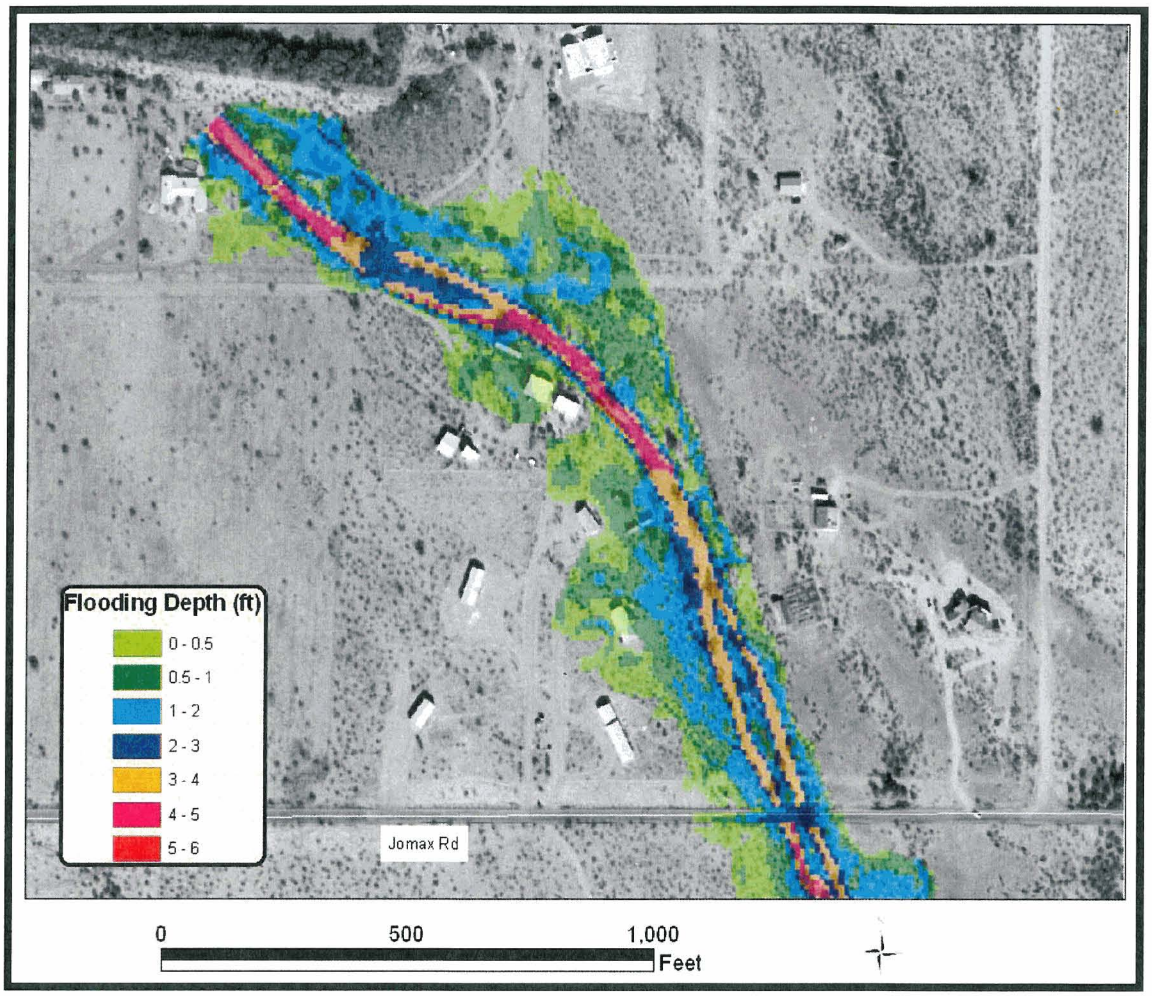
Preliminary Floodplain Delineation for Padelford Wash below Bonita Dam (from dam to downstream confluence)

(Assuming Bonita Dam Will Be Breached along Natural Drainage Path)



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1. Introduction

1.1. Background

Bonita Dam is located on the natural path of Padelford Wash. It is in the unincorporated area of Maricopa County, Arizona, and its drainage area is about 26 square miles. The drainage area covers portions of Maricopa County's unincorporated area, the City of Peoria, and the Town of Surprise. Figure 1 shows an approximate location of the dam. Figure 2 shows an aerial photo for Bonita Dam and the existing Federal Emergency Management Agency (FEMA) 100-year floodplains.

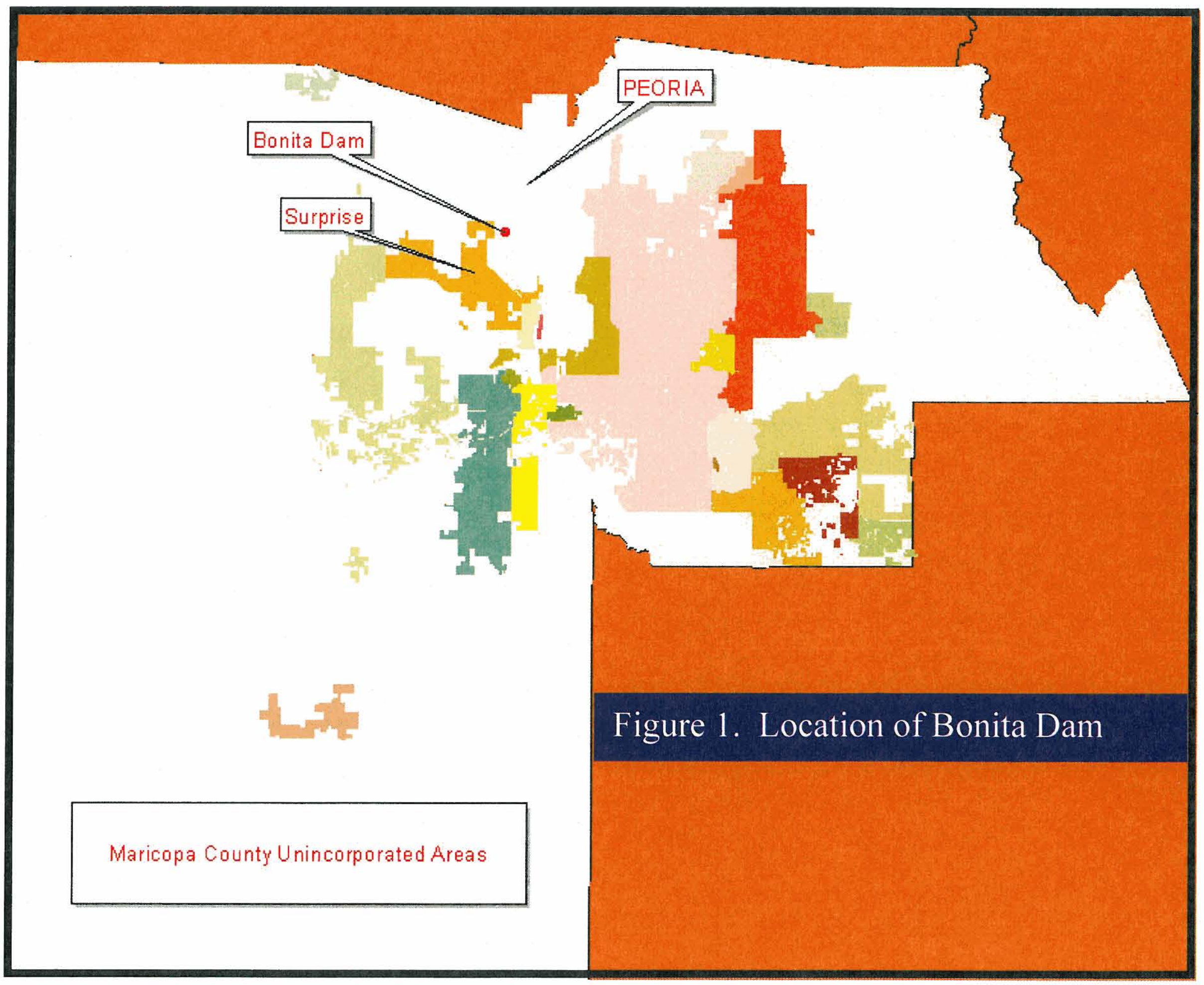


Figure 1. Location of Bonita Dam

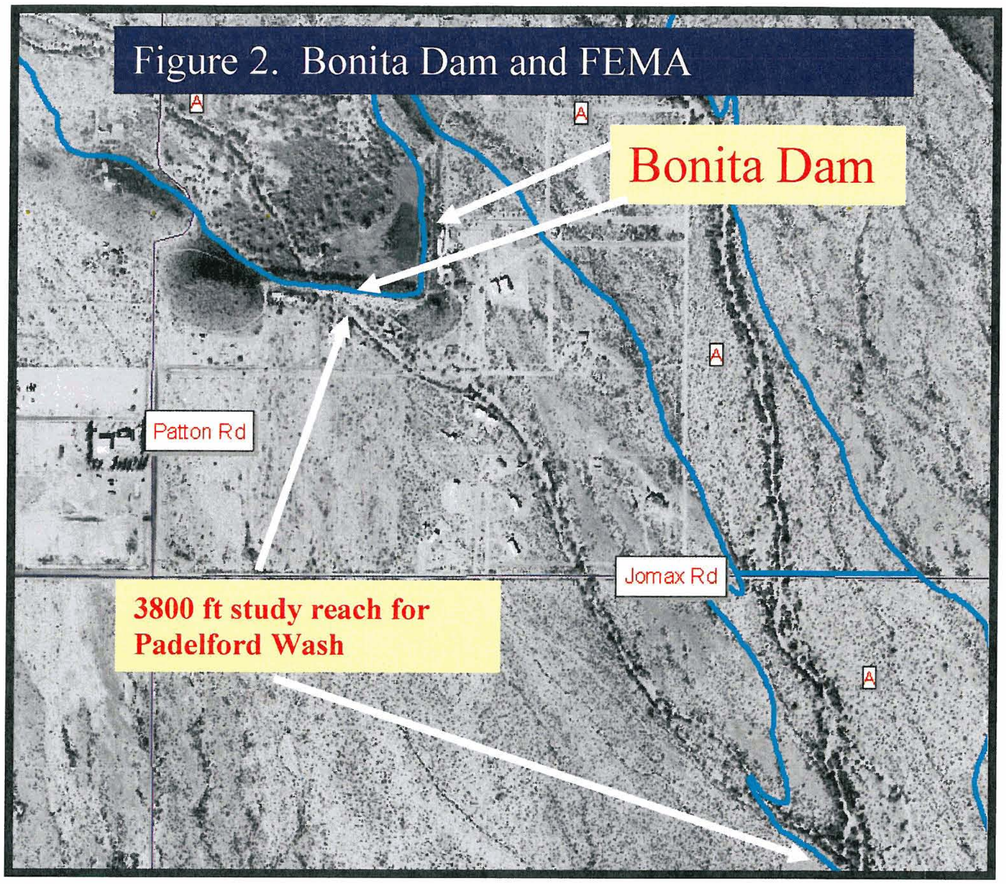


Figure 2. Bonita Dam and FEMA
Bonita Dam
A
Patton Rd
Jomax Rd
3800 ft study reach for
Padelford Wash

Bonita Dam (or Lake Bonita) is classified as an unsafe dam by Arizona Department of Water Resources (ADWR). Recently, the dam owner(s) proposed to ADWR breaching the dam (removing a segment of the dam along the natural drainage path for Padelford Wash) as the solution to the dam safety issues.

Currently, Padelford Wash from Bonita Dam to approximately 3800 feet below the dam is not on the FEMA 100-year floodplains because the dam blocks the flow from Padelford Wash (see Figure 2 for the study reach). However, if the dam is breached by the dam owner(s) in the future, this section of Padelford Wash (from Bonita Dam to 3800 feet below the dam) will be subject to potential 100-year flooding.

1.2. Purpose

The purpose of this preliminary floodplain delineation study is to delineate the 100-year floodplains for Padelford Wash between Bonita Dam and 3800 feet below Bonita Dam under the assumption that the Bonita Dam owner(s) will breach Bonita Dam along the natural drainage path at Padelford Wash. The results of this preliminary study will serve as the basis for a more detailed floodplain delineation and FEMA submittal preparation. The peak flow for this preliminary floodplain delineation study is based on a recent hydrologic study (Zhao, 2003).

2. Assumptions and Issues

As discussed in section 1.1, since Bonita Dam is classified as unsafe by ADWR, the dam owner(s) are considering breaching the dam along the Padelford Wash's natural drainage path. This preliminary floodplain delineation study is based on an assumption that Bonita Dam will be breached by the owner(s) along Padelford Wash's natural drainage path (a segment of the dam embankment will be removed to allow the water to flow along the natural drainage path at Padelford Wash).

Since this floodplain delineation study is preliminary and for planning purpose, several issues are not addressed in this study and need to be addressed in the final floodplain delineation study and FEMA CLOMR package preparation. The first issue is related to sediment transport aspects such as channel degradation (bed erosion and lateral erosion) and aggradation caused by the dam breaching. The second issue is that this preliminary study will not determine the hydraulic impact that the dam breach may have on the area downstream of the dam breach. Although the impact may be minimal due to the sub-critical flow condition, a HEC-RAS model including the proposed dam breach cross-sections should be developed by the dam breach engineer(s). The third issue is that the floodway analysis is not performed in this preliminary study, which remains to be done in the final study for CLOMR package. The fourth issue is related to the potential need for channel improvements for the study reach if the final floodplain delineation study indicates that the existing channel can not contain the 100-year peak flow and the breakout flows cause significant flooding problems.

The fifth issue is that the potential need for a 404 permit is not evaluated in this study. The sixth issue is related to the topographic data. The topographic data used in this preliminary floodplain delineation is based on a combination of two sources. One data source is GPS/RTK survey performed by both Flood Control District of Maricopa County (FCDMC) staff and FCDMC on-call surveyors. Another data source is from a draft version of an on-going mapping project (Wittmann Area Drainage Master Study mapping project). The date for this draft version deliverable is November, 2002. The mapping data for the study area will be finalized in a few weeks. Once the final topographic data for the mapping project is completed, a comparison needs to be made between the final version data and the November 2002 version data. If significant differences are found, cross-sections will need to be re-developed for HEC-RAS modeling. The seventh issue is related to an on-going Wittmann Area Drainage Master Study (ADMS) which will update the 1989 Wittmann ADMS HEC-1 models and the existing FEMA floodplains. The study reach merges with the existing FEMA floodplains. The downstream boundary condition for this preliminary floodplain delineation study is based on the existing

FEMA floodplains' flow depth at the confluence. The existing FEMA floodplain delineation was based on 4-foot contour data from the 1989 Wittmann ADMS. The on-going Wittmann ADMS is based on 2-foot contour data and its hydrology is based on the current land use condition. If this preliminary floodplain delineation study is finalized after the Wittman ADMS is finished, the HEC-RAS model should be revised to reflect the new boundary condition at the confluence. If this preliminary study is finalized before the Wittmann ADMS is finished, a sensitivity analysis should be be performed to check how the water surface elevation values near the residential areas respond to different downstream boundary conditions. Since the properties are about 2000 feet above the confluence, the water surface elevation values may not be sensitive to the downstream boundary condition. However, verification of this is necessary through a sensitivity analysis.

3. Methodology Description

HEC-GeoRAS 3.1 and HEC-RAS 3.1 are used for this preliminary floodplain delineation study. Since HEC-RAS is a 1-dimensional model, it puts flow across entire cross-section even when flow does not actually cross horizontally. To avoid this problem, artificial levees are added to each cross-section to model the actual flow conditions where the artificial levees' elevations are set at the ground elevations. Lateral spillway feature in HEC-RAS 3.1 is used to model the split flow conditions where flow overtops the channel banks to determine the amount of breakout flows. If the split flows are found to be significant, floodplain delineation will be needed for the area affected by the split flows. If the split flows are insignificant, the floodplains for the split flows may be ignored.

4. Data Collection

4.1. Hydrologic Data

The hydrology is based on Zhao (2003) in which the 100-year 24-hour storm peak discharge is found to be larger than the 100-year 6-hour storm peak discharge. The peak discharge for this preliminary floodplain delineation study is the 100-year 24-hour storm peak discharge (1850 cfs). More information about the hydrologic study can be found in Zhao (2003).

4.2. Topographic Data

The topographic data used in this preliminary floodplain delineation is based on a combination of two data sources. One data source is from GPS/RTK survey performed by both Flood Control District of Maricopa County surveying crew and on-call surveying staff. The survey data include dense points in the main channel and floodplains and finish floor elevations for the properties adjacent to Padelford Wash. Another data source is Digital Terrain Model (DTM) data with accuracy of 2-foot contour from an on-going mapping project (Wittmann Area Drainage Master Study mapping project). The date for this draft version deliverable is November, 2002. The DTM data will be finalized in a few weeks. The data from both sources are used to generate an ArcInfo TIN file for cross-section cutting in HEC-GeoRAS 3.1. Figure 3 shows the RTK/GPS ground survey points and 2-foot contour (November 2002 data).

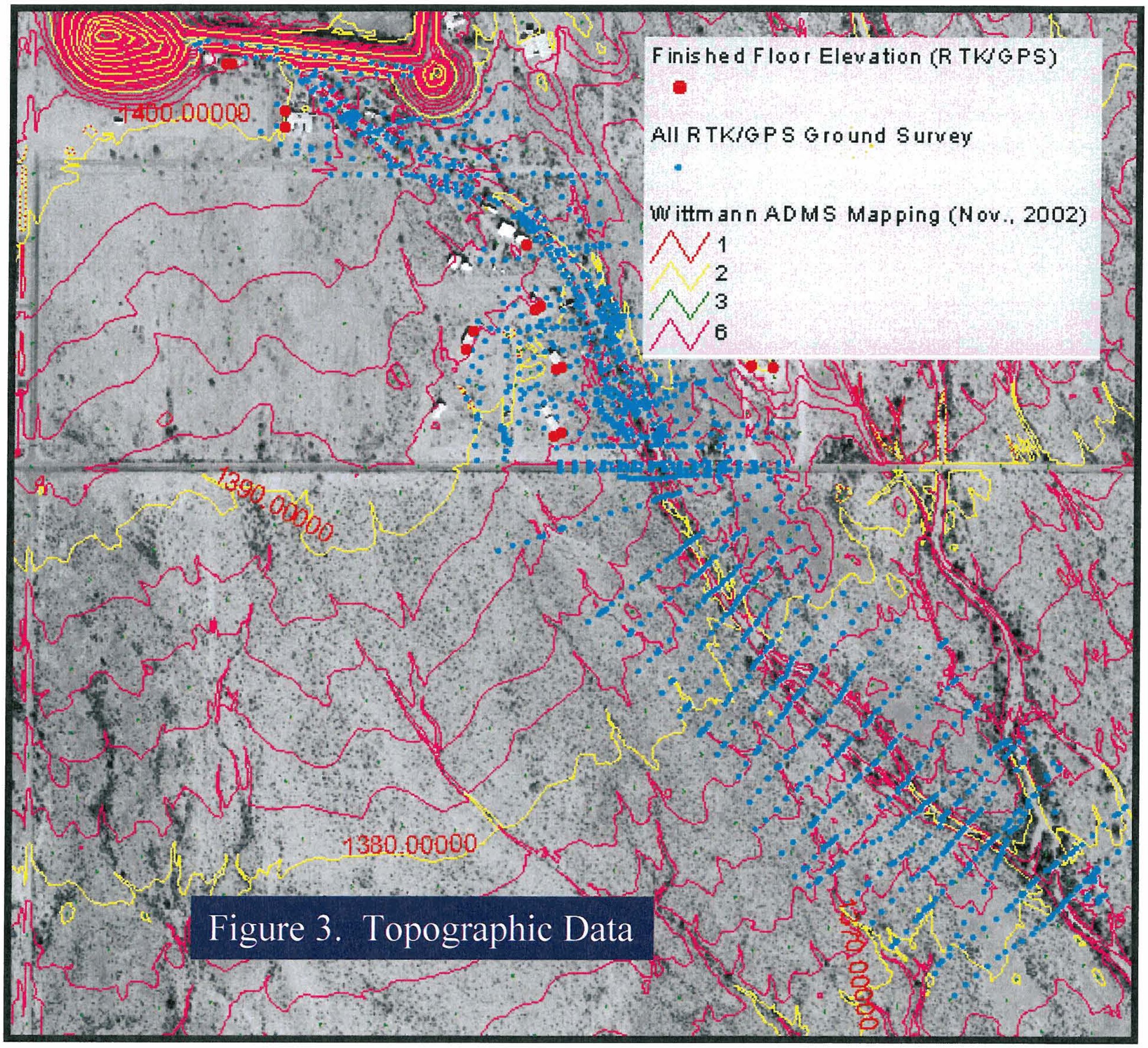


Figure 3. Topographic Data

4.3. Manning's Roughness Coefficients

The estimation of Manning's roughness coefficients is based on field trips, aerial photos, Chow (1959), and Thomsen and Hjalmarson (1991). The photos for two typical cross-sections can be seen in Appendix 1. Appendix 2 shows a GIS ArcView coverage for Manning's roughness coefficient. The GIS layer is used in HEC-GeoRAS 3.1 analysis where the Manning's roughness coefficients are automatically assigned to the cross-section data. Manning's roughness coefficient for each cross-section can be found in the digital HEC-RAS model in the CD attached in the report.

5. Hydraulic Modeling

The hydraulic modeling includes (1) cross-section cutting using HEC-GeoRAS 3.1 in ArcView 3.2 environment, (2) draft HEC-RAS 3.1 model development, (3) split flow analysis by lateral spillways within HEC-RAS 3.1, (4) final HEC-RAS 3.1 model development, and (5) floodplain delineation using HEC-GeoRAS 3.1 in ArcView 3.2 environment.

5.1. Cross-Section Cutting Using HEC-GeoRAS 3.1

An ArcInfo TIN model is developed by combing the on-going Wittmann Area Drainage Master Study mapping project data with the GPS/RTK survey data. The GPS/RTK survey data includes the points in the main channel and floodplains and finish floor elevations for the properties. The TIN model is imported into ArcView 3.2 (with spatial analyst extension and HEC-GeoRAS 3.1 extension). An ArcView shapefile for Manning's roughness coefficient is also imported into ArcView. After the stream center line, bank station lines, and overbank flow lines are drawn, wide cross-sections are cut at intervals ranging from 50 feet to 250 feet along the stream center line based on the TIN data. HEC-GeoRAS 3.1 then generates a GIS file ready to be imported into HEC-RAS 3.1. The cross-section data with other information such as reach lengths between cross-sections and Manning's roughness coefficient for each cross-section are stored in this GIS file. Figures 4a and 4b show the cross-sections and topographic data contour lines generated from the TIN data.

5.2. Draft HEC-RAS 3.1 Model Development and Results

5.2.1. Flow Rate

The flow rate for the floodplain delineation study is 1850 cfs based on the 100-year 24-hour storm peak flow (Zhao, 2003). It is used for each cross-section.

5.2.2. Downstream Boundary Condition

Since the study reach merges with an existing FEMA floodplains (delineated in the 1989 Wittmann ADMS), and the study reach and the existing FEMA floodplains have about the same time of concentration at the confluence, the water surface elevation at the confluence for the existing FEMA floodplains is used as the downstream boundary condition for the study reach's downstream boundary condition. Figure 2 shows the confluence for the study reach and the existing FEMA floodplains. The floodplain delineation study in the1989 Wittmann ADMS was based on a 4-foot contour topographic data. The on-going Wittmann ADMS which includes both hydrologic studies and floodplain delineation studies is based on a 2-foot contour topographic data. If this preliminary floodplain delineation study is finalized after the on-going Wittman ADMS is finished, the new boundary condition should be used in the HEC-RAS model. In this preliminary study, the existing FEMA floodplains will be used for the study reach's boundary condition.

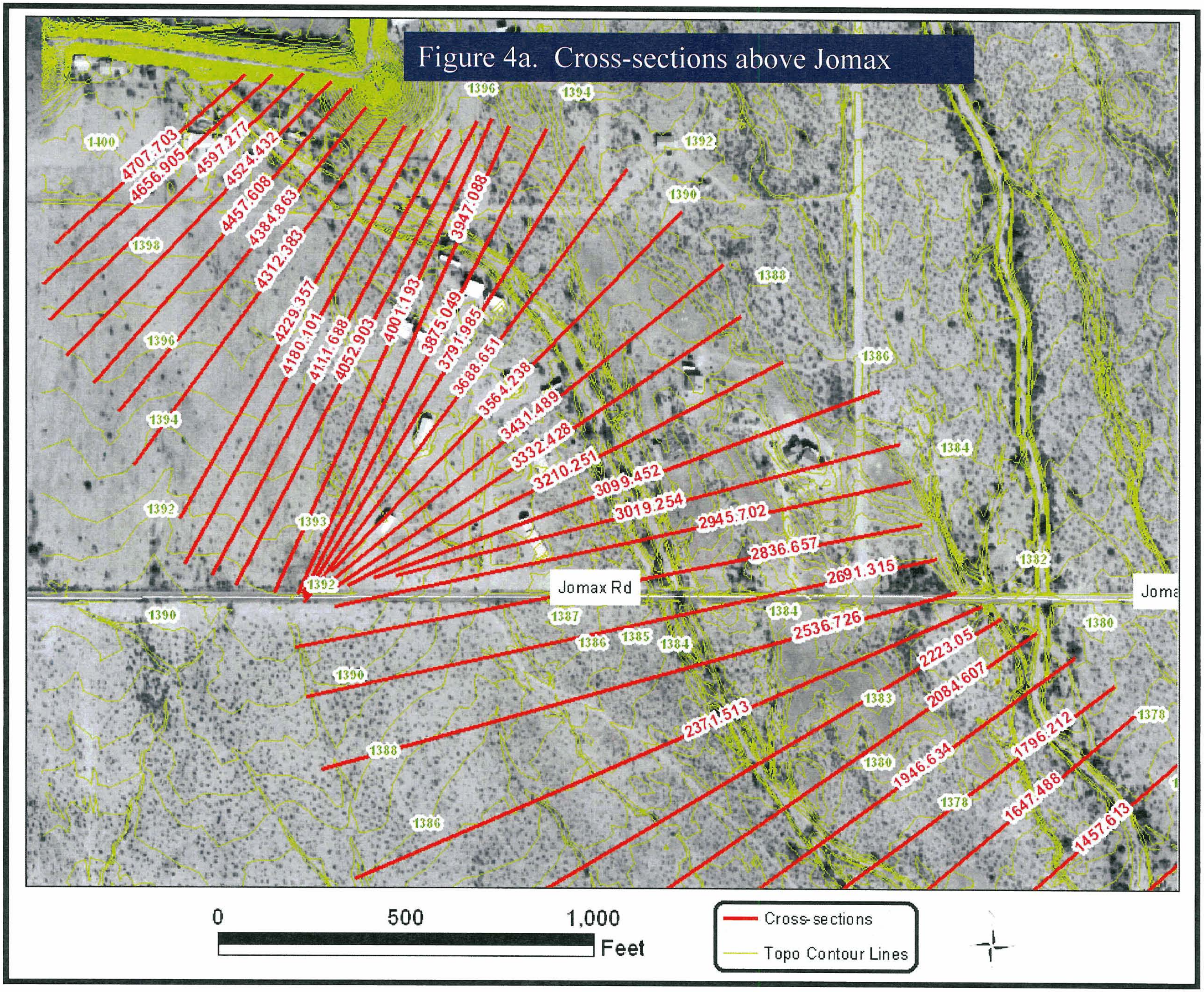


Figure 4a. Cross-sections above Jomax
Jomax Rd
0
500
1,000
Feet
Cross-sections
Topo Contour Lines

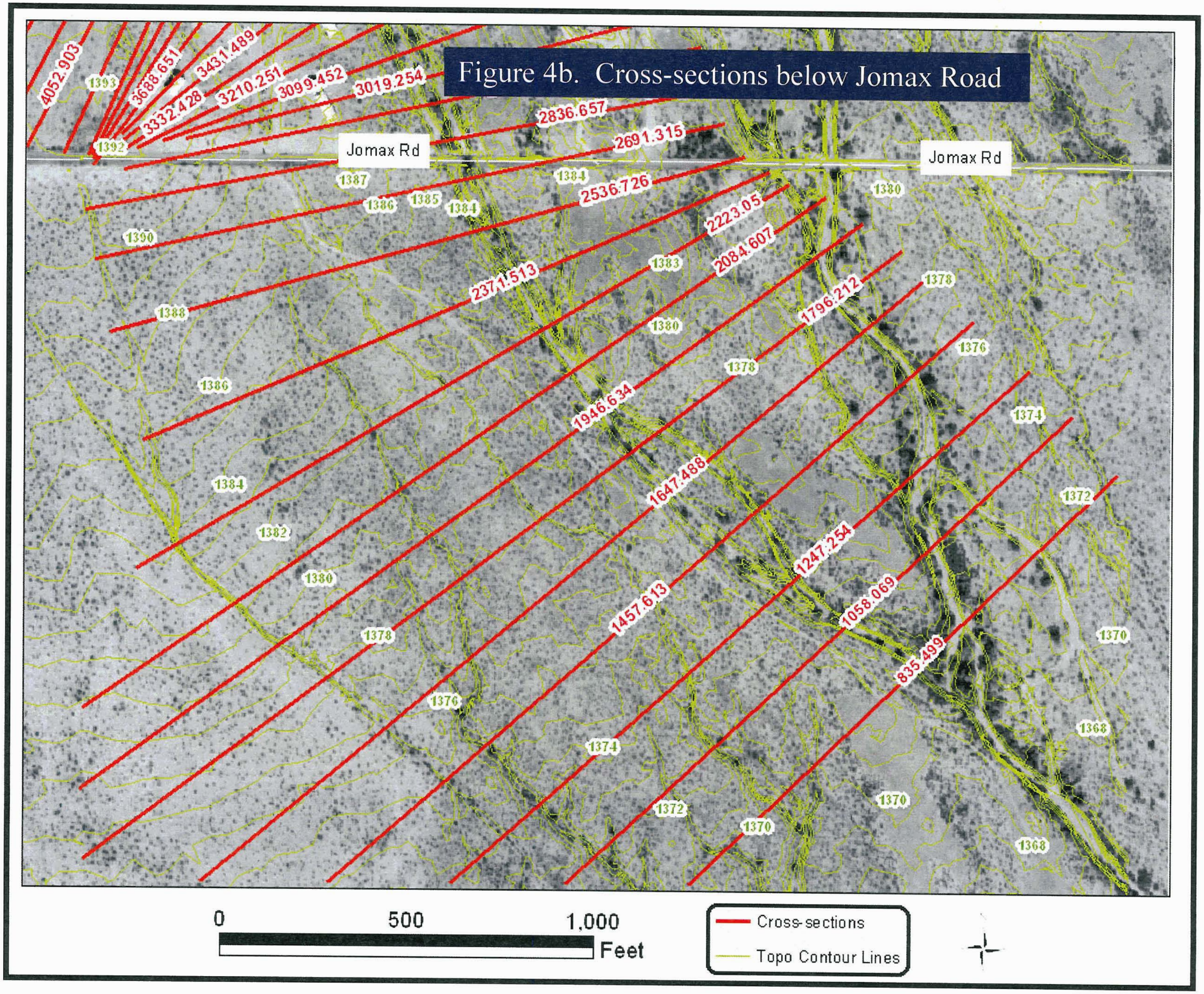


Figure 4b. Cross-sections below Jomax Road
Jomax Rd
Jomax Rd
4052.903
3688.651
3431.489
3332.428
3210.251
3099.452
3019.254
2836.657
2691.315
2536.726
2371.513
2223.05
2084.607
1946.634
1796.212
1647.488
1457.613
1247.254
1058.069
835.499
0
500
1,000
Feet
Cross-sections
Topo Contour Lines

However, the datum for the 1989 Wittmann ADMS study was based on NGVD 29 while the datum for the new TIN data is based on NAVD 88. The water surface elevation for the 1989 Wittmann ADMS' floodplain delineation study is converted to a value in NAVD88 by adding a revised flow depth (at station 1.453) to the current channel bed elevation in NAVD88 (station 835.499 in the HEC-RAS model). The reason why the flow depth from the 1989 study is revised is that the 1989 HEC-2 model's flow rate did not include the flow caused by the dam breach. The 1989 Wittmann ADMS HEC-2 model is modified by adding 1850 cfs to the existing flow rates for the cross-sections below the confluence in order to obtain the revised flow depth. The 1989 Wittmann ADMS floodplain study map for the existing FEMA floodplains near the confluence can be found in Appendix 4. The HEC-2 file can be found in the CD attached at the end of this report.

It should be pointed out that if the dam is breached as proposed by the dam owner(s) the flow rates for the cross-sections above the confluence for the existing FEMA floodplain will decrease because part of the flow for the existing FEMA floodplains is from the Bonita Dam's outflow over the spillway. Adding the dam breach flow rate directly to the existing flow rates will give a higher estimate of the flow depth in the existing FEMA floodplains. However, given the uncertainty in the 1989 Wittmann ADMS topographic data (4-foot contour) and possible change to the flow rates for the existing FEMA floodplain area (above the confluence), a conservative estimate (higher estimate) of the flow depth is used in this preliminary study.

5.2.3. Artificial Levees

HEC-RAS is a 1-dimensional model, and its computation is based on the cross-section areas. It puts water across the cross-sections as long as the ground elevations are low even if the flow should stay in the main channel. Two artificial levees are added to each cross-section in the HEC-RAS model to avoid this problem in order to reflect the actual flow paths. The artificial levee elevations are set at the ground elevations. The levees used in this study are not real levees which require special approval from FEMA.

Since HEC-RAS 3.1 has the capability of importing GIS ArcView shape files and aerial photos into HEC-RAS geometric window, the aerial photos and topographic contour data are imported into HEC-RAS as the background to help visualize the flow paths and find the locations for the artificial levees.

5.2.4. Draft HEC-RAS 3.1 Model and Results

After the HEC-RAS model is set up, a sub-critical flow run is performed. The results show that there are minor breakout flows on the right bank at several cross-sections. Although the breakout flows seem to be minor (the maximum depth over the top of right banks is less than 3 inches), a split flow analysis is performed to determine the quantity of the flow breakout (split flow). The split flow analysis will determine the significance of the split flows. If the split flow analysis shows that the split flow is significant compared with the channel flow, more analyses may be needed for the area affected by the breakout flows. However, if the split flow analysis shows that the split flow is insignificant, then impact of the split flow on the flooding hazard may be ignored.

5.3. Split Flow Analysis by Lateral Spillway in HEC-RAS 3.1

HEC-RAS 3.1 has a feature for lateral spillway analysis which is used for the split flow analysis. A split flow HEC-RAS model is developed based on the draft HEC-RAS model. Three lateral spillways are defined to model the split flows. The first one is defined from station 4229.356 to 4180.101. The second one is defined from station 4052.902 to station 3875.049. The third one is defined from station 3564.237 to 3431.489. The option of "Right Bank" is used for lateral spillway locations. However, the cross-section data on the right side of the artificial levees must be deleted in order to perform the split flow analysis for "Right Bank" option split flow analysis.

Because of the flow momentum along the main channel, the discharge coefficient for lateral spillway (also called side weir) is smaller than that for the standard in-line weir. A preliminary analysis for the selection of the discharge coefficient is based on a manual iterative process between HEC-RAS 3.1 and the use of Hager's equation (Hager, 1987). The preliminary result for the discharge coefficient is 1.8. A reasonable value for lateral weir flow discharge coefficient is selected as 2.0 for conservative estimation (over-estimate for lateral flow). It should be pointed out that when the HEC-RAS 3.1 model is run, the option for split flow optimization under the sub-critical run must be selected in order to automatically determine the breakout flow and the remaining channel flow.

Tables 1a, 1b, and 1c show the results for the split flow analysis. Table 2 shows more results for the cross-sections. As can be observed, the split flow is rather small (16 cfs) and its impact on the flooding hazard is rather insignificant.

Table 1a. Split Flow Analysis from 4229.356 to 4180.101

: Below Bonita PadelFordWashBel MainWash RS: 4229.356 Lat Struct Profile: PF 1E.G. US. (ft)	1396.85	**Weir Sta US (ft)**	
W.S. US. (ft)	1396.23	**Weir Sta DS (ft)**	
E.G. DS (ft)	1396.45	**Weir Max Depth (ft)**	
W.S. DS (ft)	1395.97	**Weir Avg Depth (ft)**	
Q US (cfs)	1850.00	**Weir Submerg**	
Q Leaving Total (cfs)	0.00	**Min El Weir Flow (ft)**	1396.44
Q DS (cfs)	1850.00	**Wr Top Wdth (ft)**	
Perc Q Leaving	0.00	**Q Gate Group (cfs)**	
Q Weir (cfs)		**Gate Open Ht (ft)**	
Q Gates (cfs)		**Gate #Open**	
Q Culv (cfs)	0.00	**Gate Area (sq ft)**	
Q Lat RC (cfs)		**Gate Submerg**	
Weir Flow Area (sq ft)		**Gate Invert (ft)**	

Table 1b. Split Flow Analysis from 4052.902 to 3875.04

: Below Bonita PadelFordWashBel MainWash RS: 4052.902 Lat Struct Profile: PF 1E.G. US. (ft)	1395.52	**Weir Sta US (ft)**	24.17

W.S. US. (ft)	1394.88	Weir Sta DS (ft)	172.00
E.G. DS (ft)	1394.50	Weir Max Depth (ft)	0.32
W.S. DS (ft)	1394.00	Weir Avg Depth (ft)	0.13
Q US (cfs)	1850.00	Weir Submerg	0.00
Q Leaving Total (cfs)	16.07	Min El Weir Flow (ft)	1393.88
Q DS (cfs)	1833.80	Wr Top Wdth (ft)	147.83
Perc Q Leaving	0.88	Q Gate Group (cfs)	
Q Weir (cfs)	16.07	Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)	19.53	Gate Invert (ft)	

Table 1c. Split Flow Analysis from 3564.237 to 3431.489

: Below Bonita PadelFordWashBel MainWash RS: 3564.237 Lat Struct Profile: PF 1E.G. US. (ft)	1392.19	Weir Sta US (ft)	
W.S. US. (ft)	1391.40	Weir Sta DS (ft)	
E.G. DS (ft)	1391.10	Weir Max Depth (ft)	
W.S. DS (ft)	1390.64	Weir Avg Depth (ft)	
Q US (cfs)	1833.80	Weir Submerg	
Q Leaving Total (cfs)	0.00	Min El Weir Flow (ft)	1392.42
Q DS (cfs)	1833.80	Wr Top Wdth (ft)	
Perc Q Leaving	0.00	Q Gate Group (cfs)	
Q Weir (cfs)		Gate Open Ht (ft)	
Q Gates (cfs)		Gate #Open	
Q Culv (cfs)	0.00	Gate Area (sq ft)	
Q Lat RC (cfs)		Gate Submerg	
Weir Flow Area (sq ft)		Gate Invert (ft)	

Table 2. Summary of HEC-RAS Results for Split Flow Analysis

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	
4707.703	PF 1	1850.00	1394.22	1399.43	1400.29	0.005689	7.63	0.75
4656.905	PF 1	1850.00	1393.68	1399.47	1399.92	0.004062	5.59	0.54
4597.277	PF 1	1850.00	1393.32	1398.78	1399.56	0.007798	7.76	0.69
4524.432	PF 1	1850.00	1394.02	1398.58	1398.95	0.005961	6.22	0.60
4457.608	PF 1	1850.00	1393.03	1397.73	1398.46	0.008274	7.81	0.68
4384.863	PF 1	1850.00	1393.05	1397.36	1397.84	0.005386	6.28	0.58
4312.383	PF 1	1850.00	1393.64	1397.07	1397.42	0.005330	5.34	0.54
4229.357	PF 1	1850.00	1392.53	1396.23	1396.85	0.008779	6.68	0.74
4229.356		Lat Struct						
4180.101	PF 1	1850.00	1391.96	1395.97	1396.45	0.006322	5.89	0.64
4111.688	PF 1	1850.00	1391.34	1395.46	1396.00	0.006655	6.11	0.65
4052.903	PF 1	1850.00	1390.62	1394.88	1395.52	0.009596	6.65	0.75
4052.902		Lat Struct						
4001.193	PF 1	1845.73	1390.47	1394.91	1395.16	0.002814	4.56	0.45
3947.088	PF 1	1837.16	1389.89	1394.40	1394.92	0.006337	6.62	0.60
3875.049	PF 1	1833.80	1388.60	1393.99	1394.50	0.005015	6.56	0.62
3791.985	PF 1	1833.80	1388.15	1393.17	1393.94	0.006218	7.38	0.69
3688.651	PF 1	1833.80	1387.24	1392.67	1393.21	0.006669	6.61	0.63
3564.238	PF 1	1833.80	1387.08	1391.40	1392.19	0.008093	7.59	0.72
3564.237		Lat Struct						
3431.489	PF 1	1833.80	1387.03	1390.64	1391.09	0.004853	6.38	0.66
3332.428	PF 1	1833.80	1386.58	1390.13	1390.57	0.005692	6.07	0.64
3210.251	PF 1	1833.80	1385.90	1389.38	1389.81	0.007592	5.92	0.64

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Froude # Chl
3099.452	PF 1	1833.80	1384.91	1388.66	1389.07	0.006425	5.55	0.63
3019.254	PF 1	1833.80	1384.41	1388.20	1388.59	0.005631	5.44	0.59
2945.702	PF 1	1833.80	1383.91	1387.46	1388.04	0.009768	6.49	0.77
2836.657	PF 1	1833.80	1383.04	1386.72	1387.23	0.005589	5.92	0.65
2691.315	PF 1	1833.80	1381.20	1385.29	1385.94	0.016435	6.83	0.75
2536.726	PF 1	1833.80	1379.40	1384.30	1384.56	0.005098	4.66	0.47
2371.513	PF 1	1833.80	1378.02	1383.13	1383.54	0.007837	5.96	0.60
2223.050	PF 1	1833.80	1377.16	1382.37	1382.59	0.004551	4.44	0.44
2084.607	PF 1	1833.80	1376.38	1380.85	1381.53	0.013011	7.55	0.80
1946.634	PF 1	1833.80	1375.50	1379.73	1380.14	0.005998	5.99	0.61
1796.212	PF 1	1833.80	1374.45	1378.70	1378.86	0.004438	3.71	0.48
1647.488	PF 1	1833.80	1373.35	1377.64	1377.97	0.008239	4.81	0.64
1457.613	PF 1	1833.80	1371.85	1376.28	1376.49	0.007016	3.99	0.55
1247.254	PF 1	1833.80	1369.97	1374.10	1374.53	0.012897	5.97	0.83
1058.069	PF 1	1833.80	1368.64	1372.62	1372.81	0.006301	3.87	0.55
835.499	PF 1	1833.80	1367.35	1370.24	1370.68	0.016576	4.86	0.81

5.4. Final HEC-RAS 3.1 Model Development and Results

Since HEC-RAS model is a one-dimensional model, its computation is based on a cross-section area and puts water across the cross-sections as long as the ground elevations adjacent to the main channel are low. Therefore, engineering judgment must be made based on the topographic contour lines to "guide" the flow distributions in each cross-section. The approach of artificial levee is used to make sure the flow will stay in the channel if no split flow is observed. Two artificial levees are added to each cross-section to correctly reflect the actual flow paths. It should be pointed out that the levees' elevations are set at the natural ground elevations. Topographic contour data and aerial photos are imported into HEC-RAS 3.1 to help find the locations for the artificial levees.

Since the split flow analysis shows that the split flow is rather insignificant, the artificial levee's elevation (at the right bank side) for the split flow areas are slightly increased to just contain the flow in order to correctly delineate the floodplain in HEC-GeoRAS 3.1. The flow rate for the cross-sections downstream of split flow could be decreased slightly since the split flow analysis shows that a total of 16 cfs is split over the bank. However, since the amount of split flows is rather small, 1850 cfs is still used throughout every cross-section for conservative estimation purpose. The HEC-RAS model is run and the results are obtained. Table 3 summaries the results.

Table 3. Summary of Final HEC-RAS Results

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	
4707.703	PF 1	1850.00	1394.22	1399.43	1400.29	0.005689	7.63	0.75
4656.905	PF 1	1850.00	1393.68	1399.47	1399.92	0.004062	5.59	0.54
4597.277	PF 1	1850.00	1393.32	1398.78	1399.56	0.007798	7.76	0.69
4524.432	PF 1	1850.00	1394.02	1398.58	1398.95	0.005961	6.22	0.60
4457.608	PF 1	1850.00	1393.03	1397.73	1398.46	0.008274	7.81	0.68
4384.863	PF 1	1850.00	1393.05	1397.36	1397.84	0.005385	6.28	0.58
4312.383	PF 1	1850.00	1393.64	1397.07	1397.42	0.005329	5.34	0.54
4229.357	PF 1	1850.00	1392.53	1396.23	1396.85	0.008782	6.68	0.74
4180.101	PF 1	1850.00	1391.96	1395.97	1396.45	0.006326	5.89	0.64
4111.688	PF 1	1850.00	1391.34	1395.46	1396.00	0.006676	6.11	0.65
4052.903	PF 1	1850.00	1390.62	1394.88	1395.52	0.009541	6.63	0.74
4001.193	PF 1	1850.00	1390.47	1394.91	1395.16	0.002805	4.56	0.44
3947.088	PF 1	1850.00	1389.89	1394.40	1394.92	0.006320	6.62	0.60
3875.049	PF 1	1850.00	1388.60	1394.00	1394.50	0.005029	6.58	0.62
3791.985	PF 1	1850.00	1388.15	1393.18	1393.95	0.006234	7.40	0.69
3688.651	PF 1	1850.00	1387.24	1392.68	1393.22	0.006747	6.65	0.64
3564.238	PF 1	1850.00	1387.08	1391.41	1392.20	0.008072	7.60	0.72
3431.489	PF 1	1850.00	1387.03	1390.65	1391.10	0.004847	6.39	0.66
3332.428	PF 1	1850.00	1386.58	1390.13	1390.58	0.005700	6.09	0.65
3210.251	PF 1	1850.00	1385.90	1389.39	1389.82	0.007534	5.92	0.64
3099.452	PF 1	1850.00	1384.91	1388.67	1389.08	0.006455	5.58	0.63
3019.254	PF 1	1850.00	1384.41	1388.21	1388.60	0.005654	5.46	0.59
2945.702	PF 1	1850.00	1383.91	1387.47	1388.05	0.009718	6.50	0.77
2836.657	PF 1	1850.00	1383.04	1386.74	1387.24	0.005606	5.95	0.66
2691.315	PF 1	1850.00	1381.20	1385.30	1385.95	0.016427	6.85	0.75
2536.726	PF 1	1850.00	1379.40	1384.31	1384.57	0.005108	4.67	0.47
2371.513	PF 1	1850.00	1378.02	1383.14	1383.55	0.007814	5.96	0.60
2223.050	PF 1	1850.00	1377.16	1382.38	1382.61	0.004528	4.45	0.44
2084.607	PF 1	1850.00	1376.38	1380.85	1381.54	0.013163	7.59	0.80
1946.634	PF 1	1850.00	1375.50	1379.73	1380.15	0.006096	6.04	0.62
1796.212	PF 1	1850.00	1374.45	1378.71	1378.87	0.004439	3.72	0.48
1647.488	PF 1	1850.00	1373.35	1377.65	1377.98	0.008184	4.81	0.64
1457.613	PF 1	1850.00	1371.85	1376.28	1376.50	0.007127	4.02	0.56
1247.254	PF 1	1850.00	1369.97	1374.12	1374.54	0.012606	5.93	0.82
1058.069	PF 1	1850.00	1368.64	1372.63	1372.82	0.006325	3.88	0.55
835.499	PF 1	1850.00	1367.35	1370.25	1370.69	0.016448	4.85	0.81

5.5. Floodplain Delineation Using HEC-GeoRAS 3.1

After the hydraulic results are obtained by running HEC-RAS 3.1, the results are exported from HEC-RAS 3.1 in a GIS format, which are then imported into ArcView 3.2 with HEC-GeoRAS 3.1 and Spatial Analyst extensions. Within HEC-GeoRAS 3.1, the spatial results for the floodplain areas, flooding depth, and water surface elevation are obtained. Figures 5-8 show the floodplain boundary, flooding depth, water surface elevation, and finish floor elevations as compared with water surface elevations.

6. Hydraulic Modeling Results and Analysis

The results can be seen on Figures 5-8. Appendix 3 shows cross-section plots with water surface elevation and velocity distribution. Figure 5 indicates that some properties are within the 100-year floodplain boundary. However, Figure 8 shows the finish floor elevations for the surveyed properties are above the 100-year water surface elevations, which indicates that the properties may be considered to be outside the 100-year floodplains. However, certain requests must be approved by FEMA, one of which is Elevation Certificate.

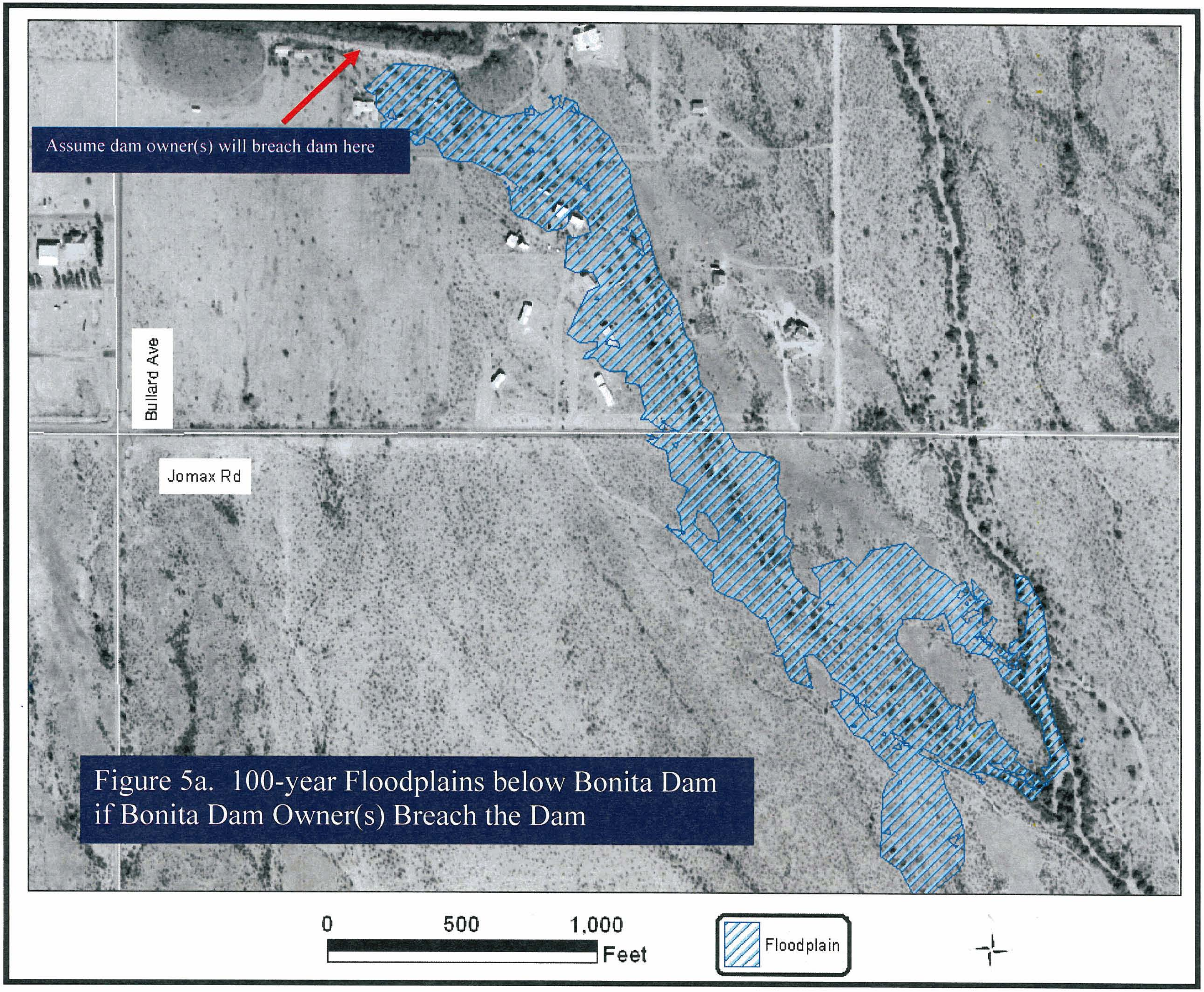


Figure 5a. 100-year Floodplains below Bonita Dam if Bonita Dam Owner(s) Breach the Dam

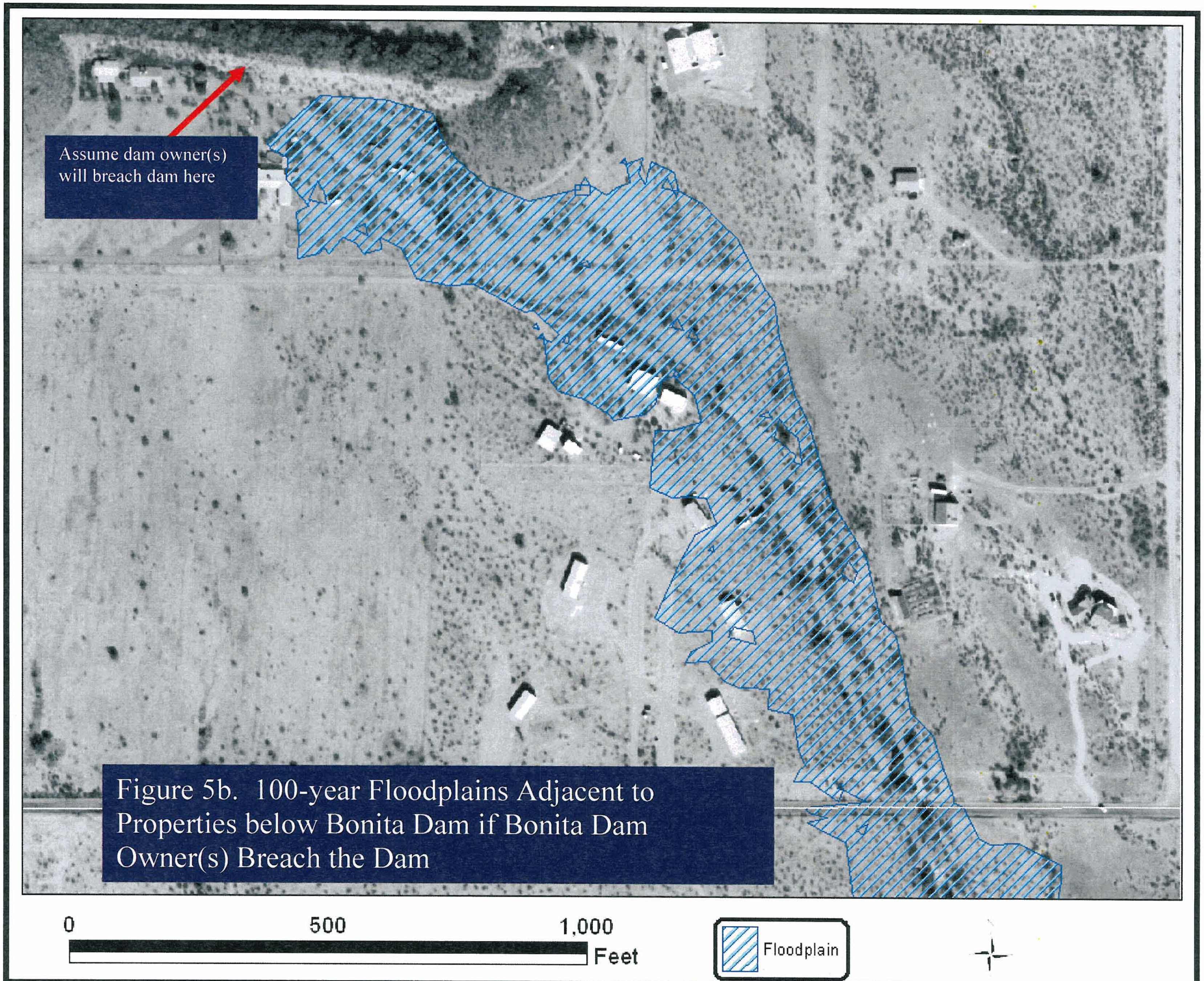


Figure 5b. 100-year Floodplains Adjacent to Properties below Bonita Dam if Bonita Dam Owner(s) Breach the Dam

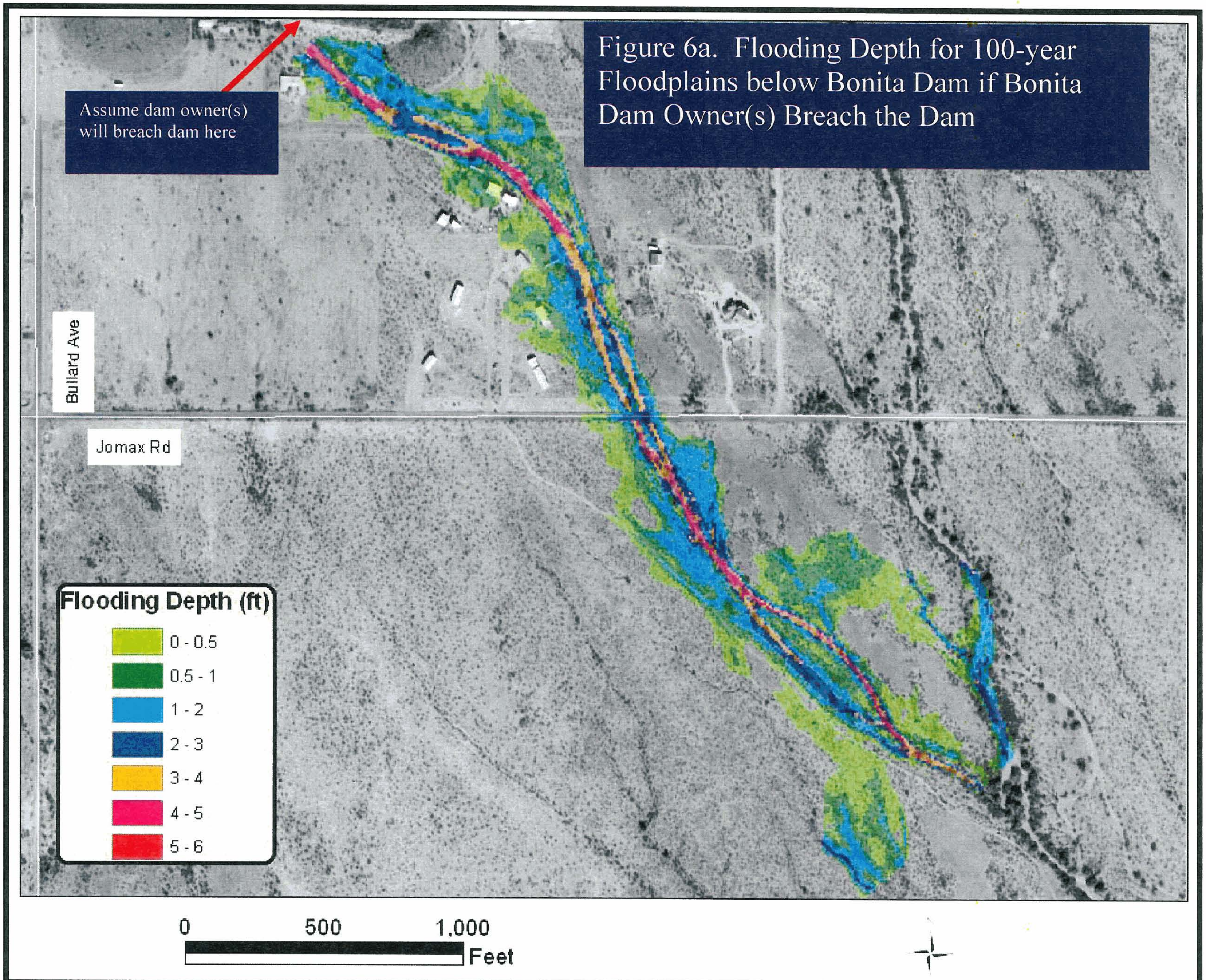


Figure 6a. Flooding Depth for 100-year Floodplains below Bonita Dam if Bonita Dam Owner(s) Breach the Dam
Assume dam owner(s) will breach dam here
Bullard Ave
Jomax Rd
Flooding Depth (ft)
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
0
500
1,000
Feet

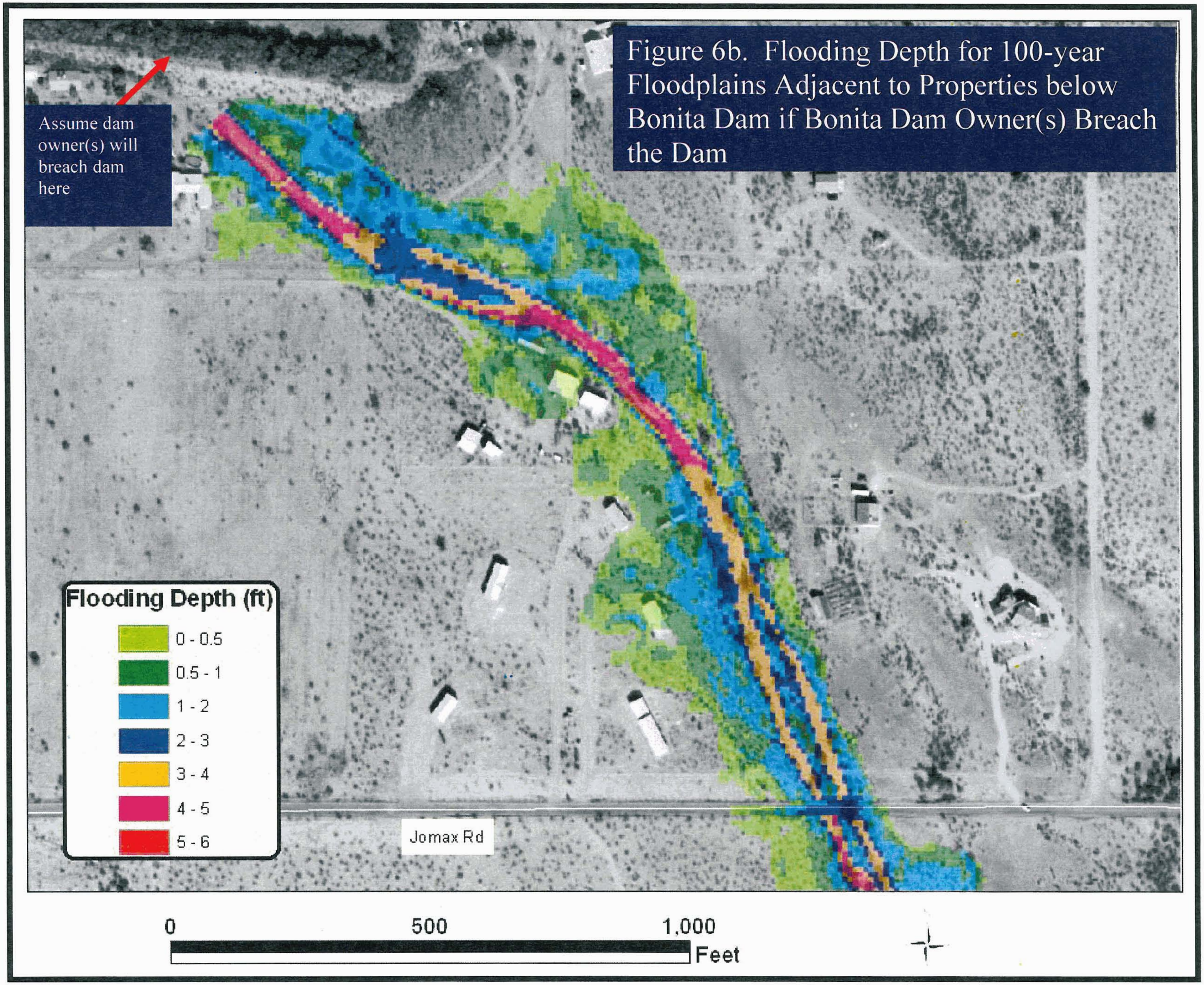


Figure 6b. Flooding Depth for 100-year Floodplains Adjacent to Properties below Bonita Dam if Bonita Dam Owner(s) Breach the Dam
Assume dam owner(s) will breach dam here
Flooding Depth (ft)
0 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
Jomax Rd
0
500
1,000
Feet

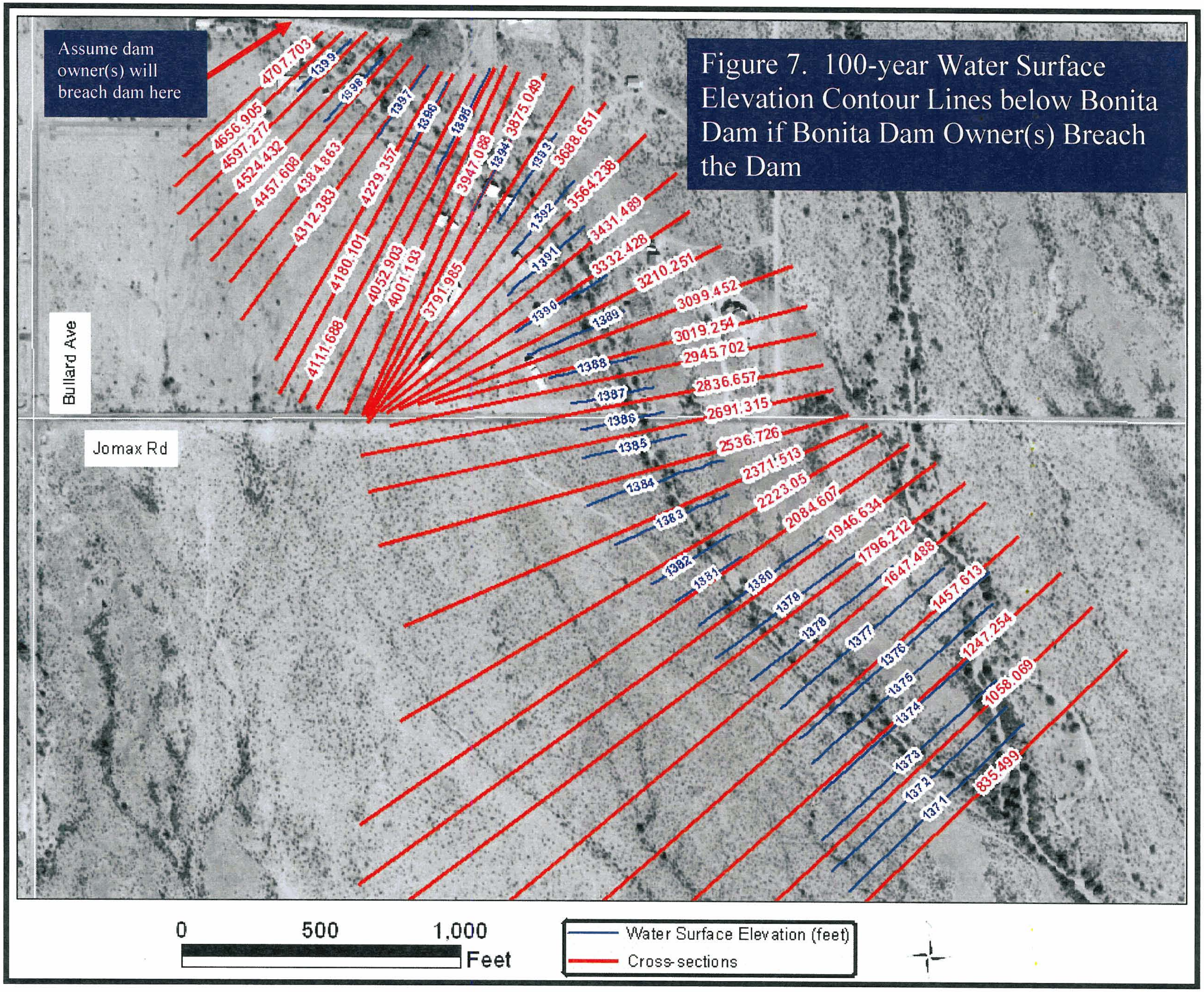


Figure 7. 100-year Water Surface Elevation Contour Lines below Bonita Dam if Bonita Dam Owner(s) Breach the Dam

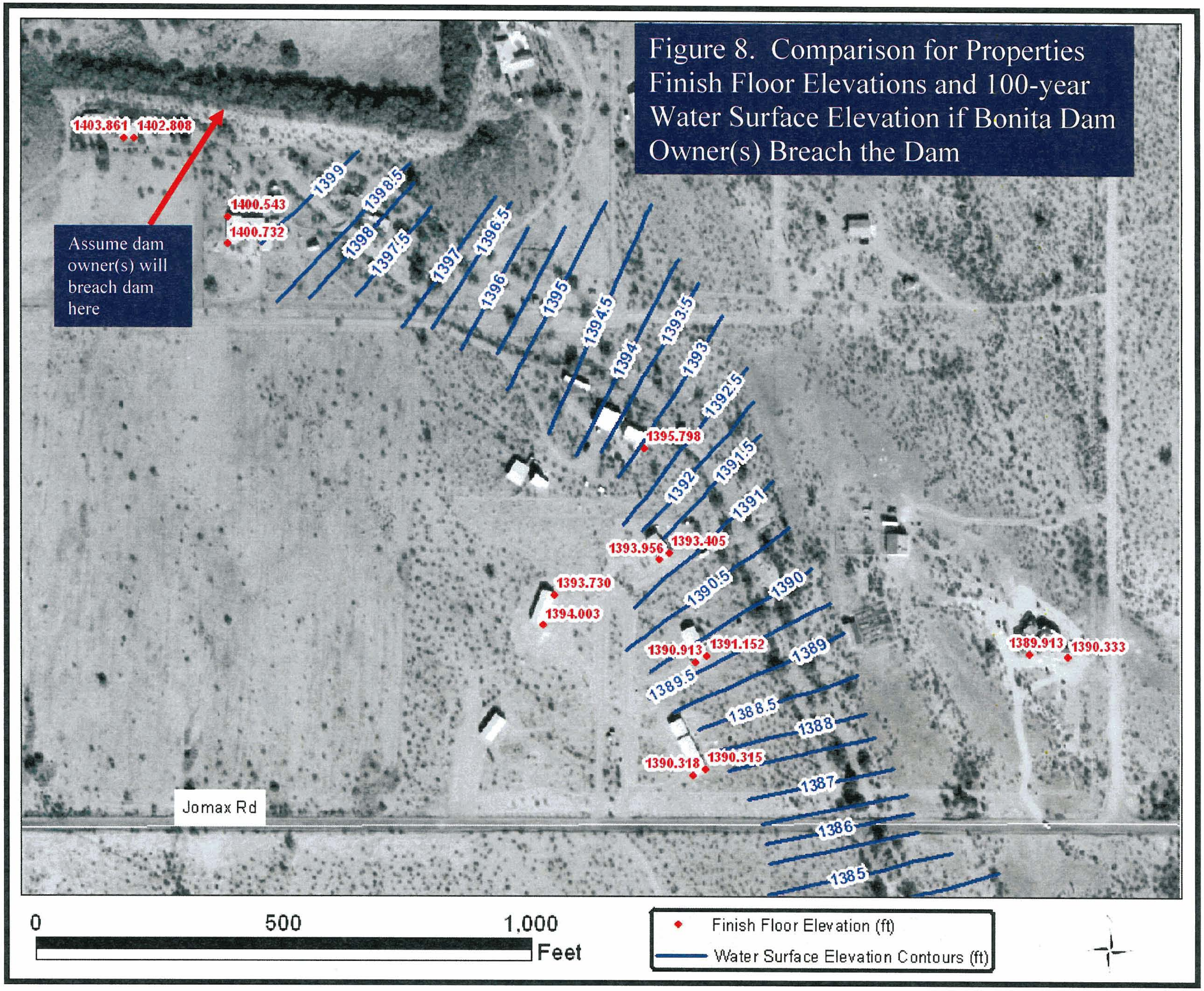


Figure 8. Comparison for Properties Finish Floor Elevations and 100-year Water Surface Elevation if Bonita Dam Owner(s) Breach the Dam
Assume dam owner(s) will breach dam here
1403.861
1402.808
1400.543
1400.732
1395.798
1393.956
1393.405
1393.730
1394.003
1390.913
1391.152
1389.913
1390.333
1390.318
1390.315
1399
1398.5
1398
1397.5
1397
1396.5
1396
1395
1394.5
1394
1393.5
1393
1392.5
1392
1391.5
1391
1390.5
1390
1389.5
1389
1388.5
1388
1387
1386
1385
Jomax Rd
0
500
1,000
Feet
Finish Floor Elevation (ft)
Water Surface Elevation Contours (ft)

7. Summary and Conclusions

Arizona Department of Water Resources (ADWR) classifies Bonita Dam as an unsafe dam. The dam owner(s) proposed to ADWR breaching the dam (removing a segment of dam embankment) along Padelford Wash's natural drainage path. Currently, Padelford Wash between Bonita Dam and 3800 feet below the dam is not on FEMA 100-year floodplains. However, if the dam is breached, this reach of Padelford Wash will be on FEMA 100-year floodplains. This preliminary floodplain delineation study is performed to delineate the preliminary 100-year floodplains limits and evaluate the potential for flooding impact on the existing properties adjacent to Padelford Wash.

Initial results from this preliminary floodplain delineation study indicate that the finish floor elevations for the surveyed properties appear to be above the 100-year water surface elevations, and thus the properties appear to be outside the 100-year floodplains. Prior to concluding such results however the final floodplain delineation study must fully address issues discussed in section 2 in this report. Certain requests must also be sent to FEMA for approval and approved by FEMA. One of the supporting documents is Elevation Certificate which must be filled out by an Arizona-registered land surveyor.

8. References

Chow, V.T. (1959). "Open-Channel Hydraulics," McGraw-Hill, Inc., New York, New York.

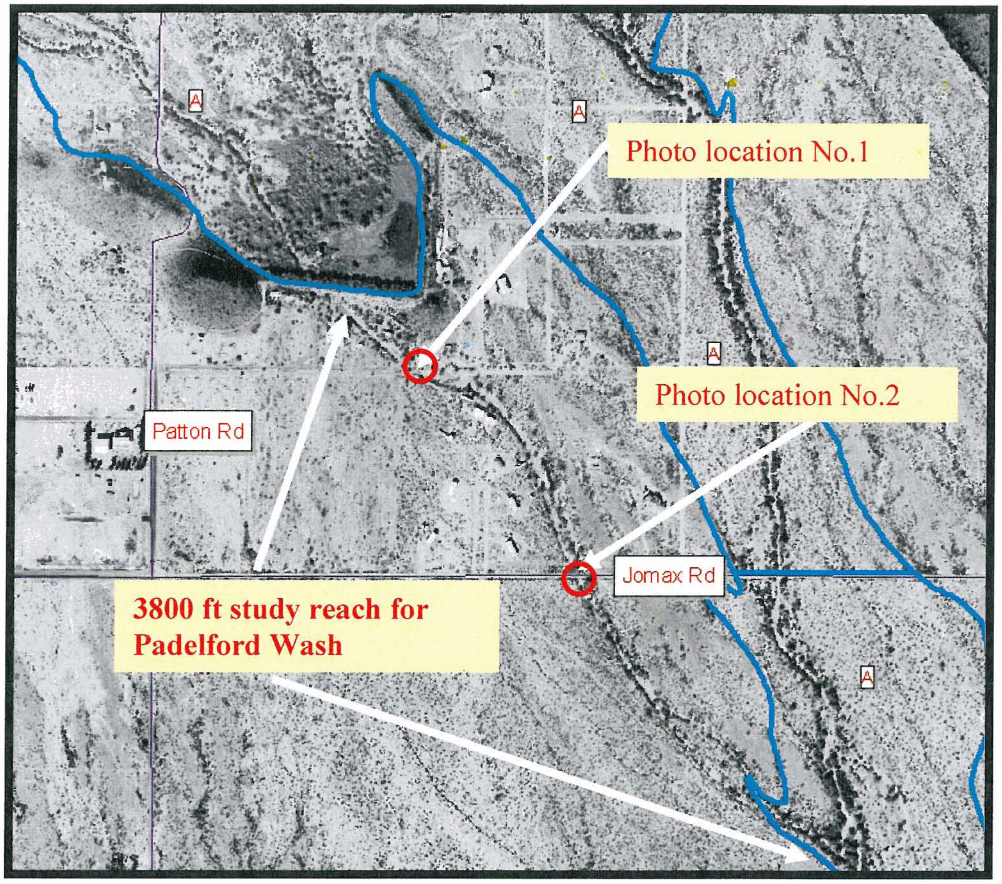
Hager, W.H. (1987). "Lateral Outflow Over Side Weirs," 113(4), Journal of Hydraulic Engineering, ASCE, New York, New York.

Thomsen, B.W. and Hjalmarson, H.W. (1991). "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona," prepared by Water Resources Division, USGS, 375 South Euclid Avenue, Tucson, Arizona 85719, prepared for Flood Control District of Maricopa County, Arizona.

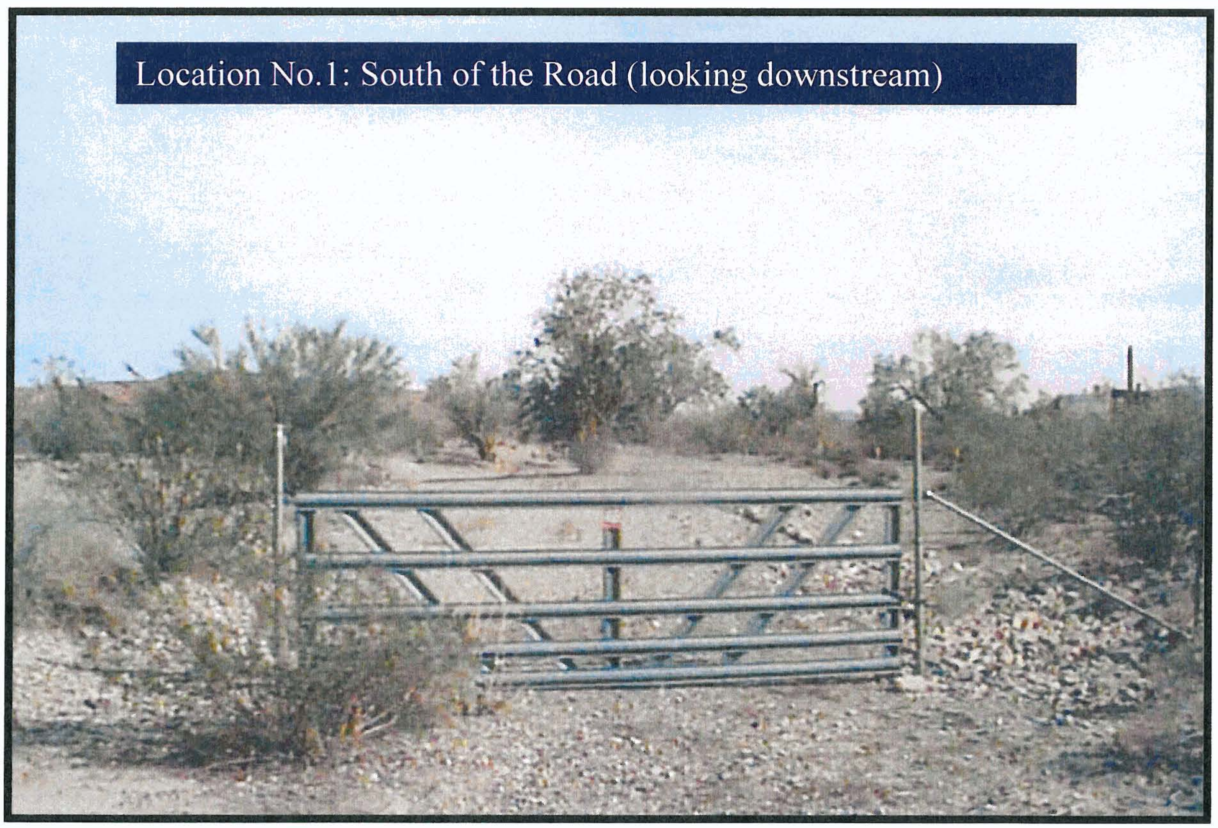
WLB Group Inc. (1989). "Wittmann Area Drainage Master Study, Part A: Hydrology and Hydraulics," prepared for Flood Control District of Maricopa County, Maricopa County, Arizona.

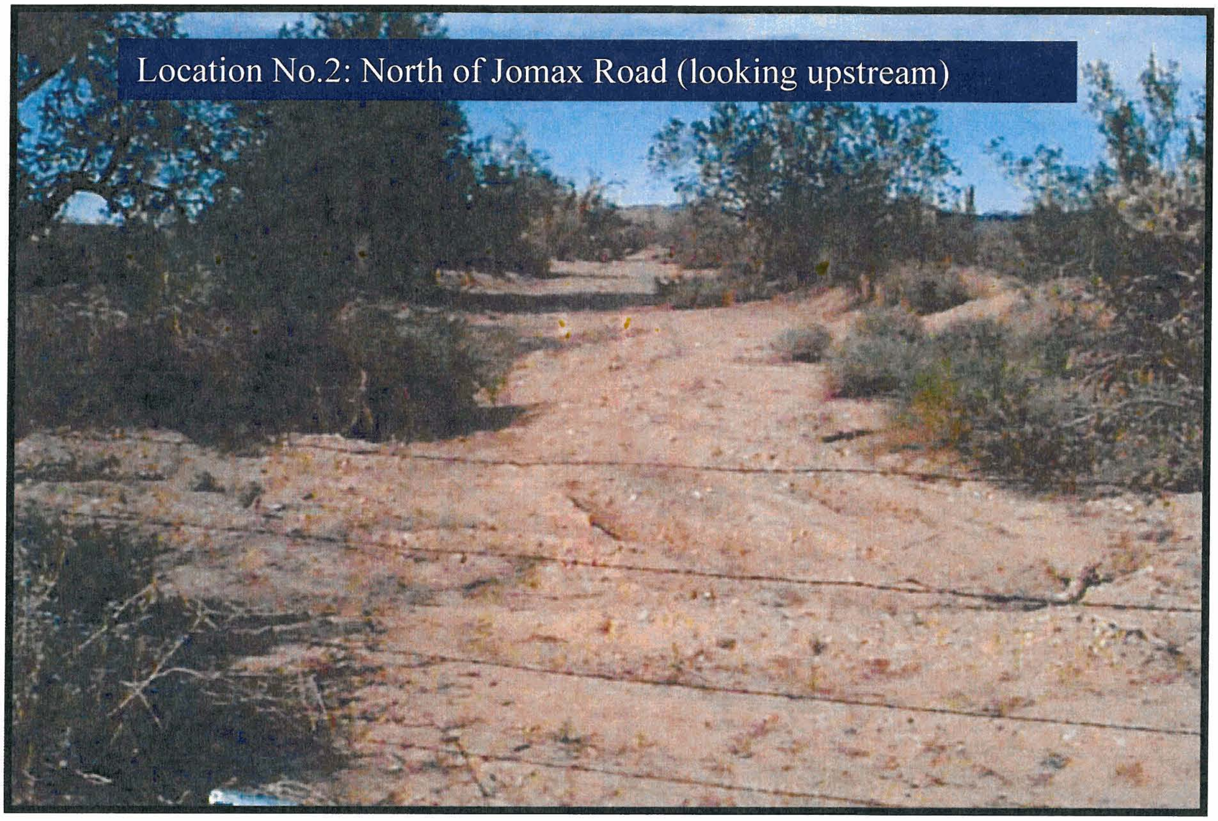
Zhao, B. (2003). "Hydrologic Study for Bonita Dam Maricopa County, Arizona," Flood Control District of Maricopa County, Arizona.

Appendix 1. Photos at Typical Cross-sections




Location No.1: North of the Road (looking upstream)


Location No.1: South of the Road (looking downstream)


Location No.2: North of Jomax Road (looking upstream)


Location No.2: South of Jomax Road (looking downstream)

Appendix 2. GIS Coverage for Manning's Roughness Coefficient

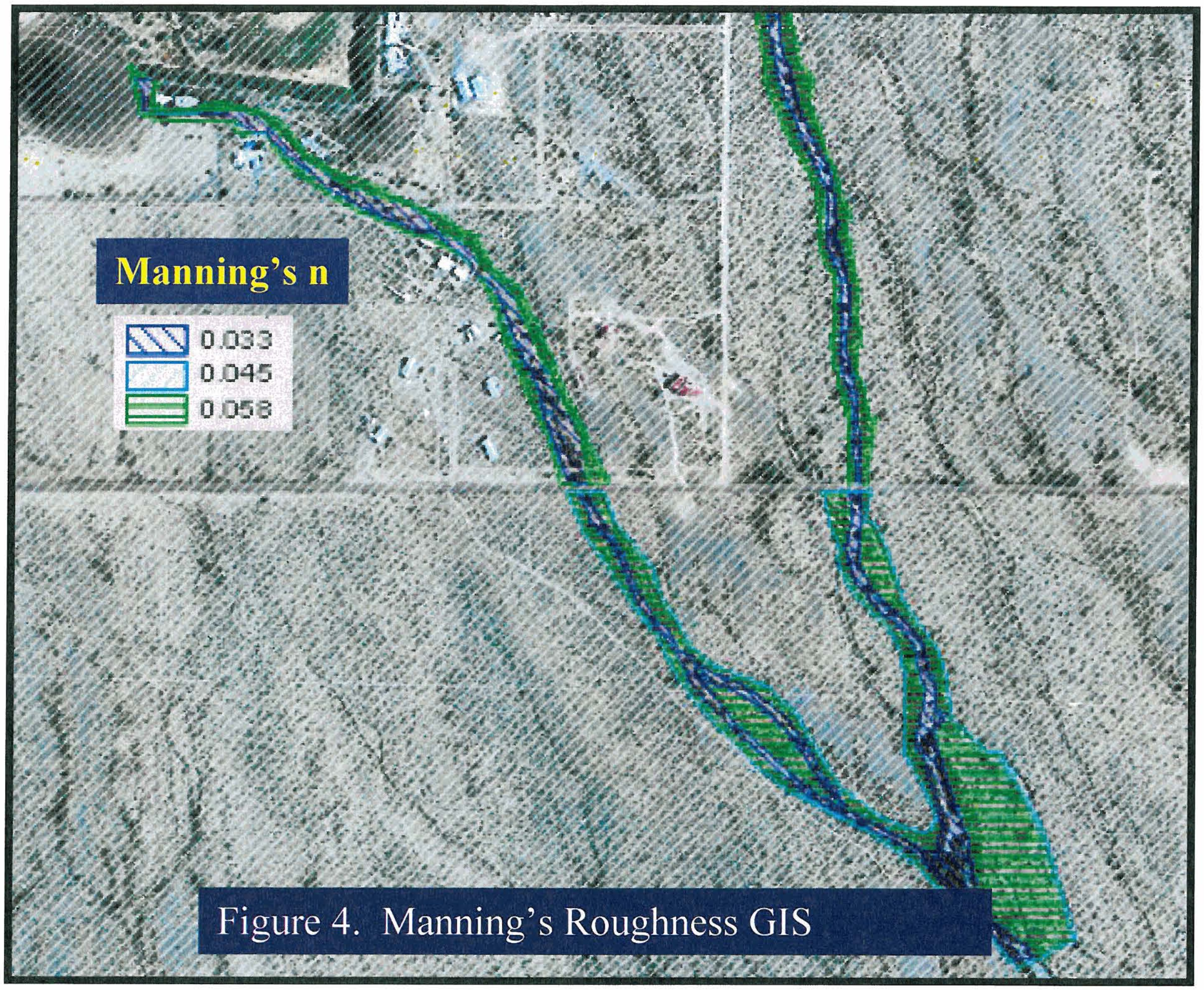
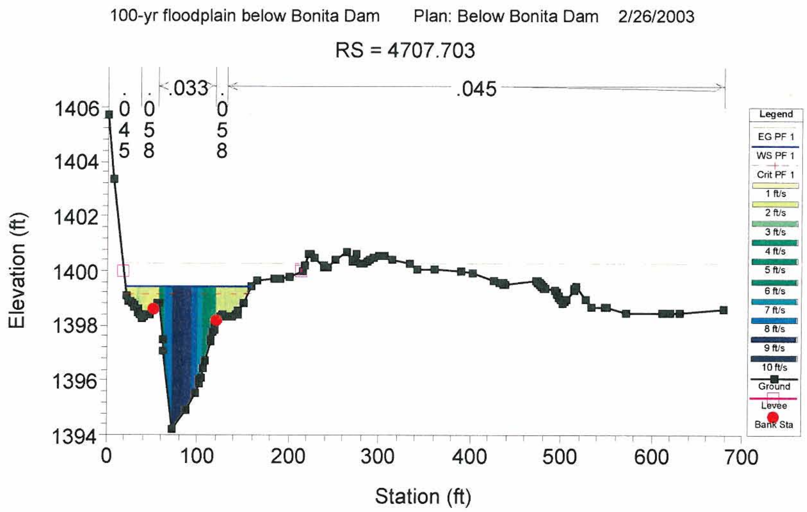
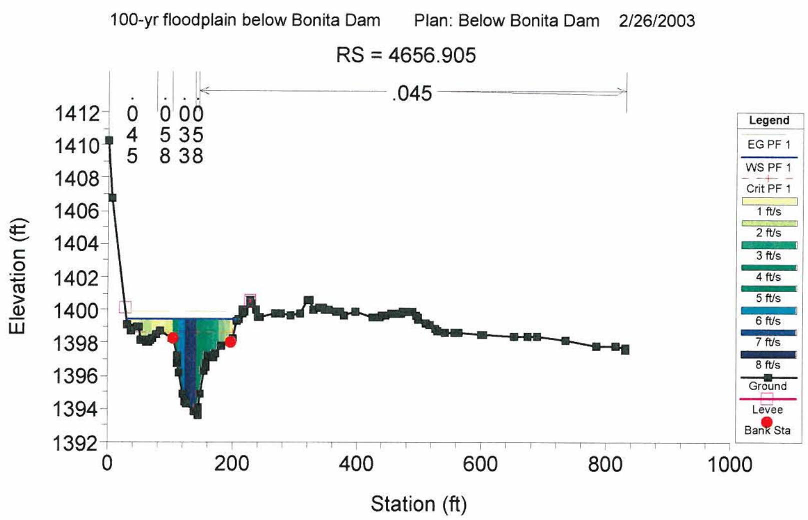
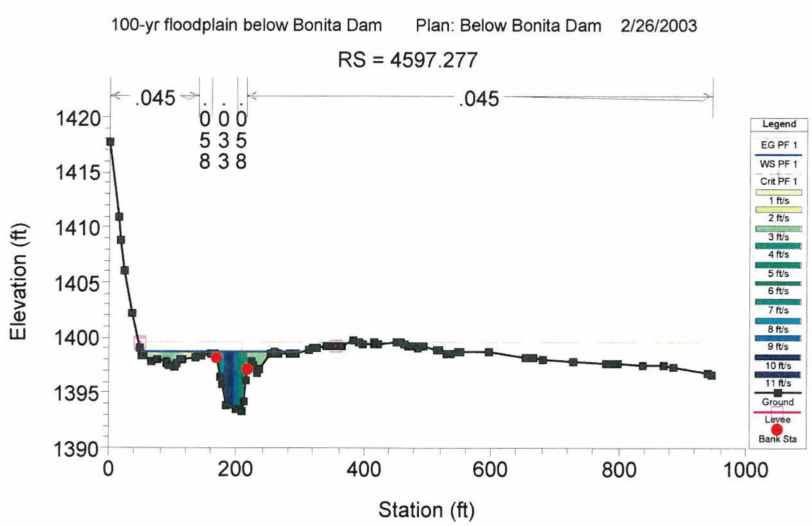


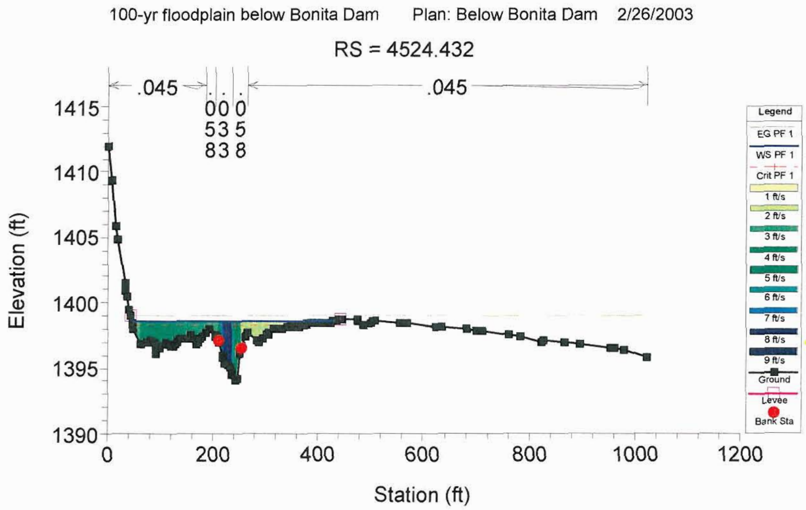
Figure 4. Manning's Roughness GIS

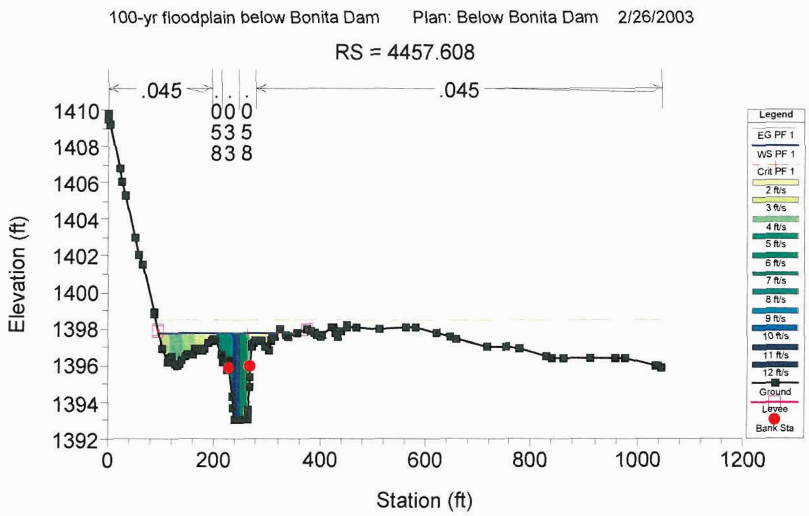
Appendix 3. HEC-RAS Results with Cross-sections Plots








100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 4524.432
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
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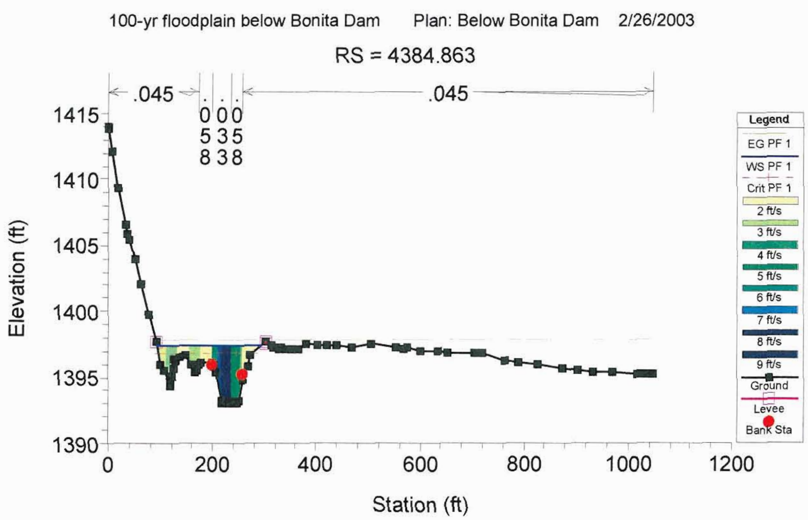
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta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.045
Elevation (ft)
Station (ft)
Legend
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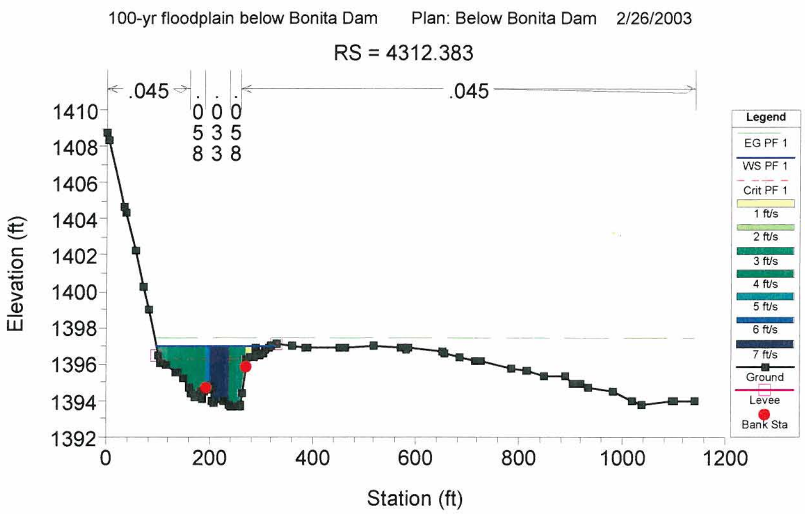
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta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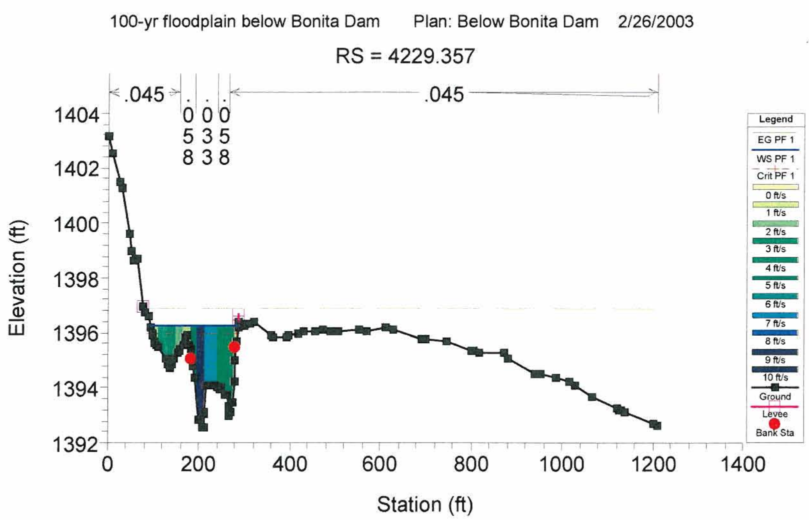
.058
.033
.058
.045
Elevation (ft)
1392
1394
1396
1398
1400
1402
1404
1406
1408
1410
Station (ft)
0
200
400
600
800
1000
1200
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
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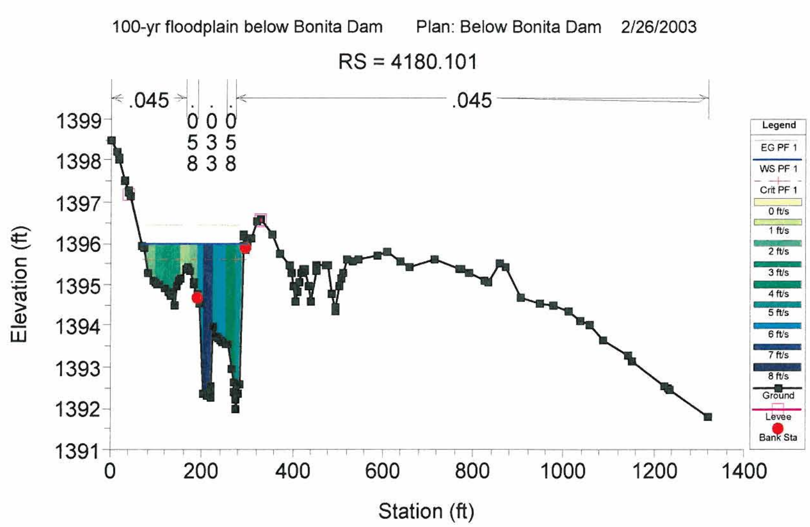
.045
.058
.033
.058
.045
Elevation (ft)
1392
1394
1396
1398
1400
1402
1404
Station (ft)
0
200
400
600
800
1000
1200
1400
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 4180.101
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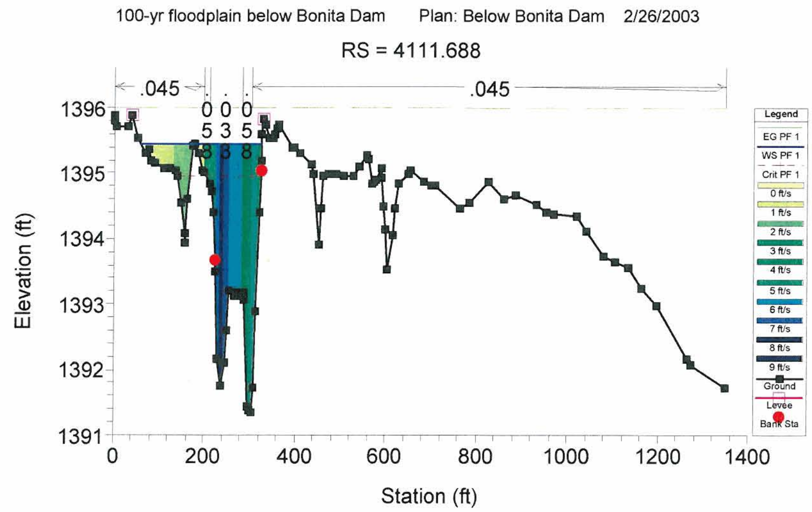
.058
.033
.058
.045
Elevation (ft)
1391
1392
1393
1394
1395
1396
1397
1398
1399
Station (ft)
0
200
400
600
800
1000
1200
1400
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 4111.688
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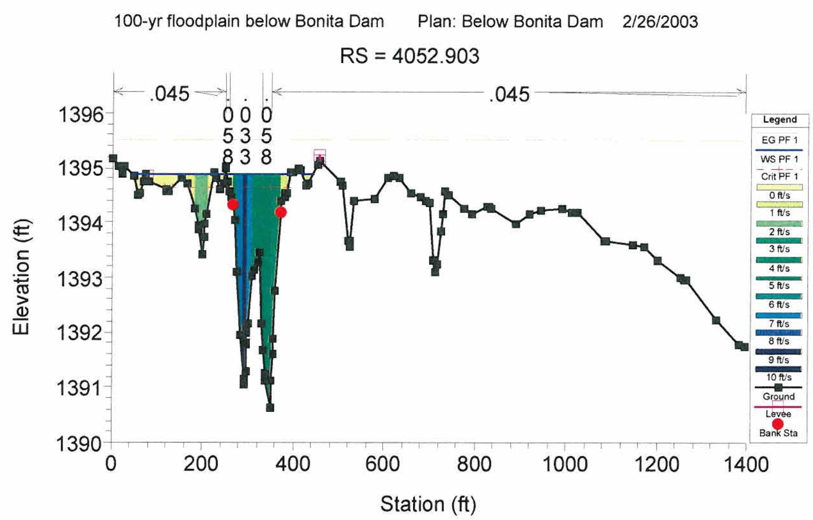
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)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RS = 4052.903
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.045
Legend
EG PF 1
WS PF 1
Crit PF 1
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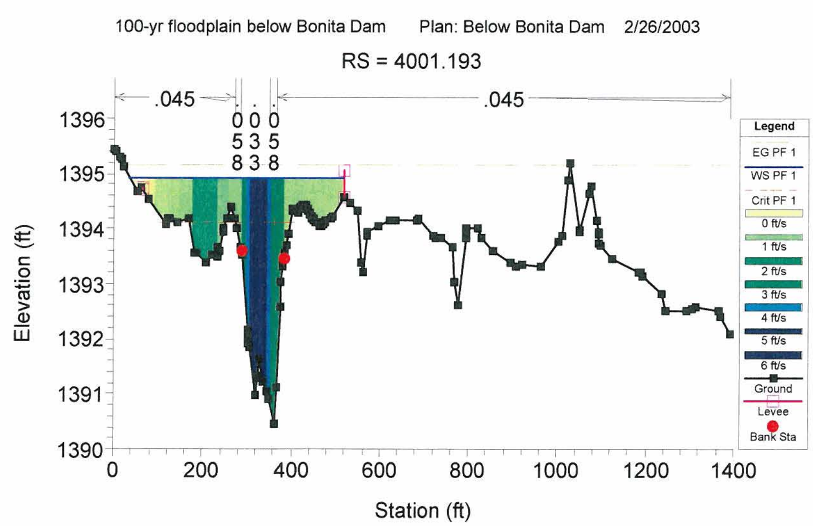
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)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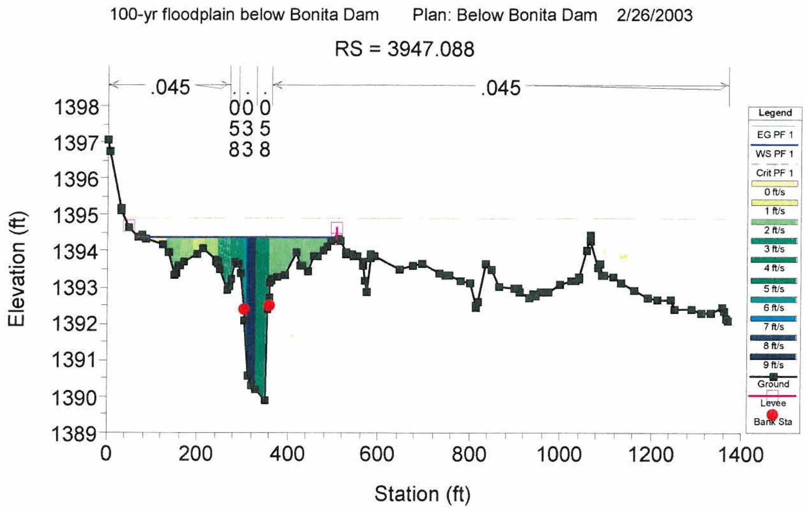
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)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Elevation (ft)
Station (ft)
Legend
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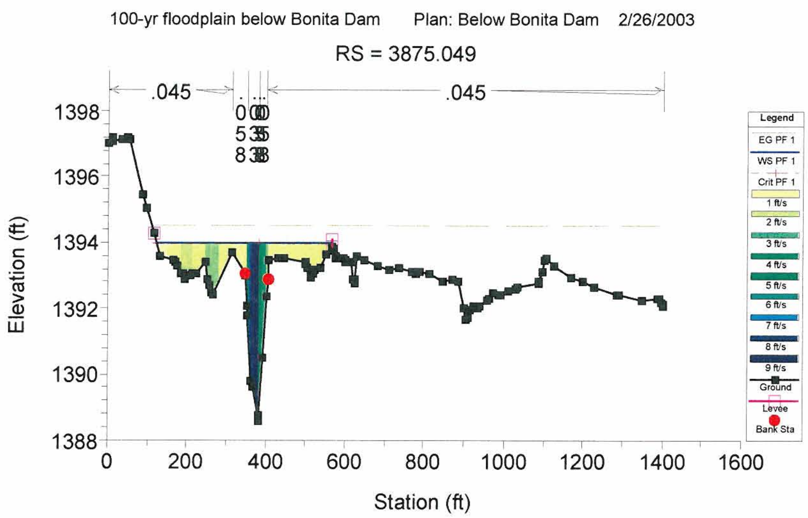
Crit PF 1
Ground
Levee
Bank Sta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Station (ft)
Legend
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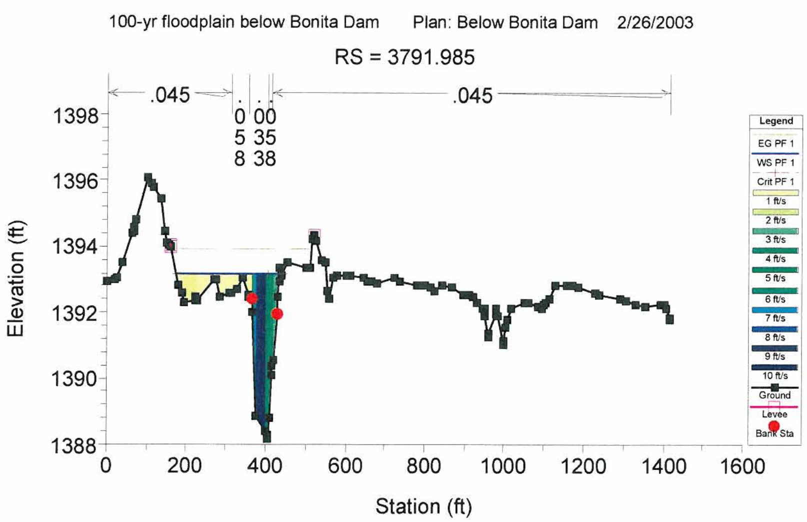
Crit PF 1
Ground
Levee
Bank Sta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Station (ft)
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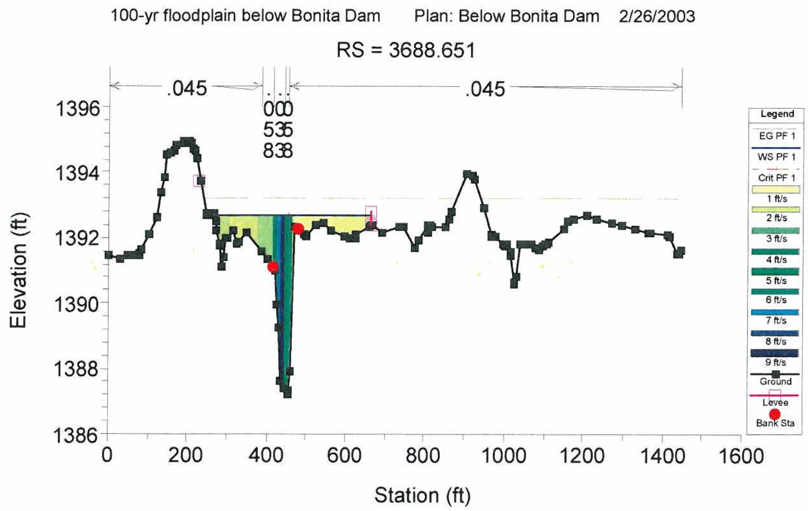
Crit PF 1
Ground
Levee
Bank Sta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.045
Elevation (ft)
Station (ft)
Legend
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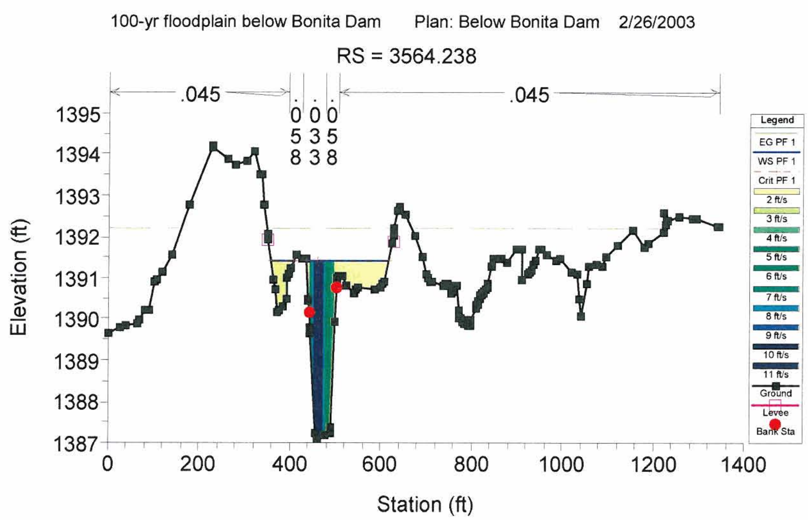
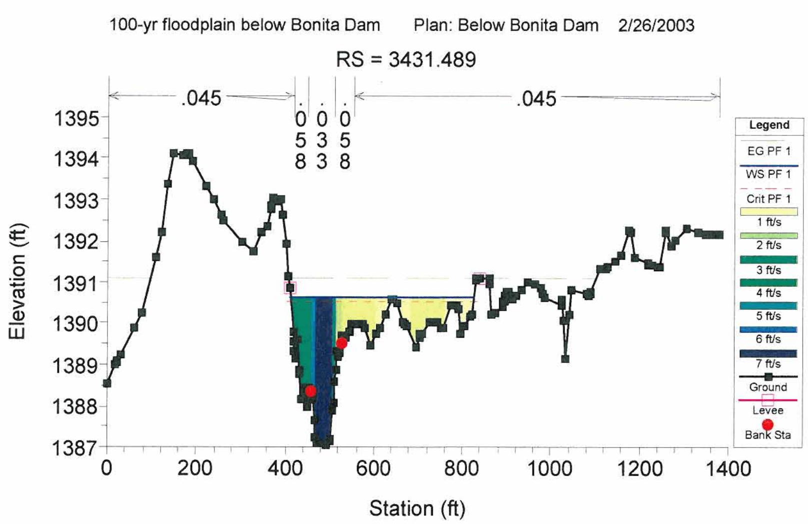
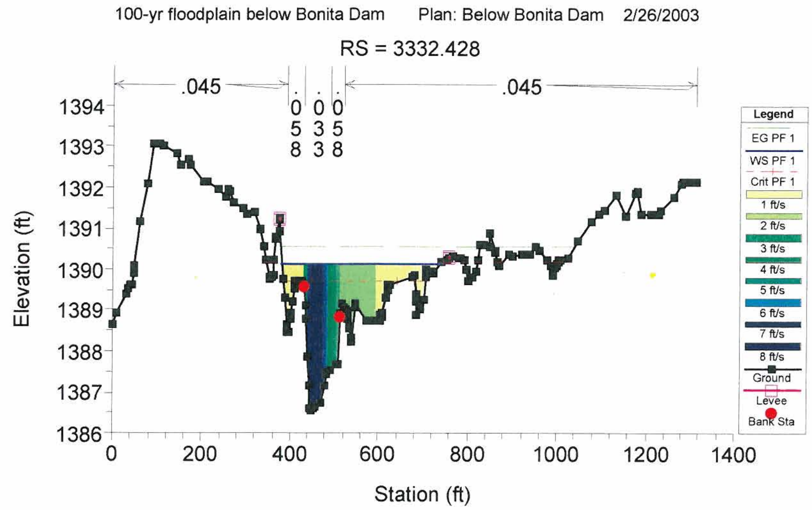
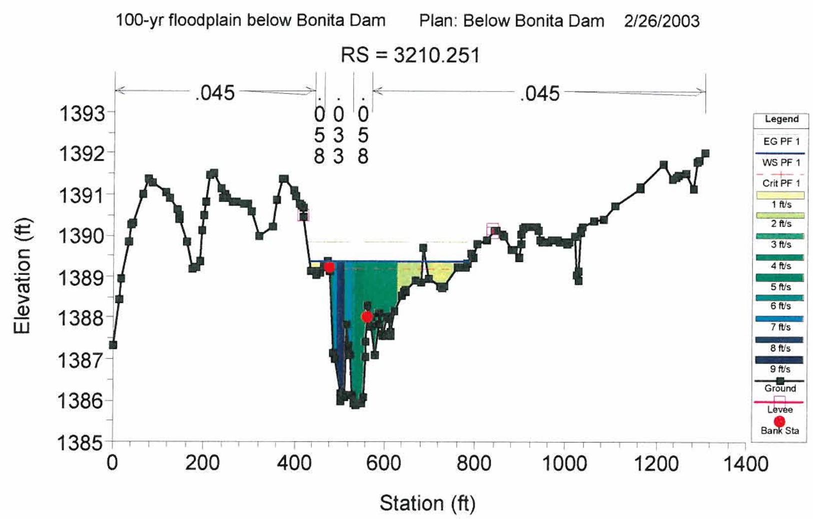
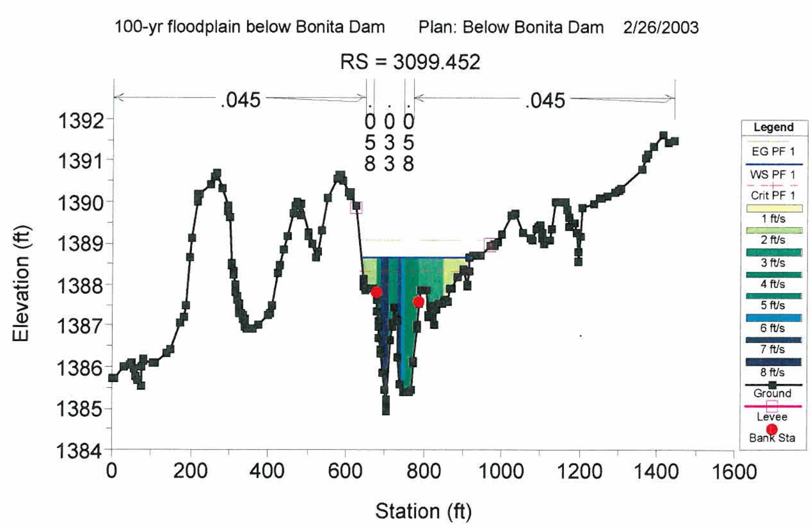
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Levee
Bank Sta

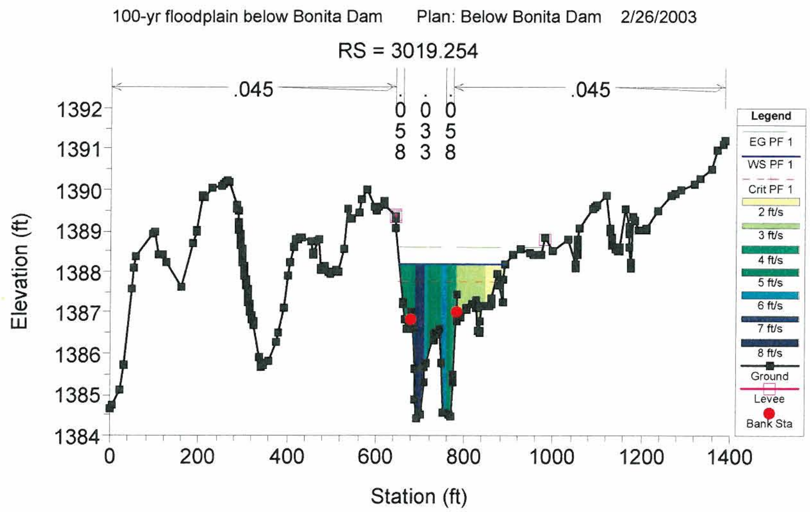

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3564.238
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
Ground
Levee
Bank Sta

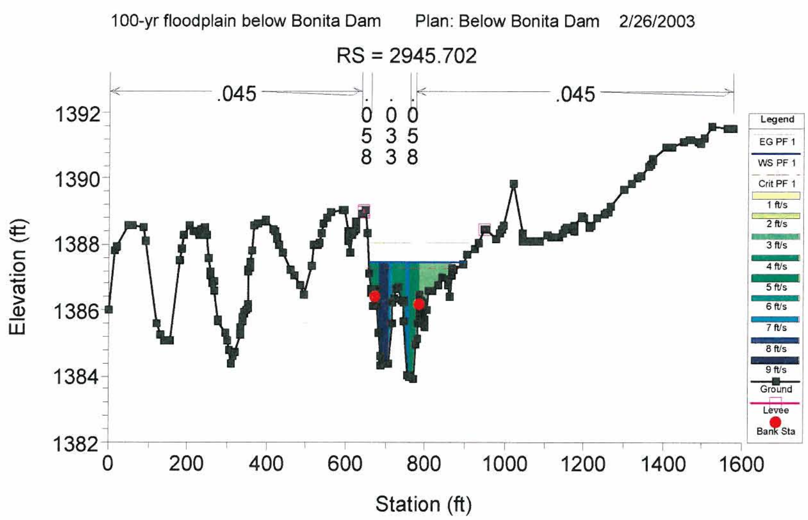

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3431.489
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta

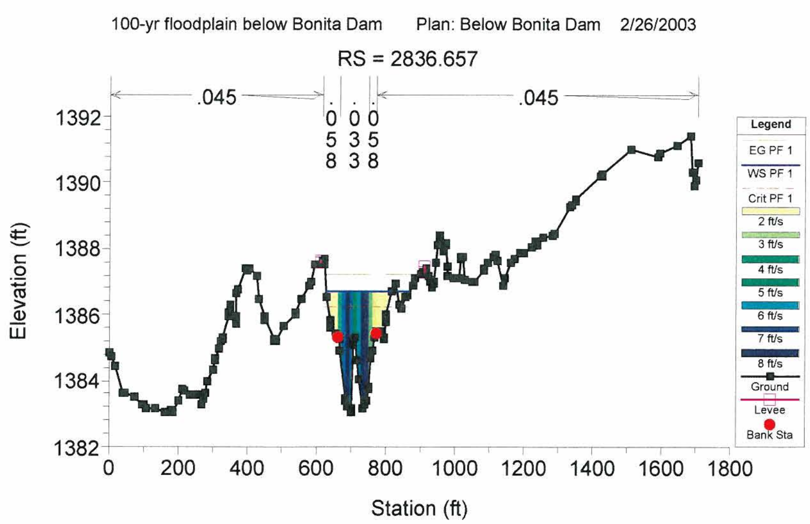

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3332.428
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Levee
Bank Sta

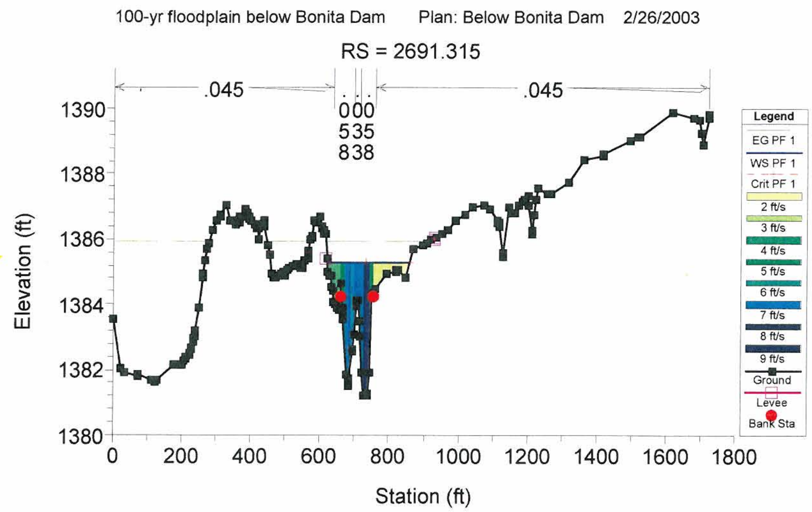

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3210.251
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Levee
Bank Sta

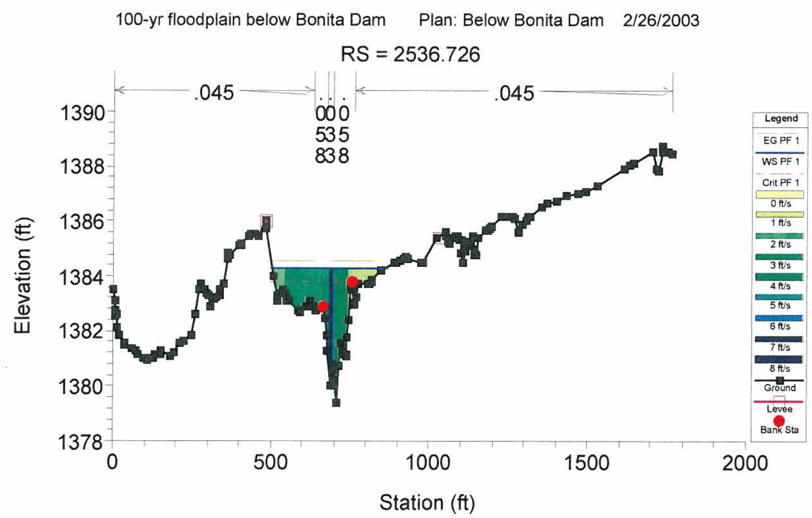

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3099.452
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Levee
Bank Sta

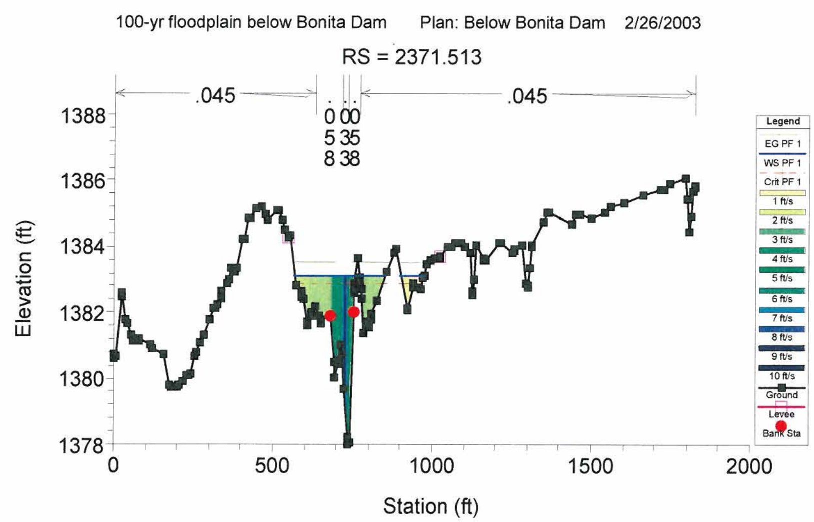

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 3019.254
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Levee
Bank Sta

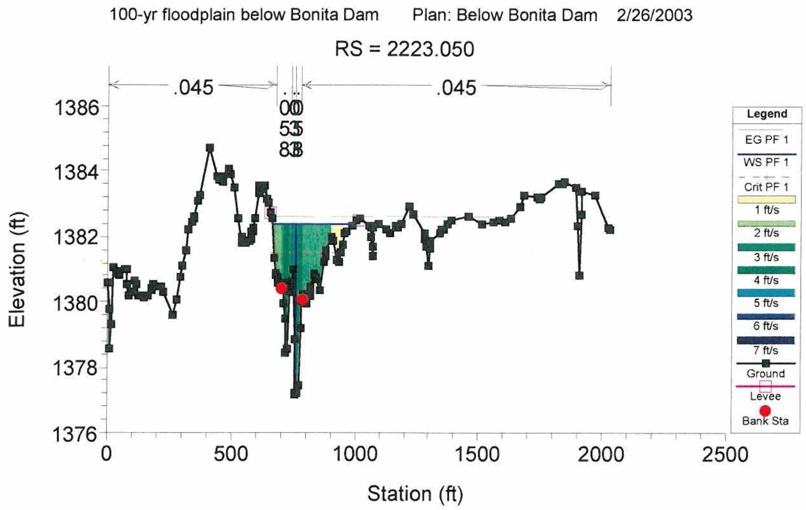

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2945.702
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Levee
Bank Sta

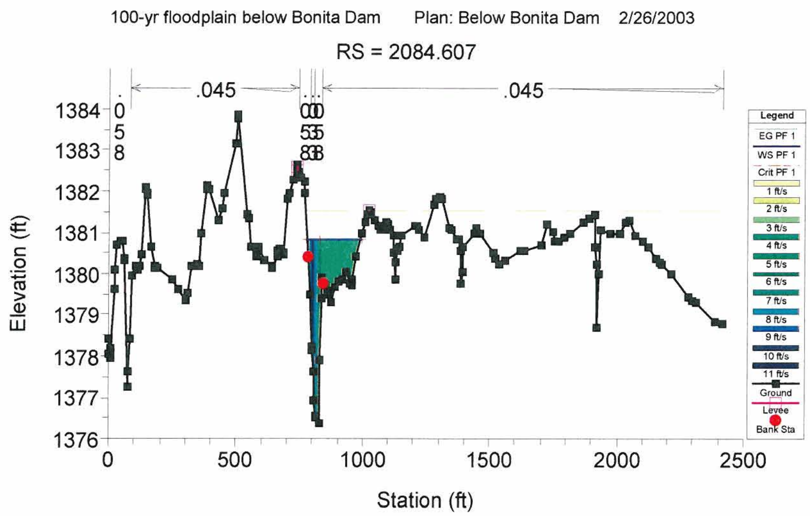

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2836.657
.045
.058 .033 .058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
Ground
Levee
Bank Sta

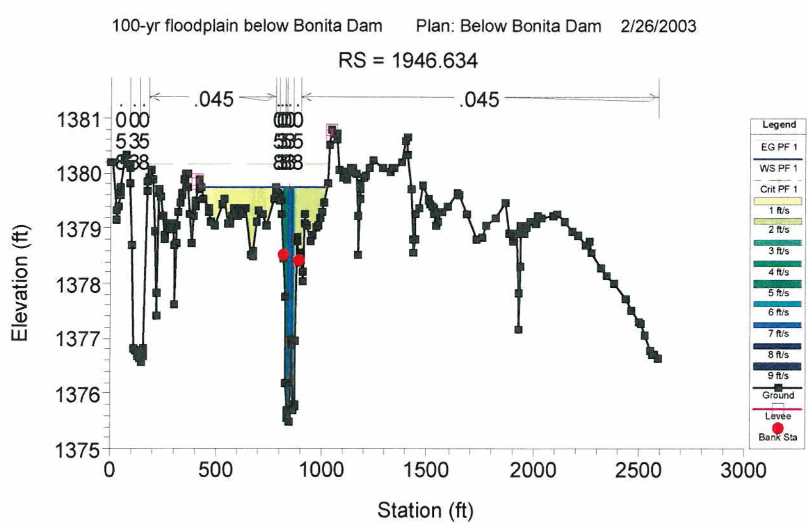

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2691.315
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

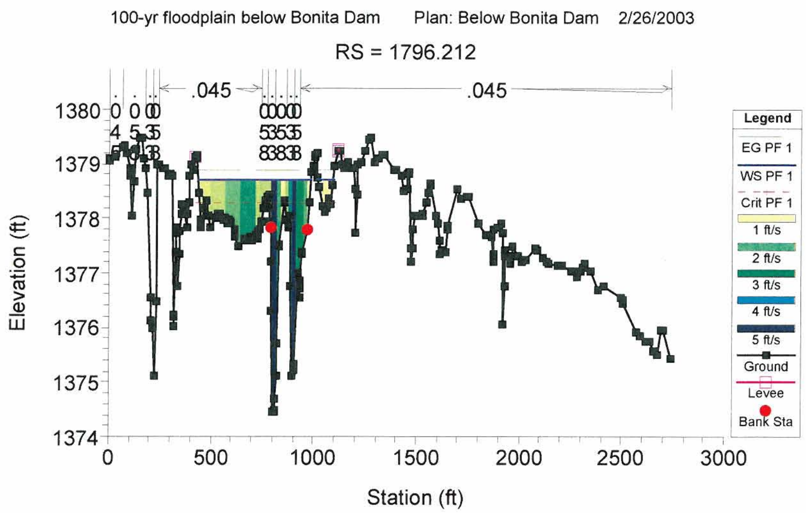

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2536.726
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

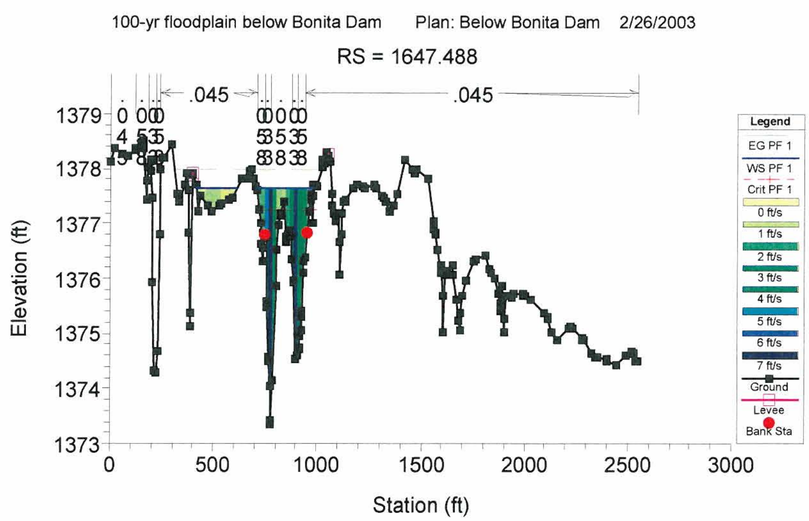

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2371.513
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

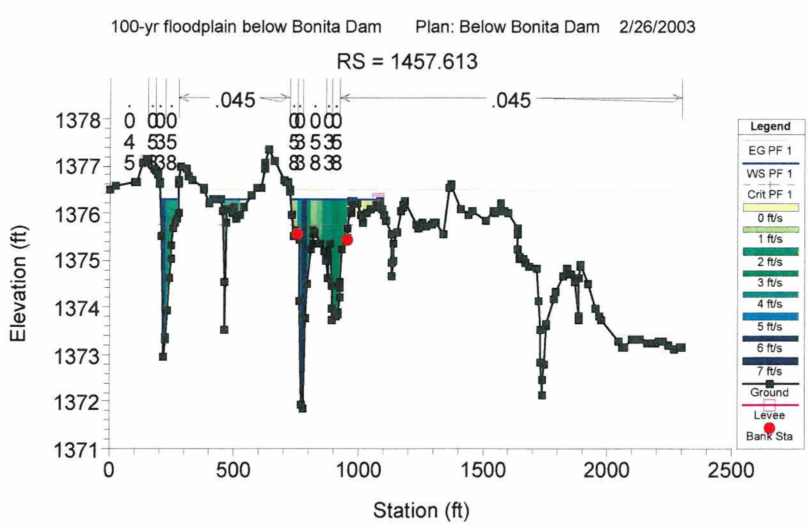

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2223.050
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta

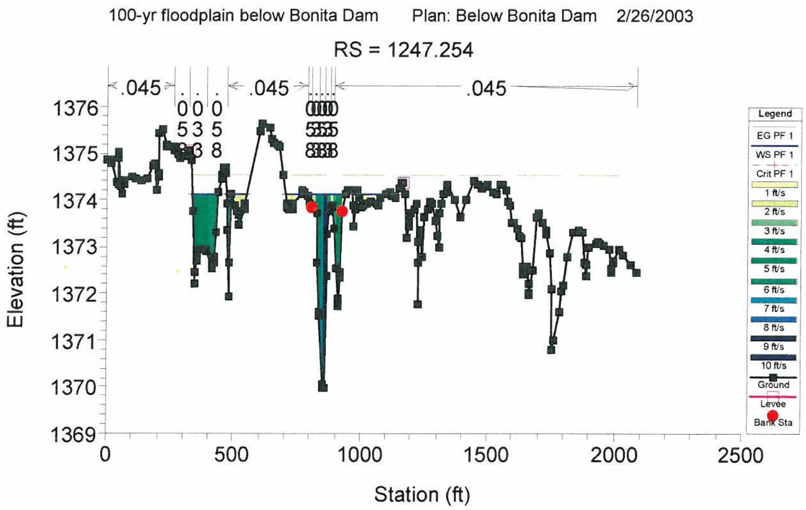

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 2084.607
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
11 ft/s
Ground
Levee
Bank Sta

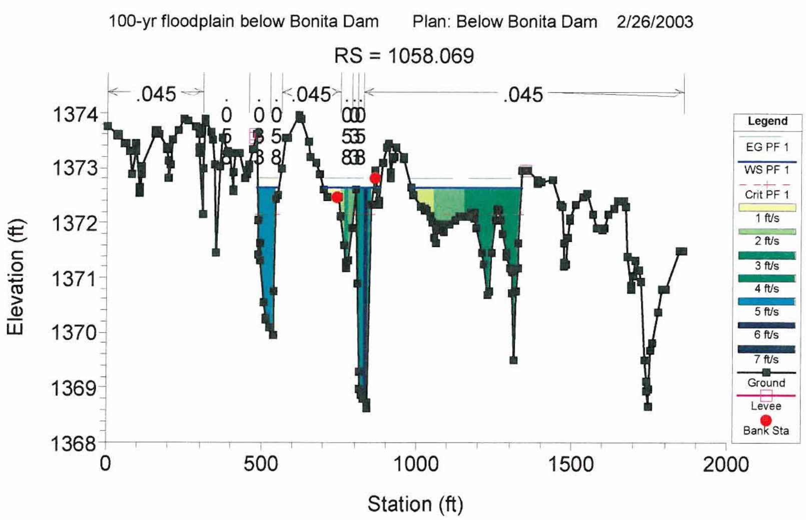

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1946.634
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
Ground
Levee
Bank Sta

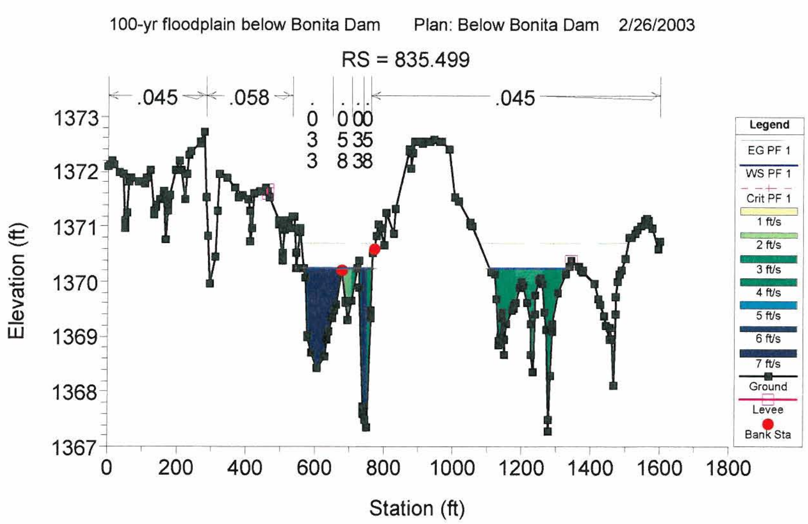

100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1796.212
.045
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1647.488
.045
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1457.613
.045
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1247.254
.045
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
8 ft/s
9 ft/s
10 ft/s
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 1058.069
.045
.045
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta


100-yr floodplain below Bonita Dam Plan: Below Bonita Dam 2/26/2003
RS = 835.499
.045
.058
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Levee
Bank Sta

Appendix 4. Floodplain Exhibit from 1989 Wittmann ADMS

NOTE: SECTION LINE ROADS SHOWN ARE APPROXIMATE LOCATIONS ONLY. SURVEY DID NOT INCLUDE LOCATING SECTION CORNERS.

SCALE 1" = 400'

CONTOUR INTERVAL 4 FEET

The WLB Group Inc. WLB

Cooper Aerial Survey Co.

FLOODPLAIN MAP

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

AERIAL MAPPING FOR

WITTMANN ADMS MC-25

AREA BETWEEN McMICKEN DAM & C.A.P.

DATE FLOWN: 11-20-86 SHEET 35 OF 55

NOTE: SECTION LINE ROADS SHOWN ARE APPROXIMATE LOCATIONS ONLY. SURVEY DID NOT INCLUDE LOCATING SECTION CORNERS.

SCALE 1" = 400'
400 200 0 400 800
CONTOUR INTERVAL 4 FEET

The WLB Group Inc. WLB
Cooper Aerial Survey Co.

FLOODPLAIN MAP
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
AERIAL MAPPING FOR
WITTMANN ADMS MC-25
AREA BETWEEN McMICKEN DAM & C.A.P.
DATE FLOWN: 11-20-86 SHEET 35 OF 55

Appendix 5. CD: HEC-RAS and revised 1989 Wittmann ADMS HEC-2 file