

5.0 MAJOR DESIGN FEATURES

5.1 Introduction

This section describes the major design features used to develop the alternatives for widening SR 86 from a 2-lane highway to a divided 4 - 6-lane roadway. All of the alternatives meet the ADOT Design Standards in the ADOT Roadway Design Guidelines.

5.2 Design Controls

The following design controls for SR 86 were used in the development of the alternatives:

- Design Year: 2030
- Design Speed:

Roadway Type	Terrain	Design Speed
Fringe Urban Divided Hwy	Level	65 mph

The existing posted speed of SR 86 is 65 mph from the beginning of the project to MP 163.8 and 55 mph from MP 163.8 through the end of the project. As stated in Section 101.1 of the ADOT RDG, the design speed and the posted speed are independent of each other. The design speed is based on the ADOT RDG criteria for a Fringe Urban Roadway with managed access and establishes geometric parameters for the highway. The posted speed will be determined based on the operational characteristics of the highway, using the 85th percentile speed of traffic.

- Shoulder and Lane Widths: (see Typical Sections, Appendix A):
 - Travel Lane Width: 12-feet
 - Turn Lane Width: 12-feet
 - Shoulder Width:
 - Outside Shoulder: 10-feet
 - Inside Shoulder: 4-feet
 - Shoulder adjacent to turn lane: 4-feet
- Drainage Ditch Offset: 20-feet from edge of pavement to ditch centerline
- Slope Criteria: ADOT Standard Detail C-02.20 and ADOT RDG Figure 306.3 (Fringe-Urban Arterial)
- Gradient:
 - 5% Maximum (Fringe Urban Arterial, Level Terrain)
 - 0.4% Minimum
- Maximum Superelevation: 0.06 ft/ft (Fringe Urban Hwy)

- Maximum Horizontal Curve:

Design Speed (mph)	Max. Superelevation Rate	Max. Degree of Curve
65	0.06 ft/ft	3° 27'

- All other roadway features are per current ADOT Roadway Design Guidelines.
- Median crossovers associated with the divided roadway alternatives are provided at major intersections. Additional median crossovers are provided where major intersections are more than 1-mile apart to accommodate U-turn movements. Median crossovers are not provided at less than ½-mile spacing. Median crossovers are shown on the recommended design concept alternative plans in **Appendix B**. If additional access points are needed they should be consistent with the provisions noted in **Section 6, Access Management Plan**.
- Roadside Recovery Area: The width of the Roadside Recovery Area is 30-feet. If this width is not available a suitable barrier such as guardrail can be used. Guardrail will comply with ADOT Criteria and/or AASHTO Roadside Design Guide.

Extensions and relocations of Pima County roads as part of the improvement of SR 86 will be in accordance with Design Criteria contained in the current **Pima County Roadway Design Manual**.

5.3 Horizontal and Vertical Alignments

The existing horizontal and vertical alignment for SR 86 will be used as much as possible where the design criteria (as defined by the requirements of the ADOT RDG) is met for the design speeds listed in Section 5.2. There are 9 horizontal curves in the existing roadway, which comprises less than 30-percent of the total project length. The degree of curvature of all of the horizontal curves is less than the maximum degree of curvature shown in the current RDG for the design speeds. The superelevation rates of all the horizontal curves are between the minimum and maximum rates shown in the RDG.

There are 14 vertical curves on SR 86 within the study limits. The stopping sight distance of all of the vertical curves exceeds the required distance for the design speeds listed in Section 5.2 as defined by the requirements of the current RDG.

Utilizing the existing roadway in the new roadway sections is desirable for the following reasons:

- Enhances maintenance of traffic during construction.
- Mitigates the impact on the environment by minimizing the construction area.
- Maintains access to adjoining properties.
- Reduces the cost of the proposed improvements.

There are no overpass structures within the project limits.

5.4 Access, Management of Access

Management of access is recommended along SR 86 to enhance traffic operations and safety as well as to preclude uncontrolled future access and random strip development. Developing an access management plan involves providing access to private and public property while simultaneously preserving the flow of traffic on the roadway system in terms of safety, capacity, and speed. Access management on SR 86 will consist of partial access control which will allow needed access to adjacent properties while protecting the function of SR 86 as a regional transportation corridor. Partial access control will be implemented as part of the reconstruction of SR 86 to four-lanes. See **Section 6, Access Management Plan**, for details.

5.5 Right-of-Way

The existing SR 86 R/W corridor varies in width from 200-feet to 250-feet. The ownership of adjacent property is mixed, with approximately 30% owned by the USA, 25% in private ownership, 20% owned by the City of Tucson, 15% owned by the Arizona Board of Regents and 10% owned by the State of Arizona.

Additional R/W will be required for widening the highway from a 2-lane roadway to a 4 - 6-lane roadway. Additional R/W will also be required where local road intersections are being realigned or relocated to better fit the wider state highway.

The desirable R/W width per ADOT standards for a fringe urban divided highway (ADOT RDG, Figure 306.3) is 90 feet from the centerline of each roadway. The centerline to centerline separation between the divided roadways has been established at 74 feet for this project to provide 2 feet shy distance between the inside shoulders and a median barrier in the future when an additional lane is added in each

direction in the median of the roadway, and the width of the inside shoulders are increased to 10 feet. Additional R/W width may also be required for right-turn lanes.

As a result of coordination with the Utility Owners it has been determined by ADOT that the R/W for SR 86 will be widened enough to allow most of the utility lines that are now within the SR 86 R/W to relocate within the expanded SR 86 R/W. See Section 5.12; Utilities, Page 31.

Where new R/W is required for the realignment or relocation of local roads the width of the R/W will be in accordance with the requirements of Pima County.

Drainage Easements (DE) will be required for construction and maintenance of drainage channels, drainage dikes and outlets of RCBC.

Table 5-1 lists the County Assessor's parcel numbers and the estimated area of additional R/W and DE required for SR 86 for recommended Alternative C. Table 5-2 lists the County Assessor's parcel numbers and the estimated area of additional R/W required for local road connections

TABLE 5-1, R/W AND DE REQUIRED FOR SR 86

Parcel Number*			Owner	Approx. Take (Acres)	
BK	MP	PG		R/W	DE
209	20	003A	AZ Board of Regents	3.59	
209	20	003B	AZ Board of Regents		.04
209	17	003B	AZ Board of Regents	3.33	
209	17	003C	AZ Board of Regents		.09
209	16	006E	City of Tucson		.05
209	16	006F	AZ Board of Regents	1.20	
209	16	006G	Tucson 738	5.49	
209	15	006E	Tucson 738 LLC	1.64	
209	15	006F	City of Tucson	1.94	
209	15	006G	Tucson 738 LLC	1.36	
209	14	001D	United States of America	5.77	
210	14	0030	United States of America	2.99	11.19
210	14	0020	City of Tucson	4.43	
210	14	001A	AZ Board of Regents	3.57	11.86
210	14	001B	City of Tucson	2.50	
210	15	0030	State of Arizona	2.06	
210	15	004A	State of Arizona	1.88	1.45
210	15	0100	United States of America	4.32	1.27
210	12	0010	United States of America	.06	
210	16	012D	United States of America	.01	
210	11	045A	State of Arizona	4.37	.34
210	11	0490	United States of America	3.87	

TABLE 5-1, R/W AND DE REQUIRED FOR SR 86

Parcel Number*			Owner	Approx. Take (Acres)	
BK	MP	PG		R/W	DE
210	09	0720	United States of America	.01	
210	09	025N	Fidelity National Title Tr. 30226	.63	
210	09	0730	United States of America	1.43	
210	09	017A	United States of America	.54	
210	09	018A	United States of America	.55	
210	09	019A	United States of America	.38	
210	09	021A	United States of America	.51	
210	09	022A	United States of America	.17	
210	09	067A	State of Arizona	.48	1.36
210	09	0690	United States of America	1.78	
210	09	0700	United States of America	2.66	
212	45	107B	Henry S. Montoya	.27	
212	45	1080	Dolores Montoya & Maria Victoria Harvey	.29	
212	45	1100	State of Arizona	.65	
212	45	1120	State of Arizona	.60	
212	45	1130	Reay's Ranch Investors	.39	
212	48	069D	Pima County	.53	
212	48	069E	City of Tucson	4.18	
212	48	0700	United States of America	1.69	
212	48	042A	Ramirez Revocable Trust	.57	
212	48	043A	Erick M. Ramirez & Tracy M. Ramirez	.62	
212	48	045A	Juan A. & Deborah E. Valdez	.5	
212	48	045C	State of Arizona	.49	
212	48	045B	Juan A & Deborah E. Valdez	.16	
212	48	0380	Harold & Sandra Kay Schwartz	.07	
212	48	0590	Bobbi B. & Alma D. Shenk Revocable Trust	.03	
212	48	044B	West Ajo Baptist	.40	
212	48	046A	Old Town Feed & Supply LLC	.22	
212	48	047A	Mark Q. & Holly L. Waldon (50%) & Phil Galloway (50%)	.19	.82
212	48	037A	Paul Moroz	.52	
212	48	036A	Mike Car LLC	.61	
212	48	035A	Jaime C. & Maria G. Reyes	.23	
212	48	034A	Michelle Chavez	.19	
212	48	048A	Jacob F. & Carol R. Struble	.19	
212	48	049C	Michael C. Penny	.12	
212	48	049B	Ballah Family Trust	.10	
212	48	050A	Ramirez Revocable Trust	.21	
212	48	051A	Franklin C. T. Ginn & Shew Ying Ginn	.20	
212	50	001D	Stewart Title & Trust TR 1580		.08
212	50	001F	Stewart Title & Trust TR 1580		.23
212	50	005M	Stewart Title & Trust TR 1580		1.35
212	50	005P	Stewart Title & Trust Tr. 1580	.05	.12
212	50	005R	Donahue Schriber Realty		1.46
212	50	005T	Donahue Schriber Realty		.83
212	50	0060	Stewart Title & Trust TR 1582		.07

TABLE 5-1, R/W AND DE REQUIRED FOR SR 86

Parcel Number*			Owner	Approx. Take (Acres)	
BK	MP	PG		R/W	DE
212	50	011A	Stewart Title & Trust TR 1580		.06
212	50	012F	Stewart Title & Trust Tr. 1580	.83	2.36
212	50	012G	Stewart Title & Trust TR 1580	.52	
TOTAL AREA R/W AND DE - SR 86				79.14	35.03

*Parcel Numbers are from Pima County GIS Maps.

TABLE 5-2, R/W REQUIRED FOR LOCAL ROAD CONNECTIONS

Parcel Number*			Owner	Local Road	Approx. Take (Acres)	
BK	MP	PG			R/W	DE
210	14	0030	United States of America	Valencia Rd.	0	
210	15	004A	State of Arizona	Old Ajo Hwy.	0.28	
210	09	0690	United States of America	Camino Verde	1.01	
210	09	067A	State of Arizona	Camino Verde	3.31	
212	48	069D	Pima County	Tucson Estates Pkwy.	1.85	
212	48	0070	United States of America	Spencer St.	1.66	
212	48	060G	Swink	Spencer St.	0.21	
212	48	060H	Celaya	Spencer St.	0.13	
212	48	047A	Waldon & Galloway	Sunset Blvd.	.44	
212	48	056B	Wilson	Sunset Blvd.	.23	
212	48	056A	United States of America	Sunset Blvd.	.21	
212	48	048A	Struble	Sunset Blvd.	.13	
212	48	0550	Grijalva	Sunset Blvd.	.50	
212	48	051A	Ginn	Sheridan Ave.	.07	
212	48	044B	West Ajo Baptist Church	Oklahoma St.	.53	
212	48	060H	Celaya	Oklahoma St.	.18	
212	48	056A	Grierson	Oklahoma St.	.25	
212	48	063B	State of Arizona	Oklahoma St.	.50	
212	48	0620	State of Arizona	Oklahoma St.	.48	
212	48	061A	Dicochea, Armida & Dicochea	Oklahoma St.	.21	
212	50	001F	Stewart Title & Trust	Kinney Rd.		1.58
212	50	005M	Stewart Title & Trust	Kinney Rd.	.09	
212	50	011A	Stewart Title & Trust	Kinney Rd.	.08	
212	50	012G	Stewart Title & Trust	Kinney Rd.	.30	
212	50	012F	Stewart Title & Trust	Kinney Rd.	.23	
212	52	248D	First American Title	Kinney Rd.	.02	
TOTAL AREA R/W AND DE - LOCAL ROADS					12.90	1.58

*Parcel Numbers are from Pima County GIS Maps

5.5.1 Bureau of Land Management (BLM) Concerns

The following information was contained in a letter from the BLM to Mary Frye, FHWA dated June 12, 2008.

This project area is covered by four BLM right-of-way authorizations AZA 6032, AR01697, AR01698, and AR01699. Our records show that no final Environmental Analysis (EA) was prepared for these authorizations, except for a draft EA that was furnished to BLM in 1987. There is no evidence in our records of a final EA and Finding of No Significant Impact (FONSI)/Decision Record having been provided to our office. Our office is required to review and comment on the new analysis to ensure that the new EA meets BLM’s National Environmental Policy Act (NEPA) standards, and will allow our office to issue our own FONSI/Decision Record.

The proposed highway modification will require that the existing right-of-way authorizations be modified to reflect the final project built-out designs. If the proposed project is expanded to outside of the authorized right-of-way area, ADOT will be required to submit a right-of-way application to authorize those areas falling outside the existing authorized areas.

A follow-up transmittal memo from BLM to Billah Khan, ADOT Roadway Predesign, dated 10/02/2008 stated: In addition to this letter it is our understanding the ADOT project may affect Pima County Roads which have been granted and authorized to them by the BLM. Any alterations of these roads require BLM’s approval and possibly additional requirements.

5.6 Coordination With ADOT Aeronautics Group & Airport Development

Existing SR 86 is within the Runway Protection Zone (RPZ) for Ryan Airfield. The FAA – Western Pacific Region is prohibiting the construction of new roads in airport RPZ. However, since SR 86 is an existing road it is anticipated the FAA will allow the construction of improvements to SR 86. The Tucson Airport Authority provided comments, by letter dated April 21, 2010, on the planned improvements to SR 86. The comments included general concurrence in issues they consider important. The letter also commented on the future acquisition of property from the Tucson Airport Authority for ADOT right-of-way for the SR 86 project. The point was made that the property in question will be part of future commercial and industrial development by the Airport Authority.

Coordination with the Tucson Airport Authority has been ongoing during the development of the DCR. The coordination should continue

TABLE 5-3, EXISTING AND PROPOSED DRAINAGE STRUCTURES

Milepost	Exist. Station*	Existing Drainage Structure Size/Type	Proposed Drainage Structure Size/Type	Q 100-year 3-hour (cfs)	Comments
157.02	629+58 (Rt)	24" CMP	24" CMP	6	
157.06	631+03	5-10'x5' RCBC	9-10'x5' RCBC	2,790	
157.39	648+72 (Rt)	24" CMP	24" CMP	7	
157.41	649+52	3-8'x6' RCBC	6-8'x6' RCBC	1,762	
157.48	653+44 (Rt)	24" CMP	24" CMP	3	
157.51	654+40	3-8'x4' RCBC	6-8'x4' RCBC	1,523	
157.71	665+97 (Rt)	24" CMP	24" CMP	7	
157.74	666+91	4-8'x6' RCBC	8-8'x6' RCBC	2,996	
157.73	668+58 (Rt)	6'x3.5' Conc. Arch	6'x3.5' Conc. Arch	25	
157.99	680+78 (Rt)	24" CMP	24" CMP	4	
158.05	683+14	8-10'x4' RCBC	13-10'x4' RCBC	4,029	
158.38	701+28 (Rt)	24" CMP	24" CMP	6	
158.39	701+86	2-8'x3' RCBC	3-8'x3' RCBC	425	
158.60	712+79 (Rt)	24" CMP	24" CMP	5	
158.61	713+35	2-8'x3' RCBC	5-8'x3' RCBC	715	
158.86	726+29 (Rt)	24" CMP	24" CMP	7	
158.92	729+14	10-10'x4' RCBC	10-10'x4' RCBC	2,152	
159.05	739+48 (Rt)	24" CMP	24" CMP	6	
159.11	739+79	6'x3' RCBC	2-6'x3' RCBC	231	
159.21	744+61 (Rt)	24" CMP	24" CMP	8	
159.38	753+20	4-10'x5' RCBC	4-10'x5' RCBC	548	
159.71	770+87	2-36" CMP	2-36" CMP	39	
160.16	794+80	7-10'x5' RCBC	14-10'x5' RCBC	5,302	
160.38	803+67	2-24" CMP	2-30" or 3-24" CMP	59	
160.65	816+03 (Rt)	36" CMP	36" CMP	34	
160.70	817+02	5-10'x6' RCBC	7-10'x6' RCBC	2,666	
160.72	818+38 (Rt)	36" CMP	36" CMP	6	
161.25	855+05	3-10'x5' RCBC	6-10'x5' RCBC	1,427	
161.67	867+55 (Rt)	24" CMP	24" CMP	4	
161.65	866+88	10'x7' RCBC	6-10'x7' RCBC	6,760 as 3 culvert system, including splits from the east	3 culverts function as a system. Dike to west of 10'x7' RCBC should be raised to El. 2432.5.
161.75	871+75	2-10'x6' RCBC	5-10'x6' RCBC		
161.83	876+41	2-6'x7' RCBC	4-6'x7' RCBC		
162.05	890+41	4 span, 129' long Bridge	Add 130' span bridge to widen channel under existing roadway. Use 260' bridge for new roadway.	8,190 including 1,620 split from Snyder Hill	Exist. Black Hills Wash Bridge does not have hydraulic capacity for the 100yr-3hr storm. An additional bridge is recommended. Lower exist. Dike to elev. 2434.0 to allow high flow to split to west to culverts @ 866+88, 871+75 & 876+41.
162.15	893+19	36" CMP	36" CMP	28	
162.20	902+00	6-span, 199' long Bridge	Maintain and rehab. dikes. Improve Br. conveyance by excavation and erosion protection. Use 200' bridge for new roadway.	5,615 as 2-culv. & bridge system	Exist. Snyder Hill Wash Br. & culvs. will handle 4,400 cfs. 1200 cfs will go to downstream bridge. Maintain existing culvert Maintain existing culvert
162.48	910+43	10'x4' RCBC	10'x4' RCBC		
162.63	918+32	10'x4' RCBC	10'x4' RCBC		
163.41	959+93 (Lt)	18" CMP	18" CMP	4	

*Existing stationing taken from as-built plans F-056-1-503, EMP-S-222(26), F-056-1(1)

during the Design Phase. Concurrence of the SR 86 improvements with the RPZ for Ryan Airfield should be obtained early in the Design Phase.

The Tucson Airport Authority approved a Ryan Airfield Master Plan Update December 1, 2009.

The official contact for coordination of this project with the Aeronautics Division is:

Kenneth Potts, Airport Planning Grants Manager
 ADOT Aeronautics Group & Airport Development
 206 S. 17th Avenue
 Phoenix, AZ 85007
 Tel: (602) 712-7597
 e-mail: KPotts@azdot.gov

The official contact for coordination of this project with the Tucson Airport Authority is:

Jordan D. Feld, CM, AICP
 Director of Planning
 Tucson Airport Authority
 7005 S. Plumer Ave.
 Tucson, AZ 85756
www.tucsonairport.org
 e-mail: jfeld@tucsonairport.org
 Tel: (520) 573-5115 office
 Tel: (520) 573-8006 fax

5.7 Drainage

Drainage conditions have been evaluated in a separate drainage report prepared for this study, entitled: *Initial Drainage Report, in support of the Design Concept Report for SR 86 (Ajo Highway), dated July 2007.*

The purpose of the Drainage Report is to document the existing hydrologic analyses for SR 86 and to quantify the peak flow that will intersect SR 86. Results of the analysis will be used to determine the drainage facilities required for the SR 86 roadway improvement project.

Due to the floodplain characteristics and urbanization in the area, the design team must evaluate the impact of the roadway improvements for the 100-year storm event [Federal Emergency Management Agency (FEMA) criteria]. ADOT and the Pima County Regional Flood Control District (PCRFCDD) agreed that the regional HEC-1 models developed by JE Fuller for Pima County are to be used for the drainage analysis. Therefore, ADOT concurred in analyzing the existing conditions based on the Tucson Storm Water Management rainfall distribution for the 100-year 3-hour storm.

TABLE 5-3, EXISTING AND PROPOSED DRAINAGE STRUCTURES (CONTINUED)

Milepost	Exist. Station*	Existing Drainage Structure Size/Type	Proposed Drainage Structure Size/Type	Q 100-year 3-hour (cfs)	Comments
163.69	974+66	48" CMP	48" CMP	118	Upstream flow is directed under SR 86 with the realignment of Camino Verde.
164.01	991+60 (Rt)	10-10'x5' RCBC	10-10'x5' RCBC	3,093	Culvert to be replaced with Camino Verde realignment work.
164.04	992+85 (Rt)	3-30" CMP	Not required	154	Pipes are partially clogged, flows travel south to cross culvert crossing Camino Verde, south side of SR 86.
164.05	993+42	2-24" CMP	4-10'x4' RCBC	794	Both 24" pipes are clogged. Culverts are to be replaced with realignment of Camino Verde.
164.44	1014+13 (Lt)	2-26"x22" CMPA	To be removed	794	Old Ajo Hwy. intersection to be removed
165.04	1045+84 (Lt)	36" CMP	36" CMP	17	
165.34	1061+67 (Rt)	24" CMP	24" CMP	n/a	Local drain. Replace in kind if necessary.
165.44	1066+91	3-10'x4' RCBC	3-10'x4' RCBC	576	
165.67	1078+74 (Lt)	24" CMP	24" CMP	10	
165.70	1080+74 (Lt)	24" CMP	24" CMP	3	
165.80	1084+86	4-10'x4' RCBC	5-10'x4' RCBC	1,132	Construct berm at western end of box to elev. 2566.5.
166.25	1110+40 (Rt)	2-26"x22" CMPA	2-26"x22" CMPA	10	Pipes are clogged – flow overtops driveway entrance.
166.25	1110+44 (Lt)	2-24" CMP	3-10'x4' RCBC	832	Improved culvert inlet to be located on north side of McDonalds.
166.25	1110+44 (Lt)	2-24" CMP	30" CMP	17	
166.26	1112+25 (Rt)	26"x20" CMPA	26"x20" CMPA	3	
166.27	1112+50 (Lt)	26"x20" CMPA	24" CMP	7	McDonalds turnout is slightly overtopped.
166.28	1114+92	4-10'x3' RCBC	4-10'x3' RCBC	450	Improve inlet. HWEL above 2585 causes breakout to west.
166.40	1117+13 (Lt)	2-36" CMP	Improve Dip	450	Turnout is overtopped and may cause SR 86 to be overtopped. Recommend turnout be eliminated when property is developed.

*Existing stationing taken from as-built plans F-056-1-503, EMP-S-222(26), F-056-1(1)

5.7.1 Existing Conditions

Generally, storm water runoff flows northwesterly towards SR 86, except that east of Camino Verde storm water runoff flows southwesterly toward SR 86; then flows westerly along SR 86 to Snyder Hills Wash and ultimately flows northwesterly. **Figure 5.1, Page 29**, shows the drainage basin boundaries for the project.

There are two major washes within this project: the Black Hills Wash and Snyder Hills Wash. Both washes flow northwesterly towards SR 86.

5.7.2 Existing Culverts and Bridges

There are 56 existing drainage structures along SR 86, within the study limits. The breakdown of structures is as follows:

- Two bridges; Black Hills Wash bridge and Snyder Hills Wash bridge.
- 22 concrete box culverts (RCBC).
- 32 corrugated metal pipe (CMP) culverts.

Both bridges, eleven of the RCBC, and seven of the CMP culverts do not have adequate hydraulic capacity for the design storm (See **Table**

5-3, Existing and Proposed Drainage Structures and the Initial Drainage Report for locations and recommended sizes or actions).

5.7.3 Hydrology and Hydraulics Methodology

- **Hydrology**

JE Fuller developed hydrologic models for the watershed to Valencia Road and Camino Verde. The models used Pima County’s storm distribution (100-year 3-hour storm event). Since the JE Fuller models stopped at Valencia Road and Camino Verde, the drainage study for this project modified JE Fuller’s HEC-1 models as necessary to determine peak discharges along SR 86. The hydrology was extended to the west to Sandario Road.

The procedures utilized to develop peak discharges were determined in accordance with the ADOT Highway Drainage Design Manual – Hydrology, and the Pima County Department of Transportation and Flood Control District *Hydrology Manual for Engineering Design and Flood Plain Management with Pima County, Arizona*. Peak discharges for SR 86 culverts with drainage areas greater than 160 acres were estimated using the Corps of Engineers HEC-1 program. The Rational Method was used for drainage areas less than 160 acres.

- **Hydraulics**

Existing culverts were designed for the 25-year event, but future culvert crossings will be designed for the PCDFCD 100-year 3-hour storm event. ADOT Drainage Design agreed to use PCDFCD 100-year 3-hour storm in lieu of ADOT 50-year 24-hour storm event since they result in approximately similar results and the 100-year 3-hour storm event satisfies FEMA criteria.

The ADOT culvert program was utilized to analyze the existing capacity of the existing drainage structures and the size of proposed drainage structures. The capacity of proposed culverts was determined as the size of culvert required to pass the design discharge with a headwater 3-inches below the edge of pavement.

5.7.4 Drainage Requirements

Table 5-3 summarizes the drainage structures required for the design concept. These structures were only designed for the offsite drainage requirements. The culvert quantities do not include specific provisions for onsite culverts or special ditches. **Note: The hydraulics analysis for this report is preliminary in nature. A final hydraulic study will be required for the final design.** The final hydraulic study should include an analysis of impacts on the FEMA floodplain. The possible need for a Conditional Letter of Map Revision should be addressed.

Median inlets will be provided as needed.

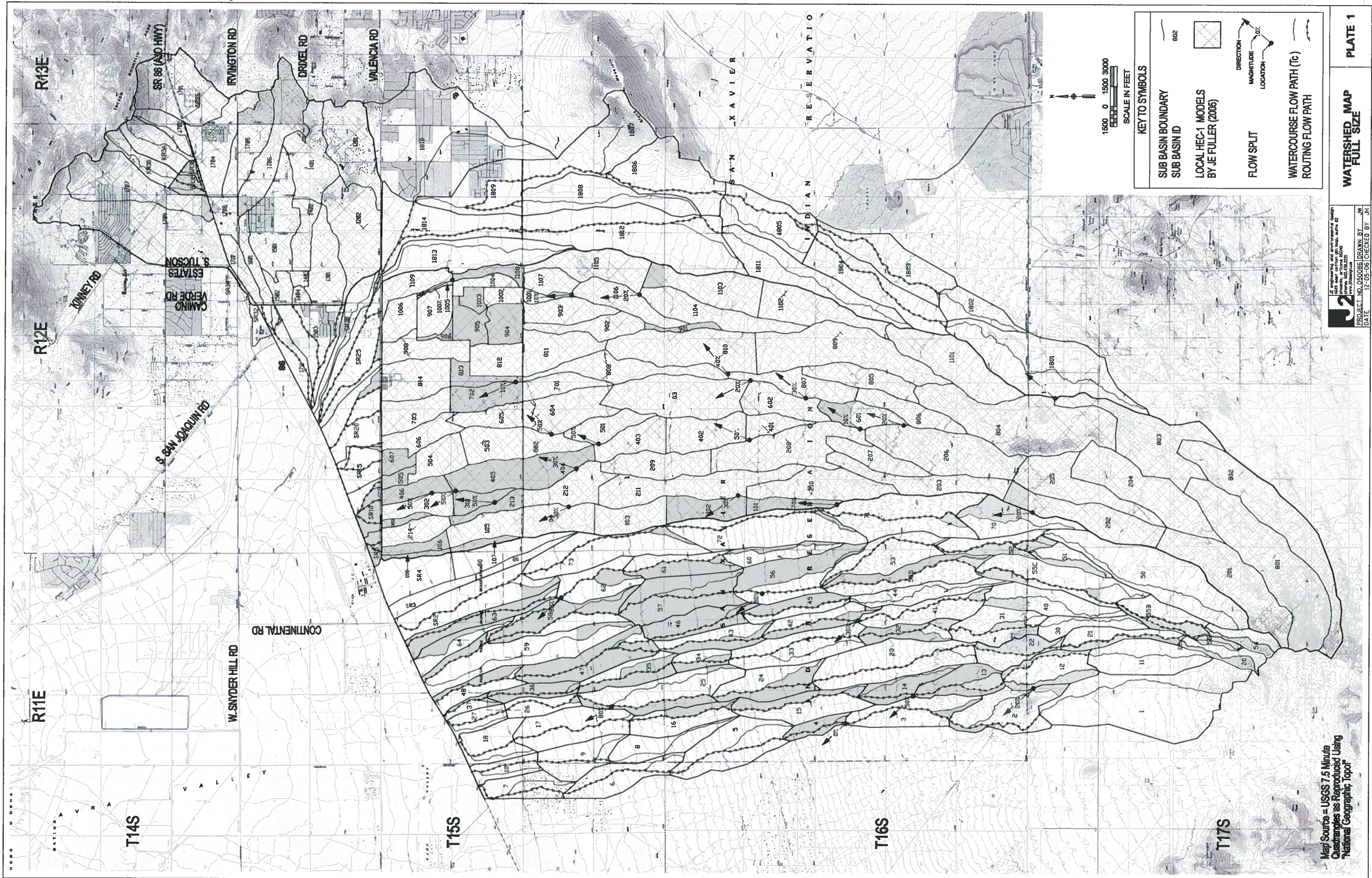
The eastern end of the project from Camino Verde Road to Kinney Road contains three existing roadside drainage channels which will be replaced. The channels have been divided into Reaches and are shown in Table 5-4, Drainage Channels.

Table 5-4, Drainage Channels

Reach No. (Sta. to Sta.)	Q (cfs)	Bottom Width (ft)	Side Slope (h:v)
1 (1109+00 to 1093+50)	775	40	3:1
2 (1093+50 to 1084+20)	911	35	3:1
3 (1076+00 to 1067+00)	580	25	3:1
4 (1062+70 to 1045+80)	600	30	3:1
5 (1045+80 to 1027+50)	800	40	3:1
6 (1027+50 to 1014+10)	800	40	3:1
7 (1014+10 to 994+00)	800	40	3:1

5.7.5 Drainage Dikes

A system of dikes has been utilized on the south side of SR 86 between the beginning of the project at MP 156.88 to approximately MP 162.8 to direct storm flows from the southeast to drainage culverts and bridges that pass the storm flows under SR 86. From MP 156.88 to Valencia Road at approximately MP 159.6 the new eastbound roadway will occupy the area of the existing dikes and new dikes will be constructed along the southerly R/W line. From approximately MP 160.1 to MP 162.8 most of the existing dikes are located outside the SR 86 R/W, and have been eroded and damaged to the extent they will be reconstructed. Drainage easements will be acquired where new dikes are needed or existing dikes are located outside the R/W or drainage easements (See Appendix B, Concept Plans and Profiles).



U2
PROJECT NO. 0500086 DRAWN BY J.W.
DATE 12-05-06 CHECKED BY J.H.

WATERSHED MAP FULL SIZE PLATE 1

Figure 5-1

5.8 Section 404 of the Clean Water Act

Coordination with the U.S. Army Corps of Engineers (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 waterward of 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.

Based on field review, 23 streams and washes that are crossed by the design concept alternatives have been identified as falling under COE jurisdiction. A Jurisdictional Delineation Request has been submitted to the COE for review and comments have been received. The Jurisdictional Delineation Request is currently being revised to address COE comments; after which, it will be resubmitted for approval. The following table lists the streams and washes along SR 86 within the project limits by MP (refer to plan and profile sheets in **Appendices A & B**) that have been identified as falling under COE jurisdiction.

**TABLE 5-5
CORPS OF ENGINEERS
JURISDICTIONAL STREAMS AND WASHES**

Location (MP)	Description
156.9	(2) 8'x 6' CBC within Un-Named Wash
157.1	(5) 10'x 5' CBC within Un-Named Wash
157.5	(3) 8'x 6' CBC within Un-Named Wash
157.6	(3) 8'x 4' CBC within Un-Named Wash
157.8	(4) 8'x 6' CBC within Un-Named Wash
158.1	(8) 10'x 4' CBC within Un-Named Wash
158.5	(2) 8'x 3' CBC within Un-Named Wash
158.7	(2) 8'x 3' CBC within Un-Named Wash
158.9	(10) 10'x 4' CBC within Un-Named Wash
159.2	6'x 3' CBC within Un-Named Wash
159.5	(4) 10'x 5' CBC within Un-Named Wash
160.2	(7) 10'x 5' CBC within Un-Named Wash
160.7	(5) 10'x 6' CBC within Un-Named Wash
161.3	(3) 10'x 5' CBC within Un-Named Wash
161.6	10'x 7' CBC within Un-Named Wash
161.7	(2) 10'x 6' CBC within Un-Named Wash
161.8	(2) 6'x 7' CBC within Un-Named Wash

**TABLE 5-5
CORPS OF ENGINEERS
JURISDICTIONAL STREAMS AND WASHES**

Location (MP)	Description
162.1	Black Hills Wash 4-span Bridge
162.3	Snyder Hill Wash 6-span Bridge
162.4	10'x 4' CBC within Un-Named Wash
163.7	48" CMP within Un-Named Wash
164.0	(10)10'x 5' CBC within Un-Named Wash
165.7	(4)10'x 4' CBC within Un-named Wash

5.9 Maintenance of Traffic During Construction

Maintenance of traffic through the work zone is a critical element associated with any improvement of SR 86. Valencia Road is an east-west County Arterial road that intersects SR 86 near Ryan Field and provides an alternate route easterly towards I-19 for some of the traffic that may desire an alternate route. However, the majority of the traffic that uses SR 86 will have to be accommodated on SR 86 during construction.

The construction of the improvements to SR 86 between Sandario Road and the end of the project east of the Kinney Road Intersection will be implemented in phases. See **Section 8, Implementation**.

One lane of eastbound traffic and one lane of westbound traffic will be maintained on SR 86 during construction of each phase of the improvements. Short term closures will be limited to night or weekend hours where the traffic lanes may require re-striping or other minor modifications as the work progresses. Local road intersections will remain open to the extent feasible. All closures and detours of local roads will be coordinated with Pima County.

When the new two-lane roadway is complete for each construction phase, two-way traffic will be routed onto it while improvements to the existing roadway are completed. Where the existing roadway will be removed and two new directional roadways will be constructed two-way traffic will be maintained on the existing roadway until one of the new directional roadways is complete and traffic can be routed onto the new roadway.

Detailed plans for maintenance of traffic during construction will be required for each phase of construction.

5.10 Earthwork

Existing SR 86 within the study limits is constructed on embankment through most of the project. Since the existing roadway will be incorporated into the construction of a 4-lane divided roadway, the existing line and grade of the roadway will not change appreciably when the roadway is improved. The earthwork quantities shown in **Table 5-6** include both roadway and drainage excavation, but do not include shrink or swell factors. Shrink or swell factors will not be known until the site for borrow material is selected. The geotechnical report that will be required during Final Design will provide the factors to be used.

**TABLE 5-6
EARTHWORK SUMMARY
CUBIC YARDS [CY]**

Design Concept Alternative C	Excavation CY	Embankment CY	Balance CY
MP 156.88 to MP 166.58	122,000	398,000	-276,000

Table 5-6, Earthwork Summary, shows that approximately 300,000 CY of borrow material will be required to construct the roadway improvements. No ADOT furnished borrow source is set up for this project. Materials sources shall be as specified in the ADOT Standard Specifications for Road and Bridge Construction. Borrow material may be available from the Arizona State Land Dept. (ASLD). A stockpile of material is located on State Trust Land on the south side of W. Snyder Hill Road, north of SR 86. The material would have to be tested for suitability and the Contractor would have to enter into an agreement with ASLD.

Two new bridges will be required across major washes within the project, and several large box culverts will be required. The bridge inspection reports for the existing bridges indicate that the material upon which the bridges will be constructed is scour susceptible.

An extensive geotechnical investigation will be required during final design of the recommended alternative to provide foundation information and define the materials needed to construct the roadway improvements.

5.11 Pavement Structure

The preliminary pavement structural sections for this project were provided by the ADOT Pavement Design Section, and are:

New Roadway:

- 5-inches AC & 12-inches AB.
- 1/2-inch AR-ACFC on travel lanes (25').
- Fog and Blotter on shoulders.

Existing Roadway:

- Mill 2.5-inches and replace with 2.5-inches AC and 1/2-inch AR-ACFC.

Crossroads:

- 5-inches AC & 6-inches AB.

Detours:

- 2.5-inches AC & 4-inches AB.

The preliminary pavement structural sections will be reviewed and may be revised during final design when the geotechnical investigation is complete.

5.12 Utilities

Arizona Blue Stake was contacted to get information about utility companies who have facilities along SR 86 within the project limits. The ADOT District Permit Log was also used to identify utility companies with facilities along SR 86. All known utility companies within the project limits were contacted and information was requested regarding utilities and an indication of possible conflicts with the alternative roadway improvements under study.

A meeting with utility companies/agencies located along the SR 86 corridor was held June 16, 2008 for the purpose of informing the utilities about the proposed improvement of SR 86 and to obtain information from the utilities about their existing lines and facilities with and along the ADOT R/W.

Additional meetings were held with City of Tucson Water Department, Qwest, and Central Arizona Project (CAP).

Existing utility lines are shown in **Appendix E, Existing Utility Plans**.

There are a significant number of utility lines along the SR 86 corridor within the project limits. It will be necessary to identify and address utility conflicts and coordinate the resolution of conflicts as early in the Design Phase as possible. As a result of coordination with the Utility

Owners it has been determined by ADOT that the R/W for SR 86 will be widened enough to allow most of the utility lines that are now within the SR 86 R/W to relocate within the expanded SR 86 R/W. Utility lines that are currently outside the SR 86 R/W, but that will be within the expanded SR 86 R/W may be accommodated within the expanded R/W or may relocate outside the expanded R/W. Specific conflicts between the utility facilities and the improvement of SR 86 will be determined through further coordination between the utility owners and ADOT during the Design Phase of the improvement of SR 86.

Some of the following information from utility companies indicates they will claim prior rights. The ADOT Right of Way Group will investigate any claims of prior rights early in the final design phase when utility conflicts are more clearly identified.

- Pima County Wastewater Management Department has several sanitary sewer lines crossing SR 86 and located within the R/W of SR 86. The contact is:
Debbie Stratton
Pima County Wastewater Management
100 North Stone Avenue
Tucson, AZ 85701
Phone: (520) 617-8224

The following information was received from Pima County Wastewater Management Department:

Currently, 45 days are allocated for review of initial plan submittals.

Utility tracking number U-2008-041 has been assigned to the SR 86 project.

Pima County Regional Wastewater Reclamation Department (PCRWRD) claims of prior ownership are as follows:

PCRWRD has existing public sanitary sewer conveyance facilities near Sta. 845+20 to 846+50, constructed in 2006 (Improvement Plan #G-2005-014), near the eastern boundary line of Section 7, T 15 S, R 12 E.

PCRWRD has sanitary sewer conveyance facilities near Sta. 873+90 to 875+50, constructed in 2003 (improvement plan #G-2002-104, near the center section line of Section 8, T 15 S, R 12 E.

PCRWRD has sanitary sewer conveyance facilities from Sta. 903+30 to 912+70, constructed in 1977 (Improvement Plan #C-114), near the SW 1/4 corner of Section 4, T 15 S, R 12 E.

PCRWRD has sanitary sewers C-123 (1978) and G-86-25 (1986) from Sta. 1015+50 to 1020+40, near the south line of Section 34, T 14 S, R 12 E.

PCRWRD has sanitary sewers G-86-115 (1988) from Sta. 1026+00 to 1029+20 and Sta. 508+80 to 521+00, Tucson Estates Parkway.

PCRWRD has sanitary sewers C-123 (1978), G-2004-034 (2005), C-79+B (1973), C 143 (1978) and M-603 (1979), SR 86 (Ajo Highway) from S. Sheridan Avenue to terminus of the project, Section 36, T 14 S, R 12 E.

- The contact for City of Tucson Water Department is:
Tony Tineo
City of Tucson Water Department
310 West Alameda St.
Tucson, AZ
Mail to: P.O. Box 27210
Tucson, AZ 85726-7210

City of Tucson Water Department has a 42-inch concrete cylinder water line located on the south side of SR 86 within the ADOT SR 86 R/W from Sandario Road easterly to the old alignment of Valencia Road, across from Ryan Airfield. It conveys water from the Avra Valley Well Field east to the Martin Reservoir. This main is the single supply source for the region. The long term integrity and the ability to access this main are key concerns of Tucson Water.

The following information was received from Tucson Water:

Tucson Water recommends that if new drainage dikes and/or channels must be constructed south of Ajo Highway, that they be moved to a location even further south of the existing Ajo Highway right-of-way. This will minimize the potential negative impacts to the 42" water main including excessive fill over the 42" pipe and obstructing maintenance access to the pipe.

The pipe manufacturer, Ameron, recommends that any increase in cover over the 42" pipe be limited so that the total cover is a maximum of 10'. As-built drawings indicate that the existing cover over the pipe is approximately 3' to 8'. Therefore Tucson Water recommends that if Alternative "C" remains the recommended design, then the 42" main be potholed extensively during the DCR phase of the project to determine the feasibility of building dikes over the 42" main. Also please check that the toe of the new dikes (including subgrade prep.) should maintain at least 2' of working cover (vertical clearance) over the top of the 42" main.

(Note: Pothole plans have been prepared and reviewed by Tucson Water. ADOT will proceed with potholing the 42" water main during the final design phase.)

The combination of new dikes and extending the culverts to the south will concentrate existing sheet flow across the 42" water main at several locations within the project limits. It may be necessary to install bank protection (riprap, concrete apron, etc.) over the 42" main to insure that the existing cover is maintained.

The drainage excavation required to extend the culvert inlets to the south may also adversely impact existing cover over the 42" main. These issues need to be addressed in the DCR. Possible unrestrained pipe joints in these areas are another reason to mitigate for scour.

Please note that the 42" main is cathodically protected (CP). Any new utilities that require CP should be coordinated with Tucson Water. The CP cabinets and power poles may have to be relocated as part of this project.

There are numerous corrosion test stations, access manholes, vaults, water meters, and fire hydrants that may have to be relocated because they are within the cut/fill limits of the project or because maintenance access has been locked by the proposed drainage dikes.

Tucson Water is limited in its ability to allow for any shutdown of the 42" transmission main. The 42" main may only be shutdown for a maximum of 8 calendar days for any one shut-down. Only two shut-downs will be allowed with a minimum of 30 days between shutdowns. Any planned shutdown of the 42" main must be scheduled with Tucson Water Operations and Maintenance Section, and it must occur during the off-peak season (October 1st to March 30th). It may not be feasible to shutdown, dewater, make connections, and repressurize the 42" main within the allowable 8 day window. This means that it may not be feasible to relocate the 42" main. If it becomes apparent during the roadway design process that the 42" main must be relocated, ADOT's design consultant may need to consult a pipeline contractor to see if there are any innovative techniques that can be used to relocate the 42" main within the allowable 8 day shutdown window. Tucson Water requires a minimum of 45 days to review and comment on any shutdown proposal. Only overnight shutdowns/connections shall be permitted for the other water main work along Ajo Highway.

Spread footings over the 42" main will not be permitted. Please insure that all new signal and utility poles maintain a minimum 5' horizontal separation from the outside face of the new pole foundation to the outside face of any new and existing water mains.

Tucson Water's Planning Section has identified the need for a new 16" water main (B-Zone) along Ajo Highway from Sandario Road to Valencia Road. There is a need for a new 12" main (C-Zone) from Camino Verde to Sheridan Road (this will replace the existing 6" main). Also, the existing 8" water main that lies in Camino Verde and crosses Ajo Highway must be replaced with a new 12" main and repositioned to match the new alignment of Camino Verde. It is anticipated that these mains will be designed by ADOT's design consultant and installed using ADOT's roadway contractor. A proposed 12" main (D-Zone) between Sheridan Road and Kinney Road will be constructed as part of Pima County DOT's Kinney/Ajo Intersection Improvement Project. This 12" main will replace the existing 6" main in order to meet increased demand by the proposed Wal-Mart at the northwest corner of Kinney Road and Ajo Highway.

Tucson Water's Planning Section has also identified the need for a new 72" water main that will cross Ajo Highway at Spencer Avenue.

Tucson Water anticipates that a root barrier will be installed with any new landscaping (trees) constructed within 10' (horizontal) of new or existing water mains. All trees shall maintain a minimum 5' horizontal separation from new and existing water mains.

It appears that the proposed drainage channel along the north Ajo Highway right-of-way (from Camino Verde to Kinney Road) may impact Central Arizona Project (CAP) and Tucson Water facilities in the area. Also, the proposed channel may be in conflict with several Tucson Water mains including a 42" transmission main. Water mains must be 3' below the bottom of lined channels and 5' below the bottom of unlined channels (or 2' below scour depth whichever is greater).

Please ensure that all existing water mains have a minimum of 2' of working cover between the bottom of the new pavement subgrade prep (6" below the bottom of pavement section) and the top of the existing water main. The water main must be relocated where this minimum working cover cannot be met.

Please make sure that all drainage structures either pass at least 1' under existing water mains, or 3.5' over the water mains.

Tucson Water sent a letter to ADOT Utilities and Railroads Section, dated August 21, 2008 in which they claimed prior rights for their 42" water line on the south side of SR 86 between Sandario Road and Valencia Road. ADOT R/W Titles Section researched the prior rights claim and determined that Tucson Water does not have prior rights. ADOT Utilities and Railroad Section sent a letter to Tucson Water dated January 7, 2009 advising Tucson Water that no prior rights exist.

- The contact for Central Arizona Project (CAP) is:

Tom Fitzgerald, Land Administrator
Central Arizona Project
P.O. Box 43020
Phoenix, AZ 85080
Phone: (623) 869-2209

CAP has a 108-inch water line on the north side of SR 86 from approximately MP 164.4 to approximately MP 164.7. The water line approaches SR 86 along the alignment of Irvington Road and then turns to the east just north of the SR 86 R/W line. The proposed drainage channel that is part of this ADOT project will be directly over the CAP 108-inch water line. The water line also crosses under Tucson Estates Parkway north of SR 86. An overhead power line supplies power to the CAP cathodic protection rectifier.

CAP also has a 78-inch water line and steel casing pipe, a 15KV underground power conduit and low voltage conduit, and a 115KV underground electric conduit that cross SR 86 in a 100 ft. R/W west of S. Spencer Street.

CAP has fee impacts for design reviews and contractor fees for working over/in CAP R/W.

- Comcast Cable has fiber optic lines along the SR 86 R/W between Sandario Road and Valencia Road. Comcast fiber optic lines also cross SR 86 at Sheridan Road. The contact is:

Mike Ginn
Comcast Cable
8251 N. Cortaro Road
Tucson, AZ 85743
Phone: (520) 744-5477 or Cell (520) 906-4560

- TRICO Electric Cooperative, Inc has a 3-phase primary line within the ADOT R/W approximately 5 ft. inside the south R/W line of SR 86 from Sandario Road to Valencia Road, a single-phase primary line crosses SR 86 at Postvale Road, and a 3-phase primary line crosses SR 86 at approximate MP 162.3. The contact is:

Paul Newton
TRICO Electric Cooperative
Dispatch Center

8600 West Tangerine Road P.O. Box 930
Marana, AZ 85653-0930
Phone: (520) 740-9944, Ext. 1320

- The contact for Southwest Gas is:

Kelly Fleenor
Southwest Gas Corporation
3401 East Gas Road
Tucson, AZ 85714
Phone: (520) 794-6107

Southwest Gas has a 6-inch gas line that is located on the north side of SR 86 from Sandario Road to the westerly intersection of SR 86 and the Old Ajo Highway. The 6-inch gas line then follows along the Old Ajo Highway. Southwest Gas has several crossings of SR 86 and several 2-inch local service lines within the project limits.

There are also three regulator stations, one rectifier, many valves, and high pressure and distribution facilities. Southwest Gas will likely have direct conflicts with the proposed dike and drainage structures. The roadway widening may place the roadway in close proximity to existing above ground gas facilities. There are existing high pressure facilities on Valencia and Camino Verde that may be affected by re-alignment of portions of those roads.

Southwest Gas has several existing easements along SR 86:

An existing easement on the south side of SR 86 from Sheridan Avenue to Seymour Road including Kinney Road south of SR 86 (book 5681 page 139 and book 2596 page 141).

An easement on the east side of Sheridan Avenue (book 2596 page 141).

Southwest Gas believes there is an easement on the north side of SR 86 near Valencia Road and is currently researching this area.

Southwest Gas requires a minimum one foot separation from distribution facilities and any proposed structures and two feet separation from high pressure gas facilities. Due to seasonal demands, relocation of high pressure gas facilities is limited to April through September.

- Quest has both direct burial and underground lines intermittently along SR 86 on both the north and south sides of the highway through the length of the project. (Note: Quest terminology refers to both buried and underground lines. Buried means direct burial lines; underground means lines that are generally in conduits and go through manholes.)

From the beginning of the project near Sandario Road to the vicinity of Tucson Estates Parkway, and intermittently from there to Sheridan Avenue, Qwest has lines located on the north side of SR 86 within the ADOT R/W. From approximately MP 164.1 to the end of the project at Kinney Road Qwest has lines on the south side of SR 86 within the ADOT R/W. There are numerous lines crossing SR 86.

The contact for Qwest is:

Larry Lewis
Qwest Communications
333 East Wetmore Road, 3rd Floor
Tucson, AZ 85705
Phone: (520) 292-8255

- The contact for El Paso Natural Gas is:

Kelley Hall
El Paso Natural Gas
5151 E. Broadway Blvd.
Tucson, AZ 85711
Phone: (520) 663-4223

El Paso Natural Gas has a 30-inch gas line and a 26-inch gas line that cross SR 86 on a diagonal at approximate MP 163.5, approximately 600-feet east of the existing intersection of SR 86 and San Joaquin Road. The pipelines generally follow the alignment of San Joaquin Road to the north of SR 86.

The El Paso lines under SR86 have recently been reconditioned and the improvements to SR 86 should not impact them. If the SR 86 improvement plans change and relocation of the El Paso lines become necessary, El Paso will likely claim prior rights.

El Paso Natural Gas requests that they be contacted prior to any construction activities within their easement area so an El Paso Operations Field Tech can be onsite during construction.

Any other utility lines that will cross El Paso Natural Gas Lines will need at least 2 ft. of separation and will need to be placed lower in the ground than the El Paso Natural Gas pipelines.

Overhead power lines that cross El Paso Natural Gas easement will need to be a minimum of 30 ft. above grade within the easement area.

- The contact for Tucson Electric Power is:

Cynthia Garcia
Tucson Electric Power
P.O. Box 711, Mailstop DB101

Tucson, AZ 85702
Phone: (520) 918-8246, Cell (520) 906-4560

Tucson Electric Power (TEP) has numerous power line crossings of SR 86 between Ryan Airfield on the west and the easterly end of the SR 86 project, east of Kinney Road. An overhead power line is located inside the SR 86 R/W on the north side from approximately MP 164.5 easterly to the end of the project.

TEP has conflicts with the SR 86 roadway design and will need to relocate a majority of its pole lines. TEP will claim prior rights for its overhead lines shown on plan sheets C-7 to C-9, C-11 and C-12 except where it crosses SR 86.

TEP requests that drivable access be maintained to TEP poles, equipment and facilities. The relocation of TEP facilities such as feeder, sub-transmission and transmission lines is limited to TEP's off-peak season, October through April. TEP poles will remain in place until all other joint-use participants have transferred facilities from TEP poles. Pole bracing may be necessary depending upon the ADOT contractor's construction sequence.

For the latest TEP Electric Service Requirement and Construction Standards visit the TEP web site at

<http://www.tep.com/business/construction.ServReqBook.asp>.

TEP has a pole and two anchors that appear to be in conflict with a new dike shown of sheet UTL 9 where TEP has prior rights. The new dike is to be designed to avoid the conflict.

TEP requests that a single-6" conduit be installed either by TEP's contractor or ADOT's contractor at the time of road construction at the following locations:

Under SR 86 on a diagonal along the alignment of W. Drexel Road from approx. Sta. 904 to 909.

Under SR 86 at the San Joaquin Road intersection, approx. Sta. 959.

Under SR 86 at the proposed alignment of Camino Verde Road, approx. Sta. 995.

Under SR 86 at the intersection of Tucson Estates Parkway, approx. Sta. 1030.

TEP requests that space be provided in the new SR 86 R/W for a concrete encased duct bank for two-6" conduits along the new southerly R/W from Spencer Street to Irvington Road alignment.

ADOT's contractor is to be advised to contact Blue Stake a minimum of ten working days in advance to request over head protection or pole bracing.

5.13 Structures

There are two bridge structures and fourteen reinforced concrete box culverts (RCBC) within the project limits that are classified as structures because they are 20-feet or more in length. The Drainage Study has determined that the following structures do not provide the needed hydraulic capacity for the design flows.

- Str. No. 6938, MP 157.06 – 5-10'x5' RCBC.
- Str. No. 6939, MP 157.41 – 3-8'x6' RCBC.
- Str. No. 6940, MP 157.51 – 3-8'x4' RCBC.
- Str. No. 6941, MP 157.74 – 4-8'x6' RCBC.
- Str. No. 6942, MP 158.05 – 8-10'x4' RCBC.
- Str. No. 6945, MP 160.16 – 7-10'x5' RCBC.
- Str. No. 6464, MP 160.70 – 5-10'x6' RCBC.
- Str. No. 6465, MP 161.25 – 3-10'x5' RCBC.
- Str. No. 6466, MP 161.75 – 2-10'x6' RCBC.
- Str. No. 1606, MP 162.05 – Black Hills Wash Bridge.
- Str. No. 1607, MP 162.20 – Snyder Hills Wash Bridge.
- Str. No. 6488, MP 165.80 – 4-10'x4' RCBC.

The existing bridges (Str. Nos. 1606 and 1607) on the existing two lane roadway that will be incorporated into the four-lane divided roadway have bridge load ratings less than the AASHTO minimum of HS20. Both bridges have sufficiency ratings of 83.36. Both bridges are currently carrying legal loads without showing any significant distress. See **Structure Evaluations in Appendix D; AASHTO Controlling Design Criteria Report.**

Neither of the existing bridges provides the needed hydraulic capacity for the design flows at Black Hills Wash (MP 162.05) or Snyder Hills Wash (MP 162.20). Therefore, the existing bridges will be supplemented as follows to carry the design volumes of water.

- Black Hills Wash (MP 162.05): The existing bridge will remain and a new 130-foot long bridge will be constructed immediately to the east of the existing bridge. The channel will be widened under the new bridge. The existing bridge rail will be removed from the existing bridge and will be replaced with the same type of barrier used on the new bridge.
- Snyder Hills Wash (MP 162.20): The existing bridge will remain. The wash bottom will be cleared out and excavated to the stable slope invert, which is at the approximate existing elevation of

2436-feet. Further analysis is required during final design to determine a design stable slope invert.

New bridges will be required on the new two-lane roadway at Black Hills Wash and Snyder Hills Wash. A new 260-foot long bridge will be constructed on the new roadway at Black Hills Wash (MP 162.05) and a new 200-foot long bridge will be constructed on the new roadway at Snyder Hills Wash (MP 162.3).

The ten existing RCBC structures that have openings of more than 20-feet and that do not have adequate hydraulic capacity will be improved by adding cells to the existing RCBC as shown in **Table 50-2, Section 5.7.4, Drainage Requirements.**

The RCBC structures will be extended across the median and the new directional roadway. The extension of the RCBC structures will provide the required recovery area and guard rail will not be required. Those RCBC structures that currently do not have adequate recovery area will be extended from the existing roadway to provide adequate recovery area and existing guard rail will be removed.

The bridge load ratings for Structure No. 1606, Black Hills Wash Bridge and Structure No. 1607, Snyder Hill Wash Bridge are less than HS 20. The Structure Evaluation Report dated 05/03/2007 states that both structures are carrying legal loads without showing any significant distress. It is planned that these two bridges will remain in place.

Both of these bridges are located within the Phase II section of this project which is currently unfunded. During Final Design these two bridges should be further evaluated to determine if the deck/superstructure needs to be rehabilitated or replaced.

THIS PAGE INTENTIONALLY LEFT BLANK