

TECHNICAL DATA NOTEBOOK  
FOR THE  
VENTANA CANYON WASH/ESPERERO WASH

LETTER OF MAP REVISION (LOMR)

PIMA COUNTY, ARIZONA

Prepared for:

Pima County Regional Flood Control District  
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Tucson, Arizona 85701

By:

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Final  
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EXPIRES 06/30/2013

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*(Note: Page numbering does not include the FEMA forms/attachments provided in Section 2.2.)*

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## I. INTRODUCTION

The Pima County Regional Flood Control District (RFCD) contracted with JE Fuller/Hydrology and Geomorphology, Inc. (JEF) to prepare this request for a Letter of Map Revision (LOMR) for the Ventana Canyon Wash and the Esperero Wash (see Figures 1 and 2). The Pima County contract number is PO 09019014, and the project manager is Terry Hendricks, CFM, Chief Hydrologist. A copy of the scope of work is included in Appendix B.

This LOMR will address changes to the regulatory flood plain as currently mapped on Panels 1655, 1663, and 1665 (Reference 1). This Technical Data Notebook (TDN), which follows the outline specified in Arizona Department of Water Resources, State Standard 1-97, contains all the information required in support of this request, including the applicable Federal Emergency Management Agency (FEMA) forms.

The request is based on a more detailed hydrologic analysis of the contributing watersheds and on updated topographic mapping. It consolidates the numerous Letters of Map Change (LOMC) that have been issued since the current mapping became effective and includes revisions to areas affected by private developments. In addition, the effect of one newly constructed culvert and enlarged bridge are accounted for with the revised mapping.

The project reach for the Ventana Canyon Wash begins at the Tanque Verde Creek confluence, which is the downstream limit of the effective mapping, and extends approximately 6.6 miles upstream to the boundary of the Coronado National Forest. The majority of the project reach was previously mapped by detailed methods using HEC-2 (Reference 2) and includes a combination of Zone AE and shaded Zone X designations. However, approximately 1000 feet was only mapped by approximate methods (i.e., the effective Zone A areas), and approximately 1000 feet was not previously mapped. The revised mapping of the entire project reach is by detailed methods. The modeling was performed using HEC-RAS (Reference 3).

The project reach for the Esperero Wash begins at the Ventana Canyon Wash confluence and extends approximately 1.8 miles. The majority of the project reach was previously mapped by detailed methods (HEC-2) and includes a combination of Zone AE and shaded Zone X designations. However, approximately 1900 feet was only mapped by approximate methods (i.e., the effective Zone A areas), and approximately 800 feet was not previously mapped. The revised mapping of the entire project reach is by detailed methods (HEC-RAS).

The discharges associated with this request were computed using HEC-1 (Reference 4). The RFCD provided JEF with a base model that was compiled by Tetra Tech, Inc. in 2002 under contract with the RFCD (Reference 5). However, Tetra Tech's base model was limited to the 100-year return interval. A copy of the Tetra Tech's summary report is provided in PDF format in Appendix D. As part of this LOMR request, per the Pima County's current hydrologic modeling criteria, JEF updated the base model to incorporate (1) the new NOAA Atlas Volume 14 data; (2) the 3-hour, upper 90% confidence interval precipitation values from NOAA 14; (3) the Hydro-40 aerial reduction factors, and (4) the SCS Type II distribution. In addition, JEF expanded the modeling effort to included the 10-, 50-, 100-, and 500-year return intervals. A total of ten point-precipitation-value data sets were obtained from the NOAA 14 web site based

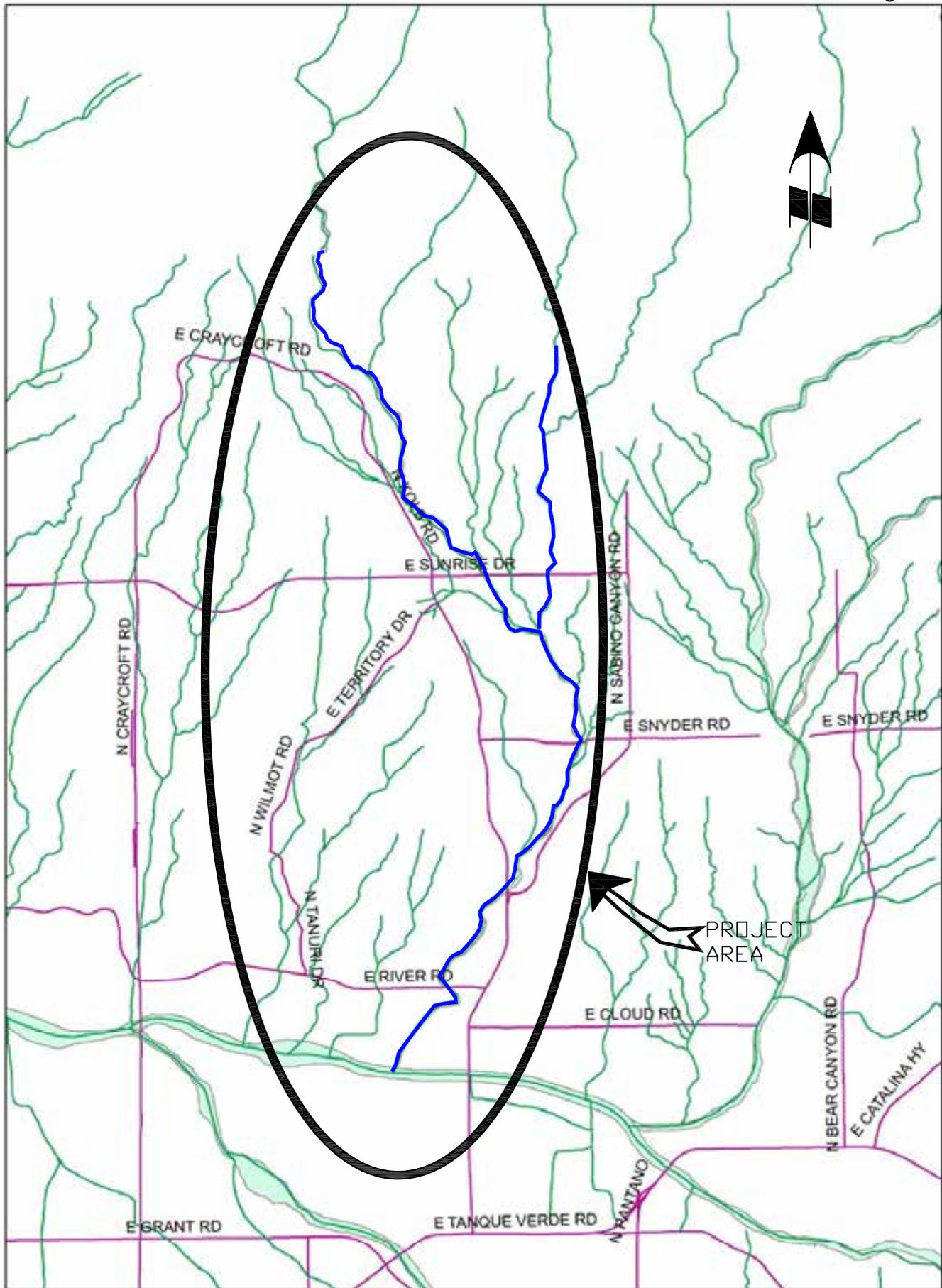
on the longitude and latitude of the centroid of each the ten major sub-basins. However, since the range of individual values was narrow, an average value was selected for each return interval. An areal reduction factor was then applied to define a basin average value for each of the ten major sub-basins. The results of the HEC-1 analysis are summarized in Table 1.1. In addition, Table 1.1 provides a comparison between the effective discharges and the revised discharges. The revised HEC-1 models are provided in Appendix D. A printout of the watershed map is also provided in Appendix D.

As previously noted, the hydraulic analysis was conducted using HEC-RAS. Using the results of the HEC-1 modeling, interpolated discharge values were defined at key locations in the HEC-RAS model in an attempt to maintain the gradually-varied flow assumption while accounting for the variation in peak discharges in the downstream direction. A combination of as-built plans and field survey (performed by Stantec Consulting, Inc.) was used to define the geometry of all bridge openings and/or culvert crossing. The n-values were determined from an extensive field investigation. The results of that investigation, with supporting documentation (field photographs), was summarized in a field reconnaissance report (Reference 8). A copy of the field reconnaissance report prepared by JEF and the field notes from Stantec's survey are provided in Appendix C. The revised 500-year and 100-year floodplain and floodway boundaries are shown on the attached work maps.

The topographic information used in conjunction with the re-mapping was based on the North American Vertical Datum of 1988 (NAVD 88). The effective mapping was based on the National Geodetic Vertical Datum of 1929 (NGVD 29). Therefore, both elevations are shown on the work maps. A tabular listing of water-surface elevations for both datums is also provided in Appendix E. The difference in elevations is based on a single conversion factor – 2.26 feet (i.e., the NAVD 88 elevations are approximately 2.26 feet higher than the NGVD 29 elevations).

The only ties to the effective mapping occur at the Tanque Verde Creek confluence. The effective base water-surface elevation in the Tanque Verde Creek at the confluence is approximately 2463.0 (NGVD 29) or 2465.25 (NAVD 88). Since the computed water-surface elevation for the Ventana Canyon Wash at the confluence is 2467.4 (NGVD) or 2469.7 (NAVD), which is based on critical depth, there is no hydraulic tie between the Tanque Verde Creek and the Ventana Canyon Wash. Therefore, graphic ties were made between the revised floodplain/floodway boundaries for the Ventana Canyon Wash and those associated with the Tanque Verde Creek.





PROJECT AREA

**Figure 2**  
LOCATON MAP

Table 1.1 Summary of Applied Discharges for Esperero Wash and Ventana Canyon Wash LOMR  
(with a comparison between the effective and revised discharges)

Flooding Source	Concentration Point	Drainage Area (sq mi)	Q <sub>10</sub>		Q <sub>50</sub>		Q <sub>100</sub>		Q <sub>500</sub>	
			effective (cfs)	revised (cfs)	effective (cfs)	revised (cfs)	effective (cfs)	revised (cfs)	effective (cfs)	revised (cfs)
Esperero Wash	Node 4	5.9	4239	5121	8789	8907	11037	10762	19000	15953
	Node 5	6.11	3350	4333	7319	7067	9116	9170	16000	13663
	Node 6	6.19	2947	4246	6795	6949	8440	8898	14400	13574
Ventana Canyon Wash	Node 8	3.85	3304	5179	6621	8813	7836	10596	13250	14864
	Node 10	6.98	4172	5378	8684	9448	10770	12044	19500	17805
	Node 11	7.94	4140	5271	8888	9151	11082	11484	18500	17544
	Node 6 +11	14.14	4952	8122	11451	14053	14775	17753	27000	27253
	Node 15	16.64	3217	5066	--	9030	9371	11527	17000	18238

## II. ADWR/FEMA FORMS

### 2.1 Study Documentation Abstract (LOMR)

Subsection	Information Requested	Response
2.1.1	Date Study Accepted:	Accepted: April 27, 2010 Effective: September 13, 2010.
2.1.2	Study Contractor: Contact: Address:  Phone: Internal Reference Number:	JE Fuller/Hydrology & Geomorphology, Inc. Robert L. Shand, P.E., Project Manager 40 E. Helen Street Tucson, Arizona 85705 520-623-3112 PCRFC-D-Ventana_Esperero_LOMR
2.1.3	FEMA Technical Review Contractor:  Contact: Address:  Phone: Internal Reference Number:	Baker AECOM  Mounir Boudjemaa, M.S. c/o LOMC Clearinghouse 6730 Santa Barbara Court Elkridge, MD 21075 703-317-6295 Case No. 09-09-2406P
2.1.4	FEMA Regional Reviewer:  Phone:	Director, Mitigation Division , Dept. of Homeland Security's FEMA, Oakland, CA  510-627-7175
2.1.5	State Technical Reviewer: Phone:	Brian Cosson, CFM. 602-771-8657
2.1.6	Local Technical Reviewer:  Phone:	Terry Hendricks, CFM Chief Hydrologist 520-740-6350
2.1.7	Reach Descriptions (approximate):	(1) 6.6 miles of the Ventana Canyon Wash beginning at the Tanque Verde Creek confluence; (2) 1.8 miles of the Esperero Wash beginning at the Ventana Canyon Wash confluence.

Subsection	Information Requested	Response
2.1.8	USGS Quad Sheets: Digital Mapping provided by Pima Association of Governments	Sabino Canyon., 7.5' quadrangle, 1992 1998 and 2000 topo/photo coverage of study area
2.1.9	Unique Conditions and Problems:	None
2.1.10	Coordination of Peak Discharges:	Pima County concurs with the application of the revised peak discharges.

## 2.2 FEMA Forms

FEMA MT-2 Forms 1, 2 and 3 are included as attachments to this section. Each form includes a supplemental information sheet that provides information that could not be placed within the form structure. The form's section and item number is referenced on this sheet. Normally, Sections 3 through 7 of the standard TDN provides overflow information that cannot be placed within the FEMA form structure. If the information requested in Sections 3 through 7 is already provided on the supplemental information sheet, it will be referenced accordingly. In addition, some of the information requested in Sections 3 through 7 may be provided in one of the appendices. If that is the case, the location where the information can be found will be referenced accordingly.

**U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY  
OVERVIEW & CONCURRENCE FORM**

*O.M.B No. 1660-0016  
Expires: 12/31/2010*

**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, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

**A. REQUESTED RESPONSE FROM DHS-FEMA**

This request is for a (check one):

- CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).
- LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

**B. OVERVIEW**

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

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301	City of Katy	TX	480301	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
040073	Pima County Arizona and Incorporated Areas	AZ	04019C	1655K	02/08/99
040073	Pima County Arizona and Incorporated Areas	AZ	04019C	1663K	04/22/04

2. a. Flooding Source: Ventana Canyon Wash, Esperero Wash

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

3. Project Name/Identifier: Ventana Canyon Wash/Esperero Wash LOMR

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

5. Basis for Request and Type of Revision:

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

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

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

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

- Structures:     Channelization     Levee/Floodwall     Bridge/Culvert  
 Dam     Fill     Other (Attach Description)

**C. REVIEW FEE**

Has the review fee for the appropriate request category been included?  Yes Fee amount: \$\_\_\_\_\_  No, Attach Explanation

Please see the DHS-FEMA Web site at [http://www.fema.gov/plan/prevent/fhm/fm\\_fees.shtm](http://www.fema.gov/plan/prevent/fhm/fm_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: Robert L. Shand	Company: JE Fuller/Hydrology & Geomorphology, Inc	
Mailing Address: 40 E. Helen Street Tucson, AZ 85705	Daytime Telephone No.: 520-623-3112	Fax No.: 520-623-3130
	E-Mail Address: rob_shand@jefuller.com	
Signature of Requester (required): <i>Robert L. Shand</i>	Date: July 08, 2009	

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, P.E., Director/Chief Engineer, Regional Flood Control District	Community Name: Pima County	
Mailing Address: 97 East Congress Street, 3rd Floor Tucson, AZ 85701	Daytime Telephone No.: 520-243-1800	Fax No.: 520-243-1821
	E-Mail Address: suzanne.shields@rfcd.pima.gov	
Community Official's Signature (required): <i>Suzanne Shields</i>	Date: <i>7/9/09</i>	

**CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR**

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

Certifier's Name: Robert L. Shand	License No.: 24026	Expiration Date: 06/30/2010
Company Name: JE Fuller/Hydrology & Geomorphology, Inc	Telephone No.: 520-623-3112	Fax No.: 520-623-3130
Signature:	Date: 09/24/2008	

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

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



MT-2, Form 1 – Overview and Concurrence (Supplemental Information)

*Note: This supplemental information applies either in whole or in part to all flooding sources.*

■ Section B – OVERVIEW

- Item 1, Panels Affected/Effective Date – Panels 1655K (effective 02/08/99), 1663K (effective 02/08/99, LOMR 04/22/04), and 1665 (effective 02/08/33, LOMR 07/24/00).

■ Section C – REVIEW FEE

- This map change request is based on more detailed hydrologic and hydraulic analyses and is intended to improve upon the information shown on the effective map and within the effective FIS. In addition, the request provides detailed mapping to replace areas that were previously mapped by approximate methods.

**PAPERWORK REDUCTION ACT**

Public reporting burden for this form is estimated to average 3.25 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, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: Ventana Canyon Wash  
**Note:** Fill out one form for each flooding source studied

**A. HYDROLOGY**

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

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

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

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
upstream of Resort Drive	3.85	7836	10596
downstream of Ventana W.	14.14	14775	17753
at Tanque Verde Wash	16.64	9371	11527

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

- Statistical Analysis of Gage Records     
  Precipitation/Runoff Model HEC-1  
 Regional Regression Equations     
  Other (please attach description)

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

4. Review/Approval of Analysis

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

5. Impacts of Sediment Transport on Hydrology

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

**B. HYDRAULICS**

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit	confluence with Tanque Verde Crk	RS 2, A (effective)	2473.1 NGVD	2472.1 NGVD
Upstream Limit	of detailed study	RS 81	n/a	3220.6 NGVD

2. Hydraulic Method/Model Used

HEC-RAS Version 4

## B. HYDRAULICS (CONTINUED)

### 3. Pre-Submittal Review of Hydraulic Models

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. These review programs may help 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](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. Review of your submittal and resolution of valid modeling discrepancies may result in reduced review time.

4. <u>Models Submitted</u>	<u>Natural Run</u>	<u>Floodway Run</u>	<u>Datum</u>
Duplicate Effective Model*	File Name:	Plan Name:	File Name: Plan Name: _____
Corrected Effective Model*	File Name:	Plan Name:	File Name: Plan Name: _____
Existing or Pre-Project Conditions Model	File Name:	Plan Name:	File Name: Plan Name: _____
Revised or Post-Project Conditions Model	File Name: Ventana	Plan Name:	File Name: Ventana Plan Name: _____
<u>NAVD</u>			
Other - (attach description)	File Name:	Plan Name:	File Name: Plan Name: _____

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

Digital Models Submitted? (Required)

## 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.).

Digital Mapping (GIS/CADD) Data Submitted

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.

Annotated FIRM and/or FBFM (Required)

## D. COMMON REGULATORY REQUIREMENTS\*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase?  Yes  No
  - a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:
    - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot.
    - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot.
  - b. 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.
  
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/CLOMR requests, does this request have the potential to impact an endangered species?  Yes  No

If Yes, please submit documentation to the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA). Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA.

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

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

**PAPERWORK REDUCTION ACT**

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Flooding Source: Esperero Wash  
**Note:** Fill out one form for each flooding source studied

**A. HYDROLOGY**

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

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

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

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
d/s of Thimble View Way	5.9	11037	10762
d/s of Sunrise Dr.	6.11	9116	9170
u/s of Ventana Cyn Wash	6.19	8440	8898

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

- Statistical Analysis of Gage Records     
  Precipitation/Runoff Model HEC-1  
 Regional Regression Equations     
  Other (please attach description)

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

4. Review/Approval of Analysis

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

5. Impacts of Sediment Transport on Hydrology

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

**B. HYDRAULICS**

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit	confluence Ventana Cyn Wash	RS 1	~2678.9 NGVD	2679.2 NGVD
Upstream Limit	of detailed study	RS 25	n/a	3070.9 NGVD

2. Hydraulic Method/Model Used

HEC-RAS version 4

## B. HYDRAULICS (CONTINUED)

### 3. Pre-Submittal Review of Hydraulic Models

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. These review programs may help 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](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. Review of your submittal and resolution of valid modeling discrepancies may result in reduced review time.

### 4. Models Submitted

	<u>Natural Run</u>		<u>Floodway Run</u>		<u>Datum</u>
Duplicate Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	_____
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	_____
Existing or Pre-Project Conditions Model	File Name:	Plan Name:	File Name:	Plan Name:	_____
Revised or Post-Project Conditions Model	File Name: Ventana	Plan Name:	File Name: Ventana	Plan Name:	_____
<b>NAVD</b>					
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	_____

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

Digital Models Submitted? (Required)

## 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.).

Digital Mapping (GIS/CADD) Data Submitted

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.

Annotated FIRM and/or FBFM (Required)

## D. COMMON REGULATORY REQUIREMENTS\*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase?  Yes  No
  - a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:
    - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot.
    - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot.
  - b. 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.
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/CLOMR requests, does this request have the potential to impact an endangered species?  Yes  No  
If Yes, please submit documentation to the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA). Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA.  
  
For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA.

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

## MT-2, Form 2 – Riverine Hydrology and Hydraulics (Supplemental Information)

*Note: This supplemental information applies either in whole or in part to all flooding sources.*

### ■ Section A, HYDROLOGY

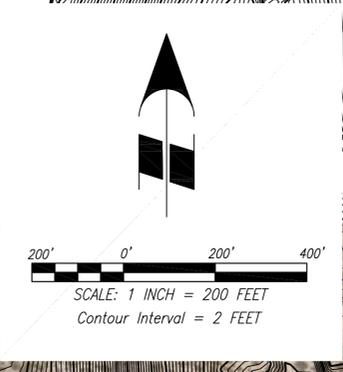
- Item 2, Comparison of Representative Discharges – (see Table 1.1)
- Item 3, HEC-1 Model Submitted – A total of thirty-two (32) individual HEC-1 models are provided – one for each of the eight key concentration points or nodes and one for each of the four return intervals (10-, 50-, 100-, 500-year). The file name structure is as follows (example file name: **100N6-3.dat**): **100** identifies the return interval; **N6** identifies the concentration point or node; and, **3** denotes the 3-hour thunderstorm. The only exception is N61 which represents the combination of Node 6 and Node 11. The individual models, including the output, are provided in Appendix D. A watershed map showing the location of the concentration points is also provided in Appendix D.

### ■ Section B, HYDRAULICS

- Item 1, Reach to be Revised – The entire reach of the Ventana Canyon Wash from its downstream limit at the Tanque Verde Wash confluence to its upstream limit at the Coronado National Forest boundary, and the entire reach of the Esperero Wash from its confluence with the Ventana Canyon Wash to a point located just south of the Coronado National Forest boundary.
- Item 4, Models Submitted – The HEC-RAS project file name is Ventana.prj (see Appendix E). The project was divided into three reaches described as *Esperero Wash Reach-1*, which extends from the Ventana Canyon Wash confluence to the upstream limit of the study reach); *Ventana Canyon Lower Ventana*, which extends from the Tanque Verde Creek confluence to the Esperero Wash confluence; and, *Ventana Canyon Upper Ventana*, which extends from the Esperero Wash confluence to the upstream limit of the study reach. The project file includes two (2) plans. Plan 1 models the 10-, 50-, and 100-year discharges and the floodway. Plan 2 models the 500-year discharge.

### ■ Section D, COMMON REGULATORY REQUIREMENTS

- Item 1b and 3, Property Owner Notification – The notification process will begin after any major concerns with the modeling have been adequately addressed.



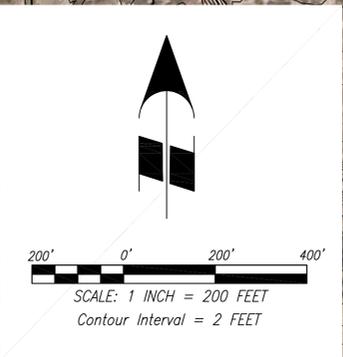
**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

Flooding Source	River Sta	Q Total (cfs)	NAVD89		NGVD29	
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)
Tanque Verde Creek confluence						
Ventana Canyon Wash	0.5	10186	2460.0	2469.7	2457.7	2467.4
	0.75	Lat Struct				
	1	10209	2460.4	2471.4	2458.1	2469.2
	1.5	Lat Struct				
	2	11099	2463.1	2473.8	2460.8	2471.6
	2.25	Lat Struct				
Cloud Road	2.5	12058	2465.0	2478.9	2462.7	2476.6
	3	12058	2467.0	2481.9	2464.8	2479.7
	4	12058	2470.4	2482.3	2468.2	2480.1
	5	12414	2473.7	2486.4	2471.5	2484.1
	5.5	Culvert				
	6	12414	2474.2	2487.5	2471.9	2485.2
	7	12414	2477.8	2488.5	2475.5	2486.2
	8	13061	2480.3	2492.9	2478.0	2490.7
	9	13061	2484.8	2496.2	2482.6	2493.9
	9.5	13061	2486.7	2498.5	2484.4	2496.3
River Road	10	13061	2489.5	2502.9	2487.2	2500.7
	10.5	13061	2491.3	2504.2	2489.0	2502.0
	11	13613	2493.4	2508.2	2491.2	2506.0
	11.5	Bridge				
	12	13613	2494.0	2513.3	2491.8	2511.1
	13	13613	2498.4	2513.7	2496.1	2511.4
	14	14255	2503.4	2513.9	2501.1	2511.7
	15	14255	2511.7	2520.5	2509.4	2518.2
16	15070	2515.8	2525.2	2513.5	2523.0	
17	15070	2519.8	2529.9	2517.5	2527.6	
18	15070	2526.2	2534.4	2523.9	2532.2	



**Work Map**  
Ventana Canyon Wash/Esperero Wash LOMR  
Sheet 1 of 6  
JE Fuller / Hydrology & Geomorphology, Inc.



**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

Flooding Source	River Sta	Q Total (cfs)	NAVD88		NGVD29	
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)
Ventana Canyon Wash	18	15070	2526.2	2534.4	2523.9	2532.2
	19	15519	2529.8	2539.9	2527.6	2537.6
	20	15519	2534.0	2544.1	2531.7	2541.8
	21	15939	2537.9	2546.9	2535.6	2544.6
	21.5	Culvert				
Sabino Canyon Road	22	15939	2538.6	2549.4	2536.3	2547.1
	23	15939	2544.1	2551.1	2541.8	2548.9
	24	16556	2549.4	2557.3	2547.2	2555.0
	25	16556	2552.9	2562.4	2550.6	2560.2
	26	16556	2557.0	2567.7	2554.8	2565.5
	27	16556	2565.5	2574.4	2563.3	2572.1
	28	16556	2570.9	2581.2	2568.6	2578.9
	29	16556	2577.3	2587.6	2575.0	2585.4
	30	16556	2584.8	2594.1	2582.5	2591.8
	31	16556	2588.8	2600.6	2586.5	2596.3
Synder Road dip crossing	32	16556	2593.8	2606.8	2591.5	2604.6
	33	16556	2598.1	2610.9	2595.8	2608.7
	34	16556	2604.1	2612.5	2601.8	2610.3
	35	16556	2611.1	2617.5	2608.8	2615.2

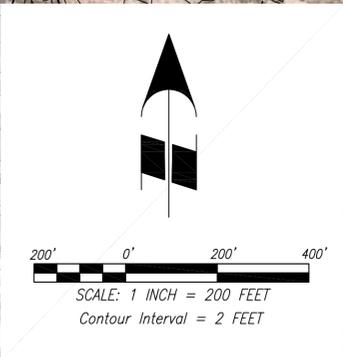


**Work Map**  
Ventana Canyon Wash/Esperero Wash LOMR  
Sheet 2 of 6  
JE Fuller / Hydrology & Geomorphology, Inc.



Match Sheet 4 of 6

Match Sheet 6 of 6



**Legend**

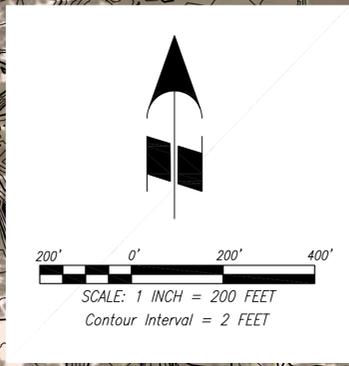
- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway



**Work Map**  
 Ventana Canyon Wash/Esperero Wash LOMR  
 Sheet 3 of 6  
 JE Fuller / Hydrology & Geomorphology, Inc.

Flooding Source	River Sta	Q Total (cfs)	NAVD88		NGVD29		
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)	
Ventana Canyon Wash	35	16556	2611.1	2617.5	2608.8	2615.2	
	36	16968	2613.5	2622.6	2611.2	2620.4	
	37	16968	2620.0	2628.9	2617.8	2626.6	
	38	16968	2626.0	2635.3	2623.7	2633.0	
	39	17342	2634.0	2643.3	2631.8	2641.0	
	40	17342	2643.5	2650.9	2641.2	2648.6	
	41	17753	2651.4	2659.6	2649.1	2657.4	
	42	17753	2657.3	2669.3	2655.0	2667.0	
	Esperero Wash confluence						
		43	11484	2666.4	2676.4	2664.2	2674.2
	44	11916	2674.5	2683.6	2672.2	2681.3	
	45	11916	2683.0	2692.5	2680.7	2690.2	
	46	11916	2693.8	2701.8	2691.5	2699.5	
	46.5	11916	2696.5	2706.9	2694.3	2704.6	
	47	11916	2705.4	2714.7	2703.1	2712.5	
	48	11916	2716.1	2723.6	2713.9	2721.3	
	49	12044	2725.0	2732.6	2722.7	2730.3	
Sunrise Drive	49.5	Bridge					
	50	12044	2725.0	2738.5	2722.7	2736.3	
	51	12044	2730.8	2740.0	2728.5	2737.7	
Ventana Canyon Wash confluence							
Esperero Wash	1	8898	2676.1	2681.4	2673.8	2679.2	
	2	9049	2683.4	2689.2	2681.1	2686.9	
	3	9049	2693.2	2699.1	2690.9	2696.8	
	4	9049	2699.9	2706.6	2697.7	2704.3	
	5	9170	2709.8	2718.0	2707.5	2715.7	
Sunrise Drive	5.5	Culvert					
	6	9170	2712.9	2723.8	2710.6	2721.5	
	7	9170	2723.3	2730.5	2721.0	2728.2	
	8	9637	2735.4	2742.4	2733.1	2740.1	
	9	9637	2747.4	2754.3	2745.1	2752.0	

Match Sheet 2 of 6



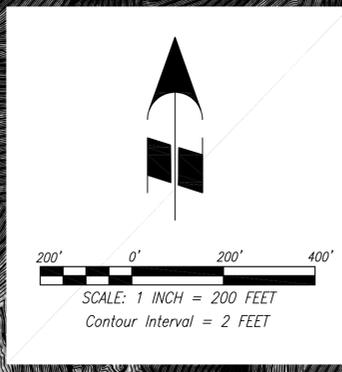
**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

Flooding Source	River Sta	Q Total (cfs)	NAVD88		NGVD29	
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)
Ventana Canyon Wash Sunrise Drive	49	12044	2725.0	2732.6	2722.7	2730.3
	49.5	Bridge				
	50	12044	2725.0	2738.5	2722.7	2736.3
	51	12044	2730.8	2740.0	2726.5	2737.7
	52	11100	2744.0	2752.8	2741.8	2750.5
	53	11100	2758.2	2765.1	2755.9	2762.8
	54	11100	2767.6	2776.0	2765.3	2773.8
	55	11100	2777.5	2783.9	2775.3	2781.7
	56	11100	2789.5	2797.2	2787.2	2794.9
	57	11100	2801.1	2809.4	2796.9	2807.1
	58	11100	2812.2	2821.7	2809.9	2819.4
	59	11100	2825.3	2833.6	2823.1	2831.3
60	11017	2844.0	2850.7	2841.8	2848.5	
61	11017	2850.0	2863.2	2847.7	2861.0	
Ventana Canyon Drive	61.5	Bridge				
	62	11017	2850.9	2866.5	2848.6	2864.2
	62.5	11017	2857.8	2867.2	2855.6	2864.9
	63	11017	2861.6	2871.4	2859.4	2869.2
	63.5	10768	2867.7	2878.1	2865.4	2875.8
	64	10768	2876.2	2885.4	2873.9	2883.1
	64.5	10768	2887.6	2893.5	2885.3	2891.3
	65	10768	2897.1	2906.5	2894.8	2904.3
	65.5	10768	2904.5	2913.4	2902.2	2911.1
	66	10768	2917.6	2924.0	2915.3	2921.8

**Work Map**  
 Ventana Canyon Wash/Esperero Wash LOMR  
 Sheet 4 of 6  
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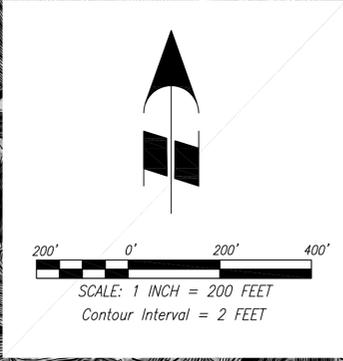
**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

Flooding Source	River Sta	Q Total (cfs)	NAVD88		NGVD29	
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)
Ventana Canyon Wash	64	10768	2876.2	2885.4	2873.9	2883.1
	64.5	10768	2887.6	2893.5	2885.3	2891.3
	65	10768	2897.1	2906.5	2894.8	2904.3
	65.5	10768	2904.5	2913.4	2902.2	2911.1
	66	10768	2917.6	2924.0	2915.3	2921.8
	66.5	10768	2926.0	2932.4	2923.8	2930.2
	67	10768	2935.6	2942.9	2933.3	2940.7
	67.5	10768	2943.4	2951.6	2941.2	2949.3
	68	10768	2953.7	2960.3	2951.4	2958.0
	68.5	10768	2963.0	2968.9	2960.7	2966.6
	69	10768	2970.7	2976.8	2968.4	2974.5
	69.5	10768	2973.0	2982.3	2970.7	2980.0
70	10768	2979.6	2991.3	2977.3	2989.0	
Resort Drive	70.5	Culvert				
	71	10768	2981.7	2993.3	2979.5	2991.0
	72	10768	2997.8	3007.5	2995.5	3005.2
	73	10596	3010.8	3021.1	3008.5	3018.8
	74	10596	3035.6	3047.9	3033.3	3045.6
	75	10596	3064.9	3074.7	3062.7	3072.4
	76	10596	3089.0	3103.1	3086.8	3100.9
	77	10596	3111.2	3121.8	3108.9	3119.6
	78	10596	3138.2	3147.3	3136.0	3145.0
	79	10596	3158.1	3169.5	3155.9	3167.3
	80	10596	3177.0	3190.2	3174.8	3188.0
	81	10596	3208.5	3222.9	3206.2	3220.6



**Work Map**  
 Ventana Canyon Wash/Esperero Wash LOMR  
 Sheet 5 of 6  
 JE Fuller / Hydrology & Geomorphology, Inc.



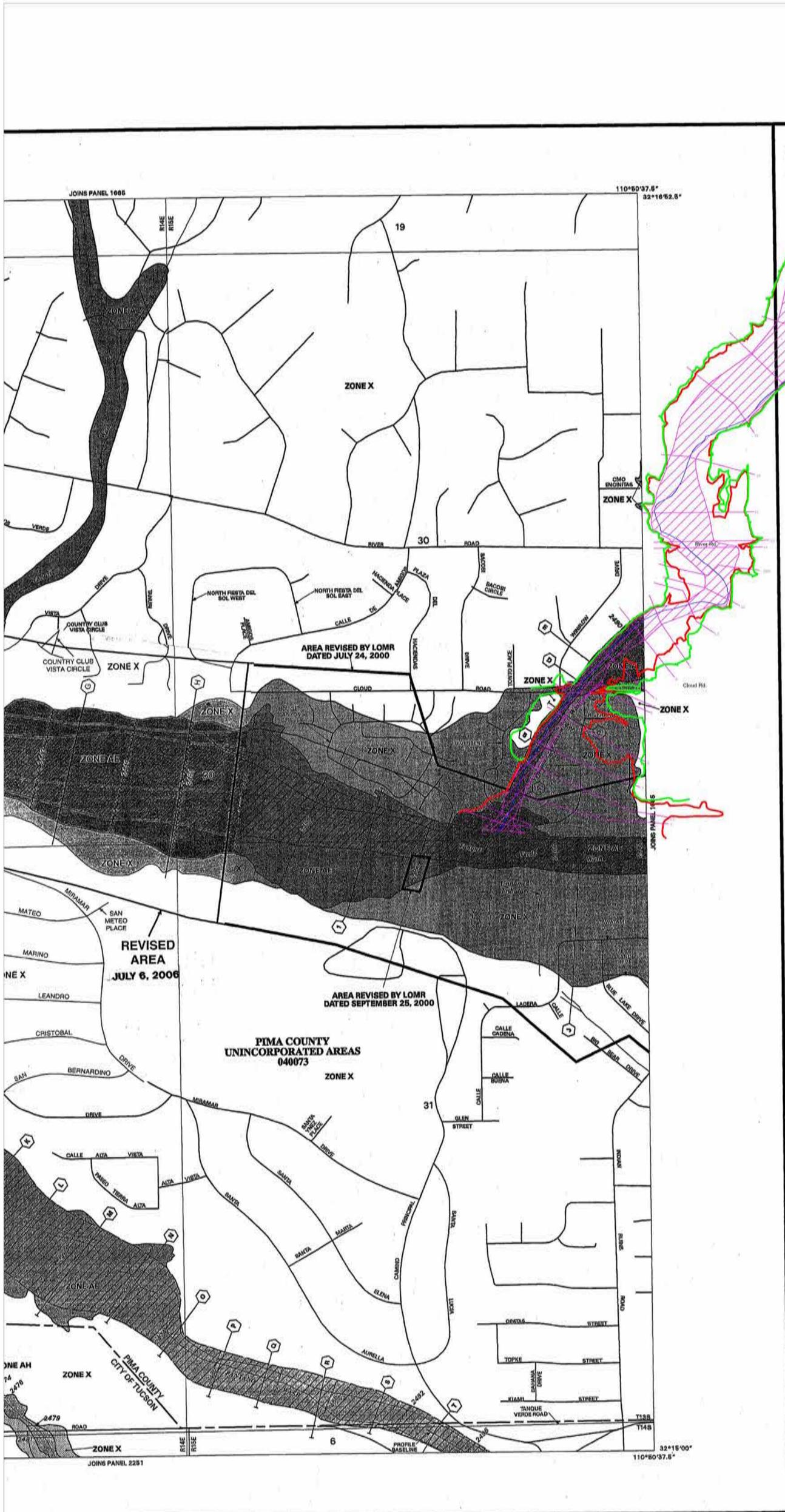
Flooding Source	River Sta	Q Total (cfs)	NAVD88		NGVD29	
			Min Ch El (ft)	W.S. Elev (ft)	Min Ch El (ft)	W.S. Elev (ft)
Esperero Wash	9	9637	2747.4	2754.3	2745.1	2752.0
	10	9637	2759.7	2765.7	2757.4	2763.4
	11	10274	2772.0	2780.3	2769.7	2778.1
	12	10274	2787.0	2795.1	2784.7	2792.8
	13	10274	2799.0	2806.6	2796.8	2804.3
	14	10274	2812.0	2819.0	2809.8	2816.8
	15	10762	2829.8	2835.9	2827.5	2833.7
	16	10762	2840.4	2848.8	2838.1	2846.5
	17	10762	2852.3	2861.9	2850.0	2859.7
	17.1	7094	2857.1	2863.2	2854.8	2860.9
	18	7094	2868.9	2877.6	2866.6	2875.3
	19	7094	2890.9	2899.1	2888.6	2896.9
	20	7094	2917.8	2928.2	2915.5	2926.0
	21	7094	2949.7	2960.8	2947.5	2958.6
	22	7094	2980.8	2994.2	2978.5	2992.0
	23	7094	3013.9	3027.0	3011.6	3024.8
	24	7094	3037.9	3050.0	3035.6	3047.7
	25	7094	3060.2	3073.1	3057.9	3070.9

**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway



**Work Map**  
Ventana Canyon Wash/Esperero Wash LOMR  
Sheet 6 of 6  
JE Fuller / Hydrology & Geomorphology, Inc.



### LEGEND

**SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD EVENT**

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones AE, AH, AO, AR, AY, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

**ZONE AE** No base flood elevations determined.

**ZONE AH** Base flood elevations determined.

**ZONE AO** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

**ZONE AR** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

**ZONE AR** Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood event.

**ZONE AR** Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no base flood elevations determined.

**ZONE AY** Coastal flood zone with velocity hazard (wave action); no base flood elevations determined.

**ZONE VE** Coastal flood zone with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

**Legend Symbols:**

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or velocities.
- Base Flood Elevation line and value; elevation in feet\*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet\*

\*Referenced to the National Geodetic Vertical Datum of 1929

**Map Symbols:**

- Cross Section Line
- Transect Line
- Geographic coordinates referenced to the North American Datum of 1927 (NAD 27)
- 1000-meter Universal Transverse Mercator grid values, zone 12
- 5000-foot grid ticks
- Bench mark (see explanation in Notes to Users section of this FIRM panel).
- River Mile

**MAP REPOSITORY**  
Refer to Repository Listing on Index Map

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
FEBRUARY 8, 1999

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

**MAP SCALE 1" = 500'**

250 0 500 1000 FEET  
150 0 150 300 METERS

PANEL 1663K

## FIRM

### FLOOD INSURANCE RATE MAP

PIMA COUNTY,  
ARIZONA  
AND INCORPORATED AREAS

PANEL 1663 OF 4700  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
PIMA COUNTY, UNINCORPORATED AREAS	040073	1663	K
TUCSON CITY OF	2000	1663	K

**REVISED TO REFLECT LOMR DATED JULY 6, 2006**

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used in insurance applications for the subject community.

**MAP NUMBER**  
04019C1663K

**EFFECTIVE DATE:**  
FEBRUARY 8, 1999

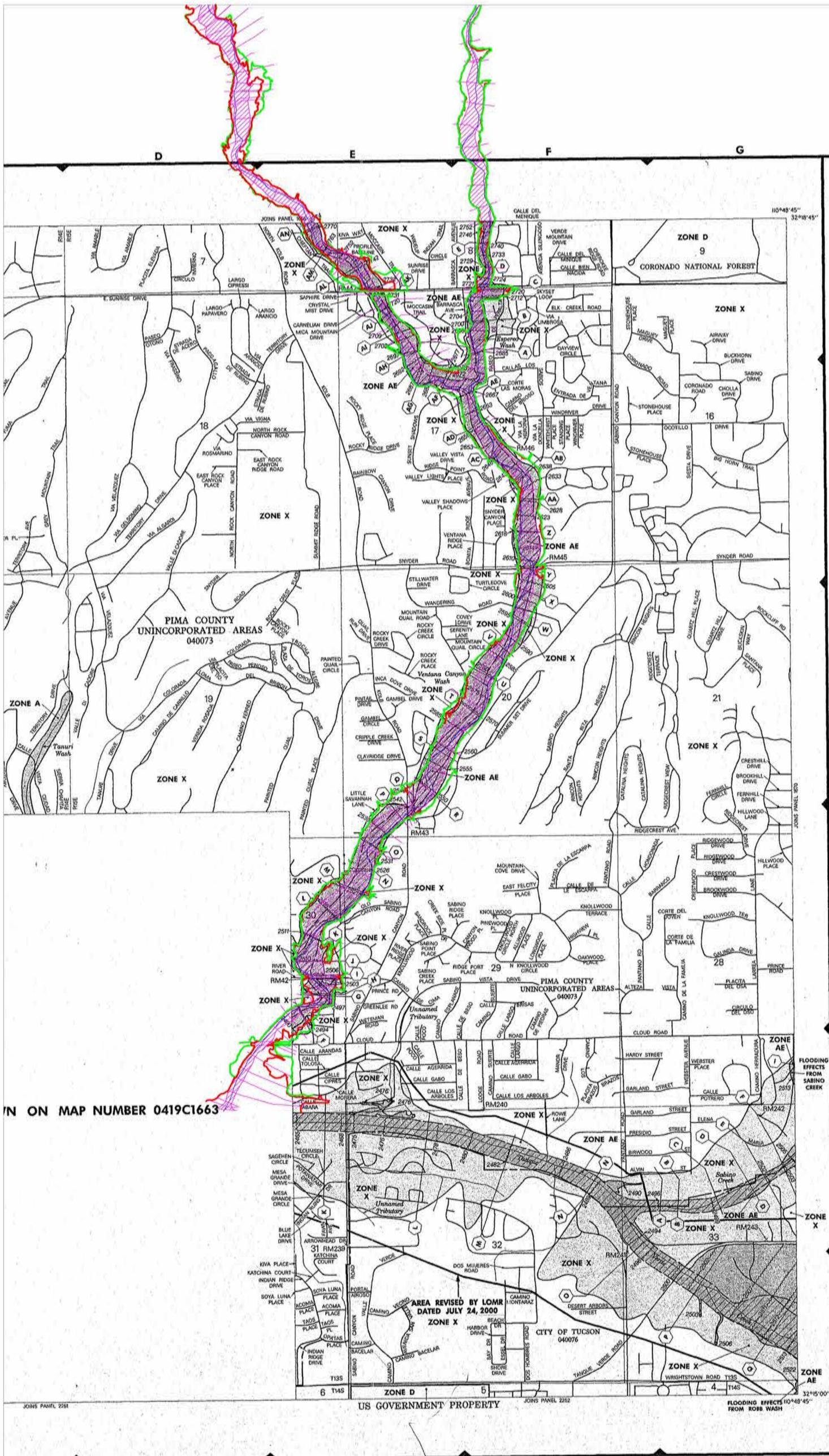
Federal Emergency Management Agency

### Legend

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

### Annotated FIRM

Ventana Canyon Wash/Eesperero Wash LOMR  
Panel No. 1663  
JE Fuller / Hydrology & Geomorphology, Inc.



### LEGEND

**SPECIAL FLOOD HAZARD AREAS INUNDED BY 100-YEAR FLOOD**

- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow sloping terrain); average depths determined; for areas of shallow flooding, velocities also determined.
- ZONE APP** To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

**OTHER FLOOD AREAS**

- ZONE X** Areas of 100-year flood, areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

**OTHER AREAS**

- ZONE X** Areas determined to be outside 100-year floodplain.
- ZONE D** Areas in which flood hazards are undetermined.

**UNDEVELOPED COASTAL BARRIERS**

- Identified 1983
- Identified 1990
- Observed Protected Area

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

**BOUNDARIES**

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones

**ELEVATIONS**

- Base Flood Elevation Line
- Elevation in Feet. See Map Index for Elevation Datum.
- Cross Section Line
- Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- Elevation Reference Mark
- River Mile

Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

97°07'30", 32°22'30"

### NOTES

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size or of irregular features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on "BFE's" and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, AH, AO, APP, V, VE and X.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydrologic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 100 inch.

Coastal base flood elevations apply only to landward of 0.0 NVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and/or Other Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 8.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

**MAP REPOSITORY**  
Refer to Repository Listing on Map Index.

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:**  
FEBRUARY 8, 1999

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:**

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 659-4620.

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**  
FLOOD INSURANCE RATE MAP

**PIMA COUNTY, ARIZONA AND INCORPORATED AREAS**

**PANEL 1665 OF 4700**  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COUNTY	COMMUNITY	NUMBER	PANEL	SUFFIX
TUCSON	CITY OF PIMA COUNTY UNINCORPORATED AREAS	04076	1665	K
TUCSON	CITY OF PIMA COUNTY UNINCORPORATED AREAS	04073	1666	K

**MAP NUMBER**  
04019C1665 K

**EFFECTIVE DATE:**  
FEBRUARY 8, 1999

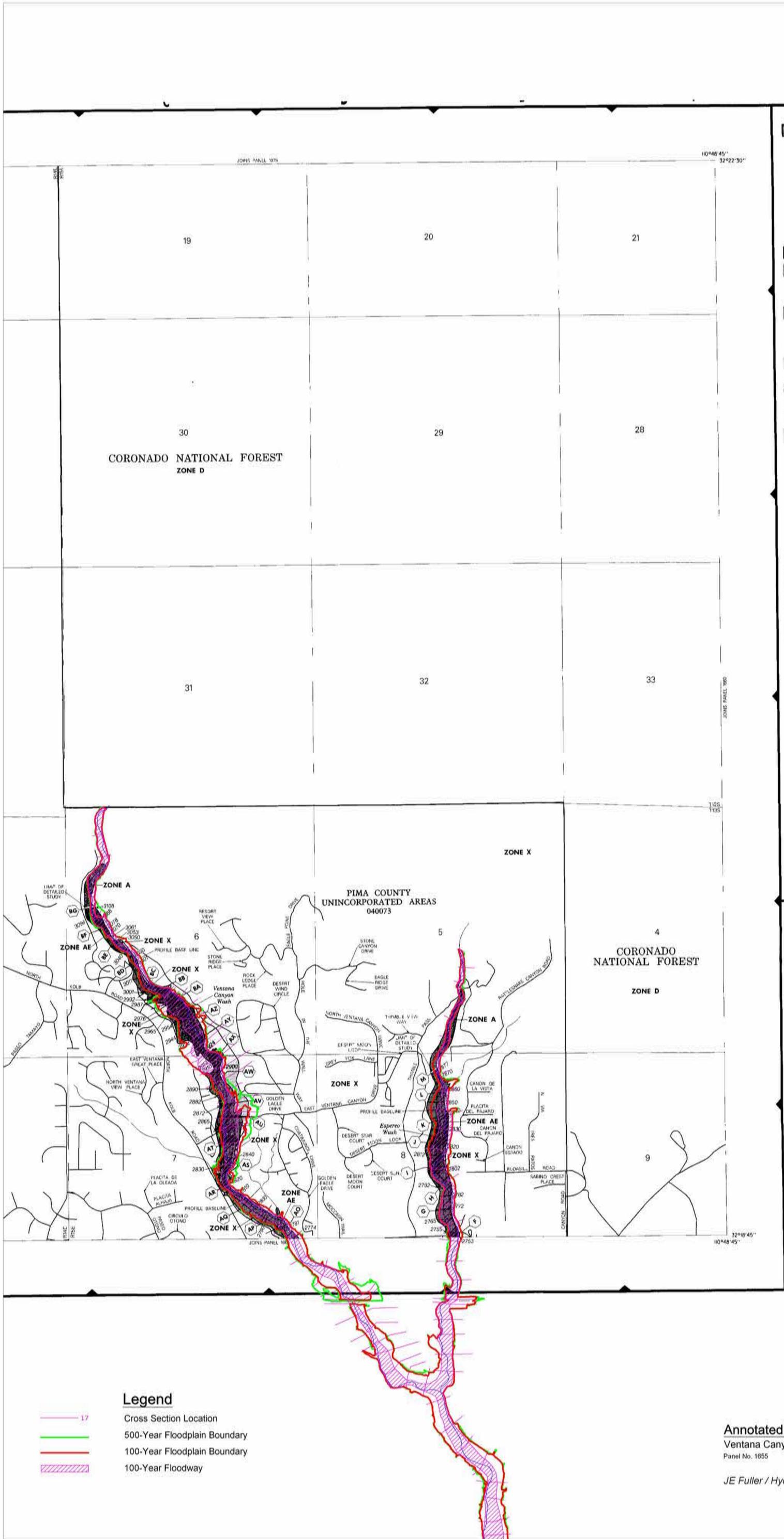
Federal Emergency Management Agency

### Legend

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

**Annotated FIRM**  
Ventana Canyon Wash/Esperero Wash LOMR  
Panel No. 1665

JE Fuller / Hydrology & Geomorphology, Inc.



### LEGEND

**SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD**

- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 1.5 feet usually areas of ponding; base flood elevations determined.
- ZONE AO** Flood depths of 1 to 1.5 feet usually sheet flow or rising terrain; average depths determined for areas of alluvial fan flooding; velocities also determined.
- ZONE AP9** To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

**OTHER FLOOD AREAS**

- ZONE X** Areas of 500-year flood areas of 100-year flood with average depths of less than 1 foot or with drainage area less than 1 square mile and areas protected by levees from 100-year flood.

**OTHER AREAS**

- ZONE X** Areas determined to be outside 500-year floodplain.
- ZONE D** Areas in which flood hazards are undetermined.

**UNDEVELOPED COASTAL BARRIERS**

Identified 1983	Identified 1990	Otherwise Protected Areas
-----------------	-----------------	---------------------------

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

**BOUNDARIES**

- Historian Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones
- Base Flood Elevation Line: Elevation in Feet. See Map Index for Elevation Datum.
- Cross Section Line
- Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum, Elevation Reference Mark.
- RM7
- RM2

**NOTES**

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify areas subject to flooding, particularly from local drainage sources of small size, or all planning features outside Special Flood Hazard Areas. The community map preparator should be consulted for more detailed data on FEMA and for any information on floodway delineations prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, AH, AO, AP9, V, VE and VI-V10.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic computations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 100 feet.

Coastal base flood elevations apply only in areas of 0.0 MSL and include the effects of wave action. Wave effects may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate appropriate boundaries of Coastal Barrier Resource System Units and/or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1980 (P.L. 96-359).

For community map revision history prior to community mapping, see Section B.3 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

**MAP REPOSITORY**  
Refer to Repository Listing on Map Index.

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:**  
FEBRUARY 8, 1999

**EFFECTIVE DATES OF REVISIONS TO THIS PANEL:**

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actual rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6625.

APPROXIMATE SCALE IN FEET  
1000 0 1000

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**  
**FLOOD INSURANCE RATE MAP**

**PIMA COUNTY, ARIZONA AND INCORPORATED AREAS**

PANEL 1655 OF 4700  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:	COMMUNITY	NUMBER	PANEL	SUFFIX
PIMA COUNTY UNINCORPORATED AREAS	040773	1655	K	

**MAP NUMBER 04019C1655 K**

**EFFECTIVE DATE: FEBRUARY 8, 1999**

Federal Emergency Management Agency

**Legend**

- 17 Cross Section Location
- 500-Year Floodplain Boundary
- 100-Year Floodplain Boundary
- 100-Year Floodway

**Annotated FIRM**  
Ventana Canyon Wash/Esperero Wash LOMR  
Panel No. 1655

JE Fuller / Hydrology & Geomorphology, Inc.

**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, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: Ventana Canyon Wash  
**Note:** Fill out one form for each flooding source studied

**A. GENERAL**

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

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

Description Of Structure

**1. Name of Structure: Cloud Road culvert**

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

Location of Structure: at Cloud Road

Downstream Limit/Cross Section: 5

Upstream Limit/Cross Section: 6

**2. Name of Structure: Sabino Canyon Road bridge**

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

Location of Structure: at Sabino Canyon Road

Downstream Limit/Cross Section: 21

Upstream Limit/Cross Section: 22

**3. Name of Structure:**

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

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):

- |  |  |
|--|--|
| <input type="checkbox"/> Levees [Attach Section E (Levee/Floodwall)]                 | <input type="checkbox"/> Drop structures                         |
| <input type="checkbox"/> Superelevated sections                                      | <input type="checkbox"/> Transitions in cross sectional geometry |
| <input type="checkbox"/> Debris basin/detention basin [Attach Section D (Dam/Basin)] | <input type="checkbox"/> Energy dissipator                       |
| <input type="checkbox"/> Other (Describe):   |  |

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: Ventana Canyon Wash

Name of Structure: Cloud Road culvert

1. This revision reflects (check one):

- Bridge/culvert not modeled in the FIS  
 Modified bridge/culvert previously modeled in the FIS  
 Revised analysis of bridge/culvert previously modeled in the FIS

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

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

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Dimensions (height, width, span, radius, length) | <input checked="" type="checkbox"/> Erosion Protection                         |
| <input checked="" type="checkbox"/> Shape (culverts only)                            | <input type="checkbox"/> Low Chord Elevations – Upstream and Downstream        |
| <input type="checkbox"/> Material  | <input type="checkbox"/> Top of Road Elevations – Upstream and Downstream      |
| <input type="checkbox"/> Beveling or Rounding  | <input type="checkbox"/> Structure Invert Elevations – Upstream and Downstream |
| <input type="checkbox"/> Wing Wall Angle   | <input type="checkbox"/> Stream Invert Elevations – Upstream and Downstream    |
| <input type="checkbox"/> Skew Angle  | <input type="checkbox"/> Cross-Section Locations                               |
| <input type="checkbox"/> Distances Between Cross Sections                            |  |

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.

MT-2, Form 3 – Riverine Structures (Supplemental Information)

Note: *This supplemental information applies to the Ventana Canyon Wash. No new structures exist along Esperero Wash flooding source.*

■ Section A, GENERAL

- Description of Structures – Ventana Canyon Wash – Structure No. 4: Name: Resort Drive culvert; Type: Bridge/Culvert; Location of Structure: at Resort Drive; Downstream Cross Section 70; Upstream Cross Section 71.

■ Section C, BRIDGE/CULVERT

- Item 3, Plans of Structures – The information checked in this section was obtained from using a combination of the field survey notes, which includes sketches and an AutoCAD drawing file, and the actual plan sheets. Copies of this information are provided in Appendix C.

### **III. MAPPING AND SURVEY INFORMATION**

#### **3.1 Field Survey**

Stantec Consulting conducted a field survey to define the geometry of all existing bridge openings and/or culvert crossings along the project reach. The survey included the following: (1) cross sections within five feet of the upstream and downstream face of each structure; (2) bed elevations at the base of each pier along the upstream and downstream face of each bridge; (3) vertical profiles of the bridge at the each pier, including a definition of the shape and the associated low cord elevation; (4) cross reference points in common with the Pima Association of Governments (PAG) topography; and (5) monuments at each structure. The basis of elevation was the North American Vertical Datum of 1988 (NAVD 88). Copies of the survey notes and an AutoCAD drawing file from Stantec Consulting are provided in Appendix C. In addition, a field reconnaissance was conducted to verify channel characteristics and to collect data for determining Manning's n-value. Photographs taken at various locations along the study reach are provided in Appendix C.

#### **3.2 Mapping and Records**

The hydraulic analysis was conducted using a combination of 1998 and 2000, 1' = 100', two-foot contour interval mapping provided by Pima County for this study. The horizontal control was based on the North American Datum of 1983 (NAD 1983). As previously noted, the vertical control was based on the North American Vertical Datum of 1988 (NAVD 1988).

## IV. HYDROLOGY

### 4.1 Method Description

The regulatory discharges associated with this request were computed using HEC-1 (Reference 4). The base model, which was initially prepared by Tetra Tech, Inc. in 2002 (Reference 5), was provided by the RFCDD. A copy of the Tetra Tech's summary report is provided in Appendix D. However, Tetra Tech's base model was limited to the 100-year return interval. As part of this LOMR request, per the Pima County's current hydrologic modeling criteria, JEF updated the base model to incorporate (1) the new NOAA Atlas Volume 14 data; (2) the 3-hour, upper 90% confidence interval precipitation values from NOAA 14; (3) the Hydro-40 aerial reduction factors, and (4) the SCS Type II distribution. In addition, JEF expanded the modeling effort to included the 10-, 50-, 100-, and 500-year return intervals. A total of ten point-precipitation-value data sets were obtained from the NOAA 14 web site based on the longitude and latitude of the centroid of each the ten major sub-basins. However, since the range of individual values was narrow, an average value was selected for each return interval. An areal reduction factor was then applied to define a basin average value for each of the ten major sub-basins. The results of the HEC-1 analysis are summarized in Table 1.1. In addition, Table 1.1 provides a comparison between the effective discharges and the revised discharges. The revised HEC-1 models are provided in Appendix D.

Subsection	Requested Information	Description/Location
4.1	Method Description	Thirty-two HEC-1 models – separate models for each return interval at eight nodes (4, 6, 8, 10, 11, 6-11, 14, and 15).
4.2	Parameter Estimation	
4.2.1	Drainage Area Boundaries	Watershed Map, Reference 5
4.2.2	Watershed Work Maps	Reference 5
4.2.3	Gage Data	n/a
4.2.4	Statistical Parameters	n/a
4.2.5	Precipitation	Reference 6
4.2.6	Physical Parameters	Reference 5
4.3	Special Problems, Solution, Modeling Messages	none
4.4	Calibration	n/a
4.5	Final Results	
4.5.1	Hydrologic Analysis Results	Table 1.1 in Section I
4.5.2	Verification of results	n/a

## V. HYDRAULICS

The majority of the information that pertains to this section is provided on FEMA MT-2 Form 2 or on the supplemental information sheet that accompanies that form. Using the outline provided in State Standard 1-97 – *Instructions for Organizing and Submitting Technical Documentation for Flood Studies*, the following table briefly describes the information requested and/or indicates its location in the TDN.

Subsection	Requested Information	Description/Location
5.1	Method Description	FEMA Forms
5.2	Work Study Maps	Attached to MT-2 Form 2
5.3	Parameter Estimation	
5.3.1	Roughness Coefficients	Reference 8
5.3.2	Expansion and Contraction Coefficients	Typical values for uniform reaches and bridges were applied.
5.4	Cross Section Description	New placement and orientation along majority of revised reach. All new sections from DTM and topographic mapping.
5.5	Modeling Considerations	
5.5.1	Hydraulic Jump and Drop Analysis	n/a
5.5.2	Bridges and Culverts	Special Bridge and Culvert Methods in HEC-RAS models.
5.5.3	Levees and Dikes	n/a
5.5.4	Islands and Flow Splits	n/a
5.5.5	Ineffective Flow Areas	Overbank depressions and/or low areas and areas immediately upstream and downstream of bridge crossings
5.6	Floodway Modeling	Method 4 followed by Method 1
5.7	Problems Encountered During the Study	none
5.7.1	Special Problems and Solutions	none
5.7.2	Modeling Warning and Error Messages	Only typical messages that are not significant to results obtained.
5.8	Calibration	n/a
5.9	Final Results	
5.9.1	Hydraulic Analysis Results	Appendix E
5.9.2	Verification of Results	n/a

**VI. SEDIMENT TRANSPORT/EROSION**

No sediment transport study was conducted for this project.

**VII. FIS REPORT DATA**

Subsection	Requested Information	Description/Location
7.1	Summary of Discharges	See Table 7.1
7.2	Floodway Data	See Table 7.2
7.3	Annotated FIRM	Attachment MT-2 Form 2
7.4	Flood Profiles	Appendix B

Table 7.1 Revised FIS Summary of Discharges

Flooding Source	Location	Drainage Area (sq mi)	Peak Discharges (cfs)			
			10-year (in)	50-year (in)	100-year (cfs)	500-year (cfs)
Esperero Wash	downstream of Thimble View Way	5.9	5121	8907	10762	15953
	upstream of Sunrise Drive	6.11	4333	7067	9170	13663
	upstream of confluence with Ventana Canyon Wash	6.19	4246	6949	8898	13574
Ventana Canyon Wash	upstream of Resort Drive	3.85	5179	8813	10596	14864
	upstream of Sunrise Drive	6.98	5378	9448	12044	17805
	upstream of confluence with Esperero Wash	7.94	5271	9151	11484	17544
	downstream of confluence with Esperero Wash	14.14	8122	14053	17753	27253
	upstream of Sabino Canyon Road	15.87	7271	12547	15939	25162
	downstream of River Road at confluence with Tanque Verde Creek	--	5325	9453	12058	19072
		16.64	5066	9030	11527	18238

Table 7.2 Floodway Data

Flooding Source				Floodway			Base Flood Water Surface Elevation			
Watercourse	Cross Section	Distance <sup>1</sup> (ft)	Distance <sup>1</sup> (mi)	Width (ft)	Section Area (sq ft)	Mean Velocity (ft/s)	Regulatory W.S. Elev (ft)	Without Floodway (ft)	With Floodway (ft)	Increase (ft)
Esperero Wash	1	640	0.121	276	938.3	9.5	2681.4	2681.4	2681.9	0.5
	2	990	0.188	228	849.6	10.7	2689.2	2689.2	2689.3	0.2
	3	1400	0.265	267	892.2	10.1	2699.1	2699.1	2699.1	0.0
	4	1720	0.326	284	932.8	9.7	2706.6	2706.6	2706.6	0.0
	5	2060	0.390	169	762.0	12.0	2718.0	2718.0	2718.0	0.0
	6	2185	0.414	681	1894.7	8.1	2723.8	2723.8	2723.8	0.0
	7	2605	0.493	152	735.6	12.5	2730.5	2730.5	2730.5	0.0
	8	3025	0.573	169	789.7	12.2	2742.4	2742.4	2742.4	0.0
	9	3445	0.652	177	807.2	11.9	2754.3	2754.3	2754.3	0.0
	10	3810	0.722	223	876.4	11.0	2765.7	2765.7	2765.7	0.0
	11	4250	0.805	269	1060.7	9.7	2780.3	2780.3	2780.3	0.0
	12	4755	0.901	154	817.5	12.6	2795.1	2795.1	2795.1	0.0
	13	5055	0.957	302	1049.0	9.8	2806.6	2806.6	2806.6	0.0
	14	5455	1.033	328	1138.1	9.0	2819.0	2819.0	2819.4	0.4
	15	5905	1.118	223	947.5	11.4	2835.9	2835.9	2836.2	0.3
	16	6315	1.196	248	1057.7	10.2	2848.8	2848.8	2849.2	0.4
	17	6715	1.272	121	800.5	13.4	2861.9	2861.9	2862.1	0.2
	17.1	6750	1.278	89	519.3	13.7	2863.2	2863.2	2863.5	0.3
	18	7125	1.349	65	476.4	14.9	2877.6	2877.6	2877.7	0.2
	19	7525	1.425	54	438.9	16.2	2899.1	2899.1	2899.6	0.5
	20	7940	1.504	98	558.4	12.7	2928.2	2928.2	2928.2	0.0
	21	8350	1.581	71	491.3	14.4	2960.8	2960.8	2960.8	0.0
	22	8765	1.660	58	457.5	15.5	2994.2	2994.2	2994.2	0.0
	23	9205	1.743	87	525.8	13.5	3027.0	3027.0	3027.0	0.0
	24	9545	1.808	82	502.3	14.1	3050.0	3050.0	3050.0	0.0
25	9855	1.866	68	472.8	15.0	3073.1	3073.1	3073.1	0.0	

<sup>1</sup> miles above confluence with Ventana Canyon Wash

Table 7.2 Floodway Data

Flooding Source				Floodway			Base Flood Water Surface Elevation			
Watercourse	Cross Section	Distance <sup>1</sup>	Distance <sup>1</sup>	Width (ft)	Section Area (sq ft)	Mean Velocity (ft/s)	Regulatory W.S. Elev (ft)	Without Floodway (ft)	With Floodway (ft)	Increase (ft)
		(ft)	(mi)							
Ventana Canyon Wash	0.5	0	0	168	929.4	10.8	2469.7	2469.7	2469.9	0.2
	1	85	0.016	119	806.3	12.5	2471.4	2471.4	2471.8	0.4
	2	301.69	0.057	128	759.1	14.6	2473.8	2473.8	2473.8	0.0
	2.5	581.69	0.110	150	890.3	13.5	2478.9	2478.9	2478.9	0.0
	3	806.69	0.153	158	1337.0	9.0	2481.9	2481.9	2481.9	0.0
	4	1123.28	0.213	115	774.4	15.6	2482.3	2482.3	2482.3	0.0
	5	1363.28	0.258	249	1520.4	8.2	2486.4	2486.4	2486.4	0.0
	6	1438.28	0.272	254	1715.7	7.2	2487.5	2487.5	2488.4	0.9
	7	1803.28	0.342	108	794.0	15.6	2488.5	2488.5	2488.5	0.0
	8	2157.67	0.409	195	1116.4	11.7	2492.9	2492.9	2492.9	0.0
	9	2391.08	0.453	161	1045.7	12.5	2496.2	2496.2	2496.4	0.2
	9.5	2681.08	0.508	111	961.8	13.6	2498.5	2498.5	2499.5	0.9
	10	3041.08	0.576	224	1828.8	7.1	2502.9	2502.9	2503.0	0.1
	10.5	3351.08	0.635	304	1443.6	9.9	2504.2	2504.2	2504.7	0.5
	11	3971.24	0.752	558	1976.6	6.9	2508.2	2508.2	2508.9	0.7
	12	4049.37	0.767	383	3328.7	4.1	2513.3	2513.3	2513.5	0.2
	13	4429.77	0.839	506	4527.1	3.0	2513.7	2513.7	2514.1	0.4
	14	5054.96	0.957	223	1303.1	10.9	2513.9	2513.9	2514.3	0.4
	15	5685.82	1.077	490	2663.0	5.4	2520.5	2520.5	2521.4	0.9
	16	6157.08	1.166	397	1798.5	8.4	2525.2	2525.2	2525.3	0.1
	17	6694.84	1.268	357	2082.6	7.2	2529.9	2529.9	2530.5	0.6
	18	7278.79	1.379	340	1746.1	8.6	2534.4	2534.4	2535.1	0.7
	19	7792.94	1.476	368	1983.5	7.8	2539.9	2539.9	2540.6	0.7
	20	8156.36	1.545	292	1603.7	9.7	2544.1	2544.1	2544.9	0.8
	21	8379.5	1.587	273	1902.3	10.2	2546.9	2546.9	2547.7	0.8
	22	8443.51	1.599	298	2452.3	7.0	2549.4	2549.4	2550.2	0.8
	23	8977	1.700	320	1601.0	10.0	2551.1	2551.1	2551.8	0.6
	24	9541.37	1.807	361	1796.0	9.2	2557.3	2557.3	2557.8	0.5
	25	10058.71	1.905	292	1641.6	10.1	2562.4	2562.4	2563.4	1.0
26	10530.25	1.994	319	1705.3	9.7	2567.7	2567.7	2568.3	0.5	
27	11110.98	2.104	341	1708.2	9.7	2574.4	2574.4	2574.5	0.1	
28	11632.31	2.203	291	1647.6	10.1	2581.2	2581.2	2582.0	0.8	
29	12133.13	2.298	315	1733.9	9.6	2587.6	2587.6	2587.8	0.2	

<sup>1</sup> miles above confluence with Tanque Verde Creek

Table 7.2 Floodway Data

Flooding Source				Floodway			Base Flood Water Surface Elevation			
Watercourse	Cross Section	Distance <sup>1</sup>	Distance <sup>1</sup>	Width (ft)	Section Area (sq ft)	Mean Velocity (ft/s)	Regulatory W.S. Elev (ft)	Without Floodway (ft)	With Floodway (ft)	Increase (ft)
		(ft)	(mi)							
Ventana Canyon Wash (continued)	30	12682.51	2.402	228	1422.6	11.6	2594.1	2594.1	2594.6	0.6
	31	13210.72	2.502	224	1457.0	11.4	2600.6	2600.6	2601.0	0.5
	32	13647.69	2.585	245	1545.8	10.7	2606.8	2606.8	2606.9	0.1
	33	13948.97	2.642	204	1432.3	11.6	2610.9	2610.9	2611.0	0.0
	34	14035.41	2.658	229	1746.2	9.5	2612.5	2612.5	2613.2	0.7
	35	14620.63	2.769	417	1680.6	9.9	2617.5	2617.5	2618.2	0.7
	36	14927.75	2.827	359	1753.9	9.7	2622.6	2622.6	2623.2	0.6
	37	15451.28	2.926	244	1426.9	11.9	2628.9	2628.9	2629.6	0.7
	38	15789.69	2.990	201	1355.3	12.5	2635.3	2635.3	2636.2	0.9
	39	16283.9	3.084	201	1322.5	13.1	2643.3	2643.3	2643.6	0.3
	40	16853.9	3.192	319	1731.2	10.0	2650.9	2650.9	2651.8	1.0
	41	17430.17	3.301	207	1397.2	12.7	2659.6	2659.6	2660.6	1.0
	42	18020.09	3.413	152	1225.8	14.5	2669.3	2669.3	2669.7	0.4
	43	18524.75	3.508	145	977.6	11.8	2676.4	2676.4	2677.0	0.6
	44	18966.38	3.592	101	790.3	15.1	2683.6	2683.6	2684.1	0.5
	45	19600.5	3.712	262	1239.2	9.6	2692.5	2692.5	2693.3	0.8
	46	20093.75	3.806	254	1196.9	10.0	2701.8	2701.8	2702.5	0.8
	46.5	20352.75	3.855	126	824.5	14.5	2706.9	2706.9	2707.4	0.5
	47	20638.75	3.909	120	852.1	14.0	2714.7	2714.7	2715.3	0.6
	48	21048.38	3.986	142	882.7	13.5	2723.6	2723.6	2724.6	1.0
	49	21298.79	4.034	118	809.4	14.9	2732.6	2732.6	2732.6	0.0
	50	21418.57	4.057	151	1542.3	7.8	2738.5	2738.5	2738.5	0.0
	51	21794.69	4.128	174	977.3	12.3	2740.0	2740.0	2740.0	0.0
	52	22361.86	4.235	208	1047.6	10.6	2752.8	2752.8	2753.4	0.7
	53	22942.31	4.345	147	841.5	13.2	2765.1	2765.1	2765.2	0.1
	54	23433.88	4.438	160	954.2	11.6	2776.0	2776.0	2776.9	0.9
	55	23853.88	4.518	189	899.4	12.3	2783.9	2783.9	2784.2	0.3
	56	24348.9	4.612	192	994.6	11.2	2797.2	2797.2	2797.9	0.7
	57	24822	4.701	118	782.5	14.2	2809.4	2809.4	2810.1	0.7
58	25268.97	4.786	92	725.9	15.3	2821.7	2821.7	2822.4	0.7	

<sup>1</sup> miles above confluence with Tanque Verde Creek

Table 7.2 Floodway Data

Flooding Source				Floodway			Base Flood Water Surface Elevation			
Watercourse	Cross Section	Distance <sup>1</sup>	Distance <sup>1</sup>	Width	Section Area	Mean Velocity	Regulatory W.S. Elev	Without Floodway	With Floodway	Increase
		(ft)	(mi)							
Ventana Canyon Wash (continued)	59	25775.08	4.882	195	959.8	11.6	2833.6	2833.6	2834.3	0.8
	60	26244.94	4.971	321	1189.2	9.3	2850.7	2850.7	2851.2	0.5
	61	26512.96	5.021	299	1471.9	9.2	2863.2	2863.2	2863.9	0.7
	62	26576.02	5.033	372	2510.7	5.3	2866.5	2866.5	2867.4	1.0
	62.5	26781.02	5.072	310	1225.8	9.0	2867.2	2867.2	2867.3	0.1
	63	26951.02	5.104	350	1367.4	8.1	2871.4	2871.4	2872.4	1.0
	63.5	27164.02	5.145	200	952.5	11.3	2878.1	2878.1	2878.3	0.3
	64	27375.02	5.185	144	860.1	12.5	2885.4	2885.4	2885.6	0.2
	64.5	27650.02	5.237	200	909.4	11.8	2893.5	2893.5	2894.1	0.5
	65	27911.02	5.286	313	1218.0	8.8	2906.5	2906.5	2907.1	0.6
	65.5	28163.02	5.334	414	1373.7	7.8	2913.4	2913.4	2914.4	1.0
	66	28438.02	5.386	234	971.2	11.1	2924.0	2924.0	2924.5	0.5
	66.5	28622.02	5.421	332	1149.0	9.4	2932.4	2932.4	2933.0	0.6
	67	28838.02	5.462	211	984.3	10.9	2942.9	2942.9	2943.3	0.3
	67.5	29062.02	5.504	288	1090.1	9.9	2951.6	2951.6	2951.9	0.4
	68	29267.02	5.543	253	1046.1	10.3	2960.3	2960.3	2960.7	0.5
	68.5	29530.02	5.593	339	1076.2	10.0	2968.9	2968.9	2969.4	0.6
	69	29768.02	5.638	418	1227.3	8.8	2976.8	2976.8	2977.8	1.0
	69.5	29883.02	5.660	271	1047.3	10.3	2982.3	2982.3	2982.6	0.3
	70	29988.02	5.680	228	1157.9	9.3	2991.3	2991.3	2991.9	0.7
	71	30030.02	5.688	213	1339.4	8.0	2993.3	2993.3	2994.2	0.9
72	30500.02	5.777	133	837.4	12.9	3007.5	3007.5	3008.4	0.9	
73	30899.02	5.852	80	674.1	15.7	3021.1	3021.1	3021.8	0.8	
74	31410.02	5.949	72	669.7	15.8	3047.9	3047.9	3048.8	0.9	
75	31935.02	6.048	111	753.0	14.1	3074.7	3074.7	3075.1	0.4	
76	32484.02	6.152	233	1117.5	9.5	3103.1	3103.1	3103.1	0.0	
77	32957.02	6.242	109	754.8	14.0	3121.8	3121.8	3121.8	0.0	
78	33462.02	6.338	182	918.8	11.5	3147.3	3147.3	3147.3	0.0	
79	33967.02	6.433	135	852.0	12.4	3169.5	3169.5	3169.5	0.0	
80	34463.02	6.527	131	865.5	12.2	3190.2	3190.2	3190.2	0.0	
81	35011.02	6.631	110	800.2	13.2	3222.9	3222.9	3222.9	0.0	

<sup>1</sup> miles above confluence with Tanque Verde Creek

**APPENDIX A**

References

**REFERENCES**

1. Federal Emergency Management Agency, *Flood Insurance Study – Pima County, Arizona and Incorporated Areas*, Pima County, Community Number – 040073, February 8, 1999.
2. U.S. Army Corps of Engineers, *HEC-2: Water Surface Profiles*, Version 4.6.2, May 1991.
3. US Army Corps of Engineers Hydrologic Engineering Center, *HEC-RAS River Analysis System*, Version 4, March 2008.
4. U.S. Army Corps of Engineers, *HEC-1: Flood Hydrograph Package*, Version 4.1, June 1998.
5. Tetra Tech, Inc., *Summary of Ventana Canyon Hydrologic Modeling*, June 20, 2002.
6. National Oceanic & Atmospheric Administration, *Precipitation-Frequency Atlas of the United States*, NOAA Atlas 14, Volume 1, Version 4, extracted October 3, 2008.
7. National Oceanic & Atmospheric Administration, *Depth-Area Ratios in the Semi-Arid Southwest United States*, NOAA Technical Memorandum NWS Hydro-40, August 1984.
8. JE Fuller / Hydrology and Geomorphology Inc., *Ventana Canyon Wash and Esperero Wash, Letter of Map Revision, Field Reconnaissance Report*, August 2005

**APPENDIX B**

General Documentation & Correspondence

**APPENDIX C**

Site Photographs & Survey Field Notes

**APPENDIX D**

Hydrologic Analysis – Summary of Supporting Documentation

**APPENDIX E**

Hydraulic Analysis – Summary of Supporting Documentation

**Appendix F**

GIS Shape Files