WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

Technical Data Notebook
Volume I of II

PREPARED FOR:

The Flood Control District of Maricopa County

2801 West Durango Street
Phoenix, AZ 85009
(602) 506-1501
FCD Contract 2009-C006
Assignment 3

PREPARED BY:

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January 6, 2011
Project # 10013714 01

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: September 28, 2010

To: Timothy S. Phillips, P.E., Chief Engineer and General Manager

From: Richard P. Harris, P.E., CFM

Subject: Wittmann Phase III Limited Detail Floodplain Delineation Study TDN and Maps, Contract FCD 2009C006, Work Assignment # 3

The floodplain and floodway study for the Wittmann Phase III FDS is now ready for use as the best available technical information. The study documentation will be sent to FEMA for review and incorporation into the County's FIRM panels.

The background for the study includes the following:

> The study produced provided updated Hydrology and delineated approximately 13 linear miles of Limited Detail (without Floodway) Zone AE floodplain boundaries. The topographic basis for the study is 2-foot and 4-foot contour interval mapping in NAVD88 vertical datum by Stewart Geo Technologies. The study area was flown in April of 2002. The study Consultant was PBS & J Consulting. The project manager for the Consultant was Seth Ahrens, P.E, CFM. The project managers for the District were Richard Harris, P.E., CFM, and Jonathan Lesperance, E.I.T., CFM.

Please concur and authorize below the use of this new study.

Richard P. Harris 9/27/10 Project Manager Date:	Timothy S. Phillips, P.E., Chief Engineer and General Manager Date: 10/4/10
Jonathan Lesperance Project Co-Manager Date: 9/28/10	Assistant Project Manager Date:
9,28,10 Hydrology/Hydraulics Branch Manager Date:	Assistant Project Manager Date:
Edward Rabago 9/29/2010 Engineering Division Manager Date:	Assistant Project Manager Date:
Kellie A Serfich 9/29/10 Floodplain Management & Services Division Manager Date:	Assistant Project Manager Date:
File Copies: 1. _____ 2. _____	YES ☐ GIS Posted (Pending Floodplain Only) Date: N/A

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

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E.5 HYDRAULIC CALCULATIONS
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24" X 36" COPIES OF HYDRAULIC WORK MAPS

SECTION 1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of the *Wittmann Phase III Floodplain Delineation Study* (*FDS*) was to delineate the 100-year floodplain along approximately 13 miles of washes near the small unincorporated community of Wittmann, Arizona. This study will be submitted to FEMA via a Letter of Map Revision (LOMR) request in order to map the results on the Digital Flood Insurance Rate Maps (DFIRMs) that impact the study area.

PBS&J completed the hydraulic modeling and the floodplain mapping of the studied streams. The hydrology was established by a separate contractor. Copies of the supporting documentation for the hydrology may be found in Appendix D.

1.2 Authority for Study

PBS&J was contracted by the Flood Control District of Maricopa County (FCDMC) to perform this *FDS* under contract number FCD 2009-C006 signed on May 18, 2009. The *FDS* was completed as part of Assignment 3 on this contract. The project manager for FCDMC was Mr. Richard Harris, P.E., CFM.

1.3 Location

The study area is located in northwest Maricopa County, Arizona in the vicinity of the community of Wittmann. This community is not incorporated; therefore, the study area jurisdiction falls within unincorporated Maricopa County. The study area resides within Township 5 North, Range 3 West, Sections 2 and 11 and Township 6 North, Range 3 West, Sections 14, 15, 22, 23, 26, 27, 34, and 35. Figure 1.3.1 shows a location map of the study area, and Figure 1.3.2 shows a vicinity map of the study area.

1.4 Methodology

The hydrologic analysis was completed by Entellus under contract number FCD 2002-C029 and was documented in *Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volume HY-Addendum,* which is an addendum to *Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volumes HY-I, HY-II, and HY-III.* Their analysis employed the U.S. Army Corps of Engineers's (USACE) program HEC-1 (Version 4.1, 1998) to complete the hydrological analysis.

PBS&J completed the hydraulic analyses associated with the *Wittmann Phase III FDS*. This modeling was completed using HEC-RAS version 4.0.

1.5 Acknowledgements

PBS&J would like to thank Mr. Richard Harris, Mr. Jonathan Lesperance, and Mr. Amir Motamedi, and the rest of the staff at FCDMC for the opportunity to work with them on this project. We are very grateful for this opportunity.

1.6 Results

Approximately 13 linear miles of the 100-year floodplain were delineated. This modeling and mapping will be submitted to FEMA via a LOMR request in order to map the results on the DFIRMs that impact the study area.

Figure 1.3.1 Location Map

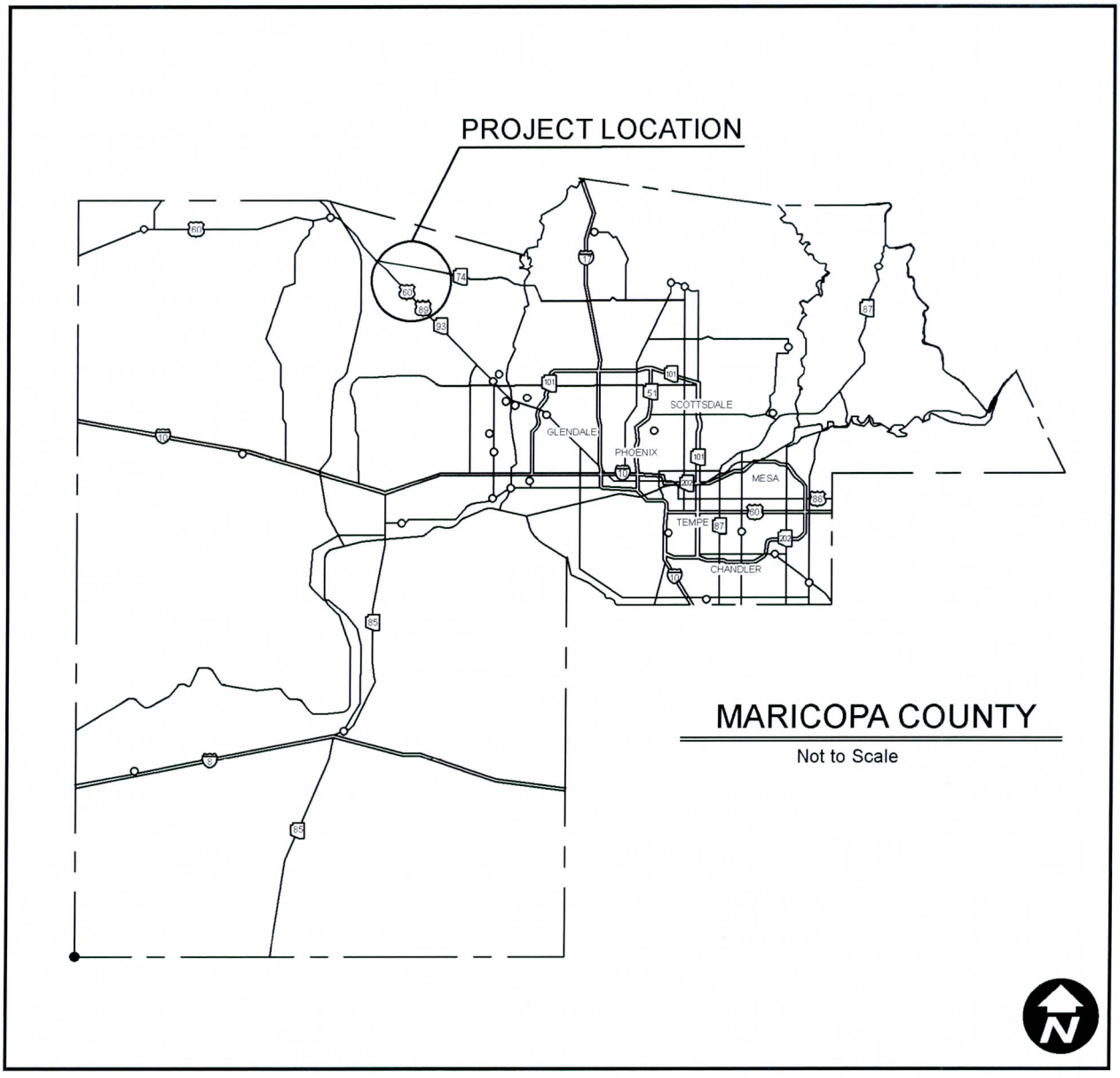
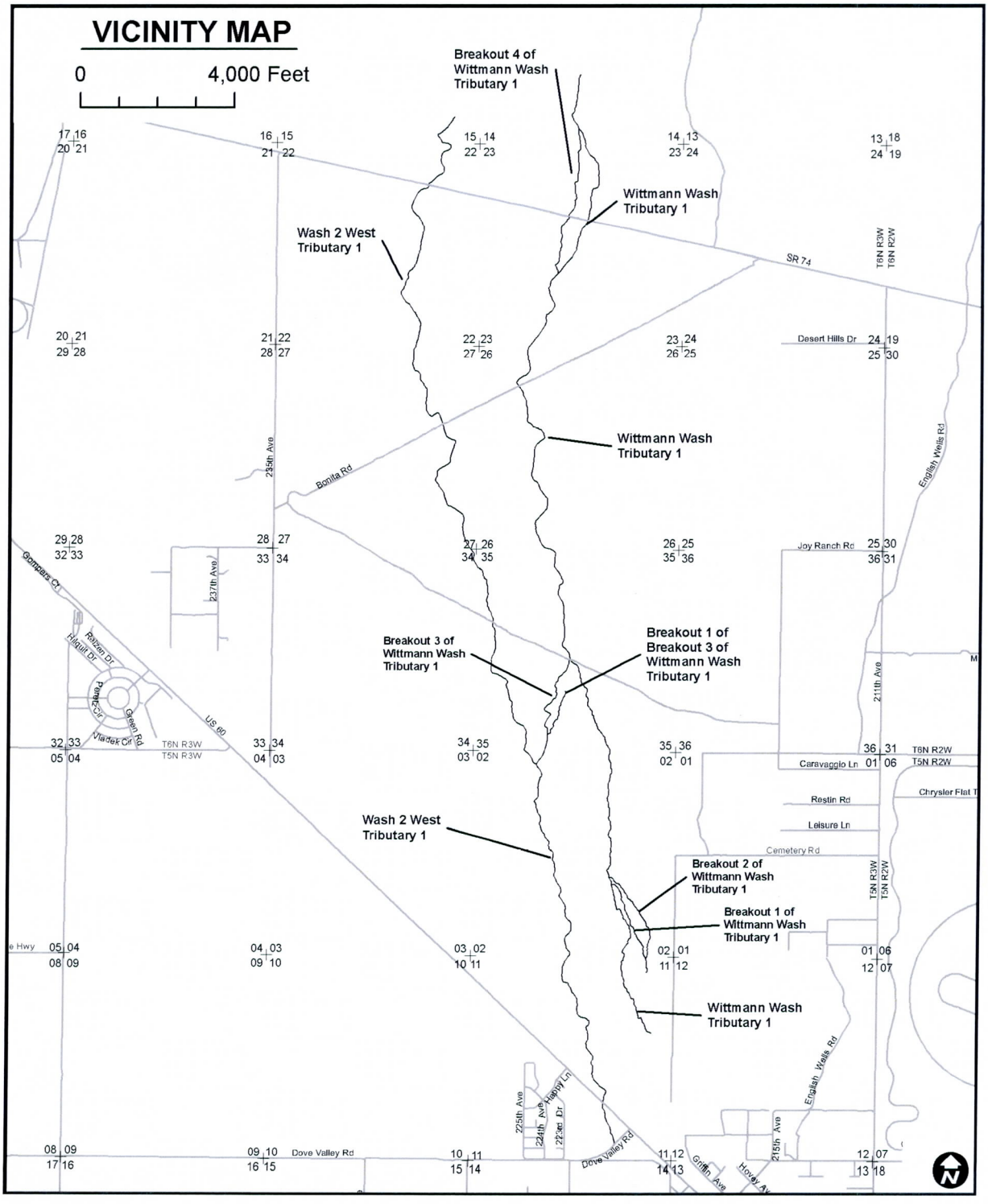


Figure 1.3.2 Vicinity Map



SECTION 2.0 ADWR / FEMA FORMS

2.1 Study Documentation Abstract for FEMA Submittals

Study Documentation Abstract for FEMA Submittals	Initial Study	X	Restudy		CLOMR		LOMR		Other	

Section 2.1 – Study Documentation Abstract for FEMA Submittals – Wittmann Phase III FDS		
2.1.1	Date Study Accepted	
2.1.2	Study Contractor	PBS&J 20860 North Tatum Boulevard, Suite 300 Phoenix, Arizona 85050 Contact: Mr. Seth Ahrens, P.E., CFM Phone: (480) 419-7275 Fax: (480) 419-7202 Contract No. FCD 2009-C006 Assignment 3
2.1.3	FEMA Technical Review Contractor	Michael Baker, Jr. 3601 Eisenhower Avenue Alexandria, Virginia 22304 Phone: (703) 960-8800 Fax: (703) 960-9125
2.1.4	FEMA Regional Reviewer	N/A
2.1.5	State Coordinator	Mr. Brian Cosson, CFM, Arizona Dept. of Water Resources
2.1.6	Local Technical Reviewer	Mr. Richard Harris, P.E., CFM (Project Manager) Mr. Jonathan Lesperance, EIT, CFM (Deputy Project Manager) Flood Control District of Maricopa County 2801 West Durango Street Phoenix, Arizona 85009 Phone: (602) 506-1501 Fax: (602) 506-4601
2.1.7	Reach Descriptions	Wash 2 West Tributary 1 Wittmann Wash Tributary 1 Breakout 1 of Wittmann Wash Tributary 1 Breakout 2 of Wittmann Wash Tributary 1 Breakout 3 of Wittmann Wash Tributary 1 Breakout 4 of Wittmann Wash Tributary 1 Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1.
2.1.8	USGS Quad Sheets	No USGS quad maps were used during this project since FCDMC provided aerial photography and topographic data for the project area.
2.1.9	Unique Conditions and Problems	No unique situations.
2.1.10	Coordination of Peak Discharges	Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volume HY-Addendum. Addendum to Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volumes HY-I, HY-II, and HY-III. Completed by Entellus, July 2005.

2.2 FEMA MT-2 Forms

FEMA MT-2 Forms 1, 2, and 3 may be found on the following pages.

MT-2 FORMS

SUPPLEMENTAL EXPLANATIONS

Wittmann Phase III Floodplain Delineation Study
FCDMC Contract 2009-C006, Assignment 3
July 2010

This document contains additional information pertaining to the FEMA MT-2 Forms.

Form 1 – Part C

The map changes requested as part of this LOMR application are based on flood hazard information meant to improve upon that which is shown on the flood map or within the flood study. This study was studied by a local agency (Flood Control District of Maricopa County), and it addressed an area where there is currently minimal FEMA mapping. Therefore, no review fee has been included.

Form 2 – Part A – Question 5 – All Studied Washes

Sediment transport was not considered since this is a Floodplain Delineation Study, and sediment transport analysis is not typically included in such a project. Note that no design work was completed as part of this project.

Form 2 – Part B – Question 1 – All Studied Washes Except Wash 2 West Tributary 1

These washes were determined to have coincident peaks with the washes at their downstream confluences. The Proposed/Revised water-surface elevations presented on the form for the downstream limits represent the backwater water-surface elevations at the downstream ends of the streams as well as the downstream boundary conditions in the models.

Form 2 – Part B – Question 1 – Wash 2 West Tributary 1

The Proposed/Revised water-surface elevation presented on the form for the downstream limit is the water surface elevation at the most downstream cross section in this model.

Form 3 – Part C – Question 3 – All Washes with Structures

All three structures in this study may be found under State Route 74. As-built plans for these three structures were available and may be found in Appendix C.3. Invert elevations and top-of-road elevations were measured via field survey. Additional information related to this survey may be found in Section 3 and Appendix C.

Form 3 – Part C – Question 4 – All Washes with Structures

Sediment transport was not considered since this is a Floodplain Delineation Study, and sediment transport analysis is not typically included in such a project. Note that no design work was completed as part of this project.

MT-2 FORMS

FORM 1

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 480287	City of Katy Harris County	TX TX	480301 48201C	0005D 0220G	02/08/83 09/28/90
040037	Maricopa County	AZ	04013C	0685G	09/30/05
040037	Maricopa County	AZ	04013C	0695H	09/30/05

2. a. Flooding Source: Wash 2 West Tributary 1, Wittmann Wash Tributary 1, and five breakouts associated with Wittmann Wash Tributary 1.

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

3. Project Name/Identifier: Wittmann Phase III Floodplain Delineation Study

4. FEMA zone designations affected: A (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/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: Mr. Richard Harris, P.E., CFM	Company: Flood Control Dist. of Maricopa County	
Mailing Address: Flood Control Dist. of Maricopa County 2801 W Durango St, Phoenix, AZ 85009	Daytime Telephone No.: 602.506.1501	Fax No.: 602.506.4601
	E-Mail Address: rph@mail.maricopa.gov	
Signature of Requester (required): Richard T. Harris	Date: 9/27/10	

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: Mr. Timothy Phillips, P.E., Chief Engineer and General Manager	Community Name: Maricopa County	
Mailing Address: Flood Control Dist. of Maricopa County 2801 W Durango St, Phoenix, AZ 85009	Daytime Telephone No.: 602.506.1501	Fax No.: 602.506.4601
	E-Mail Address: tsp@mail.maricopa.gov	
Community Official's Signature (required): T S P	Date: 10/4/10	

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 data. All documents submitted in support of this request are correct to the best of my knowledge. All analyses have been performed correctly and in accordance with sound engineering practices. All project works are designed in accordance with sound engineering practices to provide protection from the 1% annual chance flood. If "as-built" conditions data/plan provided, then the structure(s) has been built according to the plans being certified, is in place, and is fully functioning. 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: Mr. Seth Ahrens, P.E., CFM	License No.: AZ 47097	Expiration Date: 12-31-2010
Company Name: PBS&J	Telephone No.: 480.538.1509	Fax No.: 480.419.7202
Signature: SA		Date: 9.16.10

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

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

Seal (Optional)

MT-2 FORMS

FORM 2

Wash 2 West Tributary 1
Wittmann Wash Tributary 1
Breakout 1 of Wittmann Wash Tributary 1
Breakout 2 of Wittmann Wash Tributary 1
Breakout 3 of Wittmann Wash Tributary 1
Breakout 4 of Wittmann Wash Tributary 1
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

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: Wash 2 West Tributary 1
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)

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	Upstream of BNSF Railroad bridge	3.526	n/a	1727.08
Upstream Limit	2,400 ft upstream from State Route 74	9.189	n/a	2070.69

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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	Natural Run		Floodway Run		Datum
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: 2WTrib1.prj	Plan Name: Plan 01	File Name:	Plan Name:	NAVD 88
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.

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

PAPERWORK REDUCTION ACT

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Flooding Source: Wittmann Wash Tributary 1
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)

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 Wittmann Wash	0.128	n/a	1744.13
Upstream Limit	4,000 ft upstream from State Route 74	5.376	n/a	2113.26

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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	Natural Run		Floodway Run		Datum
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: WittTrib1.prj	Plan Name: Plan 01	File Name:	Plan Name:	NAVD 88
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.

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

PAPERWORK REDUCTION ACT

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Flooding Source: Breakout 1 of Wittmann Wash Tributary 1
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)

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	Wittmann Wash	0.112	n/a	1761.55
Upstream Limit	Wittmann Wash Tributary 1	0.224	n/a	1768.26

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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

Models Submitted	Natural Run		Floodway Run		Datum
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: WittTrib1Brkout1.prj	Plan Name: Plan 01	File Name:	Plan Name:	
NAVD 88					
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.

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
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Flooding Source: Breakout 2 of Wittmann Wash Tributary 1
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)

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	Breakout 1 of Wittmann Wash Tributary 1	0.074	n/a		1763.63
Upstream Limit	Wittmann Wash Tributary 1	0.388	n/a		1780.16

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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

Models Submitted	Natural Run		Floodway Run		Datum
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: WittTrib1Brkout2.prj	Plan Name: Plan 01	File Name:	Plan Name:	
NAVD 88					
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.

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Flooding Source: Breakout 3 of Wittmann Wash Tributary 1
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)

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	Wash 2 West Tributary 1	0.052	n/a	1824.43
Upstream Limit	Wittmann Wash Tributary 1	0.513	n/a	1853.17

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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	Natural Run		Floodway Run		Datum
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: WittTrib1Brkout3.prj	Plan Name: Plan 01	File Name:	Plan Name:	
NAVD 88					
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.

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

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: Breakout 4 of Wittmann Wash Tributary 1
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)

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	Wittmann Wash Tributary 1	0.013	n/a	2016.96
Upstream Limit	Wittmann Wash Tributary 1	0.706	n/a	2083.37

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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	Natural Run		Floodway Run		Datum
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 NAVD 88	File Name: WittTrib1Brkout4.prj	Plan Name: Plan 01	File Name:	Plan Name:	
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.

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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

PAPERWORK REDUCTION ACT

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Flooding Source: Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1
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)

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	Breakout 3 of Wittmann Wash Tributuary 1	0.005	n/a	1832.09
Upstream Limit	Breakout 3 of Wittmann Wash Tributuary 1	0.235	n/a	1849.10

2. Hydraulic Method/Model Used

HEC-RAS 4.0

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. 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

Models Submitted	Natural Run		Floodway Run		Datum
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: WittT1Brk1ofBrk3.prj	Plan Name: Plan 01	File Name:	Plan Name:	NAVD 88
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 FORMS

FORM 3

Wash 2 West Tributary 1 – State Route 74
Wittmann Wash Tributary 1 – State Route 74
Breakout 4 of Wittmann Wash Tributary 1 – State Route 74

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

RIVERINE STRUCTURES FORM

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

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: Wash 2 West Tributary 1
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: State Route 74

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

Location of Structure: Where wash crosses State Route 74

Downstream Limit/Cross Section: 5.468

Upstream Limit/Cross Section: 5.489

2. Name of Structure:

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

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

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: There is no channelization along this 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 [Attach Section D (Dam/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: Wash 2 West Tributary 1 -- See survey data in Appendix C for culvert geometry.

Name of Structure: State Route 74

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 4.0
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/BASIN

Flooding Source: There are no dams/basins along this 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. The Dam was permitted as (check one):

   a. ☐ Federal Dam ☐ State Dam

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

      Permit or ID number Permitting Agency or Organization

   b. ☐ Local Government Dam ☐ Private Dam

      Provided related drawings, specification and supporting design information.

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

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

   Was the dam/basin designed using critical duration storm?

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

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

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

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

6. Does the Base Flood Elevation behind the dam 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		

7. 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)

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: Extend table 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: No sediment transport analysis has been done for this 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.

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

RIVERINE STRUCTURES FORM

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

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: Wittmann Wash Tributary 1
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: State Route 74

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

Location of Structure: Where wash crosses State Route 74.

Downstream Limit/Cross Section: 1.344

Upstream Limit/Cross Section: 1.378

2. Name of Structure:

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

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

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: There is no channelization along this 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 [Attach Section D (Dam/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: Wittmann Wash Tributary 1 -- See survey data in Appendix C for culvert geometry.

Name of Structure: State Route 74

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 4.0
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/BASIN

Flooding Source: There are no dams/basins along this 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. The Dam was permitted as (check one):

   a. ☐ Federal Dam ☐ State Dam

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

      Permit or ID number Permitting Agency or Organization

   b. ☐ Local Government Dam ☐ Private Dam

      Provided related drawings, specification and supporting design information.

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

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

   Was the dam/basin designed using critical duration storm?

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

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

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

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

6. Does the Base Flood Elevation behind the dam 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		

7. 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: Extend table 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: No sediment transport analysis has been done for this 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.

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

RIVERINE STRUCTURES FORM

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

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: Breakout 4 of Wittmann Wash Tributary 1
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: State Route 74

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

Location of Structure: Where wash crosses State Route 74

Downstream Limit/Cross Section: 0.294

Upstream Limit/Cross Section: 0.317

2. Name of Structure:

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

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

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: There is no channelization along this 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 [Attach Section D (Dam/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: Breakout 4 of Wittmann Wash Tributary 1 -- See survey data in Appendix C for culvert geometry.

Name of Structure: State Route 74

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 4.0
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/BASIN

Flooding Source: There are no dams/basins along this 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. The Dam was permitted as (check one):

   a. ☐ Federal Dam ☐ State Dam

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

      Permit or ID number Permitting Agency or Organization

   b. ☐ Local Government Dam ☐ Private Dam

      Provided related drawings, specification and supporting design information.

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

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

   Was the dam/basin designed using critical duration storm?

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

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

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

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

6. Does the Base Flood Elevation behind the dam 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		

7. 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: Extend table 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: No sediment transport analysis has been done for this 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.

SECTION 3.0 SURVEY AND MAPPING INFORMATION

3.1 Field Survey Information

Field survey data were acquired by the survey branch of Premier Engineering Corporation in June 2010.

The project control was the Maricopa County Geodetic Densification and NGS Control Point 4KE1. Observations were performed with a Trimble 5800 real-time kinematic GPS instrument. All data were taken on the Horizontal Datum of 1983-92 State Plane Coordinate System, Arizona Central Zone. The Vertical Datum is the North American Vertical Datum of 1988 (NAVD 88). Observations were reported to the nearest 0.01 of an international foot. The survey report for all field survey data acquired for this study may be found in Appendix C.3. This report has been sealed by Mr. Mark A. Luond, RLS, PLS, CFedS, Survey Project Manager at Premier Engineering Corporation.

The goals of the field survey were to acquire inlet and outlet elevations of the major hydraulic structures in the study area, to acquire the roadway deck profile over each of these structures, and to survey a sample of the hydraulic cross sections to determine the Root Mean Square Error (RMSE) of the topographic data used to complete the hydraulic modeling. Please see Appendix C.3 for a ground survey map showing the locations of the structures that were surveyed.

Benchmarks were provided by FCDMC for reference. Points were either Geodetic Densification and Cadastral Survey (GDACS) control monuments or National Geodetic (NGS) points. In the *Control-Monuments* folder in the *Appendix C* folder on the DVD may be found shapefiles of the GDACS and NGS survey control points. In addition, metadata for these points as downloaded from the Maricopa County of Department of Transportation (MCDOT) website (for GDACS) and the National Oceanic and Atmospheric Administration (NOAA) website may also be found in this folder. Hardcopies of these metadata are included in Appendix C.3 of this report.

Part of the field survey that was acquired involved the acquisition of ground survey along many of the hydraulic cross section alignments. This ground survey information was used to compute the root mean square error (RMSE) between the ground survey and FCDMC's topographic dataset to confirm that it met FEMA's vertical accuracy standards according to Appendix A of FEMA's *Guidelines*. This computation may be found in the file *Wittmann-PhIII-Topo-Statistical-Comparison.xls* located in the *Statistical-Comparison* folder in the Appendix C folder on the DVD. Table 3.1 presents the results of this analysis, which confirmed that the topographic data met FEMA's RMSE standards.

Table 3.1 – Computed RMSE Vs. Acceptable RMSE

Area	Contour Interval of Topographic Data	Maximum Acceptable RMSE (feet)	Computed RMSE (feet)
South of Cloud Road Alignment	Two-foot	0.6	0.59
North of Cloud Road Alignment	Four-foot	1.2	1.07

3.2 Mapping

No new mapping was completed under this contract. FCDMC provided PBS&J with aerial photography, two-foot and four-foot contours, mass points, and breaklines of the project area created by Stewart Geo Technologies under contract number FCD 2001-C021. This information was referenced to NAVD 88 and to the North American Datum of 1983, High-Accuracy Reference Network (NAD 83 – HARN). Note that the topographic data has a resolution acceptable for two-foot contour mapping south of the Cloud Road alignment and a resolution acceptable for four-foot contour mapping north of the Cloud Road alignment.

The flight date to acquire the topographic data was April 2002. The aerial photography was acquired over multiple flights that occurred in September 2008 and October 2009.

All mapping is referenced to the Central Zone of the Arizona State Plane projection.

3.3 Vertical Datum Conversion

The conversion between NAVD 88 and the National Geodetic Vertical Datum of 1929 was determined using the VERTCON website established by the National Geodetic Survey at http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html.

Using USGS quadrangle maps, the center of the study was estimated to be at 33 degrees, 49 minutes, 30 seconds North and 112 degrees, 32 minutes, and 50 seconds West. According to the VERTCON website, NAVD 88 minus NGVD 29 equals 0.627 meters, which is 2.06 feet. This conversion has been included on the hydraulic work maps.

SECTION 4.0 HYDROLOGY

4.1 Method Description

The 100-year peak flow rates used in the *Wittmann Phase III FDS* were taken from Entellus' *Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volume HY-Addendum*. This report, completed in July 2005 under contract number FCD 2002-C029, is an addendum to Entellus' *Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volumes HY-I, HY-II, and HY-III*, also completed under contract FCD2002-C029. The date of this report is October 2004.

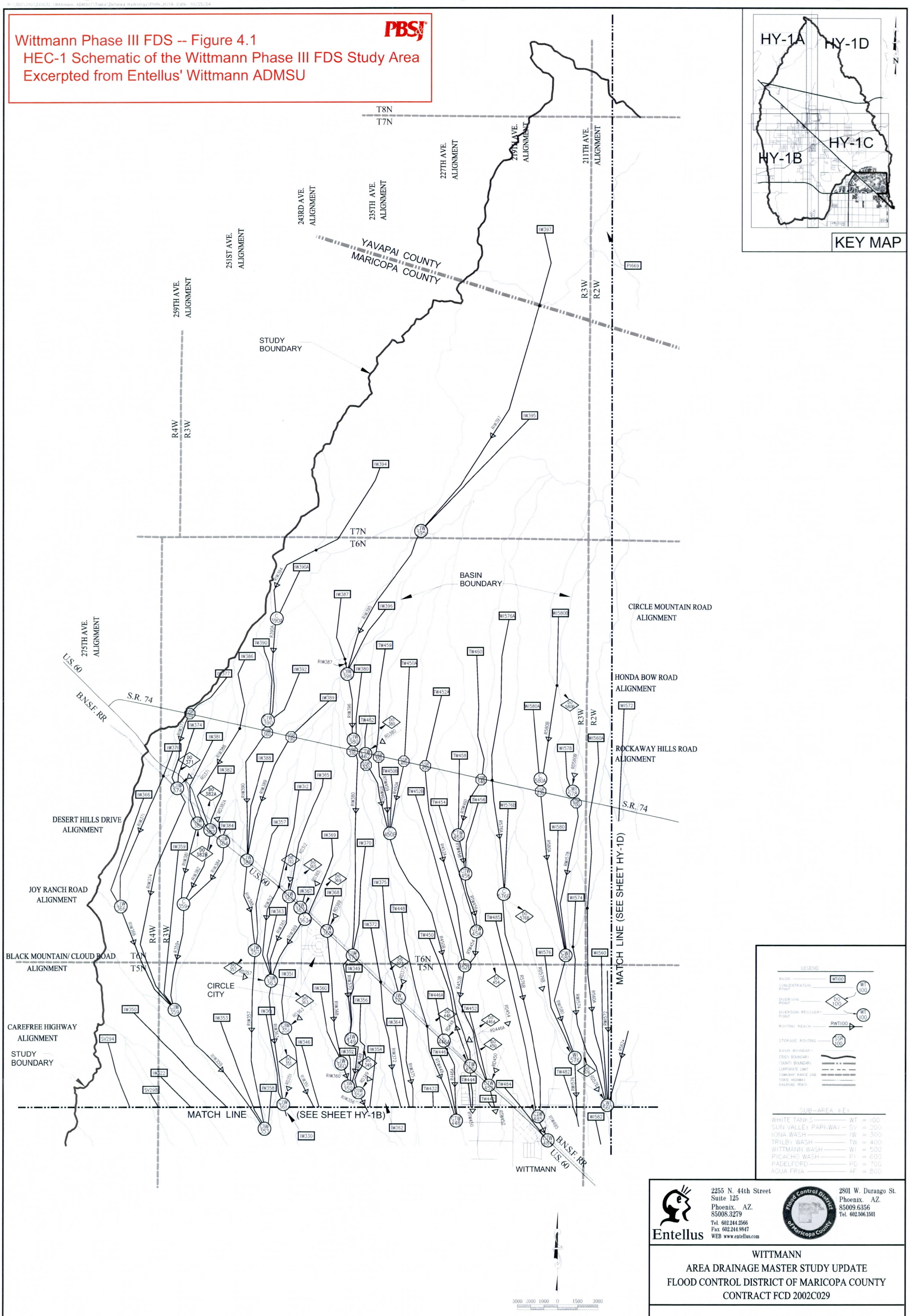
FCDMC provided PBS&J with a digital copy of the HEC-1 modeling from Entellus' study. The models supplied were *wtec6-addendum* (*.hc1 and *.out) and *wtec24-addendum* (*.hc1 and *.out). These models analyze the 6-hour and 24-hour events, respectively, for the study area. Both models assume existing conditions and have run dates of May 4, 2005. Digital copies of the models may be found on the DVD in front of this report in the folder named *Appendix D*. Please refer to Figure 4.1 for a schematic of the HEC-1 model in the vicinity of the *Wittmann Phase III FDS* study area. Please refer to the folder *TDN-Figures* in the *Appendix D* folder on the DVD for a digital copy of all of the figures included in Section 4..

At every concentration point applicable to the *Wittmann Phase III FDS*, the peak flow rate for the 6-hour event was higher than the peak flow rate for the 24-hour event. Therefore, all of the hydraulic modeling completed for the *Wittmann Phase III FDS* applied the peak flow rates computed for the 6-hour event. Finally, for situations where the modeled flow rates decreased in the downstream direction, the higher upstream discharge was used to be conservative.

Portions of Entellus' report may be found in Appendix D in the *Excerpts* folder. This includes the main report text prior to the appendices from *Volume HY-I* (*1ADMSU-VolumeHYI-MainBody.pdf*) , the main report text prior to the appendices from the *Addendum* (*2ADMSU-Addendum-MainBody.pdf*), a summary table from the *Addendum* of the existing conditions HEC-1 model of the ADMSU study area for the 6- and 24-hour events (*3ADMSU-Addendum-HEC1OutputSummaryTable.pdf*), and the full output of the existing conditions HEC-1 model of the ADMSU study area for the 6-hour event since all of the sub-basins in the *Wittmann Phase III FDS* study area are governed by the 6-hour event (*4ADMSU-Addendum-HEC1Output.pdf*). A full digital copy of *Volumes HY-I*, *HY-II*, *HY-III*, and the *Addendum* of the ADMSU may be found in the *Appendix D* folder on the DVD at the front of this TDN.

Wittmann Phase III FDS -- Figure 4.1
HEC-1 Schematic of the Wittmann Phase III FDS Study Area
Excerpted from Entellus' Wittmann ADMSU

PBS&J



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WITTMANN
AREA DRAINAGE MASTER STUDY UPDATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002C029

PLATE HY-1A
HEC-1 SCHEMATIC
(1 of 4)

4.2 Parameter Estimation

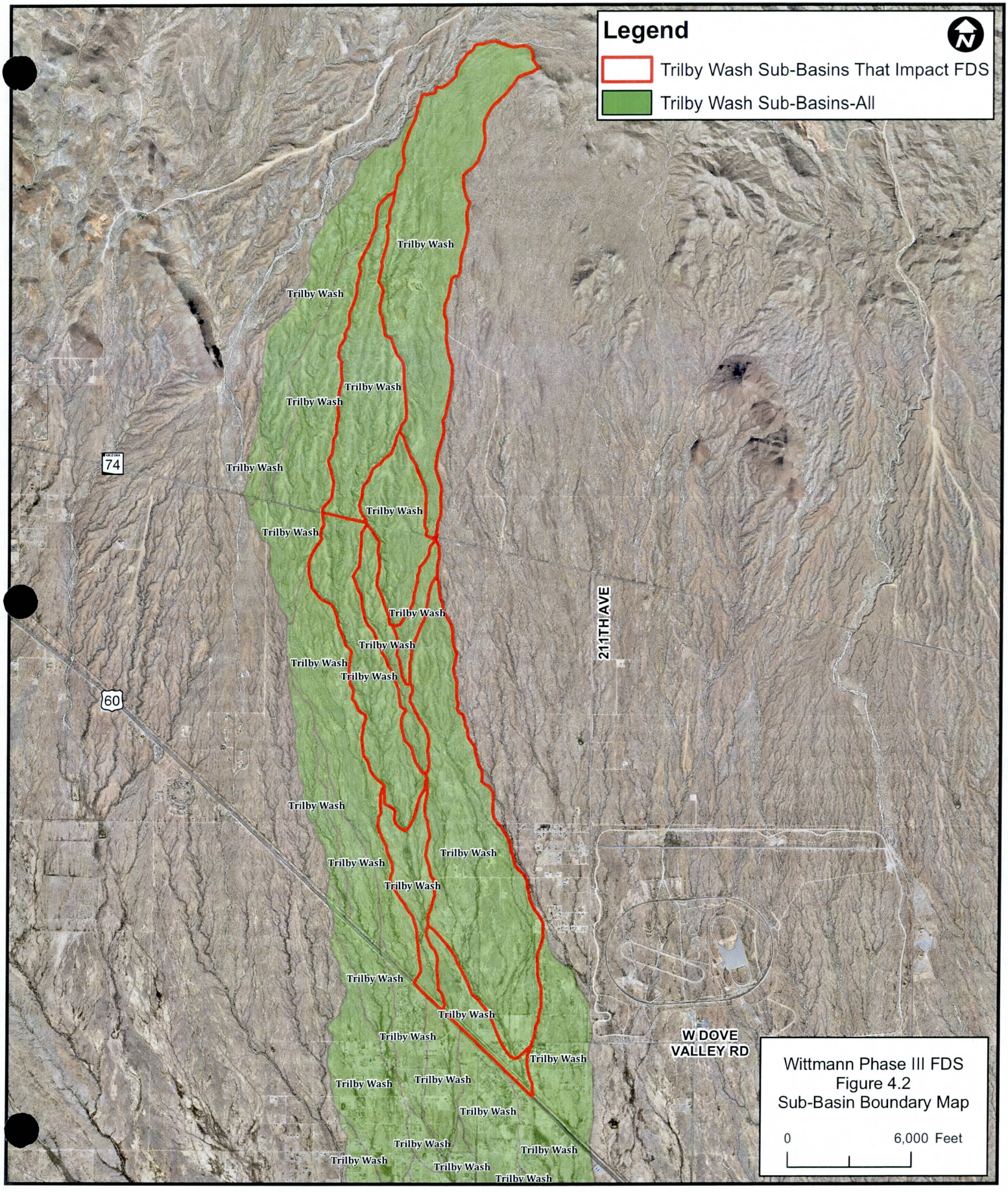
When developing their report, Entellus followed the methodology outlined in FCDMC's *Drainage Design Manual for Maricopa County, Arizona, Volume 1, Hydrology* (Sabol et al., 1995). Input parameters for the modeling were computed using the 2003 version of the Watershed Modeling System (WMS), Version 7.0.

Watershed boundaries were delineated using USGS DEM contour mapping, 10-foot contour mapping, 4-foot contour mapping, and 2-foot contour mapping. All contour mapping was supplied by FCDMC and was prepared by Landata, Inc., in June 2002. Digital ortho-rectified aerial photographs with a date of 2001 were also supplied by FCMDC.

The entire watershed was subdivided into eight sub-watersheds: White Tank Mountains, Sun Valley Parkway, Iona Wash, Trilby Wash, Wittmann Wash, Picacho Wash, Padelford Wash, and Agua Fria River. The total area of these eight sub-watersheds is approximately 220 square miles. Of these eight sub-watersheds, the *Wittmann Phase III FDS* study area resides completely within the Trilby Wash sub-watershed. The Trilby Wash sub-watershed is composed of 42 sub-basins with a combined drainage area of 43.0 square miles. Within the Trilby Wash watershed are 9 sub-basins with a total area of 8.8 square miles in which the *Wittmann Phase III FDS* study area resides. Please refer to Figure 4.2 for a sub-basin boundary map, which presents the Trilby Wash sub-watershed boundaries from the ADMSU that impacted the *Wittmann Phase III FDS*.

Per FCDMC guidelines, point rainfall depths were estimated using the National Oceanic and Atmospheric Administration's Atlas 2 dataset (see the folder *NOAA-rainfall-info* in *Appendix D* on the DVD at the front of this TDN). Rainfall losses were determined using the Green-Ampt infiltration model. Unit hydrographs were developed using the Clark Unit Hydrograph Method. Channel routing was completed using the normal depth storage-outflow channel routing methodology.

SR 74 is an elevated highway with a tall embankment, and the potential for storage behind this highway during the 100-year is significant. To account for this storage, Entellus applied a stage discharge-storage methodology when hydrologically modeling the structures under SR 74 along Wash 2 West Tributary 1 and Wittmann Wash Tributary 1 under SR 74.


Legend
Trilby Wash Sub-Basins That Impact FDS
Trilby Wash Sub-Basins-All
Trilby Wash
74
60
211TH AVE
W DOVE VALLEY RD
Wittmann Phase III FDS
Figure 4.2
Sub-Basin Boundary Map
0
6,000 Feet

According to Entellus, "[p]ortions of the watershed are characterized by distributary and braided flow and contain multiple split flow locations. Aerial photography and topographic mapping were reviewed to identify potential flow splits. Once these splits were identified, their downstream runoff was assessed and insignificant splits were ignored" (*Volume HY-I*, Page 4-18).

Of the many split locations that Entellus identified, two of them impacted the *Wittmann Phase III FDS*. Both of these splits were modeled in the ADMSU HEC-1 model. The first split occurs at the downstream end of sub-basin TW454 where Breakout 1 of Wittmann Wash Tributary 1 splits from Wittmann Wash Tributary 1 due to the braided nature of this area. This split is modeled in the HEC-1 model at concentration point D454. A normal depth procedure was applied to this split to determine the magnitude of flow that proceeded in each direction. The HEC-1 modeling parameters for this split were determined via the calculations presented on pages 19 and 20 of *Volume HY-II* of the ADMSU (see the folder *HEC-1-split-calcs* in *Appendix D* on the DVD at the front of this TDN).

The second split that impacted the FDS is located just upstream of the railroad bridge at the downstream end of sub-basin TW450. Flows that break out upstream of the bridge flow parallel to the railroad on its north side toward the downstream end of sub-basin TW452 where it eventually enters Wash 2 West Tributary 1. This split was modeled in the HEC-1 model at concentration point D450 using a rating curve. This railroad bridge was identified as bridge RR450 in the ADMSU, and supporting calculations for the flow split at this bridge may be found on pages 636 to 639 in *Volume HY-I* of the ADMSU (see the folder *RR-bridge-rating-curve* in *Appendix D* on the DVD at the front of this TDN).

Three additional concentration points were added by PBS&J to Entellus' HEC-1 modeling. These modifications were necessary because each of these concentrations points had multiple routing reaches and/or sub-basins entering them, and it was desirable to know the combined flow from only some of the reaches/sub-basins entering the concentration point as opposed to all of them. A digital copy of the modified HEC-1 model, called *WittPhIIIFDS* (*.hc1 and *.out), may be found on the DVD at the front of this TDN in the *Appendix D* folder.

The three concentration points that were added to the HEC-1 model are called Witt1, Witt2, and Witt3. A brief description of each of these points follows.

Witt1 is located at the downstream end of sub-basin TW452. The existing concentration point at this location, CTW452, combined the flow rates from sub-basin TW452, routing reach R452B, and routing reach RD450. This new

concentration point combined only sub-basin TW452 and routing reach R452B. RD450 is the routed hydrograph of flow that breaks out of sub-basin TW450 and flows east parallel to the north side of the BNSF railroad. Adding Witt1 meant that the peak flow rate for Wash 2 West Tributary 1 that originated from sub-basin TW485 and points along the wash centerline upstream could be determined without the contribution from the sub-basin TW450 breakout.

Witt2 may be found at the downstream end of sub-basin TW452B. The existing concentration point at this location, C452B, combined the hydrographs from sub-basin TW452B, routing reach R452A, and routing reach RTW454. Witt2 combined just sub-basin TW452B and routing reach R452A. Routing reach RTW454 routes flow along Breakout 3 of Wittmann Wash Tributary 1. Witt2 was added because it was desirable to know the peak flow rate along Wash 2 West Tributary 1 that originated from basin TW452B and points along the wash centerline upstream prior to the combination of this flow with the flow from Breakout 3.

The final new concentration point is Witt3, which is located at the downstream end of sub-basin TW485. The existing concentration point at this location, CTW485, combined the hydrographs from sub-basin TW485, routing reach RD454, and routing reach R576B. This new concentration point combined only sub-basin TW485 with routing reach RD454. Routing reach R576B routes flow that breaks out of sub-basin WI576B at its downstream end. This breakout flow enters Wittmann Wash downstream of the downstream end of Wittmann Wash Tributary 1, so it has no impact on the *Wittmann Phase III FDS*. Therefore, it was desirable to compute the combined peak flow rate that originated along Wittmann Wash Tributary 1 on TW 485 and points along the centerline upstream prior to this contribution from sub-basin WI576B.

No changes beyond the addition of these three concentration points were made to Entellus' HEC-1 modeling.

4.3 Problems Encountered During the Study

4.3.1 Interpolated Flow Rates

During the extraction of the pertinent peak flow rates from the hydrologic modeling for use in the hydraulic modeling, it was discovered that there were some locations where it was desirable to know the peak flow rate, but a concentration point was not available in the HEC-1 modeling. To determine the peak flow rates at these locations, a linear, area-weighted interpolation routine was applied. At each interpolated concentration point, the drainage area to that point was determined. Using the drainage area and peak flow rate at the upstream end of the sub-basin and

the drainage area and the peak flow rate at the downstream end of the sub-basin, the peak flow rate at the interpolated concentration point was determined by linearly interpolating the peak flow rates using the drainage areas. For a demonstration of this routine, consider the following example for sub-basin TW452B. Refer to Figure 4.3 and note the blue sub-basin within sub-basin TW452B. This sub-basin is called 452B-1. Note that TW452B-1 would have been a clearer name, but sub-basin names are limited to six characters per FCDMC standards. The area draining to the downstream end of 452B-1 is 1.38 square miles, the area draining to the upstream end of sub-basin TW452B is 1.08 square miles, and the area draining to the downstream end of TW452B is 2.11 square miles. The HEC-1 output indicated that the 100-year peak flow rate the upstream end of sub-basin TW452B was 1,047 cfs and 1,366 cfs at the downstream end of the sub-basin. The following equation was applied to determine the 100-year peak flow rate at the downstream end of 452B-1:

$$Q_{interp} = Q_{up} + \frac{(A_{interp} - A_{up})}{(A_{down} - A_{up})} * (Q_{down} - Q_{up})$$

$$Q_{interp} = 1047cfs + \frac{1.38\ mi^2 - 1.08\ mi^2}{2.11\ mi^2 - 1.08\ mi^2} * (1366\ cfs - 1047\ cfs)$$

$$Q_{interp} = 1140\ cfs$$

where Q_{interp} is the interpolated peak flow rate,
Q_{up} is the peak flow rate at the upstream end of sub-basin TW452B,
Q_{down} is the peak flow rate at the downstream end of sub-basin TW452B,
A_{interp} is the area draining to the downstream end of sub-basin 452B-1,
A_{down} is the area draining to the downstream end of sub-basin TW452B, and
A_{up} is the area draining to the upstream end of sub-basin TW452B.

Note that all peak flow rates are in cfs and all drainage areas are in square miles.

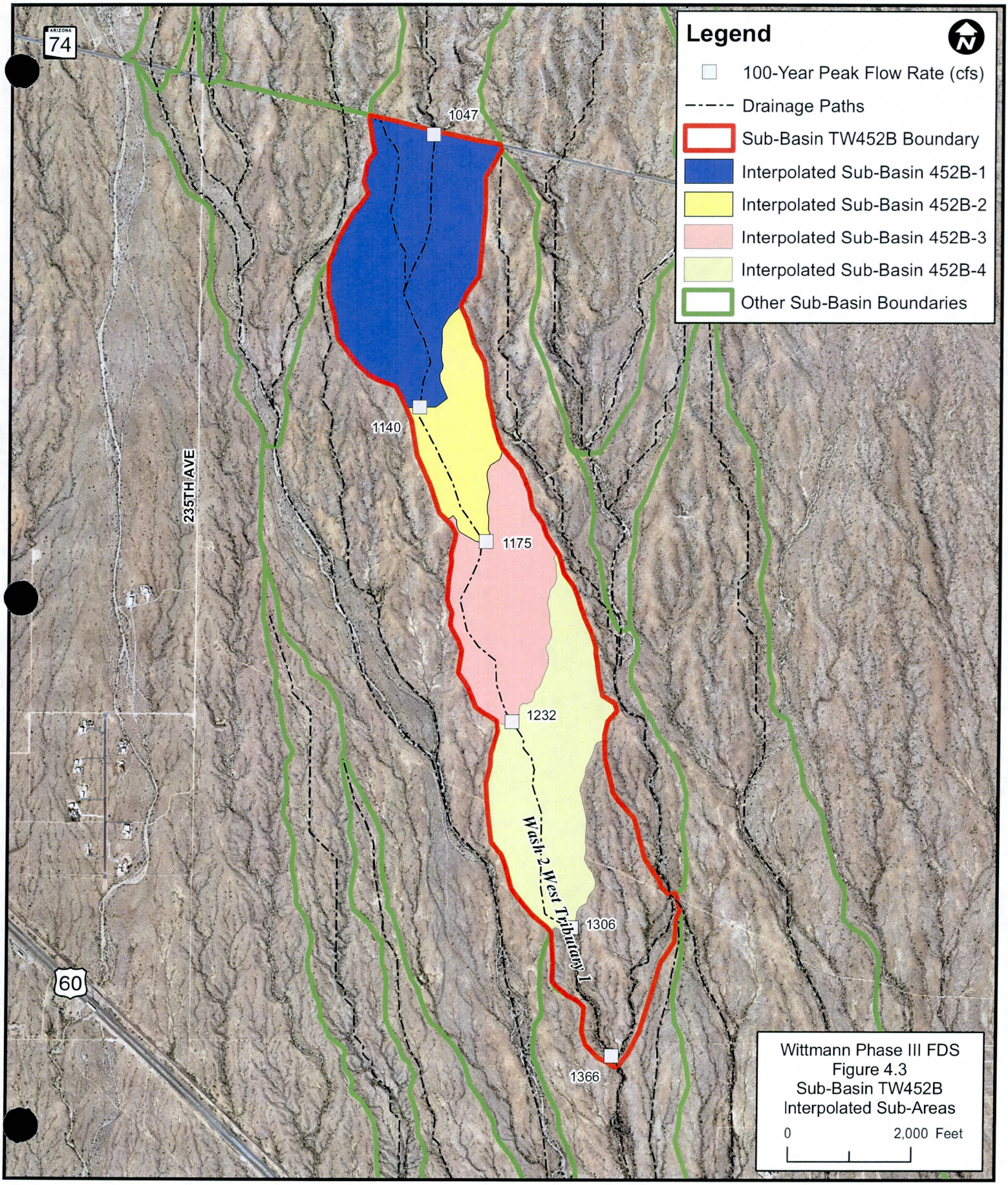
Interpolated peak flow rates were computed at points within sub-basins TW452B, TW458, and TW485. Please refer to Figures 4.3, 4.4, and 4.5, respectively, to see where the interpolated peak flow rates were determined. Points were interpolated along sub-basin TW452B because this basin was about three miles long, and it was desirable to determine peak flow rates over shorter distances along the routing reach through this sub-basin. An interpolated point was added to sub-basin TW458 because most of the contributing area within sub-basin TW458 does not drain to Wittmann Wash Tributary 1 until just before the downstream end of the sub-basin, and it was desirable to know the peak flow rate along Wittmann Wash Tributary 1

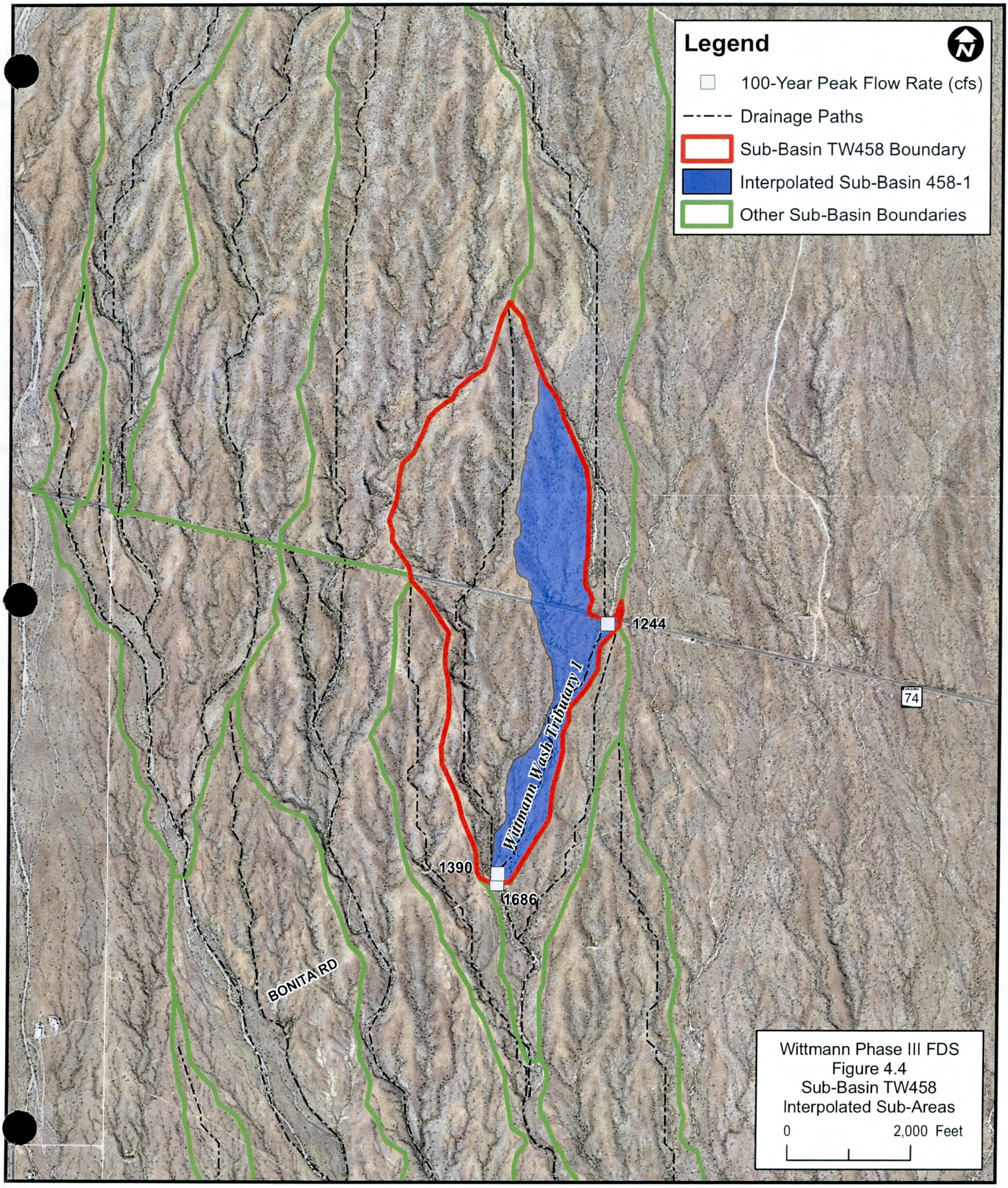
without the contribution from this significant portion of sub-basin TW458. Finally, an interpolated point was added to sub-basin TW485 to determine the peak flow rate at the downstream end of Wittmann Wash Tributary 1.

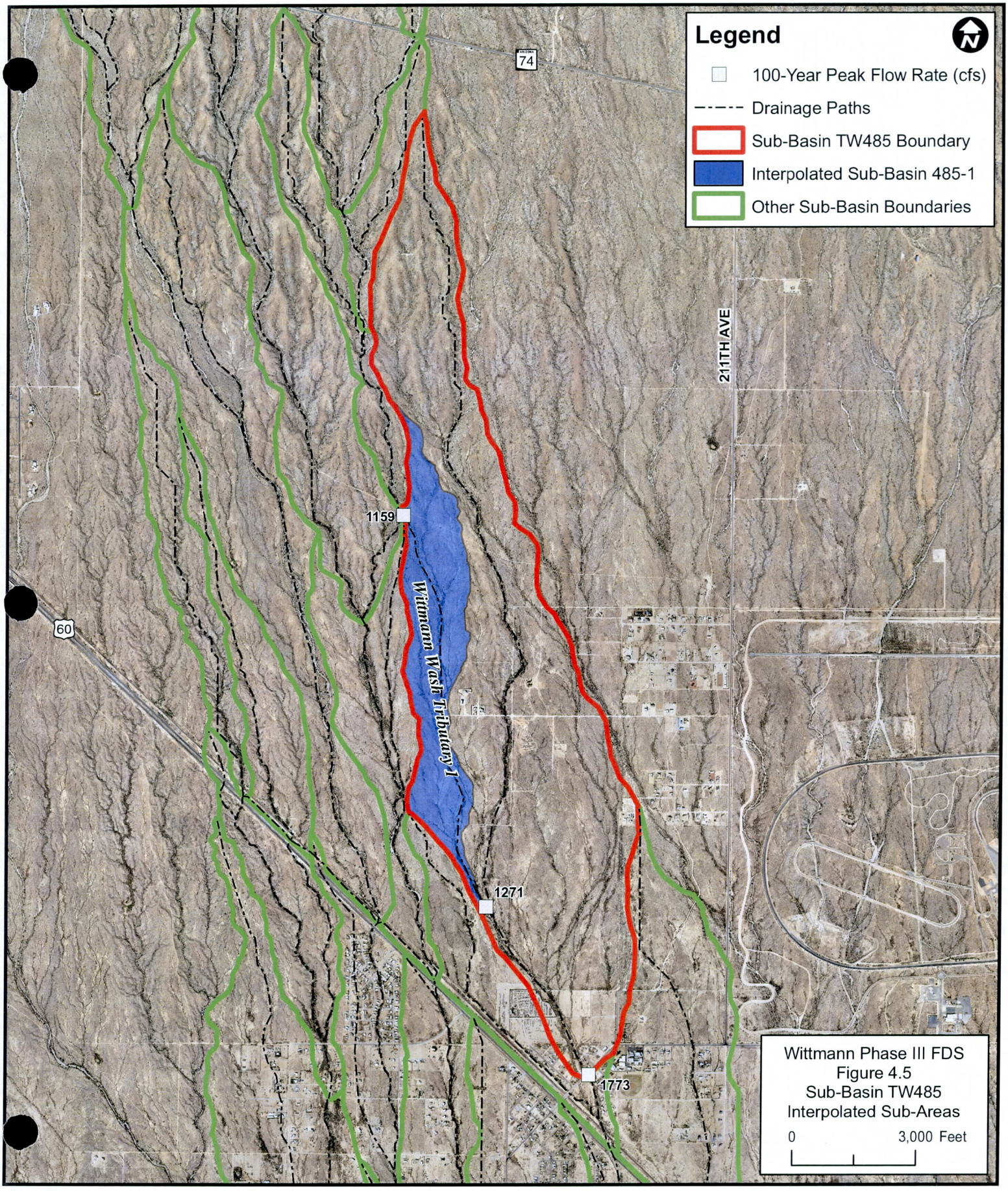
Table 4.1 summarizes the peak flow rates and drainage areas that were used to determine the interpolated peak flow rates. Full calculations for the interpolations may be found in Appendix D in *wittmann-phIII-hydrology.xls*.

Table 4.1: Interpolated 100-Year Peak Flow Rates and the HEC-1 Drainage Areas/Discharges Used to Determine the Interpolated Flow Rates

Sub-Basin TW452B			
Location	**Drainage Area (mi^2)**	**100-Year Peak Flow Rate (cfs)**	**Source of Peak Flow Rate**
Conc. Pt. SSR450	1.08	1,047	HEC-1
Downstream End of 452B-1	1.381	1,140	Interpolated
Downstream End of 452B-2	1.493	1,175	Interpolated
Downstream End of 452B-3	1.677	1,232	Interpolated
Downstream End of 452B-4	1.917	1,306	Interpolated
Conc. Pt. Witt2	2.11	1,366	HEC-1
Sub-Basin TW458			
Location	**Drainage Area (mi^2)**	**100-Year Peak Flow Rate (cfs)**	**Source of Peak Flow Rate**
Conc. Pt. SSR540	2.32	1,244	HEC-1
Downstream End of 458-1	2.542	1,390	Interpolated
Conc. Pt. CTW458	2.99	1,686	HEC-1
Sub-Basin TW485			
Location	**Drainage Area (mi^2)**	**100-Year Peak Flow Rate (cfs)**	**Source of Peak Flow Rate**
Conc. Pt. DO454	3.52	1,159	HEC-1
Downstream End of 485-1	3.951	1,271	Interpolated
Conc. Pt. Witt3	5.89	1,773	HEC-1


Legend
100-Year Peak Flow Rate (cfs)
Drainage Paths
Sub-Basin TW452B Boundary
Interpolated Sub-Basin 452B-1
Interpolated Sub-Basin 452B-2
Interpolated Sub-Basin 452B-3
Interpolated Sub-Basin 452B-4
Other Sub-Basin Boundaries
1047
1140
1175
1232
1306
1366
ARIZONA 74
235TH AVE
60
Wash 2 West Tributary 1
Wittmann Phase III FDS
Figure 4.3
Sub-Basin TW452B
Interpolated Sub-Areas
0
2,000 Feet


Legend
100-Year Peak Flow Rate (cfs)
Drainage Paths
Sub-Basin TW458 Boundary
Interpolated Sub-Basin 458-1
Other Sub-Basin Boundaries
1244
1390
1686
Wittmann Wash Tributary 1
BONITA RD
74
Wittmann Phase III FDS
Figure 4.4
Sub-Basin TW458
Interpolated Sub-Areas
0
2,000 Feet


Legend
100-Year Peak Flow Rate (cfs)
Drainage Paths
Sub-Basin TW485 Boundary
Interpolated Sub-Basin 485-1
Other Sub-Basin Boundaries
74
60
211TH AVE
1159
Wittmann Wash Tributary 1
1271
1773
Wittmann Phase III FDS
Figure 4.5
Sub-Basin TW485
Interpolated Sub-Areas
0
3,000 Feet

4.3.2 HEC-1 Routing Reach Adjustment

During the course of the study, it was discovered that the lengths of two of the routing reaches in the HEC-1 modeling were incorrect. This issue impacted the length of routing reaches RD454 and RTW454. PBS&J contacted FCMDC to discuss a plan of action, and FCDMC took the lead on modifying the HEC-1 model and supplying PBS&J with a corrected version. To learn more about this issue, please refer to the e-mails in the *HEC-1-Routing-Reach-Error* folder in the *Appendix B* folder on the DVD. Both the original HEC-1 model as supplied by FCDMC at the beginning of the study and the modified HEC-1 model as supplied by FCDMC after the routing reach issue was resolved may be found on the DVD as well. Please see the *Original-from-FCDMC* folder in the *Appendix D* folder on the DVD for the original HEC-1 modeling and the *Modified-for-this-FDS* folder in *Appendix D* on the DVD for the revised HEC-1 modeling. Note that the revised HEC-1 model also contains the concentration points that PBS&J added to the modeling. Please see Section 4.2 for additional discussion related to these concentration points.

4.4 Calibration

Entellus noted that there were not enough stream gauge data to calibrate the HEC-1 modeling properly. In lieu of calibration, Entellus did compare their results to results from previous studies; however, no results from these previous studies were available for the washes being modeled in the *Wittmann Phase III FDS*.

Entellus did apply indirect methods to verify that the computed 100-year peak flow rates were reasonable. This application involved a comparison of the output of the HEC-1 model with the peak flow rates predicted by two USGS equations. The first USGS equation is equation 8.1 in FCDMC's *Drainage Design Manual (Hydrology)*:

$$Q_{100} = 850A^{0.54}$$

where Q_{100} is the peak flow rate (cfs) and
A is the contributing drainage area in square miles.

The second equation is the equation in Table 8.2 in FCDMC's *Drainage Design Manual (Hydrology)* for the 100-year recurrence interval. This equation is the 100-year Flood Magnitude-Frequency Relation for the Central Arizona Region (Region 12):

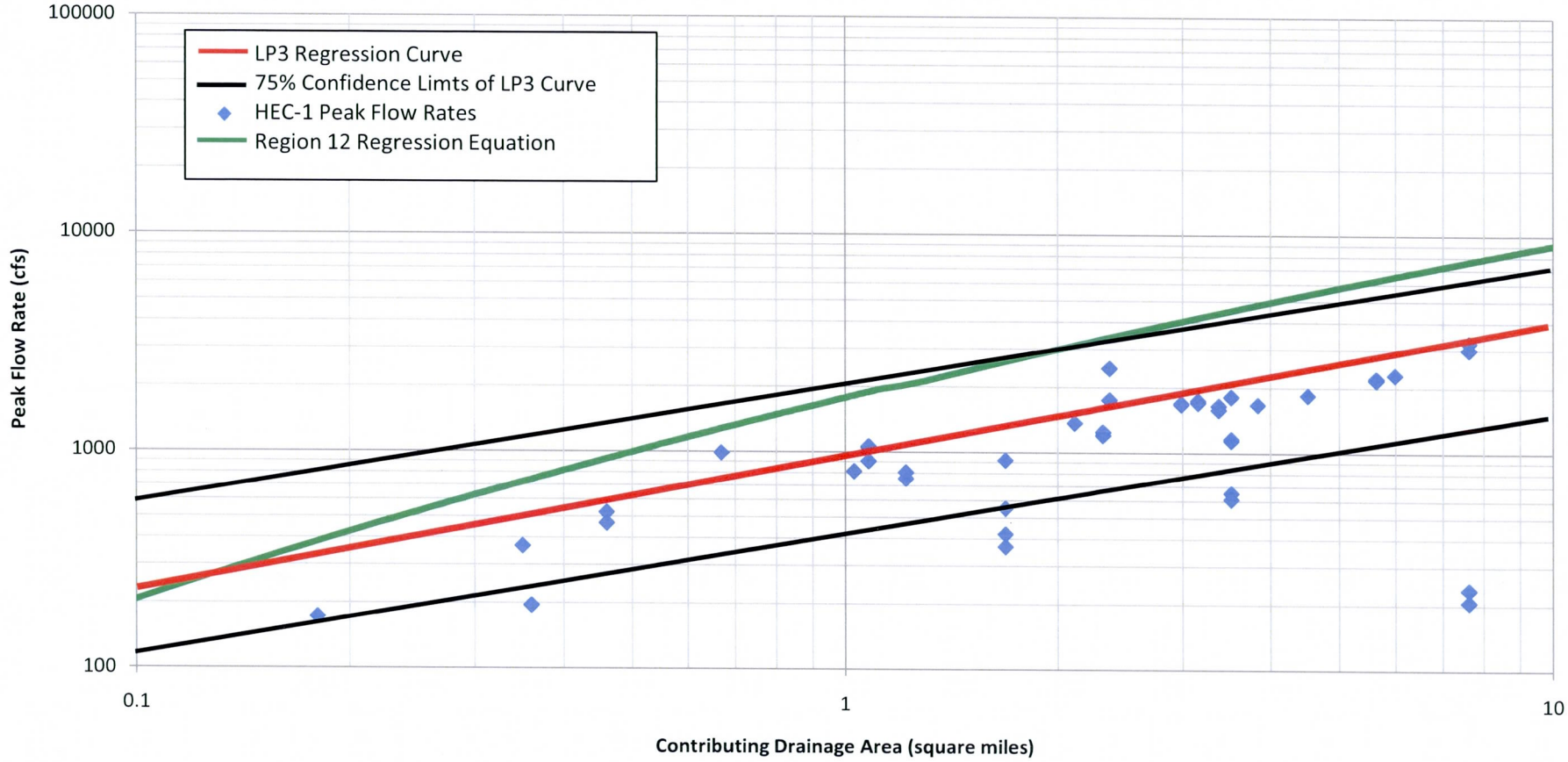
$$Log_{10}Q = 6.55 - 3.17Area^{-0.11} - 0.454Log_{10}Elev$$

where Q is the 100-year peak flow rate (cfs),
Area is the drainage area in square miles, and
Elev is the mean basin elevation, in feet divided by 1000.

Entellus computed a basinwide value of 1.932 for *Elev*. A cursory check of the topography in the *Wittmann Phase III FDS* revealed that this was a reasonable value to apply to the Trilby Wash watershed.

The output from the HEC-1 model for the concentration points in the Trilby Wash watershed upstream of US 60 that impacted the *Wittmann Phase III FDS* was compared to the peak flow rates predicted by these two regression equations. A graphical representation of this comparison may be found in Figure 4.6. Overall, the HEC-1 output shows very good agreement with the first USGS regression equation (LP3 Regression Curve). No HEC-1 peak flow rates exceed the 75% confidence limit, and although a handful fall below the 75% confidence limit, most of them do so due to the split flows in the HEC-1 model, which reduced the computed peak flow rates at the splits but not the contributing drainage areas. Regarding the second USGS equation (Region 12 Regression Equation), the HEC-1 output does not agree as well with the peak flows predicted by this equation. Interestingly, all computed HEC-1 values fall below the peak flow rates predicted by this equation. When comparing the peak flow rates produced by the two regression equations, it is clear that the first regression equation produces peak flow rates that match the results of the HEC-1 modeling of the *Wittmann Phase III FDS* study area better than the second equation.

Figure 4.6 - Comparison of Trilby Wash HEC-1 Output to Discharges Predicted by USGS Regression Equations



4.5 Final Results

Please refer to Table 4.2 for a summary of the HEC-1 and interpolated 100-year peak flow rates in the *Wittmann Phase III FDS* study area. Also refer to Figure 4.7, which presents a graphical summary of the hydrologic results. Table 4.2 was built using the values in Table D.6 of Entellus' *Addendum* report and the results of the peak flow rates interpolations discussed in Section 4.4. In Table 4.2 may be found the concentration points from Entellus' HEC-1 models that affect the *Wittmann Phase III FDS*, the contributing area to each point for the 6-hour and 24-hour storm, the peak discharges for both the 6-hour and the 24-hour storms at each concentration point, and which storm produces the higher peak flow rate at each concentration point as well as the peak flow rate from that storm. It is the peak flow rates in the column "Controlling 100-Year Peak Discharge" that have been applied to hydraulic analysis completed for the *Wittmann Phase III FDS*. Note that for all points in this table, the 100-year peak flow rate for the 6-hour event is higher than the 100-year peak flow rate for the 24-hour event.

Note that the drainage area for the 24-hour event is not always equal to the drainage area at the same point for the 6-hour event. Entellus indicated in their reporting that this occurs because "the HEC-1 hard coding was performed separately for the 24-hour and 6-hour storms" (*Addendum*, Table D.6).

Table 4.2 – Hydrologic Analysis Results

Drainage ID	24-Hour Event		6-Hour Event		Controlling Event	Controlling 100-Year Peak Discharge (cfs)	Unit Discharge for Controlling Event (cfs/mi^2)
	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)			
C452B	3.38	1,605	3.38	1,954	6-Hour	1,954	578
C576B	1.69	687	1.69	919	6-Hour	919	544
CTW450	7.59	2,832	7.62	3,229	6-Hour	3,229	424
CTW452	4.29	1,626	4.52	1,979	6-Hour	1,979	438
CTW454	3.52	1,564	3.52	1,811	6-Hour	1,811	514
CTW456	3.16	1,517	3.16	1,736	6-Hour	1,736	549
CTW484	5.99	1,685	5.99	1,874	6-Hour	1,874	313
CTW458	2.99	1,479	2.99	1,686	6-Hour	1,686	564

Table 4.2 – Hydrologic Analysis Results

Drainage ID	24-Hour Event		6-Hour Event		Controlling Event	Controlling 100-Year Peak Discharge (cfs)	Unit Discharge for Controlling Event (cfs/mi^2)
	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)			
CTW485	5.64	1,594	5.64	1,844	6-Hour	1,844	327
D450	7.59	157	7.62	235	6-Hour	235	31
D450	7.59	2,675	7.62	2,994	6-Hour	2,994	393
D454	3.52	563	3.52	652	6-Hour	652	185
D454	3.52	1,001	3.52	1,159	6-Hour	1,159	329
D576B	1.69	412	1.69	552	6-Hour	552	327
DO454	3.52	1,001	3.52	1,159	6-Hour	1,159	329
DO576B	1.69	275	1.69	368	6-Hour	368	218
R452A	1.08	675	1.08	907	6-Hour	907	840
R452B	3.38	1,480	3.38	1,830	6-Hour	1,830	541
R576A	1.22	558	1.22	755	6-Hour	755	619
R576B	1.69	347	1.69	420	6-Hour	420	249
RD450	7.59	120	7.62	206	6-Hour	206	27
RD454	3.52	925	3.52	1,106	6-Hour	1,106	314
RTW454	3.52	548	3.52	640	6-Hour	640	182
RTW456	3.16	1,461	3.16	1,701	6-Hour	1,701	538
RTW458	2.99	1,457	2.99	1,670	6-Hour	1,670	559
RTW460	2.32	1,152	2.32	1,201	6-Hour	1,201	518
RTW485	5.64	1,554	5.64	1,829	6-Hour	1,829	324
SSR450	1.08	820	1.08	1,047	6-Hour	1,047	969
SSR540	2.32	1,207	2.32	1,244	6-Hour	1,244	536
TW452	0.46	320	0.46	466	6-Hour	466	1,013

Table 4.2 – Hydrologic Analysis Results

Drainage ID	24-Hour Event		6-Hour Event		Controlling Event	Controlling 100-Year Peak Discharge (cfs)	Unit Discharge for Controlling Event (cfs/mi^2)
	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)	Drainage Area (mi^2)	100-Year Peak Discharge (cfs)			
TW452A	1.08	822	1.08	1,062	6-Hour	1,062	983
TW452B	1.03	615	1.03	813	6-Hour	813	789
452B-1	--	--	1.381[1]	1,140	6-Hour	1,140	825
452B-2	--	--	1.493[1]	1,175	6-Hour	1,175	787
452B-3	--	--	1.677[1]	1,232	6-Hour	1,232	735
452B-4	--	--	1.917[1]	1,306	6-Hour	1,306	681
TW454	0.36	128	0.36	195	6-Hour	195	542
TW456	0.18	117	0.18	172	6-Hour	172	956
TW458	0.67	726	0.67	985	6-Hour	985	1,470
TW460	2.32	1,213	2.32	1,412	6-Hour	1,412	609
458-1	--	--	2.542[1]	1,390	6-Hour	1,390	547
TW484	0.35	245	0.35	365	6-Hour	365	1,043
TW485	2.37	1,589	2.37	1,746	6-Hour	1,746	737
485-1	--	--	3.951[1]	1,271	6-Hour	1,271	322
WI576A	1.22	633	1.22	806	6-Hour	806	661
WI576B	0.46	356	0.46	522	6-Hour	522	1,135
Witt1	--	--	3.84	1,954	6-Hour	1,954	509
Witt2	--	--	2.11	1,366	6-Hour	1,366	647
Witt3	--	--	2.37	1,773	6-Hour	1,773	748

[1]Drainage area for each interpolated sub-basin is the total drainage area in the Trilby Wash watershed that drains to the outlet of the interpolated sub-basin. All other drainage areas are the drainage areas associated with that Drainage ID (i.e. concentration point) in the HEC-1 modeling.

Legend
SSR540 HEC-1 Concentration Points
Useful Concentration Points (100-Year Q)
Hydrology Drainage Paths
Trilby Wash Sub-Basins That Impact FDS
Interpolated Sub-Basin Boundaries
Trilby Wash Sub-Basins - All
TW452A
TW460
SSR450
1062
1047
TW452A
TW458-1
(interp)
SSR540
1244
TW460
1412
TW458
(non-interp)
Wash 2 West
Tributary 1
ARIZONA
74
Wittmann Wash Tributary 1
TW452B-1
(interp)
TW454
TW456
1140
1390
TW452B-2
(interp)
1686
CTW458
1175
TW452B-3
(interp)
1736
CTW456
211TH AVE
1232
TW452B-4
(interp)
CTW454
1811
1306
652
D454
1159
DO454
TW452
(non-interp)
Breakout 3 of
Wittmann Wash Tributary 1
Wittmann Wash Tributary 1
Witt2
1366
1954
C452B
Wash 2 West
Tributary 1
60
TW452
TW485-1
(interp)
TW485
(non-interp)
1271
TW484
Witt1
1954
1979
CTW452
Witt3
1773
1844
CTW485
Wittmann Phase III FDS
Figure 4.7
Hydrologic Summary
0
2,000 Feet

SECTION 5.0 HYDRAULICS

5.1 Method Description

The washes studied during this FDS are located in northwest Maricopa County in the vicinity of the small unincorporated community of Wittmann. The study area was notable for its lack of development. Except for US 60 and SR 74, each of which cuts through the study area along an east-west alignment, there were very few structures in the vicinity of the washes. The washes themselves tended to be made up of flat sandy bottoms with heavily vegetated banks. Although the bank vegetation was thick, as one moved away from the banks, the vegetation quickly thinned. Vegetation throughout the area was comprised of the typical foliage found in the lower Sonoran Desert.

The FDS analyzed 7 reaches. Base Flood Elevations (BFEs) were calculated via step backwater calculations using HEC-RAS version 4.0. The names of the HEC-RAS files used in this study, along with the range of cross sections in each model, are listed below. All models have a run date of September 22, 2010.

Wash 2 West Tributary 1 – Cross Sections 3.526 to 9.189
HEC-RAS Model: *2WTrib1.prj*

Wittmann Wash Tributary 1 – Cross Sections 0.128 to 5.376
HEC-RAS Model: *WittTrib1.prj*

Breakout 1 of Wittmann Wash Tributary 1 – Cross sections 0.112 to 0.224
HEC-RAS Model: *WittTrib1Brkout1.prj*

Breakout 2 of Wittmann Wash Tributary 1 – Cross sections 0.074 to 0.388
HEC-RAS Model: *WittTrib1Brkout2.prj*

Breakout 3 of Wittmann Wash Tributary 1 – Cross sections 0.052 to 0.513
HEC-RAS Model: *WittTrib1Brkout3.prj*

Breakout 4 of Wittmann Wash Tributary 1 – Cross sections 0.013 to 0.706
HEC-RAS Model: *WittTrib1Brkout4.prj*

Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1 – Cross sections 0.005 to 0.235

HEC-RAS Model: *WittT1Brk1ofBrk3.prj*

The downstream boundary condition for each wash was determined using either a normal depth calculation or a known water surface elevation. Table 5.1 lists each wash and the boundary condition used to begin the hydraulic modeling of that wash.

Table 5.1 – Downstream Boundary Conditions Used in the Hydraulic Modeling

Washes Begun with a Normal Depth Boundary Condition	
Flooding Source	**Normal Depth Slope (foot/foot)**
Wash 2 West Tributary 1	0.0068

Washes Begun with a Known Water Surface Elevation		
Flooding Source	**Wash that Flooding Source Ties into**	**Known Water Surface Elevation (feet, NAVD 88)**
Wittmann Wash Tributary 1	Wittmann Wash (not studied in this FDS)	1,744.13
Breakout 1 of Wittmann Wash Tributary 1	Wittmann Wash (not studied in this FDS)	1,761.55
Breakout 2 of Wittmann Wash Tributary 1	Breakout 1 of Wittmann Wash Tributary 1	1,763.63
Breakout 3 of Wittmann Wash Tributary 1	Wash 2 West Tributary 1	1,824.43
Breakout 4 of Wittmann Wash Tributary 1	Wittmann Wash Tributary 1	2,016.96
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	Breakout 3 of Wittmann Wash Tributary 1	1,832.09

The normal depth calculation for Wash 2 West Tributary 1 was based on the stream bed slope at the most downstream cross section of the wash. The bed slope was determined by locating the two-foot contours located immediately upstream and downstream of the most downstream cross section in the model, measuring the length along the channel between the two contours, and then dividing two feet (i.e. the elevation difference between the two contours) by the length to determine the slope. A spreadsheet of these calculations may be found in *Downstream-Boundary-*

Conditions.xls in Appendix E.5 and digitally in the *Downstream-Boundary-Conditions* folder in the *Appendix E* folder on the DVD.

A known water surface elevation was used as the downstream boundary condition in those cases where the times to peak at the confluence of both the modeled wash and the tie-in wash were determined to be coincident according to Section C.3.3 of FEMA's *Guidelines*. Calculations that demonstrate coincident peaks at the downstream end of all washes except for Wash 2 West Tributary 1 (begun using normal depth) may be found in *Coincident-Peaks-Determinations.xls* in Appendix E.5 and digitally in the *Downstream-Boundary-Conditions* folder in the *Appendix E* folder on the DVD.

The flow rates presented in Table 4.2 and Figure 4.7 were used to populate the Steady Flow Data window in HEC-RAS. Since HEC-RAS reads flows along a model in an upstream-to-downstream fashion, flow rates were assigned to the upper end of the reach to which they applied. Furthermore, flow increases caused by confluences were assigned to the cross section just upstream of the confluence so that the water surface elevation profile across the confluence was not underestimated.

No floodway boundaries were computed for any of the washes studied during this FDS.

Note that no internal rating curves and no changes in the water surface elevation were specified in the Steady Flow Data of the HEC-RAS models.

5.2 Work Study Maps

The work maps for this study are on 24" x 36" sheets plotted at a scale of 1 inch = 200 feet. The contour interval on all mapping is two feet, and all elevations are referenced to NAVD 88. All data shown on the work maps have been identified in the map legend. Full size copies of the work maps have been included in Volume II of this report. Reduced size (11" x 17") copies may be found in Section 7 of this report. The maps show a hydraulic base line for each wash. Each hydraulics base line was established by tracing the thalweg of the wash. All channel flowpath distances were measured along the hydraulic base line. All cross sections were stationed such that the intersection of the cross section and the hydraulic baseline was station 10,000 (feet) on the cross section.

Please refer to Figure 1.3.2 for a general vicinity map of the study area.

5.3 Parameter Estimation

5.3.1 Roughness Coefficients

Manning's *n* values were determined using the procedures described in *Estimated Manning's Roughness Coefficients for Stream Channel and Flood Plains in Maricopa County, Arizona*, a manual prepared by the United States Geological Survey (USGS) in April 1991 for FCDMC. A report that describes the derivation of the Manning's *n* values used in the FDS may be found in Appendix E.1.

5.3.2 Expansion and Contraction Coefficients

Default expansion and contraction coefficients of 0.3 and 0.1, respectively, were used throughout the study reach. In the vicinity of the hydraulic structures, the expansion and contraction coefficients were revised to 0.5 and 0.3, respectively.

5.4 Cross Section Description

Cross section station and elevation data were extracted using HEC-GeoRAS, Version 4.1 from a Triangulated Irregular Network (TIN) produced using the mass points and breaklines provided by FCDMC. All cross sections were stationed from left to right looking downstream and were oriented perpendicular to the direction of the 100-year flow at the cross section. Station 10,000 (feet) on each cross section is where the hydraulic baseline intersects the cross section. The cross sections were placed no more than 500 feet apart. The cross section labeling on the work maps is in miles.

5.5 Modeling Considerations

5.5.1 Hydraulic Jump and Drop Analyses

No hydraulic jumps or drops occurred in the study reach. In many locations, the HEC-RAS model defaulted to critical depth when the model was run under the assumption of a subcritical flow regime. This suggests that there may be supercritical flow at these locations along the study reaches. However, since FEMA states that hydraulic modeling for floodplain mapping studies of unlined/natural washes should assume that flow remains in the subcritical regime, all HEC-RAS models have been executed under the assumption of subcritical flow.

5.5.2 Bridges and Culverts

Major pipes and box culverts have been included in the HEC-RAS modeling. Please see Table 5.2 for a list of the hydraulic structures modeled during the FDS.

All structure inverts and roadway deck elevations were taken from the field survey completed by Premier Engineer Corporation in June 2010, and this information was used in the hydraulic modeling. Note that all modeled structures may be found underneath SR 74. PBS&J contacted the Maricopa County Department of Transportation (MCDOT) to locate as-built plans for all structures. As-built plans were available for all three crossings in the plan set *Plan and Profile of Proposed State Highway, Morristown—New River, Maricopa County* (No. S-434-508). This as-built plan set may be found in Appendix C.3. The structure lengths found in these as-built plans were used in the hydraulic modeling. Structure dimensions (e.g. rise, span, and diameter) were confirmed in the field.

The field survey revealed that each structure contained either minimal or no sediment. Therefore, it was assumed for hydraulic modeling purposes that the structures were unblocked.

Note that each structure was able to pass the 100-year event without overtopping. However, per direction from FCDMC and to adhere to current FEMA mapping standards, additional Zone A floodplains were superimposed on the study sheets in these areas to illustrate the "without structure" scenarios. This is meant to provide a worst-case flooding condition where the roadway embankment could fail during the upstream ponding area's maximum stage. The boundaries of the superimposed approximate zones taper gradually downstream until they match up to the Zone AE boundaries.

Table 5.2 – Structures Modeled in HEC-RAS

Flooding Source	Road the Structure Crosses	HEC-RAS Station of Structure (Miles)	Description of Structure	Upstream Invert Elevation(s) (feet, NAVD 88)	Downstream Invert Elevation(s) (feet, NAVD 88)
Wash 2 West Tributary 1	SR 74	8.733	1 – 10-foot x 8-foot box culvert	2,032.86*	2,031.86*
Wittmann Wash Tributary 1	SR 74	4.602	4 – 10-foot by 6-foot box culverts	2,043.07* 2,043.10* 2,043.36* 2,043.30*	2,042.50* 2,042.42* 2,042.46* 2,042.57*

Table 5.2 – Structures Modeled in HEC-RAS

Flooding Source	Road the Structure Crosses	HEC-RAS Station of Structure (Miles)	Description of Structure	Upstream Invert Elevation(s) (feet, NAVD 88)	Downstream Invert Elevation(s) (feet, NAVD 88)
Breakout 4 of Wittmann Wash Tributary	SR 74	0.303	1 – 30-inch RCP	2,045.13	2,042.40

* Ground survey was acquired for left and right sides of culvert invert. These two values were averaged for each structure to determine a single invert elevation.

5.5.3 *Levees and Dikes*

Approximately, the most downstream 800 feet of Wash 2 West Tributary 1 flows along the north side of the Burlington Northern Santa Fe railroad, and the right side of the floodplain mapping along this portion of the wash was contained by the railroad embankment. For further discussion regarding this embankment, please refer to Section 5.8.4.

5.5.4 *Islands and Flow Splits*

Some low-lying areas shown to be above the WSEL in the cross section plots were mapped within the floodplain zone. These areas were generally very small in area and exceeded the WSEL by less than 1.5 feet. Other natural areas that were larger and identified as being above the floodplain zone, but encompassed (or nearly so) by the floodplain, were labeled as Zone X on the hydraulic work maps.
There were several locations where flow splits were hydraulically modeled. Please refer to Section 5.8.1 for a detailed discussion of these flow splits.

5.5.5 *Ineffective Flow Areas*

Generally, except for the structures under SR 74, the effective flow limits of the floodplain match the floodplain boundaries. For areas where there were abrupt changes in the floodplain width, the effective flow limits were transitioned using contraction ratios of 1:1 and expansion ratios of 4:1 to 1:1 based on engineering judgment.

5.5.6 *Supercritical Flow*

In many locations, the HEC-RAS model defaulted to critical depth when the model was run under the assumption of a subcritical flow regime. This suggested that there might be localized supercritical flow at multiple locations. However, since FEMA states that hydraulic modeling for floodplain mapping studies of unlined/natural washes should assume that flow remains in the subcritical regime, all HEC-RAS models were executed under the assumption of subcritical flow, and all results presented herein were obtained through a subcritical flow analysis.

5.5.7 *Lateral Weirs*

A defining characteristic of this FDS was the number of lateral weirs that were required to complete the hydraulic modeling. In multiple locations, the topography did not contain the 100-year floodplain, and at each of these locations a lateral weir was added to the HEC-RAS modeling. Lateral weirs were added to the HEC-RAS models for all washes except Breakout 2 of Wittmann Wash Tributary 1.

The weir coefficient used along each lateral weir was 2.0 for two reasons. First, this is the default value in HEC-RAS. Second, during PBS&J's work on the *Gavilan Peak FDS* for FCDMC, PBS&J confirmed with Dr. Bing Zhao of the FCDMC that a weir coefficient of 2.0 is a reasonable coefficient to use with natural lateral weirs in Maricopa County.

Table 5.3 contains a list of the lateral weirs in each wash, the upstream and downstream bounding cross sections for each lateral weir, and the 100-year flow rates that overtopped the weir. Note that all partial 100-year flow rates from HEC-RAS have been rounded up to the next whole number.

Table 5.3 – Lateral Weirs Used in the HEC-RAS Modeling

Wash	Weir ID and Location	Downstream RS	Upstream RS	100-Year Flow Rate Over Weir (cfs)
Wash 2 West Tributary 1	3.661 Left overbank	3.626	3.674	20
Wash 2 West Tributary 1	4.047 Left overbank	3.920	4.057	61

Table 5.3 – Lateral Weirs Used in the HEC-RAS Modeling

Wash	Weir ID and Location	Downstream RS	Upstream RS	100-Year Flow Rate Over Weir (cfs)
Wash 2 West Tributary 1	4.364 Right overbank	4.097	4.381	312[1]
Wash 2 West Tributary 1	4.374 Left overbank	4.207	4.381	231[1]
Wash 2 West Tributary 1	4.501 Left overbank	4.451	4.527	230
Wash 2 West Tributary 1	4.644 Right overbank	4.591	4.703	7
Wash 2 West Tributary 1	5.668 Right overbank	5.619	5.676	3
Wash 2 West Tributary 1	6.487 Right overbank	6.388	6.489	8
Wash 2 West Tributary 1	8.736 Right overbank	8.733	8.759	60
Wittmann Wash Tributary 1	0.345 Right overbank	0.128	0.347	114
Wittmann Wash Tributary 1	0.972 Left overbank	0.877	0.974	25
Wittmann Wash Tributary 1	1.503 Left overbank	1.429	1.510	102[2]
Wittmann Wash Tributary 1	1.806 Right overbank	1.381	1.807	249[2]
Wittmann Wash Tributary 1	2.178 Right overbank	2.005	2.201	237[3]
Wittmann Wash Tributary 1	2.254 Left overbank	2.005	2.261	192[3]
Wittmann Wash Tributary 1	3.032 Left overbank	2.907	3.033	522[4]

Table 5.3 – Lateral Weirs Used in the HEC-RAS Modeling

Wash	Weir ID and Location	Downstream RS	Upstream RS	100-Year Flow Rate Over Weir (cfs)
Wittmann Wash Tributary 1	3.078 Right overbank	3.033	3.082	251[4]
Wittmann Wash Tributary 1	3.455 Right overbank	3.350	3.456	6[5]
Wittmann Wash Tributary 1	3.634 Right overbank	3.456	3.635	639[5]
Wittmann Wash Tributary 1	4.280 Right overbank	4.183	4.287	38
Wittmann Wash Tributary 1	4.405 Left overbank	4.336	4.408	12
Wittmann Wash Tributary 1	4.650 Left overbank	4.616	4.653	7
Wittmann Wash Tributary 1	5.246 Left overbank	5.173	5.258	32
Wittmann Wash Tributary 1	5.362 Left overbank	5.329	5.376	12
Breakout 1 of Wittmann Wash Tributary 1	0.208 Left overbank	0.175	0.224	23
Breakout 3 of Wittmann Wash Tributary 1	0.415 Left overbank	0.362	0.418	5
Breakout 4 of Wittmann Wash Tributary 1	0.341 Right overbank	0.317	0.349	139[6]
Breakout 4 of Wittmann Wash Tributary 1	0.348 Left overbank	0.317	0.349	112[6]
Breakout 4 of Wittmann Wash Tributary 1	0.403 Right overbank	0.362	0.414	78[6]
Breakout 4 of Wittmann Wash Tributary 1	0.606 Left overbank	0.508	0.607	11

Table 5.3 – Lateral Weirs Used in the HEC-RAS Modeling

Wash	Weir ID and Location	Downstream RS	Upstream RS	100-Year Flow Rate Over Weir (cfs)
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	0.227 Left overbank	0.077	0.235	71

[1] Optimized in unison. See following paragraph for additional explanation.

[2] Optimized in unison. See following paragraph for additional explanation.

[3] Optimized in unison. See following paragraph for additional explanation.

[4] Optimized in unison. See following paragraph for additional explanation.

[5] Optimized in unison. See following paragraph for additional explanation.

[6] Optimized in unison. See following paragraph for additional explanation. Note that lateral weirs 0.341 and 0.348 are always optimized, even for the 100-year floodplain run.

To determine the 100-year flow rate that left via each lateral weir, that lateral weir was optimized. At the direction of FCDMC, each lateral weir was optimized independently of all of the other weirs in a given model unless the weirs shared one or more common cross sections. The superscripts in Table 5.3 point out those weirs that were optimized as part of an optimization that included more than one weir.

All lateral weirs have been shown on the hydraulic work maps. Note that some of the HEC-RAS cross sections located along the lateral weirs indicate that the floodplain is contained even through there are breakouts between the cross sections.

For each wash where there was a lateral weir, the floodplain mapping in this FDS was based on the full flow remaining in the wash except for one case involving two weirs. Lateral weirs 0.341 and 0.348 in Breakout 4 of Wittmann Wash Tributary 1 are located just upstream of SR 74. The structure underneath the roadway at this location is a single 30-inch RCP. When the HEC-RAS model for this wash was run under the assumption that the full flow remained in the wash, SR 74 was overtopped and about 9 feet of water backed up behind the structure. Floodplain mapping showing the highway overtopped was unrealistic considering that the water could never physically back up behind the highway that deeply since it would overtop the banks of the wash and escape to the east and west well before the road would be overtopped. At the direction of FCDMC, the floodplain mapping for this wash upstream of SR 74 was based on the weirs' being optimized via the "Optimize"

check boxes in the "Steady Flow Analysis – Flow Optimization Options" menu. While this was the case, it should be noted that the flow that leaves via these two weirs was assumed to return to the wash between RS 0.294 and RS 0.260 per direction from FCDMC so that the portion of the wash downstream of SR 74 could be mapped under the conservative approach that no water will leave via lateral weirs 0.341 and 0.348, which is the preferred policy of FCDMC.

Each breakout over a lateral weir with a peak flow rate under 250 cfs has been indentified on the hydraulic work maps with a flow direction arrow and the 100-year peak flow rate of the breakout as per direction from FCDMC. In each case, the flow that escaped was not modeled downstream of the weir.

For those breakouts with peak flow rates equal to or in excess of 250 cfs, some of the breakouts were modeled downstream of the weirs and some were not depending on the guidance received from FCDMC. Overall there were five lateral weirs with breakouts of 250 cfs or higher—lateral weirs 1.806 (actually 249 cfs), 3.032, 3.078, and 3.634 along Wittmann Wash Tributary 1 and lateral weir 4.364 along Wash 2 West Tributary 1. The breakouts over lateral weirs 1.806 and 3.634 return to Wittmann Wash Tributary 1 and have been mapped with a Zone A floodplain using normal depths determined via FlowMaster. Cross sections have been placed on the hydraulic work maps showing where normal depths were calculated. The FlowMaster models, along with supporting documentation for the models (input station-elevation data, normal depth slope determinations, etc.), may be found in the *FlowMaster-Models* folder in the *Appendix E* folder on the DVD. Note that the east (left) sides of the three FlowMaster cross sections downstream from lateral weir 1.806 are inundated due to the incoming flow from the lateral weir.

The breakout over lateral weir 3.078 returns to Wittmann Wash Tributary 1 as well, but it only travels a short distance and its Zone A floodplain has been estimated visually.

The breakouts over lateral weir 3.032 along Wittmann Wash Tributary 1 and lateral weir 4.364 along Wash 2 West Tributary 1 were not mapped even though their breakout flow rates exceeded 250 cfs. These breakouts will leave the study area and further modeling and mapping them would have involved extensive hydrologic and hydraulic analysis beyond the scope of this contract. FCDMC has stated that modeling these breakouts and the washes into which they flow are excellent candidates for future floodplain mapping projects. These locations have been demarcated on the study sheets with "Limit of Study" labels.

5.6 Floodway Modeling

Per the scope for this FDS, no floodways were modeled along any of the studied washes.

5.7 Floodplain Mapping

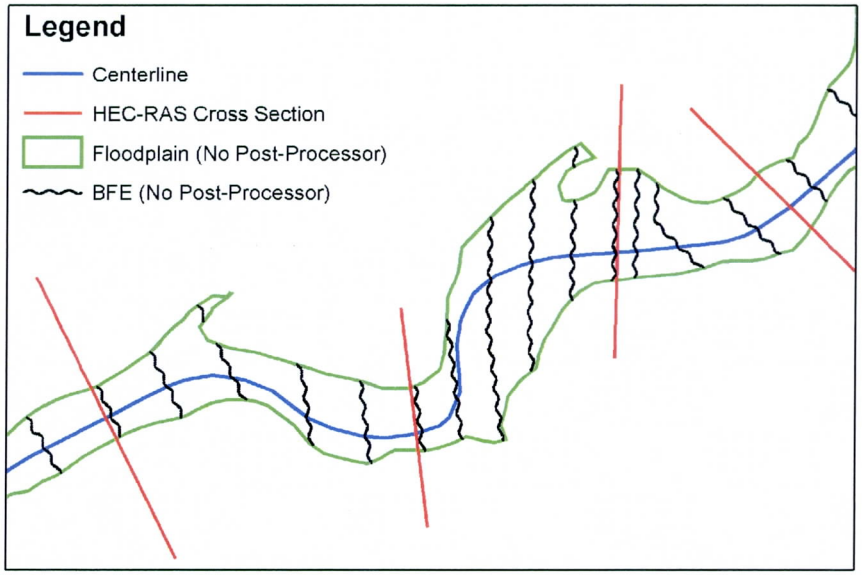
The 100-year floodplains were mapped on a raster with a five-foot cell size that was derived from the TIN that was used to cut the cross sections. The delineation was performed using customized GIS tools developed by PBS&J; the floodplain boundaries are essentially smooth "zero depth" contours that indicate where the floodplain has a depth of zero (i.e. along the edges of the floodplain) and are not pixilated like the floodplains produced using other GIS-based floodplain mapping tools . Among the post-processing tools that were used was one that was used to interpolate the water surface elevations between cross sections. The tool and its application were designed so that the "contours" of the water surface elevation surface would be uniformly perpendicular to the expected flowlines throughout the floodplain, even when the stream has substantial sinuosity between a pair of cross sections. Interpolation of the water surface results in a more accurate delineation between cross sections. A benefit of using this tool was that it automatically produced BFE lines that look as expected (i.e. perpendicular to expected flow direction) and that exactly match the delineation at the correct floodplain boundary location.

To see how the post-processing tool works, please refer to Figure 5.7.1, which shows a portion of a wash before and after the post-processing was applied. In the top image, note how the BFE lines are not drawn properly between each pair of cross sections. In the lower image, an additional set of "guideline" cross sections is shown. These are not hydraulic cross sections where the water-surface elevation is calculated using the energy equation; instead, the water-surface elevation is interpolated linearly between the cross sections along the hydraulic baseline.

In some places, after the post-processing tools were used to produce the 100-year floodplain, the mapping was modified manually to produce a cleaner floodplain product. For instance, in those areas where braided flooding occurs, the floodplain was filled so that there are no holes in it. Overall, the great majority of the mapping presented on the work maps is unaltered from the original output of the mapping algorithm.

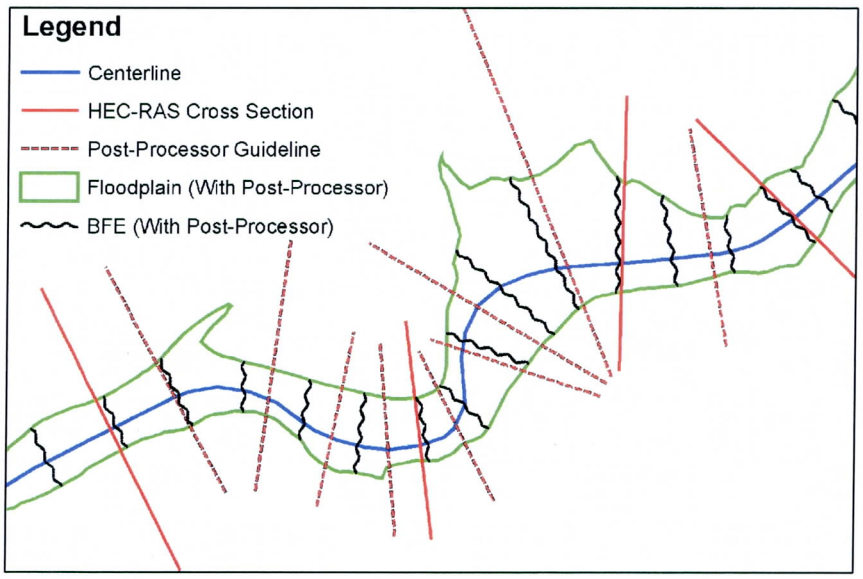
The results of the mapping may be found on the hydraulic work maps. Note that on the hydraulic work maps, each cross section has been labeled with its stationing in river miles, the 100-year peak flow rate assigned to that cross section, and the 100-year water surface elevation that was determined at that cross section.

Figure 5.7.1 – Floodplain Mapping Before and After Applying the Post-Processing Floodplain Mapping Tool



Top: This figure demonstrates what the floodplain mapping looks like before the Post-Processor is applied. Note that in many locations the BFE lines are not perpendicular to the direction of flow. This is more or less what the BFE line layout would like if the floodplain had been generated using the interpolation routines in other typically used GIS-based mapping tools.

Bottom: This image shows what the floodplain mapping looks like after the Post-Processor is applied. The guidelines are used to interpolate linearly the water surface elevation along the centerline between each pair of HEC-RAS cross-sections. Note how the BFE lines are perpendicular to the direction of flow.



5.8 Problems Encountered During Study

5.8.1 Split Flows

At a few locations in the modeling, split flow locations were identified. Split flows occurred at the upstream end of the following washes: Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, Breakout 4 of Wittmann Wash Tributary 1, and Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1.

To determine the 100-year flow rates downstream of each split, the following methodology was employed. Using the split at the upstream end of Breakout 4 of Wittmann Wash Tributary 1 as an example, a cross section was placed along the main wash, which in this example is Wittmann Wash Tributary 1, where this split begins. The cross section was placed on the main wash at the most upstream river station where it is not ambiguous which flow path the flow at each station along the cross section will follow. This cross section was added to the hydraulic model of both the main wash (e.g. RS 5.047) and the breakout wash (e.g. RS 0.706) and there was a station on this cross section (determined by visual inspection of the topography) where all flow to one side of the station will remain in the main wash and where all flow to the other side of that station will flow into the breakout wash. In this example, that station is station 10115.12, and at this station, an ineffective flow identifier was placed in each model. Whether the left side or right side of the cross section is ineffective depends on which flow path the flow follows in that particular model. In this example, flow to the right of station 10115.12 on RS 5.047 is ineffective in the Wittmann Wash Tributary 1 model because flow to the right of station 10115.12 leaves Wittmann Wash Tributary 1 and enters Breakout 4 of Wittmann Wash Tributary 1. On the other hand, flow to the left of station 10115.12 on RS 0.706 is ineffective in the Breakout 4 of Wittmann Wash Tributary 1 model because flow to the left of station 10115.12 remains in Wittmann Wash Tributary 1 and does not enter Breakout 4 of Wittmann Wash Tributary 1.

Once the models were built, the flow rates that followed each flow path were determined iteratively. In this example, the total flow rate upstream of the split was 1,412 cfs. A guess was made regarding the flow rate that entered the breakout wash. The flow that remained in the main wash was 1,412 cfs minus whatever was guessed to enter the breakout wash. The two models were run, and the energy grade line elevation at RS 5.047 and RS 0.706 were compared. If the two elevations were within 0.1 foot of one another, as specified by FCDMC, then the split was considered to be balanced energy wise, and whatever flows were assumed to enter the breakout wash and remain in the main wash were then considered the actual flow rates that stayed/remained. If the energy grade line elevations differed by more than 0.1 foot,

then a new guess was made regarding the flow rate that entered the breakout wash, and the iterative process was repeated until the elevations matched to within 0.1 foot.

Table 5.4 includes a summary of the flow splits in this FDS. In this table may be found for each split the total flow rate just upstream of the split, the main wash, the breakout wash, the name of the duplicate cross section in each model, the flow rate at each cross section, the energy grade line elevation, and the water surface elevation.

Table 5.4 – Summary of Split Flows Present in the Hydraulic Modeling

Main Wash	Breakout Wash	Total Flow Rate (cfs)	Main Wash			Breakout Wash		
			RS	Flow Rate	Energy Grade Line Elevation (feet)	RS	Flow Rate	Energy Grade Line Elevation (feet)
Wittmann Wash Tributary 1	Breakout 1 of Wittmann Wash Tributary 1	675	0.580	425	1768.33	0.224	250	1768.36
Wittmann Wash Tributary 1	Breakout 2 of Wittmann Wash Tributary 1	1,175	0.800	675	1780.32	0.388	500	1780.40
Wittmann Wash Tributary 1	Breakout 3 of Wittmann Wash Tributary 1	1,811	1.926	1,011	1853.29	0.513	800	1853.35
Wittmann Wash Tributary 1	Breakout 4 of Wittmann Wash Tributary 1	1,412	5.047	1,112	2084.06	0.706	300	2084.05
Breakout 3 of Wittmann Wash Tributary 1	Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	800	0.442	475	1849.31	0.235	325	1849.34

At certain locations downstream of some of these splits, additional computations were necessary to determine the 100-year peak flow rate. There are six areas that warrant additional discussion:

- Wash 2 West Tributary 1 at RS 5.434,
- Wittmann Wash Tributary 1 at RS 1.863,
- Wittmann Wash Tributary 1 at RS 4.689,
- Breakout 1 of Wittmann Wash Tributary 1 at RS 0.148,
- Breakout 2 of Wittmann Wash Tributary 1 at RS 0.074, and
- Breakout 3 of Wittmann Wash Tributary 1 at RS 0.185.

Additional discussion for each location follows.

Just downstream of RS 5.434 of Wash 2 West Tributary 1, Breakout 3 of Wittmann Wash Tributary 1 enters Wash 2 West Tributary 1. The 100-year flow rate along Wash 2 West Tributary 1 upstream of this confluence is 1,366 cfs and the 100-year flow rate at the downstream end of Breakout 3 of Wittmann Wash Tributary 1 is 800 cfs. According to *Coincident-Peaks-Determinations.xls* in Appendix E.5, the hydrographs along each of these washes were coincident. Therefore, the combined peak flow rate at RS 5.434 was determined to be 1,366 cfs plus 800 cfs equals 2,166 cfs.

At RS 4.689 of Wittmann Wash Tributary 1, the 100-year flow rate jumps from 1,112 cfs to 1,412 cfs due to flow that breaks out of Breakout 4 of Wittmann Wash Tributary 1 under the "fail" condition for the stock pond (see Section 5.8.7). At RS 0.387 in Breakout 4 of Wittmann Wash Tributary 1, water either remains in the wash and flows south or it heads southeast out of Breakout 4 of Wittmann Wash Tributary and into Wittmann Wash Tributary 1. At the direction of FCDMC, it was assumed that the full flow rate of 300 cfs in Breakout 4 of Wittmann Wash Tributary 1 would remain in the wash and that the full flow rate of 300 cfs would also flow toward Wittmann Wash Tributary 1. Since this flow rate is 300 cfs, the flow rate at RS 4.689 in Wittmann Wash Tributary 1 was increased from 1,112 cfs to 1,412 cfs to account for this breakout.

RS 1.863 of Wittmann Wash Tributary 1 is located just downstream of the split that was used to determine the 100-year flow rates that entered Breakout 3 of Wittmann Wash Tributary 1 and remained in Wittmann Wash Tributary 1. The 100-year flow rate that remained in Wittmann Wash Tributary 1 was 1,011 cfs and the 100-flow rate at RS 1.863 was determined to be 1,175. To determine why the flow rate was increased at RS 1.863 requires a re-visit of the HEC-1 modeling completed by Entellus.

This HEC-1 model also modeled the split where Breakout 3 of Wittmann Wash Tributary 1 leaves Wittmann Wash Tributary 1, but it employed a simple diversion-inflow-outflow table that is not nearly as detailed of an approach as the hydraulic split calculation discussed earlier in Section 5.8.1. The hydrologic split may be found at concentration point D454 in the HEC-1 model. At this location, the HEC-1 model predicted that 1,159 cfs would remain in Wittmann Wash Tributary 1. This flow travels along routing reach RD454 as it moves to the downstream end of Wittmann Wash Tributary 1. At the downstream end of the routing reach at concentration point RD454, the flow rate was 1,106 cfs. Based on the interpolation calculations in *Wittmann-phIII-hydrology.xls* in Appendix D.1, the flow rate at the downstream end of this routing reach was 1,271 cfs (see Location 485-1 in the spreadsheet) after the flow that originated on the portion of sub-basin TW485 where Wittmann Wash Tributary 1 is located was combined with the flow at the downstream end of routing reach RD454. Since FCDMC directed that the results of the hydraulic split calculation should supersede the results of the hydrologic split calculation, the flow rate of 1,271 cfs needed to be adjusted to account for the results of the hydraulic split calculation. Since the difference between 1,271 cfs and 1,106 cfs is 165 cfs, 165 cfs was added to 1,011 cfs, which was the flow rate in Wittmann Wash Tributary 1 downstream of the hydraulic split calculation, for a total of 1,175 cfs at RS 1.863. Note that 165 cfs was added to 1,011 cfs as opposed to 112 cfs (1,271 cfs minus 1,159 cfs) in order to be slightly more conservative.

RS 0.148 of Breakout 1 of Wittmann Wash Tributary 1 and RS 0.074 of Breakout 2 of Wittmann Wash Tributary 1 share the same alignment since these two washes combine at this cross section. Since the 100-year flow rate along Breakout 1 of Wittmann Wash Tributary 1 is 250 cfs and the 100-year flow rate along Breakout 2 of Wittmann Wash 1 is 500 cfs, the combined flow rate is 750 cfs. Due to the steady state nature of the hydraulic modeling of these two washes, they were assumed to experience coincident peaks.

Just downstream of RS 0.185 of Breakout 3 of Wittmann Wash Tributary 1, Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1 enters Breakout 3 of Wittmann Wash Tributary 1. The 100-year flow rate along Breakout 3 of Wittmann Wash Tributary 1 upstream of this confluence is 475 cfs and the 100-year flow rate at the downstream end of Breakout 3 of Wittmann Wash Tributary 1 is 325 cfs. Due to the steady state nature of the hydraulic modeling of these two washes, they were assumed to experience coincident peaks. Therefore, the combined 100-year peak flow downstream of the confluence was determined to be 475 cfs plus 325 cfs equals 800 cfs.

5.8.2 *Downstream End of Wash 2 West Tributary 1*

The downstream end of Wash 2 West Tributary 1 presented a unique modeling situation that warrants discussion. Per guidance from FCDMC, the downstream end of this model was placed just upstream of the Burlington Northern Santa Fe railroad bridge since FEMA had established an effective Zone A floodplain at this location and FCDMC preferred that the modeling for Wash 2 West Tributary 1 use this floodplain as the downstream boundary condition. The extents of this floodplain were established using results from a HEC-1 model (WTM100YR.OUT) created by The WLB Group as part of the *Wittmann Area Drainage Master Study* (FCD Contract 86-24). A digital copy of this model may be found in the *HEC-1 modeling\by_WLB_Group* folder in the *Appendix D* folder on the DVD. The model itself employed a Modified Puls storage routing analysis at concentration point C37 to determine the ponded depth of the water behind the railroad bridge during the 100-year event, and it predicted that the 100-year water surface elevation behind the bridge was 1,721.51 feet (NGVD 29) or 1,723.57 feet (NAVD 88). Unfortunately, when this elevation was used as the downstream boundary condition for Wash 2 West Tributary 1, the model was unable to converge at RS 3.526. It turns out that the reason the model could not converge was that the elevation of 1,723.57 feet was based on a 100-year peak flow rate at concentration point C37 in The WLB Group's HEC-1 model of only 810 cfs, and the HEC-RAS model was not able to "fit" the 2,166 cfs present at the downstream end of the Wash 2 West Tributary 1 HEC-RAS model under the elevation of 1,723.57 feet. An additional issue was that the highest flow rate on the SQ card in the HEC-1 model was 1,680 cfs, which meant that it was not possible to use the rating table in the HEC-1 model to determine what the 100-year water surface elevation would be if the flow rate were 2,166 cfs instead of 810 cfs.

To resolve this issue, PBS&J sought guidance from FCDMC, and at their direction the most downstream cross section in Wash 2 West Tributary 1 (RS 3.526) was placed in the effective FEMA Zone A floodplain and the downstream boundary condition for the wash was determined using a normal depth calculation. Upstream of RS 3.526, the floodplain mapping is Zone AE. Downstream of this cross section, a new Zone A floodplain has been estimated visually so that the new Zone AE floodplain smoothly ties into the effective Zone A floodplain.

Finally, it should be noted that while the downstream end of the modeling of Wash 2 West Tributary 1 for this FDS is located upstream of the railroad bridge, the stationing of this model is based on the true length of Wash 2 West Tributary 1, which drains into Wash 2 West a few miles downstream. As part of their ADMSU, Entellus modeled portions of Wash 2 West Tributary 1 outside of the *Wittmann Phase III FDS* study area using HEC-RAS. PBS&J generated the stationing for

Wash 2 West Tributary 1 by tie-ing into RS 3.335 in Entellus' model and measuring channel lengths from there.

5.8.3 *Downstream Ends of Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, and Breakout 2 of Wittmann Wash Tributary 1*

The downstream end of Wittmann Wash Tributary 1 ties into Wittmann Wash, which has been previously mapped by Entellus as part of the *Wittmann Area Drainage Master Study Update* (Contract FCD 2002C029). Note that this floodplain mapping, at the time of this writing, was not present on the effective DFIRM panels applicable to this area. It is expected that this mapping will be effective once the Countywide DFIRM update currently being conducted by FEMA is complete. RS 0.128 in Wittmann Wash Tributary 1 has been placed so that it was more or less coincident with RS 4.370 along Wittmann Wash. In addition, it has been assumed that the times to peak of both washes at this location were coincident (see *Coincident-Peaks-Determinations.xls* in Appendix E.5). Therefore, the downstream end of the new floodplain mapping for Wittmann Wash Tributary 1 has been snapped to the western boundary of the existing mapping along Wittmann Wash. Per direction from FCDMC, a small Zone A floodplain has been added to Wittmann Wash Tributary 1 downstream of the right edge of RS 0.128 so that the new mapping for Wittmann Wash Tributary 1 ties in smoothly to the existing mapping for Wittmann Wash.

The downstream end of Breakout 1 of Wittmann Wash Tributary 1 also ties into Wittmann Wash. Since Wittmann Wash and Wittmann Wash Tributary 1 experience coincident peaks and since Breakout 1 of Wittmann Wash Tributary and Wittmann Wash Tributary 1 experience coincident peaks, it was assumed that Breakout 1 of Wittmann Wash Tributary 1 and Wittmann Wash experience coincident peaks as well. In order to tie into the floodplain mapping for Wittmann Wash seamlessly, the downstream boundary condition for Breakout 1 of Wittmann Wash Tributary 1 was determined by noting where the Wittmann Wash floodplain intersected the most downstream cross section in Wittmann Wash Tributary 1 (RS 0.112) and extracting the ground elevation at this point from the TIN (1,761.55 feet). Since the depth of a floodplain is zero at its edge, this ground elevation equaled the water surface elevation of the Wittmann Wash floodplain at this location. It is this water surface elevation that was used to begin the Breakout 1 of Wittmann Wash Tributary 1 model. Note that a benefit of this methodology is that the right edge of the floodplain on RS 0.112 of Breakout 1 of Wittmann Wash Tributary 1 is located exactly on the right edge of the Wittmann Wash floodplain.

Breakout 2 of Wittmann Wash Tributary 1 joins Breakout 1 of Wittmann Wash Tributary near RS 0.148 on Breakout 1 of Wittmann Wash Tributary 1. Since this cross section reaches across the combined floodplain of both of these breakouts, RS

0.148 in Breakout 1 of Wittmann Wash Tributary 1 has the same footprint as RS 0.074 in Breakout 2 of Wittmann Wash Tributary 1. To establish the downstream boundary condition of Breakout 2 of Wittmann Wash Tributary 1, the Breakout 1 of Wittmann Wash Tributary 1 HEC-RAS model was run using the combined flow rate of the breakouts (750 cfs) at RS 0.112 and RS 0.148. This model computed a water surface elevation of 1,763.63 feet at RS 0.148. Since the two breakout models share this common cross section, which is the same flow rate in each model since the floodplains are combined at this location, and because the two breakout washes peak coincidentally, this water surface elevation was used as the downstream boundary condition at RS 0.074 on Breakout 2 of Wittmann Wash Tributary 1.

5.8.4 *Burlington Northern Santa Fe Railroad Embankment*

During the initial study development, it was discovered that the most downstream 800 feet (approximately) of Wash 2 West Tributary 1 flowed along the north side of the Burlington Northern Santa Fe railroad, and the right side of the floodplain mapping along this portion of the wash was contained by the railroad embankment. Per guidance from FCDMC and to maintain current FEMA standards of floodplain mapping in this area, FCDMC requested that the downstream limit of study be moved just upstream of the railroad crossing. FCDMC plans to study the "fail" condition of this railroad as part of a future regional study. The goal of this approach will be to determine the impact of the railroad's failing on not just Wash 2 West Tributary 1 but on all of the washes along this stretch of the railroad.

5.8.5 *Floodplain Mapping of Breakout Flow Downstream from Lateral Weirs 1.806 and 3.634 along Wittmann Wash Tributary 1*

The 100-year breakout flow downstream of lateral weirs 1.806 and 3.634 along Wittmann Wash Tributary 1, as discussed in Section 5.5.7, has been modeled with FlowMaster and mapped with a Zone A floodplain. These FlowMaster models may be found in the *FlowMaster-Models* folder in the *Appendix E* folder on the DVD.

Near the middle of the floodplain downstream from lateral weir 3.634, along its west side, is a "Limit of Study" line. This line has been placed here at the direction of FCDMC since FCDMC considers the floodplain upstream of the "Limit of Study" line to be a good candidate for future study.

5.8.6 *Breakouts Downstream from RS 1.863 and RS 4.560 in Wittmann Wash Tributary 1*

"Limit of Study" lines and breakout flow arrows plus 100-year flow rates have been placed on the right side of the floodplain just downstream from RS 1.863 in Wittmann Wash Tributary 1 and on the left side of the floodplain just downstream from RS 4.560 of Wittmann Wash Tributary 1. This information was added to work

maps because at each location there is a channel that was flooded by the floodplain mapping that flows out of the system of washes being modeled. At the direction of FCDMC, a HEC-RAS Flow Distribution was set up at these two cross sections to determine the peak 100-year flow rate that left via each channel. Please see Table 5.5 for a summary of the Flow Distribution parameters that were used to determine the breakout flow rates. Note that at the direction of FCDMC, since the breakout flow rates were less than 250 cfs, these breakout flow rates were not modeled/mapped downstream from the breakout locations.

Table 5.5 – Summary of Breakout Flow Rates Determined Via the Flow Distribution Routine in HEC-RAS

Flooding Source	Location	Number of Flow Distribution SubSections	Flow Taken from Which Stations in the Flow Distribution Output	Breakout Flow Rate (cfs)
Wittmann Wash Tributary 1	Downstream from RS 1.863 – Right Side	LOB = 1 Chan = 1 ROB = 43	Right of Station 10247.33	80
Wittmann Wash Tributary 1	Downstream from RS 4.560 – Left Side	LOB = 43 Chan = 1 ROB = 1	Left of Station 9939.07	177

5.8.7 *Floodplain Mapping in the Vicinity of RS 0.387 along Breakout 4 of Wittmann Wash Tributary 1*

As discussed in Section 5.8.1, at RS 0.387 in Breakout 4 of Wittmann Wash Tributary 1, water either remains in the wash and flows south or it heads southeast out of Breakout 4 of Wittmann Wash Tributary and into Wittmann Wash Tributary 1. This uncertainty in the flow path is due to the presence of a stock pond in this area. Since it is possible for the edge of this stock pond to fail, at the direction of FCDMC, it was assumed that the full flow rate of 300 cfs in Breakout 4 of Wittmann Wash Tributary 1 would remain in the wash and that the full flow rate of 300 cfs would also flow toward Wittmann Wash Tributary 1. Therefore under the "no-fail" condition for the pond, a worst case scenario of 300 cfs was assumed to remain in Breakout 4 of Wittmann Wash Tributary 1 and under the "fail" condition for the pond a worst case scenario of 300 cfs was assumed to flow to the southeast toward Wittmann Wash Tributary 1. Since the distance between RS 0.387 and where the

300 cfs enters Wittmann Wash Tributary 1 is only about 200 feet, the boundaries of the Zone A floodplain along this short flowpath have been estimated visually.

5.9 Calibration

Calibration data such as continuous gage data or well-documented high-water marks were not available for this study. FCDMC provided aerial photos for the FDS study area, and throughout the course of this study, these aerial photos were used during the development of effective flow limits, the determination of Manning's *n* values, and other tasks.

5.10 Final Results

The results of the hydraulic analyses are presented on the hydraulic work maps in Section 7 (reduced size) and Volume II (full size). Printouts of "Standard Table 1" from the HEC-RAS models are included at the end of Section 5.

Table 5.6 contains a summary of the flow rates from Entellus' hydrology that were used in the hydraulic modeling. This table includes each flow rate specified in the HEC-RAS modeling, the concentration point from Entellus' HEC-1 modeling for that flow rate, and the range of cross sections where that flow rate applies. For additional supporting hydrologic documentation, please refer to Section 4.

Table 5.6 – Discharges Used in the HEC-RAS Modeling

Wash Name	Concentration Point	100-Year Peak Flow Rate (cfs)	Lower RS Where Flow Rate Applies	Highest RS Where Flow Rate Applies
Wash 2 West Tributary 1	TW452A	1,062	8.893	9.189
Wash 2 West Tributary 1	452B-1	1,140	7.761	8.691
Wash 2 West Tributary 1	452B-2	1,175	7.280	7.711
Wash 2 West Tributary 1	452B-3	1,232	6.588	7.199
Wash 2 West Tributary 1	452B-4	1,306	5.836	6.551
Wash 2 West Tributary 1	Witt2	1,366	5.497	5.804
Wash 2 West Tributary 1	Downstream of Split[1]	2,166	3.526	5.434
Wittmann Wash Tributary 1	TW460	1,412	5.128	5.376

Table 5.6 – Discharges Used in the HEC-RAS Modeling

Wash Name	Concentration Point	100-Year Peak Flow Rate (cfs)	Lower RS Where Flow Rate Applies	Highest RS Where Flow Rate Applies
Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	1,112	4.730	5.047
Wittmann Wash Tributary 1	Downstream of Split[1]	1,412	3.780	4.689
Wittmann Wash Tributary 1	CTW458	1,686	3.699	3.699
Wittmann Wash Tributary 1	CTW456	1,736	3.033	3.635
Wittmann Wash Tributary 1	CTW454	1,811	2.005	2.980
Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	1,011	1.926	1.926
Wittmann Wash Tributary 1	Downstream of Split[1]	1,175	0.877	1.863
Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	675	0.622	0.800
Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	425	0.128	0.580
Breakout 1 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	250	0.175	0.224
Breakout 1 of Wittmann Wash Tributary 1	Downstream of Split[1]	750	0.112	0.148
Breakout 2 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	500	0.168	0.388
Breakout 2 of Wittmann Wash Tributary 1	Downstream of Split[1]	750	0.074	0.074
Breakout 3 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	800	0.513	0.513
Breakout 3 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	475	0.214	0.442
Breakout 3 of Wittmann Wash Tributary 1	Downstream of Split[1]	800	0.052	0.185

Table 5.6 – Discharges Used in the HEC-RAS Modeling

Wash Name	Concentration Point	100-Year Peak Flow Rate (cfs)	Lower RS Where Flow Rate Applies	Highest RS Where Flow Rate Applies
Breakout 4 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	300	0.013	0.706
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	Split Flow See Table 5.4[2]	325	0.005	0.235

[1] The 100-year peak flow rate for this sub-reach was impacted by a split flow calculation located farther upstream. See text after Table 5.4 in Section 5.8.1 for supporting documentation.

[2] The 100-year peak flow rate for this sub-reach was determined via a split flow calculation. See Section 5.8.1 up to and including Table 5.4 for supporting documentation.

Please see the remaining pages of this section for printouts of HEC-RAS Standard Table 1. There is one table for each model.

SECTION 5

HEC-RAS OUTPUT TABLES
STANDARD TABLE 1

Wash 2 West Tributary 1
Wittmann Wash Tributary 1
Breakout 1 of Wittmann Wash Tributary 1
Breakout 2 of Wittmann Wash Tributary 1
Breakout 3 of Wittmann Wash Tributary 1
Breakout 4 of Wittmann Wash Tributary 1
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1

HEC-RAS Plan: 2WestTrib1 River: Wash 2 West Reach: Tributary 1 Profile: 100yr

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)	
Tributary 1	9.189	100yr	1062.00	2066.47	2070.70	2070.69	2071.68	0.015607	8.50	166.60	124.91	0.87
Tributary 1	9.143	100yr	1062.00	2062.81	2068.08	2067.46	2068.55	0.009636	6.34	242.84	118.39	0.57
Tributary 1	9.093	100yr	1062.00	2060.10	2064.35	2064.14	2064.89	0.022078	7.33	209.46	120.82	0.78
Tributary 1	9.032	100yr	1062.00	2056.12	2059.59	2058.98	2060.07	0.010875	7.70	237.52	107.81	0.84
Tributary 1	8.999	100yr	1062.00	2053.28	2057.65	2056.96	2058.14	0.012698	6.25	214.22	93.04	0.60
Tributary 1	8.956	100yr	1062.00	2049.74	2054.23	2054.09	2054.89	0.018962	8.05	196.23	98.25	0.81
Tributary 1	8.932	100yr	1062.00	2048.13	2052.42	2052.17	2053.23	0.009392	7.95	185.49	90.00	0.80
Tributary 1	8.893	100yr	1062.00	2045.00	2049.27	2049.08	2050.04	0.032551	7.74	160.19	78.10	0.85
Tributary 1	8.852	100yr	1062.00	2042.88	2046.48	2045.73	2046.95	0.007636	6.67	210.56	95.85	0.70
Tributary 1	8.79	100yr	1062.00	2038.45	2045.92	2042.33	2046.01	0.001496	2.57	458.98	99.68	0.21
Tributary 1	8.759	100yr	1062.00	2036.20	2045.85	2039.50	2045.88	0.000378	1.41	753.33	126.83	0.10
Tributary 1	8.736		Lat Struct									
Tributary 1	8.733	100yr	1062.00	2034.00	2045.71	2038.00	2045.81	0.000425	2.53	420.43	90.72	0.14
Tributary 1	8.717		Culvert									
Tributary 1	8.712	100yr	1062.00	2031.71	2036.77	2036.20	2038.16	0.007195	9.47	112.11	64.21	0.80
Tributary 1	8.691	100yr	1140.00	2029.92	2035.56	2035.56	2036.80	0.019081	9.63	152.78	65.70	0.89
Tributary 1	8.672	100yr	1140.00	2028.51	2032.53	2032.53	2033.26	0.024932	8.48	204.91	132.88	0.96
Tributary 1	8.643	100yr	1140.00	2026.45	2030.22	2029.92	2030.71	0.009951	5.92	233.61	138.80	0.71
Tributary 1	8.614	100yr	1140.00	2024.31	2027.12	2026.99	2027.89	0.042158	7.07	161.19	86.51	0.91
Tributary 1	8.579	100yr	1140.00	2021.13	2024.76	2023.94	2025.04	0.007224	4.48	310.62	181.95	0.48
Tributary 1	8.537	100yr	1140.00	2018.09	2021.29	2021.22	2021.98	0.037895	7.02	178.76	110.78	0.90
Tributary 1	8.476	100yr	1140.00	2013.17	2017.59	2016.99	2017.99	0.005926	5.77	294.35	141.55	0.57
Tributary 1	8.434	100yr	1140.00	2011.26	2015.34	2014.88	2015.86	0.019455	6.75	209.65	94.66	0.74
Tributary 1	8.404	100yr	1140.00	2008.65	2012.23	2012.15	2013.05	0.016375	8.51	192.19	104.01	0.98
Tributary 1	8.356	100yr	1140.00	2004.54	2008.27	2008.08	2008.89	0.015967	6.63	201.76	121.51	0.81
Tributary 1	8.299	100yr	1140.00	2001.47	2004.56	2004.24	2004.90	0.010467	5.90	312.19	195.44	0.64
Tributary 1	8.277	100yr	1140.00	1999.35	2003.13	2002.68	2003.65	0.010754	6.73	229.09	106.81	0.77
Tributary 1	8.252	100yr	1140.00	1996.68	2000.87	2000.87	2001.73	0.019759	8.21	189.75	118.84	0.86
Tributary 1	8.185	100yr	1140.00	1992.36	1995.90	1995.16	1996.09	0.008482	4.31	352.65	184.02	0.47
Tributary 1	8.151	100yr	1140.00	1990.01	1993.36	1992.89	1993.72	0.017907	5.88	253.85	135.58	0.68
Tributary 1	8.134	100yr	1140.00	1989.10	1992.57	1991.94	1992.83	0.006292	5.01	346.73	185.74	0.55
Tributary 1	8.1	100yr	1140.00	1986.64	1990.41	1990.41	1990.96	0.023205	6.91	240.92	190.28	0.76
Tributary 1	8.05	100yr	1140.00	1981.65	1985.58	1985.58	1986.27	0.012263	7.56	214.54	161.95	0.86
Tributary 1	7.974	100yr	1140.00	1976.21	1979.84	1979.31	1980.13	0.011296	4.91	268.33	157.57	0.57
Tributary 1	7.896	100yr	1140.00	1971.60	1975.60	1975.37	1976.01	0.010317	6.11	289.61	187.76	0.61
Tributary 1	7.83	100yr	1140.00	1966.56	1970.92	1970.67	1971.45	0.016866	6.59	223.54	124.45	0.69
Tributary 1	7.761	100yr	1140.00	1963.42	1965.59	1965.35	1965.91	0.013236	5.92	310.79	275.00	0.80
Tributary 1	7.711	100yr	1175.00	1959.09	1962.50	1962.06	1962.70	0.012066	4.84	358.93	242.42	0.60
Tributary 1	7.657	100yr	1175.00	1956.68	1959.93	1959.59	1960.18	0.007997	5.40	380.72	262.80	0.60
Tributary 1	7.609	100yr	1175.00	1953.37	1957.03	1956.32	1957.43	0.015894	5.05	232.77	152.72	0.63
Tributary 1	7.567	100yr	1175.00	1950.27	1954.16	1953.11	1954.44	0.011129	4.26	275.66	123.09	0.50
Tributary 1	7.513	100yr	1175.00	1946.71	1949.78	1949.78	1950.67	0.015828	8.14	187.94	112.12	0.90
Tributary 1	7.441	100yr	1175.00	1942.15	1945.95	1945.02	1946.09	0.006731	3.84	390.97	188.77	0.43
Tributary 1	7.366	100yr	1175.00	1936.75	1941.94	1941.08	1942.39	0.016900	5.37	218.99	94.19	0.62
Tributary 1	7.316	100yr	1175.00	1933.22	1937.17	1937.17	1938.11	0.014670	8.71	186.92	103.86	0.90
Tributary 1	7.28	100yr	1175.00	1931.25	1935.50	1935.02	1935.83	0.008549	5.48	316.25	242.59	0.55
Tributary 1	7.199	100yr	1232.00	1926.60	1931.16	1930.17	1931.48	0.012393	4.55	271.04	116.13	0.52
Tributary 1	7.153	100yr	1232.00	1923.64	1928.88	1927.42	1929.12	0.007756	3.93	316.61	145.98	0.43
Tributary 1	7.091	100yr	1232.00	1920.53	1924.21	1924.18	1924.91	0.025940	7.79	214.61	137.39	0.88
Tributary 1	7.056	100yr	1232.00	1917.67	1921.63	1921.36	1922.31	0.008580	6.80	215.48	133.19	0.74
Tributary 1	6.965	100yr	1232.00	1912.51	1917.17	1916.82	1917.60	0.012081	6.29	287.84	168.95	0.63
Tributary 1	6.944	100yr	1232.00	1911.49	1915.71	1915.53	1916.46	0.008448	7.80	245.37	140.35	0.77
Tributary 1	6.92	100yr	1232.00	1909.65	1914.00	1913.98	1915.10	0.012944	9.34	180.28	87.61	0.98
Tributary 1	6.87	100yr	1232.00	1906.54	1910.36	1910.36	1911.23	0.016451	7.75	183.81	116.32	0.95
Tributary 1	6.783	100yr	1232.00	1900.09	1906.42	1904.20	1906.61	0.005072	3.56	346.52	107.60	0.35
Tributary 1	6.738	100yr	1232.00	1899.10	1903.49	1903.49	1904.27	0.027785	8.60	201.67	113.84	0.85
Tributary 1	6.703	100yr	1232.00	1896.27	1900.40	1899.33	1900.71	0.007142	4.46	276.06	107.10	0.49
Tributary 1	6.662	100yr	1232.00	1894.23	1898.76	1897.33	1899.04	0.008316	4.22	291.85	102.60	0.44
Tributary 1	6.614	100yr	1232.00	1891.99	1896.16	1895.13	1896.51	0.012199	4.72	260.77	102.29	0.52
Tributary 1	6.588	100yr	1232.00	1890.62	1893.93	1893.47	1894.45	0.017973	5.75	214.23	191.28	0.71
Tributary 1	6.551	100yr	1306.00	1887.35	1891.15	1890.79	1891.61	0.011951	6.00	269.16	144.65	0.72
Tributary 1	6.489	100yr	1306.00	1883.61	1887.60	1887.50	1888.26	0.008975	8.85	294.46	174.33	0.83
Tributary 1	6.487		Lat Struct									
Tributary 1	6.452	100yr	1306.00	1881.09	1885.98	1885.54	1886.40	0.008945	6.06	321.75	176.58	0.56
Tributary 1	6.388	100yr	1306.00	1876.68	1882.07	1882.07	1882.80	0.013243	7.61	253.66	172.07	0.72
Tributary 1	6.36	100yr	1306.00	1874.70	1879.98	1879.46	1880.21	0.007346	4.89	409.41	234.79	0.48
Tributary 1	6.331	100yr	1306.00	1873.77	1878.38	1876.91	1878.71	0.012333	5.67	310.58	158.96	0.60
Tributary 1	6.302	100yr	1306.00	1872.03	1876.22	1876.22	1876.90	0.013215	6.72	239.84	209.08	0.67
Tributary 1	6.262	100yr	1306.00	1869.35	1874.16	1872.56	1874.45	0.005548	5.54	423.17	277.10	0.52
Tributary 1	6.201	100yr	1306.00	1866.81	1870.84	1870.20	1871.55	0.018206	8.14	256.82	176.93	0.82
Tributary 1	6.129	100yr	1306.00	1861.96	1867.22	1866.82	1867.62	0.006578	6.52	357.48	183.82	0.59
Tributary 1	6.088	100yr	1306.00	1860.62	1865.54	1864.29	1865.83	0.009746	5.53	341.30	168.46	0.57
Tributary 1	6.021	100yr	1306.00	1856.19	1861.35	1861.33	1861.86	0.014966	7.07	315.26	252.07	0.72
Tributary 1	5.976	100yr	1306.00	1853.89	1858.52	1858.34	1858.83	0.009392	5.83	419.29	349.93	0.58
Tributary 1	5.894	100yr	1306.00	1848.85	1853.64	1853.59	1854.10	0.014054	6.64	306.60	277.75	0.67
Tributary 1	5.836	100yr	1306.00	1846.53	1850.03	1849.37	1850.28	0.010390	4.56	334.12	185.45	0.52
Tributary 1	5.804	100yr	1366.00	1843.09	1847.56	1847.52	1848.07	0.016267	7.53	272.55	235.04	0.84
Tributary 1	5.743	100yr	1366.00	1840.38	1844.44	1843.70	1844.63	0.006662	4.52	427.40	242.55	0.48
Tributary 1	5.707	100yr	1366.00	1836.61	1842.63	1842.46	1843.06	0.014297	7.07	336.30	227.37	0.69

HEC-RAS Plan: 2WestTrib1 River: Wash 2 West Reach: Tributary 1 Profile: 100yr (Continued)

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)	
Tributary 1	5.676	100yr	1366.00	1836.31	1840.88	1840.62	1841.27	0.007466	7.44	435.84	290.86	0.69
Tributary 1	5.668		Lat Struct									
Tributary 1	5.619	100yr	1366.00	1832.92	1837.55	1837.17	1837.78	0.009858	5.54	447.07	324.42	0.59
Tributary 1	5.549	100yr	1366.00	1830.21	1833.50	1832.97	1833.70	0.011721	5.45	417.98	277.82	0.65
Tributary 1	5.497	100yr	1366.00	1826.61	1830.02	1829.52	1830.27	0.012310	5.50	391.35	270.15	0.63
Tributary 1	5.434	100yr	2166.00	1822.77	1826.65	1826.30	1826.98	0.010678	6.17	556.72	319.54	0.76
Tributary 1	5.348	100yr	2166.00	1817.45	1821.32	1820.91	1821.67	0.013125	6.53	538.20	394.57	0.66
Tributary 1	5.281	100yr	2166.00	1813.12	1817.40	1816.97	1817.64	0.012169	5.17	597.02	364.48	0.58
Tributary 1	5.23	100yr	2166.00	1810.90	1814.54	1813.95	1814.74	0.009350	5.33	674.37	389.25	0.55
Tributary 1	5.159	100yr	2166.00	1807.99	1810.87	1810.35	1811.12	0.011543	5.57	604.37	365.57	0.80
Tributary 1	5.102	100yr	2166.00	1804.57	1807.40	1807.04	1807.65	0.014839	5.94	588.91	445.03	0.71
Tributary 1	5.054	100yr	2166.00	1801.41	1804.34	1803.65	1804.52	0.009153	4.27	634.68	459.58	0.51
Tributary 1	5.016	100yr	2166.00	1798.20	1802.38	1801.77	1802.66	0.011292	5.22	544.44	315.22	0.49
Tributary 1	4.978	100yr	2166.00	1796.75	1800.15	1799.74	1800.45	0.010378	6.65	617.84	440.43	0.73
Tributary 1	4.935	100yr	2166.00	1794.57	1797.56	1797.30	1797.95	0.012878	8.43	524.17	352.62	0.92
Tributary 1	4.871	100yr	2166.00	1790.21	1794.23	1793.71	1794.45	0.009236	6.14	711.25	437.46	0.59
Tributary 1	4.82	100yr	2166.00	1787.51	1791.51	1790.98	1791.76	0.012401	6.00	632.35	673.12	0.61
Tributary 1	4.757	100yr	2166.00	1783.84	1787.60	1787.33	1787.87	0.010020	6.43	622.66	590.43	0.67
Tributary 1	4.703	100yr	2166.00	1781.76	1785.02	1784.88	1785.32	0.009677	6.66	629.72	853.98	0.75
Tributary 1	4.644		Lat Struct									
Tributary 1	4.627	100yr	2166.00	1777.54	1781.73	1781.46	1782.00	0.008642	5.98	642.97	609.81	0.62
Tributary 1	4.591	100yr	2166.00	1775.82	1779.67	1779.37	1780.04	0.010317	6.85	501.35	348.17	0.68
Tributary 1	4.527	100yr	2166.00	1773.20	1776.57	1776.27	1776.94	0.008630	7.25	538.40	395.72	0.79
Tributary 1	4.501		Lat Struct									
Tributary 1	4.451	100yr	2166.00	1768.37	1772.53	1772.27	1773.03	0.008130	5.61	450.72	272.37	0.59
Tributary 1	4.381	100yr	2166.00	1765.36	1769.62	1769.31	1769.94	0.010495	4.67	495.59	503.30	0.56
Tributary 1	4.374		Lat Struct									
Tributary 1	4.364		Lat Struct									
Tributary 1	4.358	100yr	2166.00	1764.29	1768.35	1767.78	1768.59	0.006629	4.13	565.28	511.20	0.46
Tributary 1	4.306	100yr	2166.00	1762.02	1765.45	1765.45	1766.17	0.012118	7.03	353.76	290.54	0.90
Tributary 1	4.262	100yr	2166.00	1758.95	1763.10	1762.31	1763.55	0.006003	6.94	535.42	295.96	0.69
Tributary 1	4.207	100yr	2166.00	1757.14	1761.09	1760.33	1761.65	0.008206	7.35	421.21	201.90	0.71
Tributary 1	4.147	100yr	2166.00	1754.06	1758.53	1758.26	1759.18	0.008370	7.73	432.64	221.22	0.71
Tributary 1	4.097	100yr	2166.00	1751.42	1755.99	1755.66	1756.65	0.010958	8.02	474.71	349.65	0.72
Tributary 1	4.057	100yr	2166.00	1750.20	1753.74	1753.55	1754.22	0.011441	7.53	498.81	444.62	0.77
Tributary 1	4.047		Lat Struct									
Tributary 1	3.992	100yr	2166.00	1747.14	1750.52	1750.52	1750.94	0.008162	7.37	690.01	647.53	0.96
Tributary 1	3.92	100yr	2166.00	1743.25	1746.45	1746.23	1746.94	0.007832	7.40	606.17	490.13	0.79
Tributary 1	3.851	100yr	2166.00	1739.27	1744.17	1743.44	1744.50	0.006932	5.33	583.43	361.61	0.50
Tributary 1	3.82	100yr	2166.00	1737.84	1742.32	1742.32	1743.09	0.010440	8.59	445.89	334.79	0.78
Tributary 1	3.768	100yr	2166.00	1734.26	1739.10	1739.10	1739.73	0.008441	8.60	484.99	393.12	0.99
Tributary 1	3.735	100yr	2166.00	1732.66	1737.19	1737.19	1737.82	0.009513	8.49	535.35	384.04	0.76
Tributary 1	3.674	100yr	2166.00	1729.48	1734.35	1733.61	1734.76	0.008996	6.03	534.66	337.86	0.60
Tributary 1	3.661		Lat Struct									
Tributary 1	3.626	100yr	2166.00	1726.72	1731.97	1731.48	1732.44	0.008943	7.18	491.46	228.28	0.61
Tributary 1	3.566	100yr	2166.00	1723.96	1728.74	1728.50	1729.57	0.009068	8.48	384.66	169.79	0.75
Tributary 1	3.526	100yr	2166.00	1723.18	1727.08	1726.78	1727.94	0.006804	7.95	358.60	158.89	0.77

HEC-RAS Plan: Wittmann Was River: Wittmann Wash Reach: Tributary 1 Profile: 100yr

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)	
Tributary 1	5.376	100yr	1412.00	2110.79	2113.26	2113.11	2113.58	0.017557	5.28	316.45	346.10	0.70
Tributary 1	5.362		Lat Struct									
Tributary 1	5.329	100yr	1412.00	2105.73	2108.30	2108.30	2108.83	0.020337	6.66	276.27	255.60	0.97
Tributary 1	5.258	100yr	1412.00	2098.92	2101.69	2101.41	2101.90	0.010700	5.54	464.15	608.10	0.77
Tributary 1	5.246		Lat Struct									
Tributary 1	5.219	100yr	1412.00	2095.66	2097.85	2097.85	2098.26	0.021254	6.73	350.11	404.34	1.13
Tributary 1	5.173	100yr	1412.00	2091.57	2094.35	2093.68	2094.44	0.007630	2.92	608.17	477.07	0.41
Tributary 1	5.128	100yr	1412.00	2088.28	2091.35	2091.34	2091.95	0.020972	6.84	274.48	260.56	0.87
Tributary 1	5.047	100yr	1112.00	2081.63	2083.70	2083.52	2084.06	0.015865	5.53	262.70	301.40	0.82
Tributary 1	5.009	100yr	1112.00	2077.41	2079.51	2079.37	2079.91	0.024099	7.23	235.74	219.73	1.10
Tributary 1	4.939	100yr	1112.00	2070.70	2073.75	2073.23	2074.06	0.012559	4.90	251.85	144.53	0.62
Tributary 1	4.878	100yr	1112.00	2065.92	2068.74	2068.74	2069.38	0.018588	6.56	173.26	188.84	0.96
Tributary 1	4.796	100yr	1112.00	2057.71	2060.96	2060.96	2061.65	0.015284	7.31	167.64	119.78	0.89
Tributary 1	4.730	100yr	1112.00	2052.09	2055.63	2054.71	2055.89	0.006866	4.15	279.77	145.09	0.49
Tributary 1	4.689	100yr	1412.00	2047.75	2052.50	2052.41	2053.66	0.014333	8.64	163.36	66.14	0.96
Tributary 1	4.653	100yr	1412.00	2044.43	2049.38	2049.38	2050.37	0.020684	8.32	201.86	122.09	0.93
Tributary 1	4.650		Lat Struct									
Tributary 1	4.616	100yr	1412.00	2043.63	2048.59	2046.84	2048.96	0.002392	4.87	289.95	345.63	0.44
Tributary 1	4.602		Culvert									
Tributary 1	4.597	100yr	1412.00	2040.55	2043.99	2043.99	2045.34	0.014359	9.35	151.07	61.54	0.99
Tributary 1	4.560	100yr	1412.00	2038.27	2040.91	2040.91	2041.52	0.017111	6.76	263.24	223.18	0.93
Tributary 1	4.473	100yr	1412.00	2030.17	2032.77	2032.20	2033.03	0.012762	4.13	341.73	212.32	0.57
Tributary 1	4.408	100yr	1412.00	2023.96	2026.39	2026.39	2027.17	0.021874	7.73	201.78	135.15	1.15
Tributary 1	4.405		Lat Struct									
Tributary 1	4.336	100yr	1412.00	2016.07	2019.88	2019.88	2020.67	0.010819	7.53	247.79	179.29	0.86
Tributary 1	4.287	100yr	1412.00	2011.91	2015.23	2014.57	2015.65	0.013923	5.28	289.73	176.28	0.61
Tributary 1	4.280		Lat Struct									
Tributary 1	4.219	100yr	1412.00	2006.51	2009.74	2009.74	2010.38	0.015984	7.89	291.11	224.17	0.99
Tributary 1	4.183	100yr	1412.00	2003.72	2005.79	2005.60	2006.13	0.013256	5.32	351.49	273.16	0.74
Tributary 1	4.126	100yr	1412.00	1998.78	2002.33	2001.91	2002.68	0.013330	6.05	336.16	183.80	0.64
Tributary 1	4.082	100yr	1412.00	1995.08	1998.47	1998.47	1999.34	0.018141	8.98	233.47	128.14	1.04
Tributary 1	4.022	100yr	1412.00	1990.03	1993.51	1993.41	1994.19	0.010590	7.95	241.37	150.86	0.91
Tributary 1	3.957	100yr	1412.00	1985.10	1988.08	1988.08	1988.85	0.026115	7.84	225.05	146.47	1.00
Tributary 1	3.861	100yr	1412.00	1977.88	1979.40	1978.29	1979.50	0.006235	2.83	542.26	315.35	0.58
Tributary 1	3.780	100yr	1412.00	1971.28	1974.90	1974.76	1975.53	0.018572	8.17	290.67	185.58	0.89
Tributary 1	3.699	100yr	1686.00	1964.97	1968.24	1968.01	1968.57	0.016319	6.84	463.09	329.93	0.82
Tributary 1	3.635	100yr	1736.00	1959.57	1963.08	1963.08	1963.70	0.016695	8.05	399.61	290.97	0.89
Tributary 1	3.634		Lat Struct									
Tributary 1	3.577	100yr	1736.00	1955.55	1958.99	1958.67	1959.39	0.011689	6.77	391.45	298.28	0.73
Tributary 1	3.507	100yr	1736.00	1950.40	1952.68	1952.45	1953.00	0.026562	6.08	403.53	344.44	0.85
Tributary 1	3.456	100yr	1736.00	1946.99	1949.27	1948.67	1949.43	0.009774	4.20	543.44	377.41	0.66
Tributary 1	3.455		Lat Struct									
Tributary 1	3.422	100yr	1736.00	1944.28	1946.84	1946.54	1947.21	0.022481	5.95	364.94	262.51	0.86
Tributary 1	3.350	100yr	1736.00	1938.68	1942.44	1941.96	1942.83	0.008723	6.23	375.73	207.22	0.72
Tributary 1	3.292	100yr	1736.00	1935.38	1938.99	1938.87	1939.70	0.014241	7.39	329.84	206.83	0.76
Tributary 1	3.249	100yr	1736.00	1931.95	1936.21	1936.21	1936.96	0.010212	8.20	363.45	237.11	0.81
Tributary 1	3.200	100yr	1736.00	1929.12	1932.66	1932.57	1933.33	0.016726	7.21	304.44	183.25	0.87
Tributary 1	3.136	100yr	1736.00	1924.54	1928.36	1928.30	1928.88	0.010688	7.05	423.67	312.71	0.81
Tributary 1	3.082	100yr	1736.00	1921.92	1925.07	1925.01	1925.69	0.013555	7.73	368.29	244.62	0.87
Tributary 1	3.078		Lat Struct									
Tributary 1	3.033	100yr	1736.00	1919.06	1921.84	1921.47	1922.17	0.012030	5.38	454.36	303.41	0.66
Tributary 1	3.032		Lat Struct									
Tributary 1	2.980	100yr	1811.00	1915.37	1918.23	1918.17	1918.68	0.017291	6.41	362.58	524.70	0.88
Tributary 1	2.941	100yr	1811.00	1912.81	1916.39	1915.80	1916.60	0.007553	5.45	565.67	475.89	0.65
Tributary 1	2.907	100yr	1811.00	1911.07	1914.71	1914.10	1915.04	0.008984	5.11	414.28	431.54	0.59
Tributary 1	2.843	100yr	1811.00	1905.03	1910.81	1910.64	1911.33	0.016560	7.35	379.41	215.08	0.69
Tributary 1	2.765	100yr	1811.00	1900.53	1906.63	1906.03	1906.94	0.008298	5.95	472.03	210.53	0.55
Tributary 1	2.691	100yr	1811.00	1895.66	1902.52	1902.27	1903.21	0.014070	8.19	341.15	161.98	0.70
Tributary 1	2.624	100yr	1811.00	1891.93	1898.48	1897.82	1898.95	0.010554	6.15	343.39	162.05	0.58
Tributary 1	2.558	100yr	1811.00	1887.89	1893.90	1893.74	1894.58	0.015689	8.39	346.45	187.92	0.76
Tributary 1	2.496	100yr	1811.00	1884.92	1889.00	1889.00	1889.76	0.014040	8.78	345.95	197.89	1.02
Tributary 1	2.444	100yr	1811.00	1881.55	1886.65	1885.72	1886.93	0.006264	4.41	468.12	218.49	0.42
Tributary 1	2.400	100yr	1811.00	1879.01	1883.88	1883.88	1884.53	0.019242	8.69	372.95	280.46	0.83
Tributary 1	2.328	100yr	1811.00	1874.32	1878.48	1877.91	1878.67	0.010168	5.69	668.38	577.20	0.62
Tributary 1	2.261	100yr	1811.00	1870.94	1874.03	1873.73	1874.26	0.017031	5.78	492.29	455.59	0.75
Tributary 1	2.254		Lat Struct									
Tributary 1	2.201	100yr	1811.00	1867.52	1869.83	1868.92	1869.97	0.008654	3.76	612.16	453.53	0.62
Tributary 1	2.178		Lat Struct									
Tributary 1	2.147	100yr	1811.00	1864.05	1867.66	1867.08	1867.85	0.011287	5.51	609.65	544.75	0.61
Tributary 1	2.089	100yr	1811.00	1860.50	1863.19	1862.81	1863.35	0.014415	5.01	622.66	573.89	0.64
Tributary 1	2.005	100yr	1811.00	1854.10	1858.39	1858.09	1858.61	0.017157	4.47	496.60	491.36	0.59
Tributary 1	1.926	100yr	1011.00	1849.94	1853.18	1852.68	1853.29	0.008789	3.42	408.49	736.10	0.46
Tributary 1	1.863	100yr	1175.00	1844.94	1848.47	1848.37	1848.84	0.028839	6.87	268.53	577.11	0.87
Tributary 1	1.807	100yr	1175.00	1841.18	1843.64	1843.21	1843.79	0.010119	3.00	385.40	372.52	0.47
Tributary 1	1.806		Lat Struct									
Tributary 1	1.718	100yr	1175.00	1835.00	1837.41	1837.17	1837.65	0.017286	5.24	326.57	383.78	0.82
Tributary 1	1.644	100yr	1175.00	1829.83	1832.53	1832.21	1832.65	0.010272	3.49	470.03	556.81	0.49
Tributary 1	1.565	100yr	1175.00	1824.19	1827.37	1827.35	1827.62	0.016507	5.90	395.38	565.27	0.74
Tributary 1	1.510	100yr	1175.00	1820.76	1823.92	1823.59	1824.16	0.009262	6.36	392.34	373.42	0.70

HEC-RAS Plan: Wittmann Was River: Wittmann Wash Reach: Tributary 1 Profile: 100yr (Continued)

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)	
Tributary 1	1.503		Lat Struct									
Tributary 1	1.429	100yr	1175.00	1816.70	1818.54	1818.38	1818.75	0.024530	6.34	358.19	499.23	0.92
Tributary 1	1.381	100yr	1175.00	1812.92	1815.88	1815.28	1816.00	0.009870	3.93	466.96	437.61	0.49
Tributary 1	1.309	100yr	1175.00	1808.74	1809.97	1809.59	1810.10	0.018320	4.99	436.52	553.13	0.98
Tributary 1	1.230	100yr	1175.00	1804.77	1805.25	1804.73	1805.31	0.008331	0.84	611.54	825.28	0.30
Tributary 1	1.152	100yr	1175.00	1799.14	1800.39	1800.18	1800.55	0.014966	4.03	371.39	512.07	0.92
Tributary 1	1.052	100yr	1175.00	1792.14	1794.71	1794.23	1794.81	0.009623	2.89	475.93	457.93	0.45
Tributary 1	1.013	100yr	1175.00	1789.68	1792.01	1791.58	1792.18	0.013037	4.22	356.98	305.99	0.62
Tributary 1	0.974	100yr	1175.00	1787.42	1790.02	1789.41	1790.16	0.007181	3.70	414.85	358.96	0.49
Tributary 1	0.972		Lat Struct									
Tributary 1	0.922	100yr	1175.00	1783.64	1787.86	1787.66	1788.14	0.010407	6.77	407.29	348.38	0.65
Tributary 1	0.877	100yr	1175.00	1782.14	1784.84	1784.68	1785.05	0.012448	6.04	428.92	453.20	0.74
Tributary 1	0.800	100yr	675.00	1777.60	1780.12	1779.85	1780.32	0.011030	5.15	206.02	626.75	0.68
Tributary 1	0.709	100yr	675.00	1772.66	1775.32	1775.21	1775.52	0.010614	4.82	241.76	384.99	0.75
Tributary 1	0.622	100yr	675.00	1767.90	1770.73	1770.56	1770.89	0.008220	4.80	285.30	948.35	0.59
Tributary 1	0.580	100yr	425.00	1766.03	1768.13	1768.08	1768.33	0.020431	5.26	150.00	894.90	0.81
Tributary 1	0.536	100yr	425.00	1763.92	1765.45	1765.17	1765.54	0.009177	3.76	210.81	453.80	0.68
Tributary 1	0.490	100yr	425.00	1760.87	1762.56	1762.54	1762.69	0.013908	5.09	201.70	531.34	0.85
Tributary 1	0.418	100yr	425.00	1755.96	1758.83	1758.48	1758.92	0.007202	3.77	221.78	353.57	0.49
Tributary 1	0.347	100yr	425.00	1752.15	1755.64	1755.64	1755.89	0.010103	5.18	187.52	437.01	0.60
Tributary 1	0.345		Lat Struct									
Tributary 1	0.291	100yr	425.00	1749.84	1752.65	1752.38	1752.72	0.004675	3.38	267.13	667.88	0.42
Tributary 1	0.236	100yr	425.00	1746.92	1749.96	1749.96	1750.40	0.013059	6.02	107.01	749.53	0.72
Tributary 1	0.128	100yr	425.00	1741.88	1744.13	1743.05	1744.18	0.002285	2.09	231.04	679.20	0.30

HEC-RAS Plan: WittTrib1Brk1 River: Wittmann Wash Reach: Trib 1-Brkout 1 Profile: 100yr

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)	
Trib 1-Brkout 1	0.224	100yr	250.00	1765.43	1768.26	1768.11	1768.36	0.008333	3.58	125.34	991.17	0.50
Trib 1-Brkout 1	0.208		Lat Struct									
Trib 1-Brkout 1	0.175	100yr	250.00	1762.12	1765.06	1765.06	1765.39	0.017361	5.32	69.29	116.90	0.73
Trib 1-Brkout 1	0.148	100yr	750.00	1761.07	1763.63	1763.25	1763.76	0.009267	4.19	285.06	335.78	0.59
Trib 1-Brkout 1	0.112	100yr	750.00	1759.23	1761.55	1761.14	1761.75	0.011227	4.12	214.62	206.41	0.59

HEC-RAS Plan: WittTrib1Brk2 River: Wittmann Wash Reach: Trib 1-Brkout 2 Profile: 100yr

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)	
Trib 1-Brkout 2	0.388	100yr	500.00	1778.41	1780.16	1780.01	1780.40	0.018505	5.98	142.43	633.71	0.94
Trib 1-Brkout 2	0.300	100yr	500.00	1772.67	1774.99	1774.64	1775.13	0.007895	3.75	174.79	192.05	0.57
Trib 1-Brkout 2	0.214	100yr	500.00	1768.21	1770.10	1769.85	1770.35	0.015134	4.40	125.58	124.26	0.75
Trib 1-Brkout 2	0.168	100yr	500.00	1766.03	1767.62	1767.33	1767.69	0.007378	3.36	251.86	386.13	0.54
Trib 1-Brkout 2	0.074	100yr	750.00	1760.06	1763.63	1763.32	1763.78	0.009233	4.91	284.47	335.46	0.55

HEC-RAS Plan: WittTrib1Brk3 River: Wittmann Wash Reach: Trib 1-Brkout 3 Profile: 100yr

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)	
Trib 1-Brkout 3	0.513	100yr	800.00	1851.87	1853.17	1852.94	1853.34	0.022235	5.02	243.04	731.77	1.08
Trib 1-Brkout 3	0.442	100yr	475.00	1845.80	1849.04	1848.67	1849.31	0.007723	4.33	123.65	334.53	0.65
Trib 1-Brkout 3	0.418	100yr	475.00	1844.19	1847.92	1847.43	1848.29	0.010233	5.26	124.52	124.28	0.60
Trib 1-Brkout 3	0.415		Lat Struct									
Trib 1-Brkout 3	0.362	100yr	475.00	1839.80	1843.56	1843.56	1844.08	0.020443	6.50	101.15	221.35	0.80
Trib 1-Brkout 3	0.315	100yr	475.00	1836.87	1840.55	1839.70	1840.70	0.008066	3.35	151.82	139.02	0.44
Trib 1-Brkout 3	0.261	100yr	475.00	1832.72	1836.84	1836.24	1837.41	0.018901	6.15	82.17	44.67	0.69
Trib 1-Brkout 3	0.214	100yr	475.00	1830.44	1834.96	1834.04	1835.14	0.004900	3.43	138.35	78.89	0.46
Trib 1-Brkout 3	0.185	100yr	800.00	1828.49	1833.74	1832.85	1834.05	0.009761	4.91	192.04	89.56	0.50
Trib 1-Brkout 3	0.154	100yr	800.00	1826.76	1831.57	1831.57	1832.25	0.012227	7.78	177.47	130.41	0.73
Trib 1-Brkout 3	0.114	100yr	800.00	1823.69	1827.97	1827.56	1828.54	0.010489	6.91	163.26	80.03	0.67
Trib 1-Brkout 3	0.088	100yr	800.00	1822.68	1826.00	1826.00	1826.63	0.018728	7.12	151.23	112.72	0.92
Trib 1-Brkout 3	0.052	100yr	800.00	1821.22	1824.43	1823.69	1824.55	0.004199	4.00	330.74	304.01	0.48

HEC-RAS Plan: WittTrib1Brk4 River: Wittmann Wash Reach: Trib 1-Brkout 4 Profile: 100yr

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)	
Trib 1-Brkout 4	0.706	100yr	300.00	2081.00	2083.37	2083.37	2084.05	0.018535	6.64	45.15	269.42	1.03
Trib 1-Brkout 4	0.677	100yr	300.00	2078.84	2080.59	2080.31	2080.83	0.020424	3.97	75.54	71.30	0.68
Trib 1-Brkout 4	0.607	100yr	300.00	2071.70	2073.81	2073.81	2074.42	0.015121	6.28	47.78	40.23	1.02
Trib 1-Brkout 4	0.606		Lat Struct									
Trib 1-Brkout 4	0.558	100yr	300.00	2067.15	2069.13	2069.13	2069.65	0.012625	5.86	55.70	70.92	0.88
Trib 1-Brkout 4	0.508	100yr	300.00	2061.91	2064.09	2063.90	2064.43	0.019951	4.66	64.43	61.84	0.80
Trib 1-Brkout 4	0.483	100yr	300.00	2057.42	2062.08	2061.78	2062.29	0.013021	3.61	83.47	297.85	0.63
Trib 1-Brkout 4	0.459	100yr	300.00	2056.50	2058.66	2058.66	2058.95	0.080307	4.36	68.73	218.93	0.99
Trib 1-Brkout 4	0.434	100yr	300.00	2054.48	2056.34	2055.29	2056.35	0.001173	0.85	351.32	281.48	0.13
Trib 1-Brkout 4	0.414	100yr	300.00	2054.00	2056.31	2054.36	2056.32	0.000157	0.44	674.42	317.27	0.05
Trib 1-Brkout 4	0.403		Lat Struct									
Trib 1-Brkout 4	0.387	100yr	300.00	2053.92	2055.76	2055.76	2056.20	0.023825	5.31	57.52	280.19	0.96
Trib 1-Brkout 4	0.362	100yr	300.00	2051.05	2052.54	2052.13	2052.64	0.010165	2.56	117.16	131.89	0.48
Trib 1-Brkout 4	0.349	100yr	300.00	2049.67	2050.88	2050.88	2051.25	0.053518	4.86	61.68	86.42	1.01
Trib 1-Brkout 4	0.348		Lat Struct									
Trib 1-Brkout 4	0.341		Lat Struct									
Trib 1-Brkout 4	0.334	100yr	294.14	2047.45	2050.50	2048.75	2050.51	0.000677	0.93	315.80	198.33	0.13
Trib 1-Brkout 4	0.317	100yr	52.58	2045.97	2050.44	2047.17	2050.46	0.000350	1.03	51.08	221.78	0.09
Trib 1-Brkout 4	0.303		Culvert									
Trib 1-Brkout 4	0.294	100yr	52.58	2040.65	2042.52	2041.83	2042.64	0.002809	2.78	18.94	33.53	0.40
Trib 1-Brkout 4	0.260	100yr	300.00	2035.81	2038.64	2038.43	2039.13	0.035891	5.61	53.45	37.42	0.83
Trib 1-Brkout 4	0.213	100yr	300.00	2029.66	2032.78	2032.46	2033.23	0.016849	5.37	55.89	37.19	0.76
Trib 1-Brkout 4	0.179	100yr	300.00	2025.00	2027.54	2027.54	2028.19	0.057294	6.49	46.23	36.39	1.01
Trib 1-Brkout 4	0.160	100yr	300.00	2022.39	2025.85	2025.13	2026.17	0.006822	4.56	65.78	34.88	0.59
Trib 1-Brkout 4	0.114	100yr	300.00	2020.46	2023.12	2023.12	2023.68	0.017175	5.98	50.15	45.57	1.01
Trib 1-Brkout 4	0.073	100yr	300.00	2017.13	2020.78	2020.41	2020.94	0.008868	3.55	115.10	115.94	0.46
Trib 1-Brkout 4	0.041	100yr	300.00	2014.09	2017.37	2017.28	2018.11	0.041842	6.94	43.21	25.79	0.95
Trib 1-Brkout 4	0.013	100yr	300.00	2014.01	2016.96	2015.62	2017.01	0.002249	1.86	168.07	127.70	0.25

HEC-RAS Plan: Brk1ofBrk3 River: Wittmann Wash Reach: Trib1-Brk1ofBrk3 Profile: 100yr

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)	
Trib1-Brk1ofBrk3	0.235	100yr	325.00	1846.13	1849.10	1849.10	1849.34	0.020637	5.32	118.48	349.75	0.72
Trib1-Brk1ofBrk3	0.227		Lat Struct									
Trib1-Brk1ofBrk3	0.158	100yr	325.00	1840.53	1843.46	1843.25	1843.56	0.009113	3.63	164.99	224.18	0.46
Trib1-Brk1ofBrk3	0.077	100yr	325.00	1833.50	1836.68	1836.68	1837.31	0.027040	6.87	61.92	60.60	0.84
Trib1-Brk1ofBrk3	0.005	100yr	325.00	1828.38	1832.09	1831.09	1832.18	0.002471	2.74	170.39	130.32	0.32

SECTION 6.0 EROSION AND SEDIMENT TRANSPORT

No erosion or sediment transport analyses were performed for this study.

SECTION 7.0 DRAFT FIS REPORT DATA

See the following pages for the Summary of Discharges Table (Table 7.2), the Annotated FIRM panels (Figures 7.1.1 and 7.1.2), the RASPLOT flood profiles (Figure 7.2), and reduced size (11" x 17") copies of the hydraulic work maps (Figure 7.3).

The RASPLOT flood profiles were produced using RASPLOT Version 2.5. Except for Wash 2 West Tributary 1, all washes were begun using a known water surface elevation. These known water surface elevations were discussed in Section 5.1 and computed in the spreadsheet *Downstream-Boundary-Computations.xls*. Additionally, they were used as the backwater elevations in the RASPLOT profiles.

The downstream end of Wash 2 West Tributary 1 ties into a Zone A floodplain. See Section 5.1 for additional information. As there is no detailed water surface elevation immediately downstream from RS 3.526, the water surface elevation computer by HEC-RAS at this cross section was also the backwater elevation for this wash.

The backwater elevation used in each plot, as well as the name of the wash that provided the backwater elevation, may be found in Table 7.1.

Table 7.1 – Backwater Elevations Used in the RASPLOT Profiles

Profile	Backwater Wash	Backwater Elevation (Feet NAVD 88)
Wash 2 West Tributary 1	None	1,727.08
Wittmann Wash Tributary 1	Wittmann Wash	1,744.13
Breakout 1 of Wittmann Wash Tributary 1	Wittmann Wash	1,761.55
Breakout 2 of Wittmann Wash Tributary 1	Breakout 1 of Wittmann Wash Tributary 1	1,763.63
Breakout 3 of Wittmann Wash Tributary 1	Wash 2 West Tributary 1	1,824.43
Breakout 4 of Wittmann Wash Tributary 1	Wittmann Wash Tributary 1	2,016.96
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	Breakout 3 of Wittmann Wash Tributary 1	1,832.09

SECTION 7

TABLE 7.2
SUMMARY OF DISCHARGES

Table 7.2 - Summary of Discharges		
Flooding Source	**Cross Section**	**100-Year Discharge (cfs)**
Wash 2 West Tributary 1	9.189	1,062
	8.691	1,140
	7.711	1,175
	7.199	1,232
	6.551	1,306
	5.804	1,366
	5.434	2,166
Wittmann Wash Tributary 1	5.376	1,412
	5.047	1,112
	4.689	1,412
	3.699	1,686
	3.635	1,736
	2.980	1,811
	2.005	1,811
	1.926	1,011
	1.863	1,175
	0.800	675
	0.580	425
Breakout 1 of Wittmann Wash Tributary 1	0.224	250
	0.148	750
Breakout 2 of Wittmann Wash Tributary 1	0.388	500
	0.074	750
Breakout 3 of Wittmann Wash Tributary 1	0.513	800
	0.442	475
	0.185	800
Breakout 4 of Wittmann Wash Tributary 1	0.706	300
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	0.235	325

SECTION 7

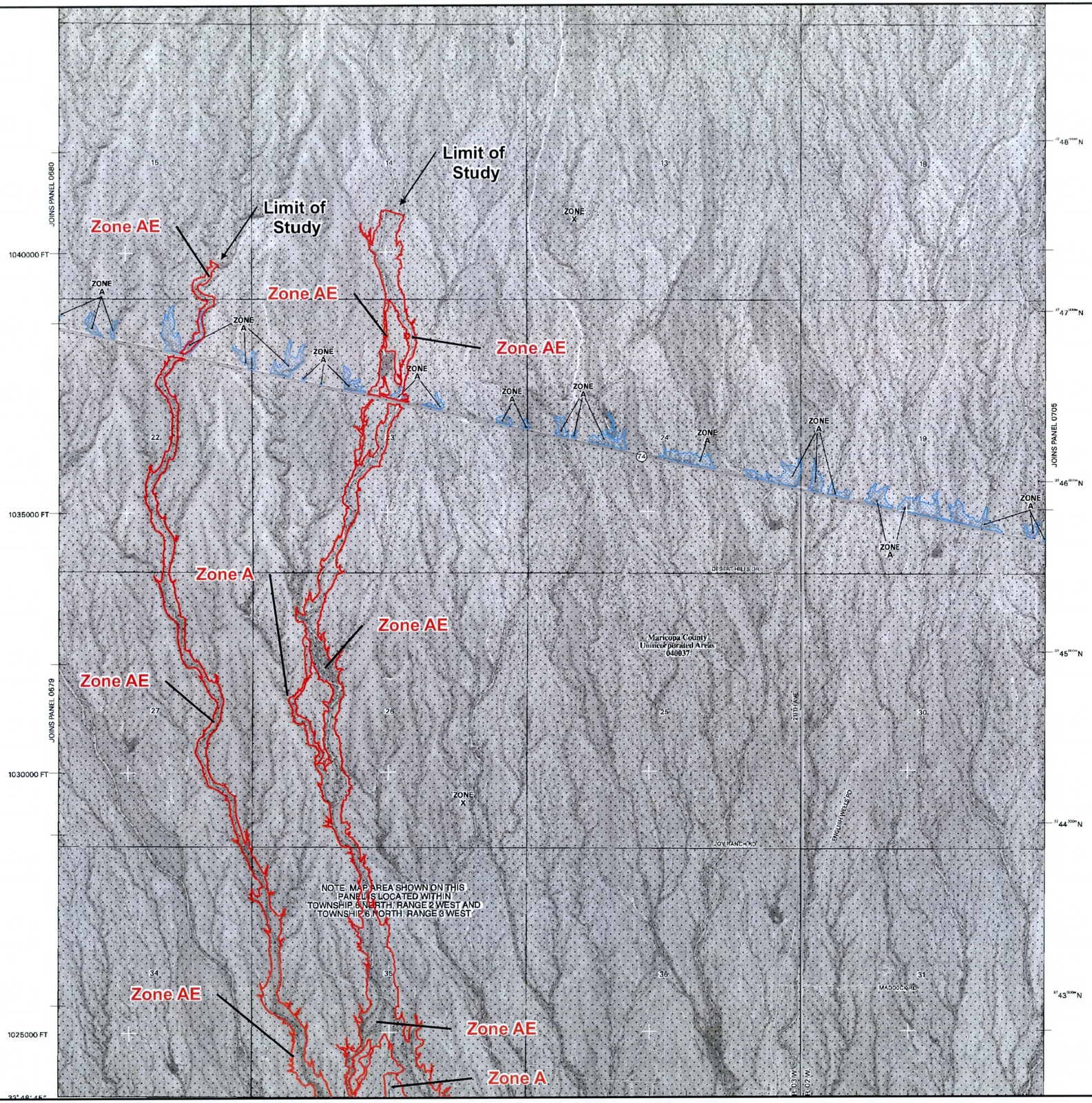
ANNOTATED FIRMS

FIGURE 7.1.1 – PANEL 685G
FIGURE 7.1.2 – PANEL 695H

Wittmann Phase III
Floodplain Delineation Study

Figure 7.1.1
Annotated FIRM Panel 685G

Revised 100-year floodplain determined during the Wittmann Phase III FDS.



N

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0685G

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 685 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0685	G

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

MAP NUMBER
04013C0685G
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced map. This does not reflect the changes or amendments whch may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov.

Wittmann Phase III
Floodplain Delineation Study
Figure 7.1.2
Annotated FIRM Panel 695H

Revised 100-year floodplain determined during the Wittmann Phase III FDS.

100-Year Floodplain determined by Entellus under Contract FCD 2002C029, FEMA Case #07-09-1634P. This dataset to be incorporated in the upcoming Countywide FIRM panel update.

N

1 inch = 2,000 feet

0 1,150 2,300 4,600 Feet

THIS AREA SHOWN AT
A SCALE OF 1" = 500' ON
MAP NUMBER 04013C0694

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0695H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 695 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0695	H

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

MAP NUMBER
04013C0695H
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

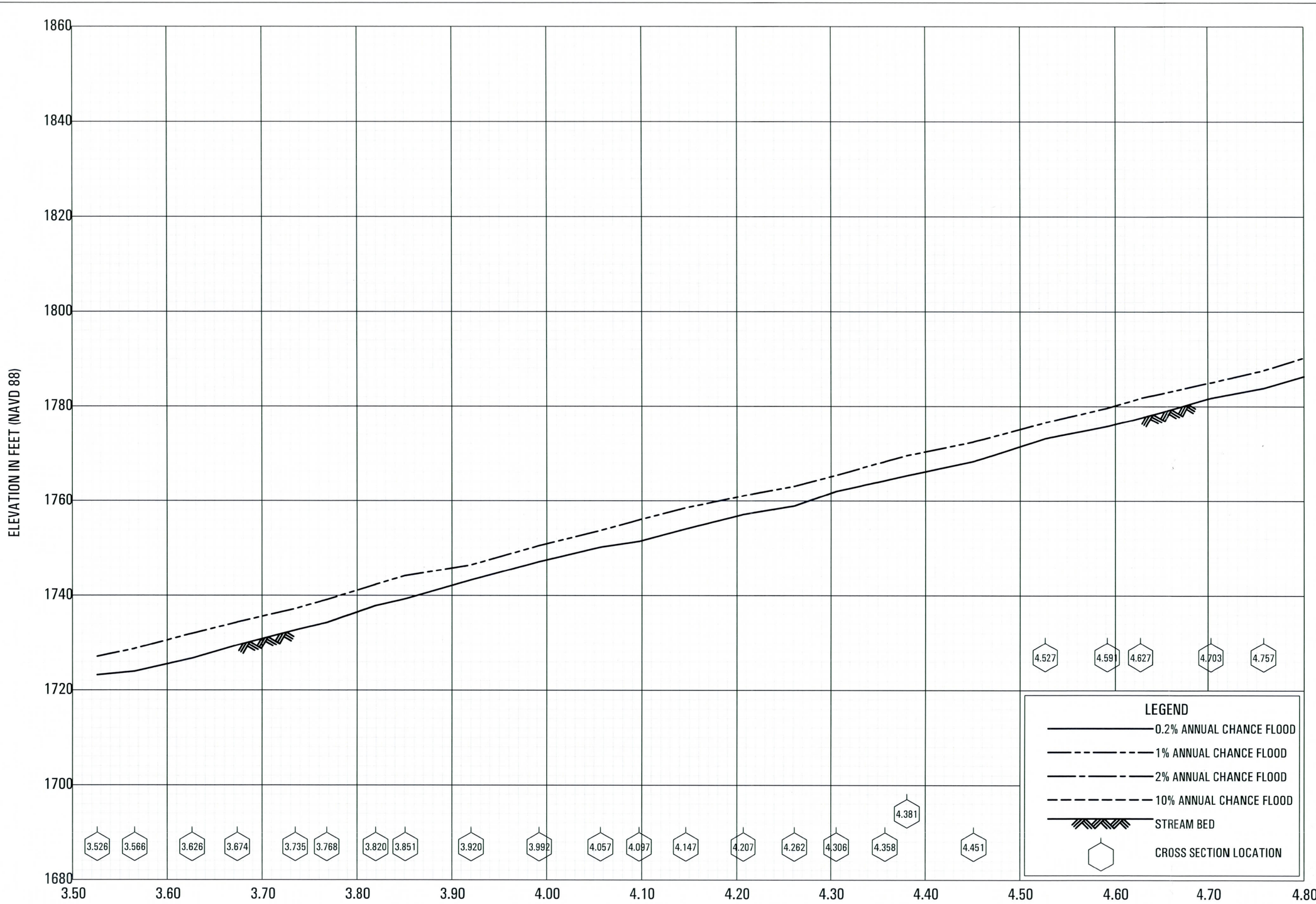
This is an official copy of a portion of the above referenced map. This does not reflect the changes or amendments whch may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov.

SECTION 7

FIGURE 7.2
RASPLOT PROFILES

RASPLOT profiles may be found on the following pages for these washes:

Wash 2 West Tributary 1
Wittmann Wash Tributary 1
Breakout 1 of Wittmann Wash Tributary 1
Breakout 2 of Wittmann Wash Tributary 1
Breakout 3 of Wittmann Wash Tributary 1
Breakout 4 of Wittmann Wash Tributary 1
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1



FLOOD PROFILES

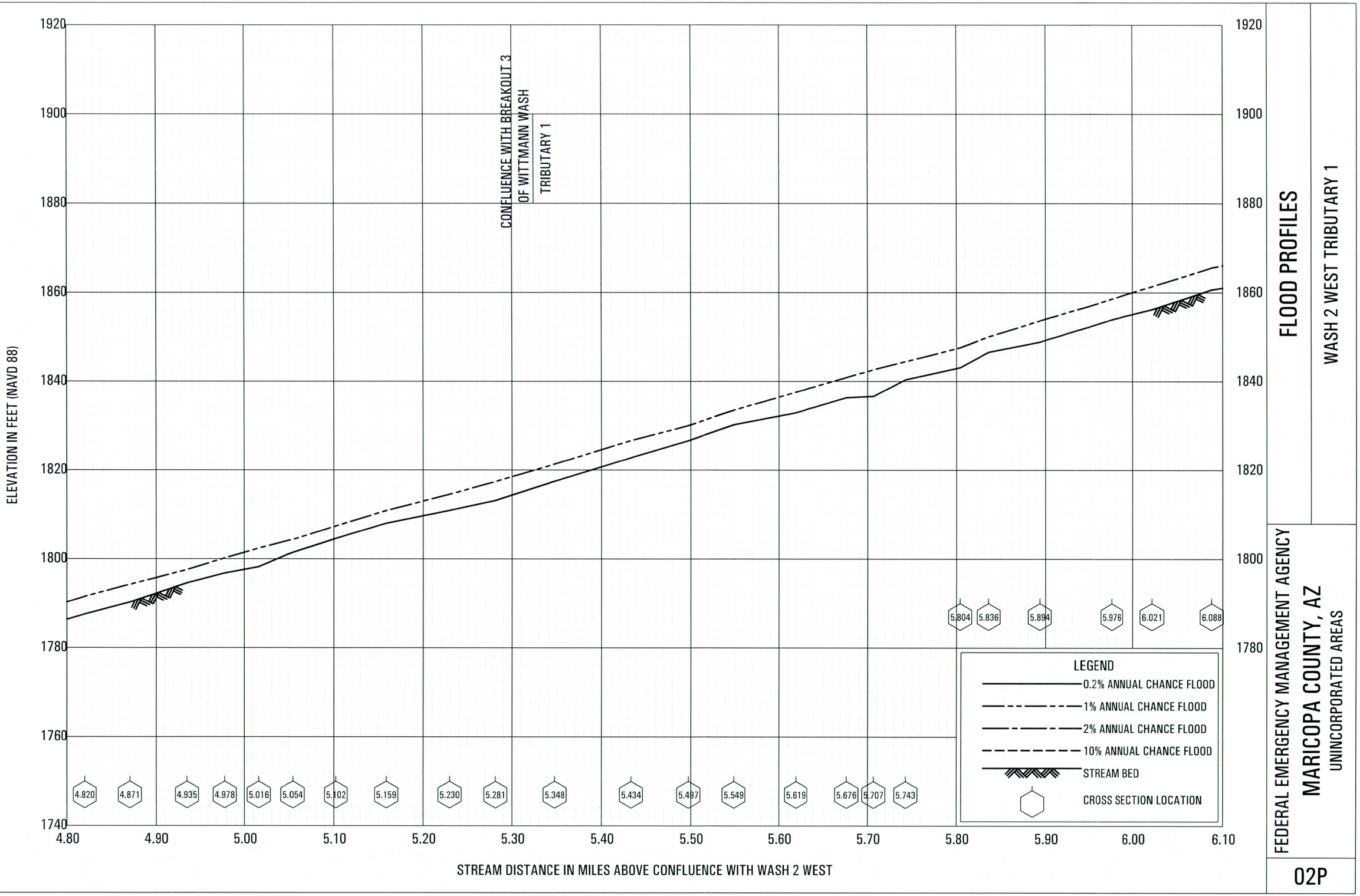
WASH 2 WEST TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P



FLOOD PROFILES

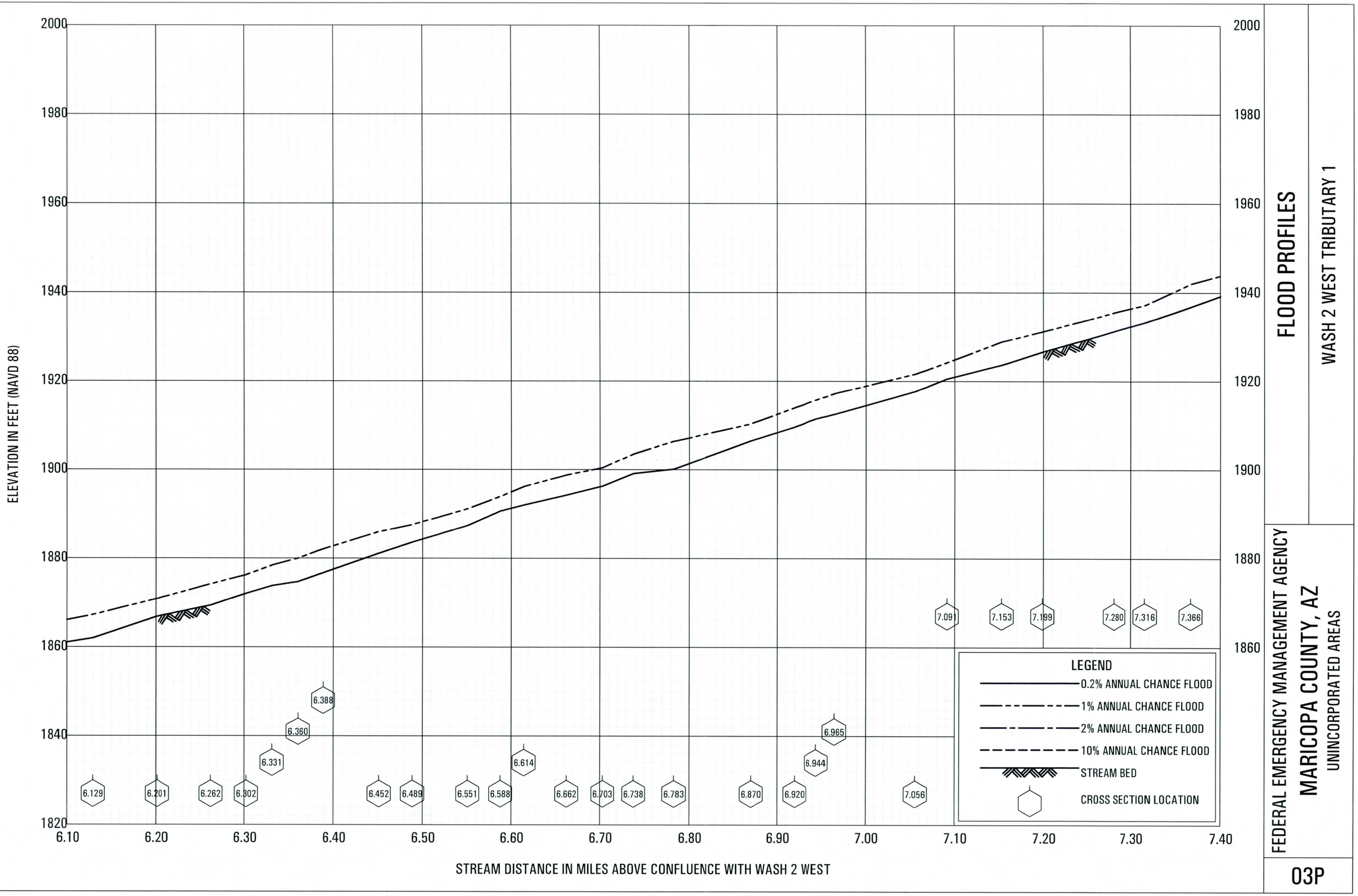
WASH 2 WEST TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

02P



FLOOD PROFILES

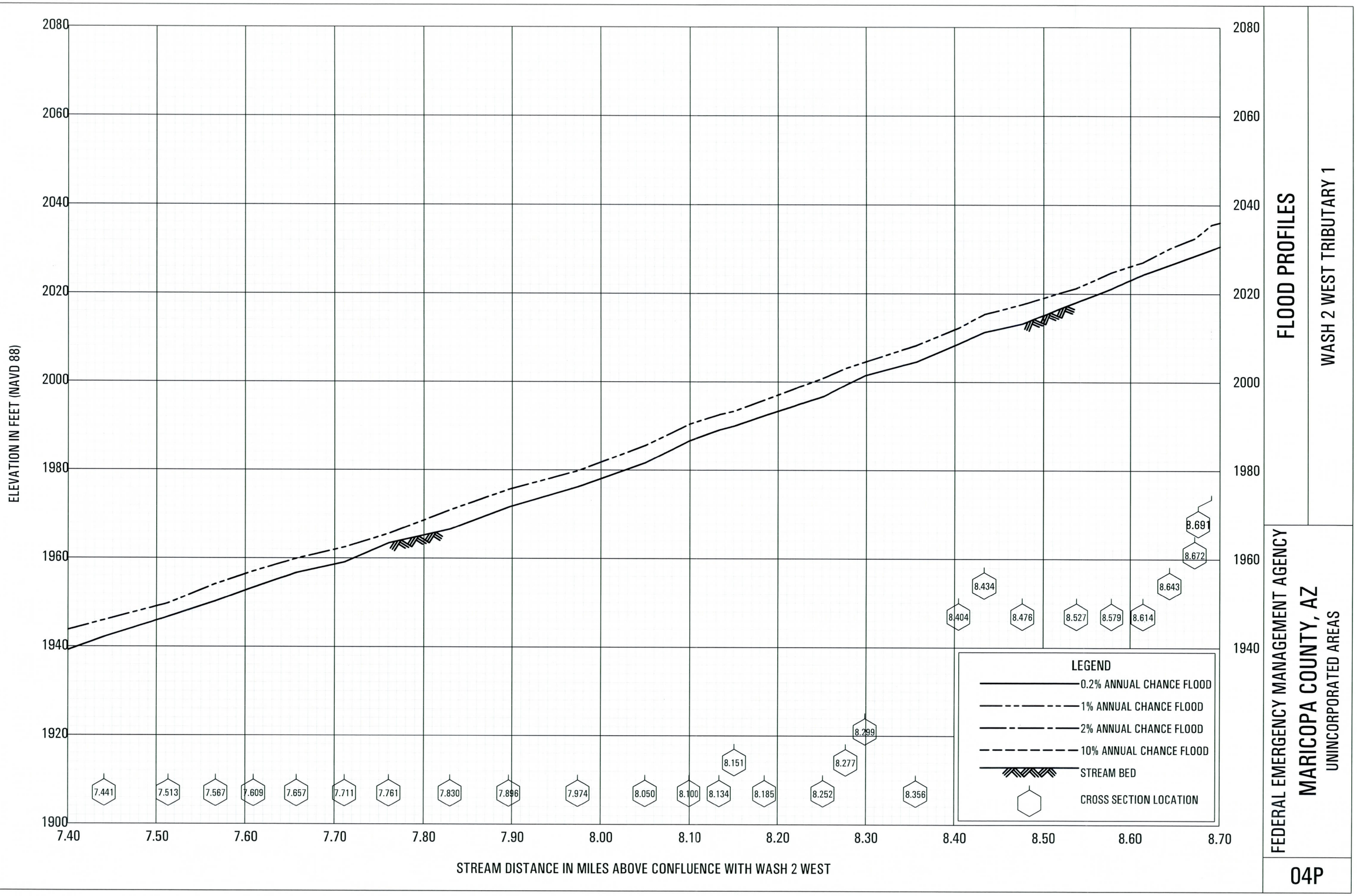
WASH 2 WEST TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

03P



FLOOD PROFILES

WASH 2 WEST TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

04P

FLOOD PROFILES

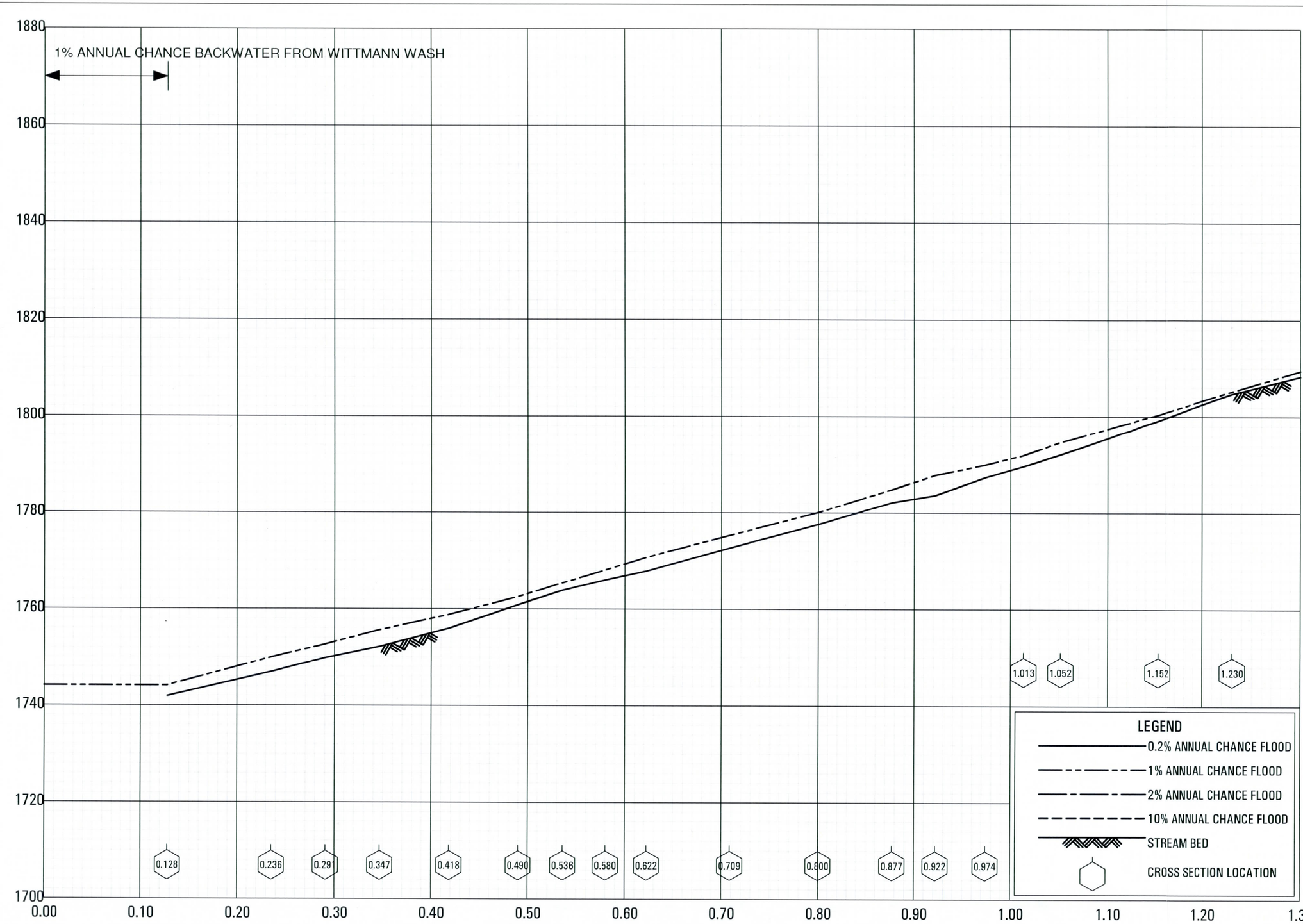
WASH 2 WEST TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

05P



FLOOD PROFILES

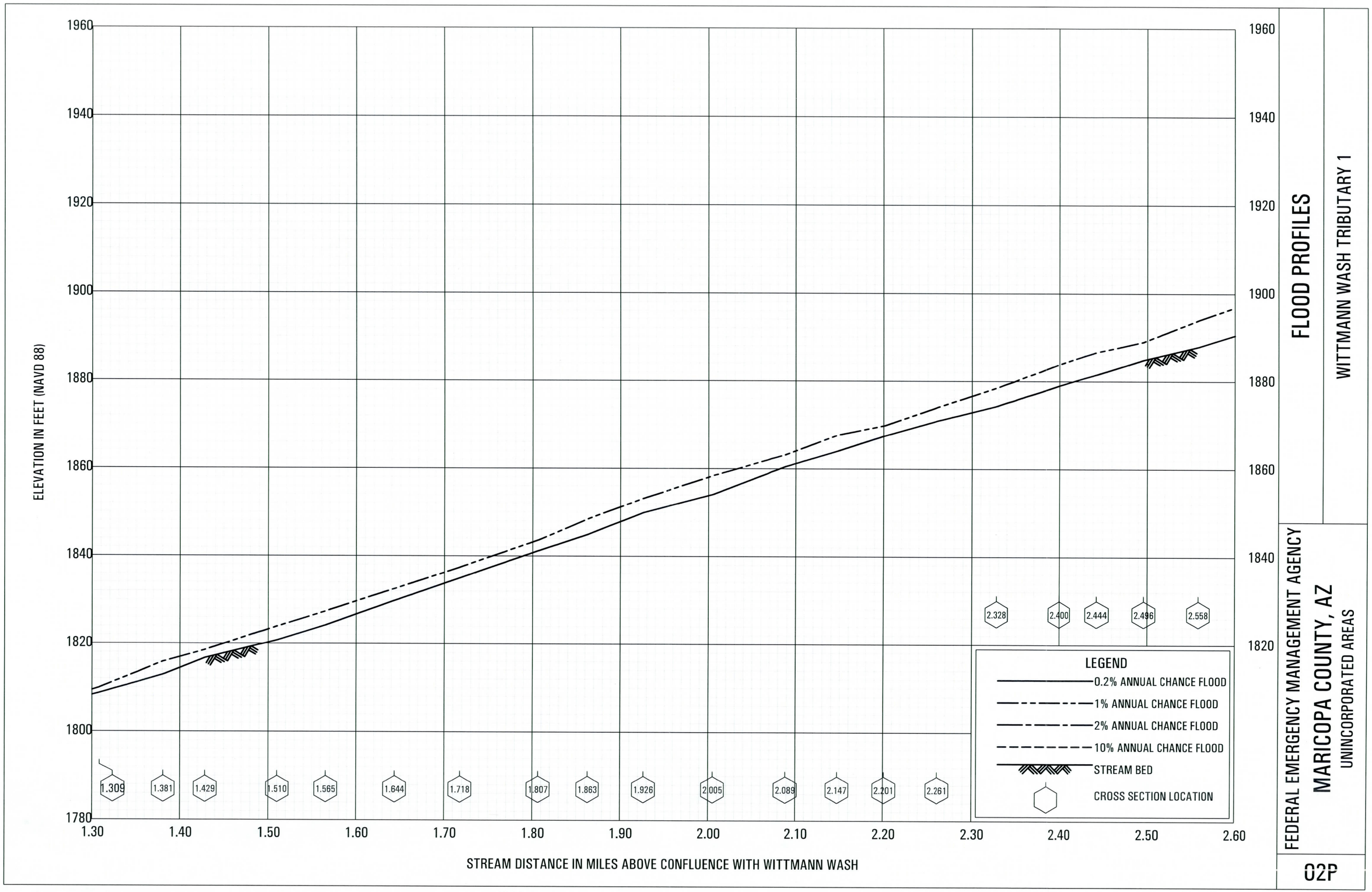
WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P



FLOOD PROFILES

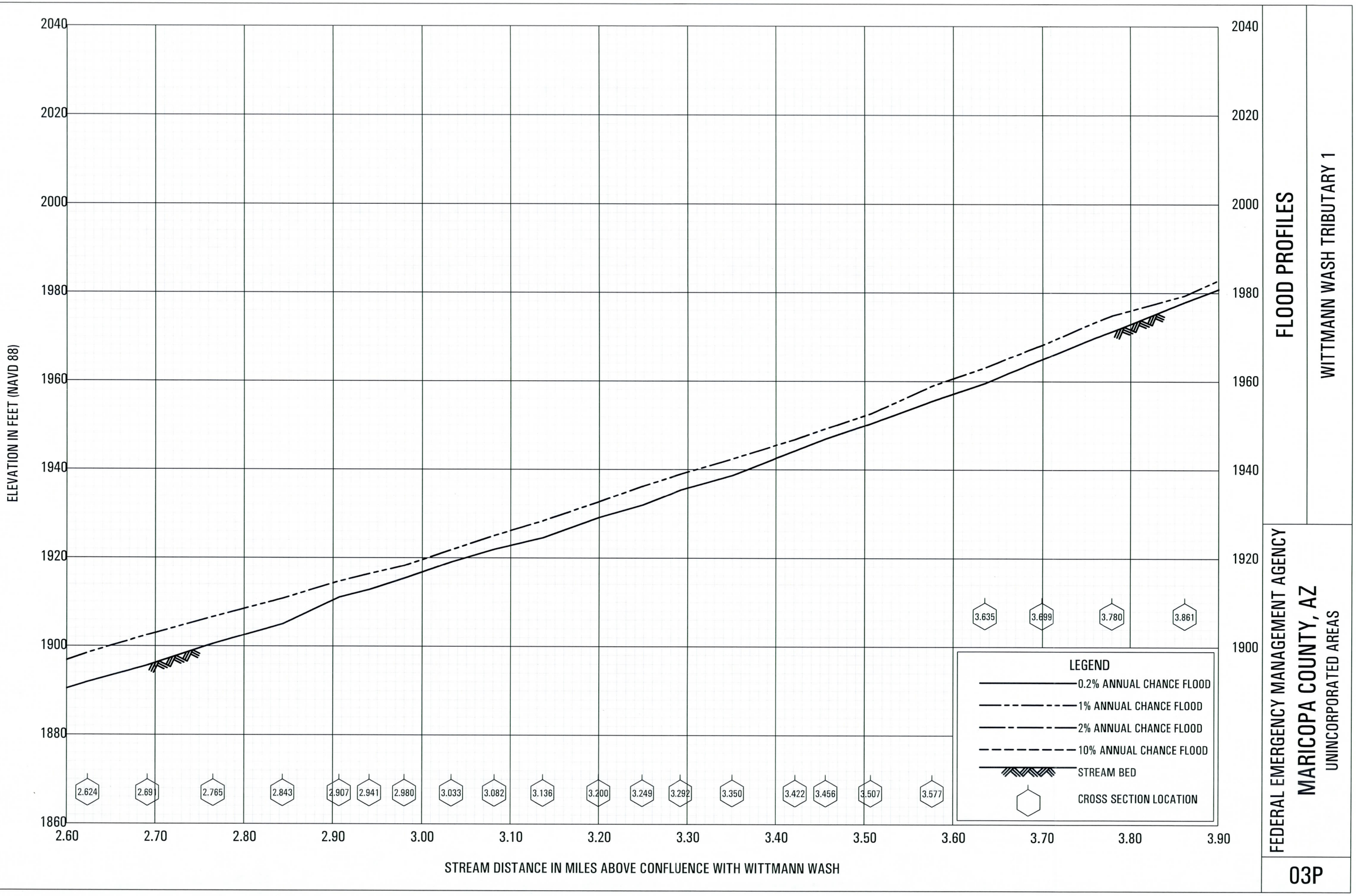
WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

02P



FLOOD PROFILES

WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

03P

FLOOD PROFILES

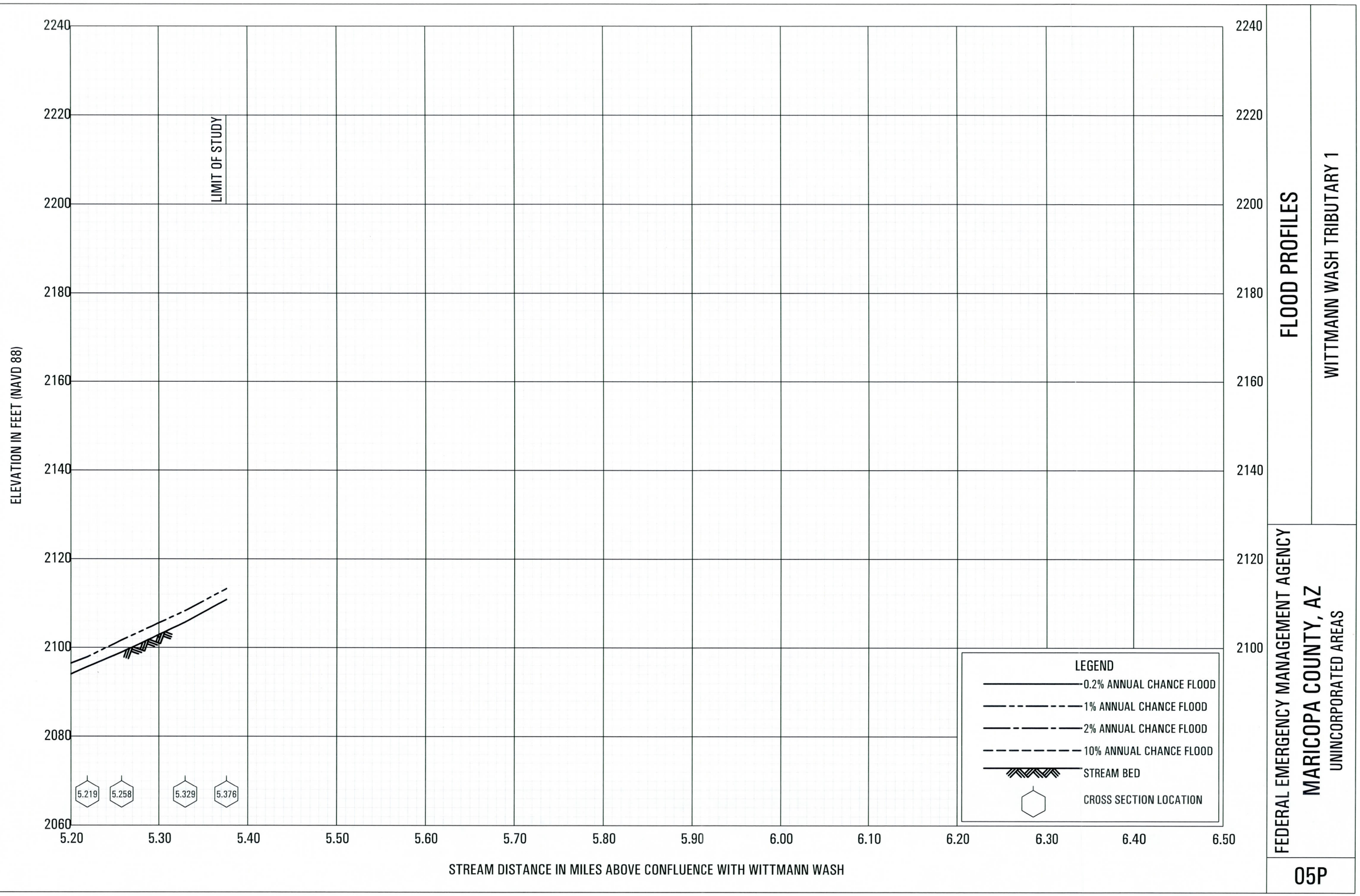
WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

04P



FLOOD PROFILES

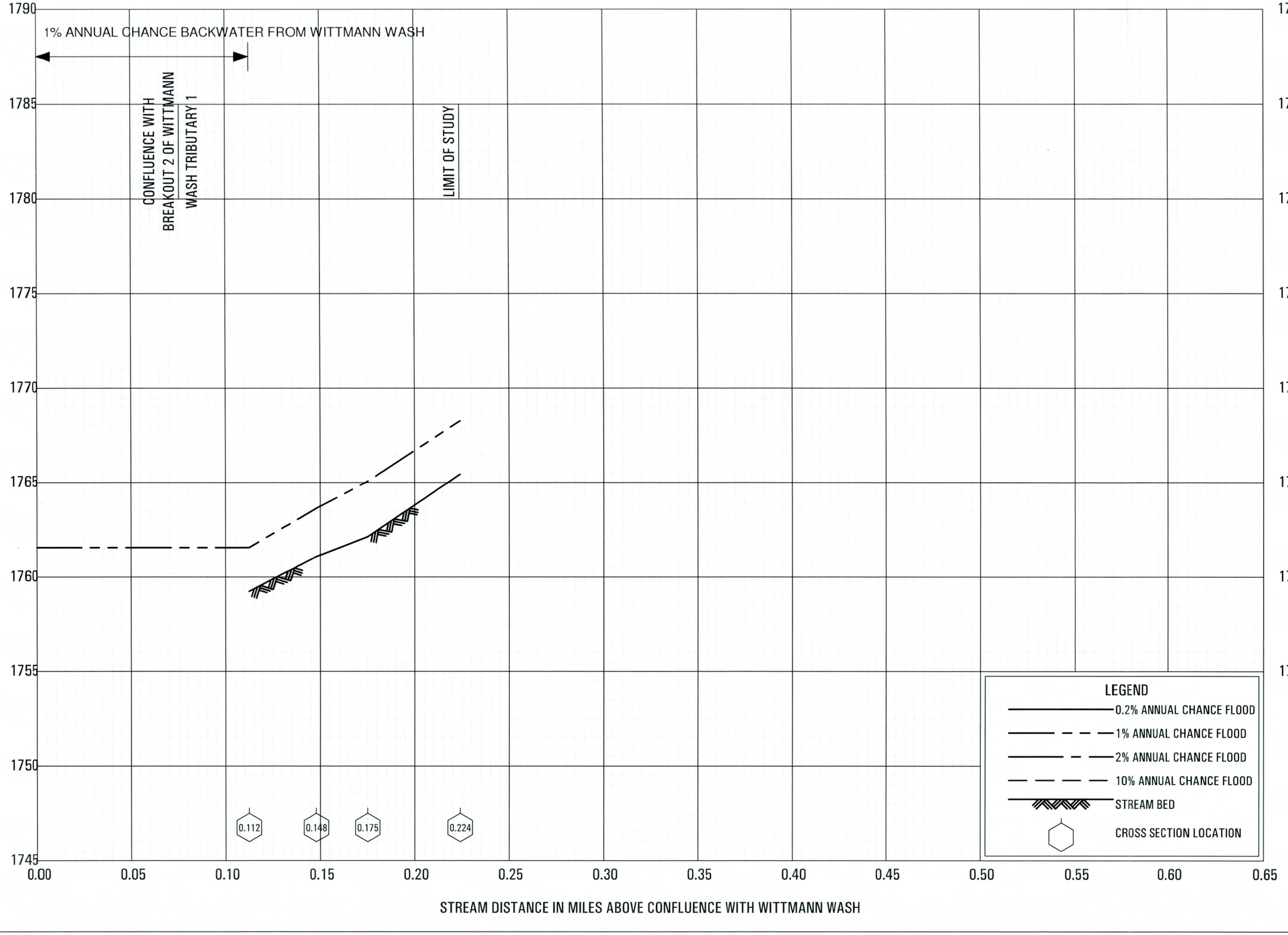
WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

05P



FLOOD PROFILES

BREAKOUT 1 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P

1% ANNUAL CHANCE BACKWATER FROM BREAKOUT 1 OF WITTMANN WASH TRIBUTARY 1

LIMIT OF STUDY

ELEVATION IN FEET (NAVD 88)

1795
1790
1785
1780
1775
1770
1765
1760
1755
1750

0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65

STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH BREAKOUT 1 OF WITTMANN WASH TRIBUTARY 1

0.074 0.168 0.214 0.300 0.388

LEGEND
- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

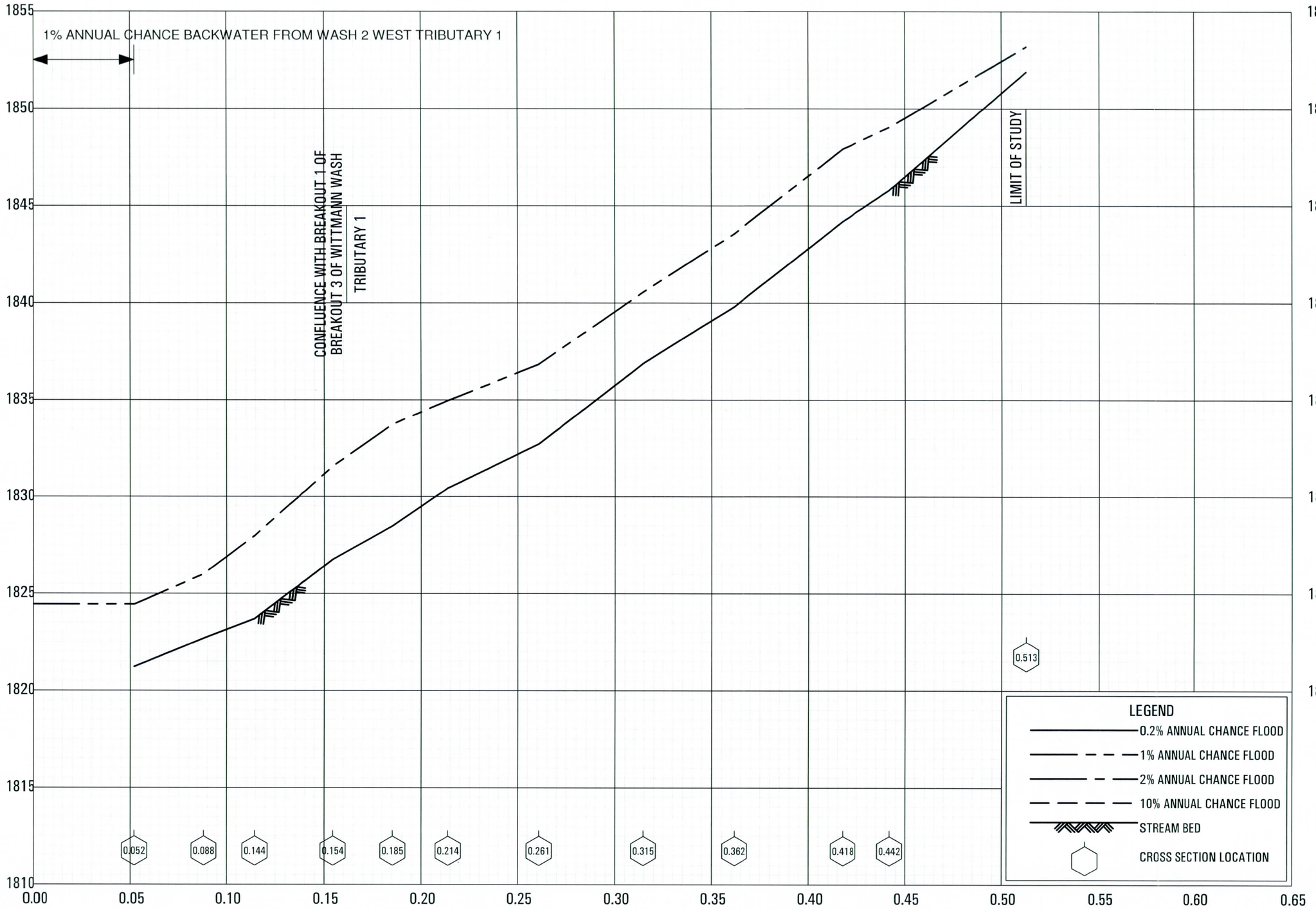
BREAKOUT 2 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P



FLOOD PROFILES

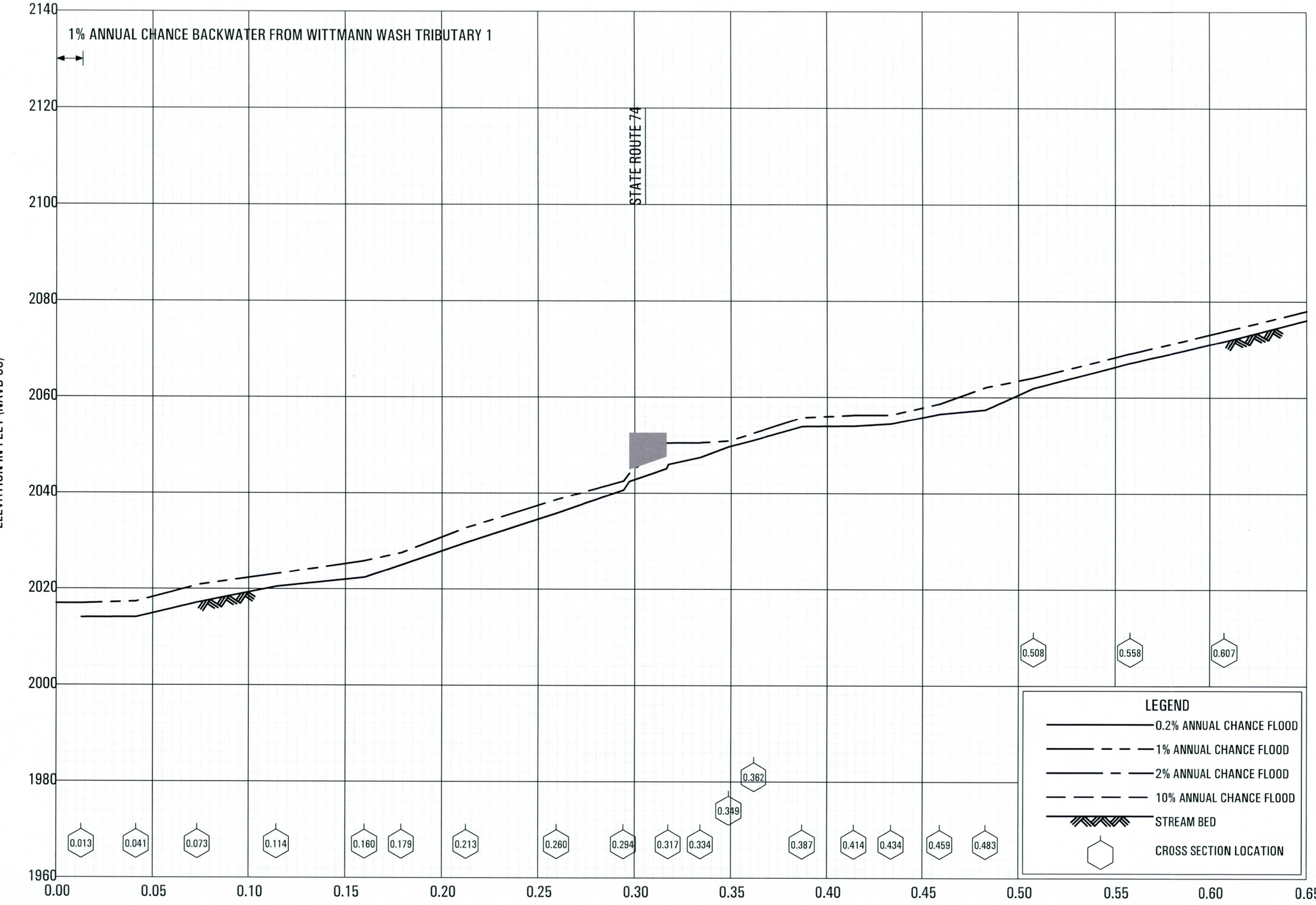
BREAKOUT 3 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P



FLOOD PROFILES

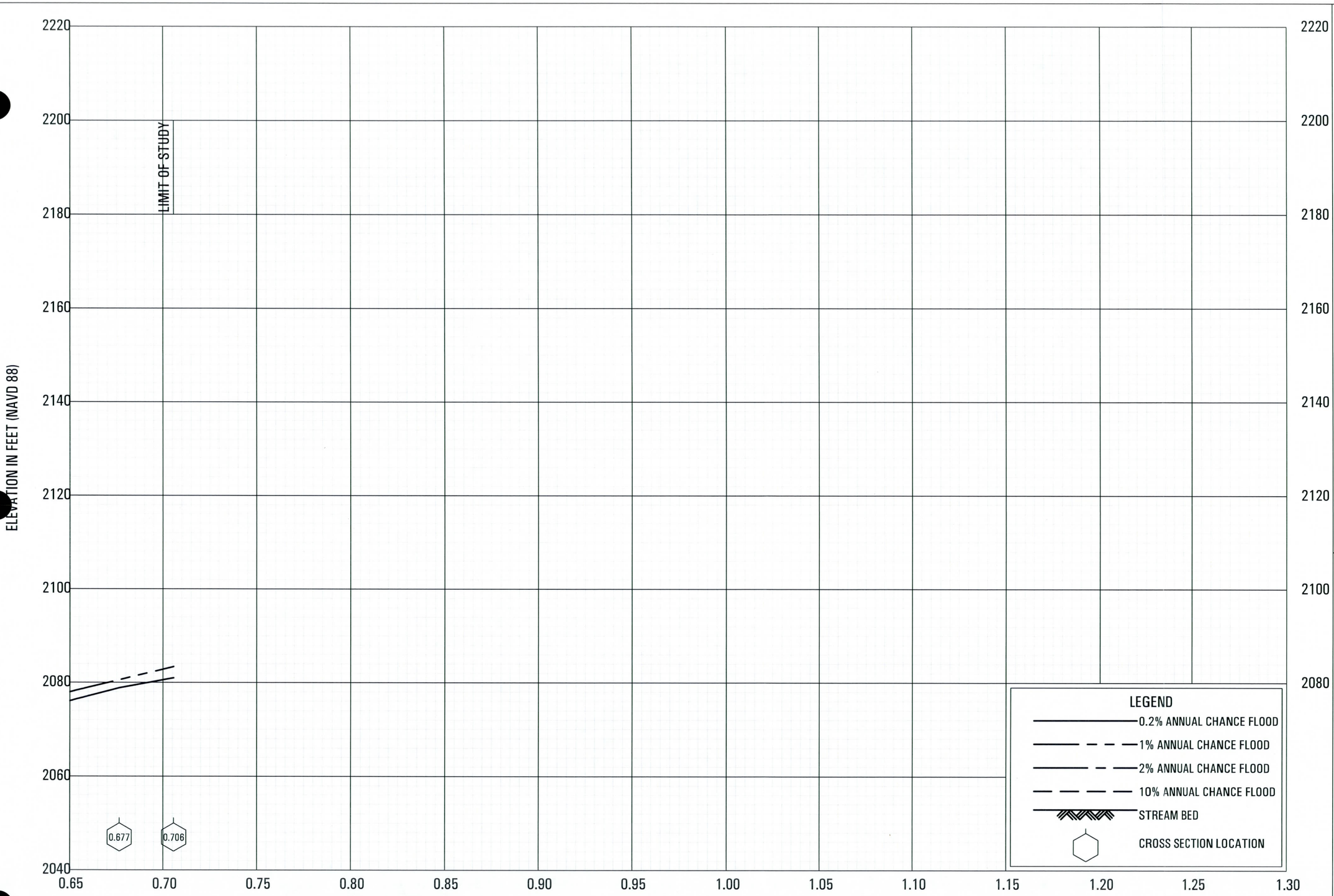
BREAKOUT 4 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P



FLOOD PROFILES

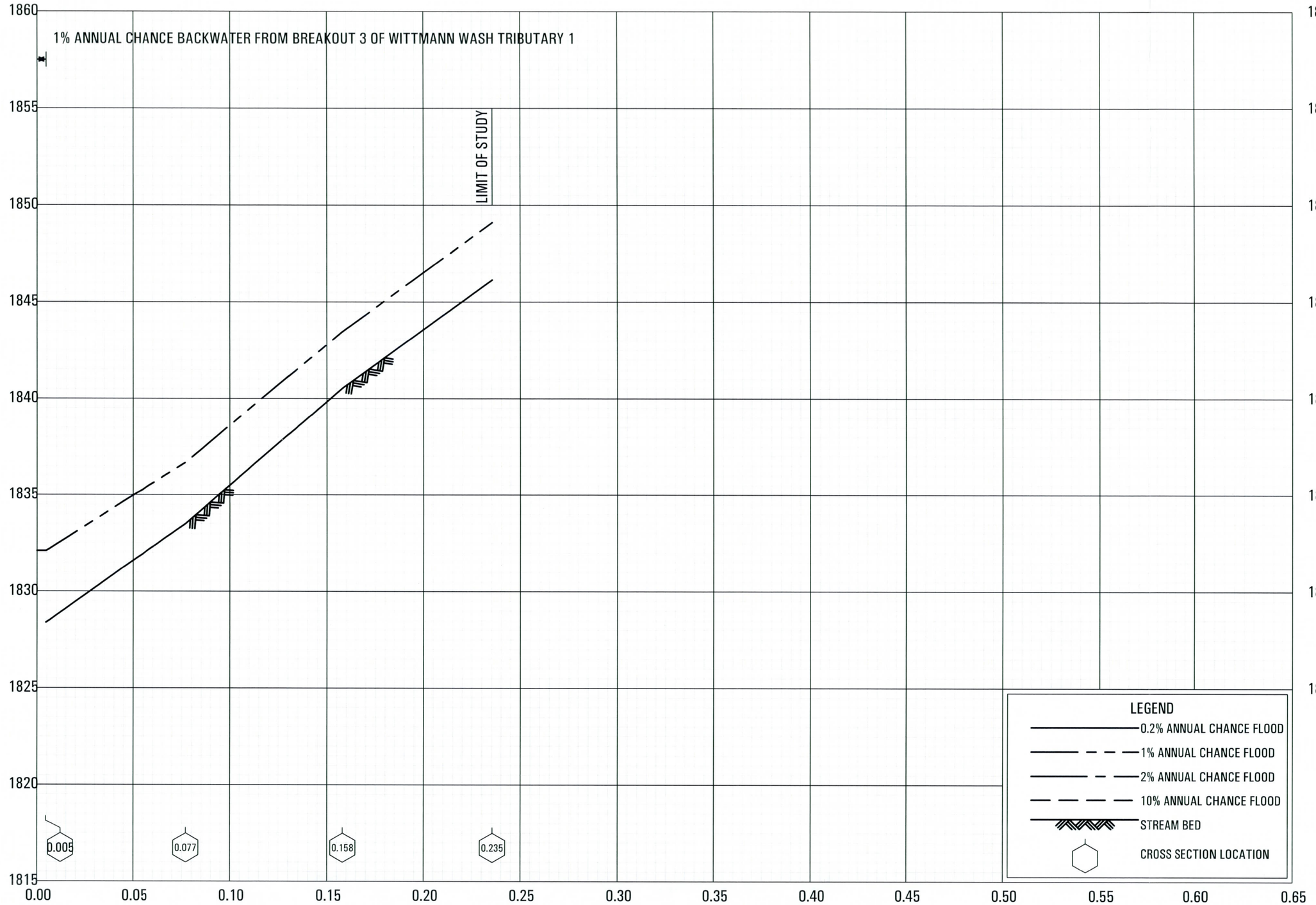
BREAKOUT 4 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

02P



FLOOD PROFILES

BREAKOUT 1 OF BREAKOUT 3 OF WITTMANN WASH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY, AZ

UNINCORPORATED AREAS

01P

SECTION 7

FIGURE 7.3

HYDRAULIC WORK MAPS

11” x 17” COPIES

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III
FLOODPLAIN DELINEATION STUDY
FCD CONTRACT 2009-C006 -- ASSIGNMENT 3
SUBMITTED ON JANUARY 6, 2011

SHEET INDEX

Sheet	Contents
1	Cover Sheet
2-11	100-Year Floodplain Mapping

WASH INDEX

Wash	Sheet(s)
Wash 2 West Tributary 1	2, 4, and 6-10
Wittmann Wash Tributary 1	3 and 5-10
Breakout 1 of Wittmann Wash Tributary 1	9 and 10
Breakout 2 of Wittmann Wash Tributary 1	9 and 10
Breakout 3 of Wittmann Wash Tributary 1	8
Breakout 4 of Wittmann Wash Tributary 1	3 and 5
Breakout 1 of Breakout 3 of Wittmann Wash Tributary 1	8

Notes

1. Horizontal projection is Arizona State Plane Central Zone, High Accuracy Reference Network North American Datum of 1983 (HARN-NAD 83).

2. All elevations based on the North American Vertical Datum of 1988 (NAVD 88).

Data Sources

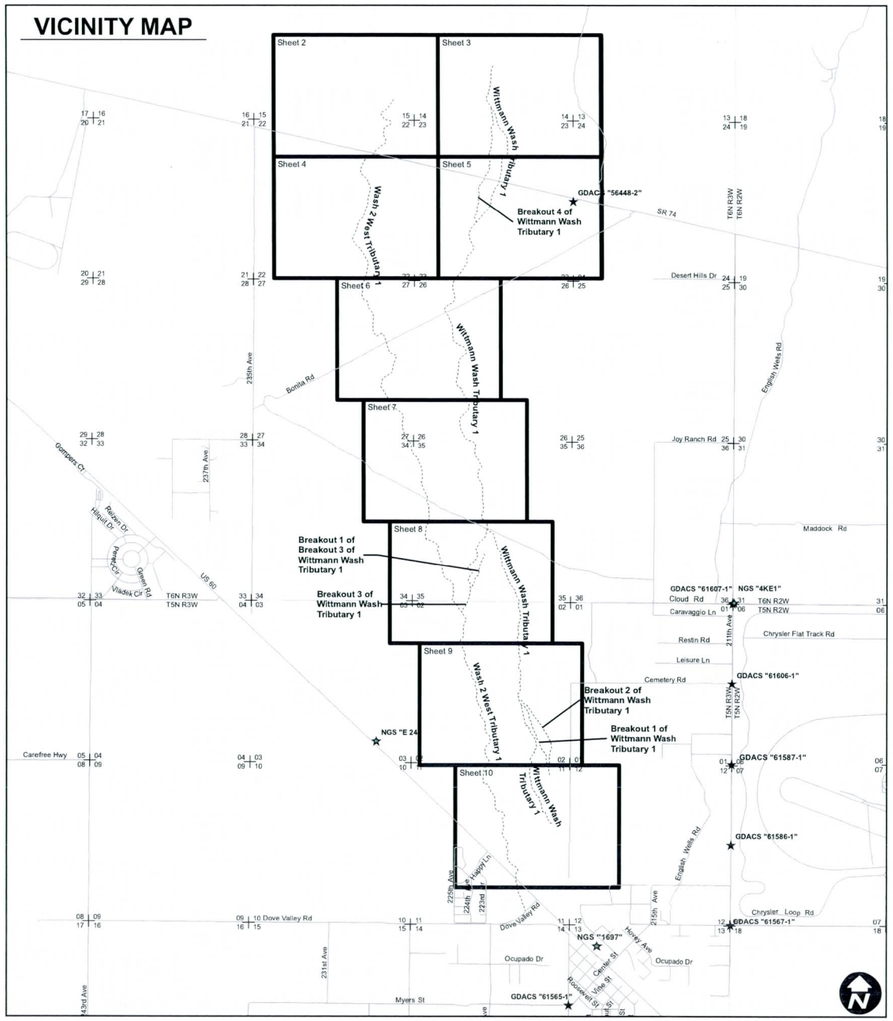
FCDMC provided the following data sources for use in this study:

1. Mass points, breaklines, and two-foot and four-foot contours. Two-foot contours were available south of the Cloud Road alignment and four-foot contours were available north of the Cloud Road alignment. Aerial photogrammetry was flown in April 2002 by Stewart Geo Technologies under FCDMC Contract FCD2001-021. Vertical datum was NAVD 88. Contour interval was two feet or four feet. Mapping scale was 1:100 (inch:foot). Original coordinate system of data was State Plane, Zone 3176, International Feet, GRS 1980.

2. Aerial photography. Flights occurred in September 2008 and October 2009.

3. The report *Wittmann Area Drainage Master Study Update, ADMSU Hydrology, Volumes HY-I, HY-II, HY-III,* and *HY-Addendum* completed by Entellus in October 2004. This report was created under FCDMC Contract FCD2002-C029. This report provided the 100-year flow rates used to complete the hydraulic analysis.

VICINITY MAP



Benchmarks (NAD 83-HARN and NAVD 88)

GDACS Survey Monuments

GDACS monument 56448-2, Elevation 2,021.724 feet
Northing: 1,036,451.884 feet Easting: 512,704.358 feet
3-inch Arizona Highway Department (ADOT) aluminum cap set in concrete raised 0.3 foot and stamped "102.32 OUT STA. 315+48.32 1966".

GDACS monument 61565-1, Elevation 1,679.592 feet
Northing: 1,010,051.531 feet Easting: 512,547.196 feet
2 3/4-inch MCDOT brass cap in handhole 0.7 feet down and stamped "T5N R3W 1/4 S14 S13 1997 LS 28742".

GDACS monument 61567-1, Elevation 1,699.063 feet
Northing: 1,012,668.636 feet Easting 517,839.025
2 3/4-inch MCDOT brass cap in handhole 0.6 feet down and stamped "T5N R3W R2W 12 7 18 13".

GDACS monument 61586-1, Elevation 1,722.597 feet
Northing: 1,015,308.917 feet Easting 517,857.182 feet
2 3/4-inch MCDOT brass cap in handhole 0.6 feet down and stamped "T5N R3W R2W 1/4 12 7 1995".

GDACS monument 61587-1, Elevation 1,756.310 feet
Northing: 1,017,950.077 feet Easting: 517,872.184 feet
2 3/4-inch MCDOT brass cap in handhole 0.6 feet down and stamped "T5N 1 6 7 12 R3W R2W 1995".

GDACS monument 61606-1, Elevation 1,787.539 feet
Northing: 1,020,592.546 feet Easting: 517,888.537 feet
2 3/4-inch MCDOT brass cap in handhole 0.6 feet down and stamped "T5N R3W R2W 1 6 1/4 1995".

GDACS monument 61607-1, Elevation 1,818.543 feet
Northing: 1,023,234.867 feet Easting: 517,904.722 feet
2 3/4-inch MCDOT brass cap in handhole 0.7 feet down and stamped "T6N 36 31 R3W 1 6 R2W T5N 1995".

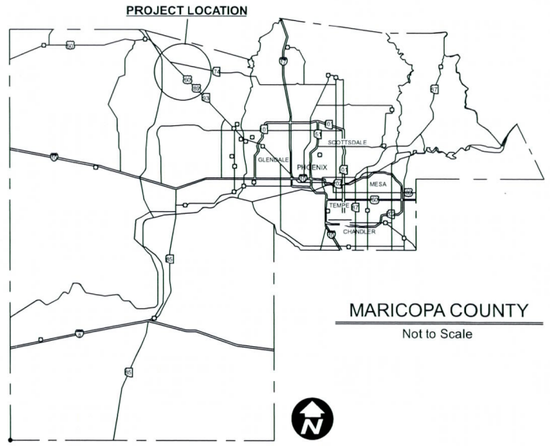
NGS Survey Monuments

NGS monument with Designation 4KE1, Elevation 1,819.40 feet
Northing: 1,023,250.10 feet, Easting: 517,954.25 feet
As described by MCDOT in 2000 by JJR, to reach the station, drive westerly on State Route 74 from Interstate 17 approximately 22 miles to 211th Avenue, then turn left (south) onto 211th Avenue and drive 2.2 miles to the station on the left and 50 feet east of the road. The station is marked by an aluminum cap compressed on a 6.0 foot stainless steel rod driven to refusal, encased in a 1-inch greased PVC sleeve enclosed in a 5-inch PVC pipe with a County logo access cover stamped 4KE1, surrounded with a concrete collar flush with the ground, witnessed by a white carsonite marker.
Station ties: 75 ft north of mile post 2, 6 feet west of a barbed wire fence on the east side of 211th Avenue.

NGS monument with Designation 1697, Elevation 1,697.62
Northing: 1,011,975 feet Easting: 513,484 feet, both +/- 590 feet
As described by National Geodetic Survey from 1939, this station is 7.4 miles southeast from Hot Springs Junction. Proceed 7.4 miles southeast along the Atchison, Topeka, and Santa Fe railway (now BNSF) from Hot Springs Junction to the siding at Wittmann. The station is 450 feet northwest of the station booth, 200 feet northwest of culvert E-158, and 75 feet northeast of the centerline of the track. A United States Geological Survey standard cap, stamped 1697 PHNX, has been riveted to the top of a 3.5-inch iron pipe.

NGS Monument with Designation E24, Elevation 1,783.26
Northing: 1,018,700 feet Easting: 506,168 feet, both +/- 590 feet
As described by National Geodetic Survey from 1939, this station is 5.4 miles southeast from Hot Springs Junction. Proceed 5.4 miles southeast along the Atchison, Topeka, and Santa Fe railway (now BNSF) from Hot Springs Junction, 600 feet northwest of milepost 156, to Culvert G-156. Marker is in the top of the southwest concrete headwall. A standard disk, stamped E 24 1933, may be found here.

PROJECT LOCATION



MARICOPA COUNTY
Not to Scale

Survey Statement

I, Mark A. Luond, an Arizona Registered Land Surveyor, certify that the field surveys, documented herein, along with all field and office process procedures used during the course of this survey, were performed under my direct supervision, and that these surveys are retraceable and repeatable. Further, I certify that the survey report was prepared under my direct supervision and that the coordinate values, as shown in the report, are correct.

Mark A. Luond, RLS
AZ RLS # 39873

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY
FCD CONTRACT 2009-C006
ASSIGNMENT 3

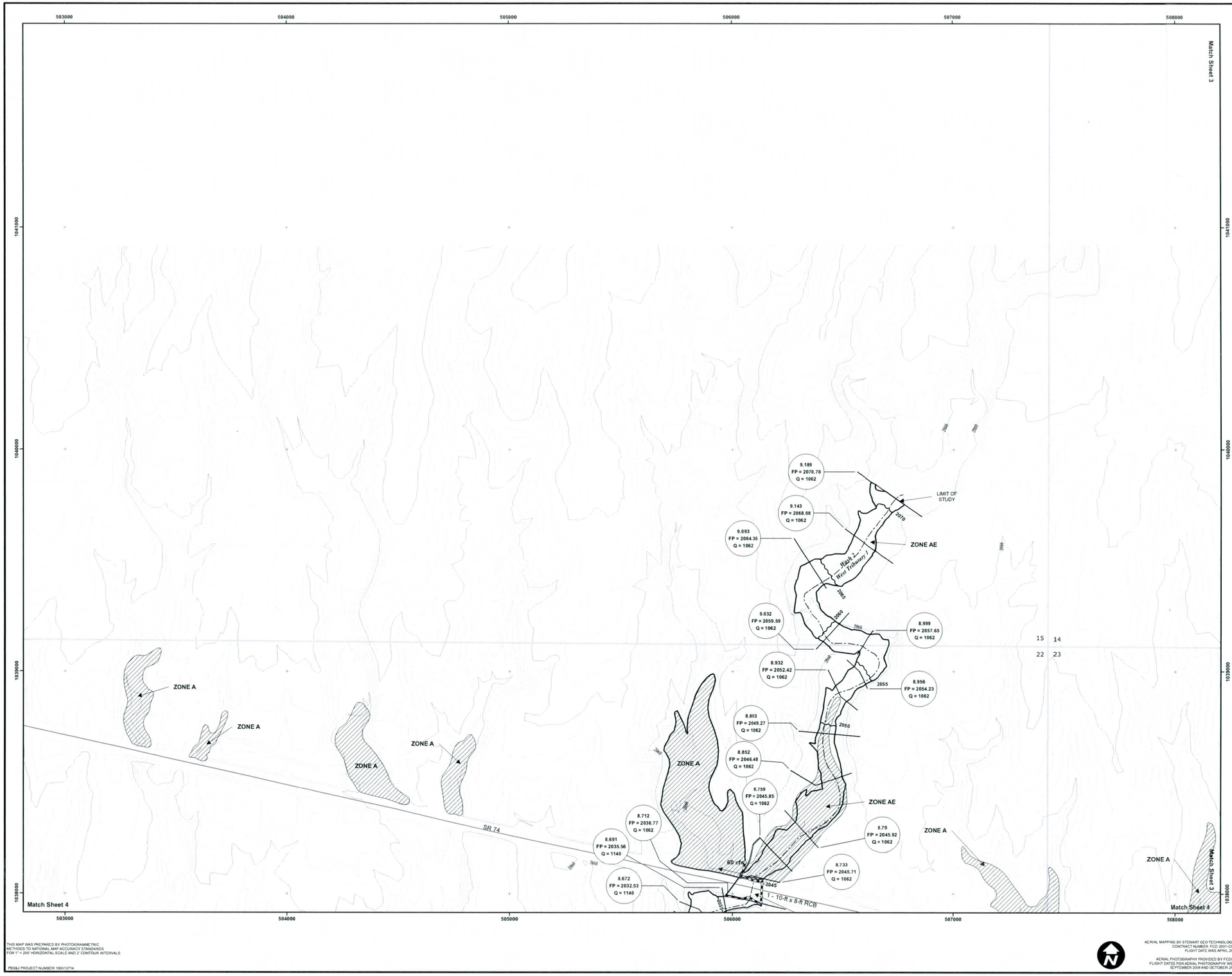
Statement of Professional Registration

The Zone AE floodplain delineation and the approximate 100-year floodplain delineation were prepared under my direct supervision using hydrology produced by others.

20860 North Tatum Boulevard, Suite 300
Phoenix, Arizona 85050
(480) 419-7275

Design	SA	September 2010
Design Check	HD	September 2010
Plans	SA	September 2010
Plan Check	HD	September 2010

PBS&J Project Number 100013714

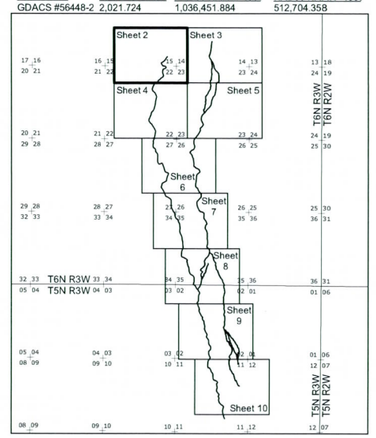


Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
- 2320 — Base Flood Elevation Line
- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
- Effective FEMA Floodplain Mapping
- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
- 2320 — Index Contour
- Intermediate Contour

Benchmark Information: See Cover Sheet for list of benchmarks in vicinity of study area as well as their locations. Benchmarks are either GDACS Survey Monuments (GDACS #) or NGS Survey Monuments (NGS #). Only GDACS #56448-2 falls within the work map sheet boundaries. See Sheet 5.

Point Name	Elevation NAVD 88 - Feet	Northing NAD83 HARN - feet	Easting NAD83 HARN - feet
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



CONTOUR INTERVAL = FOUR FEET ON SHEETS 2 THROUGH 7 AND NORTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8.
CONTOUR INTERVAL = TWO FEET SOUTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8 AND ON SHEETS 9 AND 10.

CONTOURS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
NAVD 88 VALUES MINUS NGVD 29 VALUES EQUAL 2.06 FEET.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
ASSIGNMENT 3

The Engineer's seal on this map applies to the hydraulic modeling and associated floodplain mapping completed for this FDS. Please refer to the cover sheet for the Land Surveyor's seal for the ground survey data acquired for this FDS. Please refer to Appendix D for the Engineer's seal for the hydrologic modeling completed for this FDS.

PBS&J
20860 North Tatum Boulevard, Suite 300
Phoenix, Arizona 85050
(480) 419-7275

Design	SA	September 2010
Design Check	HD	September 2010
Plans	SA	September 2010
Plan Check	HD	September 2010

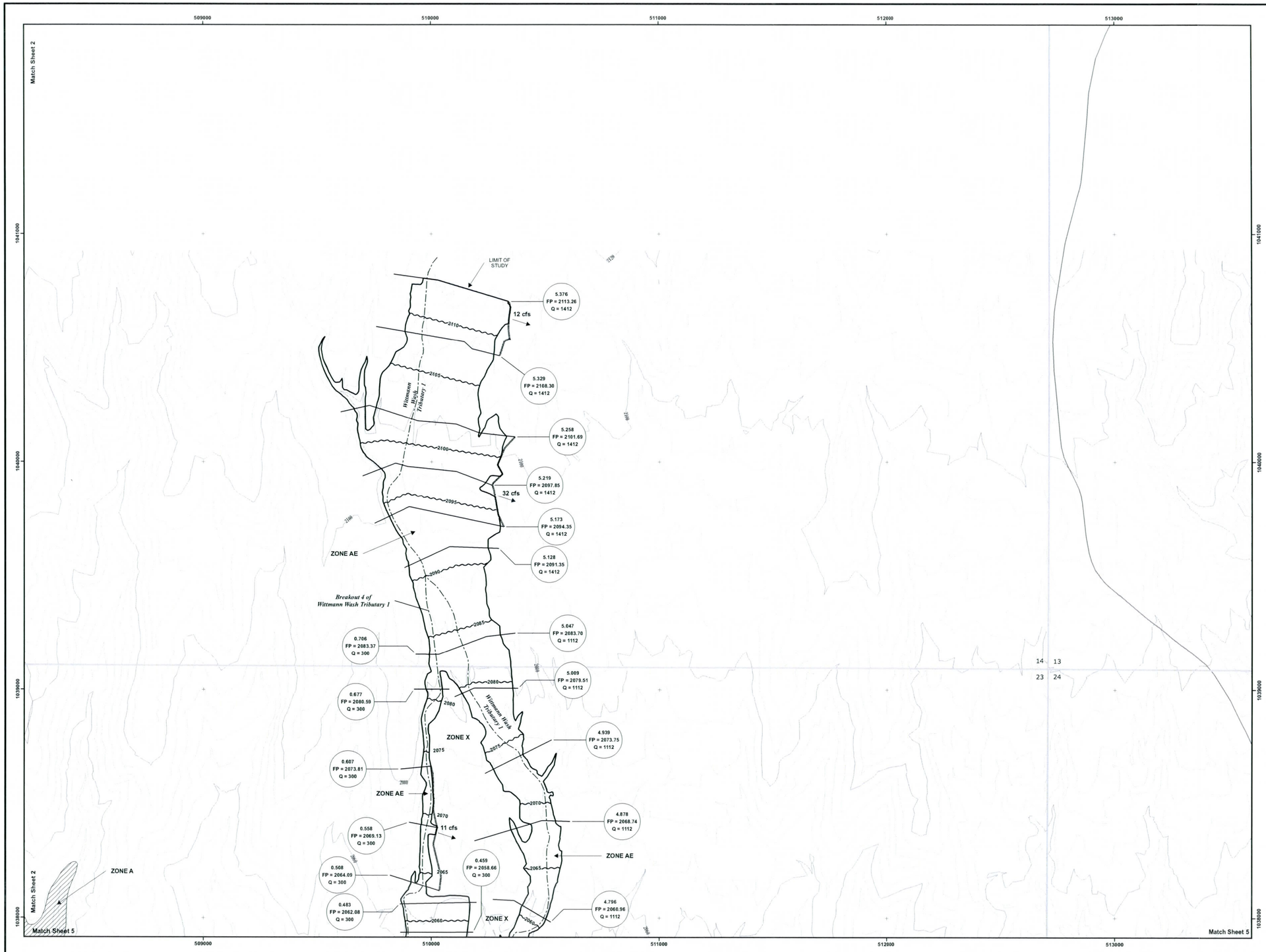
Sheet 2 of 10

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS.

PBS&J PROJECT NUMBER 100013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES CONTRACT NUMBER: FCD 2001-C022.1 FLIGHT DATE WAS APRIL 2002.

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2008.



THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS

PBS&J PROJECT NUMBER 130013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES
CONTRACT NUMBER: FCD 2001-C021
FLIGHT DATE WAS APRIL 2002

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC
FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009

Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
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- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
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- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
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- Intermediate Contour

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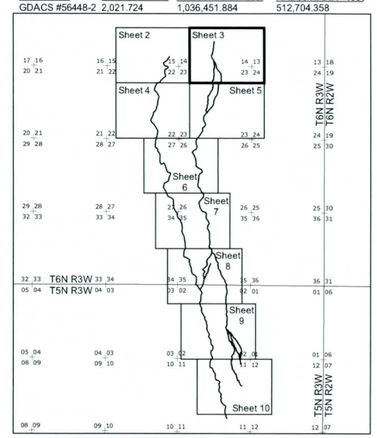
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
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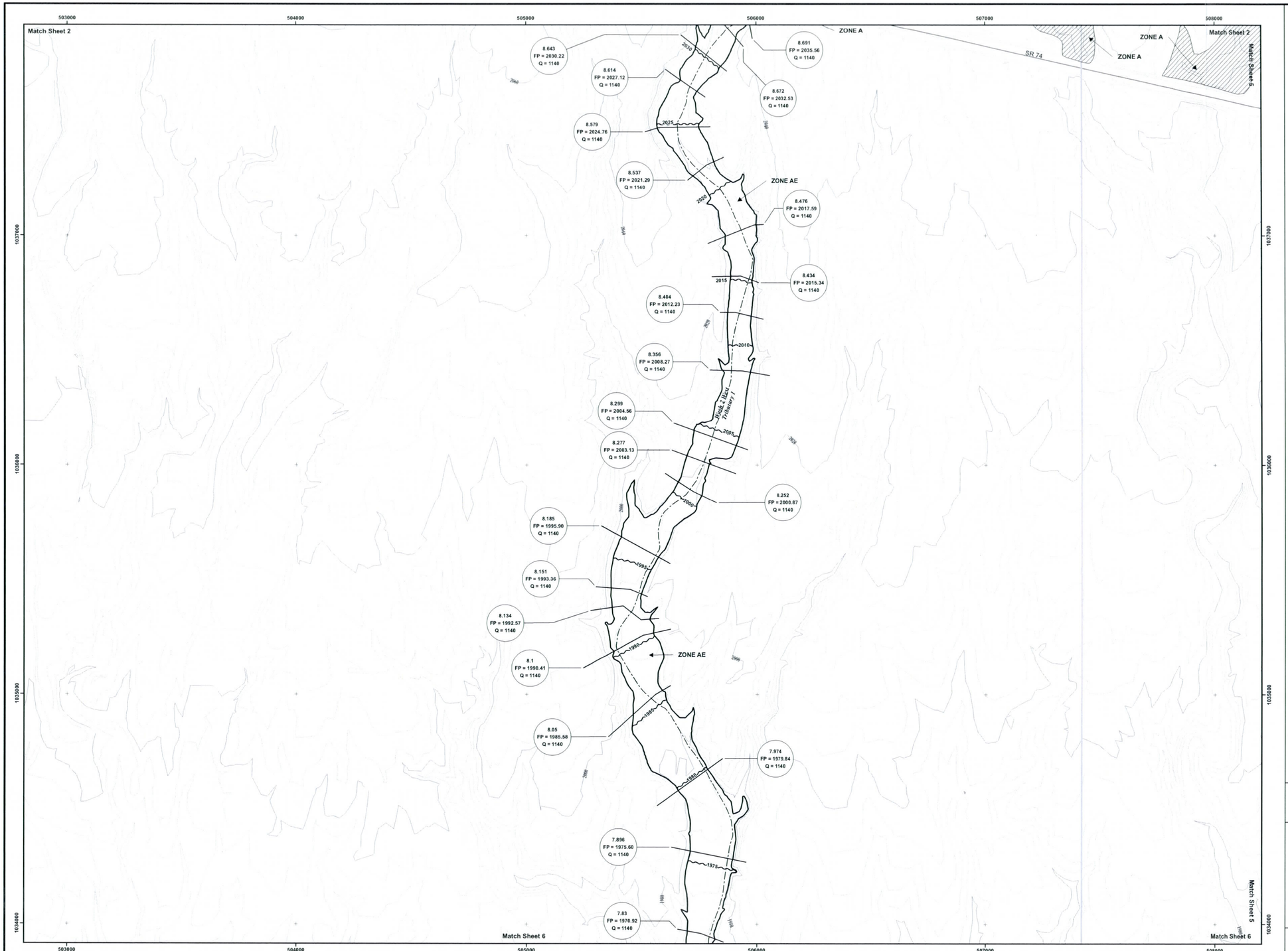
47097 SETH AHRENS — Registered Professional Engineer — State of Arizona — Expires 12-31-2010

PBS&J
20860 North Tatum Boulevard, Suite 300
Phoenix, Arizona 85050
(480) 419-7275

Design	SA	September 2010
Design Check	HD	September 2010
Plans	SA	September 2010
Plan Check	HD	September 2010



THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS.

PBS&J PROJECT NUMBER 100013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES
CONTRACT NUMBER: FCD 2001-C021
FLIGHT DATE WAS APRIL 2002

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC.
FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009

Legend

- Benchmark (Type + Point Name)
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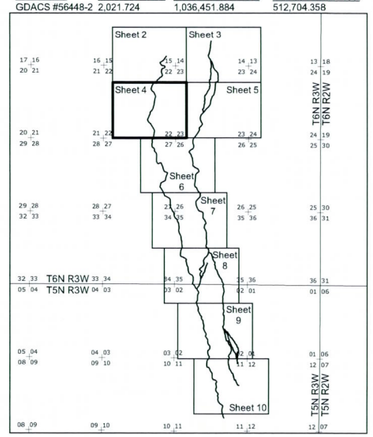

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
ASSIGNMENT 3

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47097 SETH AHRENS Registered Professional Engineer ARIZONA U.S.A. Expires 12-31-2010

PBS&J
20860 North Tatum Boulevard, Suite 300
Phoenix, Arizona 85050
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Design	SA	September 2010
Design Check	HD	September 2010
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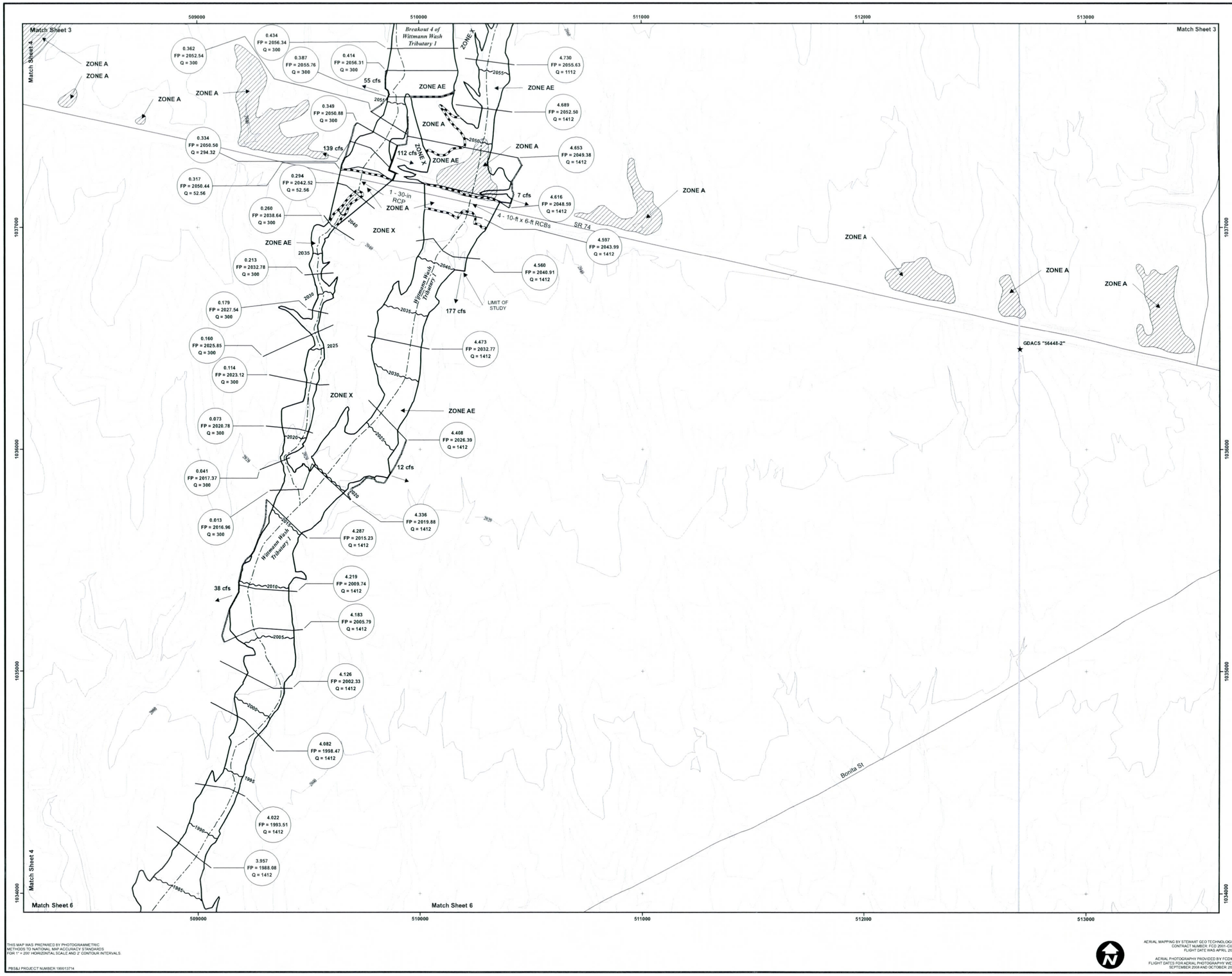

Legend

- Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
- 2320 — Base Flood Elevation Line
- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
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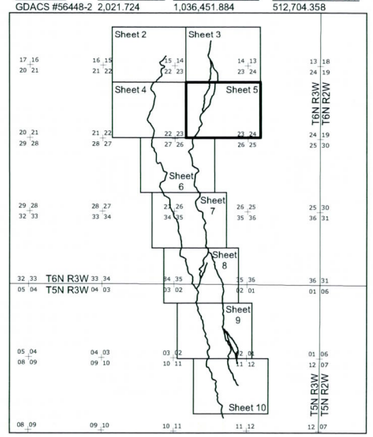
- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
- 2320 — Index Contour
- Intermediate Contour

Benchmark Information: See Cover Sheet for list of benchmarks in vicinity of study area as well as their locations. Benchmarks are either GDACS Survey Monuments (GDACS #) or NGS Survey Monuments (NGS #). Only GDACS #56448-2 falls within the work map sheet boundaries. See Sheet 5.

Point Name	Elevation NAVD 88 - Feet	Northing NAD83 HARN - feet	Easting NAD83 HARN - feet
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



CONTOUR INTERVAL = FOUR FEET ON SHEETS 2 THROUGH 7 AND NORTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8.
CONTOUR INTERVAL = TWO FEET SOUTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8 AND ON SHEETS 9 AND 10.

CONTOURS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
NAVD 88 VALUES MINUS NGVD 29 VALUES EQUAL 2.06 FEET.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
ASSIGNMENT 3

The Engineer's seal on this map applies to the hydraulic modeling and associated floodplain mapping completed for this FDS. Please refer to the cover sheet for the Land Surveyor's seal for the ground survey data acquired for this FDS. Please refer to Appendix D for the Engineer's seal for the hydrologic modeling completed for this FDS.

Registered Professional Engineer — 47097 — SETH AHRENS — ARIZONA U.S. — Expires 12-31-2010

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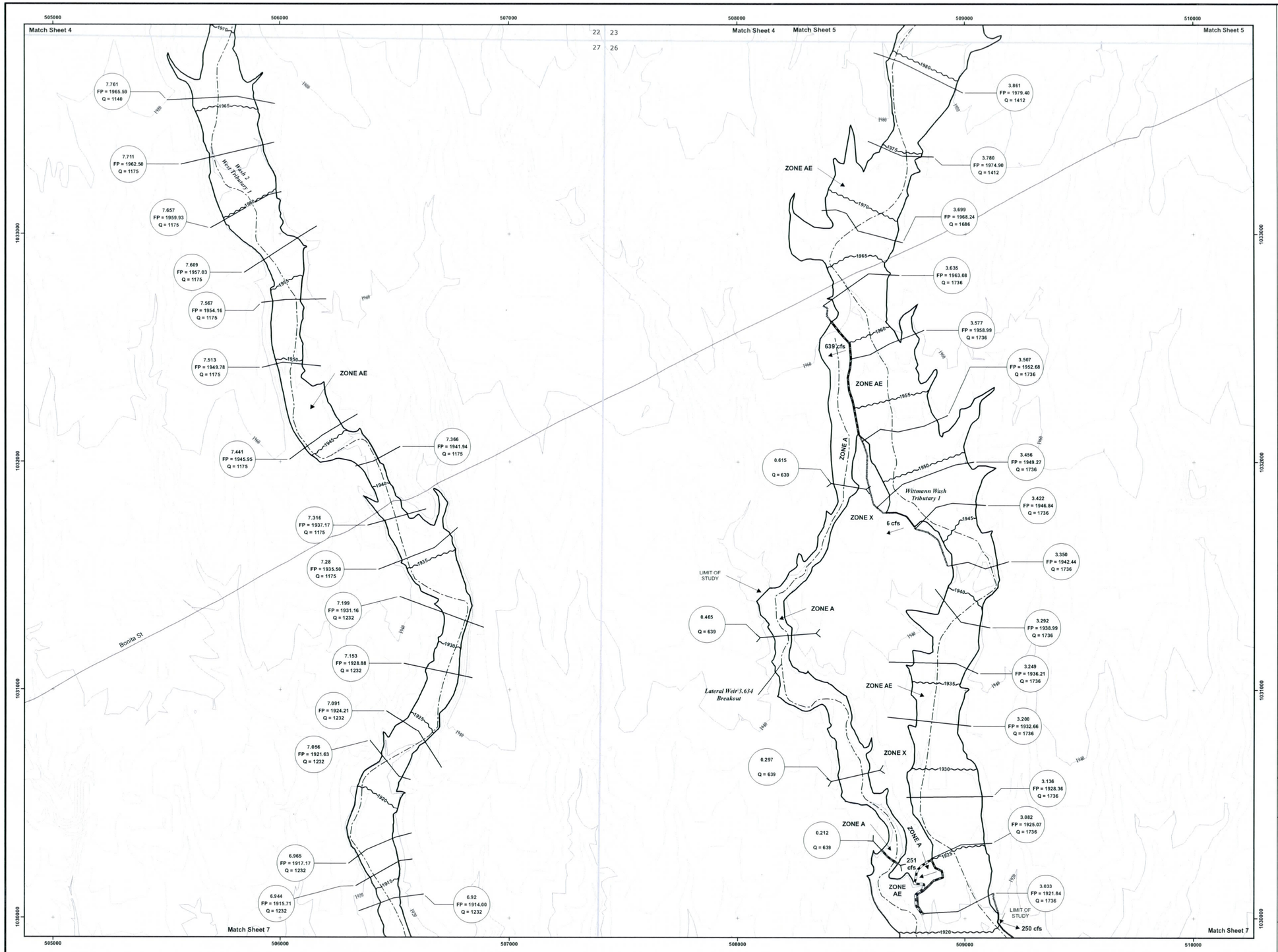
Design	SA	September 2010
Design Check	HD	September 2010
Plans	SA	September 2010
Plan Check	HD	September 2010

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS.

PBS&J PROJECT NUMBER 19013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES CONTRACT NUMBER: FCD 2001-C021 FLIGHT DATE WAS APRIL 2002

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC. FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009



Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
- 2320 — Base Flood Elevation Line
- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
- Effective FEMA Floodplain Mapping
- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
- 2320 — Index Contour
- Intermediate Contour

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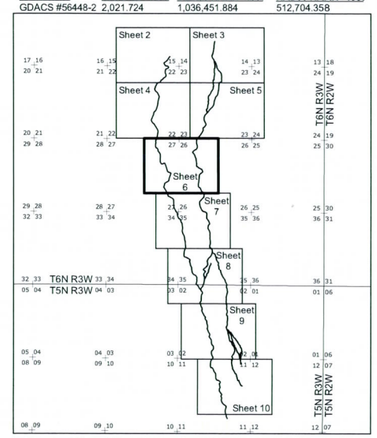
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



CONTOUR INTERVAL = FOUR FEET ON SHEETS 2 THROUGH 7 AND NORTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8.
CONTOUR INTERVAL = TWO FEET SOUTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8 AND ON SHEETS 9 AND 10.

CONTOURS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
NAVD 88 VALUES MINUS NGVD 29 VALUES EQUAL 2.06 FEET.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
ASSIGNMENT 3

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Design	SA	September 2010
Design Check	HD	September 2010
Plans	SA	September 2010
Plan Check	HD	September 2010

Sheet 6 of 10

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS.

PBS&J PROJECT NUMBER 100613714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES
CONTRACT NUMBER: FCD 2001-C021
FLIGHT DATE WAS APRIL 2002.

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC.
FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009.

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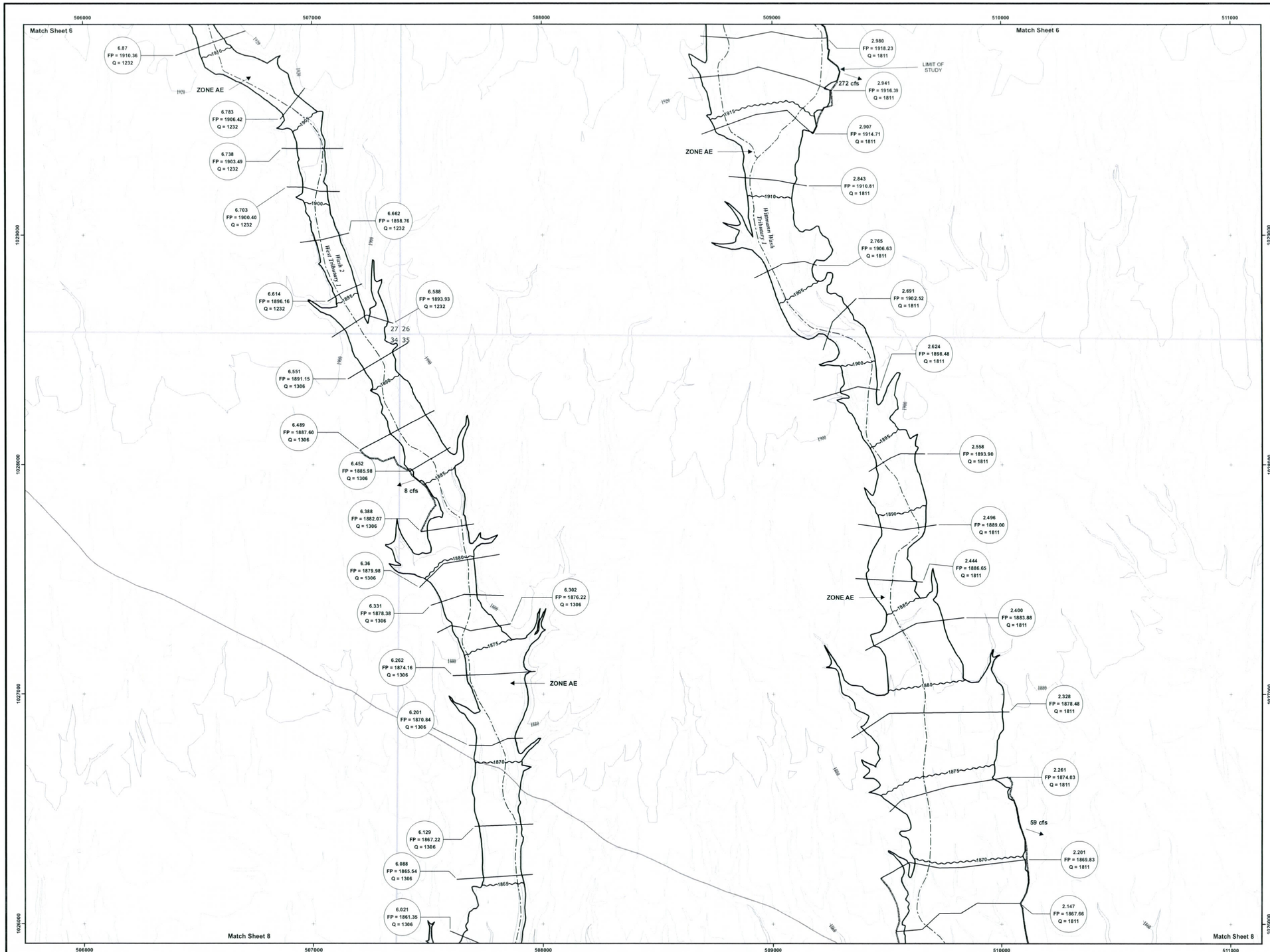

Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- HEC-RAS Cross Section (RS # / FP Elev / Flow Rate)
- 2326 Base Flood Elevation Line
- Lateral Weirs
- FlowMaster Cross Section (RS # / Flow Rate)
- Effective FEMA Floodplain Mapping
- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
- 2320 Index Contour
- Intermediate Contour

Benchmark Information: See Cover Sheet for list of benchmarks in vicinity of study area as well as their locations. Benchmarks are either GDACS Survey Monuments (GDACS #) or NGS Survey Monuments (NGS #). Only GDACS #56448-2 falls within the work map sheet boundaries. See Sheet 5.

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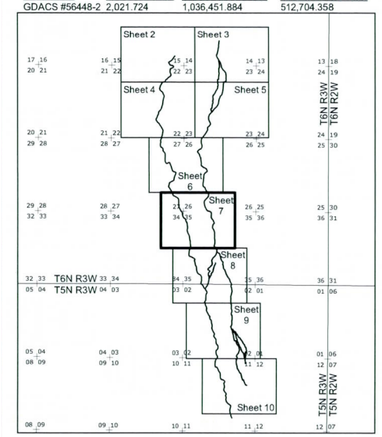
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



CONTOUR INTERVAL = FOUR FEET ON SHEETS 2 THROUGH 7 AND NORTH OF RANGE 2W/RANGE 3W BOUNDARY ON SHEET 8.
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NAVD 88 VALUES MINUS NGVD 29 VALUES EQUAL 2.06 FEET.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
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Plan Check	HD	September 2010

Sheet 7 of 10

47097 SETH AHRENS Registered Professional Engineer ARIZONA U.S.A. Expires 12-31-2010

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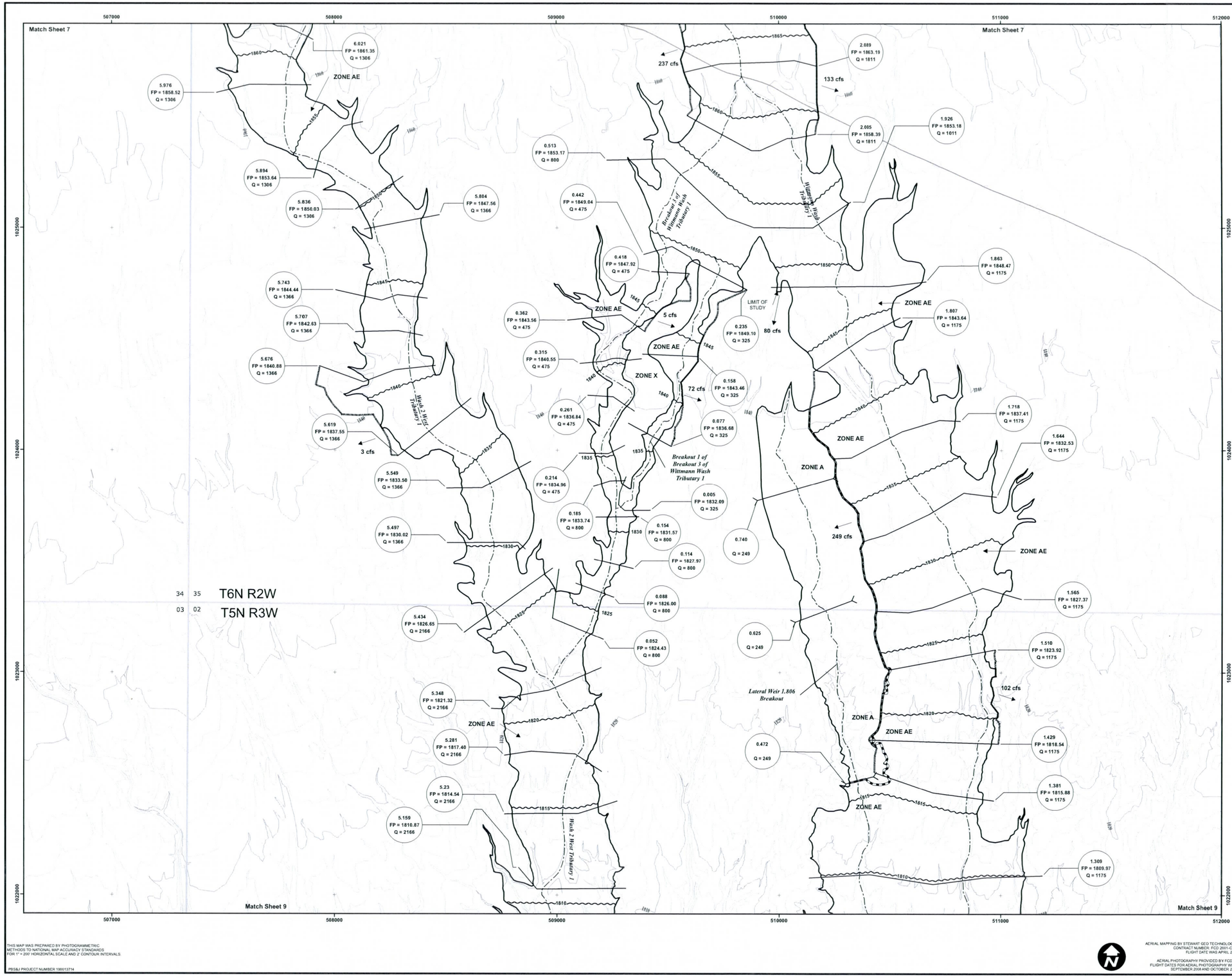
PBS&J PROJECT NUMBER 100013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES CONTRACT NUMBER: FCD 2001-C021 FLIGHT DATE WAS APRIL 2002

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC. FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009



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PBS&J PROJECT NUMBER 19001374

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES CONTRACT NUMBER: FCD 2001-CO21 FLIGHT DATE WAS APRIL 2002.

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC. FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009.

Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
- 2320 — Base Flood Elevation Line
- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
- Effective FEMA Floodplain Mapping
- FCDMC Floodplain Mapping by Others
- Section Line
- Road
- Building
- 2320 — Index Contour
- Intermediate Contour

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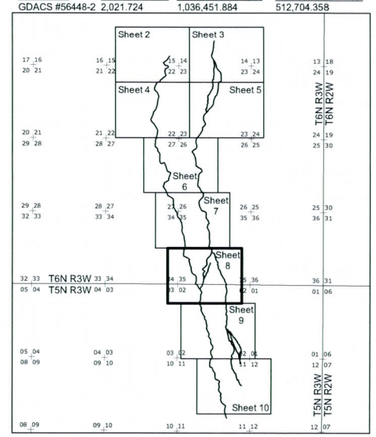
GDACS #56448-2	2,021.724	1,036,451.884	512,704.358



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006
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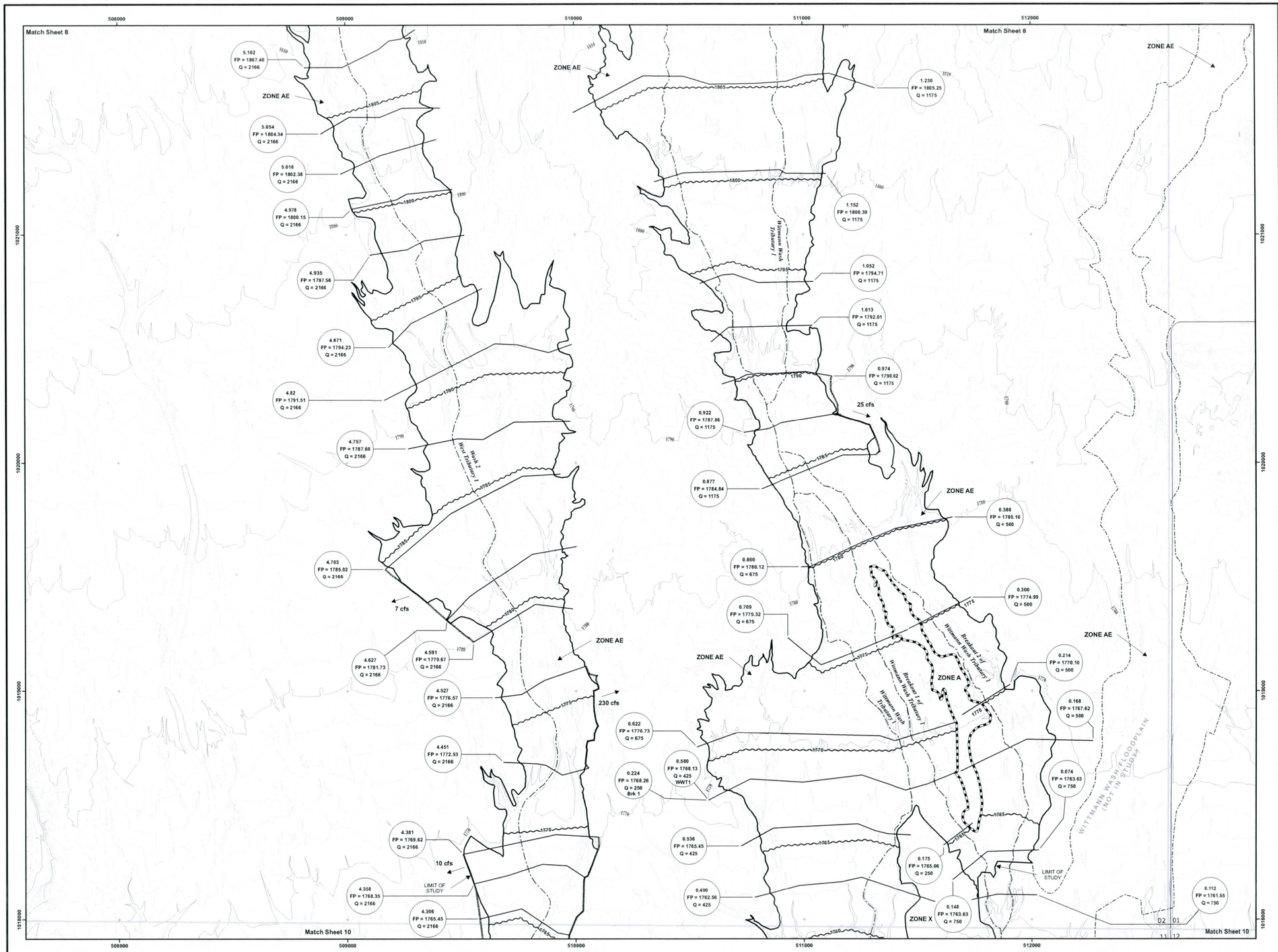

Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
- 2320 — Base Flood Elevation Line
- Lateral Weirs
- RS # / Flow Rate — FlowMaster Cross Section
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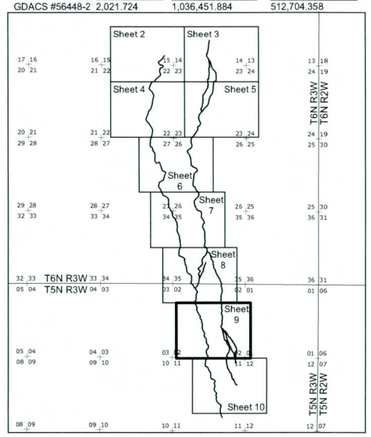

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Plan Check	HD	September 2010

Sheet 9 of 10

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PBS&J PROJECT NUMBER 100013714

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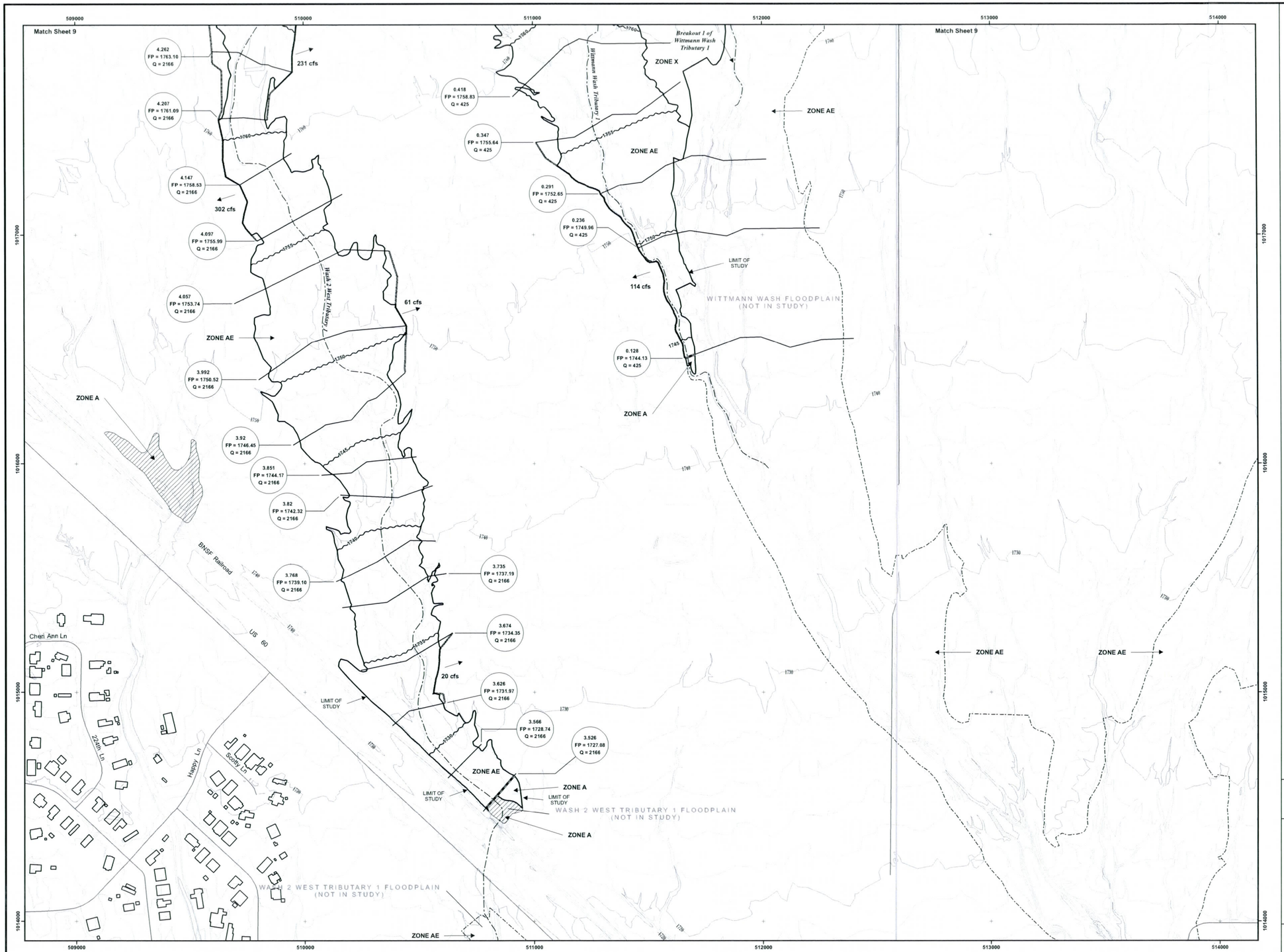

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CONTRACT NUMBER: FCD 2001-C021
FLIGHT DATE WAS APRIL 2002

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC.
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Legend

- ★ Benchmark (Type + Point Name)
- 100-Year Floodplain
- 100-Year Floodplain Zone Break
- Hydraulic Baseline
- RS # / FP Elev / Flow Rate — HEC-RAS Cross Section
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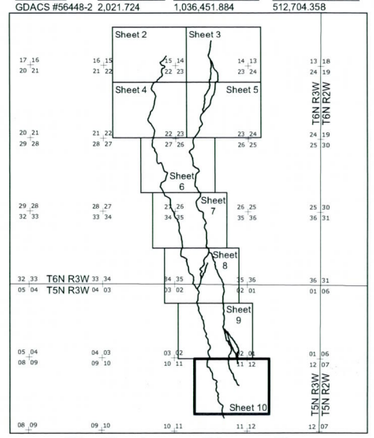

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Registered Professional Engineer — 47097 — SETH AHRENS — Date Signed — ARIZONA U.S.A. — Expires 12-31-2010

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APPENDIX A.1

DATA COLLECTION SUMMARY

DATA COLLECTION SUMMARY

A.1.1 Previous Studies

Two studies were completed in the vicinity of the *FDS* that impacted the *FDS* in some way. The first study was the *Wittmann Area Drainage Master Study* by The WLB Group that was completed under contract FCD 86-24. This study was completed in 1989. The second study was the *Wittmann Area Drainage Master Study Update* by Entellus that was completed under contract FCD 2002C029. This study was completed in 2005.

The downstream end of the floodplain mapping for Wash 2 West Tributary 1 ties into a Zone A floodplain that was delineated as part of The WLB Group's study. At this time of this writing, this floodplain was considered to be effective by FEMA.

The downstream end of Wittmann Wash Tributary 1 ties into Wittmann Wash. Entellus delineated a Zone AE floodplain and a floodway along Wittmann Wash in the vicinity of Wittmann Wash Tributary 1 as part of their study. At the time of this writing, this floodplain was not considered to be effective by FEMA; however, the results of the study were in the Physical Map Revision (PMR) process and will become effective at some point in the future.

A.1.2 Published/Unpublished Historical Flood Information

No published or unpublished historical flood information of the study area was available.

A.1.3 Research Contacts

All background data for this project were provided by FCDMC.

A.1.4 Digital Data Collected from FCDMC

At the beginning of the project, PBS&J requested the aerial photography, topographic data, and cultural data of the study area that the FCDMC had on hand. The extent of this request was the extent of the FEMA panels (04013C0685G and 04013C0695H) impacted by the project as well as those panels that border these affected panels. In response to this request, PBS&J received the following information:

- Aerial photography – All aerial photography was delivered in MrSID format. Flight dates of the photography were September 2008 and October 2009. The resolutions of the photography were 0.8 feet (September 2008

and part of October 2009) and 0.32 feet (remaining part of October 2009). The entire modeling area was available in the October 2009 data with a resolution of 0.32 feet.

- Digital Terrain Model (DTM) data – DTM data (LF and PF files) of the project area were delivered in text format. This information was used to create the Triangulated Irregular Network (TIN) that supplied the elevation data for the hydraulic modeling.

- DXF (AutoCAD) data – The following DXF datasets for the study area were received: alris_streams, bridge, carto, cnl, ctrl, ctrlplss, culvert, drnbsn, drnpth, elv, fpbln, fpctlfcd, fpsrfelv, fpsrffcd, fpxfcd, fpxfema, fpznfcd, fpznfema, lake, mag_future_landuse07, mag_genplan_landuse07, mag_landuse2004draft, river, rr, scs_soil, stnetres, strct, strtdtl, and swtrln.

- Arc/Info Interchange files (E00) – The following E00 datasets for the study area were received: alris_streams, bridge, carto, cnl, ctrl, ctrlplss, culvert, drnbsn, drnpth, elv, fpbln, fpctlfcd, fpsrfelv, fpsrffcd, fpxfcd, fpxfcdbk, fpxfcdfp, fpxfcdfw, fpxfcdmn, fpxfema, fpznfcd, fpznfema, lakes, mag_future_landuse07, mag_genplan_landuse07, mag_landuse2004draft, river, rr, scs_soil, stnetres, strct, strtdtl, and swtrln.

- ArcMap Shapfiles (SHP) – The following shapefiles for the study area were received: alris_streams, BaselineFCD, BaselineFEMA, BFEFCD, BFEFEMA, bridge, cartoln, cartopt, cnl, ctrl, ctrlplss, culvert, drnbsn, drnpthln, drnpthpt, elvln, elvpt, fpbln, fpctlfcd, fpsrfelv, fpsrffcd, fpxfema, fpznfcd, fpznfema, lake, LOMR, mag_future_landuse07, mag_genplan_landuse07, mag_landuse2004draft, parcels, river, rr, scs_soil, stnetres, strct, strtdtl, swtrln, xsfcd, and xsfema.

FCDMC also provided PBS&J with a DVD entitled "Hydrology and Hydraulic Data for the Trilby Watershed Area". Note that the Wittmann Phase III study area resides in the Trilby Wash watershed. The following datasets were on this DVD:

- Arc/Info Interchange files (E00) – fpbln, fpxfcd, fpxfcdbk, fpxfcdfp, fpxfcdfw, and fpxfcdmn.

- ArcMap Shapfiles (SHP) – BaselineFCD, BaselineFEMA, drnbasn, drnpthln, drnpthpt, fpctlfcd, fpsrfelv, fpsrffcd, fpxfema, fpznfcd, fpznfema, LOMR, Subbasins_FCDMC, swtrln, xsfcd, and xsfema.

PBS&J contacted FCDMC to acquire the *Wittmann Area Drainage Master Study Update* by Entellus. Jonathan Lesperance (FCDMC) provided Volume HY-Addendum of the TDN, dated July 2005 (Final Addendum No. 1, Contract FCD

2002C029). He also provided a digital copy of the HEC-1 modeling from this analysis.

PBS&J also contacted FCDMC to acquire the *Wittmann Area Drainage Master Study* by The WLB Group. Jonathan Lesperance (FCDMC) provided this report, dated May 1986, (Contract FCD 86-24). He also provided a digital copy of the HEC-1 modeling from this analysis.

A.1.5 Data Collected from the City of Surprise (COS)

PBS&J contacted COS and spoke with Jeff Davidson, P.E., CFM, a senior engineer in the Municipal CIP Division of the City's Public Works Department. PBS&J asked whether any subdivisions were planned for the Wittmann Phase III FDS study area. Mr. Davidson provided a Development Status Map (*developmentStatusMap.pdf*) and a scan of the preliminary plat for the Austin Ranch West subdivision (*00003369.tif*). Both of these files may be found in the *City-of-Surprise* folder in the *Appendix A* folder on the report DVD.

The Development Status Map revealed that the majority of the Wittmann Phase III FDS study area resides on State Trust land. Near the south end of the study, on the north side of US 60, the map showed a proposed development called "BNSF Commercial". It is unknown at this time if or when the Burlington North Santa Fe (BNSF) railroad plans to develop this area or what this development might include.

A.1.6 Data Collected from ADOT

As-built plans were available for the three structures that were hydraulically modeled during the study in ADOT's as-built plan set *Plan and Profile of Proposed State Highway, Morristown-New River, Maricopa County*, dated 12-22-64. A digital copy of these plans may be found in the file *454-507 RD.pdf*, which has been included in the *Appendix C* folder on the DVD. The information in this plan set that applies to the *FDS* may be found on Sheet 6 of 10 of the plan set (Sheet 9 of 19 of the PDF).

A.1.7 Data Collected from the Field

Two site visits were made. Richard Harris (FCDMC), Jonathan Lesperance (FCDMC), and Seth Ahrens (PBS&J) attended the first visit on March 4, 2010. Jonathan Lesperance and Seth Ahrens made a follow-up visit on March 23, 2010. During each visit, photographs and field notes were taken throughout the project site. Between the two visits, 242 photos were taken. Throughout the field work, a

Trimble GPS Pathfinder Pro Series receiver was used to generate GPS way points to confirm the locations where the photographs were taken. A spreadsheet has been made for each visit that catalogs the photographs and the field notes that were taken. These spreadsheets may be found in *Appendix E* of this TDN. Digital copies of the photographs may be found in the *AppendixE.6-Field-Photography* folder on the DVD included with the TDN.

DATA PROVIDED BY THE CITY OF SURPRPISE

LEGAL DESCRIPTION
AUSTIN RANCH - Phase I

That portion of Section 15, Township 4 North, Range 2 West of the Gila and Salt River Base and Meridian, Maricopa County, Arizona, more particularly described as follows:

BEGINNING at the Southwest corner of said Section 15; thence N 00* 08′ 45″ W along the West line of the Southwest quarter of Section 15 a distance of 1311.18 feet to the Southwest corner of FRANK E. BELLAMY SUBDIVISION as recorded in Book 11 of Maps, page 19, records of Maricopa County, Arizona; thence continuing N 00°08′ 45″ W along said West line of Section 15 a distance of 1310.88 feet to the West quarter corner of Section 15; thence N 89° 53′ 58″ E along the East-West mid-section line and along the North line of Lots 21, 22, 23 and 24 of said FRANK E. BELLAMY SUBDIVISION a distance of 1337.09 feet to the Northeast corner of said Lot 21; thence N 00° 11′ 18″ W along the West line of Lot 13 and its northerly extension and along the West line of Lot 4, both of said FRANK E. BELLAMY SUBDIVISION a distance of 1313.95 feet to the Northwest corner of said Lot 4; thence S 89° 46′ 19″ W along the North line of Lot 5 of said subdivision a distance of 16.17 feet to the West line of the Northeast quarter of the Northwest quarter of said Section 15; thence N 00° 10′ 26″ W along said West line a distance of 1313.60 feet to the North line of the Northwest quarter of Section 15; thence N 89° 38′ 43″ E along said North line a distance of 1319.89 feet to the North quarter corner of Section 15; thence S 00° 11′ 21″ E along the North-South mid-section line a distance of 1316.51 feet to the Northeast corner of said FRANK E. BELLAMY SUBDIVISION; thence N 89° 47′ 23″ E along the North line of the Southwest quarter of the Northeast quarter of Section 15 a distance of 1320.12 feet to the Northeast corner thereof; thence S 00° 11′ 58″ E along the East line of the Southwest quarter of the Northeast quarter of Section 15 a distance of 1319.01 feet to the East-West mid-section line; thence N 89° 53′ 00″ E along said line a distance of 1320.35 feet to the East quarter corner of Section 15; thence S 00° 12′ 48″ E along the East line of the Southeast quarter of Section 15 a distance of 2627.41 feet to the Southeast corner of Section 15; thence S 89° 57′ 47″ W along the South line of the Southeast quarter of Section 15 a distance of 2642.21 feet to the South quarter corner of Section 15; thence South 89° 56′ 08″ W along the South line of the Southwest quarter of Section 15 a distance of 2642.78 feet to the POINT OF BEGINNING.

EXCEPT Lot 17 of said FRANK E. BELLAMY SUBDIVISION; and
EXCEPT the South half of the Northeast quarter of the Southeast quarter of the Southwest quarter of said Section 15

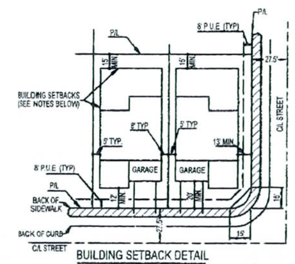
Containing 427.6644 acres.

CLOMR NOTE:

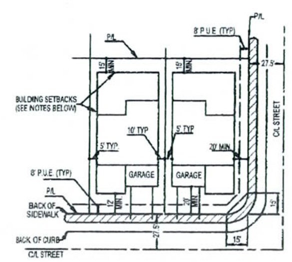
A CLOMR FOR THE WITTMAN WASH HAS BEEN SUBMITTED ON SEPTEMBER 9, 2005 TO MARICOPA COUNTY FLOOD CONTROL DISTRICT FOR REVIEW. THIS PROJECT IS WITHIN FEMA FLOOD ZONES"AE" & "X"

Floodplain taken from: ENTELLUS WITTMANN AREA DRAINAGE MASTER STUDY Amended: June 2005
Maps L-12, M-12 Dated 10/2004 and M-11,
M-10 Dated 7/2005

RETENTION REQUIRED = 2,195,678 CM
RETENTION PROVIDED = 2,540,964 CM
C= 0.65



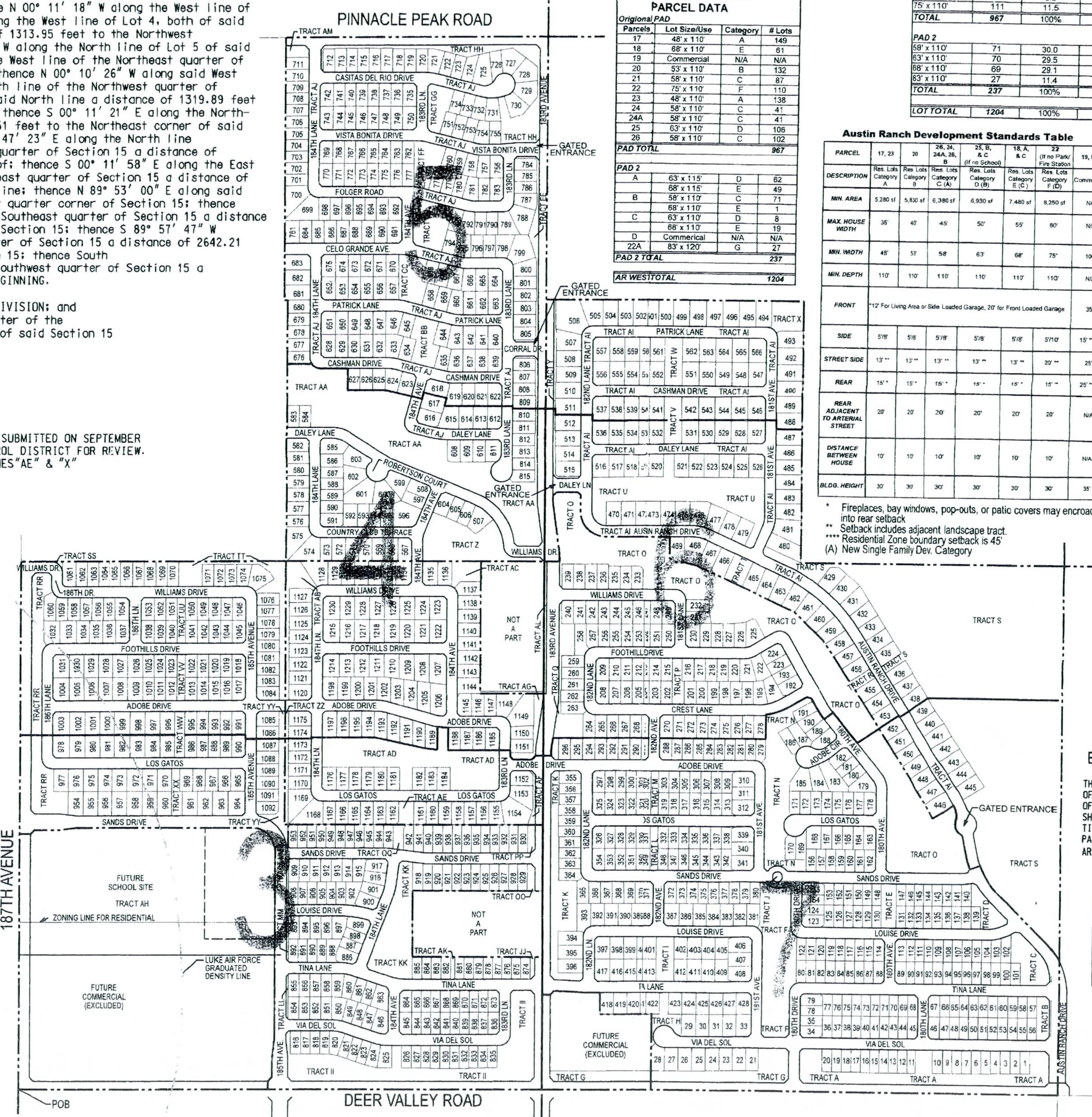
BUILDING SETBACK DETAIL



BUILDING SETBACK DETAIL for 75' AND 83' WIDE LOTS

PRELIMINARY PLAT FOR
AUSTIN RANCH WEST

BEING A PORTION OF SECTION 15, TOWNSHIP 4 NORTH RANGE 2 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, CITY OF SURPRISE, MARICOPA COUNTY, AZ.



AUSTIN RANCH WEST PARCEL DATA

Parcels	Lot Size/Use	Category	# Lots
Origional PAD			
17	48' x 110'	A	149
18	68' x 110'	E	61
19	Commercial	N/A	N/A
20	53' x 110'	B	132
21	58' x 110'	C	87
22	75' x 110'	F	110
23	48' x 110'	A	138
24	58' x 110'	C	41
24A	58' x 110'	C	41
25	63' x 110'	D	106
26	58' x 110'	C	102
PAD TOTAL			**967**
PAD 2			
A	63' x 115'	D	62
	68' x 115'	E	49
B	58' x 110'	C	71
	68' x 110'	E	1
C	63' x 110'	D	8
	68' x 110'	E	19
D	Commerical	N/A	N/A
22A	83' x 120'	G	27
PAD 2 TOTAL			**237**
AR WESTTOTAL			**1204**

AUSTIN RANCH WEST PAD LOT MIX DATA

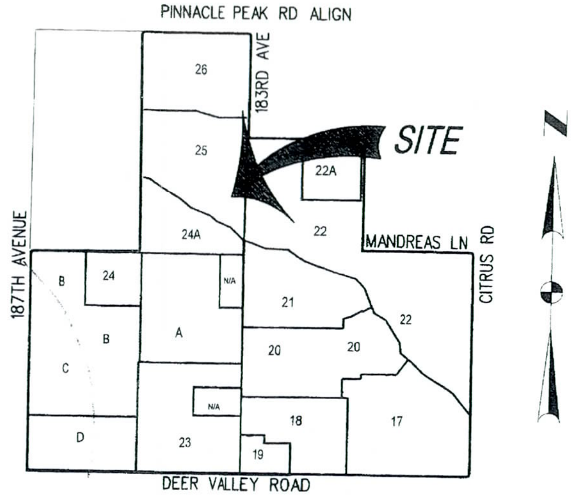
Min. Lot Size	No. of Lots	Percentage	Acres	Density du/ac
Origional PAD				
48' x 110'	287	29.7	71.0	4.01
53' x 110'	131	13.5	28.4	4.65
58' x 110'	271	28.0	85.8	3.16
63' x 110'	106	11.0	26.7	3.97
68' x 110'	61	6.3	20.9	2.92
75' x 110'	111	11.5	72.9	1.51
TOTAL	**967**	100%	305.7	3.16
				3.37 Allowed Density
PAD 2				
58' x 110'	71	30.0	21.3	3.33
63' x 110'	70	29.5	28.1	2.49
68' x 110'	69	29.1	27.8	2.48
83' x 110'	27	11.4	10.0	2.7
TOTAL	**237**	100%	87.2	2.72
				3.0 Allowed Density
LOT TOTAL	**1204**	100%	392.9	3.06

Austin Ranch Development Standards Table

PARCEL	17, 23	20	26, 24, 24A, 26, B	25, B, & C (If no School)	18, A, & C	22 (If no Park/ Fire Station	19, B, C	22A
DESCRIPTION	Res. Lots Category A	Res. Lots Category B	Res. Lots Category C (A)	Res. Lots Category D (B)	Res. Lots Category E (C)	Res. Lots Category F (D)	Commercial	Res. Lots Category (E)
MIN. AREA	5,280 sf	5,830 sf	6,380 sf	6,930 sf	7,480 sf	8,250 sf	N/A	9,130 sf
MAX. HOUSE WIDTH	35'	40'	45'	50'	55'	60'	N/A	65'
MIN. WIDTH	48'	53'	58'	63'	68'	75'	100'	83'
MIN. DEPTH	110'	110'	110'	110'	110'	110'	N/A	110'
FRONT	*12' For Living Area or Side Loaded Garage, 20' for Front Loaded Garage						35'	*
SIDE	5'/8'	5'/8'	5'/8'	5'/8'	5'/8'	5'/10'	15' ****	8'/10'
STREET SIDE	13' **	13' **	13' **	13' **	13' **	20' **	25'	20'**
REAR	15' *	15' *	15' *	15' *	15' *	15' **	25' ****	15'**
REAR ADJACENT TO ARTERIAL STREET	20'	20'	20'	20'	20'	20'	N/A	20'
DISTANCE BETWEEN HOUSE	10'	10'	10'	10'	10'	10'	N/A	16'
BLDG. HEIGHT	30'	30'	30'	30'	30'	30'	35'	30'

* Fireplaces, bay windows, pop-outs, or patio covers may encroach 10' into rear setback
** Setback includes adjacent landscape tract.
**** Residential Zone boundary setback is 45'
(A) New Single Family Dev. Category

PINNACLE PEAK RD ALIGN



VICINITY MAP
and PARCEL NUMBERS

SECTION 15, T4N, R2W
SCALE 1" = 1000'

Tract	Designation	Acres	Tract	Designation	Acres
A	Landscape, Drainage, Retention	2.42	JJ	Landscape	0.06
B	Landscape	0.32	KK	Landscape, Retention	1.82
C	Landscape, Retention	0.75	LL	Landscape	0.05
D	Landscape, Retention	0.44	MM	Landscape	0.05
E	Landscape, Retention	0.40	NN	Landscape	0.05
F	Landscape, Retention	2.74	OO	Landscape	0.12
G	Landscape, Drainage, Retention	1.28	PP	Landscape	0.12
H	Landscape, Retention	0.40	QQ	Landscape	0.15
I	Landscape, Retention	0.46	RR	Landscape, Drainage	2.18
J	Landscape	0.05	SS	Landscape	0.01
K	Landscape	1.07	TT	Landscape, Drainage	1.20
L	Landscape	0.19	UU	Landscape	0.22
M	Landscape	0.19	VV	Landscape	0.22
N	Landscape, Retention	2.40	WW	Landscape	0.27
O	Landscape, Drainage, Retention, Pocket Park	11.84	XX	Landscape	0.26
P	Landscape	0.29	YY	Landscape, Drainage	0.54
Q	Landscape	0.13	ZZ	Landscape, Drainage	0.25
R	Landscape, Retention	0.15	AB	Landscape, Drainage	0.62
S	Landscape, Drainage, Retention	25.36	AC	Landscape	0.36
T	Landscape	0.31	AD	Landscape, Retention	3.34
U	Landscape, Retention	3.45	AE	Landscape	0.20
V	Landscape, Retention	0.50	AF	Landscape	0.10
W	Landscape, Retention	0.50	AG	Landscape	0.26
X	Landscape	0.55	AH	Drainage,future School Site	17.84
Y	Landscape	0.27	AI	Private Street	10.08
Z	Landscape, Retention	1.84	AJ	Private Street	12.66
AA	Landscape, Drainage	3.45	AK	Landscape, Drainage	0.05
BB	Landscape, Retention	0.64	AL	Drainage, Access Easement	0.20
CC	Landscape, Retention	0.70	AM	Landscape	0.16
DD	Landscape, Retention	0.92			
EE	Landscape	0.42			
FF	Landscape, Retention	0.63			
GG	Landscape, Retention	0.52			
HH	Landscape, Retention	1.71			
II	Landscape, Drainage, Retention	3.80	*Total Tract Area*		**124.53**

All development phases depicted on this preliminary plat shall be provided a minimum of (2) separate points of unobstructed access with a minimum width of twenty feet, installed and maintained pursuant to the requirements of the City of Surprise.

BASIS OF BEARING

THE SOUTH LINE OF THE SOUTHWEST QUARTER OF SECTION 15, TOWNSHIP 4 NORTH, RANGE 2 WEST, OF THE GILA AND SALT RIVER BASE AND MERIDIAN AS SHOWN ON THE ALTA/ACSM LAND SURVEY TITLE SURVEY, AS RECORDED IN BOOK 590 OF MASS AT PAGE 42, OF THE RECORDS OF MARICOPA COUNTY, ARIZONA SAID BEARING BEGING: SOUTH 89°56′08″ WEST

CITY OF SURPRISE
PLANNING AND ZONING DEPARTMENT
APPROVED
THIS APPROVAL IS NOT TO BE CONSTRUED AS AN APPROVAL OF ANY VIOLATION OF THE SURPRISE MUNICIPAL CODE, 2000 INT'L. BUILDING, PLUMBING, MECHANICAL AND THE NATIONAL ELECTRICAL CODES.
Case No.: PP05-034
P&Z Comm. Approval: 12-20-05
City Council Approval: 1-26-06
B.O.A. Approval:
Stipulations: A - J

UTILITY COMPANIES		SUBMITTAL DATE
ELECTRIC	APS	
CABLE TV	COX COMMUNICATIONS	
TELEPHONE	QWEST	
WATER	BEARDSLEY	
SEWER	CITY OF SURPRISE	

Registered Professional Engineer (Civil) 38798 CESAR PEREZ Date Signed 10/31/05 ARIZONA U.S.A.

ENGINEER :
SAGE ENGINEERING CORPORATION
3414 S. 48TH STREET, SUITE 8
PHOENIX, ARIZONA 85040
(480) 966-9971
(480) 929-9901 (FAX)
CONTACT: MR. CESAR PEREZ

DEVELOPER :
COURTLAND HOMES
5333 N. 7TH STREET, SUITE 310
PHOENIX, ARIZONA 85014
(602) 265-3713
CONTACT: MR. JOE WALSH

RECEIVED
NOV 01 2005
COMMUNITY DEVELOPMENT

PRELIMINARY PLAT
FOR
AUSTIN RANCH WEST
SHEET 1 OF 7

DATE: JANUARY 17 2005
REVISED: SEPTEMBER 21, 2005
REVISED: SEPTEMBER 29, 2005
REVISED: OCTOBER 31, 2005

Sage engineering corporation
3414 S 48th ST. -- SUITE 8
PHOENIX, ARIZONA 85040
(480)966-9971

1354004/PLANNING/PREPLAT/SHEET 1

Development Status Map

ID	DEVELOPMENT	LOT COUNT	ID	DEVELOPMENT	LOT COUNT
1	Arizona Traditions	1810	52	Lake Pleasant 5000	9800
2	Ashton Ranch	1220	53	Cielo Crossing	1570
3	Bell West Ranch	1100	54	TIERRA VERDE	538
4	Canyon Ridge West	518	55	Tierra Rico	177
5	Countryside	768	56	Surprise Ranch	662
6	Coyote Lakes	709	57	Surprise Foothills	2129
7	Desert Oasis	3520	58	Sierra Norte	374
8	Fox Hill Run	98	59	Buena Vista Ranch	1285
9	Fox Trail	3000	60	Austin Ranch II	241
10	Greenway Parc	643	61	Asante North	8962
11	Kingswood Parke	1483	62	Grand Vista	21161
12	Legacy Parc	1031	63	BNSF Commercial	
13	Litchfield Manor	1158	64	Surprise Pointe	
14	Litchfields	142	65	Rancho Maria	250
15	Bell Pointe 1	405	66	Trail of Light	43
16	Mountain Gate	682	67	Mequite Mountain Ranch	740
17	Mountain Vista Ranch	1908	68	Ana Mandera	467
18	Northwest Ranch	849	69	Surprise Foothills East	831
19	Stadium Village		70	Sonoran Trails	372
20	Parke Row	83	71	Voyager	
21	Rancho Gabriela	2129	72	Acoma Court	132
22	Rio Rancho	926	73	Burke Property	
23	Roseview	1328	74	Legacy Village	110
24	Royal Ranch	1189	75	Desert Cove	
25	Sierra Montana	2635	76	Sky Way	
26	Stonebrook	164	77	White Tank Foothills	
27	Sun City Grand	9510	78	Patton Place Estates	336
28	Sun Village	987	79	Grand Oasis	124
29	Surprise Farms	6013	80	Soleada	404
30	Tash	251	81	Foothills 40	46
31	Marley Park	3050	82	Sunrise Ranch	400
32	West Point Towne Center	1622	83	Twelve Oaks Estates II	164
33	Kenly Farms	200	84	Mesquite Mountain Ranch Phase	234
34	Greer Ranch	1624	85	Custer Estates	36
35	Cotton Gin	209	86	Desert Moon Estates	
36	Sierra Verde	950	87	Star Canyon Ranch	
37	Veramonte	350	88	Vistas Montanas	430
38	Sarah Ann Ranch	960	89	Rio Caballo	420
39	Sycamore Farms	1177	90	Skyway Business Park II	
40	Bell Pointe 2	155	91	City of Surprise Water Reclamation	
41	Pinnacle Peak Country Estates	561	92	Cactus Commerce Center	
42	Austin Ranch	2240	93	Summit Business Park	
43	Asante	6703	94	Original Town Site	
44	Prasada	7220	95	Sunflower Resort	
45	Walden Ranch	1761	96	Sun Ridge	
46	Marisol Ranch	2070	97	Surpise Stadium Complex	
47	Sunhaven Ranch	9012	98	Surprise Center	
48	Zenjero Trails	10500	99	Bell & Dysart Commerce Center	
49	Peak View Estates	244	100	The Orchards	585
50	Broadstone Ranch	10000	101	Interfaith Community Care Camp	
51	Rancho Mercado	5000	102	Trail of Light Phase II	43

SURPRISE
ARIZONA

City Of Surprise
Development Area Status Map

Developments Status
- Built-out
- Entitled
- Proposed
- Under Construction

- City of Surprise General Planning Area
- City Boundary
- WTP Surprise Water Reclamation Facilities
- Luke AFB & Aux 1 Noise Contours
- State Trust Land
- Bureau of Land Mgmt.

0 0.5 1 2 Miles
1 inch equals 4,000 feet

Date of Last Revision: December 27, 2007

APPENDIX A.2

REFERENCED DOCUMENTS

REFERENCED DOCUMENTS

A.2.1 Referenced Technical Papers and Documents

The following technical documents pertain to the methodology used in this study:

Arizona Department of Transportation, *Plan and Profile of Proposed State Highway, Morristown—New River, Maricopa County*, Project S-434-507, December 1964.

Arizona Department of Water Resources, *Delineation of Riverine Floodplains and Floodways in Arizona*, State Standard SS2-96, July 1996.

Arizona Department of Water Resources, *Floodplain Hydraulic Modeling*, State Standard SS9-02, July 2002.

Arizona Department of Water Resources, *Instructions for Organizing and Submitting Technical Documentation for Flood Studies,* State Standard SS1-97, November 1997.

Entellus, *Wittmann Area Drainage Master Study Update*, FCDMC Contract FCD 2002C029, July 2005.

Federal Emergency Management Agency, *Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas*, revised September 2005.

Federal Emergency Management Agency, *Guidelines and Specifications for Flood Hazard Mapping Partners*, May 2003 and November 2009.

Federal Emergency Management Agency, *RASPLOT User's Guide*, Version 2.5, March 2005.

Flood Control District of Maricopa County, *Computer Aided Drafting and Design (C.A.D.D) Data Delivery Specifications, Rev. 1.0*, January 2000.

Flood Control District of Maricopa County, *Consultant Guidelines*, December 2003.

Flood Control District of Maricopa County, *Data Delivery Specifications: The Hydrologic Information System (H.I.S.), Rev. 3.1*, June 1998.

Flood Control District of Maricopa County, *Drainage Design Manual – Hydraulics*, April 2010 (Draft).

United States Army Corps of Engineers, *HEC-1 Flood Hydrograph Package User's Manual*, June 1998.

United States Army Corps of Engineers, *HEC-GeoRAS User's Manual*, Version 4, September 2005.

United States Army Corps of Engineers, *HEC-RAS Hydraulic Reference Manual*, Version 4.0, March 2008.

United States Army Corps of Engineers, *HEC-RAS User's Manual*, Version 4.0, March 2008.

United States Geological Survey, *Estimated Manning's Roughness Coefficients for Stream Channel and Flood Plains in Maricopa County, Arizona*, April 1991.

WLB Group, The, *Wittmann Area Drainage Master Study*, FCDMC Contract 86-14, May 1989.

APPENDIX B.1

SPECIAL PROBLEMS REPORTS

SPECIAL PROBLEMS REPORTS

B.1.1 Special Problems Report -- Hydrology

Two special problems were identified. The first involved the need to interpolate linearly flow rates at places located between concentration points in the HEC-1 modeling. This issue is discussed in more detail in Section 4.3.1 of the TDN report.

The second issue was related to an error discovered in the routing reach lengths of two of the routing reaches in the HEC-1 modeling. This issue is discussed in more detail in Section 4.3.2 of the TDN report.

B.1.2 Special Problems Report – Hydraulics and Floodplain Mapping

There were multiple special problems with respect to the hydraulics and the floodplain mapping. Each of these issues is discussed in detail in Section 5.8 of the TDN report. Below is a summary of the special problems that are discussed in this section:

- 5.8.1 – Split Flows – Discusses the split flows throughout the study and how they were modeled.
- 5.8.2 – Downstream End of Wash 2 West Tributary 1 – Discusses how the downstream boundary condition for this wash was established.
- 5.8.3 – Downstream Ends of Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, and Breakout 2 of Wittmann Wash Tributary 1 – Discusses how the downstream boundary conditions for these washes were established.
- 5.8.4 – Burlington Northern Santa Fe Railroad Embankment – Discusses the impact the railroad had on the modeling and floodplain mapping of the downstream end of Wash 2 West Tributary 1.
- 5.8.5 – Floodplain Mapping of Breakout Flow Downstream from Lateral Weirs 1.806 and 3.634 along Wittmann Wash Tributary 1 – Discusses how the Zone A floodplain downstream from these weirs was determined.
- 5.8.6 – Breakouts Downstream from RS 1.863 and RS 4.560 in Wittmann Wash Tributary 1 – Discusses how the breakout flow rates at these locations were determined.
- 5.8.7 – Floodplain Mapping in the Vicinity of RS 0.387 along Breakout 4 of Wittmann Wash Tributary 1 – Discusses the floodplain mapping near RS 0.387, including the presence of the Zone A floodplain between Breakout 4 of Wittmann Wash Tributary 1 and Wittmann Wash Tributary 1.

APPENDIX B.2

CONTACT REPORTS

CONTACT REPORTS

B.2.1 Contact Reports

Communication regarding this project between PBS&J and FCDMC occurred mostly via e-mail. Please find copies of non-trivial, project-related email between PBS&J and FCDMC on the following pages. The following topics are covered:

- HEC-1 Routing Reach Error – Discusses the approach taken after a routing reach length error was discovered in the HEC-1 model.
- Interpolated Sub-Basin Names – Includes guidance from FCDMC regarding the naming of the interpolated sub-basins.
- Lateral Weir Optimizations – Includes guidance from FCDMC and Michael Baker, Jr. regarding how to organize the HEC-RAS models with respect to the many lateral weirs in the project area.
- PRJ_RID Request – Includes the request and assignment of the PRJ_RID number for this study.
- WLB Group ADMS Report – Includes guidance from FCDMC regarding the interpretation of the results of the WLB Group's report.

E-MAIL CORRESPONDENCE

HEC-1 ROUTING REACH ERROR

Ahrens, Seth

From: Jonathan Lesperance - FCDX [jonathanlesperance@mail.maricopa.gov]
Sent: Friday, June 18, 2010 7:29 AM
To: Ahrens, Seth
Cc: Richard Harris - FCDX; Amir Motamedi - FCDX
Subject: RE: Wittmann -- Hydrology issue

Hi Seth,

First off- thank you for your diligent work and great job on locating this error. In the hunting culture there is a term used when someone spots difficult game—"Good eyes" we say. I think the expression is fitting for hydrology as well. In discussing how to proceed, the consensus on our end was to deal with this in-house in an effort to maintain a streamlined schedule as we near the end of the fiscal year. Also, the language of the project scope states that "...the consultant will only need to complete minimal additional hydrologic calculations (sec. 5.1)." With 48 hours of project engineer time budgeted for Task 5, it appears that an in-house correction would be most appropriate.

The district GIS database shows the correct lengths, but as you have noticed the Wittmann ADMSU HEC-1 model does not. I re-ran the model first having changed only the lengths to their correct size, and came up with flows of 1616 cfs and 1671 cfs, for the downstream concentration points of C452B and CTW485, respectively. Then I performed an initial Manning's velocity calculation using the same parameters already given in the channel geometry to find NSTEPS for the routing reaches. I performed two more iterations to find NSTEPS and came up with reasonable convergence on the discharge values, which are 1605 cfs at C452B and 1594 cfs at CTW485. This is an increase of 302 cfs at C452B from the original HEC-1, and a decrease of 266 cfs at CTW485. Both of these peaks are reached prior to the routed peak reaching the concentration point. The new time to route is 40 minutes for RD454 and 15 minutes for RTW454.

The final discharge values at C452B and CTW485 should be **1605** cfs and **1594** cfs, respectively.

My calculations were reviewed by Richard, and we believe they are reasonable. However, if you feel strongly about the modifications to the model, please let us know your concerns and we will do our best to arrive at a reasonable solution in a timely manner to maintain the project schedule.

Also, as many important decisions were made regarding the model at our last monthly coordination meeting, could you please send a copy of the meeting minutes as soon as you get a chance so that we may review them as discussed?

Thanks again for your hard work and dedication to this product, it is appreciated!

Jonathan

From: Ahrens, Seth [mailto:SAhrens@pbsj.com]
Sent: Tuesday, June 15, 2010 8:55 PM
To: Richard Harris - FCDX; Jonathan Lesperance - FCDX
Subject: Wittmann -- Hydrology issue

Richard/Jonathan,

I just discovered a mistake in the HEC-1 model for Wittmann. The concentration point CTW454 is located at the upstream end of Breakout 2 of Witt Wash Trib 1. See figure 4-1 in the hydrology report, which shows the HEC-1 schematic. There is a diversion at this concentration point that sends flows down routing reaches RTW454 and RD454. Here's a quick summary of the routing reach lengths:

Reach	HEC-1 length	Length I determined	HEC-1 time to route

RD454	3342	15080	30 min
R576B	18394	ok as is	125 min
RTW454	13093	3343	10 min

It's hard to say how this impacts the flow rates in the modeling. Once the lengths are revised, the number of steps in the RS card of the routing reaches will need to be updated, too, and that's an iterative process. However, the routing cards for R576B and RTW454 are very similar (same RX/RY cards, same n values, similar slopes). So I'm guessing that the routing time for RD454 will jump significantly.

How would you like to proceed regarding this issue?

Thanks,
Seth

Seth Ahrens, P.E., CFM
Senior Water Resources Engineer
PBS&J
20860 North Tatum Boulevard
Suite 300
Phoenix, Arizona 85050
480-419-7275 ext. 1509
Direct: 480-538-1509
Fax: 480-419-7202
sahrens@pbsj.com
www.pbsj.com

This electronic mail communication may contain privileged, confidential, and/or proprietary information which is the property of either The PBSJ Corporation or one of its affiliates. If you are not the intended recipient or an authorized agent of the intended recipient please delete this communication and notify the sender that you have received it in error.

Ahrens, Seth

From: Jonathan Lesperance - FCDX [jonathanlesperance@mail.maricopa.gov]
Sent: Friday, June 18, 2010 10:28 AM
To: Ahrens, Seth
Cc: Richard Harris - FCDX; Amir Motamedi - FCDX
Subject: RE: Wittmann -- Hydrology issue

Hi Seth,

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Sent: Tuesday, June 15, 2010 8:55 PM
To: Richard Harris - FCDX; Jonathan Lesperance - FCDX
Subject: Wittmann -- Hydrology issue

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Seth Ahrens, P.E., CFM

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Ahrens, Seth

From: Jonathan Lesperance - FCDX [jonathanlesperance@mail.maricopa.gov]
Sent: Monday, June 21, 2010 1:05 PM
To: Ahrens, Seth
Cc: Richard Harris - FCDX; Amir Motamedi - FCDX
Subject: RE: Wittmann -- Hydrology issue
Attachments: WPIIIrevised.hc1; WPIIIrevised.out

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Ahrens, Seth

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To: Ahrens, Seth
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Subject: RE: Wittmann -- Hydrology issue
Attachments: NEWwtec6-addendum.hc1; NEWwtec6-addendum.out

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Ahrens, Seth

From: Richard Harris - FCDX [rph@mail.maricopa.gov]
Sent: Tuesday, June 22, 2010 11:31 AM
To: Jonathan Lesperance - FCDX
Cc: Ahrens, Seth; Richard Harris - FCDX
Subject: RE: Wittmann -- Hydrology issue

Thanks, Jonathon.

Indeed, it must be documented. I imagine (since I haven't been down this pathway much before) that the thing to do is to add text to the TDN explaining that while we recognize changes to the downstream approved discharges may be a result of the current study update, we currently can't afford to expand the project scope of work. Therefore, we would like to address this issue at a later time. Given this rough direction, we can ask Seth to put together a draft to include such language, and we will all go over it. Hopefully we will get draft of the section well-ahead of the draft TDN so that when we receive that entire document there will be little left that will be new.

Thanks,

Richard

From: Jonathan Lesperance - FCDX
Sent: Tuesday, June 22, 2010 10:57 AM
To: Richard Harris - FCDX
Subject: RE: Wittmann -- Hydrology issue

Hi Richard, thanks for getting back to me – I think we have the technical details worked out now. I had the 24 hr model, and the one we needed was the 6 hr so I went through the same process this morning with the 6 hour model and the results seem reasonable. The only difference is that the discharge values are larger since the 6 hr storm controls for this reason. But what I do need your help with is how to direct Seth to document this process in the TDN, especially since both portions of the revised split join in previous floodplain delineations downstream and reflect the incorrect values from the original HEC-1. In one instance, the split that heads west, the discharge values increase, and the previous floodplain will underestimate the inundation extents. In the other instance, where the split heads east, the discharge values decrease, and the previous floodplain will over-estimate the inundation extents. It is well beyond the scope of this project to deal with these issues, but I imagine we will have to document our findings somewhere, and I figured you would have experience with that.

Let me know what you think. Hope you're feeling better too!
-Jonathan

From: Richard Harris - FCDX
Sent: Tuesday, June 22, 2010 10:51 AM
To: Jonathan Lesperance - FCDX
Cc: Richard Harris - FCDX
Subject: RE: Wittmann -- Hydrology issue

Thanks Jonathon.

I read your emails from home, yesterday, and it sounded like there were some issues you wanted me to go over with you when I returned to work. Do those issues remain, or has the progress of your review and exchange with Seth jumped beyond them, now? It sounds like you and he are working through the

models still, per your email below. If there is anything you want to me to do at this time, please let me know.

Thanks,

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E-MAIL CORRESPONDENCE

INTERPOLATED SUB-BASIN NAMES

Ahrens, Seth

From: Richard Harris - FCDX [rph@mail.maricopa.gov]
Sent: Tuesday, June 08, 2010 5:21 PM
To: Ahrens, Seth
Subject: RE: Wittmann -- Sub-basin naming

Sounds fine to me....

From: Ahrens, Seth [mailto:SAhrens@pbsj.com]
Sent: Tuesday, June 08, 2010 4:37 PM
To: Richard Harris - FCDX
Cc: Jonathan Lesperance - FCDX
Subject: Wittmann -- Sub-basin naming

Richard,

The field DRNBSN_UL in drnbsn.shp contains the names of the sub-basins in the shapefile. This morning, we discussed adding –A or something similar to the end of the sub-basin names for those sub-basins that were divided for interpolation purposes. According to HIS standards, the limit on these names is six characters. All sub-basins, before I append –A, or already either 5 or 6 characters long. Please provide guidance on how I should rename this sub-basins.

FYI, here are the current names of the sub-basins:

TW452B
TW458
TW485

I could drop TW and call them 452B-A, 452-B, 458-A, and 485-A. These names are less six characters or less. What do you think?

Thanks,
Seth

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E-MAIL CORRESPONDENCE

LATERAL WEIR OPTIMIZATIONS

Ahrens, Seth

From: Richard Harris - FCDX [rph@mail.maricopa.gov]
Sent: Thursday, July 08, 2010 10:12 AM
To: Ahrens, Seth
Cc: Richard Harris - FCDX
Subject: FW: Wittman Phase III - Flow optimization in HEC-RAS

Hi Seth,

Below is the latest suggestion from Teri about documentation of WP III lateral weirs. Sounds like a good plan to follow. Good luck!

Richard

From: George, Teri S [mailto:tsgeorge@mbakercorp.com]
Sent: Thursday, July 08, 2010 9:20 AM
To: Richard Harris - FCDX
Subject: Wittman Phase III - Flow optimization in HEC-RAS

Richard,

Bottom line is that Seth will need to document the results of the model using the optimization versus un-checking the optimization option, then include the necessary RAS model(s) so that the reviewer (Unni) can run the model by checking or un-checking the option and get the same results. Without knowing the exact condition of where the 23 lateral weirs occur in the stream system, my suggestion is to document the results using a table that shows what the results are using optimization along with a column that reflects the flow that you chose to use.

Call if you want to discuss further.

Teri

From: Unnikrishna, Padinare
Sent: Wednesday, July 07, 2010 4:10 PM
To: Richard Harris - FCDX
Cc: George, Teri S
Subject: Flow optimization in HEC-RAS

Richard

I understand there is a question of flow optimization with regard to the Wittman study.

Using the flow optimization feature for lateral weirs will correctly partition the flow between the lateral weir and downstream using an iterative technique. It is described in the HEC-RAS User Manual (Version 4.1, Chapter 7, page 7-17). The manual states regarding flow optimization that 'this option allows the user to have the program optimize the split of flow at lateral structures, lateral diversions, stream junctions, and pump stations'.

Also stated in the manual -
' For the first iteration of the flow split optimization, the program assumes that zero flow is going out of the lateral structure. Once a profile is computed, the program will the compute the flow over the lateral structure. The program then iteratively reduces the flow in the main channel, until a balance is reached between the main river and the lateral structure'.

When the flow optimization option is chosen, and the flow is constant within the reach, then the results will show that the upstream discharge is the sum of the flow over the lateral weir and the downstream discharge. This is assuming the optimization converges, which it does in most cases if the flow condition is not complex (ex. a bridge near the lateral weir). If the flow is not constant within the reach, results are still correct but the summation will not hold because of backwater effects.

I'd recommend using the flow optimization option to determine the discharge going over the lateral weir accurately. This discharge can be used for determining the water surface profile along the flow split.

For the downstream reach, you may use the reduced discharge from the flow optimization run or decide to keep the same upstream discharge to be conservative. The model may be run without the flow optimization if no reduction in the downstream discharge is preferred. However, if a significant amount of flow is being diverted by the lateral weir as obtained by the flow optimization run, it may be overly conservative to use the upstream discharge for the downstream reach.

Hope this helps.

Thanks
Unni

Padinare V. Unnikrishna, Ph.D., P.E., CFM
Michael Baker Jr., Inc.
2929 North Central Avenue, Suite 800
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Ph: 602-798-7558
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Subject: Flow optimization in HEC-RAS

Richard

I understand there is a question of flow optimization with regard to the Wittman study.

Using the flow optimization feature for lateral weirs will correctly partition the flow between the lateral weir and downstream using an iterative technique. It is described in the HEC-RAS User Manual (Version 4.1, Chapter 7, page 7-17). The manual states regarding flow optimization that 'this option allows the user to have the program optimize the split of flow at lateral structures, lateral diversions, stream junctions, and pump stations'.

Also stated in the manual -
' For the first iteration of the flow split optimization, the program assumes that zero flow is going out of the lateral structure. Once a profile is computed, the program will the compute the flow over the lateral structure. The program then iteratively reduces the flow in the main channel, until a balance is reached between the main river and the lateral structure'.

When the flow optimization option is chosen, and the flow is constant within the reach, then the results will show that the upstream discharge is the sum of the flow over the lateral weir and the downstream discharge. This is assuming the optimization converges, which it does in most cases if the flow condition is not complex (ex. a bridge near the lateral weir). If the flow is not constant within the reach, results are still correct but the summation will not hold because of backwater effects.

I'd recommend using the flow optimization option to determine the discharge going over the lateral weir accurately. This discharge can be used for determining the water surface profile along the flow split.

For the downstream reach, you may use the reduced discharge from the flow optimization run or decide to keep the same upstream discharge to be conservative. The model may be run without the flow optimization if no reduction in the downstream discharge is preferred. However, if a significant amount of flow is being diverted by the lateral weir as obtained by the flow optimization run, it may be overly conservative to use the upstream discharge for the downstream reach.

Hope this helps.

Thanks
Unni

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E-MAIL CORRESPONDENCE

PRJ_RID REQUEST

Ahrens, Seth

From: Mark Brewer - PWX [mrb@mail.maricopa.gov]
Sent: Wednesday, June 09, 2010 8:43 AM
To: Ahrens, Seth
Cc: Richard Harris - FCDX; Jonathan Lesperance - FCDX
Subject: RE: Wittmann Phase III FDS -- (2009C006)

Prj_rid = 1302

From: Ahrens, Seth [mailto:SAhrens@pbsj.com]
Sent: Tuesday, June 08, 2010 5:34 PM
To: Mark Brewer - PWX
Cc: Richard Harris - FCDX; Jonathan Lesperance - FCDX
Subject: Wittmann Phase III FDS -- (2009C006)

Mark,

I am working with Richard and Jonathan on the Wittmann Phase III FDS. This work is being conducted under contract 2009C006, Assignment 3. Could you please provide all of us with a PRJ_RID number for this project? Do you need any additional information from me to generate this number?

Thanks,
Seth

Seth Ahrens, P.E., CFM
Senior Water Resources Engineer
PBS&J
20860 North Tatum Boulevard
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E-MAIL CORRESPONDENCE

WLB GROUP ADMS REPORT

Ahrens, Seth

From: Jonathan Lesperance - FCDX [jonathanlesperance@mail.maricopa.gov]
Sent: Tuesday, June 29, 2010 4:12 PM
To: Ahrens, Seth
Cc: Richard Harris - FCDX
Subject: RE: Wittmann ADMS HEC-1 models

Hi Seth,

As far as I can tell, your assumption of C37 seems to be correct. Unfortunately, the schematic in the report I emailed previously is all that I can find in our model (digital) library and our engineering library. Even more unfortunately, the 100-Yr HEC-1 output report in our engineering library is missing the flow summary pages that contain C37 and surrounding areas. Because of this, I do not know if the earlier version of HEC-1 would have produced a similar discharge value or not. I do not have access to the earlier HEC-1 program versions (perhaps Richard does?). The 50 year discharge value in the same report is listed as 662 cfs. I don't know if that helps. The maximum stage for that flow is 1721.01. Please let me know if we need to track down more information, but this was the best I could do with limited time this afternoon.

Thanks!
Jonathan

From: Ahrens, Seth [mailto:SAhrens@pbsj.com]
Sent: Tuesday, June 29, 2010 12:38 PM
To: Jonathan Lesperance - FCDX
Cc: Richard Harris - FCDX
Subject: RE: Wittmann ADMS HEC-1 models

Jonathan/Richard,

Thanks for forwarding to me the HEC-1 modeling and the WLB work map.

I took a look at WTM100yr.out. Note that although this file has a .out suffix, it is a HEC-1 input file. Here's what I found:

1 – I think that the concentration point of interest in this model is C37.
2 – I picked this point because it is the only storage-routing point with elevations in the range of the floodplain that is plotted on WLB's work map (elevation range 1720 to 1730 ft). In addition, the KM card says the bridge is 70 ft wide, which is about right. The KM card also says the bridge has 5 spans, which is not correct, although perhaps the bridge has been re-built since 1986. Note that I couldn't find anything on the work map that indicated what concentration point was used to map each floodplain.
3 – I re-ran the model, but the version of HEC-1 that I have is from 1998, and the date of the ADMS is 1986. Therefore, I may be getting different values in my HEC-1 output from what WLB did.
4 – The 100-year peak flow rate at C37 is 935 cfs. This corresponds to an elevation of 1722.2 ft NGVD 29 for the existing floodplain just upstream of the railroad bridge.
5 – This corresponds to 1722.2 ft NGVD + 2.06 ft = 1724.26 ft NAVD 88 for the existing floodplain. This would be the starting water surface elevation to be used to begin the HEC-RAS model for Wash 2 West Tributary 1.

Questions:

1 – Could you please review this thinking and let me know whether you agree?

2 – Would you happen to have a copy of the version of HEC-1 that was effective in 1986? Or maybe an output file for wtm100yr that was run using the old HEC-1? If you have the old version of HEC-1, could you please re-run the model to verify that that version of HEC-1 also generates a peak stage of 1722.2 at conc pt C37?

Thanks,
Seth

From: Jonathan Lesperance - FCDX [mailto:jonathanlesperance@mail.maricopa.gov]
Sent: Monday, June 28, 2010 3:16 PM
To: Ahrens, Seth
Cc: Richard Harris - FCDX
Subject: Wittmann ADMS HEC-1 models

Hi Seth,

Here are the models for the Wittmann area that you requested. I can also provide the HEC-2 files if you would like.

Thanks!

Jonathan Lesperance, Hydrologist
Hydrology and Hydraulics Branch
Engineering Division
Flood Control District of Maricopa County
O:602.506.4699
C:775.354.8831
F: 602.506.4601

Please consider the environment before printing this email.

APPENDIX B.3

MEETING MINUTES

MEETING MINUTES

B.3.1 Meeting Minutes

There were five meetings held in support of this project. Project progress meetings were held on:

- April 29, 2010
- May 26, 2010
- June 9, 2010
- June 28, 2010
- August 11, 2010

Meeting minutes for each meeting may be found on the following pages.

Note that there was no public meeting for this project because too few homeowners were impacted to warrant a meeting. Public notification for this project occurred via U.S. mail. More information may be found in Appendix B.4.

MEETING MINUTES

PROGRESS MEETING
APRIL 29, 2010

Wittmann Phase III FDS

Contract FCD 2009C006, Assignment 3

Project Status Meeting – April 29, 2010

Attendees: Richard Harris, FCDMC

Jonathan Lesperance, FCDMC

Kevin Bischel, Planning and Development

Seth Ahrens, PBS&J

Meeting Minutes

Seth gave a summary of the status of the project

FCDMC indicated that it is okay to place the field photography in Appendix E

It is not necessary to create a separate Appendix F for field work as was done for Gavilan

Team talked about ADWR guidelines for FDS's

Seth will email Jonathan a copy of these

Team went over the draft copy of the Manning's n value report

Horizontal placement of Manning's n values should be used in the RAS modeling

Use aerial photography to help assign values

Place the bank stations at their true points, not where Manning's n values change

FCDMC requested that a table be added to the report that specified the latitude and longitude of where the photos in the report were taken

FCMDC stated that FIS report should be checked to see what information is available for this area

FCDMC requested that the Summary of Discharge Table (SODT) in Section 7 of the TDN show which cross sections are located at the highway so that the SODT in the FIS can reference these flow rates

From here the discussion moved to the hydrology of the project.

PBS&J added a few concentration points to the HEC-1 modeling and interpolated the peak flow rates in three sub-basins. FCDMC requested that a point shapefile of the new concentration points and a line shapefile of the subdivided basins be included in the TDN.

For the sub-basins that are sub-divided, use the shapefiles from Entellus' study as a base since the attribute table for these sub-basins contains the Green-Ampt parameters.

FCDMC indicated it is appropriate to sub-divide sub-basins with routing reaches longer than one mile.

Wash 2 West Tributary 1 – Downstream end shall tie in to existing FCDMC RAS model. PBS&J will request this model from FCDMC.

Survey – There were discussions related to the survey of the BNSF railroad and to the presence of barbed wire along SR 74 that limits access. PBS&J will talk with Premier about this.

FCDMC requested that Premier's deliverables include a DXF of their survey.

Kevin Bischel is completing FLO-2D modeling in the project study area. Kevin provided PBS&J with rough results from the modeling. Refined results will be provided at a later date. FLO-2D results may be useful in determining peak flow rates to use in RAS modeling downstream of splits.

Wash 2 West Tributary 1 – Downstream end shall tie in to existing FCDMC RAS model. PBS&J will request this model from FCDMC.

Wash 2 West Tributary 1 – Contour mapping does not pick up one lane of the highway. This will be addressed during the survey.

Wash 2 West Tributary 1 – Railroad is acting like a levee. RAS will assume embankment does not fail. For "fail" condition, a Zone A floodplain will be added to the floodplain mapping. It is okay to estimate the limits of the Zone A floodplain mapping by hand.

Data collection report – Draft report was submitted previously. FCDMC indicated they had no comments and that as the project moves forward the report should continue to be updated if necessary.

Schedule – FCMDC requested a revised version of the schedule.

MEETING MINUTES

PROGRESS MEETING
MAY 26, 2010

Wittmann Phase III FDS

Contract FCD 2009C006, Assignment 3

Project Status Meeting – May 26, 2010

Attendees: Richard Harris, FCDMC

Jonathan Lesperance, FCDMC

Nicole Scheider, FCDMC

Seth Ahrens, PBS&J

Meeting Minutes

Invoicing

All present discussed the previous invoice. FCDMC indicated that the previous invoice will be processed once PBS&J provides all backup hydrology calculations in support of the draft hydrology report that was submitted previously. These backup calculations would include a revised version of the hydrology report that addresses FCDMC's comments on the draft, all supporting spreadsheets and shapefiles that were generated, and the original and revised HEC-1 models. Note that the only modification PBS&J made to the existing HEC-1 modeling was to add a few concentration points in order to produce additional output from the HEC-1 model.

FCDMC requested that PBS&J send three copies of the invoice during future billings. The third copy should be sent to Jonathan.

Much of the discussion throughout the rest of the meeting focused on hydraulic modeling issues:

Junctions

FCDMC stressed that the goal of every FDS is to submit a study to FEMA that receives zero comments. With respect to the confluences in the hydraulic modeling, FEMA guidelines should be followed to determine whether the starting water surface elevation for a given model should be based on the normal depth slope or on a known water surface elevation. PBS&J will apply FEMA's methodology for determining whether the peaks at a confluence are coincident or not (FEMA G&S, Appendix C, Section C.3.3.1).

Deliverables

All present discussed the various elements of the hydraulic analysis that will need to be reviewed by FCDMC. FCDMC will review the following items:

1 – Cross section alignment

2 – Manning's *n* report

3 – Hydraulic model documentation

4 – Draft floodplain delineations

5 – Section 5 of TDN

Items 1 and 2 have been submitted. Items 3 and 4 will be submitted concurrently, followed by item 5.

PBS&J requested a list of items to be included with the submittal for item 3. FCDMC said the following items should be included:

Cross section "Descriptions" in HEC-RAS "Cross Section Data" window should be completed

e.g. XS immediately upstream of US 60 boxes

XS immediately downstream of Breakout 2 split

Model "Description" in main HEC-RAS window

Input modeling descriptions

This would include a memorandum summarizing the sources of modeling input

Discuss the terrain, Manning's n, flow rates, etc.

Any unusual features in the HEC-RAS modeling (e.g. culverts under US 60)

CulvertMaster models of structures modeled by HEC-RAS

Regarding the CulvertMaster models, the HEC-1 models should be re-visited, too. Some of the structures in the Wittmann Phase III FDS study area were modeled in HEC-1 using a stage/storage routing methodology. The peak water surface elevations behind these structures should be compared to the water surface elevations predicted by CulvertMaster where applicable.

FCDMC indicated that in those cases where CulvertMaster or HEC-1 predicted higher water surface elevations than HEC-RAS, PBS&J should consider adding a Zone A floodplain that would flood the area between the extents of the HEC-RAS floodplain and the CulvertMaster/HEC-1 floodplain.

Other Modeling Issues

Area Upstream of Railroad Bridge for Wash 2W Tributary 1

On the east side of this wash, just upstream of the BNSF railroad bridge, a breakout likely occurs. This area will be modeled with a lateral weir. Note that the survey of the area will survey the top of this weir. PBS&J will review this area with FCDMC once the magnitude of the breakout is determined.

FCDMC noted that if the breakout is mapped with a Zone A floodplain, cross sections need only be placed every quarter mile.

Note that there are other areas where breakouts will occur. The same approach will be applied to each breakout: use a lateral weir to determine the flow rate that leaves via the breakout and then coordinate with FCDMC on the most appropriate modeling solution for the breakout.

Downstream End of Wittmann Wash Tributary 1

The preliminary hydraulic modeling indicated that there will be a breakout along the west side of the downstream end of Wittmann Wash Tributary 1. This breakout has the potential to flow parallel to existing floodplain mapping from the ADMSU done by Entellus. Depending on the magnitude of the breakout, a Zone A floodplain may be added to this area.

Flow Splits

In some areas there will be flow splits not because flow will leave the wash via a lateral weir, but because the floodplain extends across multiple channels, and one of chose channels eventually splits away from the main wash and takes flow with it. In areas where this kind of split occurs, the flow distribution output option in HEC-RAS will be used to determine the flow rate that proceeds down each flow path. As with the breakouts that occur via a lateral weir, PBS&J will determine the magnitude of the flow rate that leaves the wash and coordinate with FCDMC regarding the most appropriate modeling solution for the split flow.

Public Meeting

The remainder of the meeting focused on the public meeting for this FDS. Outside of the land owned by ASLD or the BNSF railroad, very few private landowners will be impacted by the study. Instead of holding a public meeting, FCDMC might send letters via certified mail to the affected property owners offering to meet them one-on-one to discuss the study. PBS&J will prepare an approximate floodplain of the study area, buffer the limits of this floodplain by 200 feet, and submit the buffered floodplain to

FCDMC. FCDMC will use this floodplain to determine how many landowners are impacted, and whether the preferred approach to public outreach is an open house or letters sent via certified mail.

Next Meeting

The next status meeting will be on June 9th.

MEETING MINUTES

PROGRESS MEETING
JUNE 9, 2010

Wittmann Phase III FDS

Contract FCD 2009C006, Assignment 3

Project Status Meeting – June 9, 2010

Attendees: Richard Harris, FCDMC
Jonathan Lesperance, FCDMC
Nicole Scheider, FCDMC
Seth Ahrens, PBS&J

Meeting Minutes

Prior to the meeting, PBS&J identified all of the flow splits and places where lateral weirs were needed. These areas were reviewed on a case-by-case basis during this meeting and a methodology was outlined for each.

Lateral Weir A -- Wash 2 West Tributary 1 – Weir 8.736

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 132 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir B -- Wash 2 West Tributary 1 – Weir 6.487

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 8 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir C -- Wash 2 West Tributary 1 – Weir 4.374

This lateral weir will be removed from the model. It looked like a breakout was occurring, but once the lateral weir was placed in the model, the flow rate that left was 0 cfs.

Lateral Weir D -- Wash 2 West Tributary 1 – Weir 4.364

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 38 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir E -- Wash 2 West Tributary 1 – Weir 4.047

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 160 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir F -- Wash 2 West Tributary 1 – Near RS 0.288

(Note: Between this meeting and the writing of the TDN, this weir was removed from the modeling.)

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 218 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir G – Wittmann Wash Tributary 1 – Weir 4.280

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 40 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir H – Wittmann Wash Tributary 1 – Weir 3.634

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 640 cfs. The breakout flow travels about 3,500 feet and then re-enters Wittmann Wash Tributary 1. Per guidance from FCDMC, this breakout will be modeled using either 2 or 3 FlowMaster cross section and mapped with a Zone A floodplain. A "Limit of Study" line will be placed along the floodplain boundary at the point where the flow that originates from the upstream drainage area enters the breakout floodplain. Text will be included in the TDN indicating that the "Limit of Study" line was

included at FCDMC's direction. Text will also be included that indicates that this area is a candidate for further study by FCDMC.

FCDMC indicated that the desire to map this area with a Zone A floodplain is driven by the need to minimize the cost of this project. FCDMC hopes that future funding will be available to revisit areas such as this at a later date when funding for a detailed analysis is available.

During the meeting, it was observed that the lateral weir might need to be extended farther downstream. PBS&J has done this by creating new lateral weir 3.455. A new weir was created so that the flow that leaves via this weir may be computed separately from the flow that leaves via lateral weir H. Preliminary calculations revealed that the flow rate that leaves is about 1 cfs.

Lateral Weir I – Wittmann Wash Tributary 1 – Weir 1.807

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 140 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Lateral Weir J – Wittmann Wash Tributary 1 – Weir 0.345

In the latest version of the HEC-RAS model of this wash, the 100-year flow rate that left via the lateral weir was 86 cfs. FCDMC indicated to PBS&J that all breakout flows less than 250 cfs do not need to be modeled. On the work maps, an arrow should be placed where the breakout flow leaves pointing in the direction of where the flow goes. The 100-year peak flow rate (cfs) that leaves via the breakout should be placed next to the arrow.

Breakout 3 of Wittmann Wash Tributary 1

The upstream end of this wash is located at a flow split that was modeled by Entellus in their HEC-1 model of the area. According to HEC-1, 1811 cfs approaches the upstream side of the split. 652 cfs proceeds down Breakout 3 and 1159 cfs proceeds down Wittmann Wash Tributary 1.

When the split was modeled using HEC-RAS, this modeling predicted that 1000 cfs would proceed down Breakout 3 and 811 cfs would remain in Wittmann Wash Tributary 1. Although this is significantly different from the flow rates determined by HEC-1, FCDMC directed PBS&J to use the results from the HEC-RAS analysis since the hydraulic analysis is more detailed and more thorough than what is in the hydrologic analysis.

There is a split within Breakout 3 on the left side of RS 0.442. Flow that leaves via this split will re-enter Breakout 3 downstream from RS 0.185. Per guidance from FCDMC, the amount of flow that leaves via this split will be determined via a flow distribution analysis in HEC-RAS. If it is less than 250 cfs, a flow

arrow will be used. Otherwise, it is acceptable to model this breakout approximately with FlowMaster and map it with a Zone A floodplain.

Wittmann Wash Tributary 1

Similar to the situation discussed for RS 0.442 in Breakout 3, there is a flow split at RS 1.926 in Wittmann Wash Tributary 1. As with the split in Breakout 3, the flow rate that leaves via the split will be determined using a flow distribution analysis in HEC-RAS. If the flow rate is less than 250 cfs, a flow arrow will be used. If greater than 250 cfs, a FlowMaster model will be built and a Zone A floodplain will be applied.

Breakout 4 of Wittmann Wash Tributary 1

According to the HEC-RAS models for this wash and Wittmann Wash Tributary 1, 300 cfs enters this wash at its upstream end.

Near RS 0.558, there is a breakout to the east. The flow rate that leaves via this breakout will be determined using a flow distribution in HEC-RAS.

The rest of the flow in this wash will head south to the ponded area visible on the aerial. Downstream of the ponded area, there is another flow split where some flow will travel southeast a short distance back into Wittmann Wash Tributary 1 and the rest will head to the southwest to a pipe culvert underneath SR 74.

Per FCDMC guidance, it will be assumed 100% of the flow that is assumed to reach the ponded area will travel to the southwest. The desire to send 100% of the flow rate down each flowpath is to account for "fail" and "no-fail" conditions for the pond. HEC-RAS will be used to model the flow that travels to the southwest and eventually returns to Wittmann Wash Tributary 1. Since the flow path that travels to the southeast travels such a short distance before it reaches Wittmann Wash Tributary 1, the floodplain mapping for Breakout 4 will be extended into the floodplain mapping for Wittmann Wash Tributary 1. In addition, it will be assumed that all of the flow in Breakout 4 will return to Wittmann Wash Tributary 1 between RS 4.336 and RS 4.287.

Another issue with Breakout 4 is that as water ponds behind SR 74, some water will leave the wash and head west upstream of the highway via a lateral weir. Since the flow rate will be less than 250 cfs, a flow arrow will be used on the work maps to show how much flow leaves. A lateral weir will also be added to the east side of Wittmann Wash Tributary 1 upstream of SR 74 to determine the flow rate that leaves the wash in this area. If this flow rate exceeds 250 cfs, PBS&J will notify FCMDC.

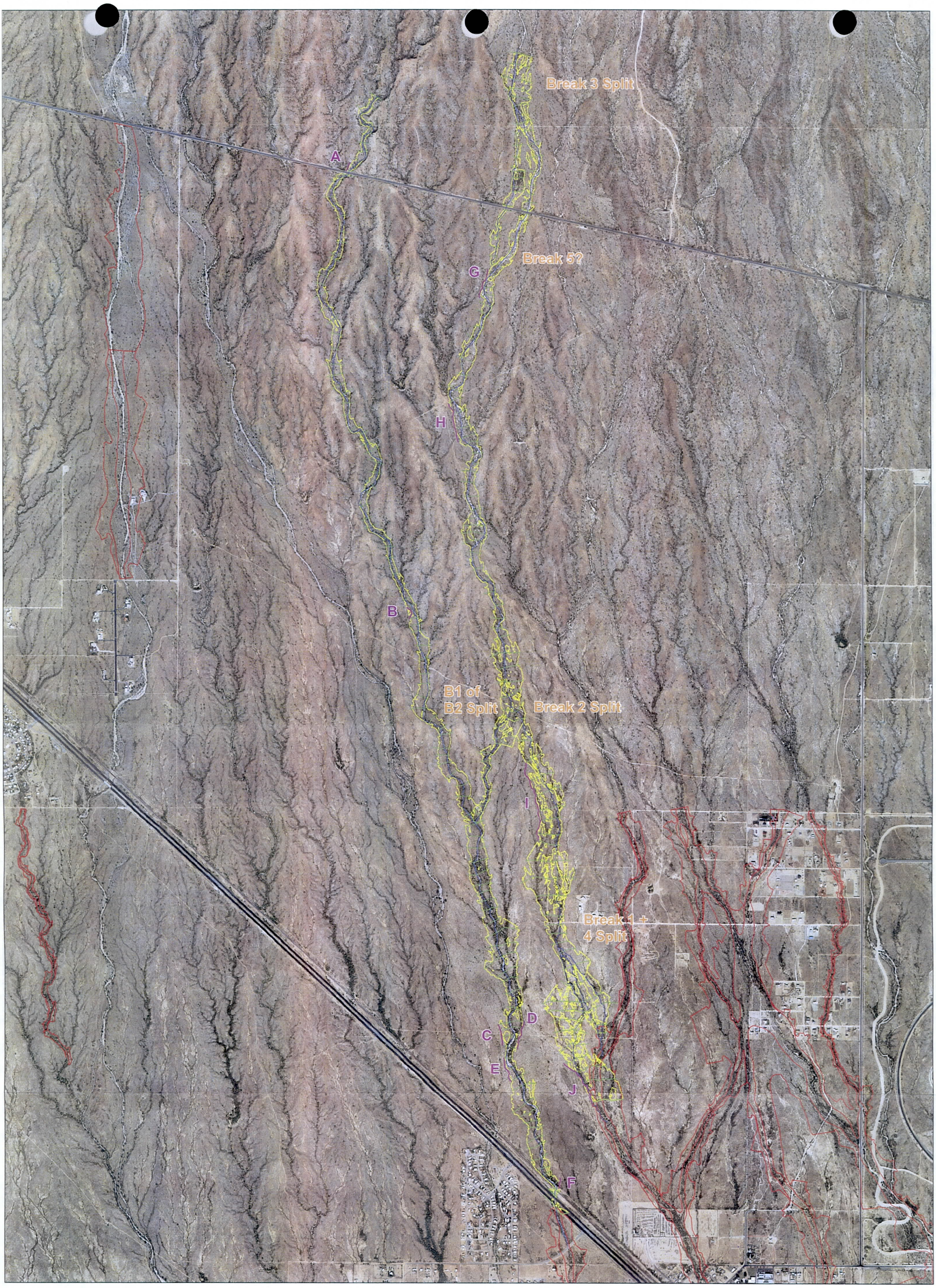
FLO-2D Results

Kevin Bischel from Maricopa County Planning and Development was previously working on a FLO-2D model of the study area, but he was re-assigned to a different project before he could complete and fully document the FLO-2D analysis. Jonathan Lesperance was able to acquire a DVD of all of the data

Kevin generated during his analysis. The data on this DVD will be included in the appendix of the Wittmann Phase III FDS TDN for reference.

Outreach

All present discussed the outreach needs for this project. Based on the results to date, the team was confident that no homes would be flooded to the west of Wittmann Wash just upstream of US 60 due to breakouts from the Wittmann Phase III FDS study streams. PBS&J would continue working to confirm that this was definitively the case using FlowMaster to model the ditches on the north side of US 60.



Wittmann Phase III FDS
Project Status Meeting
June 9, 2010

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MEETING MINUTES

PROGRESS MEETING
JUNE 28, 2010

Wittmann Phase III FDS

Contract FCD 2009C006, Assignment 3

Project Status Meeting – June 28, 2010

Attendees: Richard Harris, FCDMC
Jonathan Lesperance, FCDMC
Nicole Scheider, FCDMC
Jeff Shelton, FCDMC
Seth Ahrens, PBS&J

Meeting Minutes

The goal of this meeting was to give FCDMC the opportunity to provide feedback on the draft floodplain work maps PBS&J had prepared and to discuss how to approach the modeling of the downstream end of Wash 2 West Tributary 1.

Work Map Feedback

The following list summarizes FCDMC's suggested revisions to the work maps:

- Do not include cross sections from Entellus's ADMSU.
- Do include floodplain from Entellus's ADMSU. Label them as being not part of study.
- Do not include lateral weirs.
- Add structures (e.g. houses not culverts) to the work maps, especially on sheets 10 and 11.
- Cover sheet: Premier will need to sign/seal the survey statement.
- Cover sheet: Topo flight date was April 2002 (there were several that month). Contract FCD 01-21 was completed by Stewart Geo Technologies. PRJ Scale = 100 (this is the map scale). Vertical datum is NAVD 88. Contour interval is 2 feet.
- Along SR 74, where structures are not overtopped, add note indicating that the 100-year event is contained in the culverts.
- Downstream end of Wittmann Wash Tributary 1: Do not extend floodplain past most downstream cross section. Add a small Zone A floodplain in this area to connect new mapping to existing mapping.

Downstream End of Wash 2 West Tributary 1

Just upstream of the railroad bridge, there is a berm on the east side of the wash that re-directs water that flows parallel to the railroad bridge to the south so that it flows under the bridge. There is no rip rap protection at the base of the berm. During the 100-year event, some water flows around the north end of the berm. Overall, the project team is not confident that this berm would survive the 100-year event. Options for modeling this area were discussed during the meeting.

The option that the team felt modeled the most appropriate "fail" condition while meeting FEMA's standards involved the following:

> First, model the area assuming that the railroad bridge berm has failed. Assume that the railroad and US 60 do not fail. This is what the team referred to as the "most likely fail condition." A significant portion of the water that previously would have gone underneath the railroad bridge would flow to the southeast under fail conditions. It is likely that several structures near Wittmann Wash at US 60 would be flooded by this water.
>
> Next, model the area assuming that the railroad bridge berm, the railroad bridge, and US 60 all have failed. Before these structures were built, Wash 2 West Tributary 1 naturally flowed in a north-to-south pattern. All flooding that occurred during this all-fail condition that resided outside the Zone AE mapping of Wash 2 West Tributary 1 would be mapped with a Zone A floodplain.

After the meeting ended, Richard Harris, Jonathan Lesperance, and Seth Ahrens met with Amir Motamedi of FCDMC to discuss this approach. Amir brought some interesting big picture perspective to this area. Specifically, he indicated that studying this area to the level of detail proposed by failing the railroad berm, etc. may not be the best use of resources at this time since there are many washes along the railroad that also have berms that may fail, and it would be better for FCDMC to study all of these washes together as a system to determine more accurately what the 100-year breakout flow rates would be along the length of the railroad. Amir's preferred approach to this area would be to use the small effective FEMA floodplain just upstream of the railroad bridge that was mapped by The WBG Group in 1986 as part of the Wittmann ADMS (contract FCD 86-24, workmap G-2, sheet 5 of 55) as the downstream boundary condition for Wash 2 West Tributary 1. Although this floodplain has been mapped with a Zone A floodplain, a water surface elevation should be available in the HEC-1 modeling of this area. The project team decided that this was a reasonable approach for modeling the downstream area of Wash 2 West Tributary 1 and will apply this methodology to the modeling of the wash.

MEETING MINUTES

PROGRESS MEETING
AUGUST 11, 2010

Wittmann Phase III FDS

Contract FCD 2009C006, Assignment 3

Project Status Meeting – August 11, 2010

Attendees: Richard Harris, FCDMC
Jonathan Lesperance, FCDMC
Seth Ahrens, PBS&J

Meeting Minutes

The goal of this meeting was for PBS&J to ask FCDMC follow up questions related to the hydraulic modeling and floodplain mapping comments dated July 30, 2010. Below is a summary of each topic that was discussed as well as its resolution:

- Public outreach letters announcing study: PBS&J never received final versions of these letters. FCDMC to provide them for the TDN.
- CHECK-RAS Error Code E: Discussed how not every cross section with a lateral weir will receive this Flow Code designation from CHECK-RAS.
- Split near RS 0.387 in Breakout 4 of Wittmann Wash Tributary 1: Concluded that a Zone A floodplain between Breakout 4 of Wittmann Wash Tributary 1 and Wittmann Wash Tributary 1 is acceptable. Decided to add text in TDN discussing "with" and "without" conditions with respect to stock pond.
- FlowMaster models: FCDMC confirmed that centerlines and cross sections related to FlowMaster modeling should not be included in the official GIS datasets but that they should be included in the same folder where the FlowMaster models are located.
- Floodplain mapping near structures: Confirmed that Zone A floodplains should be added near structures to cover the "fail" condition of SR 74.
- Lateral weirs: FCDMC indicated it was okay to include the footprints of the lateral weirs on the work maps. They will not be submitted digitally.
- Wash 2 West Tributary 1 stationing: Discussed how centerline for portion of Wash 2 West Tributary studies in this FDS now snaps to the wash centerline established by Entellus during their ADMSU. PBS&J centerline now snaps to Entellus centerline at RS 3.335 in Entellus modeling. FCMDC requested that PBS&J send a screen shot of this area to them for reference.

- Legend: Since there are now 2-ft/10-ft and 4-ft/20-ft contour intervals south and north of the Cloud Road alignment, respectively, the legend will now refer to the contour lines as Index (10- or 20-ft) or Intermediate (2- or 4-ft) contours.

- Islands: Several islands that had been designated as Zone X will now be labeled Zone A since the ground elevations in these islands are not significantly higher than the mapped water surface elevations.

- Flow arrows: PBS&J will review the longer lateral weirs and add multiple flow arrows with partial flow rates as needed. Sum of partial flow rates for a given weir needs to match the total flow rate that HEC-RAS has determined leaves the wash.

- Ground survey note on cover sheet: Use note from HDR's Ocotillo Wash as much as possible.

A brief follow up meeting was held the next day (8/12/10). Here is a summary of what was discussed:

- Breakout flow rates on the hydraulic work maps and in the TDN are always rounded up to the next whole number. Make sure this is stated in the TDN.

- Discussed why flow rates jumps on RS 4.689 and not RS 4.653 along Wittmann Wash Tributary 1. Concluded this approach is appropriate since it is consistent with how the other confluences are modeled.

- With respect to Richard's Shapefile Comment 2, it is okay for the point shapefile of flows to include only flows from the HEC-1 output and not all flow rates that appear in the HEC-1 modeling.

APPENDIX B.4

GENERAL CORRESPONDENCE

GENERAL CORRESPONDENCE

B.4.1 General Correspondence

On the following pages may be found:

- A copy of the affidavit for the Legal Advertisement announcing the intent to perform the *Wittmann Phase III Floodplain Delineation Study*. This advertisement appeared in the *Arizona Business Gazette*.

- The property notification letters sent to the area property owners announcing FCDMC's intent to perform the *Wittmann Phase III Floodplain Delineation Study*.

- The property notification letters sent to the area property owners announcing the results of the study. Since so few property owners were impacted by the study's results, these letters were sent in lieu of holding a public meeting.

GENERAL CORRESPONDENCE

LEGAL ANNOUNCEMENT OF STUDY

AFFIDAVIT OF PUBLICATION
TRILBY WASH WATERSHED

Wittman Phase III

01

Arizona Business Gazette

The business resource

PO BOX 194
Phoenix, Arizona 85001-0194
(602) 444-7315 FAX (602) 444-7364

ANNOUNCEMENT OF INTENT TO PERFORM A FLOODPLAIN DELINEATION STUDY WITHIN THE TRILBY WASH WATERSHED

The Flood Control District of Maricopa County (FCDMC) has contracted with PBS&J to perform a limited detail Zone AE floodplain (without floodway) delineation study of selected watercourses within the Trilby Wash Watershed. The study area is located in the northwestern part of Maricopa County, roughly from near the intersection of the 223rd Avenue and US Highway 60 alignments to near the SW corner of Section 14 in Township 6 North, Range 3 West.

This study will examine and evaluate the flood hazard areas in the watershed to determine limited detail floodplain limits. These limits will then be used to determine the flood insurance rates used by the Federal Emergency Management Agency (FEMA).

This announcement is intended to inform all interested persons and communities of the commencement of this study and to present to them the opportunity to bring any relevant technical information to the attention of the FCDMC/FEMA for consideration during the course of this study. Your comments should be addressed to Mr. Richard P. Harris, P.E., at the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, AZ 85009, (602) 506-4528.

Published: March 4, 2010

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

Mark Gilmore, being first duly sworn, upon oath deposes and says: That he is the Legal Ad Rep of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published weekly at Phoenix, Arizona, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates indicated.

3/4/2010

Sworn to before me this
4TH day of
MARCH 2010

TABITHA ANTONIADIS
Notary Public - Arizona
Maricopa County
My Comm. Expires Nov 8, 2012

Notary Public

GENERAL CORRESPONDENCE

PROPERTY NOTIFICATION LETTERS

ANNOUNCING INTENT TO PERFORM STUDY

Project Overview

The study area is located in the northwestern part of Maricopa County, roughly from near the intersection of the 223rd Avenue and U.S. Highway 60 alignments to near the SW corner of Section 14 in Township 6 North, Range 3 West. Based on property ownership records, if you have received this mailer, your property is either located in or near an existing floodplain, or it may lie near a proposed floodplain.

This study will examine and evaluate the flood hazard areas in the watershed to determine limited detail floodplain limits. These limits will then be used to determine the flood insurance rates used by the Federal Emergency Management Agency (FEMA).

Contact

Richard Harris, P.E., CFM
Project Manager
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009
602-506-4528
rph@mail.maricopa.gov

Seth Ahrens, P.E., CFM
PBS&J
20860 North Tatum Boulevard, Suite 300
Phoenix, AZ 85050
480-419-7275
sahrens@pbsj.com

Parcel number(s) for your property within the study area is (are) located on the mailing label above your name. If you wish to get floodplain information for your parcel(s), please contact Richard Harris.

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix Arizona 85009

April 2010

Wittmann Phase III Floodplain Delineation Study

Study Notification/
Right of Entry
for Surveying and
Reconnaissance Purposes

Maricopa County Supervisor:
Max Wilson, District 4

www.fcd.maricopa.gov

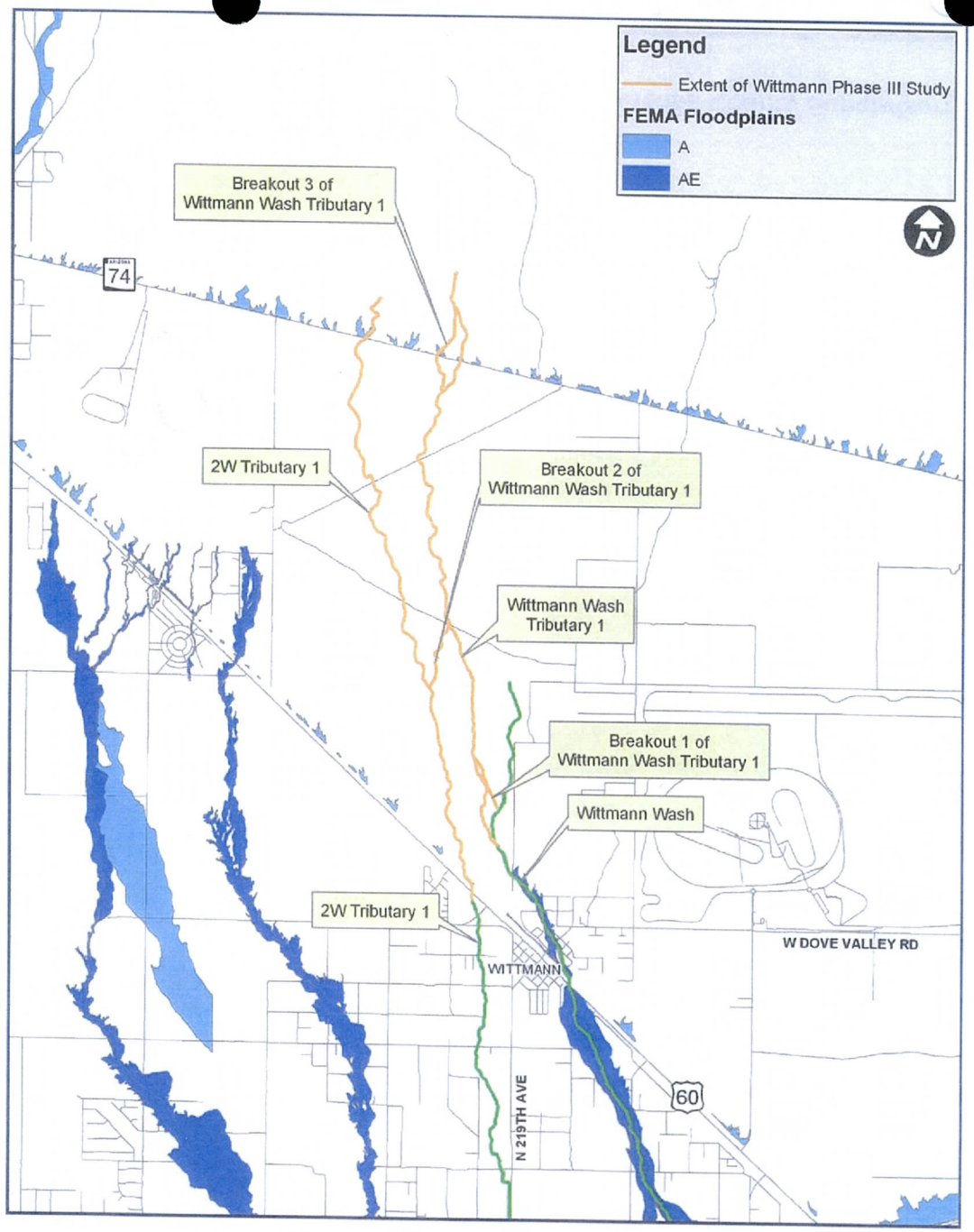
Wittmann Phase III Floodplain Delineation Study

Introduction

For more than 50 years, the Flood Control District of Maricopa County (District) has provided regional flood control services to county residents to reduce their risks of injury, death, and property damage from flooding.

The District has contracted with PBS&J to perform a limited detail Zone AE floodplain (without floodway) delineation study of selected watercourses within the Trilby Wash Watershed. The study began on April 1, 2010 and this notification is intended to advise you that it may be necessary to briefly enter or cross your property to perform surveying and reconnaissance activities in support of the study.

This activity should not result in any inconvenience to you or damage to your property. If you have any objection to the entry onto your property, please notify Richard Harris at 602-506-4528 within 72 hours of receipt of this notification. Otherwise, it will be assumed that you consent to the entry onto your property.



Map not to scale.

For more information, visit the District's Web site at www.fcd.maricopa.gov.

GENERAL CORRESPONDENCE

PROPERTY NOTIFICATION LETTERS

ANNOUNCING RESULTS OF STUDY

Flood Control District
of Maricopa County

Board of Directors
Fulton Brock, District 1
Don Stapley, District 2
Andrew Kunasek, District 3
Max Wilson, District 4
Mary Rose Wilcox, District 5

www.fcd.maricopa.gov

2801 West Durango Street
Phoenix, Arizona 85009
Phone: 602-506-1501
Fax: 602-506-4601
TT: 602-505-5897

July 23, 2010

United States of America
P. O. Box 81169
Phoenix, Arizona 85068

Assessor's Parcel Number(s): 50313001 & 50313002

Subject: Wittmann Phase III Floodplain Delineation Study, Contract FCD 2009C006, Work Assignment #3

Dear Maricopa County Property Owner:

The Flood Control District of Maricopa County (District) is writing to inform you that the results of the limited detail floodplain (without floodway) delineation performed for the Wittmann Phase III Floodplain Delineation Study are completed. Based on property ownership records, your property is at least partially within this recently identified floodplain.

The study area consists of mostly undeveloped lands that are prone to future development. Future development is likely due to the area's proximity to existing developed areas as well as its classification as a Special Planning Area by the City of Surprise, which makes the area a candidate for future annexation by the City.

The floodplain delineation study will establish the boundaries of the 1-percent annual chance (Zone AE) floodplain along those washes that were studied. The study will result in roughly 13 miles of Zone AE riverine floodplain delineation. The flood study results will increase awareness regarding the local risk of flood hazards and therefore contribute to safe and prudent future development within the area.

The delineation study will be submitted to the Federal Emergency Management Agency (FEMA) for adoption shortly after you receive this letter. The FEMA approval process may take one year or longer. FEMA will use the study data to update the Flood Insurance Rate Maps and Flood Insurance Study for the National Flood Insurance Program. In the interim, the District and other jurisdictions will use the data as the "best available information" for floodplain management. Persons with buildings on their property within the proposed floodplain may be required to purchase flood insurance after the floodplain is adopted by FEMA and the Flood Insurance Rate Maps are updated. In those cases where flood insurance is not required, the District strongly recommends that property owners purchase flood insurance coverage to protect buildings on their property from future flood damage.

If you have any questions about the delineations or would like to set up a meeting to discuss how your property is affected, please contact Richard P. Harris at (602) 506-4528 or via rph@mail.maricopa.gov or Jonathan Lesperance at (602) 506-4699 or via jonathanlesperance@mail.maricopa.gov.

Sincerely,

Richard P. Harris

Richard P. Harris, P.E.
Project Manager

Flood Control District
of Maricopa County

Board of Directors
Fulton Brock, District 1
Don Stapley, District 2
Andrew Kunasek, District 3
Max Wilson, District 4
Mary Rose Wilcox, District 5

www.fcd.maricopa.gov

2801 West Durango Street
Phoenix, Arizona 85009
Phone: 602-506-1501
Fax: 602-506-4601
TT: 602-505-5897

July 23, 2010

Atchison, Topeka and Santa Fe Railway
P. O. Box 961089
Fort Worth, Texas 76161

Assessor's Parcel Number(s): 50317306

Subject: Wittmann Phase III Floodplain Delineation Study, Contract FCD 2009C006, Work Assignment #3

Dear Maricopa County Property Owner:

The Flood Control District of Maricopa County (District) is writing to inform you that the results of the limited detail floodplain (without floodway) delineation performed for the Wittmann Phase III Floodplain Delineation Study are completed. Based on property ownership records, your property is at least partially within this recently identified floodplain.

The study area consists of mostly undeveloped lands that are prone to future development. Future development is likely due to the area's proximity to existing developed areas as well as its classification as a Special Planning Area by the City of Surprise, which makes the area a candidate for future annexation by the City.

The floodplain delineation study will establish the boundaries of the 1-percent annual chance (Zone AE) floodplain along those washes that were studied. The study will result in roughly 13 miles of Zone AE riverine floodplain delineation. The flood study results will increase awareness regarding the local risk of flood hazards and therefore contribute to safe and prudent future development within the area.

The delineation study will be submitted to the Federal Emergency Management Agency (FEMA) for adoption shortly after you receive this letter. The FEMA approval process may take one year or longer. FEMA will use the study data to update the Flood Insurance Rate Maps and Flood Insurance Study for the National Flood Insurance Program. In the interim, the District and other jurisdictions will use the data as the "best available information" for floodplain management. Persons with buildings on their property within the proposed floodplain may be required to purchase flood insurance after the floodplain is adopted by FEMA and the Flood Insurance Rate Maps are updated. In those cases where flood insurance is not required, the District strongly recommends that property owners purchase flood insurance coverage to protect buildings on their property from future flood damage.

If you have any questions about the delineations or would like to set up a meeting to discuss how your property is affected, please contact Richard P. Harris at (602) 506-4528 or via rph@mail.maricopa.gov or Jonathan Lesperance at (602) 506-4699 or via jonathanlesperance@mail.maricopa.gov.

Sincerely,

Richard P. Harris, P.E.
Project Manager

Flood Control District
of Maricopa County

Board of Directors
Fulton Brock, District 1
Don Stapley, District 2
Andrew Kunasek, District 3
Max Wilson, District 4
Mary Rose Wilcox, District 5

www.fcd.maricopa.gov

2801 West Durango Street
Phoenix, Arizona 85009
Phone: 602-506-1501
Fax: 602-506-4601
TT: 602-505-5897

July 23, 2010

Northern Lights Ventures LLC
3656 West Michigan Avenue
Glendale, Arizona 85308

Assessor's Parcel Number(s): 50317010A, 50317010B, 50317010C & 50317010D

Subject: Wittmann Phase III Floodplain Delineation Study, Contract FCD 2009C006, Work Assignment #3

Dear Maricopa County Property Owner:

The Flood Control District of Maricopa County (District) is writing to inform you that the results of the limited detail floodplain (without floodway) delineation performed for the Wittmann Phase III Floodplain Delineation Study are completed. Based on property ownership records, your property is at least partially within this recently identified floodplain.

The study area consists of mostly undeveloped lands that are prone to future development. Future development is likely due to the area's proximity to existing developed areas as well as its classification as a Special Planning Area by the City of Surprise, which makes the area a candidate for future annexation by the City.

The floodplain delineation study will establish the boundaries of the 1-percent annual chance (Zone AE) floodplain along those washes that were studied. The study will result in roughly 13 miles of Zone AE riverine floodplain delineation. The flood study results will increase awareness regarding the local risk of flood hazards and therefore contribute to safe and prudent future development within the area.

The delineation study will be submitted to the Federal Emergency Management Agency (FEMA) for adoption shortly after you receive this letter. The FEMA approval process may take one year or longer. FEMA will use the study data to update the Flood Insurance Rate Maps and Flood Insurance Study for the National Flood Insurance Program. In the interim, the District and other jurisdictions will use the data as the "best available information" for floodplain management. Persons with buildings on their property within the proposed floodplain may be required to purchase flood insurance after the floodplain is adopted by FEMA and the Flood Insurance Rate Maps are updated. In those cases where flood insurance is not required, the District strongly recommends that property owners purchase flood insurance coverage to protect buildings on their property from future flood damage.

If you have any questions about the delineations or would like to set up a meeting to discuss how your property is affected, please contact Richard P. Harris at (602) 506-4528 or via rph@mail.maricopa.gov or Jonathan Lesperance at (602) 506-4699 or via jonathanlesperance@mail.maricopa.gov.

Sincerely,

Richard P. Harris, P.E.
Project Manager

Flood Control District
of Maricopa County

Board of Directors
Fulton Brock, District 1
Don Stapley, District 2
Andrew Kunasek, District 3
Max Wilson, District 4
Mary Rose Wilcox, District 5

www.fcd.maricopa.gov

2801 West Durango Street
Phoenix, Arizona 85009
Phone: 602-506-1501
Fax: 602-506-4601
TT: 602-505-5897

July 23, 2010

Burlington Northern and Santa Fe Railway Company
2500 Lou Menk Drive AOB-3
Fort Worth, Texas 76131-2830

Assessor's Parcel Number(s): 50317001A, 50317003 & 50317004A

Subject: Wittmann Phase III Floodplain Delineation Study, Contract FCD 2009C006, Work Assignment #3

Dear Maricopa County Property Owner:

The Flood Control District of Maricopa County (District) is writing to inform you that the results of the limited detail floodplain (without floodway) delineation performed for the Wittmann Phase III Floodplain Delineation Study are completed. Based on property ownership records, your property is at least partially within this recently identified floodplain.

The study area consists of mostly undeveloped lands that are prone to future development. Future development is likely due to the area's proximity to existing developed areas as well as its classification as a Special Planning Area by the City of Surprise, which makes the area a candidate for future annexation by the City.

The floodplain delineation study will establish the boundaries of the 1-percent annual chance (Zone AE) floodplain along those washes that were studied. The study will result in roughly 13 miles of Zone AE riverine floodplain delineation. The flood study results will increase awareness regarding the local risk of flood hazards and therefore contribute to safe and prudent future development within the area.

The delineation study will be submitted to the Federal Emergency Management Agency (FEMA) for adoption shortly after you receive this letter. The FEMA approval process may take one year or longer. FEMA will use the study data to update the Flood Insurance Rate Maps and Flood Insurance Study for the National Flood Insurance Program. In the interim, the District and other jurisdictions will use the data as the "best available information" for floodplain management. Persons with buildings on their property within the proposed floodplain may be required to purchase flood insurance after the floodplain is adopted by FEMA and the Flood Insurance Rate Maps are updated. In those cases where flood insurance is not required, the District strongly recommends that property owners purchase flood insurance coverage to protect buildings on their property from future flood damage.

If you have any questions about the delineations or would like to set up a meeting to discuss how your property is affected, please contact Richard P. Harris at (602) 506-4528 or via rph@mail.maricopa.gov or Jonathan Lesperance at (602) 506-4699 or via jonathanlesperance@mail.maricopa.gov.

Sincerely,

Richard P. Harris, P.E.
Project Manager

APPENDIX B.5

CONTRACT DOCUMENTS

CONTRACT DOCUMENTS

B.5.1 Contract Documents

This project was completed under Assignment 3 of FCDMC Contract Number 2009-C006. Please find the scope of work for this assignment on the following pages. This scope was copied from the Notice-to-Proceed from FCDMC for Assignment 3.

CONTRACT DOCUMENTS

PROJECT SCOPE

CONTRACT 2009-C006
ASSIGNMENT 3

EXHIBIT A

SCOPE OF WORK

CONTRACT FCD 2009C006
Work Assignment No. 3

Wittmann Phase III Floodplain Delineation Study, including Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, and an extension of 2W Tributary 1

EXHIBIT A

SCOPE OF WORK

CONTRACT FCD 2009CO06
Work Assignment No. 3
Wittmann Phase III Floodplain Delineation Study, including Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, and an extension of 2W Tributary

GENERAL

This study will delineate limited detail Zone AE 100-year floodplains for Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, and an extension of 2W Tributary
using existing 2-foot and 4-foot contour interval mapping provided by the Flood Control District of Maricopa County (DISTRICT). Twelve point eight (12.8) linear miles of limited detail Zone AE 100-year floodplain will be delineated in the Trilby Wash Watershed. Refer to Figure 1 for a map of the study area that shows the alignments of the study reaches.

PBS&J (CONSULTANT) will use existing hydrology and will develop new HEC-RAS modeling to determine the revised floodplain boundaries for Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, and an extension of 2W Tributary.

All work must meet the requirements of the DISTRICT's Consultant Guidelines, Third Edition – December 1, 2003 - Revision 1. All work must also meet Arizona Department of Water Resources (ADWR) and Federal Emergency Management Agency (FEMA) requirements for limited detail Zone AE floodplain delineation studies. Prior to the finalization of this contract, the DISTRICT must review and accept the results of this study, and all items called for in this Scope of Work must be delivered to the DISTRICT.

All work must be completed within four hundred (457 days from the Notice to Proceed (NTP)) which includes at least eighty four (89) days for DISTRICT reviews and two hundred and fifteen (215) days for FEMA reviews. All project activities including study data submittals and Milestones shall occur as defined in the attached Work Schedule dated 02/02/10. The Work Schedule may be updated during the course of the project given prior approval by the DISTRICT's Project Manager.

TASK 1 - COORDINATION

1.1 Within seven (7) calendar days of the NTP the CONSULTANT will submit a project schedule to the DISTRICT's Project Manager showing coordination meetings and completion dates for each task identified in the Scope of Work (SOW). The schedule shall also show product submittal dates and DISTRICT product review periods. The CONSULTANT will update the project schedule quarterly and when otherwise directed by the DISTRICT.

1.2 The CONSULTANT will participate in regular coordination meetings (at least on a monthly basis) with the DISTRICT's Project Manager and in milestone coordination meetings in the development of the hydraulic analyses. The CONSULTANT is responsible for the minutes of any meetings. Draft meeting minutes must be delivered to the DISTRICT within seven (7) calendar days of any monthly meeting. Coordination and milestone meetings should be combined whenever possible.

1.3 The CONSULTANT will submit an estimate of the total monthly billing projections within seven (7) calendar days of the NTP. Thereafter, this estimate will be updated and submitted to the DISTRICT's Project Manager at least ten (10) calendar days before the end of each quarter.

1.4 The CONSULTANT will submit monthly progress reports at submittal of monthly invoices. The report shall be brief and should be no longer than two (2) typed pages. At a minimum, the monthly report shall contain the following:

a. A description of the work accomplished by task during the reporting month.
b. Percent (%) completed for the month and percent (%) cumulative completed for each task.
c. A brief description of the work to be accomplished in the following month.
d. A description of any problems encountered.
e. An Earned Value Table and Graph to illustrate the actual work status compared to initial approved projection.

1.5 The DISTRICT will be responsible for placing the legal advertising at the beginning of the study. The advertisement will run once in the Arizona Business Gazette. After the newspaper runs the ad, the DISTRICT will supply the CONSULTANT with the original affidavit of publication from the newspaper for each day that the ad ran.

1.6 The DISTRICT has prepared a separate set of guidelines for the CONSULTANT on conducting public involvement and public information activities for the DISTRICT. A copy of these guidelines will be provided to the CONSULTANT by the Public Information Office and shall be used by the CONSULTANT if or when preparing public information related materials.

1.7 The DISTRICT will notify property-owners in the vicinity of the existing and/or expected floodplain of the study using a mailer. The DISTRICT will prepare a draft notification mailer. The DISTRICT will finalize and send the mailer.

1.8 The DISTRICT will send out a second mailer announcing the study results to affected land owners.

1.9 The DISTRICT will provide any public notice beyond that described in tasks 1.5, 1.7, and 1.8.

1.10 The CONSULTANT will participate in a public information Open-house meeting prior to sending the study Technical Data Notebook (TDN) to FEMA. The DISTRICT will prepare any displays for the meeting following DISTRICT recommendations. The DISTRICT will reserve the meeting venue and secure a certificate of insurance. The CONSULTANT will provide refreshments for the open house.

1.11 CONSULTANT/DISTRICT Performance Evaluations will be performed. A formal evaluation will be performed at the completion of the project upon receipt of all deliverables.

TASK 2 - DATA COLLECTION

2.1 The CONSULTANT will collect and review pertinent data from the DISTRICT and other outside sources. Data to be collected will include previous flood hazard reports and hydrology for the study area, existing readily available topographic mapping, proposed development plans, historical flooding information, as-built plans for existing structures, FEMA Flood Hazard Boundary Maps and any Letters of Map Amendment and/or Revisions, and other pertinent information.

2.2 The CONSULTANT will consult with officials from the DISTRICT, the City of Surprise and the County and State transportation departments in order to identify local flooding problems and to obtain information on current and planned public works projects, channel modifications, storm-drainage systems, development, and corporate limits.

2.3 A written summary of the data collected will be included as a section in the TDN. A preliminary draft of this section is due within twenty-one (21) calendar days of NTP. The section will be updated to include information developed through continued research that may be necessary as the project proceeds.

TASK 3 - TOPOGRAPHIC MAPPING

3.1 Topographic mapping with 2-foot contour and 4-foot contour intervals (including digital terrain model data) will be provided for the study area by the DISTRICT. This topographic mapping will be referenced to the Arizona Central State Plane Coordinate System which is tied to the North American Datum of 1983 High-Accuracy Reference Network (NAD 83 HARN) horizontally and the North American Vertical Datum of 1988 (NAVD 88) vertically. The DISTRICT will provide the CONSULTANT with aerial photography imagery that is recent enough to be appropriate to the level of study and contiguous within the study area.

TASK 4 - FIELD SURVEY

4.1 As needed, field surveys and measurements of bridges, culverts, cross-sections, and hydraulic structures are to be obtained by the CONSULTANT when as-built plans are not available, or when conditions have changed that may impact the delineation. Geodetic Densification and Cadastral Survey (GDACS) control will be the basis of any field survey. This information should be reduced and compiled into an 11"x 17" (maximum size) drawing format approved by the DISTRICT for inclusion in the TDN. The information presented in the drawing should be in a format appropriate for use in future HEC-RAS models. It may be necessary to field survey some structures since the as-built plans may not be on the same vertical datum as the study.

4.2 Cursory inspection of the contour mapping in the area suggests that the contour mapping to be used for the basis of floodplain delineation may no longer be accurate in some places. To ensure that hydraulic analysis results are generated from accurate topographic information, ground survey data may be acquired along the hydraulic cross section alignments for up to an estimated one-third of the total hydraulic cross sections to be modeled. This could result in ground survey for up to 80 hydraulic cross sections. Before intitiating such a survey, aerial photography and contour mapping will be reviewed for changes between the latest photogrammetric flight and the most current aerial photography. This will help to refine the number of cross sections to survey.

4.3 Copies of the survey field books and office calculations will be prepared by the CONSULTANT for inclusion in the TDN as a supplement to the ground survey performed by the CONSULTANT. An Arizona Registered Land Surveyor (RLS) will seal and sign the survey notes.

TASK 5 - HYDROLOGY

5.1 Hydrologic Modeling

The hydrology from a previous study for this area (Wittmann Area Drainage Master Study Update (ADMSU) contract FCD 2002-029) will be used for this study in conjunction with more recent study results that may also be found to be appropriate. Therefore, the CONSULTANT will only need to complete minimal additional hydrologic calculations. A Hydrologic summary will be prepared by the CONSULTANT as a section in the TDN, and it will be submitted for review and approval by the DISTRICT prior to commencing with floodplain modeling. The report will be prepared as a draft of Section 4 of the Technical Data Notebook and will be prepared in accordance with ADWR State Standards Attachment 1-97 (SS1-97). The report will be organized as specified by the DISTRICT, following SSA 1-97 format. Specific deviations from this scope shall not be undertaken without the specific written authorization from the DISTRICT'S Project Manager. The report will include backup documentation from the existing hydrology as well as comprehensive drainage displays to show all sub-basins and concentration points with discharge tables. A comparative analysis against regional regression equations will be included in the report.

5.2 Meeting and Field Visits

David Evans and Associates (DEA) has recently completed some approximate floodplain mapping in the vicinity of the project area for this SOW. The CONSULTANT will meet with DEA staff to review this floodplain mapping and to acquire the hydrologic analyses used in their study.

One (1) meeting associated with the development of the hydrologic data shall be held with DISTRICT staff at the following milestone:

A. Meeting number 1: This meeting will occur after the preliminary peak discharges have been estimated. At this time, the CONSULTANT will have an opportunity to discuss any preliminary comments by the DISTRICT.

5.3 Review and Approval

The CONSULTANT shall obtain approval from the DISTRICT at each of the following steps:

a. Preliminary discharge results (Meeting 1)
b. Cross section locations with respect to changes in discharge

5.4 The Hydrologic Report

5.4.1 The findings of any new data from the existing hydrologic study will be presented in Section 4 of the TDN and will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). If there are no new hydrologic data generated in the study then this section of the report will simply refer to the appropriate appendix for copy of the relevant existing hydrologic report data. For any new data, the report will be organized as specified by the DISTRICT, following SSA 1-97 format. The report will include backup documentation from the

existing hydrology as well as comprehensive drainage displays to show all sub-basins and concentration points with discharge tables. A comparative analysis against regression equations will be included in the report. Specific deviations from this hydrologic scope shall not be undertaken without the specific written authorization from the DISTRICT's Project Manager.

5.5 Tables and Figures

5.5.1 Drainage Maps(s) showing the sub-basins, major man-made structures such as highways, levees, railroads, or culverts, and references (i.e., street names, Township, Range, Section, etc.) at a scale to be agreed upon with DISTRICT Staff shall be included in the TDN as support for the related hydraulic analysis. A table will be prepared to show the results of the study (i.e. 6-hour and 24-hour peak flows, etc.) at major concentration points. The level of detail of this map is to be developed during the study period.

5.6 Digital Hydrologic Data Deliverables

For any new hydrologic basin breakdown found necessary to complete the study, digital data in a modified shape file format will be prepared in conformance with the DISTRICT's Hydrologic Information System Data Delivery Specifications, Revision 3.1. The following themes are the ones generally used for Hydrologic data. However, for this study there may not be data for every theme identified, or the CONSULTANT might develop data for themes not listed. Therefore, only those themes, for which there are data, need to be completed. If the CONSULTANT has data that doesn't fit one of the themes listed here, the DISTRICT's Project Manager shall be contacted to determine the appropriate theme for that data.

a. DRNBSN (Drainage Basins)

b. DRNPTHLN (Drainage Flowpaths and routes)

c. DRNPTHPT (Concentration Points)

TASK 6 - FLOODPLAIN DELINEATION

6.1 Limited detail Zone AE 100-year floodplain delineations will be performed for twelve point eight (12.8) linear miles of Wittmann Wash Tributary 1, Breakout 1 of Wittmann Wash Tributary 1, Breakout 2 of Wittmann Wash Tributary 1, Breakout 3 of Wittmann Wash Tributary 1, and an extension of 2W Tributary. Hydraulic information upon which the delineations will be based will be obtained by modeling using the U.S. Army Corps of Engineers hydraulic modeling program HEC-RAS, version 4.0. and methodology acceptable to FEMA as defined in their Guidelines and Specification for Flood Hazard Mapping Partners, April 2003 and FIA Document 12, Appeals, Revisions, and Amendments to Flood Insurance Maps, December 1993. The completed delineation work will meet the requirements for floodplain delineations as prescribed by FEMA and ADWR, including the Arizona State Standard for Hydraulic Modeling (SS9-02). The modeling and attendant delineations will tie into the recently completed and pending floodplains from the Wittmann ADMSU (contract FCD 2002C029) at its downstream end. There is no existing mapping to tie into at the upstream end of the modeling covered by this SOW.

6.2 The floodplain delineation maps shall have a scale of 1 inch = 200 feet. The hydraulic modeling and delineation work maps shall be referenced to NAVD 88. This work shall include inserting

the cross section and BFE boundary line work, river mile ticks, and water surface elevation contour line work. If ponding-area floodplains occur in the study area the CONSULTANT shall provide the DISTRICT with the water surface elevations for these floodplain Zone AH ponding areas. If appropriate, the CONSULTANT will delineate conveyance areas, as floodplain Zone AE, between these ponding areas.

The CONSULTANT shall provide annotated FIRM panels to illustrate the proposed floodplain boundaries in comparison with the effective information. The annotated FIRM panels will be part of a draft addition to the FIS, which shall also include water surface profiles of the 100-year event. These materials are normally located as section number 7 of the TDN. Excerpts from the effective FIS shall be included within the TDN appendices.

The CONSULTANT will obtain DISTRICT approval at each of the following steps:

a. Estimation of Manning's "n" values
b. Cross-section location and orientation (with respect to channel bed slope changes and mass flow paths)
c. Hydraulic model feature names in context with CAD/GIS standards
d. Hydraulic model documentation
e. Floodplain (natural) delineation
f. Draft Hydraulics TDN section documentation (Section 5 of the TDN)

6.3 Field Reconnaissance

6.3.1 The CONSULTANT will conduct a field reconnaissance of the study area. This will include observation of channel and floodplain conditions for estimating Manning's "n" values; photographic documentation of floodplain characteristics; determination of channel bank characteristics; determination of channel bed particle size; observation of possible overflow areas; observation and classification of levees or other flood control structures, and nominal measurement of bridge and culvert dimensions not included in the survey task. Such measurement will be made to classify smaller cross-drainage structures as non-effective.

6.3.2 Manning's "n" values are to be determined using the methodology in the USGS report, *Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channel, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona, 2006.* If approved by the DISTRICT, another report entitled, *Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, 1991*, may be substituted. Copies of these reports are available through the DISTRICT. Manning's "n" values will be presented for typical reach types observed in the project area, rather than specific reaches of specifically named watercourses. It is anticipated that five (5) typical reach types will be identified during the field reconnaissance. Supplemental field photos will be used to substantiate slight roughness value variations from the typical reach types for locations where slight roughness value variations can be applied without providing complete calculations. These variations will be fully documented in Section 5 of the TDN and in the hydraulic model's general Description.

6.3.3 Representative Manning's "n" values will be selected and documented in an "n value" report. The report will present the determination of channel and overbank "n" values using captioned color photographs for each type in the project area, and the extents of each type will be

displayed on an exhibit. The "n value" report will also discuss floodplain conditions affecting the delineation, describe all structures and obstructions, and provide color photos or photocopies of major hydraulic structures. Photo location for channels, structures, and "n" value determinations will then be displayed on reduced scale mapping and included in the draft TDN hydraulic documentation appendix and in all subsequent TDN versions.

6.4 Cross Sections

6.4.1 The location and alignment of cross sections and channel centerlines will be submitted for the DISTRICT's review and approval. Cross sections will be spaced approximately every five hundred feet, unless geographic or structural constraints dictate otherwise, and will extend the full width of the area inundated by 100-year floodwaters. Cross section placement locations shall be selected with respect to grade-breaks in the channel profile and existing structures such as roads, railways, drainage features and confluences, as well as at future roadway alignments and cadastral section lines. Cross section spacing should be done in such a way as to minimize computational head loss and where natural channel bed grade breaks evidently occur in thalweg profile plots. Cross section stationing will be from left to right looking downstream with the hydraulic baseline at station 10,000. Identification of cross sections will be in river miles, increasing upstream. The stationing will tie into the specified river mile of any existing FEMA studies. The cross sections may need to be reoriented or altered after running the HEC-RAS model to ensure that they are perpendicular to the center of mass of flow per FEMA criteria. Cross sections developed by the HEC-RAS interpolation feature are not to be used. The CONSULTANT must coordinate and then document the methodology for generating the cross section geometric data. Acceptable methods might include collecting the data directly off paper copies of the DISTRICT's 2-foot and 4-foot contour interval mapping, use of a computer program to develop the data from digital information, or from field surveys.

6.4.2 The HEC-RAS output in the TDN, in addition to summary tables and a full output report, shall include fully labeled profile and cross section plots.

6.4.3 CHECK-RAS reports and RASPLOT profiles of the 100-year event will be created for inclusion into the TDN on the 12.8 miles of limited detail study reaches.

6.5 Bridges and culverts must be modeled according to HEC-RAS modeling requirements for the selected routine. Where multiple bridges occur, each bridge will be modeled separately. The HEC-RAS modeling results for bridges, culverts, and other hydraulic structures will be verified by creating a CulvertMaster model for each structure that was modeled using HEC-RAS. The hydraulic effects of bridges and culverts shall be incorporated into assessing the floodplain around such structures, especially in areas where ponding will occur. Minor conveyance structures such as small culverts (i.e. less than 30" in diameter) or structures considered likely to become clogged during the 100-year peak discharge, shall not be included in the hydraulic analyses.

6.6 It is possible that during the course of the hydraulic modeling, it will be discovered that the 100-year event breaks out of one or more of the reaches being studied. If the modeling suggests that any break outs occur, the CONSULTANT will promptly contact the DISTRICT to coordinate an appropriate course of action, which may include modification of the SOW and fee for the project.

6.7 Flood zone boundaries will be determined according to FEMA criteria and will be clearly labeled on the final drawings. The drawing cover sheet shall show the study title and DISTRICT contract number, location and vicinity maps, and a sheet index in a cadastral section background. A list of survey control monuments (or ERM's) with elevations and coordinates shall be shown along with the topographic mapping contour interval, vertical and horizontal datums, State Plane coordinates, and the conversion factor between the NAVD 88 and NGVD 29 vertical datums. A field survey certification note will be provided and will include the signature and seal of the RLS responsible for all ground survey. The dates of both the topographic flights and the aerial photography flights shall be listed.

6.8 The main project Description box of the HEC-RAS models should include the following:

a. Project name and FCD contract number, work assignment number, and project control number

b. DISTRICT Project Manager's name and e-mail address

c. CONSULTANT name, phone number, address, website address, and company job number

d. Study purpose

e. File name and latest run date/final date if completed

f. Vertical datum of the model, base map date, and base map contractor information

g. Any notable features that are considered unique or unusual to the hydraulic modeling

h. HEC-RAS program version

i. Source of hydrology and discharges used

j. Wash names, including River and Reach Names used in the HEC-RAS modeling

k. The name of the wash as labeled on the hydraulic work maps

l. Locations where slight roughness value variations were applied without providing complete calculations (per Task 6.3.2)

m. Subsequent update information, if any

In addition, minor descriptions should be added to the model for hydraulic cross sections located above or below drainage structures, at section lines, at highways and railway crossings, at canals, and at confluences. Model descriptions should be added to culverts and lateral structures, and at any other features considered pertinent to the modeling.

6.9 The CONSULTANT will provide work maps using the DISTRICT's most recent contour mapping. The work map drawings will be 24" X 36" in size. The work map scale will be 1" = 200'. The cover sheet of the work map drawings shall be prepared as specified in Task 6.7. Each study sheet work map drawing shall include the project title, contract number, source of topographic mapping, and a location map showing the geographic range covered by each specific mapping sheet. Each study sheet will include watercourse names and existing floodplain boundaries, proposed floodplain boundaries, a north arrow, the map scale, site-specific section lines and section corners, current streets and highway names, subdivision boundary names, Horizontal and Vertical Datum references (State Plane Coordinate System, NAD 83 HARN, and NAVD 88), all MCDOT GDACS monuments and NGVD monuments located within that individual sheet's boundaries, major drainage features, corporate boundaries, hydraulic cross section lines, the sheet index map, peak discharges, and relative Township and Range labels. A conversion factor from NAVD 88 to NGVD 29 should also be shown.

6.10 Technical Data Notebook (TDN)

6.10.1 The findings of the floodplain delineation study will be presented in Section 5 of the TDN and will be prepared in accordance with ADWR State Standards Attachment 1-97 (SS1-97). The report will be organized as specified by DISTRICT standards, following SS1-97 format.

6.10.2 The hydraulic analysis/HEC-RAS output in the TDN, in addition to summary tables and full output report, should include fully labeled cross section plots. Section plots should be grouped per study reach, and reach groups should be separated and then indexed within the main report to expedite data recovery.

6.11 The CONSULTANT shall review the output of the HEC-RAS computer models to ensure the flow depths and velocities are reasonable and realistic with respect to those expected in this watershed. Adjustments to the model input should be completed as necessary to obtain the most realistic results. The CONSULTANT shall provide proper QA/QC of the models and TDN before delivering them to the DISTRICT.

6.12 The CONSULTANT shall fill out all the forms required by FEMA (MT-2 forms) for the submittal of a Floodplain Delineation Study.

TASK 7 – DIGITAL DATA

Digital data will be delivered in a modified shape file format per Shape file Data Delivery Specifications V1.2, date May 1st, 2007 and will be prepared in conformance with the above standards. The following themes are generally used for the data developed for Floodplain Delineation Studies. However, for this study there may not be data for every theme identified here, or the CONSULTANT might develop data for themes not listed here. Therefore, only those themes for which there are data need to be completed. If the CONSULTANT has data that does not fit one of the themes listed here, the DISTRICT's Project Manager shall be contacted to determine the appropriate theme for that data.

a. PRJ (Project Boundaries)
b. DQ (Data Quality)
c. FPSRFFCD (Floodplain FCD Water Surface Elevation)
d. FPXFCD (Floodplain FCD Cross Section)
e. FPZNFCD (Floodplain FCD Zone)
f. FPBLN (Floodplain Baseline Route System)
g. PRJDAT (Project Identification)
h. NDXPRJ (Hydraulic Work Map Sheet Layout)

TASK 8 – DELIVERABLES

8.1 Both paper and electronic deliverables will be made at the completion of each task.

8.2 Prior to FEMA Submittal: The CONSULTANT will deliver the following items to the DISTRICT.

8.2.1 Two (2) copies of the Draft TDN including draft work maps according to ADWR State Standards Attachment 1-97 (SSA 1-97). The report shall be organized as specified by

DISTRICT standards, following SSA 1-97 format. A third copy of the draft work maps will be submitted that uses the aerial photography as a base map.

8.2.2 Preliminary Digital Data Delivery including all digital files listed under Task 7 applicable to the final deliverable. The DISTRICT will be responsible for transmittal of one set of data to the City of Surprise.

8.3 FEMA Submittal: The CONSULTANT will submit the following items to the DISTRICT for review by FEMA and any other appropriate governmental agency. All of the following products are considered deliverables for the FEMA submittal:

8.3.1 Two (2) complete sets of blackline paper topographic base maps with the floodplain delineations shown. All drawings will be signed and sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed. The DISTRICT will be responsible for transmittal of one set of data to the City of Surprise.

8.3.2 Three (3) complete copies of the TDN including completed FEMA forms, annotated Flood Insurance Rate Maps showing the proposed delineation and HEC-RAS input/output files on DVD. The TDN will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The notebook will be organized as specified by the DISTRICT, following SSA 1-97 format. The DISTRICT will be responsible for transmittal of one set of data to the City of Surprise.

8.4 Final Submittal: The following products are considered deliverables for the final submittal to the DISTRICT after FEMA approval is issued.

8.4.1 One (1) complete set of Mylars and two (2) complete sets of sealed blackline paper flood study work topographic maps with the floodplain delineations shown. The DISTRICT will be responsible for transmittal of one set of data to the City of Surprise. All drawings will be signed and sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed.

8.4.2 All remaining floodplain delineation data in conformance with the DISTRICT's HIS Specifications.

8.4.3 Three (3) complete copies of the TDN including HEC-RAS input/output files on DVD. The TDN will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The notebook will be organized as specified by the DISTRICT, following SSA 1-97 format. This submittal of the TDN shall include any correspondence and/or meeting minutes with the reviewing agencies and shall reflect any revisions required by those reviewing agencies. Revisions may include, but are not limited to, addressing FEMA's comments, modifications to the delineation maps, the HEC-RAS model, and/or the Final Report. The report shall also be prepared in PDF format. The DISTRICT will be responsible for transmittal of one set of data to the City of Surprise.

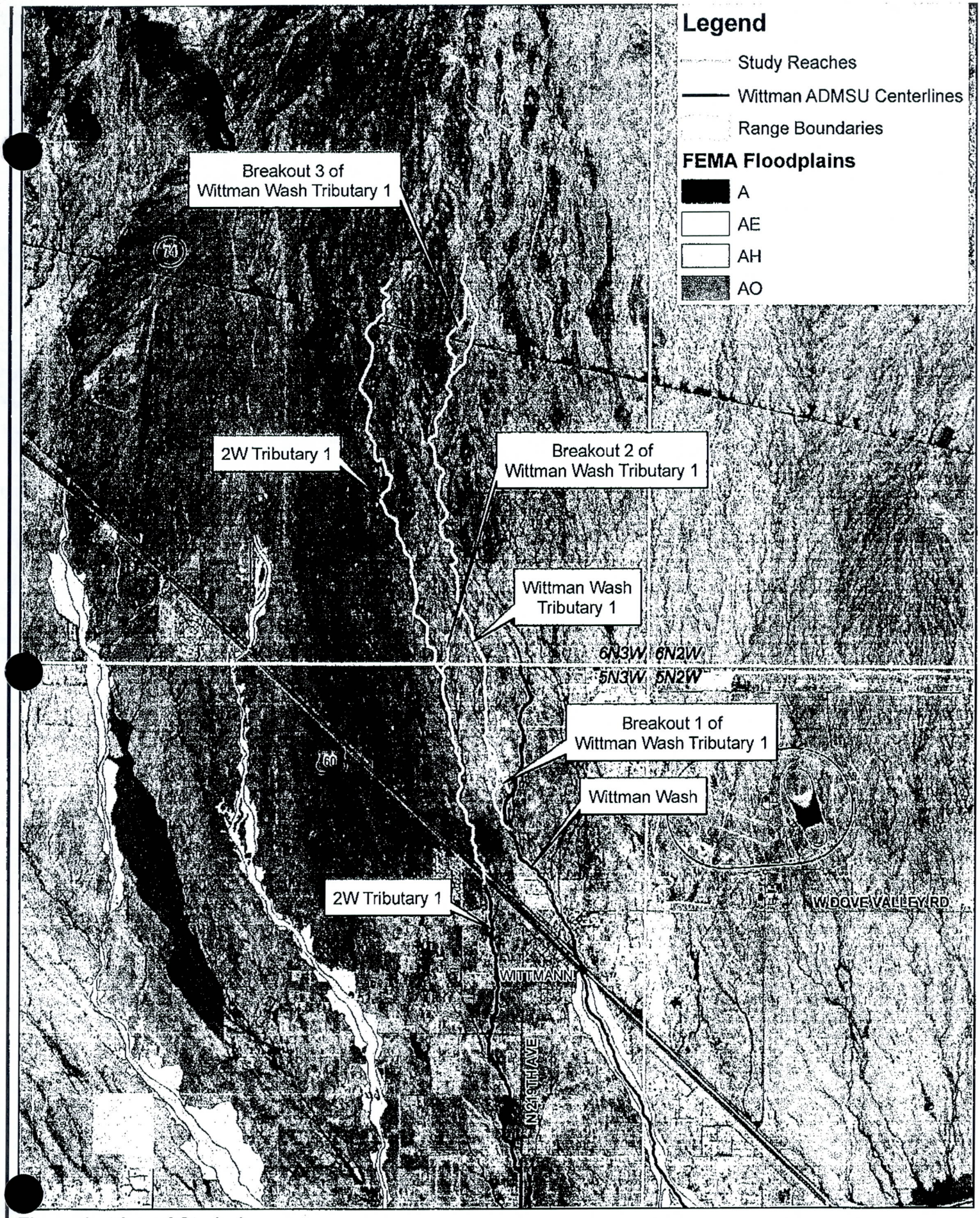


Figure 1 - Map of Study Area
Contract FCD2009C006 - Assn 3
February 3, 2010

1 0.5 0 1 Miles

PBSJ

APPENDIX B.6

FEMA CORRESPONDENCE

Baker

Michael Baker Jr., Inc.

2929 North Central Avenue
Suite 800
Phoenix, AZ 85012

Phone: 602-279-1234
FAX: 602-279-1411

January 7, 2011

Mr. Richard Harris, P.E.
Project Manager
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009

Dear Mr. Harris,

We have completed a review of the submitted data for the updated Wittman Phase III Floodplain Delineation Study - Technical Data Notebook (TDN) dated January 6, 2011. This updated TDN was prepared by PBS&J in response to our review comments dated December 2, 2010.

All review comments have been addressed. If you have any questions, please contact us at 602-798-7558.

Sincerely

Padinare V. Unnikrishna, Ph.D., P.E., CFM

FEMA CORRESPONDENCE

B.6.1 FEMA Correspondence

Michael Baker Jr., Inc provided comments on the TDN submittal. These comments were dated December 2, 2010.

PBS&J responded to these comments. The date of these responses was January 6, 2011.

A copy of both the comments and the responses may be found on the following pages.

FEMA CORRESPONDENCE

MICHAEL BAKER JR'S COMMENTS DATED DECEMBER 2, 2010

Michael Baker Jr., Inc.

2929 North Central Avenue
Suite 800
Phoenix, AZ 85012

Phone: 602-279-1234
FAX: 602-279-1411

December 2, 2010

Mr. Richard Harris, P.E.
Project Manager
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009

Dear Mr. Harris,

We have completed a review of the submitted data for Wittman Phase 3 Floodplain Delineation Study, Technical Data Notebook (TDN). The TDN was prepared by PBS&J and dated September 2010. The results of our review found items that should be addressed prior to acceptance of this study. The purpose of this letter is to summarize our review comments.

We performed a review of the following submitted data:

- Wittman Phase 3 Floodplain Delineation Study Technical Data Notebook
- Hydrologic Models (HEC-1)
- Hydraulic Models (HEC-RAS)
- Floodplain Work Maps

Hydrologic Analysis

1. Please include pages from the Entellus 2004 ADMSU cited in the TDN. These include NOAA 2 figures and pages 636-639 in Volume HY-1 and pages 19-20 of Volume HY-II of the ADMSU referred to in page 13 of the TDN.

2. The 11" x 17" Figure 4.1 HEC-1 schematic has small print for the node names. Please include a larger Figure 4.1 or a pdf file of the same.

3. Figure 4.7 Hydrologic Summary is very helpful in explaining flow splits and discharges. Please include HEC-1 nodes and wash names in this figure.

Hydraulic Analysis

1. Please include a table relating HEC-RAS flow change stations to HEC-1 nodes. In cases where the flows are from interpolated locations or lateral weirs, those can be stated as well. This will make it easier to relate the descriptions to the modeling and results.

2. In Wittman Wash Tributary 1, lateral weir outflow is 191 cfs at RS 2.254. This is not shown on Workmap 7. Please include.

Floodplain Work Maps

1. No comments.

Please respond to the issues detailed above. If you have any questions, please contact me at 602-798-7558.

Sincerely

Padinare V. Unnikrishna, Ph.D., P.E., CFM

FEMA CORRESPONDENCE

PBS&J'S RESPONSES DATED JANUARY 6, 2011

MEMORANDUM

TO: Padinare V. Unnikrishna, Michael Baker, Jr.

CC: Richard Harris, FCDMC
Jonathan Lesperance, FCDMC

FROM: Seth Ahrens, PBS&J

DATE: January 6, 2010

SUBJECT: Responses to the Michael Baker Jr.'s December 2nd, 2010 comments on PBS&J's September 2010 Draft Hydraulics Report for the Wittmann Phase III Floodplain Delineation Study (2009-C006-#3)

Thank you very much for your comments. Please find below PBS&J's responses.

Hydrologic Analysis

1. Please include pages from the Entellus 2004 ADMUS cited in the TDN. These include NOAA 2 figures and pages 636-639 in Volume HY-1 and pages 19-20 of Volume HY-II of the ADMSU referred to in page 13 of the TDN.

   Response: A full digital copy of Entellus' report may now be found in the *Appendix D* folder on the TDN DVD. See the folder *Wittmann_ADMSU_Entellus*. PDFs of the pages discussing the NOAA 2 figures, pages 636-639, and pages 19-20 may be found in the *Excerpts* folder where Entellus' report is located. Chapter 4 of the TDN report has been modified to indicate that digital copies of this material may be found on the DVD.

2. The 11" x 17" Figure 4.1 HEC-1 schematic has small print for the node names. Please include a larger Figure 4.1 or a PDF file of the same.

   Response: PDFs of all figures in Section 4 have been included on the DVD. See the *TDN-Figures* folder in the *Appendix D* folder on the DVD. TDN report text has been modified to indicate that these images may be found on the DVD.

3. Figure 4.7 Hydrologic Summary is very helpful in explaining flow splits and discharges. Please include HEC-1 nodes and wash names in this figure.

   Response: HEC-1 nodes and wash names have been added to this figure.

Hydraulic Analysis

1. Please include a table relating HEC-RAS flow change stations to HEC-1 nodes. In cases where the flows are from interpolated location or lateral weirs, those can be stated as well. This will make it easier to relate the descriptions to the modeling and results.

   Response: This information may be found in Table 5.6 of the TDN report.

2. In Wittmann Wash Tributary 1, lateral weir outflow is 191 cfs at RS 2.254. This is not shown on Workmap 7. Please include.

   Response: Some of the weirs are long enough that it did not make sense on the workmaps to show the entire lateral weir flow leaving at a single location. 2.254 is one of those weirs. On sheet 7, between RS 2.201 and RS 2.261, a breakout rate of 59 cfs has been shown. Additionally, on sheet 8, between RS 2.005 and RS 2.089, a breakout rate of 133 cfs has been shown on the map. The total breakout along this weir is 133 cfs + 59 cfs = 192 cfs, which matches the breakout flow rate shown on Table 5.3 of the TDN report. No changes have been made to the workmaps.

APPENDIX C.1

SURVEY FIELD NOTES FOR AERIAL MAPPING CONTROL

SURVEY FIELD NOTES FOR AERIAL MAPPING CONTROL

C.1.1 Survey Field Notes for Aerial Mapping Control

No new aerial mapping was completed during the course of this study.

APPENDIX C.2

SURVEY FIELD NOTES FOR HYDROLOGIC MODELING

SURVEY FIELD NOTES FOR HYDROLOGIC MODELING

C.2.1 Survey Field Notes for Hydrologic Modeling

The hydrology for this project was created under separate contract.

APPENDIX C.3

SURVEY FIELD NOTES FOR HYDRAULIC MODELING

SURVEY FIELD NOTES FOR HYDRAULIC MODELING

C.3.1 Survey Control Monuments

FCDMC provided a list of significant survey control points that reside in the vicinity of the FDS study streams. Two types of control points were included—Geodetic Densification and Cadastral Survey (GDACS) points and National Geodetic (NGS) points. The following table lists general information for the GDACS and NGS survey control points supplied by FCDMC.

Table C.1 – Survey Control Point General Information

Control Point Type	Point Name	Elevation (feet, NAVD 88)	Northing (feet, NAD83-HARN)	Easting (feet, NAD83-HARN)
GDACS	56448-2	2,021.724	1,036,451.884	512,704.358
GDACS	61565-1	1,679.592	1,010,051.531	512,547.196
GDACS	61567-1	1,699.063	1,012,668.636	517,839.025
GDACS	61586-1	1,722.597	1,015,308.917	517,857.182
GDACS	61587-1	1,756.310	1,017,950.077	517,872.184
GDACS	61606-1	1,787.539	1,020,592.546	517,888.537
GDACS	61607-1	1,818.543	1,023,234.867	517,904.722
NGS	4KE1	1,819.40	1,023,250.10	517,954.25
NGS	1697	1,697.62	1,011,975	513,484
NGS	E24	1,783.26	1,018,700	506,168

In the *Control-Monuments* folder in the *Appendix C* folder on the DVD may be found shapefiles of the GDACS and NGS survey control points. In addition, metadata for these points as downloaded from the Maricopa County of Department of Transportation (MCDOT) website (for GDACS) and the National Oceanic and Atmospheric Administration (NOAA) website may also be found in this folder. Hardcopies of these metadata are included in this appendix.

C.3.2 Survey Field Notes for Hydraulic Modeling

Field survey data were acquired by Premier Engineering Consultants in June 2010. The project control was the Maricopa County Geodetic Densification and NGS Control Point 4KE1. Observations were performed with a Trimble 5800 real-time kinematic GPS instrument. All data were taken on the Horizontal Datum of 1983-92 State Plane Coordinate System, Arizona Central Zone. The Vertical Datum is the North American Vertical Datum of 1988 (NAVD 88). Observations were reported to the nearest 0.01 of an international foot. The survey report for all field survey data acquired for this study may be found in Appendix C.3. This report has

been sealed by Mr. Mark A. Luond, RLS, PLS, CFedS, Survey Project Manager at Premier Engineering Corporation.

Acquisition of the field survey served two purposes. The first was to acquire inlet and outlet elevations of the major hydraulic structures in the study area and to acquire the roadway deck profile over each of these structures. The second was to acquire station/elevation data for a number of the hydraulic cross sections to complete a statistical comparison between the cross sections generated from the field survey versus the cross sections generated from the project Triangulated Irregular Network (TIN) created using baseline and masspoint data provided by FCDMC.

Inlet elevations, outlet elevations, and deck profile elevations were sought at three structures. Those structures are listed in Table C.2. A map showing the locations of these structures has been included in this appendix as well in the *Appendix C* folder on the DVD in the file *AppC-survey-map.pdf*. Location Number in Table C.2 refers to the location number on this map.

Table C.2 – List of Structures Where Field Survey Was Acquired

Location Number	Wash	Location
1	Wash 2 West Tributary 1	State Route 74
2	Breakout 4 of Wittmann Wash Tributary 1	State Route 74
3	Wittmann Wash Tributary 1	State Route 74

All raw survey may be found in the text file *ALL-FIELDS-POINTS_070110.txt*, which may be found on the DVD in the *Appendix C* folder. PBS&J converted this text file into a shapefile called *all-survey.shp* that also may be found on the DVD in the *Appendix C* folder.

C.3.3 As-Built Plans

As-built plans were available for the three structures in Table C.2 in the Arizona Department of Transportation (ADOT) plan set *Plan and Profile of Proposed State Highway, Morristown-New River, Maricopa County*, dated 12-22-64. A digital copy of these plans may be found in the file *454-507 RD.pdf*, which has been included in the *Appendix C* folder on the DVD at the front of Volume I of this report. The information in this plan set that applies to the *FDS* may be found on Sheet 6 of 10 of the plan set (Sheet 9 of 19 of the PDF).

These plans have been included in this appendix. The lengths of the culverts from the as-built plans were used in the hydraulic modeling. Copies of these as-built plans may be found in this Appendix.

Table C.3 – List of Structures Where Structures May Be Found in the As-Built Plans

Location Number	Wash	Station of Structure in State Route 74 As-Built Plan Set
1	Wash 2 West Tributary 1	247+70
2	Breakout 4 of Wittmann Wash Tributary 1	285+15
3	Wittmann Wash Tributary 1	289+88.00 to 290+32.17

C.3.4 Root Mean Square Error Computations

As discussed in Section 3.2 of the TDN report, the root mean square error (RMSE) of the topographic data that FCMDC provided for this project was computed. The spreadsheet used to complete this calculations, Wittmann-PhIII-Topo-Statistical-Comparison.xls, may be found in this appendix as well as on the DVD in the *Statistical-Comparison* folder in the *Appendix C* folder on the DVD.

SURVEY CONTROL MONUMENTS

METADATA FOR GDACS POINTS

maricopa.gov

Land Survey Section: Report

Other Monuments

The information here on was gathered by the Maricopa County Department of Transportation (MCDOT) and is deemed reliable but is not guaranteed and should always be verified by the user. MCDOT is currently in the process of quality control checks. The elevations contained here are derived by GPS static procedures with a rigorous vertical adjustment. It is entirely the responsibility of any other user to determine its suitability and errors and/or omissions before using it for themselves and/or for another purpose.

Unofficial Document

Unique ID:	8406
Point Name:	56448-2
Alias:	5644802
Import Date:	10/17/2005
Modified Date:	
Classification:	
Township:	
Range:	
Section:	
UPLSS Corner Name:	
USPLSS Corner Type:	
Determination Status:	
Latitude NAD83(1992):	33.505097621N (DD.MMSSsssss)
Longitude NAD83(1992):	112.320080797W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1924.629
SPC AZ C Northing (Int Feet):	1036451.884
SPC AZ C Easting (Int Feet):	512704.358
NAVD88 Elev. (Int feet):	2021.724
Combination Grid Factor:	1.00015172
Convergence:	
Last Date Visited:	1/14/2005
FIRM/Agency:	RBF
MCR Number:	2005-1265410
MCR Book:	773
MCR Page:	45
Project Number:	69012
Project Name:	GDACS
Monument Status:	
Description:	FD 3" AZ HWY DEPT. AL CAP SET IN CONC. RAISED 0.3' STAMPED "102.32 OUT STA. 315+48.32 1966"
Comments:	

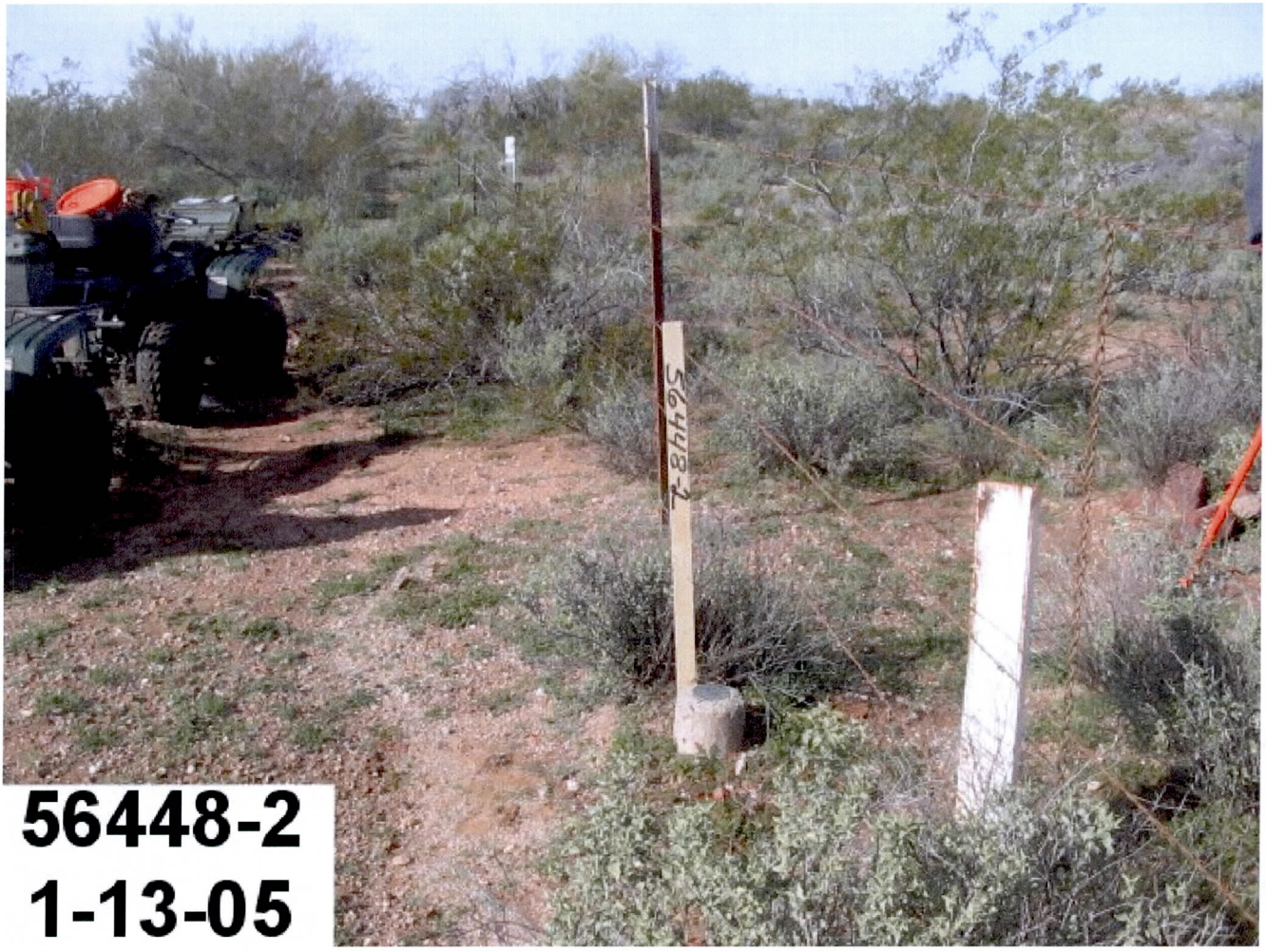
Photos of Survey Point

56448-2-MON-01.jpg

56448-2
1-13-05

56448-2-MON-02.jpg

56448-2-VIC-01.jpg



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Land Survey Section: Report

UPLSS Corners

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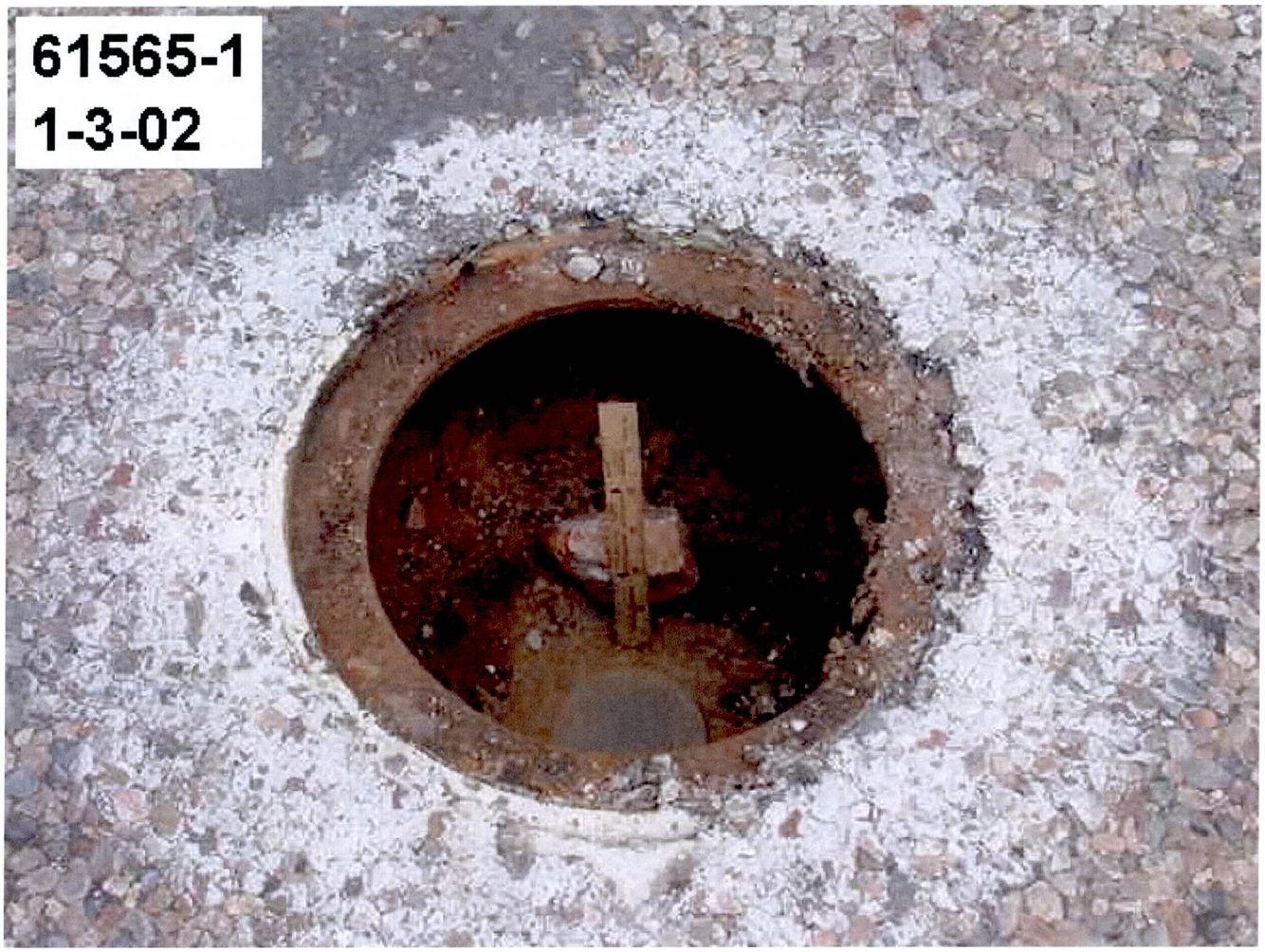
Unofficial Document

Unique ID:	1852
Point Name:	61565-1
Alias:	6156501
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	14
UPLSS Corner Name:	East 1/4
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.462978715N (DD.MMSSssss)
Longitude NAD83(1992):	112.320079594W (DDD.MMSSssss)
Ellipsoid Height (Int. Feet):	1581.694
SPC AZ C Northing (Int Feet):	1010051.531
SPC AZ C Easting (Int Feet):	512547.196
NAVD88 Elev. (Int feet):	1679.592
Combination Grid Factor:	1.00013529
Convergence:	
Last Date Visited:	7/18/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.7' DN STAMPED "T5N R3W 1/4 S14 S13 1997 LS 28742"
Comments:	

Photos of Survey Point

mvc-010s.jpg



mvc-006f.jpg

61565-1
7-18-01
MARICOPA
COUNTY
D.O.T.
R 3 W
1/4
S 14
1997
CORRECTION FOR

mvc-002f.jpg

mvc-001f.jpg

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Land Survey Section: Report

UPLSS Corners

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Unofficial Document

Unique ID:	1983
Point Name:	61567-1
Alias:	6156701
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	13
UPLSS Corner Name:	Northeast
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.465598744N (DD.MMSSsssss)
Longitude NAD83(1992):	112.305828586W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1601.311
SPC AZ C Northing (Int Feet):	1012668.636
SPC AZ C Easting (Int Feet):	517839.025
NAVD88 Elev. (Int feet):	1699.063
Combination Grid Factor:	1.00013846
Convergence:	
Last Date Visited:	7/19/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.6' DN STAMPED "T5N R3W R2W 12 7 18 13"
Comments:	

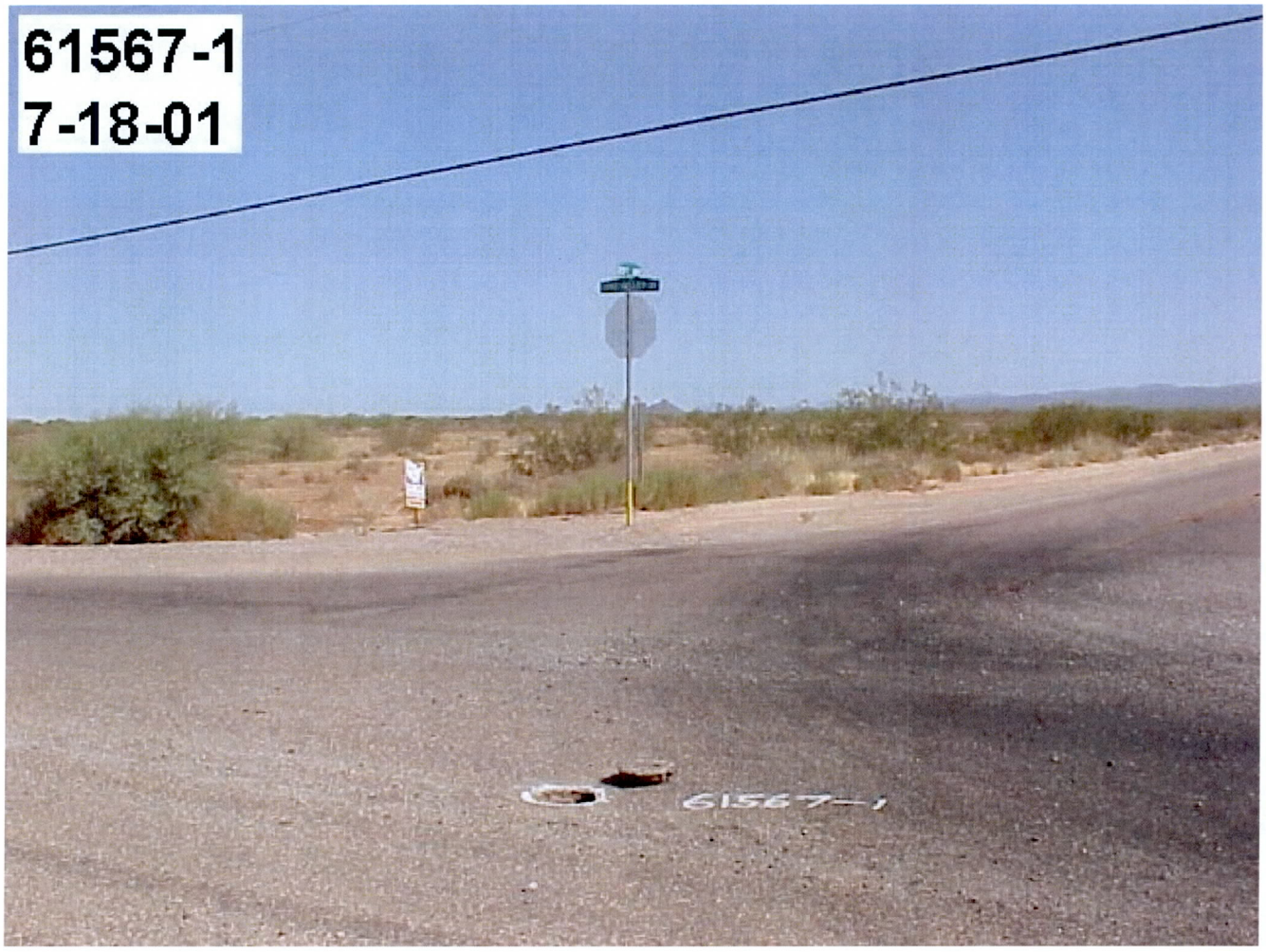
Photos of Survey Point

mvc-005f.jpg

mvc-004f.jpg

mvc-002f.jpg

mvc-001f.jpg



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Land Survey Section: Report

UPLSS Corners

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Unofficial Document

Unique ID:	12438
Point Name:	61586-1
Alias:	6158601
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	12
UPLSS Corner Name:	East 1/4
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.472210909N (DD.MMSSsssss)
Longitude NAD83(1992):	112.305825276W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1624.920
SPC AZ C Northing (Int Feet):	1015308.917
SPC AZ C Easting (Int Feet):	517857.182
NAVD88 Elev. (Int feet):	1722.597
Combination Grid Factor:	1.00013960
Convergence:	
Last Date Visited:	7/19/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.6' DN STAMPED "T5N R3W R2W 1/4 12 7 1995"
Comments:	

Photos of Survey Point

mvc-005f.jpg

61586-1
7-19-01
TEMPERATURE CORRECTION FOR
LUFKIN STEEL TAPES
150 FT.

mvc-004f.jpg

mvc-002f.jpg

mvc-001f.jpg

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Land Survey Section: Report

UPLSS Corners

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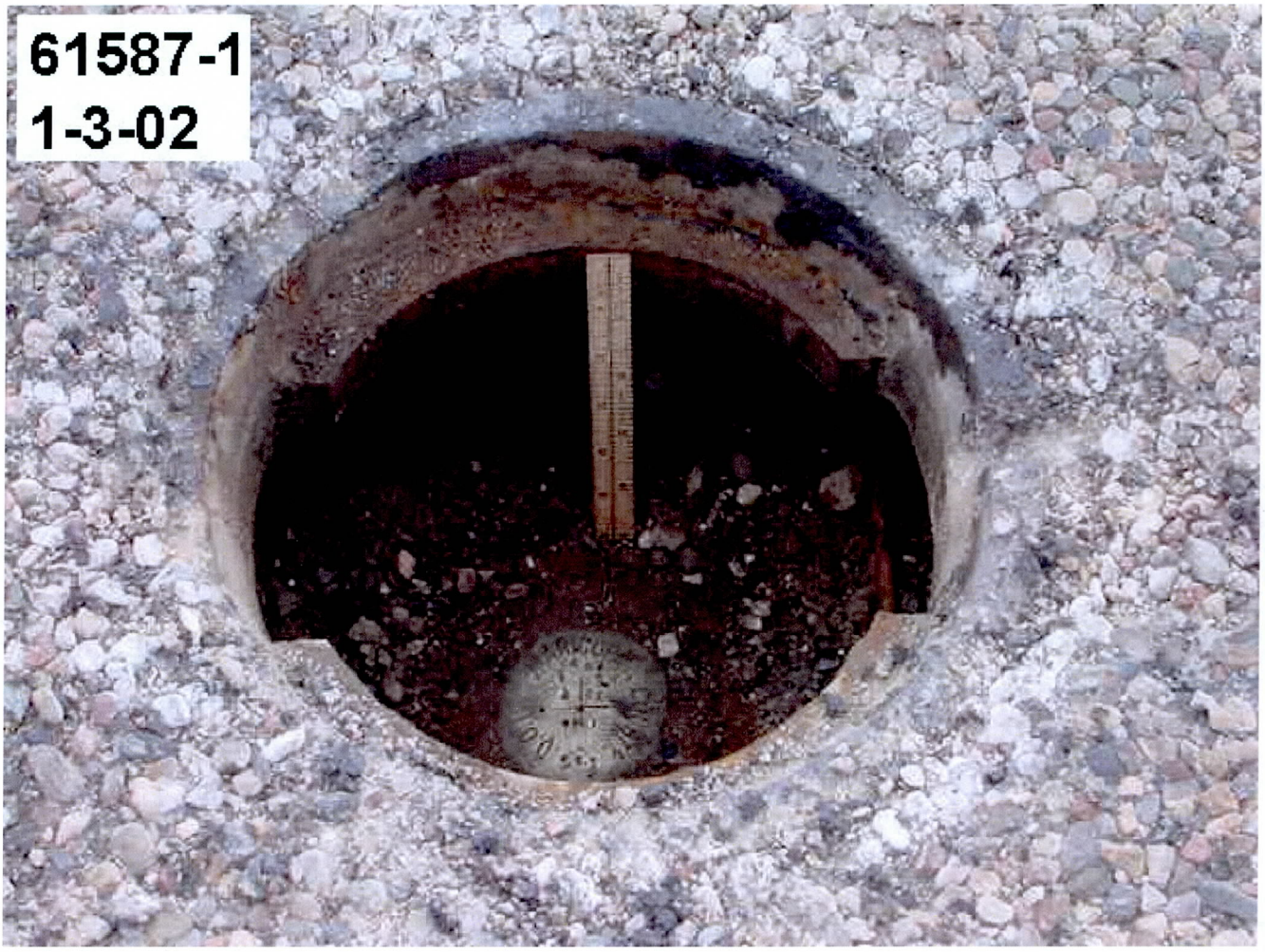
Unofficial Document

Unique ID:	12437
Point Name:	61587-1
Alias:	6158701
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	12
UPLSS Corner Name:	Northeast
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.474823922N (DD.MMSSsssss)
Longitude NAD83(1992):	112.305825714W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1658.713
SPC AZ C Northing (Int Feet):	1017950.077
SPC AZ C Easting (Int Feet):	517872.184
NAVD88 Elev. (Int feet):	1756.310
Combination Grid Factor:	1.00014122
Convergence:	
Last Date Visited:	7/19/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.6' DN STAMPED "T5N 1 6 7 12 R3W R2W 1995"
Comments:	

Photos of Survey Point

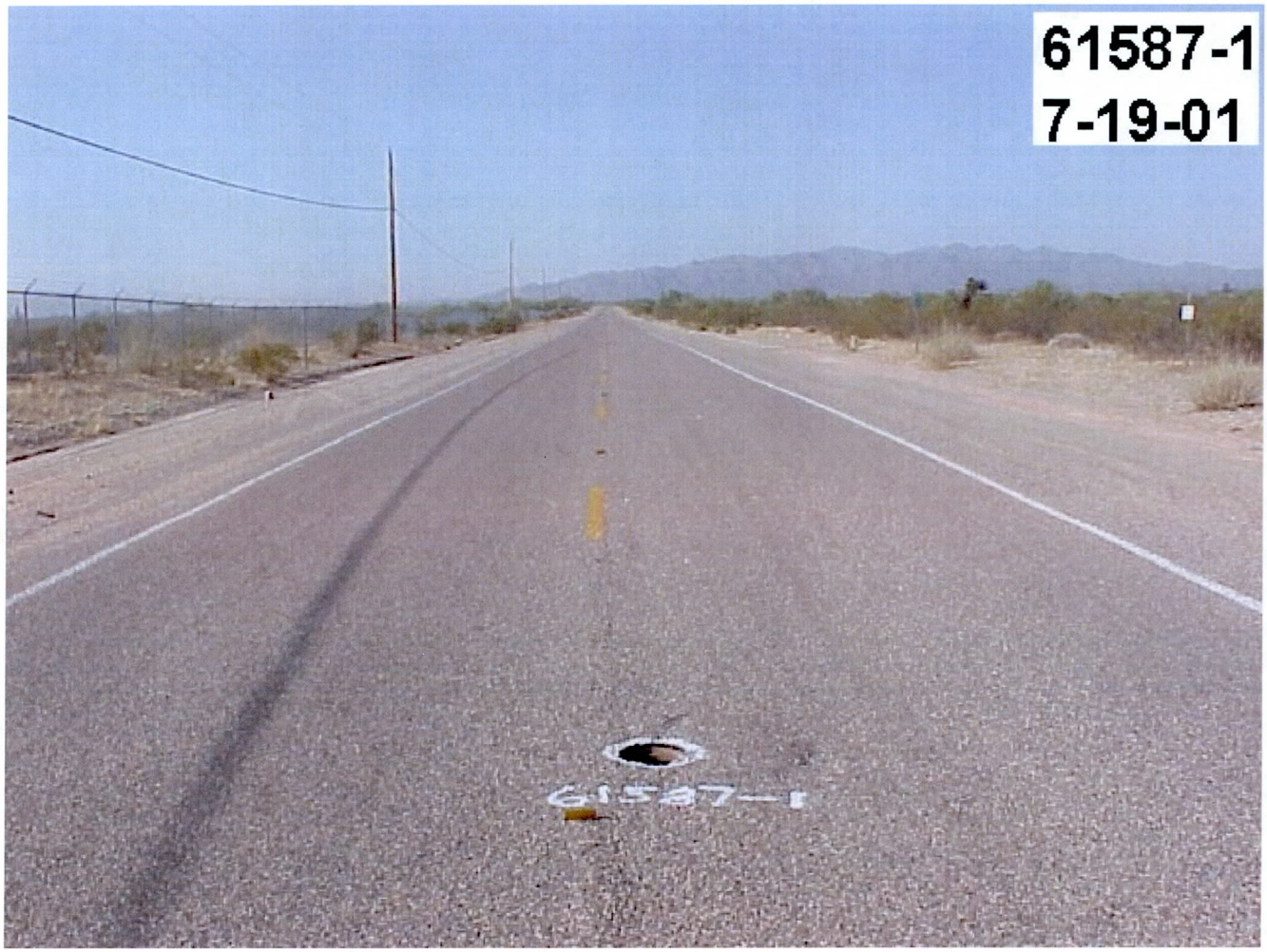
mvc-019s.jpg

mvc-018s.jpg



mvc-002f.jpg

mvc-001f.jpg



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Land Survey Section: Report

UPLSS Corners

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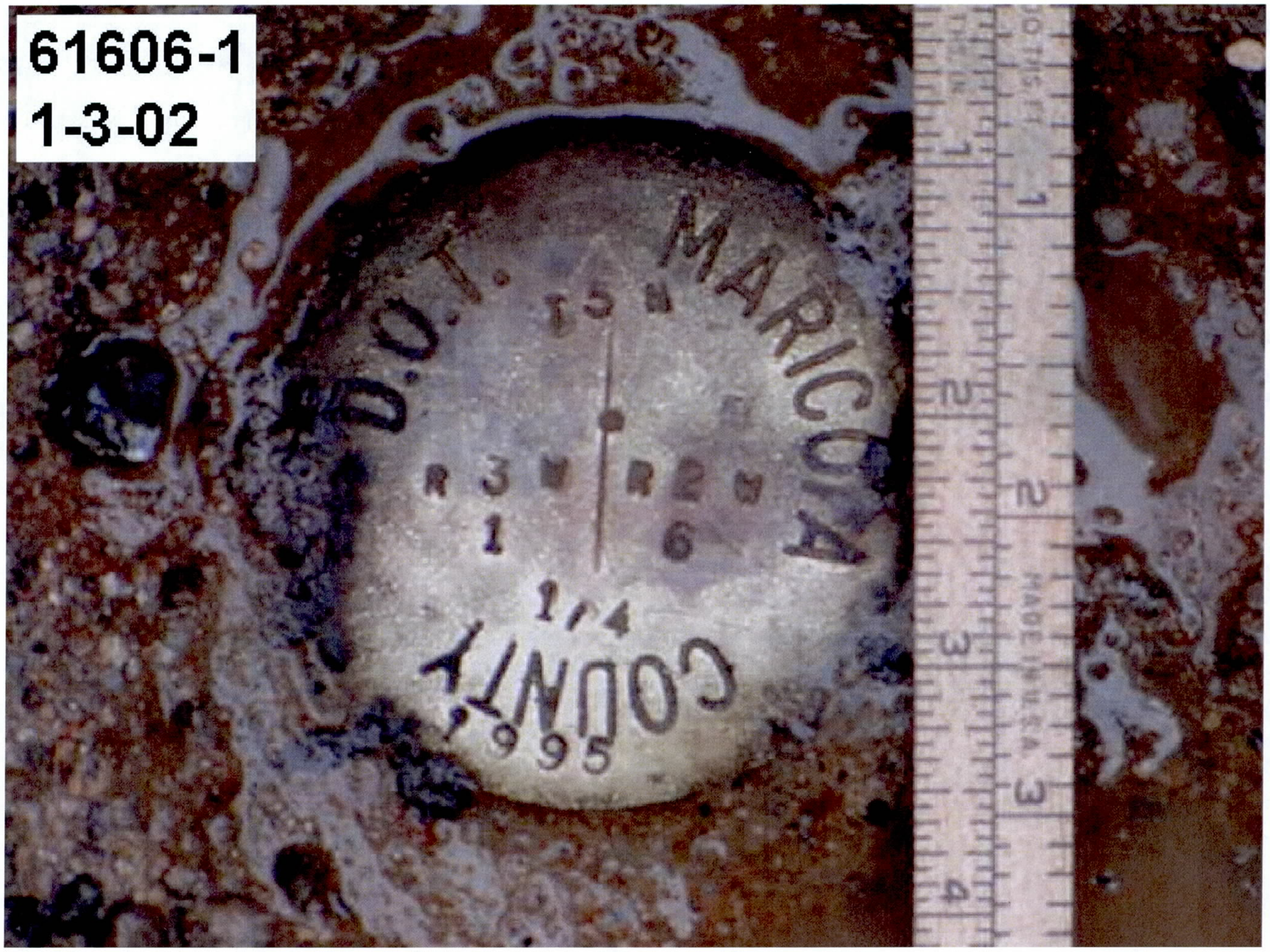
Unofficial Document

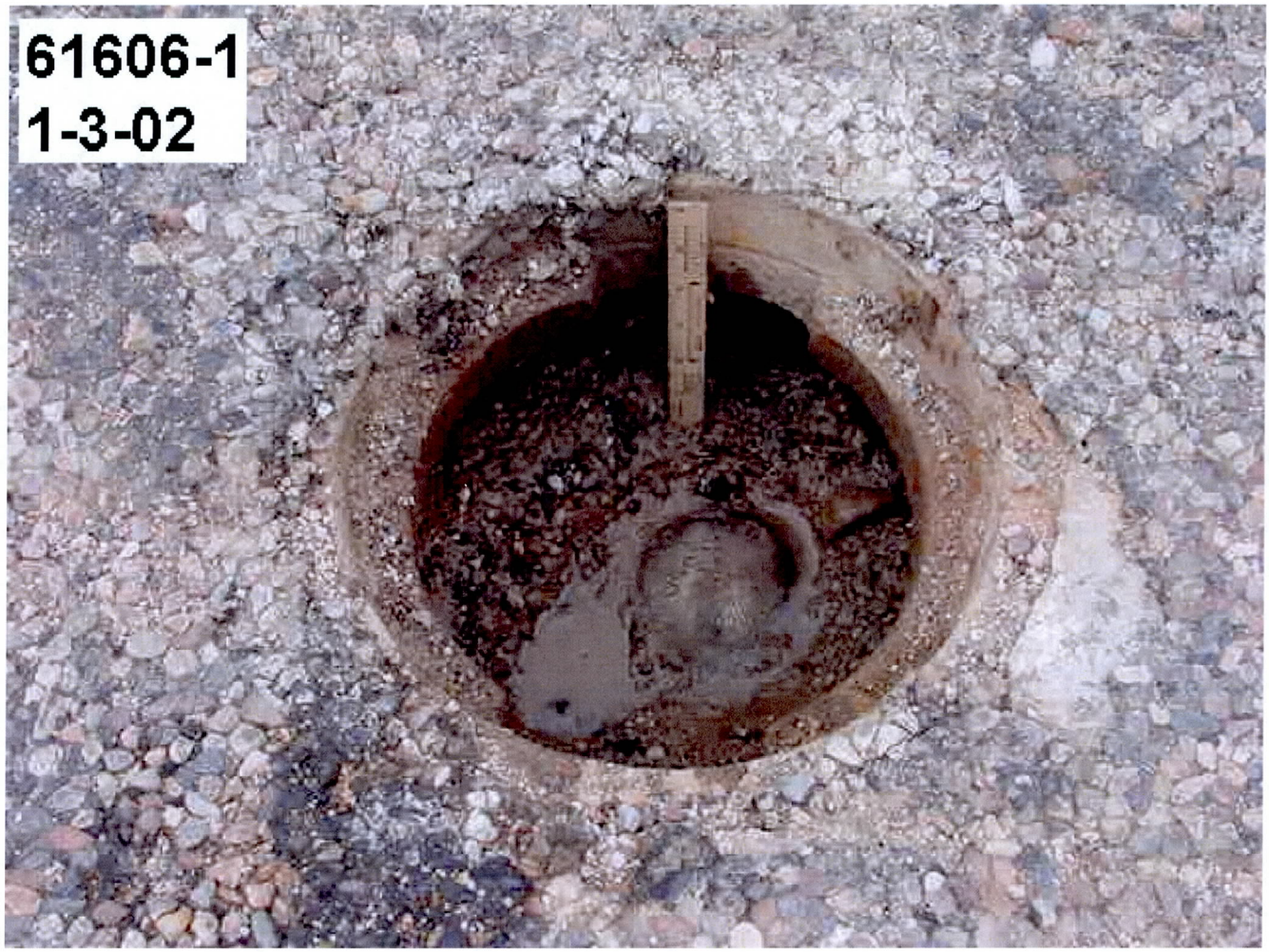
Unique ID:	11550
Point Name:	61606-1
Alias:	6160601
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	1
UPLSS Corner Name:	East 1/4
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.481438234N (DD.MMSSsssss)
Longitude NAD83(1992):	112.305824563W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1690.023
SPC AZ C Northing (Int Feet):	1020592.546
SPC AZ C Easting (Int Feet):	517888.537
NAVD88 Elev. (Int feet):	1787.539
Combination Grid Factor:	1.00014272
Convergence:	
Last Date Visited:	7/19/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.6' DN STAMPED "T5N R3W R2W 1 6 1/4 1995"
Comments:	

Photos of Survey Point

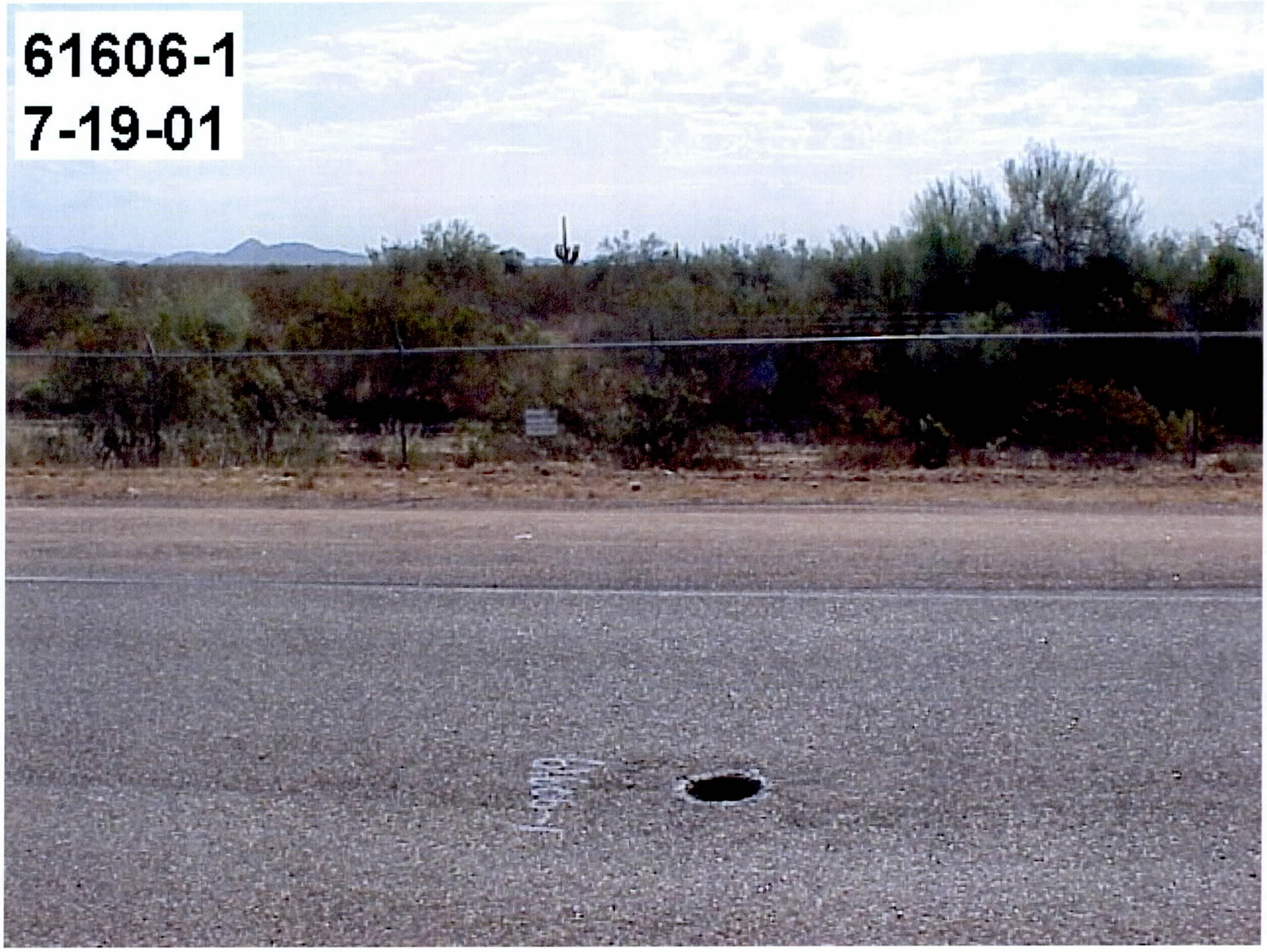
mvc-025s.jpg



mvc-022s.jpg



mvc-002f.jpg



mvc-001f.jpg

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Land Survey Section: Report

UPLSS Corners

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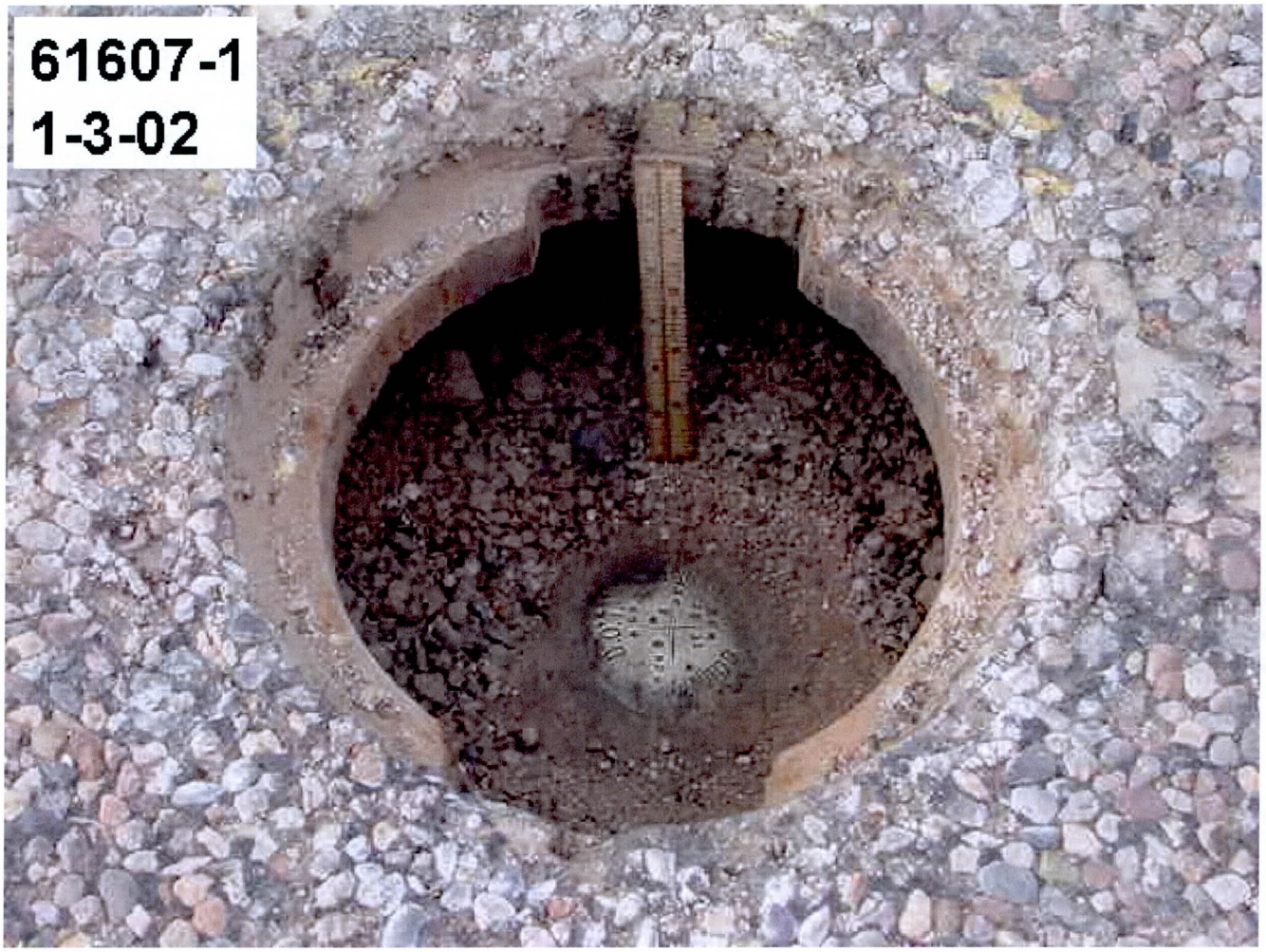
Unofficial Document

Unique ID:	11551
Point Name:	61607-1
Alias:	6160701
Import Date:	3/9/2003
Modified Date:	
Classification:	USPLSS Monument
Township:	T05N
Range:	R03W
Section:	1
UPLSS Corner Name:	Northeast
USPLSS Corner Type:	
Determination Status:	Resolved
Latitude NAD83(1992):	33.484052396N (DD.MMSSsssss)
Longitude NAD83(1992):	112.305823614W (DDD.MMSSsssss)
Ellipsoid Height (Int. Feet):	1721.110
SPC AZ C Northing (Int Feet):	1023234.867
SPC AZ C Easting (Int Feet):	517904.722
NAVD88 Elev. (Int feet):	1818.543
Combination Grid Factor:	1.00014421
Convergence:	
Last Date Visited:	7/25/2001
FIRM/Agency:	WOOD PATEL
MCR Number:	2002-0939871
MCR Book:	605
MCR Page:	19
Project Number:	40069012
Project Name:	GDACS
Monument Status:	
Description:	FD 2 3/4" MCDOT BC IN HH 0.7' DN STAMPED "T6N 36 31 R3W 1 6 R2W T5N 1995"
Comments:	

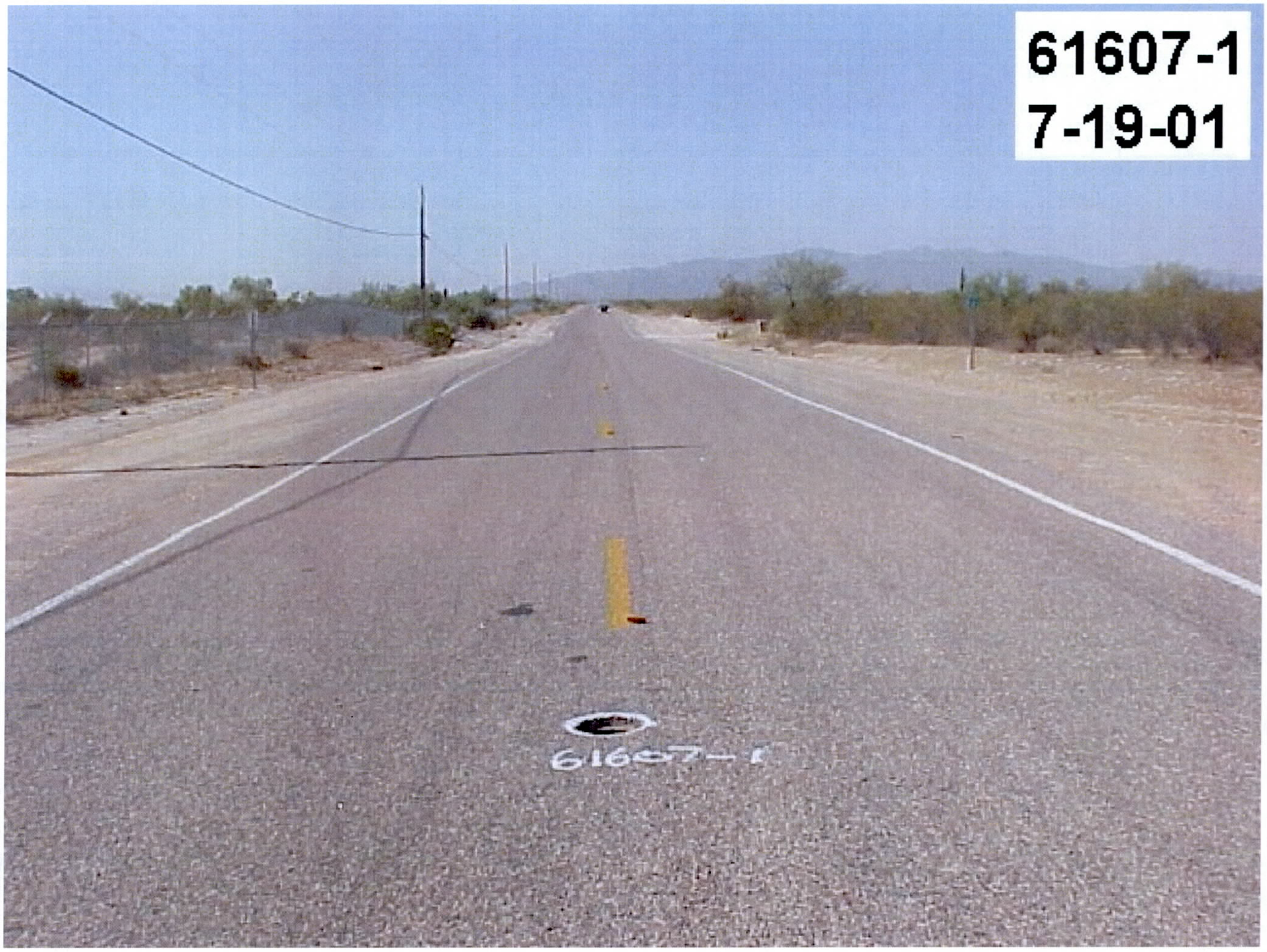
Photos of Survey Point

mvc-029s.jpg

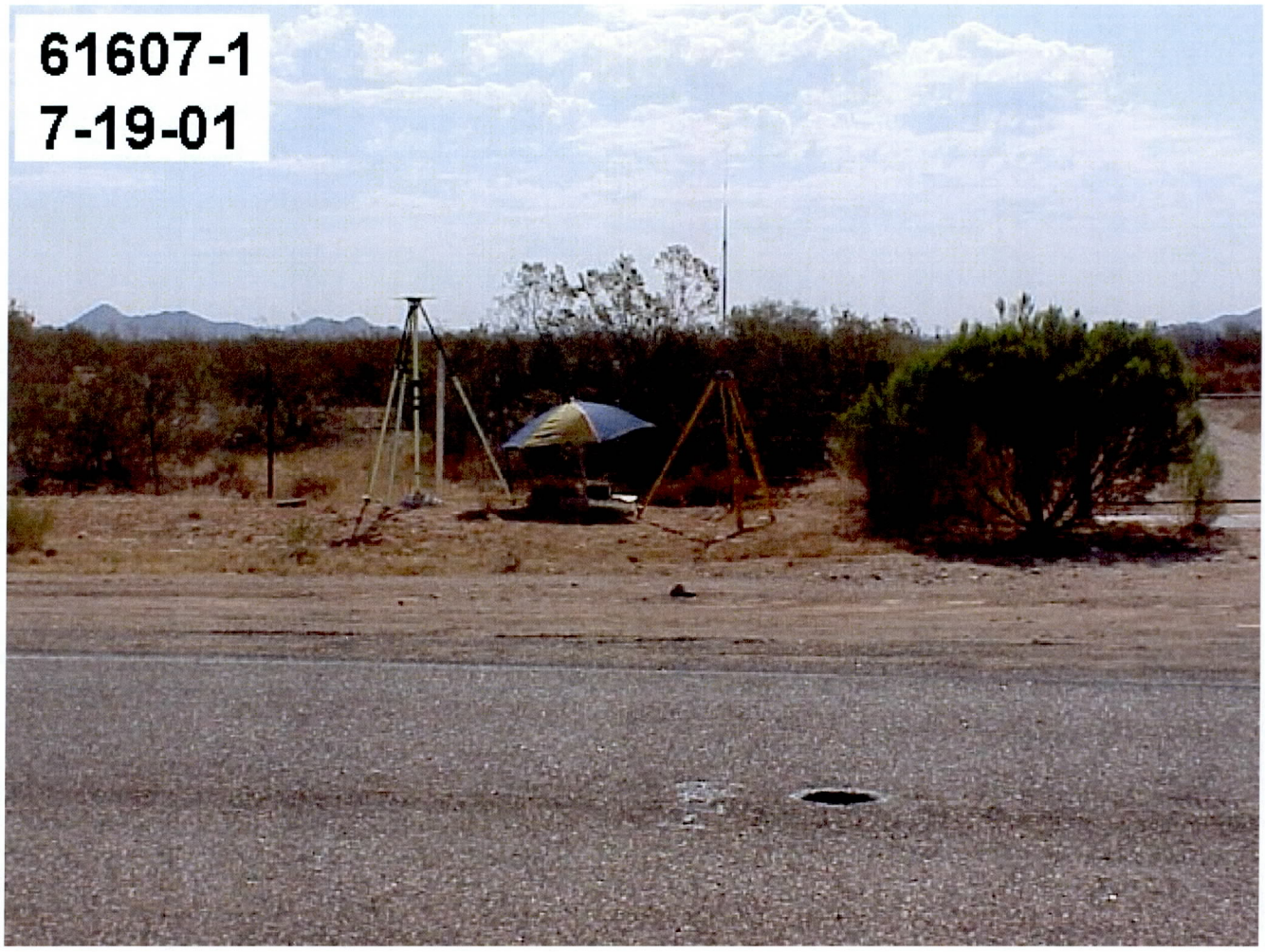
mvc-028s.jpg



mvc-002f.jpg



mvc-001f.jpg



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SURVEY CONTROL MONUMENTS

METADATA FOR NGS POINTS

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1        National Geodetic Survey,   Retrieval Date = JULY 21, 2010
 DV0920 ***********************************************************************
 DV0920  DESIGNATION -  1697
 DV0920  PID         -  DV0920
 DV0920  STATE/COUNTY-  AZ/MARICOPA
 DV0920  USGS QUAD   -  WITTMANN (1981)
 DV0920
 DV0920                         *CURRENT SURVEY CONTROL
 DV0920  ___________________________________________________________________
 DV0920* NAD 83(1986)-  33 46 49.     (N)    112 31 50.     (W)     SCALED
 DV0920* NAVD 88     -       517.437  (meters)    1697.62   (feet)  POSTED
 DV0920  ___________________________________________________________________
 DV0920  GEOID HEIGHT-        -29.85  (meters)                      GEOID09
 DV0920  DYNAMIC HT  -        516.820 (meters)    1695.60   (feet)  COMP
 DV0920  MODELED GRAV-    979,434.2   (mgal)                        NAVD 88
 DV0920
 DV0920  VERT ORDER  -  * POSTED, Code NC , SEE BELOW
 DV0920
 DV0920.The horizontal coordinates were scaled from a topographic map and have
 DV0920.an estimated accuracy of +/- 6 seconds.
 DV0920
 DV0920.The orthometric height was determined by differential leveling
 DV0920.and adjusted in November 2005.
 DV0920.* This is a POSTED BENCH MARK height.  Code NC indicates the bench mark
 DV0920.was located on a no-check spur therefore a value was not computed.
 DV0920.No vertical observational check was made to the station.
 DV0920
 DV0920.The geoid height was determined by GEOID09.
 DV0920
 DV0920.The dynamic height is computed by dividing the NAVD 88
 DV0920.geopotential number by the normal gravity value computed on the
 DV0920.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 DV0920.degrees latitude (g = 980.6199 gals.).
 DV0920
 DV0920.The modeled gravity was interpolated from observed gravity values.
 DV0920
 DV0920;                     North         East     Units  Estimated Accuracy
 DV0920;SPC AZ C     -   308,450.      156,510.      MT  (+/- 180 meters Scaled)
 DV0920
 DV0920                         SUPERSEDED SURVEY CONTROL
 DV0920
 DV0920  NGVD 29 (??/??/92)  516.918  (m)         1695.92   (f) ADJ UNCH    2 0
 DV0920
 DV0920.Superseded values are not recommended for survey control.
 DV0920.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 DV0920.See file dsdata.txt to determine how the superseded data were derived.
 DV0920
 DV0920_U.S. NATIONAL GRID SPATIAL ADDRESS: 12SUC582388(NAD 83)
 DV0920_MARKER: P = PIPE CAP
 DV0920_SETTING: 17 = SET INTO TOP OF METAL PIPE DRIVEN INTO GROUND
 DV0920_SP_SET: METAL PIPE DRIVEN INTO GROUND
 DV0920_STAMPING: 1697 PHNX
```

```
DV0920_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
DV0920_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
DV0920+SATELLITE: SATELLITE OBSERVATIONS - April 29, 2007
DV0920
DV0920  HISTORY     - Date     Condition        Report By
DV0920  HISTORY     - UNK      MONUMENTED       USGS
DV0920  HISTORY     - 1939     GOOD             NGS
DV0920  HISTORY     - 20070429 GOOD             GEOCAC
DV0920
DV0920                          STATION DESCRIPTION
DV0920
DV0920'DESCRIBED BY NATIONAL GEODETIC SURVEY 1939
DV0920'7.4 MI SE FROM HOT SPRINGS JUNCTION.
DV0920'7.4 MILES SOUTHEAST ALONG THE ATCHISON, TOPEKA AND SANTA FE RAILWAY
DV0920'FROM HOT SPRINGS JUNCTION, AT THE SIDING AT WITTMANN, 450 FEET
DV0920'NORTHWEST OF THE STATION BOOTH, 200 FEET NORTHWEST OF CULVERT E 158,
DV0920'AND 75 FEET NORTHEAST OF THE CENTERLINE OF THE TRACK.  A UNITED STATES
DV0920'GEOLOGICAL SURVEY STANDARD CAP, STAMPED 1697 PHNX AND RIVETED ON THE
DV0920'TOP OF A 3-1/2 IRON PIPE.
DV0920
DV0920                          STATION RECOVERY (2007)
DV0920
DV0920'RECOVERY NOTE BY GEOCACHING 2007 (ACM)
DV0920'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:01
```

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1        National Geodetic Survey,   Retrieval Date = JULY 21, 2010
 AJ3878 ***********************************************************************
 AJ3878  HT_MOD       -  This is a Height Modernization Survey Station.
 AJ3878  DESIGNATION -  4KE1
 AJ3878  PID         -  AJ3878
 AJ3878  STATE/COUNTY-  AZ/MARICOPA
 AJ3878  USGS QUAD   -  WITTMANN (1981)
 AJ3878
 AJ3878                         *CURRENT SURVEY CONTROL
 AJ3878  ___________________________________________________________________
 AJ3878* NAD 83(2007)-  33 48 40.67749(N)    112 30 57.65025(W)     ADJUSTED
 AJ3878* NAVD 88     -       554.55   (meters)    1819.4    (feet)  GPS OBS
 AJ3878  ___________________________________________________________________
 AJ3878  EPOCH DATE  -        2007.00
 AJ3878  X           -  -2,031,647.137 (meters)                     COMP
 AJ3878  Y           -  -4,900,955.247 (meters)                     COMP
 AJ3878  Z           -   3,529,366.928 (meters)                     COMP
 AJ3878  LAPLACE CORR-          2.69  (seconds)                     DEFLEC09
 AJ3878  ELLIP HEIGHT-        524.808 (meters)          (02/10/07) ADJUSTED
 AJ3878  GEOID HEIGHT-         -29.72  (meters)                     GEOID09
 AJ3878
 AJ3878  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 AJ3878  Type    PID    Designation                        North   East  Ellip
 AJ3878  -------------------------------------------------------------------
 AJ3878  NETWORK AJ3878 4KE1                                0.76   0.71   1.25
 AJ3878  -------------------------------------------------------------------
 AJ3878
 AJ3878.The horizontal coordinates were established by GPS observations
 AJ3878.and adjusted by the National Geodetic Survey in February 2007.
 AJ3878
 AJ3878.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 AJ3878.See National Readjustment for more information.
 AJ3878.The horizontal coordinates are valid at the epoch date displayed above.
 AJ3878.The epoch date for horizontal control is a decimal equivalence
 AJ3878.of Year/Month/Day.
 AJ3878
 AJ3878.The orthometric height was determined by GPS observations and a
 AJ3878.high-resolution geoid model using precise GPS observation and
 AJ3878.processing techniques.
 AJ3878
 AJ3878.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 AJ3878
 AJ3878.The Laplace correction was computed from DEFLEC09 derived deflections.
 AJ3878
 AJ3878.The ellipsoidal height was determined by GPS observations
 AJ3878.and is referenced to NAD 83.
 AJ3878
 AJ3878.The geoid height was determined by GEOID09.
 AJ3878
 AJ3878;                        North         East     Units Scale Factor Converg.
 AJ3878;SPC AZ C     -   311,886.630   157,872.454   MT  0.99993794   -0 20 00.7
 AJ3878;SPC AZ C     - 1,023,250.10    517,954.25   iFT  0.99993794   -0 20 00.7
```

```
AJ3878;UTM  12      - 3,742,266.661   359,684.302   MT  0.99984272   -0 50 37.5
AJ3878
AJ3878!             -  Elev Factor  x  Scale Factor =   Combined Factor
AJ3878!SPC AZ C     -   0.99991762  x   0.99993794  =   0.99985556
AJ3878!UTM  12      -   0.99991762  x   0.99984272  =   0.99976035
AJ3878
AJ3878                          SUPERSEDED SURVEY CONTROL
AJ3878
AJ3878  NAD 83(1992)-  33 48 40.67683(N)    112 30 57.64977(W) AD(        ) B
AJ3878  ELLIP H (04/12/01)  524.829  (m)                       GP(        ) 3 2
AJ3878
AJ3878.Superseded values are not recommended for survey control.
AJ3878.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AJ3878.See file dsdata.txt to determine how the superseded data were derived.
AJ3878
AJ3878_U.S. NATIONAL GRID SPATIAL ADDRESS: 12SUC5968442266(NAD 83)
AJ3878_MARKER: I = METAL ROD
AJ3878_SETTING: 15 = METAL ROD DRIVEN INTO GROUND. SEE TEXT FOR ADDITIONAL
AJ3878+WITH SETTING: INFORMATION.
AJ3878_STAMPING: 4KE1
AJ3878_MARK LOGO: MCDOT
AJ3878_PROJECTION: PROJECTING 23 CENTIMETERS
AJ3878_MAGNETIC: B = BAR MAGNET IMBEDDED IN MONUMENT
AJ3878_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AJ3878+STABILITY: POSITION/ELEVATION WELL
AJ3878_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AJ3878+SATELLITE: SATELLITE OBSERVATIONS - July 31, 2008
AJ3878_ROD/PIPE-DEPTH:  1.8 meters
AJ3878_SLEEVE-DEPTH  :  0.8 meters
AJ3878
AJ3878  HISTORY     - Date     Condition        Report By
AJ3878  HISTORY     - 2000     MONUMENTED       MCDOT
AJ3878  HISTORY     - 20080731 GOOD
AJ3878
AJ3878                          STATION DESCRIPTION
AJ3878
AJ3878'DESCRIBED BY MARICOPA CO DOT 2000 (JJR)
AJ3878'THE STATION IS LOCATED ABOUT 3.5 MI (5.6 KM) NORTH-NORTHEAST OF THE
AJ3878'TOWN OF WITTMANN, TOWNSHIP 6 NORTH, RANGE 2 WEST, SECTION 31
AJ3878'OWNERSHIP - PRIVATE
AJ3878'TO REACH THE STATION FROM THE JUNCTION OF INTERSTATE 17 AND STATE
AJ3878'ROUTE 74 AT EXIT 223, DRIVE WESTERLY ON STATE ROUTE 74 APPROXIMATELY
AJ3878'22 MI (35.4 KM) TO THE INTERSECTION OF 211TH AVENUE AND STATE ROUTE
AJ3878'74, THENCE TURN LEFT (SOUTH) ONTO 211TH AVENUE AND DRIVE SOUTHERLY 2.2
AJ3878'MI (3.5 KM) TO THE STATION ON THE LEFT 50 FT (15.2 M) EAST OF THE ROAD
AJ3878'THE STATION IS MARKED BY AN ALUMINUM CAP COMPRESSED ON A 6.0 FOOT (1.8
AJ3878'M) STAINLESS STEEL ROD DRIVEN TO REFUSAL, ENCASED IN A 1 INCH GREASED
AJ3878'PVC SLEEVE ENCLOSED IN A 5 INCH PVC PIPE WITH A COUNTY LOGO ACCESS
AJ3878'COVER STAMPED 4KE1, SURROUNDED WITH A CONCRETE COLLAR FLUSH WITH THE
AJ3878'GROUND, WITNESSED BY A WHITE CARSONITE MARKER
AJ3878'STATION TIES -
AJ3878'75 FT (22.9 M) NORTH OF MILE POST 2
AJ3878'6 FT (1.8 M) WEST OF A BARBED WIRE FENCE ON THE EAST SIDE OF 211TH
AJ3878'AVENUE
AJ3878'FOR A TO REACH MAP, STATION IMAGES AND ADDITIONAL INFORMATION, YOU CAN
AJ3878'VISIT-WWW.MCDOT.MARICOPA.GOV       SEARCH KEYWORD  GDACS
AJ3878
AJ3878                          STATION RECOVERY (2008)
AJ3878
AJ3878'RECOVERY NOTE BY CITY OF SURPRISE GEODETIC SURVEY 2008 (BSF)
```

AJ3878'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:00

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1        National Geodetic Survey,   Retrieval Date = JULY 21, 2010
 DV0922 ***********************************************************************
 DV0922  DESIGNATION -  E 24
 DV0922  PID         -  DV0922
 DV0922  STATE/COUNTY-  AZ/MARICOPA
 DV0922  USGS QUAD   -  WITTMANN (1981)
 DV0922
 DV0922                         *CURRENT SURVEY CONTROL
 DV0922  ___________________________________________________________________
 DV0922* NAD 83(1986)-  33 47 55.     (N)     112 33 17.     (W)     SCALED
 DV0922* NAVD 88     -       543.539  (meters)    1783.26    (feet)  POSTED
 DV0922  ___________________________________________________________________
 DV0922  GEOID HEIGHT-        -29.83  (meters)                       GEOID09
 DV0922  DYNAMIC HT  -        542.890 (meters)    1781.13    (feet)  COMP
 DV0922  MODELED GRAV-     979,429.2  (mgal)                         NAVD 88
 DV0922
 DV0922  VERT ORDER  -  * POSTED, Code NC , SEE BELOW
 DV0922
 DV0922.The horizontal coordinates were scaled from a topographic map and have
 DV0922.an estimated accuracy of +/- 6 seconds.
 DV0922
 DV0922.The orthometric height was determined by differential leveling
 DV0922.and adjusted in November 2005.
 DV0922.* This is a POSTED BENCH MARK height.  Code NC indicates the bench mark
 DV0922.was located on a no-check spur therefore a value was not computed.
 DV0922.No vertical observational check was made to the station.
 DV0922
 DV0922.The geoid height was determined by GEOID09.
 DV0922
 DV0922.The dynamic height is computed by dividing the NAVD 88
 DV0922.geopotential number by the normal gravity value computed on the
 DV0922.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 DV0922.degrees latitude (g = 980.6199 gals.).
 DV0922
 DV0922.The modeled gravity was interpolated from observed gravity values.
 DV0922
 DV0922;                        North         East     Units  Estimated Accuracy
 DV0922;SPC AZ C     -   310,500.      154,280.      MT  (+/- 180 meters Scaled)
 DV0922
 DV0922                          SUPERSEDED SURVEY CONTROL
 DV0922
 DV0922  NGVD 29 (??/??/92)  543.011  (m)          1781.53   (f) ADJ UNCH    2 0
 DV0922
 DV0922.Superseded values are not recommended for survey control.
 DV0922.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 DV0922.See file dsdata.txt to determine how the superseded data were derived.
 DV0922
 DV0922_U.S. NATIONAL GRID SPATIAL ADDRESS: 12SUC560409(NAD 83)
 DV0922_MARKER: DB = BENCH MARK DISK
 DV0922_SETTING: 30 = SET IN A LIGHT STRUCTURE
 DV0922_SP_SET: CULVERT
 DV0922_STAMPING: E 24 1933
```

```
DV0922_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
DV0922_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
DV0922+SATELLITE: SATELLITE OBSERVATIONS - February 03, 2007
DV0922
DV0922  HISTORY     - Date     Condition        Report By
DV0922  HISTORY     - 1933     MONUMENTED       CGS
DV0922  HISTORY     - 1939     GOOD             NGS
DV0922  HISTORY     - 20070203 GOOD             GEOCAC
DV0922
DV0922                          STATION DESCRIPTION
DV0922
DV0922'DESCRIBED BY NATIONAL GEODETIC SURVEY 1939
DV0922'5.4 MI SE FROM HOT SPRINGS JUNCTION.
DV0922'5.4 MILES SOUTHEAST ALONG THE ATCHISON, TOPEKA AND SANTA FE RAILWAY
DV0922'FROM HOT SPRINGS JUNCTION, 600 FEET NORTHWEST OF MILEPOST 156, AT
DV0922'CULVERT G 156, AND IN THE TOP OF THE SOUTHWEST CONCRETE HEADWALL.  A
DV0922'STANDARD DISK, STAMPED E 24 1933.
DV0922
DV0922                          STATION RECOVERY (2007)
DV0922
DV0922'RECOVERY NOTE BY GEOCACHING 2007 (ACM)
DV0922'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:00
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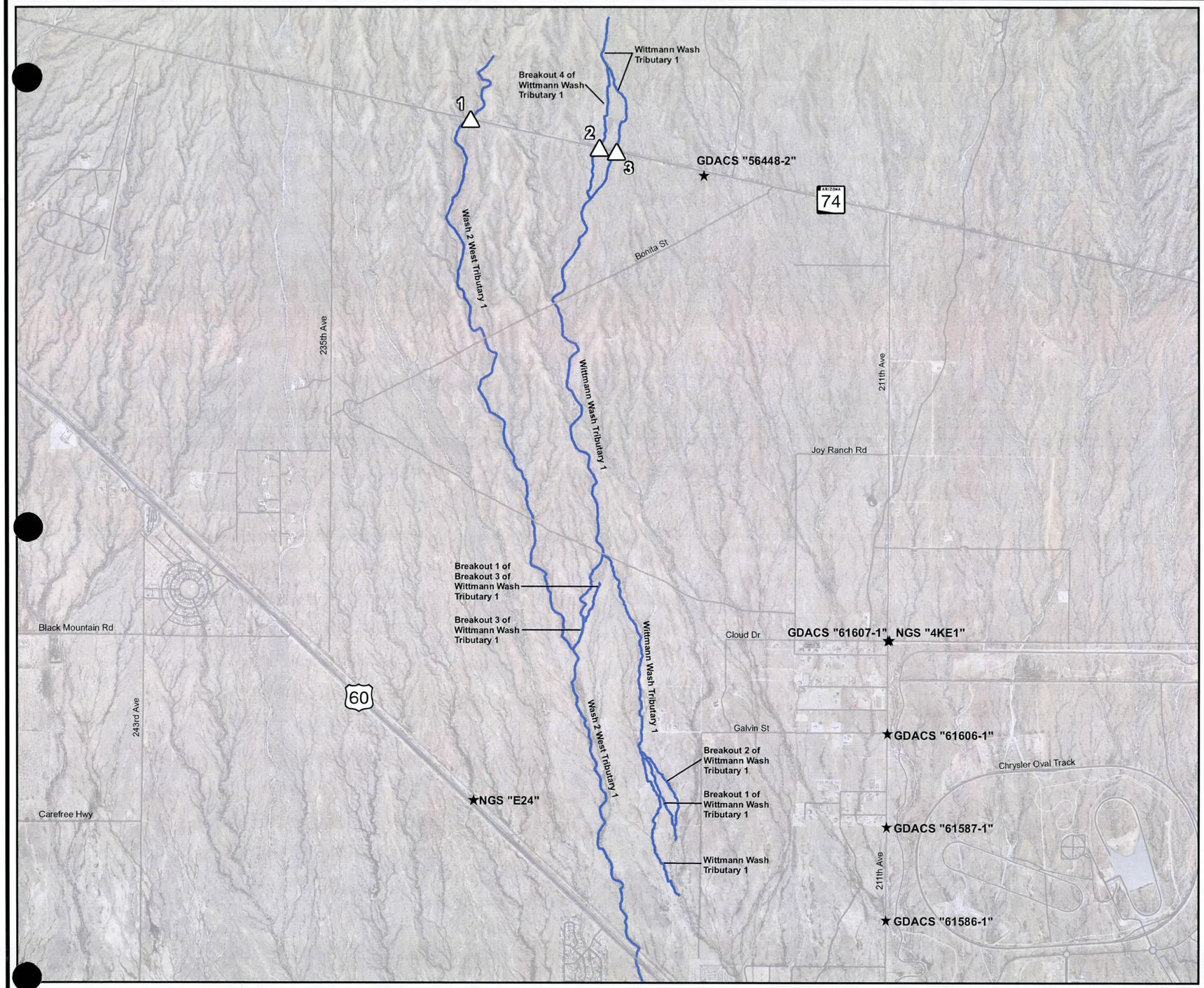
LOCATION MAP OF GROUND-SURVEYED STRUCTURES



LOCATION MAP OF GROUND-SURVEYED STRUCTURES

STRUCTURES INDEX

Location Number	Wash	Structure
1	Wash 2 West Tributary 1	1 - 10-ft x 8-ft RCB
2	Breakout 4 of Wittmann Wash Tributary 1	1 - 30-in RCP
3	Wittmann Wash Tributary 1	4 - 10-ft x 6-ft RCBs

★ Benchmark

Benchmark Information: Benchmarks are either GDACS Survey Monuments (GDACS #) or NGS Survey Monuments (NGS #).

Point Name	Elevation NAVD 88 - Feet	Northing NAD83 HARN - feet	Easting NAD83 HARN - feet
GDACS "56448-2"	2,021.724	1,036,451.884	512,704.358
GDACS "61586-1"	1,722.597	1,015,308.917	517,857.182
GDACS "61587-1"	1,756.310	1,017,950.077	517,872.184
GDACS "61606-1"	1,787.539	1,020,592.546	517,888.537
GDACS "61607-1"	1,818.543	1,023,234.867	517,904.722
NGS "4KE1"	1,819.40	1,023,250.10	517,954.25
NGS "E24"	1,783.26	1,018,700 +/- 590	506,168 +/- 590

3,000 1,500 0 3,000
Feet

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

WITTMANN PHASE III FLOODPLAIN DELINEATION STUDY

FCD CONTRACT 2009-C006 ASSIGNMENT 3

PBS&J
20860 North Tatum Boulevard, Suite 300
Phoenix, Arizona 85050
(480) 419-7275

Design	KP	July 2010
Design Check	SA	July 2010
Plans	KP	July 2010
Plan Check	SA	July 2010

Sheet 1 of 1

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS.

PBS&J PROJECT NUMBER 100013714

AERIAL MAPPING BY STEWART GEO TECHNOLOGIES
CONTRACT NUMBER: FCD 2001-C021.
FLIGHT DATE WAS APRIL 2002.

AERIAL PHOTOGRAPHY PROVIDED BY FCDMC.
FLIGHT DATES FOR AERIAL PHOTOGRAPHY WERE SEPTEMBER 2008 AND OCTOBER 2009.

PREMIER ENGINEERING CORPORATION'S FIELD SURVEY REPORT

PREMIER
ENGINEERING CORPORATION

Project Survey Report: Wittmann Phase III Floodplain Deliniation Study

September 20, 2010

Mr. Seth Ahrens, PE
PBS&J
20860 N. Tatum Blvd., Suite 300
Phoenix, AZ 85284

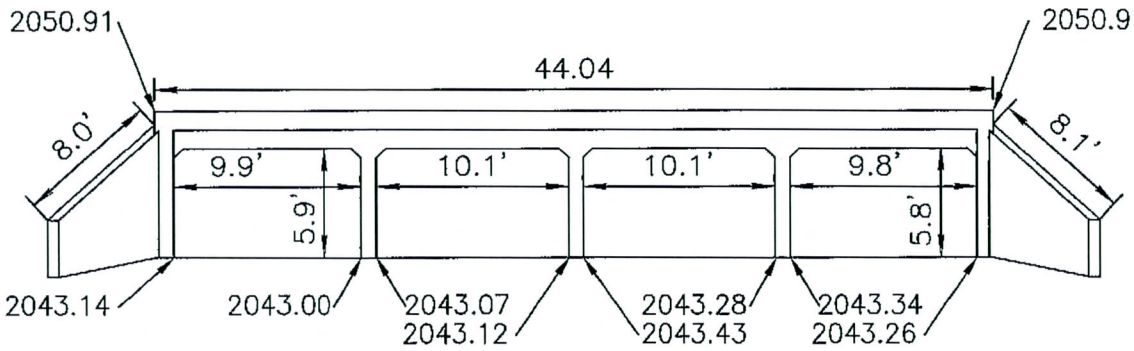
Project narrative:

At the request of PBS&J, consultant, and Richard Harris PE, FCD, the survey branch of Premier Engineering Corporation performed field observations in June 2010.

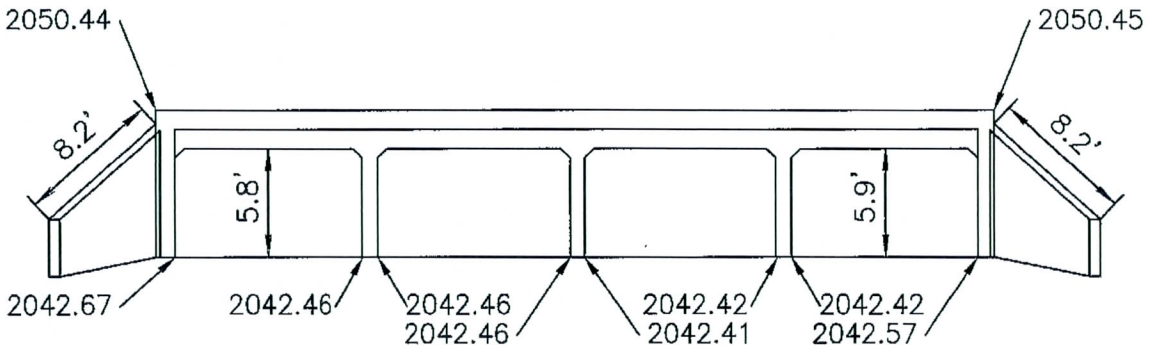
The project control was the Maricopa County Geodetic Densification and NGS Control point 4KE1.
Observations were performed with a Trimble 5800 real time kinematic GPS instrument.
And were taken on the Horizontal Datum of 1983-92 State Plane Coordinate System, Arizona Central Zone.
The Vertical Datum is The North American Vertical Datum of 1988.
Observations were reported to .01 international feet.

Mark Luond, RLS, PLS, CFedS
Survey Project Manager
Premier Engineering Corporation

6437 W. Chandler Blvd., Suite 1 • Chandler, AZ 85226 • (480) 829-6000 • Fax (480) 829-6016



North end
looking south
(Upstream face)



South end
looking north
(Downstream face)

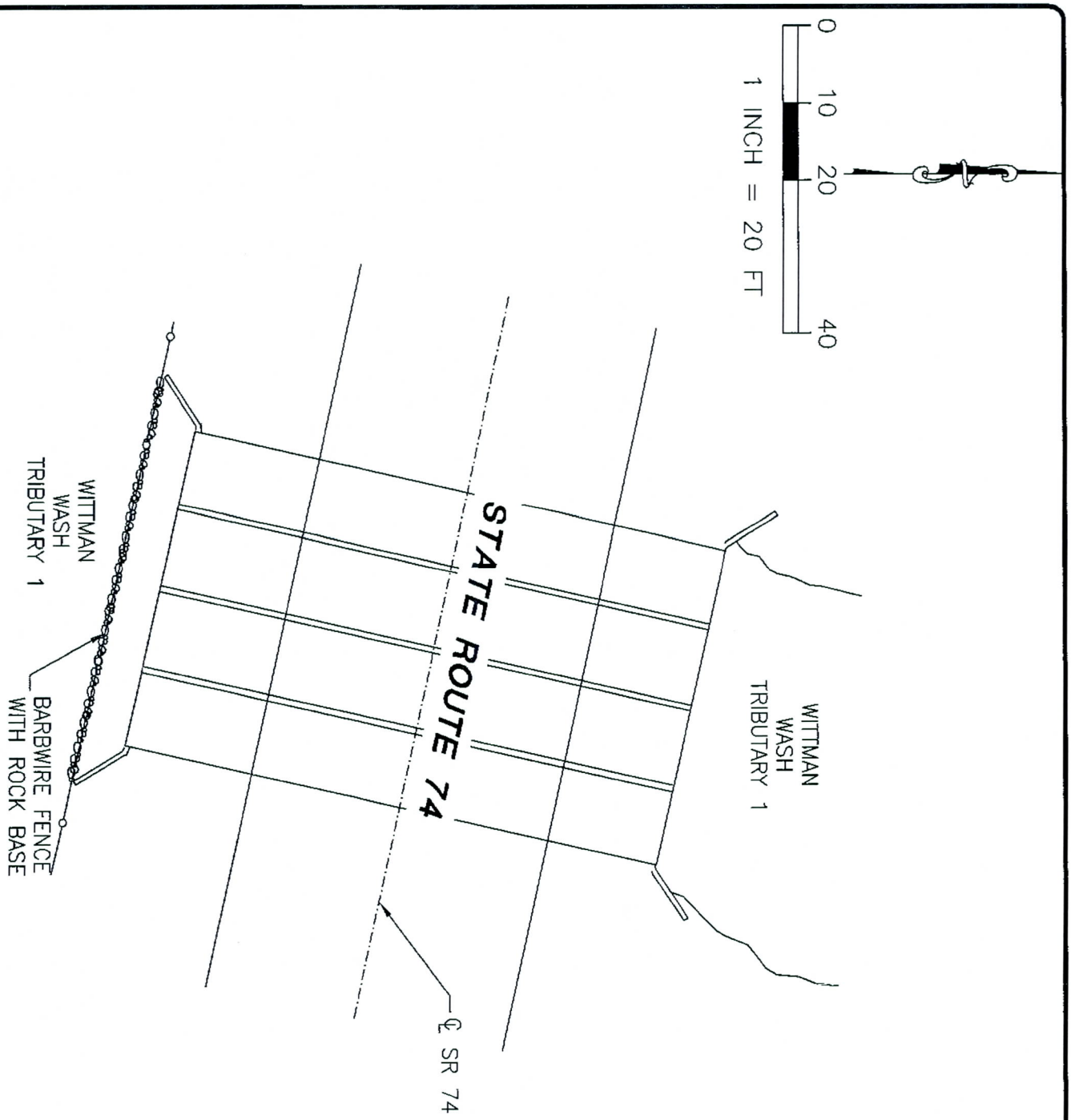
WITTMAN WASH TRIBUTARY 1 AT SR74

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A.
LUOND
Date Signed: 8/12/10
ARIZONA, U.S.A.
EXPIRES 9-30-2012

PREMIER
ENGINEERING CORPORATION
8437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

EXHIBIT "A"
CROSS SECTION #27
N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.
CULVERT CROSS SECTION
ROADWAY BOX CULVERT

PROJECT No.	DRAWN BY	DATE
1000901	DMH	SEPT 20, 2010
PAGE No.	CHECKED BY	
1 OF 2	MAL	



WITTMAN WASH TRIBUTARY 1 AT SR74

EXHIBIT "A"
PLAN VIEW #27
N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.
CULVERT CROSS SECTION
ROADWAY BOX CULVERT

PROJECT No.	DRAWN BY	DATE
1000901	DMH	SEPT 20, 2010
PAGE No.	CHECKED BY	
2 OF 2	MAL	

PREMIER
ENGINEERING CORPORATION
6437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A.
LUOND
Date Signed: 09/22/10
ARIZONA, U.S.A.
EXPIRES 9-30-2012

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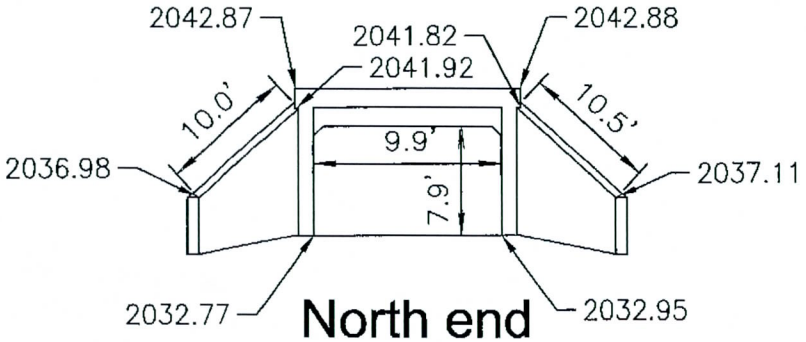
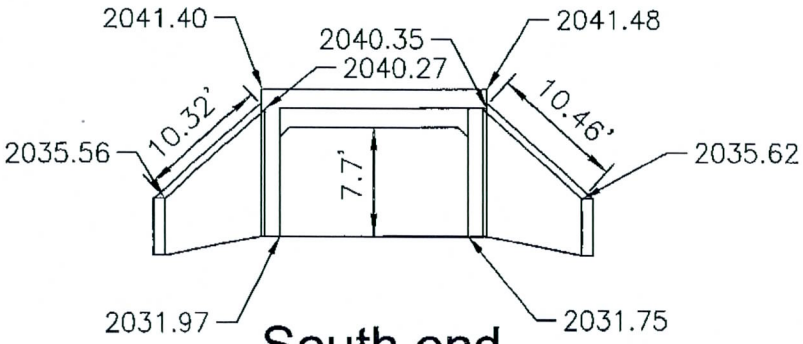


North end
looking south
(Upstream face)



South end
looking north
(Downstream face)

WASH 2 WEST TRIBUTARY 1 AT SR74

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A.
LUOND
Date Signed: 9/30/12
ARIZONA, U.S.A.
EXPIRES 9-30-2012

PREMIER
ENGINEERING CORPORATION
8437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

EXHIBIT "A"
CROSS SECTION #76
N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.
CULVERT CROSS SECTION
ROADWAY BOX CULVERT

PROJECT No.	DRAWN BY	DATE
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PAGE No.	CHECKED BY	
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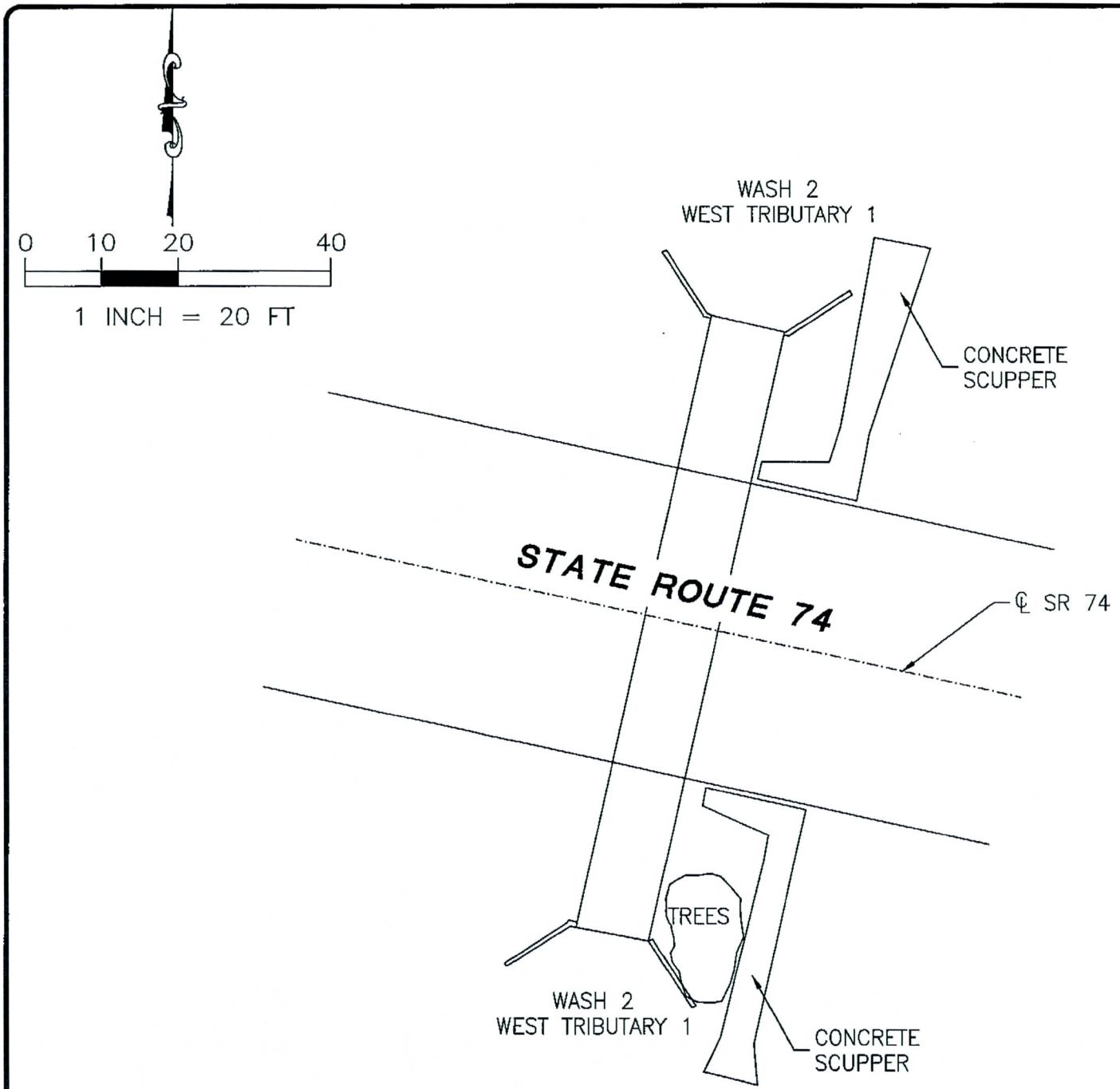

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A.
LUOND
Date Signed: 9/1/12
ARIZONA, U.S.A.
EXPIRES 9-30-2012

PREMIER
ENGINEERING CORPORATION
8437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

WASH 2 WEST TRIBUTARY 1 AT SR74

EXHIBIT "A"
PLAN VIEW #76
N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.
CULVERT CROSS SECTION
ROADWAY BOX CULVERT

PROJECT No.	DRAWN BY	DATE
1000901	DMH	SEPT 20, 2010
PAGE No.	CHECKED BY	
2 OF 2	MAL	

BREAKOUT 4 OF WITTMAN WASH TRIBUTARY 1 AT SR74

EXHIBIT "A"

CROSS SECTION CULVERT

N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.

CULVERT CROSS SECTION

PROJECT No.	DRAWN BY	DATE
1000901	DMH	SEPT 20, 2010
PAGE No.	CHECKED BY	
1 OF 2	MAL	

REGISTERED LAND SURVEYOR
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MARK A.
LUOND
Date Signed: 9/30/12
ARIZONA, U.S.A.
EXPIRES 9-30-2012

PREMIER
ENGINEERING CORPORATION
6437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

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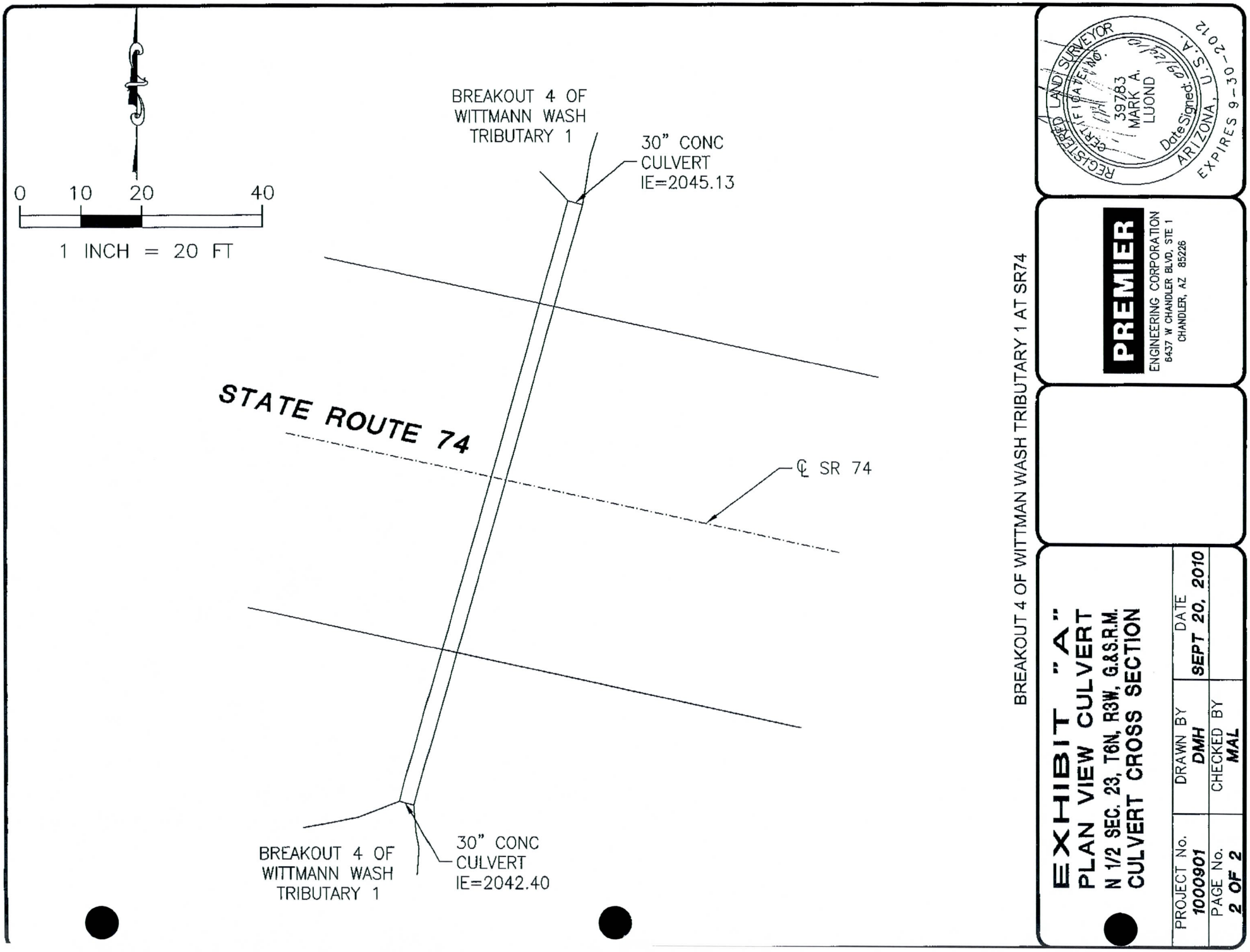

BREAKOUT 4 OF WITTMAN WASH TRIBUTARY 1 AT SR74

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A. LUOND
Date Signed: 9/21/10
ARIZONA, U.S.A.
EXPIRES 9-30-2012

PREMIER
ENGINEERING CORPORATION
6437 W CHANDLER BLVD, STE 1
CHANDLER, AZ 85226

EXHIBIT "A"
PLAN VIEW CULVERT
N 1/2 SEC. 23, T6N, R3W, G.&S.R.M.
CULVERT CROSS SECTION

PROJECT No.	DRAWN BY	DATE
1000901	DMH	SEPT 20, 2010
PAGE No.	CHECKED BY	
2 OF 2	MAL	

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Point	Northing	Easting	Elevation	Description
10000	1038630.2873	502906.7483	2068.6268	4LF2 CHECK
30000	1023250.1065	517954.3399	1819.1872	4KE1 CHECK
30001	1014472.3388	510763.8729	1729.4384	NG_SPOT
30002	1014457.6092	510778.7984	1729.6338	NG_SPOT
30003	1014447.1976	510788.7840	1729.4639	NG_TOP
30004	1014439.2261	510799.1275	1722.7656	NG_TOE
30005	1014431.9396	510806.7175	1722.0410	NG_SPOT
30006	1014422.0251	510817.7179	1722.0118	NG_SPOT
30007	1014412.4465	510829.3524	1720.6968	NG_SPOT
30008	1014401.5431	510841.1001	1721.7232	NG_TOE
30009	1014387.8783	510855.3507	1728.6136	NG_TOP
30010	1014381.0753	510863.3766	1728.7232	NG_SPOT
30011	1014376.2181	510869.7011	1728.8897	NG_SPOT
30012	1014381.2602	510902.2575	1727.3533	NG_SPOT
30013	1014398.5503	510882.3530	1728.3252	NG_SPOT
30014	1014406.6791	510873.0611	1728.9450	NG_SPOT
30015	1014416.8713	510863.0836	1726.7883	NG_TOP
30016	1014433.0469	510845.5628	1721.2451	NG_TOE
30017	1014434.8180	510841.0377	1721.2649	NG_SPOT
30018	1014445.2641	510831.1846	1722.1223	NG_SPOT
30019	1014455.5322	510821.1044	1722.6650	NG_SPOT
30020	1014459.5918	510815.8987	1722.5794	NG_TOE
30021	1014473.3696	510800.3474	1729.9998	NG_TOP
30022	1014478.8282	510793.6649	1729.9560	NG_SPOT
30023	1014511.9628	510738.6430	1732.2952	RR_RAIL
30024	1014515.6607	510741.9997	1732.2931	RR_RAIL
30025	1014513.8890	510740.3527	1731.5190	RR_TIE
30026	1014513.3636	510740.9495	1731.4501	NG_SPOT
30027	1014478.7391	510777.3559	1731.2571	NG_SPOT
30028	1014478.1423	510777.9329	1731.3632	RR_TIE
30029	1014480.0306	510779.6560	1732.0183	RR_RAIL
30030	1014476.4584	510776.2676	1732.0063	RR_RAIL
30031	1014444.1499	510817.5984	1731.7331	RR_RAIL
30032	1014440.5629	510814.3163	1731.7445	RR_RAIL
30033	1014442.3467	510815.9338	1731.0558	RR_TIE
30034	1014442.9600	510815.1850	1730.9622	NG_SPOT
30035	1014406.5190	510853.8711	1730.7434	NG_SPOT
30036	1014406.9553	510853.3726	1730.8324	RR_TIE
30037	1014408.7925	510855.0966	1731.4644	RR_RAIL
30038	1014405.1737	510851.6900	1731.5021	RR_RAIL
30039	1014373.7014	510892.2287	1731.1947	RR_RAIL
30040	1014370.1192	510888.9347	1731.2354	RR_RAIL
30041	1014371.8241	510890.5664	1730.6054	RR_TIE
30042	1014372.3136	510889.9812	1730.4801	NG_SPOT
30043	1014336.9099	510927.4868	1730.1533	NG_SPOT
30044	1014337.3401	510926.9048	1730.2261	RR_TIE
30045	1014339.3002	510928.7476	1730.8532	RR_RAIL
30046	1014335.7255	510925.3398	1730.8907	RR_RAIL
30047	1014305.2700	510964.6102	1730.3401	RR_RAIL
30048	1014301.6663	510961.2717	1730.3544	RR_RAIL
30049	1014303.4256	510962.8950	1729.6877	RR_TIE
30050	1014303.8299	510962.3457	1729.6005	NG_SPOT
30051	1014284.1315	510983.0374	1729.3593	NG_SPOT
30052	1014284.7154	510982.4873	1729.4045	RR_TIE
30053	1014286.6256	510984.3169	1730.0567	RR_RAIL
30054	1014282.9965	510980.9338	1730.0889	RR_RAIL
30055	1014341.3118	510851.7154	1723.4390	NG_SPOT
30056	1014341.5506	510835.1894	1722.4749	NG_TOP
30057	1014342.0099	510830.5397	1720.9993	NG_TOE
30058	1014345.4712	510819.4313	1720.7778	NG_SPOT
30059	1014351.1805	510805.4485	1720.2595	NG_SPOT
30060	1014357.7127	510792.3150	1720.6497	NG_SPOT

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
39783
MARK A.
LUOND
Date Signed 09/20/10
ARIZONA, U.S.A.
Expires 09/30/12

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AS-BUILT PLANS

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY, MORRISTOWN-NEW RIVER, MARICOPA COUNTY

INCLUDES AS-BUILT INFORMATION FOR ALL STRUCTURES MODELED IN THIS FDS

REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.	S-434(1)	1	13	12-22-64
		S-434(2)		14	

ENGINEERING RECORDS SERVICES

FILE COPY II

ENGINEERING RECORDS

FILE COPY II

STATE OF ARIZONA
STATE HIGHWAY DEPARTMENT

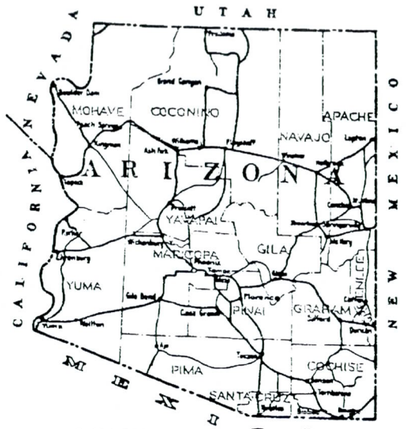
PLAN AND PROFILE OF PROPOSED

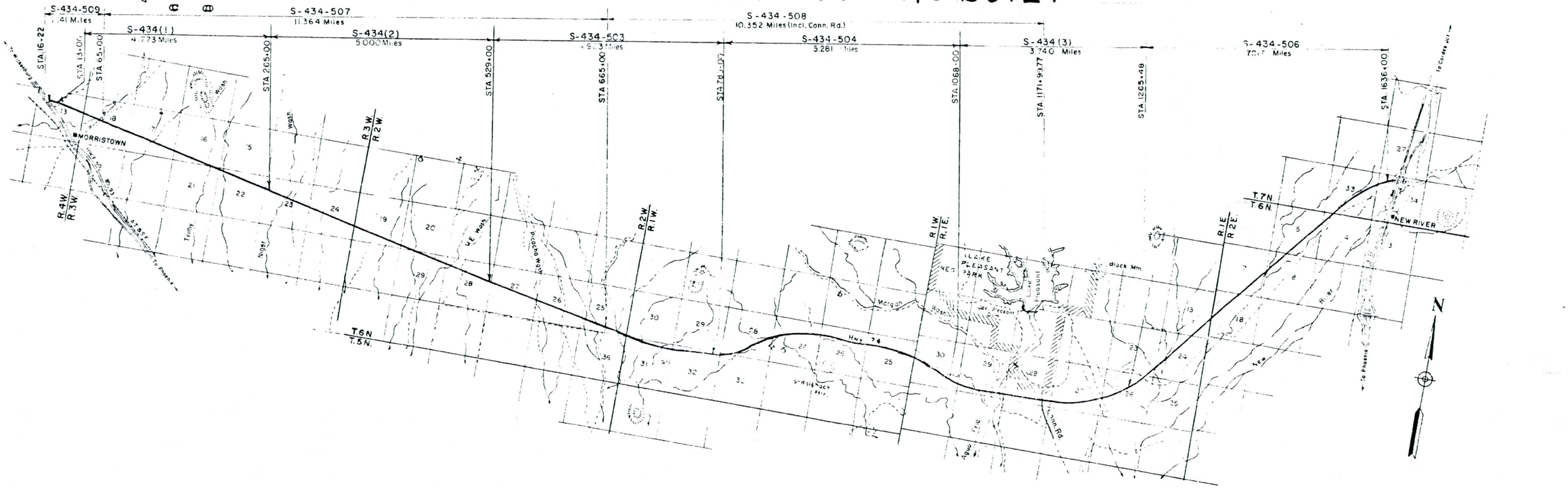
STATE HIGHWAY

MORRISTOWN—NEW RIVER

MARICOPA COUNTY

S-434-507 AS BUILT





ARIZONA STATE HIGHWAY COMMISSION
APPROVED [illegible] PRICE
STATE HIGHWAY ENGINEER

APPROVED DATE

CHIEF DEPUTY STATE ENGINEER

APPROVED DATE

DEPUTY STATE ENGINEER

J. B. Alerte

US DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED DATE

DIVISION ENGINEER

Destroyed 12-87 KD

MORRISTOWN-NEW RIVER HWY.
MORRISTOWN-LAKE PLEASANT
MARICOPA COUNTY

NEW CORRUGATED PIPE CULVERT

Station	Size	Length	2 2/3"x1/2" Uncoated	2 2/3"x1/2" Bit. Coated	3"x1" Uncoated	3"x1" Bit. Coated	Remarks
178+05	54"	16'	14		16		Extend Outlet

NEW REINFORCED CONCRETE PIPE

Station	Size	Length	Placement	Class	Remarks
433+25	42"	12'	Type I	III	Extend Outlet

EMBANKMENT CURB &/OR SPILLWAY
Sta C-4.01
2498 Lin. Ft. Curb

Station	Inlet	Length	Outlet
Rt 143+80	sgl	29'	1
Lt 111+30	sgl	13'	1
Lt 234+33	sgl	6'	1
Rt 248+50	sgl	31'	1
Lt 248+50	sgl	30'	1
Rt 402+20	sgl	24'	1
Lt 480+63	sgl	31'	1
Lt 495+50	sgl	36'	1
Rt 495+50	sgl	32'	1
Rt 600+55	-	40'	
Lt 601+90	-	50'	
Lt 619+30	-	40'	
Rt 620+30	-	40'	
Lt 643+44	-	51'	
Rt 639+72	-	96'	
Lt 653+35	-	45'	
Rt 654+00	-	52'	
Lt 680+28	-	40'	
Rt 681+65	-	56'	
Lt 500+75		46'	C.O. #7
Rt 500+25		40'	C.O. #7
Lt 547+75		61'	C.O. #7

CATTLE GUARD

Station	Units	Remarks
Lt 65-00	2	Reconstruct w/o gate Std C-11.01
Rt 65+73	5	Without gate, Std. C-11.01
Lt 65+68	5	" " " "
Rt 96+22	3	" " " "
Rt 109-00	3	" " " "
Lt 190+37	3	" " " "
Lt 301+04		" " " "
Rt 331+15	4	" " " "
Lt 455+20	3	" " " "
Rt 516+65	3	" " " "
Lt 517+75	3	" " " "
Lt 641+25	3	" " " "

LINE FENCE AND GATES
539 Lin. Ft. Barbed Wire Game Fence
120,000 Lin. Ft. Barbed Wire Fence
10 Ea. 16 Foot Wire Gate

SCHEDULE No. 1
SURFACING THICKNESS

Station	to Station	Sel. Mat'l Inches	Asph. Conc. Inches
65+00	76+00	7	4
76+00	108+00	14	6
108+00	123+00	13	4
123+00	131+00	15	5
131+00	154+00	9	5
154+00	163+00	15	5
163+00	201+00	7	4
201+00	209+00	14	6
209+00	260+00	9	5
260+00	265+00	15	5

SCHEDULE No 2
SURFACING THICKNESS

Station	to Station	Sel. Mat'l Inches	Asph. Conc. Inches
265+00	298+00	9	5
298+00	313+00	12	5
313+00	365+00	7	4
365+00	385+00	9	5
385+00	420+00	15	5
420+00	477+00	12	5
477+00	525+00	7	4
525+00	529+00	10	4

SCHEDULE No 3.
SURFACING THICKNESS

Station	to Station	Sel. Mat'l Inches	Asph. Conc. Inches
529+00	553+00	17	6
553+00	583+00	16	4
583+00	666+00	11	4

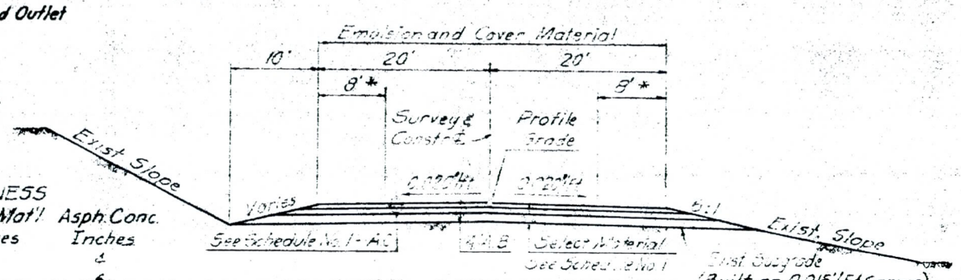
CLEARING & GRUBBING
1.5 Acres

WATER USAGE
Sta C-4.01
11,200 Gal.

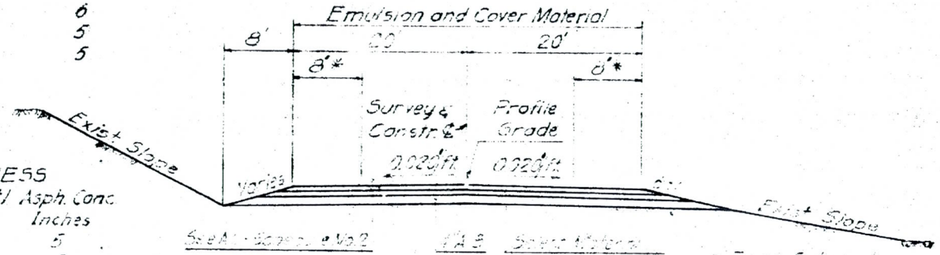
DELINEATORS
238 Ea.

GUARD RAIL
Sta C-4.01 Std.
Sta C-4.01 Mod.
63 Lin. Ft.

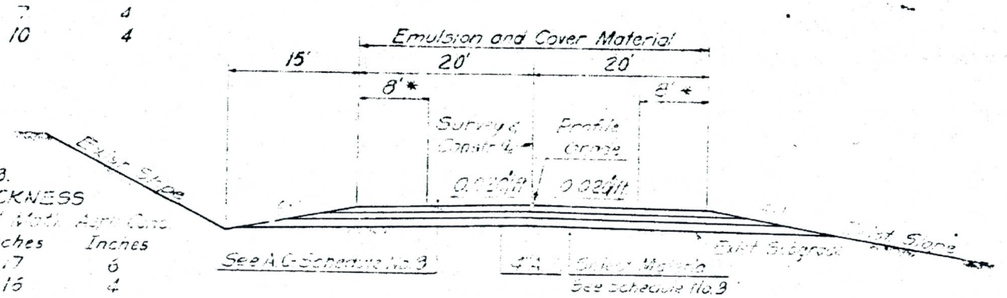
DESIGN DATA
ADT 1972
1921 ADT 3392
Min. Design Speed 70 M.P.H.



TYPICAL SECTION
Sta 65+00.00 to Sta 265+00.00



TYPICAL SECTION
Sta 265+00.00 to Sta 529+00.00



TYPICAL SECTION
Station 529+00.00 to to Sta 665+00.00

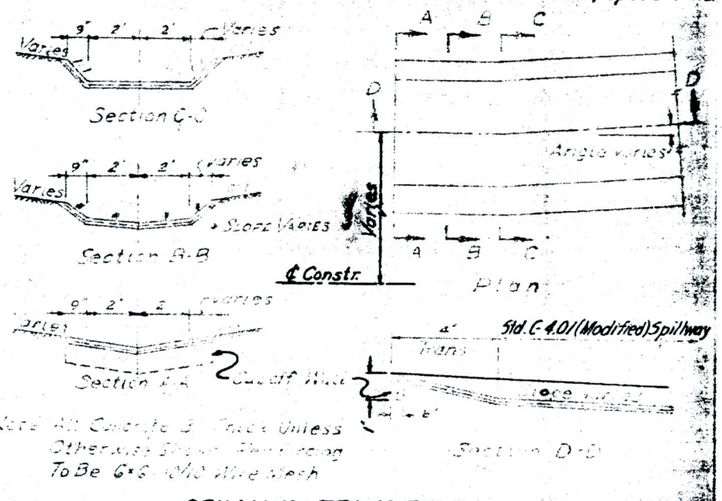
* See special provisions

SURVEY MONUMENT & COVER
Std. C-21.01
1 Required

LENGTH OF PROJECT
Sta 65-00.00 to Sta 665-00.00 = 60,000 Ft.
Net and Gross Length = 11.364 Miles
Mile Post 1.23 to Mile Post 12.59

INDEX OF SHEETS

Sheet No.	Sheet Type
1	Face Sheet
2	Summary Sheet
2A,2B	List of Standards
3	Structure Summary Sheet
4-10	Plan Sheets
11-15	Box Culvert Location & Spec. Details



Note: All Concrete 3" Thick Unless Otherwise Shown. Reinforcing To Be 6x6 - W5 Wire Mesh

SPILLWAY TRANSITION

GENERAL NOTES

as shown on shts. 2A & 2B

select

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	S-434-507	2	15	NOT TO SCALE 5-28-75

MORRISTOWN–NEW RIVER HWY.
MORRISTOWN–LAKE PLEASANT.
MARICOPA COUNTY

DESIGN DATA
1971 A.D.T. 1372
1991 A.D.T. 3392
Min. Design Speed: 70 M.P.H.

NEW CORRUGATED PIPE CULVERT

Station	Size	Length	2 2/3"x1/2" Uncoated	2 2/3"x1/2" Bit. Coated	3"x1" Uncoated	3"x1" Bit. Coated	Remarks
178+05	54"	16'	14		16		Extend Outlet

NEW REINFORCED CONCRETE PIPE

Station	Size	Length	Placement	Class	Remarks
433+25	42"	12'	Type I	III	Extend Outlet

EMBANKMENT CURB &/OR SPILLWAY
Std. C-4.01
~~2535~~ 2498 Lin. Ft. Curb

Station	Inlet	Length	Outlet
Rt. 143+80	sgl	~~24~~ 29'	1
Lt. 144+30	sgl	~~24~~ 13'	1
Lt. 231+52	33 sgl	~~32~~ 6'	1
Rt. 248+32	50 sgl	~~24~~ 31'	1
Lt. 248+72	50 sgl	~~24~~ 30'	1
Rt. 492+28	20 sgl	~~23~~ 24'	1
Lt. 492+28	3 sgl	~~23~~ 31'	1
Lt. 494+98	50 sgl	~~23~~ 36'	1
Rt. 495+20	50 sgl	~~23~~ 32'	1
Rt. 606+08	5 -	~~33~~ 40'	
Lt. 607+00	90 -	~~35~~ 50'	
Lt. 619+52	30 -	~~35~~ 40'	
Rt. 620+58	30 -	~~35~~ 40'	
Lt. 639+50	44 -	~~50~~ 51'	
Rt. 640+00	72 -	~~100~~ 96'	
Lt. 653+52	35 -	~~50~~ 45'	
Rt. 654+25	00 -	~~50~~ 52'	
Lt. 662+40	28 -	~~50~~ 40'	
Rt. 668+40	65 -	~~50~~ 56'	
Lt 500+75		46'	C.O. #7
Rt 500+25		40'	C.O. #7
Lt 547+75		61'	C.O. #7

CATTLE GUARD

Station	Units	Remarks
℄ 65+00	2	Reconstr. w/o gate Std C-11.01
Rt. 65+00	73 5	Without gate; Std. C-11.01
Lt. 66+25	68 5	" " " "
Rt. 96+22	3	" " " "
Rt. 109+00	3	" " " "
Lt. 190+37	3	" " " "
Lt. 391+00	04 4	" " " "
Rt. 391+10	4	" " " "
Lt. 455+20	3	" " " "
Rt. 616+65	3	" " " "
Lt. 616+75	3	" " " "
Lt. 641+25	3	" " " "

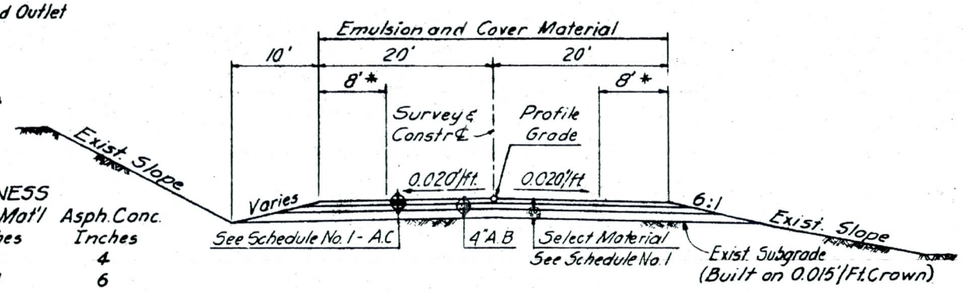
LINE FENCE AND GATES
~~539~~ Std. C-12.02
120,~~850~~ Lin. Ft., 4-Wire Game Fence
10 ~~9~~ Gates Type I (one is locked)

NEW DYKE
Std C-3.01
Station Type
Lt. 375+00 M
Lt. 440+00 A

GUARD RAIL
Std C-10. Series
11,200 Lin. Ft.

SCHEDULE No. 1
SURFACING THICKNESS

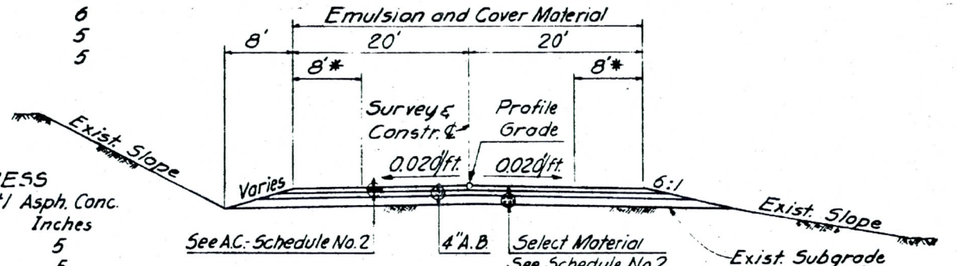
Station to Station		Sel. Mat'l Inches	Asph. Conc. Inches
65+00	76+00	7	4
76+00	108+00	14	6
108+00	123+00	13	4
123+00	131+00	15	5
131+00	154+00	9	5
154+00	163+00	15	5
163+00	201+00	7	4
201+00	209+00	14	6
209+00	260+00	9	5
260+00	265+00	15	5



TYPICAL SECTION
Sta. 65+00.00 to Sta 265+00.00

SCHEDULE No. 2
SURFACING THICKNESS

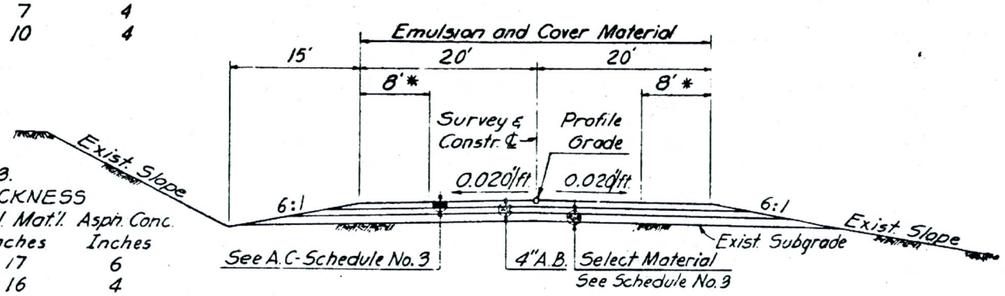
Station to Station		Sel. Mat'l Inches	Asph. Conc. Inches
265+00	298+00	9	5
298+00	318+00	12	5
318+00	365+00	7	4
365+00	385+00	9	5
385+00	430+00	15	5
430+00	477+00	12	5
477+00	525+00	7	4
525+00	529+00	10	4



TYPICAL SECTION
Sta. 265+00.00 to Sta 529+00.00

SCHEDULE No. 3.
SURFACING THICKNESS

Station to Station		Sel. Mat'l. Inches	Asph. Conc. Inches
529+00	559+00	17	6
559+00	583+00	16	4
583+00	665+00	11	4



TYPICAL SECTION
Station 529+00.00 to 665+00.00

* See special provisions for shoulder demarcation

CLEARING AND GRUBBING
1.5 Acres

DELINEATORS
Std. C-9 Series
~~229~~ 235 Type M8-1 or Alt. M8-1

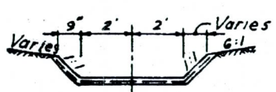
BANK PROTECTION
Std. C-17.01
~~75~~ 63 Lin. Ft. Type I

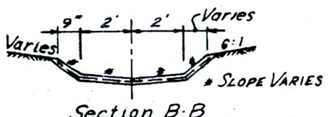
SURVEY MONUMENT & COVER
Std. C-21.01
1 Required

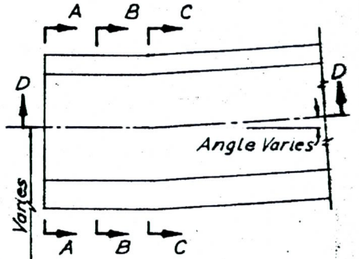
LENGTH OF PROJECT
Sta. 65+00.00 to Sta 665+00.00 = 60.000 Ft.
Net and Gross Length = 11.364 Miles
Mile Post 1.23 to Mile Post 12.59

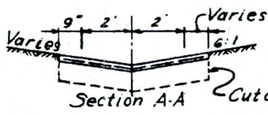
INDEX OF SHEETS

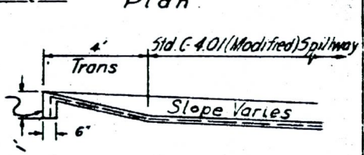
Sheet No.	Sheet Type
1	Face Sheet
2	Summary Sheet
2A, 2B	List of Standards
3	Structure Summary Sheet
4-10	Plan Sheets
11-15	Box Culvert Location & Spec. Details











Note: All Concrete 3" Thick Unless Otherwise Shown. Reinforcing To Be 6-6: 10/10 Wire Mesh

SPILLWAY TRANSITION

GENERAL NOTES

Right of way encroachments shall be removed by order of the State unless otherwise noted.

All right of way provisions shall be complied with before job acceptance.

The project roadways shall be striped in accordance with the current edition of the Pavement Marking Standards.

Bench markers will be furnished by the State and placed by the Contractor. Std. C-21.02.

Right of way markers shall be furnished and placed by the Contractor as directed by the Engineer. Std. C-21.01.

Changes in location or length of spillway installations may be made by the Engineer to improve drainage conditions.

This project has been designed using the 1971 Construction Standards and current revisions to same as shown on shts 2A & 2B.

Reshaping of the existing grade and drain sections to the new crown slope standards and general repair of the roadway shall be accomplished by utilizing select material.

A. H. D. Roadway Construction Standards

STANDARD NO.	SUBJECT	LAST REVISION DATE:	CURRENT REVISION DATE:
C-13.14	Backfill Special, Measurement, Culverts & Pipe Lines		5/72
C-13.13	Backfill, Special Placement, Culverts & Pipe Lines	3/71	5/72
C-17.01	Bank Protection, Rail & Wire, Types 1, 2 & 3	3/71	
C-17.02	Bank Protection, Rail & Wire, Types 4, 5 & 6	3/71	5/72
C-10.08	Barrier, Concrete, Median		5/72
C-10.09	Barrier, Concrete, Median, Transition Details	10/70	
C-12.05	Barrier Fence, Cable Only		5/72
C-10.11	Barrier Fence, Chain Link & Cable	3/71	
C-12.05	Barrier Post		5/72
C-13.11	Box Culvert, Struct. Excav. Payment Limits	3/71	5/72
C-15.08	Catch Basin, Construction Drain		5/72
C-15.08	Catch Basin, Depressed Apron, Off Roadway		5/72
C-15.08	Catch Basin, Depressed Apron, P.C.C., Gutter Location		5/72
C-15.06	Catch Basin, Grate & Frame, Longitudinal Bars	12/68	
C-15.07	Catch Basin, Grate & Frame, Transverse Bars	12/68	
C-15.09	Catch Basin, Median	10/70	
C-15.10	Catch Basin, Median Dyke, C.B.C. Inlet Details	10/70	5/72
C-15.01	Catch Basin-Type 1 Combination	3/71	
C-15.02	Catch Basin-Type 2, Combination, Adjustable Curb	3/71	5/72
C-15.03	Catch Basin-Type 3, Curb Opening Only	3/71	
C-15.04	Catch Basin-Type 4, Grate Opening Only	3/71	
C-15.05	Catch Basin-Type 5, Combination Sweeper	3/71	
C-11.01	Cattle Guard	**5/72**	**7**/72
C-11.04	Cattle Guard, Drainage	12/68	
C-11.03	Cattle Guard, Railroad		
C-11.02	Cattle Guard, Ranch & Side Road	3/71	***7/72***
C-13.05	C.M.P. & Pipe Arch End Section	4/70	
C-13.10	C.M.P. & Pipe Arch Invert Pavement	11/68	
C-13.08	C.M.P. Arch, Fill Heights	1/71	
C-13.09	C.M.P. Arch, Fill Heights Design Data	12/68	
C- 4.02	C.M.P. Downdrain	11/68	5/72
C- 4.04	C.M.P. Downdrain Length Table	3/71	5/72
C-13.06	C.M.P. Fill Heights	1/71	
C-13.07	C.M.P. Fill Heights Design Data	12/68	
C-13.01	C.M.P. Perforated, Installation	3/71	
C- 2.04	Crown, Parabolic	12/68	
C-13.11	Culvert, Box, Struc. Excav. Payment Limits	3/71	5/72
C-13.05	Culvert, C.M.P. & Pipe Arch End Section	4/70	
C-13.10	Culvert, C.M.P. & Pipe Arch Invert Pavement	11/68	
C-13.10	Culvert, C.M.P. Arch, Fill Heights	11/68	

STANDARD NO.	SUBJECT:	LAST REVISION DATE:	CURRENT REVISION DATE:
C-13.06	Culvert, C.M.P. Fill Heights	1/71	
C-13.09	Culvert, C.M.P. Fill Heights Design Data	12/68	
C-13.01	Culvert, Pipe, Installation	3/71	
C-13.11	Culvert Pipe, Struc. Excav. Payment Limits	3/71	5/72
C-13.04	Culvert, R.C.P., End Section		
C-13.03	Culvert, R.C.P., Fill Heights		
C-13.02	Culvert, R.C.P., Placement	2/71	5/72
C- 5.01	Curb Concrete		
C- 5.01	Curb, Depressed, Driveway Detail		
C- 4.01	Curb, Embankment, Concrete	2/70	5/72
C- 5.02	Curb, Measurement		
C- 9.02	Delineators, Face Plate Details		
C- 9.03	Delineators, Interchange Spacing		
C- 9.05	Delineators, Main Line Spacing		
C- 9.03	Delineators, Placement		
C- 9.04	Delineators, Post and Mounting Details		
C- 9.08	Delineators, Snow Markers		
C- 9.07	Delineators, Spacing Table		
C- 9.01	Delineators, Usage		
C- 6.02	Detour, Entrance Design Table	12/68	5/72
C- 3.01	Ditches		5/72
C- 2.01	Ditches, Paved, Class A-A Roadway		
C- 2.02	Ditches, Paved, Class A & B Roadways		
C- 2.03	Ditches, Paved, Class C & D Roadways		
C- 4.02	Downdrain, C.M.P.	11/68	5/72
C- 4.04	Downdrain, C.M.P. Length Table	3/71	
C- 5.01	Driveway, Details		
C- 5.01	Driveway, Layout		
C- 3.01	Dykes		5/72
C- 4.01	Embankment Curb, Concrete	2/70	5/72
C-13.02	Encasement, Culvert	2/71	5/72
C-13.05	End Sections, C.M.P. & Pipe Arch	4/70	
C-13.04	End Sections, Reinforced Concrete Pipe		
C-12.05	Fence, Barrier, Cable Only		5/72
C-10.11	Fence, Barrier, Chain Link & Cable	3/71	
C-12.03	Fence, Chain Link	3/71	5/72
C-12.02	Fence, Culvert Wing	11/68	5/72
C-12.04	Fence, Industrial, Chain Link Pipe Constr.	3/71	5/72
C-12.04	Fence, Industrial, Chain Link Rolled Shape Constr.	3/71	5/72
C-12.02	Fence, Game	11/68	5/72

NOTE: All Roadway Construction Standards are listed. The current revision date, if any is shown. When no date is shown, no revision has been made.

When these plans specify a certain standard, a number of standards or a series of standards, the standard or standards appropriate to this project is the one bearing the latest date.

A. H. D. Roadway Construction Standards (Cont.)

STANDARD NO.	SUBJECT:	LAST REVISION DATE:	CURRENT REVISION DATE:
C-12.01	Fence, Line	12/68	5/72
C-12.02	Fence, Stock	11/68	5/72
C-19.02	Fords	12/68	
C-19.01	Ford, Concrete Cutoff Walls	3/71	
C-12.04	Gate, Driveway, Chain Link	3/71	5/72
C-16.03	Gate, Irrigation		
C-12.01	Gate, Line Fence, Barbed Wire	12/68	5/72
C-12.01	Gate, Line Fence, Rigid	12/68	5/72
C-12.02	Gate, Removal Detail	11/68	5/72
C-12.03	Gate, Walk, Chain Link	3/71	5/72
C-10.10	Glare Screen, Median	3/71	5/72
C- 5.02	Grades, Street Intersection		
C-10.03A&B	Guard Rail, Approach End Treatment, Pavement Widening		5/72
C-10.04A&B	Guard Rail, Bridge Approach Alignment, Pavement Widening	12/68	5/72
C-10.05A&B	Guard Rail, Flare to Median, Pavement Widening		5/72
C-10.02	Guard Rail, Installation on Structures		5/72
C-10.02	Guard Rail, Median Barrier Detail		5/72
C-10.02	Guard Rail, Pier Attachment Detail		5/72
C-10.01A&B	Guard Rail, Single Face Detail, Pavement Widening	12/68	5/72
C-10.02	Guard Rail, Special Terminal Section Detail		5/72
C-10.06	Guard Rail, Typical Installations	12/68	5/72
C- 5.01	Gutter, Concrete		
C- 5.02	Gutter, Measurement		
C- 2.01	Gutter, Paved Cut Ditch, Class A-A Roadways		
C- 2.02	Gutter, Paved Cut Ditch, Class A & B Roadways		
C- 2.03	Gutter, Paved Cut Ditch, Class C & D Roadways		
C- 5.01	Gutter, Valley		
C-14.03	Headwall, Drop Inlet	3/71	
C-16.01	Headwall, Irrigation		
C-14.01	Headwall, Straight, "L" & "U" Types		5/72
C-14.02	Headwall, Wing Type	1/71	5/72
C- 4.01	Inlet, Concrete Spillways	2/70	5/72
C- 5.02	Intersection Grades		
C-13.10	Invert Pavement, C.M.P. & Pipe Arch	11/68	
C-16.03	Irrigation Gates		
C-16.03	Irrigation Valves		
C- 7.01	Joint, Bridge Approach Slab		
C- 7.04	Jointed Concrete Pavement Anchorage		
C- 7.02	Joint, P.C.C. Pavement Longitudinal		
C- 7.01	Joint, P.C.C. Pavement Transverse		

STANDARD NO.	SUBJECT:	LAST REVISION DATE:	CURRENT REVISION DATE:
C-13.02	Joint, R.C.P.	2/71	5/72
C-18.01	Manhole, Detail		
C-18.02	Manhole, Frame & Cover Details		
C-21.01	Marker, Right of Way		5/72
C-10.08	Median Barrier, Concrete		5/72
C-21.01	Monument, Survey		5/72
C- 7.03	Pavement, Cut Replacement		5/72
C-13.10	Pavement, Invert, C.M.P. & Pipe Arch	11/68	
C- 8.02	Pavement, Nose, Ramp Terminal		
C-13.11	Payment Limits, Structural Excavation	3/71	5/72
C-13.01	Perforated C.M.P. Installation	3/71	
C-13.01	Pipe Culvert, Installation	3/71	
C-13.11	Pipe, Line, Structural Excav. Payment Limits	3/71	5/72
C-12.05	Post Barrier		
C-20.01	Railroad Crossing Signs		5/72
C- 8.02	Ramp, Entrance Typical Terminal Detail		5/72
C- 8.01	Ramp, Exit Terminal Detail		5/72
C-13.04	Reinforced Concrete Pipe End Section		
C-13.03	Reinforced Concrete Pipe Fill Heights		
C-13.02	Reinforced Concrete Pipe Placement	2/71	5/72
C-21.01	Right of Way Marker		5/72
C- 5.01	Sidewalk, Concrete		
C-20.01	Signs, Railroad Crossing		5/72
C- 2.02	Slopes, Class A & B Roadways		
C- 2.03	Slopes, Class C & D Roadways		
C- 2.01	Slopes, Class A-A & Interstate Roadways		
C-13.13	Special Backfill Placement		5/72
C-13.14	Special Backfill Measurement		5/72
C- 4.01	Spillway, Concrete	2/70	5/72
C- 4.03	Spillway Concrete Lenght Table		5/72
C- 4.02	Spillway C.M.P.	11/68	
C- 4.04	Spillway, C.M.P. Length Table	3/71	
C-16.02	Standpipe, Irrigation		
C-13.12	Structural Excavation Payment Limits		
C-21.01	Survey Monument		5/72
C- 1.01	Symbols, Plans	1/71	
C- 6.01	Turnouts		
C-22.01	Utility Line, Underground, Concrete Slab Protection		
C- 5.01	Valley Gutter		

Reinforced Concrete Box Culverts 20' clear span or less

Station on ℄	Description	Specs. Units	Standards	Struct. Excav. cu yds	Class A Conc. cu yds	Steel lbs	cu yds	[illegible]	[illegible] each	Drain Excav cu yds
107+60	Exist 8'x7'x51'-0 Extend Lt 18'-0 & Rt. 16'-6	11	CI-8-1 & CW-2	~~30~~ 46.5	64.40	4470	200	4	10	
201+30	Exist. 10'x8'x54'-0 Extend Lt. 17'-9 & Rt. 13'-9	11	CI-10-1 & CW-2	~~50~~ 51.0	80.32	6055	260	5	14	
219+50	Exist. 6'x7'x72'-0 Extend Rt. 6'-6 with outlet apron Rt.	12&15	CI-6-1 & CW-2	~~10~~ 4.7	25.62	1480	50	6		
374+85	Exist. 2-8'x4'x56'-6 Extend Lt. 17'-0 & Rt. 12'-0	12	CI-8-2 & CW-1	~~50~~ 60.1	60.84	6100	65	4	24	
383+85	Exist. 2-8'x7'x66'-6 Extend Lt. 10'-9 & Rt. 8'-3	13	CI-8-2 & CW-2	~~40~~ 66.1	66.55	5110	125	4	24	
396+50	Exist. 2-8'x4'x64'-6 15° Sk. Lt. Extend Lt. 12'-6 & Rt. 11'-6	13	CI-8-2 & CW-3	~~40~~ 51.4	54.13	5235	55	3	24	
404+85	Exist. 2-8'x4'x69'-6 Extend Rt. 7'-0 with 2-8'x7 with outlet apron Rt.	14&15	CI-8-2 & CW-1	~~20~~ 41.2	38.82	2810	50	6	12	
484+30	Exist. 10'x5'x52'-6 Extend Lt. 19'-0 & Rt. 14'-0	14	CI-10-1 & CW-1	~~40~~ 38.9	60.94	4975	115	4	14	

Reinforced Concrete Box Culverts [illegible] 20' clear span

Station Beginning & Ending	Description	Spec. Units	Standards	Struct. Excav. cu yds	Class A Conc. cu yds	Reinf. Steel lbs	cu yds	cu yds	each	Tied Wire Riprap cu yds
209+08.00 to 209+41.33	Exist 3-10'x8'x69'-6 Extend Lt. 9'-3 with 3-10'x8 & Rt. 6'-9 with 3-10'x10' w/outlet apron Rt.	11&15	CI-10-3, Special Section, CW-2 & CW-9	~~[illegible]~~ 97.3	126.14	11,790	205	8	44	
297+69.00 to 297+91.50	Exist. 2-10'x8'x64'-0 Extend Lt 12'-0 & Rt. 9'-6	12	CI-10-2 & CW-2	~~[illegible]~~ 72.8	92.02	8100	200	5	30	
414+39.00 to 414+61.50	Exist. 2-10'x6'x57'-0 Extend Lt. 17'-3 & Rt. 11'-3 w/outlet apron Rt.	14&15	CI-10-2 & CW-2	~~[illegible]~~ 58.4	101.37	9465	140	6	30	
460+43.00 to 460+76.34	Exist 3-10'x5'x81'-0 Add riprap outlet apron	14								33

Standards: CI-6-1, CI-6-5, CI-8-1, CI-8-2, CI-8-5, CI-10-1, CI-10-2, CI-10-3, CI-10-5, CW-1, CW-2, CW-3, CW-9

Bridges and Miscellaneous Structures

Station Beginning & Ending	Description	Spec. Sheet Nos.	Standards

Please be advised that the contractor's bid on the above referred project was $1,354,884.25. The completed contract cost was $1,354,270.55, a decrease of $613.70.

Change Orders, Force Account Work, and Fiscal Variance Reports which supplement the contract are as follows:

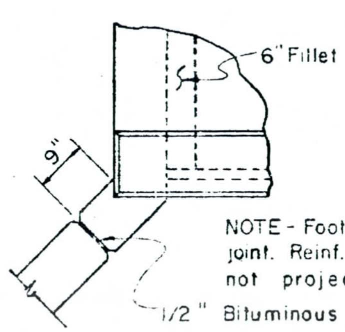
Change Order No.	Amount	Remarks
1	0	To allow the use of a 25' "T" Beam attachment to the blade of a motor grader for leveling aggregate base surface in lieu of the device specified.
2	0	To permit application of Prime Coat at a minimum of 60° atmospheric temperature in the shade.
3	0	To obtain approximately 1,600 tons of Cover Material from Pit Serial No. 6984.
4	+$ 737.38	Construct a 16' x 30' asphaltic concrete turnout right of Station 259+40.
5	-$ 1,100.00	To delete the requirement for shoulder demarcation by use of a lighter colored chip. A uniform chip seal will be applied.
6	0	To reduce mixing time cycle for asphaltic concrete from thirty seconds to twenty-five seconds.
7	-$16,328.84	Decrease Prime Coat, Tack Coat, and Embankment Spillways.

Force Account Work	Amount	Remarks
1	+$ 454.24	Remove excess Select Material from the grade at Station 500 to 512. This material to be used in various turnouts.

Fiscal Variance Report	Amount	Remarks
1	+$25,655.10	Increase Select Material, Aggregate Base and Asphaltic Concrete.

J. C. COOK, Coordinator

* Clear span denotes distance along ℄ roadway between inside face of exterior walls.



NOTE - Footing shall be cont. with no joint. Reinf. steel in wing walls shall not project through joint.

1/2" Bituminous joint filler.

WINGWALL JOINT DETAIL
ALL BOX CULVERTS

GENERAL NOTES: - (Box Culverts Structures)

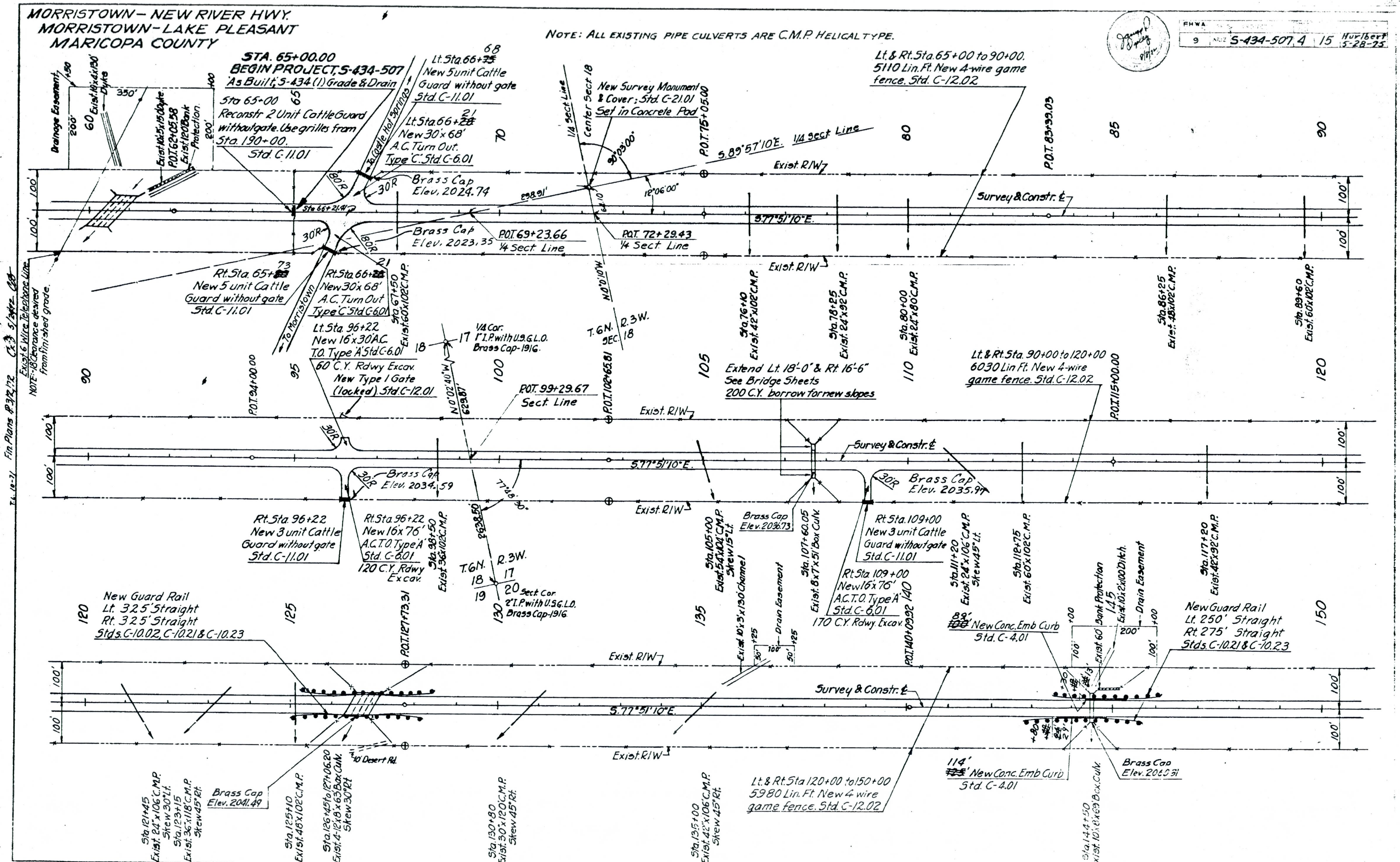
Construction - Standard Specs. Arizona Highway Dept. Edition of 1969.

Joints - All box culverts structures shall have contraction or cold joints in the top slab and walls (optional in floor slab) spaced not more than 40 feet apart or as shown. The joint may be made with 1/4 plywood bulkhead which shall be left in place. Reinforcing steel shall project through the joint.

Reinforcing Steel - All reinforcing steel shall have 2" clear cover unless noted otherwise. All dimensions for reinforcing steel shall be to the center of bars unless noted otherwise. Dimensions shall not be scaled from drawing.

BRIDGE DIVISION
STRUCTURE SUMMARY SHEET

APJ 5-72
MaB 5-72


MORRISTOWN – NEW RIVER HWY.
MORRISTOWN – LAKE PLEASANT
MARICOPA COUNTY
NOTE: ALL EXISTING PIPE CULVERTS ARE C.M.P. HELICAL TYPE.
FHWA 9 S-434-507.4 15 Hurlbert 5-28-75
STA. 65+00.00
BEGIN PROJECT, S-434-507
"As Built", S-434 (1) Grade & Drain
Sta 65+00
Reconstr 2 Unit Cattle Guard without gate. Use grilles from Sta. 190+00.
Std. C-11.01
Lt. Sta. 66+68
New 5 unit Cattle Guard without gate
Std. C-11.01
Lt. Sta. 66+21
New 30'x 68' A.C. Turn Out. Type 'C' Std. C-6.01
Brass Cap Elev. 2024.74
Brass Cap Elev. 2023.35
New Survey Monument & Cover; Std. C-21.01 Set in Concrete Pad
1/4 Sect. Line
Center Sect. 18
P.O.T. 75+05.00
S 89°57'10"E. 1/4 Sect. Line
Exist. R/W
Lt. & Rt. Sta. 65+00 to 90+00.
5110 Lin. Ft. New 4-wire game fence. Std. C-12.02
P.O.T. 83+33.03
Survey & Constr. ℄
S 77°51'10"E.
P.O.T. 69+23.66 1/4 Sect. Line
P.O.T. 72+29.43 1/4 Sect. Line
Drainage Easement
Exist. 10'x4'x130' Dyke
Exist. 120' Bank Protection
P.O.T. 62+05.58
To Castle Hot Springs
To Morristown
Rt. Sta. 65+73
New 5 unit Cattle Guard without gate
Std. C-11.01
Rt. Sta. 66+21
New 30'x 68' A.C. Turn Out Type 'C' Std. C-6.01
Sta. 67+50 Exist. 60"x102" C.M.P.
Sta. 76+10 Exist. 42"x102" C.M.P.
Sta. 78+25 Exist. 24"x92" C.M.P.
Sta. 80+00 Exist. 24"x80" C.M.P.
Sta. 86+25 Exist. 48"x102" C.M.P.
Sta. 89+60 Exist. 60"x102" C.M.P.
N 0°01'10"W
T.6N. R.3W. SEC. 18
Exist. 6 Wire Telephone Line
NOTE: 18' Clearance desired from finished grade.
Fin. Plans
Lt. Sta. 96+22
New 16'x30' A.C. T.O. Type 'A' Std. C-6.01
60 C.Y. Rdwy. Excav.
New Type 1 Gate (locked) Std. C-12.01
1/4 Cor. 1" I.P. with U.S.G.L.O. Brass Cap-1916.
P.O.T. 94+00.00
P.O.T. 99+29.67 Sect. Line
P.O.T. 102+65.81
N 0°02'40"W 629.87'
Extend Lt. 18'-0" & Rt. 16'-6"
See Bridge Sheets
200 C.Y. borrow for new slopes
Lt. & Rt. Sta. 90+00 to 120+00
6030 Lin. Ft. New 4-wire game fence. Std. C-12.02
P.O.T. 115+00.00
Brass Cap Elev. 2034.59
Brass Cap Elev. 2035.97
Brass Cap Elev. 2036.73
Rt. Sta. 96+22
New 3 unit Cattle Guard without gate
Std. C-11.01
Rt. Sta. 96+22
New 16'x76' A.C. T.O. Type 'A' Std. C-6.01
120 C.Y. Rdwy. Excav.
Sta. 98+50 Exist. 36"x102" C.M.P.
T.6N. R.3W.
Sect. Cor. 2" I.P. with U.S.G.L.O. Brass Cap-1916
Sta. 105+00 Exist. 54"x104" C.M.P. Skew 15° Lt.
Sta. 107+60.05 Exist. 8'x7'x51' Box Culv.
Rt. Sta. 109+00
New 3 unit Cattle Guard without gate
Std. C-11.01
Rt. Sta. 109+00
New 16'x76' A.C. T.O. Type 'A' Std. C-6.01
170 C.Y. Rdwy. Excav.
Sta. 111+20 Exist. 24"x106" C.M.P. Skew 45° Lt.
Sta. 112+75 Exist. 60"x102" C.M.P.
Sta. 117+20 Exist. 42"x92" C.M.P.
New Guard Rail
Lt. 325' Straight
Rt. 325' Straight
Stds. C-10.02, C-10.21 & C-10.23
P.O.T. 127+73.31
Exist. 10'x3'x130' Channel
Drain Easement
P.O.T. 140+09.92
88' New Conc. Emb. Curb Std. C-4.01
Bank Protection
Exist. 10'x2'x100' Ditch
Drain Easement
New Guard Rail
Lt. 250' Straight
Rt. 275' Straight
Stds. C-10.21 & C-10.23
10' Desert Rd.
Brass Cap Elev. 2041.49
Lt. & Rt. Sta. 120+00 to 150+00
5980 Lin. Ft. New 4 wire game fence. Std. C-12.02
114' New Conc. Emb. Curb Std. C-4.01
Brass Cap Elev. 2050.31
Sta. 121+45 Exist. 24"x106" C.M.P. Skew 30° Lt.
Sta. 123+15 Exist. 36"x118" C.M.P. Skew 45° Rt.
Sta. 125+10 Exist. 48"x102" C.M.P.
Sta. 126+45 to 127+06.20 Exist. 4-12'x8'x63' Box Culv. Skew 30° Rt.
Sta. 130+80 Exist. 30"x120" C.M.P. Skew 45° Rt.
Sta. 135+00 Exist. 42"x106" C.M.P. Skew 45° Rt.
Sta. 144+50 Exist. 10'x8'x69' Box Culv.

MORRISTOWN - NEW RIVER HWY.
MORRISTOWN - LAKE PLEASANT
MARICOPA COUNTY

ALL EXIST. PIPE CULVERTS ARE C.M.P. HELICAL TYPE

FHWA					
9	ARIZ.	S-434-507	5	15	Nur. Dist. 5-28-75

Fin. Plans M.H. APR. '72 Rev. 5/26/72 Ref.

V&Cor:
1"I.P.pipe with U.S.G.L.O. Brass Cap-1916.

T6N R3W

M.Lt. 10.0 N.

POT 153+35.31
Sect. Line

Sect. Line
2"I.P.pipe with U.S.G.L.O. Brass Cap-1916

264.14
868.51

Sta. 154+40 Exist. 36"x100' C.M.P. Stew 45° Rt.

4 strand barb wire along section line.

Sta. 159+30 Exist. 42"x82' C.M.P.

Survey & Constr. ℄

S.77°51'10"E.

Exist. R/W

T.7°49'23"

POT. 161+00.00

Sta. 162+30 Exist. 54"x102' C.M.P.

Exist. 10'x6'x200' Dyke

Exist. 10.5' Bank Protect.

Exist. 4 Wire Fence

Drain Easement

Sta. 168+00 Exist. 30"x92' C.M.P.

Exist. 10'x4'x300' Dyke

Exist. 10.5' Bank Protect.

TRIBLY WASH

Exist. 10'x6'x300' Dyke

POT. 196+00.00

Exist. 10'x4'x300' Dyke

Exist. 10'x4'x300' Ditch

Sta. 169+40 Exist. 30"x102' C.M.P.

Sta. 170+70 Exist. 36"x100' C.M.P. Stew 30° Rt.

Exist. 10' Berm

POT. 174+96.93

Extend exist. pipe with New 54"x16' C.M.P.
~~5 C.Y. Str. Excav.~~
15 C.Y. Spec. Backfill

Lt. & Rt. Sta. 150+00 to 180+00
6000' New 4 Wire Game Fence
Std. C-12.02

Sect. Cor.
2" I.P.-U.S.G.L.O. Brass Cap-1916

100 C.Y. Borrow to flatten slope on Rt.

Sta. 178+05 Exist. 54"x102' C.M.P.

Extend Lt. 9'-3" with 3-10'x8' Box & Rt. 6'-9" with 3-10'x10' Special Barrel with outlet apron Rt.
See Bridge Sheets

400 C.Y. Borrow for new slopes

T6N.-R.3W.

Lt. Sta. 180+00 to 190+50
1050' New 4 Wire Game Fence
Std. C-12.02

POT. 184+50

New 3-Unit Cattle Guard without gate
Std. C-11.01

Lt. Sta. 190+37
New 16'x 76' A.C.T.O.
Type 'A' Std. C-6.01
55 C.Y. Borrow

Lt. Sta. 199+20 to 210+00
1110' New 4 Wire Game Fence
Std. C-12.02

4 strand barb Wire along Sect. Line

1263.92'

Lt. Sta. 204+96
New 16'x 30' A.C.T.O.
Type A. Std. C-6.01
45 C.Y. Rdwy Excav.

Lt. Sta. 204+96
New Type I Gate
Std. C-12.01

POT. 207+19.75

12°06'35"

30'R

Survey & Constr. ℄

S.77°51'10"E.

Sta. 180+50 Exist. 30"x102' C.M.P.

Rt. Sta. 180+00 to 210+00
3030' New 4-Wire Game Fence
Std. C-12.02

S.89°57'15"E. 2644.87'

1/4 Cor.
1"I.Pipe-U.S.G.L.O. Brass Cap-1916

Sta. 183+75 Exist. 60"x102' C.M.P.

Sta. 185+50 Exist. 24"x100' C.M.P.

Remove Exist. Fence, Type 2 Gate & Exist. Cattle Guard within new R/W
Salvage grilles for State Use at Sta. 65+00.

Brass Cap Elev. 2047.60

Sta. 189+95 Exist. 30"x102' C.M.P. Stew 45° Lt.

POT. 194+55.87
Sect. Line

Sta. 193+85.6/194+50.83 Exist. 6'-10.1'x8'-5.7' Box Culv.

New Guard Rail
800' Lt. ~~225~~ 'Straight
800' Rt. ~~225~~ 'Straight
Std. C-10.02, C-10.21 & C-10.23

Sta. 198+36/198+96.33 Exist. 5'-10.1'x8'-5.8' Box Culv.

Exist. R/W

Brass Cap Elev. 2070.91

Brass Cap Elev. 2071.99

Sta. 201+30 Exist. 10.8'x8.3' Box Culv.

Extend Lt. 17'-9" & Rt. 13'-9"
See Bridge Sheets
80 C.Y. Borrow for new slopes

POT. 207+48.75
Sect. Line

2644.87'

N.89°57'15"W.

1/4 Cor.
1"I.Pipe-U.S.G.L.O. Brass Cap-1916

Sta. 205+50 Exist. 30"x102' C.M.P.

Brass Cap Elev. 2064.36

Sta. 209+08.6/209+41.33 Exist. 3-10.1'x6'-9.6' Box Culv.

90° ~~100'~~ New Grader Ditch
Std. C-3.01

POT. 218+45.53

POT. 228+00.00

New Guard Rail
400' Lt. ~~225~~ 'Straight
Std. C-10.02, C-10.21 & C-10.23

237' ~~150'~~ New Conc. Emb. Curb
Std. C-4.01

POT. 234+74.14

+33
6'

Survey & Constr. ℄

S.77°51'10"E.

Exist. R/W

Extend Rt. 6'-6" with outlet apron Rt.
See Bridge Sheets
50 C.Y. Borrow for new slope

Brass Cap Elev. 2059.07

Sta. 219+50 Exist. 6'x7'x72' Box Culv.

Sta. 221+75 Exist. 36"x102' C.M.P. Stew 15° Rt.

Lt. & Rt. Sta. 210+00 to 240+00
6/60' New 4 Wire Game Fence
Std. C-12.02

Brass Cap Elev. 2056.00

Brass Cap Elev. 2052.46

Sta. 229+30 Exist. 10'x8'x70' Box Culv. Stew 30° Lt.

Sta. 233+90 Exist. 6'x5'x74' Box Culv.

Sta. 212+15 Exist. 30"x102' C.M.P.

Sta. 214+30 Exist. 30"x102' C.M.P.

Sta. 217+15 Exist. 24"x102' C.M.P.

Sta. 237+30 Exist. 30"x86' C.M.P.

MORRISTOWN – NEW RIVER HWY
MORRISTOWN – LAKE PLEASANT
MARICOPA COUNTY

FHWA | 9 | ARIZ | S-434-507 | 6 | 15 | Hurlgart 5-28-75

ALL EXIST PIPE CULVERTS ARE C.M.P. HELICAL TYPE TO STA. 261+

T6N R3W
15 14
22 23
Section Cor.
2" Iron pipe with B.C.
U.S.G.L.O. - 1916

P.O.T. 241+43.15

New Guard Rail
Lt. 425' Straight
550' Rt. ~~425'~~ Straight
Std. C-10.21 & C-10.23

263' ~~275'~~ New Conc. Emb Curb
Std. C-4.01

Lt. & Rt. Sta. 240+00 to 270+00
6480' New 4-Wire Game Fence
Std. C-12.02

P.O.T. 259+00

P.O.T. 256+63.84

Exist R/W

BEARING EQUATION
Sta 264+00.00
S 77°51'10" E Back =
S 77°48'20" E Ahd

N 0°06'15" W
1404.30

P.O.T. 263+99.09

New Guard Rail
325' Lt. ~~350'~~ Straight
300' Rt. ~~250'~~ Straight
Std. C-10.21 & C-10.23

Exist 10'x 9' x 150' Chan.

Std. C-4.01

P.O.T. 261+44.89
Sect Line

Survey & Construct ℄

S 77°51'10" E

+40

30° R
1301 A.C.T.O.
C.O. #4.

77°46'39"

S 77°48'20" E.

Exist R/W

New 14' Type I Gate

392' ~~300'~~ New Conc. Emb Curb
Std. C-4.01

ALL EXIST. PIPE CULVERTS ARE REINF. CONC. BETWEEN STA'S 270 & 330

Sta. 243+45
Exist 24"x118' C.M.P.
Sk. 45° Lt.

Brass Cap
Elev. 2031.86

Brass Cap
Elev. 2039.13

Sta. 245+80
Exist. 10'x 8'x 96' Box Culv.

Sta. 247+70
Exist. 10'x 8'x 82' Box Culv.

Sta. 251+70
Exist. 30"x 79' C.M.P.
Sk. 15° Lt.

Sta. 261+25
Exist. 60"x 102' C.M.P.

2640.04

1/4 Cor.
1" I.P. pipe-U.S.G.L.O. Brass Cap
1916.

STA. 265+00
END S-434(1) As Built
BEGIN S-434(2) As Built
Grade and Drain only

F.A.S. Sign
Brass Cap
Elev. 2044.12

Sta. 266+90
Exist 6'x 5' 95° Box Culv.

Brass Cap
Elev. 2034.55

Extend Lt. 12'-0" & Rt. 9'-6"
See Bridge Sheets
150 C.Y. Borrow for new slopes

Sta. 295+00.00

P.O.T. 295+00.00

Exist 10'x 2'x 60° Pitch & Gate

Exist 10'x 2'x 60° Pitch & Gate

Exist R/W

NIGER WASH
Exist 10'x 3'x 70° Pipe

Exist 10'x 3'x 70° Pipe

Exist 10'x 3'x 320° Channel

P.O.T. 284+00.00

P.O.T. 276+00.00

Sta. 276+35.60

Sta. 274+75
Exist 24"x 80' R.C.P.

New Guard Rail
Lt. ~~200'~~ Straight 150'
Rt. ~~200'~~ Straight 225'
Std. C-10.21 & C-10.23

Brass Cap
Elev. 2041.42

Sta. 279+65
Exist 6'x 5' x 43' Box Culv.

Survey & Construct ℄

S 77°48'20" E.

Exist. R/W.

Lt. & Rt. Sta. 270+00 to 300+00
6060' New 4-Wire Game Fence
Std. C-12.02

Sta. 289+88.00 to 290+32.17
Exist 4'-0" x 6'-7" 6" Box Culv.

Brass Cap
Elev. 2048.31

New Guard Rail
Lt. 300' Straight
Rt. 300' Straight
Std. C-10.02, C-10.21 & C-10.23

Sta. 297+69.00 to 297+91.00
Exist 2'-10" x 6'-4" 0" Box Culv.

Brass Cap
Elev. 2043.84

Sta. 271+90
Exist 24"x 82' R.C.P.

Sect Cor.
2" I.P. with U.S.G.L.O. Brass Cap.
1916

Sta. 285+15
Exist 30"x 102' R.C.P.

N 0°02'22" E.
2643.57'

T. 6 N.
R. 3 W.

P.O.T. 313+06.96

P.O.T. 318+00.00

Lt. Sta. 323+75
New Type I Gate
Std. C-12.01

Lt. Sta. 323+75
New 16'x 30' A.C.T.O.
Type "A", Std. C-6.01
40 C.Y. Rdwy Excav.

P.O.T. 325+00.00

Exist. 10'x 2'x 200' Pitch

Rt. Sta. 303+00
New 16'x 30' A.C.T.O.
Type A - Std. C-6.01
45 C.Y. Rdwy Excav.

Rt. Sta. 303+00
New Type I Gate
Std. C-12.01

Sta. 306+38
Exist. 36"x 100' R.C.P.
Skew 5° Lt.

Lt. & Rt. Sta. 300+00 to 330+00
6020' New 4-Wire Game Fence
Std. C-12.02

Sta. 312+00
Exist. 54"x 102" R.C.P.

P.O.T. 315+48.32
Sect Line

Sta. 315+20
Exist 30"x 102" R.C.P.

1/4 Cor. 1" I.P. with U.S.G.L.O. Brass Cap 1916

N 0°01'25" W.
2637.18'

Sect Cor.
2" I.P. Pipe with U.S.G.L.O. Brass Cap
1916

Brass Cap
Elev. 2022.63

Sta. 322+43
Exist. 2-8'-5" x 7'-6" Box Culv.

Sta. 324+40
Exist 30"x 103" R.C.P.

Brass Cap
Elev. 2023.18

Sta. 330+00
Exist. 36"x 106" R.C.P.
Skew 15° Lt.

R=30'

77°50'42"

Exist R/W

Survey & Constr. ℄

S 77°48'20" E.

R=30'

Exist R/W

Brass Cap
Elev. 2023.18

Fin. Plans M.A.H. APR. '72. Checked April '72 JP CLD 6/24/72 Det

T.L. 10-71

MORRISTOWN - NEW RIVER HWY.
MORRISTOWN - LAKE PLEASANT
MARICOPA COUNTY

ALL EXIST. PIPE CULVERTS ARE REINF. CONC. BETWEEN STA. 330 AND 420

FHWA	STATE	PROJECT	NO. SHEETS	ADJ. SHT
9	ARIZ	S-434-507	7	15

Fin. Plans, Apr. '72 - M.U.H. Checked April '72 - R. Cox 5/26/72

T.L. 10-71

Drain. Easement 400'
Exist 10'x2'x30' Ditch & Dyke
100' 100'
330 800'
335
P.O.T. 336+00.00
340
Existing 10'x2'x50' Ditch
Existing 10'x2'x100' Ditch
345
P.O.T. 346+00.00
Existing 10'x2'x100' Ditch
Exist. R/W
350
Survey & Constr. ℄
S. 77°48'20" E.
P.O.T. 353+39.95
355
Existing 10'x2'x50' Ditch & Dyke
P.O.T. 359+00.00
New Guard Rail
Lt. 150' Straight
Rt. 125' Straight
Std. C-10.21 & C-1023
360
Lt. & Rt. Sta. 330+00 to 360+00
6000' New 4-Wire Game Fence
Std. C-12.02

Sta. 331+60 Exist. 36"x102" R.C.P.
Sta. 339+25 Exist. 36"x102" R.C.P. Skew 30° Lt.
Sta. 341+37 Exist. 30"x102" R.C.P. Skew 30° Lt.
Sta. 344+00 Exist. 48"x146" R.C.P. Skew 45° Lt.
Sta. 347+60 Exist. 18"x102" R.C.P.
Sta. 350+70 Exist. 24"x100" R.C.P. Skew 15° Lt.
Sta. 351+70 Exist. 30"x108" R.C.P.

Brass Cap Elev. 2019.71

New Guard Rail
Lt. 150' Straight
Rt. 175' Straight
Std. C-1002, C-1021 & C-1023
360
365
Exist. 10'x2'x50' Dike
1/4 Cor. 1" I.P. with U.S.G.L.O. Brass Cap-1916
P.O.T. 369+46.53
370
N 77°48'20" W. 1047.26'
P.O.T. 369+51.08 Sec. Line
New 10'x3'x55' Dyke Type M, Std. C-3.01 170 C.Y. Borrow
375
Extend Lt. 17'-0" & Rt. 12'-0" See Bridge Sheets 200 C.Y. Borrow for new slopes
P.O.T. 380+00.00
Exist. 10'x2'x100' Ditch
Exist. R/W
385
Exist. 10'x2'x80' Ditch
P.O.T. 388+00.00
Exist. 10'x2'x100' Ditch
390
Survey & Constr. ℄
S. 77°48'20" E.
Brass Cap Elev. 2000.22
Lt. & Rt. Sta 360+00 to 390+00
6140' New 4-Wire Game Fence
Std. C-12.02
Brass Cap Elev. 1996.04
Extend Lt. 10'-9" & Rt. 8'-3" See Bridge Sheets 200 C.Y. Borrow for new slopes
Brass Cap. Elev. 1993.54

Brass Cap Elev. 2004.06
Sta. 360+00 to 360+47.14 Exist. 3'-0"x4'-7"x6" Box Culv. Skew 45° Lt.
Sta. 363+00 Exist. 30"x100" R.C.P.
+04
Lt. & Rt. Sta 391+10
Exist. 14'x20' T.O.
Reconstr. to New 20'x76' A.C.T.O. Type "A", Std. C-6.01
85 C.Y. Rdwy. Excav.
Sta. 367+95 Exist. 60"x102" R.C.P.
T6N-R3W
R2W.
2638.76'
N 0°50' W.
Sect. Cor. 5" I.P. with U.S.G.L.O. Brass Cap-1916
Sta. 371+40 Exist. 48"x102" R.C.P.
Sta. 374+85 Exist. 8'-8"x4'-8½" Box Culv.
Sta. 378+20 Exist. 24"x80" R.C.P.
Sta. 385+85 Exist. 8'-8"x4'-6½" Box Culv.

390
10'x2'x50' Ditch Existing
Brass Cap Elev. 1992.46
10' rad.
R=30'
R=30'
395
Extend Lt. 12'-6" & Rt. 11'-6" See Bridge Sheets 100 C.Y. Borrow for new slopes
P.O.T. 399+00.00
400
Exist. 10'x2'x100' Ditch
405
Exist. 10'x2'x150' Ditch
Exist. R/W
410
Survey & Constr. ℄
S. 77°48'20" E.
P.O.T. 411+50.00
Exist. 10'x2'x250' Ditch
415
Lt. & Rt. Sta. 390+00 to 420+00
6170' New 4-Wire Game Fence
Std. C-12.02
420

Lt. & Rt. Sta. 391+10
New 4-Unit Cattle Guard without gate
Std. C-11.01
Brass Cap Elev. 1990.05
Brass Cap Elev. 1993.40
Brass Cap Elev. 1993.54
Brass Cap Elev. 1989.65
Brass Cap Elev. 1982.14

Sta. 390+70 Exist. 36"x100" R.C.P.
Sta. 392+40 Exist. 2-8'-1"x7'-5" Box Culv. Skew 15° Lt.
Sta. 396+50 Exist. 2-8'-4"x6'-6" Box Culv. Skew 15° Lt.
Sta. 400+35 Exist. 48"x110" R.C.P. Skew 30° Lt.
Sta. 402+40 Exist. 24"x102" R.C.P.
Sta. 404+85 Exist. 2-8'-4"x6'-6" Box Culv.
Extend 7'-0" with 2-8'x7'-0" barrel and outlet apron Rt. See Bridge Sheets 100 C.Y. Borrow for new slopes
Extend Lt. 17'-3" & Rt. 11'-3" with outlet apron Rt. See Bridge Sheets 300 C.Y. Borrow for new slopes
Sta. 414+30.00 to 414+61.50 Exist. 2-10'-0"x5'-5" Box Culv.
Sta. 417+90 Exist. 36"x103" R.C.P. Skew 30° Lt.

MORRISTOWN - NEW RIVER HWY.
MORRISTOWN - LAKE PLEASANT
MARICOPA COUNTY

ALL EXIST. PIPE CULVERTS ARE REINF. CONC. BETWEEN STA 420 to 510

FHWA NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	Hor Scale
9	ARIZ.	S-434-507	8	15	Hor Scale 1"=20' Ver Scale 1"=5'

Fin. Plans Apr. '72 - M.A.H. T.L. 10-71

Checked Sept. '72 - Lake Sketch Add

PLAN: SURVEYED, PLOTTED, NOTE BOOK, NO., GRADES CHECKED, R/W & ROLLD, STRUCTURE NOTES RECKD., BY, DATE, CHECKED, RT. OF WAY CHECKED

PROFILE: SURVEYED, PLOTTED, NOTE BOOK, NO., GRADES CHECKED, R/W & ROLLD, STRUCTURE NOTES RECKD., BY, DATE, CHECKED

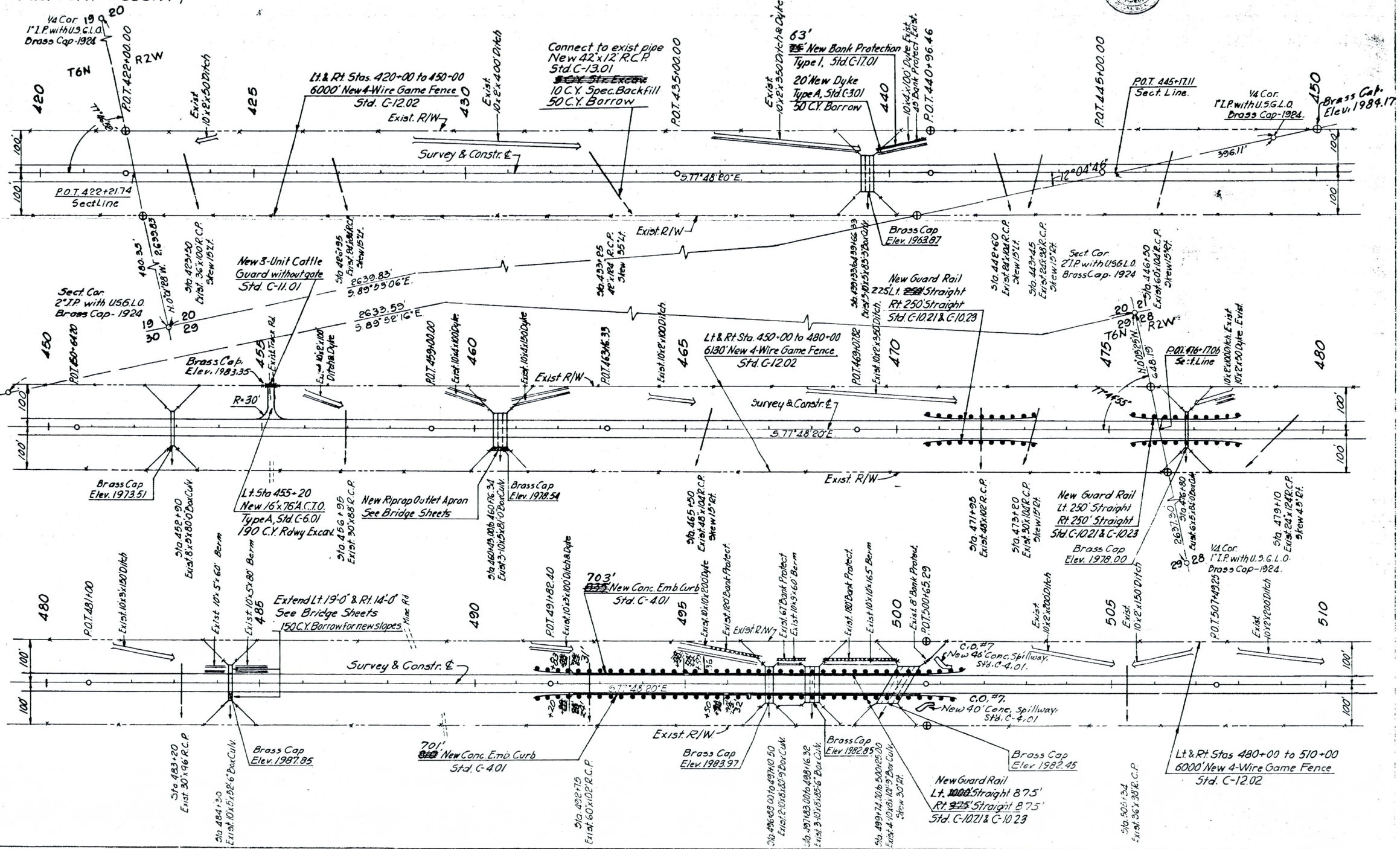


PLATE 1 - PLAN - PROFILE

MORRISTOWN - NEW RIVER HWY.
MORRISTOWN - LAKE PLEASANT
MARICOPA COUNTY

ALL EXIST. PIPE CULVERTS ARE REINF. CONCRETE BETWEEN STA. 510 AND 600.

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	S-434-507	9	15	Hurlbert 5-28-75

T6N-R2W 21 22 28 27 Sect.Cor. 2"I.P. with U.S.G.L.O. Brass Cap. 1924

N.0°02'57"E.

New Type 1 Gate Std C-12.01

Exist. 10'x6'x50' Ditch

Exist. 10'x6'x100' Ditch

P.O.T. 519+23.26

Lt. & Rt. Sta. 510+00 to 540+00
6120' New 4 Wire Game Fence
Std. C-12.02

P.O.T. 527+36.06

P.O.T. 528+02.00

Remove exist Fence and 2-Unit Cattle Guards Gate within R/W and Salvage for State

Exist R/W

Survey & Constr. ℄

90° R.

77°41'17"

S.77°48'20"E.

S.77°45'31"E.

Brass Cap Elev. 1980.27

P.O.T. 536+10.97

Brass Cap Elev. 1967.42

Brass Cap Elev. 1974.20

Sta. 501+40 Exist. 42"x102" R.C.P.

Sta. 514+10 Exist. 30"x138" R.C.P. Skew 45° Lt.

Sta. 515+15 Exist. 30"x100" R.C.P.

Sta. 517+60 Exist. 42"x144" R.C.P. Skew 45° Lt.

Lt. Sta. 519+23
New 16'x30' A.C.T.O.
Type A, Std. 6.01
60 C.Y. Rdwy. Excav.

Sta. 520+35 Exist. 30"x84" R.C.P. Skew 30° Lt.

Exist. R/W

Sta. 524+20 Exist. 84"x84" R.C.P.

STA. 529+00
END S-434(2)
BEGIN S-434-503
Grade and Drain only

BEARING EQUATION
S 72°48'20"E Bk =
S 72°45'31"E Ahd.

Sta. 530+25 Exist. 6'x7'x108'0" Box Culv.

2638.81
899.01

P.O.T. 530+25.31
Sect. Line

1/4 Cor. 1"I.P. with U.S.G.L.O. Brass Cap. 1924

Sta. 533+00 Exist. 8'x7'x106'0" Box Culv.

P.O.T. 563+31.24

Sta. 538+70 Exist. 6'x6'x120' Box Culv.

P.O.T. 569+00.00

P.O.T. 541+39.17

P.O.T. 546+00.00

Brass Cap Elev. 1959.22

C.O. #7
New 6' Conc. Spillway.

P.O.T. 555+43.48

Brass Cap Elev. 1974.35

Exist. R/W

Brass Cap Elev. 1950.04

Brass Cap Elev. 1947.57

Survey & Constr. ℄

S.77°45'31"E.

Brass Cap Elev. 1969.03

Exist. R/W

Sta. 544+40 Exist. 36"x164" R.C.P. Skew 30° Lt.

Lt. & Rt. Sta. 540+00 to 570+00
6090' New 4 Wire Game Fence
Std. C-12.02

Sta. 549+60 Exist. 60"x168" R.C.P. Skew 30° Lt. Headwall Lt.

Sta. 550+90 Exist. 84"x150" R.C.P.

Sta. 555+75 Exist. 2-6'x11'x130' Box Culv.

Sta. 557+55 Exist. 48"x158" R.C.P. Headwall Lt.

Sta. 561+35 Exist. 60"x150" R.C.P. Skew 15° Lt. Headwall Lt.

Sta. 565+75 Exist. 48"x166" R.C.P. Skew 30° Lt. Headwall Lt.

Brass Cap Elev. 1962.84

Brass Cap Elev. 1951.57

Lt. & Rt. Sta. 570+00 to 600+00
6130' New 4 Wire Game Fence
Std. C-12.02

P.O.T. 581+00.00
10' Dirt Rd

Exist. 91' Rail Road Protect.

Brass Cap Elev. 1943.01

Drain. Easement 250'

Exist. 10'x3'x90' Gate

Exist. 45° Wing Wall

Exist. 10'3"x6'0" Box Culv.

290.78

Sta. 583+21.34 to 583+54.66 Exist. 3-10'x4'x65'-6" Box Culv.

27 26 1/4 Cor. 1"I.P. with U.S.G.L.O. Brass Cap. 1924

New Guard Rail
Lt. 225' Straight
Rt. 225' Straight
Std. C-10.02, C-10.21 & C-10.23

Brass Cap Elev. 1945.97

Exist. R/W

P.O.T. 584+25.70
Sect. Line

77°37'08"

S.77°45'31"E.

50° R.

Brass Cap Elev. 1921.97

Exist. 10'x5'x50' Gate

Drain. Easement 300'

Exist. 10'x5'x290' Channel

Brass Cap Elev. 1961.20

Exist. R/W

Brass Cap Elev. 1947.52

Sta. 572+46 Exist. 60"x128" R.C.P. Skew 15° Lt. Headwall Lt.

Sta. 576+18 Exist. 36"x180" R.C.P. Skew 45° Lt.

Sta. 579+13 Exist. 24"x104" R.C.P.

2 New Type 1 Gates
Std. C-12.02

581+80

Lt. & Rt. Sta. 582+00
Exist. 10'x20' T.O.
Reconstr. to
New 16'x30' A.C.T.O.
Type "A", Std. C-6.01
5 C.Y. Rdwy. Excav.

N.0°01'34"E.
8640.74

T6N R2W 27 26 34 35 Sect. Cor. 27 P. with U.S.G.L.O. Brass Cap-1924.

Sta. 588+39 Exist. 42"x204" R.C.P. Skew 45° Lt.

Sta. 590+11 Exist. 42"x174" R.C.P. Skew 30° Lt.

Sta. 592+98 Exist. 60"x142" R.C.P. Skew 20° Lt. Headwall Lt.

Sta. 594+00 Exist. 2-6'x6'x150' Box Culv.

P.O.T. 591+00.00

BRUNING 44-512

MORRISTOWN - NEW RIVER HWY.
MORRISTOWN - LAKE PLEASANT
MARICOPA COUNTY

ALL EXIST. PIPE CULVERTS ARE REINF. CONCRETE BETWEEN 600 AND 690

F.A.P. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	BUILT
9	ARIZ.	S-434-507	10	15	Hurlbert 5-28-75

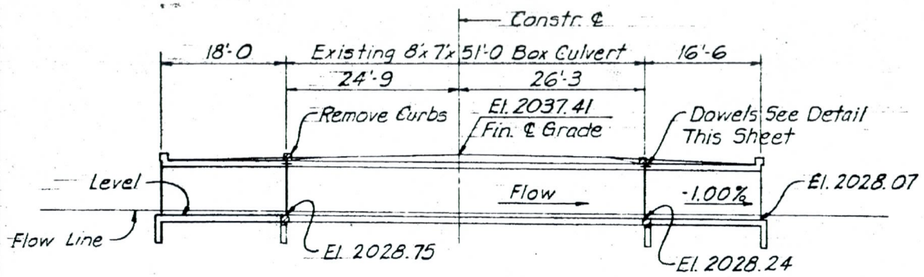
T.L. 10-71 Fin. Plans Apr '72-M.A.H. Checked Apr '72-R.

P.O.T. 602+00.00
Brass Cap Elev. 1927.60
Sta. 600+47 Exist. 36"x104" R.C.P.
Brass Cap Elev. 1924.64
Lt. & Rt. Sta. 600+00 to 630+00
6170' New 4-Wire Game Fence
Std. C-12.02
Sta. 603+90 Exist. 42"x148" R.C.P. Skew 30° Lt.
Exist. 10'x3'x50' Dyke
Exist. 10'x3'x80' Channel
Brass Cap Elev. 1916.14
Brass Cap Elev. 1915.22
50' New Conc. Spillway plus inlet transition See detail & Std. C-4.01
30 C.Y. Borrow
40' New Conc. Spillway plus inlet transition. See detail & Std. C-4.01
30 C.Y. Borrow
Sta. 607+30 Exist. 6'x8' Box Culv.
P.O.T. 611+00.00
Lt. Sta. 616+75 New 3-Unit Cattle Guard without gate Std. C-11.01
Brass Cap Elev. 1913.77
Lt. Sta. 616+75 Exist. 10'x20' T.O. Reconstr. to New 16'x76' A.C.T.O. Type "A", Std. C-6.01
300 C.Y. Rdwy Excav.
Brass Cap Elev. 1907.40
40' New Conc. Spillway plus inlet transition. See detail & Std. C-4.01
30 C.Y. Borrow
Exist. R/W
Survey & Constr. ℄
S 77°45'31" E.
P.O.T. 623+00.00
Brass Cap Elev. 1904.32
Lt. & Rt. Sta. 600+00 to 630+00
6170' New 4-Wire Game Fence
Std. C-12.02
Brass Cap Elev. 1911.45
Exist. R/W
Rt. Sta. 616+65 New 3-Unit Cattle Guard without gate, Std. C-11.01
40' New Conc. Spillway plus inlet transition. See detail & Std. C-4.01
30 C.Y. Borrow
Sta. 615+93 Exist. 36"x108" C.P. Skew 15° Rt.
Sta. 620+35 Exist. 6'x7'x100' Box Culv. Skew 45° Lt.
New Guard Rail Lt. 200' Straight Rt. 200' Straight
Std. C-10.02, C-10.21 & C-10.23
Sta. 624+76 Exist. 24"x100' R.C.P. Skew 20° Lt.
Sta. 627+06 Exist. 24"x106' R.C.P. Skew 30° Lt.
"L" Headwall Lt.
Lt. & Rt. Sta. 630+00 to 660+00
5950' New 4-Wire Game Fence
Std. C-12.02
Brass Cap Elev. 1904.63
P.O.T. 634+00.00
Exist. 10'x3'x60' Dyke
Exist. 10'x3'x75' Channel
¼ Cor. T.1N. R.2W. with U.S.G.L.O. Brass Cap. 1928
P.O.T. 638+32.72
5/8" I.P. Sect. Tie
e634.86
N 01°39'E
Exist. 10'x5'x300' Channel
Sta. 609+38 Exist. 24"x84" R.C.P. "L" Headwall Lt.
Lt. Std. 641+25 Exist. 10'x20' T.O. Reconstr. to New 16'x76' A.C.T.O. Type A, Std. C-6.01
20 C.Y. Rdwy. Excav.
Sta. 611+90 Exist. 24"x102" C.P. Exist. 10'x3'x80' Dyke Exist. 7'Rail Bank Protect. 45° Lt. "L" Headwall Lt.
Exist. 10'x3'x80' Dyke
Drain Easement
Exist. 7'Rail Bank Protect.
Exist. 10'x5'x80' Dyke
Sta. 614+08 Exist. 42"x180" R.C.P. Skew 30° Lt.
New 3-Unit Cattle Guard without gate Std. C-11.01
Brass Cap Elev. 1888.65
P.O.T. 646+00.00
Brass Cap Elev. 1885.08
Exist. R/W
Survey & Constr. ℄
S 77°45'31" E.
45' New Conc. Spillway plus inlet transition See detail & Std. C-4.01
45 C.Y. Borrow
Exist. 10'x5'x90' Dyke
Exist. 30' Rail Bank Protect.
Brass Cap Elev. 1867.94
Exist. 7'Rail Bank Protect.
Exist. 10'x5'x70' Dyke
P.O.T. 657+46.04
Brass Cap Elev. 1900.26
Sta. 631+48 Exist. 36"x104" R.C.P. Skew 30° Lt.
Lt. & Rt. Sta. 660+00 to 665+00
1220' New 4-Wire Game Fence
Std. C-12.02
Brass Cap Elev. 1875.19
40' New Conc. Spillway plus inlet transition. See detail & Std. C-4.01
45 C.Y. Borrow
Brass Cap Elev. 1862.87
Sect. Cor. 2" I.P. with U.S.G.L.O. Brass Cap 1924
T. 6N. R. 2W. 25 26 35 36
Future Sta 665+00. Remove exist. 186' fence & gate Salvage for State
New Type 1 Gate Std. C-12.01
Sta. 640+20 Exist. 6'x5'x27' Box Culv. Skew 30° Lt.
Sta. 641+96 Exist. 3'x10'x69'6" Box Culv.
Rt. Sta. 641+25 Exist. 10'x20' T.O. Reconstr. to New 16'x30' A.C.T.O. Type "A", Std. C-6.01
20 C.Y. Rdwy. Excav.
Brass Cap Elev. 1888.71
Exist. R/W
New Guard Rail Lt. 275' Straight Rt. 275' Straight
Std. C-10.01B, C-10.02 & C-10.03B
52' New Conc. Spillway plus inlet transition See detail & Std. C-4.01
45 C.Y. Borrow
Sta. 654+28 Exist. 10'x6'x54' Box Culv. Skew 30° Lt.
Exist. 4-10'x6'x102'6" Box Culv.
Sta. 656+39 Exist. 24"x104" C.P.
New Guard Rail Lt. 400' Straight Rt. 350' Straight
Std. C-10.21 & C-10.23
Future 315' New Conc. Emb. Curb Std. C-4.01
Exist. 10'x3'x30' Dyke
Exist. 28'x8' Rail Bank Protect.
Exist. 10'x3'x50' Channel
P.O.T. 680+00.00
Drain Easement
Brass Cap Elev. 1857.89
Exist. R/W
Survey & Constr. ℄
S 77°45'31" E.
Brass Cap Elev. 1847.41
Exist. 10'x3'x140' Channel
Exist. 10'x3'x30' Dyke
P.O.T. 690+00.00
Brass Cap Elev. 1870.10
56' New Conc. Spillway plus inlet transition See detail & Std. C-4.01
45 C.Y. Borrow
Sta. 661+89 Exist. 36"x148" R.C.P. Skew 30° Lt.
Sta. 662+70 Exist. 6'x5'x102'6" Box Culv.
Sta. 664+35 Exist. 24"x84" R.C.P.
Future Lt. Sta. 665+16 New 3-Unit Cattle Guard without gate Std. C-11.01
12° Curve
30' R.
50' R.
Future Lt. & Rt. Sta. 665+43 New 16'x76' A.C.T.O. Type C, Std. C-6.01
Future Rt. Sta. 665+72, New 3-Unit Cattle Guardwithout gate Std. C-11.01
STA. 665+00.00
END PROJECT S-434-507
BEGIN PROJECT S-434-508
Sta. 668+78 Exist. 24"x 83" R.C.P.
Sta. 671+86 Exist. 24"x106" R.C.P. Skew 15° Lt.
Exist. R/W
Brass Cap Elev. 1858.53
Future Lt. & Rt. Sta. 665+00 to 690+00 4865' New 4-Wire Game Fence 186' Reconstructed Fence
Std. C-12.02
Sta. 681+00 to 681+93.20 Exist. 3-10'x10'x122'6" Box Culv. Skew 45° Lt.
Sta. 683+00 to 683+63.00 Exist. 2-12'x10'x84'6" Box Culv.
Future New Guard Rail Lt. 800' Straight Rt. 450' Straight
Std. C-10.02, C-10.21 & C-10.23
Sta. 688+68 Exist. 24"x114" R.C.P. Skew 10° Lt.

7	S-434-507	10 OF 10	

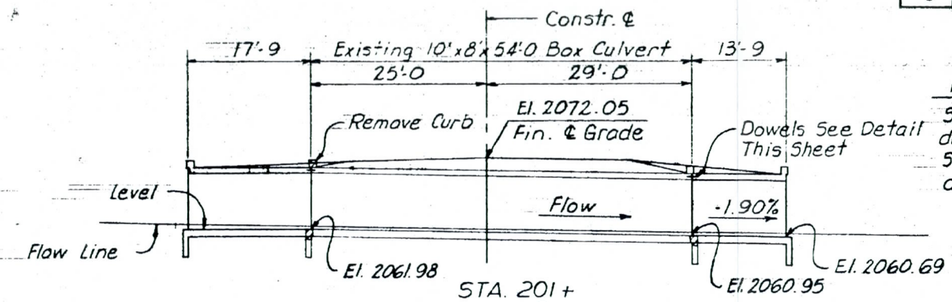
MORRISTOWN - NEW RIVER HWY.
MARICOPA COUNTY

PROJ. SECTION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZONA	S-434-507	11	15	7-16-74 44



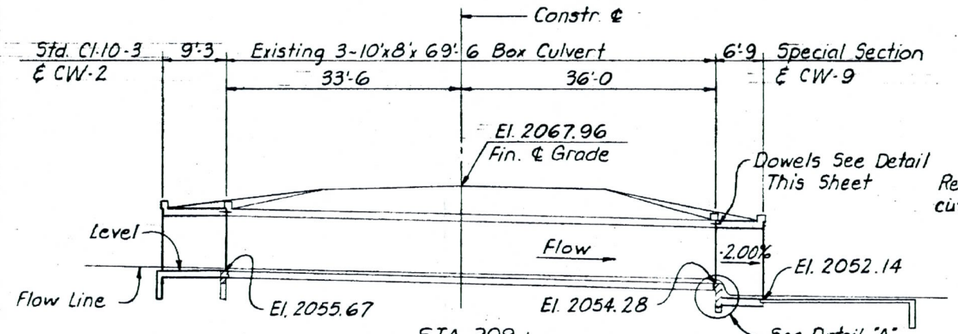
STA. 107+
SECTION ON ℄ EXISTING CULVERT
Existing 8'x7'x51'-0 Box Culvert
Extend Lt. 18'-0 ℄ Rt. 16'-6
Scale: 1"=10'-0

NOTE STA. 107+
See Std. CI-8-1 for all other barrel details, dimensions, and bend diagrams. See Std. CW-2 for all other headwall details.

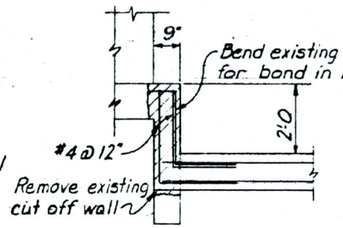


STA. 201+
SECTION ON ℄ EXISTING CULVERT
Existing 10'x8'x54'-0 Box Culvert
Extend Lt. 17'-9 ℄ Rt. 13'-9
Scale: 1"=10'-0

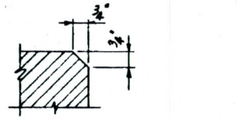
NOTE STA. 201+
See Std. CI-10-1 for all other barrel details, dimensions, and bend diagrams. See Std. CW-2 for all other headwall details.



STA. 209+
SECTION ON ℄ EXISTING CULVERT
Existing 3-10'x8'x 69'-6 Box Culvert
Extend Lt. 9'-3 with 3-10'x8' Std. CI-10-3
Extend Rt. 6'-9 with 3-10'x 10' Special Barrel with outlet apron Rt.
Scale: 1" = 10'-0

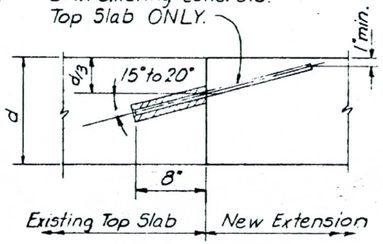


DETAIL "A"
Scale: 1/2"=1'-0

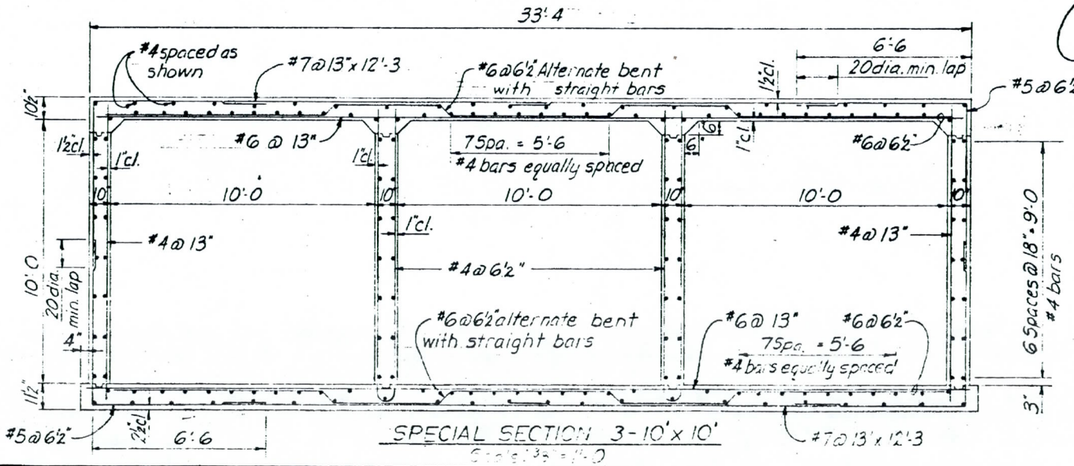


Chamfer all exposed corners thus unless otherwise noted. This note applicable to all culvert pertaining to this project.

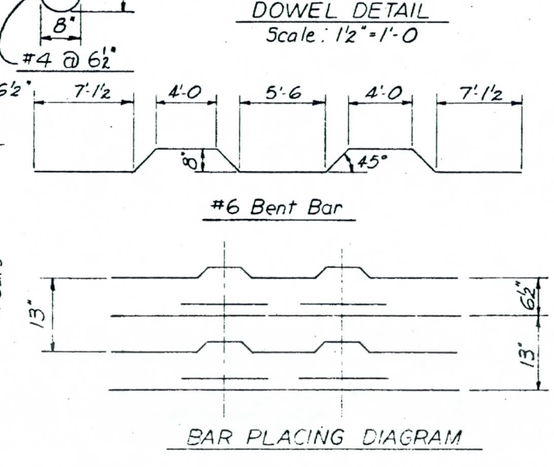
*6 dowels @ 18" cts. 1'-9 long. Drill and set in sulphur 8" in existing concrete. Top Slab ONLY.



DOWEL DETAIL
Scale: 1'2"=1'-0



SPECIAL SECTION 3-10'x10'
Scale: 3/8"=1'-0



#6 Bent Bar

BAR PLACING DIAGRAM

NOTE STA. 209+
See Std. CI-10-3 and Special Section for all other barrel details, dimensions, and bend diagrams. See Std. CW-2 & CW-9 for all other headwall details. See Sheet 5 of 5 for outlet apron details.

GENERAL NOTES

Construction - Std. Specs Arizona Highway Department Edition of 1969, revised to date.
Design - A.A.S.H.O. Std. Specs for Highway Bridges, revised to date.
Loading Class - H 520-44
Stresses - Class A concrete fc = 1000 psi ; n = 12
Reinforcing Steel fs = 20,000 psi
Reinforcing Steel shall conform to ASTM Spec. A615 Grade 40
All reinforcing steel dimensions shall be to center of bars unless noted otherwise.
Remove existing headwalls and hatched areas as required for new construction. Measurement and payment for removal of structural concrete shall be computed for 1'-6 maximum horizontal clearance to new construction.
Use projecting reinforcing steel for bond in new concrete.
See Structure Summary Sheet for estimated quantities and miscellaneous details.

ALL CONCRETE CLASS "A"

		DATE
LAYOUT		
DESIGN		
ARCHITECTURE		
DRAWN	AFJ	4-72
TRACED		
CHECKED	[illegible]	4-72

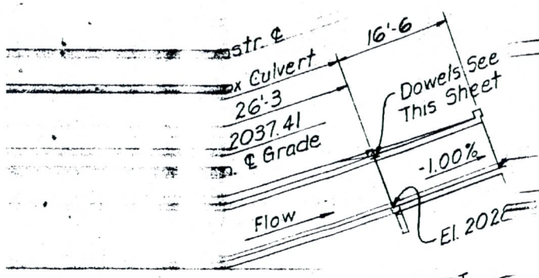
ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STA. 107+ 201+ & 209+
LOCATION & SPECIAL DETAILS

SHEET NO. 1 OF 5 | BRIDGE NUMBER | DRAWING NUMBER | BRIDGE ENGINEER

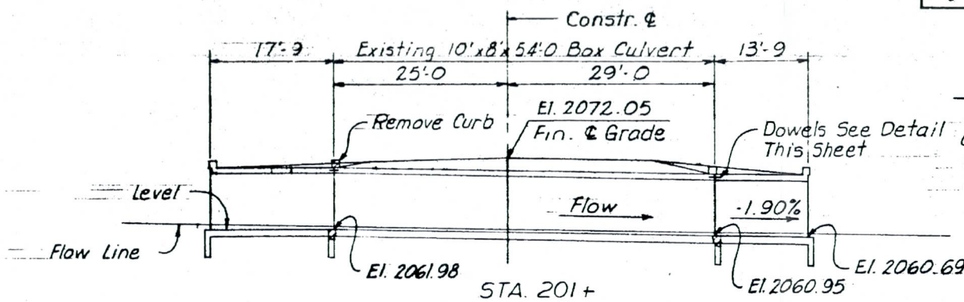
S-434-507

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZONA	S-434-507	11	15	7-16-74 AA



8.07

A. 107+
CI-8-1 for all other barrel
imensions, and bend diagrams.
CW-2 for all other headwall details.



STA. 201+
SECTION ON ℄ EXISTING CULVERT
Existing 10'x8'x54'-0 Box Culvert
Extend Lt. 17'-9 & Rt. 13'-9
Scale: 1"=10'-0

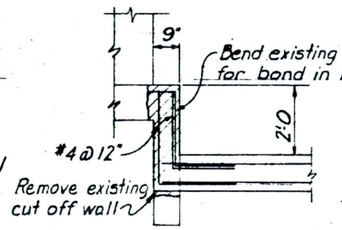
NOTE STA. 201+

See Std. CI-10-1 for all other barrel details, dimensions, and bend diagrams. See Std. CW-2 for all other headwall details.

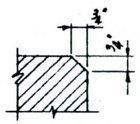
. 107+
EXISTING CULVERT
7'x51'-0 Box Culvert
Lt. 18'-0 & Rt. 16'-6
ale: 1"=10'-0

ection

Detail

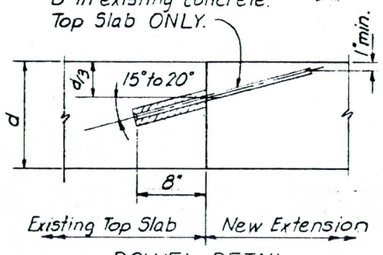


DETAIL "A"
Scale: 1½"=1'-0



Chamfer all exposed corners thus unless otherwise noted. This note applicable to all culvert pertaining to this project.

*6 dowels @ 18" cts. 1'-9 long. Drill and set in sulphur 8" in existing concrete. Top Slab ONLY.



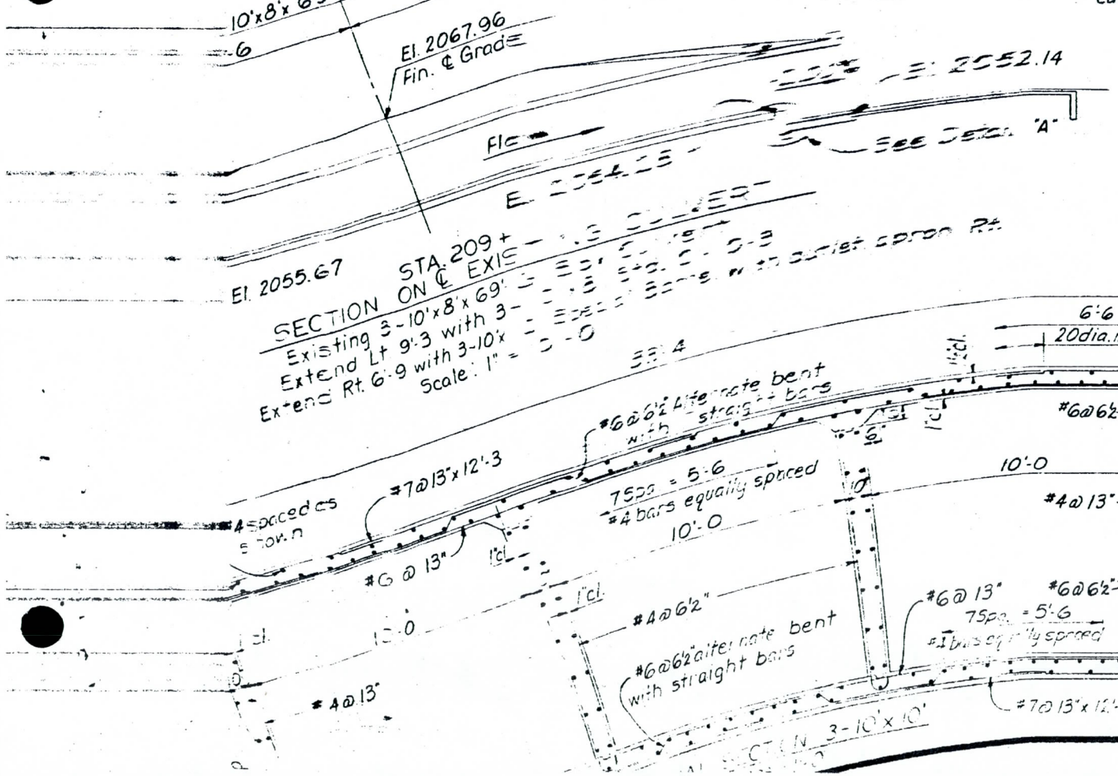
DOWEL DETAIL
Scale: 1½"=1'-0

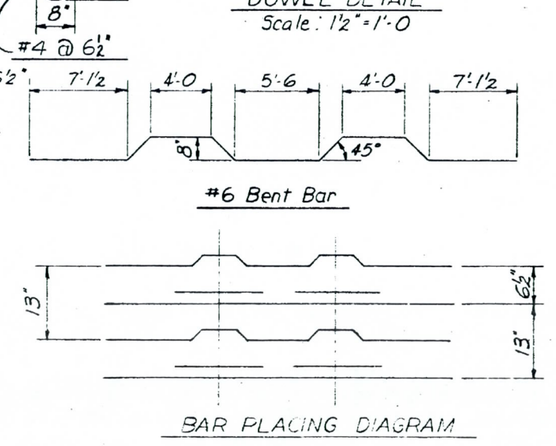
GENERAL NOTES

Construction - Std. Specs Arizona Highway Department Edition of 1969, revised to date.
Design - A.A.S.H.O. Std. Specs for Highway Bridges, revised to date.
Loading Class - H S 20-44
Stresses - Class A concrete fc = 1000 psi; n = 12
Reinforcing Steel fs = 20,000 psi
Reinforcing Steel shall conform to ASTM Spec. A615 Grade 40
All reinforcing steel dimensions shall be to center of bars unless noted otherwise.
Remove existing headwalls and hatched areas as required for new construction. Measurement and payment for removal of structural concrete shall be computed for 1'-6 maximum horizontal clearance to new construction.
Use projecting reinforcing steel for bond in new concrete.
See Structure Summary Sheet for estimated quantities and miscellaneous details.

NOTE STA. 209+

See Std. CI-10-3 and Special Section for all other barrel details, dimensions, and bend diagrams. See Std. CW-2 & CW-9 for all other headwall details. See Sheet 5 of 5 for outlet apron details.





#6 Bent Bar

BAR PLACING DIAGRAM

ALL CONCRETE CLASS "A"

		DATE
LAYOUT		
DESIGN		
ARCHITECTURE		
DRAWN	APJ	4-72
TRACED		
CHECKED		4-72

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

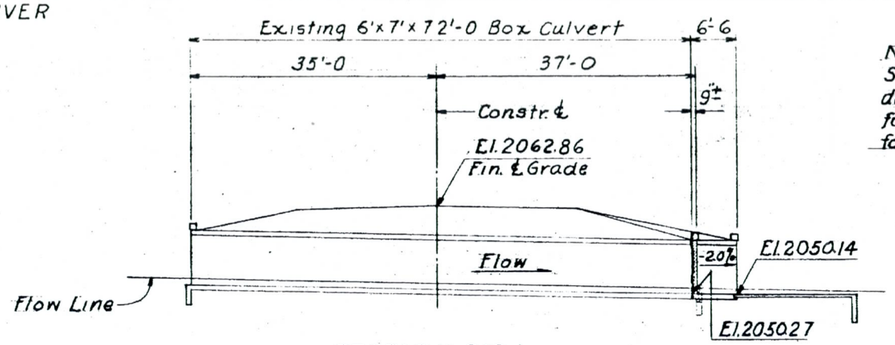
STAS. 107+ 201+ & 209+
LOCATION & SPECIAL DETAILS

SHEET NO. 1 OF 5 | BRIDGE NUMBER | DRAWING NUMBER | BRIDGE ENGINEER

S-434-507

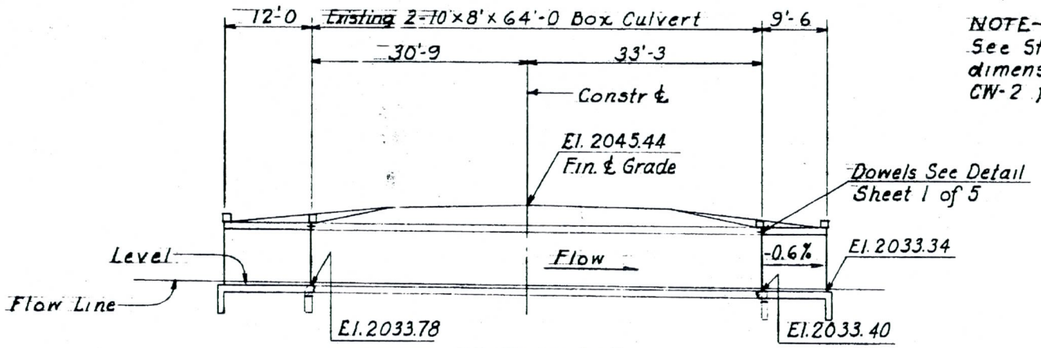
MORRISTOWN-NEW RIVER
MARICOPA COUNTY

FHWA PROJECT NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZONA	S-434-507	2	15	7-16-74 AL



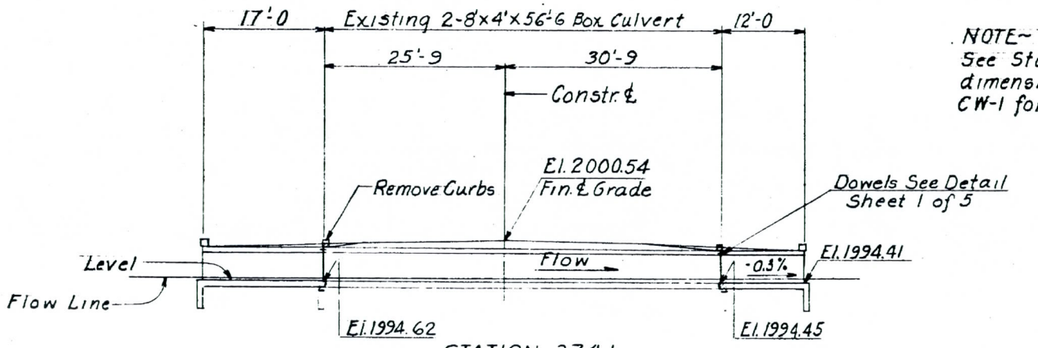
STATION 219+
SECTION ON ℄ EXISTING CULVERT
Existing 6'x7'x72'-0 Box Culvert
Extend Rt. 6'-6 with Outlet Apron Rt.
Scale: 1" = 10'-0

NOTE~ Station 219+
See Standard CI-6-1 for all other barrel details, dimensions, and bend diagrams. See Standard CW-2 for all other headwall details. See Sheet 5 of 5 for outlet apron details.



STATION 297+
SECTION ON ℄ EXISTING CULVERT
Existing 2-10'x8'x64'-0 Box Culvert
Extend Lt. 12'-0 and Rt. 9'-6
Scale: 1" = 10'-0

NOTE~ Station 297+
See Standard CI-10-2 for all other barrel details, dimensions, and bend diagrams. See Standard CW-2 for all other headwall details.



STATION 374+
SECTION ON ℄ EXISTING CULVERT
Existing 2-8'x4'x56'-6 Box Culvert
Extend Lt 17'-0 and Rt 12'-0
Scale: 1" = 10'-0

NOTE~ Station 374+
See Standard CI-8-2 for all other barrel details, dimensions, and bend diagrams. See Standard CW-1 for all other headwall details.

ALL CONCRETE CLASS "A"

		DATE
LAYOUT		
DESIGN	APJ	4-72
ARCHITECTURE		
DRAWN	DLC	4-72
TRACED		
CHECKED	[illegible]	4-72

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

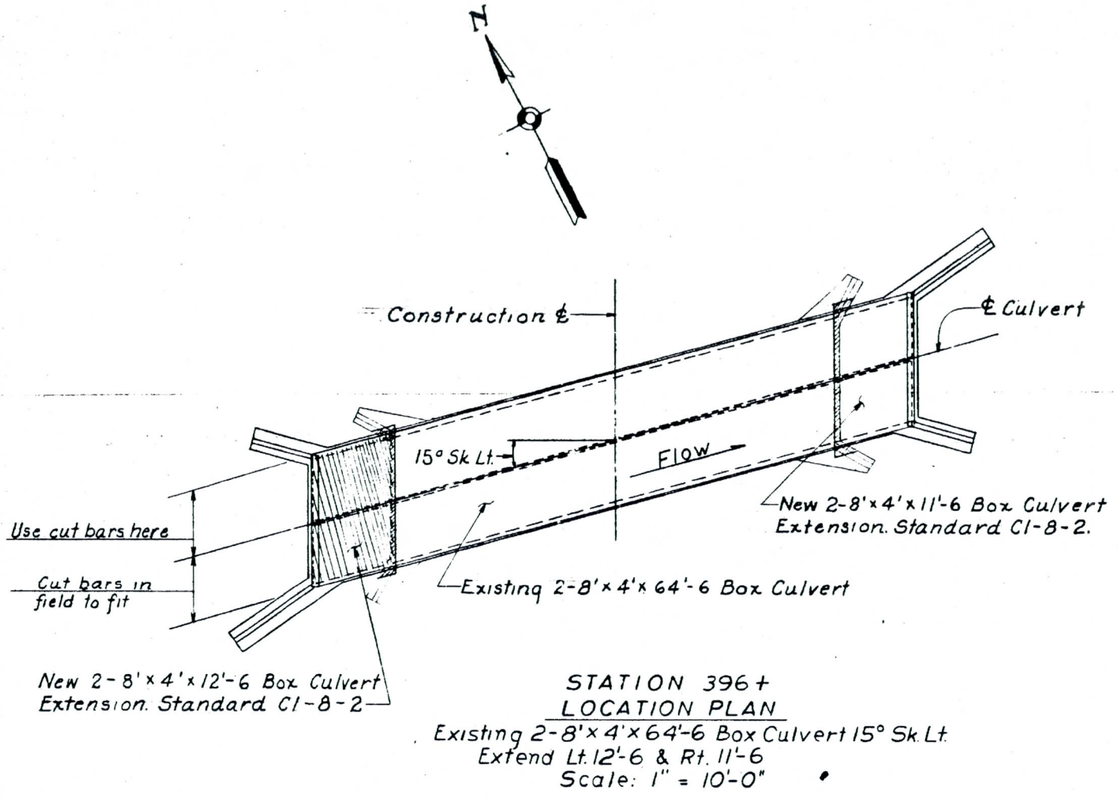
STATIONS
219+297+ & 374+
LOCATION & SPECIAL DET'S

SHEET NO. 2 OF 5 | BRIDGE NUMBER | DRAWING NUMBER | BRIDGE ENGINEER

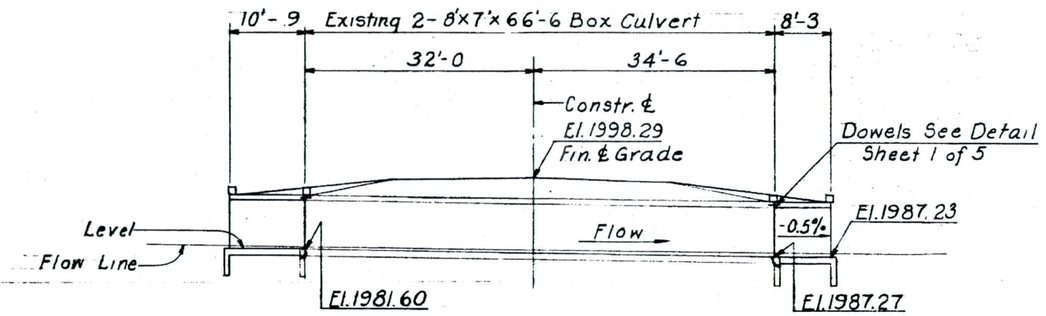
S-434-507

MORRISTOWN-NEW RIVER
MARICOPA COUNTY

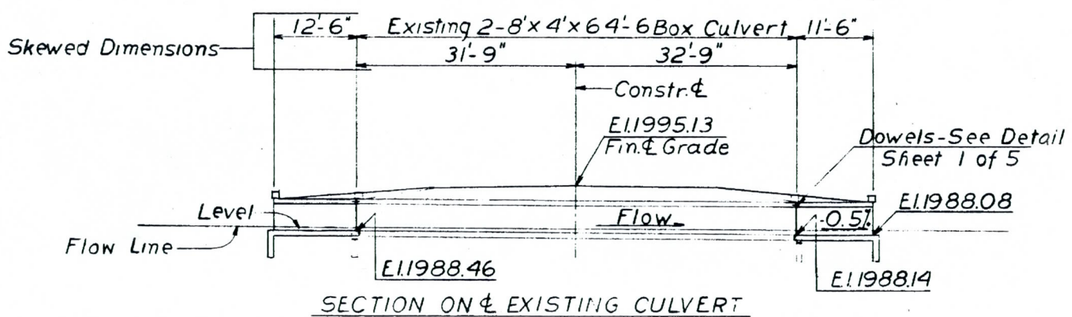
PUBLIC ROADS DIVISION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9		S-434-507	13	15	7-16-74



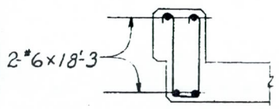
STATION 396+
LOCATION PLAN
Existing 2-8'x4'x64'-6 Box Culvert 15° Sk Lt.
Extend Lt. 12'-6 & Rt. 11'-6
Scale: 1" = 10'-0"



STATION 383+
SECTION ON ℄ EXISTING CULVERT
Existing 2-8'x7'x66'-6 Box Culvert
Extend Lt. 10'-9 and Rt. 8'-3
Scale: 1"=10'-0



SECTION ON ℄ EXISTING CULVERT



NEW CURB DETAIL
Scale: 3/4" = 1'-0

NOTE STA. 396+
See Std. C1-8-2 for all other barrel details, dimensions, & bend diagrams.
See Std. CW-3 for all other headwall details.

NOTE STA. 383+
See Standard C1-8-2 for all other barrel details, dimensions, and bend diagrams.
See Standard CW-2 for all other headwall details.

ALL CONCRETE CLASS "A"

		DATE
LAYOUT		
DESIGN	APJ	4-72
ARCHITECTURE		
DRAWN	DLC	4-72
TRACED		
CHECKED	[illegible]	4-72

ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

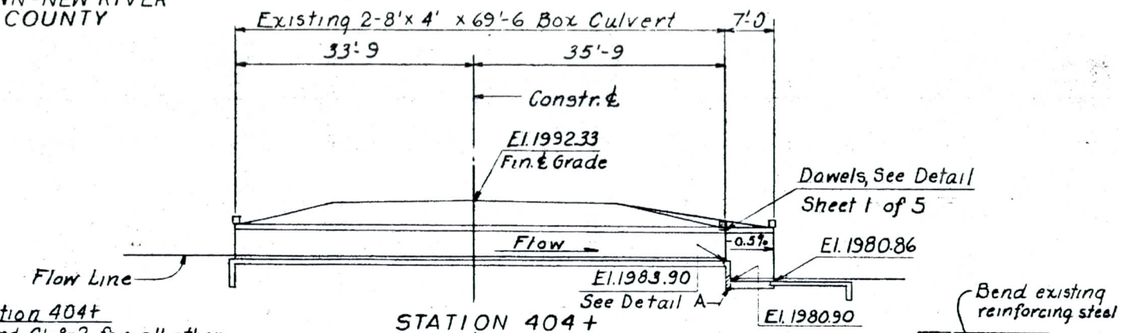
STATIONS 383+ & 396+
LOCATION & SPECIAL DET'S.

SHEET NO. 3 OF 5 | BRIDGE NUMBER | DRAWING NUMBER | BRIDGE ENGINEER

S-434-507

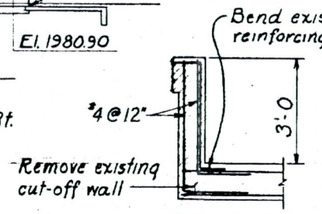
MORRISTOWN-NEW RIVER
MARICOPA COUNTY

TYPE REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZONA	S-434-507	14	15	7-16-74

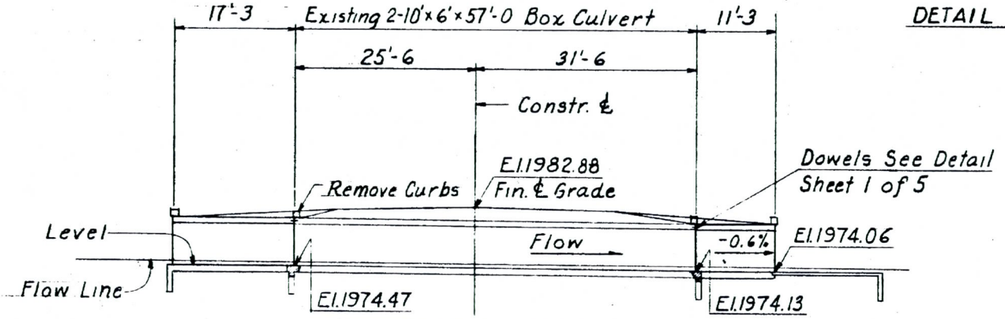


NOTE~ Station 404+
See Standard CI-8-2 for all other barrel details, dimensions and bend diagrams.
See Standard CW-1 for all other headwall details.

STATION 404+
SECTION ON ℄ EXISTING CULVERT
Existing 2-8'x4'x 69'-6 Box Culvert
Extend 7'-0 Rt. 2-8'x7'-0 barrel w/outlet apron Rt.
Scale: 1" = 10'-0



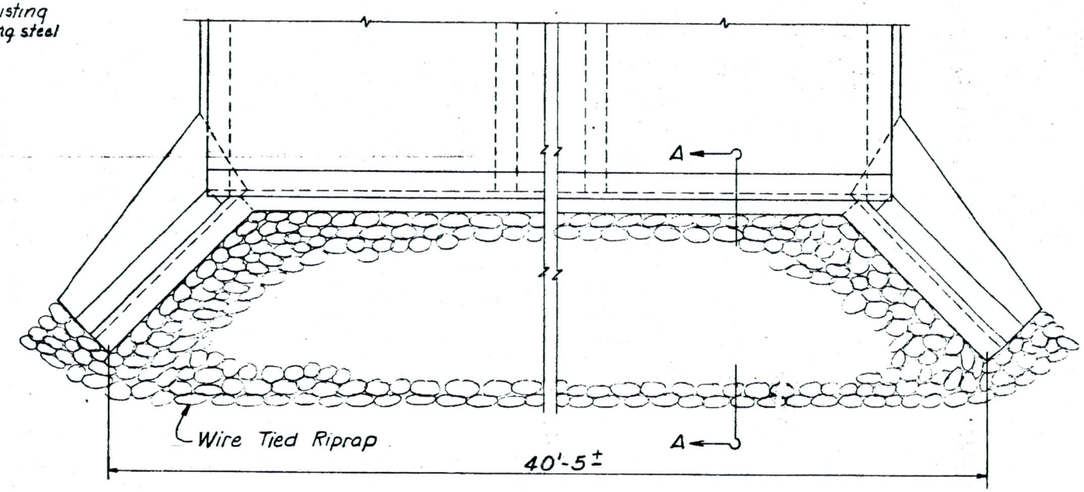
DETAIL A



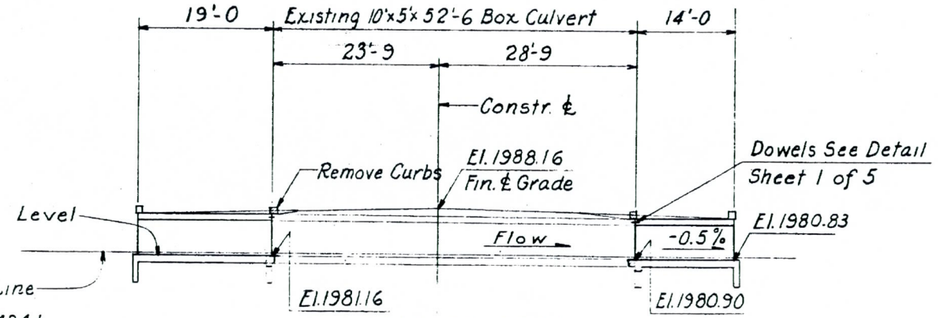
NOTE~ Station 414+
See Standard CI-10-2 for all other barrel details, dimensions, and bend diagrams.
See Standard CW-2 for all other headwall details.

STATION 414+
SECTION ON ℄ EXISTING CULVERT
Existing 2-10'x6'x57'-0 Box Culvert
Extend Lt. 17'-3 and Rt. 11'-3 w/outlet apron Rt.
Scale: 1" = 10'-0

NOTE~ Station 460+
Riprap to be enclosed by 6x6 - #10/10 welded wire fabric. Basket to be connected together with #9 galvanized wire at top and bottom of basket. Top fabric mat to include top and sides and to be connected to bottom mat with #9 galvanized wire. Minimum diameter of stones to be 6 inches.

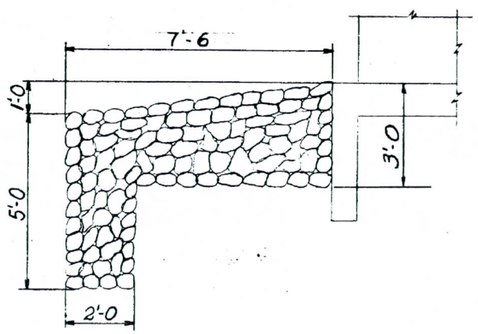


STATION 460+
RIPRAP PLAN
Existing 3-10'x5'x81'-0 Box Culvert
No Scale



NOTE~ Station 484+
See Standard CI-10-1 for all other barrel details, dimensions, and bend diagrams.
See Standard CW-1 for all other headwall details.

STATION 484+
SECTION ON ℄ EXISTING CULVERT
Existing 10'x5'x 52'-6 Box Culvert
Extend Lt. 19'-0 and Rt. 14'-0
Scale: 1" = 10'-0



SECTION A-A
Scale: 1/2" = 1'-0

ALL CONCRETE CLASS 'A'

		DATE
LAYOUT		
DESIGN	APJ	4-72
ARCHITECTURE		
DRAWN	DLC	4-72
TRACED		
CHECKED	MAG	4-72

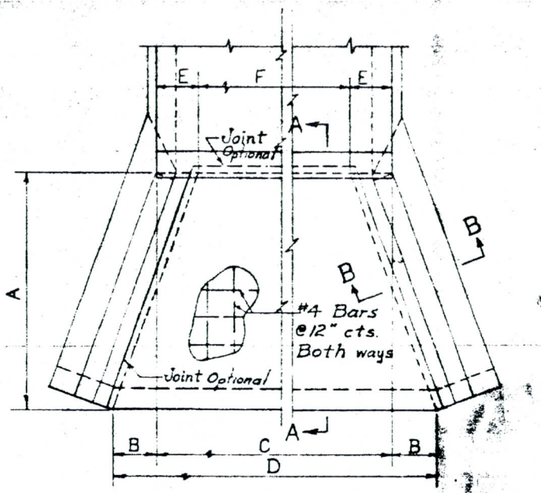
ARIZONA HIGHWAY DEPARTMENT
BRIDGE DIVISION

STATIONS
404+, 414+, 460+, & 484+
LOCATION & SPECIAL DET'S.

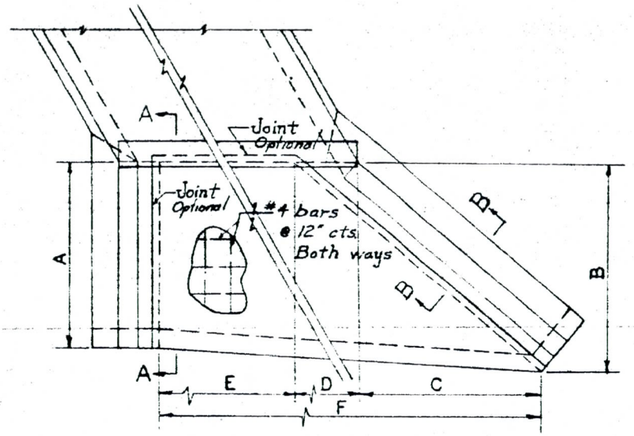
SHEET NO. 4 OF 5
BRIDGE NUMBER
DRAWING NUMBER
BRIDGE ENGINEER

S-434-507

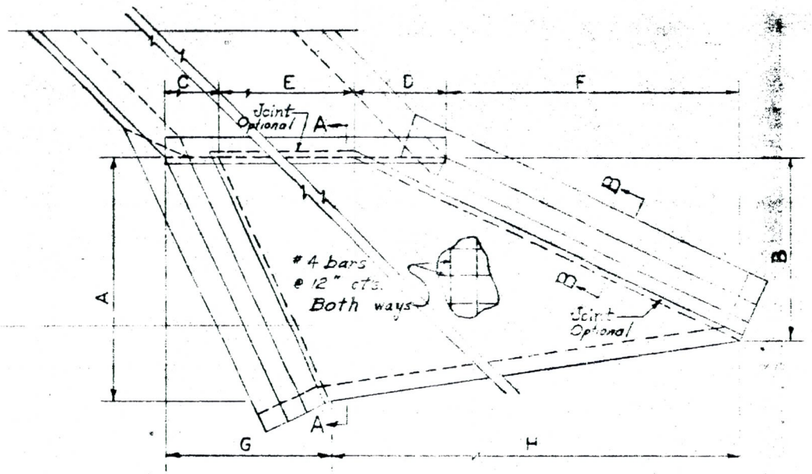
MORRISTOWN-NEW RIVER HWY
MARICOPA COUNTY



PLAN
APRON FOR RIGHT ANGLE BOX CULVERT



PLAN
APRON FOR 30° SKEW BOX CULVERT



PLAN
APRON FOR 45° SKEW BOX CULVERT

TABLE FOR RIGHT ANGLE BOX CULVERT

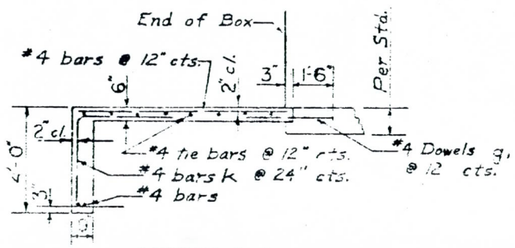
STATION	A	B	C	D	E	F
209+	21'9⅝	5'9¾	33'4	44	1½ 2'1/2	29'1
219+	17'0⅜	4'3⅜	7'4	5'10⅛	1'11⅛	3'5⅛
404+	17'0⅜	4'3⅜	8'3	26'9¼	1'11⅛	14'4¼
414+	15'8	3'9	22'6	30'0	1'11⅛	18'7¼

TABLE FOR 30° SKEW BOX CULVERT

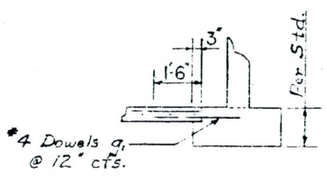
STATION	A	B	C	D	E	F

TABLE FOR 45° SKEW BOX CULVERT

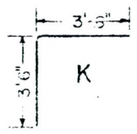
STATION	A	B	C	D	E	F	G	H



SECTION A-A



SECTION B-B



BEND DIAGRAM

FOR GENERAL NOTES SEE SHEET 1 OF 2

ROOT MEAN SQUARE ERROR COMPUTATIONS

Wittmann Phase III Floodplain Delineation Study (FDS)
July 2010
FCDMC Contract 2009C006, Assignment #3

PBS&J

This spreadsheet determines the root mean square error (RMSE) between the ground survey acquired for the Wittmann Phase III FDS and the topographic data provided by FCDMC that was used to complete the hydraulic modeling and floodplain mapping.

According to http://www.math-interactive.com/Products/CalGraph/Help/Fit_Curve_to_Data/Root_Mean_Squared_Error.htm the RMSE of a data set may be computed using the following equation:

$$RMSE = \sqrt{\frac{\sum (f(x_i) - y_i)^2}{n}}$$

where RMSE = root mean square error in feet,
f(xi) = elevation of the TIN at point i in feet,
yi = ground survey point elevation at point i in feet,
n = number of points used to compute RMSE

This equation was applied via the following process:

FCDMC indicated that north of the southern boundary of T6N, R3W, Section 35, their topographic data met the standards for 4-foot contours.

FCDMC indicated that south of the southern boundary of T6N, R3W, Section 35, their topographic data met the standards for 2-foot contours.

Divide the ground survey into two point shapefiles. One shapefile is of points that resided in the 4-ft contour area. The other shapefile is of points that fell in the 2-ft contour area.

For each ground survey point, extract the elevation of the TIN at that point's location.

Review each ground survey point and remove those points that are of the hydraulic structures. The TIN is not accurate at these structures, and including these points would have produced an artificially high RMSE.

Review those points where the ground survey elevation and the TIN elevation differed significantly (i.e. where the square of the difference exceeded 1.0.). Remove those points where the TIN was obviously incorrect, so as in those areas where erosion had occurred between the topo flight date and the ground survey data. Note that only a handful of points were removed from each point shapefile.

Compute the RMSE of the remaining points in the two point shapefiles.
These calculations may be found below.

According to FEMA, Guidelines and Specifications, Appendix A, Table A-2,
the RMSE for 4-ft contours should be less than 1.2 feet.
Likewise, the RMSE for 2-ft contours should be less than 0.6 feet.

Summary of results:

North dataset: RMSE was 1.071 feet, which is less than 1.2 feet. The north dataset meets the standards for 4-ft contour mapping.

Note: North dataset RMSE calculations begin below.

South dataset: RMSE was 0.594 feet, which is less than 0.6 feet. The south dataset meets the standards for 2-ft contour mapping.

Note: South dataset RMSE calculations begin on page 30.

Below are the calculations that determine the RMSE of the north and south datasets.

RMSE determination for north points.

Shapefile: north-points-none-removed.shp = Ground survey and TIN elevations for all points where ground survey was taken in the 4-ft contour area.
Shapefile: north-points-struct-outliers-removed.shp = Take north-points-none-removed.shp and remove those points that were at structures and those few points where the TIN was obviously incorrect.

Point Number	Survey ID	Y	X	Survey Notes	Survey Elev (ft)	Tin_Spot Elev (ft)	Tin Spot Elev minus Survey Elev (ft)	Elevation Difference Squared (sq ft).
1	30156	1038095.656	506013.6033	NG_SPOT	2041.528	2042.376	0.848	0.719
2	30157	1038086.384	506045.5126	NG_BL	2042.754	2042.367	-0.387	0.150
3	30158	1038081.138	506081.3433	NG_BL	2037.825	2038.102	0.277	0.077
4	30188	1037957.32	506072.1741	CTRL_SET_60DNAI	2031.616	2032.085	0.469	0.220
5	30197	1037964.084	506092.0809	CONC_EDGE_AP	2034.976	2034.653	-0.323	0.104
6	30198	1037962.254	506099.1958	CONC_EDGE_AP	2035.441	2035.513	0.072	0.005
7	30202	1037993.689	505980.4505	NG_SPOT	2038.167	2039.454	1.287	1.657
8	30203	1037981.762	506012.6424	NG_SPOT	2036.127	2036.507	0.380	0.144
9	30204	1037971.079	506030.3126	NG_SPOT	2034.044	2034.610	0.567	0.321
10	30205	1037965.601	506042.6549	NG_TOP	2033.289	2033.904	0.615	0.379
11	30206	1037963.997	506048.5095	NG_TOE	2032.180	2033.758	1.578	2.490
12	30207	1037962.187	506060.4768	NG_SPOT	2032.054	2032.704	0.650	0.422
13	30208	1037960.018	506076.6265	NG_SPOT	2031.415	2032.316	0.901	0.812
14	30209	1037958.323	506082.4668	NG_TOE	2031.806	2033.119	1.313	1.724
15	30210	1037950.253	506101.9401	NG_TOP	2036.787	2037.312	0.525	0.276
16	30211	1037932.297	506133.8326	NG_SPOT	2038.246	2039.440	1.194	1.425
17	30212	1037927.217	506171.5092	NG_TOE	2041.092	2041.889	0.796	0.634
18	30213	1037922.281	506204.8121	NG_SPOT	2049.992	2048.796	-1.196	1.431
19	30214	1037931.207	506241.0653	NG_TOP	2054.257	2054.857	0.600	0.360

20	30227	1038049.895	506217.0872	NG_SPOT	2048.808	2050.073	1.265	1.601
21	30228	1038058.6	506189.4798	NG_SPOT	2049.011	2049.202	0.191	0.036
22	30229	1038063.603	506153.123	NG_TOP	2049.670	2049.627	-0.043	0.002
23	30232	1037441.231	509042.3127	CTRL_SET_1/2	2059.198	2058.763	-0.434	0.189
24	30302	1037165.276	510414.9433	NG_SPOT	2048.993	2049.299	0.306	0.093
25	30303	1037175.41	510372.8239	NG_SPOT	2047.248	2047.693	0.445	0.198
26	30304	1037182.214	510344.9971	NG_SPOT	2047.232	2047.794	0.562	0.316
27	30305	1037186.75	510311.5541	NG_SPOT	2047.541	2048.013	0.472	0.223
28	30306	1037190.826	510289.5069	NG_TOP	2046.364	2046.151	-0.213	0.045
29	30307	1037196.966	510267.9966	NG_TOE	2043.817	2044.349	0.532	0.283
30	30308	1037200.625	510257.7076	NG_SPOT	2043.779	2044.114	0.335	0.112
31	30309	1037203.716	510247.2875	NG_SPOT	2043.584	2044.141	0.557	0.310
32	30310	1037205.765	510241.1341	NG_TOE	2043.758	2044.679	0.922	0.849
33	30311	1037207.473	510234.6209	NG_TOP	2045.157	2045.206	0.049	0.002
34	30312	1037219.681	510202.4689	NG_SPOT	2046.463	2046.819	0.356	0.127
35	30313	1037224.072	510161.287	NG_SPOT	2046.222	2046.649	0.426	0.182
36	30314	1037234.573	510113.3701	NG_SPOT	2047.553	2048.106	0.554	0.307
37	30340	1036968.617	510373.2487	NG_SPOT	2046.504	2047.099	0.596	0.355
38	30341	1036980.696	510314.693	NG_SPOT	2043.977	2044.416	0.438	0.192
39	30342	1036994.72	510254.7501	NG_SPOT	2042.874	2042.876	0.002	0.000
40	30343	1037000.061	510229.5232	NG_TOP	2043.240	2041.627	-1.612	2.600
41	30344	1036999.895	510223.3354	NG_TOE	2039.981	2040.818	0.838	0.702
42	30345	1037006.98	510209.0557	NG_SPOT	2040.084	2039.916	-0.167	0.028
43	30346	1037013.2	510193.9732	NG_SPOT	2039.871	2039.798	-0.073	0.005
44	30347	1037014.507	510176.1821	NG_TOE	2040.742	2040.258	-0.484	0.234
45	30348	1037017.023	510165.7365	NG_TOP	2042.902	2041.625	-1.278	1.633
46	30349	1037020.776	510136.8291	NG_SPOT	2043.372	2042.812	-0.561	0.314
47	30350	1037030.161	510087.1104	NG_SPOT	2042.646	2042.334	-0.313	0.098
48	30351	1037039.046	510051.4321	NG_SPOT	2042.420	2042.216	-0.204	0.042
49	30352	1037046.998	510014.7771	NG_SPOT	2044.165	2043.138	-1.027	1.055
50	30361	1030022.084	508820.338	NG_SPOT	1921.085	1921.696	0.612	0.374
51	30362	1030028.44	508826.3885	DIRTRD_EDGE	1920.842	1921.396	0.554	0.307
52	30363	1030034.29	508833.5524	DIRTRD_EDGE	1920.521	1921.098	0.577	0.333
53	30364	1030035.855	508863.176	NG_SPOT	1919.484	1919.516	0.032	0.001
54	30365	1030031.725	508902.8169	NG_SPOT	1920.210	1920.924	0.714	0.510
55	30366	1030023.515	508938.6975	NG_SPOT	1920.486	1920.697	0.211	0.045
56	30367	1030028.672	508966.9482	NG_SPOT	1920.469	1920.540	0.071	0.005
57	30368	1030036.054	508972.8648	NG_TOP	1920.055	1920.294	0.239	0.057
58	30369	1032725.908	508359.8593	CTRL_SET_1/2	1966.060	1966.429	0.369	0.136
59	30371	1032699.309	508347.5473	CTRL_SET_1/2	1964.871	1964.642	-0.228	0.052
60	30375	1030042.707	508977.7039	NG_TOE	1919.268	1920.022	0.754	0.568
61	30376	1030050.734	508981.6788	NG_SPOT	1919.461	1919.788	0.327	0.107
62	30377	1030070.457	508997.1451	NG_SPOT	1920.293	1920.214	-0.079	0.006
63	30378	1030086.19	509010.4533	NG_SPOT	1919.972	1920.440	0.468	0.219

64	30379	1030094.91	509016.3833	NG_TOP	1920.075	1920.222	0.146	0.021
65	30380	1030098.337	509018.8708	NG_TOE	1919.654	1920.023	0.369	0.136
66	30381	1030108.955	509026.7365	NG_SPOT	1919.878	1919.569	-0.309	0.095
67	30382	1030116.971	509033.0725	NG_TOE	1920.021	1919.756	-0.264	0.070
68	30383	1030125.999	509041.6453	NG_TOP	1921.027	1921.419	0.392	0.154
69	30384	1030124.731	509078.1302	NG_SPOT	1920.770	1920.728	-0.042	0.002
70	30385	1030126.788	509089.1951	NG_TOE	1920.114	1920.302	0.189	0.036
71	30386	1030128.366	509117.6846	NG_TOP	1925.693	1924.548	-1.144	1.310
72	30387	1030117.193	509129.5873	NG_SPOT	1925.506	1925.219	-0.287	0.082
73	30388	1030192.487	508901.2124	NG_SPOT	1924.244	1925.211	0.968	0.936
74	30389	1030193.887	508905.8582	NG_TOP	1923.609	1924.849	1.240	1.537
75	30390	1030189.375	508917.5672	NG_TOE	1921.212	1923.472	2.261	5.111
76	30391	1030190.196	508921.0393	NG_SPOT	1921.087	1923.187	2.100	4.408
77	30392	1030196.865	508924.8795	NG_TOE	1921.268	1923.203	1.935	3.745
78	30393	1030196.893	508928.0223	NG_TOP	1922.112	1923.164	1.052	1.107
79	30394	1030199.886	508931.0093	NG_SPOT	1922.203	1923.156	0.953	0.909
80	30395	1030206.294	508939.2278	NG_SPOT	1922.224	1923.116	0.892	0.795
81	30398	1030230.978	508938.8488	NG_TOE	1922.120	1923.234	1.115	1.242
82	30399	1030232.151	508941.8426	NG_TOP	1922.795	1923.194	0.399	0.159
83	30400	1030239.512	508951.5787	NG_SPOT	1923.034	1922.880	-0.154	0.024
84	30401	1030243.106	508955.1078	NG_TOP	1923.127	1922.469	-0.659	0.434
85	30402	1030247.104	508960.1004	NG_TOE	1921.509	1921.938	0.429	0.184
86	30403	1030246.628	508972.1263	NG_SPOT	1921.441	1921.516	0.075	0.006
87	30404	1030250.851	508984.2458	NG_TOE	1920.760	1921.898	1.138	1.294
88	30405	1030252.402	508988.8637	NG_TOP	1923.001	1922.415	-0.586	0.344
89	30406	1030248.616	509023.4269	NG_SPOT	1922.659	1923.412	0.753	0.567
90	30407	1030276.089	509063.5306	NG_SPOT	1922.510	1922.916	0.406	0.165
91	30408	1030286.008	509080.0385	NG_TOE	1921.892	1922.877	0.985	0.971
92	30409	1030295.937	509119.821	NG_TOP	1927.845	1927.836	-0.009	0.000
93	30410	1030280.475	509151.7966	NG_SPOT	1927.411	1927.940	0.528	0.279
94	30411	1030529.383	508743.9304	NG_SPOT	1929.641	1929.252	-0.388	0.151
95	30412	1030536.327	508768.6319	NG_SPOT	1929.087	1928.055	-1.032	1.066
96	30413	1030535.034	508783.927	NG_TOP	1928.657	1926.576	-2.082	4.334
97	30414	1030532.415	508798.8791	NG_TOE	1924.600	1924.579	-0.021	0.000
98	30415	1030535.038	508808.535	NG_SPOT	1924.767	1925.003	0.236	0.056
99	30416	1030538.084	508818.0695	NG_TOE	1925.102	1925.527	0.425	0.181
100	30417	1030541.331	508827.8688	NG_TOP	1927.105	1926.593	-0.513	0.263
101	30418	1030532.436	508867.8189	NG_SPOT	1926.298	1927.785	1.488	2.213
102	30419	1030534.135	508920.2104	NG_SPOT	1926.571	1927.719	1.148	1.318
103	30420	1030531.38	508974.3512	NG_SPOT	1926.433	1926.904	0.471	0.222
104	30421	1030532.065	509022.0878	NG_SPOT	1926.520	1926.208	-0.312	0.097
105	30422	1030534.886	509073.2755	NG_SPOT	1928.329	1928.302	-0.026	0.001
106	30423	1030531.795	509123.0975	NG_SPOT	1930.877	1932.168	1.291	1.666
107	30424	1031540.245	508904.5024	NG_SPOT	1944.467	1944.405	-0.062	0.004

108	30425	1031560.79	508936.7706	NG_SPOT	1941.961	1943.145	1.185	1.403
109	30426	1031564.542	508954.0047	NG_TOP	1940.968	1940.851	-0.117	0.014
110	30427	1031566.604	508957.4656	NG_TOE	1939.278	1940.609	1.331	1.772
111	30428	1031570.602	508963.0871	NG_TOE	1939.725	1941.073	1.348	1.817
112	30429	1031571.685	508967.937	NG_TOP	1940.176	1941.350	1.174	1.379
113	30430	1031573.473	508980.439	NG_SPOT	1939.967	1941.563	1.596	2.546
114	30431	1031561.626	509006.0331	NG_SPOT	1940.801	1941.664	0.863	0.745
115	30432	1031542.751	509024.2127	NG_TOP	1941.144	1940.844	-0.300	0.090
116	30433	1031538.601	509029.9695	NG_TOE	1939.480	1940.473	0.993	0.987
117	30434	1031539.422	509042.1228	NG_SPOT	1939.187	1939.792	0.606	0.367
118	30435	1031539.019	509069.5238	NG_TOE	1939.347	1940.041	0.694	0.482
119	30436	1031535.388	509075.5579	NG_TOP	1941.137	1940.871	-0.266	0.071
120	30437	1031533.213	509088.4805	NG_SPOT	1940.885	1941.186	0.301	0.091
121	30438	1031800.889	508608.4872	NG_SPOT	1948.971	1950.098	1.127	1.270
122	30439	1031847.288	508655.3012	NG_SPOT	1948.801	1949.537	0.736	0.542
123	30440	1031875.364	508679.2224	NG_TOP	1947.559	1947.964	0.405	0.164
124	30441	1031878.265	508682.0869	NG_TOE	1946.116	1947.671	1.556	2.420
125	30442	1031883.417	508687.5116	NG_SPOT	1946.467	1946.937	0.470	0.221
126	30443	1031888.185	508692.5152	NG_TOE	1946.654	1947.281	0.627	0.393
127	30444	1031892.126	508697.2484	NG_TOP	1947.690	1947.922	0.232	0.054
128	30445	1031910.135	508710.9712	NG_SPOT	1948.042	1948.753	0.711	0.505
129	30446	1031908.015	508725.6601	NG_SPOT	1947.819	1948.580	0.761	0.578
130	30447	1031937.014	508750.4988	NG_SPOT	1948.467	1948.393	-0.075	0.006
131	30448	1031975.584	508804.2095	NG_SPOT	1947.781	1948.308	0.527	0.278
132	30449	1031984.379	508841.2513	NG_TOP	1947.699	1947.552	-0.147	0.022
133	30450	1031985.393	508843.6	NG_TOE	1945.823	1947.369	1.546	2.390
134	30451	1031985.737	508849.8376	NG_SPOT	1945.851	1946.932	1.081	1.168
135	30452	1031986.912	508855.419	NG_TOE	1946.113	1946.983	0.870	0.757
136	30453	1031989.939	508859.9916	NG_TOP	1947.709	1947.129	-0.580	0.336
137	30454	1032001.591	508901.1769	NG_SPOT	1948.395	1947.913	-0.482	0.232
138	30455	1031998.409	508953.431	NG_SPOT	1947.311	1948.278	0.967	0.935
139	30456	1032011.38	508978.348	NG_TOP	1946.613	1947.776	1.163	1.353
140	30457	1032015.96	508984.6482	NG_TOE	1945.329	1946.674	1.344	1.807
141	30458	1032018.938	508989.9694	NG_TOE	1945.189	1947.144	1.956	3.825
142	30459	1032020.667	508993.865	NG_TOP	1947.479	1948.044	0.565	0.320
143	30460	1032007.075	509031.9948	NG_BL	1953.184	1953.541	0.357	0.127
144	30463	1040569.471	509767.8911	NG_SPOT	2109.870	2109.365	-0.504	0.254
145	30464	1040562.382	509818.1171	NG_SPOT	2107.927	2108.402	0.475	0.225
146	30465	1040554.663	509867.5131	NG_SPOT	2108.013	2108.208	0.196	0.038
147	30466	1040548.704	509910.6548	NG_TOP	2107.300	2106.415	-0.884	0.782
148	30467	1040548.178	509914.505	NG_TOE	2105.705	2105.874	0.169	0.029
149	30468	1040547.676	509922.5182	NG_SPOT	2105.981	2105.265	-0.715	0.512
150	30469	1040546.297	509928.7033	NG_TOE	2105.983	2105.318	-0.665	0.443
151	30470	1040546.123	509930.6004	NG_TOP	2106.700	2105.343	-1.357	1.842

152	30471	1040542.035	509949.617	NG_TOP	2107.126	2105.569	-1.556	2.422
153	30472	1040541.61	509953.0164	NG_TOE	2105.572	2105.614	0.042	0.002
154	30473	1040541.348	509959.7689	NG_SPOT	2105.480	2105.769	0.290	0.084
155	30474	1040540.038	509964.2937	NG_TOE	2105.625	2106.164	0.539	0.290
156	30475	1040539.433	509969.0866	NG_TOP	2106.912	2106.591	-0.320	0.103
157	30476	1040535.327	510015.5904	NG_SPOT	2109.306	2108.919	-0.387	0.150
158	30477	1040525.802	510063.7563	NG_SPOT	2107.487	2108.491	1.004	1.009
159	30478	1040521.57	510116.6767	NG_SPOT	2107.030	2108.262	1.232	1.518
160	30479	1040517.659	510140.1291	NG_SPOT	2108.059	2108.748	0.689	0.475
161	30480	1040497.516	510154.4738	NG_TOP	2107.563	2107.614	0.050	0.003
162	30481	1040496.352	510156.2808	NG_TOE	2106.511	2107.327	0.816	0.665
163	30482	1040493.361	510161.7332	NG_SPOT	2106.593	2107.026	0.434	0.188
164	30483	1040493.267	510161.7595	NG_SPOT	2106.571	2107.031	0.460	0.212
165	30484	1040486.332	510163.5734	NG_TOE	2106.517	2107.397	0.880	0.775
166	30485	1040484.125	510166.3069	NG_TOP	2108.054	2107.616	-0.438	0.192
167	30486	1040472.122	510170.9692	NG_SPOT	2107.642	2107.664	0.022	0.001
168	30487	1040465.291	510209.2613	NG_SPOT	2107.030	2106.277	-0.753	0.567
169	30488	1040458.043	510259.6517	NG_SPOT	2107.302	2107.483	0.181	0.033
170	30489	1040449.787	510301.1169	NG_SPOT	2109.097	2108.928	-0.169	0.029
171	30490	1039897.448	510264.6966	NG_SPOT	2098.534	2098.984	0.450	0.203
172	30491	1039914.246	510220.177	NG_SPOT	2097.901	2097.590	-0.311	0.097
173	30492	1039934.292	510171.6153	NG_SPOT	2096.950	2097.091	0.141	0.020
174	30493	1039951.561	510124.8747	NG_SPOT	2098.322	2098.088	-0.233	0.054
175	30494	1039957.907	510110.3477	NG_SPOT	2098.653	2098.092	-0.561	0.315
176	30495	1039961.024	510060.4447	NG_SPOT	2097.148	2096.313	-0.835	0.698
177	30496	1039961.408	510053.731	NG_TOP	2097.050	2096.102	-0.948	0.898
178	30497	1039963.891	510049.7783	NG_TOE	2096.114	2095.969	-0.145	0.021
179	30498	1039966.73	510045.1053	NG_SPOT	2096.146	2095.813	-0.334	0.111
180	30499	1039969.952	510037.1841	NG_TOP	2096.795	2096.702	-0.093	0.009
181	30500	1039967.767	510010.4011	NG_SPOT	2096.969	2096.964	-0.006	0.000
182	30501	1039973.79	509960.9355	NG_SPOT	2096.816	2096.646	-0.169	0.029
183	30502	1039976.074	509911.6154	NG_SPOT	2097.369	2097.633	0.264	0.070
184	30503	1039974.585	509889.3928	NG_SPOT	2097.452	2097.905	0.453	0.205
185	30504	1039979.812	509887.3769	NG_TOP	2097.561	2097.575	0.014	0.000
186	30505	1039984.139	509884.6163	NG_TOE	2096.106	2097.178	1.072	1.149
187	30506	1039984.604	509876.4562	NG_SPOT	2095.822	2096.246	0.424	0.180
188	30507	1039989.384	509867.6908	NG_TOE	2095.934	2096.221	0.287	0.082
189	30508	1039993.335	509863.3601	NG_TOP	2097.506	2096.882	-0.623	0.388
190	30509	1039993.638	509842.2834	NG_SPOT	2097.528	2097.899	0.371	0.138
191	30510	1039977.118	509802.4675	NG_TOP	2095.916	2094.945	-0.971	0.944
192	30511	1039963.925	509766.8998	NG_TOP	2102.425	2101.091	-1.334	1.780
193	30512	1039957.043	509750.4765	NG_SPOT	2103.507	2102.776	-0.732	0.535
194	30513	1039936.622	509698.8669	NG_SPOT	2104.614	2104.544	-0.070	0.005
195	30514	1039212.215	509934.0479	NG_SPOT	2090.119	2089.775	-0.344	0.118

196	30515	1039214.088	509985.3113	NG_SPOT	2084.475	2085.178	0.704	0.495
197	30516	1039216.274	509999.6451	NG_TOP	2084.235	2083.661	-0.573	0.329
198	30517	1039217.125	510004.222	NG_TOE	2082.137	2083.035	0.898	0.806
199	30518	1039217.791	510016.448	NG_SPOT	2081.926	2082.385	0.460	0.211
200	30519	1039219.265	510025.011	NG_TOE	2081.998	2082.818	0.820	0.673
201	30520	1039220.217	510030.5892	NG_TOP	2084.222	2083.329	-0.893	0.798
202	30521	1039220.277	510056.3612	NG_SPOT	2084.041	2083.321	-0.721	0.519
203	30522	1039234.432	510090.1767	NG_TOP	2083.093	2083.007	-0.086	0.007
204	30523	1039237.023	510091.3935	NG_TOE	2081.564	2083.035	1.471	2.163
205	30524	1039241.292	510093.4135	NG_TOE	2081.680	2083.126	1.446	2.091
206	30525	1039242.607	510098.7676	NG_TOP	2083.159	2083.447	0.288	0.083
207	30526	1039244.974	510108.5365	NG_TOP	2082.740	2083.218	0.477	0.228
208	30527	1039244.678	510110.0748	NG_TOE	2081.411	2083.039	1.629	2.652
209	30528	1039249.605	510116.9556	NG_SPOT	2081.486	2082.637	1.151	1.324
210	30529	1039252.896	510122.689	NG_TOE	2081.329	2083.113	1.784	3.182
211	30530	1039253.942	510125.9996	NG_TOP	2082.915	2083.362	0.447	0.200
212	30531	1039262.878	510144.7062	NG_SPOT	2084.482	2084.681	0.199	0.040
213	30532	1039284.495	510190.3621	NG_SPOT	2083.742	2084.659	0.917	0.842
214	30533	1039296.897	510218.9314	NG_SPOT	2085.121	2085.259	0.138	0.019
215	30534	1039321.895	510261.2653	NG_SPOT	2085.642	2085.586	-0.056	0.003
216	30535	1039347.817	510306.5661	NG_SPOT	2086.919	2086.837	-0.082	0.007
217	30536	1039358.339	510319.5998	NG_SPOT	2086.975	2087.121	0.146	0.021
218	30537	1038878.216	510129.7465	NG_SPOT	2079.841	2080.386	0.545	0.297
219	30538	1038896.434	510087.1693	NG_SPOT	2079.689	2079.584	-0.104	0.011
220	30539	1038915.751	510039.6797	NG_TOP	2079.397	2079.524	0.126	0.016
221	30542	1038926.784	510015.6834	NG_TOE	2077.460	2078.412	0.952	0.907
222	30543	1038927.76	510012.781	NG_TOP	2078.950	2078.082	-0.868	0.754
223	30544	1038935.797	509993.542	NG_SPOT	2078.322	2076.930	-1.392	1.939
224	30545	1038943.04	509979.6622	NG_TOE	2078.619	2078.286	-0.333	0.111
225	30546	1038958.036	509947.7514	NG_TOP	2084.090	2083.644	-0.446	0.199
226	30547	1038975.266	509907.5412	NG_SPOT	2085.573	2085.552	-0.020	0.000
227	30548	1038633.894	510233.1545	NG_SPOT	2074.177	2075.251	1.075	1.155
228	30549	1038654.739	510272.0965	NG_TOP	2073.782	2073.366	-0.416	0.173
229	30550	1038656.011	510276.5522	NG_TOE	2071.591	2072.551	0.960	0.921
230	30551	1038659.395	510281.9237	NG_SPOT	2071.434	2071.481	0.047	0.002
231	30552	1038661.061	510287.7498	NG_TOE	2071.550	2071.461	-0.089	0.008
232	30553	1038663.012	510292.9149	NG_TOP	2073.018	2071.450	-1.568	2.460
233	30554	1038666.698	510300.5014	NG_SPOT	2073.553	2071.445	-2.109	4.446
234	30555	1038669.734	510308.4116	NG_TOP	2073.346	2071.434	-1.911	3.654
235	30556	1038672.415	510313.2991	NG_TOE	2071.465	2071.441	-0.024	0.001
236	30557	1038676.398	510319.2492	NG_TOE	2071.423	2071.730	0.307	0.094
237	30558	1038676.533	510321.6281	NG_TOP	2072.194	2071.876	-0.318	0.101
238	30559	1038687.043	510342.1384	NG_SPOT	2073.657	2072.594	-1.063	1.131
239	30560	1038706.933	510379.861	NG_TOP	2072.356	2071.463	-0.892	0.796

240	30561	1038707.827	510382.3428	NG_TOE	2071.500	2071.295	-0.204	0.042
241	30562	1038713.782	510396.2583	NG_TOE	2071.139	2072.510	1.371	1.880
242	30563	1038714.522	510402.9475	NG_TOP	2073.746	2074.276	0.531	0.282
243	30564	1038738.996	510446.2909	NG_SPOT	2075.267	2075.033	-0.234	0.055
244	30565	1038777.76	510524.7577	NG_SPOT	2076.047	2076.701	0.654	0.428
245	30566	1038432.298	510510.0765	NG_TOE	2066.124	2066.581	0.457	0.209
246	30567	1038432.294	510517.0837	NG_TOP	2067.682	2067.155	-0.527	0.277
247	30568	1038424.21	510560.9376	NG_SPOT	2069.674	2069.558	-0.116	0.013
248	30569	1038419.657	510608.9803	NG_SPOT	2069.889	2070.180	0.291	0.085
249	30570	1038428.533	510483.5659	NG_SPOT	2066.059	2067.915	1.855	3.443
250	30571	1038417.509	510448.3944	NG_TOE	2067.456	2067.746	0.290	0.084
251	30572	1038411.497	510440.0474	NG_TOP	2068.212	2068.419	0.207	0.043
252	30573	1038397.39	510388.5593	NG_SPOT	2069.173	2069.436	0.263	0.069
253	30574	1038382.468	510339.6838	NG_SPOT	2069.136	2069.063	-0.072	0.005
254	30575	1038367.291	510292.4001	NG_SPOT	2069.155	2069.484	0.329	0.108
255	30576	1038354.238	510245.3634	NG_SPOT	2068.073	2067.454	-0.620	0.384
256	30577	1038335.729	510189.1032	NG_SPOT	2069.534	2069.714	0.179	0.032
257	30578	1037313.015	510451.8322	NG_SPOT	2051.836	2051.172	-0.663	0.440
258	30579	1037321.603	510403.4061	NG_SPOT	2050.601	2050.350	-0.252	0.063
259	30580	1037331.143	510356.365	NG_SPOT	2051.586	2050.723	-0.863	0.745
260	30581	1037341.187	510308.8032	NG_TOP	2048.125	2048.295	0.171	0.029
261	30582	1037342.846	510302.7	NG_TOE	2046.816	2047.735	0.919	0.844
262	30583	1037343.906	510285.0076	NG_SPOT	2045.146	2045.550	0.404	0.163
263	30584	1037344.621	510274.4433	NG_TOE	2044.393	2044.901	0.508	0.258
264	30585	1037348.283	510261.2749	NG_TOP	2047.994	2047.745	-0.249	0.062
265	30586	1037348.672	510252.6835	NG_SPOT	2048.313	2048.197	-0.117	0.014
266	30587	1037353.865	510203.4195	NG_SPOT	2049.888	2048.995	-0.892	0.796
267	30588	1037362.533	510154.6384	NG_SPOT	2050.203	2049.518	-0.685	0.469
268	30589	1037365.836	510119.0656	NG_SPOT	2050.471	2050.115	-0.356	0.126
269	30590	1037549.535	510166.6973	NG_SPOT	2053.821	2054.146	0.325	0.106
270	30591	1037544.41	510215.6186	NG_SPOT	2053.484	2053.657	0.173	0.030
271	30592	1037535.998	510265.2979	NG_SPOT	2053.377	2053.057	-0.320	0.102
272	30593	1037533.564	510289.3464	NG_TOP	2051.748	2051.410	-0.338	0.114
273	30594	1037531.943	510299.322	NG_TOE	2048.674	2049.521	0.847	0.717
274	30595	1037526.214	510312.2829	NG_SPOT	2048.423	2048.082	-0.341	0.116
275	30596	1037520.208	510326.4056	NG_TOE	2048.562	2049.916	1.355	1.835
276	30597	1037520.988	510335.978	NG_TOP	2051.595	2050.937	-0.658	0.433
277	30598	1037524.414	510363.7102	NG_SPOT	2054.593	2053.911	-0.682	0.465
278	30599	1037515.66	510417.4706	NG_SPOT	2055.286	2054.600	-0.686	0.470
279	30600	1037727.134	510431.5735	NG_SPOT	2058.944	2058.249	-0.695	0.483
280	30601	1037733.162	510381.3494	NG_SPOT	2055.217	2053.841	-1.376	1.892
281	30602	1037745.29	510330.2316	NG_TOP	2053.501	2052.634	-0.867	0.751
282	30603	1037742.567	510318.4231	NG_TOE	2052.220	2052.149	-0.071	0.005
283	30604	1037744.141	510307.8943	NG_SPOT	2052.338	2052.083	-0.255	0.065

284	30605	1037745.213	510297.4043	NG_TOE	2052.134	2053.767	1.633	2.668
285	30606	1037746.537	510289.1861	NG_TOP	2055.846	2055.112	-0.734	0.538
286	30607	1037747.293	510282.6415	NG_TOP	2055.062	2054.994	-0.068	0.005
287	30608	1037748.677	510276.8844	NG_TOE	2052.972	2054.486	1.514	2.292
288	30609	1037749.168	510274.3481	NG_TOE	2052.878	2053.973	1.095	1.200
289	30610	1037749.316	510269.623	NG_TOP	2055.215	2055.183	-0.032	0.001
290	30611	1037755.292	510233.7103	NG_SPOT	2057.565	2056.850	-0.716	0.512
291	30612	1037757.361	510209.8985	NG_SPOT	2059.090	2057.959	-1.131	1.279
292	30613	1038119.349	510034.9866	NG_SPOT	2065.626	2065.588	-0.038	0.001
293	30614	1038134.205	509989.8949	NG_SPOT	2065.480	2065.121	-0.359	0.129
294	30615	1038142.471	509963.0947	NG_TOE	2063.958	2062.253	-1.705	2.907
295	30616	1038140.821	509965.0152	NG_TOP	2064.447	2062.142	-2.304	5.309
296	30617	1038145.118	509953.8108	NG_SPOT	2063.919	2062.917	-1.002	1.003
297	30618	1038152.255	509939.7323	NG_TOP	2064.910	2063.963	-0.947	0.897
298	30619	1038162.272	509891.956	NG_SPOT	2064.799	2065.460	0.662	0.438
299	30620	1038178.289	509845.9792	NG_SPOT	2068.311	2066.171	-2.140	4.578
300	30621	1038185.383	509817.9763	NG_SPOT	2068.495	2067.253	-1.242	1.542
301	30622	1038062.426	509862.8418	NG_SPOT	2063.018	2063.507	0.489	0.239
302	30623	1038063.805	509911.4258	NG_SPOT	2062.911	2061.063	-1.848	3.414
303	30624	1038066.33	509935.4665	WASH_EDGE	2063.321	2061.639	-1.682	2.828
304	30625	1038063.21	509960.9746	NG_SPOT	2062.553	2061.892	-0.661	0.437
305	30626	1038062.596	509986.1475	NG_SPOT	2062.150	2061.718	-0.432	0.187
306	30627	1038063.554	510006.4356	WASH_EDGE	2061.959	2061.109	-0.849	0.721
307	30628	1038063.917	510111.8945	NG_SPOT	2059.100	2057.467	-1.633	2.666
308	30629	1038064.308	510158.1604	NG_TOE	2058.663	2058.727	0.064	0.004
309	30630	1038065.629	510177.2607	NG_TOP	2062.866	2062.401	-0.465	0.216
310	30631	1038066.411	510196.9525	NG_SPOT	2062.499	2062.133	-0.366	0.134
311	30632	1037701.985	510188.7156	NG_SPOT	2056.934	2056.710	-0.224	0.050
312	30633	1037701.976	510177.653	NG_TOP	2057.438	2056.969	-0.469	0.220
313	30634	1037701.014	510168.3793	NG_TOE	2054.609	2053.972	-0.637	0.406
314	30635	1037699.937	510138.4639	NG_SPOT	2054.397	2053.604	-0.793	0.629
315	30636	1037700.25	510089.2771	NG_SPOT	2055.087	2053.968	-1.120	1.254
316	30637	1037697.949	510037.448	NG_SPOT	2054.952	2054.348	-0.603	0.364
317	30638	1037695.497	509988.4453	NG_SPOT	2053.535	2052.793	-0.741	0.550
318	30639	1037694.711	509936.8451	NG_SPOT	2053.238	2052.364	-0.874	0.764
319	30640	1037692.913	509888.8016	NG_SPOT	2053.598	2053.092	-0.506	0.256
320	30641	1037693.611	509876.4113	NG_TOE	2054.117	2053.323	-0.794	0.631
321	30642	1037693.146	509861.7105	NG_TOP	2056.628	2055.247	-1.381	1.908
322	30643	1037690.885	509847.8784	NG_SPOT	2056.071	2056.628	0.558	0.311
323	30644	1037581.794	509856.3881	NG_SPOT	2055.665	2055.644	-0.021	0.000
324	30645	1037580.966	509904.7324	NG_SPOT	2055.484	2054.475	-1.010	1.019
325	30646	1037581.462	509955.9092	NG_SPOT	2056.431	2055.814	-0.617	0.381
326	30647	1037582.912	510006.9749	NG_SPOT	2056.119	2055.074	-1.044	1.090
327	30648	1037583.045	510055.8153	NG_SPOT	2053.862	2054.091	0.229	0.052

328	30649	1037575.706	510108.9353	NG_TOP	2054.396	2053.128	-1.267	1.606
329	30650	1037574.887	510112.2709	NG_TOE	2052.009	2052.806	0.797	0.635
330	30651	1037575.038	510117.7969	NG_TOE	2052.304	2052.721	0.417	0.174
331	30652	1037574.152	510120.2686	NG_TOP	2054.163	2053.072	-1.091	1.191
332	30653	1037570.423	510132.8258	NG_SPOT	2054.325	2054.130	-0.194	0.038
333	30655	1038253.098	506121.1144	NG_SPOT	2056.574	2054.903	-1.671	2.793
334	30656	1038214.492	506160.511	NG_SPOT	2044.479	2044.974	0.495	0.245
335	30657	1038027.094	506311.5837	CTRL_SET_1/2	2053.573	2053.488	-0.085	0.007
336	30662	1037170.857	509654.6338	NG_SPOT	2045.325	2045.392	0.068	0.005
337	30663	1037158.814	509701.4469	NG_SPOT	2043.198	2043.291	0.093	0.009
338	30667	1037149.119	509751.1366	NG_SPOT	2043.685	2043.885	0.200	0.040
339	30668	1037135.617	509798.5773	NG_SPOT	2045.836	2045.883	0.047	0.002
340	30669	1037126.371	509848.3439	NG_SPOT	2045.884	2046.091	0.207	0.043
341	30670	1037122.65	509863.743	NG_SPOT	2046.098	2046.027	-0.071	0.005
342	30671	1037242.045	509886.4799	NG_SPOT	2049.132	2049.802	0.670	0.449
343	30672	1037252.603	509839.5881	NG_SPOT	2048.197	2049.196	0.999	0.998
344	30673	1037260.387	509788.9811	NG_SPOT	2046.811	2047.513	0.702	0.492
345	30676	1037266.596	509760.0441	WASH_EDGE	2045.816	2046.245	0.429	0.184
346	30677	1037269.181	509747.1231	NG_SPOT	2045.824	2046.011	0.188	0.035
347	30678	1037271.233	509726.8199	WASH_EDGE	2046.557	2046.464	-0.093	0.009
348	30679	1037277.218	509691.3381	NG_SPOT	2047.816	2047.322	-0.495	0.245
349	30680	1037282.886	509653.3858	NG_SPOT	2049.156	2048.237	-0.919	0.845
350	30687	1038097.968	506272.6127	NG_SPOT	2053.082	2052.215	-0.867	0.751
351	30688	1038111.751	506259.1626	NG_BL	2051.268	2050.486	-0.782	0.612
352	30689	1038133.217	506237.2085	NG_SPOT	2041.075	2043.383	2.307	5.325
353	30690	1038152.807	506220.9479	NG_TOE	2035.360	2037.734	2.374	5.636
354	30691	1038151.426	506222.8381	NG_TOP	2037.048	2038.263	1.215	1.477
355	30692	1038154.999	506217.5479	NG_SPOT	2035.284	2036.823	1.538	2.367
356	30693	1038158.433	506214.0558	NG_TOE	2035.674	2036.298	0.624	0.390
357	30694	1038160.76	506209.7179	NG_TOP	2037.756	2036.488	-1.269	1.610
358	30695	1038169.093	506203.5522	NG_SPOT	2037.871	2036.975	-0.895	0.802
359	30696	1038178.913	506195.3552	NG_TOP	2037.254	2037.569	0.316	0.100
360	30697	1038180.456	506192.9355	NG_TOE	2036.620	2037.697	1.077	1.160
361	30698	1038182.316	506188.8166	NG_SPOT	2035.868	2037.892	2.024	4.096
362	30699	1038186.27	506185.289	NG_TOE	2035.919	2038.158	2.240	5.016
363	30700	1038187.349	506183.5235	NG_TOP	2037.673	2038.254	0.581	0.337
364	30701	1038207.561	506388.7654	NG_SPOT	2058.803	2058.629	-0.173	0.030
365	30702	1038218.762	506377.036	NG_BL	2057.568	2056.548	-1.020	1.040
366	30703	1038242.6	506356.8567	NG_SPOT	2048.776	2048.167	-0.610	0.372
367	30704	1038256.666	506342.6712	NG_TOP	2042.774	2042.917	0.143	0.020
368	30705	1038264.422	506337.7093	NG_TOE	2038.285	2040.434	2.150	4.621
369	30706	1038270.303	506332.9086	NG_SPOT	2038.077	2038.496	0.419	0.176
370	30708	1038275.315	506329.2268	NG_TOE	2038.293	2039.467	1.174	1.379
371	30709	1038279.254	506325.7502	NG_TOP	2040.267	2040.274	0.006	0.000

372	30710	1038296.592	506307.5533	NG_SPOT	2040.198	2040.079	-0.119	0.014
373	30711	1038305.933	506299.6374	NG_TOE	2040.558	2040.999	0.441	0.195
374	30712	1038327.792	506277.8673	NG_BL	2050.543	2048.105	-2.437	5.940
375	30713	1038358.266	506252.6522	NG_BL	2057.391	2056.006	-1.385	1.919
376	30714	1038374.882	506236.6424	NG_SPOT	2057.825	2057.020	-0.805	0.648
377	30715	1038557.406	506262.3666	NG_SPOT	2062.480	2062.074	-0.406	0.165
378	30716	1038531.807	506303.1926	NG_SPOT	2053.324	2054.142	0.818	0.669
379	30717	1038505.316	506346.8746	NG_SPOT	2048.470	2048.066	-0.404	0.163
380	30718	1038487.146	506376.6901	NG_SPOT	2047.813	2047.408	-0.405	0.164
381	30719	1038499.09	506410.0119	NG_TOP	2047.071	2045.723	-1.348	1.817
382	30720	1038502.414	506418.9054	NG_TOE	2043.493	2044.490	0.997	0.994
383	30721	1038508.008	506436.5751	NG_SPOT	2043.732	2043.351	-0.382	0.146
384	30722	1038511.764	506448.1138	NG_TOE	2043.016	2043.474	0.458	0.210
385	30723	1038513.234	506451.2378	NG_TOP	2043.635	2043.608	-0.026	0.001
386	30724	1038517.327	506464.2993	NG_TOE	2042.964	2043.182	0.218	0.048
387	30725	1038519.865	506467.6843	NG_SPOT	2042.645	2043.242	0.597	0.356
388	30726	1038521.828	506471.9673	NG_TOE	2043.270	2043.985	0.715	0.512
389	30727	1038523.874	506475.4791	NG_TOP	2044.746	2044.675	-0.071	0.005
390	30728	1038544.725	506515.6425	NG_SPOT	2050.827	2051.301	0.474	0.225
391	30729	1038544.825	506539.5432	NG_SPOT	2054.945	2056.094	1.149	1.320
392	30730	1039075.221	506563.8236	NG_TOP	2059.008	2058.871	-0.137	0.019
393	30731	1039099.81	506576.0984	NG_TOE	2053.710	2054.634	0.924	0.853
394	30732	1039117.886	506590.8355	RD_EDGE_WASH_	2053.052	2054.175	1.123	1.261
395	30733	1039107.538	506583.5995	WASH_EDGE	2052.800	2053.702	0.902	0.814
396	30734	1039125.337	506596.5575	DIRTRD_EDGE	2054.716	2055.532	0.816	0.665
397	30735	1039134.887	506602.1473	NG_SPOT	2055.393	2055.658	0.265	0.070
398	30736	1039182.194	506637.1765	NG_SPOT	2058.890	2060.992	2.102	4.417
399	30737	1039266.081	506527.9721	NG_SPOT	2070.133	2070.223	0.090	0.008
400	30738	1039228.02	506494.3948	NG_SPOT	2061.103	2061.629	0.526	0.277
401	30739	1039197.038	506474.5346	NG_TOP	2057.805	2056.896	-0.909	0.827
402	30740	1039192.505	506473.074	NG_TOE	2055.513	2056.260	0.747	0.559
403	30741	1039191.588	506461.0762	NG_SPOT	2055.973	2056.390	0.417	0.174
404	30742	1039185.3	506455.9448	NG_TOE	2056.171	2056.606	0.435	0.189
405	30743	1039176.36	506448.948	NG_TOP	2058.337	2056.905	-1.432	2.050
406	30744	1039168.497	506440.6506	NG_SPOT	2058.135	2057.367	-0.768	0.589
407	30745	1039155.239	506431.7035	NG_SPOT	2058.066	2057.488	-0.578	0.334
408	30746	1039151.759	506425.7802	NG_TOE	2054.910	2056.355	1.445	2.089
409	30747	1039149.926	506423.2444	NG_SPOT	2055.073	2056.421	1.348	1.817
410	30748	1039145.752	506420.3825	NG_TOE	2055.479	2057.429	1.950	3.804
411	30749	1039143.55	506417.2008	NG_TOP	2058.191	2057.940	-0.250	0.063
412	30750	1039137.227	506409.2814	NG_BL	2058.192	2059.000	0.807	0.652
413	30751	1039115.171	506395.6405	NG_SPOT	2065.712	2064.901	-0.811	0.657
414	30752	1039096.34	506376.3957	NG_SPOT	2071.649	2071.263	-0.386	0.149
415	30753	1039374.049	506421.6961	NG_SPOT	2067.760	2069.085	1.326	1.758

416	30754	1039383.994	506415.8857	NG_TOP	2066.542	2067.312	0.769	0.592
417	30755	1039394.18	506407.7744	NG_TOE	2060.608	2062.369	1.761	3.100
418	30756	1039400.825	506403.3396	NG_SPOT	2060.276	2060.416	0.140	0.020
419	30757	1039404.968	506400.2967	NG_TOE	2060.459	2061.087	0.627	0.393
420	30758	1039410.544	506396.6019	NG_TOP	2062.416	2061.919	-0.497	0.247
421	30759	1039416.924	506392.8778	NG_SPOT	2062.600	2062.285	-0.315	0.099
422	30760	1039458.419	506368.255	NG_SPOT	2062.899	2062.841	-0.058	0.003
423	30761	1039499.474	506340.0601	NG_SPOT	2064.293	2064.775	0.482	0.233
424	30763	1039570.213	506292.5593	NG_TOP	2094.510	2094.369	-0.141	0.020
425	30764	1039596.673	506278.2448	NG_SPOT	2098.288	2097.859	-0.429	0.184
426	31012	1039968.754	510041.1484	NG_TOE	2095.792	2096.242	0.450	0.203
427	31013	1039974.598	509797.0678	NG_TOE	2093.308	2094.605	1.297	1.683
428	31014	1039974.049	509795.1149	NG_SPOT	2093.195	2094.595	1.401	1.962
429	31015	1039973.382	509791.6443	NG_TOE	2093.486	2095.281	1.795	3.223
430	31016	1038710.374	510389.3374	NG_SPOT	2071.384	2070.785	-0.599	0.359
431	31017	1038150.503	509945.4039	NG_TOE	2063.771	2063.592	-0.178	0.032
432	31018	1038515.636	506461.8098	NG_TOP	2044.214	2043.654	-0.559	0.313
433	31189	1036790.154	510109.4371	NG_TOP	2038.526	2039.035	0.509	0.259
434	31190	1036792.095	510107.1826	NG_TOE	2037.598	2039.022	1.425	2.030
435	31191	1036799.204	510096.9769	WASH_EDGE	2038.241	2038.281	0.040	0.002
436	31192	1036800.11	510087.7384	NG_SPOT	2038.061	2037.589	-0.471	0.222
437	31193	1036804.472	510080.4003	NG_TOP	2037.612	2037.010	-0.602	0.362
438	31194	1036805.897	510076.1073	NG_TOE	2035.802	2036.681	0.879	0.773
439	31195	1036813.014	510060.38	NG_SPOT	2035.922	2035.543	-0.378	0.143
440	31196	1036826.471	510038.5244	NG_SPOT	2037.026	2036.727	-0.299	0.089
441	31197	1036835.119	510017.3557	NG_TOE	2037.132	2037.735	0.603	0.363
442	31198	1036837.649	510012.4435	NG_TOP	2038.491	2037.992	-0.500	0.250
443	31199	1036842.678	510004.469	NG_SPOT	2039.026	2038.448	-0.577	0.333
444	31200	1036862.508	509961.4718	NG_SPOT	2040.730	2039.942	-0.788	0.621
445	31201	1036878.22	509929.7216	NG_SPOT	2041.658	2040.618	-1.040	1.081
446	31202	1036508.867	509764.4938	NG_SPOT	2034.237	2033.700	-0.537	0.289
447	31203	1036499.539	509814.5924	NG_SPOT	2031.574	2031.632	0.058	0.003
448	31204	1036490.633	509862.7477	NG_SPOT	2031.682	2030.837	-0.845	0.714
449	31205	1036479.922	509910.1841	NG_SPOT	2032.055	2030.886	-1.168	1.365
450	31206	1036476.023	509942.2259	NG_TOP	2031.102	2030.612	-0.490	0.241
451	31207	1036475.833	509947.324	NG_TOE	2030.311	2030.506	0.195	0.038
452	31208	1036470.614	509958.2578	NG_SPOT	2030.228	2030.247	0.019	0.000
453	31209	1036474.101	509968.81	NG_TOE	2030.886	2030.855	-0.031	0.001
454	31210	1036473.451	509973.5971	NG_SPOT	2032.102	2031.110	-0.992	0.984
455	31211	1036473.237	509971.6481	NG_TOP	2032.169	2031.002	-1.167	1.362
456	31212	1036473.203	509975.8937	NG_TOP	2031.862	2031.233	-0.628	0.395
457	31213	1036472.065	509978.8853	NG_TOE	2031.087	2031.385	0.298	0.089
458	31214	1036465.928	509989.281	NG_SPOT	2030.862	2031.895	1.032	1.066
459	31215	1036462.634	509994.4911	NG_TOE	2030.848	2032.148	1.300	1.690

460	31216	1036461.102	509999.5992	NG_TOP	2031.700	2032.419	0.719	0.517
461	31217	1036459.376	510008.9405	NG_SPOT	2032.380	2033.042	0.662	0.438
462	31218	1036452.6	510042.3502	NG_SPOT	2035.635	2035.256	-0.378	0.143
463	31219	1035932.671	509514.1027	NG_SPOT	2020.900	2021.055	0.155	0.024
464	31220	1035932.67	509514.0892	NG_SPOT	2020.897	2021.056	0.159	0.025
465	31221	1035912.073	509465.2691	NG_SPOT	2017.304	2018.018	0.715	0.511
466	31222	1035892.421	509425.3589	NG_TOE	2014.077	2016.351	2.274	5.171
467	31223	1035888.991	509420.9825	NG_TOE	2014.270	2015.634	1.364	1.861
468	31224	1035885.22	509413.9364	NG_TOP	2015.825	2015.478	-0.347	0.121
469	31225	1035863.056	509366.6406	NG_SPOT	2017.094	2018.038	0.944	0.892
470	31226	1035773.803	509311.7538	NG_SPOT	2017.143	2017.567	0.425	0.180
471	31227	1035739.128	509347.4323	NG_SPOT	2015.036	2013.805	-1.231	1.517
472	31228	1035734.341	509350.963	NG_TOP	2013.829	2012.821	-1.008	1.015
473	31229	1035732.414	509354.7718	NG_TOE	2012.048	2011.991	-0.057	0.003
474	31230	1035726.266	509359.8327	NG_TOE	2012.340	2012.008	-0.332	0.110
475	31231	1035723.084	509363.5938	NG_TOP	2013.616	2012.076	-1.541	2.374
476	31232	1035705.043	509380.6561	NG_SPOT	2013.899	2012.473	-1.425	2.032
477	31233	1035686.397	509391.7	NG_TOP	2013.132	2012.764	-0.368	0.136
478	31234	1035685.429	509398.6482	NG_TOE	2011.918	2012.831	0.913	0.834
479	31235	1035679.718	509407.107	NG_SPOT	2011.935	2013.162	1.227	1.505
480	31236	1035672.359	509413.3771	NG_TOE	2011.923	2013.966	2.043	4.175
481	31237	1035668.989	509417.0356	NG_TOP	2013.691	2014.386	0.695	0.483
482	31238	1035635.238	509454.6984	NG_SPOT	2013.003	2014.656	1.653	2.733
483	31239	1035623.84	509477.9711	NG_TOE	2013.616	2015.875	2.260	5.107
484	31240	1035608.167	509489.868	NG_TOP	2017.611	2018.293	0.682	0.465
485	31241	1035184.887	509471.1559	NG_SPOT	2015.263	2015.027	-0.236	0.056
486	31242	1035182.281	509461.174	NG_TOP	2014.428	2014.992	0.564	0.318
487	31243	1035184.609	509433.7396	NG_TOE	2004.386	2006.011	1.625	2.640
488	31244	1035180.994	509422.2302	WASH_EDGE	2004.178	2004.237	0.059	0.004
489	31245	1035178.617	509409.1833	NG_LOW	2002.618	2003.017	0.399	0.159
490	31246	1035183.713	509388.5826	WASH_EDGE	2003.842	2004.930	1.088	1.183
491	31247	1035187.893	509380.544	NG_SPOT	2004.057	2004.974	0.918	0.842
492	31248	1035191.206	509330.3139	NG_SPOT	2004.175	2004.788	0.613	0.376
493	31249	1035194.891	509279.103	NG_SPOT	2004.239	2004.753	0.514	0.264
494	31250	1035189.766	509264.3346	WASH_EDGE	2004.045	2004.255	0.210	0.044
495	31251	1035187.697	509253.9495	NG_SPOT	2003.058	2003.719	0.661	0.436
496	31252	1035188.564	509244.5603	NG_TOE	2003.379	2004.384	1.005	1.010
497	31253	1035187.641	509240.6256	NG_TOP	2003.946	2004.691	0.745	0.555
498	31254	1035183.245	509235.201	NG_SPOT	2003.717	2004.451	0.734	0.539
499	31255	1035179.344	509225.1593	NG_TOP	2003.992	2004.353	0.361	0.130
500	31256	1035178.217	509223.3723	NG_TOE	2002.710	2004.197	1.487	2.211
501	31257	1035171.405	509213.431	NG_SPOT	2003.100	2003.534	0.434	0.189
502	31258	1035168.595	509206.8896	NG_TOE	2003.158	2003.714	0.556	0.309
503	31259	1035166.441	509203.3295	NG_TOP	2003.956	2003.872	-0.084	0.007

504	31260	1035163.591	509196.4502	NG_SPOT	2004.538	2004.198	-0.340	0.115
505	31261	1035161.259	509185.564	WASH_EDGE	2004.191	2004.741	0.550	0.302
506	31262	1035153.239	509173.5196	NG_SPOT	2004.116	2005.446	1.331	1.770
507	31263	1035149.83	509168.2514	NG_TOE	2003.874	2005.857	1.983	3.934
508	31264	1035149.477	509163.8989	NG_TOP	2004.814	2006.154	1.340	1.796
509	31265	1035146.255	509156.6719	NG_BL	2005.058	2006.702	1.644	2.702
510	31266	1035142.453	509146.4364	NG_BL	2007.196	2007.462	0.266	0.071
511	31267	1035130.083	509119.1392	NG_SPOT	2007.076	2008.115	1.040	1.081
512	31268	1034484.748	509036.2408	NG_SPOT	1992.040	1993.074	1.034	1.069
513	31269	1034480.641	509086.7483	NG_SPOT	1991.611	1992.540	0.929	0.862
514	31270	1034466.463	509115.2886	NG_TOP	1991.104	1991.135	0.031	0.001
515	31271	1034469.716	509119.6854	NG_TOE	1989.049	1991.192	2.143	4.591
516	31272	1034473.581	509129.6334	NG_SPOT	1988.972	1991.146	2.173	4.722
517	31273	1034469.573	509141.315	NG_SPOT	1989.882	1990.973	1.091	1.190
518	31274	1034461.339	509157.3208	NG_SPOT	1990.386	1990.278	-0.108	0.012
519	31275	1034448.44	509164.6721	NG_TOE	1989.599	1991.198	1.599	2.557
520	31276	1034445.102	509173.6483	NG_TOP	1993.694	1992.850	-0.843	0.711
521	31277	1034436.116	509209.5274	NG_SPOT	1996.250	1996.441	0.190	0.036
522	31278	1033753.129	508722.8029	NG_SPOT	1978.620	1979.224	0.604	0.365
523	31279	1033731.806	508766.1892	NG_SPOT	1978.103	1977.949	-0.153	0.024
524	31280	1033707.695	508807.6026	NG_SPOT	1976.868	1977.526	0.658	0.433
525	31281	1033687.959	508852.7644	NG_SPOT	1976.810	1977.046	0.236	0.056
526	31282	1033686.104	508856.8414	WASH_EDGE	1976.757	1976.978	0.221	0.049
527	31283	1033675.369	508870.7475	NG_SPOT	1976.833	1976.611	-0.222	0.049
528	31284	1033663.931	508893.502	NG_SPOT	1976.990	1976.203	-0.788	0.620
529	31285	1033652.126	508915.8403	NG_SPOT	1976.800	1976.773	-0.027	0.001
530	31286	1033640.872	508943.3119	WASH_EDGE	1976.709	1977.564	0.855	0.732
531	31287	1033626.235	508968.5933	NG_SPOT	1979.585	1980.955	1.370	1.877
532	31288	1033617.343	508991.2861	NG_SPOT	1981.064	1981.505	0.441	0.194
533	31289	1032962.149	508729.4645	NG_SPOT	1969.084	1969.132	0.048	0.002
534	31290	1032976.128	508682.2074	NG_SPOT	1966.915	1966.945	0.029	0.001
535	31291	1032979.686	508672.0223	NG_LOW	1965.165	1965.537	0.373	0.139
536	31292	1032983.884	508650.9922	NG_BL	1968.027	1968.443	0.416	0.173
537	31293	1032986.953	508631.2646	NG_BL	1967.854	1968.716	0.862	0.743
538	31294	1032991.534	508615.6466	NG_SPOT	1965.521	1966.527	1.007	1.013
539	31295	1033001.588	508584.5407	NG_SPOT	1965.385	1966.689	1.304	1.700
540	31296	1033020.747	508529.689	NG_TOP	1965.689	1966.544	0.856	0.732
541	31297	1033023.136	508525.649	NG_TOE	1964.014	1966.070	2.056	4.226
542	31298	1033026.013	508517.5881	NG_SPOT	1963.931	1965.201	1.270	1.613
543	31299	1033028.019	508510.2129	NG_TOE	1963.758	1965.270	1.511	2.284
544	31300	1033030.937	508503.7081	NG_TOP	1965.321	1965.893	0.572	0.327
545	31301	1033036.222	508496.5224	NG_TOP	1965.442	1966.841	1.399	1.956
546	31302	1033044.754	508493.591	NG_TOE	1964.603	1966.960	2.357	5.554
547	31303	1033058.899	508490.8527	NG_TOE	1963.634	1967.119	3.485	12.146

548	31304	1033061.814	508489.2709	NG_TOP	1966.298	1967.144	0.846	0.715
549	31305	1033091.111	508477.8197	NG_SPOT	1966.339	1967.192	0.853	0.728
550	31306	1033134.245	508448.3035	NG_SPOT	1966.308	1966.986	0.677	0.459
551	31307	1033104.421	508430.6666	NG_SPOT	1965.969	1967.061	1.092	1.193
552	31308	1033104.158	508368.1368	NG_SPOT	1969.045	1970.615	1.570	2.466
553	31309	1032449.505	508487.9621	NG_SPOT	1957.539	1958.148	0.609	0.370
554	31310	1032457.381	508523.7504	WASH_EDGE	1956.599	1957.387	0.789	0.622
555	31311	1032460.997	508539.6911	NG_SPOT	1956.373	1956.835	0.462	0.214
556	31312	1032472.21	508579.8852	NG_SPOT	1956.851	1957.047	0.196	0.039
557	31313	1032480.01	508594.7318	NG_TOP	1957.479	1956.714	-0.766	0.586
558	31314	1032480.06	508595.1354	NG_TOP	1957.606	1956.689	-0.916	0.840
559	31315	1032481.076	508596.8925	NG_TOE	1955.844	1956.564	0.721	0.519
560	31316	1032490.947	508609.2859	NG_SPOT	1956.923	1955.619	-1.304	1.701
561	31317	1032496.701	508624.245	NG_SPOT	1957.499	1957.274	-0.226	0.051
562	31318	1032499.163	508631.8186	NG_TOP	1957.279	1957.399	0.120	0.014
563	31319	1032501.836	508634.2634	NG_TOE	1956.243	1957.488	1.245	1.551
564	31320	1032519.016	508646.3296	NG_SPOT	1957.521	1958.298	0.777	0.604
565	31321	1032519.354	508671.1576	NG_TOP	1956.653	1957.475	0.822	0.676
566	31322	1032520.593	508674.709	NG_TOE	1955.399	1956.971	1.572	2.472
567	31323	1032522.188	508683.2424	NG_SPOT	1955.072	1956.810	1.739	3.023
568	31324	1032523.411	508691.2526	NG_TOE	1955.278	1957.366	2.088	4.359
569	31325	1032526.492	508694.6595	NG_TOP	1957.067	1957.714	0.647	0.419
570	31326	1032535.646	508706.1016	NG_SPOT	1957.545	1958.832	1.287	1.655
571	31327	1032551.347	508750.5247	NG_SPOT	1956.996	1957.018	0.022	0.000
572	31328	1032571.832	508799.0426	NG_SPOT	1959.666	1960.087	0.421	0.177
573	31329	1032580.485	508822.2996	NG_SPOT	1960.991	1961.063	0.072	0.005
574	31330	1032204.568	508923.401	NG_SPOT	1955.045	1955.729	0.685	0.469
575	31331	1032183.569	508877.6953	NG_SPOT	1953.707	1952.733	-0.974	0.949
576	31332	1032178.61	508863.5797	NG_BL	1950.898	1951.712	0.814	0.662
577	31333	1032173.491	508853.3102	NG_TOP	1950.441	1950.983	0.542	0.294
578	31334	1032172.282	508851.4764	NG_TOE	1949.760	1950.842	1.082	1.171
579	31335	1032166.559	508844.4881	NG_TOE	1950.104	1950.459	0.355	0.126
580	31336	1032164.242	508842.0273	NG_TOP	1950.695	1950.706	0.011	0.000
581	31337	1032166.006	508832.8288	NG_SPOT	1950.778	1951.290	0.513	0.263
582	31338	1032164.314	508828.2656	NG_TOP	1950.707	1951.574	0.866	0.750
583	31339	1032165.212	508825.2053	NG_TOE	1949.599	1951.769	2.170	4.708
584	31340	1032165.103	508820.6746	NG_SPOT	1949.279	1951.853	2.573	6.621
585	31341	1032160.429	508816.2017	NG_TOE	1949.101	1951.729	2.628	6.905
586	31342	1032159.713	508814.6527	NG_TOP	1950.538	1951.704	1.166	1.359
587	31343	1032147.976	508779.6288	NG_SPOT	1950.782	1951.229	0.447	0.200
588	31344	1032147.99	508771.0484	NG_LOW	1949.470	1951.170	1.700	2.889
589	31345	1032144.787	508757.1779	NG_SPOT	1950.417	1951.184	0.767	0.588
590	31346	1032140.568	508724.1745	NG_SPOT	1951.043	1951.613	0.570	0.325
591	31347	1032132.902	508704.6844	NG_SPOT	1950.895	1951.676	0.781	0.610

592	31348	1032134.498	508688.1178	NG_TOP	1950.586	1951.174	0.589	0.347
593	31349	1032134.674	508685.1386	NG_TOE	1949.370	1950.997	1.627	2.649
594	31350	1032135.532	508678.1643	NG_SPOT	1949.461	1950.453	0.992	0.985
595	31351	1032136.614	508671.5219	NG_TOE	1949.683	1950.832	1.149	1.321
596	31352	1032136.749	508667.2843	NG_TOP	1950.942	1951.090	0.147	0.022
597	31353	1032140.245	508655.7697	NG_SPOT	1951.328	1951.693	0.364	0.133
598	31354	1032134.571	508651.2614	WASH_EDGE	1951.547	1951.790	0.243	0.059
599	31355	1032128.188	508639.3216	WASH_EDGE	1951.711	1952.041	0.330	0.109
600	31356	1032138.405	508625.0519	NG_SPOT	1952.148	1952.416	0.269	0.072
601	31357	1032136.068	508613.8446	NG_TOP	1952.100	1951.986	-0.113	0.013
602	31358	1032135.609	508609.78	NG_TOE	1951.172	1951.720	0.548	0.301
603	31359	1032133.852	508606.1314	NG_SPOT	1951.370	1951.438	0.068	0.005
604	31360	1032133.204	508603.3958	NG_TOE	1951.678	1951.471	-0.206	0.043
605	31361	1032132.183	508600.5236	NG_TOP	1952.092	1951.497	-0.595	0.354
606	31362	1032113.474	508584.055	NG_SPOT	1951.152	1951.308	0.155	0.024
607	31363	1032086.66	508539.2734	NG_SPOT	1951.831	1953.172	1.342	1.800
608	31364	1029254.743	508812.0709	NG_SPOT	1914.028	1915.092	1.064	1.132
609	31365	1029249.464	508863.05	NG_SPOT	1910.421	1911.563	1.142	1.305
610	31366	1029247.516	508889.9792	NG_TOP	1907.766	1908.690	0.924	0.854
611	31367	1029247.624	508894.7056	NG_TOE	1904.965	1907.305	2.340	5.478
612	31368	1029246.783	508902.185	NG_SPOT	1904.863	1905.109	0.246	0.060
613	31369	1029245.579	508909.0133	NG_TOE	1905.259	1906.294	1.035	1.071
614	31370	1029244.648	508911.1641	NG_TOP	1906.085	1906.710	0.625	0.391
615	31371	1029244.075	508960.7399	NG_SPOT	1908.155	1909.504	1.348	1.818
616	31372	1029239.067	509018.6622	NG_SPOT	1909.668	1910.031	0.363	0.132
617	31373	1029229.61	509068.9119	NG_SPOT	1907.930	1908.916	0.986	0.972
618	31374	1029228.747	509081.0791	NG_LOW	1906.868	1908.109	1.241	1.540
619	31375	1029218.079	509116.2787	NG_SPOT	1911.549	1912.141	0.592	0.351
620	31376	1029212.952	509149.0393	NG_SPOT	1912.150	1912.920	0.770	0.593
621	31377	1028279.906	509174.3323	NG_SPOT	1902.410	1902.988	0.578	0.334
622	31378	1028293.99	509223.981	NG_SPOT	1901.410	1901.891	0.481	0.231
623	31379	1028311.478	509271.2247	NG_SPOT	1899.978	1900.035	0.056	0.003
624	31380	1028325.238	509317.5726	NG_SPOT	1894.950	1897.611	2.662	7.084
625	31381	1028330.099	509333.8683	NG_TOP	1894.417	1895.303	0.886	0.785
626	31382	1028330.542	509337.3408	NG_TOE	1893.585	1894.183	0.598	0.358
627	31383	1028330.569	509341.5527	NG_TOE	1893.610	1894.966	1.356	1.838
628	31384	1028330.572	509346.3806	NG_TOP	1895.274	1896.197	0.923	0.852
629	31385	1029378.125	507133.1603	NG_SPOT	1914.854	1915.432	0.577	0.333
630	31386	1029377.187	507076.1733	NG_BL	1914.578	1912.957	-1.621	2.627
631	31392	1029375.632	507033.055	NG_TOP	1900.125	1900.106	-0.019	0.000
632	31393	1029374.794	507038.3904	NG_TOE	1898.788	1899.592	0.804	0.646
633	31396	1029376.551	506984.4818	NG_SPOT	1900.656	1901.997	1.342	1.800
634	31397	1029378.362	506963.9724	NG_BL	1900.739	1902.535	1.796	3.226
635	31398	1029378.272	506952.3956	NG_BL	1902.281	1902.830	0.548	0.301

636	31399	1029377.227	506931.0883	NG_BL	1902.124	1903.896	1.772	3.139
637	31400	1029377.029	506883.0111	NG_SPOT	1909.121	1908.414	-0.707	0.500
638	31401	1029374.973	506867.1002	NG_SPOT	1909.999	1909.324	-0.675	0.455
639	31402	1028712.821	507062.5117	NG_SPOT	1900.504	1900.444	-0.060	0.004
640	31403	1028726.484	507090.8489	NG_BL	1897.371	1897.658	0.287	0.082
641	31404	1028727.75	507100.225	NG_TOP	1894.149	1895.651	1.502	2.255
642	31405	1028734.76	507103.6861	NG_TOE	1891.327	1894.389	3.062	9.378
643	31406	1028741.231	507109.5346	NG_SPOT	1890.818	1892.387	1.569	2.463
644	31407	1028744.931	507113.1903	NG_TOE	1891.079	1892.324	1.244	1.548
645	31408	1028748.251	507118.4414	NG_TOP	1892.863	1892.886	0.024	0.001
646	31409	1028751.864	507125.3719	NG_SPOT	1893.296	1893.078	-0.218	0.048
647	31410	1028771.175	507170.5694	NG_SPOT	1892.682	1893.575	0.894	0.799
648	31411	1028773.096	507177.91	NG_TOE	1892.858	1894.652	1.795	3.221
649	31412	1028781.293	507227.1345	NG_RIDGE	1900.718	1900.014	-0.704	0.496
650	31413	1026488.393	509509.1681	NG_SPOT	1874.786	1875.992	1.206	1.455
651	31414	1026530.065	509548.0702	NG_SPOT	1870.589	1870.814	0.225	0.051
652	31415	1026540.597	509563.9279	NG_SPOT	1871.091	1872.682	1.591	2.532
653	31416	1026552.158	509570.9895	NG_TOP	1871.316	1871.169	-0.147	0.022
654	31417	1026553.609	509573.7621	NG_TOE	1869.367	1870.424	1.058	1.118
655	31418	1026553.936	509576.2084	NG_TOE	1869.330	1869.995	0.665	0.443
656	31419	1026554.169	509580.2547	NG_TOP	1871.580	1871.073	-0.507	0.257
657	31420	1026551.374	509614.6104	NG_SPOT	1872.005	1873.022	1.017	1.035
658	31421	1026565.351	509660.3477	NG_TOP	1872.018	1873.283	1.265	1.599
659	31422	1026566.165	509662.2979	NG_TOE	1870.808	1872.817	2.009	4.036
660	31423	1026567.655	509671.4175	NG_SPOT	1870.133	1871.189	1.056	1.115
661	31424	1026569.106	509677.5464	NG_TOE	1870.438	1872.637	2.199	4.835
662	31425	1026572.472	509683.133	NG_TOP	1872.289	1873.454	1.166	1.359
663	31426	1026579.121	509708.781	NG_SPOT	1872.086	1873.581	1.496	2.237
664	31427	1026591.66	509758.3491	NG_SPOT	1871.310	1872.923	1.613	2.603
665	31428	1026603.32	509818.292	NG_SPOT	1872.522	1873.363	0.841	0.708
666	31429	1026610.583	509867.7051	NG_SPOT	1872.189	1873.414	1.225	1.501
667	31430	1026626.364	509905.867	NG_LOW	1870.357	1871.116	0.760	0.577
668	31431	1026621.524	509917.7611	NG_SPOT	1871.462	1872.919	1.457	2.124
669	31432	1026630.028	509966.9867	NG_SPOT	1872.997	1874.108	1.112	1.236
670	31433	1026637.761	510024.3731	NG_SPOT	1874.784	1875.202	0.418	0.175
671	31434	1025716.029	509527.3766	NG_SPOT	1861.281	1862.279	0.998	0.996
672	31435	1025719.277	509577.5073	NG_SPOT	1861.663	1862.182	0.520	0.270
673	31436	1025722.464	509625.2439	NG_SPOT	1860.983	1862.649	1.666	2.776
674	31437	1025723.635	509676.5359	NG_SPOT	1861.834	1862.432	0.598	0.358
675	31438	1025728.055	509725.6298	NG_SPOT	1862.085	1863.241	1.156	1.337
676	31439	1025728.341	509776.5419	NG_SPOT	1861.263	1862.530	1.267	1.605
677	31440	1025729.848	509810.9252	NG_TOP	1861.794	1862.091	0.297	0.088
678	31441	1025729.37	509816.7138	NG_TOE	1860.759	1861.002	0.243	0.059
679	31442	1025728.584	509823.0939	NG_SPOT	1860.882	1860.476	-0.406	0.165

680	31443	1025730.082	509828.658	WASH_EDGE	1861.185	1860.452	-0.733	0.537
681	31444	1025733.037	509860.6505	WASH_EDGE	1861.696	1862.711	1.015	1.031
682	31445	1025735.07	509864.723	WASH_EDGE	1861.210	1862.643	1.434	2.055
683	31446	1025733.124	509877.896	NG_SPOT	1861.728	1862.296	0.568	0.323
684	31447	1025736.626	509925.1882	NG_SPOT	1860.704	1862.126	1.422	2.022
685	31448	1025739.127	509975.0554	NG_SPOT	1859.897	1861.513	1.616	2.611
686	31449	1025740.288	509995.6813	NG_TOP	1859.394	1859.031	-0.363	0.132
687	31450	1025740.707	509999.4316	NG_TOE	1857.944	1859.498	1.555	2.417
688	31451	1025741.37	510003.003	NG_TOP	1859.715	1860.513	0.799	0.638
689	31452	1025740.105	510023.9389	NG_SPOT	1860.628	1861.877	1.250	1.562
690	31453	1025743.085	510055.5141	NG_SPOT	1861.193	1862.525	1.331	1.772
691	31454	1025736.253	510086.9606	NG_LOW	1859.344	1859.163	-0.180	0.033
692	31455	1025725.553	510109.2246	NG_SPOT	1860.231	1861.713	1.482	2.197
693	31456	1025730.398	510163.9462	NG_SPOT	1862.839	1863.246	0.407	0.166
694	31457	1025489.711	509590.8282	NG_SPOT	1857.500	1859.330	1.830	3.348
695	31458	1025469.168	509636.1181	NG_SPOT	1856.276	1856.193	-0.083	0.007
696	31459	1025467.427	509641.9491	NG_SPOT	1855.045	1856.549	1.505	2.264
697	31460	1025449.982	509683.5817	NG_SPOT	1857.228	1858.583	1.355	1.836
698	31461	1025428.033	509728.3384	NG_SPOT	1856.456	1857.962	1.506	2.268
699	31462	1025423.531	509739.5155	NG_TOP	1856.253	1857.034	0.781	0.610
700	31463	1025422.618	509741.6548	NG_TOE	1855.308	1856.494	1.186	1.407
701	31464	1025421.179	509745.3247	NG_TOE	1855.472	1856.054	0.583	0.339
702	31465	1025419.873	509748.2925	NG_TOP	1856.306	1856.682	0.375	0.141
703	31466	1025410.511	509774.5059	NG_SPOT	1857.695	1858.183	0.488	0.238
704	31467	1025390.943	509821.9983	NG_SPOT	1856.522	1858.146	1.624	2.638
705	31468	1025376.154	509863.0036	NG_TOP	1855.961	1856.671	0.710	0.504
706	31469	1025375.677	509865.4624	NG_TOE	1854.338	1856.209	1.871	3.501
707	31470	1025375.184	509867.339	NG_TOE	1854.441	1856.263	1.823	3.322
708	31471	1025373.56	509871.0007	NG_TOP	1856.138	1857.457	1.319	1.739
709	31472	1025369.302	509893.178	NG_TOP	1856.389	1856.901	0.513	0.263
710	31473	1025369.348	509896.4668	NG_TOE	1855.904	1855.698	-0.207	0.043
711	31474	1025368.872	509900.0162	NG_SPOT	1855.809	1855.531	-0.279	0.078
712	31475	1025367.888	509904.6149	NG_TOE	1855.647	1855.791	0.144	0.021
713	31476	1025367.746	509911.3025	NG_TOP	1856.729	1857.143	0.414	0.172
714	31477	1025369.313	509944.7265	NG_SPOT	1857.096	1857.969	0.874	0.763
715	31478	1025381.595	509996.2244	NG_SPOT	1857.130	1857.811	0.682	0.465
716	31479	1025393.141	510042.7344	NG_TOP	1856.494	1856.901	0.407	0.166
717	31480	1025395.099	510048.6189	NG_TOE	1853.540	1855.608	2.068	4.276
718	31481	1025397.671	510055.2454	NG_SPOT	1853.612	1854.159	0.548	0.300
719	31482	1025398.342	510060.1909	NG_TOE	1853.640	1855.136	1.496	2.237
720	31483	1025399.013	510064.4313	NG_TOP	1856.948	1856.638	-0.310	0.096
721	31484	1025398.582	510074.8838	NG_SPOT	1856.509	1857.357	0.848	0.719
722	31485	1025408.488	510088.4304	NG_TOP	1856.309	1855.559	-0.750	0.562
723	31486	1025410.471	510091.4355	NG_TOE	1854.184	1854.638	0.454	0.206

724	31487	1025412.168	510094.5521	NG_SPOT	1853.870	1855.231	1.361	1.853
725	31488	1025416.381	510102.4214	NG_TOE	1854.259	1857.290	3.031	9.187
726	31489	1025416.154	510105.4809	NG_TOP	1856.037	1857.487	1.450	2.104
727	31490	1025423.223	510138.9876	NG_SPOT	1858.616	1858.897	0.281	0.079
728	31491	1025428.952	510164.7425	NG_SPOT	1858.812	1859.353	0.541	0.293
729	31492	1024865.509	509913.3286	NG_SPOT	1850.884	1852.017	1.133	1.285
730	31493	1024868.185	509964.2778	NG_SPOT	1849.980	1850.726	0.746	0.557
731	31494	1024867.954	510012.6976	NG_SPOT	1849.334	1849.089	-0.245	0.060
732	31495	1024871.218	510057.1815	NG_BL	1849.167	1850.325	1.158	1.342
733	31496	1024871.468	510069.422	NG_TOP	1847.641	1849.130	1.489	2.216
734	31497	1024869.516	510071.6403	NG_TOE	1847.162	1848.159	0.997	0.995
735	31498	1024867.029	510078.7295	NG_TOE	1847.270	1848.665	1.395	1.946
736	31499	1024865.381	510081.6463	NG_TOP	1849.077	1849.409	0.332	0.110
737	31500	1024864.742	510086.4166	NG_TOP	1848.983	1850.662	1.679	2.818
738	31501	1024864.443	510088.3268	NG_TOE	1847.635	1850.658	3.022	9.134
739	31502	1024863.552	510090.4624	NG_TOE	1847.726	1850.612	2.886	8.332
740	31503	1024863.732	510093.0503	NG_TOP	1848.886	1850.559	1.673	2.798
741	31504	1024871.787	510111.9947	NG_SPOT	1849.506	1850.180	0.674	0.455
742	31505	1024874.001	510162.9451	NG_SPOT	1849.120	1849.547	0.427	0.183
743	31506	1024873.489	510212.1846	NG_SPOT	1849.122	1849.640	0.518	0.268
744	31507	1024875.462	510255.8536	NG_SPOT	1849.113	1849.629	0.517	0.267
745	31508	1024882.902	510272.1733	NG_TOP	1849.440	1849.272	-0.168	0.028
746	31509	1024883.464	510276.7485	NG_TOE	1847.443	1848.531	1.087	1.183
747	31510	1024885.167	510282.6281	NG_SPOT	1847.328	1847.566	0.238	0.057
748	31511	1024886.216	510289.8261	NG_TOE	1847.185	1848.811	1.626	2.645
749	31512	1024886.166	510295.7629	NG_TOP	1849.011	1850.337	1.326	1.758
750	31513	1024887.261	510305.5794	NG_SPOT	1849.401	1850.705	1.304	1.700
751	31514	1024892.912	510335.6221	NG_SPOT	1850.238	1851.225	0.987	0.975
752	31515	1024721.076	509850.0497	NG_SPOT	1848.853	1849.470	0.617	0.381
753	31516	1024743.759	509806.6593	NG_SPOT	1848.758	1848.766	0.008	0.000
754	31517	1024767.396	509762.0877	NG_SPOT	1847.357	1848.658	1.301	1.693
755	31518	1024792.446	509723.2736	NG_LOW	1845.871	1846.368	0.497	0.247
756	31519	1024816.887	509675.5461	NG_SPOT	1847.445	1848.299	0.854	0.730
757	31520	1024840.916	509630.8484	NG_SPOT	1847.671	1849.351	1.680	2.822
758	31521	1024849.708	509612.6205	NG_SPOT	1847.443	1849.556	2.113	4.463
759	31522	1024855.348	509607.3635	NG_LOW	1846.626	1847.402	0.776	0.602
760	31523	1024868.617	509597.2517	NG_SPOT	1846.741	1849.114	2.374	5.634
761	31524	1024883.992	509565.9407	NG_SPOT	1847.505	1849.265	1.760	3.097
762	31525	1024889.617	509548.8346	NG_TOP	1846.284	1847.223	0.939	0.882
763	31526	1024890.659	509544.5457	NG_TOE	1844.988	1845.882	0.893	0.798
764	31527	1024892.65	509540.1472	NG_TOE	1844.699	1846.796	2.097	4.397
765	31528	1024894.52	509538.7666	NG_TOP	1847.074	1847.276	0.202	0.041
766	31529	1024916.116	509518.3772	NG_SPOT	1846.861	1849.018	2.156	4.650
767	31530	1024884.892	509496.7879	NG_TOP	1845.887	1848.126	2.239	5.015

768	31531	1024885.271	509493.2388	NG_TOE	1843.912	1847.074	3.162	9.996
769	31532	1024887.985	509487.9436	NG_TOE	1844.300	1845.596	1.296	1.681
770	31533	1024889.501	509484.8009	NG_TOP	1845.713	1846.136	0.423	0.179
771	31534	1024889.465	509439.2699	NG_SPOT	1848.559	1849.437	0.878	0.770
772	31535	1024880.421	509385.9237	NG_SPOT	1848.885	1850.195	1.310	1.715
773	31536	1024804.633	509422.6984	NG_SPOT	1847.823	1849.634	1.811	3.280
774	31537	1024804.035	509474.9335	NG_SPOT	1845.772	1846.641	0.869	0.755
775	31538	1024806.1	509482.2651	NG_TOP	1844.765	1845.347	0.581	0.338
776	31539	1024807.611	509484.6656	NG_TOE	1843.078	1844.886	1.808	3.269
777	31540	1024806.61	509491.8123	NG_SPOT	1843.159	1844.297	1.138	1.295
778	31541	1024811.739	509500.1128	NG_TOE	1843.711	1845.163	1.452	2.107
779	31542	1024805.232	509505.3592	NG_TOP	1845.194	1846.606	1.412	1.993
780	31543	1024798.549	509522.7292	NG_SPOT	1846.025	1847.567	1.541	2.375
781	31544	1024798.258	509573.9516	NG_SPOT	1845.364	1846.523	1.160	1.345
782	31545	1024795.392	509596.165	NG_SPOT	1846.786	1848.775	1.989	3.955
783	31546	1024411.347	509377.2238	NG_SPOT	1842.316	1843.622	1.306	1.706
784	31547	1024404.044	509318.3431	NG_SPOT	1840.107	1841.285	1.178	1.387
785	31548	1024412.774	509288.4925	NG_SPOT	1839.040	1840.503	1.463	2.142
786	31549	1024409.882	509279.4748	NG_BL	1838.972	1840.041	1.069	1.142
787	31550	1024410.344	509275.3748	NG_LOW	1837.678	1838.886	1.208	1.459
788	31551	1024411.151	509266.4216	NG_BL	1838.358	1840.281	1.923	3.699
789	31552	1024413.303	509242.6185	NG_SPOT	1838.975	1840.508	1.534	2.353
790	31553	1024404.081	509238.2513	NG_TOP	1838.429	1839.004	0.576	0.332
791	31554	1024402.886	509236.8539	NG_TOE	1837.647	1838.450	0.803	0.644
792	31555	1024401.025	509231.0249	NG_TOE	1837.628	1838.127	0.499	0.249
793	31556	1024400.922	509226.5102	NG_TOP	1838.678	1839.315	0.637	0.406
794	31557	1024401.071	509208.8887	NG_SPOT	1839.050	1840.962	1.912	3.655
795	31558	1024398.636	509184.0006	NG_TOP	1837.912	1838.567	0.655	0.429
796	31559	1024399.215	509179.8689	NG_TOE	1836.306	1837.677	1.371	1.880
797	31560	1024400.109	509175.9327	NG_SPOT	1835.712	1836.874	1.162	1.350
798	31561	1024401.099	509172.5104	NG_TOE	1835.643	1836.965	1.322	1.748
799	31562	1024400.501	509167.6983	NG_TOP	1838.194	1838.041	-0.153	0.023
800	31563	1024397.912	509158.0325	NG_SPOT	1839.719	1841.863	2.145	4.599
801	31564	1024401.224	509136.4396	NG_BL	1842.739	1843.404	0.665	0.442
802	31565	1024389.845	509102.0394	NG_SPOT	1843.978	1844.850	0.871	0.759
803	31566	1024351.992	510151.5386	NG_SPOT	1843.264	1843.878	0.614	0.377
804	31567	1024380.257	510193.1086	NG_SPOT	1843.348	1843.337	-0.011	0.000
805	31568	1024391.785	510208.1315	NG_TOP	1841.235	1841.035	-0.201	0.040
806	31569	1024393.18	510210.9421	NG_TOE	1840.407	1840.666	0.259	0.067
807	31570	1024395.815	510219.8335	NG_TOE	1840.311	1843.022	2.711	7.352
808	31571	1024396.495	510221.4429	NG_TOP	1841.806	1843.466	1.660	2.756
809	31572	1024407.059	510234.1123	NG_SPOT	1842.580	1843.145	0.565	0.320
810	31573	1024434.627	510275.5642	NG_SPOT	1841.775	1843.238	1.464	2.142
811	31574	1024458.087	510309.177	NG_TOP	1842.299	1842.927	0.628	0.395

812	31575	1024460.066	510312.4423	NG_TOE	1840.541	1841.768	1.227	1.505
813	31576	1024461.413	510324.1334	NG_TOE	1840.628	1842.705	2.077	4.313
814	31577	1024464.709	510326.3312	NG_TOP	1842.103	1843.400	1.297	1.682
815	31578	1024492.182	510347.4907	NG_TOP	1842.282	1843.769	1.486	2.209
816	31579	1024494.958	510350.5047	NG_TOE	1841.016	1842.480	1.464	2.144
817	31580	1024494.884	510359.6522	NG_TOE	1841.386	1841.009	-0.378	0.143
818	31581	1024496.145	510362.0069	NG_TOP	1842.211	1841.590	-0.621	0.385
819	31582	1024518.215	510395.4553	NG_SPOT	1842.136	1842.127	-0.009	0.000
820	31583	1024541.525	510440.2281	NG_SPOT	1841.299	1842.508	1.209	1.461
821	31584	1024556.245	510470.1219	NG_TOP	1841.003	1840.529	-0.473	0.224
822	31585	1024558.028	510474.8554	NG_TOE	1839.970	1840.458	0.488	0.238
823	31586	1024559.639	510480.0321	NG_TOP	1841.243	1842.099	0.856	0.734
824	31587	1024565.681	510485.8917	NG_SPOT	1841.239	1841.795	0.556	0.309
825	31588	1024567.155	510488.301	NG_TOP	1841.067	1841.309	0.242	0.059
826	31589	1024569.77	510492.9809	NG_TOP	1840.863	1840.798	-0.065	0.004
827	31590	1024568.318	510491.5524	NG_TOE	1839.928	1840.633	0.705	0.498
828	31592	1024598.077	510546.1351	NG_SPOT	1844.063	1844.358	0.296	0.087
829	31593	1023569.847	510274.177	NG_SPOT	1831.067	1831.984	0.917	0.841
830	31594	1023580.25	510325.3839	NG_SPOT	1831.475	1831.480	0.005	0.000
831	31595	1023594.325	510373.9115	NG_SPOT	1830.924	1832.080	1.156	1.337
832	31596	1023606.804	510420.6171	NG_SPOT	1831.818	1832.119	0.301	0.091
833	31597	1023619.379	510476.1305	NG_SPOT	1831.661	1832.686	1.025	1.050
834	31598	1023639.703	510505.0914	NG_TOP	1831.291	1831.418	0.127	0.016
835	31599	1023641.061	510508.856	NG_TOE	1830.203	1830.804	0.601	0.362
836	31600	1023641.006	510513.4302	NG_TOP	1831.263	1831.685	0.421	0.178
837	31601	1023640.14	510522.929	NG_SPOT	1831.265	1832.384	1.119	1.252
838	31602	1023662.51	510566.5421	NG_SPOT	1831.130	1831.619	0.489	0.239
839	31603	1023681.605	510612.8793	NG_SPOT	1831.155	1831.430	0.275	0.075
840	31604	1023702.939	510656.8545	NG_SPOT	1831.317	1831.763	0.446	0.199
841	31605	1023718.613	510688.0029	NG_TOP	1831.354	1831.235	-0.119	0.014
842	31606	1023719.69	510689.9186	NG_TOE	1829.398	1830.751	1.353	1.830
843	31607	1023724.065	510693.8196	NG_SPOT	1829.389	1830.175	0.785	0.617
844	31608	1023725.858	510698.9185	NG_TOE	1829.851	1831.218	1.367	1.869
845	31609	1023726.775	510702.2767	NG_TOP	1831.042	1831.874	0.832	0.692
846	31610	1023737.028	510715.3363	NG_SPOT	1831.663	1832.261	0.598	0.358
847	31611	1023764.935	510759.2992	NG_SPOT	1831.815	1832.636	0.821	0.673
848	31612	1023767.801	510770.6693	NG_TOP	1831.597	1831.572	-0.025	0.001
849	31613	1023769.219	510773.3966	NG_TOE	1829.865	1829.946	0.080	0.006
850	31614	1023770.035	510776.2238	NG_TOE	1829.927	1830.330	0.404	0.163
851	31615	1023770.778	510778.13	NG_TOP	1831.438	1830.968	-0.470	0.221
852	31616	1023791.971	510790.2035	NG_TOP	1830.612	1830.359	-0.253	0.064
853	31617	1023792.803	510790.7475	NG_TOE	1829.683	1830.109	0.427	0.182
854	31618	1023796.506	510794.7097	NG_TOE	1829.395	1830.485	1.090	1.189
855	31619	1023795.979	510798.1674	NG_TOP	1831.401	1830.908	-0.493	0.243

856	31620	1023811.021	510831.187	NG_SPOT	1831.979	1832.601	0.622	0.387
857	31621	1023803.464	510879.1916	NG_SPOT	1830.490	1831.500	1.011	1.021
858	31622	1023796.095	510929.9885	NG_SPOT	1830.599	1831.354	0.755	0.571
859	31623	1023789.198	510978.2171	NG_SPOT	1832.759	1834.013	1.254	1.573
860	40173	1032210.405	506331.6816	NG_SPOT	1950.927	1951.627	0.700	0.490
861	40174	1032183.713	506288.9899	NG_SPOT	1949.962	1950.614	0.652	0.425
862	40175	1032175.662	506275.8397	NG_TOP	1950.065	1950.382	0.317	0.101
863	40176	1032157.427	506247.9633	NG_FL	1940.767	1941.472	0.705	0.496
864	40177	1032149.783	506236.0718	NG_BL	1942.473	1942.646	0.172	0.030
865	40178	1032131.027	506204.23	NG_SPOT	1943.641	1944.454	0.813	0.661
866	40179	1032112.8	506175.7645	NG_SPOT	1944.017	1944.574	0.557	0.310
867	40180	1032083.059	506136.33	NG_SPOT	1943.915	1944.160	0.245	0.060
868	40181	1032070.421	506122.0072	NG_BL	1942.452	1942.759	0.307	0.094
869	40182	1032069.53	506120.8762	NG_TOE	1941.024	1942.622	1.598	2.554
870	40183	1032063.029	506111.5139	NG_TOE	1941.240	1944.002	2.762	7.628
871	40184	1032040.624	506081.1523	NG_TOP	1956.289	1955.448	-0.841	0.707
872	40185	1032022.129	506057.0578	NG_SPOT	1958.411	1957.813	-0.598	0.358
873	40186	1032008.196	506038.7819	NG_SPOT	1958.920	1958.636	-0.284	0.081
874	40187	1032694.326	505848.2129	NG_TOP	1968.919	1968.863	-0.056	0.003
875	40188	1032699.2	505902.2706	NG_BL	1965.257	1964.797	-0.459	0.211
876	40189	1032703.992	505953.7871	NG_BL	1954.720	1956.287	1.568	2.457
877	40190	1032709.535	506015.114	NG_SPOT	1951.516	1951.901	0.384	0.148
878	40191	1032710.359	506025.1306	NG_SPOT	1951.883	1951.557	-0.325	0.106
879	40192	1032711.382	506052.042	NG_TOP	1952.077	1950.618	-1.460	2.131
880	40193	1032711.701	506058.2344	NG_TOE	1949.482	1950.401	0.918	0.843
881	40195	1032713.575	506112.0478	NG_TOP	1958.523	1958.495	-0.028	0.001
882	40196	1032712.21	506124.867	NG_SPOT	1958.677	1959.411	0.733	0.538
883	40197	1032713.038	506174.9326	NG_SPOT	1960.715	1960.610	-0.105	0.011
884	40198	1032713.125	506197.8383	NG_SPOT	1960.451	1961.126	0.675	0.455
885	40199	1034731.823	505867.3759	NG_TOP	1993.663	1993.858	0.195	0.038
886	40200	1034686.726	505804.8419	NG_BL	1987.285	1987.671	0.386	0.149
887	40201	1034671.487	505783.0174	NG_TOE	1976.597	1978.552	1.956	3.825
888	40202	1034661.829	505770.8881	NG_TOE	1976.842	1976.860	0.018	0.000
889	40203	1034657.699	505768.4175	5	1978.543	1977.209	-1.333	1.778
890	40204	1034633.068	505730.1329	5	1979.064	1978.568	-0.496	0.246
891	40205	1034603.572	505689.4685	NG_BL	1978.897	1978.085	-0.812	0.659
892	40206	1034595.646	505677.5903	NG_TOE	1976.454	1977.455	1.001	1.003
893	40207	1034587.249	505666.4215	NG_TOE	1976.508	1977.549	1.042	1.085
894	40208	1034574.42	505649.5868	NG_TOP	1984.982	1983.502	-1.480	2.191
895	40209	1034545.316	505608.2749	NG_BL	1985.413	1985.898	0.484	0.234
896	40210	1034535.682	505593.9915	NG_BL	1987.124	1986.579	-0.545	0.297
897	40211	1034514.653	505565.3552	NG_SPOT	1987.871	1987.695	-0.176	0.031
898	40212	1035453.143	505529.9646	NG_TOP	2000.912	2000.056	-0.856	0.732
899	40213	1035456.772	505505.3314	NG_BL	1991.581	1993.925	2.344	5.492

900	40214	1035454.928	505494.1673	NG_TOE	1990.369	1990.962	0.593	0.351
901	40215	1035453.089	505478.8872	NG_TOE	1989.736	1990.755	1.019	1.039
902	40216	1035452.924	505472.7397	NG_TOP	1992.421	1991.130	-1.291	1.666
903	40217	1035458.148	505449.8361	NG_SPOT	1991.619	1991.557	-0.063	0.004
904	40218	1035460.58	505404.1726	NG_BL	1990.919	1991.893	0.974	0.948
905	40219	1035461.058	505387.0741	NG_TOE	1989.175	1990.992	1.817	3.303
906	40220	1035461.018	505384.5019	NG_TOE	1989.194	1990.796	1.603	2.569
907	40221	1035464.524	505332.5359	NG_SLOPE	2003.226	2002.844	-0.382	0.146
908	40222	1035467.55	505262.6726	NG_TOP	2014.273	2012.172	-2.101	4.414
909	40223	1035836.079	505531.1573	70257	2008.746	2007.227	-1.518	2.305
910	40224	1035793.931	505586.1215	NG_TOE	1995.793	1996.163	0.370	0.137
911	40225	1035785.48	505597.4025	NG_TOE	1995.550	1995.982	0.432	0.187
912	40226	1035781.905	505602.0487	NG_BL	1996.964	1996.536	-0.428	0.183
913	40227	1035770.18	505618.4773	NG_BL	1997.521	1996.978	-0.543	0.295
914	40228	1035764.019	505627.9764	NG_TOE	1995.229	1997.014	1.785	3.188
915	40229	1035750.195	505648.5869	NG_TOE	1995.685	1996.895	1.210	1.464
916	40230	1035735.025	505664.1336	NG_BL	2004.750	2002.167	-2.583	6.674
917	40231	1035721.255	505684.0216	NG_TOP	2007.780	2006.849	-0.930	0.865
918	40232	1035704.162	505706.5303	NG_SPOT	2008.376	2007.695	-0.680	0.463
919	40233	1035961.019	505908.1311	NG_SPOT	2013.623	2013.541	-0.082	0.007
920	40234	1035971.364	505878.2062	NG_TOP	2012.906	2012.253	-0.653	0.427
921	40235	1036006.171	505784.9612	NG_BL	2001.286	2001.816	0.530	0.281
922	40236	1036007.934	505780.9998	NG_TOE	1999.829	2001.106	1.277	1.631
923	40237	1036015.951	505761.4134	NG_TOE	1999.249	2000.168	0.919	0.845
924	40238	1036017.616	505754.442	8	2001.578	2000.592	-0.986	0.971
925	40239	1036031.475	505720.3301	8	2001.251	2000.964	-0.287	0.082
926	40240	1036032.963	505714.0551	NG_TOE	2000.222	2000.944	0.722	0.521
927	40241	1036034.974	505709.3818	8	2000.305	2000.913	0.608	0.369
928	40242	1036032.35	505696.5329	NG_BL	2001.132	2001.693	0.561	0.315
929	40243	1036044.125	505680.9599	NG_BL	2009.666	2007.729	-1.937	3.752
930	40244	1036049.003	505668.034	NG_TOP	2011.858	2010.826	-1.031	1.064
931	40245	1036064.768	505629.7172	NG_SPOT	2013.114	2011.929	-1.185	1.403
932	40246	1031271.315	506887.2919	NG_SPOT	1944.021	1943.916	-0.105	0.011
933	40247	1031288.938	506839.5624	71	1945.689	1944.997	-0.692	0.479
934	40248	1031300.563	506807.3598	NG_TOE	1925.648	1927.483	1.835	3.368
935	40249	1031306.788	506791.6192	NG_TOE	1925.880	1927.363	1.483	2.200
936	40250	1031310.074	506782.3795	NG_BL	1928.006	1927.802	-0.204	0.042
937	40251	1031323.461	506746.6934	NG_SPOT	1930.231	1929.228	-1.003	1.005
938	40252	1031340.734	506699.9024	NG_SPOT	1931.064	1931.501	0.437	0.191
939	40253	1031358.31	506652.8443	NG_SPOT	1932.877	1932.982	0.106	0.011
940	40254	1031371.113	506619.8304	NG_BL	1934.975	1935.381	0.406	0.165
941	40255	1031384.227	506583.7876	NG_TOP	1939.269	1938.232	-1.037	1.075
942	40256	1031392.709	506559.1085	NG_SPOT	1940.520	1940.901	0.380	0.145
943	40257	1031408.176	506517.7833	NG_SPOT	1941.586	1942.456	0.870	0.757

944	40258	1030775.904	506389.4324	NG_TOP	1932.479	1932.016	-0.462	0.214
945	40259	1030726.734	506429.4954	NG_BL	1921.549	1922.703	1.154	1.333
946	40260	1030698.769	506451.4408	NG_BL	1920.065	1920.325	0.260	0.068
947	40261	1030680.955	506465.8441	NG_TOE	1916.883	1917.985	1.102	1.215
948	40262	1030665.433	506478.4228	NG_TOE	1917.051	1919.150	2.099	4.404
949	40263	1030662.967	506480.4692	NG_BL	1918.506	1919.444	0.938	0.880
950	40264	1030653.123	506489.0822	NG_BL	1919.867	1920.449	0.582	0.339
951	40265	1030613.771	506520.1647	NG_BL	1919.029	1920.901	1.872	3.506
952	40266	1030603.578	506566.0424	NG_BL	1926.591	1926.625	0.034	0.001
953	40267	1030593.212	506599.1249	NG_SPOT	1927.702	1927.872	0.170	0.029
954	40268	1029677.77	508638.6879	NG_SPOT	1921.323	1920.244	-1.078	1.163
955	40269	1029680.737	508671.0139	NG_TOP	1920.803	1918.824	-1.979	3.917
956	40270	1029688.217	508740.0445	NG_BL	1911.646	1911.545	-0.100	0.010
957	40271	1029690.75	508760.8355	NG_BL	1910.662	1909.779	-0.882	0.778
958	40272	1029690.662	508766.2919	NG_TOE	1908.976	1909.387	0.411	0.169
959	40273	1029691.287	508771.1343	NG_TOE	1909.252	1909.476	0.224	0.050
960	40274	1029697.28	508823.6668	NG_TOP	1918.510	1918.679	0.169	0.029
961	40275	1029704.143	508853.8216	NG_TOP	1919.033	1918.345	-0.688	0.474
962	40276	1029711.265	508879.8834	NG_BL	1915.782	1917.293	1.511	2.283
963	40277	1029728.039	508932.0754	NG_SPOT	1916.035	1915.824	-0.212	0.045
964	40278	1029726.197	508959.8686	NG_BL	1915.820	1914.803	-1.017	1.033
965	40279	1029723.702	508965.0236	NG_TOE	1913.310	1914.208	0.898	0.807
966	40280	1029716.968	508985.7657	NG_TOE	1913.469	1913.950	0.481	0.232
967	40281	1029716.083	508993.1077	NG_BL	1915.004	1914.546	-0.458	0.210
968	40282	1029703.466	509036.2293	NG_SPOT	1914.853	1914.960	0.107	0.011
969	40283	1029686.993	509096.7017	NG_TOE	1914.226	1914.246	0.020	0.000
970	40284	1029684.669	509104.3332	NG_TOE	1913.588	1914.686	1.098	1.205
971	40285	1029683.821	509105.5446	NG_BL	1914.627	1914.737	0.110	0.012
972	40286	1029676.919	509132.4362	NG_SPOT	1914.778	1915.154	0.376	0.141
973	40287	1029656.166	509186.3263	NG_SPOT	1914.161	1914.888	0.727	0.528
974	40288	1029650.203	509200.0812	NG_BL	1913.563	1913.711	0.148	0.022
975	40289	1029650.095	509201.2999	NG_TOE	1913.034	1913.579	0.545	0.297
976	40290	1029633.513	509211.2845	NG_TOE	1912.918	1914.237	1.319	1.740
977	40291	1029637.023	509220.3826	NG_TOP	1915.815	1915.596	-0.219	0.048
978	40292	1029627.279	509259.4785	NG_TOE	1915.590	1916.745	1.156	1.336
979	40293	1027740.977	509368.5256	NG_SPOT	1893.574	1894.685	1.112	1.236
980	40294	1027733.696	509421.0556	NG_TOP	1892.823	1893.145	0.322	0.104
981	40295	1027722.493	509499.7589	NG_TOE	1884.307	1884.560	0.253	0.064
982	40296	1027721.702	509504.1732	NG_TOE	1884.130	1885.608	1.478	2.183
983	40297	1027720.479	509510.2067	NG_BL	1885.187	1887.188	2.001	4.005
984	40298	1027714.974	509556.5404	NG_SPOT	1886.401	1887.926	1.525	2.325
985	40299	1027724.113	509619.588	NG_BL	1886.397	1886.789	0.392	0.154
986	40300	1028340.796	509368.3198	NG_SPOT	1895.640	1897.283	1.644	2.702
987	40301	1028318.035	509404.6956	NG_TOP	1893.208	1894.995	1.787	3.195

988	40302	1028316.631	509409.6238	NG_TOE	1891.245	1893.565	2.320	5.384
989	40303	1028331.761	509420.4669	NG_SPOT	1891.266	1892.385	1.119	1.253
990	40304	1028329.917	509426.4647	NG_TOE	1891.854	1893.559	1.704	2.905
991	40305	1028328.796	509431.3163	NG_TOP	1893.052	1894.502	1.450	2.102
992	40306	1028329.365	509446.535	NG_TOE	1894.389	1897.394	3.005	9.032
993	40307	1028329.213	509451.8357	NG_TOP	1897.041	1898.409	1.369	1.873
994	40308	1028326.949	509464.7373	NG_SPOT	1898.262	1899.354	1.092	1.193
995	40309	1027725.002	509626.4428	NG_TOE	1884.643	1885.915	1.272	1.617
996	40310	1027728.238	509645.5847	NG_TOE	1884.912	1886.557	1.645	2.705
997	40311	1027733.568	509682.7252	NG_TOP	1890.604	1891.181	0.577	0.333
998	40312	1027738.966	509711.8744	NG_SPOT	1891.287	1891.488	0.201	0.040
999	40313	1027334.491	509833.7765	NG_SPOT	1884.894	1885.156	0.262	0.069
1000	40314	1027328.424	509783.7849	NG_SPOT	1884.409	1884.459	0.051	0.003
1001	40315	1027322.502	509734.3279	NG_SPOT	1883.029	1883.468	0.439	0.193
1002	40316	1027316.914	509684.2492	NG_SPOT	1882.182	1882.829	0.647	0.419
1003	40317	1027310.909	509634.9403	NG_SPOT	1880.461	1882.473	2.012	4.048
1004	40318	1027310.108	509627.1673	NG_SPOT	1880.344	1882.210	1.866	3.483
1005	40319	1027284.447	509581.1114	NG_BL	1879.265	1881.340	2.075	4.305
1006	40320	1027282.216	509573.9425	NG_TOE	1877.981	1880.907	2.926	8.562
1007	40321	1027274.122	509558.38	NG_TOE	1878.137	1880.667	2.531	6.404
1008	40322	1027272.153	509553.9158	NG_BL	1880.104	1881.697	1.593	2.537
1009	40323	1027262.007	509535.6174	NG_TOP	1882.416	1883.108	0.691	0.478
1010	40324	1027241.168	509493.1503	NG_SPOT	1883.274	1884.102	0.828	0.685
1011	40325	1027219.469	509451.2364	NG_SPOT	1882.484	1883.620	1.136	1.290
1012	40326	1027190.853	509401.0951	NG_SPOT	1883.349	1884.664	1.316	1.732
1013	40333	1027740.363	507694.726	NG_TOP	1888.887	1889.828	0.941	0.886
1014	40334	1027734.51	507653.1075	NG_TOE	1876.120	1878.035	1.915	3.666
1015	40335	1027732.072	507639.653	NG_TOE	1877.243	1876.888	-0.355	0.126
1016	40336	1027731.874	507633.846	NG_BL	1877.380	1878.009	0.629	0.396
1017	40337	1027730.602	507630.1843	NG_BL	1878.934	1879.285	0.351	0.124
1018	40338	1027725.079	507595.7179	NG_SPOT	1879.640	1880.810	1.171	1.370
1019	40339	1027717.456	507546.4295	NG_SPOT	1880.443	1881.131	0.688	0.474
1020	40340	1027710.363	507497.4029	NG_BL	1881.315	1881.906	0.591	0.349
1021	40341	1027705.551	507468.7314	NG_TOP	1884.251	1885.958	1.707	2.915
1022	40342	1027078.653	507602.7128	NG_SPOT	1878.864	1878.250	-0.614	0.377
1023	40343	1027080.219	507647.4236	NG_TOP	1876.577	1877.392	0.815	0.664
1024	40344	1027080.936	507671.1442	NG_BL	1870.306	1870.338	0.031	0.001
1025	40345	1027081.602	507680.3844	NG_BL	1870.574	1869.610	-0.963	0.927
1026	40346	1027082.072	507690.2484	NG_TOE	1868.905	1869.949	1.045	1.091
1027	40347	1027082.093	507701.4616	NG_TOE	1868.914	1872.800	3.886	15.103
1028	40348	1027082.965	507706.4897	NG_BL	1871.635	1873.189	1.554	2.415
1029	40349	1027084.121	507752.4123	NG_SPOT	1872.293	1873.504	1.211	1.466
1030	40350	1027084.823	507775.8507	NG_SPOT	1872.594	1873.514	0.920	0.847
1031	40351	1027088.324	507825.6813	NG_SPOT	1872.032	1872.996	0.964	0.928

1032	40352	1027091.993	507875.5024	NG_SPOT	1870.327	1872.617	2.290	5.243
1033	40353	1027095.316	507901.7131	NG_BL	1870.751	1870.707	-0.044	0.002
1034	40354	1027095.882	507906.9798	NG_TOE	1868.648	1869.403	0.755	0.571
1035	40355	1027095.264	507910.1825	NG_TOE	1868.640	1869.923	1.284	1.647
1036	40356	1027103.686	508035.598	NG_TOP	1887.095	1887.931	0.836	0.699
1037	40357	1027098.499	507964.0301	NG_SLOPE	1877.484	1877.922	0.438	0.192
1038	40358	1025639.372	507897.8008	NG_SPOT	1857.039	1859.408	2.369	5.614
1039	40359	1025639.865	507878.1629	NG_BL	1857.352	1858.570	1.218	1.482
1040	40360	1025639.836	507843.523	NG_BL	1855.329	1857.661	2.332	5.439
1041	40361	1025639.89	507803.3407	NG_BL	1855.807	1855.936	0.130	0.017
1042	40362	1025640.28	507797.0468	NG_TOE	1853.569	1854.866	1.298	1.684
1043	40363	1025641.473	507783.184	NG_TOE	1852.774	1854.024	1.250	1.562
1044	40364	1025642.844	507773.7033	87	1856.730	1857.399	0.669	0.447
1045	40365	1025640.646	507697.6134	NG_SPOT	1856.190	1857.324	1.134	1.286
1046	40366	1025640.907	507647.6892	NG_SPOT	1856.064	1857.856	1.792	3.213
1047	40367	1025641.13	507620.6146	NG_SPOT	1856.022	1857.878	1.856	3.443
1048	40368	1025635.891	507598.742	NG_FL	1854.642	1855.896	1.254	1.572
1049	40369	1025636.082	507600.899	NG_BL	1855.937	1856.368	0.431	0.186
1050	40370	1025635.319	507595.442	NG_BL	1855.978	1855.817	-0.161	0.026
1051	40371	1025629.801	507572.6518	NG_SPOT	1855.767	1857.198	1.431	2.049
1052	40372	1025617.871	507523.9707	NG_BL	1857.499	1859.103	1.604	2.572
1053	40373	1025607.981	507483.2464	NG_TOP	1860.941	1862.304	1.362	1.856
1054	40374	1025605.749	507472.0272	NG_SPOT	1861.400	1862.278	0.879	0.773
1055	40375	1025081.203	508094.3583	NG_TOP	1849.437	1852.489	3.052	9.315
1056	40376	1025100.346	508119.9018	NG_BL	1847.016	1847.489	0.473	0.223
1057	40377	1025102.358	508124.6603	NG_FL	1845.424	1846.049	0.625	0.391
1058	40378	1025104.656	508128.435	NG_BL	1846.728	1846.673	-0.054	0.003
1059	40379	1025116.354	508142.8676	NG_SPOT	1846.972	1848.922	1.950	3.804
1060	40380	1025126.545	508159.1629	NG_BL	1847.683	1848.605	0.922	0.851
1061	40381	1025130.338	508163.2798	NG_TOE	1845.444	1846.516	1.072	1.148
1062	40382	1025133.602	508167.5042	NG_TOE	1845.498	1847.222	1.724	2.971
1063	40383	1025135.666	508169.1342	NG_BL	1847.656	1847.593	-0.063	0.004
1064	40384	1025143.863	508183.2335	NG_TOE	1845.250	1847.146	1.896	3.596
1065	40385	1025141.197	508178.6571	NG_BL	1847.812	1848.099	0.287	0.082
1066	40386	1025148.571	508190.1481	NG_TOE	1845.177	1847.489	2.312	5.347
1067	40387	1025150.277	508192.4959	NG_BL	1847.377	1848.096	0.719	0.517
1068	40388	1025168.103	508217.5492	NG_SPOT	1847.536	1849.074	1.538	2.365
1069	40389	1025178.602	508230.8123	89	1846.921	1847.805	0.884	0.781
1070	40390	1025180.263	508232.6277	NG_TOE	1845.298	1846.758	1.460	2.131
1071	40391	1025181.722	508235.499	NG_TOE	1845.626	1846.707	1.081	1.169
1072	40392	1025184.682	508239.2529	NG_BL	1846.967	1847.770	0.804	0.646
1073	40393	1025196.612	508256.8365	NG_BL	1846.946	1848.423	1.477	2.181
1074	40394	1025199.349	508260.2066	NG_FL	1845.408	1848.768	3.361	11.295
1075	40395	1025209.41	508273.6555	NG_BL	1853.057	1852.975	-0.083	0.007

1076	40396	1025232.702	508308.1347	70228	1855.967	1856.987	1.020	1.040
1077	40397	1025057.239	508471.0419	NG_TOP	1853.549	1854.028	0.479	0.229
1078	40398	1025044.585	508400.5558	NG_BL	1846.151	1848.235	2.084	4.345
1079	40399	1025046.043	508370.4091	NG_BL	1845.398	1844.521	-0.877	0.768
1080	40400	1025047.208	508362.6512	NG_FL	1843.341	1843.735	0.394	0.155
1081	40401	1025046.205	508358.6718	NG_BL	1844.754	1844.521	-0.233	0.054
1082	40402	1025029.782	508323.5052	NG_SPOT	1845.238	1846.504	1.266	1.602
1083	40403	1025020.673	508274.2744	NG_SPOT	1845.699	1847.141	1.442	2.080
1084	40404	1025010.628	508225.2874	NG_SPOT	1845.564	1846.801	1.237	1.530
1085	40405	1025004.712	508192.5493	NG_TOE	1843.550	1846.508	2.959	8.754
1086	40406	1025004.432	508194.5889	NG_BL	1845.322	1846.526	1.205	1.451
1087	40407	1025001.276	508172.9637	NG_TOE	1842.947	1844.663	1.717	2.948
1088	40408	1024997.456	508154.2305	NG_BL	1847.943	1848.474	0.530	0.281
1089	40409	1024994.019	508133.5923	NG_SPOT	1848.208	1849.852	1.644	2.702
1090	40410	1024721.604	508004.4508	NG_SPOT	1850.673	1851.590	0.917	0.841
1091	40411	1024709.975	508053.2434	NG_BL	1850.515	1850.676	0.161	0.026
1092	40412	1024699.272	508100.5917	NG_BL	1847.944	1848.450	0.506	0.256
1093	40413	1024687.359	508149.7381	NG_BL	1842.021	1843.100	1.079	1.164
1094	40414	1024675.497	508198.9955	NG_SPOT	1842.168	1843.284	1.116	1.245
1095	40415	1024673.31	508210.4794	NG_SPOT	1842.240	1843.294	1.055	1.112
1096	40416	1024688.491	508252.3213	NG_BL	1841.604	1842.531	0.928	0.861
1097	40417	1024689.936	508256.2204	NG_TOE	1839.005	1841.304	2.298	5.282
1098	40418	1024693.084	508265.0455	NG_TOE	1838.941	1841.633	2.692	7.249
1099	40419	1024695.112	508270.1545	NG_BL	1841.887	1842.704	0.817	0.667
1100	40420	1024698.125	508280.5375	NG_SPOT	1841.792	1842.869	1.077	1.161
1101	40421	1024692.31	508330.0595	NG_SPOT	1840.963	1842.089	1.126	1.269
1102	40422	1024690.097	508346.2082	NG_BL	1841.440	1841.832	0.392	0.154
1103	40423	1024688.938	508356.4239	NG_TOE	1839.105	1839.953	0.848	0.719
1104	40424	1024688.517	508360.273	NG_TOE	1839.037	1841.033	1.995	3.982
1105	40425	1024687.761	508377.0734	NG_BL	1844.358	1845.229	0.871	0.758
1106	40426	1024680.928	508429.6	NG_SPOT	1844.930	1845.917	0.987	0.974
1107	40427	1024515.676	508394.949	NG_SPOT	1843.118	1844.566	1.448	2.098
1108	40428	1024521.711	508364.3892	NG_BL	1842.644	1842.975	0.331	0.110
1109	40429	1024525.473	508345.3206	NG_TOE	1837.636	1839.352	1.716	2.943
1110	40430	1024530.526	508329.0775	NG_TOE	1837.090	1840.840	3.750	14.062
1111	40431	1024531.203	508322.5285	NG_BL	1840.105	1841.495	1.390	1.932
1112	40432	1024535.94	508296.7733	NG_SPOT	1840.124	1841.450	1.326	1.759
1113	40433	1024538.208	508285.6935	NG_SPOT	1840.153	1841.493	1.341	1.798
1114	40434	1024536.593	508235.9146	NG_SPOT	1840.562	1841.351	0.789	0.623
1115	40435	1024534.893	508185.5935	NG_SPOT	1840.495	1841.365	0.871	0.758
1116	40436	1024533.217	508139.2949	NG_BL	1840.217	1841.078	0.861	0.741
1117	40437	1024532.309	508108.0319	NG_BL	1845.671	1846.424	0.753	0.567
1118	40438	1024532.022	508091.3367	NG_BL	1846.431	1848.446	2.015	4.060
1119	40439	1024302.644	508114.0484	NG_SPOT	1839.989	1841.619	1.630	2.656

1120	40440	1024320.077	508161.086	NG_SPOT	1838.758	1840.663	1.905	3.631
1121	40441	1024337.257	508207.7486	NG_SPOT	1837.439	1838.622	1.182	1.398
1122	40442	1024354.66	508254.8523	NG_SPOT	1838.370	1838.989	0.619	0.384
1123	40443	1024360.138	508269.4364	NG_SPOT	1838.016	1839.411	1.395	1.945
1124	40444	1024364.752	508322.4444	NG_BL	1838.446	1838.582	0.136	0.019
1125	40445	1024364.68	508327.6917	NG_TOE	1835.255	1837.580	2.325	5.405
1126	40446	1024367.514	508339.5743	NG_TOE	1835.607	1837.329	1.722	2.965
1127	40447	1024368.921	508345.715	NG_BL	1838.331	1838.490	0.158	0.025
1128	40448	1024371.003	508368.6854	NG_SPOT	1838.261	1839.527	1.265	1.601
1129	40449	1024376.727	508418.41	NG_SPOT	1839.563	1840.263	0.700	0.490
1130	40450	1024380.474	508451.8161	NG_BL	1839.979	1841.269	1.290	1.664
1131	40451	1024233.973	508608.7604	NG_BL	1842.019	1843.577	1.558	2.429

1132	40452	1024196.313	508560.9248	NG_BL	1834.715	1836.765	2.050	4.203
1133	40453	1024187.172	508549.3622	NG_FL	1833.660	1834.564	0.904	0.818
1134	40454	1024172.209	508530.2979	NG_SPOT	1834.701	1836.110	1.409	1.986
1135	40455	1024140.672	508491.4792	NG_SPOT	1834.647	1836.085	1.439	2.069
1136	40456	1024109.88	508452.3196	NG_SPOT	1835.425	1836.340	0.916	0.839
1137	40457	1024093.962	508435.1182	NG_BL	1835.845	1836.374	0.529	0.280
1138	40458	1024089.443	508426.9547	NG_TOE	1833.091	1834.620	1.529	2.338
1139	40459	1024082.443	508418.5773	NG_TOE	1832.748	1834.156	1.408	1.984
1140	40460	1024076.106	508408.8868	NG_BL	1834.772	1836.795	2.023	4.093
1141	40461	1024047.89	508373.7258	NG_SPOT	1835.315	1836.311	0.996	0.991
1142	40462	1024016.802	508334.6165	NG_SPOT	1835.306	1836.206	0.900	0.810
1143	40463	1023979.286	508287.4876	NG_BL	1837.924	1838.644	0.720	0.518
1144	40464	1023827.32	508496.9614	NG_BL	1835.834	1836.449	0.615	0.379
1145	40465	1023828.146	508547.0938	NG_SPOT	1833.523	1834.285	0.763	0.582
1146	40466	1023828.476	508596.9894	NG_SPOT	1831.336	1832.361	1.025	1.051
1147	40467	1023828.801	508623.7291	NG_BL	1831.237	1831.310	0.073	0.005
1148	40468	1023829.666	508628.6522	NG_TOE	1829.699	1830.554	0.855	0.731
1149	40469	1023829.654	508632.7085	NG_TOE	1829.522	1830.100	0.579	0.335
1150	40470	1023829.767	508637.5988	NG_BL	1830.954	1831.046	0.092	0.008
1151	40471	1023829.826	508658.1036	NG_SPOT	1831.173	1832.464	1.291	1.667
1152	40472	1023844.994	508685.3844	NG_BL	1831.175	1832.442	1.266	1.604
1153	40473	1023848.617	508693.3441	NG_TOE	1829.290	1831.048	1.758	3.091
1154	40474	1023853.192	508701.959	NG_TOE	1829.000	1831.273	2.273	5.167
1155	40475	1023856.23	508707.1192	NG_BL	1831.387	1832.213	0.826	0.682
1156	40476	1023881.046	508755.1342	NG_SPOT	1830.507	1832.008	1.501	2.253
1157	40477	1023900.368	508790.1199	NG_SPOT	1830.159	1832.059	1.900	3.611
1158	40478	1023912.403	508805.2683	NG_BL	1830.374	1830.350	-0.024	0.001
1159	40479	1023912.757	508810.9896	NG_FL	1828.659	1829.609	0.950	0.902
1160	40480	1023923.79	508835.8754	NG_BL	1835.307	1835.610	0.302	0.091
1161	40481	1023935.043	508853.1157	100	1835.843	1837.015	1.172	1.373
1162	40482	1023948.768	508880.1925	NG_SPOT	1835.321	1837.264	1.943	3.774
1163	40483	1023401.424	509080.9228	NG_BL	1827.114	1827.075	-0.039	0.002
1164	40484	1023387.549	509117.7573	NG_BL	1824.318	1825.469	1.151	1.325
1165	40485	1023379.813	509139.0928	NG_SPOT	1824.131	1824.942	0.811	0.657
1166	40486	1023367.101	509169.463	NG_BL	1824.527	1824.597	0.070	0.005
1167	40487	1023364.262	509173.2001	NG_BL	1823.315	1824.128	0.813	0.661
1168	40488	1023361.813	509189.8998	NG_TOE	1822.181	1823.240	1.059	1.122
1169	40489	1023359.549	509197.6658	NG_TOE	1822.071	1822.957	0.886	0.785
1170	40490	1023357.841	509201.3047	NG_BL	1824.769	1823.862	-0.906	0.822
1171	40491	1023349.894	509223.1652	NG_BL	1827.011	1826.845	-0.166	0.027
1172	40492	1023338.498	509253.2332	NG_SPOT	1827.696	1827.973	0.278	0.077

Sum (Diff Elev^2)=	1344.912
RMSE =	**1.071**

RMSE determination for south points.

Shapefile: south-points-none-removed.shp = Ground survey and TIN elevations for all points where ground survey was taken in 2-ft contour area.

Shapefile: south-points-struct-outliers-removed.shp = Take south-points-none-removed.shp and remove those points that were at structures and those few points where the TIN was obviously incorrect.

Point Number	Survey ID	Y	X	Survey Notes	Survey Elev (ft)	Tin_Spot Elev (ft)	Tin Spot Elev minus Survey Elev (ft)	Elevation Difference Squared (sq ft).
1	30830	1014513.513	510905.4888	NG_RIDGE_END	1727.530	1727.046	-0.484	0.234
2	30831	1014519.885	510909.3022	NG_TOE	1724.988	1724.865	-0.123	0.015
3	30832	1014563.796	510923.1423	NG_SPOT	1726.537	1726.163	-0.374	0.140
4	30833	1014638.656	510924.8046	NG_SPOT	1727.701	1727.895	0.194	0.038
5	30834	1014702.883	510929.4176	NG_SPOT	1729.195	1728.893	-0.302	0.091
6	30835	1014709.363	510925.0609	NG_SPOT	1729.390	1729.081	-0.309	0.095
7	30836	1014671.937	510890.3091	NG_SPOT	1728.558	1728.631	0.073	0.005
8	30837	1014634.978	510854.2925	NG_SPOT	1726.473	1726.136	-0.337	0.113
9	30838	1014596.154	510822.7296	NG_SPOT	1725.809	1725.279	-0.531	0.282
10	30839	1014562.569	510786.2015	NG_SPOT	1723.127	1723.481	0.354	0.125
11	30840	1014552.096	510771.7033	NG_TOE	1723.007	1723.492	0.485	0.236
12	30841	1014550.344	510768.7304	NG_TOP	1724.417	1723.730	-0.687	0.472
13	30842	1014534.961	510757.7939	NG_SPOT	1726.471	1726.396	-0.074	0.006
14	30844	1014969.713	510694.3669	NG_SPOT	1731.894	1731.586	-0.307	0.094
15	30845	1014960.103	510645.6891	NG_SPOT	1730.406	1730.010	-0.396	0.156
16	30846	1014949.407	510596.2174	NG_SPOT	1732.487	1731.821	-0.666	0.444
17	30847	1014940.664	510548.0773	NG_SPOT	1730.104	1729.760	-0.343	0.118
18	30848	1014930.695	510503.8136	NG_TOP	1728.649	1728.625	-0.024	0.001
19	30849	1014931.265	510500.5067	NG_TOE	1726.056	1727.894	1.838	3.380
20	30850	1014928.119	510492.6021	NG_SPOT	1725.794	1727.086	1.292	1.668
21	30851	1014926.919	510486.0237	NG_TOE	1725.871	1726.869	0.999	0.997
22	30852	1014921.915	510476.2063	NG_TOP	1729.844	1729.046	-0.798	0.638
23	30853	1014916.773	510450.6447	NG_SPOT	1730.822	1730.937	0.114	0.013
24	30854	1014900.619	510412.6228	NG_SPOT	1730.020	1729.995	-0.026	0.001
25	30855	1014876.476	510392.103	NG_TOE	1730.335	1730.366	0.031	0.001
26	30856	1014862.477	510379.0706	NG_TOP	1734.254	1733.915	-0.339	0.115
27	30857	1015092.338	510245.4492	NG_SPOT	1734.725	1734.337	-0.388	0.151
28	30858	1015106.274	510295.6941	NG_SPOT	1734.087	1733.857	-0.231	0.053
29	30859	1015116.624	510341.5315	NG_SPOT	1733.591	1733.438	-0.153	0.024
30	30860	1015125.099	510390.8844	NG_SPOT	1733.036	1732.488	-0.548	0.301
31	30861	1015137.815	510441.571	NG_SPOT	1733.346	1732.804	-0.542	0.293
32	30862	1015159.548	510474.6191	NG_TOP	1732.677	1732.300	-0.377	0.142
33	30863	1015160.916	510477.4642	NG_TOE	1730.003	1732.240	2.237	5.003
34	30864	1015172.204	510498.0265	NG_SPOT	1730.713	1729.541	-1.172	1.373
35	30865	1015181.778	510511.2361	NG_TOE	1731.020	1730.576	-0.444	0.197
36	30866	1015188.032	510516.3734	NG_TOP	1732.885	1732.047	-0.837	0.701

37	30867	1015190.154	510524.589	NG_SPOT	1733.057	1732.277	-0.779	0.607
38	30868	1015213.683	510569.8858	NG_SPOT	1734.933	1733.974	-0.959	0.919
39	30869	1015239.567	510611.6138	NG_SPOT	1735.056	1734.564	-0.492	0.242
40	30870	1015258.8	510641.4079	NG_SPOT	1735.217	1734.613	-0.604	0.364
41	30871	1016028.622	510483.333	NG_SPOT	1744.560	1744.569	0.009	0.000
42	30872	1016022.252	510433.357	NG_SPOT	1744.392	1744.078	-0.315	0.099
43	30873	1016019.519	510423.8281	NG_TOP	1743.897	1743.275	-0.622	0.386
44	30874	1016018.475	510417.2058	NG_TOE	1741.414	1741.917	0.503	0.253
45	30875	1016013.615	510395.7876	WASH_EDGE	1742.479	1740.482	-1.997	3.987
46	30876	1016014.091	510390.5864	NG_SPOT	1742.286	1740.281	-2.005	4.019
47	30877	1016016.372	510371.7353	NG_TOE	1739.426	1739.585	0.159	0.025
48	30878	1016017.469	510376.5144	NG_TOP	1742.189	1739.769	-2.420	5.857
49	30879	1016015.043	510363.3767	NG_SPOT	1739.543	1739.369	-0.174	0.030
50	30880	1016010.912	510353.8102	NG_TOE	1739.913	1740.495	0.582	0.339
51	30881	1016009.265	510345.6086	NG_TOP	1742.424	1742.395	-0.029	0.001
52	30882	1016011.495	510336.8369	NG_SPOT	1742.225	1742.445	0.220	0.048
53	30883	1016009.519	510286.6882	NG_SPOT	1743.379	1743.312	-0.067	0.004
54	30884	1016008.663	510267.9626	NG_SPOT	1744.131	1743.830	-0.301	0.091
55	30885	1015979.553	510229.8092	NG_LOW	1740.714	1740.764	0.050	0.002
56	30886	1015961.482	510202.8198	NG_SPOT	1743.743	1742.633	-1.110	1.231
57	30887	1015954.607	510151.5999	NG_SPOT	1744.218	1743.573	-0.644	0.415
58	30888	1015950.521	510102.8104	NG_SPOT	1745.193	1744.384	-0.809	0.654
59	30889	1016081.272	509950.553	NG_SPOT	1747.227	1746.880	-0.346	0.120
60	30890	1016107.397	509994.6587	NG_SPOT	1746.432	1746.181	-0.250	0.063
61	30891	1016135.29	510034.6879	NG_SPOT	1745.604	1744.978	-0.626	0.392
62	30892	1016161.208	510076.433	NG_SPOT	1746.535	1745.905	-0.630	0.397
63	30893	1016169.414	510090.6633	NG_SPOT	1746.543	1746.292	-0.251	0.063
64	30894	1016179.078	510139.5983	NG_SPOT	1746.358	1745.651	-0.707	0.500
65	30895	1016188.18	510187.8273	NG_SPOT	1746.058	1745.968	-0.090	0.008
66	30896	1016227.269	510235.1779	NG_SPOT	1746.106	1745.415	-0.691	0.477
67	30897	1016273.094	510273.327	NG_SPOT	1745.180	1744.992	-0.188	0.035
68	30898	1016287.951	510310.4079	NG_SPOT	1745.011	1745.201	0.190	0.036
69	30899	1016305.879	510328.9127	WASH_EDGE	1745.073	1744.718	-0.356	0.127
70	30900	1016319.832	510349.3196	NG_SPOT	1744.149	1743.613	-0.535	0.287
71	30901	1016327.012	510360.6288	NG_SPOT	1745.319	1743.480	-1.839	3.382
72	30902	1016332.473	510367.1632	NG_SPOT	1744.391	1743.402	-0.989	0.978
73	30903	1016350.695	510380.4205	NG_TOE	1743.194	1745.738	2.544	6.472
74	30904	1016354.392	510383.2248	NG_TOP	1746.891	1746.938	0.047	0.002
75	30905	1016356.935	510392.4351	NG_SPOT	1747.177	1746.964	-0.213	0.045
76	30906	1016395.672	510439.0796	NG_SPOT	1748.669	1748.510	-0.159	0.025
77	30907	1017176.443	510167.2999	NG_SPOT	1757.036	1756.551	-0.485	0.235
78	30908	1017151.47	510122.4705	NG_SPOT	1756.324	1756.027	-0.297	0.088
79	30909	1017127.087	510078.5765	NG_SPOT	1755.846	1755.743	-0.102	0.010
80	30910	1017105.296	510035.9682	NG_SPOT	1755.365	1755.210	-0.155	0.024

81	30911	1017077.596	509998.7374	NG_SPOT	1754.953	1754.372	-0.581	0.337
82	30912	1017066.363	509962.8331	NG_TOP	1752.953	1751.456	-1.497	2.240
83	30913	1017063.206	509957.7781	NG_TOE	1752.041	1751.503	-0.538	0.289
84	30914	1017058.871	509950.9065	NG_SPOT	1751.793	1751.687	-0.106	0.011
85	30915	1017054.583	509942.9075	NG_TOE	1751.763	1751.900	0.137	0.019
86	30916	1017047.51	509929.3442	NG_TOP	1754.545	1754.840	0.295	0.087
87	30917	1017035.448	509906.3505	NG_SPOT	1754.740	1754.805	0.065	0.004
88	30918	1017011.262	509859.4086	NG_SPOT	1754.693	1754.255	-0.438	0.191
89	30919	1016984.174	509818.9139	NG_SPOT	1755.627	1755.741	0.113	0.013
90	30920	1016961.674	509769.3347	NG_SPOT	1756.073	1756.020	-0.053	0.003
91	30921	1017218.729	509716.1842	NG_SPOT	1757.446	1757.542	0.096	0.009
92	30922	1017245.74	509761.2458	NG_SPOT	1758.340	1756.732	-1.608	2.586
93	30923	1017268.814	509801.6374	NG_SPOT	1757.180	1755.995	-1.185	1.403
94	30924	1017271.733	509810.5611	NG_TOP	1756.690	1755.854	-0.836	0.698
95	30925	1017275.482	509815.2686	NG_TOE	1755.143	1755.556	0.413	0.171
96	30926	1017285.547	509827.9038	NG_SPOT	1755.105	1754.363	-0.741	0.550
97	30927	1017292.643	509844.6327	NG_TOE	1754.006	1754.464	0.459	0.211
98	30928	1017295.331	509850.7909	NG_TOP	1756.299	1755.956	-0.343	0.118
99	30929	1017320.045	509889.9061	NG_SPOT	1758.099	1757.943	-0.156	0.024
100	30930	1017346.627	509932.8664	NG_SPOT	1759.194	1759.137	-0.058	0.003
101	30931	1017354.68	509946.697	NG_SPOT	1759.354	1759.458	0.104	0.011
102	30932	1017270.227	509797.1419	NG_SPOT	1757.465	1756.037	-1.428	2.040
103	30940	1017351.365	509674.9278	NG_SPOT	1758.810	1759.004	0.194	0.038
104	30941	1017505.278	509629.1328	NG_SPOT	1760.425	1761.078	0.653	0.426
105	30942	1017506.031	509669.3319	NG_TOP	1760.541	1760.534	-0.006	0.000
106	30943	1017508.761	509675.4244	NG_TOE	1757.579	1759.582	2.002	4.010
107	30944	1017508.752	509692.3498	NG_SPOT	1757.577	1757.421	-0.156	0.024
108	30945	1017510.251	509706.8411	NG_TOE	1757.886	1757.787	-0.099	0.010
109	30946	1017511.046	509738.5855	NG_SPOT	1757.976	1758.318	0.342	0.117
110	30947	1017508.144	509762.1383	NG_TOP	1758.639	1757.839	-0.801	0.641
111	30948	1017508.683	509767.1592	NG_TOE	1757.094	1757.795	0.701	0.492
112	30949	1017508.38	509773.2729	NG_SPOT	1757.326	1757.720	0.394	0.155
113	30950	1017504.038	509777.5596	NG_TOE	1757.373	1757.215	-0.159	0.025
114	30951	1017502.996	509783.4745	NG_TOP	1758.223	1757.560	-0.662	0.439
115	30952	1017497.708	509840.5881	NG_SPOT	1761.023	1761.430	0.407	0.165
116	30953	1017400.422	511009.4575	NG_SPOT	1756.669	1756.656	-0.012	0.000
117	30954	1017406.589	511060.2985	NG_SPOT	1756.251	1756.250	0.000	0.000
118	30955	1017414.112	511110.4479	NG_SPOT	1755.511	1755.370	-0.141	0.020
119	30956	1017420.09	511159.8558	NG_SPOT	1755.979	1755.707	-0.272	0.074
120	30957	1017423.084	511180.6284	NG_SPOT	1755.826	1755.499	-0.326	0.106
121	30958	1017448.966	511223.547	NG_SPOT	1754.858	1754.855	-0.003	0.000
122	30959	1017466.472	511254.7708	NG_TOP	1755.540	1754.713	-0.827	0.683
123	30960	1017471.199	511260.0965	NG_TOE	1752.278	1752.149	-0.129	0.017
124	30961	1017471.366	511267.1304	NG_TOE	1752.053	1752.522	0.469	0.220

125	30962	1017472.001	511268.7893	NG_TOP	1754.876	1753.474	-1.402	1.967
126	30963	1017498.232	511309.3285	NG_SPOT	1754.772	1755.252	0.480	0.230
127	30964	1017520.468	511346.9031	NG_SPOT	1755.523	1755.571	0.048	0.002
128	30965	1017523.264	511396.3752	NG_SPOT	1755.741	1755.491	-0.250	0.062
129	30966	1017525.121	511450.7845	NG_SPOT	1755.467	1755.689	0.222	0.049
130	30967	1017553.864	511492.724	NG_SPOT	1755.393	1755.064	-0.329	0.108
131	30968	1017583.779	511532.2489	NG_SPOT	1755.639	1755.484	-0.155	0.024
132	30969	1017613.323	511571.5739	NG_SPOT	1756.220	1755.694	-0.526	0.277
133	30970	1017640.785	511614.4834	NG_SPOT	1756.841	1756.481	-0.360	0.130
134	30971	1017664.977	511646.4712	NG_SPOT	1756.654	1756.603	-0.052	0.003
135	31042	1021263.57	511100.4488	NG_SPOT	1800.484	1800.790	0.306	0.094
136	31043	1021264.73	511069.3833	NG_TOP	1800.429	1799.831	-0.598	0.358
137	31044	1021263.965	511066.0219	NG_TOE	1798.166	1798.971	0.805	0.647
138	31045	1021263.848	511063.868	NG_TOE	1797.969	1798.474	0.505	0.255
139	31046	1021263.477	511062.2458	NG_TOP	1800.202	1798.407	-1.795	3.222
140	31047	1021262.747	511057.9797	NG_TOP	1800.245	1798.316	-1.929	3.722
141	31048	1021262.843	511056.669	NG_TOE	1798.300	1798.330	0.030	0.001
142	31049	1021261.841	511052.2312	NG_TOE	1798.372	1798.623	0.251	0.063
143	31050	1021263.739	511047.5047	NG_TOP	1800.204	1800.140	-0.064	0.004
144	31051	1021263.983	511000.2658	NG_SPOT	1800.208	1800.069	-0.139	0.019
145	31052	1021264.332	510949.5691	NG_SPOT	1800.460	1800.515	0.055	0.003
146	31053	1021265.858	510925.6821	NG_SPOT	1800.624	1800.330	-0.294	0.086
147	31054	1021272.589	510911.6349	NG_TOP	1800.024	1799.791	-0.233	0.054
148	31055	1021273.721	510909.6237	NG_TOE	1799.004	1799.356	0.352	0.124
149	31056	1021276.39	510906.0254	NG_TOE	1799.278	1799.499	0.220	0.049
150	31057	1021276.481	510905.1248	NG_TOP	1800.148	1799.591	-0.558	0.311
151	31058	1021283.866	510889.6486	NG_SPOT	1800.557	1800.649	0.092	0.008
152	31059	1021285.223	510881.7957	NG_TOP	1800.609	1800.290	-0.320	0.102
153	31060	1021287.218	510877.6942	NG_TOE	1798.834	1799.615	0.781	0.610
154	31061	1021288.382	510873.4752	NG_TOP	1800.676	1800.208	-0.467	0.218
155	31062	1021282.571	510845.926	NG_SPOT	1800.494	1800.749	0.255	0.065
156	31063	1021278.986	510796.4102	NG_SPOT	1800.137	1799.995	-0.142	0.020
157	31064	1021276.42	510747.691	NG_SPOT	1800.682	1800.690	0.009	0.000
158	31065	1021273.849	510723.8604	NG_SPOT	1800.898	1800.699	-0.200	0.040
159	31066	1021272.113	510674.2951	NG_SPOT	1800.647	1800.378	-0.268	0.072
160	31067	1021271.455	510622.026	NG_SPOT	1799.499	1799.423	-0.076	0.006
161	31068	1021268.53	510574.3456	NG_SPOT	1799.814	1799.934	0.120	0.015
162	31069	1021269.242	510524.1257	NG_SPOT	1799.815	1799.777	-0.039	0.001
163	31070	1021267.265	510477.0222	NG_SPOT	1799.187	1799.451	0.264	0.070
164	31071	1021257.047	510450.4756	NG_TOP	1798.163	1798.039	-0.124	0.015
165	31072	1021256.473	510447.9069	NG_TOE	1797.467	1797.514	0.048	0.002
166	31073	1021255.761	510442.653	NG_TOP	1798.435	1798.656	0.222	0.049
167	31074	1021254.53	510428.7367	NG_SPOT	1798.663	1798.946	0.284	0.080
168	31075	1021255.869	510416.4418	NG_TOP	1798.599	1798.502	-0.097	0.009

169	31076	1021255.476	510411.3396	NG_TOE	1797.613	1797.816	0.204	0.041
170	31077	1021254.143	510405.2628	NG_TOP	1798.829	1798.768	-0.061	0.004
171	31078	1021238.534	510382.5619	NG_SPOT	1800.383	1800.827	0.444	0.197
172	31079	1021229.331	510346.0702	NG_SPOT	1801.765	1801.610	-0.155	0.024
173	31080	1020346.681	510641.8704	NG_SPOT	1794.013	1794.015	0.002	0.000
174	31081	1020379.645	510707.0965	NG_SPOT	1789.010	1789.281	0.271	0.074
175	31082	1020369.921	510719.8515	NG_SPOT	1788.781	1788.608	-0.173	0.030
176	31083	1020383.526	510745.5935	NG_SPOT	1788.967	1788.671	-0.296	0.088
177	31084	1020391.897	510766.0943	NG_TOP	1788.671	1787.264	-1.407	1.981
178	31085	1020394.382	510768.982	NG_TOE	1786.632	1786.452	-0.180	0.032
179	31086	1020397.447	510773.3665	NG_TOE	1785.838	1787.376	1.538	2.366
180	31087	1020397.344	510780.1831	NG_TOP	1789.078	1788.752	-0.327	0.107
181	31088	1020397.516	510784.4765	NG_SPOT	1789.159	1788.779	-0.380	0.144
182	31089	1020395.199	510788.692	NG_TOP	1788.696	1787.794	-0.903	0.815
183	31090	1020394.745	510791.2755	NG_TOE	1786.708	1786.872	0.165	0.027
184	31091	1020394.298	510795.268	NG_TOE	1786.597	1787.116	0.520	0.270
185	31092	1020394.005	510799.3594	NG_TOP	1788.936	1788.441	-0.494	0.244
186	31093	1020392.803	510805.7218	NG_SPOT	1788.921	1788.748	-0.173	0.030
187	31094	1020386.194	510816.8501	NG_TOP	1788.359	1787.602	-0.757	0.572
188	31095	1020385.497	510819.413	NG_TOE	1786.753	1787.036	0.284	0.080
189	31096	1020383.368	510824.0558	NG_TOP	1788.682	1788.029	-0.653	0.426
190	31097	1020387.189	510845.1035	NG_SPOT	1788.853	1789.161	0.308	0.095
191	31098	1020392.093	510894.3828	NG_SPOT	1788.959	1789.125	0.166	0.028
192	31099	1020393.88	510920.0406	NG_TOP	1788.942	1788.342	-0.600	0.360
193	31100	1020393.848	510922.6494	NG_TOE	1786.660	1787.674	1.014	1.029
194	31101	1020393.087	510926.5236	NG_TOE	1786.536	1788.042	1.507	2.270
195	31102	1020393.137	510930.6207	NG_TOP	1789.079	1788.764	-0.315	0.099
196	31103	1020394.713	510946.1181	NG_SPOT	1789.243	1789.282	0.040	0.002
197	31104	1020397.543	511005.6081	NG_SPOT	1789.581	1789.567	-0.014	0.000
198	31105	1020388.671	511057.1988	NG_SPOT	1790.089	1790.107	0.018	0.000
199	31106	1020380.193	511118.8269	NG_SPOT	1790.498	1790.750	0.252	0.063
200	31107	1018077.626	511575.0585	NG_SPOT	1763.886	1763.632	-0.255	0.065
201	31108	1018092.257	511528.3249	NG_SPOT	1763.837	1762.953	-0.884	0.782
202	31109	1018107.148	511480.413	NG_SPOT	1762.624	1762.457	-0.166	0.028
203	31110	1018123.026	511434.4285	NG_SPOT	1762.951	1762.334	-0.617	0.380
204	31111	1018127.371	511412.755	NG_TOP	1762.725	1761.675	-1.049	1.101
205	31112	1018128.951	511408.3447	NG_TOE	1760.378	1760.491	0.113	0.013
206	31113	1018132.638	511405.0915	NG_TOP	1762.433	1761.771	-0.662	0.439
207	31114	1018141.059	511385.8377	NG_SPOT	1763.194	1762.740	-0.454	0.206
208	31115	1018154.691	511337.8098	NG_SPOT	1763.052	1762.817	-0.235	0.055
209	31116	1018173.462	511286.9788	NG_TOP	1763.082	1762.559	-0.523	0.274
210	31117	1018174.309	511283.8745	NG_TOE	1760.786	1761.478	0.693	0.480
211	31118	1018175.98	511278.7407	NG_TOE	1760.298	1760.976	0.678	0.459
212	31119	1018177.515	511274.0857	NG_TOP	1762.907	1762.140	-0.768	0.589

213	31120	1018185.045	511248.2339	NG_SPOT	1762.970	1762.729	-0.241	0.058
214	31121	1018169.717	511194.6194	NG_TOP	1762.111	1761.883	-0.228	0.052
215	31122	1018169.293	511189.4179	NG_TOE	1760.094	1760.263	0.169	0.029
216	31123	1018166.576	511183.44	NG_TOP	1762.602	1762.290	-0.312	0.097
217	31124	1018162.4	511162.9276	NG_SPOT	1762.345	1762.351	0.006	0.000
218	31125	1018158.626	511112.5997	NG_SPOT	1762.982	1762.163	-0.820	0.672
219	31126	1018152.835	511064.2131	NG_SPOT	1762.627	1762.385	-0.242	0.059
220	31127	1018150.16	511013.4127	NG_SPOT	1762.647	1762.367	-0.280	0.078
221	31128	1018146.744	510977.9426	NG_SPOT	1762.412	1762.279	-0.132	0.018
222	31129	1018128.236	510931.106	NG_TOP	1762.444	1762.233	-0.211	0.045
223	31130	1018126.175	510927.5468	NG_TOE	1760.583	1761.184	0.600	0.360
224	31131	1018124.176	510925.1532	NG_TOE	1760.410	1760.461	0.051	0.003
225	31132	1018123.705	510922.7175	NG_TOP	1762.003	1760.962	-1.041	1.083
226	31133	1018122.412	510880.9291	NG_SPOT	1761.520	1761.416	-0.103	0.011
227	31134	1018110.508	510833.0701	NG_SPOT	1763.322	1762.900	-0.422	0.178
228	31135	1018110.516	510833.1368	NG_SPOT	1763.302	1762.898	-0.403	0.163
229	31136	1018096.239	510779.6822	NG_SPOT	1763.933	1764.117	0.185	0.034
230	31137	1018520.348	510579.9632	NG_SPOT	1770.876	1770.093	-0.782	0.612
231	31138	1018544.309	510627.5818	NG_SPOT	1769.263	1769.094	-0.169	0.029
232	31139	1018565.86	510669.7572	NG_SPOT	1768.266	1768.024	-0.242	0.059
233	31140	1018577.569	510707.4629	NG_LOW	1766.277	1766.023	-0.254	0.064
234	31141	1018588.726	510713.9883	NG_SPOT	1767.751	1767.479	-0.272	0.074
235	31142	1018613.846	510761.5119	NG_SPOT	1768.213	1767.651	-0.562	0.315
236	31143	1018611.472	510811.6116	NG_SPOT	1767.731	1767.292	-0.439	0.192
237	31144	1018608.421	510823.035	NG_TOP	1767.216	1766.682	-0.533	0.284
238	31145	1018609.235	510827.7103	NG_TOE	1765.134	1765.622	0.489	0.239
239	31146	1018609.871	510832.627	NG_TOP	1767.645	1766.665	-0.980	0.961
240	31147	1018606.744	510861.9284	NG_SPOT	1768.162	1767.574	-0.588	0.346
241	31148	1018605.562	510912.6775	NG_SPOT	1768.275	1767.730	-0.545	0.297
242	31149	1018603.684	510961.175	NG_SPOT	1768.336	1767.680	-0.656	0.430
243	31150	1018600.029	510992.8657	NG_SPOT	1768.161	1767.648	-0.512	0.262
244	31151	1018607.27	511007.3427	NG_LOW	1767.183	1767.054	-0.129	0.017
245	31152	1018607.929	511042.3207	NG_SPOT	1767.454	1767.182	-0.272	0.074
246	31153	1018613.709	511091.0024	NG_SPOT	1768.407	1768.202	-0.206	0.042
247	31154	1018619.202	511141.9978	NG_SPOT	1768.563	1768.277	-0.286	0.082
248	31155	1018625.637	511190.7484	NG_SPOT	1768.701	1768.383	-0.318	0.101
249	31156	1018632.479	511251.0137	NG_SPOT	1768.403	1768.079	-0.324	0.105
250	31157	1018616.774	511296.7983	NG_SPOT	1768.091	1767.428	-0.663	0.439
251	31158	1018611.644	511318.3206	NG_LOW	1766.709	1766.616	-0.092	0.009
252	31159	1018600.799	511346.4154	NG_SPOT	1767.728	1767.438	-0.291	0.084
253	31160	1018584.504	511394.3143	NG_SPOT	1767.813	1767.716	-0.097	0.009
254	31161	1018565.842	511444.8693	NG_SPOT	1768.100	1767.733	-0.367	0.134
255	31162	1018570.011	511459.1921	NG_TOP	1767.844	1767.405	-0.439	0.193
256	31163	1018571.726	511462.6456	NG_TOE	1766.213	1766.213	0.000	0.000

257	31164	1018575.275	511469.9262	NG_TOE	1766.199	1766.435	0.236	0.056
258	31165	1018577.052	511473.1134	NG_TOP	1767.710	1767.079	-0.631	0.399
259	31166	1018579.036	511493.2279	NG_SPOT	1768.021	1767.574	-0.448	0.200
260	31167	1018594.202	511542.5222	NG_SPOT	1768.666	1767.987	-0.679	0.461
261	31168	1018609.426	511567.7964	NG_TOP	1767.384	1766.205	-1.179	1.391
262	31169	1018609.408	511570.3308	NG_TOE	1765.951	1765.626	-0.325	0.106
263	31170	1018608.541	511574.9309	NG_TOE	1766.066	1766.614	0.547	0.300
264	31171	1018605.941	511580.1964	NG_TOP	1767.926	1767.768	-0.158	0.025
265	31172	1018609.728	511589.8557	NG_SPOT	1768.241	1767.765	-0.477	0.227
266	31173	1018629.245	511636.0613	NG_SPOT	1767.925	1767.648	-0.277	0.077
267	31174	1018644.646	511674.1265	NG_SPOT	1768.809	1768.227	-0.582	0.339
268	31175	1018535.719	511717.3591	NG_SPOT	1766.871	1766.487	-0.384	0.147
269	31176	1018511.4	511661.5919	NG_LOW	1765.313	1764.610	-0.703	0.494
270	31177	1018510.643	511670.0021	NG_SPOT	1766.386	1766.245	-0.140	0.020
271	31178	1018494.932	511635.9193	NG_TOP	1766.063	1766.139	0.076	0.006
272	31179	1018489.896	511631.4494	NG_TOE	1763.776	1763.733	-0.044	0.002
273	31180	1018484.498	511626.6465	NG_TOP	1766.043	1765.334	-0.710	0.503
274	31181	1018470.539	511574.9413	NG_SPOT	1767.189	1766.845	-0.343	0.118
275	31182	1018326.024	511609.8064	NG_SPOT	1765.279	1765.617	0.338	0.114
276	31183	1018354.971	511650.5099	NG_SPOT	1765.145	1764.771	-0.374	0.140
277	31184	1018396.362	511682.6946	NG_TOP	1764.618	1764.594	-0.023	0.001
278	31185	1018399.315	511687.1936	NG_TOE	1762.677	1762.567	-0.110	0.012
279	31186	1018400.78	511692.131	NG_TOP	1764.820	1763.341	-1.478	2.186
280	31187	1018422.405	511738.3117	NG_SPOT	1765.710	1765.552	-0.158	0.025
281	31624	1023102.485	510972.9455	NG_SPOT	1825.114	1826.314	1.200	1.440
282	31625	1023012.2	510495.2686	NG_SPOT	1823.692	1824.229	0.537	0.288
283	31626	1023017.042	510520.9202	NG_LOW	1822.564	1822.375	-0.189	0.036
284	31627	1023020.795	510542.9449	NG_SPOT	1823.413	1823.758	0.344	0.119
285	31628	1023027.924	510585.027	NG_LOW	1821.803	1821.877	0.075	0.006
286	31629	1023028.303	510592.718	NG_SPOT	1822.241	1822.480	0.240	0.057
287	31630	1023038.045	510640.0292	NG_SPOT	1823.852	1823.570	-0.282	0.080
288	31631	1023048.39	510689.0412	NG_SPOT	1823.620	1823.248	-0.372	0.138
289	31632	1023056.472	510739.0189	NG_SPOT	1823.889	1824.143	0.254	0.065
290	31633	1023064.34	510770.185	NG_LOW	1821.933	1822.144	0.210	0.044
291	31634	1023068.389	510783.1429	NG_TOP	1822.654	1822.552	-0.102	0.010
292	31635	1023067.814	510786.8614	NG_TOE	1821.209	1821.233	0.025	0.001
293	31636	1023065.818	510789.9212	NG_TOP	1822.876	1821.593	-1.282	1.644
294	31637	1023076.651	510825.8888	NG_TOP	1822.298	1823.089	0.791	0.625
295	31638	1023076.925	510829.8266	NG_TOE	1821.165	1822.439	1.274	1.623
296	31639	1023075.459	510835.0542	NG_TOE	1820.629	1821.902	1.272	1.619
297	31640	1023076.974	510839.307	NG_TOP	1822.672	1821.855	-0.818	0.669
298	31641	1023075.505	510848.8058	NG_SPOT	1823.117	1821.838	-1.279	1.635
299	31642	1023078.212	510854.1989	NG_TOP	1823.007	1821.665	-1.342	1.801
300	31643	1023081.837	510858.5282	NG_TOE	1820.141	1821.188	1.047	1.096

301	31644	1023083.518	510864.2546	NG_TOE	1820.491	1820.938	0.447	0.200
302	31645	1023084.667	510867.5277	NG_TOP	1822.685	1821.185	-1.500	2.250
303	31646	1022077.743	510131.1636	NG_SPOT	1812.570	1812.907	0.337	0.114
304	31647	1022080.97	510182.5442	NG_SPOT	1810.246	1810.246	0.001	0.000
305	31648	1022081.348	510231.3392	NG_TOP	1808.373	1808.489	0.115	0.013
306	31649	1022082.555	510238.7314	NG_TOP	1808.350	1808.341	-0.008	0.000
307	31650	1022082.352	510235.0811	NG_TOE	1807.465	1808.157	0.692	0.479
308	31651	1022083.975	510282.3297	NG_TOE	1808.994	1809.083	0.089	0.008
309	31652	1022086.065	510336.7725	NG_LOW	1807.842	1807.974	0.133	0.018
310	31653	1022086.217	510358.1945	NG_TOP	1807.492	1807.472	-0.020	0.000
311	31654	1022086.548	510360.2031	NG_TOP	1806.966	1807.197	0.232	0.054
312	31655	1022084.966	510343.9495	NG_SPOT	1808.232	1808.099	-0.133	0.018
313	31656	1022088.991	510363.6833	NG_TOE	1806.895	1807.268	0.373	0.139
314	31657	1022090.638	510366.6921	NG_TOP	1808.023	1807.962	-0.061	0.004
315	31658	1022088.52	510381.9375	NG_SPOT	1808.465	1808.192	-0.273	0.074
316	31659	1022090.156	510411.08	NG_SPOT	1809.693	1809.811	0.117	0.014
317	31660	1022084.397	510461.6102	NG_SPOT	1809.071	1809.235	0.164	0.027
318	31661	1022076.525	510511.9194	NG_SPOT	1809.431	1809.845	0.413	0.171
319	31662	1022068.092	510560.2312	NG_SPOT	1809.845	1810.003	0.158	0.025
320	31663	1022066.145	510613.1873	NG_SPOT	1810.185	1810.416	0.231	0.053
321	31664	1022053.432	510659.4273	NG_SPOT	1810.343	1810.521	0.178	0.032
322	31665	1022048.78	510694.4547	NG_SPOT	1810.405	1810.814	0.409	0.167
323	31666	1022054.042	510724.2978	NG_LOW	1809.023	1809.264	0.242	0.058
324	31667	1022055.803	510751.3897	NG_SPOT	1809.523	1810.337	0.814	0.662
325	31668	1022060.119	510794.4638	NG_SPOT	1810.261	1810.738	0.477	0.228
326	31669	1022063.837	510821.8062	NG_TOP	1810.457	1809.781	-0.677	0.458
327	31670	1022065.965	510827.4083	NG_TOE	1808.763	1808.754	-0.009	0.000
328	31671	1022067.073	510833.37	NG_TOE	1808.794	1809.117	0.323	0.104
329	31672	1022067.335	510836.9745	NG_TOP	1809.876	1809.757	-0.119	0.014
330	31673	1022072.002	510862.3198	NG_LOW	1809.312	1809.679	0.368	0.135
331	31674	1022069.346	510848.5481	NG_SPOT	1810.199	1810.463	0.264	0.070
332	31675	1022073.614	510893.5223	NG_SPOT	1810.733	1811.053	0.320	0.103
333	31676	1022077.981	510925.511	NG_SPOT	1810.496	1811.301	0.805	0.648
334	31677	1022078.054	510975.7384	NG_SPOT	1810.240	1810.663	0.423	0.179
335	31678	1022080.426	511026.0397	NG_SPOT	1809.352	1809.343	-0.010	0.000
336	31679	1022081.026	511029.9169	NG_TOP	1809.173	1809.275	0.102	0.010
337	31680	1022081.431	511035.6856	NG_TOE	1808.020	1808.564	0.543	0.295
338	31681	1022082.098	511039.7104	NG_TOP	1808.708	1809.118	0.410	0.168
339	31682	1022079.442	511050.9399	NG_SPOT	1809.209	1809.411	0.202	0.041
340	31683	1022081.506	511061.8276	NG_TOP	1808.747	1808.000	-0.747	0.558
341	31684	1022080.664	511063.9698	NG_TOE	1807.384	1807.679	0.296	0.087
342	31685	1022080.422	511069.7354	NG_TOP	1809.273	1809.345	0.072	0.005
343	31686	1022082.478	511074.6587	NG_SPOT	1809.590	1809.470	-0.120	0.014
344	31687	1022083.122	511126.27	NG_SPOT	1810.344	1810.352	0.008	0.000

345	31688	1022085.986	511186.8967	NG_SPOT	1811.404	1811.932	0.528	0.279
346	31689	1019107.924	510040.8386	NG_SPOT	1776.893	1776.667	-0.226	0.051
347	31690	1019092.474	509994.1874	NG_SPOT	1775.834	1775.396	-0.439	0.192
348	31691	1019078.398	509947.7554	NG_SPOT	1775.687	1775.239	-0.448	0.200
349	31692	1019073.378	509938.464	NG_TOP	1775.110	1774.089	-1.020	1.041
350	31693	1019072.32	509933.955	NG_TOE	1773.083	1773.042	-0.041	0.002
351	31694	1019068.901	509923.6245	NG_TOE	1772.903	1773.009	0.107	0.011
352	31695	1019068.108	509920.8917	NG_TOP	1774.790	1773.917	-0.873	0.761
353	31696	1019057.272	509900.2111	NG_SPOT	1775.346	1774.773	-0.574	0.329
354	31697	1019045.134	509859.4382	NG_SPOT	1775.280	1775.318	0.039	0.001
355	31698	1019018.057	509817.447	NG_SPOT	1775.864	1775.265	-0.599	0.358
356	31699	1019004.278	509800.5364	NG_TOP	1774.906	1774.421	-0.484	0.235
357	31700	1019000.422	509796.2281	NG_TOE	1773.487	1773.649	0.161	0.026
358	31701	1018995.642	509791.1301	NG_SPOT	1772.753	1773.311	0.558	0.311
359	31702	1018990.814	509783.8332	NG_TOE	1772.359	1773.346	0.988	0.975
360	31703	1018987.85	509777.3012	NG_TOP	1775.678	1775.879	0.201	0.041
361	31704	1018985.642	509762.4729	NG_SPOT	1776.009	1775.771	-0.238	0.057
362	31705	1018977.635	509712.3588	NG_SPOT	1776.209	1775.926	-0.284	0.080
363	31706	1018969.768	509643.5063	NG_SPOT	1777.030	1776.759	-0.271	0.073
364	40327	1020594.796	512674.2187	CTRL_SET_1/2	1796.601	1796.751	0.149	0.022
365	40329	1020575.705	512662.3425	CTRL_SET_1/2	1796.337	1796.230	-0.107	0.011
366	40493	1023022.219	509196.7437	NG_SPOT	1823.906	1823.950	0.044	0.002
367	40494	1023009.145	509166.0998	NG_BL	1824.128	1824.025	-0.103	0.011
368	40495	1022988.841	509118.646	NG_BL	1820.281	1820.774	0.493	0.243
369	40496	1022983.093	509104.9116	102	1819.424	1819.761	0.337	0.113
370	40497	1022963.225	509059.1273	NG_SPOT	1819.542	1819.648	0.105	0.011
371	40498	1022937.016	508995.8724	NG_TOE	1816.582	1817.893	1.311	1.719
372	40499	1022937.439	508998.2097	NG_BL	1818.728	1818.172	-0.556	0.309
373	40500	1022927.656	508977.8935	NG_TOE	1817.474	1818.584	1.110	1.231
374	40501	1022926.839	508975.3967	NG_BL	1819.617	1819.350	-0.266	0.071
375	40502	1022920.679	508953.6334	NG_SPOT	1819.134	1819.260	0.126	0.016
376	40503	1022912.137	508912.8036	NG_SPOT	1819.689	1819.712	0.023	0.001
377	40504	1022901.659	508864.399	NG_SPOT	1820.063	1820.048	-0.014	0.000
378	40505	1022892.069	508815.3046	NG_SPOT	1821.457	1821.435	-0.022	0.000
379	40506	1022859.316	508783.0475	NG_SPOT	1819.838	1819.629	-0.209	0.044
380	40507	1022835.648	508755.4568	NG_SPOT	1821.251	1820.994	-0.257	0.066
381	40508	1022835.887	508700.9934	NG_SPOT	1823.087	1823.412	0.324	0.105
382	40509	1022122.171	508826.8873	NG_SPOT	1813.487	1813.165	-0.322	0.103
383	40510	1022083.946	508859.5181	NG_SPOT	1811.698	1812.065	0.367	0.135
384	40511	1022046.37	508891.848	NG_SPOT	1810.838	1810.946	0.108	0.012
385	40512	1022027.011	508907.9084	NG_SPOT	1809.034	1809.844	0.810	0.655
386	40513	1022026.922	508929.4097	NG_BL	1809.292	1808.488	-0.804	0.646
387	40514	1022027.01	508934.4118	NG_TOE	1807.634	1808.039	0.405	0.164
388	40515	1022026.727	508958.3664	NG_TOE	1808.590	1809.765	1.174	1.379

389	40516	1022026.892	508961.8439	NG_BL	1809.801	1810.145	0.344	0.119
390	40517	1022036.373	508993.6987	108	1809.791	1810.202	0.411	0.169
391	40518	1022046.204	509015.3894	NG_BL	1810.263	1810.199	-0.064	0.004
392	40519	1022050.484	509023.7259	NG_TOE	1808.096	1808.767	0.671	0.450
393	40520	1022055.405	509037.9254	NG_TOE	1808.916	1809.393	0.477	0.228
394	40521	1022057.406	509040.9051	NG_BL	1809.896	1809.667	-0.229	0.052
395	40522	1022065.856	509060.7939	NG_SPOT	1810.200	1810.226	0.026	0.001
396	40523	1022081.908	509098.7873	NG_SPOT	1809.430	1809.950	0.520	0.270
397	40524	1022104.868	509152.7959	NG_SPOT	1808.694	1808.629	-0.065	0.004
398	40525	1022113.899	509194.316	NG_SPOT	1808.910	1809.281	0.371	0.138
399	40526	1022125.739	509242.8078	NG_SPOT	1809.321	1809.824	0.503	0.253
400	40527	1022137.571	509291.4361	NG_SPOT	1812.157	1812.509	0.353	0.124
401	40528	1022140.218	509306.5527	NG_BL	1812.879	1812.883	0.004	0.000
402	40529	1019950.059	509931.4241	NG_BL	1785.588	1785.348	-0.240	0.058
403	40530	1019947.484	509881.6797	110	1784.565	1784.255	-0.310	0.096
404	40531	1019946.008	509862.7478	NG_BL	1783.667	1783.394	-0.273	0.075
405	40532	1019945.036	509854.4907	NG_FL	1782.385	1782.190	-0.195	0.038
406	40533	1019945.545	509851.8142	NG_BL	1782.936	1782.677	-0.259	0.067
407	40534	1019944.364	509831.6134	NG_SPOT	1783.648	1783.647	0.000	0.000
408	40535	1019941.636	509781.8004	NG_SPOT	1784.213	1783.984	-0.229	0.052
409	40536	1019940.212	509764.0339	NG_SPOT	1783.887	1784.134	0.247	0.061
410	40537	1019925.313	509734.871	NG_BL	1783.679	1783.962	0.283	0.080
411	40538	1019922.08	509728.6679	NG_TOE	1780.888	1782.219	1.331	1.771
412	40539	1019918.427	509722.6394	NG_TOE	1781.484	1781.794	0.310	0.096
413	40540	1019917.137	509719.6574	NG_BL	1783.075	1782.573	-0.502	0.252
414	40541	1019894.508	509675.7476	NG_SPOT	1784.386	1784.462	0.076	0.006
415	40542	1019871.044	509631.3287	NG_SPOT	1784.628	1784.803	0.175	0.030
416	40543	1019859.074	509611.5827	NG_BL	1784.294	1784.336	0.042	0.002
417	40544	1019848.028	509586.6737	NG_TOE	1781.941	1782.716	0.775	0.601
418	40545	1019836.272	509567.7808	NG_TOE	1781.848	1782.610	0.762	0.581
419	40546	1019834.877	509564.5496	NG_BL	1784.182	1783.639	-0.543	0.295
420	40547	1019824.466	509542.4913	NG_SPOT	1784.095	1784.324	0.229	0.052
421	40548	1019801.701	509498.319	NG_SPOT	1783.600	1783.938	0.338	0.114
422	40549	1019797.593	509490.6881	NG_BL	1783.671	1783.858	0.187	0.035
423	40550	1019794.019	509484.5421	NG_FL	1782.474	1782.706	0.231	0.054
424	40551	1019791.912	509478.5379	NG_BL	1783.753	1783.909	0.156	0.024
425	40552	1019778.51	509454.0423	NG_SPOT	1784.450	1784.260	-0.191	0.036
426	40553	1019745.726	509415.4521	NG_SPOT	1783.816	1784.318	0.502	0.252
427	40554	1019713.875	509377.7665	NG_SPOT	1784.089	1784.535	0.446	0.199
428	40555	1019680.629	509339.804	NG_SPOT	1784.337	1784.244	-0.092	0.009
429	40556	1019641.74	509309.3917	NG_BL	1783.982	1783.749	-0.233	0.054
430	40557	1019645.977	509313.0275	NG_FL	1782.727	1783.223	0.496	0.246
431	40558	1019647.814	509315.6944	NG_BL	1783.961	1783.299	-0.662	0.438
432	40559	1019616.127	509263.8061	NG_SPOT	1784.134	1784.127	-0.006	0.000

433	40560	1019583.659	509225.6942	NG_SPOT	1784.238	1784.331	0.093	0.009
434	40561	1019551.032	509187.3779	NG_SPOT	1785.272	1784.891	-0.381	0.145
435	40562	1019526.763	509160.0874	NG_SPOT	1785.257	1785.162	-0.095	0.009
436	40563	1020508.137	509181.4786	NG_BL	1795.538	1794.990	-0.548	0.300
437	40564	1020543.638	509216.3431	NG_BL	1793.491	1793.560	0.069	0.005
438	40565	1020578.419	509248.7808	NG_BL	1792.184	1792.479	0.295	0.087
439	40566	1020581.633	509251.7402	NG_TOE	1789.772	1790.991	1.220	1.487
440	40567	1020583.362	509256.1175	NG_TOE	1789.813	1790.248	0.434	0.189
441	40568	1020583.573	509262.2914	NG_BL	1791.645	1791.213	-0.432	0.187
442	40569	1020613.738	509283.437	NG_SPOT	1792.283	1792.508	0.225	0.051
443	40570	1020634.554	509326.8741	NG_SPOT	1792.660	1792.979	0.319	0.102
444	40571	1020667.183	509396.123	NG_BL	1791.998	1791.898	-0.100	0.010
445	40572	1020670.595	509399.061	NG_TOE	1791.027	1791.693	0.666	0.444
446	40573	1020696.646	509424.9591	NG_TOE	1790.696	1791.096	0.400	0.160
447	40574	1020699.661	509428.8307	NG_BL	1792.818	1792.307	-0.512	0.262
448	40575	1020701.159	509462.3574	NG_BL	1792.201	1792.146	-0.055	0.003
449	40576	1020704.039	509467.1199	NG_FL	1791.301	1791.575	0.274	0.075
450	40577	1020704.971	509470.0007	NG_BL	1792.102	1791.815	-0.287	0.083
451	40578	1020722.801	509507.0656	NG_SPOT	1792.956	1793.170	0.215	0.046
452	40579	1020744.873	509551.6846	NG_SPOT	1793.163	1793.428	0.266	0.071
453	40580	1020763.673	509590.1183	NG_BL	1794.938	1795.166	0.228	0.052
454	40581	1021550.906	509412.6791	NG_SPOT	1804.579	1804.633	0.054	0.003
455	40582	1021551.141	509362.7187	NG_SPOT	1803.746	1804.032	0.286	0.082
456	40583	1021551.323	509312.0844	NG_SPOT	1802.873	1803.118	0.245	0.060
457	40584	1021550.458	509284.5686	NG_BL	1802.842	1802.363	-0.479	0.230
458	40585	1021552.638	509268.9081	NG_TOE	1800.446	1800.836	0.390	0.152
459	40586	1021559.76	509257.9346	NG_TOE	1799.788	1801.100	1.313	1.724
460	40587	1021560.377	509251.5872	NG_BL	1801.988	1802.552	0.564	0.319
461	40588	1021548.42	509235.7237	NG_BL	1802.627	1802.387	-0.239	0.057
462	40589	1021546.629	509231.504	NG_TOE	1800.024	1801.079	1.056	1.114
463	40590	1021543.95	509226.0078	NG_TOE	1800.245	1800.874	0.630	0.396
464	40591	1021541.779	509219.1025	NG_BL	1801.889	1802.370	0.482	0.232
465	40592	1021533.158	509199.3993	NG_SPOT	1802.356	1802.429	0.073	0.005
466	40593	1021514.749	509152.7104	NG_SPOT	1803.245	1803.799	0.554	0.307
467	40594	1021511.707	509137.1228	NG_BL	1803.234	1803.507	0.273	0.075
468	40595	1021512.315	509129.8335	NG_FL	1801.949	1801.986	0.038	0.001
469	40596	1021512.217	509126.1352	NG_BL	1802.794	1802.394	-0.400	0.160
470	40597	1021512.572	509103.9119	NG_BL	1803.312	1802.641	-0.671	0.450
471	40598	1021512.929	509099.7745	NG_TOE	1800.763	1801.642	0.879	0.773
472	40599	1021513.028	509094.3945	NG_TOE	1801.178	1801.413	0.235	0.055
473	40600	1021513.336	509092.0927	NG_BL	1802.227	1802.017	-0.210	0.044
474	40601	1021511.694	509076.3579	NG_BL	1803.227	1802.972	-0.256	0.065
475	40602	1021510.754	509074.4721	NG_TOE	1799.813	1802.189	2.376	5.645
476	40603	1021512.842	509062.3993	NG_TOE	1800.539	1801.204	0.666	0.444

477	40604	1021512.59	509054.218	NG_BL	1802.001	1801.960	-0.041	0.002
478	40605	1021513.522	509036.6961	NG_BL	1803.344	1803.323	-0.021	0.000
479	40606	1021513.488	509009.9476	NG_BL	1804.254	1803.715	-0.539	0.290
480	40607	1021506.021	509003.6419	NG_FL	1802.557	1802.694	0.137	0.019
481	40608	1021502.685	508998.9357	NG_BL	1803.333	1803.326	-0.008	0.000
482	40609	1021489.529	508976.5623	NG_BL	1803.004	1802.743	-0.262	0.068
483	40610	1021485.594	508972.8273	NG_FL	1800.398	1801.382	0.984	0.968
484	40611	1021485.225	508966.1479	NG_BL	1803.180	1802.484	-0.695	0.484
485	40612	1021464.361	508930.5695	NG_SPOT	1804.877	1805.220	0.343	0.118
486	40613	1021439.132	508885.5081	NG_SPOT	1806.138	1806.186	0.048	0.002
487	40614	1018661.707	510053.7472	NG_SPOT	1772.894	1772.674	-0.220	0.049
488	40615	1018651.861	510017.4794	NG_BL	1772.290	1771.934	-0.356	0.127
489	40616	1018649.036	510001.1068	NG_BL	1770.012	1769.783	-0.229	0.053
490	40617	1018649.598	509982.9336	NG_TOE	1768.588	1768.247	-0.341	0.116
491	40618	1018642.852	509975.3267	NG_TOE	1768.654	1768.765	0.111	0.012
492	40619	1018642.187	509974.1732	NG_BL	1770.108	1769.377	-0.730	0.533
493	40620	1018636.359	509952.1653	NG_BL	1773.328	1772.432	-0.896	0.804
494	40621	1018627.862	509924.9009	NG_BL	1773.212	1772.389	-0.823	0.677
495	40622	1018645.418	509914.4985	NG_BL	1770.530	1769.852	-0.678	0.460
496	40623	1018648.549	509911.3473	NG_TOE	1767.958	1768.664	0.706	0.499
497	40624	1018656.007	509897.2345	NG_TOE	1768.896	1768.627	-0.269	0.072
498	40625	1018658.956	509894.8751	NG_BL	1770.606	1769.665	-0.941	0.886
499	40626	1018673.457	509866.2059	NG_SPOT	1771.262	1771.542	0.280	0.078
500	40627	1018677.257	509850.605	NG_BL	1771.350	1771.110	-0.240	0.057
501	40628	1018679.013	509844.2921	NG_FL	1770.165	1770.459	0.294	0.087
502	40629	1018679.85	509837.8864	NG_BL	1771.080	1771.263	0.184	0.034
503	40630	1018682.539	509779.6822	NG_SPOT	1771.930	1771.759	-0.171	0.029
504	40631	1018683.689	509728.9873	NG_SPOT	1773.281	1773.381	0.100	0.010
505	40632	1018685.191	509678.8689	NG_SPOT	1773.153	1773.489	0.336	0.113

Sum (Diff Elev^2)=	178.193
RMSE =	**0.594**