ADOT

Prepared for:
Arizona Department of Transportation

Prepared by:
Stanley Consultants, Inc.
1661 E. Camelback Road, Suite 400
Phoenix, Arizona 85016

Stanley Consultants INC.

In Association with
EcoPlan, Wood, Corral Design Group, ACS, and
Newton Environmental Consulting

Final Design Concept Report

I-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction)

MP 229-262

ADOT Project No. 17 MA 229 H6800 01L
Federal Project No. STP-017-A(ARV)S

Phoenix – Cordes Junction Highway

APRIL 2019

PROJECT DETERMINATION FORM

Project Number and Federal ID	County and ADOT District	Project Name and Highway	Final Design Concept Report Date
017 MA 229 H6800 01L	Maricopa, Yavapai Counties	I-17, Anthem Way TI to Jct. SR 69	April 2019
017-A(ARV)S	Central, Northwest Districts	Phoenix-Cordes Junction Highway	

Project Description:	Widen I-17 Anthem Wy to Black Cyn City; construct flex lanes Black Cyn City to Sunset Point

Existing Program	
Yes	No
X	

Program Year	Programmed Budget
2020-2023	$207,800,000
	DCR Construction Cost Estimate
	$331,800,000

Operating Partnership Category					
S	F	T	D	Z	N/A
X					

Public Hearing: In the Highway Development Process, at least one public hearing or the opportunity for a hearing will be offered for any project that:

	Requires a significant amount of new right-of-way:
	Substantially changes the layout or function of connecting roadway or the facility being improved;
	Has a significant adverse impact on abutting real property;

	Otherwise has a significant social, economic, environmental or other effect
	Is controversial on environmental grounds;
	Or has significant floodplain encroachment
X	None of the above conditions apply

Recommends:

Yes:	No:				
	X	Public Forum	Environmental Category		
	X	Offer a combined Location / Design Hearing	Class 1	Class II	Class III
	X	Offer Separate Location/Design Hearing		X	
	X	Hold a Design Public Hearing			

DocuSigned by:
Asadul Karim, P.E. — Project Manager, Major Projects 605E — 5/2/2019 — Date

Concur:

DocuSigned by:
Raul Amavisca — 5/2/2019
Raul Amavisca, P.E. — Engineering Administrator, Central District PM00 — Date

DocuSigned by:
Alvin Stump — 5/3/2019
Alvin Stump, P.E. — District Engineer, Northwest District P800 — Date

DocuSigned by:
Gregory Byres — 5/3/2019
Greg Byres, P.E. — Director, Multimodal Planning Division 611E — Date

Comments:

_____

_____

Table of Contents

List of Figures

List of Tables

Glossary of Acronyms and Abbreviations

AA	aesthetic area
AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ABC	accelerated bridge construction
AC	asphaltic concrete
AC	alternating current
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AFNM	Agua Fria National Monument
AGFD	Arizona Game and Fish Department
ASLD	Arizona State Land Department
AT&T	American Telephone and Telegraph
BCC	Black Canyon City
BLM	Bureau of Land Management
CA	character area
CBC	concrete box culvert
CCTV	closed circuit television
CE	Categorical Exclusion
CIP	cast in place
CLOMR	Conditional Letter of Map Revision
CMP	corrugated metal pipe
COE	US Army Corps of Engineers
CV	connected vehicle
DCR	Design Concept Report
DDHV	directional design hourly volume
DEA	Draft Environmental Assessment
DMS	dynamic message sign
DPS	Department of Public Safety
DSRC	dedicated short range communications
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	flood insurance rate map
FY	fiscal year
HSIP	Highway Safety Improvement Program
I-10	Interstate 10
I-17	Interstate 17
I-40	Interstate 40
ICO	Issues, concerns, and opportunities
IDCR	Initial Design Concept Report
IHSDM	Interactive Highway Safety Design Model
ITS	Intelligent Transportation Systems
LED	light emitting diode
LOS	Level of Service
LRTP	Long Range Transportation Plan
MP	mile post
mph	miles per hour
MUTCD	Manual on Uniform Traffic Control Devices
NB	northbound
NEPA	National Environmental Policy Act
NISCP	Noxious and Invasive Species Control Plan
PEL	Planning and Environmental Linkages
RCBC	reinforced concrete box culvert
RDG	Roadway Design Guidelines
RDS	Roadside Design Section (ADOT)
RHRS	Rock Hazard Rating System
RMP	Resource Management Plan
RPM	raised pavement marker
ROW	right-of-way
SB	southbound
SE	superelevation
SN	structural number
SR	State Route
SWPPP	Storm Water Pollution Prevention Plan
TI	traffic interchange
TOC	Traffic Operations Center
TSM&O	Transportation Systems Management and Operations Group
US	United States
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
Waters	Waters of the United States
Western	Western Area Power Administration

EXECUTIVE SUMMARY

The Arizona Department of Transportation (ADOT), in partnership with the Federal Highway Administration (FHWA), has initiated Project No. 17 MA 229 H6800 01L [Federal Reference Number STP-017-A(ARV)S], a study to prepare the design concept for the addition of capacity to Interstate 17 (I-17) from the Anthem Way Traffic Interchange (TI) to the I-17 interchange with State Route 69 (SR 69). This project is located within the Arizona Department of Transportation's Central District and Northwest District in Maricopa and Yavapai counties. The overall study area begins at the I-17/Anthem Way TI at milepost (MP) 229.1 and extends north to the I-17/ SR 69 TI (also known as Cordes Junction) (MP 262.0).

ADOT has identified I-17 as a Key Commerce Corridor, which indicates that improvements to the transportation infrastructure support the greatest potential commercial and economic benefits. Key Commerce Corridors connect the major economic centers of Arizona with their major markets. As such, these inter-regional routes are the most essential for future, quality economic growth in Arizona and support high quality job growth. Efficient movement of supplies and goods support growth and expansion of base industries and the state's overall economy. The I-17 corridor is an important commerce and tourism corridor, connecting southern Arizona to northern Arizona. It connects the major east-west corridors of I-10 and I-40, facilitating the movement of goods, economic development, and tourism.

The study provides a long-range implementation strategy that will guide future decisions regarding the near-term and ultimate improvements to modify I-17 to meet the capacity and operational needs of the traveling public over the next 20-25 years. Implementation of the study recommendations will depend on funding availability and prioritization of roadway construction projects.

The No Build Alternative and Build alternatives were developed and evaluated for mainline I-17. The **Recommended Alternatives** are described as follows:

- In the near term, the **recommended widening** would provide an additional through lane in each direction between the Anthem Way TI and the Black Canyon City TI. It would add capacity in both directions, as well as match the improvements already completed south of the Anthem Way TI. This project is partially programmed for construction in fiscal year 2020.
- In the near term, **two flex lanes** would be constructed between Black Canyon City and Sunset Point. The flex lanes are new lanes that would be added along the median side of southbound I-17 and would be used by northbound traffic on Friday and Saturday and by southbound traffic on Sunday. It would add capacity in the peak direction, as well as provide flexibility for managing traffic during maintenance activities and crash-related restrictions.
- In the longer term, **Alternative E** is recommended, which would provide three southbound lanes on a new roadway alignment west of existing I-17 and four northbound lanes on the existing northbound and southbound roadways between Black Canyon City and Sunset Point. Alternative E would also widen the existing roadway between Sunset Point and Cordes Junction to three lanes in both directions. Constructing a new alignment provides incident management flexibility and opportunities for re-routing traffic for maintenance activities.

The Bureau of Land Management (BLM) manages nearly all of the land on both sides of I-17 and in several wide median areas between the existing northbound and southbound I-17 alignments. Approximately 4.5 acres of new right-of-way (ROW) and 2.9 acres of drainage easement are required for near-term improvements.

The following implementation strategy is recommended for the proposed improvements to I-17:

Near Term: Construct one additional general purpose lane in each direction from the Anthem Way TI to the Black Canyon City TI.

Near Term: Construct two flex lanes adjacent to existing SB I-17 from Black Canyon City to Sunset Point.

Long Term: Alternative E – construct two southbound lanes (three if the flex lanes were not previously constructed) on new alignment.

ADOT's Tentative 2020-2024 Five-Year Transportation Facilities Construction Program includes five line items for I-17 in the project area as shown in the table below.

Beg. MP I-17	County	ADOT District	Location	Type of Work	Length (mile)	Amount (in thousands)	Fiscal Year
229		MAG	Anthem Way-Yavapai County Line, SB	Construct Widening ROW for Widening Design Widening		$40,000 $5,000 $5,000	2020
238	MA	Northwest	Moores Gulch Bridge	Construct Bridge Replacement	1	$10,500	2023
245	YV	Northwest	Black Canyon – Sunset Point	Final Design Widen Roadway	5	$15,000 $62,402 $65,907	2020 2021 2022
248	YV	Northwest	Bumble Bee TI OP NB	Construct Bridge Rehabilitation	1	$4,000	2020
252	YV	Northwest	Sunset Point Rest Area	Design (Water & WW Repairs) Construct (Water & WW Repairs)		$575 $4,800	2021 2022

Work began on an Environmental Assessment (EA) in 2006; however, the scope of the environmental studies was reduced when FHWA/ADOT policies changed regarding the approval of environmental documents for projects that were not included in an approved transportation improvement program. A Planning and Environmental Linkages (PEL) Checklist was prepared in 2015 to document the efforts completed with the EA (e.g., biological resources, cultural resources), identify important issues identified during the study process, and provide a basis for identifying smaller projects which may accomplish some improvements at a lower cost. The preparation of a Categorical Exclusion (CE) is currently underway.

Additional reports prepared for this study include an AASHTO Controlling Design Criteria Report, Scoping Report, Preliminary Traffic Report, Preliminary Geotechnical Assessment, Preliminary Drainage Report, Cultural Resources Assessment, Visual Impact Assessment, Biological Evaluation, Air Quality Report, Preliminary Noise Analysis, Initial Site Assessment, and a Bridge Selection Report.

ADOT Multimodal Planning Division prepared a Corridor Profile Report for I-17 between Phoenix and Flagstaff in 2017. The profile study evaluated key performance measures relative to the I-17 corridor and used those measures as a means to set priorities for future improvements in areas that show critical deficiencies.

1.0 Introduction

1.1 Foreword

The Arizona Department of Transportation (ADOT), in partnership with the Federal Highway Administration (FHWA), has initiated a design concept study and related environmental studies to evaluate proposed improvements to Interstate 17 (I-17) in Maricopa and Yavapai counties, Arizona. The overall study area begins at the I-17/Anthem Way Traffic Interchange (TI) at milepost (MP) 229.1 and extends north to the I-17/Junction State Route 69 (SR 69) TI (Cordes Junction).

The design concept study area is located north of the Phoenix metropolitan area in south-central Arizona. The study area is located ADOT's Central and Northwest districts.

The study will provide a long-range implementation strategy that will guide future decisions regarding the interim and ultimate improvements required to modify I-17 to meet the capacity and operational needs of the traveling public over the next 20-25 years. A Categorical Exclusion is being prepared for I-17 between the Anthem Way TI and the Sunset Point TI. Implementation of the study recommendations will depend on funding availability and prioritization of roadway construction projects.

The functional classification for I-17 is Principal Arterial Interstate-Rural. The posted speed limit varies from 75 mph at the south end of the project, 65 mph in the Black Canyon Hill area (MP 244 to MP 252), and 75 mph from Sunset Point to Cordes Junction (MP 252 to MP 262).

1.2 Purpose of and Need for the Project

ADOT has identified I-17 as a Key Commerce Corridor, which indicates that improvements to the transportation infrastructure support the greatest potential commercial and economic benefits. Key Commerce Corridors connect the major economic centers of Arizona with their major markets. As such, these inter-regional routes are the most essential for future, quality economic growth in Arizona and supporting high quality job growth. Efficient movement of supplies and goods support growth and expansion of base industries and the state's overall economy. The I-17 corridor is an important commerce and tourism corridor, connecting southern Arizona to northern Arizona. It also connects the major east-west corridors of I-10 and I-40, two of the nation's principal east-west highways, and facilitates goods movement, economic development, and tourism.

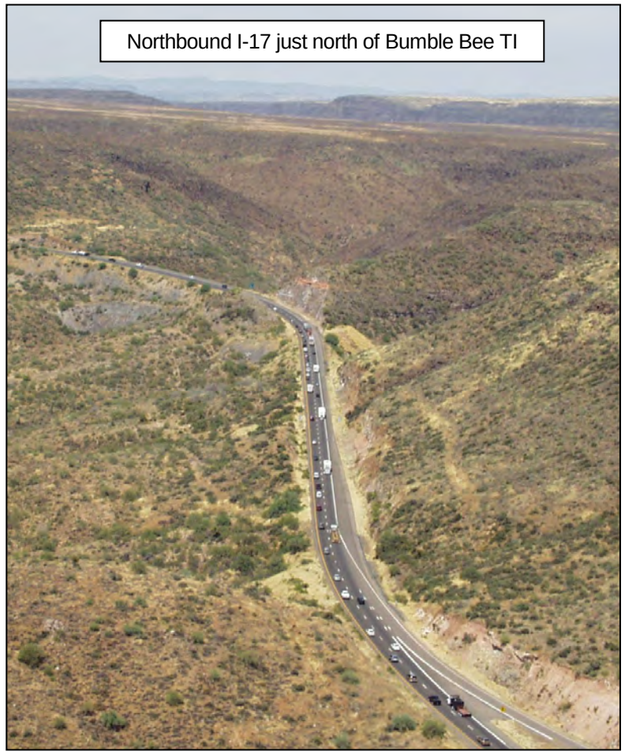
The preliminary priorities list from ADOT's 2015 Passing Lane/Climbing Lane Study reflects the segment of northbound I-17 between MP 246 and MP 250 as the highest-ranked need for a climbing lane on multi-lane highways in the state of Arizona. Another segment of I-17 within the study area, northbound from MP 255 to MP 256, also ranks high on the statewide list.

The purpose of this project is to add capacity to and improve operations of I-17 from the Anthem Way TI to Cordes Junction. The study will develop and evaluate feasible alternatives for the future expansion of I-17, as well as near-term improvements, to improve traffic operations and to accommodate projected traffic volumes in the 2040 design year. The results of the engineering analyses are fully documented in this Design Concept Report (DCR).

North of the New River TI, most of the study route is located adjacent to land that is administered by the Bureau of Land Management (BLM), including the Agua Fria National Monument (AFNM) abutting the eastern ADOT right-of-way between MP 245.0 and MP 260.3. BLM also manages the land west of I-17 for most of the project length, as well as portions of the median area between northbound and southbound I-17. The Arizona State Land Department (ASLD) administers most of the remaining adjacent land; however, the adjacent land between Anthem Way TI and just north of New River Road TI is owned by the City of Phoenix or is privately-owned.

The existing roadway is a four-lane divided rural highway with full access control, traversing level to rolling to mountainous terrain. I-17 from the Anthem Way TI to New River TI is in level terrain, while New River TI to Black Canyon City TI is in rolling terrain. The mountainous terrain extends from approximately MP 244.5 to MP 250.5 (Black Canyon City to Sunset Point). The I-17 horizontal and vertical alignments in this mountainous terrain present challenges related to steep grades and horizontal curves with limited sight distance. In addition, crashes can result in closures of I-17 that cause lengthy travel delays along the route. I-17 experiences heavy volumes during weekends and holidays as the main route for traffic between the Phoenix metropolitan area, Flagstaff, and recreational destinations to the north. The combination of large volumes of passenger cars, trucks, and recreational vehicles results in a substantial speed differential condition on the steep grades of the Black Canyon Hill. This condition affects the operational capacity of the interstate and results in congestion and long traffic back-ups. There are distant detour options for long-term closures; however, there are no alternate routes in the area for short-term closures.

The remaining segments of the northbound and southbound alignments are located within rolling terrain from MP 250.5 to Cordes Junction at MP 262.0, the north end of the study area.


Northbound I-17 just north of Bumble Bee TI

1.3 Description of the Project

The study area begins on I-17 at approximately MP 229, at its interchange with Anthem Way, and extends north to approximately MP 262, just south of the junction with SR 69. The I-17/SR 69 interchange, also known as the Cordes Junction TI, was reconstructed in 2013. A vicinity map detailing the study limits and the surrounding area is shown on Figure 1.

In the long term, constructing three southbound lanes on new alignment and converting the existing roadways to carry northbound traffic is recommended from MP 245 to MP 252 (approximately Black Canyon City to Sunset Point). The long-term project will add one new lane in each direction from MP 252 to MP 262 by widening to the inside of the existing northbound and southbound roadways.

In the nearer term, one additional through lane in each direction is recommended between Anthem Way and Black Canyon City, as well as two flex lanes on the Black Canyon Hill to add capacity and incident management flexibility.

1.4 Project Objectives

The addition of roadway capacity will help ADOT meet its long-range goal of providing an improved roadway from the Phoenix area to Flagstaff. Widening the roadway will lessen traffic congestion and improve the level of service.

The primary objectives of this study include the addition of mainline capacity to accommodate projected future traffic volumes. The addition of mainline lanes is anticipated to reduce congestion and travel times. The addition of an alternative alignment would provide flexibility for ADOT to more effectively manage incidents related to crashes, as well as relieve congestion and facilitate maintenance.

1.4.1 Public Involvement

To ensure that the community was given ample opportunity to provide comments and be involved in the development and evaluation of alternatives, this study included a public involvement process with public meetings, question and answer sessions, newspaper advertisements, and a project web site.

1.4.1.1 Scoping

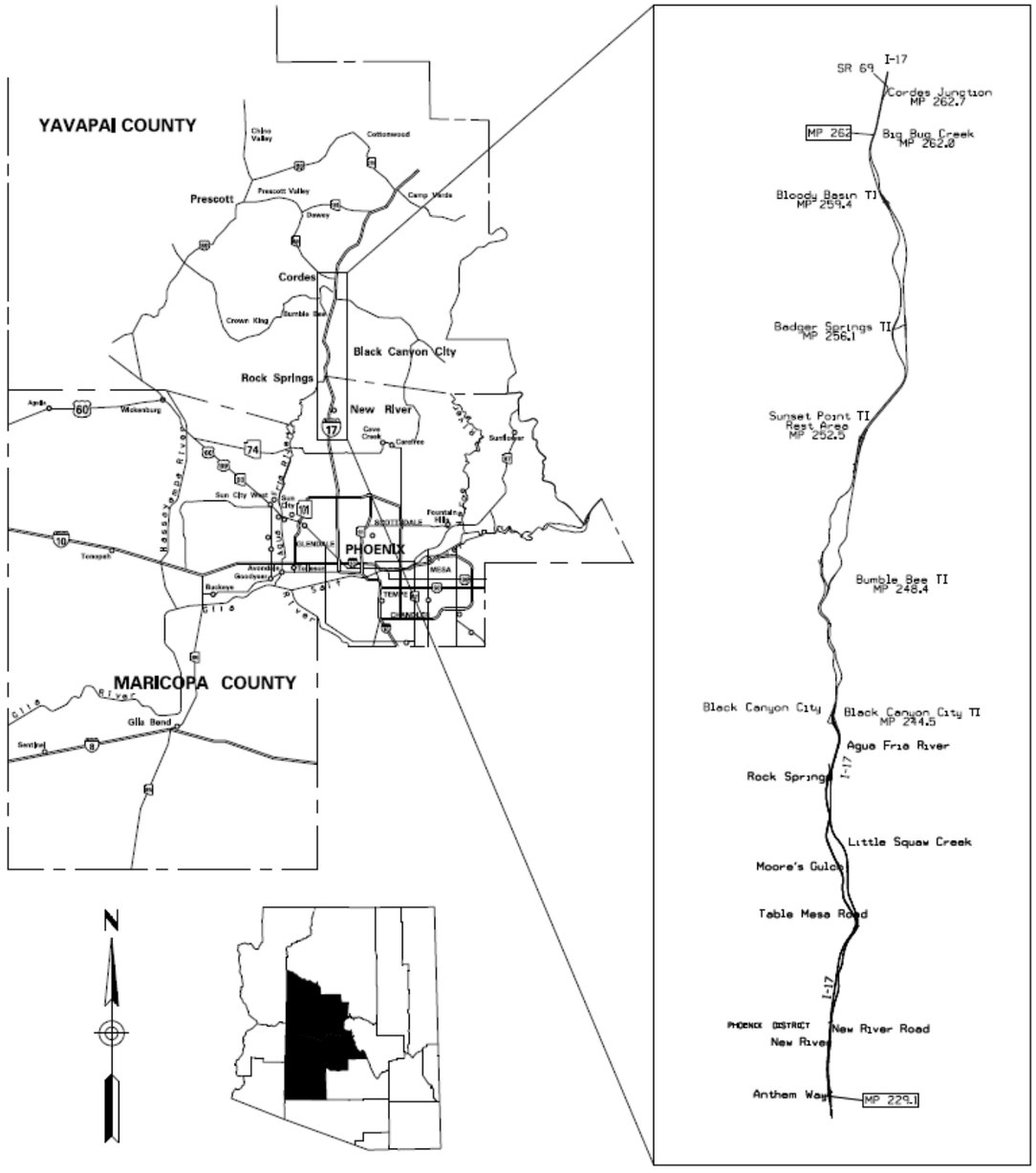
ADOT initiated the I-17 design concept study in 2006 by conducting scoping meetings with federal, state, county, and local agency representatives and the public. The scoping meetings for the project were held on July 13, 2006, in Spring Valley, Arizona. The purpose of these meetings was to provide a general overview of the study area and to obtain information from the agency representatives, business people, and area residents about the existing roadway and surrounding area, and to identify the issues, concerns, and opportunities (ICOs) that should be addressed by the evaluation criteria for use during the development and analysis of alternatives in the DCR and environmental document.

1.4.1.2 Public Information Meetings

Public information meetings were held on January 23, 2007, in Black Canyon City at Cañon School and on January 25, 2007, in Spring Valley at Mayer Junior/Senior High School. In total, 116 community members attended the meetings. Seventy people attended the meeting in Black Canyon City; 12 comment forms were completed. Forty-six people attended the meeting in Spring Valley; eight comment forms were completed. The purpose of these meetings was to present the preliminary alternatives initially developed for study and to solicit public comments on the alternatives.

An additional public meeting was held on April 3, 2018, from 6:00 to 8:00 pm at Cañon Elementary School to provide the public an update on potential improvements along I-17 within the project area. The format for the meeting was an open house; 216 people signed in at the meeting. There were three areas with project study boards on display for attendees to view, ask questions directly of project team, and leave comments if desired. There were also two areas with video capability for the public to view areas of interest; this method was used in lieu of roll plot maps. A ten-minute PowerPoint presentation by Alvin Stump, Northwest District Engineer, provided the public with an overview/history of the project and descriptions of the current project, including a video simulation of the proposed flex lanes. There was no formal question and answer at the end of presentation; rather, the public was invited to visit display areas and remain as long as necessary to ask questions and obtain the information they desired.

FIGURE 1 – VICINITY MAP



1.4.1.3 Other Activities

Throughout the study duration, a project web site has been used to provide up-to-date study information and to collect feedback from the public. The current web site address is https://www.azdot.gov/I17AnthemWaySR69.

1.5 Characteristics of the Corridor

Interstate 17 extends north from Jct. I-10 in central Phoenix to its northern terminus in Flagstaff, connecting I-10 to I-40.

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

TABLE 1 – PREVIOUS PROJECTS WITHIN STUDY AREA

PROJECT NO.	BEG. MP	END MP	CONSTR. DATE	DESCRIPTION
FAS-39(1947)	225.1	230.6	1947	GRADING & PAVING
NS 39(47)A	225.1	231.88	1948	BST
NS 39(48)A	231.9	231.92	1948	BRIDGE & ABUTMENTS
S 38(1)	244.8	247.87	1948	AGUA FRIA RIVER-ARRASTRE CREEK BST
S 39(4)	232.1	236.55	1949	BST
NS 38(50)A	247.9	251.35	1949	ROCK SPRINGS-CORDES JCT MBS
S 38(2)	247.9	251.35	1949	ARRASTRE CREEK-BLACK MESA BST
S 38(3)	251.2	259.59	1949	BLACK MESA STATION BST
NS 38(49)A	251.4	262.9	1949	ROCK SPRINGS-CORDES JCT MBS
NS 39(51)A	220.5	234.5	1950	PHOENIX - ROCK SPRINGS SEAL COAT
S 39(5)	236.6	239.66	1950	GD
S 39(6)	236.6	242	1950	BST
NS 38(50)C	244.8	259.72	1950	ROCK SPRINGS-CORDES JCT GUARD RAIL
538(5)	262	262	1950	BIG BUG CREEK BRIDGE
S 38(5)	259.7	262.21	1951	BLACK MESA-CORDES JCT BST
NS 39(55)A	229	236	1954	NEW RIVER - TABLE MESA SEAL COAT
NS 38(54)A	252.4	259.73	1954	BADGER SPRINGS-SOUTH SEAL COAT
NF 156(56)A	236.6	241.8	1955	NEW RIVER - COUNTY LINE SEAL COAT
NF 156(56)B	244.8	253.3	1955	SPRINGS-NORTH SEAL COAT
FI 156(4)	259.7	269.67	1955	BIG BUG CREEK- CORDES JCT BST
F 003-2(58)	217	229.7	1957	PHOENIX - CORDES JUNCTION HWY SEAL COAT
NI 003-2-58A	217	229.7	1957	SKUNK CREEK BRIDGE – NORTH SEAL COAT
NI 17-1(60)A	251	260	1959	ROCK SPRINGS-CORDES JCT SEAL COAT
I 17-1(23)	261	264	1960	CORDES JCT-SOUTH AC
NI 17-1-501	228.5	234.5	1961	BELL ROAD - YAVAPAI COUNTY LINE SEAL COAT
NI 17-1(61)A	259.7	261.36	1961	CORDES INTERCHANGE-SOUTH SEAL COAT
I 17-1(56)	220.5	225.08	1963	AC PAVEMENT
I 17-1(29)22	220.7	233.1	1963	AC PAVEMENT
I 17-1(44)	254	260.98	1963	BADGER SPRINGS-CORDES JCT OVERLAY
I-17-1(57)	225.1	230.57	1964	AC PAVEMENT
I 17-1(37)	242.3	244.93	1964	NORTH GD
I 17-1(59)	242.3	244.93	1964	NORTH BC AC
I 17-1(54)	245	247.86	1964	BLACK CYN-BUMBLE BEE TI (NB) GD
I 17-1(62)	236.8	243.11	1965	AC PAVEMENT
I 17-1-905	241.8	251.6	1965	MARICOPA COUNTY LINE - NORTH SEAL COAT
I 17-1-907	242		1965	NORTH CMP FOR ACCESS ROAD
I 17-1(67)	242.5		1965	GRADE SEPARATION/STRUCTURES
I 17-1-503	244.8	245.19	1965	BLACK CANYON TI REVAMP OFFRAMP
I 17-1(60)	248	250.37	1965	BUMBLEE TI-SUNRISE PT GD/STR (NB)
I 17-2(29)	262	263	1965	CORDES JCT INTERCHANGE LANDSCAPING
I 17-1(61)	230.5	236.33	1966	AC
I 17-1(55)	245	254.18	1966	BLACK CYN-BADGER SPRING (NB) BC-AC
I-17-1(74)	226.95		1967	
I 17-1(65)	245	254.13	1967	BLACK CANYON-BADGER SPRING AC (SB)
I 17-1-916	213.4	230.5	1968	BELL ROAD – NEW RIVER SEAL COAT
LSI 17-1(77)	216.7	233.95	1968	DEER VALLEY - BLACK CANYON TI LANDSCAPING
I 17-1(70)	242.1		1969	ROCK SPRINGS TI LIGHTING
I 17-1-924	242.5	253	1969	ROCK SPRINGS - CORDES JUNCTION SEAL COAT
I 17-1(49)	252	252	1969	SUNSET POINT REST AREA FACILITIES
I 17-1-926	252	252	1969	SUNSET REST AREA TEST WELL
I 17-1-929	213.4	241.6	1970	BELL ROAD - YAVAPAI COUNTY LINE SEAL COAT
I-17-1(113)	232	232	1973	NEW RIVER TI LIGHTING
17-2(22)64	261.4	262.3	1973	CORDES JUNCTION TI
I 17-1-951	229.1	233.1	1974	DESERT HILLS - NEW RIVER SEAL COAT
I 17-2-908	262	269.14	1974	CORDES JCT-ASH CREEK SEAL COAT
I 17-1-971	239.5		1975	SB REPAIR
I 17-1(120)	230.7	233.3	1976	NEW RIVER TI SIGNING
ER 17-1-988	243.3	243.5	1979	AGUA FRIA RIVER BRIDGE – DEMOL (STRM) 12/78 SEE (139)
I 17-1-989	243.3	243.3	1979	AGUA FRIA RIVER BRIDGE 12/78 FLOOD DETOUR
ER 17-1(139)	243.4		1979	FLOOD DAMAGE
I-17-1(994)	231.4		1980	NEW RIVER BRIDGE MAINTENANCE
I 17-1-995	248.4	248.4	1980	BUMBLE BEE TI UP(SB) BRIDGE REPAIRS
I 17-1(82)	251	261.75	1980	SUNSET PT TI-CORDES JCT TI SAFETY

PROJECT NO.	BEG. MP	END MP	CONSTR. DATE	DESCRIPTION
I 17-1(136)	220.5	236.62	1981	RESURFACING
ER 17-1(144)	252	252	1981	SUNSET POINT REST AREA WATER LINE
I 17-1(145)	252	252	1981	SUNSET POINT REST AREA SEWER SYSTEM
IR 17-1(149)	225	238	1983	AC OVERLAY
I 17-1(83)	236.6	251.6	1984	TABLE MESA TI - SUNSET POINT TI PERMANENT SIGNING
IR 17-1(153)	238	244	1984	AC&ACFC
I 17-3-911	239.5		1984	SB REPAIR
IR 17-1(157)	252.5	252.5	1984	SUNSET POINT REST AREA INCREASE LGHTG
IR 17-1(159)	244	250	1985	ACFC
IR 17-1(164)	250	256	1986	SUNSET POINT-BADGER SPRINGS AC OVERLAY
IR 17-1(168)	244	250.6	1989	REMOVE /REPLACE
I-17-1-891	252	252	1989	SUNSET POINT REST AREA VENDING MACHINES
IR 17-1(190)	245	245	1991	NB/SB BLACK CYN-SUNSET MILL REPL OLAY ACFC
I 17-1-514	251.8	251.8	1991	SUNSET POINT R A INFO BOARD
ER 17-1(224)	238	240	1993	BANK PROTECTION/SPUR DYKE STR
MA 17-1(226)	226	232	1994	OVERLAY NB & SB LANES
ER-17-1-(224)	238.2	239.55	1995	SCOUR PROTECTION AT MOORES GULCH AND LITTLE SQUAW CREEK
IM-17-1(327)	252.5	256.5	1998	SUNSET PT TI-BADGER SPRINGS TI PVMT PRES
I-17-1-549	229	229	1999	ANTHEM WAY TI
ITS-020-4(511)A	245.5	300.5	2006	INSTALLATION OF 511 SIGNING
017 YV 250 H720501C	250.4	252.5	2007	MILL AND REPLACE (NB)
IM-017-A(213)	229	279.34	2010	ANTHEM WAY TO CHERRY RD SIGN REHABILITATION
17-A(207)B	229.17	224.32	2010	SR 74 TO ANTHEM WAY – ROADWAY WIDENING
IM-HES-017-B(007)A	245.00	254.90	2010	MILL AND REPLACE, SAFETY IMPROVEMENTS
IM-017-1(345)A	251.27	251.87	2010	REST AREA REHABILITATION
17-A(214)A	239.36	239.74	2012	SB BRIDGE REPLACEMENT & NB BRIDGE DECK REHABILITATION
STP-017-A(223)A	251.27	251.87	2013	SUNSET PT REST AREA REHABILITATION
IM-017-B(001)N	261.52	263.68	2013	RECONSTRUCT TI
IM-017-A(229)T	245.0	250.4	2014	COLDWATER CYN RD-CROWN KING RD (NB)
17-A(226)T	231	232	2017	NEW RIVER BRIDGES – SCOUR RETROFIT
IM 17-1(220)	216	280		PINNACLE PEAK ROAD - CHERRY ROAD SIGN UPDATE
IM 17-1(329)	232	238.6		PHOENIX - CORDES JUNCTION HWY (I-17) - NEW RIVER - MOORES GULCH
N 900-0-538	232			PRESCOTT DISTRICT I-17 MINOR TI IMPROVEMENT PROGRAM
IM 17-1(342)	238.55	245		PHOENIX - CORDES JUNCTION HWY (I-17) - MOORES GULCH - BLACK CANYON - MI
IM 17-1(228)	245	250.4		BLACK CYN T.I-SUNSET POINT (NB)-MILL & REPLACE
I 017-A-504	245.2	249.8		PHOENIX-CORDES JCT. HIGHWAY (I-17), SB MP 245.2-MP 249.8
IM 17-1(340)	246	252.5		PHX-CRDS JCT HWY (I-17)-SNST PNT-SNST PT TI-M
AC IM-17-1(343)P	250	250		PHX-CRDS JCT HWY I-17-SNST PNT-RCKFLL CNTNMNT
TEA 17-1(332)	251.87	252.37		CONSTRUCT MEMORIAL OVERLOOK
IM 17-1(341)P	256	262.7		PHX-CRDS JCT HWY (I-17)-BDGR SPRNGS-CRDS JCT-
AC- 017-B(005)A	256.02	263.0		PHX-CORDES JCT HWY I-17 BADGER SPRINGS RD. BIG BUG CREEK- MILL & BRIDGE FIX

1.5.1 Roadway Characteristics

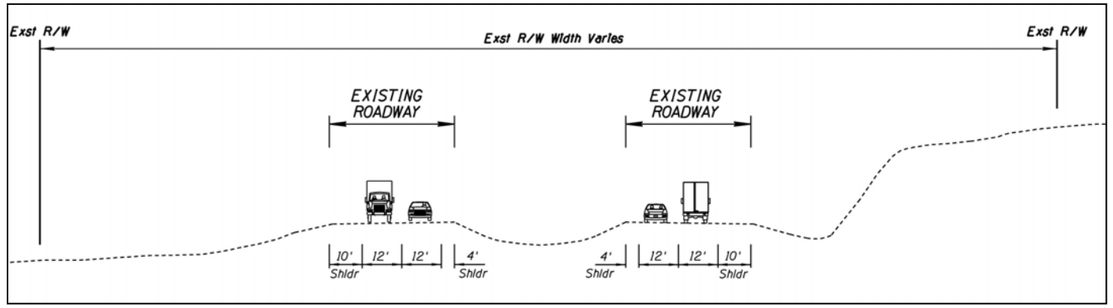
Traffic interchanges exist at the following locations:

TABLE 2 – ROADWAY CHARACTERISTICS

I-17 CROSSING	MP	COMMENTS
Anthem Way TI	229.1	Southern study limit - diamond interchange
New River TI	232.0	Diamond Interchange
Table Mesa TI	236.0	Trumpet-type Interchange with loop ramp in SW quadrant
Rock Springs TI	242.2	Diamond Interchange
Black Canyon City TI	244.4	Diamond Interchange
Bumble Bee TI	248.4	Diamond Interchange - wide median
Sunset Point TI / Rest Area	252.5	Rest area in southwest quadrant – compact diamond interchange
Badger Springs TI	256.1	Diamond Interchange – wide median
Bloody Basin TI	259.4	Diamond Interchange
Big Bug Creek bridges	262.0	Northern study limit
SR 69 / Cordes Jct TI	262.7	TI reconstructed in 2013

Interstate 17 is a four-lane divided highway within the study limits. The existing mainline lane widths are twelve feet, with ten-foot outside shoulders and four-foot inside shoulders. The existing pavement structure consists of asphaltic concrete (AC). The existing normal highway cross slope varies from 1.5% to 2.0%. The southbound roadway was the original two-lane highway built in 1949 and was constructed with a parabolic crown rather than a straight left-to-right cross slope. The northbound roadway was constructed in 1965 with a constant cross slope.

FIGURE 2 – EXISTING TYPICAL CROSS SECTION



Two-way frontage roads exist on both sides of I-17 from Anthem Way TI to New River Road TI (west frontage road ends south of New River bridge) and north of the Rock Springs TI.

The American Association of State Highway and Transportation Officials (AASHTO) publishes guidelines for a range of geometric design criteria, including horizontal degree of curvature, superelevation rate, profile grade, and stopping sight distance in the 2005 *A Policy on Design Standards, Interstate System* and the 2011 *A Policy on Geometric Design of Highways and Streets* (Green Book). 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 study area was separated into three segments based on terrain:

- MP 229.1-244.5 – Rolling Terrain
- MP 244.5-250.5 − Mountainous Terrain
- MP 250.5-262.0 − Rolling Terrain

Rolling Segment (MP 229.1 to MP 244.5)

The southern limit of the study area is the I-17/Anthem Way TI. North of the interchange, I-17 is a four-lane divided highway with a posted speed limit of 75 mph. The northbound and southbound roadways follow symmetrical horizontal alignments to New River Road TI at MP 232.0. I-17 crosses over New River at MP 231.4. The southbound I-17 roadway was originally constructed as SR 69. There are two-way frontage roads along both sides of the freeway in this area. The west frontage road ends just south of New River and the east frontage road ends north of New River Road.

North of the New River TI, the northbound and southbound roadways follow independent alignments, with the northbound roadway generally following the west side of New River. Much of this area will require roadway or rock excavation for widening. One exception is MP 235.3, where southbound I-17 is on a 50-foot tall embankment.

The Table Mesa TI is at MP 236.0. The bifurcated alignments become parallel and symmetrical just north of the Rock Springs TI at MP 242.2 and cross the Agua Fria River at MP 243.3.

Mountainous Segment (MP 244.5 to MP 250.5)

The mountainous segment begins at the Black Canyon City TI. North of this interchange, I-17 is a four-lane divided highway with a posted speed limit of 65 mph. This mountainous segment extends from Black Canyon City to the top of Black Mesa near Sunset Point. The roadway elevation increases by over 1,250 feet through the six-mile mountainous segment, from an approximate elevation of 2,130 feet at Black Canyon City to 3,390 feet at the top of Black Mesa. The northbound roadway grades range from +0.4% to +6.0% and the southbound grades range from +1.7% to -6.3%.

The northbound and southbound roadways follow independent alignments through this segment. The existing horizontal alignments consist of curves with degrees of curvature ranging from 0º30' to 4º00'. The superelevation on many curves does not meet current AASHTO standards; this condition occurs more often in the southbound direction, which was constructed as SR 69 in 1949.

The alignments follow the terrain up the Black Canyon Hill with winding curves which cut into the hillside and, in some locations, limit the available sight distance. The northbound and the southbound vertical alignments differ in elevation because of the steep terrain and do not provide opportunities for traffic to cross over between the roadways in case of an incident. At approximately MP 248, the southbound and northbound roadways are cut into an area known as Cape Horn. Rockfall issues exist in this area.

The Bumble Bee TI is located roughly halfway up the hill at MP 248.4. The TI provides access to the town of Bumble Bee and the Black Canyon valley floor. There are no services at this interchange.

North of the Bumble Bee TI, the I-17 roadways follow separate, divergent alignments to the top of the mesa. The northbound roadway continues along the face of the Black Canyon Hill until it reaches the top of the mesa. Just below the top of the mesa, a large cut segment with steep rock faces on both sides of the roadway require wire mesh draping over the slopes to prevent falling rock debris on the roadway. The southbound roadway north of the Bumble Bee TI follows a more westerly route around the face of the hill to the top of the mesa. This segment of roadway is winding and has grades steeper than 6%. At the top of the mesa (MP 250.5), the terrain changes from mountainous to rolling and the posted speed increases from 65 mph to 75 mph.


Looking north, I-17 MP 247

Rolling Segment (MP 250.5 to MP 262.0)

On the mesa, the terrain becomes less severe, with existing roadway grades ranging from -4.8% to +5.0% in the northbound direction and from -6.2% to +4.5% in the southbound direction.

From the Sunset Point TI (MP 252.5) to Big Bug Creek (MP 262.0), a 176-foot median separates the parallel northbound and southbound lanes. South of the Badger Springs TI (MP 256.1), the northbound and southbound roadway alignments diverge for several miles, then converge again near the Bloody Basin TI (MP 259.4). Median widths within the study limits vary from 64 feet to more than 1800 feet.

The Sunset Point Rest Area at MP 252.5 opened in 1970. Improvements at the rest area in 2013 included the construction of a new restroom building and new scenic overlook area. A new 60,000-gallon water tank and pump house were constructed as part of the renovation project, which also provided relief to the existing pump within the Agua Fria National Monument, collecting water from the Agua Fria River.

1.5.2 Land Use

The land adjacent to I-17 through the project area is mostly undeveloped, except for the southern end near the Anthem Way and New River Road TIs. On the west side of I-17, just north of Anthem Way, there are commercial developments including Outlets at Anthem and Old West Cactus Farm. Also in this area along both sides of I-17 are several residential developments including Circle Mountain, Anthem Coventry Homes, and two RV parks.

The area north of New River is comprised mostly of grazing and undeveloped lands. Some residences and commercial properties are also present. However, this area is growing and an increasing number of residential and commercial properties are becoming established.

On the east side of I-17 from Black Canyon City to south of Cordes Junction is the Agua Fria National Monument, which is administered by the BLM. BLM also manages the land on the west side of I-17 and in several wide median areas between the existing northbound and southbound I-17 alignments.

Small areas of State land and private land exist near Black Canyon City and near Cordes Junction. Scattered residential development exists in both areas.

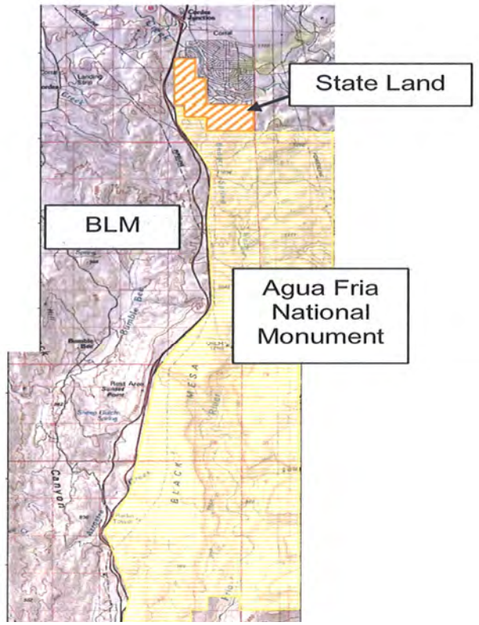


FIGURE 3 – BLACK CANYON TO CORDES JUNCTION LAND USE

Recreation use is common on adjacent BLM and ASLD land.
A number of grazing allotments and mining claims are located in the study area. A multi-use transportation and utility corridor has been designated in BLM's Agua Fria National Monument/ Bradshaw-Harquahala Resource Management Plan. The multi-use corridor begins north of New River and continues north to SR 69 and ranges from one to three miles wide. A natural gas pipeline operated by Transwestern Pipeline Company was recently constructed in a 200-foot easement west of the I-17 mainline. The pipeline is located within BLM's multi-use corridor.

1.5.3 Utilities

The major existing utilities in the I-17 corridor are presented in Table 3.

TABLE 3 – EXISTING UTILITIES

UTILITY TYPE	LOCATION
AT&T Fiber Optic	
Fiber Optic (1 ¼ " inner duct)	The line lies west of I-17, turning west along Anthem Way and then running north, paralleling Lake Pleasant Road to New River, then paralleling the gas pipeline north.
Fiber Optic (1 ¼ " inner duct)	Crosses I-17 SB at Sta 2011+50 (MP 238.96)
Fiber Optic (1 ¼" inner duct)	Crosses I-17 NB at Sta 2052+50 (MP 239.69)
Fiber Optic (1 ¼ " inner duct)	Along east ROW line from I-17 NB Sta 2057+00 to NB Sta 2110+50 (MP 239.74 to 240.69)
Fiber Optic (1 ¼ " inner duct)	Crosses I-17 NB at Sta 2110+50 (MP 240.69)
Fiber Optic (1 ¼ " inner duct)	Crosses I-17 SB at Sta 2117+50 (MP 240.85)
Fiber Optic (1 ¼ " inner duct)	Along west ROW line from Sta 2117+50 to Sta 2185+00 (MP 240.85 to MP 242.18)
Fiber Optic (1 ¼ " inner duct)	West of Black Canyon City TI (MP 244.5) follows old Route 69 alignment (Maggie Mine Road) paralleling I-17
Fiber Optic (1 ¼ " inner duct)	Follows old Route 69 alignment (Crown King Road) paralleling I-17 from the Bumble Bee TI (MP 248.4) to the Badger Springs TI (MP 256.1)
Fiber Optic (1 ¼ " inner duct)	Follows old Route 69 alignment (Crown King Road) in the northwest direction to Cordes
Arizona Public Service	
Overhead Power	Crosses I-17 at NB Sta 1503+50 (MP 229.29) and SB Sta 1502+20 (MP 229.24)
Overhead Power	Crosses I-17 at Sta 1538+00 (MP 229.96)
Overhead Power	Crosses I-17 at Sta 1611+50 (MP 231.35)
Overhead Power	Crosses I-17 at Sta 1671+00 (MP 232.35)
Overhead Power	Crosses I-17 at NB Sta 1863+50 and SB Sta 1860+80 (MP 236.09 and MP 236.04)
Overhead Power	Crosses I-17 at NB Sta 1883+00 and SB Sta 1883+50 (MP 236.46 and MP 236.47)
Overhead Power	Crosses I-17 at SB Sta 1991+55 and NB Sta 2007+47 (MP 238.50 and MP 238.80)
Overhead Power	Crosses I-17 at NB Sta 2202+00 and SB Sta 2201+70 (MP 242.77 and MP 242.76)
Overhead Power	Crosses I-17 at NB Sta 2225+00 and SB Sta 2223+80 (MP 243.22 and MP 243.19)
Overhead Power	Crosses I-17 at NB Sta 2248+80 and SB Sta 2248+50 (MP 243.68 and MP 243.67)
Overhead Power	Crosses I-17 at NB Sta 2284+20 and SB Sta 2283+70 (MP 244.37 and MP 244.36)
Overhead Power	West of Black Canyon City TI (MP 244.5) follows old Route 69 alignment (Maggie Mine Road) paralleling I-17
Overhead Power	Crosses I-17 at 2431+40 (MP 247.4)
Overhead Power	Continues north east to Radio Tower east of the Bumble Bee TI (MP 248.4)
Western Area Power Administration	
345 kV Transmission Line	Crosses I-17 at Table Mesa TI
345 kV Transmission Line	Within ROW from Sta 1881+00 (MP 236.42) (SB) to Sta 1931+50 (MP 237.36) (NB); Crosses SB I-17 at Sta 1886+50 (MP 236.52) and NB I-17 at Sta 2040+00 (MP 239.43)
345 kV Transmission Line	Within SB I-17 ROW from Sta 1965+00 to Sta 1976+20 (MP 238.00 to MP 238.21)
345 kV Transmission Line	Crosses SB I-17 at Sta 1995+00 (MP 238.58), Sta 2198+00 (MP 251.34), Sta 2236+00 (MP 243.43) and NB I-17 at Sta 2103+50 (MP 239.00), Sta 2195+00 (MP 251.28), Sta 2367+00 (MP 245.97)
345 kV Transmission Line	West of Black Canyon City TI (MP 244.5) paralleling I-17
345 kV Transmission Line	Crosses southbound (SB) I-17 2356+80 (MP 245.88)

UTILITY TYPE	LOCATION
345 kV Transmission Line	Crosses northbound (NB) I-17 2367+62 (MP 246.11)
345 kV Transmission Line	Paralleling East of I-17 within the Agua Fria National Monument
345 kV Transmission Line	Crosses NB I-17 2950+02 (MP 257.20)
345 kV Transmission Line	Crosses SB I-17 2998+04 (MP 258.11)
There are numerous transmission towers supporting overhead (OH) lines throughout the project limits.	
El Paso Natural Gas	
20" Gas Pipeline	Crosses SB I-17 at Sta 2012+50 (MP 238.91)
20" Gas Pipeline	Crosses NB I-17 at Sta 2054+00 (MP 239.69)
20" Gas Pipeline	Crosses I-17 at Sta 2208+80 (MP 242.87) (south of Agua Fria River)
20" Gas Pipeline	West of Black Canyon City TI (MP 244.5) paralleling I-17
20" Gas Pipeline	Crosses I-17 at 2431+40 (MP 247.4)
20" Gas Pipeline	Crosses I-17 NB at 2920+90 (MP 256.65)
20" Gas Pipeline	Crosses I-17 SB at 2929+24 (MP 256.81)
Southwest Gas	
1 1/4" Gas	Crosses I-17 NB at Sta 1657+00 (MP 232.20) and SB I-17 at 1656+00 (MP 232.18)
Eagle West Cable	
Cable	Aerial crossing over I-17 at Mud Springs
Transwestern Pipeline Company	
42" Gas Pipeline	West of Black Canyon City TI (MP 244.5) paralleling I-17
Black Canyon City Water Improvement District	
4" Water line (Abandoned)	Crosses I-17 at Sta 2205+00 (MP 242.83)
2" Water line	Crosses I-17 at Sta 2216+50 (MP 243.02)
4" Water line	Crosses I-17 at Sta 2232+00 (MP 243.35)
6" Water line	Crosses I-17 at Sta 2233+00 (MP 243.37)

There are no railroad crossings in the study area.

1.5.4 Drainage

Existing Drainage Conditions and Facilities

In addition to the bridge crossings at washes, the drainage facilities along the I-17 corridor range from small-diameter corrugated metal pipe culverts to multi-cell reinforced concrete box culverts (RCBC). There are approximately 39 reinforced concrete box culverts and 257 corrugated metal or reinforced concrete pipe culverts from Anthem Way TI to Cordes Junction. Other existing drainage features include catch basins connected to small-diameter pipes to drain median areas.

The watershed contributing to the project area between Anthem and Black Canyon City generally originates in the hills and mountains to the northeast. The drainage typically flows in a southwest direction and first crosses the northbound lanes of I-17 and then the southbound lanes. Some drainage basins originate to the west of I-17 beginning 0.5 mile north of the New River TI. These basins flow in a southeasterly direction, crossing I-17 and then reversing direction and crossing the roadway again, flowing southwest. Slopes range from 1% in the lower alluvial areas to approximately 25%.

Rock outcrops interspersed with shallow deposits of sandy loams overlying bedrock characterize the upper, steeper portion of the watershed. The lower watershed soils are made up of alluvial materials washed down from the surrounding hills. Gravelly/sandy loam soils make up much of this area.

Vegetation is sparse (approximately 10-20%) and representative of the Sonoran desert region. Species noted within the project limits include palo verde, mesquite, saguaro cacti, cholla, and prickly pear cacti. Desert shrubs such as greasewood and desert grasses constitute an additional percentage of the vegetative cover.

North of Black Canyon City, the existing I-17 roadway alignments are situated between major drainage tributaries. In general, the northbound lanes parallel the Agua Fria River and Badger Springs Wash to the east and the southbound lanes parallel Black Canyon Creek and Bumble Bee Creek to the west. Relative to these tributaries, the existing I-17 alignments are located away from major watercourses, with many smaller washes crossing the existing roadway alignments.

There are five major drainage crossings of the existing I-17 alignments within the study area. New River crosses under I-17 south of the New River Road TI, Little Squaw Creek and Moores Gulch cross I-17 near MP 239, the Agua Fria River crosses under I-17 at Black Canyon City, and Big Bug Creek crosses under I-17 at the north end of the project, just south of the Cordes Junction TI.

The existing onsite drainage is characterized by sheet flow off the roadway, with the runoff being intercepted by open ditches or channels and conveyed to offsite cross-drain outfalls. Roadway curb has been constructed to intercept the pavement drainage at some locations. This curb conveys the runoff to either down drain pipes or spillways, where the flows are conveyed down the roadway embankment.

A listing of large box and pipe culverts is shown in Table 4. Large culverts are defined as having a diameter of 54 inches or larger.

TABLE 4 – EXISTING LARGE BOX CULVERTS AND PIPES GREATER THAN 54 INCHES

MILEPOST	ROADWAY	SIZE	LENGTH (FT)	TYPE
229.4	NB & SB	2-6'X5'	428	RCBC
230.5	NB &SB	6'X4'	277	RCBC
230.8	NB & SB	6'X4'	251	RCBC
231.2	NB & SB	2-10'x7'	201	RCBC
232.2	NB & SB	60"	348	CMP
232.5	NB	2-10'X8'	201	RCBC
232.5	SB	2-10'X8'	199	RCBC
233.0	NB	10'X8'	134	RCBC
233.2	SB	10'X8'	198	RCBC
233.8	NB	2-10'X8'	95	RCBC
233.9	SB	2-10'X8'	125	RCBC
234.4	NB	2-8'X7'	107	RCBC
234.5	SB	10'X10'	167	RCBC
235.6	SB	6'X7'	134	RCBC
235.6	NB	6'X7'	87	RCBC

MILEPOST	ROADWAY	SIZE	LENGTH (FT)	TYPE
236.4	SB	6'X4'	169	RCBC
236.8	SB	60"	112	CMP
236.8	SB	78"	104	CMP
236.8	NB	72"	223	CMP
237.1	SB	60"	136	CMP
237.1	NB	60"	212	CMP
237.4	NB	10'X3'	55	RCBC
238.1	NB	72"	216	SPP
238.2	SB	84"	140	CMP
238.6	NB	3-10'X10'	142	RCBC
238.8	NB	10'X4'	49	RCBC
239.1	SB	84"	134	CMP
239.6	NB	78"	180	CMP
239.6	SB	8'X7'	104	RCBC
239.7	NB	10'X10'	151	RCBC
239.8	NB	60"	307	CMP
240.4	NB	54"	200	CMP
240.5	SB	60"	90	CMP
240.7	NB	10'X10'	114	RCBC
240.8	SB	8'X7'	92	RCBC
241.8	SB	2-10X8'	143	RCBC
241.8	NB	6'X6'	110	RCBC
242.0	NB	2-10'X8'	169	RCBC
242.1	NB & SB	60"	511	CMP
244.8	NB & SB	6'x7'	266	RCBC
245.6	NB	54”	190	CMP
246.7	SB	54"	113	CMP
246.8	SB	2-8’X7’	230	RCBC
247.6	SB	54"	112	CMP
248.3	SB	78”	594	CMP
249.0	SB	6’x7’	563	RCBC
249.6	SB	2-10’X8’	253	RCBC
249.7	SB	6x7	105	RCBC
250.8	SB	60”	180	CMP
248.8	SB	6'x7'	103	RCBC
251.0	NB	6'x7'	86	RCBC
251.0	SB	6'x7'	160	RCBC
252.9	NB	6'x7'	96	RCBC
253.0	SB	6'x7'	88	RCBC
255.0	SB	8'X7'	87	RCBC
255.0	NB	8'X7'	86	RCBC
255.7	NB	72"	372	CMP
256.0	NB	60"	228	CMP
256.2	NB	8'X7'	174	RCBC
256.6	SB	60"	169	CMP
256.9	SB	84"	101	CMP
257.0	NB	60"	120	CMP
259.1	NB	10'x8'	74	RCBC
259.2	SB	10'X8'	100	RCBC
260.0	SB	8'X7'	141	RCBC
260.5	NB	6'x7'	71	RCBC
260.8	NB	60"	348	CMP
260.9	NB	72"	290	CMP
261.8	NB	72"	259	CMP

1.5.5 Right-of-Way

Existing right-of-way widths vary widely along the corridor as detailed in Table 5. In areas where the northbound and southbound roadways are parallel, right-of-way widths are typically 200 feet east of the northbound centerline and 200 feet west of the southbound centerline. In sections where the northbound and southbound alignments are bifurcated and in interchange areas, right-of-way widths increase to as much as 2100 feet.

Several of the wide median areas are under the jurisdiction of BLM.

TABLE 5 – EXISTING RIGHT-OF-WAY WIDTHS

FROM		TO		ROW WIDTH (FEET)	COMMENTS
MP	STATION	MP	STATION		
228.76	1475+00	230.77	1581+00	249	Includes Anthem Way TI
230.77	1581+00	231.85	1638+00	300	Includes New River Road TI
231.85	1638+00	233.12	1705+00	Varies Typ. 96' West of SB centerline (cl) and 96' East of NB cl	
233.12	1705+00	233.41	1720+00	Varies Typ. 96' West of SB cl and 100' East of NB cl	
233.41	1720+00	234.64	1788+00 (NB)	Varies Typ. 96' West of SB cl and 200' East of NB cl	
234.64	1788+00 (NB)	234.91	1802+00 (NB)	Varies Typ. 96' West of SB cl and 100' East of NB cl	
234.91	1802+00 (NB)	235.41	1828+69 (NB)	Varies Typ. 96' West of SB cl and 200' East of NB cl	
235.41	1828+69 (NB)	235.67	1842+00 (NB)	496	
235.67	1842+00 (NB)	237.00	1912+00 (SB)	Varies Typ. 100' West of SB cl and 96' East of NB cl	Includes Table Mesa TI
237.00	1912+00 (SB)	237.37	1932+00 (NB)	Varies Typ. 184' West of SB cl and 96' East of NB cl	

FROM		TO		ROW WIDTH (FEET)	COMMENTS
MP	STATION	MP	STATION		
237.37	1932+00 (NB)	238.36	1984+40 (NB)	225	
237.37	1936+27 (SB)	238.66	1999+47 (SB)	400	
238.36	1984+40 (NB)	239.19	2028+00 (NB)	200	
238.66	1999+47 (SB)	238.77	2005+47 (SB)	700	Moores Gulch
238.77	2005+47 (SB)	239.68	2053+00 (SB)	400	
239.55	2028+00 (NB)	239.27	2032+00 (NB)	300	Little Squaw Creek
239.27	2032+00 (NB)	239.63	2051+45 (NB)	200	
239.68	2053+00 (SB)	239.73	2056+00 (SB)	350	
239.73	2056+00 (SB)	239.86	2062+50 (SB)	300	
239.85	2051+45 (NB)	239.84	2062+50 (NB)	250	
239.84	2062+50 (NB)	240.37	2090+48 (NB)	200	
239.86	2062+50 (SB)	240.49	2096+17 (SB)	400	
240.49	2090+48 (NB)	240.65	2110+00 (NB)	Varies	
240.65	2110+00 (NB)	241.53	2151+42 (NB)	Varies Typ. 200' West of SB cl and 100' East of NB cl	
241.53	2151+42 (NB)	241.59	2154+87 (NB)	Varies Typ. 100' West of SB cl and 125' East of NB cl	
241.59	2154+87 (NB)	241.87	2169+65 (NB)	Varies Typ. 100' West of SB cl and 100' East of NB cl	
241.87	2169+65 (NB)	242.20	2186+81 (NB)	Varies	Includes Rock Springs TI
242.20	2186+81 (NB)	243.33	2231+00 (NB)	300	
243.33	2231+00 (NB)	244.94	2313+95 (NB)	Varies	Includes Black Canyon City TI
244.94	2313+95 (NB)	245.23	2328+50 (NB)	406	
245.23	2328+50	246.46	2386+08	500-1100+	Includes median
246.46	2386+08	248.05	2468+67	575-780	
248.05	2469+75	248.72	2490+00	610-1100	Includes Bumble Bee TI
248.72	2505+00	250.99	2625+00	400 NB, 400 SB	BLM land
250.99	2625+00	253.11	2742+00	490-1300	Includes Sunset Point rest area and TI
253.11	2742+00	254.02	2800+00	600	
254.02	2600+00	254.46	2809+00	430-490	
254.46	2809+00	256.44	2910+00	430-2100	Includes Badger Springs TI and median area
256.44	2910+00	257.01	2940+00	760-1000	
257.01	2940+00	258.62	3025+00	760-2200	Includes median area as ADOT ROW
258.62	3025+00	259.26	3060+00	700-1100	
259.26	3060+00	259.76	3087+00	430-870	Includes Bloody Basin TI
259.76	3090+00	260.82	3145+00	400-830	
260.82	3145+00	261.29	3180+00	400	
261.29	3170+00	262.2	3220+00	400-460	

1.5.6 Structures

General

There are six precast prestressed concrete girder bridges, eight steel girder bridges, and fourteen continuous reinforced concrete slab bridges within the project limits. Newer structures include the Anthem Way TI Underpass, constructed in 2000, and the Little Squaw Creek bridge SB, constructed in 2011. The Big Bug Creek NB and SB bridges were replaced in 2013 with the Cordes Junction TI reconstruction project. The oldest structure, I-17 SB over Moores Gulch, was constructed in 1950. The remaining structures were constructed between 1960 and 1970. In most cases, the bridges are supported on spread footings or H piles, except for the newer bridges at Big Bug Creek and Little Squaw Creek SB. In general, the bridges are founded on granitic and volcanic rocks, with siltstone and claystone at the Badger Springs NB TI overpass (OP). None of the waterway crossings are listed as scour critical. The existing (2018) National Bridge Inventory bridges are listed in Table 6.

TABLE 6 – EXISTING STRUCTURES

STRUCTURE NAME	STRUCT. NO.	MP	YEAR BUILT	MIN. VERTICAL CLEARANCE (Ft)	INVENTORY RATING	SUFFICIENCY RATING
Anthem Way TI UP	2537	229.0	2000	17.4	HS-26	99
New River Bridge NB	1290	231.4	1968	N/A	HS-20	96
New River Bridge SB	1291	231.4	1968	N/A	HS-20	96
New River TI OP NB	1292	232.0	1968	19.9	HS-24	94
New River TI OP SB	1293	232.0	1968	15.9	HS-24	95
Table Mesa TI UP SB	1294	235.9	1968	16.1	HS-22	F 96
Table Mesa TI UP NB	1295	235.9	1968	16.6	HS-21	F 96
Moores Gulch Bridge NB	0967	238.2	1967	N/A	HS-25	95
Moores Gulch Bridge SB	0339	238.6	1950	N/A	HS-16	F 65
Little Squaw Creek Bridge NB	0968	239.2	1967	N/A	HS-24	89
Little Squaw Creek Bridge SB	2965	239.6	2011	N/A	HS-34	91
Rock Springs TI UP NB	0969	242.2	1967	15.9	HS-27	97
Rock Springs TI UP SB	0970	242.2	1967	16.0	HS-27	97
Mud Springs UP	0863	243.0	1965	16.5	HS-21	91
Agua Fria River Bridge NB	1807	243.3	1980	N/A	HS-21	97
Agua Fria River Bridge SB	1808	243.3	1980	N/A	HS-21	97
Coldwater Canyon TI OP NB	0764	244.4	1964	14.3	HS-22	96
Coldwater Canyon TI OP SB	0765	244.4	1964	14.7	HS-22	96
Bumble Bee TI UP SB	1170	248.40	1966	16.3	HS-29	99
Bumble Bee TI OP NB	1171	248.40	1966	15.3	HS-18	93
Sunset Point TI OP SB	1352	252.50	1969	17.4	HS-21	94
Sunset Point TI OP NB	1237	252.50	1969	16.5	HS-20	94
Badger Springs TI OP SB	0750	255.90	1963	16.1	HS-21	F 93
Badger Springs TI OP NB	0749	256.05	1963	15.0	HS-21	F 93

STRUCTURE NAME	STRUCT. NO.	MP	YEAR BUILT	MIN. VERTICAL CLEARANCE (Ft)	INVENTORY RATING	SUFFICIENCY RATING
Bloody Basin TI OP SB	0752	259.43	1963	15.8	HS-21	F 93
Bloody Basin TI OP NB	0751	259.43	1964	15.1	HS-21	F 93
Big Bug Creek Bridge SB	20028	262.05	2012	N/A	HS-27	97
Big Bug Creek Bridge NB	20027	262.05	2012	N/A	HS-27	97

Note: A sufficiency rating preceded by an "F" denotes functional obsolescence and is assigned by ADOT Bridge Operations Service, Bridge Management Section. Functional obsolescence refers to bridges with lane widths, shoulder widths, or vertical or lateral clearances that do not meet current standards, or the bridge may not be able to handle occasional roadway flooding.

The existing bridges are generally in good structural condition, with sufficiency ratings above 90 in all but four crossings and load ratings of HS-20 or above in all but two locations. The bridge sufficiency rating is a formula-based calculation that considers structural condition and adequacy, functional obsolescence, level of service, and essentiality for public use to present a numeric value representing the bridge's sufficiency to remain in service. The result is a percentage from zero to 100, in which 100 percent would represent a bridge entirely sufficient for its intended use.

Some bridges are reported to have lateral and/or vertical clearances that do not conform to current design standards. These are typically listed as "Functionally Obsolete" in the structure inventory and appraisal data. A functionally obsolete bridge is one that does not meet the current minimum federal geometric or clearance requirements for a new bridge.

Bridges with structural or load capacity issues are listed as "Structurally Deficient"; however, there are no structures classified as structural deficient within the project limits. A structurally deficient bridge typically requires maintenance and/or repair and eventual rehabilitation or replacement to address deficiencies; however, the term does not imply that a bridge is unsafe.

Underpass Bridges

There are seven underpasses within the project limits. In most locations, the proposed I-17 widening requires a 63-foot lateral underclearance, including the anticipated concrete barriers, 10-foot shoulders and two-foot barrier offsets. Limited lateral underclearances exist at the Table Mesa and Bumble Bee TI underpasses. The remaining underpass bridges have sufficient horizontal clearance to accommodate the proposed I-17 widening.

Vertical clearances on these underpasses are currently adequate but surplus clearance is limited, so widening will need to be configured to avoid reducing vertical clearances over I-17 below sixteen feet.

Overpass Bridges

Eleven existing bridges are overpasses. The six overpasses at the Sunset Point, Badger Springs, and Bloody Basin TIs will not be impacted by the near-term proposed widening but will be impacted by the future long-term widening plans for this corridor.

As with the underpasses, overpasses have limited surplus vertical clearance and, in some cases, below-standard clearances such that widening will need to be configured to avoid reducing vertical clearances to less than sixteen feet. For overpasses with existing clearances below sixteen feet, the clearances cannot be reduced further by the I-17 improvements.

Waterway Bridges

Ten of the bridges are over waterways. Only the recently-constructed Little Squaw Creek Bridge SB and the Big Bug Creek bridges offer surplus deck width that can accommodate I-17 widening. Any scour issues have been addressed by previous ADOT scour mitigation improvements; none of the waterway crossings are currently identified as scour critical.

Looking east at Bloody Basin Road bridges

1.5.7 Geotechnical Profile

Geologic Setting

The section of the I-17 alignment from Anthem Way to Sunset Point in central Arizona is located within the northern limits of the Basin and Range Physiographic Province (Basin and Range) and the southern limits of the Arizona Transition Zone. The Basin and Range is characterized by rugged isolated fault-bounded mountain ranges separated by broad alluvium-filled valleys. Mountain ranges in the Basin and Range generally trend in a north to northwesterly direction. The Transition Zone separates the Basin and Range to the southwest from the Colorado Plateau to the northeast. The rugged terrain of the Transition Zone is characterized by dissected alluvial basins and large bedrock ranges comprised of some of the oldest rocks in Arizona. These old Precambrian basement rocks commonly are overlain with younger Tertiary sedimentary and volcanic rocks.

The generalized geologic units encountered along the project alignment consist of Precambrian metavolcanic rocks, schist and granite intrusions; and interbedded sequence of Tertiary basalts, tuffs, volcaniclastic deposits; Quaternary/Tertiary pediment deposits; and Quaternary surface deposits. In the vicinity of New River, the valley fill consists of well-stratified lake deposits and poorly sorted stream deposits. Numerous Quaternary landslide deposits are present, especially north of Black Canyon City.

The local vegetation consists of various desert grasses, mesquites, palo verdes, creosote, saguaros, and other varieties of small cacti.

The project alignment begins at MP 229 within the valley floor of the New River, west of Daisy Mountain. The corridor circumvents the town of New River, located at an approximate elevation of 2,000 feet. At approximate MP 234, immediately east of Table Mountain, the northbound and southbound lanes of I-17 divide to follow two different alignments. The I-17 alignment begins to traverse mountainous terrain that is wedged between the southwest extension of the Bradshaw Mountains in the Castle Creek Wilderness Area and the New River Mountains. The two alignments then traverse Moore's Gulch at approximate MP 239 and join back together just north of the Rock Springs TI at MP 242. The project alignment continues north towards Black Canyon City and the Black Canyon TI (MP 244.4), also at an approximate elevation of 2,000 feet.

The main drainage systems within these areas are the Agua Fria River and New River, which flow from the northeast to the southwest. From north to south, the major tributaries to these rivers that are paralleled and traversed by the project corridor are Little Squaw Creek and Deadman Wash. Numerous tributaries to these waterways also traverse the alignment, predominantly in a northeast to southwest direction.

North of the Black Canyon City TI, I-17 lies primarily in mountainous bedrock terrain along the west edge of the New River Mountains and just east of the larger Bradshaw Mountains. A fault crosses southbound I-17 north of Black Canyon City (approx. MP 247.8). Movement of this fault, which may be attributed to a nearby landslide,

Looking west at rock containment steel mesh fencing draped on cut slope of northbound I-17

has caused the need for increased roadway maintenance in this area. The terrain along the corridor generally consists of rolling hills and ridges typical of mountain foothills at the south and north ends of the corridor and a large flat-topped mesa that marks the western edge of the New River Mountains referred to as Black Mesa. Landslide deposits locally occur along the alignment and are exposed just south of, and on the approach up to, the flat-topped mesa.

The existing I-17 corridor between MP 244.4 and MP 247 is predominantly underlain by Tertiary sediments, with a minor amount of metavolcanic rock located north of MP 246. Between approximately MP 247 and MP 248, the existing roadway is predominantly underlain by Hickey Formation basalt. North of MP 248, the northbound roadway roughly follows the contact between Hickey Formation basalt metavolcanic rock until the road tops out on Black Mesa at approximately MP 250. The southbound roadway is underlain by metavolcanic rock from approximately MP 248 until it tops out on Black Mesa at MP 250.5. The southbound and northbound roadways are then underlain by basalt to approximately MP 256.5 and metavolcanic rock from MP 256.5 to Big Bug Creek at MP 262. Several old landslide deposits have recently been mapped by the Arizona Geological Survey north of the Black Canyon City TI and south of Bumble Bee Road. While there is no indication that this represents a fatal flaw for the project, these landslides and others yet to be identified may impact the existing I-17 roadways and will need to be investigated further in final design.

There are several inclinometer locations between the Black Canyon City TI and Bumble Bee TI. These locations were designated to measure the stability of the cut slopes along the northbound roadway. Four inclinometers are located along the outside shoulder of the northbound roadway at MP 247.4 between the outside edge of roadway striping and the existing guardrail. Another location is at the top of the large cut known as Cape Horn, MP 247.5. Another inclinometer is located between the northbound and southbound roadways at MP 247.5. The functionality of these monitoring stations should be maintained; the contractor will need to protect or replace the units during the construction of the recommended alternative.

Groundwater/Surface Water Conditions

Water was observed in Bumble Bee Creek at the bridge crossing just south of Bumble Bee Ranch (2007). Residents in the area indicated that this water originates from springs along the flanks of the creek upstream of the bridge. A small amount of water was also observed in a small wash immediately west of existing I-17 near MP 245 (2007). Within Little Squaw Creek SB, test boring B-3, located at the bridge pier location, was completed as an open standpipe piezometer. Water was observed in Little Squaw Creek prior to bridge construction (2009) with an approximate groundwater depth ranging from 12 to 33 feet (elevation of 1887 to 1908 feet). It is assumed the piezometer was abandoned in accordance with Arizona Department of Water Resources requirements during construction. Shallow groundwater may be anticipated in other drainages and low-lying areas throughout the project corridor, especially following large and/or prolonged rain storms.

Roadway Cuts

Information on the existing roadway cuts is presented in Table 7. Recent wedge and block failures and slope deterioration were observed along several existing cut slopes within the project corridor. The existing slopes are susceptible to continued block erosion when exposed to water and may require continued maintenance. In general, in areas where rockfall has been noted, the existing pavement surface has been dented and otherwise slightly damaged.

TABLE 7 – ROADWAY CUTS

Milepost	Geologic Material	Observed Potential Geological Hazards
NB MP 232 to MP 240	Quaternary sediments and Precambrian metavolcanics	Moderate to large scale sloughing, some rockfall
SB MP 251 to MP 248	Tertiary basalt and Precambrian metavolcanics	Rockfall and large wedge failures, moderate sloughing
SB MP 248 to MP 245	Tertiary basalt, Precambrian metavolcanics, and Tertiary sandstone and tuff	Rockfall, moderate to large scale sloughing, mapped landslides
SB MP 244 to MP 242	Quaternary sediments	Heavily eroded, undercutting
SB MP 240 to MP 238	Quaternary alluvial sediments	Rockfall on both center lane and shoulder (large cobbles and medium to large boulders), seep on center lane over slough material
SB MP 238 to MP 236	Quaternary sediments	Sloughs on both center lane and shoulder, right of way on road adjacent to I-17 is being undercut and cut has eroded back to guard rail
SB MP 235 to MP 234	Precambrian metavolcanics	Large scale wedge failure

Ditches and containment walls appeared to be completely full in most cases (as recently as 2018) and should be cleaned out more regularly in order to decrease rock material from making its way onto the roadway. In addition, larger catchment areas and alterations in slope geometry should be considered during final design.

Roadway Fills

The roadway alignment typically is constructed on two approximately three- to five-foot high embankments divided by an intermediate ditch. These fill sections increase to heights in excess of 60 feet at select locations near drainage/canal crossings. Existing fill slopes along the alignment are approximately 6H:1V (horizontal to vertical) at the south end of the project area but increase significantly by the north end of the study segment. The slopes appear to be stable with a significant amount of desert vegetation growing on them. However, minor to moderate rain-induced surface erosion was observed locally along the project corridor.

Pavement Subgrade Conditions

In general, it is anticipated that subgrade conditions will be suitable for most of the alignment. The preliminary investigation identified the following areas of poor subgrade:

- SB Sta 1877+50 to 1957+00 (~MP 236 to 238);
- NB and SB Sta 2289+00 to 2320+00 (~MP 244 to 245); and
- SB Sta 2625+00 to 2710+00 (~MP 251 to 252).

Pavement Conditions

I-17 is a divided four-lane highway with 12-foot wide primary travel lanes and paved shoulders. Pea gravel or recycled AC placement has occurred beyond the paved shoulder in some areas of the southbound lanes.

In 2007, except for select localized areas in the shoulder, the existing pavements along both northbound and southbound lanes of I-17 was in good to very good condition throughout the length of the project alignment. In general, the pavements did not display potholes, rutting, corrugation, depressions, swells, and/or slippage cracking. In reviewing ADOT Pavement Management System Information it is apparent that neither cracking nor rutting is a concern in the study section.

Review of ADOT's Pavement Management System Information shows that both the northbound and southbound segments have received varying surface treatments. Table 2 of the 2007 Preliminary Geotechnical Assessment in the project geotechnical assessment report summarizes the treatments that have been applied to the existing project alignment since its construction. More than 20 roadway construction and/or resurfacing projects have been conducted within the project corridor since 1949. Most of the project length has been re-paved since 2007.

The entire roadway has been milled and overlaid since 1992. A 2003 project involved milling and filling, re-alignment, and bridge repair from MP 256 to MP 263. The northbound roadway from MP 240 to MP 245 was re-paved in mid-2013. Based on the review of the as-built plans, the existing pavement section varies from 0.5 inches of friction course over 3.0 to 11.0 inches of bituminous materials over 3 to 13 inches of aggregate base (AB) over 6 to 24 inches of select material. Occasional areas had sealed subgrade up to 12 inches thick, but generally any treatment of the subgrade is not apparent from the review of the as-built plans.

2.0 Traffic and Crash Data

2.1 Traffic Analysis

2.1.1 Introduction

A Preliminary Traffic Report (March 2007), a traffic Technical Memorandum (November 2014), and an updated Preliminary Traffic Report (October 2017) were prepared in support of the development of the Design Concept Report for this project. The traffic analyses present traffic volume projections and roadway capacity analyses for mainline I-17 beginning at the I-17/Anthem Way TI and extending north to approximately MP 262, south of the Cordes Junction TI. The scope of the study assumed no major modifications to the traffic interchanges. Therefore, no traffic volume projections or ramp terminal capacity calculations were performed as part of the traffic analysis.

A design year of 2030 was used in the original 2007 analysis. Because work on this study stopped for several years and economic conditions changed substantially, growth projections were revised downward and the design year is now 2040. The purpose of the 2014 memorandum was to summarize the criteria and methodology for developing 2035 and 2040 traffic volumes, capacity analysis, and level of service results, which are included in this chapter, along with updated crash data. The current traffic report uses 2040 traffic volumes.

2.1.2 Year 2040 Traffic Volume Development

Projected traffic growth rates have changed substantially since the original traffic study for this project was completed in 2007. Traffic volumes for the study section of I-17 and for sections north and south of the study area were obtained from the ADOT Transportation Planning website. The process included collection of 2016 traffic data, including volumes, K, D, and T factors. Table 8 presents a summary of 2016 traffic data.

TABLE 8 – I-17 MAINLINE 2016 TRAFFIC DATA SUMMARY

Location	Two Way AADT	K	D	T
Anthem Way to New River Road	45,900	10%	61%	11.6%
New River to Black Canyon City	41,600	10%	60%	24.1%
Black Canyon City to Sunset Point	34,200	10%	56%	26.1%
Sunset Point to Cordes Junction	36,200	10%	60%	26.1%

The peak hour traffic on I-17 fluctuates widely in the study area depending on day of week and time of year. This section of I-17 serves a mix of traffic that can be described as rural/recreational traffic. The rural/recreational traffic has a unique traffic characteristic, where the weekend peak hour traffic exceeds the weekday peak hour. This characteristic is considerably different than the typical urban weekday morning and late afternoon work-home commuting peak hour of traffic. In addition to the weekend peak hour of traffic, the rural/recreational traffic is typically subject to seasonal volume variations. For example, there are generally more recreational trips in the summer season. The rural segments of I-17 have many of the highest hourly volumes occurring on popular travel holidays such as Memorial Day and Labor Day.

By examining the existing 2016 volumes, it was determined that Saturday traffic volumes are on average 20% greater than the seven-day average volumes. These seven-day averages are typically considered to be the traditional AADT.

Traffic volume projections for the year 2030 and existing K, D, and T factors for the study section of I-17 were obtained from ADOT Transportation Planning website. Traffic volume projections for the year 2040 were provided by ADOT Multimodal Planning Division. In addition to obtaining AADT projections for the years 2030 and 2040, the Saturday AADT was calculated by increasing the seven-day volumes by 20%. The Saturday AADT was used to represent volumes for a peak weekend traffic condition.

Once the 2040 traffic volumes were determined, the K and D factors were applied to determine the directional design hourly volume (DDHV=AADT*K*D). Table 9 presents a summary of the DDHV. The values for Monday through Sunday were considered seven-day DDHV and the values for Saturday were considered Weekend DDHV.

TABLE 9 – I-17 MAINLINE DDHV SUMMARY

Location	2016 (Mon-Sun)	2016 (Sat)	2040 (Mon-Sun)	2040 (Sat)
Anthem Way to New River Road	2,797	3,356	3,595	4,315
New River Road to Black Canyon City	2,498	2,998	3,391	4,069
Black Canyon City to Sunset Point	1,913	2,295	2,918	3,501
Sunset Point to Cordes Junction	2,171	2,605	3,145	3,774

2.1.3 Capacity Analysis and Results

Level of service (LOS) is a method of describing the operating characteristics of a section of highway. Broadly defined in terms of traffic flow, LOS A is associated with free flow traffic, LOS B indicates reasonable free flow, LOS C is stable operations, LOS D is the lower range of stable flow, LOS E is unstable flow, and LOS F indicates breakdowns in flow.

The Highway Capacity Manual (HCM) was used to evaluate freeway capacity and level of service. The measure used to provide an estimate of freeway LOS is density expressed in terms of the number of equivalent passenger cars per mile per lane (pc/mi/ln). Table 10 summarizes the LOS and density thresholds for freeway analysis.

TABLE 10 – HCM LEVEL OF SERVICE AND DENSITY CRITERIA

LOS	Freeway Mainline Density (pc/mi/ln)
A	≤11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	>45

Source: HCM 2010

General design levels of service and capacity for Arizona state roadways are described in the *Roadway Design Guidelines* (RDG) from the ADOT Roadway Engineering Group. The design levels of service and capacity for various conditions are shown in Table 103.2A of the guidelines. Table 11 summarizes the design levels of service. The RDG indicates that where a range is given, the higher level of service should be provided except where costs or environmental constraints dictate a lower level of service.

TABLE 11 – ADOT DESIGN LEVELS OF SERVICE

Freeway Type	Design Levels of Service
Controlled Access Hwy	
Level terrain	B
Rolling terrain	B
Mountainous terrain	B-C
Urban/ Fringe Urban	C-D

Source: Table 103.2A, ADOT *Roadway Design Guidelines*.

The portion of I-17 included in this study area is unique in many ways. Primary factors include the mix of traffic and the connection to major urban areas from northern Arizona. Weekend traffic is approximately 20 percent higher than the average weekday traffic. As growth continues in Maricopa, Yavapai, and Coconino counties, the area in between is predicted to develop into an urban / urban fringe area.

Taking into account the varying traffic demands, mix of vehicles, seasonal travel demand and the urbanization of northern and central Arizona, ADOT has selected LOS D as the appropriate level of service to be utilized for I-17 in this study.

Because terrain and speed impact the capacity analysis results, the I-17 mainline was broken into four segments for evaluation. The southern portion (MP 229-232) was evaluated as level terrain. The next segment to the north (MP 232-244) was evaluated as rolling terrain. On the Black Canyon Hill, MP 244-252 was evaluated using the composite grade methodology for mountainous terrain. The northern portion of the project area (MP 252-262) was evaluated as rolling terrain. The northbound and southbound roadways in the mountainous terrain portion of the project were analyzed separately, based on the specific grades. Table 12 summarizes each segment and the respective roadway characteristics evaluated.

TABLE 12 – I-17 MAINLINE SEGMENTS

Segment	Terrain	Speed
I-17, Anthem Way to New River (MP 229-232)	Level	75 MPH
I-17, New River to Black Canyon City (MP 232-244)	Rolling	75 MPH
I-17, Black Canyon City to Sunset Point (MP 244-252)	Mountainous/Composite Grade	65 MPH
I-17, Sunset Point to Cordes Junction (MP 252-262)	Rolling	75 MPH

Using the DDHV and roadway characteristics, the capacity analysis was conducted using the Highway Capacity Software (HCS). Table 13 and Table 14 summarize the results of the capacity analysis:

TABLE 13 – 2016 AND 2040 7-DAY DDHV LEVEL OF SERVICE

Roadway Section and Terrain	No. of Lanes in Each Direction	2016 7-Day DDHV		2040 7-Day DDHV	
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
NB and SB (MP229-232) Level	2	25.9	C	40.0	E
	3	[redacted]		21.1	C
NB and SB (MP232-244) Rolling	2	31.2	D	63.8	F
	3	[redacted]		26.7	D
NB (MP244-252) Mountainous Upgrade	2	27.4	D	72.0	F
	3	[redacted]		28.1	D
SB (MP252-244) Mountainous Downgrade	2	19.5	C	36.3	E
	3	[redacted]		19.9	C
NB and SB (MP252-262) Rolling	2	25.9	C	53.7	F
	3	[redacted]		24.7	C

TABLE 14 – 2016 AND 2040 WEEKEND DDHV LEVEL OF SERVICE

Roadway Section and Terrain	No. of Lanes in Each Direction	2016 Weekend DDHV		2040 Weekend DDHV	
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
NB and SB (MP229-232) Level	2	34.8	D	65.5	F
	3	[redacted]		27.0	D
	4			18.6	C
NB and SB (MP232-244) Rolling	2	44.9	E	174.0	F
	3	[redacted]		36.3	E
	4			23.0	C
NB (MP244-252) Mountainous Upgrade	2	37.5	E	257.2	F
	3	[redacted]		38.7	E
	4			24.1	C
SB (MP252-244) Mountainous Downgrade	2	24.6	C	56.1	F
	3	[redacted]		25.2	C
	4			17.6	B
NB and SB (MP252-262) Rolling	2	34.9	D	114.1	F
	3	[redacted]		32.8	D
	4			21.5	C

2.1.4 Two-Lane and Three-Lane Failure Year Sensitivity Analyses

As part of the capacity analysis, the last year during which each segment of the study area exhibits LOS D (the minimum acceptable design level of service) with two lanes and three lanes was determined. Utilizing the HCS, the maximum DDHV that corresponds with a density of 34.9 pc/mi/ln was calculated for each portion of the study area. Once the DDHV was calculated, the K and D factors were used to determine the AADT associated with the "failure year." Failure year is defined as the last year in which forecasted traffic volumes result in the segment operating at an acceptable LOS D; the following year, operations deteriorate to LOS E. Upon determining the failure year AADT values, linear relationships between the 2016 and 2040 Saturday AADTs were used to estimate the failure year for peak weekend traffic conditions.

Table 15 shows the predicted two-lane failure year for each representative segment. Table 16 shows the predicted three-lane failure year for each representative segment.

TABLE 15 – TWO-LANE FAILURE YEAR SUMMARY

Location on I-17 Mainline	MP	Failure Year AADT	Weekend Failure Year
Anthem Way to New River Rd	229 – 232	55,080	2016*
New River Rd to Black Canyon City	232 – 244	N/A	Currently Failing
Black Canyon City to Sunset Point (NB)	244 – 252	N/A	Currently Failing
Sunset Point to Black Canyon City (SB)		50,980	2027
Sunset Point to Cordes Jct.	252 – 262	43,420	2016*

* Minimal growth in the 2016 traffic counts should result in LOS E in 2017

TABLE 16 – THREE-LANE FAILURE YEAR SUMMARY

Location on I-17 Mainline	MP	Failure Year AADT	Weekend Failure Year
Anthem Way to New River Rd	229 – 232	82,620	2058
New River Rd to Black Canyon City	232 – 244	66,500	2038
Black Canyon City to Sunset Point (NB)	244 – 252	59,290	2036
Sunset Point to Black Canyon City (SB)		76,520	2056
Sunset Point to Cordes Jct.	252 – 262	65,080	2043

2.1.5 Flex Facility (Black Canyon City TI to Sunset Point TI)

As part of the capacity analysis, two-lane reversible, or "flex" roadway facilities were evaluated for the segment of I-17 from Black Canyon City to Sunset Point.

An estimate of 45% of the Weekend DDHV was assigned to the new flex roadway. This estimate of traffic using the flex lane facility assumes that traffic will be fairly well balanced between the mainline and flex facility. Speed, density, and travel time data will be collected and displayed on DMS prior to the mainline/flex facility split to allow motorists to select the fastest route. As the volume increases on one facility and travel times increase, this information can be provided to motorists, allowing them to select the route with the fastest travel time, balancing traffic between the two routes.

It was assumed that the 2040 volumes would follow the same trend as the existing 2016 volumes, with peak volumes in the northbound direction Monday through Saturday and the off-peak volume in the southbound direction. In addition, the peak volumes would occur in the southbound direction on Sunday, with the off-peak volume in the northbound direction. To address this trend, the two-lane flex roadway would operate in the northbound direction Friday and Saturday, and in the southbound direction on Sunday. The 2040 Weekend DDHV volumes were analyzed to consider the peak traffic conditions along the corridor.

Table 17 summarizes the DDHV for the flex facility:

TABLE 17 – I-17, MAINLINE AND FLEX ROADWAY PEAK WEEKEND DDHV

Year	Peak Direction Weekend DDHV		Off-Peak Direction Weekend DDHV
	I-17 Mainline	Flex Facility	I-17 Mainline
2040	1,926	1,575	2,751

Using the Weekend DDHV, peak hour characteristics, and roadway characteristics, the capacity analysis was conducted using the HCS. Results of the I-17 northbound and southbound two-lane flex lane capacity analysis are summarized in Table 18 and Table 19, respectively, below:

TABLE 18 – I-17, NORTHBOUND TWO-LANE FLEX LANE LOS RESULTS

Description	Number of Lanes	2040 Saturday		Comment
		LOS	Density	
NB Mainline	2	D	27.6	55% of 2040 Peak DDHV
NB Flex	2	C	19.7	45% of 2040 Peak DDHV
SB Mainline	2	D	32.6	2040 Off-Peak DDHV

TABLE 19 – I-17, SOUTHBOUND TWO-LANE FLEX LANE LOS RESULTS

Description	Number of Lanes	2040 Sunday		Comment
		LOS	Density	
SB Mainline	2	B	15.7	55% of 2040 Peak DDHV
SB Flex	2	C	21.0	45% of 2040 Peak DDHV
NB Mainline	2	F*	58.7	2040 Off-Peak DDHV

* The off-peak direction will operate at a LOS D until exceeding a volume of approximately 2,210 vehicles per hour. This volume is expected to be exceeded after the year 2026.

2.1.6 Flex Facility Merge and Diverge Analysis (Black Canyon City TI to Sunset Point TI)

As part of the flex facility capacity analysis, the merge and diverge areas were evaluated to determine the recommended number of lanes exiting or entering I-17 to and from the flex lanes. The merge and diverge analysis was conducted using HCS.

As assumed with the flex facility capacity analysis, a peak directional volume of 3,501 vehicles between Black Canyon City and Sunset Point was assumed by 2040. It was also assumed that 55% of the 2040 volume (1,926 vehicles) would utilize the existing I-17 alignment and 45% (1,575 vehicles) would utilize the flex lanes. The truck percentage for this segment is 26%, which represents a total of 910 trucks (501 on the I-17 alignment and 409 on the flex lane alignment).

Table 20 summarizes the results of the merge analysis for both northbound and southbound I-17 with the flex lanes.

TABLE 20 – SUMMARY OF MERGE ANALYSIS

Configuration at Gore Point	Overall LOS	I-17 LOS (V/C)	Flex Lane Ramp LOS (V/C)
South Crossover, Southbound Flex Lanes Merging with SB I-17			
Two I-17 Lanes, One Flex Lane	**F**	**F (1.08)**	**F (1.06)**
Two I-17 Lanes, Two Flex Lanes	A	**F (1.08)**	N/A (0.53)
North Crossover, Northbound Flex Lanes Merging with NB I-17			
Two I-17 Lanes, One Flex Lane	**F**	**F (1.09)**	**F (1.07)**
Two I-17 Lanes, Two Flex Lanes	**F**	**F (1.09)**	N/A (0.54)

The results of the HCS analysis for the southbound flex lanes merging with southbound I-17 show that a one-lane ramp from the flex lanes will not provide enough capacity for the vehicles on the flex lane. The analysis also shows that the I-17 segment following the merge will not provide enough capacity for the total number of vehicles. However, the software assumes this segment is only two lanes as it cannot model an added lane from the on-ramp. Based on adjusted calculations, a three-lane segment following the merge would provide enough capacity. A two-lane ramp from the flex lanes will provide enough capacity for the vehicles on the flex lanes. The two-lane ramp may be one exit-only lane and one option lane.

The results of the HCS analysis for the northbound flex lanes merging with northbound I-17 show that neither a one-lane ramp nor a two-lane ramp from the flex lanes will provide enough capacity for the vehicles on the flex lane. The analysis also shows that the I-17 segment following the merge will not provide enough capacity for the total number of vehicles.

A sensitivity analysis was conducted to determine when the northbound flex lanes merge with northbound I-17 will fail. The results of the sensitivity analysis determined that the last year that the merge would operate at an acceptable level of service is 2034. However, the Preliminary Traffic Report shows that the basic freeway segment directly after this merging area will fail much sooner than this, within the (past) year of 2016, if the segment is left as a two-lane roadway.

Table 21 summarizes the results of the diverge analysis for both northbound and southbound I-17 with the flex lanes.

TABLE 21 – SUMMARY OF DIVERGE ANALYSIS

Configuration at Gore Point	Overall LOS	I-17 LOS (V/C)	Flex Lane Ramp LOS (V/C)
South Crossover, NB Flex Lanes Diverging with NB I-17			
Three I-17 Lanes, One Optional Exit Lane	**F**	N/A (0.42)	**F (1.13)**
Three I-17 Lanes, One Trapped Exit Lane	**F**	N/A (0.42)	**F (1.136)**
Three I-17 Lanes, One Trapped & One Optional Exit Lane	A	N/A (0.42)	N/A (0.57)
North Crossover, SB Flex Lanes Diverging with SB I-17			
Two I-17 Lanes, One Optional Exit Lane	**F**	N/A (0.59)	**F (1.06)**
Two I-17 Lanes, One Trapped Exit Lane	**F**	N/A (0.59)	**F (1.06)**
Two I-17 Lanes, One Trapped & One Optional Exit Lane	A	N/A (0.59)	N/A (0.53)

The results of the HCS analysis for the northbound flex lanes diverging from northbound I-17 show that a one-lane ramp, either optional or trapped lane, exiting to the flex lanes from I-17 will not provide enough capacity. The analysis shows that the I-17 segment north of the diverge area will provide enough capacity for the number of vehicles remaining on I-17. The results also indicate that a two-lane ramp exiting to the flex lanes from I-17 will provide enough capacity. The two-lane ramp may be one exit-only lane and one option lane.

The results of the HCS analysis for the southbound flex lanes diverging with southbound I-17 show that a one-lane ramp, either optional or trapped lane, exiting to the flex lanes from I-17 will not provide enough capacity. The analysis shows that the I-17 segment south of the diverge area will provide enough capacity for the number of vehicles remaining on I-17. The results also indicate that a two-lane ramp exiting to the flex lanes from I-17 will provide enough capacity. The two-lane ramp may be one exit-only lane and one option lane.

2.1.7 Northbound Climbing Lane (Black Canyon City TI to Sunset Point TI)

A northbound climbing lane from Black Canyon City to Sunset Point was also evaluated as part of the capacity analysis. In that analysis, the climbing lane was found to improve the LOS from a borderline LOS C/D to a solid LOS C. According to the analysis results, construction of a northbound climbing lane between Black Canyon City and Sunset Point would improve the level of service in 2040 from LOS F to LOS E. The results indicate that the last year this segment would operate at LOS D with the implementation of a climbing lane is the year 2036.

The beginning of a freeway climbing lane depends on the speeds at which trucks approach the grade. According to AASHTO, this point should occur at or prior to a ten mph decrease in truck speed below the average running speed. The climbing lane should extend to a point beyond the crest, where a typical truck could attain a speed that is within ten mph of the speed of other vehicles. Based on the criteria established by AASHTO and a normal operating speed of 65 mph, the northbound climbing lane should begin at approximately MP 244.44 and end at approximately 252.65.

2.2 Crash Analysis

2.2.1 Source of Data

Crash data was obtained from ADOT for the I-17 mainline from MP 228 to MP 262. The data covers a five-year period from June 2012 to May 2017.

2.2.2 Crash Data

The five-year crash history for the study section is summarized in Table 22 and Table 23. Table 22 shows the number of crashes by manner of collision. On average, there are more crashes in the northbound direction, with 215 crashes per year in the study section. There are approximately 150 crashes per year in the southbound direction. The majority of the crashes in the study section are single vehicle crashes. There is also a large proportion of rear-end crashes, particularly in the northbound direction.

TABLE 22 – I-17, MP 229 – 262 CRASHES BY MANNER OF COLLISION

MANNER OF COLLISION	6/1/2012 TO 12/31/2012	1/1/2013 TO 12/31/2013	1/1/2014 TO 12/31/2014	1/1/2015 TO 12/31/2015	1/4/2016 TO 12/31/2016	1/1/2017 TO 5/31/2017	5-YEAR TOTAL	YEARLY AVG TOTAL
Northbound								
Angle	0	2	2	1	5	0	10	2
Head on	0	1	2	1	1	0	5	1
Rear End	34	54	63	103	108	39	401	80.2
Sideswipe (Opposite Direction)	0	2	0	2	2	0	6	1.2
Sideswipe (Same Direction)	15	27	19	28	33	13	135	27
Single Vehicle	52	92	92	109	103	44	492	98.4
Rear to Rear	0	0	1	0	0	0	1	0.2
Left Turn	0	0	0	0	0	0	0	0
Rear to Side	0	0	0	0	0	1	1	0.2
Other	1	5	3	9	5	1	24	4.8
Northbound Total	**102**	**183**	**182**	**253**	**257**	**98**	**1075**	**215**
Southbound								
Angle	1	1	0	1	1	0	4	0.8
Head on	0	1	1	0	1	0	3	0.6
Rear End	18	19	22	34	46	13	152	30.4
Sideswipe (Opposite Direction)	0	1	0	0	0	0	1	0.2
Sideswipe (Same Direction)	11	12	16	12	24	6	81	16.2
Single Vehicle	41	80	86	88	121	51	467	93.4
Rear to Rear	0	0	0	0	0	1	1	0.2
Left Turn	0	0	0	0	1	1	2	0.4
Rear to Side	0	0	0	0	0	0	0	0
Other	1	6	6	8	11	2	34	6.8
Southbound Total	**72**	**120**	**131**	**143**	**205**	**74**	**745**	**149**

Table 23 shows the number of crashes by severity. The data indicates the northbound and southbound roadways exhibit similar levels of severe crashes. The southbound roadway tends to have slightly more fatal crashes, with a mean of approximately three fatal crashes per year compared to the northbound roadway's approximately two and a half fatal crashes per year.

TABLE 23 – I-17, MP 229 – 262 CRASHES BY SEVERITY

SEVERITY	6/1/2012 TO 12/31/2012	1/1/2013 TO 12/31/2013	1/1/2014 TO 12/31/2014	1/1/2015 TO 12/31/2015	1/4/2016 TO 12/31/2016	1/1/2017 TO 5/31/2017	5-YEAR TOTAL	YEARLY AVG TOTAL
Northbound								
No Injury	77	125	120	181	174	72	749	149.8
Possible Injury	11	22	26	28	27	10	124	24.8
Non-Incapacitating Injury	10	27	24	34	44	11	150	30
Incapacitating Injury	2	8	8	9	10	3	40	8
Fatal	2	1	4	1	2	2	12	2.4
Northbound Total	**102**	**183**	**182**	**253**	**257**	**98**	**1075**	**215**
Southbound								
No Injury	55	75	72	93	141	48	484	96.8
Possible Injury	6	20	21	15	25	7	94	18.8
Non-Incapacitating Injury	8	16	27	23	32	15	121	24.2
Incapacitating Injury	0	6	7	9	6	4	32	6.4
Fatal	3	3	4	3	1	0	14	2.8
Southbound Total	**72**	**120**	**131**	**143**	**205**	**74**	**745**	**149**

The crash data was also sorted and grouped by MP location to identify potential high crash locations within the study area. The results of this analysis are presented in the bar charts shown in Figure 4 and Figure 5. Each bar represents the average number of crashes within a one-mile segment. For example, there were an average of approximately eight crashes per year on northbound I-17, between MP 244.00 and MP 244.99.

FIGURE 4 – NORTHBOUND I-17 AVERAGE NUMBER OF CRASHES BY MILEPOST

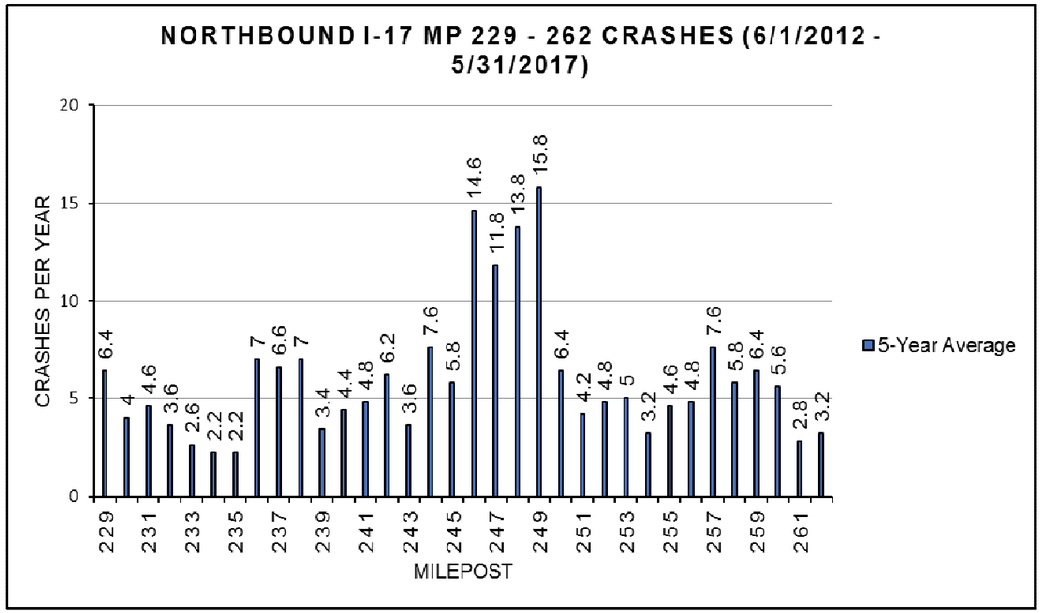
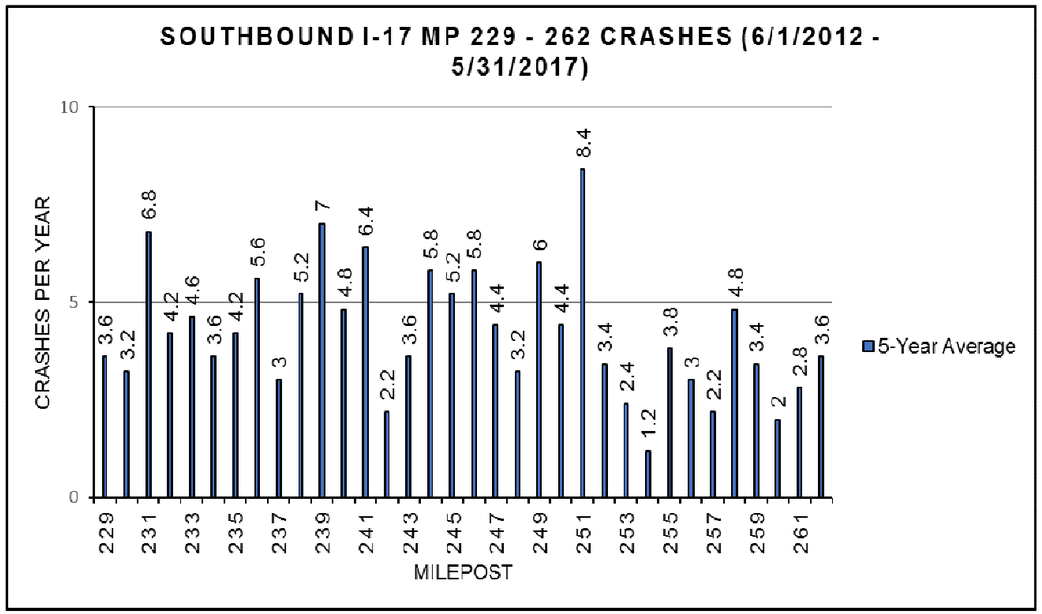


FIGURE 5 – SOUTHBOUND I-17 AVERAGE NUMBER OF CRASHES BY MILEPOST



The data indicate that in the northbound direction, the average number of crashes per mile tends to be higher in the mountainous portions of the study area (MP 244 to 252). As a result, the manner of collision and severity analyses were refined to focus on this area. The results are shown in Table 24 and Table 25.

Table 24 shows the number of crashes by manner of collision for the mountainous section. On average, there was almost twice as many crashes in the northbound direction, with approximately 85 crashes per year. There were approximately 47 crashes per year in the southbound direction. Approximately 50% of the crashes in the northbound mountainous section were rear-end crashes. The number of northbound rear-end crashes in this segment account for more than half of all northbound rear-end crashes within the entire project area. Approximately 60% of the crashes in the southbound mountainous section were single-vehicle crashes.

TABLE 24 – I-17, MP 244 – 252 CRASHES BY MANNER OF COLLISION

MANNER OF COLLISION	6/1/2012 TO 12/31/2012	1/1/2013 TO 12/31/2013	1/1/2014 TO 12/31/2014	1/1/2015 TO 12/31/2015	1/4/2016 TO 12/31/2016	1/1/2017 TO 5/31/2017	5-YEAR TOTAL	YEARLY AVG TOTAL
Northbound								
Angle	0	0	0	1	2	0	3	0.6
Head on	0	0	0	0	0	0	0	0
Rear End	24	23	31	58	60	17	213	42.6
Sideswipe (Opposite Direction)	0	0	0	1	1	0	2	0.4
Sideswipe (Same Direction)	8	16	5	10	14	4	57	11.4
Single Vehicle	11	26	22	40	31	7	137	27.4
Rear to Rear	0	0	1	0	0	0	1	0.2
Left Turn	0	0	0	0	0	0	0	0
Rear to Side	0	0	0	0	0	1	1	0.2
Other	0	2	1	4	2	0	9	1.8
Northbound Total	**43**	**67**	**60**	**114**	**110**	**29**	**423**	**84.6**
Southbound								
Angle	1	0	0	0	0	0	1	0.2
Head on	0	1	1	0	0	0	2	0.4
Rear End	8	3	5	13	20	5	54	10.8
Sideswipe (Opposite Direction)	0	1	0	0	0	0	1	0.2
Sideswipe (Same Direction)	2	1	6	4	4	0	17	3.4
Single Vehicle	10	26	33	30	28	20	147	29.4
Rear to Rear	0	0	0	0	0	0	0	0
Left Turn	0	0	0	0	0	0	0	0
Rear to Side	0	0	0	0	0	0	0	0
Other	0	1	3	1	4	2	11	2.2
Southbound Total	**21**	**33**	**48**	**48**	**56**	**27**	**233**	**46.6**

Table 25 shows the number of crashes by severity for the mountainous section. The data indicates the northbound and southbound roadways exhibit similar levels of severe crashes. The southbound roadway tends to have more fatal crashes within the mountainous section of the study area, with approximately twice the number of fatal crashes per year compared to the northbound roadway. However, the southbound roadway also exhibits approximately 60% of the number of incapacitating injury crashes per year compared to the northbound roadway.

TABLE 25 – I-17, MP 244 – 252 CRASHES BY SEVERITY

SEVERITY	6/1/2012 TO 12/31/2012	1/1/2013 TO 12/31/2013	1/1/2014 TO 12/31/2014	1/1/2015 TO 12/31/2015	1/4/2016 TO 12/31/2016	1/1/2017 TO 5/31/2017	5-YEAR TOTAL	YEARLY AVG TOTAL
Northbound								
No Injury	38	53	41	80	78	25	315	63
Possible Injury	0	5	7	19	14	1	46	9.2
Non-Incapacitating Injury	3	6	9	12	13	3	46	9.2
Incapacitating Injury	2	3	1	2	5	0	13	2.6
Fatal	0	0	2	1	0	0	3	0.6
Northbound Total	**43**	**67**	**60**	**114**	**110**	**29**	**423**	**84.6**
Southbound								
No Injury	13	16	31	32	43	18	153	30.6
Possible Injury	5	7	4	5	6	3	30	6
Non-Incapacitating Injury	3	6	8	8	6	5	36	7.2
Incapacitating Injury	0	2	2	2	1	1	8	1.6
Fatal	0	2	3	1	0	0	6	1.2
Southbound Total	**21**	**33**	**48**	**48**	**56**	**27**	**233**	**46.6**

2.3 Conclusions

The following conclusions were presented in the 2017 updated preliminary traffic report:

1. The representative 2016 AADTs reported by ADOT's Transportation Planning website and the 2040 AADTs projected by ADOT for the study section of I-17 (MP 229-MP 262) are as follows:

Location on I-17 Mainline	MP	2016 7-Day AADT	2040 7-Day AADT
Anthem Way to New River Rd	229 – 232	45,900	58,944
New River Rd to Black Canyon City	232 – 244	41,600	56,505
Black Canyon City to Sunset Point	244 – 252	34,200	52,101
Sunset Point to Cordes Jct.	252 – 262	36,200	52,420

2. The following traffic behaviors were observed based on the 2016 traffic data collected at this ATR:
   - This study area experiences rural/recreational characteristics as opposed to typical urban characteristics. Instead of a weekday morning and late afternoon peak hour work-home commute traffic, the study area experiences weekend peak traffic. The average Saturday volumes are a factor of 1.2 larger than an average 7-day volume.
   - This study area experiences a large number of trips traveling away from the Phoenix metropolitan area at the beginning of the weekend on Friday and Saturday and returning to the area at the end of the weekend on Sunday.
   - This study area does not experience substantial seasonal changes. Many of the months exhibit relatively similar volumes on an average Saturday, except for the month of December, which is lower.
3. There was an average of approximately 365 crashes per year within the study area, based on 5 years of crash data.
4. There tends to be more crashes in the northbound direction as compared to the southbound direction.
5. The crashes in both the northbound and southbound directions tend to exhibit similar levels of severity.
6. Traveling northbound, the average number of crashes per mile tends to be higher in the mountainous terrain as compared to the level and rolling terrain.
7. Rear-end crashes are the predominant manner of collision on the northbound roadway in the mountainous area.
8. Single vehicle crashes are the predominant manner of collision on the southbound roadway in the mountainous area.
9. To maintain a LOS D in the study section, I-17 should be widened to three lanes in each direction, with an additional fourth lane in both directions south of Black Canyon City as well as climbing or flex lanes in the northbound direction in the mountainous segment between Black Canyon City and Sunset Point.
10. Based on the criteria established by AASHTO and a normal operating speed of 65 MPH, the northbound climbing lane should begin at approximately MP 244.44 and end at approximately 252.65.
11. The capacity analysis for the flex roadway indicates construction of a two-lane flex roadway would provide acceptable levels of service in the peak direction for the mainline lanes and the flex lanes. However, the northbound mainline lanes would operate at LOS F during the off-peak (Sunday) hours after the year 2026.

3.0 Design Concept Alternatives

3.1 Introduction

This section includes background information explaining why particular alternatives are being evaluated and what issues are driving development of the alternatives. This chapter is divided into several sections to discuss the various project elements:

- Anthem Way to Black Canyon City (MP 229.1 – MP 244.5)
- Black Canyon City to Cordes Junction (MP 244.5 – MP 262.0)
    - o Alternatives Eliminated from Further Study
    - o Long Term Alternatives
    - o Near Term Alternatives
- Evaluation Criteria
- Evaluation Matrices
- Recommended Alternatives

3.2 Anthem Way to Black Canyon City Alternatives

This segment of I-17 was included in the 2004 ADOT Project H5162 01L, which consisted of design concept development and long-range implementation strategies for the addition of general purpose and HOV lanes from SR 101L to the Black Canyon City TI. Four general purpose lanes and one HOV lane were recommended on I-17 between Anthem Way and New River Road; four general purpose lanes were recommended between New River Road and Black Canyon City.

The traffic volumes and projections developed in 2004 far exceed those developed for the current report. Based on current traffic projections, three travel lanes in each direction will be adequate until 2058 from Anthem Way to New River Road, and until 2038 from New River Road to Black Canyon City. Based on the current traffic projections, three travel lanes in each direction are recommended from the Anthem Way TI to the Black Canyon City TI.

The 2004 report considered inside, outside, and centered widening. Because that report considered a much wider typical section, the widening recommendations have been re-evaluated based on a three-lane typical section.

No Build Alternative

The No Build Alternative assumes that no major improvements would be made to I-17 from the Anthem Way TI to Black Canyon City. Under the No Build Alternative, traffic flow within the study area would continue to deteriorate due to increasing congestion. This congestion would intensify in future years from traffic growth generated by ongoing land development and urbanization. The No Build Alternative would not fulfill the purpose of the project of reducing traffic congestion and improving the capacity and traffic operational characteristics of the route for regional traffic.

Anthem Way TI to New River Road TI

This section of I-17 is considered fringe-urban as there are large, urban commercial, and residential developments near the Anthem Way TI. This three-mile segment of I-17 is similar to the five miles to the south (Carefree Highway to Anthem Way) in that the horizontal alignments are parallel, the speed limits are the same, and the areas are both fringe-urban. The five-mile section to the south was widened to three lanes in 2010 by sawcutting and widening the existing pavement on the median-side in both directions. In addition to widening the pavement in this area, half barrier was installed on the high (northbound) side since the remaining median width is 75 feet or less.

This segment of I-17 should match the typical section of the segment to the south by sawcutting and widening existing pavement on the median side, as well as adding half barrier along the northbound inside shoulder. An advantage to inside widening in this area is that there are two-way frontage roads along the outside of I-17 on both sides of the freeway; inside widening avoids the need to reconstruct the frontage roads. The median in this area is generally flat and should accommodate inside widening well, except for a segment starting 2,000 feet south of and continuing to the New River Road TI, where rock excavation is required. However, rock excavation would be required in this area regardless of inside or outside widening.

New River Road TI to Black Canyon City TI

North of the New River Road TI (MP 232), the northbound and southbound roadways diverge and follow different horizontal alignments and partially separate rights-of-way for approximately ten miles. The northbound and southbound horizontal alignments become parallel near the Rock Springs TI, at approximately MP 242.1. From this point north to Black Canyon City TI (MP 244.4), the alignments are parallel with a 76-foot median.

Physical features and widening constraints include rock slopes, the New River floodplain, existing bridges, utilities, and an adjacent frontage road/ramp. Because of these constraints and the rolling terrain from MP 232 to Black Canyon City, the widening is recommended to be a combination of inside and outside widening. Tables 26 and 27 detail the widening recommendations for the northbound and southbound roadways and note constraints for each section.

TABLE 26 – NORTHBOUND WIDENING RECOMMENDATIONS MP 232 – 245

Start MP	End MP	Constraint	Recommen-dation	Comment
232.0	233.0	--	Inside	Match widening to south
233.0	233.5	Local road	Inside	Avoid impacts to local road
233.5	235.5	Floodplain	Inside	Avoid impacts to floodplain
235.5	236.5	Table Mesa TI	Inside	Avoid reconstruction of Table Mesa TI ramps
236.5	237.2	--	Inside	Match widening to south
237.2	240.4	Rock	Inside	More removal necessary on outside
240.4	241.8	--	Inside	Match widening to south
241.8	242.5	Rock Springs TI	Inside	Avoid reconstruction of Rock Springs TI ramps
242.5	244.1	Local road, ROW	Inside	Parallel alignments accommodate inside widening; existing Mud Springs bridge better accommodates inside widening
244.1	245.0	Black Canyon City TI	Inside	Avoid impacts to Black Canyon City TI ramps

Inside widening is recommended along northbound I-17 between New River Road and Black Canyon City.

TABLE 27 – SOUTHBOUND WIDENING RECOMMENDATIONS MP 232 – 245

Start MP	End MP	Constraint	Recommendation	Comment
232.0	232.5	--	Inside	Match widening to south
232.5	235.5	Rock	Inside	More removal necessary on outside
235.5	236.5	Table Mesa TI	Inside	Avoid reconstruction of Table Mesa TI ramps
236.5	237.0	Rock	Inside	More removal necessary on outside
237.0	239.0	Rock	Outside	More removal necessary on inside
239.0	240.7	Little Squaw Creek Bridge	Outside	New bridge constructed in 2010 accommodates outside widening
240.7	242.5	Rock Springs TI	Inside	Avoid reconstruction of Rock Springs TI ramps
242.5	244.1	ROW	Inside	Parallel alignments and 76' median accommodate inside widening; existing Mud Springs bridge better accommodates inside widening
244.1	245.0	Black Canyon City TI	Inside	Avoid reconstruction of Black Canyon City TI ramps

A **combination** of inside and outside widening is recommended along southbound I-17 between New River Road and Black Canyon City. A new horizontal curve is used for the two transitions between inside and outside widening.

3.3 Black Canyon City to Junction SR 69 (Cordes Junction) Alternatives

This project (H6800 01L) began in 2006 with engineering studies extending from the Black Canyon City TI to Cordes Junction. In addition to the No Build alternative, nine "build" alternatives were developed and evaluated in the 2007 *Alternative Selection Report* for the project. The no build alternative considers that no improvements would be made to the existing facility.

In addition to the alternatives that were developed to satisfy the long-term needs of I-17, several near-term alternatives were developed more recently. The near-term alternatives are discussed later in this chapter.

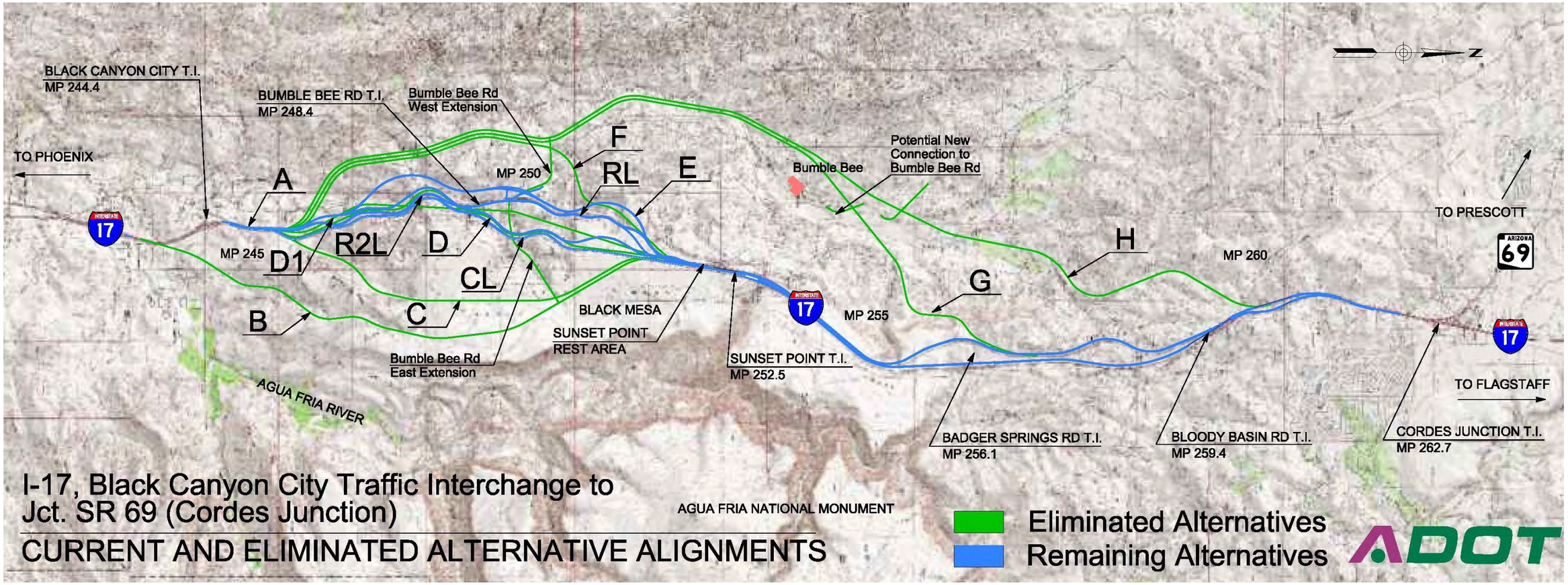
The identification and evaluation of feasible improvement alternatives for the I-17 mainline, from the Black Canyon City TI to Jct. SR 69, has been conducted to accommodate projected traffic volumes for the 2040 design year. The development of these alternatives incorporated input from other agencies, such as BLM, the US Army Corps of Engineers (COE), Arizona Game & Fish Department (AGFD), Western Area Power Administration (Western), Central Yavapai Metropolitan Planning Organization, as well as the public. A number of issues, concerns, and opportunities surfaced during discussions. Some of the major concerns included rapidly increasing congestion, safe flow of traffic through the corridor, protection of natural and cultural resources, a possible bypass route that could be used by motorists to avoid crash locations that result in lengthy closures of I-17 between Black Canyon City and SR 69, future land use, impacts to communities, and local property values. This segment of I-17 also has numerous physical features and constraints that must be considered, including steep rock slopes, severe terrain, existing utilities, and existing bridges.

Table 28 lists all of the original alignment alternatives that were developed for this segment of I-17. These alternatives are illustrated in Figure 6.

TABLE 28 – ORIGINAL 2007 ALTERNATIVES

	ALTERNATIVE DESCRIPTION
No Build	No improvements to existing I-17 roadways
A	Mainline widening
B	New east alignment from 0.5 mile south of the Black Canyon City TI to 1 mile south of the Sunset Point TI
C	New east alignment from 0.5 mile north of the Black Canyon City TI to 1 mile south of the Sunset Point TI
D	New middle alignment in the median, from 0.5 mile north of the Black Canyon City TI to 1 mile south of the Sunset Point TI
D-1	New middle alignment with a series of tunnels, from 0.5 mile north of Black Canyon City TI to 1 mile south of the Sunset Point TI
E	New middle alignment west of southbound I-17, from 0.5 north of the Black Canyon City TI to 1 mile south of the Sunset Point TI
F	New west alignment from 0.5 mile north of the Black Canyon City TI to 1 mile south of the Sunset Point TI
G	New west alignment from 0.5 mile north of the Black Canyon City TI to the Badger Springs TI
H	New west alignment from 0.5 north of the Black Canyon City TI to 1 mile south of the Bloody Basin TI

FIGURE 6 – BLACK CANYON CITY TI TO CORDES JUNCTION, PRELIMINARY ALTERNATIVE ALIGNMENTS (2007)



The evaluation criteria included design, environmental, and socioeconomic considerations that were developed during the agency and public involvement process. These criteria were used to determine the viability of the alternatives and evaluate the alternatives against the purpose and need of the project. The criteria used in the initial screening process included:

- Improve traffic operations
- Improve incident management on Black Canyon Hill
- Constructability
- Earthwork/geotechnical
- Impacts to traffic during construction
- Estimated construction costs
- Structure and retaining wall construction
- Impacts to utilities and maintenance of facilities
- Maintain connectivity and access to crossroads
- Minimize environmental and socioeconomic impacts
- Minimize impacts to existing structures
- Minimize ROW acquisition
- Public comment


Looking east toward I-17 on Black Canyon Hill

The assessment of alternatives also addressed factors such as land use and ownership, jurisdiction, water resources, biological impacts, visual resources, air quality, noise, hazardous materials, and cultural resources.

3.3.1 Alternatives Considered but Eliminated from Further Study – Long-term Solutions

As documented in the Alternative Selection Report, the alternatives discussed in this section were evaluated and eliminated from further consideration. The alternatives were originally developed to satisfy higher projected levels of population and employment growth and correspondingly higher projected traffic volumes; the descriptions that follow have been updated to reflect the current recommended number of lanes.

Alternative A, Mainline Widening

Alternative A consists of widening the existing northbound and southbound alignments from MP 244.5 to MP 262. This alignment would consist of adding one lane and additional shoulder width in both directions. A climbing lane would be added in the northbound direction from MP 244.65 to 250.40.

This alternative would consist of a combination of widening to the inside and outside of the existing roadways. Modifications to the existing horizontal geometry would be incorporated with the widening construction. The existing horizontal and stopping sight distance would be increased by cutting back slopes at key locations and flattening the sharp curves. There are also a number of existing curves where the superelevation does not meet current design criteria. The existing pavement would be reconstructed where it does not meet current criteria. This alternative would not change the existing maximum grades of 6% and design exceptions would be required.

Maintaining traffic during construction to improve the existing roadways would be a difficult and expensive undertaking. Construction would be very disruptive to existing I-17 traffic and prolonged because of high existing traffic volumes and because there is no alternate route to carry traffic during construction. In addition, earthwork operations, including blasting and mitigation of rockfall hazards, would require complete closures of both lanes in at least one direction and possibly both directions depending on the proximity of the traffic to construction activity.

Alternative A was eliminated from further consideration as a standalone alternative because:

- Traffic must be maintained during construction. No alternate route would be available during construction along the six-mile segment of I-17 on the Black Canyon Hill as part of this proposed alternative. Therefore, construction at this location would be expensive and difficult and the duration lengthy due to heavy existing high-speed traffic.
- Blasting and rockfall mitigation in close proximity to existing I-17 would require complete closures of both lanes in one direction.
- Grades exceed the maximum 5% in mountainous terrain allowable by AASHTO and ADOT's *Roadway Design Guidelines* for a rural highway from MP 244.5 to 250.5.
- Widening of the northbound roadway could possibly impact the Agua Fria National Monument. Four mining claims would also be affected.

Alternative B, New East Alignment

In this alternative, a new alignment east of the existing I-17 corridor would be constructed. This alignment would consist of three lanes in both directions with a possible climbing lane in areas of sustained uphill grade. It would depart from the existing highway 0.5 mile south of the Black Canyon TI, near the Agua Fria River Bridge. The alignment would travel along a canyon within the AFNM to the top of Black Mesa. Several large structures may be required for the alignment to cross from one side of the canyon to the other. Once at the top of Black Mesa, the alignment would parallel the existing I-17 corridor for 1.5 mile until it ties back into the existing highway one mile south of the Sunset Point TI. Once the alignment ties back in with the existing I-17 alignment, the alternative would consist of widening the existing northbound and southbound alignments north to the project limit.

The proposed roadway profile would have a sustained grade of 5% for approximately 4.5 miles. Landings or interruptions of the maximum sustained grade could be provided by additional earthwork or by allowing a steeper grade. At the top of Black Mesa, the grade would be relatively level until it ties back in with existing I-17.

Bumble Bee Road could be connected to the new alignment by constructing a new TI east of existing I-17 on the mesa. This would be accomplished with a two-mile long crossroad that would cross west from the new alignment down a steep canyon to connect to the existing Bumble Bee Road.

This alternative was eliminated from further consideration because:

- The area near the Black Canyon City TI proposed for the new alignment has various residential and commercial developments. This alternative would require the displacement of approximately 50 single family residences, 6 apartment buildings, and other outbuildings.
- The new alignment would be located on private land and within the Agua Fria National Monument. A large amount of ROW acquisition would be required.
- It would require extensive earthwork and there is a moderate to high risk of slope instability and rockfall hazards in areas with high slopes.
- Roadway foundation conditions are poor to fair, with a moderate potential for expansive soils in the southern portion of the alignment.
- There is a high impact probability to wildlife and wildlife habitat. The new alignment would fragment pronghorn habitat and fawning areas, have potential impacts to riparian habitat where major drainages are crossed, and potentially encroach on the Agua Fria River floodplain.
- The new alignment is not consistent with the BLM Resource Management Plan. There would be direct impacts to the Agua Fria National Monument. It would impact recreational experiences by severing existing trails and highly affecting visual quality.

- AFNM cultural resources would be highly impacted.
- Constructing a crossroad to connect Bumble Bee road to the new alignment would require steep grades and extensive earthwork.
- It had low public and agency support.

Alternative C, New East Alignment

Alternative C also proposed a new alignment east of the existing I-17 corridor. This alignment would consist of three lanes in both directions with a possible climbing lane in areas of sustained uphill grade. It would begin 0.5 miles north of the Black Canyon City TI and proceed northeast, east of existing I-17. The new alignment would climb steep canyons within the AFNM to the top of Black Mesa. The corridor would then parallel existing I-17 for approximately one mile until it ties back into the existing I-17 alignment south of the Sunset Point TI. Once the alignment ties back in with the existing I-17 alignment, the alternative would consist of widening the existing northbound and southbound alignments north to the project limits.

The proposed profile would have an initial sustained grade of 10% for several miles north of Black Canyon City because the alternative must rapidly ascend the face of the Black Mesa. At the top of Black Mesa, the roadway grade would be relatively flat until it ties back in with the existing I-17 roadways south of Sunset Point TI.

Bumble Bee Road could be connected to the new alignment by constructing a new TI east of existing I-17 on Black Mesa. This would be accomplished with a two-mile long crossroad that would cross west from the new alignment down a steep canyon to connect to the existing Bumble Bee Road.

This alternative was eliminated from further consideration because:

- The 10% grade would exceed the maximum grade allowed by AASHTO and ADOT's RDG, which is 5% maximum in mountainous terrain.
- The new alignment would be located on private land and within the Agua Fria National Monument. A large amount of ROW acquisition would be required.
- It would require extensive earthwork and there is a moderate to high risk of slope instability and rockfall hazards in areas with high slopes.
- Roadway foundation conditions are poor to fair, with a moderate potential for expansive soils in southern portion of alignment.
- There is a high impact probability to wildlife and wildlife habitat. The new alignment would fragment pronghorn habitat and fawning areas, have potential impacts to riparian habitat where major drainages are crossed, and potentially encroach on the Agua Fria floodplain.
- The new alignment is not consistent with the BLM Resource Management Plan. There would be direct impacts to the Agua Fria National Monument. It would impact recreational experiences by severing existing trails and highly affecting visual quality.
- AFNM cultural resources would be highly impacted.
- Constructing a crossroad to connect Bumble Bee road to the new alignment would require steep grades and extensive earthwork.
- The alternative would affect one mining claim and two grazing allotments.
- It has low public and agency support.

Alternative D-1, New Middle Alignment

Alternative D-1 consists of a new roadway alignment to be developed near the existing highway. The alternative would provide three lanes in both directions with a possible climbing lane in areas of sustained uphill grade. The new alignment would begin 0.5 mile north of the Black Canyon City TI. It would proceed north, utilizing the ROW between the existing northbound and southbound I-17 roadways and by using a series of tunnels to navigate the mountainous terrain. Using tunnels would result in a simple horizontal alignment with grades between 1% and 5%.

At its south end, the alignment would begin parallel to the existing northbound I-17 alignment. It would then cross over the existing southbound I-17 alignment and continue along its west side. The first tunnels would be constructed just south of the existing Bumble Bee TI; these tunnels would be just over a mile in length. The new alignment would tunnel under the existing southbound I-17 roadway once and existing northbound I-17 roadway twice, as well as under existing Bumble Bee Road. The parallel tunnels would daylight just north of existing Bumble Bee Road and the alignment would be aboveground for approximately one mile before entering another tunnel. The final series of mile-long tunnels would surface at the top of Black Mesa. From here, the alignment would tie back into the existing highway just south of the Sunset Point TI. Once the alignment ties back in with the existing I-17 alignment, the alternative would consist of widening the existing northbound and southbound alignments north to the project limits.

A new TI approximately 2000 feet north of the existing Bumble Bee TI could be constructed to connect the new alignment to Bumble Bee Road.

This alternative was eliminated from further consideration because:

- Preliminary geotechnical analysis has determined that the soil conditions in the area are unfavorable for tunnel construction. There is also a high risk of slope instability and rockfall hazards in areas with high slopes.
- Constructability would be difficult, earthwork would be extensive, and tunnel costs would be prohibitively high, estimates for tunnel construction could range from $50,000 to $70,000 per linear foot of tunnel (2007 estimate).
- Construction would be disruptive to existing I-17 traffic. Blasting and rockfall mitigation in close proximity to I-17 may require complete closures of both lanes in one direction.
- Hazardous cargo may not be permitted to pass through tunnels. Therefore, one of the existing I-17 roadways would need to be retained or another acceptable route be established for hazardous cargo transport.
- There would be medium impacts to existing utilities.
- Four mining claims would be affected.

Alternative F, New West Alignment

In this alternative, a new alignment west of the existing I-17 corridor would be constructed. This alternative would provide three lanes in both directions with a possible climbing lane in areas of sustained uphill grade. It would begin 0.5 miles north of the Black Canyon City TI, cross over the existing southbound I-17 alignment, and continue in a north to northwest direction. The new alignment would follow alongside the existing Maggie Mine Road and Crown King Road (Old Route 69) alignments. It would then travel east up the face of Black Mesa toward the existing I-17 roadway and would connect back to the existing I-17 alignment one mile south of the Sunset Point TI. Once the alignment ties back in with the existing I-17 alignment, the alternative would consist of widening the existing northbound and southbound alignments north to the project limits.

The southern segment for this alternative consists of borderline mountainous and rolling terrain. The climb to the top of Black Mesa would consist of a 5% grade followed by a 10% grade to traverse the steep face of Black

Mesa without extensive cuts. At the top of Black Mesa, the profile grade would be relatively flat to its tie-in with the existing I-17 profile.

This alternative was eliminated from further consideration because:

- The 10% grade for 1.2 miles would exceed the maximum grade allowed by AASHTO and ADOT's RDG, which is 5% maximum in mountainous terrain.
- ROW acquisition requirements are medium to high.
- It would require extensive earthwork and there is a moderate to high risk of slope instability and rockfall hazards in areas with high slopes.
- There is a high impact probability to wildlife and wildlife habitat.
- The new alignment is not consistent with the BLM Resource Management Plan. It would impact recreational experiences by severing existing trails and highly impacting visual quality.
- There would be medium to high impacts to existing utilities and 17 mining claims would be affected.

Alternative G, New West Alignment

Alternative G also would construct a new alignment west of the existing I-17 corridor. This alternative would provide three lanes in both directions with a possible climbing lane in areas of sustained uphill grade. It would begin 0.5 miles north of the Black Canyon City TI and follow the same alignment as Alternative F south of the existing Bumble Bee TI. North of Bumble Bee Road, Alternative G would closely follow the existing Crown King Road alignment, passing just east of Bumble Bee Ranch. By staying along the bottom and the side of Black Canyon and crossing the entrance of Alkali canyon, this new alignment would climb gradually and connect with existing I-17 near the Badger Springs Road TI. Once the alignment ties back in with the existing I-17 alignment, the alternative would consist of widening the existing northbound and southbound alignments north to the project limits.

The southern segment for this alternative would cross borderline mountainous and rolling terrain of approximately 1% to 5% grade. The alignment would then ascend at a 5% grade for several miles. Due to the skew of the roadway up the side of Black Canyon and crossing the entrance of Alkali Canyon as it ascends to Badger Springs Road, several sections of deep cut and long fill slopes are anticipated.

This alternative was eliminated from further consideration because:

- A large amount of ROW acquisition would be required.
- There is a high impact probability to wildlife and wildlife habitat. With eleven stream crossings, it has the potential to impact riparian habitat as well as the AGFD's northern wildlife water catchment.
- The new alignment is not consistent with the BLM Resource Management Plan. It would impact recreational experiences by severing existing trails and impacting visual quality.
- There will be medium to high impacts to existing utilities.
- Seventeen mining claims and four BLM grazing allotments would be affected.
- Because of the elevation difference, access to the Sunset Point TI and rest area may not be possible.
- Terrain would make the connection back into I-17 north difficult.

Alternative H, New Far West Alignment

Alternative H consists of a new alignment beginning approximately one mile north of the Black Canyon City TI and ending at approximately one mile south of the Bloody Basin TI. Three lanes would be provided in both directions; a climbing lane would be considered in areas of sustained uphill grades. The current Alternative H alignment was modified from the original version presented to the public in 2007. The revised alignment avoids more of the riparian area and bypasses locations that were identified as being environmentally sensitive during the data collection and technical studies phase of this study.

The southern segment of the Alternative H alignment would be similar to Alternative E. The new alignment would proceed northward until passing Maggie Mine to the east, then would begin to turn in a northwesterly direction across the valley to the opposing hillside. The new alignment would proceed westward and cross over Arrastre Creek. The alignment would pass to the east of Gillespie Mine, pass between two other mines, and then turn northward along the western face of Black Canyon. A range of hills would separate the new alignment from the existing I-17 alignments. Alternative H would run parallel to the existing Crown King Road along the west, crossing over Crown King Road several times to accommodate the terrain.

As Alternative H approaches the valley floor south of Bumble Bee Ranch, the alignment would turn to the east over Sheep Gulch. The alignment would then continue its course north on the hillside of Black Mesa for three miles, maintaining distance from the floodplain, as well as creating a physical nature barrier between the roadway and a view from the valley floor. The alignment would bridge over Alkali Canyon and resume its climb up the hillside to reach the top of Black Mesa and connect with existing I-17 south of the Bloody Basin Road TI. Once the alignment connects to existing I-17, the alternative would widen the existing northbound and southbound roadways north to the project limit.

The profile for Alternative H from the south would consist of an upgrade of 5% for the first mile, then level out for the next half mile. As the alignment crosses to the opposing hillside, it would climb at a grade of 4.5% for approximately 1.5 mile. The profile over the next eight miles ranges from a downgrade of 1.5% to an upgrade of 3.8%. Where the roadway travels up the hillside to reach the top of the mesa, the grades would increase to 5% for approximately three miles.

New structures would bridge rough terrain or span locations where fills are greater than 60 feet.

Because Alternative H is west of and much lower in elevation than the existing I-17, it would not provide access to the Sunset Point TI or rest area or the Badger Springs TI.

Although it was recommended for further study in the Alternative Selection Report, this alternative has since been eliminated from further consideration because:

- A large amount of new right-of-way would be required.
- The new alignment would not be consistent with the BLM's recently amended Resource Management Plan because it would not conform to BLM's recreation management and visual quality objectives. In addition, approximately 50 percent of the alignment would be located outside BLM's designated multi-use transportation/utility corridor.
- Eleven mining claims and four BLM grazing allotments would be affected.
- Foraging yellow-billed cuckoos, a US Fish and Wildlife threatened species, would potentially be impacted where the new alignment parallels riparian habitat along Black Canyon and Bumble Bee creeks.
- Alternative H would have an adverse effect on three historic properties recommended or determined eligible for listing in the National Register of Historic Places that would be avoided by Alternatives D and E. Thus, Alternative H would not comply with the requirements of Section 4(f) of the Department of Transportation Act of 1966, which protects historic properties of federal, state, or local significance.
- The new alignment of Alternative H would not provide access to Bumble Bee Road, the Sunset Point TI, the Sunset Point Rest Area, or the Badger Springs TI.
- Alternative H received low public and agency support.

3.3.2 Alternatives Recommended for Further Study – Long-term Solutions

The alternatives discussed below were originally defined in the Alternative Selection Report. Based on favorable preliminary evaluations, they were developed further.

No Build Alternative

The No Build Alternative assumes that no major improvements would be made to I-17 from the Black Canyon City TI to Cordes Junction. Under the No Build Alternative, traffic flow within the study area would continue to deteriorate due to increasing congestion. This congestion would intensify in future years from traffic growth generated by ongoing land development and urbanization. The No Build Alternative would not fulfill the purpose of the project of reducing traffic congestion and improving the capacity and traffic operational characteristics of the route for regional traffic.

Alternative D

As in the other alternatives, Alternative D would extend the three-lane section in each direction (with revised traffic projections) recommended by the DCR to the south of the Black Canyon City TI. Alternative D consists of a new alignment constructed primarily in the median area between the existing northbound and southbound roadways where topography and spacing permit. The alternative alignment begins approximately 0.5 mile north of the Black Canyon City TI and ends approximately one mile south of the Sunset Point TI. Once the alignment ties back in with the existing I-17 alignment near Sunset Point, the alternative would consist of widening the existing northbound and southbound roadways north to the project limit. Four lanes would be provided in the northbound direction on the existing roadways by using the two existing northbound lanes and converting the two southbound lanes into northbound lanes and three lanes provided in the southbound direction on a new alignment from Black Canyon City to Sunset Point Rest Area. North of Sunset Point, three lanes would be provided in both directions.

South of the existing Bumble Bee TI, the new alignment would cross over the existing southbound alignment and Bumble Bee Road. From there, the new alignment would follow along the west side of the existing northbound alignment within the existing median and tie back in to the existing southbound roadway south of the Sunset Point TI. From this point to the northern project limit, the existing roadways would be widened to three lanes.

The vertical profile for the new alignment would consist of 4% to 5% grades to the top of Black Mesa. Once at the top of Black Mesa, the grade would be relatively level as the highway follows the terrain to connect with the existing I-17 profile.

Five new structures would be required for this alternative. Two structures would be necessary to cross over southbound I-17. Another bridge would be located at the existing Bumble Bee TI over the existing crossroad. The remaining locations would bridge rough terrain, deep valleys, and an existing underground gas line. Bridges spanning deep valleys that do not have elements such as utilities, roadways, or significant water crossings have been minimized to reduce cost due to the expected availability of large amounts of suitable fill material within the project limits. Bridge structures would range from 250 feet to 590 feet in length. In addition, the two existing overpass structures at the Sunset Point TI are recommended for widening and the existing overpass structures at Badger Springs TI and Bloody Basin TI should be replaced to accommodate the roadway widening. The existing Bumble Bee TI structures are not impacted by this alternative.

Conversion of the existing southbound I-17 roadway to allow northbound traffic to use it would require removing the existing ramps at the Bumble Bee TI, removing and replacing existing signs and protection devices, and correcting adverse crown.

Alternative D Connection to Bumble Bee Road: Alternative D crosses well above Bumble Bee Road because of topography and required bridge clearance over I-17. The horizontal alignment for Alternative D is between and close to both the existing northbound and southbound roadways at Bumble Bee Road. The close proximity to the existing roadways does not provide adequate space for new ramp connections to Bumble Bee Road. The new ramps would have very steep grades, ranging from 9% to 18%, which far exceed allowable ramp grades per the RDG.

The steep ramp grades eliminated southbound access options to Bumble Bee for Alternative D. However, Alternative D would provide northbound and southbound access to the Black Canyon City TI and the Sunset Point Rest Area and TI.

Alternative E

Alternative E consists of a new alignment generally to the west of the existing southbound I-17 roadway, beginning approximately 0.5 mile north of the Black Canyon City TI and ending approximately one mile south of the Sunset Point TI. Four lanes would be provided in the northbound direction on the existing roadways and three lanes would be provided in the southbound direction on a new alignment from Black Canyon City to Sunset Point. North of Sunset Point, three lanes would be provided in both directions north to Cordes Junction. Widening would consist of adding lanes to the inside of the existing roadways, the outside, or a combination of both.

At the south end of the project, the new alignment follows the existing southbound alignment. The new roadway would turn westward to cross over Arrastre Creek. Proceeding north, Alternative E would cross over a realigned section of Bumble Bee Road west of the existing TI. The new alignment stays west of and roughly parallel to the existing southbound roadway from Bumble Bee Road north to its tie-in at Sunset Point.

The vertical profile for Alternative E would consist of grades ranging from 0.5% to 5% from Black Canyon City to the top of Black Mesa. Once at the top of Black Mesa, grades would be relatively flat as Alternative E follows the terrain until it ties back in with the existing I-17 roadways.

Alternative E would require a total of six new structures, ranging from 140 feet to 1460 feet in length. The structures would bridge rough terrain, deep valleys, and existing underground gas and fiber optic lines. Bridges spanning deep valleys that do not have elements such as utilities, roadways, or substantial water crossings were minimized to reduce cost because of the expected availability of large amounts of suitable fill material within the project limits. One mainline structure and one ramp structure would be necessary to cross above the realigned segment of the Bumble Bee crossroad west of the existing traffic interchange.

Two existing overpass structures at the Sunset Point TI would be widened and the existing overpass structures at Badger Springs TI and Bloody Basin would be replaced to accommodate the roadway widening. The existing Bumble Bee TI structures are not impacted by this alternative.

Alternative E Connection of Southbound I-17 to Bumble Bee Road: Reasonable ramp horizontal alignments and grades can be provided with Alternative E.

Two TI configurations were considered to find a good solution to connect southbound I-17 to Bumble Bee Road with an acceptable exit ramp grade and length: a Loop Alternative and a Half Diamond (western half) Alternative. The loop configuration was rejected because it potentially could be confusing to drivers and encourage wrong-way movements. In addition, the loop configuration is not consistent with driver expectancy for the rest of the traffic interchanges in the corridor and it requires additional right-of-way.

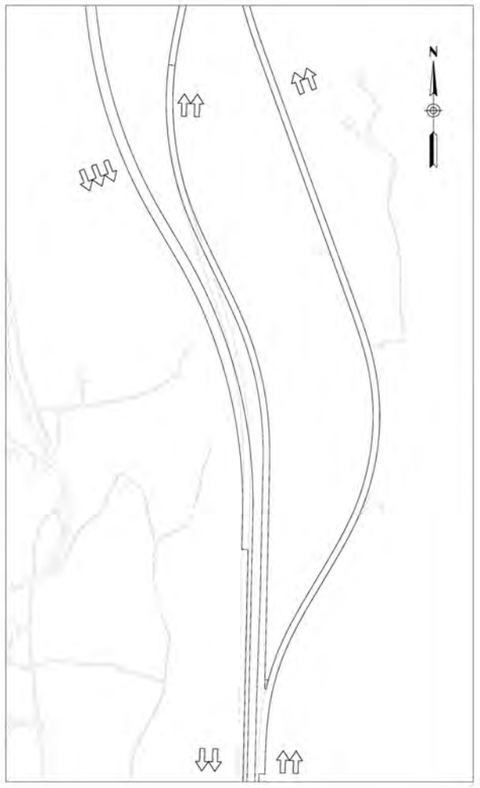
The diamond alternative would require a new connector road to access existing Bumble Bee Road. The location of the TI allows a flatter grade on the southbound exit ramp. The initial grade for the southbound exit ramp would

be 5%, then reduced to 1% for the last 800 feet of the ramp. The entrance ramp has an upgrade of 3.3% before matching the mainline downgrade of 1.5%. A parallel entrance ramp is recommended to allow trucks to gain speed before merging into the main flow of traffic.

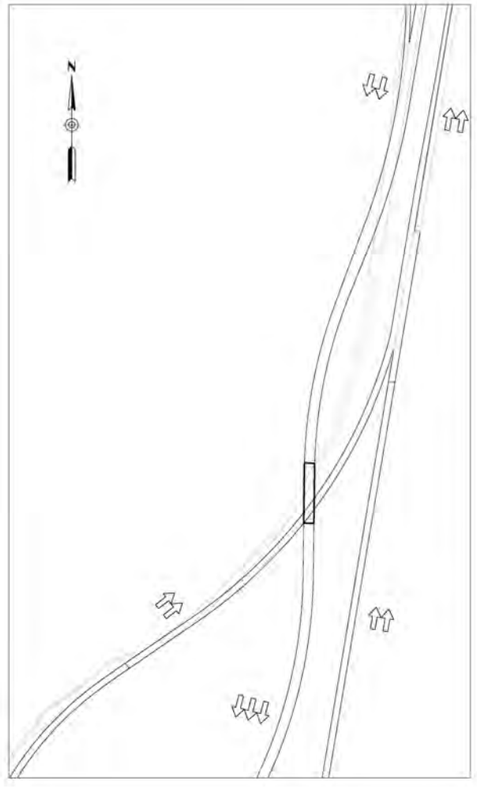
While more complicated to construct with two added structures and road connector, the diamond TI was recommended as the more desirable configuration.

Figures 7 and 8 below illustrate the connections from Alternatives D and E to existing I-17 near Black Canyon City ('South End') and Sunset Point ('North End').

FIGURE 7 – ALTERNATIVE D CONNECTION LAYOUTS AT SOUTH AND NORTH TERMINI

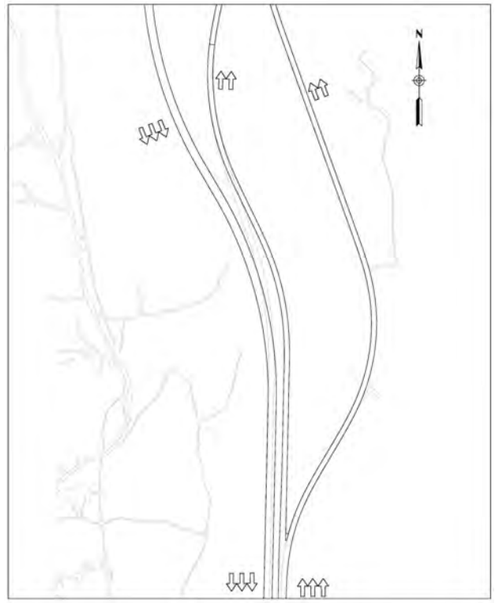


SOUTH END

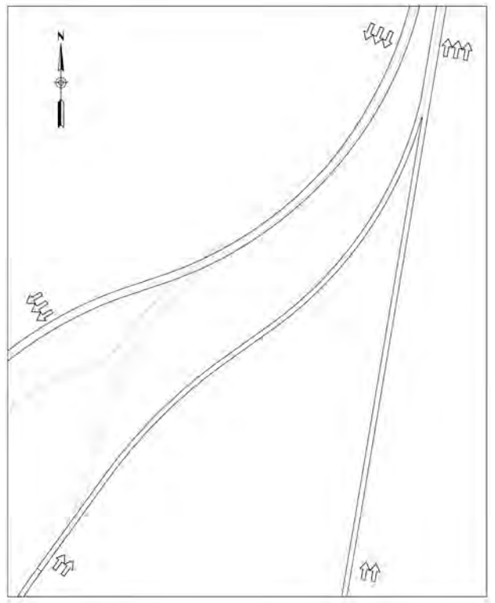


NORTH END

FIGURE 8 – ALTERNATIVE E CONNECTION LAYOUTS AT SOUTH AND NORTH TERMINI



SOUTH END



NORTH END

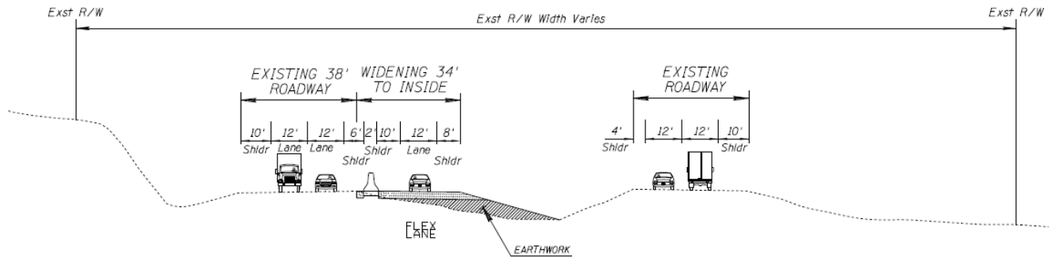
3.3.3 Alternatives Considered but Eliminated from Further Study – Near-term Solutions

The alternatives with new roadways on new alignments are costly to construct. Because of limited funding availability, less expensive, nearer-term alternatives were developed that may not satisfy the traffic capacity needs in the design year 2040 but would improve current operations at a lower cost than the long-term alternatives on new alignment.

One- and two-lane flex lane alternatives were developed. The one-lane flex lane alternative has been eliminated from further consideration.

Flex Roadway – One Lane

Flex traffic lanes add peak-direction capacity to a two-way facility and decrease congestion by providing additional lane capacity for the peak direction. This alternative would retain the two southbound lanes on the existing southbound roadway and the two northbound lanes on the existing northbound roadway and add a barrier-separated one-lane flex roadway alongside the southbound lanes between Black Canyon City and Sunset Point.



I-17 Typical Section Flex Lane Alternative

To add the flex lane adjacent to the southbound lanes, a 42" concrete barrier would be added next to the inside shoulder with a two-foot shy distance on both sides. A new twelve-foot lane with eight-foot shoulders would carry northbound traffic during peak northbound hours (e.g., Friday and Saturday) and would carry southbound traffic during peak southbound hours (e.g., Sunday and holiday weekends). The traffic direction could be changed if needed due to crashes or maintenance.

Signing will be required to direct both directions of traffic. Breakaway posts will need to accommodate bi-directional traffic. Guardrail ends and attenuators will be fitted for approaches in both directions.

Because the flex lane would be barrier separated from the southbound lanes for the length of the Black Canyon Hill, no access to or from the Bumble Bee TI would be possible for traffic on the flex lane. Southbound traffic entering I-17 from the Sunset Point TI would not be able to access the flex lane because of limited distance between the Sunset Point TI entrance ramp and the top of the downgrade. A short section of temporary or moveable concrete barrier could be included to provide emergency access for this traffic. Several emergency access gates should be included for use by first responders.

The flex lane would connect to the existing northbound and southbound roadways near Black Canyon City and Sunset Point via slip ramps meeting ADOT design criteria for entrance and exit ramps. Dynamic message signs in advance of the flex lane entries would be added south of Black Canyon City (northbound) and north of Sunset Point (southbound) to alert drivers to the status of the flex lane.

Entry to the flex lane would be controlled by gates or a moveable barrier system. The series of gates at the entry points would be designed to prevent cars from going the wrong way. If a recent Florida project were used as an example, the initial gates should be well marked, with large, orange "Do Not Enter" signs suspended from the arm before a final steel arm. Even if a driver were to ignore the digital signs preceding the gates and crash through several of them, the final steel arm would prevent the driver from entering the flex lanes going in the wrong direction. Should the computer system fail, the gates would remain locked down in whatever position they were in last to prevent head-on collisions.

A sweep by operations personnel or a check of cameras would be required prior to switching the direction of traffic in the flex lanes.

This alternative would require approximately 1.5 acres of new ROW associated with two areas of rock cut slopes and associated access to the top of the cuts. An additional 2.8 acres of new drainage easement is required for improvements near MP 251.

This alternative was eliminated from further consideration because:

- The additional costs to create a flex two-lane facility are relatively nominal compared to the benefits of having two travel lanes.
- ADOT District staff indicated that having two lanes for northbound traffic is strongly preferred for future traffic control when northbound construction occurs on the Black Canyon Hill.

3.3.4 Alternatives Recommended for Further Study – Near-term Solutions

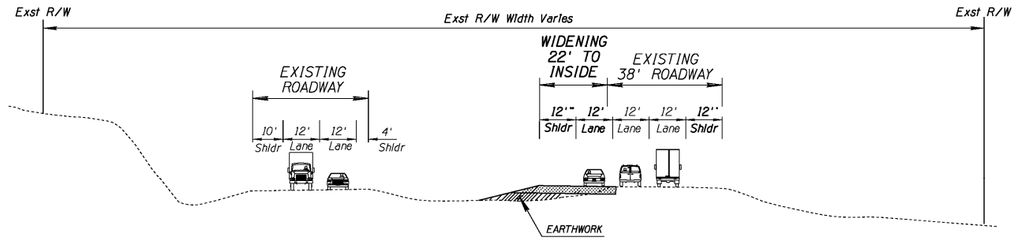
Because of limited funding availability, less expensive nearer-term alternatives were developed that focus on improving capacity and incident management options on the Black Canyon Hill between Black Canyon City and Sunset Point (MP 245-252). Three build alternatives were considered:

- Northbound climbing lane
- Two-lane flex roadway
- Part-time shoulder lane

Northbound Climbing Lane

This alternative would retain the two southbound lanes on the existing southbound roadway and add a northbound climbing lane to the existing two-lane northbound roadway.

The climbing lane would be twelve feet wide. Inside and outside shoulder widths desirably would be increased to twelve feet (per RDG Table 302.4); however, the minimum inside shoulder width is four feet and the minimum outside shoulder width is ten feet for a climbing lane. A design exception would be required from FHWA for a four-foot inside shoulder where the third lane (climbing lane) would be provided.



I-17 Typical Section Climbing Lane Alternative

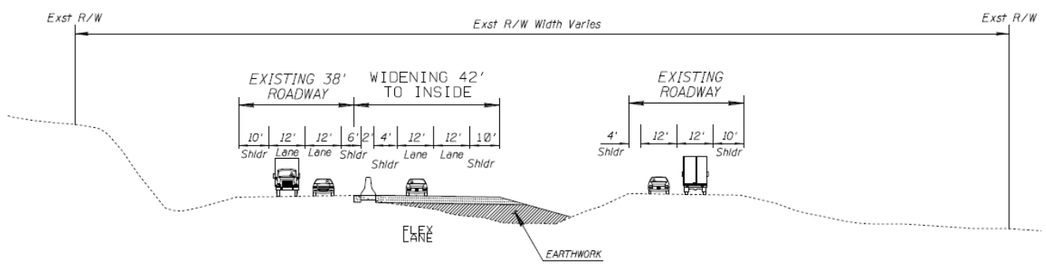
Operationally, the climbing lane would provide additional northbound capacity in the direction of slow-moving vehicles and trucks. It would provide flexibility and extra width for traffic to travel around partial closures; however, it would not provide additional southbound capacity or incident management flexibility for full closures. Access to and from the existing TIs would not change.

The proposed northbound climbing lane between Black Canyon City and Sunset Point would require widening of the northbound roadway from two to three lanes at the Bumble Bee TI. Since the Bumble Bee TI OP NB is considered "Functionally Obsolete" with a 15'-0" vertical clearance, bridge replacement is recommended over widening. ADOT is currently leading the design for this bridge. Construction funding is in ADOT's five-year plan in fiscal year 2020.

This alternative would require approximately three acres of new ROW.

Flex Roadway – Two Lanes

This alternative resembles the one-lane flex roadway alternative detailed in Section 3.3.3. It would retain the two southbound lanes on the existing southbound roadway and the two northbound lanes on the existing northbound roadway and add a barrier-separated two-lane reversible roadway alongside the southbound lanes between Black Canyon City and Sunset Point.



I-17 Typical Section Flex 2 Lane Alternative

To add the flex lanes adjacent to the southbound lanes, a 42-inch concrete barrier would be added next to the inside shoulder. A glare screen on the concrete barrier should be considered as it may be helpful to drivers when the flex lanes are being used in the northbound direction. Two new twelve-foot lanes with a four-foot inside shoulder and a ten-foot outside shoulder would carry northbound traffic during peak northbound hours (e.g., Friday and Saturday) and would carry southbound traffic during peak southbound hours (e.g., Sunday and holiday weekends). The traffic direction could be changed if needed due to crashes or maintenance.

Operational features, access constraints, and entry into the flex lanes would be the same as described for the one-lane flex alternative.

This alternative would require approximately 1.8 acres of new ROW associated with two areas of rock cut slopes and associated access to the top of the cuts. An additional 2.8 acres of new drainage easement is required for improvements near MP 251.

Part-Time Shoulder Lane

Part-time shoulder use is a transportation system management and operation strategy that allows use of the left or right shoulder as a travel lane during some, but not all, hours of the day and days of the week. This section is a summary of a project memo entitled “Part-Time Shoulder Use Feasibility.”

The I-17 traffic volumes fluctuate by day of week and are particularly influenced by rural/recreational traffic. I-17 traffic has a unique characteristic where the Friday, Saturday, and Sunday traffic volumes consistently exceed Monday through Thursday traffic. Furthermore, it is Friday afternoons, Saturday mornings, and Sunday afternoons that are the heaviest, again corresponding to the public traveling to or from recreational destinations.

Part-time shoulder operations in other states have varied, including dynamically opening shoulders when certain congestion thresholds are reached or statically opening shoulders during specified historical peak periods. Dynamic shoulder use is defined as regular or constant monitoring of the corridor and opening the shoulders for use based on traffic demand. Static shoulder use is defined as opening the shoulder only on given days and hours that are consistent week-to-week, typically based on historical traffic volumes.

Because of the regular and predictable congestion cycles on the I-17 Black Canyon Hill, a static part-time shoulder would be recommended. The regular schedule could be adjusted during certain holidays (Memorial Day, Independence Day, Labor Day) by extending hours and/or days of operation. These adjustments could be made with temporary variable message signs and media coverage.

Part-time shoulder use operations may use the left or right shoulder, depending on several considerations, including driver expectations, striping and operations at traffic interchanges, truck operations, and available lane and shoulder widths.

The primary disadvantage of a right-side shoulder is that slow moving vehicles (trucks and RVs) would use it since it would be the right-most travel lane during peak periods. Without roadway widening, the part-time shoulder lane would be narrow (11-foot lane and 1-foot shoulder) to minimize roadway widening and earthwork costs. If trucks and RVs did not use the right-side part-time shoulder, cars would pass trucks on the right side, which is undesirable. The primary advantage of the right-side shoulder is that the right shoulder would be used for disabled vehicles when closed to through traffic, which is common and is expected by drivers. Because of the heavy truck volumes on I-17, particularly slow-moving truck traffic traveling northbound up steep grades, a left-side part-time shoulder, both northbound and southbound, would be recommended. With this recommendation, clear and descriptive signing advising off-peak drivers to move crashes and broken-down vehicles to the left shoulder will be particularly important.

Given the constrained roadway geometry and high construction costs associated with widening I-17 in this corridor, minimum lane and shoulder widths are recommended to implement the part-time shoulders. These dimensions are compatible with the existing 38-foot northbound and southbound roadway widths.

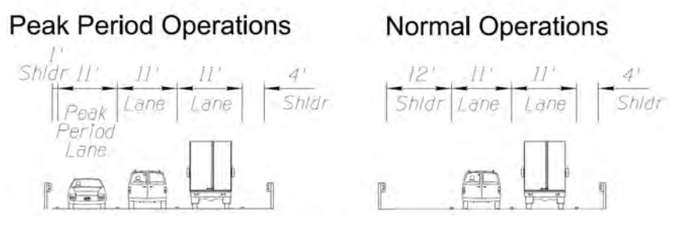
Left Shoulder (inside): 1’ – a striped shoulder is recommended to give shy distance to guardrail during shoulder use.

All travel lanes: 11’ – FHWA requirement.

Right shoulder: 4’ – FHWA requirement.

The widths listed above are absolute minimums and would require exception approval from FHWA. Northbound commercial trucks are currently confined to the right lane on the Black Canyon Hill; heavy trucks should be restricted from using the part-time shoulder lane because of the narrow shoulder.

Any surplus roadway width throughout the corridor should be utilized as lane width, particularly for the right travel lane utilized by commercial trucks. The typical section shown below illustrates the proposed left-side shoulder opened for peak period operations, as well as normal operations with the left shoulder closed to traffic.



Refuge areas for disabled vehicles should be located approximately every half-mile along a facility with static or dynamic shoulder use. The refuge area should be long enough to enable a tow truck to park and load a broken-down vehicle. The availability of space in this corridor to provide any refuge areas is limited by terrain. Building refuge areas to supplement the part-time shoulder lane may require rock excavation in places and new, large embankments and fill slopes in other areas. There are flat areas available along the right side of I-17 northbound and the right and left sides of I-17 southbound approximately every half mile. However, none of the available flat areas along I-17 northbound or southbound can accommodate refuge areas of the recommended size; earthwork operations would be required to construct pullouts along I-17.

3.4 Evaluation of Alternatives

3.4.1 Evaluation Criteria

Criteria used to evaluate the potential impacts of widening between Anthem Way and Black Canyon City include connectivity at ramps, ROW acquisition, and any other major differentiators that could impact construction cost.

Criteria used to evaluate the potential impacts of the Black Canyon City to Cordes Junction long-term and near-term alternatives include traffic operations, access to traffic interchanges, ROW acquisition, and estimated construction cost.

3.5 Evaluation – Anthem Way to Black Canyon City Near-Term Alternatives

The No Build Alternative and Inside, Outside, and Centered Widening Alternatives evaluated against these criteria. The criteria were weighted equally.

The results of the evaluation are summarized in Table 29. The alternatives with the most favorable characteristics for each criterion are identified in the 'Advantage' column. If more than one alternative was determined to have similar favorable characteristics, the alternatives are listed with an ‘or’ to indicate that they rank equally for that criterion. If the No Build alternative was ranked highest for a certain criterion, the most favorable build alternative(s) was also listed because the No Build alternative does not satisfy the purpose and need for the project. Regardless of its ranking, the No Build Alternative will be carried through the NEPA process.

3.6 Evaluation – Black Canyon City to Cordes Junction, Long-Term Alternatives

The No Build Alternative and Alternatives D and E were evaluated against these criteria. The criteria were weighted equally.

The results of the evaluation are summarized in Table 30. The alternatives with the most favorable characteristics for each criterion are identified in the 'Advantage' column. If more than one alternative was determined to have similar favorable characteristics, the alternatives are listed with an ‘or’ to indicate that they rank equally for that criterion. If the No Build alternative was ranked highest for a certain criterion, the most favorable build alternative(s) was also listed because the No Build alternative does not satisfy the purpose and need for the project. Regardless of its ranking, the No Build Alternative will be carried through the NEPA process.

3.7 Evaluation – Black Canyon City to Cordes Junction, Near-Term Alternatives

The No Build Alternative and the climbing, flex lane, and part-time shoulder lane alternatives were evaluated against similar criteria. The criteria were weighted equally.

The results of the evaluation are summarized in Table 31. The alternatives with the most favorable characteristics for each criterion are identified in the 'Advantage' column. If more than one alternative was determined to have similar favorable characteristics, the alternatives are listed with an ‘or’ to indicate that they rank equally for that criterion. If the No Build alternative was ranked highest for a certain criterion, the most favorable build alternative(s) was also listed because the No Build alternative does not satisfy the purpose and need for the project. Regardless of its ranking, the No Build Alternative will be carried through the NEPA process.

TABLE 29 – EVALUATION MATRIX, ANTHEM WAY TI TO BLACK CANYON CITY TI (MP 229.1 TO MP 244.5) NEAR-TERM ALTERNATIVES

Criterion	No Build Alternative	Inside Widening	Outside Widening	Centered Widening	Advantage
Lane Designation Legend ↓ = Existing lane direction of travel ↓ = Proposed lane direction of travel	↓↓ ↑↑	↓↓↓ ↑↑↑	↓↓↓ ↑↑↑	↓↓↓ ↑↑↑	
Typical Section	No change to existing roadways.	Existing 10-ft outside shoulders to remain. Existing 12-ft travel lanes to remain. Existing 4-ft inside shoulders removed. Add one 12-ft travel lane in each direction on inside. Add one 10-ft inside shoulder in each direction.	Existing 10-ft outside shoulders removed. Existing 12-ft travel lanes to remain. Widen 4-ft existing inside shoulders to 10 feet. Add one 12-ft travel lane in each direction on outside.	Remove part of existing shoulders. Existing 12-ft travel lanes to remain. Widen 4-ft existing inside shoulders to 10 feet. Add one 12-ft travel lane in each direction centered.	--
Connectivity at Ramps	No change to existing connections.	No change to existing connections.	Changes to ramps required.	Changes to ramps required.	No Build, Inside
Major Differentiators	N/A	<u>Anthem to New River</u> Parallel alignments accommodate future inside widening. Aligns with lanes south of Anthem. Barrier required as median width is less than 75 feet. <u>New River to Table Mesa</u> **Northbound**: Fits within right-of-way. **Southbound**: Requires less earthwork. <u>Table Mesa to Rock Springs</u> **Northbound**: Requires less earthwork. **Southbound**: Does not match widened Little Squaw Creek bridge. Requires more earthwork. <u>Rock Springs to Black Canyon City</u> Parallel alignments accommodate future inside widening. Barrier required as median width is less than 75 feet.	<u>Anthem to New River</u> Frontage roads conflict with outside widening. <u>New River to Table Mesa</u> **Northbound**: New River floodplain conflicts with outside widening. Right-of-way impacts likely. **Southbound**: Requires more earthwork. <u>Table Mesa to Rock Springs</u> **Northbound**: Requires more earthwork. **Southbound**: Matches widened Little Squaw Creek bridge. Requires less earthwork. <u>Rock Springs to Black Canyon City</u> Right-of-way constraints on outside.	<u>Anthem to New River</u> Frontage roads conflict with centered widening. Barrier required as median width is less than 75 feet. <u>New River to Table Mesa</u> **Northbound**: New River floodplain conflicted with centered widening. **Southbound**: Construction on both sides is undesirable because of impacts to traffic. <u>Table Mesa to Rock Springs</u> **Northbound**: Construction on both sides is undesirable because of impacts to traffic. **Southbound**: Does not match widened Little Squaw Creek bridge. <u>Rock Springs to Black Canyon City</u> Right-of-way constraints on outside. Construction on both sides is undesirable because of impacts to traffic. Barrier required as median width is less than 75 feet.	<u>Anthem to New River</u> Inside <u>New River to Table Mesa</u> **Northbound**: Inside **Southbound**: Inside <u>Table Mesa to Rock Springs</u> **Northbound**: Inside **Southbound**: Outside <u>Rock Springs to Black Canyon City</u> Inside

TABLE 30 – EVALUATION MATRIX, BLACK CANYON CITY TI TO SUNSET POINT TI (MP 244.5 TO MP 252.5), LONG-TERM ALTERNATIVES

Criterion	No Build Alternative	Alternative D	Alternative E	Advantage
Lane Designation Legend ↓ = Existing lane direction of travel ↓ = Proposed lane direction of travel	↓↓ ↑↑	↓↓↓ ↑↑ ↑↑	↓↓↓ ↑↑ ↑↑	
Traffic Operations / Geometrics				
Typical Section	No change to existing roadways.	On Black Canyon Hill: 3 SB lanes on new alignment west of and between exst NB & SB rdwys; 2 NB lanes on existing SB rdwy, 2 NB lanes on existing NB rdwy North of Sunset Pt, widen existing to 3 lanes each direction.	On Black Canyon Hill: 3 SB lanes on new alignment mostly west of existing I-17; 2 NB lanes on existing SB rdwy 2 NB lanes on existing NB rdwy North of Sunset Pt, widen existing to 3 lanes each direction.	--
Traffic Operations	Provides LOS F in design year 2040	Provides LOS C in design year 2040	Provides LOS C in design year 2040	Alt. D or E
Traffic Operations – Truck Route	Trucks on 6% NB grade, 6% SB grade.	Trucks on 6% NB grade, new 5% SB grade.	Trucks on 6% NB grade, new 5% SB grade.	Alt. D or E
Maintenance of Facilities **(Full or Partial Closures during ADOT maintenance or DPS crash-related activities)** **Incident Management on Black Canyon Hill** (All build alternatives are equal north of Sunset Point TI)	Full Closures – NB Full Closures – SB No new opportunities for managing incidents.	Partial closures in segment with alternative route – NB Full Closures – SB NB traffic can be shifted to the clear roadway at locations where the profiles line up vertically (Black Cyn City TI and Bumble Bee TI).	Partial closures in segment with alternative route – NB Full Closures – SB NB traffic can be shifted to the clear roadway at locations where the profiles line up vertically (Black Cyn City TI and Bumble Bee TI).	Alt. D or E
Resolve Geometric Deficiencies / Design Exceptions	No improvements to existing geometrics; numerous design exceptions will be required.	Improves horizontal alignment and superelevation (separate cost); 6% grades remain on existing roadway (3 segments above 6% in NB direction). North of Sunset Pt.., Grades greater than 4% remaining in rolling terrain: 4 segments in SB direction (5.2% to 4.0%); 6 segments in NB direction (5.0% to 4.3%)	Improves horizontal alignment and superelevation (separate cost); 6% grades remain on existing roadway (3 segments above 6% in NB direction). North of Sunset Pt.., Grades greater than 4% remaining in rolling terrain: 4 segments in SB direction (5.2% to 4.0%); 6 segments in NB direction (5.0% to 4.3%)	Alt. D or E

Criterion	No Build Alternative	Alternative D	Alternative E	Advantage
Lane Designation Legend ↓ = Existing lane direction of travel ↓ = Proposed lane direction of travel	↓↓ ↑↑	↓↓↓ ↑↑ ↑↑	↓↓↓ ↑↑ ↑↑	
Connectivity / Access				
Connectivity at Bumble Bee Crossroad	No change to existing connections.	Retain connection from existing NB roadway. Remove existing Bumble Bee SB ramps due to directional conversion from SB to NB (=no NB connection to Bumble Bee from exst SB rdwy after conversion to NB). **No connection to Bumble Bee TI from new SB alignment** because required ramp grades of 9% and 18% exceed 6% maximum allowable grade.	Retain connection from existing NB roadway. Remove existing Bumble Bee SB ramps due to directional conversion from SB to NB (=no NB connection to Bumble Bee from exst SB rdwy after conversion to NB). Construct new ramp connections to Bumble Bee from new SB alignment.	No Build, Alt. E
Routes (NB and SB) Provide Access or Motorist Must Decide Which Route Is Required (Full Access or Decision) **Black Canyon City TI** **Bumble Bee TI** **Sunset Point TI**	 NB & SB - Full Access NB & SB - Full Access NB & SB - Full Access	 NB & SB - Full Access NB – Decision **SB – No Access** NB & SB - Full Access	 NB & SB-Full Access NB - Decision NB & SB - Full Access	No Build, Alt. E
ROW Acquisition (Acres) – all public land managed by BLM	0	262	344	No Build, Alt. D
Estimated Costs				
Estimated Construction Cost (SE = Superelevation)	N/A	$ 255,900,000 BCC to Sunset Pt $ 71,600,000 Sunset Pt to Jct. SR 69 $ 327,500,000 BCC to Jct. SR 69 + $90,200,000 SE Imprvmts BCC to Jct. SR 69 (+4 acres ROW)	$ 286,000,000 BCC to Sunset Pt $ 71,600,000 Sunset Pt to Jct. SR 69 $ 357,600,000 BCC to Jct. SR 69 + $90,200,000 SE Imprvmts BCC to Jct. SR 69 (+4 acres ROW)	No Build, Alt. D

TABLE 31 – EVALUATION MATRIX, BLACK CANYON CITY TI TO SUNSET POINT TI (MP 244.5 TO MP 252.5), NEAR-TERM ALTERNATIVES

Criterion	No Build Alternative	NB Climbing Lane (Alt. CL)	(Two) Flex Lanes (Alt. FL)	Part-Time Shoulder Lane (PTSL)	Advantage
Lane Designation Legend ↓ = Existing lane direction of travel ↓ = Proposed lane direction of travel	↓↓ ↑↑	↓↓ ↑↑↑	↓↓↕↕ ↑↑	↓↓↓ ↑↑↑	
Typical Section	No change to existing roadways.	On Black Canyon Hill: 2 SB lanes on existing SB rdwy; 2+1 NB lanes on existing NB rdwy No added lanes south of Black Cyn City or north of Sunset Pt.	On Black Canyon Hill: 2 SB lanes on existing SB rdwy plus barrier-separated two-lane flex roadway; 2 NB lanes on existing NB rdwy No added lanes south of Black Cyn City or north of Sunset Pt.	On Black Canyon Hill: 2+1 part-time SB lanes on existing SB rdwy; 2+1 part-time NB lanes on existing NB rdwy No added lanes south of Black Cyn City or north of Sunset Pt.	--
Traffic Operations	Provides LOS F in design year 2040	Provides NB LOS E in design year 2040. SB LOS remains at LOS F.	Provides peak LOS C on flex facility in design year 2040. LOS B-D in peak direction on mainline. LOS D-F in non-peak direction on mainline.	Similar to No Build Alternative during non-peak periods. Similar results to one-lane flex facility during peak periods; however, crashes or vehicle breakdowns would not have shoulder width for refuge.	Alt. FL
Maintenance of Facilities (Full or Partial Closures during ADOT maintenance or DPS crash-related activities) **Incident Management on Black Canyon Hill**	Full Closures – NB Full Closures – SB No new opportunities for managing incidents.	Full Closures – NB Full Closures – SB No new opportunities for managing incidents.	Partial closures in segment with alternative route – NB or SB The flex roadway can be used during peak period or (depending on ease of reversing) to route traffic around incidents as needed.	Using the part-time shoulders would be difficult during incidents -- the shoulders may provide the only way for emergency response vehicles to get to the scene of an accident.	Alt. FL
Resolve Geometric Deficiencies / Design Exceptions	No improvements to existing geometrics; numerous design exceptions will be required.	No improvements to existing geometrics; numerous design exceptions will be required.	No improvements to existing geometrics; numerous design exceptions will be required.	No improvements to existing geometrics; numerous design exceptions will be required.	--
Routes (NB and SB) Provide Access or Decision of Route Required (Full Access or Decision) **Black Canyon City TI** **Bumble Bee TI** **Sunset Point TI**	 NB & SB - Full Access NB & SB - Full Access NB & SB - Full Access	 NB & SB - Full Access NB & SB - Full Access NB & SB - Full Access	Existing NB & SB – Full access NB & SB - Full Access **NB & SB - No Access** NB - Full Access **SB - Emergency access only**	 NB & SB - Full Access NB & SB - Full Access NB & SB - Full Access	No Build, Alt. CL, PTSL

Criterion	No Build Alternative	NB Climbing Lane (Alt. CL)	(Two) Flex Lanes (Alt. FL)	Part-Time Shoulder Lane (PTSL)	Advantage
Lane Designation Legend ↓ = Existing lane direction of travel ↓ = Proposed lane direction of travel	↓↓ ↑↑	↓↓ ↑↑↑	↓↓↕↕ ↑↑	↓↓↓ ↑↑↑	
ROW Acquisition (Acres) (All public land managed by BLM)	0	3.0	1.8	0	--
Estimated Construction Cost	N/A	$34,200,000	$106,300,000	Some construction costs to construct emergency turnouts. Other costs for guardrail, signing, pavement marking, rumble strips, and asphalt rubber also required.	No Build, Alt. CL, PTSL
Structures / Retaining Walls	No change.	Replace NB I-17 bridge over Bumble Bee Rd. Construct five walls to contain slopes in ROW.	Replace Bumble Bee Rd bridge over SB I-17. Construct three walls to contain slopes in ROW.	No change.	No Build, PTSL

3.8 Recommended Alternative – Anthem Way to Black Canyon City, Near-Term

The Anthem Way to Black Canyon City widening is identified as a Recommended Near-Term Alternative for the following reasons:

- Improved LOS compared to the existing condition
- Provides connectivity to all existing TIs
- Matches I-17 widening from Carefree Highway to Anthem Way
- Implement inside and outside widening as recommended to avoid conflicts and minimize construction costs

3.9 Recommended Alternative – Black Canyon City to Cordes Junction, Long-Term

Alternative E is identified as the Recommended Long-Term Alternative for the following reasons:

- Improved LOS compared to the existing condition
- Provides connectivity to all existing TIs
- Alternative alignment provides opportunity for horizontal curvature and superelevation elements to be improved on existing northbound and southbound roadways

If the near-term alternatives are constructed, Alternative E may need to be re-evaluated. Alternative E assumes a new three-lane facility for southbound I-17; the four existing travel lanes would be used for northbound with a total of seven lanes. If Alternative FL is constructed, there would be a total of six existing travel lanes, potentially leaving a long-term need of one additional lane. Capacity needs should be re-evaluated if a long-term alternative is selected.

3.10 Recommended Alternative – Black Canyon City to Cordes Junction, Near-Term

The Two-Lane Flex Roadway Alternative (FL) is identified as the Recommended Near-Term Alternative for the following reasons:

- Improved LOS in both directions compared to the existing condition and other near-term alternatives
- Best flexibility for incident management

3.11 Developing the Near-Term Alternatives

The Near-Term Alternatives are recommended for development for the following reasons:

- Current funding cannot accommodate Alternative E
- Short-term alternatives meet current traffic volume demands
- Length of construction is much shorter with short-term alternatives, thus offering the traveling public relief sooner, especially for incident management on the Black Canyon Hill

The next chapters of this report focus on the recommended Anthem Way to Black Canyon City widening and Alternative FL, flex lanes on the Black Canyon Hill.

4.0 Major Design Features of the Recommended Alternative

4.1 Introduction

This chapter will discuss the major design features associated with the Near-Term Recommended Alternatives – Anthem Way to Black Canyon City widening and Alternative FL, flex lanes from Black Canyon City to Sunset Point.

4.2 Design Controls

Much of the I-17 project will match existing horizontal and vertical geometry and superelevation. Where new crossover lanes are provided, they will be designed to meet ADOT design criteria and follow AASHTO guidelines. The proposed typical section for the new roadways will consist of 12-foot travel lanes and 10-foot inside and outside shoulders for typical sections with more than two lanes. For the flex lanes, a 4-foot inside (west) shoulder and a 10-foot outside (east) shoulder with a 2-foot offset to barrier are recommended. Glare screen should be considered on the flex lane barrier. Table 32 presents the preliminary design criteria for the new roadways and mainline widening. "**" is shown where the improvements will match existing geometry that doesn't meet minimum design criteria.

TABLE 32 – PRELIMINARY ROADWAY DESIGN CRITERIA

DESCRIPTION OF CRITERION	VALUE FOR DESIGN
Design Year:	2040
AADT:	52,100 – 58,900
Level of Service: Level Terrain (MP 229 – 232) Rolling Terrain (MP 232 – 244 Mountainous Terrain (MP 244.5 to 252)	 C/D (See Section 2.1.3) C/D (See Section 2.1.3 + context-sensitive considerations such as mountainous terrain, rural surroundings) C (See Section 2.1.3)
Elevation Range:	1,900 ft. to 3,800 ft.
Lane Width:	12 ft. (RDG, Section 301.3)
Shoulder Width: Inside and Outside Barrier-Side (Flex Roadway) Median-Side (Flex Roadway)	(RDG, Table 302.4) 10 ft. + 2' offset to barrier (3-lane section) 4 ft. 10 ft. + 2' offset to barrier
Median Width:	84 ft. desirable (50 ft. minimum) (RDG, Section 304.1, Figure 306.2)
Existing and Normal Cross Slope:	** 2.0% (RDG Section 301.2)
Superelevation: MP 229 to 252	 ** e_{max}=0.10 ft./ft. (RDG, Table 202.1A, Rural Highway, Elevation < 4000 ft)
Median Barrier	Required: (RDG, Section 304.4) 1.) If median width ≤ 50 ft., or 2.) If median width ≤ 75 ft. and there are 3 or more lanes in each direction
Design Speed: Mainline: (MP 229.0 to 244.5) (Controlled Access Highway, level/rolling terrain) (MP 244.5 to 250.5) (Controlled Access Highway, mountainous terrain) Ramp Exit at Mainline Gore: Taper-Type Parallel-Type Ramp Entrance: Ramp Body: Ramp Terminus: Crossroad:	 75 mph 65 mph Mainline design speed minus 10 mph (RDG, Section 503.3) Mainline design speed minus 5 mph (RDG, Section 503.3) Mainline design speed minus 10 mph (RDG, Section 503.3) 50 mph (RDG, Section 503.3) 35 mph (RDG, Section 503.3) 40 mph, but not less than design speed of crossroad approaches to the interchange
Minimum Horizontal Curve Length: MP 229.0 to 244.5 MP 244.5 to 250.5	15 x design speed (mph): (RDG, Section 203.5) ** 1125 ft. ** 975 ft.
Maximum Degree of Curve: MP 229.0 to 244.5 MP 244.5 to 250.5	 ** 2°54' (RDG, Table 202.3D) ** 4°16' (RDG, Table 202.3D)
Maximum Gradient: Mainline: MP 229.0 to 232.0 MP 232.0 to 244.5 MP 244.5 to 250.5 Ramps: Upgrade Downgrade	 3%; match existing vertical alignment (RDG, Table 204.3) ** 4%; match existing vertical alignment (RDG, Table 204.3) ** 5%; match existing vertical alignment (RDG, Table 204.3) 4% desirable, 6% maximum (RDG, Section 504.1) 5% desirable, 6% maximum (RDG, Section 504.1)
Side Slope:	ADOT Standard C-02.10 (RDG, Figure 306.2) plus, when applicable, cut slope modifications for rockfall containment and fill slope flattening to eliminate the need for roadside guardrail
Minimum Vertical Curve Length:	1000 ft (RDG, Table 204.4)
Taper Rate (Lane Drop): MP 229.0 to 244.5 MP 244.5 to 250.5 Taper Rate (Lane Addition): MP 229.0 to 252.0	Design speed (mph) to one: (RDG, Section 207) 75:1 65:1 25:1
Design Vehicle:	WB-67
Minimum Vertical Clearance (new structure): Overpass Underpass Sign Structure	(RDG, Section 206.4) 16.5 ft. ** 16.5 ft. 18.0 ft

4.3 Horizontal and Vertical Alignments

4.3.1 Anthem Way TI to Black Canyon City TI

Existing horizontal alignments control I-17 northbound widening from Anthem Way to Black Canyon City. All northbound widening in this section is to the inside; employing the existing alignment works well as the centerline will remain on a lane line between the outside two lanes, which is standard design procedure and matches the design on I-17 from Carefree Highway to Anthem Way.

For southbound I-17 from Anthem Way to Black Canyon City, the existing horizontal alignment will be used for inside widening and a new construction centerline will be established for outside widening. The new centerline will be offset 15 feet to the outside from the existing alignment. New horizontal curves were defined for transitions from inside to outside widening. Table 33 summarizes areas of southbound inside and outside widening.

TABLE 33 – SOUTHBOUND WIDENING MP 229 – 245

Start MP	End MP	Widening Direction
229.1	237.0	Inside
237.0	237.4	Transition
237.4	240.6	Outside
240.6	240.8	Transition
240.8	245.0	Inside

Existing vertical alignments will be followed for northbound and southbound widening from Anthem Way to Black Canyon City. Widening will be accomplished by sawcutting and widening using the existing cross slope.

Sawcutting/Widening: Based on a review of the record drawings, the structural section for the shoulder matched the mainline during the initial construction. However, since the initial construction, I-17 has had one or more mill and overlays on the mainline, but not the shoulder. The difference in the pavement section thickness between the mainline and the shoulder from the overlays is variable across the project length as the shoulder has been paved with rubberized asphalt in some areas, but not others. Rubberized asphalt is proposed for the mainline travel lanes and both shoulders as shown in the typical sections in Appendix A.

When considering reusing the existing shoulder as part of the future travel lanes, other considerations include the existing condition/age of the pavement and the required design (i.e., structural number) to support future traffic for the 20-year design life. The existing pavement was constructed in the 1960s and 1970s with minimal maintenance other than fog coats, according to the as-built information.

To be conservative, shoulder reconstruction is recommended. Where inside widening is proposed, the existing 4-foot shoulder will be removed. Where widening to the outside is proposed, the existing 10-foot shoulder will be removed.

A segment of southbound I-17 at approximately MP 241.2 has been the site of crashes for which wet road conditions were cited. The final designer should review the roadway geometry, cross slope through the curve, and the Rock Springs TI southbound entrance ramp merge to identify geometric or roadway drainage elements that may be contributing to crashes at this location.

4.3.2 Black Canyon City TI to Sunset Point TI

The flex lanes generally follow the existing I-17 southbound horizontal and vertical alignments except at the north and south crossovers, which will be used by northbound vehicles to access the flex lanes adjacent to the southbound roadway when permitted. The crossovers are approximately one-half mile long and have two horizontal curves, each with a radius of 9,550 feet. The final designer may consider increasing separation or adding barrier to discourage wrong-way movements.


Looking northwest at the Bumble Bee TI

The flex lanes will be controlled vertically by the existing I-17 southbound vertical alignment; the southbound roadway will be sawcut and widened at the existing freeway cross slope, with two exceptions: The first exception is at the south crossover where northbound traffic uses the crossover to enter the flex lanes just north of Black Canyon City. Existing southbound I-17 in this area is lower in elevation than northbound I-17; therefore, a new vertical alignment will be created for the flex lanes to resolve the elevation differences for the crossover. The crossover alignment is approximately 3,700 feet long.

A new vertical alignment also is required at the north crossover near Sunset Point. The existing northbound and southbound grades in this area are relatively flat at 0.7% and the terrain between them is also flat, enabling a new 1,000 feet long vertical alignment without any vertical curves.

Consideration was given to modifying the flex lanes' superelevation to meet current standards rather than extending the cross slope from the southbound lanes to the flex lanes. However, that option is not recommended because of the difficulty controlling the vertical alignment, determining a pivot point, aligning the barrier between the two facilities, and the long-term impact if the flex lane facility were to be converted to a southbound-only roadway in the future.

Cape Horn: Widening to the west should be evaluated in this area (MP 247.0 to MP 248.5, south of Bumble Bee TI) during final design to respond to concerns about movement in the slope on the east side of I-17. Widening to the west would result in the need for new ROW unless substantial retaining walls are constructed. Retaining walls and side slopes of 2:1 and 3:1 should be considered in terms of aesthetics, maintenance, right-of-way, and cost.

Plan sheets for the recommended alternatives are presented in Appendix B. The 1"=200' scale plans provide preliminary horizontal design for the recommended alternatives. Geometric data is shown for the existing and modified mainline I-17 curves.

4.3.3 Mapping and Grid Adjustment Factor

Detailed topographic mapping was prepared for this project from MP 229 to MP 252. Additional mapping may be needed during final design at cut and fill slope limits and for new signs north of the Sunset Point TI. Supplemental mapping may also be needed in order to evaluate widening to the west for the flex lanes near the Cape Horn area south of the Bumble Bee TI.

A grid adjustment factor of 1.00016 was selected, which matches record drawings for most of the project area. Right-of-way plans for ADOT projects H6368 and H5059 indicate a grid adjustment factor of 1.00026298 from MP 249 to MP 252. Grid adjustment factors are used to adjust horizontal lengths to match the topography of the earth. During final design, a single grid adjustment factor may be used for simplicity, or the project could be divided into two in order to more accurately measure horizontal lengths in the area from MP 249 to MP 252.

4.4 Access

I-17 is an access-controlled facility. Modifications to existing access for the recommended alternative should be coordinated with ADOT and FHWA to determine whether a Change of Access Report is required.

Official ADOT crossovers on the existing alignments are located at MP 231.21, 233.98, 235.63, 236.45 (Table Mesa TI), 240.75/242.55 (Rock Springs TI), 245.00, and 251.46 (Sunset Point Rest Area). The crossovers at MP 245.00 and 251.46 will be removed because they conflict with the flex lane crossovers.

South of Sunset Point at approximately Station 2623+00, a primitive road departs from the southbound I-17 roadway. The road is used by AGFD to access a wildlife water catchment. This access point is not impacted by the addition of the flex lanes.

4.4.1 Moores Gulch Grader Road

South of Black Canyon City at approximately MP 238.4, ADOT currently provides access to approximately 700 acres of private property east of I-17 near Moores Gulch. During the original construction of I-17 in the mid-1960s, access to this area was created by a circuitous route departing from the west side of I-17 at Table Mesa Road, proceeding in a north/northwest direction for approximately three miles, then crossing east via a grader road under the northbound and southbound I-17 bridges at Moores Gulch to a point on the east side of I-17. Approximately 2,800 feet of the grader road is part of the State Highway System within ADOT's right-of-way. Maintenance responsibility is ADOT's. Maintenance has proven difficult because of flooding events, which have had the effect of damaging the road within the Gulch. One of the private property owners has performed maintenance activities on the grader road. Although Forest Road 41 connects Table Mesa Road and Moores Gulch on the east side of I-17, the road is rugged and impassable for most vehicles.

ADOT considered long-term solutions to the existing grader road and associated maintenance issues. The solutions included the following:

- constructing a frontage road,
- raising the elevation of the grader road within Moores Gulch,
- constructing a full or partial traffic interchange,
- purchasing the private property to eliminate the need for access, or
- taking no action.

The recommended solution is to raise the grader road approximately two feet. ADOT Environmental Planning worked with USGS to analyze high water flows at Moores Gulch. The grader road should be relocated to an elevation above the high water elevation. USGS has noted that Moores Gulch had one of the highest flow rates in Arizona during a recent storm event. Elevating or relocating the grader road could be accomplished by rerouting the road to keep it on the south side of the wash near its intersection with northbound I-17.

4.5 Right-of-Way

Approximately 4.5 acres of new right-of-way (ROW) and 2.9 acres of drainage easement are required for the Anthem to Black Canyon City widening along northbound and southbound, as well as for the flex lanes. This right-of-way is needed for rock cut slopes and access to the top of the rock cuts during construction. Drainage easements are also required to construct new pipe and box extensions and associated outfall protection.

TABLE 34 – NEW RIGHT-OF-WAY AND DRAINAGE EASEMENT REQUIREMENTS

Station	Area Required (sq. ft.)	Type
1965+00 (SB)	11,930	New ROW
1970+00 (NB)	1,240	Drainage easement
1995+00 (NB)	5,150	New ROW
2020+00 (NB)	49,500	New ROW
2050+00 (NB(	1,250	Drainage easement
2054+00 (NB)	3,220	Drainage easement
2065+00 (NB)	12,780	New ROW
2085+00 (NB)	30,660	New ROW
2090+00 (NB)	7,410	New ROW
2566+00 (SB)	13,200	New ROW
2587+00 (SB)	66,300	New ROW
2627+00 (SB)	118,930	Drainage easement
TOTAL	**321,570**	

All required right-of-way and easements are managed by the Bureau of Land Management.

Existing permitted access should be evaluated during final design.

New right-of-way lines shown on the plan sheets in the appendices are based on limits of disturbance identified by the conceptual design layout and do not indicate the final right-of-way requirements or easements necessary for construction. Actual limits will be influenced by final geotechnical slope recommendations and will be established during the final design process.

For the new right-of-way, a steeper rock cut slope or retaining wall could be used to limit needed right-of-way, as well as various slope treatments such as stacking rocks or slope paving. ADOT Materials has indicated that from a long-term and maintenance perspective, acquiring new right-of-way is more desirable than maintenance-intensive retaining wall and slope treatment options. The drainage easements are primarily needed for grading and outlet protection and increases in backwater near adjacent culverts.

There are a number of section corners in the project area which are in or near the roadway. The monuments shall be preserved or replaced if disturbed by construction.

4.6 Drainage Considerations

Drainage design criteria as related to hydrology, hydraulics, and scour were considered at each offsite drainage facility. For existing culverts, the estimated runoff discharges were compared to the culverts' hydraulic capacity to evaluate the adequacy of the existing facilities. New roadway culverts will be designed to convey the 50-year peak discharge following the design procedures outlined in the ADOT *Highway Drainage Design Manual, Hydraulics,* and the RDG.

Looking east at existing down drain along northbound I-17 roadway

Offsite drainage improvements for sections of existing roadway will consist of extending existing culverts, erosion protection, relocating roadside ditches, and relocation of cut slope crown ditches.

New onsite drainage facilities will include barrier catch basins with storm drain outfalls, area-type inlets, spillways, down drains, and roadside ditches. In the vicinity of new guardrail installations, curb may be required to intercept roadway sheet flow and convey the discharges to new spillways and/or new down drains. Onsite drainage facilities will be designed for the 10-year rainfall event.

Additional drainage analyses necessary to present drainage solutions to existing issues and preliminary sizes of new drainage elements for the recommended alternative were included in the Preliminary Drainage Report for this project.

Anthem Way TI to Black Canyon City

Most of the drainage improvements along I-17 from the Anthem Way TI to Black Canyon City are associated with the extension of either reinforced concrete box culverts or pipe culverts. These extensions were made with consideration to clear zone requirements. The lengths of the required extensions were based on the greater of the appropriate clear zone or the width of the roadway widening at each location.

The northbound and southbound lanes of I-17 closely parallel each other from Anthem Way to just north of the New River interchange. The median area between northbound and southbound lanes is currently drained by median catch basins connected to small-diameter pipes. These pipes convey flow under either the northbound or southbound lanes to an outfall channel. The median inlets will continue to be utilized but may need to be adjusted to account for changes created by the new slopes.

The analysis of culverts within this section showed that several of the existing culverts do not meet hydraulic design requirements. An additional culvert is proposed at these locations to meet the design requirements. Table 35 lists the culverts that do not meet hydraulic requirements and the proposed culvert improvements.

Some culvert extensions will require permanent drainage easements or acquisition of right-of-way. Approximately five culverts between the Table Mesa TI and the Rock Springs TI will likely require an easement or right-of-way to accomplish the necessary improvements.

TABLE 35 – UNDERSIZED CULVERTS, ANTHEM WAY TO BLACK CANYON CITY

Culvert Station	Existing Culvert	Proposed Size
2072+54 SB	1-30” CMP	2-30” CMP
2099+17 NB	1-24” CMP	2-24” CMP
2136+23 SB	1-30” CMP	2-30” CMP
2270+10 SB	1-30” CMP	2-30” CMP
2273+10 SB	1-30” CMP	2-30” CMP
2606+56 SB	1-36” CMP	2-36” CMP

Black Canyon City to Sunset Point TI

Drainage improvements along I-17 from the Black Canyon City TI to the Sunset Point TI are associated with the extension of either reinforced concrete box culverts or pipe culverts and onsite improvements to handle runoff that would be collected and conveyed along the barrier between the existing and proposed lanes.

The roadway improvements will occur along the inside of the existing southbound lanes. In many instances, the proposed improvements require excavation in steep rock slopes along the existing roadway. A ditch will collect runoff from the proposed roadway widening at the base of the rock slopes. The existing culverts will be extended to the proposed ditch bottom. Because of the amount of rock excavation, the ditch bottom was not extended to a point that would place the culvert extension outlets outside of the clear zone. The culverts that fall into this category are circular culverts that are less than 60 inches in diameter. These culverts will have a safety end section to allow them to terminate within the clear zone. Additional culverts that terminate within the clear zone are protected by proposed guardrail.

Several existing culverts do not meet hydraulic design requirements. An additional culvert is being proposed at these locations to meet the design requirements. Table 36 lists the culverts that do not meet hydraulic requirements and the proposed culvert improvements. Some of the culverts that do not meet the HW/D<1.5 requirement are not being augmented with an additional culvert to meet this requirement because the ponding is within existing right-of-way and it is localized at the inlet.

TABLE 36 – UNDERSIZED CULVERTS, BLACK CANYON CITY TO SUNSET POINT

Culvert Station	Existing Culvert	Proposed Size
2349+20 SB	1-54” CMP	2-54” CMP
2383+94 SB	1-24” CMP	2-24” CMP
2426+30 SB	1-30” CMP	2-30” CMP
2562+26 SB	1-24” CMP	2-24” CMP
2598+08 SB	1-48” CMP	1-48”, 1-36” CMP
2606+56 SB	1-36” CMP	2-36” CMP

There is an existing culvert under the northbound and southbound lanes at the southern flex lane crossover at approximately northbound Sta 2332+59 and southbound Sta 2332+09. The crossover pavement will cover the outlet of the northbound culvert and the inlet of the southbound culvert. The culverts are not aligned along the same skew across the existing roadway, making connecting the two culverts an undesirable option. Therefore, a new culvert is recommended that will extend under both the northbound and southbound lanes and will be aligned with the upstream and downstream wash flow lines.

The roadway improvements within this section will require onsite drainage improvements to collect drainage that concentrates along the roadway against the proposed barrier between the existing and proposed lanes. The roadway is superelevated through the horizontal curves. Depending on the superelevation direction, runoff from the roadway will collect along the barrier on either the existing or proposed roadway side. A four- to six-foot shoulder is proposed on both sides of the barrier. Runoff can be conveyed along the barrier within the shoulder. When the capacity of the shoulder is exceeded, inlets will be placed to collect flow and convey it via a storm drain off the roadway. Barrier inlets with slotted drain are proposed with inlet design based on the ten-year storm event. In most instances, the storm drains that drain the inlets will be directed under the proposed roadway to outfall.

4.7 Section 404 of the Clean Water Act

Coordination with the COE during project design will be necessary to ascertain the need for any nationwide or individual permits required under Section 404 of the Clean Water Act. Any deposition of fill material or excavation below the ordinary high water mark will require a permit. Construction activities that will require permits include, but are not limited to, bridge pier construction, culvert installations, replacements and/or extensions requiring excavation and placement of fill material, and roadway embankment widening.

4.8 Floodplain Considerations

The following areas have been identified by FEMA as either floodplains or floodways and have been delineated on a Flood Insurance Rate Map (FIRM):

- Black Wash
- New River
- Moores Gulch
- Little Squaw Creek
- Agua Fria River

Within the vicinity of Black Canyon City, the Agua Fria River has been mapped as Flood Zone AE, with an associated floodway. The remaining portion of the Agua Fria River has been mapped as Flood Zone A.

Applications for Conditional Letter of Map Revision(s) (CLOMR) may be required by FEMA as a result of possible encroachments into a designated floodplain.

4.9 Geotechnical, Pavement, and Earthwork Considerations

The recommended mainline alternatives will match the existing I-17 roadway profile. Approximate earthwork requirements are presented in Table 37. Earthwork estimates are approximate and should be verified during final design.

TABLE 37 – EARTHWORK SUMMARY

LOCATION	ROADWAY EXCAVATION (CU. YDS.)	ROCK EXCAVATION (CU. YDS.)	EMBANKMENT WITH 15% SWELL (CU. YDS.)	WASTE VOLUME (CU. YDS.)
Anthem Way to Black Canyon City Northbound	240,000	485,000	225,000	500,000
Anthem Way to Black Canyon City Southbound	445,000	295,000	235,000	505,000
Black Canyon City to Sunset Pt Flex Lanes	340,000	1,580,000	140,000	1,780,000
TOTAL	**1,025,000**	**2,360,000**	**600,000**	**2,785,000**

The preferred alternative is expected to produce excess material. Some of this waste material can be used onsite in fill slopes where feasible.

Consideration should be given during final design to construction methods and contractor access to tall cut and fill slopes. Benching will likely be required to allow access for large earthmoving equipment. Sliver cuts and fills should be avoided. Tables 38 and 39 summarize approximate cut and fill heights throughout the project.

TABLE 38 – ANTHEM TO BLACK CANYON CITY CUT/FILL HEIGHTS

Location	Length (ft)	Fill – Max Height (ft)	Cut – Max Height (ft)
Sta 1496+00 to 1648+00 (SB/NB)	15,200	N/A (median ditch)	N/A (median ditch)
Sta 1648+00 to 1658+00 (SB)	1,000	10	0
Sta 1658+00 to 1668+00 (SB)	1,000	0	10
Sta 1668+00 to 1677+00 (SB)	900	30	0
Sta 1677+00 to 1702+00 (SB)	2,500	0	15
Sta 1702+00 to 1712+00 (SB)	1,000	35	0
Sta 1712+00 to 1737+00 (SB	2,500	0	20
Sta 1737+00 to 1749+00 (SB)	1,200	35	5
Sta 1749+00 to 1772+00 (SB)	2,300	0	55
Sta 1772+00 to 1781+00 (SB)	900	40	0
Sta 1781+00 to 1796+00 (SB)	1,500	0	25
Sta 1796+00 to 1801+50 (SB)	550	35	0
Sta 1801+50 to 1814+50 (SB)	1,300	0	5
Sta 1814+50 to 1852+50 (SB)	3,800	55	10

Location	Length (ft)	Fill – Max Height (ft)	Cut – Max Height (ft)
Sta 1852+50 to 1865+50 (SB)	1,300	0	40
Sta 1865+50 to 1878+00 (SB)	1,250	25	0
Sta 1878+00 to 1892+00 (SB)	1,400	0	55
Sta 1892+00 to 1911+50 (SB)	1,600	20	25
Sta 1911+50 to 1916+00 (SB)	450	0	25
Sta 1916+00 to 1932+50 (SB)	1,650	65	80
Sta 1932+50 to 1946+00 (SB)	1,350	0	55
Sta 1946+00 to 1961+50 (SB)	1,550	10	5
Sta 1961+50 to 1971+50 (SB)	1,000	0	80
Sta 1971+50 to 1977+00 (SB)	550	25	0
Sta 1977+00 to 1997+00 (SB)	2,000	0	25
Sta 1997+00 to 2006+50 (SB)	950	25	0
Sta 2006+50 to 2025+50 (SB)	1,900	25	10
Sta 2025+50 to 2065+50 (SB)	4,000	40	50
Sta 2065+50 to 2074+50 (SB)	900	10	0
Sta 2074+50 to 2087+00 (SB)	1,250	15	30
Sta 2087+00 to 2114+50 (SB)	2,750	35	20
Sta 2114+50 to 2126+00 (SB)	1,150	0	45
Sta 2126+00 to 2187+00 (SB)	8,050	10	40
Sta 2187+00 to 2327+00 (SB/NB)	14,000	N/A (median ditch)	N/A (median ditch)
Sta 1648+00 to 1673+50 (NB)	2,550	25	10
Sta 1673+50 to 1742+00 (NB)	7,050	15	55
Sta 1742+00 to 1751+50 (NB)	950	15	0
Sta 1751+50 to 1798+00 (NB)	4,650	25	35
Sta 1798+00 to 1835+50 (NB)	3,750	5	50
Sta 1835+50 to 1871+00 (NB)	3,550	15	35
Sta 1871+00 to 1889+00 (NB)	1,800	40	15
Sta 1889+00 to 1895+50 (NB)	650	15	60
Sta 1895+50 to 1911+00 (NB)	1,550	45	15
Sta 1911+00 to 1915+50 (NB)	450	0	50
Sta 1915+50 to 1926+50 (NB)	1,100	60	0
Sta 1926+50 to 1935+50 (NB)	900	5	30
Sta 1935+50 to 1958+00 (NB)	2,250	40	15
Sta 1958+00 to 1968+00 (NB)	1,000	0	25
Sta 1968+00 to 1988+00 (NB)	2,000	45	5
Sta 1988+00 to 1992+50 (NB)	450	0	30
Sta 1992+50 to 1997+00 (NB)	450	35	0
Sta 1997+00 to 2030+00 (NB)	3,300	5	45
Sta 2030+00 to 2034+50 (NB)	450	60	0
Sta 2034+50 to 2047+00 (NB)	1,250	0	25
Sta 2047+00 to 2064+50 (NB)	1,750	40	0
Sta 2064+50 to 2087+00 (NB)	2,250	0	35
Sta 2087+00 to 2115+50 (NB)	2,850	35	20
Sta 2115+50 to 2123+50 (NB)	800	5	110
Sta 2123+50 to 2141+50 (NB)	1,800	40	5
Sta 2141+50 to 2145+00 (NB)	350	0	50
Sta 2145+00 to 2151+00 (NB)	600	45	0
Sta 2151+00 to 2156+00 (NB)	500	0	110
Sta 2156+00 to 2175+50 (NB)	1,950	25	0
Sta 2175+50 to 2187+00 (NB)	2,450	0	25
Sta 2327+00 to 2348+00 (NB)	2,100	0	60
Sta 2348+00 to 2357+50 (NB)	950	20	0

TABLE 39 – BLACK CANYON CITY TO SUNSET POINT CUT/FILL HEIGHTS

Location	Length (ft)	Fill – Max Height (ft)	Cut – Max Height (ft)
Sta 2327+00 to 2345+00	1,800	0	30
Sta 2345+00 to 2354+00	900	10	10
Sta 2354+00 to 2356+50	250	20	0
Sta 2356+50 to 2386+00	2,950	5	90
Sta 2386+00 to 2391+00	500	10	0
Sta 2391+00 to 2466+00	7,500	5	125
Sta 2466+00 to 2470+00	400	5	15
Sta 2470+00 to 2501+00	3,100	10	85
Sta 2501+00 to 2508+00	700	35	0
Sta 2508+00 to 2549+50	4,150	5	55
Sta 2549+50 to 2553+00	350	5	0
Sta 2553+00 to 2579+50	2,650	0	135
Sta 2579+50 to 2596+00	1,650	5	170
Sta 2596+00 to 2599+50	350	70	0
Sta 2599+50 to 2623+50	2,400	0	75
Sta 2623+50 to 2630+50	700	35	0
Sta 2630+50 to 2641+50	1,100	0	10
Sta 2641+50 to 2652+50	950	5	5
Sta 2652+50 to 2676+00	2,350	5	5

4.9.1 Earthwork Factors

Estimated earthwork factors for the geologic units within the project corridor are as follows:

TABLE 40 – ESTIMATED EARTHWORK FACTORS

GEOLOGIC UNIT	EARTHWORK FACTOR
Native soils (Quaternary deposits)	5 to 10% shrink
Existing embankment	Even
Hickey Formation basalt	20% swell
Tertiary sediments	Even to 5% swell

GEOLOGIC UNIT	EARTHWORK FACTOR
Metavolcanic and other Precambrian rock	10% swell

The swell potential will be influenced by the methods of excavation, the final particle size, and the amount of blending with other soils and/or borrow materials.

Ground compaction during the construction of the roadway embankments will most likely occur within the fine-grained, young sediments deposited on the basin floors and the fine-grained alluvial fans of the lower piedmonts. On average, soils within the project corridor will experience 0.2 feet of ground compaction prior to earthwork activities.

For purposes of preliminary planning, it is estimated that 75 gallons of water will be required per cubic yard of material.

4.9.2 Conditions Along Alternative Alignments

The following subsections provide more detailed descriptions of the geotechnical conditions anticipated along each of the alternative alignments. The discussions are focused on the following geotechnical issues:

- General geologic conditions;
- Pavement subgrade conditions;
- Cut slope designs;
- Fill slope designs;
- Use of excavated materials;
- Bridge support systems; and
- Geological and geotechnical constraints.

4.9.3 General Geologic Conditions

Anthem Way to Black Canyon City – The generalized geologic units between approximate MPs 229 and 244.4 consist of Precambrian metavolcanic rocks and granite intrusions; interbedded sequence of Tertiary basalts, tuffs; Quaternary/Tertiary pediment deposits; and Quaternary surface deposits.

Black Canyon City to Sunset Point – The existing roadways are predominantly underlain by Tertiary sediments between approximate MPs 244.4 and 247, with a minor amount of metavolcanic rock located north of MP 246. Between approximately MPs 247 and 248, the existing roadway is predominantly underlain by Hickey Formation basalt. North of MP 248, the northbound lanes roughly follow the contact between Hickey Formation basalt and metavolcanic rock until the road tops out on Black Mesa at approximately MP 250. The southbound roadway is underlain by metavolcanic rock from approximately MP 248 until it tops out on Black Mesa at MP 250.5. The southbound and northbound roadways are then underlain by basalt to approximately MP 256.5. Old landslide deposits may also be present in the southernmost portion of the corridor.

4.9.4 Pavement Subgrade Conditions

Anthem Way to Sunset Point – Metavolcanic rock will provide suitable support for the roadway. This unit generally has moderate to high strengths and relatively low compressibility, although very localized zones of relatively softer fault gouge or sheared rock may be encountered within this unit. The Hickey Formation basalt also has moderate to high strengths and low compressibility, but may contain thick soil horizons, paleochannels, or zones of agglomerate that have lower strengths and moderate compressibility. Portions of the Hickey Formation may also contain lenses of high plasticity soils. Coarser grained portions of the Tertiary sediments should provide good support for roadways, whereas fine-grained lakebed deposits may contain highly plastic soils.

In general, it is anticipated that subgrade conditions will be suitable for most of the alignment. The preliminary investigation identified the following areas of poor subgrade:

- SB Sta 1877+50 to 1957+00 (~MP 236 to 238);
- NB and SB Sta 2289+00 to 2320+00 (~MP 244 to 245); and
- SB Sta 2625+00 to 2710+00 (~MP 251 to 252).

These areas and potentially others will require local treatment including overexcavation and replacement. The depth of overexcavation will be such that three feet below the bottom of the pavement has suitable subgrade soils.

4.9.5 Cut Slope Designs

The ADOT RDG includes several statements regarding the design of side slopes in Section 303.3 as follows:

> Cut and fill slopes should initially be designed as shown in the ADOT Construction Standard Drawing C-02.10. Final slopes are then incorporated into the design and shown on the plans as required by the Project Geotechnical Report, Materials Design Report and other considerations such as slope flattening for elimination of barrier, cut widening to facilitate drainage, rockfall, landscape and vegetation establishment, and visual mitigation.

The preliminary recommended cut slope ratios provided below are based on observed site conditions and performance of existing cuts for the various geologic units.

TABLE 41 – RECOMMENDED CUT SLOPE RATIOS

GEOLOGIC UNIT	SLOPE RATIO
Precambrian rock units	0.75H:1V
Tertiary Basalt (including Hickey Formation)	0.75H:1V
Tertiary sediments and volcanic deposits	0.75H:1V to 1H:1V
Quaternary sediments	1H:1V

Notes:

1) The slope ratio for Tertiary sediments will depend upon the competency (internal strength) of the materials.
2) A preliminary slope ratio for the Precambrian units of up to 0.75H:1V can be used, however some local flattening may be necessary where other fractures have unfavorable orientations.
3) Quaternary deposits of intermediate terrace deposits (Qirn), middle and young intermediate deposits, undivided (Qi), and old terrace deposits (Qorn) can have a preliminary slope ratio of 0.75H:1V in some areas.

The cut slope ratios presented above are considered maximum slope ratios; flatter slopes may be necessary. Site-specific conditions may require engineering controls to reduce rockfall potential. Higher cuts will

require rockfall containment ditches matched to the slope ratio and height. The following table represents the recommended slope containment ditch width relative to the cut slope ratio and cut slope height for preliminary design.

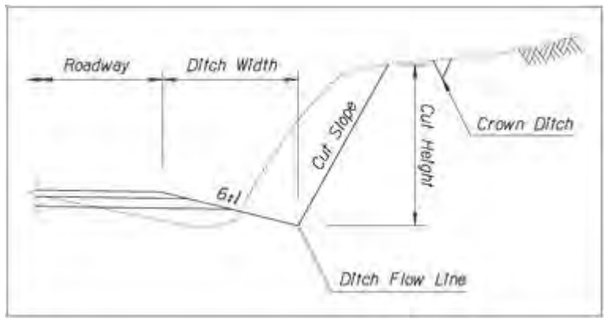
TABLE 42 – RECOMMENDED SLOPE CONTAINMENT GEOMETRY

	WIDTH of 6H:1V SIDESLOPE (ft)		
CUT SLOPE HEIGHT (ft)	CUT SLOPE 1:1	CUT SLOPE 0.75:1	CUT SLOPE 0.5:1
10 – 20	15 feet or height of cut, whichever is lower		
20	20	15	15
40	25	19	15
60	30	28	24
80	40	37	26
100	66	54	41
120	70	58	44
160	78	65	46
200	85	68	49

Notes:
1) Ditch not required for slopes less than 10 feet high.

Crown ditches are recommended on the top of proposed cuts that have exposed height of greater than 40 feet. The location of the crown ditches should be sufficiently far away from the cut slope face to provide stability and minimize erosion to the rock face.

FIGURE 9 – SLOPE CONTAINMENT MEASURES



Slope rounding is recommended per the ADOT construction standard drawings (C-02) in cuts that are not in solid rock. This rounding should be performed in the upper five feet of the cut. The slope rounding will minimize the dislodging of loose debris at the top of the cuts and will enhance the visual impacts of the cut by softening the hard edges of the top of the cut slope and better blend them into the hillside.

Additional issues which should be considered when designing cut slope ratios for the various alternatives are discussed below.

Existing Roadways – ADOT provided a Rock Hazard Rating System summary for existing cut slopes within the project corridor. The most recent survey available from ADOT was completed in 2004. The summary lists: 1) the starting and ending MPs of the cut, the direction of travel (N or S), and the side of the roadway (R or L) the cuts are located on; 2) the severity (degree of instability) of the slope ranked from 1 through 5 with 5 as the most severe; 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. Cut slopes receiving severity ratings of 5 are summarized below.

TABLE 43 – 2004 ROCK HAZARD RATING SYSTEM SUMMARY

MILEPOST		DIRECTION	SEVERITY	PRIORITY POINTS	LAST DAY SURVEYED
Start	End				
248.4	248.2	S	5	462	02/11/2004
248.6	248.7	N	5	396	02/11/2004
248.8	248.9	N-L	5	300	02/11/2004
249.0	249.1	N-L	5	342	02/11/2004
249.1	249.1	N	5	507	09/19/1995
249.9	249.6	S	5	396	02/11/2004
249.9	250.2	N-RL	5	498	02/11/2004
255.6	255.8	N-L	5	432	02/11/2004

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. Site-specific conditions may require engineering controls to reduce the potential for rockfall, erosion, and small slides at the cut slopes. Engineering controls could include rock bolting, rock containment fencing, draped mesh, and other measures.

Brugg fence at northbound MP 247.8

A Brugg rock containment fence has been installed on the right side of the road at approximately northbound MP 247.8 to protect the roadway from small slides and rockfall. Several other areas along existing northbound I-17 are signed as having a potential for small slides. A draped mesh has been installed on both sides of the rock cut on northbound I-17 just south of MP 250 to keep rocks from the basalt flow capping Black Mesa from rolling onto the roadway, and a chain-link fence has been installed on the east side of northbound I-17 near MP 250.

4.9.6 Fill Slope Designs

All non-stabilized fill slopes should be constructed no steeper than 2:1 in accordance with ADOT Standard Drawing C-02.10. Construction of fill slopes should be in accordance with Section 203-10 of the ADOT Standard Specifications. Should steeper slopes be required within drainages or near existing canal structures, use of mechanically-stabilized embankments is recommended.

In areas of potential excessive fill erosion, treatment of slopes with geosynthetics should be considered.

4.9.7 Use of Excavated Materials

It is anticipated that embankment fills will be constructed using available materials from nearby rock cuts. In general, the geologic materials exposed by the alignments will be suitable for embankment, with the exception of high plasticity soils associated with the soil horizons separating flows in the Hickey Formation and the fine-grained deposits of the Tertiary sediments. Staging and phasing of the required excavations will affect the nature of the fill materials. For example, cuts partly in lower density materials (such as the Tertiary sediments) and partly in more competent rock (basalt) will generate materials with different maximum dry densities and optimum moisture contents. Separation or blending of these materials in an embankment could affect the distribution of void spaces, and thus affect the fill densities and swell factors. Nesting of oversized boulders that may result from excavation of the Hickey Formation basalt flows should be avoided.

In general, the rock units are moderately to highly weathered and/or highly foliated and will not be suitable for use as coarse aggregate, mineral aggregate, or riprap. Some of the slightly weathered to unweathered materials, especially the basalt and to a lesser extent the Precambrian metavolcanic rocks, may be suitable for use as riprap. The basalt may locally meet the specifications for part of the coarse aggregate or mineral aggregate, but crushing and processing would be required.

4.9.8 Bridge Support Systems

Structures can be supported on conventional shallow spread-type footings in the harder Precambrian and basaltic rocks (Hickey Formation). Structures should be supported on either spread footings or deep foundations (drilled shafts) in the Tertiary sediments or in areas which may be exposed to scour.

Most of the existing bridge structures along the alignment are founded on spread footings. Many structures that cross waterways utilize driven H-piling.

4.9.9 Geological and Geotechnical Constraints

Several old landslide deposits have recently been mapped by the Arizona Geological Survey north of the Black Canyon City TI and south of Bumble Bee Road (Cape Horn area). A fault crosses southbound I-17 north of Black Canyon City (approx. MP 247.8). Movement of this fault, which may be attributed to a nearby landslide, has caused the need for increased roadway maintenance in this area. An existing fill slope serves as a buttress for the northbound lanes. Consideration should be given if cutting into this slope is required for construction of the flex lanes. Careful consideration should be given to designing appropriate slope ratios and rockfall containment ditches. Protective measures, such as rock catch fences or draped mesh, may be required at certain locations.

A number of existing cut slopes in the mountainous area between mileposts 248 and 250 have been rated by ADOT as a 5 on a severity scale of 1 through 5. The cut slope inventory identified existing cut slopes with rockfall and instability issues and/or rockfall containment ditches that are inadequate. Reducing (flattening) the slope ratio of selected cut slopes, and widening and/or deepening rockfall containment ditches adjacent to selected cut slopes, should be considered when improving the existing roadway.

Cut slope design through all new areas needs to include a rockfall containment ditch of suitable geometry based on exposed rock and cut slope angle.

4.10 Preliminary Pavement Design

A preliminary pavement design has been developed for this segment of I-17. The results of the analyses are summarized in Table 44.

Two pavement types considered for this project were asphalt concrete and Portland cement concrete pavement (PCCP). Based on the availability of materials and flexibility of placing traffic on the new surface during construction activities, a pavement section consisting of AC over AB to provide the required thickness to meet the required structural requirements is recommended. An asphalt rubber-asphaltic concrete friction course (AR-ACFC) surface course measuring ½ inch is also recommended.

The pavement sections provided in Table 44 apply only to the new lanes. In addition, there are some areas of poor subgrade (0 to 3 feet) that need to be removed from beneath the new lanes.

TABLE 44 – PAVEMENT DESIGN PARAMETERS

PARAMETER	ANTHEM WAY TO NEW RIVER ROAD	NEW RIVER ROAD TO BLACK CANYON CITY	BLACK CANYON CITY TO SUNSET POINT
Approximate Station Limits	1490+00 to 1678+00	1678+00 to 2289+00	2289+00 to 2710+00
Milepost	229 to 232	232 to 244	244 to 252
Design R Value	30	30	30
Regional Factor (Cordes Junction)	2.6	2.6	2.6
Resilient Modulus	10,075 psi	10,075 psi	10,075 psi
Pavement Design Year ADT	59,619	56,763	52,418
Lane Factor (Four-Lane Road)	0.70	0.70	0.70
Direction Factor	0.61	0.60	0.56
Traffic:			
Automobiles	88.4%	75.9%	73.9%
Commercial	11.6%	24.1%	26.1%
Vehicle Equivalencies:			
Automobiles	0.0008	0.0008	0.0008
Commercial	1.2000	1.2000	1.2000
Equivalent 18-kip Single Axle Loadings	23,480,353	44,736,277	39,940,961
Level of Reliability	99%	99%	99%
Overall Standard Error	0.35	0.35	0.35
Design Change in Serviceability (ΔPSI)	1.2	1.2	1.2
Minimum Structural Number Required	6.09	6.65	6.55
Pavement Section:			
Asphaltic Concrete	11	11	11
Aggregate Base	11	14	14

4.11 Interchanges

4.11.1 Introduction

There are seven TIs within the study area:

- Anthem Way – MP 229.1
- New River – MP 232.0
- Table Mesa – MP 236.0

- Rock Springs – MP 242.2
- Black Canyon City – MP 244.4
- Bumble Bee – MP 248.4
- Sunset Point / Rest Area – MP 252.5

The configuration of the TIs will not be impacted by the near-term alternatives, although access between three TIs (Black Canyon City, Bumble Bee, and Sunset Point) and the flex lanes will be limited.

Recent crash data was assembled and roadway segments with cluster of crashes were identified for Interactive Highway Safety Design Model (IHSDM) analysis, six of which were related to taper-type versus parallel-type ramps. Costs of crashes and injuries were estimated using FHWA criteria. The benefit to safety was compared to the costs of upgrading the roadway segment and the estimated years to return was presented for each segment. Based on the analysis results, modifying the northbound entrance ramp at the Table Mesa TI and all four ramps at the Black Canyon City TI from taper-type to parallel-type is recommended.

4.11.2 Anthem Way TI (MP 229.1)

The Anthem Way TI provides the northern access to the Anthem community and is the southern limit of the Anthem Way to Black Canyon City widening. The TI was reconstructed in 2000 and I-17 was widened in 2010. The existing pavement is wide enough for three northbound and southbound lanes, although striping will need to be adjusted to eliminate the northbound lane drop and connect to the southbound lanes. Vertical clearances meet current guidelines. The project construction begins approximately 500 feet north of the TI.

4.11.3 New River TI (MP 232.0)

The New River TI is a diamond TI that was constructed in 1968 and serves the community of New River to the east. Other than bridge widening, the TI and ramps will not be affected by the mainline widening to the inside in this area. The existing vertical clearances under the northbound and southbound I-17 bridges are 19.9 feet and 15.9 feet, respectively. A horizontal curve on northbound I-17 begins just south of the TI that separates the northbound and southbound horizontal alignments.

Looking east at New River TI

4.11.4 Table Mesa TI (MP 236.0)

The Table Mesa TI is located at MP 236.0 on I-17, approximately four miles north of the town of New River. Table Mesa Road provides access for a small number of residences and businesses east and west of I-17, including a ranch property about one mile east of the TI. East of I-17, Table Mesa Road becomes Forest Service Road 41, which extends to the Seven Springs area. To the west, Table Mesa Road runs toward Lake Pleasant Park. Both roads are unpaved.

Looking south at Table Mesa TI

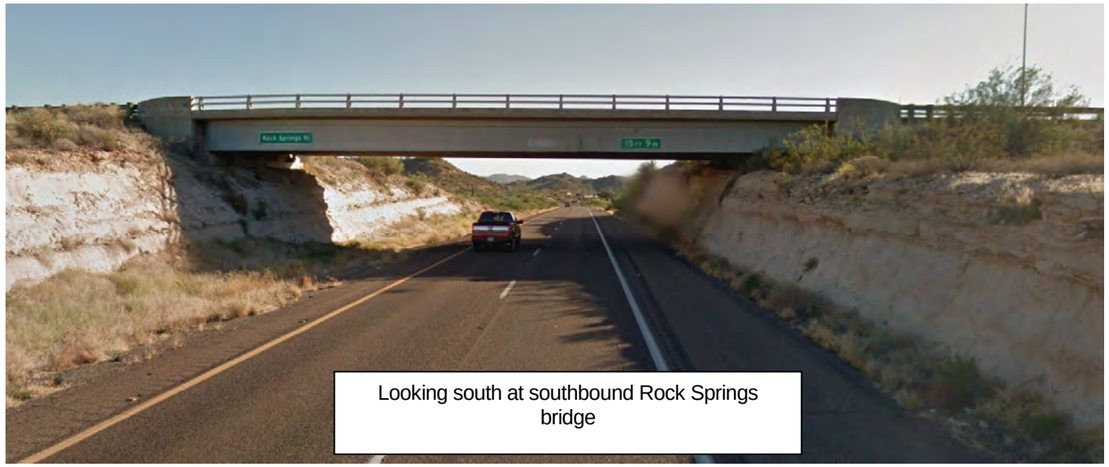
Constructed in 1968, the Table Mesa TI is a trumpet-type interchange with southbound I-17 traffic exiting via a loop ramp and with diamond ramps on the east side of I-17. Table Mesa Road crosses above the I-17 mainline via separate structures over the northbound and southbound lanes. The northbound and southbound mainline roadways, both 38 feet wide, are separated by a 175-foot median consisting primarily of rock. Horizontal and vertical control for the northbound and southbound roadways are independent. The roadway profiles differ by as much as five feet through the TI area.

The TI ramps are not impacted by the mainline widening because it is to the inside in this area; however, as noted above, the northbound entrance ramp will be modified from a taper-type to a parallel-type ramp. The existing bridges will remain in place with the proposed widening. Lateral clearance beneath the bridges is deficient by approximately three feet; the shy distance to the guardrail/barrier will be reduced to accommodate the three-lane section. The barriers will be within inches of the columns; an SD 1.02 barrier with a structural foundation will be required. A design exception for the shoulder widths/shy distance will be requested.

According to recent bridge inspections, southbound I-17 at Table Mesa Road has a vertical clearance of 16.1 feet. Inside widening using the existing southbound I-17 cross slope would reduce the vertical clearance to approximately 15.75 feet at the face of barrier. Geometric and bridge structure constraints limit options to reduce vertical clearance impacts at this location. These include: (1) the positioning of the existing lanes and limited span length restrict widening to the inside and high side of southbound I-17, (2) southbound I-17 is on a horizontal curve with low existing superelevation such that reducing the cross-slope of the new lane to increase vertical clearance is not desirable, and (3) the existing Table Mesa bridge superstructure is integral with the pier columns, making raising the superstructure impractical. The reduced vertical clearance would be limited to the inside lane and inside shoulder. Unless the existing pavement section is deep enough to allow a profile change or a break in the cross slope is added, major roadway or bridge reconstruction would be required to provide the desired 16-foot vertical clearance at this location. A design exception may be needed.

4.11.5 Rock Springs TI (MP 242.2)

The Rock Springs TI provides access to Black Canyon City and Rock Springs. The TI configuration is a modified diamond interchange with the mainline crossing under the crossroad; the southbound entrance ramp connects to the two-way west frontage road approximately 3,600 feet south of the crossroad. The southbound entrance ramp is at the southern end of a commercial area, where traffic has the option to enter southbound I-17 or enter the two-way frontage/circulation road and return to the crossroad to travel northbound.

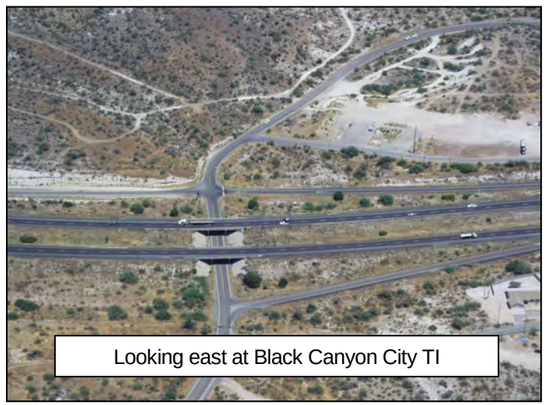


Looking south at southbound Rock Springs bridge

The TI and ramps are not impacted by the mainline widening, which is to the inside in this area. The northbound and southbound horizontal alignments become parallel near the Rock Springs TI, at approximately MP 242.1. From this point north to the Black Canyon City TI, the alignments are parallel with a 76-foot median.

The existing bridges are adequate and do not require widening or replacement. The vertical clearance to the bridges would be decreased as the proposed widening at the bridges is on the high side of the roadways. A break in the cross slope is recommended for the northbound and southbound lane widening so that the vertical clearance is not reduced. A design exception for the northbound vertical clearance will be requested.

4.11.6 Black Canyon City TI (MP 244.4)

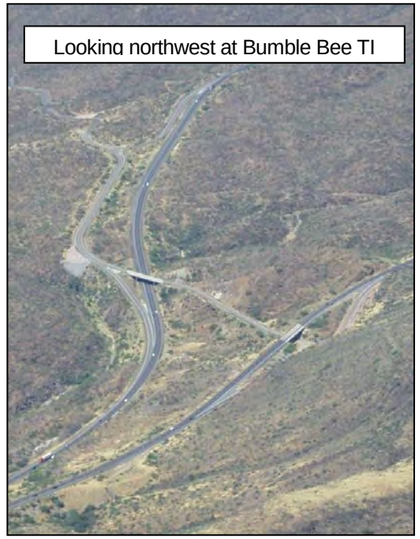


Looking east at Black Canyon City TI

The Black Canyon City TI marks the northern limit of the mainline widening and the southern limit of the flex lanes. The TI and ramps are not impacted by the widening to the inside in this area; however, the bridges will be widened and all four ramps will be modified to parallel-type ramps. Existing vertical clearances to the two-lane roadway below are 14.3 feet northbound and 14.7 feet southbound. Widening the I-17 bridges will reduce the southbound vertical clearance by 0.33 feet unless the crossroad profile is modified.

The flex lane facility connects to existing southbound I-17 approximately 1,000 feet north of the southbound exit ramp at the Black Canyon City TI; southbound vehicles in the flex lanes may not exit at Black Canyon City. Signage will indicate that flex lane drivers may not exit at the Black Canyon City TI; however, extension of the flex lanes farther south should be considered during final design to eliminate potential weaving. Rumble strips or other measures to discourage/prohibit weaving could be added to the off-ramp gore. The average daily traffic at the Black Canyon City TI southbound exit ramp is 402 vehicles per day (2018).

4.11.7 Bumble Bee TI (MP 248.8)



Looking northwest at Bumble Bee TI

The existing Bumble Bee TI is located approximately halfway up the Black Canyon Hill. The northbound and southbound roadways are separated by 1,375 feet, measured along the crossroad. Bumble Bee Road crosses above the existing southbound I-17 roadway and below northbound I-17.

Access will not be provided to the TI from the flex lanes. Flex lane signage along southbound I-17 at the top of the Black Canyon Hill will need to notify motorists to avoid the flex lanes if they intend to exit at the Bumble Bee TI. Similar signage will be required along northbound I-17 near Black Canyon City to notify northbound traffic that there is no access to the Bumble Bee TI from the flex lanes.

A new bridge is proposed to span the southbound I-17 lanes and the proposed flex lanes. The new bridge will be approximately 30 feet longer and 2.5 feet deeper than the existing bridge. To provide adequate clearance above southbound I-17 and the flex lanes, Bumble Bee Road will be reconstructed approximately 600 feet on both sides of the bridge. The raised profile is shown on Figure 10.

New Southbound Bridge

The northbound I-17 bridge is programmed for rehabilitation under a separate project. The existing Bumble Bee Road SB UP (#1170) bridge crosses southbound I-17 at a 60-degree skew such that the existing 120-foot middle span over the roadway provides only 57 feet clear between pier columns normal to the roadway.

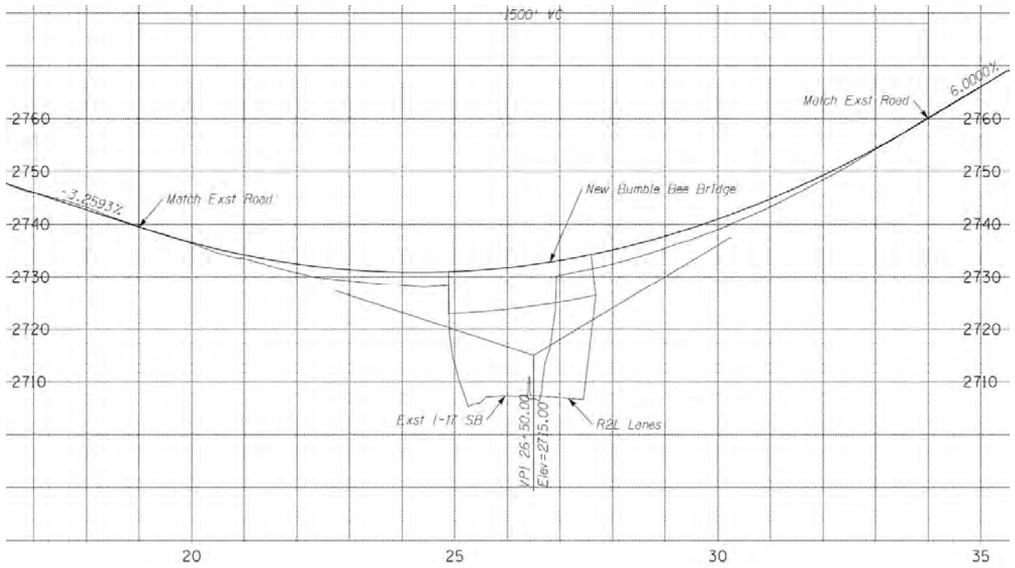
The barrier-separated flex lanes proposed at this location require a curb-to-curb width normal to I-17 of 84 feet, not including barriers. Allowing for space to maintain the existing drainage swales and provide clearance behind the barriers requires a new span of approximately 200 feet with the 60-degree skew. The desire for future lane flexibility prevents the placement of a span-shortening pier along the separation barrier between the existing southbound lanes and the new flex lanes.

The 200-foot span is beyond the capabilities of typical precast prestressed girders. While post-tensioned cast-in-place concrete can provide long spans, southbound I-17 traffic requirements and construction duration considerations suggest a steel plate girder superstructure or a post-tensioned spliced girder bridge with the splice situated toward the east end of the bridge would be less disruptive to traffic during construction.

Either option will result in a substantially deeper superstructure and would require raising the profile of Bumble Bee Road. Efforts should be made to economize on structure depth in final design; however, a structure depth increase of 2 ½ to 3 feet from the existing 5 ½ foot depth can be expected.

A two-span bridge with an inverted-T straddle bent over I-17 is also an economical option that may reduce the structure depth increase; however, significant construction activities for the straddle bent construction and girder tie-ins to the straddle would occur over I-17, complicating I-17 maintenance and protection of traffic.

FIGURE 10 – PROPOSED BUMBLE BEE ROAD PROFILE



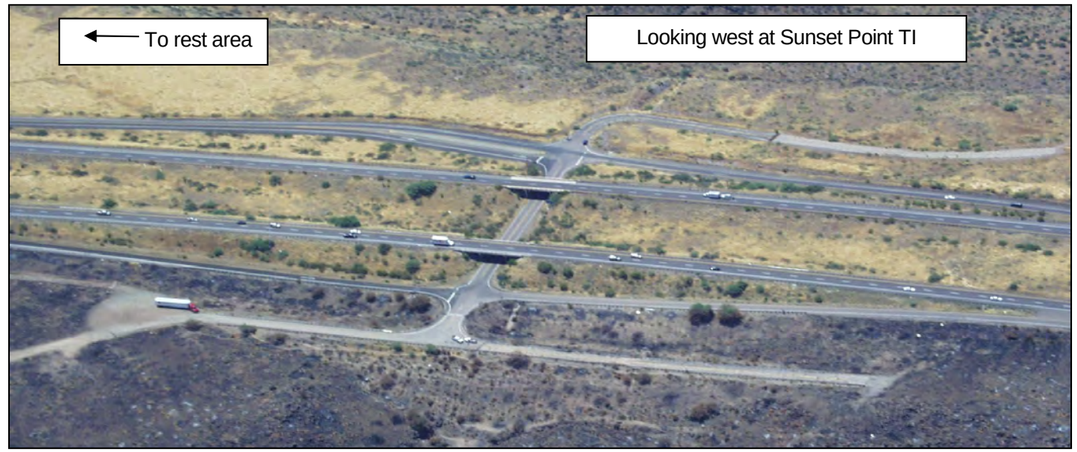
Staged construction options for bridge replacement are limited by the existing three girder end spans. Overbuilding and alignment shifts would require a significant horizontal realignment and reconstruction of Bumble Bee Road and the tie-in to the I-17 southbound ramp. Closing this cross road to remove the existing and replace with the new bridge at the same location would allow for a shorter construction duration with no staging, while minimizing approach roadway horizontal realignment.

The crossroad traffic is light and if closed to traffic, the detour is approximately eight miles for vehicles desiring to exit or enter from northbound I-17. Short term closure of southbound I-17 would also be required while girders are set; however, this can be accomplished with overnight closures and traffic rerouted through the southbound off and on ramps. A girder bridge with precast concrete deck forms can minimize construction time, cross-road closures, and nighttime I-17 closures for overhead work.

4.11.8 Sunset Point TI / Rest Area (MP 252.5)

The existing Sunset Point TI provides access to the Sunset Point Rest Area. The TI configuration is a modified diamond interchange with the mainline crossing over the crossroad; however, the southbound entrance ramp is located roughly 4,800 feet from the crossroad. The southbound entrance ramp is at the southern end of the rest area, where traffic has the option to enter southbound I-17 just north of the descent down the Black Canyon Hill or enter the two-way frontage/circulation road and return to the crossroad to travel northbound. The TI will not be affected by the flex lane construction.

Because the north flex lanes crossover is located close to the northbound exit ramp at the Sunset Point TI, insufficient weaving length is available and access cannot be provided from the flex lanes to the northbound off-ramp. Signage will indicate that drivers may not use flex lanes to exit at the Sunset Point TI. Rumble strips or other measures could be added to this off-ramp gore to further discourage/prevent weaving. Southbound entrance ramp traffic will be unable to access the flex lanes as the ramp enters I-17 south of the flex lanes southbound entrance.



4.12 Structures

4.12.1 Bridge Locations

The recommended alternatives will require replacement bridges or modifications to existing bridges at all existing crossing locations.

Between Anthem and Sunset Point, the proposed improvements will require two bridge replacements, at Moores Gulch SB (by others) and Bumble Bee SB, and ten bridge overpass or water crossing widenings. The relatively new bridge at Little Squaw Creek SB and underpasses at Mud Springs and the Rock Springs TI have sufficient clearance to accommodate I-17 widening. The Table Mesa TI UP can accommodate the widening underneath with the installation of ADOT SD 1.02 barriers to protect the pier columns and a design exception for reduced shoulder width.

4.12.2 Bridge Improvement Considerations

Vertical Clearances

ADOT bridge design guidelines call for a minimum vertical clearance of 16'-6" for new bridges and 16'-0" for existing bridges. Bridge widening on the low side or widening the roadway underneath a bridge can negatively impact vertical clearances. Bridge widening should not reduce vertical clearances below 16'-0". Existing overpass bridges at the New River TI SB, Black Canyon City TI NB and SB, and the Bumble Bee TI NB have existing vertical clearances of less than 16 feet.

Where typical widening would reduce clearances to below 16 feet, mitigation such as widening with a shallower structure depth than the existing girder bridges, cross-slope adjustments, introducing a cross slope break between lanes, or milling or reprofiling the roadway underneath should be considered.

In most cases for bridges over waterways, I-17 widening is to the high side of the roadway and will not impact freeboard. A minor 0.4-foot freeboard reduction is anticipated at the Little Squaw Creek NB bridge. If needed, a reduction in structure girder depths for the widened portion can mitigate any freeboard impacts.

Construction Considerations

Minimizing traffic disruptions along the corridor is a key requirement. Widenings will require some existing bridge removal to tie in to the existing. Removals will be kept to a minimum and will likely include removing the deck overhang to the exterior girder.

Widening will be to one side, either inside or outside, except for the Little Squaw Creek NB bridge, to limit structure removal and construction impacts to one side where practical. Partial widening on both sides of the existing Little Squaw Creek NB bridge is recommended to avoid the need to shift the existing roadway horizontal curve and helped to reduce approach roadway reconstruction costs.

Cast-in-place concrete will be avoided except for in-kind concrete slab bridge widening to avoid falsework over traffic and the horizontal and vertical clearance reductions that accompany falsework. Accelerated construction techniques and precast and prefabricated bridge elements can reduce construction durations and the accompanying traffic constraints.

Replacement structures at Moores Gulch SB (by others) and Bumble Bee TI UP SB will be replaced on the existing alignments to avoid the need for right-of-way and to minimize approach roadway reconstruction.

Structure Types

Structure types for bridge widenings will be primarily in-kind widenings of the same or similar structure type. The widened sections will be designed independent of the existing structure. In some cases, girder bridges may need to be shallower than the existing to maintain vertical clearances. This can be accomplished with more efficient or compact girder designs and possibly closer girder spacing. This is not an option with the slab bridges which are already quite shallow in structure depth.

For the new bridges at Moores Gulch SB and Bumble Bee TI UP SB, structure type is site dependent. The predominant economical structure type used in Arizona is a precast concrete girder bridge. Cast-in-place reinforced and post-tensioned concrete is also used frequently; however, the falsework requirements are a detriment to construction over active waterways, I-17 lanes, or busy cross roads.

Additional Improvements and Rehabilitation

Widened bridges will receive current ADOT standard crash-tested barriers. In addition, non-conforming barriers on the non-widened side of overpasses at the New River TI and Moores Gulch NB will also be upgraded to current standards.

Bridge widenings on existing bridges at the New River NB and SB bridges, with substandard or excessive AC overlay thicknesses, will have the existing overlays removed, and the existing bare concrete deck surface will be inspected and repaired if needed. The full widened deck surface will be sealed with penetrating deck sealant and re-overlaid with an appropriate asphaltic overlay.

Widened waterway crossings will require a reassessment of existing bank and scour protection measures in the design phase to determine if improvements or additional mitigation measures are warranted.

All existing concrete that will be removed or connected will need to be tested for asbestos. Steel girder bridges that are to be removed or repainted will need to be tested for lead paint.

4.12.3 Bridge Recommendations

The proposed improvements to the existing structures are summarized in the following tables:

TABLE 45 – ANTHEM WAY TO BLACK CANYON CITY OVERPASSES

STR NO	I-17 MP	BRIDGE NAME	PROP RDWY WIDTH (Ft)	PROP DECK WIDTH (Ft)	EXIST RDWY WIDTH (Ft)	EXIST DECK WIDTH (Ft)	HORIZ CLEARANCE SURPLUS/ (SHORTAGE)	PROP BRIDGE IMPROV-MENTS	NEW BRIDGE AREA (SF)
1290	231.4	New River Bridge NB	60.0	63.0	42.0	45.2	(17.8)	Widen	7,290
1291	231.4	New River Bridge SB	60.0	63.0	42.0	45.2	(17.8)	Widen	7,290
1292	232.0	New River TI OP NB	60.0	63.0	38.0	40.6	(22.4)	Widen	3,900
1293	232.0	New River TI OP SB	60.0	63.0	38.0	40.6	(22.4)	Widen	3,560
0967	238.2	Moores Gulch Br NB	60.0	63.0	38.0	40.6	(22.4)	Widen	4,980
0339	238.6	Moores Gulch Br SB (by others)	76.0	79.0	31.8	35.0	(44.0)	Replace (by others)	15,010
0968	239.2	Little Squaw Creek Br NB	60.0	63.0	32.5	35.6	(27.4)	Widen	11,820
2965	239.6	Little Squaw Creek Br SB	60.0	63.0	62.0	64.8	1.8	None	0
1807	243.3	Agua Fria River Br NB	60.0	63.0	42.0	45.2	(17.8)	Widen	7,990
1808	243.3	Agua Fria River Br SB	60.0	63.0	42.0	45.2	(17.8)	Widen	7,990
0764	244.4	Black Cyn City TI OP NB	60.0	63.0	38.0	43.2	(19.8)	Widen	2,240
0765	244.4	Black Cyn City TI OP SB	60.0	63.0	38.0	43.2	(19.8)	Widen	2,240

TABLE 46 – ANTHEM WAY TO BLACK CANYON CITY UNDERPASSES

STR NO	I-17 MP	BRIDGE NAME	PROP RDWY WIDTH (Ft)	PROP WIDTH (Ft)	EXIST CLEAR WIDTH (Ft)	EXIST CLEAR LANE-STRUCT	PROP CLEAR LANE-STRUCT	HORIZ CLEARANCE SURPLUS/ (SHORTAGE)	PROP BRIDGE IMPROV-MENTS	NEW BRIDGE AREA (SF)
2537	229.0	Anthem Way TI UP	60.0	63.0	90.5	24.8 (SB (Inside)	22.5 (NB Inside)	27.5	None	0
1294	235.9	Table Mesa TI UP SB	54.6*	57.6*	57.6	13.8 (Outside)	7.8 (Inside)	0.0	None	0
1295	235.9	Table Mesa TI UP NB	54.6*	57.6*	57.6	13.8 (Outside)	7.8 (Inside)	0.0	None	0
0969	242.2	Rock Springs TI UP NB	60.0	63.0	65.0	39.8 (Inside)	27.8 (Inside)	2.0	None	0
0970	242.2	Rock Springs TI UP SB	60.0	63.0	63.0	34.7 (Outside)	33.0 (Inside)	0.0	None	0
0863	243.0	Mud Springs UP	60.0	63.0	82.0	41.0 (Inside)	29.0 (Inside)	19.0	None	0

* Roadway shoulders and barrier offsets reduced to clear existing bridge columns. Roadway design exception is required.

TABLE 47 – BLACK CANYON CITY TO SUNSET POINT

STR NO	I-17 MP	BRIDGE NAME	PROP RDWY WIDTH (Ft)	PROP DECK WIDTH (Ft)	EXIST CLEAR WIDTH (Ft)	EXIST RDWY WIDTH (Ft)	EXIST DECK WIDTH (Ft)	HORIZ CLEARANCE SURPLUS/ (SHORTAGE)	PROP BRIDGE IMPROV-MENTS	NEW BRIDGE AREA (SF)
1170	248.4	Bumble Bee TI UP SB	84.0	87.0	57.0	NA	NA	(30.0)	Replace	7,000
1171	248.4	Bumble Bee TI OP NB	38.0	40.3	NA	38.0	40.3	NA	N/A	0

4.12.4 New Bridges

New replacement bridges are recommended at the existing Moores Gulch SB (MP 238.6) (by others) and Bumble Bee TI UP SB (MP 248.4). The Bumble Bee bridge was addressed in a previous section.

Moores Gulch SB (#00339) (by others)

Replacement of the Moores Gulch SB bridge is currently in the ADOT five-year program, programmed for 2022 under a separate project. ADOT is using an outside consultant to design the bridge.

The existing southbound bridge at Moores Gulch was built in 1950, has only 32 feet clear width across the bridge for two existing freeway lanes, and has a low HS 16 Inventory Load Rating. The bridge also has an Operating Load rating of 49 tons which limits heavier permit vehicles access. To accommodate the added through lane, it would need to be widened 28 feet. These factors and the low current bridge Sufficiency Rating of 70.2 make it impractical and undesirable to widen the existing bridge.

Full bridge replacement is recommended. The intent is for the southbound I-17 widening to follow the existing I-17 alignment at this location. This requires a new bridge to be built at essentially the same location as the existing.

To maintain southbound I-17 traffic during construction the new bridge will need to be overbuilt, i.e., built wider than it needs to be for the final condition. While traffic is on the existing bridge, approximately 35 feet of the new bridge will be built alongside the existing. Once the first stage is complete, traffic can be shifted to the new bridge while the existing bridge is demolished and the remainder of the new bridge is constructed. This will require building a new bridge approximately 75 feet wide, or about 12 feet wider than required for the final condition.

A multi-span steel or precast prestressed concrete girder bridge would be appropriate for the southbound Moores Gulch crossing. Precast prestressed side-by-side boxes should also be considered as an approach to accelerate construction, although this type typically costs more. Cast-in-place concrete is generally not desirable for waterway crossings because of the need for falsework, even if the waterway is typically dry.

It is anticipated the new bridge span configuration would be similar to the existing, with a slightly longer three-span bridge length of approximately 190 feet. New substructure elements would be shifted from the existing to avoid conflicts with existing bridge piles left in-place. A detailed hydraulic analysis will confirm waterway opening requirements and may lead to adjustments of this configuration.

4.12.5 Retaining Walls

One retaining wall is anticipated for the Anthem Way to Black Canyon City segment, along with bridge abutment wingwalls associated with bridge widenings or replacements. A proposed retaining wall for the flex lanes is also listed in Table 48. The retaining walls in the table are independent of bridge crossings. Bridge abutment wingwalls, required at each bridge abutment, are typical of each bridge and are not listed separately.

Key to the length and height of retaining walls is the close proximity of adjacent roadways with appreciably different profiles.

TABLE 48 – BLACK CANYON CITY TO SUNSET POINT WALLS

STATION	LOCATION DESCRIPTION	LENGTH (FT)
2295+00 – 2308+00 (Black Canyon City TI, NB Entrance Ramp)	Contain cut slope in ROW, support eroding cut slope and erosion. Additional flattening of the slope above the wall may be needed to increase stability.	1,200
2330+00 – 2364+00	Vertically separate flex lane facility and existing SB lanes	3,400

4.13 ITS / Incident Management

ADOT's Intelligent Transportation Systems (ITS) requirements are outlined in its report, *ITS Concepts for Rural Corridor Management*, September 2007, and are now incorporated in the Statewide ITS Architecture. Section 3.1.5 outlines the Prescott District's main traffic management concerns [note that District lines were re-drawn; the project is now in the Northwest District]. These include interagency communications, real-time traffic monitoring for the I-17 corridor, traveler information systems, and weather forecasting to give the driver real-time accurate information. Section 3.2, Table 4, "Districts Needs Matrix," details what ITS components are identified as significant or minor needs. Mentioned, but not covered under the types of devices, was the District's desired installation of wildlife detection and monitoring systems.

The specific needs identified by the Northwest District that relate to the I-17 corridor are:

- Real Time Traffic Monitoring of I-17
- CCTV Monitoring
- Budgetary Funding for ITS Maintenance
- Wildlife Presence Detection
- Additional Roadway Weather Information Sites
- Flood Detection Sensors
- Bridge Deck Icing Monitors
- Additional Dynamic Message Sign Locations
- Portable DMS
- Good DMS Maintenance Service
- Multiple Agency Coordination for Traveler Information and Incident Response
- District-Wide Communications (Radio, Cell, Satellite Coverage)
- Improved Traveler Information
- Comprehensive AZ 511 System
- Portable Speed Display Trailers and Photo Enforcement Programs
- Highway Advisory Radio for Work Zones
- Motorist Assist Patrols for Major Construction Projects

While many of these ITS needs are beyond the scope of this DCR, it is important to include a description or vision of the fully evolved ITS system so that ITS infrastructure elements can be included in future projects that will contribute to the long-term traffic management goals of the Department.

4.13.1 Recommended ITS Elements

The recommended ITS elements for the corridor are based on the ITS needs identified by ADOT Transportation Systems Management and Operations (TSM&O) Group and the Northwest District. The primary elements include:

- Real Time Traffic Monitoring
- CCTV Monitoring
- Dynamic Message Signs
- ITS Communications System and Power Distribution
- Flex Lanes
- Traveler Information Systems

Real Time Traffic Monitoring

Real time traffic monitoring is an important ITS element for incident detection and travel time data. Vehicle detection technology has evolved considerably over the past 20 years with the increased use of video, radar, and other non-intrusive detection devices. Some of these detection technologies have not proven to be as accurate as loop detectors under certain conditions. Other in-pavement or under pavement detection devices have also been tested by ADOT. Some of these technologies include wireless communications from the detector to the cabinet and from the cabinet to a communications hub. Other detection systems have been developed that use inductance footprint matching that can track vehicles throughout a corridor to provide very accurate travel time information, as well as the traditional spot speed and density data. Some private vendors have also developed systems that can report travel time data using a large pool of probe vehicles.

ADOT is currently getting real time traffic information through INRIX and this is envisioned by ADOT to be the primary traffic data source within the corridor going forward. The INRIX data will be supplemented by loop detectors at key locations between Black Canyon City and Sunset Point. The key locations are envisioned to include a location in advance of the flex lanes, as well as within the flex lane crossover areas for both the northbound and southbound directions.

CCTV Monitoring

CCTV cameras will be an important ITS element for accurate verification of incident location and type. This information is critical for appropriate and timely incident response. CCTV cameras should be installed to provide full coverage of the corridor within the project limits. CCTV cameras are typically installed at one mile spacing within the urban freeway corridors. For estimating purposes, camera spacing of approximately one mile has been assumed between Anthem Way and Black Canyon City. An additional eight cameras have been added to provide CCTVs on both northbound and southbound roadways where the roadways are bifurcated. There may be portions of the corridor between Anthem Way and Black Canyon City where power is not readily available to power cameras with a #2 AWG wire or smaller; within this portion of the corridor, larger spacings between CCTV would be acceptable.

Between Black Canyon City and Sunset Point, it is assumed that the southbound camera spacing will need to be one-half mile or less within the flex lane limits. The closer spacing of cameras within the flex lane limits is required to provide continuous coverage and clearance capability within the flex lanes. Cameras should be located at the flex lane entrances and exits north of the Black Canyon City TI and south of the Sunset Point TI. These cameras should be located to allow traffic operations personnel to view the merge-diverge areas and the DMS messages at these locations. Specific camera locations that provide full coverage of the corridor should be identified during the final design stages. Along northbound I-17 between Black Canyon City, camera spacing has been assumed to be one mile between devices.

ADOT typically uses pan-tilt-zoom cameras with lowering devices powered by an AC power source. Electrical service is available at the Black Canyon City TI and the Sunset Point Rest Area. However, the availability of AC power throughout the corridor is problematic and larger wire sizes may be required to power all of the CCTV cameras within the flex lanes portion of the corridor. The power demand of the camera controls (pan/tilt/zoom) and communications equipment (ethernet switches, radios, and controllers) currently being used is at the upper range or higher than can be provided with standard ADOT solar power installations. This will be particularly important for the northbound I-17 CCTV locations, where the final design will have to rely solely on solar power since a conduit system will not be constructed along northbound I-17. Camera type, communications needs, power sources, solar panel size, battery storage, etc. will need to be carefully evaluated during the final design stage to identify the best CCTV camera and power source solutions for this segment of the corridor.

Dynamic Message Signs

Dynamic message signs (DMS) are an important Traveler Information System device to support incident management and communicate travel time information to the public. DMS have been installed along the I-17 corridor over the years, with the most recent installation occurring in 2017. Current DMS locations are listed in the table below.

TABLE 49 – EXISTING DMS LOCATIONS

DIRECTION	MILEPOST
I-17 NB	235.50, 242.71, and 251.90
I-17 SB	252.83, 261.70, and 264.70

The signing concept for the two flex lanes includes one additional DMS in each direction. The DMS are integrated with the advance static signing leading into the transition to the flex lane entrances. The DMS sign locations will allow the driver to select which lanes to use based on the latest travel time and incident information.

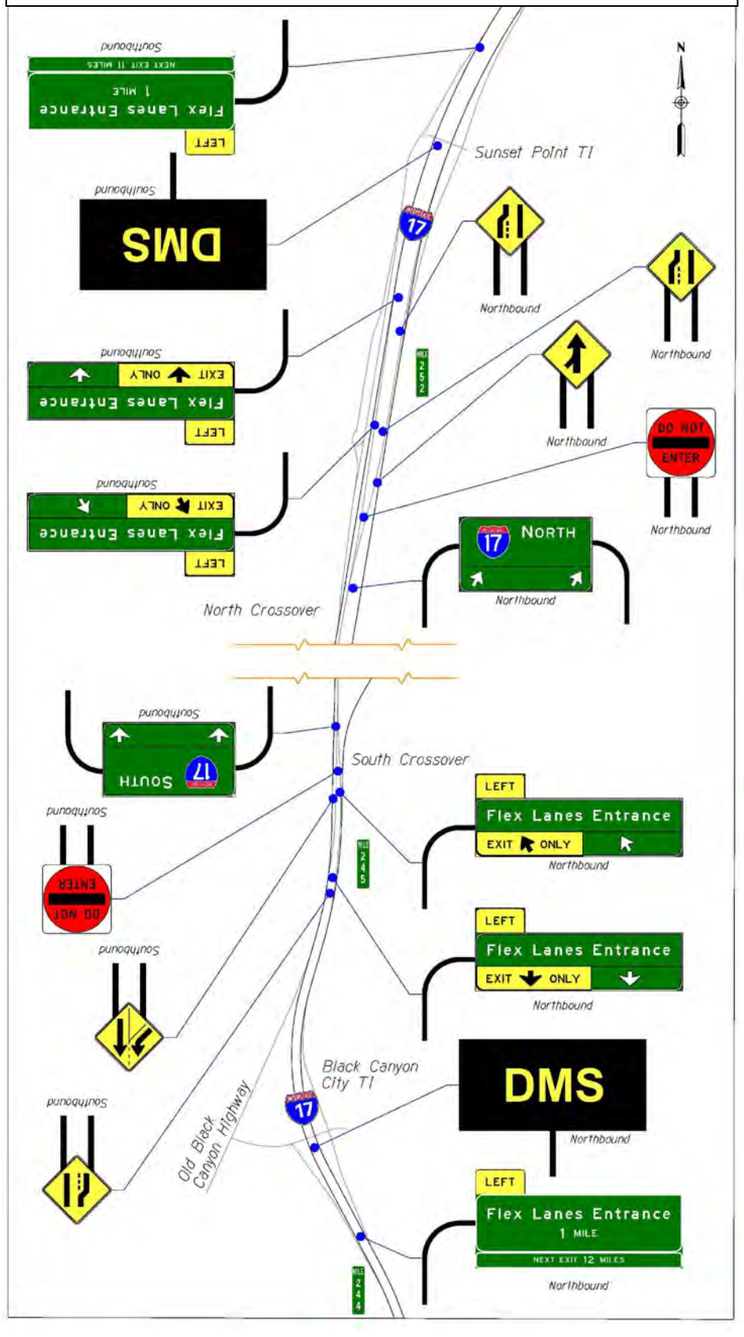
In the ultimate development of widening I-17 all the way to Cordes Junction, one DMS should also be located on northbound I-17 on the approach to Cordes Junction. Six to ten additional DMS should also be located outside the project limits to redirect traffic from the I-17 corridor to other routes such as SR 69, SR 87, SR 260, SR 89, US 93, and US 60 when road closures or long delay conditions occur along the I-17 corridor.

ITS Communications System and Power Distribution

The ITS infrastructure should be a comprehensive communications system that is comprised of a combination of fiber optic cable, cell phone, and radio communications systems. The system should provide communications from all field equipment to the ADOT Traffic Operations Center via fiber communications, as well as to the Northwest District Maintenance Facility in Prescott Valley via radio communications or other wireless means.

The backbone of this system will be 3-3” conduits throughout the project corridor. The fiber optic backbone should consist of 144 strand fiber optic cables on each side of I-17 between Anthem Way and Black Canyon City and one 144 strand fiber optic cable along the southbound flex lane between Black Canyon City and Sunset Point. New communications nodes should be located near the New River TI, the Sunset Point Rest Area, and near the Cordes Junction TI. ADOT is starting to deploy communications nodes along rural corridors with a 20-25 mile spacing to accommodate future ADOT and DPS communications needs. The concept for the rural nodes is still under development internally between ADOT and DPS, but nodes may need to include towers for wireless

FIGURE 11 – FLEX LANE SIGNING CONCEPT



communications if existing DPS coverage is not available in that area, or if ADOT determines there is a wireless communication need that would require such a tower.

The wireless communications infrastructure within the limits of the flex lane installation is envisioned to provide point to point communications from each CCTV and detector location along northbound I-17 to a counterpart device located along the flex lanes, where the northbound devices will be tied into the fiber optic backbone. The fiber and wireless components should be a part of the flex lane project construction to ensure the communications with CCTV and detector stations are integrated with the field devices that are directly connected to fiber. For example, the CCTV and detectors along the new flex lane alignment are anticipated to be connected directly to the fiber communications network while most of the CCTV and detector stations along the existing northbound I-17 alignment are anticipated to be wireless links back to the fiber optic backbone. The ADOT TSM&O Group has expressed the desire that all devices in the corridor be IP addressable. The final communications system design should be developed for the entire corridor, taking into consideration phased construction of the projects within the corridor.

Flex Lanes

The flex lanes would connect to the existing northbound and southbound roadways near Black Canyon City and Sunset Point via slip ramps meeting ADOT design criteria for entrance and exit ramps. Dynamic message signs in advance of the flex lane entries would be added near Black Canyon City (northbound) and near Sunset Point (southbound) to alert drivers to the status of the flex lanes. See signing concept in Figure 11.

If current traffic patterns continue, the flex lanes would likely be used to carry northbound traffic on Fridays and Saturdays and southbound traffic on Sundays and holiday weekends. The lanes could be closed Monday through Thursday or they could remain open in the northbound direction to assist with accommodating higher traffic flows in the climbing section of the corridor. It is not envisioned that the direction of flow would be reversed on a frequent basis during the week unless construction activities or crashes warrant reversing the flow. The system would need to be flexible enough to be reversed in a relatively short amount of time if required.

Ideally, clearing the flex lanes for reversing the direction of flow would be an automated process. Gate open/closed positions would be changed automatically from the Traffic Operations Center and the flex lanes could be visually cleared by using CCTV cameras that provide continuous coverage of the entire flex lane length. If flow reversals happen during night time hours because of crashes, the roadway may need to be physically checked to make sure traffic is clear and there are no vehicles parked on the shoulder before switching directions.

The flex lanes will require ITS infrastructure above and beyond the requirements of the typical urban or rural ITS/FMS corridor in order to monitor and control the operation of equipment required to operate the flex lanes and meet the operational objectives for the flex lane.

ADOT TSM&O personnel have indicated their desire to have a robust ITS system within the area of the flex lanes. This robust ITS system is envisioned to include an automated gate control system at the entry to the flex lanes at Black Canyon City and Sunset Point TI, as well as numerous detector stations and CCTV cameras to assist with the clearance verification process when the lanes are being switched from one direction of travel to the other. Variable speed limit signs approaching and within the limits of the flex lanes could be used to adjust the posted speed limit based on monitored traffic conditions and speeds to promote a safer travel environment. The goal is to operate and clear the flex lanes with technology that is monitored at the ADOT Traffic Operations Center (TOC) rather than by manual/personnel-intensive methodologies (driving the corridor) due to the relative remoteness of the northbound and southbound entry locations from the Phoenix metropolitan area.

Gate control systems typically consist of four or more gates in each direction that allow the flex lane to be closed in one direction, cleared, and then reopened to traffic in the opposing direction. Typically, the first few gates have

fairly lightweight gate arms as they are more prone to being struck. The series of gates at the entry points would be designed to prevent cars from going the wrong way. Using a recent Florida project as an example, the initial gates should be well marked, with large, orange "Do Not Enter" signs suspended from the arm before the final steel gate arm. The last one or more gates are “hardened” gates designed to prevent traffic from entering the flex lanes and traveling in the wrong direction. Should the central control system or communications fail, the gates would remain locked in their position prior to the failure to prevent head-on collisions.

Clearance of the flex lanes can occur manually by having ADOT or DPS personnel drive the flex lane shortly after it is closed in one direction to visually confirm that there are no disabled vehicles within the flex lane limits. This is a time and labor intense process and an ongoing operational cost that would occur every time the direction of flow is reversed, and is therefore not viewed as the preferred operational concept, even though it would be expected to provide the highest degree of confidence that the flex lane is clear.

By contrast, clearance can be achieved through technology by using a combination of CCTV cameras and detector technology. These solutions require a robust communications network to be installed along the flex lane alignment such that the control cabinets can be connected to a fiber optic communications network. ADOT has begun designing fiber installations along interstates in rural locations (e.g., I-10 between Casa Grande and Picacho Peak) and ADOT TSM&O personnel have indicated a desire to ultimately have fiber along one side of I-17 all the way from Anthem Way to SR 69. It is expected that the fiber backbone will be constructed in phases as projects are developed.

The use of CCTV cameras to visually clear the flex lanes is one aspect of technology that is expected to be deployed. Full 100% visual confirmation of the flex lane corridor is desired by TSM&O personnel. The existing terrain and horizontal curvature would significantly increase the number of CCTV cameras required to provide full coverage. In addition, cameras are an essential component of the automated gate system for verification of gate closure, as well as in advance of each DMS location for message verification. There are several key constructability concerns with deploying a significant number of CCTV cameras along the flex lanes, primarily the lack of available power sources along the corridor, as well as the subsurface soil conditions at the CCTV locations. Additional geotechnical investigation and special CCTV foundation designs will likely be required at some CCTV locations within the flex lane section.

Other types of technology such as license plate recognition systems, similar to what are used on tolling systems, could also be considered for clearance. Final selection of technology will be determined during final design, as new, more reliable technologies could be developed by the time the flex lanes are designed and constructed.

Traveler Information Systems

Traveler information systems come in many forms. It is envisioned that one or more of the ITS capabilities included in the recommended project will require an expansion and refinement of the ADOT Traveler Information System including extensive use of the AZ 511 System, connected vehicle applications such as dedicated short-range communications, improved travel information distributed to television and local radio stations, and especially to traffic conditions and navigation apps on mobile devices. The ADOT Communications office, which is responsible for public and media outreach, is a good resource to assist with the preparation of clear and concise messages. These systems will be particularly important during the construction phases of the various projects in this corridor.

4.13.2 Incident Management

The following sections describe the incident management scenarios that are anticipated based on assumed incident locations within the corridor.

Anthem Way to Black Canyon City

Scenario 1: For incidents between Anthem Way TI and New River TI, northbound and southbound traffic would be rerouted to the Anthem Way TI or the New River Road TI via the frontage road. Traffic trapped between the Anthem Way TI and the New River TI would remain until allowed to pass the incident safely under the direction and traffic control measures by ADOT and DPS. The wider proposed roadway would provide the width to bypass many incidents with 56 feet (3-12 foot lanes, 2-10 foot shoulders) of pavement.

Scenario 2: For incidents north of the New River TI, the traffic would not be rerouted but would remain until allowed to pass the incident safely under the direction and traffic control measures by ADOT and DPS. The wider proposed roadway would provide the width to bypass many incidents with 56 feet (3-12 foot lanes, 2-10 foot shoulders) of pavement.

Black Canyon City to Sunset Point

I-17 from the Black Canyon City TI to Sunset Point is a steep roadway that travels up the Black Canyon Hill. Incidents on this segment have been responsible for many hours of delay to the traveling public because of crashes and the lack of alternate routes on which to reroute traffic around incidents and maintenance activities. The existing northbound and southbound alignments are bifurcated with substantial elevation differences.

The current two-lane roadway configuration does not provide flexibility for routing traffic around crashes. Crossing traffic over to the opposing lanes, then back again past an incident is not possible. The reduction from two lanes to one lane in the direction opposite to the incident causes operations on that segment of roadway to fail as well. A full road closure is frequently required for hazardous material incidents or a fatal crash that blocks the roadway.

Sample incident management scenarios have been developed to address how traffic could be routed around incidents within specific roadway segments.

Potential Scenarios and Responses – Black Canyon City to Sunset Point (Flex Lanes)

Scenario 1: An incident occurs in the northbound direction on the existing northbound roadway. Traffic would begin to queue on the Black Canyon Hill. ADOT's traffic monitoring system would measure a slowing of traffic speed, alerting ADOT of a problem. After video verification and confirmation from DPS, the Traffic Operations Center would direct approaching northbound traffic by posting a message on the dynamic message sign south of Black Canyon City to stay left and use the northbound flex lanes.

Scenario 1A: Incidents in the northbound direction on the existing northbound roadway north of the Bumble Bee TI would follow a similar strategy except traffic could be turned around at Bumble Bee TI and rerouted south to the Black Canyon City TI, where the traffic would turn around and proceed northbound using the northbound flex lanes under traffic control measures by ADOT and DPS. Traffic trapped between the Bumble Bee interchange and the incident would remain until it was allowed to pass the incident safely.

Scenario 1B: Incidents in the northbound direction on the existing northbound roadway south of the Bumble Bee TI would require that northbound traffic be routed to the northbound flex lanes at Black Canyon City. Traffic trapped between the Black Canyon City interchange and the incident would remain until it was allowed to pass the incident safely. Motorists who desire to access Bumble Bee Road would be routed north to the Sunset Point TI, where they would turn around and proceed south to the Bumble Bee TI.

Scenario 2: An incident occurs in the southbound direction on the existing southbound roadway. Traffic would begin to queue on the Black Canyon Hill. ADOT's traffic monitoring system would measure a slowing of traffic speed, alerting ADOT of a problem. After video verification and confirmation from DPS, the Traffic Operations

Center would direct approaching southbound traffic by posting a message on the dynamic message sign north of Sunset Point to stay left and use the southbound flex lanes.

Scenario 2A: Incidents in the southbound direction on the existing southbound roadway south of the Bumble Bee TI would follow a similar strategy except traffic could be turned around at Bumble Bee TI and rerouted north to the Badger Springs Road TI, where the traffic would turn around and proceed southbound using the southbound flex lanes under traffic control measures by ADOT and DPS. Traffic trapped between the Bumble Bee interchange and the incident would remain until it was allowed to pass the incident safely.

Scenario 2B: Incidents in the southbound direction on the existing southbound roadway north of the Bumble Bee TI would require that southbound traffic be routed to the southbound flex lanes at Sunset Point. Traffic trapped between the Sunset Point interchange and the incident would remain until it was allowed to pass the incident safely. Motorists who desire to access Bumble Bee Road would be routed south to the Black Canyon City TI, where they would turn around and proceed north to the Bumble Bee TI.

Scenario 3: For incidents within the new flex lanes alignment, existing northbound or southbound traffic would not be rerouted but would remain until allowed to pass the incident safely under the direction of and traffic control measures by ADOT and DPS.

The final designer should consider whether there are opportunities to provide emergency access through the barrier between the southbound lanes and flex lanes to allow evacuation of the lanes or to provide access to emergency vehicles.

4.14 Constructability and Traffic Control

4.14.1 General

Existing highway movements and access must be maintained during construction. Because there are no convenient alternate routes, closure of Interstate 17 will not be allowed other than for short periods of time. Final construction sequencing/phasing will be determined during final design. Traffic will be managed using detailed traffic control plans and by procedures and guidelines specified in the current edition of the Manual on Uniform Traffic Control Devices and the current ADOT Traffic Control Design Guidelines.

Major construction activities that disrupt traffic are to be performed during off-peak hours. Efforts to minimize the duration of construction should be made during final design. Existing freeway movements and access to and from TIs must be maintained during construction. Other methods of reducing traffic impacts during construction, such as phasing the improvements so the entire length of the project is not under construction at one time, will be evaluated during the final design phase of the project.

Contractual incentives should be considered to minimize closure durations and facilitate traffic flow during construction. Examples of methods used successfully on other projects include the following:

- Travel-time incentives
- Motorist assist patrol to help stranded motorists
- Lane rental, with a higher cost for peak-hour closures
- Variable message signs
- Highway conditions reporting system
- Major public outreach campaign

The construction and phasing of the Anthem Way to Black Canyon City construction can likely be accomplished in one phase. This phase will include widening to the inside (or outside in one southbound segment) along the freeway. To maintain traffic during this phase of construction, the width of the inside shoulder may be reduced, but a useable (10-foot) right shoulder must be maintained. Temporary concrete barrier is recommended to protect the work area from freeway traffic.

Construction of the flex lanes could be a separate construction project or a separate phase of one overall project; the flex lanes will likely be constructed in one phase.

Replacement of the Bumble Bee TI UP bridge will require a detour and short-term southbound I-17 closures. Traffic can be detoured through the existing southbound ramps when required. The use of precast superstructure elements can limit the mainline closures and detours to primarily overnight closures. With a small shift in the Bumble Bee Road alignment over southbound I-17, staged bridge construction may allow for the maintenance of traffic on Bumble Bee Road and access to northbound I-17 except for short-term closures. Shifting the Bumble Bee Road alignment would be complicated by the mountainous terrain and large rock formations. If staged bridge construction or shifting the cross road alignment to maintain access during bridge reconstruction isn't feasible, northbound traffic accessing Bumble Bee Road will be detoured north to the Sunset Point TI and turned around. While this seven-mile detour would be inconvenient, traffic volumes are low at the Bumble Bee Road northbound exit at 147 vehicles per day (2018).

Constructability and traffic control issues have been identified for the recommended alternatives as follows:

Earthwork

- Earthwork haul routes can have a considerable impact on construction zone traffic control and construction zone congestion. It may be beneficial to require the contractor to submit a haul route design tailored to their specific equipment and its capabilities. At locations where the haul route would use existing or proposed structures, the load capacity of the structure must be identified and adhered to by the haul vehicles. It may be necessary to design some of the new structures as overload structures to facilitate the hauling activities.

Bridge Construction

- One structure (Bumble Bee Road) would be re-constructed over an existing roadway; other overcrossing structures will be widened. All of the crossings can be constructed in stages to maintain I-17 traffic with lane shifts and short-term mainline traffic diversions through the off/on ramps. Cross road closures can be limited to overnight using precast superstructure elements. Accelerated bridge construction (ABC) techniques have also been used successfully to deliver bridge replacement over the course of a weekend closure. This would require that mainline traffic be shifted to the off/on ramps during the closure.
- Table Mesa TI Underpass bridges provides a horizontal clearance of 57 to 58 feet. The proposed widening of the existing I-17 roadways will require a 63-foot horizontal clearance. Bumble Bee TI SB Underpass bridge will require 87 feet of horizontal clearance to accommodate the new flex lanes. The bridge currently provides 57 feet of clearance and the short end spans do not have adequate lateral clearance to divert the two new flex lanes through the end span opening.

4.15 Utilities

During final design, each utility company will receive and review the preliminary design for this project and develop plans for any relocations and/or adjustments.

Based on as-built plans, plans supplied by the utility companies, and the conceptual plans developed for I-17 as references, it is anticipated that utility relocations and adjustments will be necessary. The table below summarizes various utility crossings, many of which will not be directly impacted, but they should be noted and conflicts determined during final design.

TABLE 50 – PRELIMINARY UTILITY CONFLICTS

Type	Owner	Location	Disposition	Other
Gas	Southwest Gas	SB Sta 1656+00 NB Sta1657+00	No impact likely	
Overhead Power	APS	SB Sta 1671+00 NB Sta 1671+00	No impact likely	Vertical clearance approximately 25'
Overhead Power	APS	Along east side of NB NB Sta 1875+00 to Sta 1883+00 Crosses SB Sta 1883+00	No impact likely	Vertical clearance approximately 25'
Gas	El Paso Natural Gas	NB Sta 2054+00 SB Sta 2012+50	No impact likely	
Fiber Optic	ATT	NB Sta 2052+50 SB Sta 2011+50	No impact likely	
Overhead Power	APS	Along west side of SB SB Sta 2065+00 to Sta 2165+00	One pole impacted at Sta 2070+00	
Overhead Power and Fiber Optic	APS/ATT	NB Sta 2201+75 SB Sta 2202+00	No impact likely	Vertical clearance approximately 25'
Water	Black Canyon City Water	NB Sta 2201+75 SB Sta 2202+00	No impact likely	Line is adequately deep, valves should be located during final design
Gas	El Paso Natural Gas	NB Sta 2204+50 SB Sta 2204+50	No impact likely	
Water	Black Canyon City Water	NB Sta 2213+50 SB Sta 2213+50	No impact likely	Line is adequately deep, valves should be located during final design
Water	Black Canyon City Water	NB Sta 2225+00 SB Sta 2223+75	No impact likely	Line is adequately deep, valves should be located during final design
Water	Black Canyon City Water	NB Sta 2232+00 SB Sta 2232+00	No impact likely	Line is adequately deep, valves should be located during final design
Overhead Power	APS	SB Sta 2429+75	No impact likely	One pole 30' away from outside edge of pavement
Gas	El Paso Natural Gas	SB Sta 2430+00	No impact likely	

No impacts are expected to any Western Area Power Administration 345 kV transmission lines or towers.

A 42-inch Transwestern natural gas pipeline runs along the west side of I-17 from Black Canyon City northwest through the Bumble Bee Valley, then northwesterly toward Prescott.

New roadway lighting will be designed at the south and north crossover points for the flex lanes. It is anticipated that existing lighting services will be modified/upgraded to accommodate the additional lighting that will be added. Existing lighting load centers are located at the far west side of the Black Canyon City TI and within the Sunset Point Rest Area. The power company will be contacted during design to determine if more convenient/less expensive electrical service points are available; based on a review of existing conditions, it appears that this is unlikely.

ITS electrical services will be needed to support ITS equipment installations throughout the entire flex lane corridor for DMS, CCTV, and detection. It is expected that new ITS electrical services will be required near the locations of the existing lighting load centers at the far west side of the Black Canyon City TI and within Sunset Point Rest Area. Additional electrical services and load centers would be desirable at one or more locations between MP 244 and MP 252 to decrease the conductor size that would be required to run power to ITS equipment within the corridor. There is a power line overcrossing north of MP 247 that may be a potential electrical service point. The power company will be contacted during design to determine if this or additional electrical service points are available along the corridor.

The 2017 Safety Improvements project installed new ITS electrical services for DMS along northbound I-17 south of Table Mesa Road (MP 235.50), and south of Black Canyon City (MP 242.71). New ITS electrical services for DMS were installed along southbound I-17 near MP 252.83.

4.16 Signing and Pavement Marking

The roadway widening between Anthem Way and Black Canyon City will require the relocation of any existing warning, marker, or regulatory sign impacted by the widening, as well as the installation of new pavement marking along both the southbound and northbound alignments due to proposed milling and replacing AR-ACFC. At the project termini, an existing lane line and edge line will need to be restriped to properly tie into the existing lane addition in the southbound direction and tie into the existing lane drop in the northbound direction. Where inside widening occurs along the northbound and southbound alignments a new lane line and inside edge line will need to be installed.

The two-lane flex roadway facility between Black Canyon City and Sunset Point will require the relocation of any existing warning, marker, regulatory or guide sign impacted, as well as the installation of new warning, marker, and regulatory signs along the median side of road for drivers traveling in either direction along the flex lane alignment. Signing to indicate which shoulder should be used for emergencies will be included on the flex lanes. The installation of new post-mounted warning signs and overhead guide signs mounted on sign structures will also be required at the north and south crossover areas to inform drivers of the flex lanes. A proposed signing concept for these signs is shown in Figure 11. The FLEX LANES ENTRANCE 1 MILE advance guide sign for the southbound direction is located north of Sunset Point Road. It is recommended that this sign be installed in the median between Station 2728+00 and 2735+00 to avoid potential conflict with culturally significant areas. No access to Bumble Bee Road will be provided for drivers within the flex lanes. Because of the proximity of the flex lane merge point with I-17 in relation to the Sunset Point and Black Canyon City exits, insufficient weaving lengths are available and access cannot be provided from the flex lanes to the adjacent ramps. Therefore, a "NEXT EXIT XX MILES" plaque will be added to the "FLEX LANES ENTRANCE 1 MILE" advance guide signs to inform the drivers entering the flex lanes that no exits are available within the flex lane section.

New pavement marking at the crossover areas in the form of edge lines, lane lines, gore lines, and skip stripes will need to be installed. The crossover areas should also utilize raised pavement markers (RPM) that maintain red reflective markings on the back side of the RPM, as well as wrong-way pavement arrows, to better inform drivers of the correct direction of travel. Due to the different possible directions of travel along the flex roadway, both edge lines should be solid white instead of maintaining a white and a yellow edge line.

All new signing and pavement marking will be designed in accordance to ADOT's Signing and Marking Standards.

4.17 Lighting

Existing continuous lighting along I-17 ends south of the project limits at the Carefree Highway TI (MP 224); therefore, continuous lighting along I-17 between Anthem Way and Sunset Point is not recommended.

The crossovers for the two-lane flex roadway facility between Black Canyon City and Sunset Point are unique conditions, not specifically addressed by the AASHTO Roadway Lighting Design Guide, October 2005, which provides information on roadway lighting warranting conditions for rural interchanges but does not specifically address the type of roadway geometry created with the introduction of a two-lane flex roadway facility. The Guide does indicate that the installation of a few lights at the point of on- or off-movements could contribute to driver ease by providing visual indications of the maneuver areas. Lighting also improves the drivers' ability to see roadway geometry and other vehicles at extended distances ahead. For this reason, partial interchange-type lighting system is recommended to illuminate the crossover merge and diverge areas just north of the Black Canyon City TI and south of the Sunset Point TI. The partial lighting should cover the travelled way from the beginning or ending point of taper on the mainline to a point between 50 feet and 150 feet beyond the back of gore as shown in Figure 15c of the ANSI/IES RP-8-14 Roadway Lighting guide. The average maintained horizontal illuminance should be a minimum of 0.6 foot-candles with an average to minimum uniformity ratio of 4.0:1 or better.

Between Anthem Way and Black Canyon City, the TIs at Anthem Way, New River Road, Rock Springs, and Black Canyon City employ partial lighting to illuminate the points of conflict where the ramps merge and diverge from I-17; however, the Table Mesa Road TI does not currently have any lighting. All proposed roadway widening at the interchanges between Anthem Way and Black Canyon City is to the inside of the existing roadway; therefore, the existing partial lighting along this project segment will not be impacted.

North of Black Canyon City, the TI at Sunset Point employs partial lighting to illuminate the points of conflict where the ramps merge and diverge from I-17; however, the Bumble Bee Road TI does not currently have any lighting. The partial lighting at the southbound entrance and northbound exit ramps for the Sunset Point TI may need to be modified due to the additional lighting for the north flex lane roadway crossover. If modification is necessary, the partial lighting should cover the travelled way from the beginning or ending point of taper on the mainline to a point between 50 feet and 150 feet beyond the back of gore as shown in Figure 15c of the ANSI/IES RP-8-14 Roadway Lighting guide. The average maintained horizontal illuminance should be a minimum of 0.6 foot-candles with an average to minimum uniformity ratio of 4.0:1 or better.

Light Emitting Diode (LED) luminaires with a correlated color temperature of 3,000k and zero uplight should be used on this project to be in accordance with the Dark Skies recommendations.

4.18 Landscape and Aesthetic Considerations

This section establishes design criteria for the landscape and aesthetics documents to be prepared by the final designer for the corridor to adequately address the impacts of the roadway improvements on these resources. Preparation of aesthetic and landscape concepts, plans, details and special provisions should be a collaborative effort involving ADOT technical disciplines, BLM, municipal stakeholders, and the final designer. The final design scope should consider the specific submittal requirements, approvals and processes with the objective to mitigate undesirable impacts to the natural and visual quality of the I-17 project impacts using careful planning and design of ground treatments, native planting, structures rustication and paint, and slope treatments.

4.18.1 Guidelines and Predesign Resources

Landscape and aesthetics developed in final design should consider findings detailed in this DCR, mitigation measures, and supporting documents and reports. Additionally, previously-developed guidelines that are applicable to work within the project area such as the ADOT *Guidelines for Highways on Bureau of Land Management and Forest Service Lands* and *Supplement to Guidelines for Highways on Bureau of Land Management and Forest Service Lands* should be reviewed.

4.18.2 Planting Design: Objectives and Biozone Character Areas

Planting design themes should be developed through collaboration with ADOT Roadside Design Section (RDS) to develop Character Areas (CA) defining the plant palette(s), density requirements, and salvage and replanting objectives based on planting biozones. Broad objectives for the character areas should consider development growth patterns, vegetative buffers to screen views both from and to the roadway, strategic gaps to frame positive views, measures to blend disturbed areas into their surroundings, and transplant large saguaros, mature trees, and cacti to visually sensitive and critical roadway areas.

Plant Density: Urbanized planting density should be established at rates appropriate for the impacts caused by disturbance to the existing I-17 corridor, development growth patterns, and project goals as determined by ADOT and the final designer. Rural planting density should be determined by a review of the Native Plant Inventory of recommended salvageable plants by the final designer and ADOT RDS staff. The native plant density should be applied to the plantable disturbance acreage in determining the density requirements.

Soil Amendments and Agronomy Testing: The final designer should conduct agronomic soil fertility and nutrient soils testing throughout the project ROW to determine topsoil plating and prepared soil requirements. Soil sampling should occur for suitability as a planting medium for landscaping and native seeding to develop preliminary soil amendment recommendations. Samples should occur at one-mile increments within the project ROW in disturbance areas.

4.18.3 Native Plants and Seeding

The native plants surrounding the I-17 corridor are a significant resource that provide soil stabilization and wildlife habitat, and act as visual interest. During final design, efforts should be made in areas of disturbance to salvage and replant suitable species: young and healthy *Carnegia gigantea* (Saguaro 12-20 feet in height), *Ferocactus fishhook* (Barrel Cactus), and *Olneya tesota* (Ironwood), etc. Revegetation efforts in should consider the elevation of salvaged material when identifying disposition of replanted salvaged material.

Native Plant Inventory: Prepare a native plant inventory of all saguaros, barrel cactus, ocotillos, and all healthy native trees within the disturbance areas meeting the requirements of the ADOT Native Plant Salvage and Replanting Guidelines. A Salvage Operations Plan should detail all used processes, methods, equipment, and materials for plant salvage, nursery set-up and operation, and replanting of salvaged plants.

Native Seeding: All disturbed soils not paved, otherwise landscaped, or permanently stabilized by construction should be seeded using native species to the project vicinity. The various elevations, soil conditions, and drainage considerations may require that several seed mixes to be developed. Examples of project specific seed mixes includes Low Grass & Forbs, Tall Background, and Wash Seed Mixes. Additionally, clear zone and background seed mixes may be needed. The final designer should coordinate with ADOT RDS staff to prepare Seeding Special Provisions.

4.18.4 Noxious and Invasive Species Control Plan

A Noxious and Invasive Species Control Plan (NISCP) will be required to assist with controlling noxious and invasive plant species within the project area. The work under the NISCP shall consist of the detection and eradication of noxious and invasive plants. Proposed method(s) of noxious plant control include either manual eradication or herbicide application by recommended methods for each plant species identified in the NISCP and will be in accordance with NEPA and state statutes. The project area will be surveyed following rain events and during plant germination and growth periods prior to and during construction, as well as post-construction activities. Construction best management practices will include items of operation that may minimize the spread of noxious species. The NISCP shall also include post-construction measures to prevent invasive species seeds from leaving the site.

4.18.5 Irrigation System Design: Permanent and Temporary Systems

Permanent irrigation should be considered in urbanized areas planted with nursery and salvaged plants where potable water exists in adjacent municipal rights-of-way. Use of a temporary irrigation system should be considered for rural areas with salvaged and replanted landscaping and areas where no potable water exists. The final designer should coordinate with ADOT to develop performance criteria of temporary irrigation systems in the special provisions. No irrigation would be required for native seeding.

4.18.6 Aesthetics: Objectives and Corridor Aesthetic Areas

The objectives for aesthetics should include minimizing the impact of structures on the viewers' attention through use of paint, rustication, and low-profile design of structures. The final designer should collaborate with ADOT RDS to establish Aesthetic Areas (AA) defining the aesthetic theming for each of the selected characteristics occurring within the I-17 corridor. Each AA should define the paint palette(s), rustication requirements, and aesthetic concepts and patterns.

Structures Rustication: The final designer should coordinate with ADOT RDS to develop rustication designs that may vary from Hohokam symbols and patterns to simulated rock that resembles the strata and fracture qualities of the native rock. Drainage structures and headwalls are exempt from rustication. Structure elements that should be considered for rustication include:

New Bridges:

- Abutment/Wingwalls
- Piers
- Barriers (non-traffic side)
- Light Blisters

Walls:

- Noise Barrier
- Lightweight Noise Barrier
- Retaining

Fencing and Guardrail: Refer to ADOT *Guidelines for Highways on Bureau of Land Management and Forest Service Lands* and *Supplement to Guidelines for Highways on Bureau of Land Management and Forest Service Lands* and Special Provisions in final design for requirements for fencing and guardrails treatments.

Paint/Color Treatment: Paint all new and modified structures and walls to blend with the surrounding native vegetation and landscape. Assess existing structures to determine if existing conditions meet the AA objectives. Color selection should be coordinated with ADOT during Final Design and may include separate colors for each AA.

4.18.7 Slope Stabilization, Erosion, Sediment, and Stormwater Quality Control

Stabilization Goals: Minimizing dust and erosion of soils by wind and water and weed control are the primary goals of stabilization. Stabilization in urban areas is intended to enhance back-of-curb roadway areas with consistent color and gradation of rock for a clean, weed free appearance. For rural areas the salvaged surface soils is intended to blend with existing background and minimize the impact of the roadway disturbance. Inert materials plans should be identified during final design to document the placement locations, types, and colors of granite mulch, decomposed granite, and salvaged soils throughout the project area within the limits of disturbance.

Inert Materials and Salvaged Surface Soils:

Urbanized Areas: Inert materials consisting of granite mulch, 1 ¼" minus. Color(s) should be determined by CA in Final Design.

Rural Areas: Salvaged surface soils approximately the native desert ground color found in adjacent undisturbed areas. The final designer should inventory the existing conditions within areas to be disturbed to determine the types of desert pavements that could be matched or reused within the project area. If used, salvaged soils should be taken from onsite source(s) prior to roadway construction activities, stored, and then placed in geographic regions similar to the location where the material was harvested.

Rock and Slope Treatments and Techniques: The final designer and ADOT will develop a strategy to mitigate the visual impacts to rock cut slopes. It will be necessary to review the Geotechnical reports, roadway design, and right-of-way plans to determine the appropriate measures on a case by case basis. Provide the selected rock treatment techniques in the landscape details.

Techniques for rock slope mitigation include:

- rock sculpting,
- cut and fill slope warping,
- slope rounding,
- varied slope ratios,
- false cuts,
- rock staining.

Erosion, Sediment and Stormwater Quality Control: Both construction and post construction erosion control measures should be prepared by the final designer and coordinated with ADOT to establish the plan requirements for the erosion control plans that serve as part of the stormwater pollution prevention plan.

4.19 Transit Considerations

In 2010, ADOT prepared a statewide transportation plan that formulated and evaluated roadway, public transit, and rail improvements. The resulting BQAZ Statewide Transportation Planning Framework Program is a vision for the State of Arizona that recommends a comprehensive 2050 transportation scenario.

The BQAZ plan recommends I-17 as a route for intercity buses. Because of the steep terrain in the project area, with four to six percent existing and proposed roadway grades on the Black Canyon Hill, passenger rail facilities between Phoenix and Flagstaff would be precluded from utilizing the I-17 corridor and instead would be routed along gentler terrain to the west. The BQAZ plan recommends that passenger rail be routed from Phoenix to

Wickenburg, northward following an existing railroad route west of Prescott to Ash Fork, then east to Williams and Flagstaff.

4.20 Recommendations from Other Studies

Recommendations from the May 2007 *Road Safety Audit, I-17 Southbound Black Canyon Hill, Sunset Point to Black Canyon TI*, should be implemented where feasible. Some of these recommendations were implemented with the I-17 Black Canyon Hill (SB) project (017 YV 245 H6368 01C; IM-HES-017-B(007)A); others may be included in this project. Recommendations include improvements to sight distance, adding rumble strips and delineators, replacing guardrail with 42-inch tall concrete barrier, and improving/increasing signs and pavement markings.

ADOT prepared a planning-level Corridor Profile Study for Interstate 17 in 2017, extending from SR 101L in Phoenix to I-40 in Flagstaff. The recommendations were identified based on pavement, bridge, mobility, safety, and freight; several of the corridor profile study's high-priority recommendations coincide with the recommendations in this DCR.

4.21 Design Exceptions

Non-conforming features will be upgraded as part of this project to meet current standards as noted in Chapter 5. Design exceptions and design variances will be requested for the remaining non-conforming features.

The existing roadway geometry includes horizontal curves with limited sight distance. Modifications to the existing horizontal geometry are generally not recommended because of funding limitations and impacts to traffic during construction.

There are a number of existing curves where the superelevation does not meet current design criteria. Modifications to the existing superelevation rates were evaluated but are generally not recommended as detailed in the following section and the design exception request letter.

4.22 Safety Study

A safety study was completed for I-17 from Anthem Way to Sunset Point. The purpose of the study was to analyze crash data to determine crash patterns by location, type of crash, roadway characteristics, interchange type, and circumstance of the crash which would lead to potential countermeasure identification. The limits for the study included I-17 from MP 229 to MP 245, both northbound and southbound, and from MP 245 to MP 253, southbound only.

Safety data is subject to the provisions of 23 USC § 409. Any intentional or inadvertent release of this material, or any data derived from its use, does not constitute a waiver of privilege pursuant to 23 USC § 409.

Five years of crash data was collected for I-17 within the study limits from January 1, 2013 to December 31, 2017. In the northbound direction between MP 229 and MP 245, a total of 412 crashes occurred. These crashes are summarized based on crash severity and manner of collision in Table 51 and Table 52, respectively. In the southbound direction between MP 229 and MP 253, a total of 615 crashes occurred. These crashes are summarized based on crash severity and manner of collision in Table 53 and Table 54, respectively.

Table 51 – Northbound MP 229 to MP 245, Crashes by Crash Severity

Crash Severity	2013	2014	2015	2016	2017	Grand Total	Percentage
Fatal	1	1	-	2	1	**5**	1.2%
No Injury	48	41	63	51	78	**281**	68.2%
Possible Injury	9	8	9	8	12	**46**	11.2%
Suspected Minor Injury	10	10	14	16	12	**62**	15.0%
Suspected Serious Injury	5	2	3	3	5	**18**	4.4%
Total	**73**	**62**	**89**	**80**	**108**	**412**	100.0%

Table 52 – Northbound MP 229 to MP 245, Crashes by Collision Manner

Collision Manner	2013	2014	2015	2016	2017	Grand Total	Percentage
Angle (Front to side) (Other than left turn)	1	-	-	-	-	**1**	0.2%
Head On	-	1	1	1	-	**3**	0.7%
Other	1	1	1	1	3	**7**	1.7%
Rear End	19	18	29	23	47	**136**	33.0%
Sideswipe (Opposite Direction)	1	-	1	1	-	**3**	0.7%
Sideswipe (Same Direction)	8	6	7	13	12	**46**	11.2%
Single Vehicle	43	36	50	41	46	**216**	52.4%
Total	**73**	**62**	**89**	**80**	**108**	**412**	100.0%

Table 53 – Southbound MP 229 to MP 253, Crashes by Severity

Crash Severity	2013	2014	2015	2016	2017	Grand Total	Percentage
Fatal	3	3	2	1	2	**11**	1.8%
No Injury	50	62	76	106	114	**408**	66.3%
Possible Injury	15	17	12	18	15	**77**	12.5%
Suspected Minor Injury	14	18	22	20	22	**96**	15.6%
Suspected Serious Injury	5	5	2	5	6	**23**	3.7%
Total	**87**	**105**	**114**	**150**	**159**	**615**	100.0%

Table 54 – Southbound MP 229 to MP 253, Crashes by Collision Manner

Collision Manner	2013	2014	2015	2016	2017	Grand Total	Percentage
Angle (Front to side) (Other than left turn)	1	-	-	1	-	**2**	0.3%
Head On	1	1	-	-	2	**4**	0.7%
Other	-	-	-	1	-	**1**	0.16%
Rear End	15	21	27	37	56	**156**	25.4%
Rear to Rear	-	-	-	-	2	**2**	0.3%
Sideswipe (Opposite Direction)	1	-	-	-	-	**1**	0.2%
Sideswipe (Same Direction)	9	13	10	16	4	**52**	8.5%
Single Vehicle	55	64	69	87	90	**365**	59.3%
Total	**87**	**105**	**114**	**150**	**159**	**615**	100.0%

Crash rates for the entire project corridor were calculated using the following equations:

$$\text{Total Crash Rate} = \frac{1{,}000{,}000 * \#\text{ of crashes}}{AADT * 365 * \#\text{ of years} * \text{length of segment}}$$

$$\text{Fatal Crash Rate} = \frac{100{,}000{,}000 * \#\text{ of crashes involving one or more fatalities}}{AADT * 365 * \#\text{ of years} * \text{length of segment}}$$

In the northbound direction, the total corridor crash rate is calculated to be 0.86 crashes per one million vehicle miles traveled and the fatal corridor crash rate is calculated to be 1.05 crashes per 100 million vehicle miles traveled. In the southbound direction, the total corridor crash rate is calculated to be 0.91 crashes per one million vehicle miles traveled (MVMT) and the fatal corridor crash rate is calculated to be 1.63 crashes per 100 million vehicle miles traveled.

The 2017 *Arizona Motor Vehicle Crash Facts Report* and the 2016 National Highway Traffic Safety Administration *Traffic Safety Facts Report* documented the following crash rates:

Table 55 – Arizona and US Crash Rates

	Total Crash Rate/MVMT	Fatal Crash Rate/100 MVMT	Urban		Rural	
			Total Crash Rate/MVMT	Fatal Crash Rate/100 MVMT	Total Crash Rate/MVMT	Fatal Crash Rate/100 MVMT
Arizona	1.95	1.41	2.14	1.03	1.39	2.59
National	2.29	1.18	*	0.75	*	1.76

* There was not enough information provided within the 2016 National Highway Traffic Safety Administration Traffic Safety Facts Report to calculate total crash rates for urban and rural areas.

After analyzing the observed crash data on a project wide scale, I-17 was divided into analysis segments to determine areas along I-17 that required further analysis. The freeway was segmented based on roadway geometry related to the interchanges along I-17 as well as the areas within defined design exception limits in order to identify higher risk areas along the study corridor. The crossroads at the interchanges were considered segment boundaries in order to consider the areas where interchange ramps merge with or diverge from the freeway separately. Total and Fatal Crash rates were then calculated for each of these study segments. The study segments were analyzed on a macro scale by comparing them to both Arizona and National crash rates. The segments were also analyzed on a micro scale by comparing them to the project corridor crash rates.

Although there are areas that exceed the Arizona or National Fatal Crash Rates, these areas only experienced one fatal crash; however, the segment limits are small enough that the rate is calculated to be higher than average. None of the areas exceed the Arizona or National Total Crash Rates; therefore, it was determined that the study areas should be compared to the project corridor rates in order to determine higher risk areas that warrant the assessment of countermeasures.

Of the segments exhibiting higher observed crash rates than the project corridor, nine segments between MP 229 and MP 245 and eight segments between MP 245 and 253 were identified for modeling in the IHSDM. Two main improvement types were considered for the segments modeled in the IHSDM. For segments identified within traffic interchange ramp areas, IHSDM was utilized to predict the reduction in crashes that could be expected by transitioning the existing taper-type ramps to parallel-type ramps. For segments identified within horizontal or vertical design exception areas, the IHSDM, in addition to published crash modification factors, was utilized to predict the reduction in crashes that could be expected by correcting the variation between the existing and recommended superelevation or the difference between the existing and recommended vertical grade. These segments are listed below.

- Interchange Ramp-Related Improvements
  - Anthem Way (NB On Ramp)
  - New River TI (SB Ramps)
  - Table Mesa TI (SB Off Ramp)
  - Table Mesa TI (NB On Ramp)
  - Rock Springs TI (NB Ramps)
  - Black Canyon City TI (All Ramps)
- Horizontal and Vertical Design Exception Improvements
  - NB, MP 239.75 to 240.49 (Superelevation DE)
  - MP 242.14 to 242.45 (Superelevation DE)
  - NB, MP 244.34 to 244.68 (Superelevation DE)
  - NB, MP 244.81 to 245.00 (Superelevation DE)
  - SB, MP 236.70 to 237.03 (Superelevation DE)
  - SB, MP 237.85 to 238.42 (Superelevation DE)
  - SB, MP 239.57 to 240.06 (Superelevation DE)
  - SB, MP 244.33 to 244.69 (Superelevation DE)

- SB, MP 244.83 to 245.04 (Superelevation DE)
- SB, MP 246.04 to 246.32 (Max Grade and Superelevation DE)
- SB, MP 246.32 to 246.65 (Max Grade and Superelevation DE)
- SB, MP 249.15 to 249.47 (Superelevation DE)
- SB, MP 249.63 to 249.82 (Max Grade and Superelevation DE)
- SB, MP 249.82 to 250.01 (Max Grade and Superelevation DE)
- SB, MP 250.01 to 250.29 (Max Grade and Superelevation DE)
- SB, MP 250.29 to 250.64 (Max Grade and Superelevation DE)
- SB, MP 251.05 to 251.41 (Superelevation DE)

In addition to considering areas that exhibit higher than average crash rates, the impacts of different travel lane and shoulder widths along the proposed flex lane alignment were considered. For the purposes of the safety study, the “shoulder” was defined as the west-side shoulder of the flex lane alignment and the “emergency shoulder” was defined as the east-side shoulder of the flex lanes. The following comparisons were made using the modeling capabilities within the IHSDM.

- Flex Lane Cross Sections
  - 10' to 11' Lane Width
  - 11’ to 12’ Lane Width
  - 6' to 8' Emergency Shoulder Width
  - 8’ to 10’ Emergency Shoulder Width
  - 4' to 2' Shoulder Width
  - 6’ to 4’ Shoulder Width

Upon determining estimated reductions in predicted crashes, a cost-benefit analysis was conducted to determine the fiscal value to implementing the assessed countermeasures. The cost-benefit analysis was completed by first calculating an estimated annual cost savings based on the yearly reduction of crashes and the comprehensive costs associated with these crashes. Comprehensive crash costs are established to estimate the overall total cost of a crash based on severity. These costs include both monetary costs related to property damage, congestion and incurred delay, emergency services, legal costs, and medical care related to the crash as well as a cost associated with intangible impacts such as loss in quality of life. Table 56 provides the comprehensive crash costs associated with each crash type that were utilized for the cost-benefit analyses. The FHWA comprehensive crash costs were utilized as opposed to those published by Arizona because Arizona only reports crash costs for fatal and serious injury crashes.

Table 56 – Monetary Costs Based on Crash Severity

Injury Severity	Comprehensive Crash Cost
Fatal	$11,295,400
Incapacitating	$655,000
Non-Incapacitating	$198,500
Possible Injury	$125,600
No Injury	$11,900

The cost savings were then compared to one-time construction costs estimated for the assumed improvement. A “years to return” value was calculated based on the amount of time it would take for the annual cost savings to equal the one-time construction cost. This value captured the amount of time required for the improvement to offset the cost based on estimated crashes. The-cost benefit analysis results are summarized in Tables 57 through 59.

Table 57 – Interchange Ramp Improvements Cost/Benefit Summary

Location	Cost	Annual Benefit	Years to Return
Anthem TI (NB On Ramp)	$0.6M	$12k	**50.0**
New River TI (SB Ramps)	$1.2M	-$45k	**No Return**
Table Mesa TI (SB Off Ramp)	$3M	-$1k	**No Return**
Table Mesa TI (NB On Ramp)	$0.6M	$89k	**6.7**
Rock Springs TI (NB Ramps)	$1.2M	$47k	**25.5**
Black Canyon City TI (All Ramps)	$2.4M	$187k	**12.8**

Table 58 – Superelevation Improvements Cost/Benefit Summary

Location	Cost	Annual Benefit	Years to Return
NB, MP 239.75 to 240.49 (Super)	$4.4M	$130k	**33.8**
NB, MP 242.14 to 242.45 (Super)	$2.9M	$64k	**45.3**
NB, MP 244.34 to 244.68 (Super)	$3.0M	$122k	**24.6**
NB, MP 244.81 to 245.00 (Super)	$1.1M	$42k	**26.2**
SB, MP 236.70 to 237.03 (Super)	$2.0M	$27k	**74.1**
SB, MP 237.85 to 238.42 (Super)	$3.4M	$121k	**28.1**
SB, MP 239.57 to 240.06 (Super)	$2.9M	$99k	**29.3**
SB, MP 244.33 to 244.69 (Super)	$3.2M	$118k	**27.1**
SB, MP 244.83 to 245.04 (Super)	$1.3M	$48k	**27.1**
SB, MP 246.04 to 246.32 (Super & Grade)	$4.2M	$106k	**39.6**

Location	Cost	Annual Benefit	Years to Return
NB, MP 239.75 to 240.49 (Super)	$4.4M	$130k	**33.8**
NB, MP 242.14 to 242.45 (Super)	$2.9M	$64k	**45.3**
SB, MP 246.32 to 246.65 (Super & Grade)	$5.0M	$84k	**59.5**
SB, MP 249.15 to 249.47 (Super)	$4.8M	$79k	**60.8**
SB, MP 249.63 to 249.82 (Super & Grade)	$2.8M	$59k	**47.5**
SB, MP 249.82 to 250.01 (Super & Grade)	$2.8M	$40k	**70.0**
SB, MP 250.01 to 250.29 (Super & Grade)	$4.2M	$80k	**52.5**
SB, MP 250.29 to 250.64 (Super & Grade)	$5.2M	$39k	**133.3**
SB, MP 251.05 to 251.41 (Super)	$5.4M	$150k	**36.0**

Table 59 – Flex Lane Cross Section Cost/Benefit Summary

Location	Cost	Annual Benefit	Years to Return
10' to 11' Lane Width	$4.5M	$1.2M	**3.8**
11' to 12' Lane Width	$4.5M	$1.0M	**4.5**
6' to 8' Emergency Shoulder Width	$4.5M	$487k	**9.2**
8' to 10' Emergency Shoulder Width	$4.5M	$446k	**10.1**
4' to 2' Shoulder Width	-$4.5M	$147k	**Immediate**
6' to 4' Shoulder Width	-$4.5M	$45k	**Immediate**

The Arizona Highway Safety Improvement Program (HSIP) Manual (Appendix C), updated in March 2015, includes service life (in years) for specific types of roadway improvements. Based on the HSIP Manual, the expected service life for each improvement is as follows:

- Modifying Interchange Ramps from Taper-Type to Parallel-Type – 20 years
- Correcting Superelevation Variations – 20 years
- Correcting Vertical Grade – 20 years

The expected years to return for the following segments is less than the service life; therefore, it is recommended that these improvements be implemented:

- Modifying the northbound on ramp at the Table Mesa TI from the existing taper-type configuration to a parallel-type configuration
- Modifying all of the interchange ramps at the Black Canyon City TI from the existing taper-type configuration to a parallel-type configuration

For the remaining interchange ramp or design exception related segments modeled using the IHSDM, the expected years to return exceeds the service life of the modeled roadway improvement; therefore, implementation of the improvements for these segments is not recommended.

Based on the analysis results, assumptions, and modeling limitations, it is recommended that the flex lanes provide a cross-section of a 4-foot shoulder, two 12-foot travel lanes, and a 10-foot emergency shoulder. The 12-foot travel lane width and 10-foot emergency shoulder width result in the lowest predicted total number of crashes. The 2-foot shoulder width results in a slightly lower predicted total number of crashes when compared to the 4-foot shoulder. However, reducing the shoulder width to 2' would negatively affect sight distance (based on engineering judgement; stopping sight distance is not considered by the model).

The segment in the northbound direction on I-17 between MP 237.58 and MP 238.52, locally referred to as U-Haul Hill, was identified as a higher risk location based on the existing crash trends. There are a notable number of overturn crashes in this area. Based on the reviewed crash reports, it appears that these crashes are related to high operating speeds and blowing winds. It was determined that the IHSDM software would not provide a beneficial analysis of these areas as the crash prediction module does not take into account posted speed limit or presence of warning signing. Warning signs currently exist to warn drivers of strong wind areas and the importance of maintaining lower operating speeds. It is recommended that the crashes be monitored in this area to determine the effectiveness of the existing signing and determine if additional signage is warranted.

4.23 Social, Economic, and Environmental Considerations

The environmental study begins at the Anthem Way TI at MP 228.5 on I-17 in Maricopa County and extends north to the Sunset Point TI at MP 252.0 in Yavapai County.

Work began on an Environmental Assessment in 2006 (MP 232 to MP 262); however, the scope of the environmental studies was reduced when FHWA/ADOT policies changed regarding the approval of environmental documents for projects that are not included in an approved transportation improvement program. A Planning and Environmental Linkages Checklist was prepared in 2015 to document the efforts completed to date (e.g., biological resources, cultural resources), document important issues identified during the study process, and provide a basis for identifying smaller projects which may accomplish improvements at a lower cost. Environmental technical studies and an environmental document for the near-term improvements will be complete in Spring 2019.

Specific mitigation measures will be included in the environmental document.

The Final Noise Analysis Technical Report, May 2018, recommended noise barriers in three locations:

TABLE 60 – RECOMMENDED NOISE BARRIERS

Noise Barrier Description	Barrier Height Range, ft.	Length, ft.
Barrier S2 (Sta 1542+00 to Sta 1577+96)	14-16	3,600
Barrier N3 (Sta 1698+00 to Sta 1709+99)	14	1,200
Barrier S6 (Sta 2215+00 to Sta 2233+00)	16-18	1,800

The possible incorporation of fire breaks and other fire prevention measures should be evaluated and coordinated with the Bureau of Land Management during final design.

5.0 AASHTO Controlling Design Criteria

5.1 Introduction

The existing features of I-17 between Anthem Way TI and Sunset Point TI (MP 229.1 to MP 252.5) were analyzed using the AASHTO Controlling Design Criteria outlined in A *Policy on Geometric Design of Highways and Streets* (2011 edition), also known as the AASHTO Green Book. *A Policy on Design Standards – Interstate System* (2016 edition) was also used.

This section describes the non-conforming AASHTO design elements of the existing highway which will not be upgraded as part of the project and for which design exceptions will be requested. The AASHTO analysis and list of proposed design exceptions will need to be updated during final design; the recommended alternative will be used to make this determination. A complete current analysis is available in the Initial AASHTO Controlling Design Criteria Report*, I-17: SR 101L TI to Black Canyon City TI*, TRACS No. 17 MA 215 H5162 01L, October 2000, and the *I-17: Black Canyon City TI to Sunset Point TI*, TRACS No. 17 MA 229 H6800 01L, August 2018. Horizontal and vertical data summaries for mainline I-17 are provided in Appendix A.

5.2 Lane and Shoulder Widths

The existing lane and shoulder widths along the mainline of the northbound and southbound I-17 in the study area meet AASHTO recommendations. However, two locations will not meet minimum inside shoulder width requirements when I-17 is widened.

The following locations where the inside shoulder width will be less than the recommended 10’ are as follows:

- Southbound I-17 at Table Mesa TI UP (MP 235.9) – 5.5' less than recommended.
- Northbound I-17 at Table Mesa TI UP (MP 235.9) – 5.5' less than recommended.

5.3 Vertical Alignment and Stopping Sight Distance

The existing vertical stopping sight distance is less than the AASHTO recommendations at the following locations. Because the added lanes will match the existing profile grade, these crest vertical curve locations, which have been grade-adjusted, will require design exceptions:

- Northbound MP 232.0 to 232.2 -- 24’ less than the required 832’
- Northbound MP 232.8 to 233.0 -- 42’ less than the required 837’
- Northbound MP 237.2 to 237.5 -- 149’ less than the required 905’
- Northbound MP 240.0 to 240.4 -- 82’ less than the required 869’
- Northbound MP 242.2 to 242.3 -- 38’ less than the required 842’
- Southbound MP 232.0 to 232.2 -- 57’ less than the required 866’
- Southbound MP 233.5 to 233.7 -- 25’ less than the required 835’
- Southbound MP 234.9 to 235.1 -- 11’ less than the required 860’
- Southbound MP 235.7 to 236.0 -- 81’ less than the required 866’

5.4 Horizontal Alignment and Stopping Sight Distance

A listing of the horizontal curve analysis is included in Appendix A. The existing horizontal curve superelevation is less than the AASHTO recommended minimum at the following locations:

- Northbound I-17 (MP 233.30 to MP 233.40) -- 0.038 '/ft less than the recommended 0.061 '/ft
- Northbound I-17 (MP 233.80 to MP 234.00) -- 0.025 '/ft less than the recommended 0.079 '/ft
- Northbound I-17 (MP 234.20 to MP 234.40) -- 0.038 '/ft less than the recommended 0.061 '/ft
- Northbound I-17 (MP 234.70 to MP 234.90) -- 0.016 '/ft less than the recommended 0.031 '/ft
- Northbound I-17 (MP 235.20 to MP 235.30) -- 0.038 '/ft less than the recommended 0.061 '/ft
- Northbound I-17 (MP 235.80 to MP 236.40) -- 0.032 '/ft less than the recommended 0.061 '/ft
- Northbound I-17 (MP 237.20 to MP 237.60) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Northbound I-17 (MP 238.50 to MP 239.50) -- 0.016 '/ft less than the recommended 0.031 '/ft
- Northbound I-17 (MP 239.60 to MP 240.40) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Northbound I-17 (MP 242.10 to MP 242.50) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Northbound I-17 (MP 244.30 to MP 244.70) -- 0.048 '/ft less than the recommended 0.063 '/ft
- Southbound I-17 (MP 235.80 to MP 236.40) -- 0.060 '/ft less than the recommended 0.079 '/ft
- Southbound I-17 (MP 236.70 to MP 236.80) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Southbound I-17 (MP 236.90 to MP 237.00) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Southbound I-17 (MP 237.10 to MP 237.40) -- 0.038 '/ft less than the recommended 0.061 '/ft
- Southbound I-17 (MP 237.70 to MP 237.80) -- 0.026 '/ft less than the recommended 0.041 '/ft
- Southbound I-17 (MP 237.90 to MP 238.40) -- 0.036 '/ft less than the recommended 0.051 '/ft
- Southbound I-17 (MP 239.70 to MP 240.00) -- 0.038 '/ft less than the recommended 0.061 '/ft
- Southbound I-17 (MP 240.60 to MP 240.80) -- 0.025 '/ft less than the recommended 0.079 '/ft
- Southbound I-17 (MP 240.90 to MP 241.80) -- 0.006 '/ft less than the recommended 0.021 '/ft
- Southbound I-17 (MP 243.50 to MP 244.00) -- 0.011 '/ft less than the recommended 0.061 '/ft
- Southbound I-17 (MP 244.30 to MP 244.70) -- 0.046 '/ft less than the recommended 0.061 '/ft
- Southbound I-17 (MP 244.81 to MP 245.13) -- 0.019 '/ft less than the recommended 0.034 '/ft
- SB I-17 and flex lanes (MP 245.78 to MP 245.93) -- 0.047 '/ft less than the recommended 0.062 '/ft
- SB I-17 and flex lanes (MP 246.13 to MP 246.26) -- 0.057 '/ft less than the recommended 0.087 '/ft

- SB I-17 and flex lanes (MP 246.40 to MP 246.56) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 246.72 to MP 246.81) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 247.08 to MP 247.10) -- 0.016 '/ft less than the recommended 0.087 '/ft
- SB I-17 and flex lanes (MP 247.24 to MP 247.45) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 247.60 to MP 247.92) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 248.07 to MP 248.47) -- 0.040 '/ft less than the recommended 0.055 '/ft
- SB I-17 and flex lanes (MP 248.75 to MP 248.94) -- 0.018 '/ft less than the recommended 0.033 '/ft
- SB I-17 and flex lanes (MP 249.23 to MP 249.35) -- 0.057 '/ft less than the recommended 0.087 '/ft
- SB I-17 and flex lanes (MP 249.58 to MP 249.69) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 249.85 to MP 249.89) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 250.04 to MP 250.08) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 250.23 to MP 250.36) -- 0.028 '/ft less than the recommended 0.099 '/ft
- SB I-17 and flex lanes (MP 250.50 to MP 250.57) -- 0.016 '/ft less than the recommended 0.087 '/ft
- SB I-17 and flex lanes (MP 250.72 to MP 250.91) -- 0.057 '/ft less than the recommended 0.087 '/ft
- SB I-17 and flex lanes (MP 251.05 to MP 251.38) -- 0.064 '/ft less than the recommended 0.079 '/ft

With the addition of the median barrier for the flex lanes between existing southbound lanes and the flex lanes, the following horizontal curves do not provide AASHTO-recommended minimum horizontal sight distance:

- SB MP 245.75 to MP 245.90, barrier side flex lane -- 85’ less than the required 612’
- SB MP 246.29 to MP 246.56, barrier side flex lane -- 209’ less than the required 584’
- SB MP 247.15 to MP 247.55, barrier side flex lane -- 209’ less than the required 584’
- SB MP 247.99 to MP 248.42, barrier side flex lane -- 119’ less than the required 682’
- SB MP 249.54 to MP 249.57, barrier side flex lane -- 209’ less than the required 584’
- SB MP 249.79 to MP 249.92, barrier side flex lane -- 189’ less than the required 584’
- SB MP 250.27 to MP 250.39, barrier side flex lane-- 151’ less than the required 584’
- SB MP 250.97 to MP 251.37, barrier side flex lane -- 85’ less than the required 612’
- SB MP 246.22 to MP 246.37, existing inside lane -- 298’ less than the required 728’
- SB MP 246.73 to MP 246.96, existing inside lane -- 377’ less than the required 728’
- SB MP 247.10 to MP 247.22, existing inside lane -- 240’ less than the required 728’
- SB MP 247.61 to MP 248.05, existing inside lane -- 346’ less than the required 728’
- SB MP 249.23 to MP 249.48, existing inside lane -- 261’ less than the required 682’
- SB MP 249.71 to MP 249.93, existing inside lane -- 305’ less than the required 728’
- SB MP 250.10 to MP 250.34, existing inside lane -- 337’ less than the required 728’
- SB MP 250.73 to MP 251.01, existing inside lane -- 281’ less than the required 728’

5.5 Design Speed

The route's classification, use, and terrain determine the appropriate design speed to be used to evaluate the existing and proposed roadway. Because the existing facility traverses rural surroundings on rolling and mountainous terrain, the AASHTO Green Book and ADOT RDG recommend design speeds of 65 and 75 mph as detailed below:

From MP 229.0 to MP 244.5, the AASHTO-recommended minimum design speed of the highway is 70 mph (rolling terrain, rural). Posted speeds in this section are 75 mph from MP 229.0 to MP 244.5.

From MP 244.5 to MP 250.5, the AASHTO-recommended minimum design speed for evaluation of the existing highway is 50-60 mph (mountainous terrain, rural). The posted speed in this section is 65 mph.

Design speeds of 65 mph in mountainous terrain and 75 mph in rolling terrain were used for developing the preferred alternatives and are recommended for final design.

5.6 Cross Slopes

Existing cross slopes of 1.5% to 2.0% conform to current design recommendations.

5.7 Grades

Because the recommended improvements match the existing profiles, design exceptions will be required for those existing grades in excess of AASHTO guideline recommendations.

The existing gradient is greater than the AASHTO recommended 4% maximum at the following locations:

- Northbound I-17 (MP 237.49 to MP 238.19) – 1.0526% steeper than the maximum

The existing gradient is greater than the AASHTO recommended 5% maximum at the following locations:

- Southbound I-17 (MP 245.95 to MP 247.62) – 0.7368% greater than the maximum
- Southbound I-17 (MP 248.78 to MP 249.18) – 0.7143% greater than the maximum
- Southbound I-17 (MP 249.53 to MP 250.81) – 1.1739% greater than the maximum

5.8 Vertical Clearance

With implementation of the project improvements, vertical clearances will conform to current design standards except at the following locations:

- Northbound I-17, MP 242.1, Rock Springs TI UP (Str # 00969) -- 0’-1” less than the minimum 16’0”

5.9 Bridge Structures

The existing bridge structural capacity does not meet recommended AASHTO recommendations at the following location:

MP 248.40 Bumble Bee TI OP NB (#01171) – 1.7 less than the minimum HS 20.

5.10 Design Variances

Design variances were identified when reviewing proposed design elements compared to ADOT's Roadway Design Guidelines. Design variances have been requested in the following locations:

Design Feature	Type	Location	Discrepancy from Required Design Value
1) Superelevation Transition Length, Northbound I-17	ADOT Variance	MP 233.80 to MP 234.00, 600' spiral length	124' longer than the maximum Ls=476
Superelevation Transition Length, Southbound I-17	ADOT Variance	MP 246.40 to MP 246.56, 400' spiral length	63' longer than the maximum Ls=337'
		MP 246.72 to MP 246.81, 400' spiral length	63' longer than the maximum Ls=337'
		MP 247.24 to MP 247.45, 400' spiral length	63' longer than the maximum Ls=337'
		MP 247.60 to MP 247.92, 400' spiral length	63' longer than the maximum Ls=337'
		MP 249.23 to MP 249.35, 450' spiral length	61' longer than the maximum Ls=389'
		MP 249.58 to MP 249.69, 400' spiral length	63' longer than the maximum Ls=337'
		MP 249.85 to MP 249.89, 400' spiral length	63' longer than the maximum Ls=337'
		MP 250.04 to MP 250.08, 400' spiral length	63' longer than the maximum Ls=337'
		MP 250.23 to MP 250.36, 400' spiral length	63' longer than the maximum Ls=337'
2) Horizontal Align Coincident with Axis of Rotation, Southbound I-17	ADOT Variance	MP 237.0 to MP 240.8, Widened Pavement with new horizontal alignment uses existing axis of rotation between two existing lanes (exst HCL).	15' from existing HCL and PGL.
3) Use of Spiral Curves (emax=10%), Northbound I-17	ADOT Variance	MP 233.30 to MP 233.40, Widened Pavement matches existing Ls=450.24', DOC= 1°30'03", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 233.80 to MP 234.00, Widened Pavement matches existing Ls=600', DOC= 2°00'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 234.20 to MP 234.40, Widened Pavement matches existing Ls=450', DOC= 1°30'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 234.69 to MP 234.88, Widened Pavement matches existing Ls=225', DOC= 0°45'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 235.80 to MP 236.40, Widened Pavement matches existing Ls=300', DOC= 1°30'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 243.51 to MP 244.02, Widened Pavement matches existing Ls=300', DOC= 1°28'45", DS=65mph	2°45' minimum DOC for spiral curves at 65mph design speed
		MP 244.30 to MP 244.70, Widened Pavement matches existing Ls=300', DOC= 2°02'18", DS=65mph	2°45' minimum DOC for spiral curves at 65mph design speed
Use of Spiral Curves (emax=10%), Southbound I-17	ADOT Variance	MP 235.80 to MP 236.40, Widened Pavement matches existing Ls=300', DOC= 2°00'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 236.70 to MP 236.80, Widened Pavement matches existing Ls=200', DOC= 1°00'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 236.90 to MP 237.00, Widened Pavement matches existing Ls=200', DOC= 1°00'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 237.70 to MP 237.80, Widened Pavement matches existing Ls=300', DOC= 1°00'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 237.90 to MP 238.40, Widened Pavement matches existing Ls=375', DOC= 1°15'00", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 243.50 to MP 244.00, Widened Pavement matches existing Ls=300', DOC= 1°31'17", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
		MP 244.30 to MP 244.70, Widened Pavement matches existing Ls=300', DOC= 1°57'47", DS=75mph	2°15' minimum DOC for spiral curves at 75mph design speed
Use of Spiral Curves (emax=10%), Southbound I-17 Flex Lanes	ADOT Variance	MP 244.81 to MP 245.13, Widened Pavement matches existing Ls=300', DOC= 1°12'00", DS=65mph	2°45' minimum DOC for spiral curves at 65mph design speed
		MP 248.07 to MP 248.47, Widened Pavement matches existing Ls=350', DOC= 1°45'00", DS=65mph	2°45' minimum DOC for spiral curves at 65mph design speed
		MP 251.05 to MP 251.38, Widened Pavement matches existing Ls=400', DOC= 2°00'00", DS=65mph	2°45' minimum DOC for spiral curves at 65mph design speed
4) Maximum Grade Break Without a Vertical Curve, Northbound I-17	ADOT Variance	MP 229.84, 1532+00.00, Grade Break of 0.2399%	0.0399% more than 0.2000% maximum.
		MP 234.65, 1788+00.00, Grade Break of 0.3239%	0.1239% more than 0.2000% maximum.
Maximum Grade Break Without a Vertical Curve, Southbound I-17 Flex Lanes	ADOT Variance	MP 248.95, 2516+00.00, Grade Break of 0.5967%	0.3967% more than 0.2000% maximum.
		MP 249.76, 2567+00.00, Grade Break of 0.6739%	0.4739% more than 0.2000% maximum.
		MP 250.30, 2595+00.00, Grade Break of 0.4583%	0.2583% more than 0.2000% maximum.

6.0 Itemized Estimate of Probable Costs

6.1 Recommended Alternatives

The estimates of probable construction cost for the near-term, recommended mainline alternatives are as follows:

TABLE 61 – TOTAL ESTIMATED CONSTRUCTION COSTS

SEGMENT	ESTIMATED CONSTRUCTION COST
Anthem Way to Black Canyon City Widening	$202,900,000
Black Canyon City to Sunset Point (Flex Lanes)	$128,500,000

The detailed estimates of probable cost are shown on the following pages. The estimated costs are based upon unit prices from ADOT's Construction Cost Data Base. The pavement structural section used for the cost estimate was a flexible pavement throughout the project limits. The recommended pavement section for the study area is estimated at 22.5 inches (11 inches of asphaltic concrete over 11 inches of aggregate base plus 0.5 inch AR-ACFC) between the Anthem and New River TIs and 25.5 inches from the New River TI to the Black Canyon City TI (11 inches of asphaltic concrete over 14 inches of aggregate base plus 0.5 inch AR-ACFC). The existing travel lanes and remaining shoulders will be milled 0.5 inch and replaced with 0.5 inch AR-ACFC.

A project of this length is an excellent candidate for full depth pavement reconstruction through recycling the existing pavement components. There are various pavement recycling schemes that can be used to accomplish this and would use the existing aggregate base and asphaltic concrete materials as the new base and a portion of the new AC resurfacing. Pavement pulverization, foamed asphalt base, and recycled asphaltic pavement are possible approaches that should be evaluated during the final design phase as part of cost savings and reduction of waste materials. For estimating purposes at this conceptual design phase, all new materials were assumed.

Where inside widening is proposed, the existing 4-foot shoulder will be removed and replaced with the new pavement section. Where widening to the outside is proposed, the existing 10-foot shoulder will be removed and replaced with the new pavement section.

The following assumptions were also used for the cost estimate:

- Estimates include ICAP percentage 10.02% (FY 2019 rate).
- Estimates include design costs at 10%.
- No costs were assigned for new right-of-way. Since the required right-of-way is owned by the federal government, there would be no cost to ADOT for the land.
- The existing ramps and crossroads are to remain in place if determined to be in satisfactory condition at the time of final design.
- Potential utility conflicts have been identified as outlined in Section 4.15. A percentage was assumed for utility relocations.
- Cost items associated with earthwork, such as roadway excavation, borrow, and rock excavation may vary from those calculated in final design, when more detailed survey and geotechnical information is available.
- All culverts are extended to the appropriate clear zone requirements or toe of the roadway fill slope, whichever distance is greater.
- Reinforced box culvert quantities are based on Table I fill height conditions with 4:1 side slopes.
- Outlet aprons are required at all box culverts that require extension downstream.
- Existing end sections for pipe culverts are unsalvageable.
- Existing reinforced box culverts and pipe culverts are in good condition and do not require replacement.
- No improvement to washes upstream and downstream of culverts, such as energy dissipators or bank protection, are required.

ITS

The roadway widening from Anthem Way to Black Canyon City was assumed to deploy FMS conduit and pull box infrastructure and fiber communications along both sides of the freeway within this section. CCTV cameras were assumed at one-mile spacing, two new DMS in the southbound direction, and one new node building within this project limits near New River (MP 232), where there is a power source available, and which is about 18 miles from Node 15 at I-17/SR 101L.

The flex lanes include ITS within the segment between MP 245 and 252 and includes conduit and pull box infrastructure and fiber communications on one side of the freeway along the flex lane alignment, CCTV at one-half mile or less spacing for continuous coverage, detection at the flex lane transition areas, two new DMS, lane control signals and traffic gates, and power distribution with limited available power sources. A new node building will also be required at the Sunset Point TI (MP 252) or the Sunset Point rest area, where there are available power sources.

Northbound I-17 will include CCTV at approximate one-mile spacing. These devices will be powered by solar panels and communicate back to field devices along the flex lanes as discussed in this document.

Options for controlling entry into the flex lanes should be investigated at the time of design. State of the art technology for items such as advising motorists of roadway conditions, the availability of alternate routes, and measures for notifying officials of incidents should be researched and implemented at the time of design.

Signing and Pavement Marking

The roadway widening from Anthem Way to Black Canyon City was assumed to require the relocation of existing regulatory and warning signs impacted by the widening. The estimate includes the relocations of these signs as well as the new post supports, foundations, and slip bases necessary.

New signing is included only for the flex lanes and crossovers. No upgrades to existing northbound or southbound signs are included in the estimate. The estimate also includes guide signs shown in the signing concept as well as new signing that will need to be replicated for the southbound direction now that the roadway is separated by barrier or included for the northbound travel direction.

Lighting

The roadway widening from Anthem Way to Black Canyon City is not expected to require upgrades to existing lighting and therefore not included in the roadway widening estimate.

New lighting will be installed at the crossovers for the two-lane flex roadway facility. The estimate includes the installation of light poles, foundations, and fixtures as well as the required conduit and conductors. The required establishment of electrical service at both crossovers is also included.

Bridges

Assumptions for **replacement** bridges:

No costs are included for replacement or rehabilitation of the Moores Gulch SB or Bumble Bee Road NB bridge; these structure replacements are programmed under different projects.

Replacement bridge unit costs will be greater than the unit costs of a new bridge on a new alignment. Cost factors include:

- Demolition of the existing bridge: Demolition requires traffic control and protection for maintained lanes under the existing bridge. Demolition also requires evaluation of the existing structure for the presence of asbestos and lead-based paint.
- Staged construction and traffic control: The replacement structure will likely need to be constructed adjacent to and/or around existing traffic. Staged construction may be required to maintain traffic movements. Accelerated bridge construction techniques may also be required to reduce the duration of bridge construction and reduce traffic impacts.
- Bridge areas noted account for additional bridge deck, or overbuild width, required to provide adequate bridge width to maintain the required number of traffic lanes during each stage of construction.
- The proposed new bridge at Bumble Bee TI SB is estimated to have a higher unit bridge cost than most typical Arizona bridges due to the long-skewed span of the crossing over I-17 and the likely use of steel girders to facilitate this long span. Other possible options such as the use of a straddle bent or post-tensioned spliced girders are considered comparable in cost at this stage of analysis.
- ADOT RDS has requested that all new, widened, and rehabilitated bridges be painted.

Assumptions for **widened** bridges:

Widening unit bridge costs (cost per square foot) will be greater than the unit cost of a new structure. Cost factors include:

- Partial demolition of the existing bridge at tie-in points: Partial removal of the existing is required to remove the existing barrier and create an appropriate tie-in point for the widened structure. Any demolition also requires evaluation of the existing structure for the presence of asbestos and lead-based paint.
- Existing bridge tie-ins: The widened structure will need to be compatible with and tied to the existing structure.
- Traffic control: Bridge widening will need to be constructed adjacent to traffic, increasing traffic control requirements.
- Where the existing bridge has non-conforming barrier on the non-widened side the cost of replacing that barrier is also included in the bridge costs.
- Cast-in-place slab bridges are typically more economical than girder bridges and are anticipated to have a lower average cost for widening.
- Bridge areas include the anticipated additional deck area due to the partial removal of the existing bridge.

Retaining Walls

Retaining wall costs are generally expressed as a cost per square foot of wall. This cost can vary considerably depending on the height and type of wall and the topography. Cast in place concrete walls are generally more cost effective for the shorter walls, while MSE walls are typically more cost effective for taller walls.

Factors such as construction in a cut section or a fill section also impact costs. Cut sections are costlier to construct, particularly if MSE walls are specified due to the large area required behind the walls for straps. MSE walls may not be feasible where walls are required below an existing roadway.

Average wall costs used for this study include the costs of a concrete barrier with a moment slab foundation on top of the wall backfill.

Landscaping

Landscaping costs at $390,000 per mile are based on the following assumptions:

- 50’ average disturbance both sides of I-17
- Permanent irrigation may be used in urbanized areas with available water. Temporary irrigation used for revegetation areas.
- Total disturbance of 315 acres.
- $200,000 per mile for native plant salvage, nursery storage, and replanting
- One to 1.5 percent of structures costs assumed for aesthetics and rustication.
- Salvage, store, and replace top 4-6” surface soil.
- 10% of rock cuts could be stained.
- Includes herbicide and manual or mechanical weed removal of non-rock roadside areas. Herbicide has been applied to 55% of non-rock areas and manual or mechanical weed removal to 45% of non-rock areas.

TABLE 62 – ESTIMATE OF PROBABLE CONSTRUCTION COST – ANTHEM WAY TI TO BLACK CANYON CITY TI WIDENING

Item No.	Item Description	Unit	Quantity	Unit Price	Total Price
2010011	CLEARING AND GRUBBING	ACRE	182	$ 600.00	$ 109,200
2020001	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM	1	$ 90,000.00	$ 90,000
2020021	REMOVAL OF CONCRETE CURB AND GUTTER	L.FT.	10,000	$ 3.00	$ 30,000
2020027	REMOVAL OF CONCRETE BARRIER	L.FT.	2,783	$ 20.00	$ 55,660
2020036	REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.	88,045	$ 2.50	$ 220,113
2020041	REMOVAL OF PIPE	L.FT.	308	$ 100.00	$ 30,800
2020048	REMOVAL OF STRUCTURE (END SECTION)	EACH	16	$ 300.00	$ 4,800
2020050	REMOVE (HEADWALL)	EACH	25	$ 2,000.00	$ 50,000
2020053	REMOVE (SPILLWAY)	EACH	1	$ 1,000.00	$ 1,000
2020054	REMOVE (CATCH BASIN)	EACH	-	$ 500.00	$ -
2020071	REMOVE GUARD RAIL	L.FT.	51,914	$ 3.50	$ 181,699
2020080	REMOVE BITUMINOUS PAVEMENT (MILLING) (1/2")	SQ.YD.	610,250	$ 3.00	$ 1,830,750
2020101	REMOVE FENCE	L.FT.	-	$ 3.00	$ -
2030301	ROADWAY EXCAVATION	CU.YD.	725,000	$ 6.00	$ 4,350,000
2030305	ROCK EXCAVATION	CU.YD.	740,000	$ 15.00	$ 11,100,000
3030022	AGGREGATE BASE, CLASS 2	CU.YD.	232,468	$ 36.00	$ 8,368,848
4040111	BITUMINOUS TACK COAT	TON	843	$ 500.00	$ 421,500
4040116	APPLY BITUMINOUS TACK COAT	HOUR	1,396	$ 150.00	$ 209,400
4040125	FOG COAT	TON	180	$ 600.00	$ 108,000
4040163	BLOTTER MATERIAL	TON	539	$ 55.00	$ 29,645
4040270	ASPHALT BINDER (PG 70-10)	TON	14,919	$ 600.00	$ 8,951,400
4140040	ASPHALTIC CONCRETE FRICTION COURSE (ASPHALT-RUBBER)	TON	31,382	$ 50.00	$ 1,569,100
4140042	ASPHALT RUBBER MATERIAL (FOR AR-ACFC)	TON	2,825	$ 550.00	$ 1,553,750
4140044	MINERAL ADMIXTURE (FOR AR-ACFC)	TON	286	$ 90.00	$ 25,740
4160004	ASPHALTIC CONCRETE (3/4" MIX) (END PRODUCT) (SPECIAL MIX)	TON	298,378	$ 35.00	$ 10,443,230
4160031	MINERAL ADMIXTURE	TON	2,835	$ 90.00	$ 255,150
5010011	PIPE, CORRUGATED METAL, 24"	L.FT.	908	$ 80.00	$ 72,640
5010017	PIPE, CORRUGATED METAL, 30"	L.FT.	1,490	$ 110.00	$ 163,900
5010025	PIPE, CORRUGATED METAL, 36"	L.FT.	932	$ 150.00	$ 139,800
5010030	PIPE, CORRUGATED METAL, 42"	L.FT.	34	$ 170.00	$ 5,780
5010035	PIPE, CORRUGATED METAL, 48"	L.FT.	117	$ 270.00	$ 31,590
5010040	PIPE, CORRUGATED METAL, 54"	L.FT.	11	$ 300.00	$ 3,300
5010045	PIPE, CORRUGATED METAL, 60"	L.FT.	115	$ 320.00	$ 36,800
5010060	PIPE, CORRUGATED METAL, 78"	L.FT.	21	$ 400.00	$ 8,400
5010065	PIPE, CORRUGATED METAL, 84"	L.FT.	29	$ 420.00	$ 12,180
5010107	PIPE, CORRUGATED METAL, SLOTTED, 18"	L.FT.	-	$ 170.00	$ -
5010251	PIPE, CORRUGATED METAL, 43" X 27"	L.FT.	-	$ 80.00	$ -
5012518	STORM DRAIN PIPE, 18"	L.FT.	-	$ 80.00	$ -
5012524	STORM DRAIN PIPE, 24"	L.FT.	-	$ 85.00	$ -
5014118	FLARED END SECTION (18") (C-13.20)	EACH	-	$ 1,700.00	$ -
5014524	FLARED END SECTION, 24" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	9	$ 2,000.00	$ 18,000
5014530	FLARED END SECTION, 30" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	22	$ 2,200.00	$ 48,400
5014536	FLARED END SECTION, 36" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	21	$ 2,600.00	$ 54,600
5014542	FLARED END SECTION, 42" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	2	$ 2,700.00	$ 5,400
5014548	FLARED END SECTION, 48" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	4	$ 3,000.00	$ 12,000
5014618	METAL SAFETY END SECTION (18")	EACH	-	$ 1,400.00	$ -
5014624	METAL SAFETY END SECTION (24 ")	EACH	16	$ 1,900.00	$ 30,400
5014630	METAL SAFETY END SECTION (30 ")	EACH	8	$ 2,200.00	$ 17,600
5014636	METAL SAFETY END SECTION (36")	EACH	1	$ 2,500.00	$ 2,500
5014642	METAL SAFETY END SECTION (42")	EACH	-	$ 2,600.00	$ -
5014660	METAL SAFETY END SECTION (60")	EACH	-	$ 2,700.00	$ -
5014699	METAL SAFETY END SECTION (30") (DOUBLE)	EACH	-	$ 3,500.00	$ -
5030604	CONCRETE CATCH BASIN (C-15.92) H=8' OR LESS	EACH	-	$ 5,000.00	$ -
5041996	DRAINAGE STRUCTURE (HEADWALL)	EACH	10	$ 5,000.00	$ 50,000
704X001	PAVEMENT MARKING & SIGNING	L. SUM	1	$ 767,570.00	$ 767,570
731X001	LIGHTING	L. SUM	-		$ -
732X001	ITS - COMMUNICATION AND ELECTRICAL INFRASTRUCTURE	L. FT.	172,000	$ 40.00	$ 6,880,000
732X002	ITS - COMMUNICATION NODES	EACH	1	$ 200,000.00	$ 200,000
732X003	ITS - DETECTION (STATIONS)	EACH	-	$ 20,000.00	$ -
732X005	ITS - POWER (ELECTRICAL SERVICE)	L. FT.	145,000	$ 4.50	$ 652,500
732X007	ITS - CCTV ASSEMBLY	EACH	24	$ 25,000.00	$ 600,000
732X008	ITS - DMS (NEW SIGNS AND STRUCTURES)	EACH	2	$ 175,000.00	$ 350,000
732X009	ITS - MISCELLANEOUS ITEMS	L. SUM	1	$ 180,000.00	$ 180,000
7320714	UTILITY RELOCATION WORK	L.SUM	1	$ 3,600,000.00	$ 3,600,000
807X001	LANDSCAPING (LANDSCAPE & IRRIGATION)	MILE	16	$ 390,000.00	$ 6,240,000
9020002	CHAIN LINK FENCE, TYPE 1 (48")	L.FT.	15,000	$ 10.00	$ 150,000
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	43,463	$ 20.00	$ 869,260
9050026	GUARD RAIL TERMINAL (TANGENT TYPE)	EACH	49	$ 3,000.00	$ 147,000
9050036	GUARD RAIL, ANCHOR ASSEMBLY	EACH	49	$ 1,000.00	$ 49,000
9100009	CONCRETE BARRIER (VARIABLE HEIGHT)	L.FT.	2,200	$ 200.00	$ 440,000
9100012	CONCRETE BARRIER (DETAIL K)	L.FT.	28,833	$ 40.00	$ 1,153,320
9130001	RIPRAP (DUMPED)	CU.YD.	1,400	$ 80.00	$ 112,000
9140137	SOUND BARRIER WALL (MASONRY)	SQ.FT.	97,997	$ 35.00	$ 3,429,895
9140153	RETAINING WALL (REINFORCED CONCRETE CANTILEVER)	SQ.FT.	22,000	$ 60.00	$ 1,320,000
9160001	EMBANKMENT CURB	L.FT.	43,463	$ 7.00	$ 304,241
9240050	NEW RIVER BRIDGES (WIDENING)	SQ. FT	14,580	$ 170.00	$ 2,478,600
9240051	NEW RIVER TI BRIDGES (WIDENING)	SQ. FT.	7,460	$ 170.00	$ 1,268,200
9240052	MOORES GULCH NB BRIDGE (WIDENING)	SQ. FT.	4,980	$ 180.00	$ 896,400
9240053	LITTLE SQUAW CREEK NB BRIDGE (WIDENING)	SQ. FT.	11,820	$ 170.00	$ 2,009,400
9240054	AGUA FRIA RIVER BRIDGE (WIDENING)	SQ. FT.	15,980	$ 170.00	$ 2,716,600
9240055	COLDWATER CANYON TI BRIDGES (WIDENING)	SQ.FT.	4,480	$ 155.00	$ 694,400
9240056	MOORES GULCH GRADER ROAD	L. SUM	1	$ 331,000.00	$ 331,000
9240150	REINFORCED CONCRETE BOX CULVERT (6X4)	L. FT.	18	$ 850.00	$ 15,300
9240151	REINFORCED CONCRETE BOX CULVERT (6X6)	L. FT.	24	$ 1,170.00	$ 28,080
9240152	REINFORCED CONCRETE BOX CULVERT (6X7)	L. FT.	21	$ 950.00	$ 19,950
9240153	REINFORCED CONCRETE BOX CULVERT (8X7)	L. FT.	50	$ 1,600.00	$ 80,000
9240154	REINFORCED CONCRETE BOX CULVERT (2-8X7)	L. FT.	58	$ 1,870.00	$ 108,460
9240155	REINFORCED CONCRETE BOX CULVERT (10X3)	L. FT.	15	$ 1,350.00	$ 20,250
9240156	REINFORCED CONCRETE BOX CULVERT (10X4)	L. FT.	12	$ 1,670.00	$ 20,040
9240157	REINFORCED CONCRETE BOX CULVERT (10X8)	L. FT.	34	$ 2,540.00	$ 86,360
9240158	REINFORCED CONCRETE BOX CULVERT (2-10X8)	L. FT.	225	$ 1,570.00	$ 353,250
9240159	REINFORCED CONCRETE BOX CULVERT (10X10)	L. FT.	84	$ 2,170.00	$ 182,280
9240160	REINFORCED CONCRETE BOX CULVERT (2-10X10)	L. FT.	-	$ 2,580.00	$ -
9240161	REINFORCED CONCRETE BOX CULVERT (3-10X10)	L. FT.	21	$ 4,310.00	$ 90,510
				SUBTOTAL	$ 89,546,941
	MISCELLANEOUS WORK (15%)			COST 15.00%	$ 13,432,100
	Subtotal 1				**$ 102,979,041**
	DUST PALLIATIVE (1%)			COST 1.00%	$ 1,029,800
	FURNISH WATER (1%)			COST 1.00%	$ 1,029,800
	MAINTENANCE AND PROTECTION OF TRAFFIC (15%)			COST 15.00%	$ 15,446,900
	EROSION CONTROL AND POLLUTION PREVENTION (1%)			COST 1.00%	$ 1,029,800
	CONTRACTOR QUALITY CONTROL (2%)			COST 2.00%	$ 2,059,600
	CONSTRUCTION SURVEYING AND LAYOUT (2%)			COST 2.00%	$ 2,059,600
	Subtotal 2				**$ 125,634,541**
	MOBILIZATION (10%)			COST 10.00%	$ 12,563,500
	Subtotal 3				**$ 138,198,041**
	CONTINGENCIES			5.00%	$ 6,910,000
	CONSTRUCTION ENGINEERING			15.00%	$ 20,729,800
	AC QUALITY INCENTIVE	298,378	TON	$ 3.00	$ 895,200
	AR-ACFC SMOOTHNESS INCENTIVE	96	LN. MI.	$ 9,000	$ 864,000
	PUBLIC RELATIONS	20,000		1	$ 20,000
	Subtotal 4				**$ 167,617,041**
	FINAL DESIGN COSTS (10%)			COST 10.00%	$ 16,761,800
	RIGHT OF WAY	2.70	ACRE		$ -
	Subtotal 5				**$ 184,378,841**
	INDIRECT COST ALLOCATION (10.02% FY19)			10.02%	$ 18,474,800
				TOTAL ANTHEM-BCC COSTS	**$ 202,900,000**

TABLE 63 – ESTIMATE OF PROBABLE CONSTRUCTION COST – FLEX LANES

Item No.	Item Description	Unit	Quantity	Unit Price	Total Price
2010011	CLEARING AND GRUBBING	ACRE	50	$ 600.00	$ 30,000
2020001	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	L.SUM	-		$ -
2020002	REMOVE BRIDGE	L.SUM	1	$ 400,000.00	$ 400,000
2020021	REMOVAL OF CONCRETE CURB AND GUTTER	L.FT.	-	$ 3.00	$ -
2020027	REMOVAL OF CONCRETE BARRIER	L.FT.	1,123	$ 20.00	$ 22,460
2020036	REMOVAL OF ASPHALTIC CONCRETE PAVEMENT	SQ.YD.	-	$ 2.50	$ -
2020041	REMOVAL OF PIPE	L.FT.	70	$ 100.00	$ 7,000
2020048	REMOVAL OF STRUCTURE (END SECTION)	EACH	7	$ 300.00	$ 2,100
2020050	REMOVE (HEADWALL)	EACH	11	$ 2,000.00	$ 22,000
2020053	REMOVE (SPILLWAY)	EACH	1	$ 1,000.00	$ 1,000
2020054	REMOVE (CATCH BASIN)	EACH	4	$ 500.00	$ 2,000
2020071	REMOVE GUARD RAIL	L.FT.	13,996	$ 3.50	$ 48,986
2020080	REMOVE BITUMINOUS PAVEMENT (MILLING) (1/2")	SQ.YD.	98,785	$ 3.00	$ 296,355
2020101	REMOVE FENCE	L.FT.	1,335	$ 3.00	$ 4,005
2030301	ROADWAY EXCAVATION	CU.YD.	340,000	$ 6.00	$ 2,040,000
2030305	ROCK EXCAVATION	CU.YD.	1,580,000	$ 15.00	$ 23,700,000
3030022	AGGREGATE BASE, CLASS 2	CU.YD.	104,687	$ 36.00	$ 3,768,732
4040111	BITUMINOUS TACK COAT	TON	358	$ 500.00	$ 179,000
4040116	APPLY BITUMINOUS TACK COAT	HOUR	596	$ 150.00	$ 89,400
4040125	FOG COAT	TON	82	$ 600.00	$ 49,200
4040163	BLOTTER MATERIAL	TON	244	$ 55.00	$ 13,420
4040270	ASPHALT BINDER (PG 70-10)	TON	6,965	$ 600.00	$ 4,179,000
4140040	ASPHALTIC CONCRETE FRICTION COURSE (ASPHALT-RUBBER)	TON	11,487	$ 50.00	$ 574,350
4140042	ASPHALT RUBBER MATERIAL (FOR AR-ACFC)	TON	1,034	$ 550.00	$ 568,700
4140044	MINERAL ADMIXTURE (FOR AR-ACFC)	TON	105	$ 90.00	$ 9,450
4160004	ASPHALTIC CONCRETE (3/4" MIX) (END PRODUCT) (SPECIAL MIX)	TON	139,293	$ 35.00	$ 4,875,255
4160031	MINERAL ADMIXTURE	TON	1,324	$ 90.00	$ 119,160
5010011	PIPE, CORRUGATED METAL, 24"	L.FT.	1,294	$ 80.00	$ 103,520
5010017	PIPE, CORRUGATED METAL, 30"	L.FT.	342	$ 110.00	$ 37,620
5010025	PIPE, CORRUGATED METAL, 36"	L.FT.	1,163	$ 150.00	$ 174,450
5010030	PIPE, CORRUGATED METAL, 42"	L.FT.	112	$ 170.00	$ 19,040
5010035	PIPE, CORRUGATED METAL, 48"	L.FT.	67	$ 270.00	$ 18,090
5010040	PIPE, CORRUGATED METAL, 54"	L.FT.	240	$ 300.00	$ 72,000
5010045	PIPE, CORRUGATED METAL, 60"	L.FT.	61	$ 320.00	$ 19,520
5010060	PIPE, CORRUGATED METAL, 78"	L.FT.	-	$ 400.00	$ -
5010065	PIPE, CORRUGATED METAL, 84"	L.FT.	-	$ 420.00	$ -
5010107	PIPE, CORRUGATED METAL, SLOTTED, 18"	L.FT.	355	$ 170.00	$ 60,350
5010251	PIPE, CORRUGATED METAL, 43" X 27"	L.FT.	-	$ 80.00	$ -
5012518	STORM DRAIN PIPE, 18"	L.FT.	2,419	$ 80.00	$ 193,520
5012524	STORM DRAIN PIPE, 24"	L.FT.	135	$ 85.00	$ 11,475
5014118	FLARED END SECTION (18") (C-13.20)	EACH	19	$ 1,700.00	$ 32,300
5014524	FLARED END SECTION, 24" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	12	$ 2,000.00	$ 24,000
5014530	FLARED END SECTION, 30" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	3	$ 2,200.00	$ 6,600
5014536	FLARED END SECTION, 36" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	7	$ 2,600.00	$ 18,200
5014542	FLARED END SECTION, 42" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	-	$ 2,700.00	$ -
5014548	FLARED END SECTION, 48" (C-13.20 OR C-13.25) (PIPE CULVERT)	EACH	-	$ 3,000.00	$ -
5014618	METAL SAFETY END SECTION (18")	EACH	23	$ 1,400.00	$ 32,200
5014624	METAL SAFETY END SECTION (24 ")	EACH	15	$ 1,900.00	$ 28,500
5014630	METAL SAFETY END SECTION (30 ")	EACH	5	$ 2,200.00	$ 11,000
5014636	METAL SAFETY END SECTION (36")	EACH	8	$ 2,500.00	$ 20,000
5014642	METAL SAFETY END SECTION (42")	EACH	2	$ 2,600.00	$ 5,200
5014660	METAL SAFETY END SECTION (60")	EACH	2	$ 2,700.00	$ 5,400
5014699	METAL SAFETY END SECTION (30") (DOUBLE)	EACH	2	$ 3,500.00	$ 7,000
5030604	CONCRETE CATCH BASIN (C-15.92) H=8' OR LESS	EACH	49	$ 5,000.00	$ 245,000
5041996	DRAINAGE STRUCTURE (HEADWALL)	EACH	7	$ 5,000.00	$ 35,000
704X001	PAVEMENT MARKING & SIGNING	L. SUM	1	$ 817,670.00	$ 817,670
731X001	LIGHTING	L. SUM	1	$ 288,000.00	$ 288,000
732X001	ITS - COMMUNICATION AND ELECTRICAL INFRASTRUCTURE	L. FT.	41,000	$ 80.00	$ 3,200,000
732X002	ITS - COMMUNICATION NODES	EACH	1	$ 200,000.00	$ 200,000
732X003	ITS - DETECTION (STATIONS)	EACH	8	$ 20,000.00	$ 160,000
732X005	ITS - POWER (ELECTRICAL SERVICE)	EACH	206,000	$ 4.50	$ 1,000,000
732X007	ITS - CCTV ASSEMBLY	EACH	32	$ 25,000.00	$ 800,000
732X008	ITS - DMS (NEW SIGNS AND STRUCTURES)	EACH	2	$ 175,000.00	$ 350,000
732X009	ITS - MISCELLANEOUS ITEMS	L. SUM	1	$ 125,000.00	$ 125,000
732X010	ITS - LANE CONTROL SIGNALS	EACH	12	$ 6,000.00	$ 72,000
732X011	TRAFFIC GATE	EACH	12	$ 55,000.00	$ 660,000
7320714	UTILITY RELOCATION WORK	L.SUM	1	$ 500,000.00	$ 500,000
807X001	LANDSCAPING (LANDSCAPE & IRRIGATION)	MILE	7	$ 390,000.00	$ 2,730,000
9020002	CHAIN LINK FENCE, TYPE 1 (48")	L.FT.	1,000	$ 10.00	$ 10,000
9050001	GUARD RAIL, W-BEAM, SINGLE FACE	L.FT.	8,965	$ 20.00	$ 179,300
9050026	GUARD RAIL TERMINAL (TANGENT TYPE)	EACH	13	$ 3,000.00	$ 39,000
9050036	GUARD RAIL, ANCHOR ASSEMBLY	EACH	13	$ 1,000.00	$ 13,000
9100201	CONCRETE MEDIAN BARRIER	L.FT.	33,774	$ 50.00	$ 1,688,700
9130001	RIPRAP (DUMPED)	CU.YD.	695	$ 80.00	$ 55,600
9140153	RETAINING WALL (REINFORCED CONCRETE CANTILEVER)	SQ.FT.	25,000	$ 60.00	$ 1,500,000
9160001	EMBANKMENT CURB	L.FT.	8,965	$ 7.00	$ 62,755
9240057	BUMBLE BEE TI SB BRIDGE (NEW)	SQ. FT	7,000	$ 200.00	$ 1,400,000
9240152	REINFORCED CONCRETE BOX CULVERT (6X7)	L. FT.	174	$ 950.00	$ 165,300
9240160	REINFORCED CONCRETE BOX CULVERT (2-10X10)	L. FT.	56	$ 2,580.00	$ 144,480
				SUBTOTAL	$ 58,342,363
	MISCELLANEOUS WORK (15%)		COST	15.00%	$ 8,751,400
	Subtotal 1				**$ 67,093,763**
	DUST PALLIATIVE (1%)		COST	1.00%	$ 671,000
	FURNISH WATER (1%)		COST	1.00%	$ 671,000
	MAINTENANCE AND PROTECTION OF TRAFFIC (12%)		COST	12.00%	$ 8,051,300
	EROSION CONTROL AND POLLUTION PREVENTION (1%)		COST	1.00%	$ 671,000
	CONTRACTOR QUALITY CONTROL (2%)		COST	2.00%	$ 1,341,900
	CONSTRUCTION SURVEYING AND LAYOUT (2%)		COST	2.00%	$ 1,341,900
	Subtotal 2				**$ 79,841,863**
	MOBILIZATION (10%)		COST	10.00%	$ 7,984,200
	Subtotal 3				**$ 87,826,063**
	CONTINGENCIES			5.00%	$ 4,391,400
	CONSTRUCTION ENGINEERING			15.00%	$ 13,174,000
	AC QUALITY INCENTIVE	139,293	TON	$ 3.00	$ 417,900
	AR-ACFC SMOOTHNESS INCENTIVE	32	LN. MI.	$ 9,000	$ 288,000
	PUBLIC RELATIONS	20,000		1	$ 20,000
	Subtotal 4				**$ 106,117,363**
	FINAL DESIGN COSTS (10%)		COST	10.00%	$ 10,611,800
	RIGHT OF WAY	1.83	ACRE		$ -
	Subtotal 5				**$ 116,729,163**
	INDIRECT COST ALLOCATION (10.02% FY19)			10.02%	$ 11,696,300
				TOTAL FLEX LANES COSTS	**$ 128,500,000**

APPENDIX A – AASHTO CONTROLLING DESIGN CRITERIA REPORT

VERTICAL AND HORIZONTAL MAINLINE CURVE INVENTORIES AND BRIDGE EVALUATION

Attachment 1 - Vertical Curve Inventory

Project Name: !-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Northbound
Project No: 17 MA 229 H6800 01L
Roadway Type: Divided Roadway (Uni-directional)

VPI Station (ft)	Milepost		Grade (%)		Curve	Curve	Stopping Sight Distance (ft)		Speed (mph)	
	Begin	End	Approach	Departure	Length (ft)	Type	Existing	Required	Existing	Posted
1500+00.00	229.10	229.30	1.7500	0.8330	1000.00	Crest	1677	802	+100	75
1512+00.00	229.40	229.50	0.8330	1.5500	800.00	Sag	+9999	802	+100	75
1557+50.00	230.20	230.50	1.3530	0.1530	1400.00	Crest	1599	812	+100	75
1574+00.00	230.60	230.70	0.1690	-0.5890	800.00	Crest	1823	824	+100	75
1594+00.00	230.90	231.10	-0.5890	0.3000	1000.00	Sag	+9999	824	+100	75
1614+00.00	231.20	231.50	0.3000	2.9000	1600.00	Sag	2682	810	+100	75
1650+00.00	232.00	232.20	2.9000	-1.0700	1200.00	Crest	* 808	832	74	75
1670+00.00	232.40	232.50	-1.0700	2.0000	800.00	Sag	1082	832	88	75
1694+00.00	232.80	233.00	2.0000	-1.4120	1000.00	Crest	* 795	837	73	75
1711+00.00	233.10	233.30	-1.4120	1.7270	800.00	Sag	1048	837	86	75
1722+00.00	233.30	233.50	1.7270	1.3000	800.00	Crest	2927	795	+100	75
1736+50.00	233.60	233.80	1.3000	0.2500	1000.00	Crest	1528	811	+100	75
1747+50.00	233.80	234.00	0.2500	3.5000	800.00	Sag	1000	811	85	75
1760+00.00	234.00	234.30	3.5000	-0.1730	1600.00	Crest	970	817	83	75
1775+00.00	234.30	234.50	-0.1730	1.7500	800.00	Sag	5602	817	+100	75
1788+00.00	234.60	234.70	1.7500	1.2370	600.00	Crest	2403	796	+100	75
1807+00.00	234.90	235.10	1.2370	-0.4330	1000.00	Crest	1146	821	91	75
1822+00.00	235.20	235.40	-0.4330	1.3570	800.00	Sag	+9999	821	+100	75
1838+00.00	235.50	235.70	1.3570	2.5580	1000.00	Sag	+9999	794	+100	75
1855+00.00	235.70	236.10	2.5580	-2.1580	1900.00	Crest	932	850	79	75
1877+00.00	236.30	236.40	-2.1580	1.1940	800.00	Sag	962	850	81	75
1894+00.00	236.60	236.70	1.1940	-1.0000	800.00	Crest	892	831	78	75

Meaning Of Symbols:
* = Existing Stopping Sight Distance less than AASHTO required value
Note:
Input grade with direction of traffic for one-way traffic

Attachment 1 - Vertical Curve Inventory (Contd.)

Project Name: !-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Northbound
Project No: 17 MA 229 H6800 01L
Roadway Type: Divided Roadway (Uni-directional)

VPI Station (ft)	Milepost		Grade (%)		Curve	Curve	Stopping Sight Distance (ft)		Speed (mph)	
	Begin	End	Approach	Departure	Length (ft)	Type	Existing	Required	Existing	Posted
1907+00.00	236.80	237.00	-1.0000	1.0420	800.00	Sag	3482	831	+100	75
1931+00.00	237.20	237.50	1.0420	-5.0000	1600.00	Crest	* 756	905	67	75
1979+00.00	238.20	238.30	-5.0000	0.1750	800.00	Sag	* 638	905	61	75
2036+00.00	239.30	239.40	0.1750	-1.6670	800.00	Crest	986	842	82	75
2054+00.00	239.60	239.80	-1.6670	3.7930	1000.00	Sag	* 740	842	69	75
2083+00.00	240.00	240.40	3.7930	-3.1820	2000.00	Crest	* 787	869	71	75
2105+00.00	240.60	240.70	-3.1820	2.5710	1000.00	Sag	* 707	869	66	75
2140+00.00	240.90	241.70	2.5710	-2.5000	4300.00	Crest	1353	856	98	75
2171+00.00	241.80	242.00	-2.5000	1.0210	800.00	Sag	908	856	78	75
2190+00.00	242.20	242.30	1.0210	-1.6500	800.00	Crest	* 804	842	73	75
2187+00.00	242.40	242.50	-1.6500	-0.3280	800.00	Sag	+9999	842	+100	75
2203+00.00	242.70	242.80	-0.3280	-1.9050	800.00	Crest	1084	846	87	75
2224+00.00	243.10	243.20	-1.9050	-0.1500	800.00	Sag	+9999	846	+100	75
2244+00.00	243.50	243.60	-0.1500	2.0050	800.00	Sag	2622	817	+100	75
2280+00.00	244.10	244.40	2.0050	0.2920	1600.00	Crest	1420	640	+100	65
2303+72.42	244.50	244.80	0.2920	3.5000	1600.00	Sag	1897	640	+100	65

Meaning Of Symbols:
* = Existing Stopping Sight Distance less than AASHTO required value
Note:
Input grade with direction of traffic for one-way traffic

Attachment 1 - Vertical Curve Inventory

Project Name: I-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Southbound
Project No: 17 MA 229 H6800 01L
Roadway Type: Divided Roadway (Uni-directional)

VPI Station (ft)	Milepost		Grade (%)		Curve	Curve	Stopping Sight Distance (ft)		Speed (mph)	
	Begin	End	Approach	Departure	Length (ft)	Type	Existing	Required	Existing	Posted
2303+90.00	244.80	244.50	-3.5000	-0.2920	1600.00	Sag	1897	689	+100	65
2280+00.00	244.40	244.10	-0.2920	-2.0510	1600.00	Crest	1401	848	+100	75
2244+00.00	243.60	243.50	-2.0510	0.1500	800.00	Sag	2396	848	+100	75
2224+00.00	243.20	243.10	0.1500	1.9050	800.00	Sag	+9999	812	+100	75
2203+00.00	242.80	242.60	1.9050	0.3280	800.00	Crest	1084	810	89	75
2187+00.00	242.40	242.20	0.3280	1.6500	800.00	Sag	+9999	810	+100	75
2172+00.00	242.10	241.80	1.6500	-2.5000	1600.00	Crest	912	856	78	75
2153+00.00	241.70	241.60	-2.5000	1.2270	1000.00	Sag	1044	856	84	75
2142+00.00	241.60	241.50	1.2270	-0.2410	800.00	Crest	1135	818	91	75
2137+00.00	241.20	241.10	-0.2410	1.0590	600.00	Sag	+9999	818	+100	75
2119+50.00	241.10	240.80	1.0590	-2.7350	1600.00	Crest	954	861	80	75
2106+50.00	240.80	240.60	-2.7350	0.2380	800.00	Sag	1136	861	88	75
2083+00.00	240.30	240.10	0.2380	-2.4880	1200.00	Crest	975	856	81	75
2063+00.00	239.90	239.80	-2.4880	-2.8330	600.00	Crest	3428	862	+100	75
2051+00.00	239.70	239.60	-2.8330	2.8130	700.00	Sag	* 528	862	56	75
2035+00.00	239.50	239.20	2.8130	-1.0770	1600.00	Crest	942	832	81	75
2022+00.00	239.10	239.00	-1.0770	0.8750	500.00	Sag	3406	832	+100	75
2014+00.00	239.00	238.80	0.8750	-1.5710	1100.00	Crest	985	840	82	75
2000+00.00	238.70	238.60	-1.5710	5.1670	800.00	Sag	* 509	840	55	75
1988+00.00	238.50	238.30	5.1670	3.0000	1000.00	Crest	998	772	88	75
1947+00.00	237.80	237.50	3.0000	0.2410	1200.00	Crest	969	811	83	75
1918+00.00	237.20	237.10	0.2410	1.0000	600.00	Sag	+9999	811	+100	75

Meaning Of Symbols:
* = Existing Stopping Sight Distance less than AASHTO required value
Note:
Input grade with direction of traffic for one-way traffic

Attachment 1 - Vertical Curve Inventory (Contd.)

Project Name: I-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Southbound
Project No: 17 MA 229 H6800 01L
Roadway Type: Divided Roadway (Uni-directional)

VPI Station (ft)	Milepost		Grade (%)		Curve	Curve	Stopping Sight Distance (ft)		Speed (mph)	
	Begin	End	Approach	Departure	Length (ft)	Type	Existing	Required	Existing	Posted
1897+86.03	236.80	236.70	1.0000	1.9410	600.00	Sag	+9999	800	+100	75
1877+00.00	236.40	236.30	1.9500	2.9580	800.00	Sag	+9999	786	+100	75
1853+00.00	236.00	235.70	2.9580	-3.0000	1700.00	Crest	* 785	866	71	75
1837+00.00	235.70	235.50	-3.0000	1.4840	800.00	Sag	* 723	866	67	75
1806+00.00	235.10	234.90	1.4840	-2.7100	1400.00	Crest	* 849	860	74	75
1775+00.00	234.50	234.30	-2.7100	-1.2500	800.00	Sag	+9999	860	+100	75
1763+00.00	234.30	234.10	-1.2500	-2.6670	800.00	Crest	1161	859	90	75
1748+00.00	234.00	233.80	-2.6670	2.0000	800.00	Sag	* 698	859	66	75
1731+00.00	233.70	233.50	2.0000	-1.2860	1000.00	Crest	* 810	835	74	75
1689+00.00	232.90	232.70	-1.2860	-2.9410	800.00	Crest	1052	864	84	75
1672+00.00	232.60	232.40	-2.9410	0.9550	800.00	Sag	* 819	864	73	75
1650+00.00	232.20	232.00	0.9550	-3.0000	1200.00	Crest	* 809	866	72	75
1613+00.00	231.50	231.20	-3.0000	-0.1580	1600.00	Sag	2265	866	+100	75
1594+00.00	231.10	230.90	-0.1580	0.6690	800.00	Sag	+9999	817	+100	75
1574+00.00	230.70	230.60	0.6690	-0.4480	800.00	Crest	1366	822	+100	75
1557+00.00	230.40	230.20	-0.3330	-1.2730	1000.00	Crest	1648	835	+100	75
1513+00.00	229.50	229.40	-1.6000	-0.9200	400.00	Sag	+9999	841	+100	75
1497+00.00	229.30	229.10	-1.3330	-1.7590	800.00	Crest	2933	843	+100	75

Meaning Of Symbols:
* = Existing Stopping Sight Distance less than AASHTO required value
Note:
Input grade with direction of traffic for one-way traffic

Attachment 2 - Horizontal Curve Inventory

Project Name: I-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Northbound
Project No: 17 MA 229 H6800 01L

HPI Station	Milepost		Superelevation (ft/ft)			Degree Of Curve		Speed (mph)		HSO	Grade	Horizontal SSD (ft)	
(ft)	Begin	End	Existing	AASHTO Min	RDG Max	Existing	AASHTO Max	Method 2	Posted	(ft)	(%)	Existing	Required
1545+43.00	229.70	230.50	0.015	0.015	0.10	0°-15'-04"	2°-54'	>100	75	NA			
1668+11.00	231.90	232.90	0.015	0.015	0.10	0°-15'-00"	2°-54'	>100	75	NA			
1718+45.00	233.30	233.40	*0.023	0.061	0.10	1°-30'-03"	2°-54'	78	75	NA			
1749+73.00	233.80	234.00	*0.054	0.079	0.10	2°-00'-00"	2°-54'	77	75	NA			
1768+94.00	234.20	234.40	*0.023	0.061	0.10	1°-30'-00"	2°-54'	78	75	NA			
1795+01.00	234.70	234.90	*0.015	0.031	0.10	0°-45'-00"	2°-54'	91	75	NA			
1819+93.00	235.20	235.30	*0.023	0.061	0.10	1°-30'-00"	2°-54'	78	75	NA			
1866+86.00	235.80	236.40	*	0.061	0.10	1°-30'-00"	2°-54'	73	75	NA			
1932+50.00	237.20	237.60	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
2019+29.00	238.50	239.50	*0.015	0.031	0.10	0°-45'-00"	2°-54'	91	75	NA			
2071+69.00	239.60	240.40	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
2191+90.00	242.10	242.50	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
2256+93.00	243.50	244.00	0.050	0.048	0.10	1°-28'-45"	4°-16'	84	65	NA			
2295+95.00	244.30	244.70	*0.015	0.063	0.10	2°-02'-19"	4°-16'	70	65	NA			

Meaning Of Symbols:

* Requires a design exception

Note:

AASHTO Minimum superelevation derived from Method 5 to meet posted speed.
Roadway Engineering Design Guidelines (RDG) Maximum is based on elevation (See RDG Table 202.1A).
Input grade with respect to traffic for inside lane of curve; if both - & + grades within the curve, choose the negative grade; if all negative grades, choose the largest negative grade; if all positive grades, choose the smallest positive grade. (See Help file under Help Topics/Approach Grade)
HSO = Horizontal Sightline Offset

Attachment 2 - Horizontal Curve Inventory

Project Name: I-17, Anthem Way Traffic Interchange to Jct. SR 69 (Cordes Junction) Southbound
Project No: 17 MA 229 H6800 01L

HPI Station	Milepost		Superelevation (ft/ft)			Degree Of Curve		Speed (mph)		HSO	Grade	Horizontal SSD (ft)	
(ft)	Begin	End	Existing	AASHTO Min	RDG Max	Existing	AASHTO Max	Method 2	Posted	(ft)	(%)	Existing	Required
2296+39.00	244.70	244.30	*0.015	0.061	0.10	1°-57'-47"	4°-16'	71	65	NA			
2256+50.00	244.00	243.50	*0.050	0.061	0.10	1°-31'-18"	2°-54'	83	75	NA			
2132+98.00	241.80	240.90	*0.015	0.021	0.10	0°-30'-00"	2°-54'	99	75	NA			
2107+08.00	240.80	240.60	*0.054	0.079	0.10	2°-00'-00"	2°-54'	77	75	NA			
2062+77.00	240.00	239.70	*0.023	0.061	0.10	1°-30'-00"	2°-54'	78	75	NA			
2025+73.00	239.30	239.00	0.015	0.015	0.10	0°-15'-00"	2°-54'	>100	75	NA			
1972+98.00	238.40	237.90	*0.015	0.051	0.10	1°-15'-00"	2°-54'	80	75	NA			
1950+10.00	237.80	237.70	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
1925+88.00	237.40	237.10	*0.023	0.061	0.10	1°-30'-00"	2°-54'	78	75	NA			
1908+24.00	237.00	236.90	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
1895+33.00	236.80	236.70	*0.015	0.041	0.10	1°-00'-00"	2°-54'	85	75	NA			
1866+45.00	236.40	235.80	*	0.079	0.10	2°-00'-00"	2°-54'	67	75	NA			
1799+91.00	235.40	234.30	*	0.021	0.10	0°-30'-00"	2°-54'	94	75	NA			
1665+31.00	232.60	232.20	0.015	0.015	0.10	0°-12'-00"	2°-54'	>100	75	NA			
1545+52.00	230.50	229.70	0.015	0.015	0.10	0°-15'-00"	2°-54'	>100	75	NA			

Meaning Of Symbols:

* Requires a design exception

Note:

AASHTO Minimum superelevation derived from Method 5 to meet posted speed.
Roadway Engineering Design Guidelines (RDG) Maximum is based on elevation (See RDG Table 202.1A).
Input grade with respect to traffic for inside lane of curve; if both - & + grades within the curve, choose the negative grade; if all negative grades, choose the largest negative grade; if all positive grades, choose the smallest positive grade. (See Help file under Help Topics/Approach Grade)
HSO = Horizontal Sightline Offset

ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: I-17 Black Canyon City to Cordes Junction NB
Project Number: 18690
Roadway Type: PRINCIPAL ARTERIAL INTERSTATE - RURAL (MP 244.5 -262)

VPI STATION	MILEPOST		TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE		SPEED	
	BEGIN	END						AVAILABLE (ft)	AASHTO MINIMUM (ft)	AVAILABLE (mph)	DESIGN (mph)
2337+00.	245.08	245.68	1w	3.5000	0.8139	2400	Crest	1389	635	+100	65
2355+00.	245.68	245.98	1w	0.8139	6.0000	1200	Sag	911	635	81	65
2420+00.	247.03	247.18	1w	6.0000	5.0000	800	Crest	1479	593	+100	65
2445+00.	247.41	247.75	1w	5.0000	0.8500	1800	Crest	967	634	84	65
2465+00.	247.88	248.03	1w	0.8500	3.2000	800	Sag	1900	634	+100	65
2480+00.	248.24	248.24	1w	3.2000	3.0417	0	GB	GB	GB	GB	65
2520+00	248.92	249.08	1w	3.0417	6.0000	800	Sag	1145	611	95	65
2592+70.	250.15	250.60	1w	6.0000	0.4400	2400	Crest	965	808	83	75
2618+00	250.78	250.93	1w	0.4400	1.0416	800	Sag	+9999	808	+100	75
2643+00	251.23	251.37	1w	1.0416	0.5998	800	Crest	2842	806	+100	75
2686+00	251.83	252.29	1w	0.5998	-4.4300	2400	Crest	1015	893	81	75
2709+00	252.31	252.69	1w	-4.4300	2.5150	2000	Sag	1112	893	85	75
2746+00	253.11	253.26	1w	2.5150	4.5000	800	Sag	4230	778	+100	75
2769+00	253.30	253.94	1w	4.5000	-2.0000	3400	Crest	1062	848	86	75
2817+00	254.56	254.75	1w	-2.0000	-0.2500	800	Sag	+9999	848	+100	75
2849+00	255.13	255.50	1w	-0.2500	-4.8537	2000	Crest	968	902	78	75
2890+00	255.83	256.31	1w	-4.8537	1.9000	2600	Sag	1453	902	+100	75
2920+00	256.60	256.67	1w	1.9000	3.8000	400	Sag	3867	787	+100	75
2930+00	256.71	256.94	1w	3.8000	1.2000	1200	Crest	998	797	86	75
2945+00	256.99	257.22	1w	1.2000	4.7500	1200	Sag	1294	797	100	75
2973+00	257.35	257.92	1w	4.7500	-2.5000	3000	Crest	945	856	80	75
2993+00	257.92	258.11	1w	-2.5000	4.2500	1000	Sag	615 *	856	61	75
3017+00	258.40	258.55	1w	4.2500	3.5833	800	Crest	2018	764	+100	75
3035+00	258.72	258.91	1w	3.5833	5.0158	1000	Sag	+9999	764	+100	75
3061+00	259.16	259.40	1w	5.0158	0.9723	1400	Crest	864	800	79	75

Notes:

Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

Attachment 1
I-17 NB 1 -2

ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: I-17 Black Canyon City to Cordes Junction NB
Project Number: 18690
Roadway Type: PRINCIPAL ARTERIAL INTERSTATE - RURAL (MP 244.5 -262)

VPI STATION	MILEPOST		TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE		SPEED	
	BEGIN	END						AVAILABLE (ft)	AASHTO MINIMUM (ft)	AVAILABLE (mph)	DESIGN (mph)
3078+00.	259.45	259.61	1w	0.9420	3.2240	800	Sag	2092	800	+100	75
3092+00.	259.70	259.90	1w	3.2240	0.8420	1000	Crest	952	802	83	75
3106+00.	259.99	260.15	1w	0.8420	3.6900	800	Sag	1220	802	96	75
3123+00.	260.20	260.59	1w	3.6900	0.2954	2000	Crest	1128	810	91	75
3151+00.	260.86	261.01	1w	0.2954	2.1256	800	Sag	11622	810	+100	75
3170+50.	261.10	261.49	1w	2.1256	-2.9400	2100	Crest	946	864	79	75
3212+50	262.02	262.17	1w	-2.9400	2.0400	800	Sag	660 *	864	64	75
3233+50	262.34	262.64	1w	2.0400	-0.6200	1600	Crest	1139	824	91	75
3246+50	262.68	262.80	1w	-0.6200	2.2910	600	Sag	924	824	80	75
3261+00.	262.86	263.16	1w	2.2910	-2.0000	1600	Crest	897	848	78	75

Notes:

Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

Attachment 1
I-17 NB 2 -2

ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: I-17 Black Canyon City to Cordes Junction SB
Project Number: 18690
Roadway Type: PRINCIPAL ARTERIAL INTERSTATE - RURAL (MP 244.5 -262)

VPI STATION	MILEPOST BEGIN	MILEPOST END	TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE AVAILABLE (ft)	STOPPING SIGHT DISTANCE AASHTO MINIMUM (ft)	SPEED AVAILABLE (mph)	SPEED DESIGN (mph)
2319+00.	244.95	244.95	1a	3.5000	3.7000	0	GB	GB	GB	GB	65
2320+50.	244.98	244.98	1a	3.7000	3.5000	0	GB	GB	GB	GB	65
2324+50.	245.07	245.07	1a	3.5000	3.4400	0	GB	GB	GB	GB	65
2331+00.	245.13	245.35	1a	3.4400	0.9040	900	Crest	875	688	75	65
2342+50.	245.41	245.63	1a	0.9040	-1.5100	900	Crest	897	655	79	65
2348+50.	245.67	245.67	1a	-1.5100	-1.7053	0	GB	GB	GB	GB	65
2356+50.	245.72	246.02	1a	-1.7053	6.0000	1200	Sag	642 *	728	60	65
2385+00.	246.37	246.52	1a	6.0000	5.4642	800	Crest	2414	728	+100	65
2409+00.	246.82	246.97	1a	5.4642	6.0000	800	Sag	+9999	728	+100	65
2419+50.	247.10	247.10	1a	6.0000	6.0433	0	GB	GB	GB	GB	65
2428+50.	247.19	247.34	1a	6.0433	5.3600	800	Crest	1979	729	+100	65
2436+50.	247.34	247.49	1a	5.3600	6.0000	800	Sag	+9999	728	+100	65
2450+50.	247.55	247.82	1a	6.0000	-0.3000	1400	Crest	692 *	728	63	65
2458+50.	247.83	247.83	1a	-0.3000	-0.5000	0	GB	GB	GB	GB	65
2469+50.	247.97	248.12	1a	-0.5000	2.4100	800	Sag	1176	674	90	65
2481+00.	248.12	248.40	1a	2.4100	-0.7563	1500	Crest	1011	674	83	65
2494+50.	248.44	248.59	1a	-0.7563	-1.2100	800	Crest	2778	635	+100	65
2504+25.	248.60	248.80	1a	-1.2100	6.0000	1050	Sag	606 *	728	58	65
2517+00.	248.87	249.02	1a	6.0000	5.0024	800	Crest	1482	728	+100	65
2534+00.	249.15	249.38	1a	5.0024	2.3300	1200	Crest	984	712	79	65
2546+00.	249.40	249.58	1a	2.3300	5.9000	1000	Sag	1091	726	83	65
2553+50.	249.63	249.63	1a	5.9000	6.1000	0	GB	GB	GB	GB	65
2561+00.	249.77	249.77	1a	6.1000	6.3000	0	GB	GB	GB	GB	65
2566+50.	249.80	249.96	1a	6.3000	5.6600	800	Crest	2086	733	+100	65
2571+00.	249.97	249.97	1a	5.6600	5.8300	0	GB	GB	GB	GB	65

Notes:

Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

Attachment 1
I-17 SB 1 - 3

ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: I-17 Black Canyon City to Cordes Junction SB
Project Number: 18690
Roadway Type: PRINCIPAL ARTERIAL INTERSTATE - RURAL (MP 244.5 -262)

VPI STATION	MILEPOST BEGIN	MILEPOST END	TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE AVAILABLE (ft)	STOPPING SIGHT DISTANCE AASHTO MINIMUM (ft)	SPEED AVAILABLE (mph)	SPEED DESIGN (mph)
2575+00.	250.04	250.04	1a	5.8300	5.6400	0	GB	GB	GB	GB	65
2584+00.	250.21	250.21	1a	5.6400	5.5900	0	GB	GB	GB	GB	65
2588+50.	250.22	250.37	1a	5.5900	5.1600	800	Crest	2909	721	+100	65
2598+00.	250.40	250.55	1a	5.1600	6.2000	800	Sag	+9999	732	+100	65
2606+00.	250.63	250.63	1a	6.2000	6.0000	0	GB	GB	GB	GB	65
2618+50.	250.68	251.05	1a	6.0000	3.0000	2000	Crest	1199	927	87	75
2641+00.	251.16	251.37	1a	3.0000	0.5000	1200	Crest	1018	866	83	75
2663+50.	251.59	251.74	1a	0.5000	1.7080	800	Sag	+9999	843	+100	75
2676+00.	251.76	252.01	1a	1.7080	-1.4546	1400	Crest	977	843	82	75
2691+75.	252.02	252.33	1a	-1.4546	-4.5329	1600	Crest	1059	793	89	75
2709+00.	252.33	252.67	1a	-4.5329	3.1143	1800	Sag	926	868	78	75
2726+50.	252.75	252.92	1a	3.1143	1.0632	900	Crest	976	868	80	75
2744+50.	253.10	253.25	1a	1.0632	4.0440	800	Sag	1131	886	87	75
2767+50.	253.38	253.81	1a	4.0440	-1.3110	2300	Crest	963	886	79	75
2782+00.	253.82	253.91	1a	-1.3110	0.0000	500	Sag	+9999	815	+100	75
2790+00.	253.91	254.15	1a	0.0000	-2.4361	1100	Crest	987	815	84	75
2800+25.	254.26	254.26	1a	-2.4361	-2.4500	0	GB	GB	GB	GB	75
2810+00.	254.42	254.56	1a	-2.4500	-2.0000	600	Sag	+9999	785	+100	75
2819+00.	254.63	254.77	1a	-2.0000	-0.1820	600	Sag	10962	812	+100	75
2830+00.	254.89	255.02	1a	-0.1820	1.0000	600	Sag	+9999	831	+100	75
2847+00.	255.10	255.46	1a	1.0000	-3.5000	2000	Crest	979	831	83	75
2862+00.	255.50	255.61	1a	-3.5000	-1.5000	600	Sag	3200	792	+100	75
2873+00.	255.65	255.85	1a	-1.5000	-4.0000	1100	Crest	974	792	85	75
2888+00.	255.99	256.07	1a	-4.0000	-2.3950	400	Sag	+9999	780	+100	75
2907+00.	256.31	256.47	1a	-2.3950	1.5000	800	Sag	820 *	839	74	75

Notes:

Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

Attachment 1
I-17 SB 2 - 3

ATTACHMENT 1 - VERTICAL CURVE INVENTORY

Project Name: I-17 Black Canyon City to Cordes Junction SB
Project Number: 18690
Roadway Type: PRINCIPAL ARTERIAL INTERSTATE - RURAL (MP 244.5 -262)

VPI STATION	MILEPOST		TRAFFIC DIRECTION (1w, 1a or 2)	GRADE IN (%)	GRADE OUT (%)	CURVE LENGTH (ft)	CURVE TYPE	STOPPING SIGHT DISTANCE		SPEED	
	BEGIN	END						AVAILABLE (ft)	AASHTO MINIMUM (ft)	AVAILABLE (mph)	DESIGN (mph)
2925+00.	256.74	256.83	1a	1.5000	0.9378	600	Crest	2219	839	+100	75
2934+00.	256.84	257.00	1a	0.9378	3.5000	1000	Sag	1824	875	+100	75
2947+00.	257.11	257.19	1a	3.5000	5.1980	400	Sag	+9999	909	+100	75
2959+00.	257.26	257.49	1a	5.1980	2.4320	1200	Crest	968	909	78	75
2982+00.	257.71	257.81	1a	2.4320	2.0000	400	Crest	2698	855	+100	75
3016+00.	258.40	258.51	1a	2.0000	3.0000	600	Sag	+9999	866	+100	75
3030+00.	258.68	258.76	1a	3.0000	3.5000	400	Sag	+9999	875	+100	75
3037+00.	258.79	258.91	1a	3.5000	5.0000	600	Sag	+9999	905	+100	75
3052+00.	259.07	259.17	1a	5.0000	3.8750	600	Crest	1259	905	91	75
3064+00.	259.23	259.43	1a	3.8750	1.2000	1200	Crest	984	882	80	75
3099+00.	259.87	260.01	1a	1.2000	4.0000	800	Sag	1257	885	92	75
3128+00.	260.30	260.68	1a	4.0000	-0.5163	2000	Crest	978	885	80	75
3152+00.	260.88	261.03	1a	-0.5163	1.9214	800	Sag	1709	846	+100	75
3171+50.	261.12	261.52	1a	1.9214	-2.9400	2100	Crest	966	846	81	75
3212+50.	262.02	262.17	1a	-2.9400	2.2300	800	Sag	639 *	852	63	75
3233+50.	262.34	262.64	1a	2.2300	-0.6300	1600	Crest	1099	852	87	75
3246+50.	262.68	262.80	1a	-0.6300	2.3230	600	Sag	903	853	78	75
3260+00.	262.84	263.14	1a	2.3230	-2.0000	1600	Crest	894	853	77	75

Notes:

Traffic Direction:
1w = One Way Traffic in Station direction
1a = One Way Traffic against Station direction
2 = Two Way Traffic

Grades are with respect to Station direction.
* Indicates design exception required.
GB indicates grade break. Stopping Sight Distance and Speed not calculated.
Calculations are based on AASHTO 2001 and ADOT 2004 Roadway Design Guidelines formulas with adjustments for effective grade.

Attachment 1
I-17 SB 3 - 3

ATTACHMENT 2 - HORIZONTAL CURVE INVENTORY

Project Name: I-17 BBC to Jct. SR 69 NB-(Posted Speed)
Project No: 17 MA 232 H6800 01L

HPI STATION (ft)	MILEPOST		SUPERELEVATION (ft/ft)			DEGREE OF CURVE		SPEED (mph)	
	BEGIN	END	AASHTO MIN	EXISTING	AASHTO MAX	EXISTING	AASHTO MAX	EXISTING	DESIGN
2319+39.17	244.81	245.13	0.033	*0.015	0.100	0°-59.43'	4°-15'	59	65
2338+22.43	245.37	245.45	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2353+75.36	245.68	245.90	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2381+12.87	246.33	246.41	0.062	*0.015	0.100	2°-00.00'	4°-15'	67	65
2392+89.59	246.54	246.64	0.087	*0.050	0.100	3°-00.00'	4°-15'	59	65
2406+69.16	246.78	246.92	0.087	*0.050	0.100	3°-00.00'	4°-15'	59	65
2435+26.25	247.31	247.46	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2458+62.84	247.63	247.95	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2475+92.69	248.11	248.22	0.075	*0.015	0.100	2°-30.00'	4°-15'	63	65
2495+27.97	248.45	248.61	0.062	*0.015	0.100	2°-00.00'	4°-15'	67	65
2527+18.75	249.02	249.22	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2547+80.82	249.40	249.62	0.099	*0.108	0.100	4°-00.00'	4°-15'	54	65
2566+47.66	249.78	249.97	0.087	*0.050	0.100	3°-00.00'	4°-15'	59	65
2587+27.93	250.13	250.42	RC	0.015	0.100	0°-30.00'	4°-15'	97	65
2716+58.29	252.20	253.07	0.028	*0.015	0.100	0°-40.00'	3°-00'	72	75
2815+36.00	254.19	255.00	0.051	*0.015	0.100	1°-15.00'	3°-00'	75	75
2950+26.60	257.07	257.35	0.031	*0.015	0.100	0°-45.00'	3°-00'	68	75
3008+88.70	257.66	258.92	0.025	*0.015	0.100	0°-36.00'	3°-00'	76	75
3089+63.95	259.65	259.85	0.079	*0.015	0.100	2°-00.00'	3°-00'	67	75
3109+85.92	260.04	260.24	0.061	*0.015	0.100	1°-30.00'	3°-00'	73	75
3145+20.60	260.46	261.14	0.051	*0.015	0.100	1°-15.00'	3°-00'	75	75
3175+58.89	261.29	261.49	0.021	*0.015	0.100	0°-29.77'	3°-00'	83	75

Meaning Of Symbols:
RC = Remove Adverse Crown
* = Existing Superelevation outside AASHTO recommended range of values

ATTACHMENT 2 - HORIZONTAL CURVE INVENTORY

Project Name: I-17 BCC to Jct SR 69 - SB (Posted Speed)
Project No: 17 MA 232 H6800 01L

HPI STATION (ft)	MILEPOST		SUPERELEVATION (ft/ft)			DEGREE OF CURVE		SPEED (mph)	
	BEGIN	END	AASHTO MIN	EXISTING	AASHTO MAX	EXISTING	AASHTO MAX	EXISTING	DESIGN
2319+24.87	244.81	245.13	0.034	*0.015	0.100	1°-00.57'	4°-15'	58	65
2355+89.81	245.78	245.93	0.062	*0.015	0.100	2°-00.00'	4°-15'	67	65
2372+07.37	246.13	246.26	0.087	*0.030	0.100	3°-00.00'	4°-15'	59	65
2387+35.07	246.40	246.56	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2402+30.11	246.72	246.81	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2419+15.02	247.08	247.10	0.087	*0.071	0.100	3°-00.00'	4°-15'	59	65
2433+59.30	247.24	247.45	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2456+90.52	247.60	247.92	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2481+92.63	248.07	248.47	0.055	*0.015	0.100	1°-45.00'	4°-15'	69	65
2511+95.31	248.75	248.94	0.033	*0.015	0.100	1°-00.00'	4°-15'	59	65
2535+42.38	249.23	249.35	0.087	*0.030	0.100	3°-00.00'	4°-15'	59	65
2553+91.45	249.58	249.69	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2566+15.73	249.85	249.89	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2576+19.53	250.04	250.08	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2588+82.22	250.23	250.36	0.099	*0.071	0.100	4°-00.00'	4°-15'	54	65
2600+95.07	250.50	250.57	0.087	*0.071	0.100	3°-00.00'	4°-15'	59	65
2615+98.47	250.72	250.91	0.087	*0.030	0.100	3°-00.57'	4°-15'	59	65
2638+49.77	251.05	251.38	0.079	*0.015	0.100	2°-00.00'	3°-00'	67	75
2717+12.62	252.21	253.08	0.028	*0.015	0.100	0°-40.00'	3°-00'	72	75
2821+99.17	254.35	255.06	0.079	*0.024	0.100	2°-00.00'	3°-00'	67	75
2852+34.34	255.29	255.46	0.042	*0.015	0.100	1°-00.00'	3°-00'	59	75
2880+90.52	255.74	256.04	0.079	*0.024	0.100	2°-00.00'	3°-00'	67	75

Meaning Of Symbols:
* = Existing Superelevation outside AASHTO recommended range of values

ATTACHMENT 2 - HORIZONTAL CURVE INVENTORY (CONTD.)

Project Name: I-17 BCC to Jct SR 69 - SB (Posted Speed)
Project No: 17 MA 232 H6800 01L

HPI STATION (ft)	MILEPOST		SUPERELEVATION (ft/ft)			DEGREE OF CURVE		SPEED (mph)	
	BEGIN	END	AASHTO MIN	EXISTING	AASHTO MAX	EXISTING	AASHTO MAX	EXISTING	DESIGN
2910+05.73	256.24	256.65	0.042	*0.015	0.100	1°-00.00'	3°-00'	59	75
2949+38.92	257.04	257.34	0.051	*0.015	0.100	1°-15.00'	3°-00'	75	75
2983+77.10	257.63	257.71	0.079	*0.015	0.100	2°-00.00'	3°-00'	67	75
3019+60.96	258.28	258.72	0.079	*0.015	0.100	2°-00.00'	3°-00'	67	75
3060+02.13	259.22	259.44	0.031	*0.015	0.100	0°-45.00'	3°-00'	68	75
3089+29.37	259.60	259.94	0.031	*0.015	0.100	0°-45.00'	3°-00'	68	75
3144+97.56	260.46	261.15	0.042	*0.015	0.100	1°-00.00'	3°-00'	59	75
3178+47.71	261.30	261.61	0.021	*0.015	0.100	0°-30.00'	3°-00'	83	75

Meaning Of Symbols:
* = Existing Superelevation outside AASHTO recommended range of values

ROADWAY ENGINEERING GROUP
ROADWAY PREDESIGN SECTION

DATE: 3/7/2018

TO: **Amin Aman**
BRIDGE GROUP
BRIDGE MANAGEMENT SECTION, MD 635E

FEDERAL REFERENCE NO: TRACS NO: H6800
HIGHWAY: H6800 01L: I-17, Anthem Way TI to Jct. SR 69
LOCATION: H6800 01L: I-17, Anthem Way TI to Jct. SR 69
MP LIMITS: 229.00 TO: 260.00
PROJECT DESCRIPTION:

FROM: **Navaphan Viboolmate**
Bridge Group

SUBJEC **BRIDGE EVALUATION REQUEST**

Please evaluate the following structures per AASHTO guidelines:

ROUTE NO.	MILEPOST	STR. NO. AND NAME	BRIDGE LENGTH	BRIDGE ROADWAY WIDTH	BRIDGE RAIL / BARRIER					AC OVERLAY			VERTICAL CLEARANCE (MINIMUM)		BRIDGE LOAD RATING	BRIDGE SUFFICIENCY RATING
					TYPE	GEOM. OK	STRUC OK	Railings OK	Transitions OK	THICKNESS (EXISTING)	REMOVE	REPLACE / NEW				
N7*	N11	N8 & A209	N49	N51	A206A	A206B	A206C	N36A	N36B	A201	(MINIMUM)	(MAXIMUM)	NB/EB	SB/WB	N66	SRB
I 17	229	**02537** Anthem Way TI UP	220	143	Concrete	**Yes**	**Yes**	**Yes**	**N/A**	**0"**	**NA**	**NA**	**17.42**	**17.37**	**HS 20+**	**98.50**
		Comments: Approximately 5-feet of compression joint seal at the east joint, westbound outside lane has moderate adhesion failure.The compression joint seals exhibit minor debris impact in the shoulders.														
I 17	231.2	**05740** RCB														
		Comments: Culvert not at Grade														
I 17	231.4	**01290** New River Bridge NB	347	42	Concrete Barrier	**Yes**	**Yes**	**Yes**	**No**	**4"**	**4"**	**1"**	**NA**	**NA**	**HS 20**	**96.50**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay The soffit has light staining following same pattern as bottom mat of reinforcement. In span 6 the hairline cracks along the marks are more visible than in other spans. The bridge has been widened along both sides and the new slab is about 2" thicker than the old slab.														
I 17	231.4	**01291** New River Bridge SB	347	42	Concrete Barrier	**Yes**	**Yes**	**Yes**	**No**	**4"**	**4"**	**1"**	**NA**	**NA**	**HS 20**	**96.50**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay The soffit has light staining following same pattern as bottom mat of reinforcement. In span 6 the hairline cracks along the marks are more visible than in other spans. The bridge has been widened along both sides and the new slab is about 2" thicker than the old slab.														
I 17	232.02	**01292** New River TI OP NB	159	38	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**19.86**	**20.76**	**HS 20+**	**94.00**
I 17	232.02	**01293** New River TI OP SB	145	38	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**15.93**	**16.69**	**HS 20+**	**94.00**

I 17	232.45	**05742** RCB NB															
			Comments: Culvert not at Grade														
I 17	232.52	**05743** RCB SB															
			Comments: Culvert not at Grade														
I 17	233.85	**05744** RCB NB															
			Comments: Culvert not at Grade														
I 17	233.85	**05745** RCB SB															
			Comments: Culvert not at Grade														
I 17	235.94	**01294** Table Mesa TI UP SB	151	28	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**16.10**	**16.10**	**HS 20+**	**F 95.9**
			Comments:Repair embankment errosion on the west side														
I 17	235.94	**01295** Table Mesa TI UP NB	161	28	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**16.63**	**16.63**	**HS 20+**	**F 95.7**
I 17	238.2	**00967** Moores Gulch Br NB	195	38	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**NA**	**NA**	**HS 20+**	**94.60**
			Comments:Erosion at the northeast bank protection														
I 17	238.6	**00339** Moores Gulch Br SB	178	31.8	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**0"**	**NA**	**NA**	**NA**	**NA**	**HS 16.1**	**F 65.2**
			Comments: Bridge replacement is programed in 2022														
I 17	238.65	**05746** RCB NB															
			Comments: Culvert not at Grade														
I 17	239.2	**00968** Lit Squaw Crk Br NB	315	32.5	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**NA**	**NA**	**HS 20+**	**88.50**
I 17	239.55	**02965** Little Squaw Crk Br SB	209	62	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**0"**	**NA**	**NA**	**NA**	**NA**	**HS 20+**	**90.80**
			Comments:A large eroded area exists at the base of rail bank at the northwest corner next to slope protection toe. Rocks have been washed out from behind the wires creating large cavity where water still flowing behind the rail bank Channel has a small stream running under N. span at the time of inspection. Most of fill under Span 2 has washed out exposing the old concrete floor on the downstream end with 18" local scour.														

I 17	241.78	**05747** RCB SB & West Fr Rd																
		Comments: Culvert not at Grade																
I 17	241.95	**05748** RCB NB & Ramp																
		Comments: Culvert not at Grade																
I 17	242.15	**00969** Rock Spring TI UP NB	109	40	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**15.92**	**15.92**	**HS 20+**	**96.50**
		Comments: The W joint seal has fallen through.Repair fatigue cracks																
I 17	242.15	**00970** Rock Spring TI UP SB	109	40	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**16.00**	**16.00**	**HS 20+**	**96.40**
		Comments:																
I 17	242.98	**00863** Mud Springs UP	224	28	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**16.50**	**18.12**	**HS 20+**	**91.30**
		Comments:																
I 17	243.34	**01807** Agua Fria Rvr Br NB	363	42	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**NA**	**NA**	**HS 20+**	**96.80**
		Comments:																
I 17	243.34	**01808** Agua Fria Rvr Br SB	363	42	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**NA**	**NA**	**HS 20+**	**96.80**
		Comments:																
I 17	244.37	**00764** Coldwater Cyn TI OP NB	97	38.3	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**14.25**	**14.25**	**HS 20+**	**96.00**
		Comments:																
I 17	244.37	**00765** Coldwater Cyn TI OP SB	97	38.3	Concrete Barrier	**Yes**	**Yes**	**Yes**	**Yes**	**1"**	**NA**	**NA**	**14.68**	**14.68**	**HS 20+**	**96.00**
		Comments:																
I 17	248.4	**01170** Bumble Bee TI UP SB	210	28	H-2-1 on curb	**Yes**	**Yes**	**Yes**	**Yes**	**0"**	**NA**	**NA**	**16.29**	**16.29**	**HS 20+**	**99.00**
		Comments: Replace comp seal in jt at P2; Restore 1/2" Bit jt filler at abuts.Repair cracks observed in the girders at different locations. Substandard barrier replacement is preffered but not required as Non NHS bridge																
I 17	248.4	**01171** Bumble Bee TI OP NB	161	38	Concrete	**No**	**Yes**	**Yes**	**Yes**	**0"**	**NA**	**NA**	**15.22**	**16.14**	**HS 18.3**	**93.40**
		Comments: Bridge rehabilitation is programmed in 2020.																

I 17	252.5	**01237** Sunset Pt TI OP NB	107	38	H-2-1 on curb	**Yes**	**No**	**No**	**No**	**2"**	**2"**	**1"**	**16.51**	**16.51**	**HS 20+**	**94.00**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														
I 17	252.5	**01352** Sunset Pt TI OP SB	107	38	H-2-1 on curb	**Yes**	**No**	**No**	**No**	**1"**	**1"**	**1"**	**17.43**	**17.43**	**HS 20+**	**94.00**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														
I 17	255.9	**00750** Badger Spgs TI OP SB	88	38	H-1-1 ,Thrie beam	**Yes**	**No**	**No**	**Yes**	**1"**	**1"**	**1"**	**16.05**	**16.05**	**HS 20+**	**F 93.0**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														
I 17	256.05	**00749** Badger Spgs TI OP NB	90	38	H-1-1 ,Thrie beam	**Yes**	**No**	**No**	**Yes**	**1"**	**1"**	**1"**	**15.01**	**15.01**	**HS 20+**	**F 93.0**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														
I 17	259.43	**00751** Bloody Basin TI OP NB	90	38	H-1-1 ,Thrie beam	**Yes**	**No**	**No**	**Yes**	**1"**	**1"**	**1"**	**15.32**	**15.32**	**HS 20+**	**F 93.0**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														
I 17	259.43	**00752** Bloody Basin TI OP SB	90	38	H-1-1 ,Thrie beam	**Yes**	**No**	**No**	**Yes**	**1"**	**1"**	**1"**	**15.76**	**16.05**	**HS 20+**	**F 93.0**
		Comments:Existing AC overlay on bridge deck should be removed full depth, bare concrete deck top be inspected, repaired if needed and sealed with penetrating deck sealant .Then be overlaid with 1" thick appropriate asphaltic overlay. Substandard barrier replacement is recommended														

Evaluation Completed by: Masudur Rahman Date: 3/7/2018

Note: *N numbers are NBI numbers and A numbers are Arizona Items Number for bridge inventory

APPENDIX B – NEAR-TERM PREFERRED ALTERNATIVE TYPICAL SECTIONS AND PLAN & PROFILE

Typical Sections

Key Map

Plan Sheets

I-17 SB Profile (Black Canyon City to Sunset Point)

I-17 NB Profile (Sunset Point)

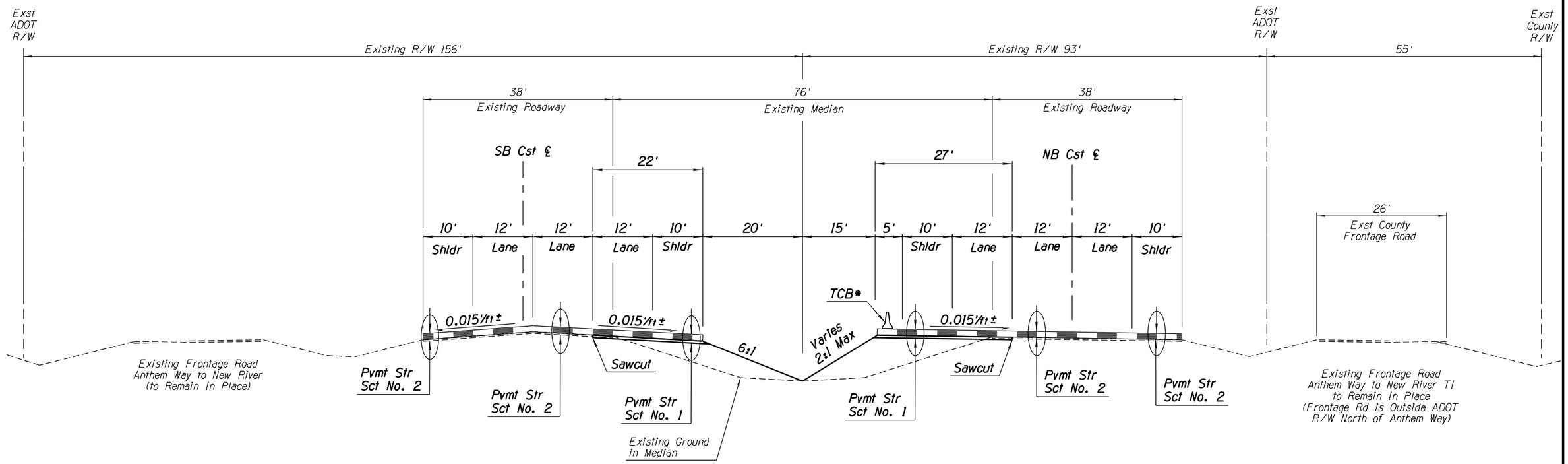
Alternative FL Profile (Black Canyon City)

North Crossover Profile

I-17 NB Profile (Black Canyon City)

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

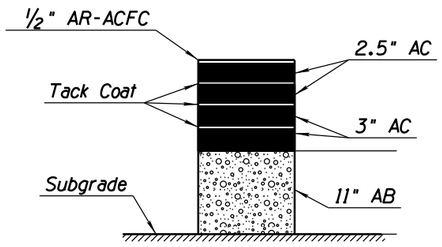
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



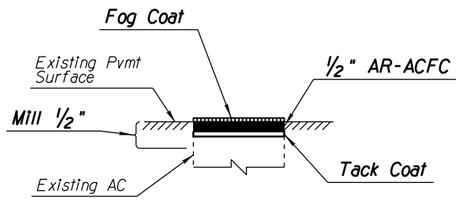
TYPICAL SECTION

I-17 NB & SB
Anthem Way TI to New River TI
Sta 1496+00 to Sta 1647+00
MP 229.1 to MP 232.0

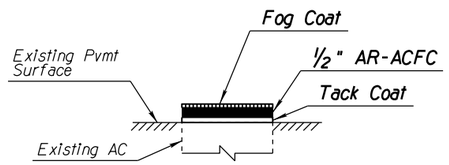
* Permanently installed temporary concrete barrier.



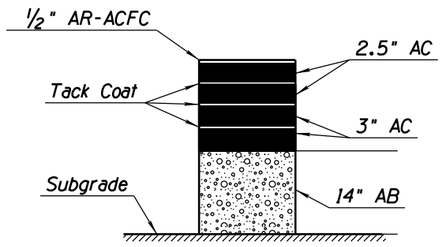
Total Thickness = 22½"
SECTION NO. 1
I-17 New Pavement



Total Thickness = ½"
SECTION NO. 2
I-17 Exst Travel Lanes
I-17 Exst Shoulders



Total Thickness = ½"
SECTION NO. 3
I-17 Exst Outside Shoulders



Total Thickness = 25½"
SECTION NO. 4
I-17 New Pavement

PAVEMENT STRUCTURAL SECTIONS

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

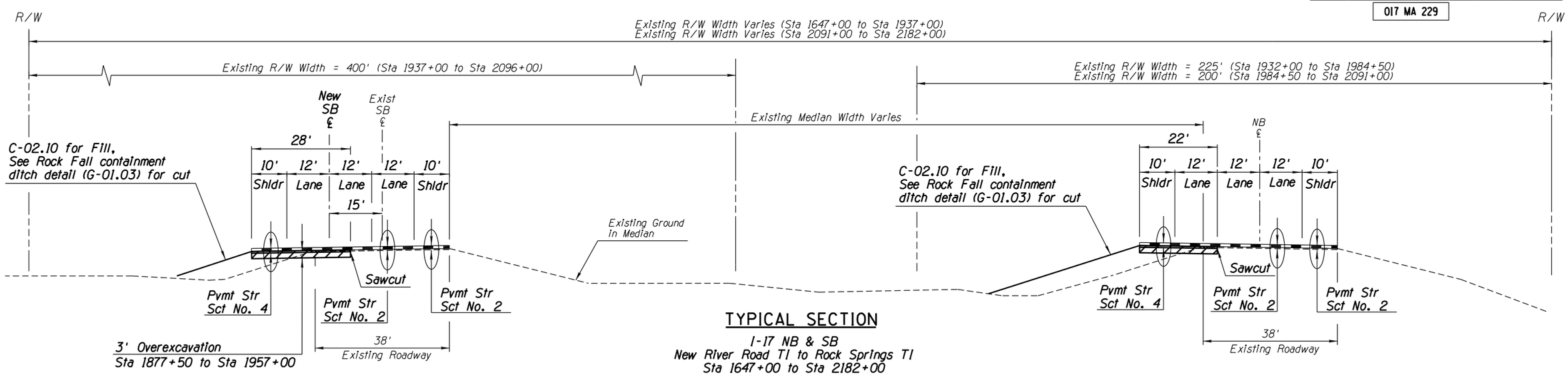
TYPICAL SECTIONS

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. G-01.01
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV)S ___ OF ___

4/29/2019 ...\11-CADD\02-Gen\h6800_typ01.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			



TYPICAL SECTION

I-17 NB & SB
New River Road TI to Rock Springs TI
Sta 1647+00 to Sta 2182+00
MP 232.0 to MP 242.1

SOUTHBOUND -
Inside Widening from New River Rd TI to Sta 1925+00
Outside Widening from Sta 1925+00 to Sta 2105+00
Inside Widening from Sta 2105+00 to Black Canyon City

SB RECOMMENDED CUT SLOPE RATIO

Station		Cut Slope Ratio
Begin	End	
1490+00	1750+00	1H:1V
1750+00	1771+00	0.75H:1V
1771+00	1857+00	1H:1V
1857+00	1864+00	0.75H:1V
1864+00	1885+00	1H:1V
1885+00	1915+00	0.75H:1V
1915+00	1933+00	1H:1V
1933+00	1951+00	1H:1V
1951+00	1971+00	0.75H:1V
1971+00	2076+00	1H:1V
2076+00	2335+00	0.75H:1V

NB RECOMMENDED CUT SLOPE RATIO

Station		Cut Slope Ratio
Begin	End	
1490+00	1674+00	1H:1V
1674+00	1699+00	0.75H:1V
1699+00	1703+00	1H:1V
1703+00	1742+00	0.75H:1V
1742+00	1750+00	1H:1V
1750+00	1775+00	0.75H:1V
1775+00	1803+00	1H:1V
1803+00	1835+00	0.75H:1V
1835+00	1852+00	1H:1V
1852+00	1868+00	0.75H:1V
1868+00	1889+00	1H:1V
1889+00	1895+00	0.75H:1V
1895+00	1927+00	1H:1V
1927+00	1930+00	0.75H:1V
1930+00	1959+00	1H:1V
1959+00	1967+00	0.75H:1V
1967+00	1988+00	1H:1V
1988+00	2010+00	1H:1V
2010+00	2027+00	0.75H:1V
2027+00	2035+00	1H:1V
2035+00	2040+00	0.75H:1V
2040+00	2065+00	1H:1V
2065+00	2078+00	0.75H:1V
2078+00	2123+00	0.75H:1V
2123+00	2335+00	0.75H:1V

NORTHBOUND -
Inside Widening from New River Rd TI to Black Canyon City

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

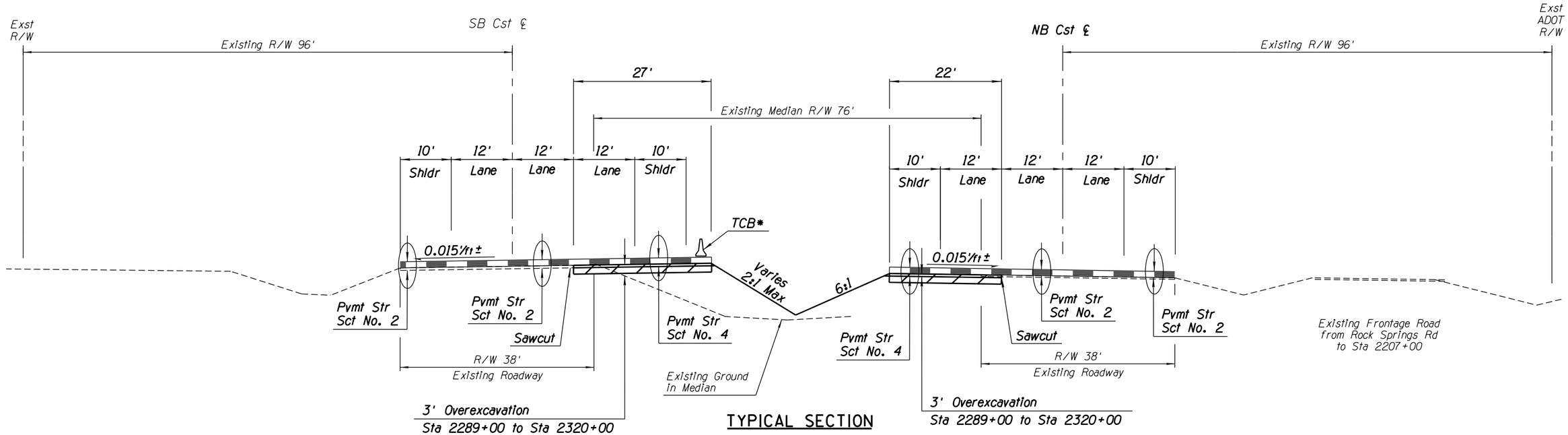
TYPICAL SECTIONS

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. G-01.02
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	____ OF ____

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

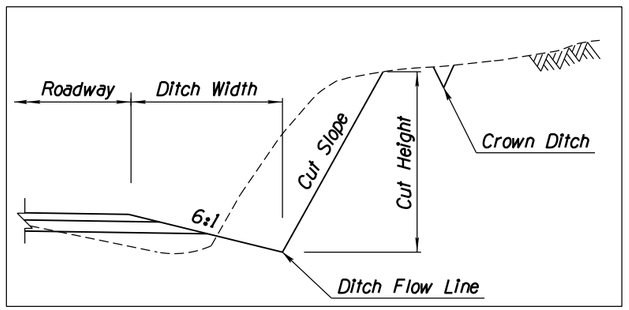
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			



TYPICAL SECTION

I-17 NB & SB
Rock Springs TI to Black Canyon City
Sta 2182+00 to 2326+66
MP 242.1 to MP 245.1

* Permanently installed temporary concrete barrier.



ROCKFALL CONTAINMENT DITCH

Width of 6H:1V Ditch (ft)		
Cut Slope Height (ft)	Cut Slope 1:1	Cut Slope 0.75:1
<20	*	*
20	20	15
40	25	19
60	30	28
80	40	37
100	66	54
120	70	58
160	78	65
200	85	68

* 15 Feet of Height or Cut, Whichever is Lower

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

TYPICAL SECTIONS

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. G-01.03

___ OF ___

4/29/2019 ...\11-CADD\02-Gen\h6800_typ03.dgn

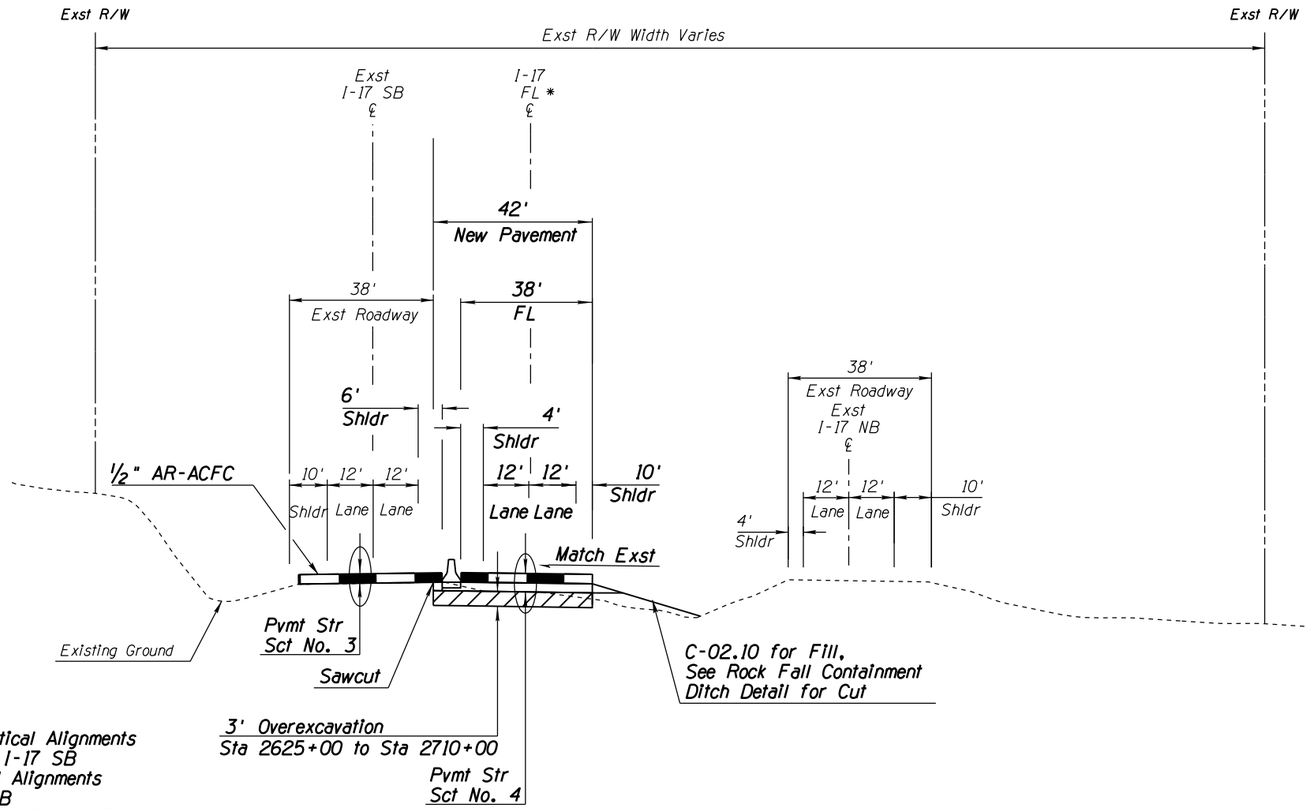
DATE- | LOCATION- | REVISIONS- | FINISHED PLANS- | SURVEY NO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

Flex Lanes Recommended Cut Slope Ratios		
Station		Cut Slope Ratio
Begin	End	
2335+00	2364+00	1H:1V
2364+00	2385+00	0.75H:1V
2385+00	2397+00	1H:1V
2397+00	2415+00	1H:1V
2415+00	2443+00	0.75H:1V
2443+00	2455+00	1H:1V
2455+00	2680+00	0.75H:1V

ROCK CONTAINMENT DITCH DETAIL



Note:
* FL Horizontal and Vertical Alignments Controlled by Existing I-17 SB Horizontal and Vertical Alignments except at Exst I-17 SB Sta 2326+65.80 to Sta 2363+98.86.

I-17 TYPICAL SECTION FLEX LANE ALTERNATIVE (TWO LANES)

I-17 STA 2326+66 TO STA 2703+14
MP 245.1 TO MP 252.4

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

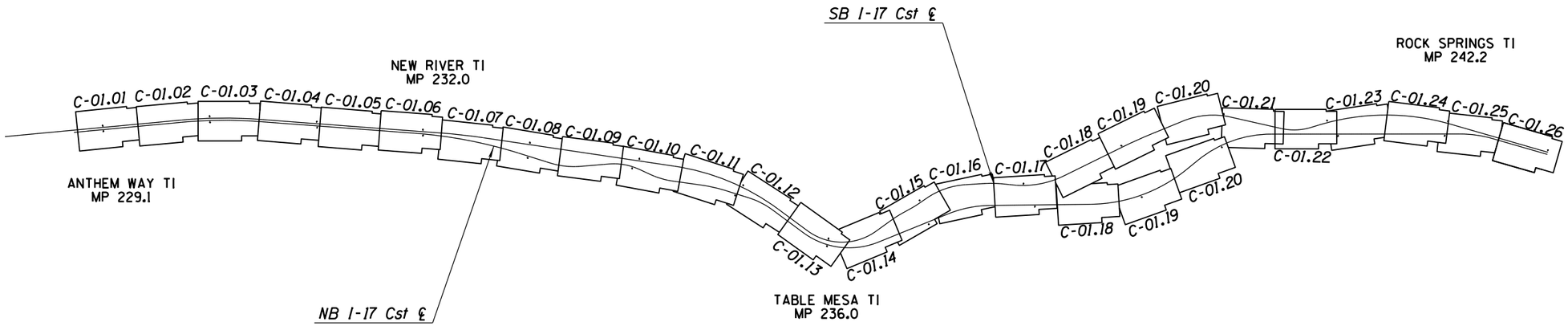
TYPICAL SECTIONS

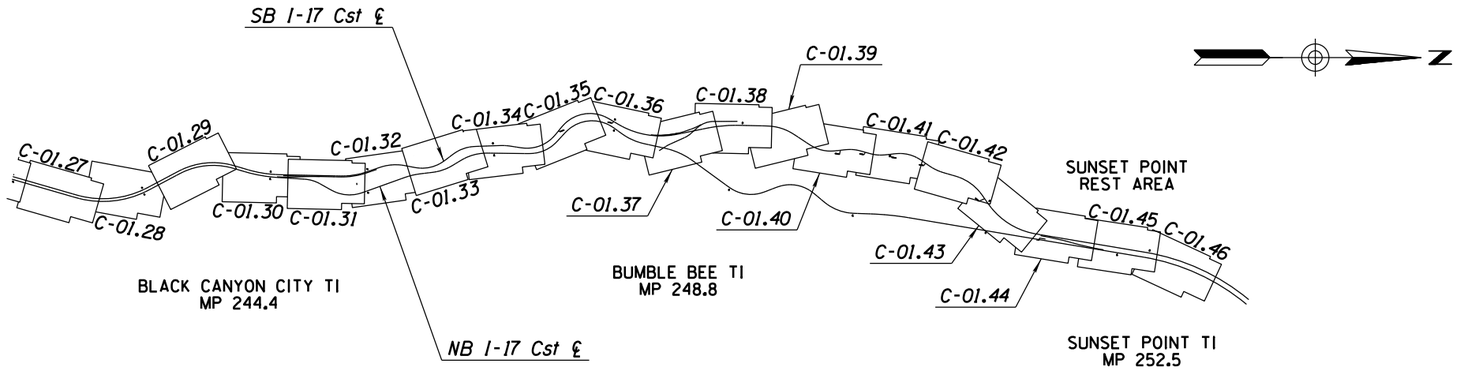
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. G-01.04
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

4/29/2019 ...\11-CADD\02-Gen\h6800_typ04.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			





	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

KEY MAP

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. G-02.01
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\h6800_g01-key.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

N

ANTHEM WAY TI
MP 229.1

Section Line

BEGIN SB WIDENING
SB I-17 CST ℄ STA 1495+96

Anthem Industrial Park

Anthem Outlet Stores

Exst Two-Way Frontage Road

1475 1480 1485 1490 1495 1500 1505

Exst R/W

SB I-17 Cst ℄

ANTHEM WAY

Adjust Striping

+50

MP 229

NO5°21'22"W

22'

27'

MATCH LINE STA 1505+00

MP 229

Begin Barrier
Sta 1495+84
Match Exst

Exst R/W

NB I-17 Cst ℄

+60

1475 1480 1485 1490 1495 1500 1505

Exst Two-Way Frontage Road

Modify Signing and Striping to Remove Lane Drop

BEGIN NB WIDENING
NB I-17 CST ℄ STA 1496+00

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1495+96 TO STA 1505+00
NB STA 1496+00 TO STA 1505+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.01

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_p01.dgn

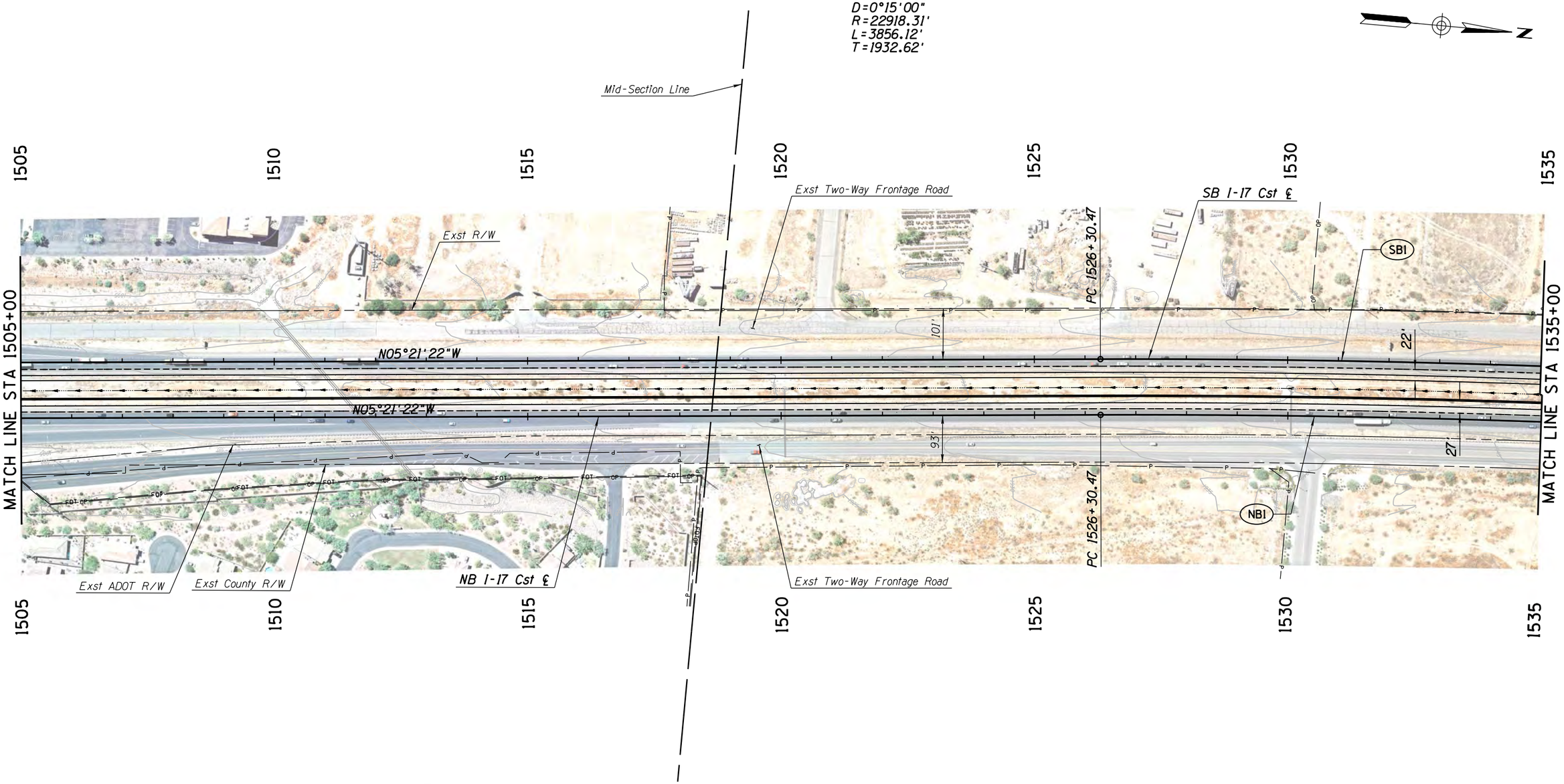
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

(SBI) CURVE DATA

PI Sta 1545+63.09

Main Curve
Δ=09°38'25" Rt
D=0°15'00"
R=22918.31'
L=3856.12'
T=1932.62'



(NBI) CURVE DATA

PI Sta 1545+53.82

Main Curve
Δ=09°38'25" Rt
D=0°15'04"
R=22808.32
L=3837.61'
T=1923.35

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1505+00 TO STA 1535+00
NB STA 1505+00 TO STA 1535+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-01.02
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

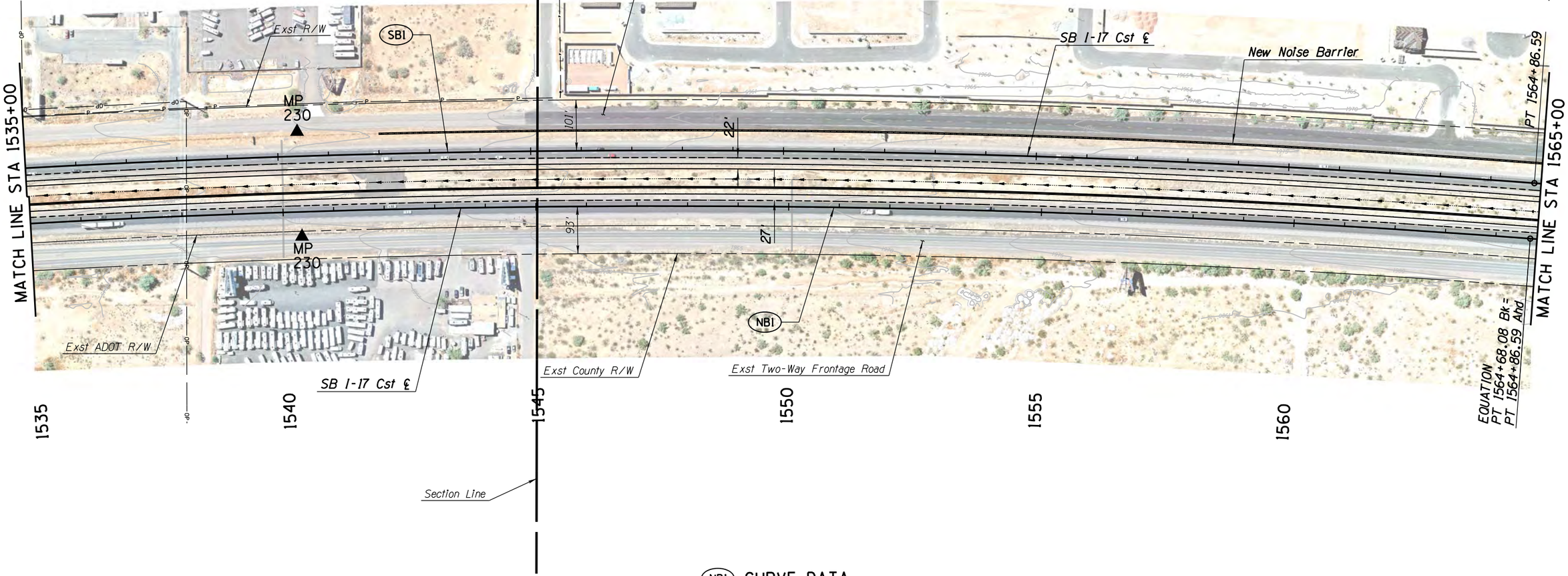
4/29/2019 ...\Stage I (DCR)\h6800_p02.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

(SB1) CURVE DATA

PI Sta 1545+63.09

Main Curve
Δ=09°38'25" Rt
D=0°15'00"
R=22918.31'
L=3856.12'
T=1932.62'



(NB1) CURVE DATA

PI Sta 1545+53.82

Main Curve
Δ=09°38'25" Rt
D=0°15'04"
R=22808.32
L=3837.61'
T=1923.35

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1535+00 TO STA 1565+00
NB STA 1535+00 TO STA 1565+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

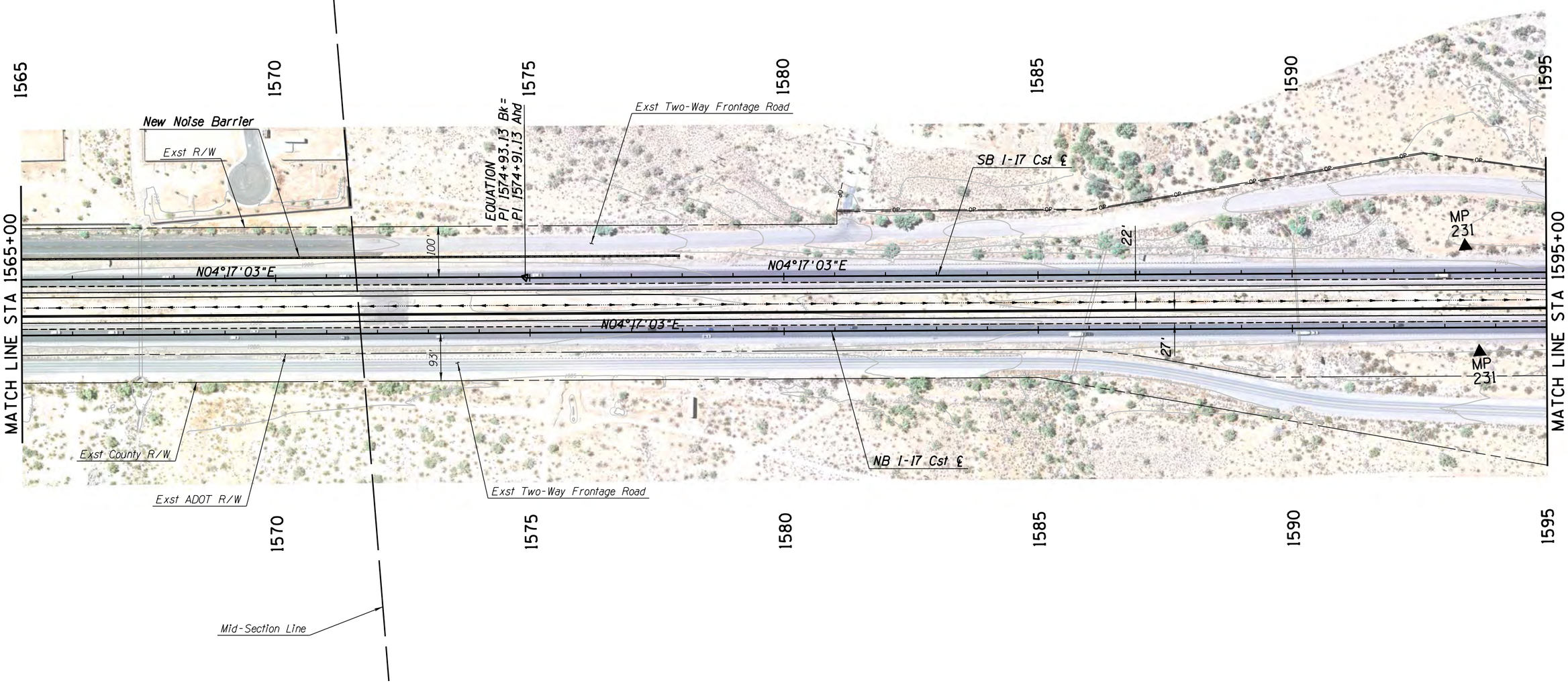
DWG NO. C-01.03

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p03.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1565+00 TO STA 1595+00
NB STA 1565+00 TO STA 1595+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

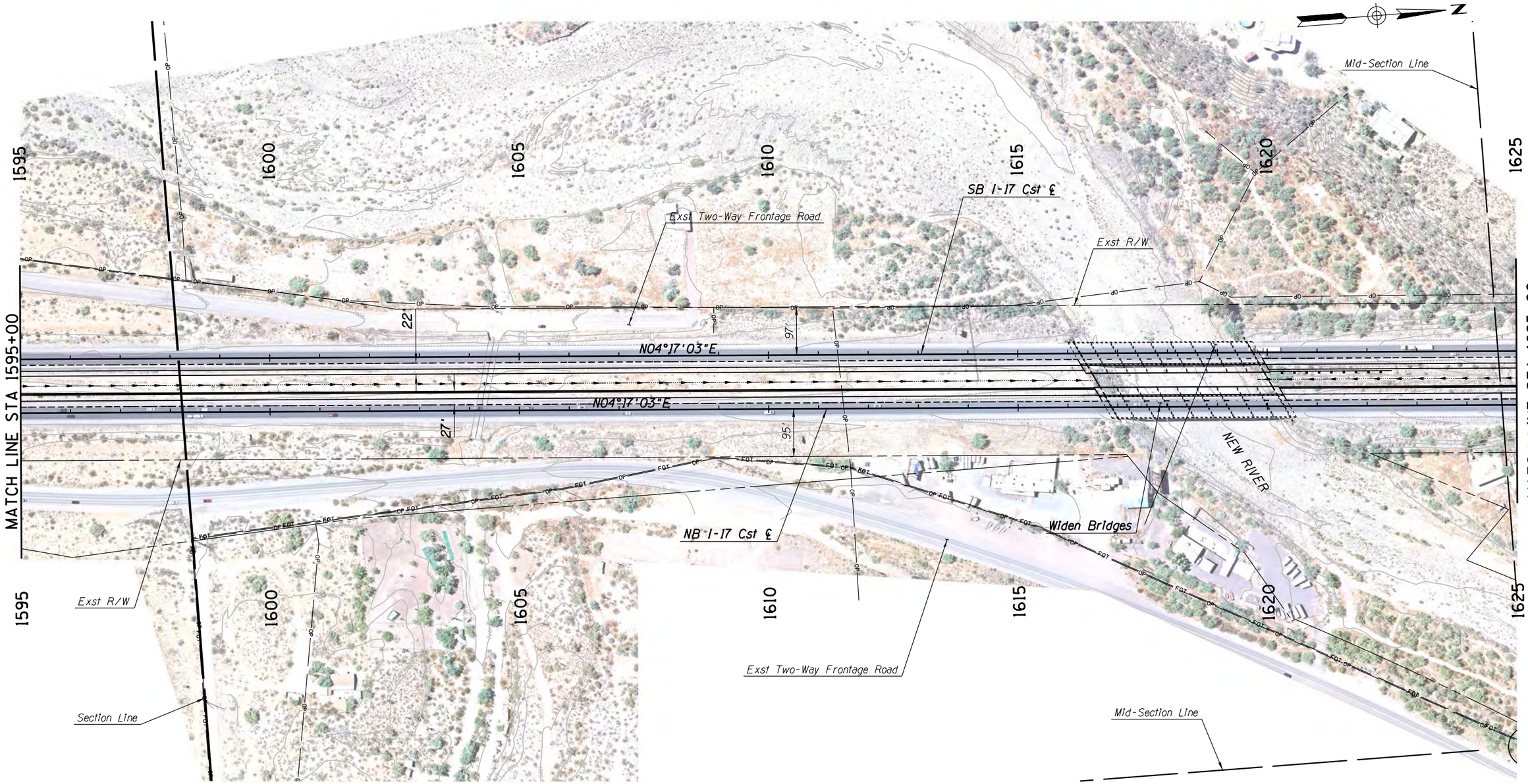
DWG NO. C-01.04

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p04.dgn

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1595+00 TO STA 1625+00
NB STA 1595+00 TO STA 1625+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.05

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p05.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

N

NEW RIVER TI
MP 232.0

Section Line

NEW RIVER ROAD

1625 1630 1635 1640 1645 1650 1655

STA 1625+00

MATCH LINE STA 1625+00

SB I-17 Csl ℄

Exst R/W

MP 232

97'

22'

N04°17'03"E

27'

95'

PC 1642+01.97

NB2

Widen Bridges

MATCH LINE STA 1655+00

NB I-17 Csl ℄

Mid-Section Line

27 34

NB2 CURVE DATA

PI Sta 1668+30.89

Main Curve
Δ=13°05'15" Rt
D=0°15'00"
R=22918.32'
L=5234.96'
T=2628.92'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1625+00 TO STA 1655+00
NB STA 1625+00 TO STA 1655+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.06

___ OF ___

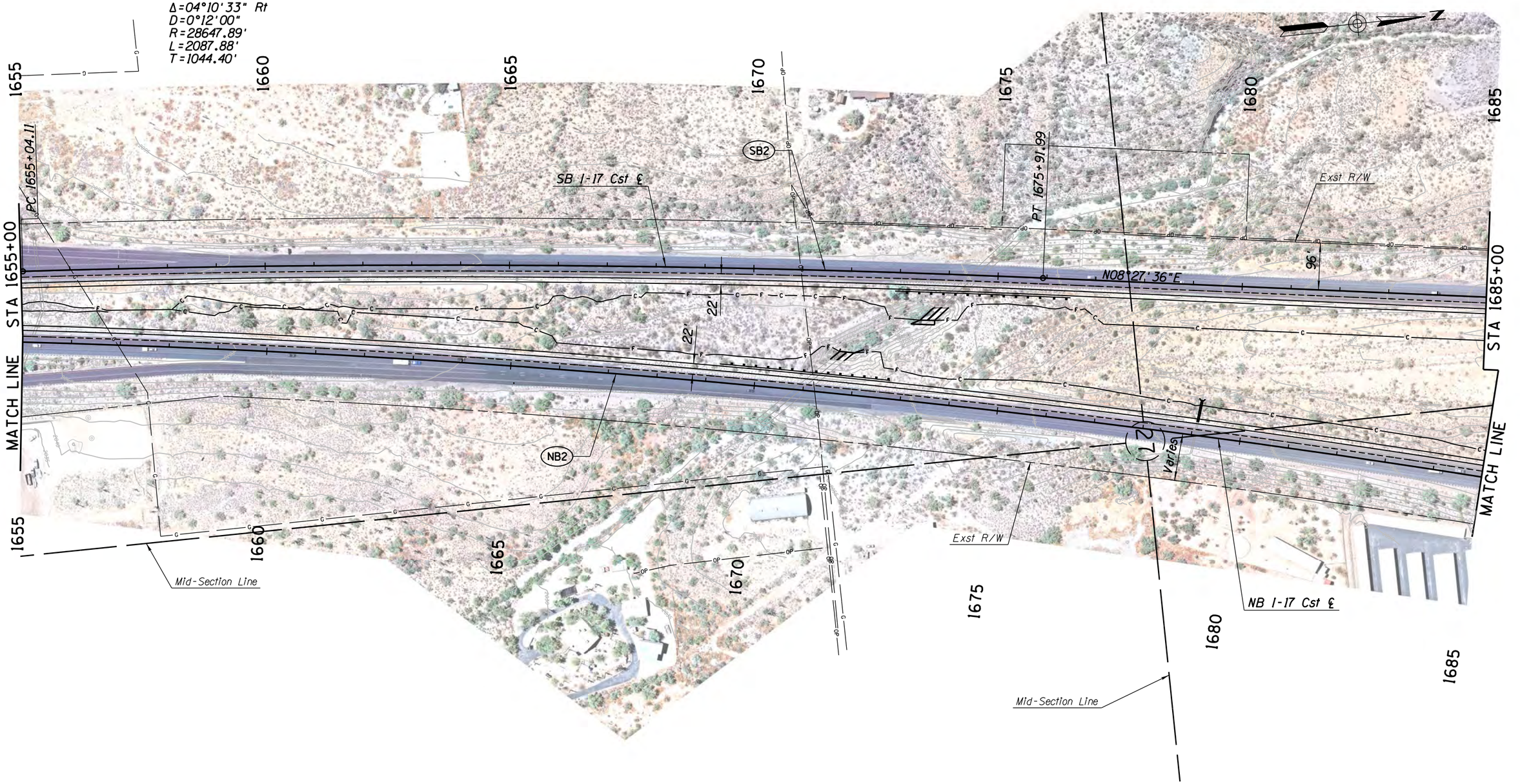
4/29/2019 ...\Stage I (DCR)\h6800_p06.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

(SB2) CURVE DATA

PI Sta 1665+48.51

Main Curve
Δ=04°10'33" Rt
D=0°12'00"
R=28647.89'
L=2087.88'
T=1044.40'



(NB2) CURVE DATA

PI Sta 1668+30.89

Main Curve
Δ=13°05'15" Rt
D=0°15'00"
R=22918.32'
L=5234.96'
T=2628.92'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1655+00 TO STA 1685+00
SB STA 1655+00 TO STA 1685+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

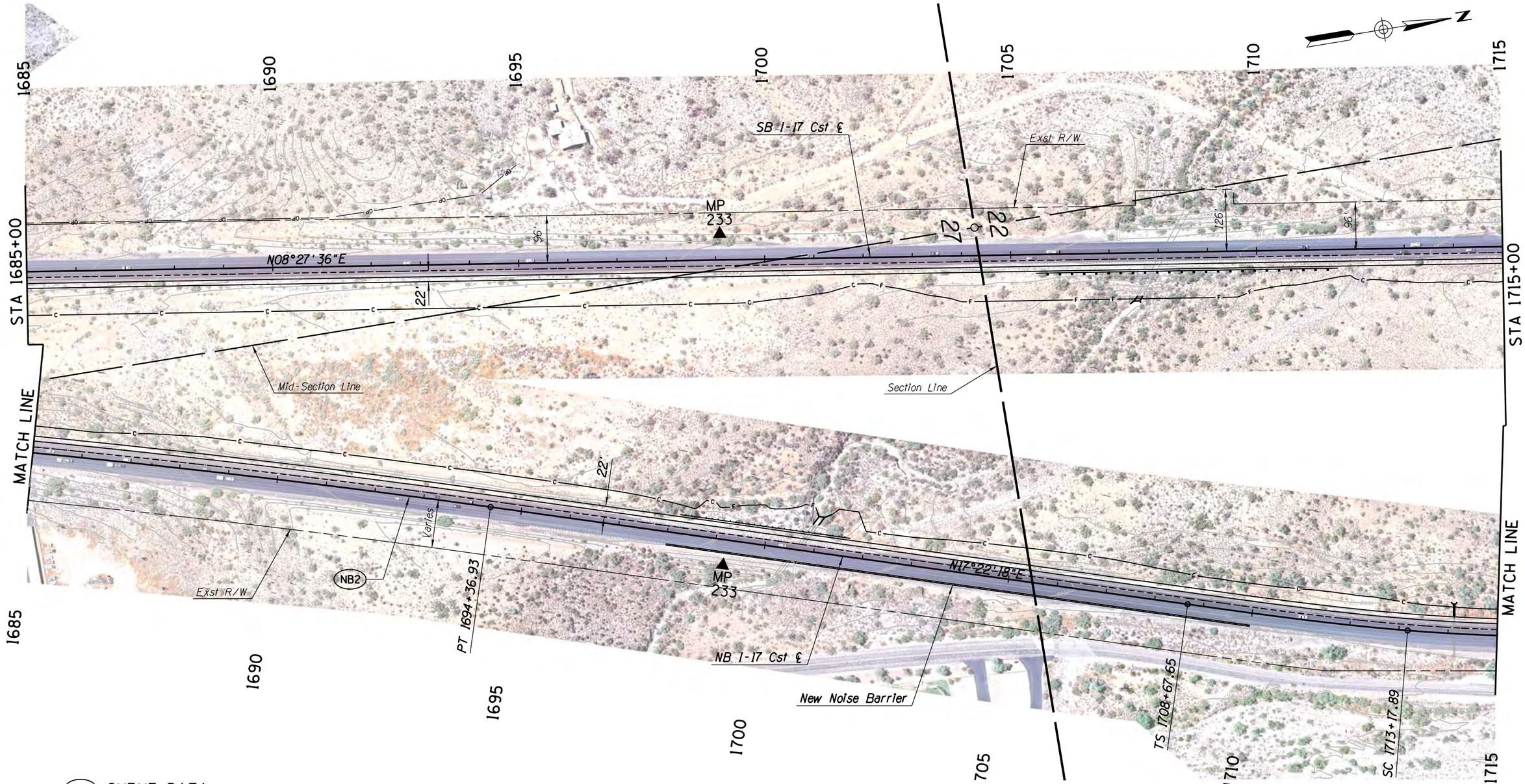
ROUTE	LOCATION	DWG NO. C-01.07
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_p07.dgn

DATE- | LOCATION- | REVISIONS- | FINISHED PLANS- | SURVEY NO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



NB2 CURVE DATA

PI Sta 1668+30.89

Main Curve
Δ=13°05'15" Rt
D=0°15'00"
R=22918.32'
L=5234.96'
T=2628.92'

Approach Spiral Curve
Δ=03°22'43"
L=450.24'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1685+00 TO STA 1715+00
NB STA 1685+00 TO STA 1715+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

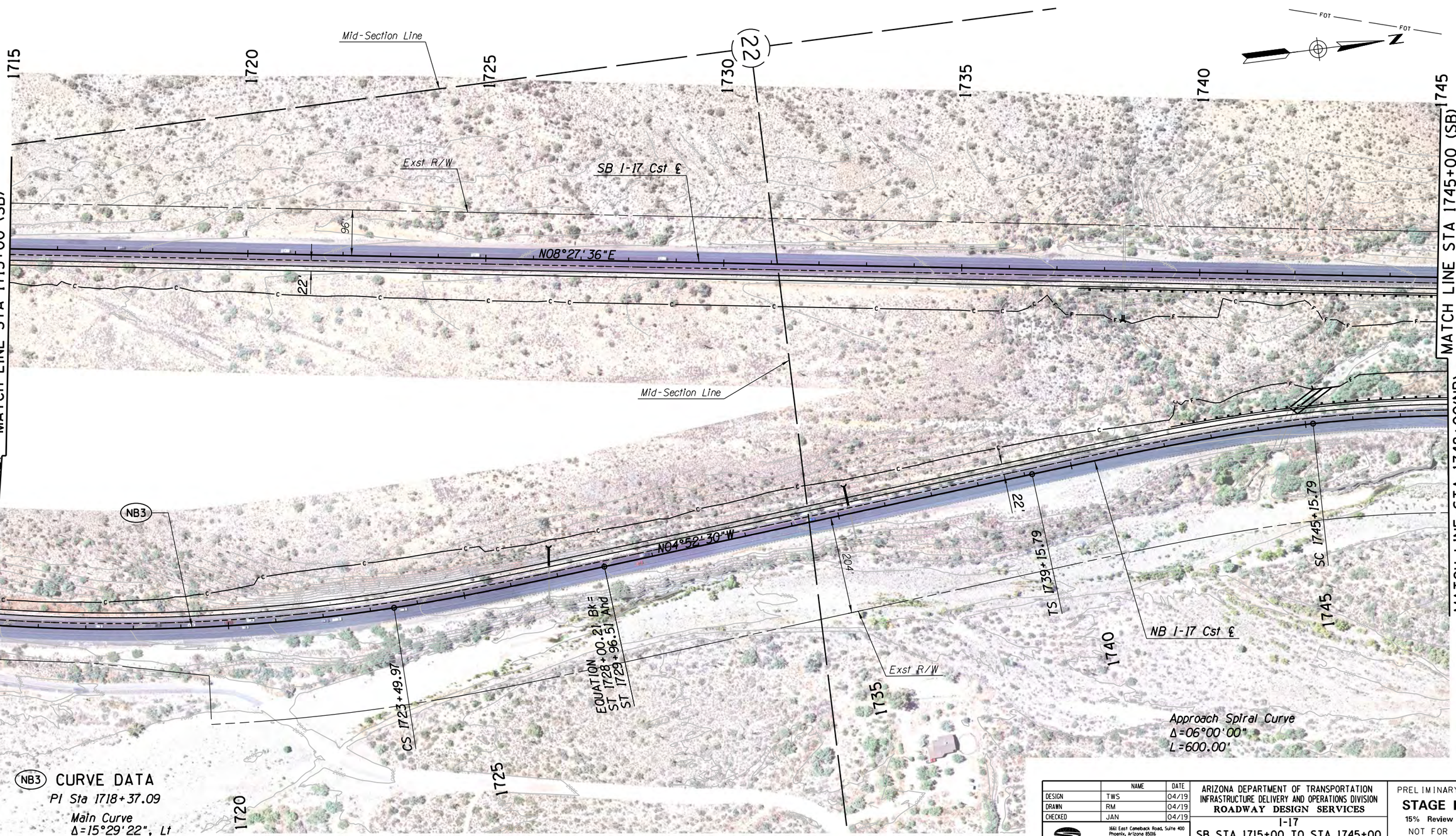
DWG NO. C-01.08

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p08.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 1715+00 TO STA 1745+00
NB STA 1715+00 TO STA 1748+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

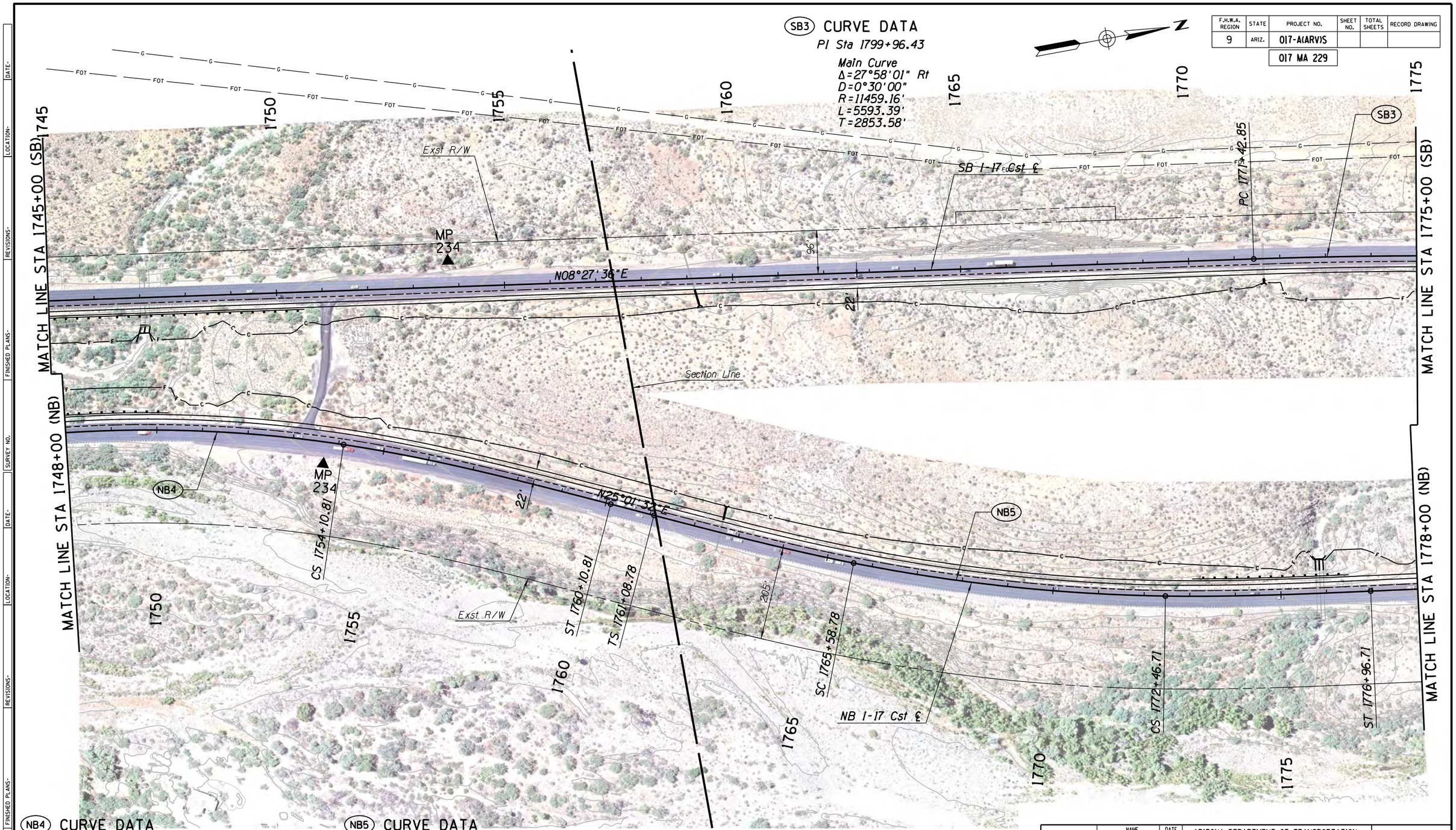
DWG NO. C-01.09

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p09.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



NB4 CURVE DATA
PI Sta 1749+66.98

Main Curve
Δ=17°54'01" Rt
D=02°00'00"
R=2864.79'
L=895.02'
T=451.18'

Departure Spiral Curve
Δ=06°00'00"
L=600.00'

NB5 CURVE DATA
PI Sta 1769+03.68

Main Curve
Δ=10°19'08" Lt
D=01°30'00"
R=3819.72'
L=687.93'
T=344.90'

Approach Spiral Curve
Δ=03°22'30"
L=450.00'

Departure Spiral Curve
Δ=03°22'30"
L=450.00'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES
I-17
SB STA 1745+00 TO STA 1775+00
NB STA 1748+00 TO STA 1778+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-01.10
I-17	ANTHEM WAY TI TO SUNSET POINT TI	___ OF ___
TRACS NO. H6800 01L		017-A(ARV)S

4/29/2019 ...\Stage 1 (DCR)\h6800_p10.dgn

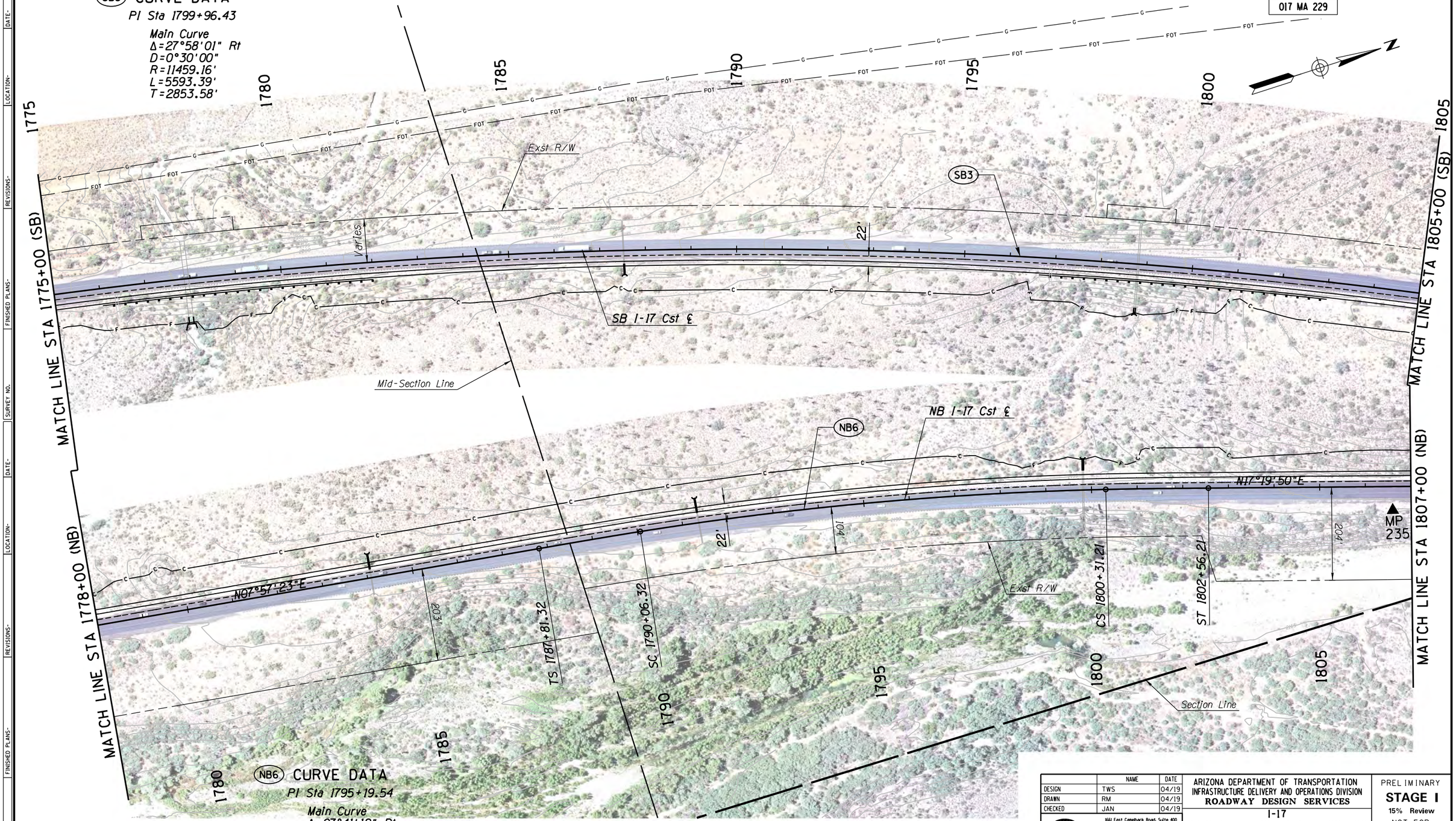
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

(SB3) CURVE DATA

PI Sta 1799+96.43

Main Curve
Δ=27°58'01" Rt
D=0°30'00"
R=11459.16'
L=5593.39'
T=2853.58'



(NB6) CURVE DATA

PI Sta 1795+19.54

Main Curve
Δ=07°41'12" Rt
D=00°45'00"
R=7639.44'
L=1024.89'
T=513.22'

Approach Spiral Curve
Δ=00°50'37"
L=225.00'

Departure Spiral Curve
Δ=00°50'37"
L=225.00'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1775+00 TO STA 1805+00
NB STA 1778+00 TO STA 1807+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.11

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p11.dgn

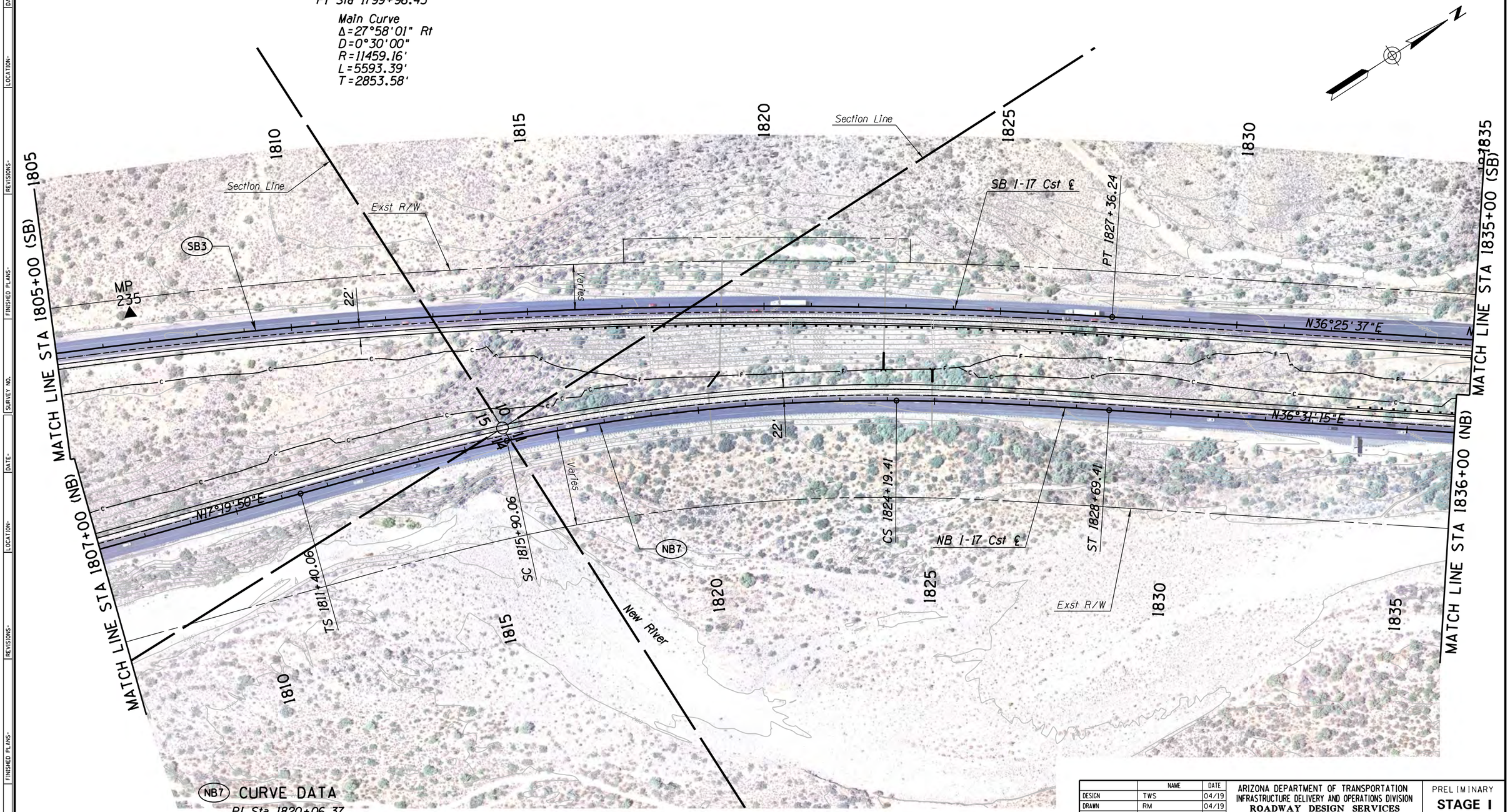
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

SB3 CURVE DATA

PI Sta 1799+96.43

Main Curve
Δ=27°58'01" Rt
D=0°30'00"
R=11459.16'
L=5593.39'
T=2853.58'



NB7 CURVE DATA

PI Sta 1820+06.37

Main Curve
Δ=12°26'25" Rt
D=01°30'00"
R=3819.72'
L=829.35'
T=416.31'

Approach Spiral Curve
Δ=3°22'30"
L=450.00'

Departure Spiral Curve
Δ=3°22'30"
L=450.00'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1805+00 TO STA 1835+00
NB STA 1807+00 TO STA 1836+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.12

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_pl2.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Approach Spiral Curve
Δ=3°00'00"
L=300.00'

SB4 CURVE DATA

PI Sta 1865+67.73

Main Curve
Δ=66°14'23" Lt
D=02°00'00"
R=2864.79'
L=3311.98'
T=1868.94'

TABLE MESA TI
MP 236.0

Transmission Tower

Exst R/W

Mid-Section Line

SB I-17 Cst ℄

TS 1843+98.79

SC 1846+98.79

SB4

MATCH LINE STA 1835+00 (SB)

MATCH LINE STA 1865+00 (SB)

MATCH LINE STA 1866+00 (NB)

MATCH LINE STA 1836+00 (NB)

N36°25'37"E

N36°31'15"E

Reduce inside shldr width under Bridge

TABLE MESA ROAD

MP 236

Exst Bridge To Remain

NB8

TS 1844+01.40

SC 1847+01.40

NB I-17 Cst ℄

New River

1835 1840 1845 1850 1855 1860 1865

NB8 CURVE DATA

PI Sta 1866+49.42

Approach Spiral Curve
Δ=02°15'00"
L=300.00'

Main Curve
Δ=54°02'32" Lt
D=01°30'00"
R=3819.72'
L=3602.82'
T=1948.02'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1835+00 TO STA 1865+00
NB STA 1836+00 TO STA 1866+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.13

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p13.dgn

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

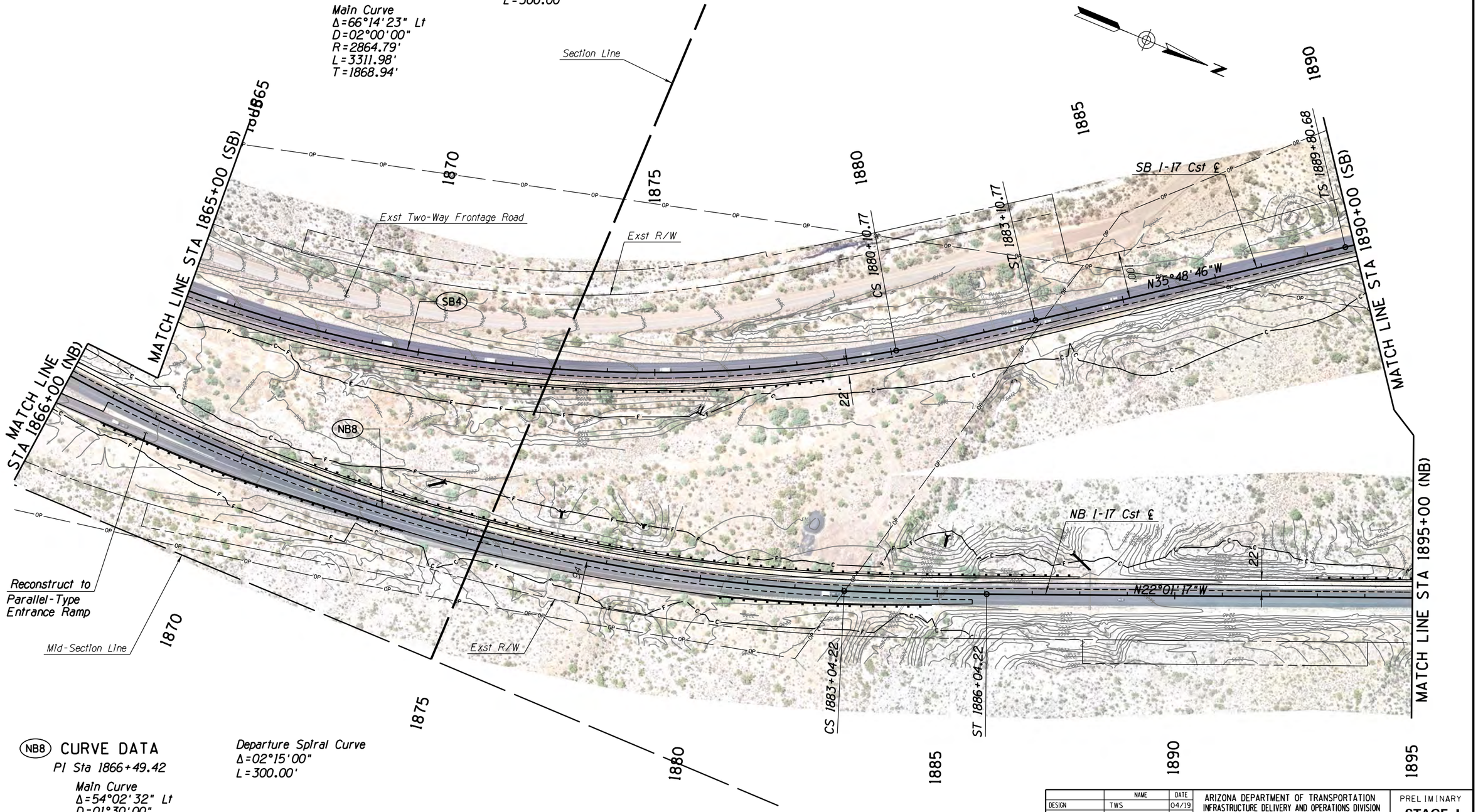
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB4 CURVE DATA

PI Sta 1865+67.73

Main Curve
Δ=66°14'23" Lt
D=02°00'00"
R=2864.79'
L=3311.98'
T=1868.94'

Departure Spiral Curve
Δ=3°00'00"
L=300.00'



NB8 CURVE DATA

PI Sta 1866+49.42

Main Curve
Δ=54°02'32" Lt
D=01°30'00"
R=3819.72'
L=3602.82'
T=1948.02'

Departure Spiral Curve
Δ=02°15'00"
L=300.00'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1865+00 TO STA 1890+00
NB STA 1866+00 TO STA 1895+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.14

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_pl4.dgn

DATE- | SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Approach Spiral Curve
Δ=01°00'00"
L=200.00'

SB5 CURVE DATA
PI Sta 1894+42.87

Main Curve
Δ=05°14'25" Rt
D=01°00'00"
R=5729.58'
L=524.02'
T=262.19'

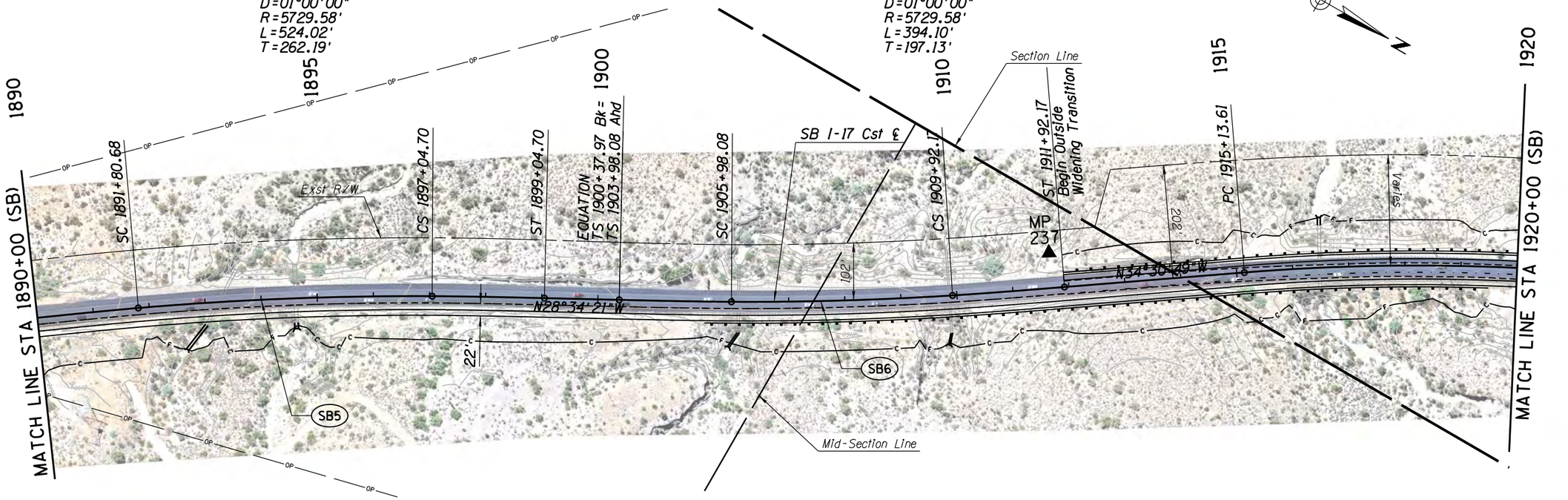
Departure Spiral Curve
Δ=01°00'00"
L=200.00'

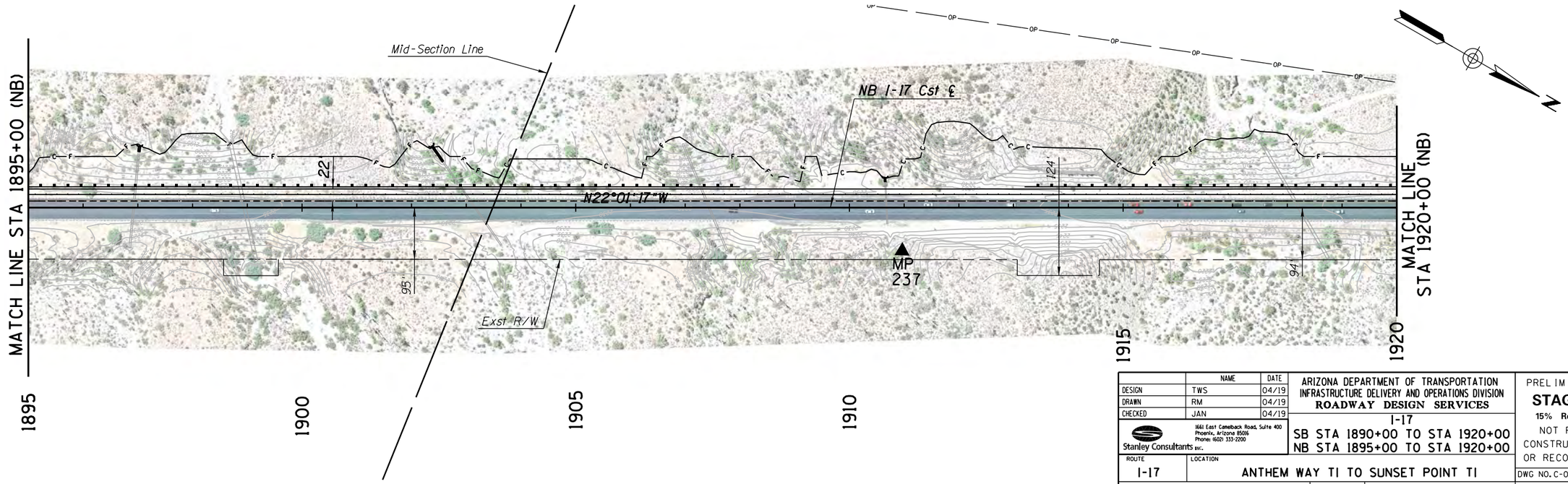
Approach Spiral Curve
Δ=01°00'00"
L=200.00'

SB6 CURVE DATA
PI Sta 1907+95.20

Main Curve
Δ=03°56'27" Lt
D=01°00'00"
R=5729.58'
L=394.10'
T=197.13'

Departure Spiral Curve
Δ=01°00'00"
L=200.00'





	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1890+00 TO STA 1920+00
NB STA 1895+00 TO STA 1920+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.15

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_pl5.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

SB7 CURVE DATA

PI Sta 1925+71.02

Main Curve
Δ=30°56'50" Rt
D=01°30'00"
R=3819.72'
L=2063.14'
T=1057.40'

Approach Spiral Curve
Δ=01°30'00"
L=300.00'

SB8 CURVE DATA

PI Sta 1949+60.64

Main Curve
Δ=06°34'32" Rt
D=01°00'00"
R=5729.58'
L=657.55'
T=329.14'

1920 1925 1930 1935 1940 1945 1950

MATCH LINE STA 1920+00 (SB)

SB7

Exst R/W

SB 1-17 Cst ℄

PT 1935+76.75
End Outside Widening Transition

Varies

Section Line

Exst R/W

N03°33'59"W

185'

215'

TS 1943+31.50

28'

SC 1946+31.50

SB8

MATCH LINE STA 1950+00 (SB)

N

MATCH LINE STA 1920+00 (NB)

Varies

PC 1921+75.69

NB9

22'

Varies

Exst R/W

NB 1-17 Cst ℄

Section Line

N00°40'02"W

100'

130'

PT 1943+11.12

125'

150'

100'

125'

MATCH LINE STA 1950+00 (NB)

N

Section Line

NB9 CURVE DATA

PI Sta 1932+55.94

Main Curve
Δ=21°21'15" Rt
D=01°00'00"
R=5729.58'
L=2135.43'
T=1080.25'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 1920+00 TO STA 1950+00
NB STA 1920+00 TO STA 1950+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.16

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_pl6.dgn

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB9 CURVE DATA
PI Sta 1972+30.65
Main Curve
Δ=27°30'22" Lt
D=01°15'00"
R=4583.66'
L=2200.48'
T=1121.87'

Departure Spiral Curve
Δ=01°30'00"
L=300.00'

Approach Spiral Curve
Δ=02°20'38"
L=375.00'

1950 1955 1960 1965 1970 1975 1980

MATCH LINE STA 1950+00 (SB)

CS 1952+89.05
ST 1955+89.05
TS 1957+33.78
SC 1961+08.78
Mid-Section Line
Exst R/W
New R/W (50' x 237')
SB I-17 CST ℄
SB9
N06°00'33"W
28'
186'
215'
MP 238
OP

MATCH LINE STA 1980+00 (SB)

Exst R/W

N

Section Line

MATCH LINE STA 1950+00 (NB)

New Drainage Easement (25' x 50')
Exst R/W
Shift Grader Road to South Side of Wash and Raise Profile Approx. 2'
Widen Bridge
N00°40'02"W
125'
100'
22'
150'
MP 238
NB I-17 Cst ℄
Exst R/W
Moores Gulch

MATCH LINE STA 1980+00 (NB)

Mid-Section Line

1950 1955 1960 1965 1970 1975 1980

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Comeback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES
I-17
SB STA 1950+00 TO STA 1980+00
NB STA 1950+00 TO STA 1980+00

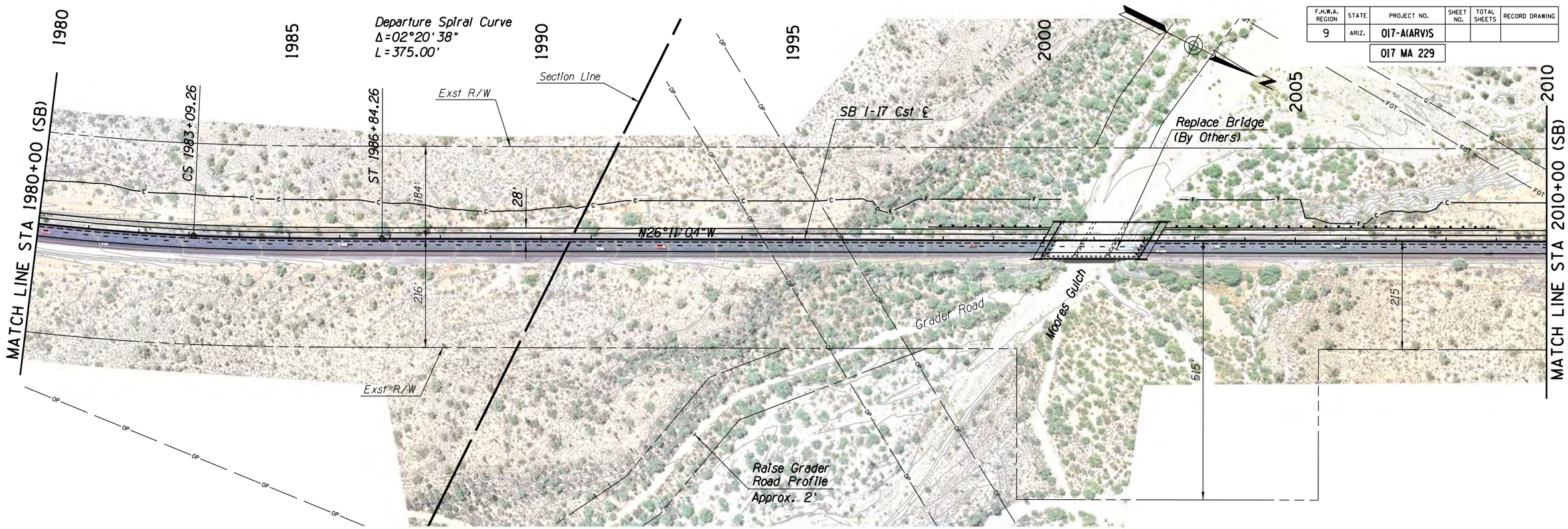
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

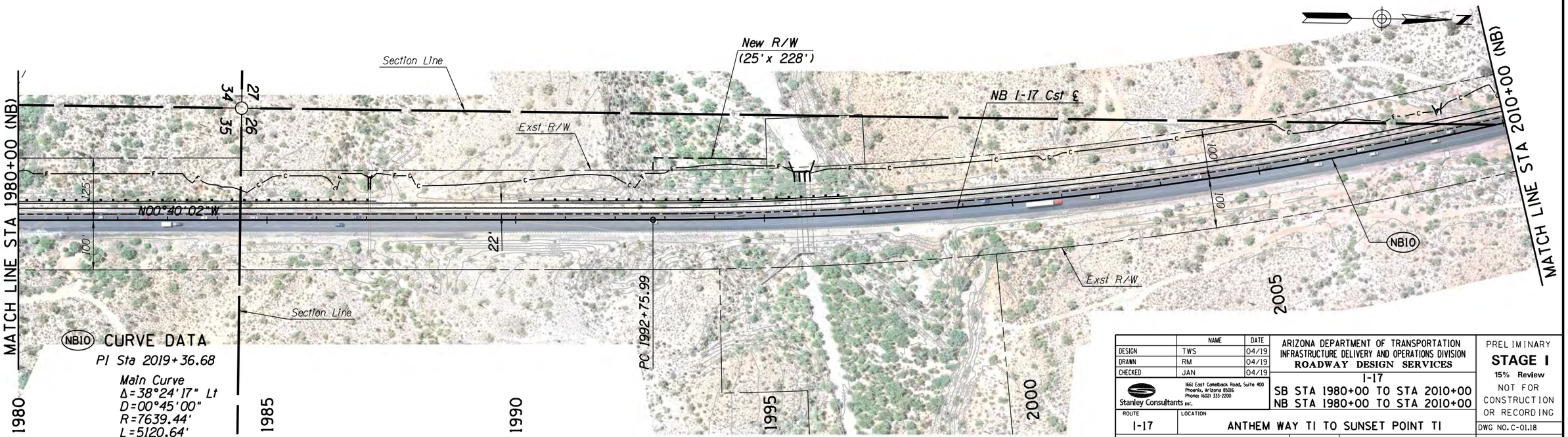
ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI
DWG NO. C-01.17

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_pl7.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			





NB10 CURVE DATA

PI Sta 2019+36.68

Main Curve
Δ=38°24'17" Lt
D=00°45'00"
R=7639.44'
L=5120.64'
T=2660.69'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 1980+00 TO STA 2010+00
NB STA 1980+00 TO STA 2010+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.18

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p18.dgn

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SBIO **CURVE DATA**

PI Sta 2025+38.47

Main Curve
Δ=03°57'40" Rt
D=00°15'00"
R=22918.32'
L=1584.47'
T=792.55'

2010 2015 2020 2025 2030 2035 2040

MATCH LINE STA 2010+00 (SB)

MATCH LINE STA 2040+00 (SB)

Mid-Section Line

Exst R/W

SB I-17 Cst ℄

PC 2017+45.92

PT 2033+30.39

MP 239

N26°11'04"W

N22°13'24"W

184'

216'

28'

SBIO

Mid-Section Line

Exst R/W

NBIO **CURVE DATA**

PI Sta 2019+36.68

Main Curve
Δ=38°24'17" Lt
D=00°45'00"
R=7639.44'
L=5120.64'
T=2660.69'

MATCH LINE STA 2010+00 (NB)

MATCH LINE STA 2040+00 (NB)

Mid-Section Line

New R/W
(50' x 987')

Exst R/W

NB I-17 Cst ℄

22'

100'

150'

MP 239

NBIO

Widen Bridge

Section Line

Section Line

Little Squaw Creek

2010 2015 2020 2025 2030 2035

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2010+00 TO STA 2040+00
NB STA 2010+00 TO STA 2040+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.19

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_pl9.dgn

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB11 CURVE DATA
PI Sta 2062+21.45
Main Curve
Δ=34°56'39" Rt
D=01°28'09"
R=3900.00'
L=2378.58'
T=1227.58'

MATCH LINE STA 2040+00 (SB)
+00 Match Exst
PC 2049+99.87
+00 Match Exst
Exst R/W
SB I-17 Cst ℄
SB11
MATCH LINE STA 2070+00 (SB)
N22°13'24"W
Exst Bridge To Remain
Little Squaw Creek
Section Line
Exst R/W
184'
216'
102'
134'
85'
28'
184'
216'
2040
2045
2050
2055
2060
2065

MATCH LINE STA 2040+00 (NB)
New Drainage Easement (40' x 80')
New Drainage Easement (125' x 50')
Section Line
Exst R/W
NB I-17 Cst ℄
New R/W (50' x 257')
N39°04'19"W
22'
100'
100'
PT 2043+96.63
PC 2051+45.13
Varies
Varies
Varies
MP 240
NB11
Exst R/W
Mid-Section Line
MATCH LINE STA 2070+00 (NB)
2040
2045
2050
2055
2060
2065

NB11 CURVE DATA
PI Sta 2071+75.94
Main Curve
Δ=39°01'59" Rt
D=01°00'00"
R=5729.58'
L=3903.30'
T=2030.80'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES
I-17
SB STA 2040+00 TO STA 2070+00
SB STA 2040+00 TO STA 2070+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI
DWG NO. C-01.20
TRACS NO. H6800 01L
017-A(ARV)S
___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p20.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

N

SB12 CURVE DATA

PI Sta 2107+04.87

Main Curve
Δ=29°35'14" Lt
D=02°00'00"
R=2864.79'
L=1479.37'
T=756.57'

NB11 CURVE DATA

PI Sta 2071+75.94

Main Curve
Δ=39°01'59" Rt
D=01°00'00"
R=5729.58'
L=3903.30'
T=2030.80'

MATCH LINE STA 2070+00 (SB)

MATCH LINE STA 2100+00 (SB)

MATCH LINE STA 2070+00 (NB)

MATCH LINE STA 2095+00 (NB)

MP 240

PT 2073+72.46

PC 2099+48.30
Begin Inside Widening Transition

PT 2090+48.43

Exst R/W

SB I-17 Cst ℄

NB I-17 Cst ℄

N12°43'16"E

N00°02'21"W

28'

184'

216'

22'

100'

Varies

Varies

Mid-Section Line

New R/W
(40' x 187')

New R/W
(50' x 616')

SB12

NB11

2070

2075

2080

2085

2090

2095

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2070+00 TO STA 2100+00
NB STA 2070+00 TO STA 2095+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.21

___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p21.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

(SB12) CURVE DATA

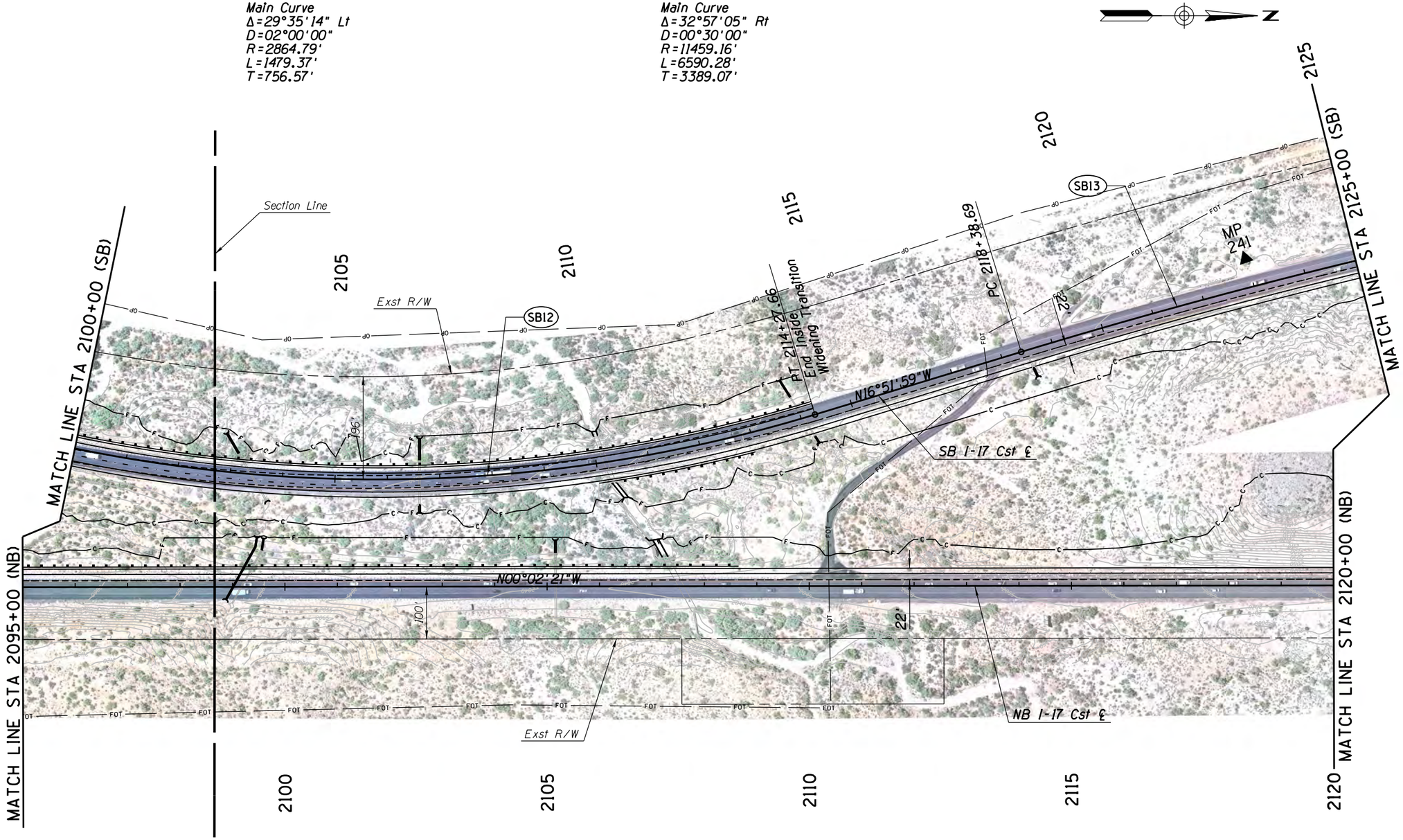
PI Sta 2107+04.87

Main Curve
Δ=29°35'14" Lt
D=02°00'00"
R=2864.79'
L=1479.37'
T=756.57'

(SB13) CURVE DATA

PI Sta 2152+27.76

Main Curve
Δ=32°57'05" Rt
D=00°30'00"
R=11459.16'
L=6590.28'
T=3389.07'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2100+00 TO STA 2125+00
NB STA 2095+00 TO STA 2120+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.22

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p22.dgn

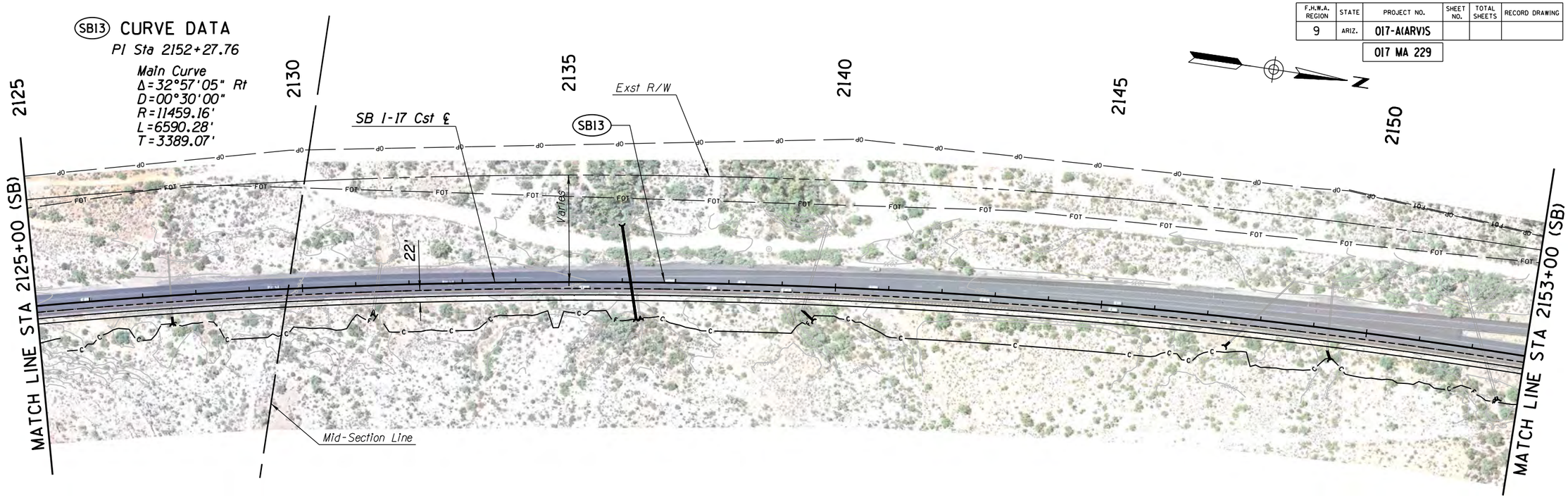
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

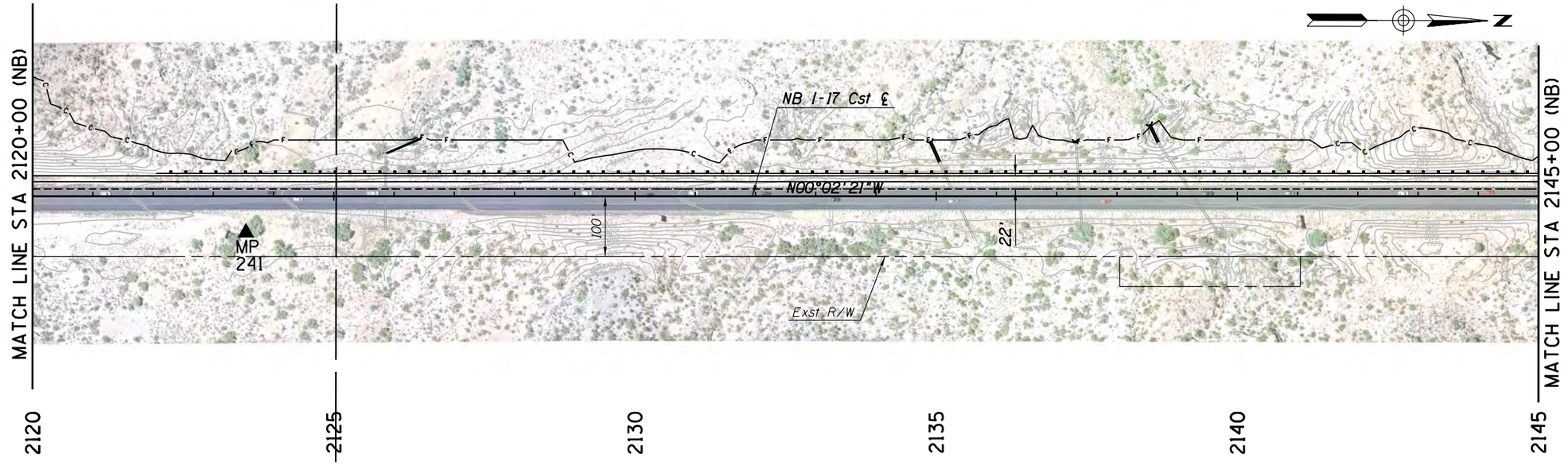
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

SB13 CURVE DATA

PI Sta 2152+27.76

Main Curve
Δ=32°57'05" Rt
D=00°30'00"
R=11459.16'
L=6590.28'
T=3389.07'





	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2125+00 TO STA 2153+00
NB STA 2120+00 TO STA 2145+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.23

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

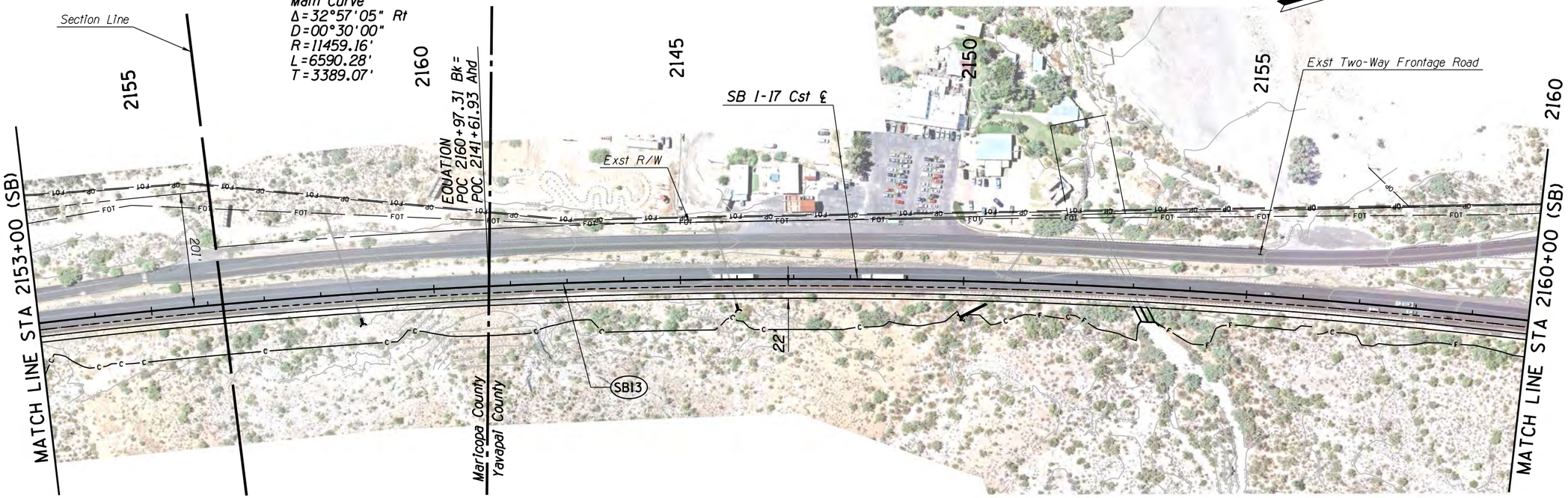
4/29/2019 ...\Stage I (DCR)\h6800_p23.dgn

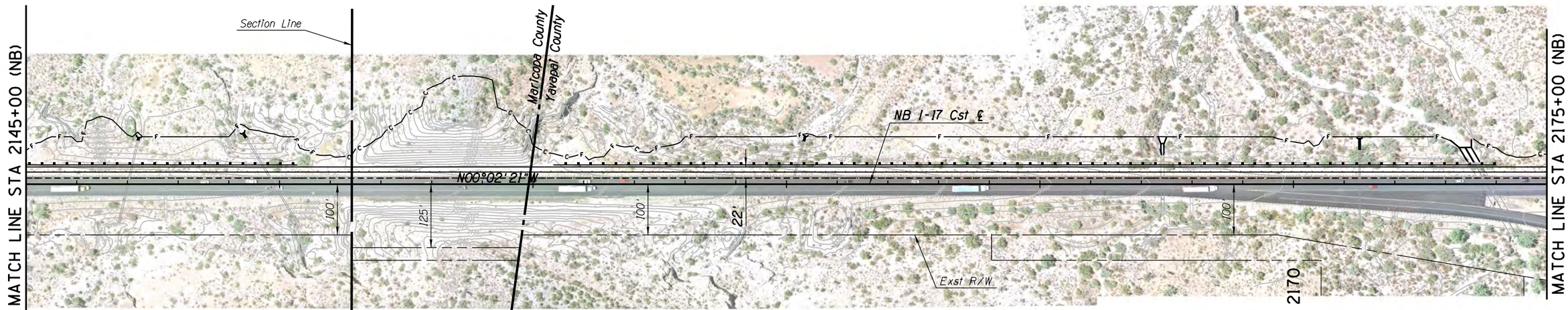
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB13 CURVE DATA

PI Sta 2152+27.76

Main Curve
Δ=32°57'05" Rt
D=00°30'00"
R=11459.16'
L=6590.28'
T=3389.07'





	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2153+00 TO STA 2160+00
NB STA 2145+00 TO STA 2175+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.24

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p24.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

N

ROCK SPRINGS TI
MP 242.2

Mid-Section Line

MATCH LINE STA 2160+00 (SB)

MP 242

PT 2164+93.50

Exst R/W

Exst Two-Way Frontage Road

Section Line

Adjust Roadway Crown to Maximize Vertical Clearance

N16°05'06"E

SB I-17 Cst ℄

VELDA ROSE RD

Exst Bridges To Remain

22'

MATCH LINE STA 2190+00 (SB)

MATCH LINE STA 2175+00 (NB)

N00°02'21"W

MP 242

22'

Adjust Roadway Crown to Maximize Vertical Clearance

PC 2183+85.09

NB I-17 Cst ℄

NBI2

EQUATION
PT 2199+97.50 Bk =
PT 2186+81.46 Ahd

Exst R/W

MATCH LINE STA 2190+00 (NB)

Exst R/W

Exst Two-Way Frontage Road

Mid-Section Line

2160 2165 2170 2175 2180 2185 2190 2195

NBI2 CURVE DATA

PI Sta 2191+96.66

Main Curve
Δ=16°07'27" Rt
D=01°00'00"
R=5729.58'
L=1612.41'
T=811.57'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

I-17
SB STA 2160+00 TO STA 2190+00
NB STA 2175+00 TO STA 2190+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.25

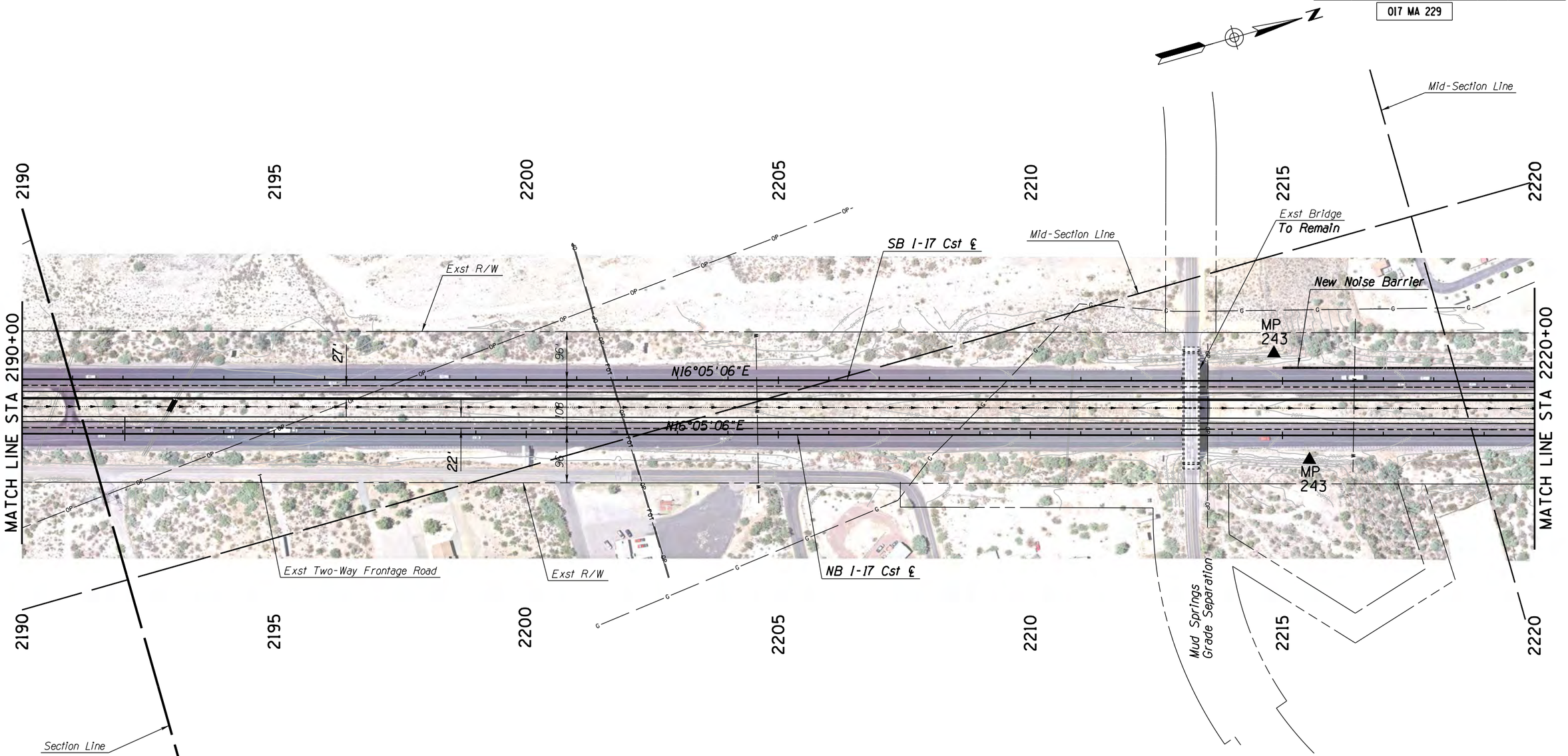
___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p25.dgn

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2190+00 TO STA 2220+00
NB STA 2190+00 TO STA 2220+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S | DWG NO. C-01.26 | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p26.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

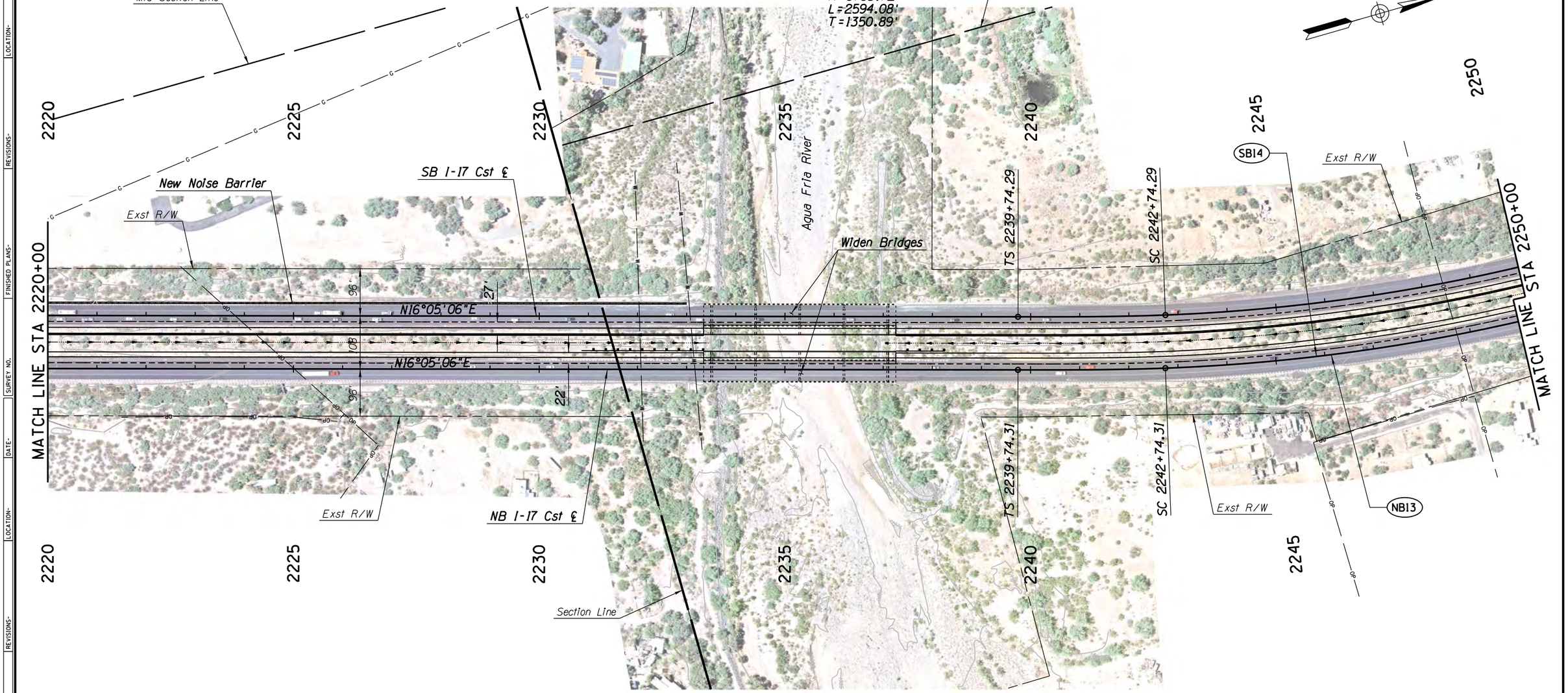
SURVEY NO. | DATE- | LOCATION- | REVISIONS- | FINISHED PLANS-

Approach Spiral Curve
Δ=02°16'56"
L=300.00'

(SB14) CURVE DATA

PI Sta 2256+25.18

Main Curve
Δ=39°28'09" Lt
D=01°31'17"
R=3765.72'
L=2594.08'
T=1350.89'



Approach Spiral Curve
Δ=02°13'07"
L=300.00'

(NB13) CURVE DATA

PI Sta 2256+68.79

Main Curve
Δ=39°35'47" Lt
D=01°28'45"
R=3873.72'
L=2677.08'
T=1394.49'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2220+00 TO STA 2250+00
NB STA 2220+00 TO STA 2250+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.27

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p27.dgn

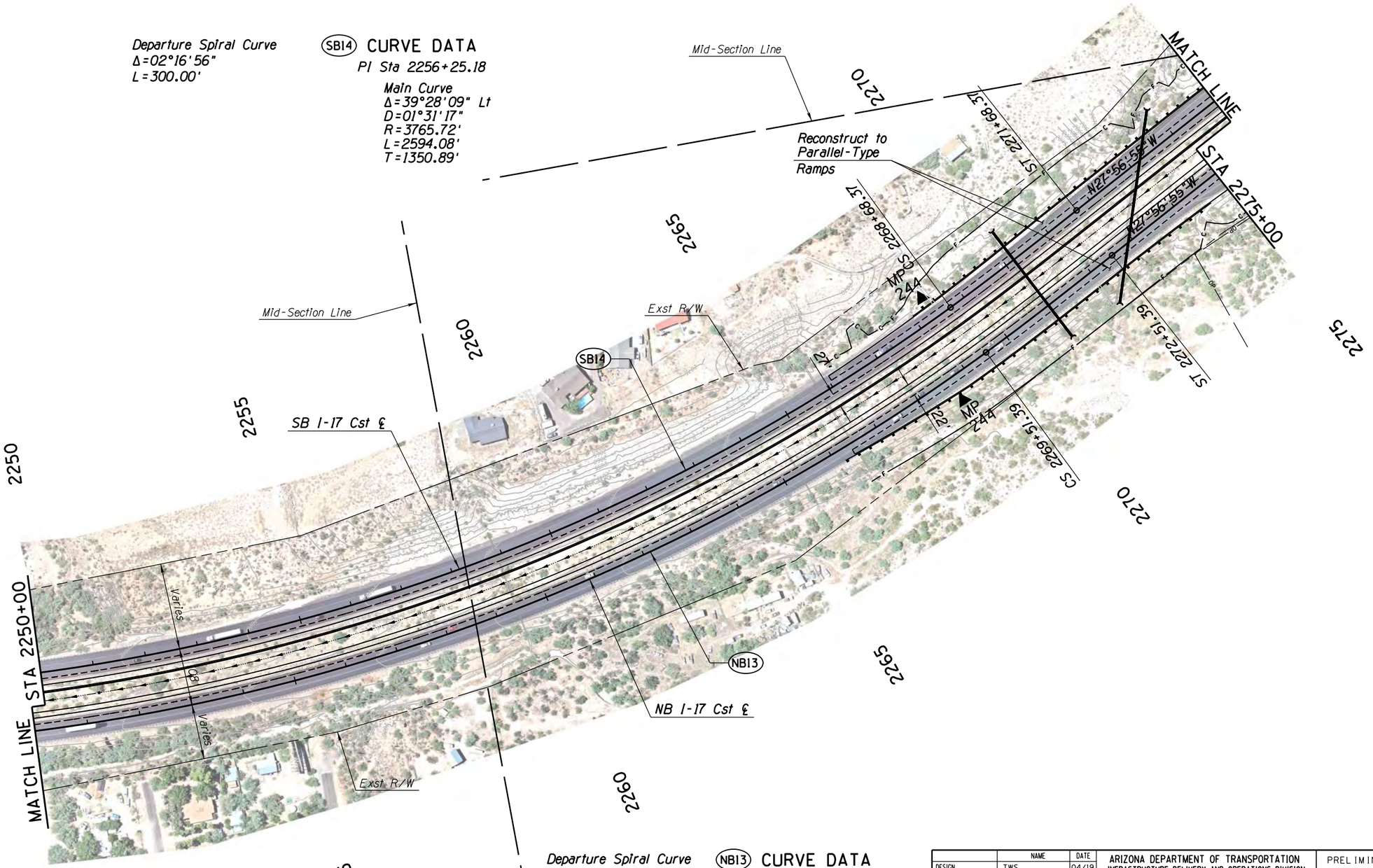
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

Departure Spiral Curve
Δ=02°16'56"
L=300.00'

(SB14) CURVE DATA
PI Sta 2256+25.18

Main Curve
Δ=39°28'09" Lt
D=01°31'17"
R=3765.72'
L=2594.08'
T=1350.89'



Departure Spiral Curve
Δ=02°13'07"
L=300.00'

(NB13) CURVE DATA
PI Sta 2256+68.79

Main Curve
Δ=39°35'47" Lt
D=01°28'45"
R=3873.72'
L=2677.08'
T=1394.49'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2250+00 TO STA 2275+00
NB STA 2250+00 TO STA 2275+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.28

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p28.dgn

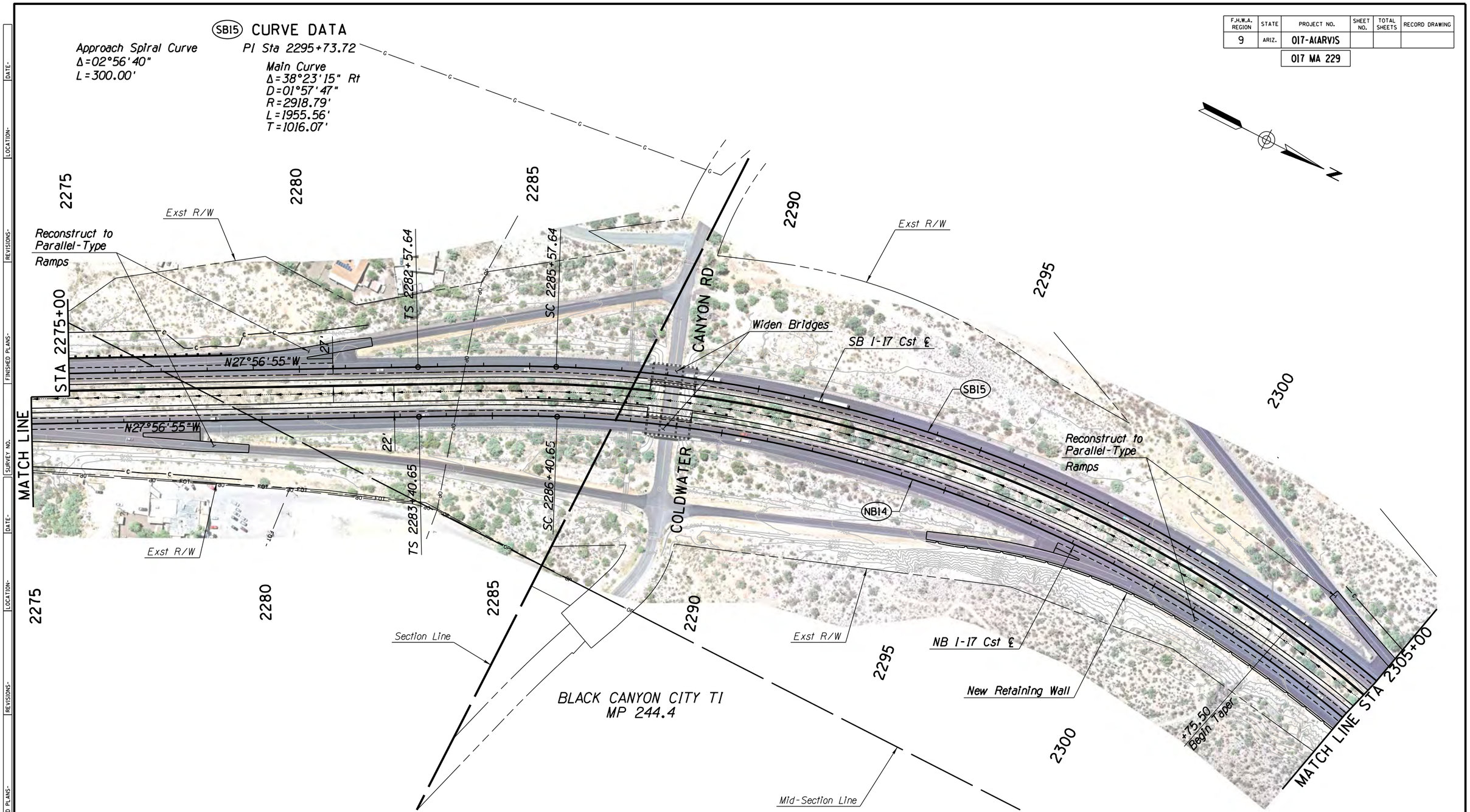
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB15 CURVE DATA

Approach Spiral Curve
Δ=02°56'40"
L=300.00'

PI Sta 2295+73.72

Main Curve
Δ=38°23'15" Rt
D=01°57'47"
R=2918.79'
L=1955.56'
T=1016.07'



NB14 CURVE DATA

Approach Spiral Curve
Δ=03°03'27"
L=300.00'

PI Sta 2296+12.91

Main Curve
Δ=38°09'41" Rt
D=02°02'18"
R=2810.79'
L=1872.10'
T=972.26'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2275+00 TO STA 2305+00
NB STA 2275+00 TO STA 2305+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.29

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p29.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Departure Spiral Curve
Δ=02°56'40"
L=300.00'

SB16 CURVE DATA

PI Sta 2318+14.77

Main Curve
Δ=13°17'00" Lt
D=1°12'00"
R=4775.00'
L=1107.04'
T=556.01'

Departure Spiral Curve
Δ=01°47'60"
L=300.00'

2305 2310 2315 2320 2325 2330

MATCH LINE STA 2305+00

CS 2305+13.20

ST 2308+13.20

+10.00 Variable HT Barrier

+55.80 End Taper

PC 2312+58.76

Exst R/W

+55.26 Begin Taper

Variable Ht Median Barrier

SB I-17 Cst ℄

Begin I-17 FL Cst ℄ Sta 100+00.00 = 38.00' Rt I-17 SB Cst ℄ Sta 2326+65.80

N16°19'40"E

27'

22'

206'

SB16

MP 245

CS 2323+65.80

ST 2326+65.80

+65.49 End Taper

N01°14'40"E

CS 2305+12.75

+85 Begin Taper

ST 2308+12.75

+35 End Taper

28'

96'

PC 2311+70.48

NB15

MP 245

N03°41'44"E

STA 2330+00

MATCHLINE

New Retaining Wall

Exst R/W

100

227'

PT 2324+45.61 Begin Full Reconstruction

NB I-17 Cst ℄

Departure Spiral Curve
Δ=03°03'27"
L=300.00'

Mid-Section Line

Reconstruct to Parallel-Type Ramps

Mid-Section Line

Begin NB South Crossover
Cst ℄ PC Sta 10+00.00 = 24' Lt
I-17 NB ℄ Sta 2324+45.61

NB15 CURVE DATA

PI Sta 2318+10.64

Main Curve
Δ=12°37'56" Lt
D=00°59'26"
R=5783.58'
L=1275.13'
T=640.16'

100 CURVE DATA

PI Sta 14+95.75

Main Curve
Δ=05°56'36" Lt
D=00°36'00"
R=9550.00'
L=990.62'
T=495.75'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2305+00 TO STA 2330+00
NB STA 2305+00 TO STA 2330+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.30

____ OF ____

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p30.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

Approach Spiral Curve
Δ=03°59'60"
L=400.00'

SB17 CURVE DATA
PI Sta 2354+59.11

Main Curve
Δ=12°11'16", Lt
D=02°00'00"
R=2864.79'
L=609.39'
T=305.85'

2330 2335 2340 2345 2350

I-17 R2L Cst ℄

Retaining Wall

Exst R/W

SB I-17 Cst ℄

+00.00 Begin Retaining Wall

Smart Cushion

MATCHLINE STA 2330+00

MATCHLINE STA 2355+00

N01°14'40"E

TS 2347+53.26

SC 2351+53.26

SB17

200

101

N03°41'44"E

PRC 19+90.62

PC 2335+43.90

PT 26+97.70

TS 120+87.46

SC 124+87.46

End NB South Crossover Cst ℄ Sta 26+97.70=
I-17 FL Cst ℄ Sta 114+49.63=
38.00' Rt I-17 SB Cst ℄ Sta 2341+15.42

NB16

Exst R/W

N29°23'22"E

PT 2341+86.25

TS 2345+18.90

SC 2349+18.90

NB I-17 Cst ℄

MP 246

ST 2361+47.09

CS 2357+47.09

NB17

Departure Spiral Curve
Δ=08°00'00"
L=400.00'

NB South Crossover Cst ℄

Section Line

END NB CONSTRUCTION
NB- I-17 STA 2361+47.09

101 CURVE DATA
PI Sta 23+44.32

Main Curve
Δ=04°14'32" Rt
D=00°36'00"
R=9550.00'
L=707.09'
T=353.70'

Approach Spiral Curve
Δ=03°56'51"
L=400.00'

NB16 CURVE DATA
PI Sta 2338+70.57

Main Curve
Δ=25°41'38" Rt
D=04°00'00"
R=1432.40'
L=642.35'
T=326.67'

200 CURVE DATA
PI Sta 128+00.05

Main Curve
Δ=12°17'33" Lt
D=01°58'26"
R=2902.79'
L=622.78'
T=312.59'

Departure Spiral Curve
Δ=03°56'51"
L=400.00'

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

NB17 CURVE DATA
PI Sta 2353+44.93

Main Curve
Δ=33°07'40" Rt
D=04°00'00"
R=1432.40'
L=828.20'
T=426.03'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2330+00 TO STA 2355+00
NB STA 2330+00 TO STA 2361+47.09

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.31

4/29/2019 ...\Stage 1 (DCR)\h6800_p31.dgn

SURVEY NO.	FINISHED PLANS	REVISIONS	LOCATION	DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Departure Spiral Curve
Δ=04°00'00"
L=400.00'

Approach Spiral Curve
Δ=04°30'00"
L=300.00'

(SB18) CURVE DATA
PI Sta 2370+53.80

Main Curve
Δ=21°03'22", Rt
D=03°00'00"
R=1909.86'
L=701.87'
T=354.94'

Departure Spiral Curve
Δ=04°30'00"
L=300.00'

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

N

2355 2360 2365 2370 2375 2380

SB I-17 Cst ℄

SB18

New Retaining Wall

CS 2357+62.65

ST 2361+62.65

TS 2363+98.86

194'

SC 2366+98.86

42'

CS 2374+00.74

ST 2377+00.74

TS 2377+68.45

MP 246

N18°56'36"W

N18°56'36"W

+98.86
End Retaining Wall

End I-17 FL Cst ℄ Sta 137+46.46 =
38.00' Rt I-17 Cst ℄ Sta 2363+98.86

N11°06'41"E

MATCHLINE STA 2355+00

MATCHLINE STA 2380+00

I-17 FL Cst ℄

CS 131+10.24

ST 135+10.24

135

Mid-Section Line

N19°44'18"W

200'

TS 2376+00.88

SC 2379+00.88

NB I-17 Cst ℄

Exst R/W

Mid-Section Line

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2355+00 TO STA 2380+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-01.32
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV)S ___ OF ___

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

SB19 CURVE DATA

PI Sta 2385+85.42

Main Curve
Δ=32°27'37" Lt
D=04°00'00"
R=1432.40'
L=811.51'
T=416.97'

Departure Spiral Curve
Δ=08°00'00"
L=400.00'

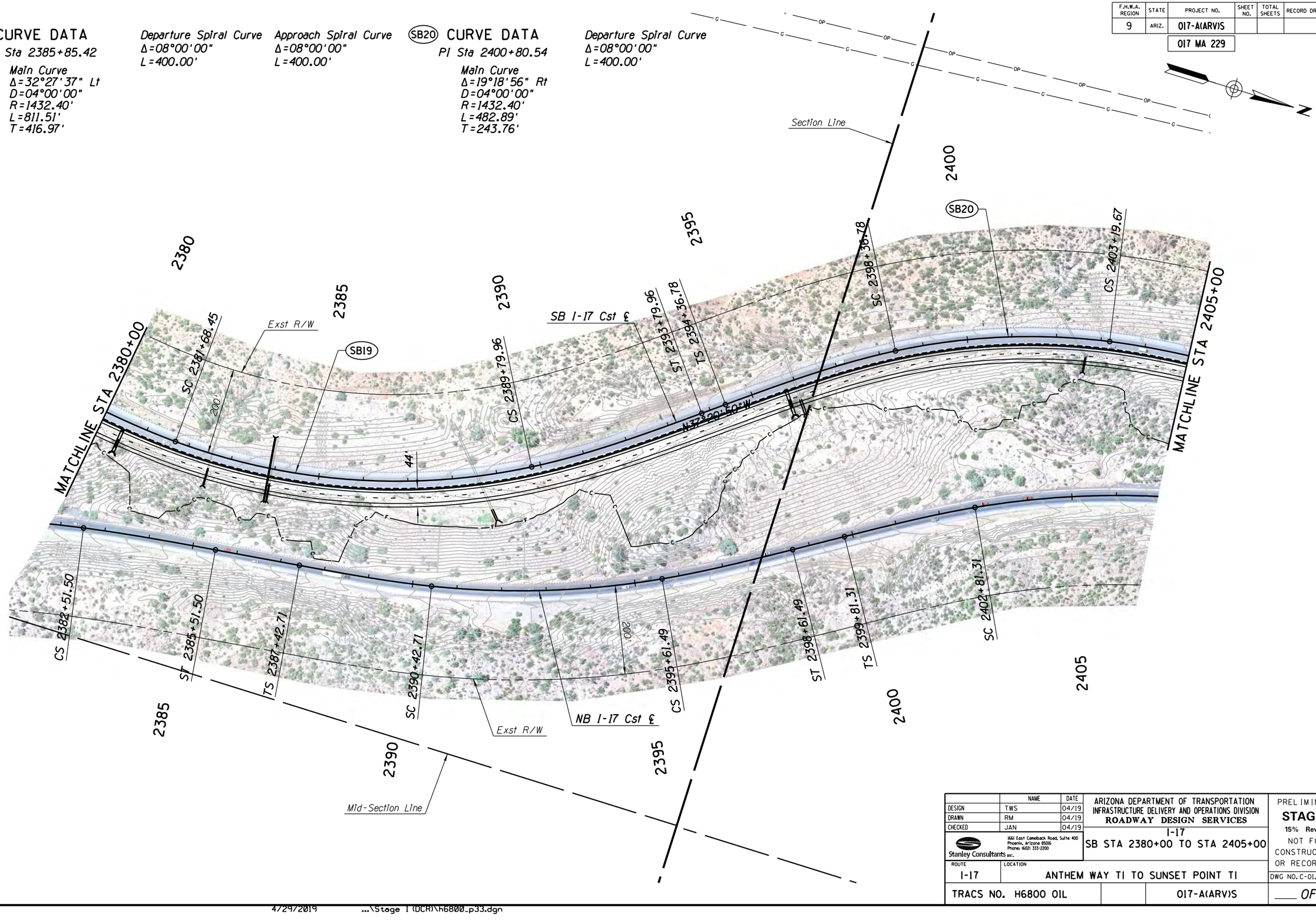
Approach Spiral Curve
Δ=08°00'00"
L=400.00'

SB20 CURVE DATA

PI Sta 2400+80.54

Main Curve
Δ=19°18'56" Rt
D=04°00'00"
R=1432.40'
L=482.89'
T=243.76'

Departure Spiral Curve
Δ=08°00'00"
L=400.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2380+00 TO STA 2405+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO.
I-17	ANTHEM WAY TI TO SUNSET POINT TI	C-01.33
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_p33.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Approach Spiral Curve
Δ=04°30'00"
L=300.00'

SB21 CURVE DATA
PI Sta 2417+64.60

Main Curve
Δ=02°03'39" Rt
D=03°00'00"
R=1909.86'
L=68.69'
T=34.35'

Departure Spiral Curve
Δ=04°30'00"
L=300.00'

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2405+00 TO STA 2430+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.34

___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p34.dgn

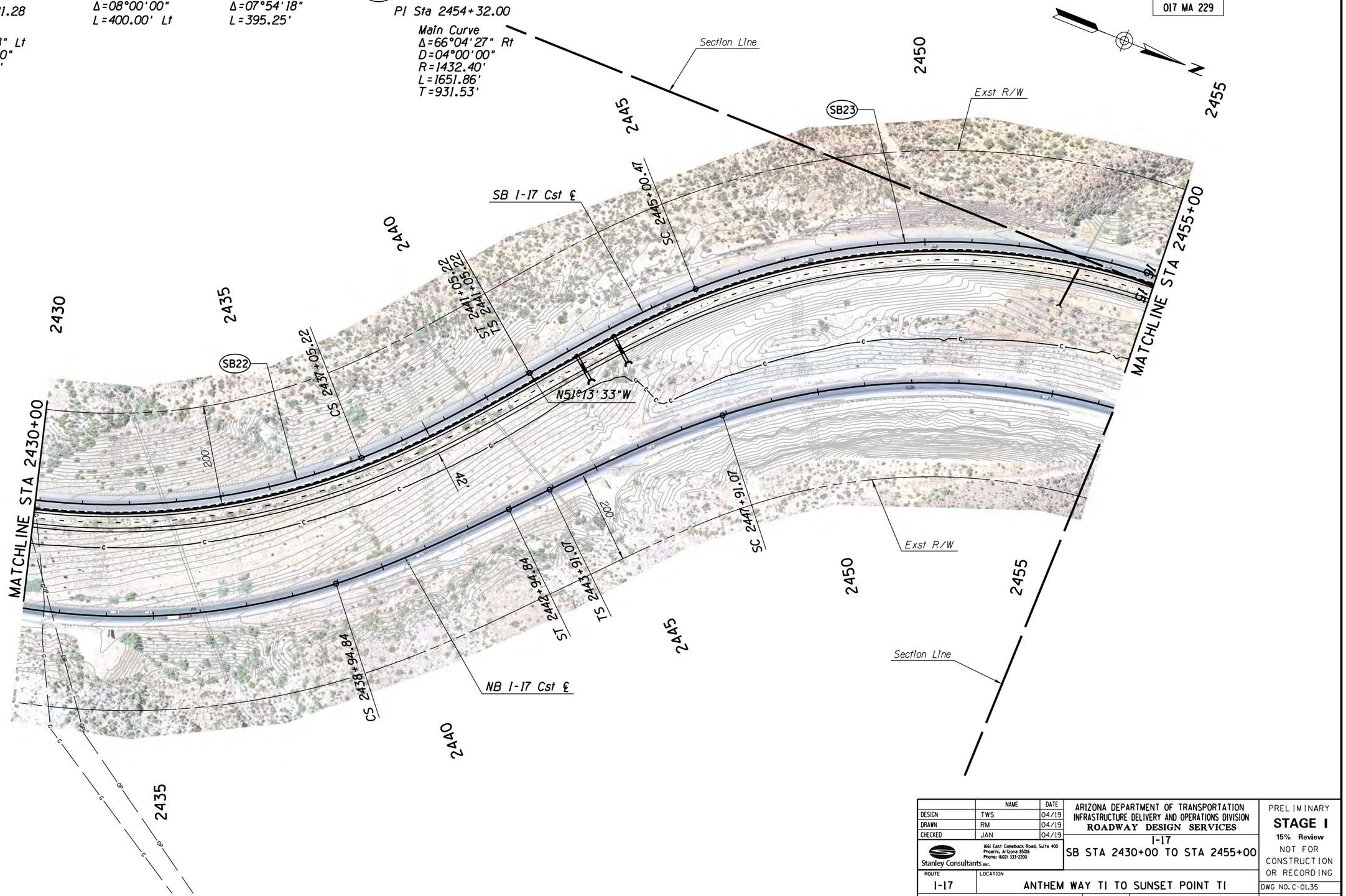
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

(SB22) CURVE DATA
PI Sta 2431+81.28
Main Curve
Δ=44°15'18" Lt
D=04°00'00"
R=1432.40'
L=1106.38'
T=582.44'

Departure Spiral Curve
Δ=08°00'00"
L=400.00' Lt

Approach Spiral Curve
Δ=07°54'18"
L=395.25'

(SB23) CURVE DATA
PI Sta 2454+32.00
Main Curve
Δ=66°04'27" Rt
D=04°00'00"
R=1432.40'
L=1651.86'
T=931.53'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2430+00 TO STA 2455+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L
017-A(ARV)S
____ OF ____

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING
DWG NO. C-01.35

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p35.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB23 CURVE DATA
PI Sta 2454+32.00
Main Curve
Δ=66°04'27" Rt
D=04°00'00"
R=1432.40'
L=1651.86'
T=931.53'

Departure Spiral Curve
Δ=08°00'00"
L=400.00'

Approach Spiral Curve
Δ=03°03'45"
L=350.00'

SB24 CURVE DATA
PI Sta 2480+51.76
Main Curve
Δ=36°14'15" Lt
D=01°45'00"
R=3274.05'
L=2070.71'
T=1071.31'

Section Line
Section Line
SB23
SB24
MATCHLINE STA 2455+00
MATCHLINE STA 2480+00
CS 2464+52.33
ST 2465+52.33
TS 2466+30.45
SC 2469+80.45
SB I-17 Cst ℄
MP 248
N30°45'12"E
200'
42'
Exst R/W
CS 2464+83.37
ST 2468+83.37
TS 2469+19.29
SC 2472+94.29
NB I-17 Cst ℄
200'
CS 2478+66.84
2455
2460
2465
2470
2475
2480

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES
I-17
SB STA 2455+00 TO STA 2480+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO.
I-17	ANTHEM WAY TI TO SUNSET POINT TI	C-01.36
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p36.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB24 CURVE DATA
PI Sta 2480+51.76
Main Curve
Δ=36°14'15" Lt
D=01°45'00"
R=3274.05'
L=2070.71'
T=1071.31'

Departure Spiral Curve
Δ=03°03'45"
L=350.00'

Approach Spiral Curve
Δ=01°30'00"
L=300.00'

BUMBLE BEE TI
MP 248.8

Section Line

Bumble Bee Ramp D Cst ℄

MATCHLINE STA 2480+00

MATCHLINE STA 2505+00

SB24

Exst R/W

PT 20+57.59

200'

CS 2490+51.16

PC 6+89.20

PT 8+92.51

ST 2494+01.16

PC 7+20.69

42'

+00 Full Reconstruction

PT 4+33.80

PC 0+83.28

POB 0+00.00

TS 2502+98.68

N11°36'33"W

PT 24+06.47

Replace Bridge

PC 27+66.39

PT 30+57.35

28'

+00 Full Reconstruction

Bumble Bee Rd Cst ℄

SB I-17 Cst ℄

ST 2482+41.84

TS 2487+76.86

PT 38+90.92

PC 36+85.25

SC 2490+76.86

Exst R/W

Mid-Section Line

NB I-17 Cst ℄

CS 2499+65.13

2480 20 2485 15 2490 10 2495 5 2500 2505

2485 2490 2495

30 35 40

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2480+00 TO STA 2505+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.37

___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800_p37.dgn

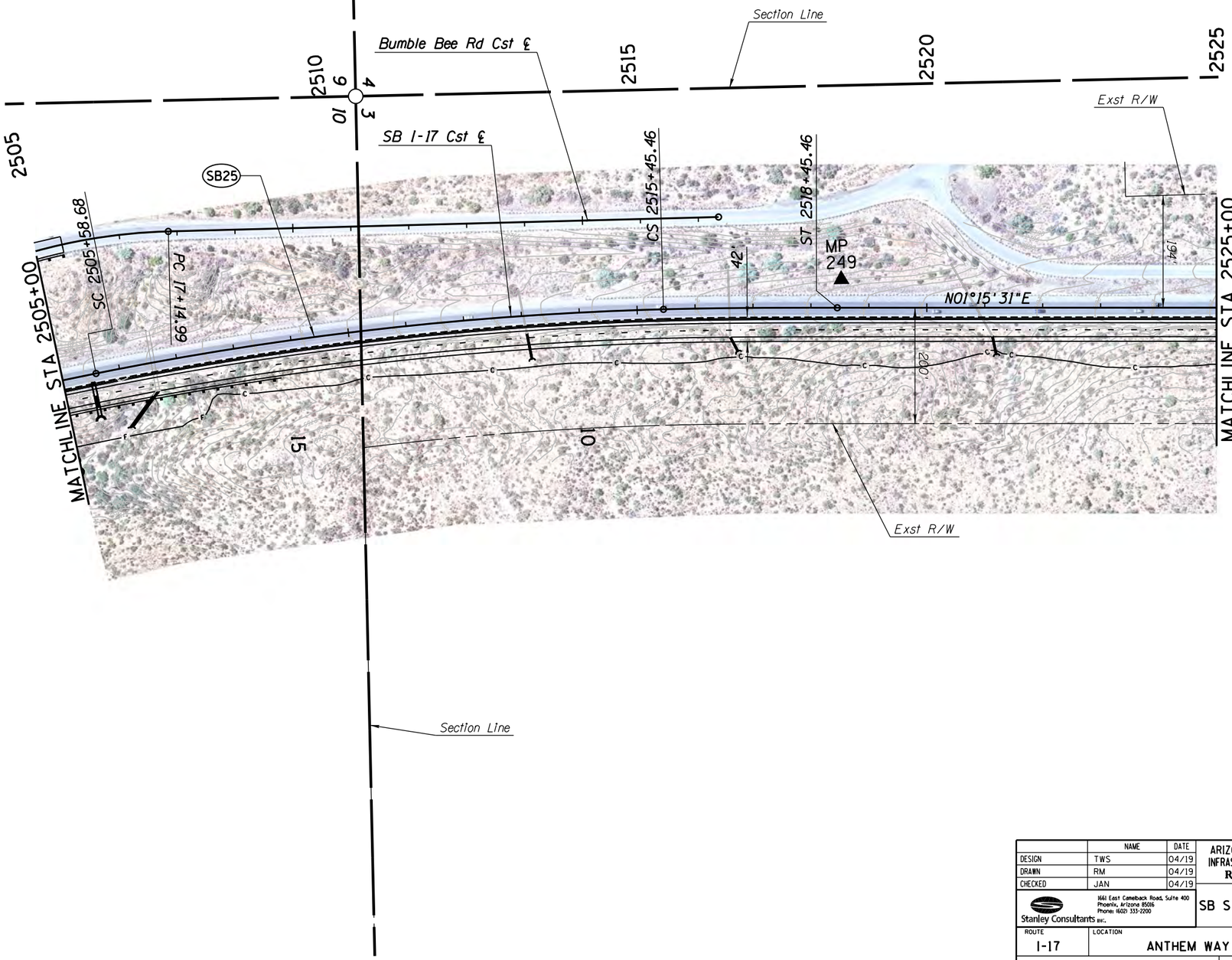
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SB25 **CURVE DATA**

PI Sta 2510+62.29

Main Curve
Δ=09°52'04" Rt
D=01°00'00"
R=5729.58'
L=986.77'
T=494.61'

Departure Spiral Curve
Δ=01°30'00"
L=300.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2505+00 TO STA 2525+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV)S

DWG NO. C-01.38

____ OF ____

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p38.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

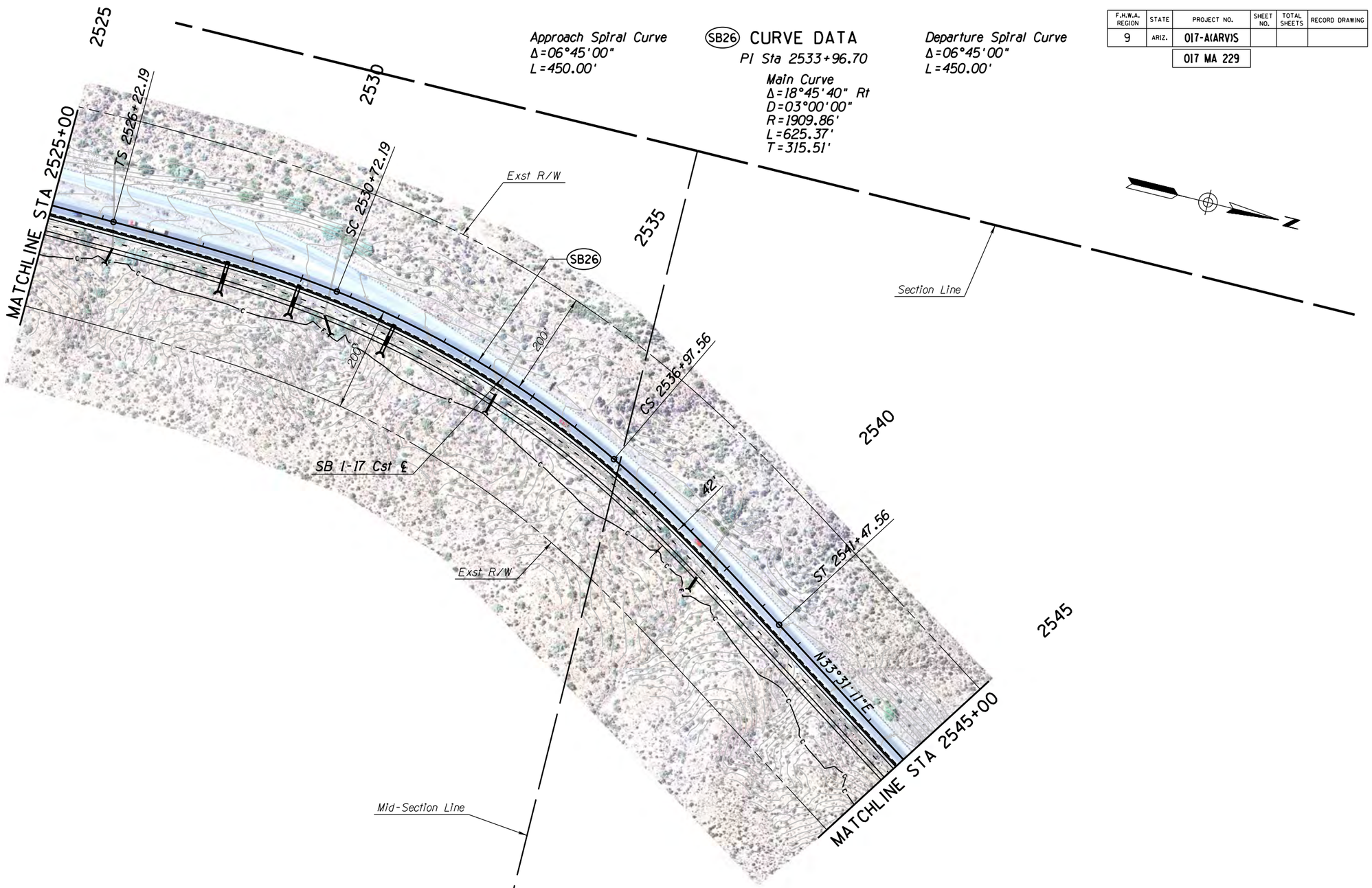
SB26 CURVE DATA

Approach Spiral Curve
Δ=06°45'00"
L=450.00'

PI Sta 2533+96.70

Main Curve
Δ=18°45'40" Rt
D=03°00'00"
R=1909.86'
L=625.37'
T=315.51'

Departure Spiral Curve
Δ=06°45'00"
L=450.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2525+00 TO STA 2545+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-01.39
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage 1 (DCR)\h6800_p39.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

(SB27) CURVE DATA
PI Sta 2552+39.68

Main Curve
Δ=24°09'39" Lt
D=04°00'00"
R=1432.40'
L=604.02'
T=306.57'

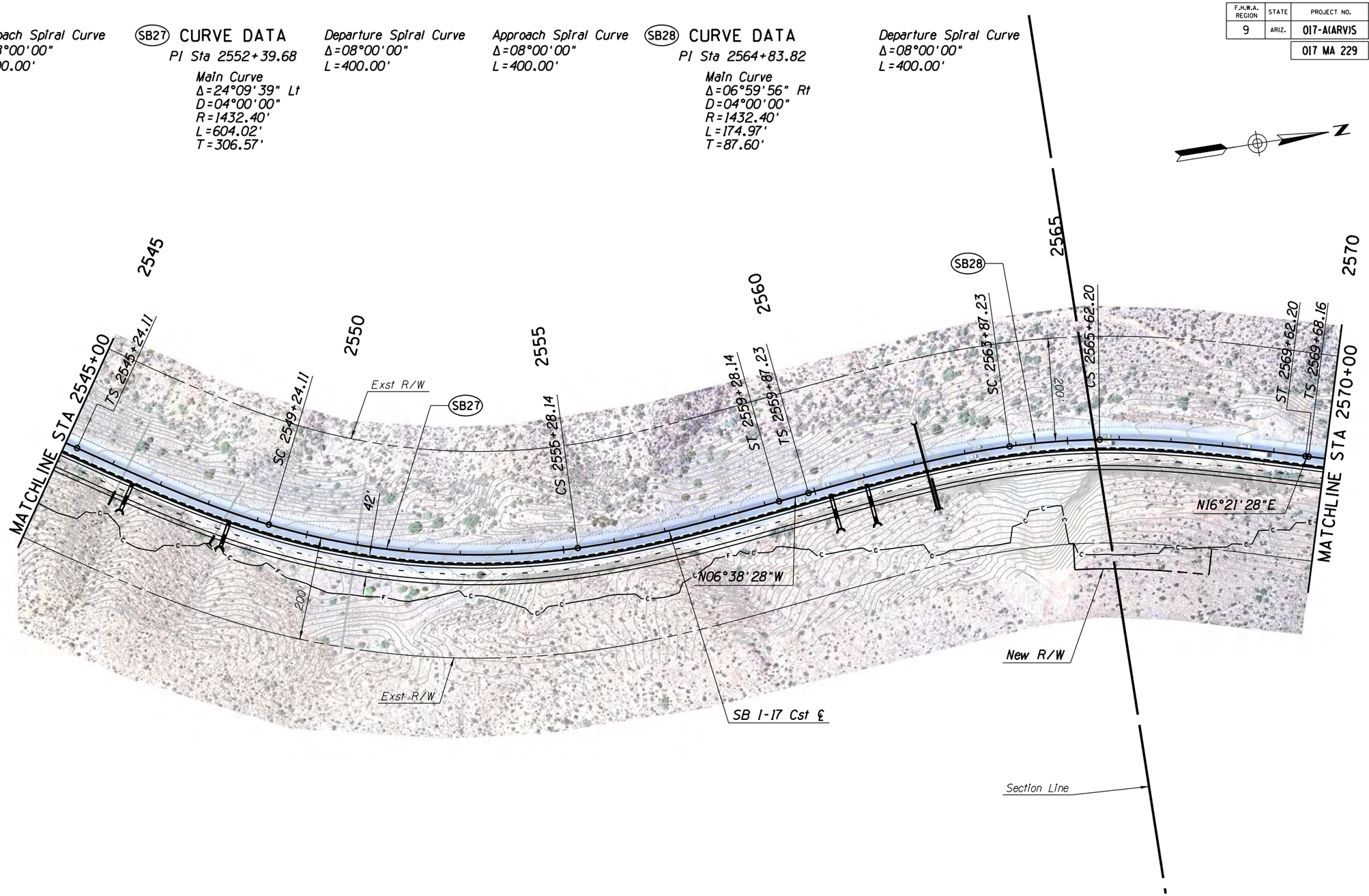
Departure Spiral Curve
Δ=08°00'00"
L=400.00'

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

(SB28) CURVE DATA
PI Sta 2564+83.82

Main Curve
Δ=06°59'56" Rt
D=04°00'00"
R=1432.40'
L=174.97'
T=87.60'

Departure Spiral Curve
Δ=08°00'00"
L=400.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2545+00 TO STA 2570+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.40

____ OF ____

4/29/2019 ...\Stage 1 (DCR)\h6800_p40.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Aproach Spiral Curve
Δ=08°00'00"
L=400.00'

(SB29) CURVE DATA
PI Sta 2574+65.91

Main Curve
Δ=07°05'28" Lt
D=04°00'00"
R=1432.40'
L=177.28'
T=88.75'

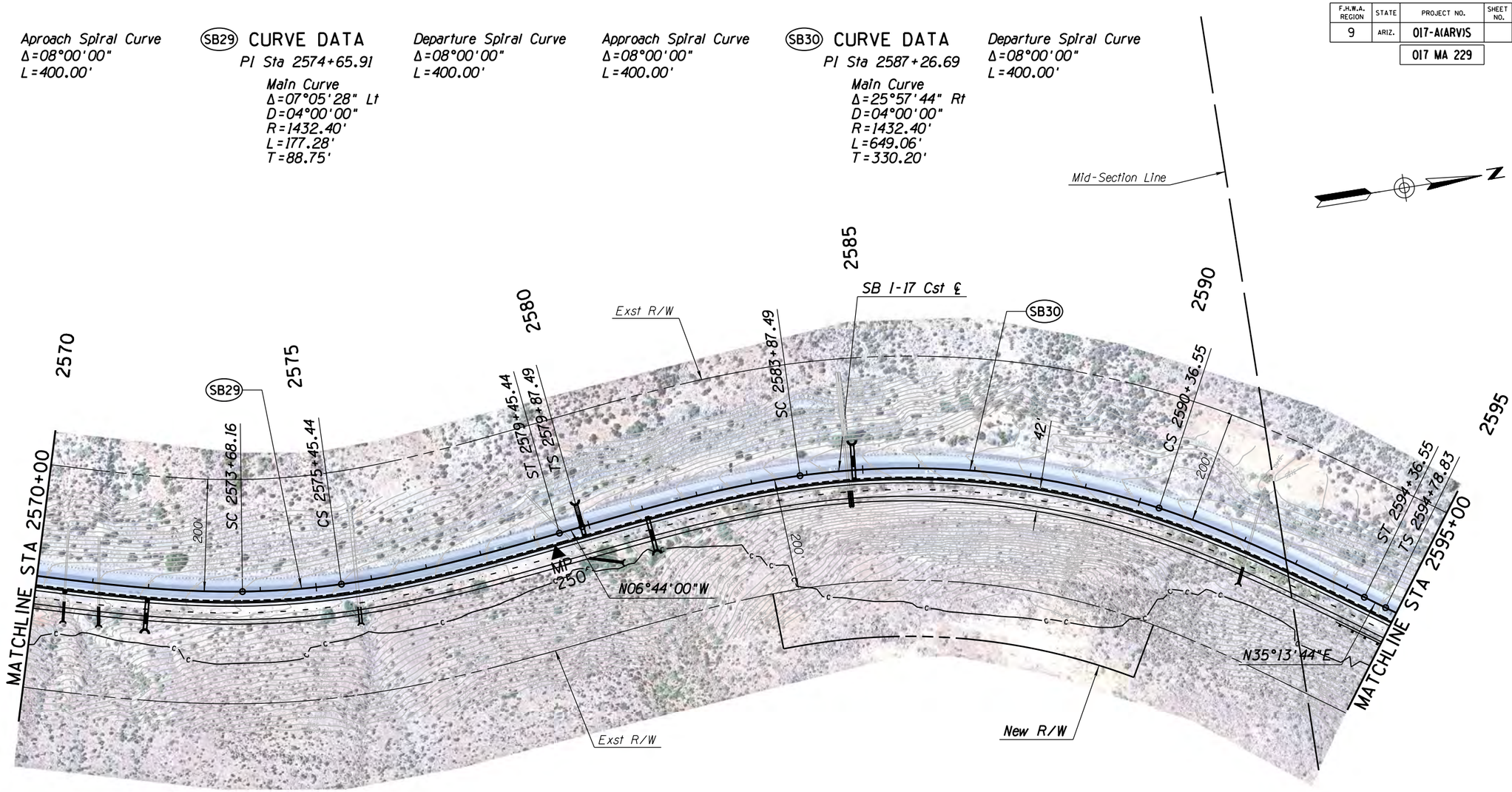
Departure Spiral Curve
Δ=08°00'00"
L=400.00'

Approach Spiral Curve
Δ=08°00'00"
L=400.00'

(SB30) CURVE DATA
PI Sta 2587+26.69

Main Curve
Δ=25°57'44" Rt
D=04°00'00"
R=1432.40'
L=649.06'
T=330.20'

Departure Spiral Curve
Δ=08°00'00"
L=400.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2570+00 TO STA 2595+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-03.41
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage 1 (DCR)\h6800_p41.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Approach Spiral Curve
Δ=04°30'00"
L=300.00'

(SB31) CURVE DATA
PI Sta 2599+60.74

Main Curve
Δ=10°20'47" Lt
D=03°00'00"
R=1909.86'
L=344.88'
T=172.91'

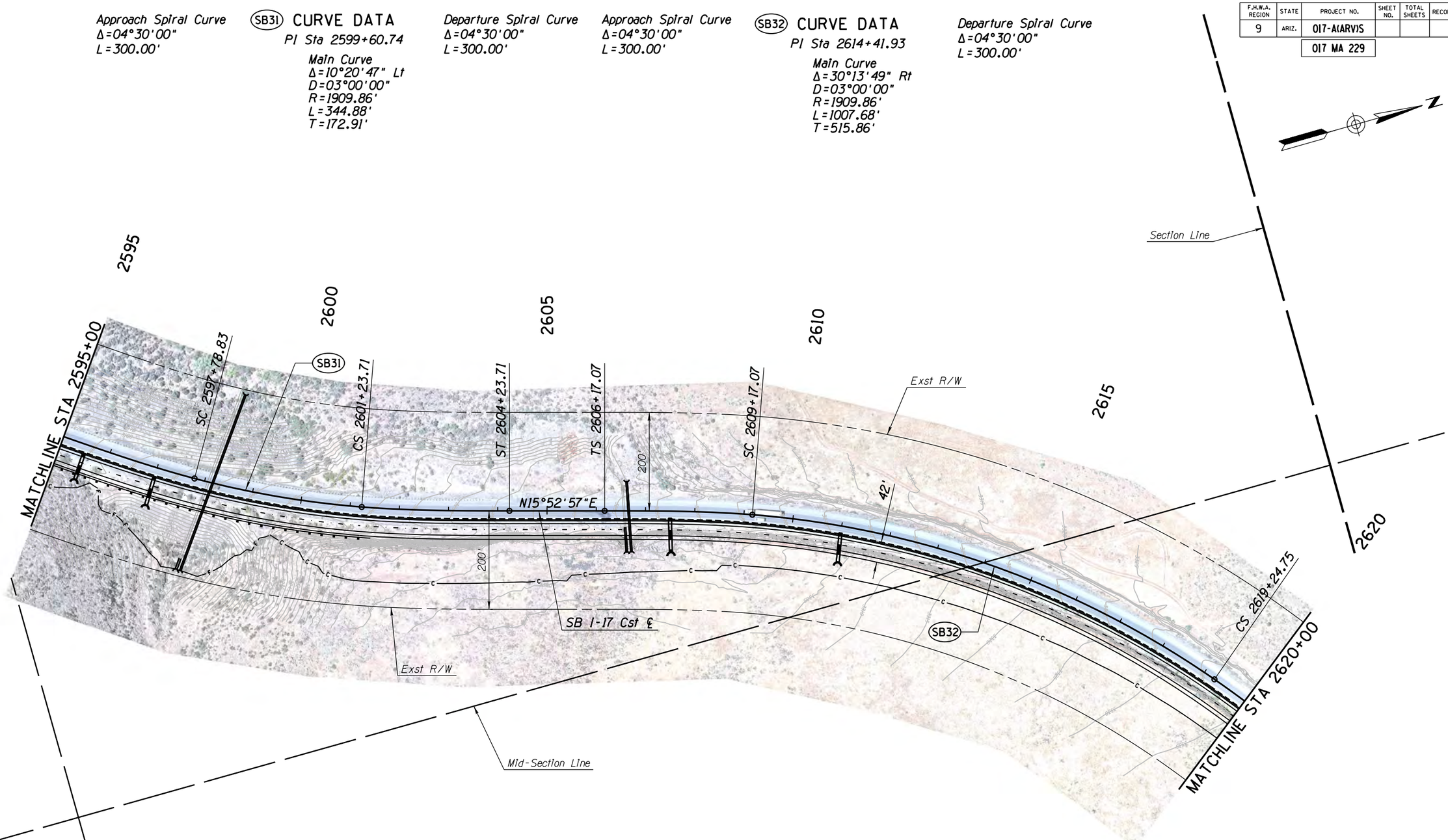
Departure Spiral Curve
Δ=04°30'00"
L=300.00'

Approach Spiral Curve
Δ=04°30'00"
L=300.00'

(SB32) CURVE DATA
PI Sta 2614+41.93

Main Curve
Δ=30°13'49" Rt
D=03°00'00"
R=1909.86'
L=1007.68'
T=515.86'

Departure Spiral Curve
Δ=04°30'00"
L=300.00'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2595+00 TO STA 2620+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.42

TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

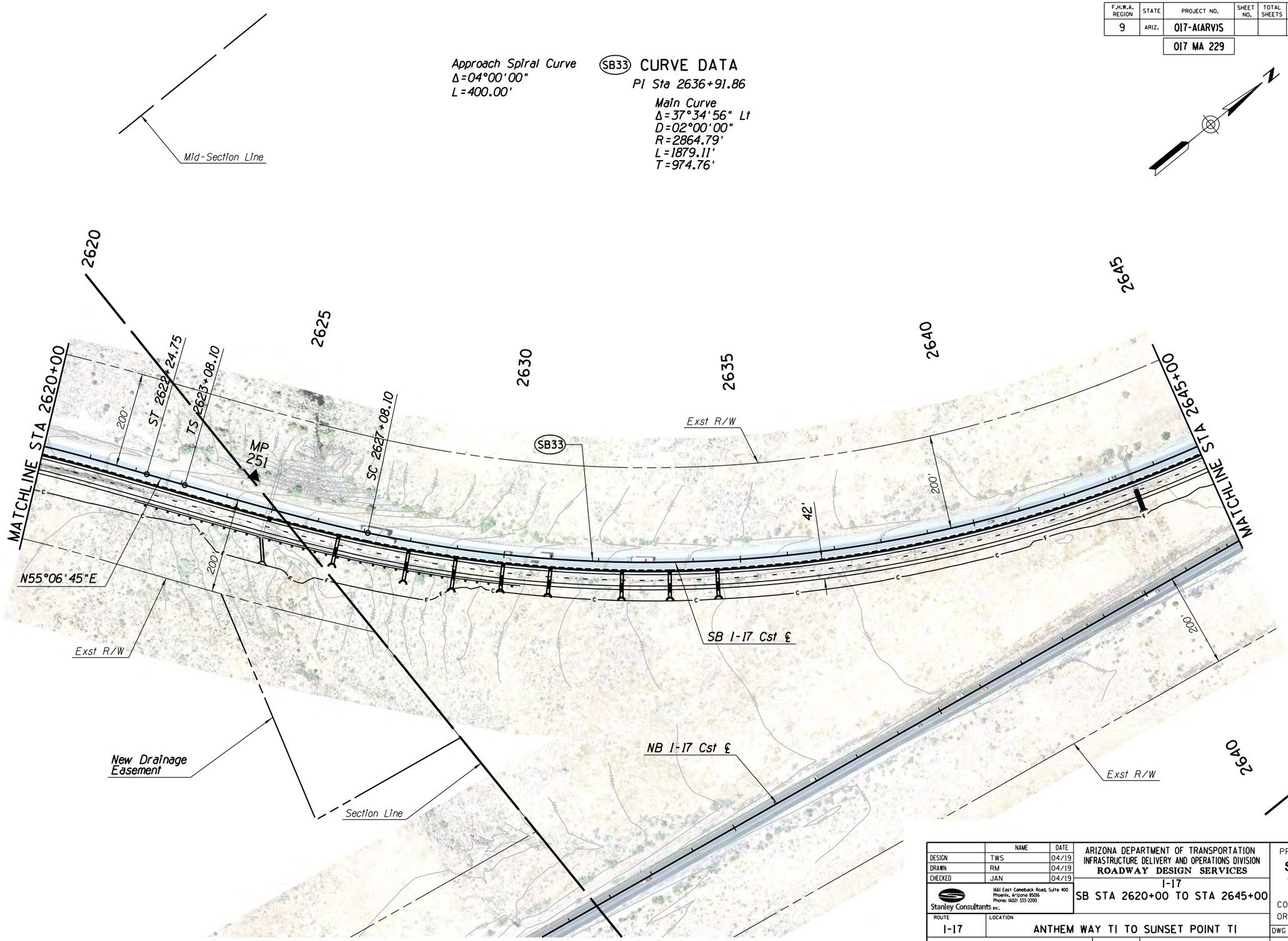
4/29/2019 ...\Stage I (DCR)\h6800_p42.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

Approach Spiral Curve
Δ=04°00'00"
L=400.00'

SB33 CURVE DATA
PI Sta 2636+91.86

Main Curve
Δ=37°34'56" Lt
D=02°00'00"
R=2864.79'
L=1879.11'
T=974.76'



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2620+00 TO STA 2645+00

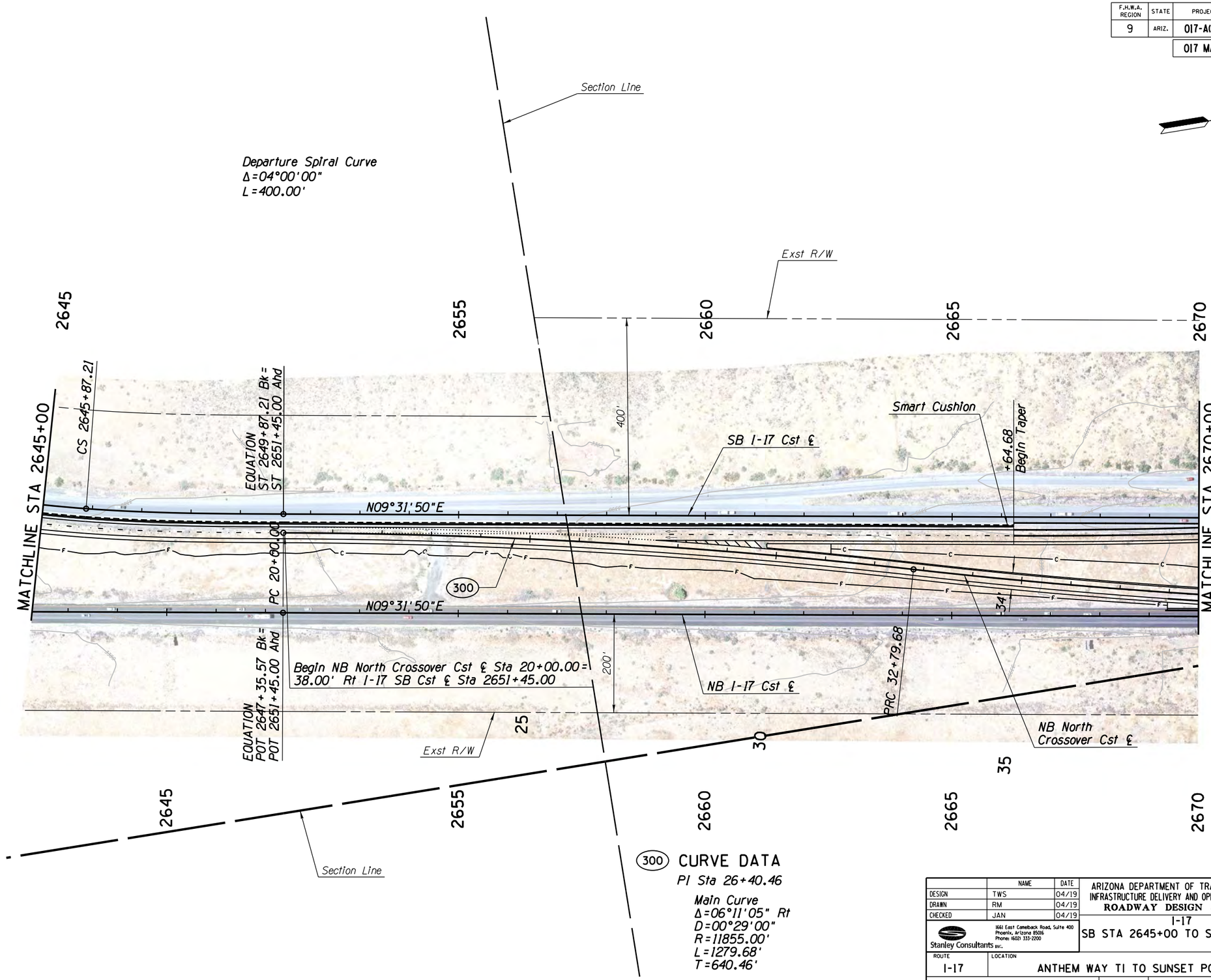
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-01.43
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)S	___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage 1 (DCR)\h6800_p43.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2645+00 TO STA 2670+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)S

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-01.44

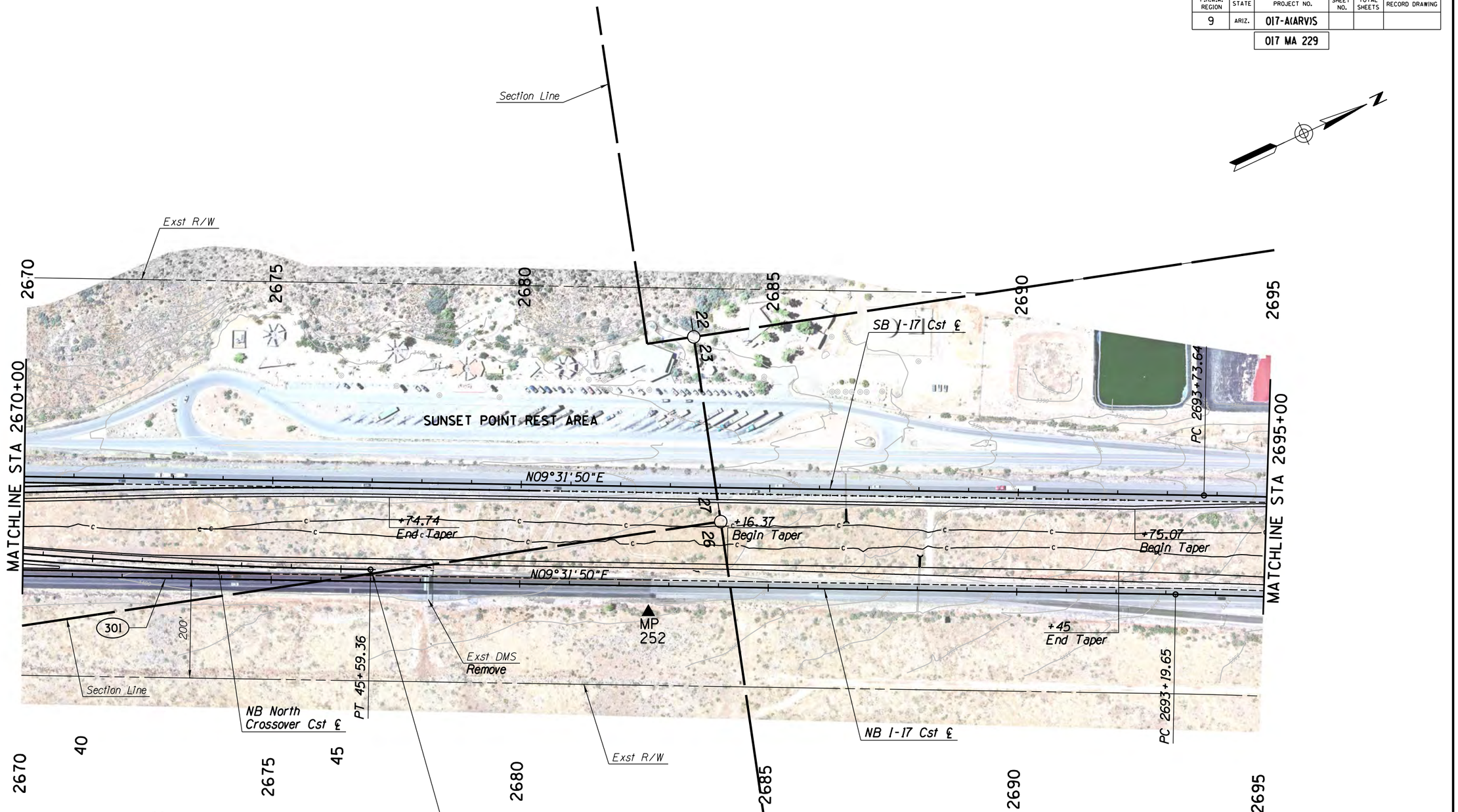
____ OF ____

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p44.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



(301) CURVE DATA

PI Sta 39+20.14

Main Curve
Δ=06°11'05" Rt
D=00°29'00"
R=11855.00'
L=1279.68'
T=640.46'

End NB North Crossover Cst ℄ Sta 45+59.36 =
24.00' Lt I-17 NB Cst ℄ Sta 2676+99.39

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
STA 2670+00 TO STA 2695+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	
I-17	ANTHEM WAY TI TO SUNSET POINT TI	DWG NO. C-01.45
TRACS NO. H6800 01L		017-A(ARV)S ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_p45.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)S			
		017 MA 229			

SUNSET POINT TI
MP 252.5

Exst R/W

Section Line

22 34 23

Section Line

Exst R/W

END PROJECT
SB I-17 STA 2696+80.10

2695 2700 2705 2710 2715 2720

SB I-17 Cst ℄

MATCHLINE STA 2695+00

MP 252

+80.10
End Taper

+08.31
Begin Taper

+88.54
End Taper

200'

Exst R/W

NB I-17 Cst ℄

2695 2700 2705 2710 2715

END PROJECT
NB I-17 STA 2709+88.54

	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
NB STA 2695+00 TO STA 2703+15

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-01.46

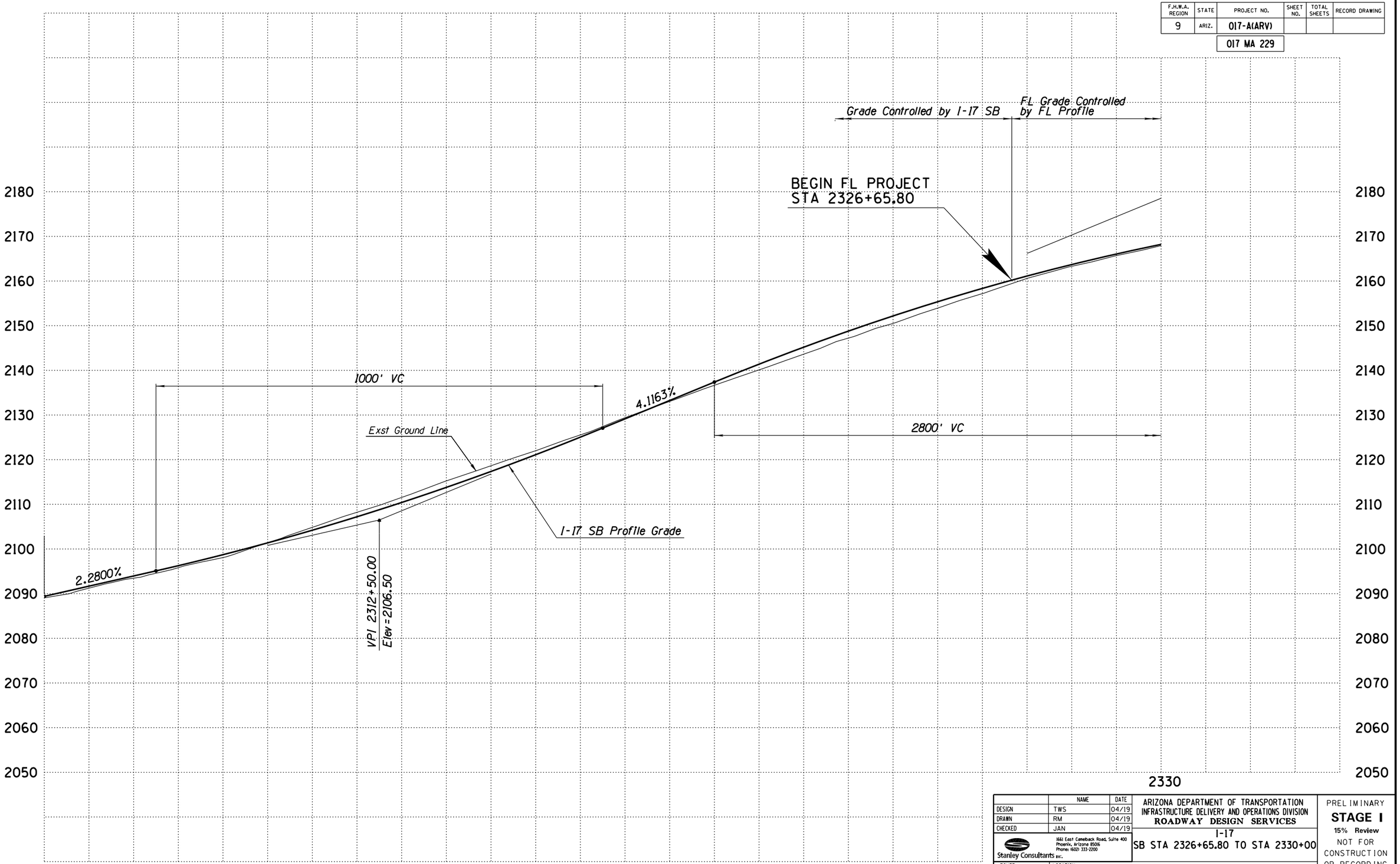
TRACS NO. H6800 01L | 017-A(ARV)S | ___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800_p46.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

I-17
SB STA 2326+65.80 TO STA 2330+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

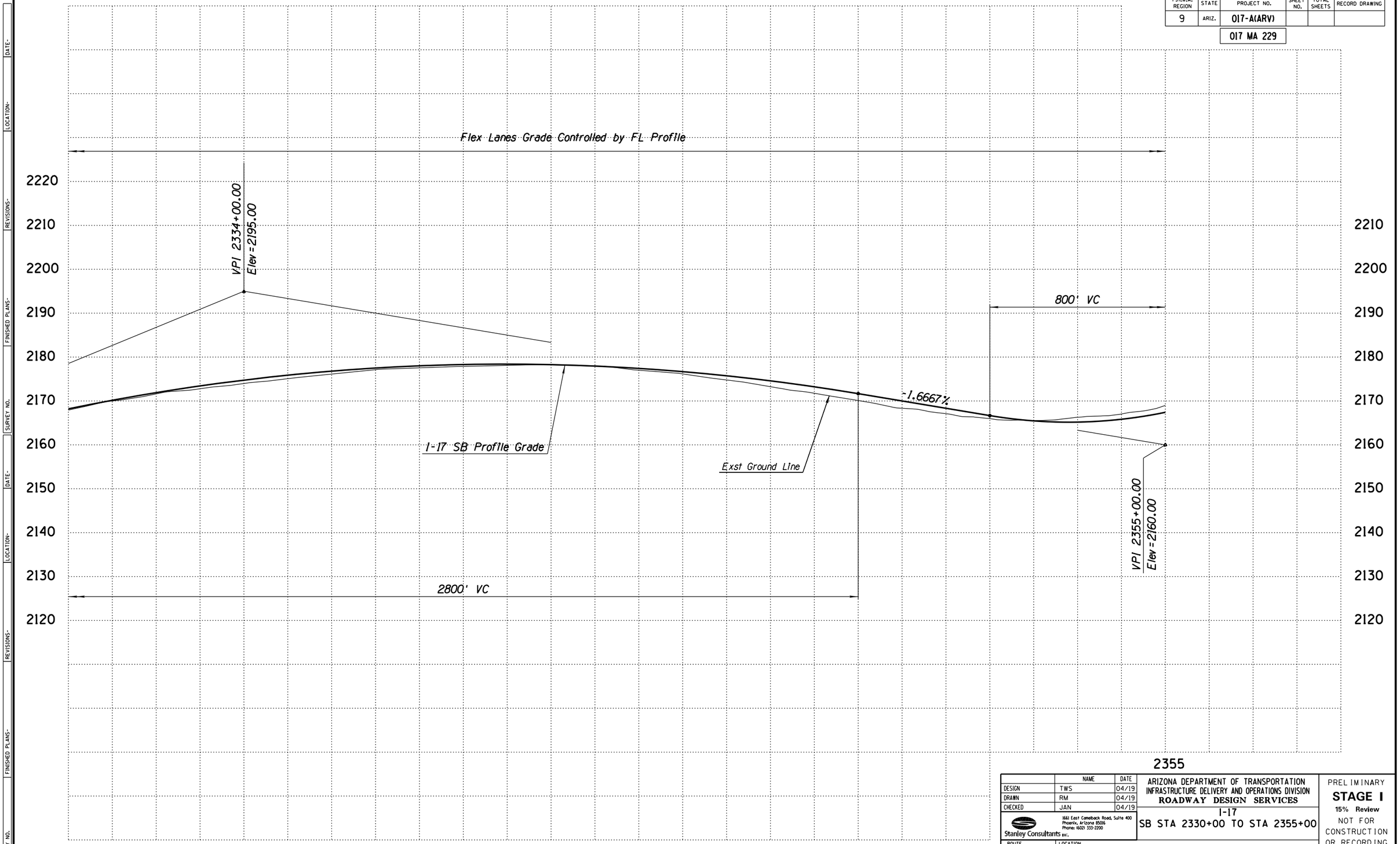
DWG NO. C-02.01

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800 v01SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

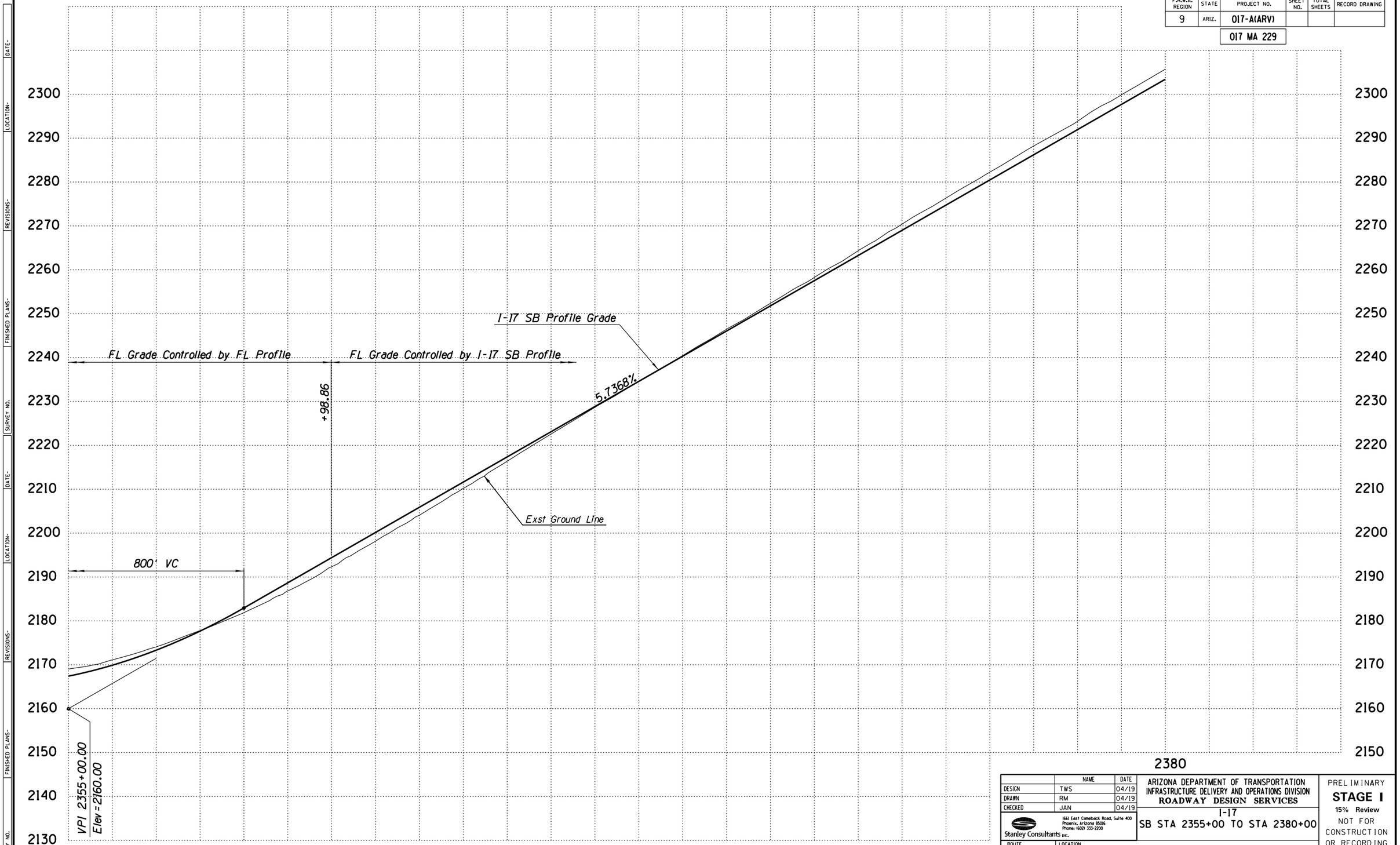
I-17
SB STA 2330+00 TO STA 2355+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-02.02
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV) ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v02SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2355+00 TO STA 2380+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-02.03
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV) ___ OF ___

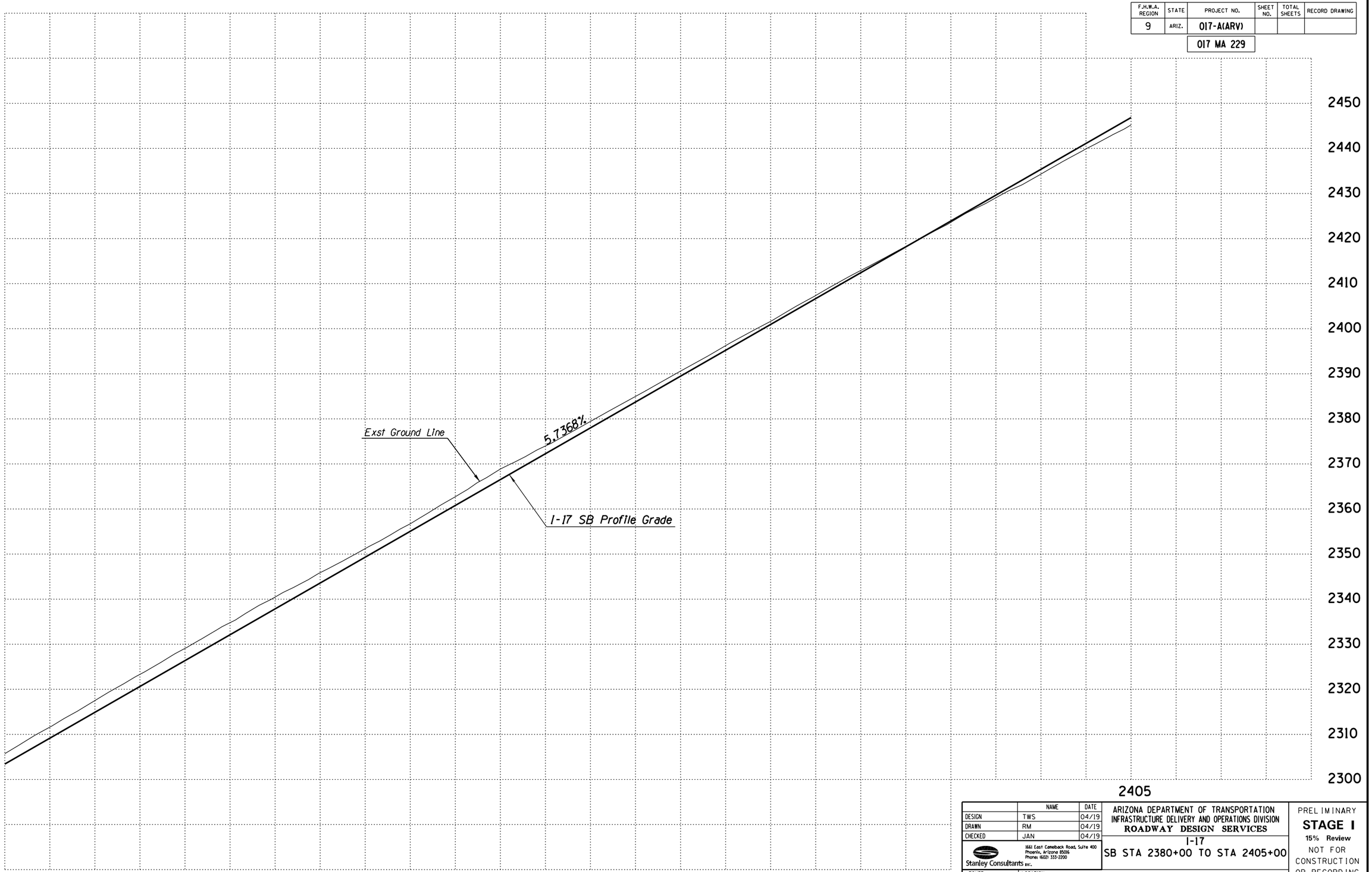
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800 v03SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			

017 MA 229

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2380+00 TO STA 2405+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

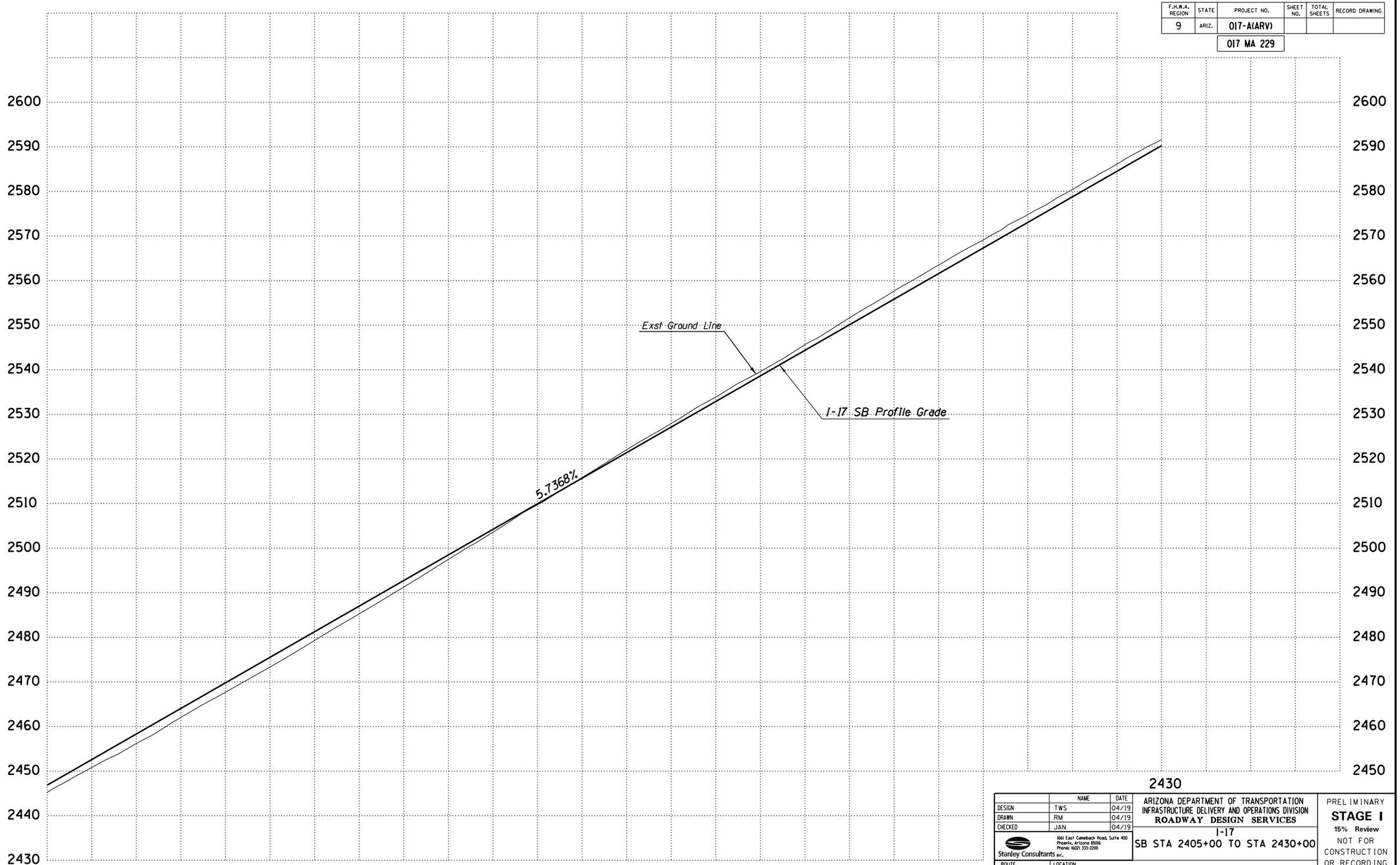
ROUTE	LOCATION	DWG NO. C-02.04
I-17	ANTHEM WAY TI TO SUNSET POINT TI	

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v04SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2405+00 TO STA 2430+00

ROUTE: I-17

LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

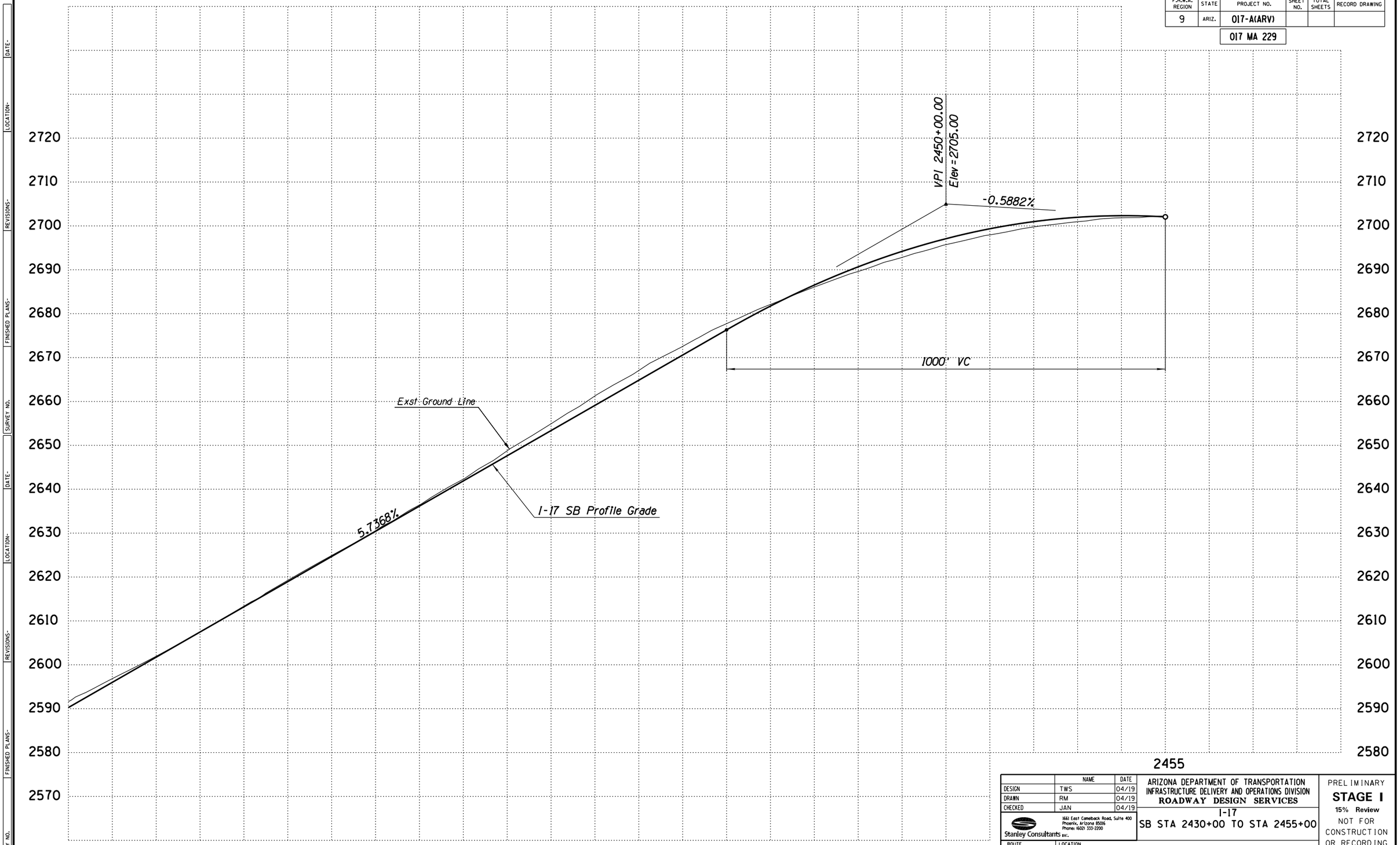
DWG NO. C-02.05

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800 v05SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2430+00 TO STA 2455+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

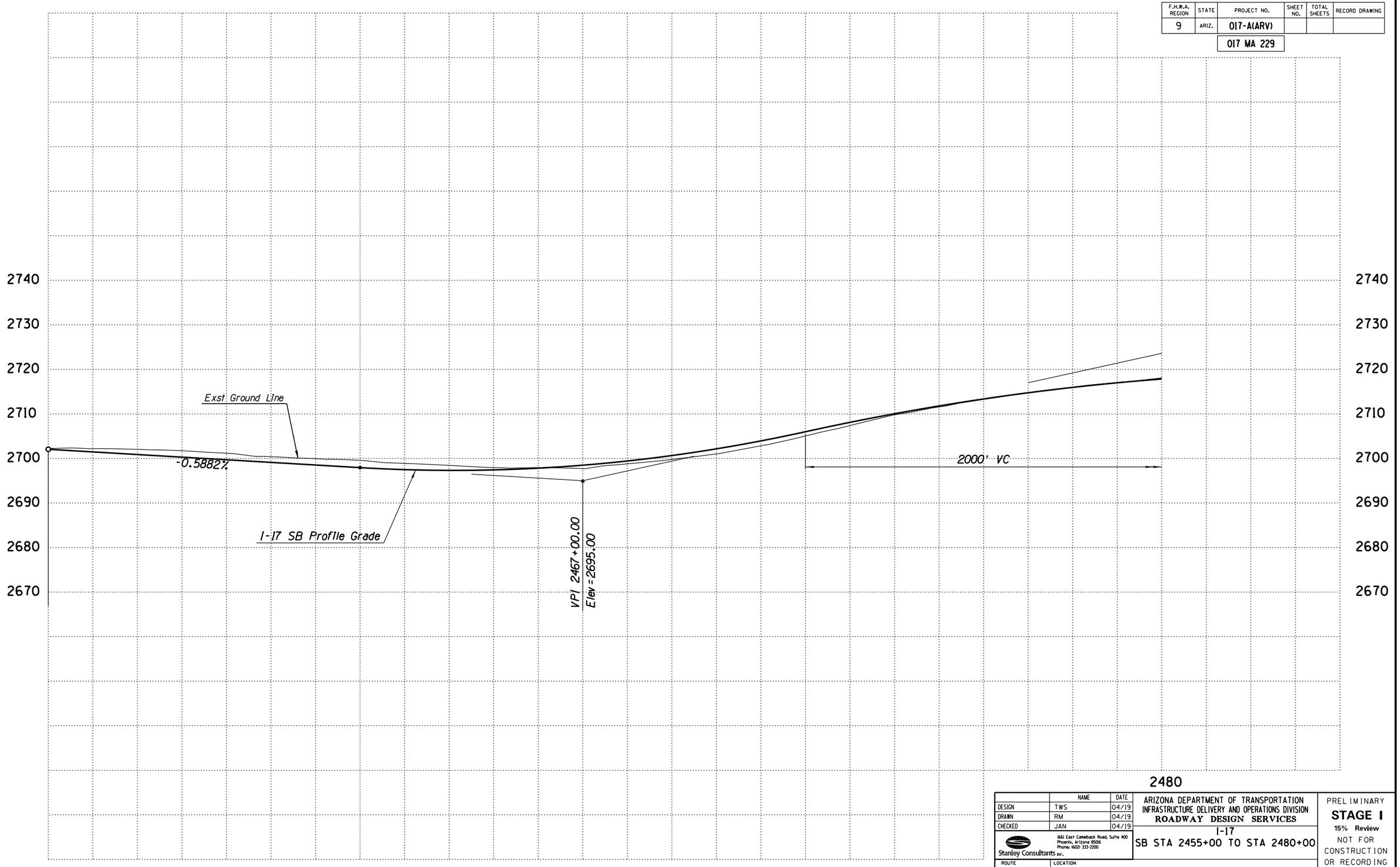
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.06

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800 v06SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2455+00 TO STA 2480+00

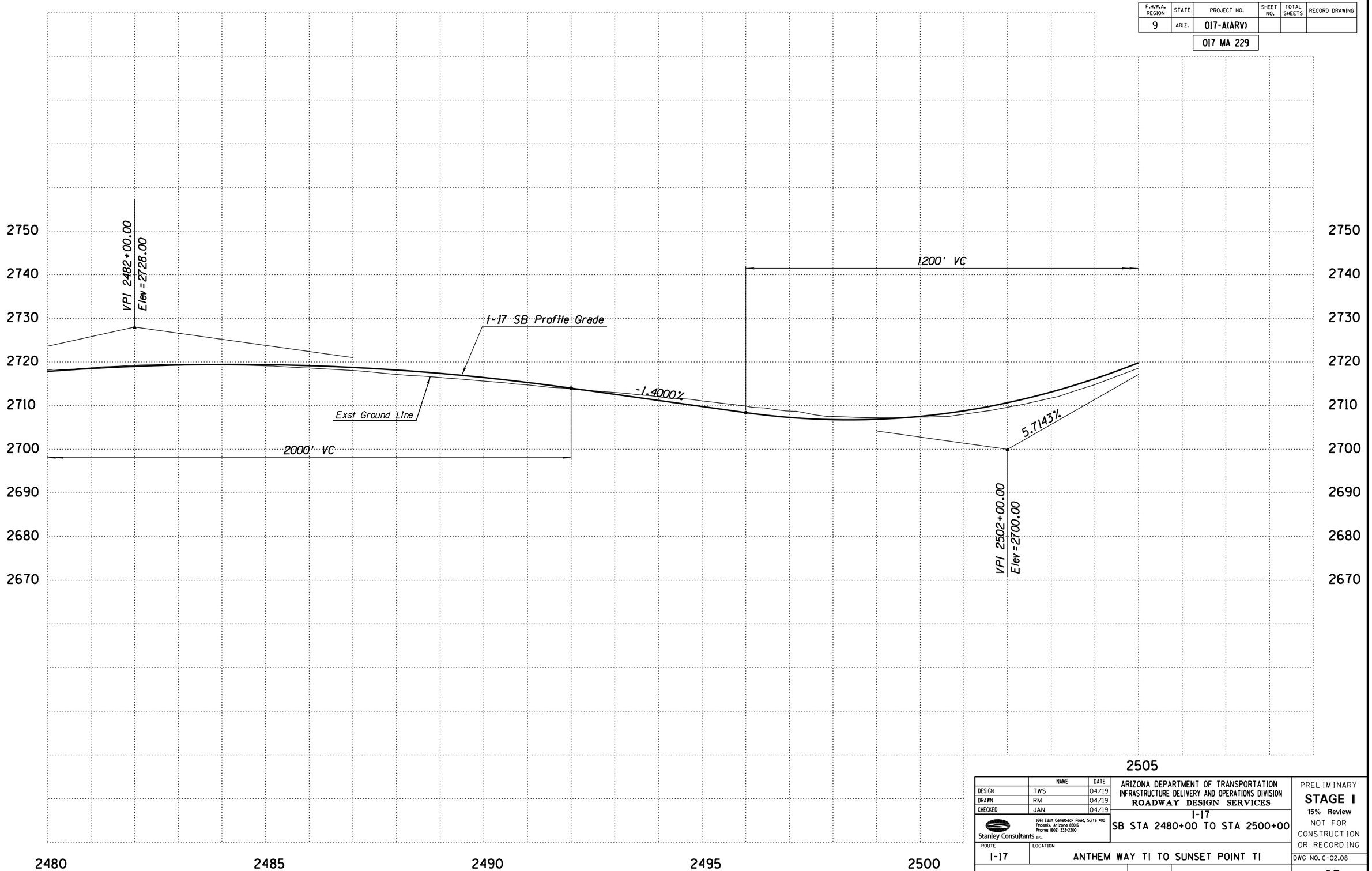
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-02.07
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)	___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v07SB.dgn

DATE- | LOCATION- | REVISIONS- | FINISHED PLANS- | SURVEY NO.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2480+00 TO STA 2500+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.08

____ OF ____

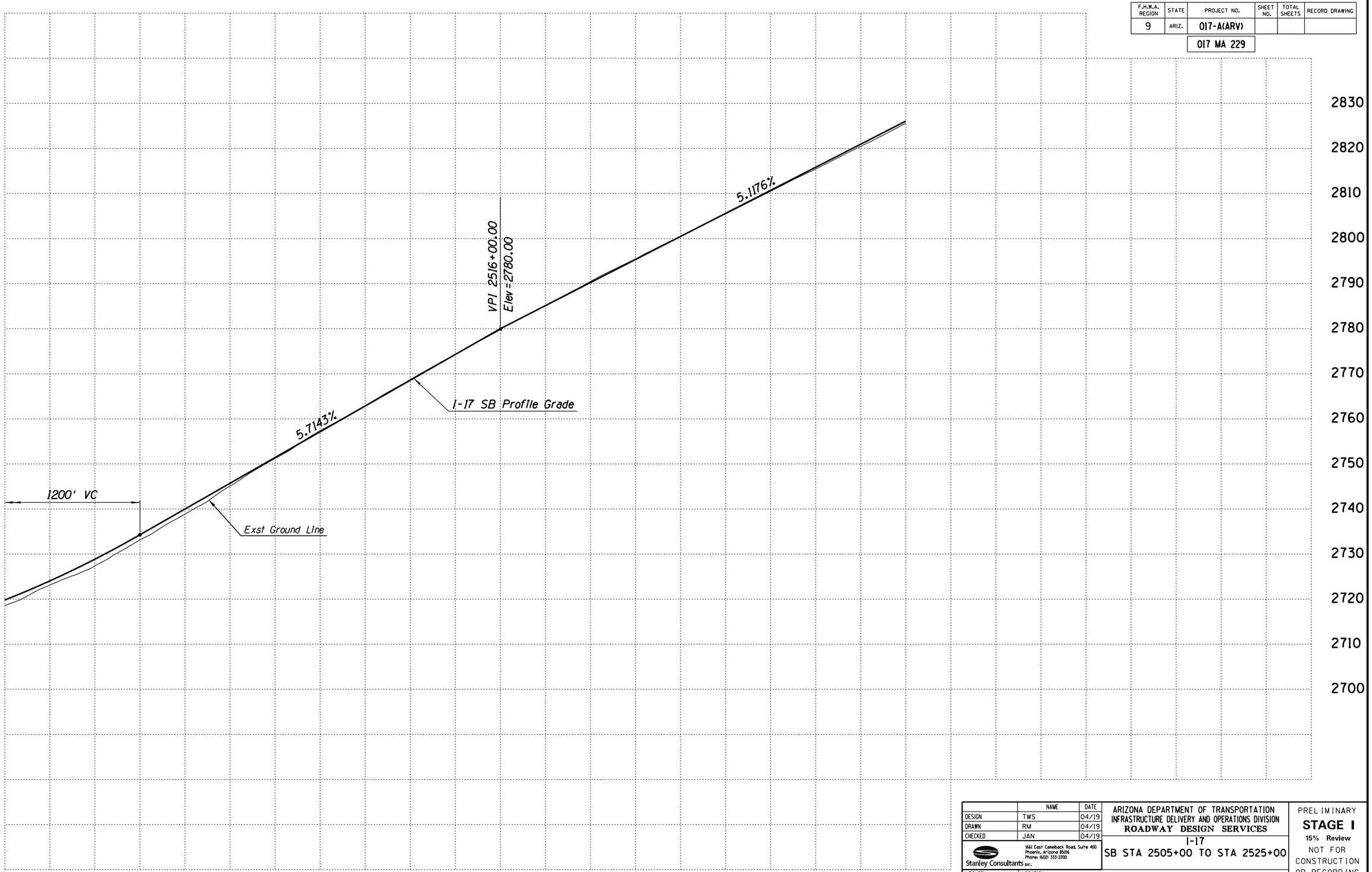
SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800 v08SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			

017 MA 229

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2505+00 TO STA 2525+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

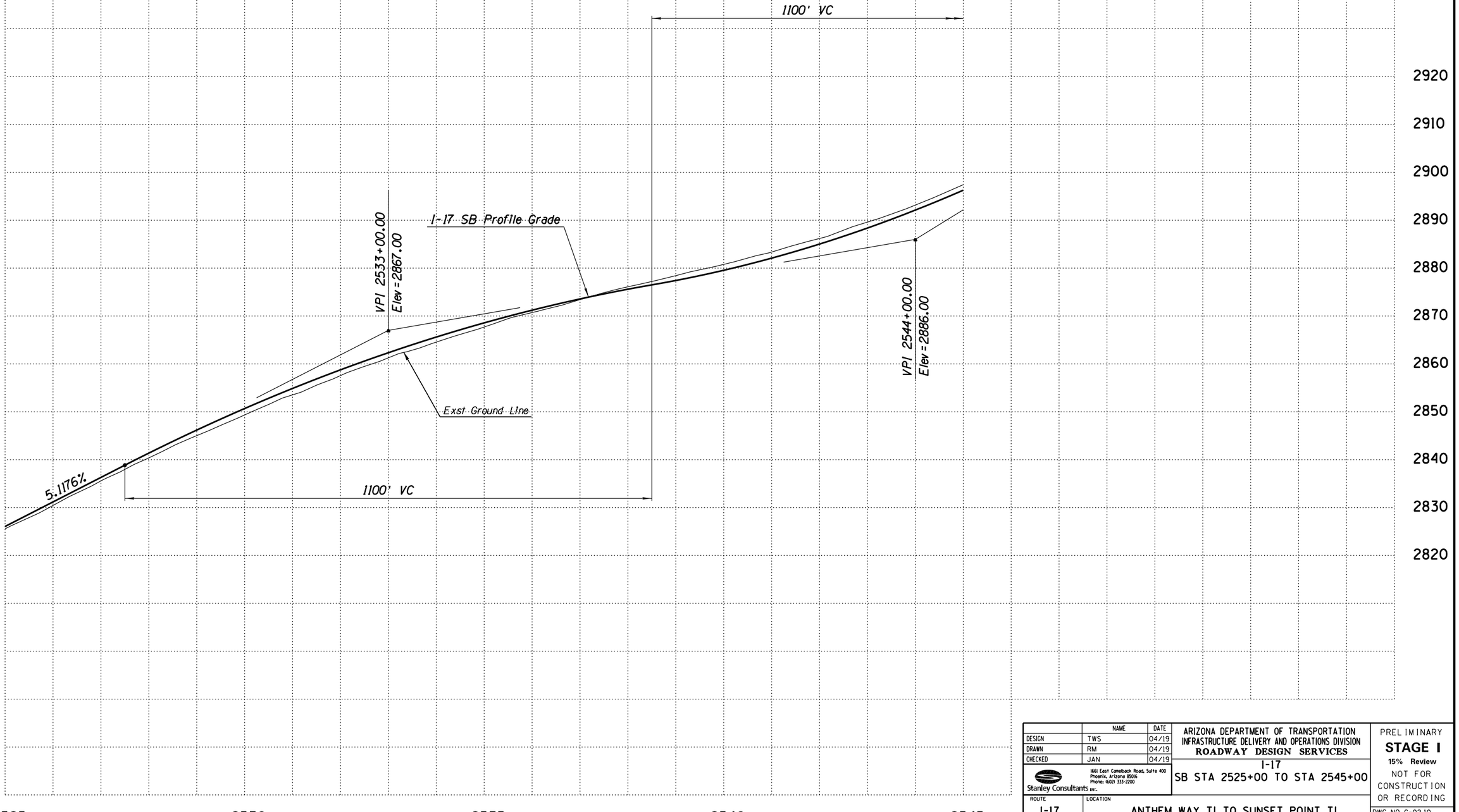
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.09

___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800 v09SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2525+00 TO STA 2545+00

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.10

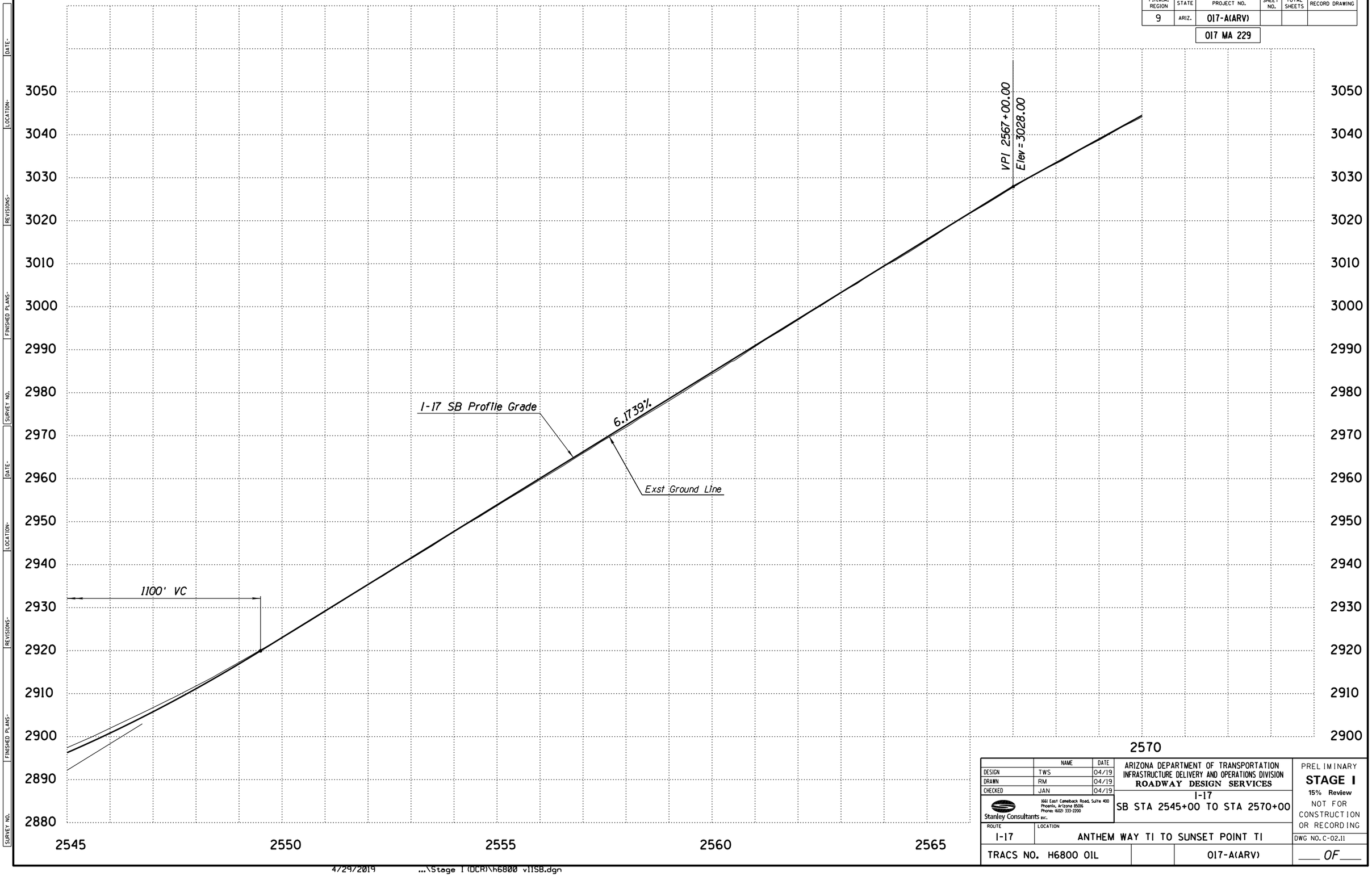
____ OF ____

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\Stage I (DCR)\h6800 v10SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2545+00 TO STA 2570+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

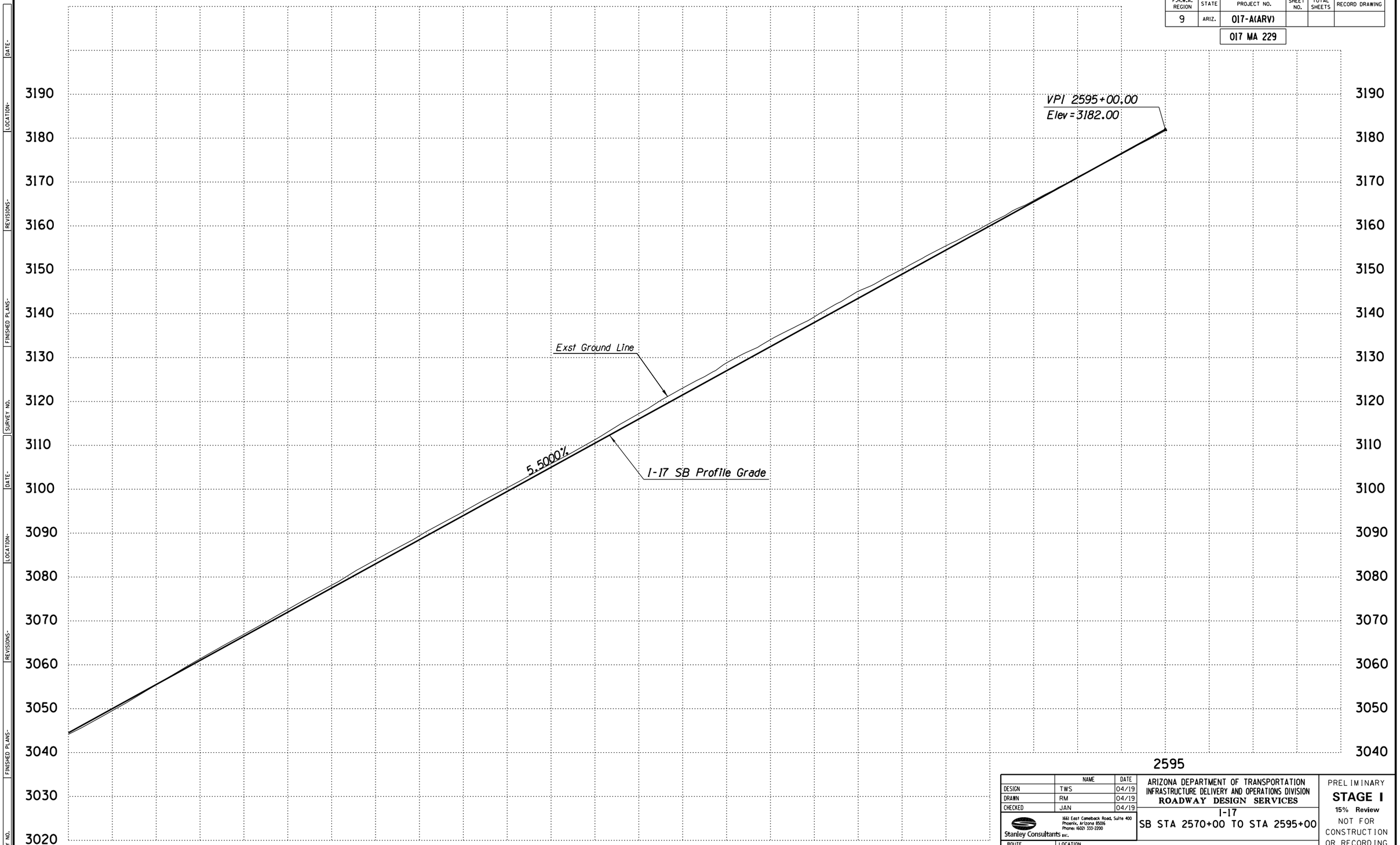
ROUTE	LOCATION	DWG NO. C-02.11
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV)

____ OF ____

4/29/2019 ...\Stage I (DCR)\h6800 v11SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			

017 MA 229



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2570+00 TO STA 2595+00

ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.12

___ OF ___

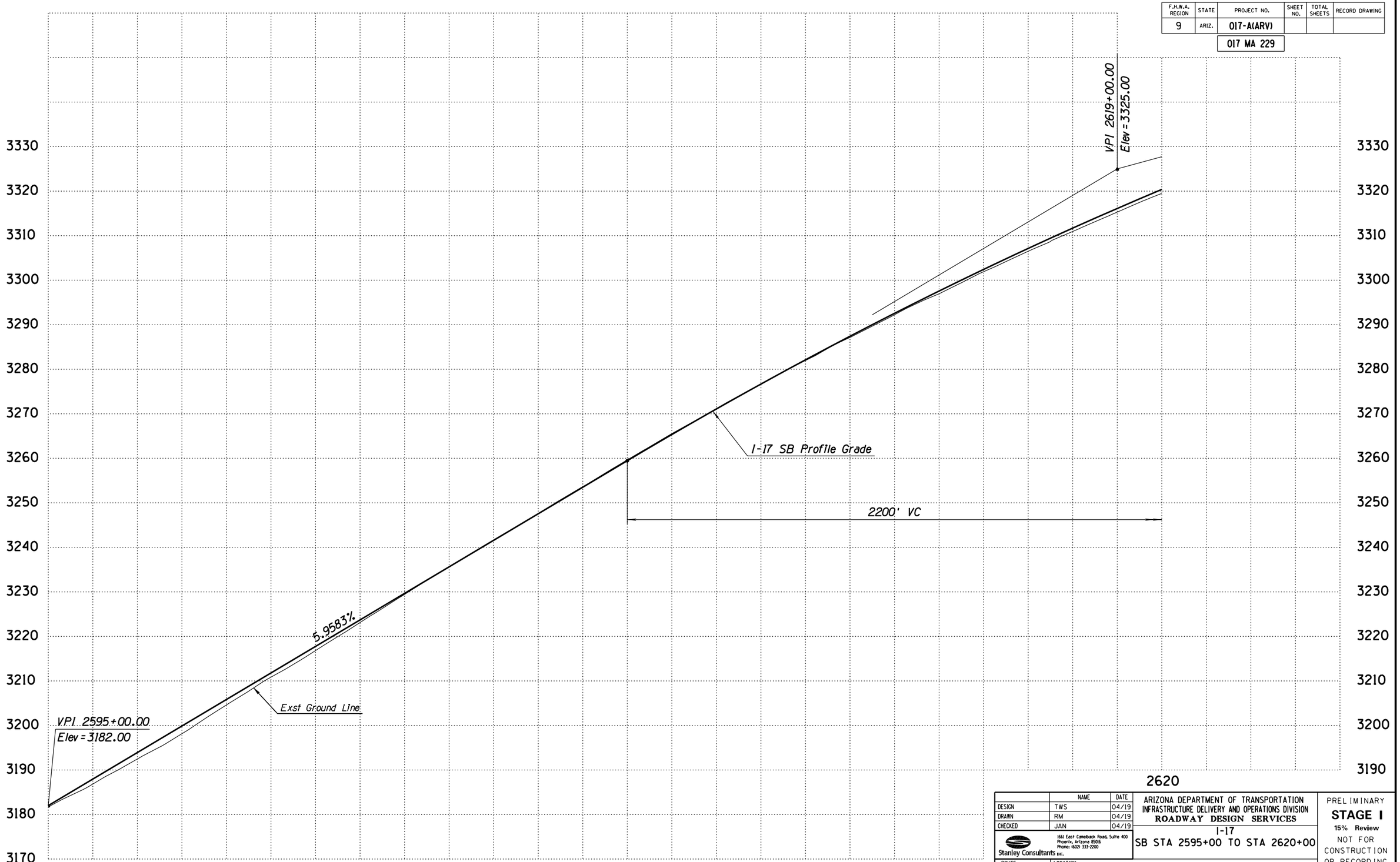
SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage I (DCR)\h6800 v12SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			

017 MA 229

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2595+00 TO STA 2620+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

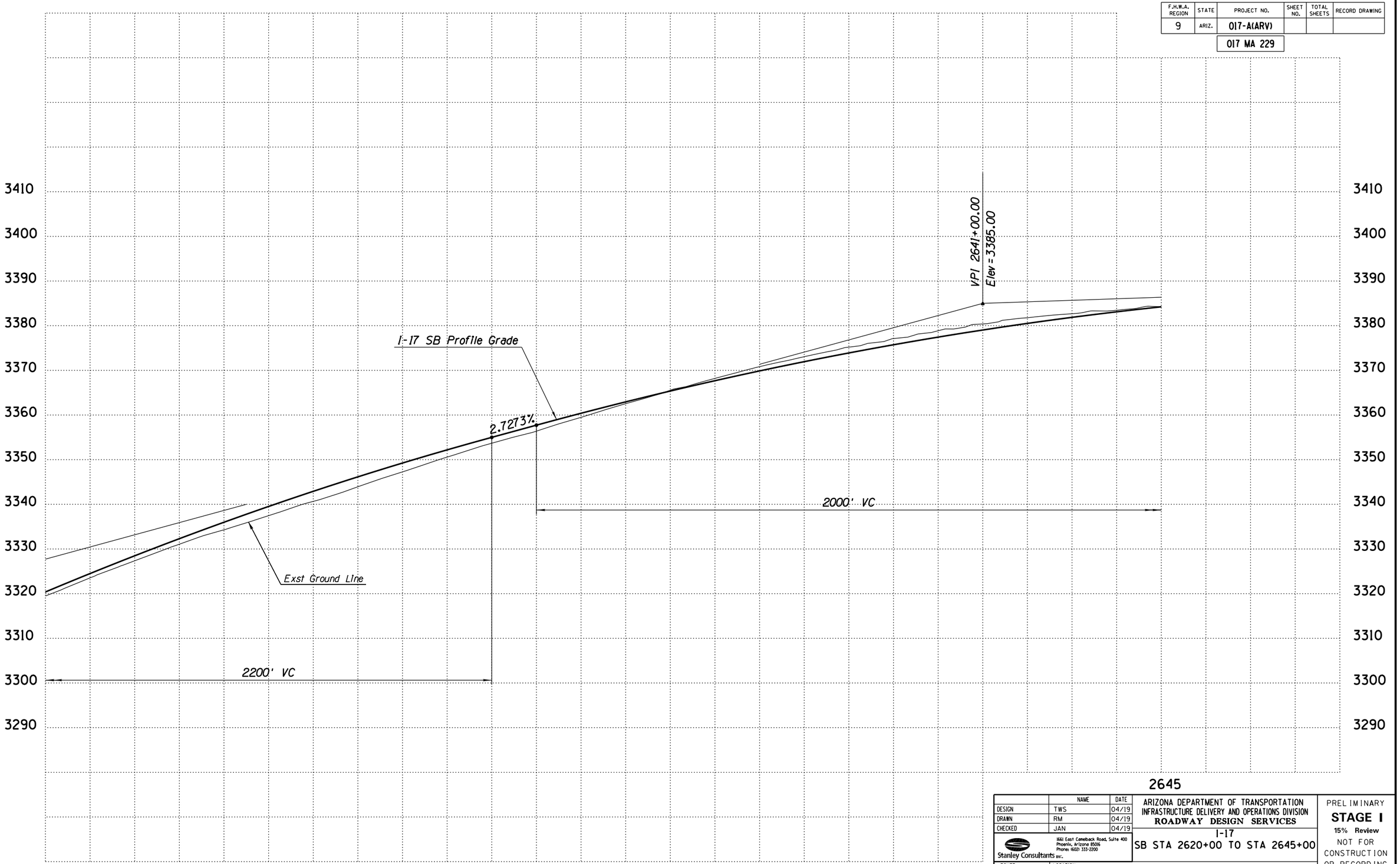
ROUTE	LOCATION	DWG NO.
I-17	ANTHEM WAY TI TO SUNSET POINT TI	C-02.13

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v13SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2620+00 TO STA 2645+00

ROUTE: I-17

LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

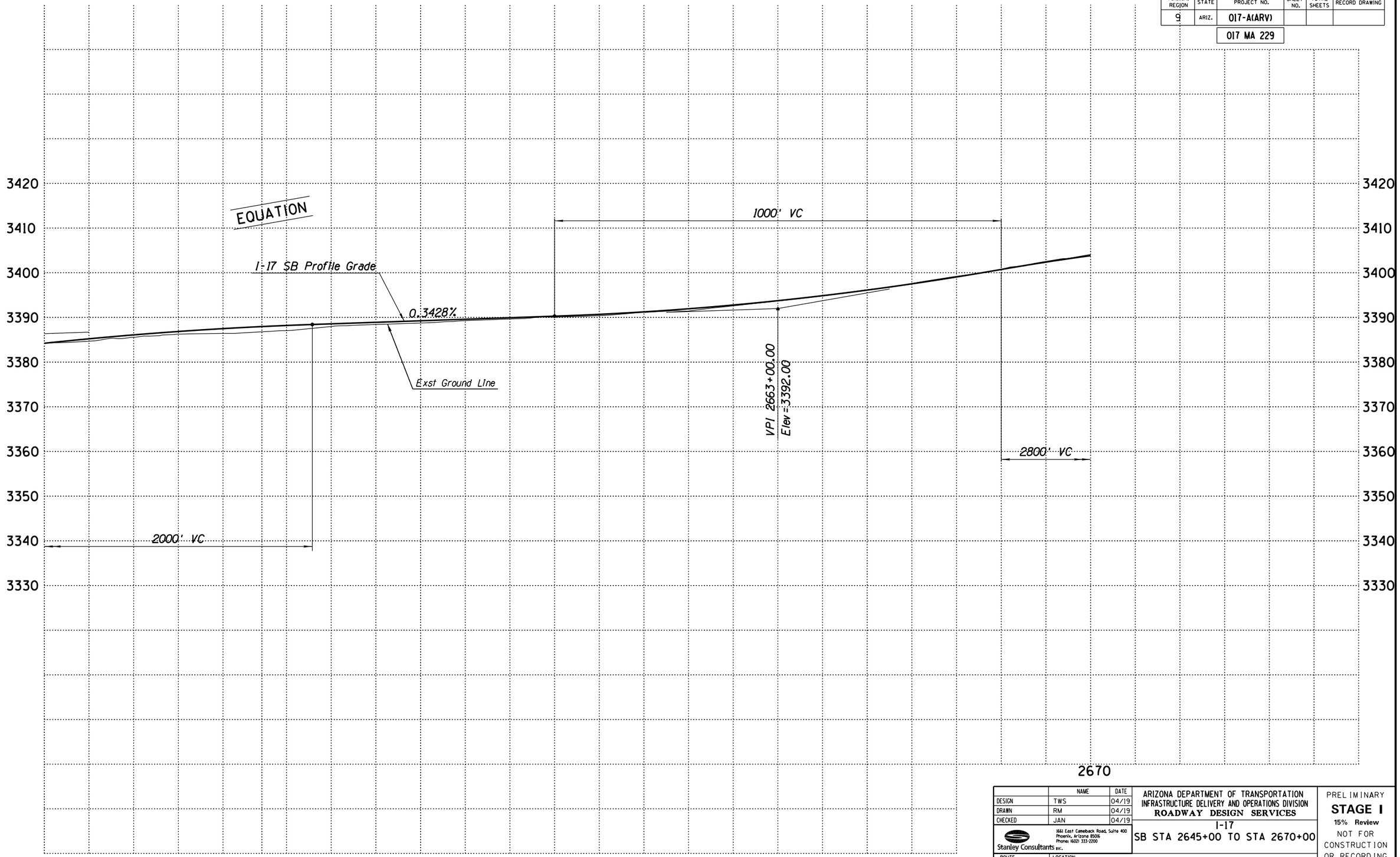
DWG NO. C-02.14

___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v14SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

SB STA 2645+00 TO STA 2670+00

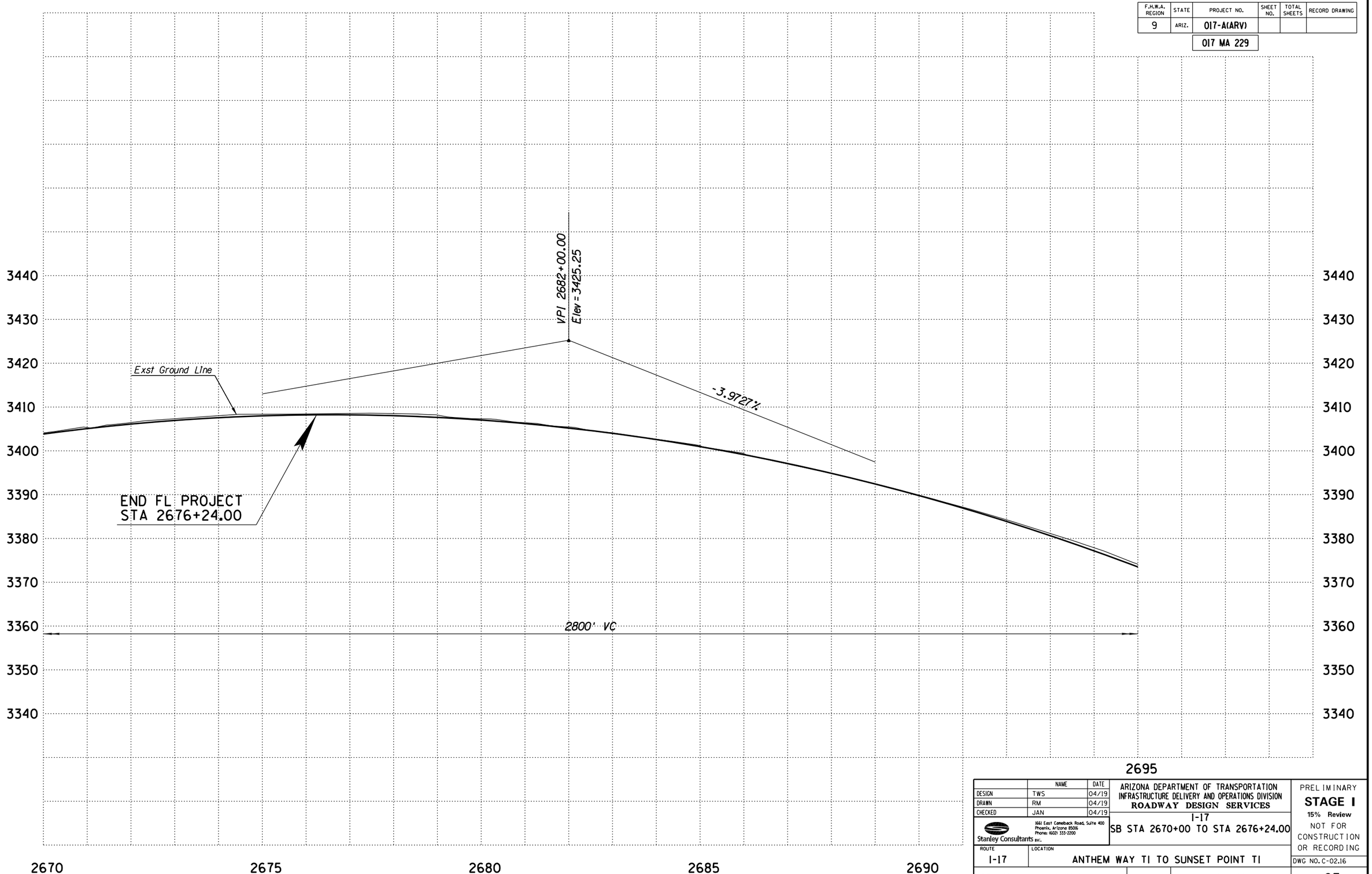
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO.
I-17	ANTHEM WAY TI TO SUNSET POINT TI	C-02.15

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/30/2019 ...\Stage I (DCR)\h6800 v15SB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
SB STA 2670+00 TO STA 2676+24.00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

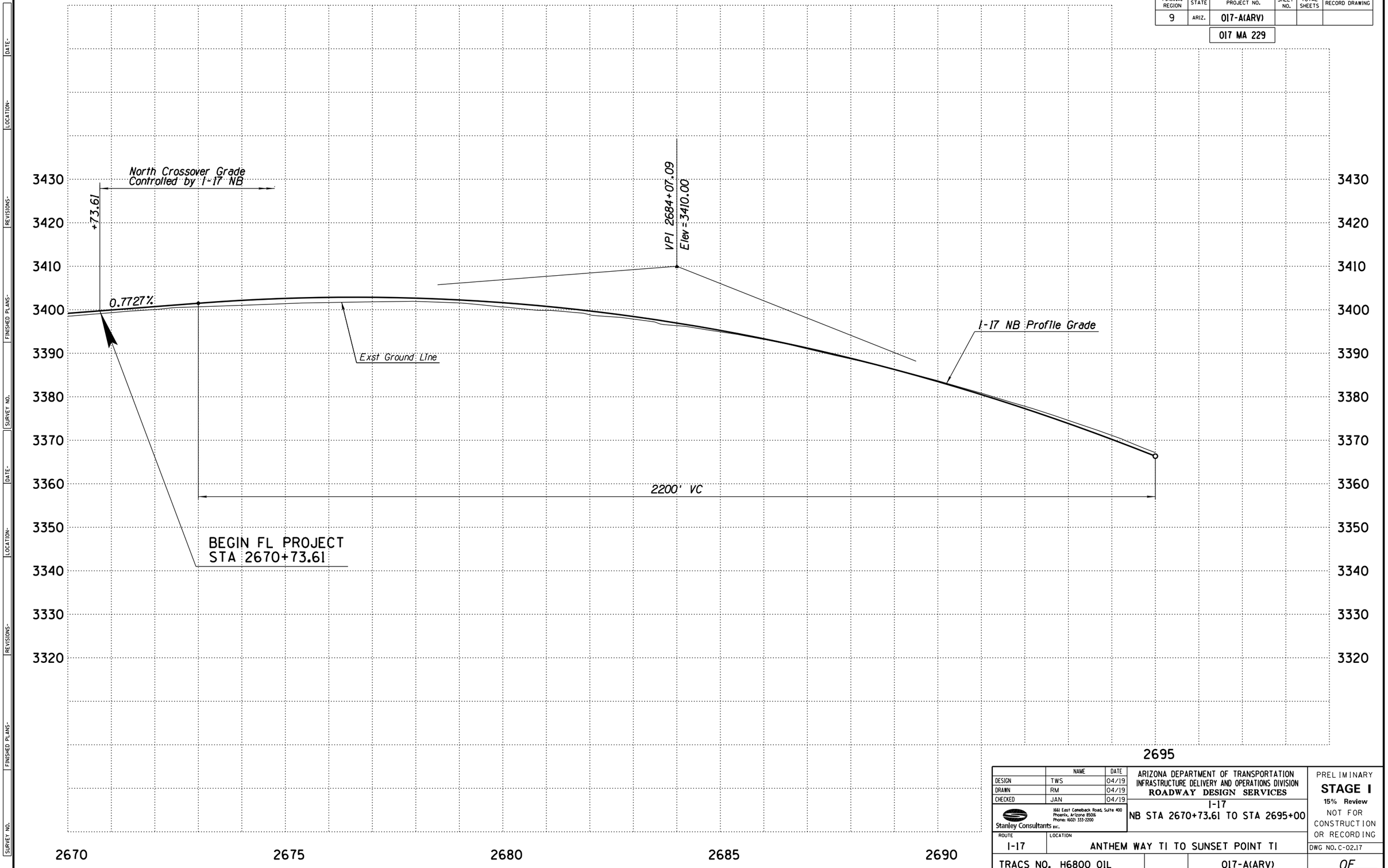
DWG NO. C-02.16

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800 v16SB.dgn

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
NB STA 2670+73.61 TO STA 2695+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-02.17

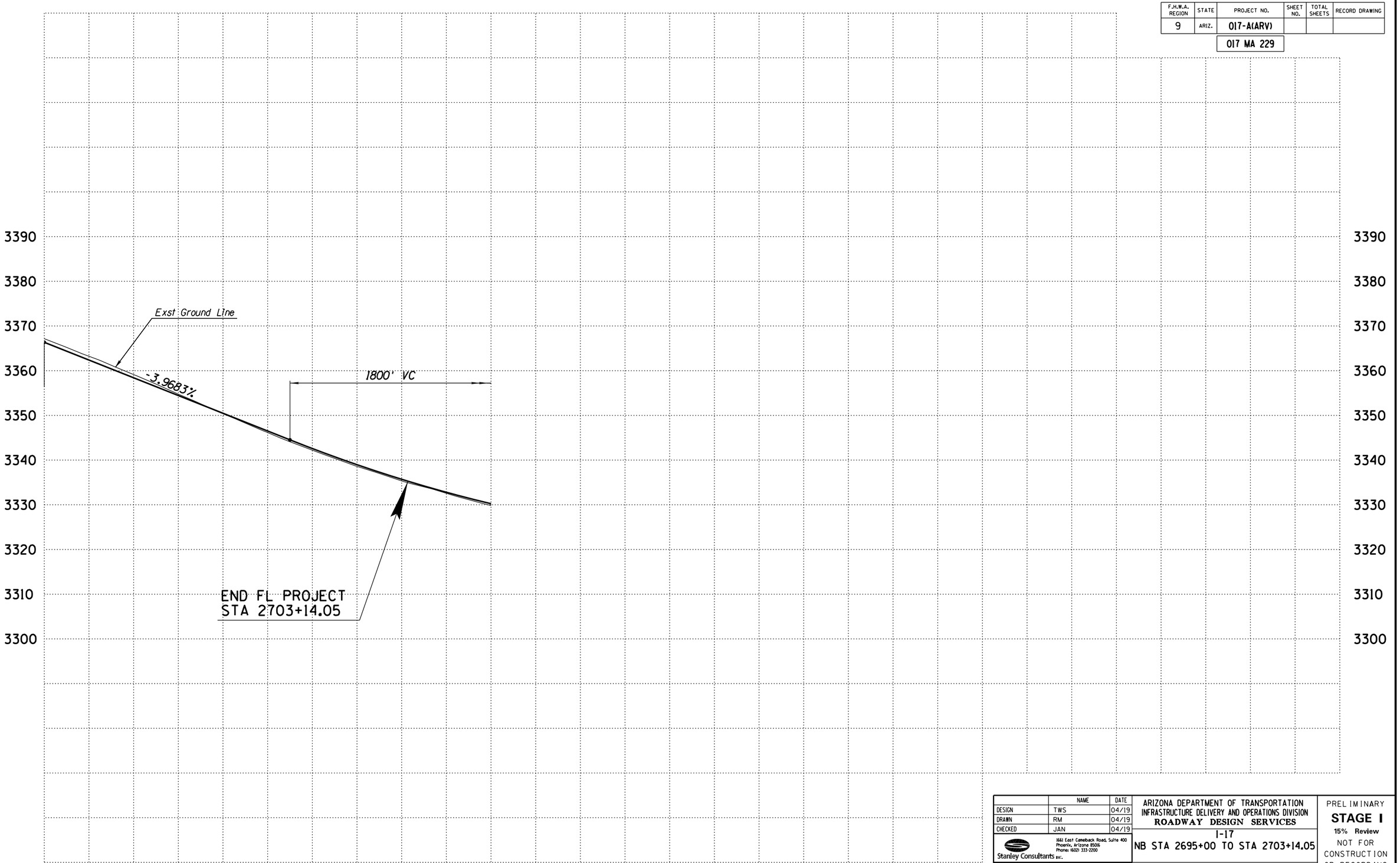
TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_v17NB.dgn

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

NB STA 2695+00 TO STA 2703+14.05

ROUTE: I-17

LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

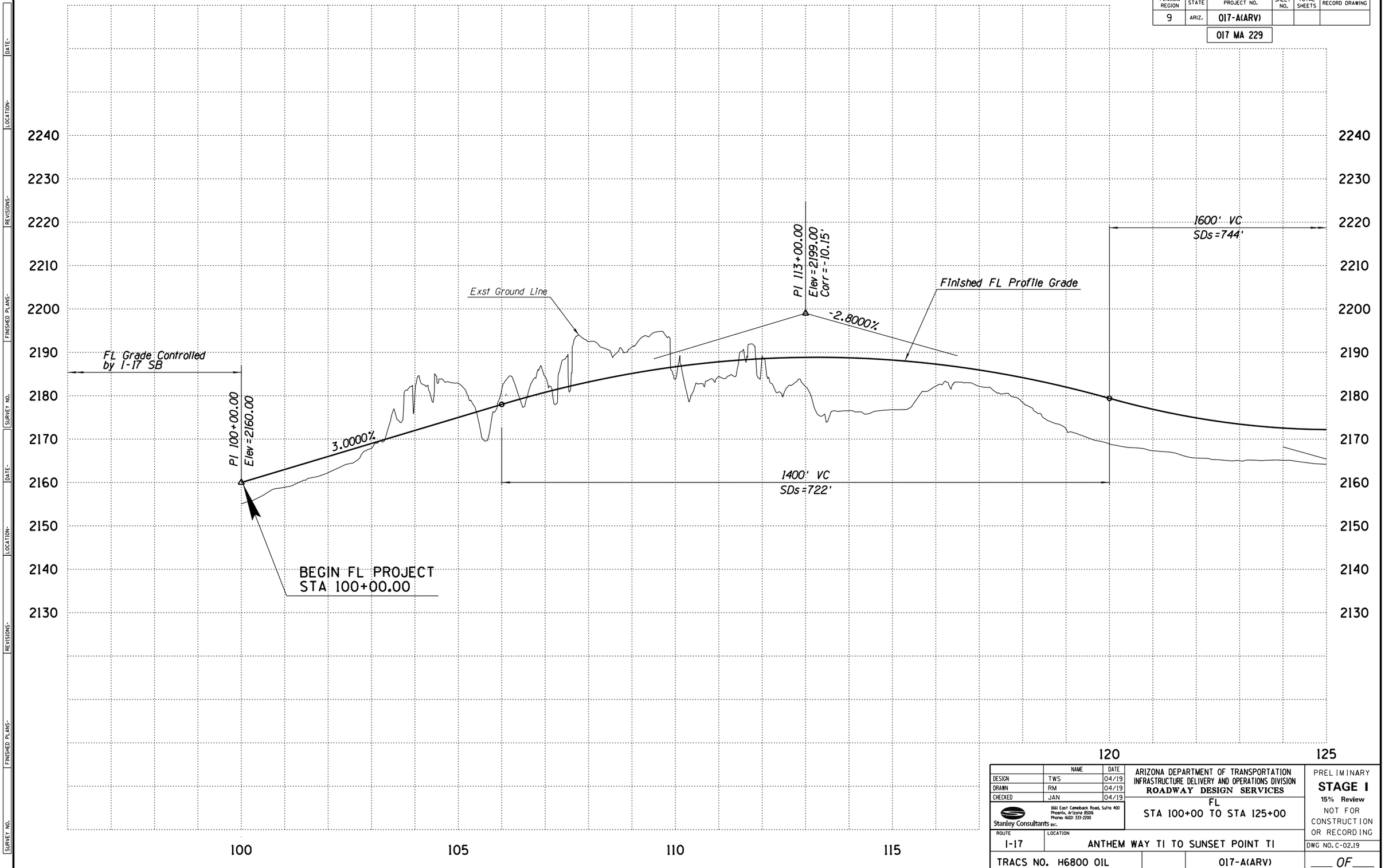
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.18

___ OF ___

4/29/2019 ...\Stage I (DCR)\h6800_v18NB.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

FL
STA 100+00 TO STA 125+00

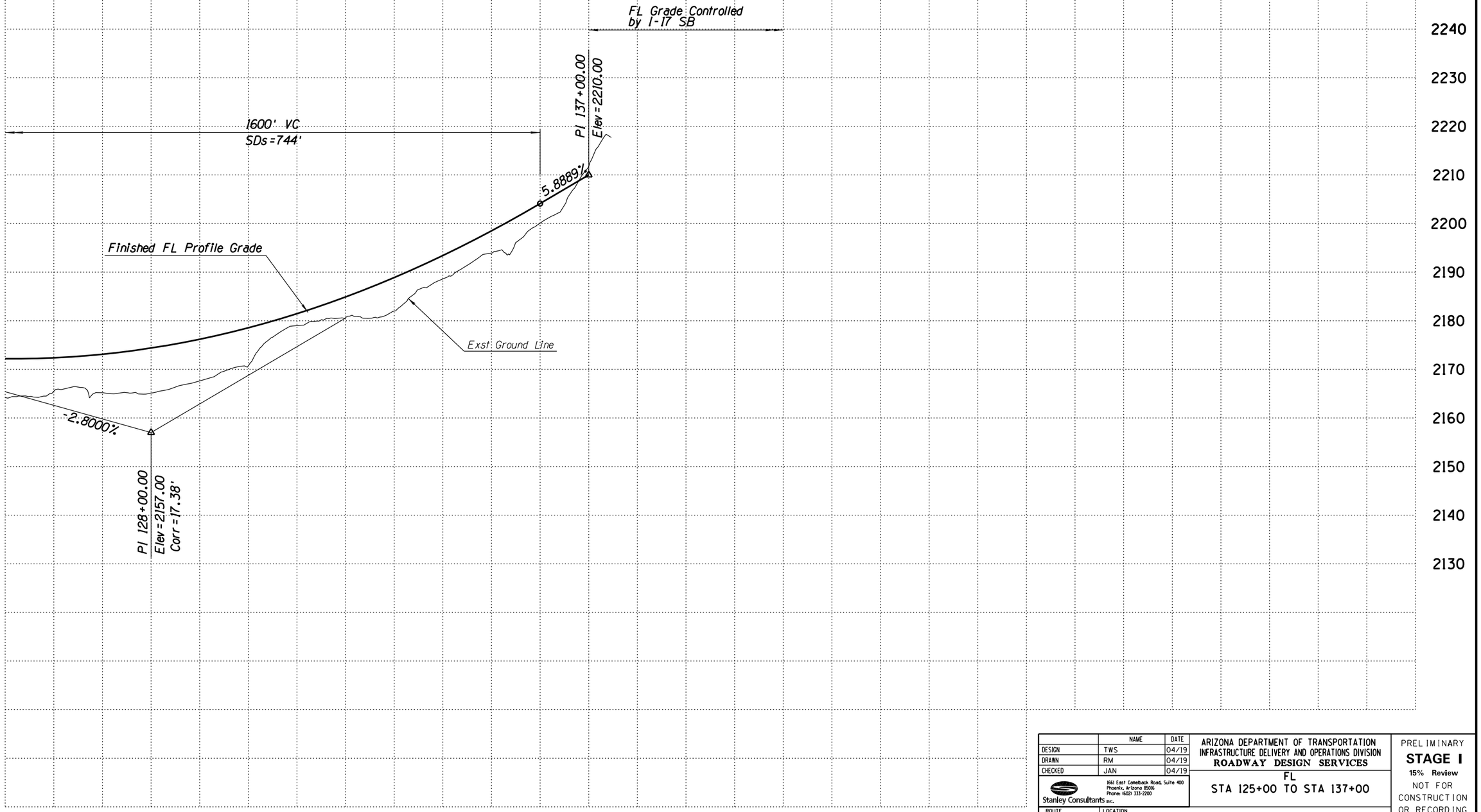
PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION	DWG NO. C-02.19
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L	017-A(ARV)	___ OF ___

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

4/29/2019 ...\h6800_v19R SouthCrossover.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

FL
STA 125+00 TO STA 137+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

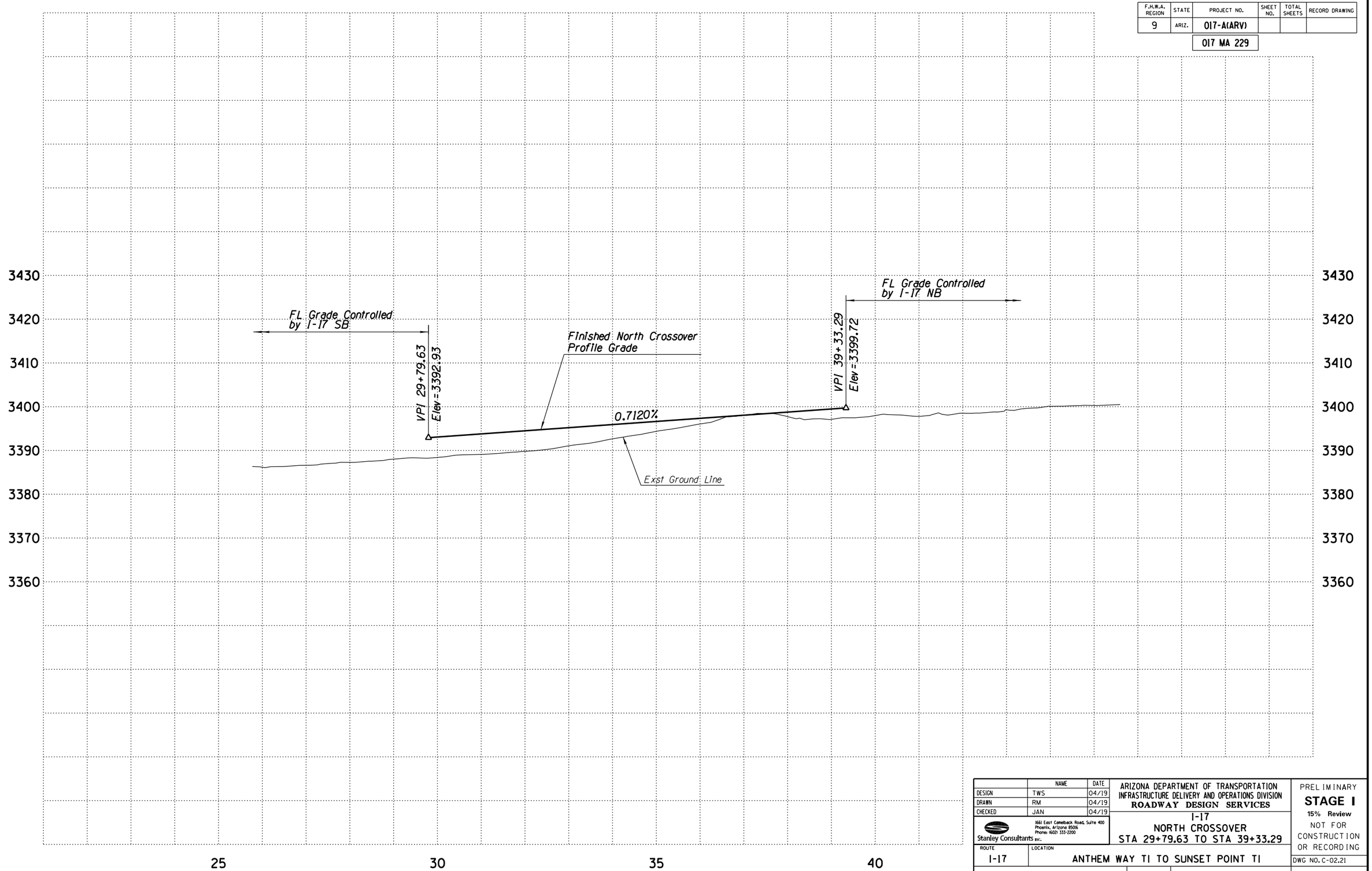
ROUTE	LOCATION	DWG NO. C-02.20
I-17	ANTHEM WAY TI TO SUNSET POINT TI	
TRACS NO. H6800 01L		017-A(ARV)

____ OF ____

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\h6800_v20 South Crossover.dgn

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
NORTH CROSSOVER
STA 29+79.63 TO STA 39+33.29

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

ROUTE	LOCATION
I-17	ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-02.21

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

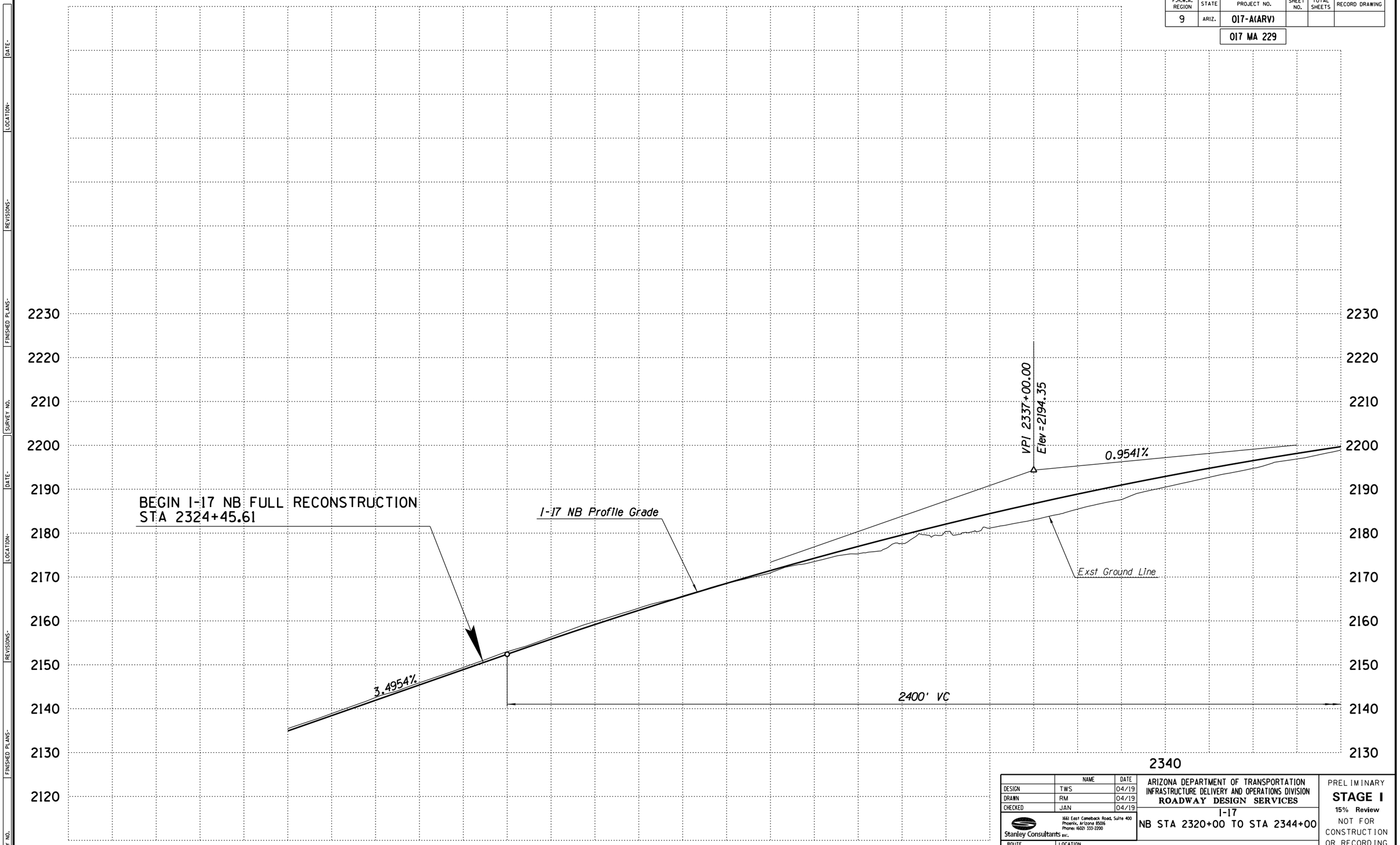
4/29/2019 ...\h6800_v21 North Crossover

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			

017 MA 229

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17
NB STA 2320+00 TO STA 2344+00

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

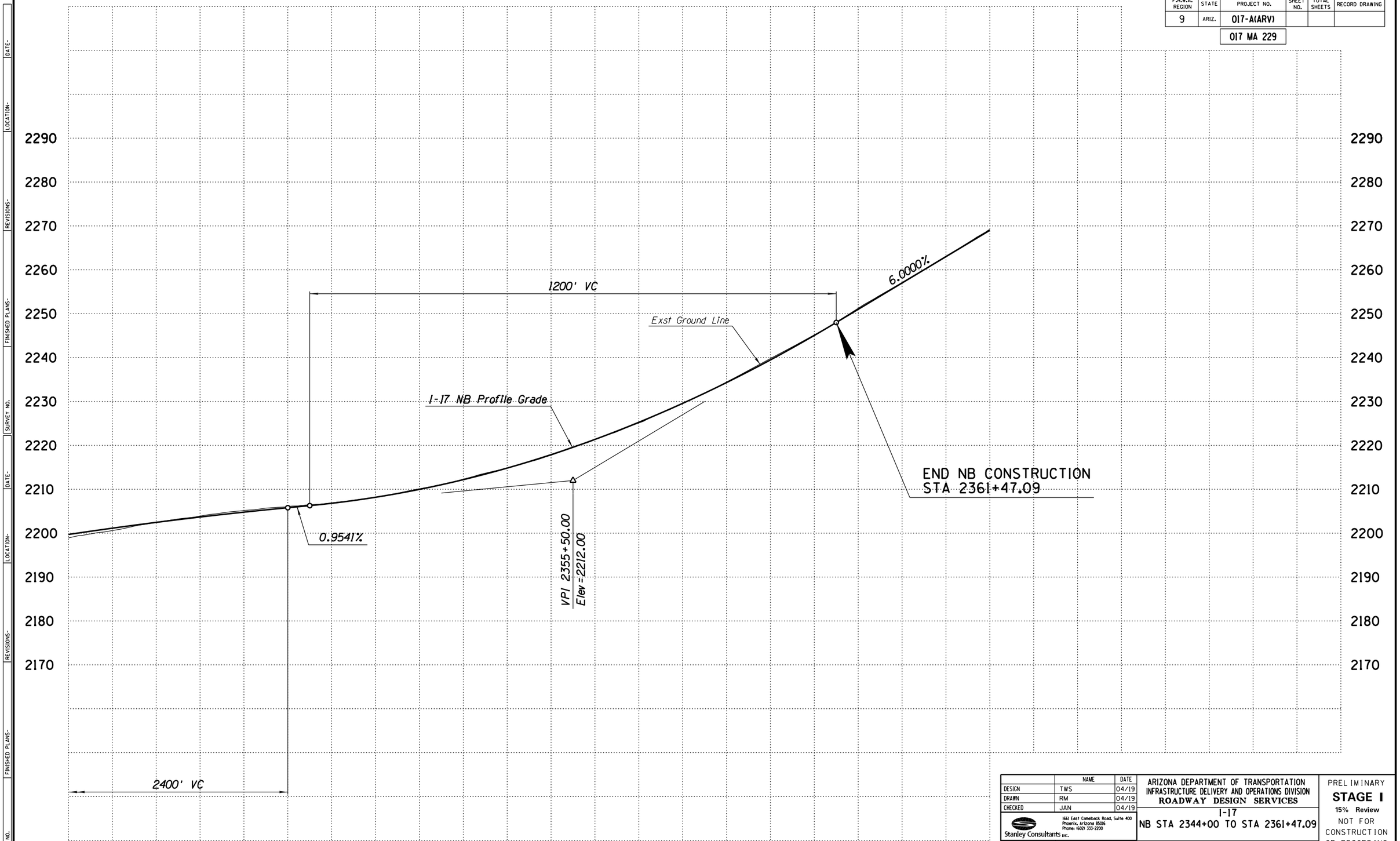
ROUTE: I-17
LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

DWG NO. C-02.22

TRACS NO. H6800 01L | 017-A(ARV) | ___ OF ___

4/29/2019 ...\Stage 1 (DCR)\h6800_v22NB

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	ARIZ.	017-A(ARV)			
		017 MA 229			



	NAME	DATE
DESIGN	TWS	04/19
DRAWN	RM	04/19
CHECKED	JAN	04/19

Stanley Consultants INC.
1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
Phone: (602) 333-2200

ARIZONA DEPARTMENT OF TRANSPORTATION
INFRASTRUCTURE DELIVERY AND OPERATIONS DIVISION
ROADWAY DESIGN SERVICES

I-17

NB STA 2344+00 TO STA 2361+47.09

ROUTE: I-17

LOCATION: ANTHEM WAY TI TO SUNSET POINT TI

TRACS NO. H6800 01L | 017-A(ARV)

PRELIMINARY
STAGE I
15% Review
NOT FOR CONSTRUCTION OR RECORDING

DWG NO. C-02.23

___ OF ___

SURVEY NO. | FINISHED PLANS- | REVISIONS- | LOCATION- | DATE-

4/29/2019 ...\Stage 1 (DCR)\h6800_v23NB

APPENDIX C – FINAL SUMMARY OF COMMENTS AND RESPONSES FOR DRAFT FINAL DCR

REVIEW COMMENTS

Submittal:	**Draft Final Design Concept Report**	***Project Name:***	**I-17, Anthem Way TI to Jct. SR 69**
Date:	3/08/2019	***Project No:***	17 MA 229 H6800 01L
Comment Due Date:	**3/22/2019**	***Federal Aid No:***	STP-017-A(ARV)S
Designer/ Consultant:	Stanley Consultants, Inc.	***ADOT Project Manager***	Asadul Karim, P.E. Major Projects

ACTION CODES:

A= WILL COMPLY ***B= CONSULTANT TO EVALUATE**

***C= ADOT TO EVALUATE** ***D= DESIGN TEAM RECOMMENDS NO FURTHER ACTION**

**** REQUIRES A WRITTEN EXPLANATION AND FINAL DISPOSITION BY CONSULTANT/DESIGNER***

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
ADOT/Asadul Karim/ Project Manager	1-1	Exec. Summary	2nd bullet - Put "on" before Friday and Saturday.	A	Will add.	A
ADOT/Asadul Karim/ Project Manager	1-2	E.S. Table	Add (mile) to the Length column.	A	Will add.	A
ADOT/Asadul Karim/ Project Manager	1-3	Pg. 1	Purpose and Need - 3rd para., 1st sentence – The purpose of the project is the add capacity to..delete "to" after capacity.	D	Grammar is correct as shown.	D
ADOT/Asadul Karim/ Project Manager	1-4	Pg. 1	Description of the project – 2nd para., can you rephrase it? Hard to understand. Make it simple.	A	Will simplify paragraph.	A
ADOT/Asadul Karim/ Project Manager	1-5	Pg. 2	Public Info. Meeting 1.4.1.2 – 2nd para., …along I-17 in the study area – revise it to within study area.	A	Will revise.	A
ADOT/Asadul Karim/ Project Manager	1-6	Pg. 4 – Sec. 1.5.1	Interstate I-17, 1st para., after the table – "within the limits of the study"…change it to within the study limits".	A	Personal preference item, but will revise.	A
ADOT/Asadul Karim/ Project Manager	1-7	Pg. 7	Rephrase it to: There are no railroad crossings within the study limits.	D	Text is correct as shown.	D

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
ADOT/Asadul Karim/ Project Manager	1-8	Pg. 15, Sec. 2.1.4	Rephrase the 1st sentence to make it more clear and understandable.	A	Will re-phrase.	A
ADOT/Asadul Karim/ Project Manager	1-9	Pg. 19, Sec. 2.3	Conclusions #10 – "the northbound climbing lane should begin at…" Where it starts and ends now? Please rephrase the sentence with further clarifications.	A	Older versions of the DCR included a more substantial climbing lane write-up. We will add part of it back in so that the conclusion makes more sense or revise the conclusion statement.	A
ADOT/Asadul Karim/ Project Manager	1-10	Pg. 51	CCTV Monitoring 2nd para., 2nd sentence. Add "and" and delete comma between… "Black Canyon City TI, at the Sunset Point Rest Area".	A	Will revise.	A
ADOT/Asadul Karim/ Project Manager	1-11	General	I did not see a cost item for PR?	C	Will add. ADOT Communications provided a PR cost of approx. $41,000 that will be added to the estimate.	A
ADOT/David Benton/Bridge Design Manager	2-1	Pg. 47	The existing vertical clearance on the SB direction for the inside widening at Rock Springs TI UP SB can be maintained with a break in the cross slope to maintain 16ft clear. Why can't we do that on the NB direction as well to maintain the 15.92 ft clear on the Rock Springs TI UP NB Bridge? The way I read it is that the only recommendation for a grade break is the SB direction only. Is this the case? And if so why? Can you please update the statement to reflect both NB and SB directions in that section, so it isn't confusing?	A	Will add statement that a cross slope break can also be added in NB direction to maintain the existing vertical clearance. (However, a design exception will still be required for VC less than 16'.)	A
ADOT/Craig Regulski/Sr. Project Manager	3-1	Tables 20 - 21	Missing labels for NB and SB for the configuration of the gore point.	A	Will add.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-1	Sec. 2.2	Tables indicate a 4-1/2 year crash evaluation period but text states it a 5 year period. Please rectify time period and crash numbers.	A	Will revise.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-2-	Pg. 29	Flex lane figure shows 6' inside shoulder and 4' inside shoulder to barrier. Following paragraph indicates a 2' shy distance for the inside barrier, should the reference to shy distance be removed?	A	Will remove reference.	A

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
ADOT/Reed Henry/ Predesign Section Mgr	4-3	Pg. 38	Section 4.3.1 4th Para. Please clarify how the structural section is different due to overlays?	A	The difference in the pavement section thickness between the mainline and the shoulder from the overlays is variable across the project length as the shoulder has been paved with asphalt rubber in some areas, but not others. Asphalt rubber is proposed for mainline travel lanes and both shoulders as shown in the typical sections in Appendix A. This information will be added to the DCR.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-4	Pg. 58	Sections 4.21 and 4.22 may be impacted by revisions to safety study and DE/DV request.	A	Section will be updated to correspond to DE/DV request.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-5	Pg. 62	Section 5.1 reference AASHTO Interstate Standard.	A	Will add reference.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-6	Pg. 62	Section 5.4 MP 252.21 to MP 253.08	A	Entry will be deleted since it's outside the construction limits.	A
ADOT/Reed Henry/ Predesign Section Mgr	4-7	Pg. 63	Section 5.4 do not use the word "adequate". Suggest stating it does not meet recommended minimum AASHTO.	A	Will revise.	A
ADOT/ Bob LaJeunesse/ NW District	5-1	3	Table 1 would be easier to read if it was sorted by construction date.	A	Will sort table by construction date.	A
ADOT/ Bob LaJeunesse/ NW District	5-2	Appendix B C-01.30	It looks like vehicles coming off the SB flex lanes could still access the Coldwater Canyon exit ramp. This could create a weaving problem that needs some attention.	C	Text will be added to call the final designer's attention to the questions. Barrier could be extended south past the exit gore. Rumble strips could be added in the gore. Relative ramp volumes at BCC will be added.	A
ADOT/James Bramble/ NW District	6-1	Pg. 54 Section 4.14.1	Is the statement that the flex lanes will likely be a separate project still accurate? Perhaps modify it to state that it could be separate or at least a separate phase of one overall project.	A	Text will be revised.	A

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
ADOT/James Bramble/ NW District	6-2	Pg. 54 Section 4.14.1	Although the traffic volumes are low, detouring NB traffic to use Sunset Point during the SB Bumble Bee bridge work will not be desirable.	C	Text will be expanded. The proposed phasing with routing Bumble Bee drivers north to Sunset Point, then back to the Bumble Bee TI would be inconvenient. Shifting the Bumble Bee Road alignment would be complicated by topography and already-tight geometrics. Consider accelerating construction with night or weekend work to limit inconvenience. Consider liquidated damages.	A
ADOT/James Bramble/ NW District	6-3	Pg. 54 Section 4.14.1	Bridge Construction; please identify the structure that would be reconstructed over existing roadways. I know it is stated elsewhere but it would be helpful to add it here	A	Will add structure name.	A
ADOT/James Bramble/ NW District	6-4	Pg. 55 Section 4.16	Signing and Pavement Marking - Milling and replacing the existing pavement friction course is the preferred method for stripe obliteration other than minor, short sections of striping.	A	Estimate assumed milling and replacing pavement friction course would be utilized for stripe obliteration wherever applicable. It was assumed that RPMs would be obliterated before milling. Text will be revised to reflect these assumptions.	A
ADOT/James Bramble/ NW District	6-5	Pg. 56 Section 4.18	ADOT has typically been including items for either spraying herbicide or mechanically removing noxious and invasive weeds. This could be a substantial item due the project's length and duration and could possibly be mentioned in this section.	A	Will add paragraph to address Noxious and Invasive Species treatment that can be incorporated as needed. Noxious weed treatment will also be added to the cost estimate.	A
ADOT/John Litteer/ NW District	7-1	16-17	Sec 2.1.6: Clarify discussion, suggest separate the discussions on the diverge and merge conditions (both directions). For NB merge, include discussion for length needed for trucks at the top of the hill to regain operating speed.	A	Northbound and southbound results will be identified in Tables 20 and 21. Climbing lane calculations included in Preliminary Traffic Report cite that trucks would regain normal operating speed of 65 MPH at approximately MP 252.65. This information will be cited in the discussion.	A
ADOT/John Litteer/ NW District	7-2	16-17	Also, it sounds from the discussion that the option lane for the flex lanes does not provide capacity, and that two exit lanes would be required. Figure 11 and plans still shows option lanes. Suggest also show	A	Results indicate that a combination trapped lane and optional exit lane configuration is necessary for both the NB and SB approaches to the flex lanes. Text will be added to clarify these are the	A

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
			schematic diagrams of alternatives discussed, and recommended alternative.		recommended alternatives. These lane configurations are reflected on the recommended alternative shown in Figure 11 and on plans in Appendix B.	
ADOT/John Litteer/ NW District	7-3	16-17	Please also discuss the short distance for NB south crossover, and that consideration should be given to extend the crossover length for separation from SB flex operations and potential wrong way movements.	C	More description/detail will be added to the text. The final designer should try to lengthen the crossover so that it's more uninviting to NB traffic when the flex lanes are open to SB traffic.	A
ADOT/John Litteer/ NW District	7-4	28	Sec 3.3.4: Suggest reference percentage of truck volumes (in RDG Table 302.4) when discussing 12' shoulders. Traffic data in report shows high truck percentage.	A	Will be added.	A
ADOT/John Litteer/ NW District	7-5	28, 37, Table 32 etc.	Should discussion on median barriers for flex lanes include glare screen? Could help with opposing headlights at night, visual distractions, etc.	A	Text will be added to consider the addition of glare screen to 42" median barrier.	A
ADOT/John Litteer/ NW District	7-6	47	Sec 4.11.6: Discuss how access will be prevented from SB flex lanes to SB exit ramp.	C	Text will be added to the DCR. See also response to Comment 5-2.	A
ADOT/John Litteer/ NW District	7-7	48	Sec 4.11.8: Discuss how access will be prevented from NB flex lanes to NB exit ramp, and from SB entrance ramp to SB flex lanes.	A	Text will be added. Similar to previous comment. The SB entrance ramp ties into I-17 downstream of the flex lane entrance. Barrier will prevent access from SB entrance ramp to SB flex lanes at Sunset Point.	A
ADOT/Todd Steinberger/ NW District	8-1	General	Has the capacity of the new median cut ditch been analyzed to see the impact of the construction of the southbound flex lanes. Will ponding on inside shoulder and passing lane occur?	A	Inlets are added along the flex lanes barrier and were placed to meet spread criteria.	A
ADOT/Jim Windsor/ TSM&O	9-1		No comments on ITS. Agree with lighting direction.			
ADOT/ Navaphan Viboolmate/ Bridge	10-1		No comments.			

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
MAG/Chaun Hill	11-1		No comments.			
ADOT/Joan Lovell/ Systems Technology Group	12-1	50	Add to the first sentence in **4.13 ITS/ Incident Management** : and is now incorporated in the Statewide ITS Architecture	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-2	50	413.1 Recommended ITS Element. The bullets items need to match the Headings on the following pages.	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-3		**413.1 Recommended ITS Element**. Add Bullet Flex Lanes to the bulleted items and place it in the proper order of headings on the following pages	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-4	51	Remove References to one mile spacing for detection between AW and BCC. Detection will only be needed in concert with the Flex lanes	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-5	51	Remove the word “acoustic” from the first Paragraph	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-6	51	Remove reference to detection at one mile spacing in the **CCTV Monitioring**.	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-7	51	**CCTV Monitoring**.. Add: Placement of CCTV in areas where power is readily available and CCTV can be powered by #2 AWG and smaller wire. Otherwise fixed cameras with a solar powered application shall be used.	C	If this comment is also applicable within the Flex Lanes section, it may limit the ability of ADOT to clear the fixed lanes if it requires using fixed cameras with solar rather than pan/tilt/zoom (PTZ) cameras powered by larger wire sizes than a #2 AWG. PTZ cameras would give ADOT much greater flexibility in the use of cameras to clear the flex lanes. Larger wires will be needed to provide enough cameras for complete coverage of the flex lanes.	A
ADOT/Joan Lovell/ STG	12-8	52	**Flex Lanes:** Paragraph 5 remove the word “Phoenix” from ADOT Phoenix Traffic Operations Center (TOC)	A	Will comply.	A
ADOT/Joan Lovell/ STG	12-9	53	**Flex Lanes** Delete: “as well as along the corridor” 2nd Paragraph on page 53 to read “The use of detectors is anticipated to supplement the CCTV camera system for clearance verification. Detector stations can be installed at key locations near the entry gates and at the end of the flex lanes.”	C	Most of the detectors will be placed near the flex lane crossovers. They are not needed south of Black Cyn City or on the flex lanes.	A

DESIGN REVIEW COMMENTS
(CONTINUED)

AGENCY/REVIEWER/ TITLE	ITEM NO	DWG, SHEET, PAGE NO	COMMENT	INITIAL CODE	DISPOSITION	FINAL CODE
ADOT/Brent Conner/ Geotechnical	13-1	Gen'l	ADOT has reviewed the preliminary geotechnical report by Wood. We have no comments on the preliminary geotechnical report or DCR. There may be opportunities in final design following completion of the geotechnical investigation to reduce excavation volume. The proposed outside widening at the Cape Horn geohazard may be evaluated in final design as discussed at the March project meeting.	A	Agreed.	A

APPENDIX D – APPROVED DESIGN EXCEPTION AND DESIGN VARIANCE LETTERS