included the active (e.g., running, take off, cruising, landing) and inactive (e.g., idling, auxiliaries, taxiing) operational components of automobile/bus, rail, or air travel in the analysis. Energy expenditures and GHG emissions for infrastructure development (e.g., rail bed and train station infrastructure, roadway, runway, and other airport infrastructure) necessary for a given mode could also be measured and compared. The type of fuel used, including its life cycle attributes (extraction, generation, refining, and distribution) could also be included in the analysis. The Tier 1 analysis undertaken for the APRCS does not quantify these elements, but such an analysis is appropriate for Tier 2 studies.

Chester and Horvath (2009) reviewed some 79 components across the different travel modes to evaluate life-cycle energy usage. **Figure 5-19** from the Chester and Horvath study shows the relative cost, in terms of energy use and GHG emissions per passenger-kilometer travelled, of several transportation modes. The data shown in the figure reflect certain assumptions, including the average occupancies used for each travel mode. While the data used in **Figure 5-19** were based on passenger-kilometers traveled rather than passenger-miles traveled, the figure shows that on a relative scale, life cycle energy expenditures and GHG emissions generated are lowest for urban buses during peak occupancy periods. For intercity travel, commuter rail proves to be relatively efficient. Lowest in terms of efficiencies are passenger vehicles and empty buses. Implementation of a passenger rail system within one of the corridor alternatives has the potential to provide energy savings and reduce the transportation system’s impact on climate change.

Figure 5-19. Energy Use and Greenhouse Gas Emissions per Passenger-Kilometer Traveled (PKT)



Note: The vehicle operation components are shown with gray patterns. Other vehicle components are shown in shades of blue. Infrastructure components are shown in shades of red and orange. The fuel production component is shown in green. All components appear in the order they are shown in the legend (from Chester and Horvath 2009).

Yellow Corridor Alternative

Implementation of a passenger rail system within the Yellow Corridor Alternative has the potential to provide energy savings and reduce the transportation system's impact on climate change. Based on ridership forecasts, passenger rail within the Yellow Corridor Alternative would decrease vehicle miles traveled by approximately 142 million per year. CO_2, the main GHG emission, would decrease by approximately 66,710 tons per year. Fuel consumption would decrease by approximately 3.04 million gallons per year. Construction equipment and vehicles operated during project construction would result in a temporary increase in fuel consumption which would cease at the end of the construction activity.

Orange Corridor Alternative

Implementation of a passenger rail system within the Orange Corridor Alternative has the potential to provide energy savings and would reduce the transportation system's impact on climate change. Based on ridership forecasts, a rail system within the Orange Corridor Alternative would decrease vehicle miles traveled by approximately 143 million per year. CO_2, the main GHG emission, would decrease by approximately 67,104 tons per year. Fuel consumption would decrease by approximately 3.06 million gallons per year. Construction equipment and vehicles operated during project construction would result in a temporary increase in fuel consumption which would cease at the end of the construction activity.

No Build Alternative

Under the No Build Alternative, no passenger rail system would be built, and no changes in effects on energy use and climate change would occur beyond those that could occur due to other reasonably foreseeable projects, such as the UP's ongoing operation and maintenance. Under the No Build Alternative, passenger train service would not be available to the public between Tucson and Phoenix, resulting in the continued reliance on automobiles, buses, and planes for transportation between communities in the study corridor. With the continued trend in substantial increases in VMT within the three-county study area, energy consumption and GHG emissions would be likely to increase steadily under the No Build Alternative. This assessment does not, however, take into account other influences, including changes in CAFE standards, bus and aircraft efficiency, fuel compositions, and other factors.

5.17.4 Potential Mitigation Measures

Mitigation may not be required for energy use and climate change because of the net benefits expected from reduced energy use and displaced emissions due to a model shift to transit, reduced congestion, and land use effects. It is expected that once a break-even point is reached, increased ridership would result in reduced overall GHG emissions in the study corridor. Further reduction of GHG emissions could be expected by employing BMPs associated with construction (e.g., conserving fuel and reducing GHG emissions during construction activities) and/or operations (e.g., improving fuel efficiency of locomotives, fueling with low-carbon footprint sources, etc.). Any efforts to increase displacement of riders from light vehicles to rail (e.g., advertising, incentives) could be developed into project design or set up as additional mitigation. Specific measures that could be incorporated into project design or developed as mitigation measures include:

- Operations
    - Identifying state-of-the-art locomotives to maximize fuel efficiency

  - Target-marketing to drivers of single-occupancy vehicles to maximize the effects of rail modal use on energy conservation and reduction of GHG emissions
  - Concentrating bus-service routes to feed passengers to train stations
  - Bringing dispersed riders to train stations through other methods (e.g., demand response systems [paratransit, taxi, shuttle, call-and-ride])
- Construction
  - Limiting construction and operational equipment idling
  - Encouraging workers to carpool
  - Locating staging areas near work sites
  - Scheduling material deliveries during off-peak hours to minimize highway congestion

5.17.5 Tier 2 Considerations

It is anticipated that ridership data could change before Tier 2 analysis is initiated for many reasons, including that population trends may not follow projections, growth may occur in different communities than anticipated, and cultural values for different modes of transportation may change. In addition, engineering design, site-specific alignment decisions, and modeling programs are also expected to be more refined. Depending on the availability of data and public concerns regarding energy use and climate change, it may be appropriate to refine the analysis during Tier 2 studies.

5.18 Visual and Aesthetic Scenic Resources

This section summarizes the regulatory setting, affected environment, environmental consequences, and measures to avoid or mitigate impacts to natural and built visual and aesthetic scenic resources (VASR) within and adjacent to the corridor alternatives.

5.18.1 Methodology and Regulatory Requirements

This section of the Tier 1 EIS was prepared in accordance with FTA's Environmental Impact and Related Procedures (23 CFR Part 771) and FRA's Procedures for Considering Environmental Impacts, (64 FR 28545, May 26, 1999) Section 14(n)(12) (FRA 1999a). The procedures outline FRA's compliance with NEPA and related environmental and historic preservation laws and regulations.

Two distinct categories of views are considered in discussing the visual environment: 1) views from the train, which are views of visual/scenic resources; and 2) views by people in adjacent areas who see components of a passenger rail system (sidings and track, trains, maintenance facilities, and stations) and who are sensitive to those views. Visual/scenic resources include historic properties, public parks, recreational areas, and natural areas within the study corridor.

To assess the existing visual environment and identify potential visual impacts, five steps were followed:

1. Define the existing visual environment and quality of existing visual resources.
2. Identify the viewing audience and their sensitivity to visual changes.
3. Define the nature of the visual change by the project.
4. Assess potential visual impacts of a passenger rail system within the corridor alternatives.
5. Propose methods to mitigate adverse visual impacts.

Land under the jurisdiction of BLM or NPS is subject to a visual resource management (VRM) system that assesses the scenic value of an area and then establishes management objectives based on an acceptable level of visual preservation or disturbance. The overall goal of BLM's VRM system is to minimize visual impacts wherever they occur on public land. See the *Visual and Aesthetic Scenic Resources Appendix* for more information on the VRM system as administered by BLM’s Lower Sonoran Field Office.

5.18.2 Existing Conditions

The potential VASR within or adjacent to the corridor alternatives are displayed in **Figure 5-20**, **Figure 5-21**, and **Figure 5-22**, and are divided into the following categories:

- **Parks and Recreation Areas** – This category includes city, county, state, and federal parks, as well as designated open space and recreational areas.
- **Natural Scenic Areas** – This category includes natural areas with scenic qualities such as mountain ranges, waterbodies, open vistas, and native desert landscapes, as shown in **Figure 5-23**. These areas are informally defined for this Tier 1 EIS and include many unique and individually scenic resources that should be analyzed further in a Tier 2 environmental document.
- **Historic Districts and Sites** – This category includes sites in the corridor alternatives listed on the National Register of Historic Places (NRHP).
- **Landmarks** – Landmarks include prominent or well-known natural landforms or built structures within the corridor alternatives. While no National Natural Landmarks are

Figure 5-20. Visual Resources in the Study Area

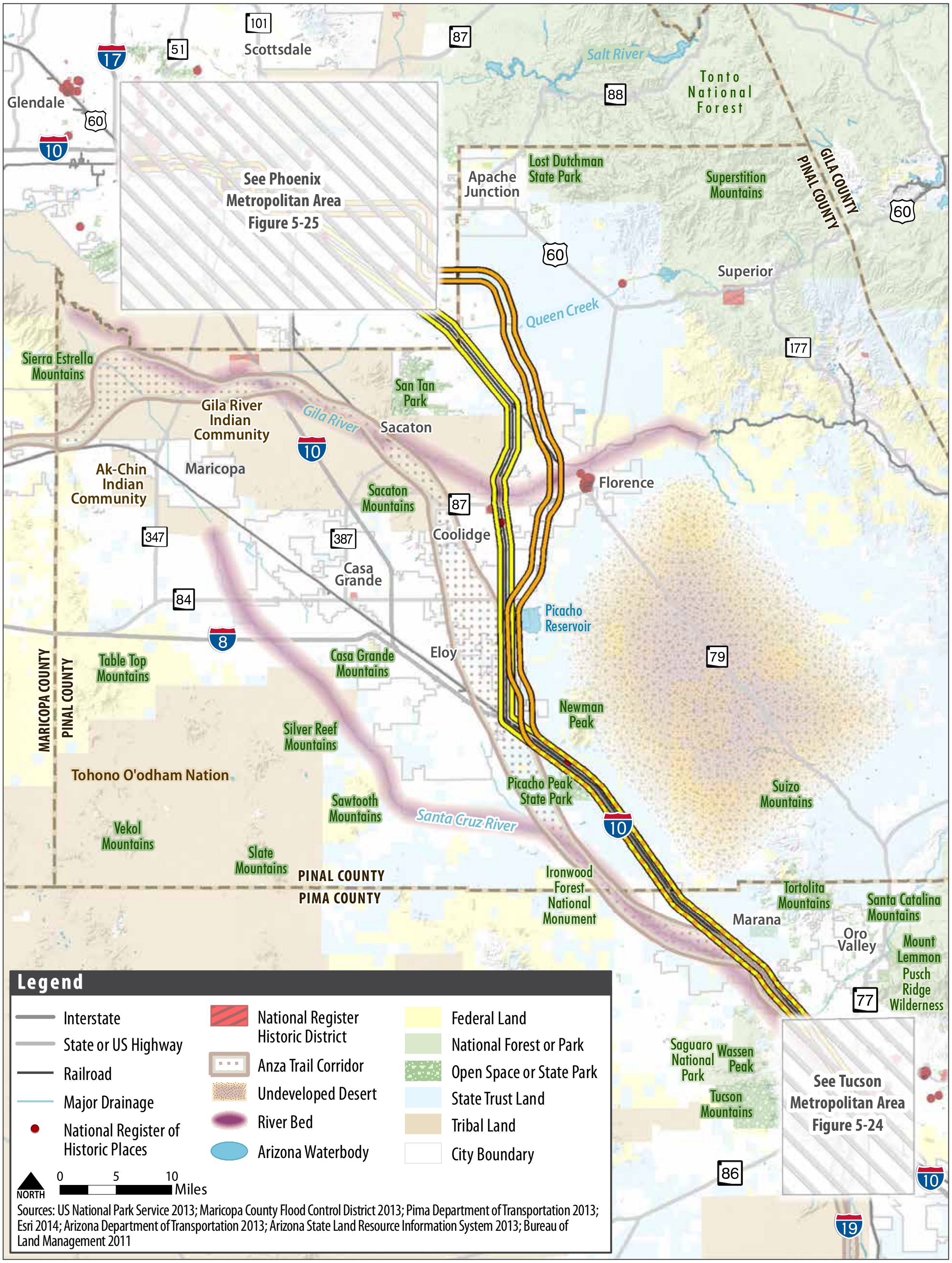


Figure 5-21. Visual Resources in the Tucson Metropolitan Area

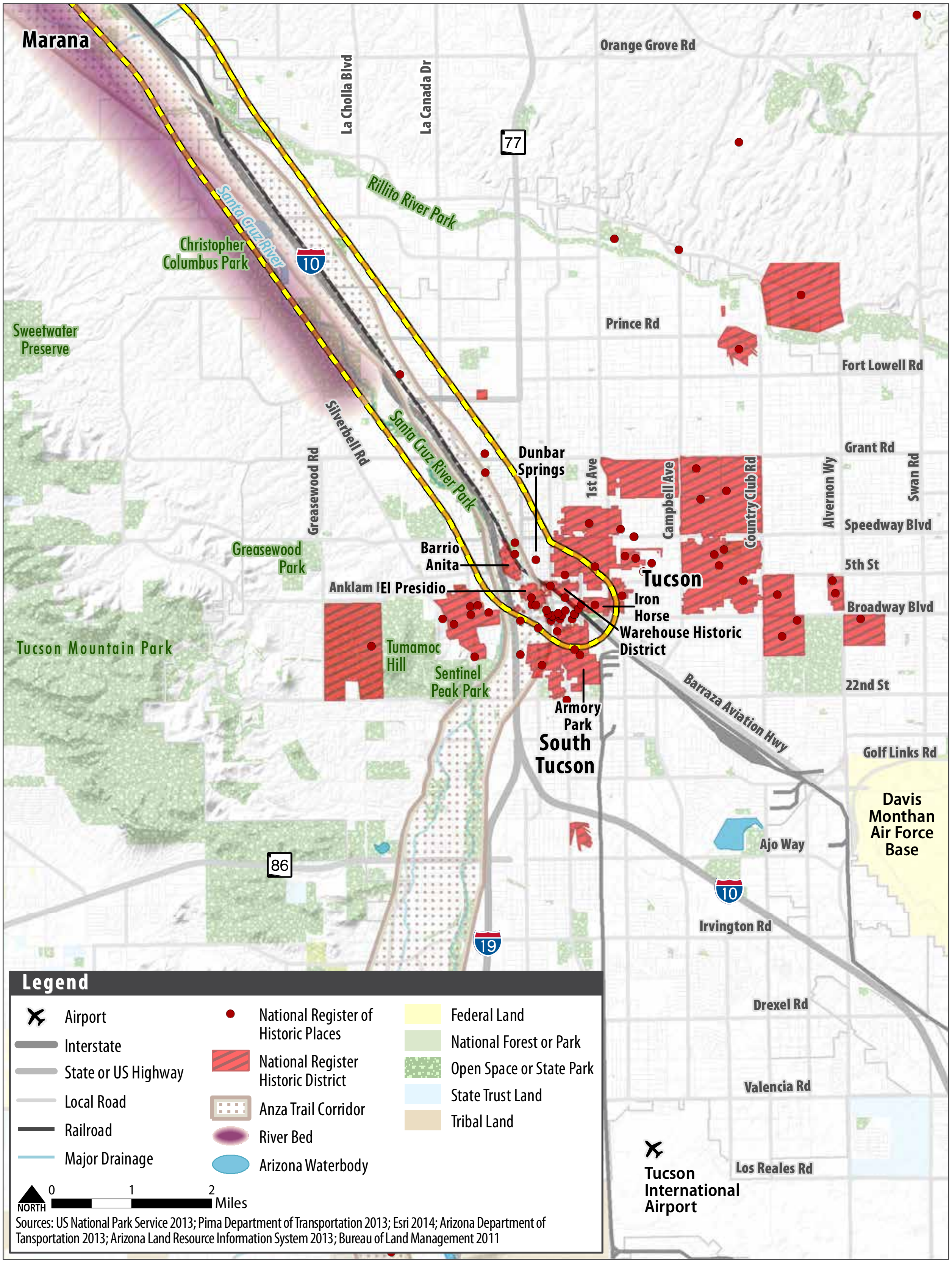


Figure 5-22. Visual Resources in the Phoenix Metropolitan Area

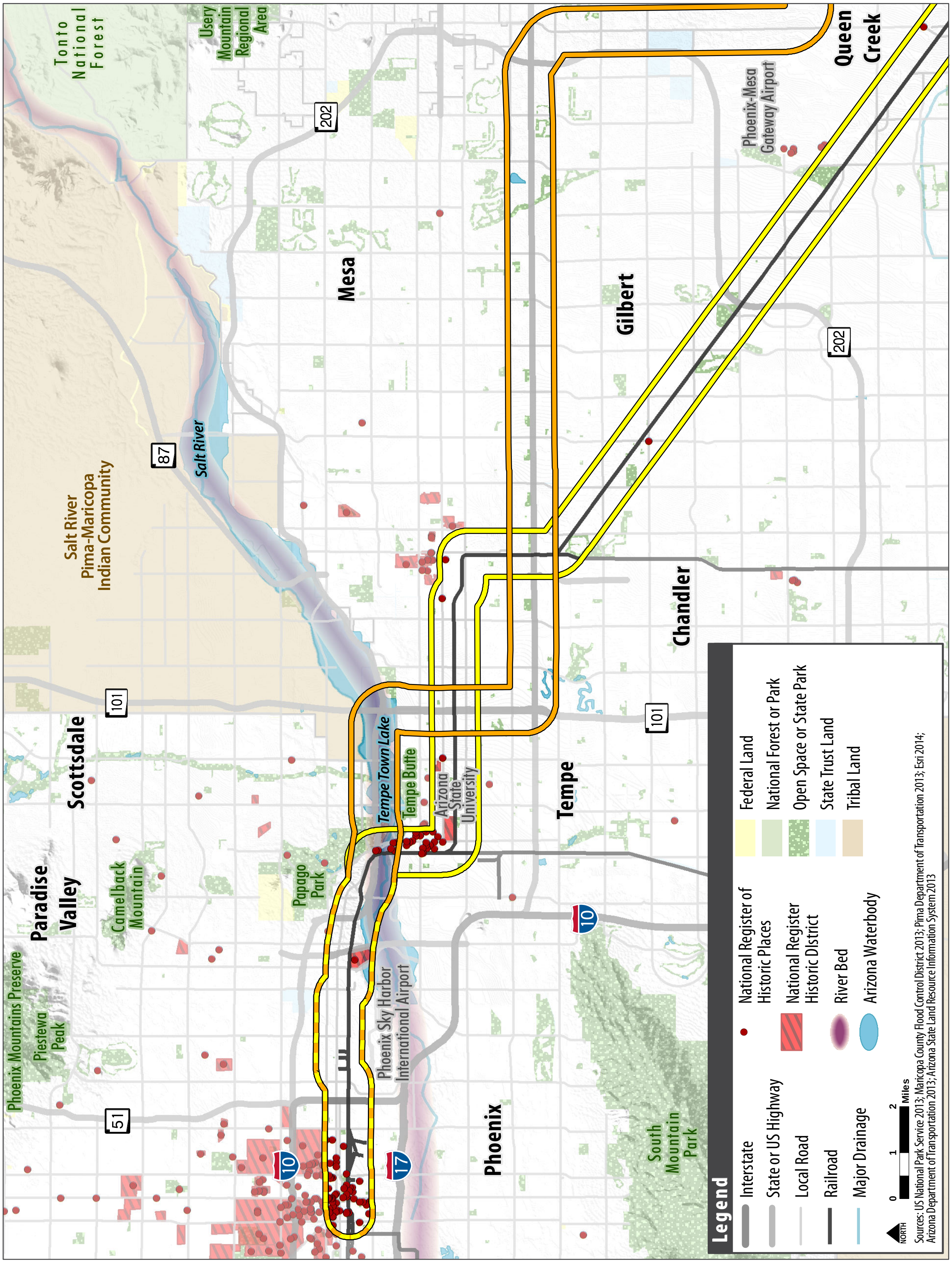
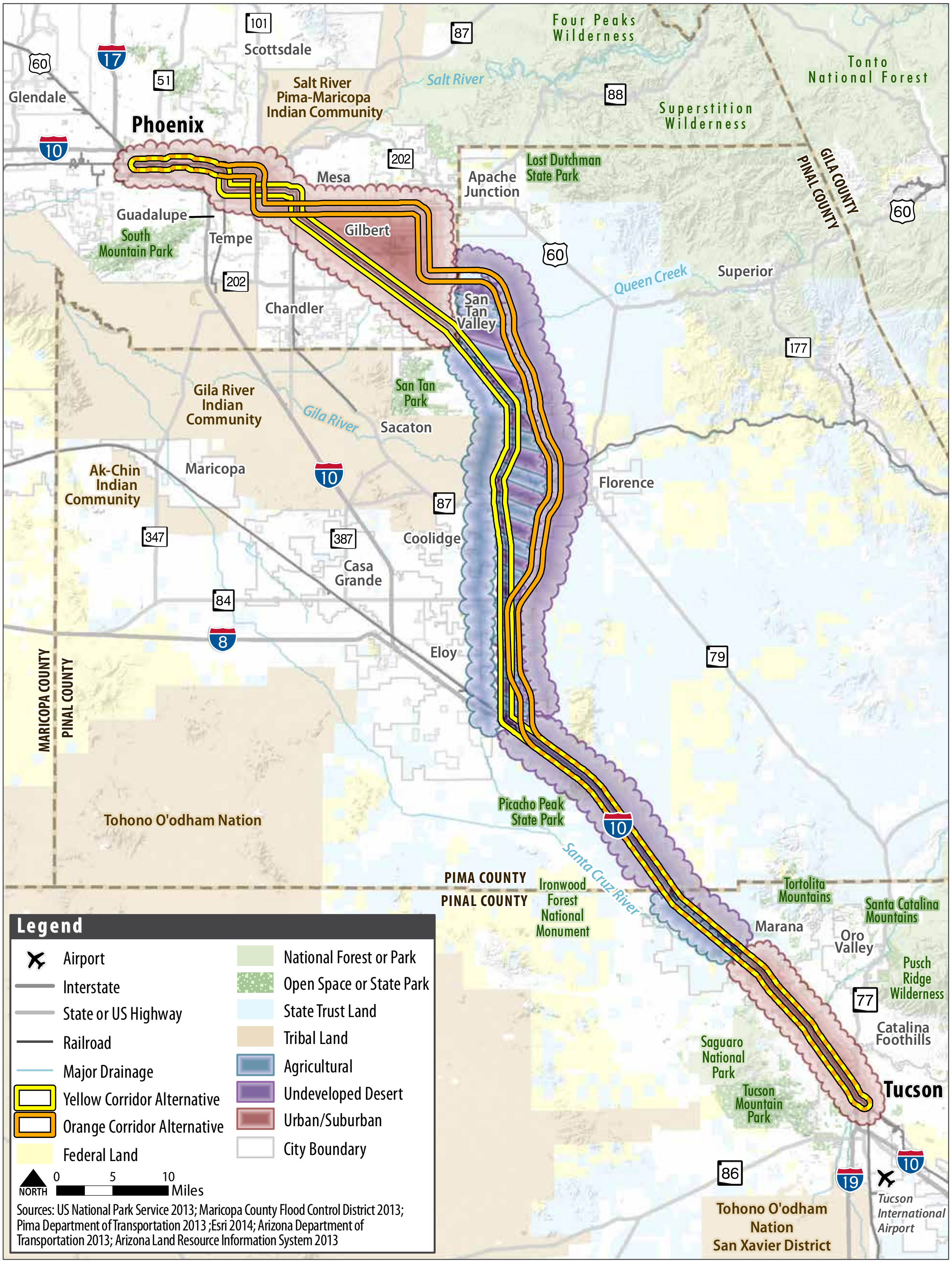


Figure 5-23. Landscape Characteristics in the Study Area



located in the study corridors (National Park Service 2012), a number of natural and built features are visible from the corridor alternatives.

Within the two corridor alternatives and a 0.25-mile buffer, 126 parks (city, county, and state), 67 recreational areas (trails, athletic fields, golf courses, stadiums, and swimming pools), 9 natural areas (including refuges and designated open space), 26 privately owned parks/recreation areas, 160 sites or districts listed or eligible for listing on the NRHP, and approximately 14 landmarks were identified. No wilderness or conservation areas and no local, state, or federal scenic highways have been designated within the corridor alternatives (Arizona Office of Tourism 2013).

The southern portion of both corridor alternatives coincides in places with the Juan Bautista de Anza National Historic Trail designated historic corridor, auto tour route, and recreation retracement route. As defined by the National Trails System Act (16 U.S.C. §§ 1241-1251), a National Historic Trail is an extended trail which follows as closely as possible and practicable the original trail or route of travel of national historical significance. While the historic corridor is not necessarily subject to BLM's VRM system, Historic Trail designation is intended to identify and protect the remains of this overland route for public use and enjoyment. The *Comprehensive Management and Use Plan/Final Environmental Impact Statement* NPS completed in response to congressional designation of the Anza Trail envisions a traveler being "able to…experience landscapes similar to those the expedition saw…." The Anza Trail corridor appears on **Figure 5-20** and **Figure 5-21** and on Maps 1-11 and 21-27 of the *Corridor Aerial Atlas Appendix*.

Visual Quality of the Study Corridor

Because of the Yellow and Orange corridor alternatives' close proximity relative to the expansive nature of many of the VASR in this Tier 1 EIS, visual quality and character are described once for the entire study corridor (see **Figure 1-1**) and pertain generally to both the Yellow and Orange corridor alternatives.

Southern Hub to Eloy

Elements of the urban and suburban landscape character dominate the visual environment within the Tucson metropolitan area. Tucson's skyline features three skyscrapers exceeding 200 feet, and eight more buildings ranging from 6 to 14 stories, all exceeding 100 feet in height. The UP /I-10 corridor, which carries high volumes of rail and automobile traffic, is a prominent visual element in the urban fabric that becomes a dominant visual feature as the study corridor extends northwest from Tucson. Visible elements of the existing railroad include moving trains and railroad infrastructure. Visible features of I-10 include noise and retaining walls, elevated sections of road, and on- and off-ramps.

Outside the Tucson metropolitan area the visual environment transitions from an urban and suburban landscape character into a mix of undeveloped desert and agricultural landscape characters. Views of the UP line and I-10 are interspersed with views of agricultural and undisturbed desert landscape character elements.

Throughout the entire southern study corridor, distant views of the surrounding mountain ranges can be seen, including the Santa Catalina Mountains and the Tortolita Mountains to the north, the Santa Rita Mountains to the south, the Rincon Mountains to the east, and the Tucson Mountains to the west. Landmarks visible from the southern corridor alternative include Mount Lemmon, Mount Wrightson, Sentinel Peak, Brown Mountain, Wassen Peak, Saguaro National Park, Picacho Peak State Park, and the bed of the Santa Cruz River. Within the City of Tucson, the historic neighborhoods of Armory Park, Barrio Anita, El Presidio, Dunbar Springs, Iron Horse, and the Warehouse Historic District are also visible from the corridor. Views of Picacho and Newman peaks are memorable and can be seen for miles by approaching viewers.

Sensitive viewers in the southern portion of the study corridor include residents and recreationists within the Tucson metropolitan area, some of whom live adjacent to I-10 within the study corridor. These viewers, as well as automobile drivers and passengers who may be less sensitive to visual changes, primarily experience views of the existing railroad, operating trains, and I-10. Existing railroad track and sidings are low-profile visual elements, while rail signals and signs, and the intermittent views of trains, are vertical elements against the landscape. Visual elements of I-10 include the at-grade or above-grade road surface, on- and off ramps, noise and retaining walls, above-grade structures, and moving vehicles. Moving to the outer extent of the study corridor, the generally flat topography and existing urban and suburban development minimize direct views of ground-level features within this portion of the corridor. Further northwest of Tucson, where land is less developed and views are more open, more expansive views of the landscape, including undeveloped land, suburban development, agricultural and industrial complexes, freight trains, and the interstate can be seen from greater distances and for longer durations. For less sensitive viewers, including automobile drivers and passengers along I-10, views of freight trains, while intermittent, are commonplace.

Overall, the southern portion of the corridor alternatives features relatively few VASR, including mountains or historic neighborhoods) in the urban, suburban, and natural landscapes. Urban development and built elements in the foreground vary in visual quality and interrupt views of the distant natural landscapes. Therefore, the overall visual quality of the southern corridor is moderately low.

Eloy to Northern Hub

The study corridor continues generally north-northwest into two distinctly different landscape types of similar size – the undeveloped desert and agricultural landscape character within Pinal County, and the more developed suburban and urban landscape character within Maricopa County and the Phoenix metropolitan area. Within Pinal County, views of the agricultural landscape character are interspersed with views of undeveloped desert landscape and, along the Yellow Corridor Alternative, small rural communities. Views of the undeveloped desert landscape dominate the Orange Corridor Alternative from Eloy all the way to the Maricopa/Pinal County line.

Due to the flat topography of the corridor alternatives, views of the existing railroad and freight train operations within the Yellow Corridor Alternative are frequent. This portion of the Orange Corridor Alternative, on the other hand, travels through a sparsely populated area that does not feature a major transportation corridor.

Vast, unconstrained middleground and background views of undeveloped desert and distant mountains are visible throughout the Pinal County portion of both the Yellow and Orange corridor alternatives. These mountains include the San Tan and Sacaton mountains in the north; the Silver Reef, Slate, and Sawtooth mountains in the south; the Suizo Mountains in the east; and the Casa Grande, Table Top, and Vekol mountains in the west. Other landmarks that train passengers might view in the northern study corridor within Pinal County include the Coolidge water tower and the dry riverbed of the Gila River.

Within Maricopa County, the dominant landscape character transitions from undeveloped desert and agricultural land to suburban and urban land uses. The Yellow Corridor Alternative continues through an urban landscape setting to the northern system hub in Phoenix. The Orange Corridor Alternative continues within an agricultural landscape setting that transitions gradually to suburban and then urban landscape settings as it progresses toward the northern system hub in Phoenix.

The expansive urban and suburban landscape of the Phoenix metropolitan area dominates foreground views from within Maricopa County. In the suburban areas on the outskirts of the metropolitan area, views are relatively uniform with a predictable pattern of similar-sized residential structures located in subdivisions, with little variation in aesthetic architectural style. Intermittent middleground and background views of distant mountain ranges are constrained by the suburban development. Sporadic views of mountain ranges in this portion of the northern study corridor include the Phoenix Mountains to the north, South Mountain and the Sierra Estrella Mountains to the south and southwest, Usery Mountain and the Superstition Mountains to the east, and the White Tank Mountains to the west.

Train passengers in this portion of the northern study corridor would view natural and man-made landmarks and other VASR including the downtown Phoenix skyline, South Mountain Park, Papago Park, Sunnyslope Mountain, Camelback Mountain, Piestewa Peak, Arizona State University, Tempe Butte, the Salt River, Tempe Town Lake, and Phoenix Sky Harbor International Airport.

Existing rail alignments and numerous vehicle transportation corridors are common visual components within portions of the Maricopa County segment of the study corridor. Visible rail infrastructure in this area includes track, sidings, and trains. Views of freight trains, light rail vehicles, and motor vehicles occur frequently in the Phoenix metropolitan area. Elements of motor vehicle infrastructure include linear features such as highways and interstates, on- and off-ramps, noise and retaining walls, and above-grade structures such as overpasses. The level topography and vertical urban and suburban development, however, minimize the number of direct views of the existing railroad and transportation corridors for many sensitive viewers within Maricopa County.

Sensitive viewers within the northern study corridor may include residents, recreationists, tourists, automobile passengers, and agricultural workers. Depending on their travel, these individuals, along with less sensitive viewers including daily commuters, business owners, employees, patrons of local commercial establishments, and students, may experience intermittent views of the railroad in the northern study corridor.

The northern study corridor within Pinal County provides memorable views of VASR in natural landscapes with agricultural and undisturbed desert landscape characteristics. Generally, development and urban elements have not interrupted these views, leaving them open, unconstrained, and memorable. Overall visual quality of the Pinal County portion of the northern study corridor is high.

The northern study corridor within Maricopa County provides few memorable views of VASR in urban, suburban, and natural landscapes. Urban and suburban development dominates the visual landscape. Therefore, the overall visual quality of the northern study corridor is low.

5.18.3 Environmental Consequences

This section analyzes corridor-level changes to VASR, landscape characters within the study corridor, and views of VASR that would result from the construction and operation of a passenger rail system within the Orange and Yellow corridor alternatives, as well as the No Build Alternative.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Permanent visual changes (physical elements) that could result from introducing a passenger rail system to the landscape could include the presence of new railroad track, bridges, tunnel portals, grade crossings, train stations, parking facilities, noise walls, open cuts, cut-and-fill areas, retaining walls, removed vegetation, and night lighting. The precise location, quantity, and design of these physical elements, and the visual changes associated with them, are not known at this time. Preliminary project planning, however, indicates that a passenger rail system within the southern Yellow Corridor Alternative would be built predominantly at grade except for grade-separated crossings and train stations.

Within the Tucson metropolitan area, the permanent visual changes associated with a passenger rail system would have a negligible impact on Tucson's visual quality and landscape character. The physical elements of a passenger rail system within this southern portion of the Yellow Corridor Alternative would have features similar to the existing transportation facilities in this urban setting. Sensitive viewers, including residents and recreationists in this portion of the corridor alternative, would be most affected by the physical impacts of a passenger rail system.

Outside the Tucson metropolitan area, the visual impacts of a passenger rail system within the Yellow Corridor Alternative would have a moderate impact on the existing visual quality and landscape character. While the physical elements of a passenger rail system would be similar to the existing transportation facilities, it could contrast with the rural agricultural and undeveloped desert landscape characters. A new railroad with above-grade elements in this location could also affect views of the prominent Picacho and Newman peaks.

While a passenger rail system within the southern Yellow Corridor Alternative would be built predominantly at grade, a few grade separations and train stations are proposed. Physical project elements such as bridges, stations, and other elevated structures could visually intrude on views of nearby and distant VASR, such as Tucson's historic neighborhoods adjacent to or within the corridor alternative, or distant mountain ranges. Overall, the permanent visual changes that could result from a passenger rail system are anticipated to result in minimal to moderate adverse impacts to the existing urban-suburban visual character of the southern portion of the corridor alternative; and views of VASR within the southern portion of the corridor alternative would generally remain the same for sensitive viewers.

Operational Impacts

Visual changes would occur within the Yellow Corridor Alternative from the operation of passenger rail trains after construction is completed. These visual changes would be intermittent and would include views of moving passenger trains and moving train lights. These operational impacts would mostly affect adjacent residents, who could consider the intermittent interruptions of nearby and distant VASR, increased nighttime views of passing train lights, and night lighting to be visually intrusive. Views of passenger trains would generally be compatible with the existing views of freight trains, and the overall impacts of operating a passenger rail system in the Yellow Corridor Alternative to the existing visual character of the southern corridor alternative are anticipated to be minimal. Views of VASR from or within the southern corridor alternative would generally remain intact.

Construction Impacts

Temporary visual changes would occur during construction within the Yellow Corridor Alternative. These changes include views of construction equipment operation, dust, material stockpiling, nighttime construction lighting and glare, construction and operation of temporary access roads, increased traffic in construction areas and along detour routes, and construction and detour signage.

The temporary visual changes that occur during construction would minimally affect views of the southern corridor alternative by sensitive viewers. The temporary visual changes would have negligible permanent impacts on the visual quality within the southern corridor alternative. Any temporary incompatible visual intrusion would not permanently obstruct views of the landscape character or VASR or degrade the existing visual quality. Therefore, the temporary visual impacts associated with construction within the southern Yellow Corridor Alternative are anticipated to be minimal.

Eloy to Northern Hub

Physical Impacts

Permanent visual changes that could result from a passenger rail system include the introduction of physical elements, such as railroad track, bridges, tunnel portals, grade crossings, train stations, parking facilities, noise walls, cut-and-fill areas, retaining walls, vegetation removal, and night lighting. The precise location, quantity, and design of these physical elements, and the visual changes associated with them, are not known at this time. Preliminary project planning indicates that a new rail system within the northern Yellow Corridor Alternative would be built predominantly at grade, except for passenger stations and grade-separated crossings.

Within Pinal County, the physical elements of a passenger rail system could contrast with the agricultural and undeveloped desert character, and views could be moderately affected by a passenger rail system. Within Maricopa County, the physical changes of a passenger rail system within the Yellow Corridor Alternative are similar to those listed in the Metropolitan Tucson portion of the southern corridor. The northern Yellow Corridor Alternative within Maricopa County contains numerous linear transportation features and corridors, including highways, expressways, and railroads in a dense suburban and urban landscape. Residents and other sensitive viewers along the passenger rail corridor alternative are accustomed to views of linear transportation corridors, retaining and noise walls, overpasses, and access ramps. Views of passenger rail infrastructure elements such as bridges, stations, and other elevated rail structures in this part of the corridor alternative would be compatible with and similar in nature to the existing transportation features and corridors.

The physical elements of a rail system within the Yellow Corridor Alternative could intrude visually on sporadic views of distant VASR, including the Phoenix Mountains, South Mountain, and the White Tank Mountains. Views of local landmarks within or adjacent to the corridor alternative may be obscured by above-grade rail corridor elements. Impacts to these viewsheds would be studied during the Tier 2 NEPA analysis. Overall, the visual changes associated with a passenger rail system in the Yellow Corridor Alternative would vary depending on the location of a future alternative within the corridor.

Operational Impacts

The visual changes associated with operation of a passenger railroad system within the Eloy to northern hub portion of the Yellow Corridor Alternative are the same as those described for the southern hub to Eloy portion of the Yellow Corridor Alternative and include intermittent views of moving passenger trains and moving train lights.

In Pinal County, the operational impacts of a passenger railroad would have a moderate adverse impact on the visual quality and character of the landscape. For sensitive viewers (including the residents, recreationists, automobile passengers, and agricultural workers within the corridor alternative), intermittent views of passenger trains would contrast with the existing agricultural and undeveloped desert visual character and could momentarily intrude on views of VASR. In addition, nighttime views of passing train lights and night lighting could increase.

In Maricopa County, the operational impacts of a passenger railroad would be similar to the operational visual impacts in the Metropolitan Tucson portion of the southern portion of the Yellow Corridor Alternative. Residents and other sensitive viewers along a passenger rail system are accustomed to views of existing transportation facilities, so the views in the Metropolitan Phoenix area would be compatible with the existing views of vehicular and train traffic. Therefore, the operational visual changes are anticipated to be minimal given the existing urban and suburban character and sporadic views of VASR.

Overall, the operational visual changes within the northern Yellow Corridor Alternative are anticipated to result in minimal-to-moderate adverse impacts to the existing landscape character and visual quality. Views of VASR for sensitive viewers would remain the same.

Construction Impacts

The temporary visual changes that occur during the construction of a passenger railroad system in the northern portion of the Yellow Corridor Alternative would be the same as those listed in the southern portion of the corridor alternative. In Pinal County, the temporary visual changes that occur during construction would introduce views of urban-based elements and intrude on foreground views of the landscape character and VASR; however, any temporary incompatible visual intrusion would not permanently obstruct views of the landscape character or VASR. In the more urban and suburban Maricopa County, the temporary construction impacts of a passenger railroad system would have minimal impacts on the visual quality and landscape character, given the short duration. Overall, the temporary visual changes during construction would minimally affect views in the northern portion of the Yellow Corridor Alternative by sensitive viewers.

Orange Corridor Alternative

Southern Hub to Eloy

The physical, operational, and construction impacts for the southern portion of the Orange Corridor Alternative would be the same as those described for the Yellow Corridor Alternative from the southern hub to Eloy.

Eloy to Northern Hub

Physical Impacts

The permanent visual changes (physical elements) of a passenger rail system within the northern portion of the Orange Corridor Alternative would be similar to those described for the northern Yellow Corridor Alternative. Preliminary project planning indicates that within the Orange Corridor Alternative extensive above-grade sections with elevated structures and bridges may be required.

Within Pinal County, a passenger rail system within the northern Orange Corridor Alternative would be constructed on a new rail alignment through undeveloped desert landscape. The physical elements introduced by a rail system would contrast with the existing visual landscape character. The sensitive viewers within and adjacent to the corridor alternative include clusters of small residential areas located near the intersections of East Randolph Road and North Wheeler Road; North Clemans Road and East Vah Ki Inn Road; North Sierra Vista Drive and East Ocotillo Road; and South Mountain Road and East Williams Field Road (see Maps 59, 61, 70, and 74 of the *Corridor Aerial Atlas Appendix*). A new railroad through these areas would impose a visual intrusion and would represent a substantial change in the areas' visual character. In addition, a new railroad with above-grade features could potentially affect the vast, unconstrained background views of distant mountains, including San Tan Mountain, Casa Grande Mountain, and the Pinal Mountains.

Like the northern Yellow Corridor Alternative, a passenger rail system within the northern Orange Corridor Alternative within Maricopa County would be visually similar to the numerous existing linear transportation features and corridors, including highways, expressways, and railroads in a dense suburban and urban landscape. Residents and other sensitive viewers within and along the corridor alternative are accustomed to views of linear transportation corridors, retaining and noise walls, overpasses, and access ramps. Due to the anticipated extensive number of above-grade features, however, a passenger rail system could visually intrude upon views of distant VASR, such as the Phoenix Mountains, South Mountain, and the White Tank Mountains, as well as VASR within or adjacent to the northern Yellow Corridor Alternative.

Overall, the visual changes associated with a passenger rail system in the Orange Corridor Alternative are anticipated to result in moderate-to-high adverse impacts to sensitive viewers, the existing visual character, views of VASR, and visual quality of this portion of the northern study corridor.

Operational Impacts

In Pinal County, the operational impacts of a passenger railroad would have a moderate adverse impact on the visual quality and landscape character. For sensitive viewers near the corridor alternative, intermittent views of passenger trains would contrast with the existing visual character of the undeveloped desert and could momentarily intrude on views of VASR. In addition, nighttime views of passing train lights and night lighting could increase.

In Maricopa County, the operational impacts of a passenger railroad would be the same as those described for the Maricopa County portion of the Yellow Corridor Alternative.

Overall, the visual changes from operation of a rail system within the Orange Corridor Alternative are anticipated to result in moderate adverse impacts to the existing landscape character, visual quality, and sensitive viewers; views of VASR would remain the same.

Construction Impacts

The temporary visual changes and impacts that would occur during construction activities within the northern portion of the Orange Corridor Alternative would be the same as those described for the northern Yellow Corridor Alternative.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be built; and no impacts to VASR would occur beyond those that could occur due to other reasonably foreseeable projects.

5.18.4 Potential Mitigation Measures

Measures to minimize and/or avoid adverse visual impacts would be developed during the Tier 2 NEPA analysis as project design details were identified. The mitigation would not only address adverse visual impacts identified from the design but would also address concerns from the viewing audience identified during the public involvement process.

The following potential mitigation measures could be considered during later phases of project development to minimize adverse impacts to the study area's existing visual quality and its surroundings:

- Restore vegetation on areas disturbed during project construction.
- Screen objectionable views of railroad facilities next to sensitive viewers such as residents or next to landmarks, cultural resources, or recreation areas.
- Apply context-sensitive design to new or reconstructed rail stations that respects scenic resources in adjacent urban or natural surroundings.
- Develop structure aesthetics to soften adverse visual changes for adjacent residents and other sensitive viewers.
- Where appropriate, apply landscape design to blend new rail facilities into their surroundings.
- Where the project would change the visual quality of existing landforms, shape cut-and-fill slopes and revegetate to blend into the surrounding landscape.
- Design new lighting to direct light to focus on where it is needed, minimize light intruding onto adjacent properties, and reduce light pollution of the night sky.

- Where appropriate, provide light screening to shield adjacent sensitive viewers from the headlights of passing trains and rail facility lighting.
- Minimize nighttime construction lighting next to residents and other sensitive viewers.
- Screen staging areas where construction equipment and materials are stored.

5.18.5 Tier 2 Considerations

A more detailed analysis of visual impacts, including the degree of visual change to the existing views and site-specific VASR, and an analysis of predicted sensitive viewer responses, would be provided in a Tier 2 NEPA document.

Some or all of the parks and recreation areas, historic sites or districts listed or eligible for listing on the NRHP, natural scenic areas, and landmarks may be considered Section 4(f) resources. As such, views of new rail facilities from these resources and impact avoidance or minimization measures would be considered and analyzed in a Tier 2 NEPA analysis.

If a future rail alignment were to traverse BLM or NPS land, a visual impact assessment in accordance with the requirements of BLM's Visual Resource Management system (adopted by NPS as well) would be undertaken during Tier 2 and submitted to BLM/NPS for review, comment, and concurrence. BLM and/or NPS would be involved in the mitigation plan to minimize visual impacts within their jurisdictional boundaries.

Phoenix is currently updating the general plan and a draft was released for public comment in Fall 2014 (City of Phoenix 2014). As the study advances to Tier 2, the general plan update should be reviewed for changes to the policies and goals applicable to VASR within or adjacent to the Phoenix portions of the corridor alternatives.

Pima County is currently updating the comprehensive plan, and a draft was released for public comment in Fall 2014 (Pima County 2014). As the study advances to Tier 2, the comprehensive plan update should be reviewed for changes to the policies and goals applicable to VASR within or adjacent to the Pima County portions of the corridor alternatives.

Site-specific mitigation measures would be developed during the Tier 2 NEPA analysis once project design details and public concerns are known.

5.19 Cultural Resources

Cultural resources are evidence of past human activity that includes objects, structures, sites, and other articles of historical, archaeological, or architectural significance. They are present throughout Arizona as a result of millennia of human history. Historic properties are cultural resources that are included in, or are eligible for inclusion in, the NRHP maintained by the Secretary of the Interior. This term, according to the National Historic Preservation Act (NHPA) (54 U.S.C. § 300101), as amended, includes prehistoric or historic districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture. The term also includes artifacts, records, and remains that are related to and located within such properties, and properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization. Historic properties are afforded certain protections in accordance with state and federal legislation.

5.19.1 Methodology and Regulatory Requirements

The consideration of impacts on cultural resources is subject to several federal laws, regulations, and guidelines. The lead federal agencies must comply with NEPA and NHPA, as amended. NEPA requires that agencies consider the effects of their actions on all aspects of the natural and physical environment and the relationship of people with that environment, including historic properties.

Section 106 of NHPA requires federal agencies to take into account the effects of their undertakings on historic properties, following regulations issued by the Advisory Council on Historic Preservation (Council). The regulations, in part, afford the Council, the State Historic Preservation Office (SHPO), Tribal Historic Preservation Offices (THPOs), and other parties with a demonstrated interest a reasonable opportunity to comment on proposed undertakings.

NHPA defines historic properties as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the NRHP, including artifacts, records, and material remains related to such a property or resource. These properties reflect many kinds of significance in architecture, history, archaeology, engineering, and culture. “The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the NRHP criteria,” as stated in 36CFR § 800.16 (l).

To be considered eligible for listing in the NRHP, a property must be at least 50 years old (with rare exception); must retain integrity of location, design, setting, material, workmanship, feeling, and association; and must also meet at least one of the following criteria:

- Criterion A – Associated with events that have made a significant contribution to the broad patterns of our history; or
- Criterion B – Associated with the lives of persons significant in our past;
- Criterion C – Embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values,

or that represent a significant and distinguishable entity whose components may lack individual distinction; or

- Criterion D – Has yielded, or may be likely to yield, information important in prehistory or history.

Amendments to NHPA in 1980 resulted in NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (TCPs). TCPs are properties that have heritage value for contemporary communities and are eligible for the NRHP because of their association with historic cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of that community. This category of resources can encompass archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that people consider essential for the preservation of a traditional culture. A TCP is ascribed an intangible cultural element or value that is linked to a specific geographic location.

Section 106 consultation should be coordinated with the American Indian Religious Freedom Act (Public Law No. 95-341), which was enacted in 1978 to protect and preserve the traditional religious rights and cultural practices of American Indians, Eskimos, Aleuts, and Native Hawaiians. The American Indian Religious Freedom Act affirms the right of Native Americans to have access to their sacred places and promotes consultation with Native American religious practitioners. Consultation should also be coordinated with NEPA, the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §§ 3001 *et seq*.), the Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa *et seq.*), and agency-specific legislation.

In addition to other federal laws (e.g., Archaeological Resources Protection Act of 1979, Native American Graves Protection and Repatriation Act of 1990), a project may also need to comply with state preservation laws including the State Historic Preservation Act of 1982 (A.R.S. §§ 41-861 and 41-864) and the Arizona Antiquities Act (A.R.S. §§ 41-841 through 41-847). The State Historic Preservation Act stipulates that state agencies work to identify and preserve historic properties and states that the chief administrator of each state agency is responsible for the preservation of historic properties which are owned or controlled by the agency. It also states that each state agency shall establish a program to locate, inventory, and nominate to the Arizona Register of Historic Places all properties that are under the agency's ownership or control and that appear to meet the criteria for inclusion on the register, and provide the Arizona SHPO an opportunity to comment on any agency plans that affect properties listed or that may qualify for inclusion on the Arizona Register of Historic Places. The Arizona Antiquities Act prohibits excavation of historic or prehistoric sites on lands owned or controlled by the State of Arizona, any agency or institution of the state, or any county or municipal corporations within the state without obtaining the written permission of the director of the Arizona State Museum, and directs those in charge of activities on such lands to notify the director of the Arizona State Museum of the discovery of any archaeological sites, historical resources, and human remains (ASM 2014) in coordination with the SHPO.

FRA, as the lead federal agency, is responsible for compliance with these and other federal and state statutes and is undertaking a phased approach to consultation under Section 106. During this Tier 1 analysis, consultation was initiated with tribes having a potential interest in this study, identified using a compiled list of federally recognized tribes with ancestral ties or an interest within the area on or near the corridor alternatives. Input from the tribes, including their THPOs, and the SHPO is helping FRA to identify cultural resource issues of concern to be addressed through continuing consultation in future Tier 2 NEPA documents.

Because a specific alignment for a passenger rail system has not been selected, no Area of Potential Effects was delineated, nor were specific effect findings made, during Tier 1 analysis. However, a limited Class I records search was completed for the Tier 1 NEPA analysis to summarize and provide an overview of cultural resources within each mile-wide corridor alternative. The records search was conducted using AZSITE, a GIS-based tool that serves as a consolidated informational network of recorded cultural resources and surface surveys within Arizona. In addition, site records housed on the NRHP website (http://www.nps.gov/nr/) were reviewed and added historic buildings and districts to the inventory of cultural resources that were not included in the AZSITE database (see Table C-1 in the *Cultural Resources Appendix*). The objective during the Tier 1 evaluation is to identify the known historic properties and cultural and historic resources within the corridor alternatives and to assess the potential for impacts on those properties.

5.19.2 Existing Conditions

The corridor alternatives intersect several large prehistoric sites that have previously undergone some archaeological testing and data recovery. As the study proceeds into a project-level Tier 2 NEPA process, site information would be obtained from other agencies and/or tribal communities and would be added to the site table (see the *Cultural Resources Appendix*) to assist with identification of cultural resources during project development.

As previously mentioned, a limited Class I records search was completed for the Tier 1 NEPA process to summarize and provide an overview of resources within each corridor alternative. As a result of the AZSITE and NRHP records search, numerous site types, both historic and prehistoric in age, were identified. Most of the sites are affiliated with prehistoric Archaic and Hohokam cultural traditions or historic American cultures (see Table 1 and Table 2 in the *Cultural Resources Appendix*). Site types include, but are not limited to, villages, habitations, artifact scatters, canals, roads, bridges, petroglyphs, structures, railroads, transmission lines, pipelines, roasting pits, and trash dumps. Several of the sites have been evaluated for inclusion in the NRHP. The evaluated sites were identified during completion of cultural resources surveys associated with an array of previous undertakings (see Table 2 in the *Cultural Resources Appendix*).

The southern portion of both corridor alternatives coincides in places with the Juan Bautista de Anza National Historic Trail designated historic corridor, auto tour route, and recreation retracement route. As defined by the National Trails System Act (16 U.S.C. §§ 1241-1251), a National Historic Trail is an extended trail which follows as closely as possible and practicable the original trail or route of travel of national historical significance. While the historic corridor is not afforded protection under the NHPA, the Historic Trail designation is intended to identify and protect the remains of this overland route for public use and enjoyment. The Anza Trail corridor appears on Maps 1-11 and 21-27 of the *Corridor Aerial Atlas Appendix*.

The AZSITE records search identified approximately 730 previous cultural resource surveys that have been conducted within the corridor alternatives (see Table 2 in the *Cultural Resources Appendix*). In total, more than 500 cultural resources were identified within the corridor alternative as a result of the records search on AZSITE. Site records on the NRHP website indicated that approximately 160 NRHP-listed properties are located within the corridor alternatives. Most of these are buildings, bridges, or historic districts; but a few properties, such as El Tiradito Shrine, Pascua Cultural Plaza, Picacho Peak Skirmish Site, and the Tempe Beach Stadium, fall outside these categories. TCPs have not been identified thus far, but further research and identification efforts would occur during the Tier 2 analysis.

The areas affected by the Yellow and Orange corridor alternatives are very similar from the southern hub to Eloy; therefore, the number of sites in each is also similar. Approximately 220 cultural resources were identified in the Yellow Corridor Alternative and 225 in the Orange Corridor Alternative. The NRHP website indicates more than 40 listed properties south of Eloy; 10 of these also appear in the AZSITE. South of Eloy, large prehistoric sites include, but are not limited to, Sunset Mesa Ruin, Los Morteros, Los Pozos, El Taller, Las Capas, and Stone Pipe Site.

Within the Yellow Corridor Alternative, the NRHP website indicates nearly 120 listed properties north of Eloy; 20 of these also appear in the AZSITE. North of Eloy, large prehistoric sites include, but are not limited to, the following: Grewe Site, La Ciudad, Pueblo Patricio, La Villa, Pueblo Grande, Las Acequias, and Germann Site. One of the listed properties within the Yellow Corridor Alternative is the Casa Grande Ruins National Monument, at the northern end of Coolidge in Pinal County. Casa Grande Ruins National Monument includes a four-story structure that is part of one of the largest Hohokam settlements and one of the longest occupied settlements in the Southwest.

According to the AZSITE and NRHP records search, the segment of the Orange Corridor Alternative north of Eloy includes approximately 50 sites that have been determined NRHP-eligible, more than 30 sites that have been recommended eligible, and at least 35 sites that may require further assessment for potential NRHP inclusion. The NRHP website indicates more than 110 listed properties north of Eloy.

According to the AZSITE and NRHP records search, the segment of the corridor alternatives south of Eloy includes more than 75 sites that have been determined NRHP-eligible, more than 35 sites that have been recommended eligible, and at least 65 sites that may require further assessment for potential NRHP inclusion. The NRHP website indicates more than 40 properties south of Eloy are listed.

North of Eloy, approximately 150 sites were identified in the Yellow Corridor Alternative, and more than 190 sites were identified in the Orange Corridor Alternative. Overall, AZSITE indicates approximately 370 sites are in the Yellow Corridor Alternative; and more than 415 are in the Orange Corridor Alternative.

5.19.3 Environmental Consequences

This evaluation assesses the potential effects on cultural resources of a passenger rail system in the Yellow and Orange corridor alternatives. The corridor alternatives are each 1.0 mile wide.

An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the NRHP. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative.

Impacts to cultural resources would vary depending on the future location of a passenger rail system within the selected corridor. Avoidance is the preferred way to address cultural resources, and decisions on avoidance methods would be reached through Section 106 Consultation during Tier 2 when more details on the design and operation are known.

Yellow Corridor Alternative

Southern Hub to Eloy

Physical Impacts

Physical impacts to cultural resources may include direct damage or destruction of cultural resources within the footprint of the passenger rail system, including any needed nearby staging areas and material sources.

Operational Impacts

Operational impacts to cultural resources could include permanent access restrictions, visual impacts, and noise and vibration impacts to properties that are in proximity to a future alignment of a passenger rail system. In addition, direct damage to or destruction of cultural resources (e.g., pot hunting) due to increased accessibility to previously isolated areas is possible. Permanent loss or temporary changes in the viewshed of potential TCPs and permanent loss or temporary change of potential TCP access and usage could result.

Construction Impacts

Construction impacts to cultural resources may include direct damage or destruction of cultural resources and noise and vibration impacts to properties that are in proximity to a future alignment (including material sources and staging areas) but that would not be permanently incorporated into the passenger rail system. Indirect damage may be caused through vibrations caused by geotechnical testing, use of heavy equipment, or any earth-moving activities. Construction impacts may also include unanticipated discovery of previously unknown cultural resources (including human burials), permanent loss or temporary changes in viewshed of potential TCPs, permanent loss or temporary change of potential TCP access and usage, and increased noise and dust. The increased noise and dust during construction could disturb visitors or adversely affect visitation to structures or potential TCPs.

Eloy to Northern Hub

Physical Impacts

Physical impacts to cultural resources would result if a resource or portion of a resource were permanently incorporated into the passenger rail system.

One of the listed properties within the Yellow Corridor Alternative is the Casa Grande Ruins National Monument at the northern end of Coolidge in Pinal County. Casa Grande Ruins National Monument includes a four-story structure that is part of one of the largest Hohokam settlements and one of the longest occupied settlements in the Southwest.

Operational Impacts

Operational impacts to cultural resources within this segment of the Yellow Corridor Alternative would be similar to those described for the segment from the southern hub to Eloy.

Construction Impacts

Construction impacts to cultural resources within this segment of the Yellow Corridor Alternative would be similar to those described for the segment from the southern hub to Eloy.

Orange Corridor Alternative

Southern Hub to Eloy

Physical, operational, and construction impacts within this segment of the Orange Corridor Alternative would be similar to those described for this segment of the Yellow Corridor Alternative.

Eloy to Northern Hub

Physical Impacts

Physical impacts to cultural resources would result if a resource or portion of a resource were permanently incorporated into the rail line.

Legislation (H.R. 1077) was introduced in the U.S. House of Representatives in February 2015 to expand the boundaries of the Casa Grande Ruins National Monument. The 1-mile-wide Orange Corridor Alternative would encroach upon the proposed expanded boundaries of the national monument. This bill was originally introduced to the 113th Congress in July 2013 as H.R. 2497.

Operational Impacts

Operational impacts to cultural resources within this segment of the Orange Corridor Alternative would be similar to those described for the Yellow Corridor Alternative from the southern hub to Eloy.

Construction Impacts

Construction impacts to cultural resources within this segment of the Orange Corridor Alternative would be similar to those described for the Yellow Corridor Alternative from the southern hub to Eloy.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be built; and no impacts to cultural resources are projected to occur beyond those that could occur due to other projects.

5.19.4 Potential Mitigation Measures

Municipalities or counties north of Eloy may require avoidance of certain archaeological sites because of established conservation or land use plans (e.g., *Historic Homes of Phoenix: An Architecture & Preservation Guide*, *Pinal County Comprehensive Land Use Plan*).

Casa Grande Ruins National Monument is one of the most prominent cultural resources within the state. It is recommended that the monument be avoided and close coordination with tribal communities and NPS occur with regard to proximity of the passenger rail system and monument boundaries.

If the alignment of a future passenger rail system resulted in an adverse effect to a property that is listed, eligible, or potentially eligible for listing on the NRHP, potential mitigation measures could include additional research to recover data or exhaust the information potential of a site, changes in project design, development of a Memorandum of Agreement (MOA), and other options that may result from Section 106 consultation.

Specific mitigation measures could include a programmatic agreement (PA), a memorandum of agreement (MOA) with a public involvement component, archaeological data recovery, archaeological treatment plans, historic buildings surveys, and historic engineering record documentation.

Consultation with all consulting parties over potentially affected properties would be key to developing a passenger rail system in either the Orange or the Yellow corridor alternatives. As the study proceeds to a Tier 2 project-level NEPA process, avoidance of these properties and mitigation of potential visual and audible impacts would be considered.

5.19.5 Tier 2 Considerations

During Tier 2 NEPA evaluations, as more detailed information is gathered for review of the preferred corridor and specific service alternatives are identified, effect findings on historic properties would be proposed to SHPOs and Tribal Historic Preservation Offices (THPOs). The SHPO, THPOs, tribes with interest in the area, and other officials with jurisdiction should be formally consulted throughout the project. The Section 106 process should be followed: establish undertaking, identify consulting parties, identify scope of work and APE, identify historic properties, finding of project effect, and assessment and resolution of adverse effects, as necessary. If any adverse effects are identified during the Tier 2 NEPA process, they would be addressed through SHPO/THPO consultation and would be in compliance with 36 CFR 800.5 (Assessment of adverse effects) and 36 CFR 800.6 (Resolution of adverse effects).

Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known. Tier 2 analyses would include data gathered from other agencies including ADOT, the Arizona SHPO, and BLM, as well as any information gathered from tribal organizations and other land managing agencies (e.g., counties, municipalities) and an appropriate level of field investigation. In part, land jurisdiction would help determine what information is sought and obtained during the Tier 2 analyses.

Mitigation measures may be developed in accordance with the terms of a programmatic agreement (PA) pursuant to 36 CFR Section 800.14 between FRA and consulting parties including the Council, SHPO, THPOs, and other officials with jurisdiction. A PA is a formal, legally binding agreement that establishes a process for consultation and review and compliance with federal laws and regulations. A project-specific PA is tailored to the nature and requirements of a specific undertaking. It establishes time frames, procedures for review, dispute resolution, discoveries, etc. A PA would focus on describing the actions that would be taken by parties to meet their environmental compliance responsibilities and establish a process through which the parties would meet these responsibilities. In other words, the PA would focus on study commitments, documentation of the qualities that contribute to the historic significance of resources, review procedures, and products to be produced during the preparation of Tier 2 NEPA documents for mitigating adverse effects.

It is recommended that close coordination with NPS continue during Tier 2 to determine a sufficient buffer between the passenger rail system and the Casa Grande Ruins National Monument boundary.

5.20 Unavoidable Adverse Impacts / Irreversible and Irretrievable Commitment of Resources

Irreversible commitments involve the use or destruction of a specific resource (for example, energy and natural resources such as water, minerals, or timber) that cannot be replaced within a reasonable timeframe. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (for example, disturbance of a cultural site or extinction of a threatened or endangered species).

5.20.1 Methodology and Regulatory Requirements

Irreversible and irretrievable commitments of resources directly relate to the trade-offs of implementing a project versus not implementing a project. Irreversible and irretrievable impacts were evaluated in accordance with NEPA (42 U.S.C. § 4321-4347), regulations published by CEQ on implementing NEPA (40 CFR 1502.16), FTA's Environmental Impact and

Related Procedures (23 CFR Part 771), and FRA's Procedures for Considering Environmental Impacts (64 FR 28545, May 26, 1999) Section 14(n)(11) (FRA 1999a).

Data gathered from the review of all applicable resources analyzed in the Tier 1 EIS were used, especially the consumption of energy (as derived from the estimated reduction in VMT generated from the operation of passenger trains between Tucson and Phoenix) cultural resources, natural resources (as derived from the assessment of water resources; topography, geology, and soils; biotic communities; wetlands; and special status species), and visual and scenic resources. Additionally, land that would be committed to a transportation use was addressed. Specific government agency coordination is not typically conducted for this resource evaluation and was not performed for this Tier 1 EIS.

The potential use of existing resources and land was assessed. In a Tier 1 analysis, the change in the use of resources can only be assessed qualitatively. The analysis considered resources on which a passenger rail system could have a direct or indirect effect; however, specific unavoidable adverse impacts and irreversible and irretrievable commitments of resources cannot be identified until future alignments are developed for a Tier 2 analysis.

5.20.2 Existing Conditions

Appendix 4.6, Figures 1 through 91, show various resources within the corridor alternatives, portions of which may be disturbed or eliminated to implement a passenger rail system, such as farmland, parkland, wetlands, wildlife habitat, and cultural resources.

5.20.3 Environmental Consequences

Yellow Corridor Alternative

Physical Impacts

Construction of a passenger rail system within the Yellow Corridor Alternative would result in the irreversible and irretrievable commitment of land, at least for the life of the project, where additional ROW is needed. The land would be converted from its current condition to a railroad grade and track, maintenance yards and facilities, and station areas with associated parking lots. In the non-urban areas, much of this land is prime and unique farmlands and farmland of unique importance, and impacts would be considered an irreversible and irretrievable commitment of resources.

Operational Impacts

Operation of a passenger rail system within the Yellow Corridor Alternative would require the commitment of several energy resources, which could include petroleum, electricity, and manpower expenditures, for operation and maintenance. Use of these resources would be irreversible and irretrievable.

Construction Impacts

Construction materials for building a passenger rail system within the Yellow Corridor Alternative would consist largely of steel, concrete, ballast rock, and wood, although water would also be consumed for mixing concrete, washing equipment, and controlling dust. Maintenance yards would incorporate these materials as well, in addition to building materials and equipment usually associated with a rail maintenance plant. Materials for station buildings and station areas would include concrete, steel, and various building materials, depending upon the station type. Parking lot construction would require asphalt and additional concrete. The use of these materials would be largely irretrievable; however, these resources are not in short supply, and many of the materials could be recycled for other projects if they were no longer required for passenger rail service. Construction would also require the commitment of energy resources including petroleum, electricity, and manpower expenditures.

Orange Corridor Alternative

Physical Impacts

Construction of a passenger rail system within the Orange Corridor Alternative would result in the irreversible and irretrievable commitment of land similar to that of the Yellow Corridor Alternative. In the non-urban areas, much of this land is prime and unique farmlands and farmland of unique importance. While the nature of the irreversible and irretrievable commitments of land would be similar to those described for the Yellow Corridor Alternative, the northern section of the Orange Corridor Alternative is approximately 12 miles longer than the northern section of the Yellow Corridor so the impact to land use could be expected to be somewhat greater than with the Yellow Corridor Alternative.

Operational Impacts

Operating a passenger rail system in the Orange Corridor Alternative would result in an irreversible and irretrievable commitment of energy resources similar to that required in the Yellow Corridor Alternative; however, the northern section of the Orange Corridor Alternative is approximately 12 miles longer than the northern section of the Yellow Corridor Alternative, so the quantity of resources required could be expected to be somewhat greater than with the Yellow Corridor Alternative.

Construction Impacts

Constructing a passenger rail system in the Orange Corridor Alternative would result in an irreversible and irretrievable commitment of resources similar to that required in the Yellow

Corridor Alternative with regard to materials and energy resources. The exception is that from the southern hub in Tucson to the northern hub in Phoenix, the Yellow Corridor Alternative is approximately 120 miles in length, while the Orange Corridor Alternative is approximately 132 miles long. Therefore, the full extent of irreversible and irretrievable commitment of physical materials, energy resources, and manpower expenditures associated with construction could be expected to be approximately 10 percent greater for a railroad within the Orange Corridor Alternative, compared to the Yellow Corridor Alternative. This 10-percent difference would also be realized in energy expenditure with regard to Tucson-to-Phoenix operations over the respective alternative corridors.

Phased Implementation of a Future Build Alternative

With phased implementation in either corridor alternative, the commitment of resources required to implement a single operable segment of a passenger rail system from Tucson to Phoenix would be less than that required for a complete Tucson-to-Phoenix rail system. The initial implementation would likely require less ROW than a system spanning the entire corridor. As additional phases are constructed, resources would be committed in stages, within respective segments of the corridor. The full extent of irreversible and irretrievable impacts over the entire length of the Tucson-to-Phoenix corridor might eventually be realized, but those impacts would occur gradually over the years of implementation as federal and state funds were allocated to such a project. Conversely, phased implementation may require more energy resources for construction because multiple mobilization and demobilization events may have to occur, including transporting heavy equipment. Irreplaceable resources may become scarcer over time, which could affect construction costs.

No Build Alternative

Under the No Build Alternative, a passenger rail system would not be built; and new commitments of resources would not occur beyond those that could occur in relation to other projects. In addition, energy resources would continue to be consumed by automobile travel between Tucson and Phoenix at a slightly higher rate than would be the case with commuter and intercity passenger rail service in one of the corridor alternatives.

5.20.4 Tier 2 Considerations

In addition to the above resources commitments, federal and state financial resources would be irreversibly and irretrievably committed for the development of Tier 2 NEPA documentation, project design, construction, operation, and maintenance. These financial resources would no longer be available for other federal or state projects.

During Tier 2 analyses, a more complete review of the design and the specific alignment for a passenger rail system would be conducted, which may further refine the nature of or potential quantity of resources that may be irreversibly and irretrievably be committed for implementation of a passenger rail system.

5.21 Short-Term Uses vs. Long-Term Productivity

Balancing the relationship between short-term impacts and long-term productivity is an important consideration in determining project feasibility. The following section discusses short-term impacts to and use of resources, and long-term effects and benefits and/or losses that could be expected under the Yellow and Orange corridor alternatives and the No Build Alternative.

5.21.1 Methodology and Regulatory Requirements

Short-term impacts to and use of resources in relation to long-term productivity were evaluated in accordance with NEPA, guidelines published by CEQ on implementing NEPA, FTA's Environmental Impact and Related Procedures (23 CFR Part 771),and FRA's Environmental Procedures (64 FR 28545, May 26, 1999) Section 14(p).

A review of construction impacts for all applicable resource sections included in this Tier 1 EIS provided the data for this analysis, which discusses the relationship between short-term impacts to and use of resources and the long-term benefits and productivity of the environment in qualitative terms.

5.21.2 Existing Conditions

Maps 1 through 91 of the *Corridor Aerial Atlas Appendix* show various resources within the corridor alternatives.

5.21.3 Environmental Consequences

Implementing passenger rail service within one of the corridor alternatives would result in the short-term impacts and use of resources described below, while increasing the long-term benefits and productivity of passenger rail transportation and economic systems.

Yellow Corridor Alternative

Short-Term Impacts

Construction of a passenger rail system within the Yellow Corridor Alternative could contribute to short-term construction impacts related to the following:

- Hazardous materials and waste disposal

- Water quality degradation from erosion and sedimentation, and/or potential fuel and lubricant spills
- Air quality degradation from equipment emissions and fugitive dust
- Noise and vibration from construction equipment
- Changes in property access
- Traffic and pedestrian delays and detours

Short-term employment, use of materials to construct the system, and local purchases of goods and services generated by construction activity could create a short-term increase in local economic activity that would end once the construction phase is completed. A passenger rail system within the Yellow Corridor might be able to utilize existing UP ROW or be built directly adjacent to it; in this case, these short-term impacts and resources required for construction might be reduced.

Short-term construction impacts such as noise, ground-borne vibration, and air pollutant emissions would occur regardless of the new passenger rail system's proximity to the existing railroad.

Long-Term Benefits

In the region between Tucson and Phoenix, the addition of passenger rail service within the Yellow Corridor Alternative would contribute to a more robust transportation network and access within the region by providing reliable passenger rail service to meet the needs of increased future travel demand and more efficient travel between major urban centers. A reduction in air pollutant emissions would likely occur as a result of passenger rail service replacing automobile, bus, and plane trips, as well as decreased congestion on local streets and highways. Improved accessibility within the region would also result in economic benefits through employment opportunities, potential for transit-oriented development, and increased economic activity. Other long-term benefits include providing an accessible alternative mode of transportation for minority and low-income populations.

Long-Term Losses/Effects

Although constructing a passenger rail system along the Yellow Corridor Alternative would result in permanent impacts to waterways, waterbodies, wetlands, floodplains, plant communities, natural habitat, and wildlife, coordination with resource agencies would be conducted to minimize impacts through appropriate mitigation measures. Other long-term losses/effects on the productivity of the environment would include the following:

- Removal of existing farmland from cultivation
- Potential economic impacts on other modes of public transportation
- Potential acquisition of park land, recreation land, and natural areas
- Noise and vibration impacts on sensitive receptors from train operations
- Conflicts with wildlife

Orange Corridor Alternative

Short-Term Impacts

Construction and operation of a passenger rail system within the Orange Corridor Alternative would contribute to short-term construction impacts related to the same components of the natural, social, and built environment as a system within the Yellow Corridor Alternative.

A short-term increase in the local economy similar to that resulting from construction within the Yellow Corridor Alternative could also result from a new rail system within the Orange Corridor Alternative. A greater degree of construction activity could occur in the Orange Corridor Alternative, as compared with the Yellow Corridor Alternative, from the longer length of the corridor as well as development in a corridor with more currently undeveloped land, resulting in a greater degree of short-term impacts and use of more resources required for construction. Short-term impacts connected with construction such as noise, ground-borne vibration, and air pollutant emissions would be similar to those impacts resulting from constructing a new passenger rail system within the Yellow Corridor Alternative.

Long-Term Benefits

In the region between Tucson and Phoenix, the addition of passenger rail service within the Orange Corridor Alternative would result in long-term benefits similar to those resulting from construction of a passenger rail system within the Yellow Corridor Alternative.

Long-Term Losses/Effects

Constructing a passenger rail system within the Orange Corridor Alternative would result in permanent impacts to waterways, waterbodies, wetlands, floodplains, plant communities, natural habitat, and wildlife. Coordination with resource agencies would be conducted to minimize impacts through appropriate mitigation measures. Other long-term losses or effects on the productivity of the environment would be similar to those resulting from constructing a passenger system within the Yellow Corridor Alternative, including the following:

- Removal of existing farmland from cultivation

- Potential economic impacts on other modes of public transportation
- Potential acquisition of park land, recreation land, and natural areas
- Noise and vibration impacts on sensitive receptors from train operations
- Conflicts with wildlife

A greater number of operational impacts would likely occur on a new passenger system within the Orange Corridor Alternative because a future alignment within this corridor has a greater potential for traversing areas of undeveloped land; however, the same long-term benefits and productivity would be realized with a new rail system within the Orange Corridor Alternative as would occur within the Yellow Corridor Alternative.

No Build Alternative

Under the No Build Alternative, no passenger rail system would be built, and no impacts would be anticipated beyond those that occurred as the result of other projects.

Short-Term Impacts

The potential construction of other projects within the study corridor could contribute to potential short-term construction impacts similar to those of the corridor alternatives discussed above. Other projects that may contribute to short-term impacts may include improvements to UP train facilities (such as bridge replacements or new warning systems at roadway crossings) widening of I-10 to accommodate more automobile traffic, or development of the North-South Corridor. The potential short-term construction impacts for these types of projects would be similar to the impacts associated with a passenger rail system, but the additive effects would be less because a new rail corridor would not be constructed. Construction of other reasonably foreseeable projects could create a short-term increase in the local economy resulting from short-term employment, use of construction materials, and purchases of ancillary goods and services that would end once the construction phases of these other projects were completed, as further discussed in **Section 5.22**, Indirect and Cumulative Effects.

Long-Term Benefits

In the region between Tucson and Phoenix, construction of other planned transportation projects would contribute in some degree to the transportation network and facilitate improved socioeconomic conditions. With the No Build Alternative, the socioeconomic changes from building the passenger rail system would not occur.

Long-Term Losses/Effects

Under the No Build Alternative, long-term productivity could be adversely affected by increases in highway congestion and traffic delays, and increased vehicle collisions. As traffic congestion increases, energy resources to fuel transportation modes between Tucson and Phoenix would be consumed at a higher rate than would occur with implementation of a future rail system within one of the corridor alternatives. This, in turn, could result in increased pollutant emissions and degraded air quality.

5.21.4 Potential Mitigation Measures

The potential mitigation measures for short-term and long-term impacts are discussed in the previous sections for each respective resource in this chapter.

5.21.5 Tier 2 Considerations

Tier 2 analysis would include evaluation of specific alignments, additional public input, and more detailed modeling of the number of persons likely to ride the passenger train and between which communities. The Tier 2 analysis of short-term use versus long-term productivity would be better able to account for specific types of impacts and benefits. For example, the assessment might include the amount of natural habitat removed, the number of low-income populations that may benefit from an additional transit option, the projected reduction in air pollutant emissions from providing an alternative as compared to automobile travel, and the extent of the economic benefits by community.

Public values and persons potentially affected may change by the time Tier 2 studies are initiated. Therefore, additional public outreach and scoping would be conducted during Tier 2, and the values, issues, and concerns identified at that time may contribute to the analysis of short-term uses versus long-term productivity.

5.22 Indirect and Cumulative Effects

5.22.1 Methodology and Regulatory Environment

CEQ regulations implementing NEPA define indirect impacts as those that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use; population density or growth rate; and related effects on air, water, and other natural systems, including ecosystems (40 CFR 1508.8[b]).

CEQ regulations define cumulative effects as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Thus, cumulative effects include the direct and indirect impacts of a project together with the impacts from reasonably foreseeable future actions.

The CEQ handbook for considering cumulative effects advises that focusing the cumulative effects analysis on meaningful cumulative impact issues, rather than on all conceivable impact relationships, is critical to the success of the analysis and to supporting more informed decisions about a proposed action and alternatives (CEQ 1997b). The handbook also advises that cumulative effects need to be analyzed in terms of the specific resources, ecosystem, and human community that may be affected by a proposed action or alternatives. The analysis must consider how cumulative effects may be manifested over short and long time frames and how they may cause meaningful impacts that extend over areas that may exceed political or administrative boundaries. Each affected resource, ecosystem, and human community must be analyzed in terms of its own capacity to accommodate additional effects, based on its own time and space parameters.

The methodology for conducting the review and evaluation of indirect and cumulative effects is in accordance with federal regulations and guidelines, including NEPA and the CEQ guidelines implementing NEPA.

Indirect impacts were evaluated in accordance with 40 CFR 1508.8(b), FTA's Environmental Impact and Related Procedures (23 CFR Part 771), and FRA's Environmental Procedures (64 FR 28545, May 26, 1999) Section 14(n). The cumulative effects were evaluated in accordance with 40 CFR 1508.7 and CEQ guidance on assessing cumulative effects (CEQ 1997b). Data from the following sources were used during review of the potential indirect and cumulative impacts on the human and natural environment as a result of the study:

- Identification of other major transportation projects within the study corridor through planning documents, including state transportation improvement plans, state long-range transportation plans, and comprehensive plans developed by regional metropolitan planning organizations and councils of governments
- Land use information
- Internet sources, such as agency or news websites
- Input from Tribal governments and government agencies as part of the scoping process

5.22.2 Existing Conditions

Public documents were reviewed to identify present and reasonably foreseeable future actions, other federal actions, and non-federal actions. In accordance with CEQ guidance, analysis was performed using available or reasonably obtainable information. To be commensurate with the level of detail associated with a Tier 1 EIS regarding project effects, the list of past, present, and reasonably foreseeable future actions includes broader categories of actions and projects rather than site-specific projects. **Table 5-30** outlines the actions considered in this analysis.

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Past Actions/Projects		
Community Population Growth	Population growth within the study corridor has led to land use changes over the last century, expending the size of urban development and the associated demand for services. The table-within-a-table on the following page provides some reference to the extent of change that was occurred in the three counties and representative cities.	As noted.

Place	Year 1900 Except where noted	Year 2010
Pima County	14,689	980,263
Tucson	7,531	520,116
Pinal County	7,779	375,770
Eloy	5,381[b]	16,631
Florence	2,173[b]	25,536
Maricopa Co.	20,457	3,817,117
Mesa	722	439,041
Chandler	1,378[a]	388,838
Tempe	885	161,719
Phoenix	5,544	1,445,632

Sources: Arizona Geographic Alliance 2014a; Pima Association of Governments 2014; US Census Bureau 1995: US Census Bureau 2010a

Notes:

[a] 1930 data – earliest identified

[b] 1970 data

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Tribal Settlements	The Gila River Indian Reservation was established in 1859, the Walt River Pima-Maricopa Indian Community was established in 1879, and the Ak-Chin Reservation was established in 1912 (Arizona Geographic Alliance 2014b).	South and east of Phoenix
Agricultural Production	Arizona data from the Census of Agriculture indicate that the quantity of land in cultivation grew in the early 1900s, peaked in the mid-1950s, and then gradually declined. For example, about 14 million acres of Arizona land was in cultivation in 1935. In 1954 the figure approached 42 million acres, but dropped to about 38 million acres by 1969 and to about 36 million acres by 1987 (U.S Department of Agriculture 2014).	Arizona statewide
Southern Pacific Railroad; now Union Pacific Railroad	The Southern Pacific Railroad was extended from Yuma reaching Tucson in 1880; the line between Tucson and Phoenix was established in the late 1800s. In 1996, the UP and Southern Pacific Railroad merged.	From Nogales through Tucson to west of Phoenix; a rail line also passes through Tucson and crosses the southern part of the state
Interstate 10	I-10 in Arizona was laid out by the Arizona Highway Department (as ADOT was called at the time) in 1956-1958, and the segment between Tucson and Phoenix was built in 1967 with two travel lanes in each direction. In more recent years, portions of the highway have been widened to include up to three travel lanes in each direction in between the Tucson and Phoenix metropolitan areas, with additional travel lanes within Tucson and Phoenix.	South-central Arizona
Highway and Road System	While roads and highways are not abundant between Tucson and Phoenix, a system of transportation routes connects various communities in the Sun Corridor. Of particular note are the segments of Old US 80 (now State Route 77, State Route 79, and US 60) that collectively provide an alternative route from Tucson to Phoenix and the suburban communities east of Phoenix.	South-central Arizona

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Utility Corridors	The Central Arizona Project was constructed between 1973 and 1993, bringing water from Lake Havasu on the Colorado River over a distance of 336 miles to Tucson, and is a major water supply source (Central Arizona Project 2014). The Palo Verde Nuclear Power Plant went into commercial operation in 1986 and became fully operational in 1988. It is a major source of electric power, generating approximately 4,000 megawatts annually for the Tucson, Phoenix, Los Angeles, and San Diego metropolitan areas (Arizona Public Service Company 2014). Various transmission lines extend from the power plant as well as from other power generation facilities, including Roosevelt Dam, located east of Phoenix.	South-central Arizona South-central Arizona; Southern California
Present Actions/Projects		
Agricultural Production	While declining from historic levels, agricultural production remains an important component of land use in the three-county study area. The 2007 Census of Agriculture (US Department of Agricultural 2007) reports: • Pima County: 622 farms; acreage of land in cultivation not disclosed • Pinal County: 785 farms and 1,047,112 acres of land in cultivation • Maricopa County: 1,793 farms and 485,469 acres of land in cultivation While county statistics are not necessarily a reflection of the corridor alternatives, the corridors intersect with land in agricultural production in each county. The majority of the farmland crossed, however, is in Pinal County.	Pima, Pinal, and Maricopa counties
Rangeland/ Grazing Allotments	Ranching has been an historic land use in Arizona, and grazing allotments remain active within the three-county study area, particularly in Pinal County.	Generally east of I-10 from about Marana north to State Route (SR) 87 (Coolidge area)

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Union Pacific Railroad	In 2012, UP employed more than 1,300 persons in Arizona, with nearly 2,100 rail cars originating and more than 96,000 rail cars terminating in Arizona (UP 2013).	From Nogales through Tucson to west of Phoenix; a rail line also crosses the southern part of the state and passes through Tucson
UP Sunset Route	UP is in the process of upgrading the Sunset Route to double tracks. Work has been occurring in the Tucson area since 2012. UP's 2013 capital plan summary indicates that a total of 30 miles of a second mainline on the Sunset Route was scheduled in Arizona and California in 2013.	Los Angeles to New Orleans, including the Tucson area
Transportation Facilities/ Highways	The major transportation features in the study corridor include I-10, SR 77, SR 79, SR 87, SR 287, SR387, and US 60. The metropolitan areas of Tucson and Phoenix also have a system of major and minor arterial streets contributing to the transportation system.	
Urban and Rural Development	Approximately 20 to 25 percent of the corridor alternatives pass through currently developed areas, including residential, industrial, and commercial/business land uses. Major planned developments that are currently in a build-out phase include, but are not limited to: Gladden Farms, Rancho Marana, San Lucas, Continental Ranch, Continental Reserve, and Dove Mountain. More than 10,000 lots in these subdivisions alone have been built, with more lots and commercial space in development.	Study corridor

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Reasonably Foreseeable Future Actions/Projects		
Major Planned Developments	Some of the major planned subdivision developments partially or fully within the study corridor include Superstition Vistas, Eastmark, The Villages at Tortolita Mountain Ranch, Saguaro Springs, Sherwood Park, Magma Ranch, and Tangerine Crossing. These developments collectively include tens of thousands of platted and proposed lots for homes as well as land allocations for commercial development.	Study corridor
Expansion of Casa Grande Ruins National Monument	In June 2013, four members of the House of Representatives introduced legislation to expand the boundaries of Casa Grande Ruins National Monument. Similar legislation was introduced in February 2015. The bill (H.R. 1077) remains with the Subcommittee on Federal Land.	Coolidge
Interstate 10	Between Tucson and Phoenix, ADOT plans to widen I-10 to five travel lanes in each direction, where feasible.	South-central Arizona
North-South Corridor	ADOT and FHWA are studying a proposed high-capacity transportation facility between US 60 in Apache Junction and I-10 near Eloy and Picacho.	Pinal County
Loop 202-South Mountain Freeway	ADOT proposes to complete the Loop 202 highway system with a freeway running east and west along Pecos Road and then turning north between 55th and 63rd avenues, connecting with I-10 on each end.	Involves a corridor passing through portions of Phoenix, Tolleson, Avondale, Chandler, Glendale, and Goodyear
Phoenix-Mesa Gateway Airport	Phoenix-Mesa Gateway Airport plans a major expansion in the next 10 to 20 years, moving the terminal across the runways and adding substantial airline capacity.	Mesa area
Phoenix Sky Harbor Airport	The City of Phoenix plans to modernize and increase the capacity of Terminal 3 and eventually close Terminal 2.	Phoenix

Table 5-30. Past, Present, and Reasonably Foreseeable Future Actions

Action/Project	Description	Location
Ak-Chin Regional Airport	The Ak-Chin Indian Community has been renovating the former Phoenix Regional Airport and, with completion of ongoing additions, will be able to accommodate more of the single-engine and multi-engine piston aircraft that the airport predominantly serves.	Between the cities of Maricopa and Casa Grande; 33 miles south-southeast of Phoenix
UP Red Rock Classification Yard	UP has submitted an application to purchase approximately 1,873 acres of land from the Arizona State Land Department to construct a classification yard where rail cars would be separated and classified and trains assembled to improve operations efficiency (RBF 2012).	Southeast of Picacho Peak State Park on the east side of I-10 between the railroad's Sunset mainline and the CAP canal
UP Sunset Route	Union Pacific Railroad proposes to double-track the Sunset Route over the next 20 to 30 years.	Los Angeles to New Orleans, including rail within the corridor alternatives
UP Track Upgrades and Increased Train Speeds	UP freight trains using tracks within the corridor alternatives currently operate at a maximum speed of 60 mph, but UP proposes to upgrade the track to increase the maximum speed to 80 mph. This proposal would not change the number of trains that operate, which is currently an average of 26 to 60 trains per day from Tucson to Eloy and 5 to 10 trains per day from Eloy to Phoenix.	UP tracks between Tucson and Phoenix
Passenger Rail Future Connections	The corridor is anticipated to connect to TUS in the south and to Surprise and Buckeye in the north.	Tucson and Phoenix metropolitan areas

5.22.3 Environmental Consequences

Corridor Alternatives

At the level of analysis conducted for this Tier 1 EIS, the indirect effects and cumulative impact analysis of the Yellow Corridor Alternative and Orange Corridor Alternative would be essentially the same.

Indirect Effects

Construction and operation associated with any phase of a passenger rail system have the potential to cause indirect impacts. The following is a list of potential indirect impacts identified through evaluation of various environmental resources; these could occur to varying degrees regardless of which corridor alternative might be selected.

- Operation of passenger trains at speeds up to 110 miles per hour would result in increased noise and ground vibration, as well as air emissions and visual and aesthetic impacts. These direct impacts could potentially result in indirect impacts of reduced use of nearby parks, recreation areas, and natural areas. Section 4(f) resources could be indirectly affected by noise, ground vibration, aesthetics, and access issues. Wildlife, including threatened or endangered species, could potentially be indirectly affected by noise, vibration, air emissions, and water quality impacts affecting habitat.
- Noise and vibration from passenger rail traffic could cause indirect impacts to cultural resources by affecting the visitor experience within a historic setting or a TCP. Also, induced transit-oriented development in the vicinity of station areas has the potential to occur, which may indirectly affect nearby cultural resources.
- Passenger train service could have the indirect effect of reducing ridership on current transportation services, such as intercity bus and flight service, by offering a competitive alternative to these modes. Diverted trips from these modes to passenger rail service may have implications for the viability of these modes in the future. Conversely, passenger train service also could have an indirect effect of increased ridership. For example, Central Arizona Regional Transit (CART) travels between Florence, Coolidge, Central Arizona College, and Casa Grande. If a station for a Tucson-to-Phoenix train were located along the CART route, passenger service would extend beyond the localized connection and might draw additional passengers that need to travel beyond the CART service area.
- Potential indirect positive effects include anticipated reductions in traffic volumes on I-10, potentially reducing congestion and accidents. This could have positive impacts on air quality and safety and could reduce future delays due to congestion.

- As a result of train traffic, as well as activities at stations and maintenance facilities, a hazardous material incident has an increased chance of occurring in these locations. Potential indirect impacts could also occur to water quality as railway contaminants or accidental chemical/fuel spills from operations and maintenance activities could reach water resources adjacent to, or downstream of, the passenger rail system infrastructure. With appropriate BMPs in place, however, water quality impacts from hazardous materials could be avoided or minimized.
- Potential indirect impacts to downstream waterbodies and wetlands could occur from culvert and/or bridge replacements.
- Transit-oriented development could indirectly result from the construction of stations and use of surrounding areas.
- Adjacent land uses could be indirectly affected from changes in traffic flow at rail crossings and near future station sites. Temporary indirect impacts to traffic would occur through closings during construction, which would lead to rerouting traffic through adjacent neighborhoods and business areas. Lack of convenient access can cause increased travel time and delay for local residents and potential economic impacts to businesses that depend on convenient accessibility, such as auto-oriented retail and services, drive-through restaurants, etc. Long-term indirect impacts could occur through potential increased congestion and traffic delays near crossings with new passenger rail service.
- A temporary increase in greenhouse gas emissions would occur from construction activities by onsite equipment as well as increased automobile and bus traffic delays and congestion from construction-related changes in access or street lane closures.
- Indirect positive impacts on air quality would be anticipated from the development of a multimodal transportation system within the three-county study area, including planned expansion of the passenger rail system, potential changes in long-term travel behavior, and advocacy for more energy-efficient modes of transport that improve air quality.
- Upgrades to rail infrastructure may indirectly benefit existing freight service.
- Transportation projects that create new or substantially improved access to areas that are relatively undeveloped indirectly induce commercial, residential, and/or business development. Construction of a future passenger rail system within one of the corridor alternatives would have the greatest potential to induce development near station stops in Pinal County where privately owned land is less developed. Even in the portions of the corridors in the developed areas of Tucson and Phoenix, a passenger rail system

could indirectly influence the type and density of development both near the rail line and beyond into areas where passenger service would extend from station stops. Station locations would be selected through coordinated efforts with local city/ county/ metropolitan area planners to help ensure that the sites and opportunities presented for development are suitable to handle increased traffic and other demands that accompany such growth, while minimizing the potential for adverse indirect and cumulative impacts.

- Induced growth would be expected in communities with passenger rail stations based on the availability of the train for transportation and the opportunities for business by concentrating a potential customer base near the stations. Because rail stations have not been identified in this stage of study, the effects of induced growth would be examined in greater detail in Tier 2 analyses. At a Tier 1 level of evaluation, the other identified impacts are not anticipated to be substantial.

Cumulative Effects

Each of the resources evaluated in this Tier 1 EIS has the potential for cumulative effects. The analysis below is in the same order as the resources were discussed earlier in this chapter.

Land Use

Land use in the corridor alternatives has been changing from undeveloped desert over the decades. While some land remains undeveloped, the land in the region has been generally used for agricultural or ranching purposes first and then converted to urban uses, including residential, commercial, and industrial. The transportation network has contributed to the pattern of land use development in some cases, and followed land use changes in others. For example, the UP was transformative in bringing people to Arizona and the West. Development is often induced by new or improved transportation systems, but rapid development and demand for access also contributes to widening of existing streets and highways, as well as the need to establish public transportation systems. The cumulative impact of passenger rail on land use within the Yellow and Orange corridors would include continued displacement of activities and land uses, and changes in future use patterns influenced by the passenger rail system and the associated transportation network. Land use development may continue in the I-10 corridor, but some of the development would also be expected to divert to follow a future alignment, particularly near future passenger stations. If passenger rail service were to extend further, the system could have farther-reaching influences on land development patterns.

Socioeconomics

Cumulative effects on socioeconomic conditions would be similar to trends in land use development influenced by the transportation network. Evolving transportation systems bring economic growth through construction jobs as well as operations and maintenance, but the greater economic influence is from the induced growth that typically follows new and enhanced transportation developments. Quality of life may be influenced positively or negatively, depending on one's perspective. Those who value a more rural lifestyle may view the changes negatively, while those who value the opportunities associated with growth or who directly benefit by having a passenger rail system nearby may view an enhanced transportation network as improving quality of life.

Environmental Justice

Several communities in the three-county study area have a larger share of minorities within the population when compared to the region. Certain areas also have greater concentrations of low-income populations when compared to the regional population; consequently, protected populations may be affected by actions in the study corridor. While Environmental Justice is particularly focused on actions that may adversely and disproportionately affect low-income and minority populations, the addition of passenger rail service would generally help these populations by providing transit options. Actions that include adverse consequences, such as displacements, changes in access, or noise and air pollution, could have adverse effects on protected populations.

Public Health and Safety

The cumulative effect of expanding the transportation network and providing multimodal options is generally beneficial to public health and safety. Alternate forms of transportation disperse the demand on any single route and system, which in turn may reduce congestion, lower the potential for accidents, and minimize exposure to noise and emissions that contribute to air pollution. Where multimodal facilities intersect, accident potential may be somewhat elevated because some modes of transportation are faster, their approach more difficult to detect, or their equipment slower to react. Traffic controls such as signalized intersections, education programs, and other BMPs can help to minimize the safety risks associated with passenger rail and associated traffic, as well as other factors that might complicate the health and safety environment, such as nearby utilities or land uses that may contribute to congestion or crime.

Parklands and Recreation Areas/Section 4(f) and 6(f) Resources

Public parks and recreation areas are provided extra protection by Section 4(f) of the USDOT Act of 1966, which helps to minimize the loss of parks and recreation areas as well as access disruptions from transportation projects. This reduces the potential for cumulative effects on parks and recreation areas; however, audio and visual intrusions from traffic or trains near recreational facilities may be a concern, depending on the proximity of the transportation facility and the other actions that may contribute to man-made sights and sounds.

Because of the protection provided to public parks, recreation areas, wildlife and waterfowl refuges, historic sites, and lands acquired or developed with Land and Water Conservation Funds, a passenger rail system would not be expected to contribute to adverse cumulative impacts on Section 4(f) and 6(f) resources when such impacts can be avoided. A more detailed analysis would be undertaken during Tier 2 studies that evaluate specific alignments, rail stations, and related facilities.

Air Quality

Ground-disturbing activities that occur concurrently with passenger rail system construction may contribute to temporary and cumulative increases in fugitive dust, including PM_{10} and $PM_{2.5}$, until soils are stabilized through restoration activities and revegetation. Ground-disturbing activities may include construction of transportation facilities and residential development as well as plowing of agricultural land. Contributors of many other types of air pollutants include emissions associated with vehicle exhaust, some industrial activities, and certain residential activities such as burning wood in fireplaces. Air quality analyses typically are cumulative by nature because the baseline air quality condition accounts for current activities that may degrade the air.

If passenger rail facilities effectively reduce the number of passenger miles traveled by automobiles, the quality of the air in the region would be expected to improve because the reduction in automobile emissions should be greater than any introduction of emissions from train operations. The planned connection to Tucson International Airport and other proposed connections beyond the hubs identified in this EIS would further reduce the volume of automobile traffic, resulting in greater beneficial effects on air quality than development of a passenger rail system from downtown Tucson to Phoenix alone.

Noise and Vibration

Actions that contribute to the cumulative effect of noise and vibration tend to be localized. Sound is a vibration that propagates as a wave through a medium such as air; however, the intensity of the vibration is affected by surfaces that the sound wave encounters, such as vegetation or buildings, so that the noise and vibration diminish with distance. In the areas nearest to new passenger rail facilities, multiple sources of noise or vibration would accumulate and have a greater effect than any one source alone. If the passenger rail were aligned near the UP or near a highway corridor, the cumulative noise and vibration effects would be greater if the noise sources occurred at the same time. In addition, the faster that a train travels, the more noise and vibrations would increase. UP's proposal to increase the maximum speed of their freight trains by 20 mph would contribute an additive effect, particularly if a passenger rail system were operated within the Yellow Corridor Alternative. Similarly, if proposed development that involves new construction occurred at the same time and in near proximity to construction activities related to a passenger rail system, the effect would be additional noise, although construction noise would be short-term.

While the Tier 1 analysis acknowledges that a new passenger rail system would add noise and vibration near the tracks, the degree of effect cannot be determined without a more precise understanding of the other projects that are likely to occur concurrently that may contribute sources of noise and vibration. The Tier 2 analysis would identify the baseline quantity of noise and vibrations within the area of potential effect, which may include sources such as farm equipment, traffic in nearby transportation corridors, train operations on the UP tracks, construction activities, and other sources. The noise and vibrations associated with each alternative would be modeled and added to the baseline to identify the degree of the cumulative effect.

Hazardous Materials

Potential key sources of hazardous or toxic materials in the area include past and present use of pesticides for agricultural production; petroleum, oils, and lubricants used by trains and automobiles in transportation corridors including the UP track and nearby streets and highways; chemicals used for industrial or commercial processes; and accidental spills from vessels using the transportation system to haul hazardous materials. Typically, proper use, storage, and disposal of hazardous materials in accordance with manufacturers' directions and per regulatory requirements keep hazardous materials from accumulating to levels that fail to comply with public health and safety standards. However, because a passenger rail system would require the use of materials with the potential to be hazardous, the system may contribute to local cumulative effects.

Geology, Topography, Soils and Prime Farmland

Localized ground disturbance during passenger rail construction would contribute to the cumulative effects on soils and geological features. Other sources of ground disturbance may include ongoing agricultural production as well as other construction for urban development or transportation facilities. Until soils are re-stabilized, ground disturbance from construction may contribute to soil erosion and downstream sedimentation. Urbanization and transportation projects that result in development of prime or unique farmlands would contribute to continued loss of such farmland. A passenger rail system would likely remove some farmland from production, and could indirectly induce growth that also removes larger areas of prime or unique farmland from production.

Natural Ecological Systems

Many of the natural ecological systems in the study corridor have been heavily affected by past actions, including extensive development in the Tucson and Phoenix metropolitan areas, population growth and development in Pinal County communities, and agricultural production. Historic and ongoing livestock grazing has also influenced the quality of the natural habitat so that native wildlife competes with livestock for forage in some areas, and plant quality and density may be diminished from the stress of historic overgrazing or drought in certain areas. Invasive species and noxious weeds have been introduced within some natural systems through development, recreational access, grazing, and other activities that contributed to dispersal of nonnative seeds. Such invasions have choked out native species in some areas and further limit the native habitat available to wildlife populations.

Barriers to wildlife movement have been introduced by features such as railroads, highways, and fences; this has fragmented habitat and, in some cases, cut off access to historically used water and foraging areas. Stronger environmental regulations in the past several decades have encouraged greater use of mitigating features such as culverts and bridges that are designed specifically to retain wildlife connectivity. A passenger rail system would contribute to the ongoing loss of natural habitat and increases in wildlife barriers. While the rail facilities would contribute to the ongoing loss of native habitat and the potential for direct mortalities on the tracks when a train passes, the effects are expected to mostly affect individual animals rather than influence the diversity or size of populations, both for common and protected wildlife.

Waters of the US

Ongoing and reasonably foreseeable future development in the corridor is likely to encroach on Waters of the US and contribute to their loss. A passenger rail line may contribute to the loss of Waters of the US along with other construction and development projects including new or widened highways and urban development, including residential growth. Past conversion of native land to agricultural uses and urban development has also contributed to the loss of Waters of the US. Cumulative effects on Waters of the US may be anticipated; however, the permits that are required when Waters of the US are adversely affected would include specific measures to help mitigate for the losses. The extent of the cumulative effects on Waters of the US would be better quantified in Tier 2 analyses.

Wetlands

Ongoing and reasonably foreseeable future development in the corridor has the potential to result in impacts to wetlands and contribute to their loss. A new passenger rail line, along with new or widened highways, urban development and residential growth, and other construction projects could contribute to adverse wetland impacts. Past conversion of native land to urban development has also adversely affected wetlands associated with river areas. Cumulative effects on wetlands may be anticipated, but permits would be required when adverse effects were anticipated. Alternatives analysis is required for all work in wetlands and the Corps must choose the least environmentally damaging practicable alternative, which should help to minimize cumulative impacts. The extent of the cumulative effects on wetlands would be better quantified in Tier 2 analyses.

Water Quality

During the construction phase and until disturbed ground has been stabilized, new passenger rail facilities may contribute to increased sediment in adjacent and downstream waterbodies. This effect is expected to be localized and temporary but may be intensified if other reasonably foreseeable future actions in close proximity, such as the North-South Corridor, are under construction at the same time. Inadvertent spills of petroleum, oils, lubricants, or chemicals from a passenger rail system or other actions occurring in the same general vicinity could contaminate surface water or groundwater if not promptly contained and cleaned up. ADOT implements controls to minimize pollution due to sediment and spills using control measures. ADOT's pollution prevention and hazardous materials response protocols are such that spills are addressed through prevention and timely response, if needed.

Floodplains

Actions that modify floodplains may interfere with natural flows, increasing the potential risk of flood damage to the infrastructure within the floodplain. Features constructed in floodplains also may contribute to higher floodwater beyond the floodplain, increasing the potential for flooding of nearby land and property. While long linear features such as a passenger rail system, the existing UP railroad, and existing and proposed highways may not be able to avoid passing through floodplains, proper design can minimize adverse effects on natural flows and reduce the potential for cumulative effects.

Energy Use and Climate Change

Construction of a passenger rail system as well as other ongoing and planned construction projects would result in the consumption of energy. Fuel is needed for construction equipment as well as to operate the trains; however, a passenger rail system is expected to reduce overall energy consumption in the context of the cumulative effects of the existing and a new transportation system because, for the foreseeable future, trains can transport large volumes of people more fuel-efficiently than passenger vehicles or buses traveling the same distances (Davis et al. 2012). Similarly, while consumption of fuel to construct and operate a passenger rail system would generate greenhouse gases that may contribute to climate change, the rail system would reduce the cumulative amount of fuel burned to transport the same volume of people over the same distance compared with the alternative options of more reliance on vehicular travel on highways. A connection to Tucson International Airport would have an additive effect to energy use associated with the Tucson-Phoenix passenger rail system assessed in this Tier 1 EIS. None of the past, present, or reasonably foreseeable future actions identified for this Tier 1 cumulative effects analysis would contribute to energy production, so the cumulative effect would be neither positive nor adverse.

Visual and Scenic Resources

Most planning documents applicable to the study corridor support the preservation of scenic views of natural features and community landmarks. In general, few natural features or community landmarks would potentially be affected; however, particularly in less developed areas, landscape views are expansive. Intrusions from existing and planned development would gradually erode the views of distant mountain ranges, native desert, and other notable features within the landscape. With a passenger rail system, the rails would be low profile and barely visible from distant views, rail stations would be dispersed, and the trains would pass quickly, minimizing the duration of their intrusion on the visual environment. In contrast, widening existing highways or building new highways would leave a more substantial visual scar.

Cultural Resources

All actions involving ground disturbance have the potential to adversely affect archaeological resources, historic properties, and/or places with cultural values. Such disturbance contributes to the cumulative and ongoing loss of cultural resources. Federal actions would be accomplished in compliance with Section 106 of NHPA; thus, affected cultural resources would be treated properly, which may include avoidance, data collection, or other mitigative strategies. Private developments on lands where cultural resources are unprotected pose the greatest threat to the loss of cultural resources. Cumulative effects can result in the loss of cultural resources to a point where important research questions about an area's prehistory or history can never be answered.

No Build Alternative

Under the No Build Alternative, a passenger rail system between Tucson and Phoenix would not be built. New direct, indirect, or cumulative impacts would not be anticipated beyond those that could occur due to other projects. The primary transportation system between these cities would continue to be I-10, although the proposed North-South Corridor, if approved and constructed, could carry some traffic in addition to other regional roadways. Traffic congestion on existing routes, potential increases in traffic accidents, and increases in vehicular emissions and the associated degradation of air quality associated with congested roadways would be expected.

5.22.4 Potential Mitigation Measures

Actions with a federal nexus undergo compliance with NEPA, including the application of mitigation measures. Actions undertaken on private land are not subject to these same types of regulations and may have impacts that are not mitigated because it is not required. No mitigation measures are proposed to address cumulative effects because those are already defined and implemented for the actions that require mitigation.

5.22.5 Tier 2 Considerations

Further evaluation of potential indirect impacts would be addressed during Tier 2 analysis when more design and operational details are known. For example, the increased noise and vibration from passenger train operations would be evaluated for potential constructive use of Section 4(f) facilities during Tier 2 analysis. Specific mitigation measures, to the extent required, would be identified and discussed during Tier 2 analysis after design details are known, recorded in NEPA documents as specific impacts are identified, and implemented prior to construction.

6 Cost Analysis

This chapter presents estimates for capital costs and operating and maintenance costs for the APRCS. The cost estimates are based on the information gathered in the course of developing and analyzing the companion AA. The cost estimate reflects a level of understanding commensurate with the conceptual engineering work performed to date. The figures will be updated and refined as the study advances to the development phase and a Tier 2 NEPA document is prepared.

This analysis presents only the capital and operating costs of the project. There is not yet an identified source of funding or a schedule for construction with which to define a financing plan.

6.1 Cost Estimate Methodology

Cost estimates were developed based upon the general alignment for the Yellow and the Orange corridor alternatives. For the purposes of this cost analysis, it is assumed that the Yellow Corridor Alternative is within or along ADOT or UP ROW, and the Orange Corridor Alternative would be located within ADOT or other private or public ROW. Costs may change depending on the eventual project-specific alignment. The generic passenger rail technology upon which estimates were based was a diesel multiple unit capable of higher-speed rail (up to 125 mph).

Capital cost estimates for a passenger rail system were prepared consistent with the level of detail available for the proposed alternative. The calculations took into consideration construction costs and annual operating and maintenance costs based upon the assumed intercity and commuter rail operating plan presented in **Chapter 4 – Transportation Impacts**. The capital cost estimates are presented in current year US dollars and were developed for opening year, horizon year (2035), and long-range future. The estimates were prepared using standardized costs based on current railroad industry unit prices. The estimated cost for intercity and commuter rail stations, train equipment, and yard and maintenance facilities are also included in the capital cost estimate at a program level.

The annual intercity and commuter rail operating and maintenance cost estimates are based upon current, similar rail operations located in the western US.

6.1.1 Capital Cost Methodology

For this Tier 1 EIS, the cost analysis is at a high level, but is built upon the specific corridor context using the most appropriate information available. The following assumptions were made for the development of the rail capital and operating cost estimates for the APRCS:

- Average speeds for local and express service for planning purposes were used for each service level to calculate fleet size. A total of 40 minutes (20 minutes at each terminal) for trains is allocated for terminal turn-back time. One spare commuter train and one spare intercity train would be provided.
- Double track costs are estimated for all elevated segments and at-grade segments at locations where trains moving in opposite directions need a second track to pass. Rights-of-way to accommodate double track are assumed along the entire corridor.
- Train sets would consist of diesel multiple units with four vehicles for commuter train sets and eight vehicles for intercity train sets.
- Bridges, such as those across canals, streets, and some washes, are assumed to be 200 feet or less in length. Some bridges across freeways, washes, and wide roadways are assumed to be between 200 feet and 300 feet in length. Major bridges are estimated on a cost per linear foot basis.
- Universal crossovers consist of four turnouts arranged in sets of two to form single crossovers in opposite directions. Crossovers will allow trains to cross from one track to another and are located at terminal stations, connections to servicing and maintenance facilities, and at intermediate locations will allow trains to operate over only one track in the event of maintenance or a problem occurring on the other track. It is assumed that crossovers will be spaced 5 miles to 10 miles apart.
- At-grade highway/railroad crossings will be rebuilt for higher train speeds and multiple tracks in accordance with federal and state regulations. Each at-grade crossing will be equipped with medians and quadrant gates (to prevent motorists from driving around the gates), constant warning predictors, concrete panel crossing surfaces, and all required signage and graphics.
- Construction will use the existing I-10 westbound frontage road from Grant Road to Eloy. Property acquisition or additional access will be required for properties affected by loss of access from the frontage road. Reconstruction of the Red Rock traffic interchange and Missile Base Road will be required, as well as new roadways providing access to the proposed Park Link Drive and Arizona Public Service power plant access road. Ina Road and Ruthrauff Road are currently being designed to accommodate a passenger rail alignment.
- Positive and centralized train control costs consist of cab signaling and automatic train protection and supervision.

- Passenger stations will consist of system hub stations located at terminals, regional stations at key junction points, and local stations located along the system. Local stations located in freeway rights-of-way will include pedestrian crossings and stairs/elevators for passenger access.
- Unit costs are based upon experience and industry source articles. Costs have been rounded up after allowing for inflation.
- A planning level contingency of 40 percent has been added to the construction cost.
- Preliminary ROW costs reflect anticipated expenditures for potential acquisitions based on a general understanding of underlying property impacts and ownership.
- Estimate includes construction of support facilities including a single maintenance and storage facility to be located near the midway point of the corridor

For purposes of the Tier 1 EIS Cost Analysis, a broad list of items was defined and categorized by line segment, as summarized in the *Cost Analysis Appendix*. Cost types such as capital, operating, maintenance, etc. were estimated by segments and defined specifically for this cost analysis and summed to obtain the total estimate for each corridor alternative. Preliminary costs for both corridor alternatives are rounded to the nearest $100,000 for smaller capital items (e.g., minor culverts) and the nearest $500,000 for larger capital cost items (e.g., siding turnouts). Real estate acquisition costs have been divided into residential, vacant, business, and institutional, and further split into urban, suburban, and rural for all categories.

6.1.2 Operating Cost Methodology

At this stage of development, the operating costs assume operation of commuter and intercity services based upon the service levels used to forecast ridership.

- Annual operating and maintenance cost estimates are based upon the 2010 National Transit Database vehicle mile and train/bus hour costs, inflated by 3 percent per year to 2013.
- Station operating costs are estimates based on a percentage of the associated total capital cost.

6.2 Capital Plan

The capital plan generally sets forth the financing requirements for funding the capital element of any project developed as part of a future Tier 2 document. Because funding sources have not been identified to advance the study into project development, the capital plan is developed according to the level of conceptual engineering performed to date. Once funding sources have been identified, a capital cost estimate and plan will be developed for the project-specific Tier 2 document(s). At that time, the capital plan will identify and rely upon refined and updated revenue opportunities to maximize and leverage revenues. It will also incorporate review and integration of the capital cost estimates and implementation schedules, including the potential for phased implementation. (A conceptual phasing plan is presented in the companion Service Development Plan [SDP].) The capital plan will document any new assumptions about annual and total receipt of federal revenues based on feedback from FRA.

6.2.1 Capital Costs

The capital cost estimates for implementing a passenger rail system within each corridor alternative are shown in **Table 6-1** and **Table 6-2**. The capital cost estimates in 2013 U.S. dollars, excluding any finance charges, are between $3.8 billion and $4.5 billion for a passenger rail system within the Yellow Corridor Alternative and between $6.5 billion and $7.6 billion for a passenger rail system within the Orange Corridor Alternative and include the items listed in the tables. These figures represent the cost of building a passenger rail system in either of the corridor alternatives.

Table 6-1. Estimated Capital Costs for a Rail System within the Yellow Corridor Alternative

ADOT Intercity Corridor Alternative: YELLOW - UP Alignment				119.8 Route Miles	
FTA Major Standard Cost Categories	Base Year Cost w/o Contingency (x000)	Base Year Allocated Contingency (x000)	Base Year Dollars Total (x000)	Base Year $ Percentage of Construction Cost	Base Year $ Percentage of Total Cost
10 Guideway & Track Elements	$1,466,063	$111,935	$1,577,997	55%	35%
20 Stations, Stops, Terminals, Intermodal	$38,333	$63,963	$102,296	4%	2%
30 Support Facilities: Yards, Shops, Admin. Buildings	$148,000	$63,963	$211,963	7%	5%
40 Sitework & Special Conditions	$449,471	$95,944	$545,415	19%	12%
50 Systems	$356,060	$79,953	$436,013	15%	10%
Construction Subtotal (10 - 50)	**$2,457,927**	**$415,758**	**$2,873,685**	**100%**	
60 ROW, Land, Existing Improvements	$120,760	$127,926	$248,686		6%
70 Vehicles	$368,000	$95,944	$463,944		10%
80 Professional Services	$251,450		$251,450		6%
Subtotal (10 - 80)	**$3,198,138**	**$639,628**	**$3,837,765**		
90 Unallocated Contingency			$639,628		14%
Total (10 - 90)			**$4,477,393**		**100%**

6.2.2 Funding Sources

Currently no funding sources are identified for the construction and operation of a passenger rail system. Depending on the final governance structure for passenger rail in Arizona, revenue could come from various sources. For example, a commuter rail system within urbanized areas between Tucson and Phoenix metropolitan areas could request Section 5309 New Starts federal grants or local funding from regional and state agencies or from private interests. Intercity service will compete for different sources of funding at the state or federal levels. In either case, substantial funding will need to be generated within Arizona to seek matching federal dollars. Various such programs are being discussed such as FRA's High Speed Intercity Passenger Rail Program (or a follow-on program), but none is well enough defined to be considered viable yet. A detailed financial plan will be developed as the study advances to the development phase and a Tier 2 analysis is prepared.

Table 6-2. Estimated Capital Costs for a Rail System within the Orange Corridor Alternative

ADOT Intercity Corridor Alternative: ORANGE - I-10 / N-S / US 60 / 101L				128.5 Route Miles	
FTA Major Standard Cost Categories	**Base Year Cost w/o Contingency (x000)**	**Base Year Allocated Contingency (x000)**	**Base Year Dollars Total (x000)**	**Base Year $ Percentage of Construction Cost**	**Base Year $ Percentage of Total Cost**
10 Guideway & Track Elements	$3,291,156	$297,301	$3,588,456	67%	47%
20 Stations, Stops, Terminals, Intermodal	$70,833	$135,137	$205,970	4%	3%
30 Support Facilities: Yards, Shops, Admin. Buildings	$106,000	$108,109	$268,109	5%	4%
40 Sitework & Special Conditions	$614,884	$162,164	$777,048	15%	10%
50 Systems	$362,710	$135,137	$497,847	9%	7%
Construction Subtotal (10 - 50)	**$4,445,583**	**$837,847**	**$5,337,430**	**100%**	
60 ROW, Land, Existing Improvements	$51,620	$108,109	$159,729		2%
70 Vehicles	$400,000	$135,137	$535,137		7%
80 Professional Services	$454,262		$454,262		6%
Subtotal (10 - 80)	**$5,405,466**	**$1,081,093**	**$6,486,559**		
90 Unallocated Contingency			$1,081,093		14%
Total (10 - 90)			**$7,567,652**		**100%**

6.3 Operating and Maintenance Plan

Operating costs cover the maintenance and operations costs of running a passenger rail system within the corridor alternatives. The elements of this cost assessment include a high-level estimate of train operations, station operations, and the needs of the maintenance and storage facility that supports the passenger services.

Operating and maintenance cost estimates were prepared for each corridor alternative based on separate costs for intercity and commuter rail. **Table 6-3** lists the existing systems referenced as part of the cost calculations. Operating and maintenance cost estimates also included total costs for maintenance staff, equipment, and facilities using travel forecasts.

Table 6-3. Operating Costs for Existing Transit Agencies Using Commuter Rail Service

Existing Rail Transit Systems	Location	Annual Operating [8] Cost	Fixed Guideway[a] Directional Route Miles	Average Operating Cost/ Route Mile
Dallas Area Rapid Transit	Dallas – Fort Worth – Arlington, TX	$25,873,787	72.3	$357,867
Peninsula Corridor Joint Powers Board (Caltrain)	San Francisco – Oakland, CA	$97,555,152	153.7	$634,711
Massachusetts Bay Transportation Authority	Boston and surrounding areas, MA	$322,088,557	776.1	$415,009
Metro Transit	Minneapolis – St. Paul, MN	$16,419,740	77.9	$210,780
Tri-Met	Portland (Westside Express), OR	$6,486,920	29.2	$222,155
Tennessee Department of Transportation	Nashville, TN	$3,939,586	62.8	$62,732
Capital Metropolitan Transportation Authority	Austin, TX	$11,358,085	64.2	$176,917
Rio Metro Regional Transit District	Albuquerque, NM	$24,226,678	193.1	$125,462
Southern California Regional Rail Authority (Metrolink)	Los Angeles – Anaheim – Long Beach, CA	$171,572,964	777.8	$220,588
Central Puget Sound Regional Transit Authority	Seattle, WA	$36,762,712	163.8	$224,437
South Florida Regional Transportation Authority	Miami, FL	$55,588,137	142.2	$390,915
Utah Transit Authority	Salt Lake City – West Valley City, UT	$20,041,804	174.5	$114,853
Maryland Transit Administration	Washington DC	$97,050,916	400.4	$242,385
Virginia Railway Express (VRE)	Washington DC	$61,552,829	161.5	$381,132
MTA Long Island Rail Road	New York – Newark, NY	$1,163,468,650	638.2	$1,823,047
NE Illinois Regional Commuter Railroad Corp.	Chicago, IL	$627,591,444	980.4	$640,138
Metro North Commuter Railroad Company	New York – Newark, NY	$940,674,081	545.7	$1,723,793
New Jersey Transit Corporation	New York – Newark, NY	$869,846,760	1,001.8	$868,284
Southern Pennsylvania Transportation Authority	Philadelphia, PA	$255,004,244	446.9	$570,607
Shaded rows indicate rail systems that include both electric multiple unit (EMU) and diesel multiple unit (DMU)rail power			Average (includes EMU/ DMU transit systems)	$495,043
Note: [a]National Transit 2012 Database Transit Agency Profiles			Average (includes only DMU transit systems)	$269,996
			2013 Value	**$278,096**

Operating and maintenance cost calculations were based on the actual costs of existing rail operations throughout the country with similar characteristics to those planned within each corridor for this passenger rail system. The operating and maintenance cost analysis for a passenger rail system within the Yellow Corridor Alternative and Orange Corridor Alternative are shown in **Table 6-4**.

Table 6-4. Comparative Estimated Annual Operating and Maintenance Costs by Corridor Alternative and Service Type

	Yellow Corridor Alternative		Orange Corridor Alternative	
Service Type	**Intercity**	**Commuter**	**Intercity**	**Commuter**
Trip Length (miles)	119.8	119.8	128.5	128.5
One Way Trip Time, NB/SB[a] (minutes)	83/82	95/96	83/85	98/99
Number of Cars[b]	8	4	8	5
Fleet Size[c]	5	13	4	15
One-Way Trips per Weekday	16	56	16	56
Weekday Miles	1,916.8	6,708.8	2,056	7,196
Annual Revenue Miles[d]	498,368	1,744,288	534,560	1,870,960
Unit Cost [e-g] (Operating Expense per Vehicle Mile)	$29.79	$29.79	$35.75[h]	$35.75[h]
Estimated O&M[i] Cost	$14,846,383	$51,962,340	$19,110,520	$66,886,820
Total Estimated Annual O&M Cost	**$66,808,722**		**$85,997,340**	
Average Operating Cost/ Route Mile	$123,926	$433,742	$148,720	$520,520

Notes:
[a] NB/SB= Northbound Trip / Southbound Trip
[b] Based on diesel multiple unit (DMU) train
[c] Includes 1 spare train for each rail service
[d] Weekdays only service assumes 260 operating days per year
[e] Operating Expenses per Vehicle Revenue Mile are in 2013 U.S. Dollars
[f] Operating Expense per Vehicle Revenue Mile from 2012 National Transit Database plus 3% inflation per year to 2013
[g] Operating Expenses per Vehicle Revenue Mile is based on the average value of 14 existing transit systems across the U.S. that have similar operations
[h] Operating Expenses per Vehicle Mile average cost inflated by 50% to take into account higher operating speed and structures estimated for this rail system
[i] O&M=Operating and Maintenance

As shown above, the estimated operating and maintenance costs are based on trip length, travel times, route miles, and fleet size for intercity and commuter service for each corridor alternative. The total estimated annual operating and maintenance cost estimates (based on 2013 U.S. dollars) are approximately $66.8 million for a passenger rail system within the Yellow Corridor Alternative, and $86 million for a passenger rail system within the Orange Corridor Alternative.

6.4 Cash Flow Plans

A cash flow analysis will be developed during project development and when funding mechanisms with annual sources and uses of funds are defined. The cash flow plans will depend on the type of funding used to pay for construction and operations. Options include pay-as-you-go approach or debt financing construction or a combination of the two approaches. The selected approach could have differing effects on the timing of impacts (e.g., acquisition of adjacent properties or construction) and on the financial management of the program. These concepts will be further developed during preparation of the Tier 2 environmental analysis.

6.5 Financial Risks and Uncertainties

The greatest financial risk to developing a passenger rail system within either corridor alternative is the potential inability to secure funding for construction, operation, and maintenance. Other financial risks could include issues affecting or delaying property acquisition and the cost of property acquisition, the volatility of material costs, and their effect on the overall cost estimate. The total cost estimate is also affected by the way funds are allocated for a multi-modal project such as passenger rail corridor shared with a highway corridor, as could be the case if the passenger rail parallels the North-South Corridor.

7 Comparison of Alternatives

7.1 Introduction

In order to accomplish a multidisciplinary evaluation of alternatives, FRA, FTA, and ADOT, in collaboration with FHWA, undertook an Alternatives Analysis (AA) as part of the APRCS that involved conceptual engineering of possible alternative alignments at a level appropriate for cost estimating, scheduling, operational analyses, and community involvement. Summary information taken from the AA forms the basis of **Chapter 3, Public Agency Coordination**; **Chapter 4, Transportation Impacts**; **Chapter 5, Existing Conditions and Environmental Consequences**; and **Chapter 7, Cost Analysis** of this Tier 1 EIS. This chapter combines the corridor-level analysis contained in **Chapter 6, Cost Analysis** with the AA findings reported in the other chapters to compare the potential performance and environmental impacts of a passenger rail system within each corridor alternative and the No Build Alternative. Community and other environmental impacts, financial feasibility, ease of implementation and operating characteristics, and mobility and safety are compared in the tables in this chapter. Detailed descriptions of the two corridor alternatives are included in **Chapter 3, Public Agency Coordination** and illustrated on **Figure 3-4**. Based on that comparison, this chapter also identifies the agencies' Preferred Alternative.

7.2 Impact and Performance Comparison

Combined, the Tier 1 EIS and AA for the APRCS cover a broad range of topics intended to inform program-level decisions as well as future decision-making on potential major infrastructure investments. Capital, operating, and maintenance cost estimates and travel times were developed in the AA based on conceptual alignments within each corridor alternative; and conceptual station locations along these alignments were used to model potential ridership and estimate potential changes in VMT, air pollutant emissions, injuries, and fatalities. All of these numbers are representational; a future passenger rail system and associated stations could be located anywhere within a given corridor, requiring further data gathering, impact analysis, and more specific mitigation tailored to a specific design and alignment. The tables on the following pages provide qualitative and high-level quantitative data on a number of criteria to allow comparison between the No Build Alternative and the two corridor alternatives.

7.2.1 Community and Other Environmental Criteria

Table 7-1 compares community and other environmental factors potentially affected by a passenger rail system within the Yellow and Orange corridor alternatives and the No Build Alternative. The resources listed on this table are a combination of data gathered for the AA and elements analyzed in **Chapter 5 – Existing Conditions and Environmental Consequences**

Table 7-1. Comparison of Community and Environmental Criteria

Criterion	Yellow Corridor	Orange Corridor	No Build
Potential need for conversion of non-transportation land uses	Moderate	Moderate to High	N/A
Compatibility with local plans	Compatible	Moderately Incompatible	Compatible
Compatibility with underlying property ownership	Moderately Incompatible	Compatible	Compatible
Compatibility of station areas[a]	Compatible	Moderately Incompatible	N/A
Existing population within station area district[b]	851,713	717,329	N/A
Existing employment within station area district[b]	796,426	726,212	N/A
Future population within station area district[b]	1,188,103	1,027,518	N/A
Future employment within station area district[b]	1,036,490	939,520	N/A
Existing minority population within station area district[b]	481,916	404,114	N/A
Existing low-income population within station area district[b]	296,018	265,145	N/A
Parks (200-foot ROW corridor)	151 (21)	146 (20)	N/A
Daily reduction in NO_X emissions (STOPS)[c] (kg.)	516	519	[d]
Daily reduction in CO emissions (STOPS) (kg.)	9,507	9,563	[d]
Daily reduction in VOC emissions (STOPS) (kg.)	340	342	[d]
Daily reduction in PM_{10} emissions (STOPS) (kg.)	6	6	[d]
Daily reduction in CO_2 emissions (STOPS) (kg.)	242,072	243,504	
Daily reduction in SO_2 emissions (STOPS) (kg.)	2.39	2.40	
Potential noise receptors (within 1,800-foot sensitivity distance)	51,260 (39,450)	50,094 (34,155)	N/A
Potential vibration impacts	4,925	2,325	N/A
Hazardous materials sites	1,511	1,142	[e]
Rivers, washes, or arroyos (linear feet)	1,480,187	1,910,872	[e]
Potential wetlands (acres)	1,032	1,476	[e]
100-year Floodplain (acres)	9,330	9,876	[e]
Wildlife corridors	20	26	[e]
Wildlife linkage zones crossed (miles)	20.3	32.93	[e]
Annual reduction in gasoline usage (gallons)	3,037,000	3,058,000	[d]

Table 7-1. Comparison of Community and Environmental Criteria

Criterion	Yellow Corridor	Orange Corridor	No Build
Visual, aesthetic, and scenic resource impacts	Minimal to Moderate	Moderate to High	Minimal
Known archaeological resources	372	418	[e]
Historic resources listed on the National Register of Historic Places	158	126	[e]

[a] Conceptual station areas at major intersections or activity centers; not specific sites
[b] A 3-mile radius surrounding each conceptual station area
[c] Simplified Trips-on-Project Software (STOPS) is a ridership modeling program utilized by FTA
[d] Likely increases in pollutant emissions and gasoline usage from increased vehicular congestion not calculated for this Tier 1 analysis
[e] Potential impacts from other reasonably foreseeable projects are not calculated for this Tier 1 analysis

using available GIS data for the 1-mile-wide corridor alternatives. Because the physical footprint and exact location of a passenger rail system have not been determined, this Tier 1 EIS reported on the total resources within a 1-mile-wide corridor to form a basis for comparing, in relative terms, the potential intensity of impacts and benefits between alternatives. Quantities of potentially affected parks and potential noise receptors were estimated for narrower corridors, in addition to their mile-wide corridor totals; the narrower-effect numbers appear in parentheses directly beneath the quantities for the mile-wide corridors.

In summary, a passenger rail system within the Yellow Corridor Alternative would be more compatible with existing local plans and property ownership; serve a larger population; and potentially affect slightly fewer natural resources, sensitive noise receptors, viewers, and known archaeological resources than a passenger rail system within the Orange Corridor Alternative. The potential to affect historic resources, hazardous materials, and parks would be slightly greater within the Yellow Corridor Alternative compared to a passenger rail system within the Orange Corridor Alternative. Although serving a smaller population, a passenger rail system within the Orange Corridor Alternative has a greater potential to reduce gasoline consumption and criteria pollutant emissions than a passenger rail system within the Yellow Corridor Alternative. The potential to affect water resources, wildlife corridors, and potential species habitat would be greater within the Orange Corridor Alternative. Compared to the No Build Alternative, a passenger rail system within either corridor alternative offers increased access to transit for protected populations and economic generators as well as improved air quality and energy consumption.

Prior to the Tier 2 NEPA analysis, special status species and wildlife movement studies/surveys would be conducted so that the data are available to inform the NEPA process and the establishment of alignment alternatives.

7.2.2 Financial Feasibility, Implementation, and Operating Characteristics

Table 7-2 compares financial feasibility, ease of implementation, and operating characteristics between a passenger rail system within the Yellow and Orange corridor alternatives and the No Build Alternative. See **Chapter 7, Cost Analysis** for a detailed explanation of the line items in the table.

Table 7-2. Comparison of Financial Feasibility, Ease of Implementation, and Operating Characteristics

Criterion	Yellow Corridor	Orange Corridor	No Build
Annual operating cost for commuter rail plus intercity rail service (2013 dollars)	$67 Million	$86.0 Million	$0
Capital cost (2013 dollars)	$4.5 Billion	$7.6 Billion	$0
Annual operating cost per commuter rail passenger (2013 dollars)	$10.37	$15.99	$0
Annual operating cost per intercity rail passenger (2013 dollars)	$14.73	$15.38	$0
Right-of-Way cost (2013 dollars)	$144.9 Million	$62.1 Million	$0
Ease of Implementation	Moderate	Low	N/A
Predictability and Dependability	Moderate	High	Low

A passenger rail system within the Orange Corridor Alternative would have a substantially greater capital cost as one within the Yellow Corridor Alternative and would be more difficult to implement. The operating and maintenance costs would be higher as well. While the ROW cost for a passenger rail system within the Yellow Corridor Alternative is potentially higher than one within the Orange Corridor Alternative, the lower estimated annual operating cost would recover the difference in estimated ROW cost within the first six years of operation. While the No Build Alternative would not incur any of these costs, it would not meet the identified purpose and need for an alternate transportation mode between Tucson and Phoenix.

7.2.3 Mobility and Safety

Table 7-3 compares mobility and safety characteristics of a passenger rail system within the Yellow Corridor Alternative to those of a passenger rail system within the Orange Corridor Alternative.

Table 7-3. Comparison of Mobility and Safety Characteristics

Criterion	Yellow Corridor	Orange Corridor	No Build
Urban stations (conceptual)	14	12	0
Rural stations (conceptual)	1	3	0
Daily commuter ridership	16,700	13,940	0
Daily intercity ridership	3,360	4,140	0
Reduction in automobile VMT (STOPS)	566,914	570,268	0
Transit and pedestrian connectivity[a]	D	C	F
Tucson to Phoenix commuter rail travel time (hours:minutes)	1:35	1:45	N/A
Tucson to Phoenix intercity rail travel time (hours:minutes)	1:23	1:30	2:22[b]
Estimated at-grade crossings[c]	112	55	0[d]
2035 reduction in fatalities per million VMT (STOPS)	2.2	2.2	0[e]
2035 reduction in injuries per million VMT (STOPS)	33.2	33.4	0[e]

Notes:
[a] Graded on an A-F scale with "A" offering the greatest number of transit and pedestrian connections, and "F" the lowest number of connections
[b] Year 2035 Baseline
[c] At-grade crossings inferred based on ADOT rail crossing database and aerial photography review
[d] Via I-10
[e] Zero reduction in fatalities and injuries; potential increases from traffic congestion not calculated for this Tier 1 analysis

In summary, a passenger rail system within the Yellow Corridor Alternative would provide shorter trip times to a larger total number of riders, with reductions in injuries and fatalities over the No Build Alternative similar to those for a passenger rail system within the Orange Corridor Alternative.

7.3 Comparison Summary and Recommended Preferred Alternative

The No Build Alternative does not meet the purpose and need for a transportation solution. It does not divert highway trips within the Tucson-to-Phoenix study corridor, reduce congestion, increase access to employment and activity centers, or provide reliable travel times and a level of safety comparable to that offered by passenger rail travel. The No Build Alternative would not connect the suburban and rural areas between Tucson and Phoenix with a high-capacity travel option, facilitate continued development of a multimodal transportation network, or provide mobility choices for existing and future needs.

In summary, considering the overall estimated costs, projected ridership, agency and public input, and potential environmental impacts associated with implementing passenger rail within in the corridor alternatives, a passenger rail system within the Yellow Corridor Alternative is considered to be more cost efficient and better performing than a passenger rail system within the Orange Corridor Alternative, with similar potential impacts to the environment. ADOT recommended the Yellow Corridor Alternative as the preferred alternative in the Tier 1 EIS. Based on that recommendation and the analysis in this EIS, FRA has identified the Yellow Corridor Alternative as the preferred alternative for purposes of NEPA.

7.3.1 Route Options

Within the preferred alternative, optional routings would be considered in Tier 2 studies as potential solutions for addressing concerns. While the preferred corridor alternative follows existing transportation system alignments (such as the UP Railroad), challenges within portions of this corridor may arise during further analysis. The options presented are based on a high-level viability assessment in response to stakeholder input. Existing conditions and environmental consequences for both options are covered under the analyses of the two corridor alternatives in the Tier 1 EIS. **Figure 7-1** shows the entire Yellow Corridor Alternative, including the route options, which together constitute the preferred alternative.

Tempe Options

As a variant of the corridor alternatives studied, a segment of what was the Orange Corridor Alternative could be used in the corridor between Tucson and Phoenix through Tempe. This routing option through Tempe could be used to avoid or minimize the potential use of Section 4(f) resources and/or potential adverse effects to historic properties (**Figure 7-2**).

Pinal County Option

Figure 7-3 shows an optional routing for the Yellow Corridor Alternative in Pinal County. Should an alignment along existing UP ROW or elsewhere within the 1-mile-wide corridor alternative through Pinal County not be feasible, this option would utilize a portion of the Orange Corridor

Alternative along the planned North-South Corridor from I-10 to its intersection with the Copper Basin Railroad, as described earlier in the discussion of the Teal Alternative under **Section 2.3.3**, **Level 3 Screening**.

Figure 7-1. Yellow Corridor Alternative with Route Options

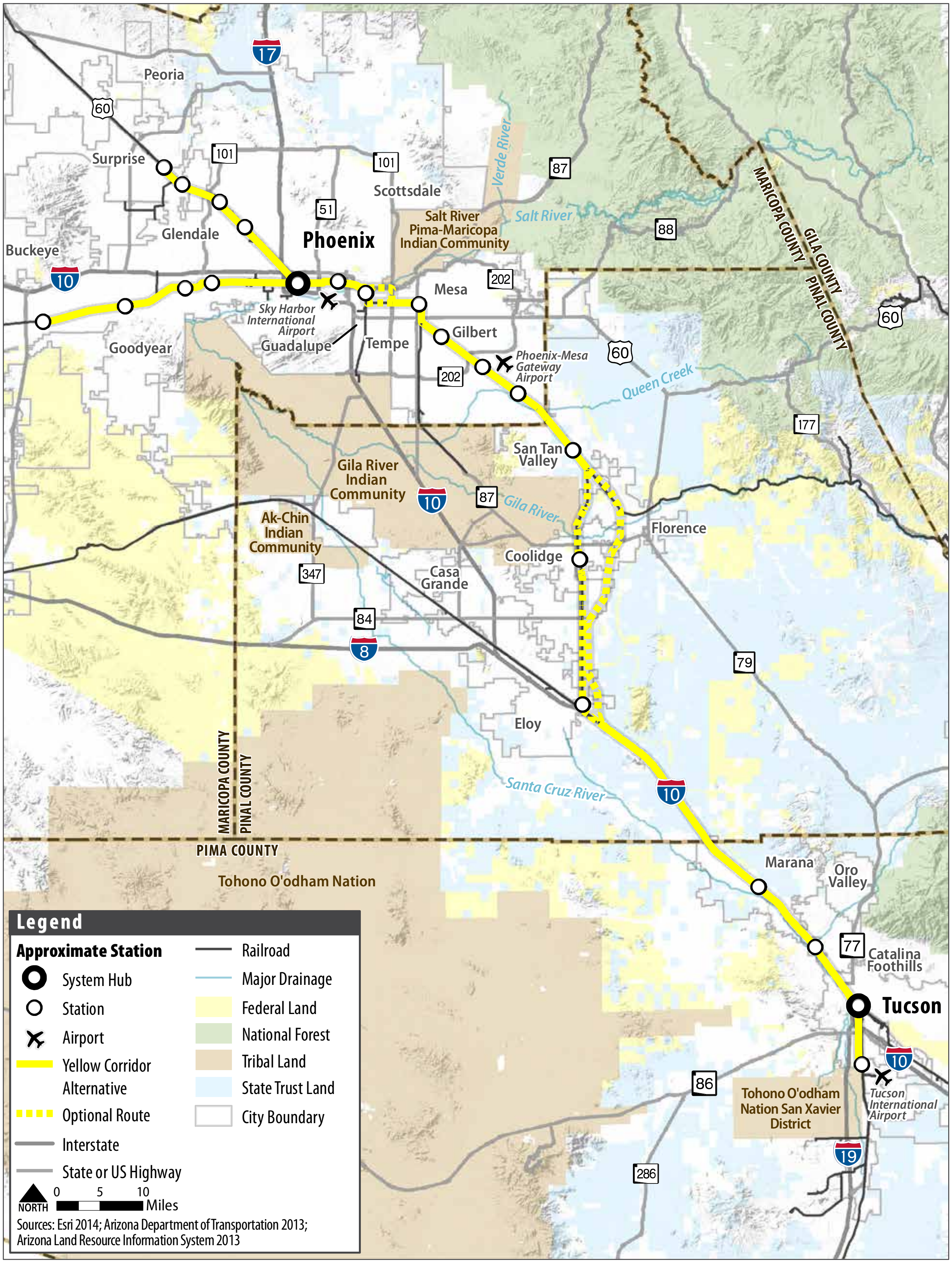


Figure 7-2. Tempe Route Option

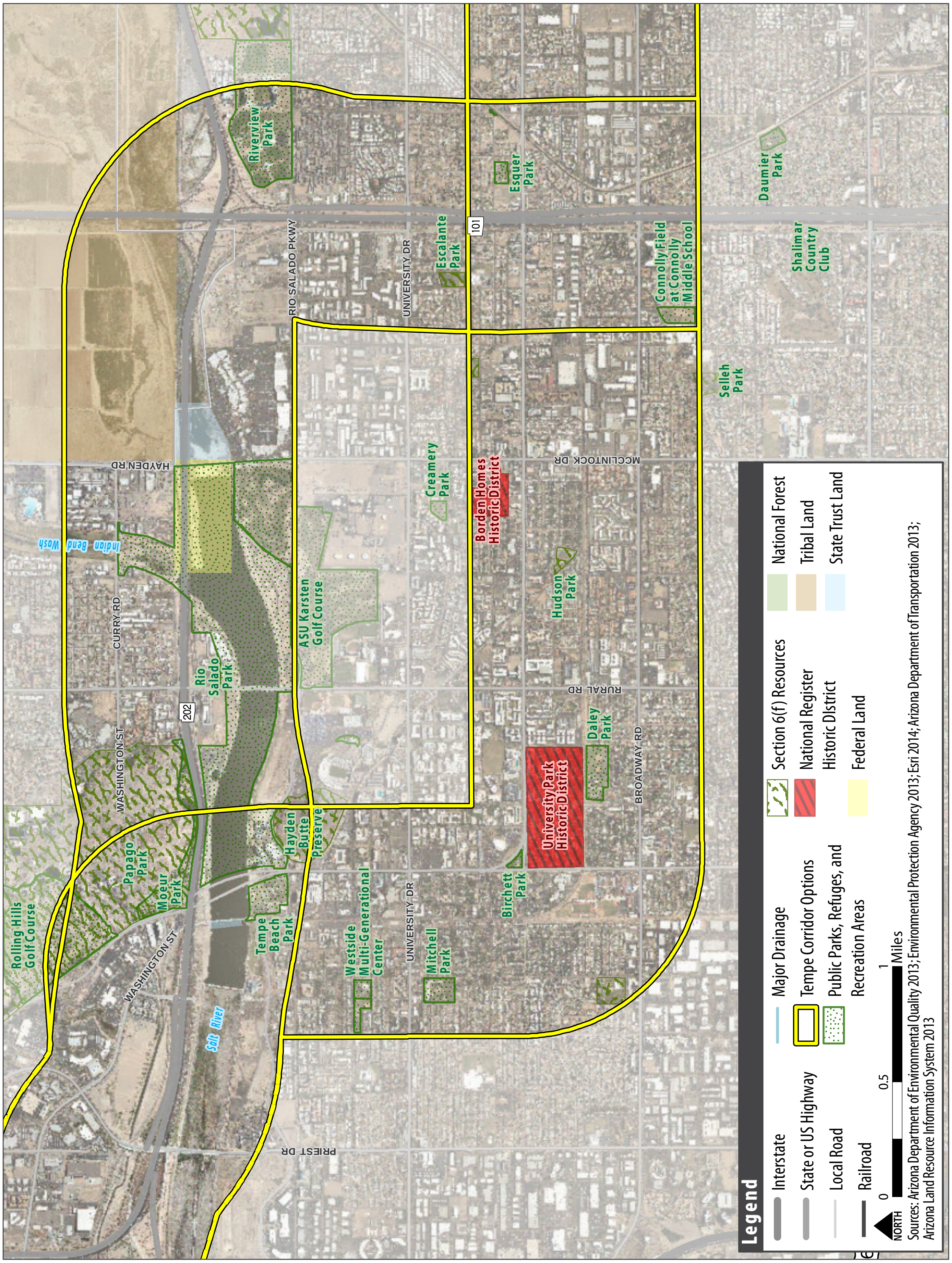
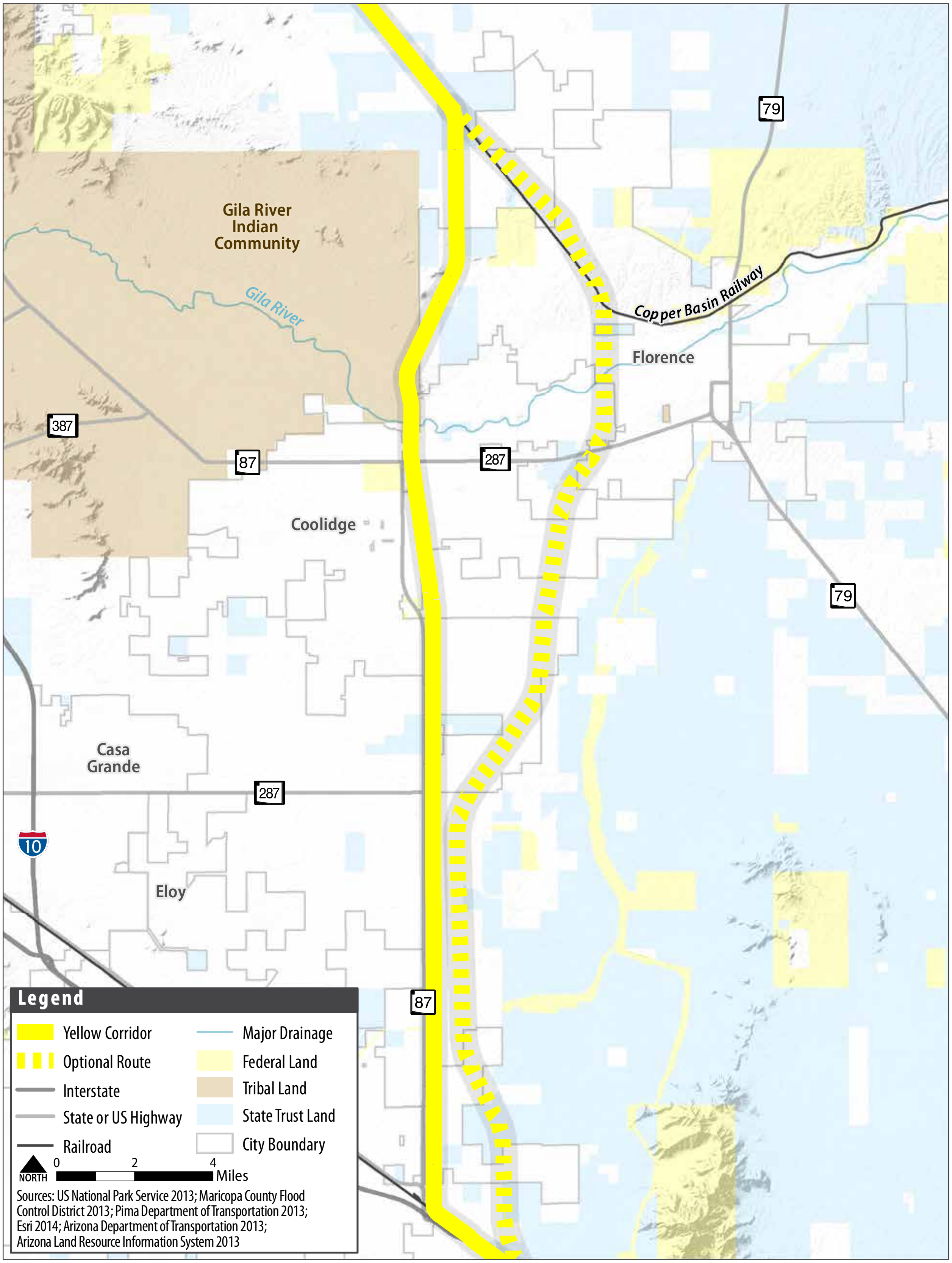


Figure 7-3. Pinal Route Option



8 Next Steps

FRA and ADOT considered public, resource agency, and tribal input during the Tier 1 process. If federal funding or approvals for the identified corridor alternative are needed, Tier 2 NEPA documentation would be completed before final design and construction of any passenger rail facility can occur. This chapter describes the additional analysis required for Tier 2 studies, NEPA documentation, and design needed to advance to the project level.

8.1 Tier 1 Completion

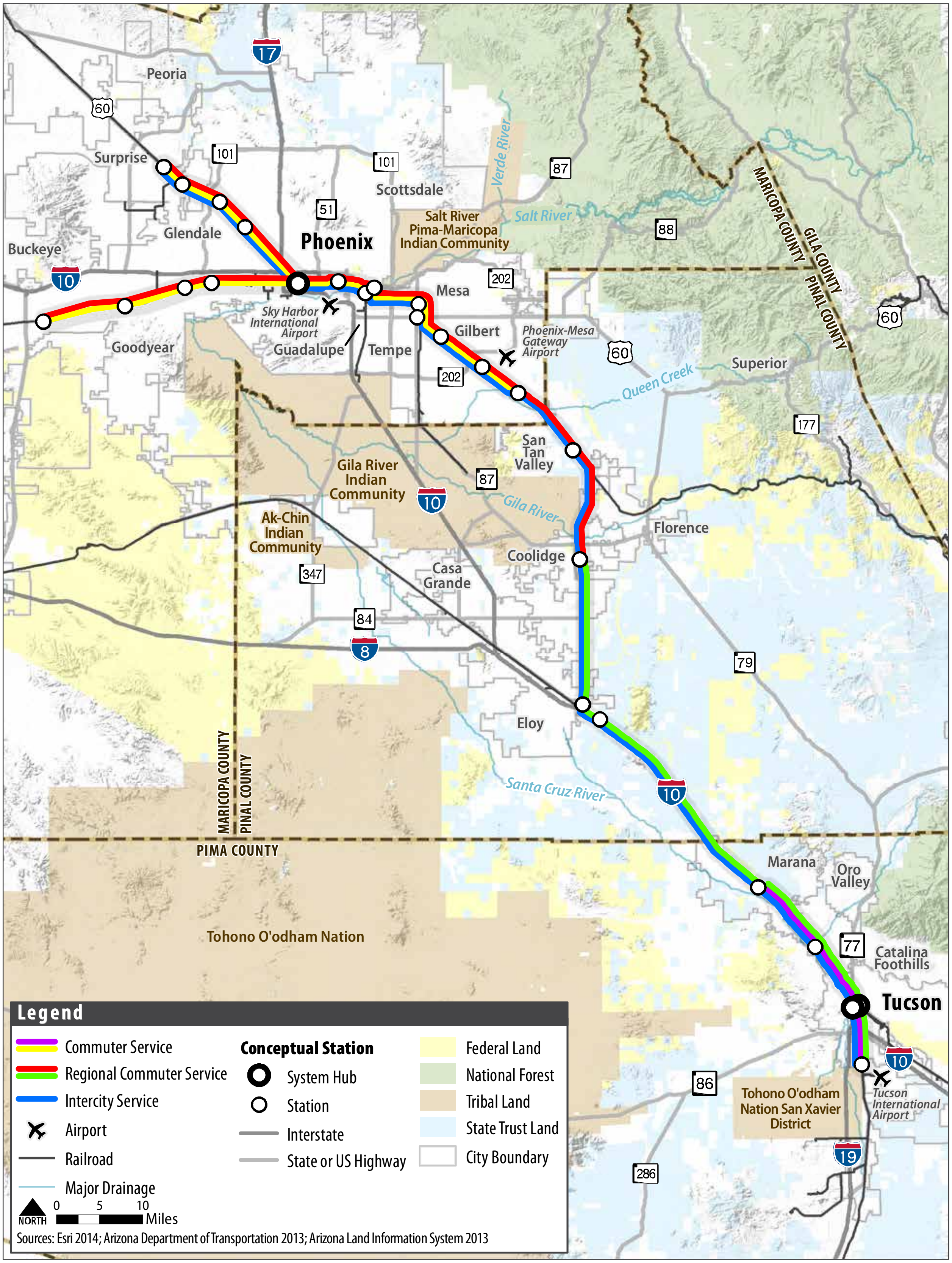
The Draft Tier 1 EIS was issued to solicit input on the corridor alternatives from the public, resource agencies, and tribes. Comments FRA and ADOT received on the Draft Tier 1 EIS during the comment period are addressed in the Final Tier 1 EIS. In part, the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Public Law 112-114) streamlined the NEPA process by allowing DOT agencies to issue a combined Final EIS/Record of Decision (ROD). After the Draft EIS was published, the Fixing America's Surface Transportation (FAST) Act (Public Law 114-94) (Section 1304) was signed into law by President Obama on December 4, 2015 which also allows DOT agencies to issue a combined Final EIS/ROD. The ROD documents the agency's decision and identifies any applicable mitigation measures to be implemented and further studied in subsequent phases.

8.2 Tier 2 Operable Corridor Sections

As funding becomes available, Tier 2 studies and NEPA documentation would be advanced for logical operable sections of a passenger rail system within the preferred corridor alternative. In other words, one or more operable corridor sections that together make up the complete passenger rail system could be developed as individual projects. Any such section would be required to have independent utility with or without construction of other sections. The specific class of NEPA document for more detailed analysis of any Tier 2 section has not yet been defined. Preliminary design and environmental studies would be conducted in support of a Tier 2 analysis. No individual section of a passenger rail system has been identified for implementation, but the following proposed corridor sections, or any other functional configurations deemed viable, could be evaluated as logical, independent sections subject to available funding and the source of that funding. These corridor sections could also be combined, modified, or revisited in the future based on available funding.

Figure 8-1 illustrates a number of possible implementation phases within the preferred corridor to be further studied at Tier 2 as follows:

Figure 8-1. Possible Implementation Phases



- Amtrak Connection– Potential service can be initiated by Amtrak, using existing freight track.
- Tucson to Marana – Commuter service within the Tucson metro area.
- Queen Creek/Santan Valley to Phoenix – Commuter service within the Phoenix metro area.
- Coolidge to Phoenix – Regional commuter service between Pinal County and Maricopa County.
- Coolidge to Tucson – Regional commuter service between Pinal County and Pima County.
- Tucson to Phoenix – Intercity service.

8.3 Additional Studies

During Tier 2, further NEPA analyses will occur to determine the potential impacts of the proposed project. Depending on preliminary design concepts, surveys for special status species and wildlife movement studies may be conducted prior to the initiation of Tier 2 NEPA analyses to inform the Tier 2 analysis. While specific studies and their timelines cannot be identified at this time, coordination with AGFD and USFWS would occur during Tier 2 NEPA scoping to discuss potential effects to wildlife and habitat, and determine the need for preliminary studies and/or surveys.

In addition, coordination and outreach (as needed) would occur during preparation of a Tier 2 analysis to engage the public more fully regarding the effects on property and issues such as design for stations and other railroad facilities. Input from the outreach effort would be incorporated into the NEPA analysis and project design.

Technical studies would be completed as part of the Tier 2 NEPA analysis and tier off of the work conducted in this Final Tier 1 EIS. These studies would provide additional detail regarding the nature and magnitude of potential impacts. The analyses would consider avoidance and minimization of impacts on sensitive environmental resources. For each Tier 2 NEPA analysis, the following project-level analyses may be required:

- Detailed local-level alternatives analysis, including route options identified in Tempe and Pinal County, as shown on **Figure 7-1**, **Figure 7-2**, and **Figure 7-3**;
- Wetland delineations and identification of Section 404 permitting requirements;
- Cultural resource surveys and Section 106 consultation;

- Threatened and endangered species surveys;
- Noise and vibration analysis;
- Section 4(f) evaluation;
- Section 6(f) analysis;
- Phase I Environmental Site Assessments;
- Air emissions analysis in nonattainment areas;
- Station-area traffic studies; and
- Engineering surveys.

8.4 Coordination with Other Studies

To ensure consistency in the planning of the transportation system and to provide alternative mode opportunities in future or expanding corridors under study, the ongoing APRCS will continue to be developed in coordination with other transportation planning studies whenever possible and appropriate. Applicable studies that are currently underway and warrant coordination with the APRCS include the I-11 Tier 1 EIS between Nogales and Wickenburg, and the Sonoran Corridor Tier 1 EIS between I-19 and I-10 south of TUS. In addition, AGFD has requested that ADOT coordinate the APRCS with their analysis of the North-South Corridor's potential impacts, and incorporate those results into the cumulative impacts analysis for this study. As the studies associated with the APRCS continue, coordination of planning efforts with additional studies may also be warranted.

8.5 Mitigation Planning

In addition to the needed studies, site specific mitigation would also be developed during Tier 2. Anticipated types of mitigation include wetland mitigation, seasonal construction restrictions for threatened and endangered species, implementation of stormwater pollution and prevention plans, implementation of best management practices, and documentation of historic structures and other properties. Specific mitigation during the Tier 2 process would be determined in consultation with the federal or state agency with jurisdiction over a given resource. As needed, formal consultation would occur with resource agencies to address obligations to minimize and mitigate impacts, such as those obligations under Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA).

Future phases to implement a passenger rail project would require further consultation between the federal agency, Native American tribes, ADOT, and the Arizona SHPO, as well as other consulting parties, for meeting historic preservation compliance requirements pursuant to Section 106. Depending on funding and phasing of the Tier 2 Projects, Section 106 consultation could be conducted programmatically. The Tier 2 effort would also require analysis under both Section 4(f) of the Department of Transportation Act and Section 6(f) of the Land and Water Conservation Act, and appropriate mitigation would be assessed.

8.6 Project Commitments

This Final Tier 1 EIS identifies potential mitigation measures for each relevant resource section in **Chapter 5, Existing Conditions and Environmental Consequences**. During the Tier 1 EIS process, the primary commitments have been to work with the public, public agencies, resource agencies, and tribes to identify the need for specific mitigation measures to be developed during the Tier 2 process that would be implemented during construction and operation of a passenger rail system.

8.7 Phased Implementation

Based on experience with other passenger rail projects, preliminary service development planning as part of the APRCS, and coordination with other transportation agencies, ADOT anticipates that the passenger rail system would be incrementally funded and that construction and operations would be implemented in phases. Within the approximate 20-year planning horizon specified in the Service Development Plan (SDP), initial and successive phases would be considered through the interim implementation phase, which is the last phase that would be implemented using existing SDP information.

Various potential phases and strategies defined by logical operating segments could be considered to introduce passenger rail services. Some of the options could overlap or be introduced incrementally, building on earlier phases and helping to fund the project progressively.

No individual section of a passenger rail system has been identified for implementation, but the following proposed corridor sections, or any other functional configurations deemed viable, could be evaluated as logical, independent sections subject to available funding and the source of that funding. These corridor sections could also be combined, modified, or revisited in the future based on available funding.

Figure 8-1 illustrates possible implementation phases.

- **Amtrak Connection Strategy** –Arizona working with Amtrak could introduce limited passenger service using Amtrak's existing statutory access to operate passenger rail operations over track owned by the freight railroads. This would require an agreement with UP and a commitment to fund the necessary improvements (i.e., stations, sidings, parking, etc.). Because the service would rely largely on existing freight track, it would be subject to coordination with UP freight activity to minimize impacts on freight movement, which could limit passenger operations. Improvements would be limited to station construction at select locations and ensuring a safe operating environment for passengers at those locations (e.g., double tracking, shelters).

This configuration, extending from Surprise to TUS, would cost approximately $1.1 billion to plan and build, then implement.

- **Growing the Service Strategy** – This approach would introduce passenger service between the two major metropolitan areas using existing UP track north of Picacho (in cooperation with UP) and constructing new track in the ADOT ROW along I-10 south of Picacho to support more frequent passenger service. This option would require coordination with freight activities north of Picacho to minimize conflicts with freight traffic, but would offer transportation benefits at a much higher level of service. This approach to implementation of passenger rail service between the two major metropolitan areas would cost $2.2 billion and could carry about 15,000 passengers once planned and built.
- **Metro Phoenix Phase** – The highest potential level of service in the short term is commuter service from Santan Valley to the Phoenix hub, connecting the major East Valley communities with the potential to carry major passenger loads along the UP freight line in a corridor as yet unserved by passenger rail. This phase could be divided into additional subsections to reduce capital and operating commitments in the short term or to provide additional time to develop solutions to constraints within the corridor. This is the most challenging of the phases from a construction perspective, due to the urban nature of the corridor, as reflected by the estimated cost of $1.5 billion for the 45-mile segment. It is also the most likely to generate ridership and effectively complement other transportation options.

  Connections to Surprise (on BNSF infrastructure) and Buckeye (on UP infrastructure) west of the Phoenix hub would provide access to an additional potential ridership base. These approximately 52 additional miles of service would add about $1.3 billion to the total capital cost. The total could be reduced in the short term by building no connections, only one of the connections, or limiting service only to stations that generate significant ridership.

  Phoenix Metro 1 proposes to connect the Santan Valley with both Surprise and Buckeye. Phoenix Metro 2 would initially connect downtown Phoenix with Surprise only, deferring a connection to Buckeye until a later time. Metro Phoenix phases have not been subject to many of the studies conducted for the Tucson to Phoenix proposal and would require all necessary design work, evaluation of rights of way and utilities, preliminary engineering, etc. These phases are assumed to be considered in any future regional transportation funding source initiatives, in addition to any federal funding for which they might qualify or private funding they might attract.

- **Metro Tucson Phase** – Commuter service in the Tucson metro area between Marana and Tucson could follow the I-10 freeway from Marana to south of Grant Road, and UP from Grant Road into downtown Tucson. While relatively straightforward from a construction perspective, this phase would require a series of decisions related to local impacts to the existing transportation system along I-10 and downtown. Building a passenger rail system between Marana and Downtown Tucson is estimated to cost approximately $900 million. Depending on the approach taken to project phasing and funding, this segment is also included in the **Growing the Service Phase** as part of the new track south of Picacho. A connection to TUS would pass through a largely urban industrial community. This effort is estimated to bring the cost for the approximately 7-mile connection to TUS estimated at $255 million.

  The Metro Tucson Phase would require a local or private funding source in addition to any federal funding that may apply.

- Intercity Phase – This phase would join the two commuter phases in the Phoenix and Tucson Metro areas with a 58-mile link, allowing a high level of intercity service. This element of the project could be developed sooner, depending on how the region evolves over the next 10 to 15 years. Intercity rail service is a highly popular feature of the project and would afford a critical link in the system that could provide passenger rail access to many growing Pinal and Pima County communities. It is also the phase that could support the highest speed performance along the line. The Picacho to Tucson section of this phase is included in the **Growing the Service Phase**. The link between Santan Valley and Picacho would cost about $600 million.

  As currently defined, the full Intercity Phase would cost about $1.5 billion, subject to available funding.

The specific phasing of a future passenger rail system would be determined as funding becomes available. Funding could be initially allocated for improvement of facilities to support higher speeds or to improve/construct particular stations and maintenance and layover facilities on existing freight railroads. Traditional and potential alternative funding sources include USDOT grant programs, federal loan programs, and public-private partnerships. Service could initially start with fewer stations and with fewer round trips. As more funding becomes available, further construction could be implemented to expand service. The specific phasing of the passenger rail system is not known at this time but would be determined as funding is allocated and as part of Tier 2 NEPA review.

8.7.1 Station Locations and Airport Access

Station Locations

This Tier 1 EIS does not identify specific station locations for analysis. Conceptual locations were included in the AA to provide a basis for corridor definition and ridership forecasting. As part of the AA, various station typologies were developed to provide context for station decision-making and local commitments; however, the exact locations of stations would require more analysis and further agency and community input. These would be part of independent localized studies and a Tier 2 NEPA document for a passenger rail facility.

Airport Connections

Throughout the development of the Arizona Passenger Rail Corridor Study Tier 1 EIS corridor analyses, the public and stakeholder agencies identified airport access as an important consideration among their preferences as a feature of future passenger rail service.

All three major airports in the study corridor – Tucson International Airport (TUS), Phoenix-Mesa Gateway Airport (AZA), and Sky Harbor International Airport (PHX) – could have connections to a future passenger rail line, but a detailed evaluation of specific alignments, impacts, or other implications of how these connections would be accomplished was not a part of this study. These analyses would be undertaken as part of future studies.

ADOT recommends the Yellow Corridor Alternative for future Tier 2 environmental studies. Likewise, ADOT and the FRA recommend studying passenger rail connectivity to TUS for future Tier 2 studies.

As noted previously, ADOT anticipates that a Tucson-to-Phoenix passenger rail system would be funded incrementally, and that construction and operations would be implemented in phases. The specific phasing of a future passenger rail system is not known at this time but would be determined as funding is allocated and as part of the Tier 2 NEPA review.

List of Preparers and Reviewers

This Tier 1 EIS was prepared and reviewed by numerous professionals comprising the Arizona Passenger Rail Corridor Study team.

Federal Railroad Administration

The following FRA staff was responsible for overall project management, technical direction, and review of the Tier 1 EIS.

Name	Title	Project Role/ Responsibilities
Andréa Martin	Environmental Protection Specialist	Project oversight and review
Kyle Gradinger	Transportation Industry Analyst	Project oversight and review
Michael Johnsen	Supervisory Environmental Protection Specialist	DEIS Reviewer
Christopher Van Nostrand	Regional Counsel	DEIS Reviewer

Federal Transit Administration

The following FTA staff was responsible for technical direction and review of the Tier 1 EIS.

Name	Title	Project Role/ Responsibilities
Alexander Smith	Community Planner	DEIS reviewer
Daniel Koenig	Environmental Protection Specialist	DEIS reviewer
Brian Jackson	Environmental Protection Specialist	DEIS reviewer

Federal Highway Administration

The following FHWA staff was responsible for technical direction and review of the Tier 1 EIS.

Name	Title	Project Role/ Responsibilities
Rebecca Yedlin	Environmental Coordinator	DEIS reviewer
Romare Truly	Community Planner	DEIS reviewer
Aaron Williams	Safety PDP	DEIS reviewer
Tremaine Wilson	Environmental Coordinator	DEIS reviewer
Aryan Lirange	Senior Urban Engineer	DEIS reviewer
Tom Deiterling	Project Delivery Team Leader	DEIS reviewer
Alan Hansen	Planning, Environment, Air Quality, and Realty Team Leader	DEIS reviewer

Arizona Department of Transportation

The following Arizona Department of Transportation staff was responsible for technical direction and review of the Tier 1 DEIS.

Name	Qualifications/Background	Project Role/ Responsibilities
Mike Kies	BS Civil Engineering; 25 years of experience	Project Manager Multimodal Planning Division
Thor Anderson	25 years of experience	PEL Manager Multimodal Planning Division
Carlos Lopez	BSE Civil Engineering; 7 years of experience	Deputy Project Manager Multimodal Planning Division
Ruth Greenspan	PhD Anthropology/New World Archaeology; 37 years of experience	Section 106, Cultural Resource Management Technical Reviewer
Linda Davis	BA Anthropology; 10 years of experience	Cultural Resources Reviewer Historic Preservation Team
Erin Bodine	MA Urban and Environmental Planning; BA Anthropology; 4 years of experience	Cultural Resources Reviewer Historic Preservation Team
Darcy Anderson	MS Meteorology, MS Hydrology; 25 years of experience	Air Quality, Noise and Vibration Reviewer
Ronald Tiller	PhD Plant Biology; BS Zoology; 31 years of experience	Biology Reviewer Environmental Planning Group
Julia Manfredi	MS Environmental Pollution Control; BS Environmental Science; 11 years of experience	Water Quality Section 404 Reviewer

Jacobs Engineering Group

The following Jacobs staff were responsible for directing and authoring the Environmental Impact Statement and notices, gathering data, and analyzing and reporting potential impacts of a passenger rail system on the natural, built, and social environment.

Name	Qualifications/Background	Project Role/ Responsibilities
Jack Allen	BA Recreation and Parks—Wildlife Management/Forestry; 28 years of experience	Tier 1 EIS project director

Name	Qualifications/Background	Project Role/ Responsibilities
Anthony Scolaro	MUP Urban/Environmental Planning; BA English; AICP CEP; 21 years of experience	Tier 1 EIS project manager and primary author
Beth Defend	BA Technical Journalism; 32 years of experience	Tier 1 EIS peer reviewer and author; Indirect and cumulative impact analysis
Betsi Phoebus	MEP Landscape and Ecological Planning; BA History; 14 years of experience	Tier 1 DEIS QA/QC reviewer; Section 4(f) and 6(f) resources, parklands, waters of the U.S., and wetlands impact analyses
Lauren Abom	MS Environmental Education; BS Environmental Resource Science; 15 years of experience	Land use impact analysis
Jennifer Zankowski	MS Community and Regional Planning; BS Human Ecology; 9 years of experience	Socioeconomic impact analysis; environmental justice impact analysis
Jewel Touchin	BA Anthropology; 20 years of experience	Cultural resources impact analysis
Mark Chenault	PhD Anthropology; MBA; MA Anthropology; BA Anthropology; RPA; 32 years of experience	Senior reviewer, cultural resources impact analysis
Jill Harris	MEP Environmental Planning; MS Environmental Resources; BS Wildlife and Fisheries Biology; AICP; 19 years of experience	Biological resources data collection and impact analysis
Bruce Palmer	Graduate studies Biology; BS Biology; 35 years of experience	Biological resources impact analysis
James Hoyt	BS Forest Service; 22 years of experience	Energy use and climate change impact analysis
Sean Watkins	MUEP; BA Anthropology; 10 years of experience	Water quality, geology/topography /soils/ prime and unique farmland, and public health and safety impact analyses
Joe D’onofrio	MEP; BSME; 25 years of experience	Noise and vibration impact analysis; peer reviewer, air quality impact analysis

Name	Qualifications/Background	Project Role/ Responsibilities
Phillip Peters	MS Biology; BA Biology; 15 years of experience	Water quality impact analysis
Dana Ragusa	BS Environmental Studies; 15 years of experience	Air quality impact analysis; hazardous materials impact analysis; peer reviewer, noise and vibration impact analysis
Diane Yates	BS Landscape Architecture; 33 years of experience	Senior reviewer, visual and aesthetic resources impact analysis
Aliina Fowler	MURP; BS Community Development and Applied Economics; BA Political Science; 3 years of experience	Visual and aesthetic resources impact analysis
Linda St. John	8 years technical editing and desktop publishing experience	Technical editor; document formatting and quality control
Jeremiah Johnston	M. Divinity; M. Theology; BA Communications Studies; 10 years writing and editing experience	Managing editor; style manual author
Phyllis Davis	MAS-GIS; BA Geography; 8 years of experience	GIS/data collection and analysis
Srdjan Todorovic	BS Urban Planning; GIS Certificate; 3 years of experience	GIS/cartography
Kyle Benne	BA Geology; MS Urban Planning 1 year of experience	GIS/cartography

Parsons Brinckerhoff

The following Parsons Brinckerhoff staff were responsible for program management and oversight, alternatives analysis, and technical direction of the Arizona Passenger Rail Corridor Study.

Name	Qualifications/Background	Project Role/ Responsibilities
Steve Hogan	MS Administration; MS Transportation Engineering; BS Engineering; PE; 36 years of experience	APRCS program manager; alternatives analysis; public and agency coordination; transportation impacts; comparison of alternatives; next steps

Name	Qualifications/Background	Project Role/ Responsibilities
Jennifer Love	M Urban & Environmental Planning, Transportation & Sustainability; BS Civil Engineering, Transportation; PE, AICP, LEED AP; 15 years of experience	APRCS program coordinator; alternatives analysis; public and agency coordination transportation impacts; cost analysis
Scott Pitera	M Urban Planning, Transportation; BS Urban & Regional Planning; AICP; 5 years of experience	Alternatives analysis; public and agency coordination; transportation impacts; comparison of alternatives

Central Creative

The following Central Creative staff were responsible for public outreach and media coordination for the Arizona Passenger Rail Corridor Study.

Name	Qualifications/Background	Project Role/ Responsibilities
Kristin Darr	BA Political Science and Journalism; 23 years of experience	Public and agency coordination
Amy Rosar	BS Business Administration/Finance; 8 years of experience	Public and agency coordination
Jared Sterlace	BS Business Administration/Marketing; 3 years of experience	Public and agency coordination

HDR

The following HDR staff were responsible for transportation demand modeling for the Arizona Passenger Rail Corridor Study.

Name	Qualifications/Background	Project Role/ Responsibilities
Scott Miller	M Public Administration; BS Urban Planning; 20 years of experience	Transportation impacts – modeling; alternatives analysis
Vijay Mahal	PhD Civil Engineering; M Transportation Engineering; M Civil Engineering; PE; 30 years of experience	Transportation impacts – modeling; alternatives analysis
Nicholas Karcz	BS Urban Planning; 10 years of experience	Transportation impacts – modeling; alternatives analysis

URS

The following URS staff were responsible for cost estimating for the Arizona Passenger Rail Corridor Study.

Name	Qualifications/Background	Project Role/ Responsibilities
Kammy Horne	MS Urban Planning; BS Environmental Planning/ NEPA Compliance and Transportation Planning; AICP; 20 years of experience	Cost analysis
Jennifer Pyne	MEP Environmental Planning; BA Politics/ NEPA Compliance and Transportation Planning; AICP; 17 years of experience	Cost analysis
John Donovan	BS Civil Engineering / Railroads and Surface Transportation; PE; 26 years of experience	Cost analysis
James Kollbaum	BS Civil Engineering /MS Civil Engineering / Traffic, Transit and Surface Transportation; PE; 18 years of experience	Cost analysis

AECOM

The following AECOM staff were responsible for land use advocacy and transit planning for the Arizona Passenger Rail Corridor Study.

Name	Qualifications/Background	Project Role/ Responsibilities
John McNamara	Graduate Studies in Urban Design; B Architecture; AICP; 40 years of experience	Alternatives analysis
Vijayant Rajvanshi	MS Urban & Regional Planning; B Planning; AICP; 10 years of experience	Alternatives analysis

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