Blanco Arroyo

Flood Hazard Assessment and Mitigation Alternatives Report
City of Aztec
San Juan, New Mexico

Prepared for the:

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Introduction

The Blanco Arroyo is an existing drainage corridor located in the City of Aztec, New Mexico. The watershed area contributing to the Arroyo encompasses 1.14 square miles. The southern and upstream portion of the watershed is predominantly undeveloped before it flows as a channel through the City of Aztec and ultimately outfalls into the Animas River. Land development has encroached into the floodplain resulting in a reduction of flood conveyance capacity in the arroyo. Conveyance capacity is further hampered by the incoming sediments from the undeveloped portion of the watershed located upstream. Culverts are routinely plugged with sediments and debris causing overtopping of the arroyo channel. The watershed experienced an extreme rainfall runoff event in 2015 that caused widespread flooding and sediment deposition in the portions of the community that are adjacent to the arroyo.

Purpose

AECOM Technical Services (AECOM) was contracted to provide professional engineering consulting services to the City of Aztec (Client) for this Blanco *Arroyo Flood Hazard Assessment* and the preparation of the Recommended Mitigation Alternative. This report details the existing drainage conditions, the drainage criteria and processes used in calculations and modelling, hydrology, hydraulics, and mitigation alternatives for the Blanco Arroyo. The primary goals are to identify areas of concern that contribute to drainage failures, recommend mitigation alternatives to reduce potential flooding, and work with the City of Aztec to help apply for grants to seek funding for future remediation projects.

Location

The Blanco Arroyo is located in the north central portion of the City of Aztec in San Juan County, New Mexico. The project location map is shown in **Figure 1.**

The Blanco arroyo runs east to west through the City of Aztec, crossing through several neighborhoods and next to Aztec High School, and beneath U.S. Highway 550. The upper limit of the watershed area is subject to large erosional events due to non-cohesive sand and gravel that easily migrate during high intensity rainfall events.

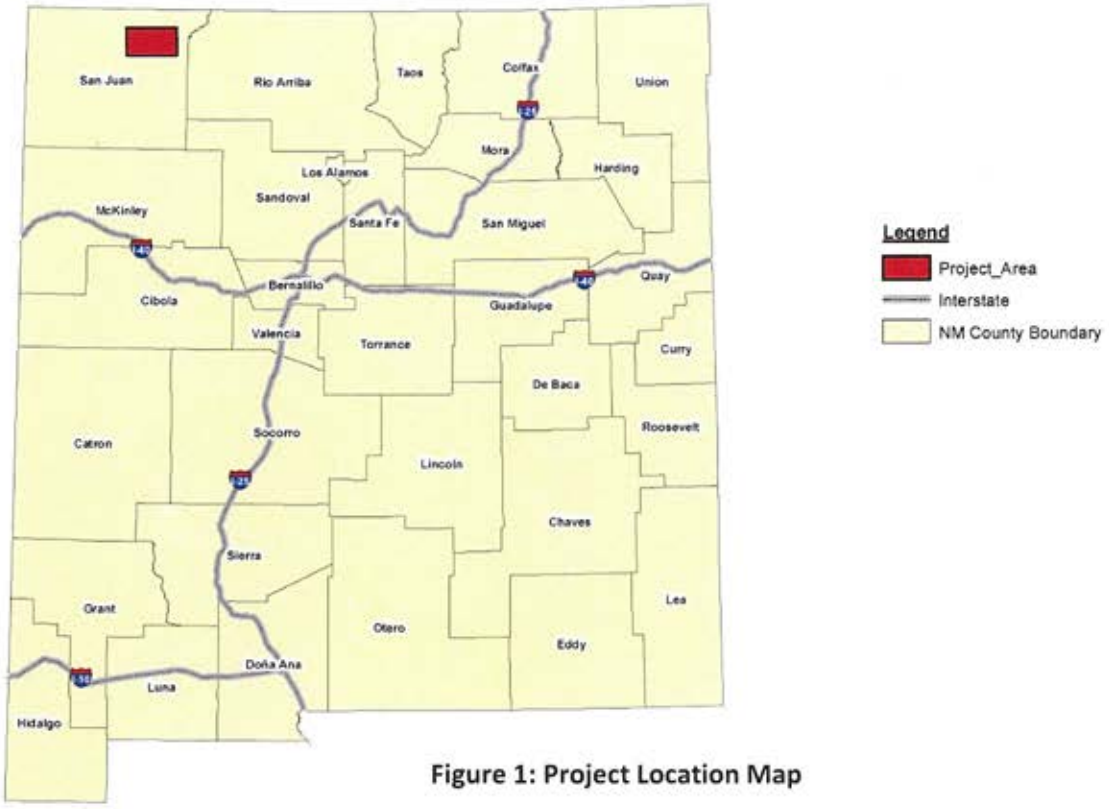

Figure 1: Project Location Map

Background

The City of Aztec area has experienced significant flooding and erosion problems associated with monsoon rainfall events. The most recent rainfall and flooding event was observed in August 2015. The erosion and incision of the upstream areas contribute high sediment loads that are carried downstream into town where the topography becomes shallower. The change in grade causes sedimentation and subsequent flooding near Aztec High School and other downstream portions in Aztec. Neighborhoods and roadways have had significant flooding and sediment deposition.

FEMA Floodplain Classification

The Federal Emergency Management Agency (FEMA) indicates that the Blanco Arroyo is encompassed by Flood Insurance Rate Map (FIRM) Panel 35045C0730F, dated August 5, 2010. The FIRM Panel indicates that the Blanco Arroyo is located within Flood Zone "A". Flood Zone "A" is defined by the Federal Emergency Management Agency (FEMA) and the FIRM Panel as follows:

Floodzone "A":

Special Flood Hazard Areas (SFHAs) subject to inundation by the 1% annual chance flood; No Base Flood Elevations determined.

The effective FIRM panel is attached in Appendix A.

Survey and Mapping Information

The City of Aztec provided 1-ft contour Light Detection and Ranging (LiDAR) topographic data for use in the watershed delineation and hydrologic/hydraulic analysis. The topographic data provided by the City of Aztec is based on the following datum:

- Horizontal Datum: Re-projected into the New Mexico State Plane West, North American Datum 1983 (NAD83) coordinate system North American Datum 1983 (NAD83), projected to State Plane New Mexico West projection
- Vertical Datum: North American Vertical Datum 1988 (NAVD88)

The contour data was deemed suitable for use in this study due to the high density of point data used in the survey collection process which increases the accuracy and reliability of the data set. The LiDAR data was collected in April 2015. Aerial imagery was also collected and provided by the City of Aztec.

Public Outreach

AECOM assisted Aztec with public outreach and coordination. Several community outreach meetings were conducted to interact with residents. Residents and community leaders expressed their concerns and related their individual flood stories. Large displays were created to show 2D modeling results to the public and explained them to homeowners. Residents reviewed the model results and shared their observations according to flooding events. The observations and input were received and used to calibrate the model results based on resident input.

Engineering Analyses

The engineering support for this study utilized Environmental Systems Research Institute's (ESRI) Arc Geographic Information System (ArcGIS), U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) Version 4.1, Hydrologic Engineering Center River Analysis System (HEC-RAS) Version 4.1.0, FLO-2D Pro Build No. 16.06.15 and AutoCAD 2016.

Hydrology

A multi-frequency hydrologic analysis was prepared for the Blanco Arroyo watershed. A unit hydrograph based hydrologic analysis was prepared with the use of the U.S. Army Corps of Engineers Hydrologic Modeling System (HEC-HMS), in conjunction with analysis criteria established in the *New Mexico State Highway and Transportation Department (NMSHTD) Hydrology Manual Volume 1*. The ArcGIS mapping platform was also used to identify all sub-basin hydrologic parameters within the watershed.

Peak storm flows were computed throughout the Blanco Arroyo Watershed for the following storm events.

- 2-year, 24-hour
- 10-year, 24-hour
- 25-year, 24-hour
- 50-year, 24-hour
- 100-year, 24-hour

Research was also performed on the recent high magnitude storm that occurred in August of 2015. Anecdotal information obtained from residents within the watershed was used to characterize the frequency / magnitude of the storm for comparison to 25- and 100-year events.

A detailed discussion of the analysis criteria, development of hydrologic parameters, and modeling results obtained as part of the hydrologic analysis is included in the following sections.

Watershed Delineation

A contributing watershed and sub-basin delineation were prepared for the Blanco Arroyo based on the detailed digital topography provided by the City of Aztec. Sub-basins were generally delineated based on uniformity of sub-basin size, topography, and land surface characteristics. Watershed concentration points were established at key analysis points throughout the watershed including junctions and points of inflow and major crossings. A series of thirteen sub-basins were delineated within the Blanco Arroyo watershed. Sub-basin areas were delineated with ArcGIS for use in the HEC-HMS model.

The watershed and sub-basin delineation superimposed on aerial imagery is graphically illustrated on **Figure 2**.

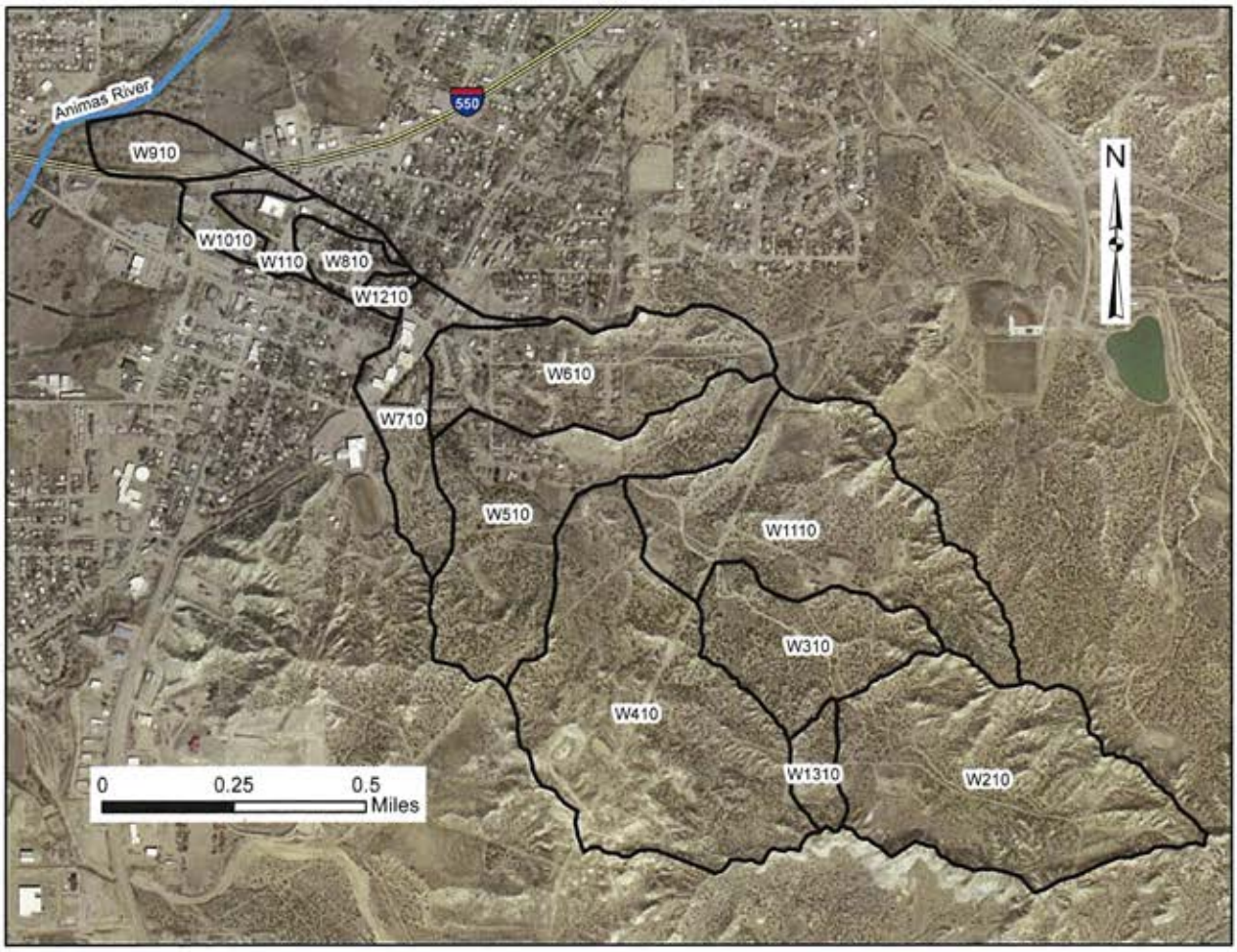

Figure 2: Blanco Arroyo Watershed Map

The sub-basin delineation and routing schematic developed within the HEC-HMS model is graphically illustrated on **Figure 3**.

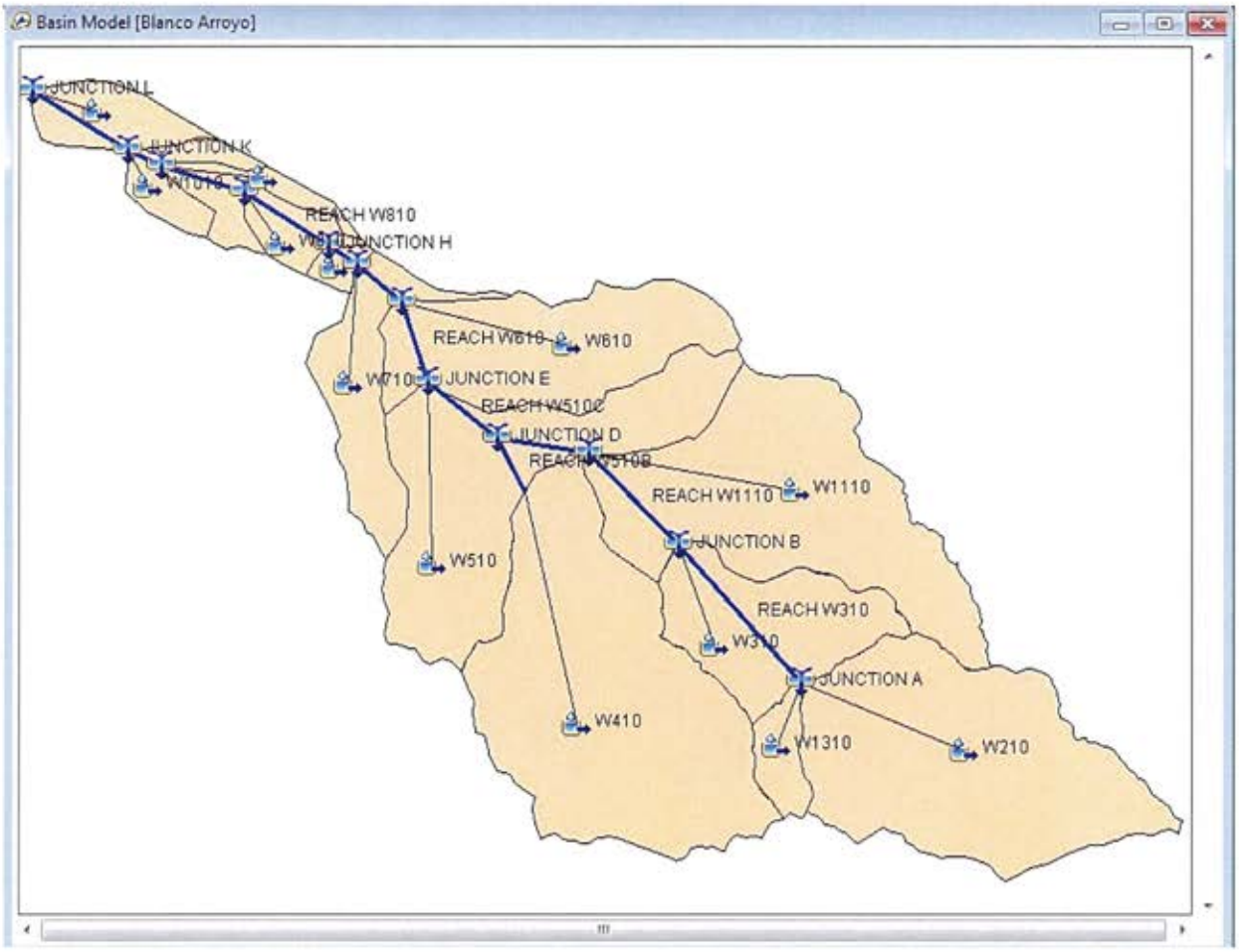

Figure 3: Blanco Arroyo Watershed HEC-HMS Schematic

Time of Concentration

Sub-basin times of concentration or the time required for water to flow within the primary watercourse from the hydraulically furthest point in the watershed to the downstream concentration point were estimated based on the detailed topography provided by the City of Aztec. The *NMSHTD Hydrology Manual Volume 1* requires use of the upland method coupled with the stream hydraulic method for estimation of sub-basin time of concentration unit hydrograph analyses. Three (3) flow patterns considered in the development of time of concentration include sheet flow, shallow concentrated flow, and open channel flow.

Sheet flow characteristics were assumed to occur in the upper 300 feet of the sub-basin areas, transitioning to shallow concentrated flow until a defined channel is reached. The sum of the three components yields the total time of concentration. A sub-basin lag time equivalent to 60% of the time of concentration required for unit hydrograph transformation was used for each hydrograph.

Sub-basin time of concentration and lag time values are summarized in Appendix B.

Soil Infiltration

Soil infiltration parameters were estimated for each sub-basin for incorporation into the HEC-HMS model. The *NMSHTD Hydrology Manual Volume 1* requires use of the Soil Conservation Service (SCS) Curve Number (CN) Method for soil infiltration parameters. Aerially weighted CN values for each sub-basin were estimated based on land cover type(s) and hydrologic soil group(s) identified by soil surveys available from the United States Department of Agriculture's Natural Resources Conservation Service.

Initial abstraction (IA) values were also estimated for each sub-basin within the watershed with a global cap of 0.350 inches applied to provide a more conservative estimate of peak storm flows.

Hydrograph Routing

The *NMSHTD Hydrology Manual Volume 1* requires use of Muskingum-Cunge hydrograph routing methodology within the HEC-HMS model. Routing or translation of hydrographs is performed by characterization of a routing reach with eight-point cross-sectional geometry, channel slope, and Manning's roughness coefficients. Cross-sectional geometry and channel slopes were estimated based on slopes and reach lengths identified from the detailed digital topography.

Rainfall Distribution

AECOM incorporated precipitation data into the hydrologic models in accordance with NMSHTD guidelines coupled with National Oceanic and Atmosperic Administration (NOAA) Atlas 14 precipitation data for each of the storms indicated previously. The precipitation depth, duration, frequency data based on the centroid of the Blanco Arroyo Watershed is summarized in the Table 1.

Table 1: NOAA 14 Precipitation Depths

PRECIPITATION DEPTH [inches]								
DURATION	STORM FREQUENCY							
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR
5-min	0.15	0.19	0.26	0.31	0.39	0.45	0.52	0.71
10-min	0.23	0.29	0.39	0.47	0.59	0.69	0.8	1.07
15-min	0.28	0.36	0.48	0.59	0.73	0.86	0.99	1.33
30-min	0.38	0.48	0.65	0.79	0.99	1.15	1.33	1.79
60-min	0.46	0.6	0.8	0.98	1.22	1.43	1.64	2.22
2-hr	0.54	0.69	0.91	1.09	1.37	1.59	1.84	2.5
3-hr	0.58	0.73	0.95	1.13	1.4	1.62	1.86	2.51
6-hr	0.7	0.87	1.1	1.29	1.57	1.8	2.04	2.69
12-hr	0.84	1.04	1.29	1.48	1.76	1.98	2.2	2.76
24-hr	0.93	1.16	1.47	1.72	2.07	2.34	2.63	3.35

For hydrologic studies in the State of New Mexico, a modified NOAA-SCS rainfall distribution is used for modelling storm events. This distribution establishes the peak rainfall intensity at hour six in a 24-hour storm event. The procedure for development of the distribution is found in the *NMSHTD Hydrology Manual Volume I* in section 3.3.1.2.3. The rainfall distribution is unique to the Blanco Arroyo Watershed and developed for each of the 2-, 10-, 25-, 50-, and 100-year; 24-hour events modeled herein. Each frequency specific distribution is summarized in Table 2.

Table 2: Frequency Specific Distribution

DURATION [hours]	CUMULATIVE DEPTH [%]				
	2-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
0	0	0	0	0	0
0.25	0.024	0.018	0.015	0.013	0.010
0.5	0.048	0.037	0.031	0.026	0.020
0.75	0.072	0.055	0.046	0.038	0.030
1	0.112	0.086	0.073	0.064	0.053
1.25	0.132	0.102	0.087	0.077	0.065
1.5	0.153	0.110	0.094	0.083	0.068
1.75	0.172	0.128	0.112	0.100	0.087
2	0.191	0.147	0.130	0.118	0.106
2.5	0.240	0.201	0.187	0.177	0.165
3	0.550	0.542	0.541	0.543	0.540
3.5	0.656	0.660	0.664	0.669	0.671
4	0.706	0.714	0.720	0.729	0.730
5	0.725	0.732	0.738	0.746	0.749
6	0.744	0.750	0.756	0.763	0.768
7	0.765	0.759	0.763	0.769	0.772
8	0.784	0.774	0.777	0.782	0.783
9	0.824	0.805	0.804	0.808	0.806
10	0.848	0.824	0.820	0.821	0.816
11	0.872	0.842	0.835	0.833	0.826
12	0.897	0.860	0.850	0.846	0.837
14	0.914	0.884	0.875	0.872	0.864
16	0.931	0.907	0.900	0.897	0.891
18	0.948	0.930	0.925	0.923	0.918
20	0.966	0.953	0.950	0.949	0.946
22	0.983	0.977	0.975	0.974	0.973
24	1.000	1.000	1.000	1.000	1.000

HEC-HMS Model

A storm event simulation using the basin, soil, and routing parameters as well as the precipitation distributions were developed in HEC-HMS for each identified storm frequency. The details of the HEC HMS calculations and assumptions are attached in Appendix B. Table 3 summarizes the hydrologic parameters used for each of the sub-basins.

Table 3: Hydrologic Parameters Summary Table

Sub-basin	A (mi^2)	Length (ft)	Tc (hrs)	Lag Time (mins)	CN	IA (inches)	Impervious Area (%)
W110	0.023	1,558	0.150	5.40	86	0.326	70%
W210	0.198	4,711	0.660	23.58	88	0.273	1%
W310	0.083	2,901	0.220	7.81	88	0.273	0%
W410	0.240	4,860	0.380	13.79	87	0.299	1%
W510	0.153	3,905	0.530	19.19	85	0.350	10%
W610	0.113	3,510	0.580	20.81	86	0.326	30%
W710	0.058	3,155	0.420	15.08	87	0.299	30%
W810	0.018	1,163	0.190	6.70	85	0.350	75%
W910	0.030	1,886	0.310	11.09	86	0.326	15%
W1010	0.020	1,034	0.210	7.45	96	0.083	50%
W1110	0.187	5,200	0.620	22.21	88	0.273	1%
W1210	0.006	493	0.080	2.70	62	0.350	50%
W1310	0.018	1,513	0.190	6.70	90	0.222	1%

Results

Multi-frequency peak flows at specific concentration points within the watershed are summarized in Table 4. Comprehensive HEC-HMS peak flow summaries for each of the storm events are included in **Appendix B**.

Table 4: Peak Flow Summary

CONC PT[1]	Description	AREA [mi^2]	PEAK FLOW [ft^3/sec]				
			2-YR	10-YR	25-YR	50-YR	100-YR
JUNCTION C	Upstream of Proposed Detention Basin	0.486	22.3	76.9	127.4	175.2	231.4
JUNCTION D	Downstream of Proposed Detention Basin	0.726	31.7	111.4	187.4	263.2	349.9
JUNCTION E	Zia St Crossing	0.879	37.8	136.1	228.7	320.1	425.8
JUNCTION F	Upstream of N Rio Grande Avenue	0.992	46	166.1	273.8	378.3	500.6
JUNCTION G	Downstream of N Rio Grande Avenue	1.05	50.5	180.6	295.6	405.7	536.8
JUNCTION H	Lovers Lane	1.056	50.9	181.3	296.4	406.2	537.6
JUNCTION I	Main Avenue	1.074	53	185.1	301.3	412.2	544.9
JUNCTION J	Ash Avenue	1.097	55.6	189.7	307.4	419.5	553.3
JUNCTION K	Aztec Boulevard	1.117	58.2	194.4	313.4	426.7	562.1
JUNCTION L	Animas River	1.147	59.6	198.4	319.6	434.9	572.6

Notes:
1. Concentration point identifier indicated based on HEC-HMS model .

Historical Storm Investigation

AECOM performed an investigation to characterize the magnitude of the historical August 2015 storm event in addition to the simulations mentioned previously. Research into available historic rainfall data in the vicinity of the Blanco Arroyo Watershed however yielded limited information. No United States Geological Survey (USGS) or National Weather Service (NWS) gages were found within the vicinity of the Blanco Arroyo watershed. The closest gage to the Blanco Arroyo Watershed was found to be a gage located over 16 miles away at the Farmington Regional Airport operated by the New Mexico State University (NMSU) Climate Center. The gage measures and reports rainfall quantities on single day time intervals. Review of the daily rainfall data in a timeframe similar to the storm that occurred in Aztec however did not reveal a similar or significant magnitude storm, thus it was not considered for use in this study.

AECOM therefore collected anecdotal storm and rainfall information from constituents during the public involvement phase of this project at the request of the City of Aztec. Anecdotal measurements provided by residents suggested estimates of 3.5 inches in a 24-hour period, in the area. A simple comparison to NOAA Atlas 14 precipitation data in Table 1 suggests that the Aztec area may have experienced a storm event similar in magnitude to a 500-year event (3.35 inches) in August of 2015. A modified NOAA-SCS rainfall distribution based on the 500-year NOAA Atlas 14 precipitation data was therefore developed and incorporated into a Historic Condition HEC-HMS model to simulate the August 2015 event. The

detail of the modified NOAA-SCS rainfall distribution is attached in Appendix B. The peak flow results are summarized in the following Table 5.

Table 5: Peak Flow Summary – Historic Storm Event

CONC PT[1]	Description	AREA [mi^2]	PEAK FLOW [ft^3/sec]
			Historical Storm Event
JUNCTION C	Upstream of Proposed Detention Basin	0.486	22.3
JUNCTION D	Downstream of Proposed Detention Basin	0.726	31.7
JUNCTION E	Zia St Crossing	0.879	37.8
JUNCTION F	Upstream of N Rio Grande Avenue	0.992	46
JUNCTION G	Downstream of N Rio Grande Avenue	1.05	50.5
JUNCTION H	Lovers Lane	1.056	50.9
JUNCTION I	Main Avenue	1.074	53
JUNCTION J	Ash Avenue	1.097	55.6
JUNCTION K	Aztec Boulevard	1.117	58.2
JUNCTION L	Animas River	1.147	59.6

Notes:
1. Concentration point identifier indicated based on HEC-HMS model .

Hydraulic Analysis – HEC-RAS

AECOM developed a one-dimensional, standard step backwater riverine hydraulic analysis for the lower 1.4 linear miles of the Blanco Arroyo, upstream from the Animas River Outfall. The hydraulic analysis used the HEC-RAS coupled with the more detailed digital topography of the watershed provided by the City of Aztec.

As mentioned previously, the lower portion of the Blanco Arroyo is located within an effective Floodzone "A" Special Flood Hazard Area. The hydraulic analysis and delineation presented herein are based on more detailed methodology and topography. The 25-year and 100-year storm events were modeled in HEC-RAS.

Methodology

Elements of the methodology associated with the Blanco Arroyo HEC-RAS Hydraulic Analysis are discussed in the following sections.

Hydraulic Baseline

The hydraulic baseline was extended along the flow line of the Arroyo from the outfall at the Animas River to 1.4 miles upstream where the development starts to occur.

Cross-Section Geometry

A series of cross-sections were oriented normal to flow and along the corridor at approximate 200-foot intervals. Additional cross-sections were incorporated where additional detail was needed such as at hydraulic structures and crossings. The cross-sections were cut from the detailed digital topography provided and identified by river stations measured from the confluence with the Animas River outfall.

Manning's N-Value

The Manning's roughness coefficients for left and right overbanks and channel components selected for use in the Blanco Arroyo were based on values identified in the NMSHTD Hydraulics Manual Volume II. A value of 0.05 was used for left and right overbanks based on an assumption of natural channels with medium to dense brush in summer. A value of 0.045 was used for the channel component based on observations of the channel bed and obstructions.

Culverts/Bridges

Thirteen culverts crossings were analyzed in the HEC-RAS model using information collected during the field reconnaissance and the existing terrain data. As-built plans were not available for the crossings. The details of the culvert crossing are shown in Table 6.

Table 6: Culvert Location Summary

Culvert/structure location
Pollard Road
Culvert at Zia Street
Culvert at Blanco/Creekside Village
Culvert at Rio Grande Ave
Alley Crossing, DS of Rio Grande Ave
Culvert at Lovers Ln
Culvert box at Mesa Verde
Alley Crossing bridge downstream of Mesa Verde
Bridge at Church Ave
Alley crossing bridge downstream of Church Ave
Culvert box at Main St
Culvert at Ash St
Culvert box at Aztec Blvd

Expansion / Contraction Coefficients

Expansion and contraction coefficients used for the hydraulic analysis were based on the values recommended in the HEC-RAS Hydraulic Reference Manual (USACE, 2016). The coefficients used were:

- Cross sections: Expansion and contraction coefficients of 0.1 and 0.3, respectively
- Bridges and culverts: Expansion and contraction coefficients of 0.3 and 0.5, respectively

The details of the model assumptions and supporting data is provided in Appendix C

Results

The results of the HEC-RAS model are shown in **Appendix C**. The HEC-RAS model results indicate that the channel overtops at several locations including culvert crossings from a 25-year storm event. Similar results are shown for the 100-year event but with more overtopping flow.

Hydraulic Analysis – Existing Condition Using FLO-2D

A grid-based 2D hydraulic model was prepared in addition to the 1D hydraulic analyses. The grid-based 2D hydraulic model was necessary to analyze the current conditions (referred as existing conditions) and impact of problematic flood mitigation improvements in future (referred as proposed conditions). FLO-2D PRO was used to estimate the flow depth and velocities of the Blanco Arroyo channel for the following storm events:

- 25-year, 24-hour
- 100-year, 24-hour

FLO-2D Model

A 10-foot x 10-foot grid size was used for the FLO-2D analysis. The smaller grid size was selected to get a good resolution of the features such as roads and buildings.

Topography

Details of the survey and topography are discussed earlier under Survey and Mapping Information.

Boundary Conditions

A boundary condition based on normal depth flow at the outflow nodes was used in the model to discharge water off the grid system. This prevents water from accumulating in the model, and allows flows to exit the system. The outflow nodes were selected along the north, south and west watershed boundary.

The inflow hydrographs were obtained from the HEC-HMS model developed to simulate the existing hydrologic conditions for the Blanco Arroyo. The hydrographs used in FLO-2D are included in **Appendix D**.

Building Footprints

The building footprints were digitized in ArcGIS for the sub-division and adjacent industrial areas based on aerial photography. The Area Reduction Factors (ARFs) and Width Reduction Factors (WRFs) were used to model the building foot prints. FLO-2D calculates the ARF and WRF based on the percentage of building that falls on each grid element. This assumes that building footprints area not available for conveyance of floods. This is considered a conservative approach to estimate overland flows.

Manning's Roughness Coefficient

Manning's roughness coefficients were established throughout the modeling area based on review of aerial imagery and landuse data using an ArcGIS shape file. The area was divided into segments based

on the type of land use and extents of vegetation. The representative n-values for the grid elements were based on element roughness coefficients recommended by the FLO-2D manual.

Details of the model parameters and time control variable are discussed in **Appendix D**.

Results

The Simulation Summary from the completion of the FLO-2D model is shown in **Appendix D**. **Figure 4** and **Figure 5** graphically illustrate the maximum flow depth for the Blanco Arroyo for a 25-Year storm Event and 100-Year storm event, respectively. The deeper flow depths were found to occur in the low lying area bound by Aztec Boulevard/Chaco Street/Ash Street and along the Blanco Arroyo drainage corridor itself, extending from the upstream inflow point to the downstream outfall into the Animas River. Maximum flow depths within the drainage corridor range from 0 feet to 3 feet for the 25-year storm event and 0 feet to 4 feet for the 100-year storm event. 100-year flow depths of over 8-feet were generated in the low-lying area.

Alternatives Analysis

The results of the existing conditions drainage analysis was used to identify and prioritize problematic drainage areas in the Blanco Arroyo Watershed. Three alternatives were developed to mitigate the problematic drainage areas along the Blanco Arroyo for a 25-year storm event. A 25-year frequency storm event was selected as a target due to its frequent consideration in applications for federal grant funding. The problematic drainage mitigation alternatives consisted of the following elements and/or combinations thereof:

- Storm water storage (e.g., detention basin)
- Hydraulic conveyance (e.g., open channel)
- Retrofits to existing drainage facilities (e.g., culvert improvements)

The three alternatives for mitigation of flooding issues within the Blanco Arroyo watershed are discussed in additional detail below. The alternatives were presented to and discussed with City of Aztec staff. The advantages and disadvantages of each alternative were considered in the development of a recommended alternative. The details of the Recommended Alternative are discussed in detail in subsequent sections of this report.

The information presented below in regard to the alternatives is preliminary and conceptual in nature. A detailed analysis and design will be required prior to any implementation of the elements associated with of these alternatives.

Alternative 1

The qualitative conceptual design for Alternative 1 includes the improvement elements identified below:

- Implementation of a detention basin located near the upstream origin of the arroyo, east of existing land development and the Swire Heights Drive Alignment
- An open drainage channel located between the detention basin mentioned previously and Zia Street
- Channel maintenance and additional channel easements for the Blanco Arroyo downstream of Zia Street
- Replace existing culverts with box culverts along Blanco Street, Rio Grande Avenue, Mesa Verde and Church Avenue
- A storm drain along Main street to convey excess street flows into the Blanco Arroyo

Alternative 2

The qualitative conceptual design for Alternative 2 includes the improvement elements identified below:

- Implementation of a detention basin located near the upstream origin of the arroyo, east of existing land development and the Swire Heights Drive Alignment

- An open drainage channel located between the detention basin mentioned previously and Zia Street
- A detention basin located just south of the Zia Street culvert crossing
- Retrofit of the existing arroyo channel including the following:
    - flattened channel side slopes at select locations
    - implementation of channel easements
    - increased channel maintenance efforts
- Replacement of existing culverts at Blanco Street, Rio Grande Avenue, Mesa Verde and Church Avenue with box culverts
- A storm drain along Main street to convey excess street flows into the Blanco Arroyo

Alternative 3

The qualitative conceptual design for Alternative 3 includes the improvement elements identified below:

- Implementation of a detention basin located near the upstream origin of the arroyo, east of existing land development and the Swire Heights Drive Alignment.
- An open drainage channel located between the detention basin mentioned previously and Zia Street.
- A detention basin located just south of the Zia Street culvert crossing.
- Retrofit of the existing arroyo channel including the following:
    - Flattened channel side slope at select locations
    - Implementation of channel easements
    - increased channel maintenance efforts
- Replacement of existing culverts at Blanco Street, Rio Grande Avenue, Mesa Verde and Church Avenue with box culverts A storm drain along Main street to convey excess street flows into the Blanco Arroyo.

The conceptual layout for Alternative 1, Alternative 2 and Alternative 3 are attached in Appendix E.

Recommended Alternative

The feasibility of each of the three alternatives was qualitatively determined based on review and discussion with City of Aztec staff. A Recommended Alternative that represents some combination of elements from each of the alternatives was developed based on the results of this assessment. The details of the Recommended Alternative are discussed in the following sections.

Figure 6 graphically illustrates the features associated with the Recommended Alternative for the Blanco Arroyo.

Detention Basin

A detention basin is proposed at the upstream origin of the arroyo, east of existing land development. A detention basin located in the upstream reaches of the Blanco Arroyo is expected to reduce peak flows and flooding issues downstream within the developed portions of the arroyo. Implementation of a basin is believed to be superior to implementation of expanded conveyance and additional drainage facilities within the downstream reach of the Blanco Arroyo due to right-of-way constraints.

The extents of the proposed detention basin were identified based on the topography provided by the City of Aztec and the basin graded using automated tools within AutoCAD Civil 3D. The proposed basin has a maximum depth of 7 feet deep with 4H: 1V side slopes to tie to existing grade. The proposed basin is expected to overflow during the expected 25-year rainfall runoff event. An overflow spillway weir was therefore considered with accommodation for a hydraulic head and width of 3 feet and 12 feet respectively to convey overflow. A 36" outlet pipe is to be provided at the bottom of the detention basin to provide a positive drainage outfall.

The detail of the detention basin calculation is attached in **Appendix F**.

Channel

An expanded open trapezoidal drainage channel oriented along the existing flow line is proposed to extend downstream from the detention basin to the upstream side of the Zia Street to convey the 25-year storm flows. The channel is assumed to include a riprap lining with 10-feet bottom width and 3H: 1V channel side slopes. The riprap lining consists of a 12 inch layer thickness and a D50 size of 6 inches. The proposed channel bed slope was assumed to require drop structure(s) to achieve the desired flow depth and velocity. The channel banks are expected to tie-in to adjacent grades along the natural drainage corridor upstream of Zia Street. A normal depth hydraulic analysis of the conceptual channel design using Bentley's FlowMaster computer program is included in **Appendix F**.

Culverts

Existing culverts that were determined to not have adequate capacity to pass the 25-year storm event were proposed to be replaced with new culverts. Table 7 summarizes the existing culverts and the proposed new culverts along the peak discharges. The culverts were modeled using Bentley's Culvert Master Program and the Federal Highway Administration's HY-8 Culvert Analysis Program.

The details of the Culvert Calculation are attached in Appendix F.

Table 7: Existing and Proposed Culvert Summary

Structure location	HEC-HMS Junction ID	Q_{25YR} (cfs)	Existing Structure Size	Allowable Head Water Elevation (ft)	Existing Culvert Capacity, (cfs)	Does the Structure need to be Resized?	Proposed Structure Size	Proposed Structure Capacity, (cfs)
Dirt road Culvert Crossing upstream of Zia St	E	119	3 -24-inch CMP - Circular	5705.99	43	RESIZE	3-36" Circular CMP	131
Culvert at Zia Street	F	169	84-inch CMP - Circular	5695.9	334	OK	N/A	N/A
Culvert at Blanco/Creekside Village	F	169	72-inch Concrete - Circular	5680.5	220	OK	N/A	N/A
Culvert at Rio Grande Ave	G	195	60-inch CMP - Circular	5672.8	154	RESIZE	81"x59" Steel/Aluminum Arch	210
Alley Crossing, DS of Rio Grande Ave	G	195	60-inch CMP - Circular	5668.5	131	RESIZE	81"x59" Steel/Aluminum Arch	257
Culvert at Lover Ln	H	196	60-inch Concrete - Circular	5655.74	143	RESIZE	81"x59" Steel/Aluminum Arch	235
Culvert at Mesa Verde	I	202	2B - 9.25 ft x 6 ft Concrete	5653.94	1000	OK	N/A	N/A
Alley Bridge Crossing bridge downstream of Mesa Verde	I	202	1 - 17 ft x 3 ft Wood Bridge	5646.5	197	RESIZE	Did not Change	N/A
Bridge at Church Ave	I	202	1 - 12 ft x 5.5 ft	5645	356	OK	N/A	N/A
Alley bridge crossing downstream of Church Ave	I	202	18.59 ft x 4.51 ft Wood Bridge	5638.53	271	OK	N/A	N/A

Table 7: Existing and Proposed Culvert Summary (continued)

Structure location	HEC-HMS Junction ID	Q_{25YR} (cfs)	Existing Structure Size	Allowable Head Water Elevation (ft)	Existing Culvert Capacity, (cfs)	Does the Structure need to be Resized?	Proposed Structure Size	Proposed Structure Capacity, (cfs)
Culvert at Main St	J	209	2B-10 ft x 4 ft Concrete	5632.5	725	OK	N/A	N/A
Culvert at Ash St	K	216	60 Inch CMP - Circular	5614.52	157	RESIZE	81"x59" Steel/Aluminum Arch	251
Culvert at Aztec Blvd	K	216	1B-14.5 ft x 6.6 ft Concrete Box	5615.03	981	OK	N/A	N/A

Notes:

1. The 25-year peak discharges for the culvert crossings were obtained from the HEC-HMS model.
2. The capacities of the existing and proposed culverts were estimated with the use of Culvert Master and HY-8.

FLO-2D Model – Recommended Alternative

The recommended flood mitigation alternative was analyzed with FLO-2D to estimate the impacts of the proposed drainage improvements on downstream problematic drainage areas and developed areas. The existing conditions FLO-2D model was used as base model to develop the recommended alternative.

The proposed detention basin was analyzed using the U.S. Army Corps of Engineer's HEC-HMS model to determine the basin outflow characteristics and the associated inflow into the proposed riprap channel. The existing land use condition HEC-HMS model was used as the base condition model and the detention basin was added into the model to estimate the inflow hydrograph for the FLO-2D model.

The proposed detention basin was characterized in the FLO-2D model by incorporation of the basin outflow hydrograph yielded by the HEC-HMS model as an inflow to the proposed riprap channel. The channel downstream of the detention basin was modeled using the channel option in FLO-2D. The grid elevations were artificially lowered along the channel to account for the channel depth. This was done to avoid any numerical stability in the model.

The existing culverts and proposed culverts were modeled using the hydraulic structure option in FLO-2D. The details of the culvert characteristics are discussed in the earlier section. The discharge rating tables were obtained by modelling the culverts using CulvertMaster and HY-8. Other hydraulic properties of the culverts such as the allowable head water and culvert inverts were obtained from the topographic data and HEC-RAS model for the Blanco Arroyo. The details of the culvert calculations are included in **Appendix F**.

The other FLO-2D input and output such as the time control, stability co-efficient and simulation summary for the recommended alternative is attached in **Appendix F**.

Results

Figure 7 and **Figure 8** show the maximum flow depths for the recommended alternative for the 25-year storm event and a 100-year storm event, respectively.

The figures show that the reduction in flow depths range from 0 to 1.5 feet, for the 25-year storm event. Implementation of the proposed detention basin was found to reduce the runoff volume from approximately 66.0 ac-feet for existing conditions to 40.2 ac-feet for proposed conditions. The area of inundation reduced from the 110.1 acres to 56.2 acres for the 25-year storm event.

Conceptual 30% design plans were developed for the recommended alternative and are attached in Appendix G.

Conclusions

- A detention basin east of the City limits would help reduce the flooding downstream in the developed area of the City.
- The proposed riprap channel upstream of Zia Street is assumed to be below grade and would help alleviate flooding issues especially on the east side of the City limits.
- Five new culverts are proposed at a location where the existing culverts were not adequate to pass the 25-year storm event.
- Periodic maintenance of the channel and culverts will be required to preserve the flow capacity in future.
- The results from the FLO-2D model show that the recommended alternative has reduced the flow depth and inundation limits due to flooding from Blanco Arroyo.
- The conceptual 30% design plans will be used to further identify and prioritize permitting and construction project of the proposed facilities. The 30% design plans are attached in Appendix G.
- Final 100% construction plans and specifications must be completed to construct the drainage facilities identified in the recommended alternative.

References

FLO-2D Software, INC (FLO-2D), 2016. FLO-2D PRO Build 16.06.15, August 2016.

New Mexico State Highway and Transportation Department, Drainage Manual Volume 1, Hydrology, December 1995.

United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) Version 4.1, July 2015.

United State Army Corps of Engineers (USACE), 2010. Hydraulic Engineering Center River Analysis System (HEC-RAS) Version 4.1.0, January 2010.

United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

Figures

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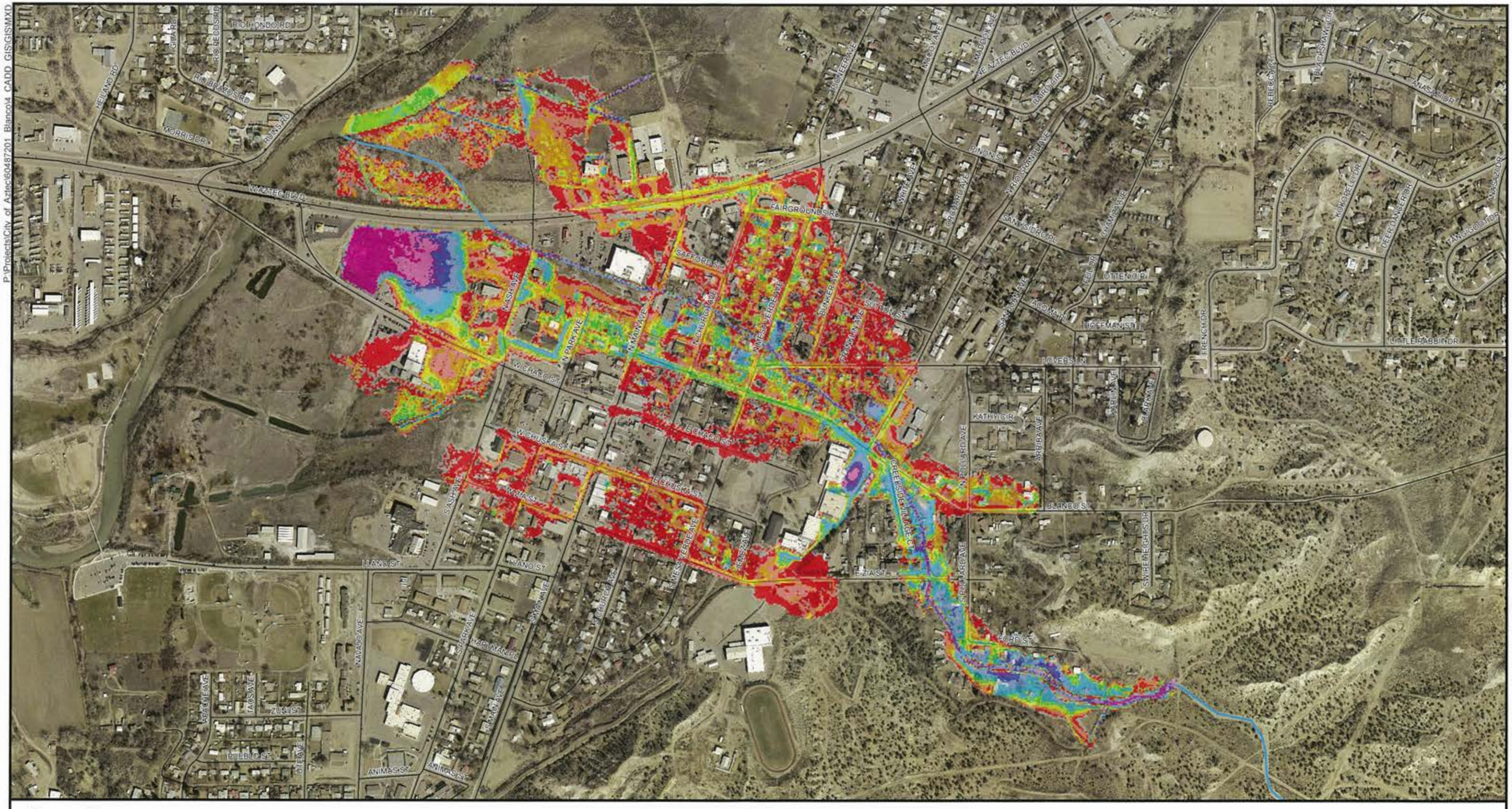

Legend

Flow Depth at Cell feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0	Blanco Arroyo	
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5	Aztec Roads	
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0	4.0 - 8.0	
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0	8.0 - 12.0	

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 4
Existing Condition
100-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM

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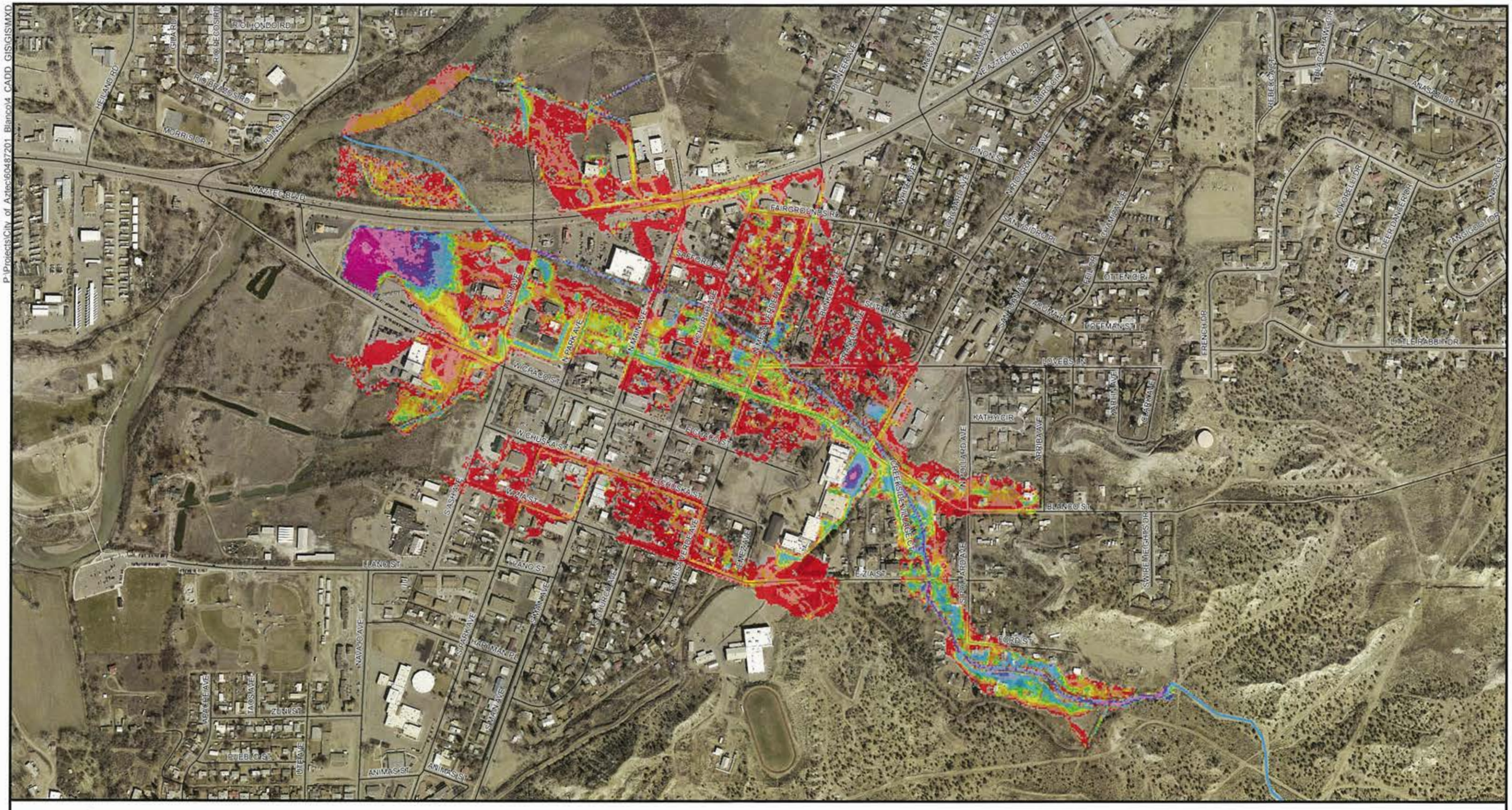

Legend

Flow Depth at Cell feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0	Blanco Arroyo	
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5	Aztec Roads	
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0	4.0 - 8.0	
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0	8.0 - 12.0	

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

N
W E
S

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 5
Existing Condition
25-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM

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81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

Alley Crossing off of Rio Grande Ave

3- 36" CMP Culvert (Proposed)

Rip Rap Lined Channel (D_{50} = 6")

Detention Basin

Proposed Channel

Legend

- Proposed Box Culvert Crossing
- Existing Box Culvert Crossing
- Proposed Channel
- Blanco Arroyo
- Aztec Roads
- Detention Basin

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 6
Recommended Alternative Features
City of Aztec, New Mexico

AECOM

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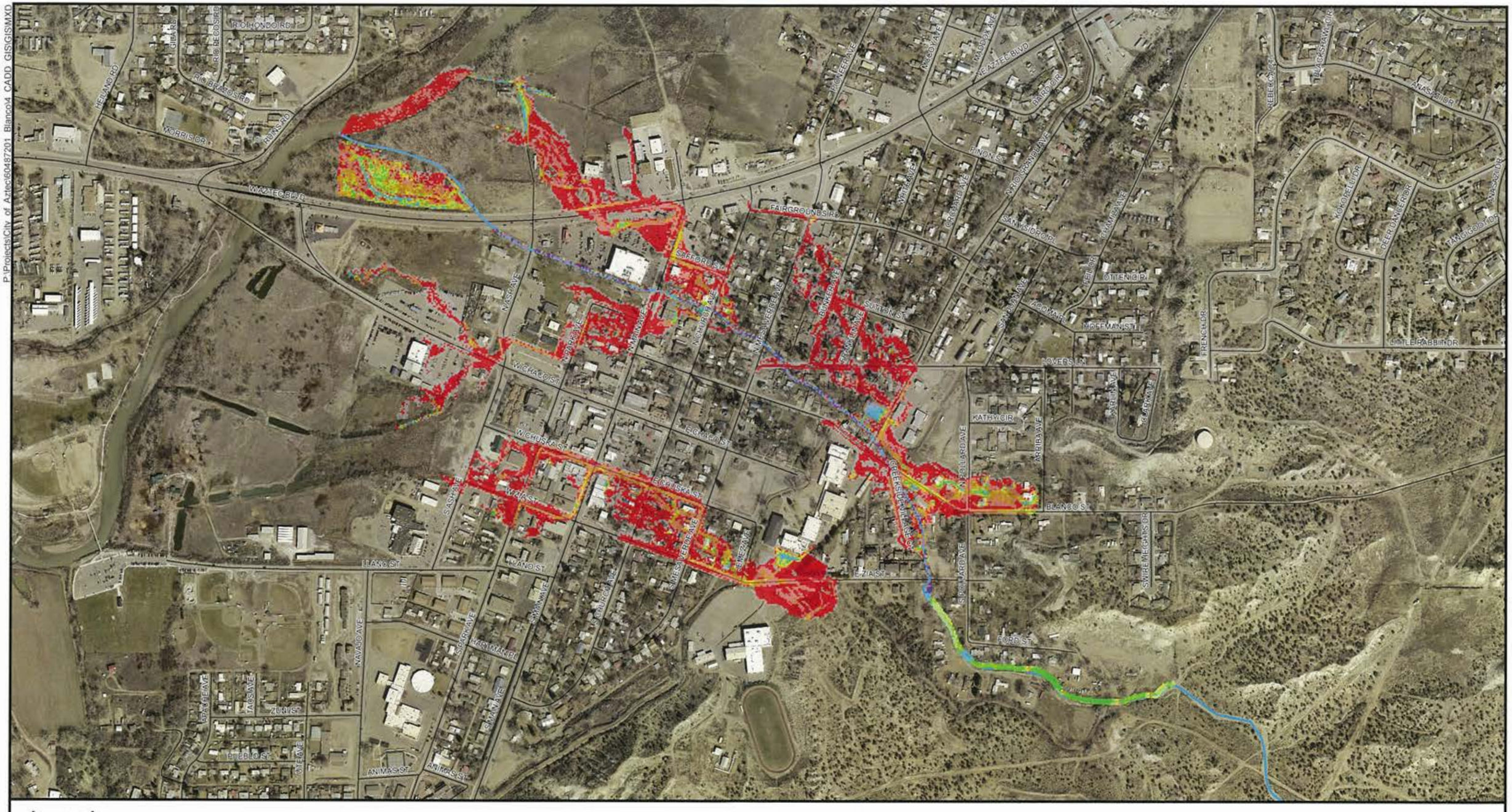

Legend

Flow Depth at Cell feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0	Blanco Arroyo	
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5	Aztec Roads	
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0	4.0 - 8.0	
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0	8.0 - 12.0	

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 7
Recommended Alternative
25-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM

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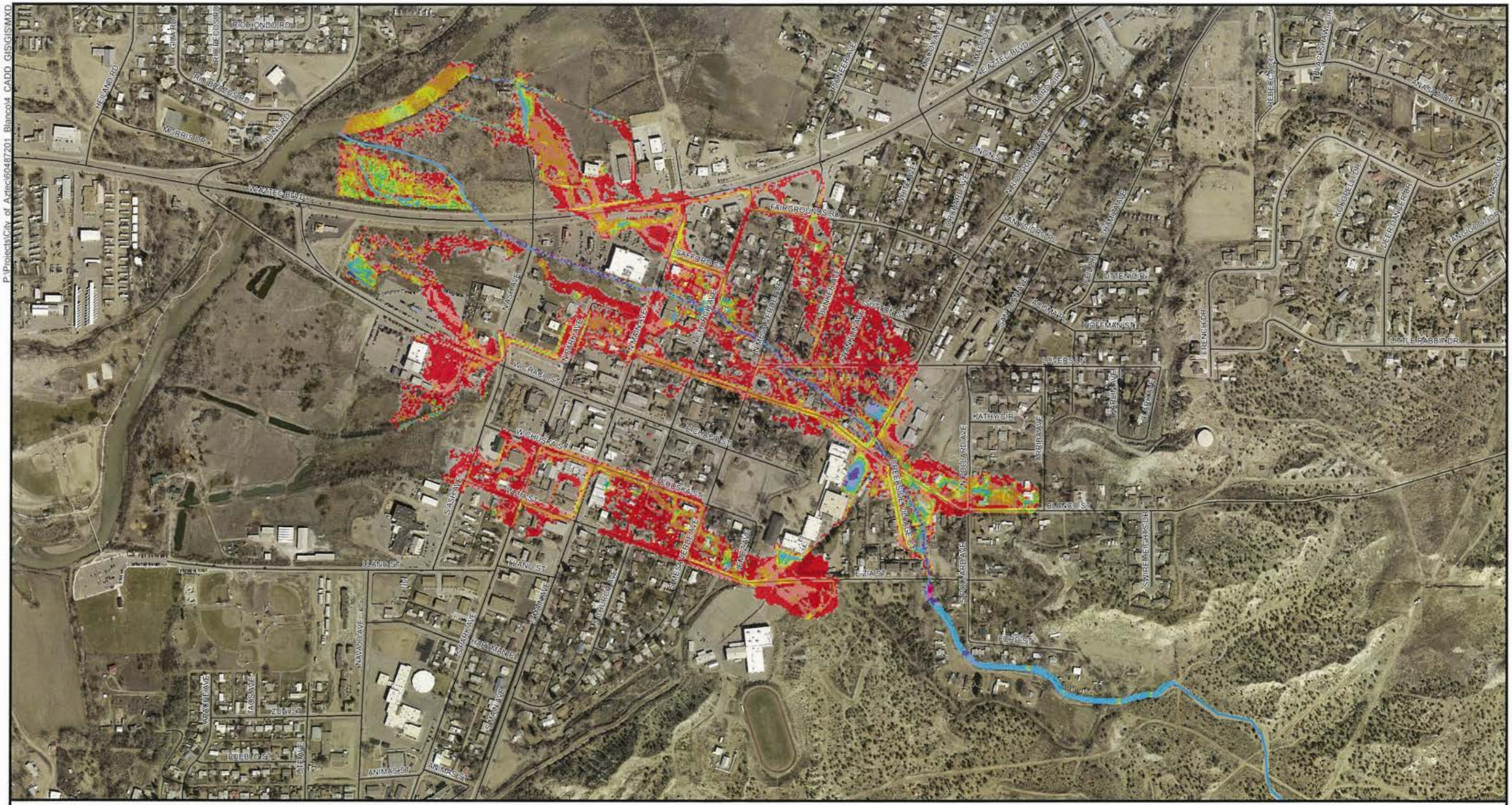


Legend

Flow Depth at Cell
feet

0.0 - 0.1	0.3 - 0.4	0.7 - 0.8	1.5 - 2.0
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	2.0 - 2.5
0.2 - 0.3	0.5 - 0.6	0.9 - 1.0	2.5 - 3.0
	0.6 - 0.7	1.0 - 1.5	3.0 - 4.0

Blanco Arroyo	4.0 - 8.0
Aztec Roads	8.0 - 12.0

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

N W E S

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 8
Recommended Alternative
100-Year, 24-Hour Maximum Depth

City of Aztec, New Mexico

AECOM

Appendix A – FEMA Effective FIRM Panel

LISTING OF COMMUNITIES

COMMUNITY NAME	COMMUNITY NUMBER	LOCATED ON PANEL(S)	INITIAL NFIP MAP DATE	INITIAL FIRM DATE	MOST RECENT FIRM PANEL DATE
AZTEC, CITY OF	350065	0710, 0720, 0730, 0740	FEBRUARY 8, 1974	JULY 15, 1988	AUGUST 5, 2010
BLOOMFIELD, CITY OF	350066	0740, 1035, 1055, 1075	MAY 17, 1974	AUGUST 8, 1978	AUGUST 5, 2010
FARMINGTON, CITY OF	350067	0670, 0685, 0690, 0695, 0700, 0715, 0982, 0985, 1001, 1002, 1005, 1006, 1007, 1010, 1050	MAY 24, 1974	SEPTEMBER 29, 1978	AUGUST 5, 2010
SAN JUAN COUNTY UNINCORPORATED AREAS	350064	0175*, 0200*, 0225*, 0250*, 0275*, 0300*, 0325, 0350, 0375, 0380, 0385, 0390, 0395, 0425, 0450, 0475, 0500, 0525*, 0550*, 0575*, 0600*, 0625, 0645, 0650, 0665, 0670, 0675, 0689, 0690, 0695, 0700, 0705, 0710, 0715, 0720, 0730, 0740, 0750, 0775, 0800, 0825, 0850*, 0875*, 0900*, 0925*, 0950, 0960, 0975, 0980, 0982, 0985, 1000, 1001, 1002, 1005, 1006, 1007, 1010, 1025, 1035, 1050, 1055, 1060, 1075, 1100, 1125, 1150, 1175*, 1200*, 1225*, 1250*, 1275*, 1300*, 1325*, 1350, 1375, 1400, 1425, 1450, 1475, 1500*, 1525*, 1550*, 1575*, 1600*, 1625*, 1650*, 1675, 1700, 1725, 1750, 1775, 1800*, 1825*, 1850*, 1875*, 1900*, 1925*, 1950*, 1975, 2000, 2025, 2050, 2075, 2100, 2125, 2150*, 2175*, 2200*, 2225*, 2250*, 2275*, 2300, 2325, 2350, 2375, 2400, 2425, 2450, 2475*, 2500*, 2525*, 2550*, 2575*, 2600*, 2625, 2650, 2675, 2700, 2725, 2750	SEPTEMBER 13, 1974	AUGUST 4, 1988	AUGUST 5, 2010

* PANEL NOT PRINTED

NOTE TO USER

Future revisions to this FIRM Index will only be issued to communities that are located on FIRM panels being revised. This FIRM Index therefore remains valid for FIRM panels dated AUGUST 5, 2010 or earlier. Please refer to the "MOST RECENT FIRM PANEL DATE" column in the Listing of Communities table to determine the most recent FIRM index date for each community

MAP REPOSITORIES

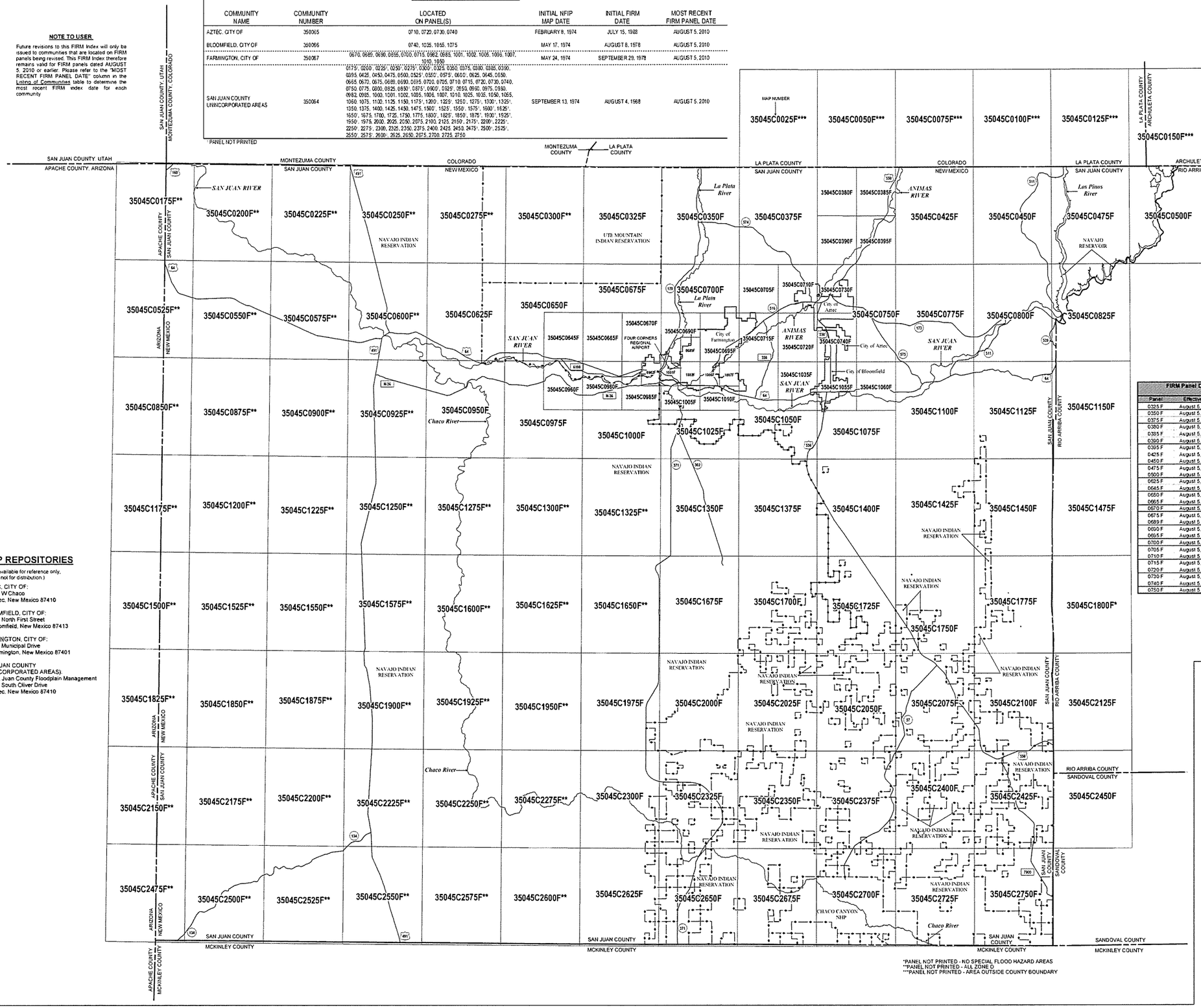
(Maps available for reference only, not for distribution.)

AZTEC, CITY OF:
201 W Chaco
Aztec, New Mexico 87410

BLOOMFIELD, CITY OF:
915 North First Street
Bloomfield, New Mexico 87413

FARMINGTON, CITY OF:
805 Municipal Drive
Farmington, New Mexico 87401

SAN JUAN COUNTY
(UNINCORPORATED AREAS):
San Juan County Floodplain Management
209 South Oliver Drive
Aztec, New Mexico 87410



*PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS
**PANEL NOT PRINTED - ALL ZONE D
***PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY

MAP DATES

This FIRM Index displays the map date for each FIRM panel at the time that this Index was printed. Because this Index may not be distributed to unaffected communities in subsequent revisions, users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website at http://msc.fema.gov or by calling the Map Service Center at 1-800-358-9616.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above

FIRM Panel Dates for Printed Panels of San Juan County, New Mexico (and Incorporated Areas)

Panel	Effective Date	Panel	Effective Date	Panel	Effective Date
0325 F	August 5, 2010	0775 F	August 5, 2010	1425 F	August 5, 2010
0350 F	August 5, 2010	0800 F	August 5, 2010	1450 F	August 5, 2010
0375 F	August 5, 2010	0825 F	August 5, 2010	1475 F	August 5, 2010
0380 F	August 5, 2010	0850 F	August 5, 2010	1675 F	August 5, 2010
0385 F	August 5, 2010	0950 F	August 5, 2010	1700 F	August 5, 2010
0390 F	August 5, 2010	0975 F	August 5, 2010	1725 F	August 5, 2010
0395 F	August 5, 2010	0980 F	August 5, 2010	1750 F	August 5, 2010
0425 F	August 5, 2010	0982 F	August 5, 2010	1775 F	August 5, 2010
0450 F	August 5, 2010	0985 F	August 5, 2010	1975 F	August 5, 2010
0475 F	August 5, 2010	1000 F	August 5, 2010	2000 F	August 5, 2010
0500 F	August 5, 2010	1001 F	August 5, 2010	2025 F	August 5, 2010
0625 F	August 5, 2010	1002 F	August 5, 2010	2050 F	August 5, 2010
0645 F	August 5, 2010	1005 F	August 5, 2010	2075 F	August 5, 2010
0650 F	August 5, 2010	1006 F	August 5, 2010	2100 F	August 5, 2010
0665 F	August 5, 2010	1007 F	August 5, 2010	2125 F	August 5, 2010
0670 F	August 5, 2010	1010 F	August 5, 2010	2300 F	August 5, 2010
0675 F	August 5, 2010	1025 F	August 5, 2010	2325 F	August 5, 2010
0689 F	August 5, 2010	1035 F	August 5, 2010	2350 F	August 5, 2010
0690 F	August 5, 2010	1050 F	August 5, 2010	2375 F	August 5, 2010
0695 F	August 5, 2010	1055 F	August 5, 2010	2400 F	August 5, 2010
0700 F	August 5, 2010	1060 F	August 5, 2010	2425 F	August 5, 2010
0705 F	August 5, 2010	1075 F	August 5, 2010	2450 F	August 5, 2010
0710 F	August 5, 2010	1100 F	August 5, 2010	2625 F	August 5, 2010
0715 F	August 5, 2010	1125 F	August 5, 2010	2650 F	August 5, 2010
0720 F	August 5, 2010	1150 F	August 5, 2010	2675 F	August 5, 2010
0730 F	August 5, 2010	1350 F	August 5, 2010	2700 F	August 5, 2010
0740 F	August 5, 2010	1375 F	August 5, 2010	2725 F	August 5, 2010
0750 F	August 5, 2010	1400 F	August 5, 2010	2750 F	August 5, 2010

NATIONAL FLOOD INSURANCE PROGRAM

MAP INDEX

FIRM

FLOOD INSURANCE RATE MAP

SAN JUAN COUNTY,
NEW MEXICO
AND INCORPORATED AREAS
(SEE LISTING OF COMMUNITIES TABLE)

MAP INDEX

PANELS PRINTED: 325, 350, 375, 380, 385, 390, 395, 425, 450, 475, 500, 625, 645, 650, 665, 670, 675, 689, 690, 695, 700, 705, 710, 715, 720, 730, 740, 750, 775, 800, 825, 950, 960, 975, 980, 982, 985, 1000, 1001, 1002, 1005, 1006, 1007, 1010, 1025, 1035, 1050, 1055, 1060, 1075, 1100, 1125, 1150, 1350, 1375, 1400, 1425, 1450, 1475, 1675, 1700, 1725, 1750, 1775, 1975, 2000, 2025, 2050, 2075, 2100, 2125, 2300, 2325, 2350, 2375, 2400, 2425, 2450, 2625, 2650, 2675, 2700, 2725, 2750

MAP NUMBER
35045CIND0A

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was New Mexico State Plane West Zone (FIPS 3003). The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the United States Geological Survey, 1989, the National Geodetic Survey, 2007, the Federal Emergency Management Agency, 1988 and 2002, U.S. Bureau of Land Management, 2006, U.S. Census Bureau, 2000 and 2003 and San Juan County, 2007. Additional information was photogrammetrically compiled at a scale of 1:12,000 from New Mexico Resource Geographic Information System aerial photography dated 2006.

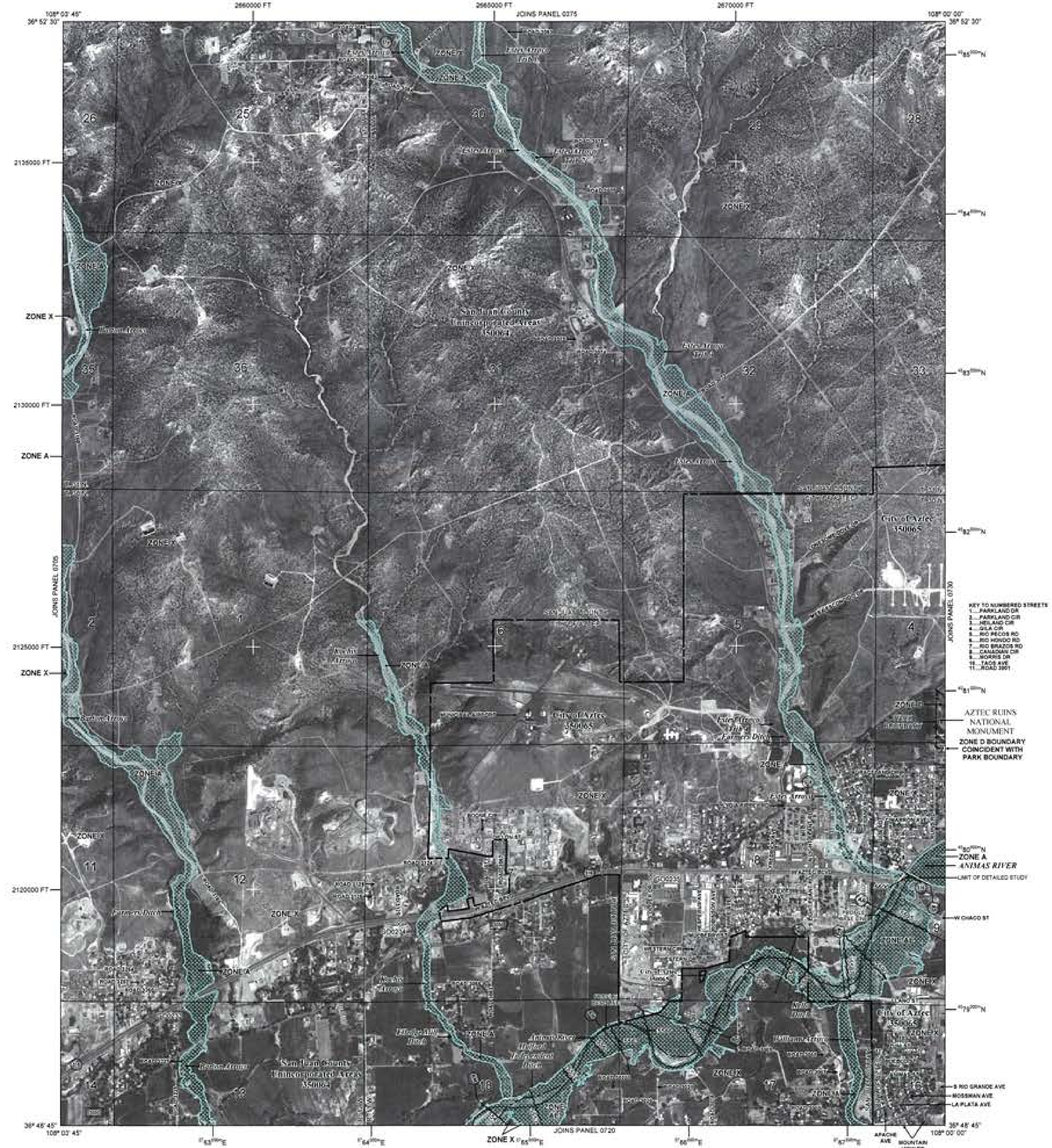
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
(A)—(A) Cross section line
(23)- - - -(23) Transect line
87° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{42}76^{000m}$E — 1000-meter Universal Transverse Mercator grid values, zones 12 & 13
600000 FT — 5000-foot grid ticks: New Mexico State Plane coordinate system, West Zone (FIPSZONE 3002), Transverse Mercator Projection
DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
AUGUST 5, 2010

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

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0710F

FIRM

FLOOD INSURANCE RATE MAP

SAN JUAN COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 710 OF 2750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AZTEC, CITY OF	350065	0710	F
SAN JUAN COUNTY	350064	0710	F

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
35045C0710F

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

NOTES TO USERS

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Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

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The **projection** used in the preparation of this map was New Mexico State Plane West Zone (FIPS 3003). The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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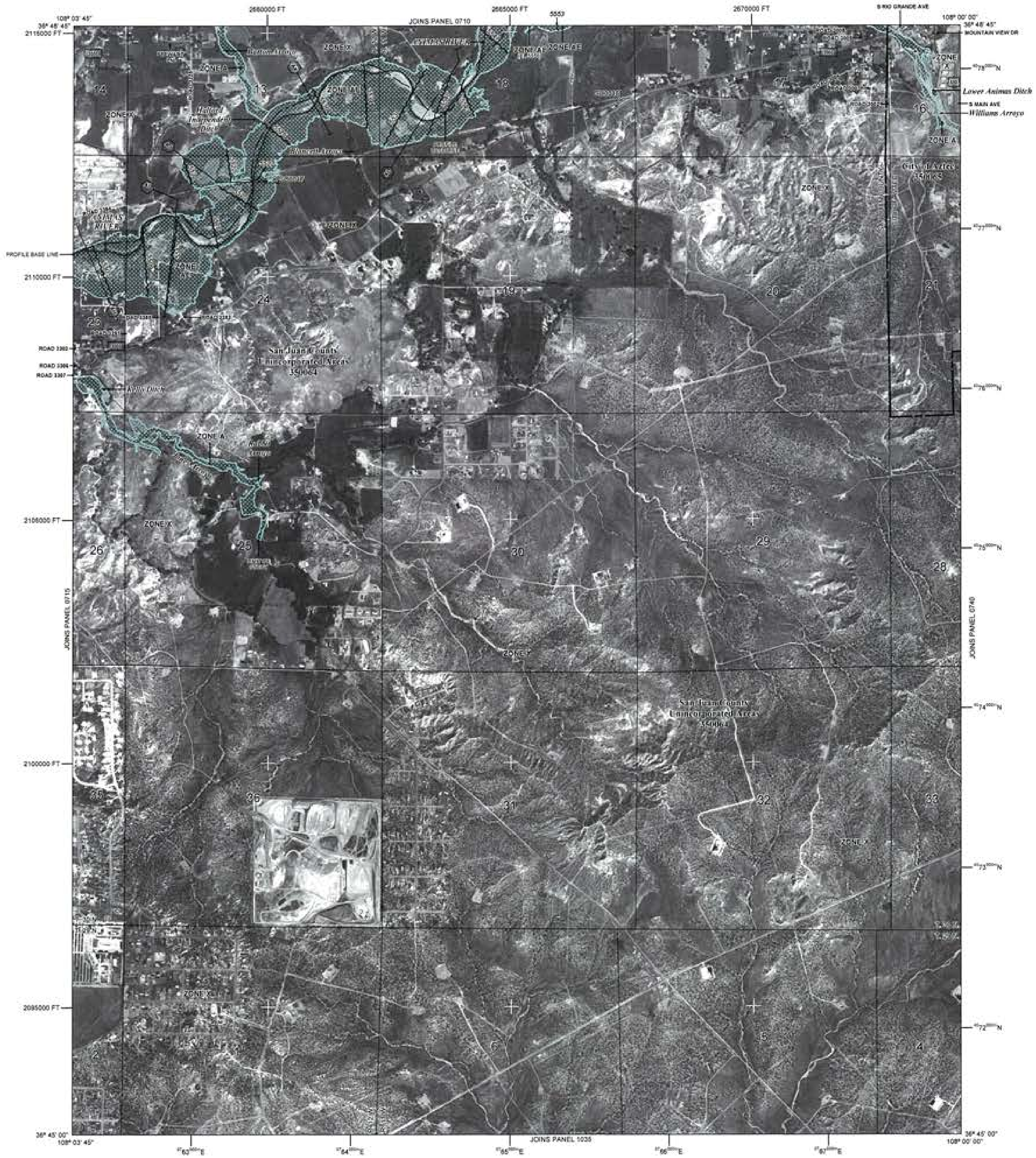

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
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FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)—(A) Cross section line
(23)- - - -(23) Transect line
97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
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DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
AUGUST 5, 2010

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

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MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0720F

FIRM
FLOOD INSURANCE RATE MAP
SAN JUAN COUNTY, NEW MEXICO
AND INCORPORATED AREAS

PANEL 720 OF 2750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

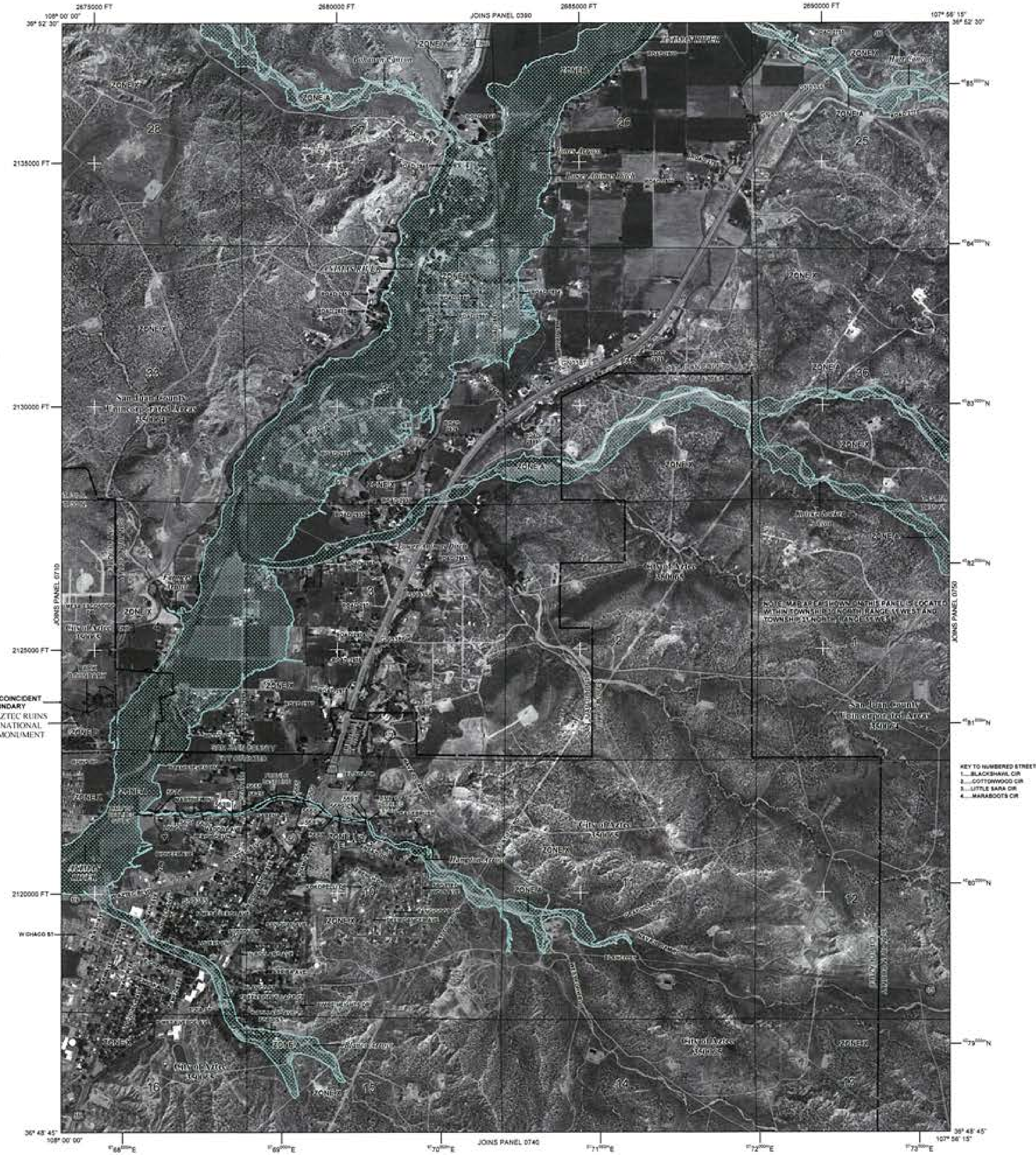
COMMUNITY	NUMBER	PANEL	SUFFIX
AZTEC, CITY OF	350063	0720	F
SAN JUAN COUNTY	350064	0720	F

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
35045C0720F

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency



NOTES TO USERS

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LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

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- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
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FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- 1% annual chance floodplain boundary
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- Floodway boundary
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MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
AUGUST 5, 2010

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

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500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0730F

FIRM
FLOOD INSURANCE RATE MAP
SAN JUAN COUNTY, NEW MEXICO
AND INCORPORATED AREAS

PANEL 730 OF 2750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AZTEC, CITY OF	350063	0730	F
SAN JUAN COUNTY	350064	0730	F

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MAP NUMBER
35045C0730F

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

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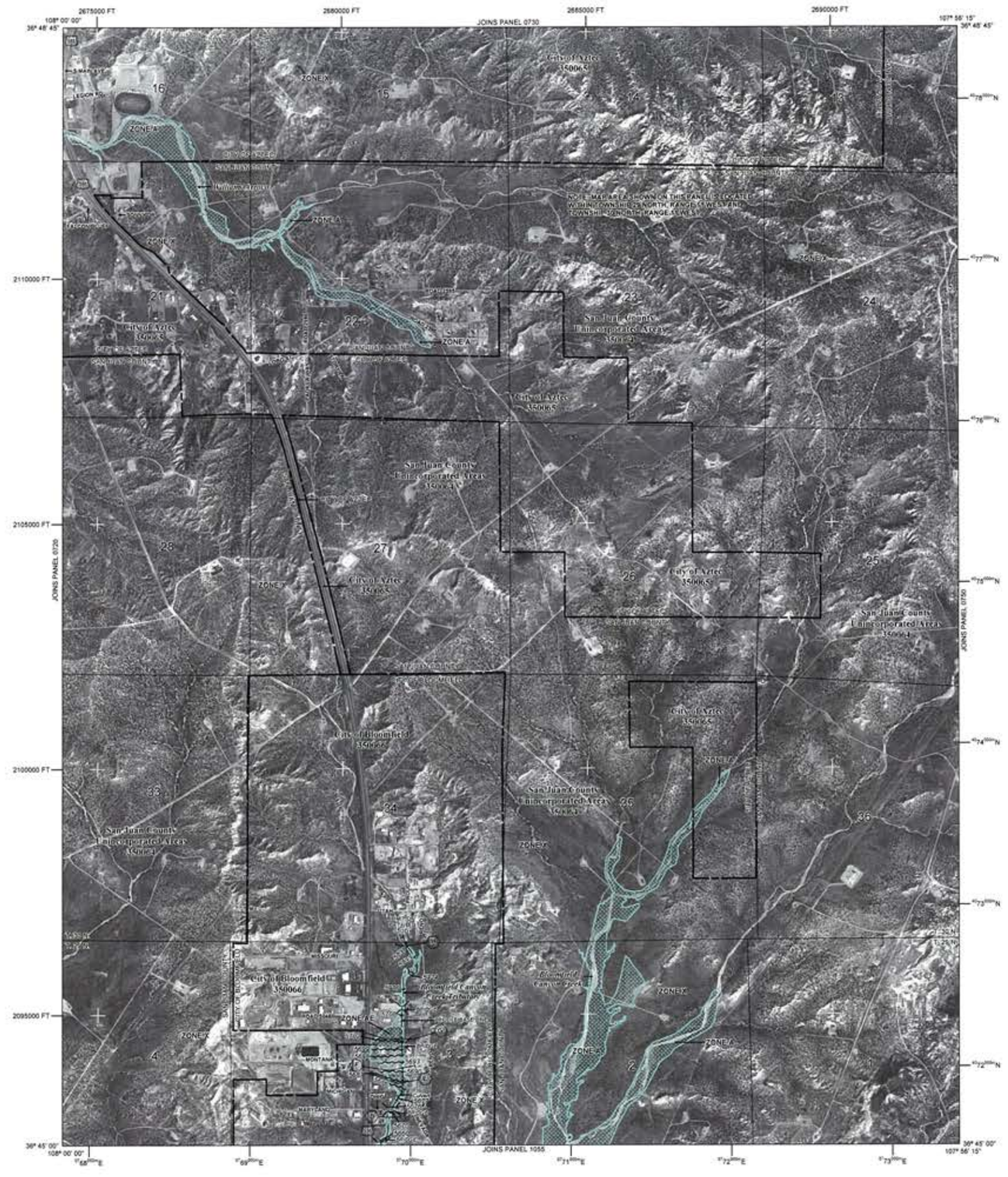

LEGEND

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

OTHER FLOOD AREAS

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

OTHER AREAS

- **ZONE X** — Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA Boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (BE 987) — Base Flood Elevation line and value; elevation in feet* / Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zones 12 & 13
- 600000 FT — 5000-foot grid ticks: New Mexico State Plane coordinate system, West Zone (FIPSZONE 3003), Transverse Mercator Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
AUGUST 5, 2010

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

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
150 0 300 600 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0740F

FIRM

FLOOD INSURANCE RATE MAP

SAN JUAN COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 740 OF 2750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AZTEC, CITY OF	350065	0740	F
BLOOMFIELD, CITY OF	350066	0740	F
SAN JUAN COUNTY	350064	0740	F

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
35045C0740F

EFFECTIVE DATE
AUGUST 5, 2010

Federal Emergency Management Agency

Appendix B – Hydrologic Calculation

Appendix B.1 – Rainfall Distribution

Appendix B. 2- Hydrologic Parameters Evaluation and HEC-HMS Results

AECOM	Calculation Sheet				
Project Name:	Blanco Arroyo			Calculation Number:	1B
Client Name:	City of Aztec, New Mexico			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	PDC / 4-28-2016
	60487201	20000	N/A		
Title:	Hydrologic Analysis Using HEC-HMS				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the hydrologic analysis prepared by AECOM for the watershed draining toward the Blanco Arroyo using HEC-HMS version 4.1.

REQUIRED DELIVERABLES:

- Multi-frequency (2; 10; 25; 50; 100-year; and Historic 24-hour) peak flows along the Blanco Arroyo.
- Estimated magnitude of the August 2015 storm event peak flows based on limited approximate information provided by residents.

DATA /ASSUMPTIONS:

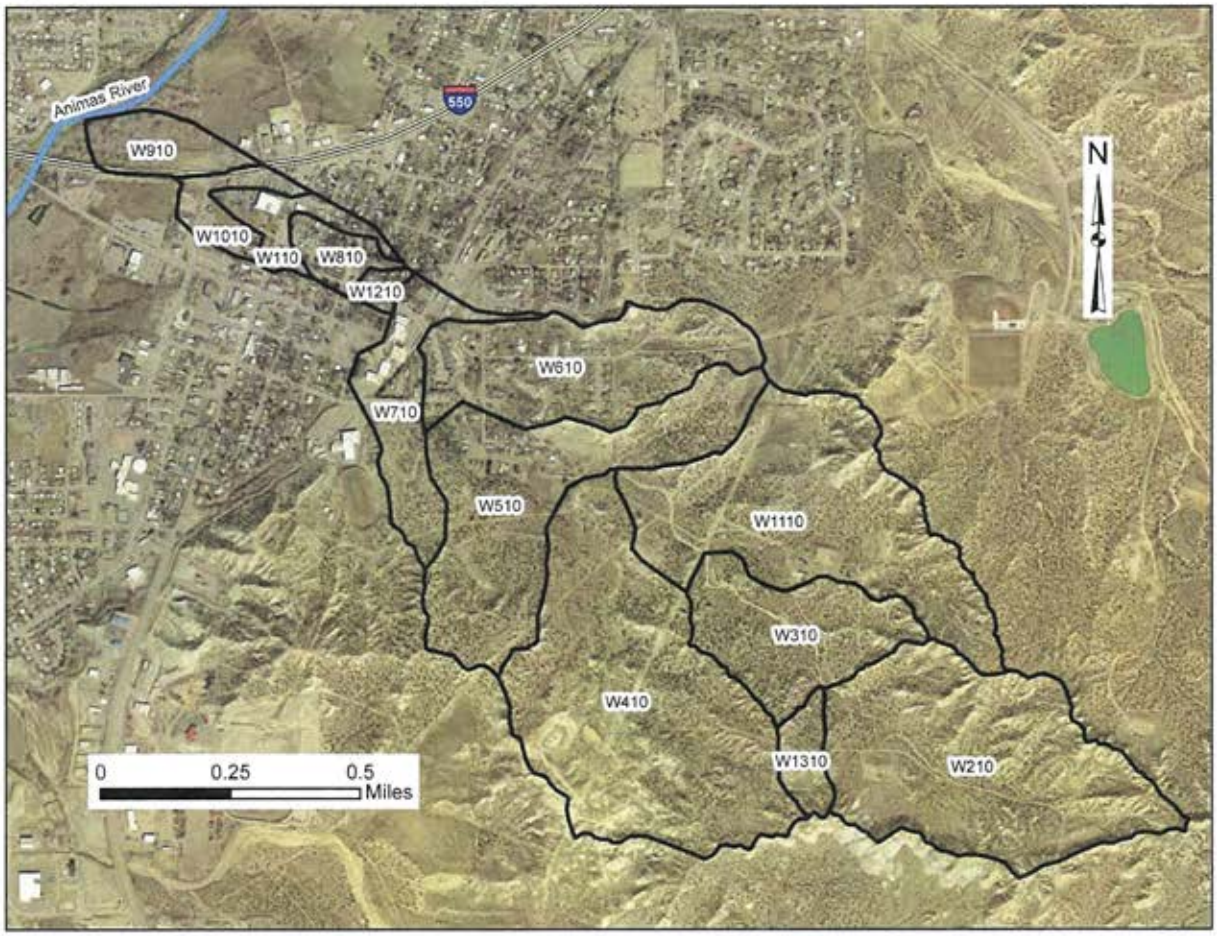
- Drainage area was delineated using 1-ft contour LiDAR data provided by the City of Aztec.
- Rainfall data for the watershed was obtained from NOAA Atlas 14, Volume 1; Version 5.
- SCS Unit Hydrograph Methodology.
- Modified NOAA-SCS rainfall distribution based on New Mexico Department of Transportation (NMDOT) procedures.
- Rainfall loss methodology based on the SCS Curve Number methods.
- Hydrologic soil group (HSG) was determined using the USDA NRCS Soil Report for Aztec, New Mexico. The watershed area consists of HSG classes A, B, C and D soil types.
- Soil impervious area percentages were estimated from readily available aerial imagery.
- Cover type was selected to be "Desert Shrub" in poor condition for the undeveloped areas due to the lack of vegetative cover observed in the field or visible on readily available aerial imagery. One area in the project areas is a cemetery and is marked as fair condition due to the percentage of vegetative cover. Runoff curve numbers were selected using TR-55 Table 2-2a and 2-2d.
- Residential properties outside of the subdivision were assumed to be 1/3 acre lots. Residential properties inside the subdivisions were assumed to be 1/4 acre lots.

Variable Definitions

T_c	Time of Concentration	P_2	2-year, 24-hour rainfall	V	*Velocity*
T_{tn}	Travel time for location 'n'	n	Manning's n value	T_t	Lag time
L	Length of drainage segment	CN	Curve Number	s	Channel slope
r	Hydraulic radius	I_a	Initial abstraction		

AECOM	Calculation Sheet				
Project Name:	Blanco Arroyo			Calculation Number:	1B
Client Name:	City of Aztec, New Mexico			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	PDC / 4-28-2016
	60487201	20000	N/A		
Title:	Hydrologic Analysis Using HEC-HMS				

Figure 1 – Watershed Delineation Map



HYDROLOGIC ANALYSIS

METHODOLOGY:

Watershed Delineation: The contributing watershed shown in Figure 1 was delineated using 10ft contour data provided by the City of Aztec.

Time of Concentration: Time required for water to flow from the hydraulically furthest point in the watershed to the concentration point. The time of concentration can be represented by sheet flow, shallow concentrated flow, and open channel flow components.

$$T_c = T_{t1} + T_{t2} + T_{t3}$$

Sheet flow: According to TR-55 Methodology, the first 300ft of the drainage area can be modeled as sheet flow. The sheet flow travel time can be determined using the following equation.

$$T_{t1} = \frac{0.007 * (nL)^{0.8}}{P_2^{0.5} * s^{0.4}}$$

Shallow Concentrated Flow: After the 300ft of sheet flow, shallow concentrated flow begins and continues until a defined channel is reached. The travel time for this segment of the drainage area is estimated using Figure 3-1 from TR-55 along with the calculated slope to find the corresponding T_{t2}.

Open Channels: Once a defined channel is reached, the flow transitions from Shallow Concentrated Flow to Open Channel Flow. Open channel flow is modeled with a variation of Manning's equation in which velocity is the unknown. Velocity is estimated using the following equation.

$$V = \frac{1.49 * r^{\frac{2}{3}} * s^{\frac{1}{2}}}{n}$$

The estimated velocity is then used in the following equation to determine the travel time for Open Channel Flow.

$$T_{t3} = \frac{L}{3600 * V}$$

Lag Time: When modeling the drainage area in HEC-HMS using the SCS Unit Hydrograph transform, a lag time is needed for the model to run. Lag time is determined using the following equation.

$$T_l = 0.6 * T_c$$

Initial Abstraction: Storm water that is lost to the environment before rainfall-runoff occurs is referred to as initial abstraction. This value I_a determined using the following equation.

$$I_a = 0.2 * X$$

Where:

$$X = \frac{1000}{CN} - 10$$

Engineering judgement was used in consideration of precipitation values in the area and runoff estimates to apply a global cap of 0.350 inches for initial abstraction in the HEC-HMS model. This better reflects the drainage conditions encountered in the Blanco Arroyo watershed and provides a more conservative estimate of peak storm flows.

All inputs regarding impervious area, CN runoff numbers, and Lag Time calculations are provided in Attachment 1.

Hydrologic Results:

Table 1: Sub-Basin Parameters Summary

Sub-basin	A (mi^2)	Length (ft)	Tc (hrs)	Lag Time (mins)	CN	I_A (inches)	Impervious Area (%)
W110	0.023	1,558	0.150	5.40	86	0.326	70%
W210	0.198	4,711	0.660	23.58	88	0.273	1%
W310	0.083	2,901	0.220	7.81	88	0.273	0%
W410	0.240	4,860	0.380	13.79	87	0.299	1%
W510	0.153	3,905	0.530	19.19	85	0.350	10%
W610	0.113	3,510	0.580	20.81	86	0.326	30%
W710	0.058	3,155	0.420	15.08	87	0.299	30%
W810	0.018	1,163	0.190	6.70	85	0.350	75%
W910	0.030	1,886	0.310	11.09	86	0.326	15%
W1010	0.020	1,034	0.210	7.45	96	0.083	50%
W1110	0.187	5,200	0.620	22.21	88	0.273	1%
W1210	0.006	493	0.080	2.70	62	0.350	50%
W1310	0.018	1,513	0.190	6.70	90	0.222	1%

Table 1 summarizes the sub-basin parameters used for the watershed area that were input into the HEC HMS model. The details of the hydrologic calculations for each of sub-basins are attached in Attachment 1. Table 2 summarizes the HEC HMS summary table with the peak discharge from the sub-basins and concentration points.

Table 2a: 100-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	100.20	01Jan2050, 00:44
W1310	0.018	19.00	01Jan2050, 00:19
JUNCTION A	0.216	106.70	01Jan2050, 00:43
REACH W310	0.216	106.70	01Jan2050, 00:47
W310	0.083	66.80	01Jan2050, 00:21
JUNCTION B	0.299	134.10	01Jan2050, 00:40
REACH W1110	0.299	134.00	01Jan2050, 00:43
W1110	0.187	97.60	01Jan2050, 00:42
JUNCTION C	0.486	231.40	01Jan2050, 00:42
REACH W510A	0.486	231.40	01Jan2050, 00:44
W410	0.240	140.30	01Jan2050, 00:31
REACH W510B	0.240	140.20	01Jan2050, 00:32
JUNCTION D	0.726	349.90	01Jan2050, 00:41
REACH W510C	0.726	349.70	01Jan2050, 00:42
W510	0.153	78.80	01Jan2050, 00:38
JUNCTION E	0.879	425.80	01Jan2050, 00:41
REACH W610	0.879	425.40	01Jan2050, 00:43
W610	0.113	80.20	01Jan2050, 00:36
JUNCTION F	0.992	500.60	01Jan2050, 00:42
REACH W710	0.992	500.40	01Jan2050, 00:43
W710	0.058	49.80	01Jan2050, 00:28
JUNCTION G	1.050	536.80	01Jan2050, 00:42
REACH W1210	1.050	536.10	01Jan2050, 00:43
W1210	0.006	8.50	01Jan2050, 00:15
JUNCTION H	1.056	537.60	01Jan2050, 00:43
REACH W810	1.056	537.30	01Jan2050, 00:44
W810	0.018	34.00	01Jan2050, 00:17
JUNCTION I	1.074	544.90	01Jan2050, 00:44
REACH W110	1.074	544.70	01Jan2050, 00:45
W110	0.023	43.90	01Jan2050, 00:17
JUNCTION J	1.097	553.30	01Jan2050, 00:45
REACH W1010	1.097	552.80	01Jan2050, 00:45
W1010	0.020	39.60	01Jan2050, 00:18
JUNCTION K	1.117	562.10	01Jan2050, 00:45
REACH W910	1.117	561.50	01Jan2050, 00:47
W910	0.030	21.80	01Jan2050, 00:25
JUNCTION L	1.147	572.60	01Jan2050, 00:47

Table 2b: 50-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	76.10	01Jan2050, 00:44
W1310	0.018	14.50	01Jan2050, 00:20
JUNCTION A	0.216	81.40	01Jan2050, 00:44
REACH W310	0.216	81.30	01Jan2050, 00:49
W310	0.083	49.40	01Jan2050, 00:21
JUNCTION B	0.299	102.80	01Jan2050, 00:47
REACH W1110	0.299	102.80	01Jan2050, 00:50
W1110	0.187	74.00	01Jan2050, 00:43
JUNCTION C	0.486	175.20	01Jan2050, 00:44
REACH W510A	0.486	175.10	01Jan2050, 00:46
W410	0.240	104.30	01Jan2050, 00:32
REACH W510B	0.240	104.20	01Jan2050, 00:33
JUNCTION D	0.726	263.20	01Jan2050, 00:42
REACH W510C	0.726	263.00	01Jan2050, 00:44
W510	0.153	59.70	01Jan2050, 00:38
JUNCTION E	0.879	320.10	01Jan2050, 00:43
REACH W610	0.879	319.50	01Jan2050, 00:45
W610	0.113	64.60	01Jan2050, 00:36
JUNCTION F	0.992	378.30	01Jan2050, 00:44
REACH W710	0.992	377.90	01Jan2050, 00:45
W710	0.058	40.10	01Jan2050, 00:28
JUNCTION G	1.050	405.70	01Jan2050, 00:44
REACH W1210	1.050	404.80	01Jan2050, 00:45
W1210	0.006	7.20	01Jan2050, 00:15
JUNCTION H	1.056	406.20	01Jan2050, 00:45
REACH W810	1.056	405.90	01Jan2050, 00:46
W810	0.018	29.00	01Jan2050, 00:17
JUNCTION I	1.074	412.20	01Jan2050, 00:46
REACH W110	1.074	412.00	01Jan2050, 00:47
W110	0.023	37.20	01Jan2050, 00:17
JUNCTION J	1.097	419.50	01Jan2050, 00:47
REACH W1010	1.097	419.10	01Jan2050, 00:48
W1010	0.020	33.60	01Jan2050, 00:18
JUNCTION K	1.117	426.70	01Jan2050, 00:48
REACH W910	1.117	426.40	01Jan2050, 00:49
W910	0.030	16.60	01Jan2050, 00:25
JUNCTION L	1.147	434.90	01Jan2050, 00:49

Table 2c: 25-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	55.70	01Jan2050, 00:45
W1310	0.018	10.60	01Jan2050, 00:20
JUNCTION A	0.216	59.70	01Jan2050, 00:45
REACH W310	0.216	59.70	01Jan2050, 00:50
W310	0.083	34.70	01Jan2050, 00:22
JUNCTION B	0.299	75.70	01Jan2050, 00:49
REACH W1110	0.299	75.70	01Jan2050, 00:53
W1110	0.187	54.10	01Jan2050, 00:44
JUNCTION C	0.486	127.40	01Jan2050, 00:45
REACH W510A	0.486	127.30	01Jan2050, 00:48
W410	0.240	74.70	01Jan2050, 00:33
REACH W510B	0.240	74.70	01Jan2050, 00:35
JUNCTION D	0.726	187.40	01Jan2050, 00:43
REACH W510C	0.726	187.30	01Jan2050, 00:46
W510	0.153	43.90	01Jan2050, 00:39
JUNCTION E	0.879	228.70	01Jan2050, 00:44
REACH W610	0.879	228.50	01Jan2050, 00:46
W610	0.113	51.20	01Jan2050, 00:36
JUNCTION F	0.992	273.80	01Jan2050, 00:45
REACH W710	0.992	273.80	01Jan2050, 00:45
W710	0.058	31.70	01Jan2050, 00:28
JUNCTION G	1.050	295.60	01Jan2050, 00:44
REACH W1210	1.050	295.30	01Jan2050, 00:45
W1210	0.006	6.00	01Jan2050, 00:15
JUNCTION H	1.056	296.40	01Jan2050, 00:45
REACH W810	1.056	296.20	01Jan2050, 00:47
W810	0.018	24.50	01Jan2050, 00:17
JUNCTION I	1.074	301.30	01Jan2050, 00:47
REACH W110	1.074	301.30	01Jan2050, 00:48
W110	0.023	31.10	01Jan2050, 00:17
JUNCTION J	1.097	307.40	01Jan2050, 00:48
REACH W1010	1.097	307.10	01Jan2050, 00:48
W1010	0.020	28.00	01Jan2050, 00:18
JUNCTION K	1.117	313.40	01Jan2050, 00:48
REACH W910	1.117	313.20	01Jan2050, 00:50
W910	0.030	12.30	01Jan2050, 00:25
JUNCTION L	1.147	319.60	01Jan2050, 00:50

Table 2d: 10-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	33.80	01Jan2050, 00:47
W1310	0.018	6.40	01Jan2050, 00:20
JUNCTION A	0.216	36.60	01Jan2050, 00:47
REACH W310	0.216	36.60	01Jan2050, 00:54
W310	0.083	19.40	01Jan2050, 00:23
JUNCTION B	0.299	47.20	01Jan2050, 00:54
REACH W1110	0.299	47.20	01Jan2050, 00:58
W1110	0.187	32.80	01Jan2050, 00:45
JUNCTION C	0.486	76.90	01Jan2050, 00:54
REACH W510A	0.486	76.90	01Jan2050, 00:57
W410	0.240	43.90	01Jan2050, 00:36
REACH W510B	0.240	43.90	01Jan2050, 00:37
JUNCTION D	0.726	111.40	01Jan2050, 00:47
REACH W510C	0.726	111.40	01Jan2050, 00:49
W510	0.153	27.20	01Jan2050, 00:40
JUNCTION E	0.879	136.10	01Jan2050, 00:47
REACH W610	0.879	136.00	01Jan2050, 00:49
W610	0.113	36.40	01Jan2050, 00:36
JUNCTION F	0.992	166.10	01Jan2050, 00:47
REACH W710	0.992	166.10	01Jan2050, 00:47
W710	0.058	22.50	01Jan2050, 00:28
JUNCTION G	1.050	180.60	01Jan2050, 00:46
REACH W1210	1.050	180.40	01Jan2050, 00:47
W1210	0.006	4.70	01Jan2050, 00:15
JUNCTION H	1.056	181.30	01Jan2050, 00:47
REACH W810	1.056	181.20	01Jan2050, 00:49
W810	0.018	19.20	01Jan2050, 00:17
JUNCTION I	1.074	185.10	01Jan2050, 00:49
REACH W110	1.074	185.00	01Jan2050, 00:50
W110	0.023	24.10	01Jan2050, 00:16
JUNCTION J	1.097	189.70	01Jan2050, 00:50
REACH W1010	1.097	189.60	01Jan2050, 00:51
W1010	0.020	21.40	01Jan2050, 00:19
JUNCTION K	1.117	194.40	01Jan2050, 00:50
REACH W910	1.117	194.20	01Jan2050, 00:53
W910	0.030	7.80	01Jan2050, 00:25
JUNCTION L	1.147	198.40	01Jan2050, 00:52

Table 2e: 2-year; 24-hour HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	9.00	01Jan2050, 01:03
W1310	0.018	1.70	01Jan2050, 00:33
JUNCTION A	0.216	10.20	01Jan2050, 01:02
REACH W310	0.216	10.20	01Jan2050, 01:11
W310	0.083	5.00	01Jan2050, 00:34
JUNCTION B	0.299	13.80	01Jan2050, 01:03
REACH W1110	0.299	13.80	01Jan2050, 01:09
W1110	0.187	8.60	01Jan2050, 01:00
JUNCTION C	0.486	22.30	01Jan2050, 01:09
REACH W510A	0.486	22.30	01Jan2050, 01:12
W410	0.240	10.10	01Jan2050, 00:42
REACH W510B	0.240	10.10	01Jan2050, 00:44
JUNCTION D	0.726	31.70	01Jan2050, 01:09
REACH W510C	0.726	31.70	01Jan2050, 01:12
W510	0.153	9.00	01Jan2050, 00:34
JUNCTION E	0.879	37.80	01Jan2050, 01:11
REACH W610	0.879	37.80	01Jan2050, 01:14
W610	0.113	18.20	01Jan2050, 00:33
JUNCTION F	0.992	46.00	01Jan2050, 01:11
REACH W710	0.992	46.00	01Jan2050, 01:12
W710	0.058	11.20	01Jan2050, 00:26
JUNCTION G	1.050	50.50	01Jan2050, 00:53
REACH W1210	1.050	50.40	01Jan2050, 00:54
W1210	0.006	2.80	01Jan2050, 00:15
JUNCTION H	1.056	50.90	01Jan2050, 00:54
REACH W810	1.056	50.90	01Jan2050, 00:56
W810	0.018	11.50	01Jan2050, 00:17
JUNCTION I	1.074	53.00	01Jan2050, 00:56
REACH W110	1.074	53.00	01Jan2050, 00:58
W110	0.023	14.30	01Jan2050, 00:16
JUNCTION J	1.097	55.60	01Jan2050, 00:58
REACH W1010	1.097	55.60	01Jan2050, 00:59
W1010	0.020	11.60	01Jan2050, 00:19
JUNCTION K	1.117	58.20	01Jan2050, 00:59
REACH W910	1.117	58.20	01Jan2050, 01:02
W910	0.030	3.30	01Jan2050, 00:21
JUNCTION L	1.147	59.60	01Jan2050, 01:02

AECOM prepared a hydrologic analysis to estimate the magnitude of the August 2015 storm event. Anecdotal rain gage measurements and rain gage information provided by residents at the request of the City of Aztec suggested estimates of 3.35 inches in a 24-hour period, in the area. Comparison to NOAA Atlas 14 records suggested that the Aztec area may have experienced a storm event similar in magnitude to a 500-year event in August of 2015. This storm event was modeled in HEC-HMS and is listed as 'Historic'. The results from HMS are in Table 3.

Table 3: Historical Storm Event HEC HMS Summary

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time to Peak
W210	0.198	169.00	01Jan2050, 00:42
W1310	0.018	31.80	01Jan2050, 00:19
JUNCTION A	0.216	179.40	01Jan2050, 00:41
REACH W310	0.216	179.30	01Jan2050, 00:45
W310	0.083	117.50	01Jan2050, 00:20
JUNCTION B	0.299	228.60	01Jan2050, 00:38
REACH W1110	0.299	228.50	01Jan2050, 00:41
W1110	0.187	164.60	01Jan2050, 00:40
JUNCTION C	0.486	393.10	01Jan2050, 00:41
REACH W510A	0.486	392.90	01Jan2050, 00:42
W410	0.240	245.50	01Jan2050, 00:29
REACH W510B	0.240	245.30	01Jan2050, 00:30
JUNCTION D	0.726	595.70	01Jan2050, 00:39
REACH W510C	0.726	595.00	01Jan2050, 00:41
W510	0.153	133.80	01Jan2050, 00:36
JUNCTION E	0.879	725.60	01Jan2050, 00:40
REACH W610	0.879	724.40	01Jan2050, 00:42
W610	0.113	123.90	01Jan2050, 00:36
JUNCTION F	0.992	842.70	01Jan2050, 00:41
REACH W710	0.992	842.30	01Jan2050, 00:41
W710	0.058	77.20	01Jan2050, 00:28
JUNCTION G	1.050	900.00	01Jan2050, 00:41
REACH W1210	1.050	899.60	01Jan2050, 00:41
W1210	0.006	12.20	01Jan2050, 00:15
JUNCTION H	1.056	901.90	01Jan2050, 00:41
REACH W810	1.056	901.60	01Jan2050, 00:42
W810	0.018	47.50	01Jan2050, 00:17
JUNCTION I	1.074	913.10	01Jan2050, 00:42
REACH W110	1.074	912.70	01Jan2050, 00:42
W110	0.023	62.00	01Jan2050, 00:17
JUNCTION J	1.097	925.80	01Jan2050, 00:42
REACH W1010	1.097	925.40	01Jan2050, 00:43
W1010	0.020	55.60	01Jan2050, 00:18
JUNCTION K	1.117	939.40	01Jan2050, 00:42
REACH W910	1.117	939.00	01Jan2050, 00:44
W910	0.030	36.90	01Jan2050, 00:24
JUNCTION L	1.147	959.30	01Jan2050, 00:43

REFERENCES:

United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report*, January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

AECOM

Attachment 1

Table 1: Sub-basin Inventory

Basin Name	Area (sq. ft)	Area (sq. Mi)	Area (acres)	Impervious Area Estimated From Aerial (%)
W110	629,303.4	0.023	14.45	70%
W210	5,510,763.1	0.198	126.51	1%
W310	2,320,781.6	0.083	53.28	0%
W410	6,698,395.5	0.240	153.77	1%
W510	4,265,246.3	0.153	97.92	10%
W610	3,155,727.2	0.113	72.45	30%
W710	1,611,095.4	0.058	36.99	30%
W810	499,307.9	0.018	11.46	75%
W910	823,313.3	0.030	18.90	15%
W1010	565,764.5	0.020	12.99	50%
W1110	5,223,467.3	0.187	119.91	1%
W1210	176,043.3	0.006	4.04	50%
W1310	500,431.4	0.018	11.49	1%

Table 2: Sub-basin Runoff Curve Numbers

Basin Name	Soil Type Group A			Soil Type Group B			Soil Type Group C			Soil Type Group D			Composite CN	I_a (inches)
	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN	Cover Type	Percent within Subbasin	CN		
W110	Urban district: Industrial	30%	81	Residental: 1/8 acre	40%	85	Residental: 1/8 acre	30%	90				86	0.326
W210										Desert shrub	100%	88	88	0.273
W310										Desert shrub	100%	88	88	0.273
W410	Desert shrub	10%	63							Desert shrub	80%	88	87	0.299
										Newly graded areas	10%	94		
W510	Residental: 1/8 acre	25%	77							Desert shrub	50%	88	85	0.353
	Desert shrub	15%	77							Newly graded areas	10%	94		
W610	Residental: 1/8 acre	25%	77							Desert shrub	50%	88	86	0.326
	Urban district: Industrial	10%	81							Residental: 1/8 acre	15%	92		
W710	Urban district: Industrial	30%	81	Urban district: Industrial	20%	88				Desert shrub	40%	88	87	0.299
										Urban district: Industrial	10%	93		
W810				Residental: 1/8 acre	100%	85							85	0.353
W910							Woods	55%	77	Fallow	28%	93	86	0.326
							Streets and roads: Paved	13%	98	Streets and roads: Paved	4%	98		
W1010	Paved parking lots, roofs, etc	60%	98				Urban Districts: Commercial	18%	94	Streets and roads: Paved	15%	98	96	0.083
							Open Space: Fair Condition	7%	79					
W1110	Desert shrub	5%	63							Desert shrub	85%	88	88	0.273
										Newly graded areas	10%	94		
W1210	Residential: 1/4 acre	95%	61	Residental: 1/4 acre	5%	75							62	1.226
W1310										Desert shrub	70%	88	90	0.222
										Newly graded areas	30%	94		

Notes:

1. Initial abstraction is capped at 0.35 inches.

Table 3: Time of Concentration and Lag Time Calculations

Basin Name	Sheet Flow Distance (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Slope	Shallow Concentrated Flow (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Slope	Channelized Flow (ft)	Channel Width (ft)	Depth (ft)	Upslope Elevation (ft)	Downslope Elevation (ft)	Wetted Perimeter (ft)	Flow Area (ft^2)	Slope	Tc (hours)	Lag Time (mins)
W110	236.00	5,644.00	5,635.00	0.04	647.00	5,635.00	5,624.00	0.02	675.00	8.62	6.00	5,624.00	5,609.00	35.45	123.69	0.022	0.15	5.40
W210	206.00	6,069.00	6,037.00	0.16	1,317.00	6,037.00	5,940.00	0.07	3,188.00	18.16	2.00	5,940.00	5,836.00	27.10	44.31	0.033	0.66	23.58
W310	123.00	5,965.00	5,920.00	0.37	1,561.00	5,920.00	5,810.00	0.07	1,217.00	26.30	3.00	5,810.00	5,776.00	39.72	96.91	0.028	0.22	7.81
W410	197.00	5,954.00	5,920.00	0.17	1,757.00	5,920.00	5,813.00	0.06	2,906.00	15.41	3.00	5,813.00	5,728.00	28.83	64.24	0.029	0.38	13.79
W510	283.00	5,841.00	5,823.00	0.06	1,608.00	5,823.00	5,740.00	0.05	2,014.00	9.82	4.00	5,740.00	5,690.00	27.71	71.29	0.025	0.53	19.19
W610	257.00	5,840.00	5,830.00	0.04	1,917.00	5,830.00	5,757.00	0.04	1,336.00	31.28	0.50	5,757.00	5,679.00	33.51	16.14	0.058	0.58	20.81
W710	267.00	5,828.00	5,787.00	0.15	2,479.00	5,787.00	5,669.00	0.05	409.00	8.85	3.00	5,669.00	5,660.00	22.27	44.55	0.022	0.42	15.08
W810	229.00	5,653.00	5,652.00	0.00	222.00	5,652.00	5,646.00	0.03	712.00	11.42	4.00	5,646.00	5,629.00	29.31	77.68	0.024	0.19	6.70
W910	285.00	5,620.00	5,617.00	0.01	933.00	5,617.00	5,607.00	0.01	668.00	14.97	4.00	5,607.00	5,593.00	32.86	91.88	0.021	0.31	11.09
W1010	232.00	5,618.00	5,616.00	0.01	508.00	5,616.00	5,609.00	0.01	294.00	8.28	5.00	5,609.00	5,607.00	30.64	91.39	0.007	0.21	7.45
W1110	290.00	6006.00	5975.00	0.11	1586.00	5975.00	5852.00	0.08	3324.00	25.87	2.00	5852.00	5741.00	34.82	59.75	0.033	0.62	22.21
W1210	166.00	5666.00	5662.00	0.02	263.00	5662.00	5653.00	0.03	64.00	3.54	5.00	5653.00	5651.00	25.90	67.69	0.031	0.08	2.70
W1310	176.00	5968.00	5916.00	0.30	779.00	5916.00	5857.00	0.08	558.00	7.41	4.00	5857.00	5836.00	25.30	61.66	0.038	0.19	6.70

NOAA Atlas 14, Volume 1, Version 5
Location name: Aztec, New Mexico, US*
Latitude: 36.8170°, Longitude: -107.9810°
Elevation: 5762 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.148 (0.127-0.172)	0.190 (0.164-0.221)	0.256 (0.220-0.298)	0.310 (0.266-0.362)	0.388 (0.330-0.452)	0.453 (0.382-0.527)	0.523 (0.436-0.608)	0.598 (0.492-0.698)	0.706 (0.568-0.826)	0.794 (0.629-0.935)
10-min	0.225 (0.194-0.262)	0.289 (0.249-0.337)	0.389 (0.335-0.454)	0.472 (0.406-0.550)	0.591 (0.503-0.688)	0.690 (0.581-0.802)	0.796 (0.663-0.926)	0.910 (0.748-1.06)	1.07 (0.864-1.26)	1.21 (0.958-1.42)
15-min	0.278 (0.240-0.325)	0.359 (0.309-0.418)	0.482 (0.416-0.562)	0.586 (0.503-0.682)	0.733 (0.624-0.853)	0.856 (0.720-0.994)	0.986 (0.822-1.15)	1.13 (0.928-1.32)	1.33 (1.07-1.56)	1.50 (1.19-1.76)
30-min	0.375 (0.323-0.438)	0.483 (0.416-0.563)	0.650 (0.560-0.757)	0.789 (0.677-0.919)	0.987 (0.840-1.15)	1.15 (0.970-1.34)	1.33 (1.11-1.55)	1.52 (1.25-1.77)	1.79 (1.44-2.10)	2.02 (1.60-2.38)
60-min	0.464 (0.400-0.542)	0.598 (0.515-0.696)	0.804 (0.693-0.937)	0.976 (0.838-1.14)	1.22 (1.04-1.42)	1.43 (1.20-1.66)	1.64 (1.37-1.91)	1.88 (1.55-2.19)	2.22 (1.79-2.60)	2.50 (1.98-2.94)
2-hr	0.538 (0.470-0.625)	0.685 (0.599-0.794)	0.908 (0.795-1.05)	1.10 (0.956-1.26)	1.37 (1.18-1.58)	1.59 (1.36-1.84)	1.84 (1.55-2.12)	2.11 (1.75-2.43)	2.50 (2.03-2.90)	2.83 (2.25-3.30)
3-hr	0.583 (0.516-0.665)	0.734 (0.647-0.839)	0.951 (0.842-1.09)	1.13 (0.996-1.29)	1.40 (1.22-1.59)	1.62 (1.40-1.84)	1.86 (1.58-2.14)	2.12 (1.78-2.46)	2.51 (2.06-2.93)	2.86 (2.28-3.33)
6-hr	0.702 (0.634-0.789)	0.872 (0.786-0.980)	1.10 (0.988-1.23)	1.29 (1.16-1.45)	1.57 (1.39-1.76)	1.80 (1.58-2.02)	2.04 (1.77-2.29)	2.31 (1.97-2.59)	2.69 (2.25-3.05)	3.01 (2.47-3.43)
12-hr	0.836 (0.757-0.926)	1.04 (0.941-1.15)	1.29 (1.16-1.42)	1.48 (1.34-1.64)	1.76 (1.58-1.94)	1.98 (1.76-2.18)	2.20 (1.94-2.43)	2.43 (2.13-2.70)	2.76 (2.37-3.08)	3.04 (2.58-3.46)
24-hr	0.925 (0.857-0.996)	1.16 (1.08-1.25)	1.47 (1.36-1.58)	1.72 (1.59-1.85)	2.07 (1.90-2.22)	2.34 (2.14-2.52)	2.63 (2.40-2.83)	2.94 (2.65-3.16)	3.35 (2.99-3.62)	3.68 (3.26-4.00)
2-day	1.07 (0.996-1.15)	1.34 (1.25-1.44)	1.68 (1.57-1.80)	1.96 (1.83-2.10)	2.33 (2.17-2.49)	2.63 (2.43-2.81)	2.94 (2.69-3.14)	3.26 (2.96-3.49)	3.69 (3.32-3.97)	4.03 (3.60-4.35)
3-day	1.16 (1.08-1.24)	1.44 (1.35-1.55)	1.80 (1.69-1.93)	2.09 (1.96-2.24)	2.49 (2.31-2.66)	2.79 (2.59-2.99)	3.11 (2.86-3.33)	3.43 (3.14-3.69)	3.87 (3.51-4.17)	4.22 (3.79-4.56)
4-day	1.24 (1.16-1.33)	1.55 (1.45-1.66)	1.93 (1.81-2.06)	2.23 (2.09-2.38)	2.64 (2.46-2.82)	2.96 (2.75-3.16)	3.29 (3.03-3.52)	3.61 (3.32-3.88)	4.06 (3.70-4.37)	4.41 (3.98-4.76)
7-day	1.43 (1.33-1.53)	1.78 (1.66-1.91)	2.22 (2.06-2.37)	2.56 (2.38-2.73)	3.02 (2.80-3.22)	3.36 (3.11-3.59)	3.71 (3.42-3.96)	4.07 (3.73-4.35)	4.54 (4.12-4.87)	4.90 (4.42-5.26)
10-day	1.62 (1.51-1.74)	2.02 (1.88-2.18)	2.50 (2.33-2.70)	2.88 (2.68-3.10)	3.38 (3.13-3.64)	3.75 (3.47-4.04)	4.13 (3.81-4.45)	4.51 (4.14-4.87)	5.01 (4.57-5.41)	5.37 (4.87-5.84)
20-day	2.09 (1.93-2.25)	2.60 (2.42-2.81)	3.22 (2.99-3.48)	3.71 (3.44-3.99)	4.35 (4.03-4.68)	4.84 (4.45-5.21)	5.33 (4.89-5.74)	5.82 (5.31-6.28)	6.46 (5.86-6.99)	6.95 (6.26-7.54)
30-day	2.48 (2.30-2.67)	3.09 (2.88-3.33)	3.81 (3.55-4.11)	4.36 (4.05-4.71)	5.08 (4.70-5.48)	5.61 (5.18-6.05)	6.13 (5.64-6.64)	6.65 (6.08-7.21)	7.31 (6.65-7.95)	7.81 (7.06-8.51)
45-day	2.99 (2.79-3.22)	3.73 (3.48-4.02)	4.60 (4.28-4.95)	5.25 (4.88-5.65)	6.09 (5.64-6.55)	6.70 (6.19-7.22)	7.30 (6.71-7.87)	7.89 (7.21-8.52)	8.64 (7.86-9.35)	9.19 (8.31-9.97)
60-day	3.45 (3.21-3.71)	4.31 (4.02-4.64)	5.29 (4.92-5.70)	6.01 (5.58-6.48)	6.94 (6.42-7.47)	7.61 (7.02-8.20)	8.26 (7.60-8.91)	8.88 (8.14-9.59)	9.67 (8.82-10.5)	10.2 (9.30-11.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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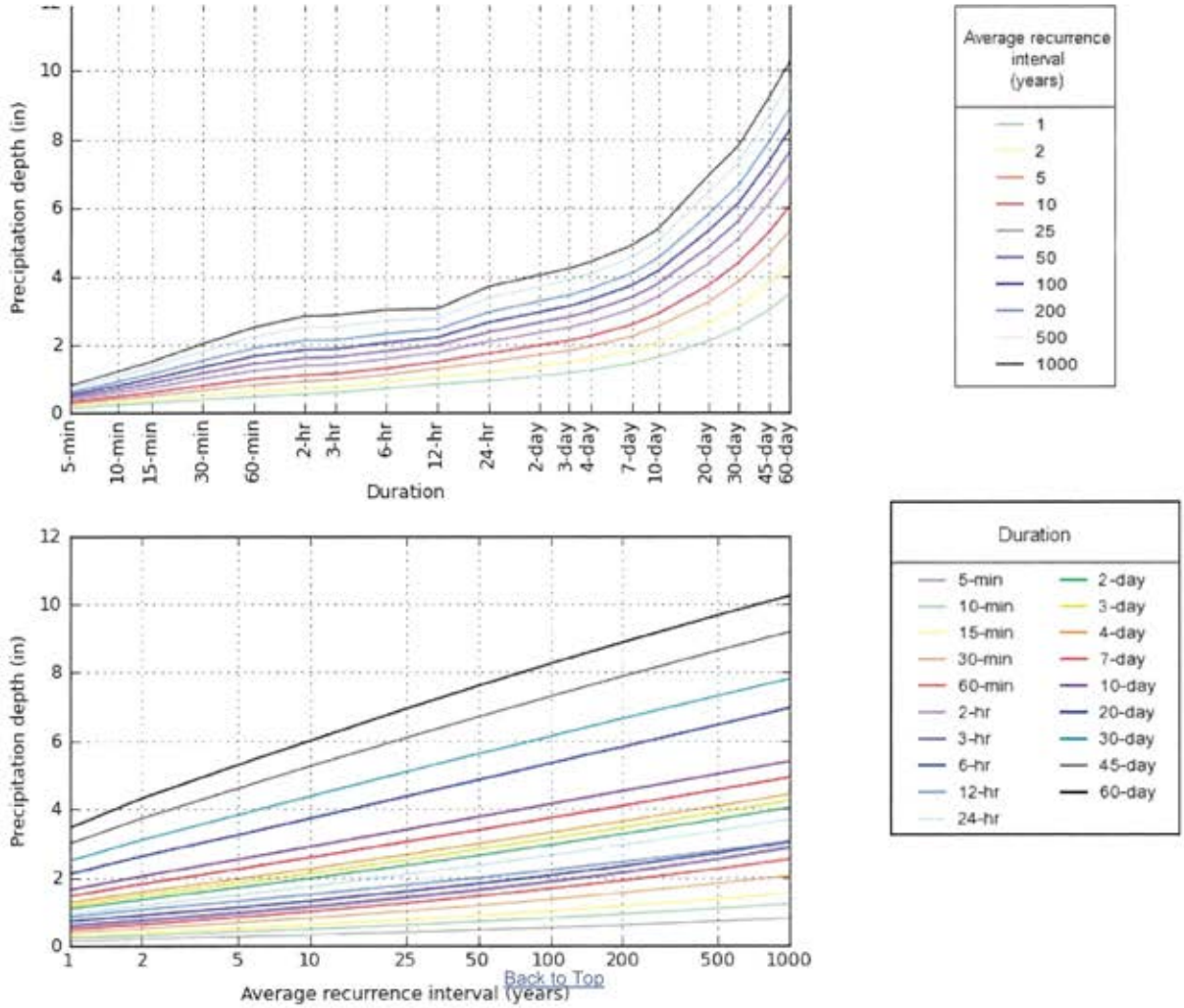
PF graphical



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NOAA Atlas 14, Volume 1, Version 5

Maps & aerials

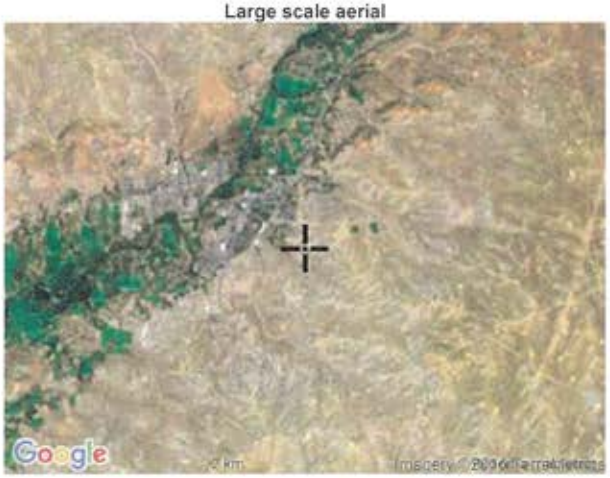
Created (GMT): Wed Mar 23 23:43:51 2016

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial



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BLANCO ARROYO WATERSHED
MODIFIED NOAA-SCS RAINFALL DISTRIBUTION

NOAA 14 Depth Duration Frequency Data [100-YEAR] [1] :

DURATION	[hours]	[inches] [1]
0	*0*	0
5-min	0.0833	*0.523*
10-min	0.1667	*0.796*
15-min	*0.2500*	*0.986*
30-min	*0.5000*	*1.330*
	0.7500	1.485
1-hr	*1.0000*	*1.640*
	1.2500	1.690
	1.5000	1.740
	1.7500	1.790
2-hr	*2.0000*	*1.840*
	2.5000	1.850
3-hr	*3.0000*	*1.860*
	3.5000	1.890
	4.0000	1.920
	5.0000	1.980
6-hr	*6.0000*	*2.040*
	7.0000	2.067
	8.0000	2.093
	9.0000	2.120
	10.0000	2.147
	11.0000	2.173
12-hr	*12.0000*	*2.200*
	14.0000	2.272
	16.0000	2.343
	18.0000	2.415
	20.0000	2.487
	22.0000	2.558
24-hr	*24.0000*	*2.630*

Modified NOAA-SCS Rainfall Distribution [2] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.027	0.027	0.010
1	0.25	0.986	0.986	1.00 TO 2.00	17	0.027	0.053	0.020
2	0.5	1.330	0.344	2.00 TO 3.00	15	0.027	0.080	0.030
3	0.75	1.485	0.155	3.00 TO 4.00	13	0.060	0.140	0.053
4	1	1.640	0.155	4.00 TO 4.50	11	0.030	0.170	0.065
5	1.25	1.690	0.050	4.50 TO 5.00	9	0.010	0.180	0.068
6	1.5	1.740	0.050	5.00 TO 5.25	7	0.050	0.230	0.087
7	1.75	1.790	0.050	5.25 TO 5.50	5	0.050	0.280	0.106
8	2	1.840	0.050	5.50 TO 5.75	3	0.155	0.435	0.165
9	2.5	1.850	0.010	5.75 TO 6.00	1	0.986	1.421	0.540
10	3	1.860	0.010	6.00 TO 6.25	2	0.344	1.765	0.671
11	3.5	1.890	0.030	6.25 TO 6.50	4	0.155	1.920	0.730
12	4	1.920	0.030	6.50 TO 6.75	6	0.050	1.970	0.749
13	5	1.980	0.060	6.75 TO 7.00	8	0.050	2.020	0.768
14	6	2.040	0.060	7.00 TO 7.50	10	0.010	2.030	0.772
15	7	2.067	0.027	7.50 TO 8.00	12	0.030	2.060	0.783
16	8	2.093	0.027	8.00 TO 9.00	14	0.060	2.120	0.806
17	9	2.120	0.027	9.00 TO 10.00	16	0.027	2.147	0.816
18	10	2.147	0.027	10.00 TO 11.00	18	0.027	2.173	0.826
19	11	2.173	0.027	11.00 TO 12.00	20	0.027	2.200	0.837
20	12	2.200	0.027	12.00 TO 14.00	21	0.072	2.272	0.864
21	14	2.272	0.072	14.00 TO 16.00	22	0.072	2.343	0.891
22	16	2.343	0.072	16.00 TO 18.00	23	0.072	2.415	0.918
23	18	2.415	0.072	18.00 TO 20.00	24	0.072	2.487	0.946
24	20	2.487	0.072	20.00 TO 22.00	25	0.072	2.558	0.973
25	22	2.558	0.072	22.00 TO 24.00	26	0.072	2.630	1.000
26	24	2.630	0.072					

Notes:
1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitaiton Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I,* 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170 ° N Longitude 107.9810° W

NOAA 14 Depth Duration Frequency Data [50-YEAR] [1] :

DURATION	[hours]	[inches] [2]
0	0	0
5-min	0.0833	0.453
10-min	0.1667	0.690
15-min	0.2500	0.856
30-min	0.5000	1.150
	0.7500	1.290
1-hr	1.0000	1.430
	1.2500	1.470
	1.5000	1.510
	1.7500	1.550
2-hr	2.0000	1.590
	2.5000	1.605
3-hr	3.0000	1.620
	3.5000	1.650
	4.0000	1.680
	5.0000	1.740
6-hr	6.0000	1.800
	7.0000	1.830
	8.0000	1.860
	9.0000	1.890
	10.0000	1.920
	11.0000	1.950
12-hr	12.0000	1.980
	14.0000	2.040
	16.0000	2.100
	18.0000	2.160
	20.0000	2.220
	22.0000	2.280
24-hr	24.0000	2.340

Modified NOAA-SCS Rainfall Distribution [2] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.030	0.030	0.013
1	0.25	0.856	0.856	1.00 TO 2.00	17	0.030	0.060	0.026
2	0.5	1.150	0.294	2.00 TO 3.00	15	0.030	0.090	0.038
3	0.75	1.290	0.140	3.00 TO 4.00	13	0.060	0.150	0.064
4	1	1.430	0.140	4.00 TO 4.50	11	0.030	0.180	0.077
5	1.25	1.470	0.040	4.50 TO 5.00	9	0.015	0.195	0.083
6	1.5	1.510	0.040	5.00 TO 5.25	7	0.040	0.235	0.100
7	1.75	1.550	0.040	5.25 TO 5.50	5	0.040	0.275	0.118
8	2	1.590	0.040	5.50 TO 5.75	3	0.140	0.415	0.177
9	2.5	1.605	0.015	5.75 TO 6.00	1	0.856	1.271	0.543
10	3	1.620	0.015	6.00 TO 6.25	2	0.294	1.565	0.669
11	3.5	1.650	0.030	6.25 TO 6.50	4	0.140	1.705	0.729
12	4	1.680	0.030	6.50 TO 6.75	6	0.040	1.745	0.746
13	5	1.740	0.060	6.75 TO 7.00	8	0.040	1.785	0.763
14	6	1.800	0.060	7.00 TO 7.50	10	0.015	1.800	0.769
15	7	1.830	0.030	7.50 TO 8.00	12	0.030	1.830	0.782
16	8	1.860	0.030	8.00 TO 9.00	14	0.060	1.890	0.808
17	9	1.890	0.030	9.00 TO 10.00	16	0.030	1.920	0.821
18	10	1.920	0.030	10.00 TO 11.00	18	0.030	1.950	0.833
19	11	1.950	0.030	11.00 TO 12.00	20	0.030	1.980	0.846
20	12	1.980	0.030	12.00 TO 14.00	21	0.060	2.040	0.872
21	14	2.040	0.060	14.00 TO 16.00	22	0.060	2.100	0.897
22	16	2.100	0.060	16.00 TO 18.00	23	0.060	2.160	0.923
23	18	2.160	0.060	18.00 TO 20.00	24	0.060	2.220	0.949
24	20	2.220	0.060	20.00 TO 22.00	25	0.060	2.280	0.974
25	22	2.280	0.060	22.00 TO 24.00	26	0.060	2.340	1.000
26	24	2.340	0.060					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I,* 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170° N Longitude 107.9810° W

NOAA 14 Depth Duration Frequency Data [25-YEAR] [1] :

DURATION	[hours]	[inches] [2]
0	0	0
5-min	0.0833	0.388
10-min	0.1667	0.591
15-min	0.2500	0.733
30-min	0.5000	0.987
	0.7500	1.104
1-hr	1.0000	1.220
	1.2500	1.258
	1.5000	1.295
	1.7500	1.333
2-hr	2.0000	1.370
	2.5000	1.385
3-hr	3.0000	1.400
	3.5000	1.428
	4.0000	1.457
	5.0000	1.513
6-hr	6.0000	1.570
	7.0000	1.602
	8.0000	1.633
	9.0000	1.665
	10.0000	1.697
	11.0000	1.728
12-hr	12.0000	1.760
	14.0000	1.812
	16.0000	1.863
	18.0000	1.915
	20.0000	1.967
	22.0000	2.018
24-hr	24.0000	2.070

Modified NOAA-SCS Rainfall Distribution [2] :

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD [hrs]	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.032	0.032	0.015
1	0.25	0.733	0.733	1.00 TO 2.00	17	0.032	0.063	0.031
2	0.5	0.987	0.254	2.00 TO 3.00	15	0.032	0.095	0.046
3	0.75	1.104	0.117	3.00 TO 4.00	13	0.057	0.152	0.073
4	1	1.220	0.117	4.00 TO 4.50	11	0.028	0.180	0.087
5	1.25	1.258	0.038	4.50 TO 5.00	9	0.015	0.195	0.094
6	1.5	1.295	0.037	5.00 TO 5.25	7	0.038	0.233	0.112
7	1.75	1.333	0.038	5.25 TO 5.50	5	0.038	0.270	0.130
8	2	1.370	0.038	5.50 TO 5.75	3	0.117	0.387	0.187
9	2.5	1.385	0.015	5.75 TO 6.00	1	0.733	1.120	0.541
10	3	1.400	0.015	6.00 TO 6.25	2	0.254	1.374	0.664
11	3.5	1.428	0.028	6.25 TO 6.50	4	0.117	1.490	0.720
12	4	1.457	0.028	6.50 TO 6.75	6	0.037	1.528	0.738
13	5	1.513	0.057	6.75 TO 7.00	8	0.038	1.565	0.756
14	6	1.570	0.057	7.00 TO 7.50	10	0.015	1.580	0.763
15	7	1.602	0.032	7.50 TO 8.00	12	0.028	1.608	0.777
16	8	1.633	0.032	8.00 TO 9.00	14	0.057	1.665	0.804
17	9	1.665	0.032	9.00 TO 10.00	16	0.032	1.697	0.820
18	10	1.697	0.032	10.00 TO 11.00	18	0.032	1.728	0.835
19	11	1.728	0.032	11.00 TO 12.00	20	0.032	1.760	0.850
20	12	1.760	0.032	12.00 TO 14.00	21	0.052	1.812	0.875
21	14	1.812	0.052	14.00 TO 16.00	22	0.052	1.863	0.900
22	16	1.863	0.052	16.00 TO 18.00	23	0.052	1.915	0.925
23	18	1.915	0.052	18.00 TO 20.00	24	0.052	1.967	0.950
24	20	1.967	0.052	20.00 TO 22.00	25	0.052	2.018	0.975
25	22	2.018	0.052	22.00 TO 24.00	26	0.052	2.070	1.000
26	24	2.070	0.052					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170° N Longitude 107.9810° W

NOAA 14 Depth Duration Frequency Data [10-YEAR][2]*:*

DURATION	[hours]	[inches][1]
0	0	0
5-min	0.0833	0.310
10-min	0.1667	0.472
15-min	0.2500	0.586
30-min	0.5000	0.789
	0.7500	0.883
1-hr	1.0000	0.976
	1.2500	1.007
	1.5000	1.038
	1.7500	1.069
2-hr	2.0000	1.100
	2.5000	1.115
3-hr	3.0000	1.130
	3.5000	1.157
	4.0000	1.183
	5.0000	1.237
6-hr	6.0000	1.290
	7.0000	1.322
	8.0000	1.353
	9.0000	1.385
	10.0000	1.417
	11.0000	1.448
12-hr	12.0000	1.480
	14.0000	1.520
	16.0000	1.560
	18.0000	1.600
	20.0000	1.640
	22.0000	1.680
24-hr	24.0000	1.720

Modified NOAA-SCS Rainfall Distribution[2]*:*

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.032	0.032	0.018
1	0.25	0.586	0.586	1.00 TO 2.00	17	0.032	0.063	0.037
2	0.5	0.789	0.203	2.00 TO 3.00	15	0.032	0.095	0.055
3	0.75	0.883	0.094	3.00 TO 4.00	13	0.053	0.148	0.086
4	1	0.976	0.093	4.00 TO 4.50	11	0.027	0.175	0.102
5	1.25	1.007	0.031	4.50 TO 5.00	9	0.015	0.190	0.110
6	1.5	1.038	0.031	5.00 TO 5.25	7	0.031	0.221	0.128
7	1.75	1.069	0.031	5.25 TO 5.50	5	0.031	0.252	0.147
8	2	1.100	0.031	5.50 TO 5.75	3	0.094	0.346	0.201
9	2.5	1.115	0.015	5.75 TO 6.00	1	0.586	0.932	0.542
10	3	1.130	0.015	6.00 TO 6.25	2	0.203	1.135	0.660
11	3.5	1.157	0.027	6.25 TO 6.50	4	0.093	1.228	0.714
12	4	1.183	0.027	6.50 TO 6.75	6	0.031	1.259	0.732
13	5	1.237	0.053	6.75 TO 7.00	8	0.031	1.290	0.750
14	6	1.290	0.053	7.00 TO 7.50	10	0.015	1.305	0.759
15	7	1.322	0.032	7.50 TO 8.00	12	0.027	1.332	0.774
16	8	1.353	0.032	8.00 TO 9.00	14	0.053	1.385	0.805
17	9	1.385	0.032	9.00 TO 10.00	16	0.032	1.417	0.824
18	10	1.417	0.032	10.00 TO 11.00	18	0.032	1.448	0.842
19	11	1.448	0.032	11.00 TO 12.00	20	0.032	1.480	0.860
20	12	1.480	0.032	12.00 TO 14.00	21	0.040	1.520	0.884
21	14	1.520	0.040	14.00 TO 16.00	22	0.040	1.560	0.907
22	16	1.560	0.040	16.00 TO 18.00	23	0.040	1.600	0.930
23	18	1.600	0.040	18.00 TO 20.00	24	0.040	1.640	0.953
24	20	1.640	0.040	20.00 TO 22.00	25	0.040	1.680	0.977
25	22	1.680	0.040	22.00 TO 24.00	26	0.040	1.720	1.000
26	24	1.720	0.040					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170° N Longitude 107.9810° W

NOAA 14 Depth Duration Frequency Data [2-YEAR](1):

DURATION	[hours]	[inches][1]
0	*0*	0
5-min	0.0833	*0.190*
10-min	0.1667	*0.289*
15-min	*0.2500*	*0.359*
30-min	*0.5000*	*0.483*
	0.7500	0.541
1-hr	*1.0000*	*0.598*
	1.2500	0.620
	1.5000	0.642
	1.7500	0.663
2-hr	*2.0000*	*0.685*
	2.5000	0.710
3-hr	*3.0000*	*0.734*
	3.5000	0.757
	4.0000	0.780
	5.0000	0.826
6-hr	*6.0000*	*0.872*
	7.0000	0.900
	8.0000	0.928
	9.0000	0.956
	10.0000	0.984
	11.0000	1.012
12-hr	*12.0000*	*1.040*
	14.0000	1.060
	16.0000	1.080
	18.0000	1.100
	20.0000	1.120
	22.0000	1.140
24-hr	*24.0000*	*1.160*

Modified NOAA-SCS Rainfall Distribution[2]:

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n [REARRANGED]	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.028	0.028	0.024
1	0.25	0.359	0.359	1.00 TO 2.00	17	0.028	0.056	0.048
2	0.5	0.483	0.124	2.00 TO 3.00	15	0.028	0.084	0.072
3	0.75	0.541	0.058	3.00 TO 4.00	13	0.046	0.130	0.112
4	1	0.598	0.058	4.00 TO 4.50	11	0.023	0.153	0.132
5	1.25	0.620	0.022	4.50 TO 5.00	9	0.025	0.178	0.153
6	1.5	0.642	0.022	5.00 TO 5.25	7	0.022	0.199	0.172
7	1.75	0.663	0.022	5.25 TO 5.50	5	0.022	0.221	0.191
8	2	0.685	0.022	5.50 TO 5.75	3	0.058	0.279	0.240
9	2.5	0.710	0.025	5.75 TO 6.00	1	0.359	0.638	0.550
10	3	0.734	0.025	6.00 TO 6.25	2	0.124	0.762	0.656
11	3.5	0.757	0.023	6.25 TO 6.50	4	0.058	0.819	0.706
12	4	0.780	0.023	6.50 TO 6.75	6	0.022	0.841	0.725
13	5	0.826	0.046	6.75 TO 7.00	8	0.022	0.863	0.744
14	6	0.872	0.046	7.00 TO 7.50	10	0.025	0.887	0.765
15	7	0.900	0.028	7.50 TO 8.00	12	0.023	0.910	0.784
16	8	0.928	0.028	8.00 TO 9.00	14	0.046	0.956	0.824
17	9	0.956	0.028	9.00 TO 10.00	16	0.028	0.984	0.848
18	10	0.984	0.028	10.00 TO 11.00	18	0.028	1.012	0.872
19	11	1.012	0.028	11.00 TO 12.00	20	0.028	1.040	0.897
20	12	1.040	0.028	12.00 TO 14.00	21	0.020	1.060	0.914
21	14	1.060	0.020	14.00 TO 16.00	22	0.020	1.080	0.931
22	16	1.080	0.020	16.00 TO 18.00	23	0.020	1.100	0.948
23	18	1.100	0.020	18.00 TO 20.00	24	0.020	1.120	0.966
24	20	1.120	0.020	20.00 TO 22.00	25	0.020	1.140	0.983
25	22	1.140	0.020	22.00 TO 24.00	26	0.020	1.160	1.000
26	24	1.160	0.020					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitation Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170° N Longitude 107.9810° W

NOAA 14 Depth Duration Frequency Data [HISTORIC] [1]:

DURATION	[hours]	[inches] [3]
0	*0*	0
5-min	0.0833	*0.706*
10-min	0.1667	*1.070*
15-min	*0.2500*	*1.330*
30-min	*0.5000*	*1.790*
	0.7500	2.005
1-hr	*1.0000*	*2.220*
	1.2500	2.290
	1.5000	2.360
	1.7500	2.430
2-hr	*2.0000*	*2.500*
	2.5000	2.505
3-hr	*3.0000*	*2.510*
	3.5000	2.540
	4.0000	2.570
	5.0000	2.630
6-hr	*6.0000*	*2.690*
	7.0000	2.702
	8.0000	2.713
	9.0000	2.725
	10.0000	2.737
	11.0000	2.748
12-hr	*12.0000*	*2.760*
	14.0000	2.858
	16.0000	2.957
	18.0000	3.055
	20.0000	3.153
	22.0000	3.252
24-hr	*24.0000*	*3.350*

Modified NOAA-SCS Rainfall Distribution [2]:

n	TIME [hours]	CUMULATIVE DEPTH [inches]	INCREMENTAL DEPTH [inches]	HYETOGRAPH TIME PERIOD (hrs)	n (REARRANGED)	INCREMENTAL DEPTH [inches]	CUMULATIVE DEPTH [inches]	CUMULATIVE DEPTH [%]
0	0	0.000		0.00 TO 1.00	19	0.012	0.012	0.003
1	0.25	1.330	1.330	1.00 TO 2.00	17	0.012	0.023	0.007
2	0.5	1.790	0.460	2.00 TO 3.00	15	0.012	0.035	0.010
3	0.75	2.005	0.215	3.00 TO 4.00	13	0.060	0.095	0.028
4	1	2.220	0.215	4.00 TO 4.50	11	0.030	0.125	0.037
5	1.25	2.290	0.070	4.50 TO 5.00	9	0.005	0.130	0.039
6	1.5	2.360	0.070	5.00 TO 5.25	7	0.070	0.200	0.060
7	1.75	2.430	0.070	5.25 TO 5.50	5	0.070	0.270	0.081
8	2	2.500	0.070	5.50 TO 5.75	3	0.215	0.485	0.145
9	2.5	2.505	0.005	5.75 TO 6.00	1	1.330	1.815	0.542
10	3	2.510	0.005	6.00 TO 6.25	2	0.460	2.275	0.679
11	3.5	2.540	0.030	6.25 TO 6.50	4	0.215	2.490	0.743
12	4	2.570	0.030	6.50 TO 6.75	6	0.070	2.560	0.764
13	5	2.630	0.060	6.75 TO 7.00	8	0.070	2.630	0.785
14	6	2.690	0.060	7.00 TO 7.50	10	0.005	2.635	0.787
15	7	2.702	0.012	7.50 TO 8.00	12	0.030	2.665	0.796
16	8	2.713	0.012	8.00 TO 9.00	14	0.060	2.725	0.813
17	9	2.725	0.012	9.00 TO 10.00	16	0.012	2.737	0.817
18	10	2.737	0.012	10.00 TO 11.00	18	0.012	2.748	0.820
19	11	2.748	0.012	11.00 TO 12.00	20	0.012	2.760	0.824
20	12	2.760	0.012	12.00 TO 14.00	21	0.098	2.858	0.853
21	14	2.858	0.098	14.00 TO 16.00	22	0.098	2.957	0.883
22	16	2.957	0.098	16.00 TO 18.00	23	0.098	3.055	0.912
23	18	3.055	0.098	18.00 TO 20.00	24	0.098	3.153	0.941
24	20	3.153	0.098	20.00 TO 22.00	25	0.098	3.252	0.971
25	22	3.252	0.098	22.00 TO 24.00	26	0.098	3.350	1.000
26	24	3.350	0.098					

Notes:

1. Precipitation depth, duration, frequency data based on NOAA Atlas 14 Online Precipitaiton Data Frequency Server.
2. Modified NOAA-SCS rainfall distribution developed based on procedures prescribed by New Mexico State Highway and Transportation Department's *Drainage Manual, Volume I*, 1995.
3. Rainfall data based on Blanco Arroyo watershed centroid located at Latitude 36.8170 ° N Longitude 107.9810° W

Appendix C – Hydraulic Calculation – HEC-RAS

AECOM	Calculation Sheet				
Project Name:	Blanco Arroyo			**Calculation Number:**	2B
Client Name:	City of Aztec, New Mexico			**Revision Number:**	0
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	PDC / 4-19-2016
	60487201	20000	N/A		
Title:	Riverine Analysis using HECRAS				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the HEC-RAS analysis prepared by AECOM for the watershed draining toward the Blanco Arroyo.

DATA /ASSUMPTIONS:

- The flow change locations were obtained from the HEC-HMS model developed to simulate the existing hydrologic conditions for the Blanco Arroyo. The flow change locations were selected at junction L, K, F, and E.
- Aerial survey and topography data was provided by the City of Aztec. The data was processed to remove the buildings and other features to reflect the bare earth topo.
- The HEC-RAS analysis was done in horizontal projection – NM State Plane West NAD 83, feet.
- The water elevations were computed as if the main channel were containing all flows. Any overtopping flows were blocked using an ineffective area.
- It was assumed that all culverts and bridges are free of blockage or debris.

Variable

Manning N values: Selection of Manning N values were based on field observation. The Manning N value for "clean, straight, full, no rifts or deep pools, but more stone and weeds", 0.035, was selected for the main channel. At some locations, the Manning N value for "Clean, winding, some pools and shoals, but some week and stones", 0.045, was selected for the main channel.

For the overbank, the Manning N of "scattered brush, heavy weeds", 0.05, was used for the overbank area.

METHODOLGY:

- The USACE HEC-GeoRAS extensions for ArcGIS were used to create the spatial data used for hydraulic.
- The USACE HEC-RAS program, version 4.1.0, was utilized to determine the water surface elevation.
- Flow change locations were obtained from the HEC-HMS model developed to simulate the existing hydrologic conditions for the Blanco Arroyo. The flow change locations were selected at junction L, K, F, and E.
- Aerial survey and topography data was provided by the City of Aztec. The data was processed to remove the buildings and other features to reflect the bare earth topo.
- The HEC-RAS analysis was done in horizontal projection – NM State Plane West NAD 83, feet.
- The water elevations were computed as if the main channel were containing all flow frequencies. Any overtopping flow frequencies were blocked using ineffective area.
- Hydraulic model is provided with this report in digital format.

INPUT:

- Hydraulic Baseline – Stream centerline was generated in ArcGIS. It was delineated using the aerial and topography data provided by the City of Aztec. The stream centerline generally followed the invert of the contours and main channel.
- Cross Section geometry – Cross sections were generated in ArcGIS. Cross sections were placed at approximately 500 feet interval and at upstream and downstream of the hydraulic baseline. Additional cross sections were placed to account for significant profile inflection points and other drop structures to account for their effects on flow. Two cross sections were placed up and down stream of structures to account for flow contraction and expansion.
- Manning's N value - Selection of Manning N values were based on field observation. The Manning N value for "clean, straight, full, no rifts or deep pools, but more stone and weeds", 0.035, was selected for the main channel. At some locations, the Manning N value for "Clean, winding, some pools and shoals, but some week and stones", 0.045, was selected for the main channel. For the overbank, the Manning N of "scattered brush, heavy weeds", 0.05, was used for the overbank area.

- Culverts and Bridges – Structure dimensions were obtained during field observation. All structures were assumed free of blockage or debris.
- Obstruction – Obstruction such as buildings were modeled as ineffective flow and/or adding blockage. In case where water elevation is below the obstruction lowest elevation, the obstruction has no effect on the water elevation and obstruction was not included.

RESULTS:

- 1-percent and 4-percent-annual-chance water elevation was computed using HEC-RAS. According to the model, the 25 year flow is contained below the channel bank between Zia Street to upstream limit study and Main Street to US 550. Between Main Street and Zia Street, there are some locations where the 25 year flow is overtopping the channel bank. For example, at just upstream of Rio Grande Ave, upstream of Lover Ave, upstream of Main Ave, where the 25 year flow is overtopping the channel bank. This could be the result of existing culverts is undersize and main channel don't have enough depth to convey flow.
- For 100 year flood event, Blanco Arroyo existing condition doesn't have enough capacity to convey the 100 year flood. Channel improvement and maintain maybe required for Blanco Arroyo. For detail information on the result, please see digital submittal of the HEC-RAS model.

HEC-RAS RESULTS

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	7212.316	2 yr	37.80	5740.48	5741.02	5741.02	5741.21	0.020917	3.73	12.02	32.56	0.96
1	7212.316	10 yr	136.10	5740.48	5741.54	5741.54	5741.92	0.017288	5.55	30.87	39.26	0.98
1	7212.316	25 yr	228.70	5740.48	5741.81	5741.81	5742.40	0.019535	6.97	42.26	49.14	1.09
1	7212.316	50 yr	320.10	5740.48	5742.24	5742.24	5742.82	0.013808	7.09	63.23	71.01	0.96
1	7212.316	100 yr	425.80	5740.48	5742.48	5742.48	5743.16	0.014159	7.85	78.41	93.35	0.99
1	6998.354	2 yr	37.80	5734.72	5735.59	5735.59	5735.86	0.023460	4.23	8.94	16.85	1.02
1	6998.354	10 yr	136.10	5734.72	5736.32	5736.32	5736.87	0.018177	5.93	22.96	21.34	1.01
1	6998.354	25 yr	228.70	5734.72	5736.78	5736.78	5737.52	0.015890	6.92	33.46	24.62	0.99
1	6998.354	50 yr	320.10	5734.72	5737.18	5737.18	5738.06	0.013886	7.57	43.94	27.69	0.97
1	6998.354	100 yr	425.80	5734.72	5737.57	5737.57	5738.60	0.012809	8.23	55.22	29.94	0.96
1	6799.955	2 yr	37.80	5730.20	5730.87	5730.87	5731.10	0.022559	3.90	9.70	107.57	0.99
1	6799.955	10 yr	136.10	5730.20	5731.49	5731.49	5731.99	0.018111	5.63	24.36	123.43	1.00
1	6799.955	25 yr	228.70	5730.20	5731.93	5731.93	5732.58	0.014604	6.47	36.63	138.84	0.95
1	6799.955	50 yr	320.10	5730.20	5732.29	5732.29	5733.06	0.013349	7.16	47.55	148.40	0.95
1	6799.955	100 yr	425.80	5730.20	5732.64	5732.64	5733.55	0.012379	7.80	59.85	155.00	0.94
1	6599.414	2 yr	37.80	5724.99	5726.10	5726.03	5726.38	0.018222	4.24	8.91	148.94	0.92
1	6599.414	10 yr	136.10	5724.99	5726.87	5726.87	5727.40	0.015131	5.92	24.22	213.47	0.94
1	6599.414	25 yr	228.70	5724.99	5727.35	5727.35	5728.06	0.013228	6.90	36.59	272.08	0.93
1	6599.414	50 yr	320.10	5724.99	5727.73	5727.73	5728.59	0.012729	7.72	47.27	399.31	0.94
1	6599.414	100 yr	425.80	5724.99	5728.15	5728.15	5729.12	0.011484	8.28	60.52	445.23	0.92
1	6398.558	2 yr	37.80	5721.11	5722.12	5722.12	5722.44	0.021173	4.53	8.39	257.64	1.00
1	6398.558	10 yr	136.10	5721.11	5722.98	5722.98	5723.63	0.014310	6.59	22.48	309.24	0.95
1	6398.558	25 yr	228.70	5721.11	5723.55	5723.55	5724.42	0.012902	7.76	33.45	333.63	0.95
1	6398.558	50 yr	320.10	5721.11	5724.03	5724.03	5725.06	0.011899	8.56	43.72	344.90	0.95
1	6398.558	100 yr	425.80	5721.11	5724.50	5724.50	5725.71	0.011289	9.35	54.78	354.64	0.95
1	6201.438	2 yr	37.80	5716.68	5717.43	5717.43	5717.70	0.020907	4.14	9.13	189.43	0.97
1	6201.438	10 yr	136.10	5716.68	5718.18	5718.18	5718.76	0.016182	6.14	22.40	263.19	0.97
1	6201.438	25 yr	228.70	5716.68	5718.68	5718.68	5719.49	0.014225	7.23	32.75	284.80	0.96
1	6201.438	50 yr	320.10	5716.68	5719.12	5719.12	5720.09	0.012913	8.00	42.45	291.05	0.95
1	6201.438	100 yr	425.80	5716.68	5719.55	5719.55	5720.70	0.012210	8.76	52.58	298.09	0.96
1	6000.676	2 yr	37.80	5711.17	5712.16	5712.16	5712.47	0.020774	4.51	8.38	13.00	0.99
1	6000.676	10 yr	136.10	5711.17	5713.02	5713.02	5713.63	0.016228	6.29	21.75	37.19	0.98
1	6000.676	25 yr	228.70	5711.17	5713.55	5713.55	5714.39	0.014166	7.40	32.31	118.18	0.97
1	6000.676	50 yr	320.10	5711.17	5714.07	5714.07	5714.98	0.011303	7.82	45.16	160.81	0.90
1	6000.676	100 yr	425.80	5711.17	5714.50	5714.50	5715.55	0.010729	8.52	56.64	208.19	0.90
1	5800.992	2 yr	37.80	5706.79	5707.85	5707.85	5708.23	0.021238	4.93	7.67	10.44	1.01
1	5800.992	10 yr	136.10	5706.79	5708.83	5708.83	5709.53	0.016033	6.70	20.51	147.22	0.98
1	5800.992	25 yr	228.70	5706.79	5709.45	5709.45	5710.37	0.013444	7.78	30.87	184.41	0.95
1	5800.992	50 yr	320.10	5706.79	5709.98	5709.98	5711.06	0.011890	8.51	40.97	219.28	0.93
1	5800.992	100 yr	425.80	5706.79	5710.49	5710.49	5711.74	0.011054	9.24	51.94	251.85	0.92
1	5727.393	2 yr	37.80	5705.17	5706.22	5706.22	5706.54	0.021318	4.57	8.28	12.88	1.00
1	5727.393	10 yr	136.10	5705.17	5707.10	5707.10	5707.68	0.017243	6.11	22.28	43.36	0.99
1	5727.393	25 yr	228.70	5705.17	5707.78	5707.78	5708.16	0.008044	5.29	62.00	175.12	0.72
1	5727.393	50 yr	320.10	5705.17	5708.00	5708.00	5708.43	0.008633	5.94	82.13	192.74	0.76
1	5727.393	100 yr	425.80	5705.17	5708.25	5708.25	5708.69	0.008137	6.26	110.20	231.71	0.75
1	5696.405	2 yr	37.80	5703.45	5705.72	5704.42	5705.77	0.000985	1.81	21.35	14.21	0.24
1	5696.405	10 yr	136.10	5703.45	5706.49	5705.59	5706.71	0.003047	4.04	48.86	123.00	0.45
1	5696.405	25 yr	228.70	5703.45	5706.63	5706.63	5707.11	0.006323	6.04	59.26	144.78	0.65
1	5696.405	50 yr	320.10	5703.45	5706.91	5706.91	5707.44	0.006899	6.74	83.05	173.68	0.70
1	5696.405	100 yr	425.80	5703.45	5707.26	5707.26	5707.72	0.005954	6.75	122.48	213.86	0.66
1	5685.063		Culvert									
1	5667.532	2 yr	37.80	5702.50	5703.36	5703.36	5703.67	0.020550	4.41	8.57	13.67	0.98
1	5667.532	10 yr	136.10	5702.50	5704.20	5704.20	5704.80	0.015964	6.22	22.11	18.30	0.97
1	5667.532	25 yr	228.70	5702.50	5704.73	5704.73	5705.55	0.014005	7.31	32.45	20.87	0.96
1	5667.532	50 yr	320.10	5702.50	5705.18	5705.18	5706.17	0.012630	8.06	42.36	23.07	0.95
1	5667.532	100 yr	425.80	5702.50	5705.62	5705.62	5706.78	0.012019	8.84	53.11	54.63	0.95
1	5654.907	2 yr	37.80	5701.13	5702.27	5702.27	5702.60	0.019719	4.65	8.13	11.51	0.97
1	5654.907	10 yr	136.10	5701.13	5703.19	5703.19	5703.81	0.017172	6.30	21.61	17.69	1.00
1	5654.907	25 yr	228.70	5701.13	5703.76	5703.76	5704.54	0.014829	7.08	32.86	21.55	0.97
1	5654.907	50 yr	320.10	5701.13	5704.19	5704.19	5705.12	0.013453	7.79	42.69	24.67	0.96
1	5654.907	100 yr	425.80	5701.13	5704.63	5704.63	5705.70	0.012047	8.39	54.35	27.99	0.94
1	5600.756	2 yr	37.80	5699.65	5700.85	5700.77	5701.13	0.014617	4.23	8.93	11.53	0.85
1	5600.756	10 yr	136.10	5699.65	5701.71	5701.71	5702.42	0.017652	6.75	20.16	14.55	1.01

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (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)	
1	5600.756	25 yr	228.70	5699.65	5702.35	5702.35	5703.24	0.015880	7.56	30.24	16.80	0.99
1	5600.756	50 yr	320.10	5699.65	5702.87	5702.87	5703.90	0.014905	8.14	39.31	18.61	0.98
1	5600.756	100 yr	425.80	5699.65	5703.31	5703.31	5704.55	0.014065	8.97	47.89	20.50	0.99
1	5401.768	2 yr	37.80	5696.03	5697.06	5697.06	5697.49	0.023413	5.26	7.19	9.43	1.06
1	5401.768	10 yr	136.10	5696.03	5698.14	5698.14	5698.86	0.017577	6.79	20.04	14.20	1.01
1	5401.768	25 yr	228.70	5696.03	5698.81	5698.81	5699.69	0.015608	7.53	30.36	16.80	0.98
1	5401.768	50 yr	320.10	5696.03	5699.26	5699.26	5700.36	0.014408	8.41	38.42	18.60	0.98
1	5401.768	100 yr	425.80	5696.03	5699.76	5699.76	5701.04	0.013099	9.14	47.93	99.40	0.97
1	5274.147	2 yr	37.80	5692.72	5693.43	5693.43	5693.69	0.023294	4.03	9.38	18.99	1.01
1	5274.147	10 yr	136.10	5692.72	5694.10	5694.10	5694.63	0.018319	5.82	23.38	22.52	1.01
1	5274.147	25 yr	228.70	5692.72	5694.96	5694.57	5695.37	0.007522	5.16	44.34	26.32	0.70
1	5274.147	50 yr	320.10	5692.72	5696.24	5694.95	5696.49	0.002223	4.07	81.87	32.92	0.42
1	5274.147	100 yr	425.80	5692.72	5696.93	5695.29	5697.21	0.001916	4.34	105.99	98.90	0.40
1	5175.087	2 yr	46.00	5688.82	5690.35	5690.20	5690.74	0.013660	5.03	9.14	7.85	0.82
1	5175.087	10 yr	166.10	5688.82	5692.92	5691.64	5693.23	0.003973	4.44	37.42	14.63	0.49
1	5175.087	25 yr	273.80	5688.82	5694.74	5692.49	5694.97	0.002193	3.85	71.17	35.69	0.38
1	5175.087	50 yr	378.30	5688.82	5696.12	5693.18	5696.32	0.001267	3.58	110.06	232.27	0.31
1	5175.087	100 yr	500.60	5688.82	5696.81	5693.85	5697.05	0.001270	3.96	137.91	279.57	0.32
1	5152.932	2 yr	46.00	5687.86	5690.40	5689.15	5690.50	0.001925	2.50	18.37	9.49	0.32
1	5152.932	10 yr	166.10	5687.86	5692.93	5690.64	5693.10	0.001765	3.38	49.41	16.35	0.33
1	5152.932	25 yr	273.80	5687.86	5694.73	5691.50	5694.91	0.001050	3.49	84.89	22.99	0.27
1	5152.932	50 yr	378.30	5687.86	5696.10	5692.29	5696.29	0.000834	3.64	120.53	144.37	0.25
1	5152.932	100 yr	500.60	5687.86	5696.75	5692.95	5697.01	0.001018	4.29	141.86	246.23	0.28
1	5131.43		Culvert									
1	5109.828	2 yr	46.00	5687.86	5689.63	5689.31	5689.97	0.017655	4.75	9.69	6.87	0.70
1	5109.828	10 yr	166.10	5687.86	5691.25	5690.91	5692.06	0.022085	7.25	22.91	9.42	0.82
1	5109.828	25 yr	273.80	5687.86	5691.97	5691.88	5693.25	0.029120	9.10	30.09	10.63	0.95
1	5109.828	50 yr	378.30	5687.86	5692.67	5692.67	5694.19	0.029026	9.89	38.38	13.20	0.98
1	5109.828	100 yr	500.60	5687.86	5693.45	5693.45	5695.10	0.023899	10.38	50.05	16.99	0.92
1	5091.725	2 yr	46.00	5687.38	5689.43	5688.87	5689.67	0.010981	3.97	11.59	7.76	0.57
1	5091.725	10 yr	166.10	5687.38	5691.02	5690.42	5691.63	0.015420	6.25	26.56	11.17	0.71
1	5091.725	25 yr	273.80	5687.38	5691.65	5691.40	5692.64	0.022651	8.00	34.24	13.50	0.88
1	5091.725	50 yr	378.30	5687.38	5692.10	5692.05	5693.45	0.025280	9.33	40.85	15.66	0.96
1	5091.725	100 yr	500.60	5687.38	5692.76	5692.76	5694.28	0.021951	9.95	52.26	18.91	0.92
1	4999.632	2 yr	46.00	5686.42	5688.31	5687.96	5688.55	0.013522	3.96	11.61	10.27	0.66
1	4999.632	10 yr	166.10	5686.42	5689.57	5689.26	5690.09	0.017430	5.77	28.76	42.65	0.80
1	4999.632	25 yr	273.80	5686.42	5690.33	5689.89	5690.96	0.013394	6.39	43.78	114.01	0.74
1	4999.632	50 yr	378.30	5686.42	5690.74	5690.43	5691.57	0.014432	7.39	53.50	138.84	0.79
1	4999.632	100 yr	500.60	5686.42	5691.17	5690.95	5692.20	0.014882	8.28	64.93	174.95	0.82
1	4799.344	2 yr	46.00	5683.67	5685.23	5685.05	5685.47	0.017564	3.97	11.60	79.92	0.74
1	4799.344	10 yr	166.10	5683.67	5686.44	5686.10	5686.87	0.014620	5.30	31.37	174.75	0.74
1	4799.344	25 yr	273.80	5683.67	5686.76	5686.70	5687.57	0.021806	7.24	38.19	192.97	0.93
1	4799.344	50 yr	378.30	5683.67	5687.20	5687.20	5688.17	0.020156	8.00	49.05	296.73	0.92
1	4799.344	100 yr	500.60	5683.67	5687.60	5687.60	5688.78	0.019763	8.82	59.80	307.77	0.94
1	4601.492	2 yr	46.00	5679.42	5681.18	5681.04	5681.51	0.022835	4.66	9.87	10.31	0.84
1	4601.492	10 yr	166.10	5679.42	5682.28	5682.28	5683.00	0.027198	6.80	24.44	67.88	0.98
1	4601.492	25 yr	273.80	5679.42	5683.07	5683.07	5683.75	0.016873	6.74	45.53	113.83	0.82
1	4601.492	50 yr	378.30	5679.42	5683.50	5683.50	5684.20	0.014748	7.12	64.01	196.13	0.79
1	4601.492	100 yr	500.60	5679.42	5683.84	5683.84	5684.62	0.014630	7.72	80.38	211.74	0.80
1	4491.537	2 yr	46.00	5676.81	5678.04	5678.04	5678.49	0.033309	5.43	8.47	9.30	1.00
1	4491.537	10 yr	166.10	5676.81	5680.06	5679.21	5680.18	0.003525	2.78	62.33	172.85	0.37
1	4491.537	25 yr	273.80	5676.81	5681.39	5679.62	5681.43	0.000778	1.90	198.16	275.27	0.19
1	4491.537	50 yr	378.30	5676.81	5681.95	5679.92	5681.99	0.000604	1.88	284.21	287.40	0.17
1	4491.537	100 yr	500.60	5676.81	5682.51	5680.45	5682.55	0.000520	1.91	381.19	332.99	0.16
1	4418.065	2 yr	58.20	5673.00	5676.29	5674.73	5676.44	0.004305	3.04	19.12	36.45	0.34
1	4418.065	10 yr	194.40	5673.00	5679.72	5676.53	5679.91	0.003173	3.55	54.94	102.54	0.32
1	4418.065	25 yr	313.40	5673.00	5681.04	5677.68	5681.27	0.002739	4.00	88.62	153.04	0.31
1	4418.065	50 yr	426.70	5673.00	5681.51	5678.65	5681.82	0.003363	4.70	109.41	221.22	0.35
1	4418.065	100 yr	562.10	5673.00	5682.00	5679.50	5682.36	0.003770	5.25	132.10	233.92	0.37
1	4350.82		Culvert									
1	4289.16	2 yr	58.20	5671.00	5672.40	5672.35	5672.95	0.030803	5.95	9.78	29.53	0.93
1	4289.16	10 yr	194.40	5671.00	5673.87	5673.87	5675.00	0.032011	8.53	22.80	41.57	1.00

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (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)	
1	4289.16	25 yr	313.40	5671.00	5674.81	5674.81	5676.21	0.030453	9.50	32.98	45.38	0.99
1	4289.16	50 yr	426.70	5671.00	5675.49	5675.49	5677.16	0.030928	10.35	41.22	48.52	1.01
1	4289.16	100 yr	562.10	5671.00	5676.25	5676.25	5678.12	0.028173	10.99	51.29	56.66	0.99
1	4235.386	2 yr	58.20	5669.67	5670.98	5670.90	5671.36	0.025858	4.94	11.77	12.45	0.90
1	4235.386	10 yr	194.40	5669.67	5673.43	5672.03	5673.66	0.004276	3.81	50.99	19.54	0.42
1	4235.386	25 yr	313.40	5669.67	5674.20	5672.73	5674.54	0.004692	4.71	67.98	29.89	0.45
1	4235.386	50 yr	426.70	5669.67	5674.70	5673.28	5675.16	0.005315	5.50	81.38	40.04	0.49
1	4235.386	100 yr	562.10	5669.67	5675.29	5673.83	5675.85	0.005465	6.13	99.30	57.68	0.51
1	4204.899	2 yr	58.20	5668.06	5669.92	5669.92	5670.45	0.031230	5.81	10.01	9.19	0.98
1	4204.899	10 yr	194.40	5668.06	5673.37	5671.25	5673.54	0.002056	3.30	62.13	67.51	0.30
1	4204.899	25 yr	313.40	5668.06	5674.13	5672.03	5674.40	0.002693	4.28	80.86	221.32	0.36
1	4204.899	50 yr	426.70	5668.06	5674.62	5672.58	5674.99	0.003332	5.10	94.88	228.96	0.40
1	4204.899	100 yr	562.10	5668.06	5675.20	5673.20	5675.67	0.003679	5.78	113.91	237.04	0.43
1	4179.083	2 yr	58.20	5666.50	5670.02	5668.19	5670.09	0.001968	2.21	26.34	11.31	0.26
1	4179.083	10 yr	194.40	5666.50	5673.37	5669.75	5673.46	0.001122	2.42	82.08	217.34	0.21
1	4179.083	25 yr	313.40	5666.50	5674.14	5670.66	5674.29	0.001485	3.13	111.45	253.19	0.25
1	4179.083	50 yr	426.70	5666.50	5674.65	5671.39	5674.84	0.001802	3.68	131.88	253.19	0.28
1	4179.083	100 yr	562.10	5666.50	5675.25	5672.10	5675.49	0.001964	4.13	156.39	253.19	0.30
1	4145.684		Culvert									
1	4114.383	2 yr	58.20	5666.50	5669.34	5668.43	5669.52	0.006350	3.36	17.30	10.14	0.45
1	4114.383	10 yr	194.40	5666.50	5670.89	5669.98	5671.32	0.008721	5.30	37.13	16.09	0.57
1	4114.383	25 yr	313.40	5666.50	5671.58	5670.82	5672.26	0.010036	6.65	49.42	79.02	0.64
1	4114.383	50 yr	426.70	5666.50	5671.89	5671.45	5672.89	0.013458	8.16	57.50	113.51	0.75
1	4114.383	100 yr	562.10	5666.50	5672.69	5672.69	5673.46	0.009036	7.64	102.84	186.69	0.64
1	4060.151	2 yr	58.20	5666.16	5668.24	5668.24	5668.76	0.031444	5.77	10.09	9.40	0.98
1	4060.151	10 yr	194.40	5666.16	5669.59	5669.59	5670.43	0.027218	7.37	26.36	15.20	0.99
1	4060.151	25 yr	313.40	5666.16	5670.29	5670.29	5671.34	0.024384	8.22	38.38	19.23	0.97
1	4060.151	50 yr	426.70	5666.16	5670.96	5670.96	5672.04	0.017859	8.40	54.51	72.99	0.87
1	4060.151	100 yr	562.10	5666.16	5671.91	5671.91	5672.59	0.008885	7.16	109.30	218.72	0.64
1	3928.021	2 yr	58.20	5662.50	5666.11	5664.45	5666.19	0.002177	2.25	25.87	190.47	0.27
1	3928.021	10 yr	194.40	5662.50	5669.01	5665.98	5669.09	0.000917	2.48	93.61	295.97	0.20
1	3928.021	25 yr	313.40	5662.50	5669.64	5666.82	5669.78	0.001319	3.24	117.43	295.97	0.25
1	3928.021	50 yr	426.70	5662.50	5670.12	5667.47	5670.30	0.001639	3.83	135.43	295.97	0.28
1	3928.021	100 yr	562.10	5662.50	5670.62	5668.30	5670.86	0.001934	4.40	154.55	295.97	0.31
1	3909.918		Culvert									
1	3873.844	2 yr	58.20	5661.40	5663.47	5662.74	5663.61	0.005875	3.09	18.84	12.91	0.45
1	3873.844	10 yr	194.40	5661.40	5664.93	5663.98	5665.25	0.007883	4.59	42.38	49.87	0.56
1	3873.844	25 yr	313.40	5661.40	5665.53	5664.76	5666.03	0.009336	5.69	55.37	224.45	0.62
1	3873.844	50 yr	426.70	5661.40	5665.89	5665.29	5666.60	0.011073	6.76	64.53	246.33	0.70
1	3873.844	100 yr	562.10	5661.40	5666.11	5665.73	5667.15	0.014807	8.22	70.98	253.72	0.81
1	3799.485	2 yr	58.20	5660.70	5662.23	5662.23	5662.67	0.030949	5.38	10.83	11.66	0.98
1	3799.485	10 yr	194.40	5660.70	5663.35	5663.35	5664.18	0.022566	7.38	27.76	111.19	0.94
1	3799.485	25 yr	313.40	5660.70	5664.16	5664.16	5665.03	0.015749	7.81	46.68	178.40	0.84
1	3799.485	50 yr	426.70	5660.70	5664.66	5664.66	5665.60	0.014185	8.31	62.83	183.12	0.82
1	3799.485	100 yr	562.10	5660.70	5665.30	5665.30	5666.12	0.010604	8.10	96.05	209.81	0.73
1	3602.989	2 yr	58.20	5655.00	5657.22	5656.83	5657.49	0.013425	4.23	13.74	10.79	0.66
1	3602.989	10 yr	194.40	5655.00	5658.21	5658.18	5659.05	0.026590	7.37	26.38	14.96	0.98
1	3602.989	25 yr	313.40	5655.00	5659.01	5658.93	5659.97	0.022784	7.85	39.95	18.61	0.94
1	3602.989	50 yr	426.70	5655.00	5659.59	5659.46	5660.68	0.019072	8.40	51.82	36.73	0.89
1	3602.989	100 yr	562.10	5655.00	5660.56	5660.56	5661.13	0.008064	6.67	124.11	174.71	0.61
1	3459.833	2 yr	58.20	5651.75	5654.01	5654.01	5654.59	0.033259	6.10	9.55	8.02	0.98
1	3459.833	10 yr	194.40	5651.75	5656.47	5655.48	5656.89	0.008782	5.25	37.19	14.79	0.57
1	3459.833	25 yr	313.40	5651.75	5657.28	5656.33	5657.89	0.009197	6.33	52.18	28.54	0.60
1	3459.833	50 yr	426.70	5651.75	5657.59	5657.02	5658.48	0.012084	7.70	63.15	93.03	0.70
1	3459.833	100 yr	562.10	5651.75	5658.31	5658.31	5658.98	0.008327	7.19	114.54	208.15	0.60
1	3407.665	2 yr	58.20	5650.00	5653.22	5651.64	5653.32	0.002892	2.55	22.85	12.78	0.30
1	3407.665	10 yr	194.40	5650.00	5656.47	5653.25	5656.60	0.001349	2.95	69.88	114.47	0.24
1	3407.665	25 yr	313.40	5650.00	5657.27	5654.15	5657.51	0.002023	4.01	90.75	152.66	0.30
1	3407.665	50 yr	426.70	5650.00	5657.59	5654.85	5657.94	0.002888	4.96	110.16	186.99	0.36
1	3407.665	100 yr	562.10	5650.00	5657.83	5655.51	5658.33	0.004058	6.04	131.71	208.35	0.43
1	3381.484		Culvert									

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (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)	
1	3352.132	2 yr	58.20	5649.75	5651.79	5651.40	5652.15	0.016258	4.84	12.03	7.99	0.69
1	3352.132	10 yr	194.40	5649.75	5653.18	5652.99	5654.04	0.024096	7.43	26.15	12.29	0.90
1	3352.132	25 yr	313.40	5649.75	5653.92	5653.84	5655.09	0.026923	8.67	36.14	59.88	0.97
1	3352.132	50 yr	426.70	5649.75	5654.47	5654.47	5655.91	0.025319	9.61	44.69	79.98	0.98
1	3352.132	100 yr	562.10	5649.75	5655.13	5655.13	5656.78	0.022439	10.33	56.09	107.82	0.95
1	3305.642	2 yr	58.20	5649.31	5651.21	5650.83	5651.44	0.011805	3.89	14.96	12.40	0.62
1	3305.642	10 yr	194.40	5649.31	5652.70	5652.03	5653.12	0.010272	5.21	37.34	17.61	0.63
1	3305.642	25 yr	313.40	5649.31	5653.57	5652.75	5654.10	0.008964	5.83	54.35	54.81	0.61
1	3305.642	50 yr	426.70	5649.31	5653.44	5653.27	5654.52	0.019604	8.34	51.27	30.33	0.90
1	3305.642	100 yr	562.10	5649.31	5654.35	5654.35	5655.05	0.009775	7.17	103.78	146.20	0.67
1	3256.598	2 yr	58.20	5648.15	5649.97	5649.97	5650.51	0.032438	5.92	9.83	9.00	1.00
1	3256.598	10 yr	194.40	5648.15	5651.32	5651.32	5652.29	0.026816	7.92	24.67	12.94	0.98
1	3256.598	25 yr	313.40	5648.15	5652.12	5652.12	5653.37	0.022292	9.02	35.93	15.34	0.95
1	3256.598	50 yr	426.70	5648.15	5653.36	5653.36	5653.81	0.006478	6.21	116.64	244.96	0.54
1	3256.598	100 yr	562.10	5648.15	5653.58	5653.58	5654.07	0.007368	6.86	141.99	249.41	0.59
1	3217.323	2 yr	58.20	5646.00	5647.08	5646.66	5647.20	0.006864	2.77	21.01	20.42	0.47
1	3217.323	10 yr	194.40	5646.00	5648.43	5647.48	5648.69	0.005272	4.10	47.38	22.02	0.46
1	3217.323	25 yr	313.40	5646.00	5649.33	5648.02	5649.69	0.004737	4.81	65.16	23.69	0.46
1	3217.323	50 yr	426.70	5646.00	5650.10	5648.48	5650.54	0.004421	5.33	80.07	25.37	0.46
1	3217.323	100 yr	562.10	5646.00	5650.92	5648.98	5651.45	0.004155	5.84	96.24	27.26	0.46
1	3188.072		Culvert									
1	3155.442	2 yr	58.20	5645.00	5645.97	5645.65	5646.11	0.009218	3.09	18.86	20.35	0.55
1	3155.442	10 yr	194.40	5645.00	5647.42	5646.46	5647.69	0.004768	4.10	47.39	22.29	0.46
1	3155.442	25 yr	313.40	5645.00	5648.12	5647.00	5648.53	0.005363	5.14	60.93	23.25	0.51
1	3155.442	50 yr	426.70	5645.00	5648.41	5647.48	5649.05	0.007369	6.40	66.66	27.42	0.61
1	3155.442	100 yr	562.10	5645.00	5648.71	5647.98	5649.64	0.009694	7.76	72.43	40.19	0.71
1	3117.597	2 yr	58.20	5643.41	5645.68	5645.03	5645.82	0.006268	3.01	19.34	14.87	0.46
1	3117.597	10 yr	194.40	5643.41	5647.24	5646.20	5647.49	0.005376	4.02	48.48	22.47	0.47
1	3117.597	25 yr	313.40	5643.41	5647.93	5646.83	5648.30	0.005695	4.93	65.23	119.42	0.50
1	3117.597	50 yr	426.70	5643.41	5648.13	5647.30	5648.73	0.008354	6.25	70.77	136.31	0.62
1	3117.597	100 yr	562.10	5643.41	5648.31	5647.78	5649.23	0.012028	7.77	75.59	141.22	0.75
1	3049.969	2 yr	58.20	5642.56	5644.39	5644.39	5644.97	0.031960	6.09	9.56	8.01	0.98
1	3049.969	10 yr	194.40	5642.56	5645.91	5645.91	5646.73	0.027779	7.26	26.76	15.88	0.99
1	3049.969	25 yr	313.40	5642.56	5646.79	5646.62	5647.61	0.018799	7.30	43.97	118.92	0.86
1	3049.969	50 yr	426.70	5642.56	5647.71	5647.57	5648.15	0.007536	5.80	103.37	238.61	0.57
1	3049.969	100 yr	562.10	5642.56	5648.14	5647.92	5648.50	0.006015	5.64	151.78	301.07	0.52
1	3009.302	2 yr	58.20	5641.50	5643.49	5643.08	5643.76	0.012196	4.15	14.01	10.44	0.63
1	3009.302	10 yr	194.40	5641.50	5644.87	5644.45	5645.43	0.015683	6.02	32.28	16.69	0.76
1	3009.302	25 yr	313.40	5641.50	5647.11	5645.16	5647.14	0.000630	2.01	267.16	270.73	0.17
1	3009.302	50 yr	426.70	5641.50	5647.88	5646.19	5647.90	0.000359	1.70	404.35	310.35	0.13
1	3009.302	100 yr	562.10	5641.50	5648.26	5646.42	5648.29	0.000382	1.84	476.05	310.68	0.14
1	2994.969		Bridge									
1	2978.489	2 yr	58.20	5641.52	5642.90	5642.82	5643.28	0.026180	4.95	11.75	12.68	0.91
1	2978.489	10 yr	194.40	5641.52	5643.97	5643.92	5644.73	0.025812	6.99	27.79	33.00	0.97
1	2978.489	25 yr	313.40	5641.52	5644.59	5644.59	5645.57	0.025026	7.93	39.54	122.68	0.99
1	2978.489	50 yr	426.70	5641.52	5645.45	5645.24	5646.23	0.013069	7.25	64.75	242.97	0.76
1	2978.489	100 yr	562.10	5641.52	5647.00	5645.75	5647.33	0.003533	5.04	134.35	333.06	0.42
1	2919.028	2 yr	58.20	5639.21	5641.07	5641.07	5641.55	0.031106	5.54	10.51	10.68	0.98
1	2919.028	10 yr	194.40	5639.21	5642.29	5642.29	5643.14	0.026672	7.39	26.32	15.12	0.99
1	2919.028	25 yr	313.40	5639.21	5642.97	5642.97	5644.08	0.023395	8.46	37.54	49.39	0.97
1	2919.028	50 yr	426.70	5639.21	5645.34	5643.58	5645.67	0.003086	4.88	102.72	285.30	0.40
1	2919.028	100 yr	562.10	5639.21	5646.92	5644.25	5647.15	0.001561	4.21	171.49	312.18	0.30
1	2833.273	2 yr	58.20	5634.51	5637.67	5636.17	5637.80	0.003757	2.88	20.22	8.68	0.33
1	2833.273	10 yr	194.40	5634.51	5639.90	5637.89	5640.22	0.005552	4.50	43.16	11.90	0.42
1	2833.273	25 yr	313.40	5634.51	5642.61	5638.90	5642.84	0.002179	3.89	85.85	175.12	0.28
1	2833.273	50 yr	426.70	5634.51	5645.31	5639.63	5645.45	0.000883	3.18	157.66	275.24	0.19
1	2833.273	100 yr	562.10	5634.51	5646.88	5640.45	5647.01	0.000697	3.15	209.04	275.24	0.17
1	2793.439		Bridge									
1	2760.729	2 yr	58.20	5634.22	5637.10	5636.40	5637.35	0.009970	4.03	14.44	8.69	0.55
1	2760.729	10 yr	194.40	5634.22	5639.11	5638.04	5639.55	0.007841	5.31	37.37	14.46	0.54
1	2760.729	25 yr	313.40	5634.22	5640.29	5638.89	5640.82	0.006341	5.95	56.95	171.31	0.51
1	2760.729	50 yr	426.70	5634.22	5641.19	5639.56	5641.76	0.005557	6.33	79.46	277.34	0.49

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (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)	
1	2760.729	100 yr	562.10	5634.22	5641.87	5640.30	5642.49	0.005412	6.79	100.00	282.18	0.50
1	2714.347	2 yr	58.20	5633.98	5636.58	5635.85	5636.86	0.010868	4.26	13.66	7.53	0.56
1	2714.347	10 yr	194.40	5633.98	5638.05	5637.57	5638.88	0.020305	7.29	26.68	109.58	0.79
1	2714.347	25 yr	313.40	5633.98	5638.75	5638.60	5640.06	0.025906	9.20	34.34	174.48	0.91
1	2714.347	50 yr	426.70	5633.98	5639.44	5639.44	5641.00	0.023981	10.10	44.28	237.57	0.91
1	2714.347	100 yr	562.10	5633.98	5640.24	5640.24	5641.78	0.019573	10.34	61.87	272.83	0.85
1	2647.003	2 yr	58.20	5633.53	5635.14	5635.14	5635.67	0.031787	5.84	9.96	9.24	0.99
1	2647.003	10 yr	194.40	5633.53	5636.61	5636.48	5637.42	0.022917	7.23	26.90	13.76	0.91
1	2647.003	25 yr	313.40	5633.53	5637.36	5637.25	5638.42	0.020918	8.30	38.35	100.43	0.91
1	2647.003	50 yr	426.70	5633.53	5639.76	5637.90	5639.98	0.002278	4.24	130.21	212.14	0.33
1	2647.003	100 yr	562.10	5633.53	5640.10	5638.85	5640.39	0.002860	4.97	145.97	212.14	0.38
1	2616.683	2 yr	58.20	5632.00	5634.52	5633.86	5634.77	0.009887	4.01	14.51	8.86	0.55
1	2616.683	10 yr	194.40	5632.00	5636.29	5635.45	5636.75	0.012305	5.46	35.66	17.45	0.66
1	2616.683	25 yr	313.40	5632.00	5637.20	5636.39	5637.76	0.009366	6.05	53.99	102.55	0.61
1	2616.683	50 yr	426.70	5632.00	5639.77	5636.98	5639.88	0.001080	3.09	176.68	203.43	0.23
1	2616.683	100 yr	562.10	5632.00	5640.11	5637.54	5640.27	0.001407	3.66	194.85	203.43	0.26
1	2598.63		Bridge									
1	2581.06	2 yr	58.20	5631.88	5634.20	5633.56	5634.37	0.007154	3.32	17.54	53.63	0.49
1	2581.06	10 yr	194.40	5631.88	5635.58	5634.84	5635.97	0.009899	4.99	38.99	101.42	0.62
1	2581.06	25 yr	313.40	5631.88	5636.08	5635.57	5636.71	0.014086	6.36	49.31	120.36	0.75
1	2581.06	50 yr	426.70	5631.88	5636.31	5636.12	5637.26	0.019457	7.83	54.53	148.68	0.89
1	2581.06	100 yr	562.10	5631.88	5636.63	5636.63	5637.91	0.022226	9.09	62.24	161.58	0.97
1	2554.403	2 yr	59.60	5631.64	5633.76	5633.51	5634.06	0.016586	4.38	13.61	54.12	0.73
1	2554.403	10 yr	198.40	5631.64	5635.11	5634.72	5635.62	0.013900	5.73	34.68	137.60	0.73
1	2554.403	25 yr	319.60	5631.64	5635.76	5635.76	5636.35	0.011530	6.36	62.25	194.23	0.70
1	2554.403	50 yr	434.90	5631.64	5636.11	5636.11	5636.70	0.010920	6.73	87.01	198.54	0.70
1	2554.403	100 yr	572.60	5631.64	5636.39	5636.39	5637.04	0.011429	7.32	107.21	198.54	0.72
1	2481.861	2 yr	59.60	5629.97	5631.82	5631.82	5632.40	0.031830	6.11	9.75	8.14	0.98
1	2481.861	10 yr	198.40	5629.97	5633.32	5633.32	5634.22	0.026920	7.58	26.26	123.16	0.98
1	2481.861	25 yr	319.60	5629.97	5634.43	5634.43	5635.07	0.011512	6.76	60.14	262.25	0.69
1	2481.861	50 yr	434.90	5629.97	5634.79	5634.79	5635.49	0.011809	7.39	78.36	266.04	0.71
1	2481.861	100 yr	572.60	5629.97	5635.08	5635.08	5635.90	0.013105	8.23	94.02	269.53	0.76
1	2456.185	2 yr	59.60	5626.50	5627.65	5627.15	5627.75	0.004863	2.53	23.60	22.63	0.42
1	2456.185	10 yr	198.40	5626.50	5629.31	5627.90	5629.49	0.002730	3.44	57.75	24.70	0.36
1	2456.185	25 yr	319.60	5626.50	5630.29	5628.46	5630.55	0.002621	4.11	77.82	25.33	0.37
1	2456.185	50 yr	434.90	5626.50	5631.08	5628.89	5631.41	0.002570	4.62	94.17	48.51	0.38
1	2456.185	100 yr	572.60	5626.50	5632.20	5629.41	5632.57	0.002148	4.89	117.21	109.30	0.36
1	2407.112		Culvert									
1	2358.572	2 yr	59.60	5626.50	5627.52	5627.14	5627.65	0.007155	2.84	21.02	61.29	0.49
1	2358.572	10 yr	198.40	5626.50	5629.15	5627.93	5629.36	0.003311	3.64	54.51	100.42	0.39
1	2358.572	25 yr	319.60	5626.50	5630.05	5628.46	5630.35	0.003250	4.38	72.96	175.27	0.41
1	2358.572	50 yr	434.90	5626.50	5630.66	5628.89	5631.06	0.003562	5.09	85.39	221.67	0.44
1	2358.572	100 yr	572.60	5626.50	5631.26	5629.41	5631.79	0.003928	5.85	97.80	247.83	0.47
1	2332.792	2 yr	59.60	5625.12	5626.97	5626.71	5627.31	0.017045	4.69	12.71	79.08	0.74
1	2332.792	10 yr	198.40	5625.12	5628.22	5628.06	5629.00	0.022777	7.12	27.85	88.14	0.91
1	2332.792	25 yr	319.60	5625.12	5628.88	5628.87	5629.94	0.026456	8.25	38.74	135.81	1.00
1	2332.792	50 yr	434.90	5625.12	5629.44	5629.44	5630.63	0.023864	8.76	49.83	202.90	0.98
1	2332.792	100 yr	572.60	5625.12	5629.99	5629.99	5631.35	0.021009	9.39	62.53	236.87	0.95
1	2198.158	2 yr	59.60	5622.28	5623.82	5623.82	5624.25	0.031569	5.26	11.33	172.88	0.99
1	2198.158	10 yr	198.40	5622.28	5624.91	5624.91	5625.66	0.027068	6.95	28.55	182.53	1.00
1	2198.158	25 yr	319.60	5622.28	5625.58	5625.58	5626.42	0.024834	7.39	43.32	191.36	0.98
1	2198.158	50 yr	434.90	5622.28	5626.01	5626.01	5627.00	0.021841	8.01	55.25	196.62	0.96
1	2198.158	100 yr	572.60	5622.28	5626.33	5626.33	5627.61	0.023535	9.12	65.11	202.12	1.01
1	1998.638	2 yr	59.60	5615.65	5618.08	5617.79	5618.41	0.016427	4.57	13.03	131.21	0.72
1	1998.638	10 yr	198.40	5615.65	5619.13	5619.13	5620.02	0.027601	7.58	26.18	148.61	0.99
1	1998.638	25 yr	319.60	5615.65	5619.88	5619.88	5620.97	0.026223	8.39	38.08	155.70	1.00
1	1998.638	50 yr	434.90	5615.65	5620.42	5620.42	5621.71	0.023255	9.14	48.02	160.49	0.98
1	1998.638	100 yr	572.60	5615.65	5621.01	5621.01	5622.49	0.020678	9.81	60.04	166.26	0.95
1	1800.411	2 yr	59.60	5611.55	5613.40	5613.40	5613.93	0.032506	5.87	10.15	9.51	1.00
1	1800.411	10 yr	198.40	5611.55	5615.28	5614.73	5615.80	0.013003	5.79	34.24	130.78	0.70
1	1800.411	25 yr	319.60	5611.55	5616.18	5615.51	5616.81	0.012132	6.39	49.98	140.47	0.70
1	1800.411	50 yr	434.90	5611.55	5616.75	5616.08	5617.52	0.012921	7.08	61.39	145.91	0.73

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (Continued)

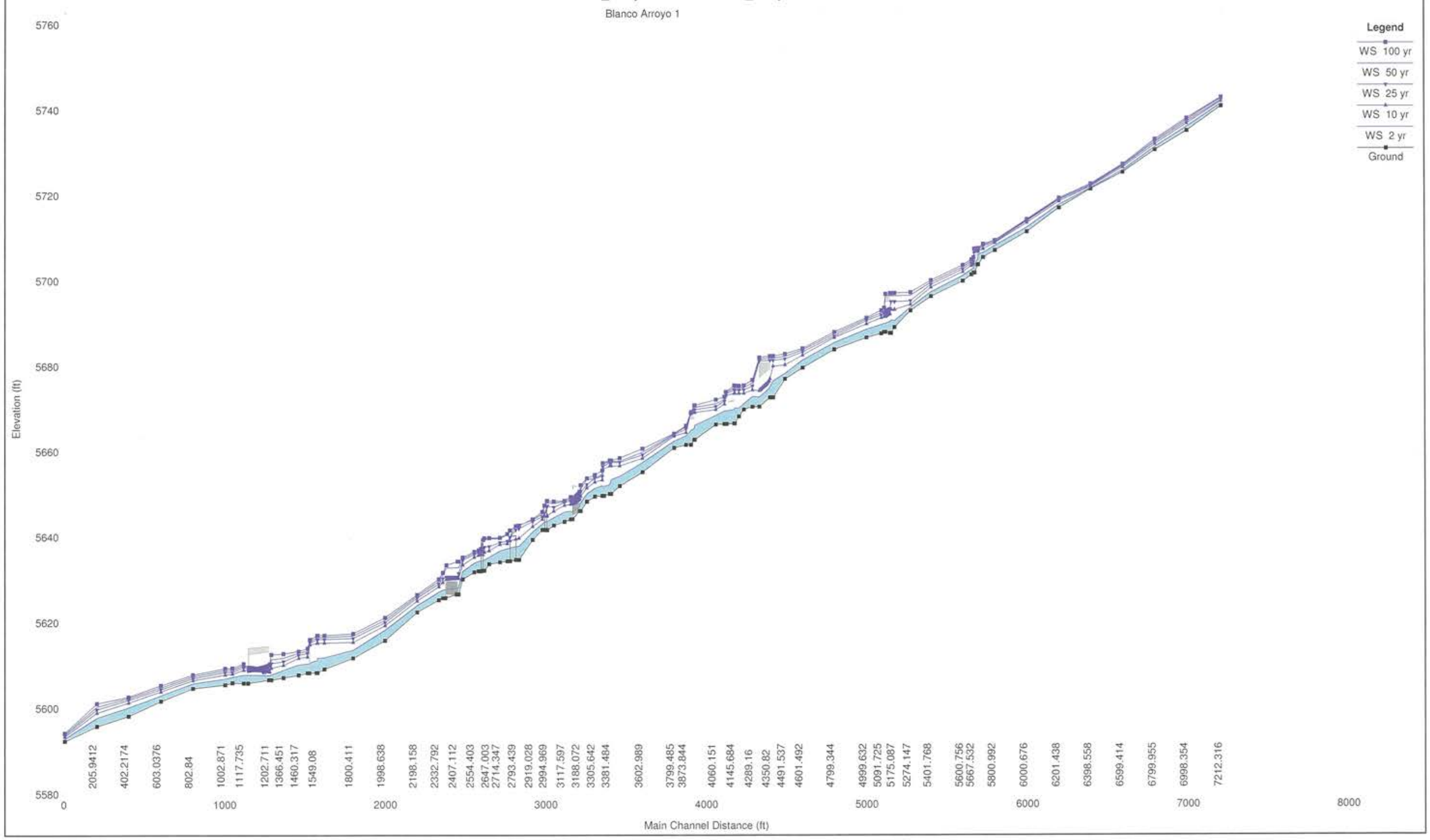
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1800.411	100 yr	572.60	5611.55	5617.25	5616.68	5618.22	0.013829	7.91	72.41	150.58	0.77
1	1620.907	2 yr	59.60	5609.02	5611.68	5610.63	5611.80	0.004058	2.82	21.13	12.02	0.37
1	1620.907	10 yr	198.40	5609.02	5615.12	5612.00	5615.22	0.001044	2.59	79.65	151.25	0.22
1	1620.907	25 yr	319.60	5609.02	5615.94	5612.82	5616.11	0.001421	3.38	104.79	172.03	0.26
1	1620.907	50 yr	434.90	5609.02	5616.43	5613.44	5616.67	0.001831	4.07	120.64	172.87	0.30
1	1620.907	100 yr	572.60	5609.02	5616.80	5614.01	5617.15	0.002484	4.95	135.54	185.69	0.35
1	1577.493	2 yr	59.60	5608.20	5611.63	5609.70	5611.68	0.001188	1.79	33.34	14.94	0.21
1	1577.493	10 yr	198.40	5608.20	5615.11	5611.06	5615.17	0.000476	1.95	111.58	192.30	0.15
1	1577.493	25 yr	319.60	5608.20	5615.93	5611.84	5616.03	0.000699	2.61	140.18	204.67	0.19
1	1577.493	50 yr	434.90	5608.20	5616.42	5612.43	5616.56	0.000921	3.16	165.52	219.06	0.22
1	1577.493	100 yr	572.60	5608.20	5616.81	5613.07	5617.00	0.001232	3.79	194.29	261.14	0.26
1	1549.08		Culvert									
1	1516.094	2 yr	59.60	5608.20	5610.24	5609.48	5610.35	0.004343	2.62	22.74	58.55	0.39
1	1516.094	10 yr	198.40	5608.20	5611.85	5610.55	5612.06	0.004173	3.62	54.80	136.48	0.42
1	1516.094	25 yr	319.60	5608.20	5612.67	5611.20	5612.95	0.004123	4.26	76.04	160.59	0.43
1	1516.094	50 yr	434.90	5608.20	5613.25	5611.70	5613.60	0.004138	4.79	96.23	180.83	0.44
1	1516.094	100 yr	572.60	5608.20	5613.85	5612.20	5614.25	0.003989	5.21	120.51	182.41	0.45
1	1460.317	2 yr	59.60	5607.60	5609.99	5609.14	5610.11	0.004258	2.70	22.06	168.56	0.39
1	1460.317	10 yr	198.40	5607.60	5611.52	5610.31	5611.78	0.005327	4.06	48.83	179.45	0.46
1	1460.317	25 yr	319.60	5607.60	5612.29	5610.99	5612.66	0.005701	4.87	65.79	185.05	0.50
1	1460.317	50 yr	434.90	5607.60	5612.76	5611.53	5613.27	0.006407	5.70	77.31	189.09	0.54
1	1460.317	100 yr	572.60	5607.60	5613.20	5612.10	5613.87	0.007387	6.63	89.53	196.72	0.59
1	1366.451	2 yr	59.60	5607.04	5608.75	5608.75	5609.22	0.031725	5.49	10.85	200.59	1.00
1	1366.451	10 yr	198.40	5607.04	5609.92	5609.92	5610.76	0.027161	7.37	26.92	208.30	1.00
1	1366.451	25 yr	319.60	5607.04	5610.71	5610.62	5611.67	0.021326	7.85	40.83	215.26	0.92
1	1366.451	50 yr	434.90	5607.04	5611.50	5611.28	5612.38	0.013633	7.66	62.48	238.68	0.78
1	1366.451	100 yr	572.60	5607.04	5612.67	5611.89	5613.21	0.005995	6.32	107.40	241.47	0.54
1	1290.539	2 yr	59.60	5606.50	5607.67	5607.30	5607.86	0.008995	3.48	17.12	75.87	0.57
1	1290.539	10 yr	198.40	5606.50	5609.15	5608.31	5609.56	0.006602	5.13	38.65	83.86	0.56
1	1290.539	25 yr	319.60	5606.50	5610.14	5608.97	5610.70	0.005942	6.02	53.10	92.29	0.56
1	1290.539	50 yr	434.90	5606.50	5610.97	5609.55	5611.66	0.005550	6.67	65.19	99.75	0.56
1	1290.539	100 yr	572.60	5606.50	5611.87	5610.13	5612.70	0.005218	7.31	78.33	169.51	0.56
1	1202.711		Culvert									
1	1117.735	2 yr	59.60	5605.80	5607.61	5606.60	5607.69	0.001275	2.25	26.46	16.49	0.29
1	1117.735	10 yr	198.40	5605.80	5608.64	5607.61	5609.00	0.003159	4.79	41.46	17.75	0.50
1	1117.735	25 yr	319.60	5605.80	5609.17	5608.27	5609.82	0.004655	6.50	49.13	19.32	0.62
1	1117.735	50 yr	434.90	5605.80	5609.40	5608.84	5610.46	0.006900	8.28	52.53	20.03	0.77
1	1117.735	100 yr	572.60	5605.80	5609.77	5609.43	5611.29	0.008622	9.88	57.94	21.14	0.87
1	1048.078	2 yr	59.60	5605.82	5607.09	5607.09	5607.40	0.018181	4.51	13.72	154.73	0.94
1	1048.078	10 yr	198.40	5605.82	5607.87	5607.87	5608.50	0.014901	6.57	32.48	161.32	0.96
1	1048.078	25 yr	319.60	5605.82	5608.32	5608.32	5609.22	0.014873	7.87	44.33	164.97	1.01
1	1048.078	50 yr	434.90	5605.82	5608.79	5608.79	5609.80	0.012730	8.43	57.22	168.65	0.97
1	1048.078	100 yr	572.60	5605.82	5609.20	5609.20	5610.42	0.012465	9.29	69.37	172.28	0.98
1	1002.871	2 yr	59.60	5605.37	5606.42	5606.34	5606.61	0.013151	3.50	17.81	156.99	0.79
1	1002.871	10 yr	198.40	5605.37	5607.07	5606.96	5607.47	0.011373	5.28	42.58	171.17	0.83
1	1002.871	25 yr	319.60	5605.37	5607.43	5607.34	5607.99	0.011886	6.37	57.82	173.42	0.88
1	1002.871	50 yr	434.90	5605.37	5607.75	5607.66	5608.43	0.011258	7.01	72.22	175.45	0.88
1	1002.871	100 yr	572.60	5605.37	5608.04	5607.88	5608.91	0.012192	7.98	85.49	182.73	0.94
1	802.84	2 yr	59.60	5601.99	5603.63	5603.63	5603.97	0.013148	5.03	16.19	464.40	0.81
1	802.84	10 yr	198.40	5601.99	5604.40	5604.40	5604.85	0.015252	6.62	45.63	503.09	0.91
1	802.84	25 yr	319.60	5601.99	5604.82	5604.82	5605.30	0.015094	7.17	69.85	520.91	0.93
1	802.84	50 yr	434.90	5601.99	5605.07	5605.07	5605.58	0.017890	7.38	87.46	533.88	1.01
1	802.84	100 yr	572.60	5601.99	5605.28	5605.28	5605.88	0.018221	8.06	103.67	536.35	1.04
1	603.0376	2 yr	59.60	5600.96	5601.79	5601.58	5601.82	0.005241	2.14	46.30	397.78	0.48
1	603.0376	10 yr	198.40	5600.96	5602.14	5601.86	5602.22	0.008532	3.12	88.50	434.59	0.64
1	603.0376	25 yr	319.60	5600.96	5602.44	5602.05	5602.54	0.007322	3.22	132.00	452.35	0.61
1	603.0376	50 yr	434.90	5600.96	5602.64	5602.17	5602.75	0.007572	3.48	162.32	465.39	0.63
1	603.0376	100 yr	572.60	5600.96	5602.88	5602.33	5603.01	0.006578	3.64	202.11	473.36	0.60
1	402.2174	2 yr	59.60	5598.06	5599.44	5599.44	5599.94	0.019474	5.68	10.49	10.55	1.00
1	402.2174	10 yr	198.40	5598.06	5600.54	5600.54	5600.74	0.006356	4.54	88.23	354.29	0.62
1	402.2174	25 yr	319.60	5598.06	5600.70	5600.70	5600.95	0.008354	5.50	122.33	371.53	0.72
1	402.2174	50 yr	434.90	5598.06	5600.84	5600.84	5601.11	0.008755	5.92	154.74	395.77	0.75

HEC-RAS Plan: Blanco_Arroyo River: Blanco Arroyo Reach: 1 (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)	
1	402.2174	100 yr	572.60	5598.06	5600.92	5600.92	5601.27	0.011654	7.00	171.88	408.43	0.87
1	205.9412	2 yr	59.60	5593.24	5593.74	5593.39	5593.75	0.002153	1.07	65.69	125.18	0.29
1	205.9412	10 yr	198.40	5593.24	5594.24	5593.62	5594.27	0.002634	1.76	129.32	133.33	0.34
1	205.9412	25 yr	319.60	5593.24	5594.54	5593.82	5594.59	0.002863	2.11	168.71	137.44	0.36
1	205.9412	50 yr	434.90	5593.24	5594.78	5593.92	5594.85	0.003021	2.37	200.50	140.79	0.38
1	205.9412	100 yr	572.60	5593.24	5595.03	5594.10	5595.13	0.003147	2.61	234.48	144.26	0.39
1	5.688278	2 yr	59.60	5592.21	5592.70	5592.69	5592.80	0.017428	3.29	30.50	120.73	0.86
1	5.688278	10 yr	198.40	5592.21	5593.00	5592.96	5593.17	0.017430	4.62	67.47	125.28	0.94
1	5.688278	25 yr	319.60	5592.21	5593.19	5593.11	5593.42	0.017421	5.36	91.03	125.98	0.98
1	5.688278	50 yr	434.90	5592.21	5593.34	5593.26	5593.63	0.017392	5.92	110.33	126.56	1.00
1	5.688278	100 yr	572.60	5592.21	5593.50	5593.40	5593.85	0.017427	6.50	130.77	127.16	1.02

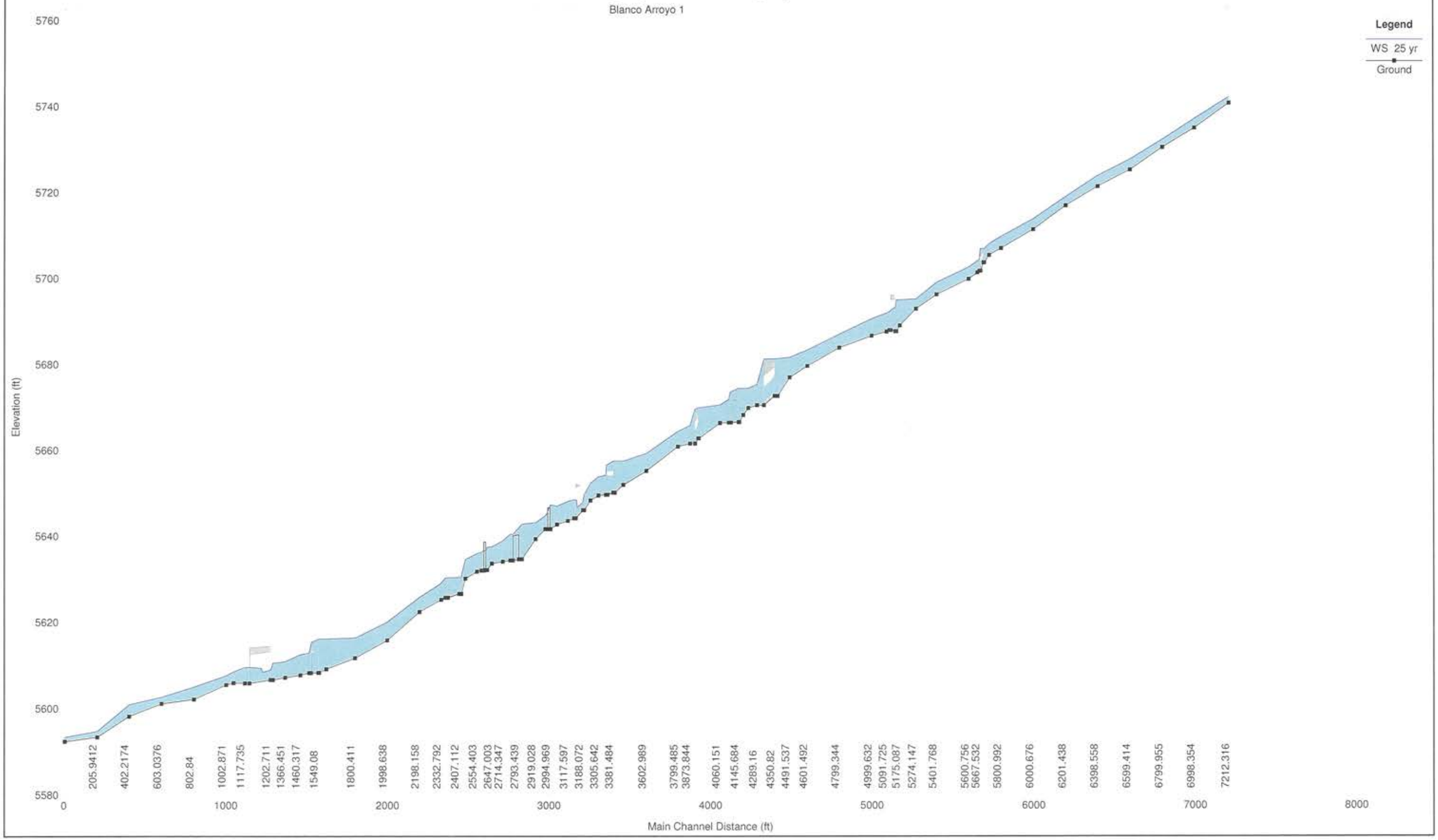
Blanco_Arroyo Plan: Blanco_Arroyo 4/26/2016

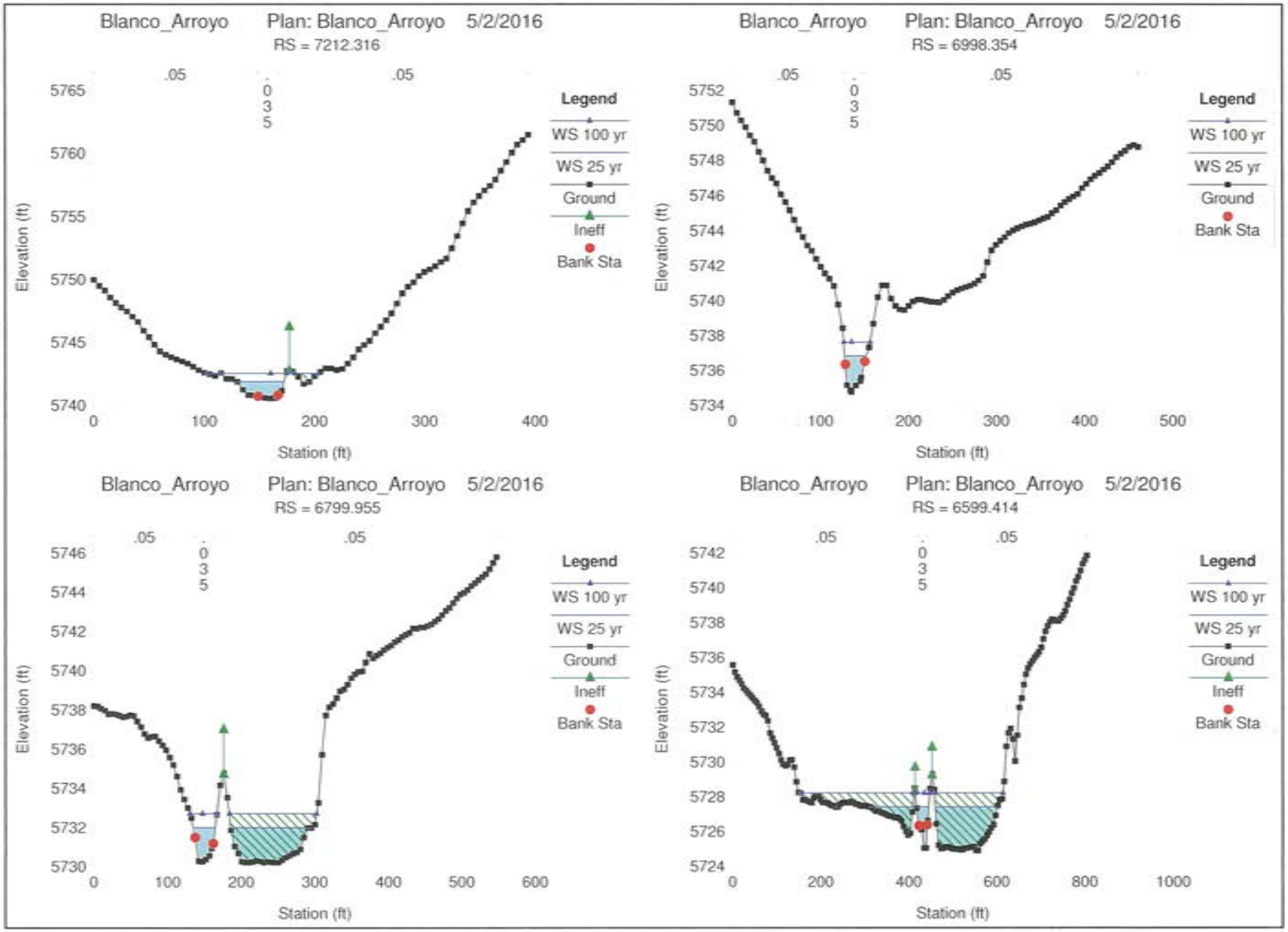
Blanco Arroyo 1



Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016

Blanco Arroyo 1

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Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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RS = 6998.354
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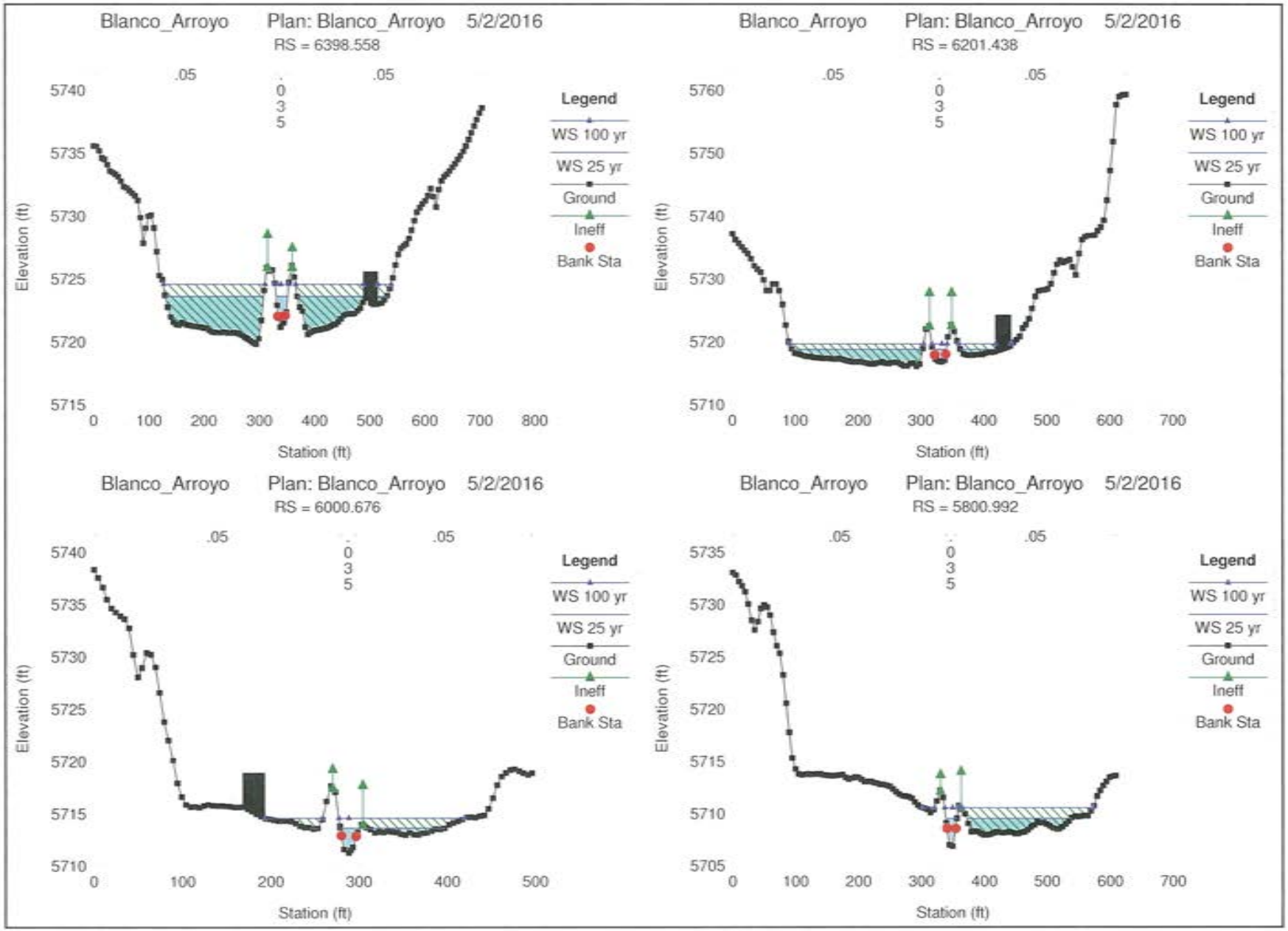
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Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
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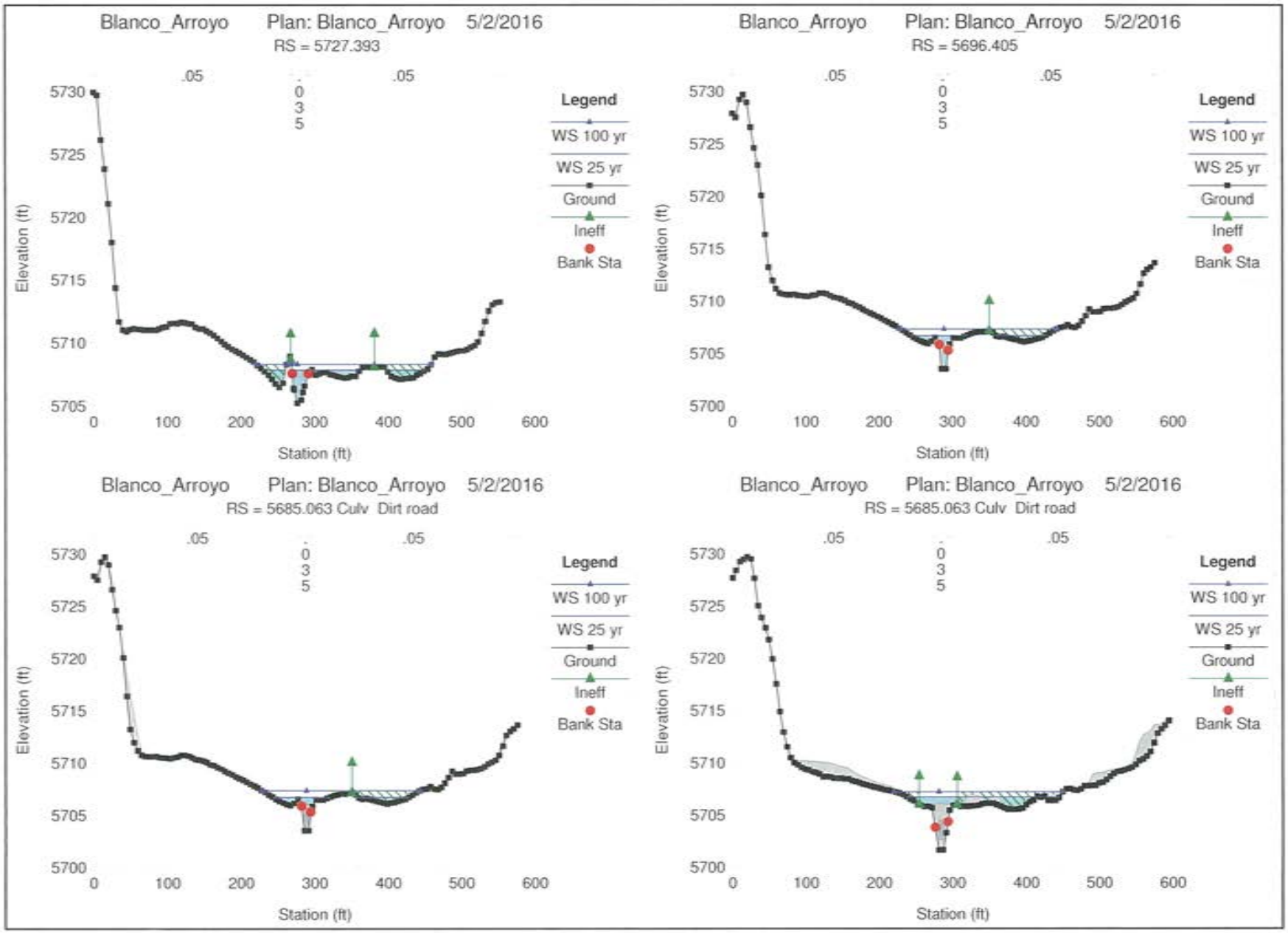
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3
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
5730
5725
5720
5715
5710
5705
0 100 200 300 400 500 600
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5696.405
.05 . .05
0
3
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
5730
5725
5720
5715
5710
5705
5700
0 100 200 300 400 500 600
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5685.063 Culv Dirt road
.05 . .05
0
3
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
5730
5725
5720
5715
5710
5705
5700
0 100 200 300 400 500 600
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5685.063 Culv Dirt road
.05 . .05
0
3
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
5730
5725
5720
5715
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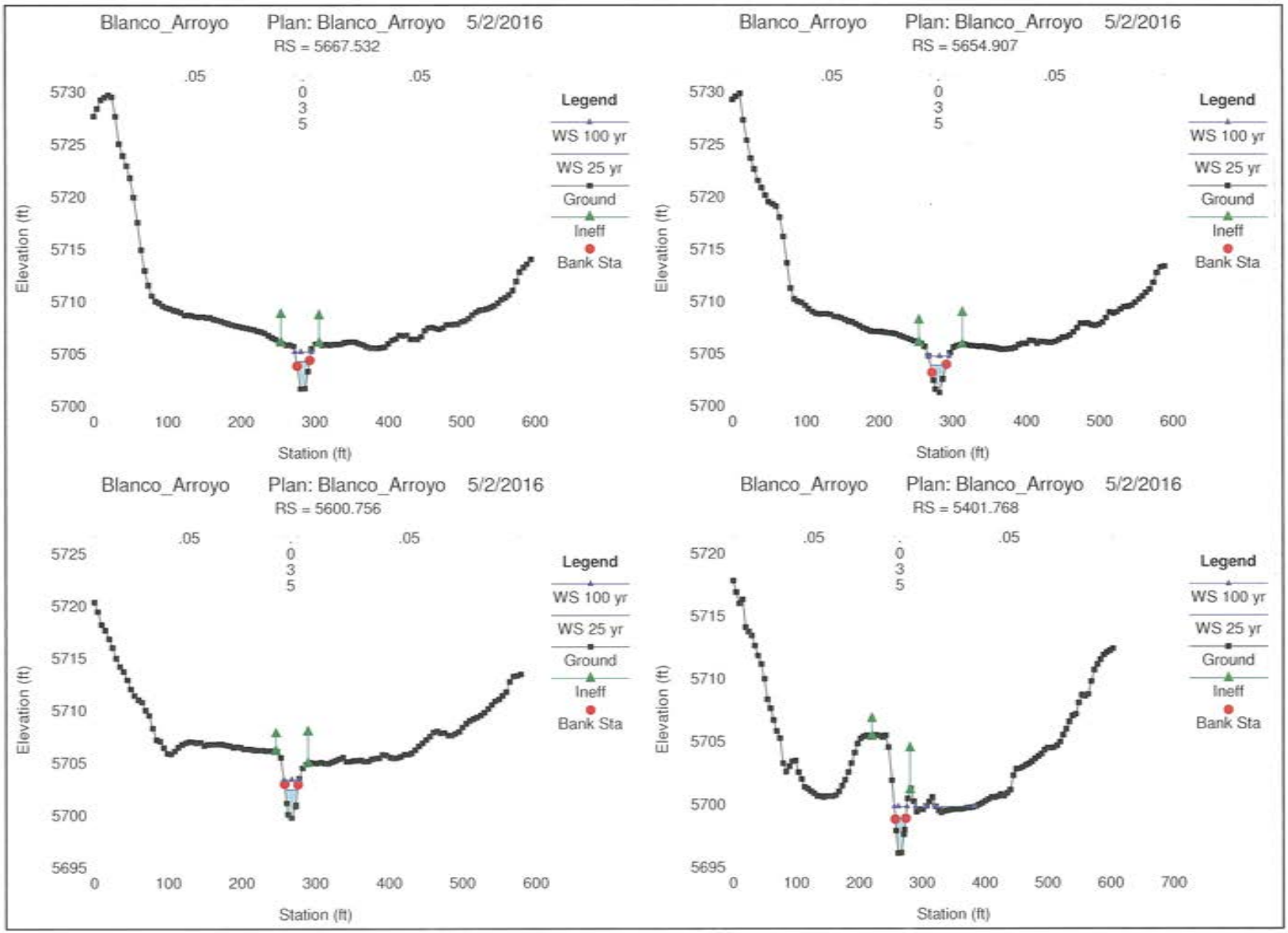
5705
5700
0 100 200 300 400 500 600
Station (ft)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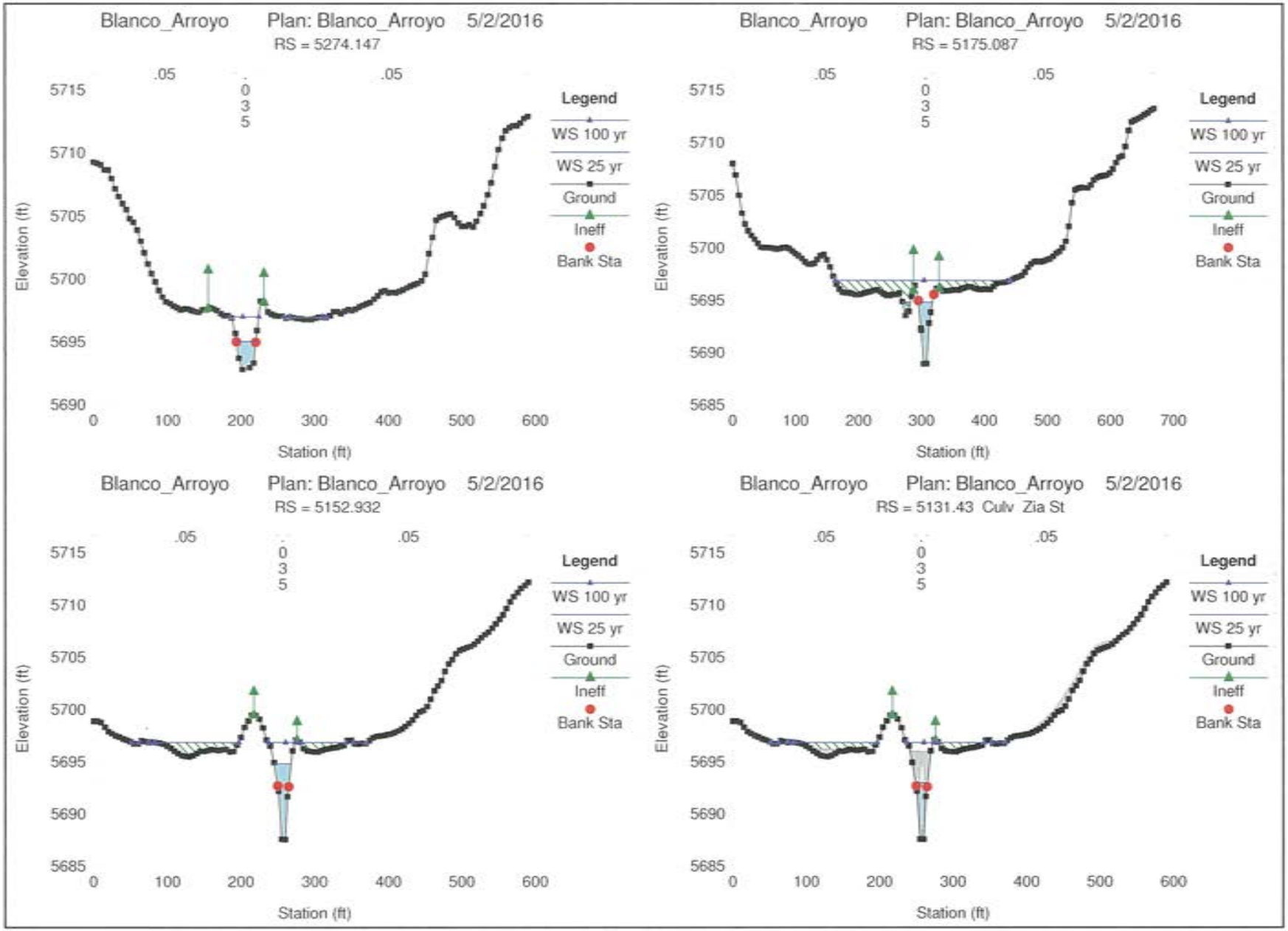
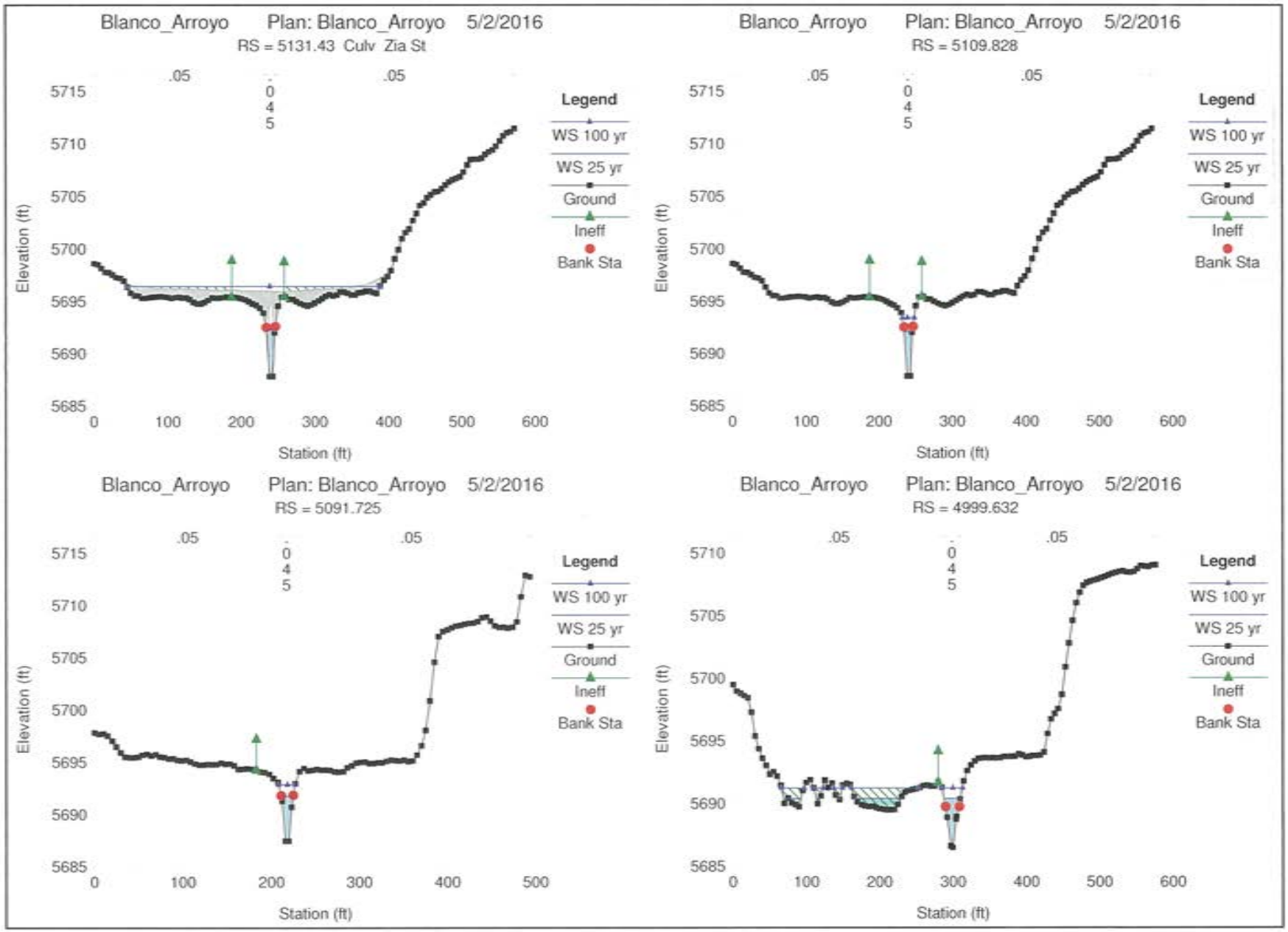
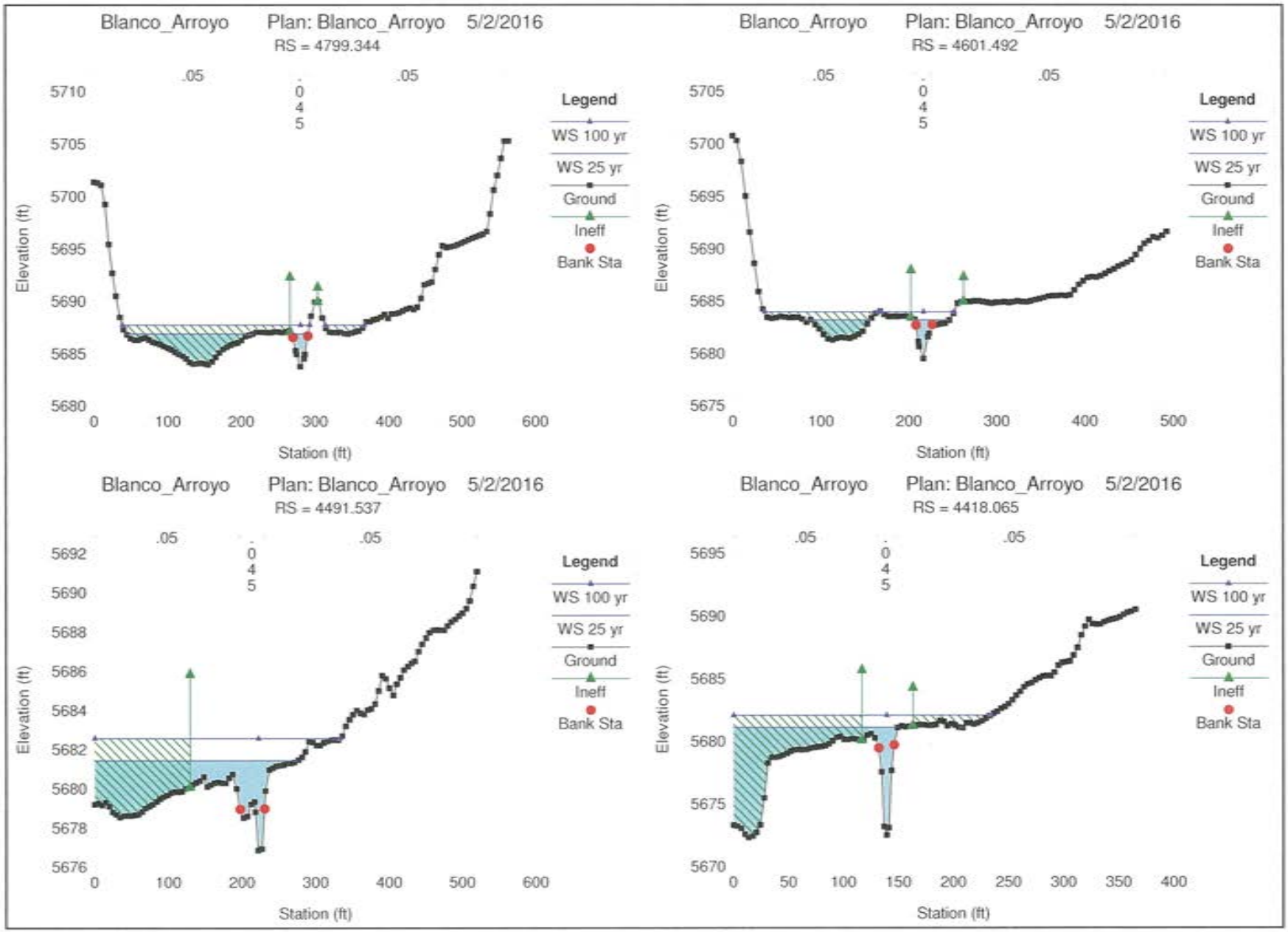
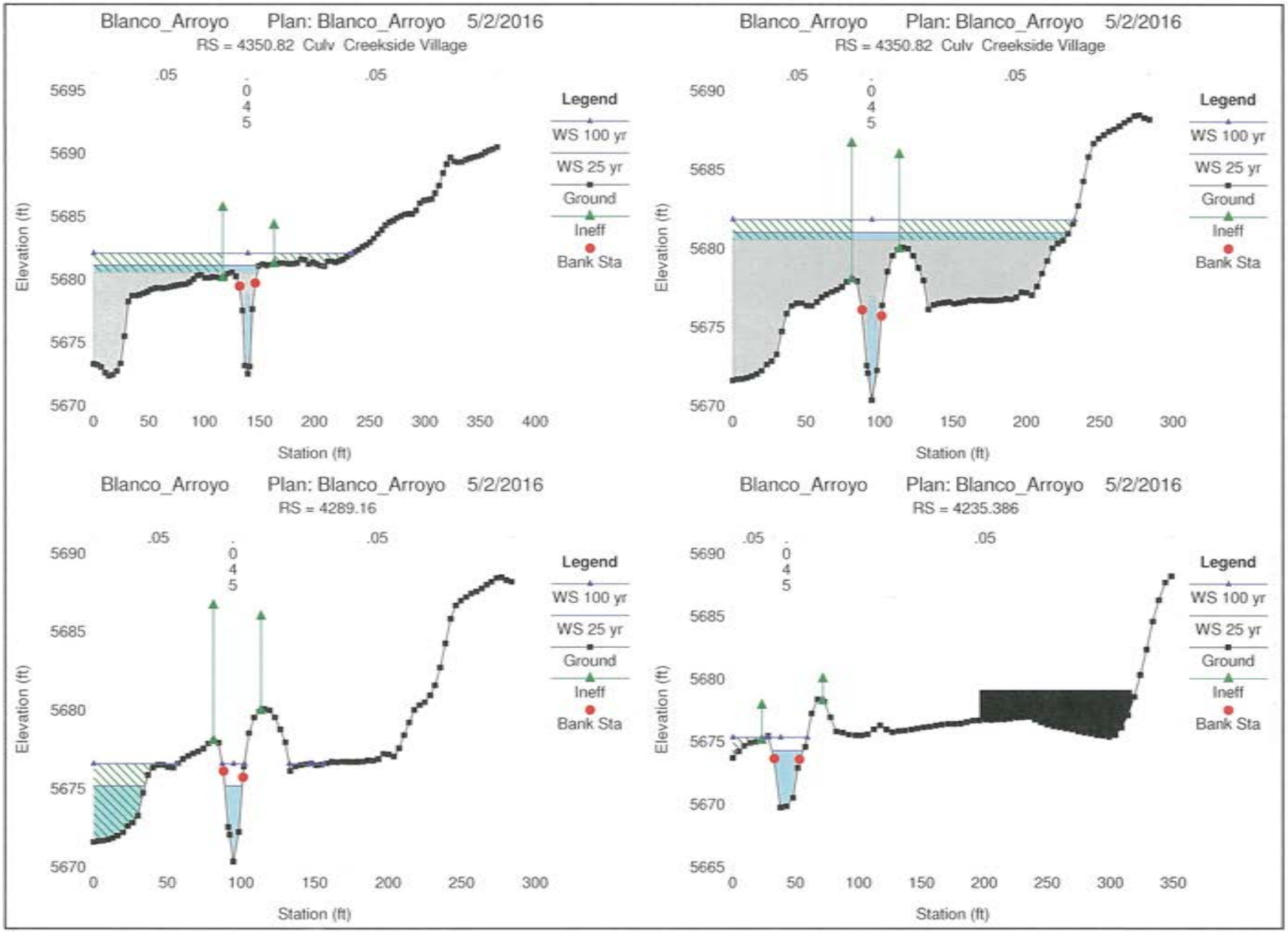
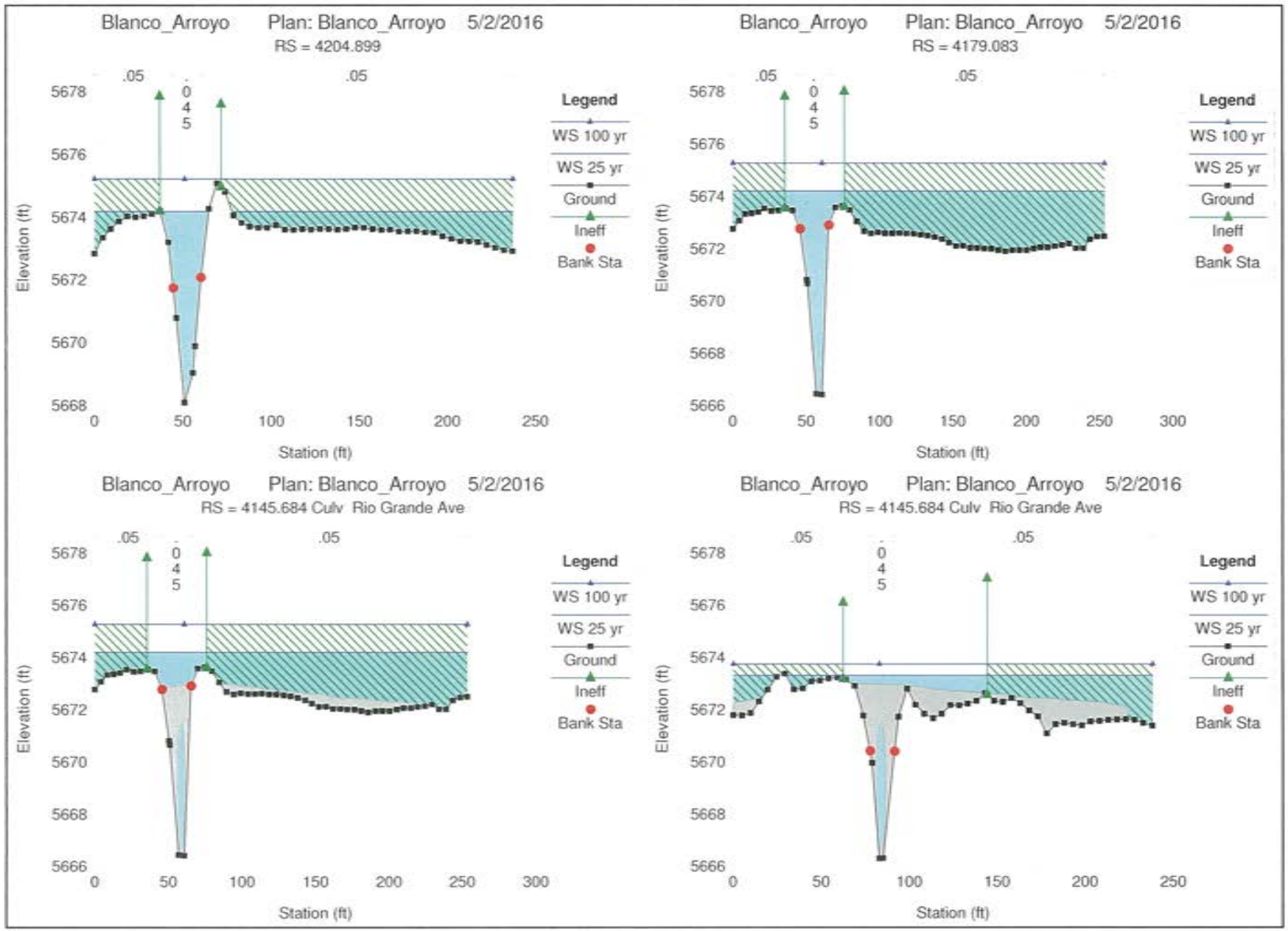
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5654.907
.05 .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5600.756
.05 .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5401.768
.05 .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

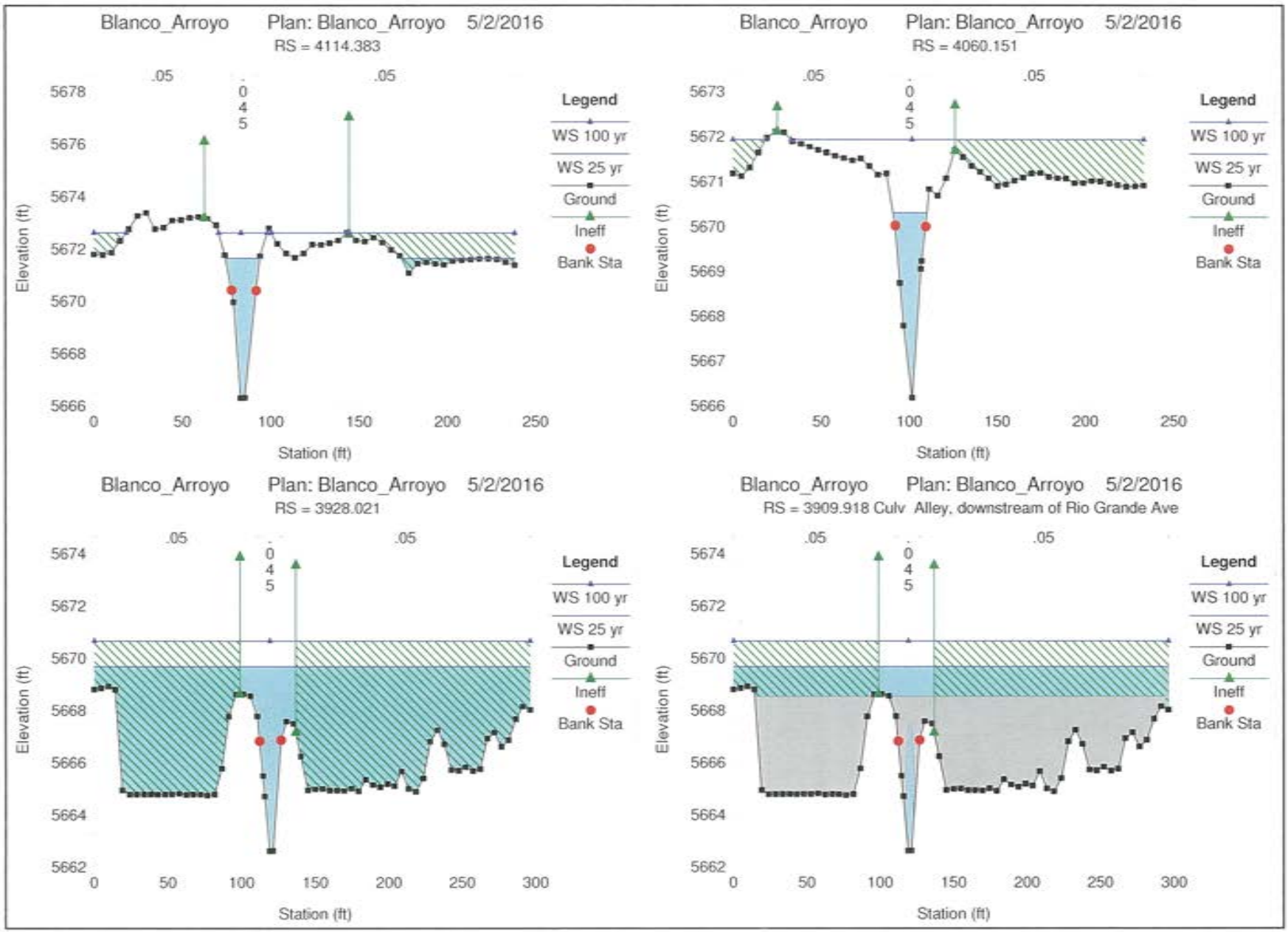

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5274.147
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5175.087
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5152.932
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5131.43 Culv Zia St
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta

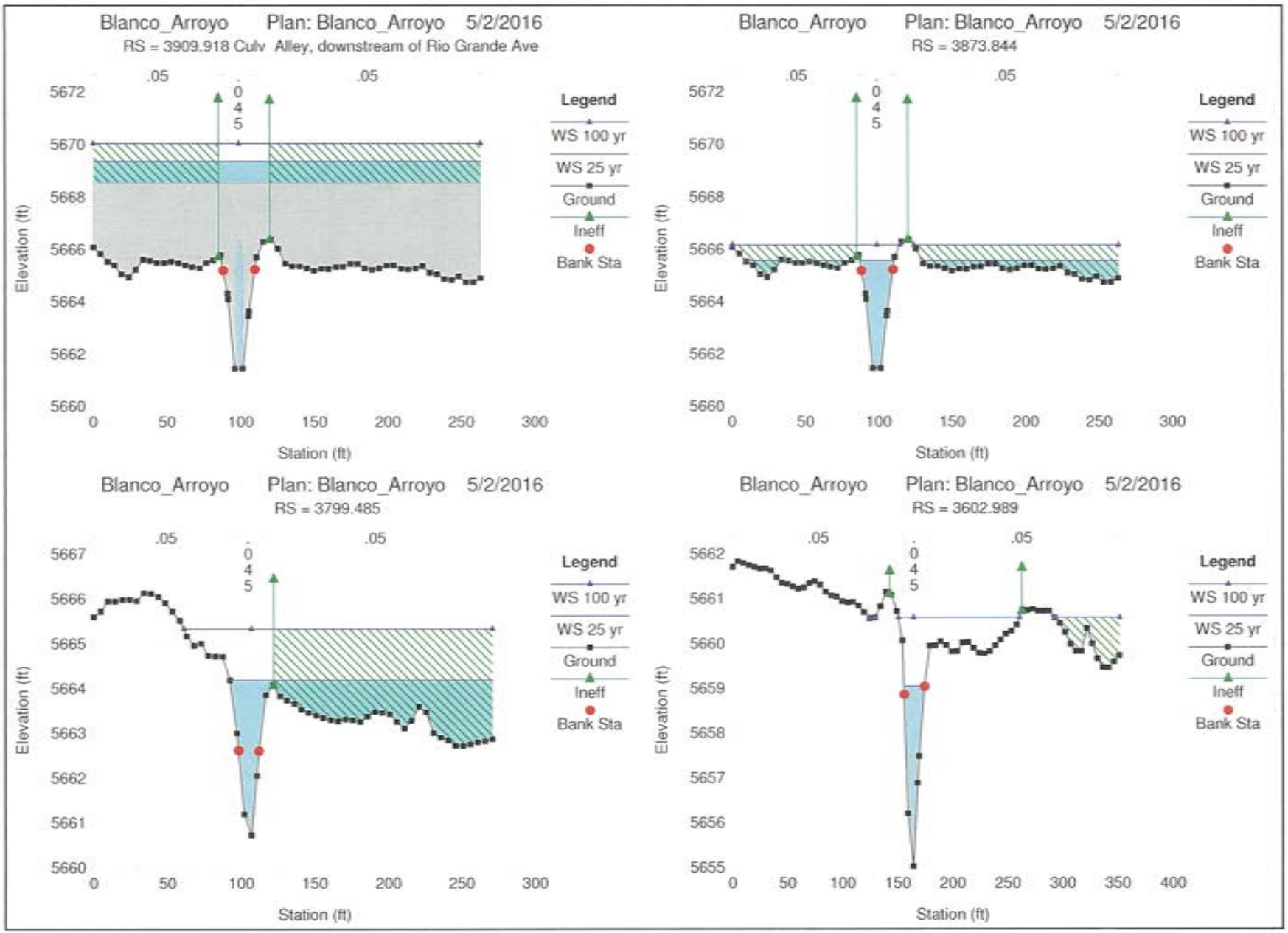

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5131.43 Culv Zia St
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5109.828
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5091.725
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4999.632
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

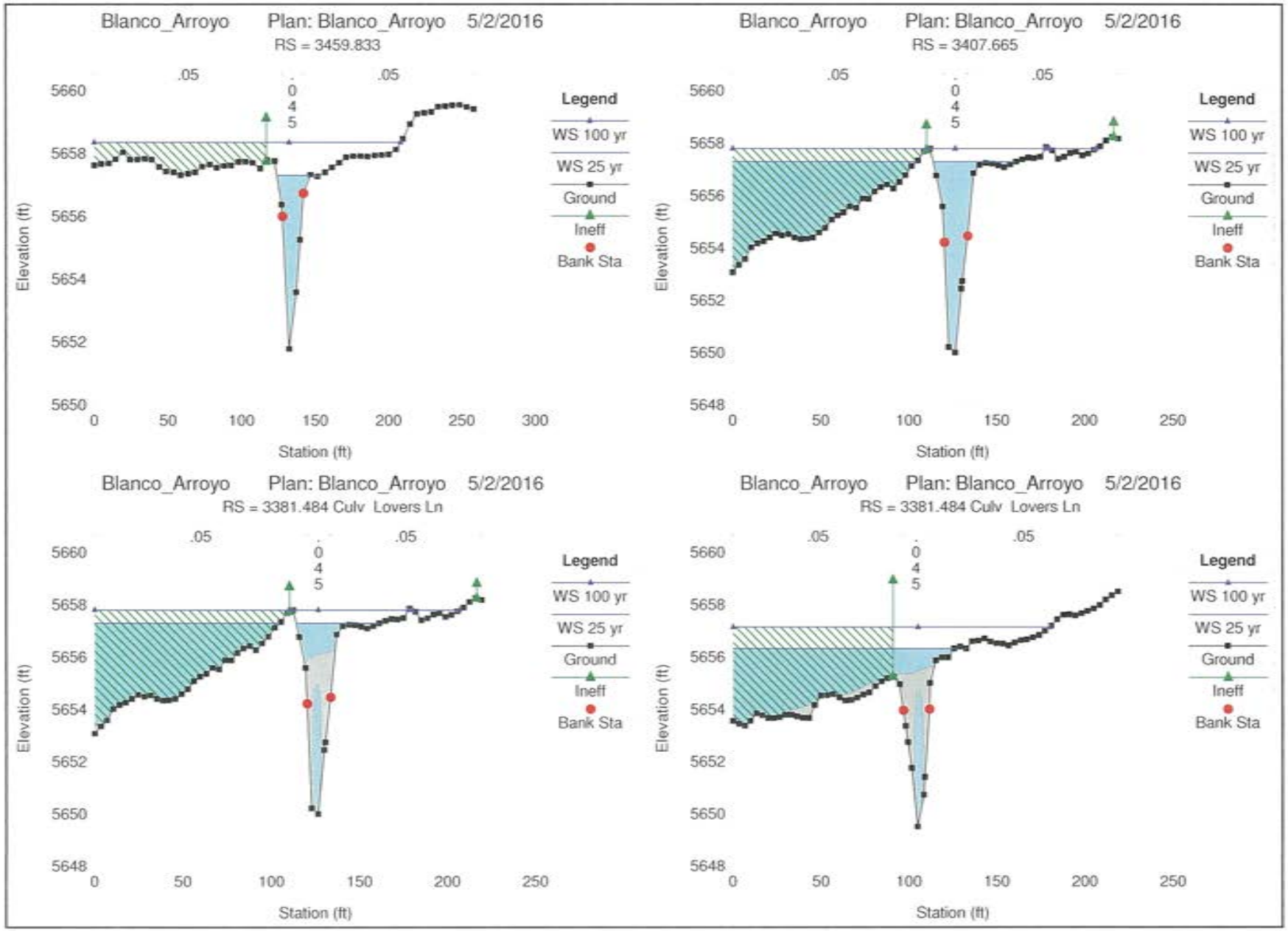

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4799.344
.05 .0 .05
0
4
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4601.492
.05 .0 .05
0
4
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4491.537
.05 .0 .05
0
4
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4418.065
.05 .0 .05
0
4
5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

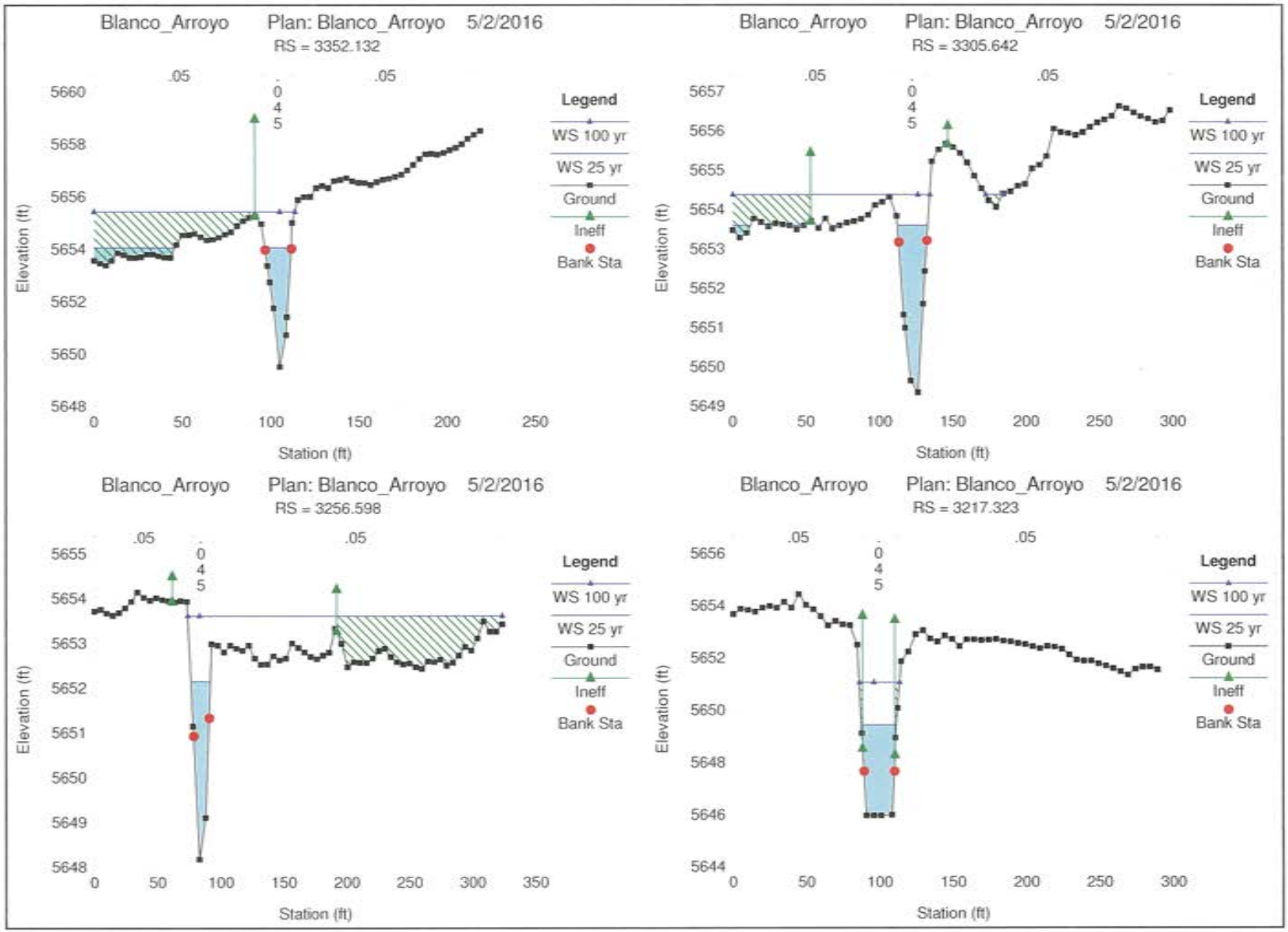

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4350.82 Culv Creekside Village
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4350.82 Culv Creekside Village
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4289.16
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4235.386
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

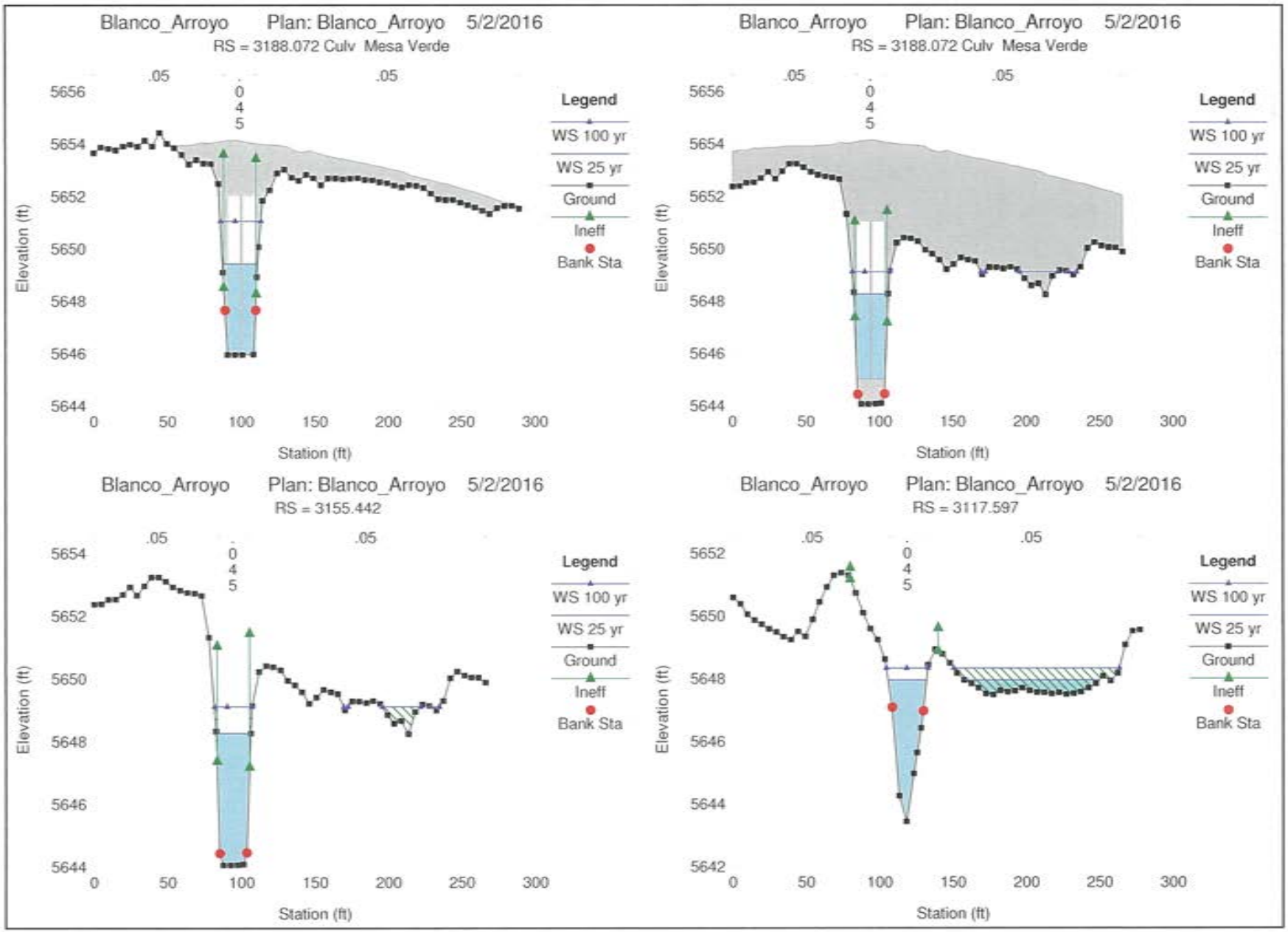

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4204.899
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4179.083
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4145.684 Culv Rio Grande Ave
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4145.684 Culv Rio Grande Ave
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

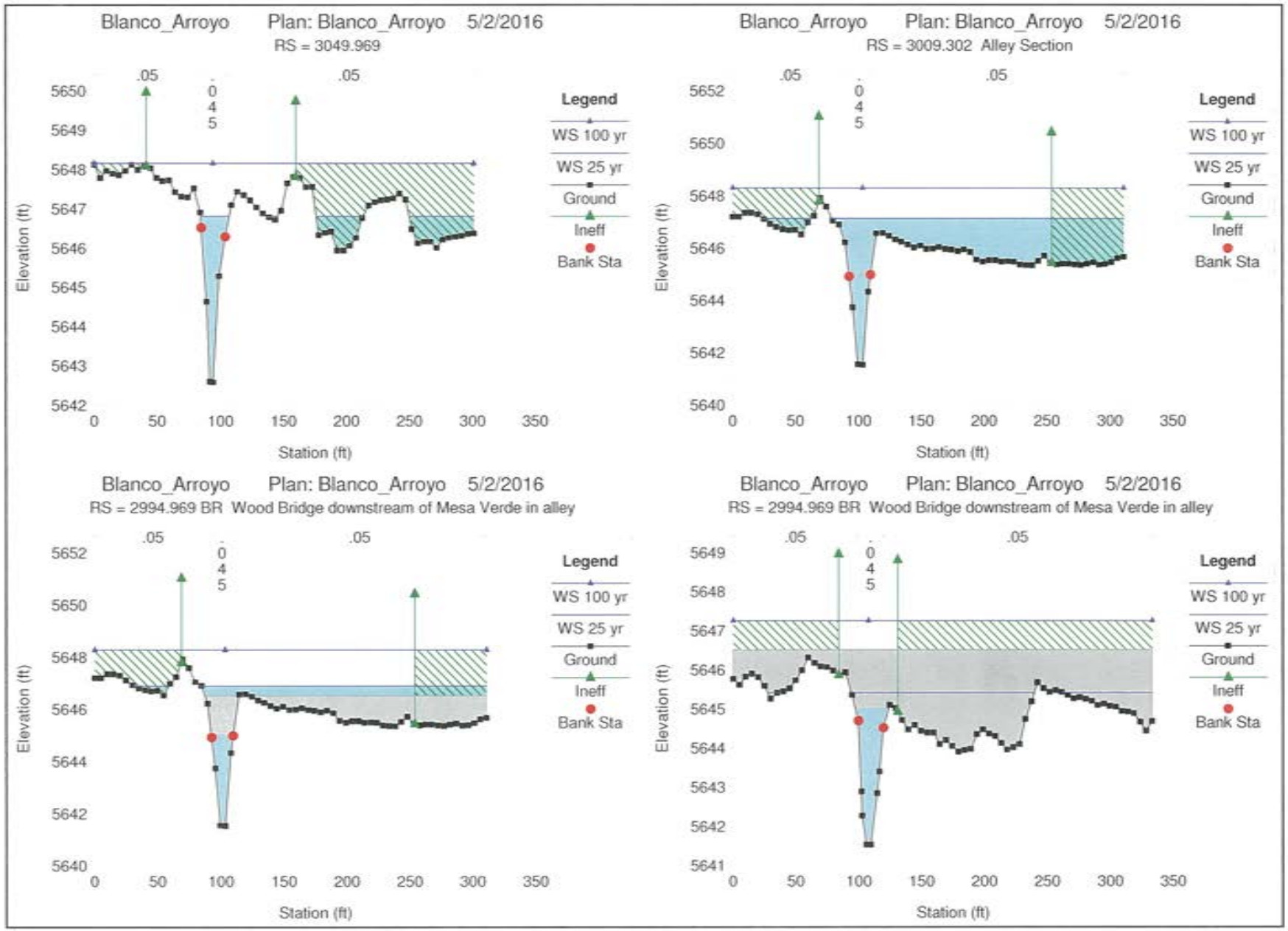

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4114.383
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 4060.151
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3928.021
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3909.918 Culv Alley, downstream of Rio Grande Ave
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta

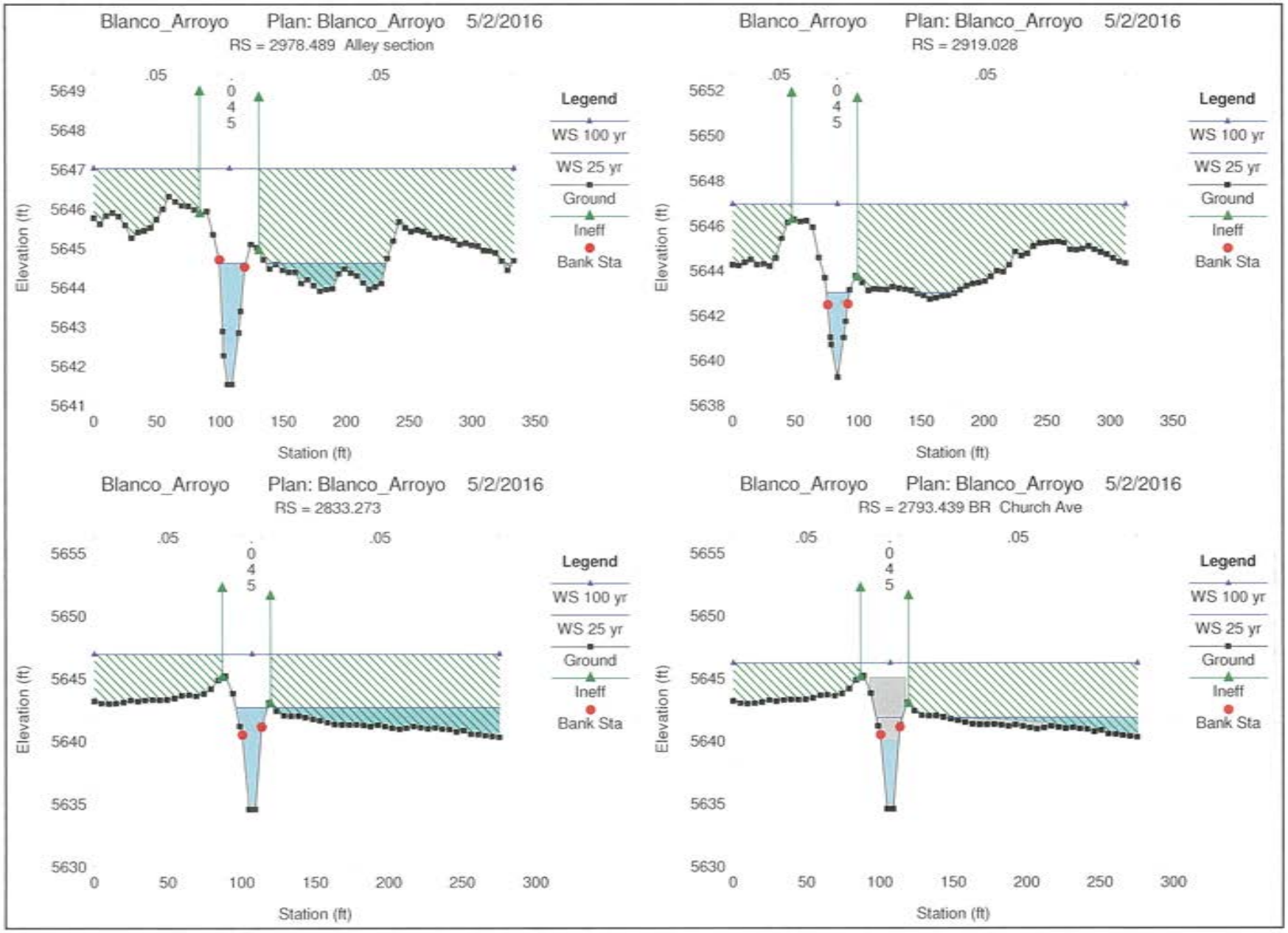

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3909.918 Culv Alley, downstream of Rio Grande Ave
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3873.844
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3799.485
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3602.989
.05
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

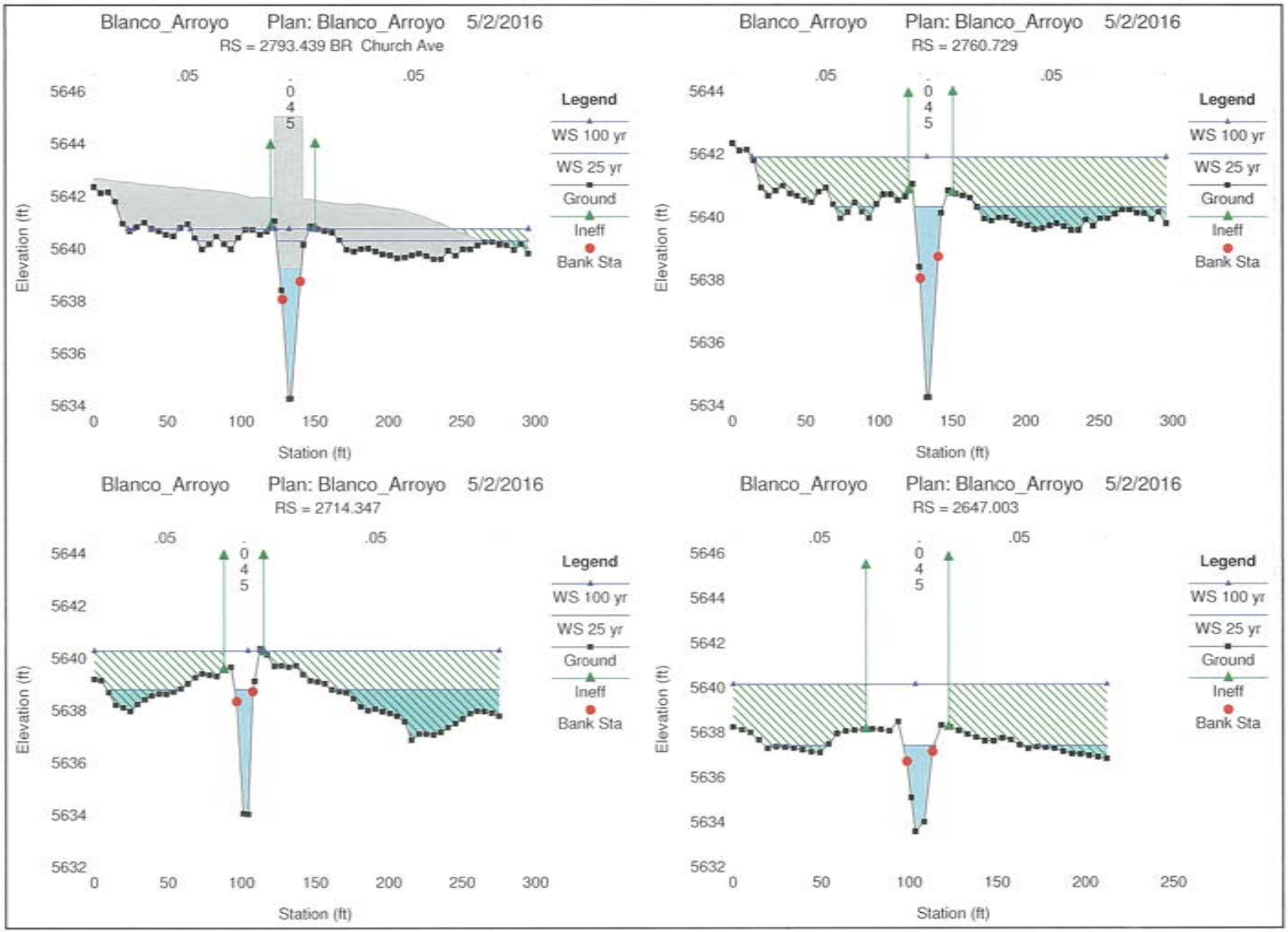

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3459.833
.05 .05
0.045
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3407.665
.05 .05
0.045
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3381.484 Culv Lovers Ln
.05 .05
0.045
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3381.484 Culv Lovers Ln
.05 .05
0.045
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta

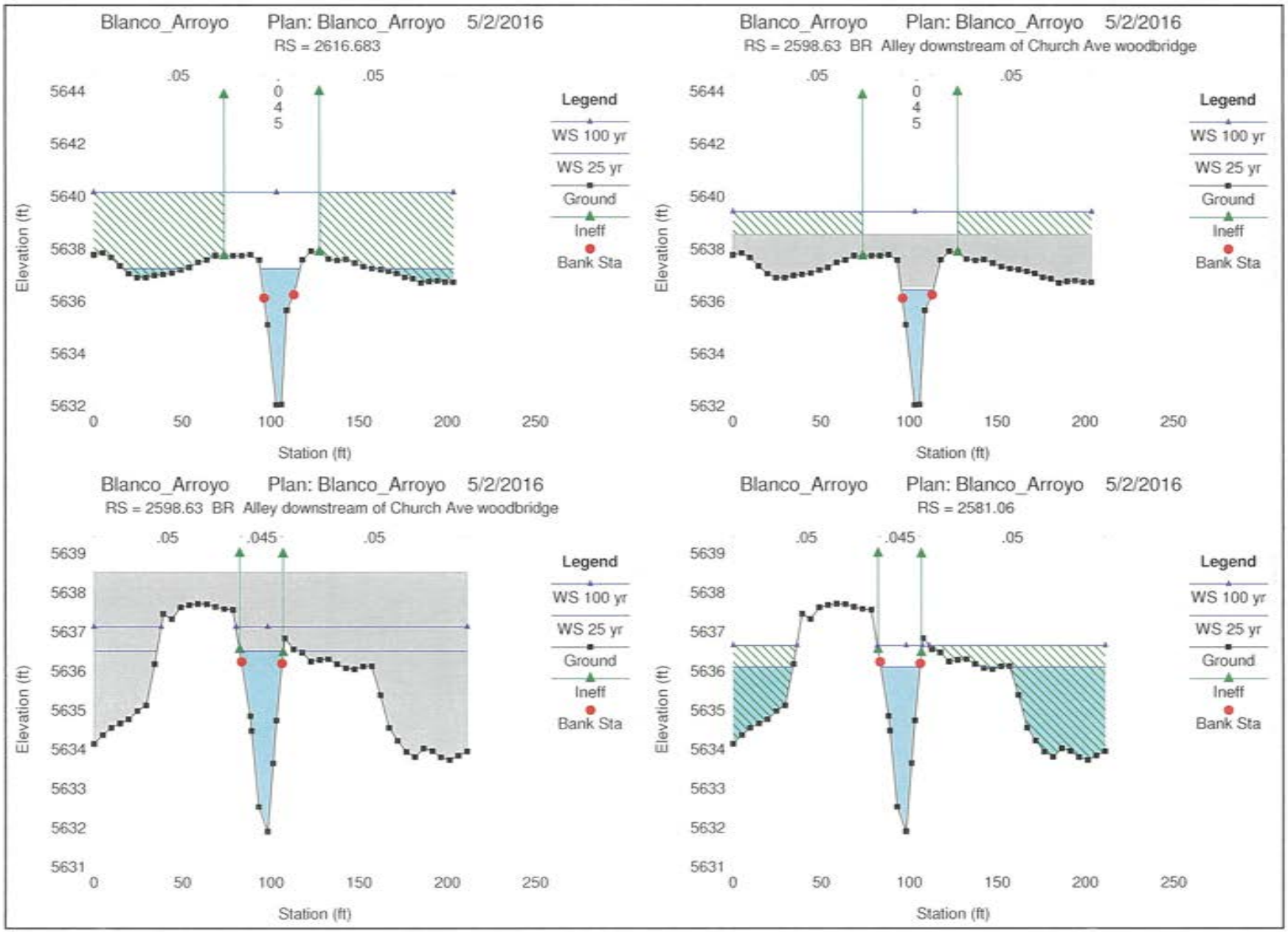

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3352.132
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3305.642
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3256.598
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3217.323
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

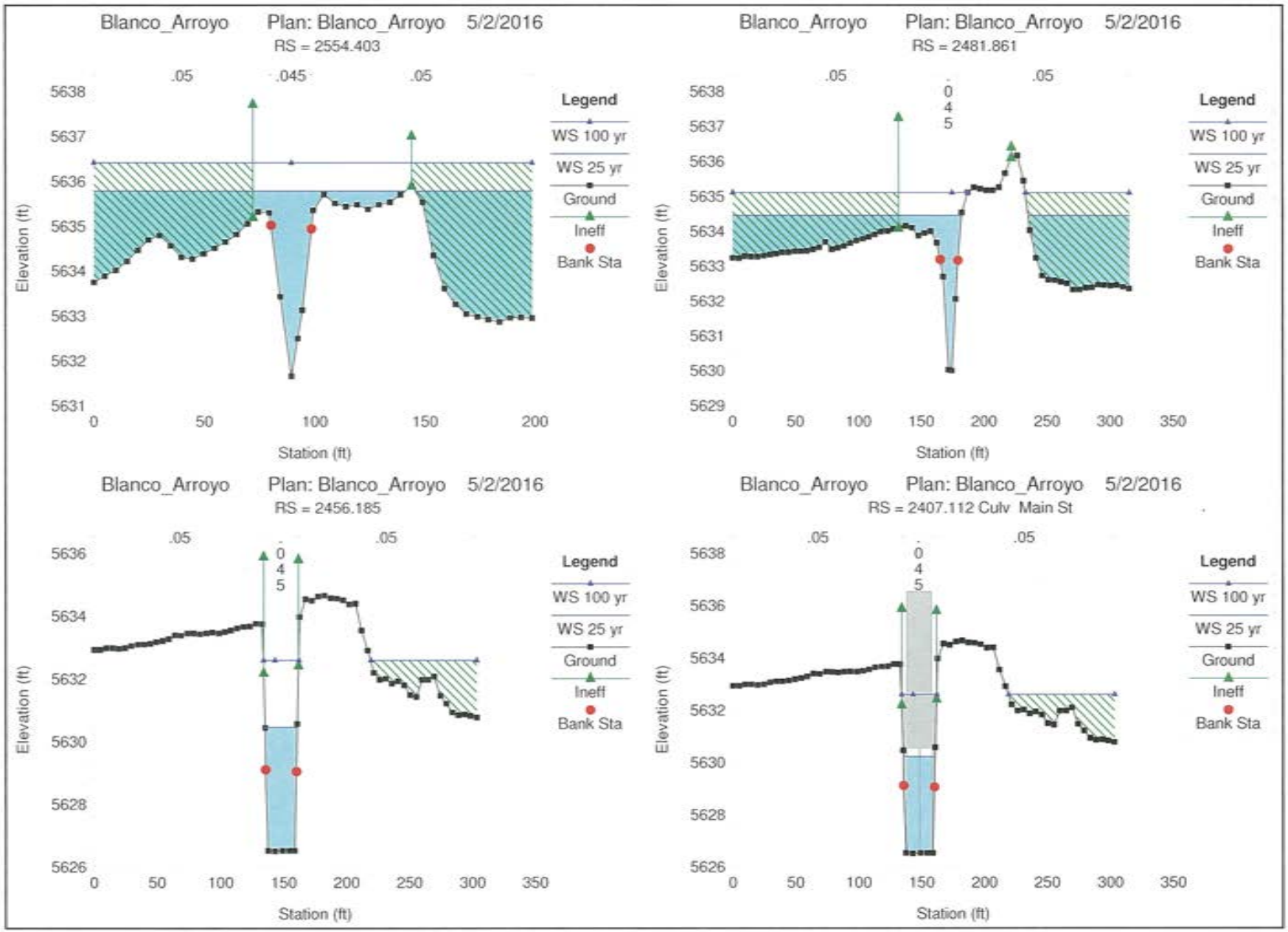

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3188.072 Culv Mesa Verde
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3188.072 Culv Mesa Verde
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3155.442
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3117.597
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

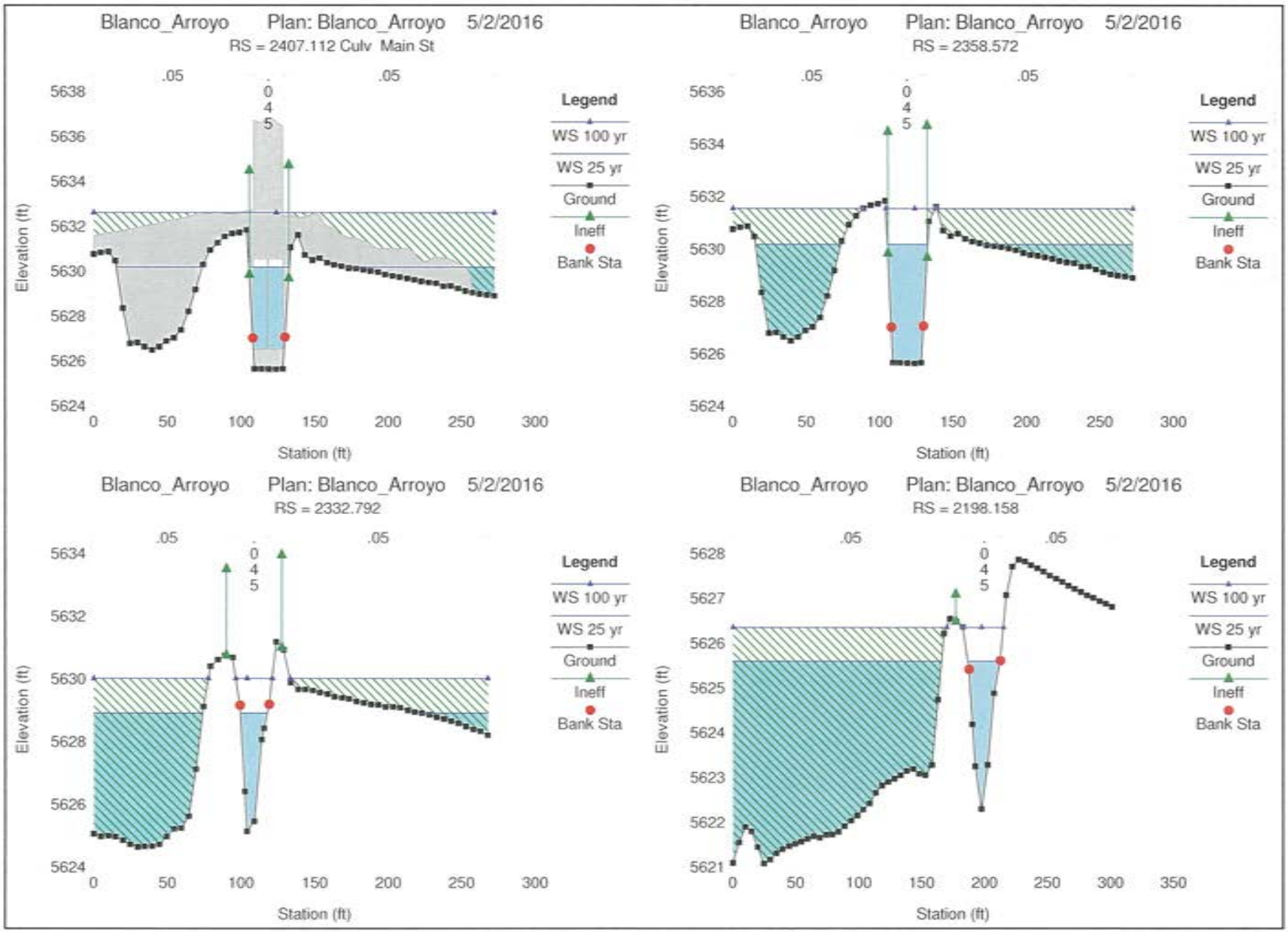

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3049.969
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 3009.302 Alley Section
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2994.969 BR Wood Bridge downstream of Mesa Verde in alley
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2994.969 BR Wood Bridge downstream of Mesa Verde in alley
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

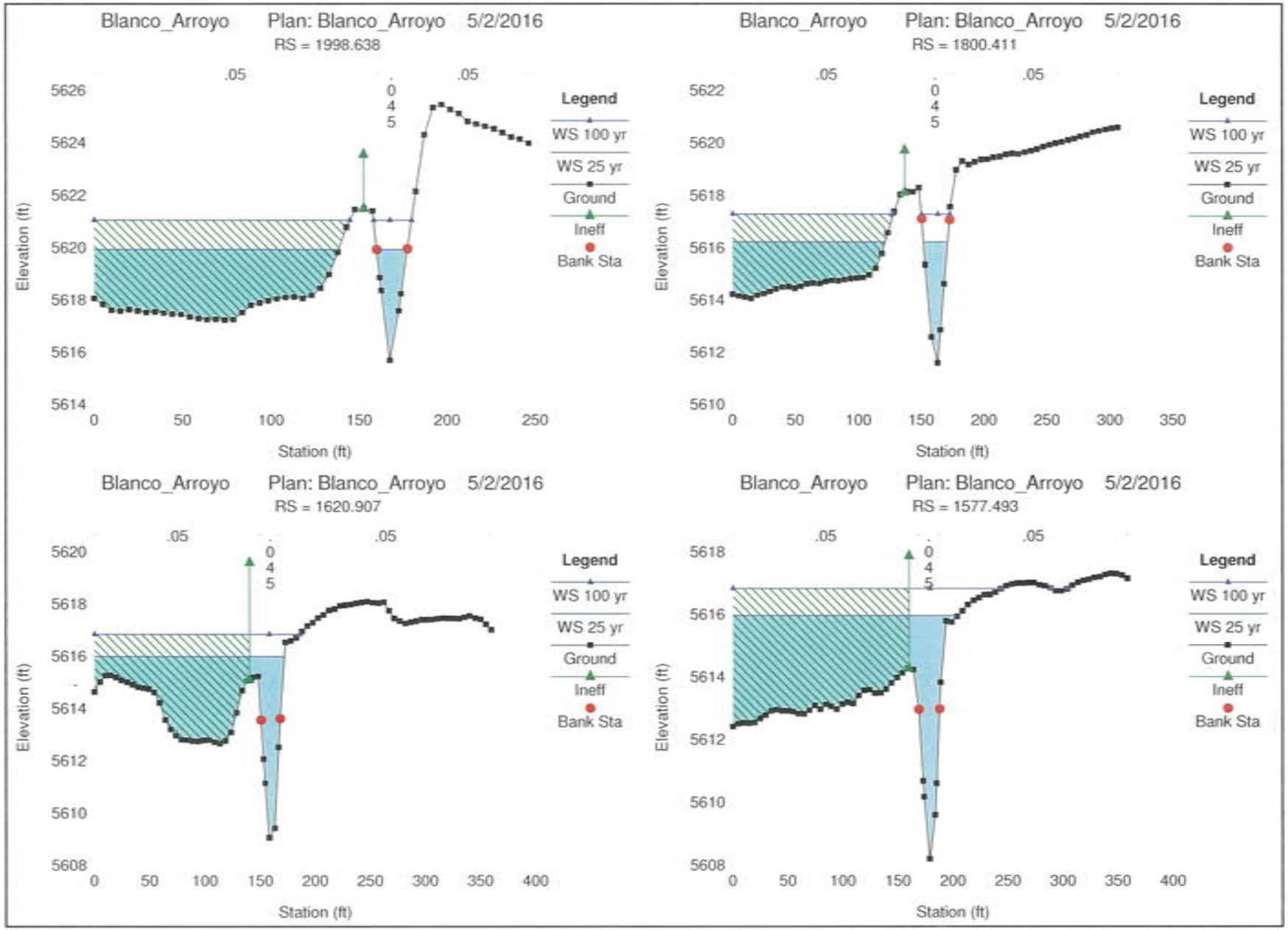

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2978.489 Alley section
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2919.028
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2833.273
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2793.439 BR Church Ave

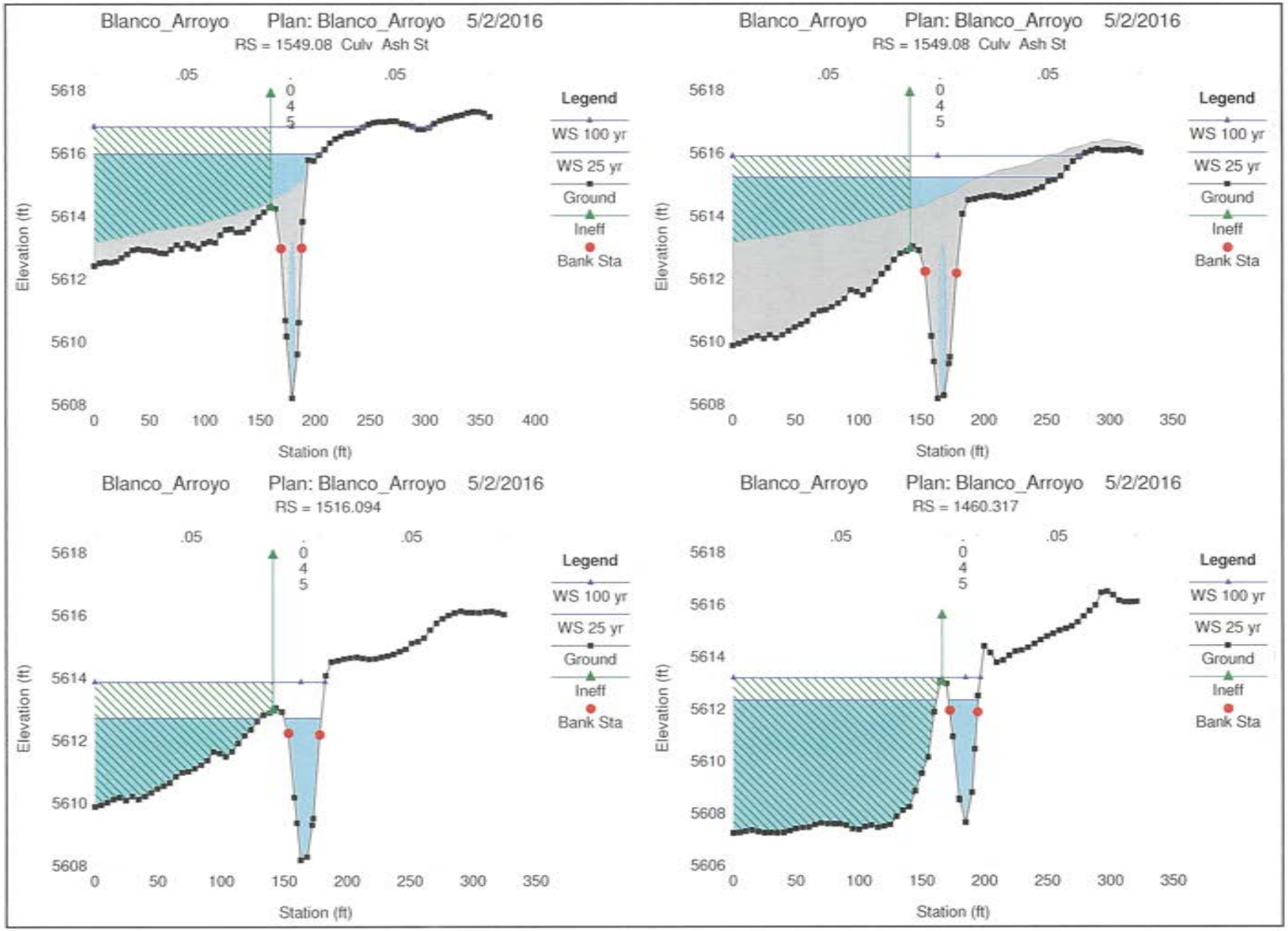

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2793.439 BR Church Ave
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2760.729
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2714.347
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2647.003

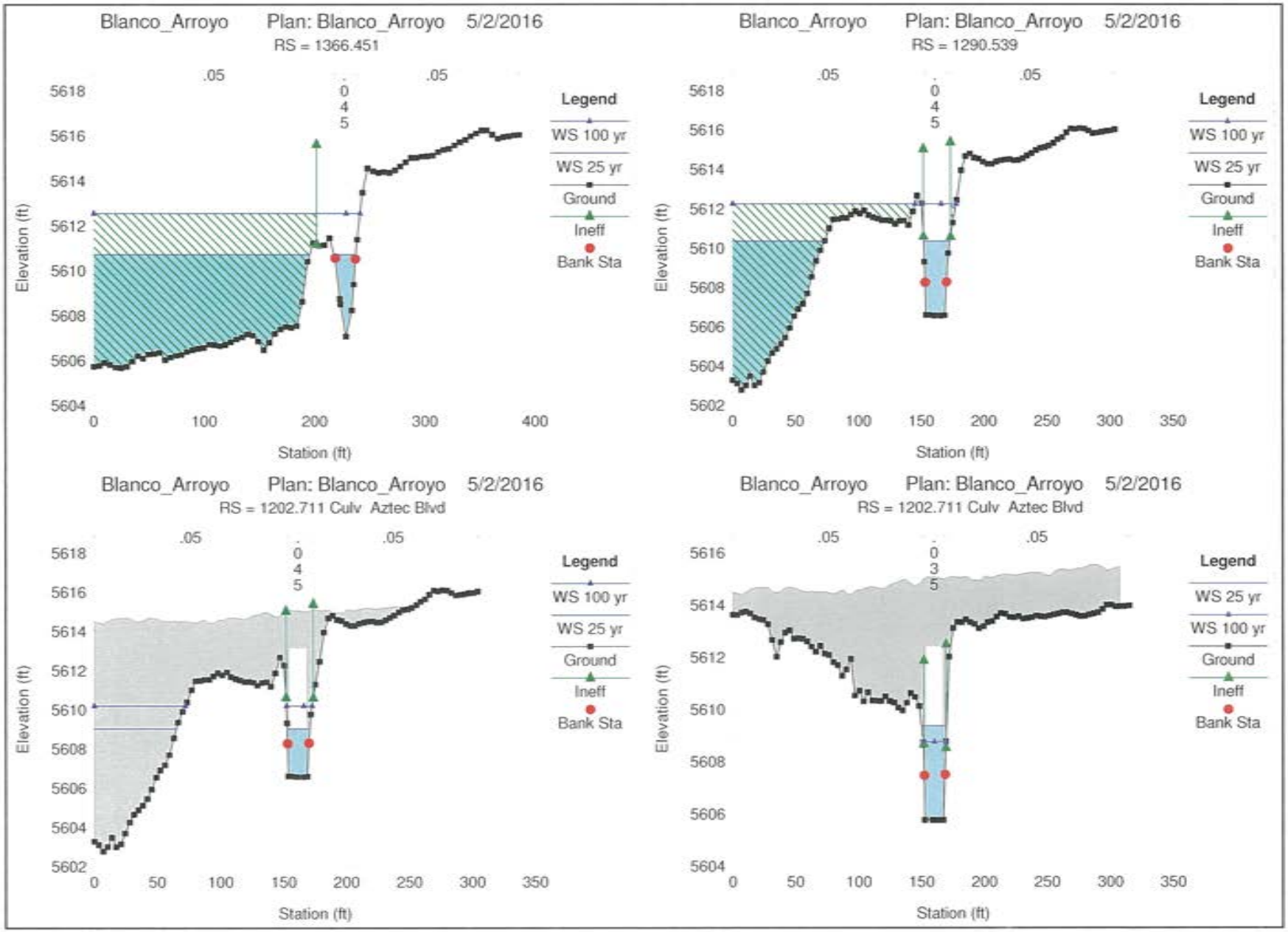

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2616.683
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2598.63 BR Alley downstream of Church Ave woodbridge
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2598.63 BR Alley downstream of Church Ave woodbridge
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2581.06

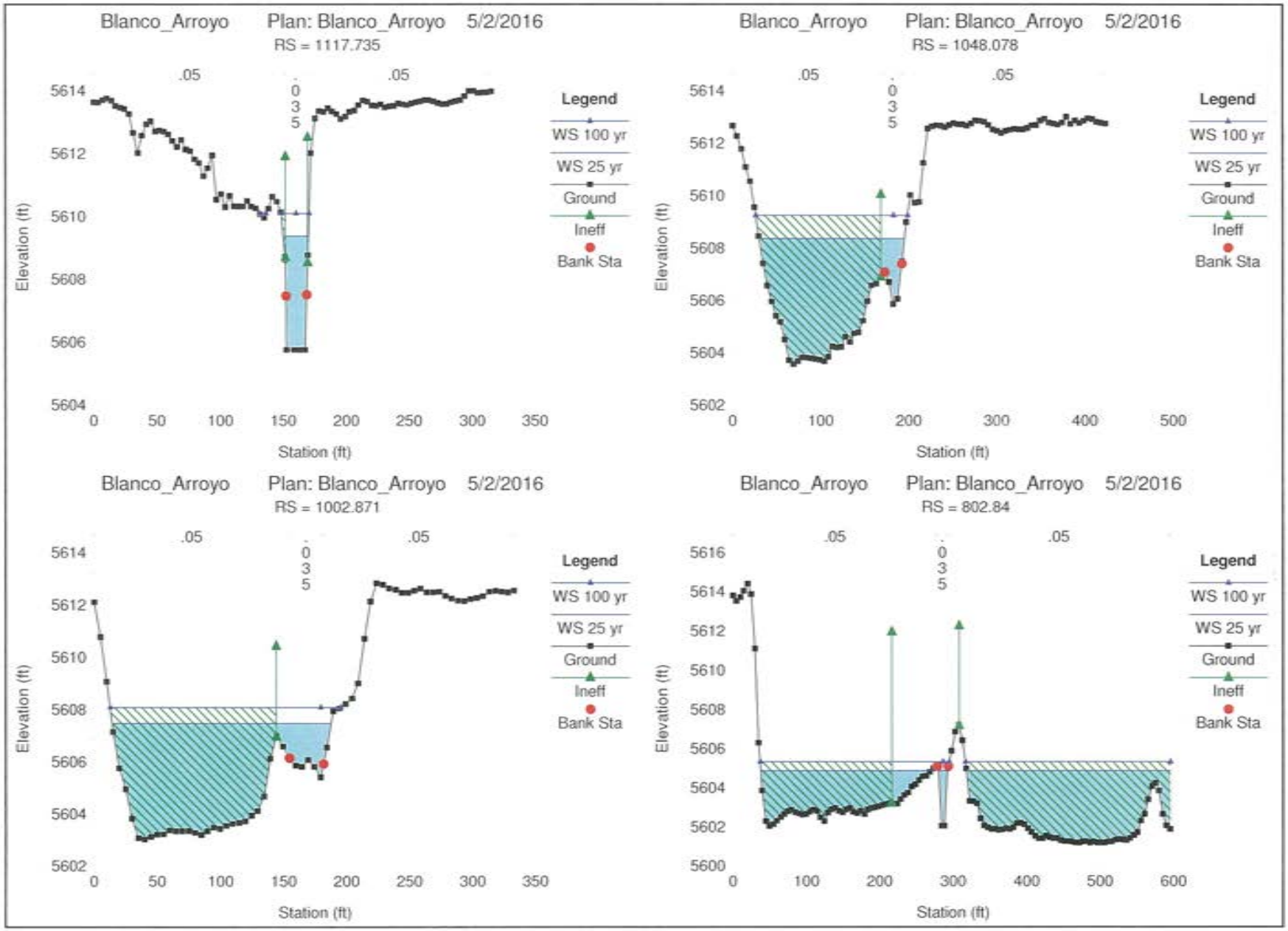

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2554.403
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2481.861
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2456.185
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2407.112 Culv Main St
.05 .045 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

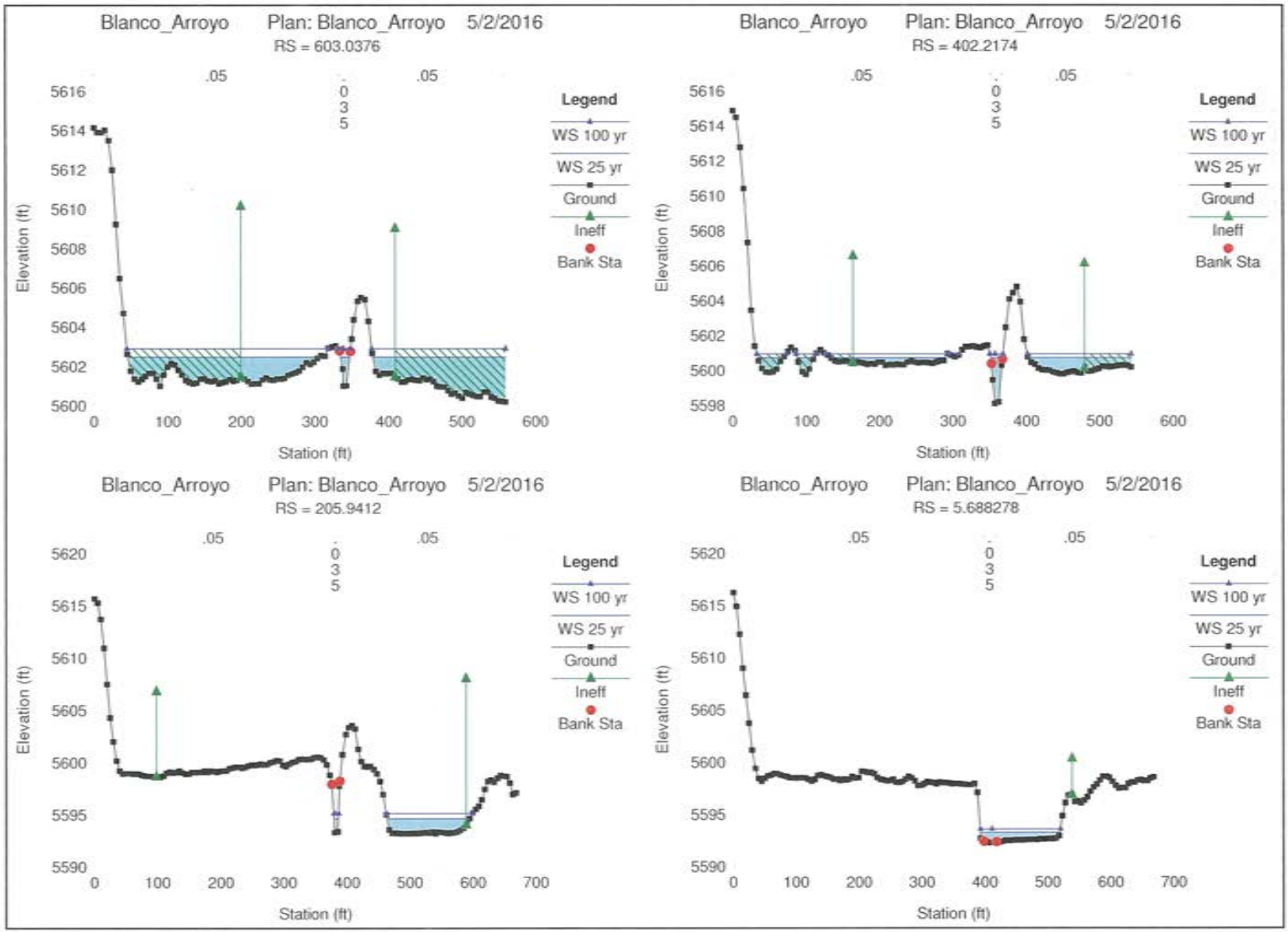

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2407.112 Culv Main St
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2358.572
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2332.792
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 2198.158
.05
.045
.05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

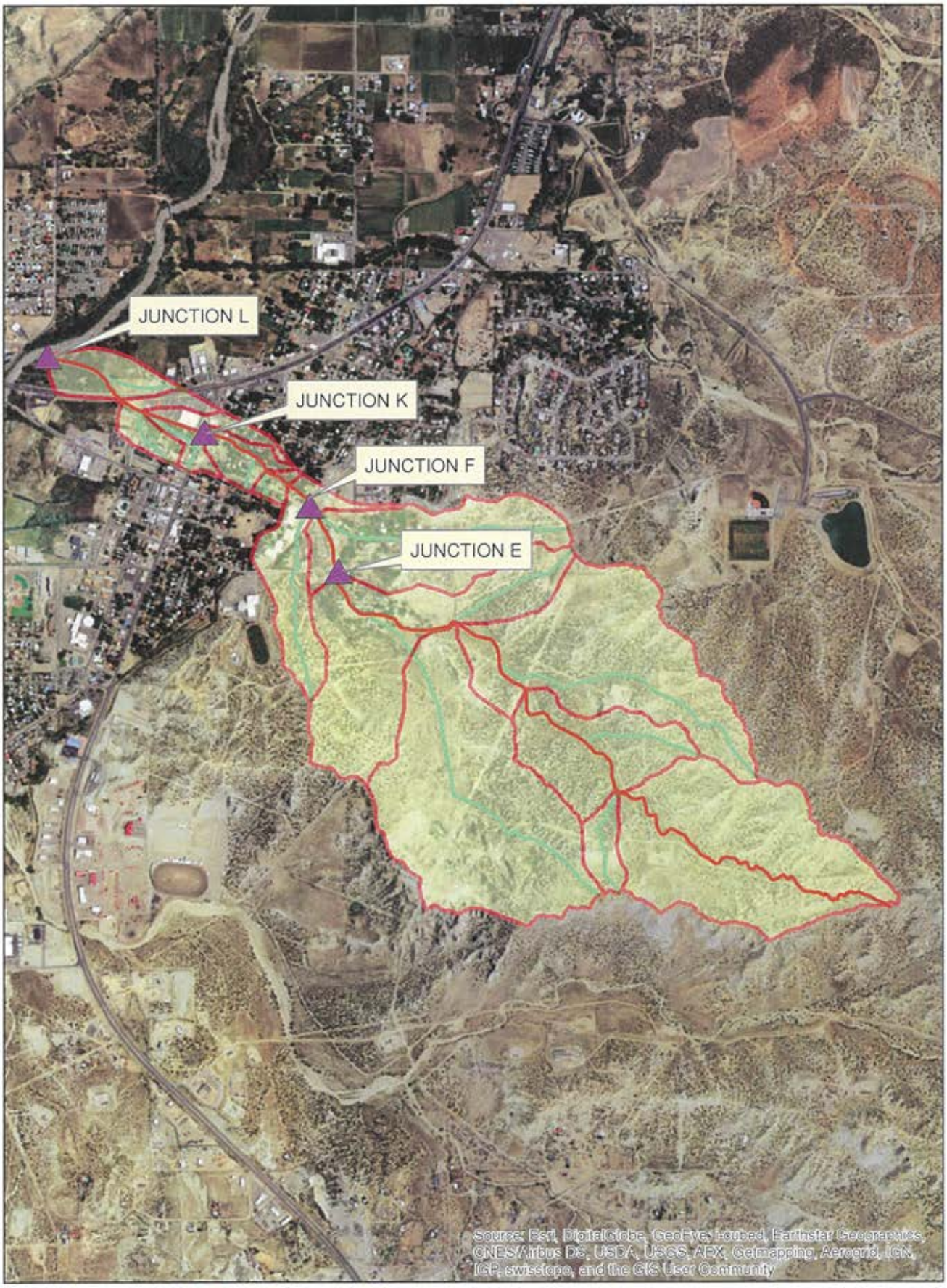

Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1998.638
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1800.411
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1620.907
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1577.493
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta


Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1549.08 Culv Ash St
.05 .05
0.045
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1549.08 Culv Ash St
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1516.094
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1460.317


Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1366.451
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1290.539
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1202.711 Culv Aztec Blvd
.05 .045 .05
Elevation (ft)
Station (ft)
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1202.711 Culv Aztec Blvd
.05 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 25 yr
WS 100 yr
Ground
Ineff
Bank Sta


Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1117.735
.05 . .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1048.078
.05 . .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 1002.871
.05 . .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 802.84
.05 . .05
0 3 5
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 603.0376
.05 .03 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 402.2174
.05 .03 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 205.9412
.05 .03 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Blanco_Arroyo Plan: Blanco_Arroyo 5/2/2016
RS = 5.688278
.05 .03 .05
Legend
WS 100 yr
WS 25 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


JUNCTION L
JUNCTION K
JUNCTION F
JUNCTION E
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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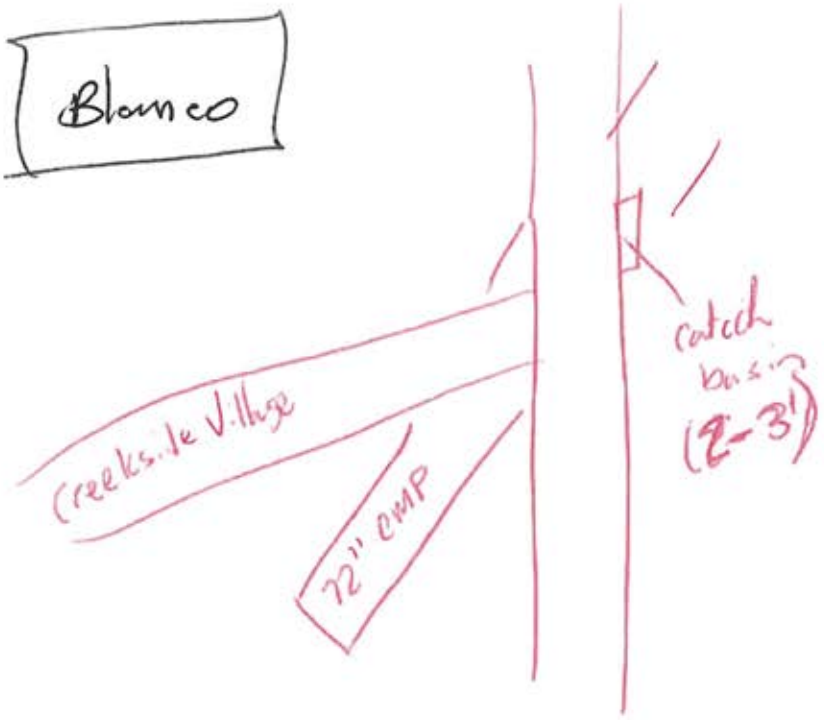

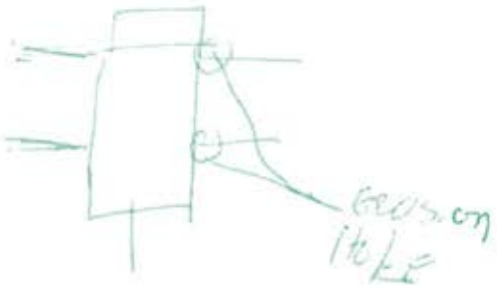

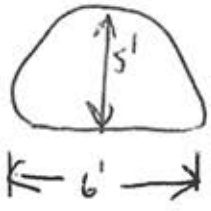

6' x 5'

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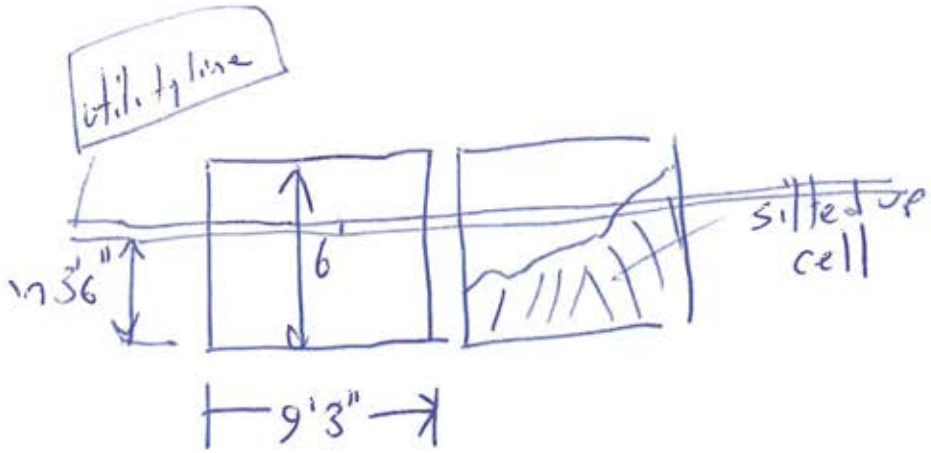
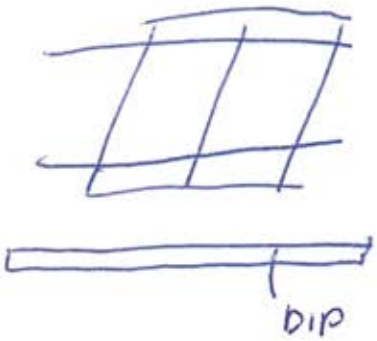
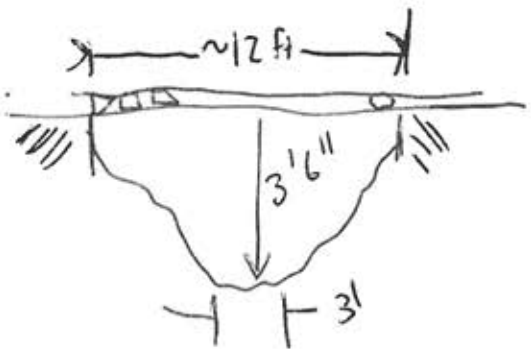
Reference

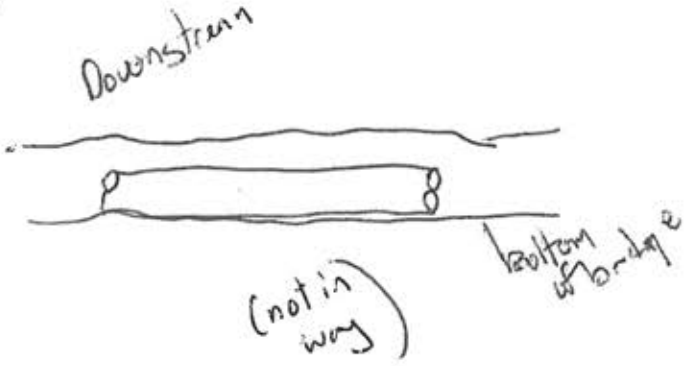
Mesa Verde / Lovers Lane





Downstream (wood foot bridge)





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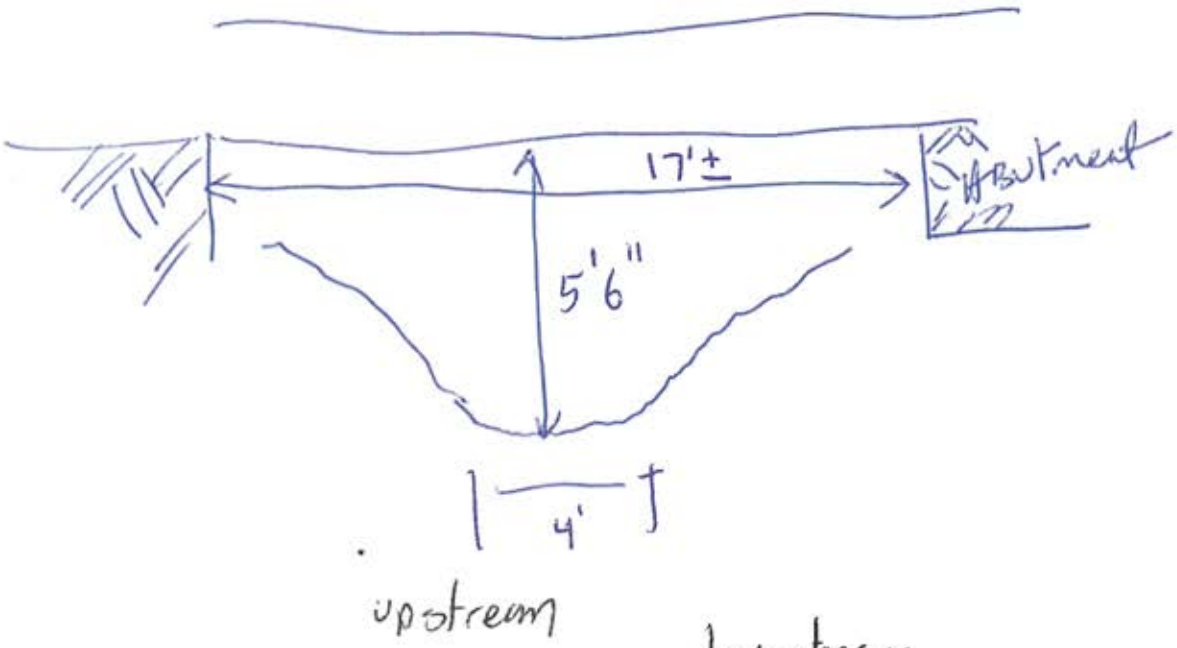
Church

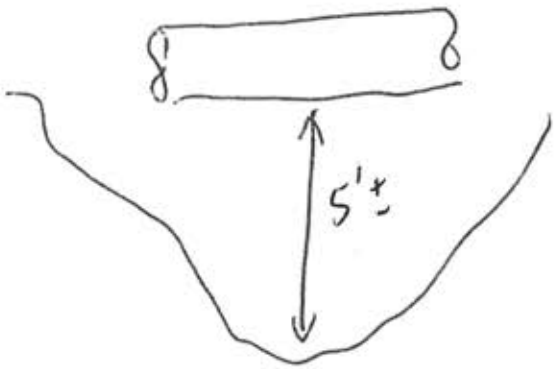


upstream

downstream

12" CMP

(5' above ℄)



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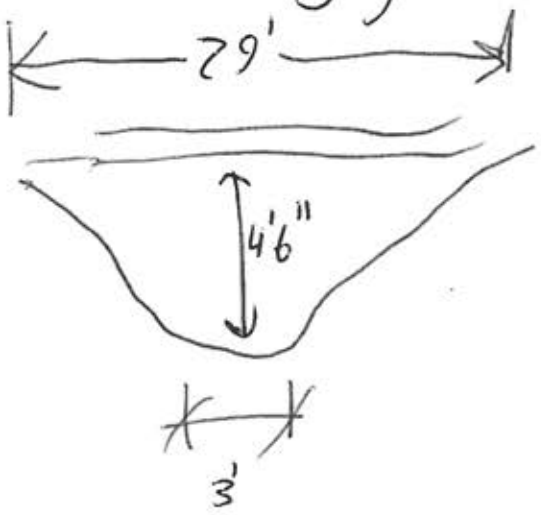
Reference

Alley downstream of Church
(wood bridge)



Blanco

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Reference

Zia

Blanco

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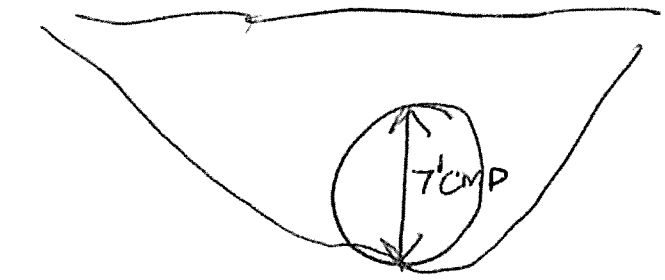


Appendix D – Hydraulic Calculation – FLO-2D Existing Conditions

AECOM	Calculation Sheet				
Project Name:	Blanco Arroyo			Calculation Number:	2B
Client Name:	City of Aztec, New Mexico			Revision Number:	0
Project Number:	Job No.	Cost Code	Parent (if any)	Prepared By/Date:	PDC / 4-19-2016
	60487201	20000	N/A		
Title:	Drainage Analysis Using FLO-2D				

PROBLEM STATEMENT:

The purpose of this calculation package is to document the FLO-2D analysis prepared by AECOM for the watershed draining toward the Blanco Arroyo using FLO-2D PRO.

REQUIRED DELIVERABLES:

- Maps showing maximum flow depth and water surface elevations for the Blanco Arroyo obtained from the FLO-2D results for the 100-year and 25-year storm events.

DATA /ASSUMPTIONS:

- The inflow hydrographs were obtained from the HEC-HMS model developed to simulate the existing hydrologic conditions for the Blanco Arroyo. The hydrographs used in FLO-2D are attached in Attachment 1.
- Aerial survey and topography data was provided by the City of Aztec. The data was processed to remove the buildings and other features to reflect the bare earth topo.
- The FLO-2D analysis was done in horizontal projection – NM State Plane West NAD 83, feet.
- The flows contributing to the Blanco Arroyo are from an array of channels. The apex is located at approximately the southeastern boundary of the subdivision. The flow from the apex channelizes downstream and has a break out at the Animas river. This channel crosses through several neighborhoods and passes beneath US 550.

Variable Definitions

n Manning's n value (roughness coefficient)

METHODOLOGY:

FLO-2D model requires topographic data in the form of ASCII grid elements as input. The input data was obtained by creating a raster grid surface from the dataset provided. The bare earth raster surface was converted to ASCII grids using ArcGIS.

A 10-foot x 10-foot grid size was used for the FLO-2D analysis. The smaller grid size was selected to get a good resolution of the features such as roads and buildings.

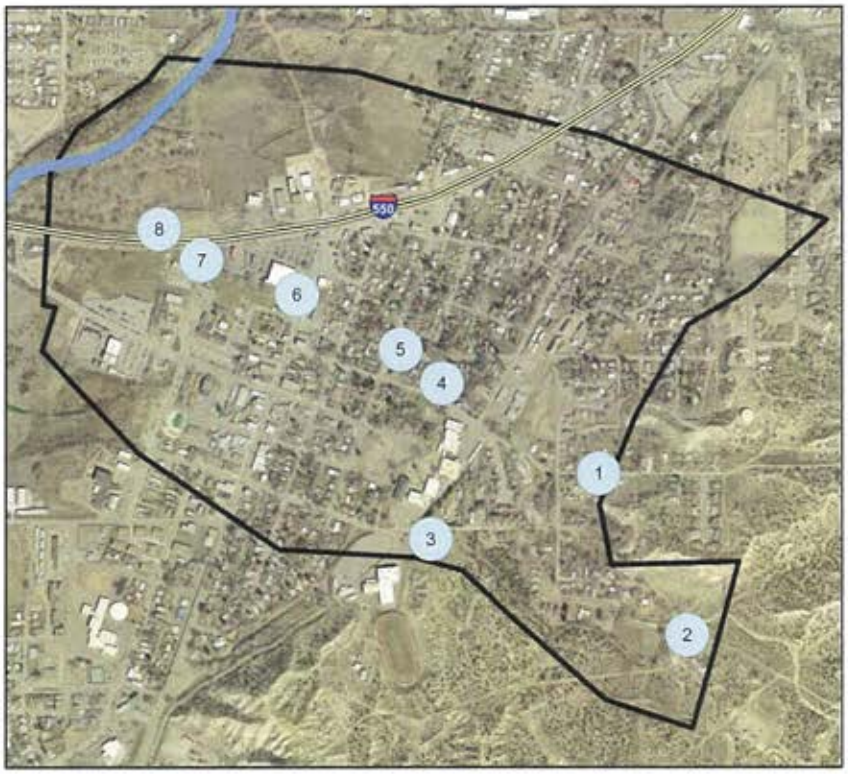
The FLO-2D domain was created encompassing the maximum potential floodplain boundary.

Manning's roughness coefficient was set using an ArcGIS shape file. The area was divided into segments based on the type of land use and extends of vegetation. The n-values for the grid elements were based on the roughness coefficient recommended by FLO-2D manual for rural areas and vegetation. Aerial imagery was used to determine the Manning's roughness coefficient. No infiltration losses were assumed to calculate the runoff from the grid elements.

Boundary Conditions

A boundary condition based on normal depth flow at the outflow nodes was used in the model to discharge water off the grid system. This prevents water from accumulating in the model, and allows flows to exit the system. The outflow nodes were selected along the downstream south, west, and north boundaries of the site. Additional inflow nodes were added along the Blanco Arroyo to simulate urban watershed runoff. The inflow hydrographs were selected from the HEC-HMS model as stated earlier. The inflow nodes chosen are shown in Figure 2.

Figure 2 – FLO-2D Inflow Node Locations



The inflow hydrographs for W610 was input into node one to simulate the incoming flow from this sub-basin. The combined flows from the sub-basins upstream of node two, Junction E in HEC-HMS, were used to simulate the flows upstream of the apex. The inflows for node two were allocated amongst 3 grid elements within the FLO-2D model. This was done to simulate the natural conditions in the drainage corridors by avoiding concentrated flows at individual grid elements. The inflow hydrograph from W710 was input into node three to simulate the incoming flow from this sub-basin. The inflow hydrograph from W1210 was input into node four to simulate the incoming flow from this sub-basin. The inflow hydrograph from W810 was input into node five to simulate the incoming flow from this sub-basin. The inflow hydrograph from W110 was input into node six to simulate the incoming flow from this sub-basin. The inflow hydrograph from W1010 was input into node seven to simulate the incoming flow from this sub-basin. The inflow hydrograph from W910 was input into node eight to simulate the incoming flow from this sub-basin. Inflow hydrographs within the gird element network were

located appropriately upstream so that the storm flows would be stable when entering the area of interest.

Building Footprints

The building footprints were digitized in ArcGIS for the sub-division and adjacent industrial areas. The Area Reduction Factors (ARFs) and Width Reduction Factors (WRFs) were used to model the building foot prints. FLO-2D calculates the ARF and WRF based on the percentage of building that falls on each grid element. This assumes that building footprints area not available for conveyance of floods. This is considered a conservative approach to estimate overland flows.

FLO-2D MODEL PARAMETERS:

Figure 2 – FLO-2D Control Variable Window

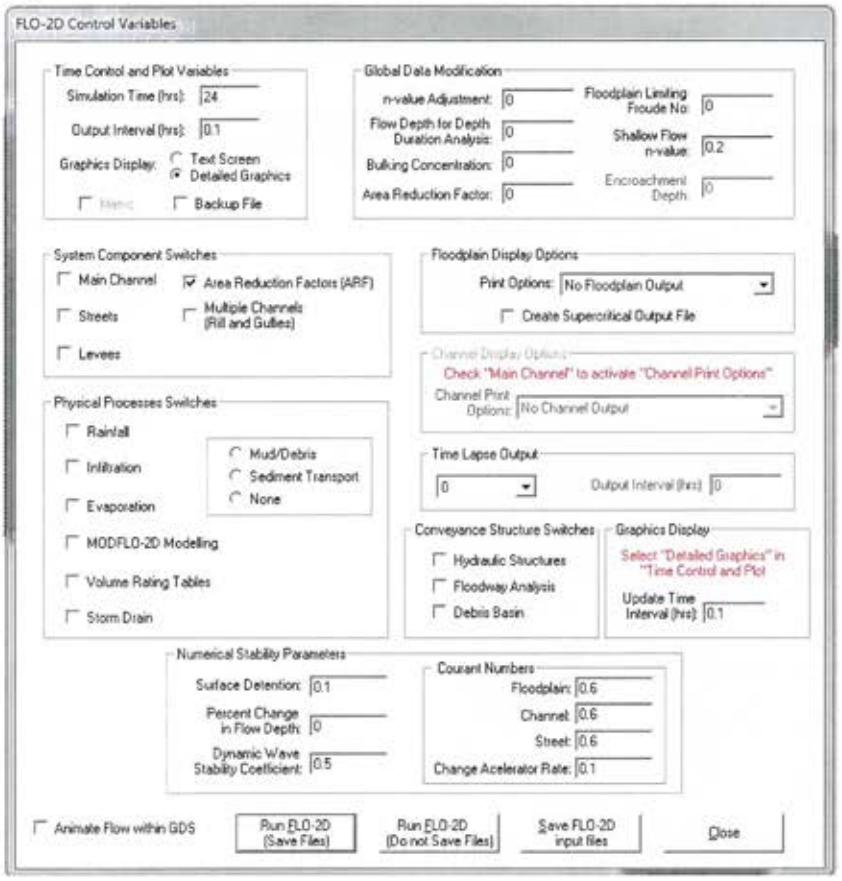


Figure 2 shows the Control Variable Window in FLO-2D used to adjust the default input parameters. No system components or physical process switches were used for the purposes of this analysis.

Time Control and Plot Variables

To improve the stability and reliability of the simulation, adjustments were made to the model parameters. The simulation time was set to 24 hours to allow the rainfall from the 24-hour storm and hydrograph to cycle completely through the model domain. Inflow hydrographs obtained from the HEC-HMS model had simulation time of 24 hours. Output intervals were set for every 6 minutes or 0.10 hours.

Numerical Stability Parameters

The Dynamic Wave Stability number for the model was set to 0.5.

RESULTS:

Figure 3 shows the Simulation Summary from the completion of the FLO-2D model. This indicates if problems were encountered with the model. All of the output boxes are checked indicating that the model performed as intended.

Figure 4 shows that the maximum flow depth for the Blanco Arroyo and the crossings through Aztec. Maximum flow depths range from 0 feet to 3.50 feet.

Figure 3a – 100-year; 24-hour FLO-2D Outputs Checklist

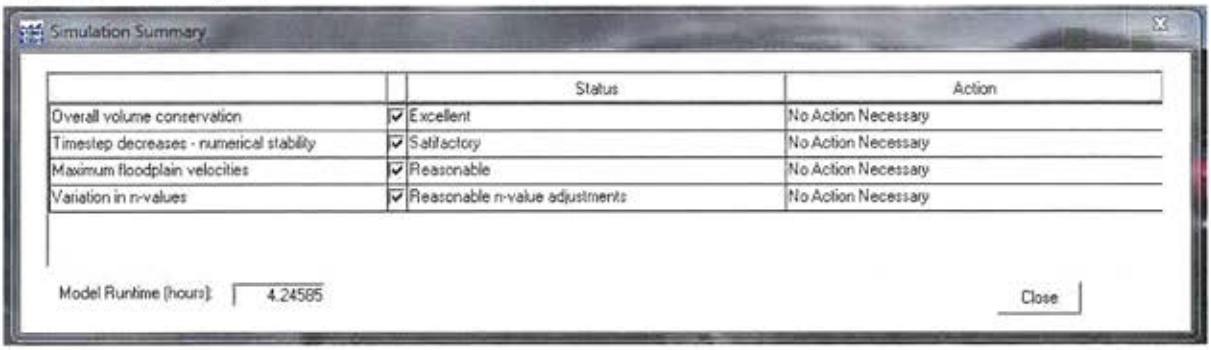


Figure 3a – 25-year; 24-hour FLO-2D Outputs Checklist

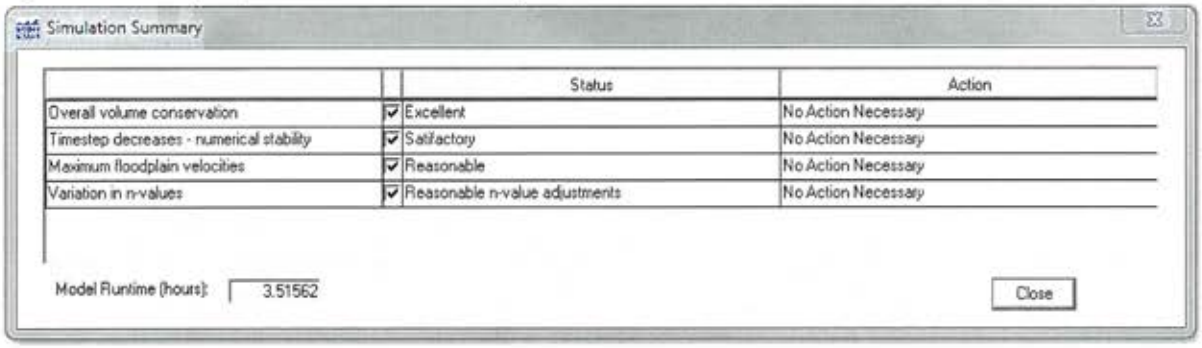


Figure 4a – 100-year; 24-hour FLO-2D Results

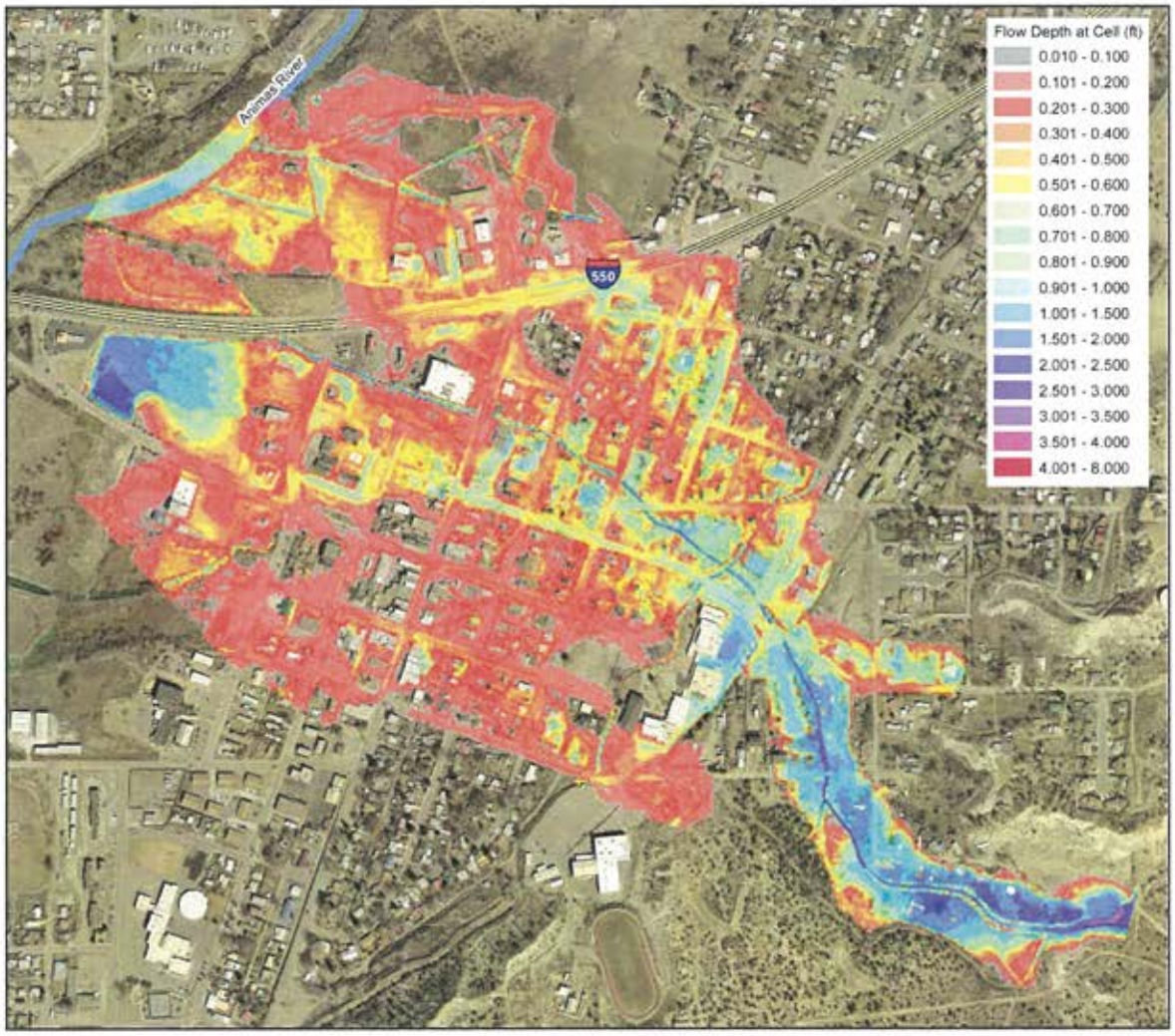
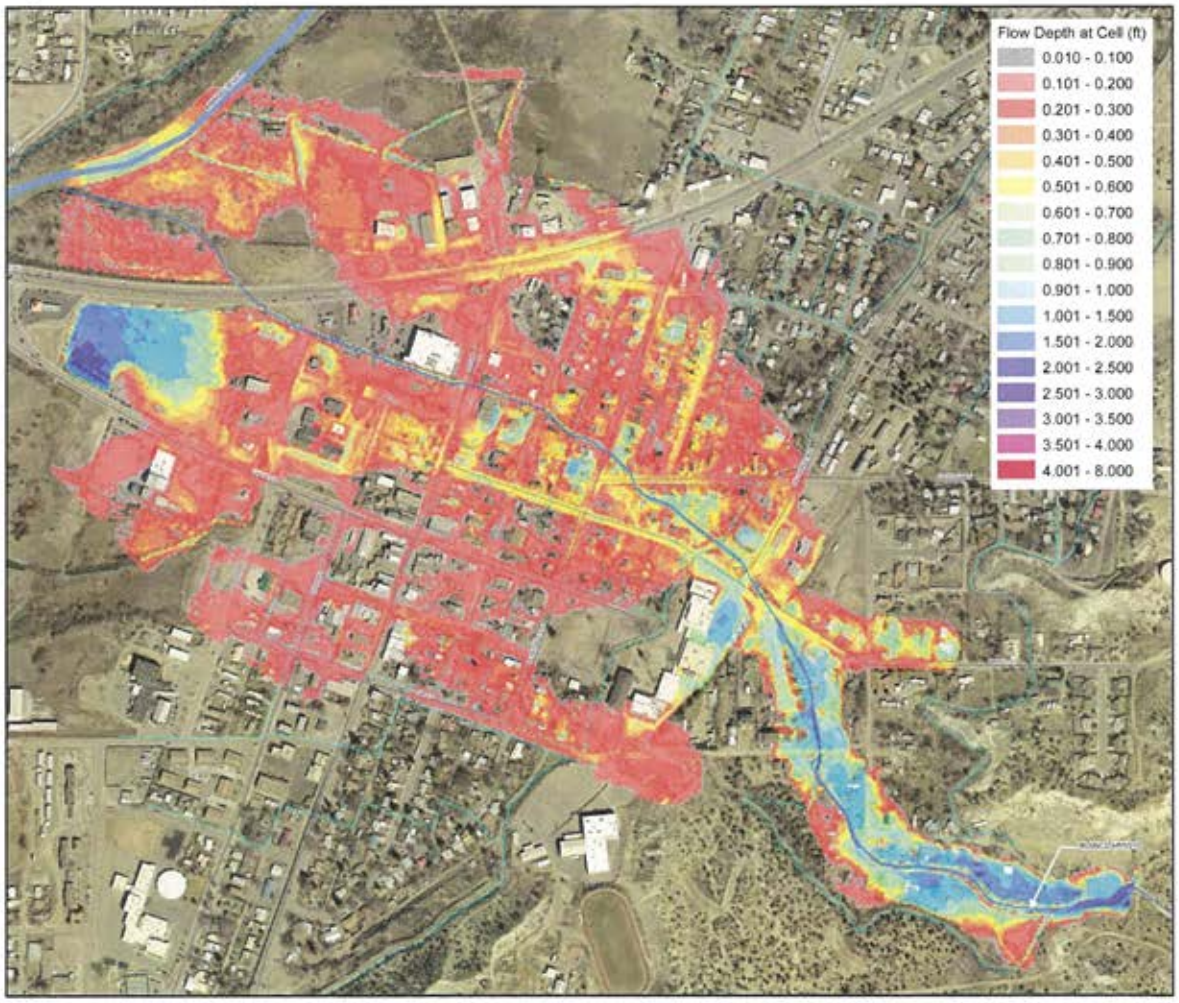


Figure 4b – 25-year; 24-hour FLO-2D Results



REFERENCES:

FLO-2D Software, INC (FLO-2D), 2015. [software package]. FLO-2D PRO, January 12, 2016.

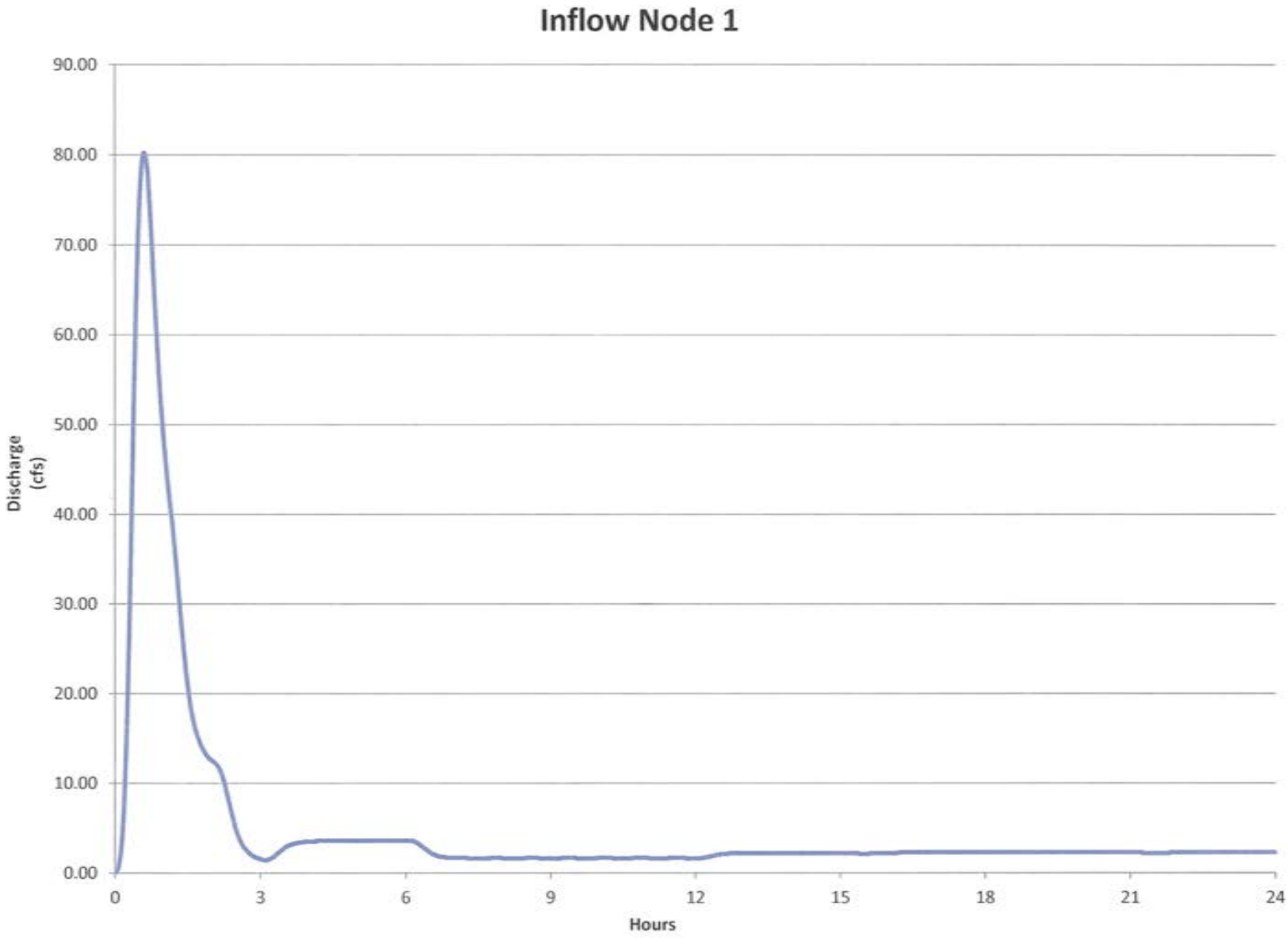
United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

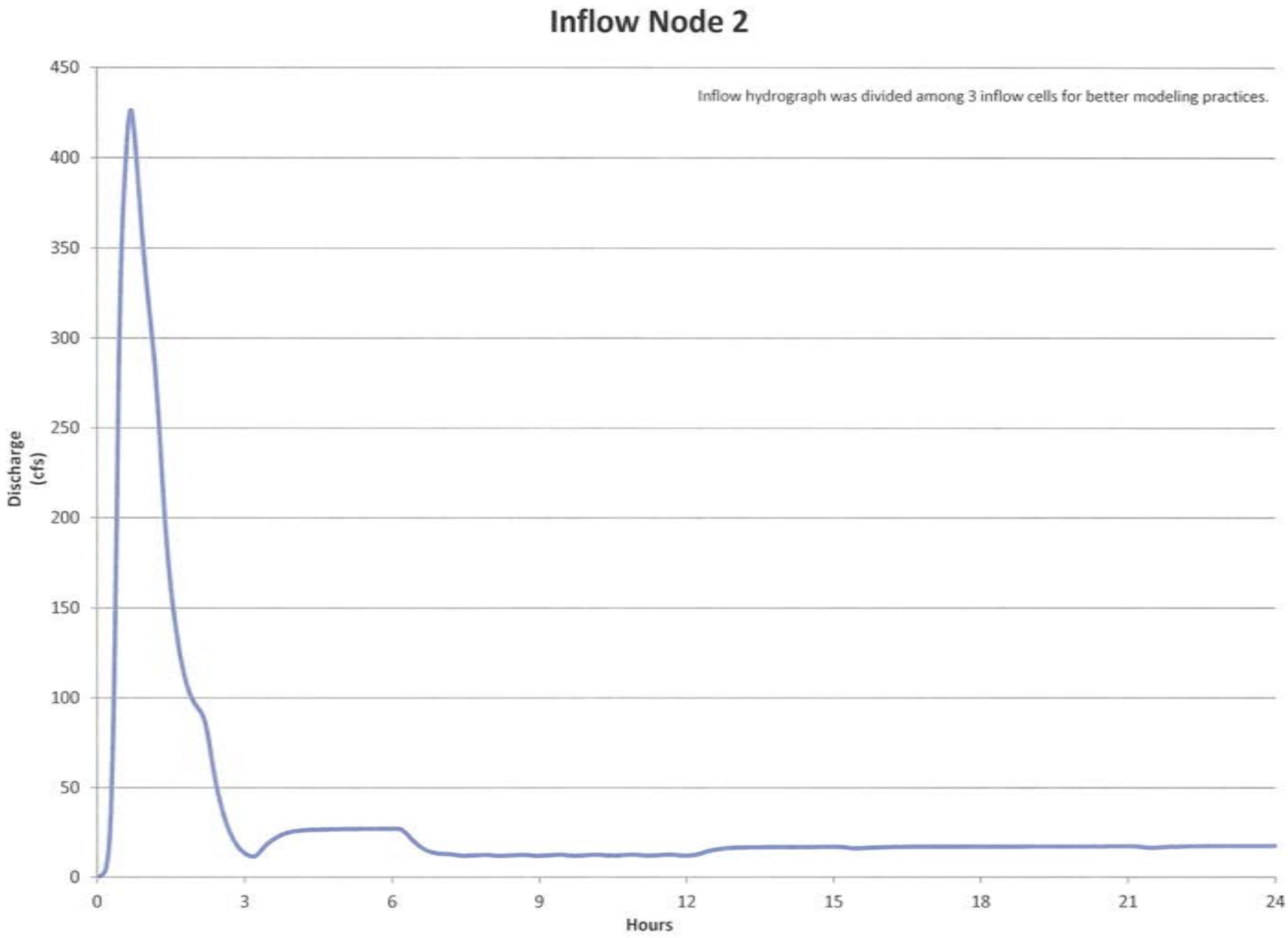
United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

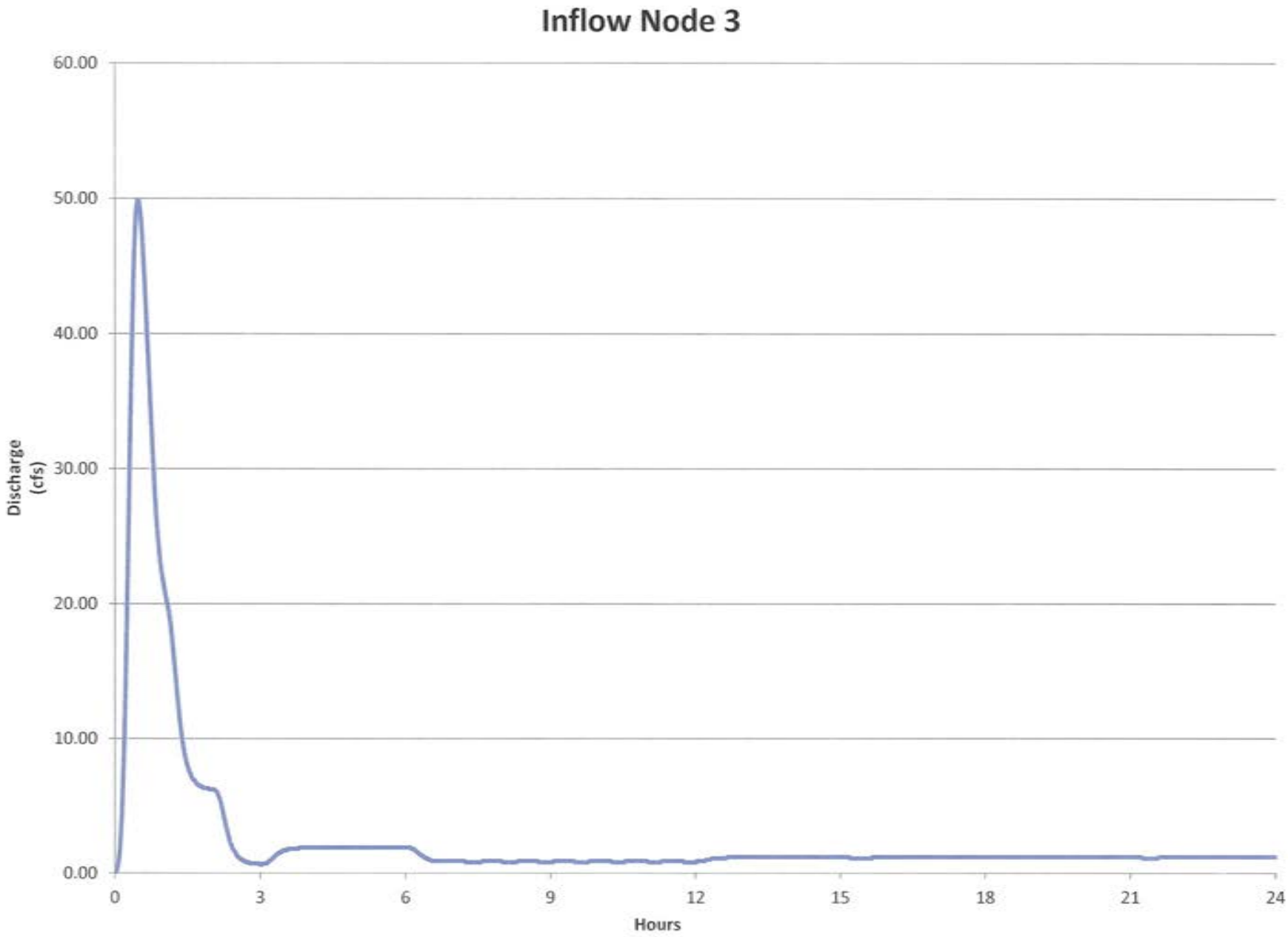
United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

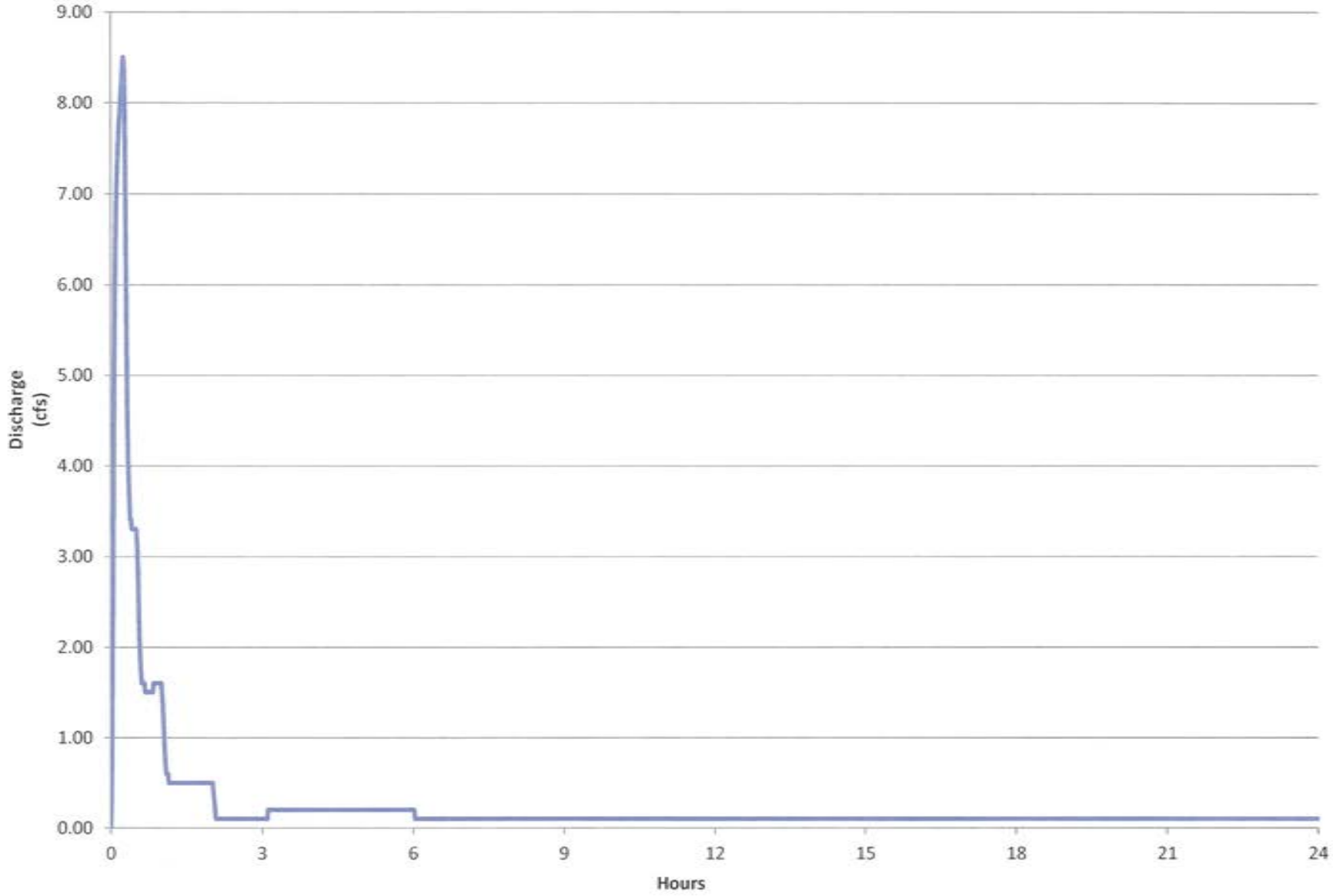
Attachment 1

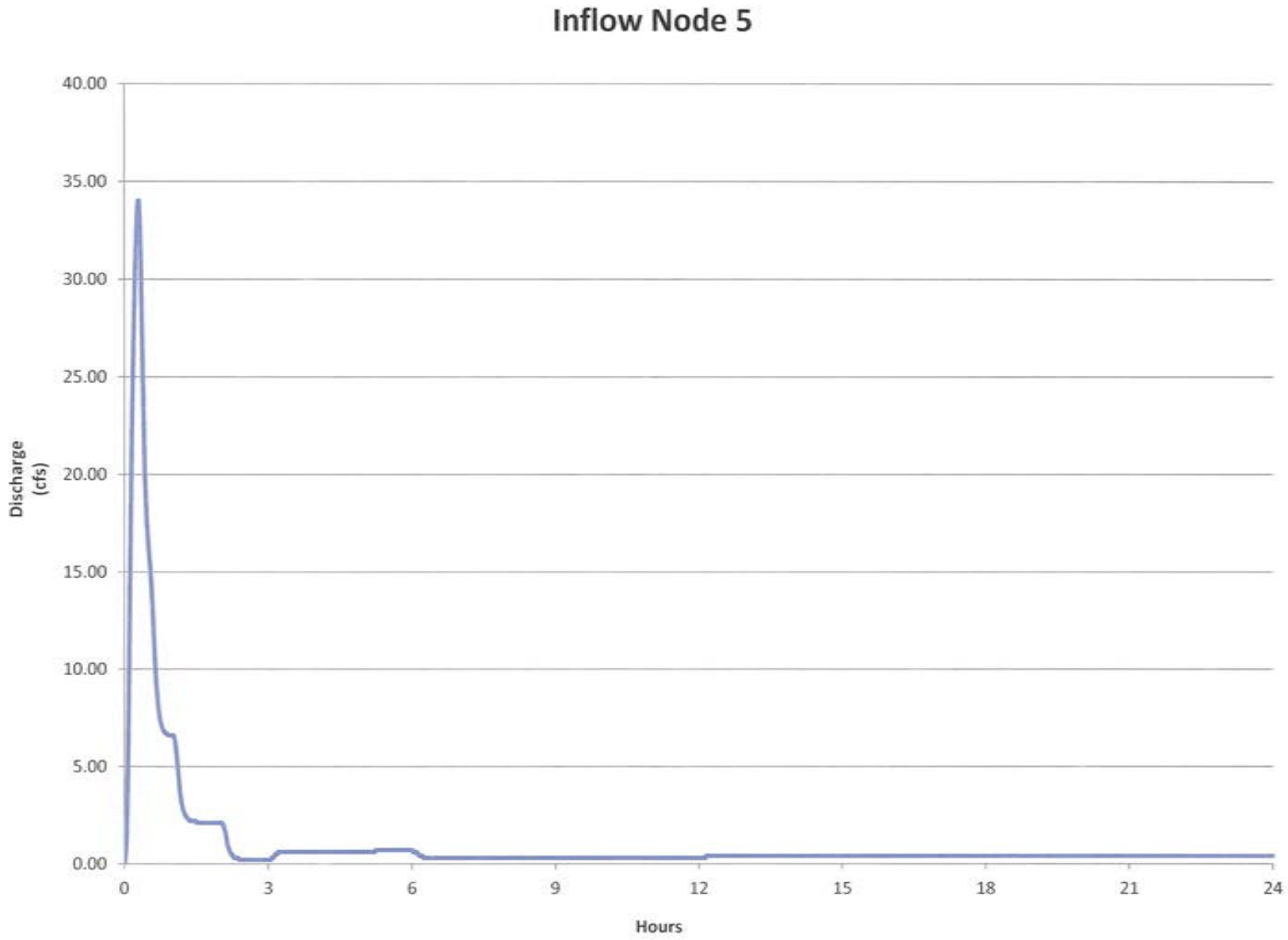

Inflow Node 1
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

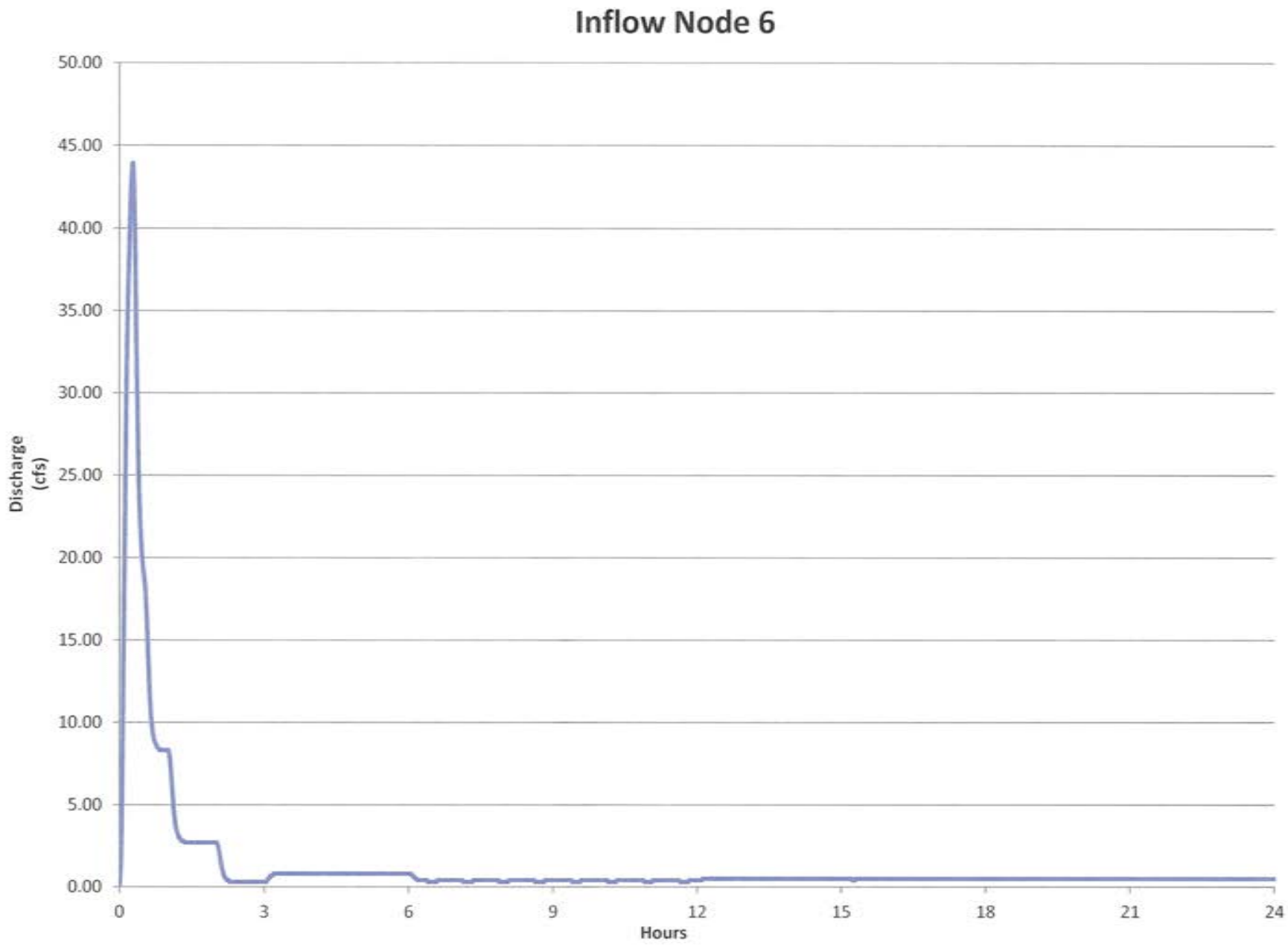

Inflow Node 2
Inflow hydrograph was divided among 3 inflow cells for better modeling practices.
Discharge (cfs)
450
400
350
300
250
200
150
100
50
0
0
3
6
9
12
15
18
21
24
Hours


Inflow Node 3
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

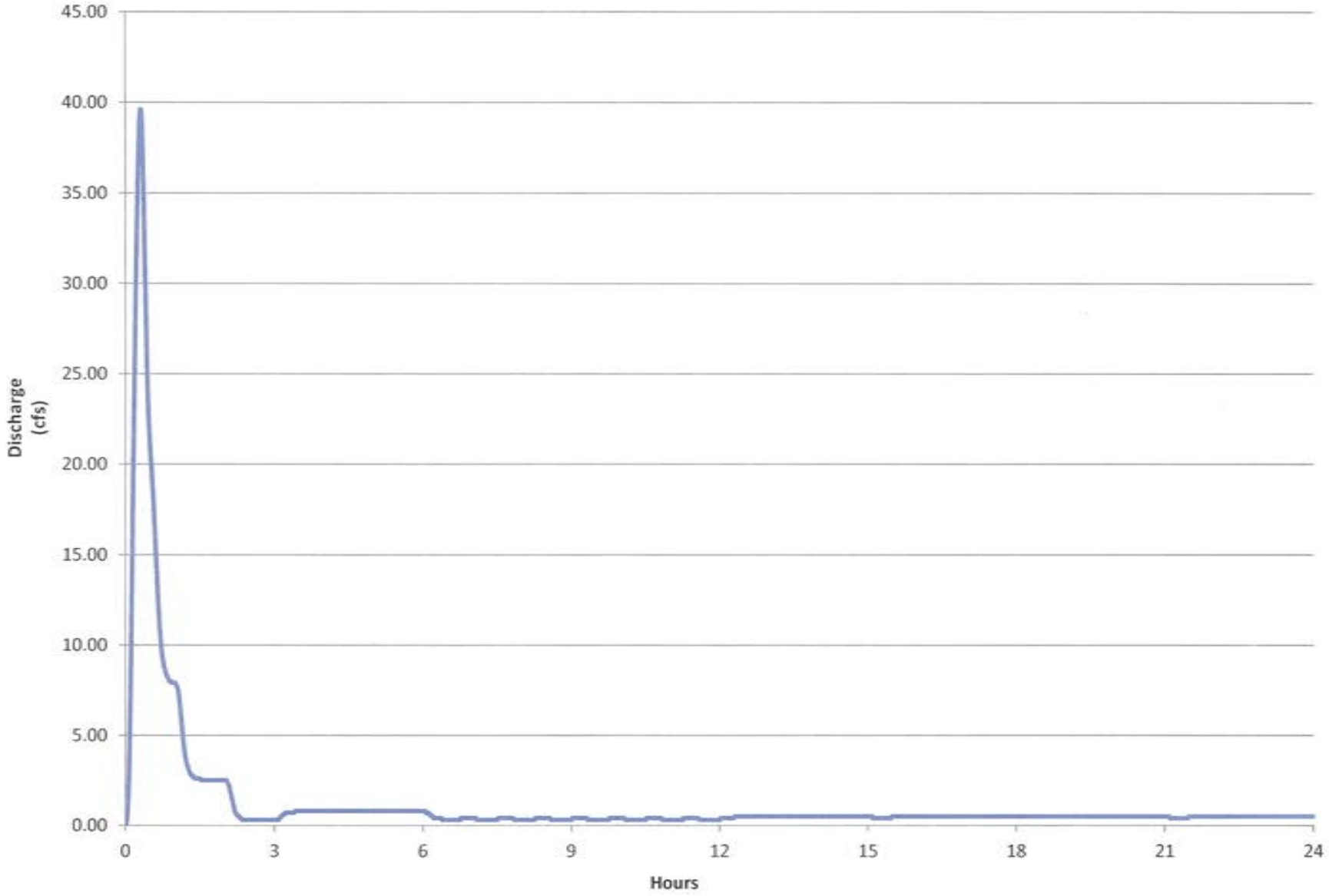
Inflow Node 4

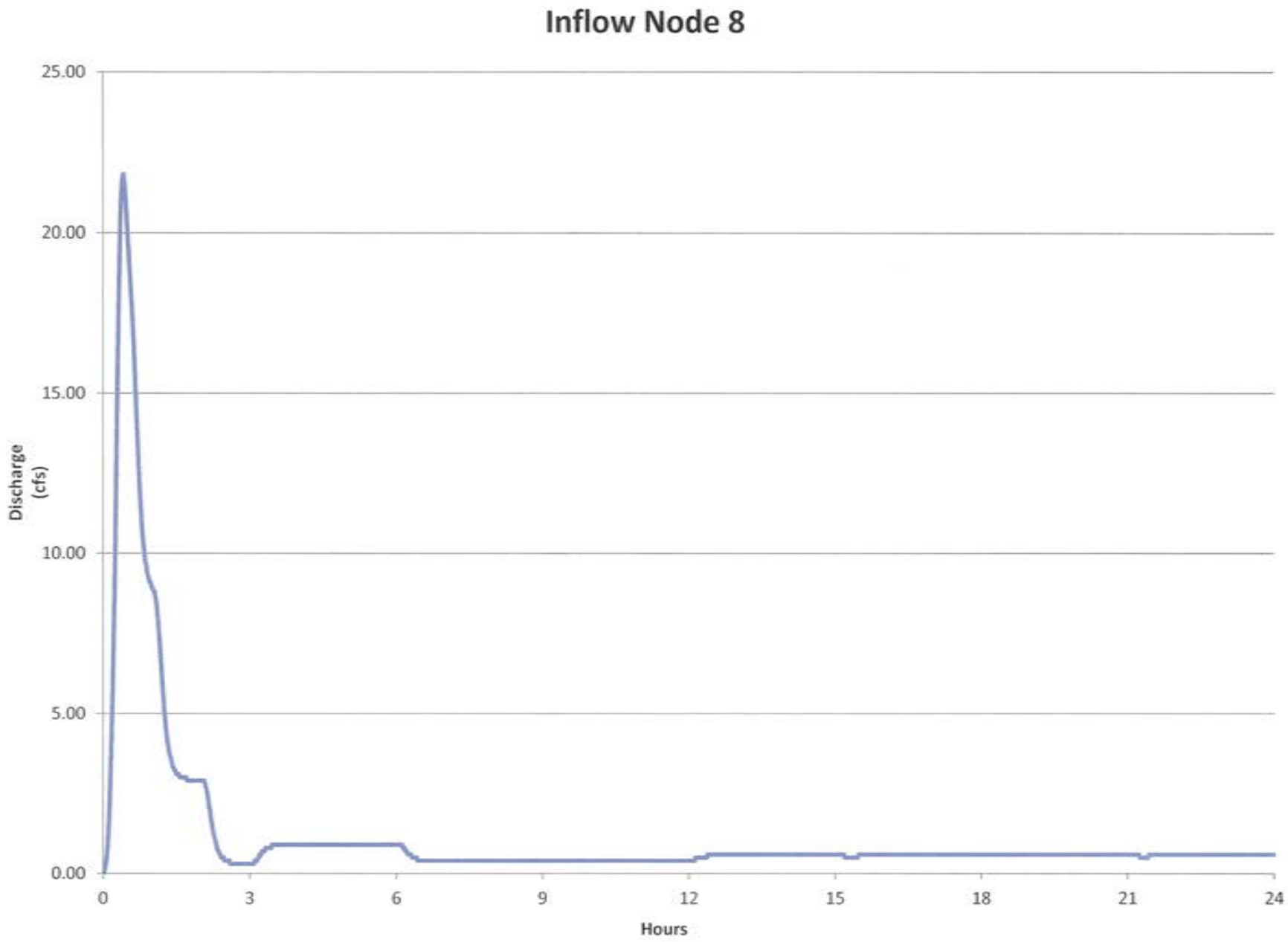


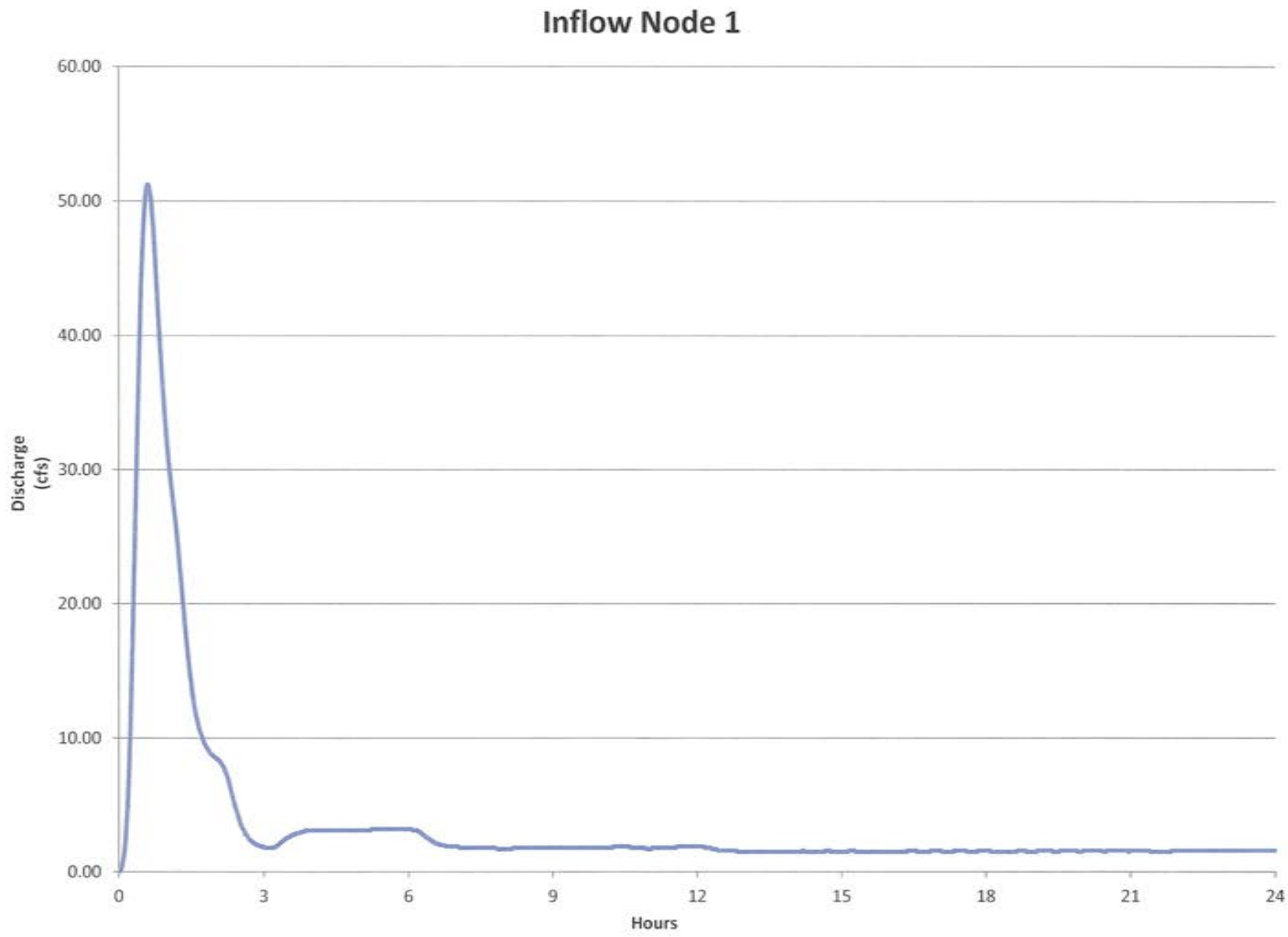

Inflow Node 5
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

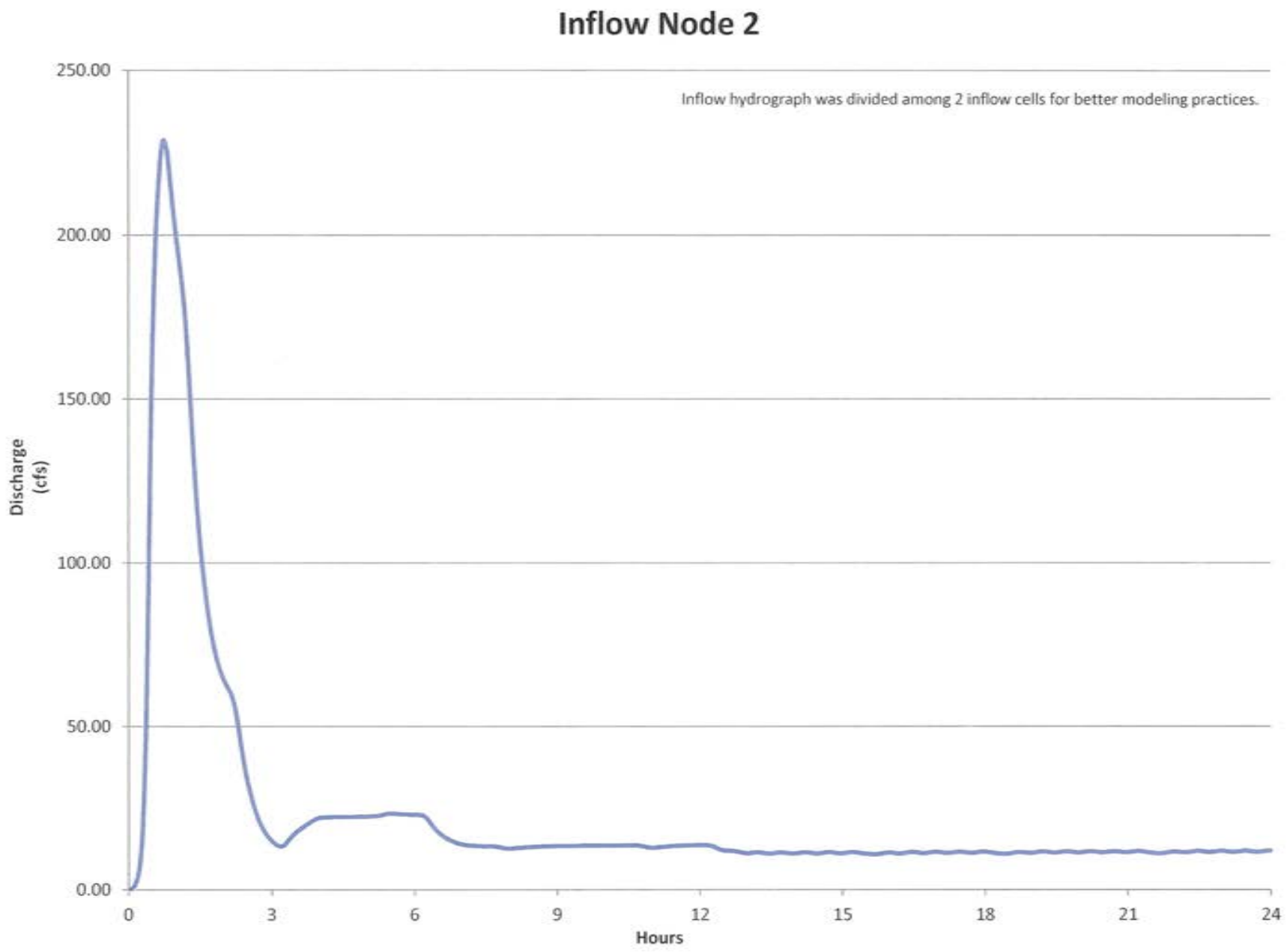

Inflow Node 6
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

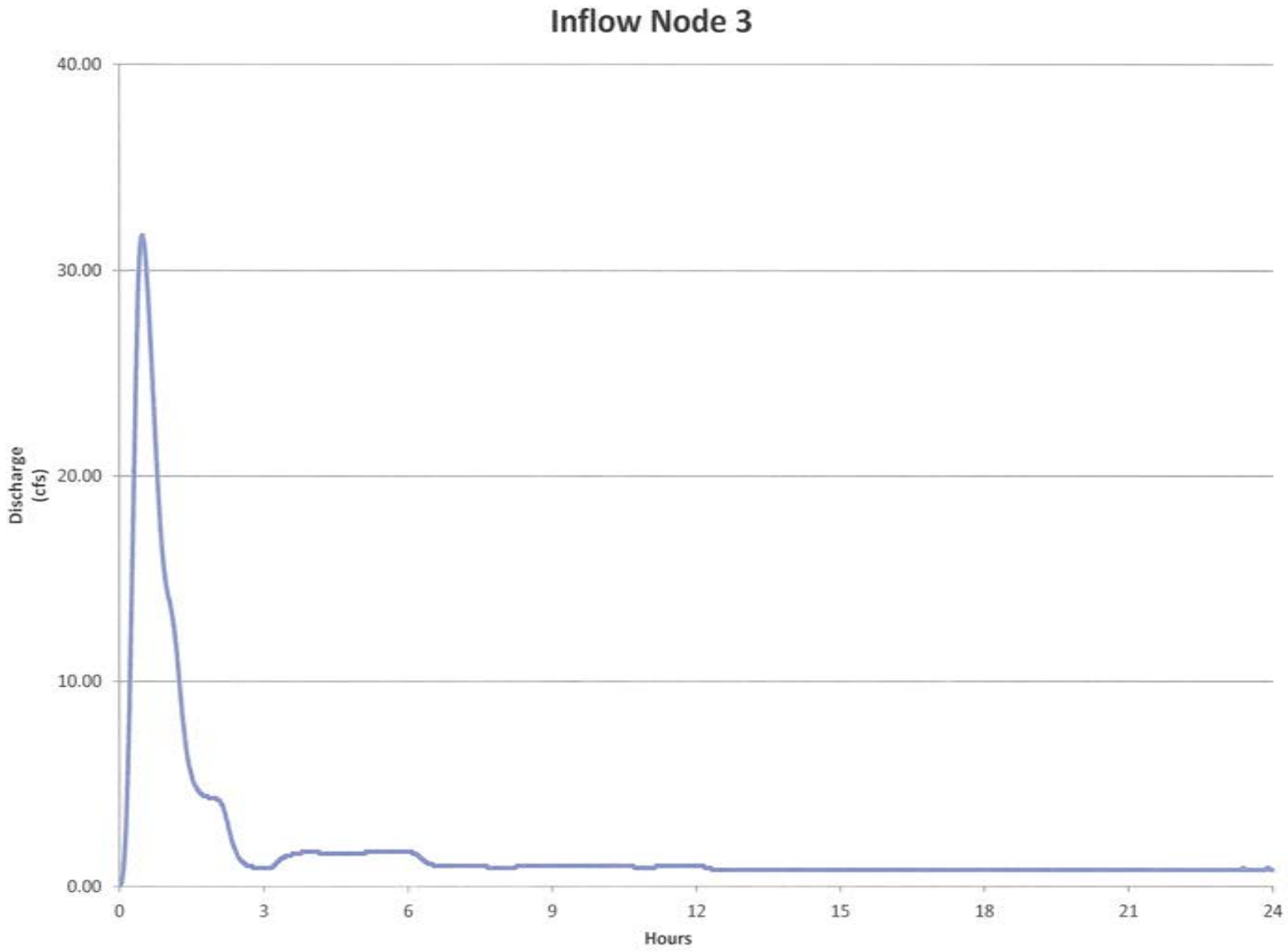
Inflow Node 7

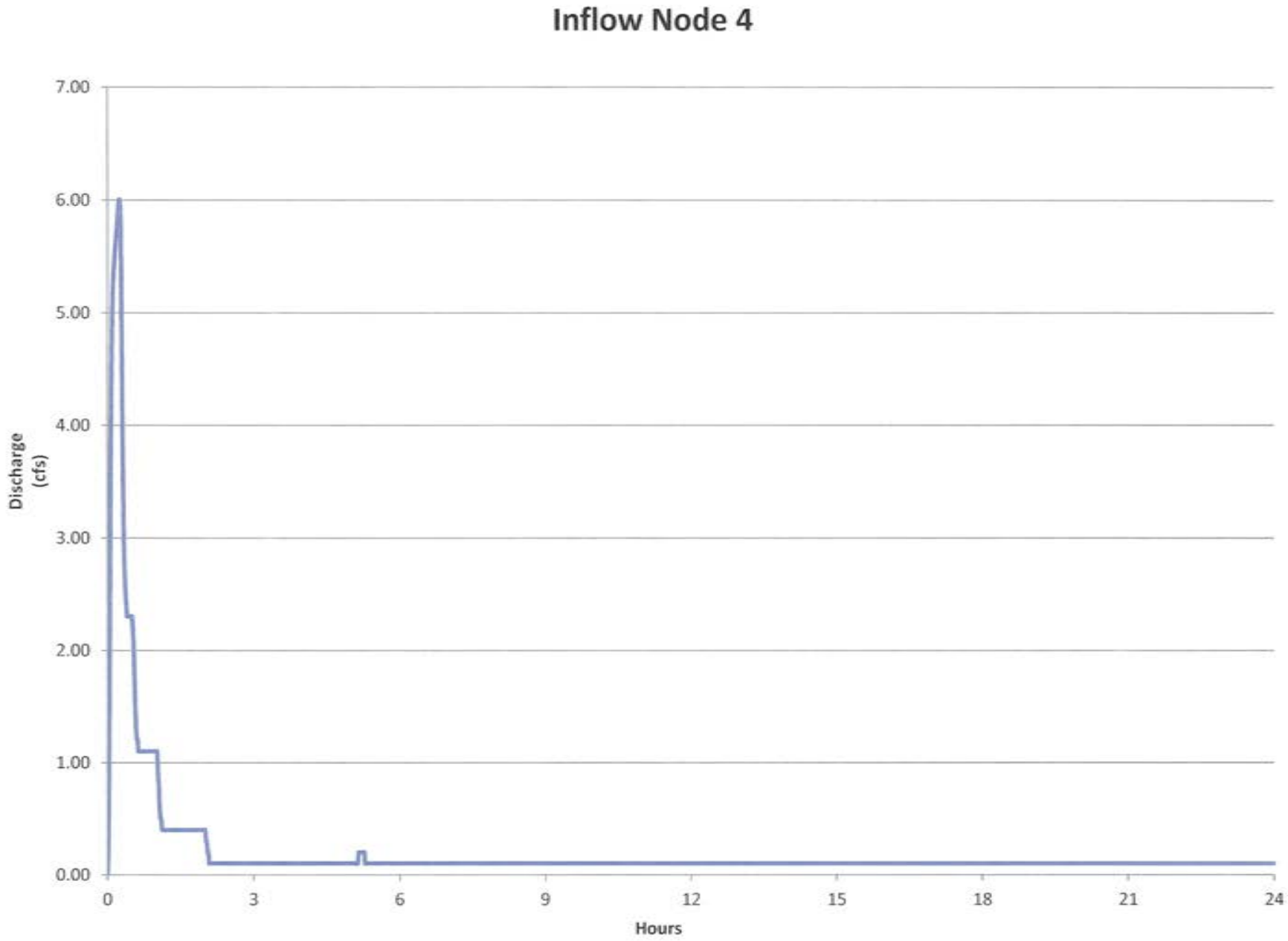


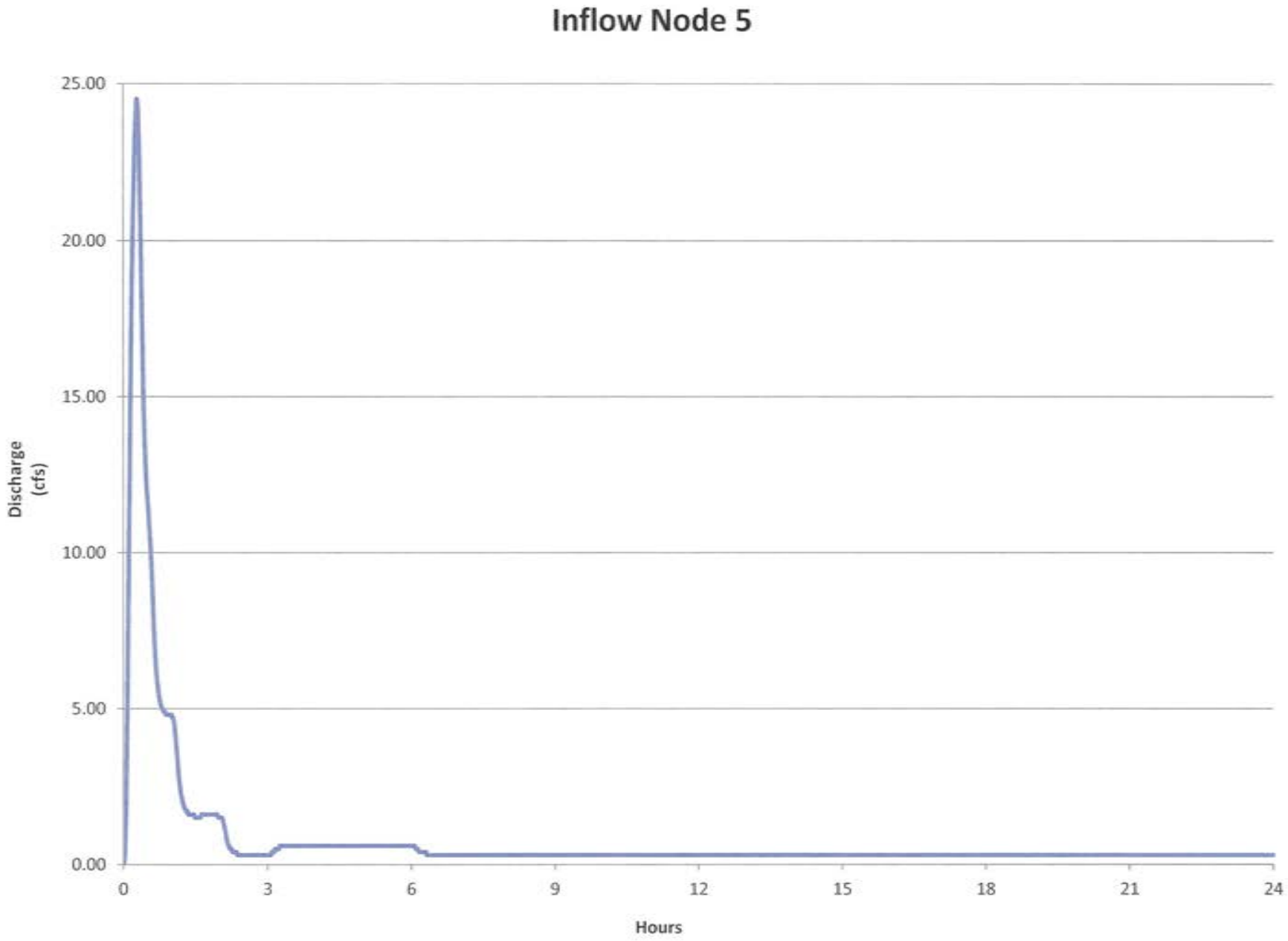

Inflow Node 8
25.00
20.00
15.00
10.00
5.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

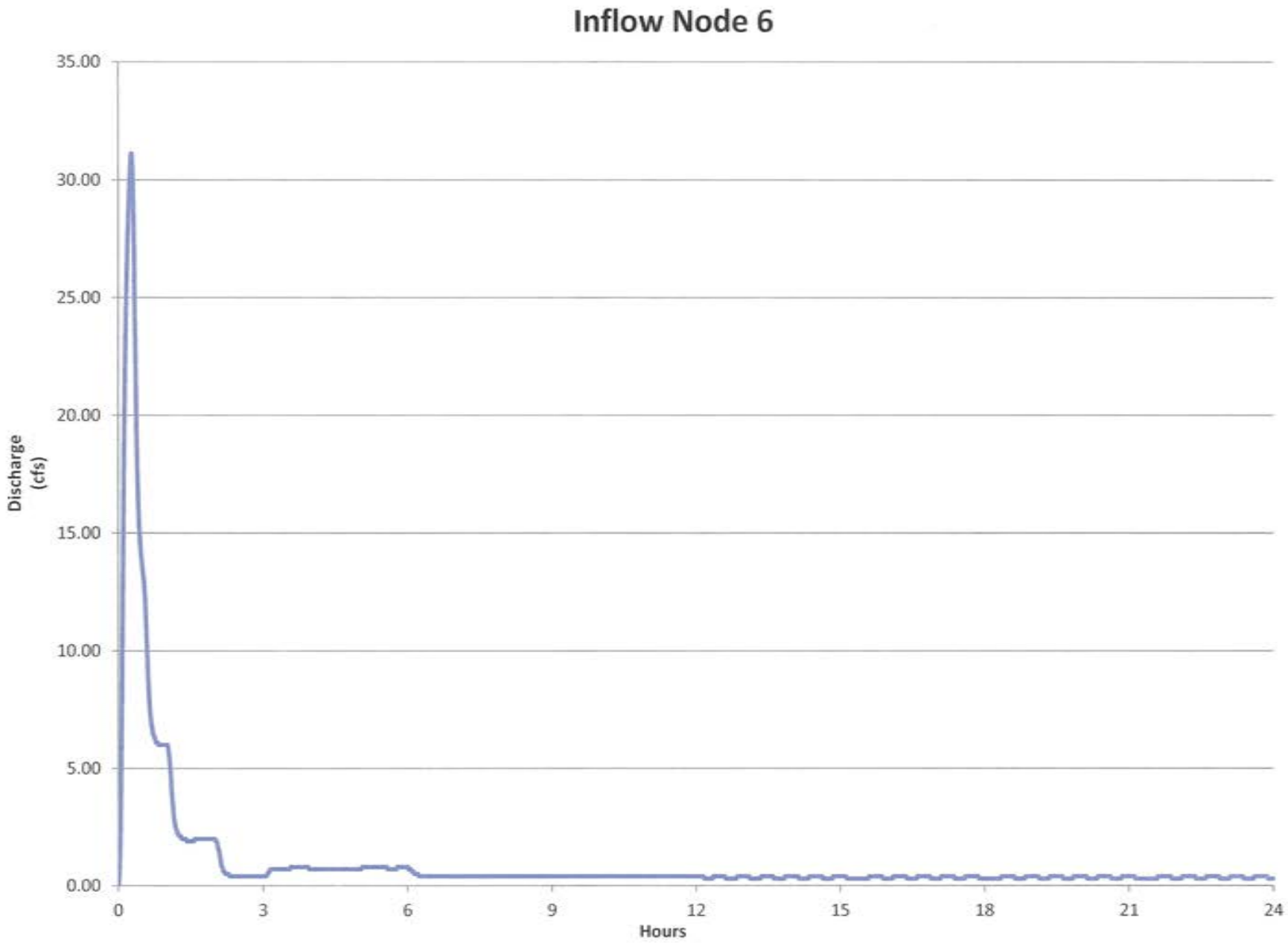

Inflow Node 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours


Inflow Node 2
Inflow hydrograph was divided among 2 inflow cells for better modeling practices.
250.00
200.00
150.00
100.00
50.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

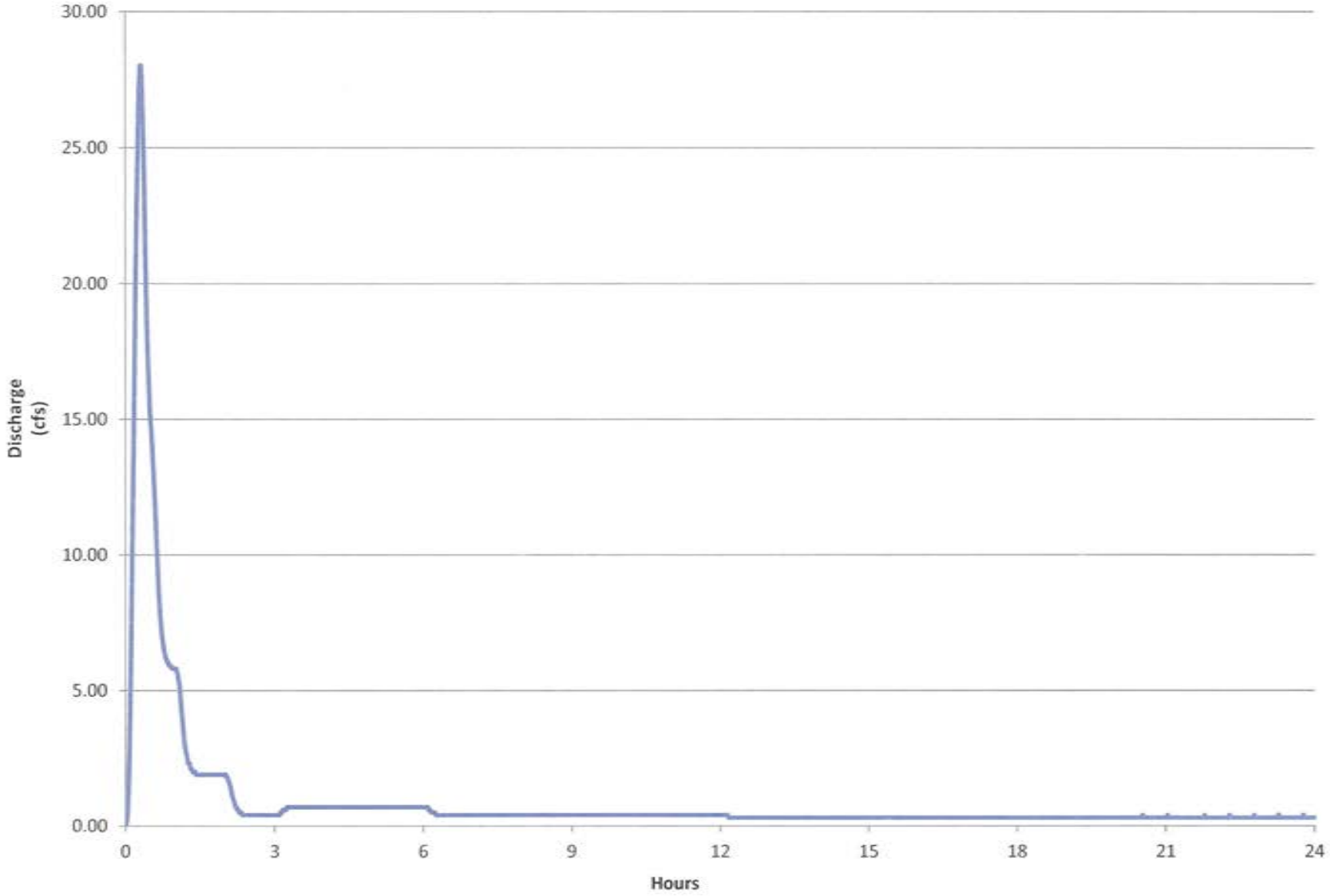

Inflow Node 3
40.00
30.00
20.00
10.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

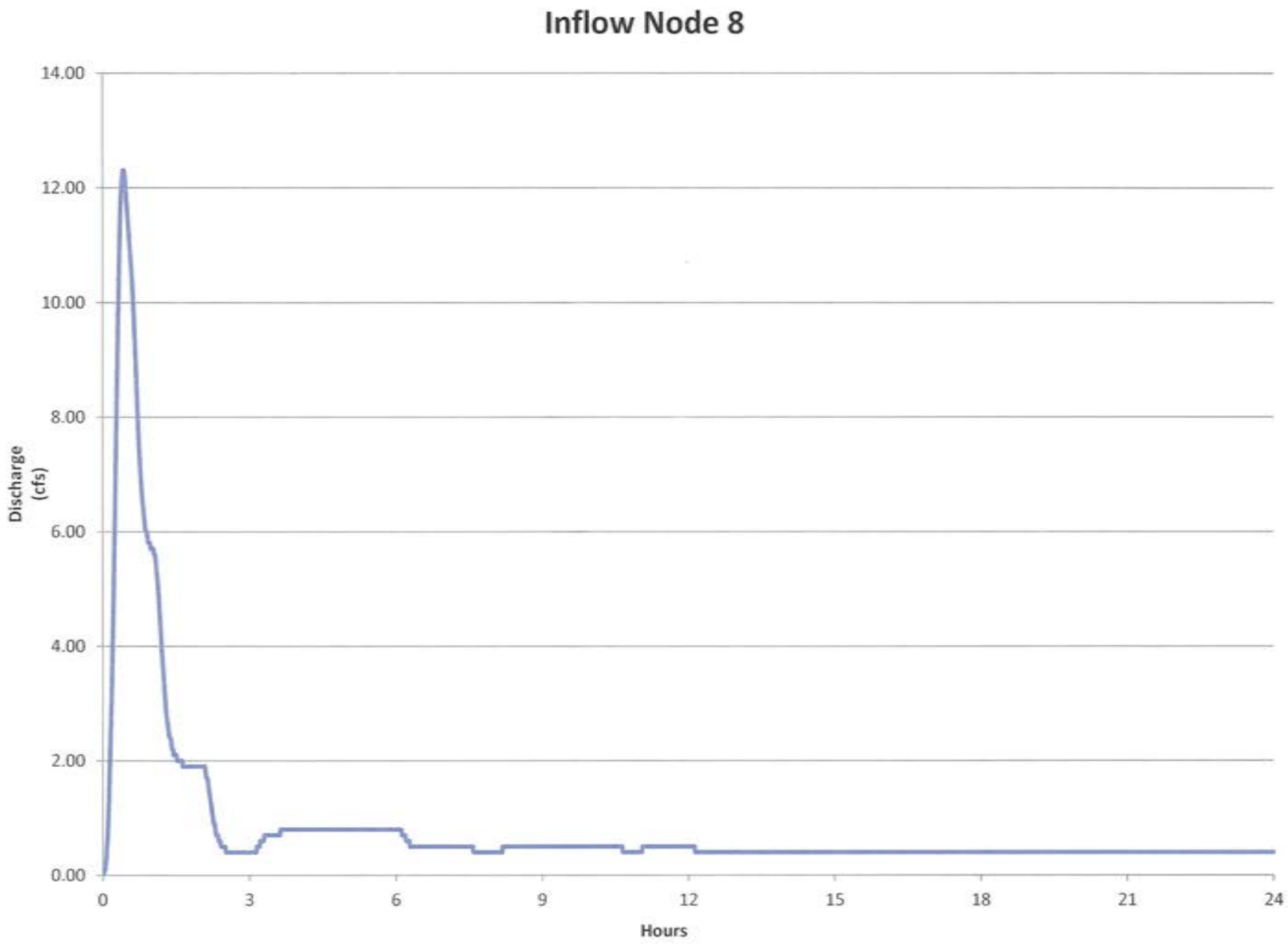

Inflow Node 4
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours


Inflow Node 5
25.00
20.00
15.00
10.00
5.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours


Inflow Node 6
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

Inflow Node 7




Inflow Node 8
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Discharge (cfs)
0
3
6
9
12
15
18
21
24
Hours

Appendix E – Alternatives Analysis – Conceptual Layout

Blanco Arroyo
Alternative 1

Legend

- Proposed Box Culvert Crossing
- Detention Basin
- Proposed Channel
- Proposed Storm Drain
- Aztec Roads
- Blanco Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 80 160 320 480 Feet

AECOM

DRAFT

Blanco Arroyo
Alternative 2

Legend

- Proposed Box Culvert Crossing
- Detention Basin
- Proposed Channel
- Proposed Storm Drain
- Aztec Roads
- Blanco Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 80 160 320 480
Feet

AECOM
DRAFT

Blanco Arroyo
Alternative 3

Legend

- Proposed Box Culvert Crossing
- Detention Basin
- Proposed Channel
- Proposed Storm Drain
- Aztec Roads
- Blanco Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 80 160 320 480 Feet

AECOM

DRAFT

Blanco Arroyo
Recommended Mitigation Concept

Legend

- Proposed Box Culvert Crossing
- Detention Basin
- Proposed Channel
- Proposed Storm Drain
- Aztec Roads
- Blanco Arroyo

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec.

0 80 160 320 480 Feet

AECOM

DRAFT

Appendix F – Recommended Alternatives Analysis

Appendix F.1 – FLO-2D Proposed Conditions

- Appendix F.1.1 – Detention Basin Calculation
- Appendix F.1.2 – Channel Calculations
- Appendix F.1.3 – Culvert Calculations

AECOM	Calculation Sheet				
Project Name:	Blanco Arroyo			**Calculation Number:**	2B
Client Name:	City of Aztec, New Mexico			**Revision Number:**	Rev_1
Project Number:	Job No.	Cost Code	Parent (if any)	**Prepared By/Date:**	TB /PDC 12-21-2017
	60487201	30000	N/A		
Title:	Drainage Analysis Using FLO-2D				

PROBLEM STATEMENT:

The purpose of this calculation package is to analyze the recommended alternative for the Blanco Arroyo watershed using FLO-2D PRO.

REQUIRED DELIVERABLES:

- Maps showing maximum flow depth from the FLO-2D results for the recommended alternative for the Blanco Arroyo for the 25-year and 100-year storm events.

DATA /ASSUMPTIONS:

- The inflow hydrographs were obtained from the HEC-HMS model developed to simulate the recommended alternative for the Blanco Arroyo. Details of the HEC-HMS model are discussed in the following sections. The hydrographs used in FLO-2D are attached in Attachment 2.
- The conceptual layout of the Recommended Alternative is shown in Figure 1.
- Aerial survey and topography data was provided by the City of Aztec. The data was processed to remove the buildings and other features to reflect the bare earth topo.
- The FLO-2D analysis was done in horizontal projection – NM State Plane West NAD 83, feet.

Variable Definitions

n Manning's n value (roughness coefficient)

METHODOLOGY:

RECOMMENDED ALTERNATIVE HEC-*HMS MODEL*

A HEC-HMS model was prepared to simulate the recommended alternatives condition for Blanco Arroyo. The existing condition HEC-HMS model was used as the base condition model, but was modified to include the proposed detention basin. The proposed detention basin was sized using Civil 3D as shown in Figure 1. The proposed basin is 7 feet deep with 4H: 1V side slopes. A weir spillway was sized with 3 feet height and 12 feet length to convey the excess flows. A 36-inch low-flow outlet pipe is assumed at the bottom of the Detention Basin. The details of the detention basins and calculations are attached in Attachment 1.

The Stage-Storage-Discharge table was entered in the Proposed Condition HEC-HMS model to obtain the outflow hydrograph from the detention basin for the 25-year and 100-year storm events. The outflow hydrograph was input in the FLO-2D model to simulate the proposed conditions.

All other inflow hydrographs input into the FLO-2D model are the same from the existing conditions. Refer to the FLO-2D existing conditions calculation package for the all other assumptions and boundary conditions unless otherwise specified below.

RECOMMENDED ALTERNATIVE *HEC-HMS MODEL*

Channel

A channel was sized downstream of the detention basin to convey the outflow from the detention basins to upstream of the Zia Street Culvert. The channel assumes an earthen bottom width of 10-feet with 3H: 1V side slopes. The channel bed slope was assumed at approximately 0.012 ft/ft and daylights into the natural channel grade upstream of the Zia Street culvert. The channel bed profile used in the FLO-2D model is attached in Attachment 2.

The channel was modelled using the channel option in FLO-2D. The grid elevations were artificially lowered along the channel to account for the channel depth. This was done to avoid any numerical stability issues in the model.

P:\Projects\City of Aztec\60487201 Blanco\4 CADD GIS\GIS\MXD

81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

81"x 49" Arch CMP Culvert (Proposed*)

Alley Crossing off of Rio Grande Ave

3- 36" CMP Culvert (Proposed)

Rip Rap Lined Channel (D_{50} = 6")

Detention Basin

Proposed Channel

Legend

- Proposed Box Culvert Crossing
- Existing Box Culvert Crossing
- Proposed Channel
- Blanco Arroyo
- Aztec Roads
- Detention Basin

Notes:
1. Aerial Imagery, Topographic dataset, Roads, Irrigation Ditches, and Waterways Flowline were provided by the City of Aztec

0 600 1,200 Feet

Blanco Arroyo Sub-Division
Figure 1
Recommended Alternative Features
City of Aztec, New Mexico

AECOM

The hydraulic properties of the channel were verified using Bentley's FlowMaster. The FlowMaster calculation for the channel segments are attached in Attachment 2.

Existing Culverts

The existing culverts along the Blanco Arroyo watershed were analyzed using Bentley CulvertMaster and HY-8 programs. The peak discharges for the 25-year and 100-year 24-hour storm events were obtained from the Proposed Condition HEC-HMS model. Other hydraulic properties of the culverts such as the allowable head water and culvert inverts were obtained from the topographic data and HEC-RAS model for the Blanco Arroyo. Other parameters such as the culvert upstream and downstream inverts and manning's roughness were adjusted in the FLO-2D model to avoid instability in the model. Two scenarios were evaluated to see how the proposed detention basin would affect the performance of the existing culverts.

Proposed Condition 1 model was created in FLO-2D to understand the effects of the existing culverts with the detention basin and the proposed channel. The culvert at Pollard Road upstream of Zia Street was assumed to be replaced for the Proposed Condition 1 model. This culvert is included as a part of the channel proposed improvements. The discharge rating table developed using CulvertMaster and HY-8 were input into the FLO-2D model. The discharge rating tables are attached in Attachment 3.

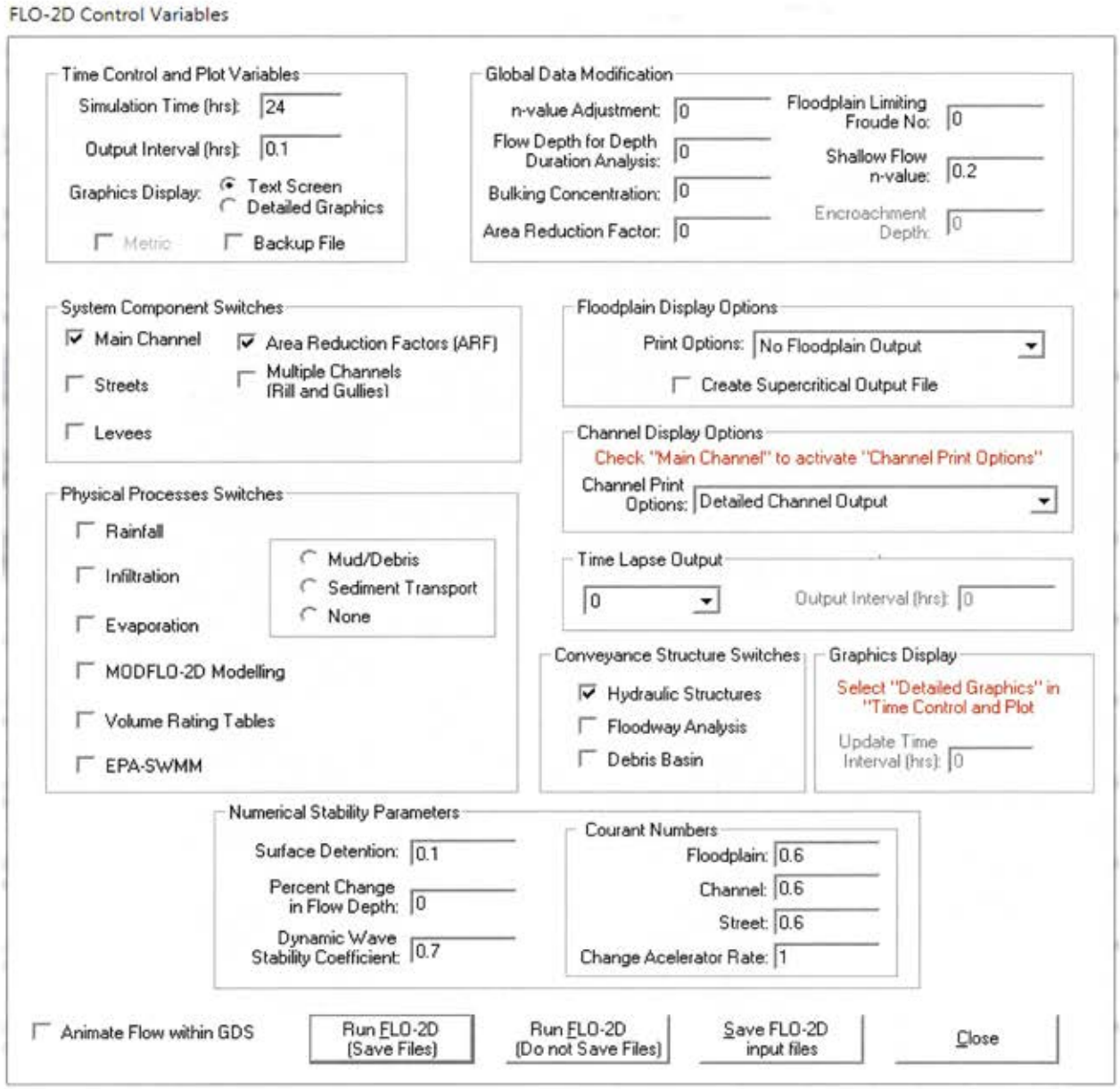
Table 1 summarizes the existing culvert sizes and peak discharge data. The culvert calculation indicated that the culvert capacity were not sufficient to pass the 25-year 24-hour storm at five locations along the Blanco Arroyo. The five culvert locations are identified in Table 1.

Figure 2 shows the Control Variable Window in FLO-2D used to adjust the default input parameters. No system components or physical process switches were used for the purposes of this analysis.

Table 1: Culvert Summary and Discharge

Culvert/structure location	Junction ID	25yr Q (cfs)	Existing Conditions Culvert Size	Allowable Head Water Elev (ft)	Existing Culvert Capacity, Q cfs	Does the Culvert need to Resized?
Dirt road Culvert Crossing upstream of Zia St	E	119	3 - 24 Inch CMP - Circular	5705.99	43	RESIZE
Culvert at Zia Street	F	169	84 Inch CMP - Circular	5695.9	334	OK
Culvert at Blanco/Creekside Village	F	169	72 Inch Concrete - Circular	5680.5	220	OK
Culvert at Rio Grande Ave	G	195	60 Inch CMP - Circular	5672.8	154	RESIZE
Alley Crossing, DS of Rio Grande Ave	G	195	60 Inch CMP - Circular	5668.5	131	RESIZE
Culvert at Lover Ln	H	196	60 Inch Concrete - Circular	5655.74	143	RESIZE
Culvert box at Mesa Verde	I	202	2 - 9.25 ft x 6 ft Concrete	5653.94	1000	OK
Alley Crossing bridge downstream of Mesa Verde	I	202	1 - 17 ft x 3 ft CMP	5646.5	197	RESIZE
Bridge at Church Ave	I	202	1 - 12 ft x 5.5 ft CMP	5645	356	OK
Alley crossing bridge downstream of Church Ave	I	202	1 - 18.59 ft x 4.51 ft CMP	5638.53	271	OK
Culvert box at Main St	J	209	2 - 10 ft x 4 ft Concrete	5632.5	725	OK
Culvert at Ash St	K	216	60 Inch CMP - Circular	5614.52	157	RESIZE
Culvert box at Aztec Blvd	K	216	1 - 14.5 ft x 6.6 ft Concrete Box	5615.03	981	OK

Figure 2 – FLO-2D Control Variable Window



Time Control and Plot Variables

To improve the stability and reliability of the simulation, adjustments were made to the model parameters. The simulation time was set to 24 hours to allow the hydrograph from the 24-hour

storm and to cycle completely through the model domain. Inflow hydrographs obtained from the HEC-HMS model had simulation time of 24 hours. Output intervals were set for every 6 minutes or 0.10 hours.

Numerical Stability Parameters

The Dynamic Wave Stability number for the model was set to 0.7.

Proposed Culverts:

Five new culverts are proposed along the Blanco Arroyo as summarized in Table 1 and shown in Figure 1. The five culverts will replace the existing culverts. The proposed culverts were analyzed with Bentley's Culvert Master to obtain the culvert rating tables.

A second scenario, Proposed Condition 2, model was created in FLO-2D to understand the effects of the proposed culverts with the detention basin and the proposed channel. The discharge rating tables for the proposed culverts were obtained from CulvertMaster and HY-8 programs.

RESULTS:

Figure 3A shows the Simulation Summary from the completion of the Proposed Condition 1 FLO-2D model. This indicates if problems were encountered with the model. The "sticky grids" were reviewed and the grid elements were adjusted.

Figure 3B shows the Simulation Summary from the completion of the Proposed Condition 2 FLO-2D model.

Figure 4 shows the flow depth for the Proposed Condition model 1 with the existing culverts for the 25-year 24-hour storm event.

Figure 5 and 6 shows the flow depth for the Proposed Condition model 2 with the proposed culverts for the 25-year and 100-year storm respectively.

Figure 7 and 8 shows the reduction in flow depths along the Blanco Arroyo compared to the existing conditions with the addition of the proposed culverts, detention basin and channel for the 25-year and 100-year storm respectively. The reduction in flow depth is the range of 0 feet to 1 foot for the 25-year storm event. The reduction in flow depth is the range of 0 feet to 1.5 foot for the 100-year storm event except in the ponding area south of Aztec Blvd.

Figure 3A – 25-year 24-hour Proposed Condition FLO-2D Outputs - Simulation Summary

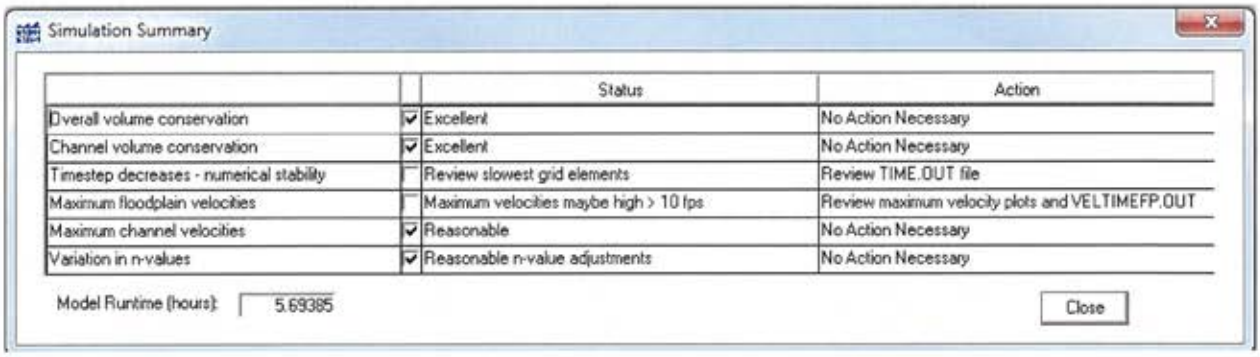


Figure 3B – 25-year 24-hour Proposed Condition FLO-2D Outputs - Simulation Summary

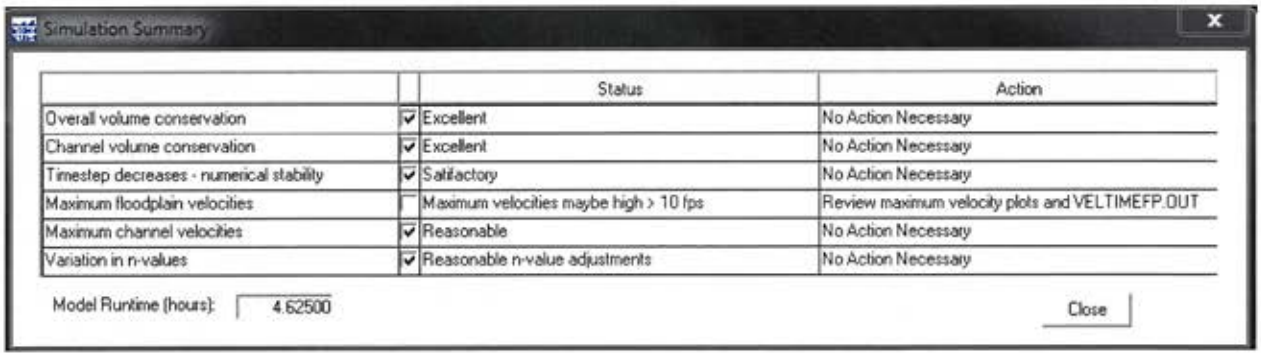


Figure 7 – 25-year 24-hour Proposed Condition 2 – Flow Depth Difference

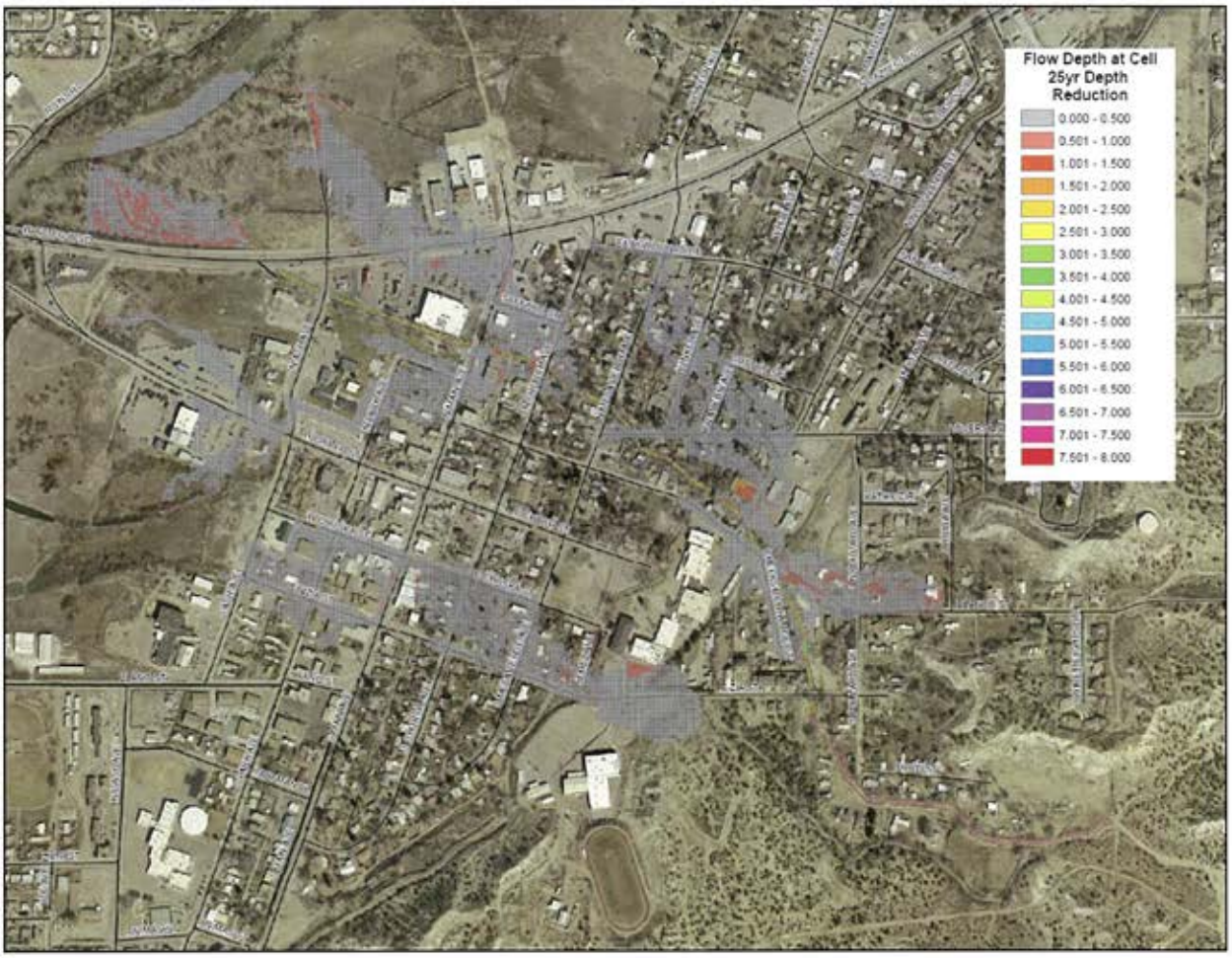
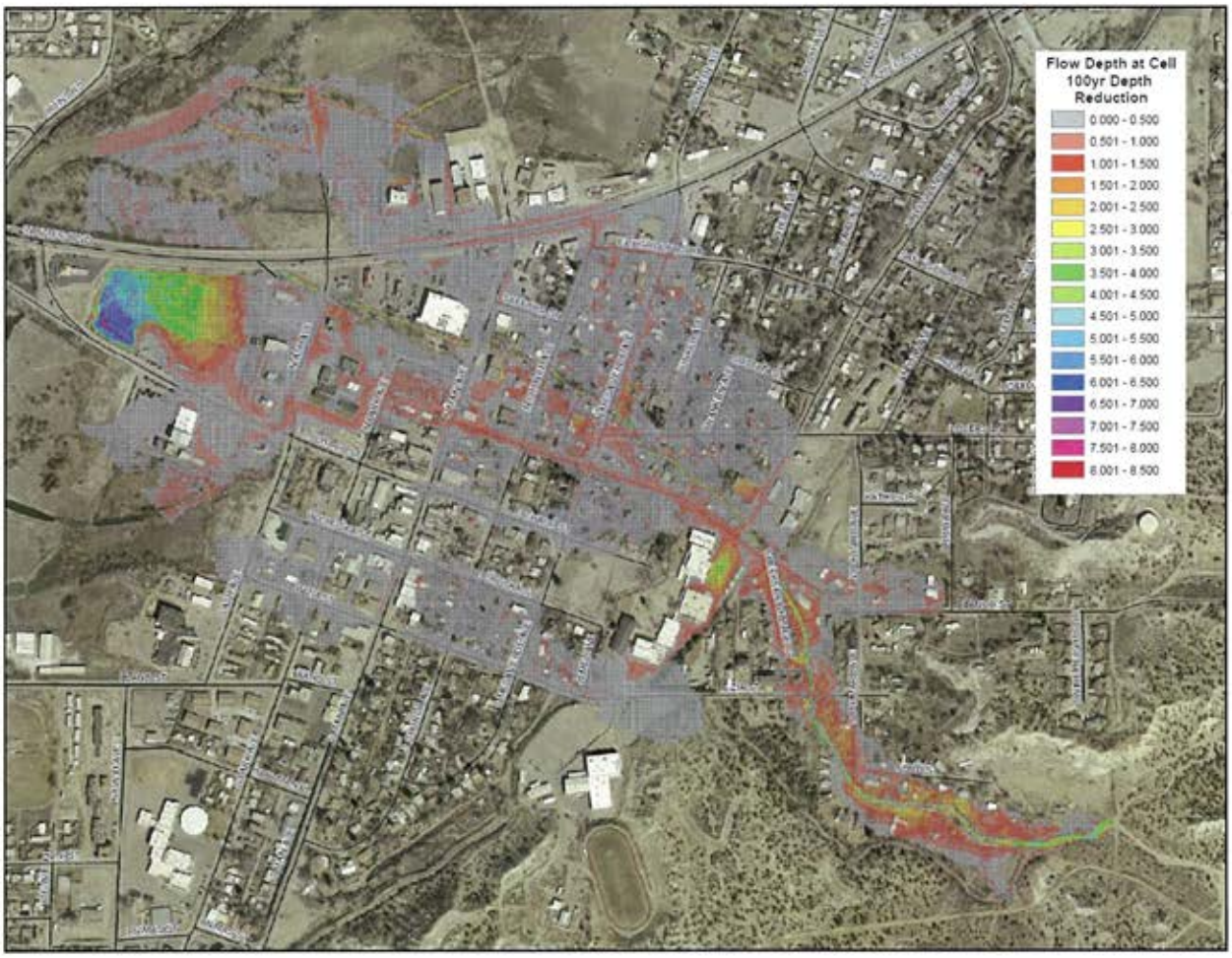


Figure 8 – 100-year 24-hour Proposed Condition 2 – Flow Depth Difference



REFERENCES:

FLO-2D Software, INC (FLO-2D), 2015. [software package]. FLO-2D PRO, January 12, 2016.

United State Army Corps of Engineers (USACE), 2015. Hydraulic Engineering Center Hydrologic Modeling System (HEC-HMS) [software package]. Version 4.1 July 2015.

United States Department of Commerce, National Oceanic and Atmospheric Administration, *NOAA Atlas 14, Volume 1, Version 5*, 2009.

United States Department of Agriculture, Natural Resources Conservation Service, *Custom Soil Resource Report,* January 2016

United States Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, June 1986.

ATTACHMENT 1 – DETENTION BASIN CALCULATIONS

Table A-1 Stage - Storage - Discharge Rating Table

STAGE	DEPTH [ft]	AREA [ft^2]	AREA [acres]	VOLUME [acre-feet]		Q_{OUT*} [ft^3/sec]
				INC	CUM	
5737.00	0.00	51109.50	1.17	0.00	0.00	0.00
5738.00	1.00	54964.39	1.26	1.22	1.22	1.00
5739.00	2.00	58919.49	1.35	1.31	2.52	1.00
5740.00	3.00	62974.80	1.45	1.40	3.92	1.00
5741.00	4.00	67122.90	1.54	1.49	5.42	1.00
5742.00	5.00	71341.23	1.64	1.59	7.01	32.40
5743.00	6.00	75688.04	1.74	1.69	8.69	91.64
5744.00	7.00	80025.67	1.84	1.79	10.48	168.36

C 2.7
L 12

* The Discharge from the Spillway Outfall was calculated using weir flow equation as shown in Table A-2
** Civil 3D was used to obtain the stage - volume calculation for the detention basin

Table A-2 Weir Calculation

Flow from Junction C, where the detention pond is 25 yr = 127.4 cfs ; V= 26.5 ac-ft

To determine the minimum length of weir

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	127.4	cfs
L=	5.90	ft
H=	4	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	11.46	cfs
L=	12.00	ft
H=	0.5	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	32.40	cfs
L=	12.00	ft
H=	1	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	59.52	cfs
L=	12.00	ft
H=	1.5	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	91.64	cfs
L=	12.00	ft
H=	2	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	128.07	cfs
L=	12.00	ft
H=	2.5	ft
C=	2.7	typical range 2.5 to 3.1

Weir Equation		
$Q = CLH^{3/2}$		
variable	***value***	***units***
Q =	168.36	cfs
L=	12.00	ft
H=	3	ft
C=	2.7	typical range 2.5 to 3.1

Culvert Calculator Report
XTO_Basin_Pipe

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,750.00	ft	Headwater Depth/Height	2.00	
Computed Headwater Elev	5,750.00	ft	Discharge	66.02	cfs
Inlet Control HW Elev.	5,748.59	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,750.00	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,744.00	ft	Downstream Invert	5,743.48	ft
Length	50.00	ft	Constructed Slope	0.010400	ft/ft

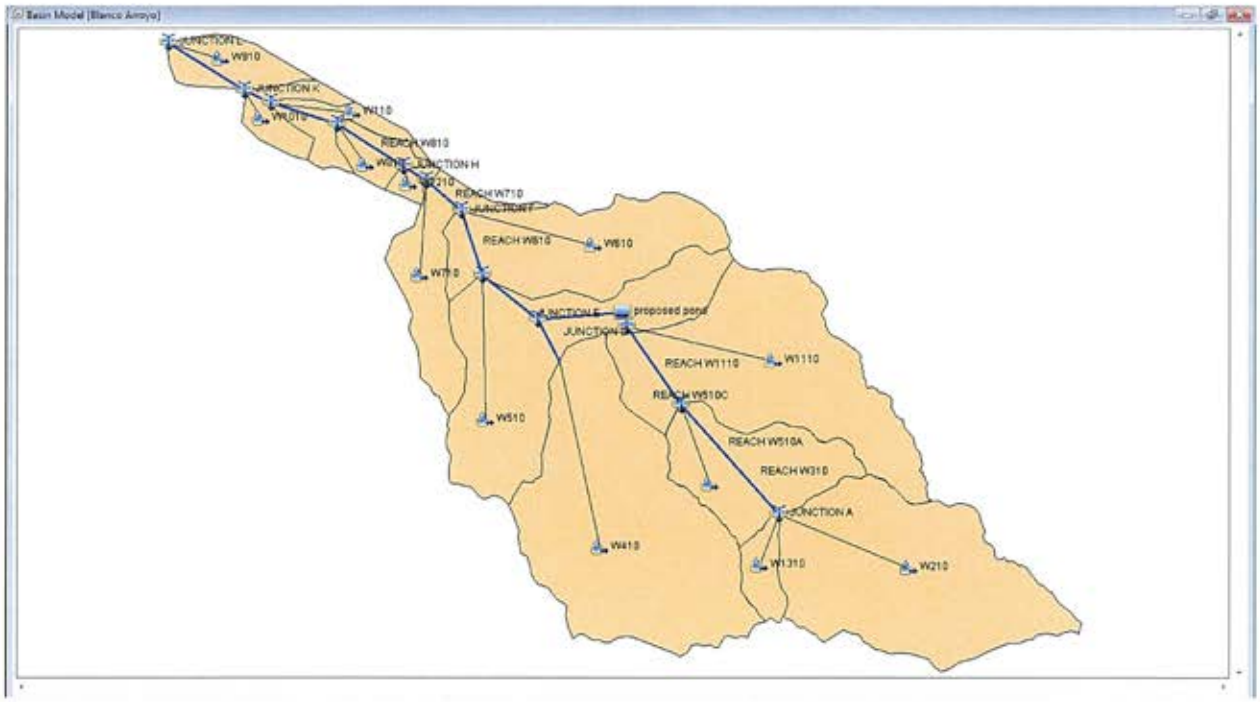
Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.60	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.60	ft
Velocity Downstream	10.14	ft/s	Critical Slope	0.030596	ft/ft

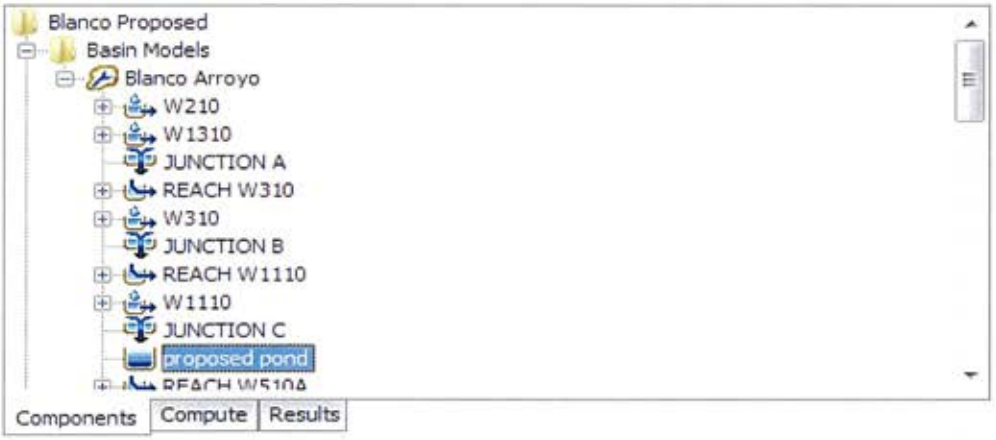
Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

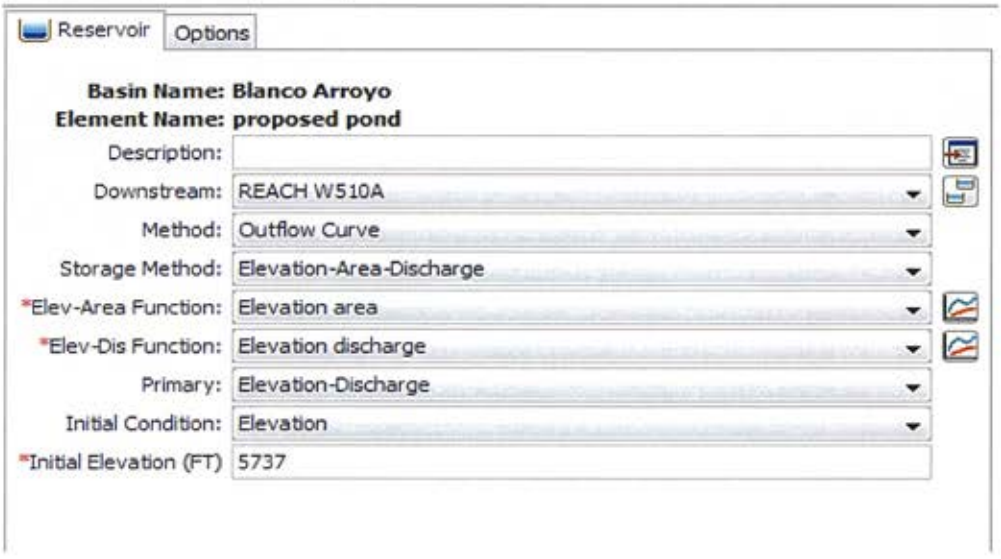
Outlet Control Properties					
Outlet Control HW Elev.	5,750.00	ft	Upstream Velocity Head	1.36	ft
Ke	0.50		Entrance Loss	0.68	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,748.59	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels		Area Full	7.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

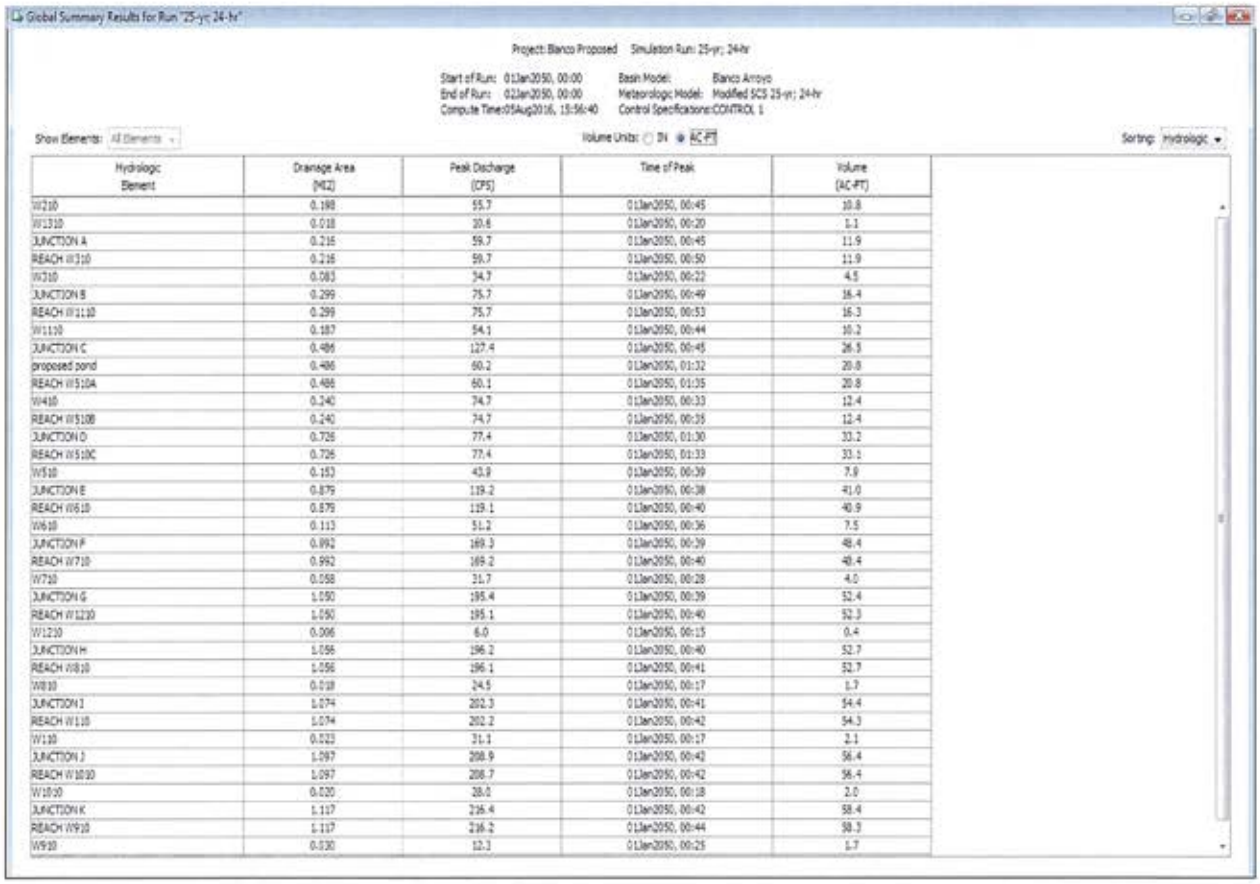
HEC-HMS MODEL







HEC-HMS RESULTS



Global Summary Results for Run "25-yr 24-hr"

Project: Blanco Proposed Simulation Run: 25-yr; 24-hr

Start of Run: 01Jan2050, 00:00
End of Run: 02Jan2050, 00:00
Compute Time:05Aug2016, 15:56:40

Basin Model: Blanco Arroyo
Meteorologic Model: Modified SCS 25-yr; 24-hr
Control Specifications:CONTROL 1

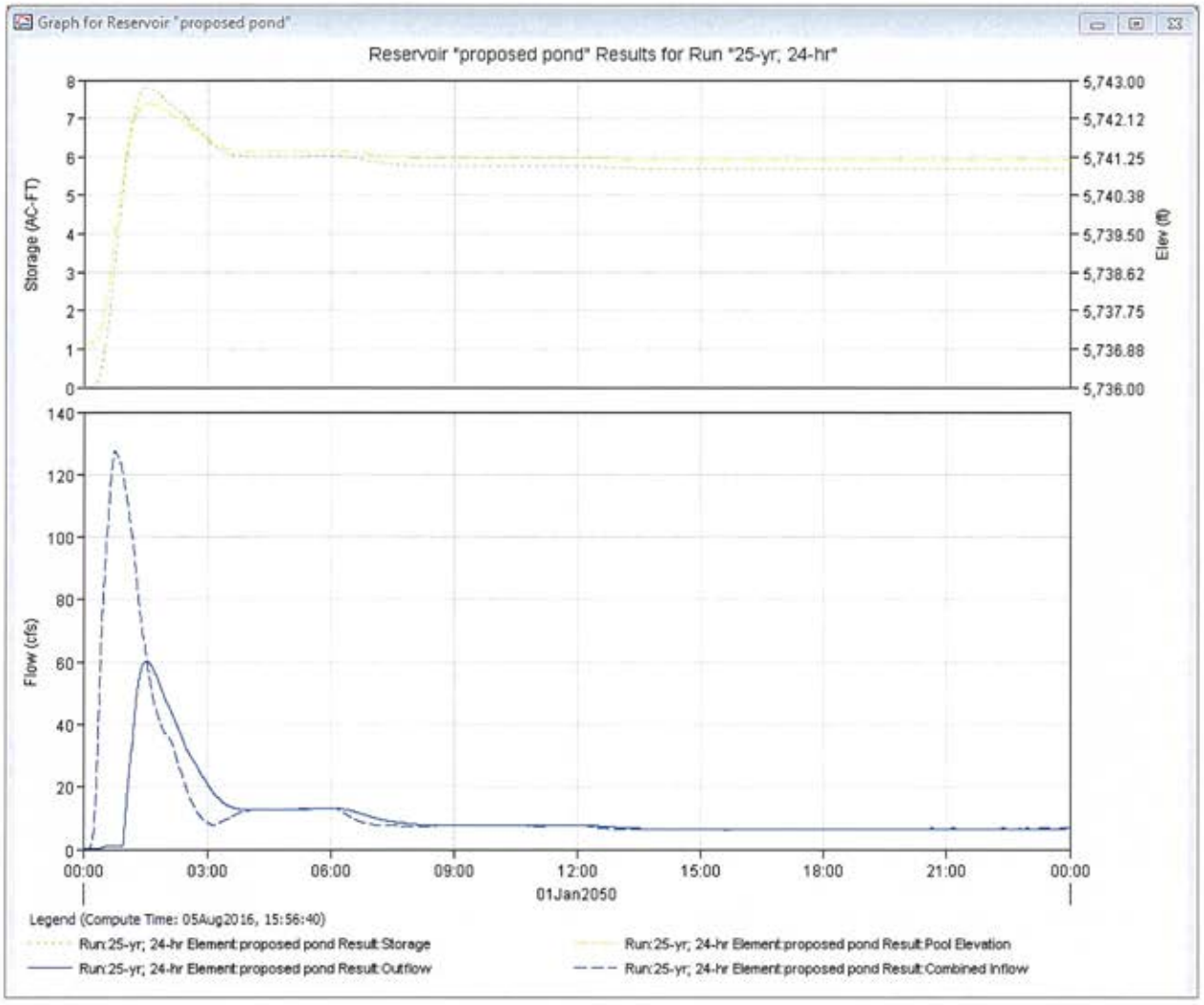
Show Elements: All Elements

Volume Units: IN AC-FT

Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
W210	0.188	55.7	01Jan2050, 00:45	10.8
W1310	0.018	10.6	01Jan2050, 00:20	1.1
JUNCTION A	0.216	59.7	01Jan2050, 00:45	11.9
REACH W310	0.216	59.7	01Jan2050, 00:50	11.9
W310	0.083	34.7	01Jan2050, 00:22	4.5
JUNCTION B	0.299	75.7	01Jan2050, 00:49	16.4
REACH W1110	0.299	75.7	01Jan2050, 00:53	16.3
W1110	0.187	54.1	01Jan2050, 00:44	10.2
JUNCTION C	0.486	127.4	01Jan2050, 00:45	26.5
proposed pond	0.486	60.2	01Jan2050, 01:32	20.8
REACH W510A	0.486	60.1	01Jan2050, 01:35	20.8
W410	0.240	74.7	01Jan2050, 00:33	12.4
REACH W510B	0.240	74.7	01Jan2050, 00:35	12.4
JUNCTION D	0.726	77.4	01Jan2050, 01:30	33.2
REACH W510C	0.726	77.4	01Jan2050, 01:33	33.1
W510	0.163	43.8	01Jan2050, 00:39	7.9
JUNCTION E	0.879	119.2	01Jan2050, 00:38	41.0
REACH W610	0.879	119.1	01Jan2050, 00:40	40.9
W610	0.113	51.2	01Jan2050, 00:36	7.5
JUNCTION F	0.992	169.3	01Jan2050, 00:39	48.4
REACH W710	0.992	169.2	01Jan2050, 00:40	48.4
W710	0.058	31.7	01Jan2050, 00:28	4.0
JUNCTION G	1.050	195.4	01Jan2050, 00:39	52.4
REACH W1210	1.050	195.1	01Jan2050, 00:40	52.3
W1210	0.006	6.0	01Jan2050, 00:15	0.4
JUNCTION H	1.056	196.2	01Jan2050, 00:40	52.7
REACH W810	1.056	196.1	01Jan2050, 00:41	52.7
W810	0.018	24.5	01Jan2050, 00:17	1.7
JUNCTION I	1.074	202.3	01Jan2050, 00:41	54.4
REACH W110	1.074	202.2	01Jan2050, 00:42	54.3
W110	0.023	31.1	01Jan2050, 00:17	2.1
JUNCTION J	1.097	208.9	01Jan2050, 00:42	56.4
REACH W1010	1.097	208.7	01Jan2050, 00:42	56.4
W1010	0.020	38.0	01Jan2050, 00:18	2.0
JUNCTION K	1.117	216.4	01Jan2050, 00:42	58.4
REACH W910	1.117	216.2	01Jan2050, 00:44	58.3
W910	0.030	12.3	01Jan2050, 00:25	1.7

Proposed Detention Basin – Outflow Hydrograph



ATTACHMENT 2 – CHANNEL CALCULATIONS

Worksheet for Trapezoidal Ch - recomd

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	61.00	ft^3/s

Results

Normal Depth	1.02	ft
Flow Area	13.35	ft^2
Wetted Perimeter	16.46	ft
Hydraulic Radius	0.81	ft
Top Width	16.13	ft
Critical Depth	0.95	ft
Critical Slope	0.02602	ft/ft
Velocity	4.57	ft/s
Velocity Head	0.32	ft
Specific Energy	1.35	ft
Froude Number	0.89	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.02	ft
Critical Depth	0.95	ft
Channel Slope	0.02000	ft/ft

Worksheet for Trapezoidal Ch - recomd

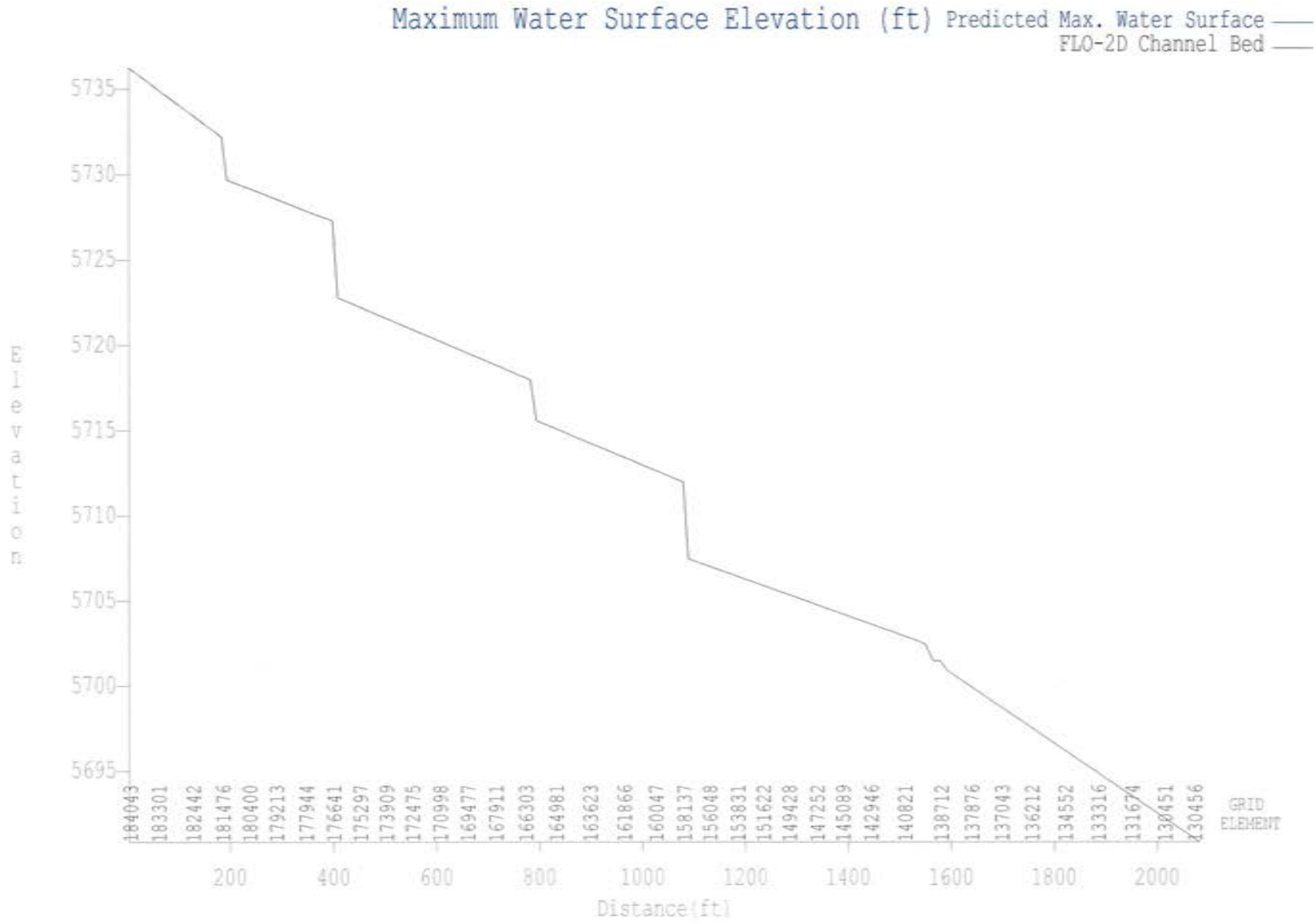
GVF Output Data

Critical Slope	0.02602	ft/ft

Messages

Notes

0.04 - 0.035 in the channel bottom and 0.055 in the banks (6"inch riprap)


Maximum Water Surface Elevation (ft)
Predicted Max. Water Surface
FLO-2D Channel Bed
Elevation
5735
5730
5725
5720
5715
5710
5705
5700
5695
184043
183301
182442
181476
180400
179213
177944
176641
175297
173909
172475
170998
169477
167911
166303
164981
163623
161866
160047
158137
156048
153831
151622
149428
147252
145089
142946
140821
138712
137876
137043
136212
134552
133316
131674
130451
130456
GRID ELEMENT
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance(ft)

ATTACHMENT 3 – CULVERT CALCULATIONS

Existing Conditions Culverts

Culvert Calculator Report
Dirt Road_proposed

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,706.50	ft	Headwater Depth/Height	1.35	
Computed Headwater Elev	5,706.50	ft	Discharge	151.42	cfs
Inlet Control HW Elev.	5,706.42	ft	Tailwater Elevation	5,704.20	ft
Outlet Control HW Elev.	5,706.50	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,702.45	ft	Downstream Invert	5,701.50	ft
Length	20.00	ft	Constructed Slope	0.047500	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.70	ft
Slope Type	Steep		Normal Depth	1.22	ft
Flow Regime	N/A		Critical Depth	2.31	ft
Velocity Downstream	7.53	ft/s	Critical Slope	0.006478	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	5,706.50	ft	Upstream Velocity Head	1.16	ft
Ke	0.50		Entrance Loss	0.58	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,706.42	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	21.2	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Rating Table Report
Dirt Road_proposed

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,702.45	5,707.45	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,702.45	0.00
5,703.45	0.00
5,704.45	48.20
5,705.45	96.12
5,706.45	148.82
5,707.45	185.98

Culvert Calculator Report
Zia_St_Culvert

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,695.90	ft	Headwater Depth/Height	1.15	
Computed Headwater Elev	5,695.90	ft	Discharge	334.34	cfs
Inlet Control HW Elev.	5,695.44	ft	Tailwater Elevation	5,691.27	ft
Outlet Control HW Elev.	5,695.90	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,687.86	ft	Downstream Invert	5,687.86	ft
Length	28.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	H2		Depth, Downstream	4.82	ft
Slope Type	Horizontal		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	4.82	ft
Velocity Downstream	11.84	ft/s	Critical Slope	0.013929	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	7.00	ft
Section Size	84 inch		Rise	7.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,695.90	ft	Upstream Velocity Head	1.50	ft
Ke	0.50		Entrance Loss	0.75	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,695.44	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	38.5	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Zia_St_Culvert

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,687.86	5,696.86	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,687.86	0.00
5,688.86	0.00
5,689.86	0.00
5,690.86	0.00
5,691.86	88.47
5,692.86	151.72
5,693.86	208.77
5,694.86	269.74
5,695.86	331.87
5,696.86	392.73

Culvert Calculator Report
Blanco_Creekside_Culvert

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,680.50	ft	Headwater Depth/Height	1.25	
Computed Headwater Elev	5,680.50	ft	Discharge	219.71	cfs
Inlet Control HW Elev.	5,679.37	ft	Tailwater Elevation	5,673.38	ft
Outlet Control HW Elev.	5,680.50	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,673.00	ft	Downstream Invert	5,671.00	ft
Length	66.00	ft	Constructed Slope	0.030303	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	2.82	ft
Slope Type	Steep		Normal Depth	2.25	ft
Flow Regime	Supercritical		Critical Depth	4.06	ft
Velocity Downstream	16.85	ft/s	Critical Slope	0.004212	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	6.00	ft
Section Size	72 inch		Rise	6.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,680.50	ft	Upstream Velocity Head	1.81	ft
Ke	0.90		Entrance Loss	1.63	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,679.37	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	28.3	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Rating Table Report
Blanco_Creekside_Culvert

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,673.00	5,681.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,673.00	0.00
5,674.00	5.46
5,675.00	20.98
5,676.00	45.17
5,677.00	76.58
5,678.00	113.62
5,679.00	154.60
5,680.00	197.80
5,681.00	241.56

Rating Table Report
Rio_Grande_Culvert

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,666.50	5,673.50	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,666.50	0.00
5,667.50	0.00
5,668.50	0.00
5,669.50	0.00
5,670.50	0.00
5,671.50	81.55
5,672.50	133.89
5,673.50	169.32

Culvert Calculator Report
Rio_Grande_Culvert

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,672.80	ft	Headwater Depth/Height	1.26	
Computed Headwater Elev	5,672.80	ft	Discharge	145.60	cfs
Inlet Control HW Elev.	5,671.96	ft	Tailwater Elevation	5,670.89	ft
Outlet Control HW Elev.	5,672.80	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,666.50	ft	Downstream Invert	5,666.50	ft
Length	52.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	CompositeH2PressureProfile		Depth, Downstream	4.39	ft
Slope Type	Horizontal		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.46	ft
Velocity Downstream	7.97	ft/s	Critical Slope	0.015682	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,672.80	ft	Upstream Velocity Head	0.85	ft
Ke	0.50		Entrance Loss	0.43	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,671.96	ft	Flow Control	N/A	
Inlet Type	Headwall		Area Full	19.6	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
Alley Crossing DS Rio Grande

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,668.50	ft	Headwater Depth/Height	1.20	
Computed Headwater Elev	5,668.50	ft	Discharge	130.95	cfs
Inlet Control HW Elev.	5,667.95	ft	Tailwater Elevation	5,664.90	ft
Outlet Control HW Elev.	5,668.50	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,662.50	ft	Downstream Invert	5,661.40	ft
Length	20.00	ft	Constructed Slope	0.055000	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	3.50	ft
Slope Type	Steep		Normal Depth	2.19	ft
Flow Regime	N/A		Critical Depth	3.28	ft
Velocity Downstream	8.92	ft/s	Critical Slope	0.014729	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,668.50	ft	Upstream Velocity Head	1.43	ft
Ke	0.90		Entrance Loss	1.29	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,667.95	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	19.6	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Rating Table Report
Alley Crossing DS Rio Grande

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,662.50	5,668.50	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,662.50	0.00
5,663.50	0.00
5,664.50	0.00
5,665.50	43.30
5,666.50	67.09
5,667.50	98.01
5,668.50	130.95

Culvert Calculator Report
Lovers_Lane

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,655.74	ft	Headwater Depth/Height	1.15	
Computed Headwater Elev	5,655.74	ft	Discharge	142.86	cfs
Inlet Control HW Elev.	5,655.47	ft	Tailwater Elevation	5,653.24	ft
Outlet Control HW Elev.	5,655.74	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,650.00	ft	Downstream Invert	5,649.75	ft
Length	44.00	ft	Constructed Slope	0.005682	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	3.49	ft
Slope Type	Steep		Normal Depth	3.00	ft
Flow Regime	N/A		Critical Depth	3.43	ft
Velocity Downstream	9.76	ft/s	Critical Slope	0.003873	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.012	
Section Material	Concrete		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,655.74	ft	Upstream Velocity Head	1.54	ft
Ke	0.50		Entrance Loss	0.77	ft

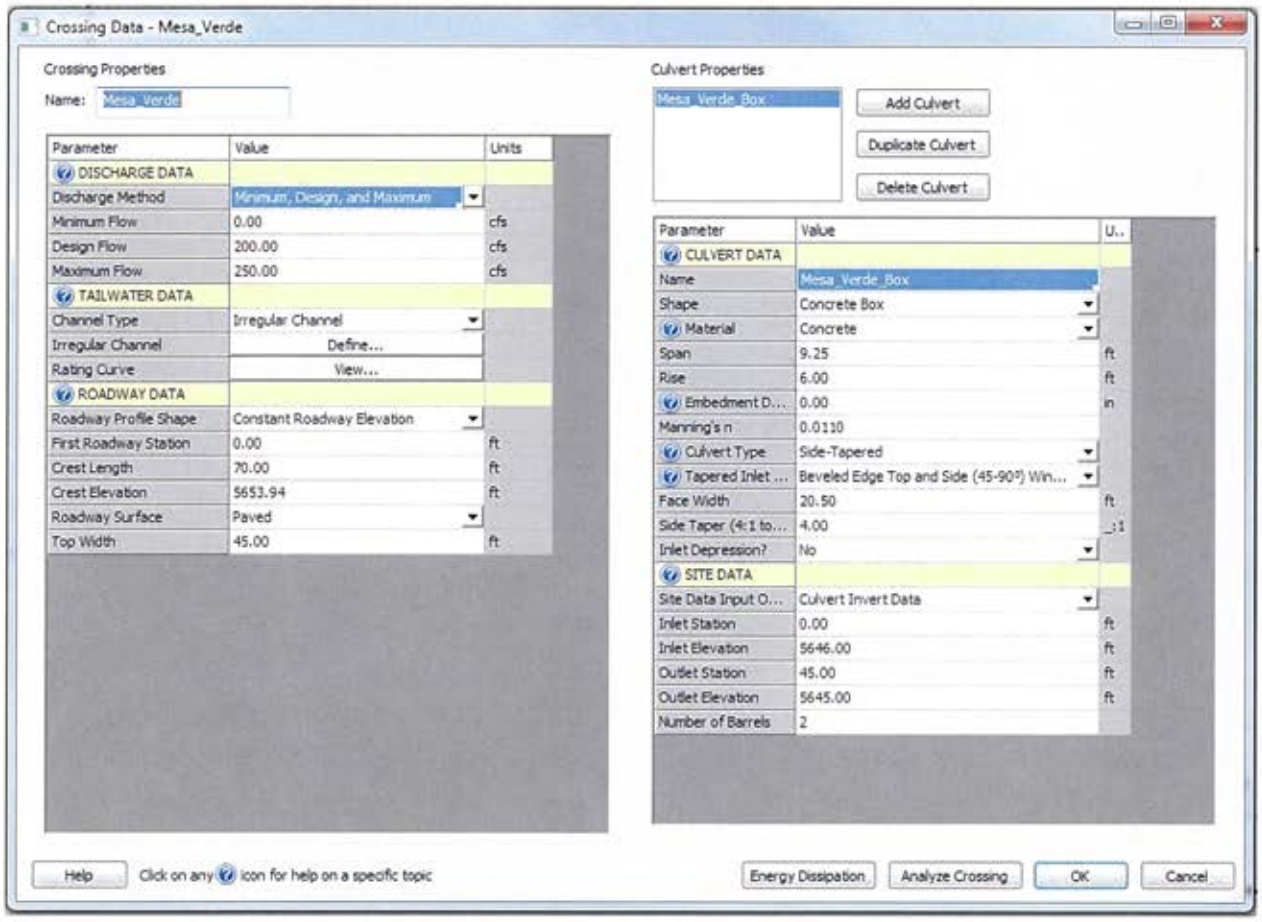
Inlet Control Properties					
Inlet Control HW Elev.	5,655.47	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	19.6	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Rating Table Report
Lovers_Lane

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,650.00	5,656.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,650.00	0.00
5,651.00	0.00
5,652.00	0.00
5,653.00	0.00
5,654.00	77.77
5,655.00	114.90
5,656.00	152.75

Mesa Verde Culvert Crossing



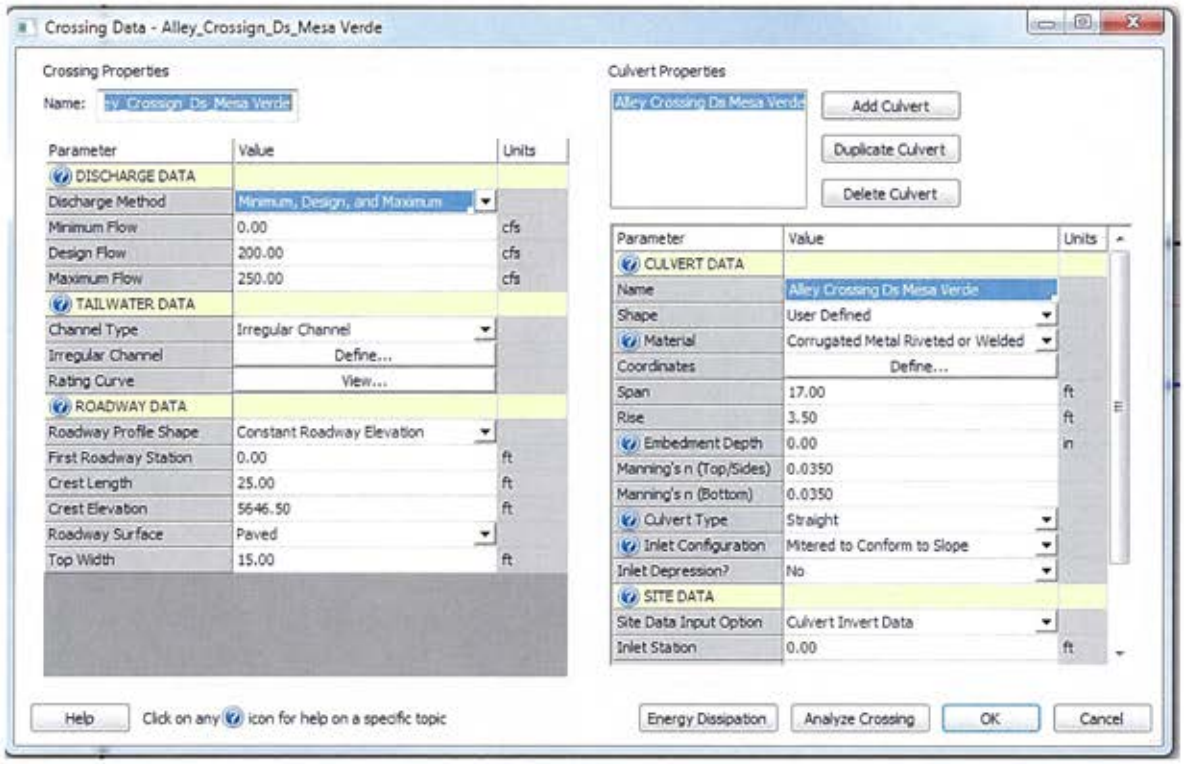
HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Mesa_Verde

Headwater Elevation (ft)	Total Discharge (cfs)	Mesa Verde Box Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5646.00	0.00	0.00	0.00	1
5646.90	25.00	25.00	0.00	1
5647.10	50.00	50.00	0.00	1
5647.30	75.00	75.00	0.00	1
5647.49	100.00	100.00	0.00	1
5647.68	125.00	125.00	0.00	1
5647.87	150.00	150.00	0.00	1
5648.05	175.00	175.00	0.00	1
5648.23	200.00	200.00	0.00	1
5648.40	225.00	225.00	0.00	1
5648.58	250.00	250.00	0.00	1
5653.94	1282.64	1282.64	0.00	Overtopping

Alley Crossing Downstream of Mesa Verde



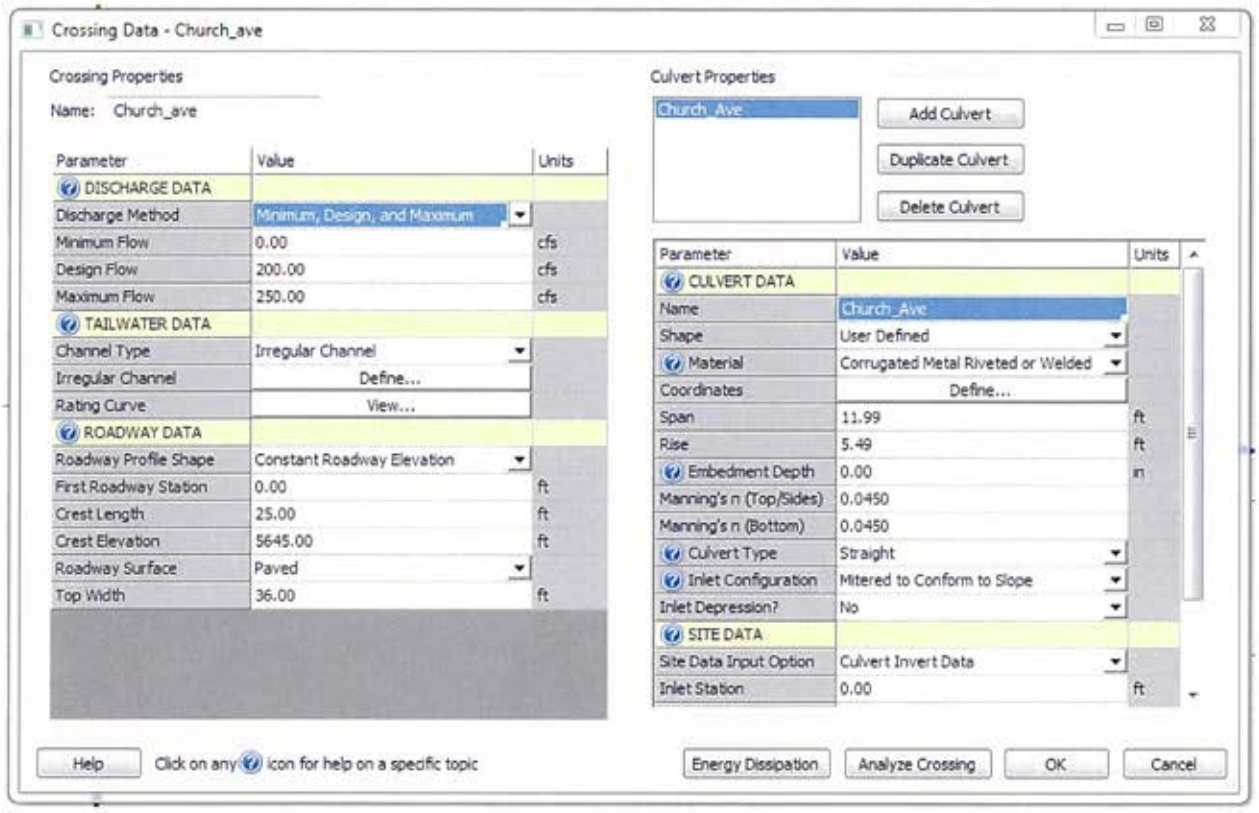
HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Alley_Crossign_Ds_Mesa Verde

Headwater Elevation (ft)	Total Discharge (cfs)	Alley Crossing Ds Mesa Verde Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5641.52	0.00	0.00	0.00	1
5643.34	25.00	25.00	0.00	1
5644.01	50.00	50.00	0.00	1
5644.51	75.00	75.00	0.00	1
5644.91	100.00	100.00	0.00	1
5645.25	125.00	125.00	0.00	1
5645.55	150.00	150.00	0.00	1
5645.87	175.00	175.00	0.00	1
5646.56	200.00	198.96	1.01	7
5646.86	225.00	208.55	16.37	5
5647.09	250.00	215.65	34.32	5
5646.50	196.95	196.95	0.00	Overtopping

Church Avenue Crossing



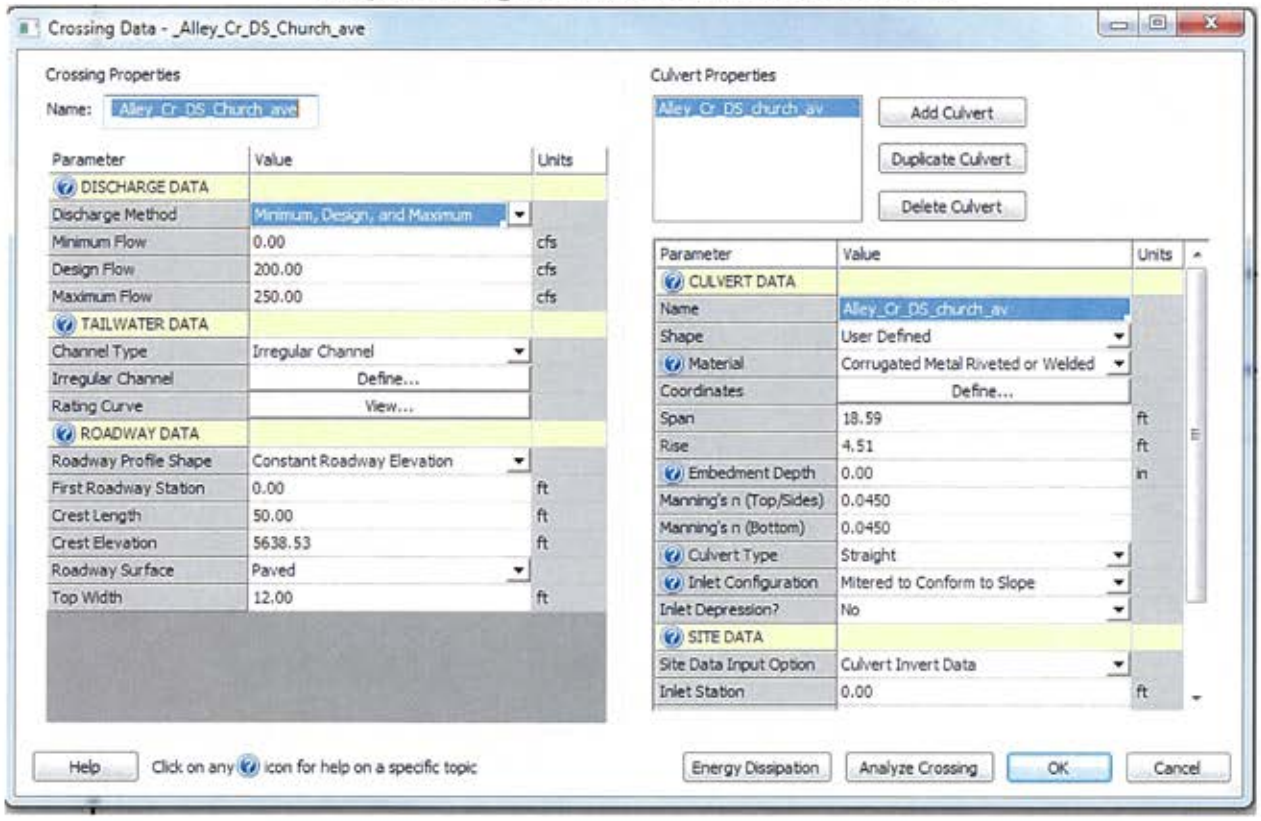
HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Church_ave

Headwater Elevation (ft)	Total Discharge (cfs)	Church Ave Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5634.51	0.00	0.00	0.00	1
5636.72	25.00	25.00	0.00	1
5637.64	50.00	50.00	0.00	1
5638.32	75.00	75.00	0.00	1
5638.88	100.00	100.00	0.00	1
5639.36	125.00	125.00	0.00	1
5639.79	150.00	150.00	0.00	1
5640.18	175.00	175.00	0.00	1
5640.81	200.00	200.00	0.00	1
5641.35	225.00	225.00	0.00	1
5641.97	250.00	250.00	0.00	1
5645.00	356.30	356.30	0.00	Overtopping

Alley Crossing Downstream of Church Avenue



HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: _Alley_Cr_DS_Church_ave

Headwater Elevation (ft)	Total Discharge (cfs)	Alley Cr DS church_ av Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5632.00	0.00	0.00	0.00	1
5633.86	25.00	25.00	0.00	1
5634.64	50.00	50.00	0.00	1
5635.23	75.00	75.00	0.00	1
5635.71	100.00	100.00	0.00	1
5636.13	125.00	125.00	0.00	1
5636.50	150.00	150.00	0.00	1
5636.83	175.00	175.00	0.00	1
5637.10	200.00	200.00	0.00	1
5637.34	225.00	225.00	0.00	1
5638.10	250.00	250.00	0.00	1
5638.53	271.49	271.49	0.00	Overtopping

Culvert Calculator Report
Main St Culvert

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,632.50	ft	Headwater Depth/Height	1.50	
Computed Headwater Elev	5,632.50	ft	Discharge	725.50	cfs
Inlet Control HW Elev.	5,632.50	ft	Tailwater Elevation	5,629.24	ft
Outlet Control HW Elev.	5,632.46	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	5,626.50	ft	Downstream Invert	5,626.50	ft
Length	70.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	CompositeH2PressureProfile		Depth, Downstream	3.45	ft
Slope Type	Horizontal		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.45	ft
Velocity Downstream	10.53	ft/s	Critical Slope	0.002348	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.011	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 4 ft		Rise	4.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,632.46	ft	Upstream Velocity Head	1.28	ft
Ke	0.50		Entrance Loss	0.64	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,632.50	ft	Flow Control	N/A	
Inlet Type	45° non-offset wingwall flares		Area Full	80.0	ft²
K	0.49700		HDS 5 Chart	12	
M	0.66700		HDS 5 Scale	1	
C	0.03390		Equation Form	2	
Y	0.80300				

Rating Table Report
Main St Culvert

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,626.50	5,632.50	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,626.50	0.00
5,627.50	0.00
5,628.50	0.00
5,629.50	176.85
5,630.50	397.22
5,631.50	562.80
5,632.50	725.50

Culvert Calculator Report
Ash_St

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,614.52	ft	Headwater Depth/Height	1.26	
Computed Headwater Elev	5,614.52	ft	Discharge	156.81	cfs
Inlet Control HW Elev.	5,614.00	ft	Tailwater Elevation	5,612.00	ft
Outlet Control HW Elev.	5,614.52	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,608.21	ft	Downstream Invert	5,608.20	ft
Length	45.00	ft	Constructed Slope	0.000222	ft/ft

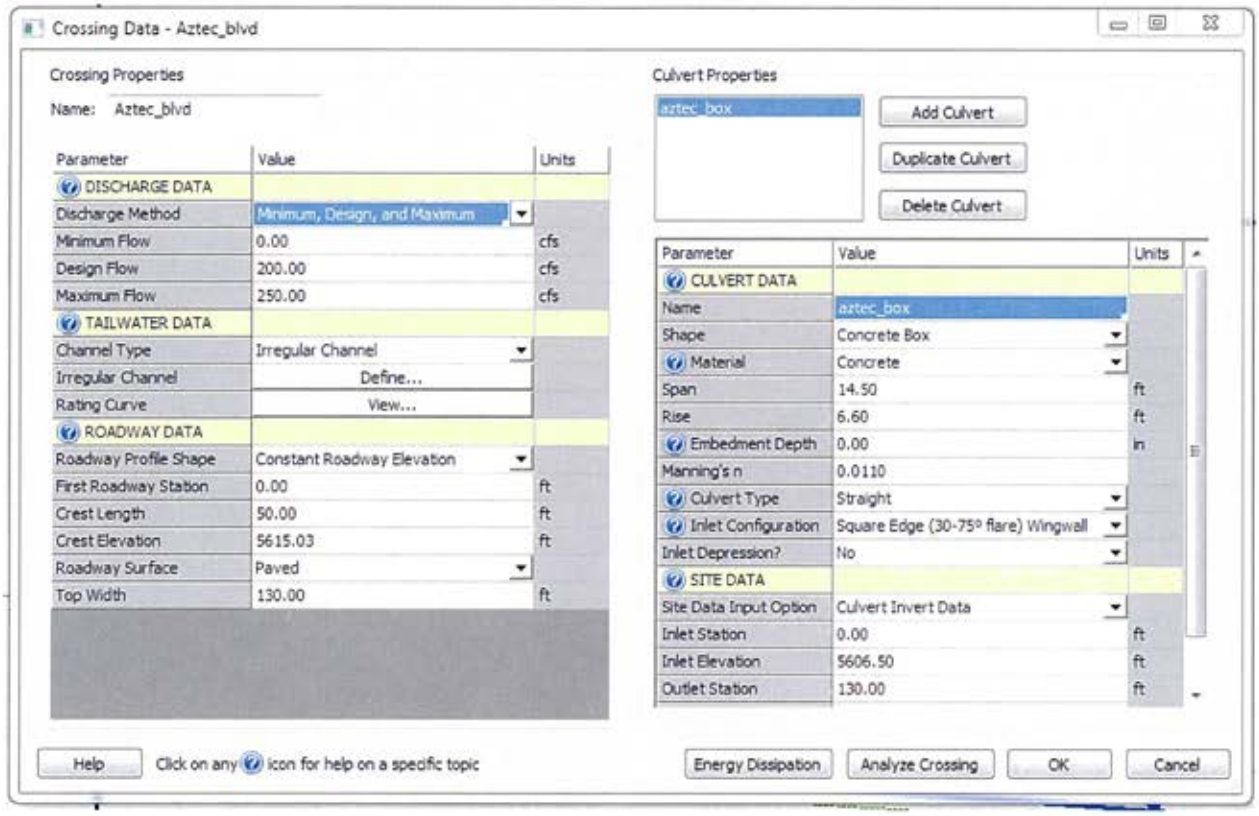
Hydraulic Profile					
Profile	M2		Depth, Downstream	3.80	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.59	ft
Velocity Downstream	9.79	ft/s	Critical Slope	0.016507	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,614.52	ft	Upstream Velocity Head	1.02	ft
Ke	0.50		Entrance Loss	0.51	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,614.00	ft	Flow Control	Transition	
Inlet Type	Headwall		Area Full	19.6	ft²
K	0.00780		HDS 5 Chart	2	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Aztec Blvd Crossing



HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Aztec_blvd

Headwater Elevation (ft)	Total Discharge (cfs)	aztec_box Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5606.50	0.00	0.00	0.00	1
5607.19	25.00	25.00	0.00	1
5607.60	50.00	50.00	0.00	1
5607.94	75.00	75.00	0.00	1
5608.24	100.00	100.00	0.00	1
5608.52	125.00	125.00	0.00	1
5608.78	150.00	150.00	0.00	1
5609.03	175.00	175.00	0.00	1
5609.26	200.00	200.00	0.00	1
5609.49	225.00	225.00	0.00	1
5609.71	250.00	250.00	0.00	1
5615.03	981.27	981.27	0.00	Overtopping

Proposed Culverts

Culvert Calculator Report
Rio_Grande_Culvert_proposed_notail_arch81x59

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,672.80	ft	Headwater Depth/Height	1.28	
Computed Headwater Elev	5,672.80	ft	Discharge	210.83	cfs
Inlet Control HW Elev.	5,672.19	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,672.80	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,666.50	ft	Downstream Invert	5,666.50	ft
Length	52.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	H2		Depth, Downstream	3.35	ft
Slope Type	Horizontal		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.35	ft
Velocity Downstream	10.58	ft/s	Critical Slope	0.019895	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.028	
Section Material	Steel and Aluminum 5x1 and 3x1 Corrugations		Span	6.75	ft
Section Size	81 x 59 inch		Rise	4.92	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,672.80	ft	Upstream Velocity Head	1.02	ft
Ke	0.50		Entrance Loss	0.51	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,672.19	ft	Flow Control	N/A	
Inlet Type	90° headwall		Area Full	26.3	ft²
K	0.00830		HDS 5 Chart	34	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Rio_Grande_Culvert_proposed_notail_arch81x59

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,666.50	5,672.50	0.50 ft

HW Elev. (ft)	Discharge (cfs)
5,666.50	0.00
5,667.00	0.40
5,667.50	7.01
5,668.00	17.84
5,668.50	31.75
5,669.00	46.34
5,669.50	66.39
5,670.00	87.42
5,670.50	109.24
5,671.00	131.82
5,671.50	154.64
5,672.00	177.11
5,672.50	198.64

Culvert Calculator Report
Dirt Road_proposed

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,706.50	ft	Headwater Depth/Height	1.35	
Computed Headwater Elev	5,706.50	ft	Discharge	130.40	cfs
Inlet Control HW Elev.	5,706.22	ft	Tailwater Elevation	5,704.20	ft
Outlet Control HW Elev.	5,706.50	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,702.45	ft	Downstream Invert	5,701.50	ft
Length	20.00	ft	Constructed Slope	0.047500	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.70	ft
Slope Type	Steep		Normal Depth	1.59	ft
Flow Regime	N/A		Critical Depth	2.15	ft
Velocity Downstream	6.49	ft/s	Critical Slope	0.019489	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	5,706.50	ft	Upstream Velocity Head	1.00	ft
Ke	0.90		Entrance Loss	0.90	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,706.22	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	21.2	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Rating Table Report
Dirt Road_proposed

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,702.45	5,707.45	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,702.45	0.00
5,703.45	0.00
5,704.45	40.02
5,705.45	81.99
5,706.45	128.10
5,707.45	167.52

Culvert Calculator Report
Alley Crossing DS Rio Grande_proposed_notail_arch81x59

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,668.50	ft	Headwater Depth/Height	1.42	
Computed Headwater Elev	5,668.50	ft	Discharge	256.64	cfs
Inlet Control HW Elev.	5,668.50	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,668.42	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	5,661.50	ft	Downstream Invert	5,661.40	ft
Length	20.00	ft	Constructed Slope	0.005000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	3.72	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.72	ft
Velocity Downstream	11.69	ft/s	Critical Slope	0.023561	ft/ft

Section				
Section Shape	Arch	Mannings Coefficient	0.028	
Section Material	5x1 and 3x1 Corrugations	Span	6.75	ft
Section Size	81 x 59 inch	Rise	4.92	ft
Number Sections	1			

Steel and Aluminum

Outlet Control Properties					
Outlet Control HW Elev.	5,668.42	ft	Upstream Velocity Head	1.57	ft
Ke	0.50		Entrance Loss	0.78	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,668.50	ft	Flow Control	N/A	
Inlet Type	90° headwall		Area Full	26.3	ft²
K	0.00830		HDS 5 Chart	34	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Alley Crossing DS Rio Grande_proposed_notail_arch81x59

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,661.50	5,668.50	0.50 ft

HW Elev. (ft)	Discharge (cfs)
5,661.50	0.00
5,662.00	2.52
5,662.50	10.20
5,663.00	21.95
5,663.50	36.95
5,664.00	54.63
5,664.50	74.45
5,665.00	95.92
5,665.50	118.67
5,666.00	142.19
5,666.50	166.46
5,667.00	190.74
5,667.50	214.76
5,668.00	238.05
5,668.50	256.64

Culvert Calculator Report
Lovers_Lane_proposed_notail_arch81x59

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,655.74	ft	Headwater Depth/Height	1.37	
Computed Headwater Elev	5,655.74	ft	Discharge	235.28	cfs
Inlet Control HW Elev.	5,655.44	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,655.74	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,649.01	ft	Downstream Invert	5,648.90	ft
Length	44.00	ft	Constructed Slope	0.002500	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	3.55	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.55	ft
Velocity Downstream	11.16	ft/s	Critical Slope	0.021708	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.028	
Section Material	Steel and Aluminum 2x1 and 3x1 Corrugations		Span	6.75	ft
Section Size	81 x 59 inch		Rise	4.92	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,655.74	ft	Upstream Velocity Head	1.25	ft
Ke	0.50		Entrance Loss	0.63	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,655.44	ft	Flow Control	N/A	
Inlet Type	90° headwall		Area Full	26.3	ft²
K	0.00830		HDS 5 Chart	34	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Lovers_Lane_proposed_notail_arch81x59

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,649.01	5,656.01	0.50 ft

HW Elev. (ft)	Discharge (cfs)
5,649.01	0.00
5,649.51	2.12
5,650.01	9.15
5,650.51	20.31
5,651.01	34.77
5,651.51	51.94
5,652.01	71.08
5,652.51	91.87
5,653.01	113.86
5,653.51	136.76
5,654.01	160.06
5,654.51	183.11
5,655.01	205.43
5,655.51	226.38
5,656.01	244.55

Culvert Calculator Report
Ash_St_proposed_notail_arch81x59

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,614.52	ft	Headwater Depth/Height	1.49	
Computed Headwater Elev	5,614.52	ft	Discharge	250.72	cfs
Inlet Control HW Elev.	5,614.06	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	5,614.52	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,607.21	ft	Downstream Invert	5,607.20	ft
Length	45.00	ft	Constructed Slope	0.000222	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	3.68	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.68	ft
Velocity Downstream	11.54	ft/s	Critical Slope	0.023023	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.028	
Section Material	Steel and Aluminum 2x1 and 3x1 Corrugations		Span	6.75	ft
Section Size	81 x 59 inch		Rise	4.92	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,614.52	ft	Upstream Velocity Head	1.42	ft
Ke	0.50		Entrance Loss	0.71	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,614.06	ft	Flow Control	N/A	
Inlet Type	90° headwall		Area Full	26.3	ft²
K	0.00830		HDS 5 Chart	34	
M	2.00000		HDS 5 Scale	1	
C	0.03790		Equation Form	1	
Y	0.69000				

Rating Table Report
Ash_St_proposed_notail_arch81x59

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	5,607.21	5,615.21	1.00 ft

HW Elev. (ft)	Discharge (cfs)
5,607.21	0.00
5,608.21	7.89
5,609.21	32.67
5,610.21	67.62
5,611.21	111.06
5,612.21	156.97
5,613.21	201.86
5,614.21	240.14
5,615.21	273.43

Appendix G - Recommended Alternative - 30% Design Plans

CITY OF AZTEC
BLANCO ARROYO

PRELIMINARY 30% DRAINAGE IMPROVEMENTS

AZTEC, NM 87410

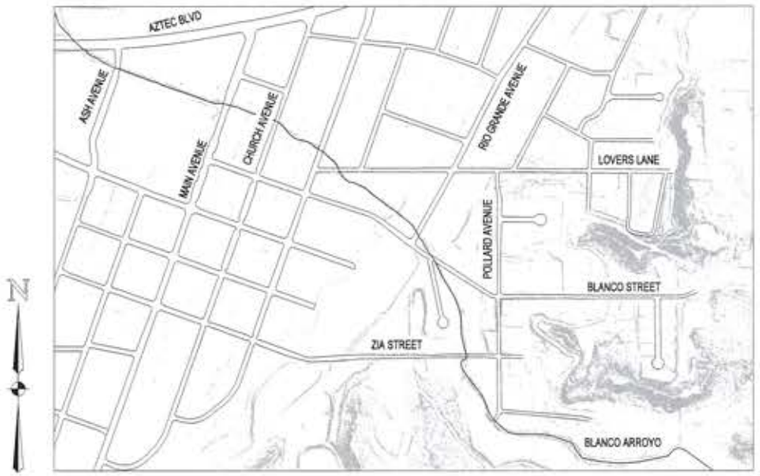
SAN JUAN COUNTY

PREPARED FOR:

CITY OF AZTEC (OWNER)
610 WESTERN DRIVE.
AZTEC, NM 87410
PUBLIC WORKS DIRECTOR:
WILLIAM WATSON, PE, PTOE
PHONE: (505) 334-7660
EMAIL: WWATSON@AZTECNM.GOV

PREPARED BY:

AECOM
7720 NORTH 16TH STREET, SUITE 100
PHOENIX, AZ 85020
PHONE: (602)371-1100



PROJECT SITE MAP
SCALE: 1" = 500'

QUANTITIES SUMMARY		
ITEM	QTY.	UNIT
HEADWALL (DET 511-04)	10	EA
81" x 49" ARCH CULVERT	128	LF
36" CMP	48	LF
ROAD SECTION REPLACEMENT	1196	SF
EXCAVATION: DETENTION BASIN	206,667,692	CY
EXCAVATION: CHANNEL	25,000	CY
RIPRAP	4500	CY
FILTER FABRIC	14,000	SY
DETENTION BASIN OUTLET STRUCTURE	14,350	CY
DETENTION BASIN 36" OUTLET PIPE	67	LF

NOTE:
THESE IMPROVEMENT PLANS ARE A 30% SET OF PLANS AND ARE NOT TO BE USED AS THE BASIS FOR CONSTRUCTION OR AS A BASIS FOR MAJOR CAPITAL DECISIONS. PLEASE BE ADVISED THESE IMPROVEMENT PLANS ARE STILL UNDERGOING INTERNAL REVIEWS BY AECOM. YOUR COMMENTS, TOGETHER WITH THOSE OF AECOM WILL BE INCORPORATED INTO A FINAL DRAFT OF THIS DOCUMENT.

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(602)371-1615 (fax)

NO.	REVISIONS	BY	DATE

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Aztec, NM 87410
(505) 334-7660

PRELIMINARY
NOT FOR CONSTRUCTION

PROJ. NO.:	60487201
DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	MCM
DATE CREATED:	4/26/2017
PLOT DATE:	4/26/2017

CITY OF AZTEC
BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

COVER SHEET

SHEET:
C-1

GENERAL NOTES:

1. GOVERNING SPECIFICATIONS FOR THIS PROJECT SHALL BE THE NEW MEXICO STATE DEPARTMENT OF TRANSPORTATION (NMDOT) STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION, 2014 EDITION.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR PREPARING ROAD BASE MATERIAL CONSISTING OF EXISTING AND IMPORTED MATERIAL.
3. NEW ASPHALT PAVING SHALL BE 3 INCHES OF COMPACTED SUPERPAVE-IV (SP-IV). HOT MIX ASPHALT SHALL COMPLY W/NMDOT STANDARD FOR SP-IV.
4. CONTRACTOR SHALL SAW CUT, TACK AND MATCH EXISTING PAVEMENT..
5. IN AREAS ADJACENT TO THE EXISTING TRAVEL LANE, THE CONTRACTOR SHALL ASSURE THAT NO PAVEMENT DROP-OFFS ARE LEFT EXPOSED DURING NON-WORKING HOURS. THE CONTRACTOR SHALL INITIATE CORRECTIVE MEANS PER THE "NMDOT PAVEMENT DROP-OFF GUIDELINE" TO ACHIEVE A MINIMUM 3:1 SLOPE. THIS WORK SHALL BE INCIDENTAL TO PAVEMENT OPERATIONS ADJACENT TO EXISTING TRAVELED LANES.
6. THE CONTRACTOR SHALL PROVIDE INGRESS AND EGRESS TO LOCAL RESIDENCES FOR THE DURATION OF THE PROJECT. THE CONTRACTOR SHALL ADVISE PROPERTY OWNERS AND THE CITY ENGINEER OF ANY SCHEDULED ACCESS MODIFICATIONS AT LEAST 24 HOURS IN ADVANCE. THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE COMPLETION OF THE PROJECT AND NO SEPARATE MEASUREMENT OR PAYMENT SHALL BE MADE THEREFOR.
7. OVERNIGHT PARKING OF THE CONTRACTOR'S EQUIPMENT SHALL NOT OBSTRUCT DRIVEWAY OPENINGS OR DESIGNATED TRAFFIC LANES. THE CONTRACTOR IS ADVISED THE CITY IS NOT RESPONSIBLE FOR THEFT OR DAMAGE TO EQUIPMENT REMAINING ON-SITE DURING OR AFTER WORK HOURS. CONTRACTOR TAKES ALL RESPONSIBILITIES FOR EQUIPMENT LEFT ON-SITE.
8. THE CONTRACTOR SHALL NOTIFY ALL EMERGENCY PROVIDERS 24 HOURS BEFORE CONSTRUCTION ACTIVITIES BEGIN.
9. TRANSPORTING MATERIALS SHALL NOT BE MEASURED OR PAID SEPARATELY. THE COST OF MATERIAL TRANSPORTATION SHALL BE INCLUDED WITH THE ITEM HAULED.
10. THE CONTRACTOR WILL NOTIFY THE AZTEC PUBLIC WORKS DIRECTOR AT LEAST 48 HOURS PRIOR TO PAVING.
11. EMERGENCY ACCESS SHALL REMAIN OPEN AT ALL TIMES.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING AND CLEAN UP OF SPILLS ASSOCIATED WITH PROJECT CONSTRUCTION AND SHALL REPORT AND RESPOND TO SPILLS OF HAZARDOUS MATERIAL SUCH AS GASOLINE, DIESEL, MOTOR OILS, SOLVENTS, SEWER CHEMICALS, TOXIC AND CORROSIVE SUBSTANCES, AND OTHER MATERIALS WHICH MAY BE A THREAT TO PUBLIC HEALTH OR THE ENVIRONMENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING PAST SPILLS ENCOUNTERED DURING CONSTRUCTION AND OF CURRENT SPILLS NOT ASSOCIATED WITH CONSTRUCTION. REPORTS SHALL BE MADE IMMEDIATELY TO THE NM ENVIRONMENT DEPARTMENT AT (505) 827-9329, (866) 428-6535.
13. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ALL CONFLICTS DURING CONSTRUCTION.
14. CONTRACTOR SHALL KEEP WORK SITE IN AN ORDERLY CONDITION. DURING CONSTRUCTION, AT COMPLETION OF WORK, CONTRACTOR SHALL REMOVE ALL DEBRIS AND LEAVE WORK SITE IN A CONDITION ACCEPTABLE TO THE CITY ENGINEER
15. THE CONTRACTOR IS RESPONSIBLE FOR REPORTING ANY DISCREPANCIES DISCOVERED IN THE PLANS AND/0R SPECIFICATIONS PROMPTLY TO THE CITY ENGINEER IN WRITING.
16. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UNDERGROUND, SURFACE AND AERIAL UTILITIES, CONSTRUCTIONS AND STRUCTURES WHETHER ON PUBLIC OR PRIVATE PROPERTY. DAMAGES THERETO BY THE CONTRACTOR SHALL BE REPLACED IN KIND OR BETTER AT NO EXPENSE TO THE PROJECT.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL REMOVALS REQUIRED TO COMPLETE THIS PROJECT.
18. PAVEMENT MARKINGS ARE NOT REQUIRED FOR THIS PROJECT.

CONSTRUCTION TESTING:

1. THE PROJECT WILL HAVE VERIFICATION, AND DENSITY TESTS COMPLETED BY A GEOTECHNICAL ENGINEERING COMPANY TO VERIFY COMPACTION.
2. THE CITY WILL USE GEOMAT TO PROVIDE QUALITY ASSURANCE (QA) TESTING. THE CONTRACTOR SHALL COORDINATE WITH GEOMAT FOR REQUIRED TESTING. CONTRACTOR SHALL PROVIDE QUALITY CONTROL TESTING AS NECESSARY TO PROVIDE ACCEPTABLE WORK QUALITY THAT CONFORMS TO THE GOVERNING SPECIFICATIONS. NECESSARY RETESTING BY GEOMAT WILL BE CHARGED BACK TO THE CONTRACTOR. GEOMAT CONTACT PHONE – (505)327-7928.
3. ROAD BASE MATERIAL SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY PER NMDOT SPECIFICATIONS SECTION 203.3.8 "MOISTURE AND DENSITY CONTROL".
4. SP-IV ASPHALT SHALL BE COMPACTED TO A MEAN DENSITY OF 93% OF THE THEORETICAL MAXIMUM DENSITY, REFER TO NMDOT SPECIFICATION DIVISION 423.
5. ASPHALT MIX DESIGN SHALL BE PER NMDOT SP-IV DESIGN. ASPHALT MIX SHALL BE TESTED BY GEOMAT.
6. GRADATION OF PROPOSED IMPORTED ROADBASE MATERIAL SHALL BE SUBMITTED TO GEOMAT FOR APPROVAL PRIOR TO IMPORT. AND TO THE AZTEC PUBLIC WORKS DIRECTOR.
7. NO MATERIAL PITS HAVE BEEN DESIGNATED FOR THIS PROJECT. THE CONTRACTOR MAY OBTAIN SPECIFICATION BORROW AND SURFACING MATERIAL (SP-IV) FROM ANY ACCEPTABLE SOURCE. ALL MATERIAL SHALL BE GOVERNED BY APPROPRIATE SECTIONS OF THE NMDOT STANDARD.

TRAFFIC CONTROL:

1. ALL TRAFFIC CONTROL DEVICES SHALL COMPLY WITH NMDOT STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION, 2014 EDITION AND THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, LATEST EDITION (MUTCD).
2. ALL ROADS SHALL BE SERVICEABLE AND MAINTAINED FOR FIRE PROTECTION AND EMERGENCY VEHICLES DURING CONSTRUCTION.
3. THE CONTRACTOR SHALL PROVIDE REASONABLE ACCESS TO PROPERTY OWNERS AFFECTED BY THE CONSTRUCTION DURING THE PERIOD OF ROAD BASE ADJUSTMENT AND COMPACTION.
4. ALL AFFECTED RESIDENTS SHALL BE INFORMED OF THE ROAD CLOSURE AT LEAST 48 HOURS PRIOR TO CLOSURE. ACCESS TO RESIDENCIES SHALL NOT BE DENIED WITHOUT THE APPROVAL OF THE CITY ENGINEER.
5. TRAFFIC CONTROL PLANS MAY VARY AS FIELD CONDITIONS DICTATE. THE CONTRACTOR WILL BE PAID A LUMP SUM FOR PLACING, RELOCATING AND MAINTENANCE OF TRAFFIC CONTROL DEVICES THROUGHOUT THE LIFE OF THE PROJECT.
6. THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN PREPARED BY A CERTIFIED TRAFFIC CONTROL SUPERVISOR TO THE CITY ENGINEER FOR APPROVAL AT LEAST 7 DAYS PRIOR TO THE BEGINNING OF ANY WORK.
7. THE CONTRACTOR SHALL HAVE A RESPONSIBLE PERSON ON SITE DURING WORKING HOURS AND ON CALL DURING NON-WORKING HOURS TO INSPECT AND MAINTAIN PROJECT TRAFFIC CONTROL NEEDED OR AS DIRECTED BY THE CITY ENGINEER.
8. THE CONTRACTOR SHALL KEEP THE CITY ENGINEER AND RESIDENTS INFORMED OF ROAD AND ACCESS CLOSURES. NO MEASUREMENT OR PAYMENT WILL BE MADE FOR THESE ADVISORIES.
9. FLAGGING SHALL BE PROVIDED FOR SAFETY WHERE NEEDED AND REQUIRED BY THE MUTCD OR AS DIRECTED BY THE CITY ENGINEER. ALL FLAGGING OPERATIONS SHALL COMPLY WITH THE REQUIREMENTS OF THE MUTCD. FLAGGERS SHALL BE CONSIDERED INCIDENTAL TO PAYMENT FOR TRAFFIC CONTROL AND NO MEASUREMENT OR PAYMENT WILL BE MADE FOR THIS SERVICE.
10. TRAFFIC CONTROL DEVICES SHALL REMAIN IN OPERATION AT ALL TIMES DURING CONSTRUCTION.

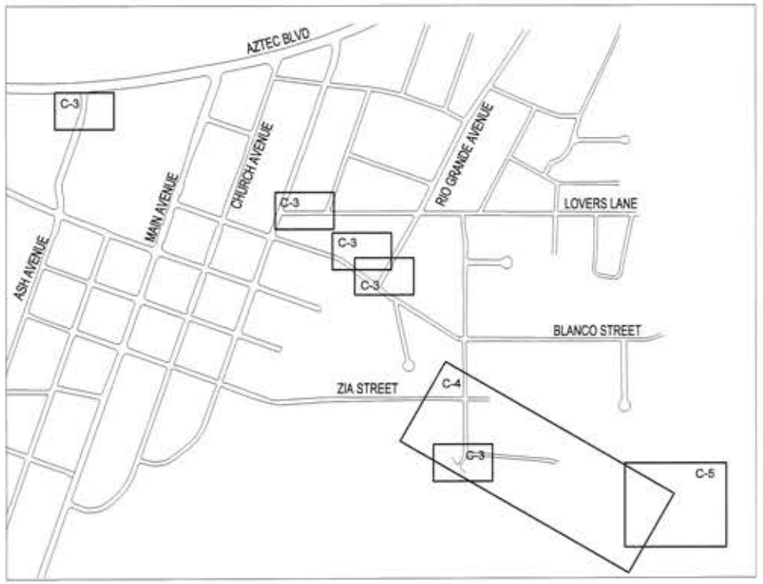
UTILITIES

1. THE EXISTENCE AND LOCATION OF UNDERGROUND UTILITY PIPES, CONDUITS AND STRUCTURES ARE WELL DOCUMENTED FROM A PREVIOUS UTILITY PROJECT. CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL UTILITIES PRIOR TO START OF CONSTRUCTION AND SHALL TAKE PRECAUTIONARY MEASURES TO PROTECT ALL UTILITIES.
2. UTILITY CONFLICTS ARE NOT ANTICIPATED ON THIS PROJECT SINCE EXCAVATIONS WILL BE VERY LIMITED. IF UTILITIES ARE ENCOUNTERED, THE CONTRACTOR SHALL COORDINATE AND COOPERATE WITH ALL UTILITY COMPANIES AND THE CITY OF AZTEC WITH REGARDS TO RELOCATING, ADJUSTING, REPLACING, AND/OR REPAIRING UTILITIES DURING CONSTRUCTION.
3. THE CONTRACTOR SHALL BE RESTRICTED TO A 35-TON (MAXIMUM) NON-VIBRATORY ROLLER FOR COMPACTION IN AREAS WHERE THE USE OF HEAVIER EQUIPMENT COULD DAMAGE UNDERGROUND UTILITIES OR ADJACENT STRUCTURES.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ANY EXISTING MANHOLES, VALVES, OR ANY OTHER UTILITY ITEMS TO GRADE PRIOR TO ACCEPTANCE OF THE IMPROVEMENTS BY THE CITY ENGINEER.

EROSION CONTROL & SWPPP

1. EROSION CONTROL WILL NOT BE REQUIRED FOR THIS PROJECT.
2. A STORM WATER PREVENTION PLAN WILL NOT BE REQUIRED FOR THIS PROJECT.

INDEX OF SHEETS



INDEX SHEET GRAPHIC (NTS)

NOTE:
THE INFORMATION SHOWN HEREIN IS PRELIMINARY AND CONCEPTUAL IN NATURE AND NOT FOR CONSTRUCTION. THESE PROPOSED IMPROVEMENTS ARE SUBJECT TO CHANGE BASED ON MORE DETAILED INFORMATION.

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Aztec, NM 87410
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PRELIMINARY
NOT FOR
CONSTRUCTION

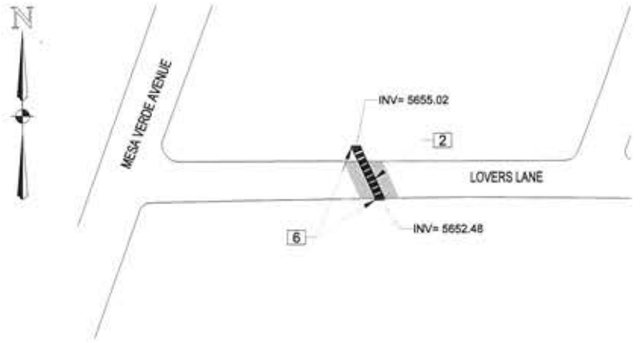
PROJ. NO.:	60487201
DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	MCM
DATE CREATED:	11/21/2016
PLOT DATE:	4/26/2017

CITY OF AZTEC
BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

GENERAL NOTES

SHEET:
C-2

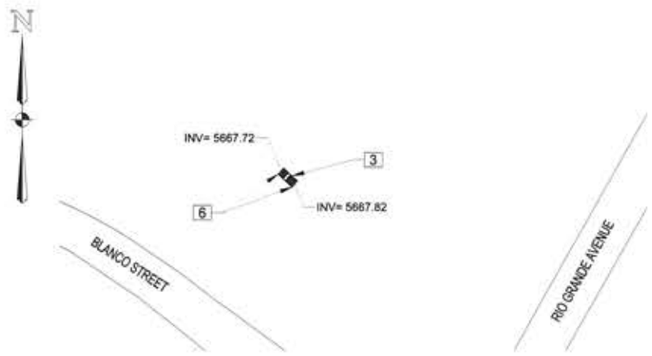
PROPOSED CULVERT
ASH AVE



PROPOSED CULVERT
LOVERS LANE

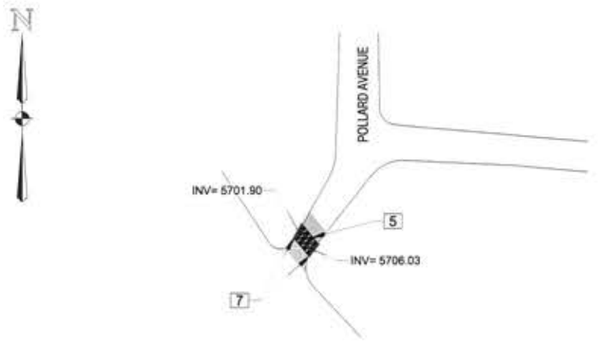
CONSTRUCTION NOTES

1. INSTALL 81"X49" ARCH CMP CULVERT (40 LF) AT INVERTS SHOWN.
2. INSTALL 81"X49" ARCH CMP CULVERT (42 LF) AT INVERTS SHOWN.
3. INSTALL 81"X49" ARCH CMP CULVERT (12 LF) AT INVERTS SHOWN.
4. INSTALL 81"X49" ARCH CMP CULVERT (34 LF) AT INVERTS SHOWN.
5. INSTALL 3 - 36" CMP CULVERTS (48 LF) AT INVERTS SHOWN.
6. INSTALL CULVERT HEADWALL PER NMDOT STD. DETAIL 511-04.
7. INSTALL CULVERT HEADWALL PER NMDOT STD. DETAIL 511-03.



PROPOSED CULVERT
ALLEY CROSSING AT RIO GRANDE AVE

PROPOSED CULVERT
RIO GRANDE AVE



PROPOSED CULVERT
POLLARD AVE

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7720 North 16th Street
Suite 100
Phoenix, AZ 85020
(602)371-1100 (phone)
(602)371-1615 (fax)

NO.	REVISIONS	BY	DATE

PREPARED FOR:
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PRELIMINARY
NOT FOR
CONSTRUCTION

PROJ. NO.:	60487201
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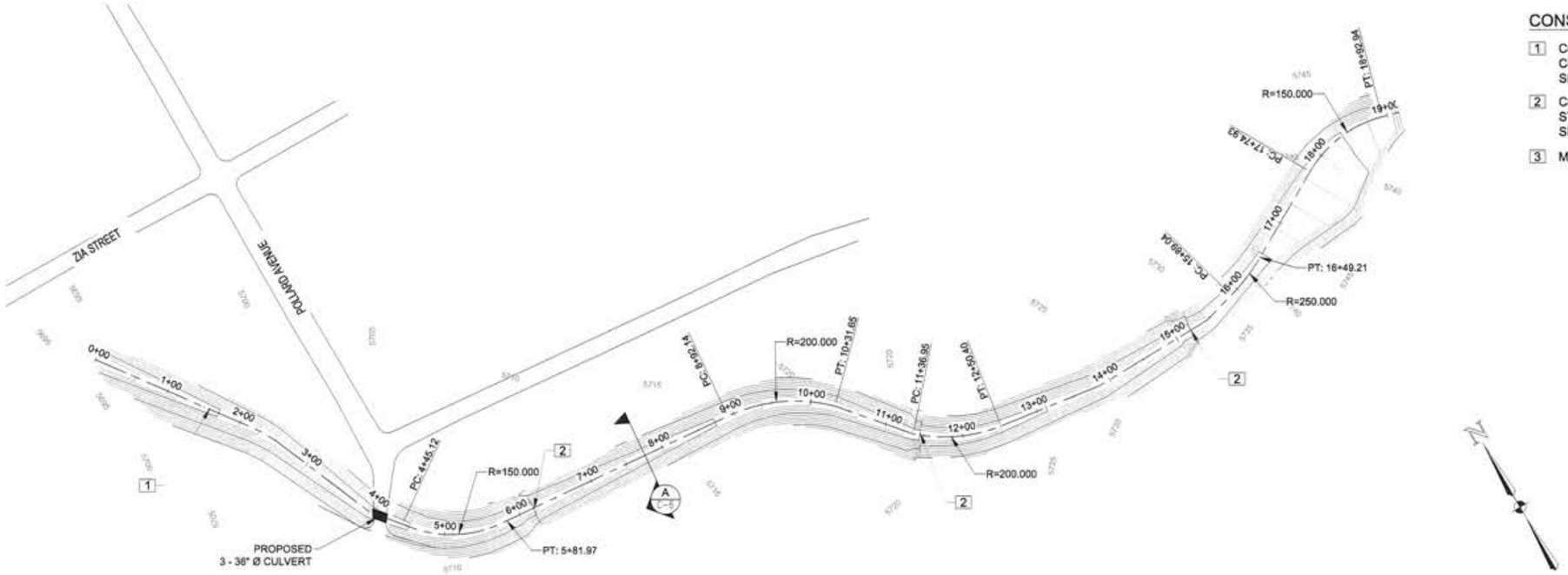
CITY OF AZTEC
BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED CULVERTS PLAN

SHEET:
C-3

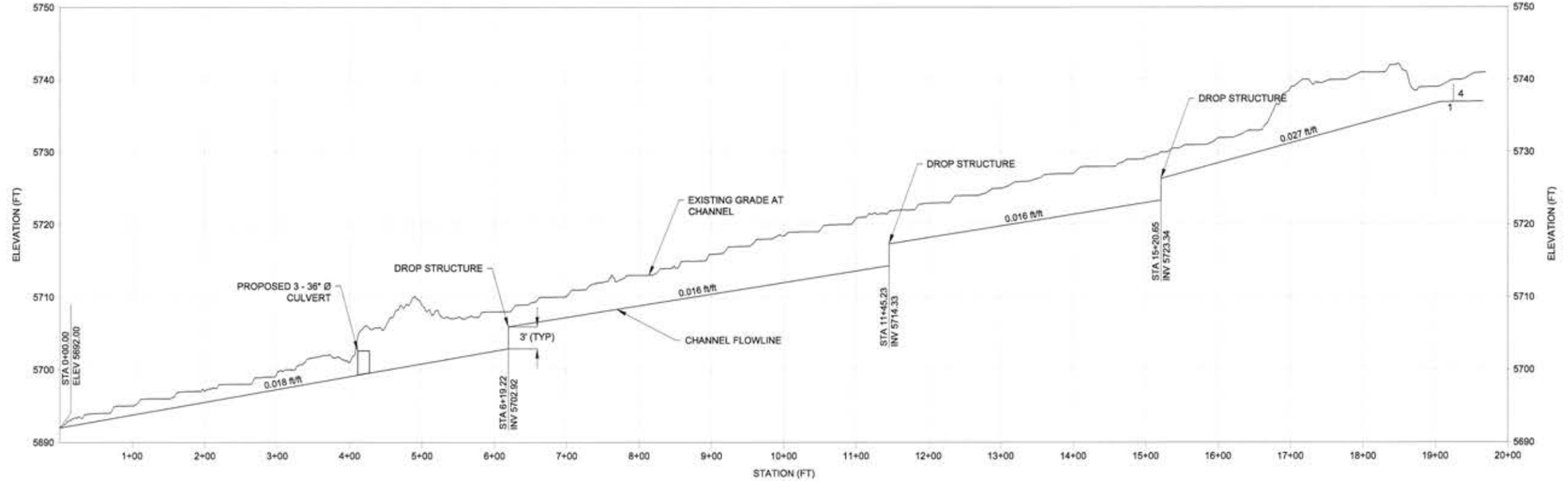
CONSTRUCTION NOTES

1. CONSTRUCT TRAPEZOIDAL CHANNEL PER DETAILS SHOWN.
2. CONSTRUCT CHANNEL DROP STRUCTURE PER DETAILS SHOWN.
3. MATCH EXISTING GRADE.



PROPOSED CHANNEL PLAN

SCALE: 1" = 75



PROPOSED CHANNEL PROFILE

SCALE: 1" = 75
HORIZONTAL

SCALE: 1" = 7.5
VERTICAL

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7720 North 16th Street
Suite 100
Phoenix, AZ 85020
(602)371-1100 (phone)
(602)371-1615 (fax)

NO.	REVISIONS	BY	DATE

PREPARED FOR:
610 Western Drive
Aztec, NM 87410
(505) 334-7660

PRELIMINARY
NOT FOR
CONSTRUCTION

PROJ. NO.:	60487201
DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	MCM
DATE CREATED:	11/22/2016
PLOT DATE:	4/26/2017

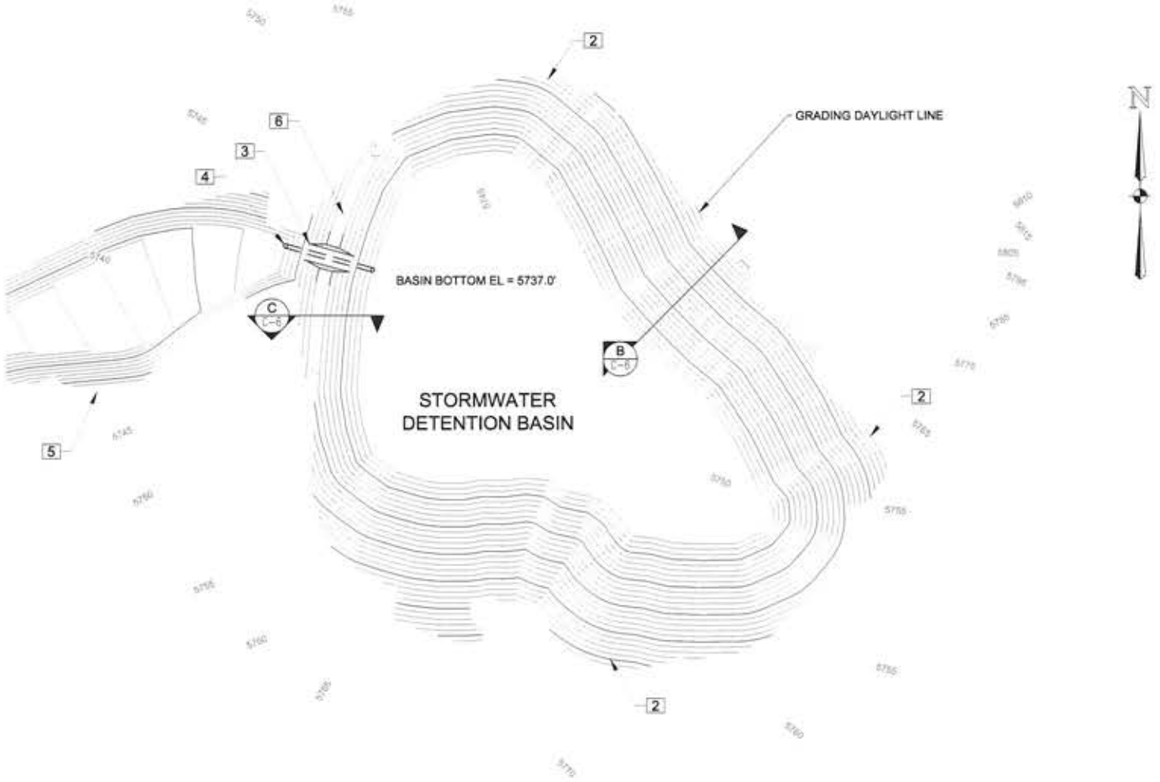
CITY OF AZTEC
BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED CHANNEL PLAN AND PROFILE

SHEET:
C-4

CONSTRUCTION NOTES

1. CONSTRUCT 80 AC.FT. STORM WATER STORAGE BASIN.
2. MATCH EXISTING GRADE.
3. CONSTRUCT BASIN SPILLWAY PER DETAIL SHOWN ON SHEET C-6.
4. CONSTRUCT BASIN LOW FLOW OUTLET, 36" CMP CULVERT, L = 67 FT.
5. SEE SHEET C-4 FOR PROPOSED CHANNEL GRADING.
6. DETENTION BASIN EMBANKMENT.



PROPOSED STORMWATER DETENTION BASIN
PLAN VIEW

AECOM
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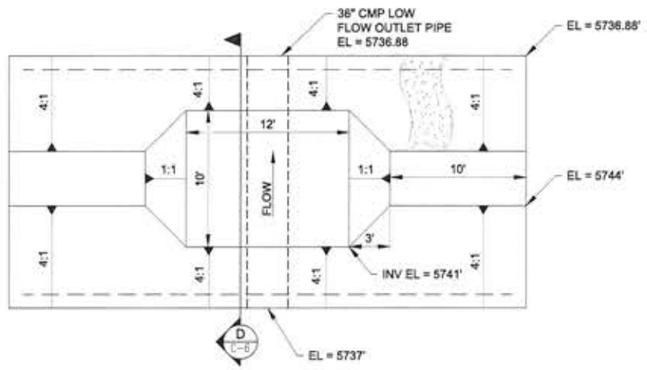
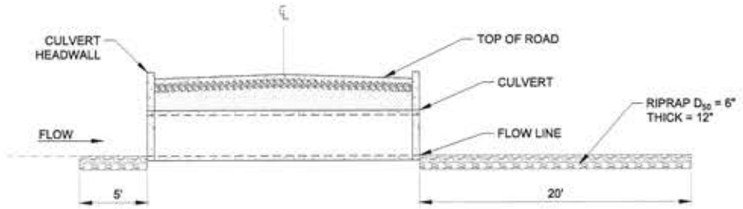
CITY OF AZTEC
BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

PROPOSED BASIN PLAN

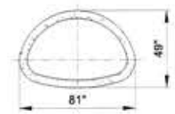
SHEET:
C-5



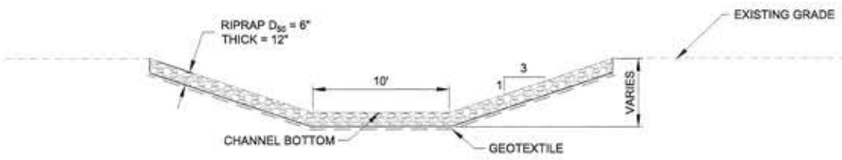
TYPICAL DETAIL
SPILLWAY



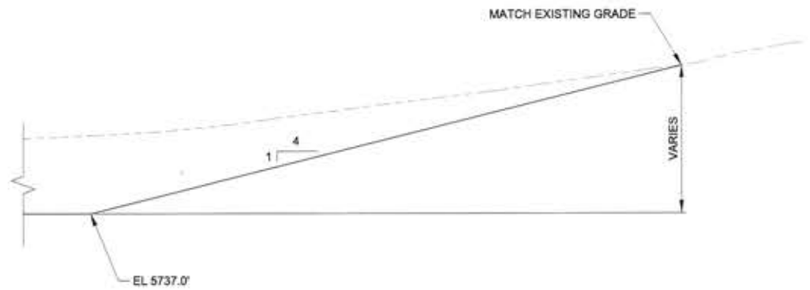
TYPICAL SECTION
CULVERT CROSSING



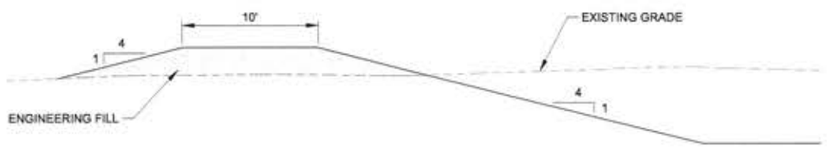
TYPICAL SECTION
ARCH CULVERT (N.T.S.)



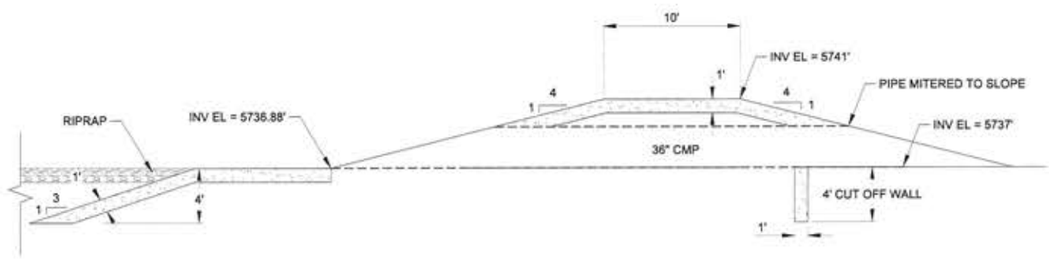
TYPICAL SECTION A
PROPOSED RIPRAP CHANNEL



TYPICAL SECTION B
STORM WATER DETENTION BASIN



SECTION C
EMBANKMENT SECTION



SECTION D
SPILLWAY SECTION

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BLANCO ARROYO
PRELIMINARY 30% DRAINAGE PLAN

MISCELLANEOUS DETAILS

SHEET:
C-6