FRIENDLY VILLAGE WASH

LETTER OF MAP REVISION

TECHNICAL DATA NOTEBOOK

Prepared for:
Pima County Regional Flood Control District
97 East Congress, 3rd floor
Tucson, AZ 85701

Prepared by:
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33 N. Stone Avenue
Tucson, AZ 85701
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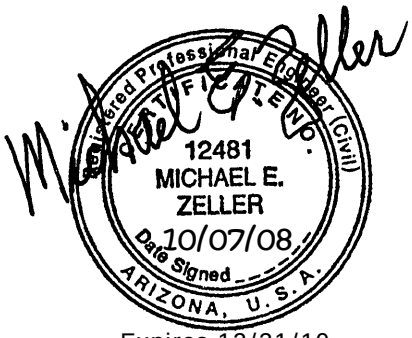
Reviewed by: Michael E. Zeller, P.E., P.H.
Date of Preparation: December 3, 2007



Expires 12/31/10

December, 2007
(Final Compilation: October 7, 2008)

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I. INTRODUCTION

This Technical Data Notebook (TDN) has been prepared in support of a Letter of Map Revision (LOMR) application for a portion of the Friendly Village Wash (FVW) located in unincorporated Pima County, Arizona. This TDN has been prepared in accordance with the "Instructions for Organizing and Submitting Technical Documentation for Flood Studies" prepared by the Arizona Department of Water Resources, Flood Mitigation Section (Refer to Arizona State Standard 1-97). This TDN also includes completed Federal Emergency Management Agency (FEMA) LOMR forms. All methodologies used in the preparation of the LOMR for which this TDN was prepared are consistent with ADWR SS 2-96 and FEMA Guidelines.

This TDN also includes detailed hydrologic and hydraulic analyses performed to determine proposed regulatory discharge rates at key locations along the FVW, and to determine floodplain limits along the study reach of the FVW. All regulatory discharges refer to "100-year" discharge rates, or flow rates that have a one percent (1%) probability of being equaled or exceeded in any given year. The hydrology is based upon the Pima County Hydrology Method and NOAA Atlas 14 upper-90% confidence-interval rainfall depths. The hydraulic analysis is based upon the U.S. Army Corps of Engineers Computer Backwater Model, HEC-RAS.

The study reach of the FVW is located in unincorporated Pima County, Arizona, and lies primarily north of Stone Loop Road/River Road and the Rillito Creek, east of Oracle Road, south of Rudasill Road, and West of First Avenue, generally within Section 13, Township 13 South, Range 13 East, G&SRM, Pima County, Arizona. The study reach of the FVW is located within a FEMA-designated "Zone A" flood-hazard area, as depicted on FIRM Map Panel Numbers 04019C1636K and 04019C1637K (February 8, 1999). Per the Flood Insurance Study for unincorporated Pima County, the "Zone A" depiction shown on the Map Panels was determined by approximate methods, and no documented hydraulics analyses were found.

Furthermore, the existing "Zone A" depiction is not consistent with current topography. This LOMR is being submitted to include better hydrologic, hydraulic, and topographic data.

This study has been authorized by the Pima County Regional Flood Control District (District):

Pima County Regional Flood Control District
97 East Congress, 3rd floor
Tucson, AZ 85701

The project surveyor is:

John B. Lynch, P.E., R.L.S.
Tetra Tech, Inc
33 N Stone Ave
Suite 1500
Tucson, AZ 85701-1413
(520) 623-7980

1.1 Project Overview

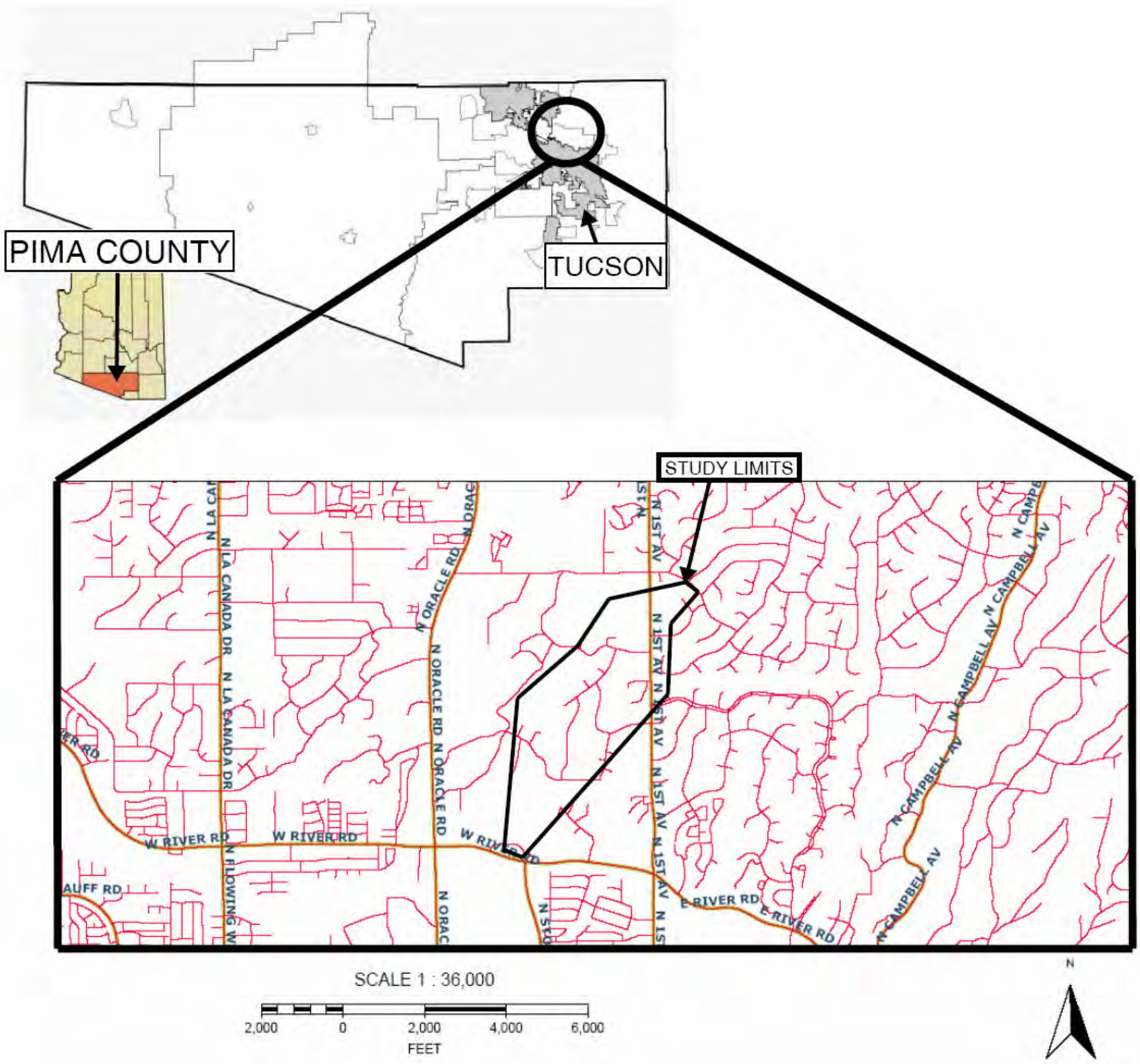
The study limits for the FVW LOMR extend from Stone Loop Road, in Section 13, Township 13 South, Range 13 East, G&SRM, Pima County (unincorporated), Arizona (FEMA Community), to just upstream (east) of First Avenue, a total distance of 3.32 miles. The purpose of the FVW LOMR is to re-map the floodplain based upon updated hydrology and topography.

Two existing culvert systems underneath First Avenue convey flows into the upper reaches of the FVW study limits. The northern leg of the FVW enters the study limits through a 2-cell, 8-foot-wide by 5-foot-high Reinforced Concrete Box Culvert (RCBC), constructed per Arizona Department of Transportation (ADOT) Standard Detail B–2.20 (see Figure 1). This RCBC is located on First Avenue just south of Rudasill Road. The drainage area located upstream of this RCBC is calculated to be 266.6 acres, with a predicted regulatory (i.e., 100-year) peak discharge of 1007 cubic feet per second (cfs). At this location, according to HEC-RAS calculations, the existing RCBC has the capacity to convey a 100-year flood. The other RCBC is located on First Avenue just north of Via Entrada, and conveys flows emanating from the eastern leg of the FVW through a single-cell, 8-foot-wide by 4-foot-high RCBC (see Figure 2), also constructed per ADOT standards. The drainage area located upstream of this RCBC is calculated to be 114.4 acres, with a predicted 100-year peak discharge of 442 cfs. At this location, according to HEC-RAS calculations, the existing RCBC also has the capacity to convey a 100-year flood.

Figure 1: Existing 2-Cell, 8-Foot-High by 5-Foot-Wide RCBC

Figure 2: Existing Single-Cell, 8-Foot-Wide by 4-Foot-High RCBC

The northern and eastern legs of the FVW converge just southwest of East Yvon Drive, at which point the contributing drainage area is calculated to be 709.5 acres, with a predicted 100-year peak discharge of 1,671 cfs. At the termination of the study limits on the FVW, the contributing drainage area is calculated to be 743.0 acres, with a predicted 100-year peak discharge of 1,610 cfs. For purposes of conservatism though, between Stone Loop Road and the junction of the northern and eastern legs of the FVW a calculated discharge rate of 1,671 cfs was used in the HEC-RAS model.



TETRA TECH, INC.

FIGURE 3

LOCATION MAP
FRIENDLY VILLAGE WASH
PIMA COUNTY, ARIZONA

II. FEMA FORMS

2.1 Study Documentation Abstract for FEMA Submittals

This section is included in accordance with the TDN guidelines. The FEMA MT-2 forms prepared for this project are presented in Section 2.2 of this TDN. Sections 2.1.1, 2.1.3, 2.1.4, and 2.1.5 are reserved for use by the ADWR, after the study has been reviewed and accepted by FEMA.

2.1.1 Date Study Accepted:_____

2.1.2 Study Contractor:

Tetra Tech, Inc.
33 N. Stone Avenue Suite 1500
Tucson, AZ 85701-1403
(520) 623-7980
Engineer of Record: Michael E. Zeller, P.E.. P.H.

2.1.3 FEMA Technical Review Contractor:_____
_____
_____
_____

2.1.4 FEMA Regional Reviewer: _____
_____
_____
_____

2.1.5 State Technical Reviewer: _____
_____
_____
_____

2.1.6 Local Technical Reviewer _____
_____
_____
_____

2.1.7 Reach Description

The FEMA-mapped floodplains come from two sources within the Friendly Village Wash TRS (unincorporated Pima County). As previously mentioned, the two washes enter the site from the east at RCBCs along First Avenue. In order to affectively model the floodplain, the washes were divided into three segments, as follows.

The northern leg of FVW, the West Agave segment, enters the study limits from the northeast and flows southwest until it converges with the eastern wash. The reach is

physically defined by its geologic floodplain and is very much a natural channel. This reach of the FVW is primarily composed of sand channels, a tree line on each of the banks, and scattered desert brush outside the banks. Also, the West Agave segment has many defined "switchbacks" after the peak discharge passes through the First Avenue/Rudasill Road RCBC. During small events, the switchbacks are clearly visible, but disappear as the events become progressively larger. The fairly wide reach has many inlets which account for a larger contributing watershed in a downstream direction. The calculated regulatory discharge as this northern leg of the FVW approaches its junction with the eastern leg of the FVW (i.e., East Agave segment) is predicted to be 1,101 cfs.

The eastern leg of the FVW, East Agave segment, enters the study limits from the east and travels southwest until it converges with the West Agave segment. This reach of the FVW is not as physically defined as the West Agave segment, but still conveys the discharge through a natural channel until it reaches its junction with West Agave segment. Much like the West Agave segment, this reach of the FVW is primarily composed of sand channels, a tree line on each of the banks, and scattered desert brush outside the banks. The reach is fairly narrow, and is primarily straight with very limited inlets. The calculated regulatory discharge as this reach approaches its junction with the northern leg of the FVW (i.e., West Agave segment) is predicted to be 666 cfs.

After the junction of the West Agave and East Agave segments, the convergence is contained within the Stone Loop Wash segment of the FVW, and flows south until its reaches the downstream boundary of the study limits. Outside of the study limits the flow is interception by the Stone Loop Road 2-cell, 12-foot-wide by 8-foot-high RCBC, which extends some distance downstream of Stone Loop Road as an underground conduit. During small events, the wash splits around an "island" located about 400 feet south of the junction of the West and East Agave segments of the FVW. The FVW wash resurfaces about 800 feet south of Stone Loop Road, and cuts west/southwest, west of Stone Avenue, as it heads to its outfall into the Rillito Creek, which is located a few hundred feet farther downstream. There is a southwest-angled ford crossing in Stone Loop Road that allows flow to enter the 2-cell, 12-foot-wide by 8-foot-high RCBC. After the junction, the predicted 100-year discharge is 1,671 cfs. Due to the split and widening of the channel as it approaches Stone Loop Road, the 100-year discharge is predicted to lower, slightly, to 1,610 cfs.

2.1.8 USGS Quad Sheets

Not applicable for this study.

2.1.9 Unique Conditions and Problems

At the outlet of each RCBC along First Avenue, there are many trees and brush that could potentially create greater depths and lower velocities as discharge exits the RCBC. These conditions could, in turn, create backwater problems that might lead to greater depths upstream of the RCBCs, as well as lead to eventual overtopping of First Avenue.

2.1.10 Coordination of Peak Discharges

All reaches were modeled with HEC-RAS and utilized the full predicted 100-year peak discharge rate, assuming no losses. Per meetings with Evan Canfield, the Pima County Regional Flood Control District Project Manager, the discharge rates that were calculated using the Pima County Hydrology Method were deemed acceptable.

2.2 FEMA Forms

The FEMA MT-2 Forms are presented in this section of the TDN. The specific forms included are: Form 1, Overview and Concurrence; Form 2, Riverine Hydrology and Hydraulics Form; and Form 3, Riverine Structures.

Multiple copies of the same form page have been included, when required, to address all river reaches and structures.

FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 3067-0148
Expires September 30, 2005

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hour 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 a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (3067-0148). 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.**

A. REQUESTED RESPONSE FROM FEMA

This request is for a (check one):

☐ CLOMR: A letter from 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 FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See Parts 60 & 65 of the NFIP Regulations.)

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
Ex: 480301 480287	City of Katy Harris County	TX TX	480301 48201C	0005D 0220G	02/08/83 09/28/90
040076	City of Tucson	AZ	040076	1636K/1637K	02/08/99
040073	Pima County	AZ	040073	1636K/1637K	02/08/99

2. Flooding Source: FRIENDLY VILLAGE WASH
3. Project Name/Identifier: FRIENDLY VILLAGE WASH
4. FEMA zone designations affected: (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 ☐ 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 types of flooding and structures (check all that apply)

Types of Flooding: ☑ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)

☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

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

☐ Dam ☐ Fill ☐ Other, Attach Description

C. REVIEW FEE

Has the review fee for the appropriate request category been included?

☐ Yes Fee amount: $_____

☑ No, Attach Explanation

Please see the 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: Adam Raczynski, EIT	Company: Tetra Tech, INC	
Mailing Address: 4801 E Broadway Blvd Suite 521 Tucson, AZ 85711	Daytime Telephone No.: 520.623.7980	Fax No.: 520.884.5278
	E-Mail Address: adam.raczynski@tetratech.com	
Signature of Requester (required):		Date: 1/7/08

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 requirement that no fill be 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. 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: Suzanne Shields, Director PCRFCD		Telephone No.: 520.243.1800
Community Name: Pima County (Comm. No. 040073)	Community Official's Signature (required): Suzanne Shields	Date: 1/8/2008

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. 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: Michael E. Zeller	License No.:	Expiration Date:
Company Name: Tetra Tech, INC	Telephone No.: 520.623.7980	Fax No.: 520.884.5278
Signature:		Date:

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 elevatio
☑ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culve addition/revision of levee/floodwall, addition/revision
☐ 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

Registered Professional Engineer (Civil) CERTIFICATE NO. 12481 MICHAEL E. ZELLER Date Signed 01/07/08 ARIZONA, U.S.A.

C. REVIEW FEE

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

☑ No, Attach Explanation

Please see the 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: ADAM G. RACZYNSKI, E.I.T.	Company: Tetra Tech, INC	
Mailing Address: 4801 E Broadway Blvd Suite 521 Tucson, AZ 85711	Daytime Telephone No.: 520.623.7980	Fax No.: 520.884.5278
	E-Mail Address: adam.raczynski@tetratech.com	
Signature of Requester (required):		Date: 1/7/08

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 requirement that no fill be 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. 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: Andy Dinaver, Town Engineer		Telephone No.: 520.791.4321
Community Name: City of Tucson (Comm. No. 040076)	Community Official's Signature (required):	Date: 1/10/08

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. 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: Michael E. Zeller	License No.:	Expiration Date:
Company Name: Tetra Tech, INC	Telephone No.: 520.623.7980	Fax No.: 520.884.5278
Signature:		Date:

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 elevatio
☑ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culve addition/revision of levee/floodwall, addition/revision
☐ 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

Registered Professional Engineer (Civil) CERTIFICATE NO. 12481 MICHAEL E. ZELLER Date Signed 01/07/08 ARIZONA, U.S.A.

C. Review Fee

No fee has been included in the LOMR submittal for the following reason: "LOMR/PMR Based Solely on Submission of More Detailed Data" of which there is no required fee (per the FEMA website http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm).

B. HYDRAULICS (CONTINUED)

3. Pre-Submittal Review of Hydraulic Models

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. These review programs verify that the hydraulic estimates and assumptions in the model data are in accordance with NFIP requirements, and that the data are comparable with the assumptions and limitations of HEC-2/HEC-RAS. CHECK-2 and CHECK-RAS identify areas of potential error or concern. These tools do not replace engineering judgment. CHECK-2 and CHECK-RAS can be downloaded from http://www.fema.gov/plan/prevent/fhm/frm_soft.shtm. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS. If you disagree with a message, please attach an explanation of why the message is not valid in this case. Review of your submittal and resolution of valid modeling discrepancies will result in reduced review time.

HEC-2/HEC-RAS models reviewed with CHECK-2/CHECK-RAS? ☐ Yes ☑ No

4. Models Submitted

Duplicate Effective Model*	Natural File Name: N/A	Floodway File Name: N/A
Corrected Effective Model*	Natural File Name: N/A	Floodway File Name: N/A
Existing or Pre-Project Conditions Model	Natural File Name:	Floodway File Name:
Revised or Post-Project Conditions Model	Natural File Name:	Floodway File Name:
Other - (attach description)	Natural File Name:	Floodway File Name:

*Not required for revisions to approximate 1%-annual-chance floodplains (Zone A) – for details, refer to the corresponding section of the instructions.

The document "Numerical Models Accepted by FEMA for NFIP Usage" lists the models accepted by FEMA. This document can be found at: http://www.fema.gov/plan/prevent/fhm/en_modl.shtm.

C. MAPPING REQUIREMENTS

A **certified topographic 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.).

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,** 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 of revision.

D. COMMON REGULATORY REQUIREMENTS

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

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.
- The proposed project encroaches upon a SFHA with BFEs established and would result in increases above 1.00 foot.

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 added. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For LOMR requests, does this request require property owner notification and acceptance of BFE increases? ☐ Yes ☐ No

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

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. No. 3067-0148
Expires September 30, 2005

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 7 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 a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (3067-0148). 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.**

Flooding Source:
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 Structure

1. **Name of Structure:** Existing RCBC on 1st AVE near Rudasill Road

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

   Location of Structure: 1st Ave near Rudasill Road

   Downstream Limit/Cross Section: West Right of Way of 1st Ave near Rudasill Road

   Upstream Limit/Cross Section: East Right of Way of 1st Ave near Rudasill Road

2. **Name of Structure:** Existing RCBC on 1st AVE near Via Entrada

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

   Location of Structure: 1st Ave near Via Entrada

   Downstream Limit/Cross Section: West Right of Way of 1st Ave near Via Entrada

   Upstream Limit/Cross Section: East Right of Way of 1st Ave near Via Entrada

3. **Name of Structure:**

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

   Location of Structure:

   Downstream Limit/Cross Section:

   Upstream Limit/Cross Section:

NOTE: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source:

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin
- ☐ Other (Describe):
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

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

3. 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):

4. Sediment Transport Considerations

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

C. BRIDGE/CULVERT

Flooding Source:

Name of Structure: NO NEW BRIDGE/CULVERTS - ALL ARE EXISTING

1. This revision reflects (check one):

- ☐ New bridge/culvert not modeled in the FIS
- ☐ Modified bridge/culvert previously modeled in the FIS
- ☐ New 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):
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

Was sediment transport considered? ☐ Yes ☐ No If yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

D. DAM

Flooding Source:

Name of Structure:

1. This request is for (check one): ☐ Existing dam ☐ New dam ☐ Modification of existing dam
2. The dam was designed by (check one): ☐ Federal agency ☐ State agency ☐ Local government agency

   ☐ Private organization Name of the agency or organization:
3. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).
4. 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.
5. Does the Base Flood Elevation behind the dam or downstream of the dam change?

   ☐ Yes ☐ No If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

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

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

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one):

☐ upgrading of an existing levee/floodwall system
☐ a newly constructed levee/floodwall system
☐ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☐ earthen embankment, dike, berm, etc.	Station	to
☐ structural floodwall	Station	to
☐ Other (describe):	Station	to

c. Structural Type (check one):

☐ monolithic cast-in place reinforced concrete
☐ reinforced concrete masonry block
☐ sheet piling
☐ Other (describe):

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☐ No

If Yes, by which agency?

e. Attach certified drawings containing the following information (indicate drawing/sheet numbers):

1. Plan of the levee embankment and floodwall structures. Sheet Numbers:
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers:
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. Sheet Numbers:
4. A layout detail for the embankment protection measures. Sheet Numbers:
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. Sheet Numbers:

2. Freeboard

a. The minimum freeboard provided above the BFE is:

Riverine

3.0 feet or more at the downstream end and throughout	☐ Yes	☐ No
3.5 feet or more at the upstream end	☐ Yes	☐ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☐ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater).	☐ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation	☐ Yes	☐ No

E. LEVEE/FLOODWALL (CONTINUED)

2. Freeboard (continued)

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☐ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☐ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

4. Embankment Protection

a. The maximum levee slope landside is:

b. The maximum levee slope floodside is:

c. The range of velocities along the levee during the base flood is: (min.) to (max.)

d. Embankment material is protected by (describe what kind):

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

(Extend table on an added sheet as needed and reference each entry)

E. LEVEE/FLOODWALL (CONTINUED)

4. Embankment Protection (continued)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:

☐ Overall height: Sta. ; height ft.

☐ Limiting foundation soil strength:

Sta. , depth to

strength ϕ = degrees, c = psf

slope: SS = (h) to (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):

c. Summary of stability analysis results:

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction		1.3
II	Sudden drawdown		1.0
III	Critical flood stage		1.4
IV	Steady seepage at flood stage		1.4
VI	Earthquake (Case I)		1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☐ Yes ☐ No

If Yes, describe methodology used:

e. Was a seepage analysis for the foundation performed? ☐ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☐ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is hours.

Attach engineering analysis to support construction plans.

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one):

☐ UBC (1988) or ☐ Other (specify):

b. Stability analysis submitted provides for:

☐ Overturning ☐ Sliding If not, explain:

c. Loading included in the analyses were:

☐ Lateral earth @ P_A = psf; P_p = psf

☐ Surcharge-Slope @ , ☐ surface psf

☐ Wind @ P_w = psf

☐ Seepage (Uplift); ☐ Earthquake @ P_{eq} = %g

☐ 1%-annual-chance significant wave height: ft.

☐ 1%-annual-chance significant wave period: sec.

d. Summary of Stability Analysis Results: Factors of Safety.

Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)

(Note: Extendable on an added sheet as needed and reference)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum		
Maximum allowable		

f. Foundation scour protection ☐ is, ☐ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

E. LEVEE/FLOODWALL (CONTINUED)

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☐ Yes ☐ No

b. The computed range of settlement is ft. to ft.

c. Settlement of the levee crest is determined to be primarily from :

☐ Foundation consolidation
☐ Embankment compression
☐ Other (Describe):

d. Differential settlement of floodwalls ☐ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage

a. Specify size of each interior watershed:

Draining to pressure conduit: acres
Draining to ponding area: acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☐ No
Ponding elevation vs. gravity flow	☐ Yes	☐ No
Differential head vs. gravity flow	☐ Yes	☐ No

c. The river flow duration curve is enclosed: ☐ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: cfs

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☐ Yes	☐ No
• Common storm (River Watershed)	☐ Yes	☐ No
• Historical ponding probability	☐ Yes	☐ No
• Coastal wave overtopping	☐ Yes	☐ No

If No for any of the above, attach explanation.

f. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No

If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is cfs

h. The length of levee system used to drive this seepage rate in item g: ft.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☐ Yes ☐ No

If Yes, include the number of pumping plants:
For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operation be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☐ is ☐ is not a problem
Hydrocompaction ☐ is ☐ is not a problem
Heave differential movement due to soils of high shrink/swell ☐ is ☐ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☐ No

Attach supporting documentation

d. Sediment Transport Considerations:

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

E. LEVEE/FLOODWALL (CONTINUED)

10. Operational Plan And Criteria

    a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☐ Yes ☐ No

    b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations? ☐ Yes ☐ No

    c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations? ☐ Yes ☐ No

    If the answer is No to any of the above, please attach supporting documentation.

11. Maintenance Plan

    a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☐ Yes ☐ No
    If No, please attach supporting documentation.

12. Operations and Maintenance Plan

    Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

F. SEDIMENT TRANSPORT

Flooding Source:

Name of Structure:

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume acre-feet

Debris load associated with the base flood discharge: Volume acre-feet

Sediment transport rate (percent concentration by volume)

Method used to estimate sediment transport:

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition:

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport:
Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

III. SURVEY AND MAPPING INFORMATION

3.1 Field Survey Information

The site survey was performed by:

John B. Lynch, P.E., R.L.S.
Tetra Tech, Inc
33 N Stone Ave
Suite 1500
Tucson, AZ 85701-1413
(520) 623-7980

The surveyor performed his work under direct contract with the owner. A signed and sealed copy of the site survey is included in Appendix C of this TDN.

IV. HYDROLOGY

4.1 Method Description

The predicted 100-year peak discharges for each of the contributory watersheds, as well as for the combined watershed, were calculated utilizing the Pima County Hydrology Method. The Pima County Hydrology Method includes parameters regarding rainfall, slope, basin factors, soils, and vegetation cover to determine time of concentration, rainfall intensity, runoff supply rate, and peak discharge. In order to determine rainfall depth, NOAA Atlas 14 upper 90% confidence interval values were used. In the past, the Pima County Hydrology Method has been deemed as a FEMA-accepted hydrologic method for prediction of 100-year peak discharge values in Pima County.

The hydrologic data sheets from the Pima County Hydrology Method have been included in Appendix D of this TDN.

4.2 Parameter Estimation

4.2.1 Drainage Area

The limits of the upstream watersheds contributing stormwater runoff to the project site were determined based upon detailed 1998 PAG 2-foot contour-interval topographic mapping provided by Pima County. These maps were supplemental with field survey where subtle elevation differences were difficult to determine in the vicinity of Stone Loop Road. In addition, these maps were further supplemented with City of Tucson hydrologic data and wash information, aerial photography, and site investigation. The topographic mapping was utilized in digital format, with drainage areas calculated using AutoCAD. The composite watershed map is located in Figure A of this TDN.

4.2.2 Watershed Work Maps

Pima County topographic maps were utilized to determine drainage area boundaries. Digital mapping enables use of AutoCAD to determine contributing watershed areas. A watershed work map has been included in Figure A of this TDN. Six separate watersheds have been delineated. The concentration points were determined based upon the RCBCs along First Avenue, as well as identifying key points of flow concentration within the FVW watershed. These key points were chosen based on the confluence of smaller washes, proceeding in a downstream direction along the study reach.

4.2.3 Gage Data

Gage Data were not utilized in this study.

4.2.4 Statistical parameters

Statistical parameters have not been evaluated in this TDN.

4.2.5 Precipitation

Precipitation data was comprised of NOAA Atlas 14 upper 90% confidence interval values, which were used in the Pima County Hydrology Method to predict 100-year peak discharge values. The centroid coordinates of each sub-basin were used with NOAA Atlas 14, from whence corresponding rainfall values were determined.

4.2.6 Physical Parameters

As mentioned in Section 3.1, the parameters utilized were mean slope, basin factors, soils, vegetation cover, and percent impervious. The mean slope was determined through investigation of topography maps and was measured along the longest watercourse within the watershed. The basin factors along the slope were determined through site investigation, aerial mapping, and previous knowledge of the site area. Soil types were determined through maps provided by the City of Tucson Department of Transportation Map Center, containing hydrologic data and wash information. Vegetative cover and percent impervious were both determined from conducting site visits and using aerial photography.

TABLE 1: PHYSICAL PARAMETERS

Sub-Basin	Mean Slope	Weighted Basin Factor	Vegetative Cover Type	Vegetative Cover (%)	Soil Types (%)		Impervious (%)
					B	C	
A	0.02462	0.038	Desert Brush	30	95	5	25
B	0.02410	0.038	Desert Brush	30	96	4	45
C	0.02043	0.038	Desert Brush	30	95	5	35
D	0.02265	0.038	Desert Brush	30	95	5	25
E	0.02135	0.038	Desert Brush	30	91	9	20
Stone Loop	0.02171	0.038	Desert Brush	30	91	9	20

4.3 Problems Encountered During the Study

4.3.1 Special Problems and Solutions

There were no problems with the hydrologic determination. The methodology is quite simple and highly reproducible, having only a few parameters to enter.

4.3.2 Modeling Warning and Error Messages

Not applicable.

4.4 Calibration

Calibration of the hydrologic model was not necessary to conduct this study. However, comparison with previous 100-year peak-discharge computations in conjunction with the construction of the two RCBCs under First Avenue yielded nearly identical results.

4.5 Final Results

4.5.1 Hydrologic Analysis Results

The Pima County Hydrology Method was utilized to determine regulatory discharge rates for the sub-basins and for the entirety of the Friendly Village Wash. The results are shown in Table 2 of this TDN.

TABLE 2: FINAL RESULTS—HYDROLOGY

Concentration Point	Concentration Point Location	Area (acres)	Q_{100} (cfs)
A	RCBC @ Via Entrada	114.4	442
B	RCBC @ Rudasill Road	266.6	1007
C	West Agave XS 2711.800	396.9	1101
D	East Agave XS 2674.162	185.9	666
E	East/West Agave Junction	709.5	1671
Stone Loop	Stone Loop	743	1610

4.5.2 Verification of Results

There was comparable hydrologic data available when researching the two RCBCs located along First Avenue. Through research of Pima County Department of Transportation Road Construction Plans, the construction “As-Builts” were found for the RCBCs evaluated in this study (see Appendix D). After reviewing the peak discharges used in conjunction with construction of the RCBCs, and presenting the findings to the Pima County Regional Flood Control District PM, Evan Canfield, the comparative results were determined to be excellent.

V. HYDRUALICS

The hydraulic modeling was performed in a composite manner for reasons described in this section of the TDN. A summary of the modeling programs or methods utilized is provided, as follows, and is described in more detail later in this section of the TDN.

Channel Mapping:	HEC-RAS 3.1.3, United States Army Corps of Engineers, May 2005, used with GEO-RAS and Arcview
Culvert Assessment:	HEC-RAS 3.1.3, United States Army Corps of Engineers, May 2005, used with GEO-RAS and Arcview

5.1 Method Description

The hydraulic modeling for FVW was primarily performed utilizing HEC-RAS, version 3.1.3. The sections were drawn electronically on three-dimensional topographic mapping. Geo-RAS and Arcview were used to generate existing-section cross-sections. The HEC-RAS model was developed in three pieces: one wash segment of the FVW emanating from the First Avenue/Rudasill Road RCBC, another wash segment of the FVW emanating from the First Avenue/Via Entrada RCBC, with the third wash segment of the FVW located downstream of the junction of the preceding two segments, which combine at Agave Road to form the remainder of the wash as it proceeds downstream and meets the RCBC at Stone Loop Road. The hydraulic modeling proceeded to the Stone Loop Road RCBC to best represent the floodplain at the conclusion of the study limits (Stone Loop Road). A summary of the hydraulic calculations, based on HEC-RAS output for the FVW, is included in Appendix E of this TDN. Normal-depth, with a slope of 0.02, was assumed for the upstream boundary condition for both the West and East Agave segments of the FVW. This boundary condition was assumed because with the steepness of the mean slope within the study reach of the FVW. In the FVW, where critical and/or supercritical flow conditions predominate, normal depth would best represent the actual flow conditions at the upstream boundaries of the study limits. Because under such conditions the flow regime typically defaults to “critical” for a subcritical run, critical flow was assumed for the downstream boundary condition at the most downstream cross-section, Cross-Section RS 8.249. This was assumed because at this location because of the drop at the RCBC downstream of Stone Loop Road, which would force critical depth to occur at or near the brink of the drop.

Other models were employed, as well, to model the complex nature of the regulatory floodplain affecting the study reach. That is, the existing roadway RCBCs were independently rated using HYDROCALC, version 1.2a, with the roadway overtopping characteristics determined using FlowMaster, version 6.0.

5.2 Work Study Maps

The work study map utilized to draw river cross sections and obtain spatial data required for input into the HEC-RAS model is shown in the Appendix of this TDN as Figure B.

5.3 Parameter Estimation

5.3.1 Roughness Coefficients

Manning "n" values selected were in the typical range of values expected considering the type of material over which flow occurs. Cross-sections with heavy amounts of brush and tree cover along the channel banks were assigned Manning "n" values of 0.030 for the channel, 0.08 for adjacent overbanks, and 0.05 for more distant overbank areas, where less vegetation exists. Cross-sections with heavy brush and trees in the channel (located at the outlet of the RCBCs), were assigned Manning "n" values of 0.050 for the channel, 0.08 for adjacent overbanks, and 0.05 for more distant overbank areas, where less vegetation exists. Cross-sections located on or near roadways were assigned Manning "n" values of 0.018 for any portion of the flow crossing asphaltic pavement on the road, and were assigned values of 0.015 for any portion of the flow crossing concrete.

5.3.2 Expansion and Contraction Coefficients

In general, the channel has gradual transitions, with a few significant exceptions. It was therefore assumed that any transition that may occur would do so with more or less minimum curvature. In general, then, C_c=0.10 and C_e=0.30 were used in the HEC-RAS model. This was also the case at outlets and inlets of the RCBCs, because of the natural characteristics of the FVW.

5.4 Cross-Section Description

Cross-section locations were selected to be perpendicular to flow paths based upon experience and knowledge of the area. At the Stone Loop Road RCBC, though, a site visit was necessary in order to ensure that cross-sections selected at this location best represented the flood plain. Cross-sections were generated using GEO-RAS and ArcView, based upon thawleg and channel topography. Topography was derived from 2005 LIDAR data represented as a Triangular Irregular Network (TIN). The orientation and precise locations of these cross-sections were refined a number of times, after reviewing model results generated by interim HEC-RAS simulations.

5.5 Modeling Considerations

5.5.1 Hydraulic Jump and Drop Analysis

There are no hydraulic jumps/drops within the study limits.

5.5.2 Bridges and Culverts

There are no bridges existing or proposed onsite or adjacent to the site.

Two RCBCs allow flows to discharge into the study reach at the upstream study limits. These are: A 2-cell, 8-foot-wide by 5-foot-high RCBC located at First Avenue/Rudasill Road (see Figure 1), as well as a single-cell, 8-foot-wide by 4-foot-high RCBC located at

First Avenue/Via Entrada (see Figure 2). The 2-cell, 12-foot-wide by 8-foot-high RCBC at Stone Loop Road accepts the flow, for its eventual discharge into Rillito Creek. There are no other culverts located within the study limits.

5.5.3 Levees and Dikes

There are no levees or dikes located within or proposed for this project.

5.5.4 Islands and Flow Splits

Along the West Agave, East Agave, and North Stone Loop Road segments of the FVW, many islands and flow splits occur. The cross-sections have many high and low elevations which create potential areas for flow to split. At the cross-sections where there is split flow, the flow depth typically defaults to critical due to the subcritical run. There are also areas that are very flat and wide, but are still located within rugged terrain. This causes split flows as well. The effects created by these areas are modeled as a part of the overall flood plain, since they do not extend beyond the "natural floodplain boundaries." The cross-sections affected by these conditions can be identified in the model "warnings and errors" output.

5.5.5 Ineffective Flow Areas

The ineffective flow option of HEC-RAS was not utilized in preparing the FVW LOMR.

5.5.6 Supercritical Flow

The flow regime for the majority of the FVW study reach is either critical or supercritical due to the steep slopes within and along the watercourses within the contributing watershed areas of the Catalina Foothills area. With a mean slope exceeding two percent (2%) along an alluvial watercourse, either critical or supercritical flow conditions are to be expected. However, in keeping with FEMA standards the floodplain was modeled as if it were dominated by subcritical flow processes.

5.6 Floodway Modeling

Floodway modeling was not performed for this study.

5.7 Problems Encountered

5.7.1 Special Problems and Solutions

There were no special problems within the study limits.

5.7.2 Model Warnings and Errors

As stated previously herein, due to the steep slopes within the FVW watershed, the flow regime is expected to be critical or supercritical. Per FEMA guidelines, it is required to run hydraulic models for subcritical flow conditions. Due to this requirement, many

cross-sections have produced warnings stating that *"During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth."* This message occurs for the following cross sections:

TABLE 3: CROSS SECTIONS DEFAULTING TO CRITICAL DEPTH

River Reach	River Station	Critical Water Surface (ft)	Channel Froude Number
North Stone Loop	1922.703	2365.34	1
North Stone Loop	1798.727	2363.52	0.85
North Stone Loop	1627.381	2360.01	0.74
North Stone Loop	1446.308	2355.28	1.03
North Stone Loop	1307.534	2352.92	1.02
North Stone Loop	1205.304	2350.79	1.03
North Stone Loop	1108.411	2348.45	1.09
North Stone Loop	982.51	2345.6	0.99
North Stone Loop	723.455	2341.59	0.85
North Stone Loop	604.932	2339.91	0.74
North Stone Loop	479.976	2336.93	0.84
North Stone Loop	304.909	2331.79	0.97
North Stone Loop	175.536	2329.3	0.86

TABLE 3 (CONTINUED)

River Reach	River Station	Critical Water Surface (ft)	Channel Froude Number
West Agave	7855.624	2510.88	0.95
West Agave	7695.344	2507.38	1.19
West Agave	7458.524	2503.46	1.18
West Agave	6763.567	2490.28	0.96
West Agave	6699.811	2488.45	0.97
West Agave	6574.371	2487.09	0.97
West Agave	6392.817	2485.6	0.8
West Agave	6238.036	2483.33	0.91
West Agave	5669.909	2475.37	1.18
West Agave	5251.436	2469.59	0.96
West Agave	5072.79	2468.1	0.9
West Agave	4901.107	2466.17	0.93
West Agave	4753.088	2464.18	0.92
West Agave	4531.991	2459.87	1.18
West Agave	4423.094	2457.2	0.91
West Agave	4330.355	2454.71	1
West Agave	3986.068	2448.34	0.86
West Agave	3864.383	2446.19	0.81
West Agave	3680.565	2442.36	1
West Agave	3481.46	2438.82	1.02
West Agave	3366.345	2436.32	1.01
West Agave	3172.293	2431.6	1.02
West Agave	3064.242	2429.57	0.97
West Agave	2940.349	2426.77	1.21
West Agave	2325.093	2413.01	1.02
West Agave	2009.964	2408.38	0.81
West Agave	1873.512	2405.2	0.88
West Agave	1717.201	2401.92	0.91
West Agave	1555.734	2398.08	1.05
West Agave	1434.165	2394.83	1.29
West Agave	1270.626	2391.76	1.12
West Agave	1042.856	2388.08	0.81
West Agave	950.695	2385.73	0.83
West Agave	818.921	2382.87	0.88
West Agave	691.898	2380.56	0.96
West Agave	589.317	2378.63	1
West Agave	496.446	2376.25	0.82
West Agave	391.885	2374.3	0.81
West Agave	318.062	2373.22	0.89
West Agave	223.718	2370.78	0.87
West Agave	106.664	2369.1	0.78

River Reach	River Station	Critical Water Surface (ft)	Channel Froude Number
East Agave	3882.219	2451.34	0.89
East Agave	3801.929	2448.67	0.96
East Agave	3726.793	2446.67	0.87
East Agave	3605.777	2444.86	0.86
East Agave	3487.724	2442.83	0.88
East Agave	3350.988	2440.45	0.9
East Agave	3199.552	2437.42	0.98
East Agave	3080.023	2434.99	0.99
East Agave	2977.182	2432.7	0.82
East Agave	2901.479	2431.07	0.97
East Agave	2786.054	2428.97	0.98
East Agave	2674.162	2426.79	0.98
East Agave	2577.322	2424.63	1.01
East Agave	2470.94	2422.16	1
East Agave	2312.754	2418.7	0.9
East Agave	2190.491	2415.34	0.96
East Agave	2088.843	2413.14	1.02
East Agave	1983.703	2410.16	0.94
East Agave	1869.547	2407.8	0.9
East Agave	1669.198	2402.64	1.06
East Agave	1445.975	2398.18	0.93
East Agave	1336.348	2396.27	1.2
East Agave	1254.975	2394.56	1.05
East Agave	1165.315	2392.42	0.97
East Agave	1065.567	2390.19	0.85
East Agave	876.724	2386.09	0.87
East Agave	753.438	2383.05	0.93
East Agave	646.732	2380.82	0.79
East Agave	524.23	2377.43	0.89
East Agave	396.746	2374.82	0.98
East Agave	311.94	2372.93	0.93
East Agave	133.392	2368.13	0.98

As stated in section 5.5.4, many cross-sections along the West Agave, East Agave, and North Stone Loop segments of the FVW experience split-flow conditions (i.e., divided flow). The model warning states *"Divided flow computed for this cross-section."* These particular cross-sections have many high and low elevations which create areas around which flow can divide. Divided flow is also exacerbated by the subcritical run requirements of FEMA. Subcritical flow conditions create higher water-surface elevations at these particular cross-sections—elevations which would normally not be as high under either critical or supercritical flow conditions. The following cross-sections have divided or split-flow messages:

TABLE 4: CROSS-SECTIONS WITH DIVIDED FLOW

River Reach	River Station		River Reach	River Station
West Agave	7855.624		**North Stone Loop**	1922.703
West Agave	6392.817		**North Stone Loop**	1446.308
West Agave	6238.036		**North Stone Loop**	1307.534
West Agave	6089.955		**North Stone Loop**	1205.304
West Agave	6026.115		**North Stone Loop**	1108.411
West Agave	5505.832		**North Stone Loop**	982.51
West Agave	5251.436		**North Stone Loop**	861.334
West Agave	4901.107		**North Stone Loop**	304.909
West Agave	4423.094		**North Stone Loop**	175.536
West Agave	4230.829		**East Agave**	4142.569
West Agave	3680.565		**East Agave**	3882.219
West Agave	3255.776		**East Agave**	3801.929
West Agave	3172.293		**East Agave**	3199.552
West Agave	3064.242		**East Agave**	3080.023
West Agave	2940.349		**East Agave**	2977.182
West Agave	2711.8		**East Agave**	2674.162
West Agave	2490.261		**East Agave**	1669.198
West Agave	2009.964		**East Agave**	1336.348
West Agave	1270.626		**East Agave**	1254.975
West Agave	1042.856		**East Agave**	1165.315
West Agave	950.695		**East Agave**	876.724
West Agave	818.921		**East Agave**	753.438
West Agave	318.062		**East Agave**	396.746
			East Agave	311.94
			East Agave	133.392

Cross-sections located at or near the junction of the West and East Agave segments of the FVW show a warning message of *"The cross-section end points had to be extended vertically for the computed water surface."* At this location, the cross-sections could not be extended farther due to the configuration of the junction. Had the cross-sections on the East Agave segment of the FVW been extended farther onto the right overbank, they would have crossed the West Agave cross-sections extended along the left overbank. East Agave cross-section 133.39; and West Agave cross-sections 106.664 and 223.718 showed these warnings.

The warning *"This may indicate the need for additional cross sections,"* occurs at the majority of the cross sections throughout the FVW. These indications result from either the calculated conveyance ratio (<.7 or >1.4), or energy loss (>1ft), occurring between cross sections. As previously stated, the sub-critical run for FEMA standards has resulted in many error messages that would normally not occur for a critical or supercritical flow regime.

5.8 Calibration

The model was not calibrated. The three RCBCs were sized with other hydraulic programs before insertion of hydraulic data into the HEC-RAS. The sizes specified were determined to be adequate to convey the 100-year peak discharge of the FVW at the applicable location. The primary channel, channel overbanks, and channel reaches were characterized by using existing, detailed topography, supplemented by field survey, all of which was input into the HEC-RAS model.

5.9 Final Results

5.9.1 Hydraulic Analysis Results

Summary tables for the HEC-RAS modeling appear in Appendix E of this TDN.

5.9.2 Verification of Results

The results of the LOMR are comparable to those of previous FEMA floodplain limits computed for the study reach of the FVW. The new results of the floodplain computed in this study extend the limits of the old study and, in doing so, include a few additional homes within the regulatory floodplain limits. This is to be expected, to some extent, since the FVW watershed has become more urbanized since the previous FEMA study was performed. Consequently, the area is more impervious than it was in the past, which has led to larger peak discharges and, as a result, a larger floodplain width in order to convey the flow to its downstream study limit at Stone Loop Road.

VI. EROSION AND SEDIMENT TRANSPORT

6.1 Method Description

This section is not applicable to this study.

6.2 Parameter Estimation

This section is not applicable to this study.

6.3 (section omitted from AWRA)

This section is not applicable to this study.

6.4 Modeling Considerations

This section is not applicable to this study.

6.5 Problems Encountered During the Study

6.5.1 Special Problems and Solutions

This section is not applicable to this study.

6.5.2 Modeling Warnings and Errors

This section is not applicable to this study.

6.6 Calibration

This section is not applicable to this study.

6.7 Final Results

6.7.1 Erosion and Sediment Transport Analysis Results

This section is not applicable to this study.

6.7.2 Verification of Results

This section is not applicable to this study.

VII. DRAFT FIS REPORT DATA

7.1 Summary of Discharges

TABLE 5: SUMMARY OF DISCHARGES

River Reach	River Station	Design Discharge (cfs)	Calculated Discharge (cfs)
East Agave	4231.989	442	442
East Agave	2674.162	666	666
North Stone Loop	1922.703	1671*	1610
West Agave	7855.624	1007	1007
West Agave	2711.8	1101	1101

*Use higher discharge for factor of safety

7.2 Floodway Data

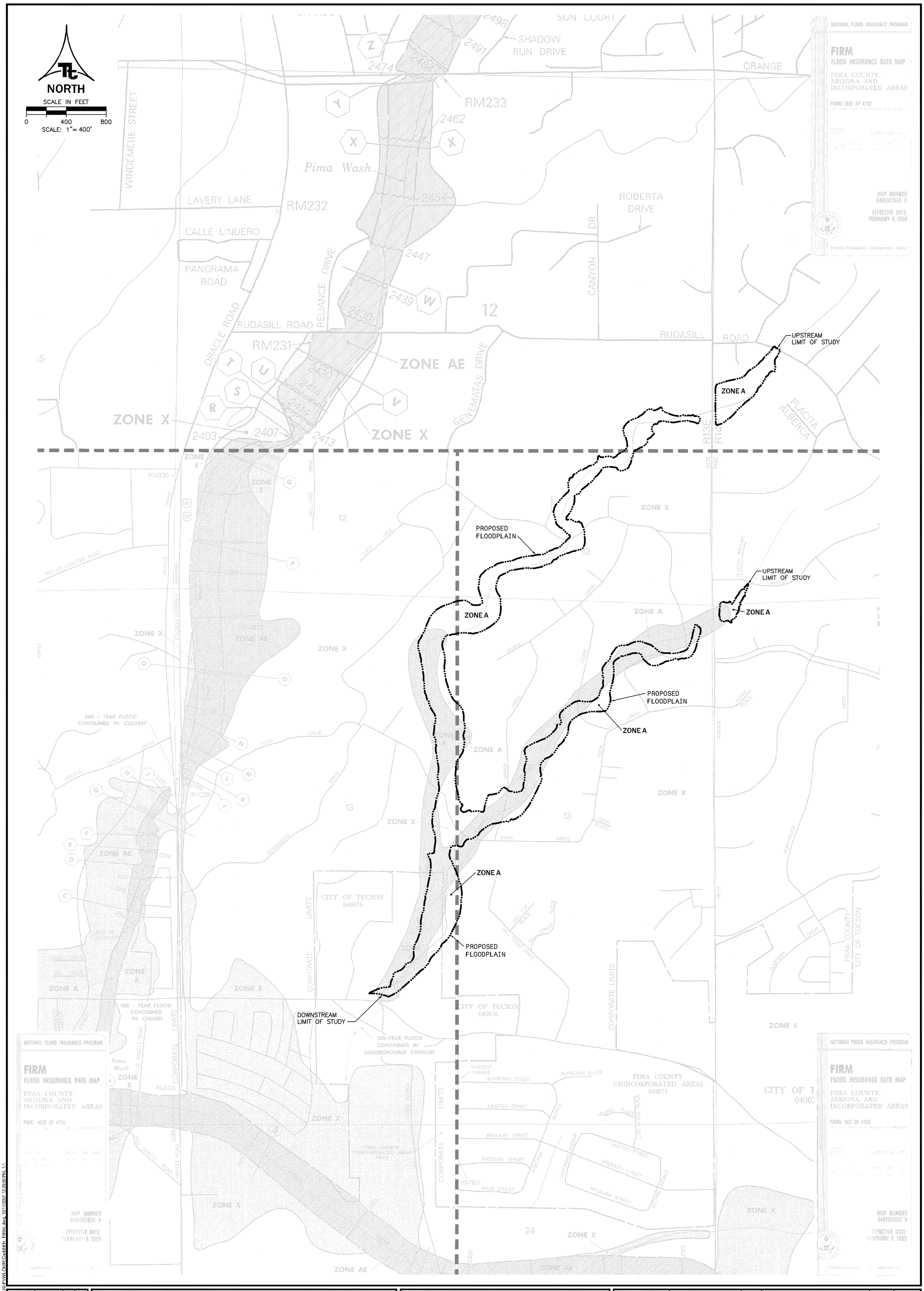
Not applicable.

7.3 Annotated Flood Insurance Rate Map

An annotated Flood Insurance Rate Map (FIRM) is included in this section of the TDN.

7.4 Flood Profiles

Flood Profiles are presented in Appendix E of this TDN.



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JOB NO:	P09039
DATE :	September – 2007
SCALE HORIZ:	1"=400'
SCALE VERT:	DNA
SHEET NO. :	1 OF 1

FVWLOMR
FRIENDLY VILLAGE WASH
FIRM MAP

TETRA TECH, INC.
33 N. STONE AVENUE, SUITE 1500
TUCSON, ARIZONA 85701-1413
(520) 623-7980 FAX (520) 884-5278

DESIGNED BY:	JDE
DRAWN BY:	CRT
CHK'D BY (DESIGN):	MEZ
CHK'D BY (FIELD ENGR):	

NO.	REVISION	APPV'D.	DATE

APPENDIX A: REFERENCES

Arizona Department of Water Resources, Flood Mitigation Section
"Instructions for Organizing and Submitting Technical Documentation for Flood Studies"
SSA1-97, November 1997

Arizona Department of Water Resources, Flood Mitigation Section
"Requirements for Flood Study Technical Documentation"
SS1-97, November 1997

Pima County Department of Transportation
"Pima County Mapguide Map"
Main Mapguide Map, 2007

Pima County Department of Transportation
"Road Construction Plans and Maps"
Plan Number: 4BFROG, 2002
Plan Number: 4BROFA, 1998

Pima County Regional Flood Control District
Evan Canfield, PHD., P.E., CFM. Chief Hydrologist
Planning and Development Division
evan.canfield@rfcd.pima.gov

Pima County Regional Flood Control District
"Pima County Hydrology Method V5.3.1 Users Manual"
March 2007

Pima County Regional Flood Control District
R.T. "Terry" Hendricks, CFM. Chief Hydrologist
Planning and Development Division
evan.canfield@rfcd.pima.gov

Tucson Department of Transportation
"Map Center"
Hydrologic Data and Wash Info, 2006

United States Army Corps of Engineers
"HEC-RAS 3.1.3 Users Manual"
May 2005

APPENDIX B: GENERAL DOCUMENTATION AND CORRESPONDENCE

Friendly Village Wash LOMR
Public Notice

The following newspaper clipping is from the classified advertisements in the April 14, 2008 publication of the Arizona Daily Star and the Tucson Citizen.

Class 4 Mon, Apr. 14, 2008 Tucson, AZ

Legal | **Legal** | **Legal**

PUBLIC NOTICE

PROPOSED CHANGES TO FLOODPLAIN BOUNDARIES WITHIN THE FRIENDLY VILLAGE WASH FLOODPLAIN THROUGH THE FEDERAL EMERGENCY MANAGEMENT AGENCY AS PART OF THE NATIONAL FLOOD INSURANCE PROGRAM

The Pima County Flood Control District is proposing revisions to the floodplain boundaries for the Friendly Village Wash based upon refined data. The revisions are located within Section 13 of Township 13 South, Range 13 East; and within Sections 7 and 18 of Township 13 South, Range 14 East. The limits of the study are from Stone Loop Road, to the south, to Rudasill Road and immediately east of North First Avenue, near Camino Arturo, to the north. The proposed revisions will change the Flood Insurance Rate Maps (FIRM)s, Panel Numbers 04019C1636K and 04019C1637K (February 8, 1999) for Incorporated City of Tucson and unincorporated Pima County, Arizona. This action is being taken through the Federal Emergency Management Agency (FEMA) as part of the National Flood Insurance Program (NFIP). Maps which delineate the proposed revised floodplain are available for review at the offices of the Pima County Department of Transportation and Flood Control District, Floodplain Management Division, located at 97 East Congress Street, 3rd Floor, Tucson, Arizona 85701.

Publish April 14, 2008
Arizona Daily Star
Tucson Citizen

Federal Emergency Management Agency

Washington, D.C. 20472

September 23, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Bob Walkup
Mayor, City of Tucson
P.O. Box 27210
Tucson, AZ 85726

IN REPLY REFER TO:
Case No.: 08-09-0473P
Community Name: City of Tucson, AZ
Community No.: 040076
Effective Date of
This Revision: **October 23, 2008**

Dear Mayor Walkup:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Oakland, California, at (510) 627-7175, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

For: William R. Blanton Jr., CFM, Chief
Engineering Management Branch
Mitigation Directorate

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

cc: (see attached list)

List of Courtesy Copies - City of Tucson, AZ

Mr. Michael Zeller, P.E.
Tetra Tech, Inc.

Mr. Andy Dinauer
Department of Transportation
City of Tucson

Mr. Leo M. Smith, P.E.
Floodplain Manager
Pima County Regional Flood Control District

Ms. Suzanne Shields, P.E.
Chief Engineer
Pima County Regional Flood Control District

Mr. R. "Terry" Hendricks, CFM
Chief Hydrologist
Pima County Regional Flood Control District

Mr. Bill Zimmerman
Planning and Development Division Manager
Pima County Regional Flood Control District

Mr. Brian Cosson, CFM
NFIP Coordinator
Office of Dam Safety and Flood Mitigation
Arizona Department of Water Resources

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Tucson Pima County Arizona	Culvert	Hydraulic Analysis Hydrologic Analysis New Topographic Data
	COMMUNITY NO.: 040076		
IDENTIFIER	Friendly Village Wash	APPROXIMATE LATITUDE & LONGITUDE: 32.298, -110.972 SOURCE: USGS QUADRANGLE DATUM: NAD 27	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 04019C1636 K DATE: February 8, 1999	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Friendly Village Wash - from just upstream of Stone Loop Road to approximately 1,500 feet upstream

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Friendly Village Wash	Zone A	Zone A	YES	YES

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER COMMUNITIES AFFECTED BY THIS REVISION

CID Number: 040073 **Name:** Pima County, Arizona

AFFECTED MAP PANELS			AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM*	NO.: 04019C1630 K	DATE: February 8, 1999	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM*	NO.: 04019C1636 K	DATE: February 8, 1999	
TYPE: FIRM*	NO.: 04019C1637 K	DATE: February 8, 1999	

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the base (1-percent-annual-chance) flood discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Sally M. Ziolkowski
Director, Mitigation Division
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, CA 94607-4052
(510) 627-7175

STATUS OF THE COMMUNITY NFIP MAPS

We are processing a revised FIRM for Pima County in our countywide format; therefore, we will not physically revise and republish the FIRM for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the countywide FIRM and FIS report, which present information from the effective FIRMs and FIS reports for your community and incorporated communities in Pima County, were submitted to your community for review on March 22, 2004. We will incorporate the modifications made by this LOMR into the countywide FIRM before it becomes effective.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

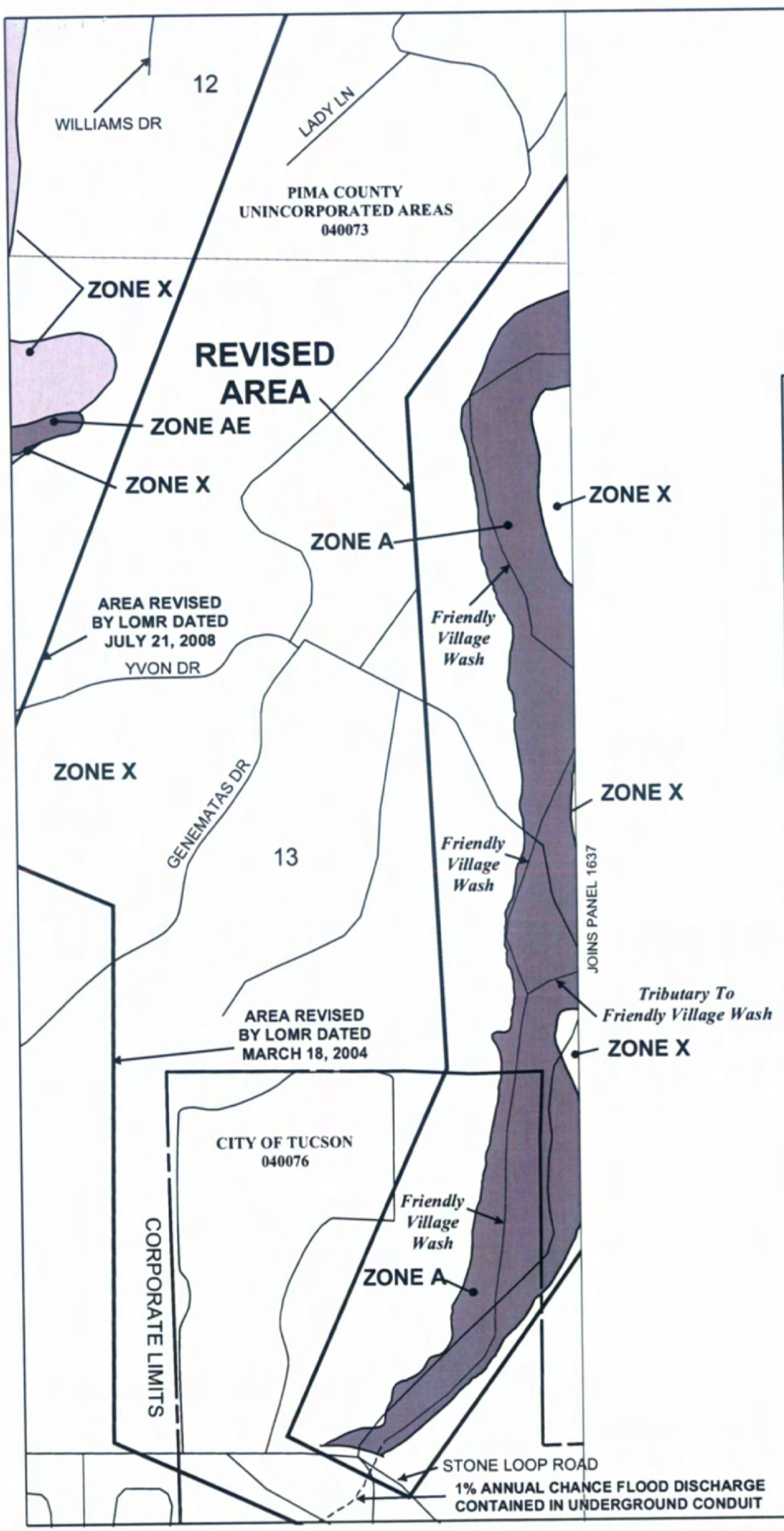
LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

This revision will become effective 30 days from the date of this letter. Any requests to review or alter this determination should be made within 30 days and must be based on scientific or technical data.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate



Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

500 250 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1636 OF 4700

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
TUCSON, CITY OF	040076	1636	K
PIMA COUNTY, UNINCORPORATED AREAS	040073	1630	K

REVISED TO REFLECT LOMR EFFECTIVE: October 23, 2008

MAP NUMBER
04019C1636 K

EFFECTIVE DATE:
FEBRUARY 8, 1999

Federal Emergency Management Agency

Federal Emergency Management Agency

Washington, D.C. 20472

September 23, 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 08-09-0473P
Community Name: Pima County, AZ
Community No.: 040073
Effective Date of This Revision: **October 23, 2008**

The Honorable Richard Elias
Chairman, Pima County
Board of Supervisors
130 West Congress 11th Floor
Tucson, AZ 85701

Dear Mr. Elias:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Oakland, California, at (510) 627-7175, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

For: William R. Blanton Jr., CFM, Chief
Engineering Management Branch
Mitigation Directorate

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

cc: (see attached list)

List of Courtesy Copies – Pima County, AZ

Mr. Michael Zeller, P.E.
Tetra Tech, Inc.

Mr. Andy Dinauer
Department of Transportation
City of Tucson

Mr. Leo M. Smith, P.E.
Floodplain Manager
Pima County Regional Flood Control District

Ms. Suzanne Shields, P.E.
Chief Engineer
Pima County Regional Flood Control District

Mr. R. "Terry" Hendricks, CFM
Chief Hydrologist
Pima County Regional Flood Control District

Mr. Bill Zimmerman
Planning and Development Division Manager
Pima County Regional Flood Control District

Mr. Brian Cosson, CFM
NFIP Coordinator
Office of Dam Safety and Flood Mitigation
Arizona Department of Water Resources

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	Pima County Arizona (Unincorporated Areas)	Culvert	Hydraulic Analysis Hydrologic Analysis New Topographic Data
	COMMUNITY NO.: 040073		
IDENTIFIER	Friendly Village Wash	APPROXIMATE LATITUDE & LONGITUDE: 36.300, -110.970 SOURCE: USGS QUADRANGLE DATUM: NAD 27	

ANNOTATED MAPPING ENCLOSURES			ANNOTATED STUDY ENCLOSURES
TYPE: FIRM*	NO.: 04019C1636 K	DATE: February 8, 1999	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM*	NO.: 04019C1637 K	DATE: February 8, 1999	
TYPE: FIRM*	NO.: 04019C1630 K	DATE: February 8, 1999	

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Friendly Village Wash - from approximately 1,500 feet upstream of Stone Loop Road to approximately 9,700 feet upstream

Tributary to Friendly Village Wash - from the confluence with Friendly Village Wash to approximately 4,200 feet upstream

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Friendly Village Wash	Zone A	Zone A	YES	YES
	Zone X (unshaded)	Zone A	YES	NONE
Tributary to Friendly Village Wash	Zone A	Zone A	YES	YES
	Zone X (unshaded)	Zone A	YES	NONE

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER COMMUNITIES AFFECTED BY THIS REVISION

CID Number: 040076 **Name:** City of Tucson, Arizona

AFFECTED MAP PANELS	AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM* NO.: 04019C1636 K DATE: February 8, 1999	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the base (1-percent-annual-chance) flood discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Sally M. Ziolkowski
Director, Mitigation Division
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, CA 94607-4052
(510) 627-7175

STATUS OF THE COMMUNITY NFIP MAPS

We are processing a revised FIRM for Pima County in our countywide format; therefore, we will not physically revise and republish the FIRM for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the countywide FIRM and FIS report, which present information from the effective FIRMs and FIS reports for your community and incorporated communities in Pima County, were submitted to your community for review on March 22, 2004. We will incorporate the modifications made by this LOMR into the countywide FIRM before it becomes effective.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate

Federal Emergency Management Agency
Washington, D.C. 20472

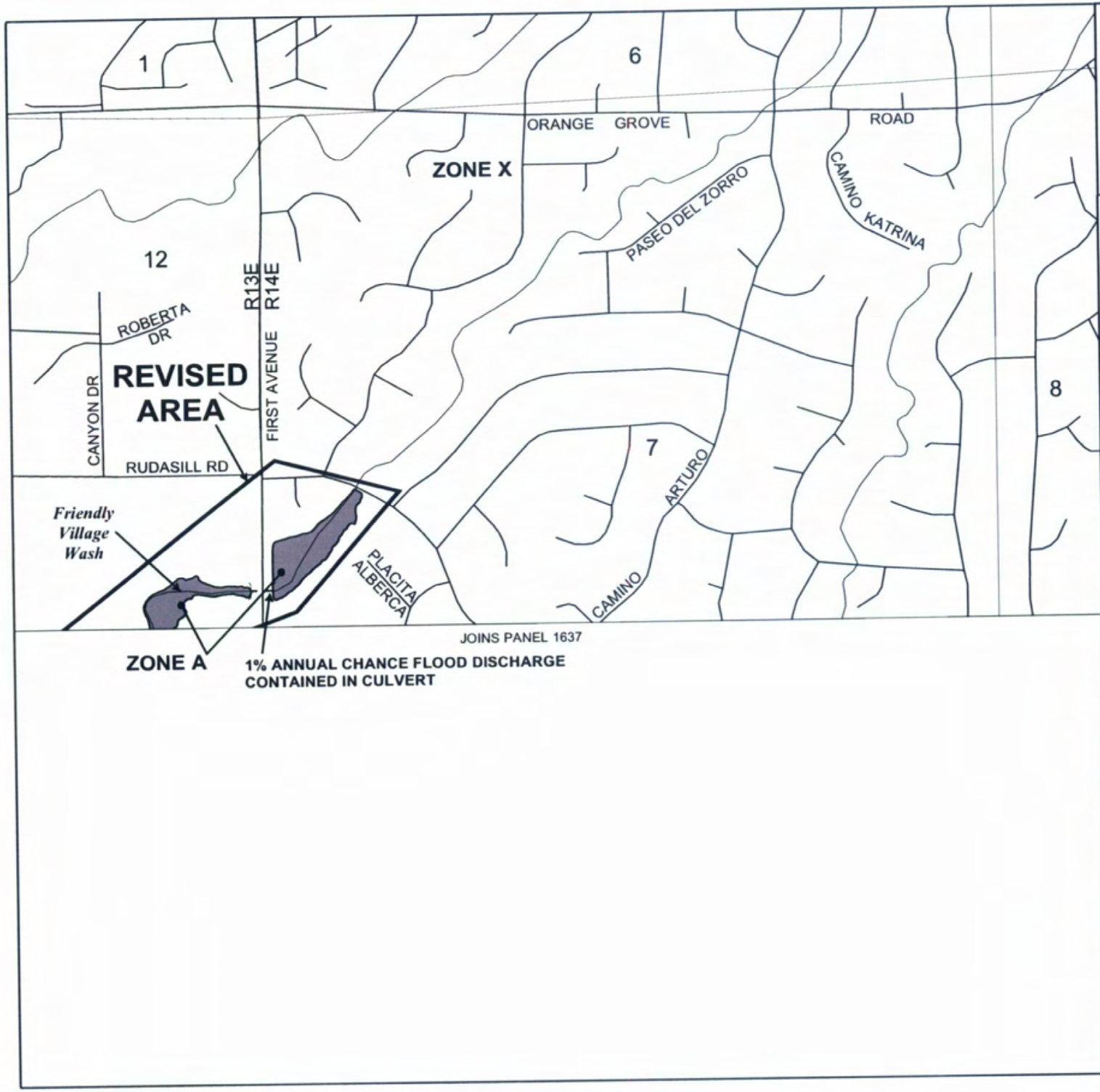
LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

This revision will become effective 30 days from the date of this letter. Any requests to review or alter this determination should be made within 30 days and must be based on scientific or technical data.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Craig S. Kennedy, CFM, Program Specialist
Engineering Management Branch
Mitigation Directorate



Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

1,000 500 0 1,000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1630 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

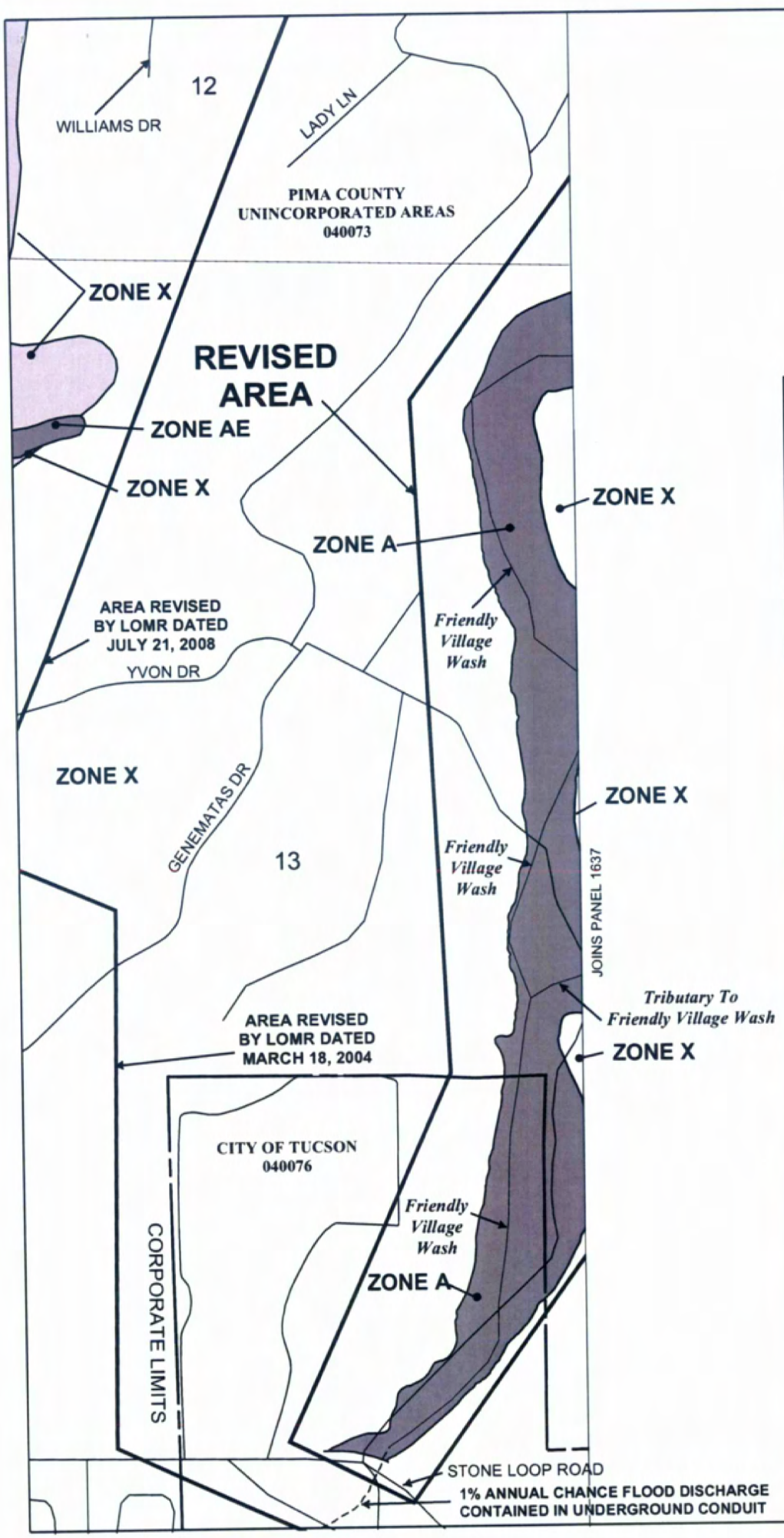
COMMUNITY	NUMBER	PANEL	SUFFIX
ORO VALLEY, TOWN OF	040109	1630	K
PIMA COUNTY, UNINCORPORATED AREAS	040073	1630	K

REVISED TO REFLECT LOMR EFFECTIVE:October 23, 2008

MAP NUMBER
04019C1630 K

EFFECTIVE DATE:
FEBRUARY 8, 1999

Federal Emergency Management Agency



Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

500 250 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1636 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

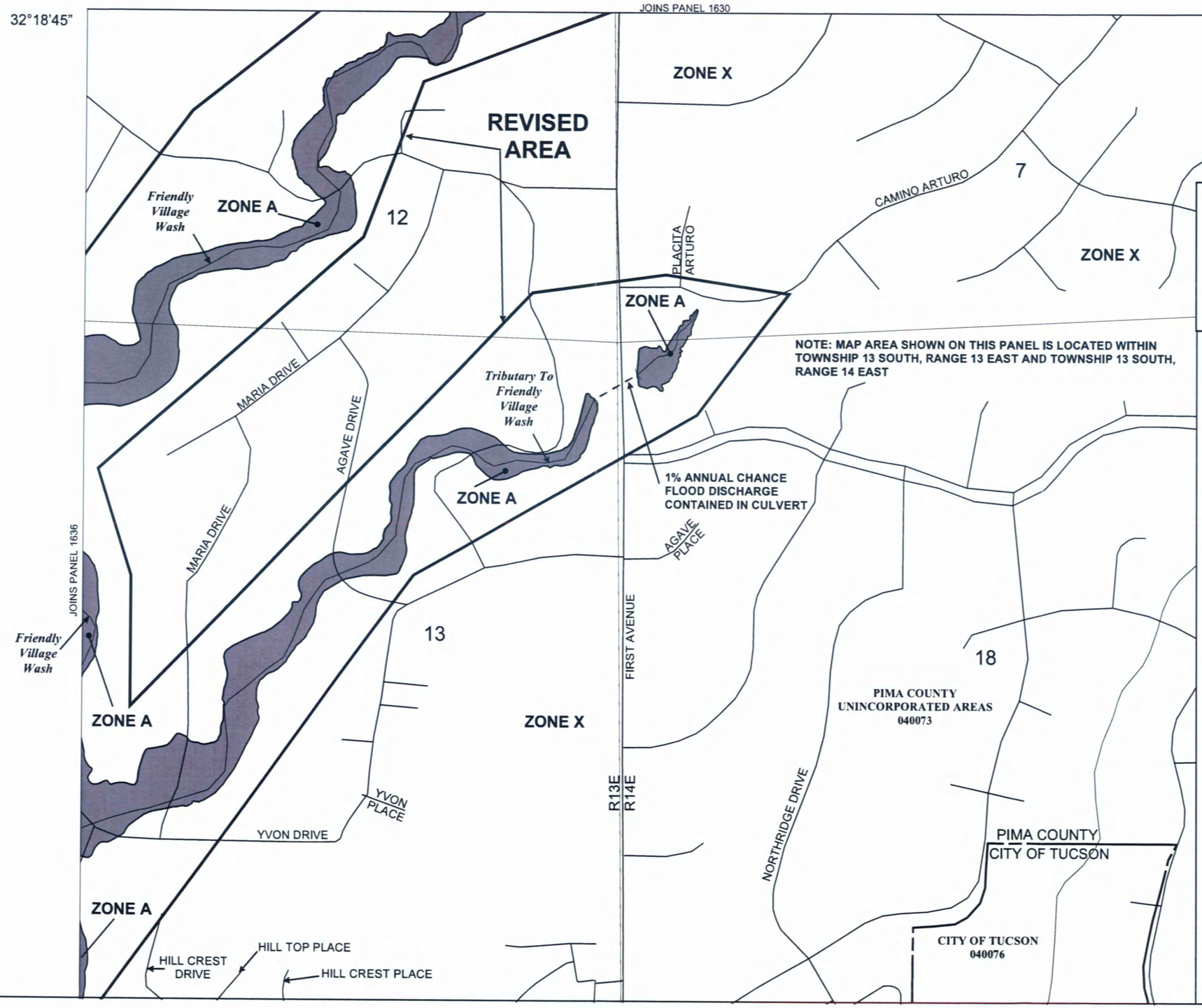
COMMUNITY	NUMBER	PANEL	SUFFIX
TUCSON, CITY OF	040076	1636	K
PIMA COUNTY, UNINCORPORATED AREAS	040073	1630	K

REVISED TO
REFLECT LOMR
EFFECTIVE: October 23, 2008

MAP NUMBER
04019C1636 K

EFFECTIVE DATE:
FEBRUARY 8, 1999

Federal Emergency Management Agency


110°58'07"
32°18'45"
JOINS PANEL 1630
ZONE X
REVISED AREA
Friendly Village Wash
ZONE A
12
7
CAMINO ARTURO
PLACITA ARTURO
ZONE X
ZONE A
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 13 EAST AND TOWNSHIP 13 SOUTH, RANGE 14 EAST
MARIA DRIVE
AGAVE DRIVE
Tributary To Friendly Village Wash
ZONE A
1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
AGAVE PLACE
MARIA DRIVE
JOINS PANEL 1636
FIRST AVENUE
Friendly Village Wash
13
18
PIMA COUNTY UNINCORPORATED AREAS 040073
ZONE A
ZONE X
R13E
R14E
YVON PLACE
YVON DRIVE
NORTHRIDGE DRIVE
PIMA COUNTY
CITY OF TUCSON
ZONE A
HILL CREST DRIVE
HILL TOP PLACE
HILL CREST PLACE
CITY OF TUCSON 040076
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500 250 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
PIMA COUNTY, ARIZONA
AND INCORPORATED AREAS
PANEL 1637 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
TUCSON, CITY OF 040076 1637 K
PIMA COUNTY, UNINCORPORATED AREAS 040073 1637 K
REVISED TO REFLECT LOMR EFFECTIVE: October 23, 2008
MAP NUMBER 04019C1637 K
EFFECTIVE DATE: FEBRUARY 8, 1999
Federal Emergency Management Agency

TETRA TECH, INC.

MEETING MINUTES

PROJECT: FRIENDLY VILLAGE WASH (FVW) LOMR

Subject: Kickoff Meeting
Location: Pima County Regional Flood Control Offices
Meeting Date: 5/22/2007
Time: 9:00 AM

Attendees

Pima County: Terry Hendricks
Tetra Tech, Inc.: Mike Zeller, Jon Elslager, Adam Raczynski

Next Meeting

To be determined.

Action Items

Tentative Target Dates

Task 1:	Data Collection	to be completed by:	06/12/2007
Task 2:	Field Reconnaissance and Survey	to be completed by:	07/06/2007
Task 3:	Hydrologic Analysis	to be completed by:	08/20/2007
Task 4:	Floodplain Delineation	to be completed by:	08/20/2007
Task 5:	Additional Surveys (Preparation of LOMAs)		TBD
Task 6:	District Review	to be completed by:	09/19/2007
Task 7:	Public Notification and Coordination		TBD
Task 8:	Deliverables		TBD
Task 9:	Additional Services		TBD
Task 10:	Monthly Invoicing and Reporting (Billable)		Monthly

Meeting Minutes

1. The kickoff meeting was opened by Terry Hendricks, on behalf of the Pima County Regional Flood Control District (District). Terry led the ensuing discussion regarding the FVW LOMR project. The first order of business discussed was that action items and issues discussed during project meetings be forwarded to Terry Hendricks to ensure that both parties understand and clear up any potential points of confusion in advance.

2. The project timeline was discussed to ensure that there was an understanding regarding the dates and deadlines to be met. It was concluded that the timelines for task completions would start from the date of Tetra Tech's receipt of notice-to-proceed from the District. Terry provided the notice-to-proceed to Tetra Tech at the kickoff meeting (i.e., May 22, 2007).

3. Topographic data and existing differences in District and FEMA elevation needs were discussed. Terry Hendricks stated that the vertical datum to be used for the FVW LOMR Project is not required to be to FEMA's specific needs—this only occurs when modifying

33 North Stone Avenue, Suite 1500, Tucson, AZ 85701-1413
Telephone: (520) 623-7980; Facsimile: (520) 884-5278

FEMA AE and AH Zones. Surveying the site needs to be completed. Ad the topography to be provided needs to be certified as to elevations (surveyor's stamp). This certification can be obtained from Manny Rosas. This is required to be in compliance with FEMA standards.

4. Terry noted that digital FIRM panels will be provided by the County in both ACAD and ESRI formats. A request form and disclaimer for digital FIRM maps will be submitted to the District to receive the files. Projection schemes were then discussed to ensure that both Pima County and FEMA would receive the correct formats. Per Terry, most engineering firms preparing LOMRs for the District use one projection scheme (the District's) to modify elements, and upon completion convert to the other projection scheme (FEMA's). Pima County's projection scheme is to be on the State Plane Coordinate System, Arizona Central Zone, Horizontal Datum NAD83 (feet). FEMA's projection scheme is to be UTM Zone 12, NAD27 (meters). Also, terry noted that PAG photos could be provided at one-half or at 1-foot resolutions.

5. The need for potential LOMAs was discussed in the event that several homes might be included within the newly defined FEMA regulatory flood zone. Terry stated that for those property owners "on the bubble," the option will be given of applying for flood insurance before the LOMR is approved by FEMA (thus potentially reducing insurance costs by up to 50 percent). If LOMAs are required, a letter would need to be submitted to the affected property owners requesting their permission to shoot elevations on their property (within the affected flood zone). Discussion also covered Pima County and FEMA standards for regulatory WSELs, relative to the foundations of houses. It was concluded that the foundations are not required to be 1 foot above base flood elevations, which is a State of Arizona requirement for newly proposed development.

6. Submittal of invoices was then discussed. It is important to submit a properly formatted invoice in order to ensure that there will be no delay of payment. Mike Zeller noted that invoice submittals would be done properly, that the billing schedule would be kept, and that there should not be any problems. Terry noted that Other Direct Costs (e.g., reproduction costs) that exceed $100.00 need proper backup when invoices are submitted. Invoices should be sent to Terry Hendricks and any problems with invoices will be handled by Mike Zeller on Tetra Tech's end.

7. The scope of work was then discussed. It was noted that that the CLOMR/LOMR process in Pima County is generally more complex and involved than in other jurisdictions, with the exception of the City of Phoenix and Maricopa County.

8. It was determined that the newly computerized version of the PC Hydro Method would be used to determine peak discharge rates; and that the method could be refined and modified, if needs be, as long as there is proper justification.

9. In order to ensure accurate HEC-RAS modeling results, a supplemental field survey will be required to properly characterize distribution of FVW flow at locations immediately upstream of and at Stone Loop Drive, before said flow enters a downstream collection inlet. The City of Tucson and PSOMAS have the design plans for hydraulics at the collection inlet, and a request for information may be needed to receive this information. The study limits were also in question, since Exhibit A shows the study limits to extend only to Stone Loop Drive, and no further south of this point. Discussion centered on whether the study limits needed to be extended at certain points to include this area. A LOMR previously prepared for the segment of FVW located south of Stone Loop Drive,

and extending to the Rillito Creek, also has data that could be useful to this project, but because it is older than 1999, there is no case number for this and could be hard to find.

10. Finally, the criteria for modeling 500-year flood was discussed, since it was not clear from reading the scope of work exactly who would receive the modeling results for this larger flood, the District or FEMA (or both). Terry noted that the 500-year event would be modeled separately, strictly for the District's purposes; and thus was to be submitted to the District only, and not to FEMA. Application of the PC Hydro Method would be sufficient for predicting the 500-year flood peak.

This concludes the meeting minutes for Tetra Tech's May 23, 2007, kickoff meeting with the Pima County Regional Flood Control District related to the Friendly Village Wash LOMR Project.

Michael E. Zeller, P.E., P.H.

Michael E. Zeller, P.E., P.H.
Manager—Water Resources Department

TETRA TECH, INC.

MEETING MINUTES

PROJECT: FRIENDLY VILLAGE WASH LOMR

Subject: Progress Report Meeting -- Meeting No. 2
Location: Pima County Regional Flood Control Offices
Date: 6/28/2007
Time: 2:00 PM

Attendees

Pima County: Evan Canfield
Tetra Tech, Inc.: Mike Zeller, Adam Raczynski

Next Meeting

To be determined

Action Items

1. Hydrology for Friendly Village Wash
    a. Basin Factors selected by Tetra Tech are acceptable to District
    b. Percent-Impervious values are acceptable to District
    c. Soil and SCS Curve Numbers are acceptable to District

2. Hydraulics Parameters for formulation of HEC-RAS model for the Friendly Village Wash
    a. District concurs that, with minor adjustments, cross-sections are basically correct in placement, number, and orientation
    b. District concurs with procedure to divide cross-section for use of appropriate Manning's "n" values in the channel, adjacent banks, and overflow areas

Meeting Minutes

1. The hydrology data and information was discussed for Friendly Village Wash to ensure that the correct assumptions and information were used to accurately determine the flood peaks at different locations of the watershed. It was determined that the values that were used were reasonable and acceptable to the District using the upper 90% confidence limit rainfall values contained in PC-Hydro Method, as these values produce flood-peak estimates similar to values predicted by prior analyses performed at the time that the box culverts along 1st Ave between River Road and Rudasill Road were installed.

    Grid analysis of aerial photography was used to estimate percent impervious. This method was acceptable to the District. During the meeting it was noted that the impervious cover for the northeastern portion of the watershed, where 50% impervious was indicated, seemed to be too high. Tetra Tech will re-investigate the area to verify or modify the percentage of impervious cover for that portion of the watershed, and will verify or modify other areas, also, if and as appropriate. The soils types (100% Type B), SCS Curve Numbers, and Basin Factors for the contributing watershed areas were also discussed in detail and all parameter sections by Tetra Tech were accepted by the District.

33 North Stone Avenue, Suite 1500, Tucson, AZ 85701-1413
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2. The hydraulic conditions along the primary watercourses were then discussed in order to arrive at an agreement regarding placement, location, and number of cross sections. There are two areas, however (the junction of the two reaches and upstream of the labeled "West Agave Reach"), were the cross-sections need some refinement/modification. These cross-sections in the noted areas needed to be investigated further to ensure that they are adequate in number and are perpendicular (or nearly so) to flow along the cross section.

   A discussion occurred about the importance of creating a HEC-RAS model for critical or subcritical flow conditions, rather than for supercritical conditions, because FEMA does not accept supercritical flow conditions for alluvial channels.

   A discussion also occurred about the vegetation blocking the west entrance of culvert at Stone Loop. It was determined by Evan that the issue was with the City of Tucson and not the Pima County Flood Control District. Also discussed was the use of FLO-2D to model the watershed in the Stone Loop area. The scope of work, however, does not state that FLO-2D is to be used to model this area.

3. Last, the Manning's "n" values were discussed, in great depth and detail, with the majority of the discussion focusing upon the adjacent bank areas, where there is heavy vegetation lining the banks of the channels, and the more-distant overbank areas. Per Mike, the HEC-RAS analysis would be performed using "n" values of 0.03, 0.06, and 0.045 for the channel, adjacent banks, and the more-distant overbank areas, respectively. The reason for this was to maintain an overall consistency between the Basin Factors used to develop the watershed hydrology and the Manning's "n" used for the hydraulic analysis. After much discussion, it was agreed by Tetra Tech and the District that a typical Manning "n" value of 0.030 would be used for the channel proper, a Manning "n" Value of 0.08 would be used for the adjacent banks, and a Manning "n" value of 0.050 would be used for the more-distant overbank areas—with the understanding that the Manning's "n" values would be increased, as appropriate, at the areas around the culverts, etc., where vegetation was more dense, based upon field investigation and aerial photography. Per Evan, the values at each cross section are also to be subdivided if the depth of the flow in channel is determined to be two times (or greater) than the depth of flow in the overbanks. Mike stated that he felt sure that this would be the case for most locations along the watercourses.

This concludes the meeting minutes for Tetra Tech's June 28, 2007, Meeting No. 2 with the Pima County Regional Flood Control District related to the Friendly Village Wash LOMR Project.

Michael E. Zeller, P.E., P.H.

Michael E. Zeller, P.E., P.H.
Manager—Water Resources Department

C:\WORD00\PROJECTS\PIMA COUNTY PROJECTS\DISTRICT ON-CALL PROJECTS FOR 2006-2007\FRIENDLY VILLAGE WASH LOMR\MTG NO. 2 \MTG MINUTES

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Progress Report Meeting; Meeting No. 3—REVISED MINUTES
Location: Pima County Regional Flood Control Offices
Date: August 24, 2007
Time: 3:00PM

Attendees:

Pima County: Evan Canfield
Tetra Tech: Mike Zeller, Adam Raczynski

Next Meeting

Date: September 21, 2007
Time: 1:00 p.m.

Action Items

1. Evan will determine the future process, if any, that is to be followed regarding the "breakout" flow at Stone Loop into the commercial area located to the southeast.

2. Evan discussed Tetra Tech's request to use funds from the direct cost budget to cover costs that might go over on other tasks associated with the project. Evan will investigate whether it is possible to do this.

3. Evan will contact the City of Tucson regarding the process for notifying the public of the new floodplain delineation emanating from this study.

4. Evan will investigate how the LOMR submittal will be paid. There was discussion as to whether Tetra Tech would be given the money to submit the LOMR package or whether the LOMR package should be given to the District and submitted. In any event, per Item 6.4 of the scope of work Pima County will pay the LOMR submittal fees.

5. Tetra Tech will forward an electronic version of the HEC-RAS model to Evan for review the week of September 4, 2007.

6. Tetra Tech will prepare the draft LOMR package and Technical Data Notebook prior to the next regularly scheduled project meeting, to beheld on September 21, 2007.

Meeting Minutes

1. The meeting minutes of June 29, 2007, were discussed to review tasks and ideas that were previously discussed at the last meeting to ensure that there had been forward movement on specific issues.

2. Hydrology for the Friendly Village Wash (FVW) was discussed, again, to ensure that the correct variables were being assumed. Per the last meeting, the impervious factors were deemed "too high," and needed to be refined. Based upon a more precise investigation, the new impervious values were acceptable. The hydrology results using the refined impervious values still produce a regulatory flood peak that is more or less in agreement with the peak discharge originally predicted by Stantec when the culverts were installed at First Avenue. This agreement provides

33 North Stone Avenue, Suite 1500, Tucson, AZ 85701-1413
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assurance that the newly calculated peak-discharge values are reasonable. There was also some discussion about the 90% UCL for the NOAA Atlas for this area (i.e., for some foothills areas, regulatory rainfall is 0.6" higher than NOAA Atlas 2, Volume VIII values), which led into conversation about the accuracy of the NOAA rainfall data, and eventually led into discussion about calculating a 500-year peak discharge. There was brief discussion regarding designing critical facilities (hospitals, etc.) so that they are protected from a 500-year flood event.

3. Floodplain delineation for the FVW was then discussed in great depth. Tetra Tech's use of FLO-2D as a calibration technique was a concern for Evan, since its use was not in the scope of work, but Evan stated that as long as Tetra Tech feels they can remain under budget it was acceptable for Tetra Tech to use FLO-2D to more accurately determine the location of cross sections to best characterize the width of the floodplain. A 10-foot-grid model of FLO-2D was acceptable, because a more densified grid model would "choke" the model and create much, much longer run times. At the start of the project, the District had expressed concern regarding a potential break out of flood flows to the west along Stone Loop. However, both HEC-RAS and the FLO-2D calibration model indicate that flood flows will break out into the commercial center located to the east of the FVW, and south of Stone Loop. It was determined that this break out is a City of Tucson issue, and Evan would need to look further into this break out issue.

   Per task 4, the cross-sections were reviewed in order to ensure that they were as accurate as possible. Evan was given a cross-section location map, as well as FLO-2D data maps, in order to comply with this task requirement. There was some discussion about the transmittal of electronic copies of Tetra Tech work products for review. Mike's concern was that giving out electronic versions ("live copies") of the cross-sections allows for the possibility of alterations to something other than what would be submitted under one's professional seal. Evan noted that the effective model will be required for any future LOMRs. The electronic model will need to be available for this purpose, and he believes that this is standard practice.

4. The need for additional LOMAs was then discussed, and it was agreed that Tetra Tech would determine what homes were in the floodplain, in order to prepare additional surveyed LOMAs and submit them to FEMA as expeditiously as possible.

5. The preparation of a Technical Data Notebook (TDN) was then discussed. It was determined that if the FEMA guidelines were followed, this would be generally acceptable for meeting State and Pima County standards. To assure this, State Standard Guidelines (SS1-97) will be used. The TDN submittal date is September 19, per Task 6 of the scope of services, to accommodate District review time.

6. Budget was briefly discussed, with some "house-keeping" issues. There was a typo on the billing rates, but there was no concern because no time was charged to the incorrect rate. The incorrect rate has been corrected by Tetra Tech. There was also some discussion on exceeding time and budget on individual tasks. Evan noted that, to cover line item overruns, $55 was transferred from Task 8 to Task 1; $112 was transferred from Task 8 to Task 2; and $11 was transferred from Task 8 to Task 5. These transfers were agreed to by Finance and Procurement. Evan noted that Line Item 8 will have $12,126 instead of the original $12,304. Mike again proposed the idea of using the direct cost budget to cover the excess time (as long as the entire budget was not exceeded).

Michael E. Zeller

Registered Professional Engineer (Civil)
CERTIFICATE NO.
12481
MICHAEL E.
ZELLER
Date Signed 08/29/07
ARIZONA, U.S.A.

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Progress Report Meeting; Meeting No. 4
Location: Pima County Regional Flood Control Offices
Date: September 21, 2007
Time: 1:00PM

Attendees:

Pima County: Evan Canfield
Tetra Tech: Mike Zeller, Adam Raczynski

Next Meeting

Date: Friday, October 5, 2007
Time: 1:00 PM

Action Items

1) Evan is to investigate the change order for the LIDAR, but also to investigate the addition of the FEMA submittal fee. The addition of the FEMA submittal fee will allow Tetra Tech, Inc to submit the LOMR.

2) Maps will be revised to stop the floodplain at Stone Loop Road and not the Stone Loop Road Culvert, per scope of work. Evan will confer with the city of Tucson to let them know of potential problems that may arise.

3) Evan will forward 2005 Orthographic photos of the Friendly Village Wash and also parcel bay shape files for the Friendly Village Wash. This is to overlay the floodplain with the parcel bays to determine which properties are in the floodplain.

4) After which, Evan will provide the "Right of Access" letter to any person(s) that are found to be in the floodplain.

5) The technical data notebook (TDN) will be updated with the comments and suggestions made by Evan.

Meeting Minutes

1) The first item on the agenda for the meeting was to discuss the meeting minutes from the previous meeting (August, 24, 2007). In doing so, the first item discussed was the "break out" flow occurring at the Stone Loop Road intersect. The finished floor elevation of the "On the Border" restaurant was determined at 2324.32'. It was unknown, however, if this elevation would be above the 100-year peak discharge due to the fact that the restaurant was an undisclosed distance downstream of the Stone Loop Road culvert. Terry had suggested that the "break out" flow here should be mapped into the floodplain as a shaded Zone X. Per the scope of work, however, the area downstream of the Stone Loop Road intersect is not to be mapped. After much discussion and clarification of the study limits, it was determined that the "break out" flow would not be mapped on the FVW LOMR, due to the fact that it was outside of the study limits listed in the scope of work. It was brought forth that Evan will contact the City of Tucson to discuss the possible complications that may arise due to this "break out" flow.

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2) The second action item from the previous meeting, *"Evan discussed Tetra Tech's request to use funds from the direct cost budget to cover costs that might go over on other tasks associated with the project. Evan will investigate whether it is possible to do this,"* was determined to have been completed.

3) The third action item from the previous meeting, *"Evan will contact the City of Tucson regarding the process for notifying the public of the new floodplain delineation emanating from this study,"* has not been completed and it was decided that Evan will proceed.

4) The fifth action item from the previous meeting, "Tetra Tech will forward an electronic version of the HEC-RAS model to Evan for review the week of September 4, 2007," was not completed. There was confusion on the agreement that was made at this meeting. Mike was under the impression that Evan was to receive these electronics documents at the conclusion of the LOMR submittal. The confusion and concern was again over the "live" documents and possible amendments to this data. After discussion, it was agreed upon that Evan would receive the electronics documents and that the compact disc would be labeled with the disclaimer "Preliminary: Not for Construction."

5) Per (1) of the action items of this memo, Evan will investigate the addition of the LOMR submittal fee to the LIDAR change order. The change order for the LIDAR should be in the range of $6000 and Evan will investigate and acknowledge Mike with the relevant information.

6) Potential LOMAs where then discussed in great depth. There was concern on using a Zone A LOMR without detailed water surface elevations to complete LOMAs. Since there are no water surface elevations for the LOMR, it was questioned if FEMA would allow this study to be used for the potential LOMAs. Per Terry, he had accomplished this before and FEMA had no issues with this. It was then determined that the orthophotography provided by Evan would allow the overlay of the floodplain onto the parcel bay map and the aerial map to best display the LOMR for investigation of the LOMAs. It was also determined that Tetra Tech, Inc was to proceed on the investigation of the LOMAs for the FVW.

7) After receiving the comments and suggestions back from Evan regarding the Technical Data Notebook (TDN), it was determined that Tetra Tech, Inc was to proceed with the amendments and complete the TDN. One concern of Evan's was the use of the term "super critical flow" in the TDN. It was discussed that this was not a specification of the flow used in the floodplain delineation but rather a statement regarding that indeed FVW was super critical in flow and modeled as subcritical. This was to be amended for clarification in the TDN.

8) The submittal of the work maps was then discussed. It was determined that Pima County desired the shape file (.shp) and drawing file (.dwg) from Tetra Tech, Inc for their archives. Although the scanned image (TIF) that would be provided to FEMA with the LOMR would be okay, it was suggested that Tetra Tech, Inc investigate other methods of providing the work maps in the UTM (FEMA) projection.

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Progress Report Meeting; Meeting No. 4
Location: Pima County Regional Flood Control Offices
Date: October 11, 2007
Time: 1:00PM

Attendees:

Pima County: Evan Canfield, Terry Hendricks
Tetra Tech: Mike Zeller, Adam Raczynski

Next Meeting

Date: TBA
Time: TBA

Action Items

1) Adam will create a list of homes that are now within the projected regulatory floodplain and that are now no longer in the projected regulatory floodplain.

2) Adam will create an 8.5" x11" exhibit denoting the new projected regulatory floodplain, with a background that includes a parcel map and the existing FEMA floodplain. This exhibit is to be sent out by Evan, via standard mailing, to the homeowners within the project study limits.

3) Evan will ask Terry for a template for the notification to the public via the city newspaper(s). However, Terry provided the template to Tetra Tech via e-mail, not long after the end of the meeting.

4) Evan will check the provided CD to ensure that all the data he needs is included, and will contact Adam if there are any missing files.

5) Mike will ask Ernest what the difference in cost would be to survey the FFE on the seven (7) homes now included in the floodplain rather than the six (6) that were originally projected in the scope of work.

Meeting Minutes

1) The first item discussed was the FEMA Map Fee, which was to be included in the submittal of the LOMR. Per Evan's review of the FEMA guidelines, it appears that there will be no need to include a fee with the submittal to FEMA. However, if the LOMR submittal were to come back as unapproved, due to non-submittal of the fee, Pima County would then supply the necessary fee.

2) The second item discussed was the LOMA package. The existing homes to be included in, and the existing homes to be removed from, the floodplain were categorized and reviewed to ensure that the process was done correctly. After review of the potential LOMAs, it was noticed that while some homes were directly within the floodplain, others might or might not be; and the owners would thus need to be notified of the possibility that they were indeed within the floodplain and might want to buy flood insurance. Also, per the scope of work, moneys were to be included

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for the survey of six (6) FFEs rather than the seven (7) that were found to be within the projected floodplain. Mike stated that he felt there would not be a problem surveying 7 rather than 6 FFEs of homes, because of their vicinity to one another.

3) The third item discussed was the need for a letter to be sent to the affected homeowners notifying them that they will need to have the FFEs of their homes determined to establish whether the homes are in or out of the projected regulatory floodplain. Mike suggested that a certified or registered letter should be sent by the District. Such a letter would better serve as formal notification, rather than a letter from Tetra Tech, Inc. It was agreed that Evan would do this, based upon the list of affected homes and homeowners that Adam would be sending to him.

4) The fourth item discussed was the exhibit that was to be included with the letter from the District notifying the homeowners within the study limits that the floodplain was projected to change. Per Evan, only the study limits were to be included, and should fit on a 8 ½" x 11" sheet of paper.

5) Lastly, a discussion ensued about the entities to which the public notification (via newspaper) should be submitted. After much discussion, it was agreed that the notification should be sent only to the Arizona Daily Star and the Tucson Citizen, and was only to be submitted for publication one time, and one time only. The letter was to be prepared following a template format provided by Evan, via Terry.

6) The work maps (.pdf) and HEC-RAS files were then submitted to Evan. This was per his request, so he could review the work products to ensure accuracy and correctness.

The meeting ended shortly before 2:00 p.m.

Michael E. Zeller

Registered Professional Engineer (Civil)
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MICHAEL E.
ZELLER
Date Signed 10/19/07
ARIZONA, U.S.A.

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Progress Report Meeting; Meeting No. 6
Location: Pima County Regional Flood Control Offices
Date: November 16, 2007
Time: 10:00 AM

Attendees:

Pima County: Evan Canfield
Tetra Tech: Mike Zeller, Adam Raczynski

Next Meeting

Date: TBA
Time: TBA

Action Items

1) Evan will contact Steve Tineo at the City of Tucson to ensure that the mapping completed is acceptable to the City. Evan will also coordinate with Steve concerning who at the City will sigh off on the Community Acknowledgement Form.

2) Evan will review the submitted "parcel map" that displays the new and old floodplains delineated, and ensure that all homes have been included in the notifications.

3) Work will be continued on the Friendly Village Wash LOMR TDN submittal, and the package will be completed upon verification by the Tetra Tech Survey Department that the LIDAR data is accurate enough to meet FEMA standards.

Meeting Minutes

1) The first item discussed concerned verification of the LIDAR data. The verification survey is nearly complete, with the exception of elevation points being determined for locations within the channels of the FVW. At this point, the LIDAR data appears to be acceptable, and thus will meet FEMA standards (with the exception of the remaining verification of the aforementioned points). Upon completion of the LIDAR-survey verification, the LOMR package will be completed and submitted to FEMA for its review.

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2) The second item discussed was the notification process. The Arizona Daily Star had quoted a price of $85.08 for a one-day publication. The Tucson Citizen did not respond to requests for a one-day price to publish. Per Evan, the District notification was only sent to the homeowners that would be mapped into the floodplain. After the LIDAR data analysis and verification process has been completed, the homeowners who will be mapped out of the floodplain will be notified.

3) The third item discussed was the schedule for the LOMR submittal. Everything is near completion, and all that remains is verification of the LIDAR data. After the survey and LIDAR verification is completed, the LOMR package can be finalized and submitted to the PCRFCD/City of Tucson for Community Acknowledgment, and then to and to FEMA for its review. MT2 forms will need to be completed and provided to Andy Dinauer (COT) and Suzanne Shields (PCRFCD) for their approval. The MT2 forms will be completed by Tetra Tech, Inc.

The meeting ended shortly before 11:00 a.m.

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Pima County Regional Flood Control District

REQUEST FORM AND DISCLAIMER FOR DIGITAL FIRM MAPS

Revised June 13, 2006

In an effort to minimize digital floodplain boundary errors, the Pima County Regional Flood Control District (District) will provide digital copies of the Flood Insurance Rate Maps (FIRMs) by panel number when requested via Email or FAX. The digital information will be in either the ArcView or AutoCAD format with the correct projection controls. The ArcView format is preferred. AutoCAD files will be delivered in 2004 format, unless requested otherwise upfront. The digital data will contain the FIRM panel(s) in both the Federal Emergency Management Agency (FEMA) and the District's projection schemes.

The FIRM panel data will include the following layers (Some layers may not be present in a given FIRM panel):

- ❑ FIRM Panel Boundary
- ❑ Flood Zones
- ❑ Floodways
- ❑ Base Flood Elevations
- ❑ Cross-sections
- ❑ FEMA Stream Lines (when available)

- ❑ LOMR Boundaries
  - The District may not have complete LOMR information within the City of Tucson, Town of Oro Valley and Town of Marana

- ❑ LOMAs (Letters of Map Amendment)
  - The District does not have any LOMA information within the City of Tucson, Town of Oro Valley and Town of Marana

- ❑ PLSS Section Boundaries
- ❑ Jurisdictional Boundaries
- ❑ Parcel Boundaries (not available in outlying areas)
- ❑ Street Network (not available in outlying areas)

Digital parcel boundaries and street network information will not be available for those areas of Pima County that have not gone through the parcel orthophoto-rectification process.

Digital LOMR CLOMR data in AutoCAD submitted for review by the local communities must be in version 2000 or earlier.

TERMS

By signing the request below, users of this information acknowledge that it is not guaranteed to be accurate, correct or complete; conclusions drawn from such information are the responsibility of the user. While every effort is made to ensure the accuracy and correctness, the District assumes no responsibility for errors or omissions, even if Pima County is advised of the possibility of such damage.

Users understand and acknowledge that the digital FIRM data is subject to constant change and its accuracy cannot be guaranteed. All data is provided AS IS, with all faults, and without warranty of any kind, either expressed or implied.

The data provided might have a number of errors, which may include, but are not limited to, the following:

- Spatial Errors: The areas depicted are approximate, and are not necessarily accurate to surveying or engineering standards. X/Y coordinates may be in error by several hundred feet or more. Parcel lines may not be in the right location.
- Registration Errors: GIS data layers may not overlay each other correctly.
- Attribute Errors: Database information may be incorrect.
- Currency Errors: GIS data layers, databases and documents may not be the most current available or may not depict the specified time. All data is subject to constant change. Data input lags real-world changes by varying periods of time.
- Completeness Errors: Data may be missing or data may be included that does not belong. Letters of Map Revisions (LOMRs) and Letters of Map Amendments (LOMAs) for incorporated cities and towns is incomplete. Users of this data are encouraged to check with local Floodplain Management Agency for LOMR and LOMA information.
- Projection Distortion: All map projections introduce distortion by representing the irregular shape of the earth's surface on flat maps. This affects feature shapes, angles, map distance, and areas.
- Calculation Errors: Results of calculations may not be exact due to rounding, precision of stored values or algorithm differences.
- Representation Errors: Maps or other displays may not properly represent the data. For instance, a white line on a white background would appear as if it wasn't there. Color-coded ("themed") map layer colors and categories may not match the current range of data values. Data may be displayed at an inappropriate scale.

In no event shall Pima County become liable to users of digital Flood Insurance Rate Map data, or any other party, of any loss or direct, indirect, special, incidental or consequential damages, including but not limited to, time, money or goodwill arising from the use or modification of the data.

I certify that I have read, understand, and agree to the terms as stated in this request.

Signature of Requestor	Jonathan Elslager **Requestor's Name (printed)**
5-22-2007 **Date**	Hydrologic/Hydraulic Designer **Requestor's Title**
Tetra Tech, Inc. **Organization Name**	520-623-7980 **Contact Number**
Jon.Elslager@tetratech.com **E-mail Address**	1636, 1637 **FIRM Panel(s) requested (Use last 4 numeric digits)**

Digital data is requested in ☑ **AutoCAD format** ☑ **ESRI format**
Please FAX this form to (520) 243-1821, or e-mail a signed scanned copy (in Adobe Acrobat) to Terry.Hendricks@dot.pima.gov

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Task 1, Data Collection
Date: 6/13/2007

Action Items

Tentative Target Dates

Task 1:	Data Collection		*Completed*
Task 2:	Field Reconnaissance and Survey	to be completed by:	07/06/2007
Task 3:	Hydrologic Analysis	to be completed by:	08/20/2007
Task 4:	Floodplain Delineation	to be completed by:	08/20/2007
Task 5:	Additional Surveys (Preparation of LOMAs)		TBD
Task 6:	District Review	to be completed by:	09/19/2007
Task 7:	Public Notification and Coordination		TBD
Task 8:	Deliverables		TBD
Task 9:	Additional Services		TBD
Task 10:	Monthly Invoicing and Reporting (Billable)		Monthly

Task 1: Data Collection

Data (with Date Requested and Collected):

1. Flood Insurance Rate Maps (ACAD and ESRI formats)
    a. Date Requested: 05/22/2007
        i. The D-FIRM data for Panels 1630, 1636 and 1637, in both the FEMA and local projections and in both ESRI and AutoCAD formats.
        ii. The PAG 2005 1 foot and 0.5 foot resolution photograph for Sections 12 and 13 Township 13 South Range 13 East. And the same for Sections 7 and 18 Township 13 South Range 14 East (local projection only)
        iii. The PAG 2005 LiDAR data for the area covered by the attached shapefile.
    b. Date Received: 05/30/2007

2. Additional Topography
    a. Date Found: 06/01/2007
    b. Pima County Map Guide: Topography 1998 - NAVD88
        i. 2 ft Contours
        ii. Quicker access to view the Friendly Village Wash

3. Hydrological and Wash Data
    a. Date Found: 06/04/2007
    b. Soil Types for the Friendly Village Wash
    c. City of Tucson Stormwater Map (online resource)

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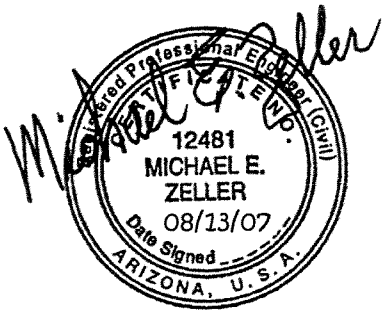
4. Additional Aerial Photography
    a. Date Found: 06/04/2007
    b. Per Pima County: Microsoft Virtual Earth "Bird's-Eye View"
        i. View and Evaluate the area
        ii. Determine the Manning's "n" values for the channel and overbanks

5. Paving Improvement Plans
    a. Tucson Department of Transportation
        i. Date Found: 06/04/2007
        ii. River Road Plan sheets (I-91-036)
    b. Pima County Department of Transportation
        i. Date Found: 06/12/2007
        ii. 1st Ave Plan Sheets (Work Order 4BFROG)



TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Task 2, Field Reconnaissance and Survey
Date Completed: 07/06/07

Action Items

Tentative Target Dates

Task 1:	Data Collection		*Completed*
Task 2:	Field Reconnaissance and Survey		*Completed*
Task 3:	Hydrologic Analysis	to be completed by:	08/20/2007
Task 4:	Floodplain Delineation	to be completed by:	08/20/2007
Task 5:	Additional Surveys (Preparation of LOMAs)		TBD
Task 6:	District Review	to be completed by:	09/19/2007
Task 7:	Public Notification and Coordination		TBD
Task 8:	Deliverables		TBD
Task 9:	Additional Services		TBD
Task 10:	Monthly Invoicing and Reporting (Billable)		Monthly

Task 2: Field Reconnaissance and Survey

1. Manning's "n" values
    a. Dates Researched: 6/10/2007 thru 6/29/2007
        i. Microsoft Virtual Earth used to view the study area from a "bird's eye" view
        ii. Ground Photos taken at road/river intersections throughout the study area to not impose on private property
        iii. Per meeting on June 28, 2007 with Evan Canfield:

        "Manning "n" value of 0.030 would be used for the channel proper, a Manning "n" value of 0.08 would be used for the adjacent banks, and a Manning "n" value of 0.050 would be used for the more-distant overbank areas-with the understanding that the Manning's "n" values would be increased, as appropriate, at the areas around culverts, etc., where vegetation was more dense, based upon field investigation and aerial photography."

        "Per Evan, the values at each cross section are also to be subdivided if the depth of the flow in the channel is determined to be two times (or greater) than the depth of the flow in the overbanks."

2. Structure Information
    a. Tucson Department of Transportation
        i. Date Found: 06/04/2007
        ii. River Road Plan sheets (I-91-036)
    b. Pima County Department of Transportation
        i. Date Found: 06/06/2007
            1. Plan Number: 4BROFA

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2. Plan Name: River Road Landscaping – 15th to 1st Av
    a. Sheet R34 and D4 show the culvert at Stone Loop.

ii. Date Found: 06/12/2007
1. Plan Number: 4BFROG
2. Plan Name: 1st Av – River Rd to Orange Grove
    a. Sheets R51 and D25 show the culvert located at the northeastern boundary of the study area.
    b. Sheets R47 and D23 show the culvert located along the eastern edge of the study area.

3. Hydrological and Wash Data
    a. Date Found: 06/04/2007
        i. Soil Types for the Friendly Village Wash
        ii. City of Tucson Stormwater Map (online resource)
    b. Date Found: 06/21/2007
        i. Vegetative Cover/Geology
        ii. Field Visit and Microsoft Virtual Earth used to view the study area from a "bird's eye" view
    c. Date Found: 06/06/2007
        i. Rainfall Data
        ii. PC-Hydro Method from the NOAA Atlas 14 and the latitude and longitude of the centroid

4. Survey Data
    a. Aerial Topography
        i. Date Received: 05/30/2007
            1. This is the data per *Task 1 Memo*
    b. Ground Survey
        i. Dates Performed: 06/21/2007 and 06/22/2007
            1. Survey the surrounding area at the Stone Loop Culvert

TETRA TECH, INC.

MEMO

PROJECT: Friendly Village Wash LOMR

Subject: Task 3, Hydrologic Analysis Completion;
Task 4, Floodplain Delineation (location of cross-sections submittal completed)

Date Completed: 8/20/07

Action Items

Tentative Target Dates

Task 1:	Data Collection		*Completed*
Task 2:	Field Reconnaissance and Survey		*Completed*
Task 3:	Hydrologic Analysis		*Completed*
Task 4:	Floodplain Delineation		*in progress*
Task 5:	Additional Surveys (Preparation of LOMAs)		TBD
Task 6:	District Review	to be completed by:	09/19/2007
Task 7:	Public Notification and Coordination		TBD
Task 8:	Deliverables		TBD
Task 9:	Additional Services		TBD
Task 10:	Monthly Invoicing and Reporting (Billable)		Monthly

Task 3: Hydrological Analysis

1. PC-Hydro
   a. Dates Researched: 6/6/2007 thru 6/30/2007
      i. Per meeting on June 28, 2007 with Evan Canfield, Mike Zeller stated:

         "The percent impervious for the northeast portion of the Friendly Village Wash Watershed appeared to be too high, and that this variable was to be re-defined."

      ii. The 500 and 100 year events have been calculated using the PC-Hydro method and the NOAA Atlas 14 (90% UCL) for the centroid latitude and longitude.

Task 4: Floodplain Delineation

1. Locations of Cross Sections
   a. Dates Researched: 6/6/2007 thru 8/15/2007
      i. Per Scope of Services:

         "Plans showing the location and alignment of cross-sections and the channel centerline will be submitted to the District for review and approval, prior to digitizing the cross-section data, and within 90 days [August 20, 2007] of receipt of notice-to-proceed from the District."

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ii. Per meeting on June 28, 2007 with Evan Canfield:
"The cross sections look good; with the exception of the junction of the two washes (located about 2000' from the Stone Loop culvert) and the switchback area on the western wash. These areas should be looked at closer and cross sections better defined."

iii. Per Evan's approval, the cross sections, in the problem areas, were corrected to best represent the floodplain, all else remained the same.

APPENDIX C: SURVEY FIELD NOTES

TETRA TECH, INC.

The accuracy of the lidar data was verified using the methods described in sections A.3, A.4 and A.8 of the *FEMA Guidelines and Specifications for Flood Hazard Mapping Partners* (April, 2003). Ground cover categories (1) bare-earth and low grass and (5) urban area, roadways were evaluated. A total of 493 points were compared. The difference was determined to be 0.2 feet (median value).

A total of 506 points were collected throughout the area defined by the 100yr flood limit (TetraTech Job 0939-FVW-LOMR) plus an additional 300 feet, from Stone Loop northeasterly to North 1st Avenue, all within Section 13, T13S, R13E and Section 18, T13S, R14E. The survey utilized a GPS/RTK base and receiver, localized on survey monuments with Arizona State Plane, Central Zone NAD83 coordinates (horizontal) and orthometric heights relative to NAVD88, published by the Pima Association of Governments (PAG). The field survey was conducted in October and November of 2007. A total of 13 points were discarded due to man-made changes in the ground surface or insufficient satellite reception.

The surface used for this survey was provided by Pima County Flood Control as lidar point file (13S13E13) using LAS format and a XYZ point cloud covering the approximate same area. A TIN was created using ArcGIS 9.2 3D Analyst and elevations extracted at locations as determined per the field survey and differences between the two were calculated.

It was found that accuracy of the lidar surface was within the two-foot equivalent contour interval ($accuracy_z$ = 1.2 foot at the 95-percent confidence level) criteria specified by FEMA. The actual ground elevation was higher then the lidar surface by an average of 0.2 feet, with a min/max range of 1.1 feet. The verification demonstrates that the lidar surface meets the criteria for lidar compliance specified in sections A.3, A.4 and A.8 of FEMA Guidelines and Specifications for Flood Hazard Mapping Partners.

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
15887
JOHN B.
LYNCH
DATE SIGNED 11/30/07
ARIZONA U.S.A.

Tetra Tech Job Number: 0939 Friendly Village Wash LOMR

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APPENDIX D: HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTS

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR
Project Name: Friendly Village Wash LOMR | Date: 6/5/2007
Concentration Point: Stone Loop Inlet Structure | Job #: P09039

Watershed Area: 743.0 ac Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	140.0	2,771	0.0505	.038
2	120.0	6,892	0.0174	.038
3	80.0	3,553	0.0225	.038
4	85.0	4,314	0.0197	.038

Length of Watercourse (Lc): 17,530 feet Mean Slope: 0.0217
Length to Cen. of Gravity (Lca): 8,765 feet Weighted Basin Fac.: 0.038
Veg. Cover Type(s): Desert Brush Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9617

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.88	1.35	1.67	2.24	2.78	3.09	3.24	3.51	3.81	4.39
Areal Values (in)	0.88	1.35	1.67	2.24	2.78	3.09	3.24	3.51	3.81	4.39

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	91	82.	86.64	0.548
C	9	87.	90.25	0.649
D	0	.	.	0.000
Imp.	20	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.637
Time of Concentration: 44.4 min
Rainfall Intensity (i) @ Tc: 3.38 in/hr
Runoff Supply Rate (q) @ Tc: 2.15 in/hr

PEAK DISCHARGE: 1,610 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash LOMR | Date: 6/6/2007

Concentration Point: Point A | Job #: P09039

Watershed Area: 114.4 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	2,010	0.0209	.038
2	52.0	1,898	0.0274	.038
3	40.0	1,466	0.0273	.038
4	40.0	1,627	0.0246	.038

Length of Watercourse (Lc): 7,001 feet | Mean Slope: 0.0246

Length to Cen. of Gravity (Lca): 3,150 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9528

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.89	1.35	1.68	2.26	2.80	3.11	3.27	3.54	3.85	4.41
Areal Values (in)	0.89	1.35	1.68	2.26	2.80	3.11	3.27	3.54	3.85	4.41

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	86.69	0.551
C	5	87.	90.29	0.652
D	0	.	.	0.000
Imp.	25	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.656

Time of Concentration: 18.8 min

Rainfall Intensity (i) @ Tc: 5.84 in/hr

Runoff Supply Rate (q) @ Tc: 3.83 in/hr

PEAK DISCHARGE: 442 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 6/6/2007

Concentration Point: Point B | Job #: P09039

Watershed Area: 266.6 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	90.0	1,619	0.0556	.038
2	40.0	1,230	0.0325	.038
3	80.0	4,688	0.0171	.038
4	50.0	1,703	0.0294	.038

Length of Watercourse (Lc): 9,240 feet | Mean Slope: 0.0241

Length to Cen. of Gravity (Lca): 5,210 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3228 Longitude: 110.9501

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.89	1.36	1.69	2.27	2.81	3.14	3.30	3.58	3.90	4.47
Areal Values (in)	0.89	1.36	1.69	2.27	2.81	3.14	3.30	3.58	3.90	4.47

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	96	82.	86.71	0.553
C	4	87.	90.3	0.653
D	0	.	.	0.000
Imp.	45	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.737

Time of Concentration: 24.1 min

Rainfall Intensity (i) @ Tc: 5.08 in/hr

Runoff Supply Rate (q) @ Tc: 3.75 in/hr

PEAK DISCHARGE: 1,007 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 6/6/2007

Concentration Point: Point C | Job #: P09039

Watershed Area: 396.9 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	130.0	2,810	0.0463	.038
2	40.0	2,200	0.0182	.038
3	80.0	4,800	0.0167	.038
4	56.0	3,260	0.0172	.038

Length of Watercourse (Lc): 13,070 feet | Mean Slope: 0.0204

Length to Cen. of Gravity (Lca): 7,070 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3197 Longitude: 110.9574

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.88	1.35	1.67	2.24	2.78	3.09	3.24	3.51	3.81	4.39
Areal Values (in)	0.88	1.35	1.67	2.24	2.78	3.09	3.24	3.51	3.81	4.39

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	86.64	0.548
C	5	87.	90.25	0.649
D	0	.	.	0.000
Imp.	35	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.695

Time of Concentration: 35.4 min

Rainfall Intensity (i) @ Tc: 3.96 in/hr

Runoff Supply Rate (q) @ Tc: 2.75 in/hr

PEAK DISCHARGE: 1,101 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash LOMR | Date: 6/6/2007

Concentration Point: Point D | Job #: P09039

Watershed Area: 185.9 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	2,010	0.0209	.038
2	52.0	1,898	0.0274	.038
3	80.0	3,093	0.0259	.038
4	22.0	1,410	0.0156	.038

Length of Watercourse (Lc): 8,411 feet | Mean Slope: 0.0226

Length to Cen. of Gravity (Lca): 3,250 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9528

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.89	1.35	1.68	2.26	2.80	3.11	3.27	3.54	3.85	4.41
Areal Values (in)	0.89	1.35	1.68	2.26	2.80	3.11	3.27	3.54	3.85	4.41

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	86.69	0.551
C	5	87.	90.29	0.652
D	0	.	.	0.000
Imp.	25	99.	99.	0.958

Weighted Runoff Coef. (Cw): 0.656

Time of Concentration: 21.3 min

Rainfall Intensity (i) @ Tc: 5.42 in/hr

Runoff Supply Rate (q) @ Tc: 3.55 in/hr

PEAK DISCHARGE: 666 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 6/6/2007

Concentration Point: Point E | Job #: P09039

Watershed Area: 709.5 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	140.0	2,753	0.0509	.038
2	120.0	6,847	0.0175	.038
3	56.0	3,308	0.0169	.038
4	64.0	2,672	0.0240	.038

Length of Watercourse (Lc): 15,580 feet | Mean Slope: 0.0214

Length to Cen. of Gravity (Lca): 6,700 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 100-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3153 Longitude: 110.9712

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	0.88	1.33	1.65	2.22	2.75	3.06	3.20	3.46	3.74	4.36
Areal Values (in)	0.88	1.33	1.65	2.22	2.75	3.06	3.20	3.46	3.74	4.36

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	91	82.	86.58	0.543
C	9	87.	90.2	0.645
D	0	.	.	0.000
Imp.	20	99.	99.	0.957

Weighted Runoff Coef. (Cw): 0.633

Time of Concentration: 38.5 min

Rainfall Intensity (i) @ Tc: 3.69 in/hr

Runoff Supply Rate (q) @ Tc: 2.34 in/hr

PEAK DISCHARGE: 1,671 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash LOMR | Date: 8/15/07

Concentration Point: Stone Loop Inlet Structure | Job #: P09039

Watershed Area: 743.0 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	140.0	2,771	0.0505	.038
2	120.0	6,892	0.0174	.038
3	80.0	3,553	0.0225	.038
4	85.0	4,314	0.0197	.038

Length of Watercourse (Lc): 17,530 feet | Mean Slope: 0.0217

Length to Cen. of Gravity (Lca): 8,765 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9617

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66
Areal Values (in)	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	91	82.	87.88	0.647
C	9	87.	91.25	0.734
D	0	.	.	0.000
Imp.	20	99.	99.	0.966

Weighted Runoff Coef. (Cw): 0.717

Time of Concentration: 36.5 min

Rainfall Intensity (i) @ Tc: 4.92 in/hr

Runoff Supply Rate (q) @ Tc: 3.52 in/hr

PEAK DISCHARGE: 2,639 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash LOMR | Date: 8/15/07

Concentration Point: Point A | Job #: P09039

Watershed Area: 114.4 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	2,010	0.0209	.038
2	52.0	1,898	0.0274	.038
3	40.0	1,466	0.0273	.038
4	40.0	1,627	0.0246	.038

Length of Watercourse (Lc): 7,001 feet | Mean Slope: 0.0246

Length to Cen. of Gravity (Lca): 3,150 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9528

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.12	1.71	2.12	2.86	3.54	3.97	4.24	4.57	4.90	5.68
Areal Values (in)	1.12	1.71	2.12	2.86	3.54	3.97	4.24	4.57	4.90	5.68

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	87.9	0.649
C	5	87.	91.27	0.736
D	0	.	.	0.000
Imp.	25	99.	99.	0.967

Weighted Runoff Coef. (Cw): 0.731

Time of Concentration: 15.6 min

Rainfall Intensity (i) @ Tc: 8.26 in/hr

Runoff Supply Rate (q) @ Tc: 6.04 in/hr

PEAK DISCHARGE: 697 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 8/15/07

Concentration Point: Point B | Job #: P09039

Watershed Area: 266.6 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	90.0	1,619	0.0556	.038
2	40.0	1,230	0.0325	.038
3	80.0	4,688	0.0171	.038
4	50.0	1,703	0.0294	.038

Length of Watercourse (Lc): 9,240 feet | Mean Slope: 0.0241

Length to Cen. of Gravity (Lca): 5,210 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3228 Longitude: 110.9501

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.13	1.72	2.13	2.87	3.55	4.00	4.28	4.61	4.96	5.76
Areal Values (in)	1.13	1.72	2.13	2.87	3.55	4.00	4.28	4.61	4.96	5.76

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	96	82.	87.91	0.650
C	4	87.	91.28	0.737
D	0	.	.	0.000
Imp.	45	99.	99.	0.967

Weighted Runoff Coef. (Cw): 0.794

Time of Concentration: 20.6 min

Rainfall Intensity (i) @ Tc: 7.01 in/hr

Runoff Supply Rate (q) @ Tc: 5.57 in/hr

PEAK DISCHARGE: 1,496 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 8/15/07

Concentration Point: Point C | Job #: P09039

Watershed Area: 396.9 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	130.0	2,810	0.0463	.038
2	40.0	2,200	0.0182	.038
3	80.0	4,800	0.0167	.038
4	56.0	3,260	0.0172	.038

Length of Watercourse (Lc): 13,070 feet | Mean Slope: 0.0204

Length to Cen. of Gravity (Lca): 7,070 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3197 Longitude: 110.9574

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66
Areal Values (in)	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	87.88	0.647
C	5	87.	91.25	0.734
D	0	.	.	0.000
Imp.	35	99.	99.	0.966

Weighted Runoff Coef. (Cw): 0.761

Time of Concentration: 29.4 min

Rainfall Intensity (i) @ Tc: 5.73 in/hr

Runoff Supply Rate (q) @ Tc: 4.37 in/hr

PEAK DISCHARGE: 1,747 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash LOMR | Date: 8/15/07

Concentration Point: Point D | Job #: P09039

Watershed Area: 185.9 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	42.0	2,010	0.0209	.038
2	52.0	1,898	0.0274	.038
3	80.0	3,093	0.0259	.038
4	22.0	1,410	0.0156	.038

Length of Watercourse (Lc): 8,411 feet | Mean Slope: 0.0226

Length to Cen. of Gravity (Lca): 3,250 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3133 Longitude: 110.9528

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.12	1.71	2.12	2.86	3.54	3.97	4.24	4.57	4.90	5.68
Areal Values (in)	1.12	1.71	2.12	2.86	3.54	3.97	4.24	4.57	4.90	5.68

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	95	82.	87.9	0.649
C	5	87.	91.27	0.736
D	0	.	.	0.000
Imp.	25	99.	99.	0.967

Weighted Runoff Coef. (Cw): 0.731

Time of Concentration: 17.8 min

Rainfall Intensity (i) @ Tc: 7.60 in/hr

Runoff Supply Rate (q) @ Tc: 5.56 in/hr

PEAK DISCHARGE: 1,042 cfs

PC-Hydro, Ver 5.3.1

HYDROLOGIC DATA SHEET FOR PIMA COUNTY FLOOD PEAK PROCEDURE

Pima County Regional Flood Control District

Client: Pima County | Prepared by: AGR

Project Name: Friendly Village Wash | Date: 8/15/07

Concentration Point: Point E | Job #: P09039

Watershed Area: 709.5 ac | Watershed Type: Suburban-Foothills

Watercourse Data By Reach

Reach No.	Height (Hi)	Length (Li)	Slope (Si)	Basin Factor (Nb)
1	140.0	2,753	0.0509	.038
2	120.0	6,847	0.0175	.038
3	56.0	3,308	0.0169	.038
4	64.0	2,672	0.0240	.038

Length of Watercourse (Lc): 15,580 feet | Mean Slope: 0.0214

Length to Cen. of Gravity (Lca): 6,700 feet | Weighted Basin Fac.: 0.038

Veg. Cover Type(s): Desert Brush | Veg. Cover Density: 30 %

RETURN PERIOD: 500-years

Rainfall Depths: NOAA Atlas 14 (90% UCL) @ Latitude: 32.3153 Longitude: 110.9712

Duration:	5-min	10-min	15-min	30-min	60-min	2-hr	3-hr	6-hr	12-hr	24-hr
Point Values (in)	1.11	1.69	2.09	2.82	3.49	3.90	4.17	4.47	4.76	5.61
Areal Values (in)	1.11	1.69	2.09	2.82	3.49	3.90	4.17	4.47	4.76	5.61

Soils Data

Soil Type	Percent	Curve # (CN)	Adj. Curve # (CN*)	Runoff Coef. (C)
B	91	82.	87.84	0.643
C	9	87.	91.22	0.731
D	0	.	.	0.000
Imp.	20	99.	99.	0.966

Weighted Runoff Coef. (Cw): 0.714

Time of Concentration: 31.4 min

Rainfall Intensity (i) @ Tc: 5.44 in/hr

Runoff Supply Rate (q) @ Tc: 3.89 in/hr

PEAK DISCHARGE: 2,780 cfs

PC-Hydro, Ver 5.3.1

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Arizona 32.3133 N 110.9617 W 2513 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Oct 3 2007

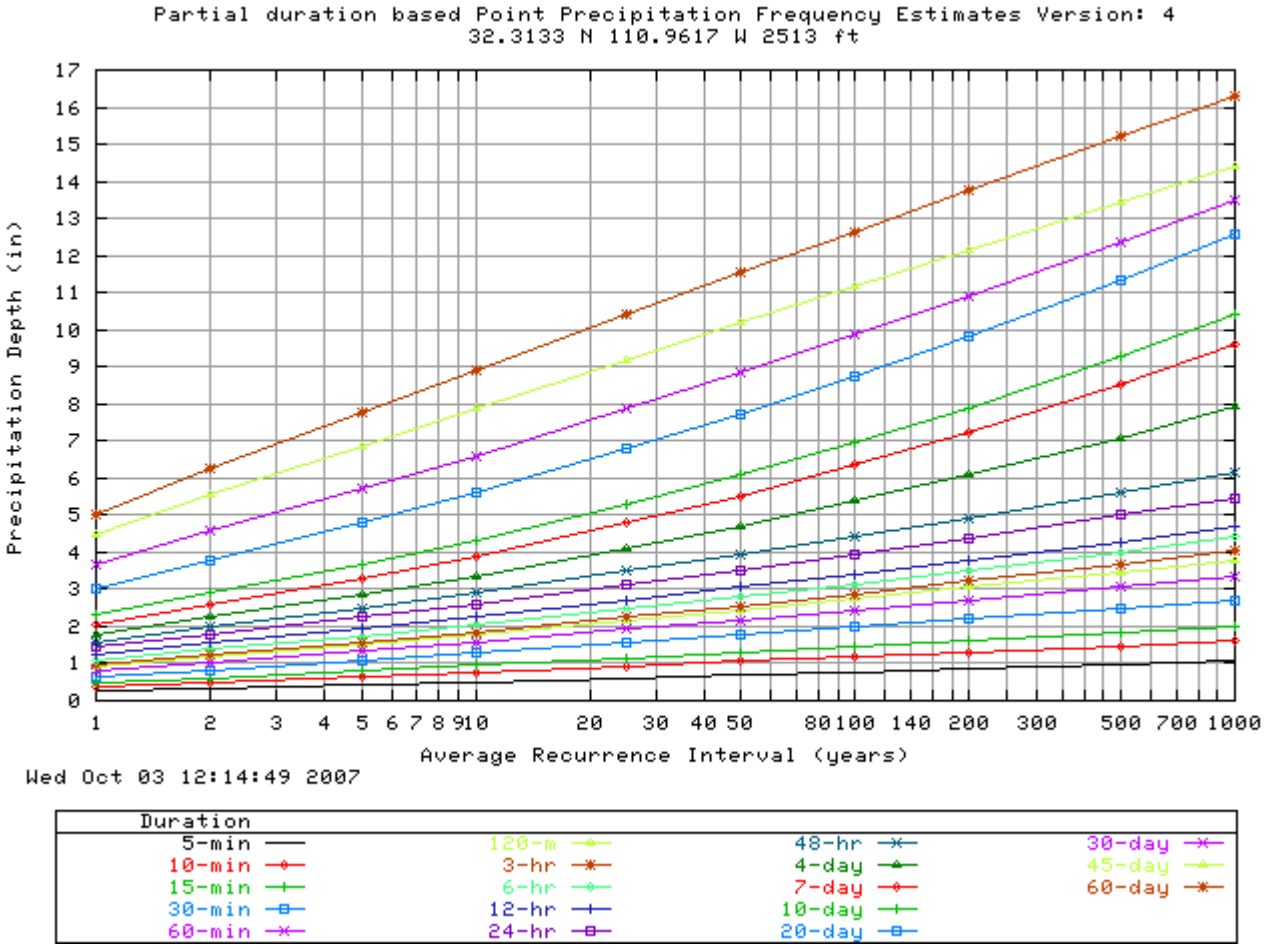
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

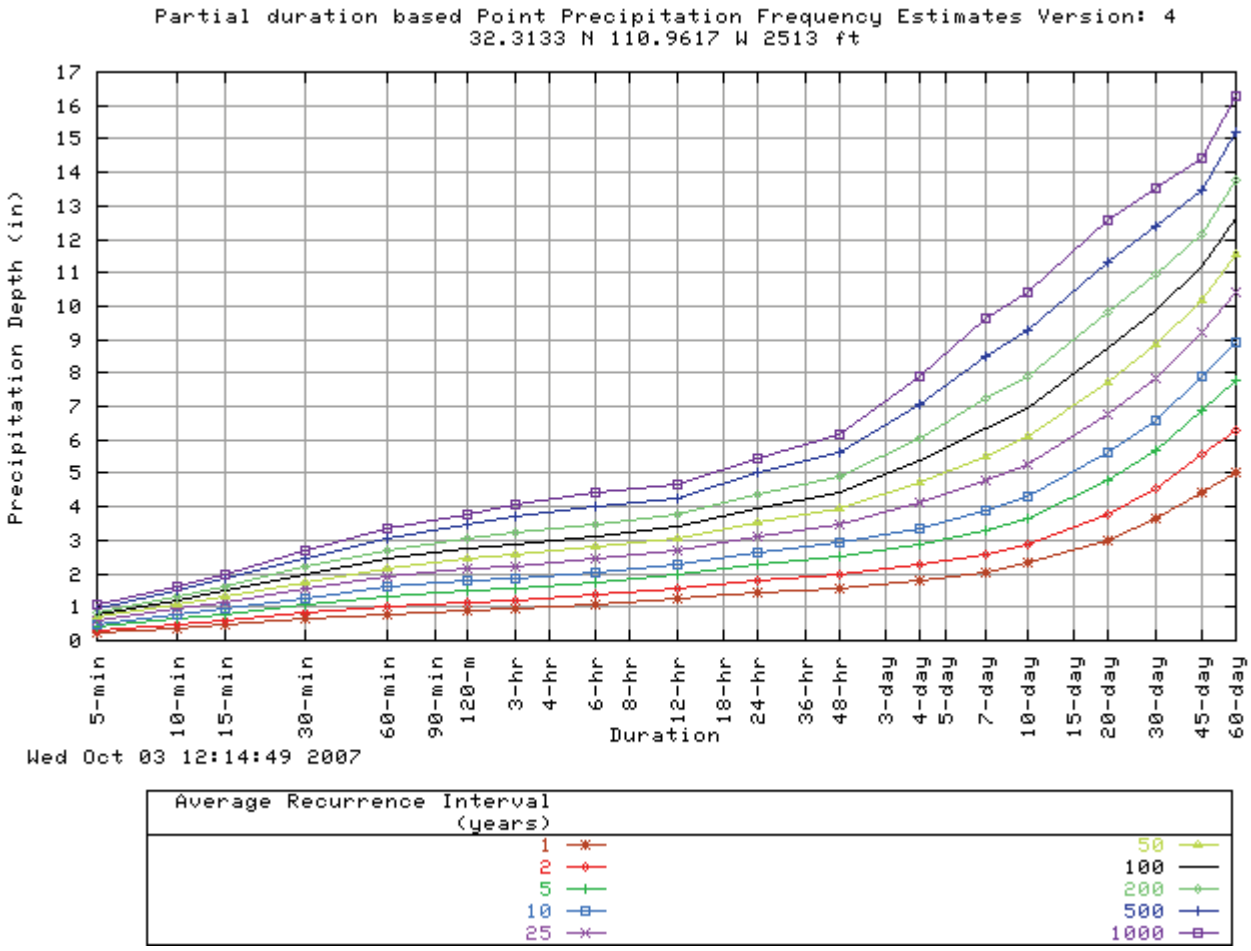
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.38	0.47	0.64	0.79	0.91	0.96	1.11	1.26	1.43	1.58	1.79	2.06	2.31	3.01	3.65	4.46	5.03
2	0.32	0.49	0.61	0.82	1.02	1.16	1.22	1.39	1.57	1.79	1.99	2.25	2.58	2.90	3.77	4.57	5.57	6.28
5	0.43	0.65	0.81	1.09	1.34	1.51	1.57	1.75	1.96	2.25	2.50	2.85	3.29	3.67	4.78	5.70	6.87	7.76
10	0.51	0.77	0.95	1.29	1.59	1.78	1.85	2.04	2.28	2.62	2.92	3.36	3.89	4.33	5.61	6.61	7.87	8.90
25	0.61	0.93	1.16	1.56	1.93	2.16	2.24	2.46	2.72	3.13	3.50	4.10	4.79	5.29	6.78	7.86	9.20	10.40
50	0.69	1.06	1.31	1.76	2.18	2.45	2.55	2.79	3.06	3.53	3.96	4.71	5.53	6.09	7.73	8.84	10.19	11.53
100	0.78	1.18	1.47	1.98	2.45	2.75	2.87	3.13	3.41	3.96	4.43	5.37	6.35	6.96	8.75	9.87	11.18	12.65
200	0.86	1.31	1.62	2.19	2.71	3.06	3.21	3.49	3.78	4.39	4.93	6.08	7.23	7.90	9.82	10.93	12.16	13.75
500	0.97	1.48	1.84	2.47	3.06	3.47	3.69	3.99	4.28	5.00	5.62	7.09	8.53	9.26	11.33	12.38	13.44	15.20
1000	1.06	1.61	2.00	2.69	3.33	3.79	4.06	4.40	4.67	5.48	6.16	7.93	9.61	10.40	12.56	13.51	14.40	16.28

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3133 N 110.9617 W 2513 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Wed Oct 03 12:14:49 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI (years)**	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
1	0.28	0.43	0.54	0.72	0.90	1.03	1.09	1.25	1.40	1.57	1.74	1.97	2.27	2.55	3.30	3.98	4.83	5.46
2	0.37	0.56	0.69	0.94	1.16	1.31	1.38	1.56	1.75	1.97	2.18	2.46	2.84	3.19	4.14	4.97	6.04	6.84
5	0.49	0.74	0.92	1.23	1.53	1.71	1.77	1.97	2.19	2.47	2.74	3.12	3.62	4.04	5.25	6.20	7.46	8.43
10	0.57	0.87	1.08	1.46	1.80	2.01	2.08	2.29	2.54	2.87	3.19	3.68	4.28	4.77	6.16	7.19	8.55	9.68
25	0.69	1.05	1.31	1.76	2.18	2.42	2.52	2.75	3.02	3.45	3.83	4.49	5.28	5.83	7.47	8.57	10.00	11.34
50	0.79	1.20	1.48	2.00	2.47	2.75	2.86	3.12	3.40	3.90	4.35	5.18	6.13	6.74	8.54	9.67	11.10	12.61
100	0.88	1.34	1.67	2.25	2.78	3.09	3.24	3.51	3.81	4.39	4.90	5.95	7.10	7.76	9.72	10.85	12.25	13.89
200	0.98	1.50	1.85	2.50	3.09	3.45	3.64	3.93	4.24	4.91	5.49	6.78	8.16	8.89	11.00	12.09	13.39	15.21
500	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66	6.33	8.02	9.77	10.56	12.87	13.88	14.94	16.99
1000	1.23	1.87	2.31	3.12	3.86	4.36	4.69	5.04	5.35	6.25	7.02	9.08	11.16	12.02	14.45	15.30	16.15	18.37

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**

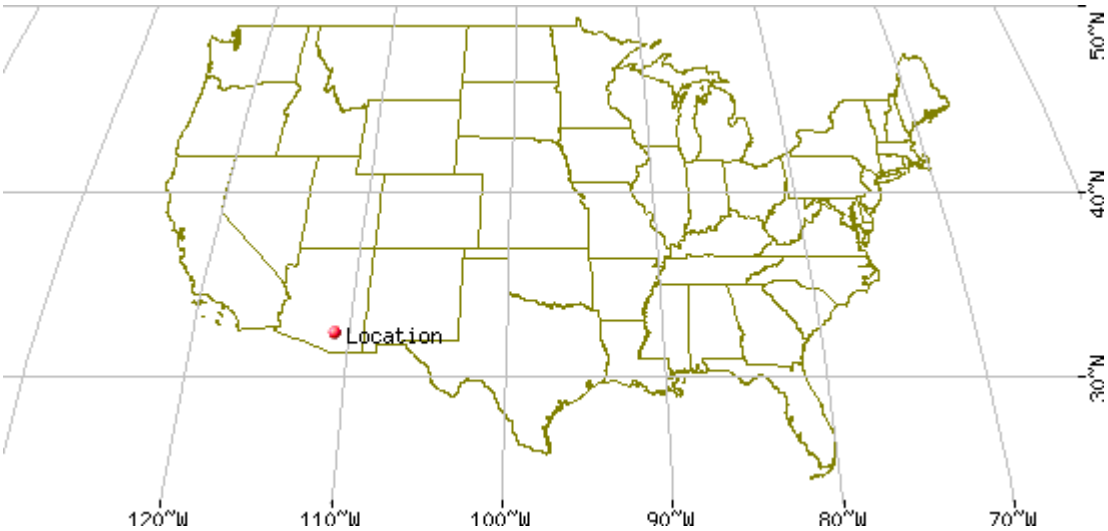
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.22	0.34	0.42	0.56	0.70	0.81	0.86	0.99	1.13	1.31	1.45	1.64	1.88	2.11	2.75	3.36	4.11	4.63
2	0.29	0.44	0.54	0.73	0.90	1.04	1.09	1.24	1.42	1.64	1.82	2.06	2.36	2.64	3.44	4.19	5.13	5.79
5	0.38	0.57	0.71	0.96	1.19	1.34	1.40	1.56	1.76	2.04	2.29	2.60	3.00	3.33	4.35	5.21	6.32	7.15
10	0.45	0.68	0.84	1.13	1.40	1.57	1.64	1.81	2.03	2.38	2.66	3.06	3.53	3.92	5.09	6.03	7.24	8.18
25	0.53	0.81	1.00	1.35	1.67	1.89	1.96	2.15	2.40	2.82	3.16	3.69	4.29	4.74	6.10	7.13	8.41	9.52
50	0.59	0.91	1.12	1.51	1.87	2.11	2.19	2.41	2.67	3.16	3.54	4.19	4.91	5.39	6.88	7.95	9.27	10.50
100	0.66	1.00	1.24	1.67	2.06	2.34	2.43	2.66	2.93	3.51	3.93	4.71	5.56	6.08	7.70	8.79	10.11	11.46
200	0.71	1.09	1.35	1.82	2.25	2.55	2.67	2.91	3.20	3.85	4.31	5.24	6.23	6.80	8.52	9.63	10.90	12.38
500	0.79	1.20	1.49	2.00	2.48	2.82	2.97	3.24	3.53	4.30	4.82	5.95	7.17	7.76	9.62	10.71	11.91	13.51
1000	0.84	1.28	1.58	2.13	2.64	3.02	3.19	3.49	3.79	4.65	5.20	6.52	7.91	8.54	10.46	11.50	12.63	14.31

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

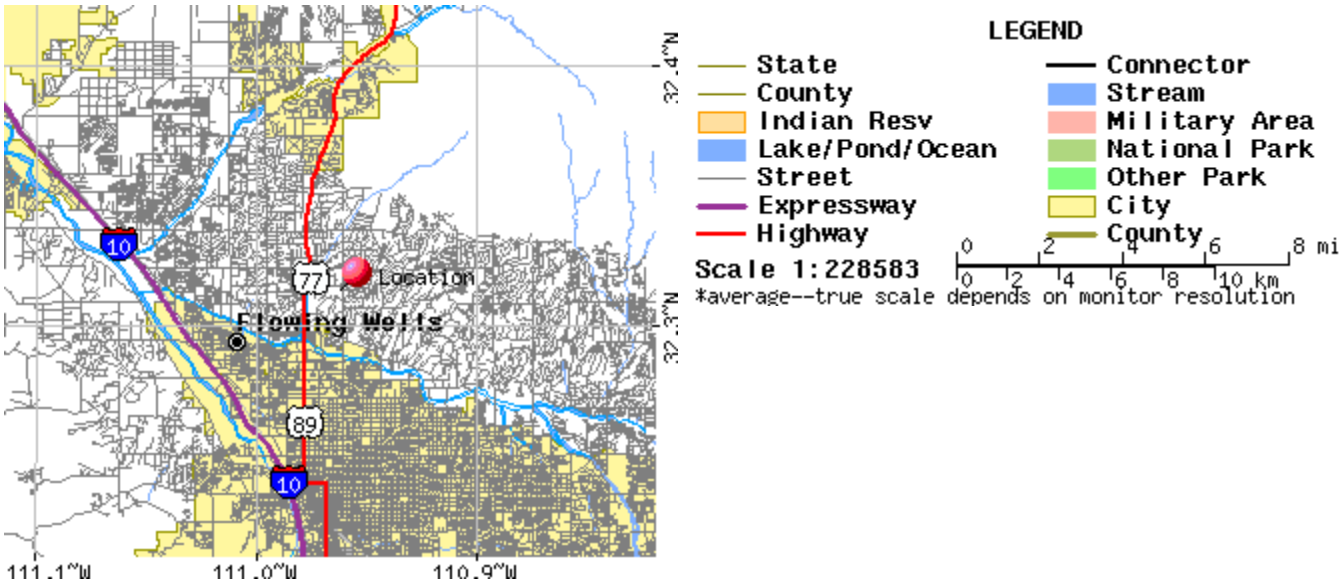
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (32.3133/-110.9617). Digital ASCII data can be obtained directly from **NCDC**.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Arizona 32.3133 N 110.9528 W 2565 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Oct 3 2007

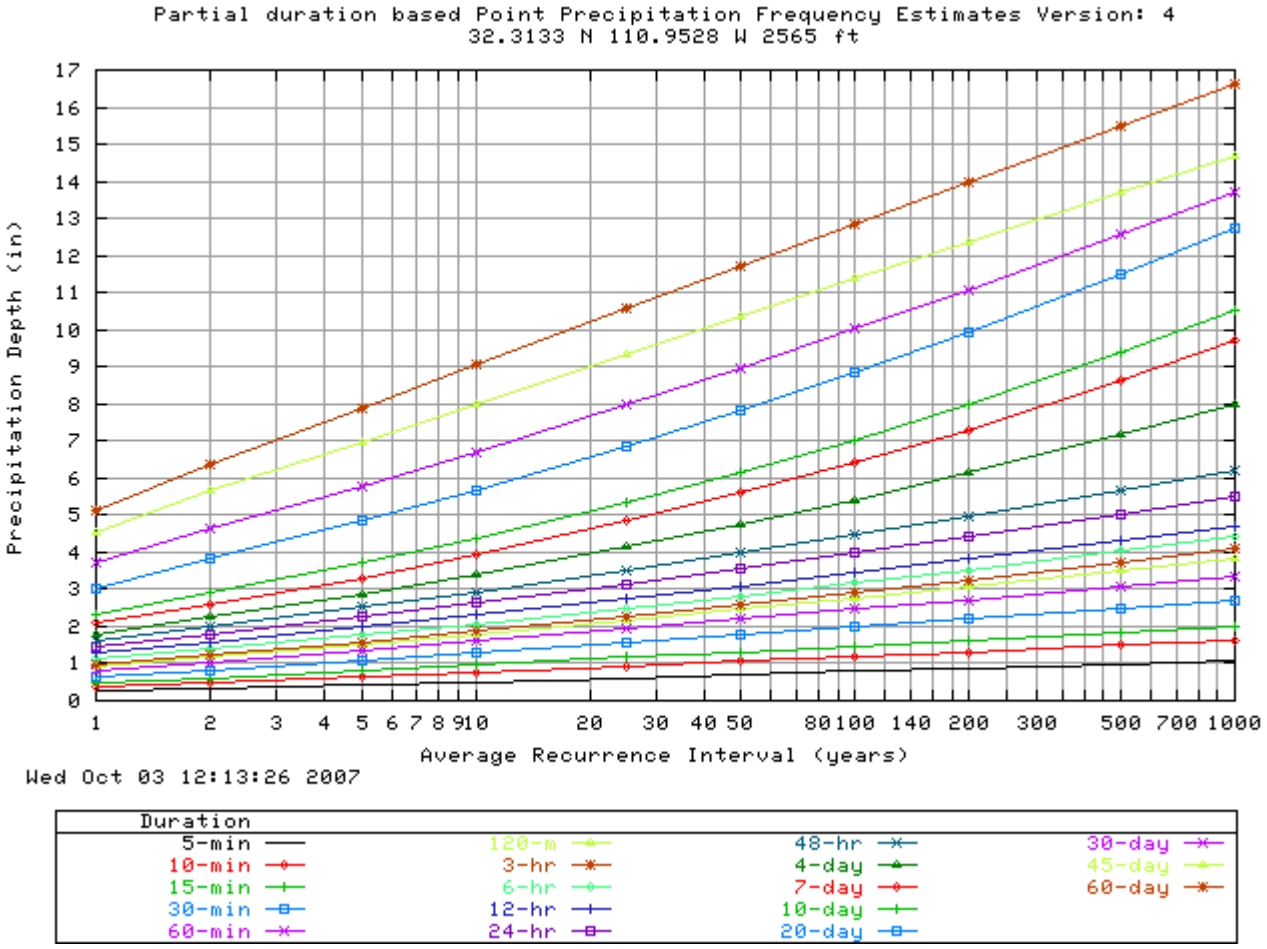
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

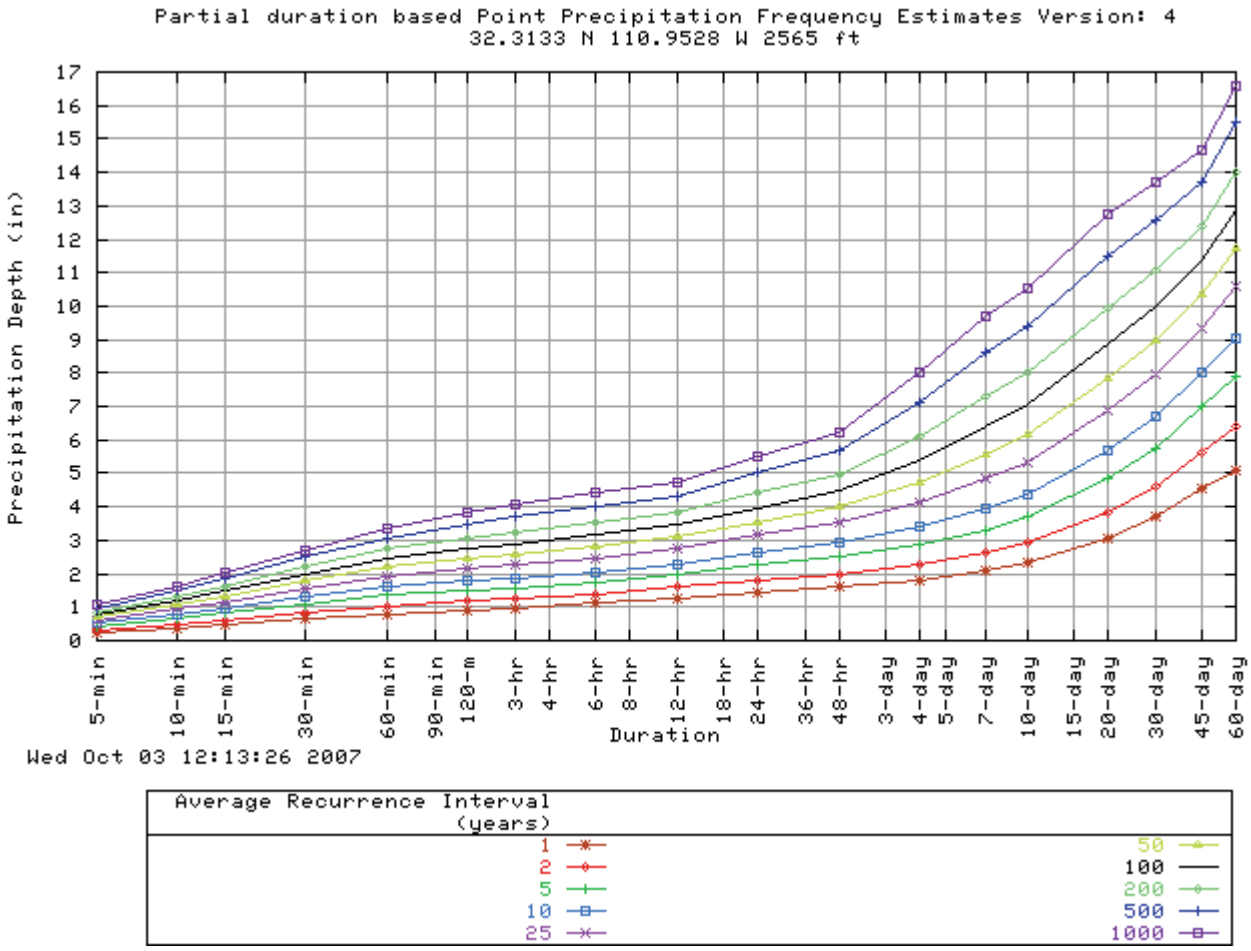
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.38	0.48	0.64	0.79	0.92	0.97	1.12	1.27	1.44	1.59	1.80	2.08	2.33	3.05	3.70	4.52	5.11
2	0.33	0.50	0.61	0.83	1.02	1.17	1.23	1.40	1.59	1.80	2.00	2.26	2.60	2.92	3.82	4.63	5.65	6.38
5	0.43	0.66	0.81	1.10	1.36	1.52	1.58	1.76	1.98	2.26	2.52	2.87	3.32	3.71	4.84	5.77	6.97	7.88
10	0.51	0.78	0.96	1.30	1.60	1.80	1.86	2.06	2.30	2.63	2.94	3.39	3.93	4.37	5.67	6.70	8.00	9.05
25	0.62	0.94	1.17	1.57	1.94	2.17	2.26	2.48	2.74	3.14	3.52	4.13	4.83	5.35	6.87	7.97	9.34	10.58
50	0.70	1.06	1.32	1.78	2.20	2.47	2.57	2.81	3.09	3.55	3.99	4.75	5.59	6.16	7.83	8.97	10.35	11.72
100	0.78	1.19	1.48	1.99	2.46	2.77	2.89	3.16	3.45	3.98	4.47	5.42	6.42	7.04	8.86	10.02	11.37	12.87
200	0.87	1.32	1.64	2.20	2.73	3.08	3.23	3.52	3.82	4.42	4.97	6.13	7.31	7.99	9.96	11.09	12.37	14.00
500	0.98	1.49	1.85	2.49	3.08	3.49	3.71	4.03	4.32	5.03	5.66	7.15	8.63	9.37	11.49	12.57	13.68	15.48
1000	1.06	1.62	2.01	2.70	3.35	3.82	4.09	4.43	4.72	5.51	6.21	8.00	9.73	10.52	12.74	13.72	14.67	16.60

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3133 N 110.9528 W 2565 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Wed Oct 03 12:13:26 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.29	0.44	0.54	0.73	0.90	1.03	1.10	1.26	1.42	1.58	1.75	1.98	2.29	2.57	3.34	4.03	4.90	5.54
2	0.37	0.57	0.70	0.94	1.17	1.32	1.39	1.57	1.77	1.98	2.19	2.48	2.87	3.22	4.19	5.04	6.13	6.95
5	0.49	0.74	0.92	1.24	1.54	1.72	1.79	1.98	2.21	2.48	2.75	3.15	3.65	4.08	5.32	6.29	7.57	8.57
10	0.58	0.88	1.09	1.47	1.82	2.02	2.10	2.31	2.56	2.89	3.21	3.71	4.32	4.82	6.24	7.29	8.68	9.84
25	0.70	1.06	1.32	1.77	2.19	2.44	2.54	2.77	3.05	3.46	3.85	4.53	5.33	5.90	7.57	8.69	10.17	11.54
50	0.79	1.20	1.49	2.01	2.49	2.77	2.88	3.14	3.44	3.92	4.38	5.22	6.20	6.81	8.65	9.81	11.29	12.83
100	0.89	1.35	1.68	2.26	2.79	3.11	3.27	3.54	3.85	4.41	4.94	6.00	7.17	7.85	9.85	11.02	12.46	14.14
200	0.99	1.50	1.86	2.51	3.11	3.47	3.67	3.96	4.29	4.93	5.54	6.84	8.25	8.99	11.15	12.28	13.64	15.49
500	1.12	1.71	2.12	2.86	3.54	3.97	4.24	4.57	4.90	5.68	6.38	8.09	9.88	10.69	13.06	14.10	15.22	17.32
1000	1.23	1.88	2.32	3.13	3.87	4.38	4.72	5.07	5.40	6.28	7.08	9.17	11.30	12.17	14.66	15.56	16.47	18.74

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*** Lower bound of the 90% confidence interval**

Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.22	0.34	0.42	0.57	0.70	0.82	0.87	1.00	1.15	1.32	1.46	1.66	1.90	2.13	2.78	3.40	4.17	4.70
2	0.29	0.44	0.55	0.74	0.91	1.05	1.10	1.25	1.43	1.65	1.83	2.07	2.38	2.67	3.48	4.25	5.20	5.87
5	0.38	0.58	0.72	0.97	1.20	1.35	1.41	1.57	1.78	2.06	2.31	2.62	3.02	3.37	4.41	5.28	6.41	7.26
10	0.45	0.68	0.84	1.14	1.41	1.59	1.65	1.83	2.05	2.39	2.68	3.08	3.56	3.96	5.15	6.12	7.35	8.31
25	0.54	0.81	1.01	1.36	1.68	1.90	1.97	2.17	2.42	2.84	3.19	3.72	4.34	4.79	6.18	7.23	8.54	9.67
50	0.60	0.91	1.13	1.52	1.88	2.13	2.21	2.43	2.70	3.18	3.57	4.22	4.96	5.45	6.97	8.07	9.41	10.67
100	0.66	1.00	1.25	1.68	2.08	2.36	2.45	2.68	2.96	3.53	3.96	4.75	5.61	6.15	7.80	8.92	10.27	11.65
200	0.72	1.09	1.36	1.83	2.26	2.57	2.69	2.94	3.23	3.87	4.35	5.29	6.30	6.88	8.63	9.77	11.08	12.58
500	0.79	1.21	1.49	2.01	2.49	2.84	2.99	3.27	3.57	4.32	4.86	6.00	7.25	7.85	9.75	10.87	12.11	13.74
1000	0.84	1.28	1.59	2.14	2.65	3.05	3.22	3.52	3.82	4.67	5.24	6.58	8.00	8.64	10.60	11.69	12.85	14.57

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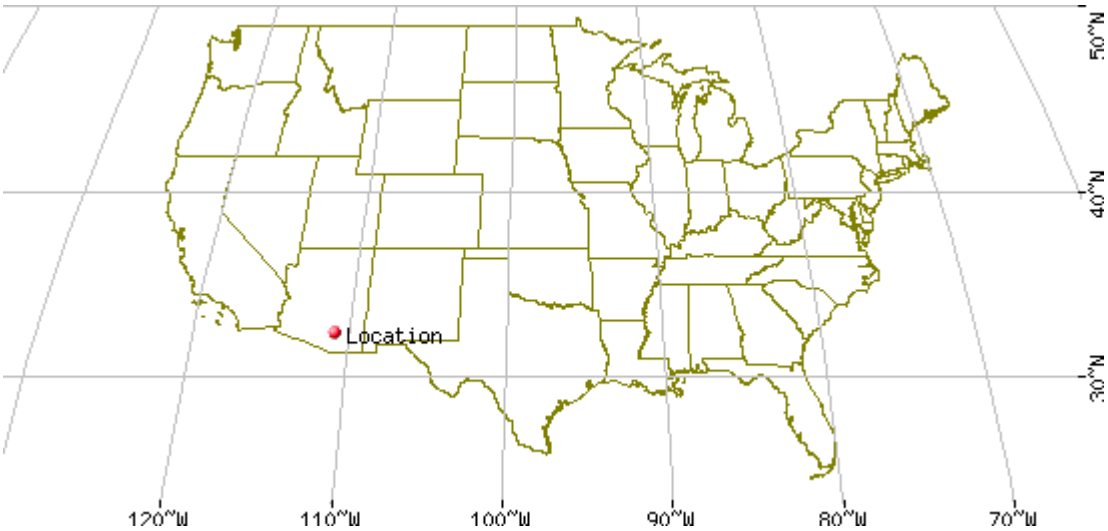
Maps -



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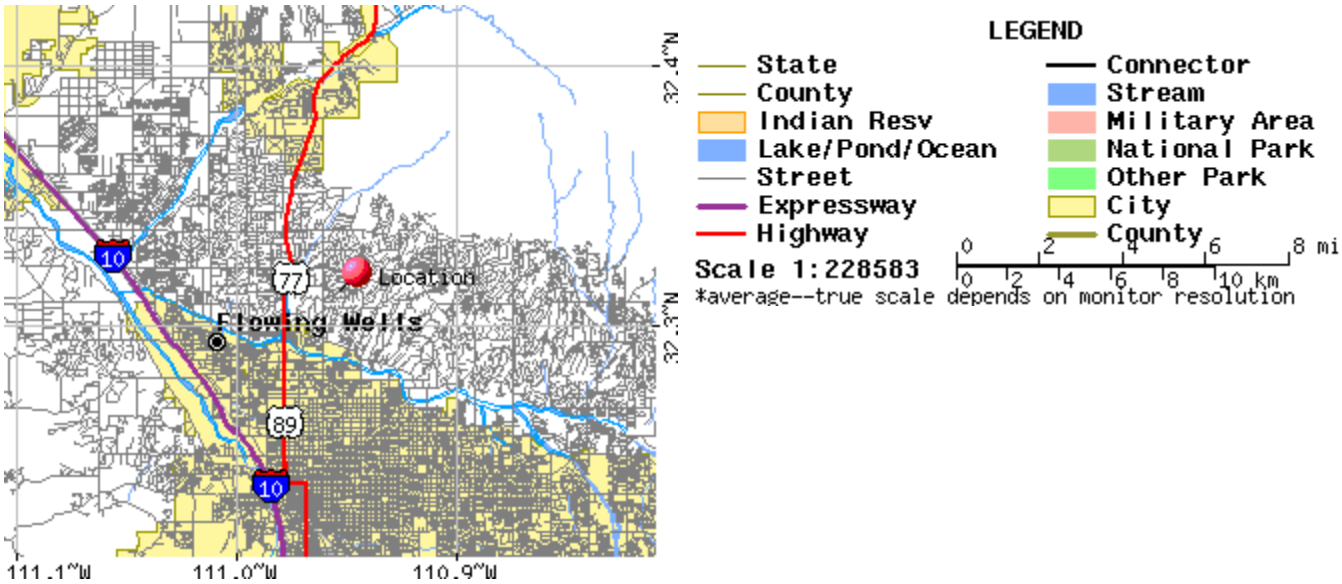

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Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Arizona 32.3228 N 110.9501 W 2598 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Oct 3 2007

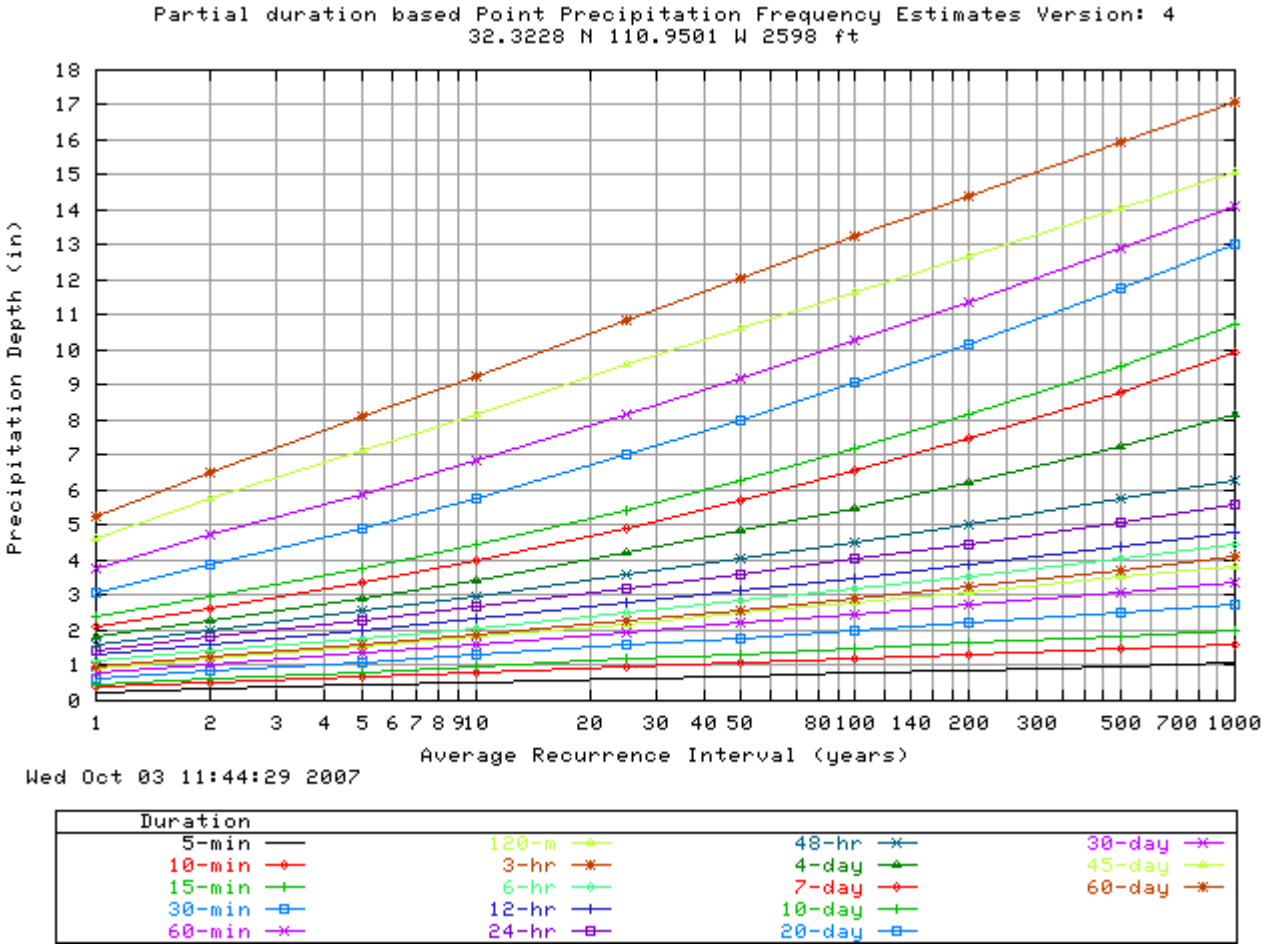
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

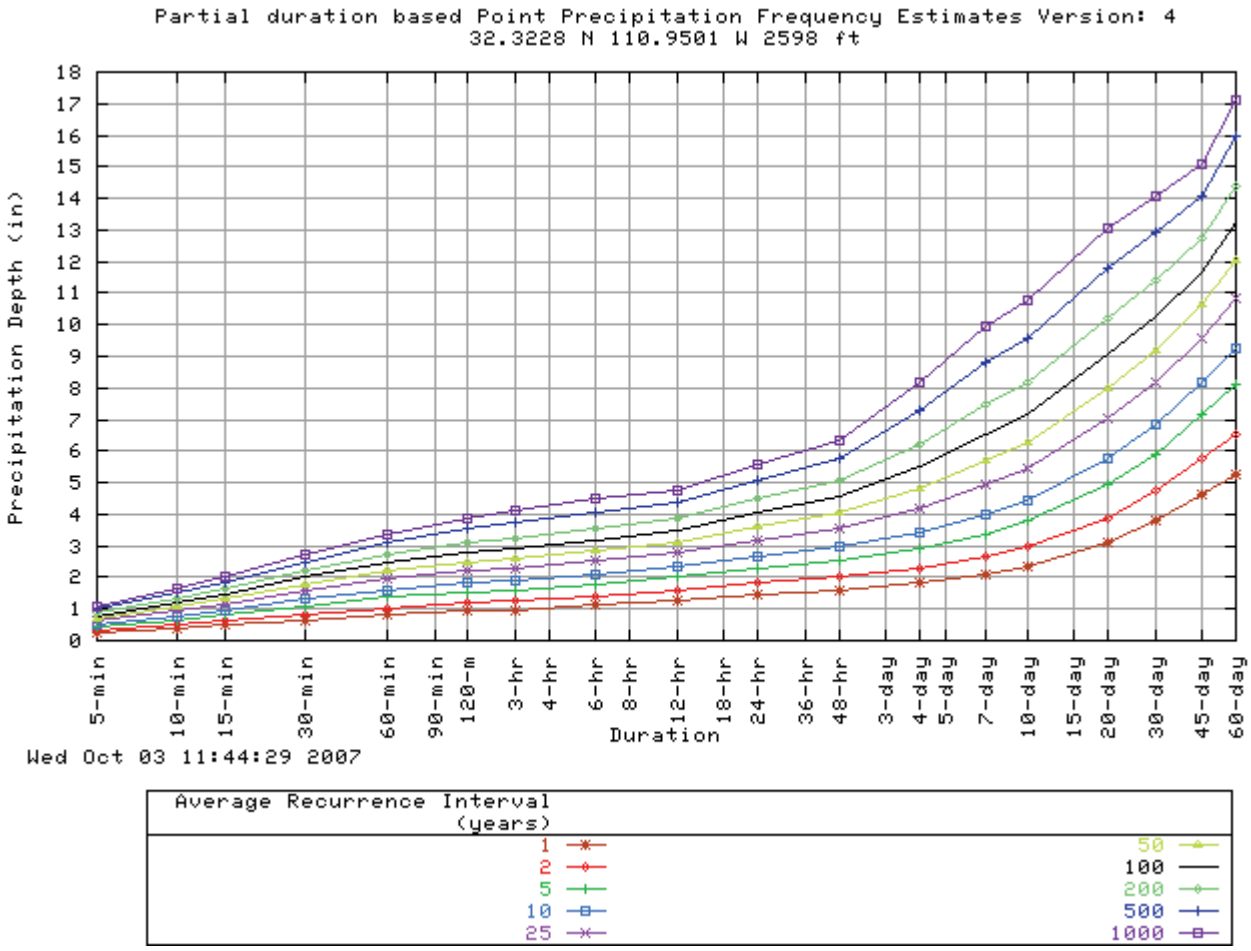
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.39	0.48	0.65	0.80	0.92	0.98	1.13	1.29	1.46	1.61	1.83	2.11	2.38	3.11	3.78	4.62	5.23
2	0.33	0.50	0.62	0.83	1.03	1.18	1.24	1.41	1.61	1.82	2.03	2.30	2.65	2.98	3.90	4.74	5.78	6.54
5	0.43	0.66	0.82	1.10	1.36	1.54	1.59	1.78	2.00	2.29	2.55	2.92	3.38	3.77	4.94	5.91	7.14	8.09
10	0.51	0.78	0.97	1.30	1.61	1.81	1.88	2.08	2.33	2.66	2.98	3.44	4.00	4.46	5.80	6.86	8.19	9.29
25	0.62	0.95	1.17	1.58	1.95	2.19	2.28	2.50	2.78	3.18	3.58	4.20	4.93	5.45	7.02	8.16	9.58	10.86
50	0.70	1.07	1.33	1.79	2.21	2.49	2.59	2.84	3.13	3.60	4.05	4.83	5.70	6.28	8.01	9.19	10.62	12.05
100	0.79	1.20	1.48	2.00	2.47	2.79	2.92	3.19	3.49	4.03	4.54	5.51	6.54	7.18	9.06	10.27	11.67	13.23
200	0.87	1.32	1.64	2.21	2.74	3.10	3.26	3.56	3.86	4.47	5.05	6.23	7.46	8.16	10.18	11.38	12.71	14.41
500	0.98	1.50	1.85	2.50	3.09	3.52	3.74	4.07	4.38	5.09	5.76	7.28	8.81	9.57	11.76	12.90	14.08	15.95
1000	1.07	1.63	2.02	2.72	3.36	3.85	4.12	4.48	4.78	5.58	6.31	8.14	9.93	10.75	13.04	14.09	15.11	17.11

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3228 N 110.9501 W 2598 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Wed Oct 03 11:44:29 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.29	0.44	0.55	0.73	0.91	1.04	1.11	1.27	1.43	1.60	1.77	2.01	2.33	2.62	3.41	4.12	5.01	5.68
2	0.37	0.57	0.71	0.95	1.18	1.34	1.40	1.59	1.79	2.00	2.22	2.52	2.92	3.27	4.28	5.15	6.28	7.12
5	0.49	0.75	0.93	1.25	1.55	1.73	1.80	2.00	2.24	2.51	2.80	3.20	3.72	4.16	5.43	6.44	7.76	8.80
10	0.58	0.89	1.10	1.48	1.83	2.04	2.12	2.34	2.59	2.92	3.26	3.77	4.41	4.92	6.38	7.47	8.90	10.10
25	0.70	1.07	1.32	1.78	2.21	2.46	2.56	2.80	3.09	3.51	3.92	4.61	5.44	6.02	7.74	8.91	10.44	11.86
50	0.80	1.21	1.50	2.02	2.50	2.79	2.91	3.18	3.48	3.97	4.45	5.32	6.32	6.96	8.85	10.07	11.60	13.19
100	0.89	1.36	1.69	2.27	2.81	3.14	3.29	3.58	3.90	4.47	5.02	6.10	7.33	8.01	10.08	11.31	12.81	14.55
200	0.99	1.51	1.87	2.52	3.12	3.50	3.70	4.01	4.34	5.00	5.63	6.97	8.43	9.19	11.41	12.61	14.03	15.95
500	1.13	1.72	2.13	2.87	3.55	4.00	4.28	4.61	4.96	5.76	6.49	8.24	10.10	10.92	13.37	14.48	15.69	17.84
1000	1.24	1.88	2.34	3.15	3.89	4.41	4.76	5.13	5.47	6.37	7.20	9.34	11.55	12.44	15.01	15.99	16.99	19.32

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*** Lower bound of the 90% confidence interval**

Precipitation Frequency Estimates (inches)

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1	0.23	0.34	0.43	0.57	0.71	0.82	0.88	1.01	1.16	1.33	1.48	1.68	1.93	2.17	2.84	3.48	4.26	4.81
2	0.29	0.44	0.55	0.74	0.92	1.05	1.11	1.27	1.45	1.67	1.86	2.10	2.42	2.71	3.56	4.34	5.32	6.02
5	0.38	0.58	0.72	0.97	1.20	1.36	1.42	1.59	1.80	2.08	2.34	2.66	3.07	3.43	4.50	5.41	6.57	7.45
10	0.45	0.69	0.85	1.15	1.42	1.60	1.66	1.85	2.08	2.42	2.71	3.13	3.63	4.04	5.26	6.26	7.53	8.52
25	0.54	0.82	1.02	1.37	1.69	1.92	1.99	2.19	2.45	2.87	3.23	3.77	4.41	4.88	6.31	7.40	8.76	9.93
50	0.60	0.92	1.14	1.53	1.89	2.15	2.23	2.45	2.73	3.22	3.62	4.29	5.04	5.56	7.12	8.27	9.65	10.96
100	0.66	1.01	1.25	1.69	2.09	2.37	2.47	2.71	3.00	3.57	4.02	4.83	5.72	6.27	7.97	9.14	10.54	11.96
200	0.72	1.10	1.36	1.84	2.27	2.59	2.71	2.97	3.27	3.92	4.42	5.37	6.42	7.01	8.83	10.02	11.38	12.93
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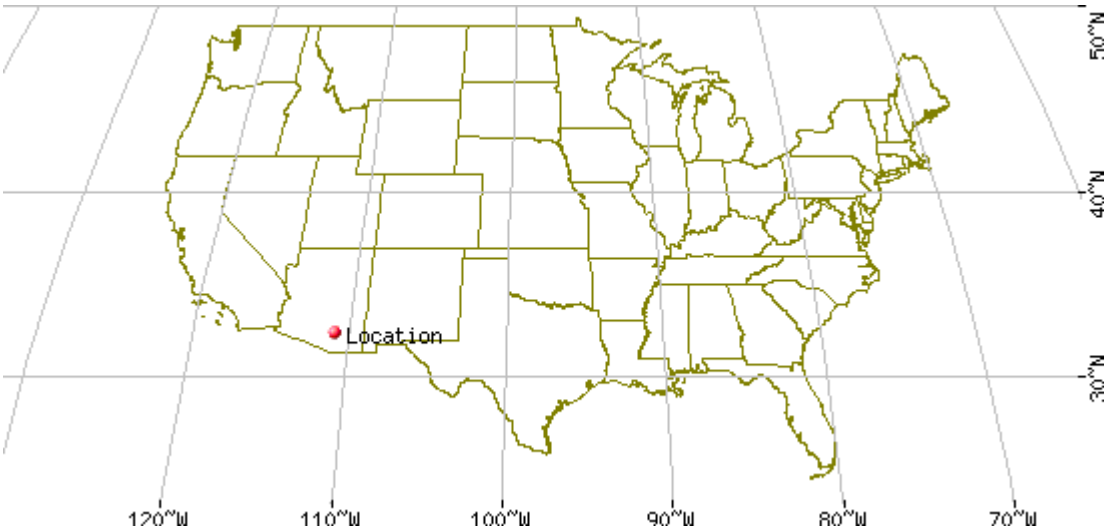

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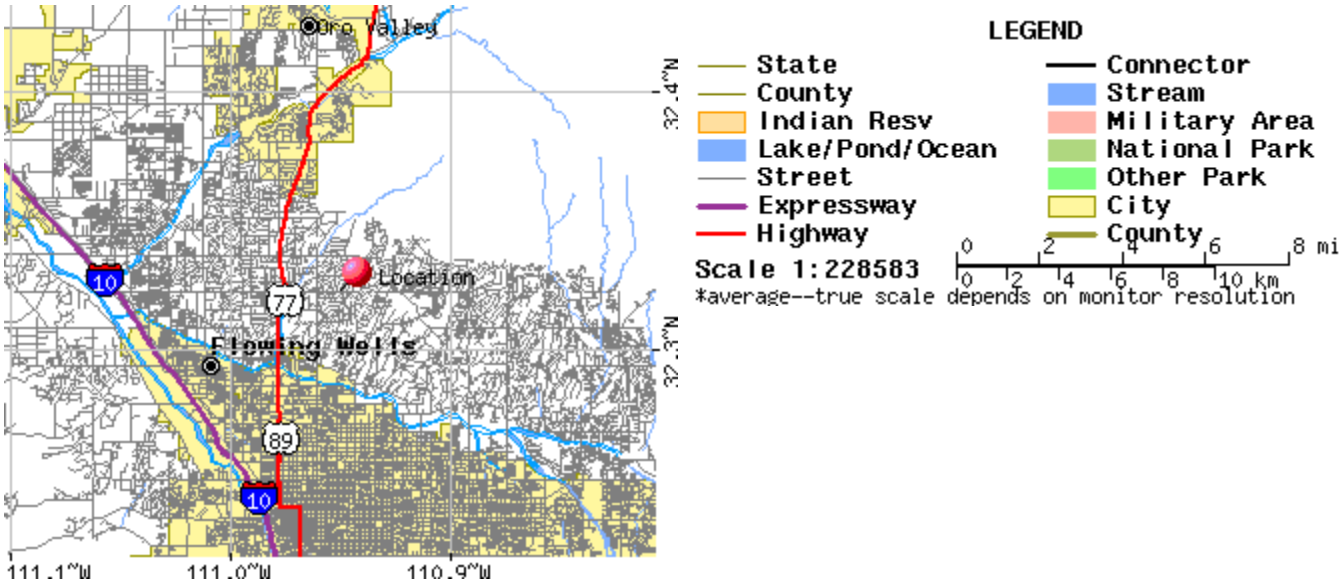

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Arizona 32.3197 N 110.9574 W 2575 feet

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Extracted: Wed Oct 3 2007

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

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2	0.32	0.49	0.61	0.82	1.02	1.16	1.22	1.39	1.57	1.79	1.99	2.25	2.58	2.90	3.77	4.57	5.57	6.28
5	0.43	0.65	0.81	1.09	1.34	1.51	1.57	1.75	1.96	2.25	2.50	2.85	3.29	3.67	4.78	5.70	6.87	7.76
10	0.51	0.77	0.95	1.29	1.59	1.78	1.85	2.04	2.28	2.62	2.92	3.36	3.89	4.33	5.61	6.61	7.87	8.90
25	0.61	0.93	1.16	1.56	1.93	2.16	2.24	2.46	2.72	3.13	3.50	4.10	4.79	5.29	6.78	7.86	9.20	10.40
50	0.69	1.06	1.31	1.76	2.18	2.45	2.55	2.79	3.06	3.53	3.96	4.71	5.53	6.09	7.73	8.84	10.19	11.53
100	0.78	1.18	1.47	1.98	2.45	2.75	2.87	3.13	3.41	3.96	4.43	5.37	6.35	6.96	8.75	9.87	11.18	12.65
200	0.86	1.31	1.62	2.19	2.71	3.06	3.21	3.49	3.78	4.39	4.93	6.08	7.23	7.90	9.82	10.93	12.16	13.75
500	0.97	1.48	1.84	2.47	3.06	3.47	3.69	3.99	4.28	5.00	5.62	7.09	8.53	9.26	11.33	12.38	13.44	15.20
1000	1.06	1.61	2.00	2.69	3.33	3.79	4.06	4.40	4.67	5.48	6.16	7.93	9.61	10.40	12.56	13.51	14.40	16.28

Text version of table

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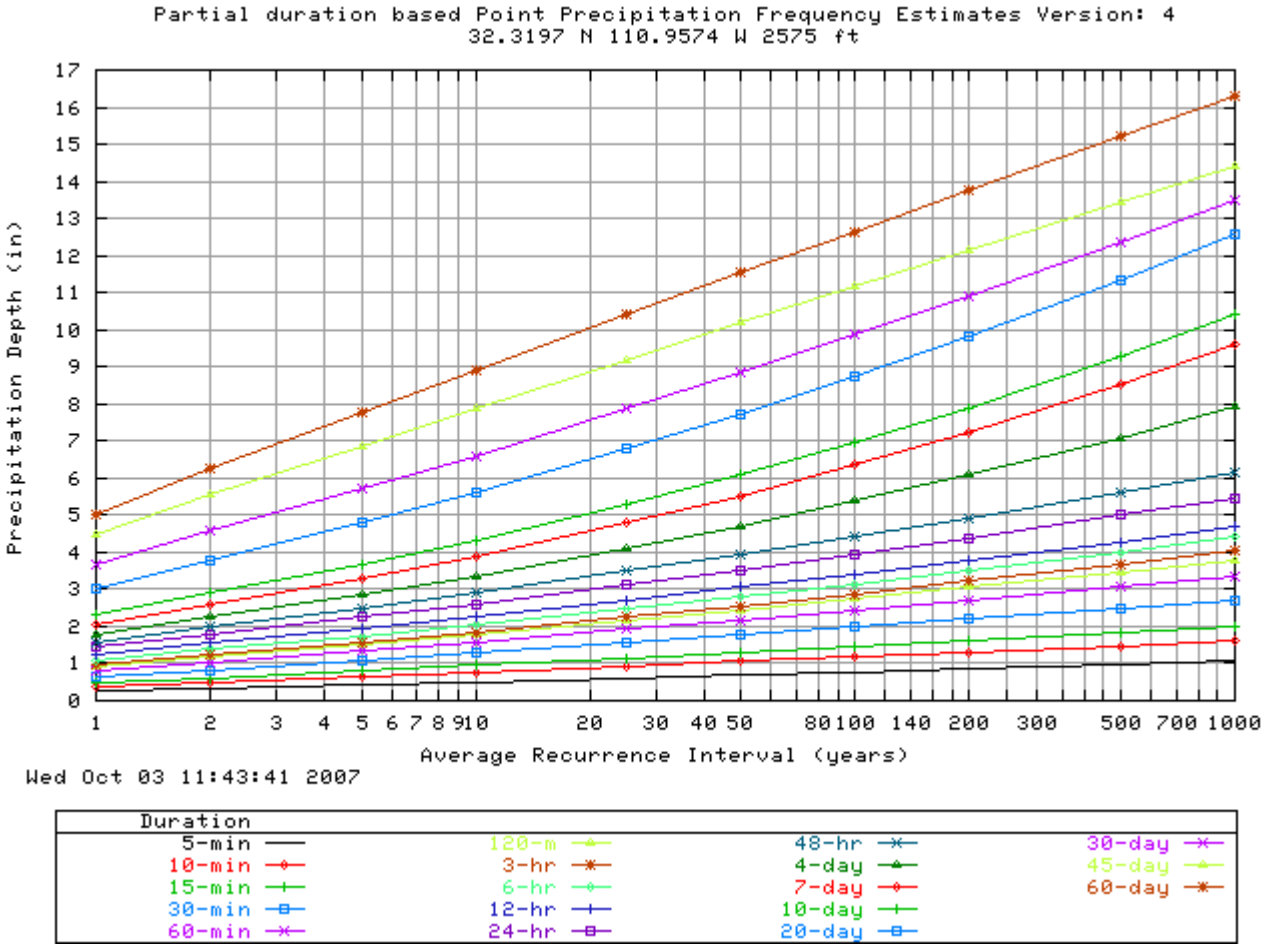
Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3197 N 110.9574 W 2575 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Wed Oct 03 11:43:41 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
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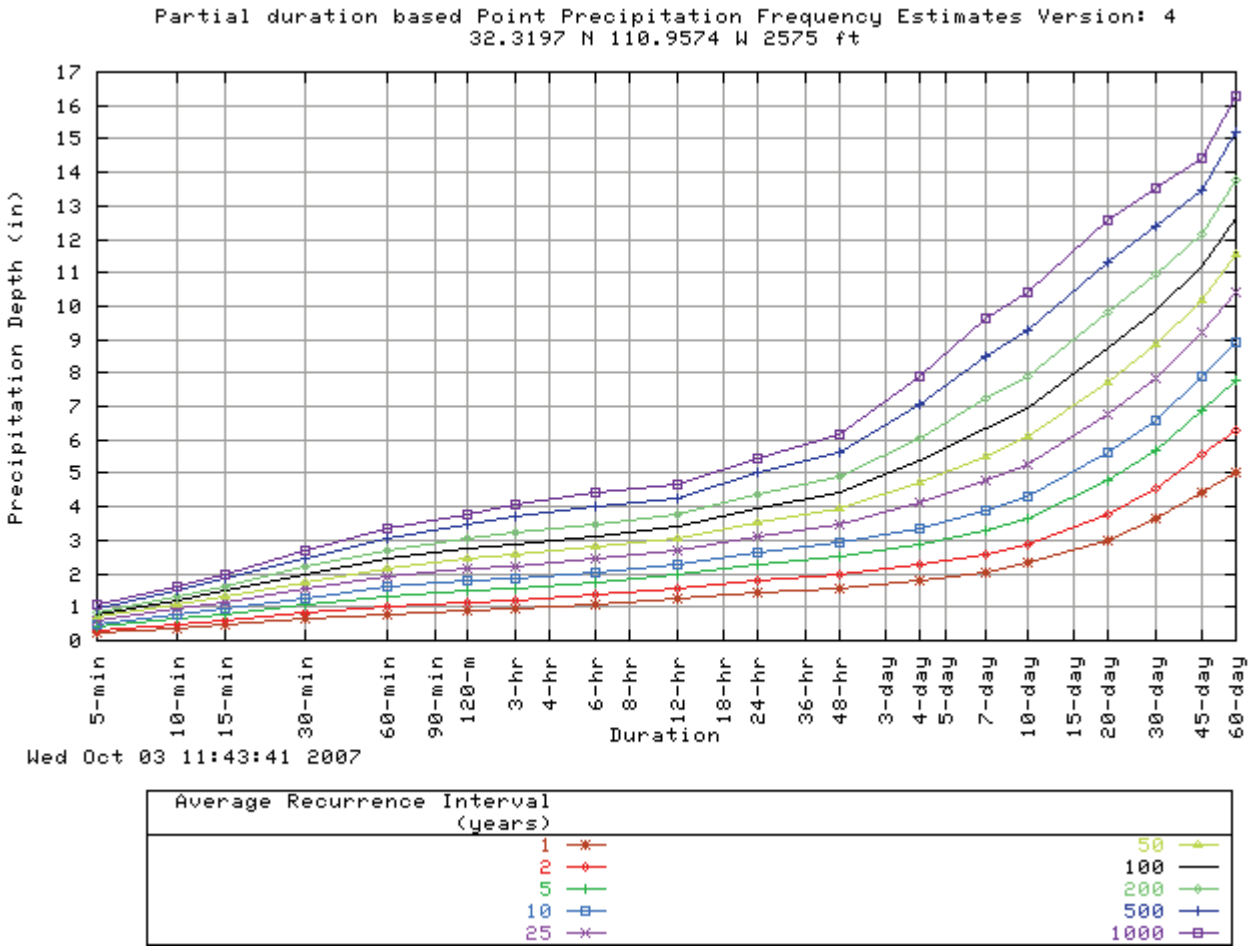
7-day
10-day
20-day
30-day
45-day
60-day



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1	0.28	0.43	0.54	0.72	0.90	1.03	1.09	1.25	1.40	1.57	1.74	1.97	2.27	2.55	3.30	3.98	4.83	5.46
2	0.37	0.56	0.69	0.94	1.16	1.31	1.38	1.56	1.75	1.97	2.18	2.46	2.84	3.19	4.14	4.97	6.04	6.84
5	0.49	0.74	0.92	1.23	1.53	1.71	1.77	1.97	2.19	2.47	2.74	3.12	3.62	4.04	5.25	6.20	7.46	8.43
10	0.57	0.87	1.08	1.46	1.80	2.01	2.08	2.29	2.54	2.87	3.19	3.68	4.28	4.77	6.16	7.19	8.55	9.68
25	0.69	1.05	1.31	1.76	2.18	2.42	2.52	2.75	3.02	3.45	3.83	4.49	5.28	5.83	7.47	8.57	10.00	11.34
50	0.79	1.20	1.48	2.00	2.47	2.75	2.86	3.12	3.40	3.90	4.35	5.18	6.13	6.74	8.54	9.67	11.10	12.61
100	0.88	1.34	1.67	2.25	2.78	3.09	3.24	3.51	3.81	4.39	4.90	5.95	7.10	7.76	9.72	10.85	12.25	13.89
200	0.98	1.50	1.85	2.50	3.09	3.45	3.64	3.93	4.24	4.91	5.49	6.78	8.16	8.89	11.00	12.09	13.39	15.21
500	1.12	1.70	2.11	2.84	3.52	3.95	4.22	4.53	4.85	5.66	6.33	8.02	9.77	10.56	12.87	13.88	14.94	16.99
1000	1.23	1.87	2.31	3.12	3.86	4.36	4.69	5.04	5.35	6.25	7.02	9.08	11.16	12.02	14.45	15.30	16.15	18.37

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ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
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2	0.29	0.44	0.54	0.73	0.90	1.04	1.09	1.24	1.42	1.64	1.82	2.06	2.36	2.64	3.44	4.19	5.13	5.79
5	0.38	0.57	0.71	0.96	1.19	1.34	1.40	1.56	1.76	2.04	2.29	2.60	3.00	3.33	4.35	5.21	6.32	7.15
10	0.45	0.68	0.84	1.13	1.40	1.57	1.64	1.81	2.03	2.38	2.66	3.06	3.53	3.92	5.09	6.03	7.24	8.18
25	0.53	0.81	1.00	1.35	1.67	1.89	1.96	2.15	2.40	2.82	3.16	3.69	4.29	4.74	6.10	7.13	8.41	9.52
50	0.59	0.91	1.12	1.51	1.87	2.11	2.19	2.41	2.67	3.16	3.54	4.19	4.91	5.39	6.88	7.95	9.27	10.50
100	0.66	1.00	1.24	1.67	2.06	2.34	2.43	2.66	2.93	3.51	3.93	4.71	5.56	6.08	7.70	8.79	10.11	11.46
200	0.71	1.09	1.35	1.82	2.25	2.55	2.67	2.91	3.20	3.85	4.31	5.24	6.23	6.80	8.52	9.63	10.90	12.38
500	0.79	1.20	1.49	2.00	2.48	2.82	2.97	3.24	3.53	4.30	4.82	5.95	7.17	7.76	9.62	10.71	11.91	13.51
1000	0.84	1.28	1.58	2.13	2.64	3.02	3.19	3.49	3.79	4.65	5.20	6.52	7.91	8.54	10.46	11.50	12.63	14.31

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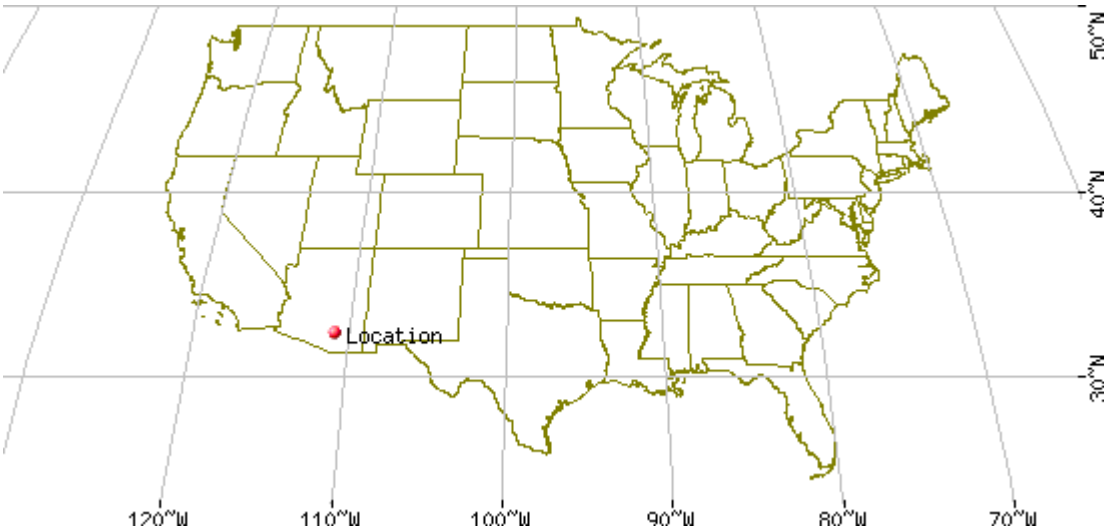

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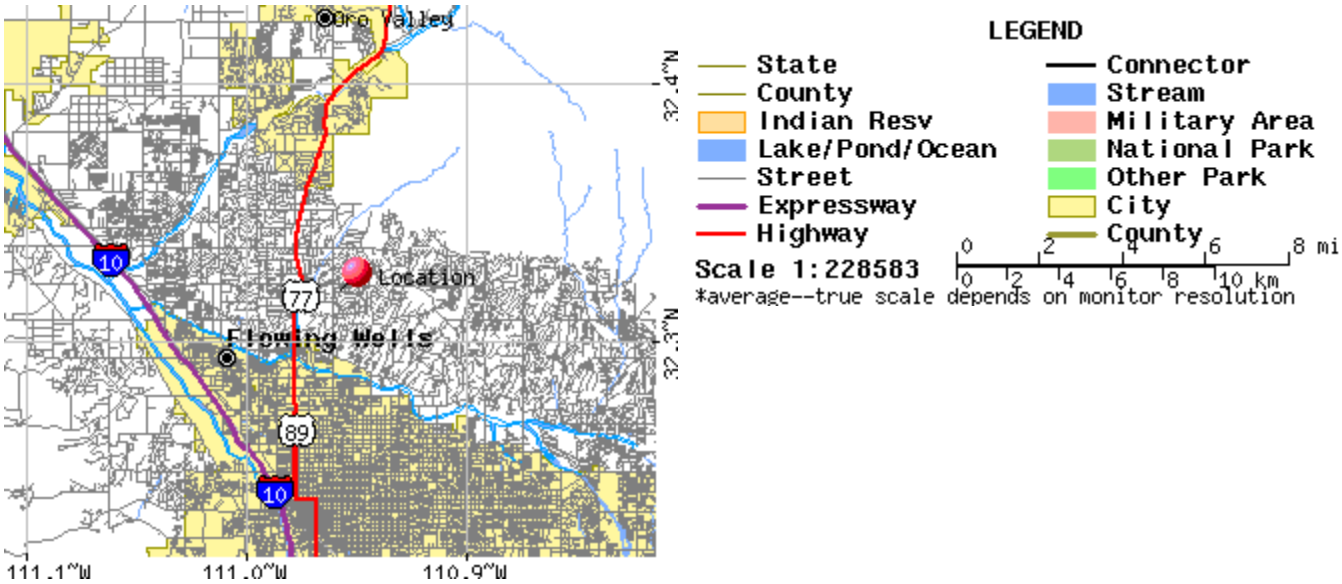

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+/-30 minutes ...OR... +/-1 degree of this location (32.3197/-110.9574). Digital ASCII data can be obtained directly from **NCDC**.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Arizona 32.3133 N 110.9528 W 2565 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Oct 3 2007

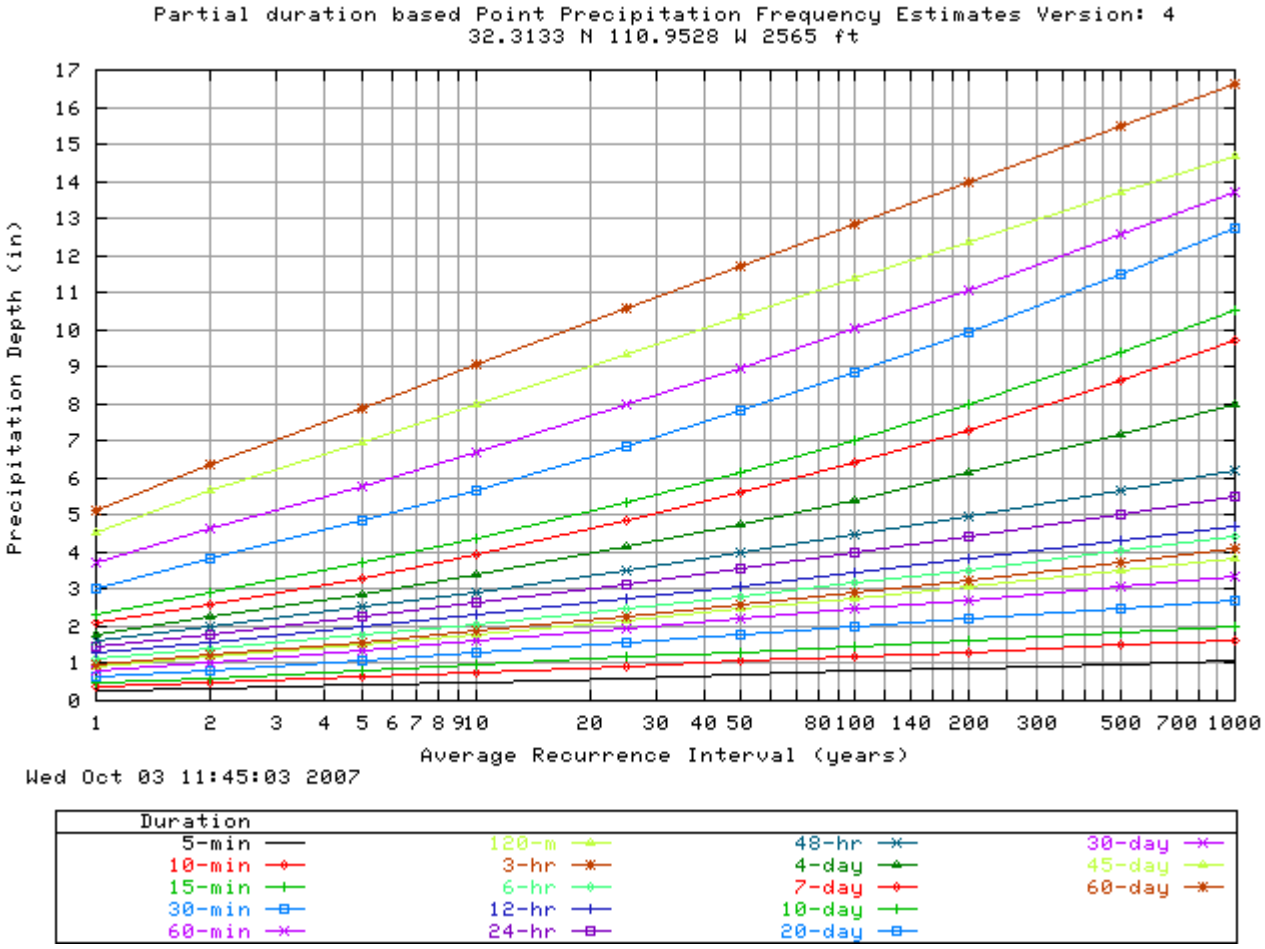
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

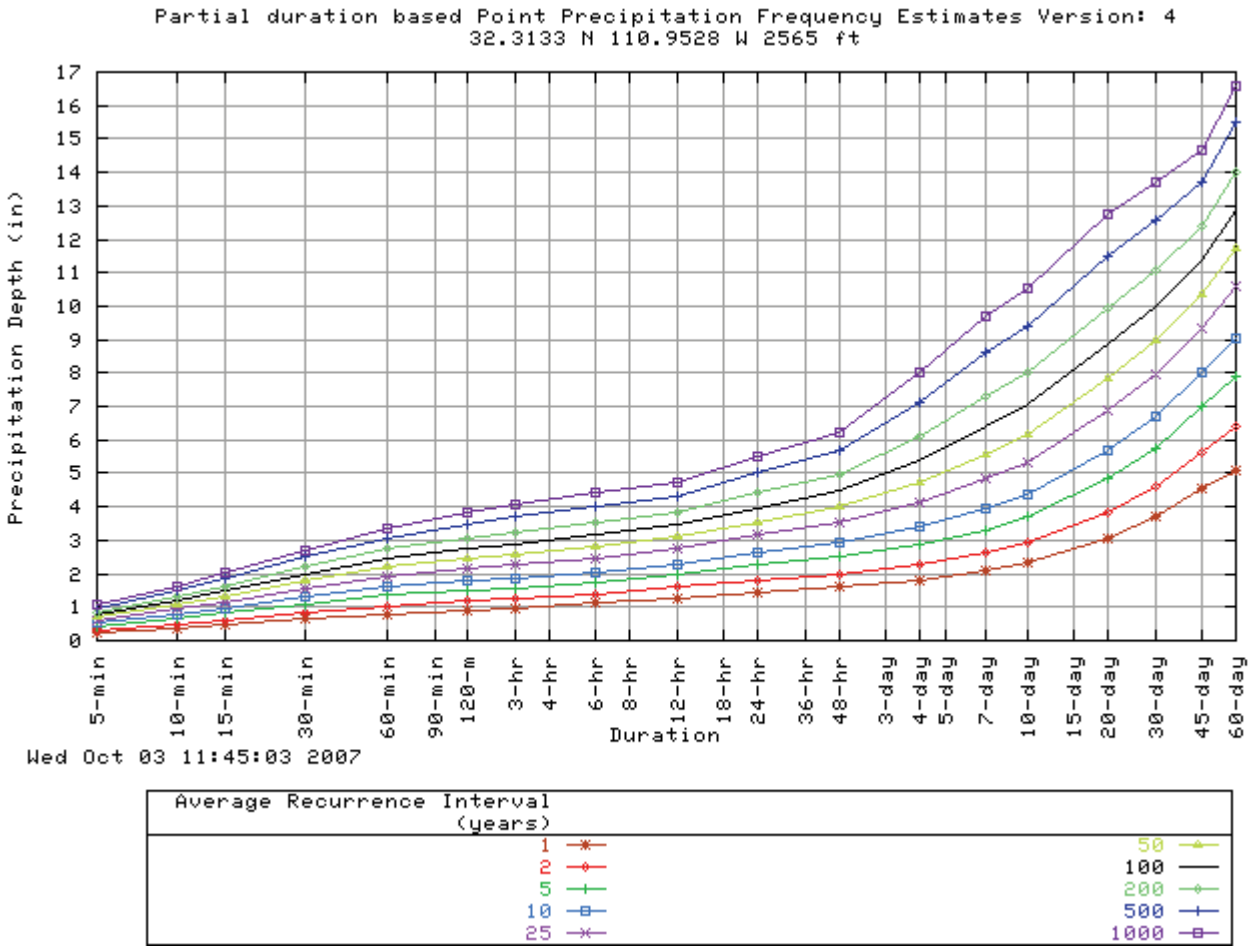
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.38	0.48	0.64	0.79	0.92	0.97	1.12	1.27	1.44	1.59	1.80	2.08	2.33	3.05	3.70	4.52	5.11
2	0.33	0.50	0.61	0.83	1.02	1.17	1.23	1.40	1.59	1.80	2.00	2.26	2.60	2.92	3.82	4.63	5.65	6.38
5	0.43	0.66	0.81	1.10	1.36	1.52	1.58	1.76	1.98	2.26	2.52	2.87	3.32	3.71	4.84	5.77	6.97	7.88
10	0.51	0.78	0.96	1.30	1.60	1.80	1.86	2.06	2.30	2.63	2.94	3.39	3.93	4.37	5.67	6.70	8.00	9.05
25	0.62	0.94	1.17	1.57	1.94	2.17	2.26	2.48	2.74	3.14	3.52	4.13	4.83	5.35	6.87	7.97	9.34	10.58
50	0.70	1.06	1.32	1.78	2.20	2.47	2.57	2.81	3.09	3.55	3.99	4.75	5.59	6.16	7.83	8.97	10.35	11.72
100	0.78	1.19	1.48	1.99	2.46	2.77	2.89	3.16	3.45	3.98	4.47	5.42	6.42	7.04	8.86	10.02	11.37	12.87
200	0.87	1.32	1.64	2.20	2.73	3.08	3.23	3.52	3.82	4.42	4.97	6.13	7.31	7.99	9.96	11.09	12.37	14.00
500	0.98	1.49	1.85	2.49	3.08	3.49	3.71	4.03	4.32	5.03	5.66	7.15	8.63	9.37	11.49	12.57	13.68	15.48
1000	1.06	1.62	2.01	2.70	3.35	3.82	4.09	4.43	4.72	5.51	6.21	8.00	9.73	10.52	12.74	13.72	14.67	16.60

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3133 N 110.9528 W 2565 ft
Precipitation Depth (in)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
1 2 3 4 5 6 7 8 9 10 20 30 40 50 80 100 140 200 300 500 700 1000
Average Recurrence Interval (years)
Wed Oct 03 11:45:03 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI (years)**	**5 min**	**10 min**	**15 min**	**30 min**	**60 min**	**120 min**	**3 hr**	**6 hr**	**12 hr**	**24 hr**	**48 hr**	**4 day**	**7 day**	**10 day**	**20 day**	**30 day**	**45 day**	**60 day**
1	0.29	0.44	0.54	0.73	0.90	1.03	1.10	1.26	1.42	1.58	1.75	1.98	2.29	2.57	3.34	4.03	4.90	5.54
2	0.37	0.57	0.70	0.94	1.17	1.32	1.39	1.57	1.77	1.98	2.19	2.48	2.87	3.22	4.19	5.04	6.13	6.95
5	0.49	0.74	0.92	1.24	1.54	1.72	1.79	1.98	2.21	2.48	2.75	3.15	3.65	4.08	5.32	6.29	7.57	8.57
10	0.58	0.88	1.09	1.47	1.82	2.02	2.10	2.31	2.56	2.89	3.21	3.71	4.32	4.82	6.24	7.29	8.68	9.84
25	0.70	1.06	1.32	1.77	2.19	2.44	2.54	2.77	3.05	3.46	3.85	4.53	5.33	5.90	7.57	8.69	10.17	11.54
50	0.79	1.20	1.49	2.01	2.49	2.77	2.88	3.14	3.44	3.92	4.38	5.22	6.20	6.81	8.65	9.81	11.29	12.83
100	0.89	1.35	1.68	2.26	2.79	3.11	3.27	3.54	3.85	4.41	4.94	6.00	7.17	7.85	9.85	11.02	12.46	14.14
200	0.99	1.50	1.86	2.51	3.11	3.47	3.67	3.96	4.29	4.93	5.54	6.84	8.25	8.99	11.15	12.28	13.64	15.49
500	1.12	1.71	2.12	2.86	3.54	3.97	4.24											

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Arizona 32.3153 N 110.9712 W 2450 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Oct 3 2007

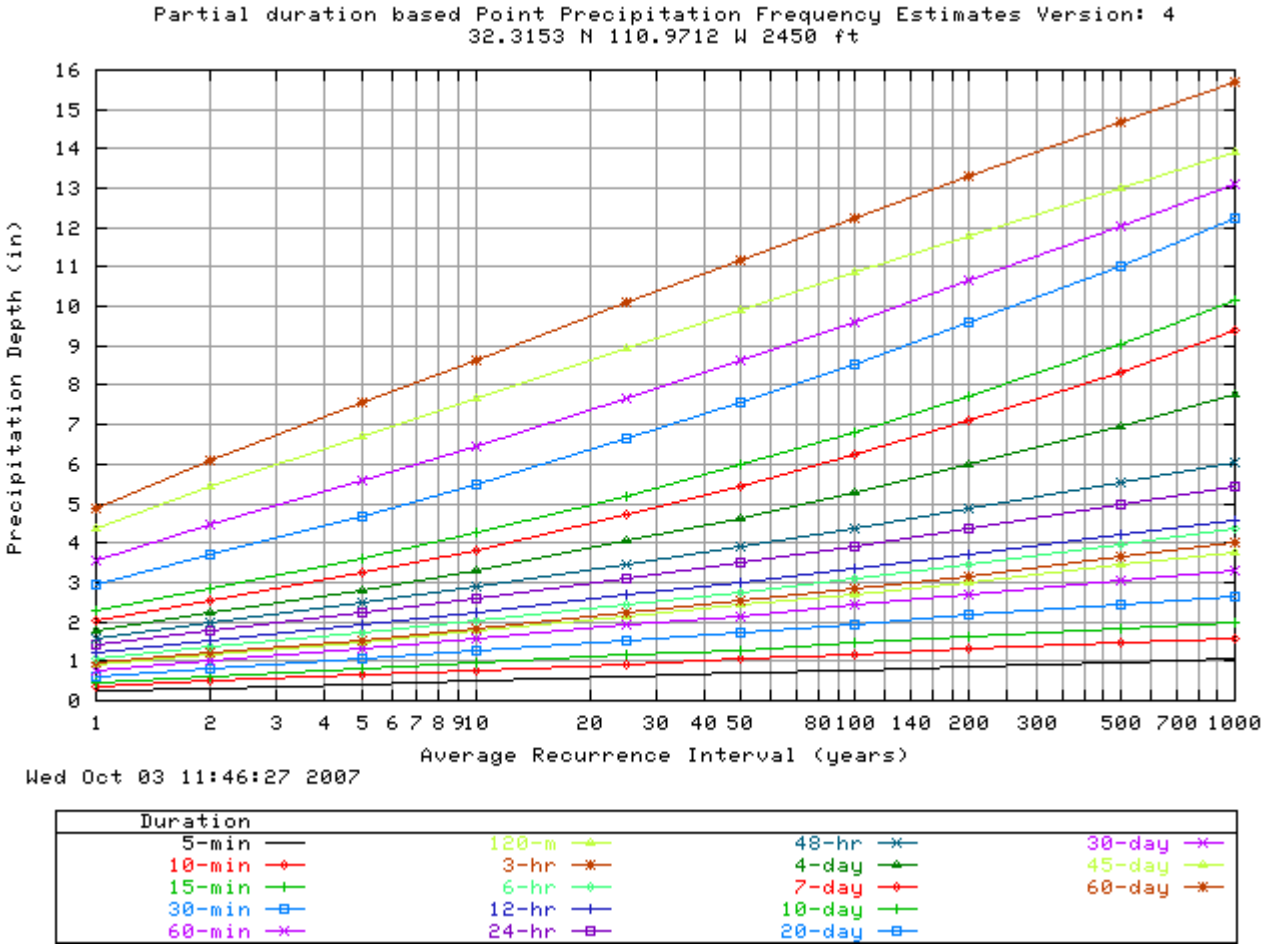
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.25	0.38	0.47	0.63	0.78	0.90	0.95	1.09	1.24	1.42	1.57	1.77	2.03	2.28	2.96	3.58	4.35	4.90
2	0.32	0.48	0.60	0.81	1.00	1.15	1.20	1.36	1.54	1.78	1.97	2.22	2.55	2.85	3.70	4.47	5.43	6.11
5	0.42	0.64	0.80	1.07	1.33	1.49	1.55	1.72	1.93	2.23	2.47	2.82	3.24	3.61	4.68	5.57	6.70	7.54
10	0.50	0.76	0.94	1.27	1.57	1.76	1.82	2.01	2.24	2.60	2.88	3.32	3.83	4.25	5.49	6.46	7.67	8.65
25	0.61	0.92	1.14	1.54	1.91	2.13	2.21	2.42	2.67	3.10	3.46	4.05	4.71	5.19	6.63	7.68	8.95	10.10
50	0.69	1.04	1.29	1.74	2.16	2.42	2.52	2.75	3.00	3.50	3.91	4.64	5.43	5.97	7.56	8.63	9.90	11.18
100	0.77	1.17	1.45	1.96	2.42	2.71	2.84	3.09	3.35	3.92	4.38	5.29	6.23	6.82	8.54	9.62	10.86	12.25
200	0.85	1.30	1.61	2.17	2.68	3.02	3.17	3.44	3.71	4.36	4.87	5.98	7.09	7.74	9.58	10.64	11.80	13.31
500	0.96	1.47	1.82	2.45	3.03	3.43	3.64	3.94	4.20	4.96	5.54	6.97	8.36	9.06	11.04	12.04	13.02	14.69
1000	1.05	1.60	1.98	2.66	3.30	3.75	4.02	4.34	4.59	5.43	6.07	7.79	9.41	10.16	12.23	13.13	13.93	15.71

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
32.3153 N 110.9712 W 2450 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Wed Oct 03 11:46:27 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
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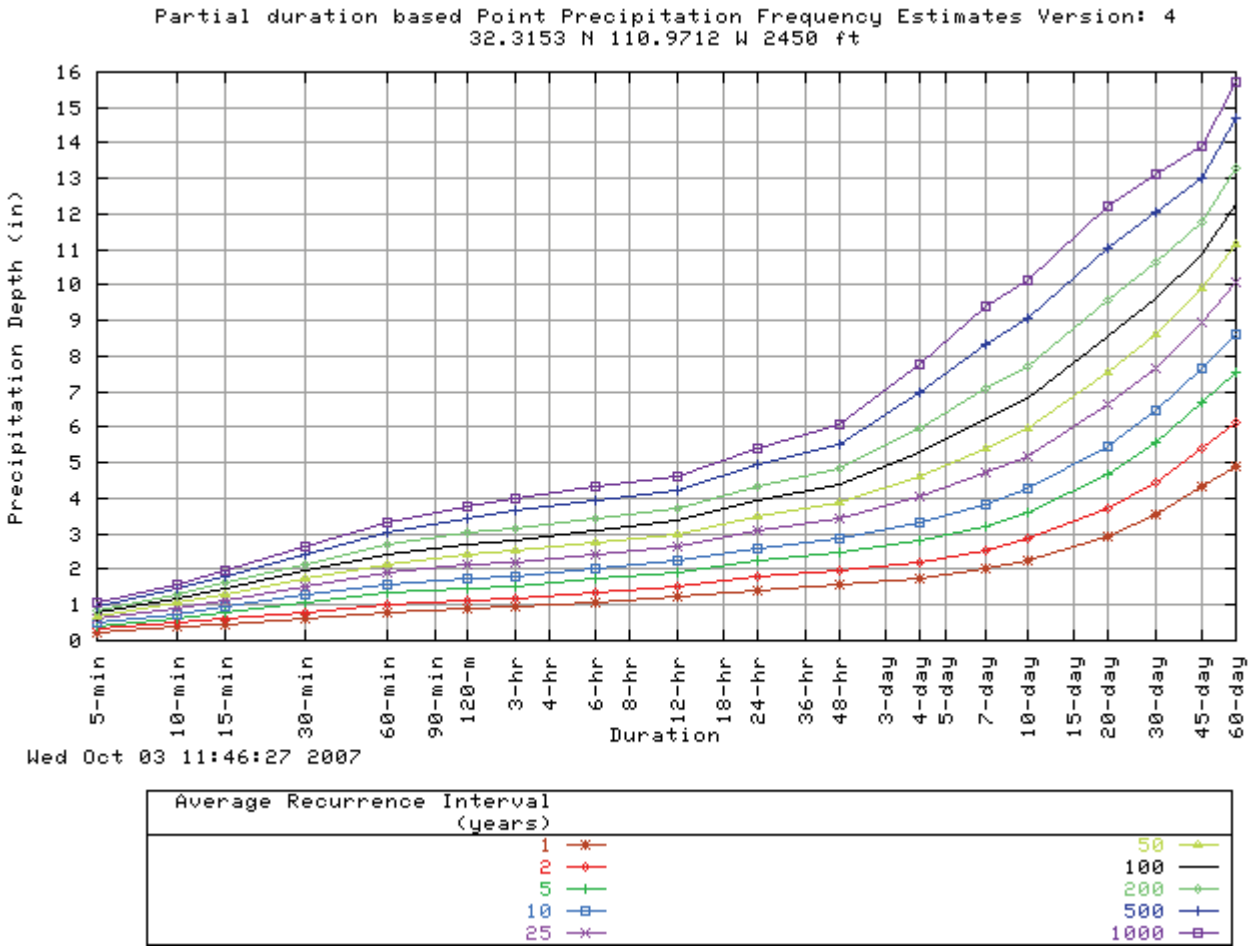
45-day
60-day



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.28	0.43	0.53	0.71	0.89	1.01	1.07	1.23	1.38	1.56	1.72	1.95	2.24	2.51	3.24	3.89	4.71	5.32
2	0.36	0.55	0.69	0.92	1.14	1.30	1.36	1.54	1.72	1.96	2.16	2.44	2.81	3.14	4.06	4.86	5.90	6.66
5	0.48	0.73	0.90	1.22	1.51	1.69	1.75	1.94	2.15	2.45	2.71	3.09	3.56	3.98	5.15	6.06	7.26	8.19
10	0.57	0.86	1.07	1.44	1.78	1.98	2.06	2.26	2.49	2.85	3.16	3.64	4.22	4.70	6.03	7.02	8.32	9.39
25	0.69	1.04	1.29	1.74	2.15	2.39	2.48	2.71	2.96	3.42	3.79	4.44	5.19	5.73	7.30	8.36	9.72	10.99
50	0.78	1.18	1.47	1.98	2.45	2.71	2.83	3.08	3.34	3.87	4.30	5.12	6.03	6.62	8.35	9.43	10.78	12.21
100	0.88	1.33	1.65	2.22	2.75	3.06	3.20	3.46	3.74	4.36	4.84	5.87	6.97	7.61	9.48	10.57	11.88	13.44
200	0.97	1.48	1.84	2.47	3.06	3.41	3.60	3.88	4.17	4.87	5.43	6.69	8.00	8.71	10.72	11.76	12.97	14.69
500	1.11	1.69	2.09	2.82	3.49	3.90	4.17	4.47	4.76	5.61	6.25	7.90	9.56	10.34	12.53	13.48	14.45	16.39
1000	1.22	1.85	2.29	3.09	3.82	4.31	4.64	4.97	5.25	6.19	6.92	8.94	10.92	11.76	14.05	14.86	15.59	17.70

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**

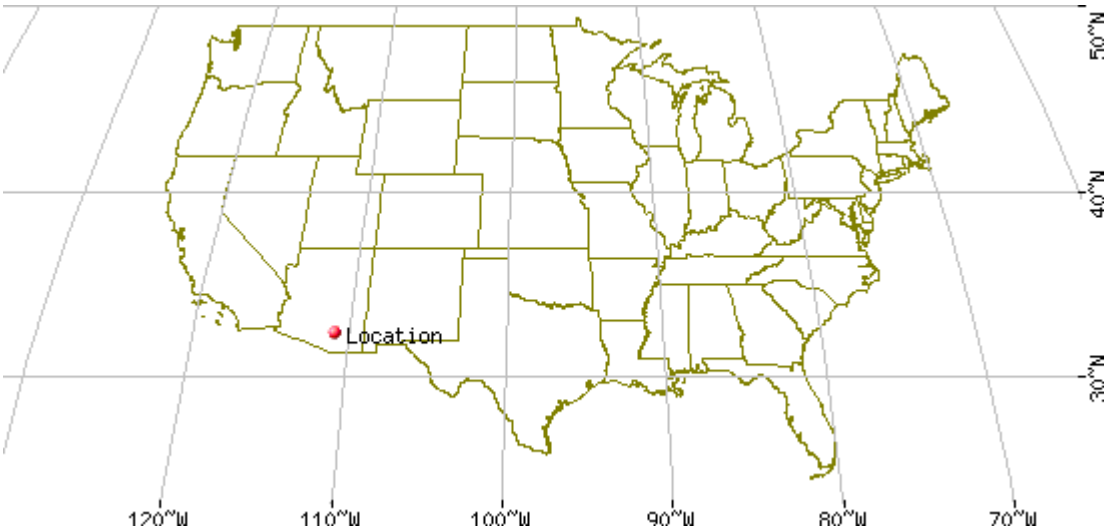
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.22	0.33	0.41	0.56	0.69	0.80	0.85	0.97	1.11	1.30	1.44	1.62	1.85	2.08	2.70	3.29	4.01	4.51
2	0.28	0.43	0.54	0.72	0.89	1.02	1.07	1.22	1.39	1.63	1.80	2.03	2.32	2.60	3.38	4.10	5.00	5.63
5	0.37	0.57	0.70	0.95	1.17	1.32	1.38	1.53	1.73	2.03	2.26	2.57	2.95	3.28	4.26	5.10	6.16	6.95
10	0.44	0.67	0.83	1.11	1.38	1.55	1.61	1.79	2.00	2.36	2.63	3.02	3.47	3.85	4.98	5.90	7.05	7.95
25	0.53	0.80	0.99	1.33	1.65	1.86	1.93	2.12	2.35	2.80	3.12	3.64	4.22	4.65	5.97	6.96	8.19	9.24
50	0.59	0.89	1.11	1.49	1.85	2.08	2.17	2.37	2.62	3.14	3.50	4.13	4.82	5.29	6.73	7.76	9.02	10.19
100	0.65	0.99	1.22	1.65	2.04	2.31	2.40	2.62	2.88	3.48	3.88	4.64	5.45	5.96	7.52	8.57	9.82	11.11
200	0.71	1.07	1.33	1.79	2.22	2.52	2.63	2.87	3.14	3.82	4.26	5.16	6.11	6.66	8.32	9.38	10.59	11.98
500	0.78	1.19	1.47	1.98	2.45	2.79	2.93	3.19	3.47	4.26	4.76	5.86	7.02	7.59	9.38	10.43	11.55	13.06
1000	0.83	1.26	1.57	2.11	2.61	2.98	3.15	3.45	3.72	4.61	5.13	6.42	7.75	8.35	10.19	11.19	12.23	13.83

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

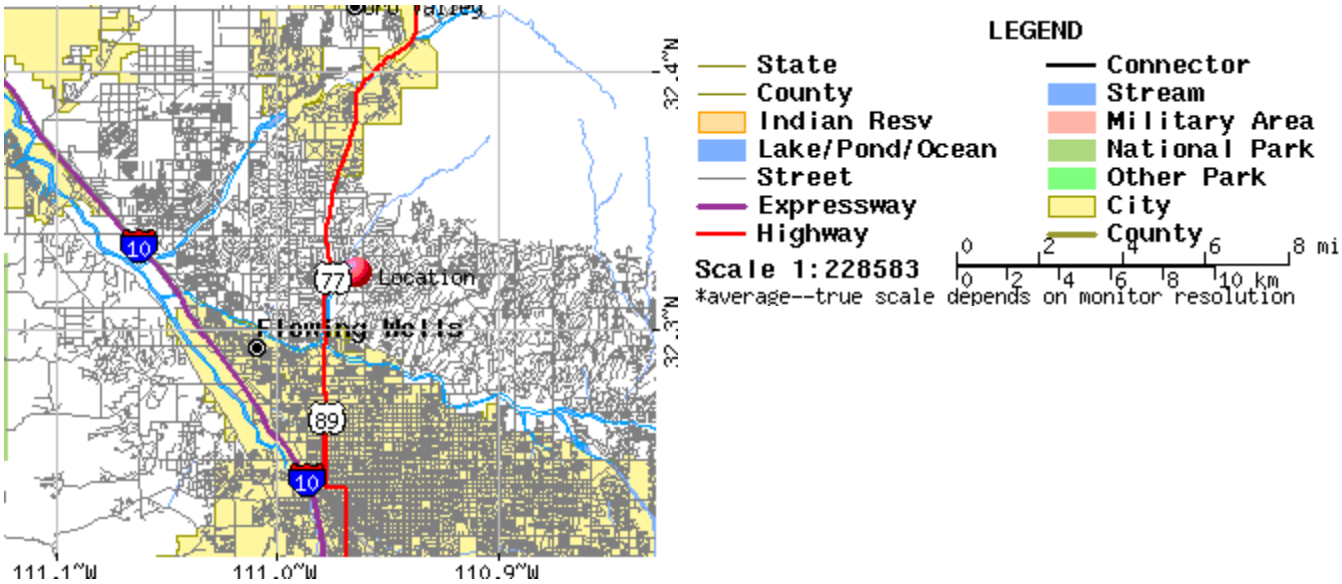
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (32.3153/-110.9712). Digital ASCII data can be obtained directly from **NCDC**.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

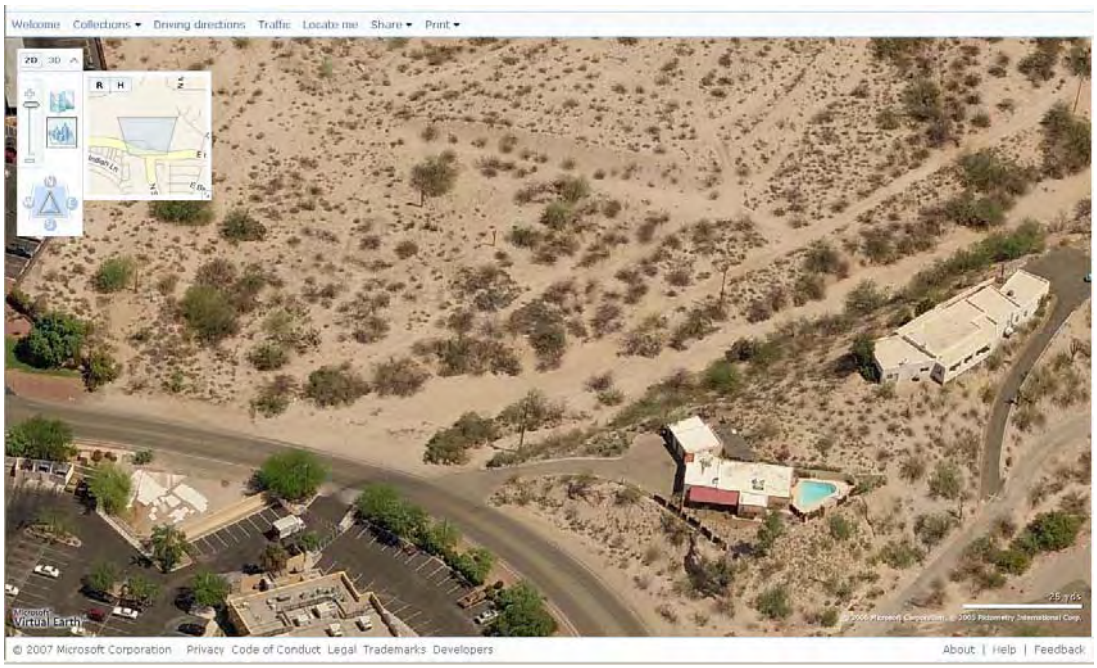
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX E: HYDRAULIC ANALYSIS SUPPORTING DOCUMENTS

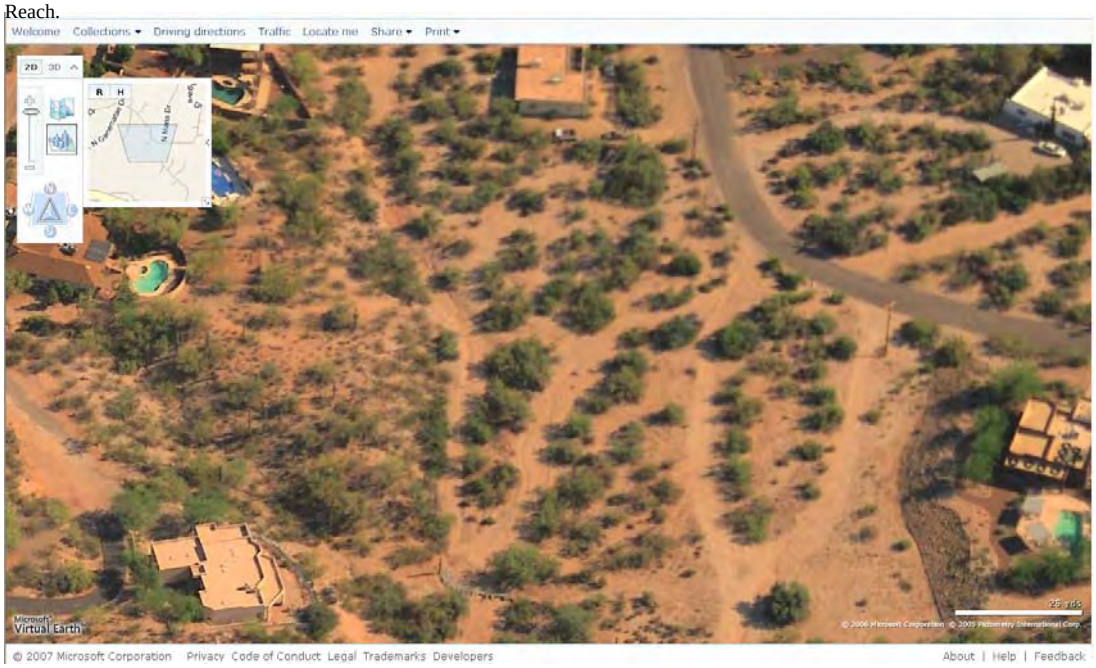
TETRA TECH, INC.

Bird's Eye View from Stone Loop: Cross Sections 8.249 thru 604.932 of the Friendly Village Wash, N Stone Loop Reach.

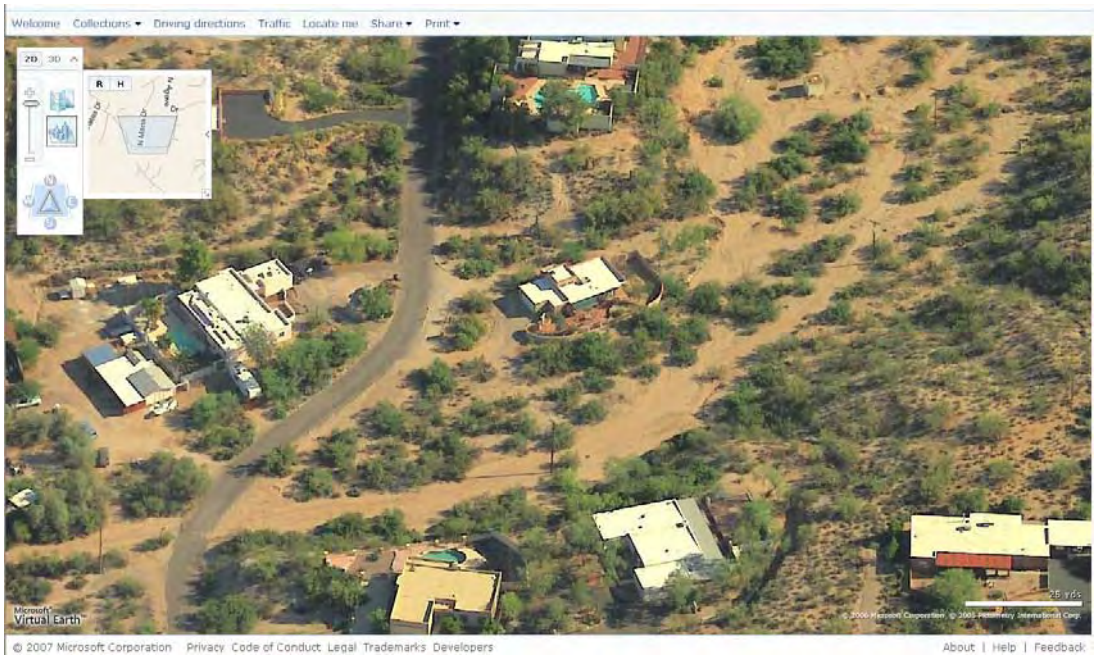


Bird's Eye View N of Stone Loop: Cross Sections 723.455 thru 11627.381 of the Friendly Village Wash, N Stone Loop Reach.

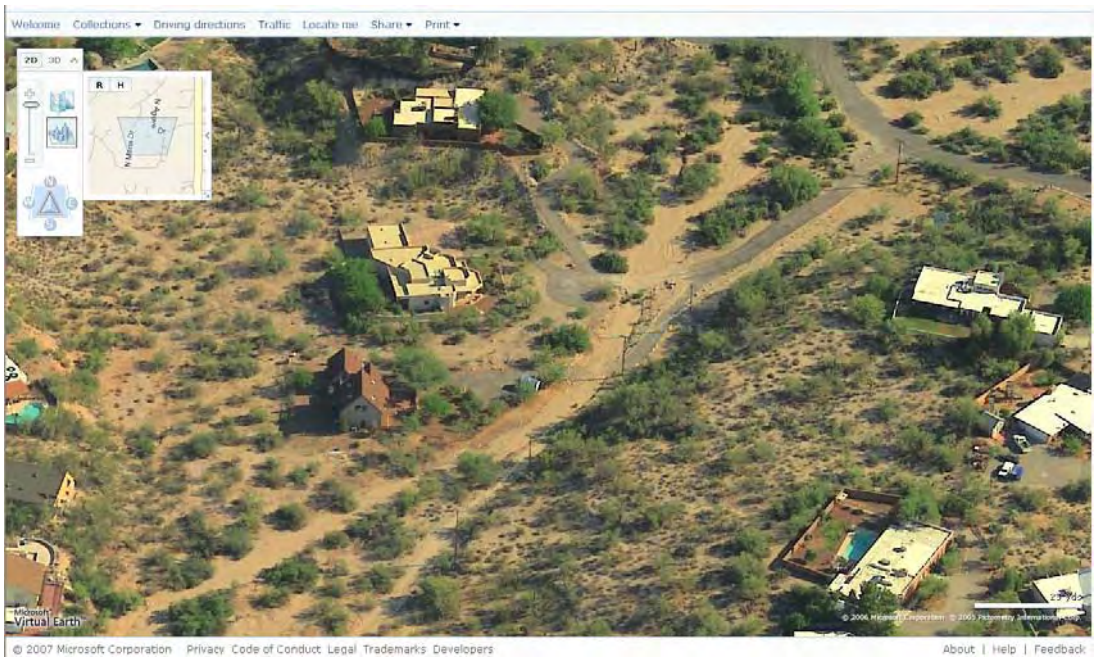
Bird's Eye View from Yvon Dr: Cross Sections 1798.727 thru 1922.703 of the Friendly Village Wash, N Stone Loop Reach, And Cross Sections 133.392 thru 396.746 of the East Agave Reach, and Cross Sections 106.664 thru 318.062 of the West Agave Reach.



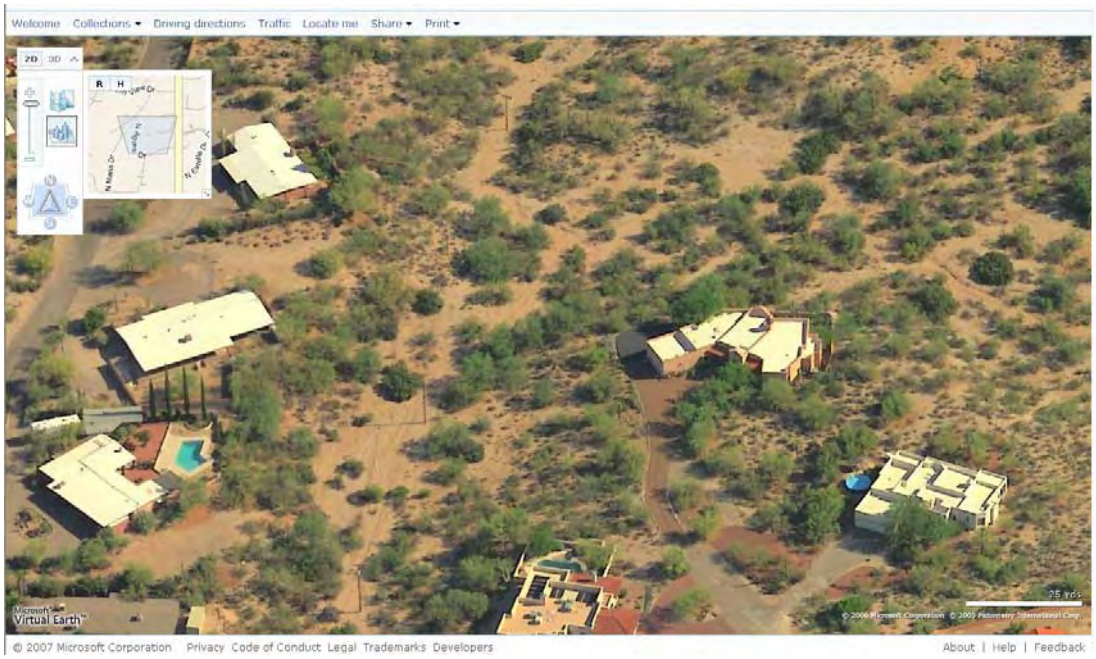
Bird's Eye View from Maria Dr: Contains Cross Sections 524.230 thru 1165.315 of the Friendly Village Wash, East Agave Reach.



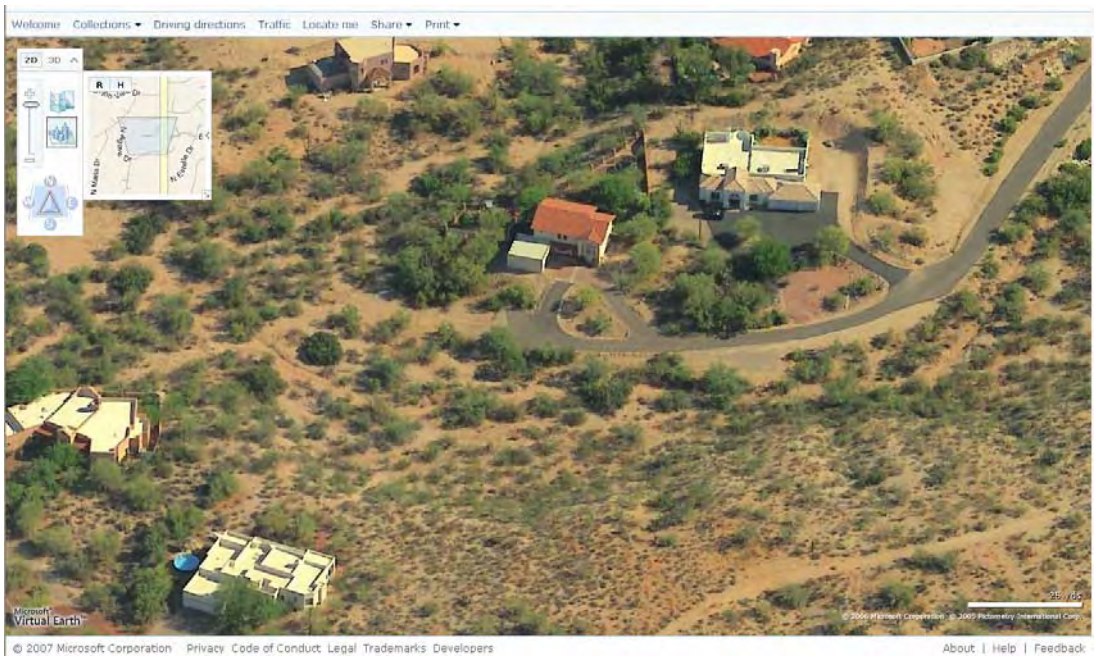
Bird's Eye View from Agave Dr: Contains Cross Sections 1254.975 thru 2008.843 of the Friendly Village Wash, East Agave Reach.



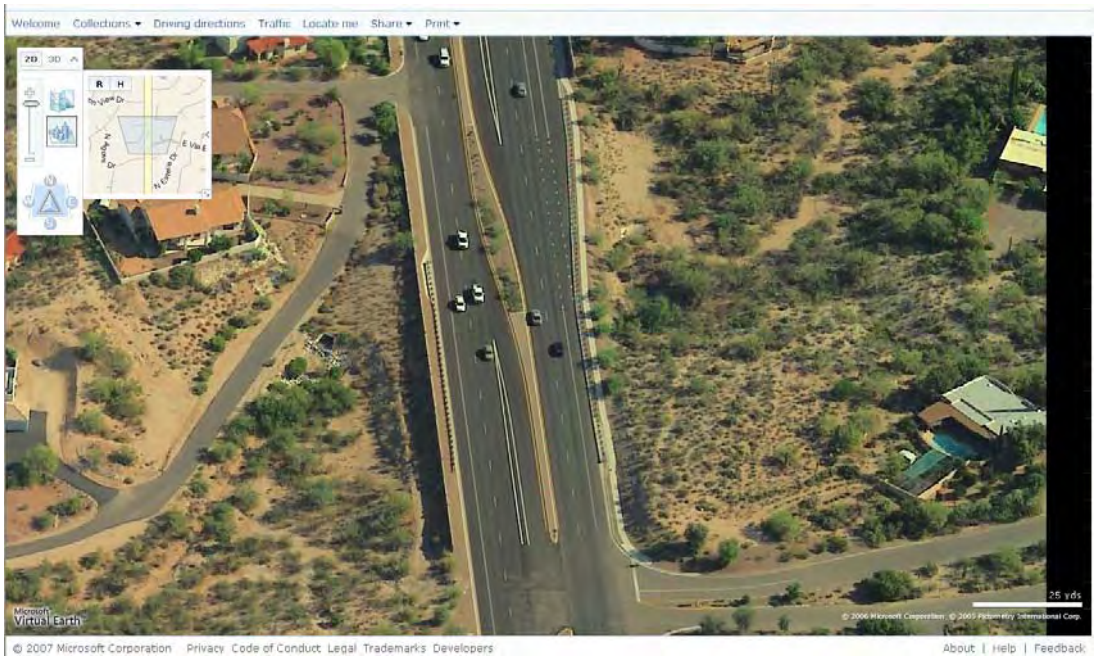
Bird's Eye View from Agave Dr: Contains Cross Sections 2190.491 thru 2977.182 of the Friendly Village Wash, East Agave Reach.



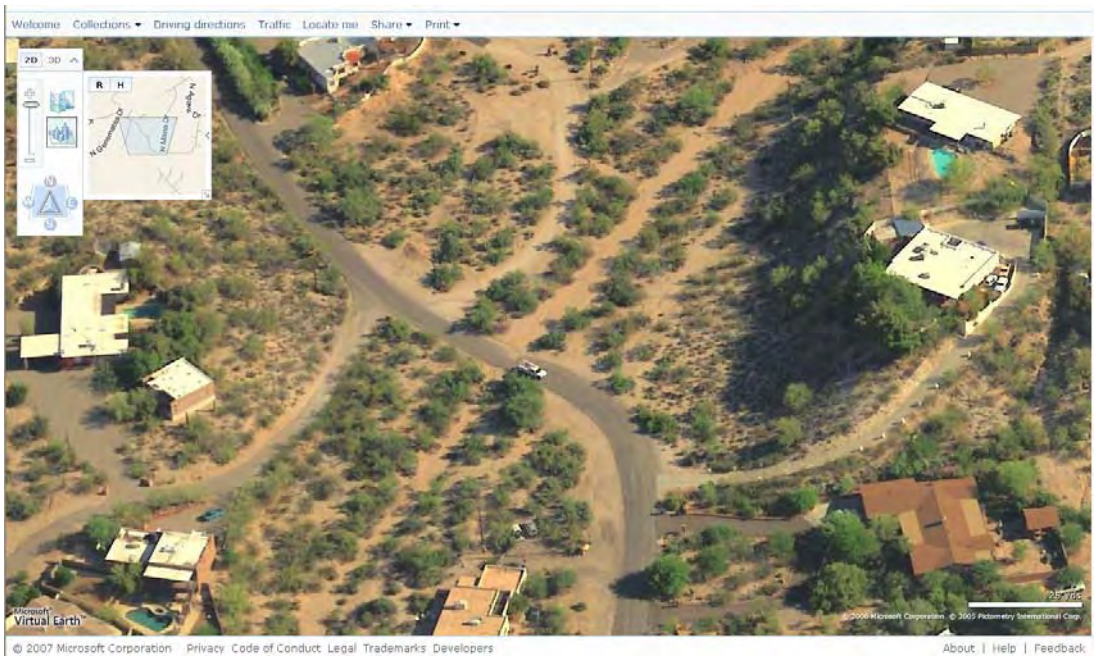
Bird's Eye View from Agave Dr: Contains Cross Sections 3080.023 thru 3487.724 of the Friendly Village Wash, East Agave Reach.



Bird's Eye View from Agave Dr: Contains Cross Sections 3605.777 thru 4231.989 of the Friendly Village Wash, East Agave Reach.

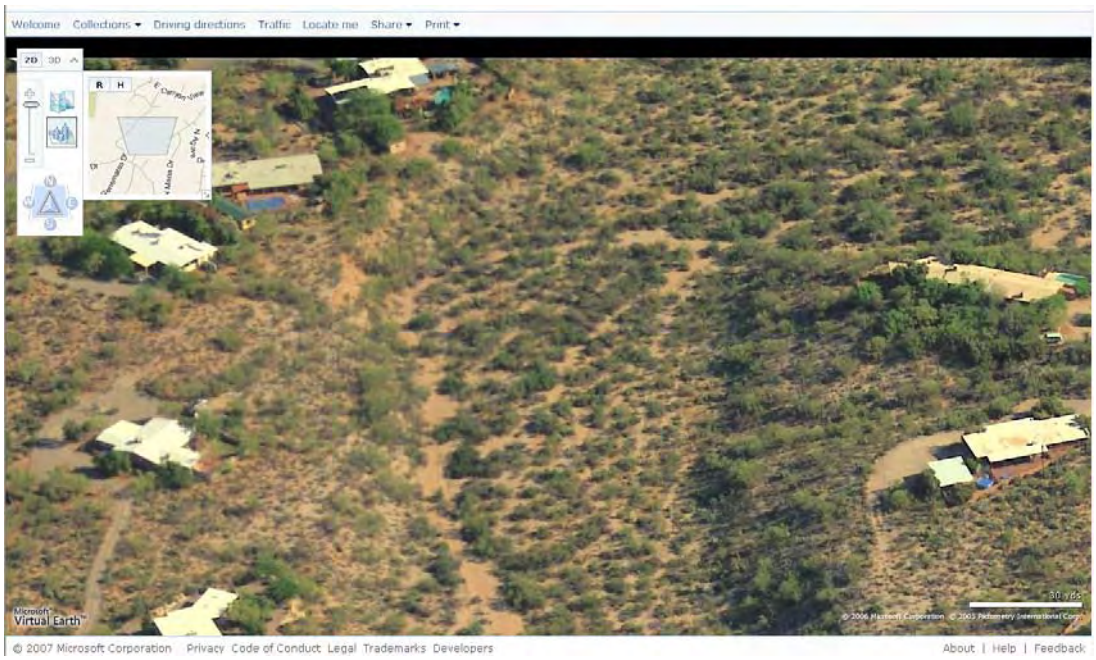


Bird's Eye View from Yvon Dr: Contains Cross Sections 391.885 thru 818.921 of the Friendly Village Wash, West Agave Reach.



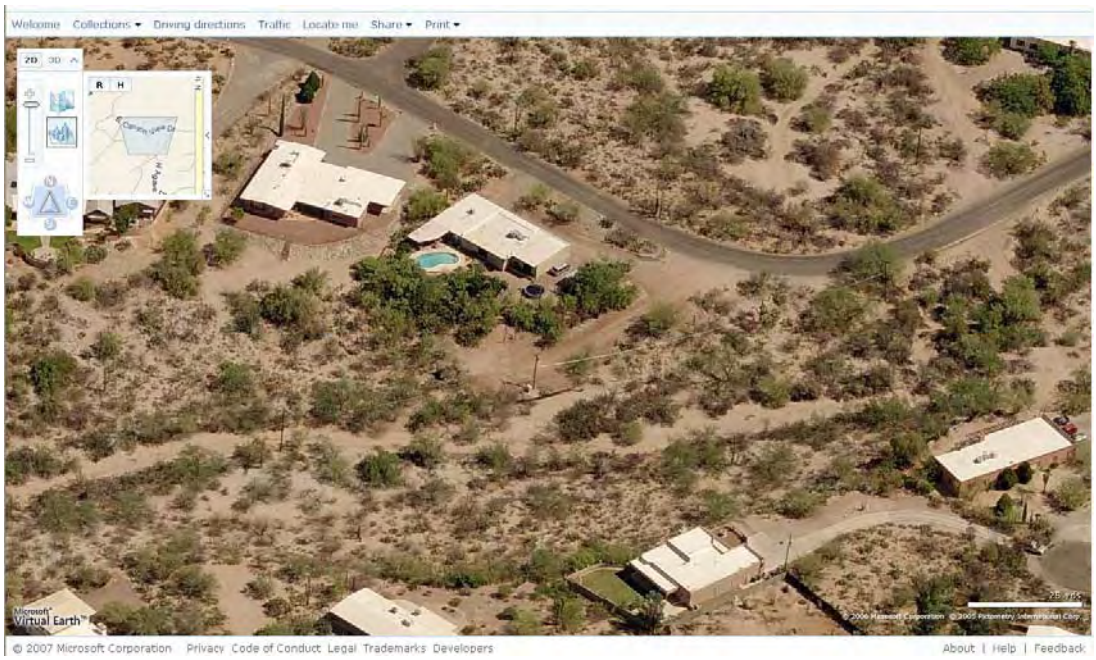
Bird's Eye View from Maria Dr: Contains Cross Sections 950.695 thru 1555.734 of the Friendly Village Wash, West Agave Reach.

Bird's Eye View from Genematas Dr: Cross Sections 1717.201 thru 2490.261 of the Friendly Village Wash, West Agave Reach.

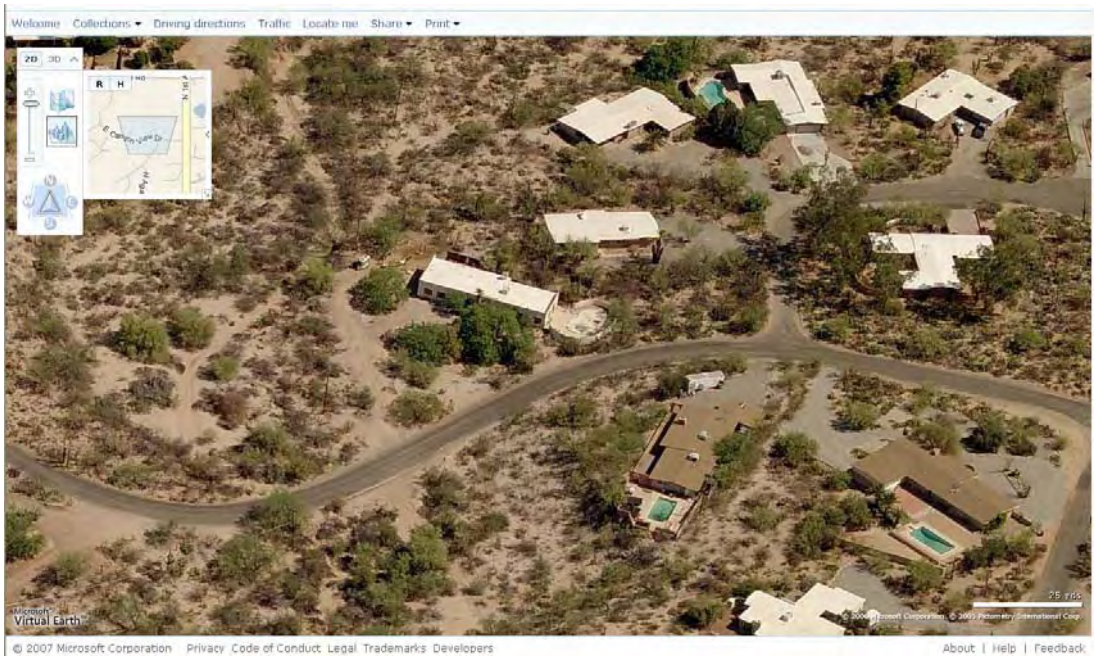


Bird's Eye View from Maria Dr: Contains Cross Sections 2711.800 thru 3481.460 of the Friendly Village Wash, West Agave Reach.

Bird's Eye View from Canyon View Dr: Cross Sections 3680.565 thru 4230.829 of the Friendly Village Wash, West Agave Reach.



Bird's Eye View from Canyon View Dr: Cross Sections 4330.355 thru 4901.107 of the Friendly Village Wash, West Agave Reach.



Bird's Eye View from 1st Ave: Contains Cross Sections 5072.790 thru 6089.955 of the Friendly Village Wash, West Agave Reach

Bird's Eye View from 1st Ave: Contains Cross Sections 6238.036 thru 7060.975 of the Friendly Village Wash, West Agave Reach

Bird's Eye View from 1st Ave: Contains Cross Sections 7322.689 thru 7855.624 of the Friendly Village Wash, West Agave Reach

HEC-RAS Plan: 100 River: East Agave Reach: Friendly Village Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Friendly Village	4231.989	PF 1	442.00	2458.08	2463.92		2463.92	0.000041	0.70	791.62	194.77	0.05
Friendly Village	4142.569	PF 1	442.00	2455.85	2463.90		2463.92	0.000058	1.40	619.00	137.37	0.09
Friendly Village	4134.666	PF 1	442.00	2453.76	2463.84	2458.07	2463.91	0.000042	2.57	486.15	111.99	0.15
Friendly Village	4008.442		Culvert									
Friendly Village	3882.219	PF 1	442.00	2447.94	2451.34	2451.34	2452.33	0.002036	8.11	68.52	66.60	0.89
Friendly Village	3801.929	PF 1	442.00	2446.72	2448.67	2448.67	2449.28	0.024564	6.31	73.11	70.71	0.96
Friendly Village	3726.793	PF 1	442.00	2443.42	2446.67	2446.67	2447.20	0.008643	6.30	93.65	90.49	0.87
Friendly Village	3605.777	PF 1	442.00	2441.70	2444.86	2444.86	2445.48	0.007675	7.32	96.57	79.22	0.86
Friendly Village	3487.724	PF 1	442.00	2440.07	2442.83	2442.83	2443.54	0.008137	7.17	79.06	60.25	0.88
Friendly Village	3350.988	PF 1	442.00	2438.22	2440.45	2440.45	2441.00	0.009333	6.34	91.74	92.60	0.90
Friendly Village	3199.552	PF 1	442.00	2435.58	2437.42	2437.42	2437.75	0.011601	6.38	135.48	197.14	0.98
Friendly Village	3080.023	PF 1	442.00	2433.35	2434.99	2434.99	2435.47	0.012226	6.05	94.86	108.85	0.99
Friendly Village	2977.182	PF 1	442.00	2430.26	2432.70	2432.70	2433.21	0.007469	6.11	98.55	133.16	0.82
Friendly Village	2901.479	PF 1	442.00	2428.85	2431.07	2431.07	2431.49	0.011582	6.11	108.75	130.84	0.97
Friendly Village	2786.054	PF 1	442.00	2426.85	2428.97	2428.97	2429.61	0.011400	6.45	71.01	62.58	0.98
Friendly Village	2674.162	PF 1	666.00	2425.29	2426.79	2426.79	2427.32	0.012258	5.86	117.72	125.21	0.98
Friendly Village	2577.322	PF 1	666.00	2422.76	2424.63	2424.63	2425.20	0.013076	6.11	109.27	97.83	1.01
Friendly Village	2470.940	PF 1	666.00	2420.25	2422.16	2422.16	2422.80	0.014098	6.42	106.14	90.32	1.00
Friendly Village	2312.754	PF 1	666.00	2416.71	2418.70	2418.70	2419.16	0.010956	5.82	143.93	162.35	0.90
Friendly Village	2190.491	PF 1	666.00	2413.66	2415.34	2415.34	2415.76	0.012336	5.24	137.62	187.78	0.96
Friendly Village	2088.843	PF 1	666.00	2411.18	2413.14	2413.14	2413.68	0.012204	6.91	161.95	152.15	1.02
Friendly Village	1983.703	PF 1	666.00	2408.15	2410.16	2410.16	2410.71	0.009702	6.99	144.21	130.97	0.94
Friendly Village	1869.547	PF 1	666.00	2405.73	2407.80	2407.80	2408.37	0.008856	6.71	137.07	133.23	0.90
Friendly Village	1669.198	PF 1	666.00	2400.79	2402.64	2402.64	2402.99	0.014206	6.52	176.07	240.41	1.06
Friendly Village	1445.975	PF 1	666.00	2396.27	2398.18	2398.18	2398.57	0.009845	6.54	185.20	208.06	0.93
Friendly Village	1336.348	PF 1	666.00	2394.52	2396.27	2396.27	2396.73	0.017576	7.70	154.08	169.07	1.20
Friendly Village	1254.975	PF 1	666.00	2392.93	2394.56	2394.56	2395.09	0.013608	6.65	136.91	140.81	1.05
Friendly Village	1165.315	PF 1	666.00	2390.65	2392.42	2392.42	2392.91	0.011393	6.22	144.60	168.21	0.97
Friendly Village	1065.567	PF 1	666.00	2387.93	2390.19	2390.19	2390.74	0.008098	6.29	136.51	136.32	0.85
Friendly Village	876.724	PF 1	666.00	2384.45	2386.09	2386.09	2386.44	0.008923	5.80	195.16	257.37	0.87
Friendly Village	753.438	PF 1	666.00	2381.41	2383.05	2383.05	2383.40	0.011024	5.68	189.73	280.79	0.93
Friendly Village	646.732	PF 1	666.00	2378.48	2380.82	2380.82	2381.22	0.006653	6.22	259.34	294.90	0.79
Friendly Village	524.230	PF 1	666.00	2375.35	2377.43	2377.43	2377.91	0.008949	6.45	162.69	176.17	0.89
Friendly Village	396.746	PF 1	666.00	2372.66	2374.82	2374.82	2375.32	0.010727	7.33	166.47	186.29	0.98
Friendly Village	311.940	PF 1	666.00	2371.03	2372.93	2372.93	2373.29	0.013341	6.08	181.32	255.35	0.93
Friendly Village	133.392	PF 1	666.00	2366.26	2368.13	2368.13	2368.68	0.010783	7.17	144.03	158.26	0.98

HEC-RAS Plan: 100 River: West Agave Reach: Friendly Village Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Friendly Village	7855.624	PF 1	1007.00	2507.78	2510.88	2510.88	2511.81	0.008465	8.88	164.01	88.09	0.95
Friendly Village	7695.344	PF 1	1007.00	2505.39	2507.38	2507.38	2507.95	0.016569	8.11	196.90	170.62	1.19
Friendly Village	7634.056	PF 1	1007.00	2504.42	2506.28	2506.26	2506.89	0.015388	7.78	184.54	146.93	1.15
Friendly Village	7548.992	PF 1	1007.00	2503.76	2504.93	2504.76	2505.30	0.015494	5.28	208.67	200.34	1.04
Friendly Village	7458.524	PF 1	1007.00	2501.54	2503.46	2503.46	2503.96	0.017003	7.57	207.25	199.63	1.18
Friendly Village	7322.689	PF 1	1007.00	2499.86	2503.08		2503.13	0.000468	2.15	678.65	275.02	0.22
Friendly Village	7060.975	PF 1	1007.00	2495.94	2503.10		2503.10	0.000029	0.69	1957.30	370.14	0.05
Friendly Village	6948.075	PF 1	1007.00	2493.40	2503.08	2497.36	2503.10	0.000015	1.63	2145.10	427.46	0.10
Friendly Village	6855.821		Culvert									
Friendly Village	6763.567	PF 1	1007.00	2485.35	2490.28	2490.28	2491.78	0.002110	9.96	118.27	55.55	0.96
Friendly Village	6699.811	PF 1	1007.00	2485.22	2488.45	2488.45	2489.61	0.009335	8.71	125.61	69.12	0.97
Friendly Village	6574.371	PF 1	1007.00	2482.22	2487.09	2487.09	2488.44	0.008951	9.35	112.91	54.01	0.97
Friendly Village	6392.817	PF 1	1007.00	2480.13	2485.60	2485.60	2486.54	0.005774	8.27	186.03	149.20	0.80
Friendly Village	6238.036	PF 1	1007.00	2479.03	2483.33	2483.33	2484.28	0.007413	9.50	207.58	137.89	0.91
Friendly Village	6089.955	PF 1	1007.00	2477.11	2480.31		2480.56	0.007262	5.79	299.66	250.95	0.80
Friendly Village	6026.115	PF 1	1007.00	2476.15	2479.46	2479.41	2479.98	0.018525	8.09	201.50	204.39	1.22
Friendly Village	5768.415	PF 1	1007.00	2473.30	2476.47	2476.45	2477.47	0.009553	8.13	139.53	83.48	0.97
Friendly Village	5669.909	PF 1	1007.00	2472.39	2475.37	2475.37	2476.05	0.022361	7.99	162.46	121.57	1.18
Friendly Village	5505.832	PF 1	1007.00	2469.24	2472.48		2472.84	0.008039	4.83	208.95	152.91	0.71
Friendly Village	5251.436	PF 1	1007.00	2466.34	2469.59	2469.59	2470.55	0.009614	7.89	133.15	94.26	0.96
Friendly Village	5072.790	PF 1	1007.00	2464.53	2468.10	2468.10	2468.86	0.008169	7.81	206.93	146.70	0.90
Friendly Village	4901.107	PF 1	1007.00	2462.68	2466.17	2466.17	2466.91	0.008537	8.37	196.67	137.80	0.93
Friendly Village	4753.088	PF 1	1007.00	2460.34	2464.18	2464.18	2465.21	0.007948	8.79	165.17	88.79	0.92
Friendly Village	4612.978	PF 1	1007.00	2458.64	2461.51	2461.23	2461.84	0.012898	4.58	219.79	171.85	0.71
Friendly Village	4531.991	PF 1	1007.00	2457.51	2459.87	2459.87	2460.46	0.017281	7.30	175.79	139.52	1.18
Friendly Village	4423.094	PF 1	1007.00	2455.02	2457.20	2457.20	2457.74	0.009374	6.54	211.90	200.37	0.91
Friendly Village	4330.355	PF 1	1007.00	2452.56	2454.71	2454.71	2455.25	0.035929	5.88	171.14	159.52	1.00
Friendly Village	4230.829	PF 1	1007.00	2449.06	2452.49		2452.66	0.007198	3.23	311.49	179.50	0.43
Friendly Village	4091.483	PF 1	1007.00	2446.58	2450.02	2449.93	2450.75	0.032353	6.84	147.27	87.74	0.93
Friendly Village	3986.068	PF 1	1007.00	2444.37	2448.34	2448.34	2449.40	0.006746	8.87	170.87	98.72	0.86
Friendly Village	3864.383	PF 1	1007.00	2442.04	2446.19	2446.19	2447.07	0.005835	8.48	192.01	115.09	0.81
Friendly Village	3680.565	PF 1	1007.00	2439.10	2442.36	2442.36	2443.26	0.010629	7.80	144.57	101.57	1.00
Friendly Village	3481.460	PF 1	1007.00	2435.94	2438.82	2438.82	2439.50	0.012665	6.60	152.50	116.93	1.02
Friendly Village	3366.345	PF 1	1007.00	2433.80	2436.32	2436.32	2436.93	0.015243	6.25	161.14	135.25	1.01
Friendly Village	3255.776	PF 1	1007.00	2431.57	2433.73	2433.70	2434.18	0.023516	5.59	189.71	202.53	1.00
Friendly Village	3172.293	PF 1	1007.00	2429.81	2431.60	2431.60	2432.02	0.026156	5.21	193.21	238.37	1.02
Friendly Village	3064.242	PF 1	1007.00	2427.94	2429.57	2429.57	2430.09	0.011771	5.85	183.03	197.23	0.97
Friendly Village	2940.349	PF 1	1007.00	2425.15	2426.77	2426.77	2427.13	0.020357	6.26	247.61	355.53	1.21
Friendly Village	2711.800	PF 1	1101.00	2420.45	2422.07	2421.97	2422.32	0.017515	4.10	275.35	384.20	0.83
Friendly Village	2490.261	PF 1	1101.00	2415.83	2417.33	2417.31	2417.70	0.025149	4.91	224.14	293.65	0.99
Friendly Village	2325.093	PF 1	1101.00	2411.15	2413.01	2413.01	2413.45	0.026130	5.33	206.56	246.47	1.02
Friendly Village	2009.964	PF 1	1101.00	2405.26	2408.38	2408.38	2408.97	0.006515	7.18	267.43	232.88	0.81
Friendly Village	1873.512	PF 1	1101.00	2402.67	2405.20	2405.20	2405.76	0.008069	7.09	249.58	213.86	0.88
Friendly Village	1717.201	PF 1	1101.00	2399.76	2401.92	2401.92	2402.44	0.008898	6.92	255.30	237.06	0.91
Friendly Village	1555.734	PF 1	1101.00	2396.13	2398.08	2398.08	2398.57	0.013259	6.88	241.34	241.99	1.05
Friendly Village	1434.165	PF 1	1101.00	2392.85	2394.83	2394.83	2395.28	0.021625	7.58	241.53	289.96	1.29
Friendly Village	1270.626	PF 1	1101.00	2390.10	2391.76	2391.76	2392.27	0.015629	6.87	231.69	282.73	1.12
Friendly Village	1042.856	PF 1	1101.00	2384.57	2388.08	2388.08	2388.77	0.006210	7.63	225.16	186.74	0.81
Friendly Village	950.695	PF 1	1101.00	2382.91	2385.73	2385.73	2386.31	0.006770	7.12	259.03	228.08	0.83
Friendly Village	818.921	PF 1	1101.00	2380.29	2382.87	2382.87	2383.49	0.008454	6.66	206.24	183.65	0.88
Friendly Village	691.898	PF 1	1101.00	2378.27	2380.56	2380.56	2381.18	0.010022	7.16	217.94	178.77	0.96
Friendly Village	589.317	PF 1	1101.00	2376.50	2378.63	2378.63	2379.21	0.011915	6.65	205.79	186.27	1.00
Friendly Village	496.446	PF 1	1101.00	2372.44	2376.25	2376.25	2376.83	0.006680	7.39	258.52	203.32	0.82
Friendly Village	391.885	PF 1	1101.00	2370.97	2374.30	2374.30	2374.78	0.006659	7.09	300.38	279.32	0.81
Friendly Village	318.062	PF 1	1101.00	2369.68	2373.22	2373.22	2373.72	0.008542	7.13	279.51	290.23	0.89
Friendly Village	223.718	PF 1	1101.00	2367.01	2370.78	2370.78	2371.46	0.007494	7.93	225.63	150.33	0.87
Friendly Village	106.664	PF 1	1101.00	2364.36	2369.10	2369.10	2369.95	0.005157	8.78	228.18	129.31	0.78

HEC-RAS Plan: 100 River: North Stone Loop Reach: Friendly Village Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Friendly Village	1922.703	PF 1	1671.00	2361.97	2365.34	2365.34	2366.37	0.010276	8.24	218.32	160.70	1.00
Friendly Village	1798.727	PF 1	1671.00	2359.89	2363.52	2363.52	2364.27	0.006606	8.30	340.83	226.11	0.85
Friendly Village	1627.381	PF 1	1671.00	2356.26	2360.01	2360.01	2360.70	0.005054	7.38	368.52	286.70	0.74
Friendly Village	1446.308	PF 1	1671.00	2352.49	2355.28	2355.28	2355.77	0.012765	6.93	359.62	325.90	1.03
Friendly Village	1307.534	PF 1	1671.00	2349.76	2352.92	2352.92	2353.37	0.011432	6.14	358.29	350.75	1.02
Friendly Village	1205.304	PF 1	1671.00	2347.97	2350.79	2350.79	2351.24	0.011844	6.07	349.87	346.53	1.03
Friendly Village	1108.411	PF 1	1671.00	2346.45	2348.45	2348.45	2348.97	0.016498	6.57	308.04	271.91	1.09
Friendly Village	982.510	PF 1	1671.00	2343.19	2345.60	2345.60	2346.24	0.014284	6.45	264.34	215.68	0.99
Friendly Village	861.334	PF 1	1671.00	2340.78	2342.94	2342.93	2343.71	0.010985	7.09	245.71	163.69	0.99
Friendly Village	723.455	PF 1	1671.00	2337.48	2341.59	2341.59	2342.55	0.006557	8.83	296.57	155.66	0.85
Friendly Village	604.932	PF 1	1671.00	2334.90	2339.91	2339.91	2340.98	0.004729	8.93	288.75	159.97	0.74
Friendly Village	479.976	PF 1	1671.00	2332.07	2336.93	2336.93	2338.07	0.006329	9.00	252.45	147.51	0.84
Friendly Village	304.909	PF 1	1671.00	2328.63	2331.79	2331.79	2333.00	0.009107	8.92	201.91	101.13	0.97
Friendly Village	237.481	PF 1	1671.00	2327.15	2331.13	2330.53	2331.68	0.004837	6.09	324.30	232.17	0.65
Friendly Village	175.536	PF 1	1671.00	2325.98	2329.27	2329.27	2330.08	0.006435	7.66	243.17	177.83	0.89

Errors Warnings and Notes for Plan : 100

Location:	River: East Agave Reach: Friendly Village RS: 4231.989 Profile: PF 1
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: East Agave Reach: Friendly Village RS: 4142.569 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: East Agave Reach: Friendly Village RS: 4008.442 Profile: PF 1 Culv: Culvert #1
Warning:	Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section downstream of the culvert has supercritical flow.
Note:	Culvert critical depth exceeds the height of the culvert.
Note:	The flow in the culvert is entirely supercritical.
Location:	River: East Agave Reach: Friendly Village RS: 3882.219 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3801.929 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3726.793 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3605.777 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3487.724 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3350.988 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3199.552 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 3080.023 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2977.182 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2901.479 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2786.054 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2674.162 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2577.322 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2470.940 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2312.754 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2190.491 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 2088.843 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1983.703 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1869.547 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to

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	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1669.198 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1445.975 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: East Agave Reach: Friendly Village RS: 1336.348 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1254.975 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1165.315 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 1065.567 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 876.724 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 753.438 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 646.732 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 524.230 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 396.746 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: East Agave Reach: Friendly Village RS: 311.940 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Note:	Manning's n values were composited to a single value in the main channel.
Location:	River: East Agave Reach: Friendly Village RS: 133.392 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1922.703 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1798.727 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1627.381 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1446.308 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1307.534 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1205.304 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 1108.411 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.

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Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 982.510 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 861.334 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: North Stone Loop Reach: Friendly Village RS: 723.455 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 604.932 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 479.976 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 304.909 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 237.481 Profile: PF 1
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: North Stone Loop Reach: Friendly Village RS: 175.536 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 92.691 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: North Stone Loop Reach: Friendly Village RS: 8.249 Profile: PF 1
Note:	Manning's n values were composited to a single value in the main channel.
Location:	River: West Agave Reach: Friendly Village RS: 7855.624 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 7695.344 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 7634.056 Profile: PF 1
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 7548.992 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 7458.524 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 7322.689 Profile: PF 1
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 6855.821 Profile: PF 1 Culv: Culvert #1
Note:	The flow in the culvert is entirely supercritical.
Location:	River: West Agave Reach: Friendly Village RS: 6763.567 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 6699.811 Profile: PF 1
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 6574.371 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 6392.817 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 6238.036 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 6089.955 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 6026.115 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 5768.415 Profile: PF 1

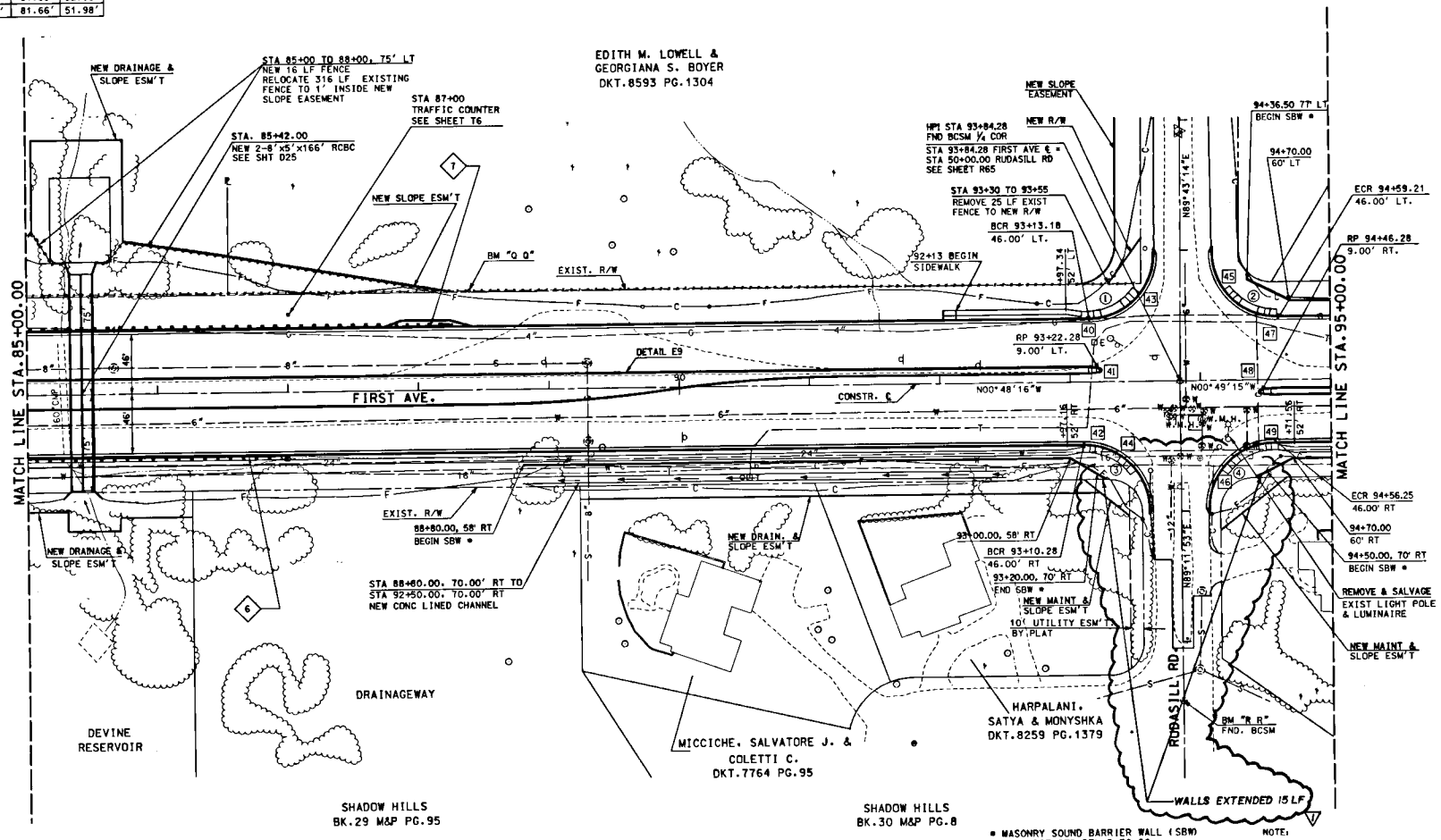
Errors Warnings and Notes for Plan : 100 (Continued)

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 5669.909 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 5505.832 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 5251.436 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 5072.790 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4901.107 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4753.088 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4612.978 Profile: PF 1
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 4531.991 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4423.094 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4330.355 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 4230.829 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Note:	Manning's n values were composited to a single value in the main channel.
Location:	River: West Agave Reach: Friendly Village RS: 4091.483 Profile: PF 1
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Note:	Manning's n values were composited to a single value in the main channel.
Location:	River: West Agave Reach: Friendly Village RS: 3986.068 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3864.383 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3680.565 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3481.460 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3366.345 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3255.776 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 3172.293 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 3064.242 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 2940.349 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

Errors Warnings and Notes for Plan : 100 (Continued)

Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 2711.800 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 2490.261 Profile: PF 1
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Location:	River: West Agave Reach: Friendly Village RS: 2325.093 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 2009.964 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1873.512 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1717.201 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1555.734 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1434.165 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1270.626 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 1042.856 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 950.695 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 818.921 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 691.898 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 589.317 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 496.446 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 391.885 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 318.062 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 223.718 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.
Location:	River: West Agave Reach: Friendly Village RS: 106.664 Profile: PF 1
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to
	critical depth.

CURVE DATA				
No.	Δ	R	L	T
1	89°28'29"	52.00'	81.20'	51.53'
2	90°32'30"	52.00'	82.17'	52.49'
3	90°00'10"	52.00'	81.68'	52.00'
4	89°58'51"	52.00'	81.66'	51.98'



BM "QQ" ELEV.=2499.71 TOP OF ⅝" I.R. IN N-S BARB WIRE FENCE ON W. R/W OF 1ST. AVE. 500'± S. OF RUDASILL RD.

BM "RR" ELEV.=2513.23 BCSM EAST OF FIRST AVE. @ INTER. RUDASILL & 1ST. STREET E. OF 1ST. (PT.#77)

* MASONRY SOUND BARRIER WALL (SBW) PER ADOT STD DTL B-30.20 H = 8'-4", T = 1'-0", W = 2'-8" SEE SPECIAL PROVISIONS; SECTION 914 FOR TYPE AND COLOR OF BLOCK. SEE A7, DETAIL B FOR BLOCK PATTERN.

NOTE:
1. SEE SHEET R8 FOR CURB ACCESS RAMP DETAILS AND INTERSECTION GRADING

AS BUILT
BY R&B DATE 4-9-02

SCALES | HORIZ. 1"=40' | SHEET R51 OF 246

48FR09-P1-SR051

FIRST-8.DGN

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

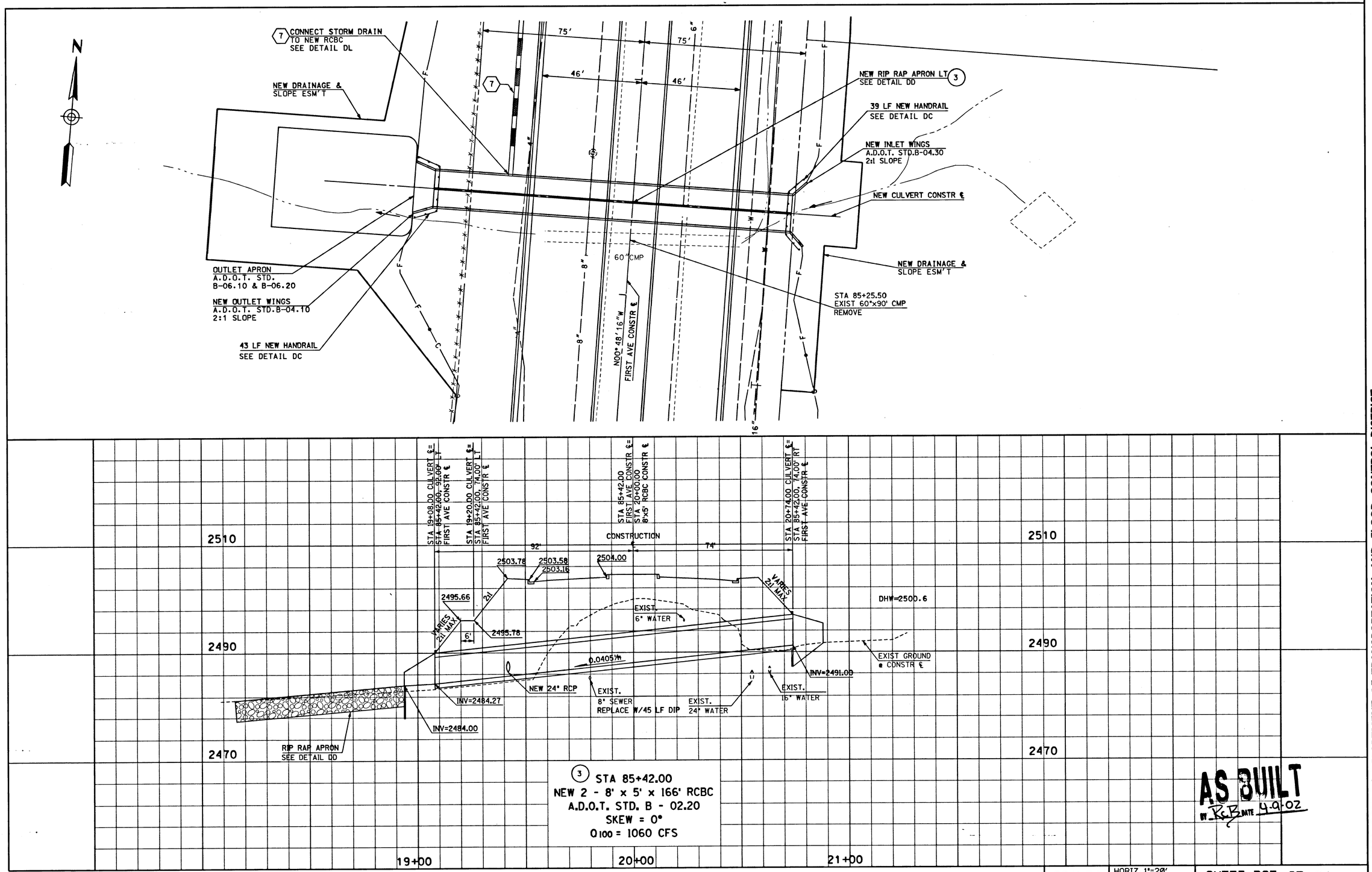
NO.	REVISION DESCRIPTION	DIV./SECT.ENGR.	DATE
V	AS BUILT	BB	3-02

CELLA BARR ASSOCIATES
9911 E. BROADWAY BLVD., TUCSON, AZ 85711
PHONE: (520)750-1414 FAX: (520)750-1416

FIRST AVENUE
RIVER ROAD TO ORANGE GROVE RD

PLAN SHEET
85+00.00 TO 95+00.00

		DATE
DESIGNED	MEM	06/98
DRAWN	GJG	06/98
CHECKED	JMM	06/98
PROJ.ENGR.	MEM	06/98



3 STA 85+42.00
NEW 2 - 8' x 5' x 166' RCBC
A.D.O.T. STD. B - 02.20
SKEW = 0°
Q100 = 1060 CFS

AS BUILT
BY R.C.B. DATE 4-9-02

SCALES	HORIZ. 1"=20'
	VERT. 1"=8'

SHEET D25 OF 246

4BFROG-P1-SD025

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

NO.	REVISION DESCRIPTION	DIV./SECT.ENGR.	DATE

CELLA BARR ASSOCIATES
4911 E. BROADWAY BLVD. TUCSON, AZ 85711
PHONE: (520) 750-7474 FAX: (520) 750-7470

REGISTERED PROFESSIONAL ENGINEER (CIVIL) JAMES M. HOCKING 18837 ARIZONA U.S.A.

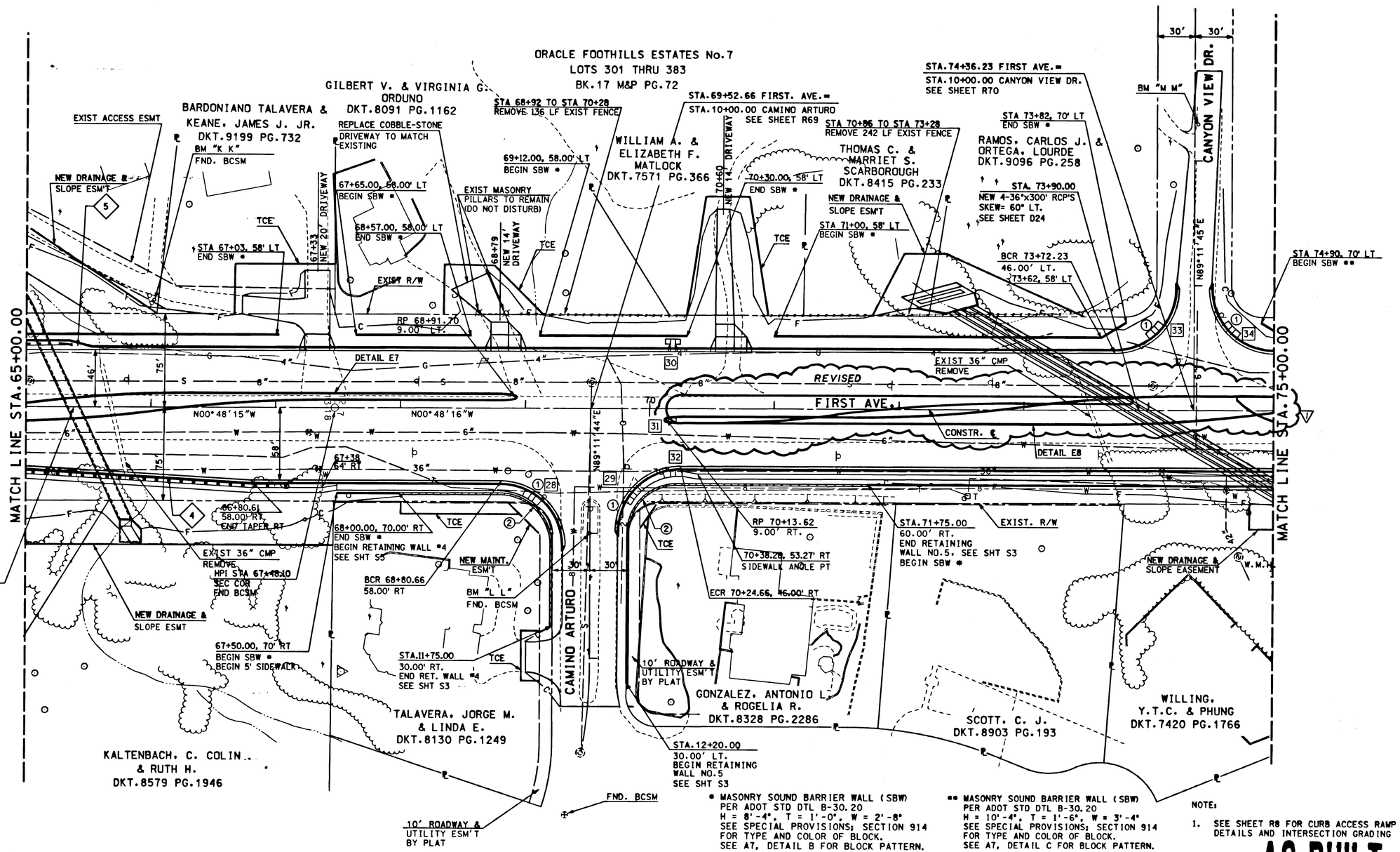
FIRST AVENUE
RIVER ROAD TO
ORANGE GROVE RD

MINOR WASH
STA. 85+35
PLAN AND PROFILE

		DATE
DESIGNED	MEM	06/98
DRAWN	GJG	06/98
CHECKED	JMH	06/98
PROJ.ENGR.	MEM	06/98

BOX-6.DGN

CURVE DATA				
No.	Δ	R	L	T
①	90°00'00"	52.00'	81.68'	52.00'
②	90°00'00"	42.00'	65.97'	42.00'



* MASONRY SOUND BARRIER WALL (SBW) PER ADOT STD DTL B-30.20 H = 8'-4", T = 1'-0", W = 2'-8" SEE SPECIAL PROVISIONS; SECTION 914 FOR TYPE AND COLOR OF BLOCK. SEE A7, DETAIL B FOR BLOCK PATTERN.

** MASONRY SOUND BARRIER WALL (SBW) PER ADOT STD DTL B-30.20 H = 10'-4", T = 1'-6", W = 3'-4" SEE SPECIAL PROVISIONS; SECTION 914 FOR TYPE AND COLOR OF BLOCK. SEE A7, DETAIL C FOR BLOCK PATTERN.

NOTE:

1. SEE SHEET R8 FOR CURB ACCESS RAMP DETAILS AND INTERSECTION GRADING

BM "KK" ELEV.=2462.48 TOP OF 5/8" PIN 12'± W. OF W. R/W LINE OF 1ST. AVE. & 130'± S. OF ℄ OF GRAVEL DR. @ 5585 N. 1ST. AVE.

BM "LL" ELEV.=2476.48 BCSM IN ℄ CAMINO ARTURO (IN MEDIAN) 100'± E. OF C 1ST. AVE.

BM "MM" ELEV.=2483.32 TOP OF 1/2" PIN W. OF 1ST. AVE. IN PAV. 6' N. OF MAILBOX FOR #660 E. CANYON VIEW DR.

AS BUILT
BY RGB DATE 4-9-02

DESIGNED	MEM	DATE 06/98
DRAWN	GJG	06/98
CHECKED	JMH	06/98
PROJ.ENGR.	MEM	06/98

PLAN SHEET
65+00.00 TO 75+00.00

NO.	REVISION DESCRIPTION	DIV./SECT.ENGR.	DATE
1	AS BUILT	BB	3-02

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

FIRST AVENUE
RIVER ROAD TO ORANGE GROVE RD

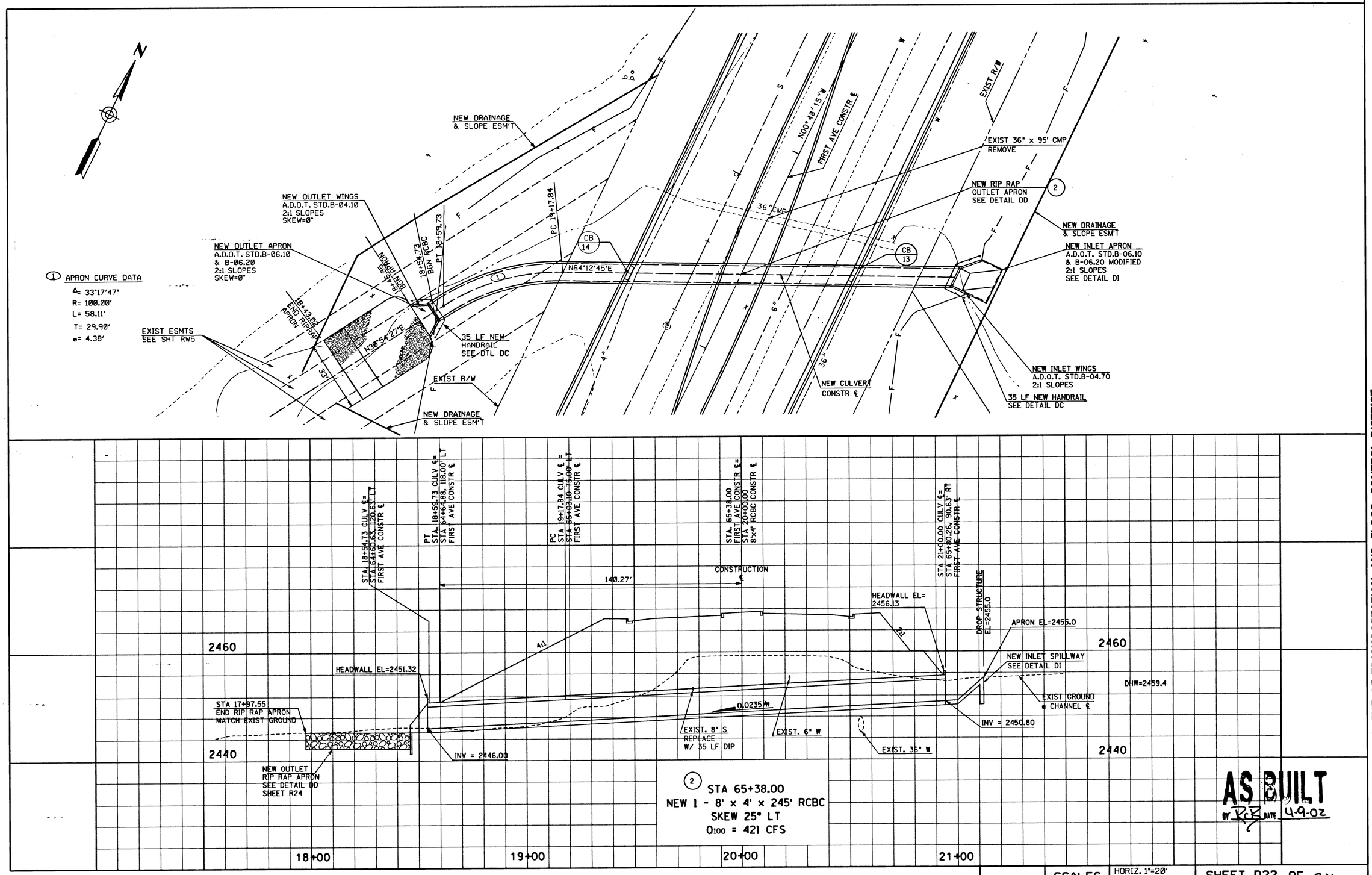
CELLA BARR ASSOCIATES
4911 E. BROADWAY BLVD., TUCSON, AZ 85711
PHONE: (520) 750-1414 FAX: (520) 750-1470

REGISTERED PROFESSIONAL ENGINEER (CIVIL) 18637 JAMES M. HOCKING ARIZONA U.S.A.

SCALES | HORIZ. 1"=40' | SHEET R47 OF 246

FIRST-6.DGN

43FROG-PI-GR047



AS BUILT
BY RCB DATE 4-9-02

SCALES	HORIZ. 1"=20'	SHEET D23 OF 246
	VERT. 1"=8'	

BOX-4.DGN

4BFROG-P1-SD023

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

NO.	REVISION DESCRIPTION	DIV./SECT.ENGR.	DATE

		DATE
DESIGNED	MEM	06/98
DRAWN	GJG	06/98
CHECKED	JMH	06/98
PROJ.ENGR.	MEM	06/98

MINOR WASH
STA. 65+38
PLAN AND PROFILE

CELLA BARR ASSOCIATES
4911 E. BROADWAY BLVD. TUCSON, AZ 85711
PHONE: (520)750-7474 FAX: (520)750-7470

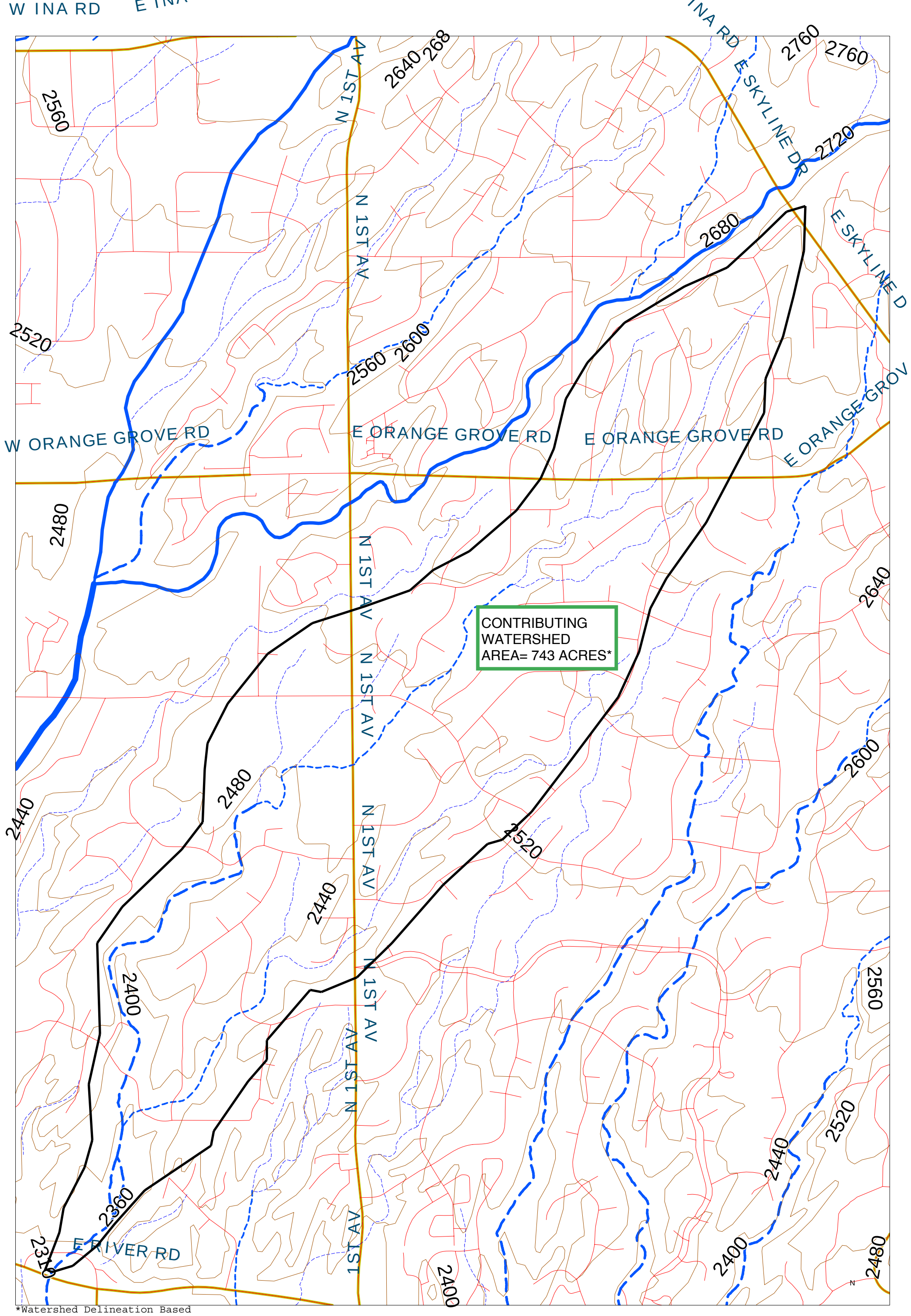
JAMES M. HOCKING
18837
REGISTERED PROFESSIONAL ENGINEER (Civil)
ARIZONA U.S.A.

FIRST AVENUE
RIVER ROAD TO
ORANGE GROVE RD

APPENDIX F: EROSION ANALYSIS SUPPORTING DOCUMENTS

Not completed for this study.

FIGURE A: HYDROLOGY EXHIBIT MAPS



*Watershed Delineation Based
On Detailed 2-Foot Contours

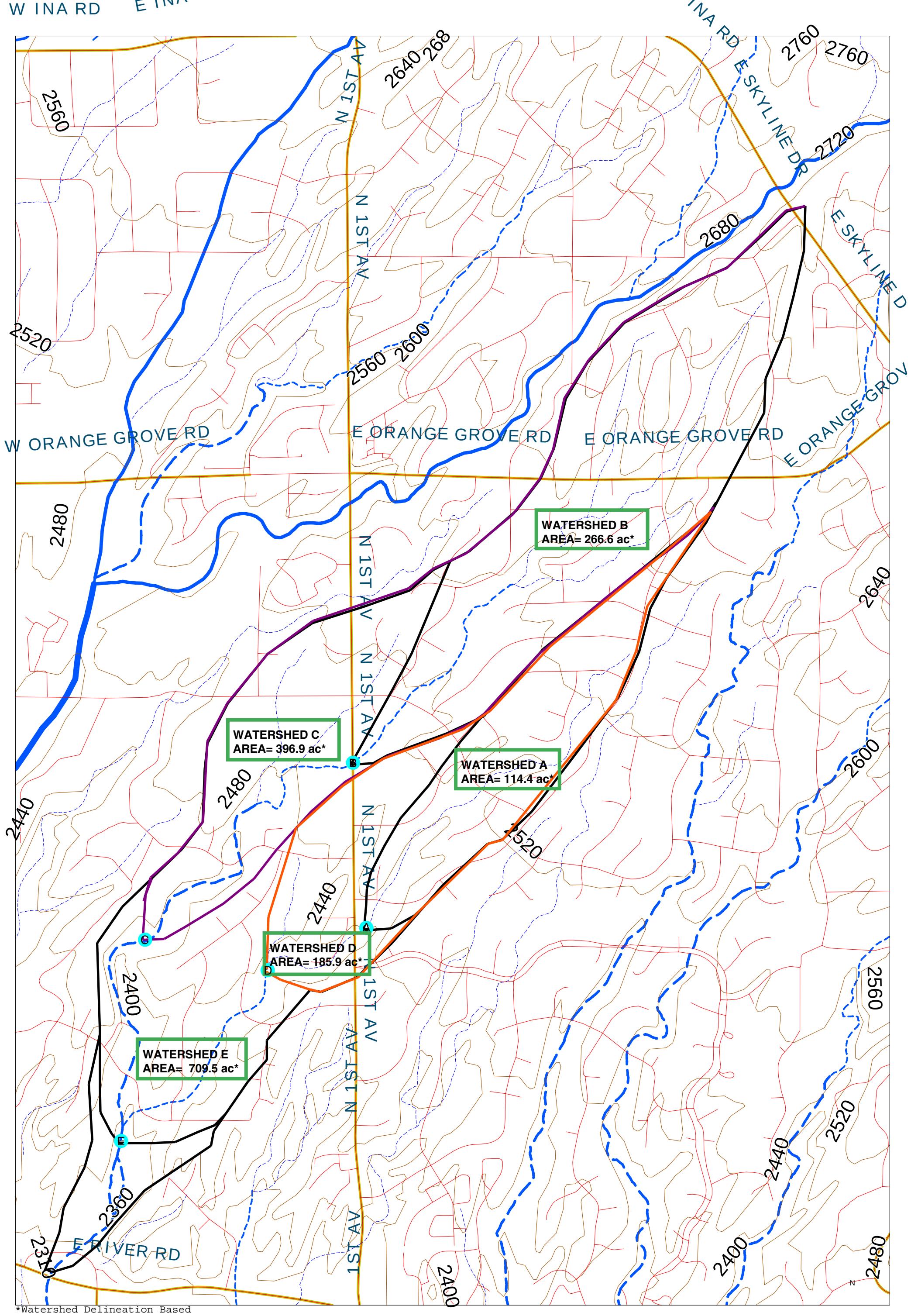
SCALE 1 : 12,000

1,000 0 1,000 2,000 3,000

FEET

FRIENDLY VILLAGE WASH
CONTRIBUTING WATERSHED AREA

TETRA TECH, INC.



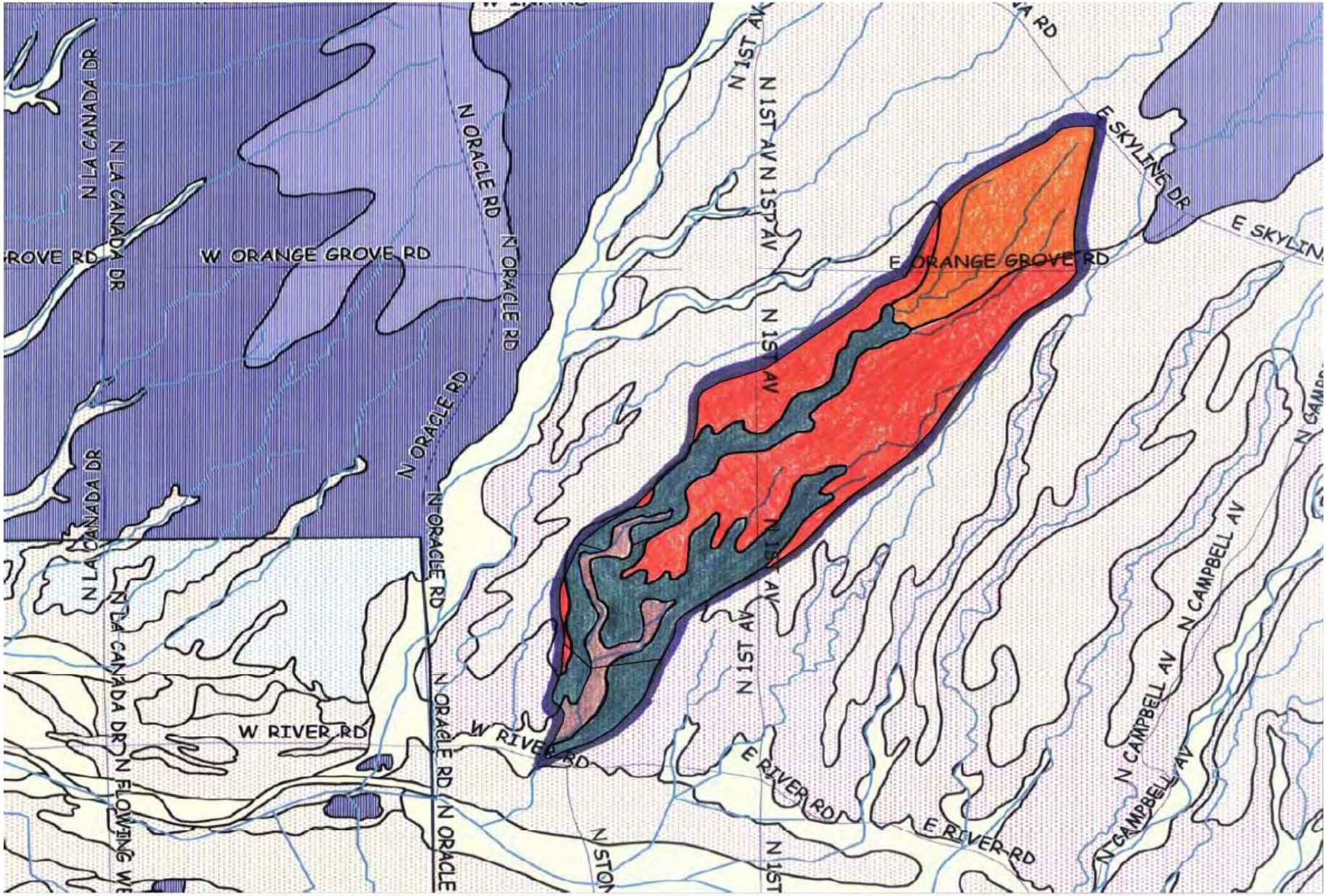
*Watershed Delineation Based
On Detailed 2-Foot Contours

SCALE 1 : 12,000

1,000 0 1,000 2,000 3,000
FEET

FRIENDLY VILLAGE WASH WITH INDIVIDUAL WATERSHEDS AND CONCENTRATION POINTS

TETRA TECH, INC.



SCALE 1 : 24,435

2,000 0 2,000 4,000 6,000

FEET

Soil TYPES

- Type B (5 to 16% Slopes)
- Type B very cobbly sandy loam (1 to 8% slopes)
- 70% B 30% C (10 to 35% Slopes)
- Type A (0 to 3% Slopes)

N

TETRA TECH, INC.

SOILS MAP FOR FRIENDLY VILLAGE WASH CONTRIBUTING WATERSHED AREA

FIGURE B: HYDRAULIC EXHIBIT MAPS

P:\P09039-FVWLOMR\Cadd\EH_HEC-RAS XSECTS.dwg, 3/6/2008 10:13:10 AM, 1:1

SHEET NO. : 1 OF 1

SCALE: HORIZ: 1"=300' VERT: DNA

DATE : September - 2007

JOB NO: P09039

FVWLOMR

FRIENDLY VILLAGE WASH

Cross-Section Location Map

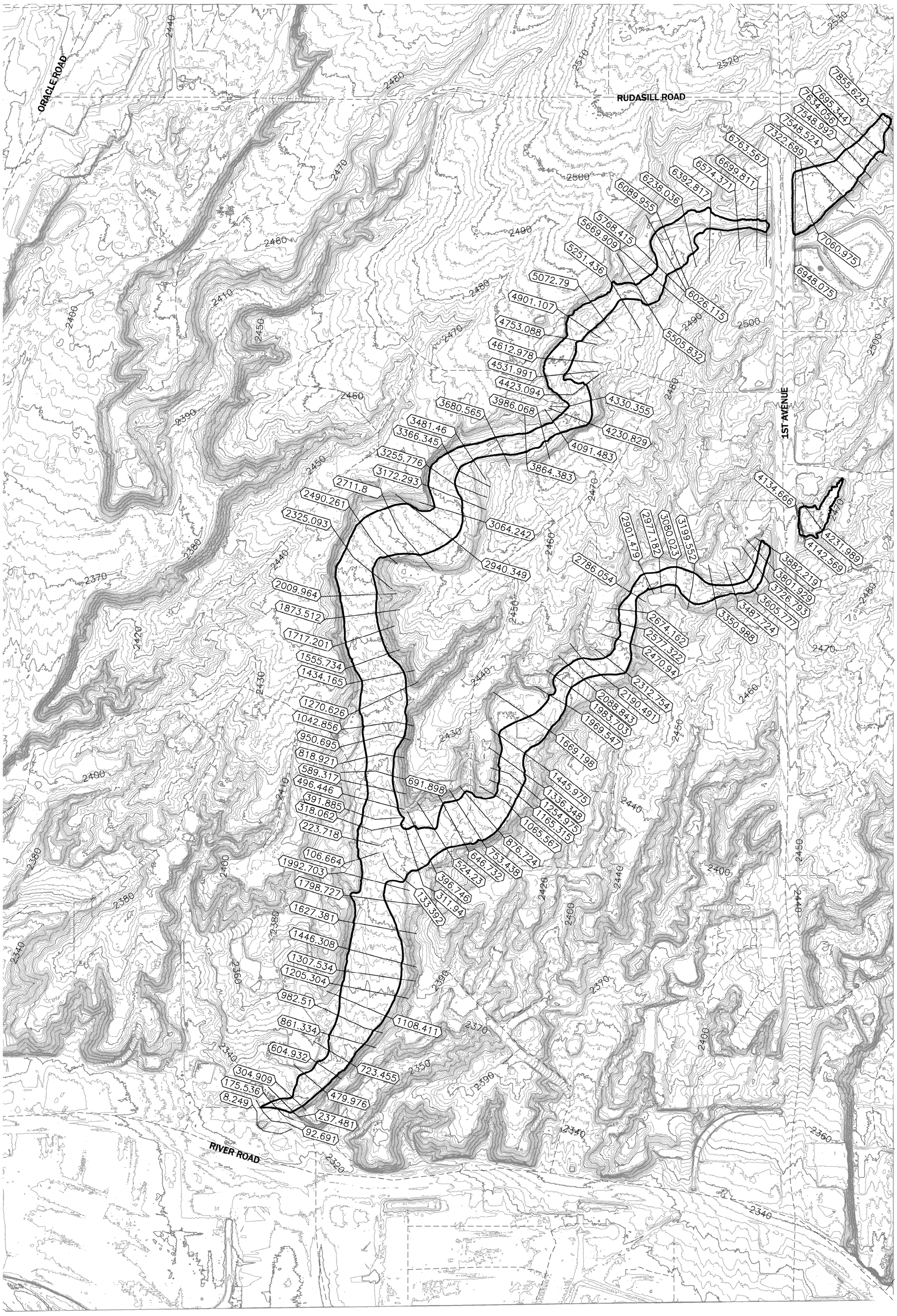
TETRA TECH, INC.
33 N. STONE AVENUE, SUITE 1500
TUCSON, ARIZONA 85701-1413
(520) 623-7980 FAX (520) 884-5278

DESIGNED BY: JDE
DRAWN BY: CRT
CHK'D BY (DESIGN): MEZ
CHK'D BY (FIELD ENGR):

Registered Professional Engineer (Civil) CERTIFICATE NO. 12481 MICHAEL E. ZELLER Date Signed 01/07/08 ARIZONA, U.S.A.
Expires 12/31/10

NO.	REVISION	APPV'D.	DATE

FIGURE C: FLOODPLAIN WORK STUDY MAPS



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JOB NO:	P09039
DATE :	September – 2007
SCALE HORIZ:	1"=300'
SCALE VERT:	DNA
SHEET NO. :	1 OF 1

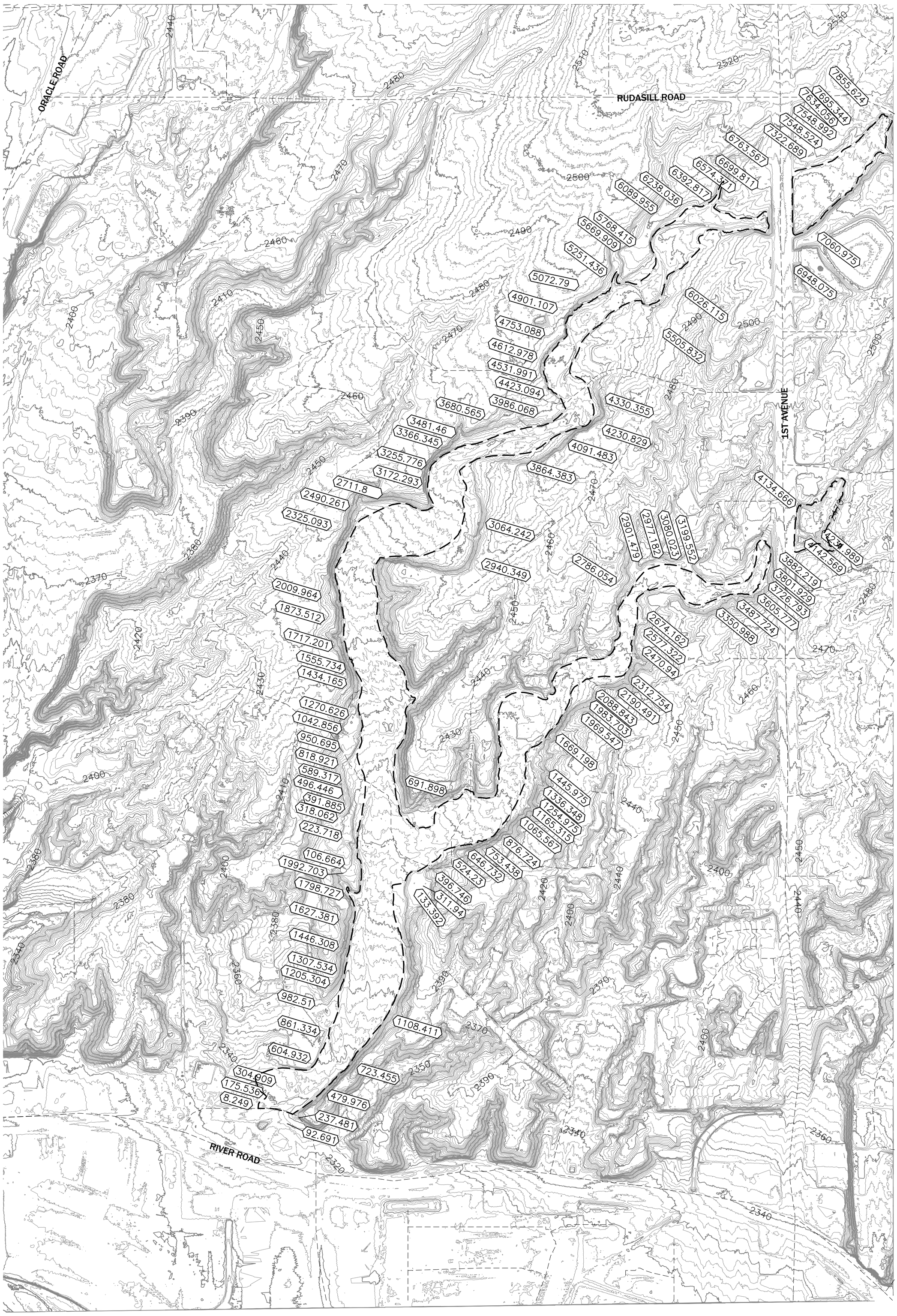
FVWLOMR
FRIENDLY VILLAGE WASH
100–YEAR FLOODPLAIN MAP

TETRA TECH, INC.
33 N. STONE AVENUE, SUITE 1500
TUCSON, ARIZONA 85701–1413
(520) 623–7980 FAX (520) 884–5278

DESIGNED BY: JDE
DRAWN BY: CRT
CHK'D BY (DESIGN): MEZ
CHK'D BY (FIELD ENGR):

Registered Professional Engineer (Civil) CERTIFICATE NO. 12481 MICHAEL E. ZELLER Date Signed 01/07/08 ARIZONA, U.S.A.
Expires 12/31/10

NO.	REVISION	APPV'D.	DATE



JOB NO:	P09039
DATE :	September – 2007
SCALE HORIZ:	1"=400'
SCALE VERT:	DNA
SHEET NO. :	1 OF 1

FVWLOMR

FRIENDLY VILLAGE WASH

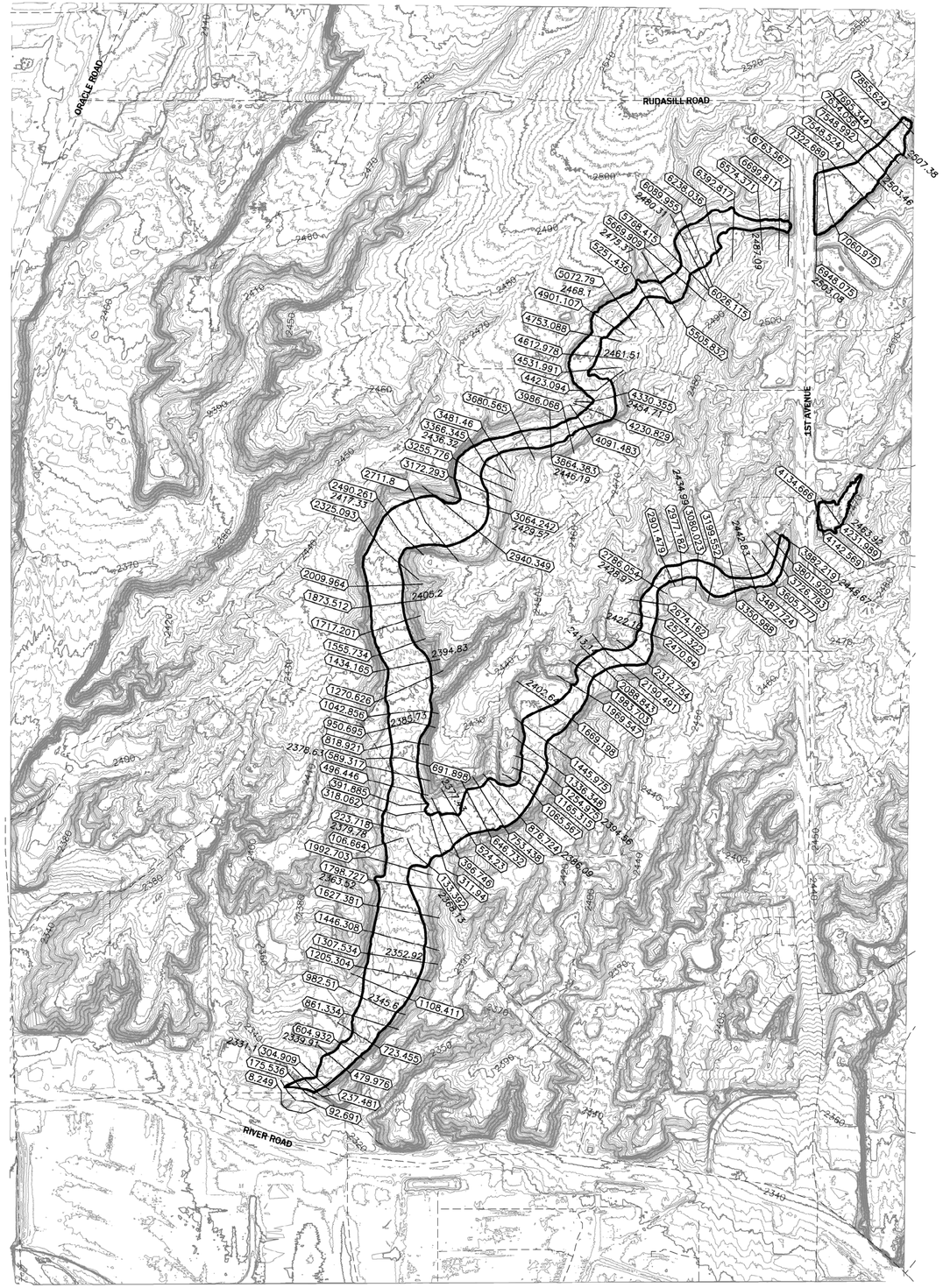
500–YEAR FLOODPLAIN MAP

TETRA TECH, INC.
33 N. STONE AVENUE, SUITE 1500
TUCSON, ARIZONA 85701–1413
(520) 623–7980 FAX (520) 884–5278

DESIGNED BY:	JDE
DRAWN BY:	CRT
CHK'D BY (DESIGN):	MEZ
CHK'D BY (FIELD ENGR):	

NO.	REVISION	APPV'D.	DATE

DISKETTES



NORTH

SCALE IS METRIC
(1 CENTIMETER = 50 METERS)

UTM 27

NO.	REVISION	APPV'D.	DATE

DESIGNED BY: JDE
DRAWN BY: CRT
CHK'D BY (DESIGN): VEZ
CHK'D BY (FIELD ENGR):

Registered Professional Engineer (Civil) CERTIFICATE NO. 12481 MICHAEL E. ZULIS Date Signed 07/07/08 ARIZONA U.S.A. Expires 12/31/10

TETRA TECH, INC.
33 N. STONE AVENUE, SUITE 1500
TUCSON, ARIZONA 85701-1417
(520) 623-7580 FAX (520) 884-5278

FVWLOMR
FRIENDLY VILLAGE WASH
100-YEAR FLOODPLAIN MAP

JOB NO:	P09039
DATE :	September – 2007
SCALE HORIZ:	METRIC 1:50
SCALE VERT:	DNA
SHEET NO. :	1 OF 1

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