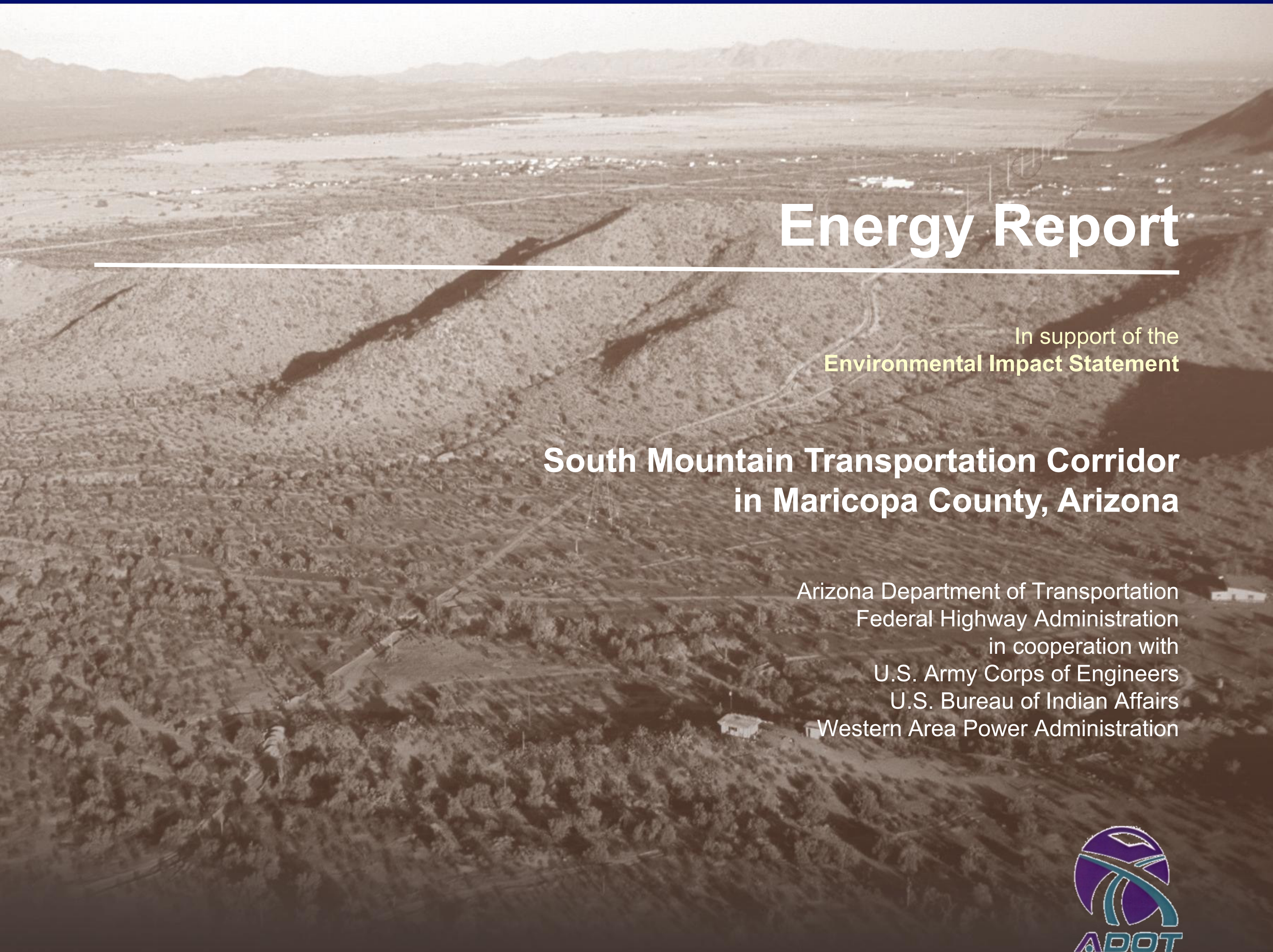
South Mountain corridor team



Energy Report

In support of the
Environmental Impact Statement

South Mountain Transportation Corridor in Maricopa County, Arizona

Arizona Department of Transportation
Federal Highway Administration
in cooperation with
U.S. Army Corps of Engineers
U.S. Bureau of Indian Affairs
Western Area Power Administration

ADOT

November 2012

Federal-aid Project Number: NH-202-D(ADY)
ADOT Project Number: 202L MA 054 H5764 01L

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Abstract: This document assesses and describes the effects on energy that would result from the construction and operation of the proposed South Mountain Freeway as adopted in the 2003 *Regional Transportation Plan*. Contents of this document will be presented in Chapter 4 of the South Mountain Transportation Corridor Environmental Impact Statement.

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List of Acronyms and Abbreviations

ADOT	Arizona Department of Transportation
C	Central
E	Eastern
E1	E1 Alternative
EIS	environmental impact statement
FR	Full Reconstruction
I-10	Interstate 10
MAG	Maricopa Association of Governments
mpg	miles per gallon
mph	miles per hour
PR	Partial Reconstruction
SMTC	South Mountain Transportation Corridor
SR	State Route
TI	traffic interchange
VHT	vehicle hours traveled
VMT	vehicle miles traveled
W101CFR	W101 Alternative, Central Option, Full Reconstruction
W101CPR	W101 Alternative, Central Option, Partial Reconstruction
W101EFR	W101 Alternative, Eastern Option, Full Reconstruction
W101EPR	W101 Alternative, Eastern Option, Partial Reconstruction
W101WFR	W101 Alternative, Western Option, Full Reconstruction
W101WPR	W101 Alternative, Western Option, Partial Reconstruction
W	Western
W59	W59 Alternative
W71	W71 Alternative

Glossary

affected environment	Those elements of the Study Area that may be changed by the proposed alternatives. These changes might be positive or negative in nature.
Arizona Department of Transportation (ADOT)	The State agency responsible for state roads and highways.
capacity	The maximum number of vehicles that a given section of roadway or traffic lane can accommodate.
direct impact	A change caused by the action that occurs at the same time and same place as the action.
Eastern Section	The portion of the Study Area located east of 59th Avenue.
environmental impact statement (EIS)	The project documentation prepared in accordance with the National Environment Policy Act when the project is anticipated to have a significant impact on the environment.
mitigation	An action taken to reduce or eliminate an adverse impact stemming from construction, operation, or maintenance of a proposed action alternative. Mitigation could reduce the magnitude and extent of an impact from a level of significance to a level of insignificance. Mitigation includes *avoiding* the impact altogether by not taking a certain action or parts of an action; *minimizing* impacts by limiting the degree of magnitude of the action and its implementation; *rectifying* the impact by repairing, rehabilitating, or restoring the affected environment; *reducing or eliminating* the impact over time by preservation and maintenance operations during the life of the action; and *compensating* for the impact by replacing or providing substitute resources or environments. (40 Code of Federal Regulations § 1508.20)
secondary impact	A change caused by the action that is later in time or farther removed in distance, but is still reasonably foreseeable. Secondary, or indirect, impacts 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.
Study Area	The geographic area within which action alternative solutions to the problem are developed.
Western Section	The portion of the Study Area located west of 59th Avenue.

1. Project Description and Purpose and Need

Project Description

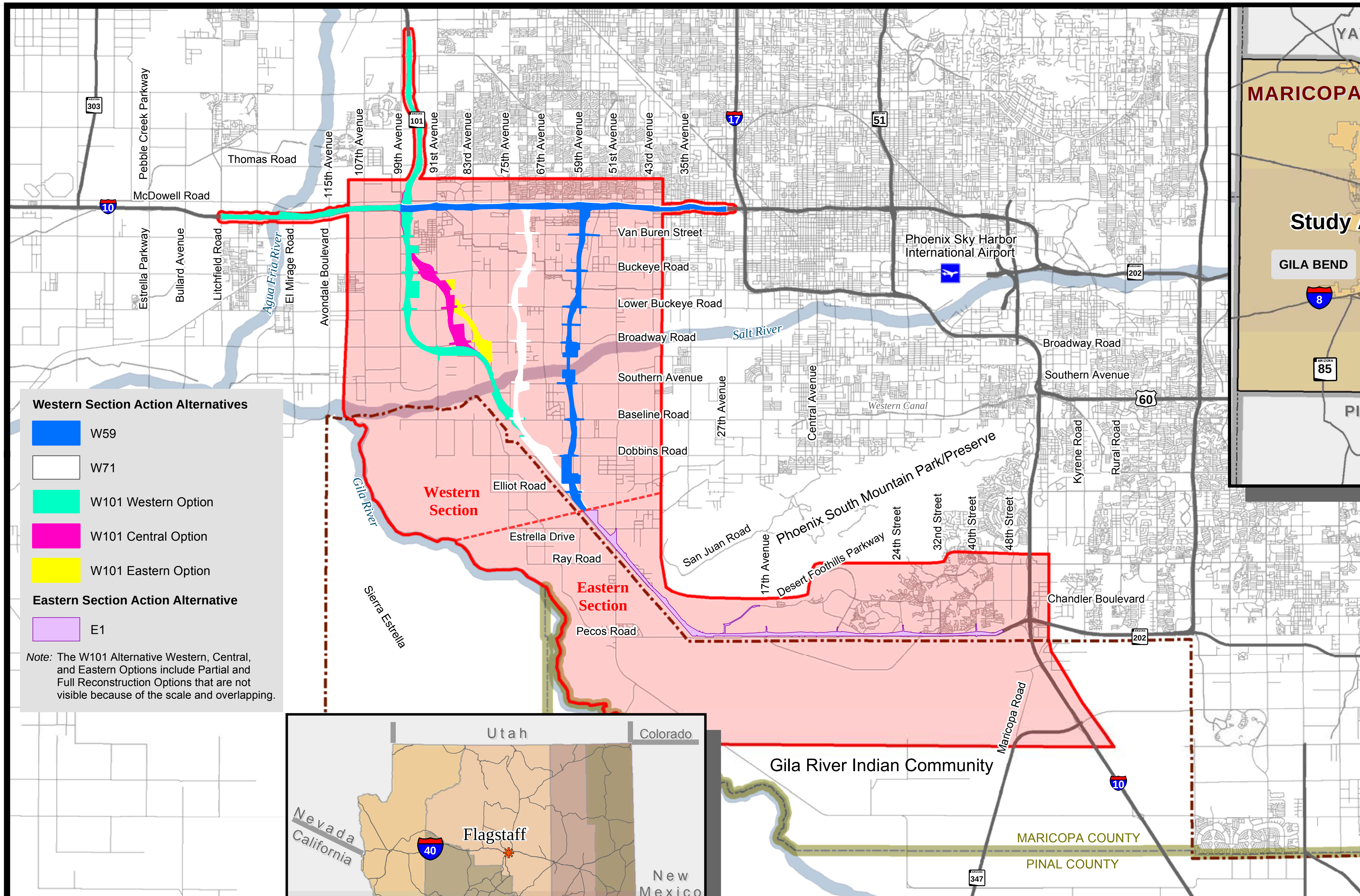
The Arizona Department of Transportation (ADOT) is studying the South Mountain Transportation Corridor (SMTC) in southern Phoenix, Maricopa County, Arizona. The South Mountain Freeway corridor was adopted into the Maricopa Association of Governments (MAG) regional freeway system in 1985 as part of the *MAG Freeway/Expressway Plan* (MAG 1985), at which time it was placed on the state highway system by the State Transportation Board. In 1988, ADOT prepared a design concept report and a state-level environmental assessment for the project, identified at that time as the South Mountain Parkway (ADOT 1988a, 1988b). As presented then, the project would connect Interstate 10 (I-10) (Maricopa Freeway) south of Phoenix with I-10 (Papago Freeway) west of the city, following an east-to-west alignment along Pecos Road through the western tip of the Phoenix South Mountain Park/Preserve, then north to I-10 between 59th and 99th avenues. Because of the time elapsed since those documents were approved and to secure eligibility for federal funding for a proposed project within this corridor, ADOT and the Federal Highway Administration are now preparing an environmental impact statement (EIS) in accordance with the National Environmental Policy Act. In November 2004, the MAG *Regional Transportation Plan* (2003) was placed before Maricopa County voters, who approved the sales tax funding the plan. The South Mountain Freeway was included in this plan.

Alternatives considered for the SMTC included past freeway proposals as well as transportation system management, transportation demand management, transit improvements, arterial street network improvements, and land use controls. A freeway facility was determined to best address the project purpose and need. Therefore, this report discusses the potential impacts of a proposed freeway in the SMTC.

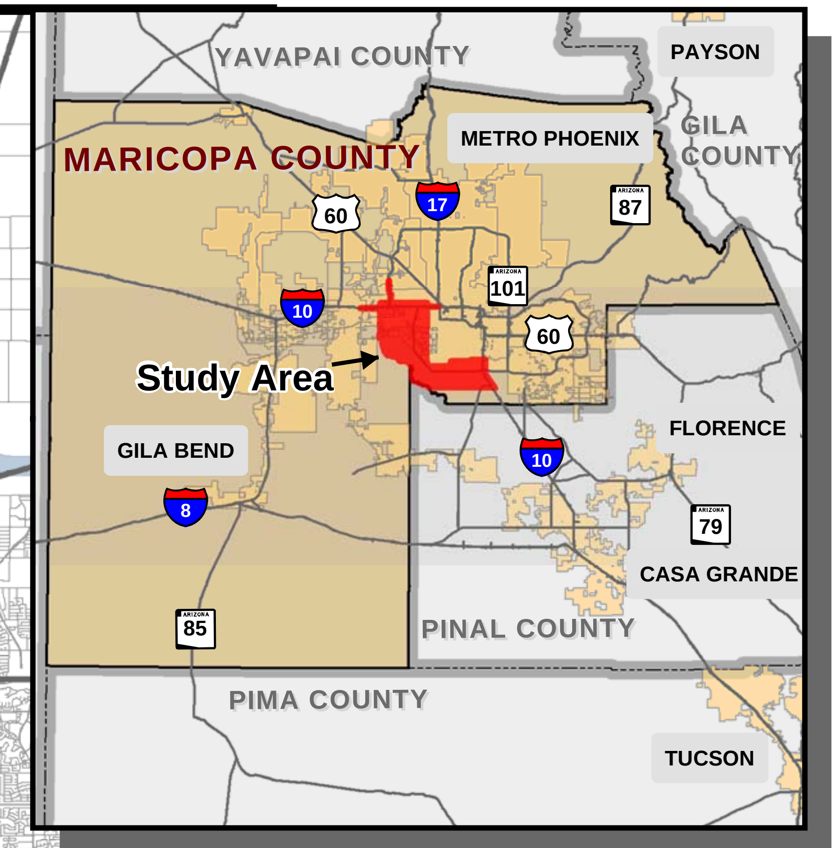
The Study Area for the EIS encompasses more than 156 square miles and is divided into a Western Section and an Eastern Section at a location common to all action alternatives (Figure 1). The division between sections occurs just east of 59th Avenue and south of Elliot Road.

Within the Western Section, three action alternatives are being considered for detailed study. These are the W59, W71, and W101 Alternatives. The W59 Alternative would connect to I-10 at 59th Avenue, while the W71 Alternative would connect at 71st Avenue. The W101 Alternative would connect to I-10 at the existing State Route (SR) 101L (Agua Fria Freeway)/I-10 system traffic interchange (TI) and has six associated options. The W101 Alternative options vary geographically among the Western (W), Central (C), and Eastern (E) Options and would vary geometrically based on a Partial Reconstruction (PR) or a Full Reconstruction (FR) of the system TI.

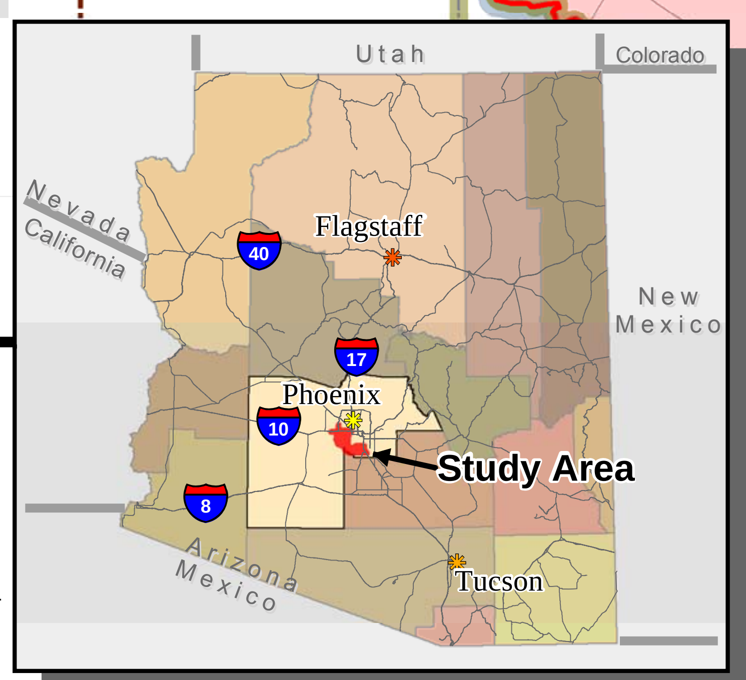
Improvements to I-10 (Papago Freeway) would occur for each Western Section action alternative (W59, W71, and W101). Improvements to SR 101L would occur for each option associated with the W101 Alternative.



Study Area and action alternatives



Location in county



Location in state

N

South Mountain Transportation Corridor
Federal-aid Project Number: NH-202-D(ADY)
ADOT Project Number: 202L MA 054 H5764 01L

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Figure 1

Study Area and Action Alternatives

Within the Eastern Section of the Study Area, one action alternatives is being considered. The E1 Alternative would begin near Elliot Road and 59th Avenue and proceed to the southeast to Pecos Road, which it would follow to the east until connecting to I-10 (Maricopa Freeway) at the Pecos Road/I-10/SR 202L (Santan Freeway) system TI.

The action alternatives and options are summarized in Table 1.

Table 1. Action Alternatives and Options

Section	Interstate 10 Connection	Action Alternative	Option – Broadway Road to Buckeye Road	Option – State Route 101L/ Interstate 10 Connection Reconstruction	Option Name
Western	59th Avenue	W59	—[a]	—	—
	71st Avenue	W71	—	—	—
	State Route 101L	W101	Western	Partial Reconstruction	W101WPR
				Full Reconstruction	W101WFR
			Central	Partial Reconstruction	W101CPR
				Full Reconstruction	W101CFR
			Eastern	Partial Reconstruction	W101EPR
				Full Reconstruction	W101EFR
Eastern	Pecos Road	E1	—	—	—

[a] not applicable

The No-Action Alternative is being considered for the entire Study Area.

Purpose and Need

An analysis of population trends, land use plans, and travel demand shows that a considerable traffic problem in the Phoenix metropolitan area is projected for the future, resulting in the need for a new freeway in the SMTC. This traffic problem is likely to worsen if plans are not made to accommodate the regional travel anticipated. The purpose of a freeway within the SMTC is to support a solution to traffic congestion. Between the early 1950s and the mid-1990s, the metropolitan area grew by over 500 percent, compared with approximately 70 percent for the United States as a whole (MAG 2001). From 1980 to 2005, the Maricopa County population more than doubled, from 1.5 million to 3.7 million. The MAG region has been one of the fastest-growing metropolitan areas in the United States; Phoenix is now the fifth-largest city in the country, and the region ranks as the 12th-largest metropolitan area in the country.

Travel demand and vehicle miles driven in the metropolitan area are expected to increase at a faster rate than the population. MAG projections (conducted in collaboration with the Arizona Department of Economic Security) indicate Maricopa County's population will increase from 3.7 million in 2005 to

6.5 million in 2035 (MAG 2007a, 2009). It is projected that in the next 25 years, daily vehicle miles traveled will increase from 101 million to 185 million.

Even with anticipated improvements in light rail service, bus service, trip reduction programs, and existing roads and freeways, vehicle traffic volumes are expected to exceed the capacity of Phoenix metropolitan area streets and highways by as much as 11 percent in 2035. A freeway within the SMTC would accommodate approximately 6 percentage points of the 11 percent of the unmet travel demand and would be part of an overall traffic solution.

2. Affected Environment

This section discusses the energy that would be used in the region for the No-Action and action alternatives. Primary energy use would be fossil fuel for consumption by vehicles traveling within and around the Study Area. Other energy use would be associated with construction and development activities. Fuel would be consumed during the planned construction of new arterial streets, freeways, and other roads identified in the *Regional Transportation Plan* and regional transportation programs. Also, fuel would be consumed during the construction of planned commercial developments, industrial buildings, and residential neighborhoods throughout the Study Area and surrounding region.

Operational energy use was calculated using vehicle miles traveled (VMT) and vehicle hours traveled (VHT) projections from the MAG travel demand model, vehicle mix percentages from Maricopa County vehicle registration records, and fuel economy data from the Energy Information Administration.

The average fuel economy of the nation's vehicles, commonly measured in miles per gallon (mpg), has been consistently improving over the past 40 years, and this trend is expected to continue during the next 20 years. Barring a technological breakthrough in the engines providing power to the vehicles of 2035, a substantial change in fuel economy is unlikely and, therefore, not assumed in the analysis. The average fuel economy of a passenger car in the United States in 1987 was 18 mpg, and 20 years later in 2007, it was 22.5 mpg (Energy Information Administration 2009). Automobiles are most efficient when operating at steady speeds between 45 and 55 miles per hour (mph) with no stops (Oak Ridge National Laboratory 2002; U.S. Department of Transportation 1983). Fuel consumption increases by approximately 30 percent when speeds drop from 30 mph to 20 mph, and a drop from 30 mph to 10 mph results in a 100 percent increase in fuel use. Similarly, fuel consumption increases by approximately 17 percent as speeds increase from 55 mph to 70 mph.

Total fuel consumption in the United States has consistently risen from year to year. From 1987 to 2007, motor vehicle fuel consumption increased from 125 to 176 billion gallons per year in the United States, and the state of Arizona consumed 3.8 billion gallons per year, or 2 percent of the 2007 total (Bureau of Transportation Statistics 2009). Increased congestion on freeways and arterial streets has become a major contributor to the increase in fuel consumption. The *2007 Urban Mobility Report* (Texas Transportation Institute 2007) reported that vehicles in the Phoenix urban area consumed approximately 59 million gallons of fuel in 2007 because of congestion.

3. Environmental Consequences

Energy impacts for the action and No-Action alternatives are presented in the following section. Also discussed are secondary and cumulative impacts.

Direct Impacts Associated with the Action and No-Action Alternatives

Construction activities for any of the action alternatives would have similar fuel commitments. While the No-Action Alternative would not need fuel for construction, other road projects and improvements would need to be developed in the Study Area to accommodate the region's growth. Construction energy use is not addressed in further detail because the total fuel needed for construction of the action alternatives was assumed to be essentially the same as the total fuel needed for construction of other road projects under the No-Action Alternative.

Operational energy use was calculated by dividing the yearly VMT projections for each of the action alternatives and for the No-Action Alternative by the fuel economy of the different classes of vehicles. The analysis included light-duty cars, light-duty trucks, and heavy-duty trucks and buses, which have average fuel economies of 22.5 mpg, 18 mpg, and 5.9 mpg, respectively (Energy Information Administration 2009). Fuel economies were adjusted for each alternative based on the projected average speed (mph), and were calculated by dividing the VMT by the VHT. The source of the traffic projections for 2035 was the MAG regional travel demand model (MAG 2010). Table 2 presents the projected daily VMT and VHT for the region, along with the calculated average speed for each alternative.

Table 2. Projected Daily Travel in the MAG Region, by Alternative, in 2035

Alternative	Vehicle Miles Traveled	Vehicle Hours Traveled	Average Speed[a] (miles per hour)
No-Action	183,941,402	5,206,408	35.3
W59/E1	185,399,004	5,156,554	36.0
W71/E1	185,334,591	5,156,362	35.9
W101/E1	185,388,605	5,154,438	36.0

Source: data extrapolated from Maricopa Association of Governments travel demand model (2010)
[a] average speed = vehicle miles traveled divided by vehicle hours traveled (VMT/VHT)

The derivation of fuel economies for each alternative assumed that the average efficiency for each vehicle type occurred at 40 mph. A linear decrease in efficiency was assumed between 40 mph and the average speed for each alternative. The resulting fuel efficiencies for each vehicle type by alternative are presented in Table 3.

Table 3. Projected Fuel Efficiency, by Vehicle Type and Alternative, in 2035

Alternative	Average Speed (miles per hour)	Fuel Efficiency[a] (miles per gallon)		
		Passenger Cars	Light-duty Trucks	Heavy-duty Trucks and Buses
No-Action	35.3	19.9	15.9	5.2
W59/E1	36.0	20.2	16.2	5.3
W71/E1	35.9	20.2	16.2	5.3
W101/E1	36.0	20.2	16.2	5.3

[a] fuel efficiency = average speed (in mph) multiplied by the base fuel economy/40 (mph)

Vehicle mix data were derived from Maricopa County vehicle registrations as projected by MAG through 2035. Gasoline and diesel vehicles for all classes were combined. Buses were added to the heavy-duty trucks category. Motorcycles, alternative fuel vehicles, and electric vehicles were assumed to have an insignificant contribution. The vehicle mix used in the analysis was 67.9 percent passenger cars, 17.2 percent light-duty trucks, and 14.9 percent heavy-duty trucks and buses (MAG 2007b).

The annual regional energy consumption for 2035 was calculated by combining all of the data presented previously. Daily VMT projections were converted to annual estimates by assuming 6 days per week (the equivalent of 1 day of traffic for Saturday and Sunday combined) and 52 weeks per year. The final results for each alternative are presented in Table 4.

Table 4. Annual Regional Energy Consumption in 2035

Alternative	Vehicle Miles Traveled per year (millions)	Operational Energy Use[a] (gallons per year, millions)			
		Passenger Cars	Light-duty Trucks	Heavy-duty Trucks and Buses	Total
No-Action	57,390	1,961	621	1,641	4,223
W59/E1	57,844	1,942	615	1,625	4,182
W71/E1	57,824	1,942	615	1,625	4,182
W101/E1	57,841	1,941	615	1,625	4,181

[a] energy use = vehicle mix multiplied by yearly vehicle miles traveled/fuel efficiency

Table 4 shows that, among the action alternatives, operational energy use is essentially the same and that all action alternatives are projected to result in less fuel consumption than the No-Action Alternative. Implementing the W59, W71, or W101 Alternative with the E1 Alternative would reduce fuel consumption regionwide by approximately 40 million gallons per year when compared with the No-Action Alternative. The annual fuel consumption savings associated with any of the action alternatives would represent substantial economic savings over the design horizon of the action alternatives, regardless of fluctuating fuel prices.

Although the No-Action Alternative shows the smallest VMT of all the alternatives, substantially more fuel use is projected because of the higher VHT. Lower speeds and, therefore, lower fuel economy are associated with the No-Action Alternative. As noted, if the No-Action Alternative were selected, energy use because of project construction would not occur; operational energy use, however, would be higher because of higher levels of traffic congestion.

Secondary and Cumulative Impacts

No secondary or cumulative impacts are anticipated with implementation of the action alternatives.

4. Mitigation

No mitigation measures are proposed.

5. Conclusions

The No-Action Alternative would involve the most energy consumption of all of the alternatives. It would consume approximately 40 million gallons of fuel per year more than any of the action alternatives in 2035. The annual fuel consumption savings associated with any of the action alternatives would represent substantial economic savings over the design life of the freeway, regardless of fluctuating fuel prices.

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