kRoad Calico

September 6, 2011

Craig Hoffman
Compliance Project Manager
California Energy Commission
1516 Ninth Street, MS-2000
Sacramento, CA 95814

Subject: Calico Solar 08-AFC-13C
Calico Solar Project Infiltration Report

Dear Mr. Hoffman:

K Road Calico Solar LLC hereby submits the Calico Solar Project Infiltration Report dated September 6, 2011. I certify under penalty of perjury that the foregoing is true, correct and complete to the best of my knowledge.

Sincerely,

Daniel J. O'Shea
On behalf of K Road Calico Solar, LLC
formerly known as Calico Solar, LLC

A/74505999.1

Calico Solar Project
Infiltration Report

Submitted to: K Road **Calico Solar LLC**
2600 Tenth Street, Suite 635
Berkeley, CA 94107

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September 6, 2011

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TETRA TECH

1. INTRODUCTION AND BACKGROUND

On December 1, 2010, the California Energy Commission (Commission) issued a decision (Commission Decision) approving and licensing the Calico Solar Project (project) that would be owned and operated by K Road Calico Solar LLC (Calico). The Project site is located on 4,613 acres of land in San Bernardino County, California, that are primarily administered by the Bureau of Land Management (BLM) [**Figure 1.1**]. The Approved Project has a generating capacity of 663.5 megawatts (MW) that would be produced by solar collectors called "SunCatchers™." Each of these solar collectors would consist of an approximately 38-foot-diameter mirrored dish and a Stirling engine, powered by hydrogen generated on the Project site. On March 22, 2011, Calico filed a petition with the Commission requesting to modify the Project to generate the same 663.5 MW capacity, but with 100.5 megawatts derived from SunCatchers™ technology and 563 MW derived from single-axis tracker photovoltaic (PV) technology. The overall project footprint for the Proposed Project is the same as for the Approved Project.

1.1. Soil and Water Conditions Require Infiltration Report

The Commission issued Soil & Water Conditions of Certification for the Approved Project. These conditions require, in-part, that Calico submit an Infiltration Report that includes *an analysis of rainfall on the project site, with the objective of quantifying the amount of change in infiltration due to the project* (**Soil&Water-13**). Calico has proposed additional requirements for Soil&Water-13 that take into account the addition of PV technology into the Proposed Project. Soil&Water-13 together with the additional considerations proposed by Calico require *calculation of the amount of storm water runoff for 1) the existing soil conditions, 2) the temporarily disturbed conditions resulting from construction, and 3) the final conditions after the installation of PV modules and SunCatchers™ and the construction of roads and buildings is complete.* The analysis is to be conducted using the 2-, 5-, 10- and 100-year storm intensities, considering durations of both 6 and 24 hours. All areas on the project site are to be identified where permeability of the ground surface may be changed due to construction of the project, including:

1. The pedestals of the SunCatchers™ and posts supporting the PV modules;
2. Any areas where facilities will be constructed, fill will be deposited, or soil will be compacted;
3. Any areas which will be paved or treated with soil stabilizers or soil-weighting agents; and
4. Any other areas where construction or operational activities may result in impacts to drainage, vegetation, and soil infiltration rates.

Soil-water flow across the site is to be modeled to assess the significance/impact of the PV modules and SunCatchers™, roadways, soil binders, and construction and operational activities on the effective infiltration on the project site. The amount of impervious surface created by each project feature is be estimated by considering worst-case conditions, including the impact of the SunCatchers™ when fully deployed; including the long-term compaction of untreated roads due to construction/maintenance vehicles and the effects on permeability from application of the soil treatments on other onsite roads. The Infiltration Report is also to include an analysis based on worst-case vegetation conditions over the life of the project, as affected by: clearance, soil compaction, shading of vegetation by PV modules and SunCatchers™, relocation of precipitation by PV modules and SunCatchers™, addition of water through the washing of PV module and SunCatchers™ mirrors, modification of stormwater flow by the

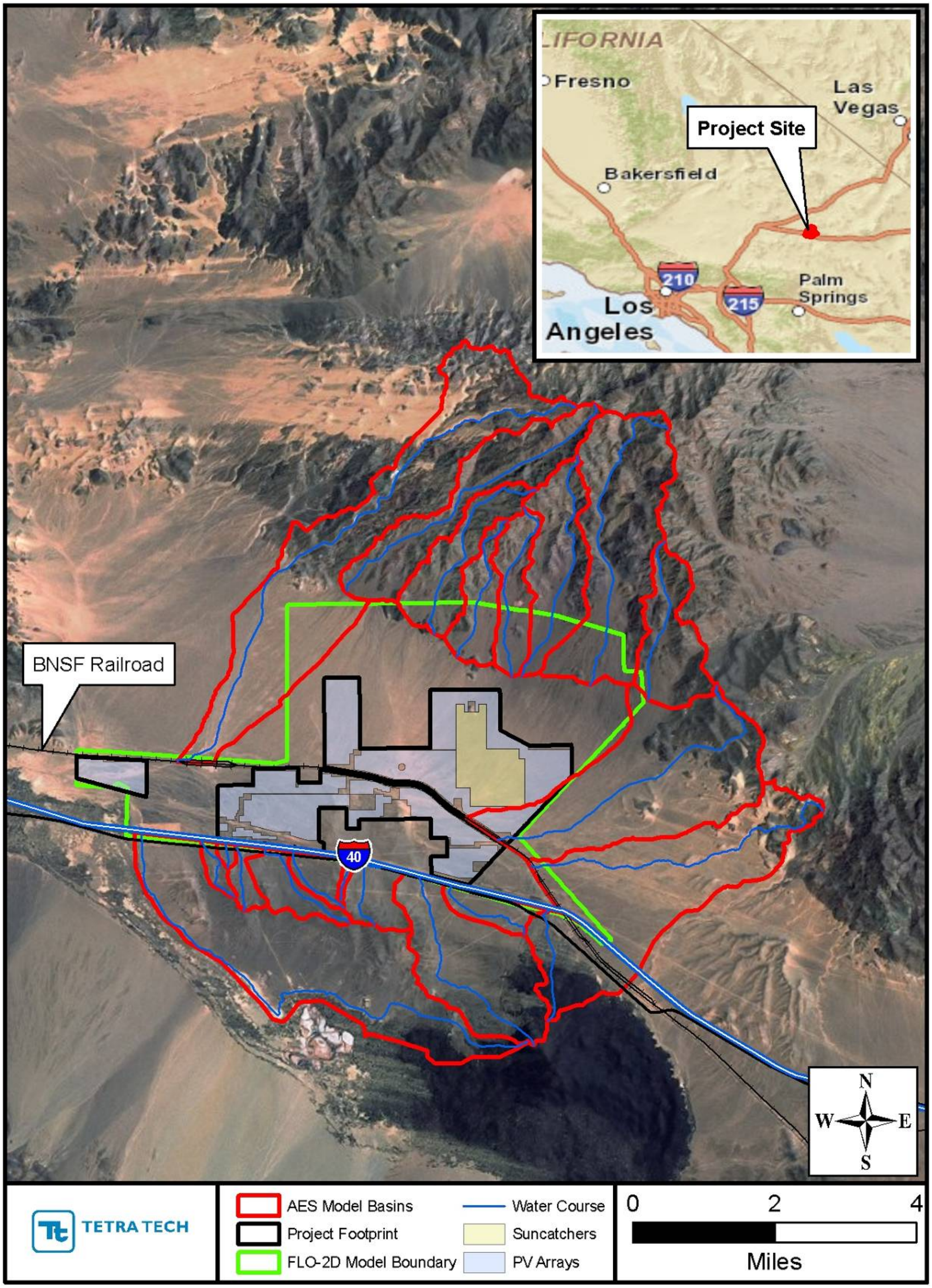

Figure 1.1. Map of the Calico Solar project site and watersheds.

presence of the modules and SunCatchers™ and access and maintenance roads, use of dust suppressants, and use of weed management practices.

The Infiltration Report is to be used to determine the change in post-construction runoff caused by the project, and is also to be considered during development of the plans and reports required under other portions of the soil and water conditions.

1.2. Authorization and Project Team

Tetra Tech, Inc. was retained by Calico to complete the Infiltration Report using site plans developed by Westwood Professional Services and other available information. Tetra Tech's Project Manager for this work was Dr. Robert Mussetter, PE, and was assisted by Dr. C.C. Yen, Ms. Alaina Smith, PE, and other Tetra Tech support staff.

During the early phases of Tetra Tech's work on the project, Dr. Mussetter participated in a field visit with representatives from Calico and Westwood. Representatives from the Commission also participated in a portion of the field visit. During the field visit, significant portions of the site were viewed by traversing the available access roads and walking portions of the site not directly accessible by vehicle. Eight grab samples of the bed-material sediments found within significant on-site washes were collected for laboratory sieve analysis to supplement the other available soils and sediment data.

2. RAINFALL-RUNOFF MODELING OF OFF-SITE BASINS

The watershed on, and upstream from, the Project site covers an area of approximately 60 square miles, including the 4,613-acre Project site, with the largest portion of the off-site drainage originating from the Cady Mountains located to the north and east (Figure 1.1). For purposes of this analysis, runoff conditions at the Project site were analyzed by separating the overall watershed into (1) the off-site basins that ultimately drain across the Project site, and (2) the portion of the watershed within the Project site (**Figure 2.1**). Stormwater runoff from the majority of the off-site basins was modeled using procedures specified in the San Bernardino County (SBC) Hydrology Manual (SBC, 1986; 2010), as implemented in the Advanced Engineering Software (AES) Flood Routing Analysis Computer Program, 2009 version (Figure 1.1). A portion of the off-site basins that cross alluvial-fan topography where there are multiple, uncertain flow paths, along with the entire project site, were then analyzed using the FLO-2D model (FLO-2D Software, Inc., 2009), Precipitation, infiltration, and runoff processes are all described internally in the FLO-2D model using procedures that are consistent with the San Bernardino County method. Flows originating from off- and on-site precipitation are routed across the site in FLO-2D using a two-dimensional (2-D) unsteady flow formulation that quantifies the flow depths and both the magnitude and direction of the flow velocity in each model cell. The AES model results for the off-site basins were used as upstream boundary conditions (i.e., inflows) for the FLO-2D model. This section describes the procedures, assumptions, and results of the AES modeling.

2.1. Watershed Characteristics that Affect Rainfall/Runoff Processes

2.1.1. Topography and Watershed Subbasin Delineations

The watershed draining to and across the Project site can be broadly divided into four zones: (1) the steep slopes and alluvial valleys of the Cady Mountains located to the north, (2) the coalesced alluvial fan (i.e., bajada) surface located downstream from the mountain front, (3) the relatively flat surface draining from the lava fields associated with the Pisgah Crater located to the south of Interstate 40 (I-40), and (4) the valley floor that generally lies between I-40 and the BNSF Railroad line. The Cady Mountains comprise approximately 22 square miles, or about 36 percent, of the total 60-square-mile drainage basin. This portion of the watershed is characterized by steep (30 to 60 percent), bedrock slopes above alluvium-filled canyon bottoms that drain generally in a south-southwesterly direction onto the alluvial fan/bajada surface on which the project site is located (**Figures 2.2 and 2.3**). The bajada surface is characterized by numerous shallow flow paths that also drain in a south-southwesterly direction at gradients ranging from 10 to 15 percent, near the mountain front, to less than 5 percent at the distal end, near the BNSF Railroad line. The portion of the watershed located south of I-40 covers an area of approximately 13 square miles (about 22 percent of the total contributing watershed area), and generally drains in a west-northwesterly direction at slopes in the range of 5 percent. The valley bottom that generally lies between I-40 and the BNSF Railroad line drains to the west at slopes in the range of 5 percent or less.

Topographic data used to develop both the AES rainfall-runoff and FLO-2D models were derived from two different sources: (1) detailed topographic data that were collected in September 2008 using Light Detection and Ranging (LiDAR) technology over an approximately 13,120-acre area that includes the project site, and (2) a 10-meter pixel resolution Digital Elevation Model (DEM) covering the entire watershed at the project site, which is available from the USGS at http://data.geocomm.com/readme/usgs/dem.html (Figure 2.1).

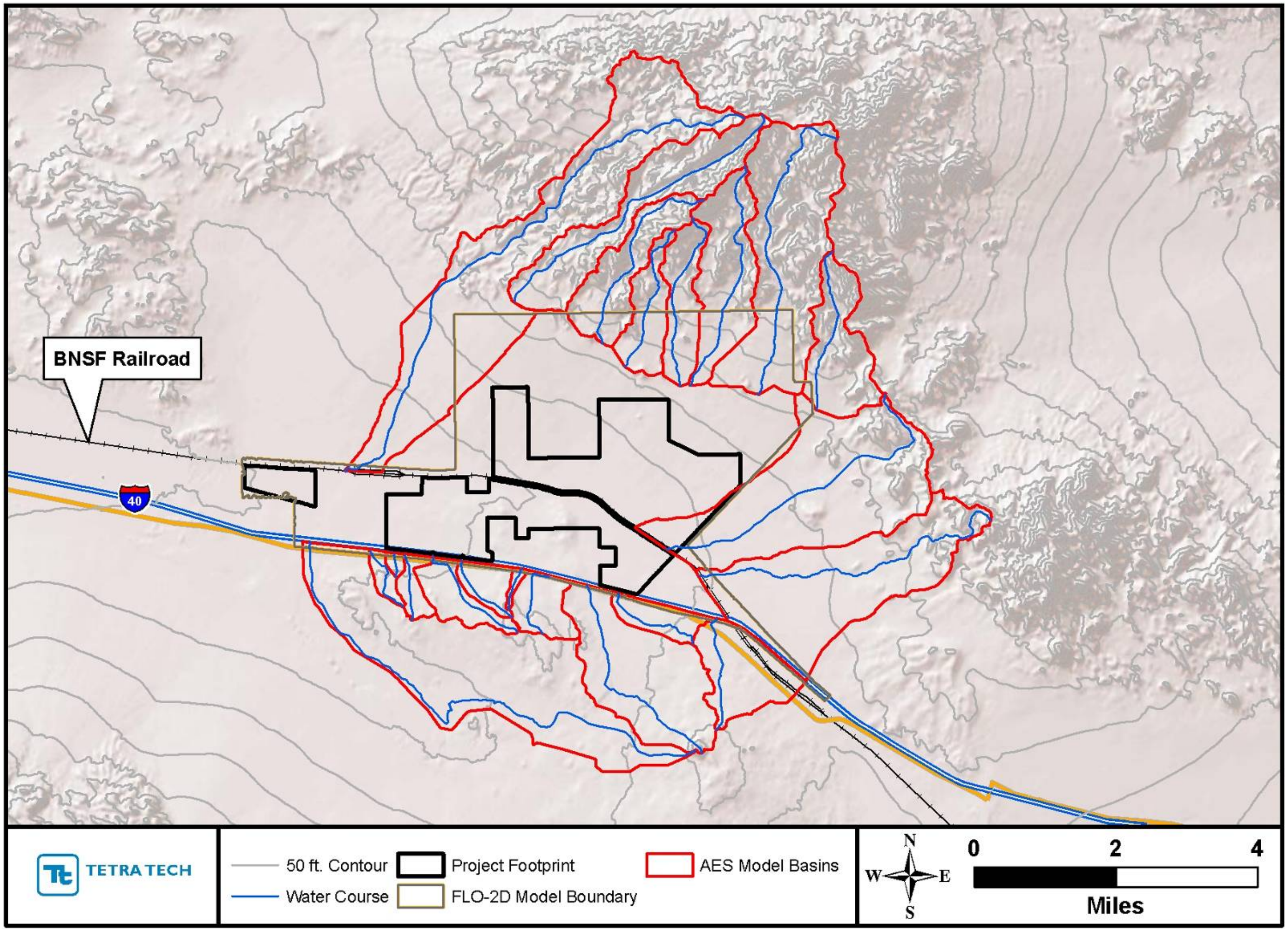

Figure 2.1. Topographic surface of the project site and upstream watershed.

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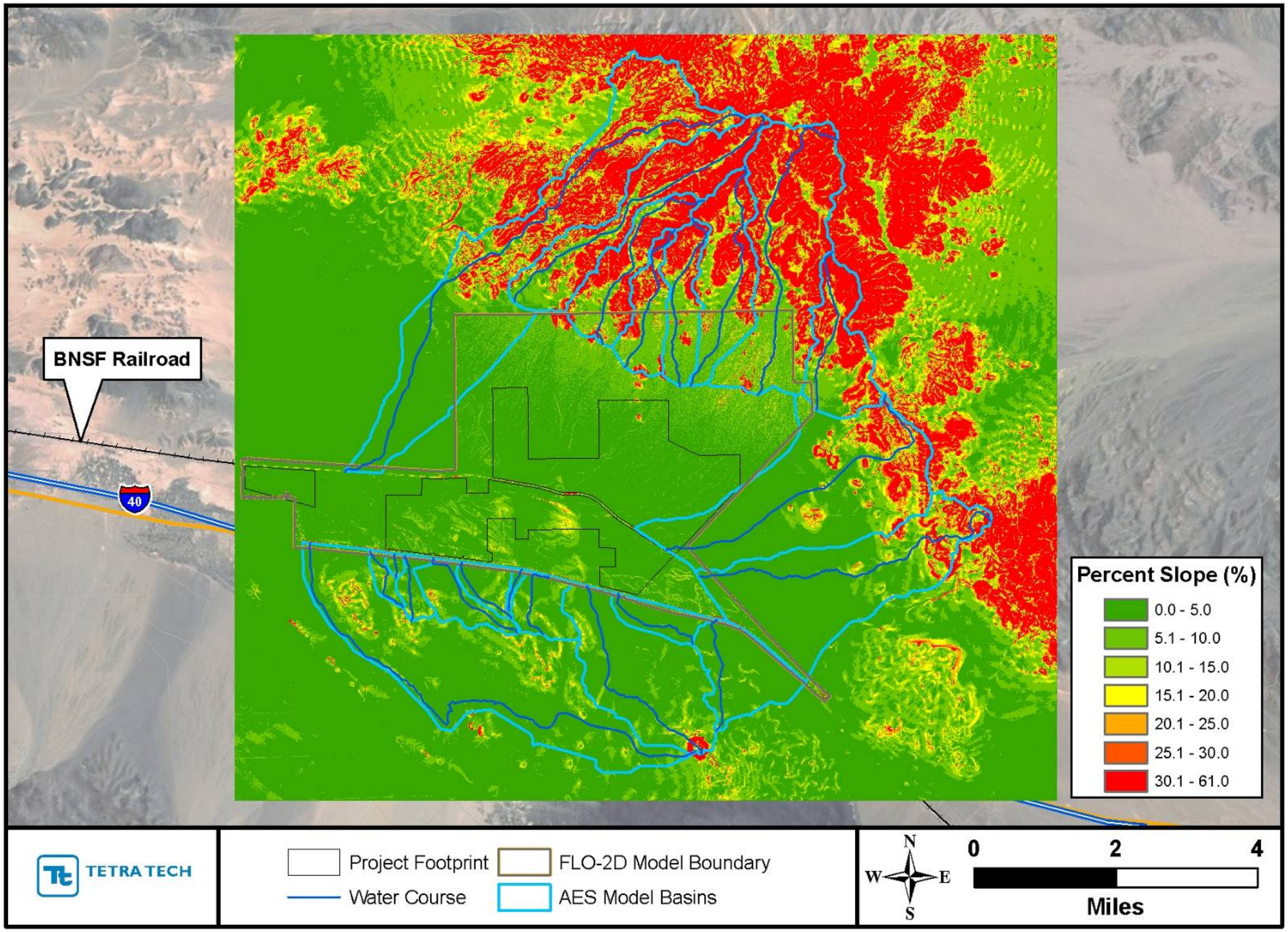

Figure 2.2. Topographic slopes at the project site and upstream watersheds.

Figure 2.3. Typical view of the bajada surface covered by the Mojave creosote bush scrub vegetation community and Cady Mountains from southeast corner of Section 4 near the extension of Hector Road.

The drainage subbasins modeled using AES were delineated based on the DEM, U.S. Geological Survey (USGS) 7.5-minute quadrangle maps, and the USGS 12-digit hydrologic unit code (HUC-12) catchment boundaries. The portion of the watershed in the Cady Mountains located north and northeast of the project site includes 10 subbasins, and the portion of the site south of I-40 includes 11 subbasins (Figure 2.3). Inflow basins 10, 18, and 19 were extended from the canyon mouth to the project boundaries because sufficiently detailed topographic data with which to perform 2-D modeling are not available. Inflow basins 20 to 30 were terminated at the I-40 drainage culverts.

2.1.2. Climate and Precipitation

Precipitation patterns in the Mojave Desert, in general, and specifically in the vicinity of the project site, are strongly influenced by a rain-shadow effect caused by the surrounding mountainous terrain that significantly reduces winter season rainfall compared to coastal and mountain areas to the south and west. The area has a typical desert climate characterized by low precipitation, hot summers, mild winters, low humidity, and strong temperature inversions. Total rainfall at the nearest long-term precipitation gage, which is located in Barstow, California, approximately 37 miles west of the project site, averages about 4.3 inches per year, with about 74 percent of the total annual rainfall occurring during the winter rainy season, and about 20 percent occurring during late summer and early fall thunderstorms (Western Regional Climate Center [WRCC] 2010; U.S. Department of Interior, Bureau of Land Management (BLM), 2010).

As recommended in SBC (2010), precipitation data were initially assessed by evaluating the available precipitation gage data in the vicinity of the project area. The nearest stations to the site are located near Barstow, and the data for these stations were downloaded from the California Department of Water Resources (DWR) website and reviewed (**Table 2.1**). Due to the short periods-of-record for each gage, coupled with the distance from each gage to the project site, these data were not used in the study.

Table 2.1. DWR precipitation gages in the vicinity of Barstow, CA.

Station Name	Station No.	Latitude	Longitude	Elevation (ft)	Data Period
Barstow NE 134	W28051950	34.884	-116.983	2040	1998 - 2004
Barstow 60	W28051950	34.903	-117.115	2180	1987 - 1992
Barstow	W28051900	34.900	-117.017	2142	1964 - 1973

The point precipitation data used for the study were downloaded in Geographic Information System (GIS) format from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 6, Version 2 (April 2011), available online at: http://hdsc.nws.noaa.gov/hdsc/pfds/

The point precipitation-frequency estimates for 2-, 5-, 10-, 25-, 50- and 100-year recurrence interval storms with durations of 5, 30, 60 minutes, and 3, 6, and 24 hours, were downloaded from the above website and used to compute the area-average rainfall depths for each subbasin within the watershed. The 6- and 24-hour total point precipitation values range from approximately 0.7 inches to 1.0 inches for a 2-year storm to 2.0 to 3.0 inches for the 100-year storm (**Table 2.2**). The NOAA Atlas 14 values vary somewhat from these average values over the approximately 60-square-mile watershed. The specific value applied to each subbasin was developed by computing area-weighted values from the spatially-variable NOAA GIS files. A summary of the values applied in the model is provided in **Appendix A** (Hydrology).

Table 2.2. Approximate point precipitation depths (inches) for the watershed at the project site.						
Duration	Recurrence Interval (years)					
	2	5	10	25	50	100
5-minute	0.13	0.18	0.23	0.30	0.36	0.42
30-minute	0.30	0.44	0.56	0.72	0.86	1.01
60-minute	0.41	0.59	0.74	0.97	1.15	1.35
3-hour	0.58	0.80	0.98	1.25	1.47	1.70
6-hour	0.70	0.96	1.17	1.48	1.73	1.99
24-hour	1.04	1.44	1.77	2.24	2.61	2.99

As recommended in SBC (1986), the nested 24-hour design storm pattern, that includes peak rainfall intensities for durations of 5 and 30 minutes, and 1, 3, 6, and 24 hours, was used in developing the offsite runoff hydrographs for application at each FLO-2D inflow basin (**Figure 2.4**). For this rainfall distribution, the peak intensity occurs about 16 hours after the start of the storm, and over 40 percent of the total rainfall occurs during the one-half-hour period encompassing the peak intensity.

2.1.3. Soil, Vegetation, and Runoff Curve Numbers

Due to its low potential for agricultural use, current soil-survey data are limited in much of the Mojave Desert, including the project site. Nevertheless, coarse-scale mapping of hydrologic soil groups is available from the San Bernardino Hydrology Manual (1986) (**Figure 2.5**); and more recent, higher resolution mapping is available from the NRCS STATSGO2 website, which can be found on-line at: http://soils.usda.gov/survey/geography/statsgo (**Figure 2.6 and Table 2.3**).

Table 2.3. Description of soils in the project watersheds from NRCS STATSGO2 mapping (see Figure 2.2).							
California ID Number	Composite Soil Name	Mapping Unit Name	Texture	Slope Range (%)	Permeability (in/hr)	Shrink-Swell Potential	Hydrologic Soil Group
61146	CHUCKWALLA	Carrizo-Rositas-Gunsight	Gravelly Silty Loam	0 - 30	2 - 6	Low	B
61281	LAVIC	Rock Outcrop -- Upspring-Sparkhule	Loamy Fine Sand	0 - 5	20	Low	B
61289	CAJON	Rock Outcrop -- Lithic Torriorthents-Calvista	Sand	0 - 8	0.2 -0.6	Moderate	A
61315	LAVIC	Rock Outcrop -- Upspring-Sparkhule	Loamy Fine Sand	0 - 5	20	Low	B
61319	ARIZO	Nickel-Arizo-Bitter	Gravelly Loamy Sand	2 - 8	2 - 6	Low	A

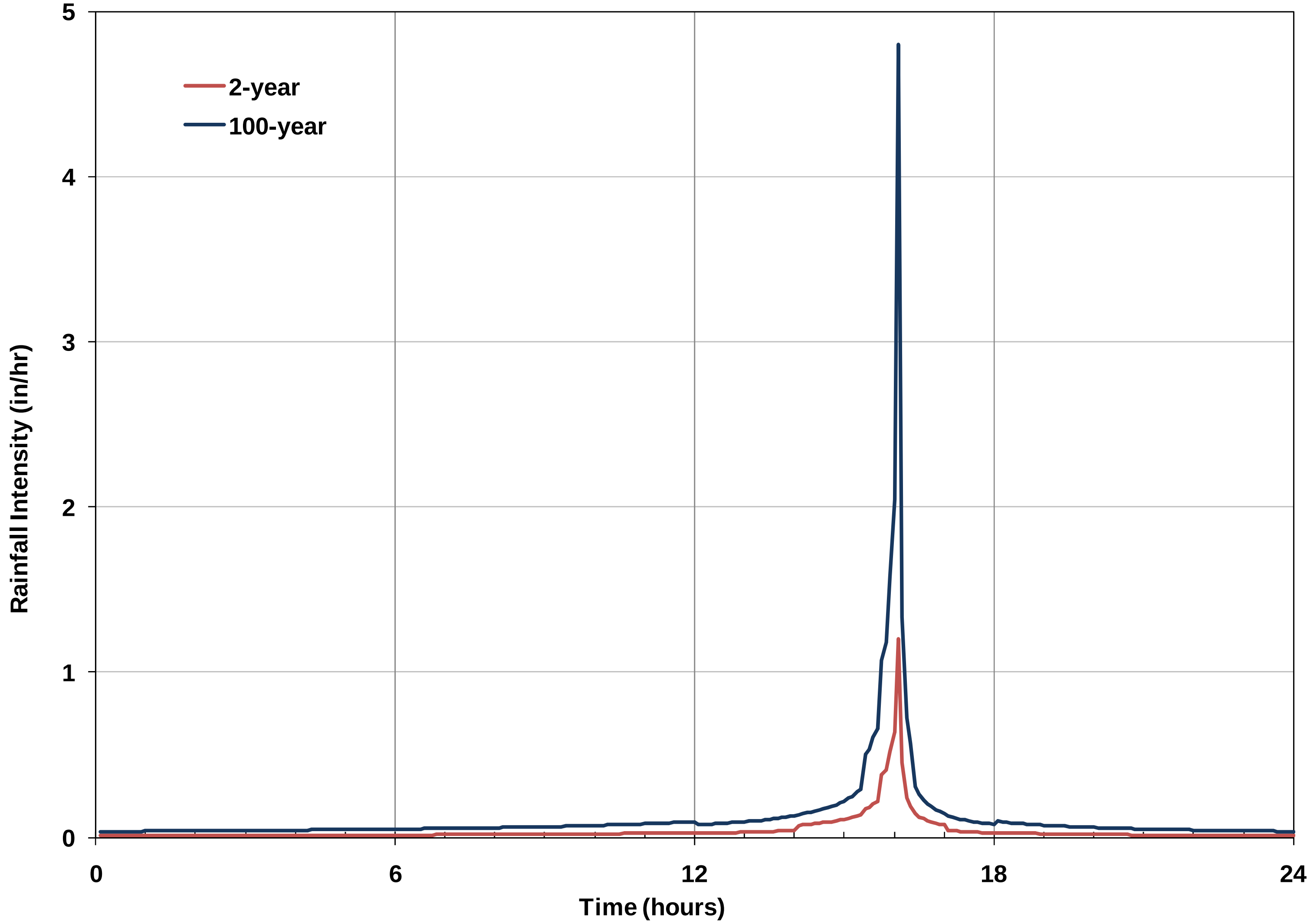

Figure 2.4. Rainfall intensity distribution for the 2- and 100-year nested-24-hour storms.

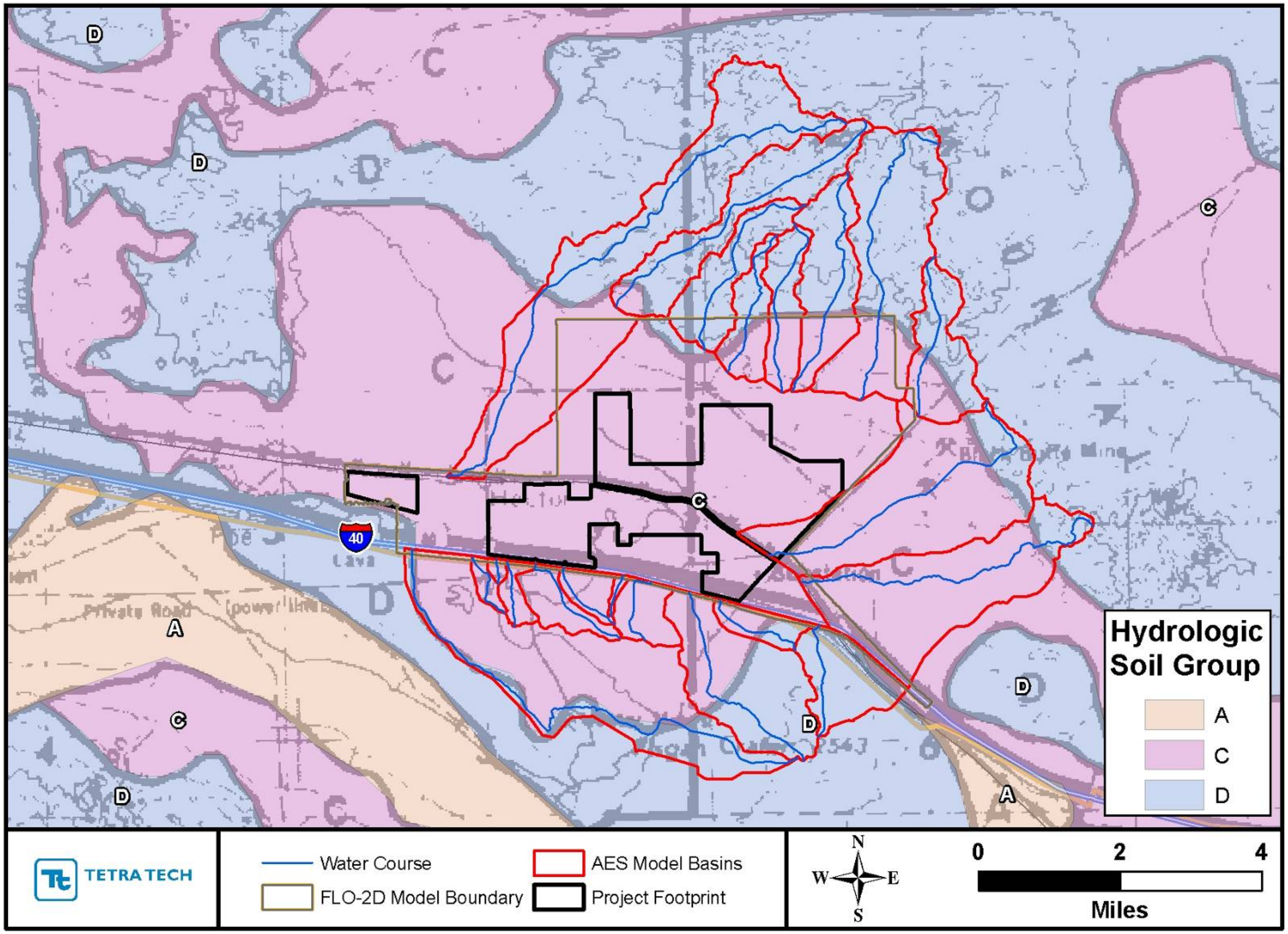

Figure 2.5. Hydrologic soil groups in the vicinity of the project, digitized from SBC (1986), Figure C-11.

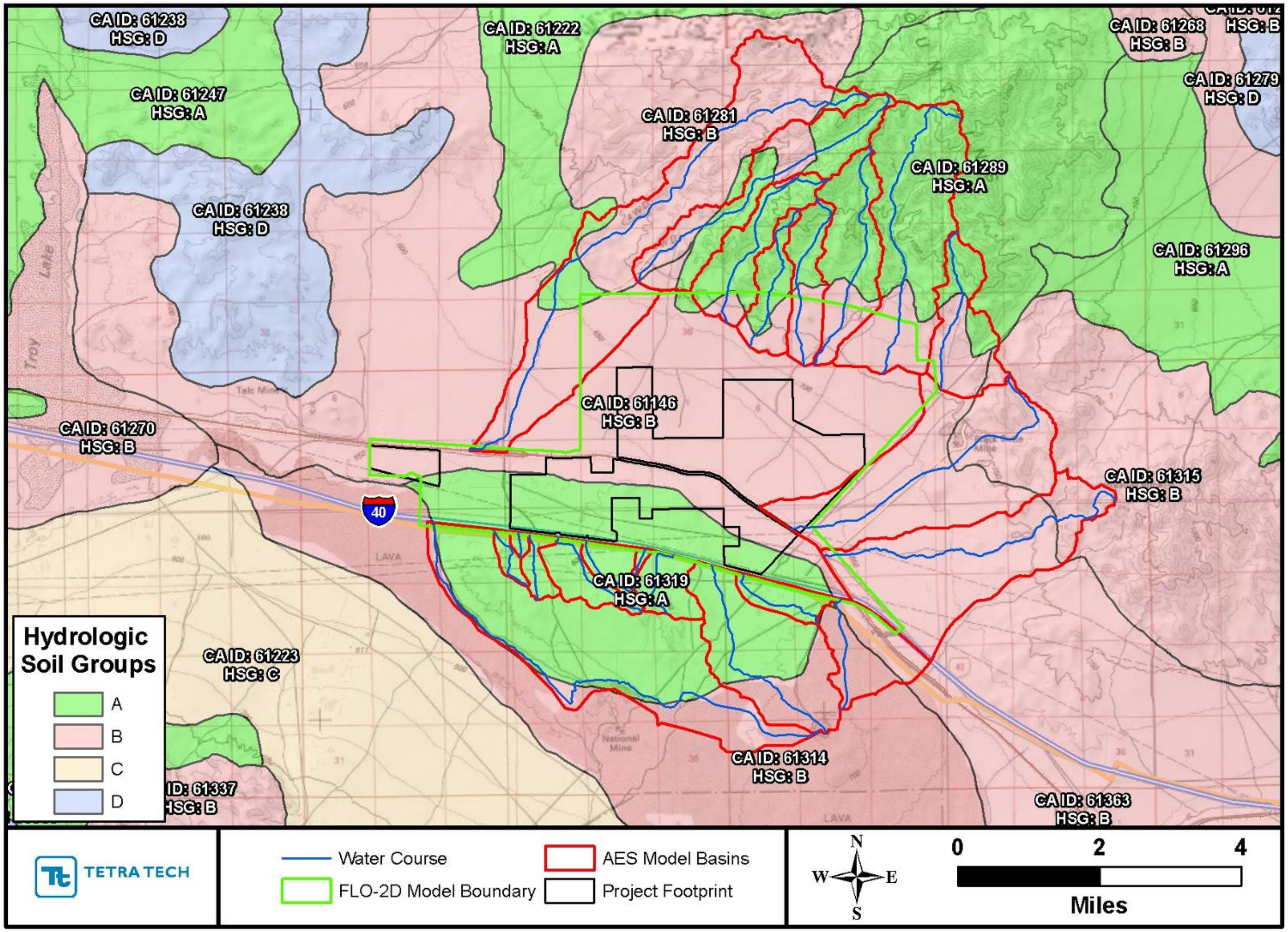

Figure 2.6. Hydrologic soil groups in the vicinity of the project from NRCS STATSGO2 website.

The surface soils in the watershed generally consist of Quaternary alluvium and fanglomerate composed of sediments washed down from the Cady Mountains located to the northeast of the project site (BLM, 2010). Small outcrops of Tertiary basalt, andesite, and volcanic breccia occur in the northernmost portion of the project site, and a small outcrop of "basalt flow" from the geologically recent Pisgah Crater eruption is present along the southernmost project site boundary, but this does not appear to contribute runoff to the site and also prevents runoff from watersheds located farther to the south and east from entering the site (**Figure 2.7**). The soils mapping provided in the San Bernardino County Hydrology Manual (1986) indicates that most of the mountainous portion of the off-site watershed contains Hydrologic Soil Group (HSG) D soils (chiefly clay soils with very slow infiltration rates when wet, and exhibiting high runoff potential), with the remainder of the soils on the alluvial fan and valley floor comprised of HSG C (chiefly silty-loam soils with slow infiltration rates when wet, and exhibiting moderate to high runoff potential).

Based on field observations, the available geologic mapping and other available information, the steep mountain slopes have significant bedrock outcrop that would exhibit runoff behavior similar to HSG D soils. On the other hand, the alluvial fan surface lying north of the BNSF Railroad line, and at least a portion of the valley floor south of the BNSF line, is recently (geologically) deposited, relatively coarse-grained (sand and gravel) alluvium that should have relatively high infiltration rates. In desert environments, a caliche (i.e., calcium carbonate precipitate) layer is often present that creates an impermeable layer below the ground surface that limits infiltration. Based on the boring logs in Terracon (2011), a calcium carbonate layer was encountered in 9 of the 32 soils borings and 12 of the 13 test pits that were completed in 2009 (**Figure 2.8**). Weak cementation that may or may not indicate caliche was also noted in 2 of the 9 borings that were completed in 2011. When it was encountered, the calcium carbonate layer in most of the samples north of the BNSF Railroad was in the range of 5 feet below the ground surface; thus, it is not anticipated that this layer would have a substantive effect on infiltration rates and runoff during the modeled storms that typically occur in this area.

For consistency with the San Bernardino County hydrology methods, the areas occupied by different soils types were delineated based on a combination of the San Bernardino County General Soils map, the STATSGO2 mapping, and the locations of bedrock indicated by the available geology mapping and aerial photography. The bedrock areas in the Cady Mountains are assumed to be relatively impervious, with runoff behavior similar to HSG D soils. These areas are clearly evident on the available aerial photography (**Figure 2.9**). The STATSGO2 mapping indicates that the soils in alluvial areas in the mountainous terrain and along the head of the bajada are HSG B, while the San Bernardino County mapping indicates HSG C soils in this area. Because the soils would generally be shallower in these somewhat steeper areas, it was conservatively assumed that all alluvial areas with slopes steeper than 5 percent would consist of at least HSG C soils. Comparison of the bedrock areas identified from the aerial photography with the slope mapping also indicates that the bedrock generally corresponds to slopes greater than 15 percent. Based on these observations, all areas in the watershed lying north of the BNSF Railroad with slopes steeper than 15 percent were assigned parameters consistent with HSG D soil; while areas with slope between 5 and 15 percent were treated as HSG C soil. All other areas were treated as HSG B soil (**Figure 2.10**). The entire watershed lying south of I-40 was conservatively treated as HSG C, based on the San Bernardino County mapping.

In addition to the soil characteristics, vegetation also plays an important role in determining the runoff characteristics of the watershed. As described in BLM (2010), the Biological Resources Technical Report for the previously submitted "Solar One Project" (SES 2009) identified two

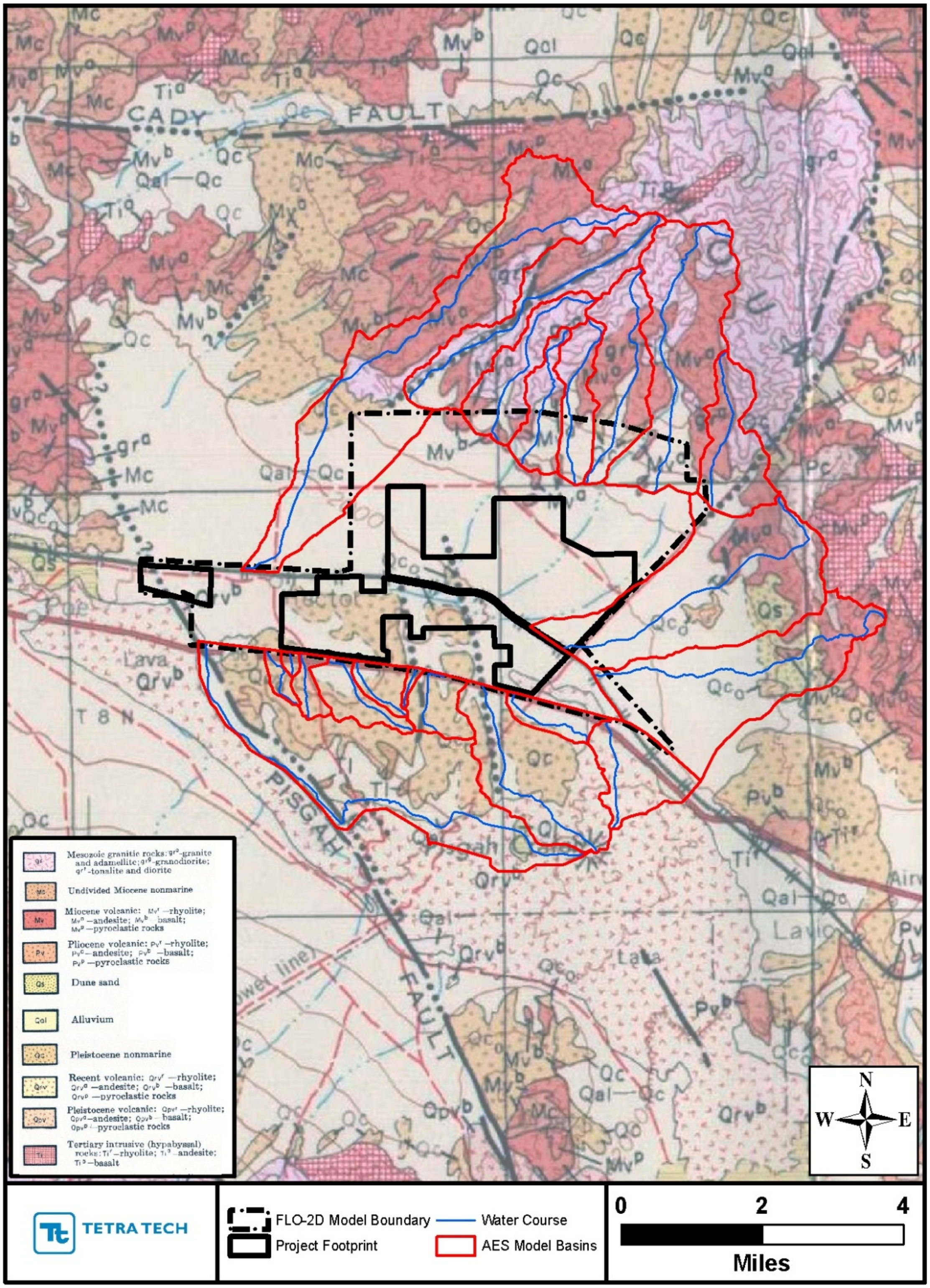

Figure 2.7. Geology map of the vicinity of the project site.

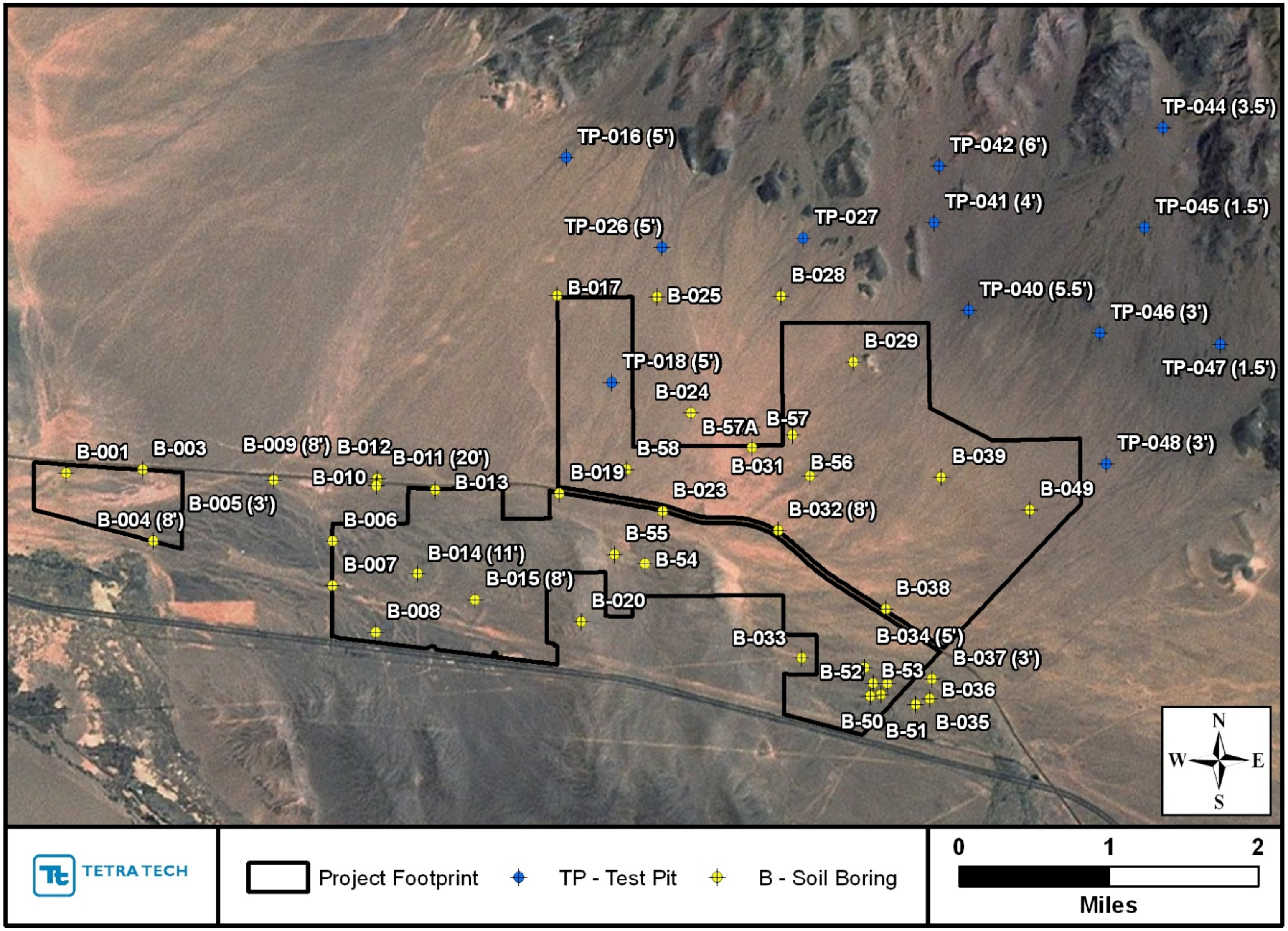

Figure 2.8. Location of soil borings and test pits reported by Terracon (2011) (Most of the borings and test pits were completed in 2009.) Parenthetical numbers after some of the labels indicate approximate depth below existing ground surface to the upper-most calcium carbonate deposits. Calcium carbonate deposits not encountered at sites with no parenthetical number after the label.

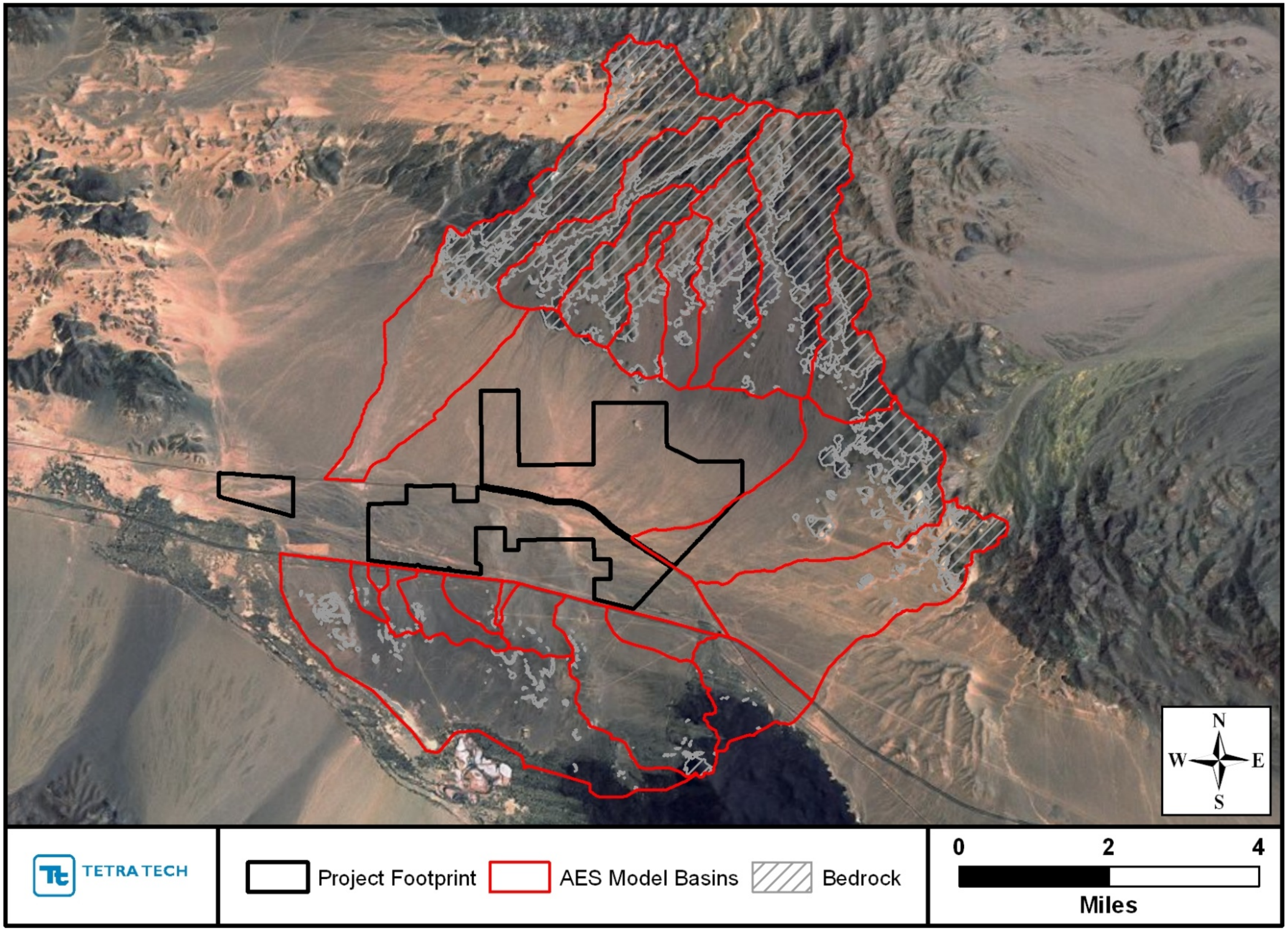

Figure 2.9. Aerial photograph (June 14, 2009) of watershed showing the bedrock and alluvial surfaces.

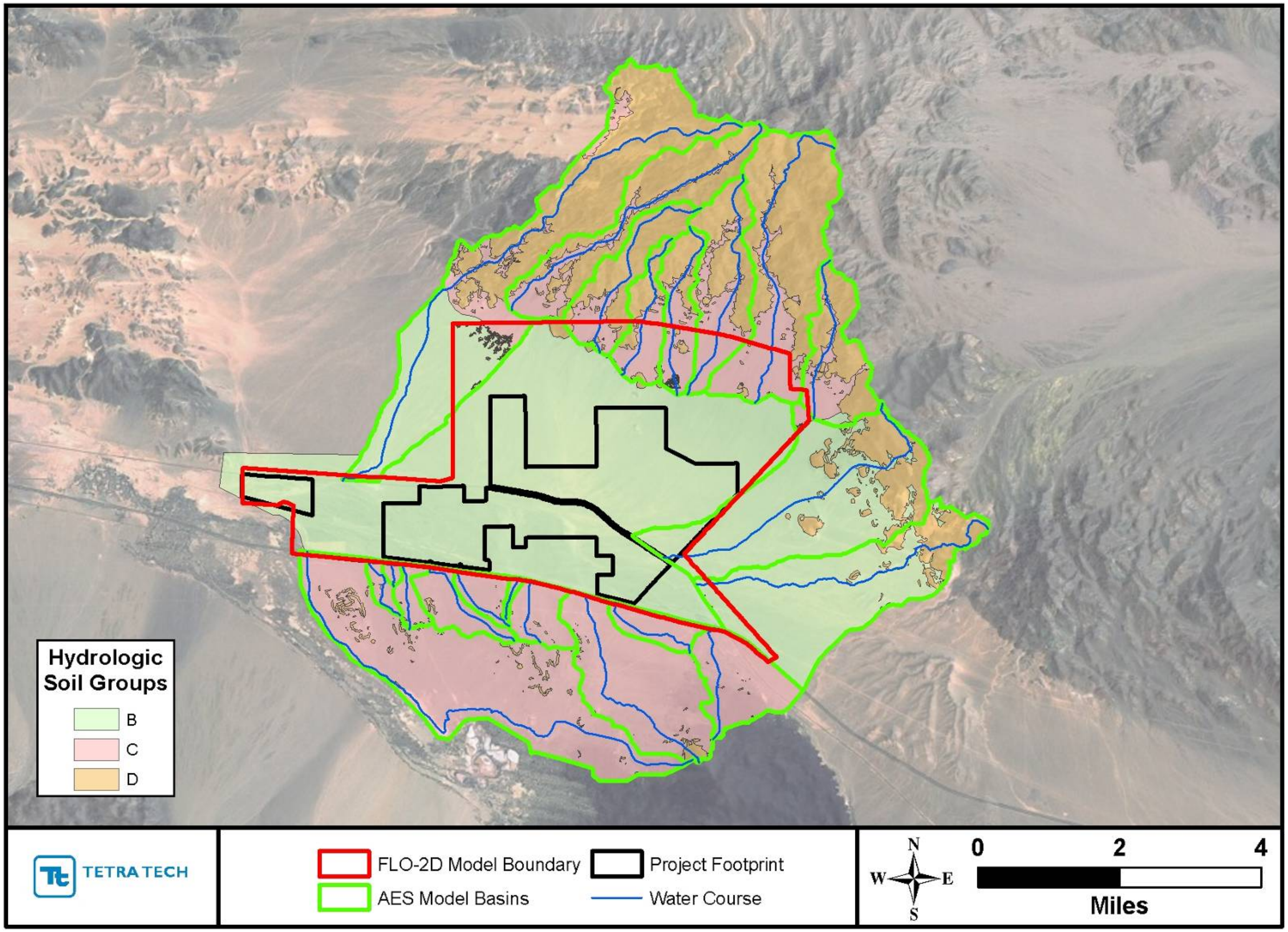

Figure 2.10. Boundaries of soil types used for the AES rainfall-runoff and FLO-2D modeling.

vegetation communities on the site: (1) Mojave creosote bush scrub, and (2) desert saltbush scrub. Of these two communities, the Mojave creosote bush scrub occupies over 97 percent of the site. The community description used for the vegetation mapping follows the relatively coarse-scale classification system described by Holland (1986) that combines several vegetation associations that occupy specific portions of the site into the broader Mojave creosote bush scrub classification. While they have not been mapped, the smaller vegetation associations include microphyll woodlands such as catclaw acacia thorn scrub that are typically associated with dry desert washes; lower elevation wash and sandfield vegetation; smoke tree woodland; and big galleta shrub-steppe.

The characteristics of this community that affect rainfall-runoff processes include the widely spaced distribution of the shrubs , along with a diverse assemblage of annual and perennial herbs that establish during periods of adequate seasonal precipitation. A number of cactus species also occur on the project site. In general, this community corresponds to the Desert Brush category, with 20-percent cover in SBC (1986, Figure C-8) for purposes of defining the runoff CNs and associated rainfall interception characteristics. For these conditions, the CNs are 83, 88 and 91 for HSG B, C, and D, respectively.

Antecedent moisture condition (AMC) also affects the infiltration and runoff characteristics of a watershed. SBC (1986) required that different AMC conditions be used for the rainfall-runoff analysis, based on the recurrence interval of the individual storm. Specifically, an AMC I condition (lowest runoff potential) was to be used for to the 2- and 5-year storms, an AMC II condition (moderate runoff potential) for the 10-, 25- and 50-year storms, and an AMC III condition (i.e., highest runoff potential) for the 100-year and greater storms. The 2010 addendum (SBC, 2010) modified this specification to allow the use of an AMC I condition for all storms in a significant portion of San Bernardino County that includes the project site (**Figure 2.11**). Based on many years of experience with arid-region hydrology throughout Arizona and Southern California, the Tetra Tech project team believes that an AMC I condition is unconservative and will probably significantly under-predict the magnitude of runoff for this area, especially for very intense storms. This occurs because the raindrop impact on the desert soil causes the surface to become significantly more impermeable than would be indicated by standard infiltration tests. As a result, AMC II conditions were applied to all of the modeled storms.

Studies by the SCS using rainfall-runoff data from the Safford W-II Experimental watershed in southeastern Arizona indicate that the duration of excess runoff and the effective CN are also strongly affected by the storm duration (Woodward, 1973). The Pima County Department of Transport and Flood Control District (PCDOT and FCD, 1979) provided preliminary relationships for the variation in curve number with storm duration and the 1-hour storm depth:

$$CN^* = [R_1(P_1-0.88)+R_2]/P_1 \text{ for } P_1>0.88$$

where CN^* = CN for a 1-hour storm,
P_1 = 1-hour storm depth, and
R_1 and R_2 = coefficients (**Figure 2.12**).

Zeller (1993) used these relationships to determine the relationship between the CN for a short duration (in this case, 1-hour) storm and the 24-hour duration storm:

$$CN_{24} = 1.42CN^*-43.7 \text{ (24-hr storm)}$$

where CN^* = CN for a 1-hour storm and
CN_{24} = equivalent CN for a 24-hours storm.

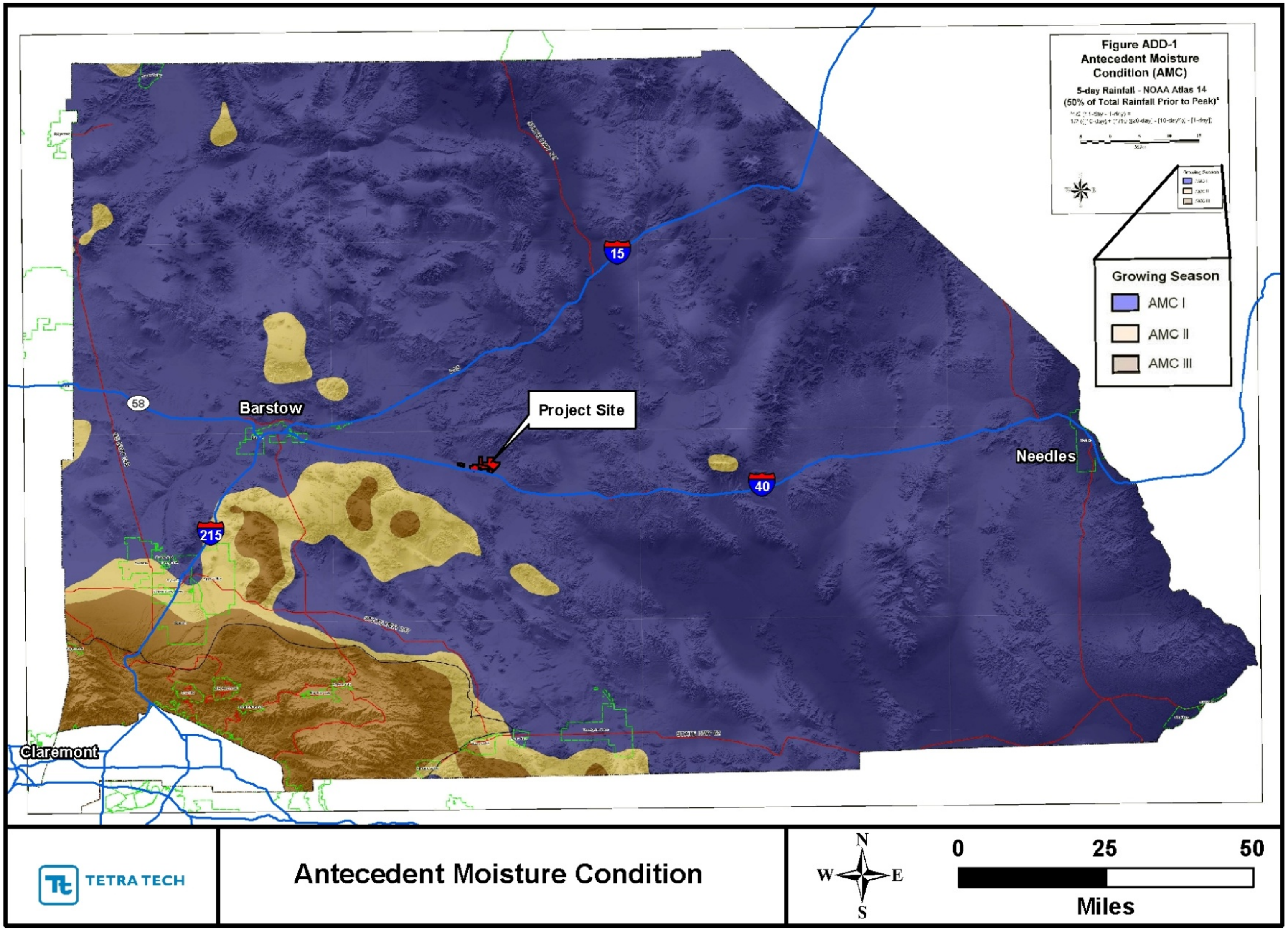

Figure 2.11. Figure ADD-1 from SBC (2010) showing the location of the project site in the portion of San Bernardino County where an AMC I condition can be used in rainfall-runoff modeling.

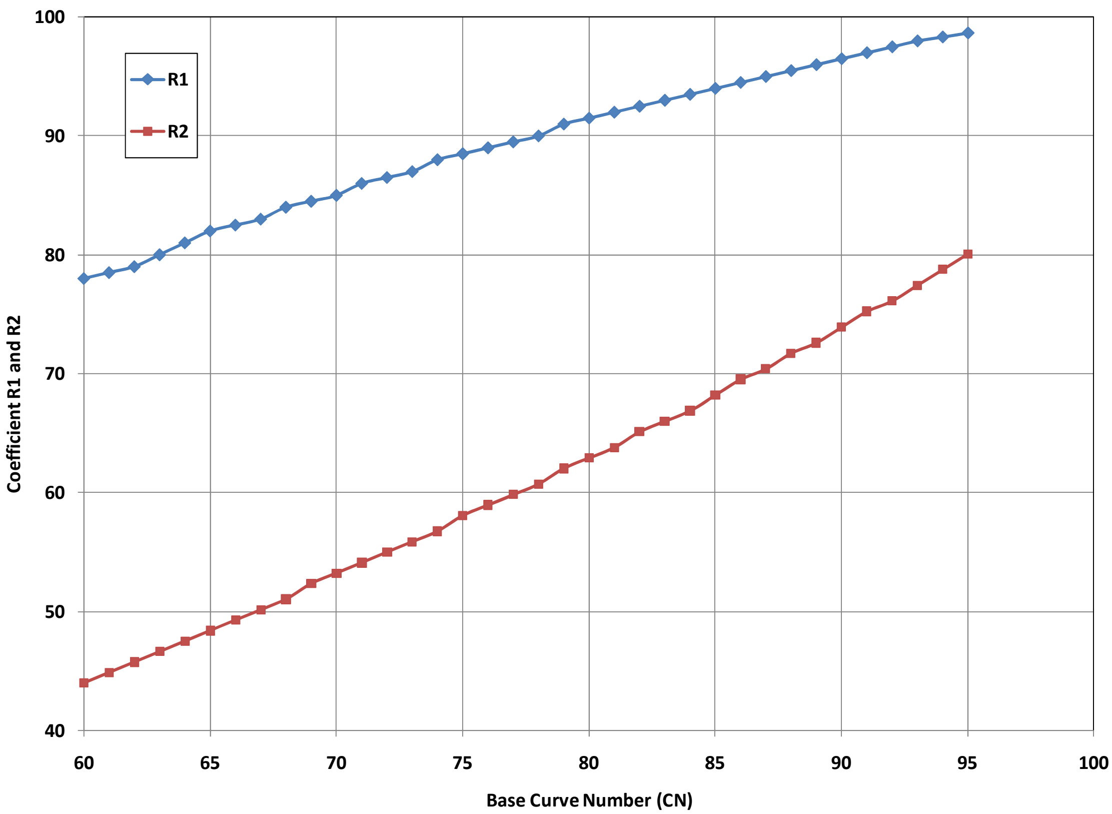

Figure 2.12. Coefficients R_1 and R_2 for use in determining CN* based on total storm depth.

The same procedure was used for this study to determine the relationship between CN* and the CN for a 6-hour storm (CN_6):

$$CN_6 = 1.22CN^* - 23.3 \text{ (6-hour storm)}$$

The resulting values of CN_{24} used for the modeled storms ranges from 63 to 72 for the portions of the watershed with HSG B soils, 72 to 79 for HSG C soils, and 78 to 83 for HSG D soils (**Table 2.4**), The values for the 6-hour storm are slightly higher, ranging from 68 to 76 for HSG B soils, 76 to 82 for HSG C soils, and 81 to 86 for HSG D soils.

As will be discussed in the following section, the applicability of these values to the watershed at the project site was assessed by comparing the rainfall-runoff model results with predicted peak discharge from the USGS regional relationships for this area.

2.2. Rainfall-Runoff Model Results

Runoff hydrographs for the relevant storm events were developed according to the procedures outlined in Section E of the San Bernardino County Hydrology Manual (SBCHM), as implemented in the Advanced Engineering Software (AES) Flood Routing Analysis Computer Program, 2009 version, using the input parameters described in the previous section. The CEC conditions require analysis of the 2-, 5-, 10- and 100-year storms with durations of 6 and 24 hours. In addition to these eight storm events, hydrographs were also developed for the 25- and 50-year events to facilitate the sediment-transport analysis to be presented in the *Geomorphic*

Table 2.4. Adjusted curve numbers for HSG B, C and D soils for the 1-, 6- and 24-hour storms.				
Return Period (years)	1-hour Precipitation Depth (in.)*	CN*	CN_6	CN_{24}
HSG B (Base CN=83)				
2	0.41	75	68	63
5	0.59	75	68	63
10	0.74	75	68	63
25	0.97	77	70	65
50	1.15	79	73	69
100	1.35	81	76	72
HSG C (Base CN=88)				
2	0.41	82	76	72
5	0.59	82	76	72
10	0.74	82	76	72
25	0.97	83	78	74
50	1.15	85	80	77
100	1.35	86	82	79
HSG D (Base CN=91)				
2	0.41	86	81	78
5	0.59	86	81	78
10	0.74	86	81	78
25	0.97	87	82	79
50	1.15	88	84	82
100	1.35	90	86	83

*The CN adjustment is applicable only to storms with total 1-hour rainfall greater than 0.88 inches. For purposes of this study, it was conservatively assumed that the adjustment for storms with depth of 0.88 inches applies to all smaller storms.

and Hydraulic and *Geomorphic and Biologic* reports that are required for CEC Condition Soil&Water 8.

The unit hydrograph method with the desert S-graph outlined in Section E of the SBC (1986) was followed in developing runoff hydrographs for all 21 subbasins considered in the modeling. The peak discharges predicted by the AES model for each storm are summarized in **Table 2.5**. The project site falls within Region 10 in *Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United* States (Blakemore et al., 1997), which is the basis for the regional regression equations in the USGS *National Streamflow Statics* program that is available on the web at http://water.usgs.gov/osw/programs/nss. To evaluate their reasonableness, the predicted peak discharges from AES model results were compared with the regional regression equations and underlying data from Blakemore et al. (1997). The predicted 25-, 50- and 100-year peak discharges are very consistent with the regional

Table 2.5. Peak discharges for the 2-, 5-, 10-, 25-, 50- and 100-year storms predicted by the AES model.

Basin ID	Area (mi^2)	6-hour Storm (cfs)						24-hour Storm (cfs)					
		2-year	5-year	10-year	25-year	50-year	100-year	2-year	5-year	10-year	25-year	50-year	100-year
10	6.85	263	524	824	1,294	1,791	2,354	253	507	795	1,256	1,782	2,335
11	2.51	210	416	596	878	1,154	1,430	201	396	576	852	1,119	1,413
12	1.43	180	340	484	697	910	1,132	172	327	470	679	891	1,109
13	0.92	136	250	357	520	666	832	127	235	342	503	649	812
14	1.03	128	244	349	510	657	819	120	230	334	492	640	805
15	1.91	199	382	547	802	1,060	1,307	187	361	526	775	1,027	1,287
16	4.11	322	627	927	1,367	1,815	2,273	309	601	895	1,333	1,763	2,239
17	1.54	214	402	579	827	1,056	1,318	198	379	555	798	1,033	1,295
18	5.19	295	564	889	1,399	1,934	2,534	269	524	825	1,319	1,884	2,467
19	4.29	272	522	819	1,288	1,767	2,305	246	479	756	1,209	1,716	2,233
20	1.36	144	275	402	598	802	1,006	137	259	384	580	778	976
21	0.52	67	134	195	289	378	473	60	123	182	275	360	459
22	2.9	218	450	673	1,022	1,349	1,756	198	414	628	974	1,309	1,704
23	0.65	98	195	281	401	525	652	88	180	263	382	508	640
24	0.07	15	30	43	60	76	95	14	27	40	57	74	92
25	0.41	73	142	207	291	376	467	65	131	194	278	364	455
26	0.65	87	172	255	366	477	599	77	159	238	349	462	582
27	0.29	59	112	162	227	291	359	53	104	152	217	283	350
28	0.07	24	44	62	85	108	131	22	42	59	82	105	129
29	0.19	34	66	96	135	175	216	30	60	90	129	169	210
30	5.85	171	371	591	928	1,284	1,698	153	350	563	887	1,272	1,676

regression relationships (**Figures 2.13a-c**), however, the modeled 2-, 5- and 10-year peaks are significantly higher than is indicated by the regional regressions (**Figures 2.13d-f**). Based on the good agreement between the modeled peak discharges and the regional regression equations, the model results for the 25-, 50- and 100-year storms are believe to be very reasonable.

Over-estimation of the peak discharges and runoff volumes for smaller, more frequent storms is a common issue with the type of rainfall-runoff modeling being used for this analysis. This occurs because the algorithms were primarily developed to facilitate analysis of large, infrequent events. A key reason is that the rainfall-runoff procedures assume that the rainfall is uniformly distributed over the entire watershed. This assumption is often valid for the large infrequent storms, but the storm cells for small, more frequent storms tend to be much smaller, typically covering only a limited portion of the watershed. To provide more realistic peak discharges and volumes for the 2-, 5- and 10-year storms, the ordinates of the modeled hydrographs were scaled linearly so that the peak discharge matches the value predicted by the regional regression equations. A typical example of the modeled and scaled hydrographs is shown in **Figure 2.14**. The resulting scaled peak discharges, along with the modeled peak discharges for the 25-, 50- and 100-year events that will be used to represent the off-site flows in the FLO-2D model are summarized in **Table 2.6**, As can be seen in Table 2.6, the peak discharges for the 6-hour storm typically slightly higher (average of about 9 percent) than the 24-hour peaks for the 2-year storm, and are 2 percent higher for the 100-year event. The change in peaks when comparing the two storm durations is small because, as noted above, most of the intense rainfall that drives the peak discharge occurs over a relatively short time period that occurs in the middle of the storm event, and the shorter, more intense storms generate relatively more runoff than longer duration events (Figure 2.4). The model input parameters and hydrographs for each individual off-site subbasin are provided in Appendix A (Hydrology).

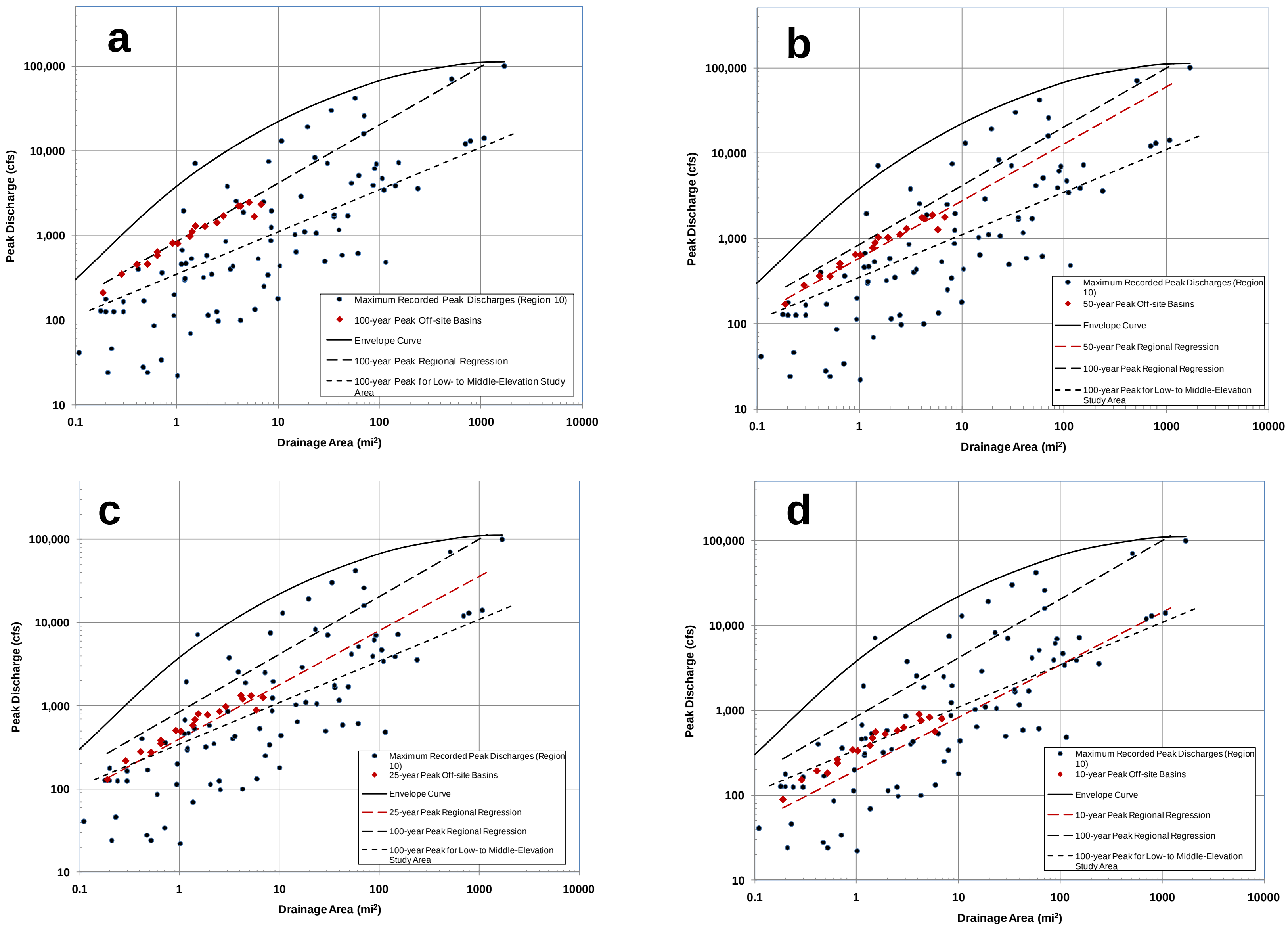

Figure 2.13. Comparison of regional regression equations and underlying data for Region 10 from Blakemore et al. (1997) with modeled peak discharges for the offsite basins at the project site. Maximum recorded peak discharges and regression curves reproduced from Figure 37 and the data appendix from Blakemore et al. (1997): (a) 100-year, (b) 50-year, (c) 25-year, (d) 10-year, (e) 5-year, and (f) 2-year.

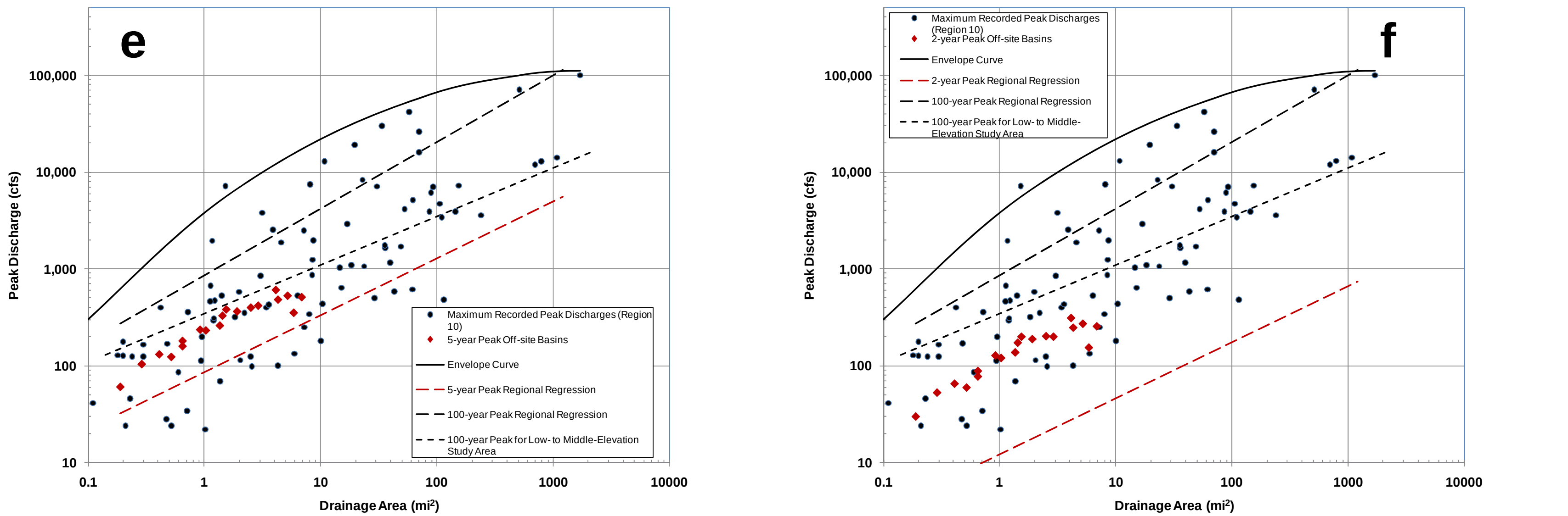

Figure 2.13. Continued: Comparison of regional regression equations and underlying data for Region 10 from Blakemore et al. (1997) with modeled peak discharges for the offsite basins at the project site. Maximum recorded peak discharges and regression curves reproduced from Figure 37 and the data appendix from Blakemore et al. (1997): (a) 100-year, (b) 50-year, (c) 25-year, (d) 10-year, (e) 5-year, and (f) 2-year.

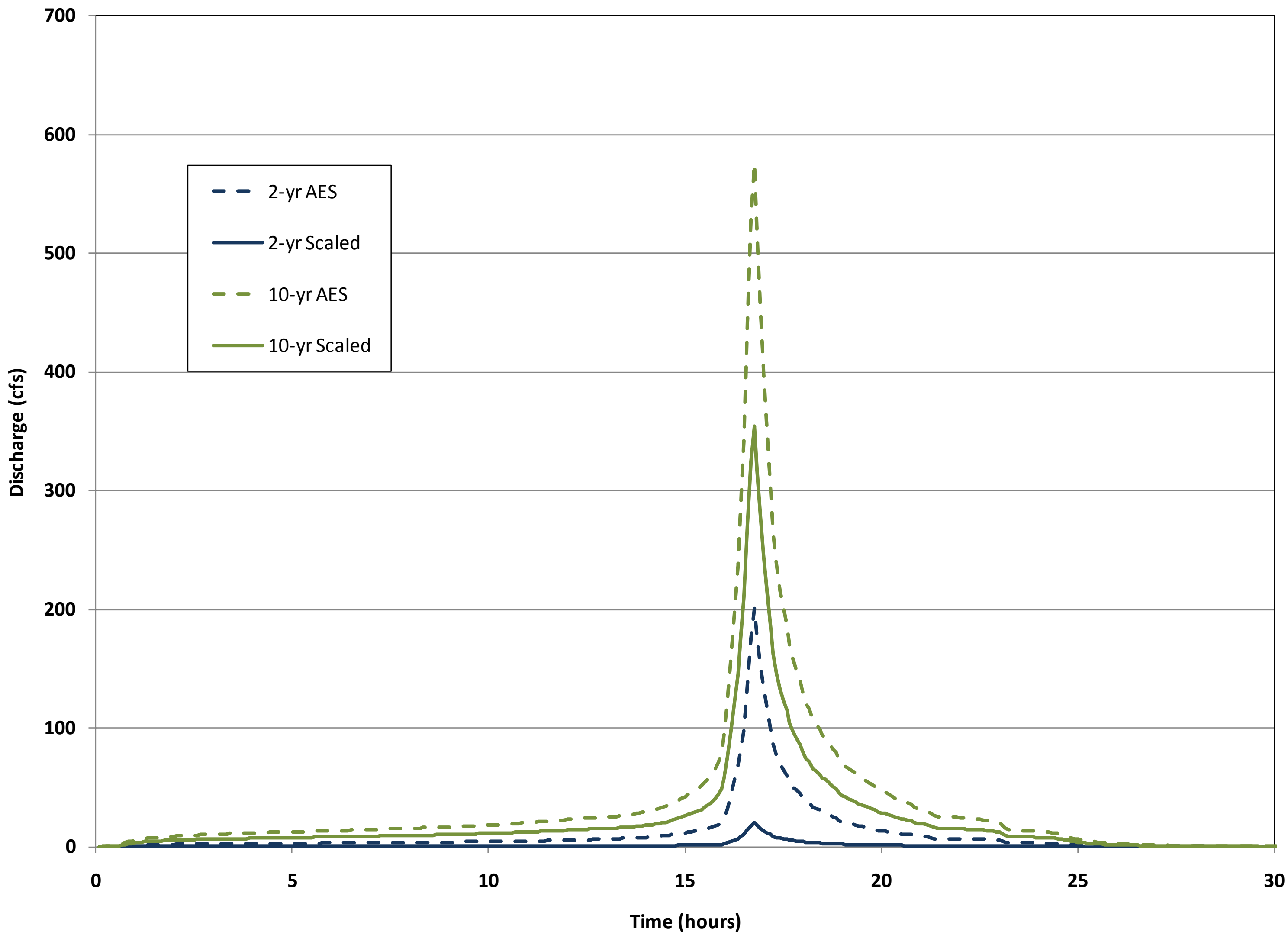

Figure 2.14. Typical modeled and scaled hydrographs for the 2- and 10-year storms (Basin 11).

Table 2.6. Peak discharges for the 2-, 5-, 10-, 25-, 50- and 100-year storms used for the FLO-2D input.

Basin ID	Area (mi^2)	6-hour Storm (cfs)						24-hour Storm (cfs)					
		2-year	5-year	10-year	25-year	50-year	100-year	2-year	5-year	10-year	25-year	50-year	100-year
10	6.85	38	273	684	1,294	1,791	2,354	37	264	659	1,256	1,782	2,335
11	2.51	21	154	366	878	1,154	1,430	20	146	354	852	1,119	1,413
12	1.43	15	109	258	697	910	1,132	15	105	250	679	891	1,109
13	0.92	12	86	198	520	666	832	11	81	190	503	649	812
14	1.03	13	92	214	510	657	819	12	87	204	492	640	805
15	1.91	19	132	311	802	1,060	1,307	17	125	299	775	1,027	1,287
16	4.11	28	204	497	1,367	1,815	2,273	27	196	480	1,333	1,763	2,239
17	1.54	17	116	273	827	1,056	1,318	15	110	261	798	1,033	1,295
18	5.19	39	242	598	1,399	1,934	2,534	31	225	555	1,319	1,884	2,467
19	4.29	31	219	534	1,288	1,767	2,305	28	201	493	1,209	1,716	2,233
20	1.36	15	109	254	598	802	1,006	14	102	242	580	778	976
21	0.52	9	63	143	289	378	473	8	58	134	275	360	459
22	2.9	25	173	415	1,022	1,349	1,756	22	159	387	974	1,309	1,704
23	0.65	10	72	164	401	525	652	9	66	154	382	508	640
24	0.07	3	19	41	60	76	95	3	18	38	57	74	92
25	0.41	8	54	122	291	376	467	7	50	114	278	364	455
26	0.65	10	72	164	366	477	599	9	66	153	349	462	582
27	0.29	7	44	99	227	291	359	6	41	93	217	283	350
28	0.07	3	20	42	85	108	131	3	18	40	82	105	129
29	0.19	5	35	77	135	175	216	5	32	72	129	169	210
30	5.85	37	256	628	928	1,284	1,698	33	241	598	887	1,272	1,676

3. FLO-2D MODELING OF PROJECT SITE

3.1. Modeling Approach

The FLO-2D model was applied to estimate the volume of infiltration and runoff, and the maximum depths and velocities on the Project site during runoff events under both existing and project conditions, including the potential impacts of the proposed project the potential for ponding and overtopping of the BNSF Railroad. FLO-2D is a two-dimensional, finite difference computer program that incorporates user input of topography, hydrology, sediment, channel, and floodplain characteristics to perform flood routing. The FLO-2D program includes clear water, sediment transport, mudflow, and groundwater components. The program is particularly well-suited and is approved by FEMA for analysis of flow on alluvial fans and similar terrain having multiple, shallow surface flow paths.

Results from the model provide the necessary hydraulic information for the design of drainage infrastructure, scour protection, and the PV array and SunCatchers^{tm} support posts. The model results also provide a means of assessing the movement of sediment across the site under existing and project conditions for the geomorphic and biologic analysis and the geomorphic and hydraulic analysis required under Condition Soil&Water-8.

3.1.1. FLO-2D Topography and Floodplain Characteristics

The FLO-2D model for the Project is comprised of approximately 218,700 nodes, with each node representing a square grid, 50 by 50 feet, covering a total surface area of about 20 square miles (**Figure 3.1**). The elevations for each grid were assigned in FLO-2D based on the average elevation of the 2,500-square-foot area of each node, as determined from the LiDAR mapping.

A Manning's roughness coefficient of 0.04 was used in the model for overland flow where vegetation and surface irregularities affect the roughness (**Figure 3.2**), and a Manning's roughness coefficient of 0.035 was used for the well-defined, mostly unvegetated channels (**Figure 3.3**). The available aerial photography was used to identify channels of sufficient width that were mostly devoid of vegetation for application of the lower roughness coefficient.

The BNSF Railroad is identified in the model as a levee that is allowed to overtop without failure. This provides a mechanism for evaluating the potential for overtopping of the railroad, and the maximum depth and duration of overtopping where it occurs under both existing and project conditions.

The trestles and box culverts that provide drainage pathways through the railroad grade (Figure 3.1) are incorporated into the model by providing openings in the levee that have restricted width and increased Manning's roughness coefficients that produce water-surface elevation versus discharge rating curves that are consistent with curves from local one-dimensional (1D) models that were developed using the Hydraulic Engineering Center - River Analysis System (HEC-RAS) software. The local HEC-RAS models were created for each drainage structure, since HEC-RAS has a more sophisticated algorithm for estimating the energy losses and hydraulic conditions through bridges of this type than is available in the FLO-2D model. Each HEC-RAS model contains six to eight cross sections in the approach and exit channels up- and downstream from the drainage structure developed from the LiDAR data. With the exception of Trestle 4, the geometry of each drainage structure was taken from field measurements by Huitt-Zollars (2009) for the previously proposed project. The opening width and drainage structure heights were taken directly from the tabular data prepared by Huitt-Zollars (2009); however, the invert elevations were taken from the LiDAR data to maintain consistency with the grid

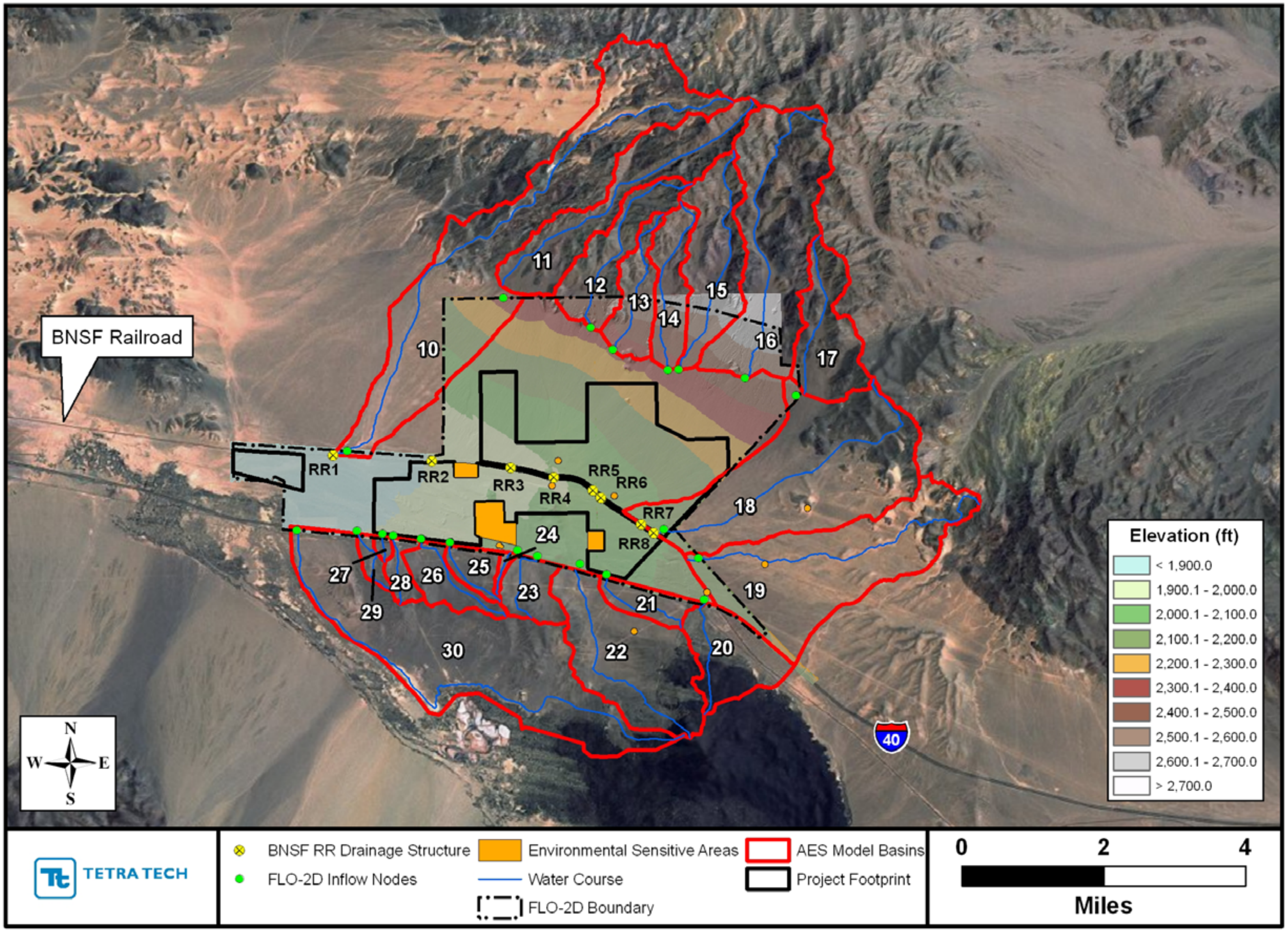

Figure 3.1. Map of project site and contributing drainage subbasins showing the locations of the FLO-2D inflow nodes for the off-site basins and the BNSF Railroad crossings.

Figure 3.2. Typical overland flow area with Manning's *n*-value of 0.040.

Figure 3.3. Typical alluvial channel with Manning's *n*-value of 0.035.

elevations used in the FLO-2D model for both the top-of-railroad and surrounding topography. The HEC-RAS models were run for the range of potential flows that could occur at each location, with an assumed normal flow at the downstream most cross section, using bed slopes measured from LiDAR data.

Output from the HEC-RAS models were used to create depth-discharge rating curves for the individual drainage structures. The FLO-2D model was adjusted through an iterative process until the results for the upstream side of the drainage structure agreed with the results of the HEC-RAS models. In some cases (e.g., Trestles 3 and 7) (**Figures 3.4a through 3.5b**), the FLO-2D rating curves diverge from the HEC-RAS curves at higher flows because, as the water surface approaches the low chord of the drainage structure, a portion of the water travels parallel to the along the railroad rather than passing through the drainage structure. This process is captured in the FLO-2D model, but not in the one-dimensional HEC-RAS model where all flow is assumed to be contained within the extents of the cross sections. Details of the HEC-RAS models and rating curves for all of the railroad drainage structures that were considered in the analysis are provided in **Appendix B** (Hydraulics).

3.1.2. FLO-2D Hydrology

Flows from the offsite watersheds were incorporated into the FLO-2D model using the inflow hydrographs developed with the AES rainfall-runoff model for each of the 21 subbasins, as described in the previous section . The FLO-2D inflow nodes are located in close proximity to the concentration point used in the off-site basin analysis for the northern and western subwatersheds (Figure 3.1). Flows that enter the Project site from the south generally do so under Interstate 40. Inflow nodes for these locations were located in the appropriate channels on the north side of the highway. The hydrographs from the rainfall-runoff model were conservatively assumed to pass through the highway drainage structures onto the Project site without alteration.

Flow generated from rainfall directly on the project site are simulated in the FLO-2D model using procedures that are consistent with the San Bernardino County procedures employed in the rainfall-runoff model described in the previous section. Similar to the rainfall-runoff model, the total rainfall depths for each recurrence interval storm were determined from an area average using GIS data downloaded from the NOAA website and the depths are assumed to be uniformly distributed across Project site in the model. The initial abstraction was estimated using the following equations taken directly from SBC (1986):

Ia = 0.2S,   where S is an estimate of total soil capacity given by:

S = 1000/CN – 10, where CN is the area curve number.

The CNs used in the model were selected under the conservative assumption that the entire Project site consists of HSG B soils (Figure 2.9). As described in the previous section, the CN values vary with both storm depth and storm duration (**Table 3.1**).

A depth-area reduction factor was applied to the total rainfall to account for the irregularly dispersed distribution of typical rainfall events. Using Figure E-4 from SBC (1986), the point-precipitation areal reduction for a 20 mi^2 area is 97 percent for a 24-hour storm and 96 percent for a 6-hour storm.

The FLO-2D model for the project routes both the offsite and accumulated onsite flows across the site, two-dimensionally, using the previously described 50-foot by 50-foot square grid following SCS methodology, with the rainfall distribution and inflow hydrographs based on the

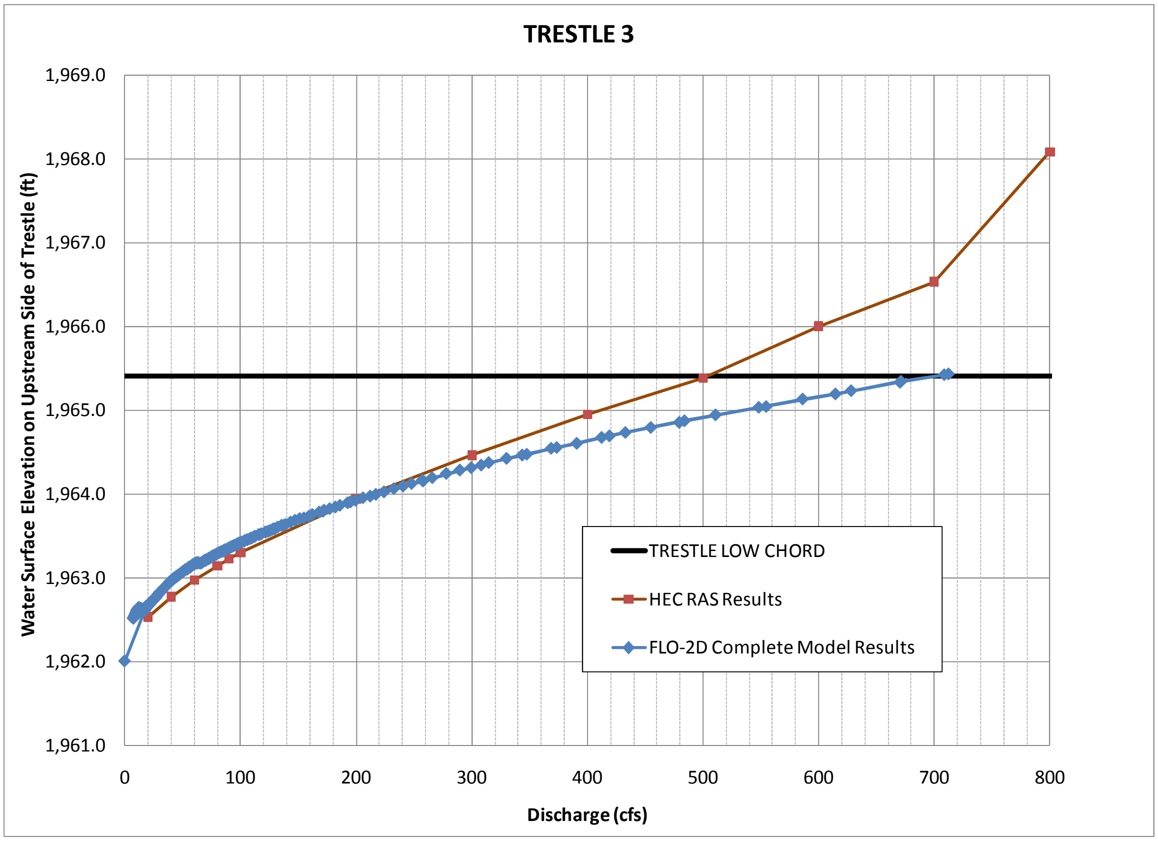

Figure 3.4a. Water-surface elevation versus discharge rating curves from the local HEC-RAS model and the FLO-2D model for Trestle 3.

Figure 3.4b. Trestle 3, looking upstream (north).

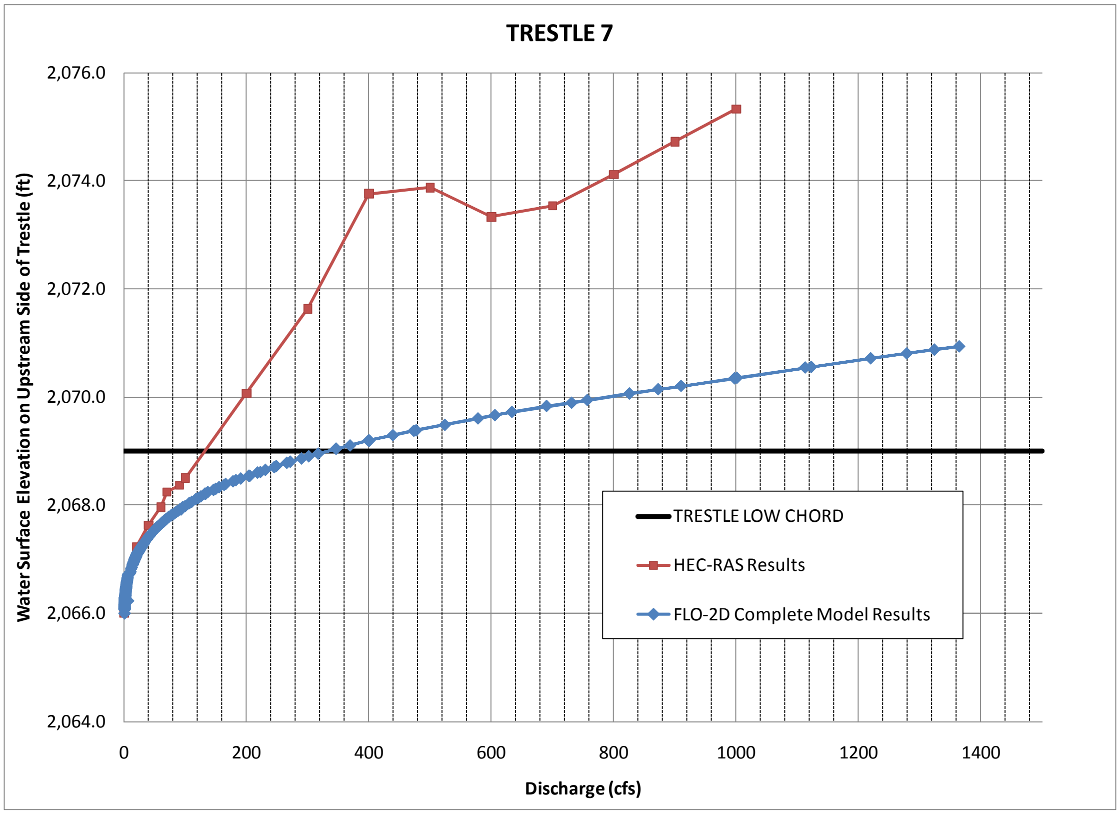

Figure 3.5a. Water-surface elevation versus discharge rating curves from the local HEC-RAS model and the FLO-2D model for Trestle 7.

Figure 3.5b. Looking upstream through Trestle 7.

Table 3.1. FLO-2D hydrologic parameters.								
Recurrence Interval (years)	6-hour Storm				24-hour Storm			
	Total Rainfall Depth (in.)	CN	Initial Abstration (in.)	Excess Runoff (in.)	Total Rainfall Depth (in)	CN	Initial Abstration (in.)	Excess Runoff (in.)
2	0.69	68.2	0.69	0.00	1.01	62.8	1.01	0.00
5	0.93	68.2	0.93	0.00	1.39	62.8	1.18	0.01
10	1.14	68.2	0.93	0.01	1.71	62.8	1.18	0.04
25	1.44	69.8	0.87	0.07	2.16	64.7	1.09	0.18
50	1.68	73.1	0.74	0.19	2.52	68.5	0.92	0.41
100	1.93	75.6	0.65	0.37	2.89	71.4	0.80	0.72

incremental rainfall distribution pattern for the project area (Figure 2.4). The details are included in the Appendix A (Hydrology).

For purposes of this Infiltration report, the model was executed for the following five scenarios for both the 6-hour and the 24-hour storm events and the 2-year, 5-year, 10-year, and 100-year events (total of 40 conditions model runs):

1. Existing conditions (Figure 3.1)
2. Full build-out conditions (**Figure 3.6**).
3. Partial build-out conditions, with only the portion of the Project site between I-40 and the BNSF Railroad completed (**Figure 3.7**).

3.2. Existing Conditions Model Results

Results from the existing conditions rainfall-runoff models indicate that flows reaching the site from the offsite basins are relatively small, ranging about 3 cfs (Basin 24) to less than 40 cfs (Basin 10) during the 2-year storm, increasing to 90 to 100 cfs (Basin 24) to about 2,500 cfs (Basin 18) for the 100-year storm (Table 2.6). The existing conditions FLO-2D model results that account for the movement of these flows across the site, as well as the accumulation, infiltration and surface movement of rainfall directly on the site, indicate that flow volumes leaving the overall project site range from about 0.3 ac-ft during the 2-year storm to about 3,900 ac-ft for the 100-year 24-hour duration storm (**Tables 3.2 and 3.3**). These runoff amounts equate to less than 0.01 inches of runoff spread uniformly over the basin for the approximately 1-inch precipitation that occurs during the 2-year storm, and about 1.2 inches of runoff for the 100-year storm, compared to the total precipitation of approximately 2.9 inches.

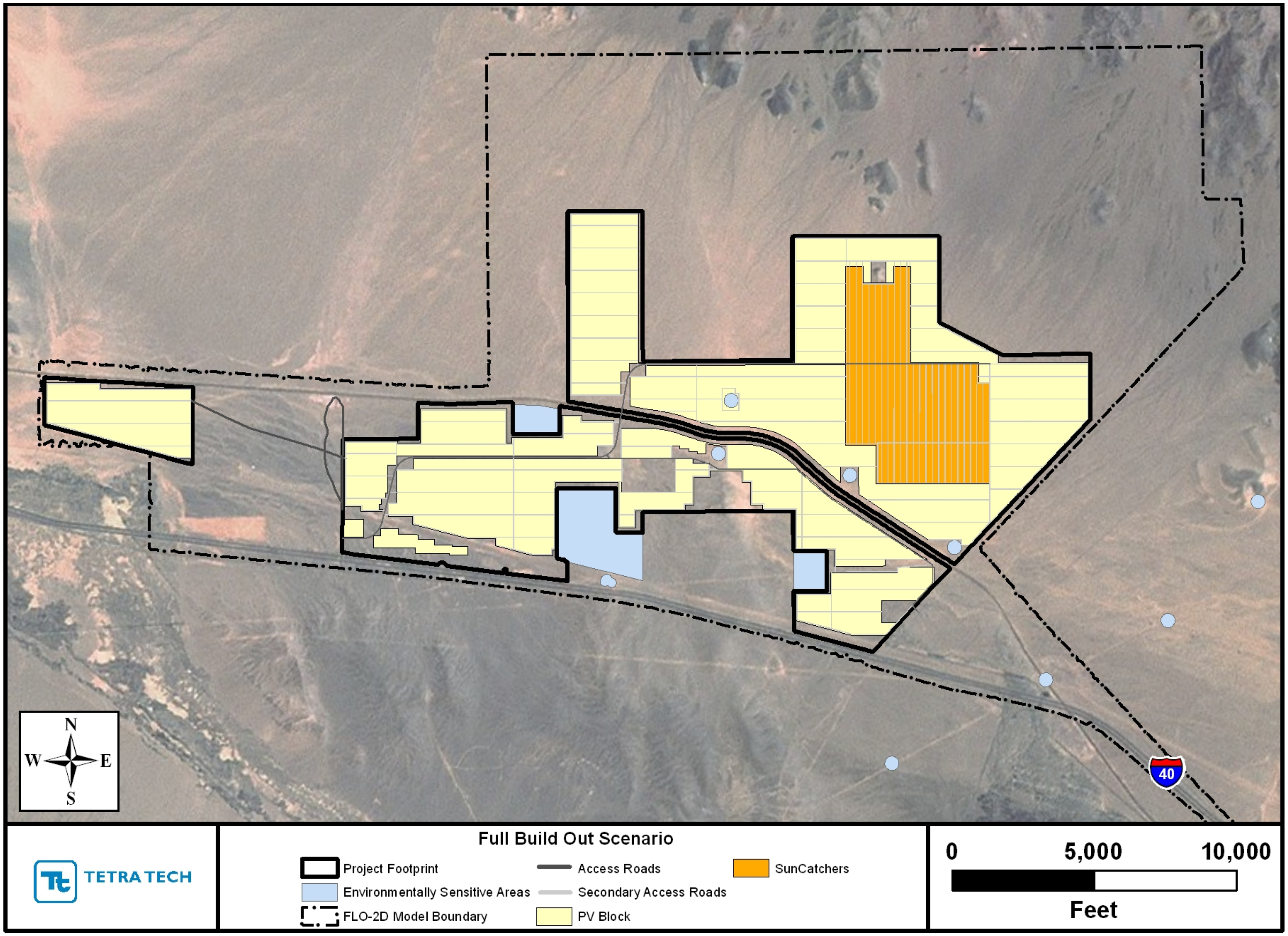

Figure 3.6. Project site map showing features under full build-out conditions.

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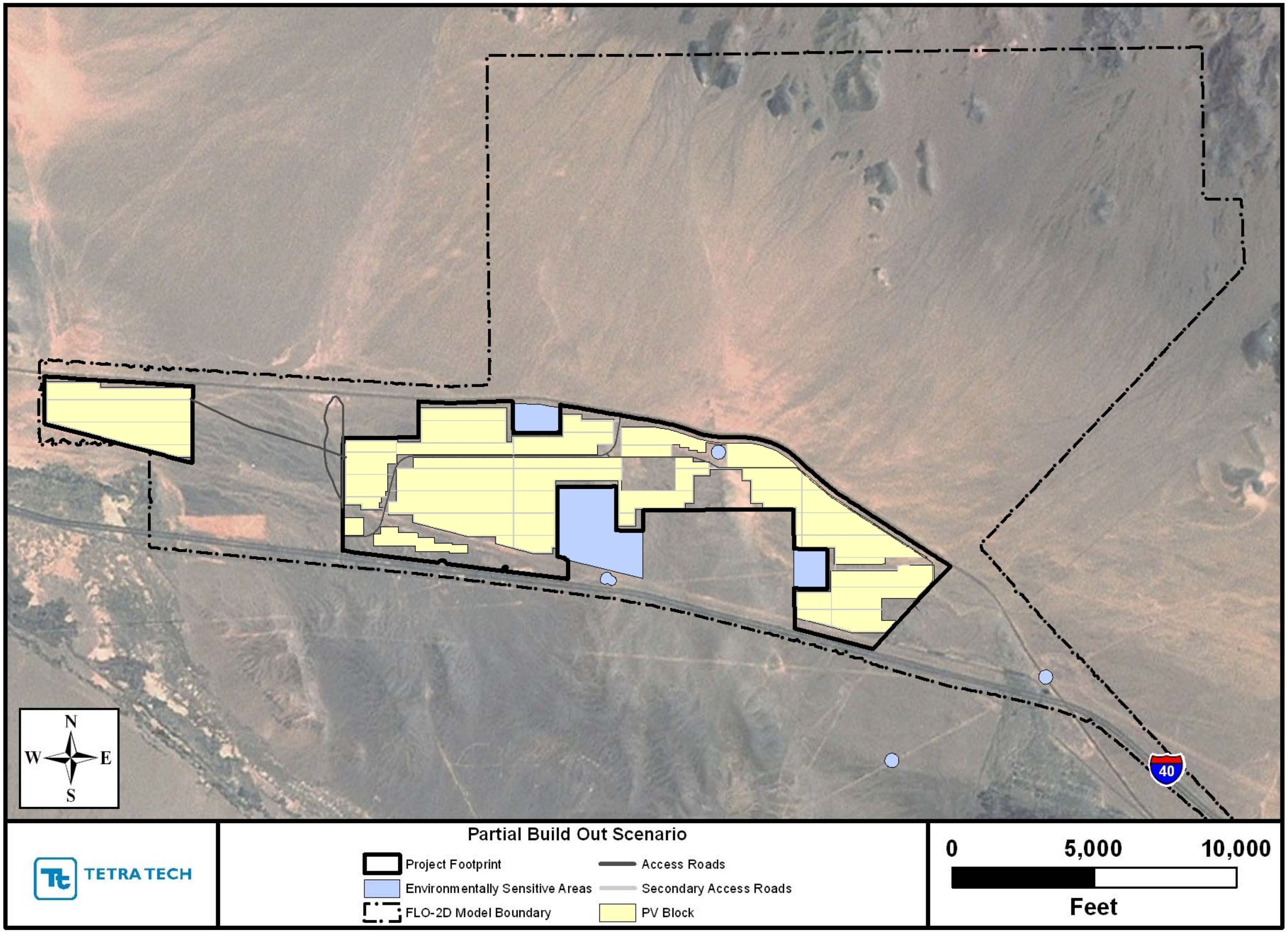

Figure 3.7. Project site map showing features under partial build-out conditions.

Table 3.2. FLO-2D results summary for the 6-hour storm event.								
	2-Year		5-Year		10-Year		100-Year	
	Existing	Proposed*	Existing	Proposed*	Existing	Proposed*	Existing	Proposed*
Maximum Velocity (ft/s)	3.06	3.06	5.07	5.07	7.31	7.30	11.41	11.41
Average Velocity (ft/s)	0.01	0.01	0.10	0.10	0.20	0.20	0.69	0.70
Median Velocity (ft/s)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum Depth (ft)	1.73	1.73	2.43	2.43	3.43	3.42	6.09	6.10
Average Depth (ft)	0.01	0.01	0.04	0.04	0.08	0.08	0.25	0.25
Median Depth	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
Inflow								
Rainfall (ac-ft)	720	720	970	970	1,189	1,189	2,013	2,013
Inflow Hydrograph (ac-ft)	27	27	214	214	552	552	2,591	2,591
Total Inflow (ac-ft)	747	747	1,185	1,185	1,741	1,741	4,604	4,604
Outflow								
Infiltration & Interception (ac-ft)	720	720	970	969	1,189	1,187	1,755	1,742
Floodplain Storage (ac-ft)	27	27	130	130	200	194	434	429
Outflow Hydrograph (ac-ft)	0.28	0.28	84	86	352	360	2,416	2,432
Total Outflow and Floodplain Storage (ac-ft)	747	747	1,185	1,185	1,741	1,741	4,604	4,604

*Proposed Condition represents the full build out (including all areas to the north of the railroad and to the west of the main service complex. Partial build-out conditions results are not presented here because they generally fall between the existing and proposed result, which are very similar.

Table 3.3. FLO-2D results summary for the 24-hour storm event.

	2-Year		5-Year		10-Year		100-Year	
	Existing	Proposed*	Existing	Proposed*	Existing	Proposed*	Existing	Proposed*
Maximum Velocity (ft/s)	2.70	2.70	4.99	4.99	7.17	7.18	11.88	11.89
Average Velocity (ft)	0.01	0.01	0.10	0.11	0.21	0.21	0.82	0.83
Median Velocity (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21
Maximum Depth (ft)	1.73	1.72	2.37	2.37	3.36	3.36	6.52	6.53
Average Depth (ft)	0.01	0.01	0.04	0.04	0.08	0.08	0.29	0.29
Median Depth (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.07
Inflow								
Rainfall (ac-ft)	1,054	1,054	1,450	1,450	1,784	1,784	3,015	3,015
Inflow Hydrograph (ac-ft)	32	32	271	271	719	719	3,546	3,546
Total Inflow (ac-ft)	1,086	1,086	1,721	1,721	2,503	2,503	6,560	6,560
Outflow								
Infiltration & Interception (ac-ft)	1,054	1,052	1,443	1,437	1,739	1,730	2,268	2,248
Floodplain Storage (ac-ft)	32	33	122	126	201	203	434	428
Outflow Hydrograph (ac-ft)	0.33	0.33	156	158	562	570	3,858	3,884
Total Outflow and Floodplain Storage (ac-ft)	1,086	1,086	1,721	1,721	2,503	2,503	6,560	6,560

*Proposed Condition represents the full build out (including all areas to the north of the railroad and to the west of the main service complex. Partial build-out conditions results are not presented here because they generally fall between the existing and proposed result, which are very similar.

Primary areas of interest in the modeling efforts within the site include the rainfall-runoff response on the alluvial fan to the inflow hydrographs and onsite rainfall, and the resulting hydrographs along the BNSF railroad, especially in the vicinity of the drainage structures that carry stormwater from the fan to the main east-west drainage path between the Railroad and I-40. Tables 3.2 and 3.3 summarize the range of velocities and depths that occur throughout the Project site for each of the modeled storms, and color gradient plots of the maximum depth and velocity that occurs at each model grid cell show the flow patterns throughout the site (**Figures 3.8a and 3.8b**). Figures 3.8a and 3.8b show these results for the 100-year, 24-hour storm.

Flows that reach the BNSF Railroad pass through the railroad at a series of drainage structures. Detailed evaluation of the model results indicates that some of these drainage structures, coupled with overflow channels on the north side of the railroad, have insufficient capacity to pass the entire flow reaching that particular location, in which case, the railroad line is overtopped (**Table 3.4**). Overtopping occurs in four locations during the 100-year recurrence interval and at only one location during the 10-year recurrence interval.

Overtopping in the vicinity of Trestle 5 occurs over the broadest area of the four locations (**Figures 3.9 and 3.10**). This location also is the only place within the project to experience overtopping during the 10-year storm. Flows overtop to the west of Trestle 5 at a location where the railroad is low compared to the adjacent land on the northern side of the railroad (**Figure 3.11**). Flow depths at this location would remain at an average of 0.6 feet for approximately 6 hours during the worst case scenario of the 24-hour, 100-year storm.

Trestle 6 also has limited transport capacity and causes some overtopping to occur to the east of the drainage structure (**Figures 3.12 through 3.14**). The close proximity of Trestles 5 and 6 have a cumulative effect on the backwater effects and resultant overtopping.

An at-grade railroad crossing exists toward the eastern portion of the project (**Figure 3.15**). The overtopping that occurs near this crossing is the least extreme of the four overtopping locations (**Figure 3.16**). Overtopping depths are estimated to be 0.3 feet for approximately 2 hours.

Trestle 9 has a limited flow area and is conservatively assumed to be ineffective in transporting flow under the railroad (**Figures 3.17 and 3.18**). As a result, overtopping occurs during the majority of the hydrograph in this area.

Table 3.4. Summary of predicted overtopping of the railroad line under existing conditions.

Location	Recurrence Interval (years)	Depth (ft)	Duration (hrs)	Linear Extent (ft)
Near Trestle 5	100	0.6	6	810
Near Trestle 5	10	0.3	4	200
Near Trestle 6	100	0.5	6	240
Near At Grade Crossing	100	0.3	2	140
Near Trestle 9	100	0.5	30	270

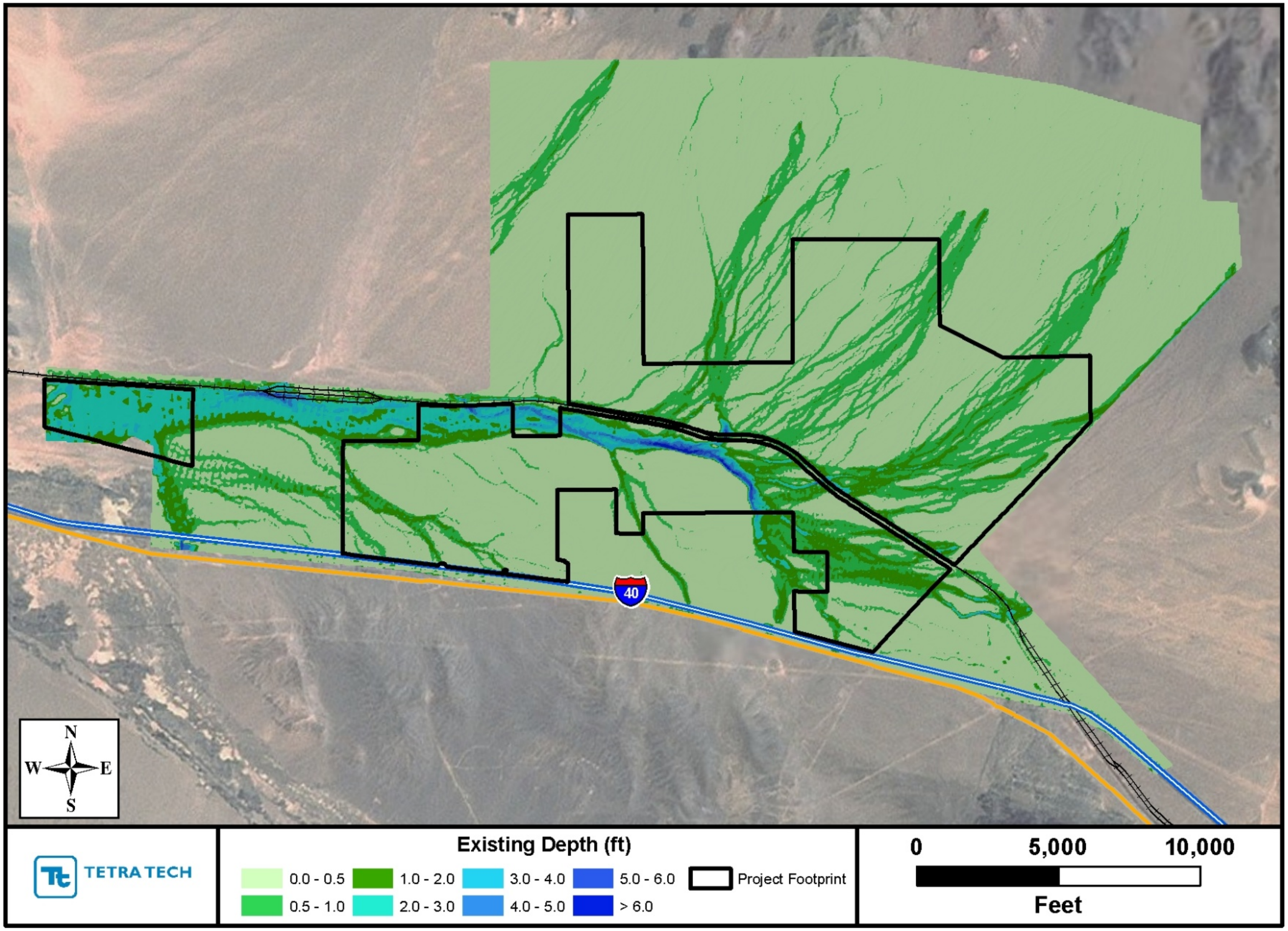

Figure 3.8a. Predicted maximum depth during 100-year, 24-hour storm under existing conditions.

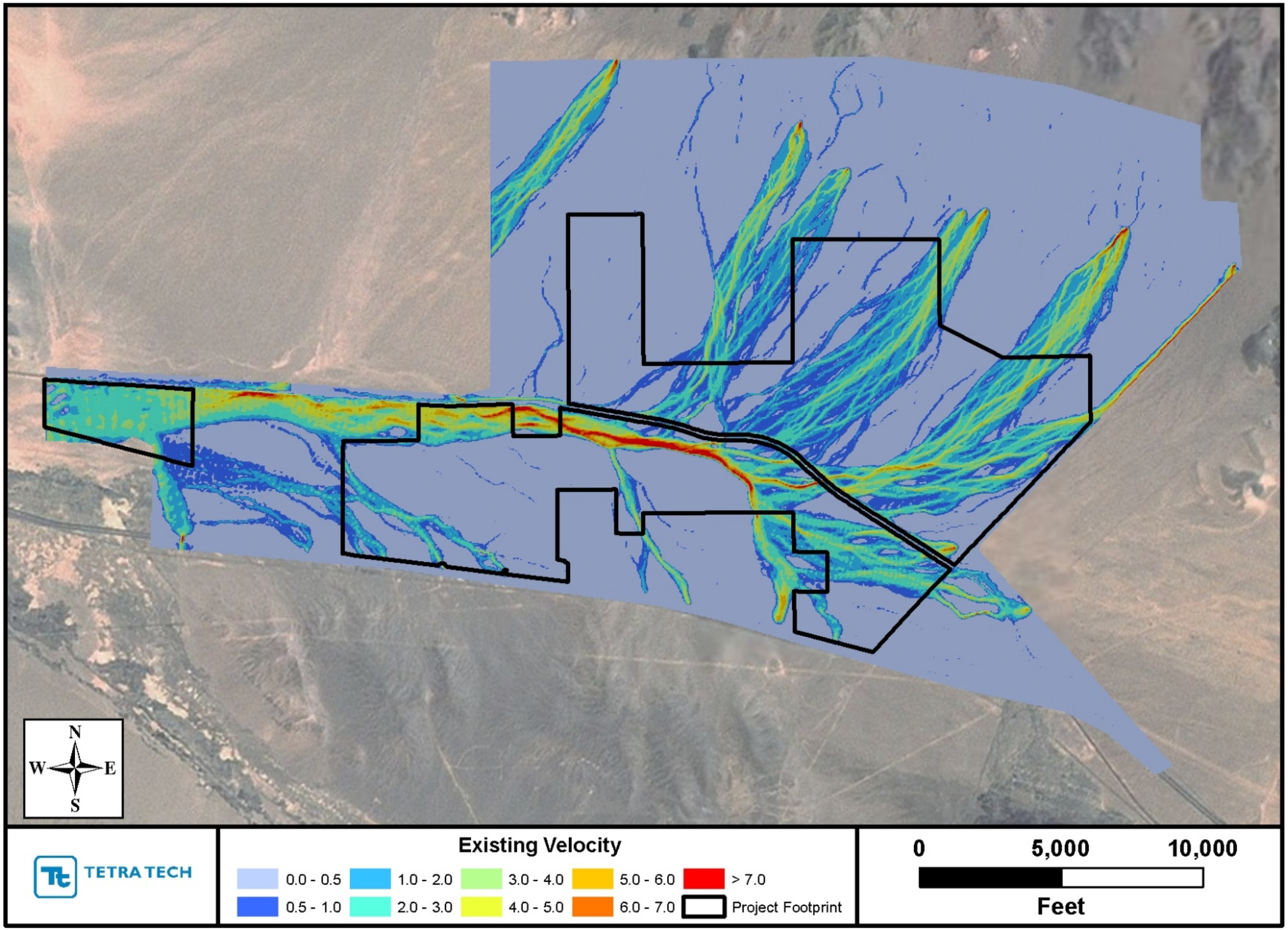

Figure 3.8b. Predicted maximum velocity during 100-year, 24-hour storm under existing conditions.

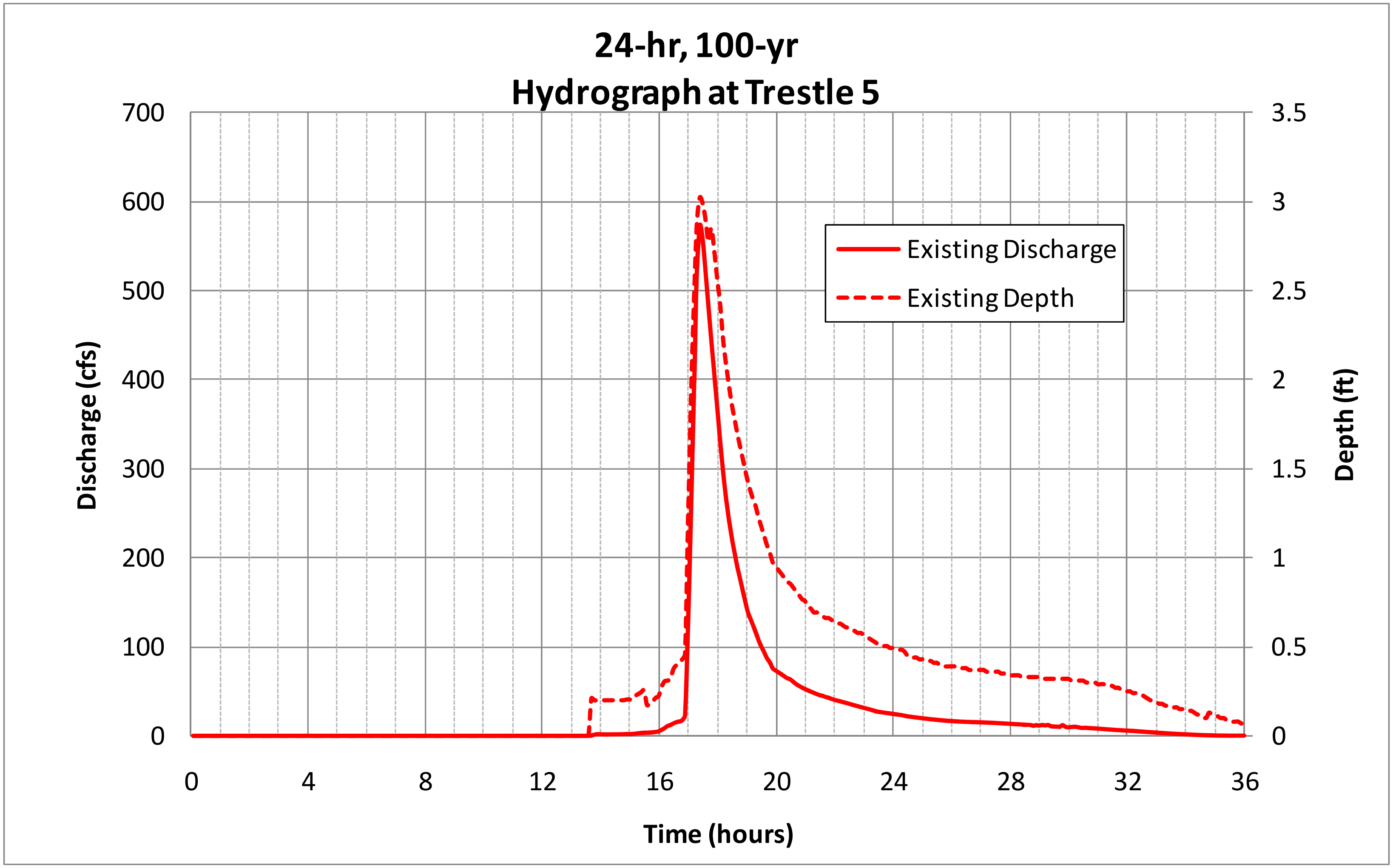

Figure 3.9. 100-year, 24-hour storm hydrograph at Trestle 5 under existing conditions.

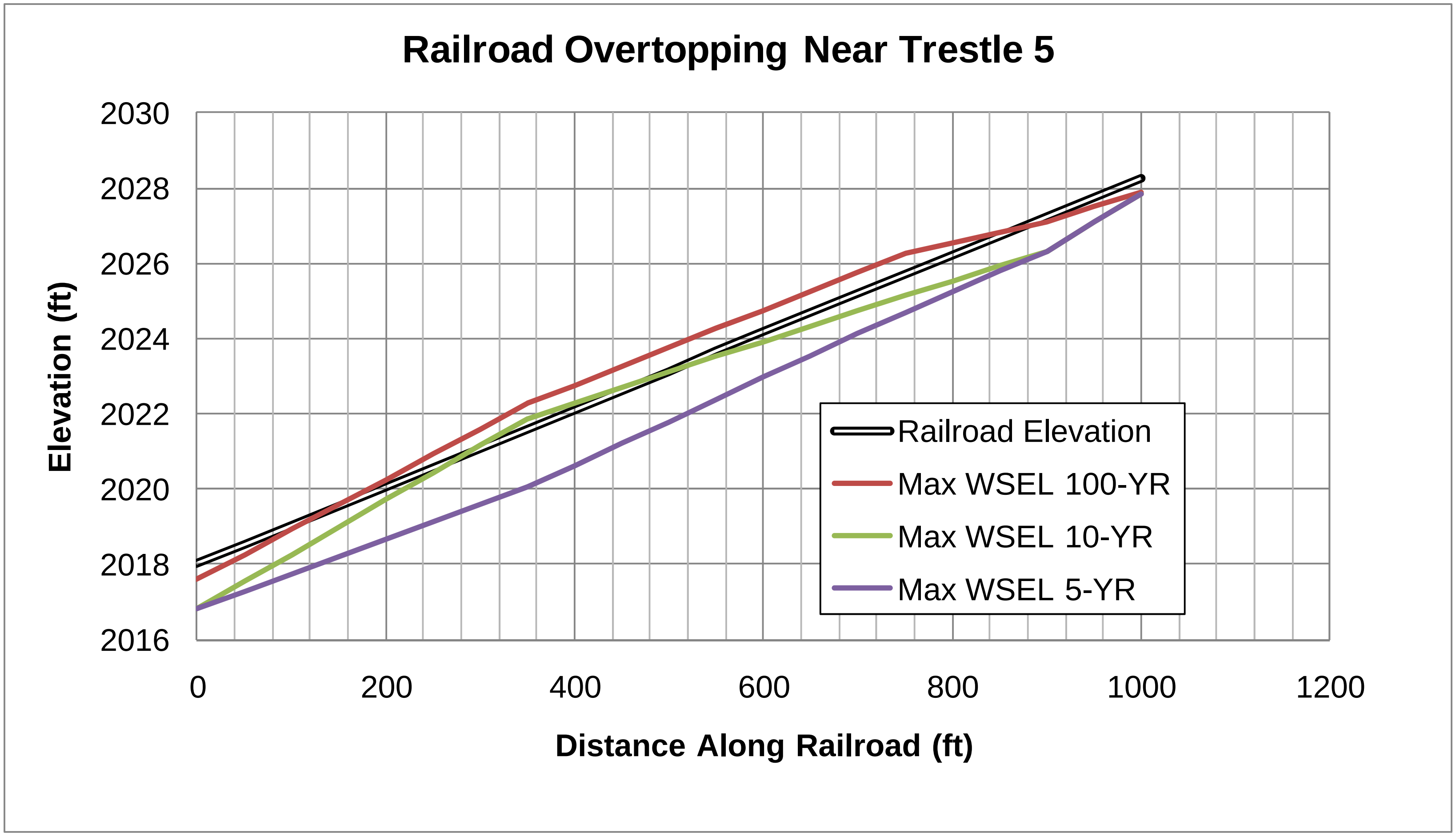

Figure 3.10. Approximate railroad profile and maximum water-surface elevations for the 5-year, 10-year and 100-year, 24-hour storms in the vicinity of Trestle 5 under existing conditions.

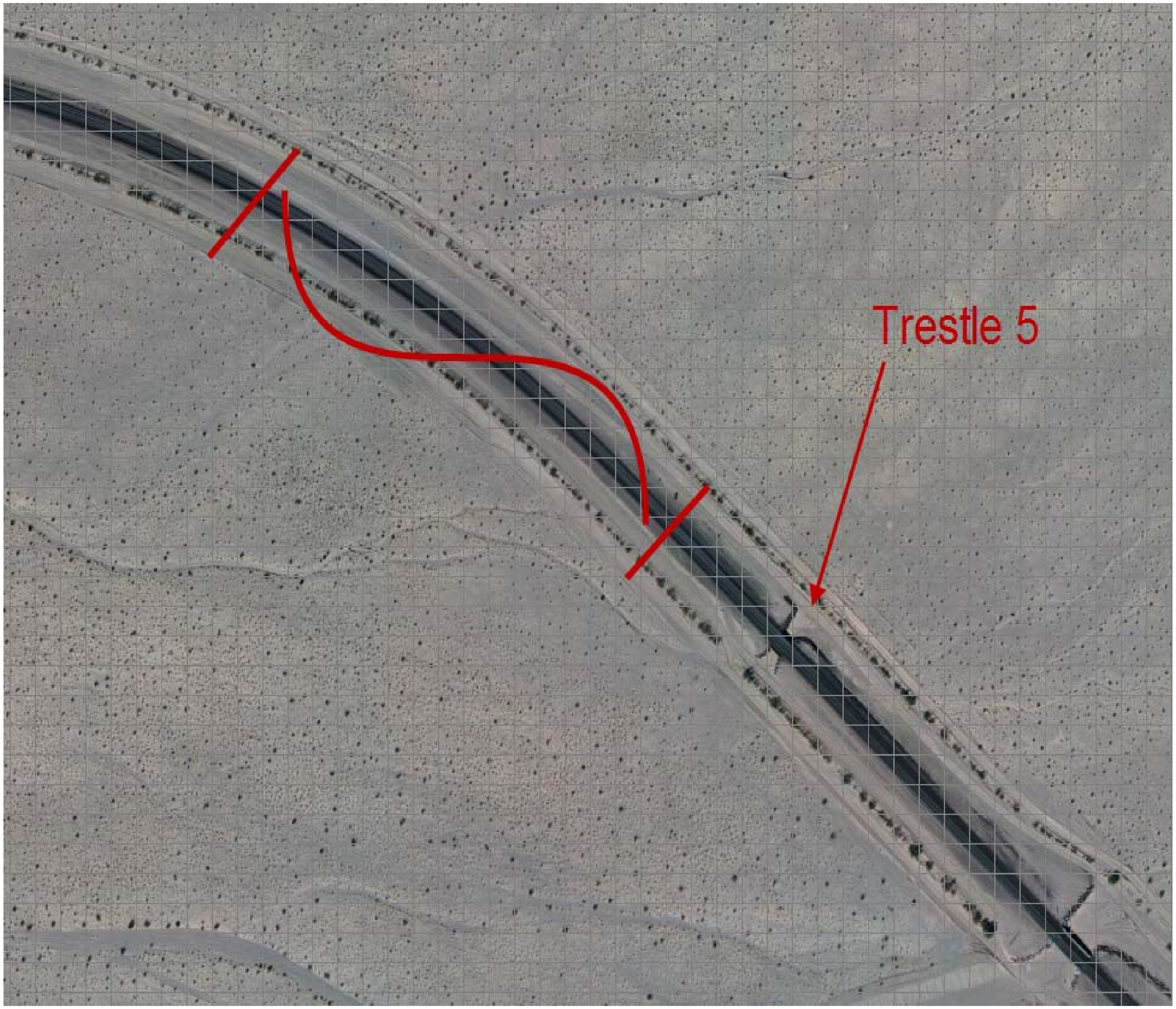

Figure 3.11. Location of railroad overtopping near Trestle 5.

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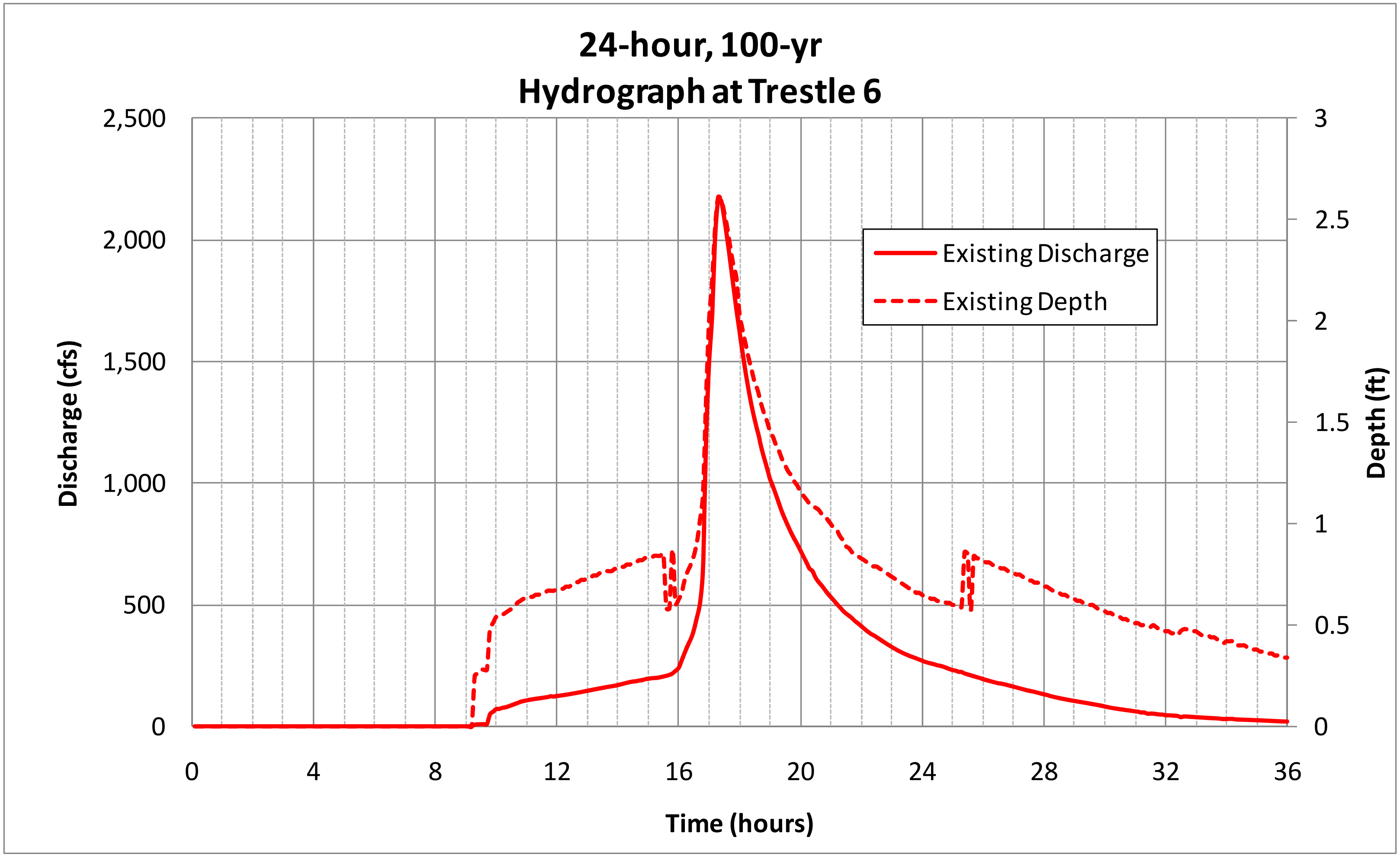

Figure 3.12. 100-year, 24-hour storm hydrograph at Trestle 6 under existing conditions.

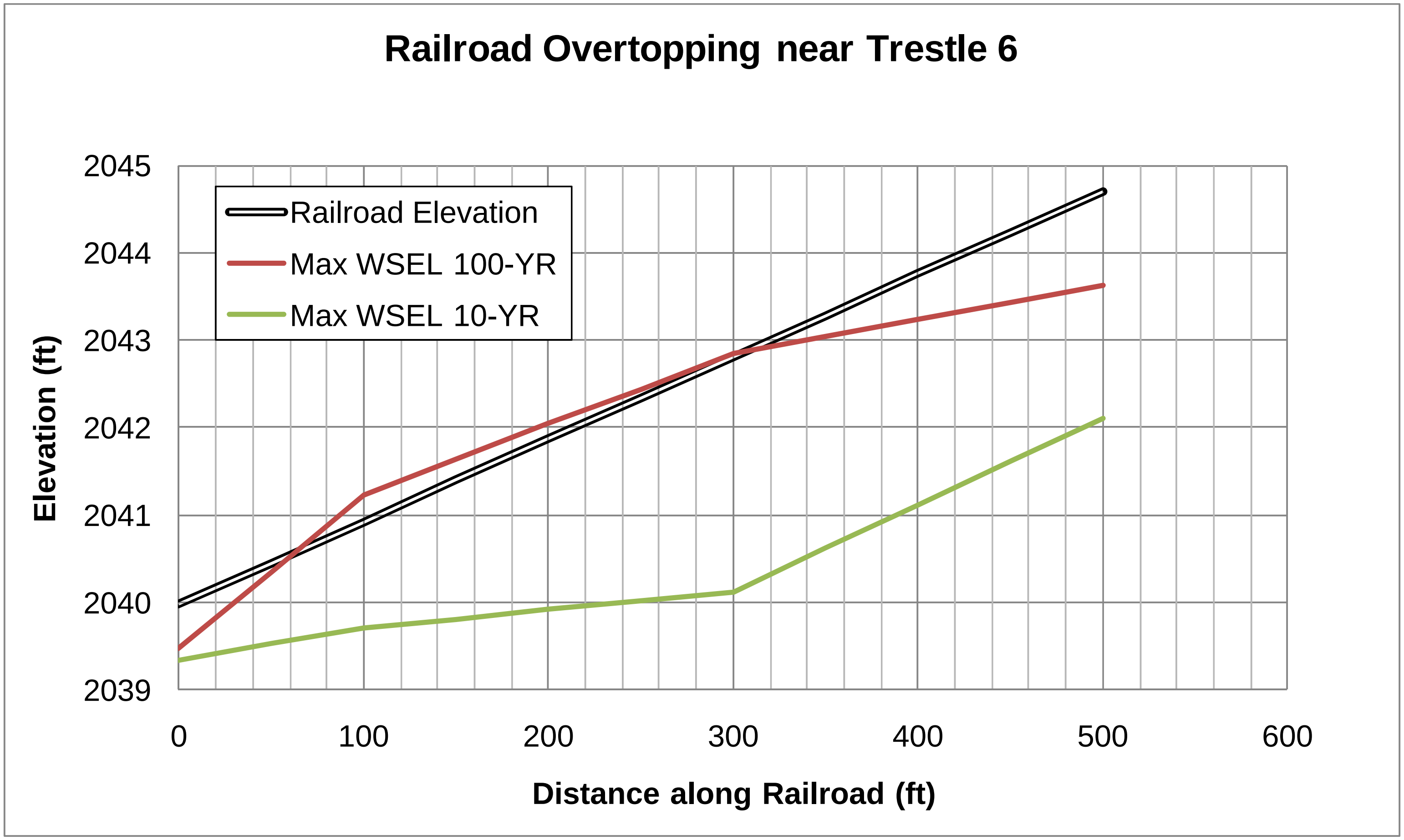

Figure 3.13. Approximate railroad profile and maximum water-surface elevations for the 5-year, 10-year and 100-year, 24-hour storms in the vicinity of Trestle 6 under existing conditions.

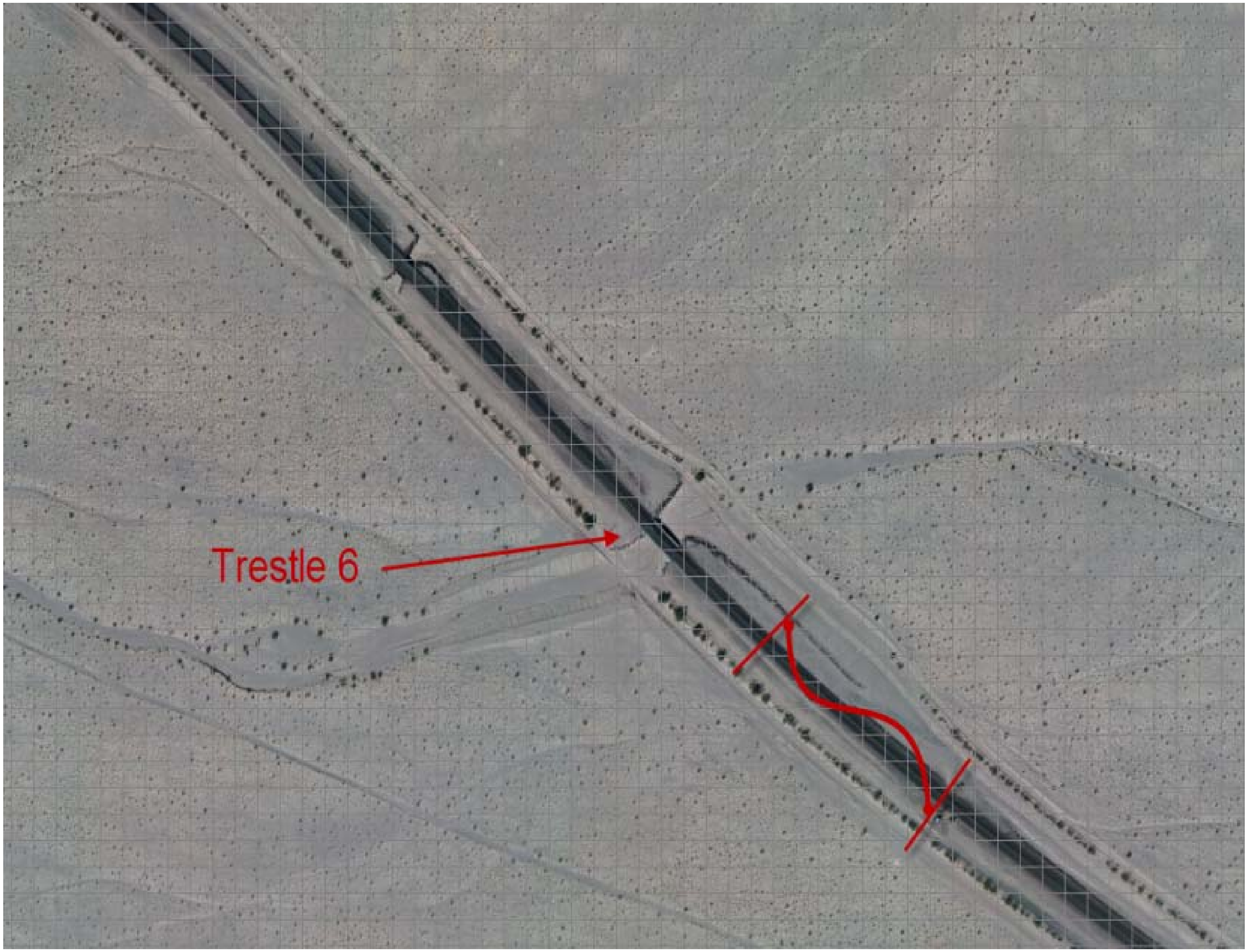

Figure 3.14. Location of railroad overtopping near Trestle 6.

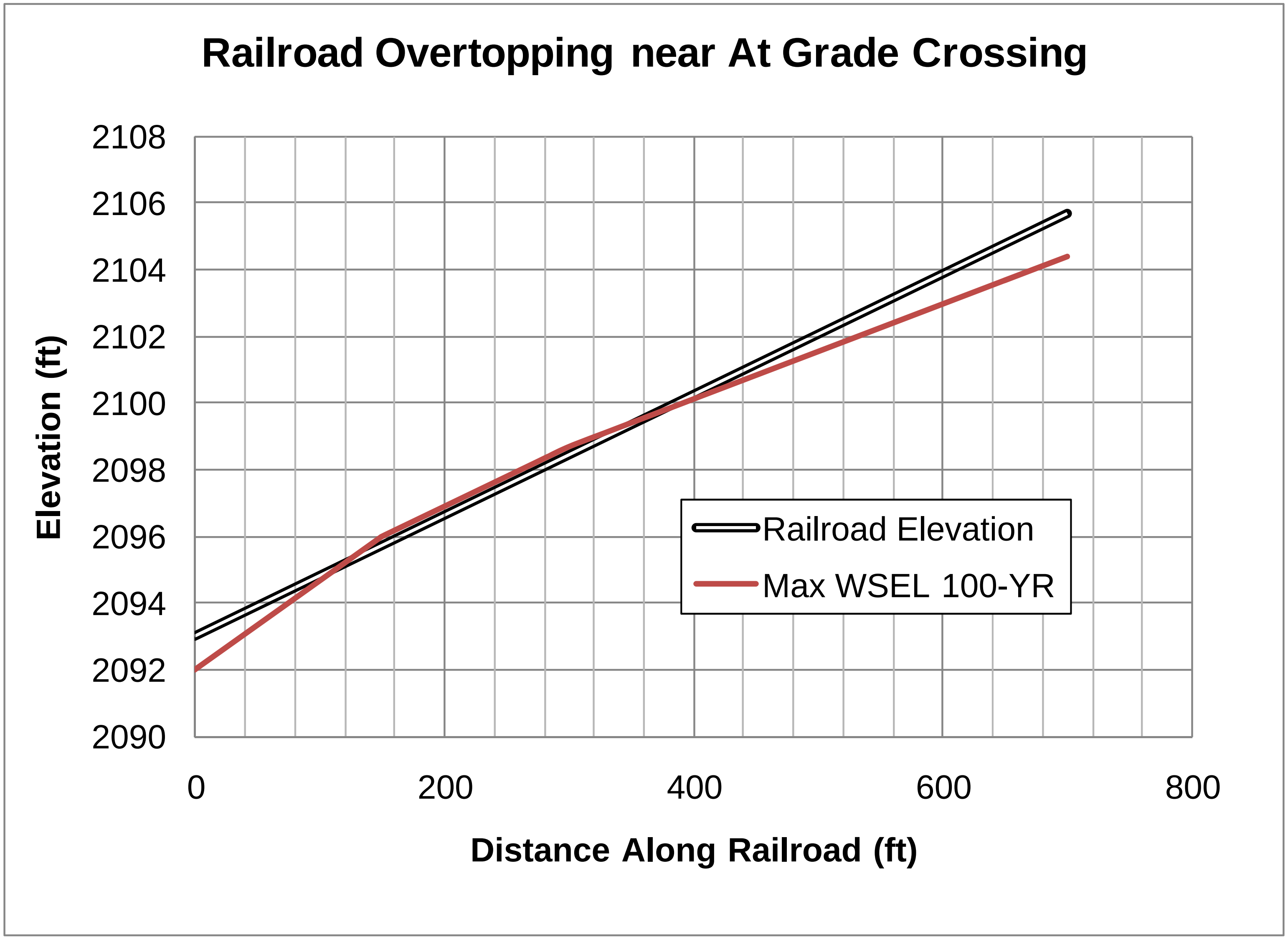

Figure 3.15. Approximate railroad profile and maximum water-surface elevations for the 5-, 10- and 100-year, 24-hour storms in the vicinity of the under existing conditions at-grade crossing.

Figure 3.16. Location of railroad overtopping near at grade crossing.

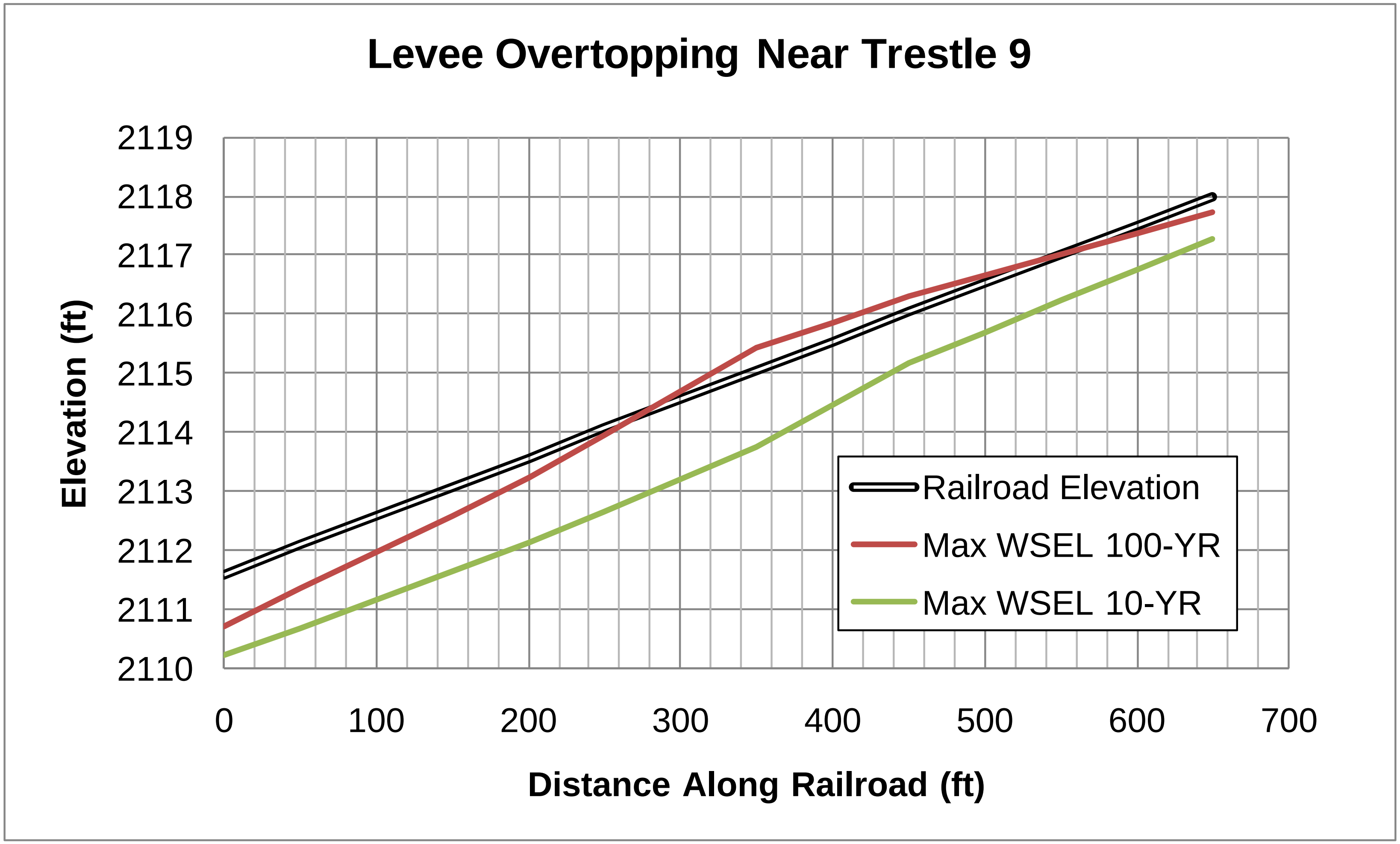

Figure 3.17. Approximate railroad profile and maximum water-surface elevations for the 5-, 10- and 100-year, 24-hour storms in the vicinity of Trestle 9 under existing conditions.

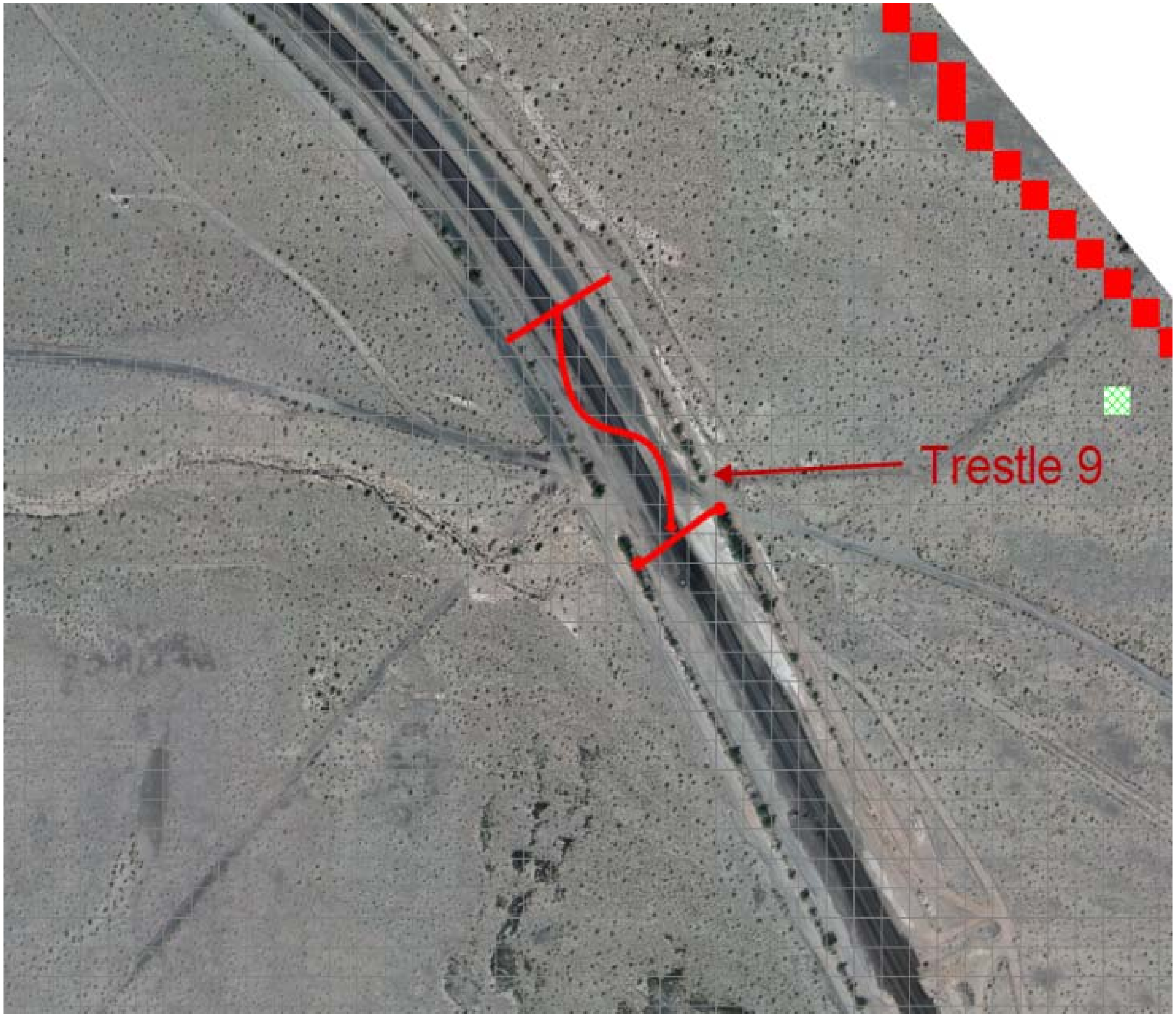

Figure 3.18. Location of railroad overtopping near Trestle 9.

3.3. Project Conditions Model

The proposed conditions models were adjusted to represent the features that will be added by the project, including roads, buildings, parking areas, PV arrays, and SunCatchers[tm] (Figures 3.6 and 3.7).

3.3.1. Main and Secondary Access Roads

The main service road will consist of an embankment that will be raised above the existing ground level and covered with a 24-foot wide strip of 4-inch-thick asphaltic concrete. Culverts will be constructed in the main drainage paths to pass stormwater from both the offsite basin and from on-site. The secondary access roads will be constructed at the existing grade, including a 6-inch-thick aggregate base course with soil stabilizer, to allow stormwater runoff to pass through the same drainage paths that are present under existing conditions. The main and secondary access roads were incorporated into the model by adjusting the affected grid elevations, as appropriate (main access road, only), increasing the CNs to account for the effects of compaction and surface paving on infiltration rates, and decreasing the Manning's roughness values to represent the decreased resistance to flow associated with the generally smoother surface.

A CN of 89 was used for the main road and a CN of 87 was used for the secondary access roads, based on guidance from NRCS (1986). The value used for the secondary access road was developed by averaging the recommended CNs for pavement of 89 and gravel roads of 85, since the soil stabilizer will increase the imperviousness of the surface to approximately midway between compacted gravel and pavement. On average, the 24-foot-wide paved section of the main access road occupies approximately one-half of each 50-foot by 50-foot grid through which it passes. To represent these areas in the model, a composite CN value was estimated using an area-weighted average:

$$CN = 0.5 * CN_{undisturbed} + 0.5*89.$$

As discussed above, the CN value for the undisturbed area depends on both the magnitude and duration the rainfall event (**Table 3.5**).

Manning's roughness coefficients of 0.025 and 0.033 were used for the main and secondary access roads, respectively.

Table 3.5. Composite curve numbers, 24-hour storm proposed conditions.

Return Period (years)	Curve Number for Undisturbed Conditions (HSG B) ($CN_{undisturbed}$)	Buildings and Parking Lots (CN=98)	Main Access Roads (CN=89)	Secondary Access Roads (CN=87)
2	62.8	80.4	75.9	74.9
5	62.8	80.4	75.9	74.9
10	62.8	80.4	75.9	74.9
25	64.7	81.4	76.9	75.9
50	68.5	83.2	78.8	77.8
100	71.4	84.7	80.2	79.2

3.3.2. Main Service Complex

The main service complex was represented in the model by adding area reduction factors (ARFs) at the proposed buildings to prevent flow entering adjacent areas and water storage in the area occupied by the buildings, adjusting the CN to account for the effects of surface compaction and paving on infiltration and runoff response, and altering the Manning's roughness coefficient to account for the generally smoother surface in the parking lot and lay-down areas. The ARF values for the buildings were set to 1.0 where the building occupies essentially the entire grid, and to the appropriate percentage, where the building occupies only a portion of the grid.

The parking lots are assumed to be impervious, and CN values of 98 were used in those locations. The lay-down areas will be used during the construction phase of the project. These areas are conservatively assumed to be impervious, as well, with CN values of 98, due to the significant amount of compaction that is likely to occur in these areas. For both locations, the Manning's roughness coefficient was reduced to 0.022 to represent the reduced resistance to flow.

3.3.3. PV Arrays and SunCatchers™

The PV arrays are made up of tracker blocks which consist of a series of rows containing modules mounted on common shafts and controlled by a single tracker motor. This shaft is oriented north-south and is the axis around which the modules follow the sun as it travels east to west (**Figure 3.19**). The individual modules are approximately 3.4-foot wide by 6.5-foot long. Typical tracker blocks contain about 19 rows and are approximately 172 feet wide and 280-feet-long. There is over 10-foot minimum of clear spacing between the rows with the modules in the horizontal position. The modules are supported above the ground by 4.5- and 6-inch diameter posts spaced at approximately 12- to 15-foot intervals along their length. With the minimum of approximately 10-foot open spacing between modules, at mid-day, the modules cover only 25 percent of the ground area. The percentage of the ground that is covered during other parts of the day decreases with other module orientations based on the relationship between the sun and the particular orientation of the array. The layout of the PV tracker blocks is shown on Figure 3.6.

The SunCatchers™ consist of 38-foot diameter mirrored dishes that are supported above the ground by 2-foot diameter posts spaced at intervals of 112 feet in the east-west direction and 56 feet in the north-south direction (**Figure 3.20**). The SunCatchers™ will be constructed in a of the Project site on the north side of the BNSF Railroad, as shown in Figure 3.6. The SunCatchers™ rotate about both a horizontal and vertical axis to optimize their angle with the sun. When oriented with their axis in the vertical direction, each dish covers an area of approximately 1,134 ft^2, or about 18 percent of the total ground area and about 45 percent of the 50-foot by 50-foot model grid cell in which they are located. The percentage of cover, of course, decreases with other orientations of the dish.

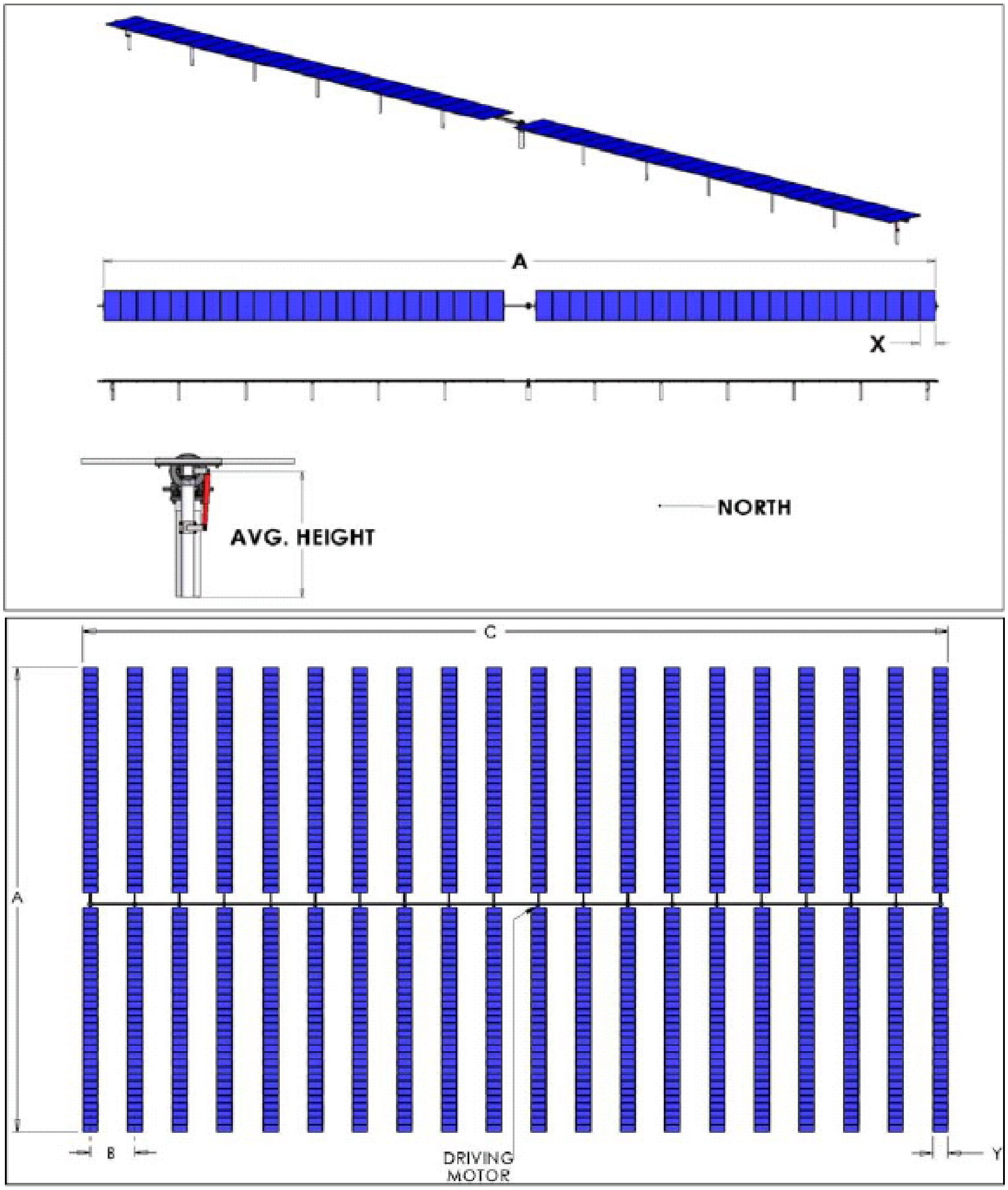

Figure 3.19. Typical PV panel layout (A=171 feet, B=19.6 feet, C=281 feet, X=3.4 feet, Y=6.5 feet).

Figure 3.20. Photo of typical SunCatchers[tm].

3.3.3.1. Worst-case Effects of PV Panels and SunCatchers[tm] Dishes on On-site Vegetation

The construction and installation at the Project site will include activities such as clearing and grubbing, excavation, and installation of the PV arrays, SunCatchers[tm] and associated support structures. The PV panels and SunCatchers[tm] will shade the ground, which may limit the amount of vegetation that grows directly beneath the structures. Additionally, main and secondary access roads will be constructed where vegetation will be removed to allow vehicular access. Vegetation will likely recover and re-establish in areas that require infrequent access for maintenance purposes. Soil compaction may temporarily inhibit vegetation growth, but species such as creosote bush and both native and non-native grasses that currently dominate the site are hardy species that grow in adverse soil conditions. It is likely that this creosote bush community will re-colonize the site and grow in all locations except directly under the structures or on permanent access roads. This vegetation is typically sparse in a desert climate and the additional water provided by occasional washing is not likely to cause denser stands of vegetation to grow than would normally occur on the site.

3.3.3.2. Effects of PV Panels and SunCatchers[tm] on Infiltration and Runoff Response

In assessing the potential effects of the PV arrays and SunCatchers[tm] on the rainfall-runoff response at the Project site, the Tetra Tech team attempted to identify studies at other similar sites where these processes were specifically evaluated. In every case that was identified, the hydrologist assumed and/or determined that impervious surfaces associated with these features would not significantly affect the response of the site, and the models were not adjusted to account for the presence of the panels (e.g., Dillon Consulting Limited, 2011). It is also worthwhile to note that the State of New Jersey enacted a law in 2010 that exempts solar panels from the calculation of impervious cover under a number of state laws that are intended to limit the increase in impervious area associated with new development (Steinberger, 2010).

Although not necessarily based on rigorous scientific analysis, the acceptability of this law indicates that the infiltration and rainfall-runoff impacts are, at the very least, believed to be relatively small.

If the PV arrays and SunCatchers^{tm} do, in fact, affect the infiltration and rainfall-runoff response of the site, this would occur through concentration of the flow along the downslope edge of the panels (or lowest point on the SunCatchers^{tm} dishes). Since the PV arrays and SunCatchers^{tm} dishes are elevated above the ground, the entire ground surface, except for the area occupied by the support posts, remains available for infiltration. As a result, even though the rain falling on the surface of the panels and dishes does not immediately infiltrate, surface flows originating from these areas that passes under adjacent structures does have the opportunity to infiltrate.

During intense, short-duration rainstorms over bare ground, the infiltration rate is typically less than occurs with longer-duration, low-intensity storms, due to a complex soil moisture interface in which the infiltration rate is limited by entrapped air within the surface soil. This process is the a key reason for adjusting the runoff CNs based on storm duration, and it implies that the infiltration rate of flows passing under the panels and dishes would be higher than would occur if the rainfall was falling directly on the ground surface.

The resolution and algorithms in standard rainfall-runoff models, such as those being used in this study, do not permit direct evaluation of this complex process. Based on the qualitative arguments presented above, it is Tetra Tech's opinion that the counterbalancing effect of higher infiltration rates under the panels and dishes may actually overcome any effect associated with flow concentration along the edges, and it is likely that the combined effect could be a net increase in infiltration and net decrease in runoff response compared to existing conditions. Because of the uncertainty in this conclusion and the likely small hydrologic effect, the with-project modeling was performed based on the assumption that the PV arrays and SunCatchers^{tm} will not affect the overall rainfall-runoff response of the site under project conditions.

3.3.3.3. Effects of PV Array and SunCatchers^{tm} Support Posts on Infiltration and Runoff Response

The 12 to 15-foot spacing of the PV array support posts results in an average of approximately nine posts for every 2,500-ft^2 model grid cell. The posts have a cross sectional areas of 0.1 ft^2 to 0.2 ft^2; thus, nine posts occupy a combined area of 1.8 ft^2, or less than 1 percent of each 50- by 50-foot model grid cell. An area reduction factor (ARF) of 0.01 was, therefore, conservatively applied to the model grid cells containing PV arrays to represent these posts.

Similarly, each 2-foot diameter SunCatchers^{tm} support post has a cross sectional area of 3.1 ft^2, which represents about 0.1 percent of the 50- by 50-foot model grid cell in which it is located. These posts were conservatively represented in the model by applying an ARF of 0.01 to each grid cell containing a post.

3.4. Project Conditions Model Results

In general, the differences in overall model results for both partial and full build-out conditions from the existing conditions results for equivalent storms are insignificant (on the order of 1 percent or less for nearly all parameters), and well within the uncertainty of the analysis (Tables 3.3 and 3.4). For example, the overall time to peak discharge at all model grid cells averages 17.07 hours after the beginning of rainfall for the 100-year, 24-hour storm, and this decreases by only 0.03 hours (1.7 minutes) under project conditions. Similar, very small differences occur for the other modeled storms. Hydraulic conditions in specific areas of the site are, however, sufficiently different to warrant use of the project conditions models for the site design. Minor differences also occur at some of the railroad drainage structures. Maximum depth and velocities throughout the site during the 100-year, 24-hour storm for full build-out conditions are shown in **Figures 3.21a and 3.21b**, and results for modeled storms other than the 100-year, 24-hour storm are provided in Appendix B (Hydraulics).

The small difference between existing and full build-out conditions at the railroad drainage structures is clearly illustrated by comparing the discharge and depth hydrographs at the Trestles 5 and 6 where some overtopping occurs during the 100-year, 24-hour storm, as discussed above (**Figures 3.22 and 3.23**). Although there are small variations in maximum flow depth on the upstream side of each of these drainage structures under project conditions, the difference in overtopping discharge and water-surface elevations at the time of overtopping between existing and full build-out conditions is insignificant.

Three additional locations within the site were selected to facilitate comparison of project conditions results with existing conditions results: (1) a potential crossing of the main service road on the south side of the railroad near the main service complex (**Figure 3.24**), (2) a potential crossing of the main service road on the north side of the railroad upstream from Trestle 4 (**Figure 3.25**), and (3) the downstream boundary of the project site (**Figure 3.26**).

At Location 1 near the Main Service Complex, the 100-year, 24-hour storm hydrographs for existing and proposed conditions are nearly identical, but there is a small increase in velocity under full build-out conditions due to the slight constricting effects of the buildings and laydown yard that occupy volume within overbank flow path (**Figure 3.27**). At both the Location 2 north of Trestle 4 and Location 3 at the downstream boundary of the project site, the discharge hydrograph and associated velocities are nearly identical under existing and full build-out conditions (**Figures 3.28 and 3.29**). Results for partial buildout conditions at Locations 1 and 3 are essentially the same as those shown in Figures 3.26 and 3.28. There is, of course, no change from existing to partial build-out conditions at Location 2 because all of the activities in this phase are located south of the railroad.

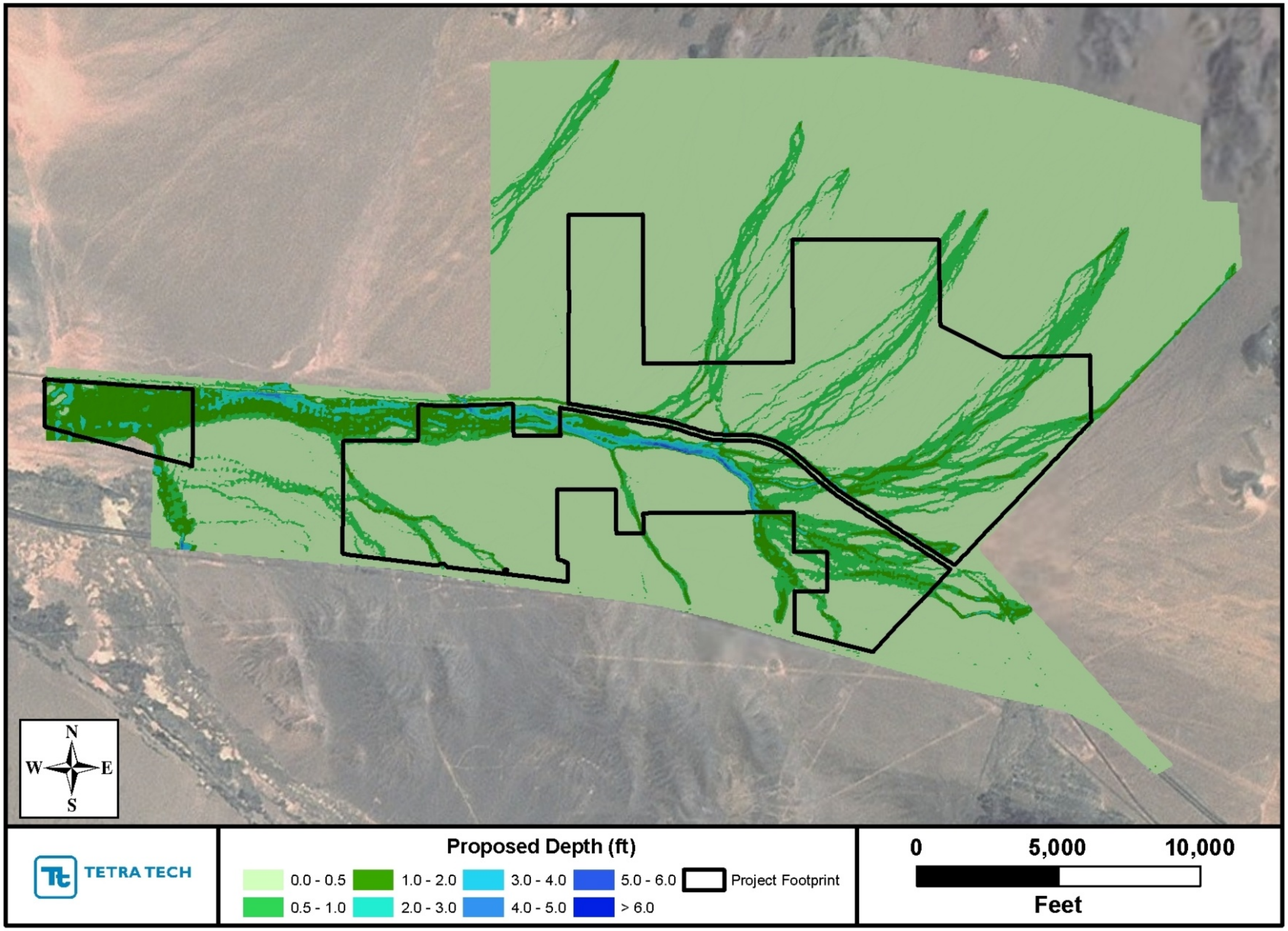

Figure 3.21a. Predicted maximum depth during 100-year, 24-hour storm under full build-out conditions.

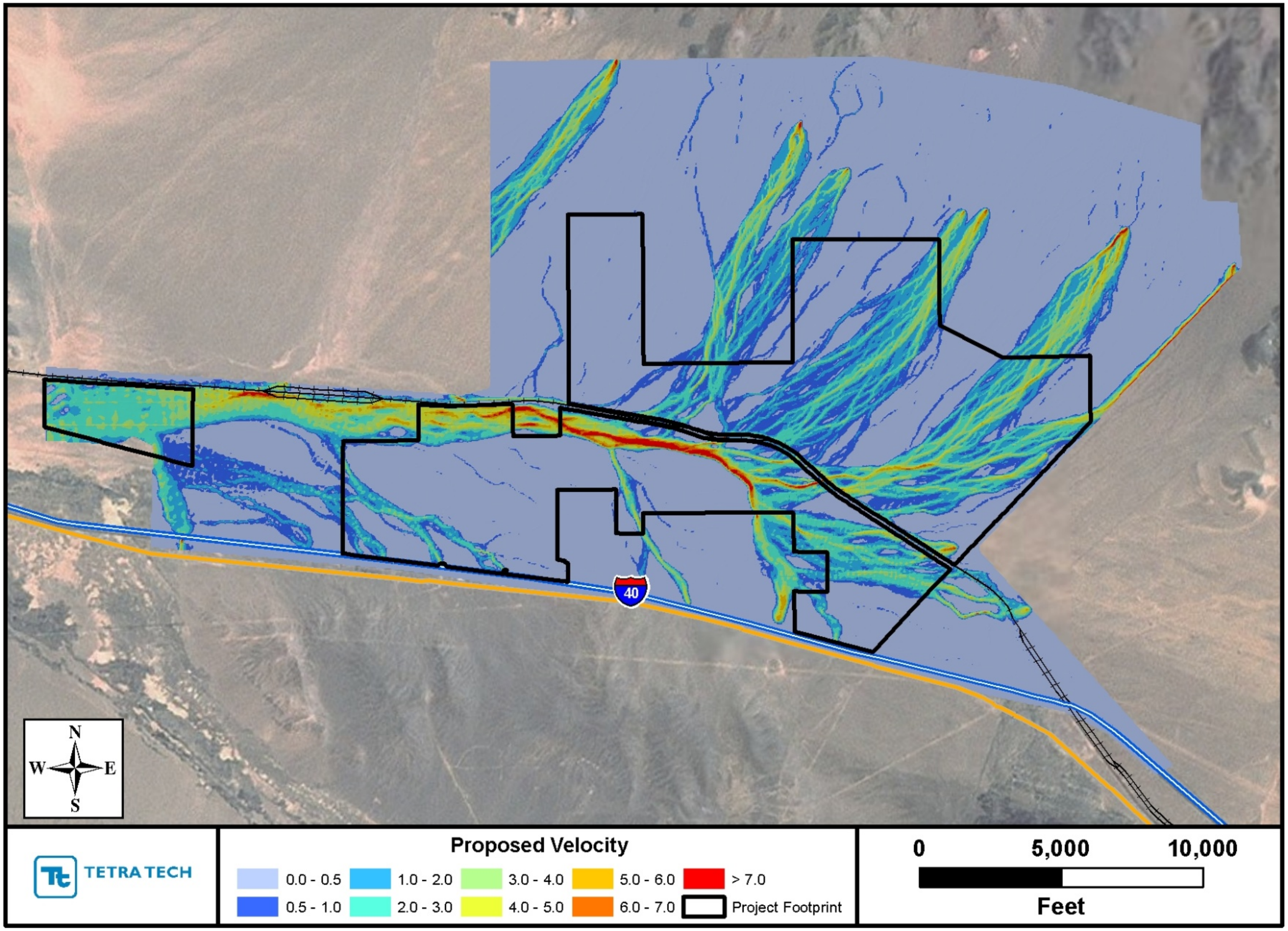

Figure 3.21b. Predicted maximum velocity during 100-year, 24-hour storm under full build-out conditions.

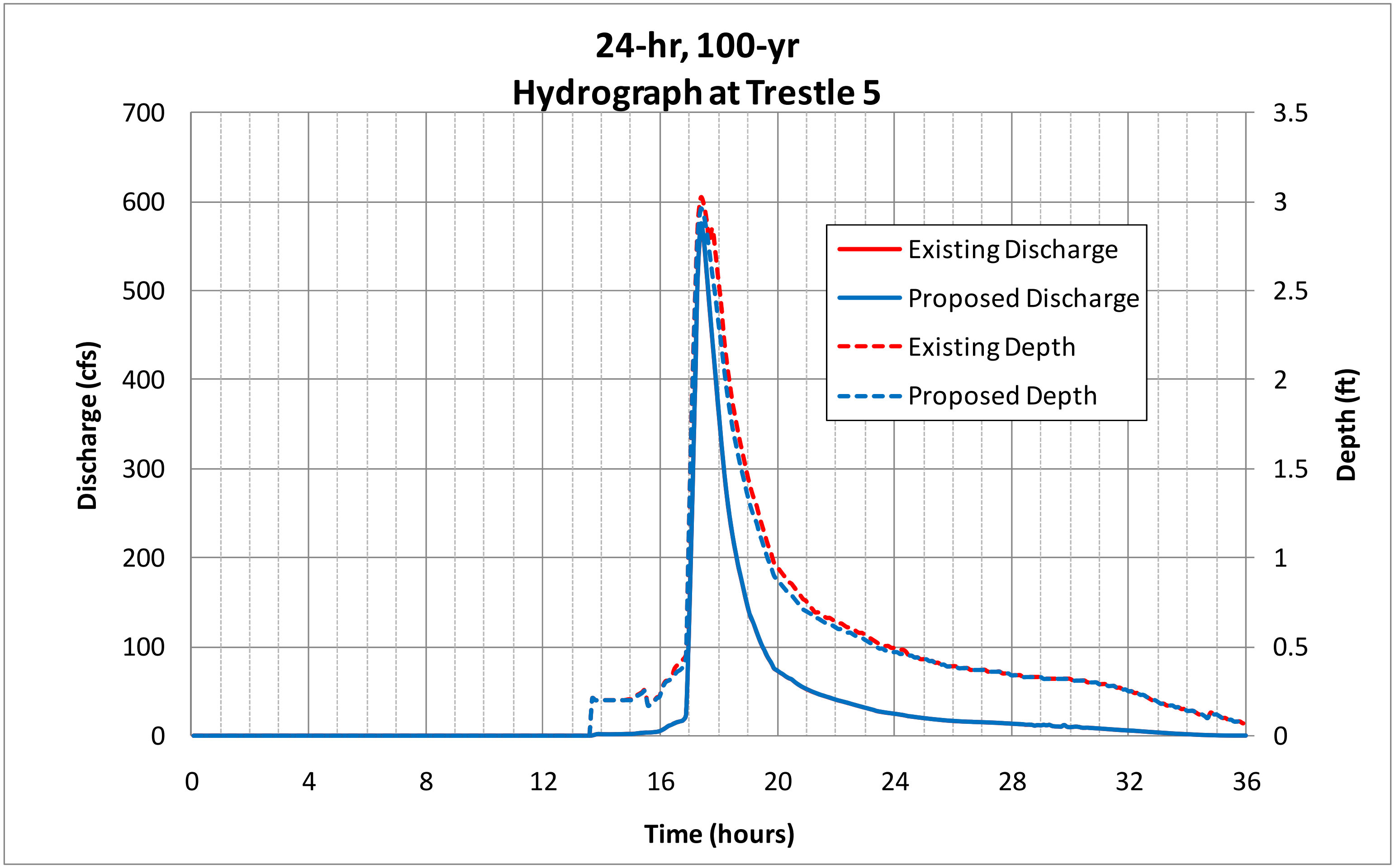

Figure 3.22. 100-year, 24-hour storm hydrographs at Trestle 5 under existing and full build-out conditions. NOTE: Existing and proposed discharges are nearly identical; thus, existing discharge line is covered by proposed discharge line.

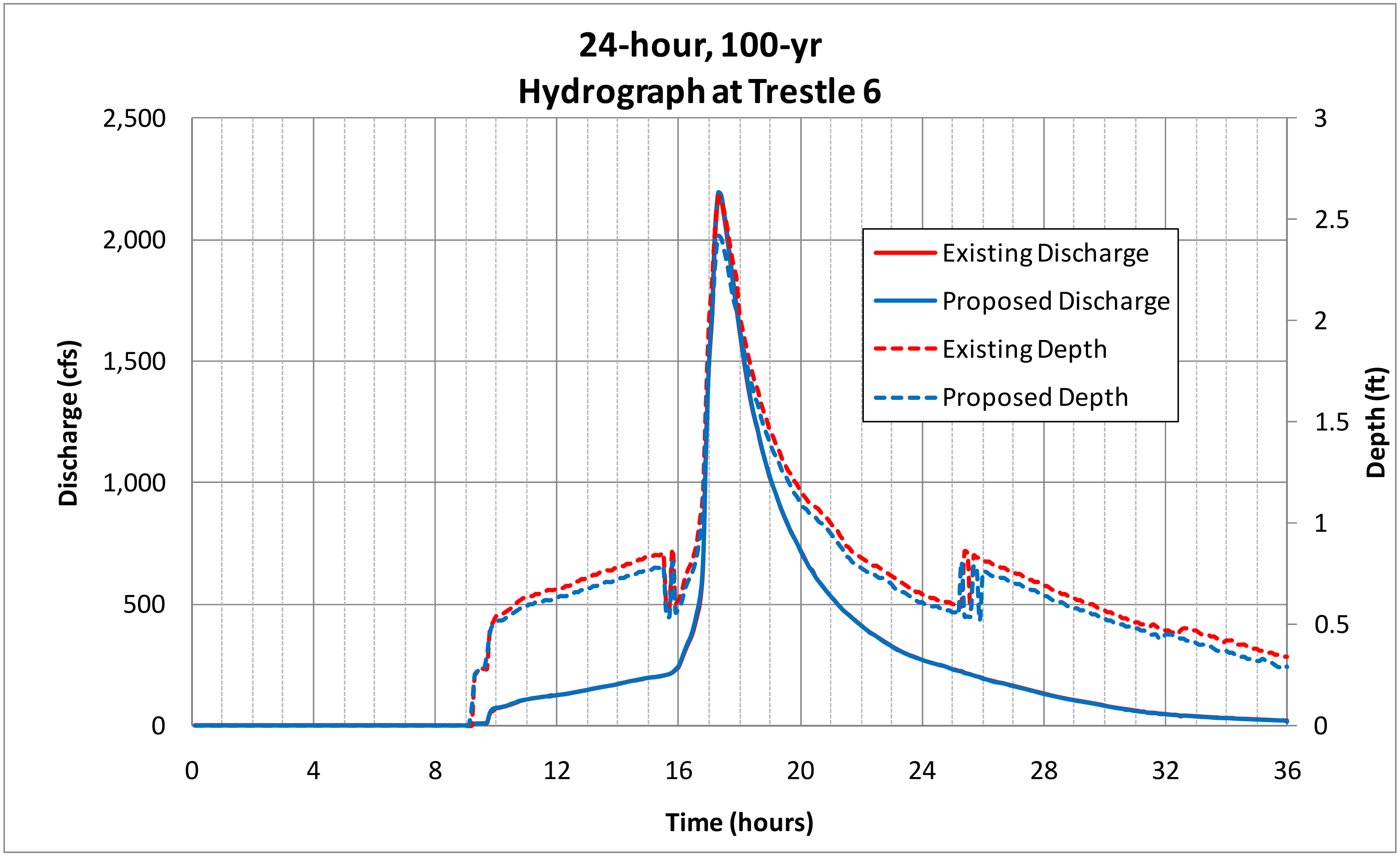

Figure 3.23. 100-year, 24-hour storm hydrographs at Trestle 6 under existing and full build-out conditions. NOTE: Existing and proposed discharges are nearly identical; thus, existing discharge line is covered by proposed discharge line.

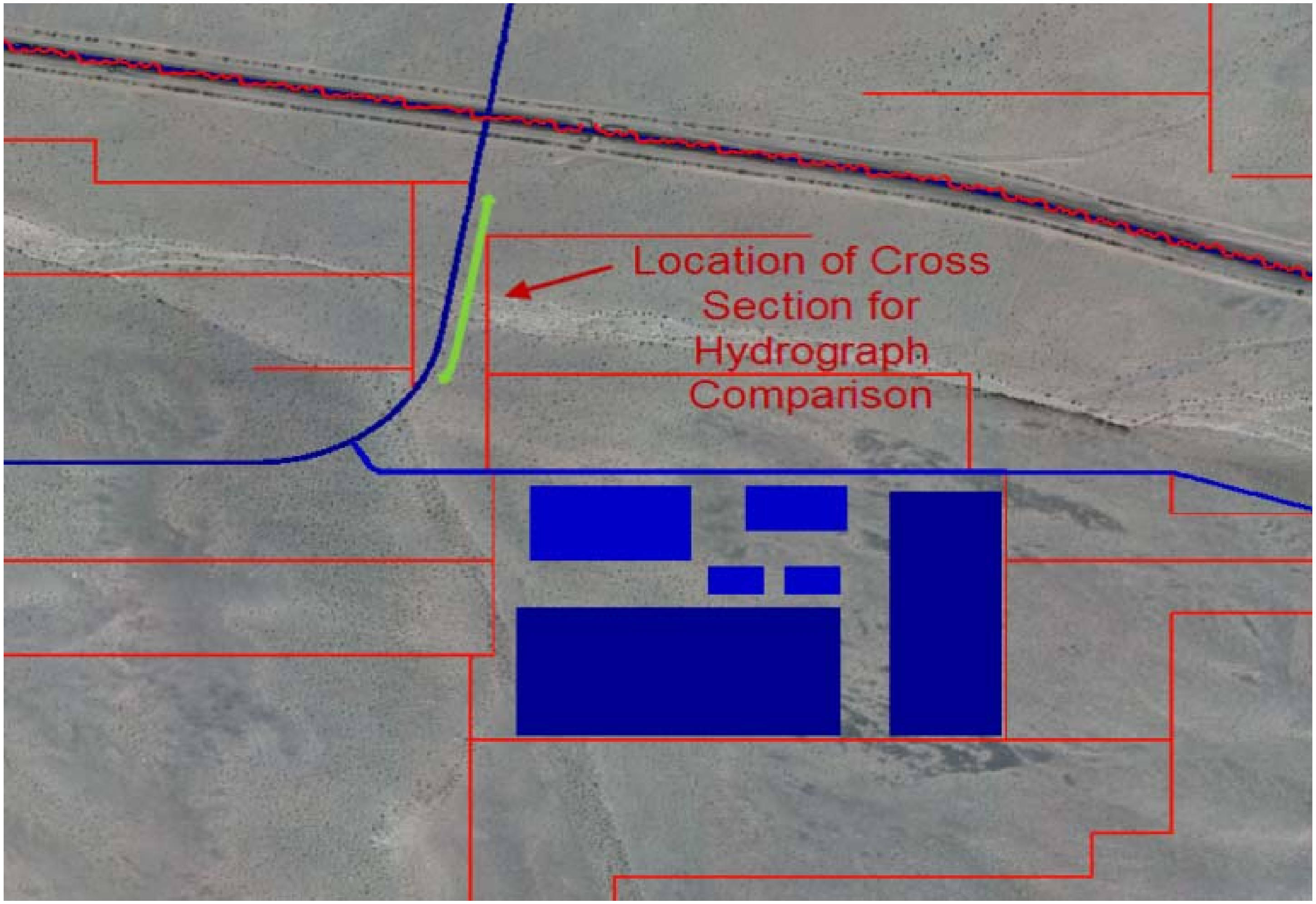

Figure 3.24. Location near Main Service Complex for hydrograph comparison.

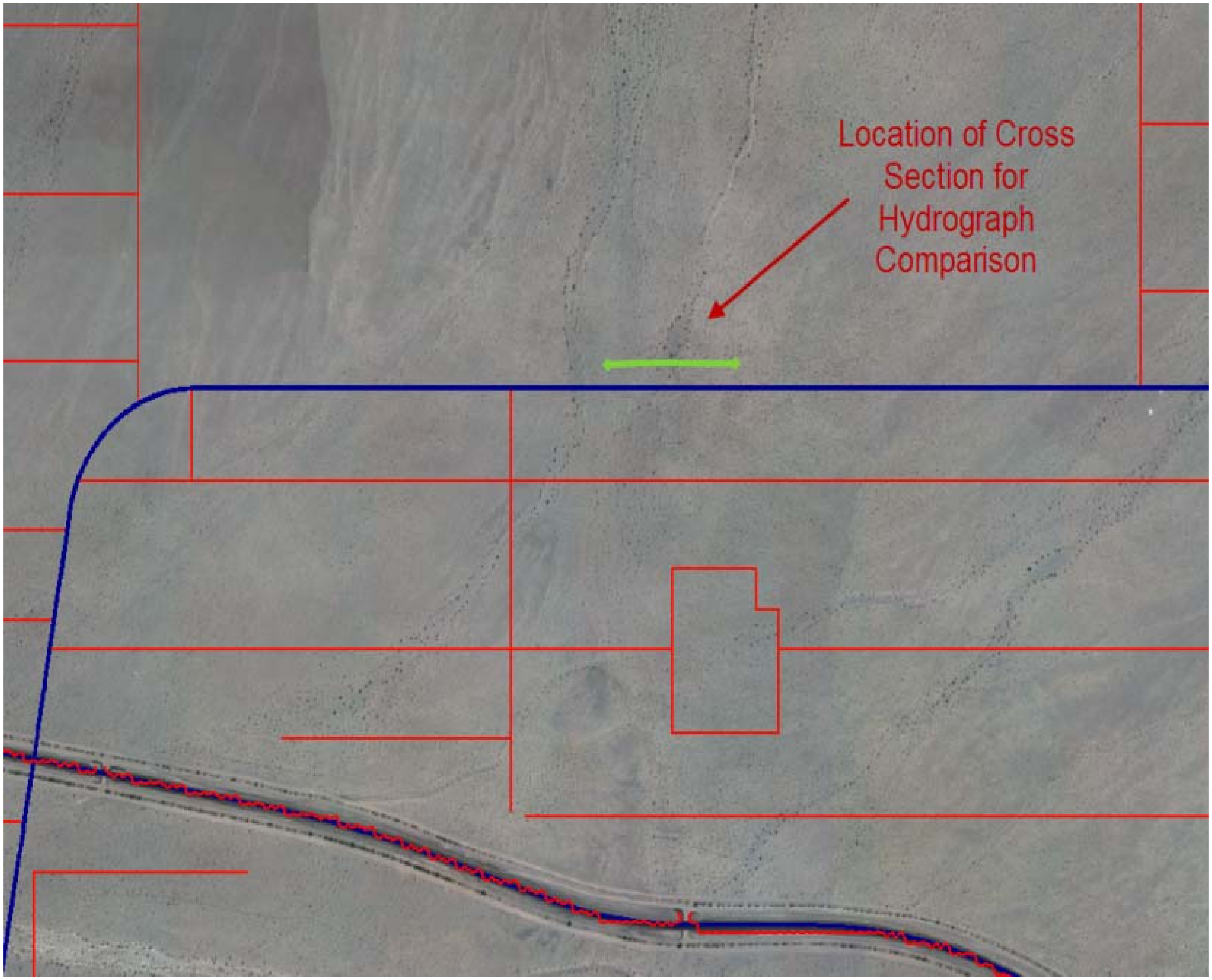

Figure 3.25. Location north of Trestle 4 for hydrograph comparison.

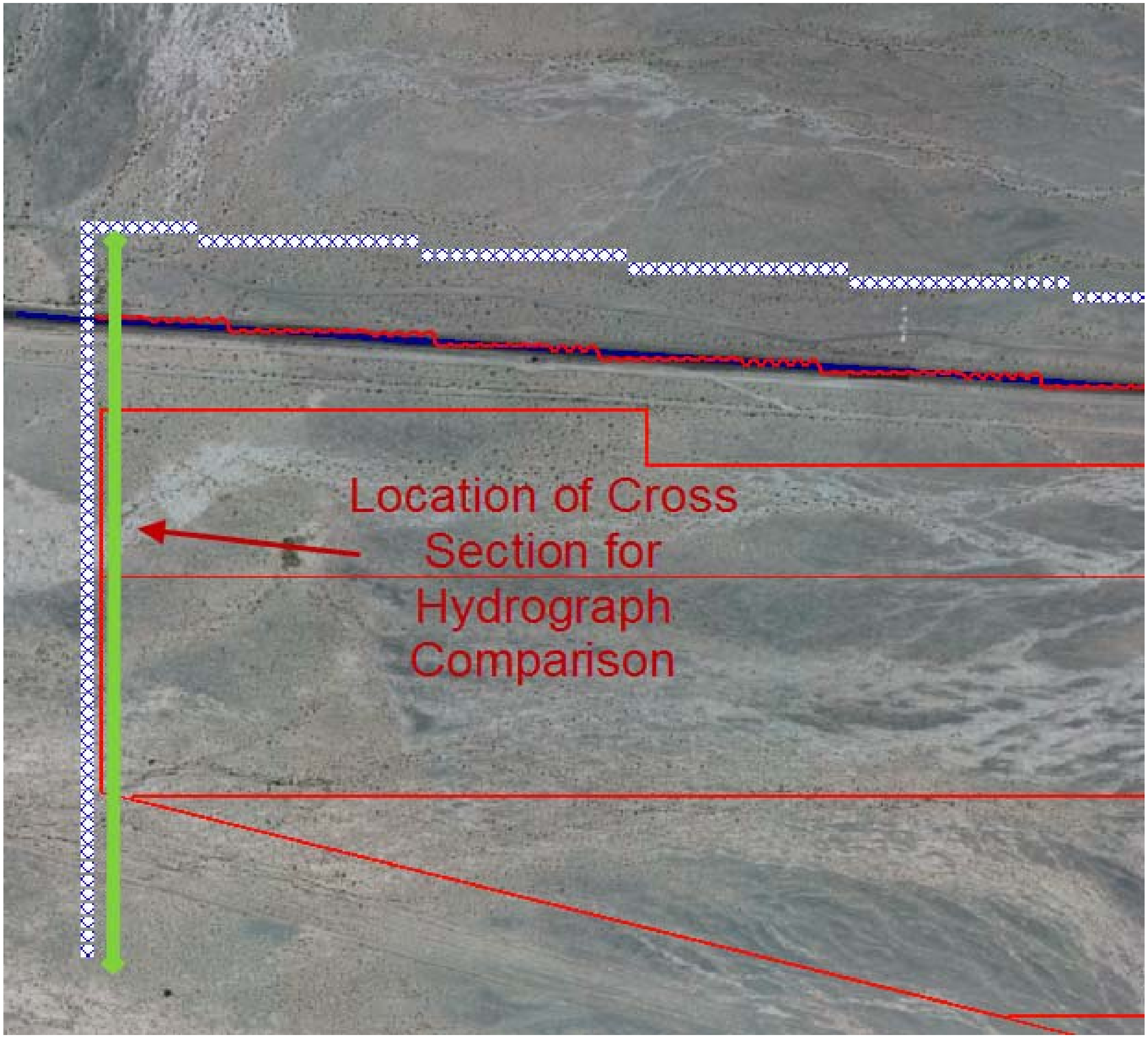

Figure 3.26. Cross section at downstream boundary of Project site for hydrograph comparison.

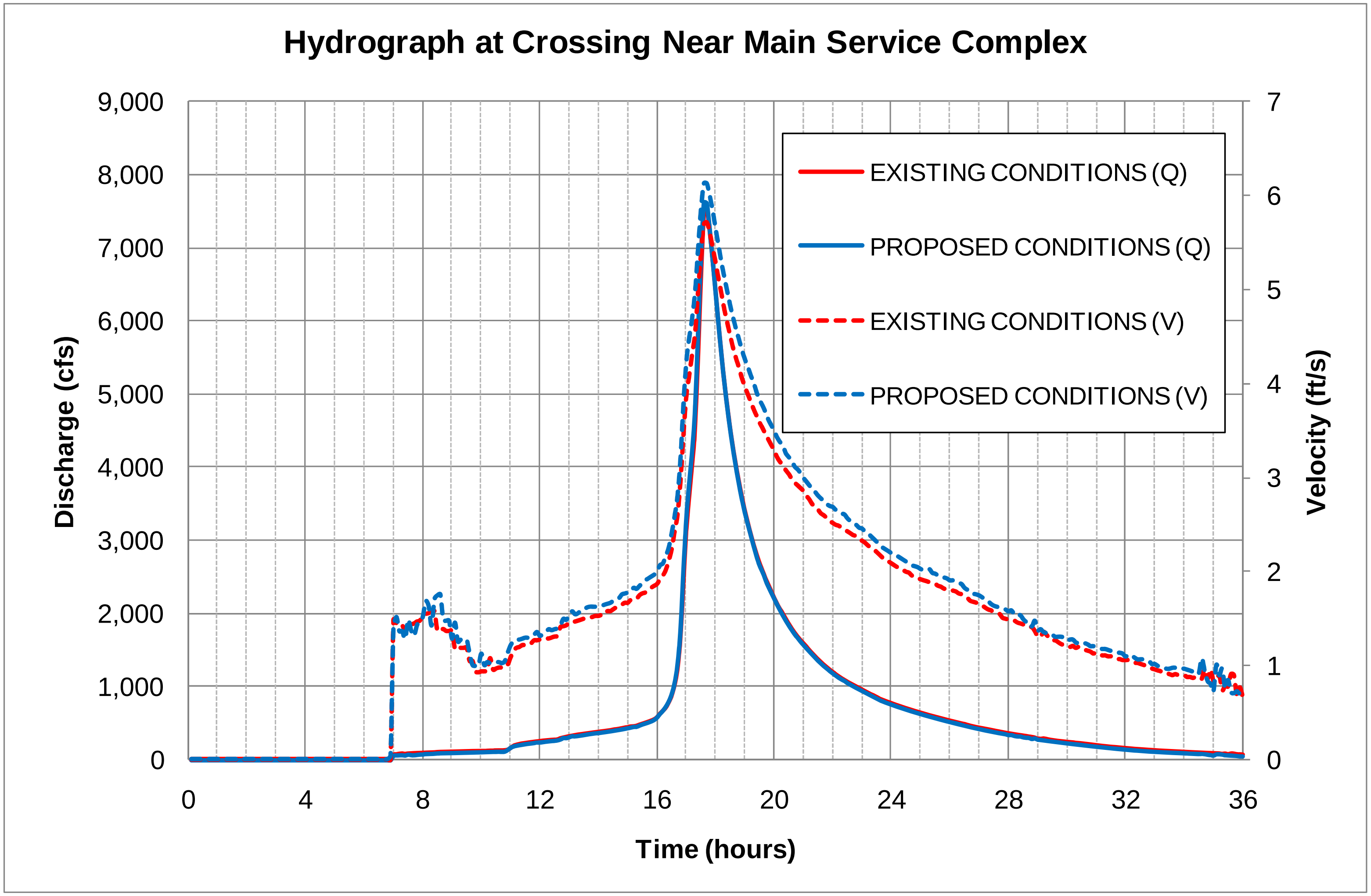

Figure 3.27. Comparison of Hydrographs at location near the Main Service Complex. NOTE: Existing and proposed discharges are nearly identical; thus, existing discharge line is covered by proposed discharge line.

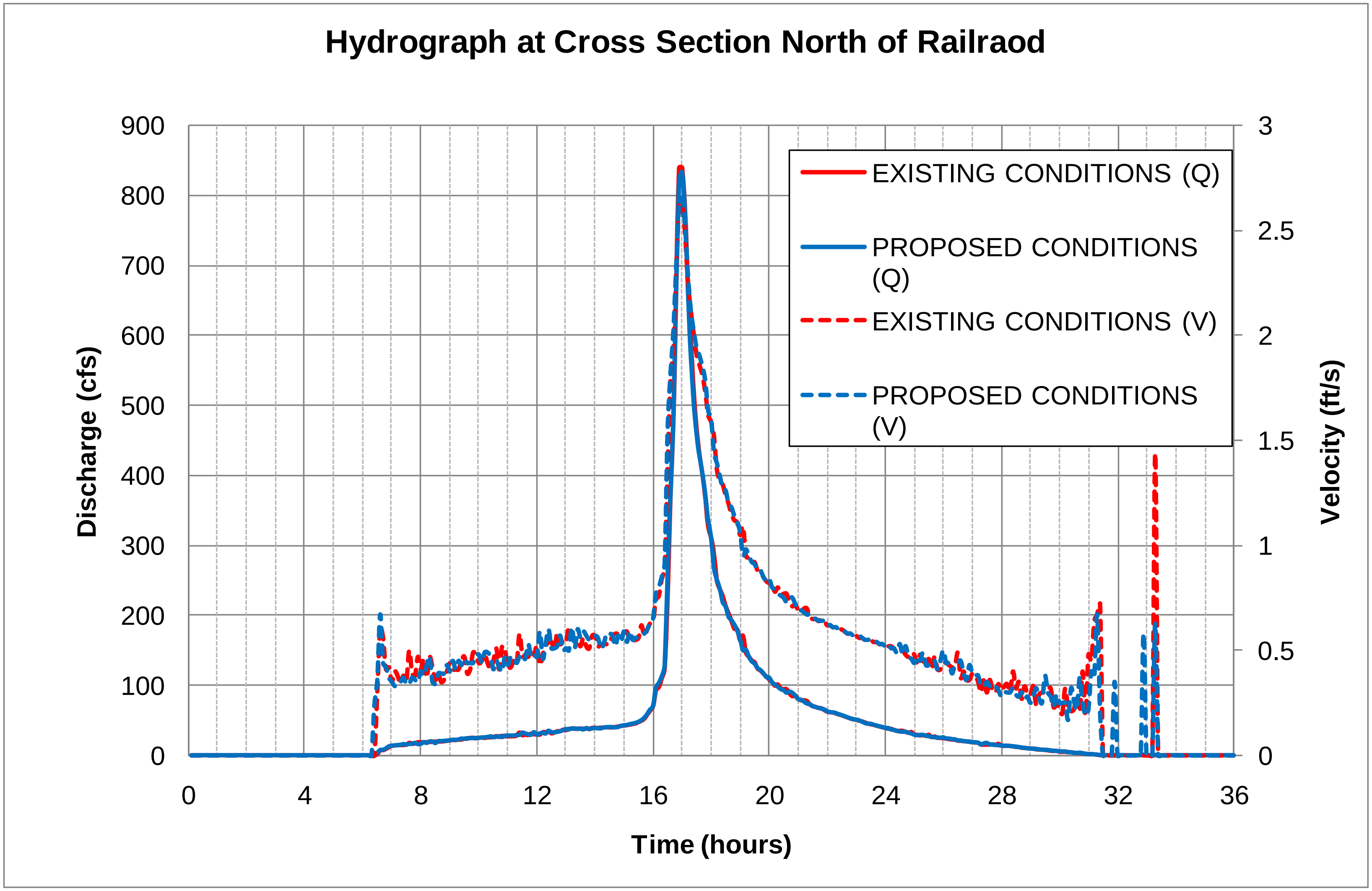

Figure 3.28. Comparison of Hydrographs at location north of Trestle 4. NOTE: Existing and proposed discharges are nearly identical; thus, existing discharge line is covered by proposed discharge line.

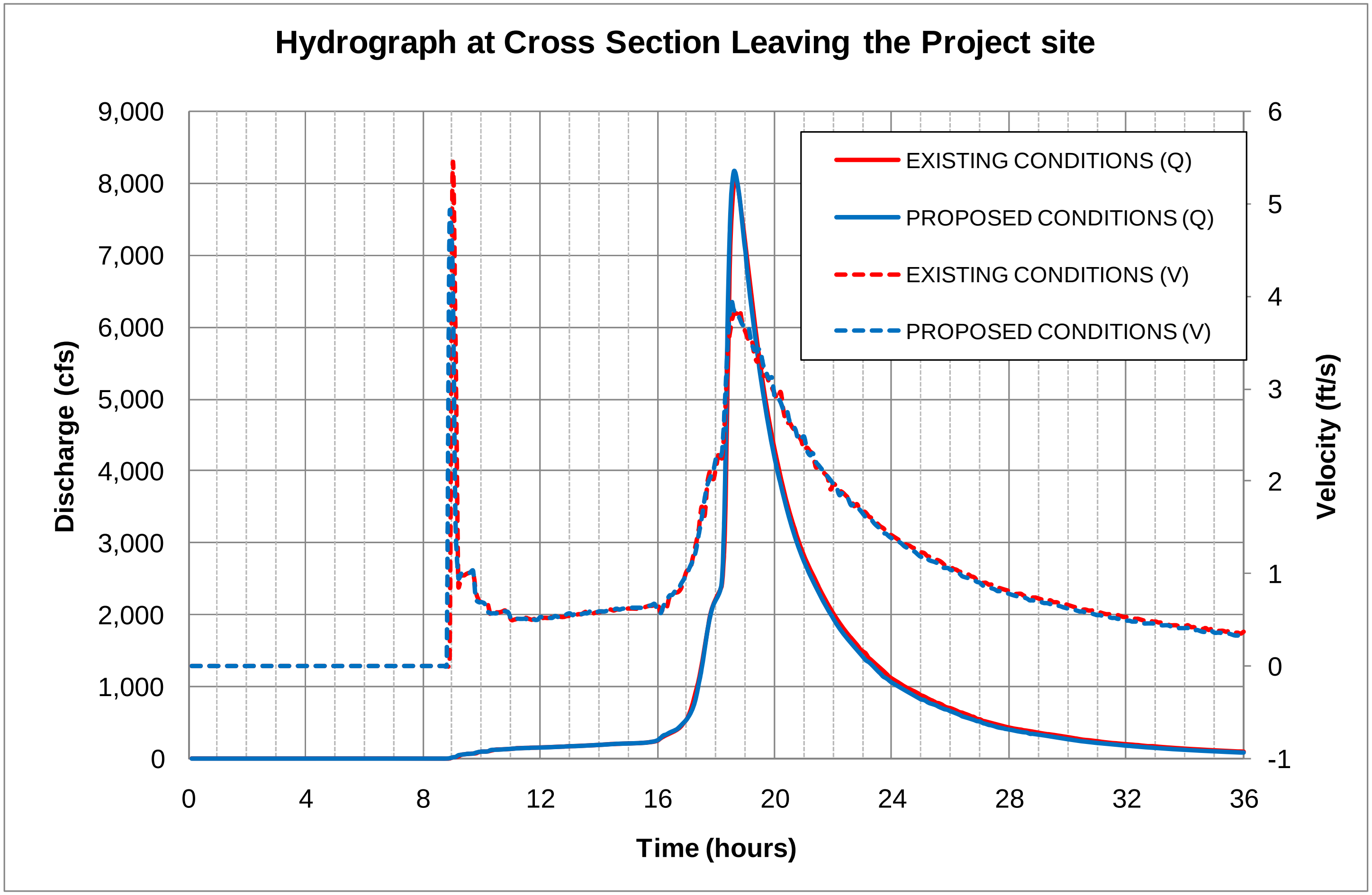

Figure 3.29. Comparison of hydrographs at downstream boundary of the project site. NOTE: Existing and proposed discharges are nearly identical; thus, existing discharge line is covered by proposed discharge line.

4. SUMMARY AND CONCLUSIONS

The analysis presented in this Infiltration Report addresses the issues spelled out in Soil & Water Condition 13 and the additional requirements set forth by Calico to address the addition of PV technology in the Proposed Project, specifically focusing on the rainfall-runoff response of the Project site to the 2-, 5-, 10- and 100-year storms under existing and project conditions, and the amount of change in infiltration due to the project. The analysis was performed by developing hydrographs for the off-site basins that would cross the project site using the AES model with procedures specified in the San Bernardino Hydrology Manual (SBC, 1986 and 2010). These hydrographs were used as input to a FLO-2D model that was developed for existing conditions and then modified, as appropriate, to represent the various project features, including the support posts and impervious surfaces of the PV arrays and SunCatchers[tm], operation, maintenance, and temporary construction facilities, and main and secondary access roads. The potential worst-case impact of the PV arrays and SunCatchers[tm] on vegetation at the site, and the resulting impact on the rainfall-runoff response during the modeled storms was also considered. The following specific conclusions can be drawn from the study:

1. Under existing conditions, very little runoff enters or leaves the project site in response to the 2-year recurrence interval storm event.
2. A total flow volume equivalent to about 1.2 inches of the total precipitation depth of about 2.9 inches leaves the Project site under existing conditions for the 100-year storm event, and this total volume increases by less than 1 percent under project conditions after complete build-out. The increase in volume is even less for partial build-out conditions associated with the first phase of the project that involves installation of PV arrays only in the portion of the Project site south (i.e., downstream) of the BNSF Railroad and north of I-40 (Figure 3.7).
3. Under existing conditions, the modeled flows in the main drainage channels exceed the capacity of the existing Trestle 5 under the BNSF Railroad during the 10-year and larger events for durations ranging from 4 hours (10-year) to 6 hours (100-year), with maximum overtopping depths of 0.3 to 0.6 feet. Modeled flows for the 100-year, 24-hour storm overtop Trestles 6 and 9 with maximum depths of about 0.5 feet and durations of 6 to 30 hours, respectively. The model also predicts that the at-grade crossing will overtop by a maximum depth of about 0.3 feet for 2 hours during the 100-year, 24-hour storm.
4. Changes in the magnitude and duration of overtopping at these locations under full build-out conditions after installation of the PV arrays and SunCatchers[tm] on the portion of the Project site north of the Railroad (Figure 3.6) would be insignificant.
5. Results from the project conditions FLO-2D model provide the specific hydraulic conditions, including discharges, velocities and depths throughout the site that can be used to assess the relative flood hazards and design the site infrastructure, including the support posts for the PV arrays and SunCatchers[tm] and the drainage structures through the main access road, and assess the continuity of sediment movement across the site.

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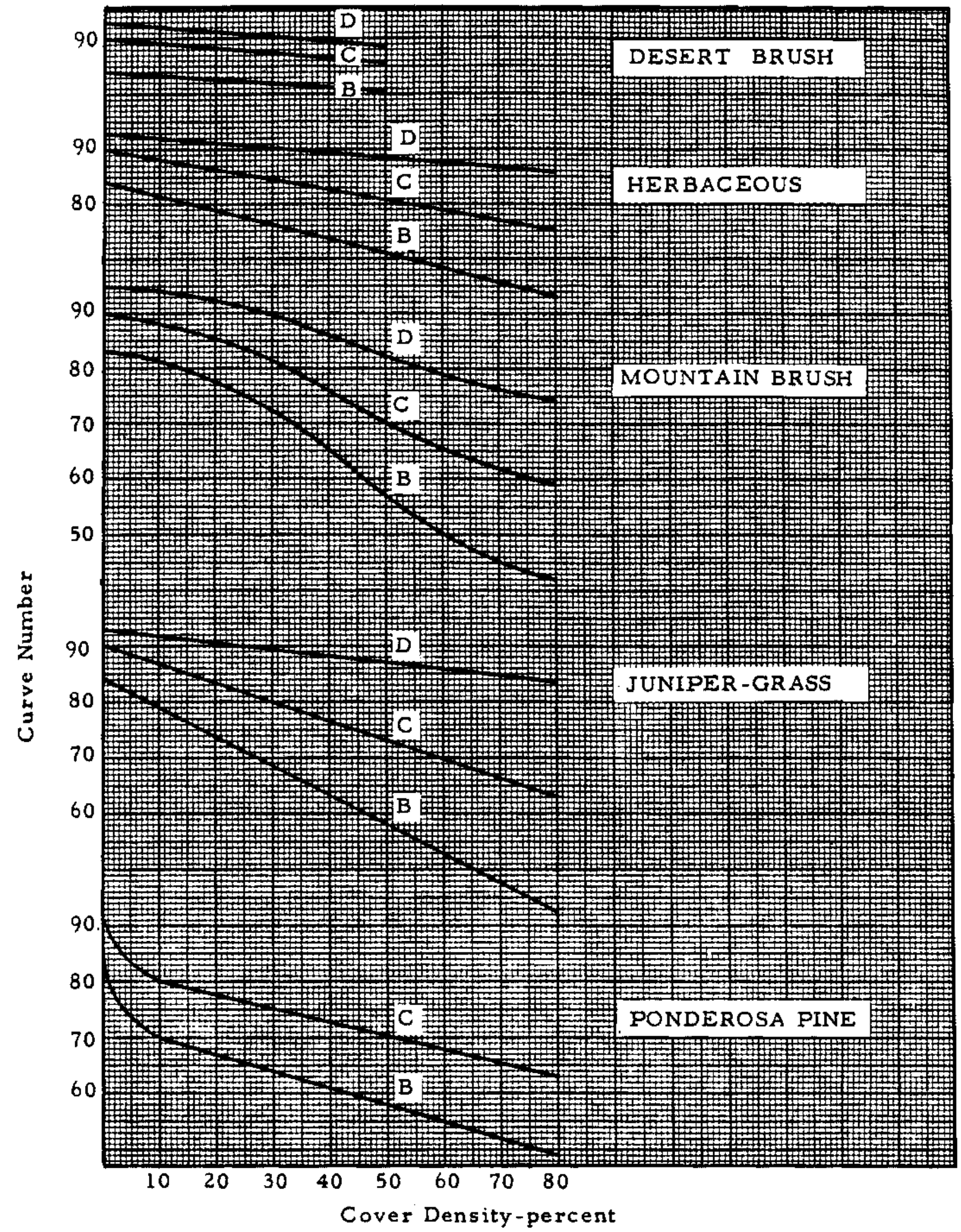
APPENDIX A

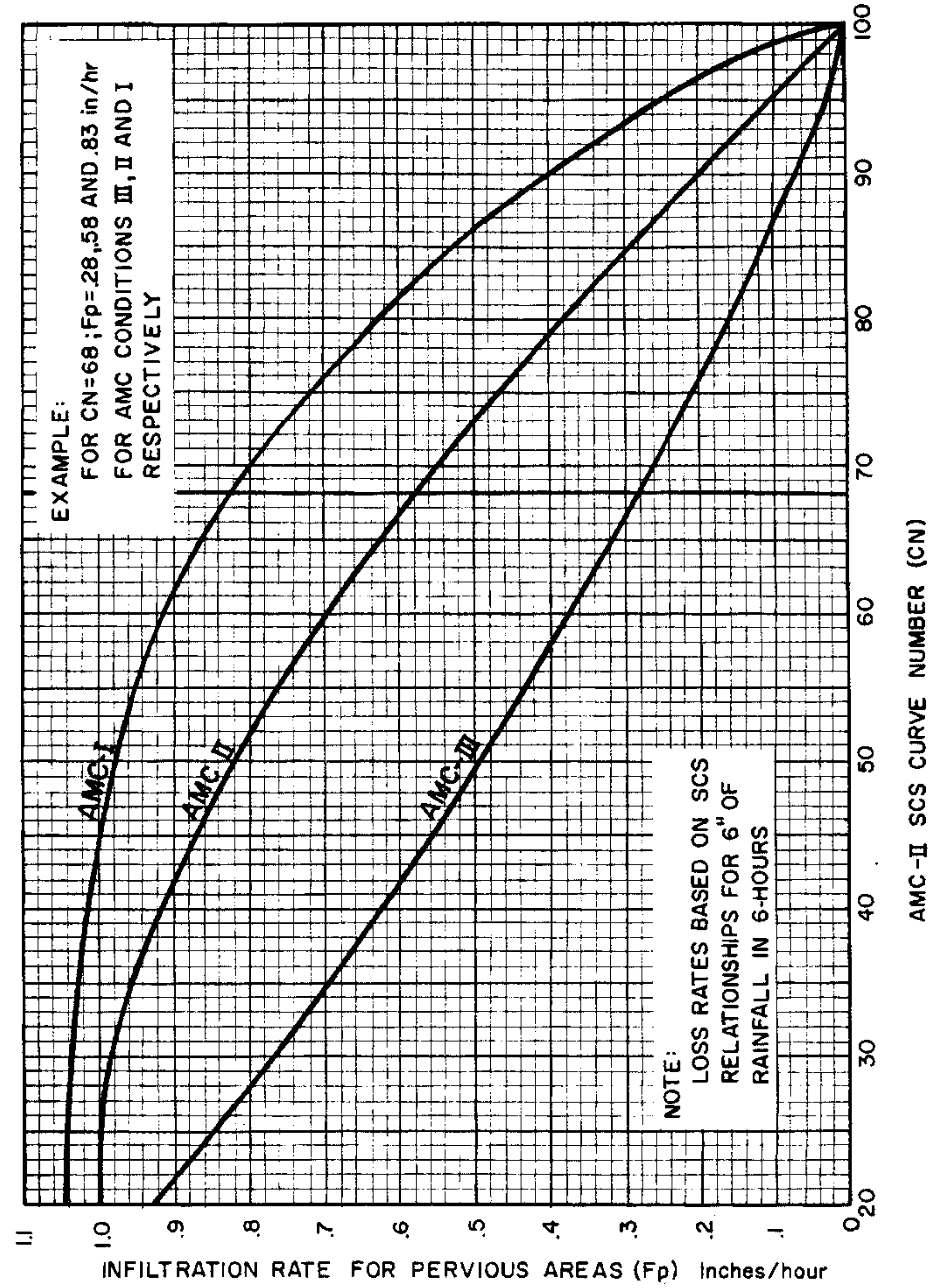
HYDROLOGY



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOIL COVER COMPLEXES AND ASSOCIATED CURVE NUMBERS

Figure C-8



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

FLD-2D Inflow Basin

Hydrologic Parameters

Infiltration Rate (in/hr), Fp, for Pervious Areas versus SCS CN

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****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =    10.00 (inches)

    SOIL-COVER     AREA     PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)  PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
        1         10.00      100.00          60.        0.700        0.490
        2         10.00      100.00          61.        0.686        0.503
        3         10.00      100.00          62.        0.672        0.517
        4         10.00      100.00          63.        0.658        0.530
        5         10.00      100.00          64.        0.644        0.543
        6         10.00      100.00          65.        0.630        0.556
        7         10.00      100.00          66.        0.614        0.570
        8         10.00      100.00          67.        0.598        0.583
        9         10.00      100.00          68.        0.582        0.596
       10         10.00      100.00          69.        0.566        0.609
       11         10.00      100.00          70.        0.550        0.622
       12         10.00      100.00          71.        0.534        0.636
       13         10.00      100.00          72.        0.518        0.649
       14         10.00      100.00          73.        0.502        0.662
       15         10.00      100.00          74.        0.486        0.675
       16         10.00      100.00          75.        0.470        0.688
       17         10.00      100.00          76.        0.452        0.701
       18         10.00      100.00          77.        0.434        0.714
       19         10.00      100.00          78.        0.416        0.726
       20         10.00      100.00          79.        0.398        0.739
       21         10.00      100.00          80.        0.380        0.752

    TOTAL AREA (Acres) =    210.00

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.547

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.378
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          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
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*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =    10.00 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
        1          10.00      100.00           81.        0.362       0.765
        2          10.00      100.00           82.        0.344       0.778
        3          10.00      100.00           83.        0.326       0.790
        4          10.00      100.00           84.        0.308       0.803
        5          10.00      100.00           85.        0.290       0.816
        6          10.00      100.00           86.        0.272       0.828
        7          10.00      100.00           87.        0.254       0.841
        8          10.00      100.00           88.        0.236       0.853
        9          10.00      100.00           89.        0.218       0.866
       10          10.00      100.00           90.        0.200       0.878

    TOTAL AREA (Acres) =    100.00
                                  _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.281
                                        _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.178
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Basin No. 10

L (ft)	46152	Length of longest watercourse
L_{ca} (ft)	23253	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	2480	Elevation difference between headwater and concentration point
n	0.04	Basin Factor
Area (ac)	4383.06	Drainage Are: Soil B = 1610.77; Soil C = 540.80; Soil D = 2231.49

24-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.30	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.17	1.37
3-hr	0.59	0.81	1.00	1.27	1.49	1.73
6-hr	0.72	0.98	1.20	1.51	1.76	2.03
24-hr	1.08	1.48	1.82	2.29	2.67	3.06

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.08	II	B	65	5.38	1.08	0.000	1.000	0.63	0.953	0.49
1.08	II	C	74	3.51	0.70	0.037	0.963	0.486		
1.08	II	D	79	2.66	0.53	0.083	0.917	0.398		
1.48	II	B	65	5.38	1.08	0.020	0.980	0.63	0.895	0.49
1.48	II	C	74	3.51	0.70	0.095	0.905	0.486		
1.48	II	D	79	2.66	0.53	0.169	0.831	0.398		
1.82	II	B	65	5.38	1.08	0.049	0.951	0.63	0.846	0.49
1.82	II	C	74	3.51	0.70	0.148	0.852	0.486		
1.82	II	D	79	2.66	0.53	0.231	0.769	0.398		
2.29	II	B	65	5.38	1.08	0.096	0.904	0.63	0.782	0.49
2.29	II	C	74	3.51	0.70	0.218	0.782	0.486		
2.29	II	D	79	2.66	0.53	0.306	0.694	0.398		
2.67	II	B	69	4.49	0.90	0.187	0.813	0.566	0.679	0.44
2.67	II	C	77	2.99	0.60	0.318	0.682	0.434		
2.67	II	D	82	2.20	0.44	0.419	0.581	0.344		
3.06	II	B	72	3.89	0.78	0.275	0.725	0.518	0.588	0.40
3.06	II	C	79	2.66	0.53	0.402	0.598	0.398		
3.06	II	D	84	1.90	0.38	0.513	0.487	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.30	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.17	1.37
3-hr	0.59	0.81	1.00	1.27	1.49	1.73
6-hr	0.72	0.98	1.20	1.51	1.76	2.03
24-hr	0.73	0.99	1.21	1.52	1.77	2.04

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.73	II	B	70	4.29	0.86	0.000	1.000	0.55	0.977	0.43
0.73	II	C	78	2.82	0.56	0.014	0.986	0.416		
0.73	II	D	82	2.20	0.44	0.041	0.959	0.344		
0.99	II	B	70	4.29	0.86	0.000	1.000	0.55	0.936	0.43
0.99	II	C	78	2.82	0.56	0.061	0.939	0.416		
0.99	II	D	82	2.20	0.44	0.111	0.889	0.344		
1.21	II	B	70	4.29	0.86	0.025	0.975	0.55	0.895	0.43
1.21	II	C	78	2.82	0.56	0.099	0.901	0.416		
1.21	II	D	82	2.20	0.44	0.165	0.835	0.344		
1.52	II	B	70	4.29	0.86	0.059	0.941	0.55	0.838	0.43
1.52	II	C	78	2.82	0.56	0.158	0.842	0.416		
1.52	II	D	82	2.20	0.44	0.237	0.763	0.344		
1.77	II	B	73	3.70	0.74	0.124	0.876	0.502	0.755	0.39
1.77	II	C	80	2.50	0.50	0.243	0.757	0.38		
1.77	II	D	84	1.90	0.38	0.333	0.667	0.308		
2.04	II	B	76	3.16	0.63	0.216	0.784	0.452	0.663	0.35
2.04	II	C	82	2.20	0.44	0.328	0.672	0.344		
2.04	II	D	86	1.63	0.33	0.426	0.574	0.272		

Basin No. 11

L (ft)	24760	Length of longest watercourse
L_{ca} (ft)	12002	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	1891	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	1607.10	Drainage Area: Soil B = 0.00; Soil C = 403.02; Soil D = 1204.08

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.46	0.58	0.76	0.90	1.06
1-hr	0.43	0.62	0.79	1.03	1.22	1.43
3-hr	0.62	0.86	1.06	1.35	1.58	1.83
6-hr	0.77	1.05	1.28	1.62	1.89	2.18
24-hr	1.17	1.61	1.98	2.49	2.90	3.34

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.17	II	B	67	4.93	0.99	0.009	0.991	0.598	0.895	0.403
1.17	II	C	75	3.33	0.67	0.060	0.940	0.47		
1.17	II	D	80	2.50	0.50	0.120	0.880	0.38		
1.61	II	B	67	4.93	0.99	0.043	0.957	0.598	0.809	0.403
1.61	II	C	75	3.33	0.67	0.130	0.870	0.47		
1.61	II	D	80	2.50	0.50	0.211	0.789	0.38		
1.98	II	B	67	4.93	0.99	0.086	0.914	0.598	0.745	0.403
1.98	II	C	75	3.33	0.67	0.187	0.813	0.47		
1.98	II	D	80	2.50	0.50	0.278	0.722	0.38		
2.49	II	B	67	4.93	0.99	0.141	0.859	0.598	0.671	0.403
2.49	II	C	75	3.33	0.67	0.257	0.743	0.47		
2.49	II	D	80	2.50	0.50	0.353	0.647	0.38		
2.90	II	B	70	4.29	0.86	0.228	0.772	0.55	0.573	0.362
2.90	II	C	78	2.82	0.56	0.366	0.634	0.416		
2.90	II	D	82	2.20	0.44	0.448	0.552	0.344		
3.34	II	B	73	3.70	0.74	0.320	0.680	0.502	0.483	0.326
3.34	II	C	80	2.50	0.50	0.452	0.548	0.38		
3.34	II	D	84	1.90	0.38	0.539	0.461	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.46	0.58	0.76	0.90	1.06
1-hr	0.43	0.62	0.79	1.03	1.22	1.43
3-hr	0.62	0.86	1.06	1.35	1.58	1.83
6-hr	0.77	1.05	1.28	1.62	1.89	2.18
24-hr	0.78	1.06	1.29	1.63	1.90	2.19

Basin area-average loss rate

$$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.78	II	B	71	4.08	0.82	0.000	1.000	0.534	0.936	0.349
0.78	II	C	78	2.82	0.56	0.026	0.974	0.416		
0.78	II	D	83	2.05	0.41	0.077	0.923	0.326		
1.06	II	B	71	4.08	0.82	0.009	0.991	0.534	0.868	0.349
1.06	II	C	78	2.82	0.56	0.075	0.925	0.416		
1.06	II	D	83	2.05	0.41	0.151	0.849	0.326		
1.29	II	B	71	4.08	0.82	0.039	0.961	0.534	0.820	0.349
1.29	II	C	78	2.82	0.56	0.116	0.884	0.416		
1.29	II	D	83	2.05	0.41	0.202	0.798	0.326		
1.63	II	B	71	4.08	0.82	0.080	0.920	0.534	0.744	0.349
1.63	II	C	78	2.82	0.56	0.178	0.822	0.416		
1.63	II	D	83	2.05	0.41	0.282	0.718	0.326		
1.90	II	B	74	3.51	0.70	0.163	0.837	0.486	0.641	0.308
1.90	II	C	81	2.35	0.47	0.284	0.716	0.362		
1.90	II	D	85	1.76	0.35	0.384	0.616	0.29		
2.19	II	B	76	3.16	0.63	0.237	0.763	0.452	0.572	0.290
2.19	II	C	82	2.20	0.44	0.356	0.644	0.344		
2.19	II	D	86	1.63	0.33	0.452	0.548	0.272		

Basin No. 12

L (ft)	15976	Length of longest watercourse
L_{ca} (ft)	6213	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	1744	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	916.70	Drainage Area: Soil B = 0.02; Soil C = 233.07; Soil D = 683.61

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.57	0.74	0.89	1.04
1-hr	0.42	0.61	0.77	1.00	1.19	1.40
3-hr	0.60	0.83	1.03	1.31	1.53	1.78
6-hr	0.74	1.01	1.23	1.56	1.82	2.09
24-hr	1.12	1.53	1.88	2.37	2.77	3.18

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.12	II	B	66	5.15	1.03	0.000	1.000	0.614	0.911	0.407
1.12	II	C	74	3.51	0.70	0.036	0.964	0.486		
1.12	II	D	80	2.50	0.50	0.107	0.893	0.38		
1.53	II	B	66	5.15	1.03	0.026	0.974	0.614	0.827	0.407
1.53	II	C	74	3.51	0.70	0.105	0.895	0.486		
1.53	II	D	80	2.50	0.50	0.196	0.804	0.38		
1.88	II	B	66	5.15	1.03	0.064	0.936	0.614	0.765	0.407
1.88	II	C	74	3.51	0.70	0.160	0.840	0.486		
1.88	II	D	80	2.50	0.50	0.261	0.739	0.38		
2.37	II	B	66	5.15	1.03	0.118	0.882	0.614	0.690	0.407
2.37	II	C	74	3.51	0.70	0.228	0.772	0.486		
2.37	II	D	80	2.50	0.50	0.338	0.662	0.38		
2.77	II	B	69	4.49	0.90	0.199	0.801	0.566	0.593	0.367
2.77	II	C	77	2.99	0.60	0.329	0.671	0.434		
2.77	II	D	82	2.20	0.44	0.433	0.567	0.344		
3.18	II	B	72	3.89	0.78	0.289	0.711	0.518	0.503	0.331
3.18	II	C	79	2.66	0.53	0.415	0.585	0.398		
3.18	II	D	84	1.90	0.38	0.525	0.475	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.57	0.74	0.89	1.04
1-hr	0.42	0.61	0.77	1.00	1.19	1.40
3-hr	0.60	0.83	1.03	1.31	1.53	1.78
6-hr	0.74	1.01	1.23	1.56	1.82	2.09
24-hr	0.75	1.02	1.24	1.57	1.83	2.10

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.75	II	B	71	4.08	0.82	0.000	1.000	0.534	0.957	0.362
0.75	II	C	78	2.82	0.56	0.013	0.987	0.416		
0.75	II	D	82	2.20	0.44	0.053	0.947	0.344		
1.02	II	B	71	4.08	0.82	0.010	0.990	0.534	0.897	0.362
1.02	II	C	78	2.82	0.56	0.059	0.941	0.416		
1.02	II	D	82	2.20	0.44	0.118	0.882	0.344		
1.24	II	B	71	4.08	0.82	0.032	0.968	0.534	0.847	0.362
1.24	II	C	78	2.82	0.56	0.105	0.895	0.416		
1.24	II	D	82	2.20	0.44	0.169	0.831	0.344		
1.57	II	B	71	4.08	0.82	0.076	0.924	0.534	0.776	0.362
1.57	II	C	78	2.82	0.56	0.172	0.828	0.416		
1.57	II	D	82	2.20	0.44	0.242	0.758	0.344		
1.83	II	B	74	3.51	0.70	0.153	0.847	0.486	0.680	0.326
1.83	II	C	80	2.50	0.50	0.251	0.749	0.38		
1.83	II	D	84	1.90	0.38	0.344	0.656	0.308		
2.10	II	B	76	3.16	0.63	0.224	0.776	0.452	0.587	0.290
2.10	II	C	82	2.20	0.44	0.338	0.662	0.344		
2.10	II	D	86	1.63	0.33	0.438	0.562	0.272		

Basin No. 13

L (ft)	12171	Length of longest watercourse
L_{ca} (ft)	4447	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	1396	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	587.11	Drainage Area: Soil B = 0.73; Soil C = 316.77; Soil D = 269.61

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.31	0.36	0.43
30-m	0.31	0.45	0.57	0.74	0.88	1.03
1-hr	0.41	0.60	0.76	0.99	1.18	1.38
3-hr	0.59	0.82	1.01	1.29	1.51	1.75
6-hr	0.73	0.99	1.21	1.53	1.79	2.06
24-hr	1.09	1.50	1.84	2.32	2.70	3.10

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.09	II	B	66	5.15	1.03	0.000	1.000	0.614	0.934	0.437
1.09	II	C	74	3.51	0.70	0.037	0.963	0.486		
1.09	II	D	80	2.50	0.50	0.101	0.899	0.38		
1.50	II	B	66	5.15	1.03	0.027	0.973	0.614	0.857	0.437
1.50	II	C	74	3.51	0.70	0.100	0.900	0.486		
1.50	II	D	80	2.50	0.50	0.193	0.807	0.38		
1.84	II	B	66	5.15	1.03	0.060	0.940	0.614	0.801	0.437
1.84	II	C	74	3.51	0.70	0.152	0.848	0.486		
1.84	II	D	80	2.50	0.50	0.255	0.745	0.38		
2.32	II	B	66	5.15	1.03	0.112	0.888	0.614	0.729	0.437
2.32	II	C	74	3.51	0.70	0.220	0.780	0.486		
2.32	II	D	80	2.50	0.50	0.332	0.668	0.38		
2.70	II	B	69	4.49	0.90	0.189	0.811	0.566	0.630	0.393
2.70	II	C	77	2.99	0.60	0.322	0.678	0.434		
2.70	II	D	82	2.20	0.44	0.426	0.574	0.344		
3.10	II	B	72	3.89	0.78	0.281	0.719	0.518	0.544	0.357
3.10	II	C	79	2.66	0.53	0.406	0.594	0.398		
3.10	II	D	84	1.90	0.38	0.516	0.484	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.31	0.36	0.43
30-m	0.31	0.45	0.57	0.74	0.88	1.03
1-hr	0.41	0.60	0.76	0.99	1.18	1.38
3-hr	0.59	0.82	1.01	1.29	1.51	1.75
6-hr	0.73	0.99	1.21	1.53	1.79	2.06
24-hr	0.74	1.00	1.22	1.54	1.80	2.07

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.74	II	B	70	4.29	0.86	0.000	1.000	0.55	0.968	0.383
0.74	II	C	78	2.82	0.56	0.014	0.986	0.416		
0.74	II	D	82	2.20	0.44	0.054	0.946	0.344		
1.00	II	B	70	4.29	0.86	0.000	1.000	0.55	0.917	0.383
1.00	II	C	78	2.82	0.56	0.060	0.940	0.416		
1.00	II	D	82	2.20	0.44	0.110	0.890	0.344		
1.22	II	B	70	4.29	0.86	0.025	0.975	0.55	0.867	0.383
1.22	II	C	78	2.82	0.56	0.107	0.893	0.416		
1.22	II	D	82	2.20	0.44	0.164	0.836	0.344		
1.54	II	B	70	4.29	0.86	0.058	0.942	0.55	0.802	0.383
1.54	II	C	78	2.82	0.56	0.162	0.838	0.416		
1.54	II	D	82	2.20	0.44	0.240	0.760	0.344		
1.80	II	B	74	3.51	0.70	0.144	0.856	0.486	0.712	0.347
1.80	II	C	80	2.50	0.50	0.244	0.756	0.38		
1.80	II	D	84	1.90	0.38	0.339	0.661	0.308		
2.07	II	B	76	3.16	0.63	0.217	0.783	0.452	0.620	0.311
2.07	II	C	82	2.20	0.44	0.333	0.667	0.344		
2.07	II	D	86	1.63	0.33	0.435	0.565	0.272		

Basin No. 14

L (ft)	14101	Length of longest watercourse
L_{ca} (ft)	6749	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	1442	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	662.32	Drainage Area: Soil B = 14.01; Soil C = 359.25; Soil D = 289.06

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.57	0.75	0.89	1.04
1-hr	0.42	0.61	0.77	1.01	1.20	1.41
3-hr	0.60	0.83	1.03	1.31	1.54	1.79
6-hr	0.74	1.01	1.24	1.57	1.83	2.11
24-hr	1.11	1.53	1.88	2.37	2.77	3.18

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.11	II	B	66	5.15	1.03	0.000	1.000	0.614	0.928	0.434
1.11	II	C	75	3.33	0.67	0.045	0.955	0.47		
1.11	II	D	80	2.50	0.50	0.108	0.892	0.38		
1.53	II	B	66	5.15	1.03	0.026	0.974	0.614	0.850	0.434
1.53	II	C	75	3.33	0.67	0.118	0.882	0.47		
1.53	II	D	80	2.50	0.50	0.196	0.804	0.38		
1.88	II	B	66	5.15	1.03	0.064	0.936	0.614	0.793	0.434
1.88	II	C	75	3.33	0.67	0.170	0.830	0.47		
1.88	II	D	80	2.50	0.50	0.261	0.739	0.38		
2.37	II	B	66	5.15	1.03	0.118	0.882	0.614	0.719	0.434
2.37	II	C	75	3.33	0.67	0.241	0.759	0.47		
2.37	II	D	80	2.50	0.50	0.338	0.662	0.38		
2.77	II	B	70	4.29	0.86	0.213	0.787	0.55	0.628	0.397
2.77	II	C	77	2.99	0.60	0.329	0.671	0.434		
2.77	II	D	82	2.20	0.44	0.433	0.567	0.344		
3.18	II	B	72	3.89	0.78	0.289	0.711	0.518	0.528	0.351
3.18	II	C	80	2.50	0.50	0.437	0.563	0.38		
3.18	II	D	84	1.90	0.38	0.525	0.475	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.57	0.75	0.89	1.04
1-hr	0.42	0.61	0.77	1.01	1.20	1.41
3-hr	0.60	0.83	1.03	1.31	1.54	1.79
6-hr	0.74	1.01	1.24	1.57	1.83	2.11
24-hr	0.75	1.02	1.25	1.58	1.84	2.12

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.75	II	B	71	4.08	0.82	0.000	1.000	0.534	0.964	0.379
0.75	II	C	78	2.82	0.56	0.013	0.987	0.416		
0.75	II	D	83	2.05	0.41	0.067	0.933	0.326		
1.02	II	B	71	4.08	0.82	0.010	0.990	0.534	0.908	0.379
1.02	II	C	78	2.82	0.56	0.059	0.941	0.416		
1.02	II	D	83	2.05	0.41	0.137	0.863	0.326		
1.25	II	B	71	4.08	0.82	0.032	0.968	0.534	0.855	0.379
1.25	II	C	78	2.82	0.56	0.112	0.888	0.416		
1.25	II	D	83	2.05	0.41	0.192	0.808	0.326		
1.58	II	B	71	4.08	0.82	0.076	0.924	0.534	0.787	0.379
1.58	II	C	78	2.82	0.56	0.171	0.829	0.416		
1.58	II	D	83	2.05	0.41	0.272	0.728	0.326		
1.84	II	B	74	3.51	0.70	0.152	0.848	0.486	0.709	0.351
1.84	II	C	80	2.50	0.50	0.255	0.745	0.38		
1.84	II	D	84	1.90	0.38	0.342	0.658	0.308		
2.12	II	B	76	3.16	0.63	0.226	0.774	0.452	0.615	0.315
2.12	II	C	82	2.20	0.44	0.344	0.656	0.344		
2.12	II	D	86	1.63	0.33	0.443	0.557	0.272		

Basin No. 15

L (ft)	18598	Length of longest watercourse
L_{ca} (ft)	9293	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	1796	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	1222.68	Drainage Area: Soil B = 0.00; Soil C = 531.26; Soil D = 691.42

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.44
30-m	0.32	0.46	0.58	0.76	0.91	1.06
1-hr	0.43	0.62	0.79	1.03	1.23	1.44
3-hr	0.62	0.86	1.06	1.35	1.59	1.84
6-hr	0.76	1.04	1.28	1.62	1.89	2.18
24-hr	1.16	1.59	1.96	2.47	2.88	3.32

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise $Y = 0$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.16	II	B	67	4.93	0.99	0.009	0.991	0.598	0.909	0.419
1.16	II	C	75	3.33	0.67	0.052	0.948	0.47		
1.16	II	D	80	2.50	0.50	0.121	0.879	0.38		
1.59	II	B	67	4.93	0.99	0.044	0.956	0.598	0.828	0.419
1.59	II	C	75	3.33	0.67	0.126	0.874	0.47		
1.59	II	D	80	2.50	0.50	0.208	0.792	0.38		
1.96	II	B	67	4.93	0.99	0.082	0.918	0.598	0.764	0.419
1.96	II	C	75	3.33	0.67	0.184	0.816	0.47		
1.96	II	D	80	2.50	0.50	0.276	0.724	0.38		
2.47	II	B	67	4.93	0.99	0.138	0.862	0.598	0.690	0.419
2.47	II	C	75	3.33	0.67	0.255	0.745	0.47		
2.47	II	D	80	2.50	0.50	0.352	0.648	0.38		
2.88	II	B	70	4.29	0.86	0.226	0.774	0.55	0.590	0.375
2.88	II	C	78	2.82	0.56	0.365	0.635	0.416		
2.88	II	D	82	2.20	0.44	0.444	0.556	0.344		
3.32	II	B	73	3.70	0.74	0.319	0.681	0.502	0.500	0.339
3.32	II	C	80	2.50	0.50	0.449	0.551	0.38		
3.32	II	D	84	1.90	0.38	0.539	0.461	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.44
30-m	0.32	0.46	0.58	0.76	0.91	1.06
1-hr	0.43	0.62	0.79	1.03	1.23	1.44
3-hr	0.62	0.86	1.06	1.35	1.59	1.84
6-hr	0.76	1.04	1.28	1.62	1.89	2.18
24-hr	0.77	1.05	1.29	1.63	1.90	2.19

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.77	II	B	71	4.08	0.82	0.000	1.000	0.534	0.958	0.365
0.77	II	C	78	2.82	0.56	0.013	0.987	0.416		
0.77	II	D	83	2.05	0.41	0.065	0.935	0.326		
1.05	II	B	71	4.08	0.82	0.010	0.990	0.534	0.890	0.365
1.05	II	C	78	2.82	0.56	0.067	0.933	0.416		
1.05	II	D	83	2.05	0.41	0.143	0.857	0.326		
1.29	II	B	71	4.08	0.82	0.039	0.961	0.534	0.835	0.365
1.29	II	C	78	2.82	0.56	0.116	0.884	0.416		
1.29	II	D	83	2.05	0.41	0.202	0.798	0.326		
1.63	II	B	71	4.08	0.82	0.080	0.920	0.534	0.763	0.365
1.63	II	C	78	2.82	0.56	0.178	0.822	0.416		
1.63	II	D	83	2.05	0.41	0.282	0.718	0.326		
1.90	II	B	74	3.51	0.70	0.163	0.837	0.486	0.659	0.321
1.90	II	C	81	2.35	0.47	0.284	0.716	0.362		
1.90	II	D	85	1.76	0.35	0.384	0.616	0.29		
2.19	II	B	76	3.16	0.63	0.237	0.763	0.452	0.590	0.303
2.19	II	C	82	2.20	0.44	0.356	0.644	0.344		
2.19	II	D	86	1.63	0.33	0.452	0.548	0.272		

Basin No. 16

L (ft)	24690	Length of longest watercourse
L_{ca} (ft)	11257	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	2001	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	2628.92	Drainage Area: Soil B = 0.00; Soil C = 839.29; Soil D = 1789.64

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.44
30-m	0.32	0.46	0.59	0.77	0.91	1.07
1-hr	0.43	0.63	0.80	1.04	1.24	1.45
3-hr	0.63	0.87	1.07	1.37	1.61	1.86
6-hr	0.77	1.06	1.30	1.64	1.92	2.21
24-hr	1.18	1.63	2.00	2.53	2.95	3.39

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$ for (P - Ia)>0; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.18	II	B	67	4.93	0.99	0.008	0.992	0.598	0.895	0.409
1.18	II	C	75	3.33	0.67	0.059	0.941	0.47		
1.18	II	D	80	2.50	0.50	0.127	0.873	0.38		
1.63	II	B	67	4.93	0.99	0.043	0.957	0.598	0.812	0.409
1.63	II	C	75	3.33	0.67	0.129	0.871	0.47		
1.63	II	D	80	2.50	0.50	0.215	0.785	0.38		
2.00	II	B	67	4.93	0.99	0.085	0.915	0.598	0.749	0.409
2.00	II	C	75	3.33	0.67	0.190	0.810	0.47		
2.00	II	D	80	2.50	0.50	0.280	0.720	0.38		
2.53	II	B	67	4.93	0.99	0.146	0.854	0.598	0.670	0.409
2.53	II	C	75	3.33	0.67	0.265	0.735	0.47		
2.53	II	D	80	2.50	0.50	0.360	0.640	0.38		
2.95	II	B	70	4.29	0.86	0.231	0.769	0.55	0.572	0.367
2.95	II	C	78	2.82	0.56	0.373	0.627	0.416		
2.95	II	D	82	2.20	0.44	0.454	0.546	0.344		
3.39	II	B	73	3.70	0.74	0.327	0.673	0.502	0.482	0.331
3.39	II	C	80	2.50	0.50	0.457	0.543	0.38		
3.39	II	D	84	1.90	0.38	0.546	0.454	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.44
30-m	0.32	0.46	0.59	0.77	0.91	1.07
1-hr	0.43	0.63	0.80	1.04	1.24	1.45
3-hr	0.63	0.87	1.07	1.37	1.61	1.86
6-hr	0.77	1.06	1.30	1.64	1.92	2.21
24-hr	0.78	1.07	1.31	1.65	1.93	2.22

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S] * P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.78	II	B	71	4.08	0.82	0.000	1.000	0.534	0.939	0.355
0.78	II	C	78	2.82	0.56	0.026	0.974	0.416		
0.78	II	D	83	2.05	0.41	0.077	0.923	0.326		
1.07	II	B	71	4.08	0.82	0.009	0.991	0.534	0.874	0.355
1.07	II	C	78	2.82	0.56	0.075	0.925	0.416		
1.07	II	D	83	2.05	0.41	0.150	0.850	0.326		
1.31	II	B	71	4.08	0.82	0.038	0.962	0.534	0.821	0.355
1.31	II	C	78	2.82	0.56	0.122	0.878	0.416		
1.31	II	D	83	2.05	0.41	0.206	0.794	0.326		
1.65	II	B	71	4.08	0.82	0.085	0.915	0.534	0.748	0.355
1.65	II	C	78	2.82	0.56	0.182	0.818	0.416		
1.65	II	D	83	2.05	0.41	0.285	0.715	0.326		
1.93	II	B	74	3.51	0.70	0.166	0.834	0.486	0.643	0.313
1.93	II	C	81	2.35	0.47	0.290	0.710	0.362		
1.93	II	D	85	1.76	0.35	0.389	0.611	0.29		
2.22	II	B	77	2.99	0.60	0.257	0.743	0.434	0.568	0.289
2.22	II	C	83	2.05	0.41	0.383	0.617	0.326		
2.22	II	D	86	1.63	0.33	0.455	0.545	0.272		

Basin No. 17

L (ft)	12652	Length of longest watercourse
L_{ca} (ft)	5216	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	1323	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	985.12	Drainage Area: Soil B = 31.33; Soil C = 300.03; Soil D = 653.76

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.58	0.75	0.89	1.05
1-hr	0.42	0.61	0.77	1.01	1.20	1.41
3-hr	0.61	0.84	1.04	1.32	1.55	1.80
6-hr	0.74	1.01	1.24	1.57	1.84	2.12
24-hr	1.12	1.55	1.91	2.42	2.82	3.24

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.12	II	B	66	5.15	1.03	0.00	0.000	1.000	0.614	0.915
1.12	II	C	75	3.33	0.67	1.25	0.045	0.955	0.47	
1.12	II	D	80	2.50	0.50	6.54	0.107	0.893	0.38	
1.55	II	B	66	5.15	1.03	0.13	0.032	0.968	0.614	0.831
1.55	II	C	75	3.33	0.67	4.50	0.116	0.884	0.47	
1.55	II	D	80	2.50	0.50	16.89	0.200	0.800	0.38	
1.91	II	B	66	5.15	1.03	0.34	0.068	0.932	0.614	0.766
1.91	II	C	75	3.33	0.67	8.50	0.178	0.822	0.47	
1.91	II	D	80	2.50	0.50	27.78	0.267	0.733	0.38	
2.42	II	B	66	5.15	1.03	0.78	0.124	0.876	0.614	0.693
2.42	II	C	75	3.33	0.67	15.00	0.248	0.752	0.47	
2.42	II	D	80	2.50	0.50	45.22	0.343	0.657	0.38	
2.82	II	B	70	4.29	0.86	1.59	0.216	0.784	0.55	0.598
2.82	II	C	77	2.99	0.60	23.75	0.337	0.663	0.434	
2.82	II	D	82	2.20	0.44	67.56	0.440	0.560	0.344	
3.24	II	B	72	3.89	0.78	2.48	0.293	0.707	0.518	0.504
3.24	II	C	80	2.50	0.50	35.75	0.441	0.559	0.38	
3.24	II	D	84	1.90	0.38	93.71	0.531	0.469	0.308	

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.19	0.24	0.31	0.37	0.43
30-m	0.31	0.45	0.58	0.75	0.89	1.05
1-hr	0.42	0.61	0.77	1.01	1.20	1.41
3-hr	0.61	0.84	1.04	1.32	1.55	1.80
6-hr	0.74	1.01	1.24	1.57	1.84	2.12
24-hr	0.75	1.02	1.25	1.58	1.85	2.13

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.75	II	B	71	4.08	0.82	0.000	1.000	0.534	0.952	0.360
0.75	II	C	78	2.82	0.56	0.013	0.987	0.416		
0.75	II	D	83	2.05	0.41	0.067	0.933	0.326		
1.02	II	B	71	4.08	0.82	0.010	0.990	0.534	0.891	0.360
1.02	II	C	78	2.82	0.56	0.059	0.941	0.416		
1.02	II	D	83	2.05	0.41	0.137	0.863	0.326		
1.25	II	B	71	4.08	0.82	0.032	0.968	0.534	0.837	0.360
1.25	II	C	78	2.82	0.56	0.112	0.888	0.416		
1.25	II	D	83	2.05	0.41	0.192	0.808	0.326		
1.58	II	B	71	4.08	0.82	0.076	0.924	0.534	0.765	0.360
1.58	II	C	78	2.82	0.56	0.171	0.829	0.416		
1.58	II	D	83	2.05	0.41	0.272	0.728	0.326		
1.85	II	B	74	3.51	0.70	0.151	0.849	0.486	0.688	0.336
1.85	II	C	80	2.50	0.50	0.254	0.746	0.38		
1.85	II	D	84	1.90	0.38	0.346	0.654	0.308		
2.13	II	B	76	3.16	0.63	0.225	0.775	0.452	0.596	0.300
2.13	II	C	82	2.20	0.44	0.343	0.657	0.344		
2.13	II	D	86	1.63	0.33	0.441	0.559	0.272		

Basin No. 18

L (ft)	25691	Length of longest watercourse
L_{ca} (ft)	12278	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	847	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	3323.86	Drainage Area: Soil B = 2486.39; Soil C = 51.43; Soil D = 786.04

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.31	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.17	1.37
3-hr	0.59	0.81	1.00	1.28	1.50	1.74
6-hr	0.72	0.97	1.20	1.51	1.77	2.04
24-hr	1.07	1.48	1.83	2.31	2.70	3.11

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise $Y = 0$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.07	II	B	65	5.38	1.08	0.000	1.000	0.63	0.980	0.573
1.07	II	C	74	3.51	0.70	0.037	0.963	0.486		
1.07	II	D	79	2.66	0.53	0.084	0.916	0.398		
1.48	II	B	65	5.38	1.08	0.020	0.980	0.63	0.944	0.573
1.48	II	C	74	3.51	0.70	0.095	0.905	0.486		
1.48	II	D	79	2.66	0.53	0.169	0.831	0.398		
1.83	II	B	65	5.38	1.08	0.049	0.951	0.63	0.905	0.573
1.83	II	C	74	3.51	0.70	0.153	0.847	0.486		
1.83	II	D	79	2.66	0.53	0.235	0.765	0.398		
2.31	II	B	65	5.38	1.08	0.100	0.900	0.63	0.849	0.573
2.31	II	C	74	3.51	0.70	0.221	0.779	0.486		
2.31	II	D	79	2.66	0.53	0.307	0.693	0.398		
2.70	II	B	69	4.49	0.90	0.189	0.811	0.566	0.753	0.511
2.70	II	C	77	2.99	0.60	0.322	0.678	0.434		
2.70	II	D	82	2.20	0.44	0.426	0.574	0.344		
3.11	II	B	72	3.89	0.78	0.280	0.720	0.518	0.662	0.466
3.11	II	C	79	2.66	0.53	0.408	0.592	0.398		
3.11	II	D	84	1.90	0.38	0.518	0.482	0.308		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.31	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.17	1.37
3-hr	0.59	0.81	1.00	1.28	1.50	1.74
6-hr	0.72	0.97	1.20	1.51	1.77	2.04
24-hr	0.73	0.98	1.21	1.52	1.78	2.05

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.73	II	B	70	4.29	0.86	0.000	1.000	0.55	0.990	0.499
0.73	II	C	78	2.82	0.56	0.014	0.986	0.416		
0.73	II	D	82	2.20	0.44	0.041	0.959	0.344		
0.98	II	B	70	4.29	0.86	0.000	1.000	0.55	0.973	0.499
0.98	II	C	78	2.82	0.56	0.051	0.949	0.416		
0.98	II	D	82	2.20	0.44	0.112	0.888	0.344		
1.21	II	B	70	4.29	0.86	0.025	0.975	0.55	0.941	0.499
1.21	II	C	78	2.82	0.56	0.099	0.901	0.416		
1.21	II	D	82	2.20	0.44	0.165	0.835	0.344		
1.52	II	B	70	4.29	0.86	0.059	0.941	0.55	0.897	0.499
1.52	II	C	78	2.82	0.56	0.158	0.842	0.416		
1.52	II	D	82	2.20	0.44	0.237	0.763	0.344		
1.78	II	B	73	3.70	0.74	0.129	0.871	0.502	0.821	0.454
1.78	II	C	80	2.50	0.50	0.242	0.758	0.38		
1.78	II	D	84	1.90	0.38	0.331	0.669	0.308		
2.05	II	B	76	3.16	0.63	0.215	0.785	0.452	0.733	0.408
2.05	II	C	82	2.20	0.44	0.332	0.668	0.344		
2.05	II	D	86	1.63	0.33	0.429	0.571	0.272		

Basin No. 19

L (ft)	26152	Length of longest watercourse
L_{ca} (ft)	11262	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	1164	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	2746.91	Drainage Area: Soil B = 2297.02; Soil C = 5.45; Soil D = 444.44

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.31	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.16	1.36
3-hr	0.59	0.81	1.00	1.27	1.49	1.73
6-hr	0.71	0.97	1.19	1.51	1.76	2.03
24-hr	1.06	1.47	1.82	2.30	2.69	3.09

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	SCS CN	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.06	II	B	65	5.38	1.08	0.000	1.000	0.63	0.986	0.592
1.06	II	C	74	3.51	0.70	0.028	0.972	0.486		
1.06	II	D	79	2.66	0.53	0.085	0.915	0.398		
1.47	II	B	65	5.38	1.08	0.020	0.980	0.63	0.956	0.592
1.47	II	C	74	3.51	0.70	0.095	0.905	0.486		
1.47	II	D	79	2.66	0.53	0.170	0.830	0.398		
1.82	II	B	65	5.38	1.08	0.049	0.951	0.63	0.921	0.592
1.82	II	C	74	3.51	0.70	0.148	0.852	0.486		
1.82	II	D	79	2.66	0.53	0.231	0.769	0.398		
2.30	II	B	65	5.38	1.08	0.100	0.900	0.63	0.866	0.592
2.30	II	C	74	3.51	0.70	0.217	0.783	0.486		
2.30	II	D	79	2.66	0.53	0.309	0.691	0.398		
2.69	II	B	69	4.49	0.90	0.190	0.810	0.566	0.772	0.530
2.69	II	C	77	2.99	0.60	0.320	0.680	0.434		
2.69	II	D	82	2.20	0.44	0.424	0.576	0.344		
3.09	II	B	72	3.89	0.78	0.278	0.722	0.518	0.687	0.487
3.09	II	C	79	2.66	0.53	0.408	0.592	0.398		
3.09	II	D	83	2.05	0.41	0.492	0.508	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.31	0.44	0.56	0.73	0.87	1.02
1-hr	0.41	0.59	0.75	0.98	1.16	1.36
3-hr	0.59	0.81	1.00	1.27	1.49	1.73
6-hr	0.71	0.97	1.19	1.51	1.76	2.03
24-hr	0.72	0.98	1.20	1.52	1.77	2.04

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.72	II	B	70	4.29	0.86	0.000	1.000	0.55	0.993	0.516
0.72	II	C	78	2.82	0.56	0.014	0.986	0.416		
0.72	II	D	82	2.20	0.44	0.042	0.958	0.344		
0.98	II	B	70	4.29	0.86	0.000	1.000	0.55	0.982	0.516
0.98	II	C	78	2.82	0.56	0.051	0.949	0.416		
0.98	II	D	82	2.20	0.44	0.112	0.888	0.344		
1.20	II	B	70	4.29	0.86	0.017	0.983	0.55	0.959	0.516
1.20	II	C	78	2.82	0.56	0.100	0.900	0.416		
1.20	II	D	82	2.20	0.44	0.167	0.833	0.344		
1.52	II	B	70	4.29	0.86	0.059	0.941	0.55	0.912	0.516
1.52	II	C	78	2.82	0.56	0.158	0.842	0.416		
1.52	II	D	82	2.20	0.44	0.237	0.763	0.344		
1.77	II	B	73	3.70	0.74	0.124	0.876	0.502	0.842	0.470
1.77	II	C	80	2.50	0.50	0.243	0.757	0.38		
1.77	II	D	84	1.90	0.38	0.333	0.667	0.308		
2.04	II	B	76	3.16	0.63	0.216	0.784	0.452	0.750	0.423
2.04	II	C	82	2.20	0.44	0.328	0.672	0.344		
2.04	II	D	86	1.63	0.33	0.426	0.574	0.272		

Basin No. 20

L (ft)	8968	Length of longest watercourse
L_{ca} (ft)	4340	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	182	Elevation difference between headwater and concentration point
n	0.05	Basin Factor
Area (ac)	872.65	Drainage Area: Soil B = 0.00; Soil C = 870.50; Soil D = 2.15

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.30	0.44	0.55	0.72	0.86	1.00
1-hr	0.40	0.58	0.74	0.96	1.14	1.34
3-hr	0.57	0.79	0.97	1.24	1.46	1.69
6-hr	0.69	0.94	1.16	1.46	1.71	1.97
24-hr	1.02	1.42	1.75	2.22	2.59	2.98

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
1.02	II	B	65	5.38	1.08	0.000	1.000	0.63	0.971	0.486
1.02	II	C	74	3.51	0.70	0.029	0.971	0.486		
1.02	II	D	79	2.66	0.53	0.078	0.922	0.398		
1.42	II	B	65	5.38	1.08	0.014	0.986	0.63	0.915	0.486
1.42	II	C	74	3.51	0.70	0.085	0.915	0.486		
1.42	II	D	79	2.66	0.53	0.155	0.845	0.398		
1.75	II	B	65	5.38	1.08	0.040	0.960	0.63	0.863	0.486
1.75	II	C	74	3.51	0.70	0.137	0.863	0.486		
1.75	II	D	79	2.66	0.53	0.217	0.783	0.398		
2.22	II	B	65	5.38	1.08	0.090	0.910	0.63	0.793	0.486
2.22	II	C	74	3.51	0.70	0.207	0.793	0.486		
2.22	II	D	79	2.66	0.53	0.297	0.703	0.398		
2.59	II	B	69	4.49	0.90	0.178	0.822	0.566	0.695	0.434
2.59	II	C	77	2.99	0.60	0.305	0.695	0.434		
2.59	II	D	81	2.35	0.47	0.390	0.610	0.362		
2.98	II	B	72	3.89	0.78	0.265	0.735	0.518	0.604	0.398
2.98	II	C	79	2.66	0.53	0.396	0.604	0.398		
2.98	II	D	83	2.05	0.41	0.480	0.520	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.13	0.18	0.23	0.30	0.36	0.42
30-m	0.30	0.44	0.55	0.72	0.86	1.00
1-hr	0.40	0.58	0.74	0.96	1.14	1.34
3-hr	0.57	0.79	0.97	1.24	1.46	1.69
6-hr	0.69	0.94	1.16	1.46	1.71	1.97
24-hr	0.70	0.95	1.17	1.47	1.72	1.98

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.70	II	B	70	4.29	0.86	0.000	1.000	0.55	1.000	0.434
0.70	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.70	II	D	82	2.20	0.44	0.043	0.957	0.344		
0.95	II	B	70	4.29	0.86	0.000	1.000	0.55	0.958	0.434
0.95	II	C	77	2.99	0.60	0.042	0.958	0.434		
0.95	II	D	82	2.20	0.44	0.105	0.895	0.344		
1.17	II	B	70	4.29	0.86	0.017	0.983	0.55	0.923	0.434
1.17	II	C	77	2.99	0.60	0.077	0.923	0.434		
1.17	II	D	82	2.20	0.44	0.154	0.846	0.344		
1.47	II	B	70	4.29	0.86	0.054	0.946	0.55	0.864	0.434
1.47	II	C	77	2.99	0.60	0.136	0.864	0.434		
1.47	II	D	82	2.20	0.44	0.224	0.776	0.344		
1.72	II	B	73	3.70	0.74	0.122	0.878	0.502	0.767	0.380
1.72	II	C	80	2.50	0.50	0.233	0.767	0.38		
1.72	II	D	84	1.90	0.38	0.320	0.680	0.308		
1.98	II	B	75	3.33	0.67	0.187	0.813	0.47	0.682	0.344
1.98	II	C	82	2.20	0.44	0.318	0.682	0.344		
1.98	II	D	86	1.63	0.33	0.419	0.581	0.272		

Basin No. 21

L (ft)	7785	Length of longest watercourse
L_{ca} (ft)	4143	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	104	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	335.01	Drainage Area: Soil B = 0.00; Soil C = 335.01; Soil D = 0.00

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.30	0.35	0.41
30-m	0.30	0.43	0.54	0.71	0.84	0.99
1-hr	0.40	0.57	0.73	0.95	1.13	1.32
3-hr	0.57	0.78	0.96	1.22	1.44	1.66
6-hr	0.68	0.93	1.14	1.44	1.68	1.94
24-hr	1.00	1.39	1.72	2.18	2.54	2.92

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.00	II	B	65	5.38	1.08	0.000	1.000	0.63	0.980	0.502
1.00	II	C	73	3.70	0.74	0.020	0.980	0.502		
1.00	II	D	79	2.66	0.53	0.070	0.930	0.398		
1.39	II	B	65	5.38	1.08	0.014	0.986	0.63	0.928	0.502
1.39	II	C	73	3.70	0.74	0.072	0.928	0.502		
1.39	II	D	79	2.66	0.53	0.151	0.849	0.398		
1.72	II	B	65	5.38	1.08	0.041	0.959	0.63	0.878	0.502
1.72	II	C	73	3.70	0.74	0.122	0.878	0.502		
1.72	II	D	79	2.66	0.53	0.215	0.785	0.398		
2.18	II	B	65	5.38	1.08	0.087	0.913	0.63	0.817	0.502
2.18	II	C	73	3.70	0.74	0.183	0.817	0.502		
2.18	II	D	79	2.66	0.53	0.289	0.711	0.398		
2.54	II	B	68	4.71	0.94	0.161	0.839	0.582	0.717	0.452
2.54	II	C	76	3.16	0.63	0.283	0.717	0.452		
2.54	II	D	81	2.35	0.47	0.382	0.618	0.362		
2.92	II	B	71	4.08	0.82	0.243	0.757	0.534	0.613	0.398
2.92	II	C	79	2.66	0.53	0.387	0.613	0.398		
2.92	II	D	83	2.05	0.41	0.473	0.527	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.30	0.35	0.41
30-m	0.30	0.43	0.54	0.71	0.84	0.99
1-hr	0.40	0.57	0.73	0.95	1.13	1.32
3-hr	0.57	0.78	0.96	1.22	1.44	1.66
6-hr	0.68	0.93	1.14	1.44	1.68	1.94
24-hr	0.69	0.94	1.15	1.45	1.69	1.95

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.69	II	B	70	4.29	0.86	0.000	1.000	0.55	1.000	0.434
0.69	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.69	II	D	82	2.20	0.44	0.043	0.957	0.344		
0.94	II	B	70	4.29	0.86	0.000	1.000	0.55	0.968	0.434
0.94	II	C	77	2.99	0.60	0.032	0.968	0.434		
0.94	II	D	82	2.20	0.44	0.096	0.904	0.344		
1.15	II	B	70	4.29	0.86	0.017	0.983	0.55	0.922	0.434
1.15	II	C	77	2.99	0.60	0.078	0.922	0.434		
1.15	II	D	82	2.20	0.44	0.148	0.852	0.344		
1.45	II	B	70	4.29	0.86	0.048	0.952	0.55	0.869	0.434
1.45	II	C	77	2.99	0.60	0.131	0.869	0.434		
1.45	II	D	82	2.20	0.44	0.221	0.779	0.344		
1.69	II	B	73	3.70	0.74	0.112	0.888	0.502	0.775	0.380
1.69	II	C	80	2.50	0.50	0.225	0.775	0.38		
1.69	II	D	84	1.90	0.38	0.314	0.686	0.308		
1.95	II	B	75	3.33	0.67	0.185	0.815	0.47	0.687	0.344
1.95	II	C	82	2.20	0.44	0.313	0.687	0.344		
1.95	II	D	85	1.76	0.35	0.390	0.610	0.29		

Basin No. 22

L (ft)	17260	Length of longest watercourse
L_{ca} (ft)	7255	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	485	Elevation difference between headwater and concentration point
n	0.04	Basin Factor
Area (ac)	1856.00	Drainage Area: Soil B = 0.00; Soil C = 1799.20; Soil D = 56.80

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.30	0.35	0.41
30-m	0.30	0.43	0.54	0.71	0.84	0.99
1-hr	0.40	0.57	0.72	0.94	1.12	1.32
3-hr	0.56	0.77	0.96	1.22	1.43	1.65
6-hr	0.68	0.92	1.13	1.43	1.67	1.93
24-hr	1.00	1.38	1.71	2.16	2.52	2.90

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
1.00	II	B	64	5.63	1.13	0.000	1.000	0.644	0.978	0.499
1.00	II	C	73	3.70	0.74	0.020	0.980	0.502		
1.00	II	D	79	2.66	0.53	0.070	0.930	0.398		
1.38	II	B	64	5.63	1.13	0.007	0.993	0.644	0.932	0.499
1.38	II	C	73	3.70	0.74	0.065	0.935	0.502		
1.38	II	D	79	2.66	0.53	0.152	0.848	0.398		
1.71	II	B	64	5.63	1.13	0.029	0.971	0.644	0.880	0.499
1.71	II	C	73	3.70	0.74	0.117	0.883	0.502		
1.71	II	D	79	2.66	0.53	0.211	0.789	0.398		
2.16	II	B	64	5.63	1.13	0.074	0.926	0.644	0.816	0.499
2.16	II	C	73	3.70	0.74	0.181	0.819	0.502		
2.16	II	D	79	2.66	0.53	0.287	0.713	0.398		
2.52	II	B	68	4.71	0.94	0.159	0.841	0.582	0.715	0.449
2.52	II	C	76	3.16	0.63	0.282	0.718	0.452		
2.52	II	D	81	2.35	0.47	0.381	0.619	0.362		
2.90	II	B	71	4.08	0.82	0.241	0.759	0.534	0.611	0.396
2.90	II	C	79	2.66	0.53	0.386	0.614	0.398		
2.90	II	D	83	2.05	0.41	0.472	0.528	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.30	0.35	0.41
30-m	0.30	0.43	0.54	0.71	0.84	0.99
1-hr	0.40	0.57	0.72	0.94	1.12	1.32
3-hr	0.56	0.77	0.96	1.22	1.43	1.65
6-hr	0.68	0.92	1.13	1.43	1.67	1.93
24-hr	0.69	0.93	1.14	1.44	1.68	1.94

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.69	II	B	69	4.49	0.69	0.000	1.000	0.566	0.999	0.431
0.69	II	C	77	2.99	0.69	0.000	1.000	0.434		
0.69	II	D	82	2.20	0.69	0.043	0.957	0.344		
0.93	II	B	69	4.49	0.93	0.000	1.000	0.566	0.966	0.431
0.93	II	C	77	2.99	0.93	0.032	0.968	0.434		
0.93	II	D	82	2.20	0.93	0.097	0.903	0.344		
1.14	II	B	69	4.49	1.14	0.009	0.991	0.566	0.928	0.431
1.14	II	C	77	2.99	1.14	0.070	0.930	0.434		
1.14	II	D	82	2.20	1.14	0.149	0.851	0.344		
1.44	II	B	69	4.49	1.44	0.042	0.958	0.566	0.872	0.431
1.44	II	C	77	2.99	1.44	0.125	0.875	0.434		
1.44	II	D	82	2.20	1.44	0.215	0.785	0.344		
1.68	II	B	73	3.70	1.68	0.113	0.887	0.502	0.789	0.395
1.68	II	C	79	2.66	1.68	0.208	0.792	0.398		
1.68	II	D	84	1.90	1.68	0.315	0.685	0.308		
1.94	II	B	75	3.33	1.94	0.180	0.820	0.47	0.684	0.342
1.94	II	C	82	2.20	1.94	0.314	0.686	0.344		
1.94	II	D	85	1.76	1.94	0.392	0.608	0.29		

Basin No. 23

L (ft)	6461	Length of longest watercourse
L_{ca} (ft)	3653	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	108	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	418.25	Drainage Area: Soil B = 0.00; Soil C = 414.77; Soil D = 3.48

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.43	0.54	0.70	0.84	0.98
1-hr	0.39	0.57	0.72	0.94	1.12	1.31
3-hr	0.56	0.76	0.94	1.20	1.40	1.62
6-hr	0.67	0.91	1.11	1.40	1.63	1.88
24-hr	0.98	1.35	1.66	2.09	2.44	2.80

Basin area-average loss rate

Y = (P - Ia)^2/{ [(P - Ia) + S]*P} for (P - Ia)>0; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.98	II	B	64	5.63	1.13	0.000	1.000	0.644	0.989	0.000
0.98	II	C	73	3.70	0.74	0.010	0.990	0.502		0.010
0.98	II	D	79	2.66	0.53	0.071	0.929	0.398		0.071
1.35	II	B	64	5.63	1.13	0.007	0.993	0.644	0.932	0.007
1.35	II	C	73	3.70	0.74	0.067	0.933	0.502		0.067
1.35	II	D	79	2.66	0.53	0.141	0.859	0.398		0.141
1.66	II	B	64	5.63	1.13	0.030	0.970	0.644	0.891	0.030
1.66	II	C	73	3.70	0.74	0.108	0.892	0.502		0.108
1.66	II	D	79	2.66	0.53	0.205	0.795	0.398		0.205
2.09	II	B	64	5.63	1.13	0.067	0.933	0.644	0.827	0.067
2.09	II	C	73	3.70	0.74	0.172	0.828	0.502		0.172
2.09	II	D	79	2.66	0.53	0.278	0.722	0.398		0.278
2.44	II	B	68	4.71	0.94	0.148	0.852	0.582	0.729	0.148
2.44	II	C	76	3.16	0.63	0.270	0.730	0.452		0.270
2.44	II	D	81	2.35	0.47	0.369	0.631	0.362		0.369
2.80	II	B	71	4.08	0.82	0.232	0.768	0.534	0.624	0.232
2.80	II	C	79	2.66	0.53	0.375	0.625	0.398		0.375
2.80	II	D	83	2.05	0.41	0.461	0.539	0.326		0.461

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.43	0.54	0.70	0.84	0.98
1-hr	0.39	0.57	0.72	0.94	1.12	1.31
3-hr	0.56	0.76	0.94	1.20	1.40	1.62
6-hr	0.67	0.91	1.11	1.40	1.63	1.88
24-hr	0.68	0.92	1.12	1.41	1.64	1.89

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.68	II	B	69	4.49	0.90	0.000	1.000	0.566	1.000	0.433
0.68	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.68	II	D	82	2.20	0.44	0.029	0.971	0.344		
0.92	II	B	69	4.49	0.90	0.000	1.000	0.566	0.966	0.433
0.92	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.92	II	D	82	2.20	0.44	0.098	0.902	0.344		
1.12	II	B	69	4.49	0.90	0.009	0.991	0.566	0.928	0.433
1.12	II	C	77	2.99	0.60	0.071	0.929	0.434		
1.12	II	D	82	2.20	0.44	0.143	0.857	0.344		
1.41	II	B	69	4.49	0.90	0.035	0.965	0.566	0.878	0.433
1.41	II	C	77	2.99	0.60	0.121	0.879	0.434		
1.41	II	D	82	2.20	0.44	0.213	0.787	0.344		
1.64	II	B	73	3.70	0.74	0.110	0.890	0.502	0.798	0.397
1.64	II	C	79	2.66	0.53	0.201	0.799	0.398		
1.64	II	D	84	1.90	0.38	0.305	0.695	0.308		
1.89	II	B	75	3.33	0.67	0.175	0.825	0.47	0.719	0.361
1.89	II	C	81	2.35	0.47	0.280	0.720	0.362		
1.89	II	D	85	1.76	0.35	0.381	0.619	0.29		

Basin No. 24

L (ft)	3303	Length of longest watercourse
L_{ca} (ft)	1349	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	107	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	44.55	Drainage Area: Soil B = 0.00; Soil C = 44.19; Soil D = 0.36

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.57	0.72	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.40	1.62
6-hr	0.67	0.90	1.11	1.39	1.63	1.87
24-hr	0.97	1.34	1.65	2.08	2.42	2.78

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$ for (P - Ia)>0; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.97	II	B	64	5.63	1.13	0.000	1.000	0.644	0.990	0.501
0.97	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.97	II	D	79	2.66	0.53	0.062	0.938	0.398		
1.34	II	B	64	5.63	1.13	0.007	0.993	0.644	0.939	0.501
1.34	II	C	73	3.70	0.74	0.060	0.940	0.502		
1.34	II	D	79	2.66	0.53	0.142	0.858	0.398		
1.65	II	B	64	5.63	1.13	0.024	0.976	0.644	0.890	0.501
1.65	II	C	73	3.70	0.74	0.109	0.891	0.502		
1.65	II	D	79	2.66	0.53	0.200	0.800	0.398		
2.08	II	B	64	5.63	1.13	0.067	0.933	0.644	0.826	0.501
2.08	II	C	73	3.70	0.74	0.173	0.827	0.502		
2.08	II	D	79	2.66	0.53	0.274	0.726	0.398		
2.42	II	B	68	4.71	0.94	0.145	0.855	0.582	0.730	0.451
2.42	II	C	76	3.16	0.63	0.269	0.731	0.452		
2.42	II	D	81	2.35	0.47	0.364	0.636	0.362		
2.78	II	B	71	4.08	0.82	0.230	0.770	0.534	0.646	0.415
2.78	II	C	78	2.82	0.56	0.353	0.647	0.416		
2.78	II	D	83	2.05	0.41	0.457	0.543	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.57	0.72	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.40	1.62
6-hr	0.67	0.90	1.11	1.39	1.63	1.87
24-hr	0.68	0.91	1.12	1.40	1.64	1.88

Basin area-average loss rate

$Y = (P - Ia)^2 / \{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.68	II	B	69	4.49	0.90	0.000	1.000	0.566	1.000	0.433
0.68	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.68	II	D	81	2.35	0.47	0.029	0.971	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.967	0.433
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.12	II	B	69	4.49	0.90	0.009	0.991	0.566	0.929	0.433
1.12	II	C	77	2.99	0.60	0.071	0.929	0.434		
1.12	II	D	81	2.35	0.47	0.125	0.875	0.362		
1.40	II	B	69	4.49	0.90	0.036	0.964	0.566	0.878	0.433
1.40	II	C	77	2.99	0.60	0.121	0.879	0.434		
1.40	II	D	81	2.35	0.47	0.186	0.814	0.362		
1.64	II	B	72	3.89	0.78	0.098	0.902	0.518	0.798	0.397
1.64	II	C	79	2.66	0.53	0.201	0.799	0.398		
1.64	II	D	84	1.90	0.38	0.305	0.695	0.308		
1.88	II	B	75	3.33	0.67	0.170	0.830	0.47	0.717	0.361
1.88	II	C	81	2.35	0.47	0.282	0.718	0.362		
1.88	II	D	85	1.76	0.35	0.378	0.622	0.29		

Basin No. 25

L (ft)	5956	Length of longest watercourse
L_{ca} (ft)	2708	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	201	Elevation difference between headwater and concentration point
n	0.035	Basin Factor: Soil B = 0.00; Soil C = 256.85; Soil D = 2.92
Area (ac)	259.77	Drainage Area

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.39	1.61
6-hr	0.67	0.90	1.10	1.39	1.62	1.86
24-hr	0.97	1.33	1.64	2.07	2.41	2.77

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.97	II	B	64	5.63	1.13	0.000	1.000	0.644	0.989	0.501
0.97	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.97	II	D	79	2.66	0.53	0.062	0.938	0.398		
1.33	II	B	64	5.63	1.13	0.008	0.992	0.644	0.939	0.501
1.33	II	C	73	3.70	0.74	0.060	0.940	0.502		
1.33	II	D	79	2.66	0.53	0.143	0.857	0.398		
1.64	II	B	64	5.63	1.13	0.024	0.976	0.644	0.889	0.501
1.64	II	C	73	3.70	0.74	0.110	0.890	0.502		
1.64	II	D	79	2.66	0.53	0.201	0.799	0.398		
2.07	II	B	64	5.63	1.13	0.063	0.937	0.644	0.830	0.501
2.07	II	C	73	3.70	0.74	0.169	0.831	0.502		
2.07	II	D	79	2.66	0.53	0.271	0.729	0.398		
2.41	II	B	68	4.71	0.94	0.145	0.855	0.582	0.733	0.451
2.41	II	C	76	3.16	0.63	0.266	0.734	0.452		
2.41	II	D	81	2.35	0.47	0.365	0.635	0.362		
2.77	II	B	71	4.08	0.82	0.227	0.773	0.534	0.649	0.415
2.77	II	C	78	2.82	0.56	0.350	0.650	0.416		
2.77	II	D	83	2.05	0.41	0.455	0.545	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.39	1.61
6-hr	0.67	0.90	1.10	1.39	1.62	1.86
24-hr	0.68	0.91	1.11	1.40	1.63	1.87

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.68	II	B	69	4.49	0.90	0.000	1.000	0.566	1.000	0.433
0.68	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.68	II	D	81	2.35	0.47	0.029	0.971	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.967	0.433
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.936	0.433
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.40	II	B	69	4.49	0.90	0.036	0.964	0.566	0.878	0.433
1.40	II	C	77	2.99	0.60	0.121	0.879	0.434		
1.40	II	D	81	2.35	0.47	0.186	0.814	0.362		
1.63	II	B	72	3.89	0.78	0.092	0.908	0.518	0.803	0.397
1.63	II	C	79	2.66	0.53	0.196	0.804	0.398		
1.63	II	D	84	1.90	0.38	0.307	0.693	0.308		
1.87	II	B	75	3.33	0.67	0.171	0.829	0.47	0.721	0.361
1.87	II	C	81	2.35	0.47	0.278	0.722	0.362		
1.87	II	D	85	1.76	0.35	0.374	0.626	0.29		

Basin No. 26

L (ft)	9249	Length of longest watercourse
L_{ca} (ft)	4146	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	219	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	416.19	Drainage Area: Soil B = 0.00; Soil C = 408.01; Soil D = 8.18

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.19	1.39	1.61
6-hr	0.66	0.90	1.10	1.39	1.62	1.86
24-hr	0.96	1.33	1.63	2.06	2.40	2.75

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.96	II	B	64	5.63	1.13	0.000	1.000	0.644	0.989	0.500
0.96	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.96	II	D	79	2.66	0.53	0.063	0.937	0.398		
1.33	II	B	64	5.63	1.13	0.008	0.992	0.644	0.938	0.500
1.33	II	C	73	3.70	0.74	0.060	0.940	0.502		
1.33	II	D	79	2.66	0.53	0.143	0.857	0.398		
1.63	II	B	64	5.63	1.13	0.025	0.975	0.644	0.894	0.500
1.63	II	C	73	3.70	0.74	0.104	0.896	0.502		
1.63	II	D	79	2.66	0.53	0.196	0.804	0.398		
2.06	II	B	64	5.63	1.13	0.063	0.937	0.644	0.828	0.500
2.06	II	C	73	3.70	0.74	0.170	0.830	0.502		
2.06	II	D	79	2.66	0.53	0.272	0.728	0.398		
2.40	II	B	68	4.71	0.94	0.146	0.854	0.582	0.731	0.450
2.40	II	C	76	3.16	0.63	0.267	0.733	0.452		
2.40	II	D	81	2.35	0.47	0.363	0.637	0.362		
2.75	II	B	71	4.08	0.82	0.225	0.775	0.534	0.649	0.414
2.75	II	C	78	2.82	0.56	0.349	0.651	0.416		
2.75	II	D	83	2.05	0.41	0.455	0.545	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.19	1.39	1.61
6-hr	0.66	0.90	1.10	1.39	1.62	1.86
24-hr	0.67	0.91	1.11	1.40	1.63	1.87

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.67	II	B	69	4.49	0.90	0.000	1.000	0.566	0.999	0.433
0.67	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.67	II	D	81	2.35	0.47	0.030	0.970	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.966	0.433
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.936	0.433
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.40	II	B	69	4.49	0.90	0.036	0.964	0.566	0.878	0.433
1.40	II	C	77	2.99	0.60	0.121	0.879	0.434		
1.40	II	D	81	2.35	0.47	0.186	0.814	0.362		
1.63	II	B	72	3.89	0.78	0.092	0.908	0.518	0.802	0.396
1.63	II	C	79	2.66	0.53	0.196	0.804	0.398		
1.63	II	D	84	1.90	0.38	0.307	0.693	0.308		
1.87	II	B	75	3.33	0.67	0.171	0.829	0.47	0.720	0.361
1.87	II	C	81	2.35	0.47	0.278	0.722	0.362		
1.87	II	D	85	1.76	0.35	0.374	0.626	0.29		

Basin No. 27

L (ft)	4972	Length of longest watercourse
L_{ca} (ft)	2442	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	162	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	186.43	Drainage Area: Soil B = 0.00; Soil C = 183.06; Soil D = 3.37

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.96	1.32	1.63	2.05	2.39	2.74

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise $Y = 0$

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.96	II	B	64	5.63	1.13	0.000	1.000	0.644	0.989	0.500
0.96	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.96	II	D	79	2.66	0.53	0.063	0.937	0.398		
1.32	II	B	64	5.63	1.13	0.008	0.992	0.644	0.938	0.500
1.32	II	C	73	3.70	0.74	0.061	0.939	0.502		
1.32	II	D	79	2.66	0.53	0.136	0.864	0.398		
1.63	II	B	64	5.63	1.13	0.025	0.975	0.644	0.894	0.500
1.63	II	C	73	3.70	0.74	0.104	0.896	0.502		
1.63	II	D	79	2.66	0.53	0.196	0.804	0.398		
2.05	II	B	64	5.63	1.13	0.063	0.937	0.644	0.832	0.500
2.05	II	C	73	3.70	0.74	0.166	0.834	0.502		
2.05	II	D	79	2.66	0.53	0.268	0.732	0.398		
2.39	II	B	68	4.71	0.94	0.142	0.858	0.582	0.734	0.450
2.39	II	C	76	3.16	0.63	0.264	0.736	0.452		
2.39	II	D	81	2.35	0.47	0.360	0.640	0.362		
2.74	II	B	71	4.08	0.82	0.223	0.777	0.534	0.651	0.414
2.74	II	C	78	2.82	0.56	0.347	0.653	0.416		
2.74	II	D	83	2.05	0.41	0.453	0.547	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.67	0.91	1.11	1.39	1.62	1.86

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.67	II	B	69	4.49	0.90	0.000	1.000	0.566	0.999	0.433
0.67	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.67	II	D	81	2.35	0.47	0.030	0.970	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.966	0.433
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.936	0.433
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.39	II	B	69	4.49	0.90	0.036	0.964	0.566	0.877	0.433
1.39	II	C	77	2.99	0.60	0.122	0.878	0.434		
1.39	II	D	81	2.35	0.47	0.187	0.813	0.362		
1.62	II	B	72	3.89	0.78	0.093	0.907	0.518	0.800	0.396
1.62	II	C	79	2.66	0.53	0.198	0.802	0.398		
1.62	II	D	84	1.90	0.38	0.302	0.698	0.308		
1.86	II	B	75	3.33	0.67	0.167	0.833	0.47	0.718	0.361
1.86	II	C	81	2.35	0.47	0.280	0.720	0.362		
1.86	II	D	85	1.76	0.35	0.376	0.624	0.29		

Basin No. 28

L (ft)	1807	Length of longest watercourse
L_{ca} (ft)	608	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	81	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	47.45	Drainage Area: Soil B = 0.00; Soil C = 47.45; Soil D = 0.00

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.96	1.32	1.62	2.05	2.38	2.73

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Area -Average Y_{bar}	Area -Average F_m
0.96	II	B	64	5.63	1.13	0.000	1.000	0.644	0.990	0.502
0.96	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.96	II	D	79	2.66	0.53	0.063	0.937	0.398		
1.32	II	B	64	5.63	1.13	0.008	0.992	0.644	0.939	0.502
1.32	II	C	73	3.70	0.74	0.061	0.939	0.502		
1.32	II	D	79	2.66	0.53	0.136	0.864	0.398		
1.62	II	B	64	5.63	1.13	0.025	0.975	0.644	0.895	0.502
1.62	II	C	73	3.70	0.74	0.105	0.895	0.502		
1.62	II	D	79	2.66	0.53	0.198	0.802	0.398		
2.05	II	B	64	5.63	1.13	0.063	0.937	0.644	0.834	0.502
2.05	II	C	73	3.70	0.74	0.166	0.834	0.502		
2.05	II	D	79	2.66	0.53	0.268	0.732	0.398		
2.38	II	B	68	4.71	0.94	0.143	0.857	0.582	0.739	0.452
2.38	II	C	76	3.16	0.63	0.261	0.739	0.452		
2.38	II	D	81	2.35	0.47	0.361	0.639	0.362		
2.73	II	B	71	4.08	0.82	0.223	0.777	0.534	0.656	0.416
2.73	II	C	78	2.82	0.56	0.344	0.656	0.416		
2.73	II	D	83	2.05	0.41	0.451	0.549	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.67	0.91	1.11	1.39	1.62	1.86

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.67	II	B	69	4.49	0.90	0.000	1.000	0.566	1.000	0.434
0.67	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.67	II	D	81	2.35	0.47	0.030	0.970	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.967	0.434
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.937	0.434
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.39	II	B	69	4.49	0.90	0.036	0.964	0.566	0.878	0.434
1.39	II	C	77	2.99	0.60	0.122	0.878	0.434		
1.39	II	D	81	2.35	0.47	0.187	0.813	0.362		
1.62	II	B	72	3.89	0.78	0.093	0.907	0.518	0.802	0.398
1.62	II	C	79	2.66	0.53	0.198	0.802	0.398		
1.62	II	D	84	1.90	0.38	0.302	0.698	0.308		
1.86	II	B	75	3.33	0.67	0.167	0.833	0.47	0.720	0.362
1.86	II	C	81	2.35	0.47	0.280	0.720	0.362		
1.86	II	D	85	1.76	0.35	0.376	0.624	0.29		

Basin No. 29

L (ft)	5686	Length of longest watercourse
L_{ca} (ft)	2698	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
Δ H (ft)	150	Elevation difference between headwater and concentration point
n	0.035	Basin Factor
Area (ac)	123.05	Drainage Area: Soil B = 0.00; Soil C = 120.59; Soil D = 2.46

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.96	1.32	1.62	2.05	2.38	2.73

Basin area-average loss rate

$Y = (P - Ia)^2/\{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN24 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN24	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.96	II	B	64	5.63	1.13	0.000	1.000	0.644	0.989	0.500
0.96	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.96	II	D	79	2.66	0.53	0.063	0.937	0.398		
1.32	II	B	64	5.63	1.13	0.008	0.992	0.644	0.938	0.500
1.32	II	C	73	3.70	0.74	0.061	0.939	0.502		
1.32	II	D	79	2.66	0.53	0.136	0.864	0.398		
1.62	II	B	64	5.63	1.13	0.025	0.975	0.644	0.893	0.500
1.62	II	C	73	3.70	0.74	0.105	0.895	0.502		
1.62	II	D	79	2.66	0.53	0.198	0.802	0.398		
2.05	II	B	64	5.63	1.13	0.063	0.937	0.644	0.832	0.500
2.05	II	C	73	3.70	0.74	0.166	0.834	0.502		
2.05	II	D	79	2.66	0.53	0.268	0.732	0.398		
2.38	II	B	68	4.71	0.94	0.143	0.857	0.582	0.737	0.450
2.38	II	C	76	3.16	0.63	0.261	0.739	0.452		
2.38	II	D	81	2.35	0.47	0.361	0.639	0.362		
2.73	II	B	71	4.08	0.82	0.223	0.777	0.534	0.654	0.414
2.73	II	C	78	2.82	0.56	0.344	0.656	0.416		
2.73	II	D	83	2.05	0.41	0.451	0.549	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.97
1-hr	0.39	0.56	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.93	1.18	1.39	1.60
6-hr	0.66	0.90	1.10	1.38	1.61	1.85
24-hr	0.67	0.91	1.11	1.39	1.62	1.86

Basin area-average loss rate

$Y = (P - Ia)^2/\{ [(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.67	II	B	69	4.49	0.90	0.000	1.000	0.566	0.999	0.433
0.67	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.67	II	D	81	2.35	0.47	0.030	0.970	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.966	0.433
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.936	0.433
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.39	II	B	69	4.49	0.90	0.036	0.964	0.566	0.877	0.433
1.39	II	C	77	2.99	0.60	0.122	0.878	0.434		
1.39	II	D	81	2.35	0.47	0.187	0.813	0.362		
1.62	II	B	72	3.89	0.78	0.093	0.907	0.518	0.800	0.396
1.62	II	C	79	2.66	0.53	0.198	0.802	0.398		
1.62	II	D	84	1.90	0.38	0.302	0.698	0.308		
1.86	II	B	75	3.33	0.67	0.167	0.833	0.47	0.718	0.361
1.86	II	C	81	2.35	0.47	0.280	0.720	0.362		
1.86	II	D	85	1.76	0.35	0.376	0.624	0.29		

Basin No. 30

L (ft)	41175	Length of longest watercourse
L_{ca} (ft)	21879	Length along longest watercourse, measured from concentration point upstream to a point opposite center of area
∆ H (ft)	682	Elevation difference between headwater and concentration point
n	0.04	Basin Factor
Area (ac)	3746.49	Drainage Area: Soil B = 0.00; Soil C = 3636.05; Soil D = 110.44

Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.57	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.40	1.61
6-hr	0.67	0.90	1.10	1.39	1.62	1.87
24-hr	0.96	1.33	1.64	2.07	2.42	2.77

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$ for $(P - Ia) > 0$; otherwise Y = 0

Where : P = Total Rainfall (inches); S = 1000/CN – 10; Ia = 0.2 * S

									Area -Average	
P (in)	AMC	Soil	SCS CN	S (in)	Ia (in)	Y	$Y_{bar} = 1 - Y$	F_m	Y_{bar}	F_m
0.96	II	B	64	5.63	1.13	0.000	1.000	0.644	0.988	0.499
0.96	II	C	73	3.70	0.74	0.010	0.990	0.502		
0.96	II	D	79	2.66	0.53	0.063	0.937	0.398		
1.33	II	B	64	5.63	1.13	0.008	0.992	0.644	0.938	0.499
1.33	II	C	73	3.70	0.74	0.060	0.940	0.502		
1.33	II	D	79	2.66	0.53	0.143	0.857	0.398		
1.64	II	B	64	5.63	1.13	0.024	0.976	0.644	0.887	0.499
1.64	II	C	73	3.70	0.74	0.110	0.890	0.502		
1.64	II	D	79	2.66	0.53	0.201	0.799	0.398		
2.07	II	B	64	5.63	1.13	0.063	0.937	0.644	0.828	0.499
2.07	II	C	73	3.70	0.74	0.169	0.831	0.502		
2.07	II	D	79	2.66	0.53	0.271	0.729	0.398		
2.42	II	B	68	4.71	0.94	0.145	0.855	0.582	0.728	0.449
2.42	II	C	76	3.16	0.63	0.269	0.731	0.452		
2.42	II	D	81	2.35	0.47	0.364	0.636	0.362		
2.77	II	B	71	4.08	0.82	0.227	0.773	0.534	0.647	0.413
2.77	II	C	78	2.82	0.56	0.350	0.650	0.416		
2.77	II	D	83	2.05	0.41	0.455	0.545	0.326		

6-hr Rainfall depth-duration-frequency (inches)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5-m	0.12	0.18	0.23	0.29	0.35	0.41
30-m	0.29	0.42	0.54	0.70	0.83	0.98
1-hr	0.39	0.57	0.71	0.93	1.11	1.30
3-hr	0.55	0.76	0.94	1.19	1.40	1.61
6-hr	0.67	0.90	1.10	1.39	1.62	1.87
24-hr	0.68	0.91	1.11	1.40	1.63	1.88

Basin area-average loss rate

$Y = (P - Ia)^2 / \{[(P - Ia) + S]*P\}$

Where : P = Total Rainfall (inches); S = 1000/CN6 – 10; Ia = 0.2 * S

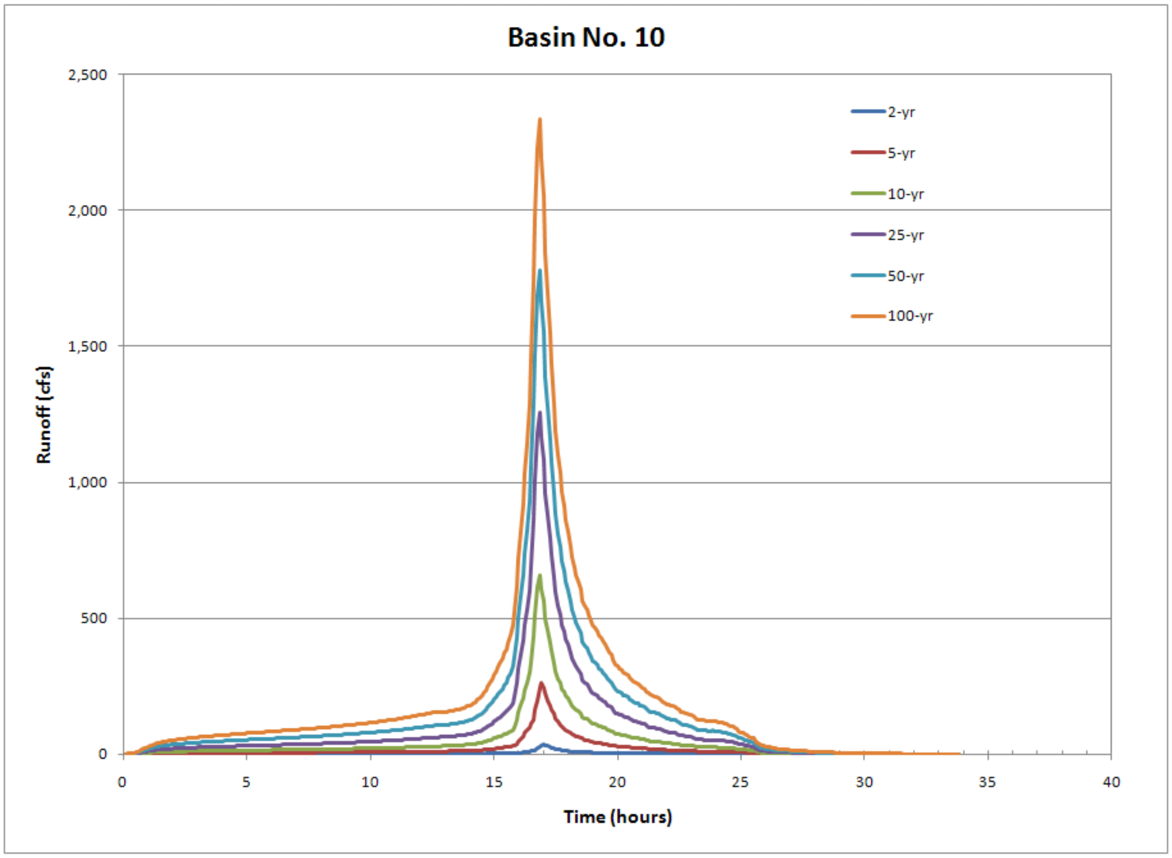
									Area -Average	
P (in)	AMC	Soil	CN6	S (in)	Ia (in)	Y	Y_{bar} = 1 - Y	F_m	Y_{bar}	F_m
0.68	II	B	69	4.49	0.90	0.000	1.000	0.566	0.999	0.432
0.68	II	C	77	2.99	0.60	0.000	1.000	0.434		
0.68	II	D	81	2.35	0.47	0.029	0.971	0.362		
0.91	II	B	69	4.49	0.90	0.000	1.000	0.566	0.966	0.432
0.91	II	C	77	2.99	0.60	0.033	0.967	0.434		
0.91	II	D	81	2.35	0.47	0.077	0.923	0.362		
1.11	II	B	69	4.49	0.90	0.009	0.991	0.566	0.935	0.432
1.11	II	C	77	2.99	0.60	0.063	0.937	0.434		
1.11	II	D	81	2.35	0.47	0.126	0.874	0.362		
1.40	II	B	69	4.49	0.90	0.036	0.964	0.566	0.877	0.432
1.40	II	C	77	2.99	0.60	0.121	0.879	0.434		
1.40	II	D	81	2.35	0.47	0.186	0.814	0.362		
1.63	II	B	72	3.89	0.78	0.092	0.908	0.518	0.801	0.395
1.63	II	C	79	2.66	0.53	0.196	0.804	0.398		
1.63	II	D	84	1.90	0.38	0.307	0.693	0.308		
1.88	II	B	75	3.33	0.67	0.170	0.830	0.47	0.715	0.360
1.88	II	C	81	2.35	0.47	0.282	0.718	0.362		
1.88	II	D	85	1.76	0.35	0.378	0.622	0.29		

FLO-2D Inflow Basin Hydrographs

(AES Input & Output Files provided on CD

based on the SBCHM Procedures)

Recommended FLO-2D Inflow Basin Hydrographs
(24-hour storm duration)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1,500
1,000
500
0
Runoff (cfs)
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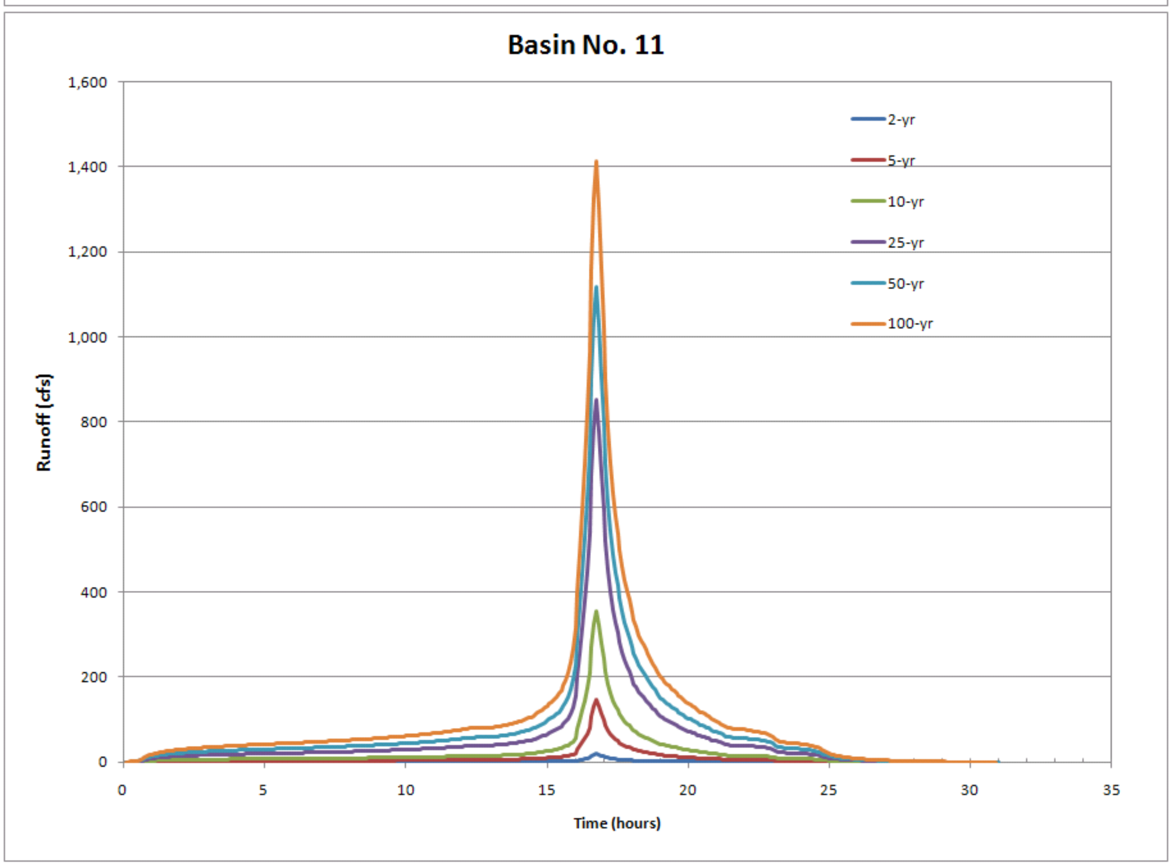
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr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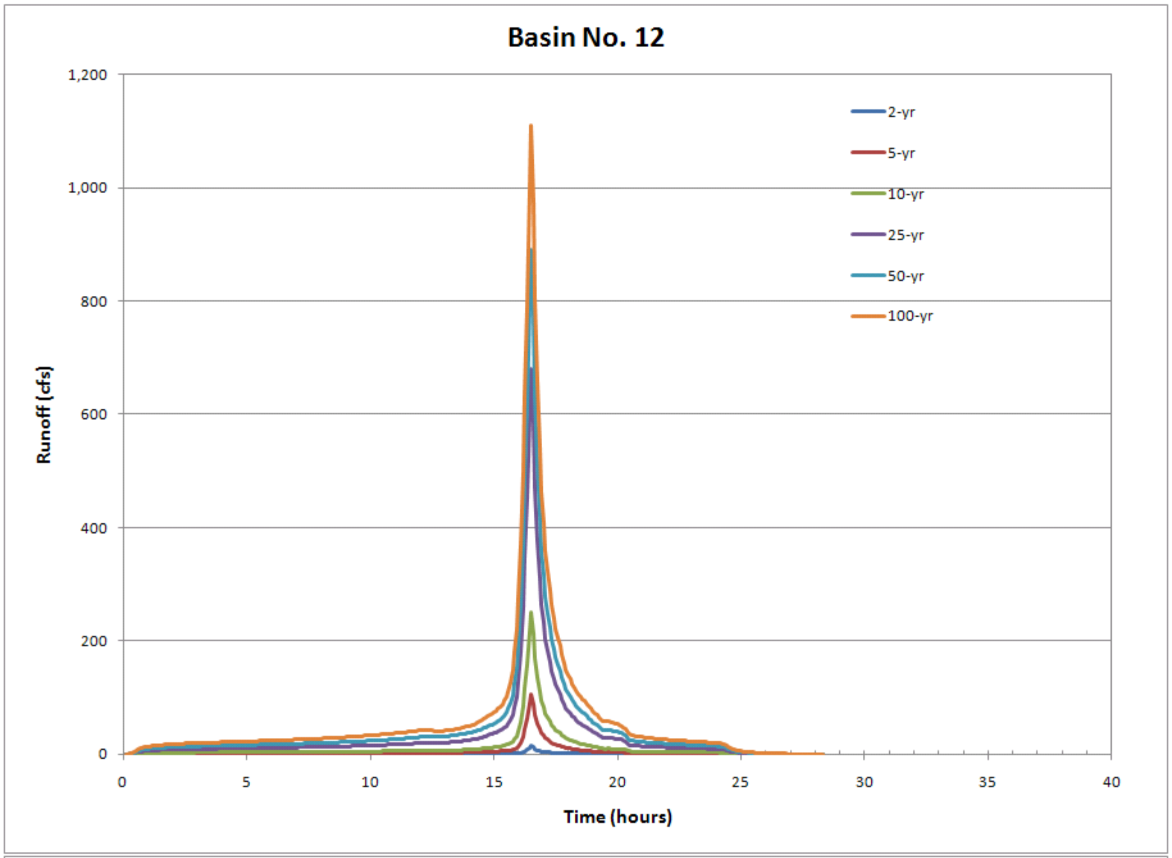
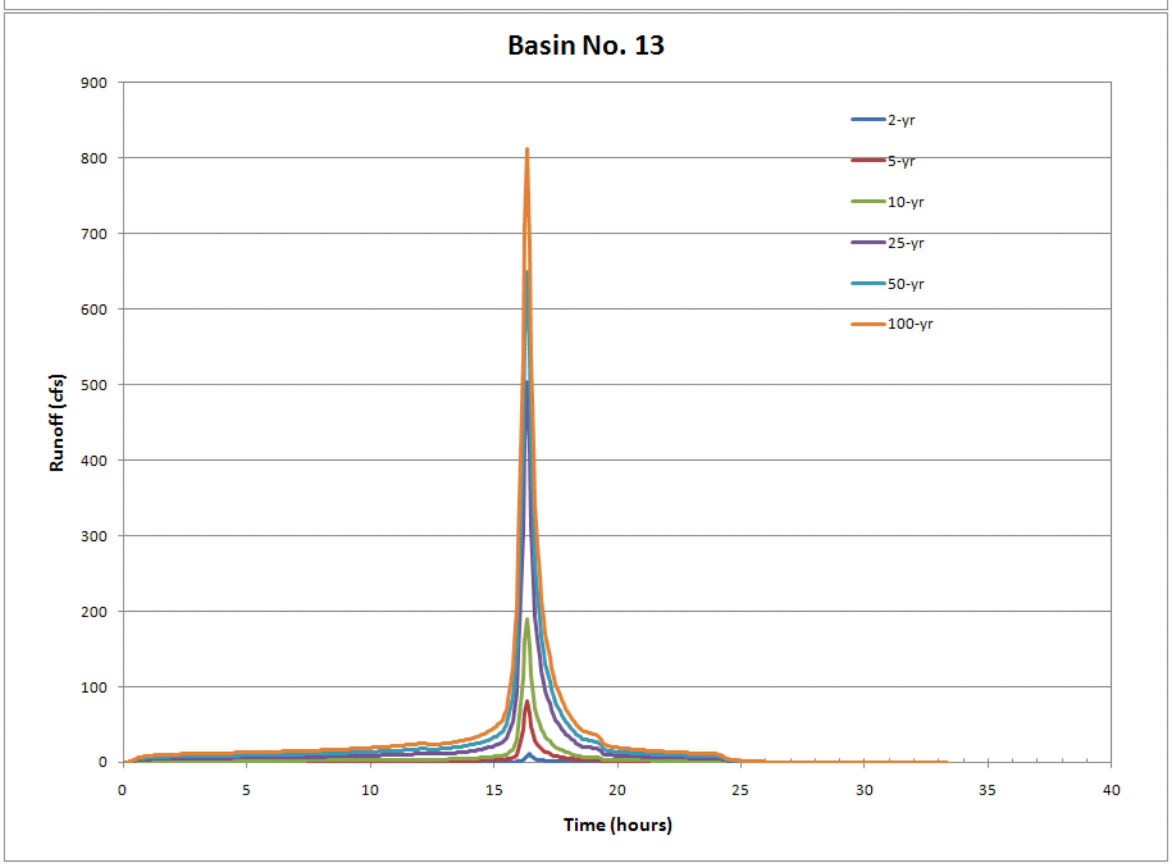
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
35
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 12
1,200
1,000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr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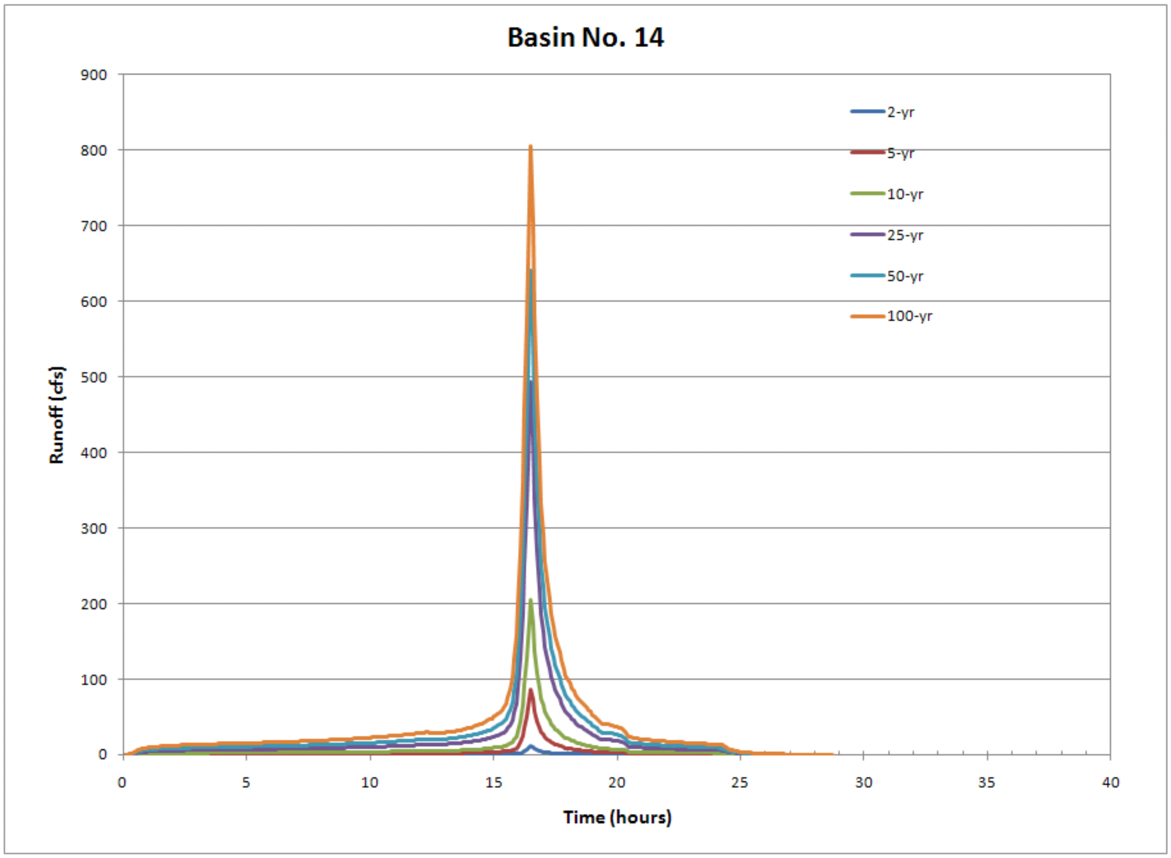
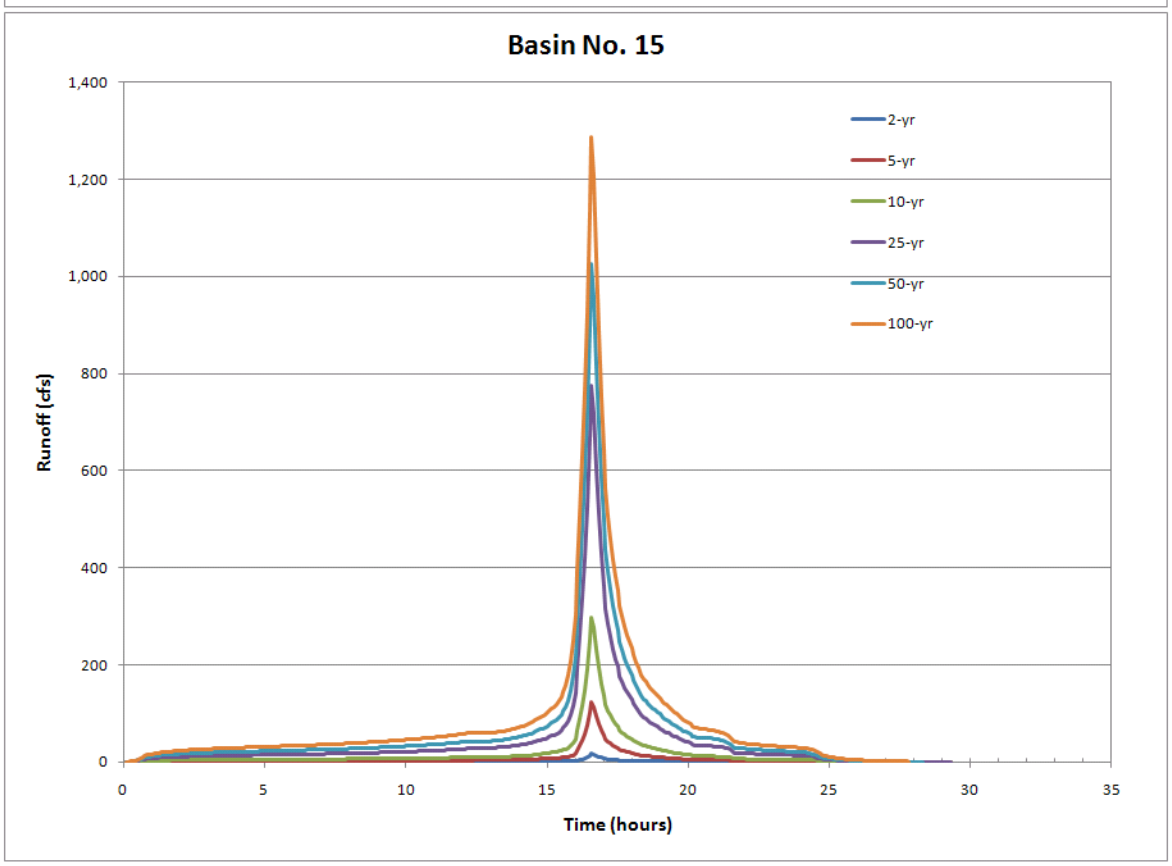
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 14
900
800
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 15
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
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25
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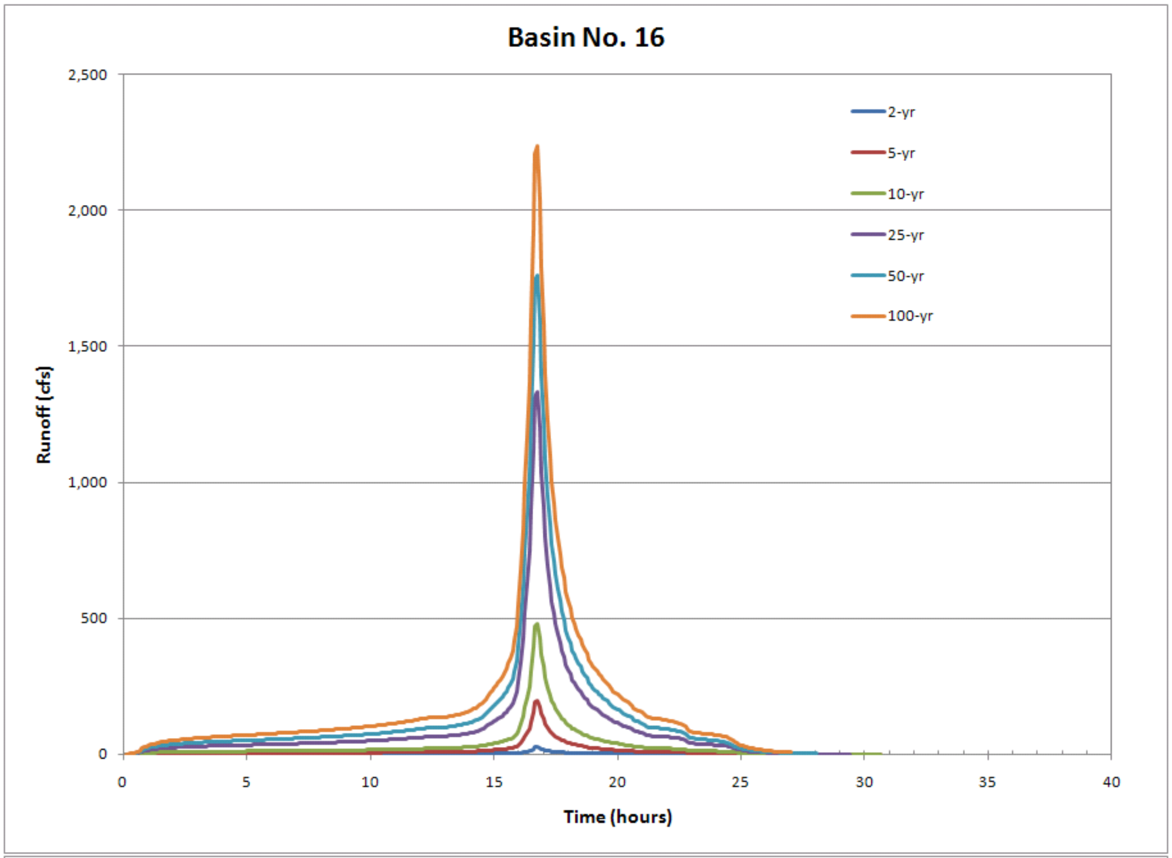
35
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr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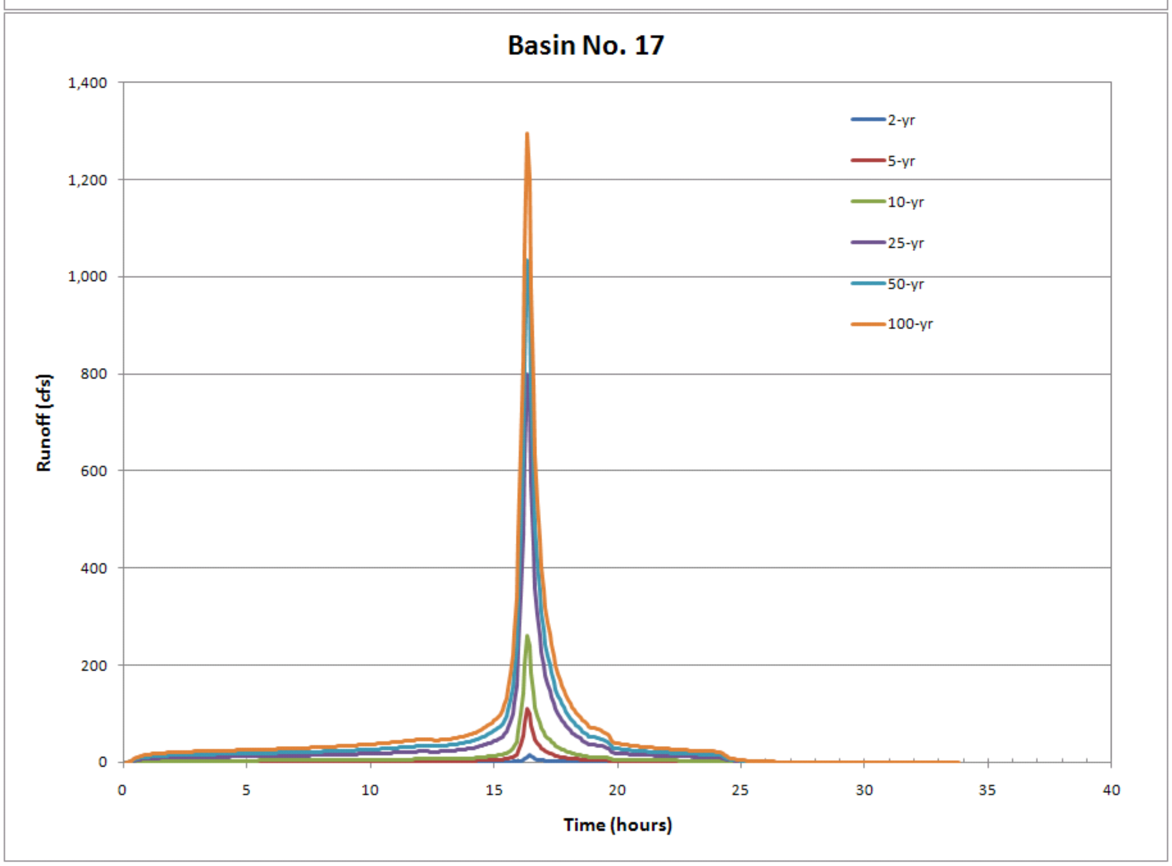
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr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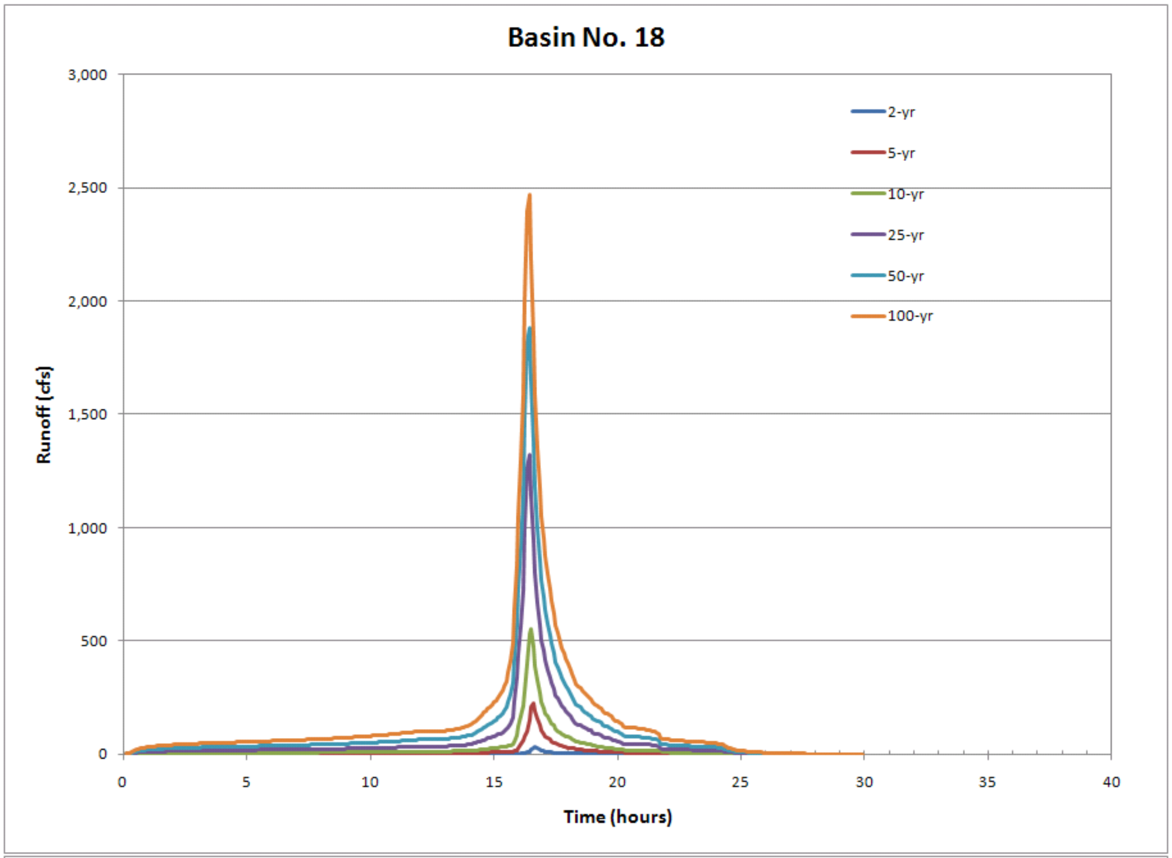
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr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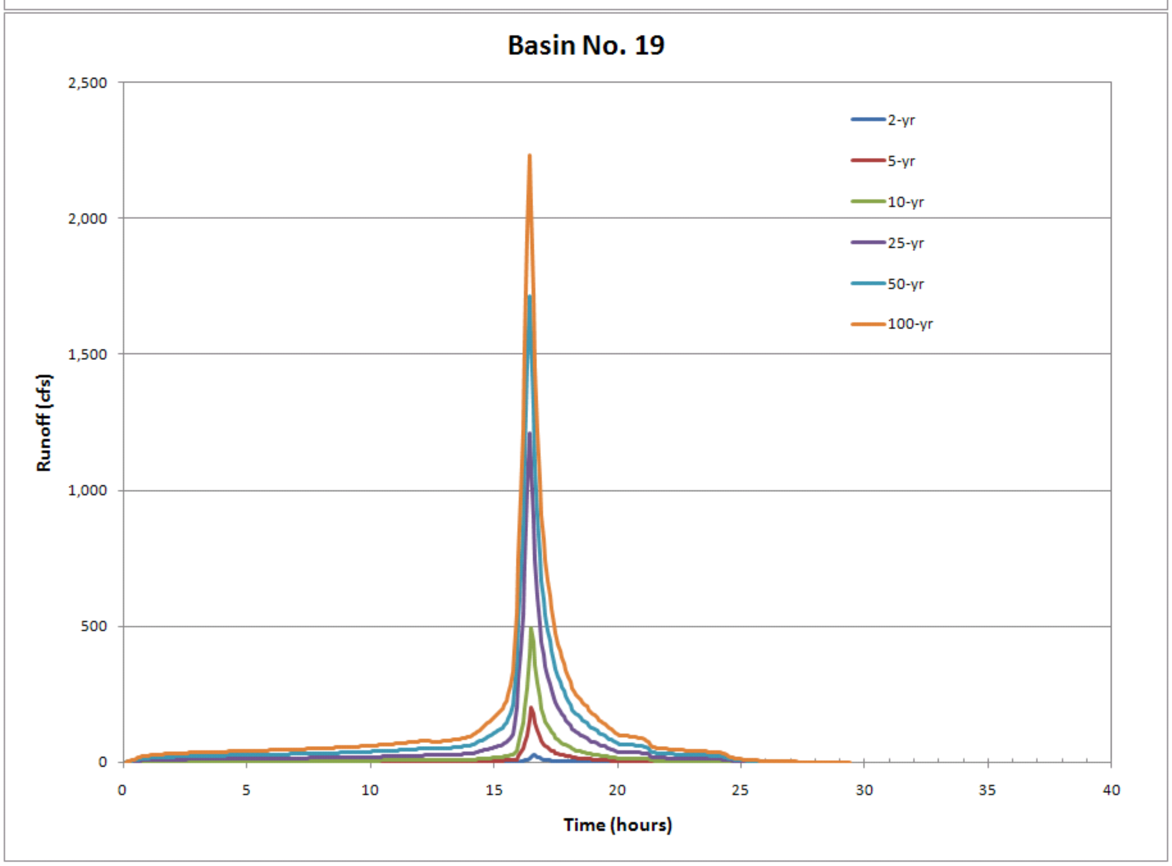
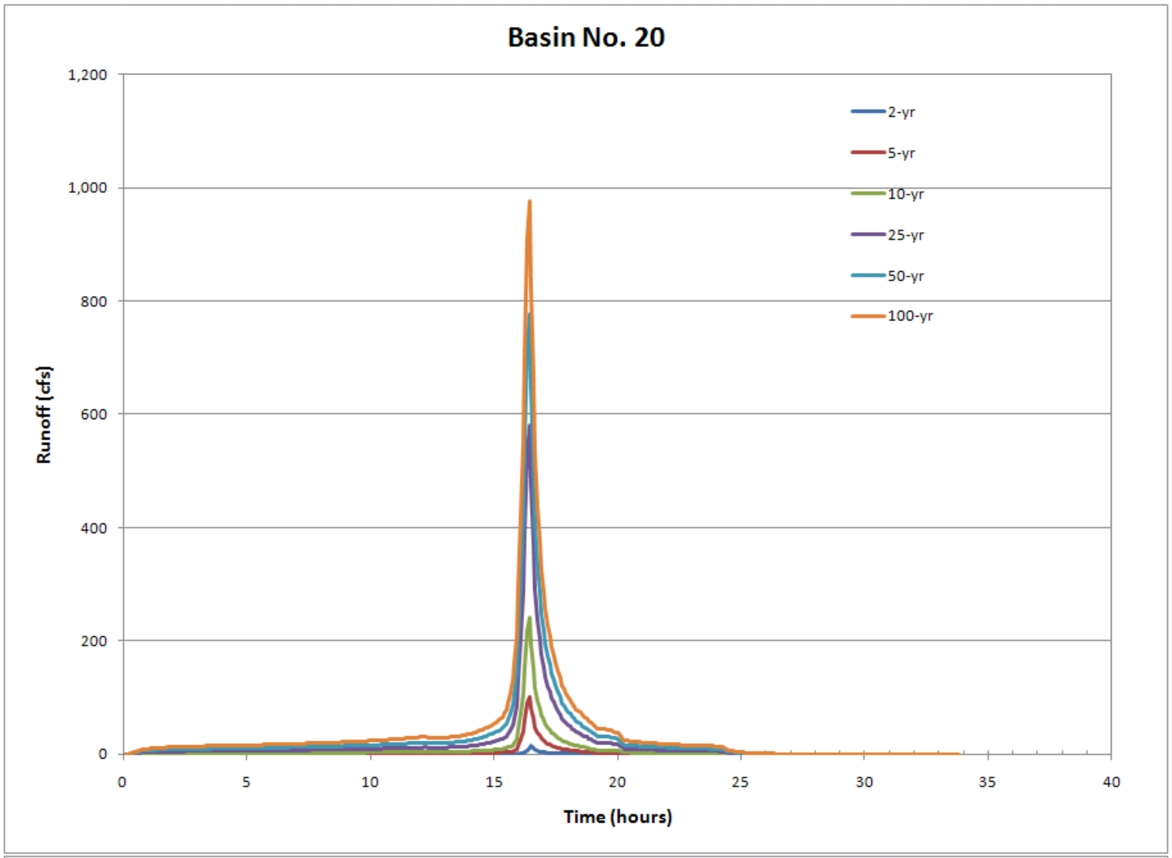
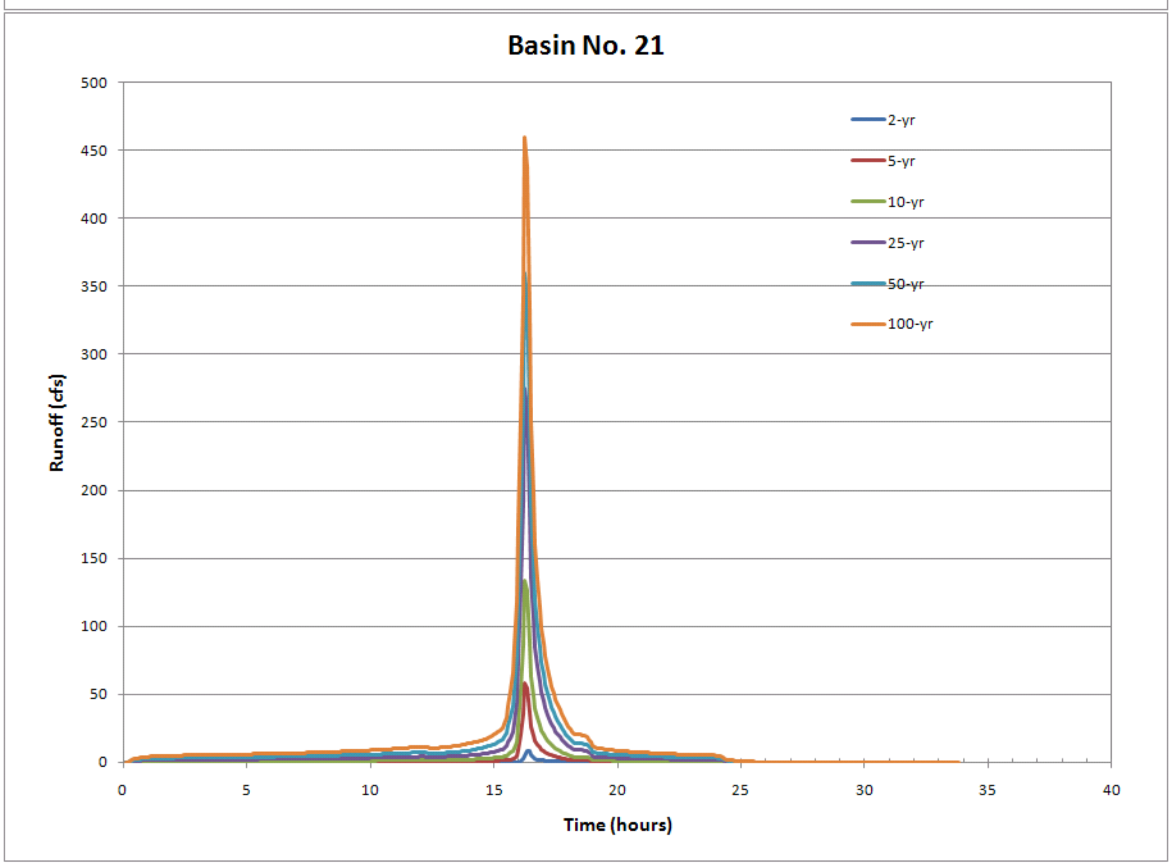
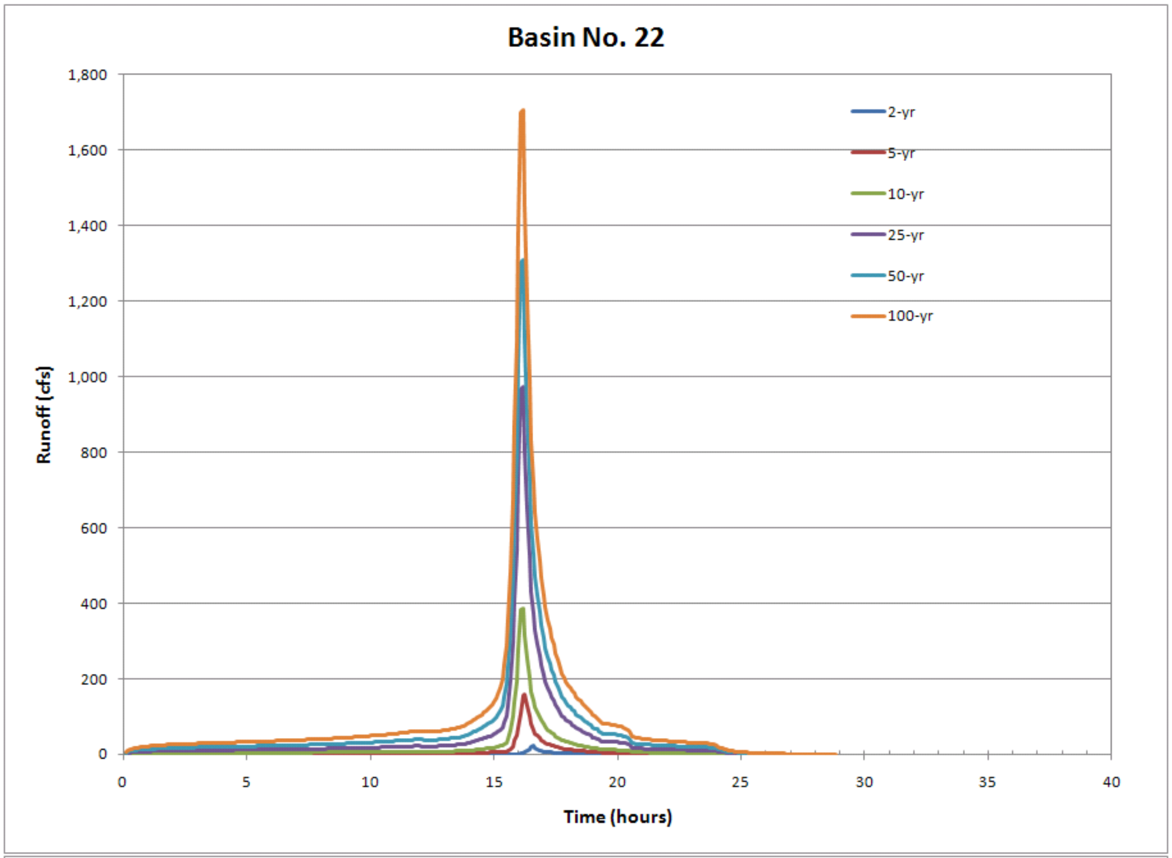
3,000
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

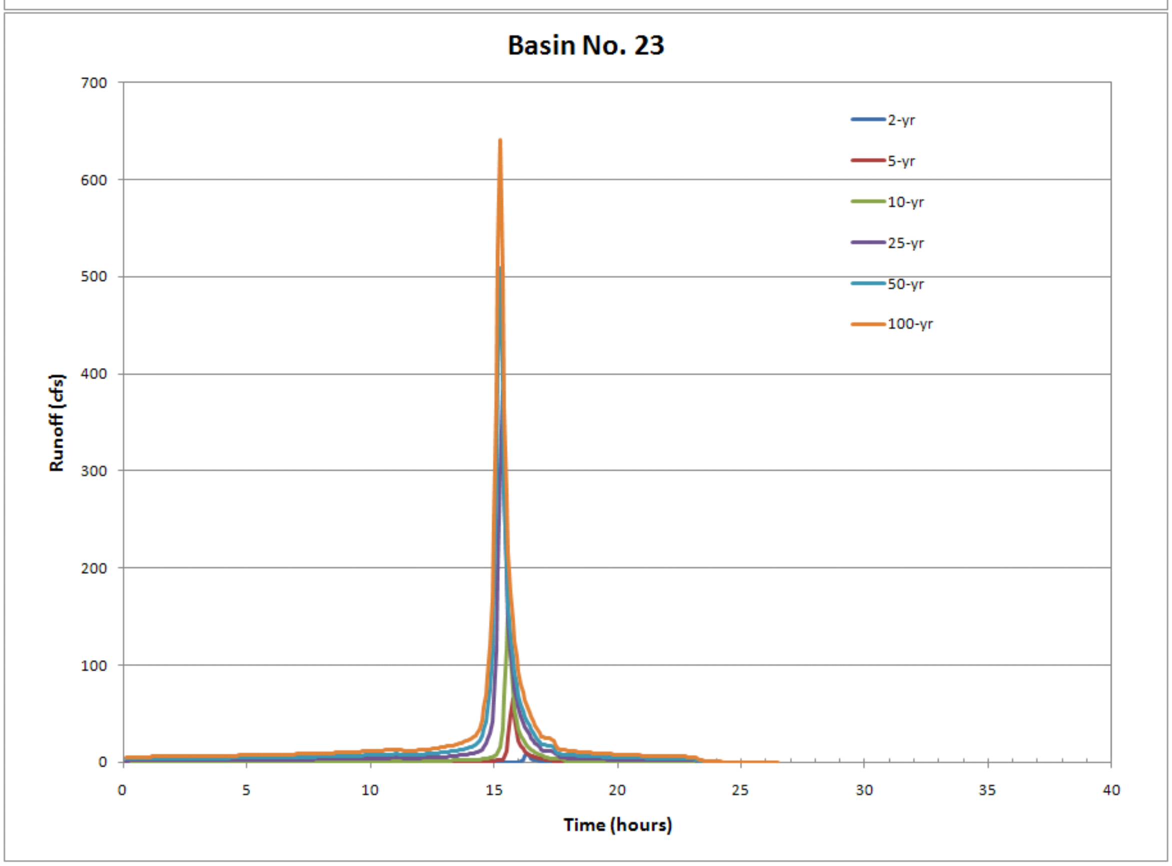

Basin No. 19
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 20
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
200
400
600
800
1,000
1,200
0
5
10
15
20
25
30
35
40

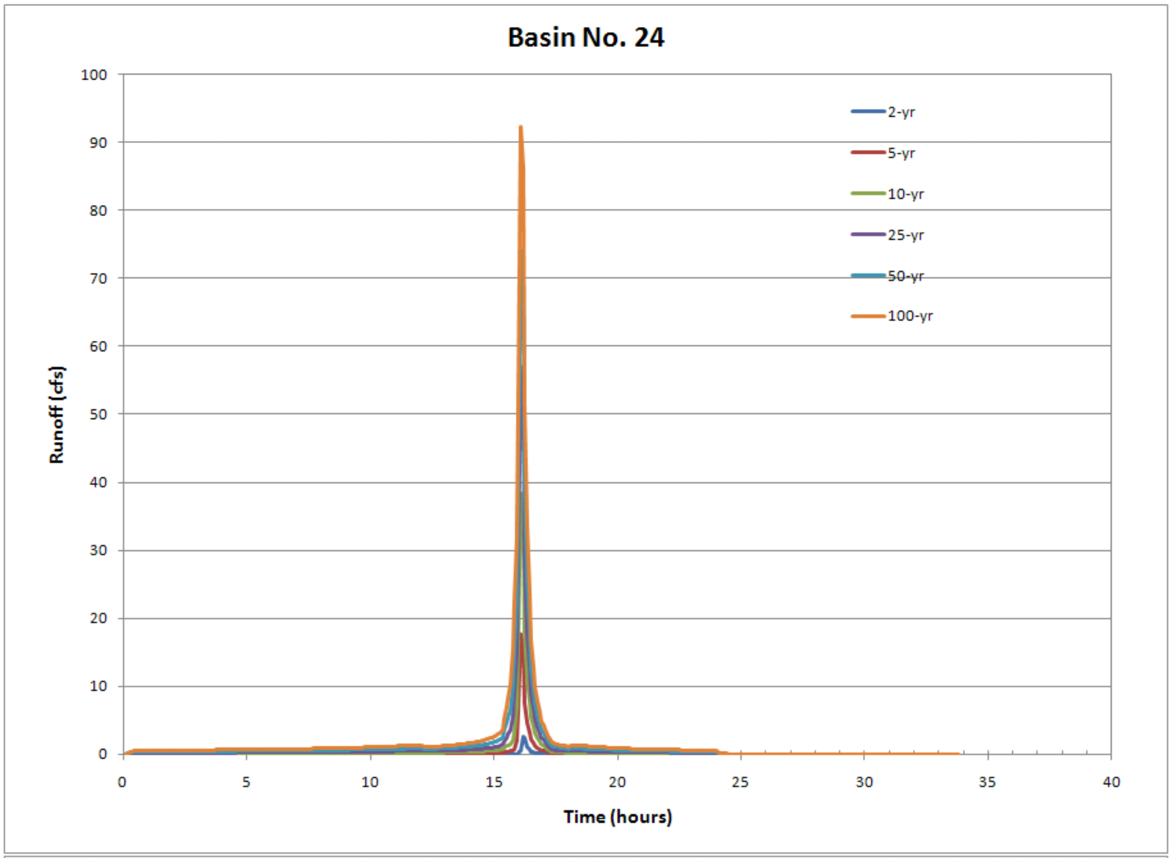

Basin No. 21
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
50
100
150
200
250
300
350
400
450
500
0
5
10
15
20
25
30
35
40



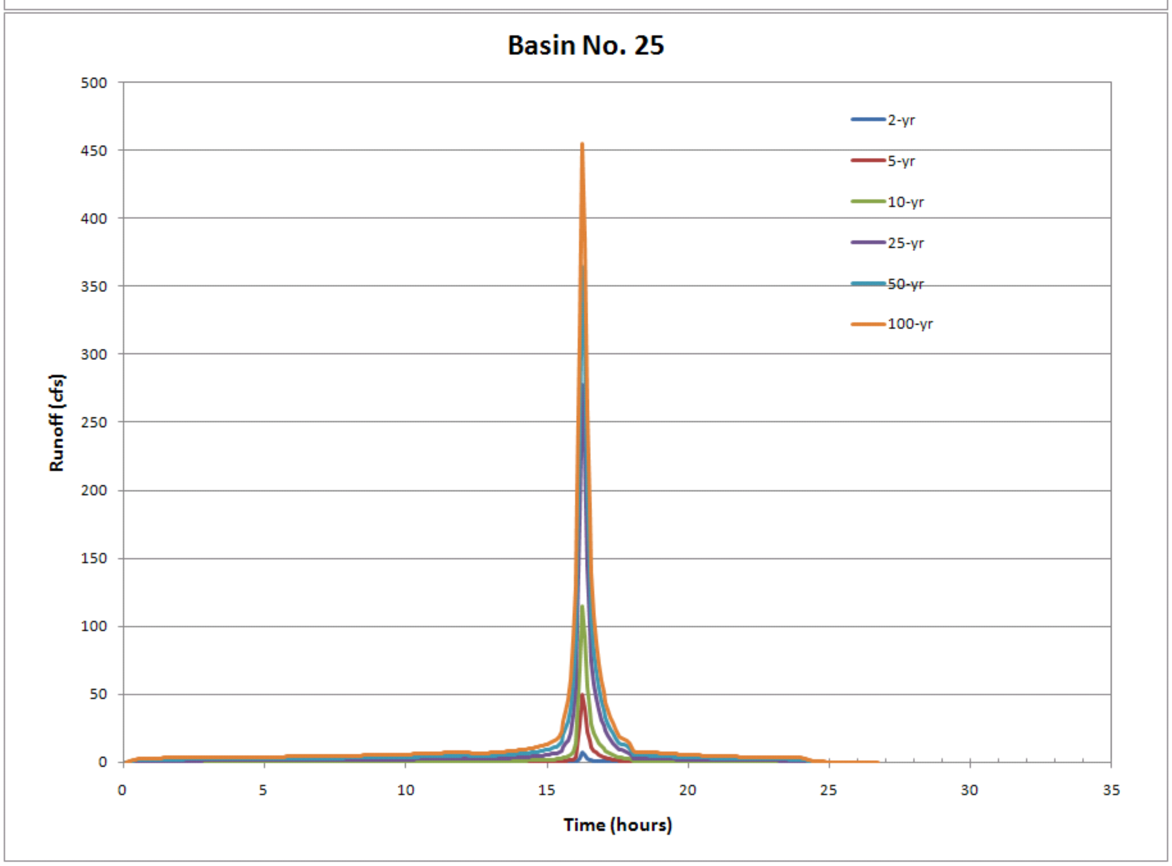
Basin No. 22
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr



Basin No. 23
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

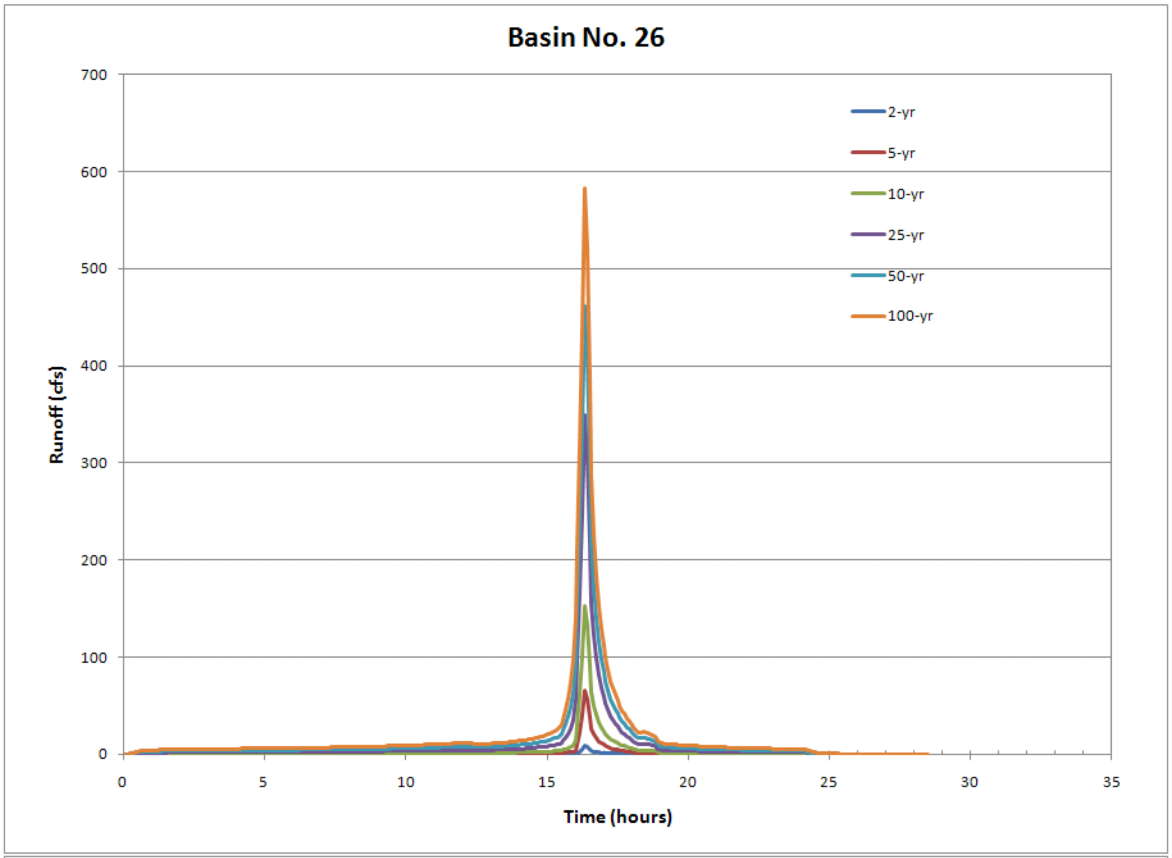


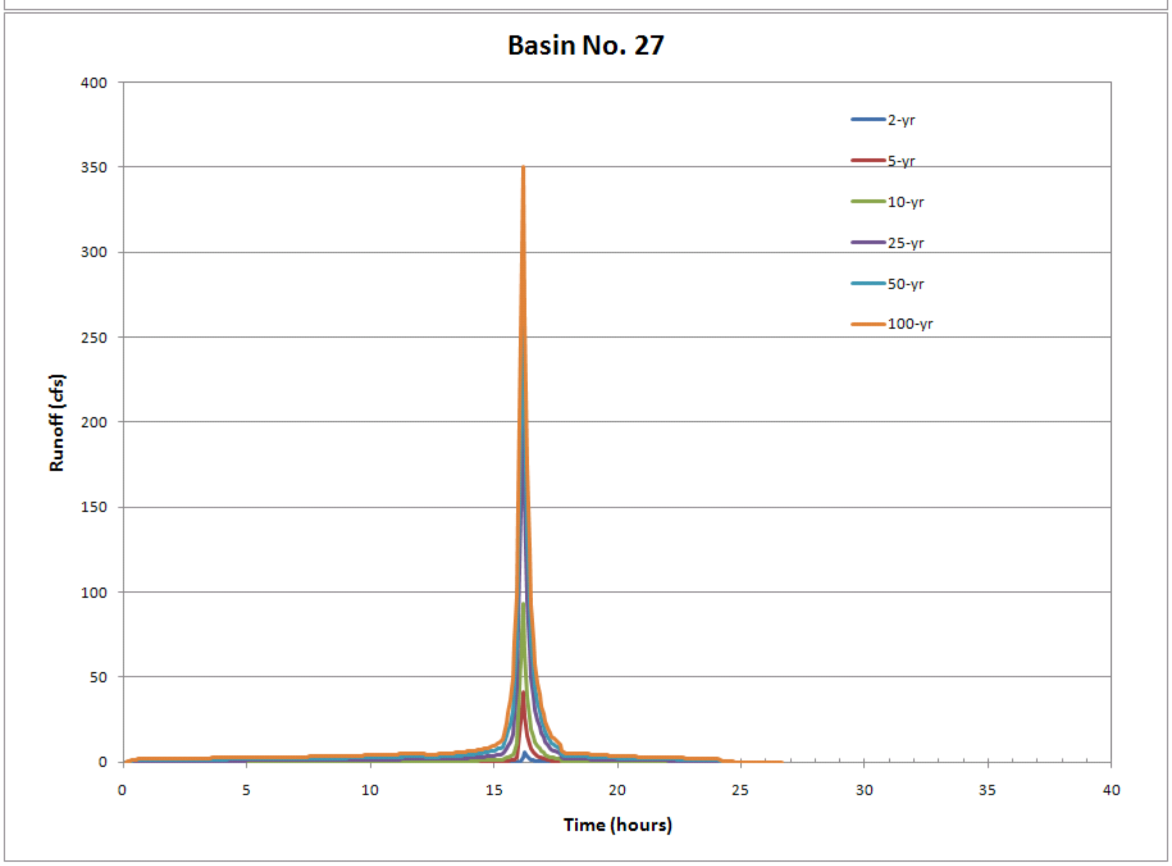
Basin No. 24
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

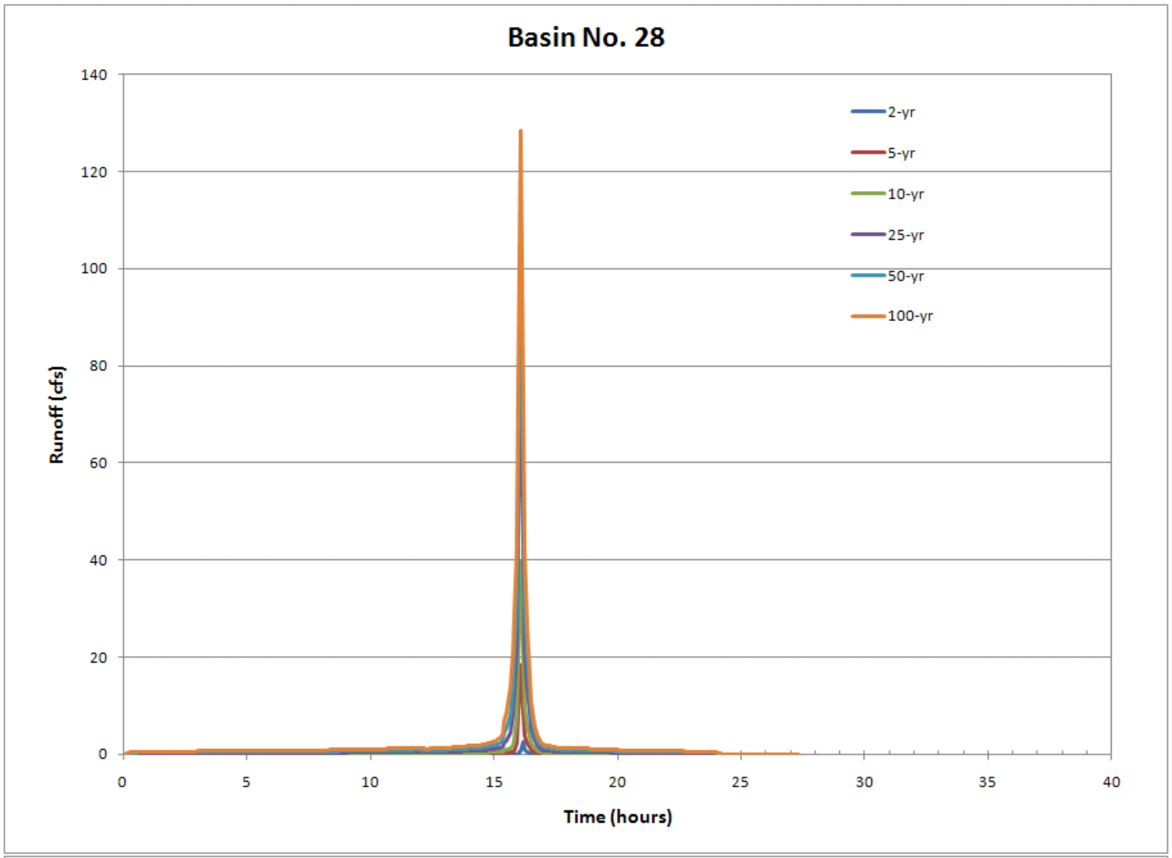


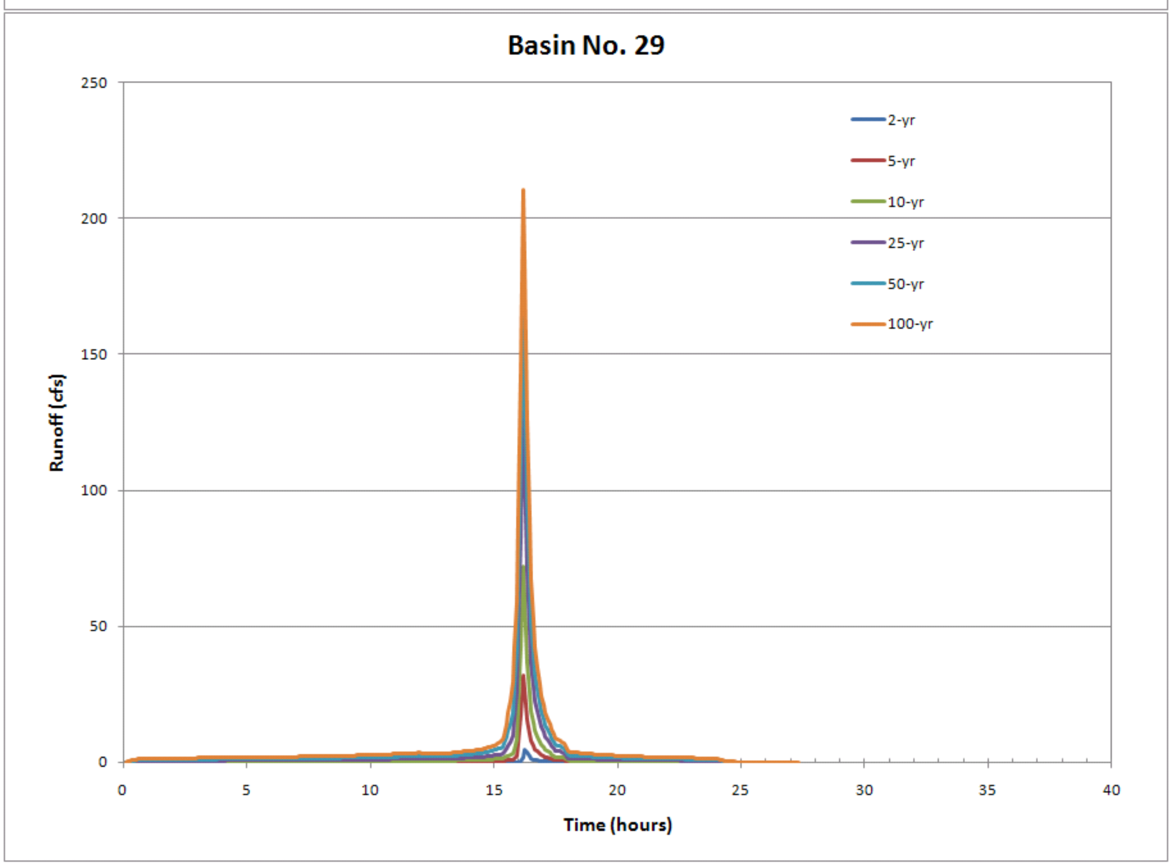
Basin No. 25
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

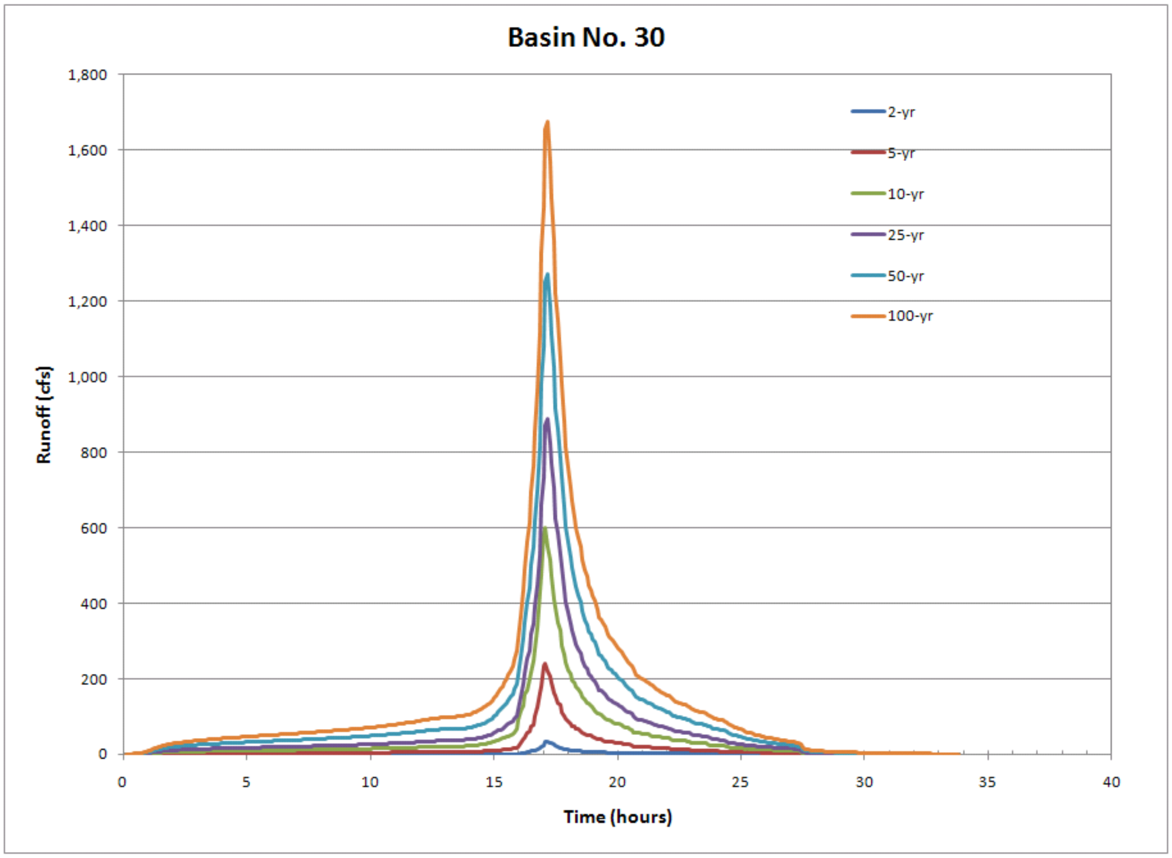
TETRA TECH


Basin No. 26
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
35
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 27
400
350
300
250
200
150
100
50
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 28
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30
35
40

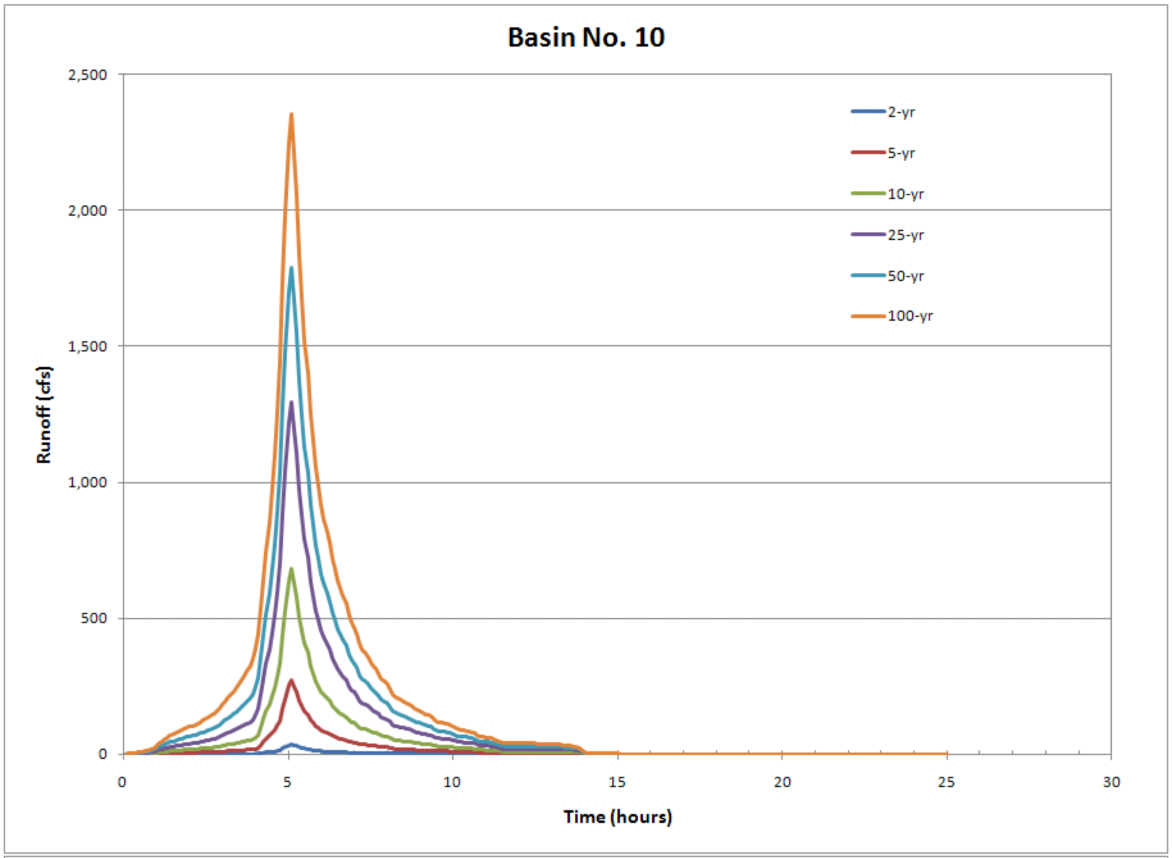

Basin No. 29
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
50
100
150
200
250
0
5
10
15
20
25
30
35
40

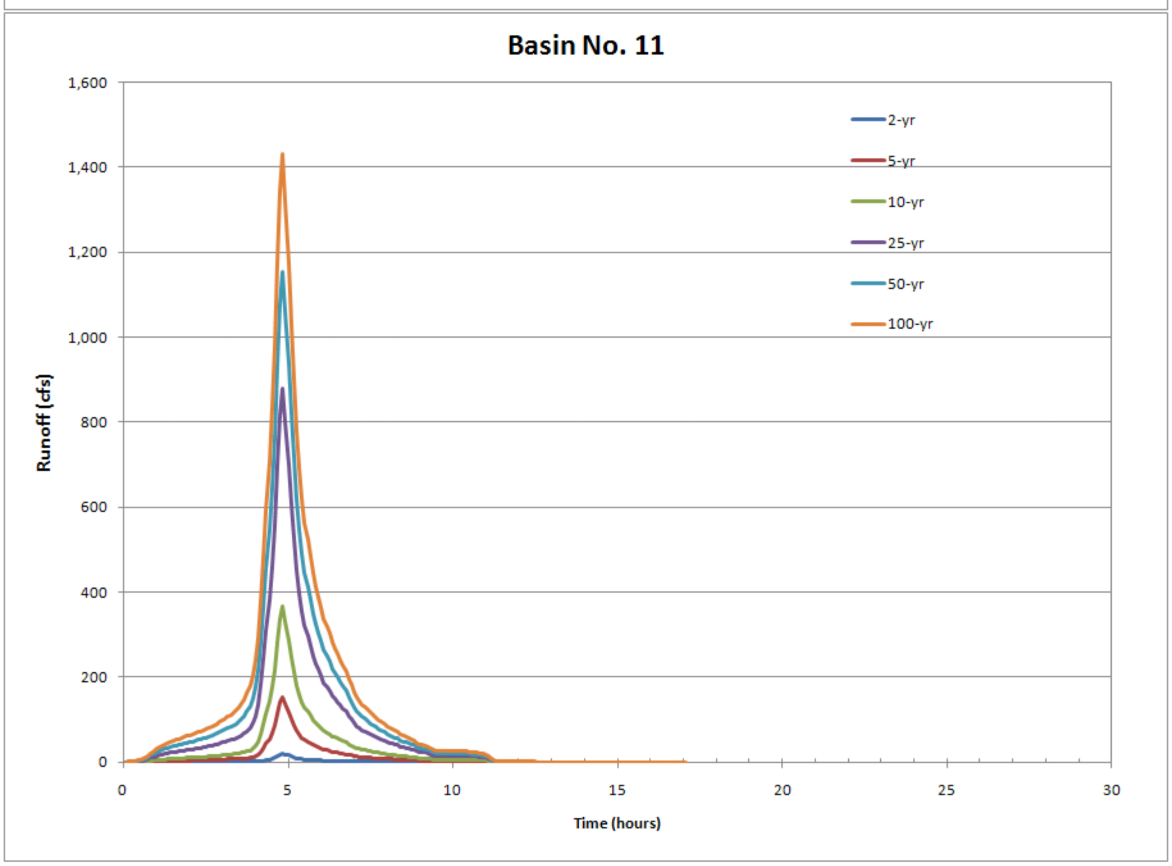


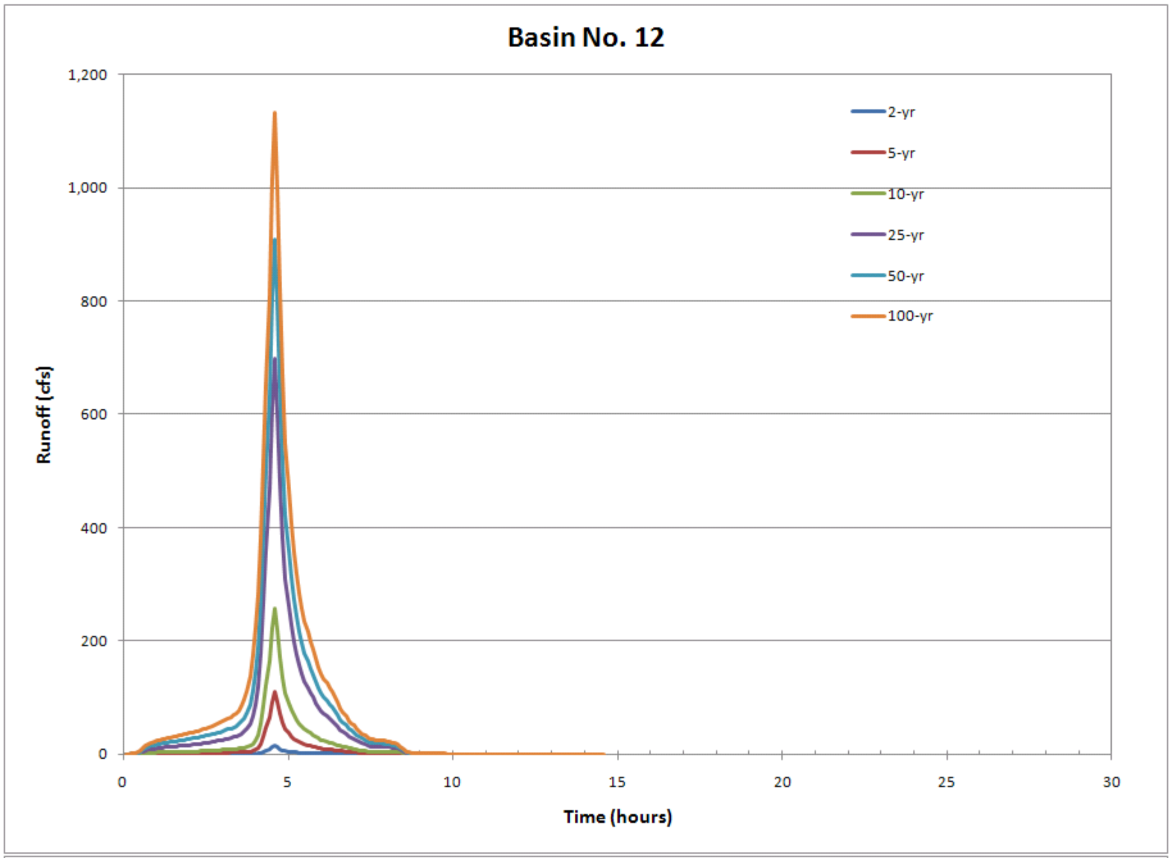
Basin No. 30
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
35
40
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

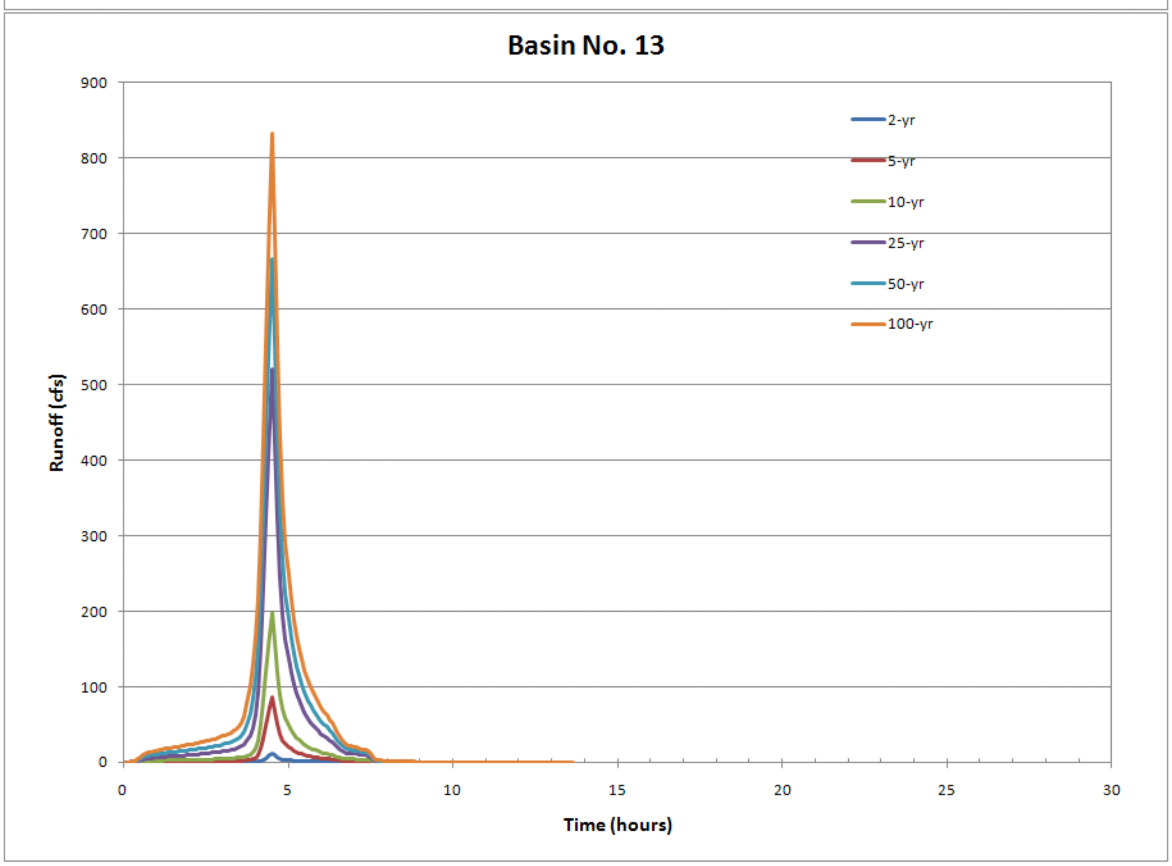
Recommended FLO-2D Inflow Basin Hydrographs

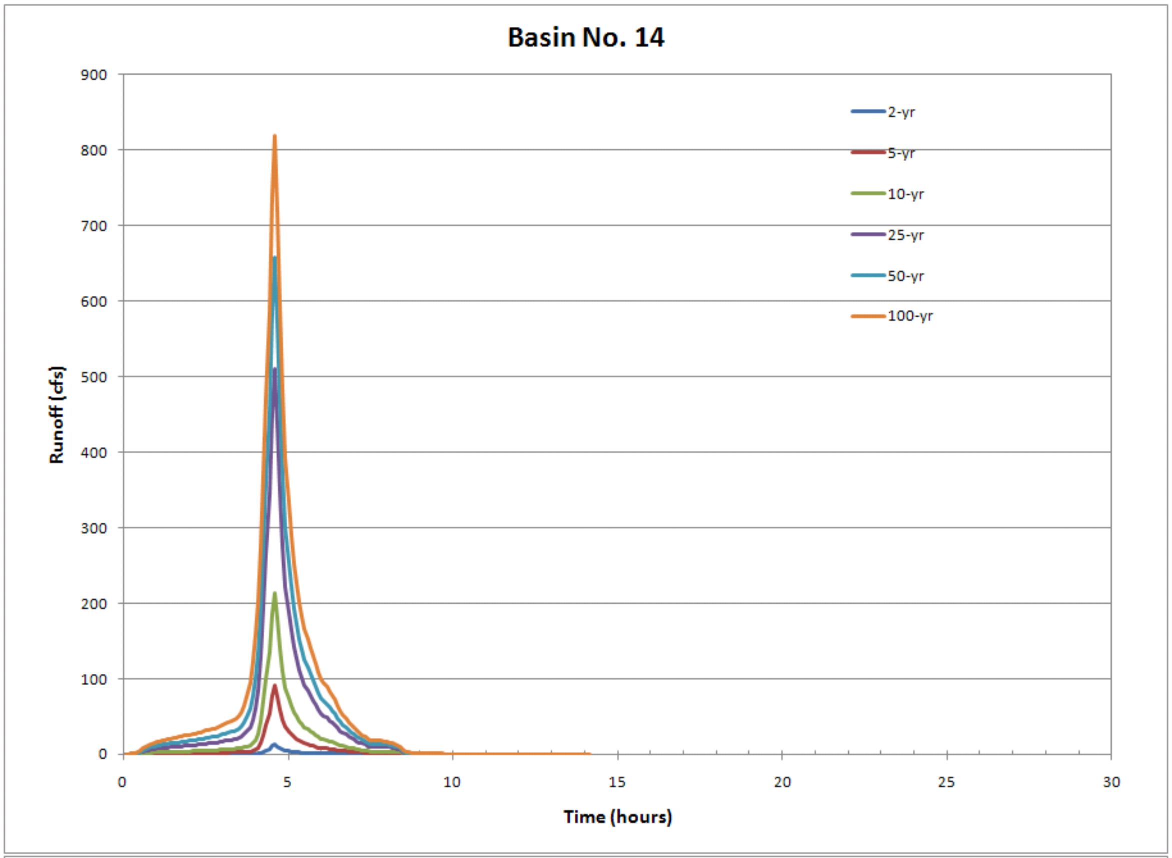
(6-hour storm duration)

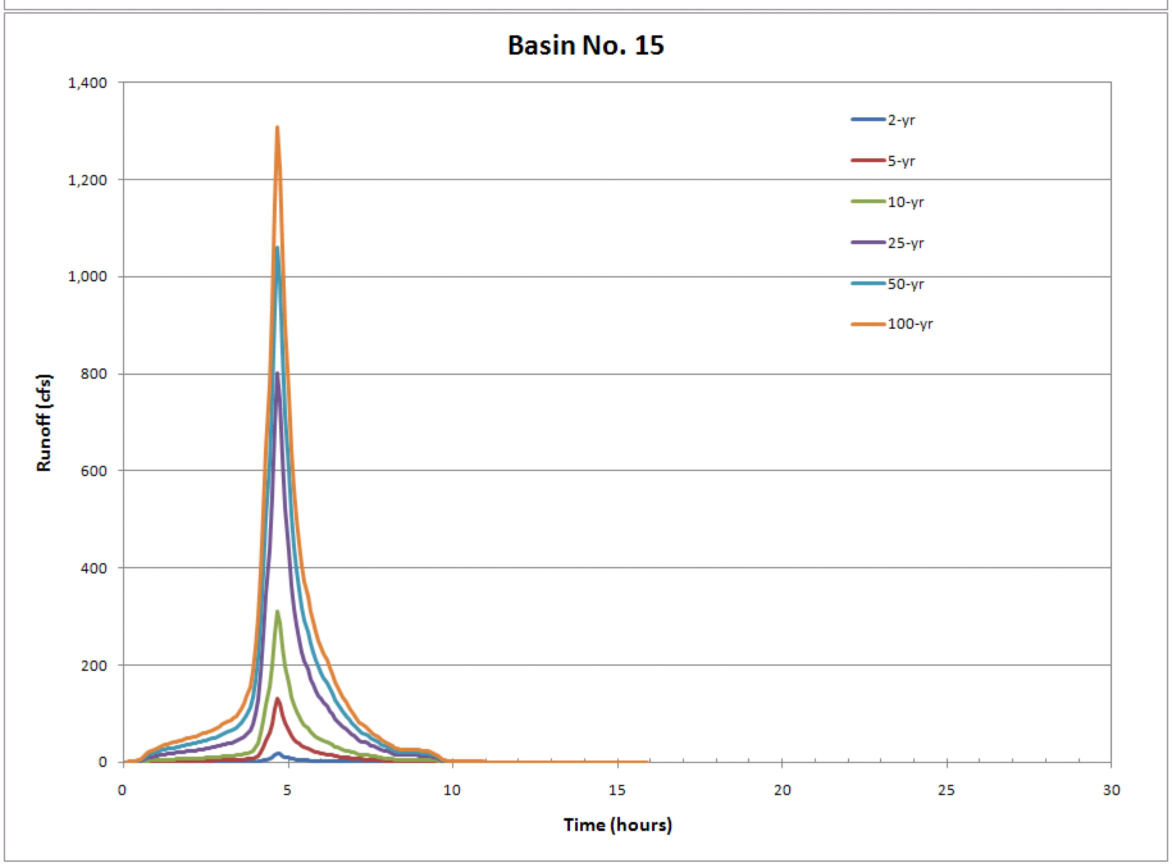

Basin No. 10
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
500
1,000
1,500
2,000
2,500
0
5
10
15
20
25
30

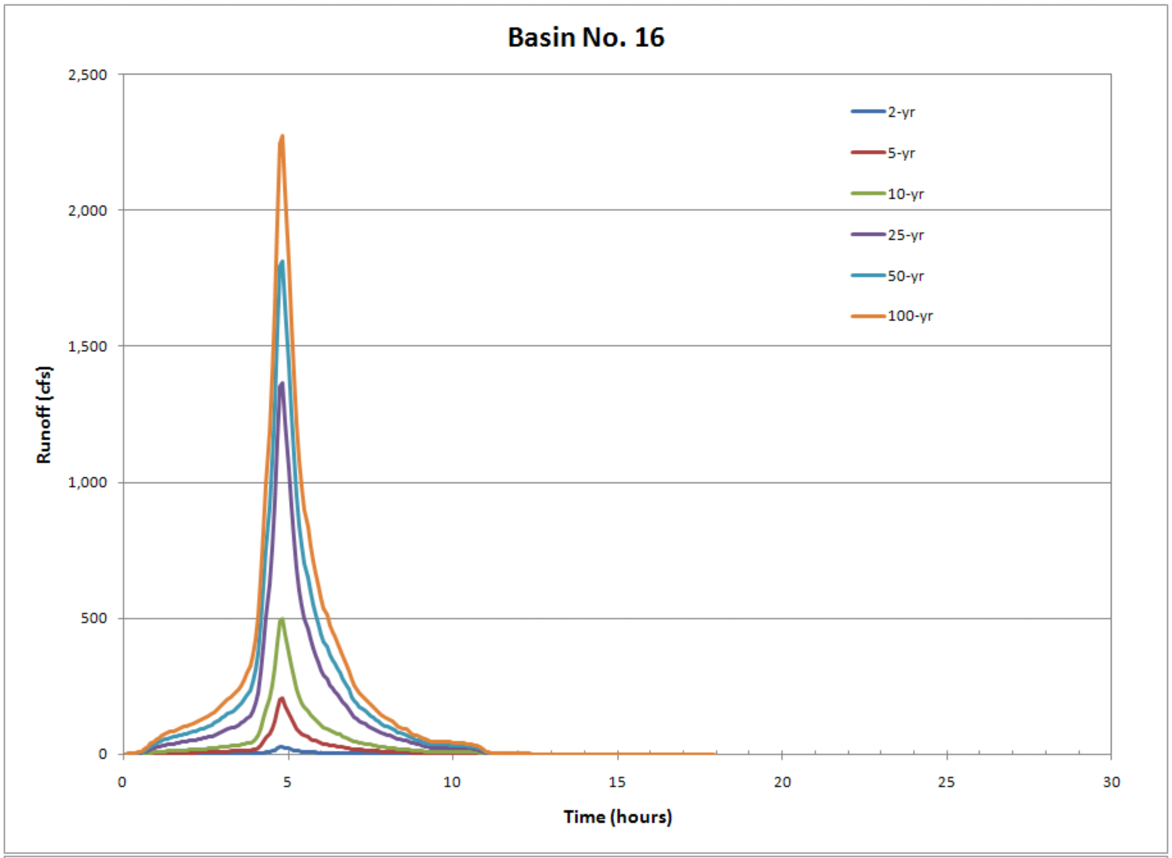

Basin No. 11
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
200
400
600
800
1,000
1,200
1,400
1,600
0
5
10
15
20
25
30

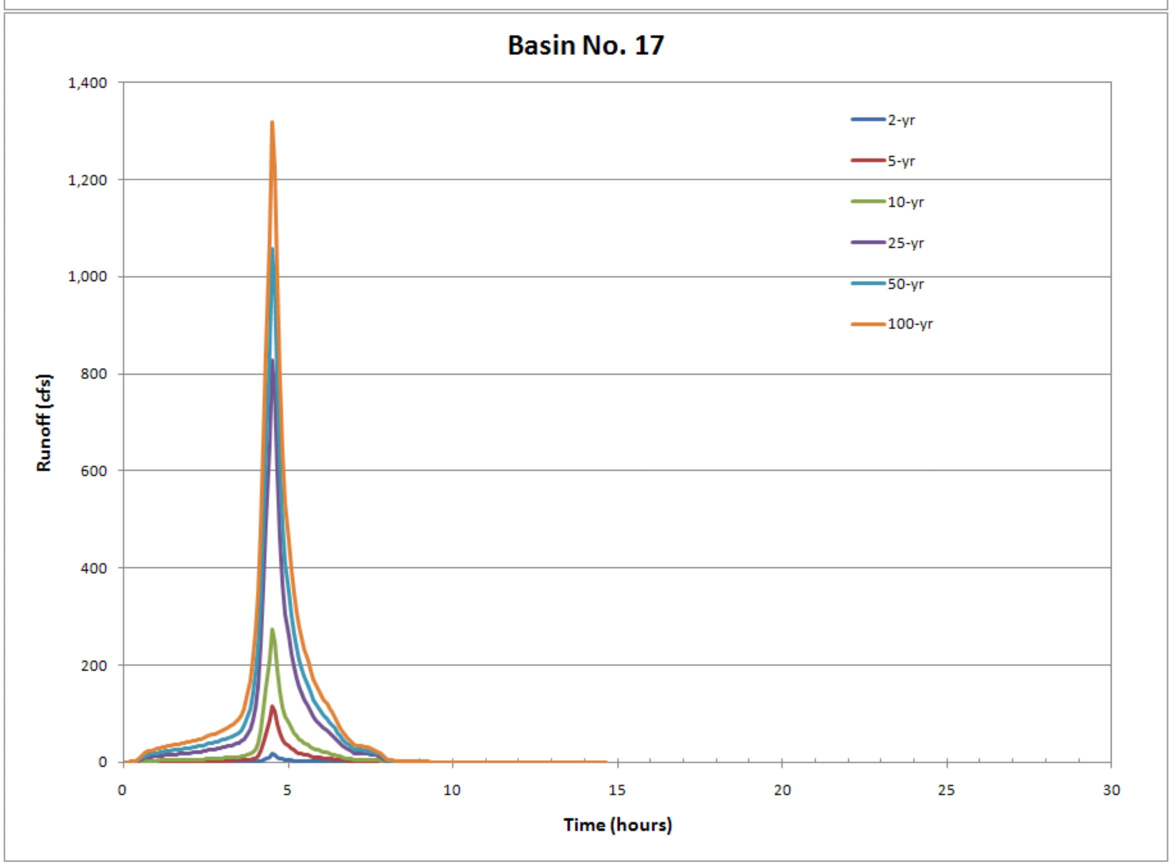

Basin No. 12
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

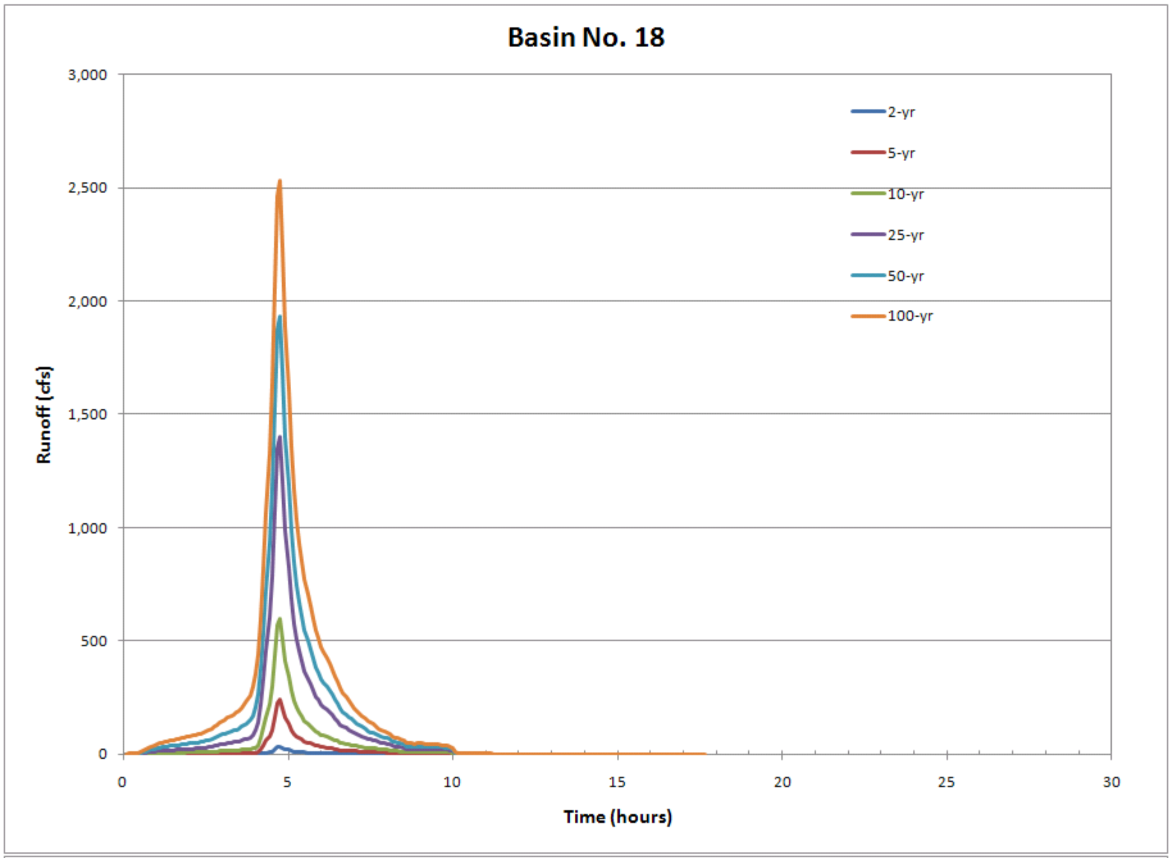

Basin No. 13
900
800
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

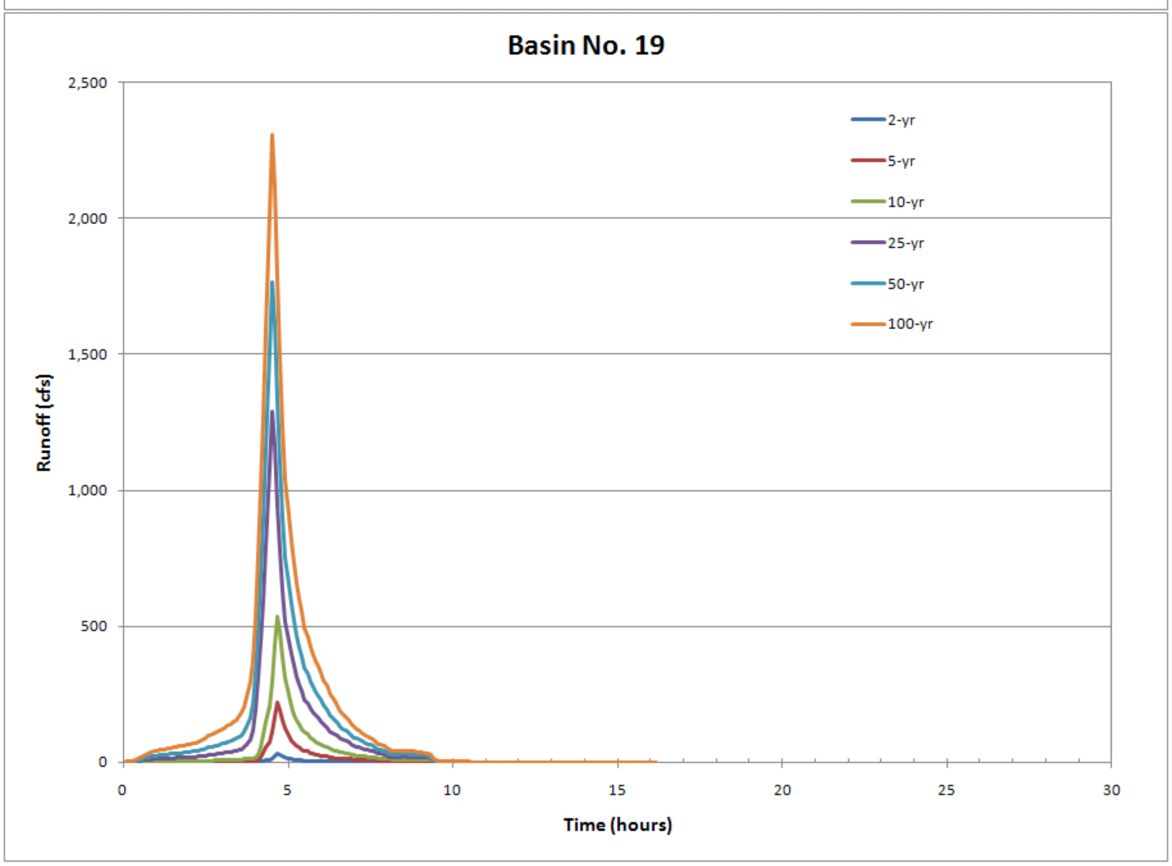

Basin No. 14
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

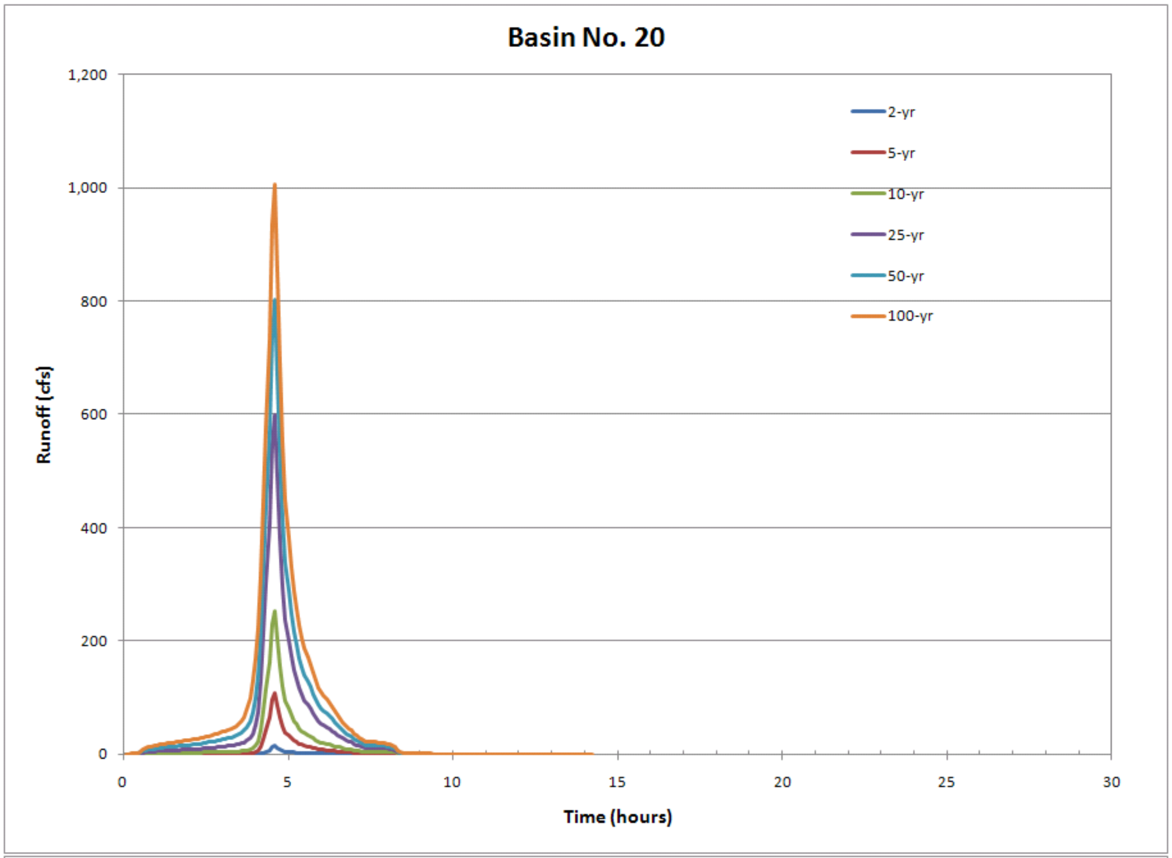

Basin No. 15
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

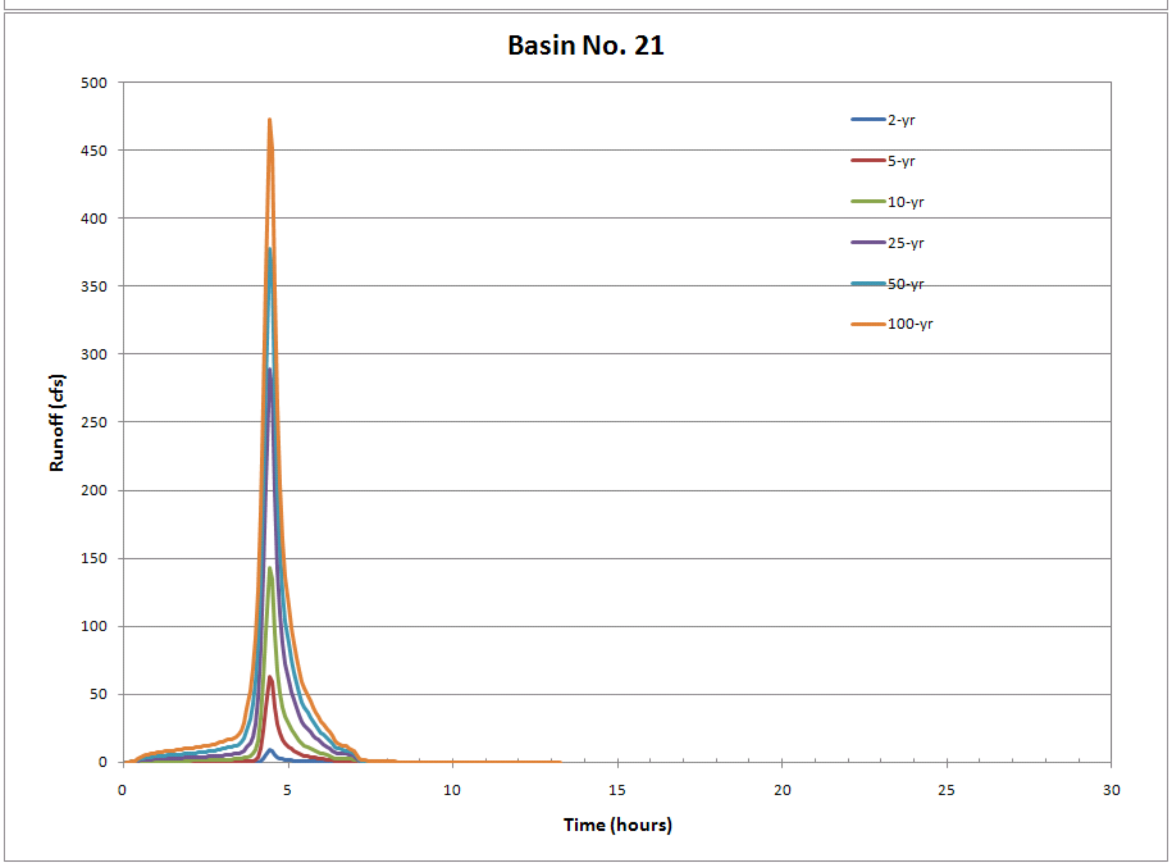

Basin No. 16
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

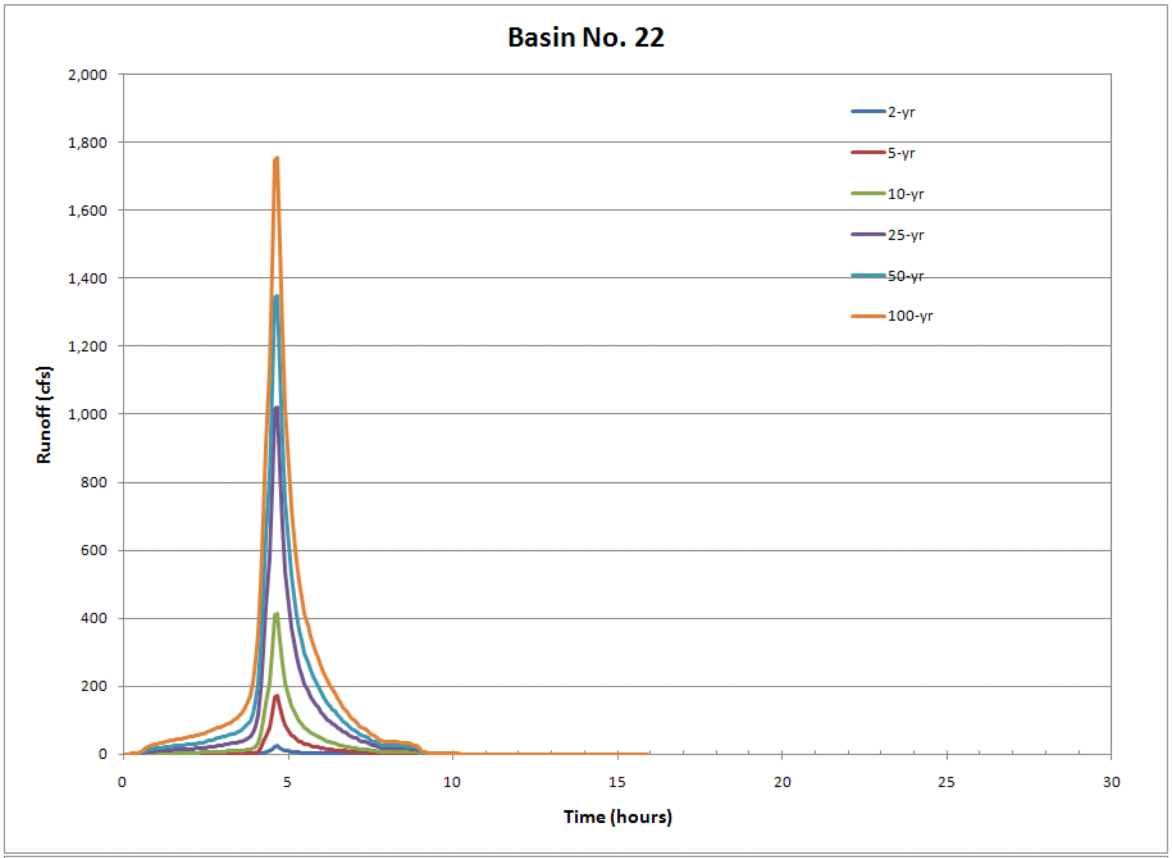

Basin No. 17
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

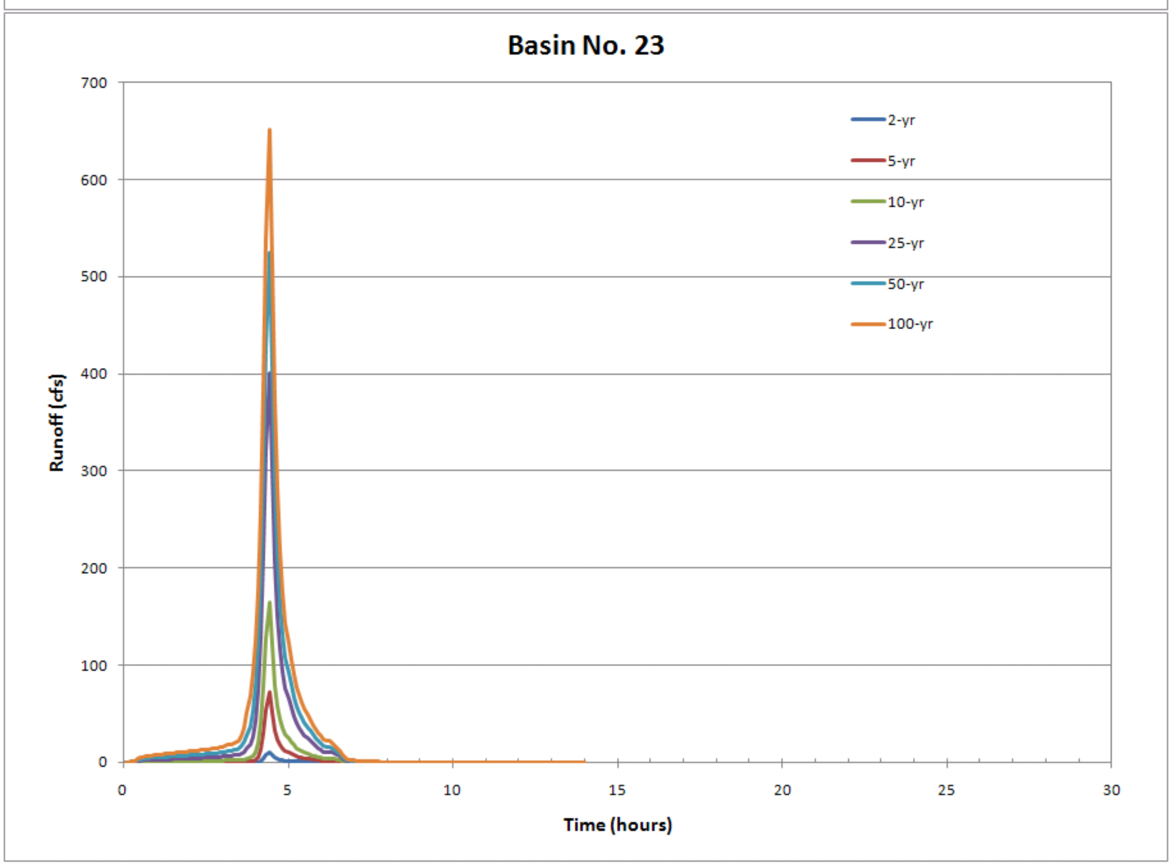

Basin No. 18
3,000
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

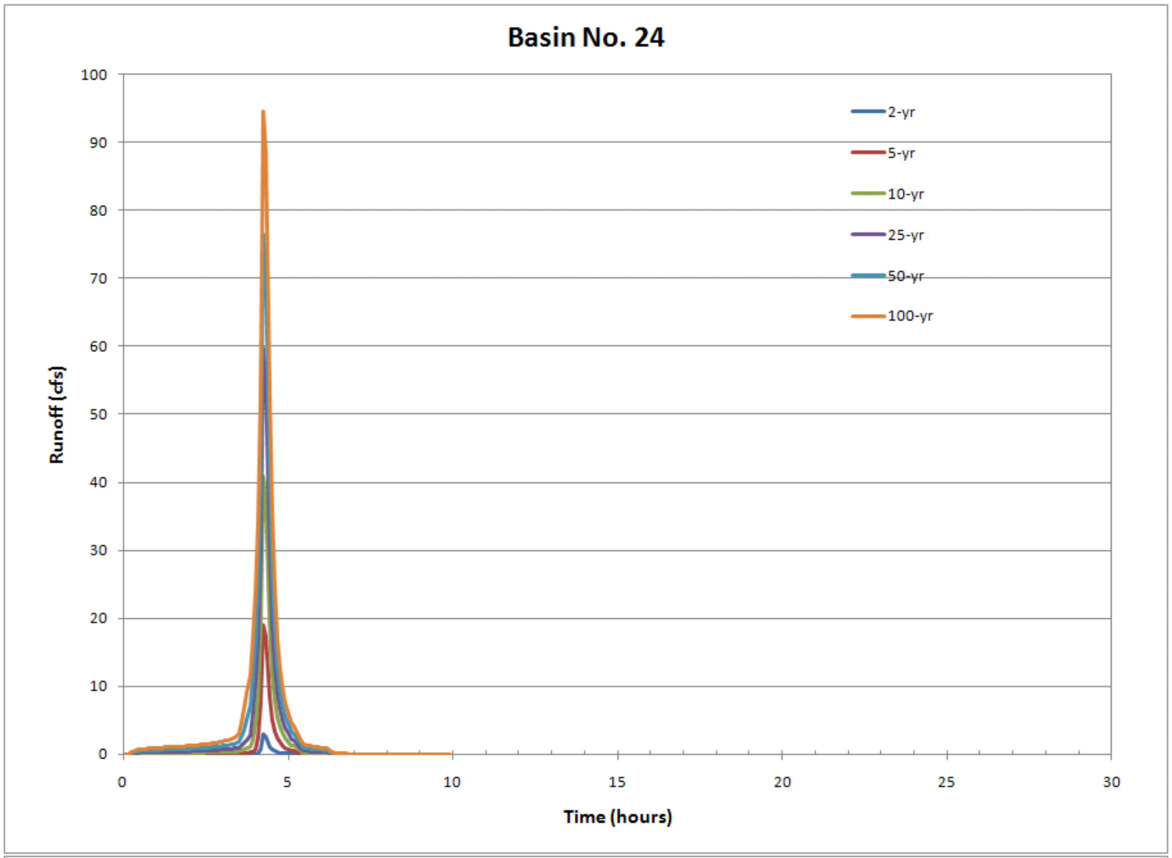

Basin No. 19
2,500
2,000
1,500
1,000
500
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

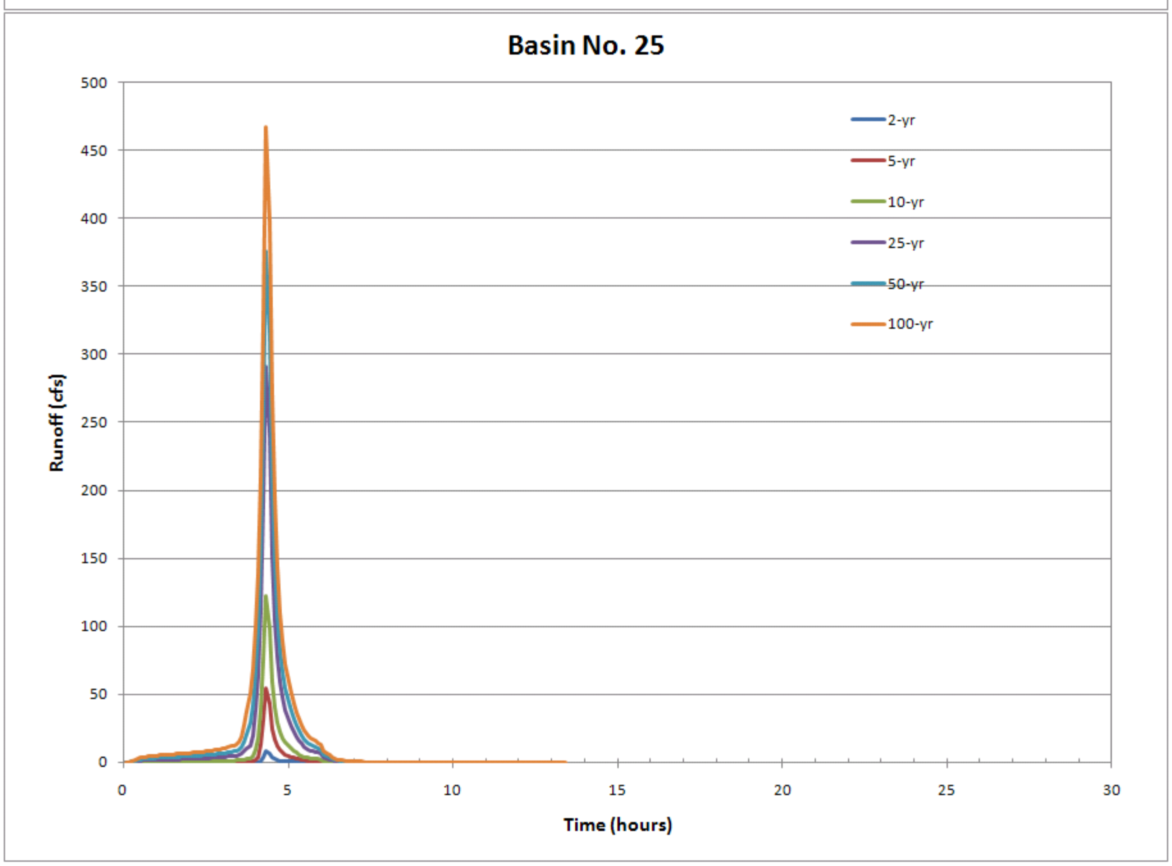

Basin No. 20
Runoff (cfs)
Time (hours)
0
200
400
600
800
1,000
1,200
0
5
10
15
20
25
30
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

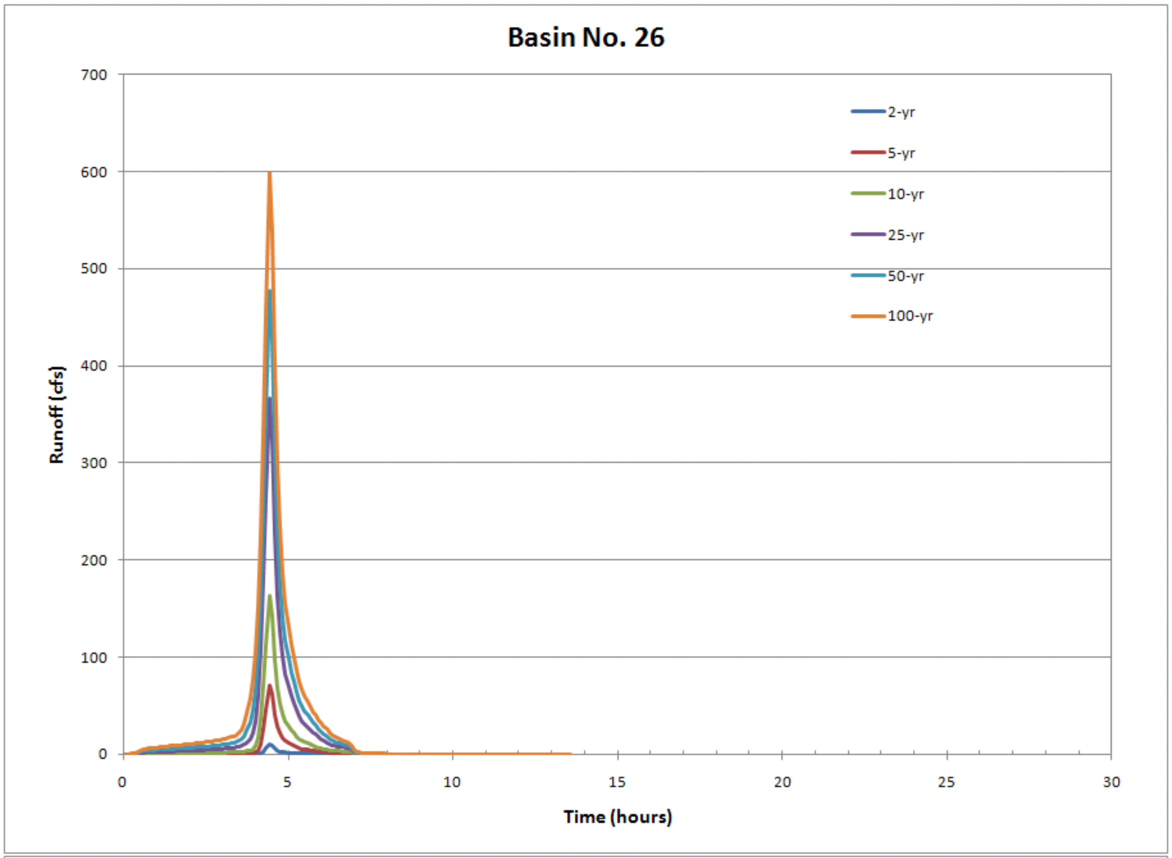

Basin No. 21
Runoff (cfs)
Time (hours)
0
50
100
150
200
250
300
350
400
450
500
0
5
10
15
20
25
30
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

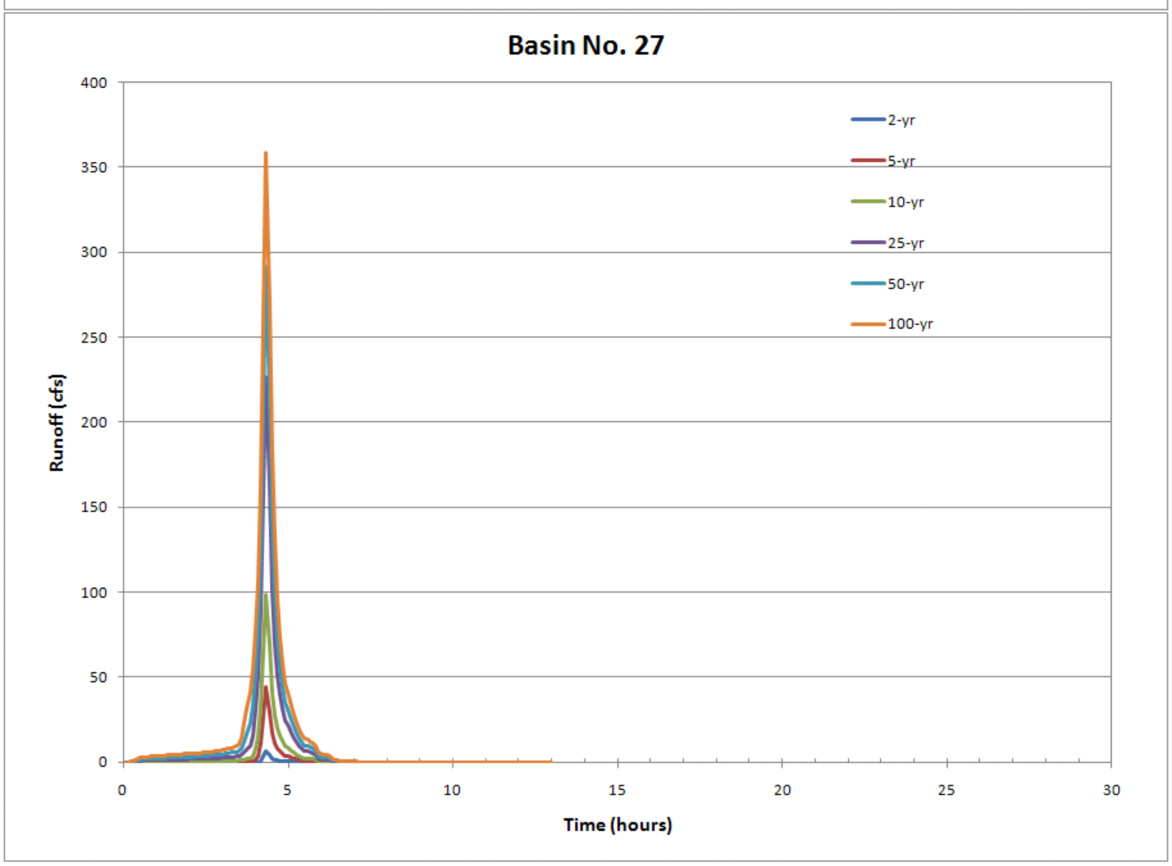

Basin No. 22
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

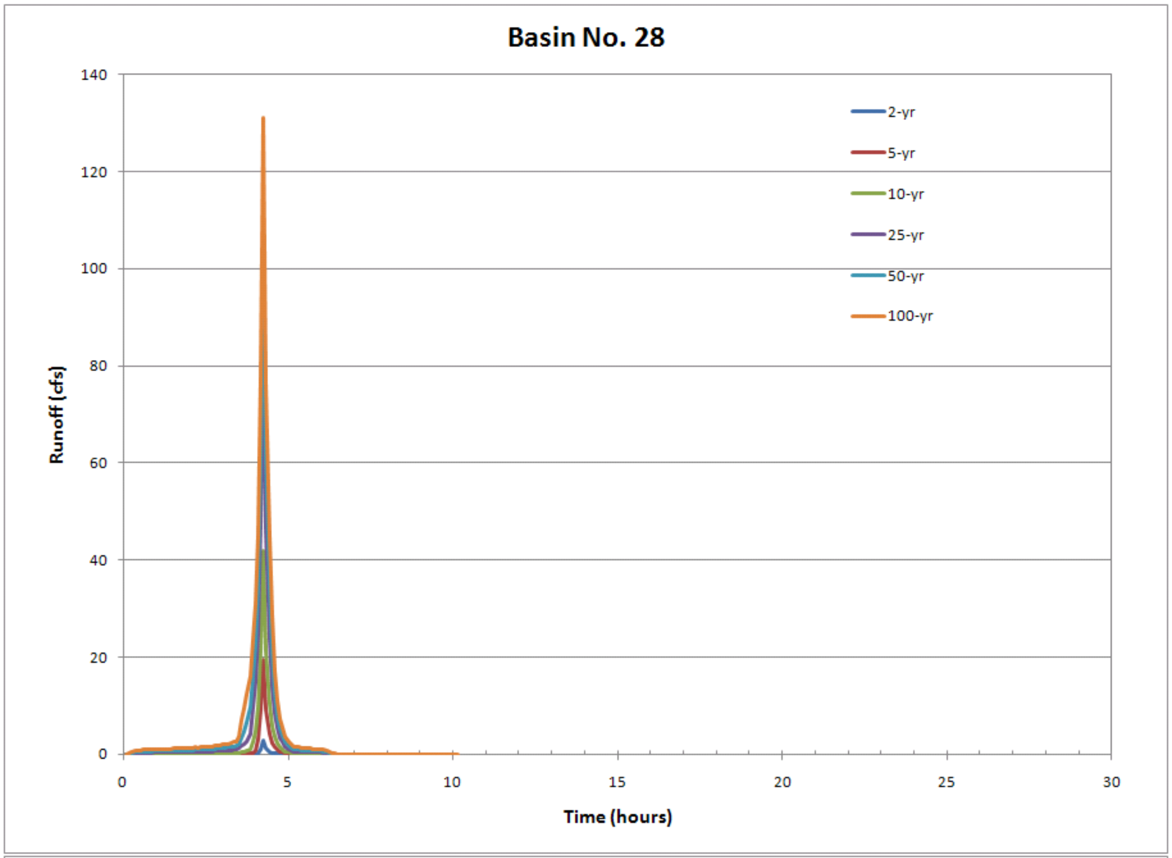

Basin No. 23
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

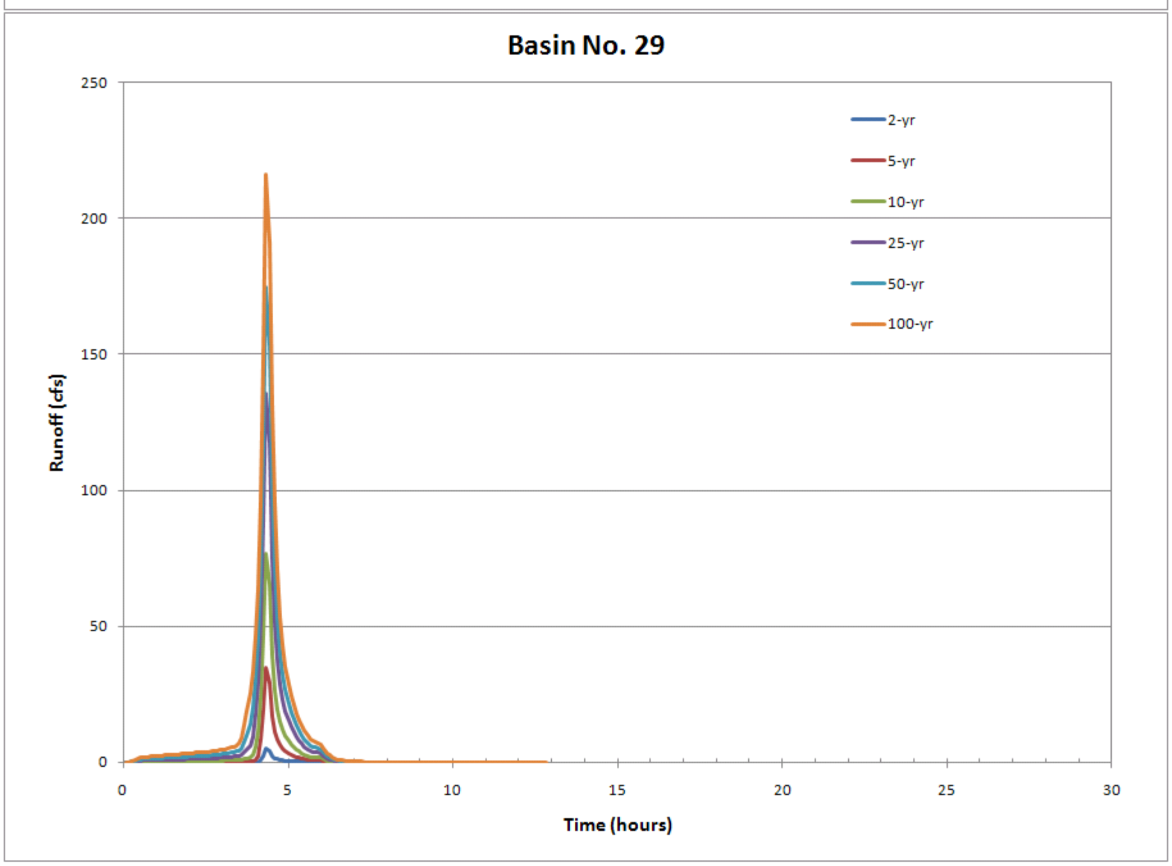

Basin No. 24
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30

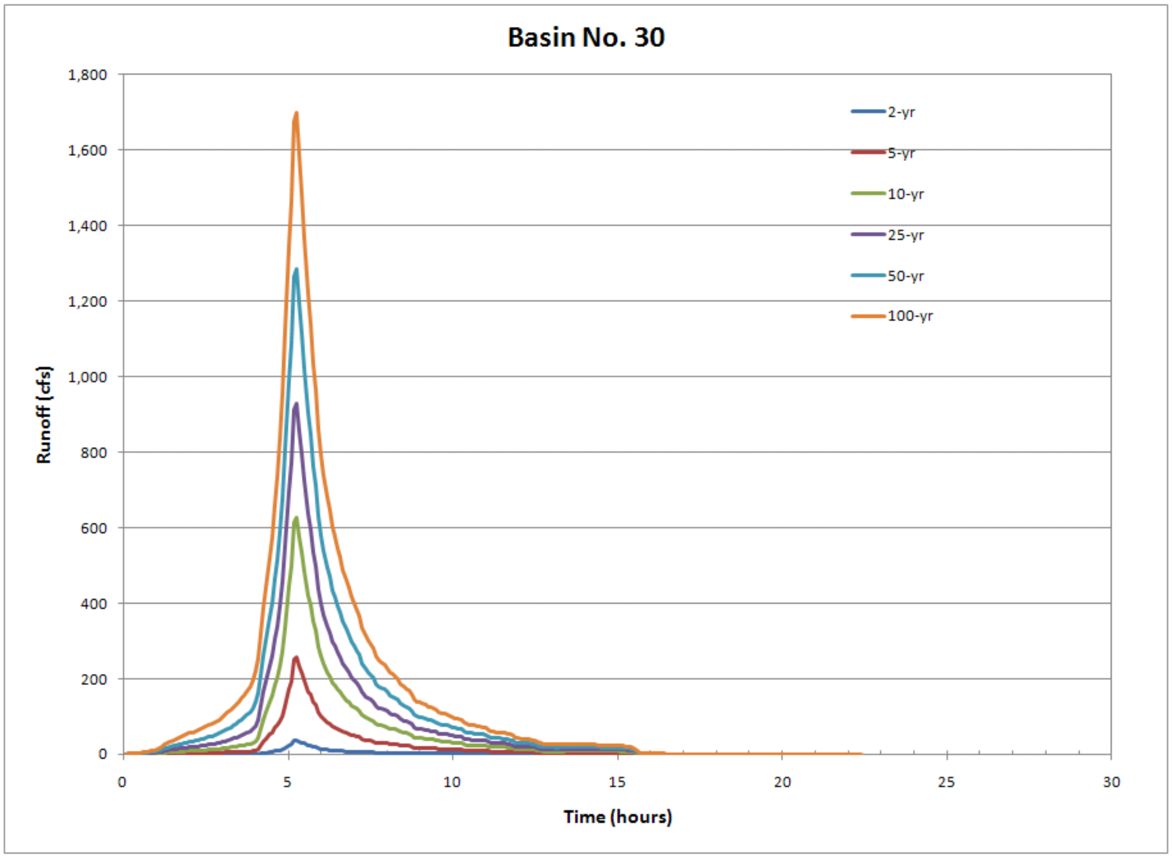

Basin No. 25
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
50
100
150
200
250
300
350
400
450
500
0
5
10
15
20
25
30


Basin No. 26
700
600
500
400
300
200
100
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr


Basin No. 27
400
350
300
250
200
150
100
50
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

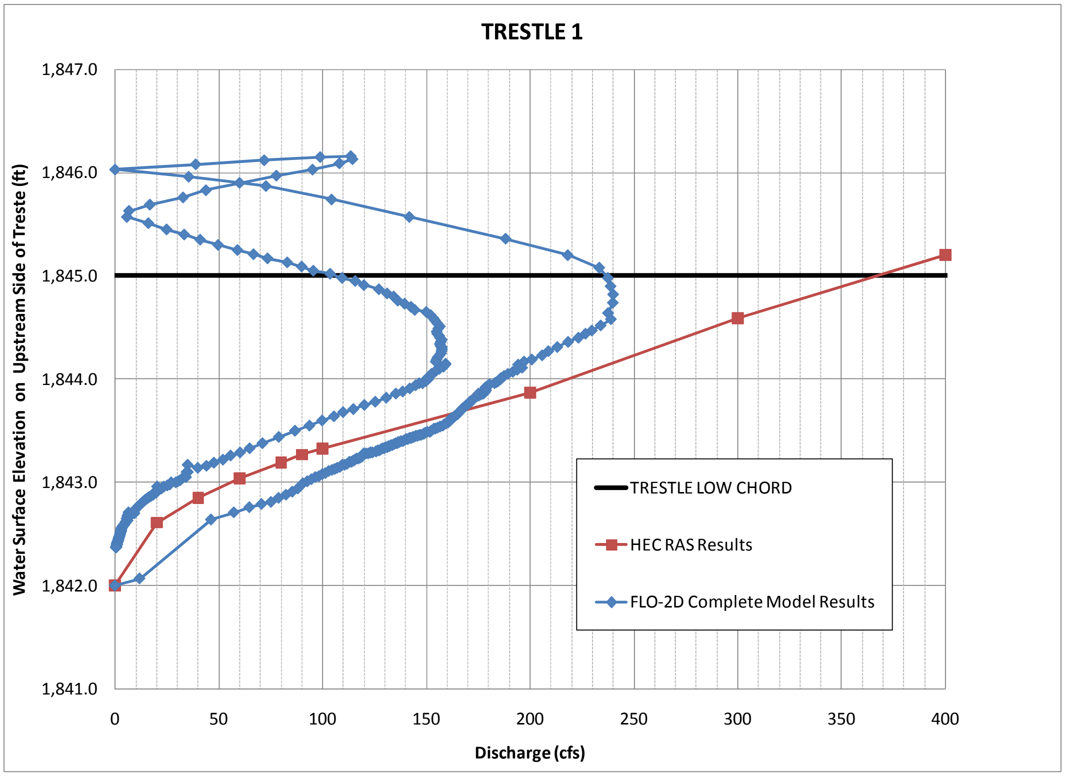

Basin No. 28
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
20
40
60
80
100
120
140
0
5
10
15
20
25
30


Basin No. 29
Runoff (cfs)
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr
0
50
100
150
200
250
0
5
10
15
20
25
30

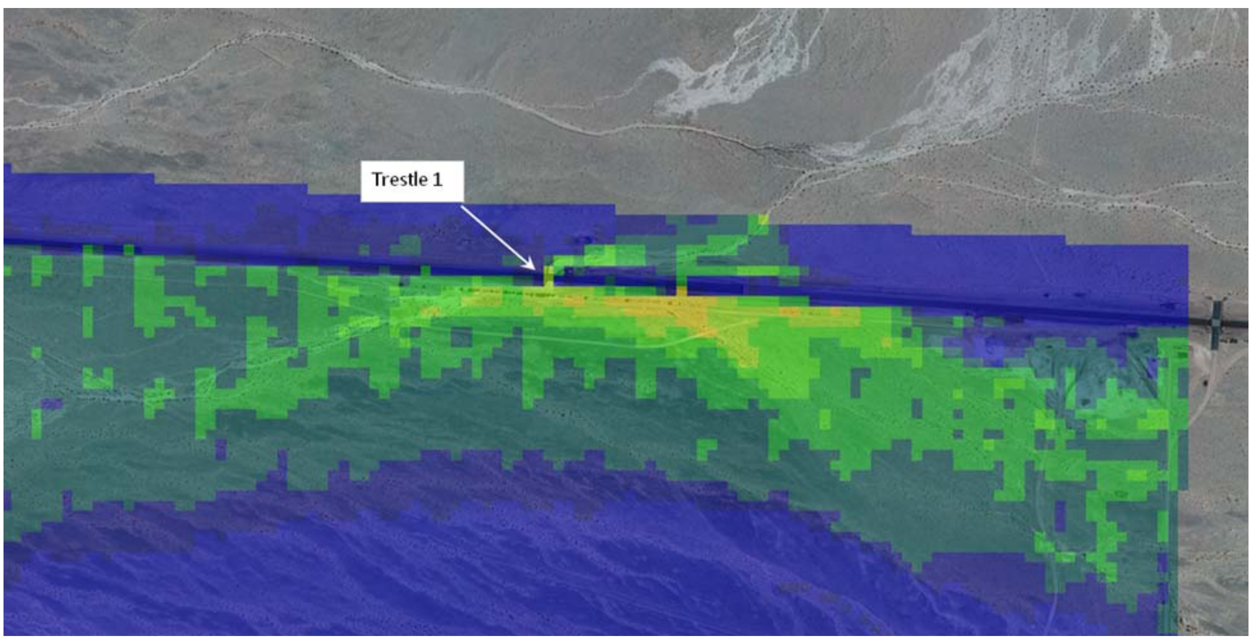

Basin No. 30
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Runoff (cfs)
0
5
10
15
20
25
30
Time (hours)
2-yr
5-yr
10-yr
25-yr
50-yr
100-yr

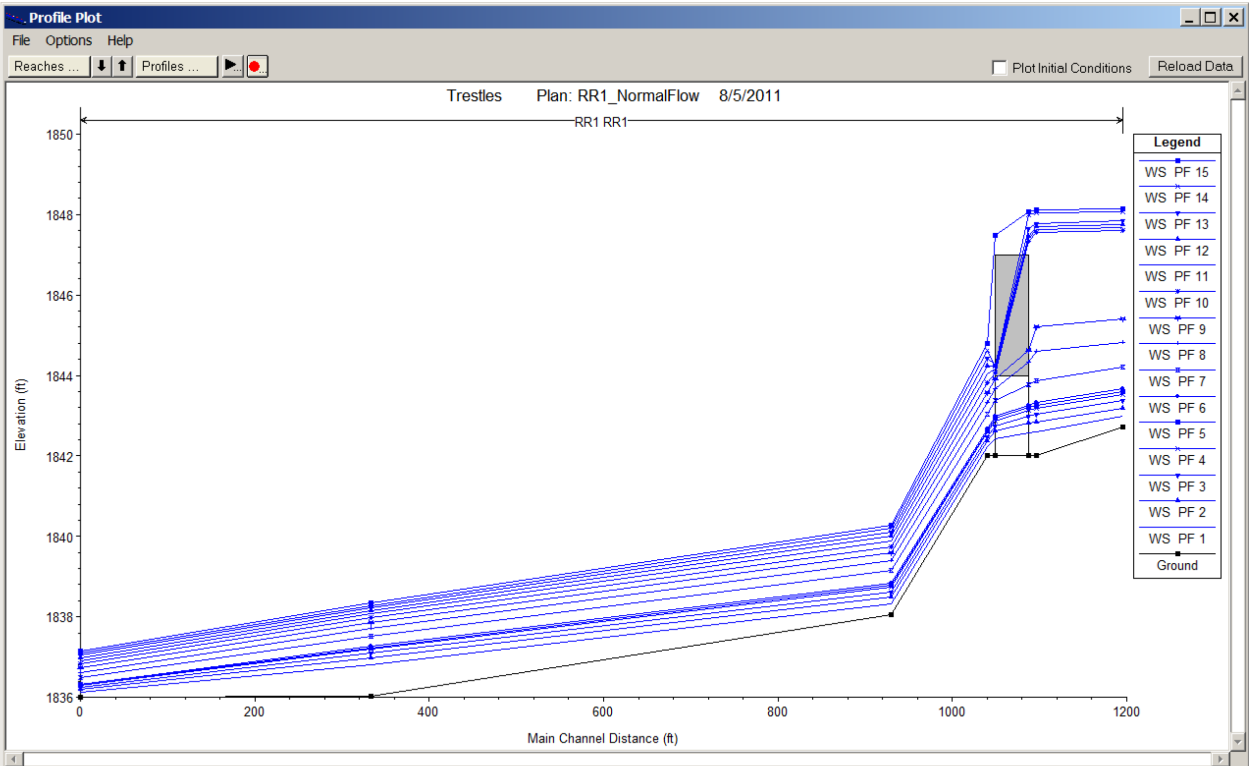
APPENDIX B
HYDRAULICS

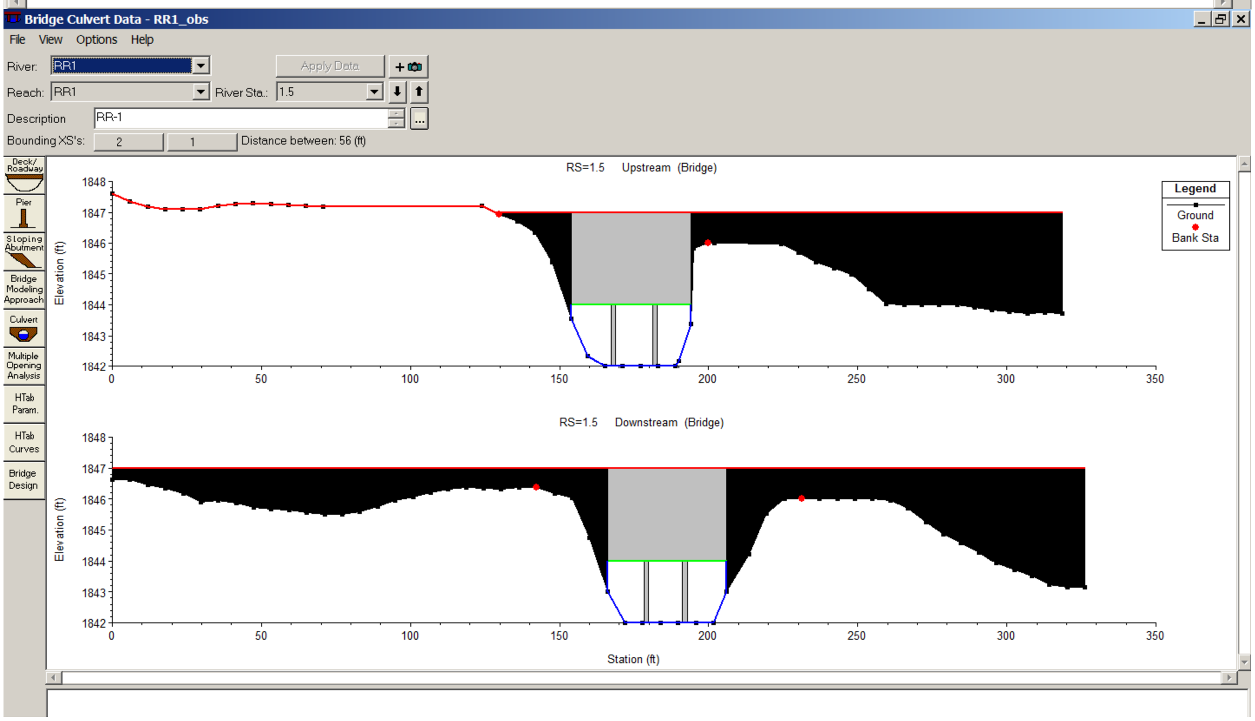
TETRA TECH



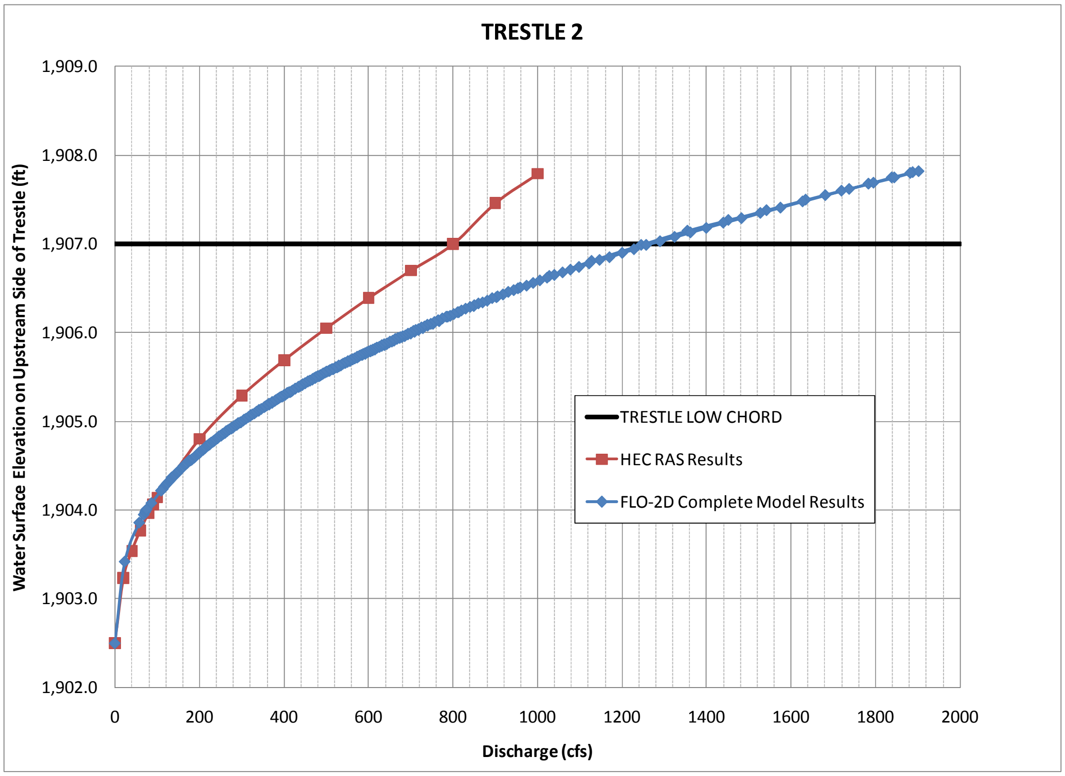
FLO-2D results for the 100-year storm: Flow passes under the trestle from the north and also from the south (as flows traveling to the west access the trestle as well). The direction of flow is time dependent relative to the water surface elevation on each side of the railroad and therefore the WSEL on the north side (plotted above) fluctuates with the altering flow direction, etc.



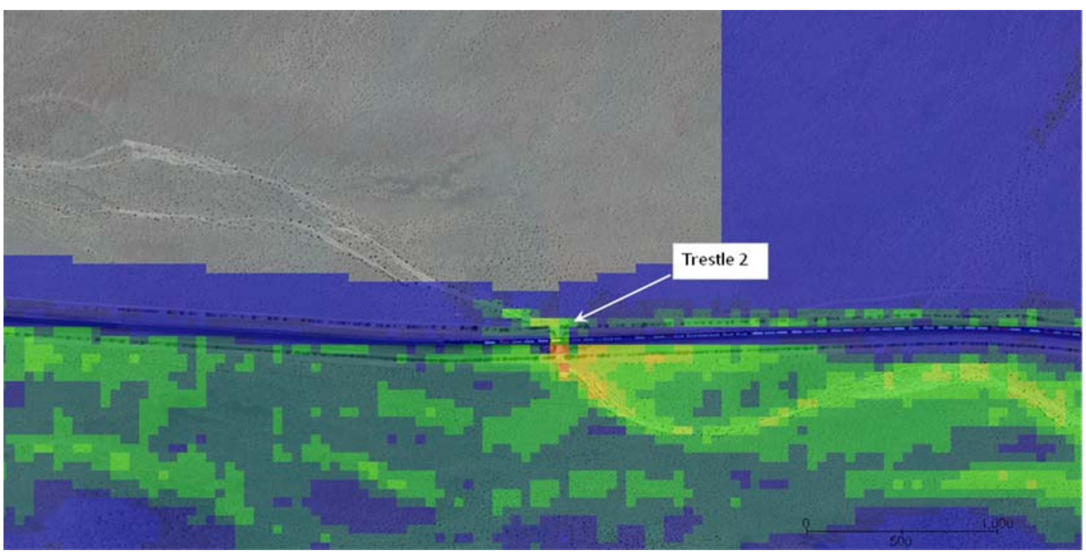

Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR1_NormalFlow 8/5/2011
RR1 RR1
Elevation (ft)
Main Channel Distance (ft)
Legend
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground


Bridge Culvert Data - RR1_obs
File View Options Help
River: RR1
Apply Data
Reach: RR1
River Sta.: 1.5
Description RR-1
Bounding XS's: 2 1 Distance between: 56 (ft)
Deck/Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=1.5 Upstream (Bridge)
RS=1.5 Downstream (Bridge)
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta

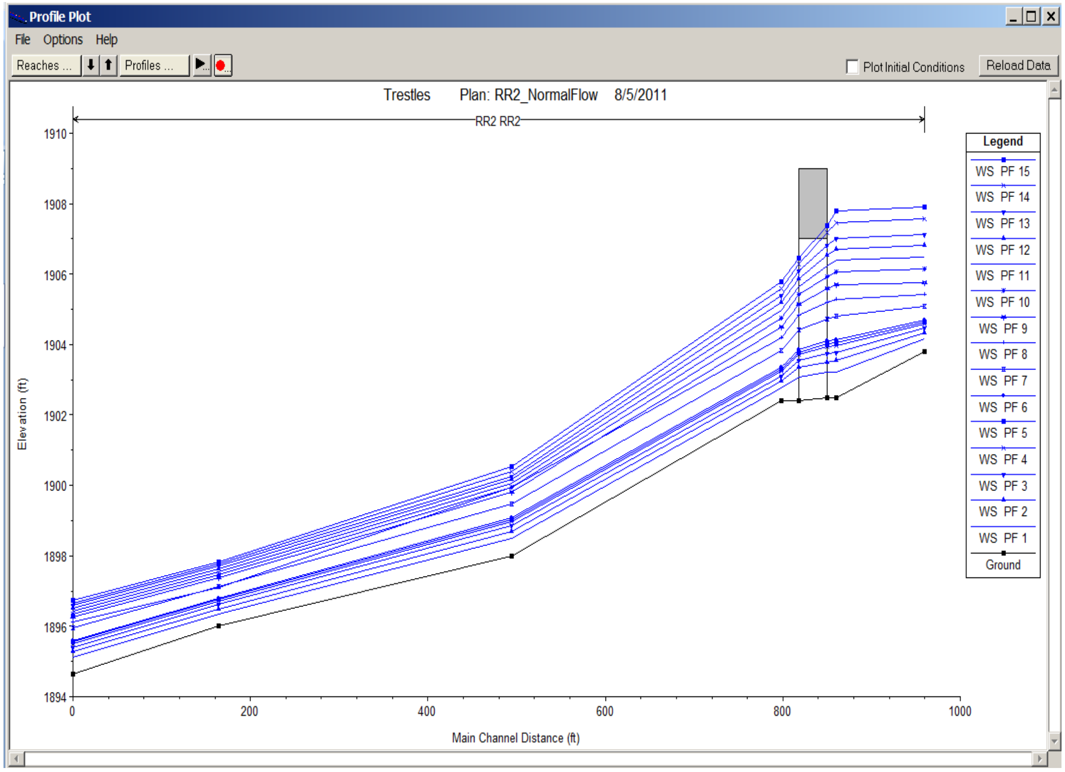
TETRA TECH

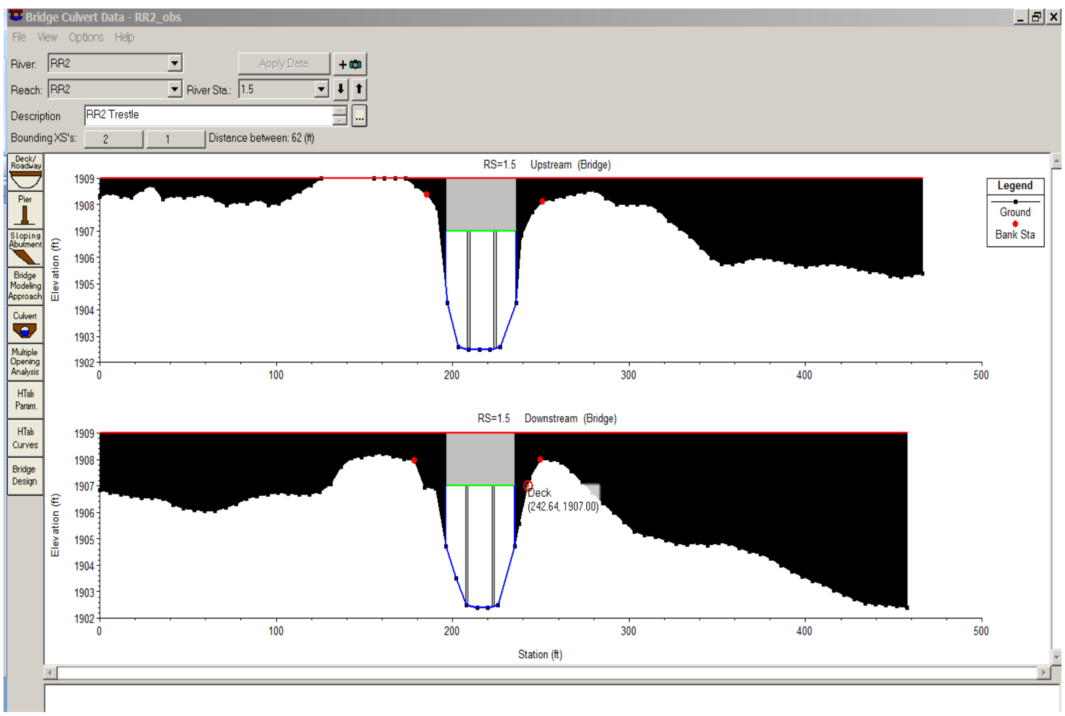


FLO-2D results for 100-year storm: Flows cross under railroad from south to north and also disperse along southern side of railroad embankment.



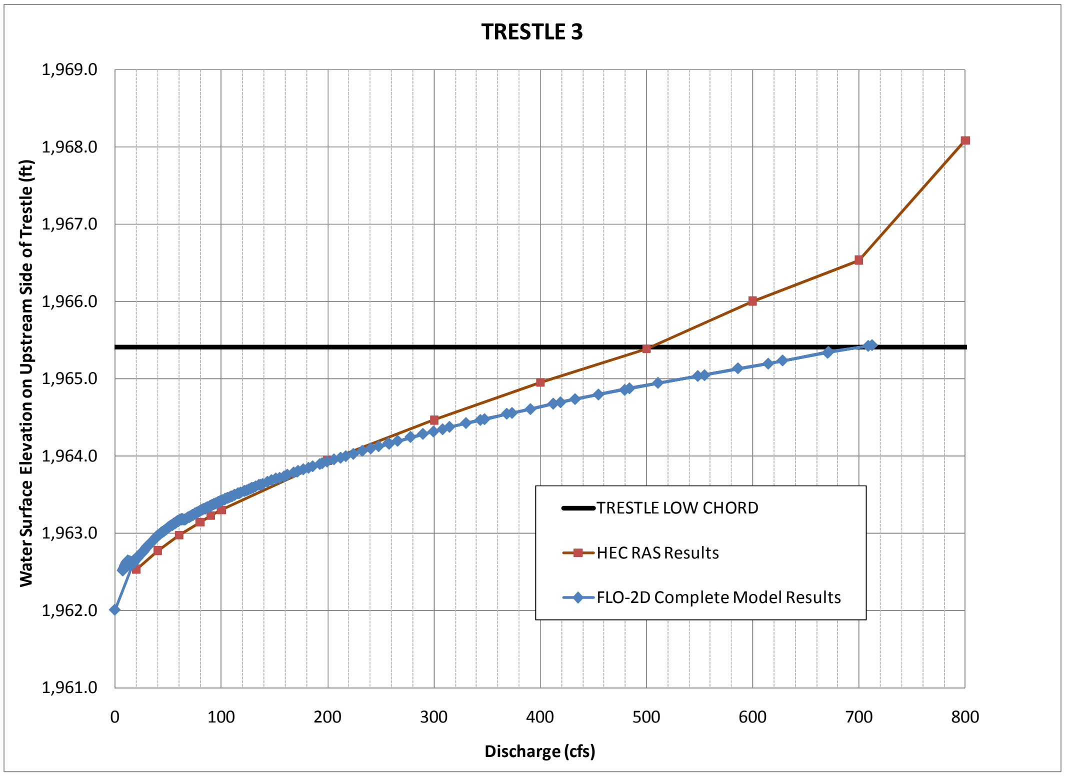
TETRA TECH


Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR2_NormalFlow 8/5/2011
RR2 RR2
Legend
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)

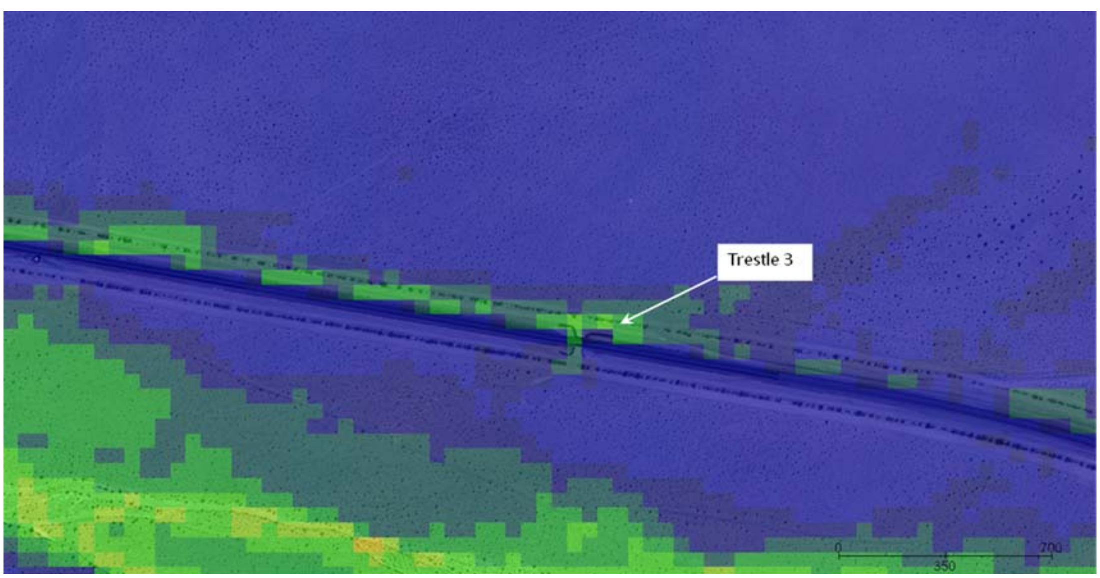

Bridge Culvert Data - RR2_obs
File View Options Help
River: RR2
Apply Data
Reach: RR2
River Sta.: 1.5
Description RR2 Trestle
Bounding XS's: 2 1 Distance between: 62 (ft)
RS=1.5 Upstream (Bridge)
RS=1.5 Downstream (Bridge)
Legend
Ground
Bank Sta
Deck
(242.64, 1907.00)
Elevation (ft)
Station (ft)

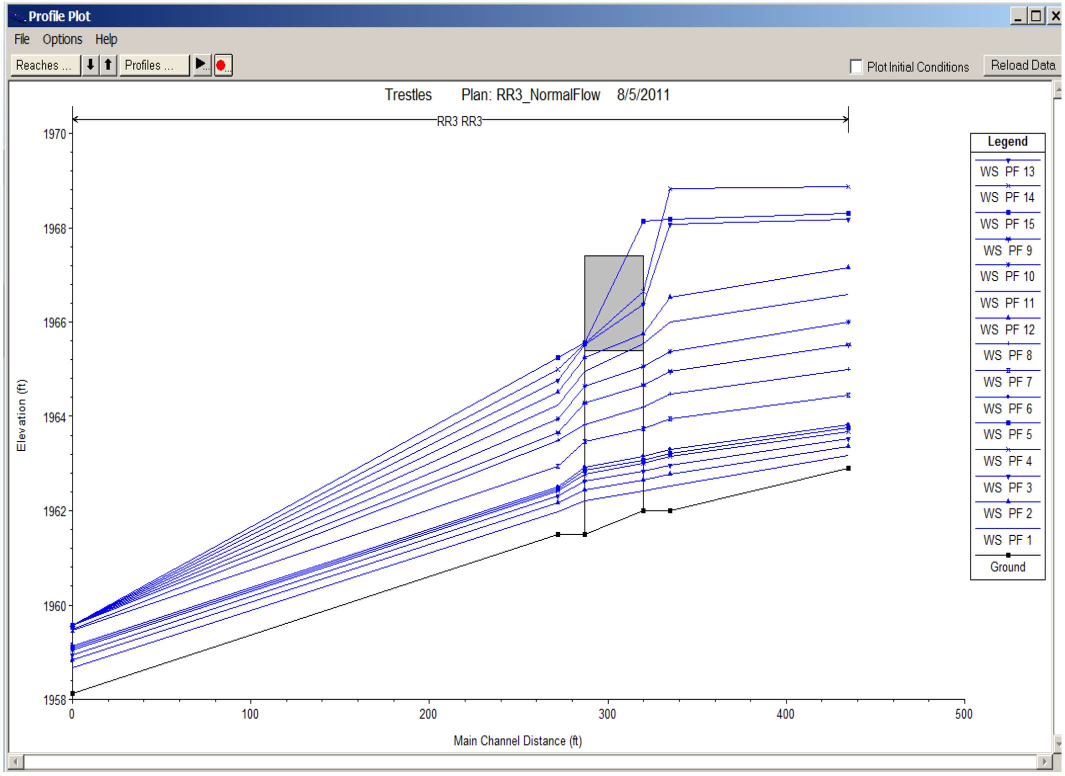
TETRA TECH

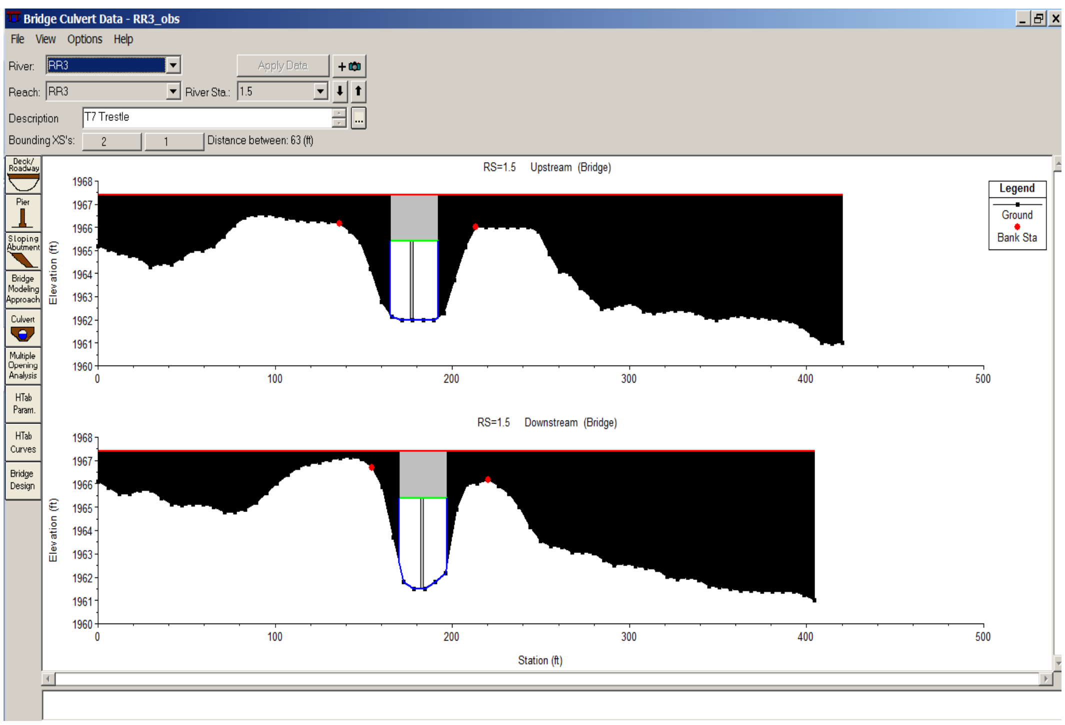
Trestle 2 - Photo taken looking upstream



FLO-2D Results - Trestle 3 is a small opening, some flow passes under the railroad and the remainder travels west on the north side of the railroad.

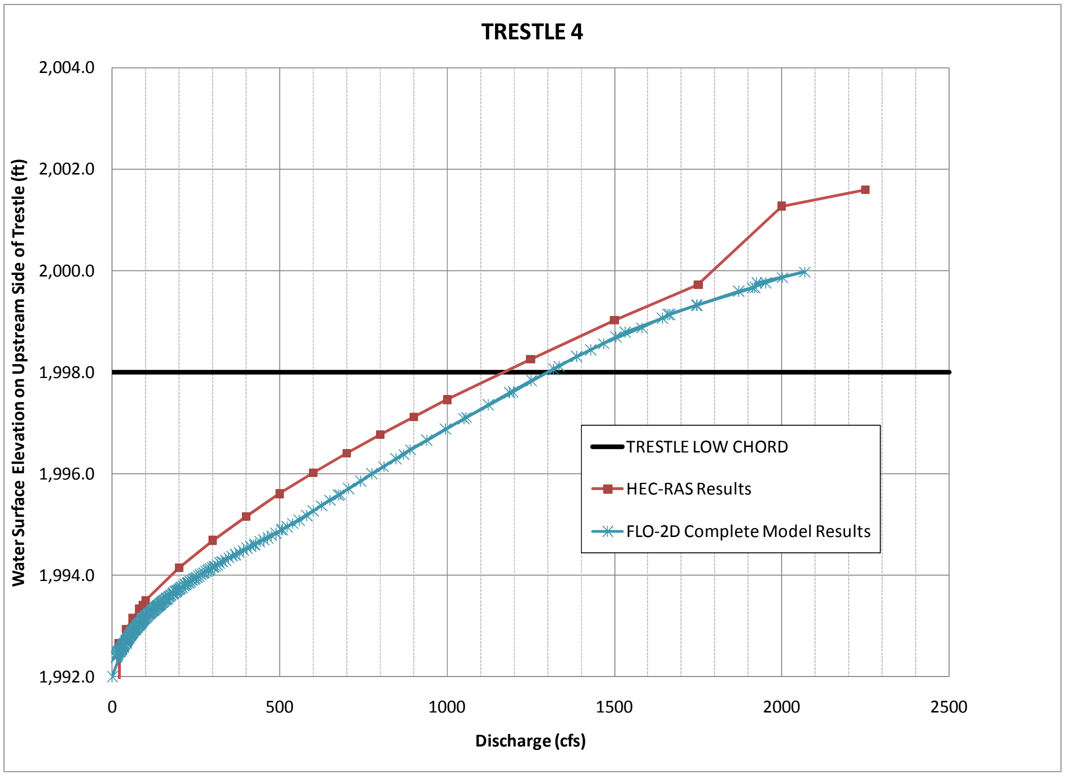



Profile Plot
Trestles Plan: RR3_NormalFlow 8/5/2011
RR3 RR3
Elevation (ft)
Main Channel Distance (ft)
Legend
WS PF 13
WS PF 14
WS PF 15
WS PF 9
WS PF 10
WS PF 11
WS PF 12
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground

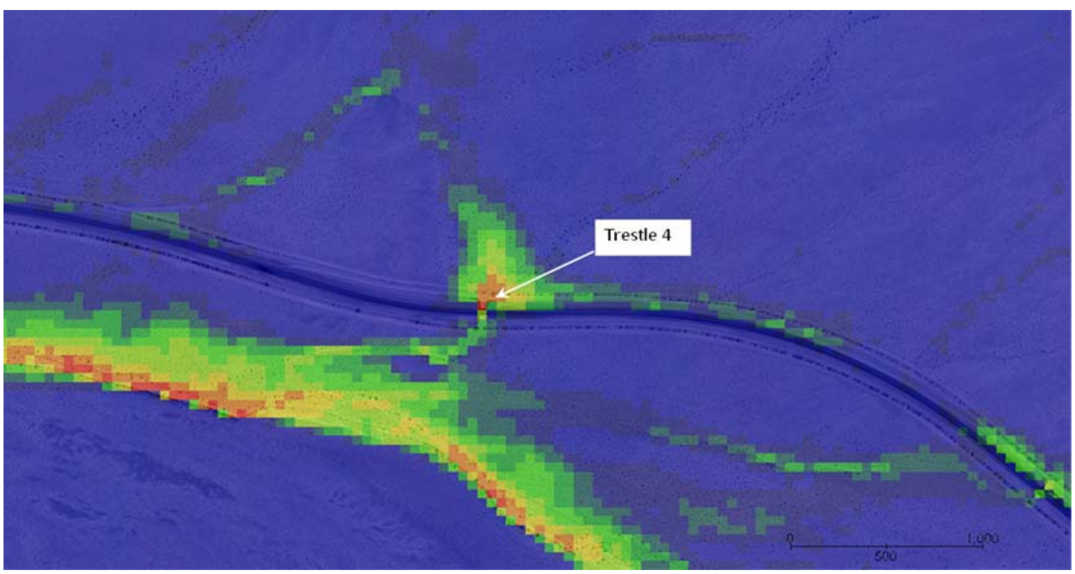

Bridge Culvert Data - RR3_obs
River: RR3
Reach: RR3 River Sta.: 1.5
Description T7 Trestle
Bounding XS's: 2 1 Distance between: 63 (ft)
RS=1.5 Upstream (Bridge)
RS=1.5 Downstream (Bridge)
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta

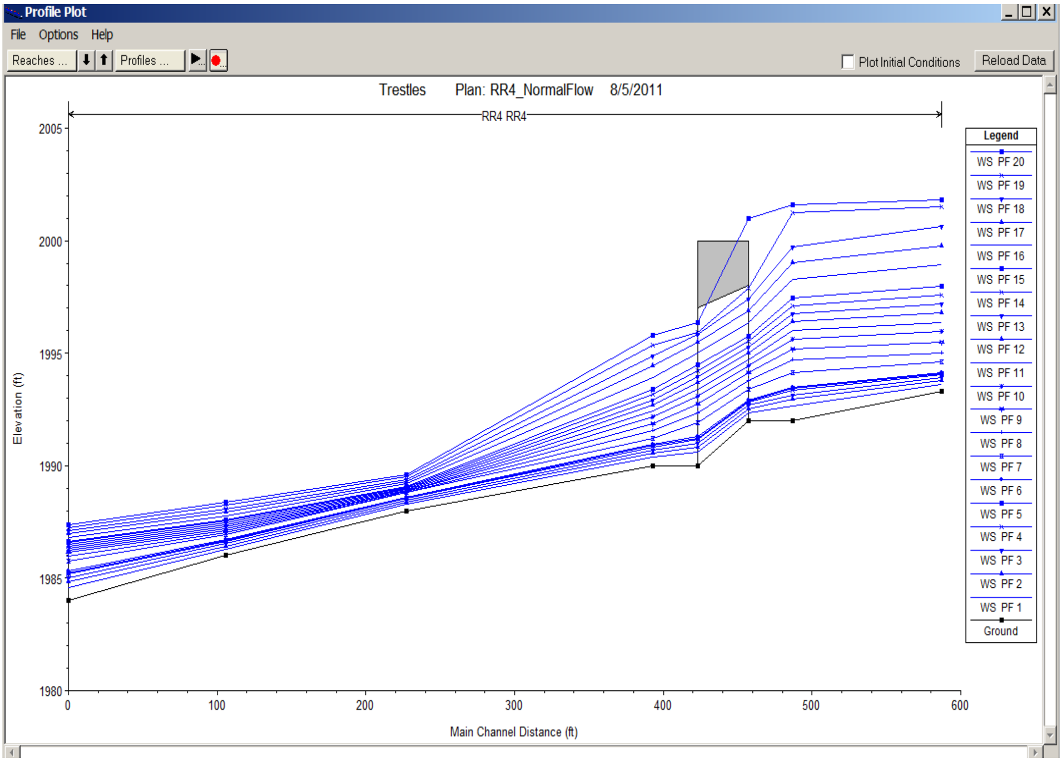
TETRA TECH

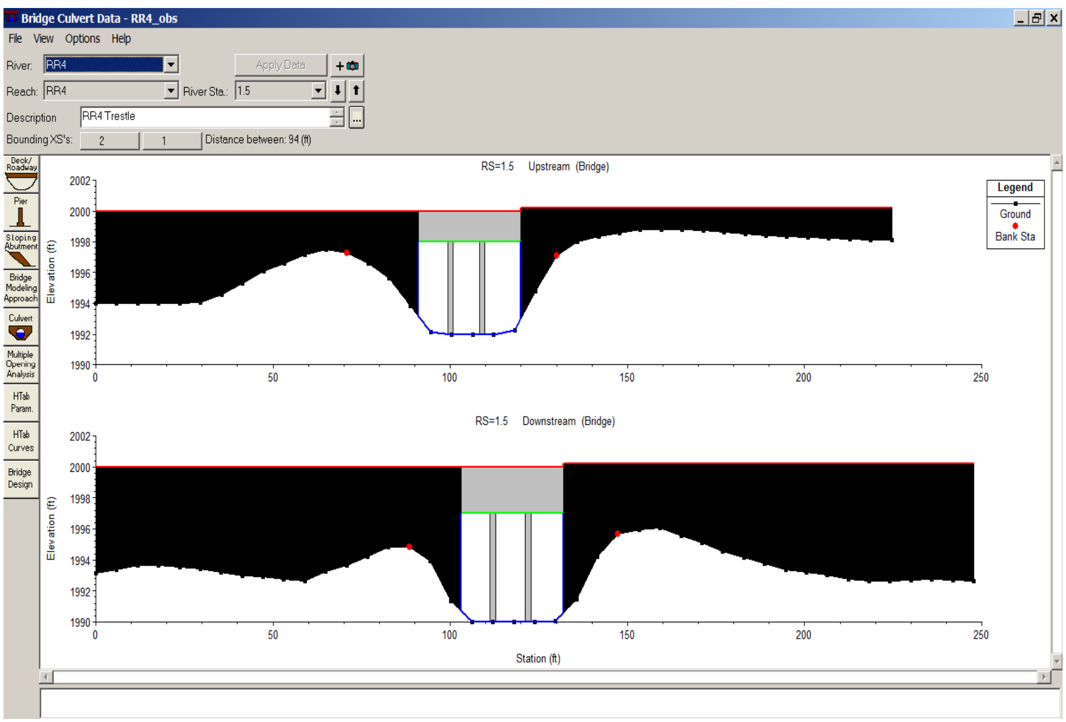
Trestle 3 - Photo taken looking upstream



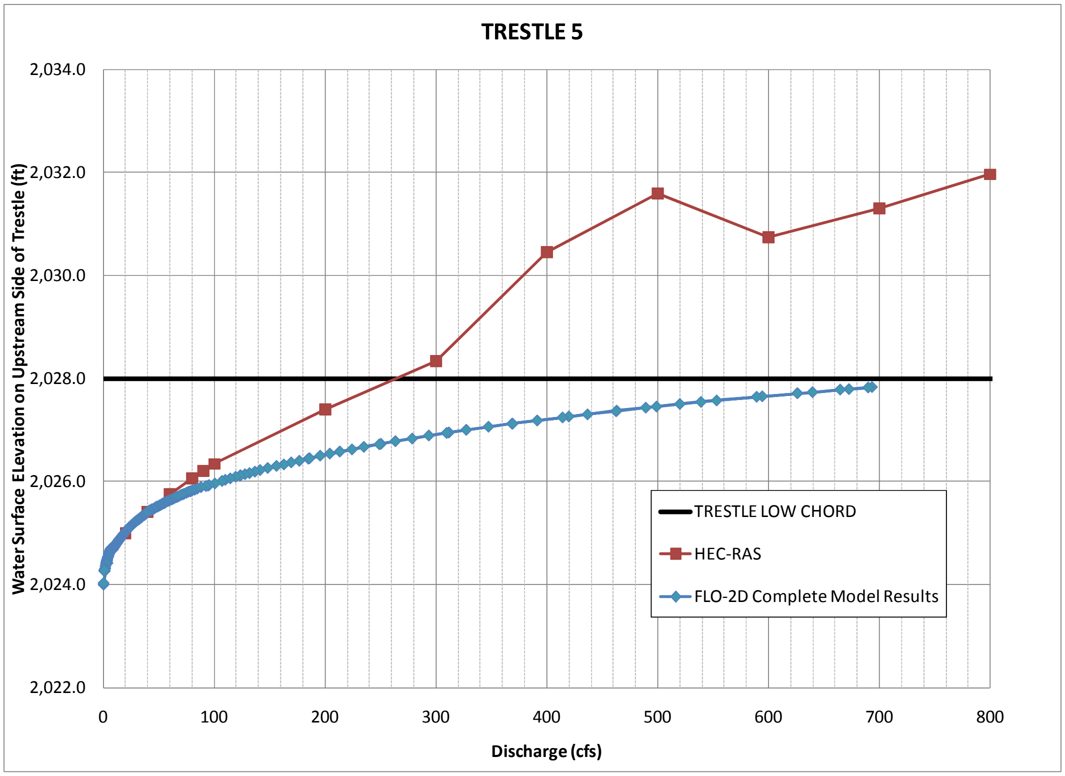
FLO-2D Results for the 100-year storm - Water ponds before flowing through trestle lending to lower WSELs than in the HEC-RAS model



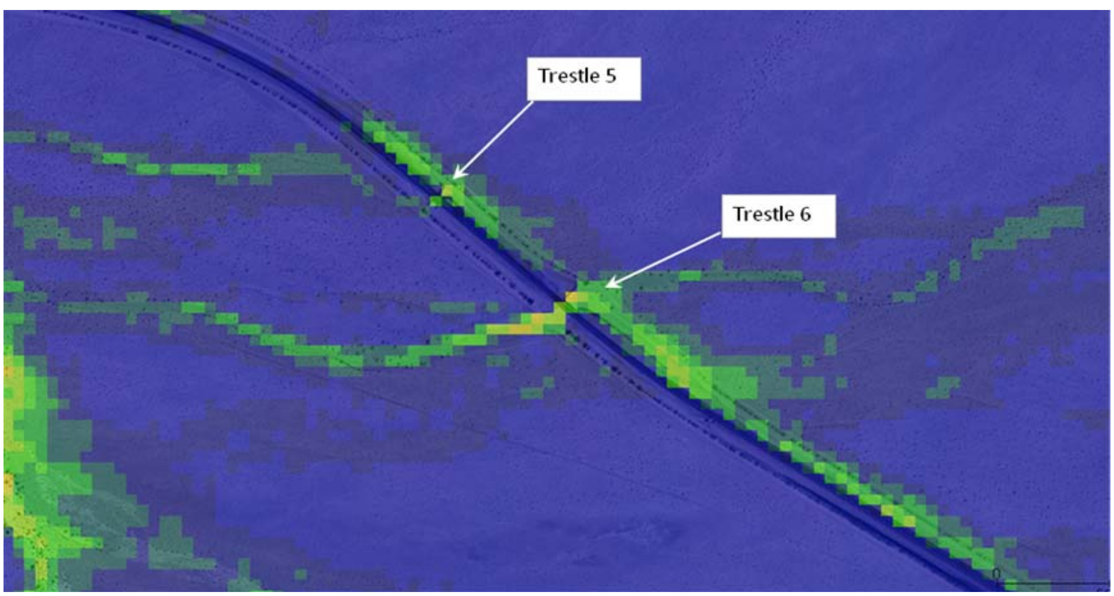

Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR4_NormalFlow 8/5/2011
RR4 RR4
Elevation (ft)
2005
2000
1995
1990
1985
1980
0
100
200
300
400
500
600
Main Channel Distance (ft)
Legend
WS PF 20
WS PF 19
WS PF 18
WS PF 17
WS PF 16
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground

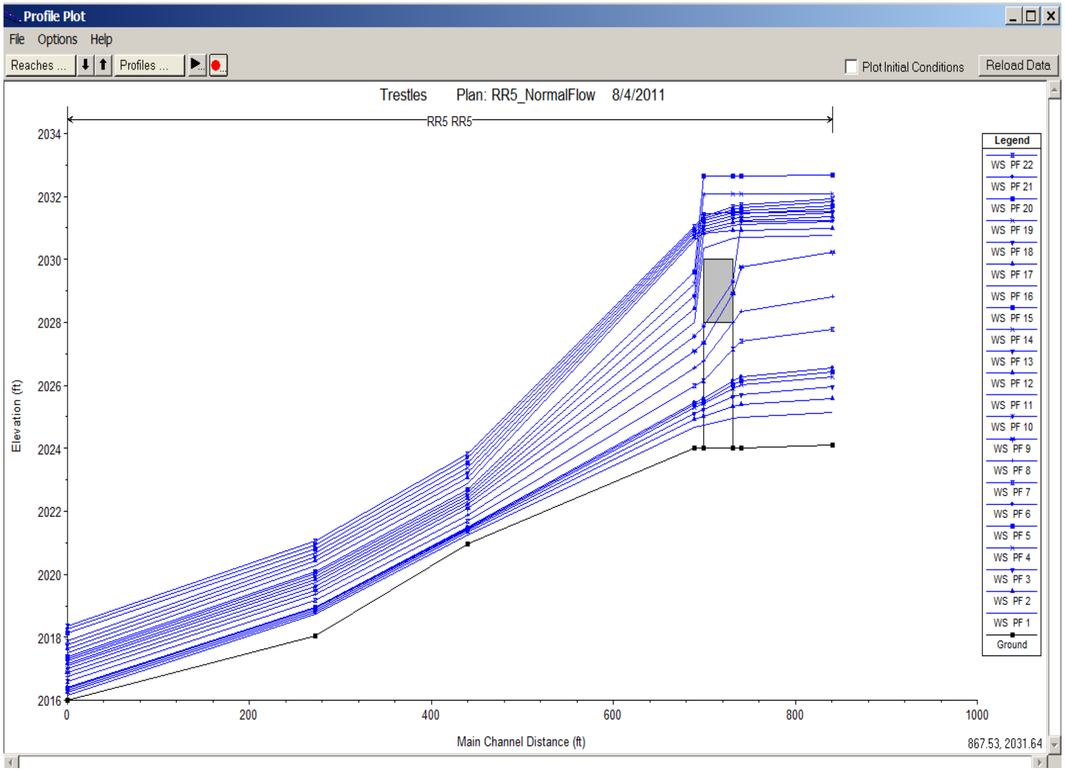

Bridge Culvert Data - RR4_obs
File View Options Help
River: RR4
Apply Data
Reach: RR4
River Sta.: 1.5
Description RR4 Trestle
Bounding XS's: 2 1 Distance between: 94 (ft)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=1.5 Upstream (Bridge)
Elevation (ft)
2002
2000
1998
1996
1994
1992
1990
0
50
100
150
200
250
Legend
Ground
Bank Sta
RS=1.5 Downstream (Bridge)
Station (ft)

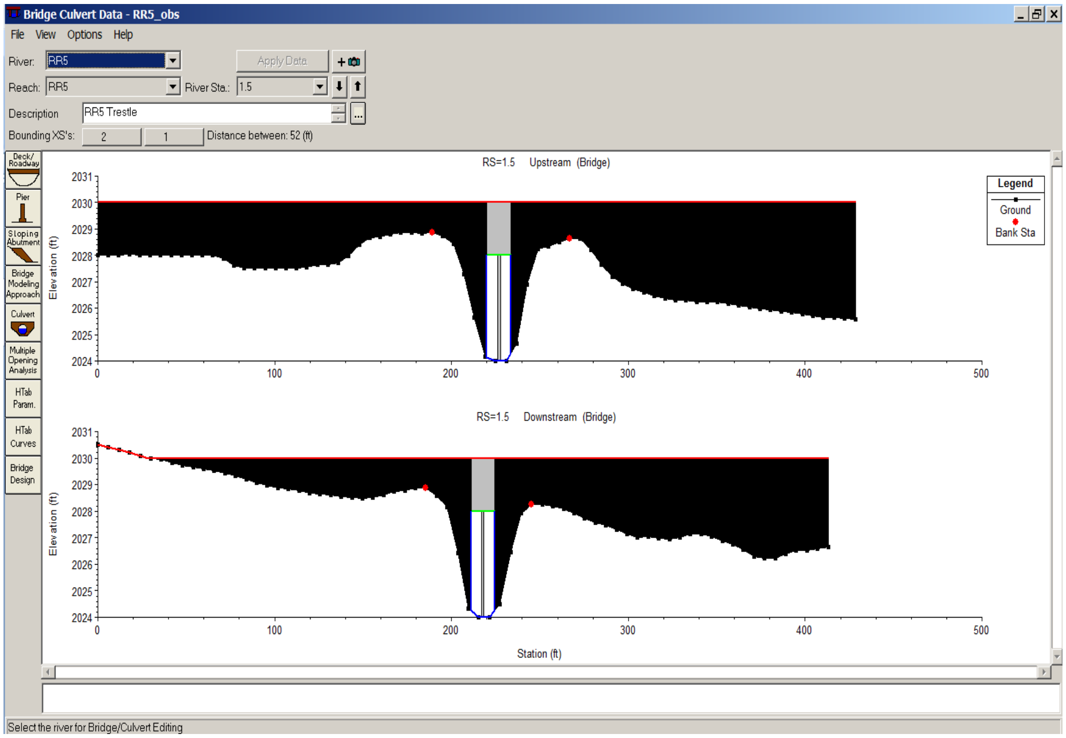
Trestle 4 – Photo taken looking upstream



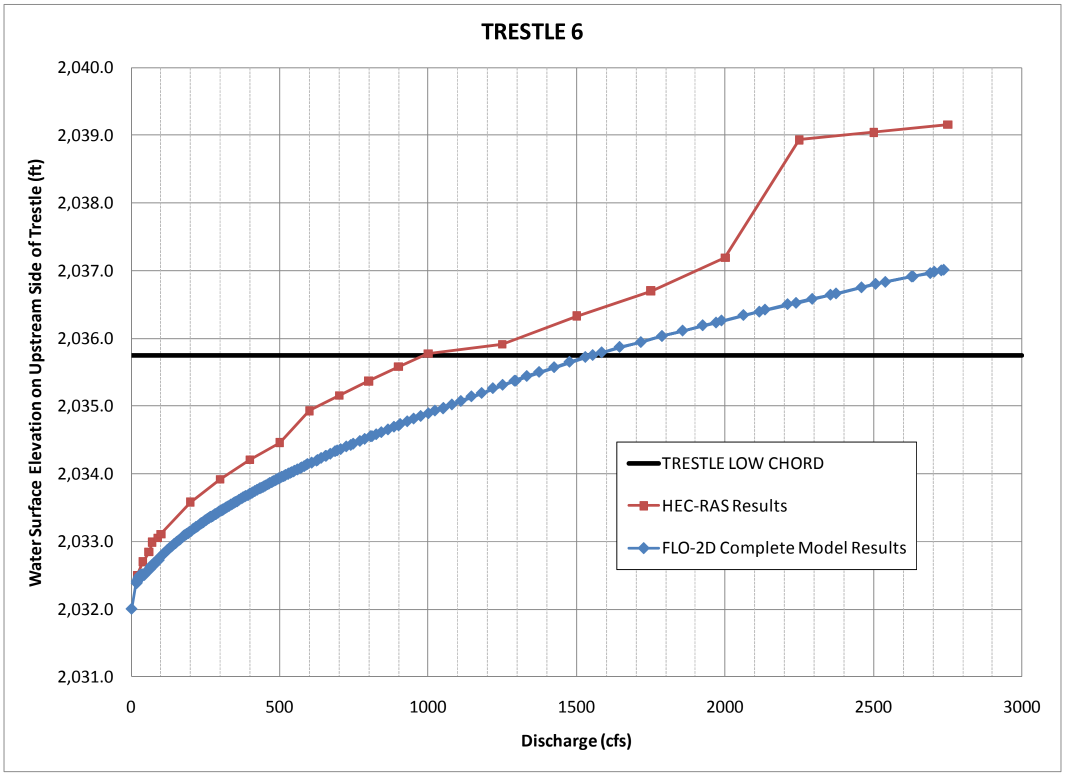
FLO-2D Results for the 100-year storm - Water ponds before flowing through trestle lending to lower WSELs than in the HEC-RAS model.



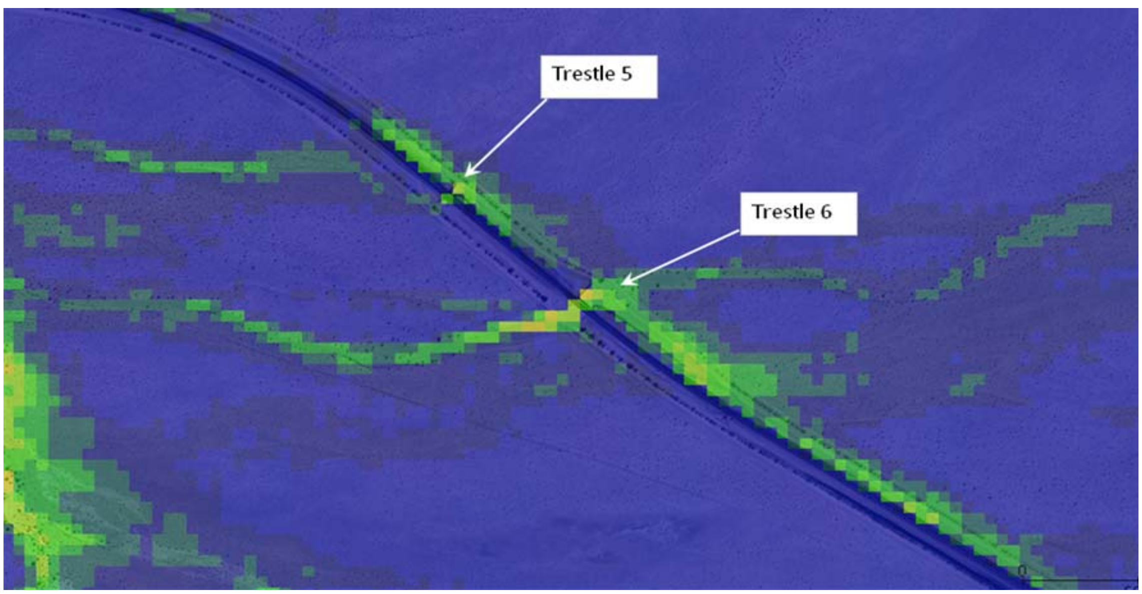

Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR5_NormalFlow 8/4/2011
RR5 RR5
Elevation (ft)
Main Channel Distance (ft)
867.53, 2031.64
Legend
WS PF 22
WS PF 21
WS PF 20
WS PF 19
WS PF 18
WS PF 17
WS PF 16
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground

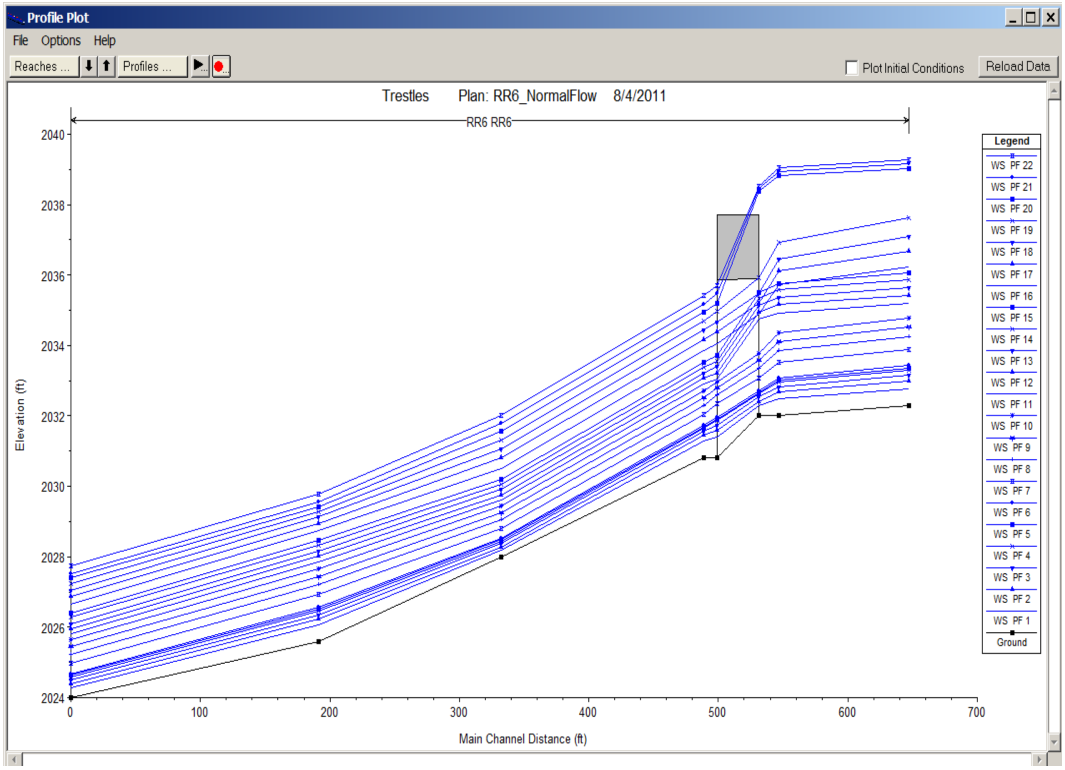

Bridge Culvert Data - RR5_obs
File View Options Help
River: RR5
Apply Data
Reach: RR5
River Sta.: 1.5
Description RR5 Trestle
Bounding XS's: 2 1 Distance between: 52 (ft)
RS=1.5 Upstream (Bridge)
RS=1.5 Downstream (Bridge)
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta
Select the river for Bridge/Culvert Editing

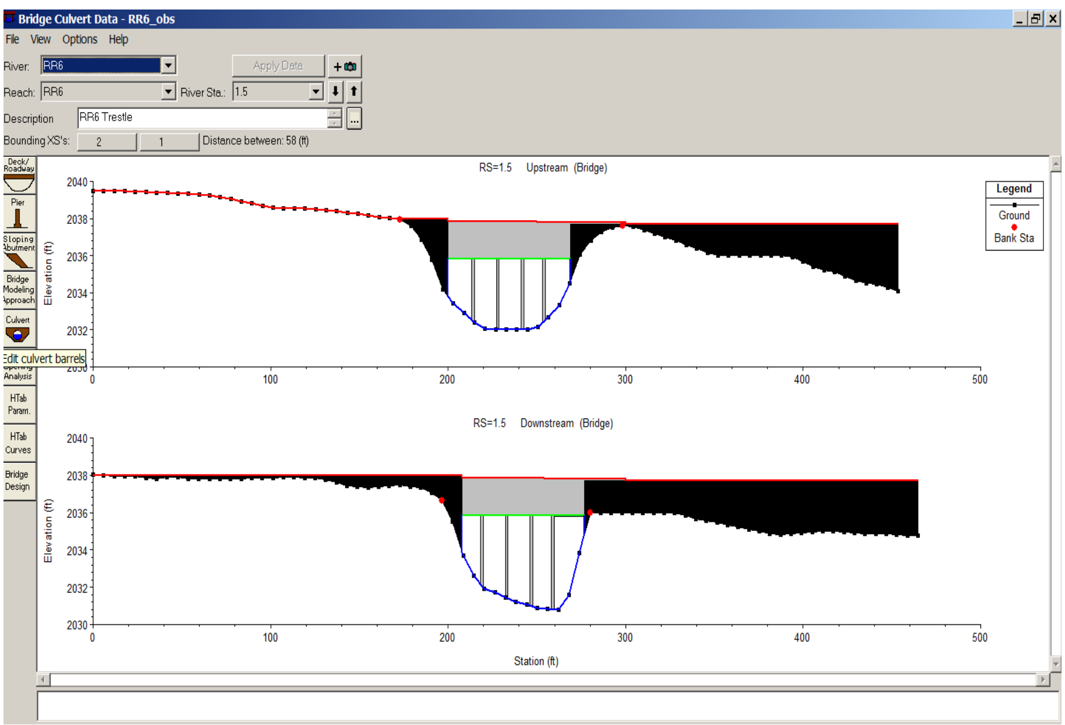
Trestle 5 – Photo taken looking upstream



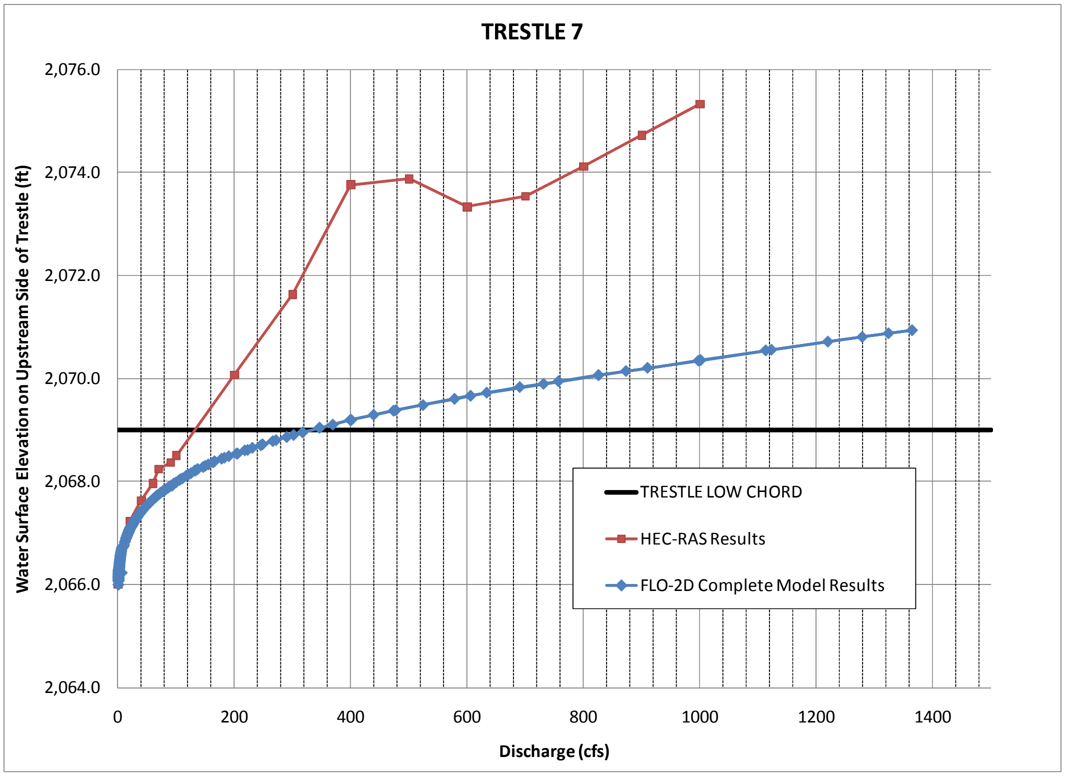
FLO-2D Results for 100-year - Water travels west along the north side of RR and also comes in from the northeast. Flow travels through the trestle, however some overflow continues toward the west where passes under Trestle 5.



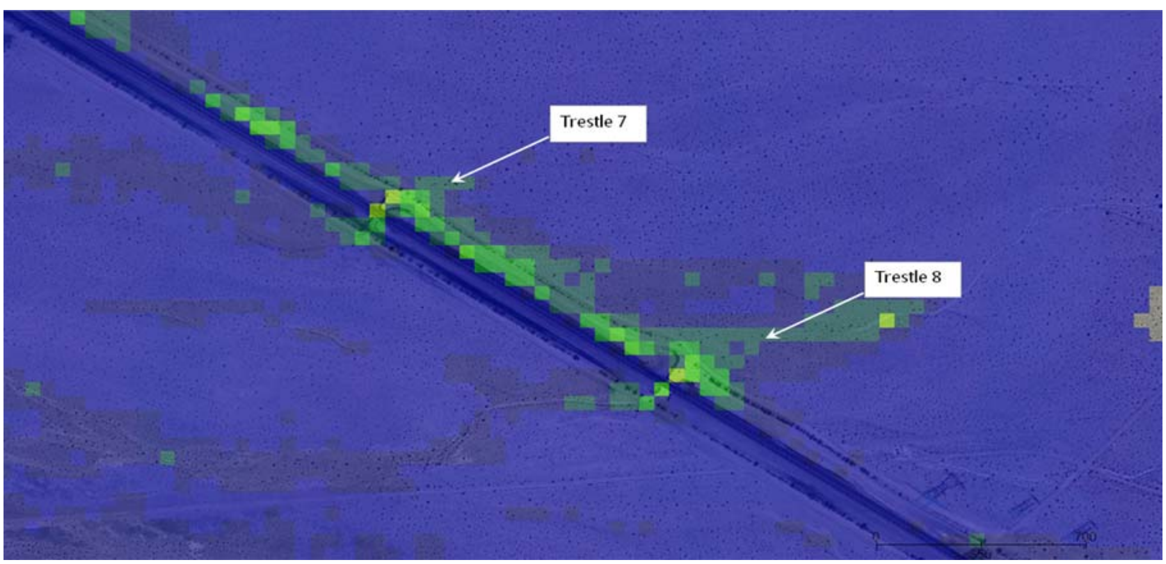

Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR6_NormalFlow 8/4/2011
RR6 RR6
Elevation (ft)
Main Channel Distance (ft)
Legend
WS PF 22
WS PF 21
WS PF 20
WS PF 19
WS PF 18
WS PF 17
WS PF 16
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground

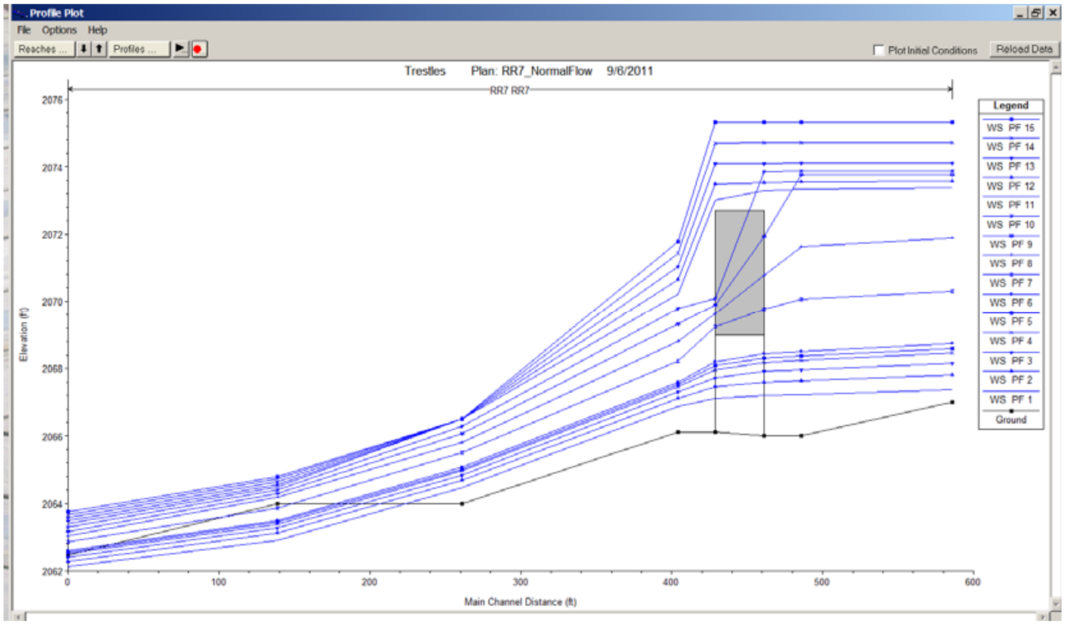

Bridge Culvert Data - RR6_obs
File View Options Help
River: RR6
Apply Data
Reach: RR6
River Sta.: 1.5
Description RR6 Trestle
Bounding XS's: 2 1 Distance between: 58 (ft)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Edit culvert barrels
HTab Param.
HTab Curves
Bridge Design
RS=1.5 Upstream (Bridge)
RS=1.5 Downstream (Bridge)
Elevation (ft)
Station (ft)
Legend
Ground
Bank Sta
Select the river for Bridge/Culvert Editing

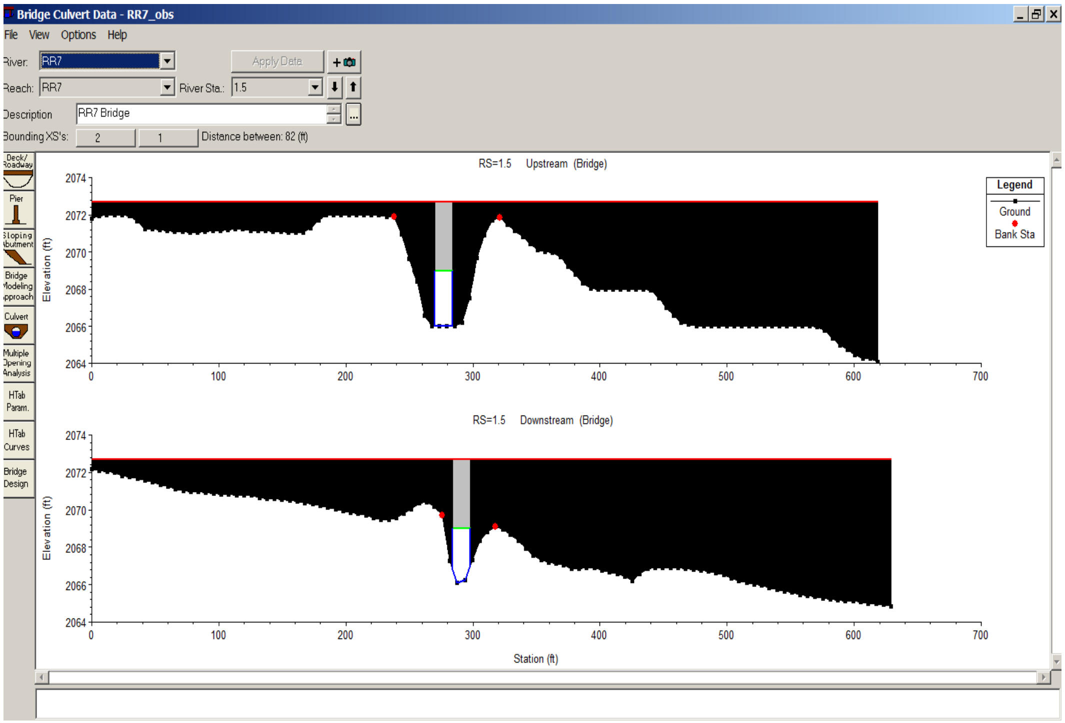
Trestle 6 – Photo taken looking upstream



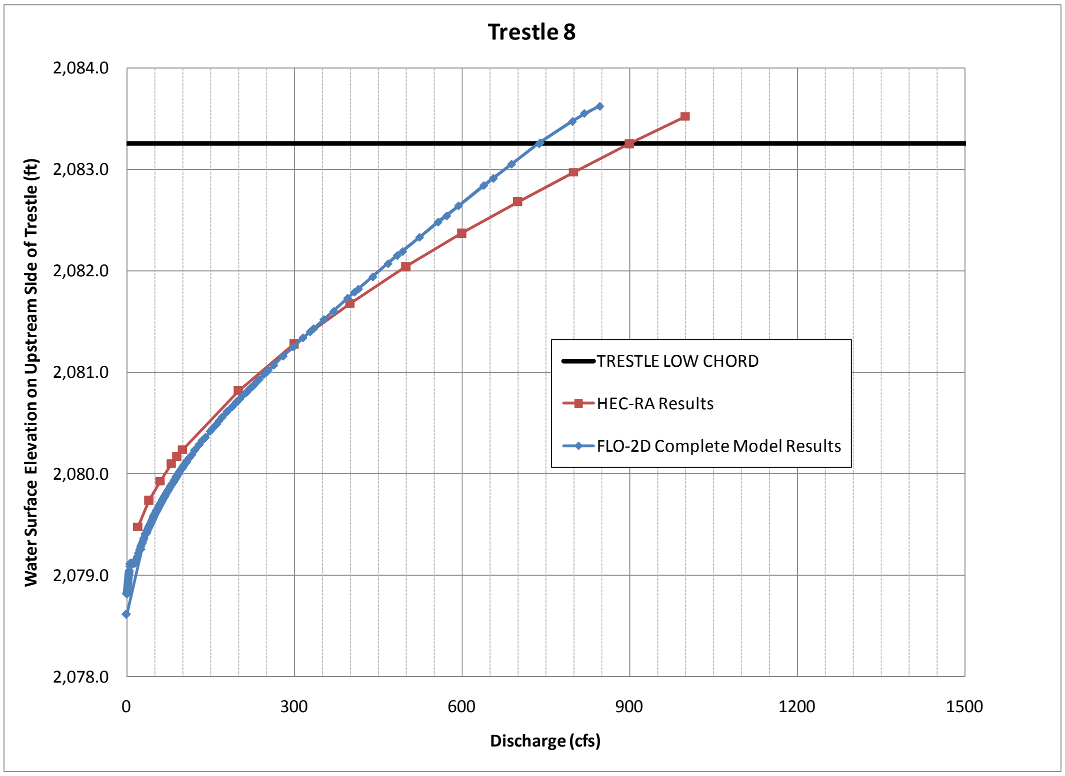
FLO-2D results for the 100-year storm below show that a portion of the flows that reach the railroad on the north near Trestle 7 do not flow through the opening but rather continue to travel along the north side of the railroad embankment.



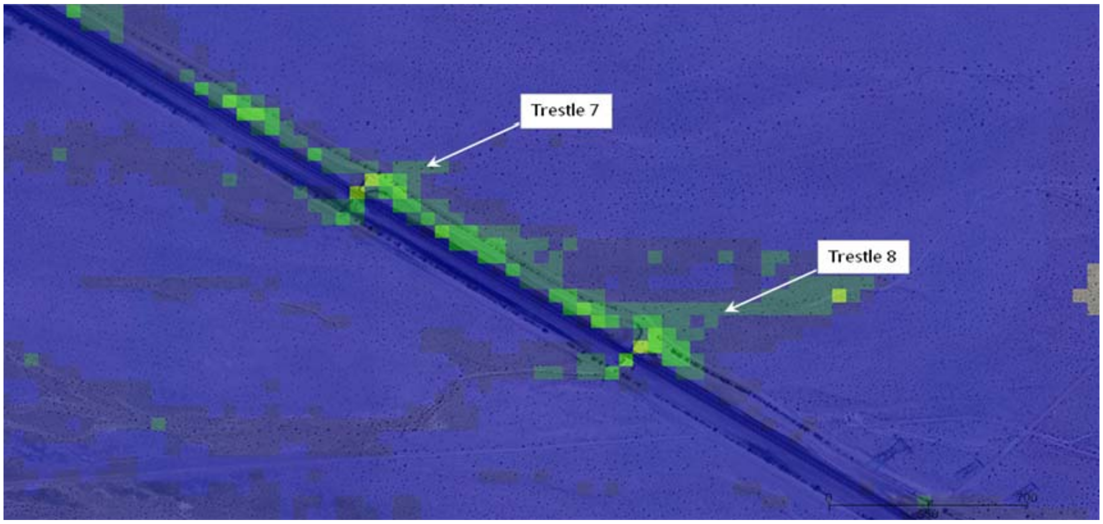

Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR7_NormalFlow 9/6/2011
RR7 RR7
Legend
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)

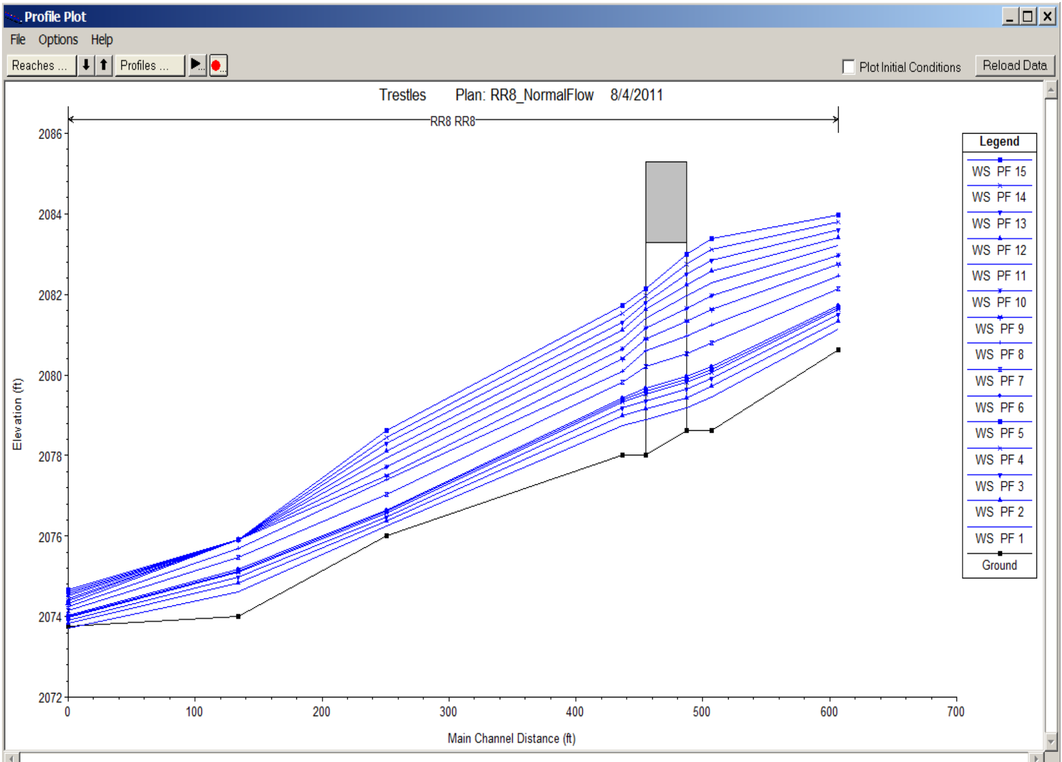

Bridge Culvert Data - RR7_obs
File View Options Help
River: RR7
Apply Data
Reach: RR7
River Sta.: 1.5
Description RR7 Bridge
Bounding XS's: 2 1 Distance between: 82 (ft)
Deck/Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=1.5 Upstream (Bridge)
Legend
Ground
Bank Sta
Elevation (ft)
RS=1.5 Downstream (Bridge)
Station (ft)

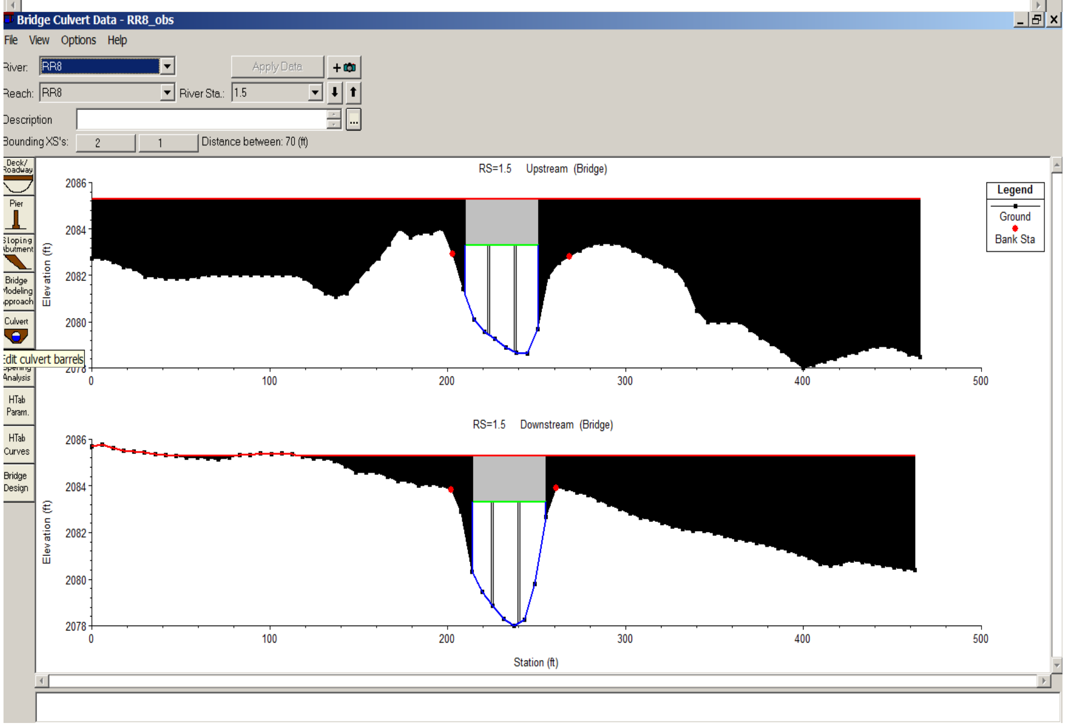
Trestle 7 – Photo taken looking upstream



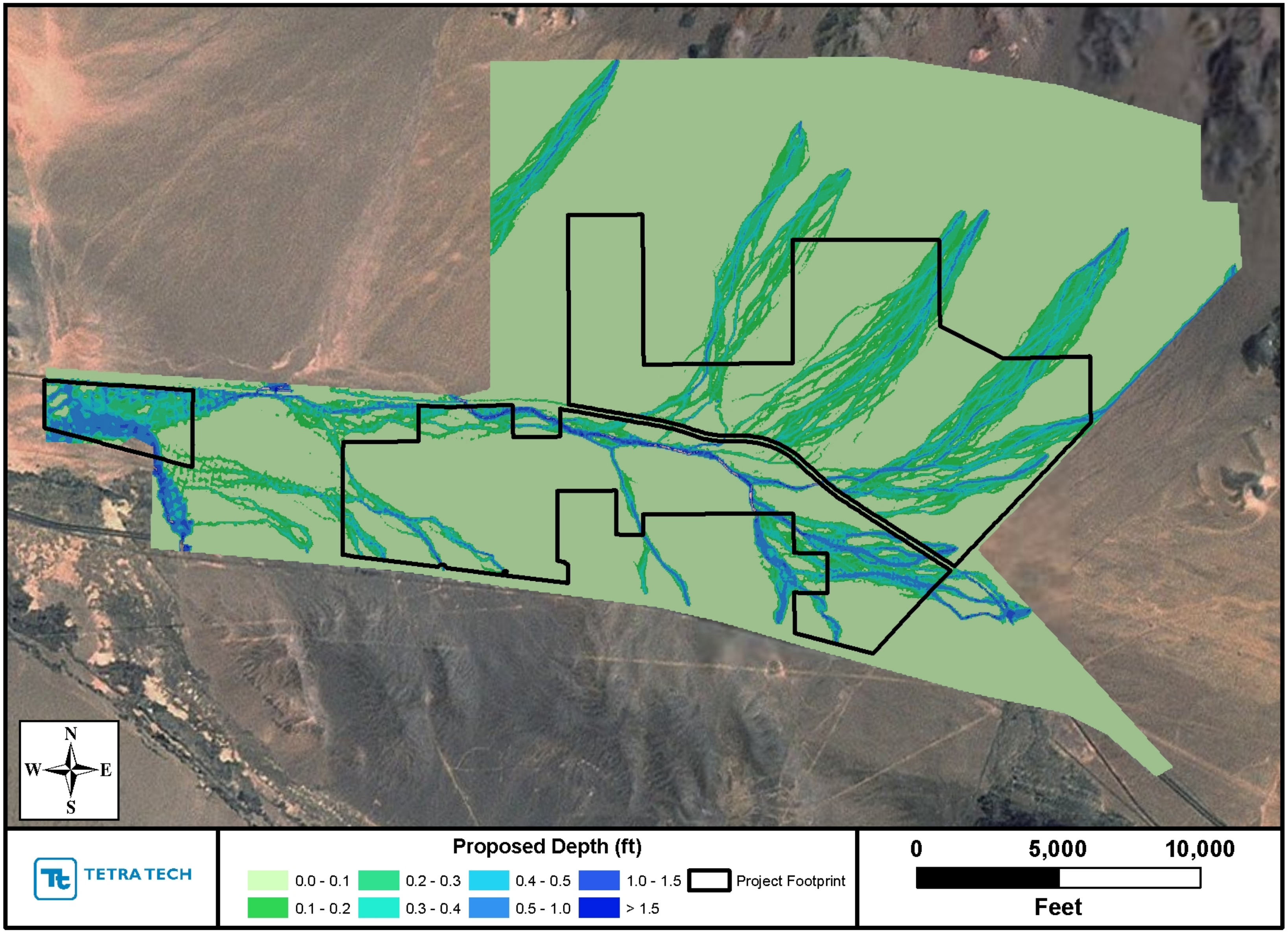
FLO-2D results for the 100-year storm - a portion of the flows that reach the railroad on the north near Trestle 8 do not flow through the opening but rather continue to travel along the north side of the railroad embankment toward Trestle 7 and beyond.



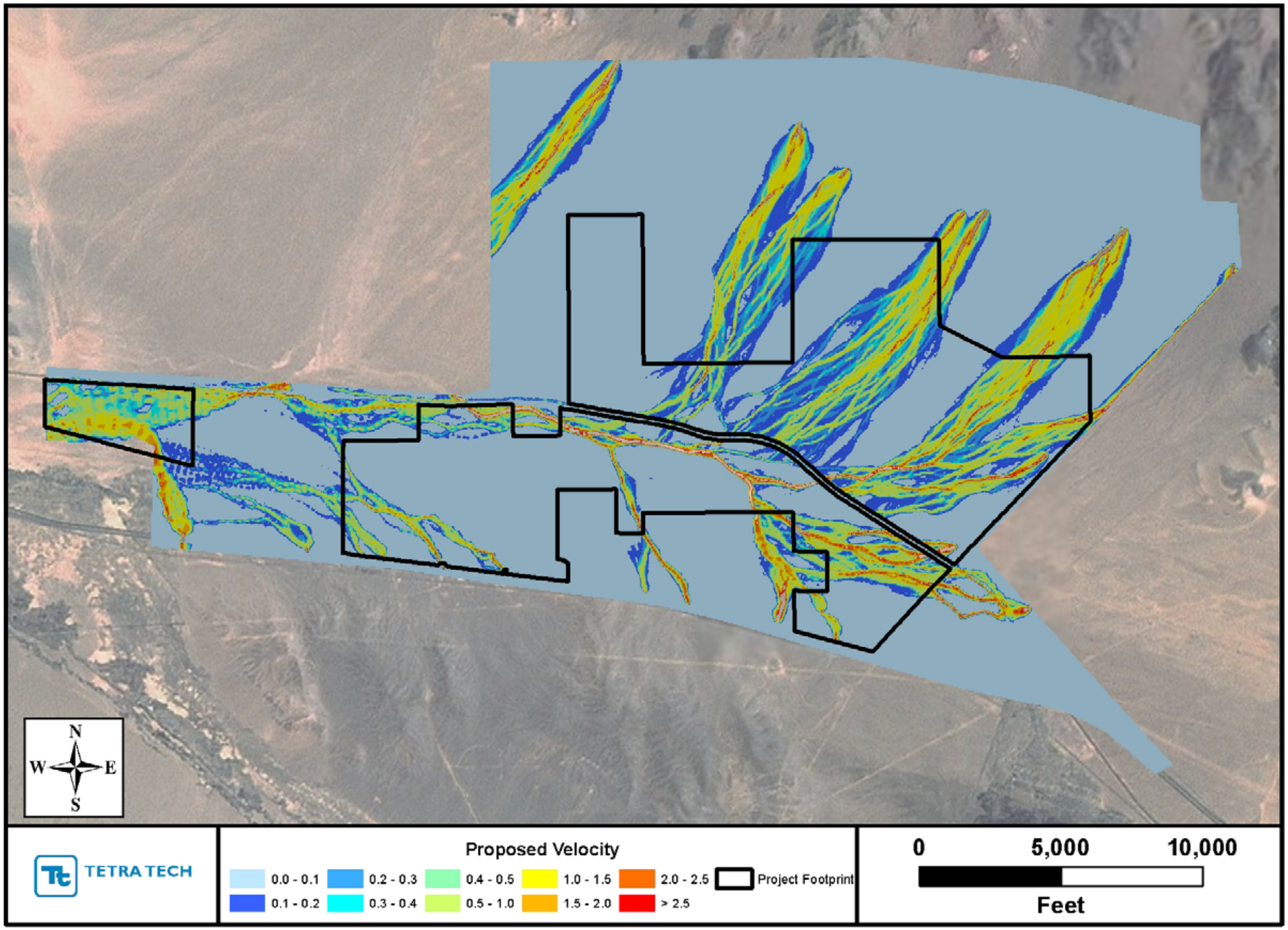

Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
Trestles Plan: RR8_NormalFlow 8/4/2011
RR8 RR8
Legend
WS PF 15
WS PF 14
WS PF 13
WS PF 12
WS PF 11
WS PF 10
WS PF 9
WS PF 8
WS PF 7
WS PF 6
WS PF 5
WS PF 4
WS PF 3
WS PF 2
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)


Bridge Culvert Data - RR8_obs
File View Options Help
River: RR8
Apply Data
Reach: RR8
River Sta.: 1.5
Description
Bounding XS's: 2 1 Distance between: 70 (ft)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Edit culvert barrels
Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=1.5 Upstream (Bridge)
Legend
Ground
Bank Sta
RS=1.5 Downstream (Bridge)
Elevation (ft)
Station (ft)

Trestle 8 – Photo taken looking upstream

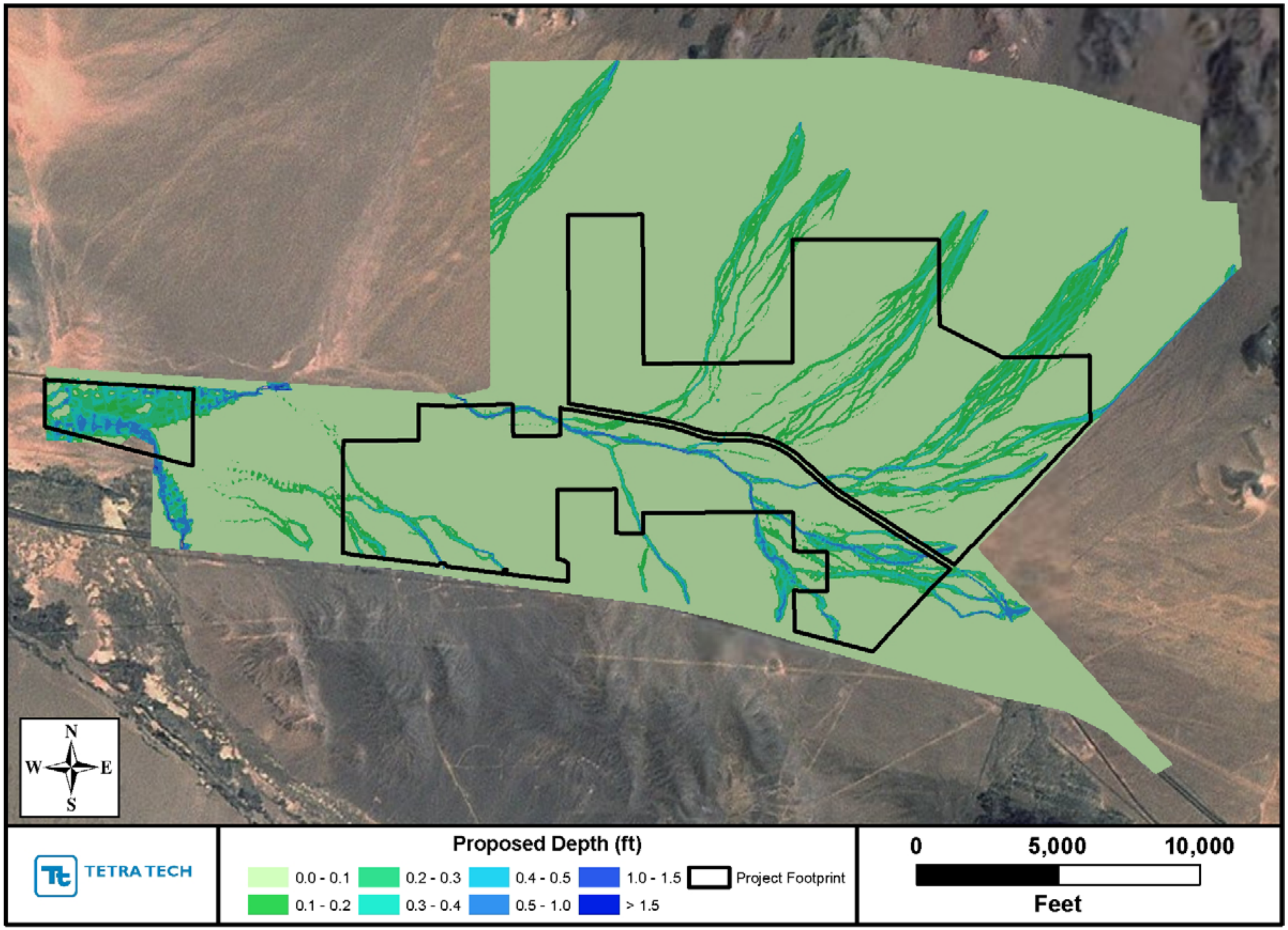


Maximum depths during the 10-year, 24-hour storm.



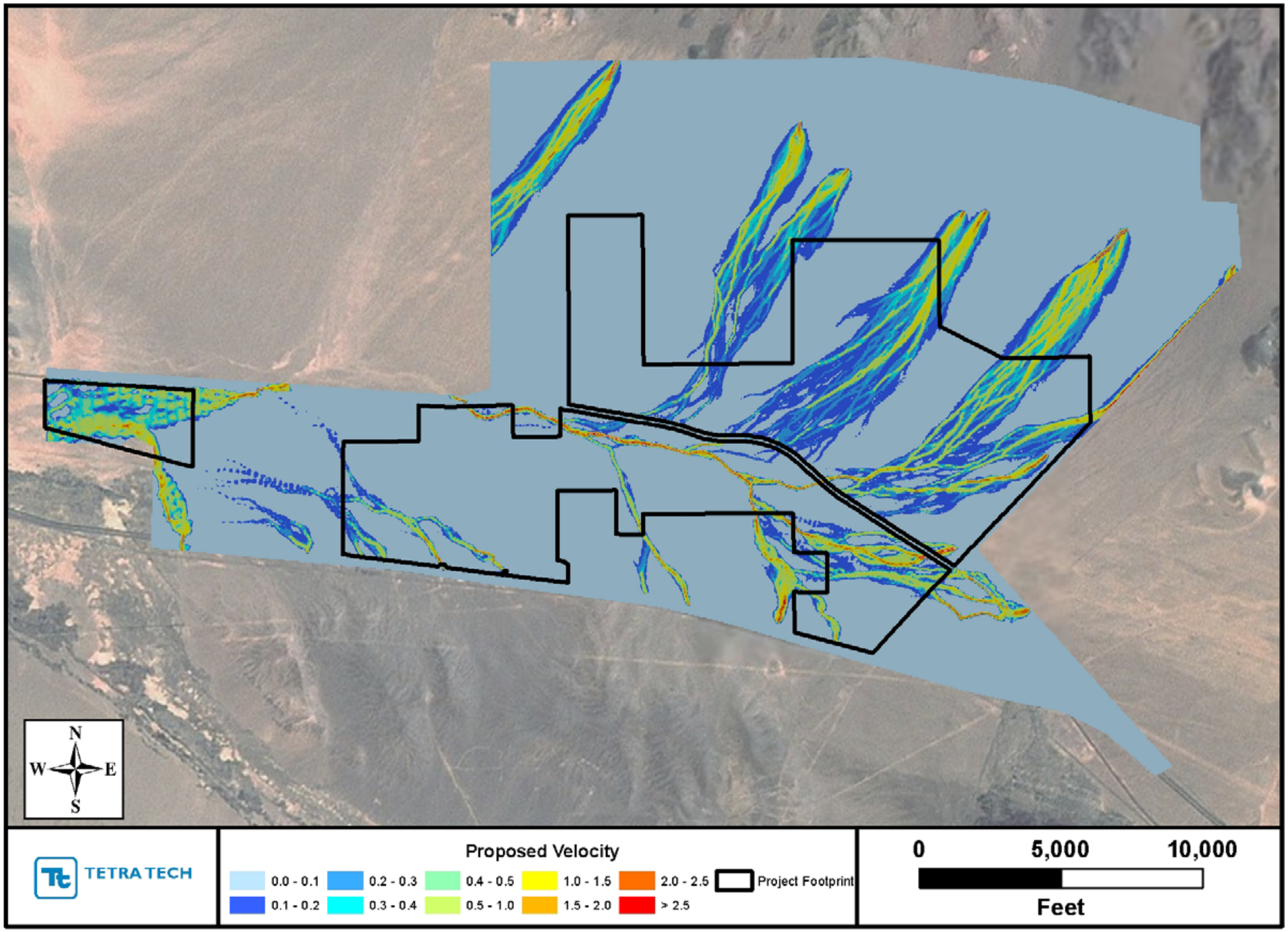
Maximum velocity during the 10-year, 24-hour storm.

TETRA TECH



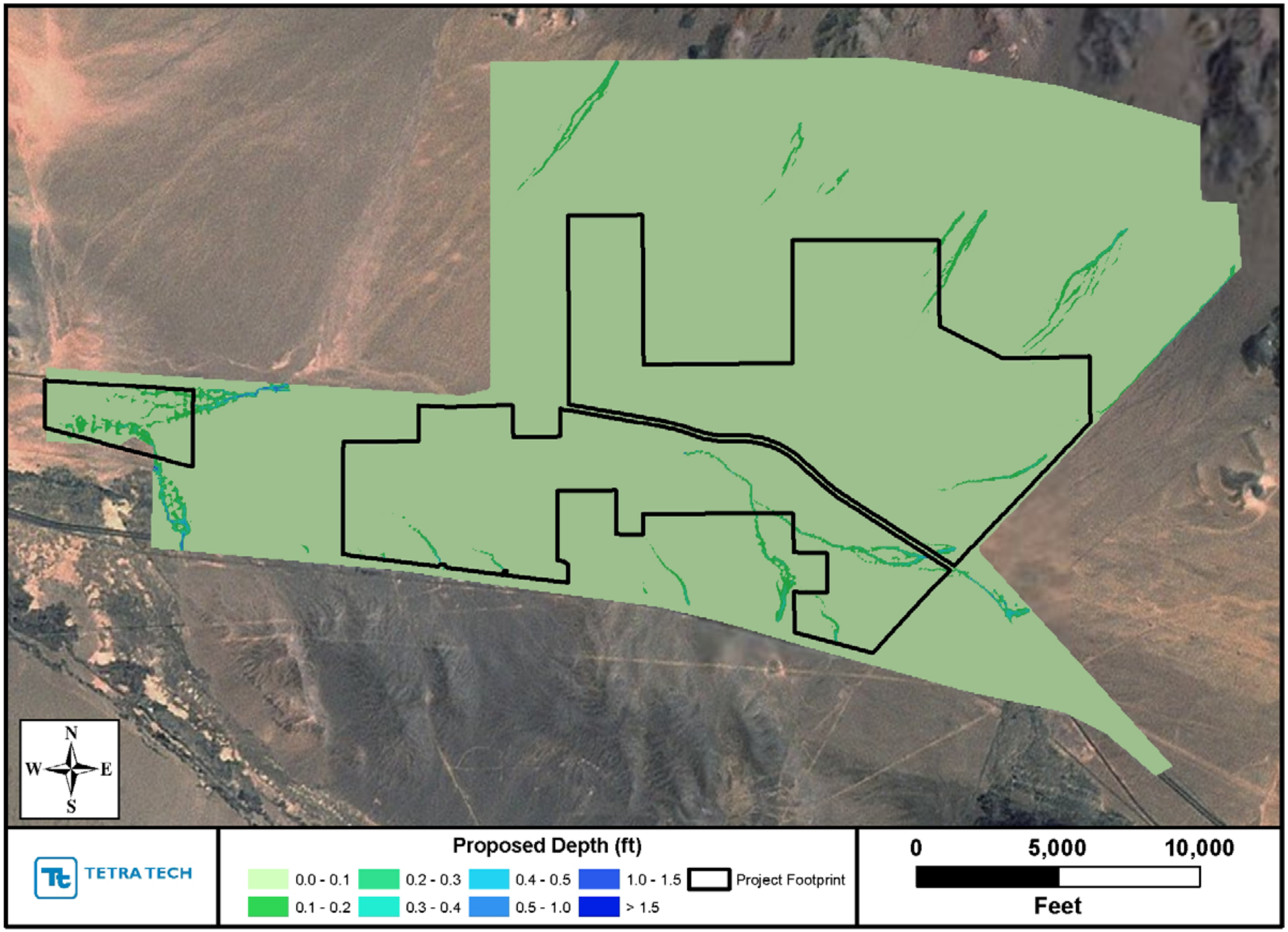
Maximum depths during the 5-year, 24-hour storm.

TETRA TECH



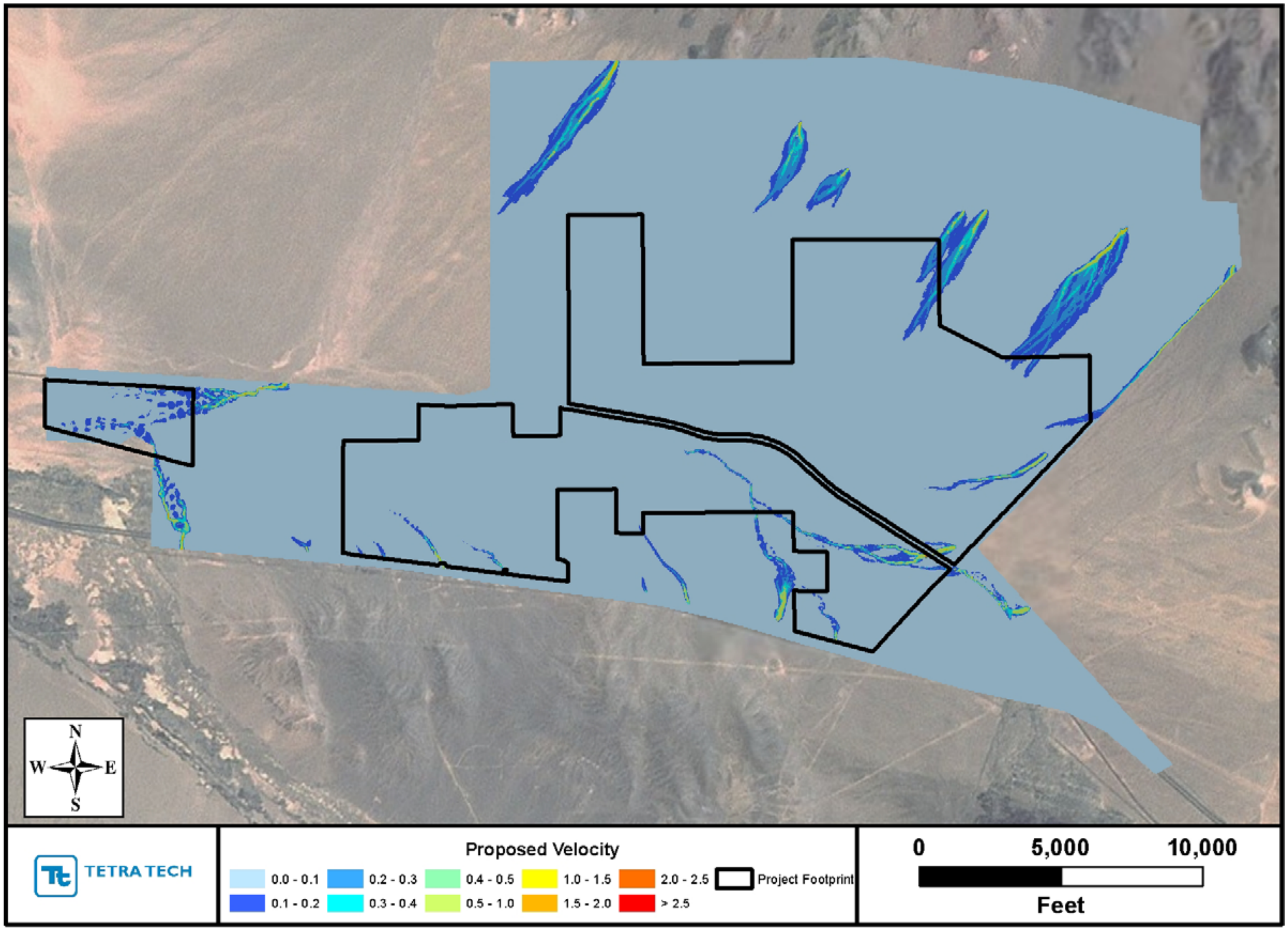
Maximum velocity during the 5-year, 24-hour storm.

TETRA TECH

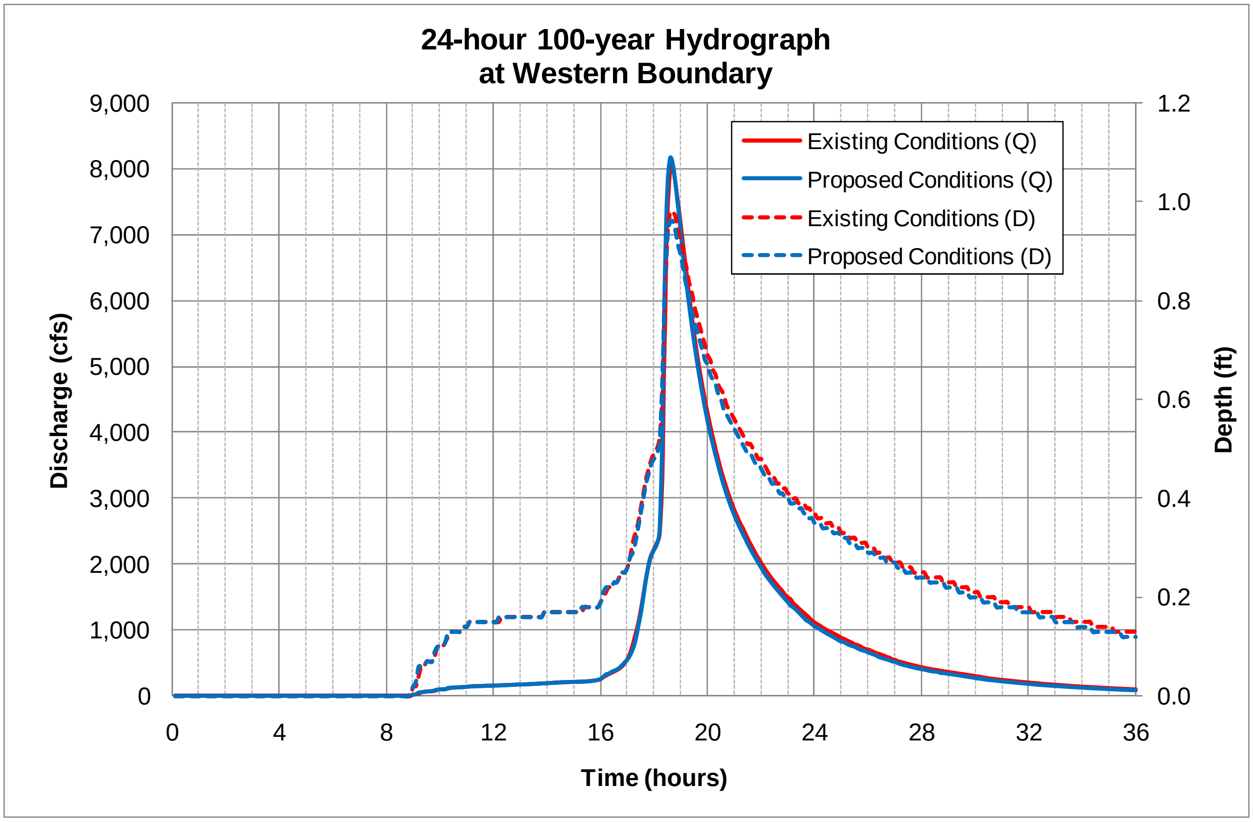


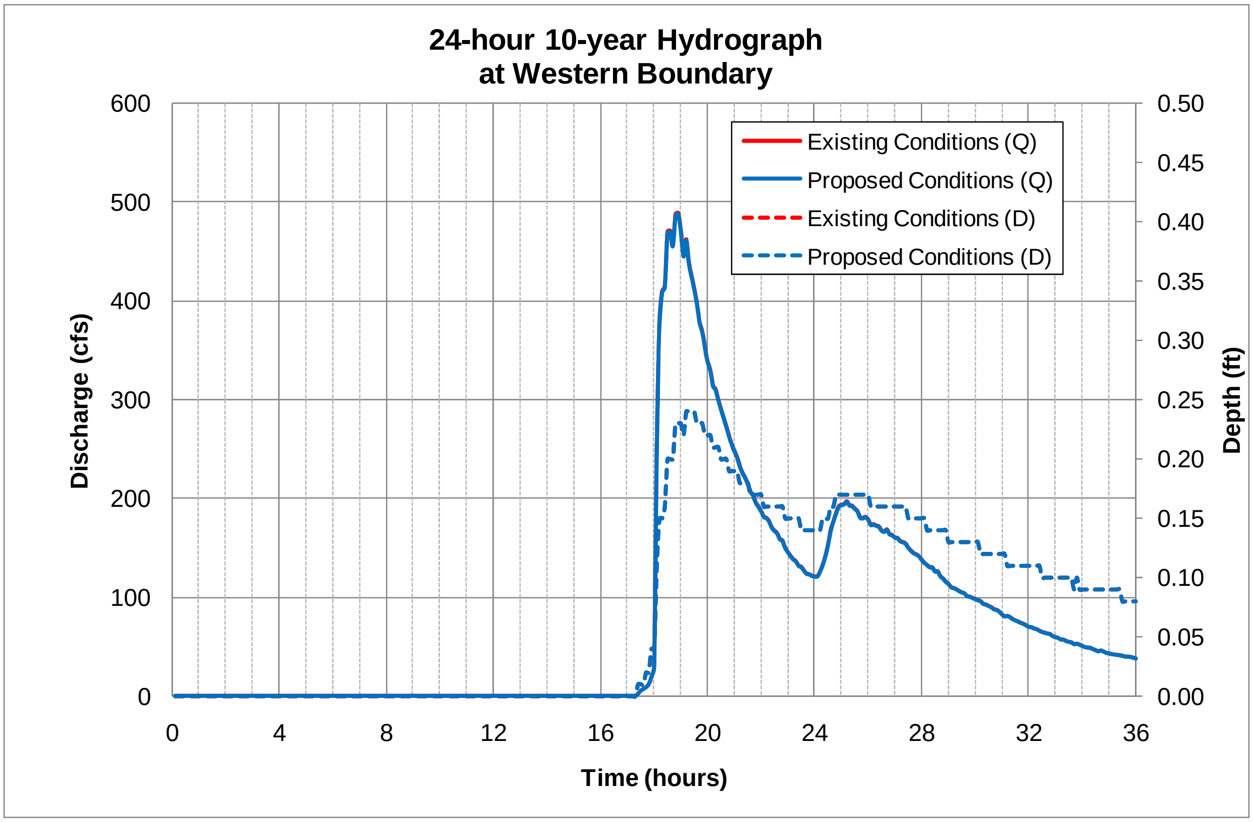
Maximum depths during the 2-year, 24-hour storm.

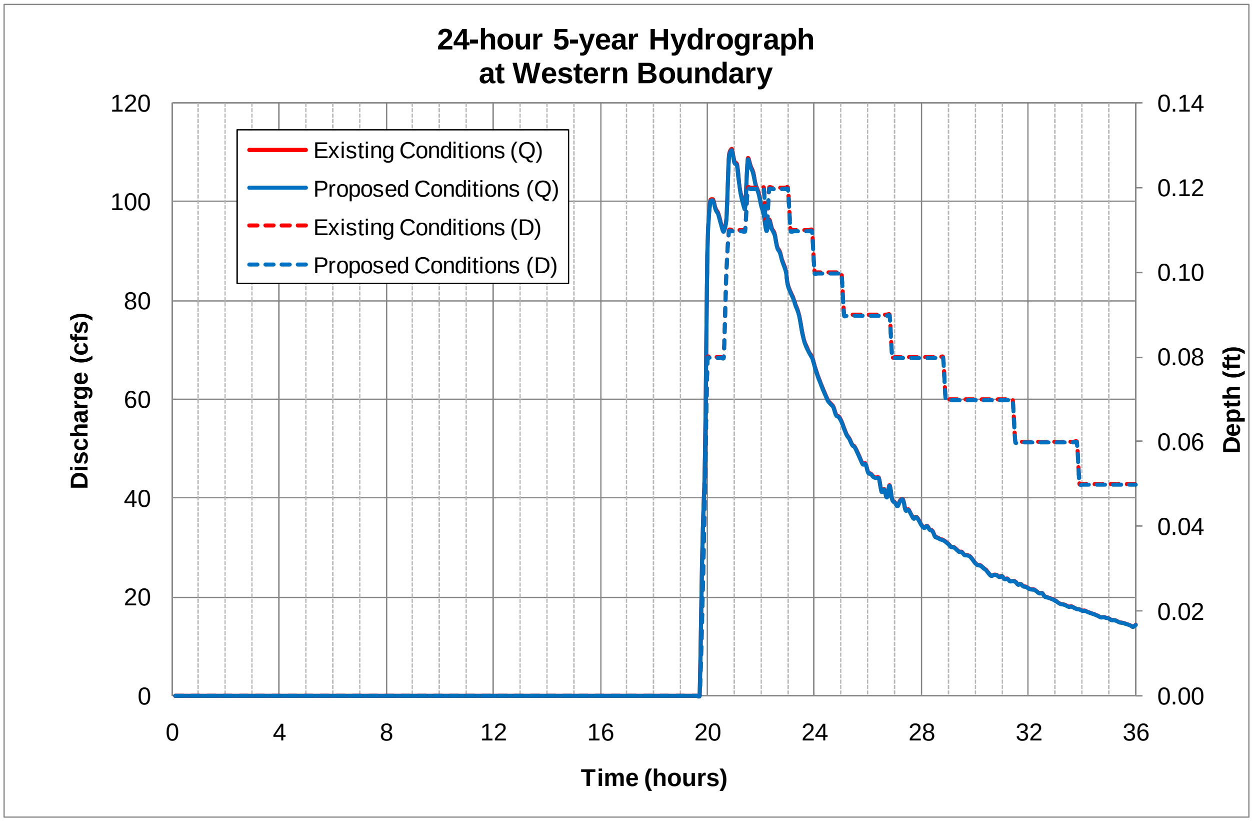
TETRA TECH

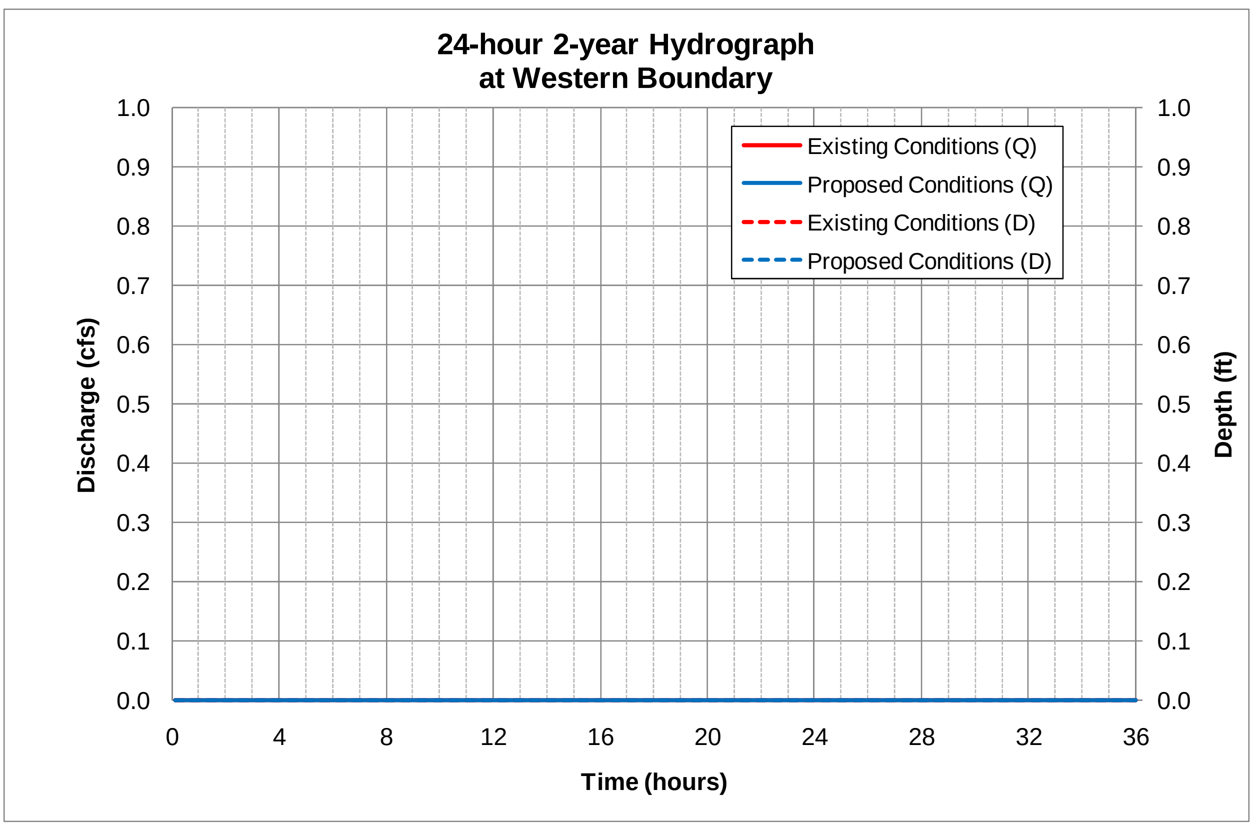


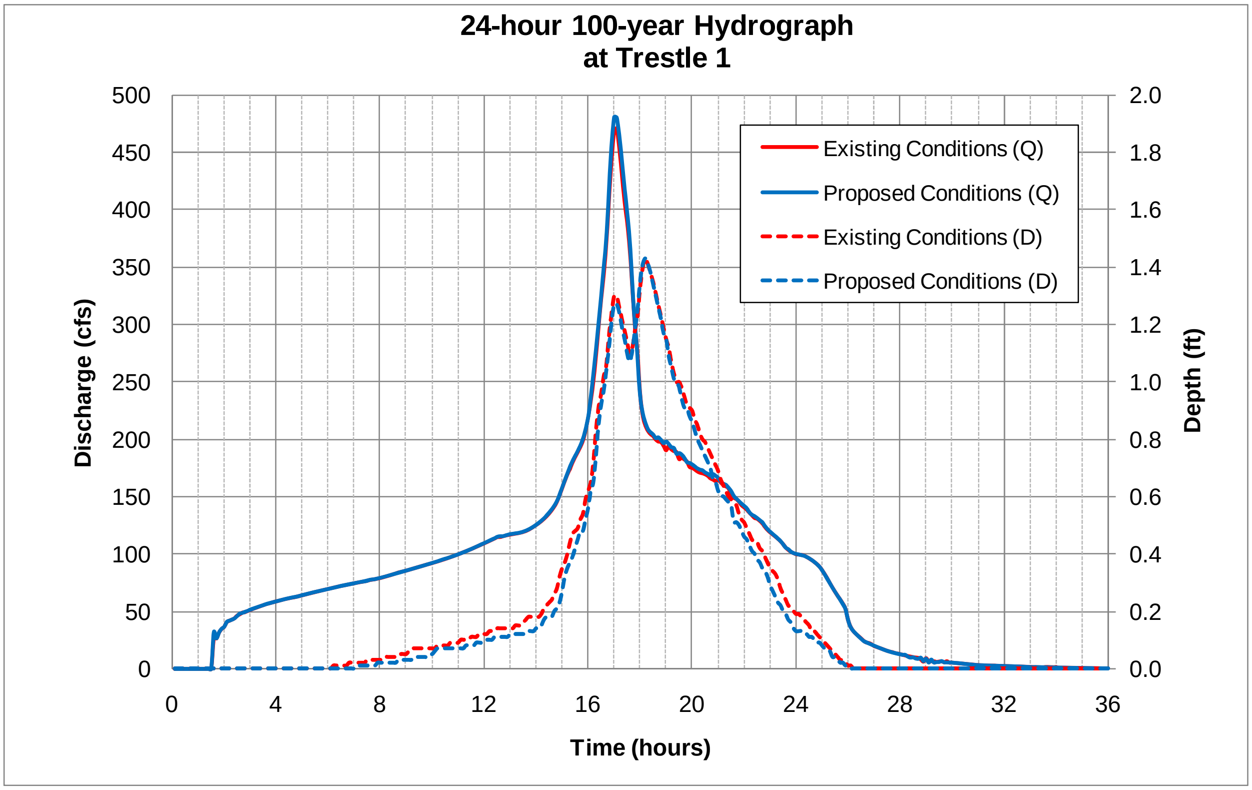
Maximum velocity during the 2-year, 24-hour storm.


24-hour 100-year Hydrograph
at Western Boundary
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Discharge (cfs)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Depth (ft)
0
4
8
12
16
20
24
28
32
36
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

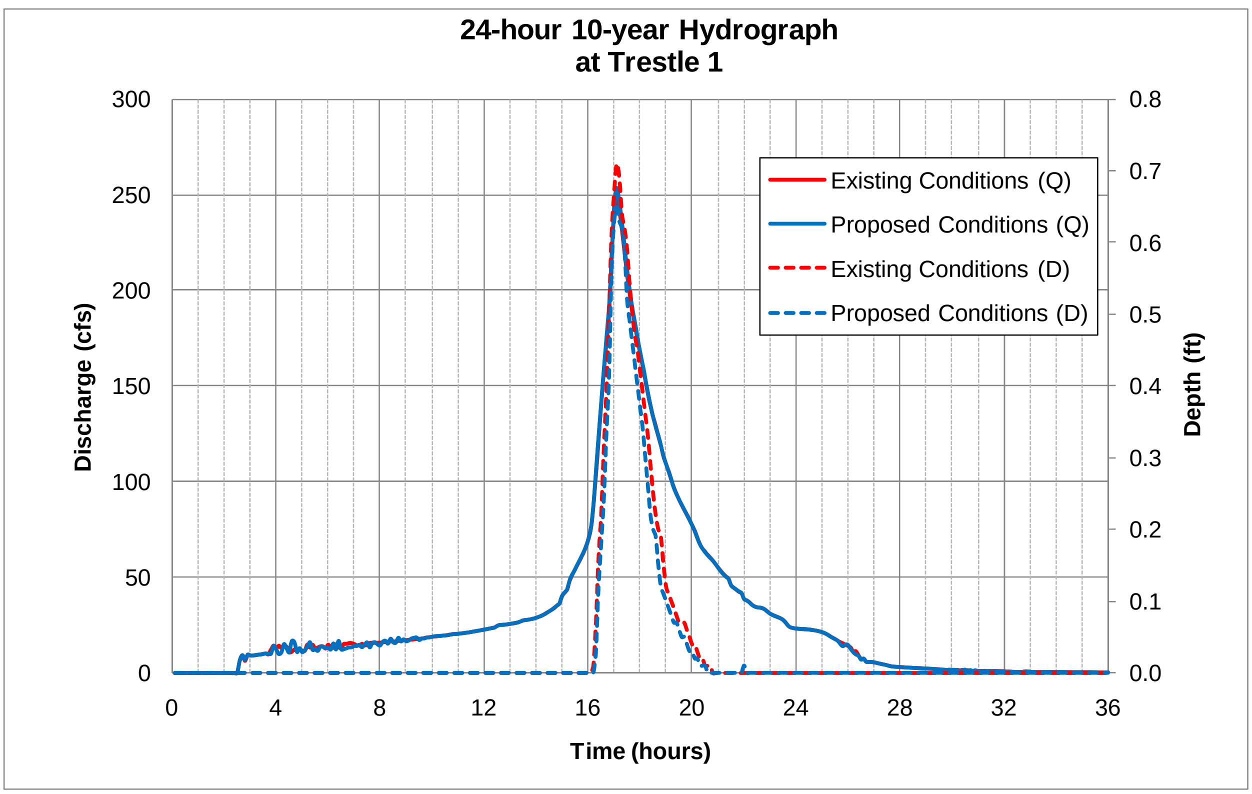

24-hour 10-year Hydrograph
at Western Boundary
600
500
400
300
200
100
0
Discharge (cfs)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Depth (ft)
0
4
8
12
16
20
24
28
32
36
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)


24-hour 5-year Hydrograph
at Western Boundary
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0
20
40
60
80
100
120
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0
4
8
12
16
20
24
28
32
36

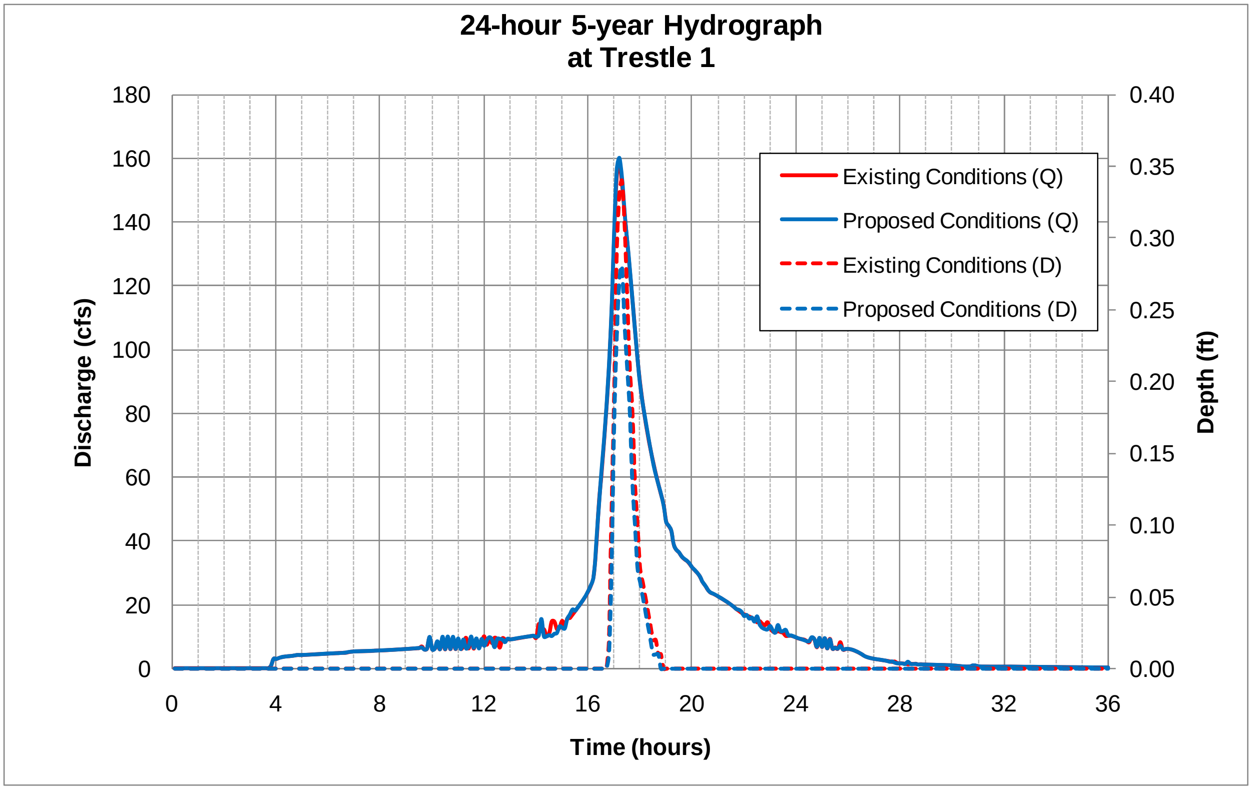

24-hour 2-year Hydrograph
at Western Boundary
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36



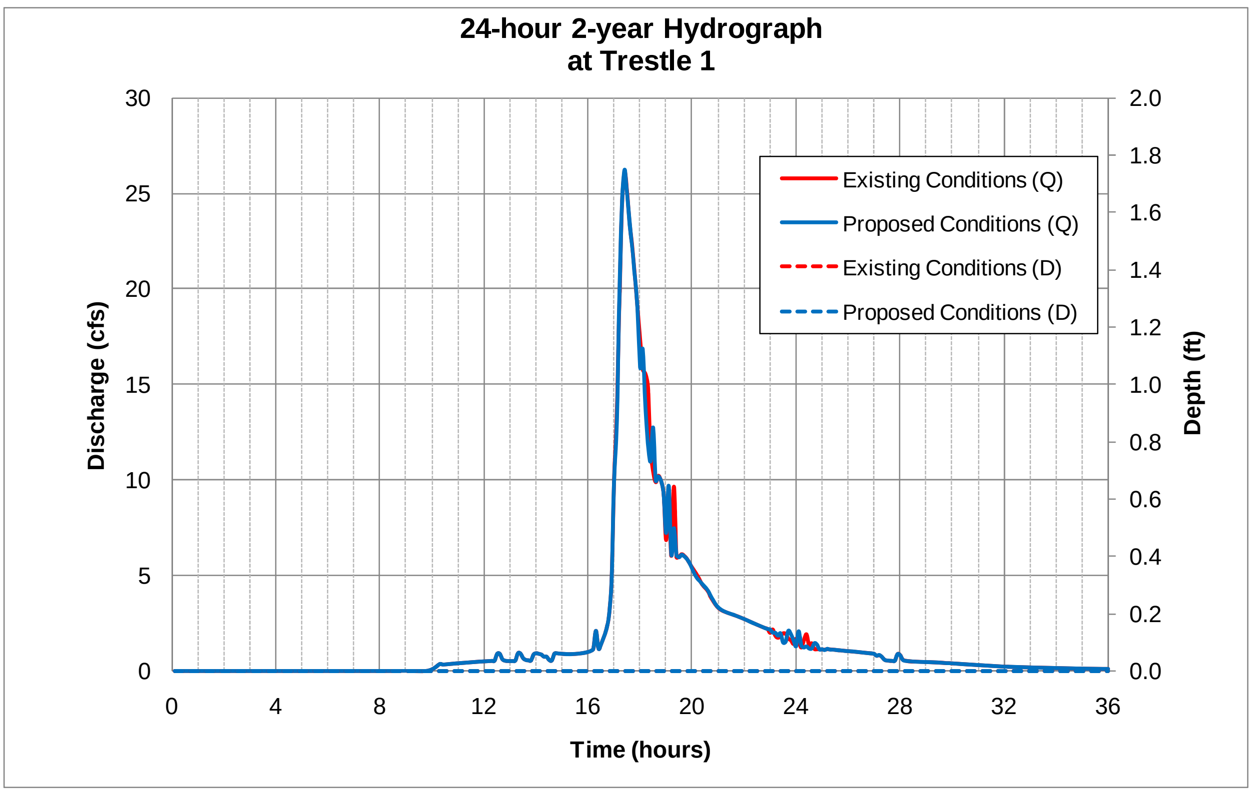
24-hour 100-year Hydrograph
at Trestle 1
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
50
100
150
200
250
300
350
400
450
500
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
4
8
12
16
20
24
28
32
36



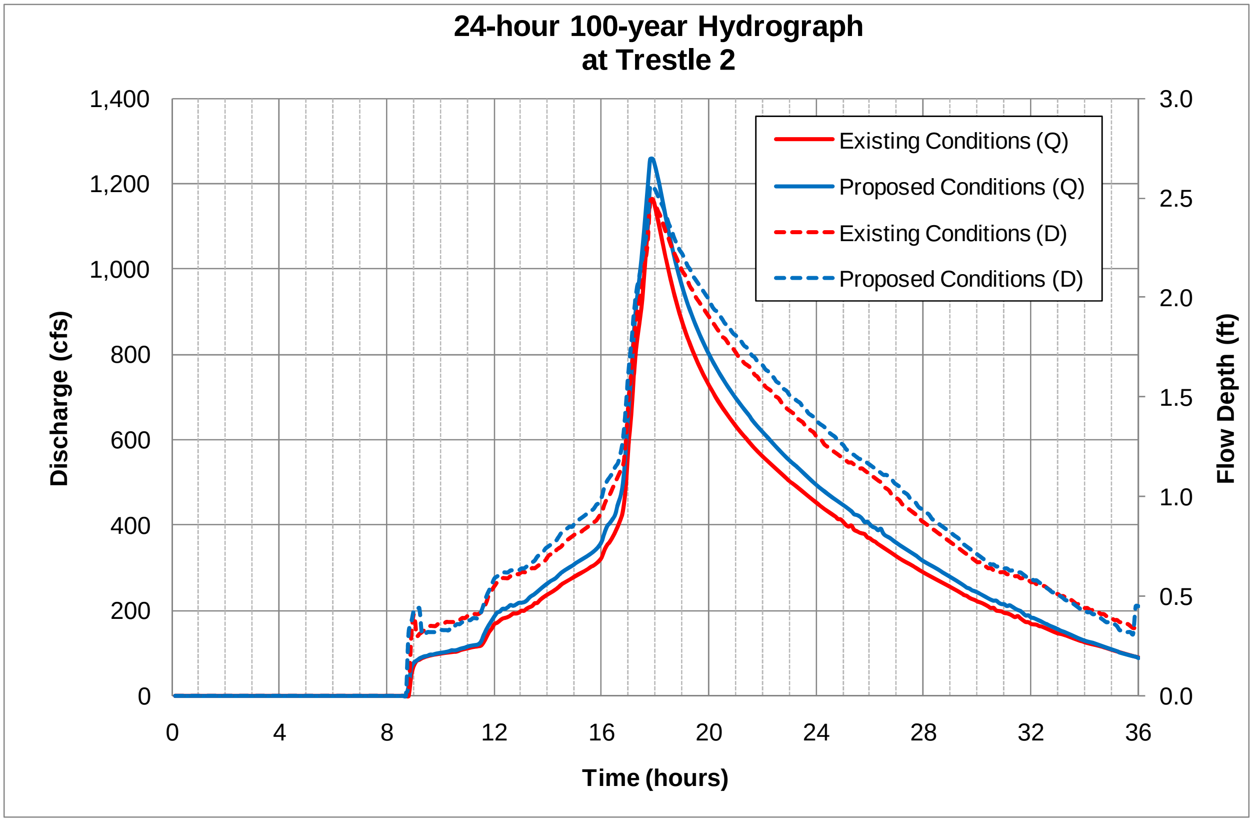
24-hour 10-year Hydrograph
at Trestle 1
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
50
100
150
200
250
300
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
4
8
12
16
20
24
28
32
36

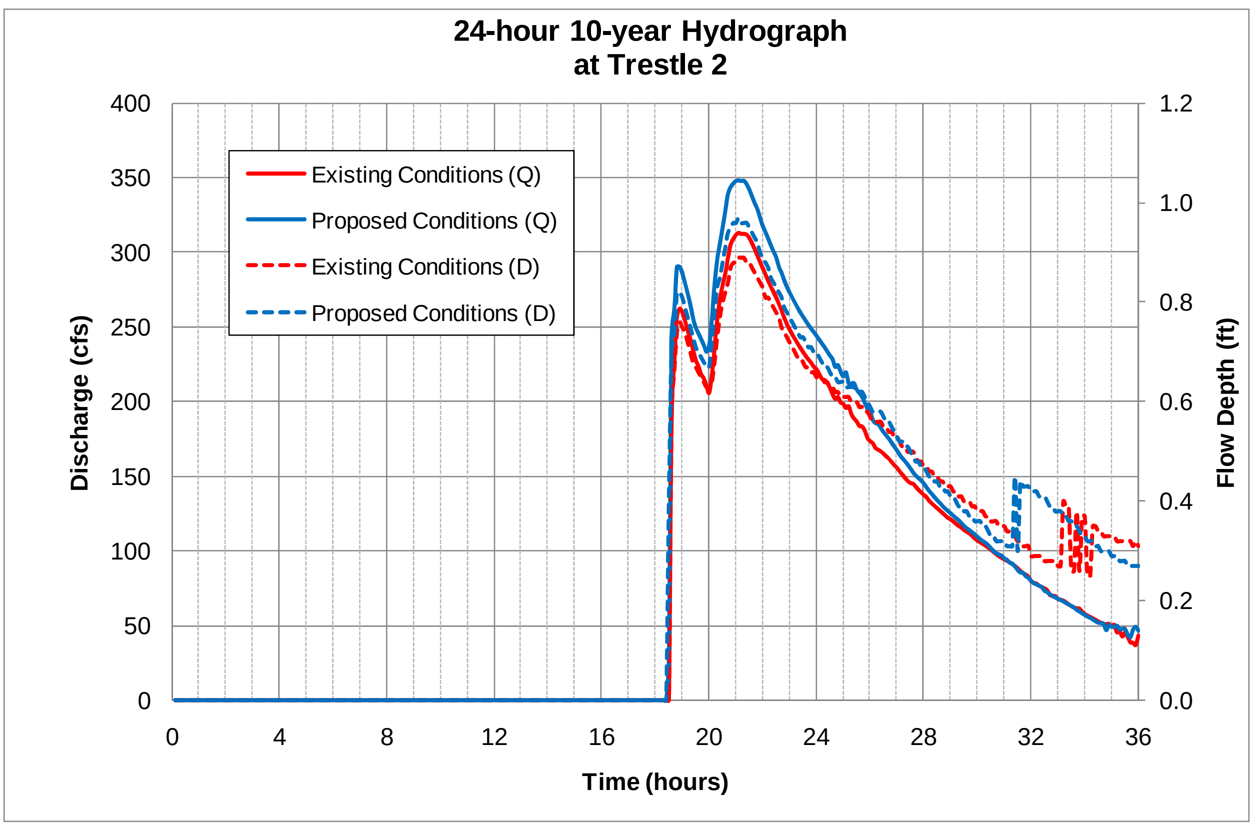


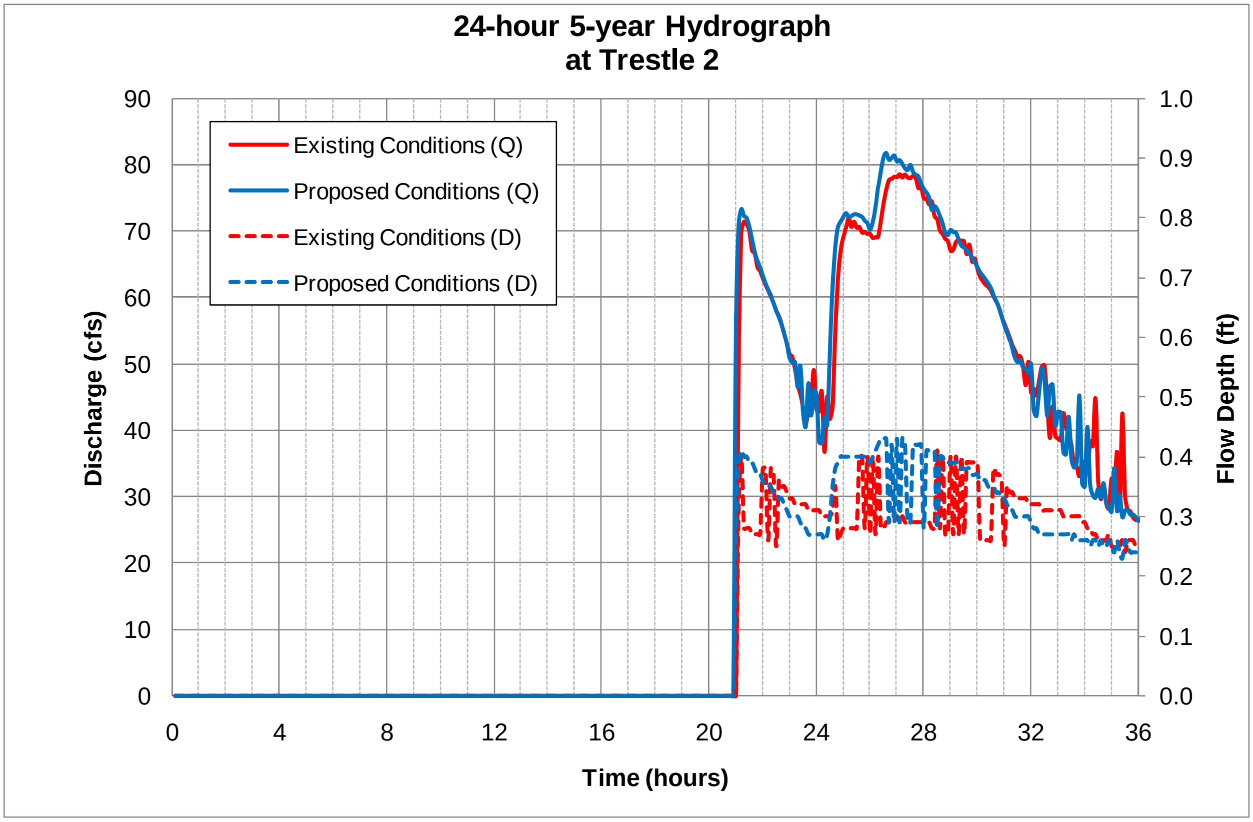
24-hour 5-year Hydrograph
at Trestle 1
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)

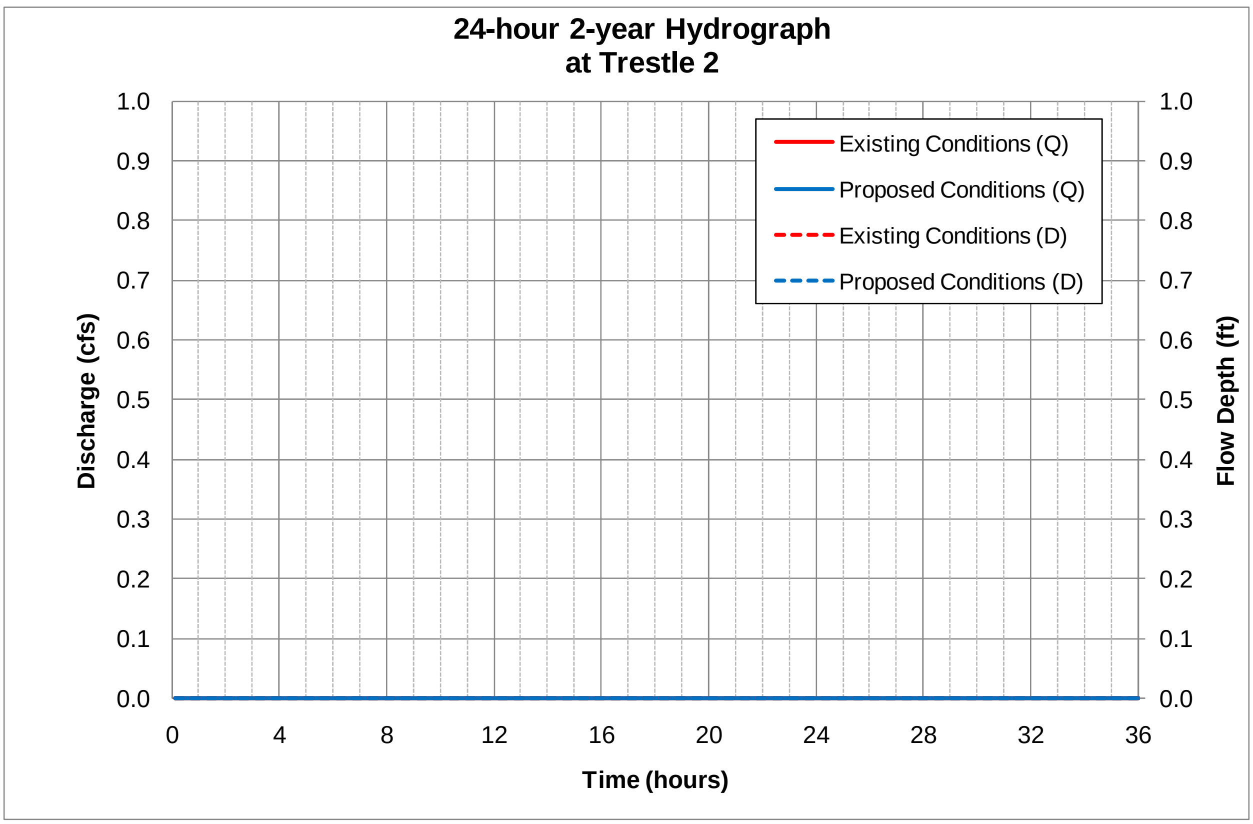


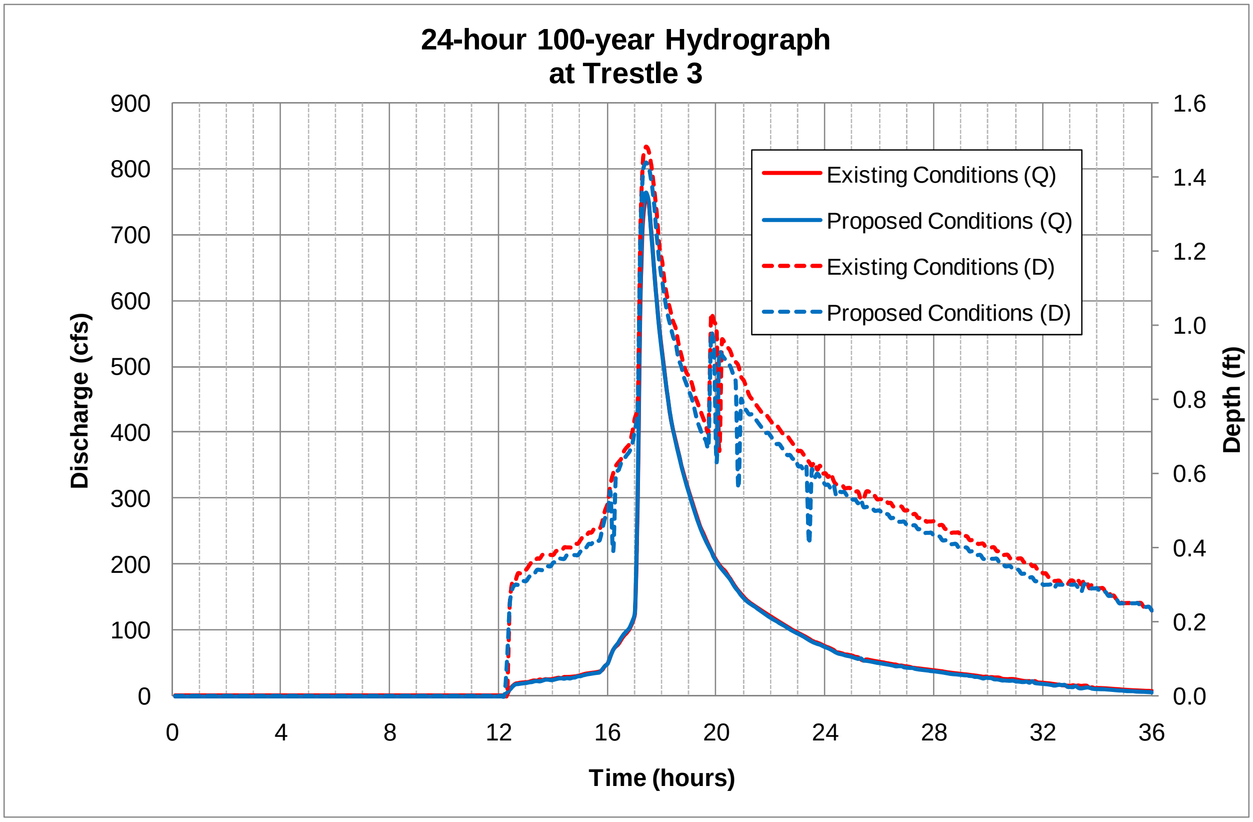
24-hour 2-year Hydrograph
at Trestle 1
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)


24-hour 100-year Hydrograph
at Trestle 2
Discharge (cfs)
Flow Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
200
400
600
800
1,000
1,200
1,400
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
4
8
12
16
20
24
28
32
36

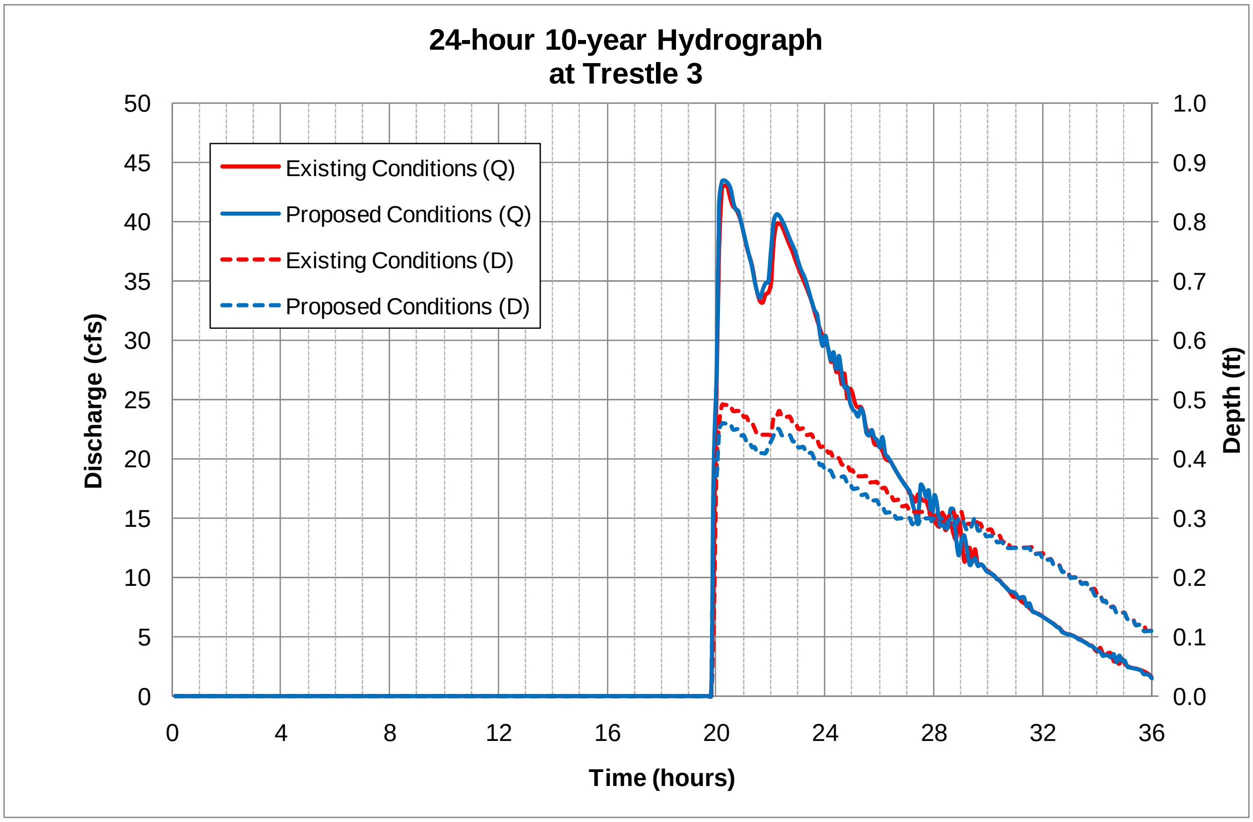

24-hour 10-year Hydrograph
at Trestle 2
Discharge (cfs)
Flow Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
50
100
150
200
250
300
350
400
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
4
8
12
16
20
24
28
32
36


24-hour 5-year Hydrograph
at Trestle 2
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Flow Depth (ft)
Time (hours)
0
4
8
12
16
20
24
28
32
36
90
80
70
60
50
40
30
20
10
0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

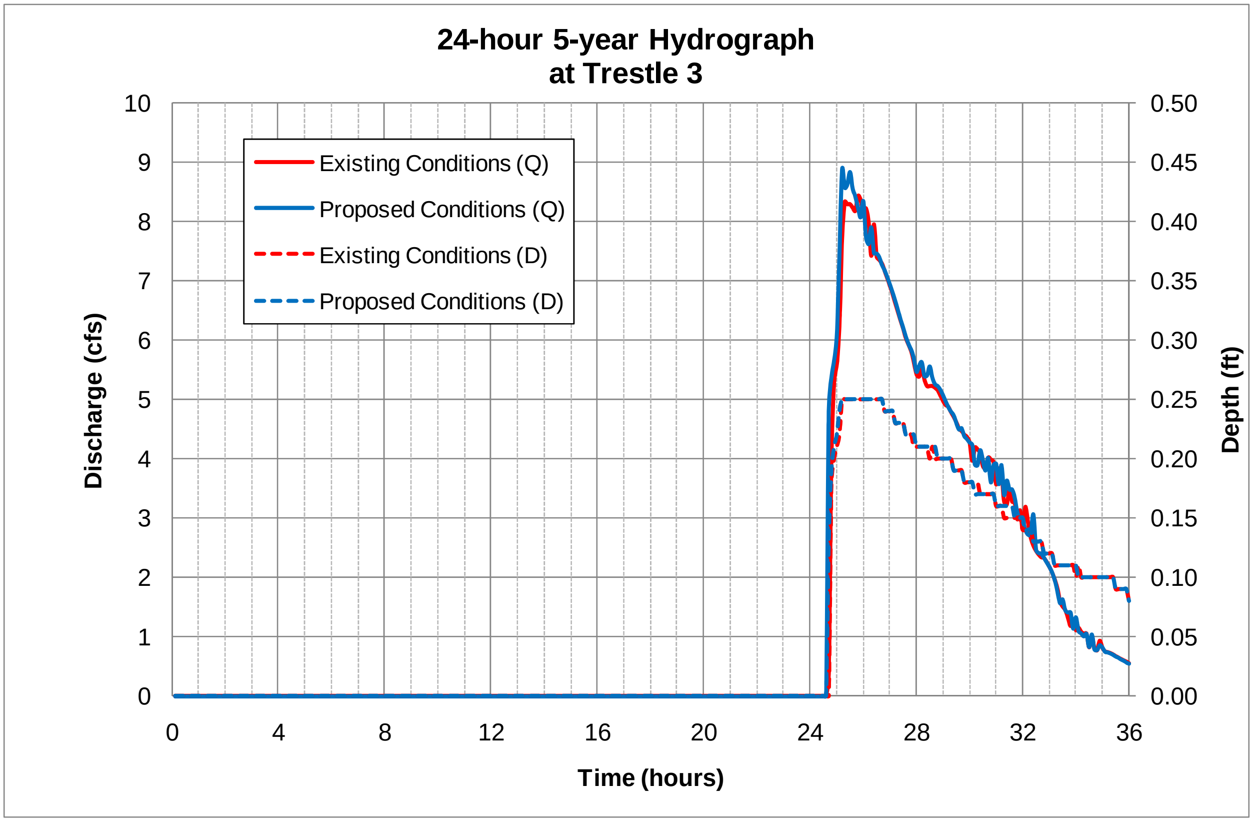

24-hour 2-year Hydrograph
at Trestle 2
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Flow Depth (ft)
Time (hours)
0
4
8
12
16
20
24
28
32
36
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

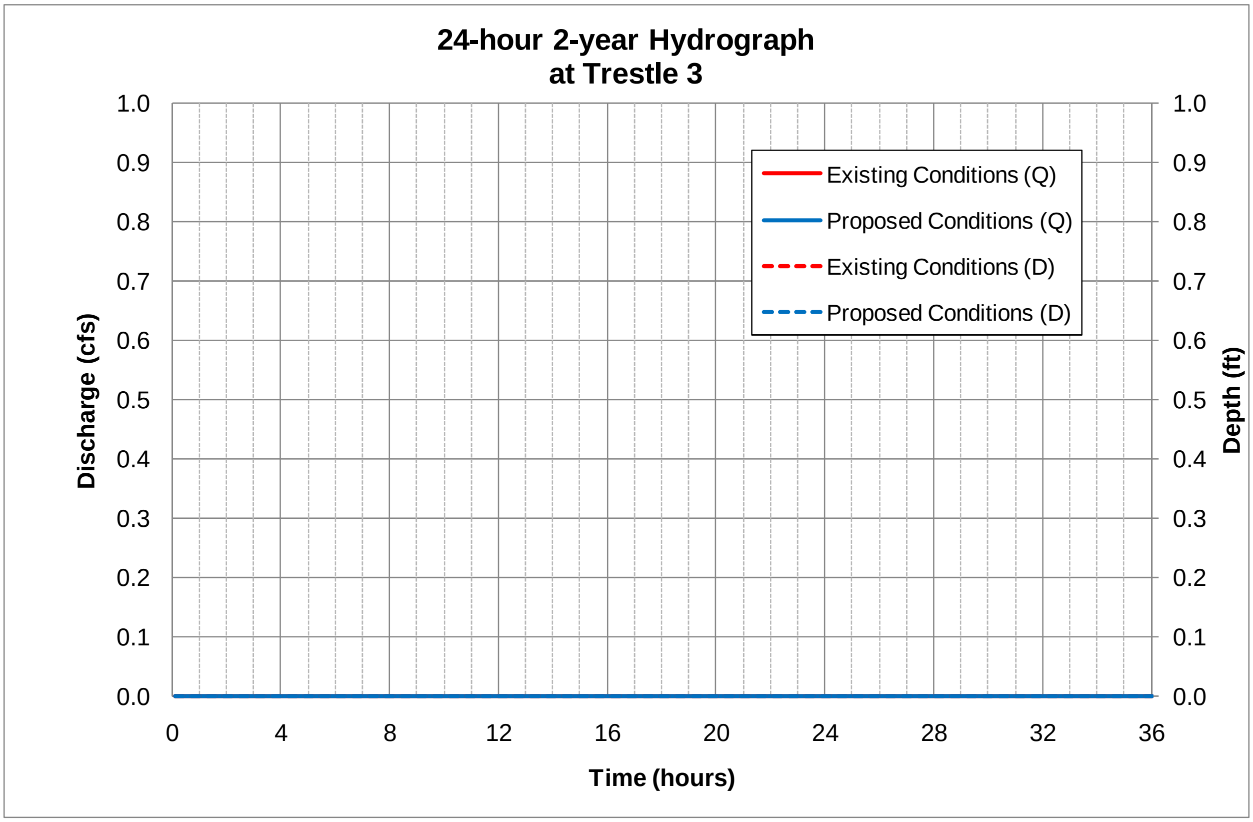


24-hour 100-year Hydrograph
at Trestle 3
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0 100 200 300 400 500 600 700 800 900
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6
0 4 8 12 16 20 24 28 32 36

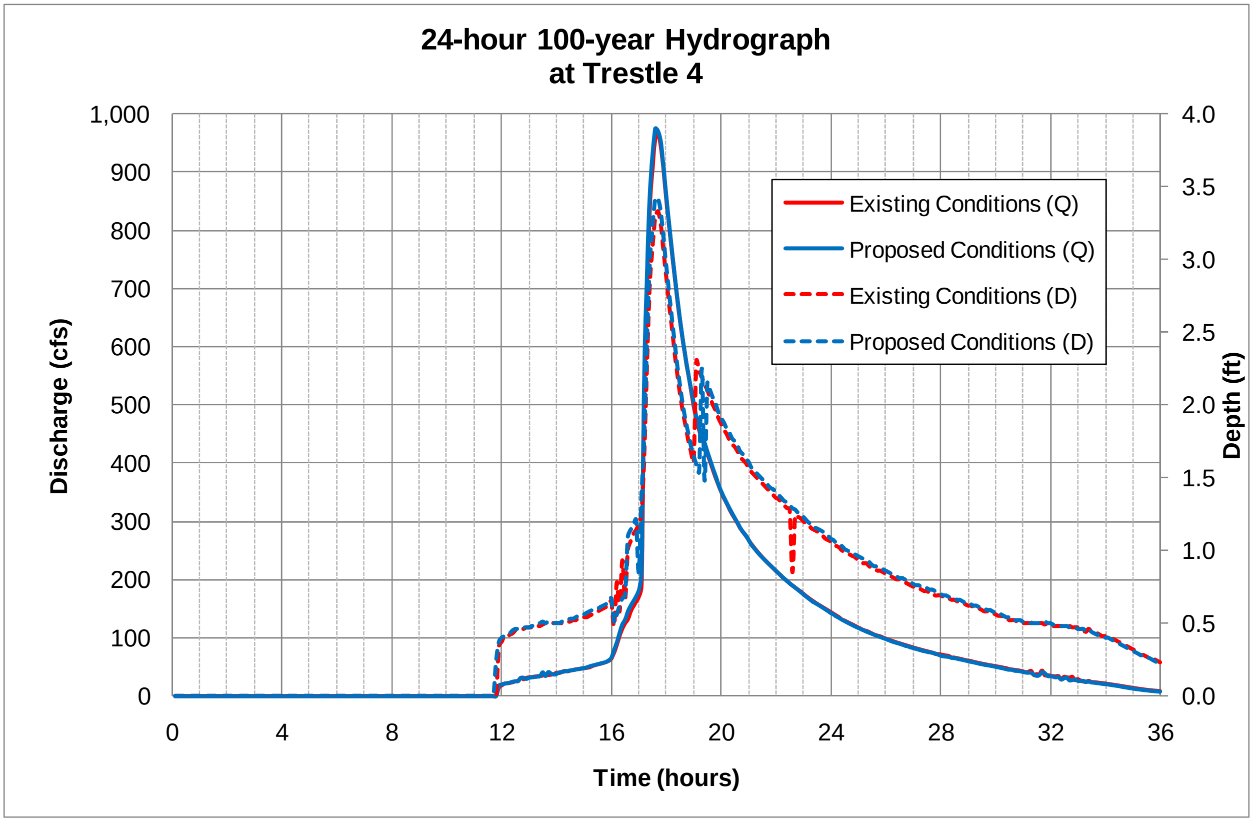


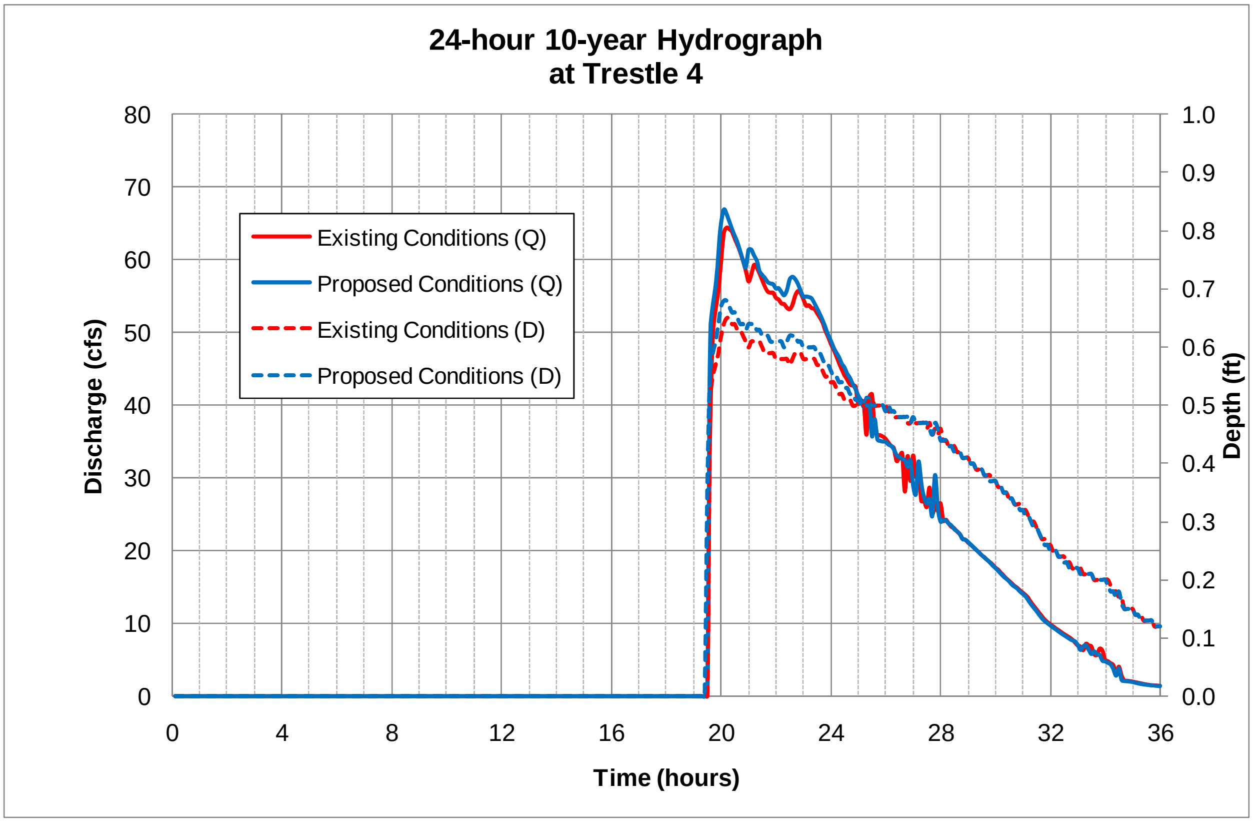
24-hour 10-year Hydrograph
at Trestle 3
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0 5 10 15 20 25 30 35 40 45 50
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
0 4 8 12 16 20 24 28 32 36

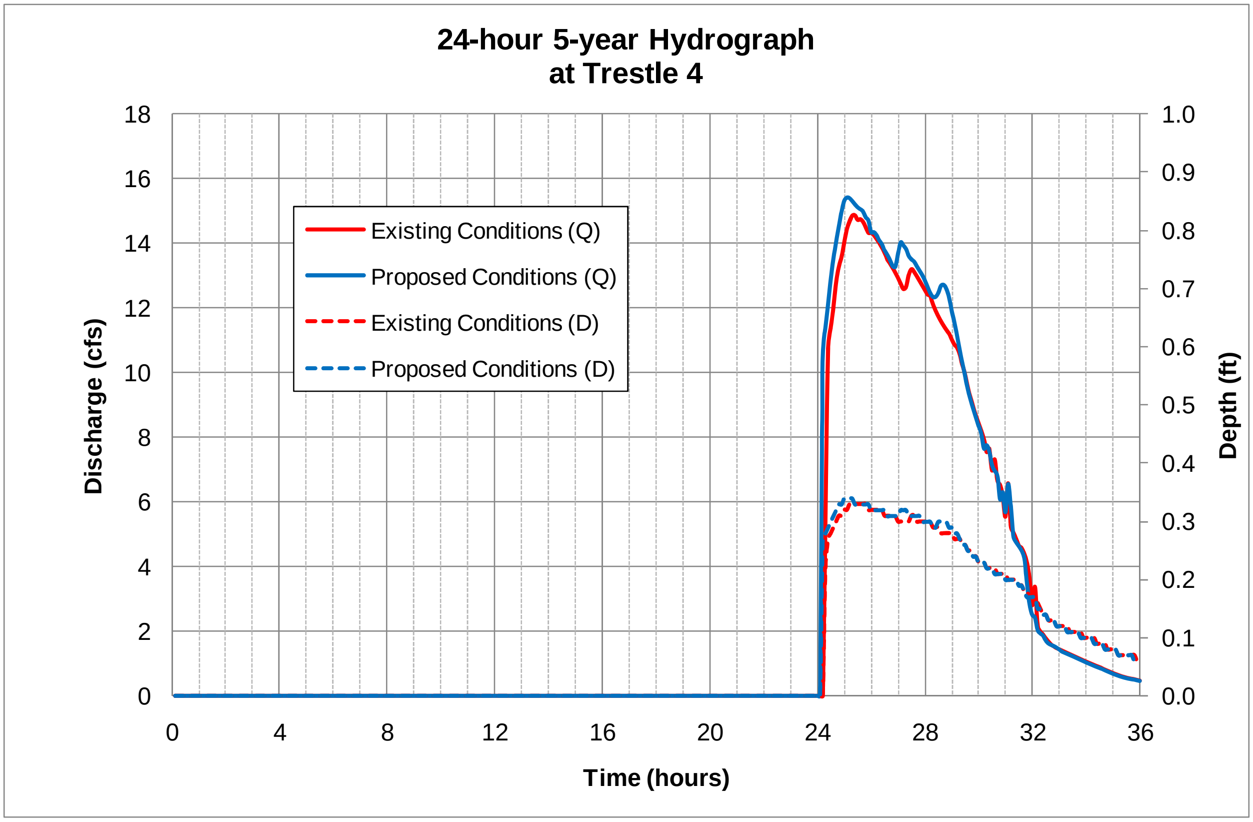

24-hour 5-year Hydrograph
at Trestle 3
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)

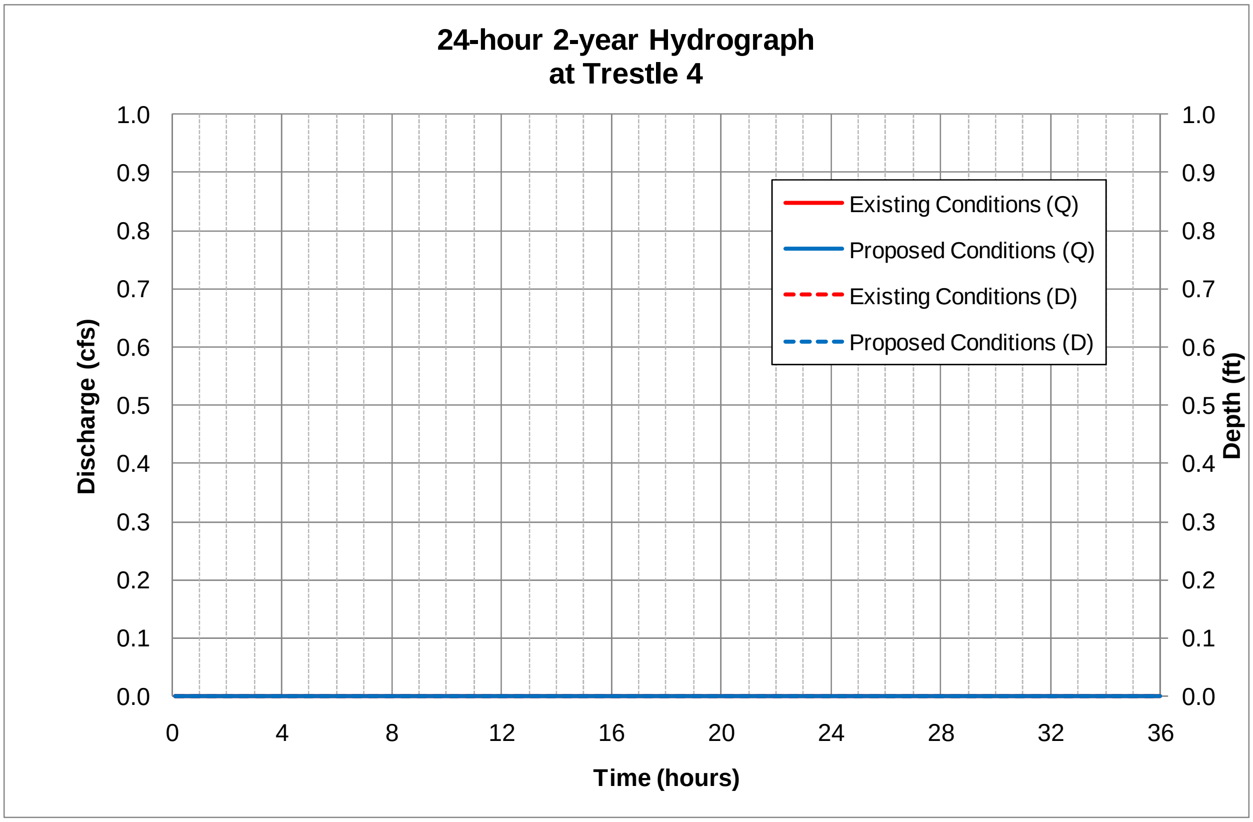

24-hour 2-year Hydrograph
at Trestle 3
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)

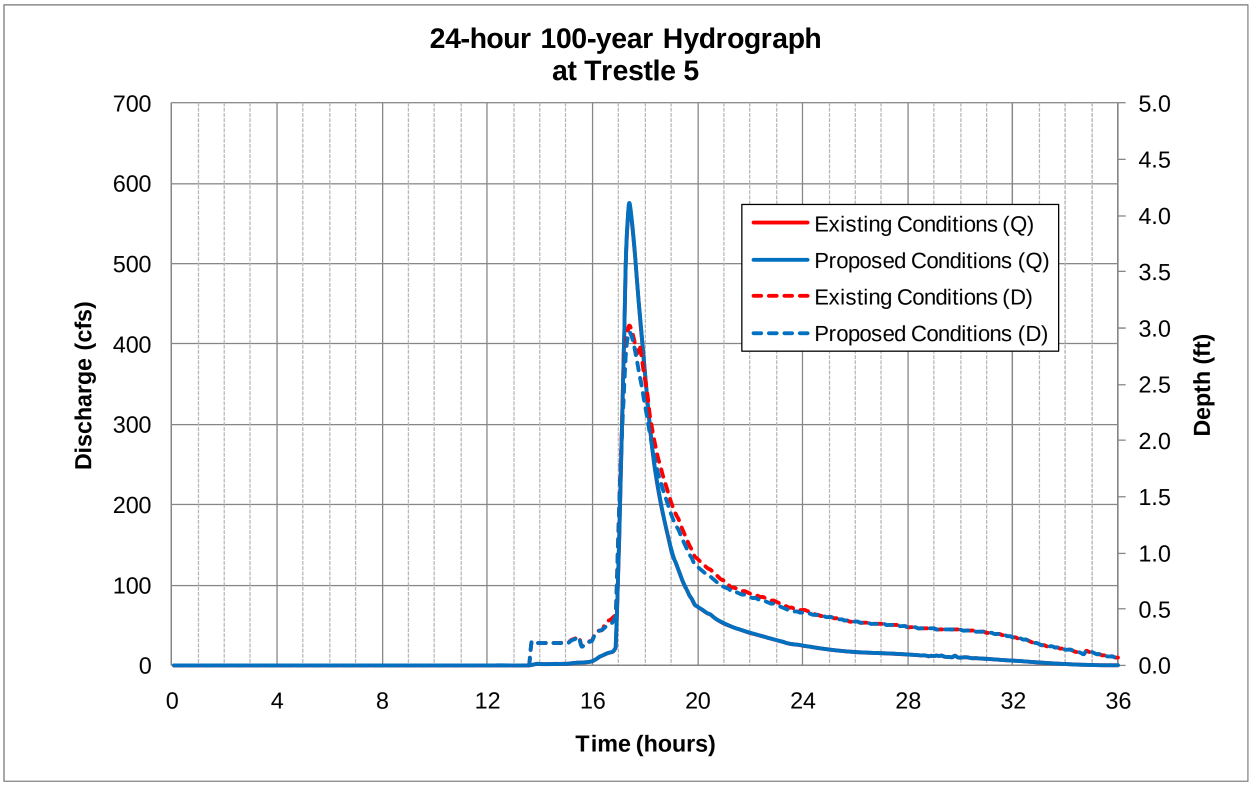
TETRA TECH

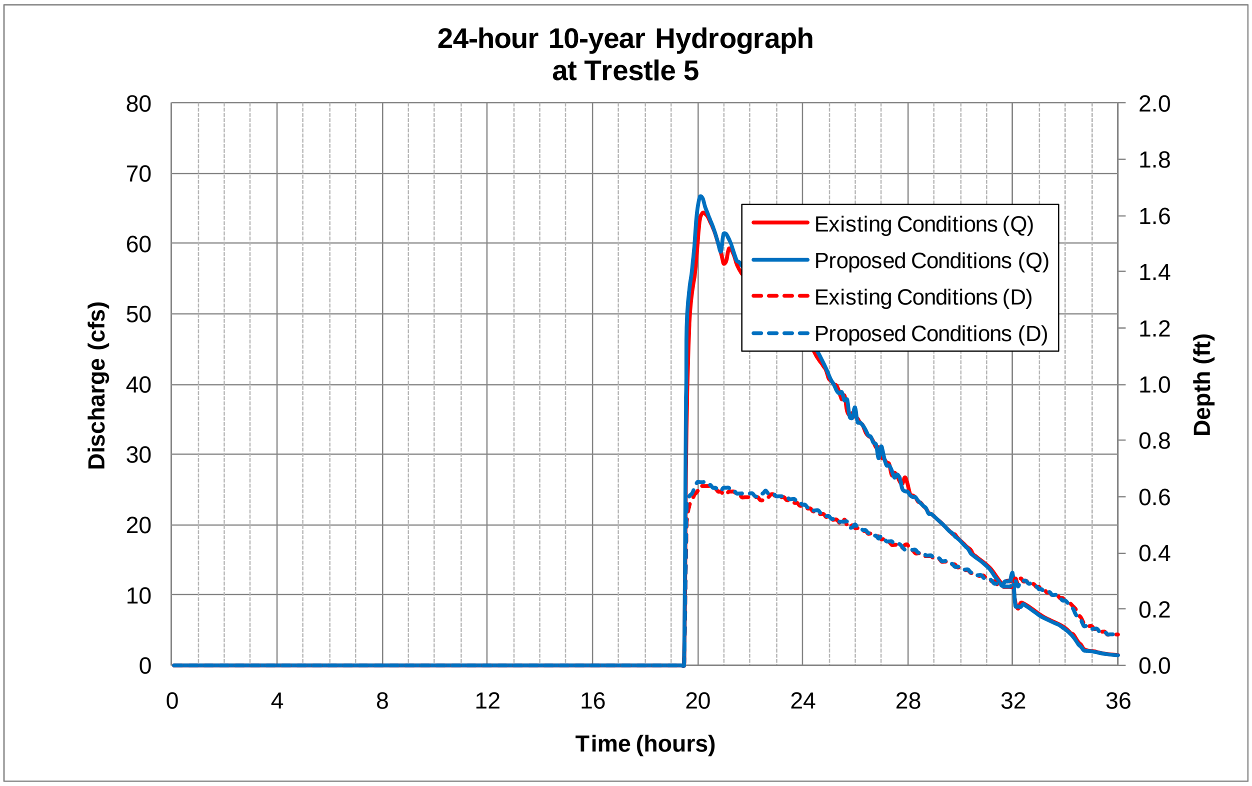

24-hour 100-year Hydrograph
at Trestle 4
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
1,000
900
800
700
600
500
400
300
200
100
0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36

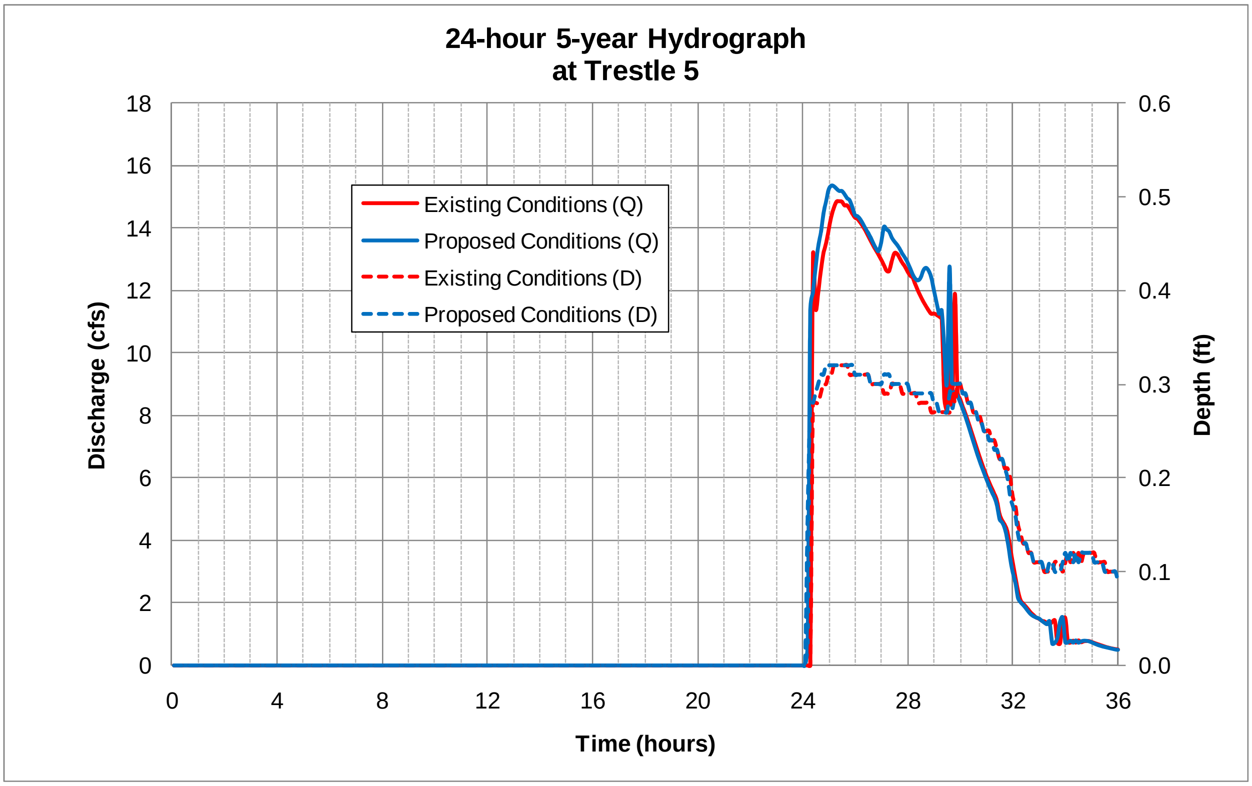

24-hour 10-year Hydrograph
at Trestle 4
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
80
70
60
50
40
30
20
10
0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36


24-hour 5-year Hydrograph
at Trestle 4
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0
2
4
6
8
10
12
14
16
18
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36

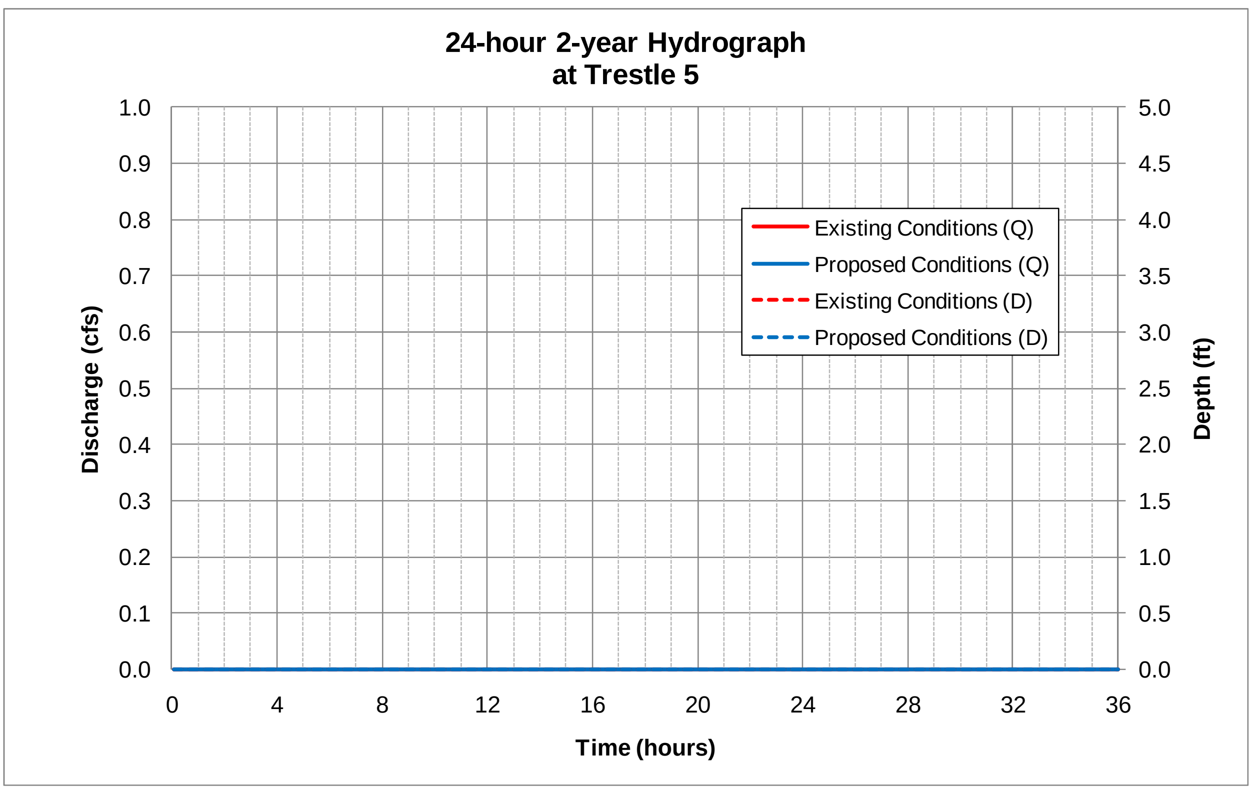

24-hour 2-year Hydrograph
at Trestle 4
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36


24-hour 100-year Hydrograph
at Trestle 5
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
100
200
300
400
500
600
700
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
0
4
8
12
16
20
24
28
32
36

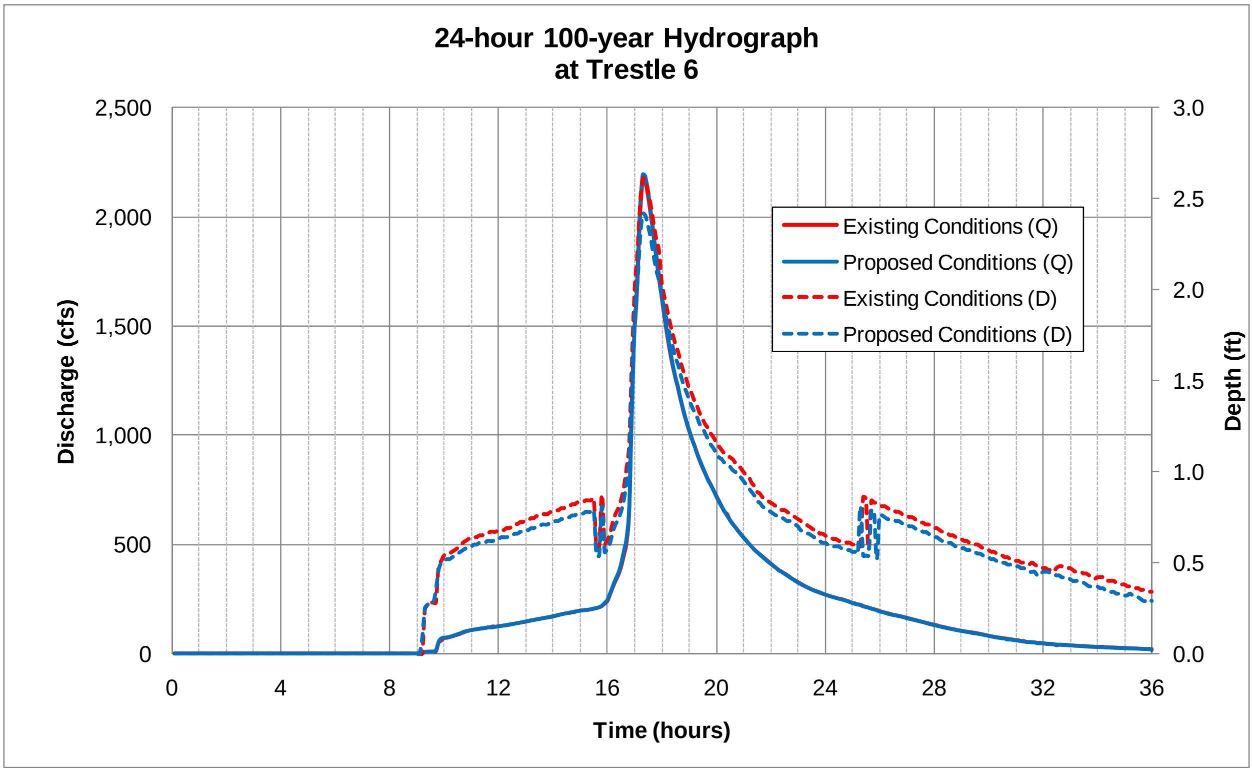

24-hour 10-year Hydrograph
at Trestle 5
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
10
20
30
40
50
60
70
80
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
4
8
12
16
20
24
28
32
36

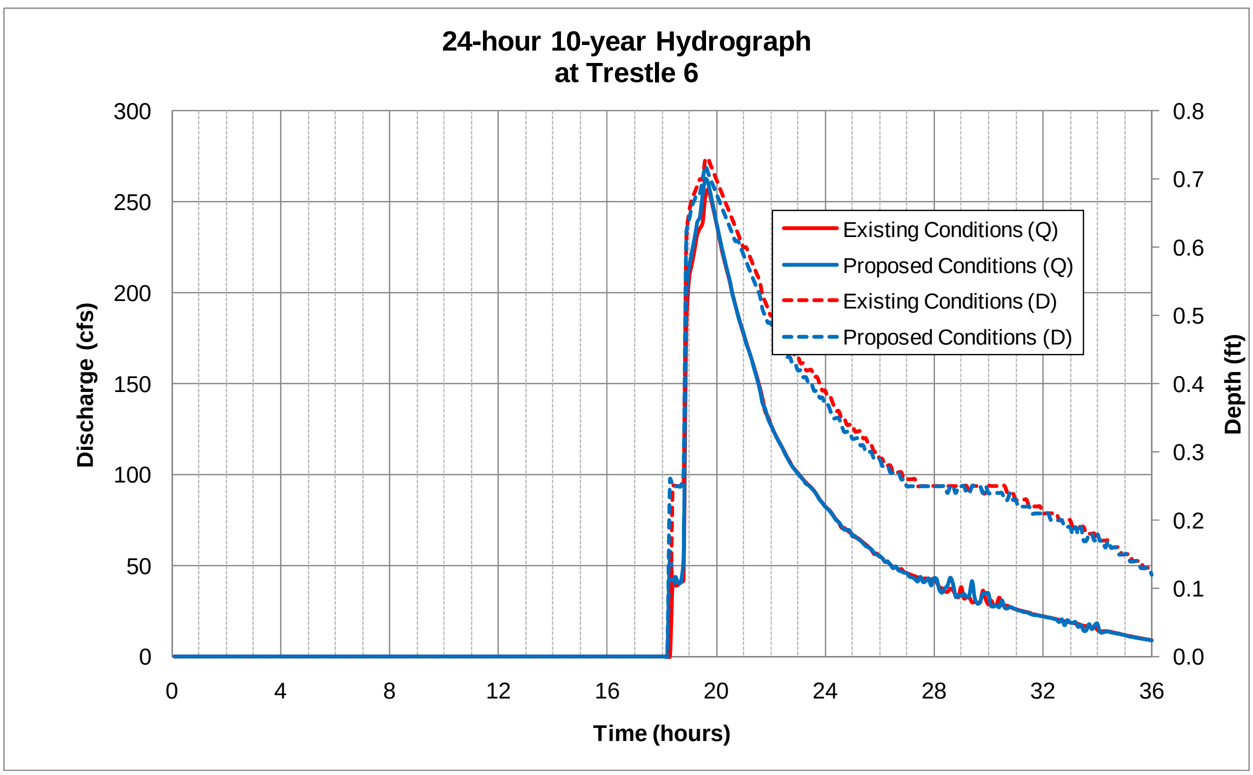


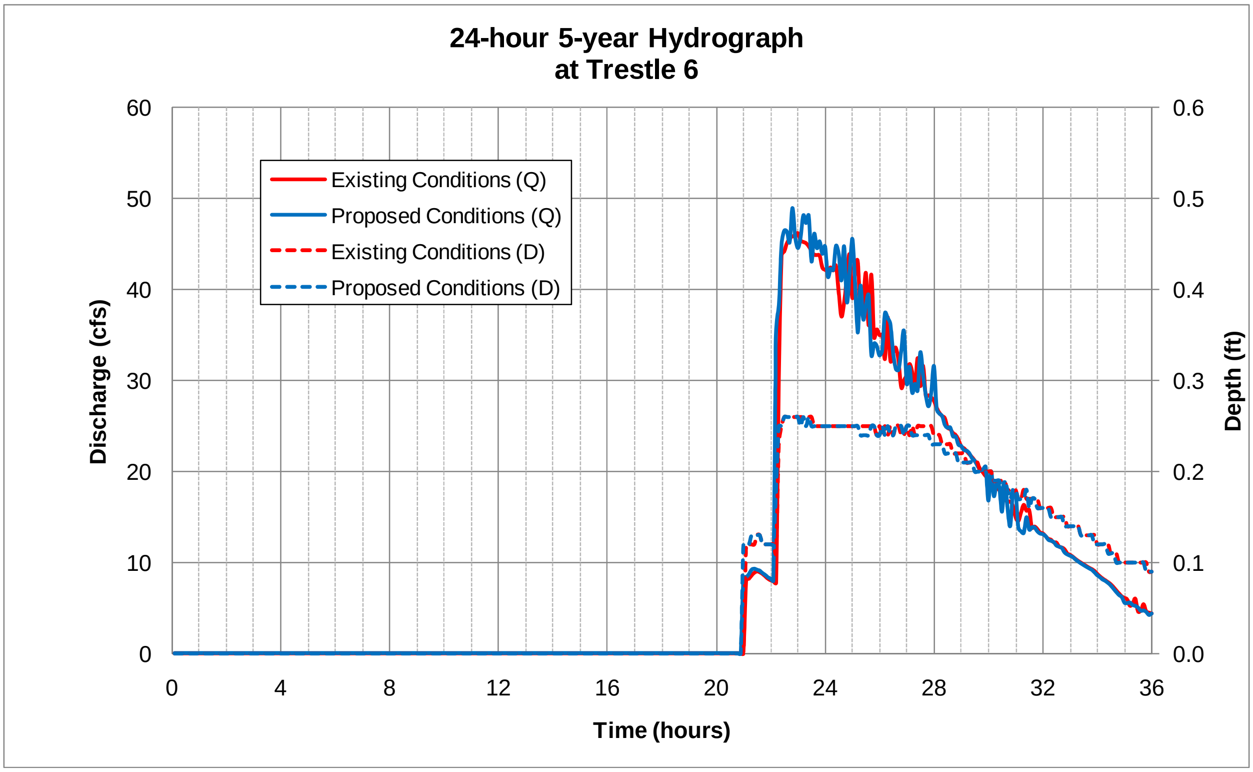
24-hour 5-year Hydrograph
at Trestle 5
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)

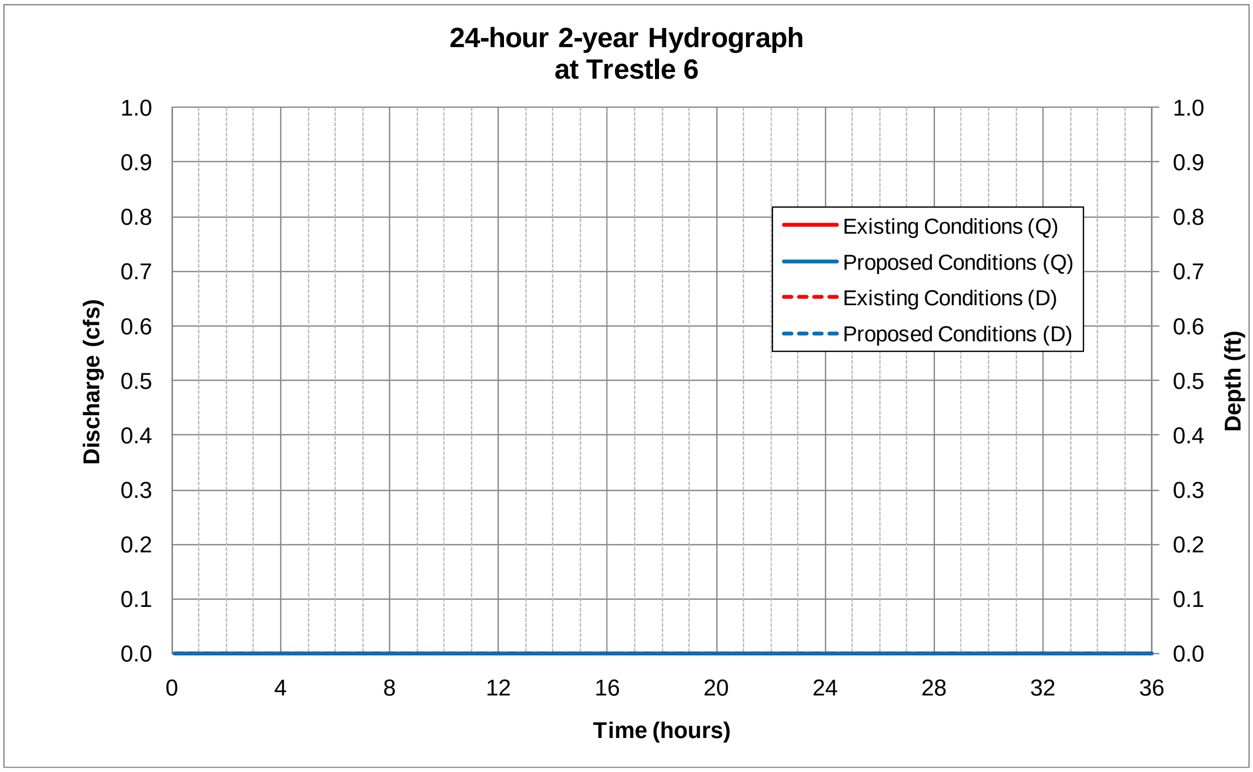


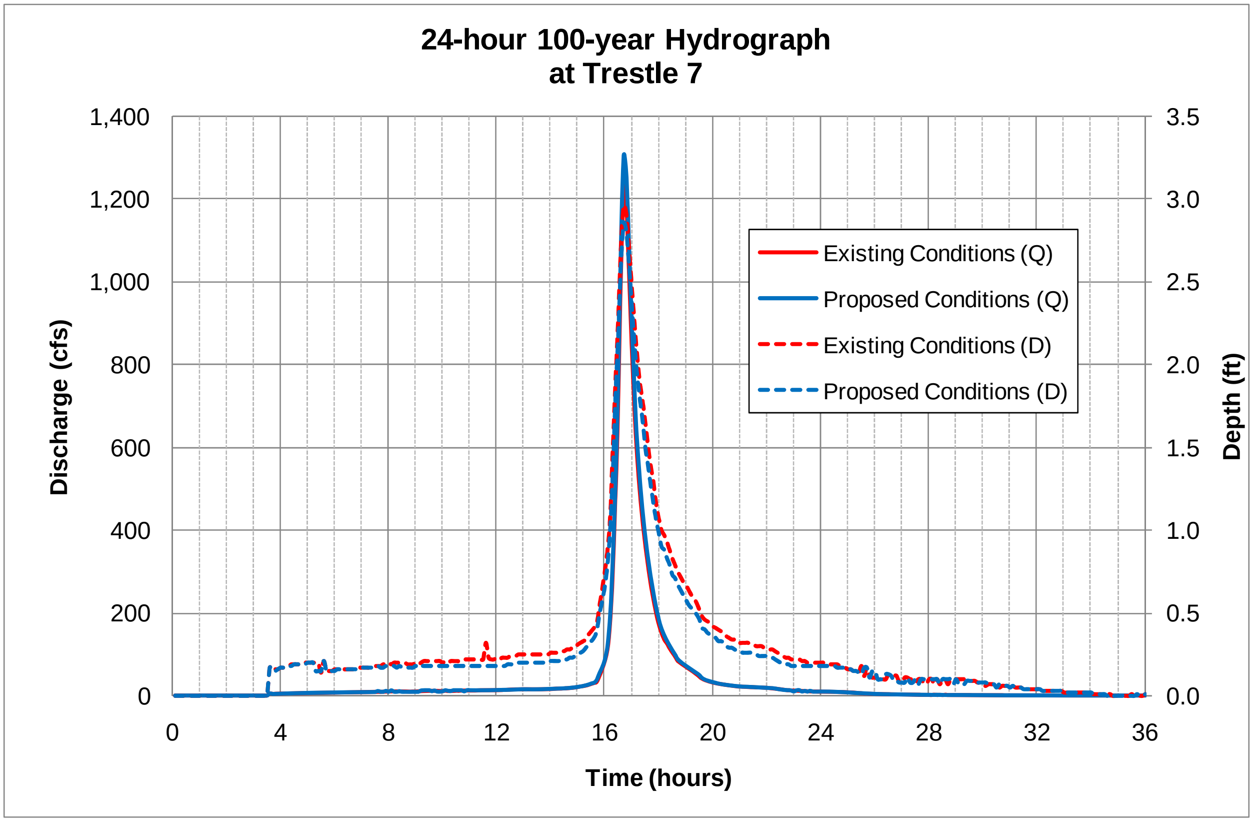
24-hour 2-year Hydrograph
at Trestle 5
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)

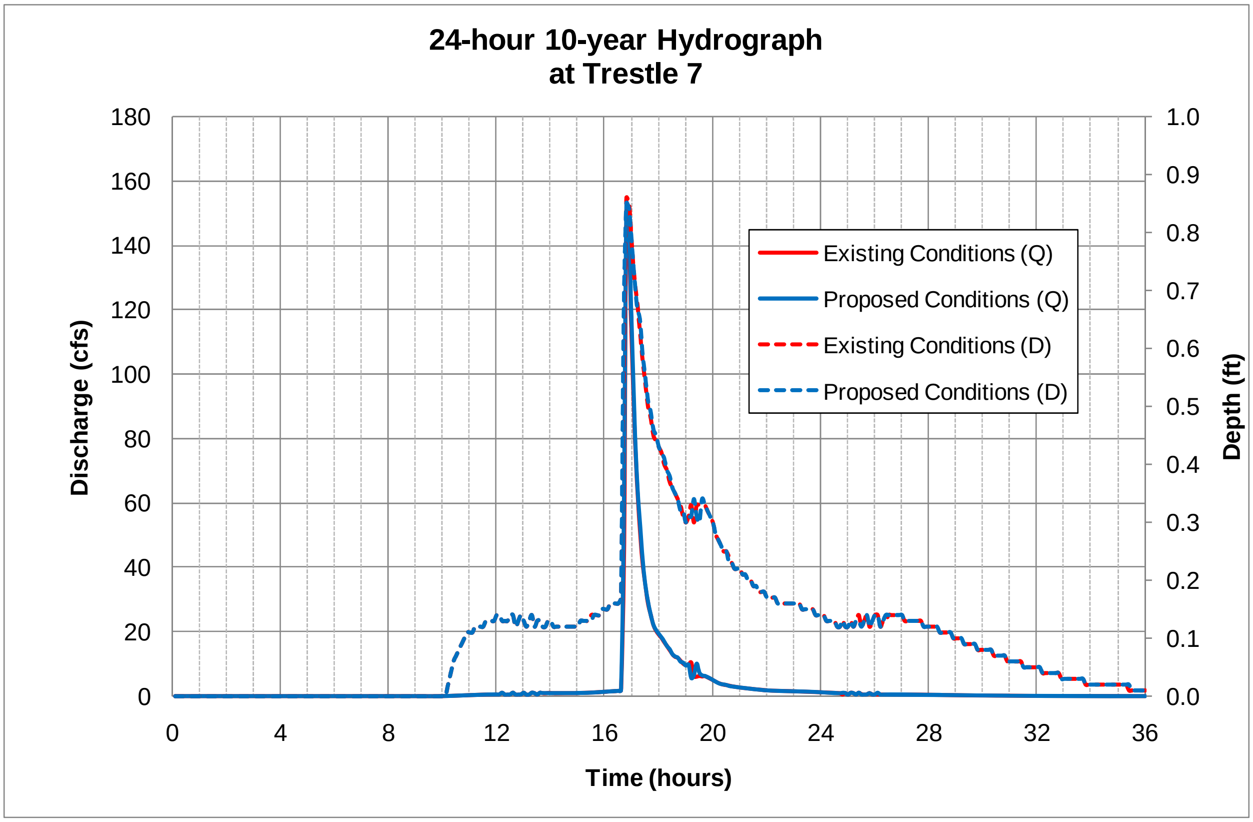

24-hour 100-year Hydrograph
at Trestle 6
Discharge (cfs)
2,500
2,000
1,500
1,000
500
0
Depth (ft)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

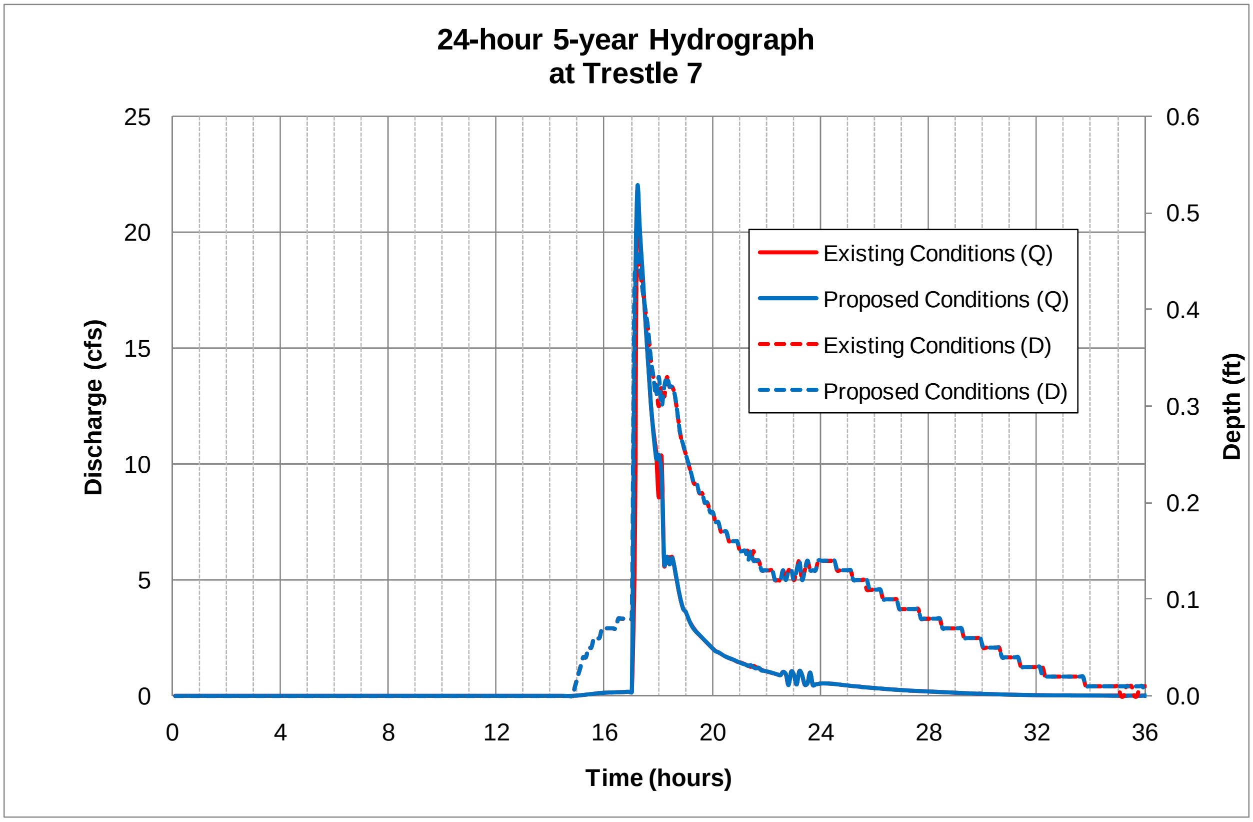

24-hour 10-year Hydrograph
at Trestle 6
Discharge (cfs)
300
250
200
150
100
50
0
Depth (ft)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

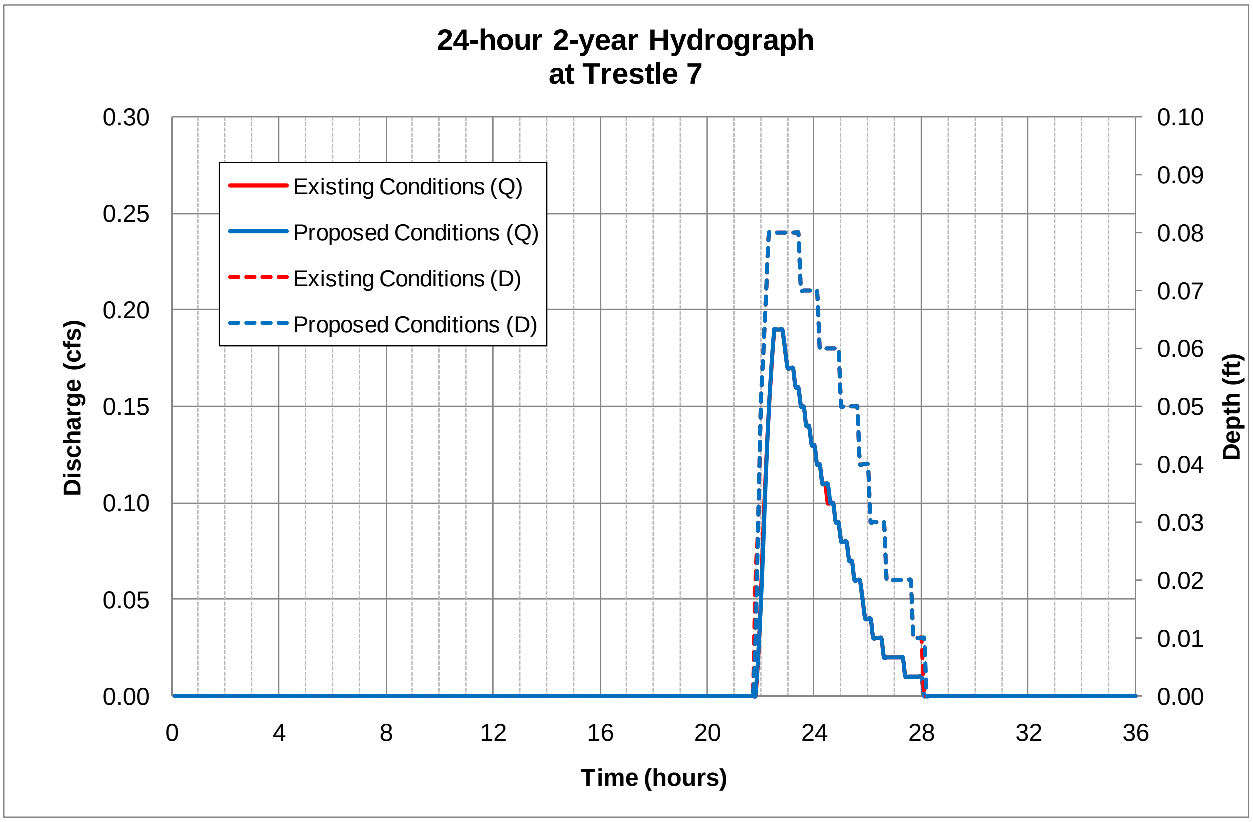

24-hour 5-year Hydrograph
at Trestle 6
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0
10
20
30
40
50
60
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
4
8
12
16
20
24
28
32
36

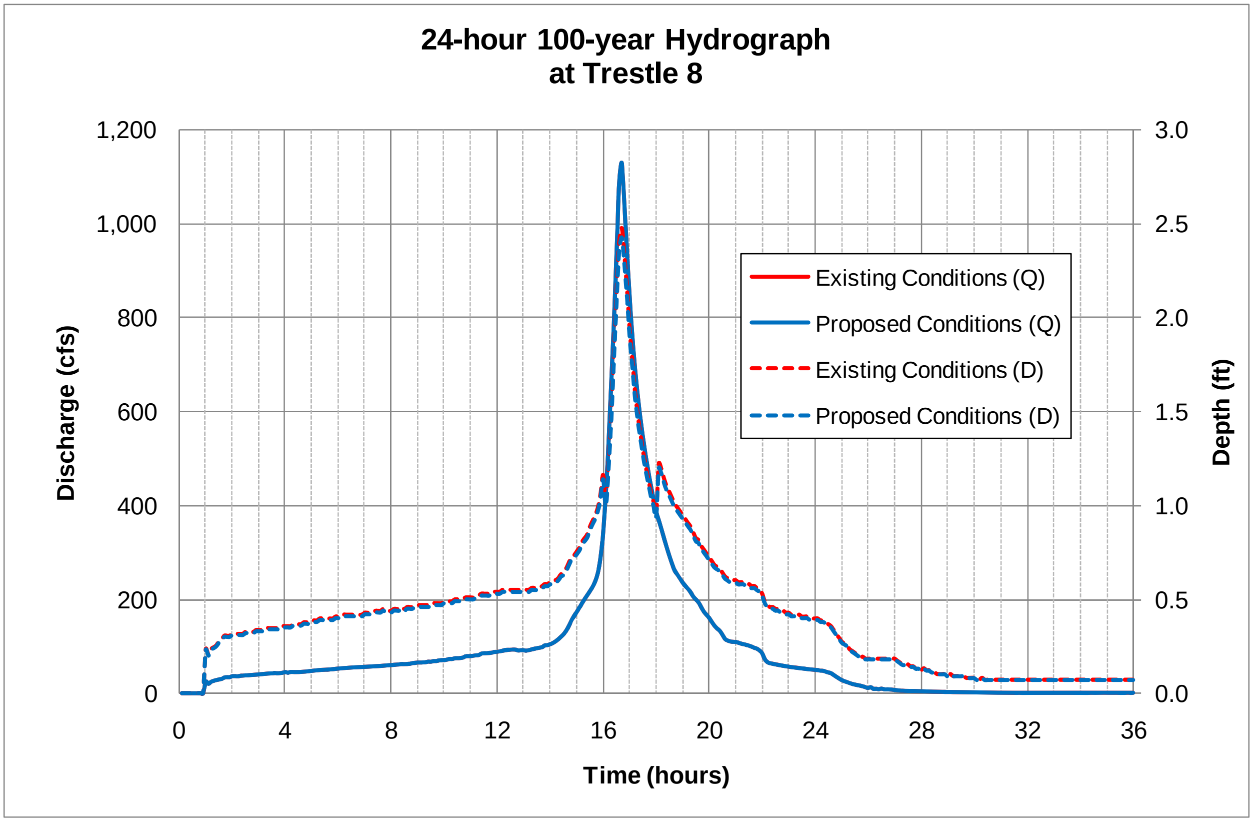

24-hour 2-year Hydrograph
at Trestle 6
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36

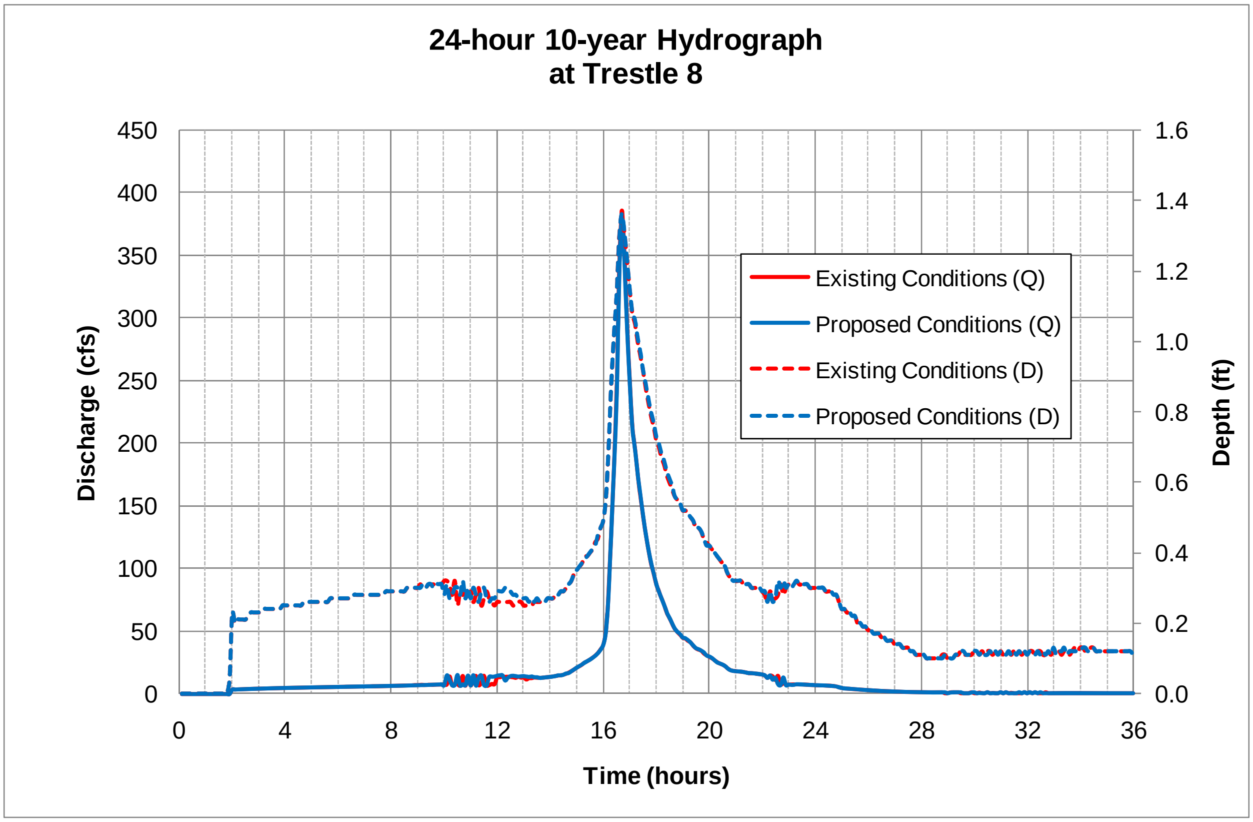

24-hour 100-year Hydrograph
at Trestle 7
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

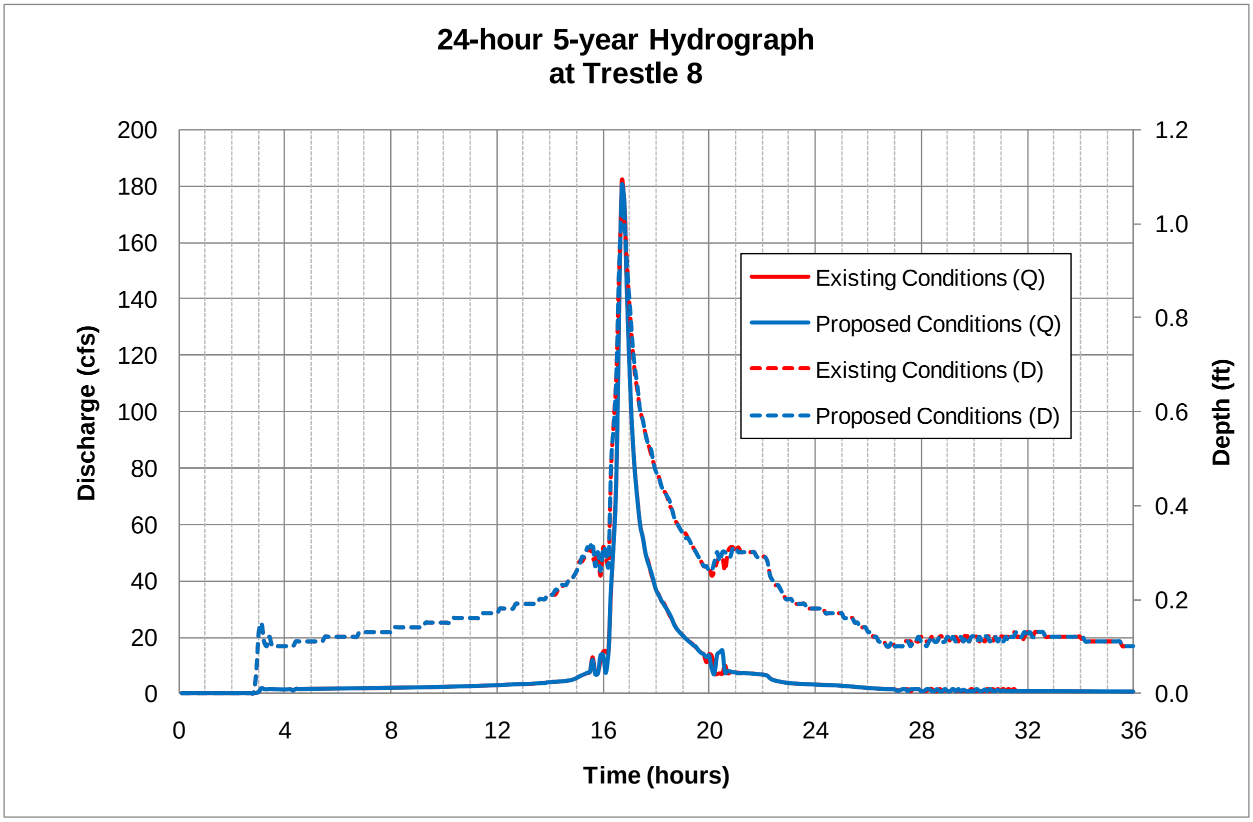

24-hour 10-year Hydrograph
at Trestle 7
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

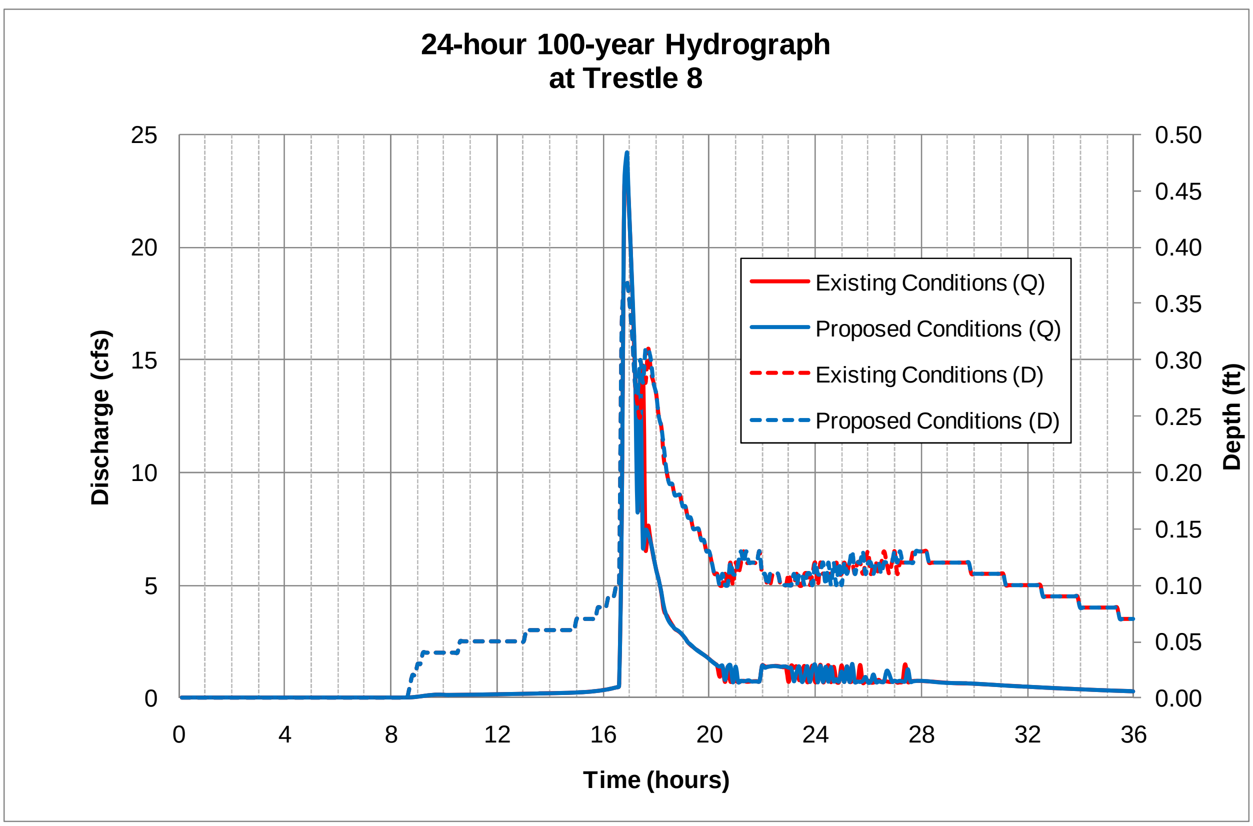

24-hour 5-year Hydrograph
at Trestle 7
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
5
10
15
20
25
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0 4 8 12 16 20 24 28 32 36

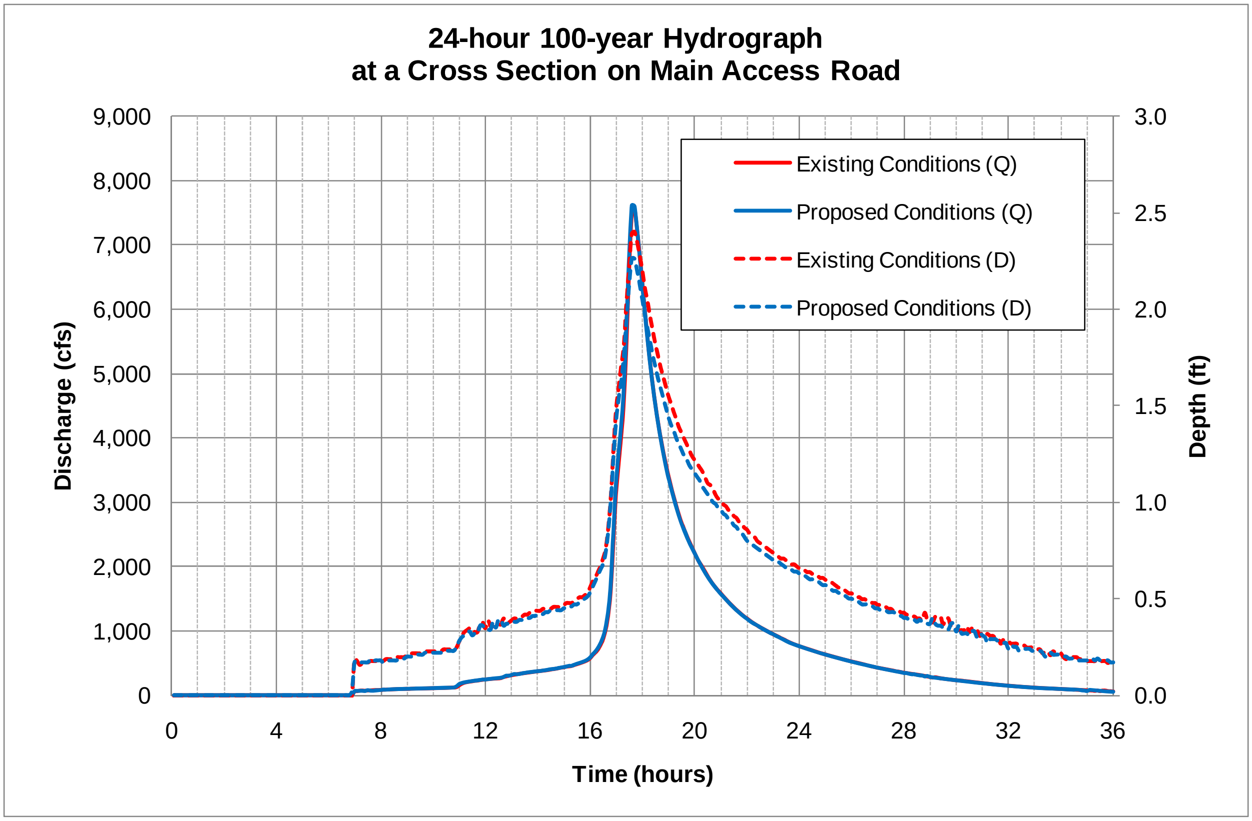

24-hour 2-year Hydrograph
at Trestle 7
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0 4 8 12 16 20 24 28 32 36


24-hour 100-year Hydrograph
at Trestle 8
Discharge (cfs)
Depth (ft)
Time (hours)
1,200
1,000
800
600
400
200
0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

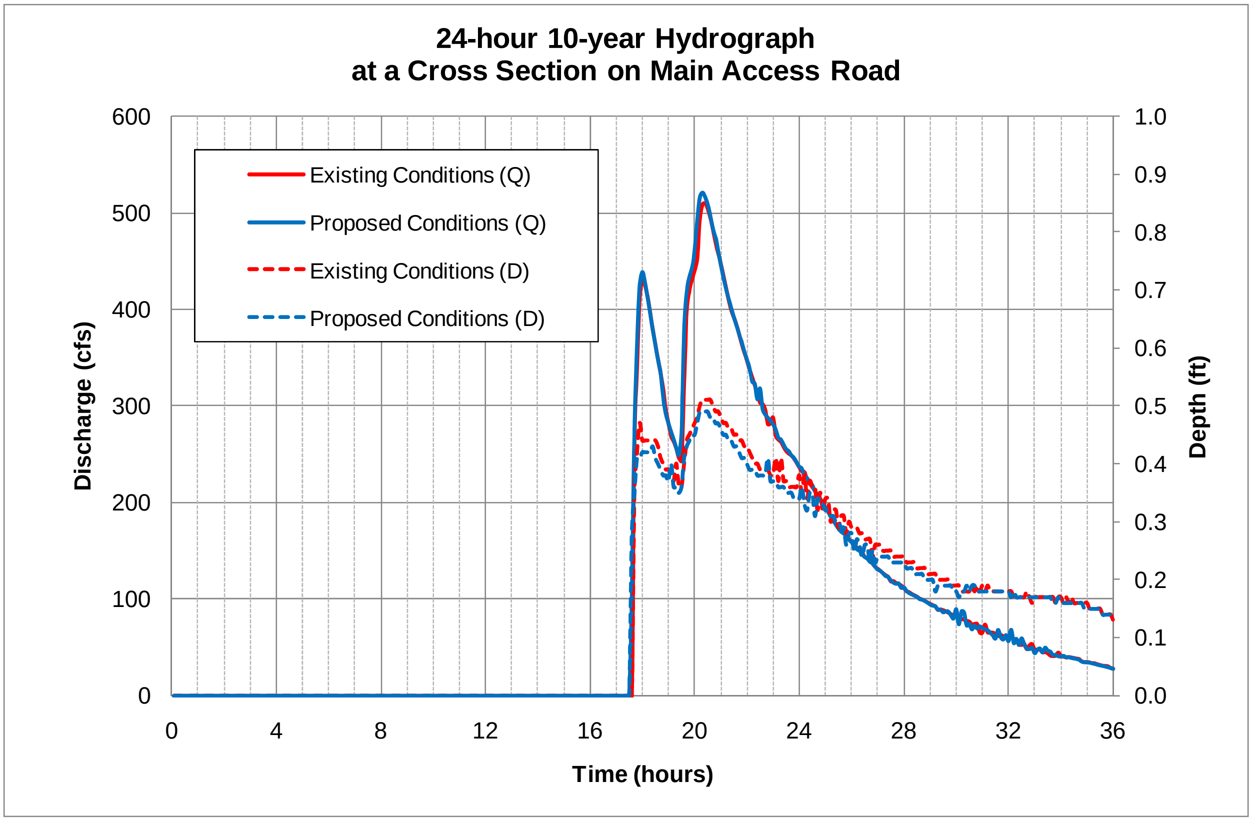

24-hour 10-year Hydrograph
at Trestle 8
Discharge (cfs)
Depth (ft)
Time (hours)
450
400
350
300
250
200
150
100
50
0
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)


24-hour 5-year Hydrograph
at Trestle 8
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
20
40
60
80
100
120
140
160
180
200
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
4
8
12
16
20
24
28
32
36

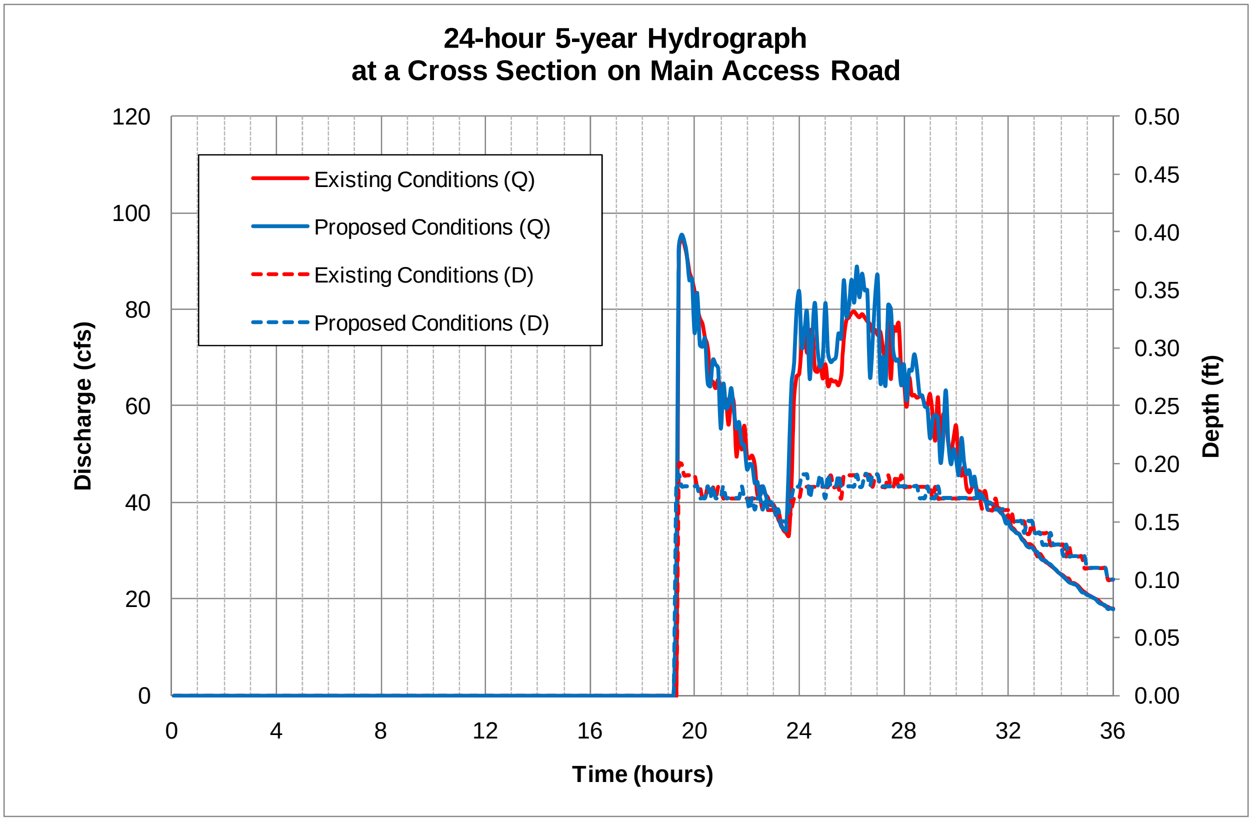

24-hour 100-year Hydrograph
at Trestle 8
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
5
10
15
20
25
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0
4
8
12
16
20
24
28
32
36

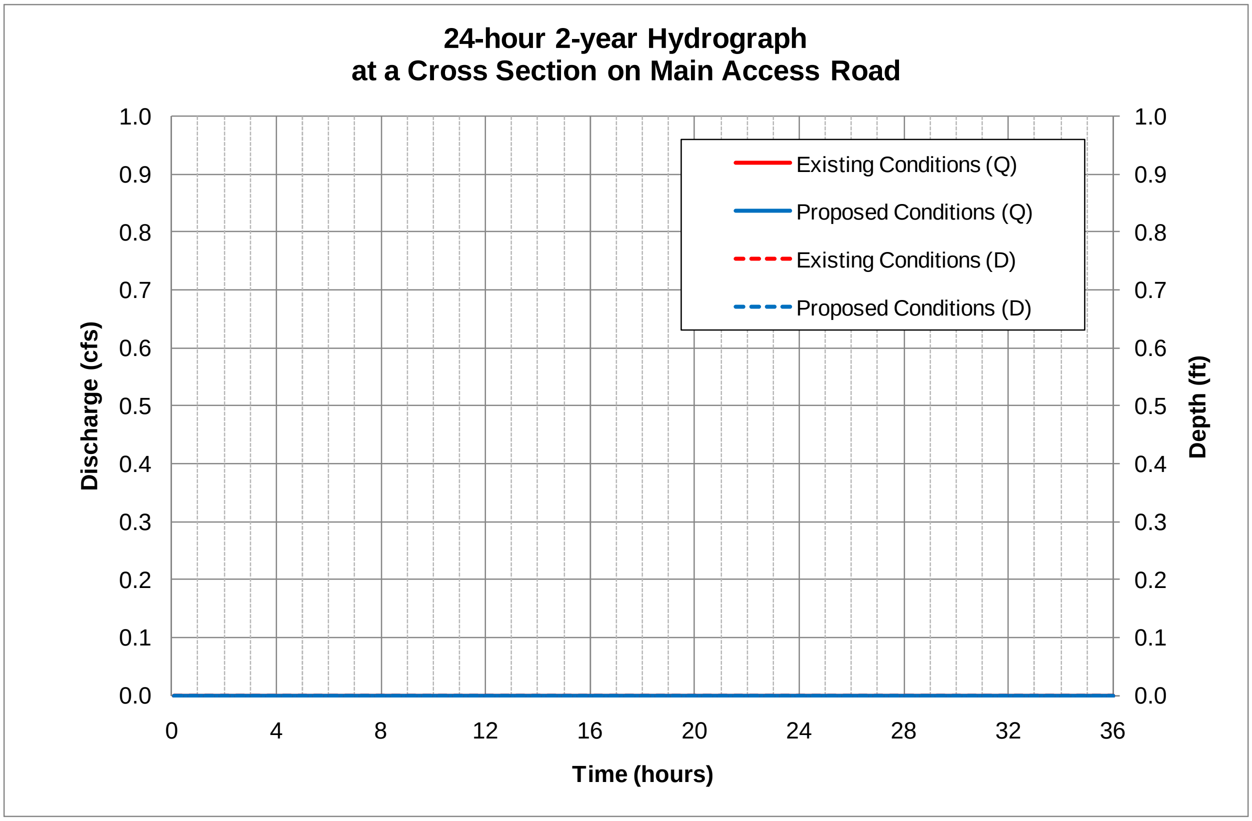


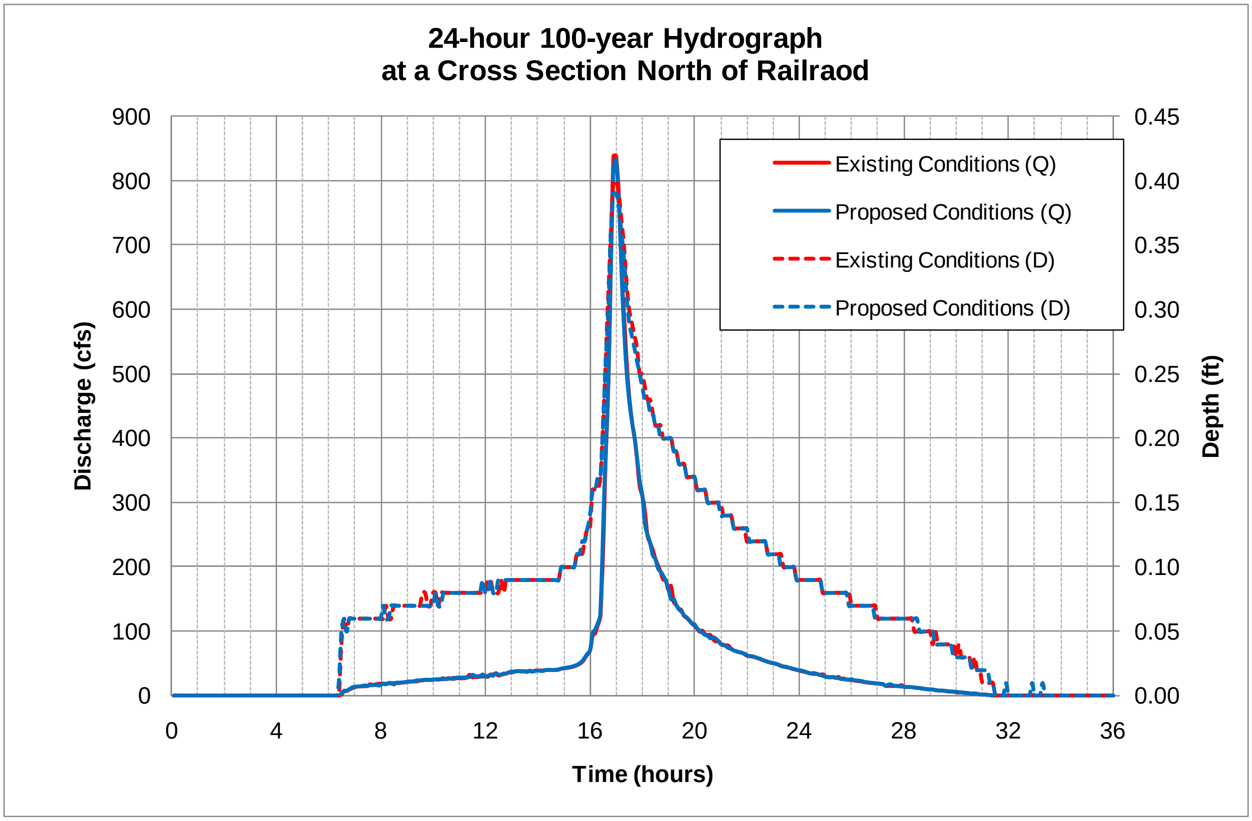
24-hour 100-year Hydrograph
at a Cross Section on Main Access Road
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
4
8
12
16
20
24
28
32
36



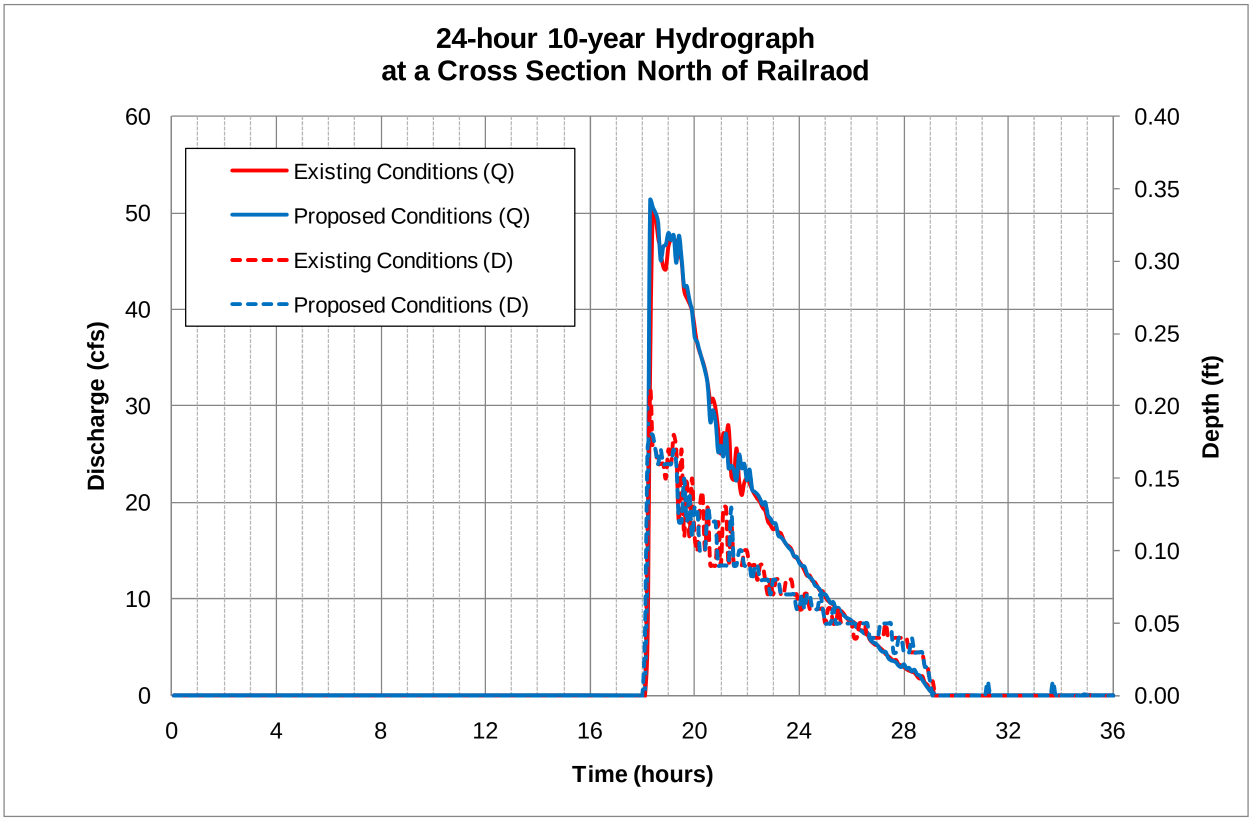
24-hour 10-year Hydrograph
at a Cross Section on Main Access Road
Discharge (cfs)
Depth (ft)
Time (hours)
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
0
100
200
300
400
500
600
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36


24-hour 5-year Hydrograph
at a Cross Section on Main Access Road
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0
20
40
60
80
100
120
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0
4
8
12
16
20
24
28
32
36


24-hour 2-year Hydrograph
at a Cross Section on Main Access Road
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
4
8
12
16
20
24
28
32
36

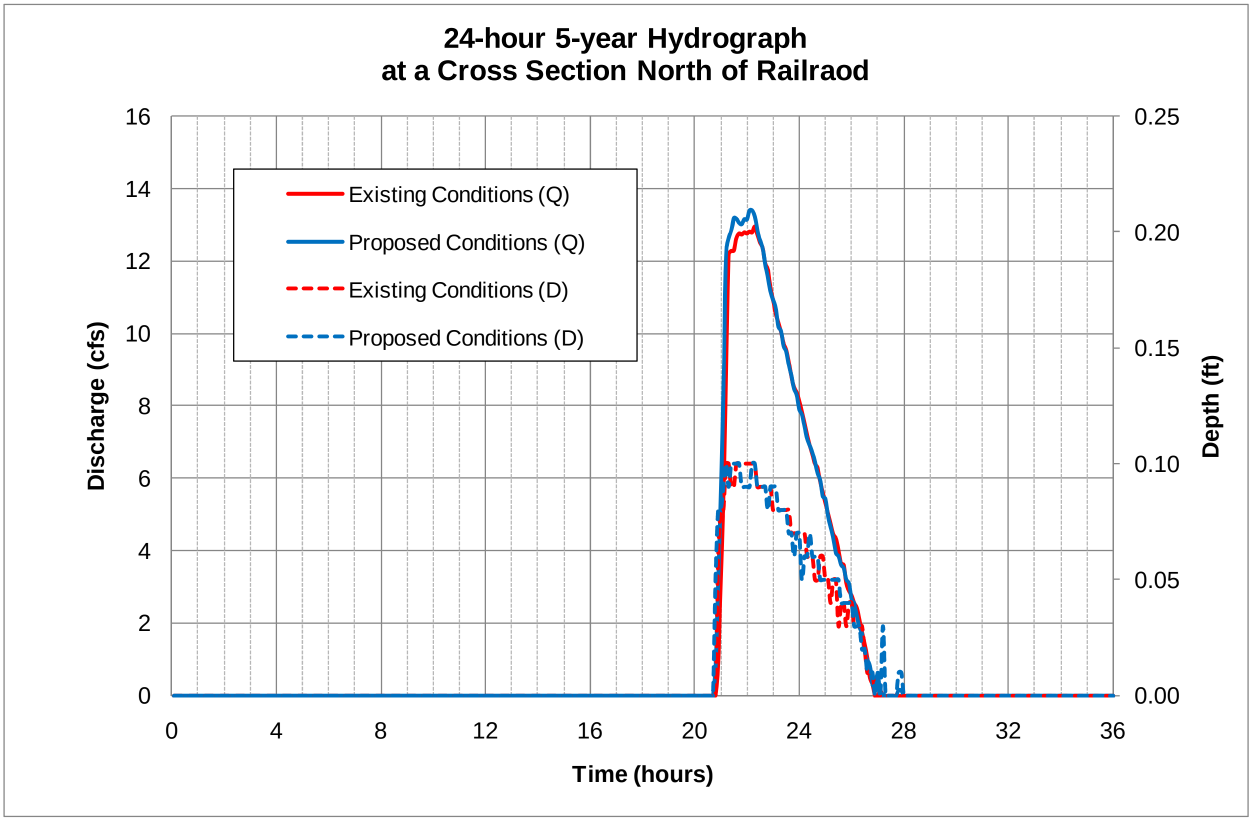


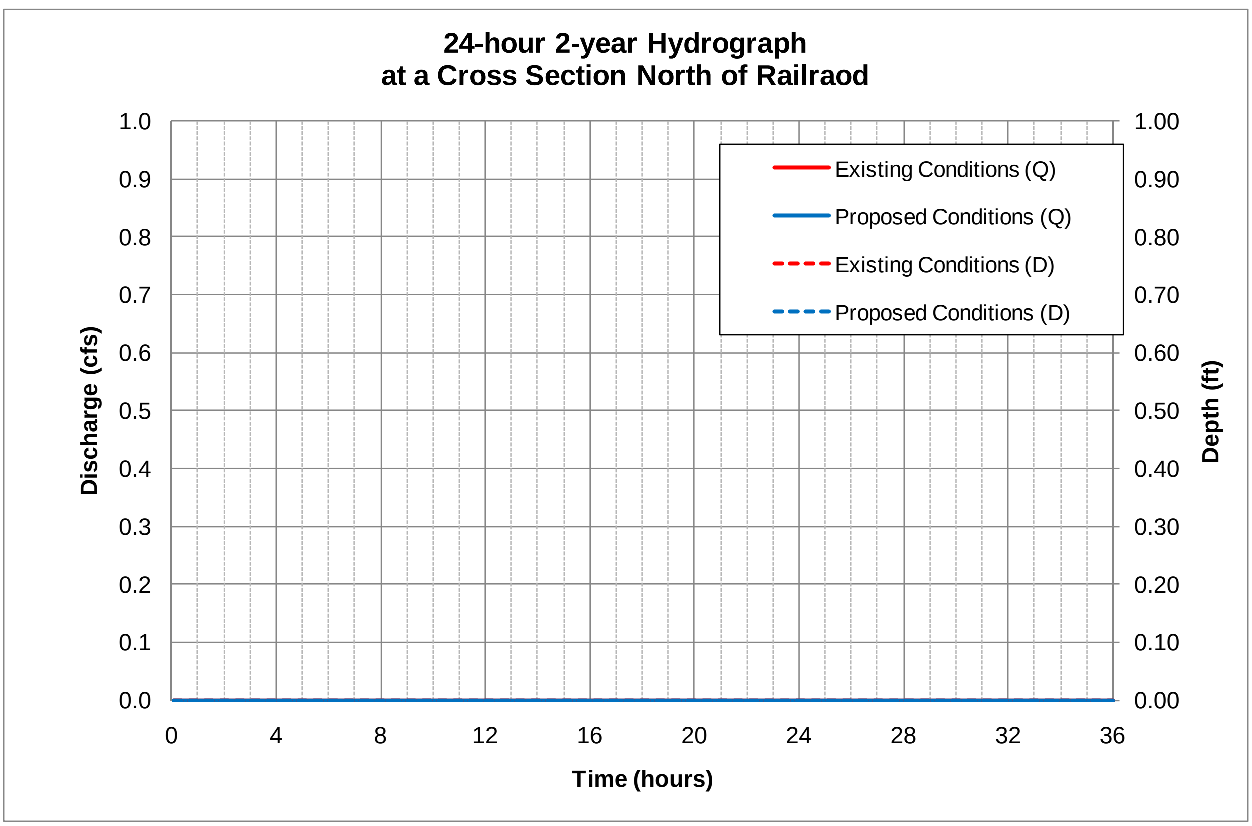
24-hour 100-year Hydrograph
at a Cross Section North of Railraod
Discharge (cfs)
Depth (ft)
Time (hours)
0
100
200
300
400
500
600
700
800
900
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0
4
8
12
16
20
24
28
32
36
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

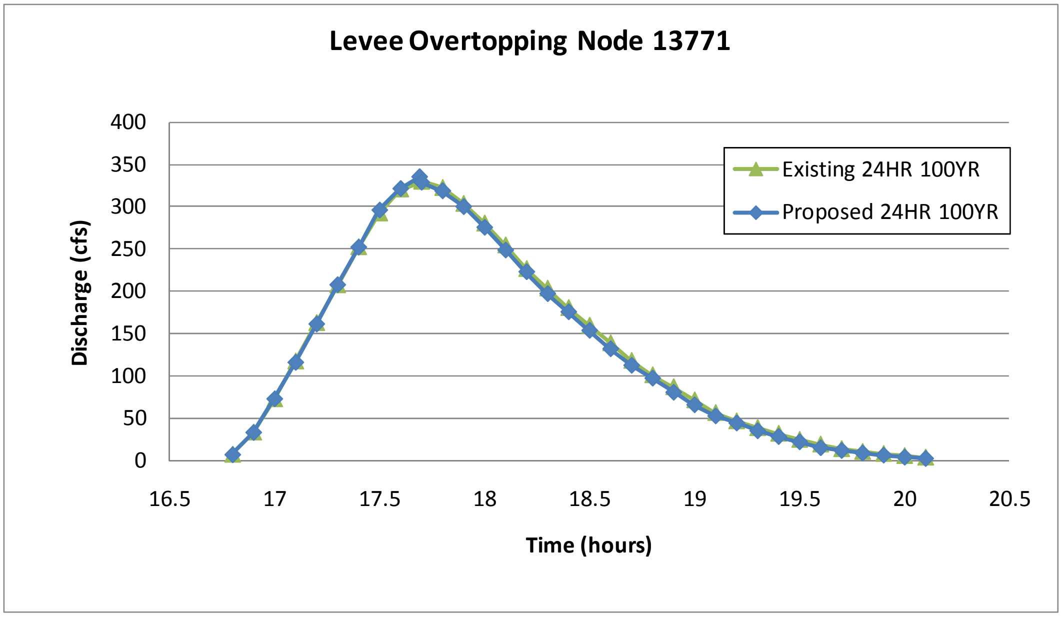


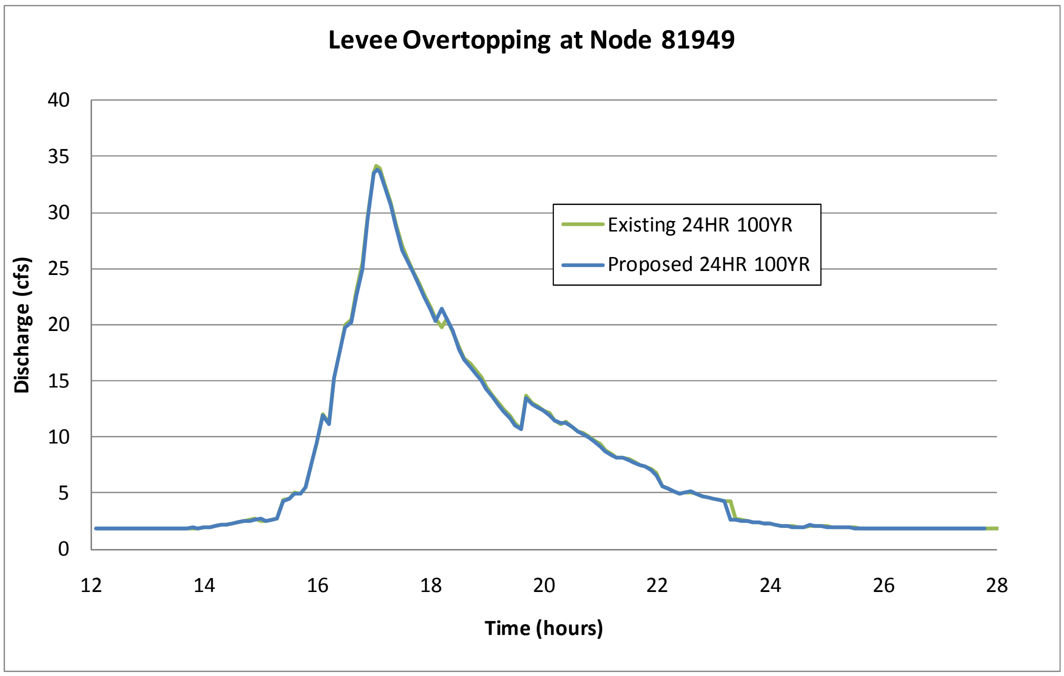
24-hour 10-year Hydrograph
at a Cross Section North of Railraod
Discharge (cfs)
Depth (ft)
Time (hours)
0
10
20
30
40
50
60
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
4
8
12
16
20
24
28
32
36
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)

TETRA TECH


24-hour 5-year Hydrograph
at a Cross Section North of Railraod
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0
2
4
6
8
10
12
14
16
0.00
0.05
0.10
0.15
0.20
0.25
0
4
8
12
16
20
24
28
32
36


24-hour 2-year Hydrograph
at a Cross Section North of Railraod
Existing Conditions (Q)
Proposed Conditions (Q)
Existing Conditions (D)
Proposed Conditions (D)
Discharge (cfs)
Depth (ft)
Time (hours)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
0
4
8
12
16
20
24
28
32
36


Levee Overtopping Node 13771
Existing 24HR 100YR
Proposed 24HR 100YR
Discharge (cfs)
Time (hours)
400
350
300
250
200
150
100
50
0
16.5
17
17.5
18
18.5
19
19.5
20
20.5


Levee Overtopping at Node 81949
Existing 24HR 100YR
Proposed 24HR 100YR
Discharge (cfs)
Time (hours)
40
35
30
25
20
15
10
5
0
12
14
16
18
20
22
24
26
28