1.0 Introduction

1.1 Foreword

Interstate 40 (I-40) is one of the nation's principal east-west highways. The intersection of I-40 and I-17 in Flagstaff makes I-40 part of critical trade and truck routes linking Mexican markets with Arizona's major urban centers and markets of New Mexico, Utah, and northern California. In addition to accommodating rapidly increasing local traffic, I-40 supports recreational traffic destined for the Grand Canyon, national forests, the City of Flagstaff, and Native American communities in northern Arizona.

The Arizona Department of Transportation (ADOT), in partnership with the Federal Highway Administration (FHWA), has initiated a design concept study and environmental studies to evaluate the proposed improvements to I-40 in Coconino County, Arizona. The study area begins west of the I-40/Bellemont Traffic Interchange (TI) at milepost (MP) 183.0 and extends east to MP 214.0, east of the Winona TI. The study area is located within ADOT's Flagstaff District.

Much of existing I-40 is located on easements from the Coconino National Forest (CNF), and, to a lesser extent, the Kaibab National Forest (KNF), which manage the majority of the land adjacent to I-40 in the project area. Privately-owned property includes land adjacent to the existing Bellemont, West Flagstaff, Flagstaff Ranch, Butler, Country Club, Cosnino, and Winona TIs, as well as properties between MP 191.5 and MP 203.0.

The existing roadway is a four-lane divided facility that traverses rolling terrain. The horizontal and vertical alignments follow relatively steep grades from MP 188.5 to MP 190.0 (Arizona Divide), MP 191.7 to MP 193.0 (West Flagstaff TI to Flagstaff Ranch TI), and MP 194.2 to MP 194.9 (west of I-40/I-17 system TI). The roadway between MP 183.0 and MP 193.0 and between MP 203.0 and MP 214.0 is classified as rural; between MP 193.0 and MP 203.0, it is classified as urban/fringe urban.

The steeper rolling terrain along the corridor presents challenges to widening the I-40 in terms of existing alignments with steep grades in deep rock cuts and narrow cross sections. In addition, severe winter weather can cause closures of I-40 that result in lengthy travel delays along the route.

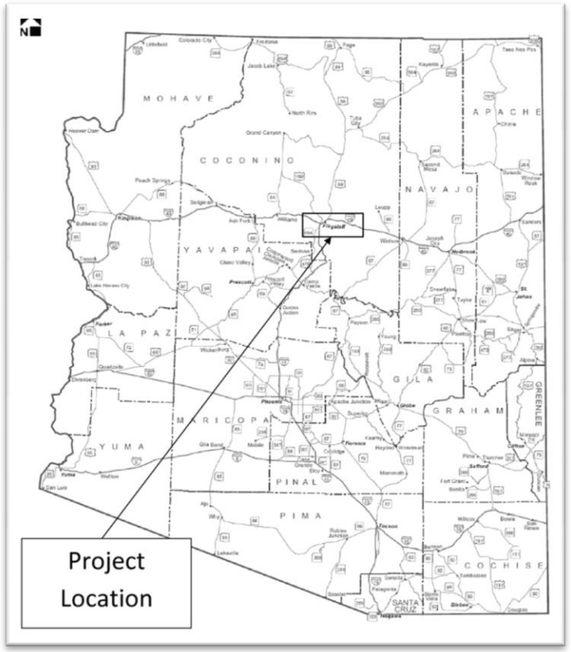
The study will provide a long-range implementation strategy that will guide future decisions regarding the interim and ultimate improvements required to meet the capacity and operational needs of the traveling public over the next 30 years. An environmental assessment (EA) is being developed in concert with this design concept study. Implementation of the study recommendations will depend on funding availability and prioritization of roadway construction projects.

1.2 Purpose of the Project

The purpose of this project is to improve operations and reduce congestion by adding capacity to I-40 from west of the Bellemont TI to east of the Winona TI. The study will develop and evaluate feasible alternatives to meet the capacity needs for the design year 2040, as well as interim (short-term) improvements. This study will identify a range of improvements, such as the widening of I-40, redesigned interchanges, and proposed new interchanges, based on the results of preliminary engineering and environmental technical studies. The results of the engineering analysis are documented in this Design Concept Report (DCR), and the results of the environmental analyses will be presented in an EA prepared to meet the requirements of the National Environmental Policy Act (NEPA) of 1969.

1.3 Description of the Project

Figure 1 – Location Map



The study area begins on I-40 at approximately MP 183.0, west of the existing Bellemont TI, and extends east to approximately MP 214.0, east of the Winona TI. The project limits also include the northern terminus of I-17 at the I-40 system interchange and all of the ramps associated with the system interchange. A location map detailing the study limits and the surrounding area is shown on Figure 1. A vicinity map is shown on Figure 2.

The project will add one lane in each direction from MP 183.6 to MP 208.4, plus auxiliary lanes between the Flagstaff Ranch TI and new Woody Mountain TI (MP 192.6 to MP 193.4) and between the I-40/I-17 system interchange and Butler TI (MP 195.6 to MP 198.2). At the western project limit, the added lanes will begin at the new Camp Navajo TI ramps. At the eastern widening limit (MP 208.4), the proposed lanes will transition to match into the existing I-40 roadway which has two lanes in each direction. Interchange improvements are recommended at several existing TIs, and four new interchanges are proposed.

Beginning at the western end, the project extends east through portions of:

Township (T) 22 North (N), Range (R) 5 East (E), Sections 35 and 36

T21N, R5E, Sections 1 and 2

T21N, R6E, Sections 6, 7, 8, 15, 16, 17, 22, 23, and 24

T21N, R7E, Sections 13, 14, 19, 22, 23, 27, 28, 29, and 30

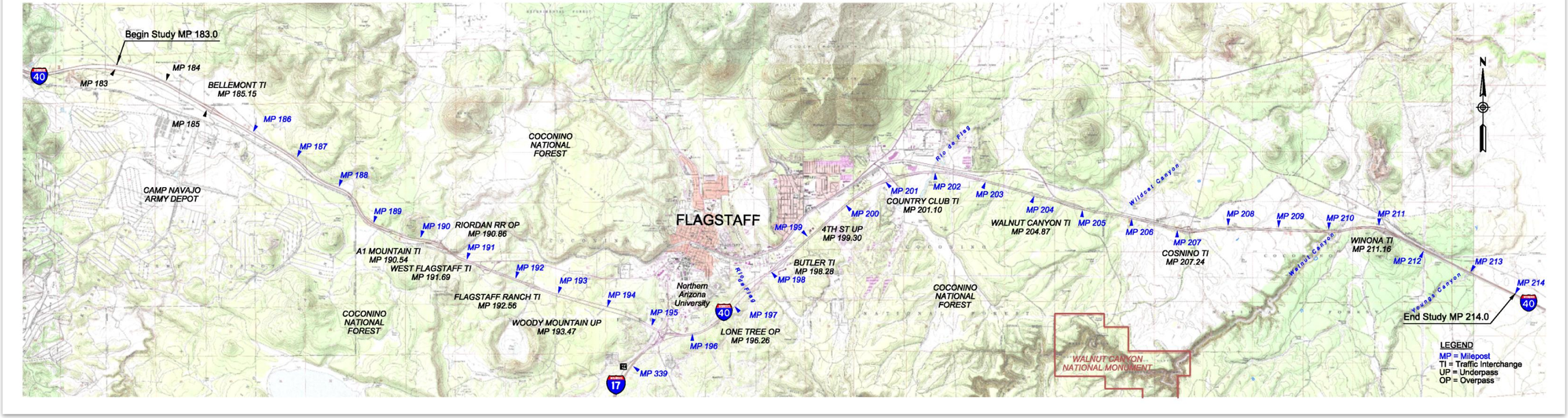
T21N, R8E, Sections 7, 8, 9, 10, 11, 13, and 14

T21N, R9E, Sections 13, 14, 15, 16, 17, 18, and 24

T21N, R10E, Sections 19, 28, 29, 30, 33, 34, and 35

These references are identified on the Bellemont, Flagstaff West, Flagstaff East, Winona, and Angell, Arizona, US Geological Survey (USGS) 7.5-minute topographic series.

Figure 2 – Vicinity Map



The project begins at approximately 6850 feet elevation at its western end in rolling terrain west of the Bellemont Flat in Coconino County. Extending southeast, the project ascends gradually over the Arizona Divide and reaches a maximum elevation of 7335 feet at approximately MP 190. Along the western 11 miles of the project, I-40 climbs and descends as it winds around the base of the San Francisco Peaks into the Flagstaff city limits. Landform throughout the corridor is typical of the Colorado Plateau region of Arizona. The I-40 alignment passes through a number of flat meadows within the corridor. The vegetation is a mix of ponderosa and oak woodlands

1.4 Project Objectives

The primary objectives of this study include evaluating the addition of mainline capacity to accommodate anticipated future traffic volumes from growth and planned development. The addition of capacity will help ADOT meet its long-range goal of providing an improved roadway on one of the major west-to-east corridors in the state, as well as improved operations through Flagstaff and the surrounding communities. Widening the roadway is anticipated to reduce congestion and travel times, as well as provide greater flexibility for ADOT to manage incidents and facilitate maintenance.

1.4.1 Public Involvement

Community members were provided an opportunity to comment and take part in the early development of this project through a public involvement process that to date has included agency and public scoping meetings, agency and public information meetings, and a presentation of project data and progress on a project web site.

1.4.2 Scoping Meetings

ADOT initiated the I-40 design concept study by conducting scoping meetings with federal, state, county, and local agency representatives and the public. An agency scoping meeting for the project was held on July 14, 2009, at the Radisson Woodlands Hotel, 1175 North Route 66, in Flagstaff, Arizona. A public scoping meeting for the project was held on the same date at the same venue later that evening. The purpose of these meetings was to provide a general overview of the study area and to obtain input from the agency representatives, business people, and area residents about the existing roadway and surrounding area. Participants, who included representatives from the agencies listed below, were invited to identify the issues, concerns, and opportunities (ICOs) that should be addressed during the development and evaluation of alternatives in the DCR and EA.

- ADOT
- AGFD
- City of Flagstaff
- Coconino County
- CNF
- Flagstaff Metropolitan Planning Organization (FMPO)
- Flagstaff United School District
- FHWA
- KNF
- National Park Service, Flagstaff Area Monuments
- Department of Public Safety, District 2
- US Army Corps of Engineers (COE)

The study team prepared and distributed an informational postcard inviting the public to attend the scoping meeting. The postcard was mailed on June 26, 2009, to approximately 13,200 individuals on the mailing list, which included property owners within 0.5 mile of I-40 between the study limits, as well as elected officials and key stakeholders identified as having an interest in area transportation studies. Twenty-two community members signed in at the meeting. Eight comment forms were completed and two letters and twelve e-mails were received.

The following ICOs were identified during the agency and public scoping meeting. Other comments were received that identified a broad-range of issues that are not within the scope of this project and will not be addressed by the study. Details of each meeting and comments received are presented in the October 2009 Scoping Summary for the project.

1.4.2.1 Design Issues, Concerns, and Opportunities

The safe flow of traffic through the corridor is a major concern of both the agencies and the general public. Design ICOs identified through the scoping process include the following:

- Construct additional travel lane in each direction to maintain the flow of traffic.
- Construct new traffic interchanges along the corridor where future development requires access to I-40.
- Address traffic operations at the existing Bellemont TI.
- Construct sound walls along residential developments.
- Consider asphalt recycling as part the construction efforts.
- Consider the use of highway lighting to improve visibility for the interstate traffic, but do not affect the nearby observatories.
- Consider an additional crossing over I-40 for Camp Navajo projected development.
- Use rubberized pavement to reduce noise impacts along this corridor.
- Consider constructing wider emergency pull-offs/chain-up areas.

1.4.2.2 Social and Economic Issues, Concerns, and Opportunities

Social and economic ICOs identified through the scoping process include the following:

- Consider impacts to Arizona State Lands property in the selection of the proposed right-of-way (R/W) required.
- Consider the future land use and growth along the corridor.
- Consider the effects of commuters to Flagstaff from the projected growth outside the project study limits.
- Evaluate and improve the signage to the Walnut Canyon National Monument.
- Evaluate how improvements along I-40 will impact development growth along this corridor.
- Coordinate with the City of Flagstaff, US Forest Service, and other non-profit organizations about existing and proposed trail locations.

1.4.2.3 Environmental Issues, Concerns, and Opportunities

Environmental ICOs identified through the scoping process include the following:

- Coordinate with Arizona Game & Fish Department (AGFD) about wildlife crossings and corridor connectivity.
- Minimize wildlife and environmental impacts during all phases of the design and construction process.
- Minimize impacts to visual quality and tree mortality.
- Consider fuel reduction actions, vegetation management, and reduction of invasive weeds.
- Minimize impacts on permanent, seasonal, and ephemeral waters in the area.

1.4.3 Information Meetings

Agency and public information meetings were held on August 5, 2010, to provide an update on the I-40 study.

The agency information meeting was held on August 5, 2010, at the Radisson Woodlands Hotel, 1175 W. Route 66, in Flagstaff, Arizona. The purpose of the meeting was to provide agency representatives with an update on study information and to receive input on the study alternatives and preliminary recommendations. Thirty-three individuals attended this meeting.

The agency information meeting began at 1:30 p.m. and included a formal presentation, followed by a discussion session. The presentation provided an overview of agency roles, the study purpose and objectives, engineering elements, preliminary design concepts, study schedule and process, and environmental studies to be completed. Roll plots identifying the study area and informational boards were also available for agency representatives to view.

Additionally, ADOT conducted a separate videoconference meeting with representatives from Northern Arizona University (NAU) and FMPO on August 11, 2010, at 3:00 p.m. at the ADOT Flagstaff/Phoenix video conference facilities; ADOT Flagstaff District Office, Main Conference Room, 1801 S. Milton Road, in Flagstaff, Arizona, and the ADOT Phoenix Administration Building, Green Room, 206 S. 17th Avenue, in Phoenix, Arizona. A separate meeting was conducted because NAU representatives had a scheduling conflict with the August 5 meeting. The same information in the format from the agency information meeting was presented to the NAU representatives.

Following the presentation, each agency representative was asked for input on the study during the discussion session. The ADOT study team contact information and comment forms were provided for agency representatives to continue providing input. The presentation, comments and responses from the agency information meeting and the separate videoconference meeting with NAU are documented in the *Agency Information Meeting Summary*, November 2010.

The public information meeting was held from 6:00 p.m. to 8:00 p.m. on August 5, 2010, in the same location as the agency information meeting. The meeting included a formal presentation, followed by a discussion session with meeting attendees. Approximately thirty individuals attended the public information meeting. The presentation provided an overview of the study purpose and objectives as well as information on proposed improvements, alternatives, and environmental status. In addition, the study schedule was reviewed. The presentation also provided contact information for meeting attendees to provide input. Informational boards and roll plots identifying the proposed improvements and alternatives were also available for the public to view.

After the presentation, meeting attendees were given the opportunity to provide input and comments, as well as the opportunity to highlight issues of importance. The presentation, verbal questions and comments received during the meeting, and the ADOT study team's summarized responses are provided in the *Public Information Meeting Summary*, November 2010.

1.5 Characteristics of the Corridor

The functional classification for I-40 is Principal Arterial Interstate – Rural. The ADOT posted speed log reflects posted speed limits as follows:

- 75 miles per hour (mph) from MP 183.00 to MP 193.07 and from MP 201.70 to MP 214.00
- 65 mph from MP 193.07 to MP 201.70

Table 1 lists the projects previously constructed within the study section, sorted by construction date.

Table 1 – Previous Projects Within the Study Area

BEGIN MP	END MP	PROJECT NO.	CONST. DATE	DESCRIPTION (PROJECT TITLE)
205.20	212.31	F.I 81(4)	1948	WALNUT - WINONA GD
212.00	217.85	IM 40-4(151)	1951	PAVEMENT PRESERVATION
212.31	219.57	F.I. 81(8)	1958	WINONA - CANYON PADRE GD
195.84	205.20	I-40-4(68)/ I-40(74)	1960	BC & PCC, CONST.
182.60	185.87	I 40-3 (21)	1963	202- BELLEMONT GD BST 1963
185.90	191.25	I 40-3 (22)	1965	BELLMONT - RIORDAN GD (BST) 1965
191.20	195.05	I 40-3 (23)	1966	RIORDAN - FLAGSTAFF GD 1966
195.40	196.16	I 40-3 (24)	1966	FLAGSTAFF INTERCHANGE GD 1966
195.80	200.71	I 40-4 (20)	1966	FLAGSTAFF - JCT US 89 GD 1965
200.80	205.25	I 40-4 (19)	1966	JCT US 89 - COSNINO OP GD 1965
199.00	199.08	I 40-4 (74)	1967	4TH ST (EAST FLAG) GRADE SEPARATION
205.20	217.85	I 40-4 (34)	1967	WALNUT CANYON - CANYON PADRE GD 1966 (EB)
189.00	195.90	I 40-3 (39)	1969	RIORDAN - FLAGSTAFF TI SIGNS & LIGHTING
190.81	190.81	I 40-3-905	1969	RIORDAN RR OP- EB BRIDGE
198.00	198.57	I 40-4 (84)	1969	BUTLER AVENUE TI RAMPS
191.24	195.84	I 40-3 (32)	1971	BASE COURSE & PCC WEST FLAGSTAFF
195.80	204.50	I-40-4(89)	1972	SIGNS AND LIGHTING
205.20	217.94	I 40-4(69)	1972	GRADE, DRAIN, PAVE ~ WALNUT CANYON
201.00	201.25	I 40-4 (501)	1974	EAST FLAG TI MODIFY TI
193.14	197.06	I 40-3-906	1975	PCCP CRACK REPAIR ~ RIORDAN
210.20	210.31	I 40-4-921	1977	SAFETY EB ~ WALNUT CANYON BRIDGE
211.40	217.90	I 40-4-924	1977	OVERLAY, MATERIALS SOURCES ~ WINONA
195.04	217.84	I 40-4-923	1979	CONCRETE APPROACH SLAB, JOINT
202.79	203.97	I 40-4-925	1979	TEST SECTIONS PAVE & DRAIN WB
179.20	190.80	I 40-3 (47)	1981	PARKS - RIORDAN RESURFACE
190.80	190.80	I 40-3-914	1983	RIORDAN OP (EB) BRIDGE REPAIR
190.81	190.81	I 40-3-912	1984	RIORDAN RR OP- EB BRIDGE REPAIR
210.24	210.24	I 40-4-927	1984	BRIDGE JOINT REPLACEMENT
190.90	195.37	I 40-3 (60)	1985	RIORDAN RR OP-US 89A OP RECONSTRUCT WB
192.10	193.10	I 40-3 (55)	1985	ASH FORK-FLAGSTAFF DAIRY RD TI PAVEMENT
190.86	190.86	I 40-3-916	1986	BRIDGE REPAIR PARAPET & HANDRAIL~RIOR
192.10	193.01	I 40-3 (65)	1986	DAIRY RD TI NEW EB STR PHASE II
205.20	212.00	I 40-4 (116)	1986	WALNUT CANYON - WINONA (EB) OVERLAY/SAFETY
198.10	198.10	I 40-4 (128)	1988	BUTLER AVENUE TI IMPROVEMENT (FLAGSTAFF)
200.80	201.70	I 40-4 (114)	1988	EAST FLAG TI RECONSTRUCTION & RAMP
205.00	218.04	I 40-4(115)	1990	WALNUT CANYON - CANYON PADRE SIGNING
205.20	212.18	40-4(124)D	1990	WALNUT CYN-WINONA RD MILL AC 1990
193.47	193.47	I 40-3-502	1991	BRIDGE REPAIR ~ WOODY MOUNTAIN UNDERPASS
210.90	217.82	I 40-4 (136)	1991	WINONA TI WB MILL/REPLACE OLAY WB PCCP EB
200.84	201.71	I 40-4-502	1992	RELOCATE FRONNTAGE ROAD ~ SOLIERE
166.60	190.87	I 40-3 (75)	1994	MILLING AC, GRADING, PIPE CULVERTS
201.10	201.10	I 40-4-507	1994	IMPROVE COUNTRY CLUB DR TI TRAFFIC SIGNAL
190.92	195.30	I 40-3 (78)	1995	REMOVE/ FURNISH NEW AR-ACFC ETC (FLAGSTAFF)
190.80	195.21	I 40-3 (62)	1997	RIORDAN RR OP-US 89A RECONSTRUCT EB RDWY
194.30	201.93	IM 40-3(80)	1998	FENCE
190.86	197.40	I 40-3-509	1999	ASH FORK-FLAGSTAFF, I-40, DECK JOINT REPAIR
194.78	196.21	ACNH 40-3(87)A	1999	FLAGSTAFF-ASHFORK HWY I 40 - I 17 - 1 40 TI PH II
194.94	195.65	ACNH 40-3(71)	1999	TRAFFIC INTERCHANGE

BEGIN MP	END MP	PROJECT NO.	CONST. DATE	DESCRIPTION (PROJECT TITLE)
205.20	212.02	40-4(152)	1999	ARAC, AR-ACFC, WIDEN BRIDGE
210.02	210.53	BR 40-4(143)	1999	BRIDGE REPLACEMNET ~ WALNUT CANYON
192.56	192.56	I 40-3-918	2001	BRIDGE REPAIR ~ DAIRY ROAD T.I.
203.72	204.22	I 40-D-503	2001	FLAGSTAFF-WINSLOW HWY I 40 - COSNINO BNSF OP
210.16	210.35	I 40-D(4)P	2001	BRIDGE REPLACEMENT ~ WALNUT CANYON
185.15	195.22	BR 040-C-(3)A	2002	HWY (I-40) SSMC RET VARIOUS BR ON I-40
195.00	202.00	I 40-D-507	2002	REMOVE AND REPLACE CONCRETE SLAB
193.47	194.73	I 40-C-501	2003	CONSTRUCT ROADWAY
196.23	196.25	BR 040-D-(010)A	2003	HWY I 40 - LONE TREE ROAD OP
199.30	204.87	BR 40-D(6)P	2003	BRIDGE SEISMIC RETROFIT
197.50	197.50	BR 040-D-(013)A	2004	FLAGSTAFF-HOLBROOK HWY I 40 - EB & WB REPLACE
201.00	201.00	IM 040-D(014)A	2004	MP 201 TO WALNUT CANYON TI MILL AND REPLACE
185.00	247.00	IM 040-C (005)A	2005	ASH FORK-FLAGSTAFF HWY (I-40) SIGN REHABILITATION
190.00	201.00	IM 040-D(019)A	2008	RIORDAN - E. FLAGSTAFF TI MILL & REPLACE 1" AC-ACFC
193.16	193.16	B40-D(200)	2008	PINE SPRINGS -SWITZER CANYON SR 40B-MILL AC

ADOT's 2011-2015 Five-Year Transportation Facilities Construction Program includes one line item for this segment of I-40 – $500,000 for a feasibility study in Fiscal Year 2011 for a new Lone Tree TI at MP 197.

1.5.1 Roadway Characteristics

Table 2 lists the interchanges and notable features that exist along the corridor.

Table 2 – Roadway Characteristics

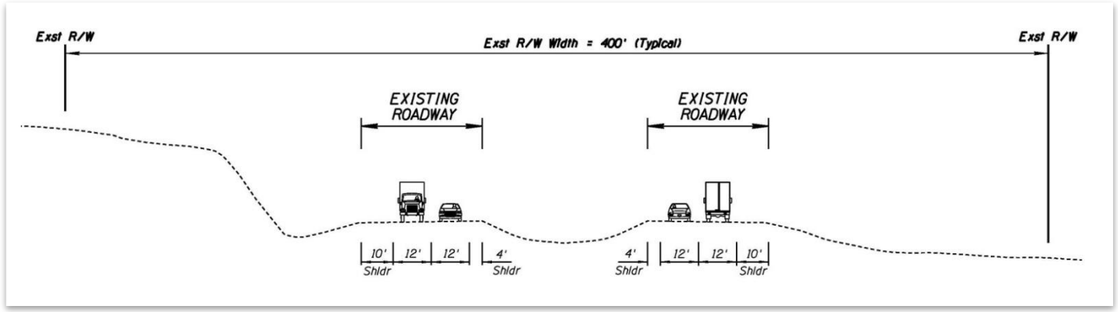
I-40 CROSSING	MP	COMMENTS
Western Study Limit	183.00	Existing two lane roadway east of Parks Rest Area (closed)
Bellemont TI UP	185.15	Diamond interchange
A-1 Mountain TI UP	190.54	Diamond interchange
BNSF Railroad OP	190.86	
West Flagstaff TI OP	191.69	Trumpet interchange with Business 40/US 66
Flagstaff Ranch TI OP	192.56	Diamond interchange
Woody Mountain UP	193.47	
SR 89A OP	195.22	
Jct. I-40/I-17	195.50	System interchange
Lone Tree OP	196.26	
Rio de Flag bridges	197.43	
Butler TI OP	198.28	Diamond interchange
Fourth Street UP	199.30	I-40 in rock cut
Country Club TI UP	201.10	Diamond interchange
Walnut Canyon TI UP	204.87	Diamond interchange – westbound entrance detached from others
Cosnino TI UP	207.24	Diamond interchange – westbound loop exit
Walnut Canyon Bridges	210.24	
Winona TI UP	211.16	Diamond interchange
East Study Limit	214.00	

UP = underpass
OP = overpass

Median crossovers are located at MP 187.73, MP 203.62, MP 207.90, MP 208.37, MP 209.61, MP 210.55, and MP 211.70.

Mainline lanes average twelve feet in width, with ten-foot outside shoulders and four-foot inside shoulders. The existing highway cross slope is 1.5% in tangent sections except in the westbound direction from approximately MP 205.5 to MP 208.5 the cross slope is 2.0%. Some segments of the westbound roadway were originally a two-way highway (US 66) and were constructed with a parabolic crown rather than a straight left-to-right cross slope. Figure 3 shows the existing typical section of the highway.

Figure 3 – Existing Typical Section



The American Association of State Highway and Transportation Officials (AASHTO) publishes guidelines for a range of geometric design criteria including the horizontal degree of curvature, superelevation rate, and profile grade in *A Policy on Geometric Design of Highways and Streets*. The *AASHTO Controlling Design Criteria Report* documents characteristics of the existing alignment and notes which criteria exceed limits set forth by the guidelines. Appendix A contains a summary of the mainline horizontal and vertical design data.

The corridor can be separated into three segments based on terrain or functional classification:

- MP 183.0-193.0 – Rural - Rolling Terrain
- MP 193.0-203.0 − Urban/Fringe Urban
- MP 203.0-214.0 – Rural - Rolling Terrain

Rural/Rolling Terrain Segment (MP 183.0 to MP 193.0)

The western limits of the study area are in rolling terrain, which extends from east of the Parks rest area (MP 181.74) through the Bellemont Flat in the KNF and CNF. The National Forest boundary is at MP 186.05 The Arizona Divide at MP 190.0 marks the location where the watershed of the Little Colorado River breaks away from Verde River. This is the highest point on I-40, and after a 1941 realignment, was the highest point on Old US 66 at 7335 feet. The existing grades range from -4.0% to +3.97% in the eastbound direction and from +4.0% to -4.75% in the westbound direction.

The eastbound and westbound roadways follow independent horizontal alignments through this segment. The existing eastbound and westbound I-40 horizontal alignments consist of curves with degrees of curvature ranging from 0º 20' to 2º 15' 09". The alignments generally follow the natural rolling terrain. Median widths vary from 84 feet to more than 400 feet.

The Bellemont TI is located at MP 185.15 and is a diamond interchange with Transwestern Road. Transwestern Road provides access to residential communities north of I-40. The former 1942 US Navajo Ordnance Depot, now owned by the Arizona National Guard and known as Camp Navajo, is located south of I-40 from west of the Bellemont TI to east of MP 188.

The terrain from MP 189.0 to MP 190.8 is more severe than elsewhere within the project limits. Rock cuts exceed 80 feet in height in some areas with slopes of 1H:1V.

The A-1 Mountain TI is located at MP 190.54 and also is a diamond interchange. A-1 Mountain Road only provides access to the north because of the proximity of the Burlington Northern and Santa Fe Railroad tracks to the south.

The Riordan Overpass is located at MP 190.86, with I-40 crossing over two tracks of the Burlington Northern Santa Fe Railroad (BNSF) and the access road to the US Naval Observatory.

The West Flagstaff TI is located at MP 191.69 and is a trumpet interchange with Business Route 40/US 66. This is the first interchange in the western section of the study that provides access to the City of Flagstaff.

The Flagstaff Ranch TI is located at MP 192.56 and is a diamond interchange with Flagstaff Ranch Road.

Urban/Fringe Urban Segment (MP 193.0 to MP 203.0)

This segment of I-40, which provides access to the City of Flagstaff and I-17 to the south, is designated as "urban/ fringe-urban" since it is within the Flagstaff urban boundary. The alignment in this section of I-40 is located within the southern portion of the City of Flagstaff. Generally, the interstate follows a southeasterly course until it intersects with I-17, then the direction changes to a northeasterly course. The horizontal alignment has fewer and flatter curves throughout this segment of I-40, with degrees of curvature generally not exceeding 1°00'.

Photograph 1-1. I-40 at A-1 Mountain Road, looking east.

Photograph 1-2. I-40 Riordan railroad overpass, looking south.

This ten-mile segment of I-40 has an overall elevation change of only 360 feet (7115 feet to 6755 feet); however, there is a steep section within a mile west of the system interchange with I-17. In this section, the existing grade in the eastbound direction is -5.0% and in the westbound direction +4.6%. The existing grades within this segment range from -5.0% to +2.0% in the eastbound direction and from -2.5% to +4.6% in the westbound direction.

There are one system interchange and two diamond interchanges in this segment.

Woody Mountain Road is a local road which crosses over I-40 at milepost 193.47. There is no existing access to the interstate at this location.

Photograph 1-3. I-40 at Woody Mountain Road, looking east.

I-40 crosses over SR 89A at MP 195.22. SR 89A, also known as Beulah Boulevard, runs parallel to and west of I-17.

The I-40/I-17 system TI at MP 195.5 provides directional access to I-17 to the south and Milton Road to the north. The NAU campus is located in the northeast quadrant of the system interchange.

Lone Tree Road is a local road which crosses under I-40 at milepost 196.26. There is no existing access to I-40 from this facility.

I-40 crosses over the Rio de Flag by means of two bridges, which were constructed in 2005.

The Butler Avenue TI (MP 198.28) is a diamond configuration with the cross road under the I-40 mainline. This interchange provides access to eastern Flagstaff.

Fourth Street crosses over I-40 at milepost 199.3 with no access to I-40.

The Country Club TI, located at MP 201.10, was reconfigured in 2007 to a diamond interchange. It provides access to the City of Flagstaff, the east end of Business 40, and US 89 to the north.

Photograph 1-4. I-40 at system TI, looking west.

Rural/Rolling Terrain Segment (MP 203.0 to MP 214.0)

The eastern rural/rolling terrain segment begins two miles east of the County Club TI and extends to the eastern limits of this project, roughly three miles east of the Winona TI (MP 211.16). Similar to the western segment, the I-40 horizontal alignments are relatively straight with long smooth curves. The eastbound alignment contains eight horizontal curves with degrees of curvature ranging from 0°06' to 1°00'. The westbound alignment includes seven horizontal curves with degrees of curvature ranging from 0°06' to 1°30'.

The I-40 vertical profile drops in elevation throughout the 11-mile segment as it leaves the City of Flagstaff in a easterly direction. The existing grades range from -3.6% to +0.5% in the eastbound direction and -2.4% to +3.6% in the westbound direction.

There are three service interchanges within this segment. The Walnut Canyon TI (MP 204.87) is a diamond interchange. This interchange provides access to the Walnut Canyon National Monument to the south and Old US 66 to the north. The short westbound entrance ramp connects to the two-way cross road approximately 2000 feet west of the other three ramps.

Photograph 1-5. I-40 at Walnut Canyon TI, looking east.

The Cosnino TI (MP 207.4) is a partial cloverleaf interchange with the westbound exit configured as a loop ramp. Cosnino Road connects to Townsend-Winona Road to the north and provides access to rural properties to north and south.

The Walnut Canyon Rest Area is located on both sides of I-40 at MP 208.0. The rest area is permanently closed.

The Interstate 40 roadways cross over Walnut Canyon at MP 210.24.

Winona TI (MP 211.16) is a diamond interchange. Townsend-Winona Road to the north connects to US 89 in Flagstaff. The interchange provides access to rural properties to the south.

The majority of the existing pavement structure within the corridor consists of asphaltic concrete (AC) and Portland cement concrete pavement (PCCP). The limits of the PCCP sections are confined to the travel and passing lanes; the existing shoulders consist of a structural section with AC on top of aggregate base (AB).

- **EB & WB MP 183 to 191.2 (Sta. 1510+00 to Sta. 1947+00)**
  - Travel Lane: ½" Asphalt Rubber-Asphaltic Concrete Friction Course (AR-ACFC), 4" AC EP (Base Mix), 2" Stabilized Base, 4" AB, 9"-15" select material, 6" subgrade seal.
  - Passing Lane: ½" AR-ACFC, 2.5" AC EP (Base Mix), 1.5" AC, 2" Stabilized Base, 4" AB, 9"-15" select material, 6" subgrade seal.
- **EB MP 191.2 to MP 195.0 (Sta. 1947+40 to Sta. 2150+00)**
  - Travel and Passing Lanes: ½" AR-ACFC, 2" AC(1/2), 6" AC(3/4), 6" Permeable Bituminous Treated Base (PBTB), 7" AB, engineering fabric.
- **WB MP 191.2 to MP 195.0 (Sta. 1947+40 to Sta. 2150+00)**
  - Travel and Passing Lanes: 2" AC (1/2), 9" AC(3/4),6" PBTB, 4" AB, engineering fabric.
- **EB & WB MP 195.0 to MP 195.7 (Sta. 2150+00 to Sta. 2190+00)**
  - Travel and Passing Lanes: ½" AR-ACFC, 13" AC, 14" AB).
- **EB MP 195.73 to MP 201.0 (Sta. 2184+00 to Sta. 207+54)**
  - Travel and Passing Lanes: ½" Asphalt Rubber-Open Graded Friction Course (AR-OGFC), 2" AR-AC, 3" AC (3/4), 8" PCCP (crack and seat).
- **EB MP 201.0 to MP 205.2 (Sta. 207+54 to Sta. 430+00)**
  - Travel and Passing Lanes: ½" AR-ACFC, 2.5" AR-AC, 3" AC(3/4), 8" PCCP (crack and seat).
- **WB MP 195.70 to MP 202.51 (Sta. 2182+00 to Sta. 288+00)**
  - Travel and Passing Lanes: 5/8" AR-ACFC, 2" AR-AC, 8" PCCP (Crack and Seat), 7" Cement Treated Base (CTB), 7" unbound limestone subbase.
- **WB MP 202.8 to MP 204.0 (Sta. 303+40 to Sta. 367+00) (PAVEMENT TEST SECTION AREA)**
  - A variety of different structural sections.
- **EB MP 205.2 to 214.0 (Sta. 430+00 to Sta. 895+00)**
  - Travel and Passing Lanes: ½" AR-ACFC, 2" AR-AC, 9" PCCP, 4" AB, 6" select material.
- **WB MP 205.2 to 214.0 (Sta. 430+00 to Sta. 895+00) (Exist US 66)**
  - Travel and Passing Lanes: ½" AR-ACFC, 2" AR-AC, 7" PCCP, 4" AB, 6" select material.
  - Portions in this segment were recently reconstructed: ½" AR-ACFC, 14" AC(3/4)EP, 4" AB.

1.5.2 Land Use

The majority of the existing I-40 roadway is located on an easement from the Coconino and Kaibab National Forests, which manage the majority of the land adjacent to I-40 in the project area. Military land is adjacent to I-40 on the south side from the western project limit to approximately MP 191. Privately-owned land and State-owned land is also present along I-40

1.5.3 Utilities

The following table lists the major existing utilities which cross I-40, except for the BNSF railroad, which crosses at MP 190.8 at the existing Riordan railroad overpass (OP).

Table 3 – Existing Utilities

UTILITY TYPE	EB/WB	STATION	MILEPOST	LOCATION
Arizona Public Service (APS) (Overhead Power Joint Line)				
OH Power Joint Line Existing	EB/WB	1609+00	184.84	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	1614+00	184.93	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	1637+00	185.37	North/south crossing
OH Power Joint Line Existing	EB/WB	1690+00	186.37	North/south crossing
OH Power Joint Line Existing	WB	1724+00	187.02	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	1945+00	191.21	North/south crossing, 69 KV
U/G Power Joint Line Existing	EB/WB	2017+00	192.56	North/south crossing
OH Power Joint Line Existing	EB/WB	2030+00	192.81	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	2095+00	194.04	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	2153+00	195.14	North/south crossing
OH Power Joint Line Existing	EB/WB	2180+00	195.65	North/south crossing
OH Power Joint Line Existing	EB	2189+00	195.82	North/south crossing
OH Power Joint Line Existing	WB	2194+00	195.92	North/south crossing
OH Power Joint Line Existing	WB	2195+00	195.93	North/south crossing
OH Power Joint Line Existing	EB/WB	2212+00	196.26	North/south crossing
OH Power Joint Line Existing	WB	2235+00	196.69	North/south crossing
OH Power Joint Line Existing	WB	2237+00	196.73	North/south crossing
OH Power Joint Line Existing	WB	2240+00	196.79	North/south crossing
OH Power Joint Line Existing	EB	2246+00	196.90	North/south crossing
OH Power Joint Line Existing	EB	2550+00	197.07	North/south crossing
OH Power Joint Line Existing	EB	5+00	197.16	North/south crossing
OH Power Joint Line Existing	WB	11+00	197.28	North/south crossing
OH Power Joint Line Existing	WB	39+00	197.81	North/south crossing
OH Power Joint Line Existing	EB	43+00	197.88	North/south crossing
OH Power Joint Line Existing	EB	166+00	200.21	North/south crossing
OH Power Joint Line Existing	WB	169+00	200.27	North/south crossing
OH Power Joint Line Existing	EB/WB	275+00	202.27	North/south crossing, 69 KV
OH Power Joint Line Existing	EB/WB	277+00	202.31	North/south crossing, 230 KV
OH Power Joint Line Existing	WB	543+00	207.33	North/south crossing
OH Power Joint Line Existing	EB	544+00	207.35	North/south crossing
OH Power Joint Line Existing	EB/WB	738+00	211.03	North/south crossing
APS (Underground Power Joint Line)				
U/G Power Joint Line Existing	EB/WB	1929+00	190.9	North/south crossing
U/G Power Joint Line Existing	EB	21+00	197.47	North/south crossing
U/G Power Joint Line Existing	WB	21+00	197.47	North/south crossing
U/G Power Joint Line Existing (Abandon)	EB/WB	63+00	198.26	North/south crossing
U/G Power Joint Line Existing	EB/WB	72+00	198.43	North/south crossing
U/G Power Joint Line Existing	EB/WB	228+00	201.39	North/south crossing
AT&T (Underground Fiber Optic Telephone Line)				
Underground Fiber Optic Telephone Line	EB, WB	170+00	200.29	North/south crossing
City of Flagstaff (Reclaimed Water)				
Reclaimed Water Existing	EB/WB	2212+00	196.26	North/south crossing, 16" DIP
Reclaimed Water Existing	EB/WB	20+00	197.45	North/south crossing, 20" DIP
Reclaimed Water Existing	EB/WB	259+00	201.97	North/south crossing, 24" line
City of Flagstaff (Sanitary Sewer)				
Sewer	EB/ WB	2159+00	195.25	North/south crossing
Sewer	WB	5+00	197.16	North/south crossing
Sewer	EB	20+00	197.45	North/south crossing, 30" pipe
Sewer	WB	23+00	197.51	North/south crossing, 30" pipe
Sewer	WB	25+00	197.54	North/south crossing, 8" PVC
Sewer	EB	103+00	199.02	North/south crossing, 21" pipe
Sewer	WB	104+00	199.04	North/south crossing, 21" pipe
Sewer	EB	145+00	199.82	North/south crossing

UTILITY TYPE	EB/WB	STATION	MILEPOST	LOCATION
Sewer	WB	147+00	199.85	North/south crossing
Sewer	EB/WB	198+00	200.82	North/south crossing
Sewer	EB/WB	259+00	201.97	North/south crossing, 33" Pipe
City of Flagstaff (Water Line)				
Water Line Existing	EB	2098+00	194.1	North/south crossing
Water Line Existing	WB	2100+00	194.14	North/south crossing
Water Line Existing	EB/WB	2160+00	195.27	North/south crossing
Water Line Existing	EB/WB	2212+00	196.26	North/south crossing
Water Line Existing	EB	20+00	197.45	North/south crossing, 20" steel
Water Line Existing	WB	23+00	197.51	North/south crossing, 30" DIP
Water Line (Abandon)	EB/WB	63+00	198.26	North/south crossing, 24" DIP
Water Line Existing	WB	165+00	200.19	North/south crossing, 12 pipe
Water Line Existing	EB	167+00	200.23	North/south crossing, 12" pipe
Water Line Existing	EB	221+00	201.25	North/south crossing, 12" pipe
Water Line Existing	WB	226+00	201.35	North/south crossing, 12" pipe
NPG Cable				
Underground Cable Television Line	EB/WB	2212+00	196.26	North/south crossing
Qwest				
OH Telephone Line Existing	EB/WB	1609+00	184.84	North/south crossing
OH Telephone Line Existing	EB/WB	1637+00	185.37	North/south crossing
OH Telephone Line Existing	EB/WB	1673+00	186.05	North/south crossing
OH Telephone Line Existing	EB/WB	1939+00	191.09	North/south crossing
OH Telephone Line Existing	WB	39+00	197.81	North/south crossing
OH Telephone Line Existing	EB	43+00	197.88	North/south crossing
OH Telephone Line Existing	EB	494+00	206.41	North/south crossing
OH Telephone Line Existing	WB	495+00	206.42	North/south crossing
OH Telephone Line Existing	EB/WB	738+00	211.03	North/south crossing

UTILITY TYPE	EB/WB	STATION	MILEPOST	LOCATION
UNISOURCE Gas				
Gas line Existing	EB/WB	1640+00	185.43	North/south crossing, 2" pipe
Gas line Existing	EB/WB	1663+00	185.86	North/south crossing, 2" pipe
Gas line Existing	EB/WB	1672+00	186.03	North/south crossing, 6" pipe
Gas line Existing	EB/WB	2017+00	192.56	North/south crossing, 8" pipe
Gas line Existing	EB/WB	2212+00	196.26	North/south crossing, 2" pipe
Gas line Existing	EB/WB	72+00	198.43	North/south crossing, 6" pipe
Gas line Existing	EB/WB	169+00	200.27	North/south crossing, 4" pipe
Gas line Existing	EB	221+00	201.25	North/south crossing, 6" pipe
Gas line Existing	WB	227+00	201.37	North/south crossing, 6" pipe
WESTERN AREA POWER ADMINISTRATION				
OH Power Joint Line Existing	EB/WB	790+00	212.01	North/south crossing
OH Power Joint Line Existing	EB/WB	791+00	212.03	North/south crossing
OH Power Joint Line Existing	EB/WB	792+00	212.05	North/south crossing
OH Power Joint Line Existing	EB/WB	793+00	212.07	North/south crossing

1.5.4 Drainage

Existing Drainage Conditions and Facilities

Drainage patterns can be separated into three sections with generally-consistent patterns through each section. The first section begins at the western end of the project and extends to approximately milepost 193, just west of the Woody Mountain Road underpass. In this section, runoff generally flows from the northeast to the southwest. The second section begins at approximately MP 193 and extends to approximately MP 202. In this section, runoff generally flows from northwest to the southeast. The final section begins at approximately MP 202 and extends to the eastern end of the project. In this section, runoff originates from the southwest and flows toward the northeast.

Named washes within the corridor include Volunteer Wash, Sinclair Wash, the Rio de Flag, Switzer Canyon Wash, Spruce Avenue Wash, Fanning Drive Wash, Penstock Avenue Wash, Wildcat Canyon Creek, and Walnut Creek. Watershed elevations range from around 6100 feet at the eastern end of the project to more than 12,500 feet at the uppermost areas at the western end of the project that includes the San Francisco Peaks. The study corridor is crossed by over 30 watercourses varying in magnitude. Culverts range in size from 24" to 72". A listing of large box and pipe culverts is shown in Table 4 (data source: ADOT topographic mapping and record drawings). Large culverts are defined as having a diameter of 48" or larger.

Table 4 – Existing Major Drainage Pipes and Culverts				
MP	ROADWAY	SIZE	LENGTH (ft)	CULVERT ID
184.0	WB & EB	10x8 ft CBC	177	2021
184.9	WB & EB	3-10x5 ft CBC	288	1002
185.4	WB & EB	48 in CMP	278	1023
185.9	WB & EB	4-10x4 ft CBC	175	1010
186.9	WB & EB	8x4 ft CBC	210	1012
187.4	WB & EB	10x8 ft CBC	209	1024
189.3	WB	72 in CMP	119	1036
189.4	WB & EB	66 in CMP	316	1032
189.4	WB & EB	12x12 ft CBC	185	1032
190.6	WB & EB	2-8x5 ft CBC	391	1045
191.1	EB	5x4 ft CBC	145	1076
191.8	WB & EB	10x8 ft CBC	149	1078
192.8	WB & EB	10x4 ft CBC	246	1059
194.0	WB	6x6 ft CBC	106	1
194.0	EB	5x4 ft CBC	107	1
197.0	EB	54 in CMP	159	2010
197.1	WB	6x7 ft CBC	217	2010
198.9	WB & EB	8x8 ft CBC	364	2026
199.0	WB & EB	2-10x8 ft CBC	387	2031
200.4	WB & EB	10x8 ft CBC	187	2036
200.8	WB & EB	10x6 ft CBC	192	2041
201.8	WB & EB	10x10 ft CBC	146	2046
201.8	WB & EB	5-10x9 ft CBC	312	2046
202.2	WB & EB	12x10 ft CBC	168	2055
202.8	WB & EB	48 in CMP	258	2057
203.3	WB & EB	10x10 ft CBC	187	2060
203.8	WB & EB	12x12 ft CBC	175	2065
204.3	WB & EB	12x12 ft CBC	196	2070
205.3	WB & EB	6x7 ft CBC	215	2080
206.5	WB & EB	2-10x8 ft CBC	130	2085
206.7	WB & EB	10x10 ft CBC	172	2090
207.5	WB & EB	6x7 ft CBC	240	2095
208.5	WB & EB	10x7 ft CBC	234	2100
209.4	WB & EB	6x7 ft CBC	139	2105
210.4	WB & EB	10x10 ft CBC	346	2110
213.2	WB & EB	3-10x8 ft CBC	192	2115
213.8	WB & EB	8x7 ft CBC	196	2120

CBC = concrete box culvert
CMP = corrugated metal pipe

Existing Flood Zones

The following table indicates the existing Federal Emergency Management Agency (FEMA) designated flood zones as shown on the Flood Insurance Rate Maps (FIRM) along the I-40 corridor.

Table 5 – FEMA Floodplain Delineation

FIRM PANEL NUMBER	WASH OR CREEK	LOCATION	FEMA FLOOD DESIGNATION
040020 0011 B	Volunteer Wash	MP 195.3	Zone A, Zone A4, Zone B
040020 0011 B	Sinclair Wash	MP 195.3	Zone A, Zone A4, Zone B
040020 0012 B 040020 0008 B 040020 0004 C	Rio de Flag	Multiple crossings	Zone A, Zone A5, Zone A15, Zone B
040020 0007 D	Switzer Canyon Wash	MP 198.9	Zone A2
040020 0008 B	Spruce Avenue Wash	MP 199.0	Zone A
040020 0003 C	Fanning Drive Wash	MP 200.4	Zone A1
040020 0004 C	Penstock Avenue Wash	MP 201.8	Zone A1
040019 3600 B	Wildcat Canyon Creek	MP 206.5	Zone A
040019 3600 B	Walnut Creek	MP 210.1	Zone A

The FEMA flood zones are defined as follows:

Zone A is defined as “no base flood elevations determined.”

Zones A1 - A30 are defined as “areas of 100-year flood; base flood elevations and flood hazard factors determined.”

Zone B is defined as “areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (medium shading)”

The remaining areas adjacent to I-40 are identified as Zone C. FEMA defines Zone C as “areas of minimal flooding. (no shading)”

1.5.5 Right-of-Way

Existing R/W widths vary along the corridor. In areas where the eastbound and westbound roadways are parallel, R/W widths are generally in the range of 400 feet, (offset 100 feet from the existing eastbound and westbound horizontal alignments). At interchanges, the R/W widths increase from 600 to more than 2000 feet. In sections where the eastbound and westbound alignments are bifurcated, R/W widths increase to as much as 900 feet. Table 6 describes the existing right-of-way widths throughout the corridor.

Table 6 – Existing Right-of-Way Widths

BEGIN MP	END MP	APPROXIMATE R/W WIDTH (FEET)	NOTES
183.0	184.3	400-610	
184.3	184.9	400	
184.9.	185.3	400-800	Bellemont TI
185.3	187.9	400	
187.9	188.9	350	BNSF railroad to the south
188.9	189.5	375	
189.5	189.7	400	
189.7	190.1	475	
190.1	190.2	400	
190.2	191.1	300-1000	A-1 Mountain TI and Riordan RR bridges
191.1	191.2	400	
191.2	191.8	400-1700	West Flagstaff TI
191.8	192.2	400	
192.2	192.8	400-1200	Flagstaff Ranch TI
192.8	192.9	400	
192.9	195.2	400-650	Woody Mountain UP
195.2	195.8	430-2200	I-40/I-17 system interchange
195.8	196.7	420-460	Lone Tree OP
196.7	198.1	400-900	Rio de Flag bridges
198.1	198.5	400-900	Butler TI
198.6	200.9	400	
200.9	201.6	400-1200	Country Club TI
201.6	204.3	400	
204.3	205.1	400-800	Walnut Canyon TI
205.1	206.4	400	
206.4	206.6	475	
206.6	206.9	465	
206.9	207.6	400-1000	Cosnino TI
207.6	208.5	400-1300	Closed Walnut Canyon Rest Area
208.5	210.0	400	
210.0	210.3	425	
210.3	210.7	400	
210.7	211.0	380	
211.0	211.4	380-1000	Winona TI
211.4	212.5	400	
212.5	214.0	356	

1.5.6 Existing Structures

The existing I-40 bridges within this corridor are in good overall structural condition according to the 2008 ADOT Bridge Management Section inspection and maintenance documents. There are a total of 30 bridges at 17 locations, including four bridges within the I-40/ I-17 system TI.

The existing structures are listed in Table 7.

Table 7 – Existing Structures

STR NO.	MILEPOST	BUILT	LENGTH (Ft)	WIDTH (Ft)	LOCATION	STRUCTURE TYPE	VERTICAL CLEARANCE (Ft-in)	LAST INSPECTION
783	185.15	1963	155	34	Bellemont TI UP EB	3-Span Continuous Rolled Steel Girder	17'-11"	2008
1083	185.15	1963	155	34	Bellemont TI UP WB	3-Span Continuous Rolled Steel Girder	17'-3"	2008
896	190.54	1966	302	28	A1 Mountain TI UP	4-Span Continuous Welded Plate Girder	16'-7"	2008

Table 7 – Existing Structures

STR NO.	MILEPOST	BUILT	LENGTH (Ft)	WIDTH (Ft)	LOCATION	STRUCTURE TYPE	VERTICAL CLEARANCE (Ft-in)	LAST INSPECTION
332	190.86	1950	507	42.2	Riordan BNSF RR OP EB	8-Span Continuous Rolled Steel Girder	22'-6" *	2008
897	190.86	1966	396	42.2	Riordan BNSF RR OP WB	6-Span Welded Plate Girder	22'-10" *	2008
1128	191.69	1965	123	38.2	W. Flagstaff TI OP EB	3-Span Continuous Reinforced CIP T-beams	15'-0"	2008
1129	191.69	1965	121	38	W. Flagstaff TI OP WB	3-Span Continuous Reinforced CIP T-beams	15'-3"	2008
2027	192.56	1987	160	42	Flagstaff Ranch TI OP EB	Post-tensioned Concrete Box Girder	16'-8"	2008
2020	192.56	1986	160	42	Flagstaff Ranch TI OP WB	Post-tensioned Concrete Box Girder	15'-10"	2008
1132	193.47	1966	178	26	Woody Mountain Road UP EB	3-Span Continuous Reinforced CIP T-beams	16'-6"	2008
1133	193.47	1966	176	26	Woody Mountain Road UP WB	3-Span Continuous Reinforced CIP T-beams	16'-3"	2008
1262	195.22	1965	347	63.4	SR 89 A OP WB	6-Span Continuous Concrete Box Girder	22'-10"	2008
1261	195.22	1966	347	44	SR 89A OP EB	6-Span Continuous Concrete Box Girder	24'-4"	2008
1263	340.02**	1966	213	45	I-40 TI OP EB	4-Span Continuous Concrete Box Girder	16'-3"	2008
1264	340.02**	1966	213	44	I-40 TI OP WB	4-Span Continuous Concrete Box Girder	16'-3"	2008
1180	196.26	1966	107	37.5	Lone Tree Road OP EB	3-Span Continuous Concrete Slab	15'-6"	2008
1181	196.26	1966	107	37.5	Lone Tree Road OP WB	3-Span Continuous Concrete Slab	15'-9"	2008
1482	197.43	2005	312	60	Rio de Flag Bridge EB	3-Span Continuous Concrete PC/PS Girder	N/A	2008
1483	197.43	2005	324	60	Rio de Flag Bridge WB	3-Span Continuous Concrete PC/PS Girder	N/A	2008
2076	198.28	1988	247	42	Butler Avenue TI OP EB	3-Span Continuous Rolled Steel Girder	16'-5"	2008
2077	198.28	1988	252	42	Butler Avenue TI OP WB	3-Span Continuous Rolled Steel Girder	16'-4"	2008
1182	199.3	1968	116	40	Fourth Street UP EB	1-Span Welded Plate Girder	19'-11"	2008

Table 7 – Existing Structures

STR NO.	MILEPOST	BUILT	LENGTH (Ft)	WIDTH (Ft)	LOCATION	STRUCTURE TYPE	VERTICAL CLEARANCE (Ft-in)	LAST INSPECTION
1183	199.3	1968	119	40	Fourth Street UP WB	1-Span Welded Plate Girder	16'-8"	2008
1926	201.1	1989	367	68	Country Club Road TI UP	3-Span Concrete PC/PS Girder	16'-3"	2008
1270	204.87	1966	283	42	Walnut Canyon TI UP EB	3-Span Continuous Rolled Steel Girder	16'-0"	2008
1271	204.87	1966	306	42	Walnut Canyon TI UP WB	3-Span Continuous Rolled Steel Girder	16'-3"	2008
1361	207.24	1967	311	26	Cosnino Road TI UP	5-Span Continuous Rolled Steel Girder	15'-10"	2008
2431	210.24	1997	306	42	Walnut Canyon Bridge WB	3-Span Concrete PC/PS Girder	N/A	2008
2588	210.24	2001	283	42	Walnut Canyon Bridge EB	3-Span Concrete PC/PS Girder	N/A	2008
1084	211.16	1967	278	31	Winona TI UP	5-Span Continuous Rolled Steel Girder	16'-0"	2008

Based on Arizona State Highway System Bridge Record - January 1997 – and more recent information as available

* Minimum vertical clearance measured to BNSF railroad tracks.

** Milepost for I-40 TI OP EB & WB Bridges is based on I-17.

CIP = cast in place

PC/PS = precast/prestressed

The bridges within the study corridor range in age from 5 to 60 years old. Some are reported to have lateral and vertical clearances that do not conform to current design standards. These bridges are typically listed as “functionally obsolete” in the structure inventory and appraisal data. Others have structural or load capacity issues and are listed as “structurally deficient.” A "functionally obsolete" bridge is one that was built to standards but does not meet the current minimum federal vertical and horizontal clearance requirements for a new bridge. A "structurally deficient" bridge typically needs maintenance and repair and eventual rehabilitation or replacement to address deficiencies. The term "structurally deficient" does not imply that it is unsafe. Both terms are used to determine eligibility for federal bridge replacement and rehabilitation funding.

Table 8 summarizes the bridges in these categories:

Table 8 – Functionally Obsolete and Structurally Deficient Bridges

STR NO.	MP	LOCATION	FUNCTIONALLY OBSOLETE	STRUCTURALLY DEFICIENT	LOAD CAPACITY < HS 20
783, 1083	185.15	Bellemont TI UP EB & WB		X	X
1128, 1129	191.69	West Flagstaff TI OP			X

STR NO.	MP	LOCATION	FUNCTIONALLY OBSOLETE	STRUCTURALLY DEFICIENT	LOAD CAPACITY < HS 20
1132	193.47	Woody Mountain Road UP EB			X
1262	195.22	HWY 89A OP WB	X		
1263, 1264	340.02 *	I-40 TI OP EB & WB	X		
1270, 1271	204.87	Walnut Canyon TI UP	X		X
1361	207.24	Cosnino Road TI UP	X		
1084	211.16	Winona TI UP	X		X

* I-40 TI OP EB & WB based on I-17 milepost.

Overpass Bridges

Within the project limits, there are seven overpass bridge locations, all of which consist of independent eastbound and westbound structures.

- The Riordan BNSF RR OP bridges consist of individual eastbound and westbound structures crossing the railroad tracks, a small wash, and Naval Observatory Road. The eastbound bridge was constructed in 1950 and widened 12 feet in 1990. It is an eight-span steel girder bridge with a sufficiency rating of 95.24. The westbound bridge was constructed in 1966 and also widened 12 feet in 1990. It is a 6-span steel girder bridge with a 48° skew angle and a sufficiency rating of 96.24. The controlling vertical clearances occur over the railroad tracks and are listed as 22.51' and 22.87' for the eastbound and westbound bridges, respectively. ADOT vertical clearance standards at railroad crossings require 23'-6" over the tracks. The eastbound and westbound bridges also have non-conforming lateral clearances at Observatory Road of 5'-6 and 8'-0, respectively. BNSF currently operates two tracks in this area but has expressed interest in constructing additional tracks (time frame unknown).

- The West Flagstaff TI OP bridges consist of three-span, reinforced concrete T-beam structures. They are skewed at 14° and were constructed in 1965. According to 2008 bridge inspection reports, both bridges have sufficiency ratings of 86.84 and are reported as having non-conforming vertical and lateral underclearances and a load rating less than HS 20.

- The Flagstaff Ranch TI OP bridges are 160-feet long, single-span post-tensioned box girder bridges. The eastbound bridge was constructed in 1987 and the westbound bridge in 1986. Both bridges have sufficiency ratings of 97.31.

- The bridges at the SR 89A OP and at the I-40 TI OP are within the I-40/I-17 system TI; both are reinforced concrete box girder bridges. The eastbound SR 89A OP bridge was constructed in 1966 and the westbound SR 89A OP bridge was constructed in 1965. Both are six-span bridges. The sufficiency ratings are 95.29 for the eastbound bridge and 91.26 for the westbound bridge. The westbound bridge has also been listed as functionally obsolete due to low underclearance ratings. These bridges also serve as a crossing location for the Flagstaff Urban Trail System (FUTS) under I-40. The I-40 TI OPs are both four-span bridges and were constructed in 1966. The 2008 bridge inspection reports have classified these bridges as functionally obsolete because of deck geometry issues and non-conforming lateral and vertical underclearances. The sufficiency ratings for these bridges are 92.0 for the eastbound bridge and 75.0 for the westbound bridge.

- The Lone Tree Road OP bridges consist of three-span continuous concrete slab bridges skewed at approximately 27° and constructed in 1966. Both bridges have sufficiency ratings of 91.96 but have been classified as functionally obsolete due to non-conforming lateral and vertical underclearances. The Lone Tree Road OP bridges provide a crossing location under I-40 for the FUTS.

- The Butler TI OP bridges consist of three-span steel girder bridges on a 45° skew. They were constructed in 1988 and have sufficiency ratings of 96.01. According to the 2008 bridge inspection report, the vertical clearance is 16.4' at the eastbound bridge and 16.31' at the westbound bridge.

Underpass Bridges

There are eight underpass bridge locations within the project corridor. Four of these consist of single bridges that span both the eastbound and westbound lanes of I-40. These structures occur at A-1 Mountain TI UP, Country Club TI UP, Cosnino TI UP and Winona TI UP.

The A-1 Mountain TI bridge is a four-span steel girder bridge built in 1966 and has a sufficiency rating of 96.95, according to the 2008 bridge inspection report. The bridge at Country Club TI UP is a precast prestressed concrete girder bridge constructed in 1989 and has a sufficiency rating of 89.84. The bridge deck includes a 6-foot sidewalk on the east side of the structure which provides a crossing over I-40 for the FUTS. The bridges at Cosnino Road and Winona are both five-span steel girder bridges. They were constructed in 1967 and have sufficiency ratings of 94.94 and 91.65, respectively. Both the Cosnino Road and Winona bridges have been classified as functionally obsolete.

The remaining underpass bridge locations at Bellemont TI UP, Woody Mountain Road UP, Fourth Street UP, and Walnut Canyon TI UP, consist of independent eastbound and westbound bridges over I-40. These bridges are located where the terrain and/or the I-40 horizontal alignment create a wide median, making a single bridge impractical.

The bridges at Bellemont TI UP are three-span steel girder bridges, constructed in 1963. According to the 2008 bridge inspection reports, they both have sufficiency ratings of 85.47 and are structurally deficient due to inventory ratings of HS-15.6.

The bridges at Woody Mountain Road UP consist of three-span reinforced concrete T-beam structures constructed in 1966. The eastbound bridge is skewed at 28° and has a sufficiency rating of 89.60, while the westbound bridge is skewed at 30° and has a sufficiency rating of 88.96.

The bridges at the Fourth Street UP consist of 115-foot long, simple span welded plate girder bridges constructed in 1968. Both bridges have sufficiency ratings of 92.93. The 2008 bridge inspection report for the eastbound bridge stated that the abutment backwalls have major spalls and delamination that require repair. A recent City of Flagstaff corridor study for the Fourth Street South Corridor recommended replacing the bridges. The Fourth Street UP bridges also provide a crossing for the FUTS over I-40.

The Walnut Canyon TI UP bridges were constructed in 1966 as three-span steel girder bridges skewed at 26°. They have sufficiency ratings of 94.90, according to the 2008 bridge inspection reports and are reported as functionally obsolete due to non-conforming underclearances.

Canyon Bridges

The existing Rio de Flag bridges are comprised of independent eastbound and westbound structures. Each is a three-span precast prestressed concrete girder bridge. The total eastbound bridge is 312'± long, with spans of

101.75'+103'+101.75', and the westbound bridge overall length is 324'±, with span lengths of 105.75'+107'+105.75'. Both bridges were constructed in 2005 and have sufficiency ratings of 95.02.

The existing bridges cross the Rio de Flag, a tributary of the San Francisco Wash that eventually feeds into the Little Colorado River. Rain storms and snow melt drain to the Rio de Flag. Effluent from the Wildcat Hill Wastewater Treatment Plant is discharged into the channel, creating a small perennial stream. The Rio de Flag channel in this area is also part of the FUTS and crosses under I-40 at this location.

The existing Walnut Canyon bridges are also comprised of independent eastbound and westbound structures. Each is a three-span precast prestressed concrete girder bridge. The eastbound bridge is 283' ± long with spans of 90'+95'+91' and was constructed in 2001. The overall westbound bridge length is 306'± with span lengths of 99.5+101'+99' and was constructed in 1997. Both bridges are skewed at 20° and have sufficiency ratings of 97.30.

Pipes and Box Culverts

Pipes and box culverts cross I-40 at numerous locations within the project corridor. Ten culverts appear on the ADOT Bridge Inventory with overall span lengths of 20 feet or more. The latest available inspection reports for these structures, dated 2006 and 2010, reflect sufficiency ratings ranging from 82.13 to 97.19.

1.5.7 Geotechnical

Geologic Setting

The project corridor is located in both the Colorado Plateau Physiographic Province which can be characterized as regionally elevated structural block consisting of gently dipping to flat lying, older sedimentary rocks that locally has been overlain by a thick sequence of volcanic rocks. Where exposed at the surface, the older sedimentary rocks have severely eroded to form a series of low hills and minor undulating valleys with entrenched, meandering drainage systems. Younger volcanic activity has subsequently modified large areas of this older terrain by burying the former valleys and drainages with thick sequences of volcanic lava flows and pyroclastic deposits.

The sedimentary rocks exposed in the general Flagstaff area consist of the Coconino Sandstone and the Kaibab Formation, both the Permian age, and the Moenkopi of Triassic age. The volcanic rocks of Tertiary to Quaternary age include basalt, andesite and dacite flows with agglomerate and cinder deposits from the San Francisco volcanic field. The bedrock sequence is locally overlain by alluvium, colluviums and residual soils formed by in situ rock decomposition, tuff deposits, cinder deposits, and manmade fill.

The San Francisco volcanic field, flanking the City of Flagstaff, is a large area of geologically recent, though currently dormant, volcanic activity that is responsible for creating most of the mountainous terrain features in the vicinity. Some of the most prominent examples of volcanic activity in the area are located just north of the I-40 corridor in the San Francisco Peaks. The majority of the volcanic features adjacent to the highway corridor are basaltic cinder cones. Major occurrences of volcanic deposits generally occur within the project corridor from MP 183.0 to MP 194.5, MP 197.8 to MP 199.05, and MP 210.5 to MP 212.0. Isolated smaller sections of volcanic materials are located throughout the study area.

The Kaibab Formation is divided into two distinct units. The lower unit is called the Fossil Mountain Member, and the upper unit is the Harrisburg Member. The Fossil Mountain Member is a light grey, cherty, thickly-bedded limestone to sandy limestone. The chert occurs in nodules, or lenses and layers of intra-formation breccias. The Harrisburg Member is an inter-bedded sequence of light red to gray limestone, dolomite, siltstone, sandstone, and gypsum. The Harrisburg Member of the Kaibab Formation is exposed from a quarter mile east of the I-40/ I-17 system interchange, at Lone Tree Road, Butler Avenue and the Fourth Street Bridge. From MP 201.95 to MP 202.2, roughly a quarter mile east of the Rio de Flag, the Fossil Mountain Member is exposed in the highway road cuts. After this point the Harrisburg Member reemerges as the dominant exposure of Kaibab Formation except in the immediate area of the Walnut Canyon Bridge. The Harrisburg Member continues under the volcanic rocks at Winona east to MP 214, the eastern end of the study.

Soil Conditions

Within the project corridor, most of the bedrock is mantled by a veneer of colluviums. The colluviums generally are less than several feet in thickness, but may locally exceed ten feet. Colluvial deposits that overlie the Kaibab Formation typically range from medium to coarse grained silty sand with some coarse-grained gravel and occasional cobbles and small boulders. However, low to high plasticity clayey soil materials also occur due to the introduction of pyroclastic materials from past volcanic activity. Colluvial deposits that overlie basalt typically consist of well graded, subangular clayey sand and clay with varying amounts of cobbles and boulders. These deposits generally are medium to high in plasticity, dark brown to reddish brown and locally contain considerable organic material.

There are recent alluvial deposits in most of the larger drainages within the project corridor limits. The alluvial deposits typically are composed of sand and gravel with varying amounts of cobbles and boulders. The majority of these soils west of the Butler TI have a top cover of two to three inches of decomposing forest organics that are generally regarded as unusable construction material.

Existing Rockfall Hazards

ADOT's Slope Management System (ASMS) has been in operation since 1989. The intent of the ASMS program was to be a proactive method for mitigating slopes with histories of rockfall hazards. The slope inventory process categorizes slopes along the state transportation system that have shown signs of rockfall events that are potentially hazardous and require recurrent maintenance activities. The inventory consists of field surveys which identified the sites and assigned a Severity Level with rankings from 1 through 5 with 5 as the most severe, and included comments concerning the types of problems encountered. The ADOT Materials Group reviews this information and compiles the data for further evaluation based on the Severity Level. For each indentified site, an additional field evaluation is conducted and integrated with information from the ADOT Districts' surveys into a systematic database which completes the inventory process. This database ranks the surveyed cut sections by priority points on a statewide basis. These rankings are used to aid in prioritizing future rockfall containment projects.

There are six identified rockfall sites within the project limits with notable priority point ratings.

ADOT provided a 2004 Rock Hazard Rating System (RHRS) summary for existing cut slopes within the project limits. The summary lists: 1) the starting and ending mileposts of the cut, the direction of travel (E or W), and the side of the roadway (R or L) on which the cuts are located; 2) the severity (degree of instability) of the slope; 3) the number of priority points (the higher the number the greater the perceived instability of the slope); and 4) field comments and/or recommendations.

Three of the existing cut slopes in the project corridor were rated by ADOT as a 5 on the severity scale according to the 2004 RHRS. There are three other existing cut slopes rated 3 within the project limits. The cut slope inventory also identified a number of existing cut slopes with inadequate rockfall containment ditches.

In general, the existing cut slopes are generating a considerable amount of rockfall, small slides were observed in the cut slopes, and the rockfall containment ditches generally are undersized. Table 9 shows the existing cut slope rating from the 2004 RHRS.

Table 9 – 2004 Rock Hazard Rating System Summary

MP		DIRECTION	SEVERITY	PRIORITY POINTS	SURVEY DATE	COMMENTS/ RECOMMENDATIONS
START	END					
188.9	188.5	WB	5	558	2/18/2004	1. Widen and deepen ditch 2. Scaling 3. Drape 4. Lay back slope
189.5	189.2	WB	5	420	2/18/2004	1. Scaling 2 Widen and deepen ditch 3. Lay back slope 4. Drape
190.9	190.7	WB	5	504	2/18/2004	1. Deepen ditch 2. Drape 3. Scaling
199.1	199.4	E-R	3	330	2/18/2004	1. Widen and deepen ditch
199.4	199.1	WB	3	336	2/18/2004	1. Widen and deepen ditch 2. Lay back slope 3. Drape
202.0	202.2	EB	3	354	2/18/2004	1. Widen and deepen ditch 2. Drape 3. Lay back slope

Groundwater/Surface Water Conditions

Within the study limits, perched ground water conditions are present. Normally shallow aquifers are found close to the surface of unconsolidated alluvium, volcanic rocks and in the interbedded sandstones in either the Moenkopi or in the Kaibab Formations. Uncontrolled ingress of moisture during and after construction can lead to construction delays and premature deterioration of embankment fills and pavement distress. The potential impact of perched ground water should be investigated further during the final geotechnical investigation for all segments of this project.

Pavement Conditions

In general, the pavement is in fair condition, although the segment of I-40 from approximately MP 195 to MP 202 is recommended for complete replacement. The I-40 pavement from approximately the Riordan railroad crossing to the Country Club TI was rehabilitated in Summer 2010.