TECHNICAL DATA NOTEBOOK:

LETTER OF MAP REVISION

for

Flowing Wells Wash & Runway Drive Area

Tucson, Arizona

EXPIRES 12-31-2019

November 2016

Prepared for:

Pima County Regional Flood Control District

201 N. Stone Ave, 9th Floor

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HYDROLOGY & GEOMORPHOLOGY, INC.

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SECTION 1: INTRODUCTION

1.1 Study Purpose

The purpose of this report is to document the analysis associated with revision of the existing flood insurance mapping along the Flowing Wells Wash and the Runway Drive Area. The subject area is located within Sections 21, 22, 27 & 28, Township 13 South, Range 13 East, Gila & Salt River Baseline, Tucson, Arizona. The revisions are provided based on structure improvements and better data.

1.2 Study Authority

This report was prepared by JE Fuller/Hydrology & Geomorphology, Inc under contract to the Pima County Regional Flood Control District.

The State of Arizona has delegated the responsibility to each county flood control district to delineate or require the delineation of floodplains and to regulate development within floodplains (ARS § 48-3609).

1.3 Study Location

Figures 1.1 shows the general vicinity of the project area. Figure 1.2. shows the study area location. The study area has a semi-arid desert climate with an average annual precipitation of generally less than 12 inches. Precipitation is typically divided between two seasons with comparable rainfall amounts: summer and winter. Summer storms are associated with warm, moist tropical air masses that enter the state from the Gulf of Mexico and Gulf of California, producing moderate to intense localized thundershowers. Winter precipitation usually originates from the Pacific Ocean and produces light to moderate precipitation over relatively large areas. A third source of precipitation is from dissipating tropical storm and/or hurricane remnants, which typically occur in fall, and which generate moderate to high rainfall intensities of moderate to long duration.

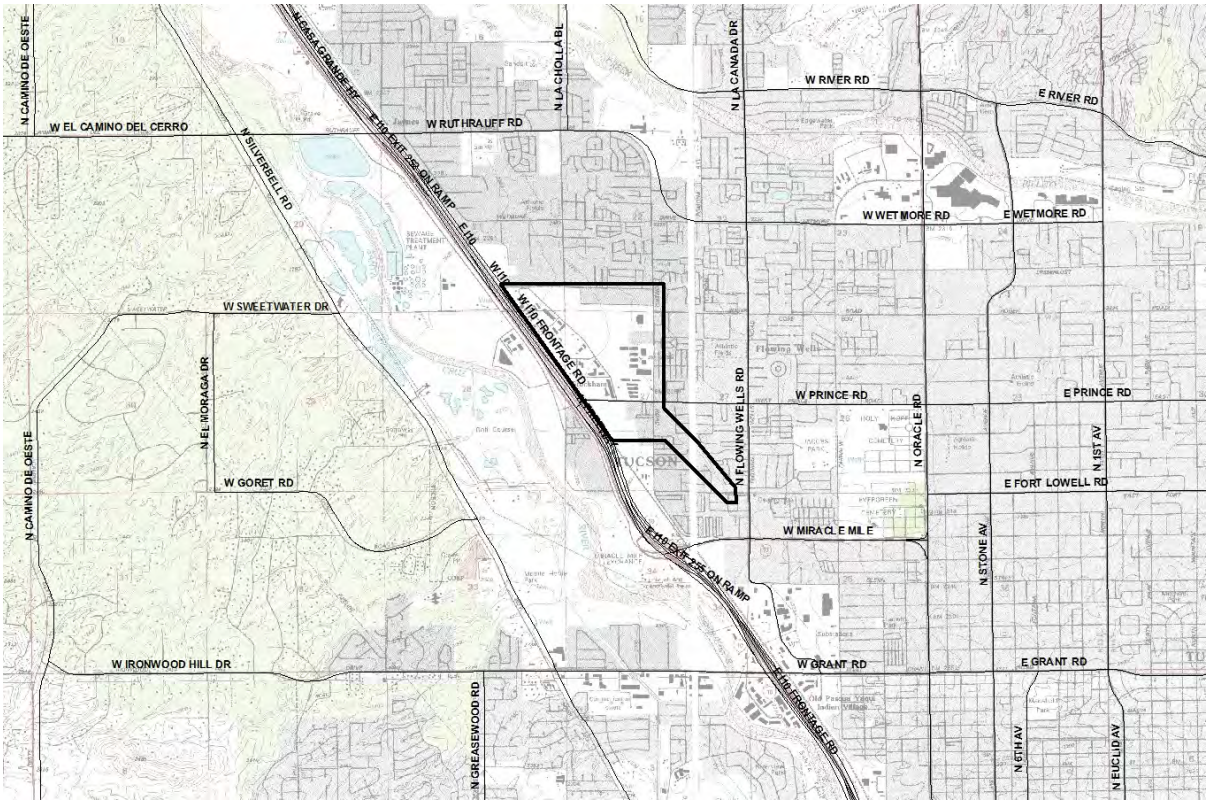

Figure 1.1 Vicinity Map

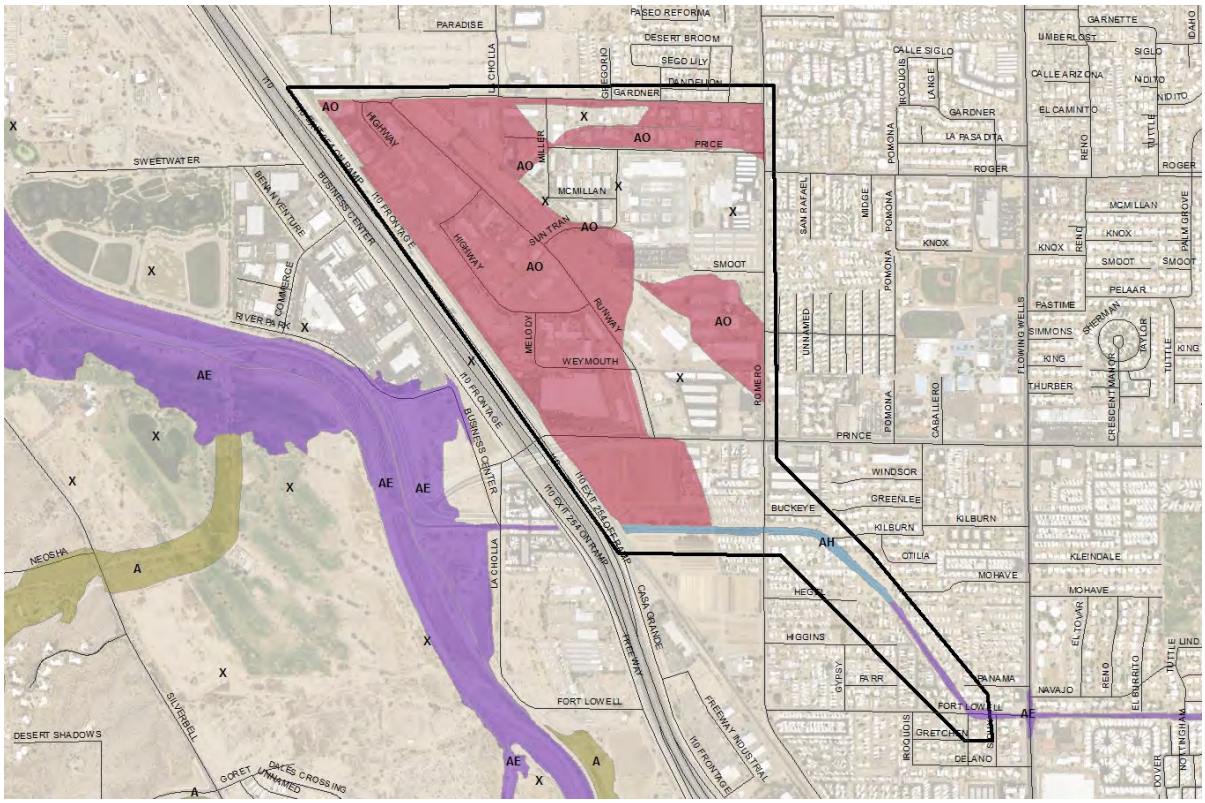

Figure 1.2 Project Location Map

1.4 Methodology

This study used methods outlined in the FEMA Guidelines (Reference 1). HEC-RAS 4.1 was used to perform the hydraulic modeling of the Flowing Wells Wash. FLO-2D Pro version, which has been approved for hydrology and hydraulics by FEMA for use in Pima County, was utilized to perform the hydraulic and hydrologic analysis for the Runway Drive area.

The study reach for the Flowing Wells Wash (FWW) extends from the Santa Cruz River confluence to Ft. Lowell Road and includes (1) the Zone AH area located between Interstate 10 and Higgins Lane, and (2) the Zone AE area located between Higgins Lane and Ft. Lowell Road. The study area for the Runway Drive Area watershed is bounded by Gardner Lane, Prince Road, I-10 and Romero Road and includes all of the Zone AO (Depth 1), AO (Depth 2), and shaded Zone X areas within this boundary.

The two affected flood-hazard areas were originally mapped in 1988 and first appeared on Community-Panel No. 040076-0010C. The FWW was mapped by detailed methods, using HEC-2 and a regulatory discharge that ranged from 5845 cfs at the Santa Cruz River to 4355 cfs between Higgins Lane and Ft. Lowell Road. The original FWW modeling determined that approximately half of the 5845 cfs or 3230 cfs overtopped the north bank of the FWW just upstream of the upstream of the then Southern Pacific Railroad (now Union Pacific Railroad[UPRR]) drainage structure, which was the basis for the AO zone designation between the wash and Prince Road. The Runway Drive Area was mapped by approximate methods using a variety of discharges ranging from 15 cfs to 1090 cfs that were collectively used to map the Zone AO and X (shaded) areas. In 1994, the regulatory discharge for the FWW was significantly reduced to its current value (3013 cfs) and the reach upstream of Higgins Lane was remapped to account for the reduced discharge and channel improvements between Romero Road and Ft. Lowell Road. As a result of that restudy, the zone designation from Higgins Lane upstream was changed from AH to AE. However, the area downstream of Higgins Lane was never remapped to account for the reduced (effective) discharge. In 1999, a small portion of the Runway Drive Area was remapped by LOMR Case No. 99-09-200P to account for channel improvements along the south side of Price Street. All of these revisions are reflected on the effective maps (i.e., Panel Nos. 04019C2277L, 04019C2279L, and 04019C2283L).

1.5 Acknowledgements

This study was funded by the Pima County Regional Flood Control District.

1.6 Study results

The study resulted in revisions to the existing Zone AE, AH and AO delineations in the project area. The resulting revised zone delineations are documented herein.

SECTION 2: ADWR/FEMA FORMS

2.1 Study Documentation Abstract for FEMA Submittals

Study Documentation Abstract For FEMA Submittals	Initial Study	Restudy	CLOMR	LOMR	X	Other
2.1.1	Date Study Accepted					
2.1.2	Study Prime Contractor	JE Fuller / Hydrology and Geomorphology, Inc.				
	Contact(s)	John Wallace, P.E.				
	Address	40 E Helen St Tucson, AZ 85705				
	Phone	520.623.3112				
	Internal Reference Number	P1750.01-3				
2.1.2	Study Sub-Contractor	None				
	Contact(s)					
	Address					
	Phone					
	Internal Reference Number					
2.1.2	Sub Study Sub-Contractor					
	Contact(s)					
	Address					
	Phone					
	Internal Reference Number					
2.1.3	FEMA Technical Review Contractor	To be determined				
	Contact(s)					
	Address					
	Phone					
	Internal Reference Number					
2.1.4	FEMA Regional Reviewer					
	Phone					
2.1.5	State Technical Reviewer	None				
	Phone					
2.1.6	Local Technical Reviewer	Pima County Regional Flood Control District (PCRFCD) Evan Canfield				
	Phone	(520) 724-4600				
2.1.7	Reach Description	Flowing Wells Wash & Runway Drive Area, Panel #s 04019C1667L, 1669L & 1688L				
2.1.8	USGS Quad Sheet(s) with original photo date & latest photo revision date	Tucson & Tucson East, published 1978				
2.1.9	Unique Conditions and Problems	Broad, shallow flow indicating need for 2-dimensional modeling approach in Runway Drive area				
2.1.10	Coordination of Peak Discharges (Agency, Date, Comments)	PCRFCD Coordination; Discussed use of HEC-RAS for Flowing Wells Wash and FLO-2D for Runway Drive area.				

2.2 FEMA Forms

FEMA forms MT2, Forms 1 & 2 are included within this section

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
040073	Pima County and Incorporated Areas	AZ	04019C	1667L	06/16/11
040073	Pima County and Incorporated Areas	AZ	04019C	1669L	06/16/11

2. a. Flooding Source: Pima Air Museum Wash

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☒ Shallow Flooding (e.g., Zones AO and AH)
   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Flowing Wells Wash & Runway Drive Area.

4. FEMA zone designations affected: A, AH, AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☐ Physical Change ☒ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☒ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☐ Yes Fee amount: $_____

☒ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: John M. Wallace	Company: JE Fuller/Hydrology & Geomorphology, Inc	
Mailing Address: 40 E. Helen Street Tucson, AZ 85705	Daytime Telephone No.: 520-623-3112	Fax No.: 520-623-3130
	E-Mail Address: john@jefuller.com	
Signature of Requester (required): John M. Wallace	Date: 11/14/2016	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Fred Felix, P.E., City Engineer	Community Name: City of Tucson, AZ	
Mailing Address: 201 N. Stone Ave. Tucson, AZ 85701	Daytime Telephone No.: 520-837-6620	Fax No.: 520-791-3190
	E-Mail Address: Fred.Felix@tucsonaz.gov	
Community Official's Signature (required): Fred Felix	Date: 11/14/16	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: John M. Wallace	License No.: AZ Civil Eng. 22922	Expiration Date: 12-31-2013
Company Name: JE Fuller/Hydrology & Geomorphology, Inc	Telephone No.: 520-623-3112	Fax No.: 520-623-3130
Signature: John M. Wallace	Date: 11/14/2016	E-Mail Address: john@jefuller.com

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if …
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

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PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Flowing Wells Wash & Runway Drive Area

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section B) ☒ No existing analysis ☒ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Flowing Wells Wash	6.1	3013	3013
Runway Drive Area	NA	NA	NA

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☒ Precipitation/Runoff Model → Specify Model: FLO-2D v2009 for RunwayDr
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*	Union Pacifc Railroad.	NA	NA	NA
Upstream Limit*	Fort Lowell Road	F	2304	2304

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS (Flowing Wells Wash) & FLO-2D (Runway Dr)

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: NA	Plan Name:	File Name: NA	Plan Name:	
Corrected Effective Model*	File Name: NA	Plan Name:	File Name: NA	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: FWWashLOMR	Plan Name:	File Name: NA	Plan Name:	
Revised or Post-Project Conditions Model	File Name: FWWashLOMR	Plan Name:	File Name: NA	Plan Name:	
Other - (attach description)	File Name: Runway Dr FLO-2D	Plan Name:	File Name: NA	Plan Name:	

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: Pima Association of Governments 2008 DEM

Source: Pima Association of Governments Date: 2008

Accuracy: +/1 one foot

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☒ Yes ☐ No

   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Flowing Wells Wash

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Flowing Wells Wash - 4 cell pipe culvert (2 pipes added to original 2)

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Union Pacific Railroad

   Downstream Limit/Cross Section: NA

   Upstream Limit/Cross Section: NA

2. Name of Structure: 2 - 10' x 8' RCBC @ 2 locations

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: UA Farm Road & Romero Road

   Downstream Limit/Cross Section: NA

   Upstream Limit/Cross Section: NA

3. Name of Structure: 2 - 10' x 7' RCBC

   Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Fort Lowell Road

   Downstream Limit/Cross Section: D

   Upstream Limit/Cross Section: E

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Flowing Wells Wash

Name of Structure: NA

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.
The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Flowing Wells Wash

Name of Structure: Culverts listed on previous page

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)

☒ Shape (culverts only)

☒ Material

☐ Beveling or Rounding

☐ Wing Wall Angle

☐ Skew Angle

☐ Distances Between Cross Sections

☐ Erosion Protection

☐ Low Chord Elevations – Upstream and Downstream

☐ Top of Road Elevations – Upstream and Downstream

☒ Structure Invert Elevations – Upstream and Downstream

☒ Stream Invert Elevations – Upstream and Downstream

☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: Flowing Wells Wash
Name of Structure: NA

1. This request is for (check one): ☐ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin

2. The dam/basin was designed by (check one): ☐ Federal agency ☐ State agency ☐ Private organization ☐ Local government agency

   Name of the agency or organization: _____

3. The Dam was permitted as (check one): ☐ Federal Dam ☐ State Dam

   Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

   Permit or ID number _____ Permitting Agency or Organization _____

   a. ☐ Local Government Dam ☐ Private Dam

   Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

FREQUENCY (% annual chance)	Stillwater Elevation Behind the Dam/Basin FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

SECTIONS E (LEVEE/FLOODWAY) & F (SEDIMENT TRANSPORT) ARE NOT APPLICABLE AND ARE NOT INCLUDED

SECTION 3: MAPPING AND SURVEY INFORMATION

3.1 Digital Projection Information

All digital files were produced with the following projection;

- Projection = State Plane, Arizona Central Zone
- Horizontal Datum = NAD83-92(HARN)
- Units = International Feet

3.2 Field Survey Information

Field work was performed to confirm the location and size of culvert structures affecting the study area.

3.3 Mapping

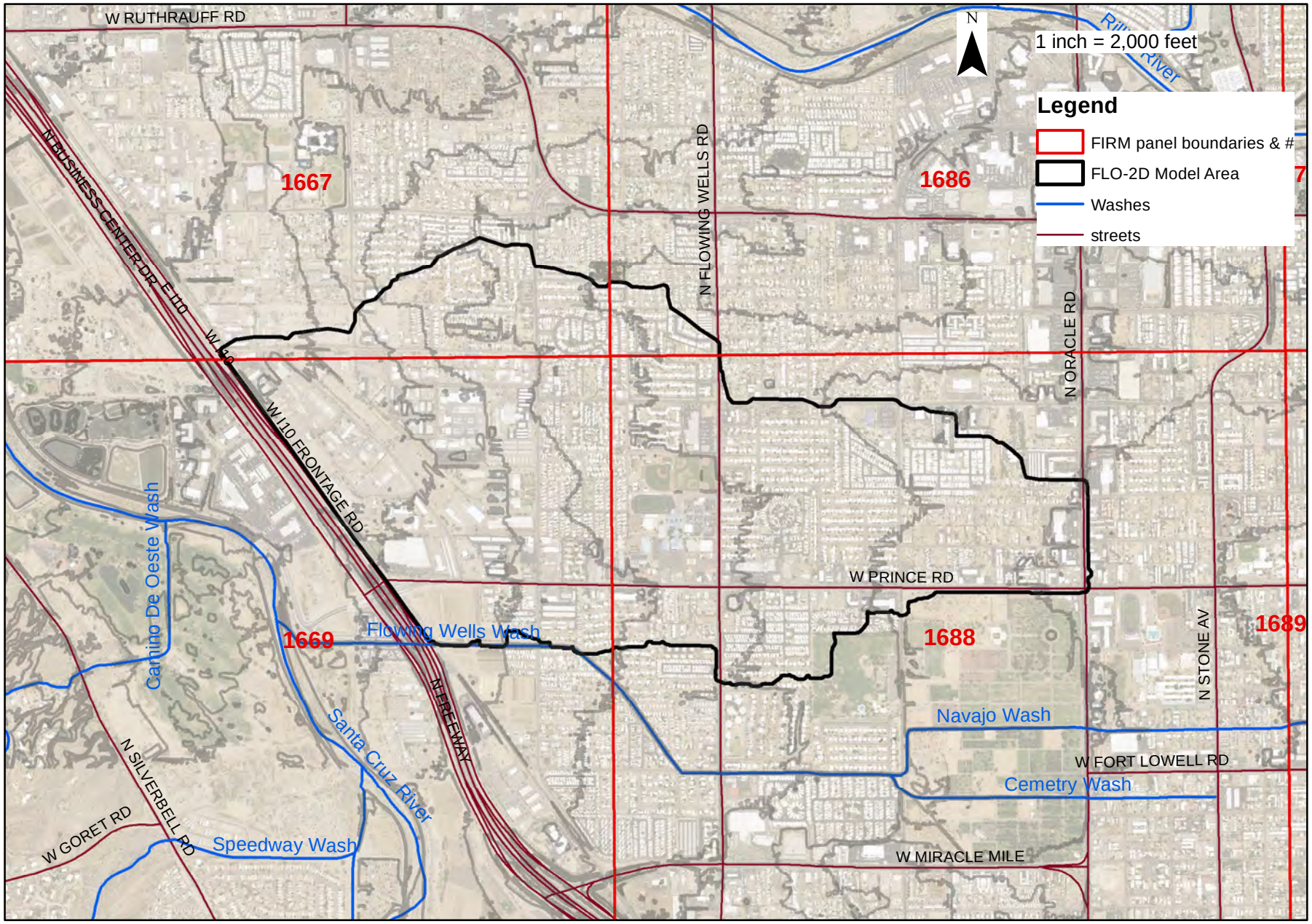
The topographic information used in conjunction with the re-mapping of both flooding sources was based on 2008 DEM data obtained from the Pima Association of Governments (PAG). The vertical datum is the North American Vertical Datum of 1988 (NAVD 88). The projection of the data is as listed in Section 3.1 above. As-built plans for the drainage structures included in the HEC-RAS modeling for the Flowing Wells Wash are provided in Appendix C. Some of the plans were based on the National Geodetic Vertical Datum of 1929 (NGVD 29). A single conversion factor of 2.19 feet is applicable to all of the older plan sets (i.e., the NAVD 88 elevations are approximately 2.19 feet higher than the NGVD 29 elevations shown on the older plans). This conversion factor was taken from the table presented in Section 3.3 of the effective FIS, dated September 28, 2012.

SECTION 4: HYDROLOGY

4.1 Hydrologic Modeling Methods

As part of this LOMR, the regulatory flood hazard area for the Flowing Wells Wash was remapped using the effective discharge (3013 cfs) from Table 6 of the effective Flood Insurance Study (FIS) in conjunction with updated topographic information. In addition, improvements to the drainage structures beneath I-10 and the UPRR were also accounted for in the remapping. As noted in the effective FIS, the 100-year return interval for the Flowing Wells Wash is the only return interval that is applicable to this flooding source. The regulatory flood plain for the Flowing Wells Wash was defined using HEC-RAS Version 4.1. The flood hazard area associated with the Runway Drive Watershed was redefined using both the hydrologic and hydraulic components of FLO-2D, Pro version (Reference 2). The FLO-2D model was used for the Runway Drive portion of the study because of the relatively shallow, urban, dispersed flow conditions which occur in the watershed tributary to the project. FLO-2D uses the full dynamic wave momentum equation and a central finite difference routing scheme with eight potential flow directions to predict the progression of a flood hydrograph over a system of square grid elements. The model is based on a grid of topographic data points at evenly spaced intervals which are developed from digital elevation model data of the study area. The model was constructed to model both rainfall-runoff and flow depths. The overall model area is shown in Figure 4.1 and covers approximately 1.6 square miles. The FLO-2D model files are contained in Appendix D.

Figure 4.1 - Runway Drive Area - FLO-2D Model Boundary



4.2 Parameter Estimation

Since the existing FIS 1% annual chance discharge value of 3013 cfs was used for Flowing Wells Wash, no hydrologic parameters were determined for that mapping. There are no other profiles currently mapped in the FIS, and no new ones are proposed in this submittal.

The tables below summarize the data and parameters used to develop the FLO-2D model for the Runway Drive area.

TABLE 4.2 - FLO-2D PARAMETERS

Parameter	Description
Topographic Data	Primary Source: Pima Association of Governments (PAG) 2008 DEM data was used to develop a surface model of the contributing drainage to and including the project area.
FLO-2D Grid	15-foot grid developed from above described DEM data. Data adjusted where needed to eliminate ponding grids and adjust for linear features not adequately reflected in the grid elevations. 201,258 total grids in model covering a total model area of 1.6 square miles.
Rainfall Data	NOAA14 Upper 90% confidence interval rainfall data was used (Reference 3). Based on the watershed size, a 3-hour storm was modeled using SCS Type II 3-hr Storm distribution per Pima County RFCD Tech Policy 018 (Reference 4). Total Storm Depth = 3.15 inches (upper 90% confidence level). As a conservative measure, aerial reduction was not applied.
Soils Data	NRCS soil survey data (Reference 5) as found in Pima County GIS shape file soilshyd.shp.
SCS Curve Number	The CN was determined using the Curve Number table associated with the PC Hydro User Guide (Arroyo Engineering, 2007) and a Hydrologic Soils Group map. CN values were adjusted for various land uses as determined from Pima County and City of Tucson zoning data.
Roughness Coefficient	Roughness coefficients were assigned based on land use assignments including streets (.020), residential (.065), right-of-way (.030), retail (.055), open space (.045), commercial (.035) and others.
Structures	None.
Special Conditions	Model domain was developed based on a conservative estimate of watershed area that might contribute flow to the study area. It is likely that the model conservatively overestimates flow contributions from the margins of the model domain.

4.3 Problems Encountered

No special problems were encountered during the study.

4.4 Calibration

No known high watermarks or flood observations were available for the Runway Drive area. For that reason, no direct calibration of model results could be made. However, a comparison of the model results was made with runoff volume estimates in the region. Percent runoff from the Runway Drive area FLO-2D model was compared to gaged data for watersheds in Tucson and southern Arizona. The FLO-2D model produced greater percent runoff than gaged data in all cases reviewed. The documentation of the runoff comparison is included in Appendix D and summarized in the table below.

TABLE 4.4 - RUNOFF COMPARISON WITH GAGED DATA

Location	Drainage Area (mi^2)	Description	Runoff as % of Rainfall
Runway Drive Area FLO-2D (this study)	1.6	FLO-2D Model (15-ft grid)	56%
Tucson Arroyo at Vine Avenue	8.2	USGS gaged watershed in Tucson, AZ, August 12, 1972 event	42%
High School Wash watershed	1.8	Measured runoff at watershed in Tucson, AZ August 8, 1971 event (USACE, 1997)	41%

4.5 Final Results

Review of Section 4.4 shows that the FLO-2D model results in runoff rates that compare well with gaged data. FLO-2D Model data (input/output) are included in Appendix D.

SECTION 5: HYDRAULIC ANALYSIS

5.1 Method Description

HEC-RAS 4.1 was used to perform the hydraulic modeling of the Flowing Wells Wash. The revised mapping is Zone AE. The HEC-RAS model is included in Appendix E.

The FLO-2D model described in the previous section was utilized to perform the hydrologic and hydraulic analysis for the Runway Drive area.. Depths determined from the FLO-2D model were utilized to determine revised Zone AO and A delineations. The FLO-2D model is included in Appendix D.

Per NFIP regulations, Section 65.12(a)(4), the City of Tucson is the only communities affected by the proposed action.

Per NFIP regulations, Section 65.12(a)(5), there are no increases in base flood elevation proposed.

5.2 Workmaps

Workmaps are included in Appendix F for both the Flowing Wells Wash HEC-RAS and Runway Drive FLO-2D analyses.

5.3 Parameter Estimation

Roughness values for the Flowing Wells Wash HEC-RAS model are based on field investigation and review of aerial photography. See Table 4.2 for data and parameters used to develop the Runway Drive FLO-2D model.

5.4 Cross-Section Description

For the Flowing Wells Wash HEC-RAS model the model included new placement and orientation along majority of revised reach with some duplicated FIS sections at upstream ties. All new sections are from DTM and mapping.

5.5 Modeling Considerations

5.5.1 Hydraulic Jump and Drop Analysis - NA

5.5.2 Bridges and Culverts - A total of 4 culverts were included in the HEC-RAS model for the map revision area. No structures were modeled in the Runway Drive area.

5.5.3 Levees and Dikes – NA

5.5.4 Non-Levee Embankments – NA

5.5.5 Islands and Flow Splits - NA

5.5.6 Ineffective Flow Areas – NA

5.5.7 Supercritical Flow - A limiting Froude Number of 0.9 was used in the FLO-2D modeling.

5.6 Floodway Modeling

NA

5.7 Issues Encountered During the Study

No special problems were encountered during the study.

5.8 Calibration

See discussion in Section 4.4

5.9 Final Results

The results of the modeling are reflected in the Workmaps and Annotated FIRMs provided in Appendices F and G, respectively.

SECTION 6: SEDIMENT TRANSPORT/EROSION

No detailed erosion or sediment transport modeling was conducted as part of this study.

SECTION 7: DRAFT FIS

7.1 Summary of Discharges

No discharge data is provided within the existing FIS and no revised discharges are proposed.

7.2 Floodway Data

NA.

7.3 Annotated Flood Insurance Rate Maps

See Appendix G. Zones have been revised based on results of modeling. Where appropriate notes indicating "100-yr flood contained in channel" notes have been added to clarify condition of flooding.

7.4 Flood Profiles

NA.

SECTION 8: ESA COMPLIANCE

Not applicable.

Appendix A

References

References

1. FEMA, 2002, Guidelines and Specifications for Flood Hazard Mapping Partners , February, 2002.

2. FLO-2D Users Manual, v2009.06, FLO-2D Inc., 2009.

3. National Oceanic and Atmospheric Administration (NOAA), National Weather Service, *NOAA Atlas 14, Precipitation Frequency Atlas of the United States*, U.S. Department of Commerce, 2004.

4. Pima County Regional Flood Control District, *Technical Policy, TECH-018*, Effective April 1, 2011.

5. Natural Resources Conservation Service (NRCS), *Soil Survey of Pima County, Arizona, Eastern Part*, 2003.

Appendix B

Correspondence

APPENDIX B

B.1 Special Problem Reports (none)

B.2 Contact (telephone) Reports (none)

B.3 Meeting Minutes or Reports (none)

B.4 General Correspondence (none)

B.5 Public Notification (none)

B.6 FEMA Correspondence (none)

Appendix C

As-Built Plans/Data

For Flowing Wells Wash Culverts at;

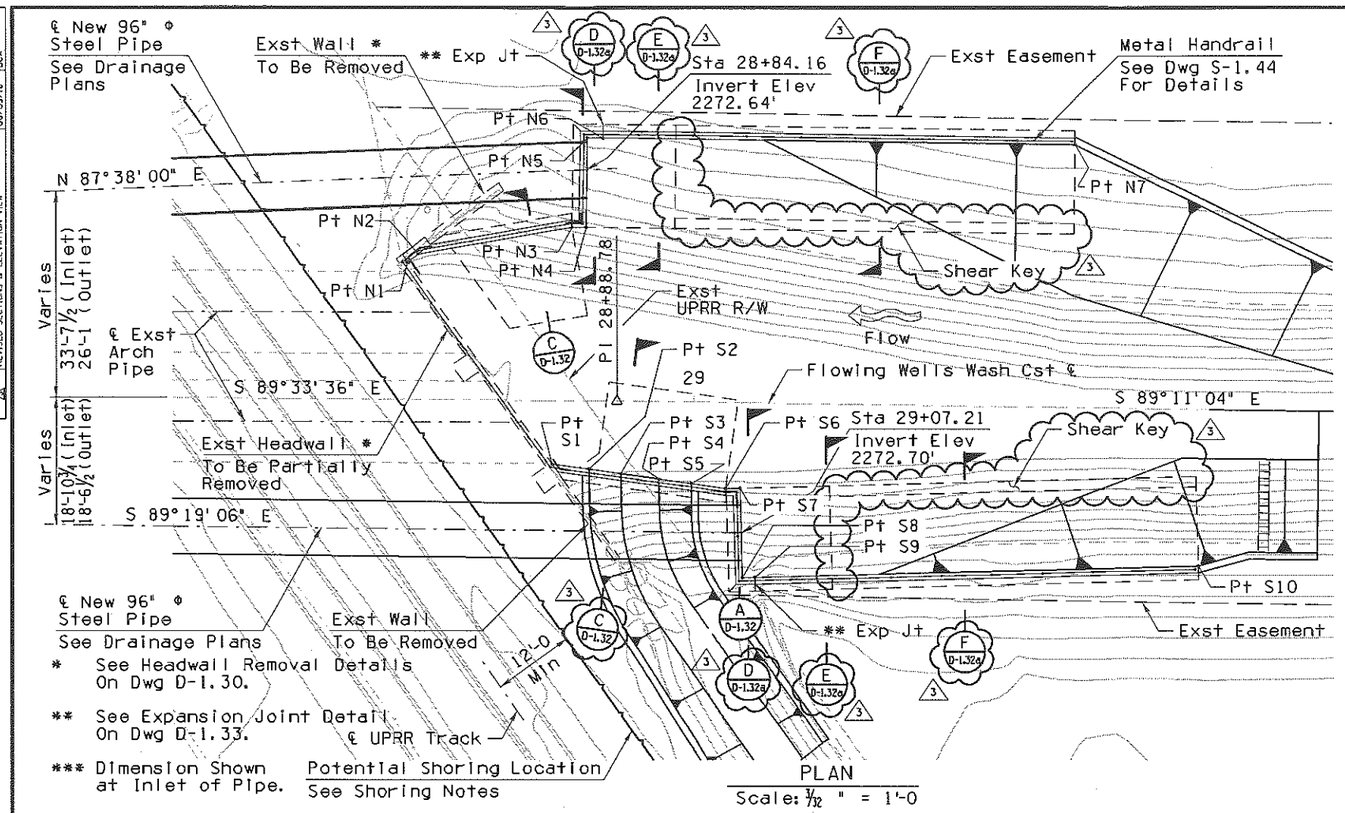
- **Union Pacific Railroad**
- **UA Farms Road**
- **Romero Road**
- **Fort Lowell Road**

FLOWING WELLS WASH @ UPRR, UPGRADE PLAN & AS-BUILT SURVEY (total 3 pages)

TO ACCOMPANY REVISION NO. 11

REV NO.	LOCATION	DATE	BY
1	REVISED ENTIRE SHEET	06/26/13	NJP
2	REVISED ENTIRE SHEET	09/16/15	NJP
3	REVISED SECTIONS & ELEVATION VIEW	06/03/16	BCA

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	010-D(013)N	200	918	
		010 PM 252			



* See Headwall Removal Details On Dwg D-1.30.

** See Expansion Joint Detail On Dwg D-1.33.

*** Dimension Shown at Inlet of Pipe.

PLAN
Scale: 3/32" = 1'-0

GENERAL NOTES:

Construction Specifications - Arizona Department of Transportation Standard Specifications for Road & Bridge Construction, Edition of 2008.

Design Specifications - AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002.

Dead Load - Weight of backfill = 120 pcf
Angle of internal friction = 33.25°

All concrete shall be Class 'S' unless noted otherwise.

Reinforcing steel shall conform to ASTM Specification A615. All reinforcing shall be furnished as Grade 60.

All bends & hooks shall meet the requirements of AASHTO Article 8.23. All bend dimensions for reinforcing steel shall be out-to-out of bars. All placement dimensions for reinforcing steel shall be to center of bars unless noted otherwise.

All reinforcing steel shall have 2 inch clear cover unless noted otherwise.

Stresses:
Class 'S' concrete ..... f'c = 3500 psi
Grade 60 reinforcement ..... fs = 24,000 psi

Chamfer all exposed corners ¾" unless noted otherwise.

Dimensions shall not be scaled from drawings.

Walls shall have construction joints spaced at no more than 30'-0. Reinforcing steel shall continue through the joint.

Detail DA shall be paid for under Item No. 6016101 (EACH).

See Detail D4 for information not shown.

SHORING NOTES:

The contractor shall install vertical shoring to protect the existing track prior to excavation. See Special Provisions.

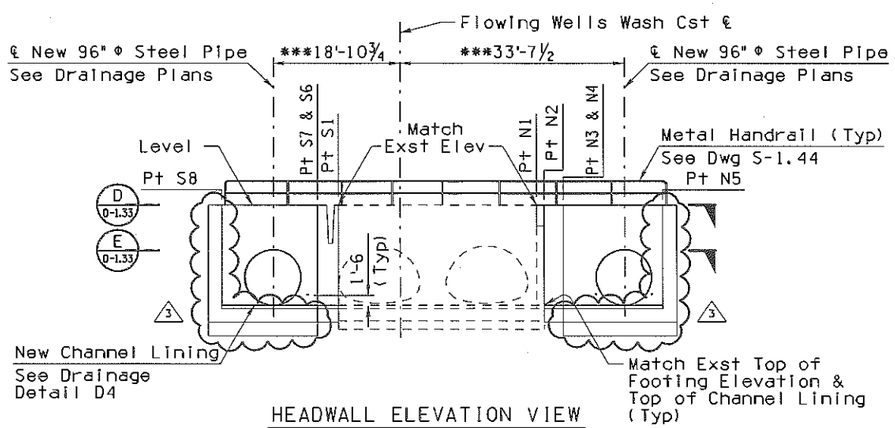
DOWEL NOTE:

Dowels shall consist of #6, Grade 60 deformed bars. The diameter of concrete dowel drill holes shall be a minimum of 1". Epoxy dowels into concrete with an epoxy resin meeting the requirements of the Standard Specifications & selected from the ADOT approved products list. Epoxy resin base adhesive shall provide 125 percent of the ultimate tensile strength of the dowel bar. Epoxy resin adhesive shall be mixed & placed in accordance with the adhesive Manufacturer's recommendations.

△1 △2

APPROXIMATE QUANTITIES						
Item	Structural Excavation CY	Structure Backfill CY	Class 'S' Concrete f'c = 3500 psi CY	Reinforcing Steel LBS	Place Dowels EA	Structural Concrete Removal CY
Detail DA	1085	340	398	48,120	60	40
Total	1085	340	398	48,120	60	40

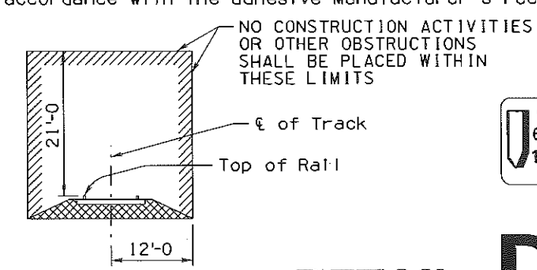
Metal Handrail will be paid for under Item No. 6110201 (LF).
Pipe (96" Jack & Bore Detail) will be paid for under Item No. 5019008 (LF).
Concrete Channel Lining (8") will be paid for under Item No. 9201008 (SY).



HEADWALL ELEVATION VIEW
Scale: 3/32" = 1'-0

Flowing Wells Wash Cst ℄			
Location	Station	Offset	TOW Elev
Pt N1	28+57.90	19.95' Lt	Match Exst
Pt N2	28+59.52	21.17' Lt	2286.45'
Pt N3	28+82.07	25.25' Lt	2286.52'
Pt N4	28+84.11	25.24' Lt	2286.52'
Pt N5	28+84.20	38.24' Lt	2286.53'
Pt N6	28+86.49	38.23' Lt	2286.53'
Pt N7	29+55.41	38.22' Lt	2286.83'
Pt S1	28+79.35	9.19' Rt	Match Exst
Pt S2	28+84.75	9.91' Rt	2286.40'
Pt S3	28+89.53	10.54' Rt	2280.90'
Pt S4	28+95.05	11.23' Rt	2280.90'
Pt S5	28+99.76	11.83' Rt	2286.40'
Pt S6	29+04.91	12.48' Rt	2286.40'
Pt S7	29+06.95	12.40' Rt	2286.40'
Pt S8	29+07.47	25.39' Rt	2286.40'
Pt S9	29+09.22	25.32' Rt	2286.40'
Pt S10	29+73.92	22.74' Rt	2283.00'

Points are located along the front face of walls or the intersection of the front faces of walls at the corner locations.



MINIMUM CONSTRUCTION CLEARANCE ENVELOPE
(Normal to Railroad)
NTS

CALL TWO WORKING DAYS BEFORE YOU DIG
602-263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

DETAIL DA

Sheet 1 of 5

PLAN & ELEVATION

	NAME	DATE
DESIGN	BCA	06/16
DRAWN	TST	06/16
CHECKED	RAS	06/16

TRANSPORTATION
AECOM TECHNICAL SERVICES INC.
7720 E. PARKER RD. SUITE 200
Tucson, Arizona 85715
T 520.295.6200 F 520.231.4777
AECOM
www.aecom.com

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION

DRAINAGE DETAIL SHEET
DETAIL DA

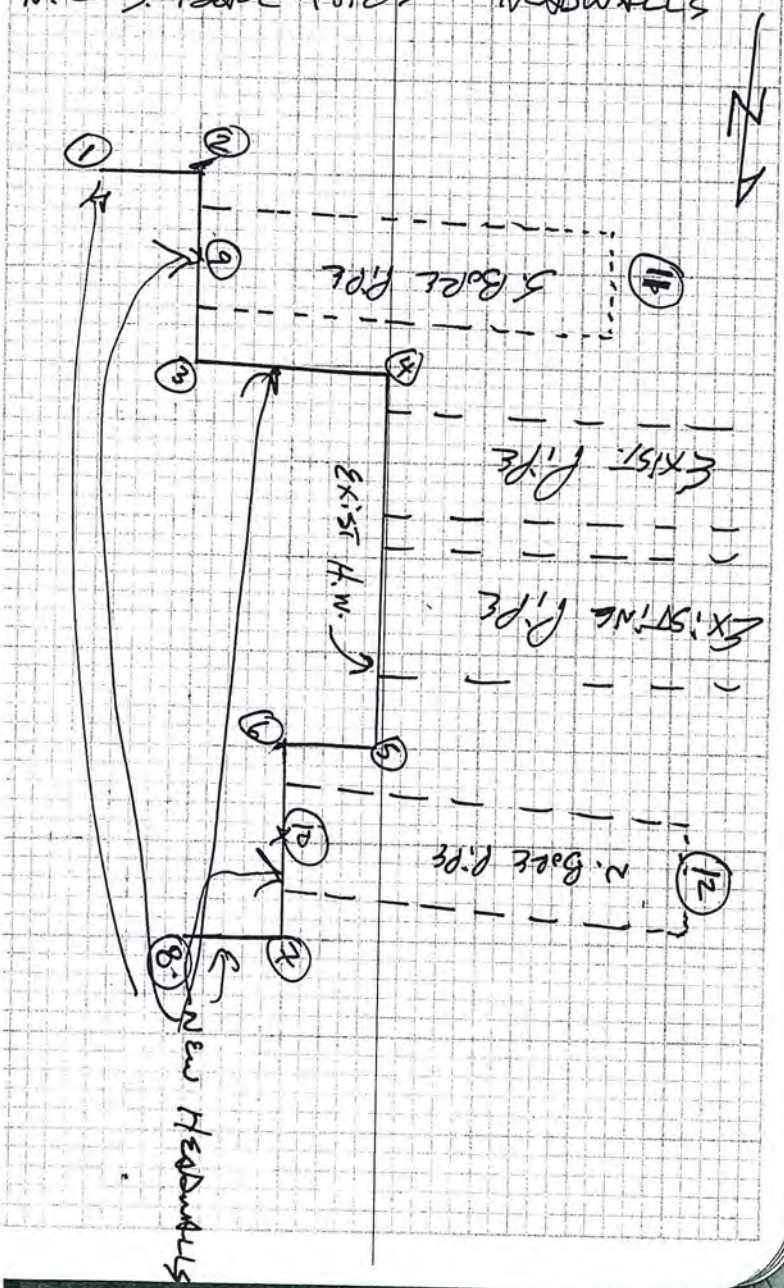
Registered Professional Engineer (Civil) CERTIFICATE NO. 53092 BENJAMIN C. ANSLEY
EXPIRES 03/31/2018

ROUTE	LOCATION	
I-10	RUTHRAUFF ROAD TO PRINCE ROAD	

DWG NO. D-1.29

TRACS NO. H 6241 01C | 010-D(013)N | ___ OF ___

AS BUILT E END 9-6-16 CONTR 58
N. & S. BORE PIPES & HEADWALLS



9/6/16

JR, CO

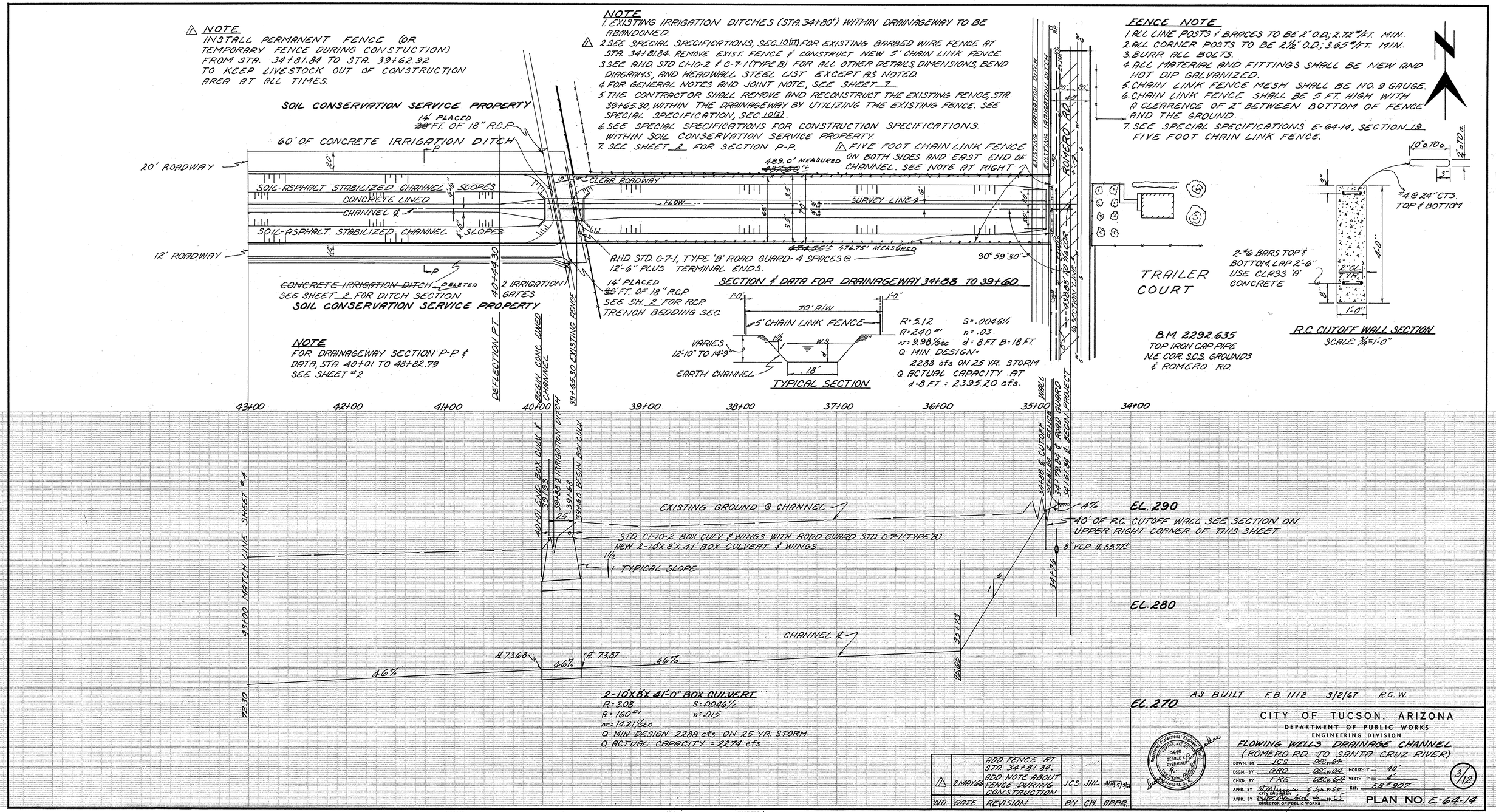
	+	π	−	Elev.
TBM	1.76	90.94		2289.18
			4.60	
1				2286.34
			4.59	
2				2286.35
			4.59	
3				2286.35
			4.60	
4				2286.34
			4.65	
5				2286.29
			4.71	
6				2286.23
			4.66	
7				2286.28
			4.66	
8				2286.28
			18.62	
9				2271.72
			18.76	
10				2272.18
			23.05	
11				2270.67
12				70.20

Chg Setup

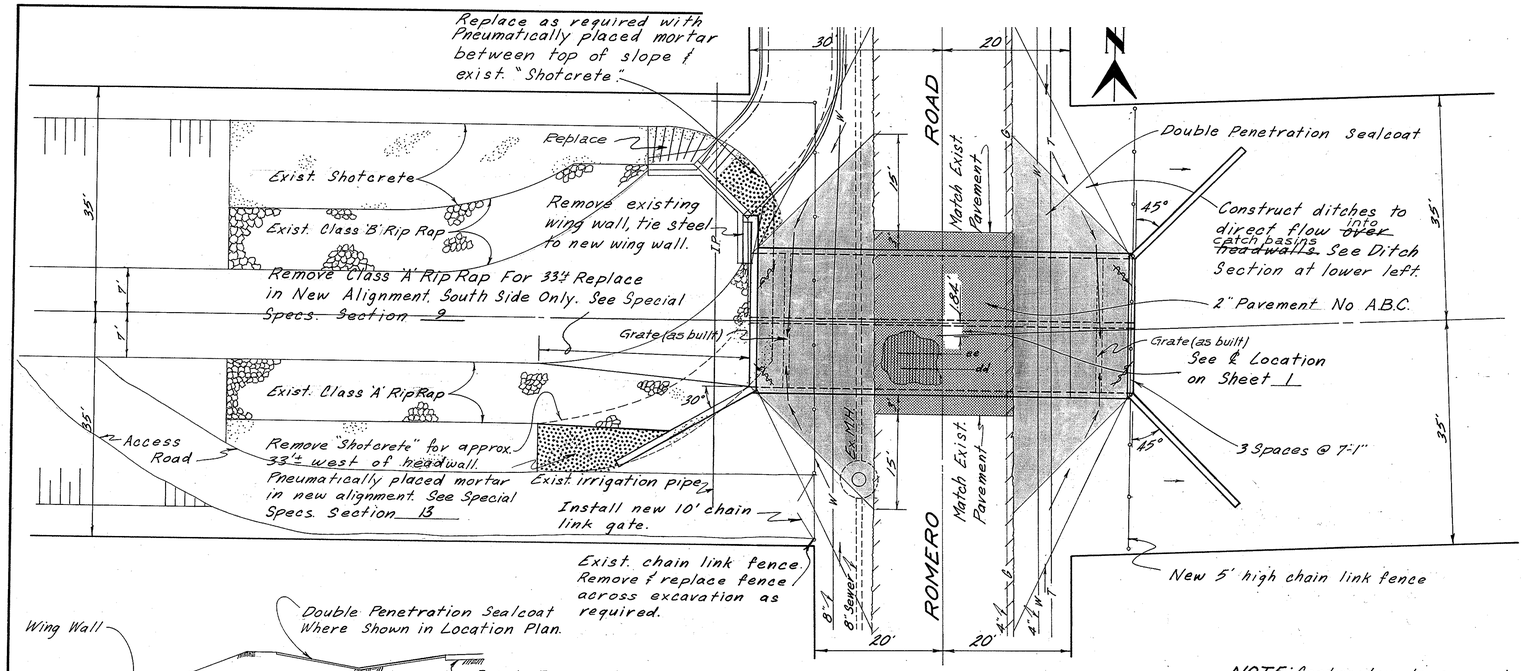
	Elev	+	π
Set @ TBM.	2289.18	4.54	2293.72

← AB Elev on 8/25/16

FLOWING WELLS WASH @ UA FARMS ROAD



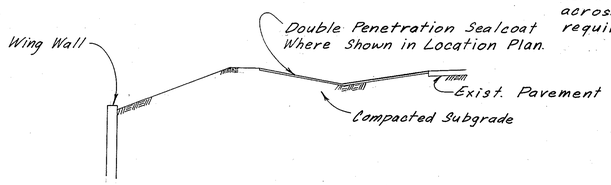
FLOWING WELLS WASH @ ROMERO ROAD



LOCATION PLAN

Scale: 1" = 10'-0"

2-10'X8'X60'-0" R.C. BOX CULVERT



DITCH SECTION

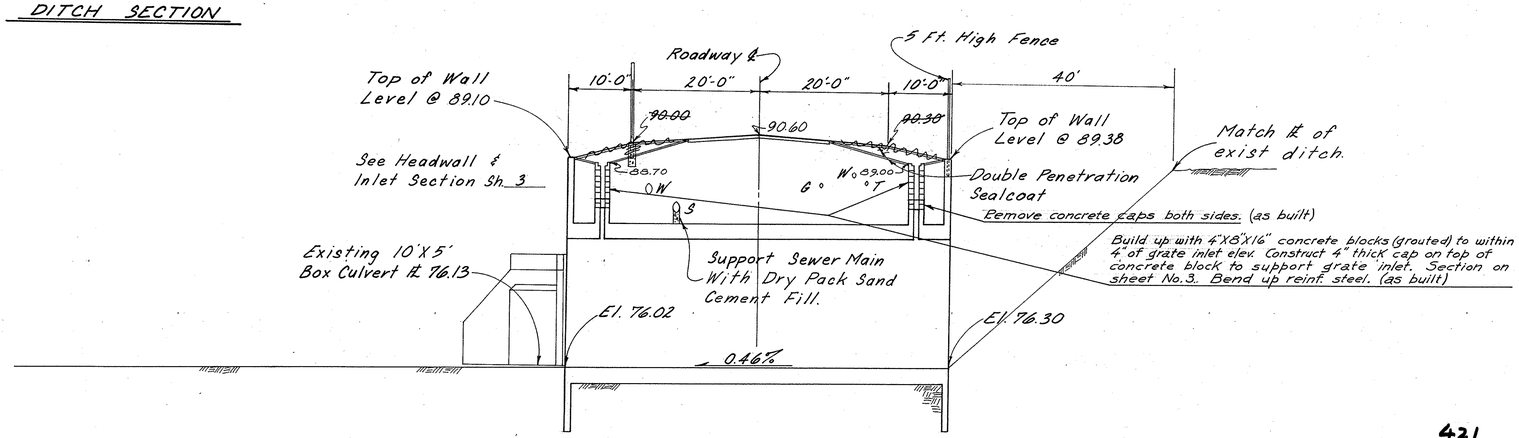
NOTE: Contractor to support all utilities across excavation during box culvert construction.

GENERAL NOTES

1. Construction - City of Tucson Standard Details and Specs.
2. Loading Class - H20-S16-44.
3. Stresses - City of Tucson Class 'A' Concrete $f'_c = 3000$ psi. Reinforcing Steel $f_s = 20{,}000$ psi.
4. Reinforcing Steel - Steel shall be intermediate grade and shall conform to A.S.T.M. specification A-15 and A-305. Dimensions for reinforcing steel shall be 1½" from the surface of the concrete to the surface of the bars except where noted otherwise. All reinforcing steel shall have a minimum lap of 1'-6" except where noted otherwise.
5. Joints - The structure shall have a construction or cold joint in top slab and optional in walls, spaced not more than fifty (50) feet apart or as shown. Bulkheads shall be removed and concrete roughened prior to placing abuting concrete.
6. Fence - Arizona Highway Dept. Standard C-17-A & C-17.
7. Welding - All welding shall conform to current A.W.S. Specs. for welding Highway and Railroad Bridge.
8. Box Culvert - Construction of Box Culvert to be Arizona Highway Dept. Bridge Standard C1-10-2 with modified wing walls.

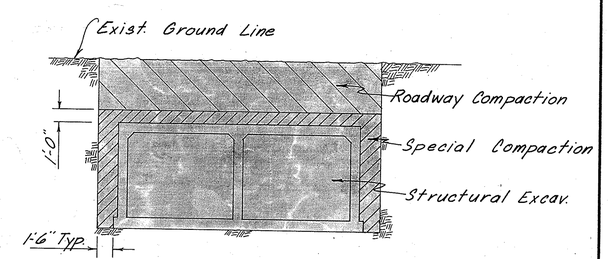
APPROXIMATE QUANTITIES

Structure	Struct. Excav. C.Y.	Special Comp. C.Y.	Class 'A' Conc. C.Y.	Reinf. Steel Lb.	Channel Excav. C.Y.	Roadway Comp. C.Y.
2-10X8X60'	1170	250	210	23,250	280	290



SECTION ALONG ℄ OF CULVERT

Scale: Vert: 1" = 4'-0"
Horz: 1" = 10'-0"



LIMITS OF EARTHWORK

Not to Scale

"As Built" F.B. 1208 & insp. copy 3-24-69 R.G.W.

421

INCHES 0 1 2 3

PLAN NO. E-68-8
SHT. NO. 2 of 3
SCALE

CITY OF TUCSON, ARIZONA
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

FLOWING WELLS DRAINAGE CHANNEL
(BOX CULVERT AT ROMERO ROAD)

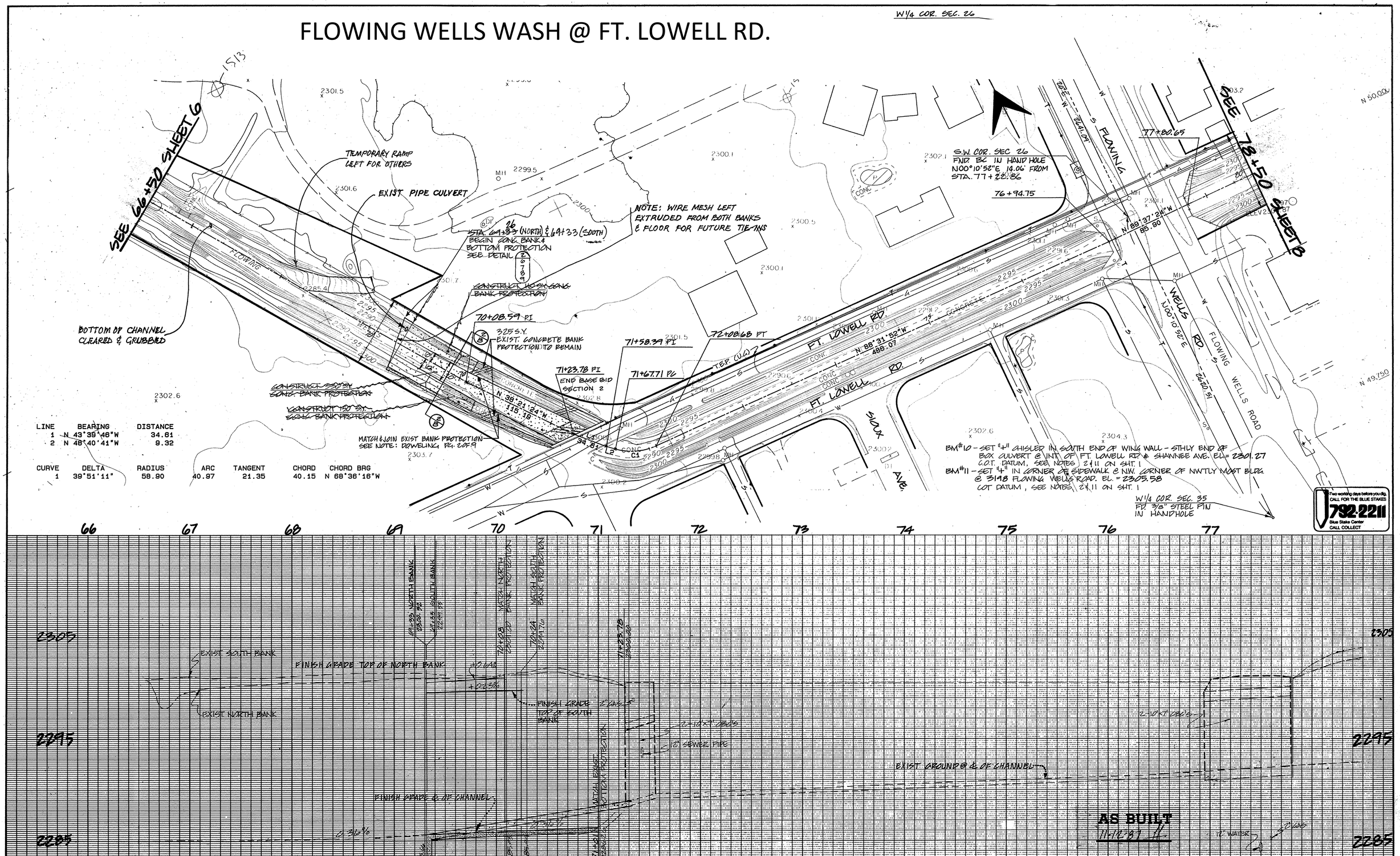
DRWN. BY JCS Aug. 19, 68
DSGN. BY JCS Aug. 19, 68
CHKD. BY JHL Aug. 19, 68
APPD. BY CITY ENGINEER 9/11 1968
APPD. BY DIRECTOR OF PUBLIC WORKS 9/11 1968

SCALES HORIZ. 1" = AS SHOWN
VERT. 1" =
REF.

2/3

PLAN NO. E-68-8

FLOWING WELLS WASH @ FT. LOWELL RD.



LINE	BEARING	DISTANCE
1	N 43°39'46"W	34.61
2	N 46°40'41"W	9.32

CURVE	DELTA	RADIUS	ARC	TANGENT	CHORD	CHORD BRG
1	39°51'11"	58.90	40.97	21.35	40.15	N 68°36'16"W

NO.	DATE	REVISION	BY	CH.	APPR.

CITY OF TUCSON, ARIZONA
DEPARTMENT OF TRANSPORTATION — ENGINEERING DIVISION
FLOWING WELLS WASH STABILIZATION
LA CHOLLA BLVD. TO FAIRVIEW AVE. PHASE I

7 OF 10

DRWN. BY LT 1985
DSGN. BY RAC 1985
CHKD. BY DCA 1986
APPD. BY CITY ENGINEER 4/87
APPD. BY 4/87
REF.
SCALE: 1"=40'H 1"=4'V
PLAN NO. E-85-09

UNITED AERIAL MAPPING 244 W. OSBORN · PHOENIX, ARIZONA, 85013 · 602-279-4141

APA # 85037; C.O.T. # 113

Appendix D

FLO-2D Model for Runway Drive Area

(provided by separate digital submittal)

Appendix E

HEC-RAS Model for Flowing Wells Wash

(provided by separate digital submittal)

Appendix F

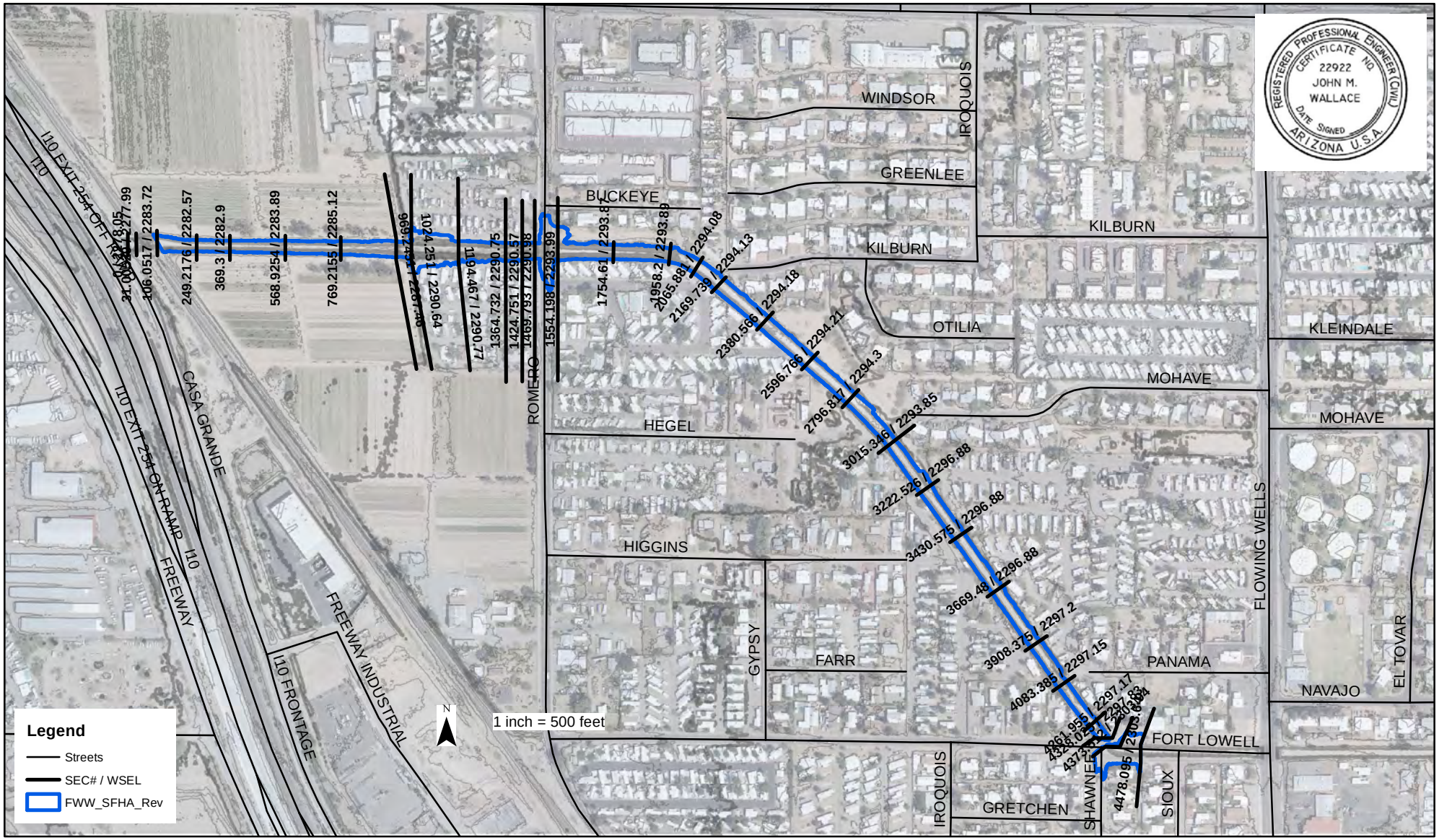
Workmaps

Flowing Wells Wash (HEC-RAS)

&

Runway Drive Area (FLO-2D)

LOMR Workmap - Flowing Wells Wash

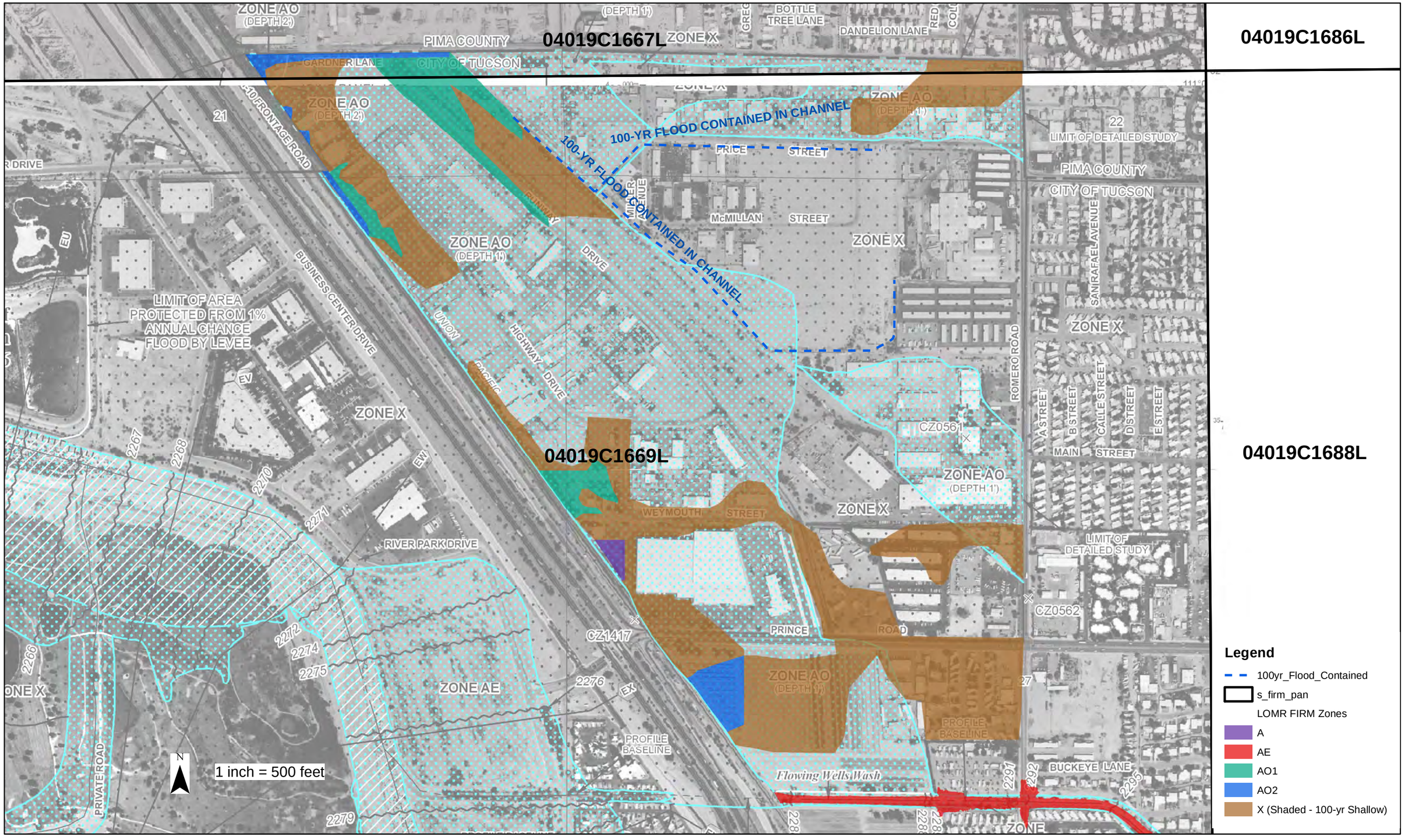


LOMR Workmap - Runway Drive Area FLO-2D Depths

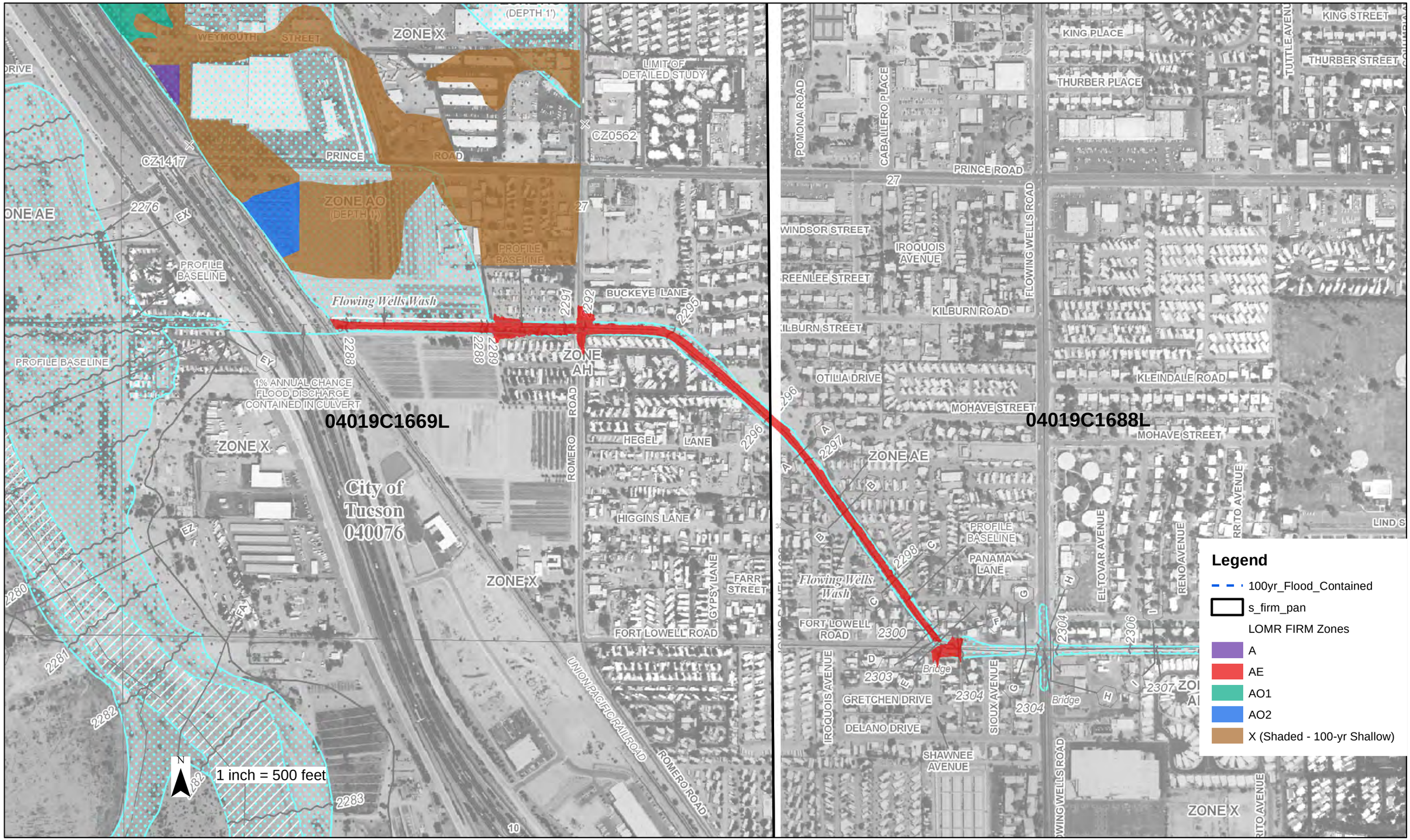
Appendix G

Annotated FIRMS

Flowing Wells Wash & Runway Drive Area LOMR - Annotated FIRM - Panels 1667L & 1669L



Flowing Wells Wash & Runway Drive Area LOMR - Annotated FIRM - Panels 1669 & 1688L



Appendix H

Shape Files

(provided by separate digital submittal)