Lower Hassayampa River Watercourse Master Plan

Maricopa County

Final Hydraulics Report, Hassayampa River (I)
Volume 3

Contract Number: FCD 2004C001

Prepared for:

JE Fuller/ Hydrology & Geomorphology, Inc.

8400 S. Kyrene Road, Suite 201
Tempe, AZ 85284

Prepared by:

WEST Consultants, Inc
960 W Elliot Road, Suite 201
Tempe, AZ 85284-1137

February 2006

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Flood Control District of Maricopa County

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Registered Professional Engineer (Civil)
Certificate No.
21560
DENNIS L.
RICHARDS
Date Signed 2-7-06
ARIZONA, U.S.A.

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Registered Professional Engineer (Civil) CERTIFICATE NO. 21560 DENNIS L. RICHARDS Date Signed 2-7-06 ARIZONA, U.S.A.

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1. Introduction

1.1. Purpose

The purpose of this project is to identify and develop technical guidance for managing flooding hazards, lateral migration of the Lower Hassayampa watercourse, and the cumulative impacts of existing and future development or encroachment into the floodplain. The specific project reach of the Hassayampa River is located west of Phoenix and extends from the Gila River confluence to the Central Arizona Project (CAP) canal crossing.

This report presents the results of the hydraulic analyses conducted in support of the sediment transport model development by JE Fuller/ Hydrology & Geomorphology, Inc (JEF).

1.2. Scope

The services performed and documented in this report include:

- **Field Reconnaissance & Data Collection.** Information on field reconnaissance and data collection is presented. Field investigation of the study reach was conducted by WEST Consultants, Inc. (WEST) personnel to obtain required physical data and to identify specific features necessary for hydraulic analysis. Data collection also included Digital Terrain Models (DTM), aerial photos, hydrologic and hydraulic data, bridge design plans, bridge As-Builts, channel improvement plans, and paper work maps from the existing Flood Insurance Study (FIS).

- **Hydraulic Analysis.** Hydraulic analysis of existing conditions is presented. The existing conditions steady state hydraulic analysis includes Manning's *n* value determination, and a one dimensional model using U.S. Army Corps of Engineers' HEC-RAS River Analysis System Version 3.1.2. An unsteady model component is also presented as part of the flood peak attenuation analysis.

1.3. Study Area

The approximately 27.5 mile long study reach of the Hassayampa River is located west of Phoenix, Arizona and extends upstream from the Gila River confluence to the Central Arizona Project (CAP) canal crossing (Figure 1-1). Approximately fourteen miles upstream of the confluence, Jackrabbit Wash flows into Hassayampa River. The Hassayampa River reach is heavily braided with notable in-channel mining pits primarily upstream of the I-10 Bridges.

The condition of the vegetation in the channel and floodplain has a high spatial variability, ranging from non-existent to very dense over very short distances. The vegetation at the Hassayampa-Gila confluence is particularly dense. Detailed descriptions of vegetation type and existing land use conditions can be found in the Manning's *n* Report in Appendix A. A summary of land use type and corresponding Manning's *n* values is provided in a later section of this report.

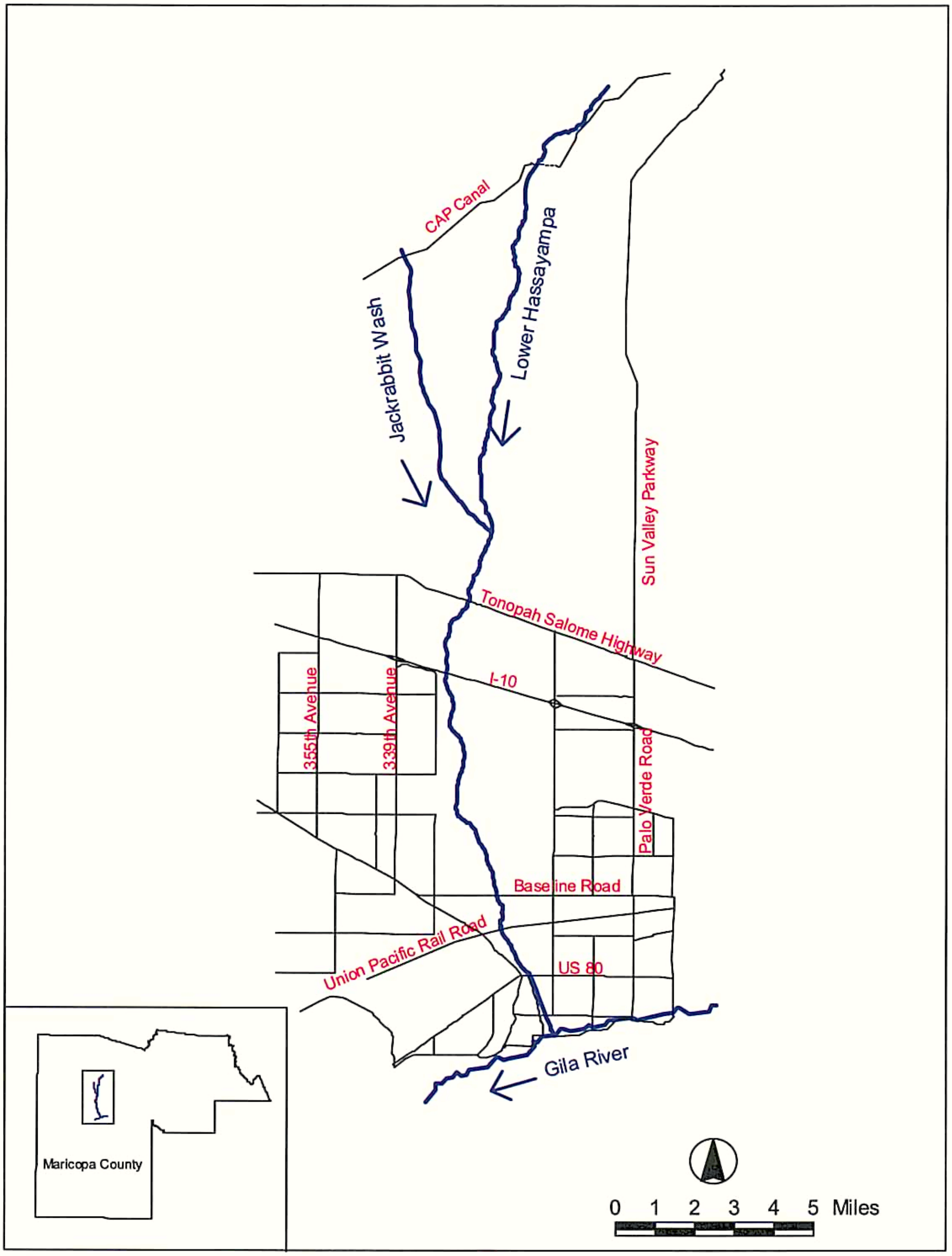

Figure 1-1 Project Location

2. Field Reconnaissance & Data Collection

2.1. Field Reconnaissance

Field reconnaissance was conducted on July 2, 2004, and July 9, 2004 to accomplish the following: (1) observe the general condition of the study reach; (2) identify and locate bridges, existing levees, and other features of interest; (3) observe spatial vegetation patterns in the main channel and the overbank areas.

The field reconnaissance confirmed three bridge crossings upstream of the Hassayampa-Gila River confluence: the Old U.S.-80 Highway Bridge approximately 2.3 miles upstream of the confluence, the Union Pacific Railroad Bridge approximately 3.7 miles upstream of the confluence, and the set of two I-10 Bridges approximately 10.8 miles upstream of the confluence. The approximate distances were measured along the hydraulic baseline (thalweg) of the Lower Hassayampa River.

2.2. Data Collection

The following data were collected for hydraulic model development:

- The Digital Terrain Models (break lines and mass points) for the study reach were provided by the Flood Control District of Maricopa County (FCDMC). Figure 2-1 shows the mass point coverage with IDs, vertical datum, and flight dates. A small portion of the mapping, near the CAP canal, was obtained by digitizing contours from scanned and rectified FIS (Cella Barr, 1988) work maps. The Digital Terrain Model flight dates are given in Table 2-1.

- Aerial color photography in Mr. SID format was provided by FCDMC. Flight dates for the aerial photos are December 9, 10, 13, and 14, 2003.
- Discharges were obtained from 1988 Cella Barr HEC-2 model for the Hassayampa River FIS (Cella Barr, 1988).
- Field surveys at bridge sites were conducted by Hersey Land Surveying, L.L.C. on November 1, 2004. Field survey notes are included in Appendix E.
- Bridge As-Builts, bridge design plans, and channel improvement design plans, which are included in Appendix F.

Table 2-1 Digital Terrain Model Flight Dates

Topography ID	Flight Date	Vertical Datum of DTM	Adjustment to convert NGVD 1929 values to NAVD 1988
1030-100	12/14/1991	NGVD 1929	+2.08
1030-200	02/07/1993	NGVD 1929	+2.08
1180	04/08/2002	NAVD 1988	-
1222	11/02/2002	NAVD 1988	-
1240	04/21/2004	NAVD 1988	-
1241	04/21/2004	NAVD 1988	-
1242	04/22/2004	NAVD 1988	-
Digitized from Cella Barr work maps	03/18/1988	NGVD 1929	+1.98

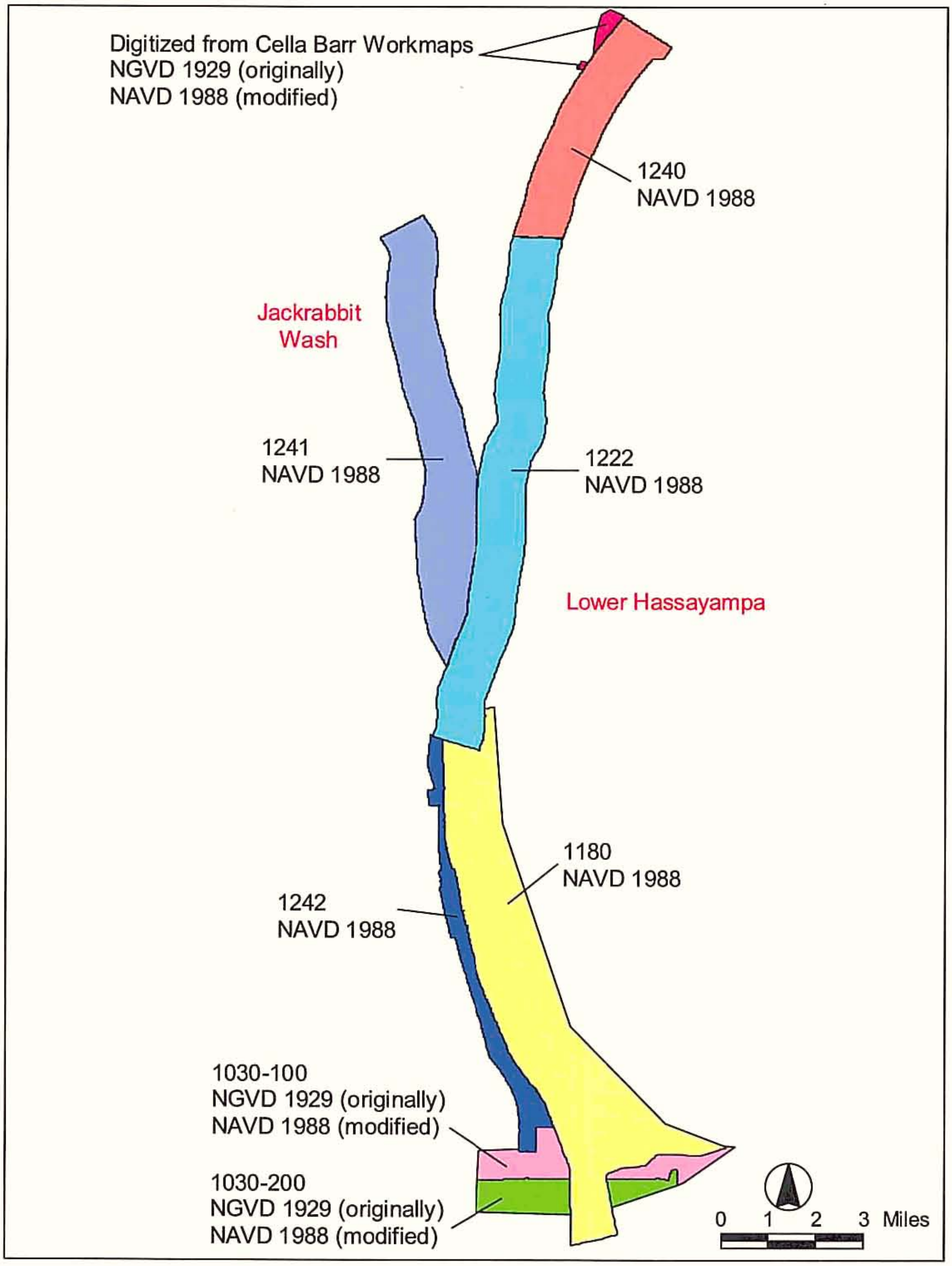

Figure 2-1 DTM Mass Point Coverage and Vertical Datum

3. Existing Conditions Hydraulic Analysis

3.1. General

The objective of the analysis was to create an existing condition hydraulic model, which would provide the initial geometry for the sediment transport analysis. The model was developed using ArcView GIS, v. 3.2a and HEC-RAS v. 3.1.2. Manning's *n* values estimates were accomplished based on aerial photos, field observation, investigators' judgment, and published references.

3.2. Peak Discharges

The peak discharges used in the hydraulic model were obtained from 1988 FIS HEC-2 model by Cella Barr Associates (Cella Barr, 1988). Table 3-1 lists the discharges by flow change locations or HEC-RAS cross section ID. Figure 3-1 shows the flow change locations.

Table 3-1 Discharges Used in the Main Channel of the Hydraulic Model

Flow Change Location (HEC-RAS Cross Section ID Number)	Discharge (cfs)
27.89	57,854
25.06	57,230
21.93	56,604
18.81	55,980
15.49	76,120
15.21	75,574
12.94	75,164
10.87	74,970
9.93	74,572
7.94	73,966
4.91	73,500
2.57	72,966*

*accomplished with a lateral structure that removes 534 cfs.

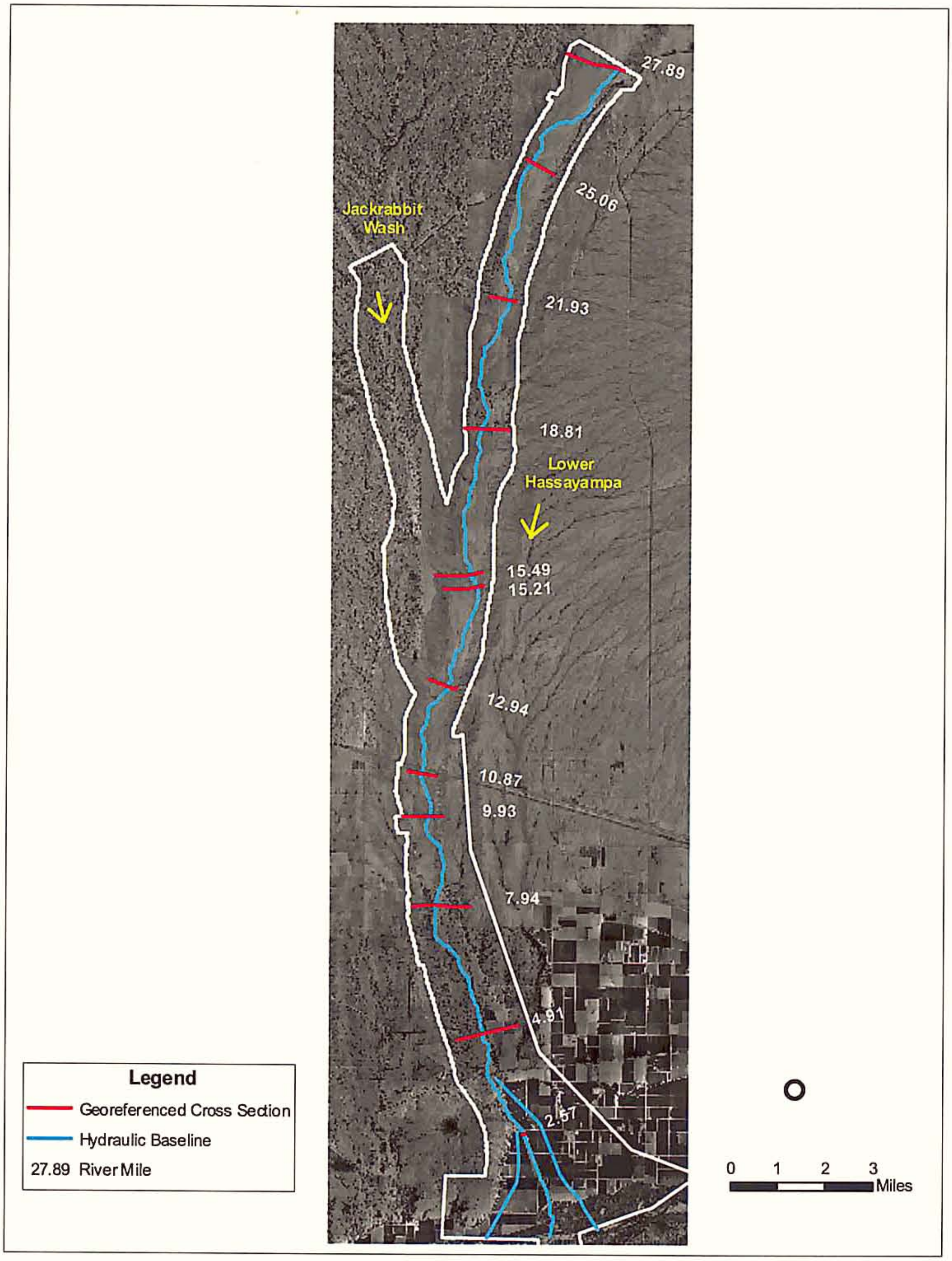

Figure 3-1 Flow Change Locations at River Miles

3.3. Existing Conditions Hydraulic Model

3.3.1. Model Development

A geo-referenced hydraulic model of the study reach was developed using the Army Corps of Engineer's HEC-RAS, v. 3.1.2 and the HEC-GeoRAS extension of ArcViewGIS v. 3.2a. A Triangulated Irregular Network (TIN) was developed from a combination of the DTM mass points and 3-D break lines. NGVD 1929 elevations from the 1030 series DTMs were increased by 2.08 feet in the downstream section of the Hassayampa reach to convert to NAVD 88 vertical datum.

The HEC-RAS hydraulic model was divided into 3 reaches: the Main Channel of the Hassayampa River, the Left Bank beginning downstream of the Union Pacific Railroad Bridge, and the Right Bank downstream of the Old U.S.-80 Highway Bridge. Cross sections were cut using the HEC-GeoRAS extension of ArcView GIS. Cross sections similar or identical to those from the FIS (Cella Barr 1988) were used when those cross sections were adequate hydraulically. Cross section numbering was not related to reach lengths but followed the same numbers as in the FIS. The original FIS numbering was used also for cross sections that were nearby, though not exactly coincident with, those from the FIS. The reach lengths between cross sections were maintained at approximately 500 feet. The reach lengths were reduced where additional cross sections were needed (e.g., at Left Bank adjacent to the Old U.S.-80 Highway Bridge). WEST attempted to match at least three cross sections per mile to those used in the FIS (Cella Barr, 1988) but that was not possible in some areas.

The proper definition of the hydraulic baseline (thalweg or the 10,000 line) was critical due to heavy braids in the channel. This was done in the conventional manner along the thalweg line. Often there were multiple candidates for the thalweg, and these paralleled each other for a mile or more. The 3-mile reach starting at cross section 24.30 up to the upstream model boundary was heavily braided. The hydraulic baseline in this reach was located close to the east (left) bank to capture the natural course of the channel from cross section 25.81 to the upstream model boundary. A local inflow channel enters the model boundary in the northwest (channel right). The bank stations were widened in this reach to capture the significant flow in the local inflow channel.

Bank stations were carefully adjusted in some areas of the study reach to maintain gradual change in main channel definition and consistency with upstream and downstream reaches. In areas where the sandy portion of the channel splits at islands, bank stations were set to capture these sandy portions to the east and west of the islands. The exception was the upstream study reach from cross sections 26.00 to 27.89 where the low parts of the cross sections were not actually sandy. In this reach, bank stations were widened to capture the low flows in the channel close to the west (channel right) bank. The vast majority of the flow was in the main channel in this upstream reach.

According to FEMA regulations, floodway limits cannot be inside of the bank stations. At some cross sections in the new HEC-RAS model, however, the bank stations lie outside of the current FEMA floodway limits. If in the future the new HEC-RAS model was used to update the FIS, the floodway would become at least as wide as the bank stations, and regions outside the current floodway would become part of the new floodway. This would have implications for current and future land development.

For the first three or four thousand feet upstream of the Old U.S.-80 Highway Bridge, the right bank stations are all outside the current floodway, typically by about 250 to 500 feet. Upstream of the railroad bridge, about 40% of the cross sections have one or both bank stations outside the current floodway. In most cases, where a bank station is outside the floodway, the bank station is usually within 100 or 200 feet of the floodway limit. The most notable exception is from cross section 25.06 and upstream, where, due to the redefinition of the right channel bank in this reach, the right bank stations are well outside the current floodway, typically from 500 to 1000 feet or more to the right of the current floodway limits.

The ineffective flow areas were set on the basis of regions of overbanks which appear to obstruct flow. However, the flow in these overbank areas can only be approximately modeled using a 1-dimensional model like HEC-RAS because of the uncertainty of flow direction in many areas. Also, these regions are largely agricultural, and some areas have abrupt changes in elevation between fields, another condition that cannot be modeled easily in HEC-RAS. Therefore the setting of the ineffective flow areas and the delineation of the floodplains in these overbanks must be considered approximate.

Ineffective flow areas were introduced in the model at the bridge locations, tributaries, and at any physical obstructions. Ineffective flow areas were used at the mining pit locations upstream of the I-10 Bridges. The use of ineffective flow areas followed the Arizona Department of Water Resources (ADWR) State Standard 9-02 titled "Floodplain Hydraulic Modeling" (ADWR, 2002). The Standard states that when off-channel pits are expected to store water but not actively convey flow downstream, which was the case in this study, the pits should be modeled as ineffective flow areas in HEC-RAS. The State Standard does not mention how the ineffective flow area elevations should be set. The predominant overbank elevation was used for this purpose. The predominant overbank elevation was set as the average overbank ground elevation adjacent to the pit (to the left and/or right). An Excel spreadsheet prepared for determining the predominant overbank elevations is included in Appendix D.

The bridges in the study reach were coded in HEC-RAS based on the As-Builts obtained from the respective owners of the structures. Table 3-2 summarizes the bridges. The two adjacent I-10 Bridges (East and West bound) were modeled as separate structures. HEC-RAS was prompted to accept the highest energy answer from the three available bridge modeling methods: Energy, Momentum, and Yarnell method. The bounding cross sections of the I-10 Bridges and the Union Pacific Railroad Bridge were cut very near the bridges. The Maricopa County Department of Transportation (MCDOT) is working on (and may have completed by now) channel modifications at the Old U.S.-80 Highway Bridge which was identified as scour critical. Channel Improvement Design Plans dated April 13, 1998 (MCDOT, 1998) for this location were obtained from MCDOT, and cross section geometry data were adjusted accordingly. The Design Plans were used since the As-Builts for the proposed channel improvement were not available at the time this report was in preparation. The following sections describe in detail how the bridges were coded into HEC-RAS.

Table 3-2 Summary of Bridge Data

Bridge ID	Mile Post	Structure No.	Project No.	Type	Agency	Date on As-Builts
I-10 Westbound	104.69	1645	N/A	Precast & Prestressed Concrete Girder	ADOT	July 1966
I-10 Eastbound	104.69	1646	N/A	Precast & Prestressed Concrete Girder	ADOT	July 1966
Old U.S.-80 Highway	N/A	N/A	68399	AASHTO Type VI Precast & Prestressed Concrete Girder	MCDOT	January 1987
Union Pacific Railroad	N/A	N/A	R-866.93	Standard Deck Plate Girder	Union Pacific Railroad	April 1925

Union Pacific Railroad Bridge

According to the bridge plans obtained from Union Pacific Railroad, the top of the concrete piers is called out at 873.77 feet and the bridge is level. The tops of the eastmost and westmost pier were surveyed; the elevations were 875.32 feet (West) and 875.68 feet (East), both in NAVD 1988. WEST took the lower of the two, 875.32 feet, and assumed all the tops of piers were at that elevation. This implies that the NAVD 1988 datum is 1.55 feet higher (875.32 – 873.77) than the vertical datum used in the railroad bridge plans. According to the railroad bridge plans, there is a 1' 9 ½" gap between the "top of masonry" (i.e.. the pier) and bottom of the steel structure. To obtain the low chord of the steel structure, which is the predominant low chord of the bridge, this 1' 9 ½" was added to the surveyed elevation at the top of the westmost pier: 875.32 + 1' 9 ½" = 877.11 feet. This value was used as the low chord of the bridge.

At both the westmost and eastmost ends of the Union Pacific Railroad Bridge, between the final concrete piers and the ends of the bridge, the low chord of the bridge is higher than the predominant low chord of the bridge. At the eastmost side, a wooden trestle has a higher low chord than the adjacent steel structure. At the westmost side, the steel structure terminates at the westmost concrete pier and the connection between that pier and the abutment is the low profile concrete structure with a higher low chord. In HEC-RAS, however, the entire low chord was coded at the lower elevation of the bottom of the steel structure. The higher low chords at the ends, which comprised a small portion of the bridge, were not coded because HEC-RAS uses the high low chord as a trigger to determine when pressure flow should take place. It was deemed unreasonable that the higher low chords, which comprise a very small portion of the bridge, should be used as the trigger elevations. In any case, for the 100-year flood, there is nearly 6 feet of freeboard.

Because the embankments are so high and wide, the bounding bridge cross sections were taken adjacent to the upstream and downstream face of the bridge, and not at the "natural ground" beyond the embankments. However, the bounding cross sections for the Union Pacific Railroad Bridge terminate just beyond the ends of the bridge.

Old U.S.-80 Highway Bridge

The bridge deck and piers of the Old U.S.-80 Highway Bridge were coded based on the design plans provided by MCDOT as well as a few points that were surveyed on the bridge. The elevation of low chord elevation of the northern girder at the westmost pier was surveyed and found to be 852.99 feet (NAVD 1988). On page 31 of the MCDOT plans, the top of the girder seat at the pier is called out as 850.98 feet. Since the bearing pad thickness is 0.5 inches, or about 0.04 feet, the low chord at that girder should be 850.98 + 0.04 = 851.02 feet in the MCDOT datum (the MCDOT datum is called out as "USGS" on the plans). The difference between NAVD 1988 and the MCDOT datum is therefore 852.99 – 851.02 = 1.97 feet. Each of the low chords, the abutments, and each of the piers (on the lower, north side) were located in the MCDOT plans, and the then the bearing pad thickness was added, along with the 1.97 foot datum adjustment, to determine the low chord elevation in NAVD 1988. The top of the guard rail was also surveyed at the westmost pier and was found to be 860.77 feet, or 6.78 feet higher than the low chord. There is also a chain link fence on top of the guard rail on the north side. The top of that chain link fence at the westmost pier was surveyed at elevation 864.99 feet, exactly 12 feet higher than the low chord. It was assumed that the fence was 12 feet higher than the low chord for the entire bridge length, and it was the top of the chain link fence which was coded as the "top of deck" in HEC-RAS because it is assumed that the fence would catch debris and obstruct flow.

Soil cement guide banks were recently constructed by MCDOT. According to the previous calculation involving the low chord, the elevation adjustment from the MCDOT datum to NAVD 1988 is + 1.97 feet (NAVD 1988 is large numerically). The adjustment from NGVD 1929, a very commonly used datum, to NAVD 1988 was also determined at the bridge location using the program Corpscon. It was found to be 2.07 feet (NAVD 1988 = NGVD 1929 + 2.07 feet). Since 2.07 feet is close to the 1.97 feet calculated using the measured low chord, it seemed very likely that MCDOT is using NGVD 1929 as their vertical datum. Therefore, 2.07 feet was used to adjust the elevations of the soil cement to be in the NAVD 1988 datum. This adjustment is more conservative that the

1.97 foot adjustment since it makes the guide banks higher and obstructs slightly more flow. The 1.97 foot adjustment was still used for the low chord, since it was based on a measured low chord and is the best estimate available. The soil cement guide banks were modeled as sloping abutments.

At the Old U.S.-80 Highway Bridge, the upstream and downstream cross sections (2.67 and 2.63) were cut beyond the embankment to capture the natural ground. However, internal cross sections, cut very close to the concrete faces of the bridge, were also cut and used as the internal bridge cross sections in the HEC-RAS model rather than the default copies of the upstream and downstream bounding sections. The upstream and downstream bounding sections, as well as the internal bridge cross sections, were skewed by 15 degrees, which is the skew of the bridge to the Hassayampa River.

I-10 Bridges

Interstate 10 has an eastbound bridge on the south side (downstream) and a westbound bridge on the north side (upstream). The bridges have a cross-slope and have 6 girders each. At each girder pad, the lowest pad height for each girder is within 1 or 2 hundredths of a foot of the corresponding lowest pad height for the same girder for the other bridge. Since the elevations were so similar, the pad height elevations of the eastbound bridge were used as a basis for the calculations.

The low chord elevation at the eastbound bridge was surveyed at the south side of the eastbound (southern) bridge, and was found to be 1034.61 feet (NAVD 1988). This corresponds to pier #1 in the bridge plans. In the HEC-RAS model it corresponds to the rightmost pier in the bridge sections. The top of pad for that girder (girder #6) appears on page 7 of the plans as 1032.481 feet. In addition, there is a 2-inch thick bearing pad, so the low chord elevation of the girder should be 1032.481 + 0.17 = 1032.65 feet. The difference between the surveyed elevation and this elevation is 1034.61 – 1032.65 = 1.96 feet. It was assumed that the difference is most likely a datum issue. Because some of the westbound bridge minimum pad heights were a few hundredths of a foot lower than the eastbound bridge's, the adjustment was reduced by 6 hundredths of a foot to 1.90 feet (which makes the low chords slightly lower). So the low chord elevation at each pier was calculated as the minimum pad height + 0.17 feet (bearing pad) + 1.90 feet. This results, for example, in the low chord at pier #1 being 1032.48 + 0.17 + 1.90 = 1032.55 feet, versus the surveyed value of 1032.61 feet. The abutments also had 2-inch thick bearing pads and the calculations were done the same way. The same low chord elevations were coded for both bridges. The elevation of the high chord was estimated by scaling off of a cross section of the bridge on Sheet 17, which shows both the girders and the top of barrier. The high chord was estimated to be 8.47 feet higher than the bottom of girder, so 8.47 feet was added to all low chord elevations to obtain the high chord.

The bridge is skewed by 10 degrees, and the distance between the piers and the abutments was reduced to take this skew into account. However, the bounding cross sections were not skewed, as 10 degrees was not considered enough to affect the sections significantly.

The bounding cross sections of the bridges were cut nearly adjacent to the concrete faces of the bridge. The riprap, which is used as abutment protection, is captured by the cut cross sections.

Expansion and Contraction Coefficients

A contraction coefficient of 0.3 and an expansion coefficient of 0.5 were used at the bridge locations. The ineffective flow areas in the upstream and the downstream sections were adjusted for contraction and expansion in the conventional manner (HEC-RAS, 2001a). The contraction and expansion ratios were 1:1 and 2:1, respectively. The expansion ratios were based on recommendation from Table B.2 in Appendix B of the HEC-RAS Hydraulic Reference Manual (HEC-RAS, 2001b). Table B.2 lists the range of expansion ratios based on two hydraulic parameter ratios: (1) the ratio of the bridge opening b to the floodplain opening B, and (2) the ratio of the overbank Manning's n value n_{ob} to the channel Manning's n value n_c. The n_{ob}/n_c ratio for the Lower Hassayampa River was mostly one (1). The b/B ratios at the bridges varied from 0.3 to 0.5. The average bed slope in the vicinity of the bridges was 0.4%. The chosen expansion ratio of 2.0 falls in the upper limit of the range of expansion ratios provided in Table B.2.

Berms

Man-made berms were identified along the downstream section of the study reach during the field visit and from inspection of the topography. The berms were located along the main channel down to the Gila-Hassayampa confluence. It was believed that the main channel flow could overtop the berms and inundate the overbank areas. The reaches which captured the overtopping flows from the main channel were identified as "Left Bank" and "Right Bank." In these reaches, bank stations had no real meaning, and therefore the bank stations were set at the outside limits of the cross sections. The ineffective flow areas were set on the basis of regions of overbanks which appeared to obstruct flow. However, the flow in these overbank areas could only be approximately modeled using a 1-dimensional model because of the uncertainty of flow direction in many areas. Also, these regions were largely agricultural, and some areas had abrupt changes in elevation between fields, another condition that could not be modeled easily in HEC-RAS. Therefore, the setting of the ineffective flow areas, and the delineation of the floodplains in these overbanks, must be considered approximate.

Flow Splits

Flow splits, representing the overbank areas on the opposite side of the berm, were introduced at two locations: on the Left Bank just downstream of the Union Pacific Railroad Bridge, and on the Right Bank downstream of the Old U.S.-80 Highway Bridge. The overbank cross sections were cut separately using HEC-GeoRAS. The overflow onto the overbanks in the last few miles of the reach, where the berms were in place, was handled using a series of lateral structures, or weirs, in HEC-RAS. These lateral structures were located along the main channel left bank (cross sections 3.91 to 2.78) downstream of the Union Pacific Railroad Bridge, and along the main channel left (cross sections 2.57 to 0.92) and right banks (cross sections 2.57 to 1.01) downstream of the Old U.S.-80 Highway Bridge. Although the berms extend downstream of cross section 0.92, additional lateral structures were not needed due flow containment in the main channel. The lateral structures heights were set to be the highest elevation on the left (or right) side of the upstream and downstream bounding cross sections. The lateral structures were modified in two places where there are openings in the berms (low crest elevation). One is due to a road crossing the main channel between cross sections 1.58 and 1.49 (left bank), and between 1.65 and 1.58 (right bank) which lowers the tops of the berms by approximately 2 feet. The other is between cross sections 3.44 and 3.34 on the left bank upstream of the Old U.S.-80 Highway Bridge where there is an opening in the berm for a drainage ditch. It was assumed for the HEC-RAS model that the berms on the left and right sides of the main channel do not fail in the flood event. Since these were not certified levees, it should be noted that this made the model, in the reach where the berms were modeled, incompatible with a FIS type model in this reach, which would require that all these berms fail.

On the original Cella Barr model, a reduced flow of 72,966 cfs was noted downstream of the Old U.S.-80 Highway Bridge. In this study, because a split flow condition was introduced upstream of the Old U.S.-80 Highway Bridge, a lateral structure was used between cross sections 2.63 and 2.57. This diversion reduced the flow in the main channel by 534 cfs (= 73,500 cfs – 72,966 cfs) where 73,500 cfs and 72,966 cfs are the discharges in the main channel in the Cella Barr model upstream of 2.57 and at 2.57, respectively.

Lateral structure discharge coefficients were determined based on Hager's (1987) method reported by Davis & Holley (1988). Hager (1987) derived an analytical function which can be used to convert a discharge coefficient, C_n, for a normal weir transverse to the direction of flow in the main channel into a discharge coefficient, C, for the same weir used as a lateral weir:

$$C = C_n\, w = C_n \left[\frac{F_w^2 + 2}{3F_w^2 + 2}\right]^{1/2}$$

where $F_w^2 = V^2/g(y\text{-}p)$; F_w is the Froude number for lateral weir flow, V is the average channel flow velocity, p is the lateral weir crest height, y is the average water surface elevation over the weir crest, and g is the gravitation constant or 32.2 ft/sec^2. The estimate of the weir discharge coefficient, C_n, was based on those for broad-crested weirs presented in the 7th Edition of the *Handbook of Hydraulics* by Brater et. al. (1996). Table 5.1 of this publication presents the broad-crested weir discharge coefficients in SI units. C_n for a broad-crested weir in SI and English units are 1.84 and 3.33, respectively. The ratio [3.33/1.84] or 1.81 multiplied by the weir coefficients in Table 5.1 of Brater et. al. (1996) gave the C_n for Hager's equation in English units. For breadth of weir crest of 14.76 feet (4.5 meters) or more which is believed to be representative of the berms, a C_n of 2.6 was obtained. Hager's method was implemented in an Excel spreadsheet by WEST. Average values were estimated for each lateral structure using the hydraulic information available at upstream and downstream main channel cross sections. An average lateral structure discharge coefficient of 2.0 was obtained from the spreadsheet and was used along the bermed reaches upstream (left overbank) and downstream (left and right overbank) of the Old U.S.-80 Highway Bridge.

Boundary Conditions

Establishing the downstream boundary condition was no trivial task due to varying topography and 100-year water surface elevations along the Gila River. Downstream water surface elevations were introduced as boundary conditions for each of the three reaches in the HEC-RAS model. These water surface elevations were obtained from a HEC-2 run of the Gila River model developed by Dames & Moore (1989). The HEC-2 model was based on NGVD 29 vertical datum. NGVD 29 water surface elevations at the confluence were increased by 2.07 feet (one-hundredth of a foot lower than 2.08 feet used for adjusting the nearby topography) to convert to NAVD 88 vertical datum. Table 3-3 lists the downstream boundary water surface elevations by sub-reaches in NAVD 88.

Table 3-3 Downstream Boundary Water Surface Elevations

Reach ID - Description	Downstream Water Surface Elevation, ft NAVD 1988
1 – Main Stem	800.81
2 – Downstream Left Overbank	803.57
3 – Downstream Right Overbank	795.74

3.3.2. Manning's *n* Estimation

The full Manning's *n* report is included in Appendix A. The Manning's *n* report includes a summary on Manning's *n* composites. A summary of the report is provided here. Aerial photographs, provided by FCDMC, and photos taken during field reconnaissance were studied and used to delineate land use polygons in ArcView GIS (Figure 3-2). The study area was classified into seventeen land use types to define the existing vegetation conditions, and each type was assigned a Manning's *n* value. Initial Manning's *n* values were estimated based on "Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona" (Thomsen and Hjalmarson, 1991)

An older *n*-value report titled "Roughness Coefficients for Stream Channels in Arizona," USGS Open-File Report 73-3 by Aldridge and Garrett (1973) was also available to establish *n*-values for the study reach. This report contains only ground photographs of various streams throughout Arizona. The ground photographs in the

Aldridge and Garrett report were examined and matched to the ground photographs taken during the field trips. If the Manning's *n*-values reported by Aldridge and Garrett were similar to the values reported by Thomsen and Hjalmarson, then this acted as independent verification that the estimated Manning's *n* values were appropriate for the Lower Hassayampa River.

The general procedure adopted for determining *n* values was to first select a base value of *n* for the bed material, followed by selection of *n* value adjustments for channel irregularities and alignment, obstructions, vegetation, and other factors. Table 3-4 lists the Manning's *n* value categories used in the hydraulic model.

HEC-RAS, when it encounters multiple *n* values in the channel, will sometimes composite them into a single *n* value. According to the HEC-RAS documentation, this occurs when the slope between any two points inside the channel is steeper than one (1) horizontal to five (5) vertical. There is no way to override this behavior, although HEC-RAS issues a warning message that the *n* value in the channel has been composited.

The problem is that the composited *n* value which HEC-RAS determines is usually unrealistically high. This is especially noticeable when one of the *n* values in the channel is significantly higher than the rest. On numerous occasions, for example, in the reach from the Old U.S.-80 Highway Bridge to the confluence with the Gila River, the composited *n* values were so high that HEC-RAS reported error messages because it could not balance the energy equation with nearby sections that did not have composited *n* values. Therefore, Manning's *n* values were composited externally in this study following the method described in Chow (1959) using the equal conveyance method.

The relevant equation and rationale for compositing the *n* values is provided in the full Manning's *n* report included in Appendix A.

Two versions of the hydraulic model based on the channel Manning's *n* value composites in the main reach conducted outside of HEC-RAS are provided on the accompanying CD. These versions are: 1) model with the original uncomposited *n* values, and 2) model with all Manning's *n* values in the "Main Channel" reach composited. The water surface profiles and cross-section plots were based on the model with all cross sections in the Main Channel reach composited. Manning's *n* values were not composited in the overbank areas and the two overbank reaches where flow split occurs. The composited Manning's *n* values were rounded to three decimal places.

Table 3-4 Manning's *n* Attributes

Land Use and Vegetation Type	*n* Value
Agricultural	0.060
Disturbed	0.035
Extremely Dense Vegetation	0.200
Extremely Dense Vegetation (Deep Channel)	0.150
Sparse Vegetation (Channel)	0.028
Sparse Vegetation (Overbank)	0.035
Tall Dense Vegetation (Channel)	0.122
Tall Dense Vegetation (Deep Channel)	0.122
Tall Dense Vegetation (Overbank)	0.175
Tall Medium Vegetation (Channel)	0.057
Tall Medium Vegetation (Deep Channel)	0.047
Tall Medium Vegetation (Overbank)	0.060
Tall Sparse Vegetation (Channel)	0.039
Tall Sparse Vegetation (Deep Channel)	0.040
Tall Sparse Vegetation (Overbank)	0.050
Unvegetated Channel	0.025
Wetted Channel	0.025

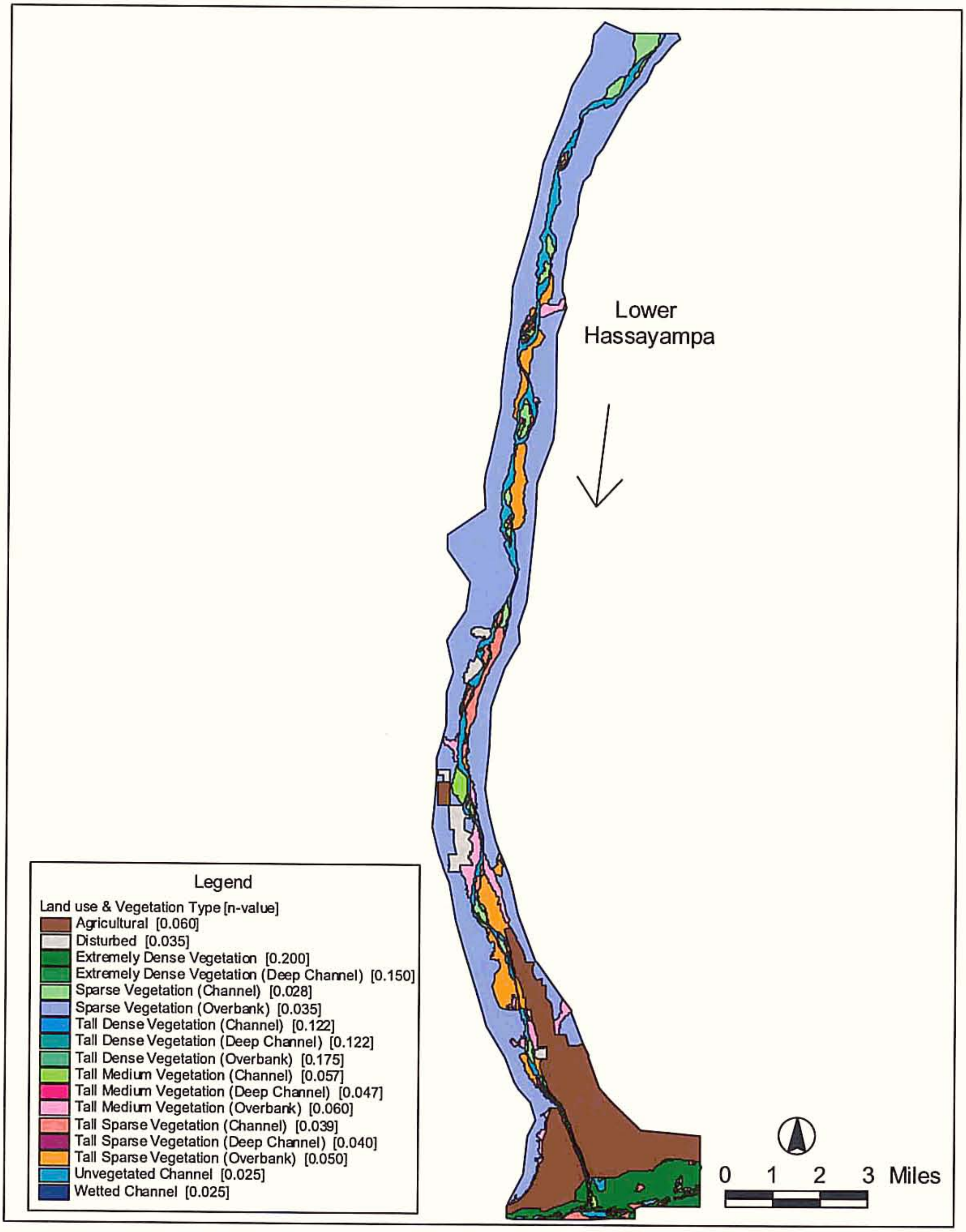

Figure 3-2 Manning's *n* Value Coverage

A qualitative Manning's *n* value comparison was conducted with the Cella Barr (1988) HEC-2 hydraulic model. The overbank Manning's *n* value in the Cella Barr model was 0.04 for the entire reach except for River Miles 0.35-0.92 where the left and right overbank *n* values were 0.085 and 0.050, respectively. Table 3-5 draws a comparison in the main channel Manning's *n* values used in this study (composited at every cross section for the purpose of comparison) by WEST versus those used by Cella Barr in the FIS.

Table 3-5 Main Channel Manning's *n* Value Comparison

River Mile (Reach)	Cella Barr (1988)	WEST Composite *n* (Reach Average)
0.35-1.58	0.045	0.06763
1.72-5.00	0.035	0.03507
5.10-27.89	0.030	0.03201

Significant growth in vegetation was noted along the main channel banks in the vicinity of the Old U.S.-80 Highway Bridge based on field observation, and comparison of 2003 Mr. Sid format color aerial photos and photos appearing in Thomsen and Hjalmarson (1991). The Cell Barr (1988) model Manning's *n* values in this reach represent desert brush along the main channel (e.g., Figure 17-E on page 64 of the Thomsen and Hjalmarson report). The 2003 aerial photo (Figure 3-3) show tall trees and dense vegetation. Dense vegetation follows along the main channel down to the Gila-Lower Hassayampa confluence. Manning's *n* values as high as 0.2 and 0.15 were used along the Gila River and at locations upstream of the confluence where dense vegetation was noted.

Figure 3-3 Vegetation in the Vicinity of the Old U.S.-80 Highway Bridge

3.3.3. Hydraulic Results

The introduction of the lateral structures in the downstream section of the study reach required the use of the split flow optimization option in HEC-RAS. This option allows HEC-RAS to compute flow over the structures at the end of water surface profile generation. HEC-RAS iteratively adjusts the flow in the main channel and overbanks, until a balance is reached between the main river and the lateral structures. On execution, HEC-RAS did not report convergence of the hydraulic model even after 30 or 60 iterations. However, the 60-iteration solution water surface elevations had nearly the same elevations (within 0.01 feet) as the 30-iteration solution at every cross section, and the discharges were within 1 cfs. It was thus assumed that convergence was achieved for practical purposes.

The flow condition in the downstream overbank areas differed from that in the main channel. The most upstream cross sections of the overbank reaches (Left and Right Banks) each started with 1 cfs. Any additional flow into these sections would get added to the total discharge, and both the total flow and the optimization would be erroneous if significant flow was introduced there. In addition, any hard-coded discharge would only work for a particular incoming discharge upstream and the intention was for it to work for a range of discharges. Therefore, there was the need to start with some discharge that was very low.

In the HEC-RAS "errors, warnings, and notes" some cross sections of the model reported "cannot balance the energy equation." The majority of these cross sections also reported that there is no subcritical solution; examination of these sections by interpolation showed that indeed the flow should be supercritical at these sections (the run was subcritical), or alternately there is some subcritical/supercritical transition very near the section. Only one cross section, 9.27 in the Main Channel reach, reported "cannot balance" without reporting that there is no subcritical solution. Examination showed that the results were either very near critical depth or at critical depth regardless of what is done nearby (e.g., additional or interpolated cross sections), even when HEC-RAS is able to balance the energy equation.

The Main Channel reach water surface elevation profile for the 100-year event is shown in Figures 3-4 through 3-6. The water surface profiles and cross section plots were based on the model with all cross sections in the Main Channel reach composited. Hydraulic results and main channel water surface profiles, and model cross sections are included in Appendices B and C, respectively.

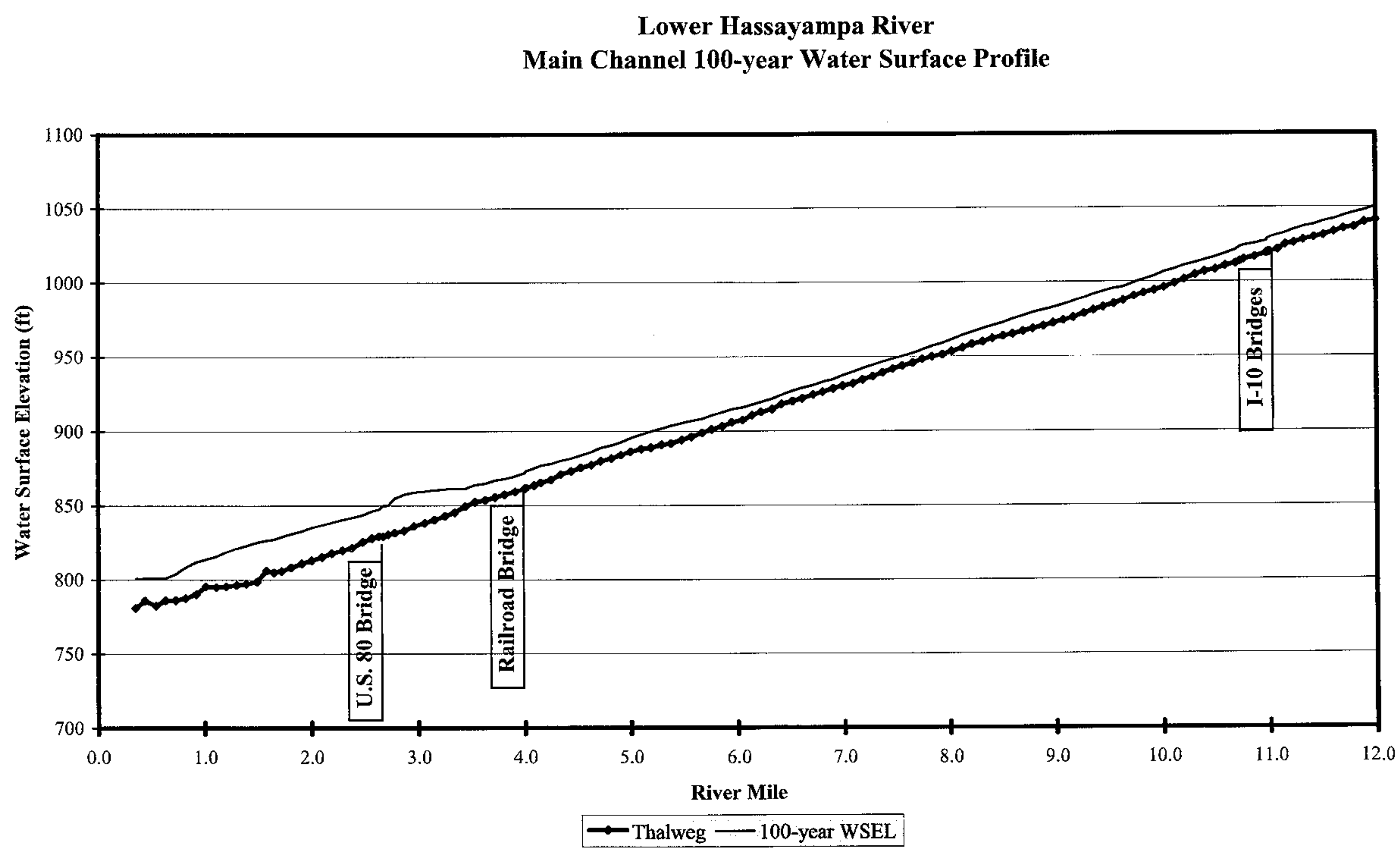

Figure 3-4 Main Channel 100-Year Event Water Surface Profile

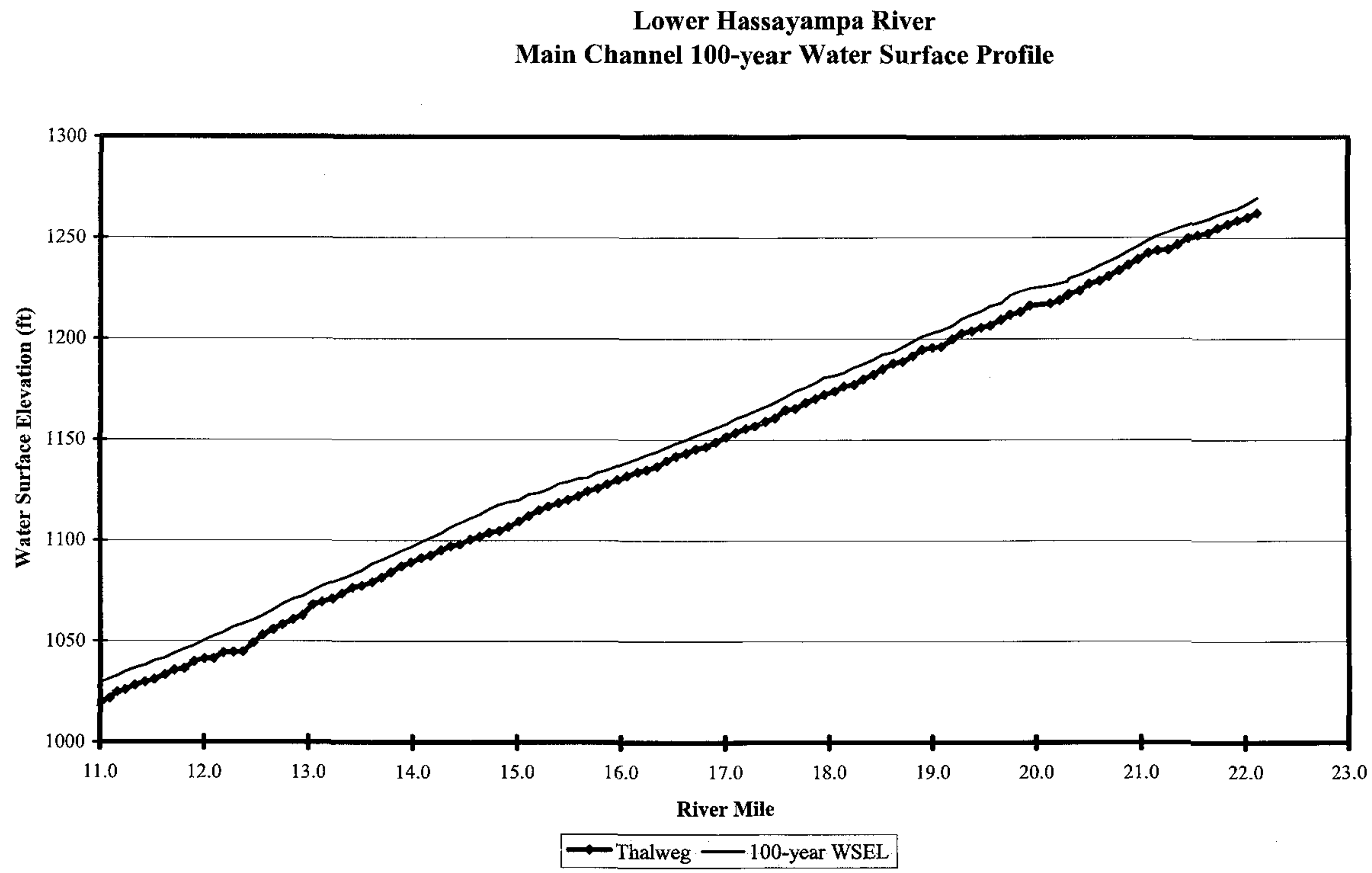

Figure 3-5 Main Channel 100-Year Event Water Surface Profile

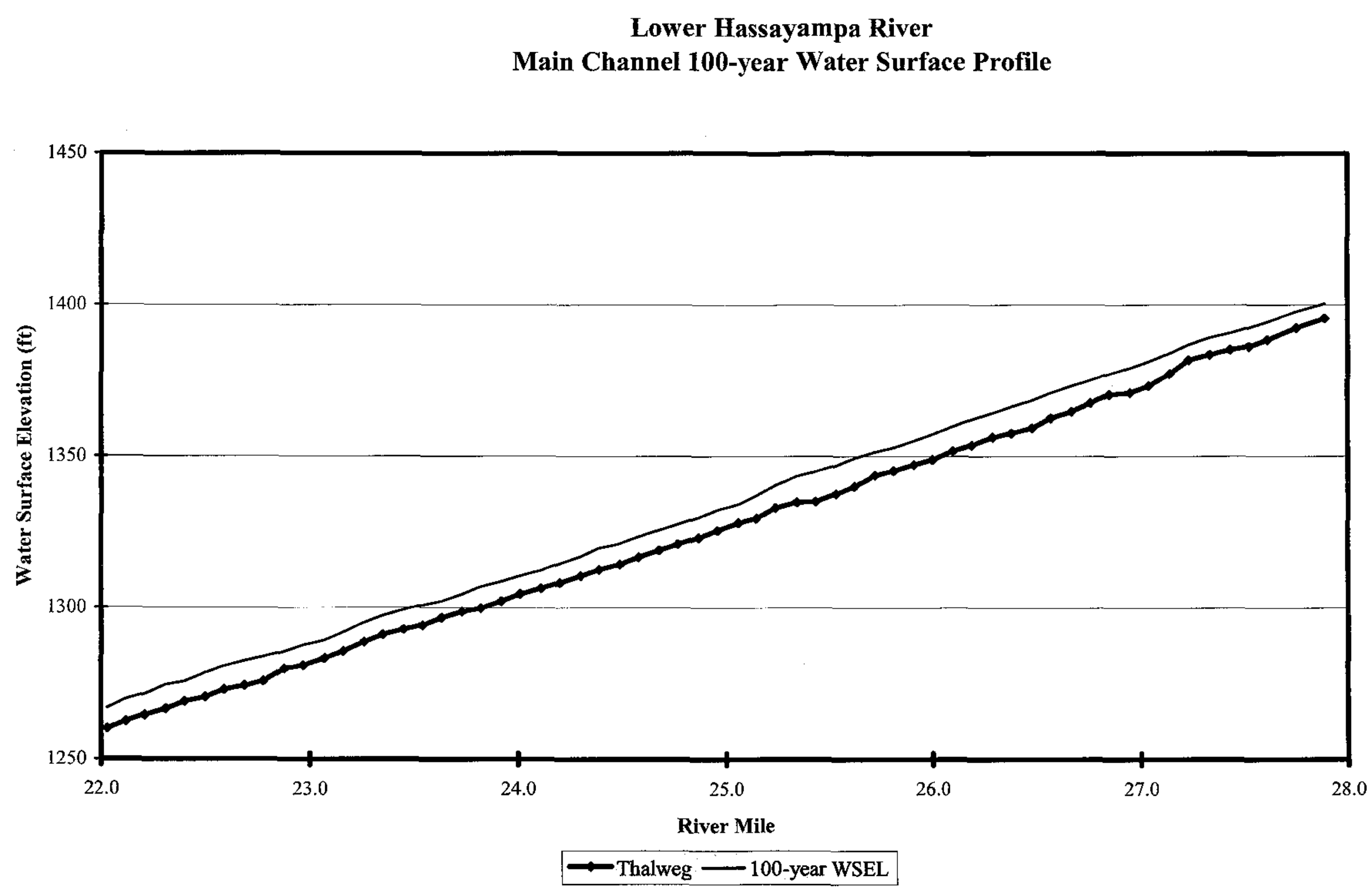

Figure 3-6 Main Channel 100-Year Event Water Surface Profile

3.3.4. Unsteady Model and Attenuation Analysis

An additional objective of the study was to analyze the effects of encroachment, to the existing floodway limits, on the attenuation of the peak flood. The loss of attenuation was estimated by running the HEC-RAS model in the unsteady mode. One model was run without encroachments, while a second model was run with encroachments. The encroachment limits, as projected onto the HEC-RAS cross sections, were determined by digitally intersecting the floodway lines (as a GIS coverage) with the HEC-RAS cross sections. The "encroached" model was then modeled by placing HEC-RAS levees at the encroachment limits; this is equivalent hydraulically to encroaching the cross sections.

The unsteady models were run between the upstream study limit (cross section 27.89) and the Union Pacific Railroad Bridge (cross section 4.01) where the flow splits onto adjacent overbank areas. Downstream of cross section 4.01, it was not possible to run the original HEC-RAS model in unsteady mode, because the complexity of the lateral structures in this reach caused the HEC-RAS model to be unstable. A separate analysis, discussed later, was therefore conducted for this reach. The analysis of changes in the flood peak were obtained by entering an inflow hydrograph into the upstream limit of the model, and comparing the peak flow at the downstream limit of the model in the existing versus the encroached conditions.

Hydrographs for the unsteady model were provided by JEF. Two hydrographs were provided, one of which applied at the upstream study limit, and the second of which applied downstream of Jackrabbit Wash. The hydrographs were based on the JEF HEC-1 models, with the hydrograph peaks scaled to match the flows from the Cella Barr (1988)

HEC-2 model (as opposed to Cella Barr hydrology report). The use of the hydrograph (downstream of Jackrabbit Wash), which had a higher peak and a higher volume, was used as an input into the upstream limit of the model for the purposes of analyzing attenuation. Note, that for the reach upstream of Jackrabbit Wash, the peak on this hydrograph exceeds the FIS peak flows in this reach. However, the use of a larger hydrograph should cause the encroachments to have a greater impact (due to the increased floodplain from the larger flows, and the corresponding larger impact of encroachment on storage), and therefore would be conservative in the sense of showing more impact due to encroachment. This hydrograph, with a peak flow of 75,600 cfs, was input in the unsteady model at the upstream limit for both existing and "encroached" conditions. This original peak flow was then compared with the downstream, attenuated, peak flows at cross section 4.01.

The unsteady models were run for a 30-hour duration hydrograph and attenuated peak flows at the downstream limit were recorded. Hydrograph time increment was 30 minutes and the computational time step was 30 seconds. A normal depth downstream boundary condition was used. A very small amount of attenuation of peak flow was noted at cross section 4.01 in both the existing and encroached conditions unsteady models. Table 3-6 lists the pre- and post unsteady run peak discharges at the upstream and downstream model limits. Drops of only 1.15% and 1.11% are seen in the peak discharge after attenuation for existing and encroached conditions (effective floodway), respectively. This was attributed to the steepness of the Lower Hassayampa River. A channel with flatter average slope would have introduced a diffusive effect which in turn would have lowered the significance of the inertia terms in the hydrodynamic (St.

Venant) equation HEC-RAS uses, resulting in more attenuation of the peak discharge. This was not the case for the Lower Hassayampa River. The "flood peak exaggeration" or the difference in the attenuated peak flow at 4.01 between the encroached and the existing conditions was only [74802 cfs – 74728 cfs] or 74 cfs, therefore the encroachment has virtually no impact on the peak flows upstream of the Union Pacific Railroad Bridge.

A proposed floodway was also developed for the Lower Hassayampa River as discussed in the following section. The encroachments developed for this proposed floodway were also used in an unsteady HEC-RAS simulation. The peak flow using the proposed encroachments is shown in Table 3-6. As with the effective floodway, the proposed floodway has virtually no impact on the peak flows upstream of the Union Pacific Railroad Bridge.

Table 3-6 Flow Attenuation Results

Cross Section ID	Peak Flow (cfs)	Attenuated Peak Flow (cfs)		
		Existing Conditions	Encroached Conditions (Effective Floodway)	Encroached Conditions (Proposed Floodway)
27.89	75,600			
4.01		74,728	74,802	74,959

For the reach downstream of the Union Pacific Railroad Bridge, a more approximate analysis was conducted. A HEC-RAS model was created with three simple cross sections, representing the approximate shape, width and elevation of the channel and overbank areas just downstream of the Union Pacific Railroad Bridge, at the Old U.S.-80 Highway Bridge, and near the downstream limit of the model. Then, HEC-RAS was instructed to interpolate numerous cross sections between these three sections. This simulates the approximate existing conditions, but with full overbank storage available in the reach, that is, simulating levees that have been breached. It was found that, using the hydrograph from downstream of Jackrabbit Wash, the attenuation was almost insignificant, reducing the peak flow from 75,600 cfs to 75,248 cfs at the downstream limit, a reduction of less than 0.5%. In the encroached condition, the attenuation would be expected to be less, but in the worst case the encroached condition does not attenuate flow at all, and this is only 0.5% higher than the existing conditions. Therefore it was concluded that, in the case of breached levees, encroachment will have a negligible effect on reducing attenuation downstream of the Union Pacific Railroad Bridge.

In the case of unbreached levees, it is possible that the effect is different. In this case, flooding in the overbank areas is due largely to the overtopping of the berms. Additional analysis was conducted with a very simplified model of the left overbank, using the approximate total flows that overtop the left berm as the input hydrograph. It was found that in the existing conditions using these assumptions, the attenuation was only about 5.2% of the peak flood by the downstream limit of the model. To get an estimate on the effect of encroachment, 1/3 of the simplified cross sections were removed from conveyance (using levees). In fact, the actual degree of encroachment at most cross sections averages less than 1/3 of the conveyance area, so the simple model should provide a conservative estimate of the effect of encroachment. The "encroached" model caused the attenuation to be reduced by 4.4% versus the original peak, which is less than a 1% increase in peak flow from the unencroached model. Therefore, encroachment will have a small effect on increasing the flood peak.

3.3.5. Lower Hassayampa River Proposed Floodway

The floodway for the Hassayampa River from the Union Pacific Railroad Bridge until the CAP canal was re-delineated (the "proposed floodway") based on the WEST hydraulic model. The goal of conducting the floodplain encroachment analysis was to determine the limits of encroachment that would produce a rise in water surface elevation that is as near the one-foot maximum as possible. Encroachment methods 4 and 5 utilizing the equal conveyance reduction option were used in HEC-RAS initially to get a first cut at the encroachment stations. Encroachment method 1 was used in the final floodway analysis. Encroachment method 1 allows the user to enter the right and left encroachment stations while method 4 lets the user specify a "target" water surface increase. Method 5 allows user to specify a "target" water surface increase and as well as a maximum change in energy (in feet). Initial floodway encroachment runs were made with several "target" values because typically the initial floodway computations provide changes in water surface elevations greater than or less than the actual targeted increase. This task was accomplished using a combination of encroachment methods 4 and 5. The floodways were developed using methods 4 and 5 in the Hassayampa River model. These encroachment stations were then converted to method 1 and stored in Profile #2 (PF2) for final analysis with specific encroachment stations.

The revised floodway limits tend to meander more than the existing regulatory floodway, in order to achieve surcharges closer to one foot. The new topography also affected the delineation. In many cases the revised floodway is narrower than the existing floodway. However, the widening of bank stations in the revised model led to a wider floodway in some areas. Also, because negative surcharges are considered undesirable by FEMA, the reduction or elimination of negative surcharges required floodway widening in some places in the revised model. Modest negative surcharges up to -0.04 feet were allowed at a few cross sections near the gravel pit.

From the Union Pacific Railroad Bridge at River Mile (RM) 4 until the I-10 Bridges at RM 11, the revised floodway tends to be slightly narrower than the existing floodway, typically by a few hundred feet. There are some locations, however, where the revised floodway extends about 200 feet outside the existing floodway limits. Upstream of the I-10 Bridges, the new floodway tends to be narrower than the existing floodway as well, with the notable exception that from RM 12.3 to 13, the revised floodway extends out as much as 750 feet beyond the existing floodway on the right bank. The expansion of the floodway was partially because narrower floodways led to negative surcharges. Just upstream of this reach, from RM 13 to RM 13.4, the revised floodway is as much as 400 feet wider than the existing floodway, but this is because the right bank stations are positioned farther out than in the FIS model.

From about RM 13.4 to RM 15.4, the revised floodway is fairly close to the existing floodway limit on the left side. The revised floodway is narrower on the right side for most of the reach, by a few hundred feet in most cases but nearly 1,000 feet narrower at one point. From RM 15.4 to RM 17.2, the revised floodway is usually hundreds of feet narrower than the existing floodway on the left side, including a quarter-mile stretch where the revised floodway is about 1,000 feet narrower. From about RM 17.2 to RM 21, the revised and existing floodway are fairly similar, with the revised limits being within 200 to 300 feet of the existing floodway limits in most places, sometimes inside the existing limits, sometimes outside. For the next mile, until RM 22, the revised floodway on the right is as much as 600 feet narrower than the existing floodway limit, but the revised floodway on the right is about 200 feet wider out than the existing floodway limits.

The revised and existing floodway limits are similar from RM 22 to RM 22.75. From RM 22 to RM 24.4, the revised floodway is similar on the right side to the existing, but is considerably narrower on the right side, typically by about 300 to 600 feet. For the next half mile up to RM 25, the existing and revised floodway are similar on both sides, the revised floodway being slightly narrower. From about RM 25.2 to the CAP canal, the revised floodway is substantially wider, typically about 600 to 1,200 feet, on the right side than the existing floodway, due entirely to the bank stations in the revised model being farther out than in the FIS model. On the left side, the revised floodway is from 200 to 600 feet narrower from RM 25.2 to 26.3. From 26.3 to the CAP canal, both existing and revised floodway follow approximately the left floodplain limit.

4. Summary and Conclusions

A hydraulic model for the Lower Hassayampa River was developed in support of sediment transport modeling. The study was completed according to the Consultants Guidelines of the Flood Control District of Maricopa County. This report presents information on field reconnaissance and data collection, hydraulic model development and analysis of results.

The positioning of the hydraulic baseline (thalweg or the 10,000 line) was critical due to heavy braids in the channel. It was done in the conventional manner along the baseline in most part. The 3-mile reach starting at cross section 24.30 up to the upstream model boundary was heavily braided. The hydraulic baseline in this reach was located close to the east (left) bank to capture the natural course of the channel from cross section 25.81 to the upstream model boundary. To capture the significant flow in the local inflow channel that enters the model boundary in the northwest (channel right), the bank stations were widened in this reach. As discussed previously, bank station locations were adjusted per 100-year event flow conditions. This was a critical factor in maintaining the main channel definitions in reaches with notable braids, contractions, and expansions.

An iterative solution scheme was applied in HEC-RAS using lateral structures in the downstream overbank areas of the study reach. The potential effect of encroachment on increasing flood peaks, due to reduction in storage, was analyzed using an unsteady flow analysis for existing and encroached conditions. It was found that encroachment will have a small effect on increasing the flood peak.

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Prepared for the Flood Control District of Maricopa County by the USGS, Tucson, AZ.

A. Manning's *n* Report

Lower Hassayampa River

SELECTION OF MANNING ROUGHNESS COEFFICIENTS

Contract FCD 2004C001
PCN 346.01.20

DRAFT REPORT

WEST Consultants, Inc.
960 W. Elliot Rd, Suite 201
Tempe, AZ 85284

July 2005

Methodology

To select the Manning's roughness coefficient for the Lower Hassayampa River, the components of Manning's n were estimated, as outlined in "Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona" by Thomsen and Hjalmarson (*1991*). That report was prepared for the Flood Control District of Maricopa County (FCDMC) and will hereby be referred to as T&H for brevity. The components of the n-value per T&H are:

n_b = base value for a straight uniform channel
n_1 = value for surface irregularities
n_2 = value for obstruction
n_3 = value for vegetation

And the total n-value is the sum of the components:

$$n = n_b + n_1 + n_2 + n_3$$

The n-value components for the Lower Hassayampa River were estimated by first categorizing geographic regions on the Lower Hassayampa River based on the degree of vegetation and the approximate expected flow depth. Aerial and ground photographs in T&H that appeared similar to each Lower Hassayampa River category were identified. The n-value components assigned to the T&H regions were then tabulated and compared. The components of each n-value for each Lower Hassayampa River category were then determined from the expected base, surface irregularity, obstruction, and vegetation n-value in the Lower Hassayampa River. This resulted in estimated n_b, n_1, n_2 and n_3 values for the each category in the Lower Hassayampa River.

An older n-value report was also available that provided n-values for Arizona entitled USGS Open-File Report 73-3 "Roughness Coefficients for Stream Channels in Arizona" by Aldridge and Garrett (1973). This report contains only ground photographs of various streams throughout Arizona. The ground photographs in Aldridge and Garrett's (1973) report were examined and matched to the ground photographs taken during the field trips. If the Manning's n-values reported by Aldridge and Garrett (1973) were similar to the values reported by T&H, then this acted as independent verification that the estimated Manning's n-values were appropriate for the Lower Hassayampa River.

Existing Hydraulic Model

The existing Flood Insurance Study (FIS) is based on a floodplain delineation completed by Cella-Barr around 1989. The hydraulics for that FIS study were modeled in HEC-2. The cross-section locations referenced in the text and photographs are the cross-sections from the Cella-Barr FIS hydraulic model.

Roughness Categories

In examining the aerial photographs of the Lower Hassayampa River, nine (9) major categories were identified: Wetted Channel, Unvegetated Channel, Sparse Vegetation, Tall Sparse Vegetation, Tall Medium Vegetation, Tall Dense Vegetation, Extremely Dense Vegetation, Agricultural, and Disturbed.

The depth of flow was also considered when selecting the *n*-values. This categorization was made because of the observation that:

> *Depth of flow must be considered in the selection of n values. The effects of roughness elements on and near the channel bottom tend to diminish as the depth of flow increases. The effect of vegetation on n values depends greatly on the depth of flow and to some extent on the flexibility of the vegetation. If the flow is of sufficient depth to submerge and (or) flatten the vegetation, n values will be lowered.* (Thomsen and Hjalmarson (1991)).

Although HEC-RAS permits the use of variation of *n*-value with discharge or with flow depth, this complicates substantially the assignment of *n*-values, and this option was not used.

In order to consider the effect of depth on the *n*-value, some scheme was needed to assign a likely depth, or depth range, to each of the geographic areas. Since the depth in the channel will generally be greater than in the overbanks, the most practical way was to separate the terrain into a part which is in the channel, and a part which is in the overbanks.

The determination of whether a particular area was in the channel or overbanks was made primarily on the basis of visual examination of the aerial photographs and topography. Note that this channel/overbank determination for the purposes of *n*-value selection does not necessarily match the channel bank stations in the HEC-RAS model. For the purposed of assignment of *n*-values, the channel corresponded to the sandy areas (except for continuously flowing areas located at the downstream of the Lower Hassayampa River with heavy vegetation in the channel). The line between the channel and overbank was generally marked by an increase in brush. In those numerous regions where the river is braided, the entire area between the outermost braids was considered to be the channel. The topography was also used as a guideline in setting the line between the channel and overbanks when a clear step in elevation was visible in the topography.

An examination of a preliminary version of the hydraulic model found the following for the 100-year flood:

(1) Flow in the overbank regions averaged about 3 feet deep.
(2) Flow in the channel regions averaged about 5 feet deep, and was rarely more than 8 feet deep, with the exception noted in item (3).

(3) The channel downstream of the railroad, which is contained on both sides by uncertified levees, is much deeper, on the order of about 10-12 feet deep for the 100-year flood. This portion of the channel was categorized separately as "deep channel".

The 3-foot depth in the overbanks and the 5-foot depth in the channel are averages; there is great variability from these values. Furthermore, for floods smaller than the 100-year, the depths would be lower. Therefore, the *n*-values in the channel were determined separately from *n*-values in the overbanks, on the basis of the average flow depth.

The hydraulic model's primary purpose is to serve as a basis for the sediment transport model. That sediment transport model will simulate a range of flows from flows just large enough to barely move sediment up to the 100-year discharge. Therefore, most of the flows that the sediment model will use are lower than the 100-year discharge. The majority of the sediment would be expected to be carried by floods in the 5- to 10-year frequency range, which are typical "channel forming" discharges in the southwest.

Although the HEC-6 model does not allow for variation in *n*-values based on depth, it does allow variations in *n*-values based on discharge. However, in the channel and the overbanks, the 100-year depths are fairly shallow compared to the height of vegetation. It would be expected that depths of flow of about 3 feet in the overbanks would not be deep enough to flatten the vegetation and significantly decrease the *n*-values. In the channel, a flow depth of 5 feet is on the shallow end of the range of depths reported in T&H. Thus, it was assumed that the variation of depth in the channel would also not have a significant impact on the overall *n*-value. A secondary consideration is that the HEC-RAS model could be used as the basis for a future floodplain model. Thus, the use of *n*-values appropriate for a 100-year flood makes the model more suitable for floodplain modeling. Taking all of this into consideration, it was decided to select the *n*-values based on the 100-year discharge alone.

Table 1 lists the *n*-value categories, their Manning *n*-value, and the percent fraction of each category in the current FEMA floodplain. This gives an indication of the relative importance of each category. Table 1 is a summary of the *n*-value calculations that are described in more detail later in the report.

Table 1. Summary of the Manning *n* categories identified for the Lower Hassayampa River

Category Name	Manning *n*-value			Percent
	Deep Channel	Channel	Overbank	
Wetted Channel	0.025		N/A	0.02%
Unvegetated Channel	0.025		N/A	14.24%
Sparse Vegetation	0.028		0.035	40.90%
Tall Sparse Vegetation	0.037	0.039	0.050	12.16%
Tall Medium Vegetation	0.047	0.057	0.060	5.80%
Tall Dense Vegetation	0.122		0.175	0.50%
Extremely Dense Vegetation	0.15	0.2	0.2	0.34%
Agricultural	N/A	N/A	0.060	22.21%[1]
Disturbed	N/A	N/A	0.035	3.82%

[1]*Most of the agricultural area is located downstream of the railroad bridge.*

The *n*-values were assigned to the cross-sections by first dividing the entire study reach into polygons corresponding to each of the categories. The intersection of each cross-section with the various polygons in different categories determined the assignment of the *n*-values in each cross-section. This corresponds to using "variation in *n*-value by horizontal station" rather than an assignment of one *n*-value each for the left bank, main channel, and right bank.

Bed and Bank Grain Size

Two samples of sand were taken by WEST from the channel bed during the fields trips. The first sample was taken near FIS cross-section 19.47. Comparing the sand visual to same representative samples of known size, the D_{50} appears to be about 0.5 mm. The second sample was taken about halfway between FIS cross-sections 13.70 and 13.79. The second sample was slightly finer than the first sample and appears to have a D_{50} of about 0.3 mm. A series of sediment samples taken by JE Fuller Hydrology and Geomorphology (Fuller samples) and graded by Speedie and Associates show a range of D_{50} from under 0.3 mm to about 1.5 mm. About two-thirds of the samples have D_{50} in the 0.4 mm to 0.6 mm range, and there is no clear trend in changing coarseness moving upstream or downstream in the study reach. The median D_{50} of the Fuller samples was about 0.5 mm.

T&H provide a table of base n_b-values as a function of median bed grain size. Since 0.5 mm appears to be a good estimate of the D_{50} of the sand in the channel, and the base Manning n_b-value for 0.5 mm sand is given as 0.022, this was used as the base n_b-value for the channel.

For the overbanks, it appears that the sand is somewhat coarser and the D_{50} was estimated to be approximately 0.8 mm. The base Manning n_b-value for 0.8 mm sand is given in T&H as 0.025, which was used as the base n_b-value for the overbanks.

Wetted Channel (n = 0.025)

This category of roughness is found near the junction of the Lower Hassayampa River and the Gila River. It consists of the small portion of the Lower Hassayampa River that continuously flows due to agricultural runoff. An aerial photograph of this area can be seen in Figure 1 while a ground photograph can be seen in Figure 2. Although the banks of the channel have dense vegetation, the actual channel that has water flowing in it is smooth. In Chow's (1959) *Open-Channel Hydraulics* book, smooth straight earth channels with short grass and few weeds are given overall n-values ranging from 0.022 to 0.033. Clean and straight natural channels are given overall n-values ranging from 0.025 to 0.033.

The determination of the n-value for the wetted channel was based on an n_b-value of 0.022 with an additional n_1-value of 0.003. A summary of these values are found in Table 2. Note that the heavily vegetated areas surrounding the Wetted Channel area have been classified as Extremely Dense Vegetation, and are discussed in a later section.

Table 2. Calculation of Manning *n* for Wetted Channel

	Selected – Wetted Channel	Notes
n_b (base)	0.022	Given in T&H as the n-value for sand with D_{50} = 0.5 mm
n_1 (irreg.)	0.003	
n_2 (obstruct.)	-	
n_3 (veg.)	-	
Depth Range	Over 10 feet	
Average Depth	Over 10 feet	
Total n	0.025	

Figure 1. Aerial photograph of Wetted Channel area (Waypoint[1] 055.1 is shown as a blue dot at coordinates 457190E, 847167N located about 40 feet upstream of FIS cross-section 1.01)

[1] A Geographic Positioning System (GPS) unit was used to record "waypoints" in the field. The waypoint numbers are presented in the captions. When a decimal point appears after the waypoint, a waypoint was not available at the exact location being reference. A nearby waypoint (the number before the decimal place) was moved to coincide with the actual location being referenced.

Figure 2. Ground photograph of Wetted Channel area (from Waypoint 055.1 at coordinates 457190E, 847167N located about 40 feet upstream of FIS cross-section 1.01)

Unvegetated Channel (n = 0.025)

The designation of Unvegetated Channel consists of areas of the main channel of the Lower Hassayampa River that have very little or no vegetation. Typically, these areas are smooth and are composed almost completely of sand. An aerial photograph of the Unvegetated Channel designation is shown in Figure 3 while a ground photograph is shown in Figure 4. On page 87, Thomsen and Hjalmarson (1991) use an *n*-value of 0.025 to describe the sandy channel shown in photographs 25C and 25D, which is due entirely to a base n_b-value of 0.025 with no n_1, n_2, or n_3 factors. Because there are some channel irregularities, the Manning *n* used should be slightly higher than what T&H present for smooth, straight, sandy channels; and an n_1-value of 0.003 was therefore used. This leads to an overall *n*-value of 0.025 for the Unvegetated Channel areas.

T&H do not include aerial photographs that compared well to the aerial photographs of the areas classified as Unvegetated Channel on the Lower Hassayampa River. Aldridge and Garrett (1973) show photographs of the Hassayampa River near Wickenburg on page 49 (slides 8 and 9). These photographs appear to be similar to the field photograph shown in Figure 4. Aldridge and Garrett (1973) assign an overall Manning *n*-value of 0.025 for this sandy portion of the Hassayampa River, which agrees well with the above calculations.

Table 3. Calculation of Manning *n* for Unvegetated Channel

Location	Centennial Wash below Southern Pacific Railroad	Selected – Unvegetated Channel
Description	T&H Figure 24, p. 85	-
Notes	-	-
n_b (base)	0.025	0.022
Flood	100-year	-
n_1 (irreg.)	-	0.003
n_2 (obstruct.)	-	-
n_3 (veg.)	-	-
Depth Range	6-9 feet	4-10 feet
Average Depth	About 7 feet	5 feet
Total *n*	0.025	0.025

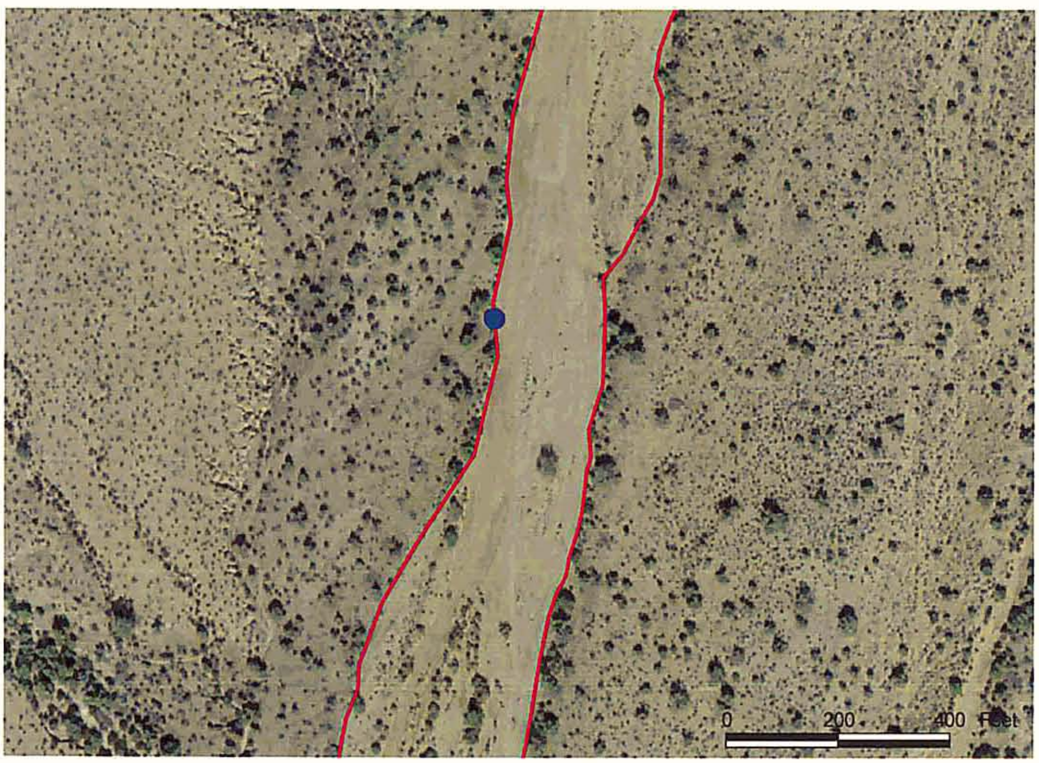

Figure 3. Aerial photograph of Unvegetated Channel area (Waypoint 048 is shown as a blue dot located at coordinates 448447E, 927685N which is located 175 feet downstream from FIS cross-section 17.86)

Figure 4. Ground photograph of Unvegetated Channel area (from Waypoint 048 located at coordinates 448447E, 927685N which is located about 175 feet downstream from FIS cross-section 17.86)

Sparse Vegetation

In the Sparse Vegetation designation, there are scattered low-growing brush and weeds on the bed and banks. This category is broken into two subgroups: Channel Sparse Vegetation and Overbank Sparse Vegetation.

Channel Sparse Vegetation (*n* = 0.028)

Figure 5 shows an aerial photograph and Figure 6 shows a ground photograph of what is classified as Channel Sparse Vegetation. These photographs were taken near the railroad bridge crossing on the Lower Hassayampa River. T&H determined the *n*-values for an area of the Hassayampa River near the CAP canal, which is the upstream limit of this project. The depth and terrain of the example area in T&H appeared roughly comparable to the Channel Sparse Vegetation category. The only difference between the two is an n_1-value of 0.003 was added to our categorization. Although at the CAP canal itself there are not many channel irregularities, most of the reach is braided or has other irregularities. Therefore, the n_1-value was set to account for these irregularities.

T&H did not include a good aerial photograph of their example area so it could not be compared to the aerial photograph shown in Figure 5. Also, Aldridge and Garrett (1973) did not have any photographs that were similar to what is shown in Figure 6.

In both the channel category, where the depth is expected to be in the 4-8 foot range, and the deep channel category, where the depth is expected to be over 8 feet, n_3 was chosen to be 0.003. Since both flows are expected to overtop the brush, a reduction in the n-value for the deep channel was not considered. A summary of the values used to calculate the overall Manning n-value is shown in Table 4.

Table 4. Calculation of Manning *n* for Channel and Deep Channel Sparse Vegetation

Location	Hassayampa at CAP Canal, Channel	Selected – Channel and Deep Channel Sparse Vegetation
Description	T&H Figure 14, p. 55	-
Notes	Approximately same overbank depth. n_b of 0.022 is for $D_{50} = 0.5$ mm.	Set n_b assuming D_{50} of 0.5 mm.
Flood	100-year	
n_b (base)	0.022	0.022
n_1 (irreg.)	-	0.003
n_2 (obstruct.)	-	-
n_3 (veg.)	0.003	0.003
Depth Range	3-5 feet	4-8 feet
Average Depth	3 feet	5 feet
Total n	0.025	0.028

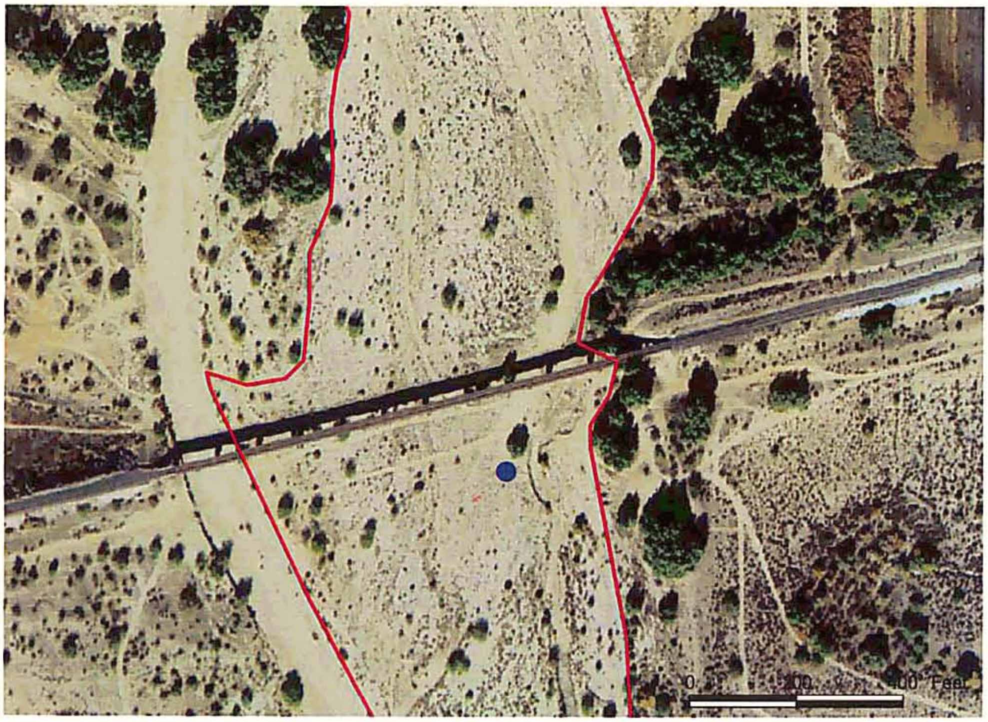

Figure 5. Aerial photograph of Channel Sparse Vegetation area near the railroad bridge (Waypoint 003 is shown as a blue dot located at coordinates 450758E, 861160N which is about 110 feet downstream from FIS cross-section 4.00)

Figure 6. Ground photograph of Channel Sparse Vegetation area near the railroad bridge (from Waypoint 003 located at coordinates 450758E, 861160N which is about 110 feet downstream from FIS cross-section 4.00)

Overbank Sparse Vegetation (*n* = 0.035)

The T&H examples chosen for comparison were Waterman Wash above Rainbow Valley, the Agua Fria River below Jomax Road, and the Hassayampa River at the CAP canal. Note the last example is actually the upstream limit of this project.

For the Agua Fria River below Jomax, an aerial photograph of a sparsely vegetated area is shown on page 100 of T&H, photographs 29A and 29B. Along the right bank, the area is sparsely populated with small shrubs and bushes. Photograph 25D on page 101 of T&H shows a ground photograph of this area. T&H assign an unusually large n_3 (vegetation) value of 0.015, which doesn't appeared justified by the photographs. T&H give this area an overall n-value of 0.043 for a depth corresponding to the 10-year flood.

An even sparser and flatter area is shown for Waterman Wash above Rainbow Valley on page 115 of T&H (photograph 33C). This area is given an overall n-value of 0.030.

The aerial photograph in Figure 7 shows a sample of the Overbank Sparse Vegetation category. This area looks similar to the aerial photographs of the right bank of the Agua Fria River as shown on page 100 (photograph 29A and 29B) of T&H. The ground photographs also look similar (compare Figure 8 to T&H's photograph 29D). Since both the Agua Fria River and the Hassayampa River at the CAP canal's n_1 (irregularity) factor were set at 0.003, the n_1 for this category set equal to 0.003. The vegetation factor was set identical to T&H's vegetation factor of 0.007 for the Hassayampa at the CAP canal since the vegetation is nearly identical. Only the n_b-value was increased beyond T&H's Hassayampa at the CAP canal example. T&H's base n_b-value was 0.022, which is for a D_{50} of 0.5 mm. It was believed that a D_{50} of 0.8 mm was more representative of the overbanks, and the base n_b was set equal to 0.025.

On page 82 of Aldridge and Garrett's (1973) report, slide 59, which was taken on Brawley Wash, looks similar to the sparse brush found in Figure 8. Aldridge and Garrett (1973) report an overall n-value of 0.035 for this slide, which matches the final n-value reported here.

Table 5. Calculation of Manning *n* for Overbank Sparse Vegetation

Location	Waterman Wash above Rainbow Valley, left bank	Agua Fria below Jomax Road, right overbank	Hassayampa at CAP canal, left overbank	Selected – Overbank Sparse Vegetation
Description	T&H Figure 32, page 113	T&H Figure 28, page 99	T&H Figure 14, p. 55	-
Notes	10-year and 100-year have same *n*-values	Has unusually high n_3. Example has very shallow flow.	Approximately the same overbank depth as Overbank Sparse Vegetation.	Used T&H Figure 14 values except n_b selected for median grain size of 0.8 mm.
Flood	10-year/100-year	10-year	100-year	-
n_b (base)	0.03	0.025	0.022	0.025
n_1 (irreg.)	-	0.003	0.003	0.003
n_2 (obstruct.)	-	-	-	-
n_3 (veg.)	-	0.015	0.007	0.007
Depth Range	0-2 feet	1-2 feet	1-2 feet	0-4 feet
Average Depth	1 foot	1 foot	2 feet	3 feet
Total *n*	0.03	0.043	0.032	0.035

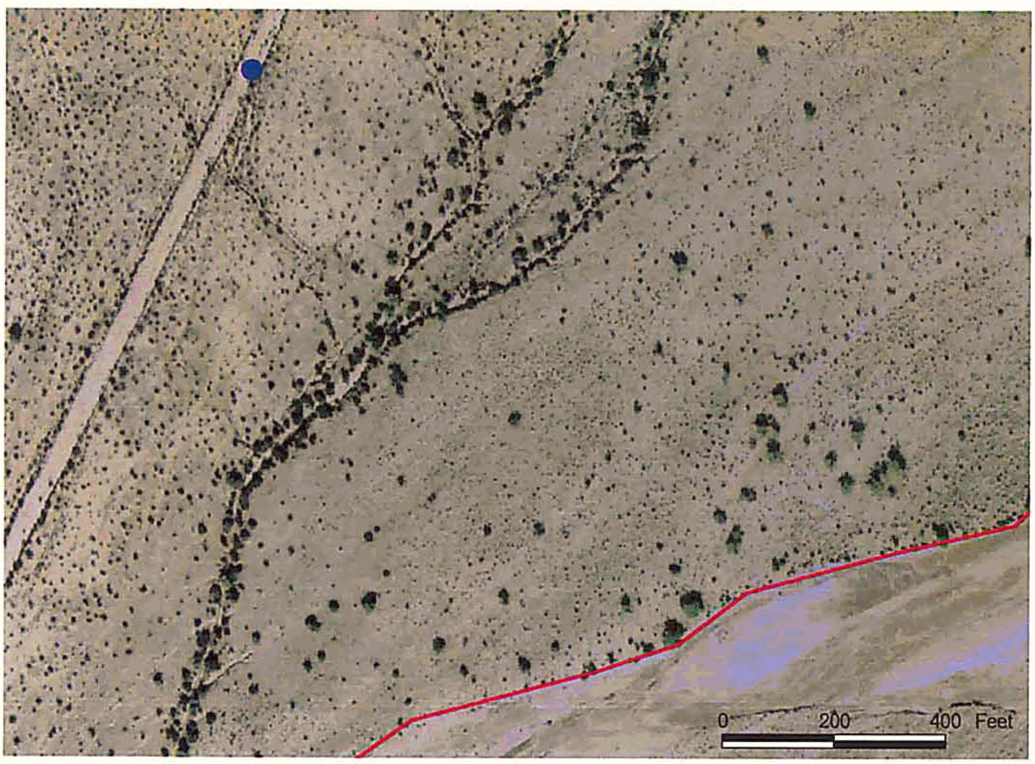

Figure 7. Aerial photograph of Overbank Sparse Vegetation area (Waypoint 042 is shown as a blue dot at coordinates 456641E, 967467N which is located about 90 feet downstream from FIS cross-section 26.19). The narrow tributary wash on the left side (more heavily vegetated) is not differentiated with a different *n*-value.

Figure 8. Ground photograph of Overbank Sparse Vegetation area (located at Waypoint 042 at coordinates 456641E, 967467N which is about 90 feet downstream from FIS cross-section 26.19)

Tall Sparse Vegetation

In these areas, trees and tall shrubs are sparsely scattered along the channel bottom and overbanks. Small bushes are also scattered along the ground. These tall trees are not likely to be overtopped by the 100-year flood. The shrubs might be pushed down by the 100-year flood, but it should not be enough to significantly lower the overall *n*-value. As a rough rule-of-thumb, the trees were considered sparse if there were about one to two large trees in a given 100-foot by 100-foot area. This category is broken into two subgroups: Channel Tall Sparse Vegetation and Overbank Tall Sparse Vegetation.

Channel and Deep Channel Tall Sparse Vegetation (n = 0.037-0.039)

The most comparable example from T&H in terms of vegetation was found in the right overbank of the Agua Fria River below U.S. Highway 74. Aerial photographs 27A and 27B on page 94 of T&H are similar to the aerial photograph of the Channel Tall Sparse Vegetation area shown in Figure 9. The ground photographs from T&H of this area (photograph 27G on page 96 and 27D on page 95) are similar to the ground photograph shown in Figure 10; however, photograph 27G and the aerial photographs 27A and 27B appear to have slightly denser vegetation than what is called Channel Tall Sparse Vegetation in this report.

The floods in the Agua Fria River are considerably deeper than the ones in the Hassayampa River; the 10-year flood in the right overbank appears to be about 2-4 feet deep while the 100-year flood appears to be about 6-9 feet deep.

Since the average channel depths on the Lower Hassayampa River are expected to be somewhere between these two values (although closer to the 6-9 foot range), it would be expected that the vegetation resistance values for the Lower Hassayampa River would lie between n_3 values reported in T&H for the two depth ranges. However, because the vegetation on the Lower Hassayampa River was lighter than in the Agua Fria River example, a vegetation resistance value of 0.012 was used, which was less than both the 10-year (0.025) and 100-year (0.015) values from the example. The n_3 value of 0.012 also corresponds to the boundary between the "small vegetation" and "medium vegetation" ranges described in T&H, which appears to be appropriate. For deep channel, the n_3 value was lowered slightly to 0.01.

It is unclear why in T&H the 10-year and 100-year Agua Fria River examples have a different n_b value, since n_b is not expected to vary with depth. For the Channel Tall Sparse Vegetation areas, a base n_b-value of 0.022 was used. A summary of all the factors used to calculate the Manning n-values is shown in Table 6.

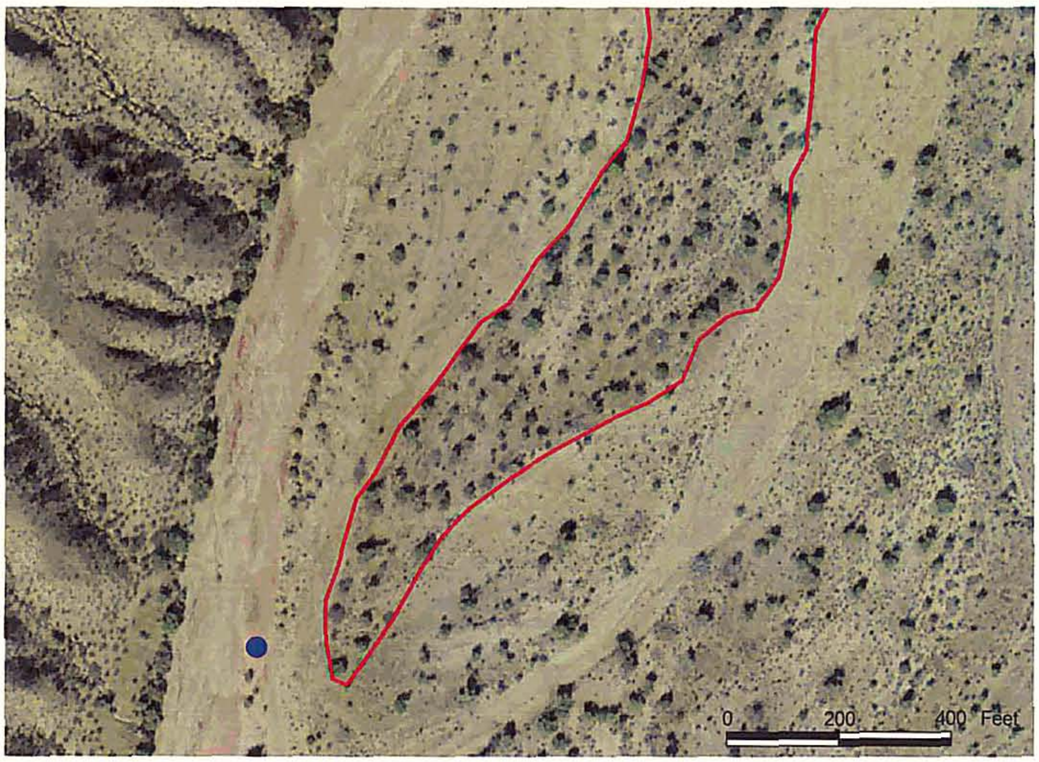

Figure 9. Aerial photograph of Channel Tall Sparse Vegetation area (Waypoint 043 is shown as a blue dot at coordinates 453167E, 959045N which is approximately 105 feet downstream from FIS cross-section 24.39)

Figure 10. Ground photograph of Channel Tall Sparse Vegetation area, located in background (from Waypoint 043 at coordinates 453167E, 959045N which is approximately 105 feet downstream from FIS cross-section 24.39)

Overbank Tall Sparse Vegetation (*n* = 0.050)

As with Channel Tall Sparse Vegetation, the most comparable example from T&H for the Overbank Tall Sparse Vegetation areas in terms of vegetation was found in the right overbank of the Agua Fria River below U.S. Highway 74. The descriptions in the previous section also apply here. However, because the expected depth of flow is lower for the overbanks, the n_3 (vegetation) value for the overbank was increased from 0.01 to 0.02. The overall *n*-value for the Overbank Tall Sparse Vegetation was estimated to be 0.050. A summary of Manning *n*-value calculations for the Overbank Tall Sparse Vegetation areas is shown in Table 6.

Table 6. Calculation of Manning n for Tall Sparse Vegetation

Location	Agua Fria River below U.S Highway 74, right overbank	Agua Fria River below U.S Highway 74, right overbank	Selected – Deep Channel Tall Sparse Vegetation	Selected -- Channel Tall Sparse Vegetation	Selected – Overbank Tall Sparse Vegetation
Figure and Page	T&H Figure 26, page 93.	T&H Figure 26, page 93.			
Notes	Vegetation slightly denser than Channel Tall Sparse. n_1 in example appears to be in error.	Vegetation slightly denser than Channel Tall Sparse.	Vegetation is slightly lighter than T&H examples	Vegetation is slightly lighter than T&H examples	Depth similar to 10-year flood on Agua Fria River, but vegetation density in this category is lower than the Agua Fria River example.
Flood	10-year flood	100-year flood	-	-	-
n_b (base)	0.030	0.025	0.022	0.022	0.025
n_1 (irreg.)	0.005	0.005	0.005	0.005	0.005
n_2 (obstruct.)	-	-	-	-	-
n_3 (veg.)	0.025	0.015	0.01	0.012	0.02
Depth Range	2-5 feet	6-9 feet	> 8 feet	4-8 feet	0-4 feet
Average Depth	3 feet	7 feet	-	5 feet	3 feet
Total n	0.055	0.045	0.037	0.039	0.050

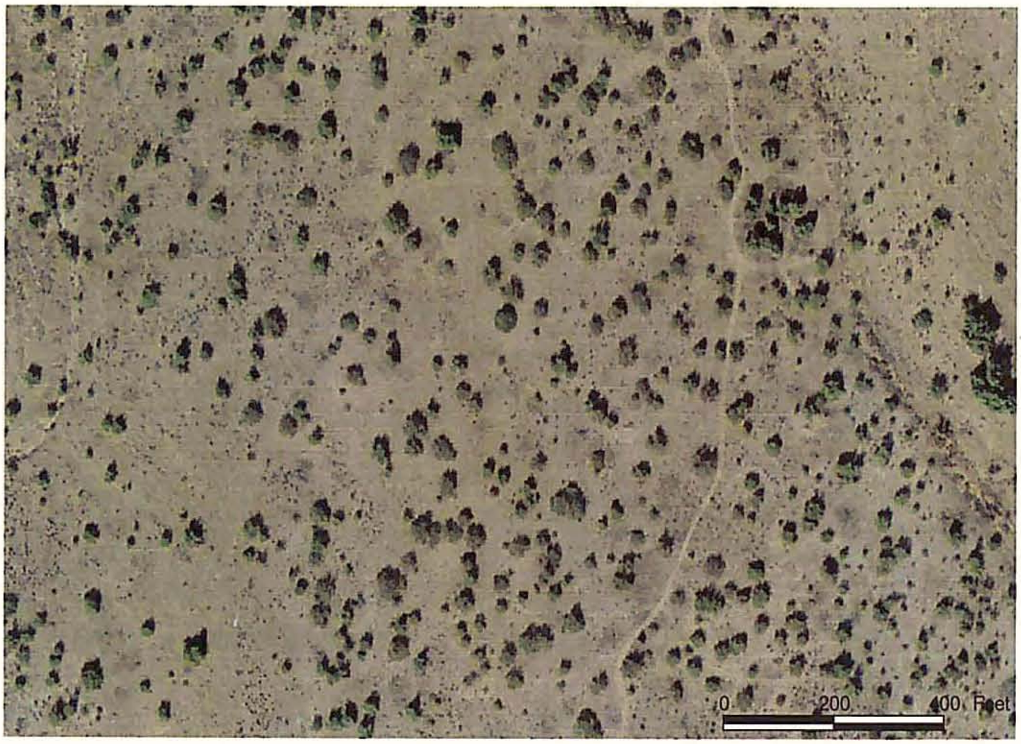

Figure 11. Aerial photograph of Overbank Tall Sparse Vegetation area (located at coordinates 447913E, 867580N which is approximately 115 feet upstream of FIS cross-section 5.29)

Figure 12. Ground photograph of Overbank Tall Sparse Vegetation area (located at Waypoint 001 at coordinates 449136E, 865843N which is approximately 40 feet upstream of FIS cross-section 4.91)

Tall Medium Vegetation

This designation is reserved for areas that have a medium density of tall trees and shrubs. As a rough rule-of-thumb, an area was considered to be medium density if there were three to seven trees in a given 100-foot by 100-foot area.

The area used for comparison from T& H was Centennial Wash below Southern Pacific Railroad. The short green area between the main channel and the left overbank on aerial photographs 25A and 25B on page 86 of *T&H is considered to have a medium vegetation* density. This category is broken into two subgroups: Channel Tall Medium Vegetation and Overbank Tall Medium Vegetation.

Deep Channel Tall Medium Vegetation (n = 0.047)

In T&H, at Cave Creek below Carefree Highway, there is a good example on the right bank of something slightly lighter than Tall Medium Vegetation at about an 8 foot depth. The n_3-value was set slightly higher than in the example from T&H (0.02 versus 0.15 in the T&H example) to account for the heavier vegetation in the Deep Channel Tall Medium Vegetation category.

Note also that this n_3-value is 0.01 lower than the n_3-value chosen for Channel Tall Medium Vegetation category, which is about 4 feet shallower. The 5-foot reduction in flow depth in T&H's Cave Creek right overbank example from the 100-year to the 10-year flood also results in a decrease of 0.01 in the n_3-value. A summary of these values is shown in Table 7.

Channel Tall Medium Vegetation (n = 0.057)

Photographs 25A and 25B on page 86 of T&H look very similar to the aerial photographs shown in Figure 13. The ground photograph for the area is shown in photograph 25G of T&H on page 89 (which corresponds to the aerial photograph on page 86 of T&H). This photograph is similar to the ground photograph taken on the Lower Hassayampa River (Figure 14).

T&H use a value of 0.060 for the overall n-value to describe the roughness of the channel type that is designated as Channel Tall Medium Vegetation in this report, for both the 10-year and the 100-year flood. The overall n-value doesn't change between the two floods because there is no change in the n_3-value (vegetation) between them (i.e., neither flood overtops the vegetation). Even though the typical depths in the channel are slightly higher than in the example from T&H, the majority of the vegetation will still not be overtopped; therefore, the same n_3-value (0.03) was used in the Channel Tall Medium Vegetation areas as was used in the T&H example.

On page 80 (slide 57), Aldridge and Garrett (1973) show a ground photograph of an area on the Santa Cruz River that looks similar to the ground photographs for the Channel Tall Medium Vegetation (Figure 14). This area is given an overall n-value of 0.060.

Overbank Tall Medium Vegetation (n = 0.060)

The aerial photographs 25A and 25B on page 86 of T&H look very similar to the aerial photographs shown in Figure 15. A ground photograph of an Overbank Tall Medium Vegetation area can be seen in Figure 16. This photograph looks very similar to the ground photograph shown on page 89 (photograph 25G) in T&H. Also, Aldridge and Garrett (1973) show a ground photograph of an area on the Santa Cruz River that looks similar to the ground photographs for the Overbank Tall Medium Vegetation on page 80 (slide 57). T&H and Aldridge and Garrett (1973) use a value of 0.060 for the overall n-value to describe the roughness of the overbanks that is designated as Overbank Tall Medium Vegetation in this report. A summary of these values is shown in Table 8.

Figure 13. Aerial photograph of Channel Tall Medium Vegetation area (Waypoint 002.1 is shown as a blue dot at coordinates 443124E, 895490N which is located about 150 feet downstream from FIS cross-section 11.09)

Figure 14. Ground photograph of Channel Tall Medium Vegetation area (at Waypoint 043 at coordinates 453167E, 959045N which is located about 105 feet downstream from FIS cross-section 24.39)

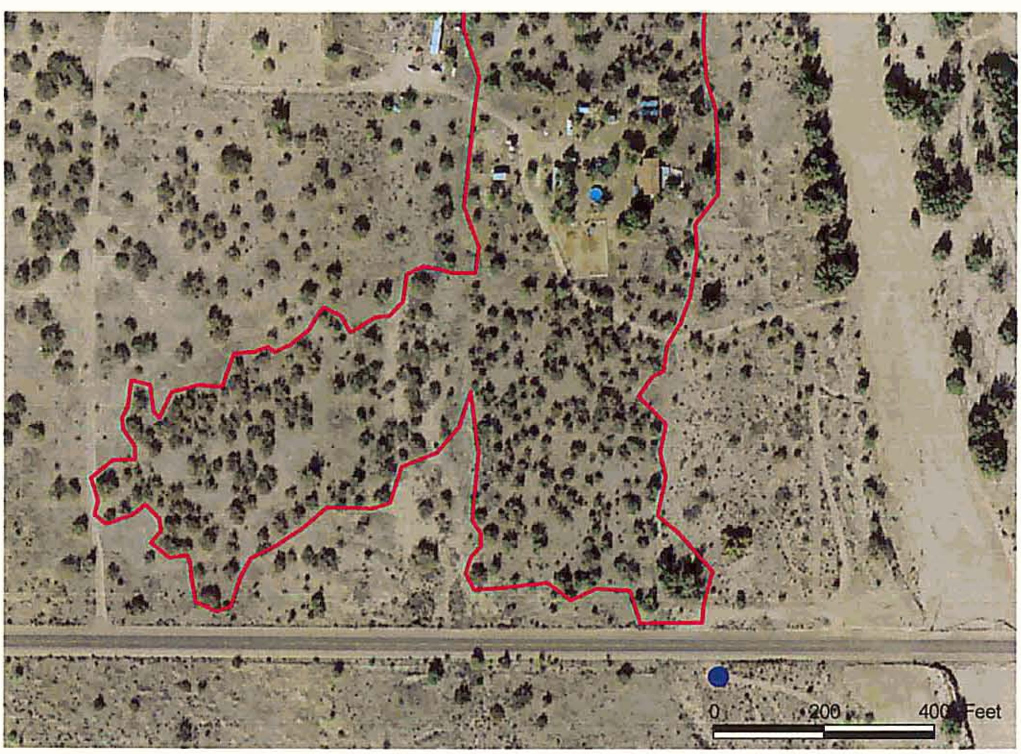

Figure 15. Aerial photograph of Overbank Tall Medium Vegetation area (located at Wpt 001 [blue dot] at coordinates 449136E, 865843N which is approximately 35 feet upstream of FIS cross-section 4.91)

Figure 16. Ground photograph of Overbank Tall Medium Vegetation area (located at Waypoint 001 at coordinates 449136E, 865843N which is approximately 35 upstream from FIS cross-section 4.91)

Table 7. Calculation of Manning *n* for Deep Channel Tall Medium Vegetation

Location	Cave Creek Below Carefree Highway, right overbank	Cave Creek Below Carefree Highway, right overbank	Selected – Deep Channel Tall Medium Vegetation
Figure and Page	T&H Figure 22, p. 79	T&H Figure 22, p. 79	-
Notes	-	-	Category has slightly more vegetation than Cave Creek example
Flood	10-year	100-year	
n_b (base)	0.03	0.03	0.022
n_1 (irreg.)	0.005	0.005	0.005
n_2 (obstruct.)	-	-	-
n_3 (veg.)	0.025	0.015	0.02
Depth Range	0-5 feet	5 – 11 feet	>8 feet
Average Depth	3 feet	8 feet	-
Total n	0.06	0.05	0.047

Table 8. Calculation of Manning n for Tall Medium Vegetation

Location	Centennial Wash below Southern Pacific Railroad, at about 8700 feet from left bank	Centennial Wash below Southern Pacific Railroad, at about 8700 feet from left bank	Selected – Channel Tall Medium Vegetation	Selected – Overbank Tall Medium Vegetation
Figure and Page	T&H Figure 24, p. 85	T&H Figure 24, p. 85	-	-
Notes	-	-	-	-
Flood	10-year	100-year		
n_b (base)	0.025	0.025	0.022	0.025
n_1 (irreg.)	0.005	0.005	0.005	0.005
n_2 (obstruct.)	-	-	-	-
n_3 (veg.)	0.03	0.03	0.03	0.03
Depth Range	2-3 feet	3-5 feet	4-8 feet	0-4 feet
Average Depth	2 feet	4 feet	5 feet	3 feet
Total n	0.06	0.06	0.057	0.06

Tall Dense Vegetation

The Tall Dense Vegetation designation corresponds to areas that have a very dense vegetation coverage composed of tall trees and shrubs. As a rough rule-of-thumb, the vegetation was considered dense if there were more than eight trees for a given 100-foot by 100-foot area or if more than 50% of the area was covered by trees.

The comparison areas from T&H were at the Gila River above Gillespie Dam, at the Hassayampa River above the highway rest stop near Wickenburg, and at Centennial Wash below Southern Pacific Railroad.

For the Gila River example, T&H show a very densely vegetated area in photograph 7G (page 29). This area is given an overall n-value of 0.20 for the 10-year flood. The amount of vegetation in this example is denser than what is considered Tall Dense Vegetation in this report.

On the Hassayampa River example (photographs 13A and 13B on page 50), T&H show aerial photographs of an area that is very similar to what is called Tall Dense Vegetation in this report (see photographs 13A and 13B). This area is located between the road and the main channel on the left overbank and is given an overall n-value of 0.125.

Another example of Tall Dense Vegetation can be found on Centennial Wash (photographs 25A and 25B on page 86 of T&H). The right overbank is composed of fairly dense vegetation and T&H give this area an overall n-value of 0.100. Aldridge and Garrett (1973) do not have any photographs that look similar to the Tall Dense Vegetation category.

This category is broken into two subgroups: Channel Tall Dense Vegetation and Overbank Tall Dense Vegetation.

Channel and Deep Channel Tall Dense Vegetation (*n* = 0.122)

The dense portion between the road and the main channel on the left overbank in photographs 13A and 13B of T&H is very similar to the aerial photograph of Figure 17. The ground photographs for the dense vegetation area of T&H are shown in photographs 13C and 13D on page 51. No ground photographs of the Channel Tall Dense Vegetation areas were taken during the field trips, so no comparison can be made to the T&H ground photographs. The aerial photograph in Figure 17 also appears to be similar to the aerial photographs on page 86 (photographs 25A and 25B). The ground photographs for this area are shown on page 88 (photographs 25E and 25F). For the Channel and Deep Channel Tall Dense Vegetation category, the overall Manning *n*-value was chosen to be 0.122 (see Table 9).

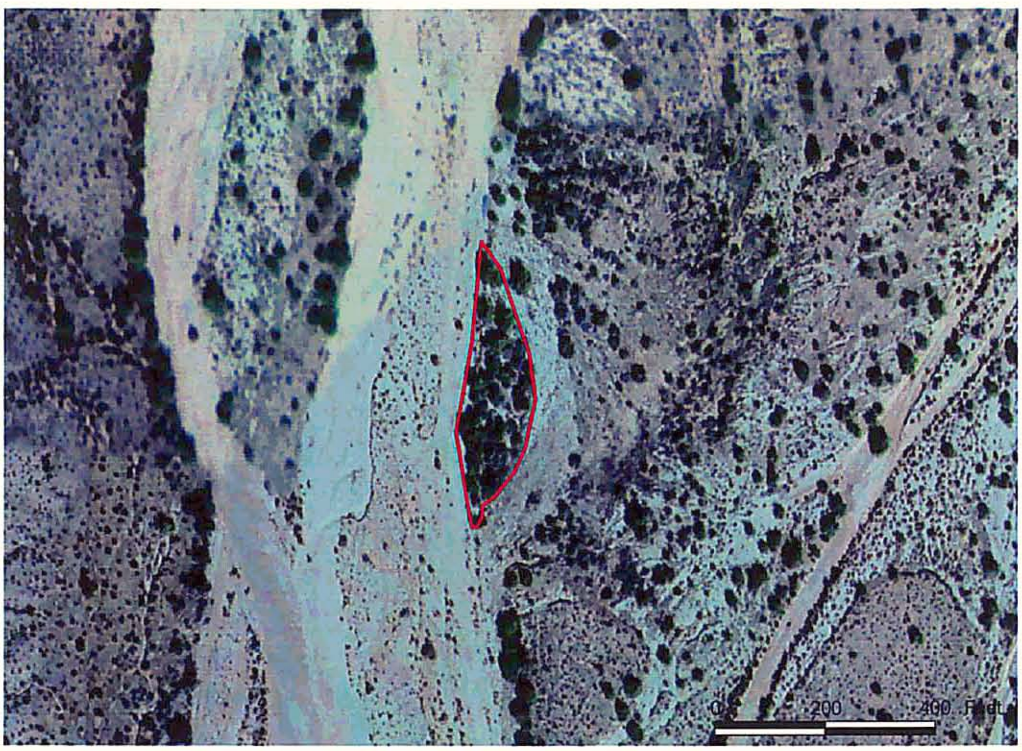

Figure 17. Aerial photograph of Channel Tall Dense Vegetation area (located at coordinates 443247E, 898539N which is approximately 150 feet downstream from FIS cross-section 11.71)

Overbank Tall Dense Vegetation (*n* = 0.175)

When comparing the aerial photographs 13A and 13B on page 50 of T&H (Hassayampa River near Wickenburg) to the aerial photograph of the overbank shown in Figure 18, many similarities can be noted. Figure 18 also has a similar appearance to photographs 25A and 25B on page 86 of T&H. There were no ground photographs from the field to make comparisons.

It was felt that since the vegetation would be denser in the overbanks than in the channel, the n_3-value (0.150) for the Overbank Tall Dense Vegetation was chosen to be slightly higher than the n_3-value (0.100) for the Channel Tall Dense Vegetation. An overall *n*-value of 0.175 was selected (see Table 9).

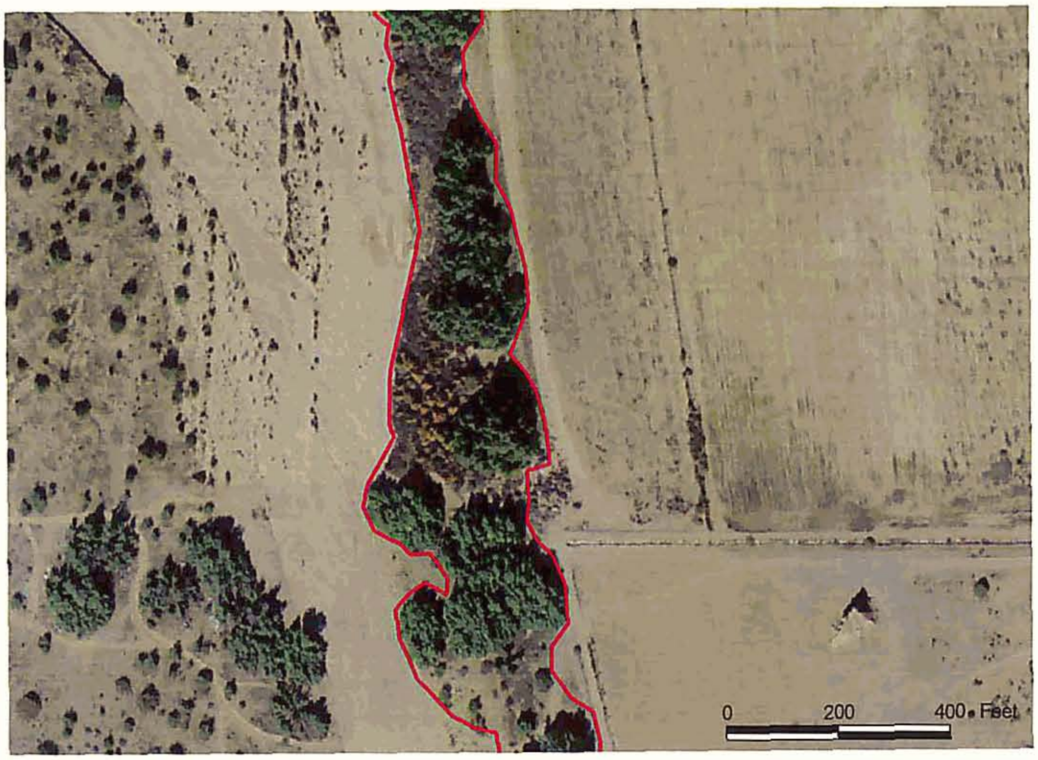

Figure 18. Aerial photograph of Overbank Tall Dense Vegetation area (located at coordinates 448450E, 871300N which is approximately 80 feet upstream of FIS cross-section 5.95)

Table 9. Calculation of Manning *n* for Tall Dense Vegetation

Location	Gila River above Gillespie Dam	Hassayampa River above highway rest stop near Wickenburg	Centennial Wash below Southern Pacific Railroad	Selected – Channel and Deep Channel Tall Dense Vegetation	Selected – Overbank Tall Dense Vegetation
Figure and Page	Figure 6, p.25	Figure 12, p. 49	Figure 24, p. 85		
Notes		Left-most portion of section. Vegetation not overtopped	Flow extremely shallow in example	Flow will not overtop vegetation so *n*-value should be relatively insensitive to depth	
Flood	10-year	10-year and 100-year (have same *n*-values)	100-year		
n_b (base)	-	0.025	0.025	0.022	0.025
n_1 (irreg.)	-	-	0. 010	-	
n_2 (obstruct.)	-	-	-	-	
n_3 (veg.)	0.20	0.10	0.065	0.10	0.15
Depth Range	5-7 feet	1-15 feet	1-2 feet	4-8 feet (channel); > 8 feet (deep channel)	< 4 feet
Average Depth	6 feet	Varies	1-2 feet	5 feet	< 4 feet
Total *n*	0.20	0.125	0.10	0.122	0.175

Extremely Dense Vegetation (n = 0.150-0.200)

On the Gila River and on the Lower Hassayampa River near the Gila River confluence, there are areas that have been designated as Extremely Dense Vegetation. This category only appears in the main channel; it was not found in the overbanks.

Two comparison areas were found in T&H: The Gila River above Gillespie Dam and the Gila River above Bullard Avenue near Avondale.

For the Gila River above Gillespie Dam, T&H show an aerial photograph of an area with very dense vegetation on page 29 (photograph 7G). For the Gila River above Bullard Avenue, T&H show some ground photographs (photographs 5G and 5H on page 21) on an area on the Gila River with vegetation that is very dense and about 15 feet high. This area also appears to be very similar to the area shown in Figure 19. Aldridge and Garrett (1973) do not have any photographs of areas that would be classified as Extremely Dense Vegetation.

In both of the examples in T&H, the overall n-value was set at 0.15 for higher depths (around 7 feet) and 0.20 for lower depths (around 13-15 feet). The expected depth in the deep channel area where the extremely dense vegetation is found is expected to be about 12 feet. Thus, for normal channel areas, the overall n-value was set equal to 0.200. For deep channel areas, the overall n-value was dropped to 0.150. A summary of various n-values is shown in Table 10.

Table 10. Calculation of Manning n for Extremely Dense Vegetation

Location	*Gila River above Gillespie Dam*	*Gila River above Gillespie Dam*	Gila River above Bullard Avenue near Avondale	Gila River above Bullard Avenue near Avondale	Selected – Deep Channel Extremely Dense Vegetation	Selected – Channel Extremely Dense Vegetation
Figure and Page	Figure 6, p.25	Figure 6, p.25	Figure 4, p. 17	Figure 4, p. 17	-	-
Notes	Far right portion of cross-section	Far right portion of cross-section	Far right portion of cross section	Far right portion of cross section	-	-
Flood	10-year	100-year	10-year	100-year		
n_b (base)	-	-	-	-	-	-
n_1 (irreg.)	-	-	-	-	-	-
n_2 (obstruct.)	-	-	-	-	-	-
n_3 (veg.)	0.20	0.15	0.20	0.15	0.15	0.20
Depth Range	5-7 feet	13-15 feet	6-9 feet	12-15 feet	10-12 feet	< 8 feet
Average Depth	6 feet	14 feet	7 feet	13 feet	12 feet	-
Total n	0.20	0.15	0.20	0.15	0.15	0.20

Figure 19. Aerial photograph of Extremely Dense Vegetation area (located at Waypoint 055.1 (blue dot) at coordinates 457190E, 847167N which is approximately 40 feet upstream of FIS cross-section 1.01)

Figure 20. Ground photograph of Extremely Dense Vegetation area (located near Waypoint 055.1 at coordinates 457190E, 847167N which is approximately 40 feet upstream of FIS cross-section 1.01)

Agriculture (n = 0.060)

Some of the areas on the banks of the Lower Hassayampa River are agricultural fields (see **Figure 21**). T&H and Aldridge and Garrett (1973) do not address agricultural fields in their reports in much detail. Both reports simply have tables for approximate roughness coefficients for cultivated areas that are based on the table found in Chow's (1959) *Open-Channel Hydraulics* book. However, Aldridge and Garrett (1973) slightly expand Chow's table as shown in **Table 11**.

Table 11. Manning's roughness coefficients for cultivated agricultural areas (from Aldridge and Garrett (1973))

Cultivated Area	Manning *n*-value		
	Minimum	Normal	Maximum
No crop	0.020	0.030	0.040
Mature row crops, such as small vegetables	0.025	0.030	0.045
Mature field crops, depth of flow at least twice the height of the vegetation	0.030	0.040	0.050
Dense field crops in full leaf, such as corn or cotton, depth of flow less than height of vegetation	0.050	---	0.100

Figure 21. Aerial photograph of agricultural area (located at coordinates 457000E, 850750N which is about 30 upstream of FIS cross-section 1.65)

The types of crops that are typical of the study area were investigated. Mr. Robert Wilson of the USDA was contacted; he mentioned that the main crops in the area are alfalfa, cotton, corn, and vegetables such as muskmelon, watermelon, carrot, and onion. Also contacted was Mr. Patrick Clay of the College of Agricultural and Life Sciences at the University of Arizona; he mentioned that the main crops in the area are cotton, alfalfa, Durum wheat, barley, and some vegetables. Based on the information received from these two gentlemen, as well as from publications, Table 12 was prepared showing some possible crops of the region as well as their seasons.

Table 12. Crops in the study area and their seasons

<table>
<tr><th>Crop</th><th>Planted</th><th>Harvested</th><th>Source</th></tr>
<tr><td>Cotton</td><td>April</td><td>November</td><td>USDA (1997);
Phone conversation with Mr. Patrick Clay from U of A</td></tr>
<tr><td>Corn</td><td>April</td><td>October</td><td>USDA (1997)</td></tr>
<tr><td>Carrot, 1st Crop</td><td>July-Aug</td><td>Oct – Dec</td><td rowspan="2">Planting Date: U of A, Tucson (1998a).
Time to harvest: 4-5 months after planted per Department of Agriculture, Western Australia (2000)</td></tr>
<tr><td>Carrot, 2nd crop</td><td>Sept -- Jan (2nd)</td><td>Dec - May</td></tr>
<tr><td>Onion</td><td>Sep- Jan</td><td>Dec - Apr</td><td>Planting Date: U of A, Tucson (1998a).
Time to harvest: 100 to 120 days per U of A, Tucson (1998c)</td></tr>
<tr><td>Muskmelon, 1st crop</td><td>December</td><td>Feb – Apr</td><td rowspan="2">Planting Date: U of A, Tucson (1998b).
Time to harvest: 70 to 130 days per U of A, Tucson (1998a) (Assuming two seasons)</td></tr>
<tr><td>Muskmelon, 2nd crop</td><td>April</td><td>Jun – Aug</td></tr>
<tr><td>Watermelon, 1st crop</td><td>December</td><td>Feb - Apr</td><td rowspan="2">Planting Date: U of A, Tucson (1998a).
Time to harvest: 70 to 130 days per U of A, Tucson (1998b) (Assuming two seasons)</td></tr>
<tr><td>Watermelon, 2nd crop</td><td>April</td><td>Jun - Aug</td></tr>
<tr><td>Alfalfa</td><td colspan="2">Perennial</td><td>Email from Mr. Robert Wilson (USDA, Natural Resources Conservation Services), October 2004;
Phone conversation with Patrick Clay from U of A, October 2004</td></tr>
<tr><td>Wheat (Durum)</td><td>December</td><td>May - Jun</td><td>USDA (1997);
Phone conversation with Mr. Patrick Clay from U of A, October 2004</td></tr>
<tr><td>Barley (Fall)</td><td>December</td><td>May - Jun</td><td>USDA (1997);
Phone conversation with Mr. Patrick Clay from U of A, October 2004</td></tr>
</table>

An examination of the flow record indicates the months of the year when large floods are likely, which could indicate what types of crops are most likely to be present during the seasons where flooding is most likely. Of the 41 yearly peaks recorded at the Arlington USGS gage, 70% of the yearly peaks occur in August through December and 90% of them occur in August through February. This is not very helpful, however, because virtually every crop in the table except for wheat and barley are capable being fully grown in the August through December time frame. Both Mr. Robert Wilson and Mr.

Patrick Clay indicated that the most common crops in the area are alfalfa and cotton. In the interest of brevity, the examination of *n*-values was restricted to these two crops.

The study "Friction Factors for Vegetated Waterways of Small Slopes" (USDA, 1977) summarizes experiments performed to determine the Manning *n*-value of various crops at different depths. The USDA report shows results of experiments with cotton, but not with alfalfa. However, the report does have results for lovegrass. Lovegrass appears to be similar to alfalfa in height and may also be similar in terms of hydraulic resistance.

According to the USDA report (USDA 1977) lovegrass stems averaged 12 inches tall with some stems 32 inches long. There was also considerable crabgrass in the channel for the lovegrass experiment, which averaged 22 inches in length and went as high as 50 inches. The experiments tended to use depths that are fairly shallow. For lovegrass, the report gives *n*-value of 0.077 for the highest two flow depths of 2.25 and 2.47 feet (actually hydraulic radius values in the USDA report).

According to the USDA report (USDA 1977), Manning *n*-values for a particular crop are best correlated to the product of the velocity and the hydraulic radius. For an estimated velocity of perhaps 2 to 3 feet per second and an estimated average depth of perhaps 2 to 3 feet, the possible product of hydraulic radius and velocity ranges from about 4 to 9 ft^2/s. Per the chart in the USDA publication (Figure 52 in USDA (1997)), for average channel conditions, the Manning *n*-value for this span of hydraulic radius and velocity products would be about 0.07 to 0.05.

For cotton, the highest hydraulic radius shown in the USDA report was only 1.53 feet, and the *n*-value reported for this height was 0.099. The average height of the cotton plants was about 21 inches, with the tallest plants averaging 27 inches. The 1.53-foot flow depth is quite low, and lack of experiments with higher flow depths limits the applicability of this reported *n*-value. However, this 0.099 *n*-value matches well with Chow's (1959) *n*-value of 0.10, which is given as the maximum *n*-value for dense field crops (including cotton) when the depth of flow is less than the height of the vegetation.

It should be noted that for the sediment model, the large agricultural overbanks will not be very relevant to the model. It can safely be assumed that most of the sediment that finds its way to the agricultural field will fall out due to the low velocities.

Based on the information outlined above, an overall *n*-value of 0.06 was selected for the Agricultural areas. This *n*-value, which is based on the average of the range of values for alfalfa, would be the most applicable.

Disturbed (n = 0.035)

Disturbed areas are areas where earthwork has been done. An aerial and ground photograph on a disturbed area can be seen in Figure 22 and Figure 23, respectively. Neither the report by Thomsen and Hjalmarson (1991) nor the report by Aldridge and Garrett (1973) discuss the roughness of areas that have been disturbed by earthwork.

From Figure 23, it can be seen that these areas have had most of the vegetation removed from them. Thus, it could be concluded that the roughness factor should be close to that of the Unvegetated Channel areas. However, the irregularities and obstructions will probably be higher than the Unvegetated Channel areas. Thus, the n_1 factor for irregularity was set at 0.01, yielding a total n-value of 0.035 (see Table 13).

Table 13. Calculation of Manning *n* for Disturbed areas

	Selected – Disturbed	Notes
n_b (base)	0.025	Given in T&H as the n-value for sand with D_{50} = 0.8 mm
n_1 (irreg.)	0.010	
n_2 (obstruct.)	-	
n_3 (veg.)	-	
Depth Range	-	
Average Depth	-	
Total n	0.035	

Figure 22. Aerial photograph of Disturbed area (located at Waypoint 050.1 [blue dot] at coordinates 443924E, 902304N which is about 10 feet downstream from FIS cross-section 12.47)

Figure 23. Ground photograph of Disturbed area (located at Waypoint 050.1 at coordinates 443924E, 902304N which is about 10 feet downstream from FIS cross-section 12.47)

Thomsen and Hjalmarson Examples in the Project Reach

T&H contains two locations that are within the project reach: the Hassayampa River at CAP canal and the Hassayampa River at old US-80.

Hassayampa River at CAP Canal

At the CAP canal, the categorization has three different types of *n*-values as shown in Table 14. This table is a summary of some of the previous tables given in the report. T&H's *n*-values at the CAP canal are summarized in Table 15.

Table 14. Manning n characterization at the CAP canal

Location	Unvegetated Channel and Deep Channel	Channel and Deep Channel Sparse Vegetation	Overbank Sparse Vegetation
Description	-	-	-
n_b (base)	0.022	0.022	0.025
n_1 (irreg.)	0.003	0.003	0.003
n_2 (obstruct.)	-	-	-
n_3 (veg.)	-	0.003	0.007
Depth Range	4-10 feet	4-8 feet	0-4 feet
Average Depth	5 feet	5 feet	3 feet
Total n	0.025	0.028	0.035

Table 15. Manning n-values at the CAP canal reported by Thomsen and Hjalmarson (1991)

Location	Hassayampa at CAP Canal, Channel	Hassayampa at CAP Canal, Overbank.
Description	T&H Figure 14, p. 55	T&H Figure 14, p. 55
Notes	n_1 of 0.022 is for D_{50} = 0.5mm.	-
Flood	100-year	100-year
n_b (base)	0.022	0.022
n_1 (irreg.)	-	0.003
n_2 (obstruct.)	-	-
n_3 (veg.)	0.003	0.007
Depth Range	3-5 feet	1-2 feet
Average Depth	3 feet	2 feet
Total n	0.025	0.032

As can be seen, the channel n-values in this report are similar to T&H's n-values. For the channel, the only difference is that this report adds 0.003 for the n_1-value, while T&H has this value at zero. For the overbanks, the only difference in the n-values is that this report used a base value of 0.025 while T&H used 0.022. These differences appear because, for vast majority of project reach, the conditions used for these categories are believed to apply.

Additionally, there is a small area in WEST's categorization of channel which has no vegetation, and therefore the final n-value is equal to the base n_b-value of 0.022 plus an n_1-value of 0.003 for irregularities.

Hassayampa River at Old US-80

At the Old US-80, T&H's categorization of n-values is quite simple: 0.025 within the levees, and 0.03 in the overbanks. Both are entirely from the base n_b-value, with no vegetation or irregularity components.

The categorization of n-values in this report at the Old US-80, between the levees, has a lower base n_b-value than T&H (n_b = 0.022). The vegetation components were also included, while T&H did not include them. Most of the categorization between the levees is Deep Channel Sparse Vegetation, which has an overall n-value of 0.028, including 0.003 for vegetation and 0.003 for irregularities. The n-values for the area also include the Extremely Dense Vegetation area, which appears on the side of the channel, and was assigned an overall n-value of 0.15. Note that T&H's photographs of the channel have significantly less vegetation than what was observed in the field. Also included in our categorization is the Wetted Channel categorization for which the base n_b-value of 0.022 plus 0.003 for irregularities. The total n-value of 0.025 for this portion therefore matches T&H's n-value in the channel. Note that T&H's n-value is due entirely to their base n_b-value of 0.025.

The overbanks were assigned an overall n = 0.06,, as explained in the agriculture section (it was assumed that the fields were cultivated). In T&H, the assumption appears to be that the fields are fallow, which they are in the picture of the right overbank given in Figure 17D on page 63 of T&H. For these fields, T&H had an overall n-value of 0.03.

Compositing of Roughness Values

HEC-RAS, when it encounters multiple n-values in the channel, will sometimes "composite" them into a single n-value. According to the HEC-RAS documentation, this occurs when the slope between any two points inside the channel is steeper than one (1) horizontal to five (5) vertical. There is no way to override this behavior, although HEC-RAS issues a warning message that the n-value in the channel has been composited.

The problem is that the "composited" n-value which HEC-RAS determines is usually unrealistically high. This is especially noticeable when one of the n-values in the channel is significantly higher than the rest. On numerous occasions, for example, in the reach from the Old US-80 Bridge to the confluence with the Gila River, the composited n-values were so high that HEC-RAS reported error messages because it could not balance the energy equation with nearby sections that did not have composited n-values.

Instead of compositing the n-values using an assumption of equivalent conveyance, the equation that HEC-RAS uses to composite the n-values is based on the assumption that each part of the area has the same velocity, which is equal to the mean velocity of the cross section. The formula for the composite n-value that HEC-RAS uses is:

$$n = \frac{\left(P_1 n_1^{1.5} + P_2 n_2^{1.5} + \cdots + P_N n_N^{1.5}\right)^{2/3}}{P^{2/3}}$$

where P is the wetted perimeter and N is the number of n-values to be composited. The compositing formula results in a disproportionately high weight on the higher n-values. For example, for a flat cross section with a channel 1000 feet wide, if 300 feet of the channel has a high n-value of 0.20, and the rest has an n-value of 0.03, the HEC-RAS composite n-value would be:

$$n = \frac{\left(300(0.20)^{1.5} + 700(0.03)^{1.5}\right)^{2/3}}{(1000)^{2/3}} = 0.0976$$

At a 10-foot depth of flow, the conveyance (K) of the composite channel would be:

$$K = \frac{1.486AR^{2/3}}{n} = \frac{1.486(10*1000)(10)^{2/3}}{0.0976} = 706{,}700 \ \text{ft}^{8/3}$$

where A is the cross-sectional area and R is the hydraulic radius. Now, suppose instead that the channel banks were moved so that they encompassed only the $n = 0.03$ portion of the cross-section. In this case, the channel conveyance is:

$$K = \frac{1.486AR^{2/3}}{n} = \frac{1.486(10*700)(10)^{2/3}}{0.03} = 1{,}609{,}400 \ \text{ft}^{8/3}$$

This value is more than twice as high as the "composited" conveyance of the entire channel. This is illogical, since a narrower channel should have less conveyance and not convey twice as much flow as the wider version of the same channel. This illustrates that the composited n-value can be unrealistically high.

What HEC-RAS normally does, unless it activates the "compositing" routine, is to sum to conveyances in each portion of the channel with different n-values. That is, under normal conditions, the conveyance of the channel is sum of the conveyances of the each slice of the channel that has a different n-value.

To overcome the problem of HEC-RAS compositing the n-values, a version of the model was created where multiple n-values in the channel were replaced with a single n-value. That single n-value was calculated so that the resulting section would convey the same discharge as the sum of the discharges of the subdivided areas. The formula to calculate the "equal conveyance" equivalent roughness is (Chow 1959):

$$n = \frac{PR^{5/3}}{\frac{P_1R_1^{5/3}}{n_1} + \frac{P_2R_2^{5/3}}{n_2} + \cdots + \frac{P_NR_N^{5/3}}{n_N}}$$

This formula depends on the depth, since the hydraulic radius of each "slice" of the cross-section and the total hydraulic radius appears in the formula. For simplicity, it was assumed that all parts of the cross-sections were at approximately the same depth and, therefore, that all the hydraulic radii were equal (or equivalently, that the water is deep compared the irregularities of the channel). This reduces the formula to:

$$n = \frac{P}{\frac{P_1}{n_1} + \frac{P_2}{n_2} + \cdots + \frac{P_n}{n_N}}$$

This formula allows the n-value to be calculated independent of depth. The equivalent-conveyance n-value calculated using the assumption of constant hydraulic radius is slightly different from the exact formula for the equivalent conveyance n-value at a particular flow depth. However, a sensitivity analysis was done between the approximate and exact formulas. Except for very shallow flow depths, the differences in n-values were found to be minor, generally in range of 0.001 to 0.003.

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B. HEC-RAS Model Results & Profiles

HEC-RAS Plan: Lower Hass Profile: 100Yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	27.890	100Yr	57854.00	1395.51	1400.30	1399.65	1400.66	0.003755	4.85	11940.68	5631.95	0.59
Main Channel	27.750	100Yr	57854.00	1392.38	1397.78	1396.85	1398.15	0.002821	4.88	11844.27	5111.87	0.53
Main Channel	27.610	100Yr	57854.00	1388.48	1394.38	1394.18	1395.06	0.007584	6.64	8867.67	4863.98	0.83
Main Channel	27.520	100Yr	57854.00	1386.23	1392.48	1391.50	1392.84	0.003115	4.92	12047.11	4857.32	0.54
Main Channel	27.430	100Yr	57854.00	1385.26	1390.81	1389.91	1391.20	0.003190	5.08	11662.32	4739.60	0.55
Main Channel	27.330	100Yr	57854.00	1383.49	1389.23	1388.51	1389.66	0.003865	5.32	10974.59	4529.53	0.59
Main Channel	27.230	100Yr	57854.00	1381.76	1386.78	1386.30	1387.34	0.005541	6.00	9652.04	4249.00	0.70
Main Channel	27.140	100Yr	57854.00	1377.23	1384.06	1383.42	1384.58	0.004709	5.81	9959.22	4044.92	0.65
Main Channel	27.040	100Yr	57854.00	1373.37	1381.25	1380.77	1381.89	0.006325	6.45	8975.06	3897.87	0.75
Main Channel	26.950	100Yr	57854.00	1371.08	1379.17	1378.08	1379.59	0.002900	5.19	11241.90	4002.04	0.53
Main Channel	26.850	100Yr	57854.00	1370.40	1377.23	1376.55	1377.78	0.004438	5.96	9717.33	3893.90	0.66
Main Channel	26.760	100Yr	57854.00	1367.67	1375.10	1374.46	1375.64	0.004490	5.90	9837.21	4190.62	0.66
Main Channel	26.670	100Yr	57854.00	1364.77	1373.28	1372.49	1373.75	0.003623	5.49	10545.36	4055.40	0.60
Main Channel	26.570	100Yr	57854.00	1362.61	1370.94	1370.38	1371.53	0.004858	6.17	9375.53	3753.44	0.69
Main Channel	26.480	100Yr	57854.00	1359.31	1368.45	1367.91	1369.08	0.005181	6.37	9083.67	3620.39	0.71
Main Channel	26.380	100Yr	57854.00	1357.56	1366.48	1365.73	1367.04	0.003822	6.08	9870.33	3689.16	0.62
Main Channel	26.290	100Yr	57854.00	1356.27	1364.34	1363.52	1364.90	0.003480	6.12	9783.11	3404.98	0.62
Main Channel	26.190	100Yr	57854.00	1353.76	1362.23	1361.32	1362.79	0.003460	6.03	9693.65	3335.85	0.60
Main Channel	26.100	100Yr	57854.00	1351.66	1359.81	1359.10	1360.47	0.004358	6.52	8979.46	3237.38	0.67
Main Channel	26.000	100Yr	57854.00	1348.84	1357.24	1356.44	1357.89	0.004424	6.49	9007.51	3168.39	0.65
Main Channel	25.910	100Yr	57854.00	1347.20	1355.10	1354.25	1355.74	0.004619	6.46	9142.52	3504.94	0.66
Main Channel	25.810	100Yr	57854.00	1345.28	1352.93	1352.36	1353.57	0.005453	6.52	9241.00	3916.18	0.69
Main Channel	25.720	100Yr	57854.00	1343.70	1351.39	1350.11	1351.83	0.002869	5.35	10950.38	3638.26	0.52
Main Channel	25.620	100Yr	57854.00	1340.14	1349.43	1348.19	1349.91	0.003208	5.58	10668.74	3526.48	0.53
Main Channel	25.530	100Yr	57854.00	1337.63	1346.92	1345.95	1347.51	0.004161	6.18	9663.33	3460.10	0.60
Main Channel	25.430	100Yr	57854.00	1335.06	1344.95	1344.07	1345.52	0.003947	6.22	9795.62	3315.25	0.59
Main Channel	25.340	100Yr	57854.00	1334.88	1343.38	1342.03	1343.92	0.002910	5.95	10290.25	3363.28	0.52
Main Channel	25.240	100Yr	57854.00	1333.03	1340.51	1340.16	1341.59	0.007713	8.36	6923.87	2921.11	0.84
Main Channel	25.150	100Yr	57854.00	1329.54	1337.04	1336.63	1337.90	0.005460	7.77	8070.08	2872.23	0.76
Main Channel	25.060	100Yr	57230.00	1328.10	1334.32	1333.82	1335.18	0.005405	7.80	7877.22	2615.35	0.76
Main Channel	24.960	100Yr	57230.00	1325.56	1332.44	1331.80	1333.24	0.004151	7.56	8318.05	2704.02	0.70
Main Channel	24.870	100Yr	57230.00	1323.11	1329.89	1329.54	1330.84	0.005230	8.31	7741.30	2658.64	0.78
Main Channel	24.770	100Yr	57230.00	1320.99	1327.53	1326.90	1328.43	0.004245	8.22	8137.73	2701.64	0.74
Main Channel	24.680	100Yr	57230.00	1318.96	1325.67	1324.90	1326.39	0.004050	7.26	8792.19	2809.24	0.67
Main Channel	24.580	100Yr	57230.00	1316.66	1323.53	1322.91	1324.29	0.004273	7.36	8549.23	2756.99	0.68
Main Channel	24.490	100Yr	57230.00	1314.27	1321.23	1320.55	1322.04	0.004927	7.47	8132.01	2596.31	0.71
Main Channel	24.390	100Yr	57230.00	1312.56	1319.63	1318.33	1320.20	0.002784	6.17	9624.39	2578.61	0.54
Main Channel	24.300	100Yr	57230.00	1310.48	1316.92	1316.60	1317.95	0.006914	8.67	7241.72	2455.86	0.83
Main Channel	24.200	100Yr	57230.00	1308.19	1314.55	1313.71	1315.31	0.003908	7.68	8534.24	2498.33	0.67
Main Channel	24.110	100Yr	57230.00	1306.41	1312.28	1311.69	1313.22	0.004186	8.63	7910.33	2326.24	0.74
Main Channel	24.010	100Yr	57230.00	1304.48	1310.54	1309.76	1311.40	0.003214	8.48	8340.94	2310.13	0.73
Main Channel	23.920	100Yr	57230.00	1302.14	1308.65	1308.23	1309.75	0.004210	9.62	7426.58	2121.72	0.83
Main Channel	23.820	100Yr	57230.00	1299.85	1306.97	1306.43	1307.97	0.003874	9.06	7701.39	2247.40	0.79
Main Channel	23.730	100Yr	57230.00	1298.69	1304.40	1304.22	1305.77	0.005443	10.04	6509.46	2014.92	0.92
Main Channel	23.630	100Yr	57230.00	1296.68	1302.16	1301.68	1303.31	0.004082	9.15	7071.60	2068.43	0.81
Main Channel	23.540	100Yr	57230.00	1294.20	1300.88	1299.82	1301.79	0.002537	8.63	8490.47	2263.53	0.69
Main Channel	23.450	100Yr	57230.00	1292.71	1299.30	1298.62	1300.69	0.003855	10.63	7271.90	2277.95	0.85
Main Channel	23.350	100Yr	57230.00	1291.13	1297.39	1297.23	1298.95	0.004747	11.65	6572.88	2195.32	0.94
Main Channel	23.260	100Yr	57230.00	1288.72	1295.01	1294.16	1296.45	0.005221	11.78	6847.81	2130.12	0.94
Main Channel	23.160	100Yr	57230.00	1285.60	1291.81	1291.74	1293.24	0.006504	11.84	6581.12	2080.50	1.06
Main Channel	23.070	100Yr	57230.00	1283.29	1289.30	1288.68	1290.33	0.005008	9.59	7292.56	2187.45	0.91
Main Channel	22.970	100Yr	57230.00	1280.84	1287.68	1286.66	1288.40	0.003255	7.95	8740.94	2370.67	0.72
Main Channel	22.880	100Yr	57230.00	1279.85	1285.59	1285.09	1286.55	0.004360	8.87	7759.84	2515.16	0.85
Main Channel	22.780	100Yr	57230.00	1275.68	1283.80	1283.18	1284.67	0.003668	7.88	7910.61	2512.52	0.75
Main Channel	22.690	100Yr	57230.00	1274.23	1282.42	1281.35	1283.12	0.002510	7.00	8739.92	2367.13	0.63
Main Channel	22.590	100Yr	57230.00	1272.93	1280.72	1280.21	1281.68	0.004316	8.07	7429.85	2315.67	0.78
Main Channel	22.500	100Yr	57230.00	1270.46	1278.43	1277.92	1279.37	0.004399	8.12	7632.88	2407.76	0.76
Main Channel	22.400	100Yr	57230.00	1269.00	1275.62	1275.49	1276.88	0.005773	9.31	6621.62	2227.49	0.90
Main Channel	22.310	100Yr	57230.00	1266.56	1274.55	1273.38	1275.28	0.002079	7.10	8730.51	2233.09	0.59
Main Channel	22.210	100Yr	57230.00	1264.55	1271.47	1271.47	1272.99	0.005451	10.12	6124.54	2099.80	0.95
Main Channel	22.120	100Yr	57230.00	1262.40	1269.79	1268.78	1270.61	0.002452	7.51	8182.85	2116.39	0.64
Main Channel	22.030	100Yr	57230.00	1260.04	1266.81	1266.81	1268.39	0.006621	10.28	5940.02	2014.18	0.97
Main Channel	21.930	100Yr	56604.00	1258.55	1264.30	1263.42	1265.21	0.003021	7.73	7736.83	2196.46	0.67
Main Channel	21.840	100Yr	56604.00	1256.69	1262.99	1262.28	1263.95	0.003656	7.97	7546.64	2376.93	0.71
Main Channel	21.740	100Yr	56604.00	1254.77	1261.19	1260.73	1262.31	0.004744	8.70	7042.96	2188.97	0.80
Main Channel	21.650	100Yr	56604.00	1252.52	1259.18	1258.74	1260.34	0.004615	9.17	7372.34	2492.60	0.82
Main Channel	21.550	100Yr	56604.00	1251.44	1257.71	1257.06	1258.85	0.002993	9.29	8104.67	2461.50	0.74
Main Channel	21.460	100Yr	56604.00	1249.51	1256.23	1255.29	1257.04	0.003826	8.03	8616.56	2281.78	0.67
Main Channel	21.360	100Yr	56604.00	1246.53	1254.60	1253.23	1255.28	0.003134	7.28	9277.02	2327.97	0.55
Main Channel	21.270	100Yr	56604.00	1244.00	1252.62	1251.73	1253.58	0.004207	8.47	7939.07	2134.34	0.64
Main Channel	21.170	100Yr	56604.00	1243.61	1250.91	1249.80	1251.71	0.003243	7.55	8627.81	2317.04	0.58
Main Channel	21.080	100Yr	56604.00	1242.35	1248.69	1247.89	1249.68	0.005002	8.35	7565.49	2071.19	0.67
Main Channel	20.980	100Yr	56604.00	1239.14	1245.67	1245.17	1246.88	0.006078	8.98	6688.48	1873.89	0.78
Main Channel	20.890	100Yr	56604.00	1236.57	1243.32	1242.54	1244.32	0.003936	8.32	7443.99	2503.41	0.70
Main Channel	20.800	100Yr	56604.00	1233.77	1240.63	1240.19	1241.63	0.005980	8.24	7215.11	2748.66	0.80
Main Channel	20.700	100Yr	56604.00	1230.92	1238.10	1237.37	1238.83	0.004774	7.18	8527.15	2995.13	0.66
Main Channel	20.610	100Yr	56604.00	1228.52	1236.21	1235.13	1236.75	0.003687	6.20	10149.46	3019.72	0.57
Main Channel	20.510	100Yr	56604.00	1227.19	1233.50	1233.12	1234.29	0.007262	7.68	8391.78	3183.42	0.75
Main Channel	20.420	100Yr	56604.00	1223.73	1231.50	1230.55	1232.27	0.002612	7.24	9019.76	3029.84	0.61
Main Channel	20.320	100Yr	56604.00	1222.17	1229.80	1229.31	1230.78	0.003366	8.37	8136.10	2929.82	0.70
Main Channel	20.300	100Yr	56604.00	1221.35	1228.13	1227.83	1229.26	0.003519	9.22	7952.43	2650.96	0.75

HEC-RAS Plan: Lower Hass Profile: 100Yr (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	20.230	100Yr	56604.00	1219.01	1227.26	1226.27	1228.14	0.001889	8.63	9829.53	2598.90	0.60
Main Channel	20.140	100Yr	56604.00	1217.45	1226.35	1225.35	1227.06	0.003123	8.04	9837.60	2589.81	0.57
Main Channel	19.940	100Yr	56604.00	1216.34	1224.86	1223.66	1225.51	0.003748	7.35	9569.70	2391.20	0.54
Main Channel	19.850	100Yr	56604.00	1213.25	1223.49	1221.73	1224.06	0.002741	6.69	10091.01	2211.69	0.47
Main Channel	19.750	100Yr	56604.00	1211.90	1221.32	1220.18	1222.27	0.005227	8.40	7597.71	1750.48	0.62
Main Channel	19.660	100Yr	56604.00	1209.32	1217.46	1216.58	1218.57	0.007563	8.68	6814.30	1681.77	0.68
Main Channel	19.560	100Yr	56604.00	1206.48	1216.07	1214.38	1216.74	0.003085	7.01	8991.36	2004.80	0.50
Main Channel	19.470	100Yr	56604.00	1205.43	1213.55	1213.06	1214.62	0.007059	8.84	7037.13	2112.92	0.74
Main Channel	19.380	100Yr	56604.00	1203.67	1211.90	1210.68	1212.56	0.004076	6.89	8924.10	2303.24	0.54
Main Channel	19.280	100Yr	56604.00	1202.50	1209.69	1208.84	1210.41	0.004969	7.19	8617.80	2604.11	0.61
Main Channel	19.190	100Yr	56604.00	1199.69	1206.33	1205.95	1207.32	0.007326	8.40	7393.21	2644.41	0.79
Main Channel	19.090	100Yr	56604.00	1195.97	1204.03	1203.33	1204.77	0.004167	7.25	8701.56	3956.28	0.66
Main Channel	19.000	100Yr	56604.00	1195.51	1202.72	1201.35	1203.25	0.002409	6.00	9946.89	3769.97	0.52
Main Channel	18.900	100Yr	56604.00	1194.59	1200.86	1200.22	1201.63	0.005392	7.42	8496.89	3772.42	0.73
Main Channel	18.810	100Yr	55980.00	1191.45	1198.60	1197.89	1199.34	0.004173	7.16	8334.94	3614.40	0.71
Main Channel	18.710	100Yr	55980.00	1188.58	1195.75	1195.60	1196.76	0.006981	8.21	7115.47	3278.49	0.89
Main Channel	18.620	100Yr	55980.00	1187.76	1193.31	1192.42	1193.98	0.002781	6.71	8869.03	2824.46	0.63
Main Channel	18.520	100Yr	55980.00	1185.03	1192.26	1191.07	1192.93	0.002772	6.57	8638.93	2290.66	0.58
Main Channel	18.430	100Yr	55980.00	1182.28	1189.75	1189.12	1190.85	0.005040	8.58	6781.90	1911.56	0.77
Main Channel	18.330	100Yr	55980.00	1180.12	1187.46	1186.45	1188.39	0.003575	7.90	7439.80	1901.16	0.67
Main Channel	18.240	100Yr	55980.00	1177.35	1185.83	1184.81	1186.69	0.003087	7.65	8065.07	2349.69	0.63
Main Channel	18.140	100Yr	55980.00	1176.43	1183.04	1183.04	1184.48	0.005420	10.04	6364.81	2273.10	0.92
Main Channel	18.050	100Yr	55980.00	1173.93	1181.91	1180.47	1182.63	0.001634	7.30	9615.34	2623.12	0.53
Main Channel	17.950	100Yr	55980.00	1172.25	1180.69	1179.52	1181.40	0.004398	7.64	8736.80	2219.12	0.62
Main Channel	17.860	100Yr	55980.00	1170.37	1178.17	1177.17	1178.95	0.005553	7.99	8291.50	2226.52	0.66
Main Channel	17.770	100Yr	55980.00	1168.26	1175.88	1174.65	1176.60	0.004667	7.57	8616.44	2217.66	0.62
Main Channel	17.670	100Yr	55980.00	1165.43	1173.97	1172.64	1174.54	0.003402	7.13	9699.52	2567.01	0.56
Main Channel	17.580	100Yr	55980.00	1164.70	1171.21	1170.74	1172.22	0.006599	9.99	7633.02	2313.98	0.89
Main Channel	17.480	100Yr	55980.00	1160.67	1168.44	1168.06	1169.39	0.004664	9.64	8516.15	3221.88	0.81
Main Channel	17.390	100Yr	55980.00	1159.03	1166.30	1165.98	1167.25	0.005265	9.76	8433.08	3156.77	0.90
Main Channel	17.290	100Yr	55980.00	1156.84	1164.22	1163.70	1164.99	0.003602	8.77	9761.56	3233.76	0.76
Main Channel	17.200	100Yr	55980.00	1155.61	1162.29	1161.89	1163.14	0.003988	8.73	9403.00	3412.84	0.79
Main Channel	17.100	100Yr	55980.00	1153.56	1160.37	1159.83	1161.24	0.003982	9.05	9457.02	3431.13	0.80
Main Channel	17.010	100Yr	55980.00	1151.51	1157.98	1157.72	1159.02	0.004898	9.63	8666.42	3251.38	0.83
Main Channel	16.910	100Yr	55980.00	1148.87	1155.95	1155.20	1156.82	0.003999	9.06	9333.40	2934.65	0.78
Main Channel	16.820	100Yr	55980.00	1146.45	1154.14	1153.45	1154.95	0.003381	8.51	9405.31	2808.72	0.72
Main Channel	16.720	100Yr	55980.00	1145.31	1152.03	1151.64	1153.14	0.003963	9.57	8357.89	2776.08	0.79
Main Channel	16.630	100Yr	55980.00	1143.31	1149.90	1149.90	1151.35	0.004367	10.74	7618.34	2717.66	0.86
Main Channel	16.530	100Yr	55980.00	1141.73	1148.29	1148.29	1149.71	0.005551	10.81	7561.38	2786.52	0.95
Main Channel	16.440	100Yr	55980.00	1139.63	1146.06	1145.77	1147.11	0.005779	9.34	7921.50	2671.51	0.93
Main Channel	16.350	100Yr	55980.00	1136.86	1144.08	1143.14	1144.75	0.003744	7.36	9252.07	2725.31	0.72
Main Channel	16.250	100Yr	55980.00	1134.96	1142.48	1141.26	1143.13	0.003222	7.43	9719.13	2825.13	0.65
Main Channel	16.160	100Yr	55980.00	1134.10	1140.50	1139.88	1141.43	0.004663	8.70	8173.44	2564.93	0.77
Main Channel	16.060	100Yr	55980.00	1132.06	1138.86	1137.83	1139.62	0.003574	7.65	8621.20	2549.26	0.66
Main Channel	15.970	100Yr	55980.00	1130.05	1136.92	1136.40	1138.01	0.003561	8.57	7282.31	2606.02	0.74
Main Channel	15.870	100Yr	55980.00	1127.94	1134.89	1134.78	1136.32	0.004568	9.96	6340.58	2416.26	0.86
Main Channel	15.780	100Yr	55980.00	1125.94	1133.74	1132.50	1134.55	0.002472	7.88	8371.81	2297.89	0.63
Main Channel	15.680	100Yr	55980.00	1124.44	1131.11	1131.04	1132.73	0.005392	10.60	5840.92	1788.82	0.93
Main Channel	15.590	100Yr	55980.00	1122.02	1130.75	1128.85	1131.36	0.001223	6.70	9700.32	2096.86	0.48
Main Channel	15.490	100Yr	76120.00	1120.29	1129.06	1127.71	1130.43	0.002399	9.79	8855.25	1831.42	0.67
Main Channel	15.400	100Yr	76120.00	1118.56	1128.05	1126.09	1129.27	0.002023	9.33	9531.66	2036.29	0.62
Main Channel	15.300	100Yr	76120.00	1116.87	1125.35	1125.35	1127.68	0.004864	12.58	6767.74	1684.49	0.91
Main Channel	15.210	100Yr	75574.00	1114.92	1123.64	1123.33	1125.39	0.003363	11.70	8258.94	2018.21	0.78
Main Channel	15.110	100Yr	75574.00	1112.01	1122.78	1120.77	1123.93	0.002011	9.50	10128.76	2003.21	0.58
Main Channel	15.020	100Yr	75574.00	1109.51	1120.10	1119.55	1122.37	0.005078	13.52	7313.60	1850.97	0.89
Main Channel	14.920	100Yr	75574.00	1106.87	1119.01	1118.09	1120.34	0.003001	10.71	9400.28	2201.24	0.66
Main Channel	14.830	100Yr	75574.00	1104.69	1117.73	1116.57	1118.99	0.002692	10.32	9735.20	1926.39	0.59
Main Channel	14.730	100Yr	75574.00	1103.87	1115.46	1114.82	1117.26	0.004512	11.39	7889.56	1820.00	0.74
Main Channel	14.640	100Yr	75574.00	1101.85	1112.71	1112.71	1114.75	0.005514	11.98	7396.02	2041.07	0.83
Main Channel	14.550	100Yr	75574.00	1100.51	1110.95	1110.22	1112.09	0.003430	9.35	9839.73	2381.30	0.65
Main Channel	14.450	100Yr	75574.00	1098.14	1108.65	1108.28	1110.06	0.004524	10.99	8992.35	2303.62	0.79
Main Channel	14.360	100Yr	75574.00	1097.18	1106.55	1106.55	1108.13	0.003323	12.19	9729.51	2670.04	0.80
Main Channel	14.270	100Yr	75574.00	1095.24	1103.52	1103.52	1105.07	0.004056	11.11	9121.51	2755.66	0.82
Main Channel	14.170	100Yr	75574.00	1092.59	1101.29	1101.12	1102.71	0.004284	10.74	9131.10	2606.37	0.83
Main Channel	14.080	100Yr	75574.00	1091.33	1099.21	1099.00	1100.48	0.005349	10.05	9139.49	2795.98	0.87
Main Channel	13.980	100Yr	75574.00	1089.10	1096.59	1096.18	1097.77	0.004459	9.33	9416.49	2724.43	0.77
Main Channel	13.890	100Yr	75574.00	1087.23	1094.83	1094.03	1095.70	0.003607	8.13	10564.58	2821.84	0.69
Main Channel	13.790	100Yr	75574.00	1084.33	1092.43	1091.96	1093.57	0.004583	9.12	9305.63	2645.39	0.80
Main Channel	13.700	100Yr	75574.00	1081.72	1090.21	1089.45	1091.08	0.004464	7.89	10474.12	3074.05	0.69
Main Channel	13.610	100Yr	75574.00	1079.31	1088.61	1087.10	1089.23	0.002881	6.56	12145.06	2873.81	0.53
Main Channel	13.510	100Yr	75574.00	1077.51	1085.13	1085.13	1086.66	0.008448	10.36	8006.73	2527.63	0.92
Main Channel	13.420	100Yr	75574.00	1076.54	1083.09	1082.07	1083.88	0.003877	7.30	10729.26	2818.67	0.64
Main Channel	13.320	100Yr	75574.00	1073.84	1081.14	1080.48	1082.06	0.004668	7.81	10009.11	2920.82	0.72
Main Channel	13.230	100Yr	75574.00	1071.15	1079.52	1078.41	1080.25	0.003392	6.95	11104.53	2787.56	0.60
Main Channel	13.130	100Yr	75574.00	1069.45	1077.40	1076.17	1078.19	0.003320	7.22	10645.28	2706.45	0.60
Main Channel	13.040	100Yr	75574.00	1068.17	1075.23	1074.28	1076.33	0.004397	8.43	8979.76	2992.19	0.70
Main Channel	12.940	100Yr	75164.00	1062.83	1072.28	1071.32	1073.66	0.004901	9.44	8036.50	2910.87	0.73
Main Channel	12.850	100Yr	75164.00	1060.78	1071.07	1069.68	1071.82	0.002189	7.53	12095.70	2847.26	0.51
Main Channel	12.750	100Yr	75164.00	1058.21	1068.43	1068.43	1069.96	0.004394	10.72	9081.97	3039.45	0.74
Main Channel	12.660	100Yr	75164.00	1055.88	1065.60	1064.77	1066.68	0.003342	9.27	10042.51	2544.50	0.68
Main Channel	12.560	100Yr	75164.00	1053.00	1062.77	1062.77	1064.53	0.005243	10.97	7789.94	2412.76	0.86

HEC-RAS Plan: Lower Hass Profile: 100Yr (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	12.470	100Yr	75164.00	1049.18	1060.47	1059.20	1061.63	0.002716	8.74	9091.91	2424.40	0.65
Main Channel	12.370	100Yr	75164.00	1044.71	1058.62	1058.10	1059.82	0.004250	9.08	9071.19	2600.56	0.75
Main Channel	12.280	100Yr	75164.00	1044.61	1057.10	1056.16	1057.89	0.003945	7.57	11006.26	2969.17	0.62
Main Channel	12.180	100Yr	75164.00	1044.37	1054.30	1053.99	1055.47	0.006926	9.16	9111.62	2861.40	0.81
Main Channel	12.090	100Yr	75164.00	1041.44	1052.60	1051.19	1053.23	0.002905	6.78	12054.01	2846.19	0.54
Main Channel	12.000	100Yr	75164.00	1041.36	1050.49	1049.51	1051.34	0.004389	7.71	10354.82	2568.92	0.64
Main Channel	11.900	100Yr	75164.00	1039.97	1047.82	1046.91	1048.82	0.005241	8.27	9436.26	2366.51	0.69
Main Channel	11.810	100Yr	75164.00	1036.53	1046.11	1044.53	1046.90	0.003163	7.30	10752.10	2227.25	0.56
Main Channel	11.710	100Yr	75164.00	1035.64	1044.11	1042.92	1045.04	0.004614	7.81	9897.66	2316.99	0.62
Main Channel	11.620	100Yr	75164.00	1033.39	1041.78	1040.95	1042.95	0.005208	8.86	8758.57	2001.98	0.72
Main Channel	11.520	100Yr	75164.00	1031.12	1040.30	1038.69	1041.19	0.002782	7.69	10132.75	2177.69	0.57
Main Channel	11.430	100Yr	75164.00	1029.80	1038.09	1037.37	1039.44	0.004466	9.43	8246.81	1895.13	0.76
Main Channel	11.330	100Yr	75164.00	1028.15	1036.73	1035.15	1037.68	0.002665	8.02	9874.65	1905.29	0.58
Main Channel	11.240	100Yr	75164.00	1026.02	1034.94	1033.70	1036.10	0.003523	8.75	8800.54	1990.61	0.66
Main Channel	11.160	100Yr	75164.00	1024.96	1032.75	1031.93	1034.26	0.004309	9.97	7916.00	1986.34	0.74
Main Channel	11.090	100Yr	75164.00	1021.71	1031.33	1029.71	1032.56	0.003067	8.91	8432.09	1996.28	0.63
Main Channel	11.010	100Yr	75164.00	1020.14	1029.85	1027.98	1031.21	0.002891	9.38	8011.64	1148.34	0.63
Main Channel	11.005		Bridge									
Main Channel	11.000	100Yr	75164.00	1019.95	1029.28	1027.89	1030.86	0.003680	10.10	7443.83	1144.81	0.70
Main Channel	10.990	100Yr	75164.00	1019.75	1029.05	1027.56	1030.60	0.003520	9.97	7538.40	1143.02	0.68
Main Channel	10.985		Bridge									
Main Channel	10.980	100Yr	75164.00	1019.02	1027.40	1027.30	1029.85	0.007550	12.55	5987.61	1140.25	0.97
Main Channel	10.870	100Yr	74970.00	1016.65	1025.57	1023.99	1026.68	0.003562	8.52	9008.32	2129.39	0.62
Main Channel	10.770	100Yr	74970.00	1014.80	1024.18	1022.34	1025.16	0.002624	8.41	10225.14	1947.10	0.56
Main Channel	10.730	100Yr	74970.00	1013.66	1023.47	1021.64	1024.46	0.002020	8.57	10710.69	2139.76	0.55
Main Channel	10.690	100Yr	74970.00	1012.07	1021.22	1021.22	1023.40	0.004484	13.05	7865.48	2060.74	0.89
Main Channel	10.590	100Yr	74970.00	1010.65	1018.99	1018.99	1020.77	0.005134	11.60	8118.39	2216.73	0.84
Main Channel	10.500	100Yr	74970.00	1008.21	1016.60	1016.37	1018.31	0.005040	11.26	8086.05	2372.56	0.85
Main Channel	10.400	100Yr	74970.00	1006.82	1014.46	1013.68	1015.82	0.004892	10.97	9574.10	2328.32	0.81
Main Channel	10.310	100Yr	74970.00	1004.63	1012.60	1010.90	1013.34	0.004530	7.92	11466.09	2384.87	0.59
Main Channel	10.210	100Yr	74970.00	1001.49	1010.69	1008.78	1011.33	0.004345	7.26	12089.64	2438.40	0.54
Main Channel	10.120	100Yr	74970.00	998.79	1008.62	1007.10	1009.34	0.004643	7.78	11983.91	2506.99	0.57
Main Channel	10.020	100Yr	74970.00	996.20	1006.44	1004.77	1007.09	0.003984	7.66	12696.92	2575.79	0.54
Main Channel	9.930	100Yr	74572.00	994.29	1003.79	1002.58	1004.59	0.005450	8.37	11479.81	2743.48	0.65
Main Channel	9.830	100Yr	74572.00	992.44	1001.35	1000.36	1002.19	0.004458	8.87	11688.88	2940.69	0.68
Main Channel	9.740	100Yr	74572.00	990.33	999.30	997.96	1000.13	0.003805	8.13	11270.84	2927.06	0.59
Main Channel	9.640	100Yr	74572.00	987.61	996.45	995.40	997.91	0.004105	9.97	8237.52	2207.45	0.73
Main Channel	9.550	100Yr	74572.00	985.36	995.37	993.13	996.28	0.002172	7.91	10294.63	2869.81	0.53
Main Channel	9.450	100Yr	74572.00	983.19	993.50	992.59	994.70	0.003999	9.28	9213.47	2794.42	0.61
Main Channel	9.360	100Yr	74572.00	981.13	991.79	991.25	993.09	0.003544	10.07	9450.86	3017.67	0.63
Main Channel	9.270	100Yr	74572.00	978.72	989.29	989.29	990.77	0.005033	11.78	9288.24	3026.87	0.75
Main Channel	9.170	100Yr	74572.00	976.12	987.06	986.58	988.03	0.004596	9.28	10321.69	2978.51	0.65
Main Channel	9.080	100Yr	74572.00	974.16	984.93	983.99	985.66	0.004751	7.67	11194.53	3236.32	0.58
Main Channel	8.980	100Yr	74572.00	972.30	982.93	981.68	983.50	0.004030	6.51	12430.62	3308.97	0.49
Main Channel	8.890	100Yr	74572.00	970.31	981.26	980.05	981.83	0.003732	6.78	12958.07	3361.42	0.50
Main Channel	8.790	100Yr	74572.00	968.53	979.42	978.26	979.99	0.003943	6.65	12759.11	3311.83	0.48
Main Channel	8.700	100Yr	74572.00	966.90	977.31	976.21	977.89	0.004394	6.56	12354.96	3248.05	0.48
Main Channel	8.600	100Yr	74572.00	964.95	975.06	973.86	975.66	0.004173	6.66	12320.24	3218.92	0.48
Main Channel	8.510	100Yr	74572.00	963.63	972.68	971.57	973.25	0.005249	6.54	12612.65	3520.59	0.51
Main Channel	8.410	100Yr	74572.00	962.19	970.65	969.30	971.11	0.003608	5.94	14112.82	3772.90	0.46
Main Channel	8.320	100Yr	74572.00	959.80	968.81	967.56	969.35	0.003764	6.58	13281.52	3464.12	0.51
Main Channel	8.220	100Yr	74572.00	958.24	966.43	965.46	967.18	0.004629	8.00	13095.31	3842.21	0.63
Main Channel	8.130	100Yr	74572.00	955.79	964.26	963.30	964.99	0.004209	7.76	13306.70	3728.80	0.62
Main Channel	8.030	100Yr	74572.00	953.54	961.33	960.95	962.25	0.007920	9.05	11623.93	3904.83	0.74
Main Channel	7.940	100Yr	73966.00	951.20	958.95	957.73	959.40	0.003518	6.90	15693.46	4498.18	0.56
Main Channel	7.840	100Yr	73966.00	949.97	956.99	955.93	957.55	0.004339	7.22	14099.77	4084.33	0.60
Main Channel	7.750	100Yr	73966.00	948.21	954.72	953.50	955.27	0.005064	6.91	13492.08	3903.11	0.60
Main Channel	7.660	100Yr	73966.00	945.86	952.29	951.36	952.94	0.005235	8.00	12842.86	3910.65	0.74
Main Channel	7.560	100Yr	73966.00	943.79	950.19	948.85	950.68	0.003242	6.81	14331.79	3895.65	0.59
Main Channel	7.470	100Yr	73966.00	941.70	948.54	947.52	949.19	0.003740	7.20	12702.30	3675.08	0.62
Main Channel	7.370	100Yr	73966.00	939.18	946.45	945.75	947.33	0.004202	8.17	11346.49	3595.69	0.70
Main Channel	7.280	100Yr	73966.00	936.68	944.49	943.64	945.52	0.003296	8.71	10568.43	3781.18	0.70
Main Channel	7.180	100Yr	73966.00	934.47	942.15	941.46	943.46	0.004562	9.62	8624.29	3658.73	0.79
Main Channel	7.090	100Yr	73966.00	931.92	939.68	939.26	941.09	0.004502	10.27	8554.57	3575.01	0.84
Main Channel	6.990	100Yr	73966.00	930.30	937.31	936.63	938.53	0.004704	9.62	8923.96	3491.08	0.80
Main Channel	6.900	100Yr	73966.00	928.41	934.63	934.35	935.83	0.005139	10.69	9492.81	3193.73	0.87
Main Channel	6.800	100Yr	73966.00	926.25	932.91	931.50	933.63	0.003624	6.66	11303.51	3204.70	0.54
Main Channel	6.710	100Yr	73966.00	924.38	930.68	929.51	931.54	0.004534	7.37	10152.88	3283.60	0.65
Main Channel	6.610	100Yr	73966.00	921.79	928.91	928.26	929.87	0.005265	8.89	9673.38	3456.84	0.79
Main Channel	6.520	100Yr	73966.00	920.05	927.16	926.56	928.02	0.004320	8.71	10928.15	3871.48	0.73
Main Channel	6.420	100Yr	73966.00	918.04	924.19	923.54	925.34	0.006524	10.40	9592.07	3542.25	0.94
Main Channel	6.330	100Yr	73966.00	914.65	921.70	920.84	922.52	0.004721	8.50	10587.94	3569.46	0.79
Main Channel	6.230	100Yr	73966.00	912.84	919.50	918.72	920.36	0.004369	8.83	10330.73	3260.40	0.78
Main Channel	6.140	100Yr	73966.00	910.60	917.84	916.99	918.63	0.003688	9.32	11890.89	3832.15	0.72
Main Channel	6.050	100Yr	73966.00	907.40	915.92	915.55	916.94	0.003139	10.63	11728.76	3672.46	0.74
Main Channel	5.950	100Yr	73966.00	905.82	914.77	913.16	915.25	0.003205	5.54	13715.25	4125.87	0.40
Main Channel	5.860	100Yr	73966.00	903.03	912.62	911.99	913.40	0.004329	8.83	11398.51	3966.68	0.63
Main Channel	5.760	100Yr	73966.00	900.88	910.51	909.82	911.32	0.003949	9.23	11743.41	4602.85	0.67
Main Channel	5.670	100Yr	73966.00	898.65	908.29	907.89	909.39	0.003612	11.31	11460.93	3981.16	0.75
Main Channel	5.570	100Yr	73966.00	896.06	906.89	905.36	907.34	0.003535	5.60	14223.84	4006.28	0.45
Main Channel	5.480	100Yr	73966.00	893.97	905.13	903.39	905.55	0.003589	5.63	14856.19	4289.90	0.44

HEC-RAS Plan: Lower Hass Profile: 100Yr (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	5.380	100Yr	73966.00	891.61	903.46	901.59	903.87	0.003164	5.56	15154.48	4174.52	0.42
Main Channel	5.290	100Yr	73966.00	890.69	901.69	900.10	902.14	0.003549	5.90	14459.36	4134.50	0.46
Main Channel	5.190	100Yr	73966.00	888.90	899.70	898.25	900.22	0.004354	6.57	13489.63	3961.67	0.51
Main Channel	5.100	100Yr	73966.00	887.81	897.56	896.33	898.03	0.004747	6.03	14103.08	4284.09	0.49
Main Channel	6.000	100Yr	73966.00	886.08	895.11	894.00	895.65	0.004880	6.81	13464.59	4263.41	0.54
Main Channel	4.910	100Yr	73500.00	883.90	892.52	891.76	893.29	0.004877	8.03	11278.99	3803.53	0.69
Main Channel	4.820	100Yr	73500.00	881.62	890.32	889.42	891.02	0.004178	8.09	11866.15	3938.47	0.69
Main Channel	4.720	100Yr	73500.00	879.83	888.67	887.87	889.28	0.002718	7.69	13932.25	4398.94	0.61
Main Channel	4.630	100Yr	73500.00	877.37	885.91	885.65	887.06	0.005599	10.38	10706.28	4371.63	0.82
Main Channel	4.530	100Yr	73500.00	875.48	883.61	882.81	884.33	0.004644	7.55	12322.64	4567.87	0.61
Main Channel	4.440	100Yr	73500.00	873.06	881.62	879.91	882.23	0.003288	6.73	12875.68	4263.12	0.51
Main Channel	4.340	100Yr	73500.00	870.85	879.95	878.46	880.52	0.003532	6.52	13208.55	4102.43	0.50
Main Channel	4.250	100Yr	73500.00	867.33	878.08	875.73	878.51	0.002923	5.63	14607.23	3722.60	0.42
Main Channel	4.150	100Yr	73500.00	865.17	876.86	873.28	877.31	0.001934	5.45	13772.11	3731.63	0.36
Main Channel	4.090	100Yr	73500.00	863.35	875.06	873.08	876.28	0.002983	9.04	8655.41	3601.33	0.60
Main Channel	4.010	100Yr	73500.00	861.59	873.16	871.21	874.82	0.002651	10.34	7111.36	912.74	0.65
Main Channel	4.005		Bridge									
Main Channel	4.000	100Yr	73500.00	861.22	871.79	871.08	874.13	0.004372	12.28	5983.36	909.41	0.84
Main Channel	3.910	100Yr	73500.00	859.29	869.59	868.72	871.69	0.004247	12.22	6817.64	1545.21	0.81
Main Channel	3.85		Lat Struct									
Main Channel	3.810	100Yr	71897.62	857.31	867.95	866.62	869.65	0.002814	11.31	7836.08	1269.95	0.72
Main Channel	3.75		Lat Struct									
Main Channel	3.720	100Yr	68040.22	855.37	866.74	865.21	868.29	0.002153	10.48	7880.51	1277.84	0.64
Main Channel	3.70		Lat Struct									
Main Channel	3.630	100Yr	64937.29	853.57	864.75	864.07	866.79	0.003162	11.75	6457.05	1336.85	0.76
Main Channel	3.60		Lat Struct									
Main Channel	3.530	100Yr	65863.79	852.36	863.66	862.45	865.42	0.002249	11.30	7537.35	1539.81	0.68
Main Channel	3.50		Lat Struct									
Main Channel	3.440	100Yr	65863.79	849.42	861.34	861.29	863.57	0.006074	12.89	6347.63	1819.05	0.89
Main Channel	3.40		Lat Struct									
Main Channel	3.340	100Yr	59514.82	845.25	861.52	857.27	862.10	0.000935	6.54	11009.82	1567.12	0.37
Main Channel	3.30		Lat Struct									
Main Channel	3.250	100Yr	59175.27	842.77	860.97	856.44	861.55	0.001294	6.41	10099.33	1598.16	0.35
Main Channel	3.20		Lat Struct									
Main Channel	3.150	100Yr	59175.27	840.41	860.34	855.82	860.82	0.001398	5.80	10965.95	1485.58	0.32
Main Channel	3.10		Lat Struct									
Main Channel	3.060	100Yr	58870.43	838.28	859.46	854.92	860.13	0.001290	6.89	9317.17	1258.26	0.37
Main Channel	3.00		Lat Struct									
Main Channel	2.960	100Yr	58780.86	836.22	858.80	853.24	859.44	0.001458	6.64	9273.35	1255.33	0.33
Main Channel	2.90		Lat Struct									
Main Channel	2.870	100Yr	58780.73	833.13	857.22	851.58	858.46	0.001799	8.98	6629.26	1554.35	0.43
Main Channel	2.80		Lat Struct									
Main Channel	2.780	100Yr	58696.66	831.54	854.77	850.49	857.02	0.002862	12.06	4909.20	1743.33	0.59
Main Channel	2.720	100Yr	58696.66	830.41	850.15	849.46	854.96	0.007327	17.65	3352.96	1258.84	0.90
Main Channel	2.670	100Yr	58696.66	829.22	849.84	846.20	852.56	0.003122	13.24	4433.86	1533.20	0.65
Main Channel	2.65		Bridge									
Main Channel	2.630	100Yr	58696.66	829.15	847.18	845.49	850.96	0.004065	15.60	3762.76	1484.80	0.83
Main Channel	2.61		Lat Struct									
Main Channel	2.570	100Yr	57564.26	827.77	846.08	844.09	849.47	0.004368	14.96	3980.99	371.60	0.73
Main Channel	2.55		Lat Struct									
Main Channel	2.54		Lat Struct									
Main Channel	2.480	100Yr	56221.77	825.42	843.37	842.04	847.08	0.005213	15.64	3708.22	363.09	0.79
Main Channel	2.45		Lat Struct									
Main Channel	2.44		Lat Struct									
Main Channel	2.380	100Yr	55224.37	821.43	841.80	839.22	844.72	0.003356	13.77	4096.22	387.80	0.69
Main Channel	2.35		Lat Struct									
Main Channel	2.34		Lat Struct									
Main Channel	2.290	100Yr	51920.36	819.69	840.44	837.55	843.05	0.003034	12.99	4020.16	354.63	0.67
Main Channel	2.25		Lat Struct									
Main Channel	2.24		Lat Struct									
Main Channel	2.190	100Yr	47451.32	817.76	838.46	836.06	841.45	0.003158	13.89	3449.98	313.44	0.71
Main Channel	2.15		Lat Struct									
Main Channel	2.14		Lat Struct									
Main Channel	2.100	100Yr	45594.41	815.28	836.87	834.39	839.81	0.003386	13.88	3374.87	317.31	0.69
Main Channel	2.05		Lat Struct									
Main Channel	2.04		Lat Struct									
Main Channel	2.000	100Yr	44027.05	813.10	835.23	832.35	837.96	0.003772	13.32	3380.84	325.26	0.67
Main Channel	1.95		Lat Struct									
Main Channel	1.94		Lat Struct									
Main Channel	1.910	100Yr	42603.86	810.97	832.74	830.71	835.76	0.005149	13.97	3070.44	304.74	0.75
Main Channel	1.85		Lat Struct									
Main Channel	1.84		Lat Struct									
Main Channel	1.810	100Yr	41139.81	808.26	830.98	828.41	833.37	0.003930	12.43	3366.32	351.29	0.67
Main Channel	1.77		Lat Struct									
Main Channel	1.76		Lat Struct									
Main Channel	1.720	100Yr	40274.33	805.84	828.85	826.09	831.20	0.004819	12.29	3288.28	351.49	0.67
Main Channel	1.69		Lat Struct									
Main Channel	1.68		Lat Struct									
Main Channel	1.650	100Yr	40274.33	804.84	827.21	824.00	829.25	0.006063	11.46	3523.91	351.71	0.62
Main Channel	1.63		Lat Struct									
Main Channel	1.62		Lat Struct									

HEC-RAS Plan: Lower Hass Profile: 100Yr (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main Channel	1.580	100Yr	40027.73	806.30	826.46	821.64	827.85	0.002062	9.47	4263.19	394.22	0.48
Main Channel	1.55		Lat Struct									
Main Channel	1.54		Lat Struct									
Main Channel	1.490	100Yr	38814.31	798.74	825.13	819.87	826.63	0.002812	9.89	3975.98	355.38	0.49
Main Channel	1.45		Lat Struct									
Main Channel	1.44		Lat Struct									
Main Channel	1.390	100Yr	38814.31	797.46	822.83	818.45	824.85	0.004447	11.41	3408.14	289.48	0.58
Main Channel	1.35		Lat Struct									
Main Channel	1.34		Lat Struct									
Main Channel	1.300	100Yr	38292.30	796.51	820.98	815.51	822.42	0.004309	9.65	4027.82	372.03	0.48
Main Channel	1.26		Lat Struct									
Main Channel	1.25		Lat Struct									
Main Channel	1.200	100Yr	36889.20	795.56	818.65	813.49	820.03	0.005105	9.44	3930.79	376.87	0.49
Main Channel	1.16		Lat Struct									
Main Channel	1.15		Lat Struct									
Main Channel	1.110	100Yr	36795.61	795.28	815.80	811.16	817.43	0.005336	10.27	3582.81	319.52	0.54
Main Channel	1.06		Lat Struct									
Main Channel	1.05		Lat Struct									
Main Channel	1.010	100Yr	38430.79	795.62	813.72	810.70	815.72	0.003352	11.38	3390.92	327.39	0.62
Main Channel	0.95		Lat Struct									
Main Channel	0.920	100Yr	35559.14	790.24	811.99	805.87	813.62	0.004469	10.25	3470.29	257.48	0.49
Main Channel	0.820	100Yr	35559.14	787.57	808.39	802.54	809.85	0.009263	9.68	3672.78	288.59	0.48
Main Channel	0.730	100Yr	35559.14	786.23	803.94	798.19	804.86	0.005666	7.66	4642.16	406.87	0.40
Main Channel	0.630	100Yr	35559.14	786.20	801.23	796.97	802.36	0.004331	8.54	4165.57	401.43	0.47
Main Channel	0.540	100Yr	35559.14	782.40	801.23	791.62	801.42	0.000612	3.54	10547.84	1085.59	0.17
Main Channel	0.440	100Yr	35559.14	785.92	801.04	790.05	801.10	0.000502	2.05	17516.90	1256.03	0.10
Main Channel	0.350	100Yr	35559.14	780.93	800.81	786.10	800.84	0.000508	1.31	27475.90	1605.77	0.06
Right Bank	2.570	100Yr	1.00	837.95	841.63	838.35	841.63	0.000000	0.00	518.24	520.22	0.00
Right Bank	2.460	100Yr	2475.90	836.85	839.98	839.54	840.23	0.015627	4.02	615.49	807.63	0.59
Right Bank	2.380	100Yr	3246.57	833.76	838.28	836.86	838.36	0.001956	2.32	1396.90	951.06	0.27
Right Bank	2.290	100Yr	6356.09	830.83	837.19	835.52	837.29	0.002272	2.59	2455.99	1520.31	0.27
Right Bank	2.190	100Yr	10825.12	829.68	835.10	834.08	835.31	0.005512	3.67	2948.78	2120.33	0.42
Right Bank	2.100	100Yr	12682.04	827.95	833.29	831.62	833.40	0.002817	2.63	4823.87	2249.41	0.28
Right Bank	2.000	100Yr	14249.39	826.53	832.03	830.33	832.13	0.002697	2.50	5703.50	2840.35	0.27
Right Bank	1.910	100Yr	15672.58	825.84	830.44	828.85	830.56	0.004479	2.82	5564.36	2865.76	0.33
Right Bank	1.810	100Yr	16575.33	822.99	829.00	827.23	829.10	0.002619	2.52	6584.81	3618.19	0.27
Right Bank	1.720	100Yr	16834.38	821.22	826.13	825.58	826.43	0.014732	4.43	3801.52	3480.62	0.58
Right Bank	1.650	100Yr	16834.38	819.09	822.34	821.21	822.50	0.005421	3.16	5334.48	2776.46	0.37
Right Bank	1.580	100Yr	17080.46	816.23	820.89	819.24	821.00	0.002740	2.62	6513.71	2571.35	0.28
Right Bank	1.490	100Yr	17080.46	814.41	819.05	818.01	819.21	0.006320	3.31	5165.72	2496.22	0.39
Right Bank	1.390	100Yr	17080.46	811.64	815.80	814.86	815.98	0.007432	3.37	5073.42	2678.08	0.42
Right Bank	1.300	100Yr	17549.74	809.40	813.68	812.49	813.81	0.004467	2.87	6112.90	2908.19	0.34
Right Bank	1.200	100Yr	18587.69	806.40	811.69	810.88	811.87	0.007981	3.40	5466.58	3247.82	0.43
Right Bank	1.110	100Yr	18754.58	803.08	810.22	808.39	810.31	0.002172	2.33	8032.37	3944.72	0.25
Right Bank	1.010	100Yr	18754.58	802.84	809.60	807.07	809.66	0.001494	2.04	9200.69	5482.08	0.21
Right Bank	0.920	100Yr	18754.58	799.24	808.92	805.99	808.99	0.002241	2.14	8756.68	4922.83	0.23
Right Bank	0.820	100Yr	18754.58	799.14	807.72	806.28	807.84	0.006349	2.79	6710.62	4943.90	0.35
Right Bank	0.730	100Yr	18754.58	795.38	806.36	803.42	806.42	0.002074	2.04	9206.01	6185.86	0.21
Right Bank	0.630	100Yr	18754.58	796.50	805.17	803.47	805.29	0.003950	2.80	6692.75	5930.46	0.29
Right Bank	0.590	100Yr	18754.58	794.71	803.05	800.79	803.19	0.004649	3.00	6244.66	5190.25	0.31
Right Bank	0.570	100Yr	18754.58	793.15	800.57	798.73	800.76	0.006107	3.54	5303.77	2308.41	0.36
Right Bank	0.550	100Yr	18754.58	783.62	798.34	796.76	798.48	0.005173	2.96	6335.26	4104.64	0.31
Right Bank	0.540	100Yr	18754.58	782.97	796.97	794.88	797.06	0.003894	2.37	7900.71	4984.40	0.25
Right Bank	0.440	100Yr	18754.58	779.46	795.83	793.85	795.89	0.003833	2.08	9032.71	6904.64	0.22
Right Bank	0.350	100Yr	18754.58	780.43	795.74	784.84	795.74	0.000108	0.52	36226.30	7966.60	0.03
Left Bank	3.910	100Yr	1.00	857.81	865.39	857.91	865.39	0.000000	0.00	3966.13	943.24	0.00
Left Bank	3.810	100Yr	1603.38	859.42	865.36	862.54	865.37	0.000423	1.13	1420.91	798.49	0.12
Left Bank	3.720	100Yr	5460.79	855.85	865.00	861.71	865.05	0.000761	1.67	3270.95	2303.06	0.15
Left Bank	3.630	100Yr	8563.72	854.74	864.51	860.62	864.60	0.001245	2.30	3716.35	2791.53	0.20
Left Bank	3.530	100Yr	7637.21	855.55	862.48	862.48	863.14	0.045258	6.48	1178.30	1298.10	0.99
Left Bank	3.440	100Yr	7637.21	850.81	860.43	858.03	860.49	0.001294	2.06	3714.03	2394.95	0.19
Left Bank	3.340	100Yr	13986.18	854.72	858.57	857.39	858.84	0.007121	4.13	3384.73	2008.99	0.44
Left Bank	3.250	100Yr	14325.73	852.29	856.15	854.51	856.30	0.003471	3.12	4597.54	2187.31	0.31
Left Bank	3.150	100Yr	14325.73	850.36	854.19	852.86	854.33	0.004269	3.01	4761.36	3635.21	0.33
Left Bank	3.060	100Yr	14630.57	848.23	852.31	850.62	852.43	0.003644	2.70	5409.69	3283.47	0.31
Left Bank	2.960	100Yr	14720.14	847.38	850.92	849.41	851.01	0.002630	2.41	6116.53	3075.38	0.27
Left Bank	2.870	100Yr	14720.28	843.63	849.04	848.08	849.18	0.005869	3.06	4811.05	3498.12	0.38
Left Bank	2.780	100Yr	14804.34	842.81	847.02	845.23	847.10	0.002294	2.31	6409.48	3543.29	0.25
Left Bank	2.720	100Yr	14804.34	840.98	845.50	843.74	845.61	0.003579	2.60	5685.06	3469.53	0.30
Left Bank	2.700	100Yr	14804.34	839.94	844.51	842.35	844.57	0.001397	1.97	7518.47	3431.70	0.20
Left Bank	2.690	100Yr	14804.34	840.30	844.01	842.35	844.09	0.002646	2.30	6425.74	3781.60	0.26
Left Bank	2.680	100Yr	14804.34	839.49	843.56	842.02	843.64	0.003049	2.32	6379.37	4117.68	0.27
Left Bank	2.670	100Yr	14804.34	838.76	843.07	841.66	843.16	0.003189	2.33	6355.24	4194.21	0.28
Left Bank	2.660	100Yr	14804.34	836.92	841.58	841.58	842.06	0.049804	5.56	2663.86	3159.79	0.99
Left Bank	2.570	100Yr	14804.34	835.46	839.28	837.56	839.35	0.002016	2.06	7175.18	4224.80	0.23
Left Bank	2.480	100Yr	14804.34	835.02	838.54	837.18	838.61	0.002582	2.15	6875.40	4069.48	0.26
Left Bank	2.380	100Yr	15031.06	833.89	837.64	836.60	837.72	0.004061	2.35	6386.70	3952.34	0.31
Left Bank	2.290	100Yr	15225.56	832.18	836.31	834.98	836.37	0.002671	2.04	7481.23	3823.38	0.26
Left Bank	2.190	100Yr	15225.56	830.32	834.67	833.56	834.76	0.003896	2.32	6557.82	3649.54	0.31
Left Bank	2.100	100Yr	15225.56	828.45	833.48	832.32	833.57	0.004014	2.41	6319.66	3402.19	0.31
Left Bank	2.000	100Yr	15225.56	826.79	831.65	830.22	831.75	0.003923	2.51	6059.05	3148.77	0.31

HEC-RAS Plan: Lower Hass Profile: 100Yr (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Left Bank	1.910	100Yr	15225.56	825.69	829.97	828.47	830.09	0.004330	2.74	5564.56	3110.35	0.33
Left Bank	1.810	100Yr	15786.86	823.22	828.39	826.97	828.50	0.003154	2.61	6038.65	2811.40	0.29
Left Bank	1.720	100Yr	16393.29	821.48	826.43	824.95	826.54	0.003376	2.69	6097.48	3412.43	0.30
Left Bank	1.650	100Yr	16393.29	820.66	825.38	823.94	825.49	0.003482	2.71	6052.34	3700.99	0.30
Left Bank	1.580	100Yr	16393.80	819.59	823.86	822.19	823.97	0.003234	2.64	6213.29	3837.14	0.29
Left Bank	1.490	100Yr	17607.23	816.53	822.13	820.48	822.26	0.003555	2.82	6249.25	3199.38	0.31
Left Bank	1.390	100Yr	17607.23	815.75	820.01	818.26	820.17	0.004627	3.16	5578.84	3144.77	0.35
Left Bank	1.300	100Yr	17659.96	812.36	818.51	816.10	818.62	0.001992	2.62	6742.51	4001.29	0.24
Left Bank	1.200	100Yr	18025.11	811.34	817.24	814.60	817.38	0.002094	2.95	6120.13	5411.44	0.25
Left Bank	1.110	100Yr	17951.81	807.91	814.82	813.72	815.27	0.010155	5.38	3334.85	5637.75	0.53
Left Bank	1.070	100Yr	16316.63	801.28	807.43	807.26	809.58	0.031481	11.76	1387.07	1388.27	0.99
Left Bank	1.030	100Yr	16316.63	801.10	806.70	803.76	806.80	0.001433	2.56	6362.92	3077.93	0.21
Left Bank	1.010	100Yr	16316.63	798.36	805.62	802.31	805.69	0.001537	2.04	8016.45	6940.49	0.19
Left Bank	0.920	100Yr	19188.28	795.10	805.55	797.57	805.56	0.000141	0.85	22476.82	9078.64	0.05
Left Bank	0.820	100Yr	19188.28	795.60	805.43	800.78	805.45	0.001258	1.25	15383.70	10314.69	0.10
Left Bank	0.730	100Yr	19188.28	793.72	804.64	799.02	804.66	0.002421	1.07	17926.48	10076.20	0.09
Left Bank	0.630	100Yr	19188.28	792.87	804.03	796.34	804.04	0.001056	0.81	23570.00	10391.66	0.06
Left Bank	0.540	100Yr	19188.28	792.16	803.76	795.46	803.76	0.000260	0.60	32212.47	10988.45	0.04
Left Bank	0.500	100Yr	19188.28	790.32	803.57	793.94	803.57	0.000158	0.39	49079.34	12185.41	0.02

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	27.890	100Yr	1400.30		1400.66	5631.95		57594.41	259.59		9911.86	15493.53	
Main Channel	27.890	PF 2	1400.30	0.01	1400.67	5581.67		57854.00		9911.86	9911.86	15493.53	15493.53
Main Channel	27.750	100Yr	1397.78		1398.15	4455.04		57854.00			9865.32	14330.67	
Main Channel	27.750	PF 2	1397.77	-0.01	1398.15	4454.96		57854.00		9865.32	9865.32	14330.67	14543.74
Main Channel	27.610	100Yr	1394.38		1395.06	4863.98		57405.66	448.34		9961.85	14331.72	
Main Channel	27.610	PF 2	1394.42	0.04	1395.09	4303.52		57854.00		9961.85	9961.85	14331.72	14331.72
Main Channel	27.520	100Yr	1392.48		1392.84	4857.32		55975.20	1878.80		9947.48	14301.59	
Main Channel	27.520	PF 2	1392.52	0.04	1392.90	4354.11		57854.00		9947.48	9947.48	14301.59	14301.59
Main Channel	27.430	100Yr	1390.81		1391.20	4739.60		56871.02	982.98		9773.86	13915.24	
Main Channel	27.430	PF 2	1390.83	0.02	1391.23	4276.59		57608.83	245.17	9773.86	9773.86	13915.24	14050.45
Main Channel	27.330	100Yr	1389.23		1389.66	4529.53	49.55	57364.62	439.82		9556.00	13856.87	
Main Channel	27.330	PF 2	1389.23	0.01	1389.68	4300.87		57854.00		9556.00	9556.00	13856.87	13856.87
Main Channel	27.230	100Yr	1386.78		1387.34	4249.00		57827.38	26.62		9545.28	13755.15	
Main Channel	27.230	PF 2	1386.78	0.00	1387.34	4209.87		57854.00		9545.28	9545.28	13755.15	13755.15
Main Channel	27.140	100Yr	1384.06		1384.58	4044.92	3.77	57850.23			9566.53	13607.27	
Main Channel	27.140	PF 2	1384.05	0.00	1384.58	4040.51		57854.00		9566.53	9566.53	13607.27	13607.27
Main Channel	27.040	100Yr	1381.25		1381.89	3897.87	0.00	57853.61	0.39		9463.48	13407.57	
Main Channel	27.040	PF 2	1381.25	0.01	1381.89	3890.40		57854.00		9463.48	9463.48	13407.57	13407.57
Main Channel	26.950	100Yr	1379.17		1379.59	4002.04		57657.23	196.77		9626.69	13333.41	
Main Channel	26.950	PF 2	1379.17	0.00	1379.59	3706.72		57854.00		9626.69	9626.69	13333.41	13333.41
Main Channel	26.850	100Yr	1377.23		1377.78	3846.32		57836.95	17.06		9857.84	13656.97	
Main Channel	26.850	PF 2	1377.23	0.00	1377.79	3799.13		57854.00		9857.84	9857.84	13656.97	13656.97
Main Channel	26.760	100Yr	1375.10		1375.64	4190.62		57819.13	34.87		9953.70	13880.33	
Main Channel	26.760	PF 2	1375.10	0.00	1375.64	3925.44		57854.00		9953.70	9953.70	13880.33	13880.33
Main Channel	26.670	100Yr	1373.28		1373.75	4055.40		57825.93	28.07		9925.78	13922.82	
Main Channel	26.670	PF 2	1373.28	0.00	1373.75	3997.04		57854.00		9925.78	9925.78	13922.82	13922.82
Main Channel	26.570	100Yr	1370.94		1371.53	3753.44	0.99	57846.38	6.63		9784.88	13510.46	
Main Channel	26.570	PF 2	1370.93	-0.01	1371.52	3750.85		57847.60	6.40	9784.88	9784.88	13510.46	13710.02
Main Channel	26.480	100Yr	1368.45		1369.08	3620.39	0.58	57853.36	0.07		9722.98	13342.60	
Main Channel	26.480	PF 2	1368.48	0.03	1369.09	3619.62		57854.00		9722.98	9722.98	13342.60	13342.60
Main Channel	26.380	100Yr	1366.48		1367.04	3689.16	21.56	55676.05	2156.39		9540.28	12655.71	
Main Channel	26.380	PF 2	1366.59	0.10	1367.15	3244.72		57179.03	674.97	9540.28	9540.28	12655.71	12785.00
Main Channel	26.290	100Yr	1364.34		1364.90	3404.98	34.03	54340.05	3479.92		9200.85	12125.74	
Main Channel	26.290	PF 2	1364.38	0.04	1365.00	3010.15		56933.46	920.54	9200.85	9200.85	12125.74	12211.00
Main Channel	26.190	100Yr	1362.23		1362.79	3335.85	163.59	57677.46	12.95		8681.23	11752.89	
Main Channel	26.190	PF 2	1362.24	0.01	1362.80	3058.92		57854.00		8681.23	8681.23	11752.89	11752.89
Main Channel	26.100	100Yr	1359.81		1360.47	3237.38	214.42	57535.07	104.52		8226.33	11244.47	
Main Channel	26.100	PF 2	1359.82	0.01	1360.49	2976.46		57854.00		8226.33	8226.33	11244.47	11244.47
Main Channel	26.000	100Yr	1357.24		1357.89	3168.39	154.57	57618.32	81.10		7899.72	11008.67	
Main Channel	26.000	PF 2	1357.25	0.01	1357.91	2912.91		57854.00		7899.72	7899.72	11008.67	11008.67
Main Channel	25.910	100Yr	1355.10		1355.74	3504.94	375.43	57348.94	129.63		7809.20	10915.93	
Main Channel	25.910	PF 2	1355.17	0.07	1355.80	3053.50		57854.00		7809.20	7809.20	10915.93	10915.93
Main Channel	25.810	100Yr	1352.93		1353.57	3916.18	561.97	56157.41	1134.62		7632.14	10770.18	
Main Channel	25.810	PF 2	1352.94	0.00	1353.63	3136.52		57854.00		7632.14	7632.14	10770.18	10770.18
Main Channel	25.720	100Yr	1351.39		1351.83	3638.26	218.31	57596.20	39.49		7515.25	10772.48	
Main Channel	25.720	PF 2	1351.43	0.05	1351.87	3257.23		57854.00		7515.25	7515.25	10772.48	10772.48
Main Channel	25.620	100Yr	1349.43		1349.91	3526.48	991.99	56616.63	245.39		7528.29	10524.94	
Main Channel	25.620	PF 2	1349.45	0.02	1349.95	2996.65		57854.00		7528.29	7528.29	10524.94	10524.94
Main Channel	25.530	100Yr	1346.92		1347.51	3460.10	1043.18	56789.62	21.20		8074.78	10908.87	
Main Channel	25.530	PF 2	1347.06	0.14	1347.63	2834.09		57854.00		8074.78	8074.78	10908.87	10908.87
Main Channel	25.430	100Yr	1344.95		1345.52	3315.25	3904.50	53929.57	19.93		8435.03	10974.23	
Main Channel	25.430	PF 2	1345.04	0.09	1345.69	2539.20		57854.00		8435.03	8435.03	10974.23	10974.23
Main Channel	25.340	100Yr	1343.38		1343.92	3363.28	1688.06	56040.02	125.92		8665.81	11010.33	
Main Channel	25.340	PF 2	1343.35	-0.03	1343.95	2344.52		57854.00		8665.81	8665.81	11010.33	11010.33
Main Channel	25.240	100Yr	1340.51		1341.59	2266.30		57835.77	18.24		8532.83	10850.42	
Main Channel	25.240	PF 2	1340.65	0.14	1341.64	2254.54		57854.00		8532.83	8532.83	10850.42	10850.42
Main Channel	25.150	100Yr	1337.04		1337.80	2872.23	7006.09	49844.66	1003.26		8346.71	10318.90	
Main Channel	25.150	PF 2	1337.48	0.45	1338.46	1972.19		57854.00		8346.71	8346.71	10318.90	10318.90

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	25.060	100Yr	1334.32		1335.18	2615.35	5087.11	46872.93	5269.95		8317.52	10140.03	
Main Channel	25.060	PF 2	1334.67	0.35	1335.82	1822.61		57230.00		8317.52	8317.52	10140.03	10140.03
Main Channel	24.960	100Yr	1332.44		1333.24	2704.02	5042.04	48655.75	3532.21		8412.81	10175.39	
Main Channel	24.960	PF 2	1332.93	0.49	1333.89	1762.58		57230.00		8412.81	8412.81	10175.39	10175.39
Main Channel	24.870	100Yr	1329.89		1330.84	2658.64	7213.09	47689.68	2327.23		8464.65	10086.91	
Main Channel	24.870	PF 2	1330.28	0.40	1331.53	1622.26		57230.00		8464.65	8464.65	10086.91	10086.91
Main Channel	24.770	100Yr	1327.53		1328.43	2701.64	10663.00	45847.00	720.00		8645.12	10085.96	
Main Channel	24.770	PF 2	1328.07	0.53	1329.16	1605.96	3060.43	54169.57		8480.00	8645.12	10085.96	10085.96
Main Channel	24.680	100Yr	1325.67		1326.39	2809.24	12192.68	45037.32			8456.60	10143.58	
Main Channel	24.680	PF 2	1326.14	0.47	1327.18	1686.98		57230.00		8456.60	8456.60	10143.58	10143.58
Main Channel	24.580	100Yr	1323.53		1324.29	2756.99	9871.83	47336.79	21.38		8320.76	10104.97	
Main Channel	24.580	PF 2	1323.96	0.43	1324.94	1784.21		57230.00		8320.76	8320.76	10104.97	10104.97
Main Channel	24.490	100Yr	1321.23		1322.04	2596.31	8660.39	48556.34	13.27		8258.41	10128.23	
Main Channel	24.490	PF 2	1321.48	0.25	1322.53	1920.23	35.94	57194.06		8208.00	8258.41	10128.23	10128.23
Main Channel	24.390	100Yr	1319.63		1320.20	2578.61	5219.89	51834.61	175.50		8090.66	10191.95	
Main Channel	24.390	PF 2	1320.07	0.44	1320.66	2101.29		57230.00		8090.66	8090.66	10191.95	10191.95
Main Channel	24.300	100Yr	1316.92		1317.95	2455.86	13366.83	43334.90	528.27		8866.41	10351.85	
Main Channel	24.300	PF 2	1317.31	0.39	1318.56	1858.85	5740.62	51489.38		8493.00	8866.41	10351.85	10351.85
Main Channel	24.200	100Yr	1314.55		1315.31	2498.33	16216.39	40020.48	993.13		9155.11	10421.57	
Main Channel	24.200	PF 2	1314.98	0.44	1315.95	1712.11	10063.54	47166.46		8709.46	9155.11	10421.57	10421.57
Main Channel	24.110	100Yr	1312.28		1313.22	2326.24	16805.96	39558.50	865.55		9457.34	10547.02	
Main Channel	24.110	PF 2	1313.20	0.92	1314.18	1559.46	10592.89	46637.11		8987.56	9457.34	10547.02	10547.02
Main Channel	24.010	100Yr	1310.54		1311.40	2310.13	19772.69	36050.28	1407.03		9717.81	10721.94	
Main Channel	24.010	PF 2	1311.44	0.90	1312.65	1435.22	9236.02	47993.98		9286.72	9717.81	10721.94	10721.94
Main Channel	23.920	100Yr	1308.65		1309.75	2121.72	18163.59	36425.35	2641.07		9950.45	10856.28	
Main Channel	23.920	PF 2	1309.50	0.84	1311.06	1292.22	8401.55	48156.95	671.50	9590.55	9950.45	10856.28	10882.77
Main Channel	23.820	100Yr	1306.97		1307.97	2247.40	18512.53	38073.31	644.16		9944.45	10977.11	
Main Channel	23.820	PF 2	1307.61	0.64	1309.23	1284.91	5802.29	51427.71		9692.20	9944.45	10977.11	10977.11
Main Channel	23.730	100Yr	1304.40		1305.77	2014.92	10914.67	46244.95	70.38		9653.57	10905.89	
Main Channel	23.730	PF 2	1304.75	0.35	1306.75	1252.32		57230.00		9653.57	9653.57	10905.89	10905.89
Main Channel	23.630	100Yr	1302.16		1303.31	2068.43	9197.59	47617.79	414.62		9662.83	10972.78	
Main Channel	23.630	PF 2	1302.79	0.63	1304.19	1309.95		57230.00		9662.83	9662.83	10972.78	10972.78
Main Channel	23.540	100Yr	1300.88		1301.79	2263.53	16161.95	40989.23	78.82		9851.47	10819.97	
Main Channel	23.540	PF 2	1301.48	0.59	1302.74	1214.97	7317.80	49912.20		9605.00	9851.47	10819.97	10819.97
Main Channel	23.450	100Yr	1299.30		1300.69	2277.95	14822.92	42407.08			9877.18	10690.47	
Main Channel	23.450	PF 2	1300.07	0.77	1301.72	1107.47	7436.29	49793.71		9583.00	9877.18	10690.47	10690.47
Main Channel	23.350	100Yr	1297.39		1298.95	2119.20	19202.98	37513.18	513.84		9905.34	10575.64	
Main Channel	23.350	PF 2	1297.76	0.37	1300.00	1090.74	12254.52	44975.48		9484.90	9905.34	10575.64	10575.64
Main Channel	23.260	100Yr	1295.01		1296.45	2130.12	26087.10	31090.62	52.28		9944.88	10491.83	
Main Channel	23.260	PF 2	1295.86	0.85	1297.49	1168.42	21274.97	35955.03		9323.41	9944.88	10491.83	10491.83
Main Channel	23.160	100Yr	1291.81		1293.24	2080.50	30106.77	26262.53	860.70		9929.40	10499.53	
Main Channel	23.160	PF 2	1292.59	0.77	1294.69	1207.49	22156.68	35073.32		9292.04	9929.40	10499.53	10499.53
Main Channel	23.070	100Yr	1289.30		1290.33	2187.45	37868.68	19006.15	355.18		9979.95	10553.08	
Main Channel	23.070	PF 2	1290.18	0.88	1291.59	1360.92	30318.81	26911.20		9192.16	9979.95	10553.08	10553.08
Main Channel	22.970	100Yr	1287.68		1288.40	2370.67	33287.92	22051.96	1890.12		9675.00	10402.90	
Main Channel	22.970	PF 2	1288.39	0.70	1289.55	1464.79	25663.68	31566.32		8938.11	9675.00	10402.90	10402.90
Main Channel	22.880	100Yr	1285.59		1286.55	2515.16	21613.13	33750.61	1866.27		9176.59	10294.45	
Main Channel	22.880	PF 2	1286.02	0.43	1287.40	1642.77	14026.69	43203.31		8651.68	9176.59	10294.45	10294.45
Main Channel	22.780	100Yr	1283.80		1284.67	2512.52	8144.24	46303.55	2782.20		8473.51	10184.27	
Main Channel	22.780	PF 2	1284.17	0.36	1285.35	1727.77	436.85	56793.15		8456.50	8473.51	10184.27	10184.27
Main Channel	22.690	100Yr	1282.42		1283.12	2367.13	8554.25	47514.91	1160.84		8667.13	10440.33	
Main Channel	22.690	PF 2	1282.70	0.28	1283.60	1832.87	1684.27	55545.73		8607.46	8667.13	10440.33	10440.33
Main Channel	22.590	100Yr	1280.72		1281.68	2315.67	4597.74	50431.28	2200.98		8650.70	10523.84	
Main Channel	22.590	PF 2	1281.03	0.31	1282.12	1873.14		57230.00		8650.70	8650.70	10523.84	10523.84
Main Channel	22.500	100Yr	1278.43		1279.37	2407.76	462.01	50122.79	6645.19		8828.46	10590.29	
Main Channel	22.600	PF 2	1278.59	0.17	1279.75	1847.92		56069.15	1160.85	8828.46	8828.46	10590.29	10676.38
Main Channel	22.400	100Yr	1275.62		1276.88	2227.49		52374.36	4855.64		9008.83	10699.26	
Main Channel	22.400	PF 2	1275.81	0.19	1277.21	1761.92		56683.13	546.87	9008.83	9008.83	10699.26	10770.75

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	22.310	100Yr	1274.55		1275.28	2233.09	670.36	52659.49	3900.15		9241.63	10887.81	
Main Channel	22.310	PF 2	1274.68	0.13	1275.55	1646.18		57230.00		9241.63	9241.63	10887.81	10887.81
Main Channel	22.210	100Yr	1271.47		1272.99	2099.80	1762.72	54179.24	1288.04		9820.99	11349.95	
Main Channel	22.210	PF 2	1271.56	0.09	1273.14	1591.67	1435.74	55794.25		9758.28	9820.99	11349.95	11349.95
Main Channel	22.120	100Yr	1269.79		1270.61	2116.39	43.44	52895.67	4290.88		9955.42	11584.99	
Main Channel	22.120	PF 2	1269.94	0.15	1270.90	1629.57		57230.00		9955.42	9955.42	11584.99	11584.99
Main Channel	22.030	100Yr	1266.81		1268.39	2014.18	345.31	54723.64	2161.05		9881.83	11408.89	
Main Channel	22.030	PF 2	1266.86	0.05	1268.58	1665.35		56927.55	302.45	9881.83	9881.83	11408.89	11568.23
Main Channel	21.930	100Yr	1264.30		1265.21	2196.46	1516.64	54880.52	206.84		9911.54	11651.07	
Main Channel	21.930	PF 2	1264.36	0.05	1265.32	1739.53		56604.00		9911.54	9911.54	11651.07	11651.07
Main Channel	21.840	100Yr	1262.99		1263.95	2376.93	1184.64	55271.46	147.90		9887.25	11659.25	
Main Channel	21.840	PF 2	1263.09	0.11	1264.07	1772.00		56604.00		9887.25	9887.25	11659.25	11659.25
Main Channel	21.740	100Yr	1261.19		1262.31	2188.97	3194.81	53377.26	31.93		9872.02	11539.90	
Main Channel	21.740	PF 2	1261.51	0.32	1262.60	1731.95	501.31	56102.70		9807.95	9872.02	11539.90	11539.90
Main Channel	21.650	100Yr	1259.18		1260.34	2492.60	7472.85	48815.74	515.41		9907.18	11283.72	
Main Channel	21.650	PF 2	1259.66	0.47	1260.92	1557.69	2105.15	54498.85		9726.03	9907.18	11283.72	11283.72
Main Channel	21.550	100Yr	1257.71		1258.85	2461.50	7426.85	47049.59	2127.56		9869.88	10916.27	
Main Channel	21.550	PF 2	1258.55	0.84	1259.71	1371.27	3748.25	52855.75		9545.00	9869.88	10916.27	10916.27
Main Channel	21.460	100Yr	1256.23		1257.04	2281.78	11348.82	40145.61	5109.58		9494.38	10614.60	
Main Channel	21.460	PF 2	1256.93	0.70	1258.17	1291.77	3748.04	52855.96		9322.83	9494.38	10614.60	10614.60
Main Channel	21.360	100Yr	1254.60		1255.28	2327.97	9726.02	43389.41	3488.58		9463.02	10575.54	
Main Channel	21.360	PF 2	1255.12	0.52	1256.18	1216.64	1838.64	54765.36		9358.90	9463.02	10575.54	10575.54
Main Channel	21.270	100Yr	1252.62		1253.58	2134.34	3883.80	46230.01	6490.19		9489.52	10500.07	
Main Channel	21.270	PF 2	1252.95	0.34	1254.25	1126.51	245.04	53668.55	2692.40	9476.76	9489.52	10500.07	10603.27
Main Channel	21.170	100Yr	1250.91		1251.71	2317.04	1330.23	50511.44	4762.34		9522.87	10789.08	
Main Channel	21.170	PF 2	1251.33	0.43	1252.28	1266.21		56604.00		9522.87	9522.87	10789.08	10789.08
Main Channel	21.080	100Yr	1248.69		1249.68	2071.19	790.77	48243.51	7569.72		9479.34	10672.38	
Main Channel	21.080	PF 2	1248.88	0.18	1250.13	1303.82		54412.02	2191.98	9479.34	9479.34	10672.38	10783.16
Main Channel	20.980	100Yr	1245.67		1246.88	1873.89	843.37	53758.23	2002.40		9230.25	10688.15	
Main Channel	20.980	PF 2	1245.78	0.11	1247.10	1457.90		56604.00		9230.25	9230.25	10688.15	10688.15
Main Channel	20.890	100Yr	1243.32		1244.32	2058.19	1575.01	51426.59	3602.40		8990.57	10399.81	
Main Channel	20.890	PF 2	1243.59	0.27	1244.63	1520.61		54144.13	2459.87	8990.57	8990.57	10399.81	10511.18
Main Channel	20.800	100Yr	1240.63		1241.63	2348.99	6601.27	49348.59	654.14		8628.32	10432.12	
Main Channel	20.800	PF 2	1241.02	0.38	1242.13	1803.80		56604.00		8628.32	8628.32	10432.12	10432.12
Main Channel	20.700	100Yr	1238.10		1238.83	2722.02	8835.27	46014.16	1754.57		8340.19	10087.01	
Main Channel	20.700	PF 2	1238.54	0.44	1239.45	1887.80	1286.20	55317.80		8199.21	8340.19	10087.01	10087.01
Main Channel	20.610	100Yr	1236.21		1236.75	3019.72	9578.06	46402.11	623.83		8163.78	10165.18	
Main Channel	20.610	PF 2	1236.96	0.75	1237.58	2001.40		56604.00		8163.78	8163.78	10165.18	10165.18
Main Channel	20.510	100Yr	1233.50		1234.29	3183.42	11654.27	44269.00	680.73		8372.10	10153.06	
Main Channel	20.510	PF 2	1233.52	0.02	1234.97	1803.09		56240.91	363.09	8372.10	8372.10	10153.06	10175.19
Main Channel	20.420	100Yr	1231.50		1232.27	3029.84	3254.11	53316.38	33.52		8475.75	10162.33	
Main Channel	20.420	PF 2	1231.93	0.43	1232.69	1686.58		56604.00		8475.75	8475.75	10162.33	10162.33
Main Channel	20.320	100Yr	1229.80		1230.78	2929.82	6238.66	50127.81	237.53		8745.41	10078.84	
Main Channel	20.320	PF 2	1230.33	0.53	1231.42	1503.84	327.16	56276.84		8575.00	8745.41	10078.84	10078.84
Main Channel	20.300	100Yr	1228.13		1229.26	2650.96	9419.34	47114.23	70.43		9014.12	10089.83	
Main Channel	20.300	PF 2	1228.99	0.87	1230.18	1367.83	2721.93	53882.07		8722.00	9014.12	10089.83	10089.83
Main Channel	20.230	100Yr	1227.26		1228.14	2598.90	15050.66	41337.32	216.02		9411.44	10151.06	
Main Channel	20.230	PF 2	1228.16	0.91	1229.25	1331.06	7842.42	48761.58		8820.00	9411.44	10151.06	10151.06
Main Channel	20.140	100Yr	1226.35		1227.06	2589.81	21104.07	34946.12	553.81		9596.91	10293.33	
Main Channel	20.140	PF 2	1227.21	0.86	1228.22	1400.62	12739.10	43864.91		8892.71	9596.91	10293.33	10293.33
Main Channel	19.940	100Yr	1224.86		1225.51	2391.20	19140.68	37364.54	98.78		9383.54	10256.84	
Main Channel	19.940	PF 2	1225.68	0.82	1226.55	1405.25	10355.04	46248.96		8851.59	9383.54	10256.84	10256.84
Main Channel	19.850	100Yr	1223.49		1224.06	2211.69	15145.10	40658.20	800.69		9154.73	10104.42	
Main Channel	19.850	PF 2	1224.14	0.65	1224.93	1327.75	6816.31	49787.70		8776.67	9154.73	10104.42	10104.42
Main Channel	19.750	100Yr	1221.32		1222.27	1750.48	12131.50	44459.02	13.48		9211.48	10128.91	
Main Channel	19.750	PF 2	1221.81	0.49	1222.98	1126.26	5240.67	51363.33		9002.65	9211.48	10128.91	10128.91
Main Channel	19.660	100Yr	1217.46		1218.57	1681.77	1663.34	46145.74	8794.92		9133.23	10177.04	
Main Channel	19.660	PF 2	1218.17	0.71	1219.40	1128.50		54286.48	2307.52	9133.23	9133.23	10177.04	10261.73

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	19.560	100Yr	1216.07		1216.74	2004.80	6685.33	42946.68	6972.00		9329.33	10343.05	
Main Channel	19.560	PF 2	1216.66	0.59	1217.60	1163.37	2135.53	53166.78	1301.69	9241.68	9329.33	10343.05	10405.03
Main Channel	19.470	100Yr	1213.55		1214.62	2112.92	2839.93	37894.81	15869.26		9434.12	10402.33	
Main Channel	19.470	PF 2	1214.25	0.70	1215.48	1387.01	2145.32	45500.97	8957.71	9310.81	9434.12	10402.33	10697.82
Main Channel	19.380	100Yr	1211.90		1212.56	2303.24	3093.02	38022.49	15488.49		9418.55	10486.60	
Main Channel	19.380	PF 2	1212.42	0.52	1213.31	1509.14	2101.51	47311.56	7190.93	9350.00	9418.55	10486.60	10859.14
Main Channel	19.280	100Yr	1209.69		1210.41	2604.11	929.99	46513.91	9160.10		9300.55	10775.84	
Main Channel	19.280	PF 2	1210.11	0.42	1210.98	1792.27		53862.84	2741.17	9300.55	9300.55	10775.84	11092.82
Main Channel	19.190	100Yr	1206.33		1207.32	2644.41	1151.90	47141.52	8310.59		9336.39	10937.25	
Main Channel	19.190	PF 2	1206.70	0.37	1207.89	1865.37		55012.36	1591.64	9336.39	9336.39	10937.25	11201.76
Main Channel	19.090	100Yr	1204.03		1204.77	2951.33	3771.60	49194.09	3638.31		9122.77	10921.98	
Main Channel	19.090	PF 2	1204.18	0.15	1205.17	1976.76		56400.63	203.38	9122.77	9122.77	10921.98	11099.53
Main Channel	19.000	100Yr	1202.72		1203.25	2729.46	19.81	52892.44	3691.75		8698.19	10858.05	
Main Channel	19.000	PF 2	1203.05	0.33	1203.60	2159.86		56604.00		8698.19	8698.19	10858.05	10858.05
Main Channel	18.900	100Yr	1200.86		1201.63	2988.08	1365.74	47329.92	7908.34		8489.23	10477.11	
Main Channel	18.900	PF 2	1201.17	0.30	1202.08	2118.68		54195.89	2408.11	8489.23	8489.23	10477.11	10607.91
Main Channel	18.810	100Yr	1198.60		1199.34	2709.16		49067.23	6912.77		8147.04	10338.77	
Main Channel	18.810	PF 2	1198.70	0.11	1199.63	2212.46		54987.75	992.24	8147.04	8147.04	10338.77	10398.71
Main Channel	18.710	100Yr	1195.75		1196.76	2897.00	0.01	53371.17	2608.82		8043.38	10494.27	
Main Channel	18.710	PF 2	1195.84	0.09	1196.92	2441.25		55980.00		8043.38	8043.38	10494.27	10494.27
Main Channel	18.620	100Yr	1193.31		1193.98	2824.46	141.11	53818.21	2020.68		8001.39	10283.58	
Main Channel	18.620	PF 2	1193.35	0.04	1194.09	2282.19		55980.00		8001.39	8001.39	10283.58	10283.58
Main Channel	18.520	100Yr	1192.26		1192.93	2290.66	504.37	55474.79	0.84		8057.56	10166.74	
Main Channel	18.520	PF 2	1192.41	0.15	1193.05	2109.18		55980.00		8057.56	8057.56	10166.74	10166.74
Main Channel	18.430	100Yr	1189.75		1190.85	1911.56	2928.35	53047.50	4.15		8468.57	10087.19	
Main Channel	18.430	PF 2	1189.85	0.10	1191.06	1618.62		55980.00		8468.57	8468.57	10087.19	10087.19
Main Channel	18.330	100Yr	1187.46		1188.39	1901.16	2486.71	53121.89	371.41		8755.13	10297.60	
Main Channel	18.330	PF 2	1187.69	0.23	1188.66	1542.47		55980.00		8755.13	8755.13	10297.60	10297.60
Main Channel	18.240	100Yr	1185.83		1186.69	2349.69	2891.62	51909.20	1179.18		8784.08	10247.18	
Main Channel	18.240	PF 2	1186.13	0.30	1187.06	1463.10		55980.00		8784.08	8784.08	10247.18	10247.18
Main Channel	18.140	100Yr	1183.04		1184.48	2273.10	4937.01	50713.16	329.83		8865.41	10233.21	
Main Channel	18.140	PF 2	1183.38	0.34	1184.98	1367.80		55980.00		8865.41	8865.41	10233.21	10233.21
Main Channel	18.050	100Yr	1181.91		1182.63	2623.12	7338.26	47507.93	1133.80		9005.51	10100.15	
Main Channel	18.050	PF 2	1182.81	0.90	1183.57	1395.27	909.05	53449.46	1621.49	8906.80	9005.51	10100.15	10302.07
Main Channel	17.950	100Yr	1180.69		1181.40	2219.12	23153.57	32795.86	30.56		9387.87	10308.23	
Main Channel	17.950	PF 2	1181.52	0.82	1182.50	1323.53	13306.66	42673.34		8984.70	9387.87	10308.23	10308.23
Main Channel	17.860	100Yr	1178.17		1178.95	2226.52	19896.28	28599.54	7484.18		9455.95	10243.27	
Main Channel	17.860	PF 2	1178.95	0.78	1180.03	1260.97	18028.03	37470.79	481.18	9002.41	9455.95	10243.27	10263.38
Main Channel	17.770	100Yr	1175.88		1176.60	2217.66	20359.41	28762.20	6858.40		9379.62	10207.37	
Main Channel	17.770	PF 2	1176.84	0.96	1177.75	1316.58	18377.95	37602.05		8890.79	9379.62	10207.37	10207.37
Main Channel	17.670	100Yr	1173.97		1174.54	2358.22	22806.97	25503.96	7669.07		9413.09	10114.64	
Main Channel	17.670	PF 2	1174.83	0.86	1175.70	1413.88	19613.86	34857.41	1508.73	8739.82	9413.09	10114.64	10153.70
Main Channel	17.580	100Yr	1171.21		1172.22	2313.98	27368.52	25559.76	3051.72		9459.72	10112.83	
Main Channel	17.580	PF 2	1171.76	0.56	1173.17	1560.00	22742.87	32757.59	479.54	8592.65	9459.72	10112.83	10152.65
Main Channel	17.480	100Yr	1168.44		1169.39	2661.80	16585.58	30561.02	8833.40		9298.15	10027.43	
Main Channel	17.480	PF 2	1169.21	0.77	1170.41	1669.74	16144.94	37684.25	2150.80	8417.94	9298.15	10027.43	10087.68
Main Channel	17.390	100Yr	1166.30		1167.25	2862.63	16964.62	28804.81	10210.57		9254.80	10071.25	
Main Channel	17.390	PF 2	1167.05	0.74	1168.42	1819.15	15485.96	38520.58	1973.46	8333.98	9254.80	10071.25	10153.13
Main Channel	17.290	100Yr	1164.22		1164.99	3233.76	11672.98	29707.48	14599.54		9257.52	10083.96	
Main Channel	17.290	PF 2	1164.58	0.36	1165.94	1908.99	11395.60	38998.23	5586.17	8321.09	9257.52	10083.96	10230.08
Main Channel	17.200	100Yr	1162.29		1163.14	3412.84	15085.11	36726.89	4168.00		9291.81	10408.55	
Main Channel	17.200	PF 2	1162.75	0.47	1163.83	1989.32	12576.17	43403.84		8419.23	9291.81	10408.55	10408.55
Main Channel	17.100	100Yr	1160.37		1161.24	3431.13	20832.27	33859.19	1288.55		9395.12	10333.37	
Main Channel	17.100	PF 2	1160.76	0.38	1161.92	2024.45	15576.98	40403.02		8306.92	9395.12	10333.37	10333.37
Main Channel	17.010	100Yr	1157.98		1159.02	3251.38	17779.98	37056.73	1143.29		9152.05	10072.26	
Main Channel	17.010	PF 2	1158.60	0.62	1159.78	1976.67	13035.41	42944.59		8095.59	9152.05	10072.26	10072.26
Main Channel	16.910	100Yr	1155.95		1156.82	2934.65	18703.53	34021.43	3255.04		9187.03	10080.28	
Main Channel	16.910	PF 2	1156.55	0.61	1157.77	1887.29	13506.47	42473.53		8192.99	9187.03	10080.28	10080.28

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	16.820	100Yr	1154.14		1154.95	2808.72	17252.43	36681.41	2046.16		9116.76	10108.25	
Main Channel	16.820	PF 2	1155.08	0.94	1156.07	1743.52	10645.56	45334.43		8364.73	9116.76	10108.25	10108.25
Main Channel	16.720	100Yr	1152.03		1153.14	2776.08	12388.24	41856.62	1735.14		9133.21	10085.05	
Main Channel	16.720	PF 2	1152.63	0.60	1154.36	1551.18	2607.57	53372.43		8533.87	9133.21	10085.05	10085.05
Main Channel	16.630	100Yr	1149.90		1151.35	2717.66	10292.41	44390.42	1297.17		9266.58	10126.67	
Main Channel	16.630	PF 2	1150.82	0.92	1152.68	1359.24	1423.61	54556.39		8767.43	9266.58	10126.67	10126.67
Main Channel	16.530	100Yr	1148.29		1149.71	2786.52	13366.56	41818.11	795.32		9196.48	10159.18	
Main Channel	16.530	PF 2	1149.07	0.77	1151.16	1322.86	1721.26	54258.75		8836.32	9196.48	10159.18	10159.18
Main Channel	16.440	100Yr	1146.06		1147.11	2671.51	16440.48	39539.51			9005.33	10346.16	
Main Channel	16.440	PF 2	1146.60	0.54	1148.31	1501.77	2918.66	53061.34		8844.39	9005.33	10346.16	10346.16
Main Channel	16.350	100Yr	1144.08		1144.75	2725.31	17341.05	38638.94			8849.82	10480.70	
Main Channel	16.350	PF 2	1144.98	0.90	1146.04	1653.49	274.99	55705.01		8827.21	8849.82	10480.70	10480.70
Main Channel	16.250	100Yr	1142.48		1143.13	2575.62	18960.03	36793.20	226.77		9097.47	10330.65	
Main Channel	16.250	PF 2	1143.14	0.66	1144.27	1476.53	5134.29	50845.71		8854.12	9097.47	10330.65	10330.65
Main Channel	16.160	100Yr	1140.50		1141.43	2416.21	15671.67	40305.63	2.70		9175.41	10355.50	
Main Channel	16.160	PF 2	1141.03	0.54	1142.39	1418.55	5043.93	50936.07		8936.95	9175.41	10355.50	10355.50
Main Channel	16,060	100Yr	1138.86		1139.62	2444.15	12444.40	42037.15	1498.45		9090.18	10413.25	
Main Channel	16.060	PF 2	1138.91	0.06	1140.15	1530.79	4840.94	51139.06		8882.46	9090.18	10413.25	10413.25
Main Channel	15.970	100Yr	1136.92		1138.01	2606.02	2210.67	53289.67	479.65		8849.78	10322.25	
Main Channel	15.970	PF 2	1137.11	0.20	1138.26	1472.47		55980.00		8849.78	8849.78	10322.25	10322.25
Main Channel	15.870	100Yr	1134.89		1136.32	2416.26	697.91	51037.67	4244.42		8806.27	10041.73	
Main Channel	15.870	PF 2	1135.52	0.63	1136.86	1284.73		55124.33	855.67	8806.27	8806.27	10041.73	10091.00
Main Channel	15.780	100Yr	1133.74		1134.55	2085.04	3988.51	41325.21	10666.28		8998.68	10069.79	
Main Channel	15.780	PF 2	1134.12	0.38	1135.30	1227.85		50374.15	5605.85	8998.68	8998.68	10069.79	10226.53
Main Channel	15.680	100Yr	1131.11		1132.73	1788.82	2220.54	49035.87	4723.59		9338.54	10488.57	
Main Channel	15.680	PF 2	1131.63	0.52	1133.42	1150.03		55980.00		9338.54	9338.54	10488.57	10488.57
Main Channel	15.590	100Yr	1130.75		1131.36	2037.37	3718.01	47618.61	4643.38		9382.12	10535.82	
Main Channel	15.590	PF 2	1131.23	0.48	1132.06	1153.70		55980.00		9382.12	9382.12	10535.82	10535.82
Main Channel	15.490	100Yr	1129.06		1130.43	1804.63	3375.34	68802.92	3941.73		9222.57	10295.36	
Main Channel	15.490	PF 2	1129.45	0.39	1131.07	1072.79		76120.00		9222.57	9222.57	10295.36	10295.36
Main Channel	15.400	100Yr	1128.05		1129.27	1874.09	2191.26	67366.73	6562.01		9383.23	10425.23	
Main Channel	15.400	PF 2	1128.21	0.16	1129.83	1083.29		75660.66	459.35	9383.23	9383.23	10425.23	10466.52
Main Channel	15.300	100Yr	1125.35		1127.68	1644.93		71478.78	4641.22		9659.77	10613.73	
Main Channel	15.300	PF 2	1125.41	0.06	1128.04	1071.70		75107.38	1012.61	9659.77	9659.77	10613.73	10731.47
Main Channel	15.210	100Yr	1123.64		1125.39	1806.53	276.51	58886.10	16411.39		9808.86	10524.95	
Main Channel	15.210	PF 2	1124.08	0.44	1125.98	1063.94		62592.61	12981.39	9808.86	9808.86	10524.95	10872.80
Main Channel	15.110	100Yr	1122.78		1123.93	1926.38	50.40	58083.41	17440.19		9885.21	10611.09	
Main Channel	15.110	PF 2	1122.87	0.09	1124.48	1067.33		65932.73	9641.26	9885.21	9885.21	10611.09	10952.54
Main Channel	15.020	100Yr	1120.10		1122.37	1703.77	55.02	56681.82	18837.15		9885.87	10469.98	
Main Channel	15.020	PF 2	1120.71	0.61	1122.89	999.96		57994.27	17579.72	9885.87	9885.87	10469.98	10885.83
Main Channel	14.920	100Yr	1119.01		1120.34	2040.50	469.44	50068.37	25036.19		9852.25	10418.99	
Main Channel	14.920	PF 2	1119.49	0.48	1121.12	1027.86		54866.93	20707.07	9852.25	9852.25	10418.99	10880.11
Main Channel	14.830	100Yr	1117.73		1118.99	1912.74	0.01	51885.27	23688.71		9907.19	10438.00	
Main Channel	14.830	PF 2	1117.87	0.14	1119.61	928.81		57853.17	17720.83	9907.19	9907.19	10438.00	10836.00
Main Channel	14.730	100Yr	1115.46		1117.26	1820.00	23.37	66026.69	9523.94		9883.29	10671.69	
Main Channel	14.730	PF 2	1115.47	0.01	1117.63	966.71		69957.79	5616.21	9883.29	9883.29	10671.69	10850.00
Main Channel	14.640	100Yr	1112.71		1114.75	2041.07	1134.46	67954.91	6484.63		9897.02	10769.20	
Main Channel	14.640	PF 2	1112.96	0.24	1115.03	1102.98		69777.16	5796.84	9897.02	9897.02	10769.20	11000.00
Main Channel	14.550	100Yr	1110.95		1112.09	2381.30	718.45	59677.09	15178.45		9770.08	10768.22	
Main Channel	14.550	PF 2	1111.27	0.32	1112.68	1336.85		66233.55	9340.45	9770.08	9770.08	10768.22	11106.83
Main Channel	14.450	100Yr	1108.65		1110.06	2303.62	321.47	49632.87	25619.66		9625.78	10378.30	
Main Channel	14.450	PF 2	1109.32	0.67	1110.80	1524.22		53857.18	21716.82	9625.78	9625.78	10378.30	11150.00
Main Channel	14.360	100Yr	1106.55		1108.13	2670.04	972.83	47708.35	26892.82		9546.95	10095.72	
Main Channel	14.360	PF 2	1106.65	0.10	1108.82	1603.05		53532.64	22041.36	9546.95	9546.95	10095.72	11150.00
Main Channel	14.270	100Yr	1103.52		1105.07	2755.66	4.04	58272.50	17297.46		9215.50	10143.16	
Main Channel	14.270	PF 2	1103.83	0.31	1105.74	1609.50		65082.88	10491.12	9215.50	9215.50	10143.16	10825.00
Main Channel	14.170	100Yr	1101.29		1102.71	2606.37	89.77	55484.56	19999.67		9157.56	10159.81	
Main Channel	14.170	PF 2	1102.20	0.91	1103.81	1477.44		65104.21	10469.79	9157.56	9157.56	10159.81	10635.00

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	14.080	100Yr	1099.21		1100.48	2795.98	11.99	54185.88	21376.13		9095.44	10384.53	
Main Channel	14.080	PF 2	1099.65	0.44	1101.74	1474.40		70497.85	5076.15	9095.44	9095.44	10384.53	10569.84
Main Channel	13.980	100Yr	1096.59		1097.77	2724.43	90.51	62615.37	12868.11		9225.52	10708.26	
Main Channel	13.980	PF 2	1097.46	0.87	1098.84	1482.74		75574.00		9225.52	9225.52	10708.26	10708.26
Main Channel	13.890	100Yr	1094.83		1095.70	2821.84	24.08	56225.50	19324.43		9204.77	10811.38	
Main Channel	13.890	PF 2	1095.32	0.50	1096.81	1606.61		75574.00		9204.77	9204.77	10811.38	10811.38
Main Channel	13.790	100Yr	1092.43		1093.57	2645.39	189.35	61759.06	13625.59		8958.79	10629.68	
Main Channel	13.790	PF 2	1093.11	0.68	1094.53	1670.89		75574.00		8958.79	8958.79	10629.68	10629.68
Main Channel	13.700	100Yr	1090.21		1091.08	3074.05	392.98	57636.21	17544.81		8735.29	10535.63	
Main Channel	13.700	PF 2	1090.91	0.70	1092.12	1800.34		75574.00		8735.29	8735.29	10535.63	10535.63
Main Channel	13.610	100Yr	1088.61		1089.23	2873.81	276.31	57913.15	17384.54		8768.16	10652.95	
Main Channel	13.610	PF 2	1088.93	0.32	1089.92	1895.45		75323.41	250.59	8768.16	8768.16	10652.95	10663.61
Main Channel	13.510	100Yr	1085.13		1086.66	2527.63	20.03	66385.91	9168.06		8750.35	10364.96	
Main Channel	13.510	PF 2	1085.58	0.44	1087.11	1889.36		71862.09	3711.91	8750.35	8750.35	10364.96	10644.90
Main Channel	13.420	100Yr	1083.09		1083.88	2818.68	136.87	59158.25	16278.88		8709.13	10724.32	
Main Channel	13.420	PF 2	1083.28	0.19	1084.39	2111.36		71701.68	3872.32	8709.13	8709.13	10724.32	10824.00
Main Channel	13.320	100Yr	1081.14		1082.05	2920.77	7.94	70802.47	4763.59		8530.62	10986.61	
Main Channel	13.320	PF 2	1081.25	0.10	1082.27	2455.99		75574.00		8530.62	8530.62	10986.61	10986.61
Main Channel	13.230	100Yr	1079.55		1080.27	2787.69	3.29	72123.02	3447.69		8703.16	11212.37	
Main Channel	13.230	PF 2	1079.66	0.10	1080.43	2509.21		75574.00		8703.16	8703.16	11212.37	11212.37
Main Channel	13.130	100Yr	1077.21		1078.08	2481.78	39.03	73632.38	1902.59		9250.33	11542.18	
Main Channel	13.130	PF 2	1077.22	0.01	1078.15	2291.85		75574.00		9250.33	9250.33	11542.18	11542.18
Main Channel	13.040	100Yr	1074.90		1075.98	2218.93	56.96	75307.97	209.07		9361.34	11523.97	
Main Channel	13.040	PF 2	1074.88	-0.01	1075.99	2162.63		75574.00		9361.34	9361.34	11523.97	11523.97
Main Channel	12.940	100Yr	1072.37		1073.45	2160.01	445.94	72404.80	2313.26		9382.78	11056.42	
Main Channel	12.940	PF 2	1072.63	0.26	1073.61	2064.78		72438.60	2725.40	9382.78	9382.78	11056.42	11450.00
Main Channel	12.850	100Yr	1071.07		1071.82	2847.26	594.47	59796.66	14772.87		9449.46	10620.58	
Main Channel	12.850	PF 2	1071.37	0.30	1072.16	2130.54		62876.74	12287.26	9449.46	9449.46	10620.58	11580.00
Main Channel	12.750	100Yr	1068.43		1069.96	3039.45	2095.45	62789.32	10279.24		9189.36	10086.97	
Main Channel	12.750	PF 2	1068.39	-0.04	1070.22	2238.51		66486.34	8677.66	9189.36	9189.36	10086.97	11450.00
Main Channel	12.660	100Yr	1065.60		1066.68	2544.50	1637.19	54911.72	18615.09		9080.70	10092.24	
Main Channel	12.660	PF 2	1065.79	0.19	1067.10	2031.32		60768.84	14395.15	9080.70	9080.70	10092.24	11200.00
Main Channel	12.560	100Yr	1062.77		1064.53	2412.76	2289.84	70246.91	2627.25		8945.30	10197.91	
Main Channel	12.560	PF 2	1062.73	-0.04	1064.73	1899.78		73015.41	2148.59	8945.30	8945.30	10197.91	10950.00
Main Channel	12.470	100Yr	1060.47		1061.63	2070.54	777.89	73185.52	1200.59		8632.65	10117.26	
Main Channel	12.470	PF 2	1060.69	0.22	1061.79	1669.51		73804.09	1359.92	8632.65	8632.65	10117.26	10500.00
Main Channel	12.370	100Yr	1058.62		1058.82	2600.56	2982.09	69388.53	2793.39		8381.82	10079.53	
Main Channel	12.370	PF 2	1059.13	0.51	1060.27	1853.18		73349.67	1814.33	8381.82	8381.82	10079.53	10235.00
Main Channel	12.280	100Yr	1057.10		1057.89	2969.17	5891.63	60916.02	8356.35		8347.82	10099.43	
Main Channel	12.280	PF 2	1057.45	0.35	1058.56	1854.00		73532.02	1631.98	8347.82	8347.82	10099.43	10201.82
Main Channel	12.180	100Yr	1054.30		1055.47	2861.40	3713.31	62366.21	9084.48		8390.89	10092.67	
Main Channel	12.180	PF 2	1055.20	0.90	1056.35	1841.15		72437.22	2726.78	8390.89	8390.89	10092.67	10232.04
Main Channel	12.090	100Yr	1052.60		1053.23	2846.19	5098.40	54035.89	16029.71		8554.64	10183.19	
Main Channel	12.090	PF 2	1053.42	0.82	1054.40	1684.81		74055.97	1108.03	8554.64	8554.64	10183.19	10239.45
Main Channel	12.000	100Yr	1050.49		1051.34	2550.09	5901.79	58249.81	11012.40		8525.53	10185.57	
Main Channel	12.000	PF 2	1051.21	0.72	1052.36	1660.04		75164.00		8525.53	8525.53	10185.57	10185.57
Main Channel	11.900	100Yr	1047.82		1048.82	2285.06	3674.75	62403.34	9085.90		8369.28	10074.16	
Main Channel	11.900	PF 2	1047.97	0.15	1049.41	1704.88		75164.00		8369.28	8369.28	10074.16	10074.16
Main Channel	11.810	100Yr	1046.11		1046.90	2227.25	4539.24	68388.23	2236.53		8323.03	10068.96	
Main Channel	11.810	PF 2	1046.19	0.08	1047.08	1897.05	2685.60	72478.40		8171.91	8323.03	10068.96	10068.96
Main Channel	11.710	100Yr	1044.11		1045.04	2316.99	650.26	73357.04	1156.70		8131.09	10070.28	
Main Channel	11.710	PF 2	1044.28	0.16	1045.21	1939.19		75164.00		8131.09	8131.09	10070.28	10070.28
Main Channel	11.620	100Yr	1041.78		1042.95	2001.98	195.84	69860.60	5107.56		8448.13	10119.63	
Main Channel	11.620	PF 2	1041.97	0.19	1043.19	1765.84		73369.86	1794.15	8448.13	8448.13	10119.63	10213.97
Main Channel	11.520	100Yr	1040.30		1041.19	2177.69	281.19	70864.46	4008.35		8694.34	10347.19	
Main Channel	11.520	PF 2	1040.42	0.11	1041.41	1652.85		75164.00		8694.34	8694.34	10347.19	10347.19
Main Channel	11.430	100Yr	1038.09		1039.44	1895.13	250.37	72671.18	2242.45		8853.05	10452.08	
Main Channel	11.430	PF 2	1038.23	0.14	1039.63	1599.03		75164.00		8853.05	8853.05	10452.08	10452.08

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

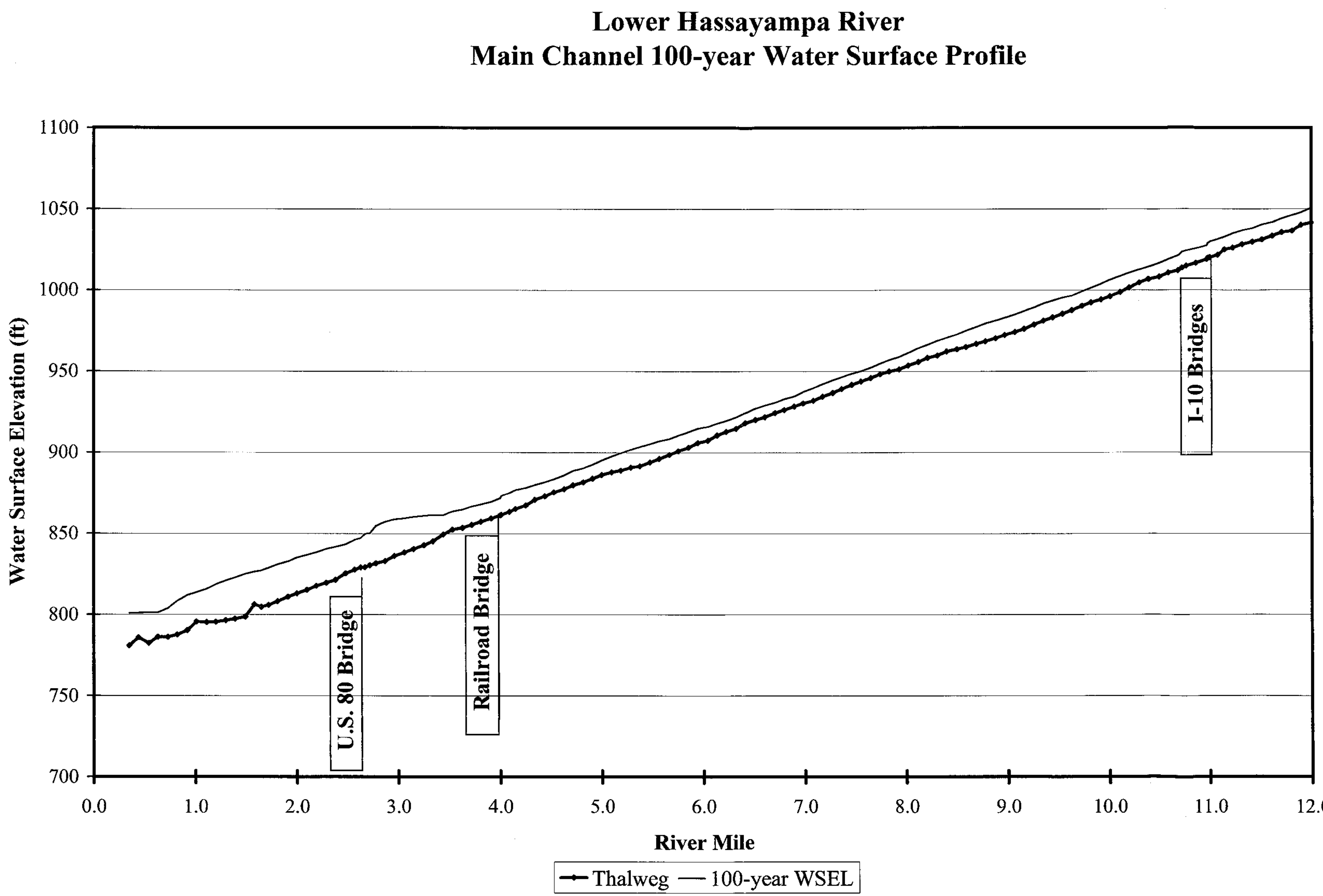
Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Main Channel	11.330	100Yr	1036.73		1037.68	1905.29	1458.56	70720.10	2985.33		8847.61	10355.69	
Main Channel	11.330	PF 2	1036.87	0.14	1037.89	1600.27	1493.59	73670.41		8755.42	8847.61	10355.69	10355.69
Main Channel	11.240	100Yr	1034.94		1036.10	1779.23	173.47	72040.36	2950.16		8740.89	10264.10	
Main Channel	11.240	PF 2	1034.94	0.00	1036.23	1590.17	162.65	75001.35		8673.93	8740.89	10264.10	10264.10
Main Channel	11.160	100Yr	1032.75		1034.26	1705.10	2085.23	73078.77			9112.30	10430.64	
Main Channel	11.160	PF 2	1032.75	-0.01	1034.31	1478.36	1293.54	73870.46		8928.81	9112.30	10430.64	10436.14
Main Channel	11.090	100Yr	1031.33		1032.56	1365.92		75164.00			9123.25	10489.28	
Main Channel	11.090	PF 2	1031.33	0.00	1032.56	1365.93		75164.00		9123.25	9123.25	10489.28	10489.28
Main Channel	11.010	100Yr	1029.85		1031.21	1148.34		75164.00			9298.37	10446.72	
Main Channel	11.010	PF 2	1029.85	0.00	1031.21	1148.34		75164.00		9298.37	9298.37	10446.72	10446.72
Main Channel	11.005 BR U	100Yr	1029.67		1031.18	1123.26		75164.00			9298.37	10446.72	
Main Channel	11.005 BR U	PF 2	1029.67	0.00	1031.18	1123.26		75164.00		9298.37	9298.37	10446.72	10446.72
Main Channel	11.005 BR D	100Yr	1029.14		1030.86	1119.83		75164.00			9296.33	10441.13	
Main Channel	11.005 BR D	PF 2	1029.14	0.00	1030.86	1119.82		75164.00		9296.33	9296.33	10441.13	10441.13
Main Channel	11.000	100Yr	1029.28		1030.86	1144.81		75164.00			9296.33	10441.13	
Main Channel	11.000	PF 2	1029.27	0.00	1030.86	1144.79		75164.00		9296.33	9296.33	10441.13	10441.13
Main Channel	10.990	100Yr	1029.05		1030.60	1143.02		75164.00			9288.79	10431.81	
Main Channel	10.990	PF 2	1029.05	0.00	1030.59	1143.01		75164.00		9288.79	9288.79	10431.81	10431.81
Main Channel	10.985 BR U	100Yr	1028.80		1030.56	1112.84		75164.00			9288.79	10431.81	
Main Channel	10.985 BR U	PF 2	1028.79	0.00	1030.55	1112.82		75164.00		9288.79	9288.79	10431.81	10431.81
Main Channel	10.985 BR D	100Yr	1027.37		1029.96	1115.63		75164.00			9285.24	10425.49	
Main Channel	10.985 BR D	PF 2	1027.37	0.00	1029.96	1115.63		75164.00		9285.24	9285.24	10425.49	10425.49
Main Channel	10.980	100Yr	1027.40		1029.85	1140.25		75164.00			9285.24	10425.49	
Main Channel	10.980	PF 2	1027.52	0.12	1029.86	1140.25		75164.00		9285.24	9285.24	10425.49	10425.49
Main Channel	10.870	100Yr	1025.57		1026.68	1593.95	89.56	73989.19	891.24		9160.06	10629.21	
Main Channel	10.870	PF 2	1026.23	0.66	1027.17	1469.15		74970.00		9160.06	9160.06	10629.21	10629.21
Main Channel	10.770	100Yr	1024.18		1025.16	1794.93	10061.59	62609.93	2298.48		9348.28	10417.03	
Main Channel	10.770	PF 2	1025.09	0.92	1026.06	1268.21	6916.94	68053.05		9148.82	9348.28	10417.03	10417.03
Main Channel	10.730	100Yr	1023.47		1024.46	1985.14	10341.77	61495.29	3132.95		9518.44	10466.28	
Main Channel	10.730	PF 2	1024.28	0.81	1025.40	1195.66	5499.29	69470.71		9270.62	9518.44	10466.28	10466.28
Main Channel	10.690	100Yr	1021.22		1023.40	1850.69	12365.66	59526.64	3077.70		9812.09	10496.00	
Main Channel	10.690	PF 2	1021.50	0.27	1024.23	1140.83	8659.49	66310.52		9355.17	9812.09	10496.00	10496.00
Main Channel	10.590	100Yr	1018.99		1020.77	2216.73	7792.46	61510.21	5667.33		9732.81	10629.93	
Main Channel	10.590	PF 2	1019.31	0.32	1021.66	1190.59	4517.06	70452.94		9439.34	9732.81	10629.93	10629.93
Main Channel	10.500	100Yr	1016.60		1018.31	2115.30	3908.29	62470.85	8590.86		9846.83	10864.55	
Main Channel	10.500	PF 2	1017.20	0.60	1019.35	1250.63	1737.17	73232.83		9613.92	9846.83	10864.55	10864.55
Main Channel	10.400	100Yr	1014.46		1015.82	2209.54	2698.35	48708.61	23563.04		9809.43	10596.52	
Main Channel	10.400	PF 2	1015.37	0.91	1017.06	1333.50	467.69	58920.67	15581.64	9755.23	9809.43	10596.52	11088.73
Main Channel	10.310	100Yr	1012.60		1013.34	2384.87	7450.85	40298.36	27220.79		9898.69	10801.00	
Main Channel	10.310	PF 2	1013.59	0.99	1014.64	1503.61	833.32	53630.53	20506.15	9825.29	9898.69	10801.00	11328.90
Main Channel	10.210	100Yr	1010.69		1011.33	2438.40	8239.97	41396.18	25333.85		9877.22	10879.45	
Main Channel	10.210	PF 2	1011.50	0.81	1012.43	1649.97	1015.71	54483.68	19470.60	9794.13	9877.22	10879.45	11444.10
Main Channel	10.120	100Yr	1008.62		1009.34	2506.99	5040.71	47673.90	22255.39		9872.91	10928.71	
Main Channel	10.120	PF 2	1009.38	0.76	1010.29	1732.44		57303.96	17666.03	9872.91	9872.91	10928.71	11605.35
Main Channel	10.020	100Yr	1006.44		1007.09	2575.79	7860.33	41926.16	25183.52		9880.59	10771.15	
Main Channel	10.020	PF 2	1007.13	0.69	1008.02	1775.16	990.07	51551.02	22428.91	9814.17	9880.59	10771.15	11589.33
Main Channel	9.930	100Yr	1003.79		1004.59	2743.48	7081.82	44649.28	22840.90		9604.37	10643.65	
Main Channel	9.930	PF 2	1004.64	0.85	1005.60	1747.41		53478.80	21093.21	9604.37	9604.37	10643.65	11351.78
Main Channel	9.830	100Yr	1001.35		1002.19	2884.02	8286.98	42317.15	23967.87		9475.97	10376.02	
Main Channel	9.830	PF 2	1002.27	0.92	1003.41	1582.67		53412.59	21159.41	9475.97	9475.97	10376.02	11058.64
Main Channel	9.740	100Yr	999.30		1000.13	2356.24	9156.22	54012.97	11402.81		9230.89	10348.01	
Main Channel	9.740	PF 2	999.46	0.15	1000.95	1313.09		68643.48	5928.53	9230.89	9230.89	10348.01	10543.98
Main Channel	9.640	100Yr	996.45		997.91	1609.13	4662.93	69785.64	123.43		8993.56	10189.81	
Main Channel	9.640	PF 2	996.84	0.38	998.39	1196.25		74572.00		8993.56	8993.56	10189.81	10189.81
Main Channel	9.550	100Yr	995.37		996.28	1831.27	4150.51	68099.88	2321.60		9056.47	10284.56	
Main Channel	9.550	PF 2	995.84	0.47	996.82	1268.56	1309.24	73262.77		9016.00	9056.47	10284.56	10284.56
Main Channel	9.450	100Yr	993.50		994.70	2058.77	69.80	64786.43	9715.77		9101.20	10059.28	
Main Channel	9.450	PF 2	994.37	0.87	995.47	1392.39		67877.32	6694.68	9101.20	9101.20	10059.28	10493.59

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

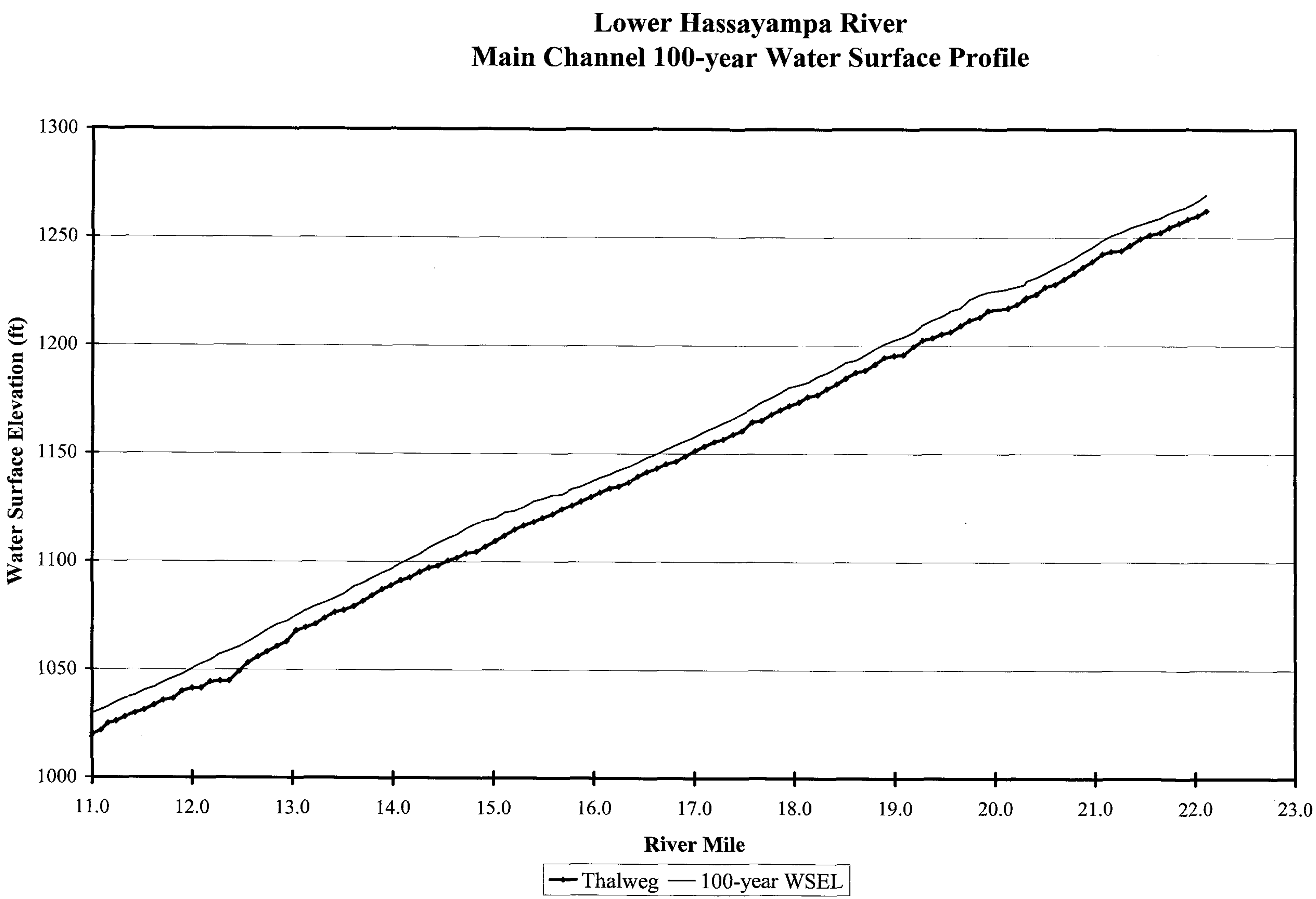
Reach	River Sta	Profile	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Wdth Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
Main Channel	9.360	100Yr	991.79		993.09	2356.84	714.20	57742.04	16115.76		9375.02	10093.42	
Main Channel	9.360	PF 2	992.79	0.99	994.16	1384.76		63959.81	10612.19	9375.02	9375.02	10093.42	10759.78
Main Channel	9.270	100Yr	989.29		990.77	2609.59	161.40	44514.22	29676.39		9725.70	10212.88	
Main Channel	9.270	PF 2	990.04	0.75	991.98	1539.67		52550.46	22021.54	9725.70	9725.70	10212.88	11265.37
Main Channel	9.170	100Yr	987.06		988.03	2852.23	42.16	42543.28	31986.56		9959.00	10684.65	
Main Channel	9.170	PF 2	987.84	0.78	989.15	1657.32		51899.70	22672.30	9959.00	9959.00	10684.65	11616.32
Main Channel	9.080	100Yr	984.93		985.66	3236.32	91.11	37659.52	36821.37		9905.31	10815.13	
Main Channel	9.080	PF 2	985.82	0.89	986.77	1843.09		46744.89	27827.11	9905.31	9905.31	10815.13	11748.40
Main Channel	8.980	100Yr	982.93		983.50	3308.97	22.52	38946.24	35603.24		9850.86	10940.05	
Main Channel	8.980	PF 2	983.84	0.91	984.63	2064.78		51323.07	23248.93	9850.86	9850.86	10940.05	11915.64
Main Channel	8.890	100Yr	981.26		981.83	3361.42	84.68	45769.96	28717.36		9827.43	10995.87	
Main Channel	8.890	PF 2	982.04	0.78	982.80	2164.91		57684.55	16887.44	9827.43	9827.43	10995.87	11992.34
Main Channel	8.790	100Yr	979.42		979.99	3311.83	117.29	46463.81	27990.90		9909.34	11084.96	
Main Channel	8.790	PF 2	979.98	0.55	980.74	2223.03		56961.57	17610.42	9909.34	9909.34	11084.96	12132.37
Main Channel	8.700	100Yr	977.31		977.89	3248.05	32.82	46429.91	28109.27		9923.39	11120.06	
Main Channel	8.700	PF 2	977.77	0.46	978.48	2248.99		53146.81	21425.18	9923.39	9923.39	11120.06	12172.38
Main Channel	8.600	100Yr	975.06		975.66	3218.92	780.52	50581.25	23210.23		9775.61	11062.66	
Main Channel	8.600	PF 2	975.73	0.66	976.37	2217.70		55958.37	18613.63	9775.61	9775.61	11062.66	11993.31
Main Channel	8.510	100Yr	972.68		973.25	3520.59	5676.68	45489.75	23405.57		9768.42	11123.56	
Main Channel	8.510	PF 2	973.56	0.88	974.26	2161.69	304.66	56223.64	18043.70	9753.39	9768.42	11123.56	11915.08
Main Channel	8.410	100Yr	970.65		971.11	3772.90	8253.61	39380.92	26937.47		9669.62	10945.79	
Main Channel	8.410	PF 2	971.65	1.00	972.29	2108.24		51258.80	23313.20	9669.62	9669.62	10945.79	11777.86
Main Channel	8.320	100Yr	968.81		969.35	3464.12	8416.65	41305.34	24850.01		9473.62	10704.31	
Main Channel	8.320	PF 2	969.75	0.94	970.55	1944.57		54550.71	20021.28	9473.62	9473.62	10704.31	11418.19
Main Channel	8.220	100Yr	966.43		967.18	3842.21	11905.89	51658.71	11007.41		9297.91	10585.53	
Main Channel	8.220	PF 2	967.06	0.63	968.25	1828.17	4365.16	66322.48	3884.36	9090.41	9297.91	10585.53	10918.58
Main Channel	8.130	100Yr	964.26		964.99	3701.73	9764.13	54439.97	10367.91		9061.09	10481.52	
Main Channel	8.130	PF 2	964.69	0.43	965.76	1966.15	6286.29	66057.65	2228.07	8703.26	9061.09	10481.52	10669.41
Main Channel	8.030	100Yr	961.33		962.25	3904.83	18540.22	48438.75	7593.03		9290.22	10427.74	
Main Channel	8.030	PF 2	962.29	0.96	963.22	2163.17	19706.71	54865.29		8264.57	9290.22	10427.74	10427.74
Main Channel	7.940	100Yr	958.95		959.40	4498.18	31149.37	32903.03	9913.60		9084.54	10091.98	
Main Channel	7.940	PF 2	959.85	0.90	960.68	2219.24	26237.06	47728.94		7872.74	9084.54	10091.98	10091.98
Main Channel	7.840	100Yr	956.99		957.55	4084.33	29172.63	39437.51	5355.86		8890.21	10102.37	
Main Channel	7.840	PF 2	957.87	0.88	958.68	2222.37	22005.35	51960.65		7880.00	8890.21	10102.37	10102.37
Main Channel	7.750	100Yr	954.72		955.27	3903.11	31199.94	37854.18	4911.88		8788.89	10132.64	
Main Channel	7.750	PF 2	955.67	0.95	956.48	2218.22	21121.92	52532.50	311.57	7943.50	8788.89	10132.64	10161.72
Main Channel	7.660	100Yr	952.29		952.94	3910.65	34614.54	36055.71	3295.75		9107.71	10333.02	
Main Channel	7.660	PF 2	953.22	0.93	954.21	2292.19	23345.84	50620.16		8040.83	9107.71	10333.02	10333.02
Main Channel	7.560	100Yr	950.19		950.68	3895.65	31421.44	37445.34	5099.22		8961.30	10290.80	
Main Channel	7.560	PF 2	951.12	0.94	951.97	2234.18	19198.31	54654.37	113.32	8062.96	8961.30	10290.80	10297.14
Main Channel	7.470	100Yr	948.54		949.19	3675.08	16779.84	52261.38	4924.78		8547.19	10264.03	
Main Channel	7.470	PF 2	949.32	0.78	950.27	2218.71	4754.95	69211.05		8045.32	8547.19	10264.03	10264.03
Main Channel	7.370	100Yr	946.45		947.33	3595.69	10012.94	58113.53	5839.53		8459.00	10128.64	
Main Channel	7.370	PF 2	946.89	0.44	948.20	2032.77	1290.10	72675.91		8091.89	8459.00	10128.64	10128.64
Main Channel	7.280	100Yr	944.49		945.52	3156.77	5949.97	59791.70	8224.33		8708.20	10126.92	
Main Channel	7.280	PF 2	944.99	0.50	946.26	2007.91	3882.78	70063.22		8119.01	8708.20	10126.92	10126.92
Main Channel	7.180	100Yr	942.15		943.46	2726.85	781.59	61374.21	11810.19		8723.55	10093.83	
Main Channel	7.180	PF 2	942.95	0.79	944.37	1787.00	1612.55	72353.45		8306.83	8723.55	10093.83	10093.83
Main Channel	7.090	100Yr	939.68		941.09	2479.39	1356.30	56835.39	15774.31		9141.17	10334.58	
Main Channel	7.090	PF 2	940.32	0.65	942.18	1753.91	2389.66	70405.30	1171.05	8623.04	9141.17	10334.58	10426.36
Main Channel	6.990	100Yr	937.31		938.53	2591.55	890.60	51671.89	21403.50		9522.96	10722.18	
Main Channel	6.990	PF 2	937.96	0.65	939.61	2118.60	2018.67	65989.15	5958.18	8854.86	9522.96	10722.18	11027.47
Main Channel	6.900	100Yr	934.63		935.83	2909.89	1932.23	35588.88	36444.89		9833.87	10539.91	
Main Channel	6.900	PF 2	935.16	0.53	936.84	2404.39	3257.28	44886.10	25822.63	9182.71	9833.87	10539.91	11587.10
Main Channel	6.800	100Yr	932.91		933.63	2845.27	1540.49	30630.97	41794.54		9791.92	10755.80	
Main Channel	6.800	PF 2	933.55	0.63	934.31	2578.68	2834.05	37246.89	33885.06	9162.16	9791.92	10755.80	11755.20
Main Channel	6.710	100Yr	930.68		931.54	2829.62	529.04	20804.99	52631.97		9667.52	10486.78	
Main Channel	6.710	PF 2	931.60	0.92	932.42	2512.19	1154.96	26409.29	46401.75	9414.77	9667.52	10486.78	12003.53

HEC-RAS Plan: Floodway River: Hassayampa Reach: Main Channel (Continued)

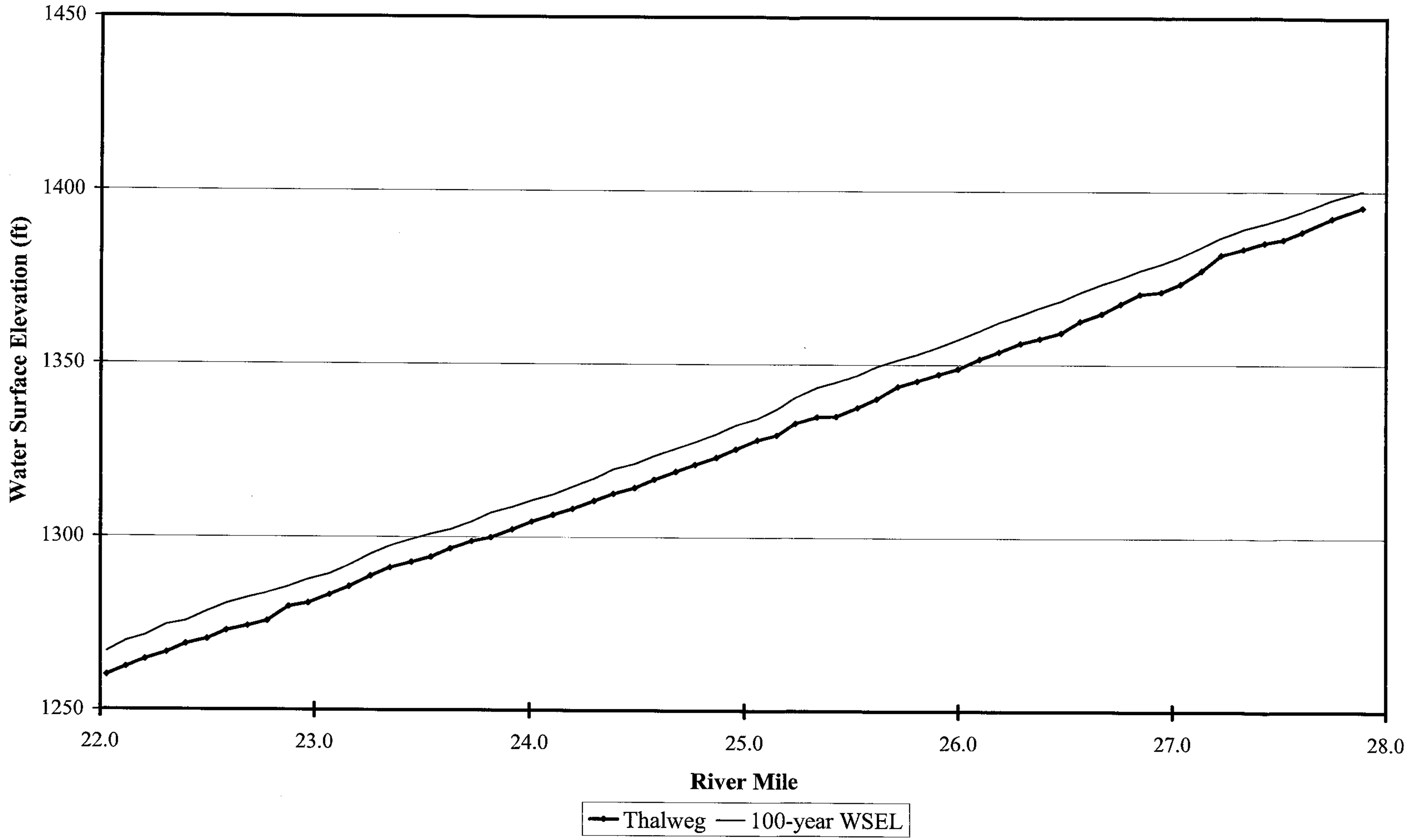
Reach	River Sta	Profile	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Wdth Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
Main Channel	6.610	100Yr	928.91		929.87	2968.08	316.02	31090.92	42559.06		9401.05	10309.55	
Main Channel	6.610	PF 2	929.63	0.73	930.79	2470.14		40686.81	33279.19	9401.05	9401.05	10309.55	11928.00
Main Channel	6.520	100Yr	927.16		928.02	3840.86	1795.80	39411.82	32758.38		9208.10	10240.83	
Main Channel	6.520	PF 2	927.77	0.61	928.92	2541.90		49719.51	24246.49	9208.10	9208.10	10240.83	11750.00
Main Channel	6.420	100Yr	924.19		925.34	3542.25	771.62	37543.11	35651.27		9147.35	10099.35	
Main Channel	6.420	PF 2	924.89	0.70	926.31	2614.26		47317.72	26648.28	9147.35	9147.35	10099.35	11761.61
Main Channel	6.330	100Yr	921.70		922.52	3569.46	486.42	28474.95	45004.63		9160.47	10099.81	
Main Channel	6.330	PF 2	922.47	0.77	923.57	2696.88		39951.14	34014.86	9160.47	9160.47	10099.81	11857.35
Main Channel	6.230	100Yr	919.50		920.36	3260.40	360.64	26285.62	47319.74		9362.67	10105.52	
Main Channel	6.230	PF 2	920.40	0.90	921.42	2724.90		35424.71	38541.29	9362.67	9362.67	10105.52	12087.57
Main Channel	6.140	100Yr	917.84		918.63	3832.15	270.56	29162.13	44533.31		9441.33	10043.31	
Main Channel	6.140	PF 2	918.33	0.49	919.54	2744.65		38023.51	35942.48	9441.33	9441.33	10043.31	12185.98
Main Channel	6.050	100Yr	915.92		916.84	3672.46	437.28	35476.53	38052.20		9655.45	10172.72	
Main Channel	6.050	PF 2	916.60	0.68	917.75	2627.50	76.28	40005.32	33884.41	9630.00	9655.45	10172.72	12336.90
Main Channel	5.950	100Yr	914.77		915.25	4125.87	627.37	20328.55	53010.08		9593.27	10204.72	
Main Channel	5.950	PF 2	915.62	0.85	916.15	2735.36		24498.81	49467.20	9593.27	9593.27	10204.72	12328.63
Main Channel	5.860	100Yr	912.62		913.40	3966.68	1039.54	25881.47	47044.99		9620.75	10098.34	
Main Channel	5.860	PF 2	913.49	0.87	914.40	2710.43	30.18	31455.00	42480.81	9607.61	9620.75	10098.34	12318.04
Main Channel	5.760	100Yr	910.51		911.32	3829.14	595.84	32068.97	41301.19		9567.38	10154.60	
Main Channel	5.760	PF 2	911.03	0.52	912.17	2746.61		40042.08	33923.92	9567.38	9567.38	10154.60	12313.99
Main Channel	5.670	100Yr	908.29		909.39	3857.47	583.85	32817.48	40564.68		9683.98	10093.47	
Main Channel	5.670	PF 2	908.96	0.67	910.18	2834.53	25.84	36829.90	37110.26	9606.09	9683.98	10093.47	12473.72
Main Channel	5.570	100Yr	906.89		907.34	4006.28	3365.72	28587.99	42012.29		9649.10	10704.05	
Main Channel	5.570	PF 2	907.61	0.73	908.14	2941.18		37008.94	36957.06	9649.10	9649.10	10704.05	12590.28
Main Channel	5.480	100Yr	905.13		905.55	4269.90	2769.62	35763.70	35432.68		9729.99	10964.88	
Main Channel	5.480	PF 2	905.90	0.76	906.36	2957.78		43576.56	30389.44	9729.99	9729.99	10964.88	12687.77
Main Channel	5.380	100Yr	903.46		903.87	4174.52	3636.88	41612.43	28716.68		9545.73	10894.04	
Main Channel	5.380	PF 2	904.26	0.80	904.73	3064.68		52063.38	21902.63	9545.73	9545.73	10894.04	12610.41
Main Channel	5.290	100Yr	901.69		902.14	4134.50	2327.46	34110.73	37527.81		9431.34	10581.45	
Main Channel	5.290	PF 2	902.48	0.78	902.98	3099.26		43652.79	30313.21	9431.34	9431.34	10581.45	12530.60
Main Channel	5.190	100Yr	899.70		900.22	3961.67	2996.52	30682.52	40286.96		9460.20	10380.82	
Main Channel	5.190	PF 2	900.60	0.91	901.15	2924.80		38157.98	35808.02	9460.20	9460.20	10380.82	12385.00
Main Channel	5.100	100Yr	897.56		898.03	4284.09	4028.66	28058.43	41878.91		9437.61	10453.28	
Main Channel	5.100	PF 2	898.55	0.99	899.11	2801.03		37973.85	35992.15	9437.61	9437.61	10453.28	12238.64
Main Channel	5.000	100Yr	895.11		895.65	4263.41	4553.47	34277.10	35135.43		9561.89	10586.64	
Main Channel	5.000	PF 2	895.98	0.88	896.72	2488.94		45902.09	28063.91	9561.89	9561.89	10586.64	12050.83
Main Channel	4.910	100Yr	892.52		893.29	3803.53	2521.04	37206.84	33772.13		9572.94	10670.45	
Main Channel	4.910	PF 2	893.42	0.90	894.41	2374.88		49216.82	24283.18	9572.94	9572.94	10670.45	11947.82
Main Channel	4.820	100Yr	890.32		891.02	3938.47	7816.30	32080.45	33603.25		9560.04	10505.48	
Main Channel	4.820	PF 2	891.09	0.77	892.16	2387.62		44078.05	29421.95	9560.04	9560.04	10505.48	11951.46
Main Channel	4.720	100Yr	888.67		889.28	4398.94	12776.89	39549.82	21173.29		9566.66	10629.59	
Main Channel	4.720	PF 2	889.61	0.95	890.40	2747.37	7249.70	50097.25	16153.05	9199.17	9566.66	10629.59	11946.54
Main Channel	4.630	100Yr	885.91		887.06	4371.63	7782.92	42335.57	23381.51		9892.27	10721.44	
Main Channel	4.630	PF 2	886.73	0.82	888.26	2716.77	7220.64	53656.22	12623.14	9368.50	9892.27	10721.44	12101.52
Main Channel	4.530	100Yr	883.61		884.33	4567.87	3916.50	52247.10	17336.40		9307.78	10756.58	
Main Channel	4.530	PF 2	884.32	0.71	885.27	2312.22		64740.31	8759.69	9307.78	9307.78	10756.58	11620.00
Main Channel	4.440	100Yr	881.62		882.23	4263.12	2359.52	57104.17	14036.31		9100.65	10672.93	
Main Channel	4.440	PF 2	882.36	0.74	883.15	2145.35		70177.38	3322.63	9100.65	9100.65	10672.93	11246.00
Main Channel	4.340	100Yr	879.95		880.52	3909.16	2304.93	56041.00	15154.07		9206.30	10846.93	
Main Channel	4.340	PF 2	880.73	0.78	881.50	1971.78		70364.77	3135.23	9206.30	9206.30	10846.93	11184.71
Main Channel	4.250	100Yr	878.08		878.51	3095.12	6405.56	57725.21	9369.23		8829.79	10653.51	
Main Channel	4.250	PF 2	878.34	0.26	879.06	1876.87		73045.02	454.97	8829.79	8829.79	10653.51	10706.66
Main Channel	4.150	100Yr	876.86		877.31	1946.79	5330.50	68166.64	2.86		8831.19	10604.56	
Main Channel	4.150	PF 2	877.01	0.14	877.52	1773.37		73500.00		8831.19	8831.19	10604.56	10604.56
Main Channel	4.090	100Yr	875.06		876.28	1295.63	3567.46	69765.53	167.00		9056.92	10151.47	
Main Channel	4.090	PF 2	875.35	0.28	876.53	1239.25	2250.64	71056.11	193.25	8956.18	9056.92	10151.47	10195.43
Main Channel	4.010	100Yr	873.16		874.82	912.72		73500.00			9137.66	10050.43	
Main Channel	4.010	PF 2	874.16	1.00	875.46	912.77		73500.00		9137.66	9137.66	10050.43	10050.43



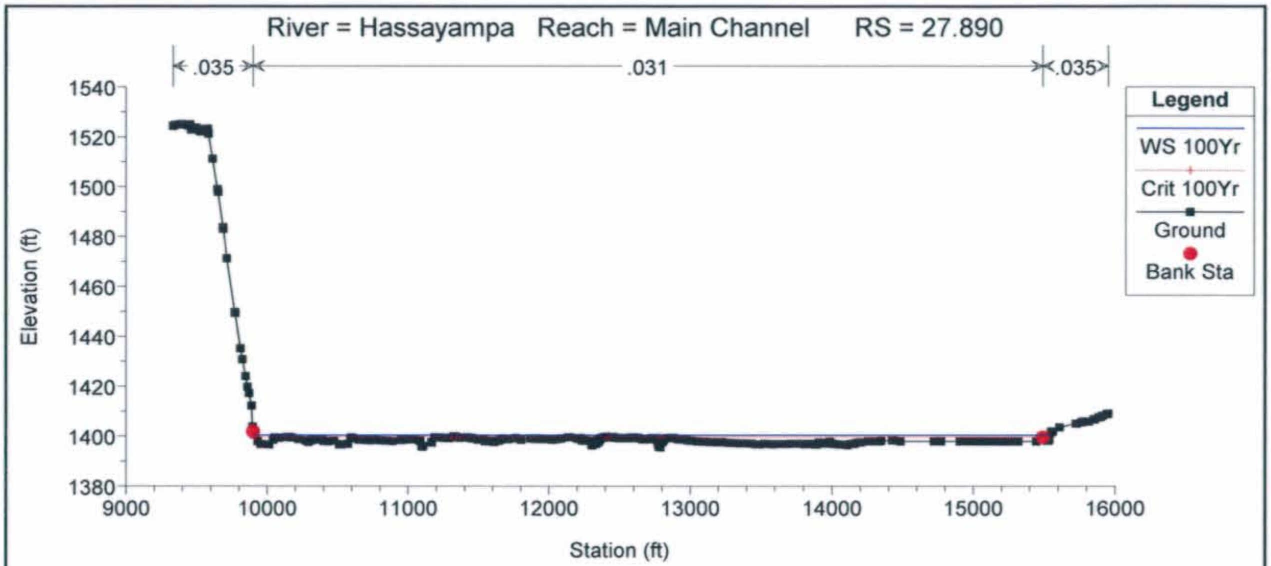
Lower Hassayampa River
Main Channel 100-year Water Surface Profile
Water Surface Elevation (ft)
1100
1050
1000
950
900
850
800
750
700
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
River Mile
U.S. 80 Bridge
Railroad Bridge
I-10 Bridges
Thalweg
100-year WSEL

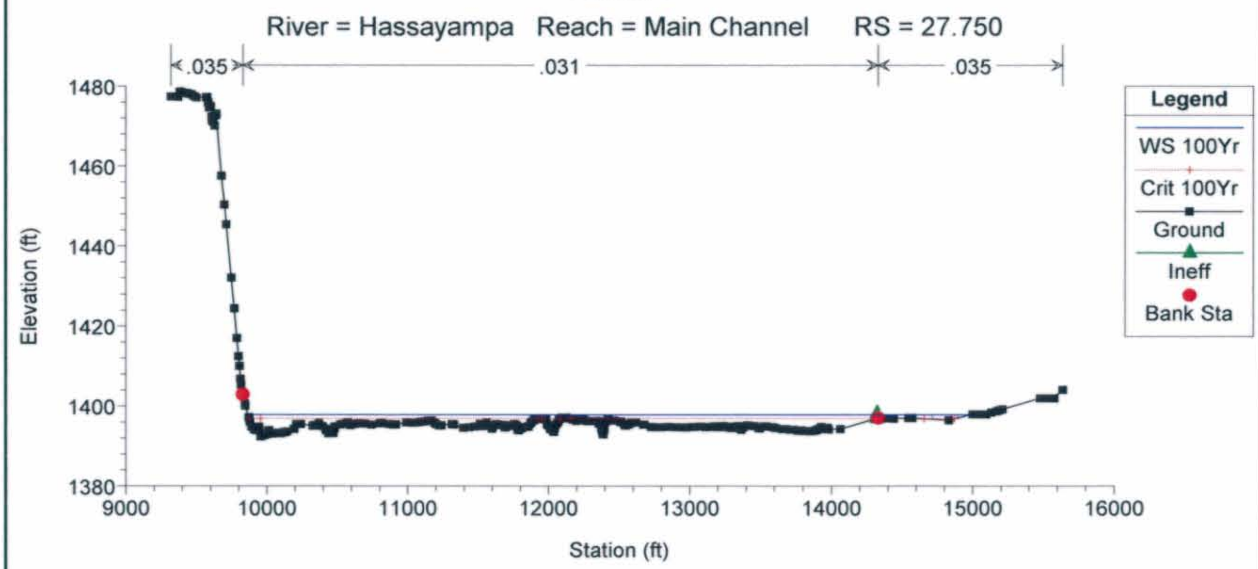

Lower Hassayampa River
Main Channel 100-year Water Surface Profile
Water Surface Elevation (ft)
1300
1250
1200
1150
1100
1050
1000
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
River Mile
Thalweg
100-year WSEL

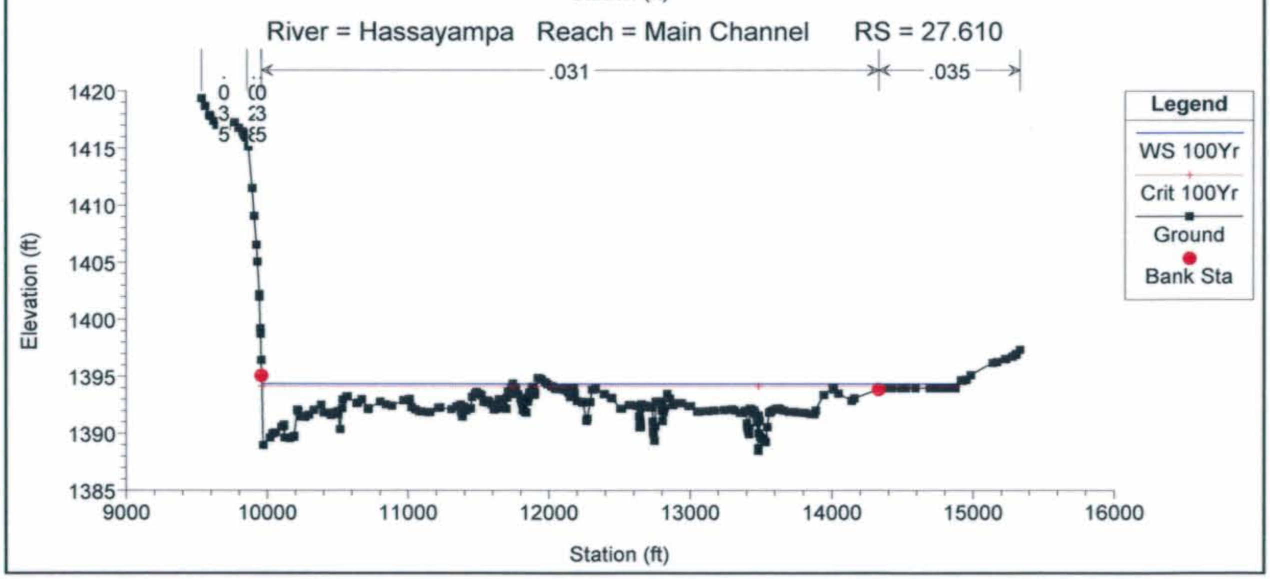
Lower Hassayampa River
Main Channel 100-year Water Surface Profile

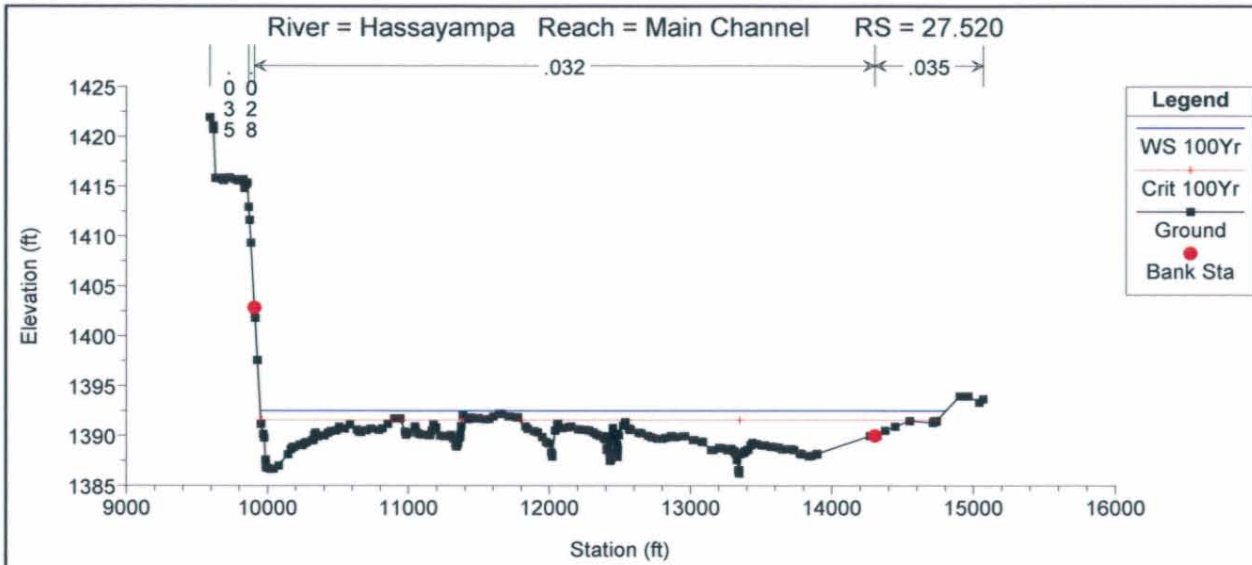


C. HEC-RAS Model Cross Sections


River = Hassayampa Reach = Main Channel RS = 27.890
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1540
1520
1500
1480
1460
1440
1420
1400
1380
9000
10000
11000
12000
13000
14000
15000
16000


River = Hassayampa Reach = Main Channel RS = 27.750
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1480
1460
1440
1420
1400
1380
9000
10000
11000
12000
13000
14000
15000
16000


River = Hassayampa Reach = Main Channel RS = 27.610
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1420
1415
1410
1405
1400
1395
1390
1385
9000
10000
11000
12000
13000
14000
15000
16000


River = Hassayampa Reach = Main Channel RS = 27.520
.032
.035
.035
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1425
1420
1415
1410
1405
1400
1395
1390
1385
9000
10000
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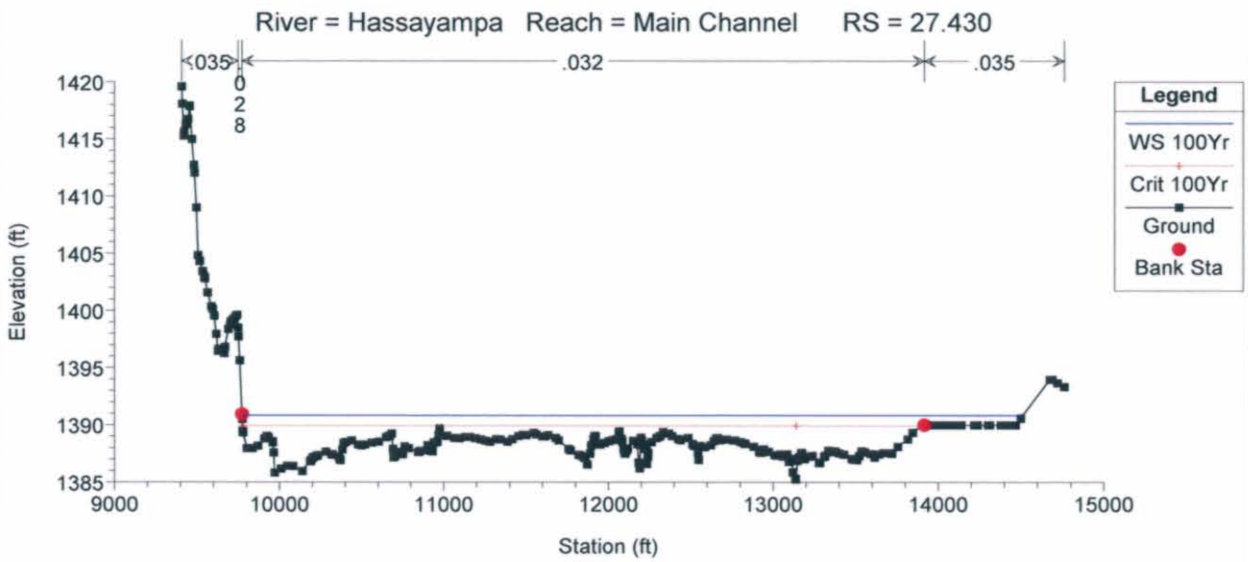
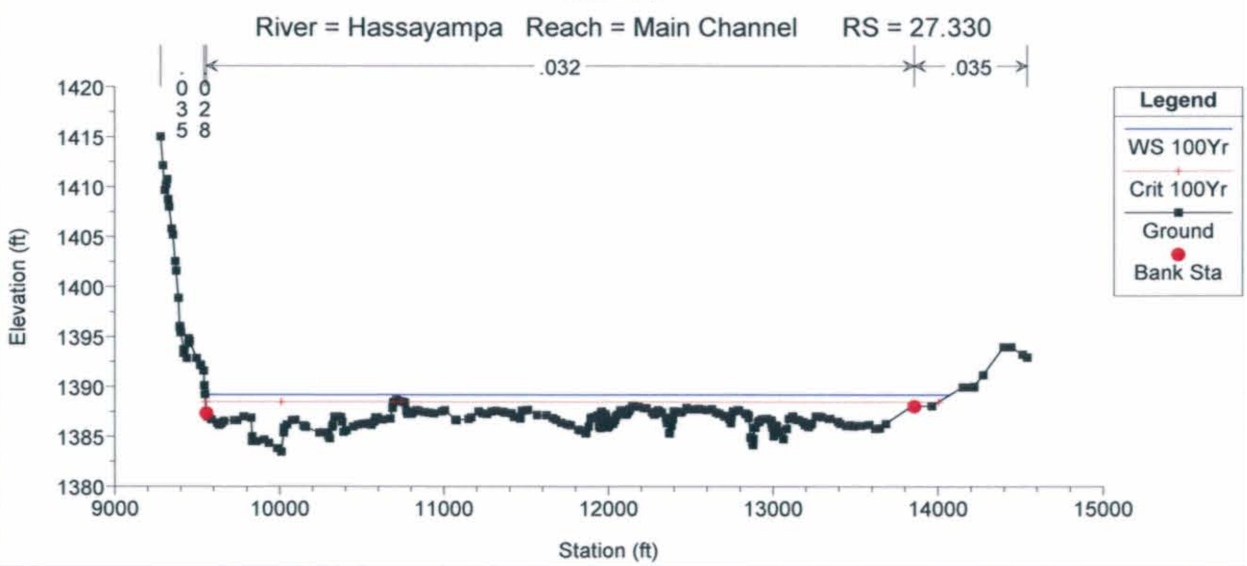
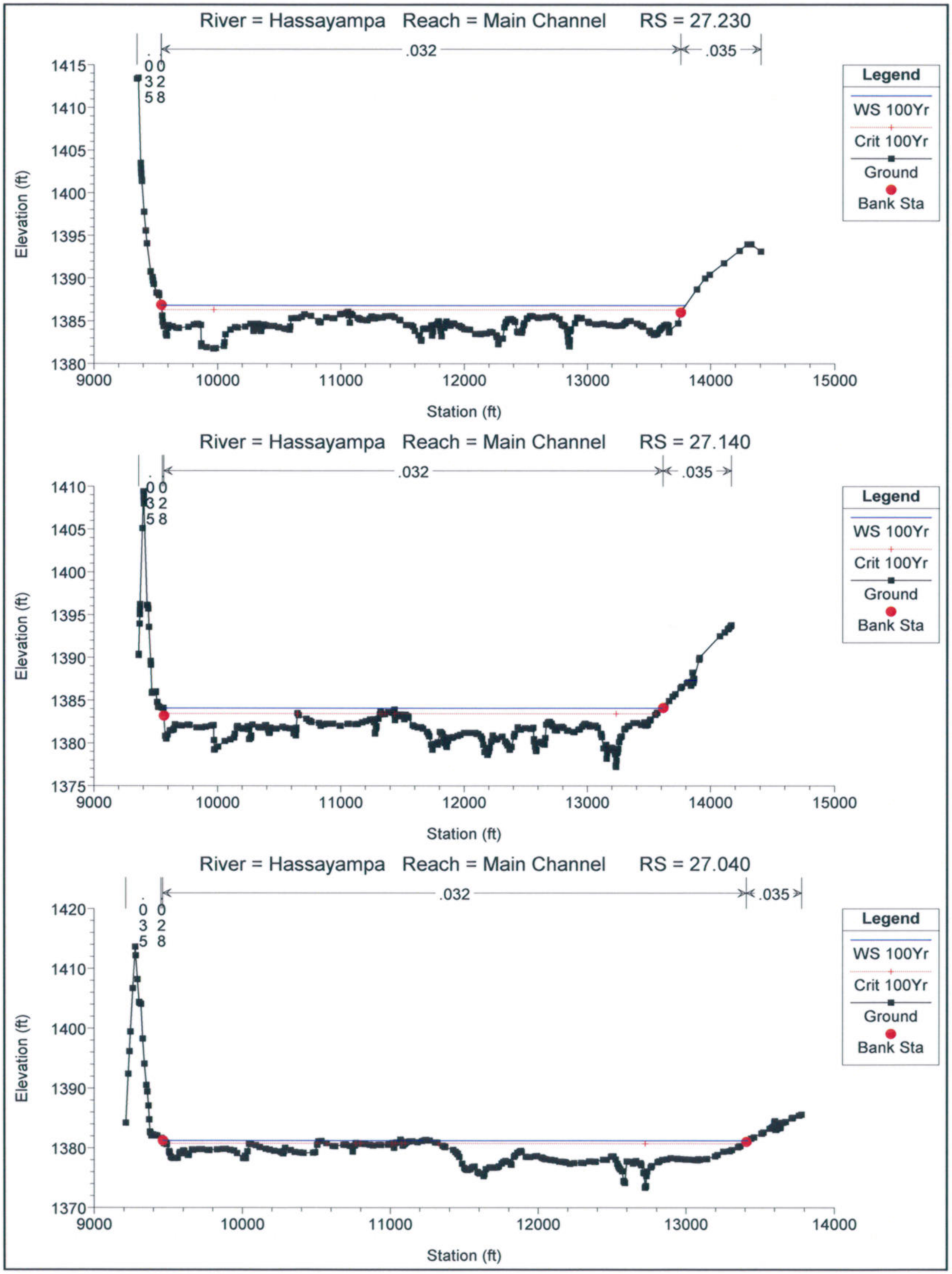
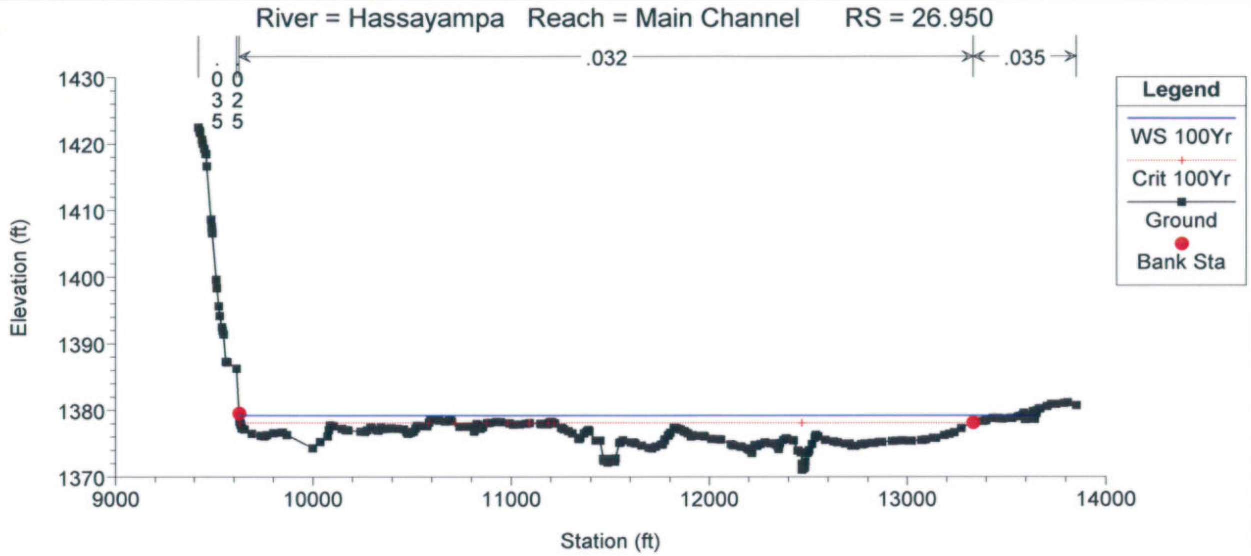
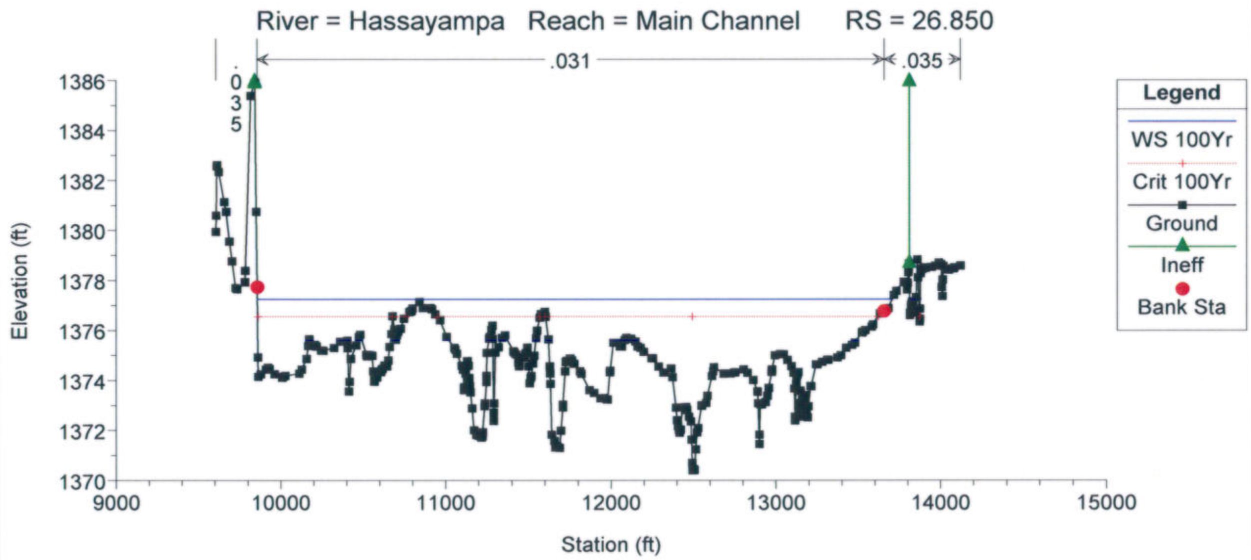
12000
13000
14000
15000
16000

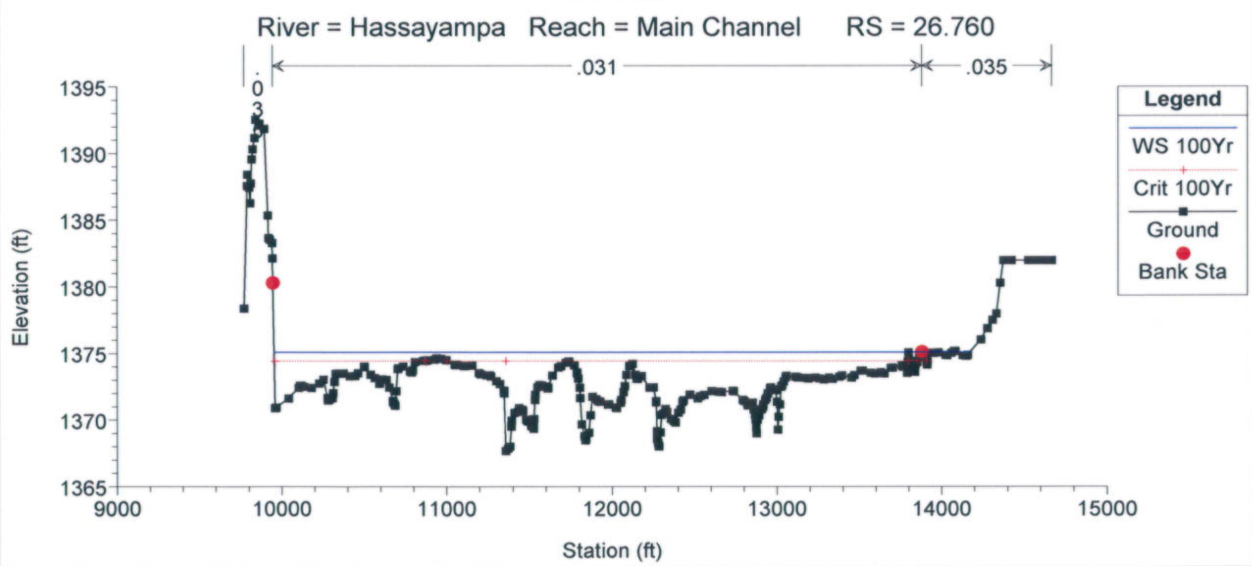

River = Hassayampa Reach = Main Channel RS = 27.430
.035
.032
.035
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1420
1415
1410
1405
1400
1395
1390
1385
9000
10000
11000
12000
13000
14000
15000

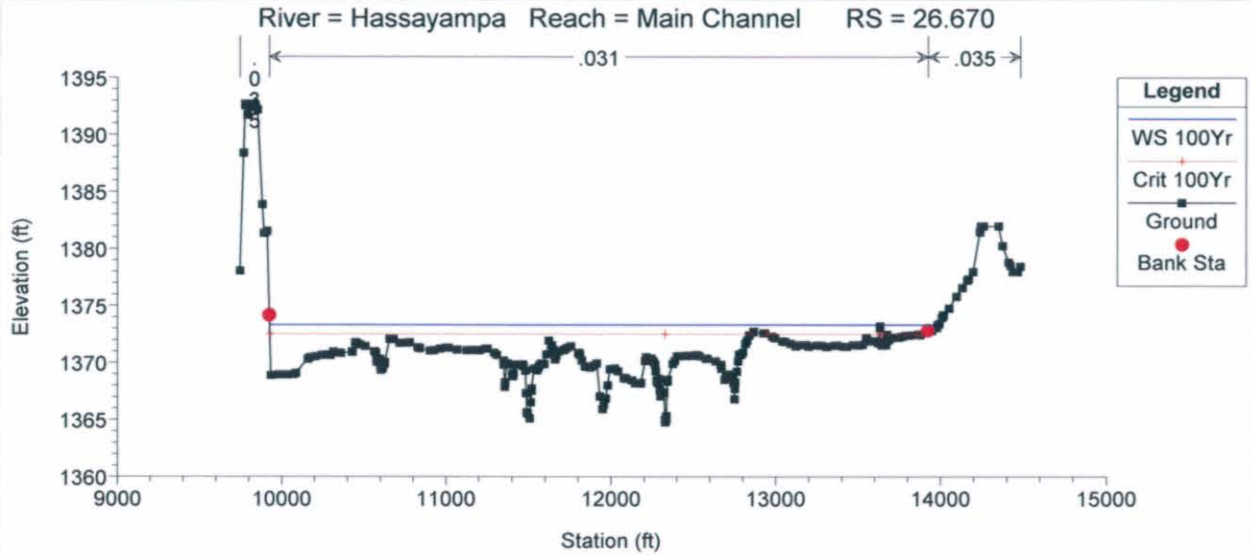

River = Hassayampa Reach = Main Channel RS = 27.330
.032
.035
.035
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1420
1415
1410
1405
1400
1395
1390
1385
1380
9000
10000
11000
12000
13000
14000
15000


River = Hassayampa Reach = Main Channel RS = 27.230
.032
.035
0
.
3
5
0
.
2
8
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 27.140
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 27.040
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

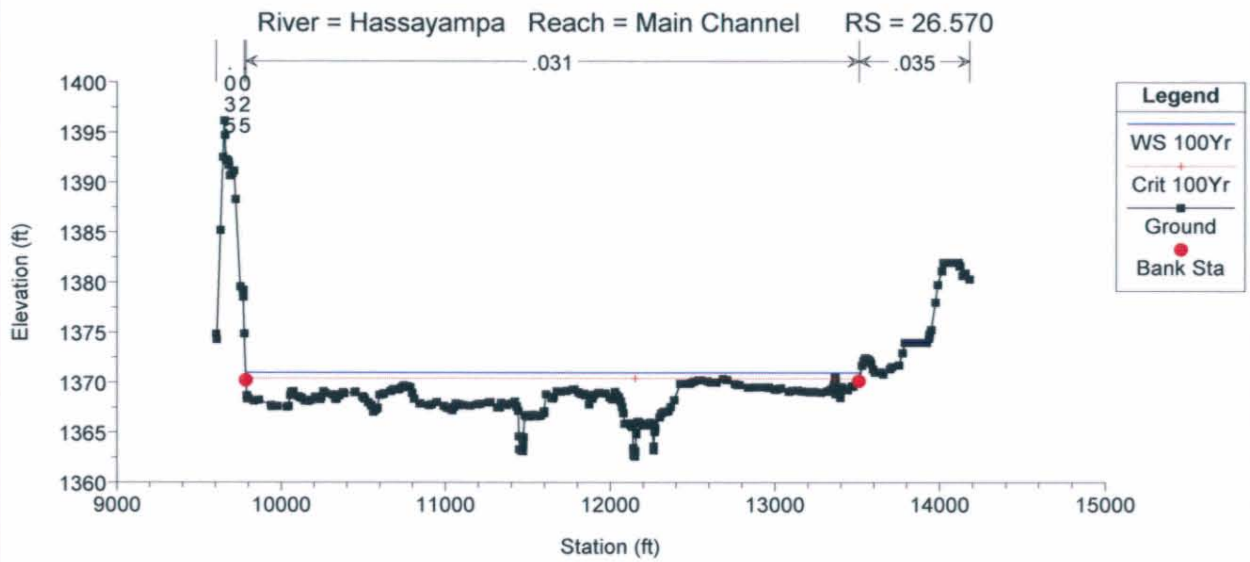

River = Hassayampa Reach = Main Channel RS = 26.950
.032
.035
.035
.025
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 26.850
.031
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

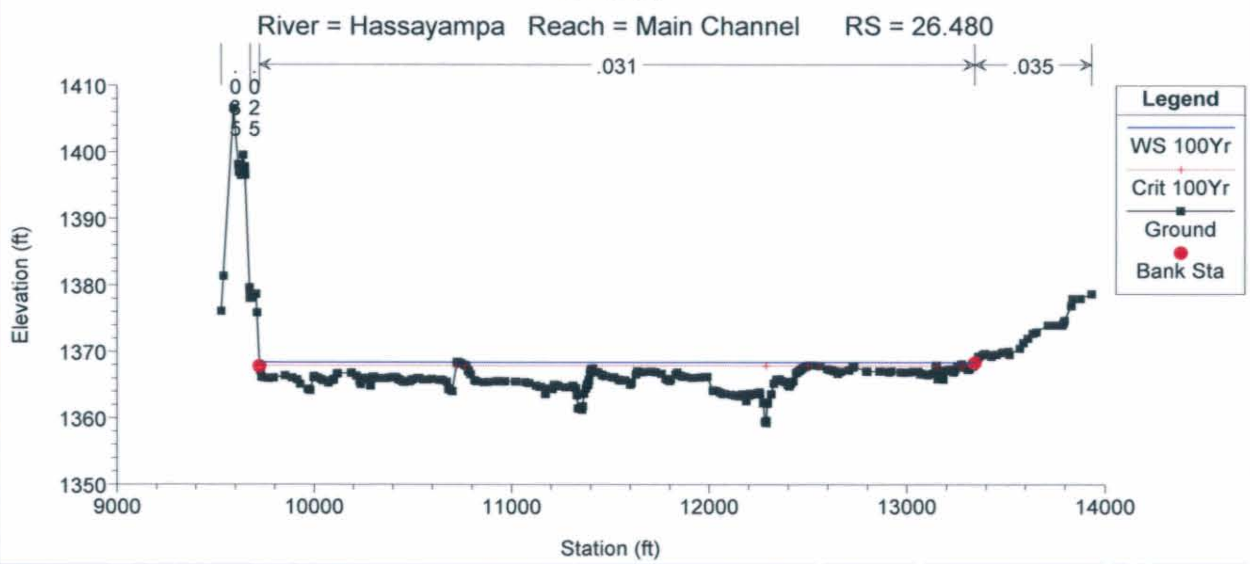

River = Hassayampa Reach = Main Channel RS = 26.760
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)



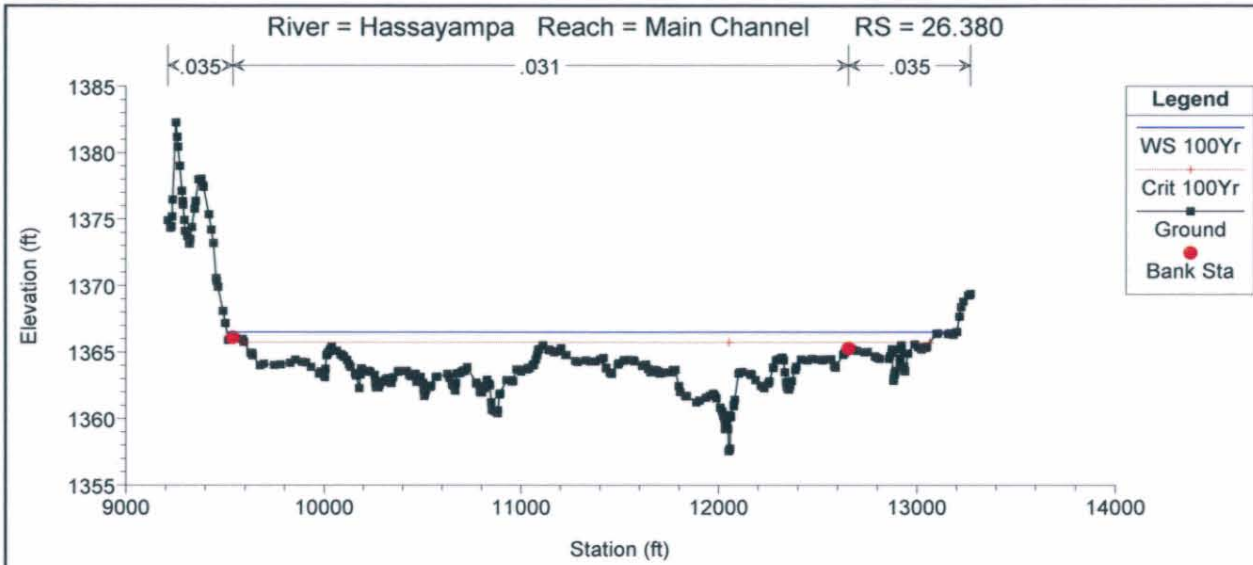
River = Hassayampa Reach = Main Channel RS = 26.670
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

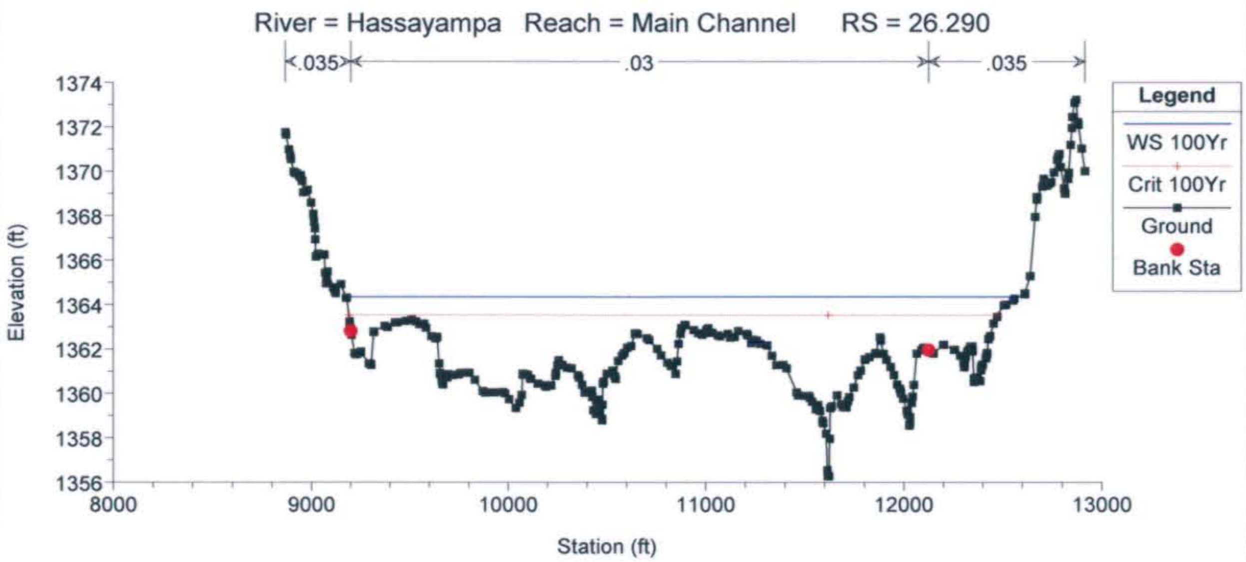


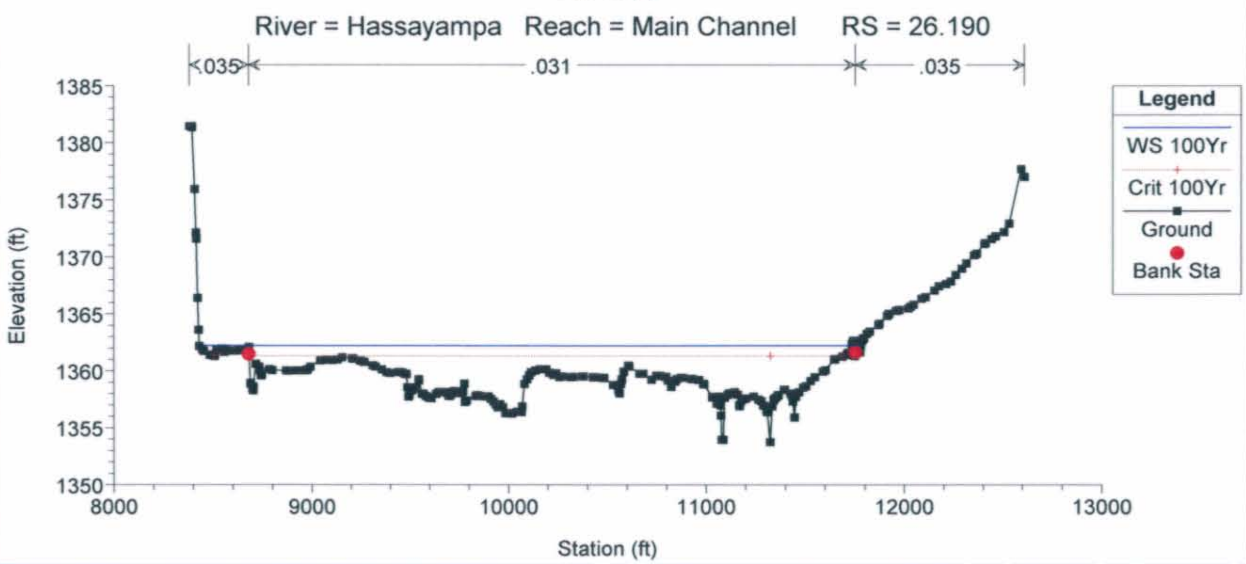
River = Hassayampa Reach = Main Channel RS = 26.570
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

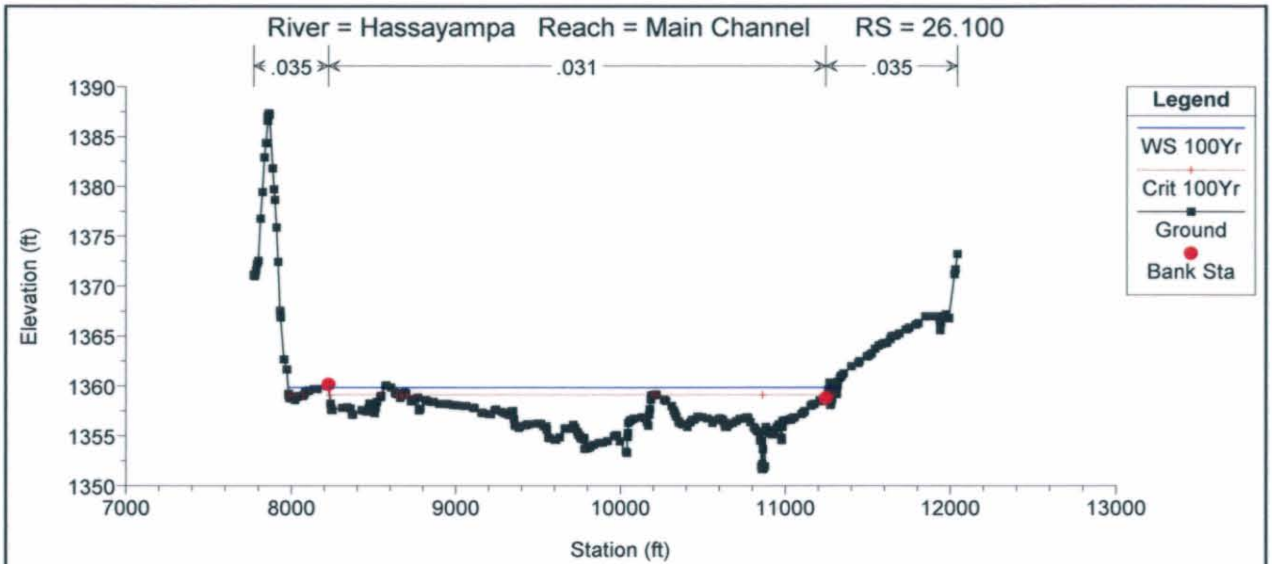


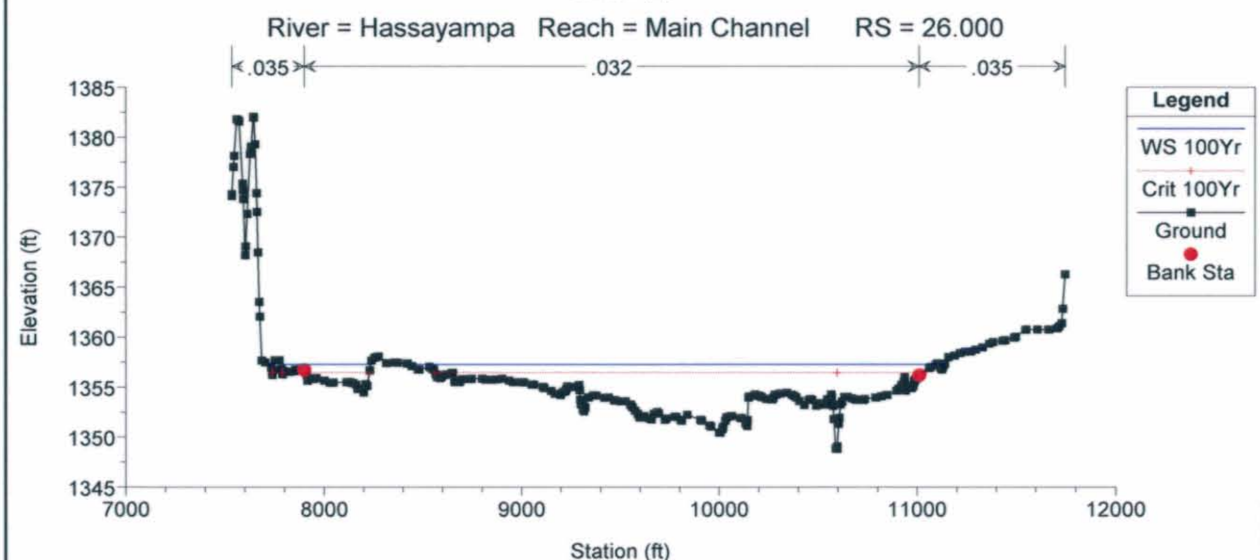
River = Hassayampa Reach = Main Channel RS = 26.480
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

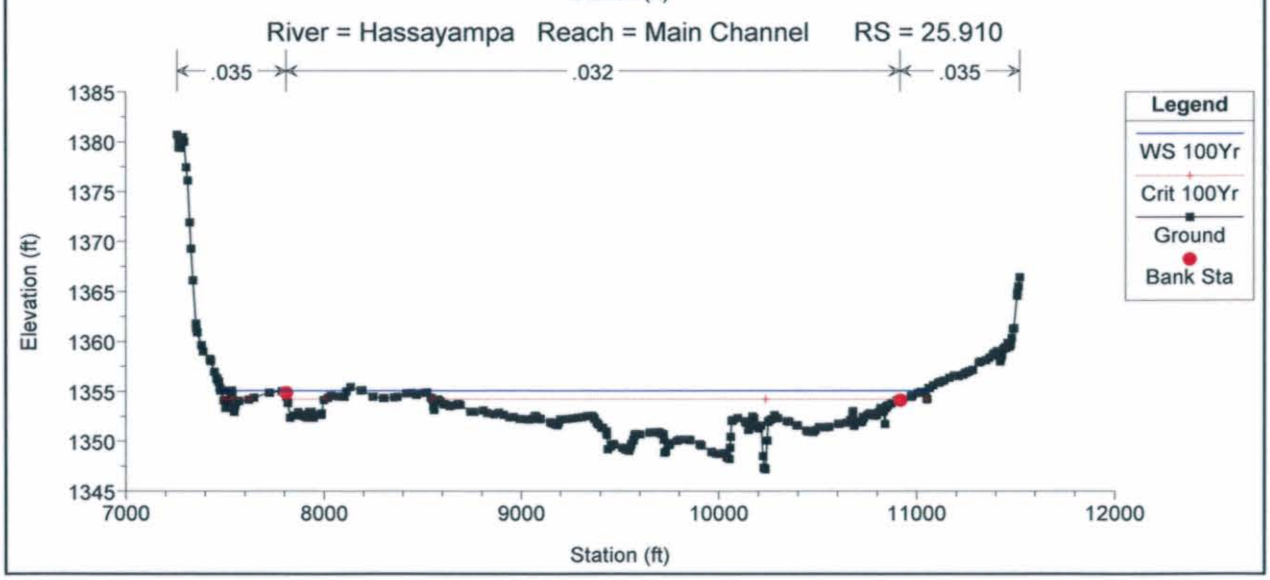

River = Hassayampa Reach = Main Channel RS = 26.380
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1355
1360
1365
1370
1375
1380
1385
9000
10000
11000
12000
13000
14000

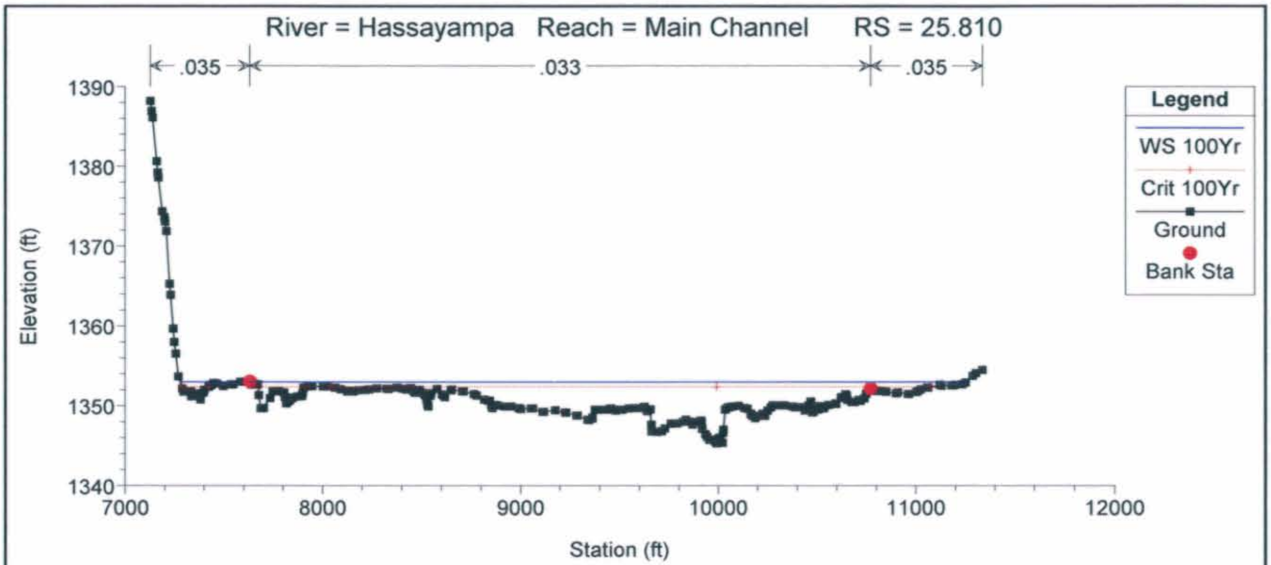

River = Hassayampa Reach = Main Channel RS = 26.290
.035
.03
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1356
1358
1360
1362
1364
1366
1368
1370
1372
1374
8000
9000
10000
11000
12000
13000

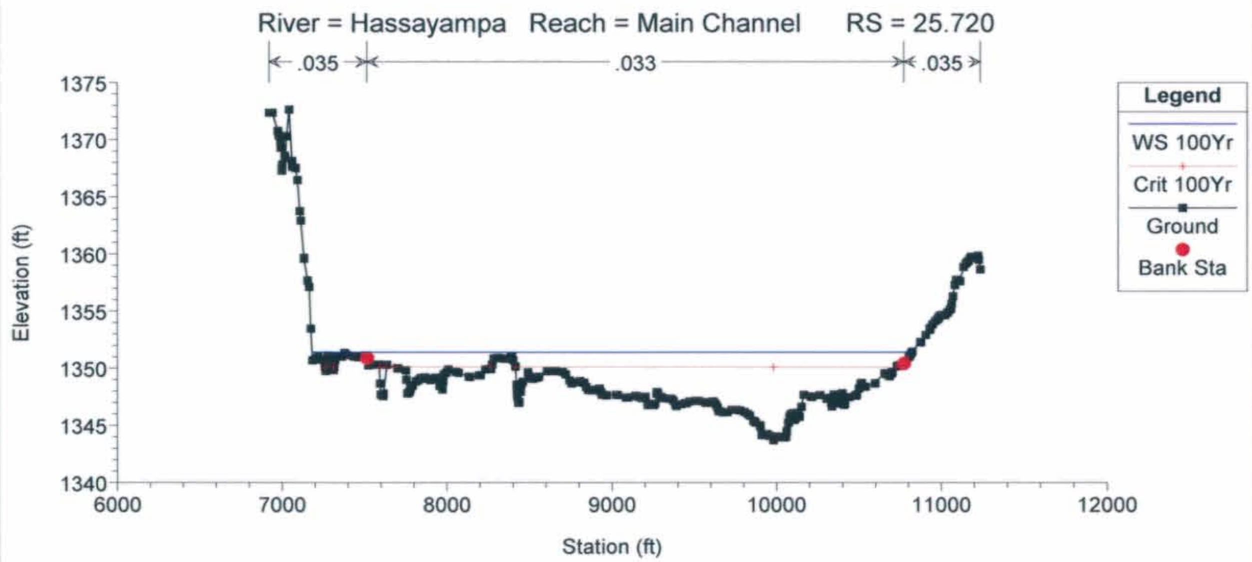

River = Hassayampa Reach = Main Channel RS = 26.190
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1350
1355
1360
1365
1370
1375
1380
1385
8000
9000
10000
11000
12000
13000

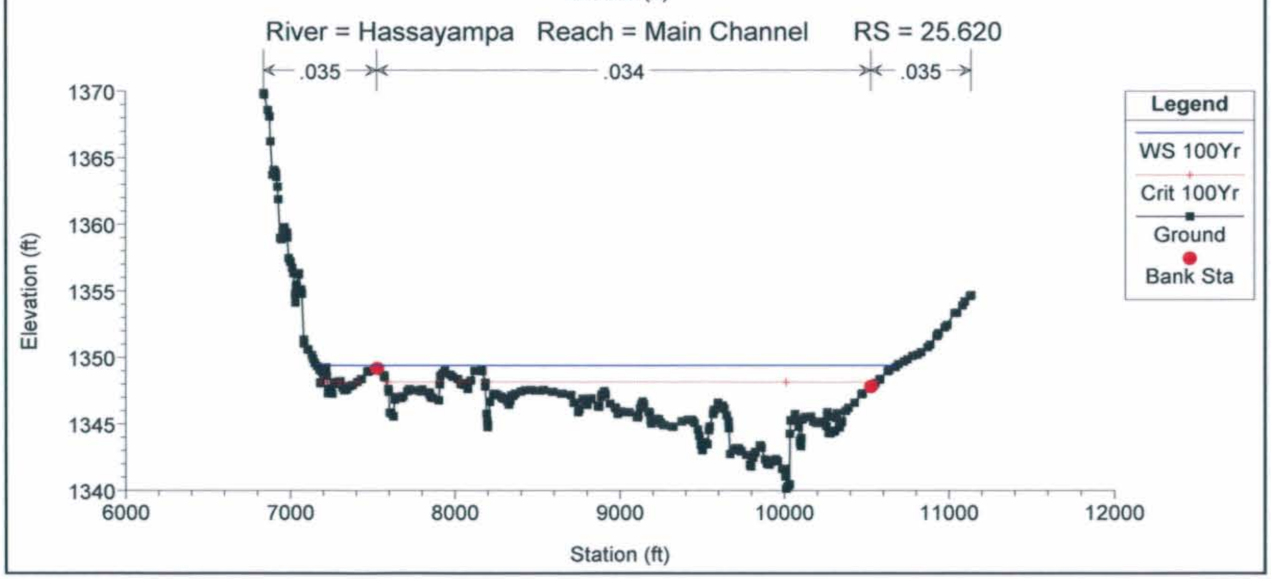

River = Hassayampa Reach = Main Channel RS = 26.100
.035 .031 .035
1390
1385
1380
1375
1370
1365
1360
1355
1350
Elevation (ft)
7000 8000 9000 10000 11000 12000 13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

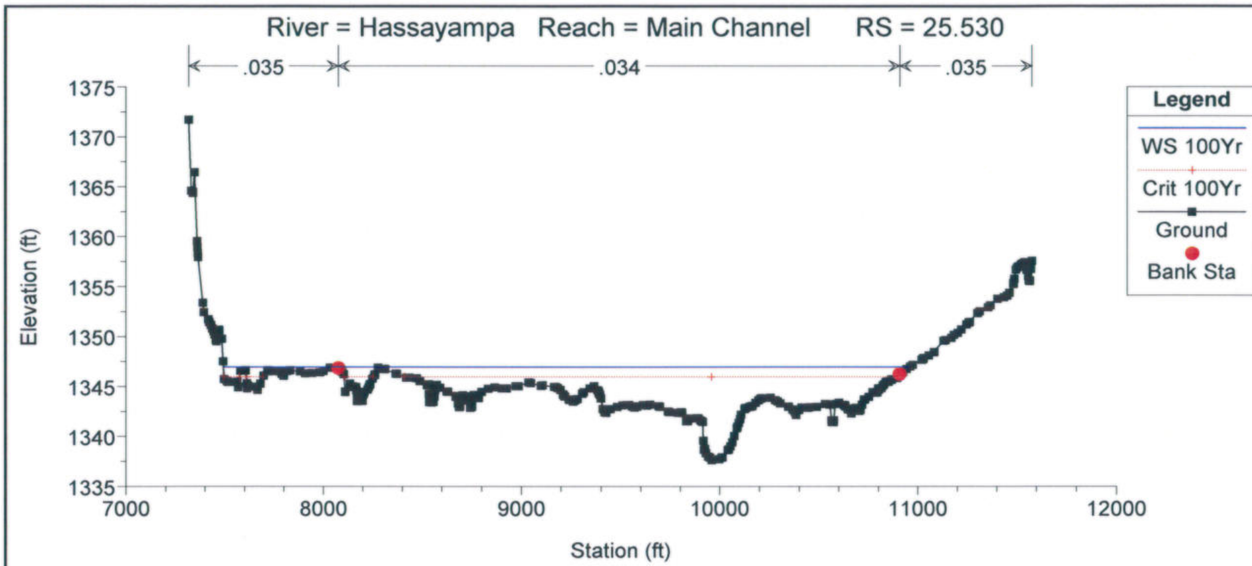

River = Hassayampa Reach = Main Channel RS = 26.000
.035 .032 .035
1385
1380
1375
1370
1365
1360
1355
1350
1345
Elevation (ft)
7000 8000 9000 10000 11000 12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

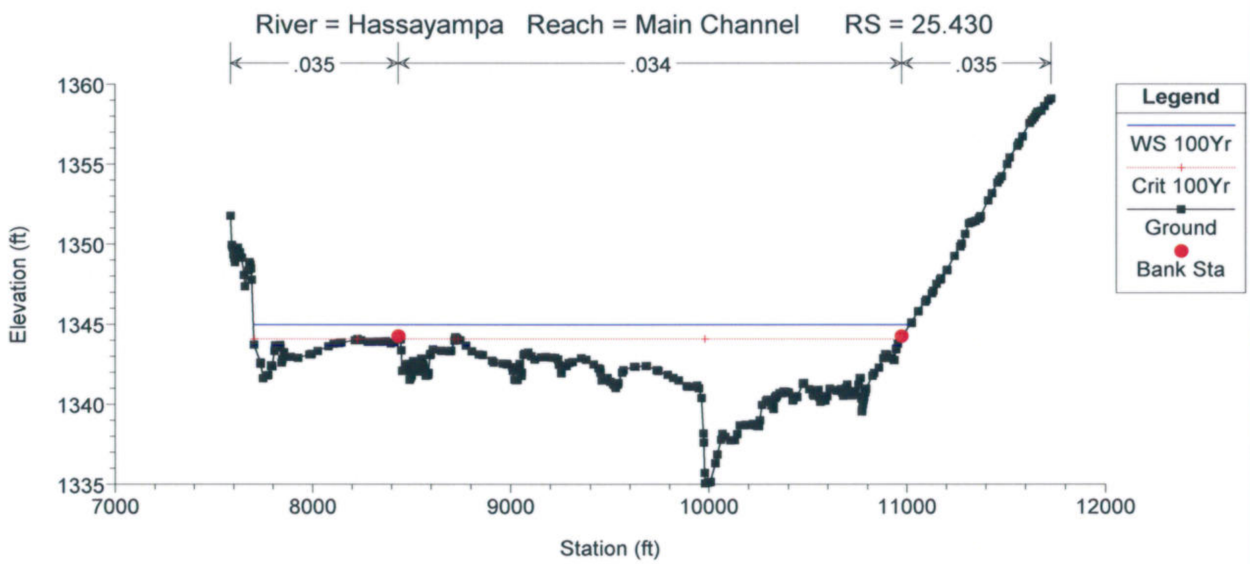

River = Hassayampa Reach = Main Channel RS = 25.910
.035 .032 .035
1385
1380
1375
1370
1365
1360
1355
1350
1345
Elevation (ft)
7000 8000 9000 10000 11000 12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

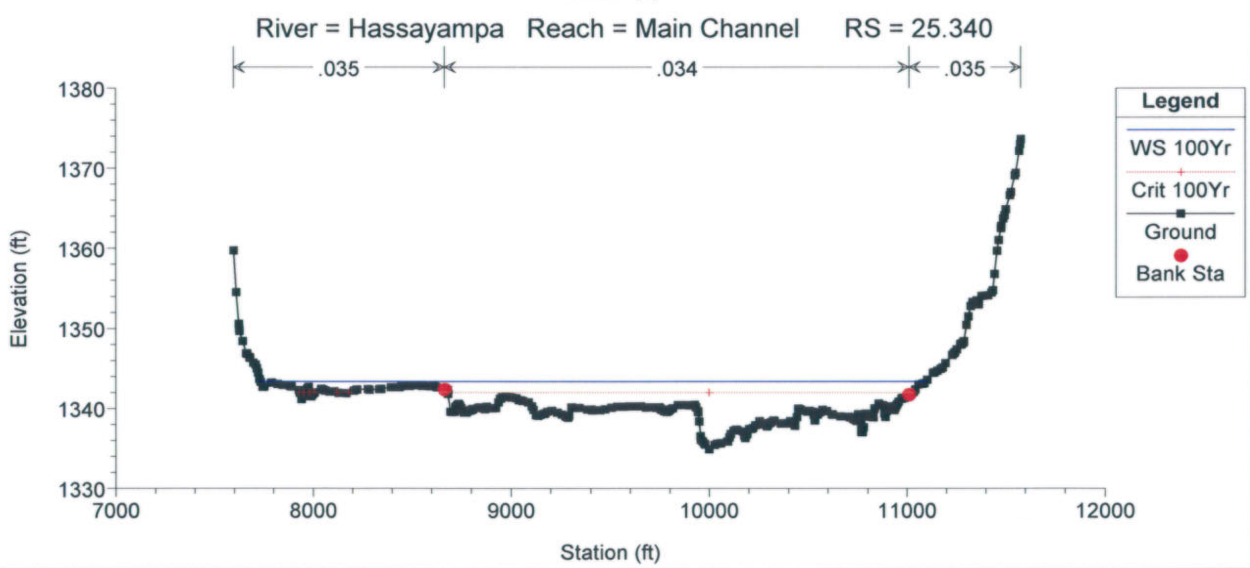

River = Hassayampa Reach = Main Channel RS = 25.810
.035
.033
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

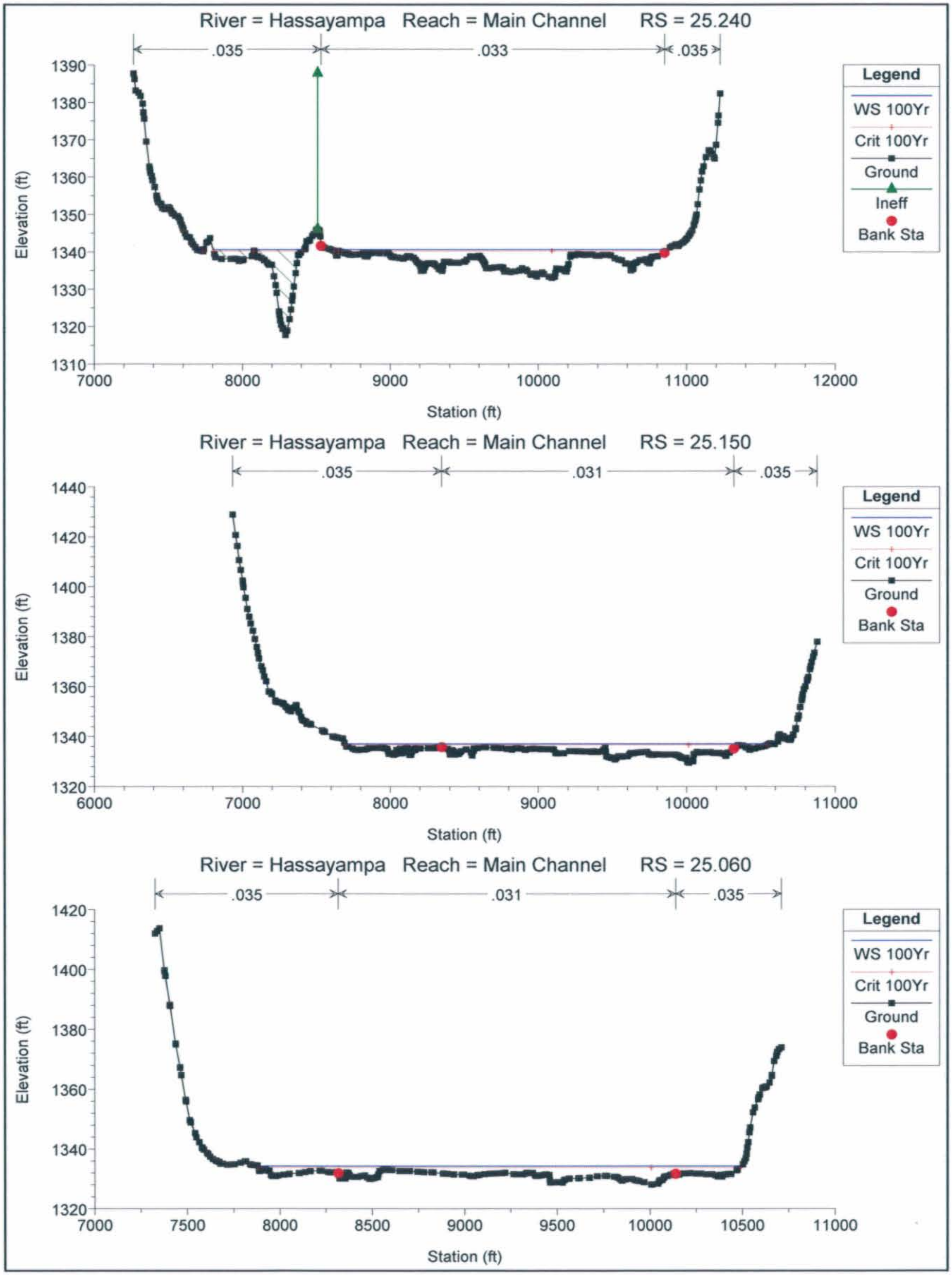

River = Hassayampa Reach = Main Channel RS = 25.720
.035
.033
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

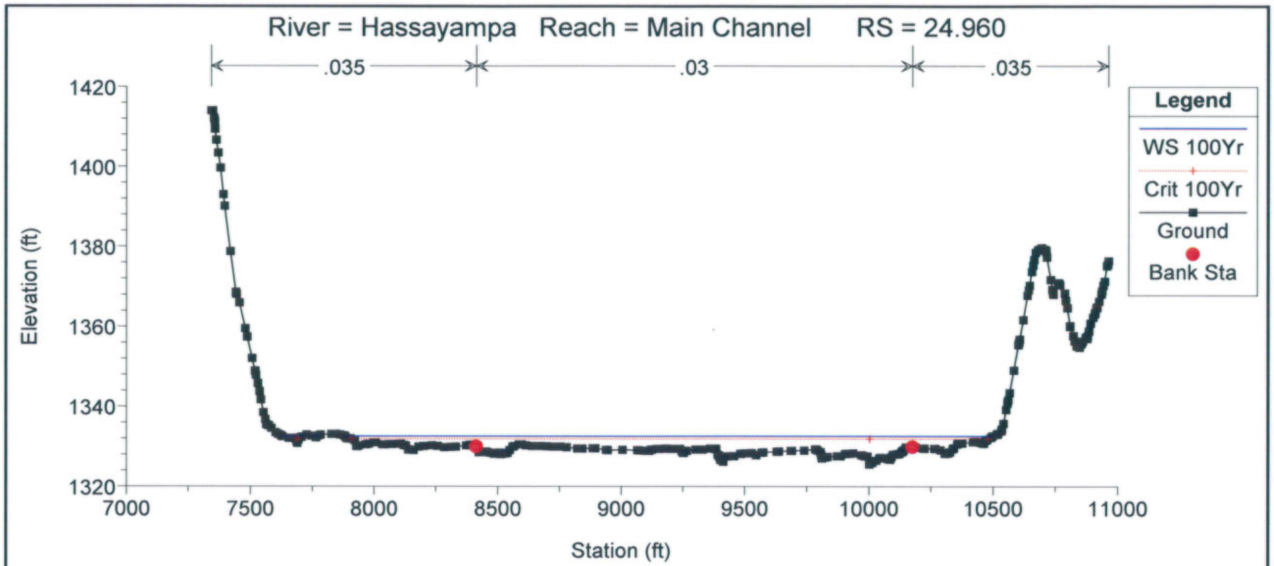

River = Hassayampa Reach = Main Channel RS = 25.620
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

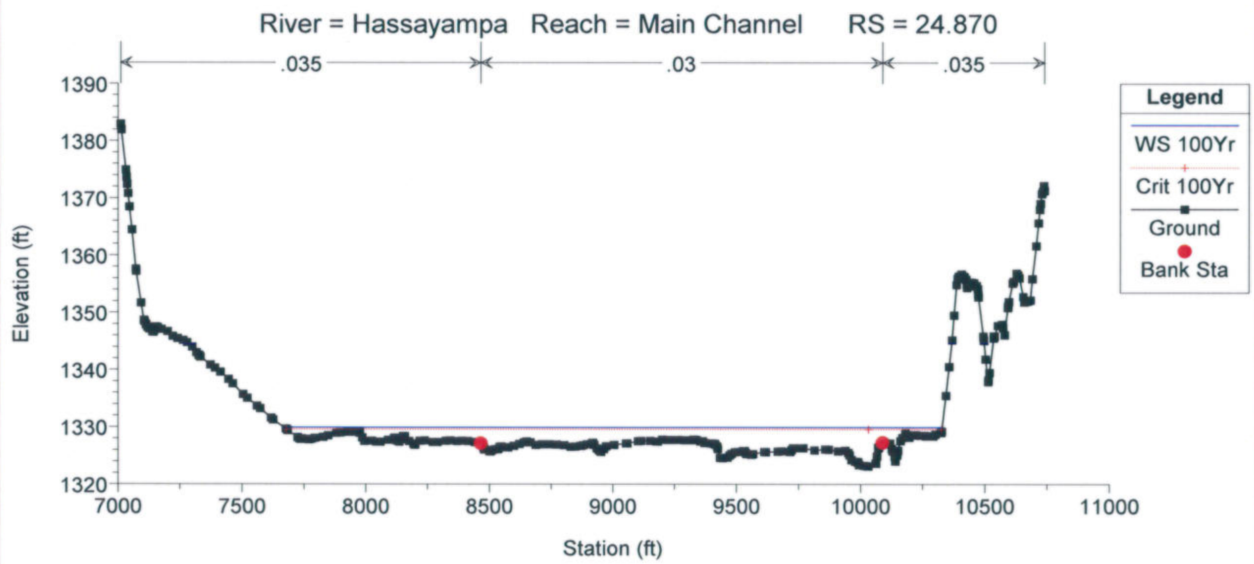

River = Hassayampa Reach = Main Channel RS = 25.530
.035
.034
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

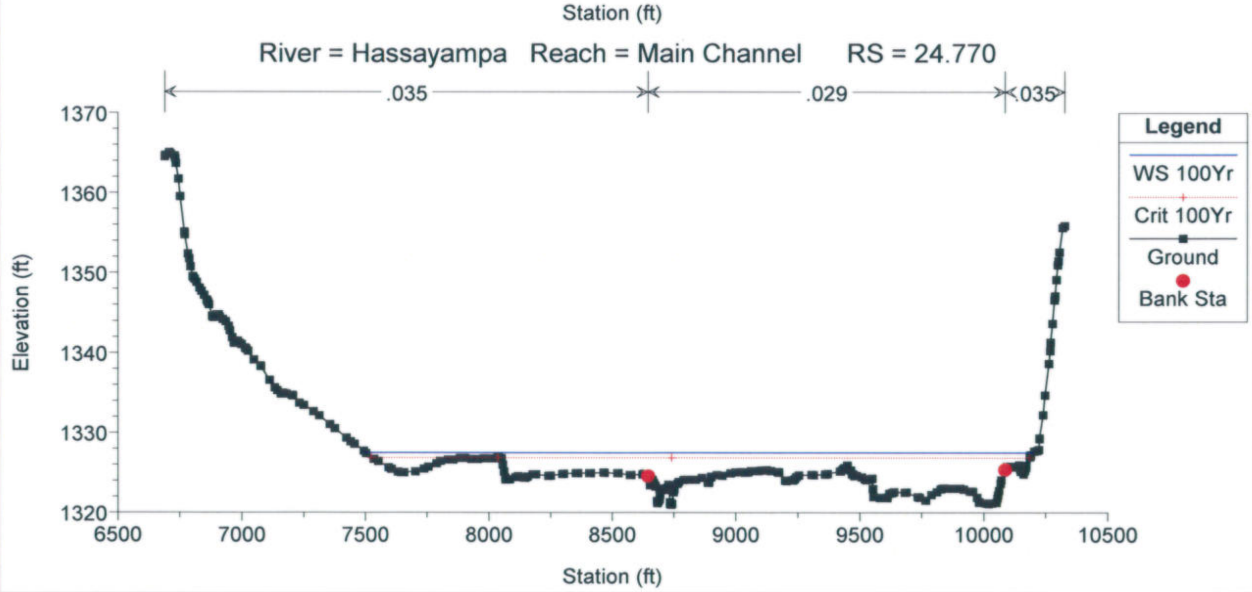

River = Hassayampa Reach = Main Channel RS = 25.430
.035
.034
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

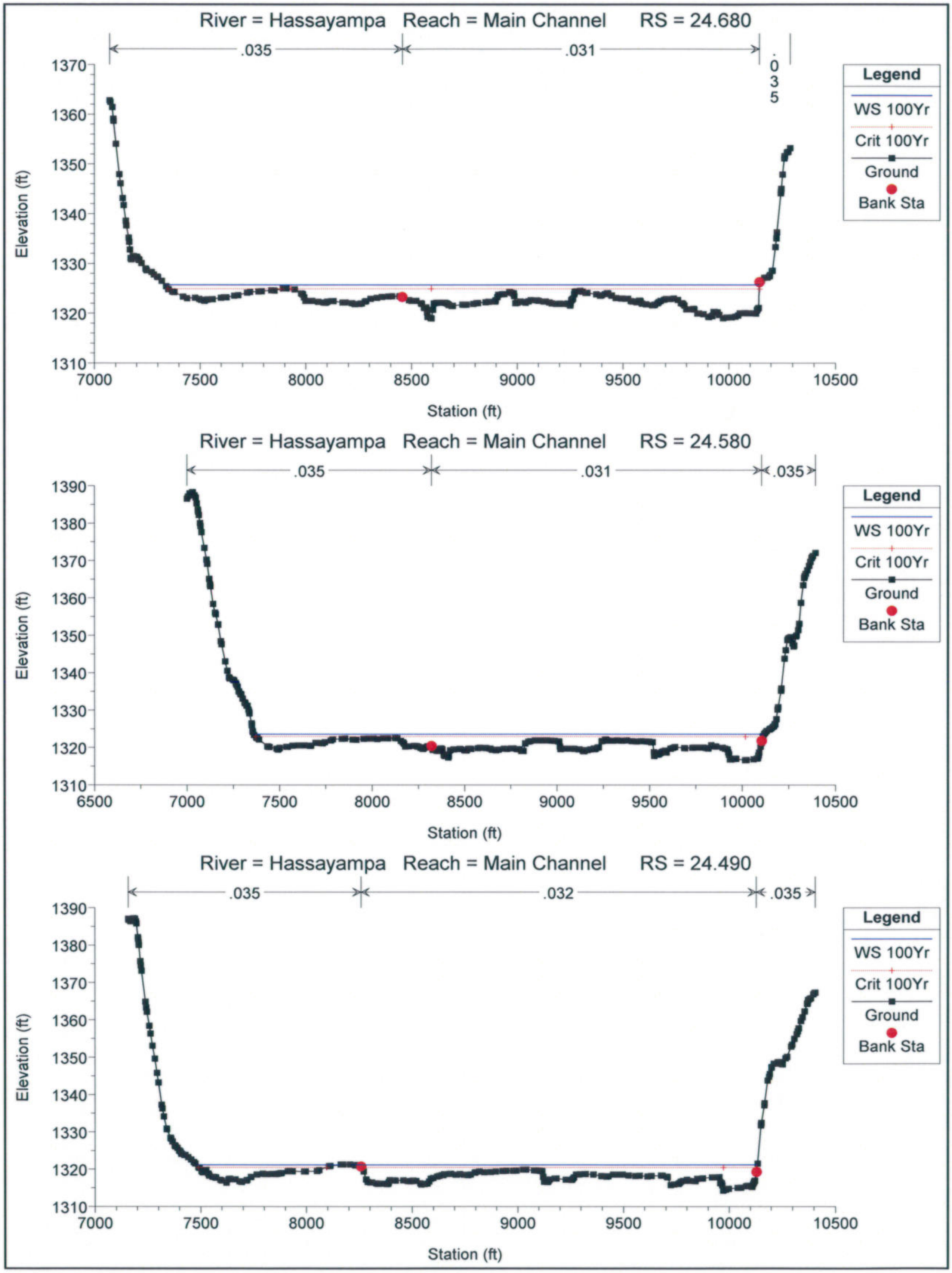

River = Hassayampa Reach = Main Channel RS = 25.340
.035
.034
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

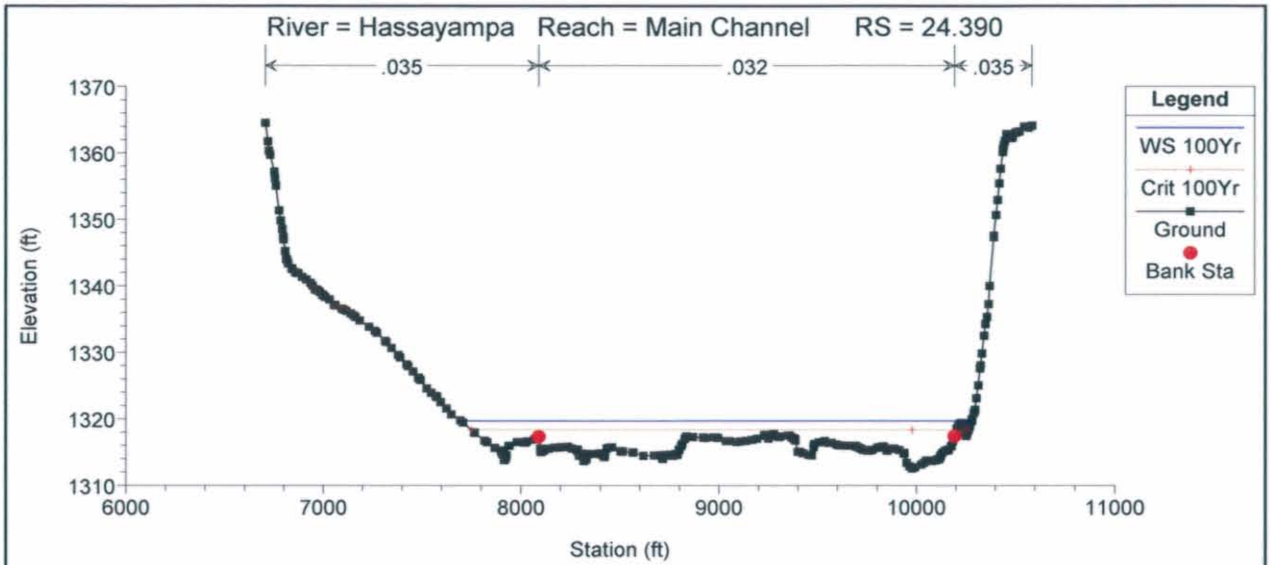

River = Hassayampa Reach = Main Channel RS = 25.240
.035
.033
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 25.150
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 25.060
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

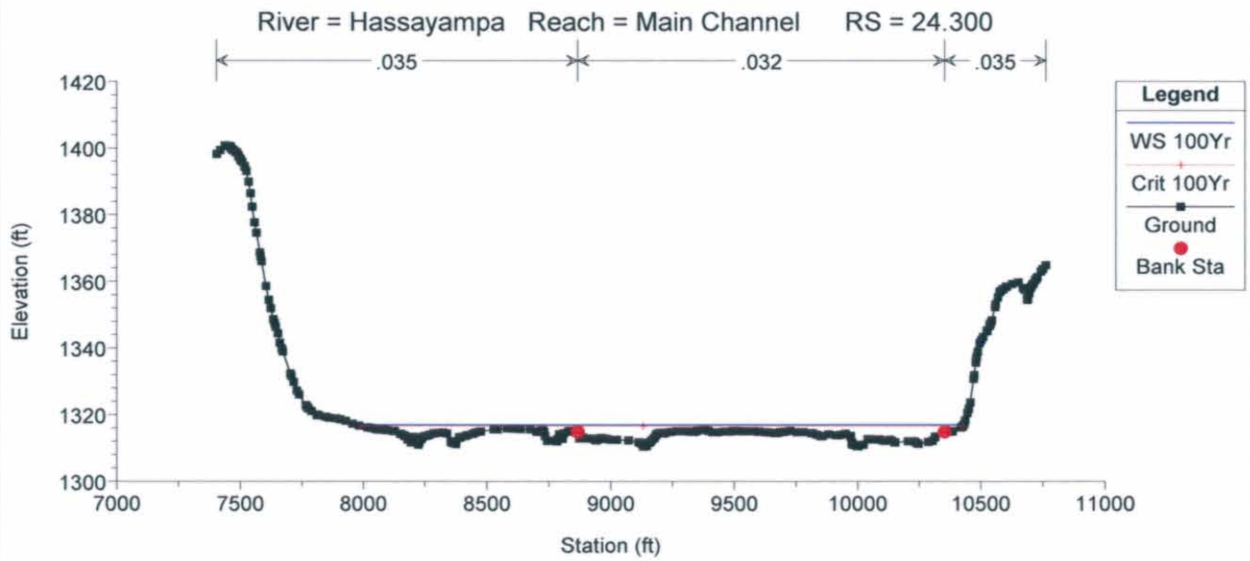

River = Hassayampa Reach = Main Channel RS = 24.960
.035
.03
.035
Elevation (ft)
1420
1400
1380
1360
1340
1320
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

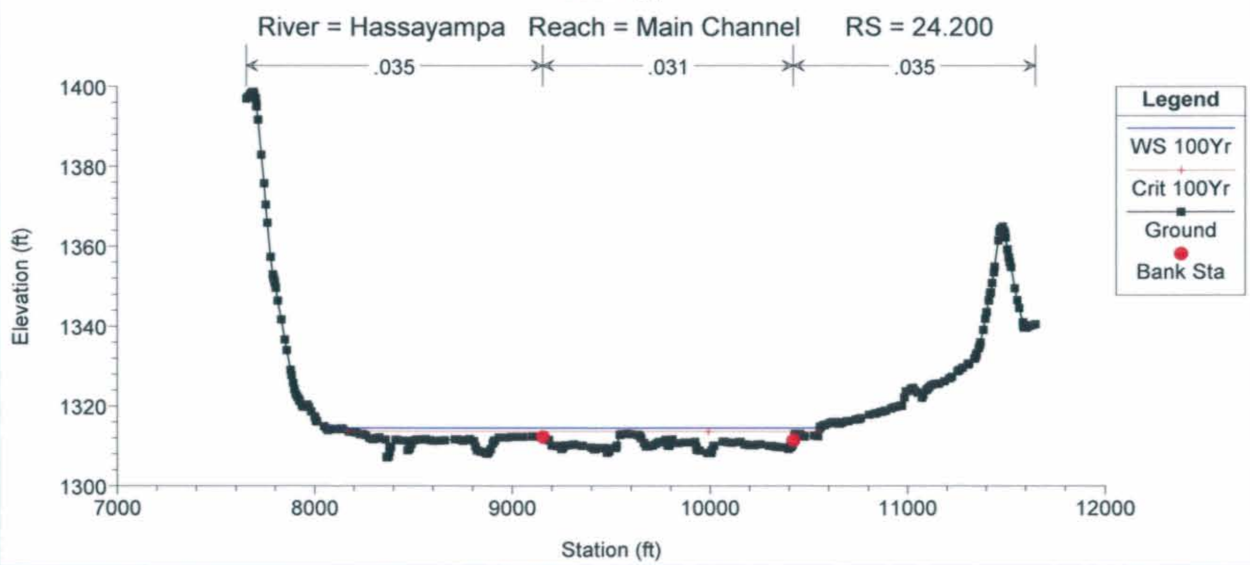

River = Hassayampa Reach = Main Channel RS = 24.870
.035
.03
.035
Elevation (ft)
1390
1380
1370
1360
1350
1340
1330
1320
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

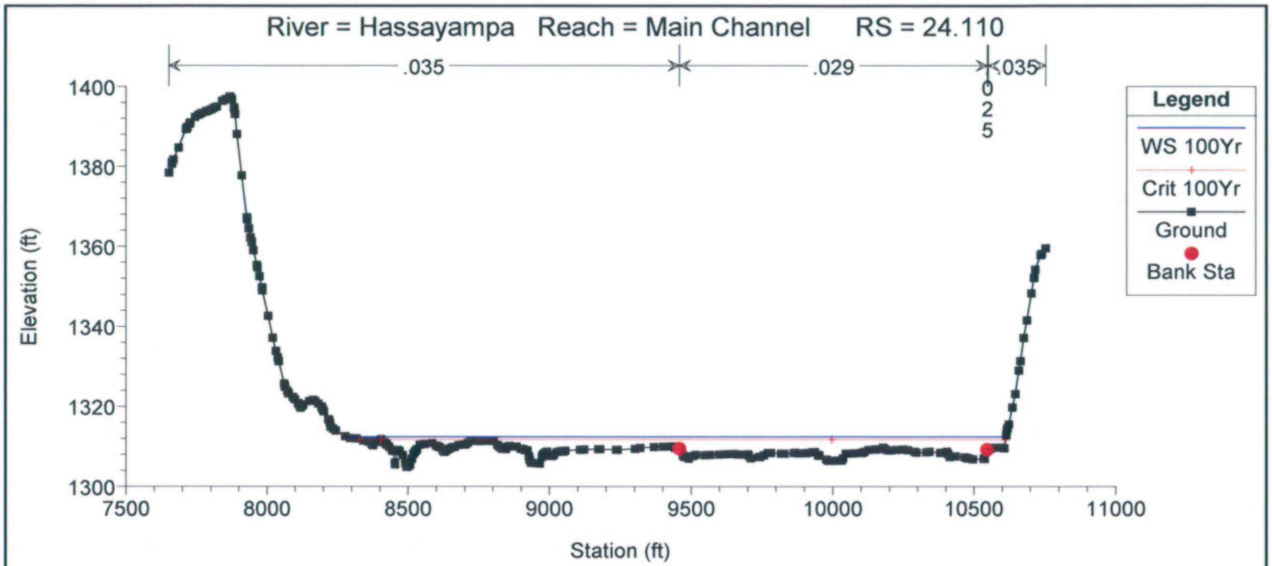

River = Hassayampa Reach = Main Channel RS = 24.770
.035
.029
.035
Elevation (ft)
1370
1360
1350
1340
1330
1320
6500
7000
7500
8000
8500
9000
9500
10000
10500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

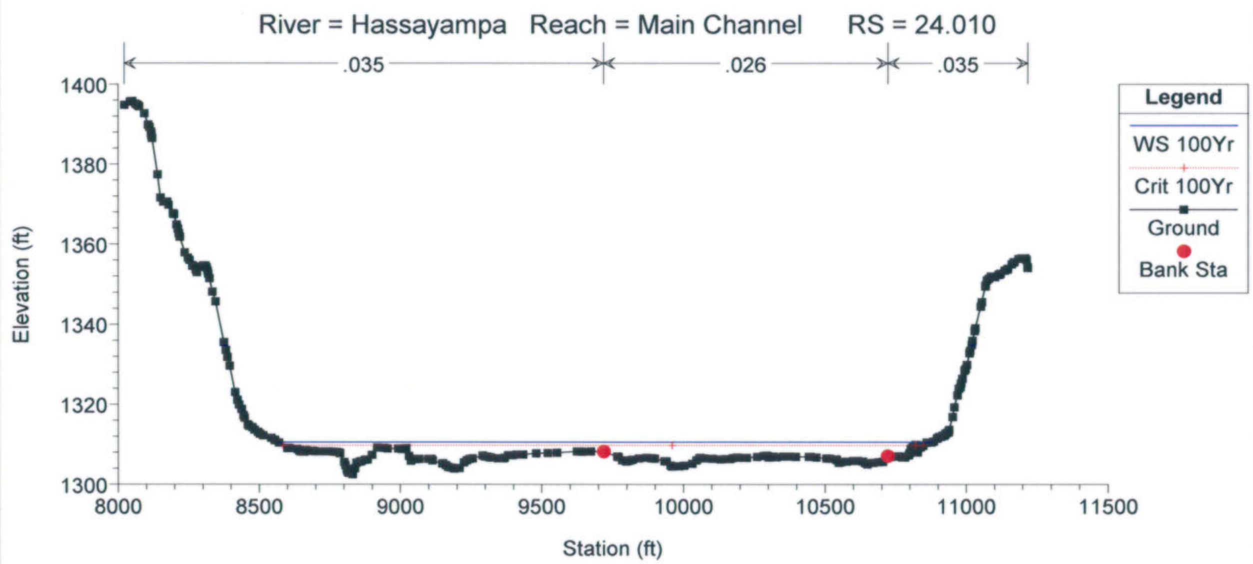

River = Hassayampa Reach = Main Channel RS = 24.680
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 24.580
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 24.490
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

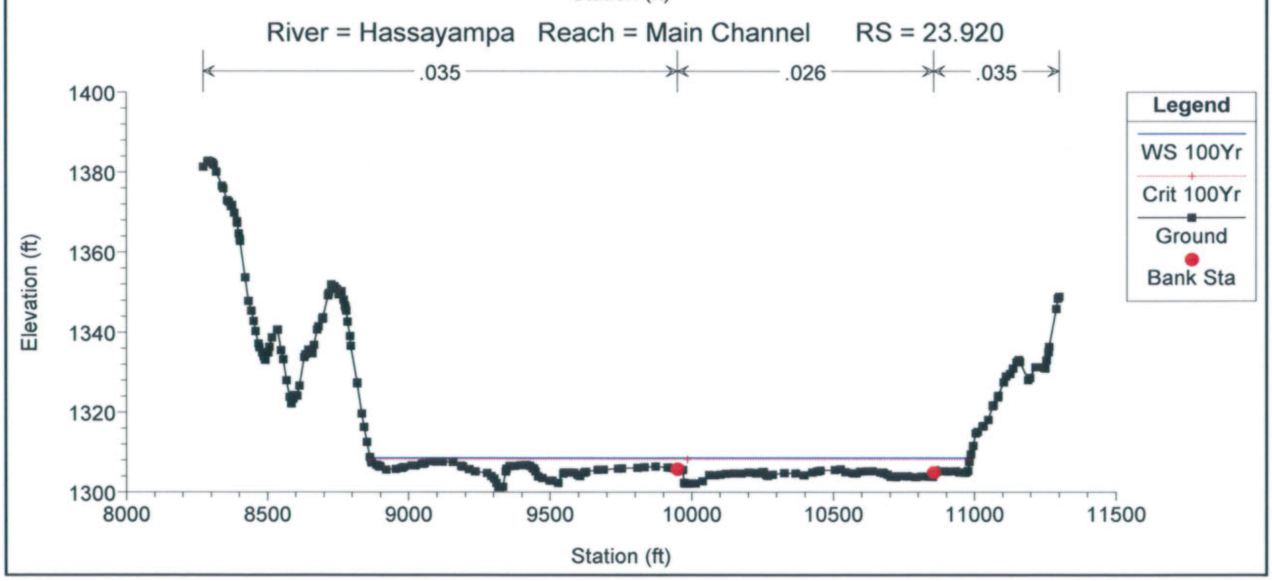

River = Hassayampa Reach = Main Channel RS = 24.390
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1370
1360
1350
1340
1330
1320
1310
6000
7000
8000
9000
10000
11000
Station (ft)

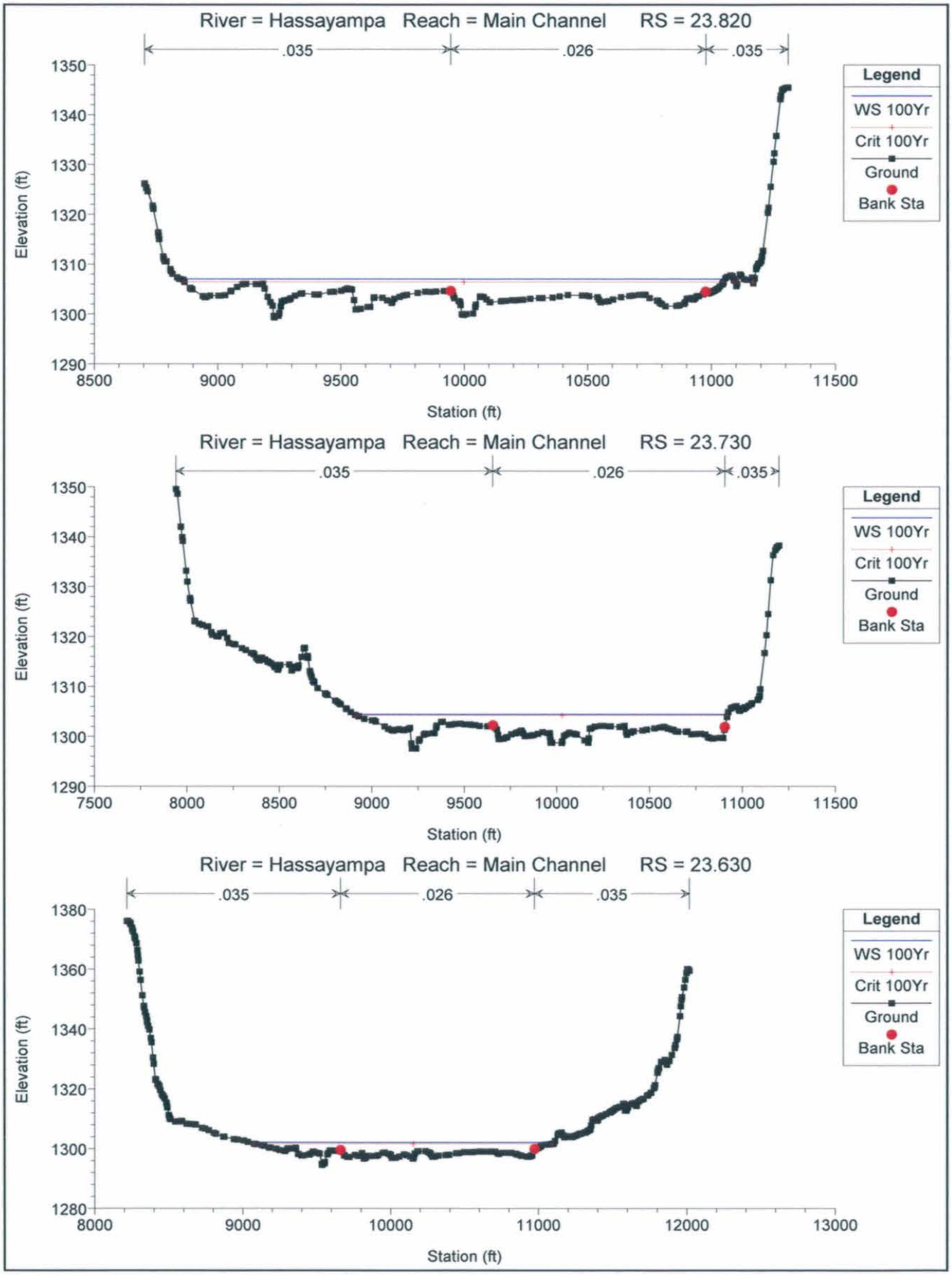

River = Hassayampa Reach = Main Channel RS = 24.300
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1420
1400
1380
1360
1340
1320
1300
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

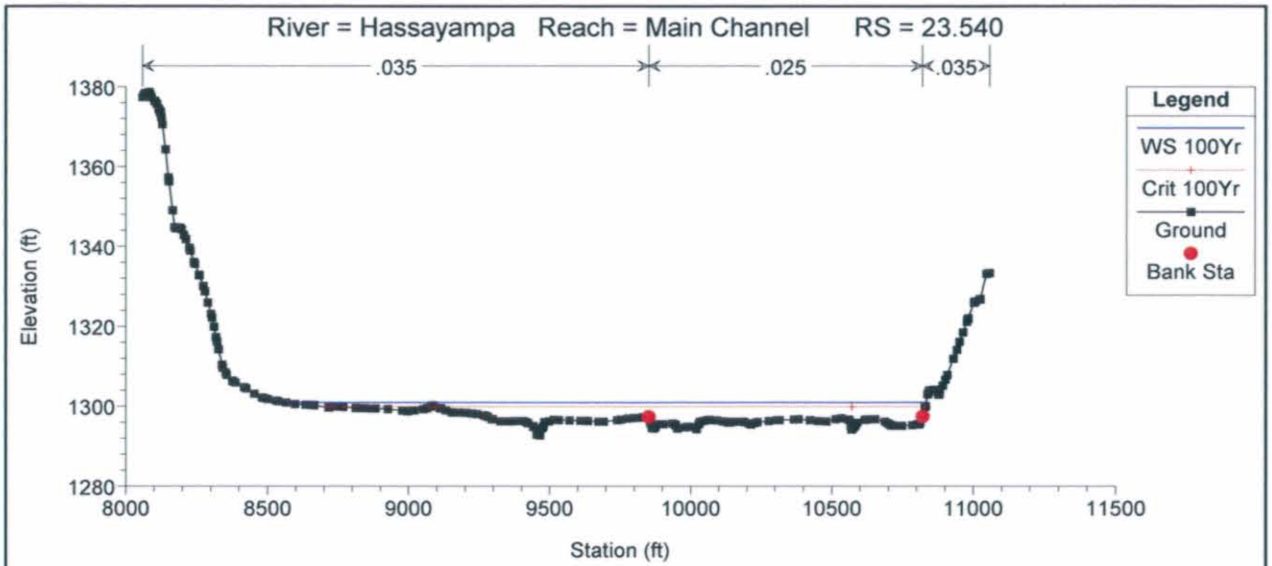

River = Hassayampa Reach = Main Channel RS = 24.200
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1400
1380
1360
1340
1320
1300
7000
8000
9000
10000
11000
12000
Station (ft)


River = Hassayampa Reach = Main Channel RS = 24.110
.035
.029
.035
0
2
5
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1400
1380
1360
1340
1320
1300
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

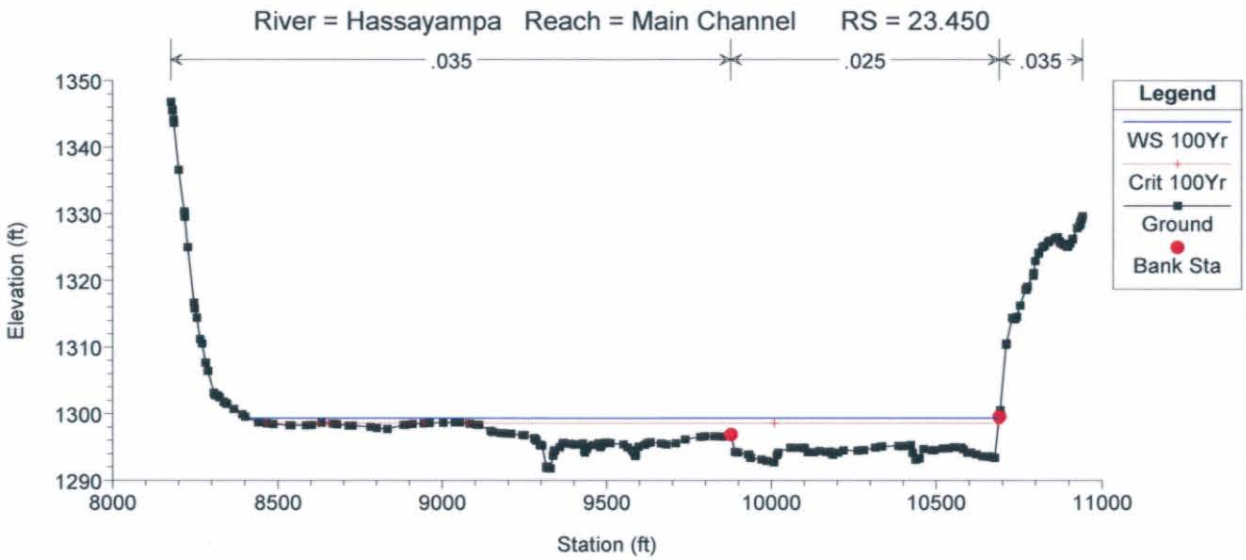

River = Hassayampa Reach = Main Channel RS = 24.010
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1400
1380
1360
1340
1320
1300
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)


River = Hassayampa Reach = Main Channel RS = 23.920
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1400
1380
1360
1340
1320
1300
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

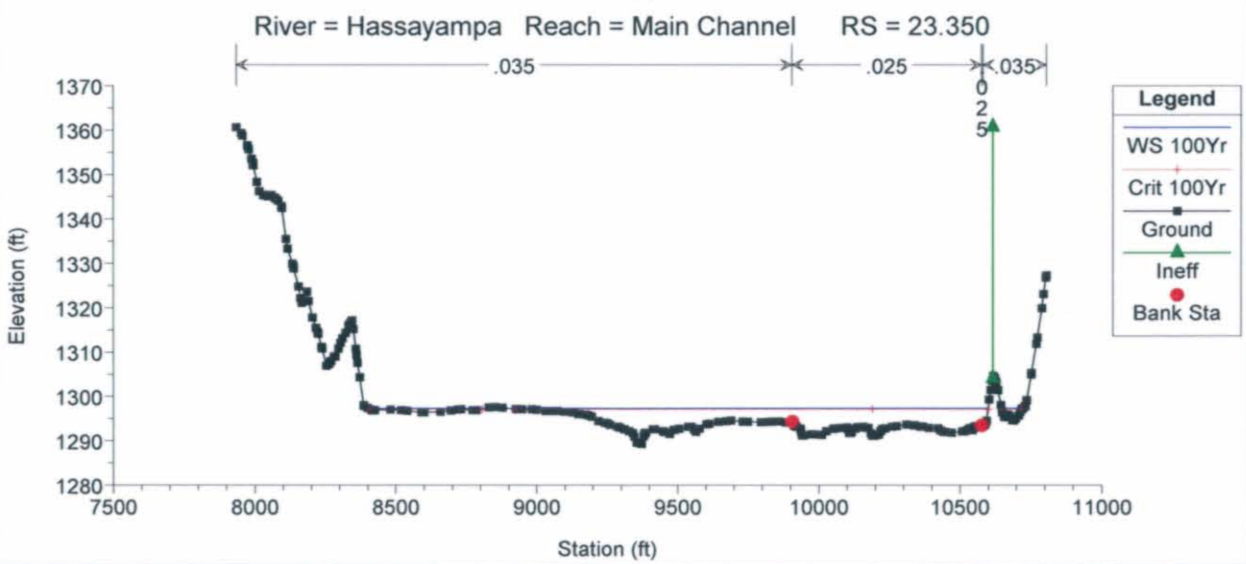

River = Hassayampa Reach = Main Channel RS = 23.820
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 23.730
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 23.630
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)



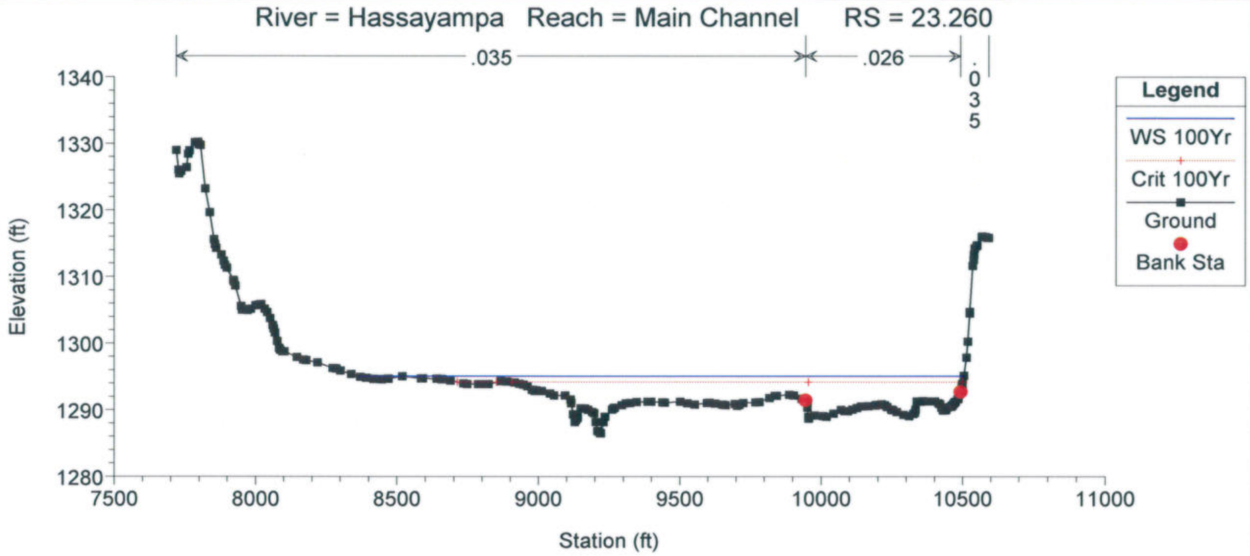
River = Hassayampa Reach = Main Channel RS = 23.540
.035
.025
.035
Elevation (ft)
1380
1360
1340
1320
1300
1280
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

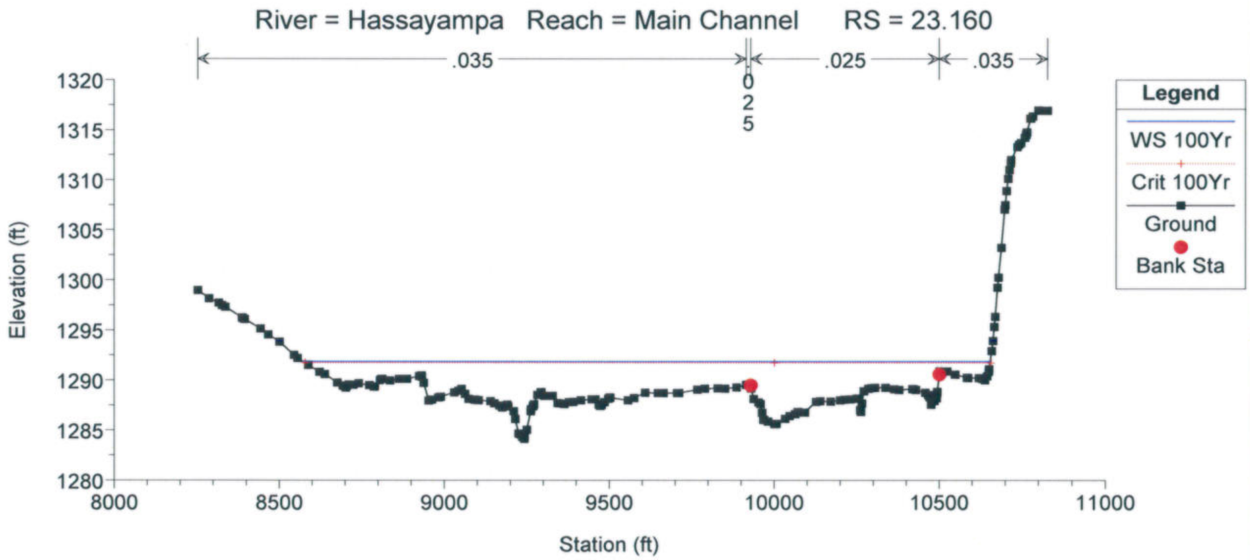


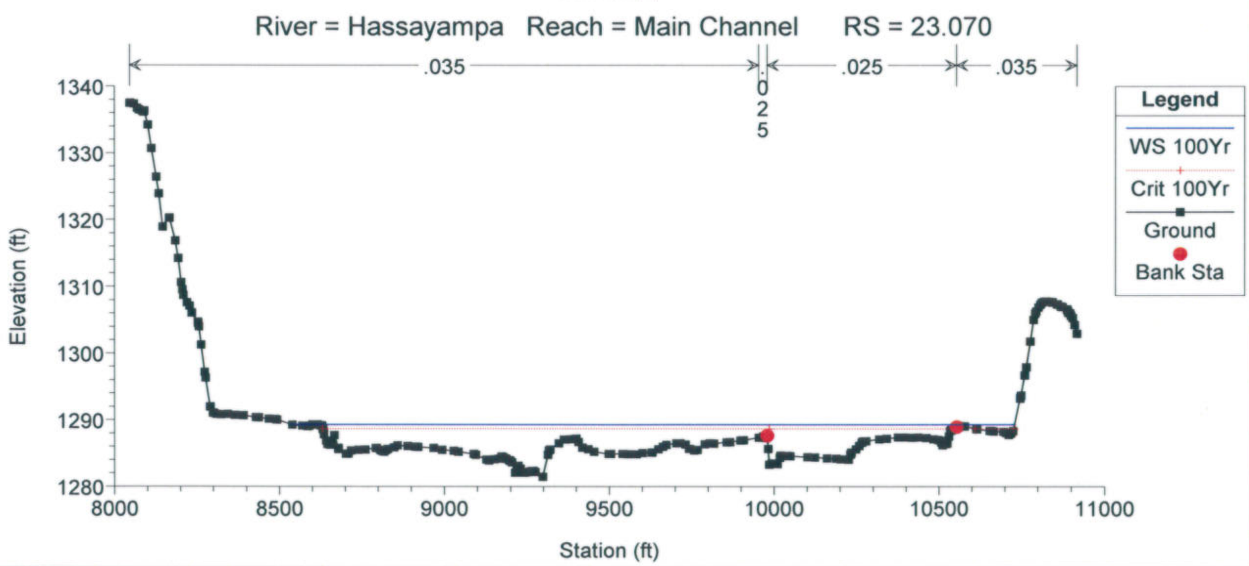
River = Hassayampa Reach = Main Channel RS = 23.450
.035
.025
.035
Elevation (ft)
1350
1340
1330
1320
1310
1300
1290
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

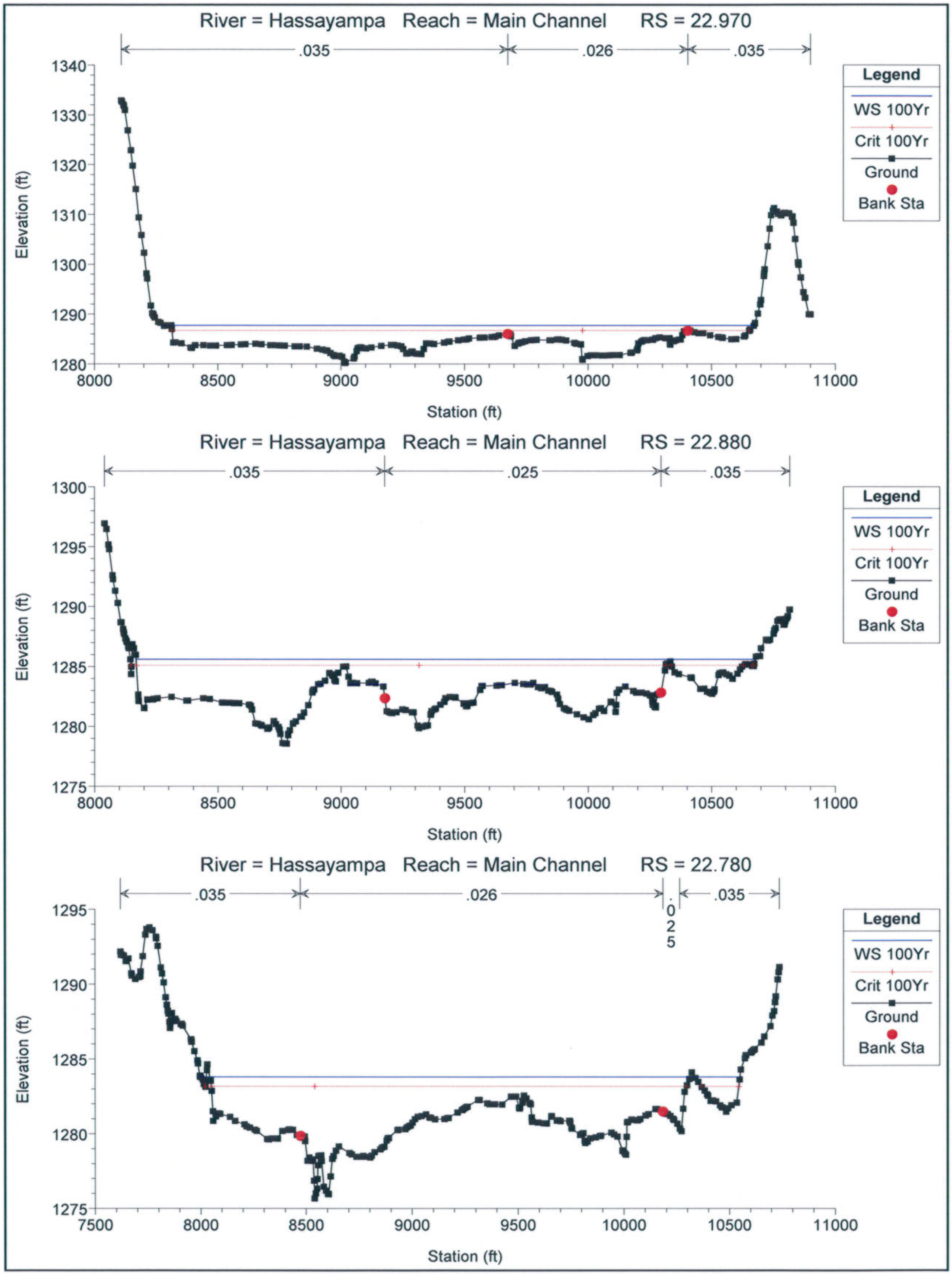


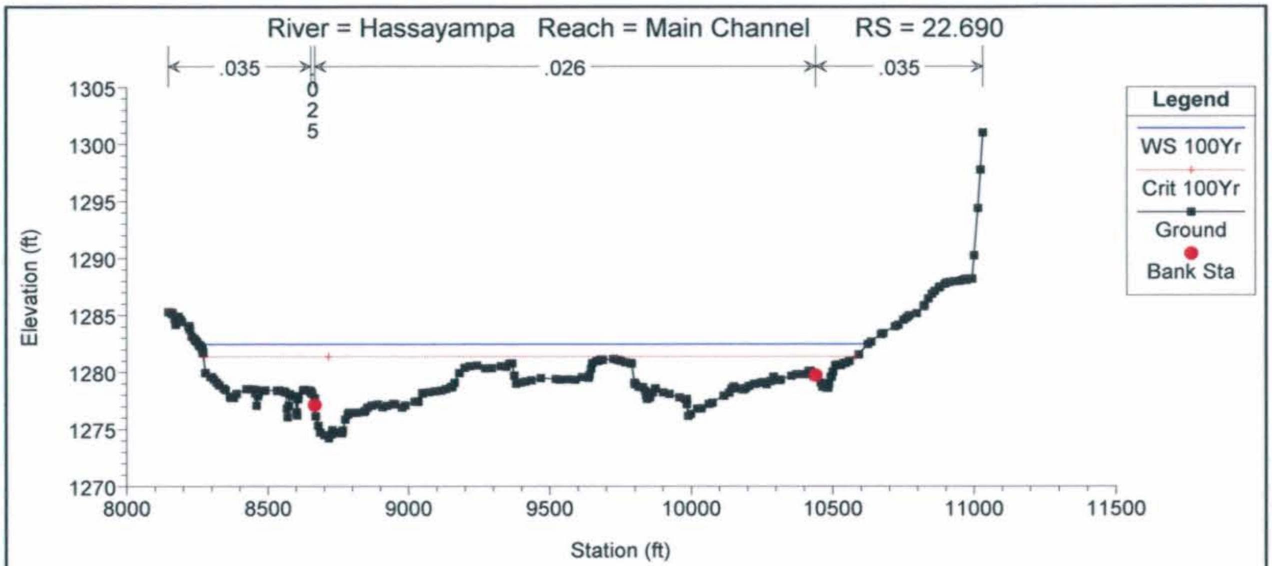
River = Hassayampa Reach = Main Channel RS = 23.350
.035
.025
.035
0
2
5
Elevation (ft)
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

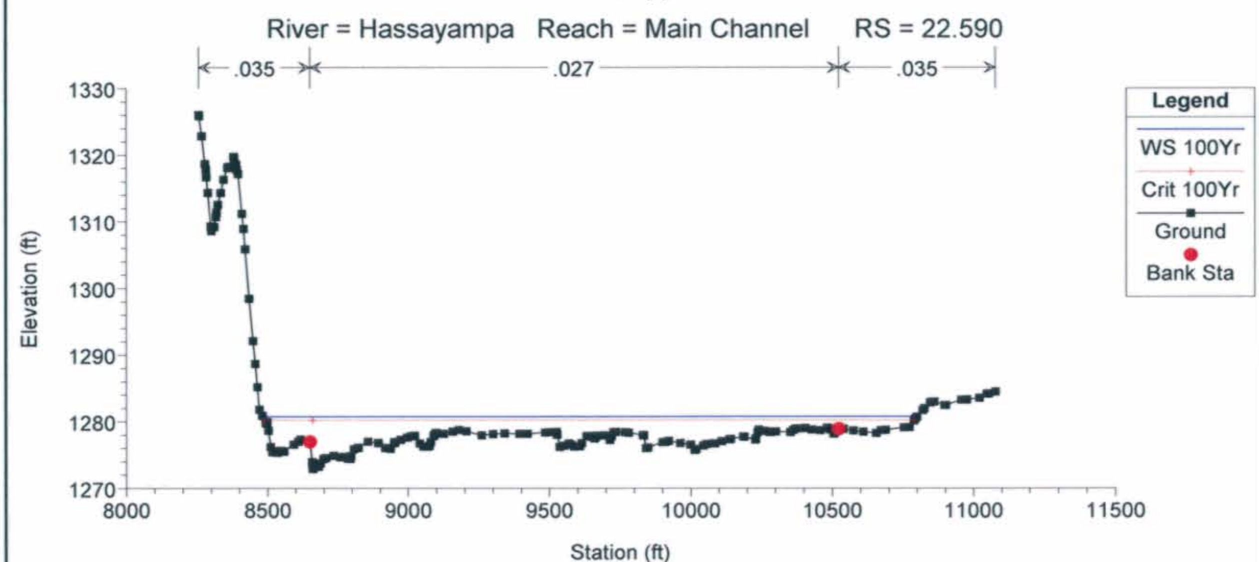

River = Hassayampa Reach = Main Channel RS = 23.260
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1340
1330
1320
1310
1300
1290
1280
7500
8000
8500
9000
9500
10000
10500
11000

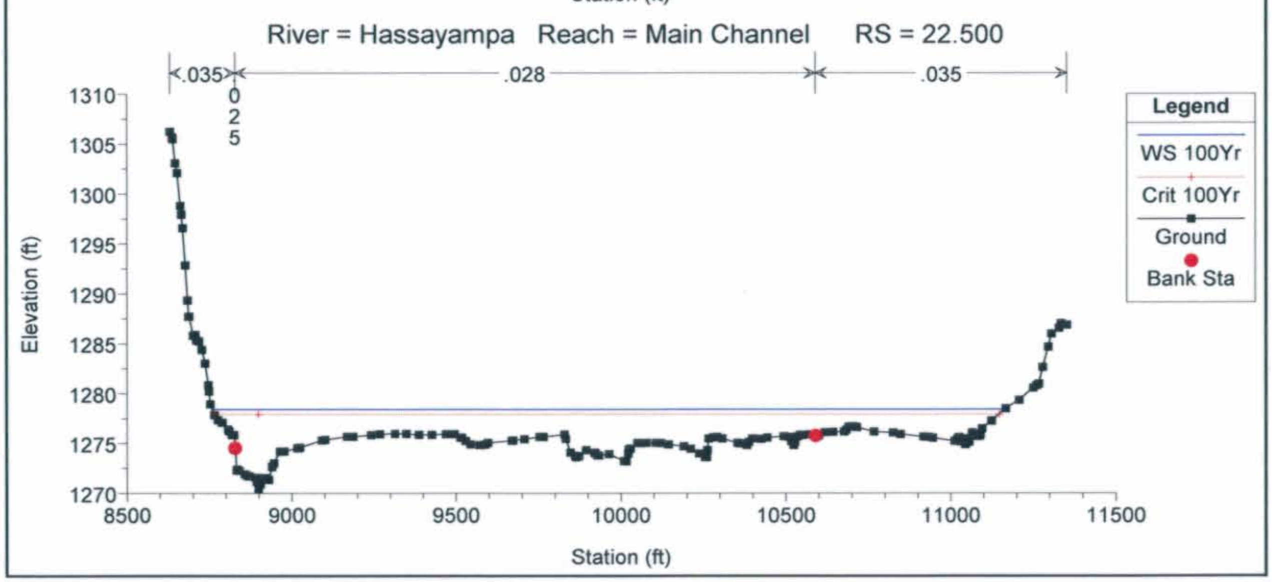

River = Hassayampa Reach = Main Channel RS = 23.160
.035
.025
.025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1320
1315
1310
1305
1300
1295
1290
1285
1280
8000
8500
9000
9500
10000
10500
11000

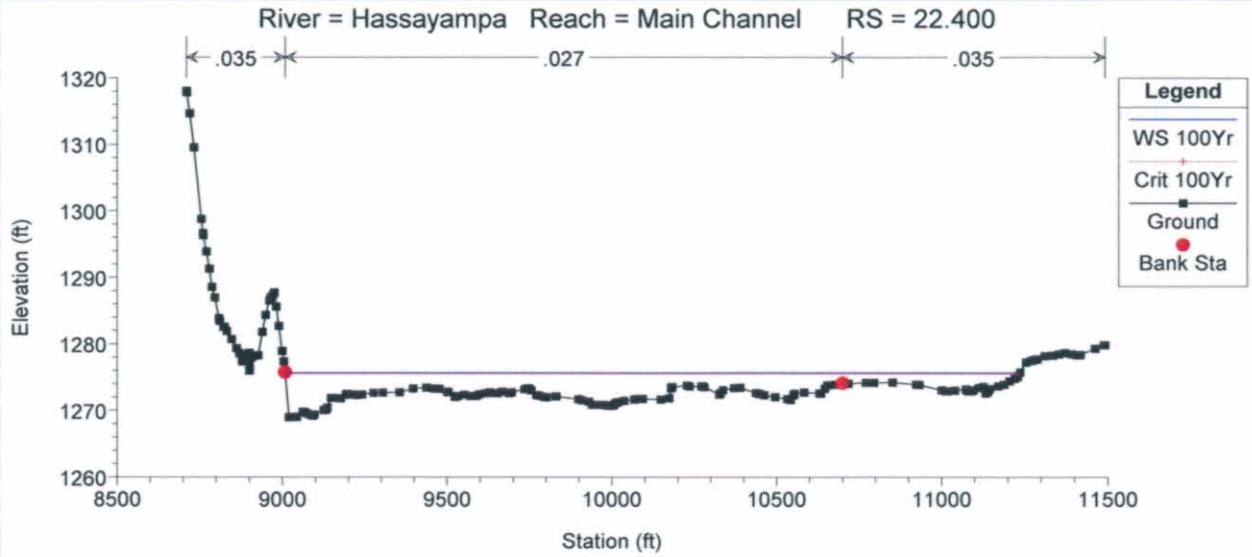

River = Hassayampa Reach = Main Channel RS = 23.070
.035
.025
.025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1340
1330
1320
1310
1300
1290
1280
8000
8500
9000
9500
10000
10500
11000

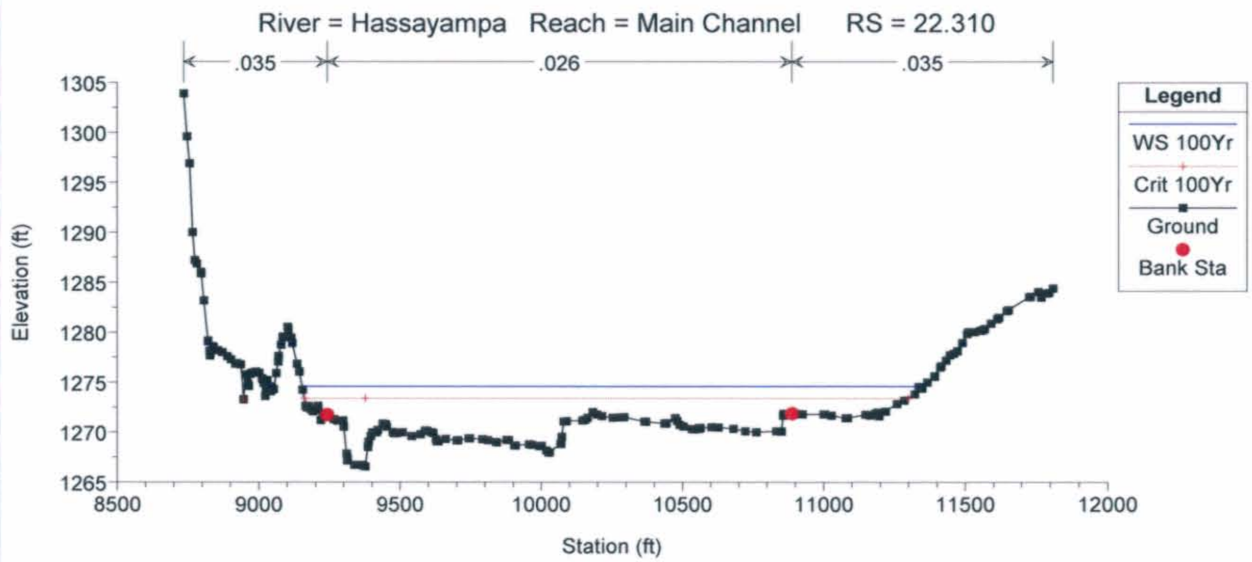

River = Hassayampa Reach = Main Channel RS = 22.970
.035
.026
.035
Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 22.880
.035
.025
.035
Elevation (ft)
1300
1295
1290
1285
1280
1275
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 22.780
.035
.026
.025
.035
Elevation (ft)
1295
1290
1285
1280
1275
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

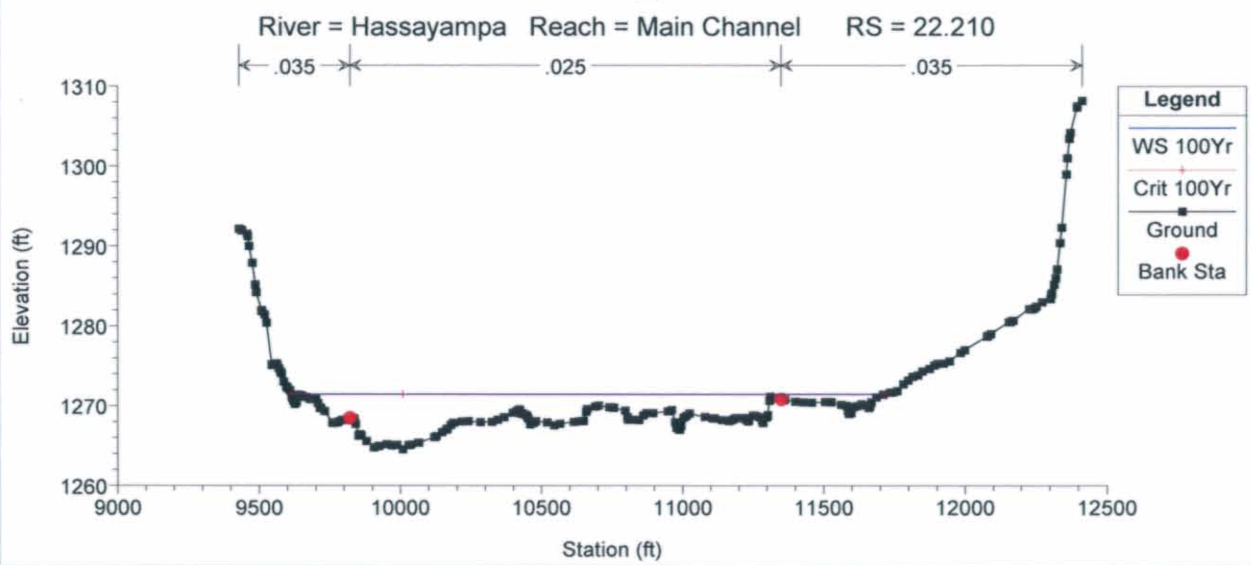

River = Hassayampa Reach = Main Channel RS = 22.690
.035
.026
.035
0
2
5
1305
1300
1295
1290
1285
1280
1275
1270
Elevation (ft)
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

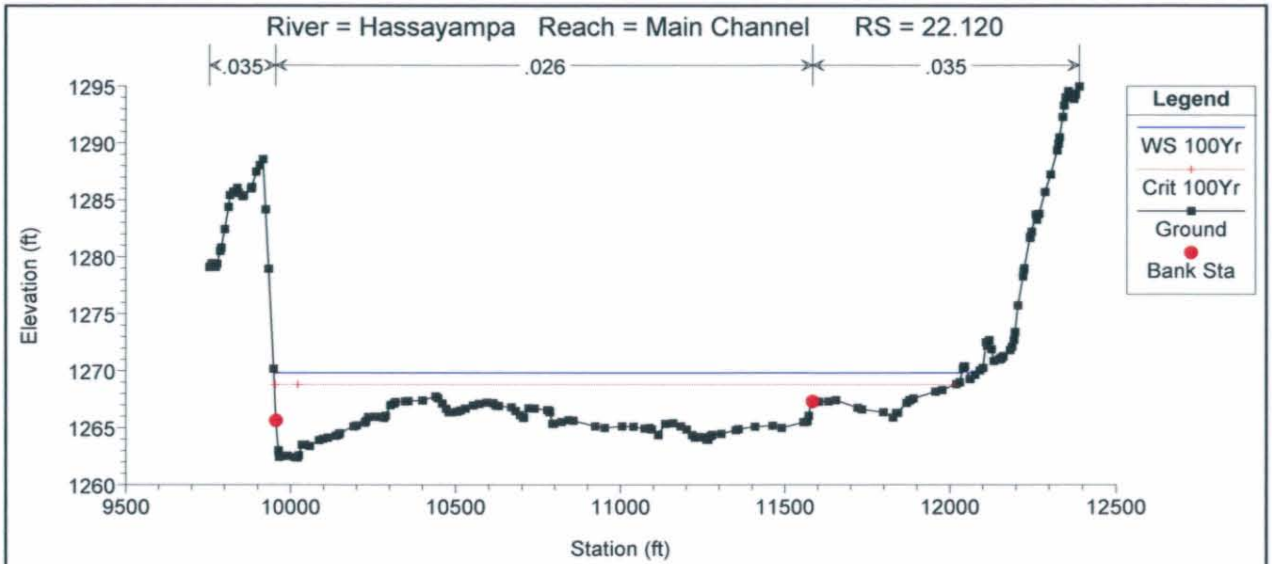

River = Hassayampa Reach = Main Channel RS = 22.590
.035
.027
.035
1330
1320
1310
1300
1290
1280
1270
Elevation (ft)
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

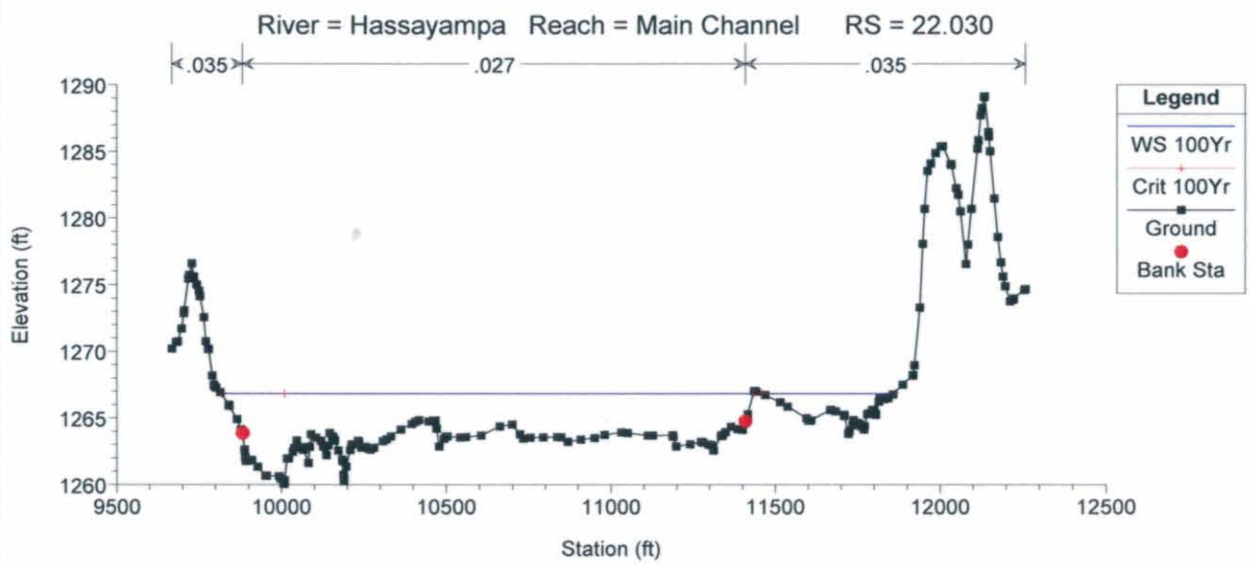

River = Hassayampa Reach = Main Channel RS = 22.500
.035
.028
.035
0
2
5
1310
1305
1300
1295
1290
1285
1280
1275
1270
Elevation (ft)
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

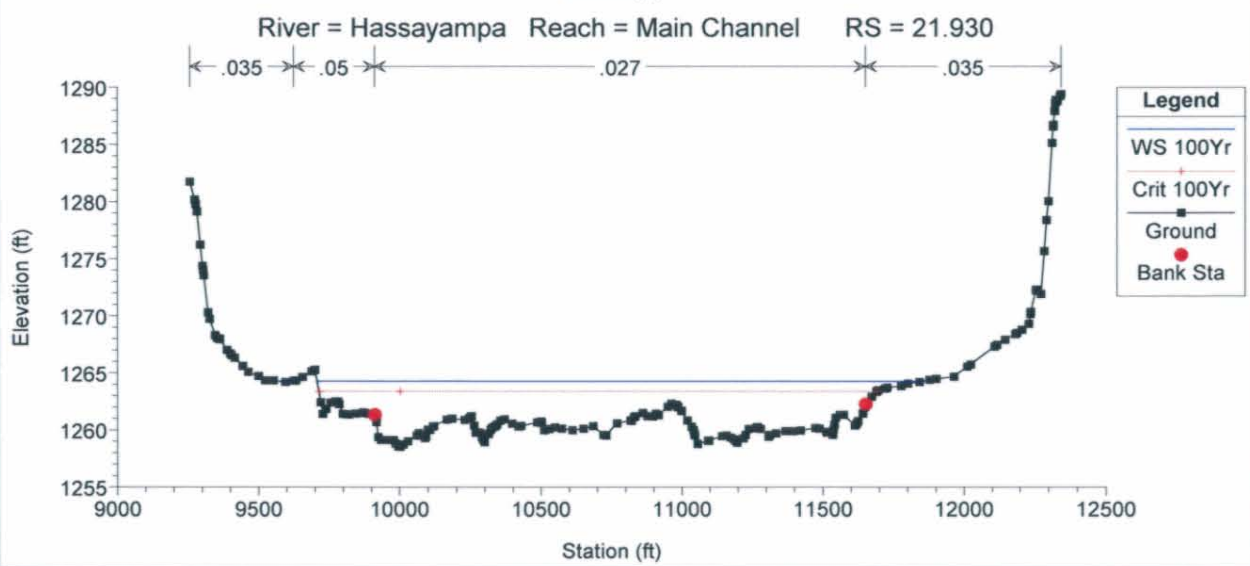

River = Hassayampa Reach = Main Channel RS = 22.400
.035
.027
.035
Elevation (ft)
Station (ft)
1320
1310
1300
1290
1280
1270
1260
8500
9000
9500
10000
10500
11000
11500
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

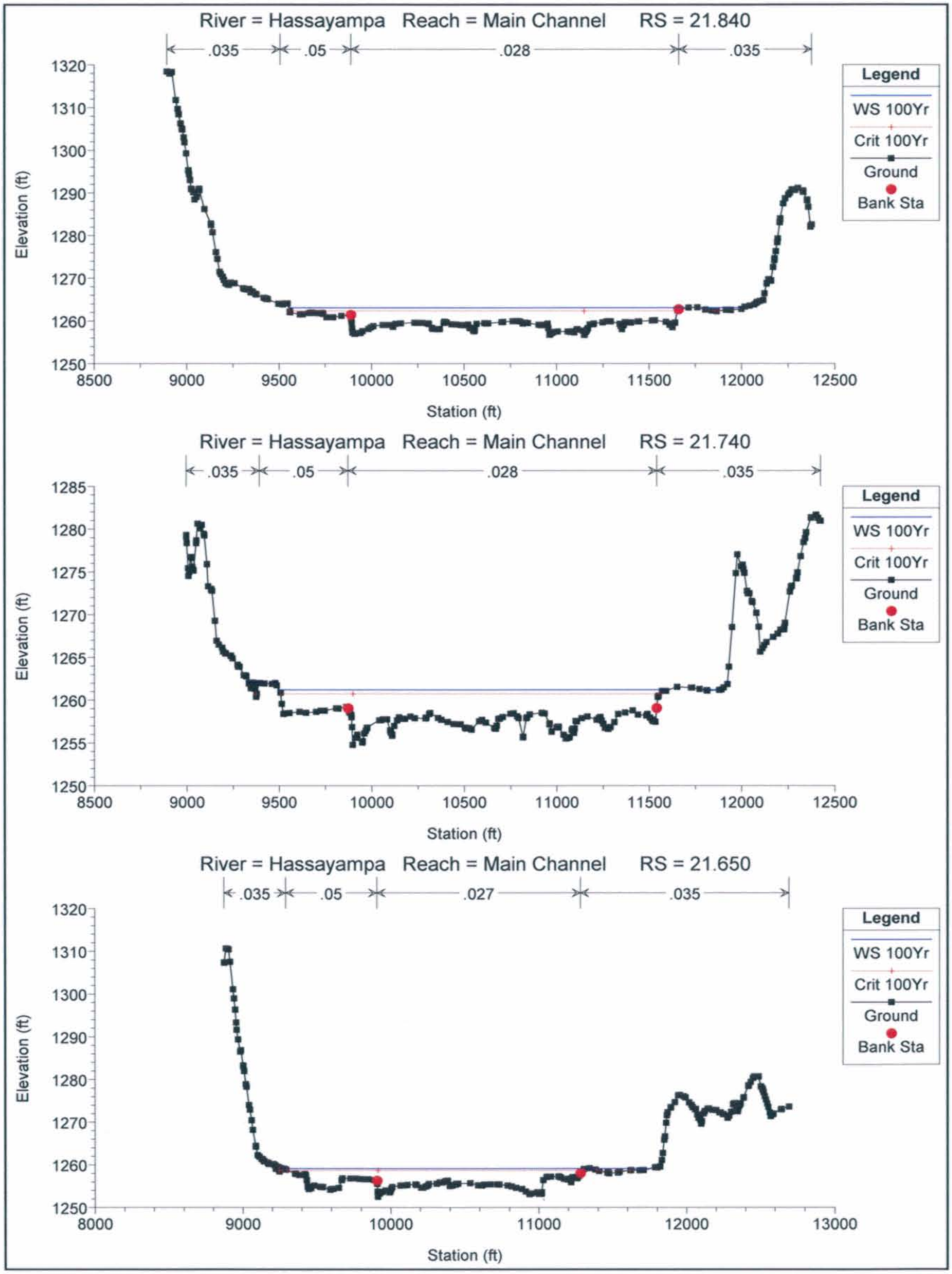

River = Hassayampa Reach = Main Channel RS = 22.310
.035
.026
.035
Elevation (ft)
Station (ft)
1305
1300
1295
1290
1285
1280
1275
1270
1265
8500
9000
9500
10000
10500
11000
11500
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

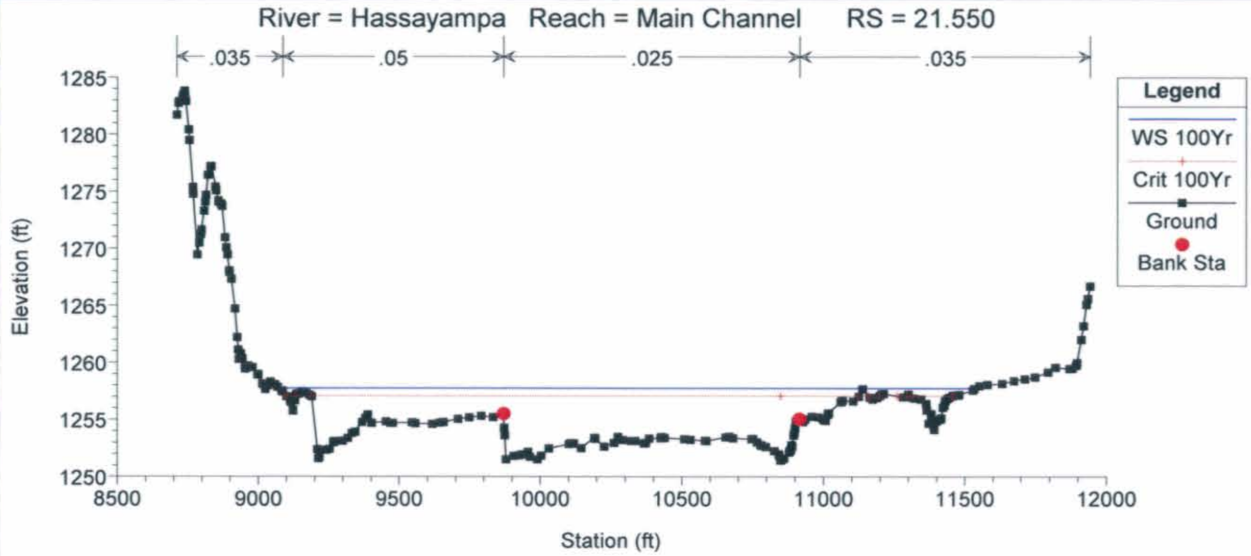

River = Hassayampa Reach = Main Channel RS = 22.210
.035
.025
.035
Elevation (ft)
Station (ft)
1310
1300
1290
1280
1270
1260
9000
9500
10000
10500
11000
11500
12000
12500
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

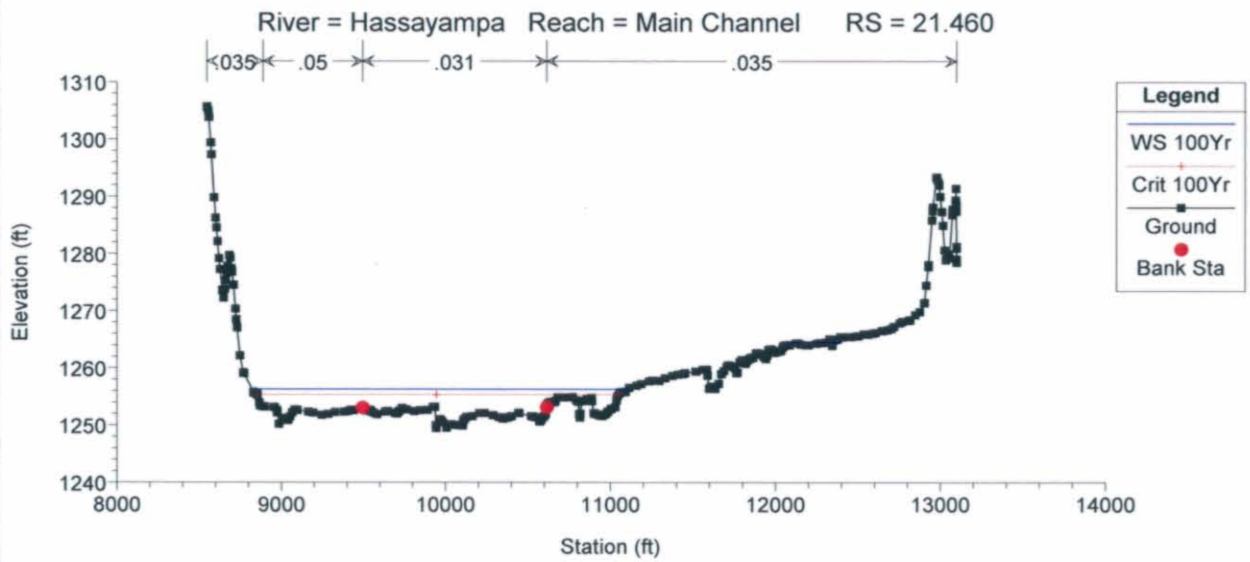

River = Hassayampa   Reach = Main Channel   RS = 22.120
.035
.026
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

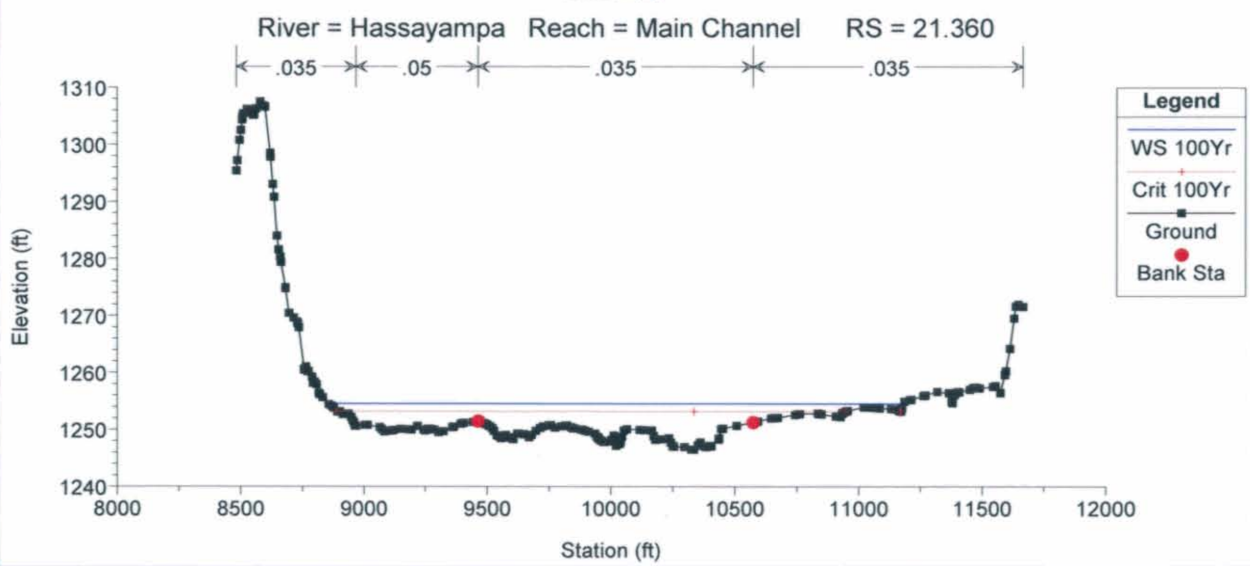

River = Hassayampa   Reach = Main Channel   RS = 22.030
.035
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

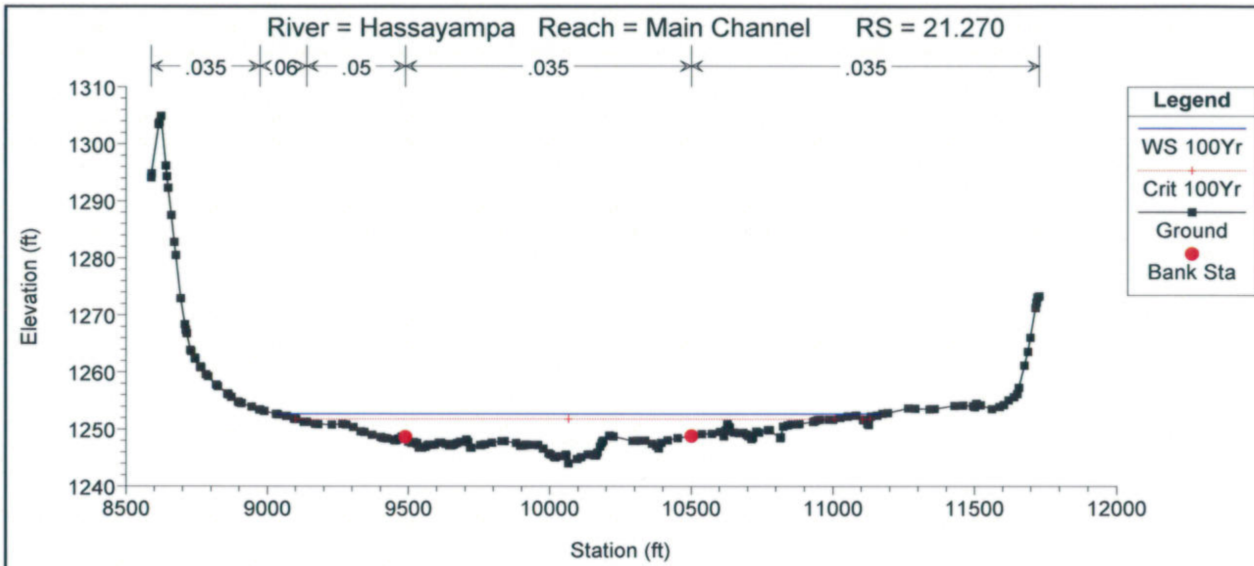

River = Hassayampa   Reach = Main Channel   RS = 21.930
.035
.05
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

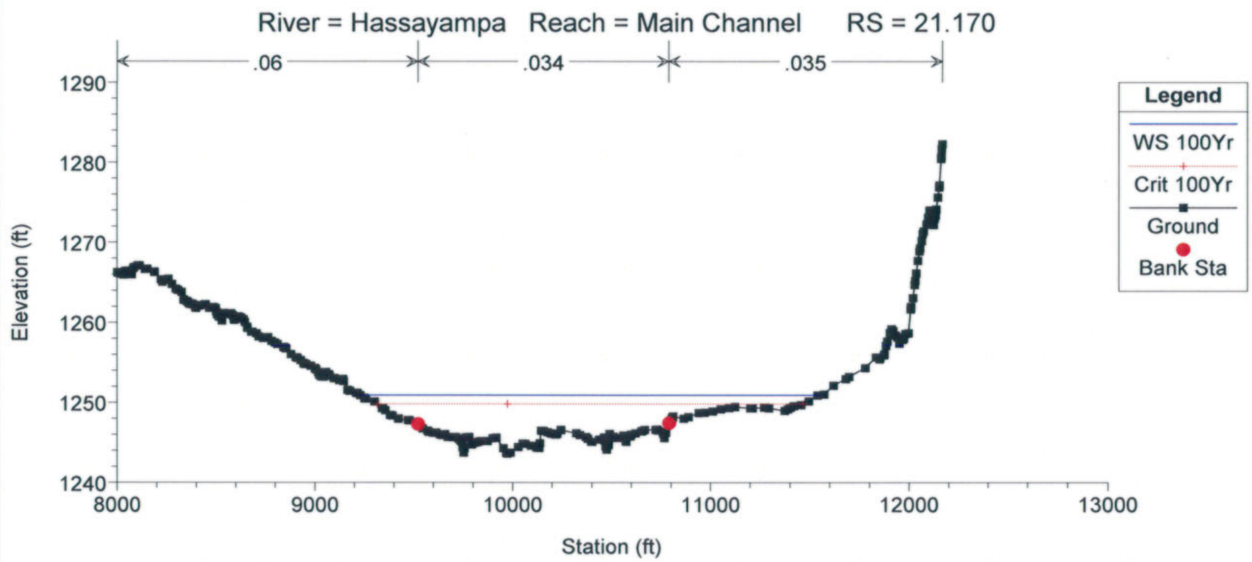

River = Hassayampa Reach = Main Channel RS = 21.840
.035
.05
.028
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1320
1310
1300
1290
1280
1270
1260
1250
8500
9000
9500
10000
10500
11000
11500
12000
12500
Station (ft)
River = Hassayampa Reach = Main Channel RS = 21.740
.035
.05
.028
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1285
1280
1275
1270
1265
1260
1255
1250
8500
9000
9500
10000
10500
11000
11500
12000
12500
Station (ft)
River = Hassayampa Reach = Main Channel RS = 21.650
.035
.05
.027
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1320
1310
1300
1290
1280
1270
1260
1250
8000
9000
10000
11000
12000
13000
Station (ft)

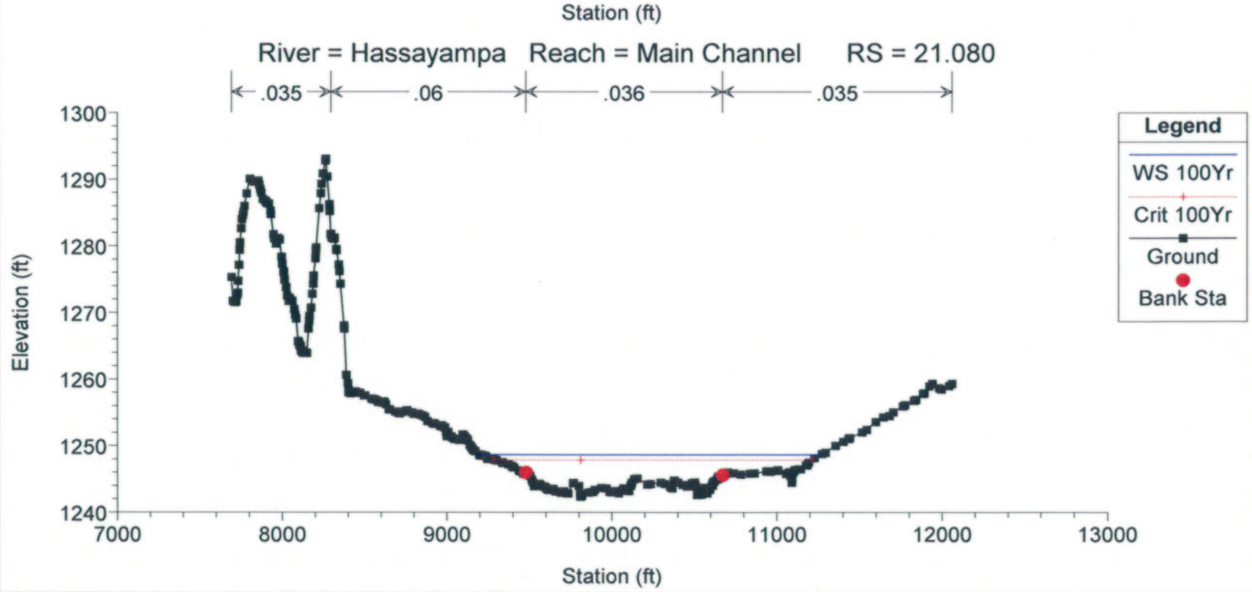

River = Hassayampa Reach = Main Channel RS = 21.550
.035
.05
.025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1285
1280
1275
1270
1265
1260
1255
1250
8500
9000
9500
10000
10500
11000
11500
12000

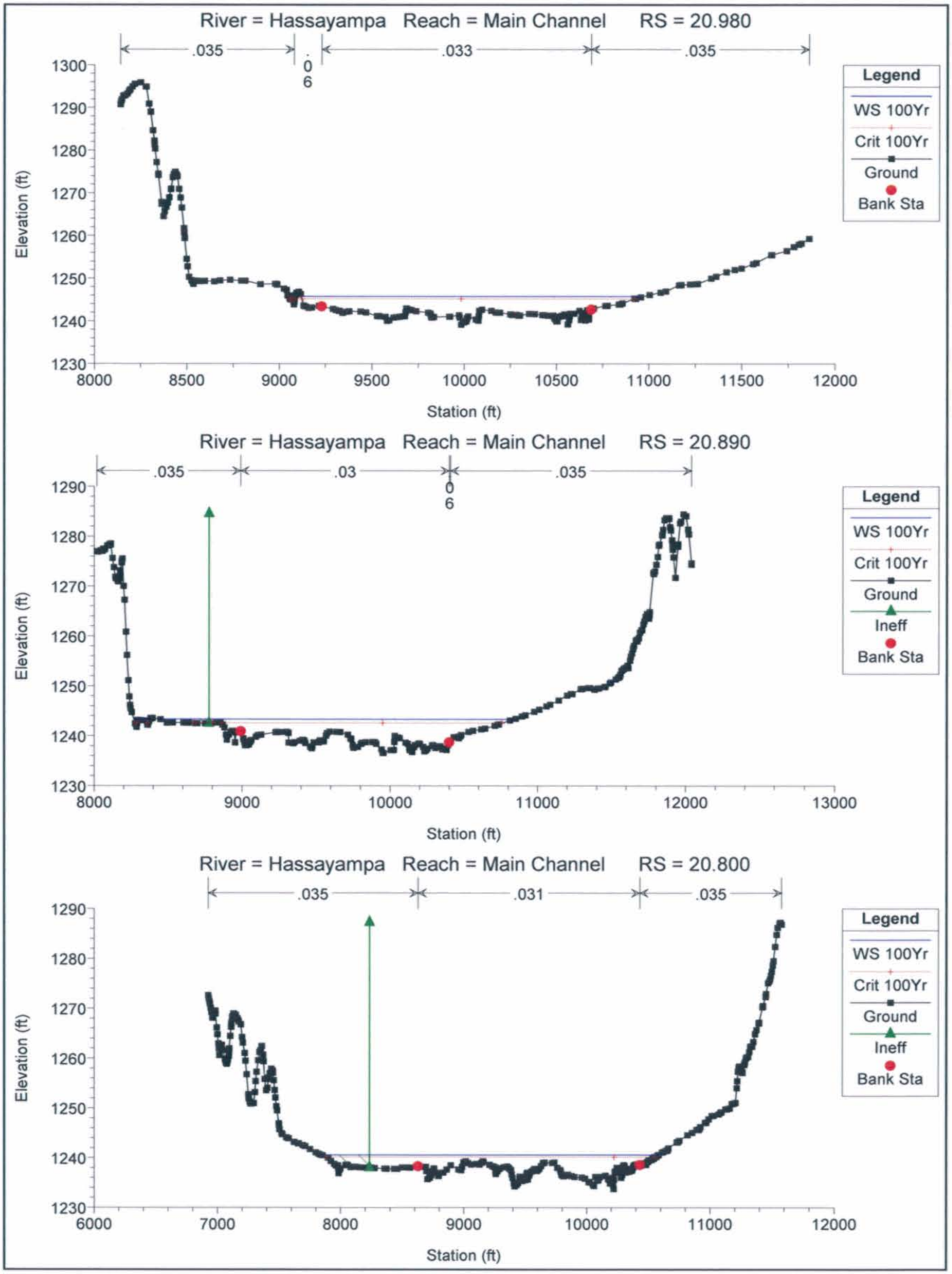

River = Hassayampa Reach = Main Channel RS = 21.460
.035
.05
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1310
1300
1290
1280
1270
1260
1250
1240
8000
9000
10000
11000
12000
13000
14000


River = Hassayampa Reach = Main Channel RS = 21.360
.035
.05
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1310
1300
1290
1280
1270
1260
1250
1240
8000
8500
9000
9500
10000
10500
11000
11500
12000

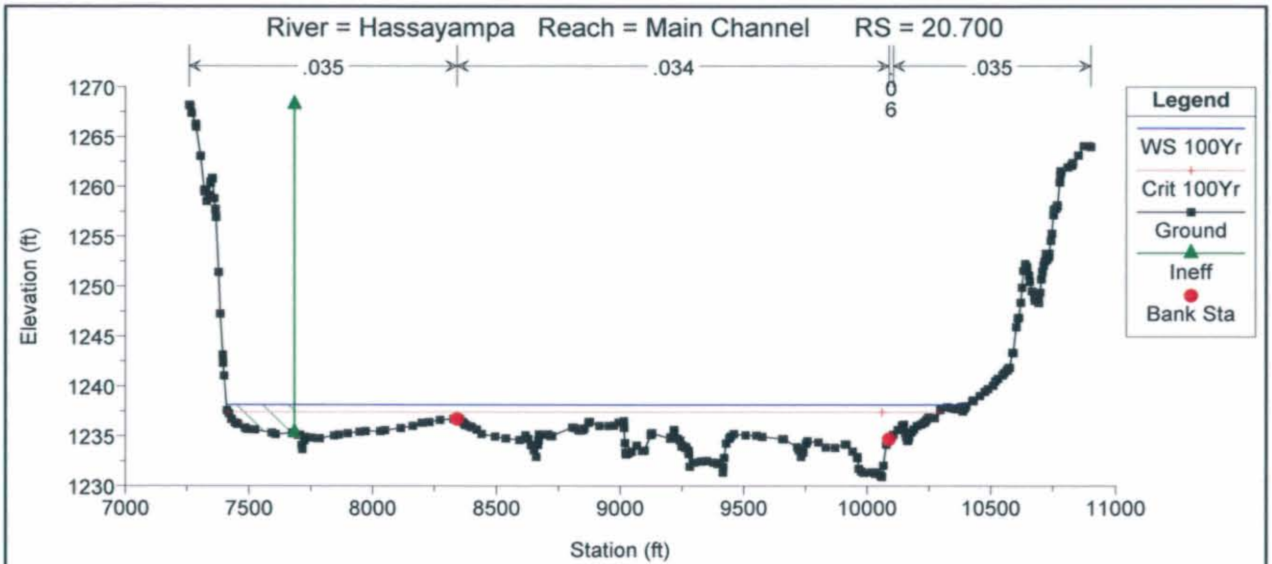

River = Hassayampa Reach = Main Channel RS = 21.270
.035
.06
.05
.035
.035
Elevation (ft)
1310
1300
1290
1280
1270
1260
1250
1240
Station (ft)
8500
9000
9500
10000
10500
11000
11500
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

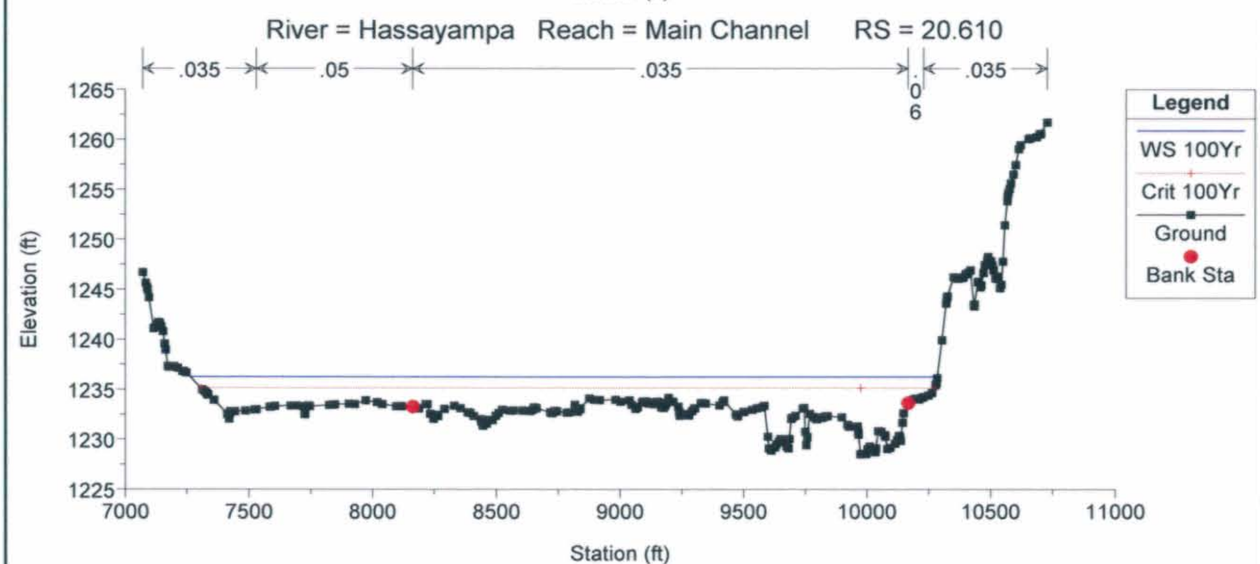

River = Hassayampa Reach = Main Channel RS = 21.170
.06
.034
.035
Elevation (ft)
1290
1280
1270
1260
1250
1240
Station (ft)
8000
9000
10000
11000
12000
13000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

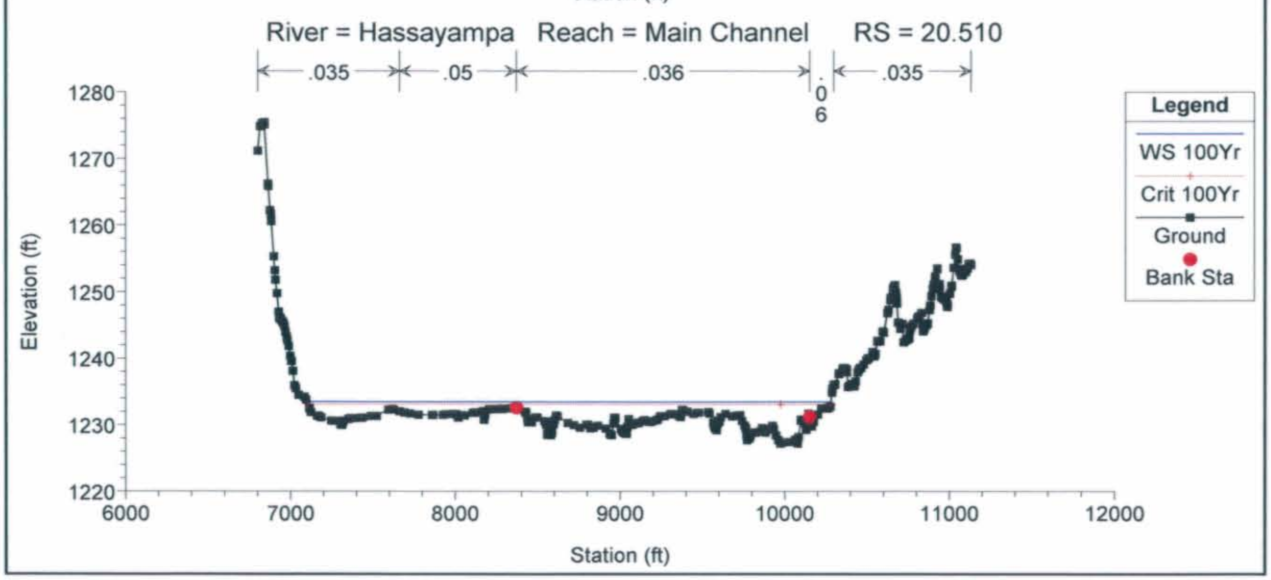

River = Hassayampa Reach = Main Channel RS = 21.080
.035
.06
.036
.035
Elevation (ft)
1300
1290
1280
1270
1260
1250
1240
Station (ft)
7000
8000
9000
10000
11000
12000
13000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

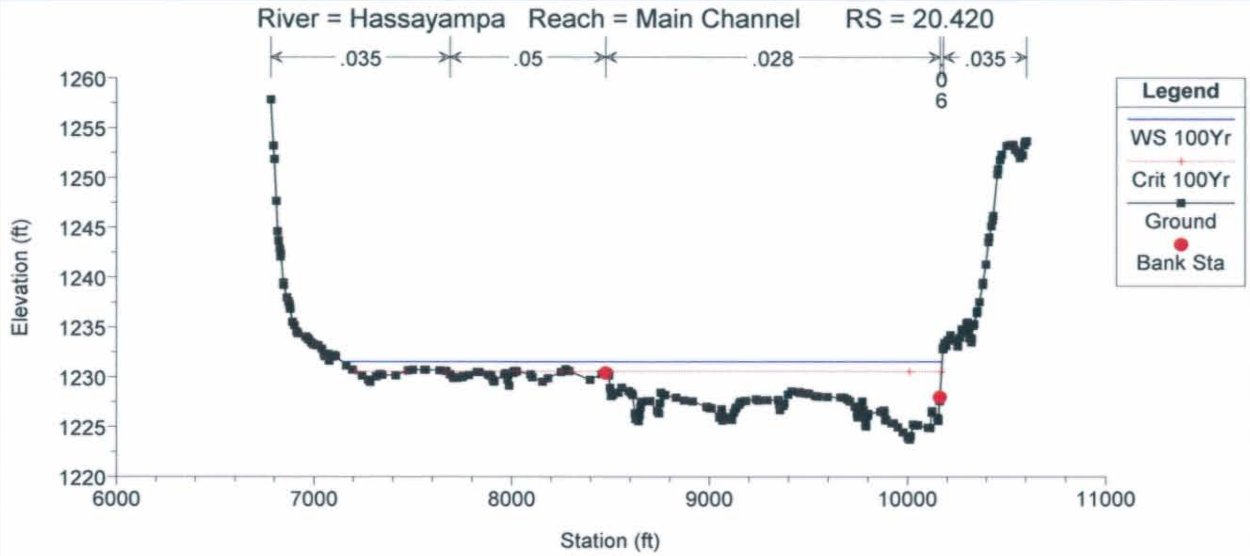


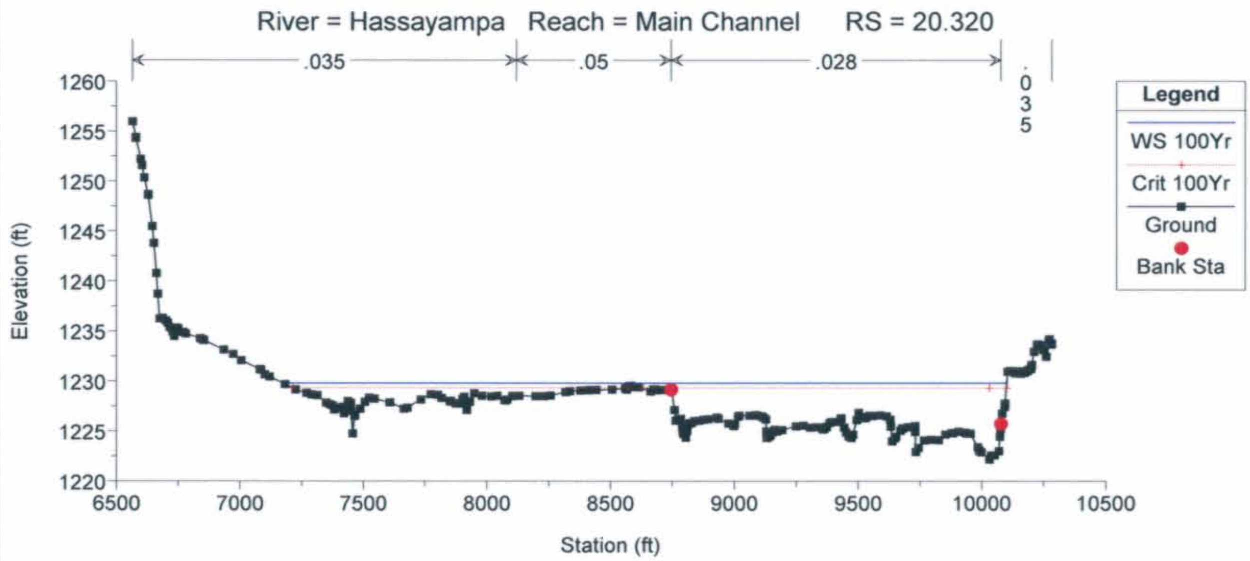
River = Hassayampa Reach = Main Channel RS = 20.980
.035
.06
.033
.035
Elevation (ft)
1300
1290
1280
1270
1260
1250
1240
1230
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 20.890
.035
.03
.06
.035
Elevation (ft)
1290
1280
1270
1260
1250
1240
1230
8000
9000
10000
11000
12000
13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 20.800
.035
.031
.035
Elevation (ft)
1290
1280
1270
1260
1250
1240
1230
6000
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

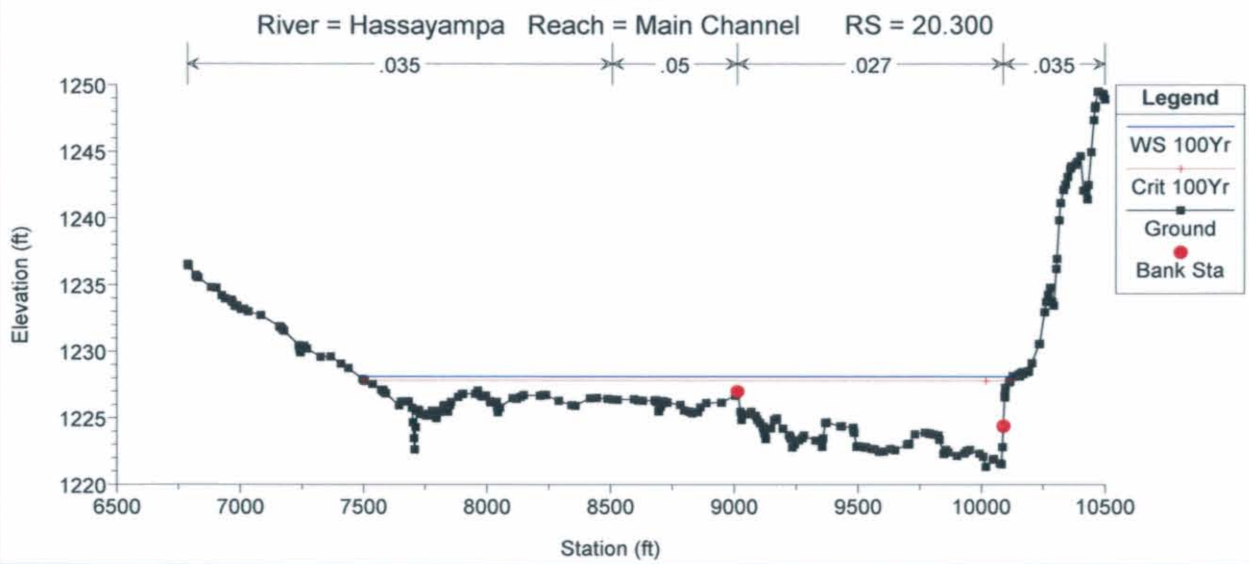

River = Hassayampa Reach = Main Channel RS = 20.700
.035
.034
.06
.035
1270
1265
1260
1255
1250
1245
1240
1235
1230
Elevation (ft)
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

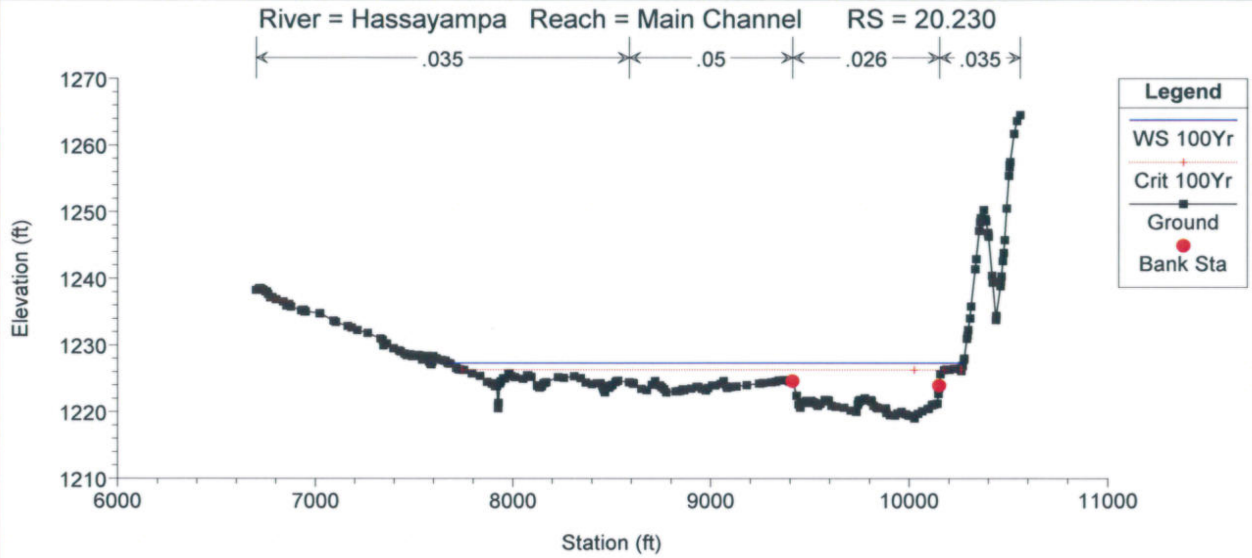

River = Hassayampa Reach = Main Channel RS = 20.610
.035
.05
.035
.06
.035
1265
1260
1255
1250
1245
1240
1235
1230
1225
Elevation (ft)
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

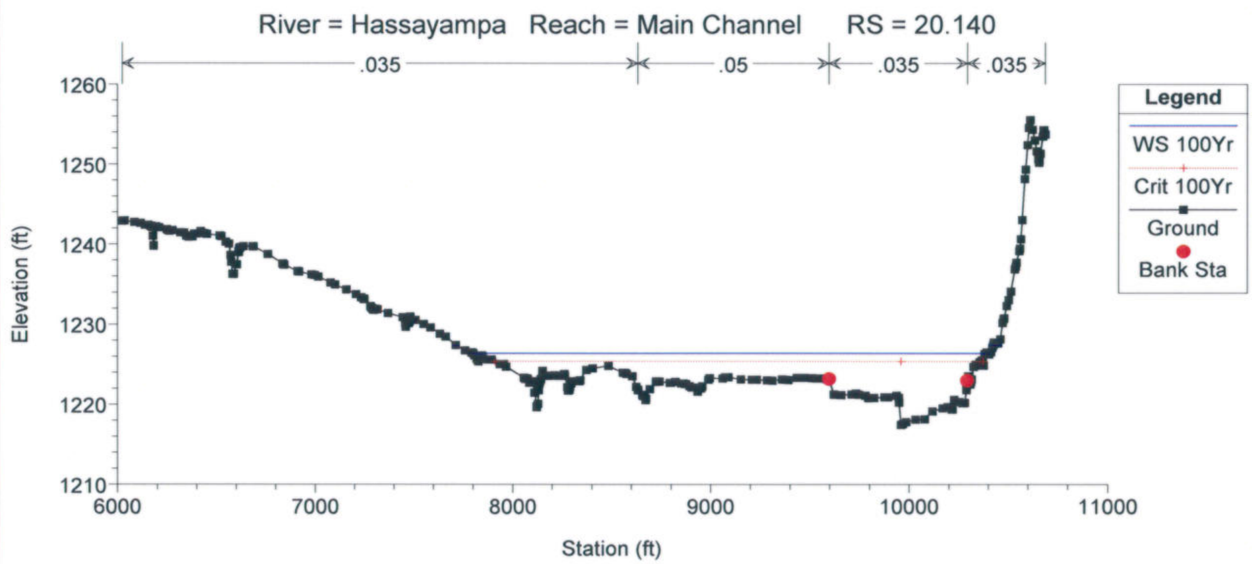

River = Hassayampa Reach = Main Channel RS = 20.510
.035
.05
.036
.06
.035
1280
1270
1260
1250
1240
1230
1220
Elevation (ft)
6000
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

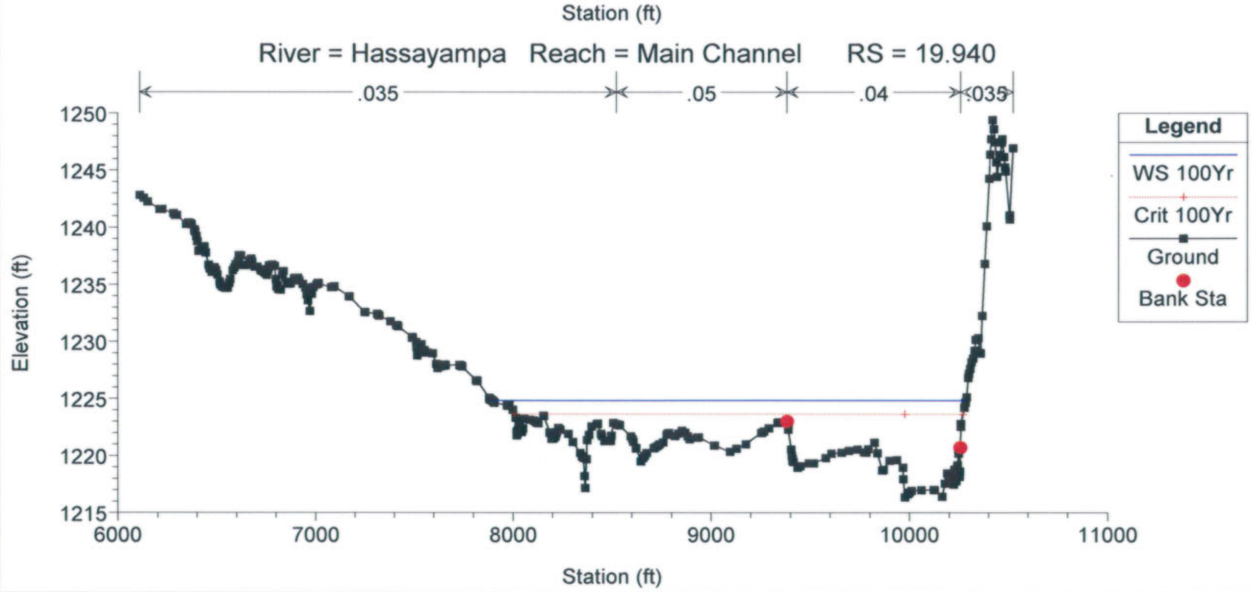

River = Hassayampa Reach = Main Channel RS = 20.420
.035
.05
.028
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

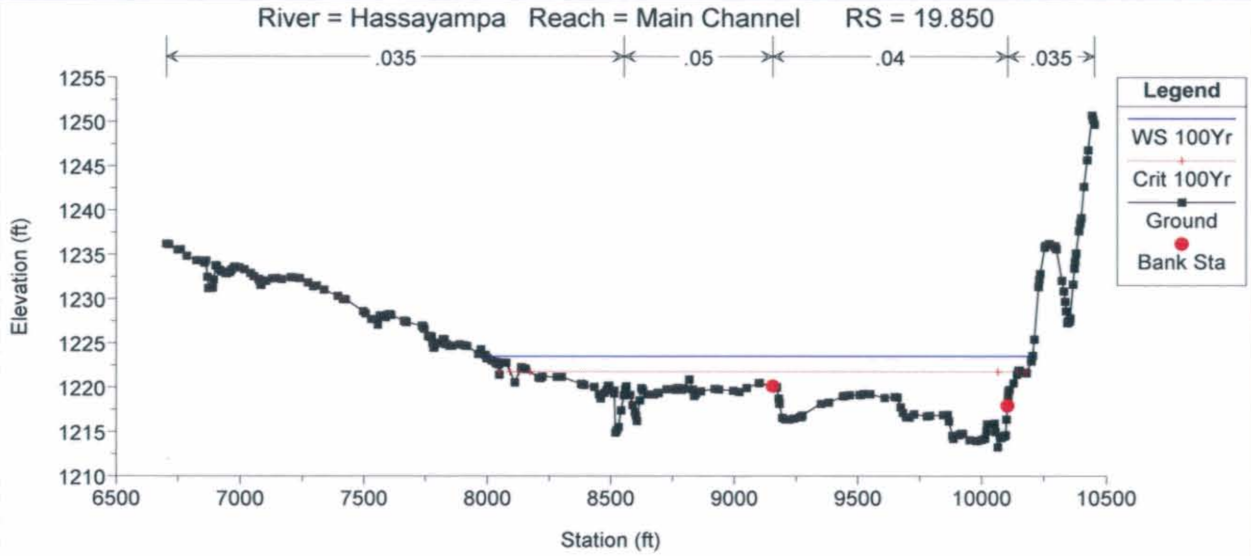

River = Hassayampa Reach = Main Channel RS = 20.320
.035
.05
.028
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

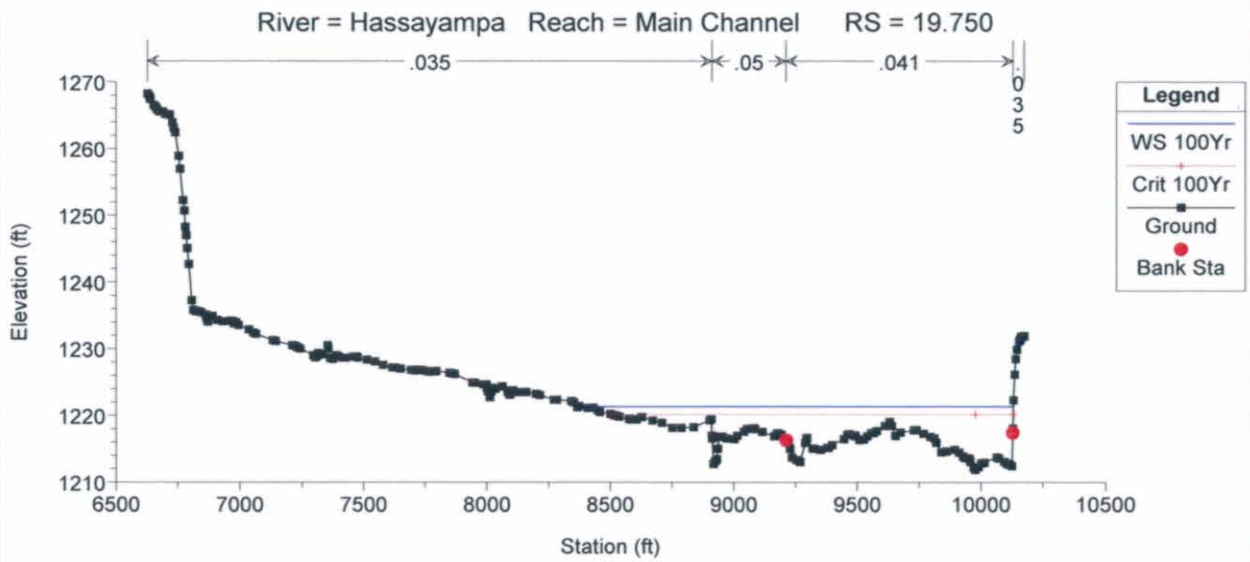

River = Hassayampa Reach = Main Channel RS = 20.300
.035
.05
.027
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

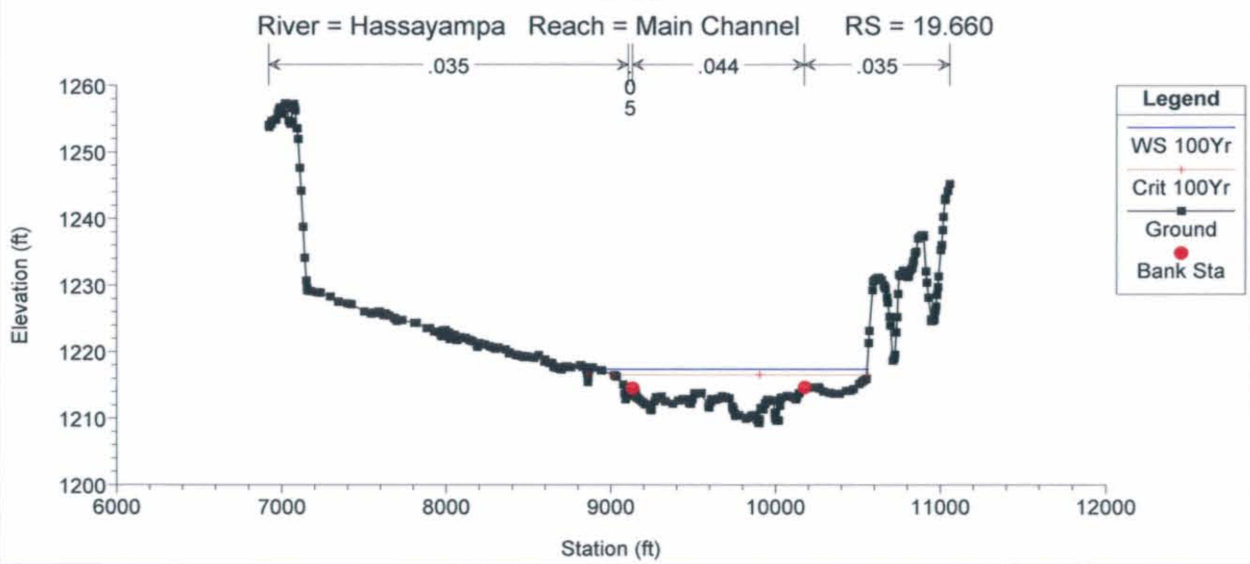

River = Hassayampa Reach = Main Channel RS = 20.230
.035
.05
.026
.035
Elevation (ft)
1270
1260
1250
1240
1230
1220
1210
6000
7000
8000
9000
10000
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

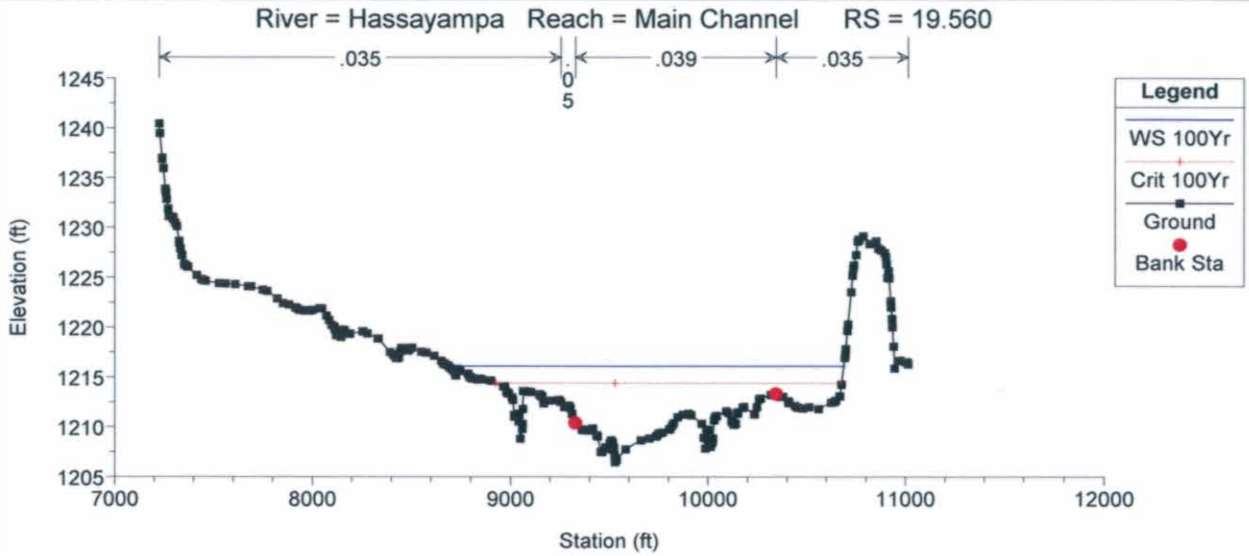

River = Hassayampa Reach = Main Channel RS = 20.140
.035
.05
.035
.035
Elevation (ft)
1260
1250
1240
1230
1220
1210
6000
7000
8000
9000
10000
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

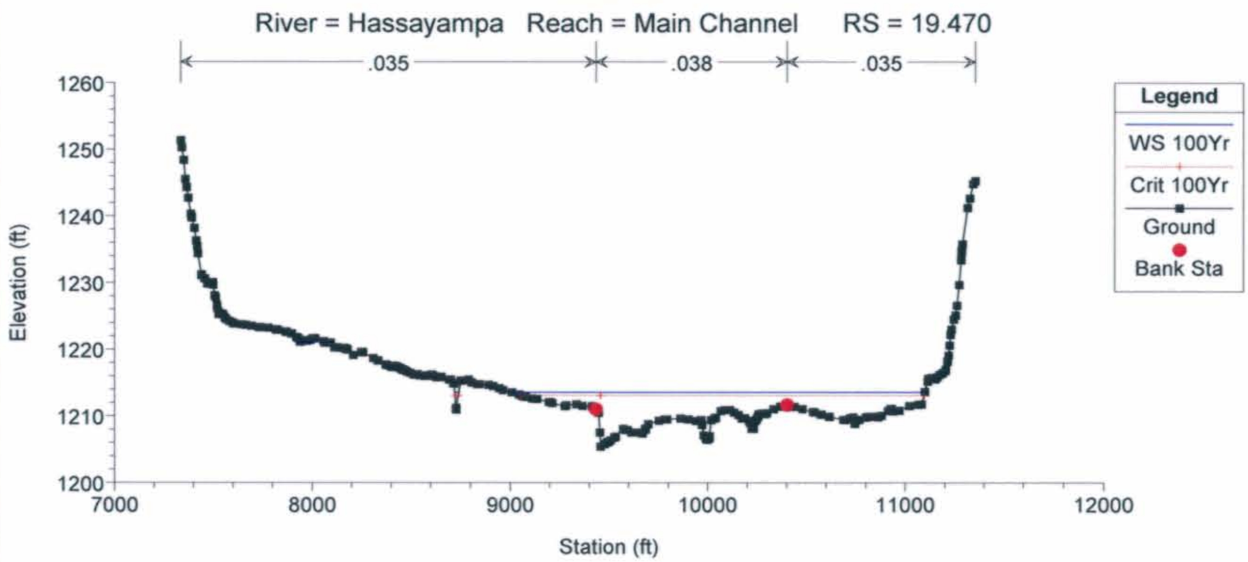

River = Hassayampa Reach = Main Channel RS = 19.940
.035
.05
.04
.035
Elevation (ft)
1250
1245
1240
1235
1230
1225
1220
1215
6000
7000
8000
9000
10000
11000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

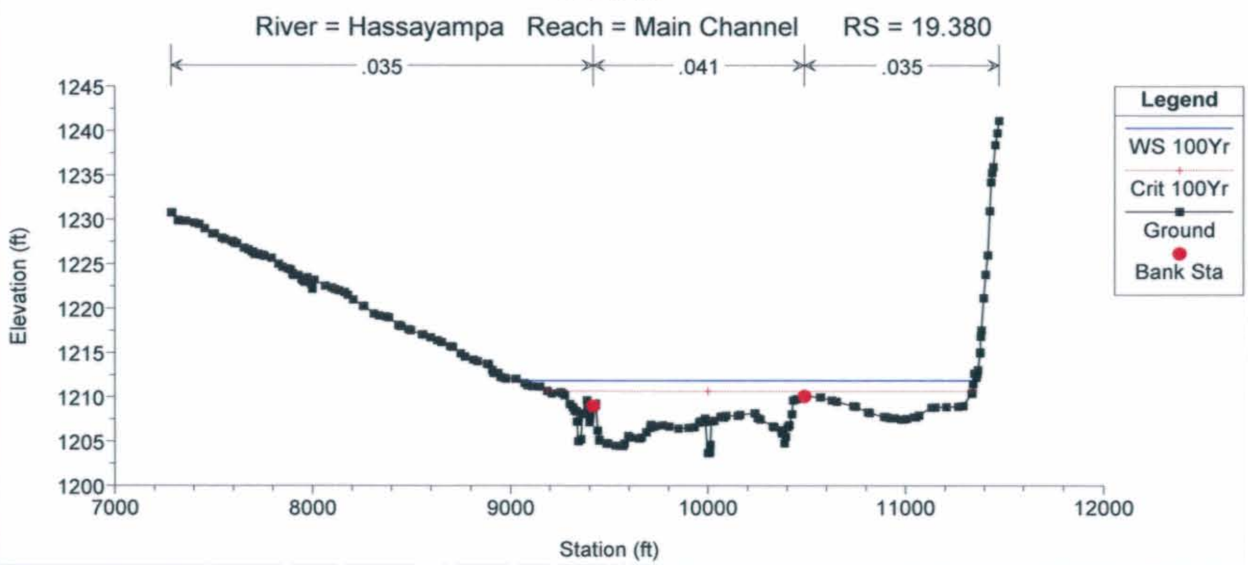

River = Hassayampa Reach = Main Channel RS = 19.850
.035
.05
.04
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1210
1215
1220
1225
1230
1235
1240
1245
1250
1255
6500
7000
7500
8000
8500
9000
9500
10000
10500

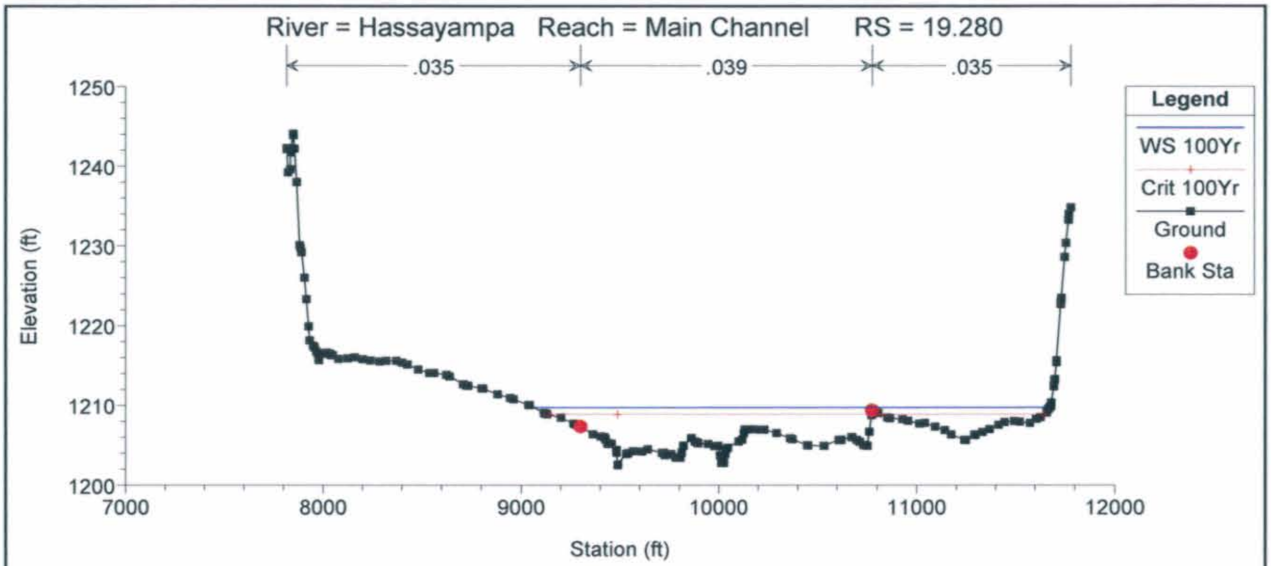

River = Hassayampa Reach = Main Channel RS = 19.750
.035
.05
.041
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1210
1220
1230
1240
1250
1260
1270
6500
7000
7500
8000
8500
9000
9500
10000
10500

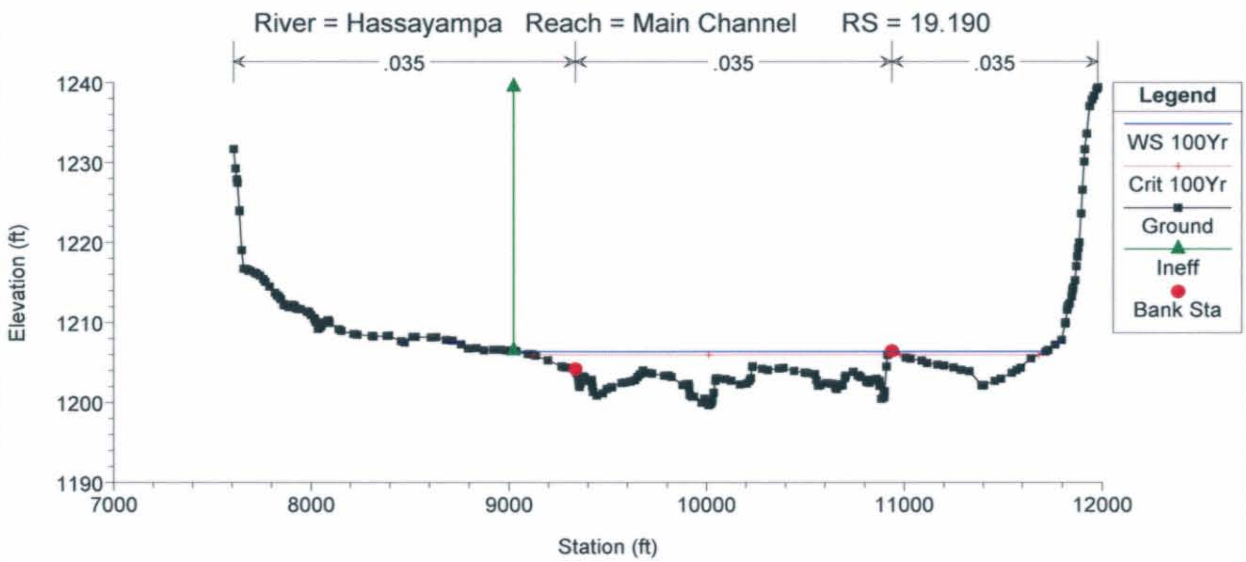

River = Hassayampa Reach = Main Channel RS = 19.660
.035
.05
.044
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1200
1210
1220
1230
1240
1250
1260
6000
7000
8000
9000
10000
11000
12000

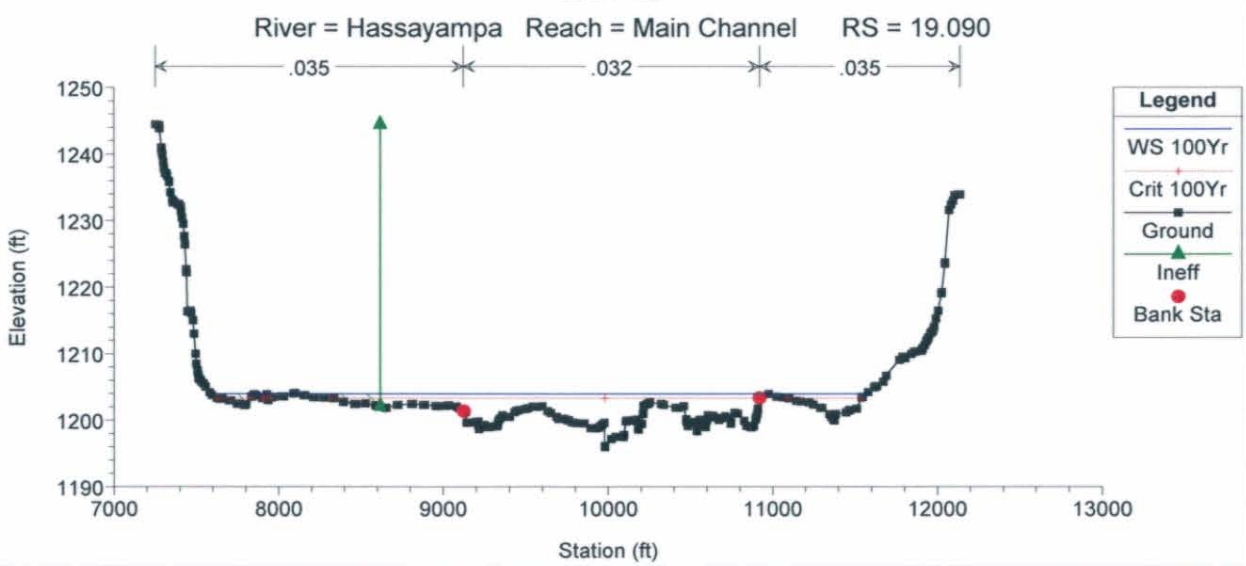

River = Hassayampa Reach = Main Channel RS = 19.560
.035
.
0
5
.039
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1245
1240
1235
1230
1225
1220
1215
1210
1205
7000
8000
9000
10000
11000
12000
Station (ft)

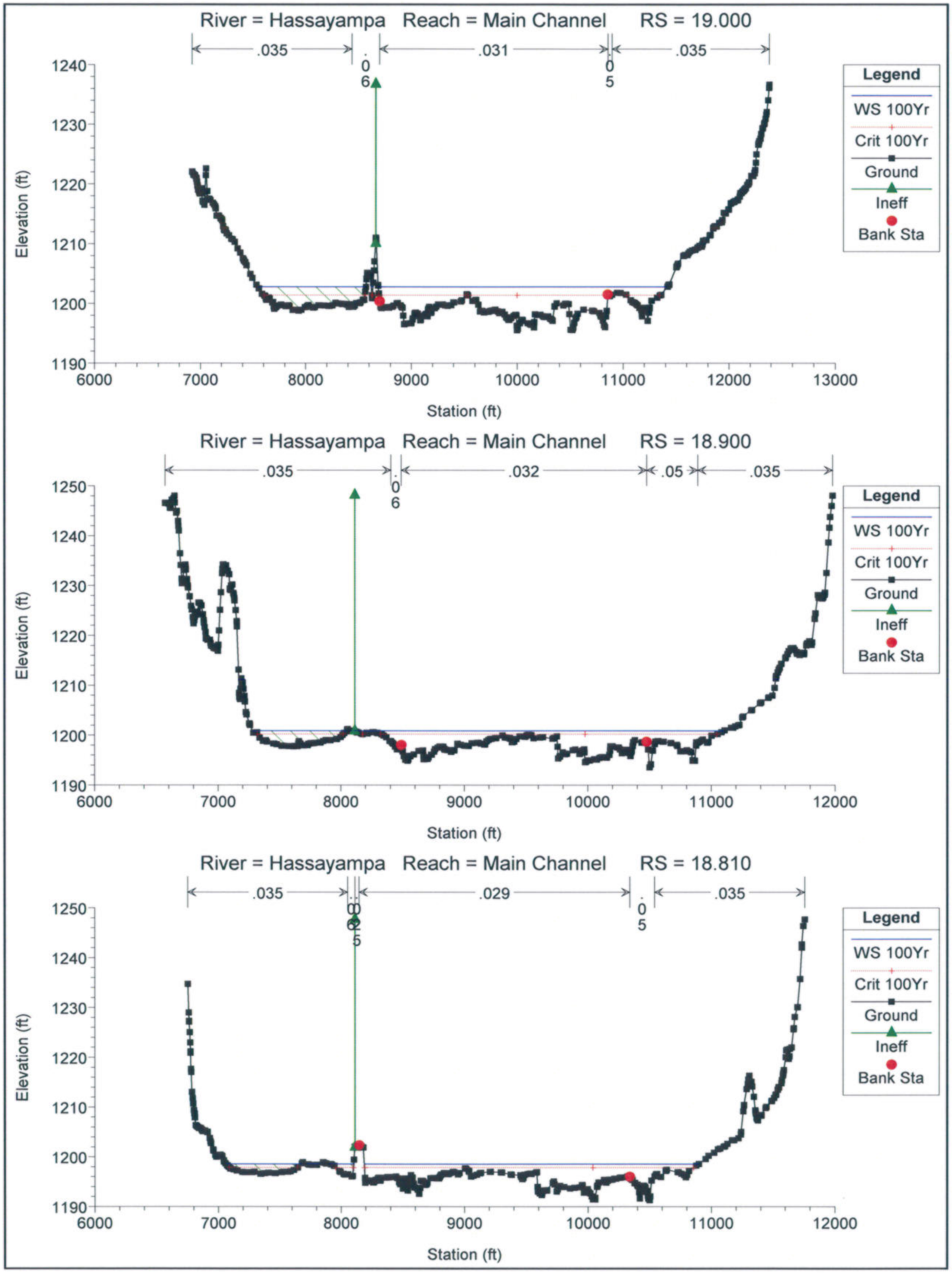

River = Hassayampa Reach = Main Channel RS = 19.470
.035
.038
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1260
1250
1240
1230
1220
1210
1200
7000
8000
9000
10000
11000
12000
Station (ft)


River = Hassayampa Reach = Main Channel RS = 19.380
.035
.041
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1245
1240
1235
1230
1225
1220
1215
1210
1205
1200
7000
8000
9000
10000
11000
12000
Station (ft)

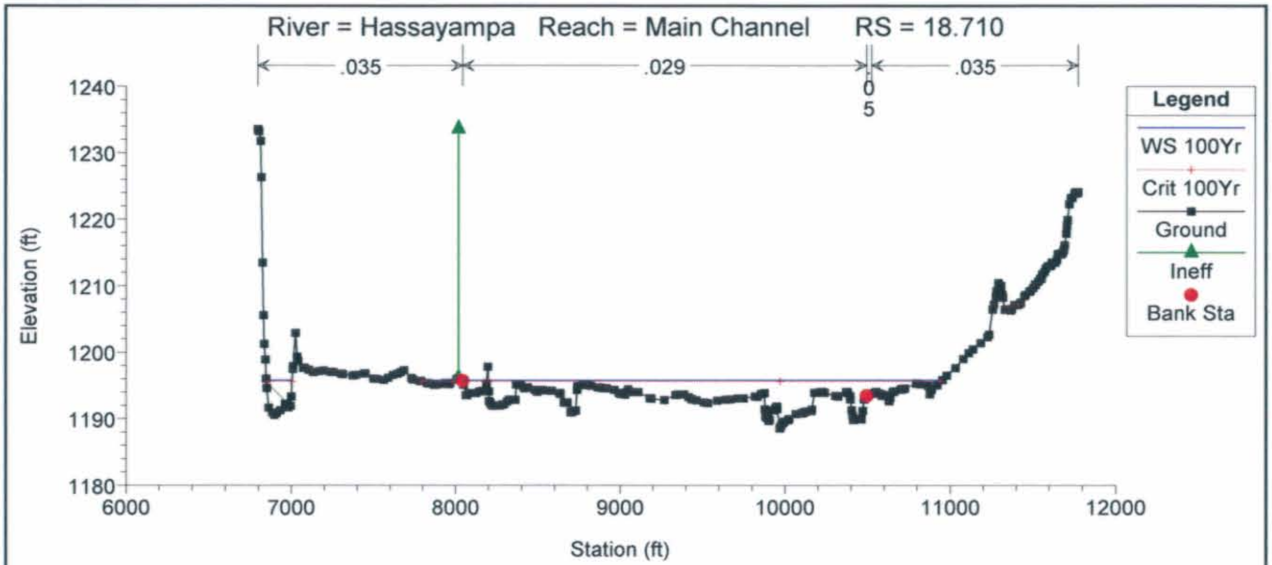

River = Hassayampa Reach = Main Channel RS = 19.280
.035
.039
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
1200
1210
1220
1230
1240
1250
7000
8000
9000
10000
11000
12000

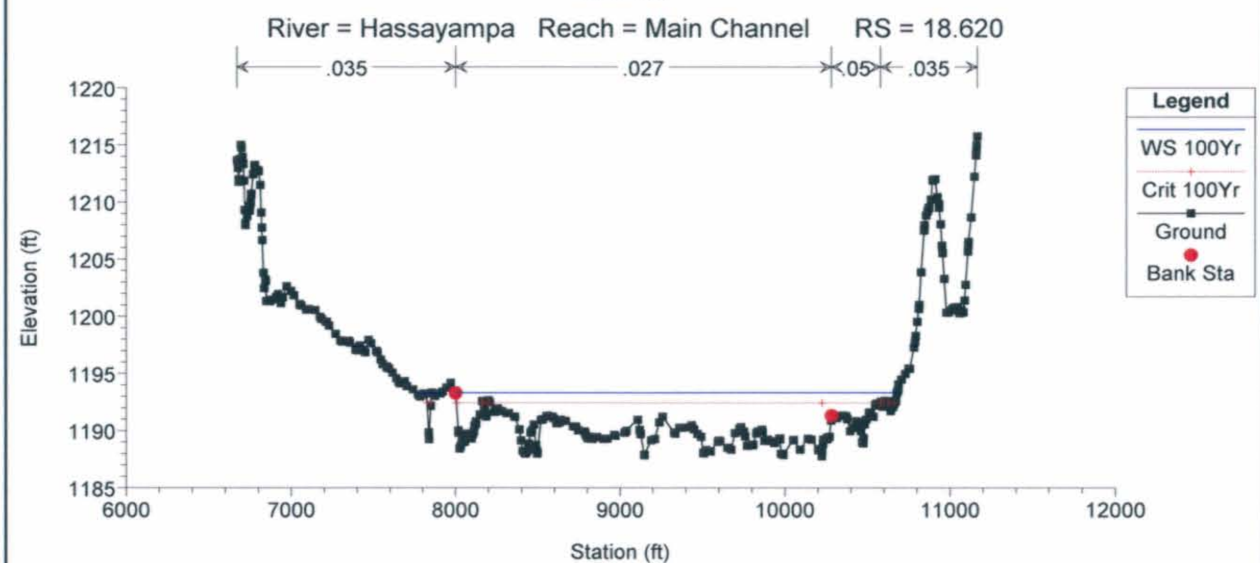

River = Hassayampa Reach = Main Channel RS = 19.190
.035
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1190
1200
1210
1220
1230
1240
7000
8000
9000
10000
11000
12000

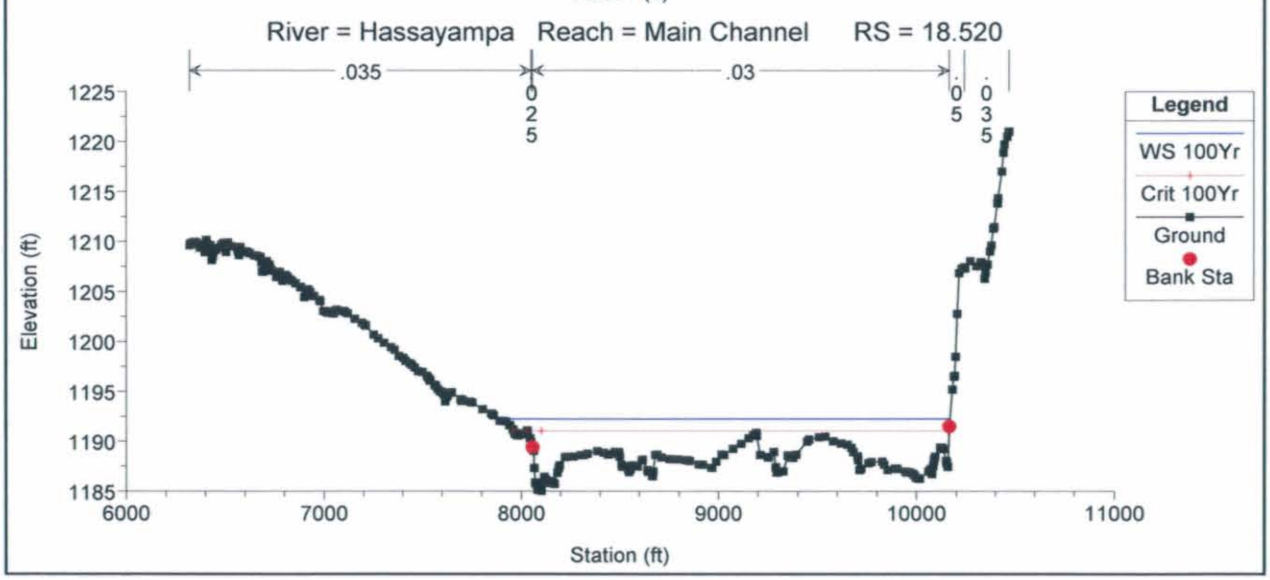

River = Hassayampa Reach = Main Channel RS = 19.090
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1190
1200
1210
1220
1230
1240
1250
7000
8000
9000
10000
11000
12000
13000

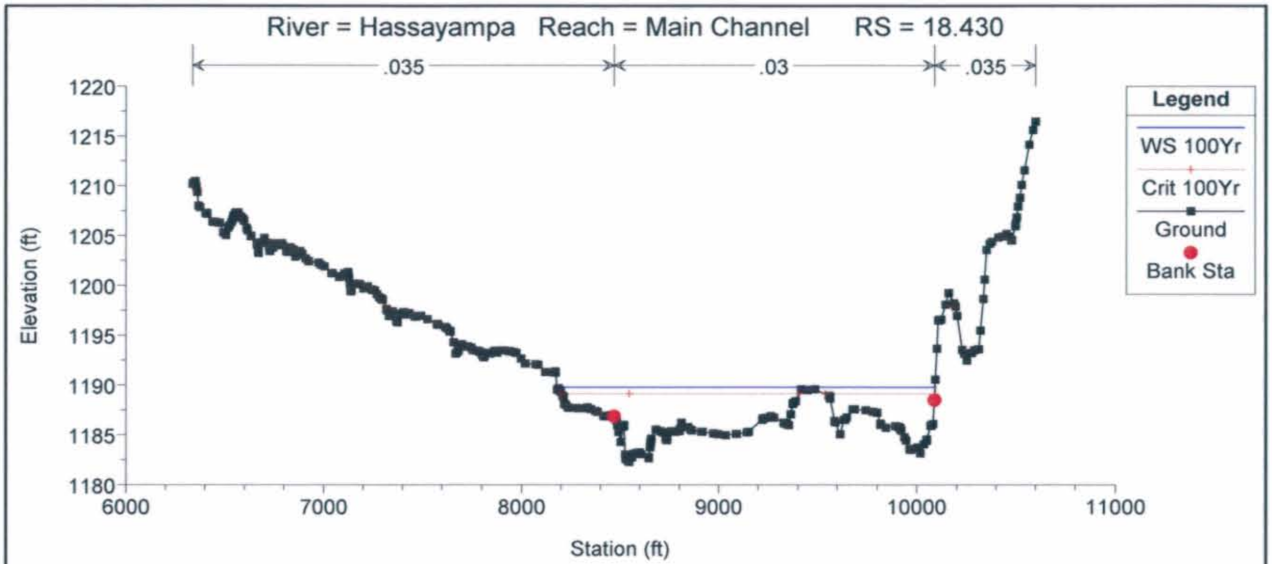


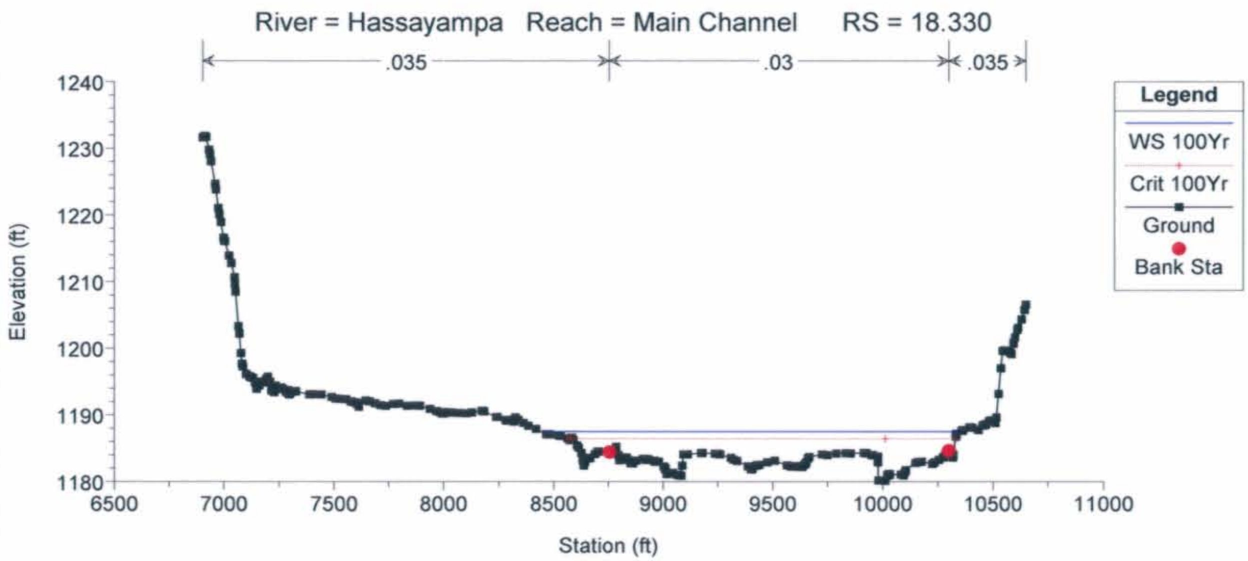
River = Hassayampa Reach = Main Channel RS = 19.000
.035
.06
.031
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 18.900
.035
.06
.032
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 18.810
.035
.029
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

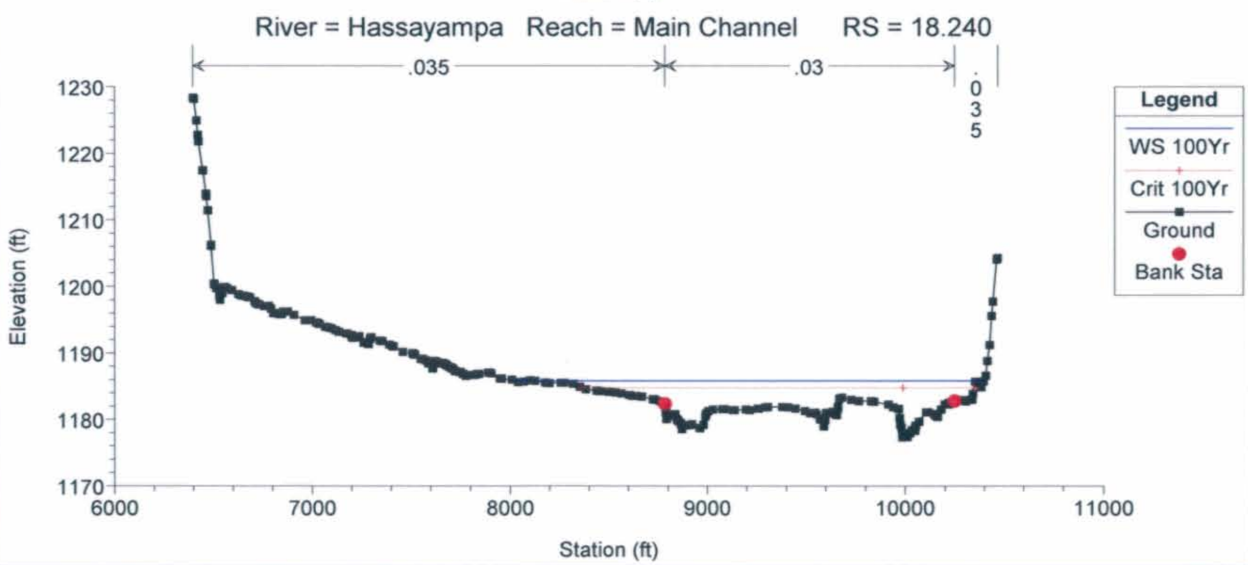

River = Hassayampa Reach = Main Channel RS = 18.710
.035
.029
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

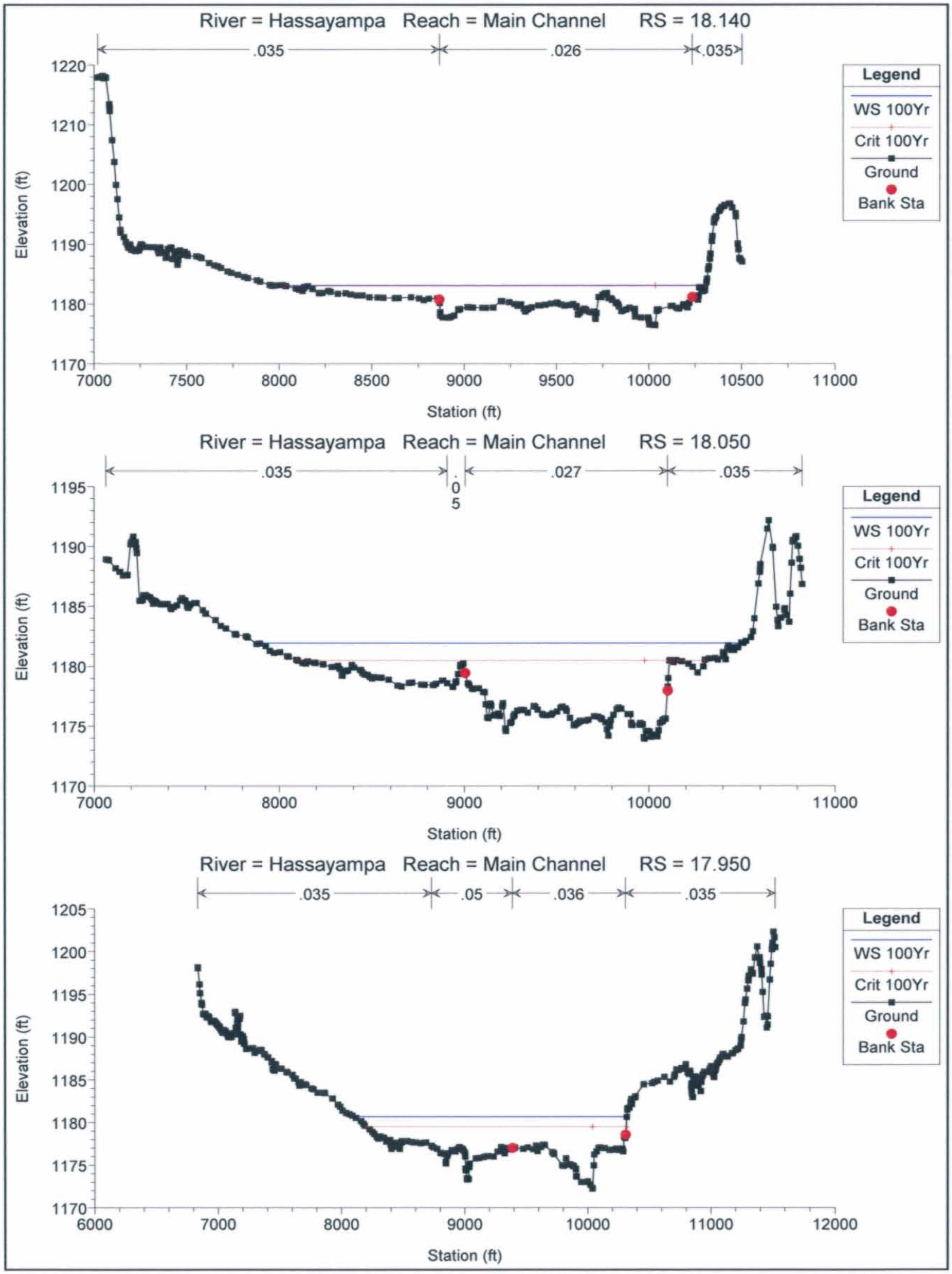

River = Hassayampa Reach = Main Channel RS = 18.620
.035
.027
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

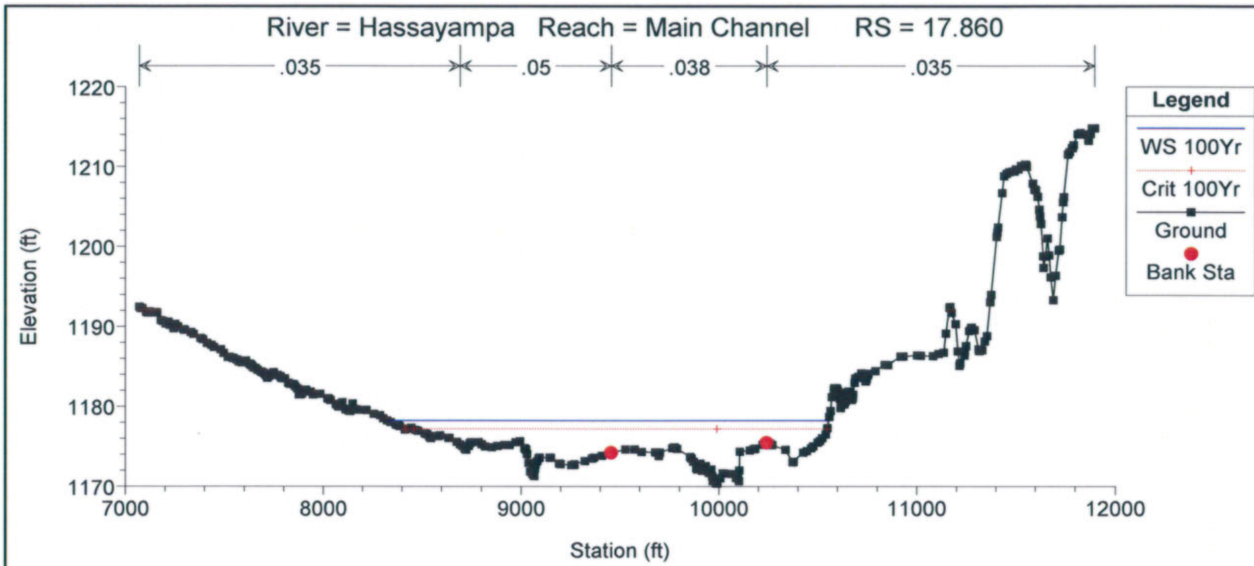

River = Hassayampa Reach = Main Channel RS = 18.520
.035
.03
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

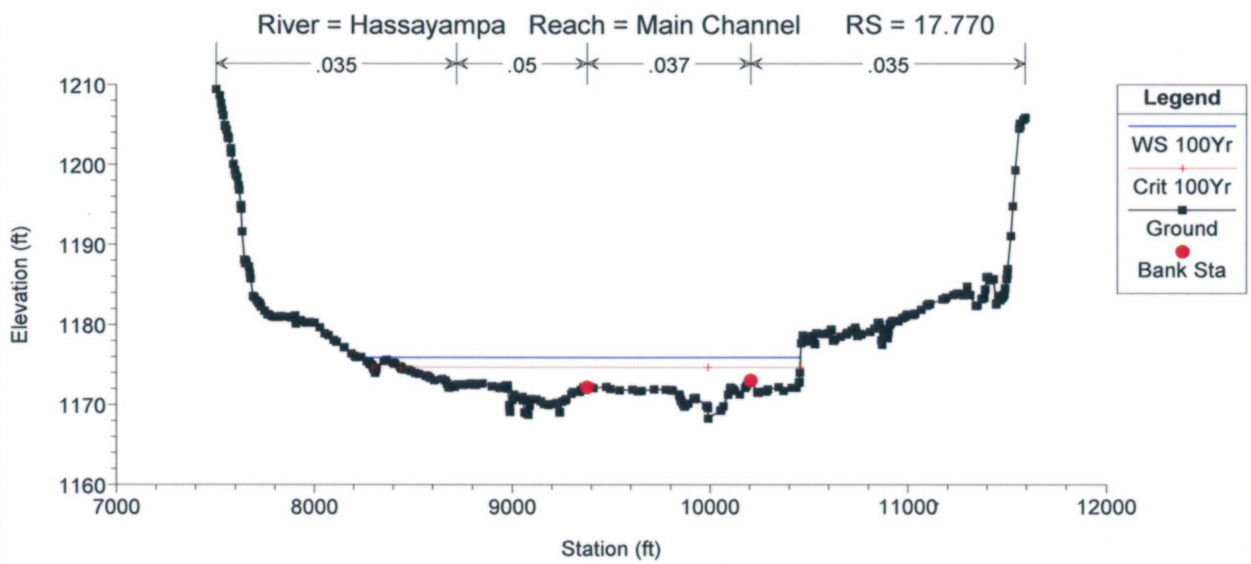

River = Hassayampa Reach = Main Channel RS = 18.430
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

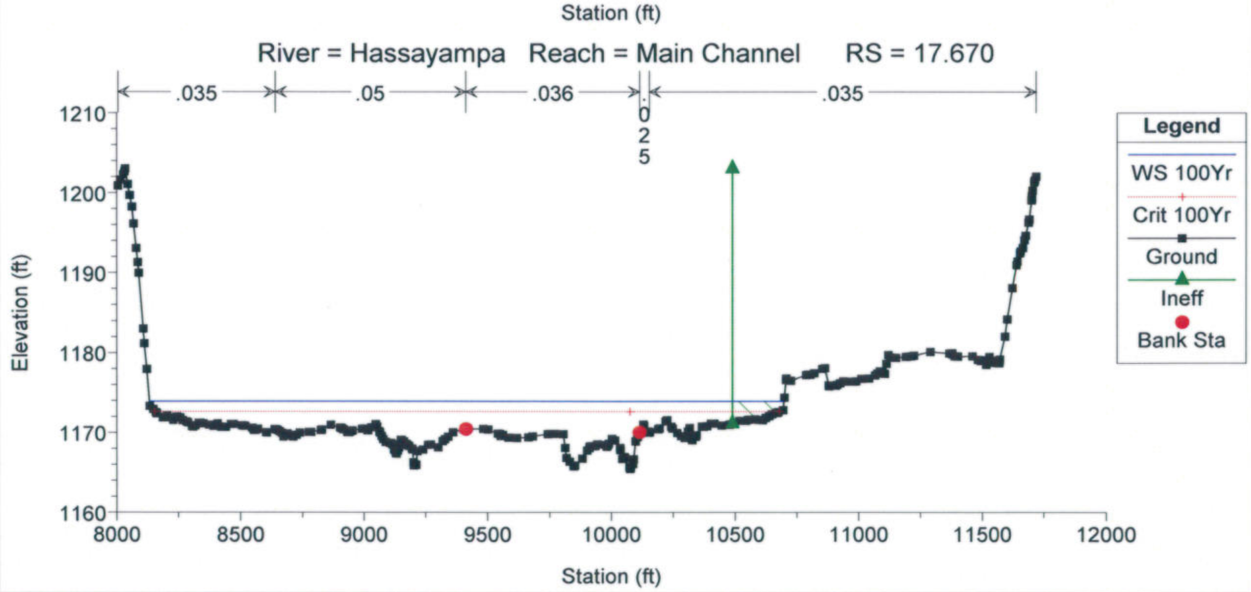

River = Hassayampa Reach = Main Channel RS = 18.330
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

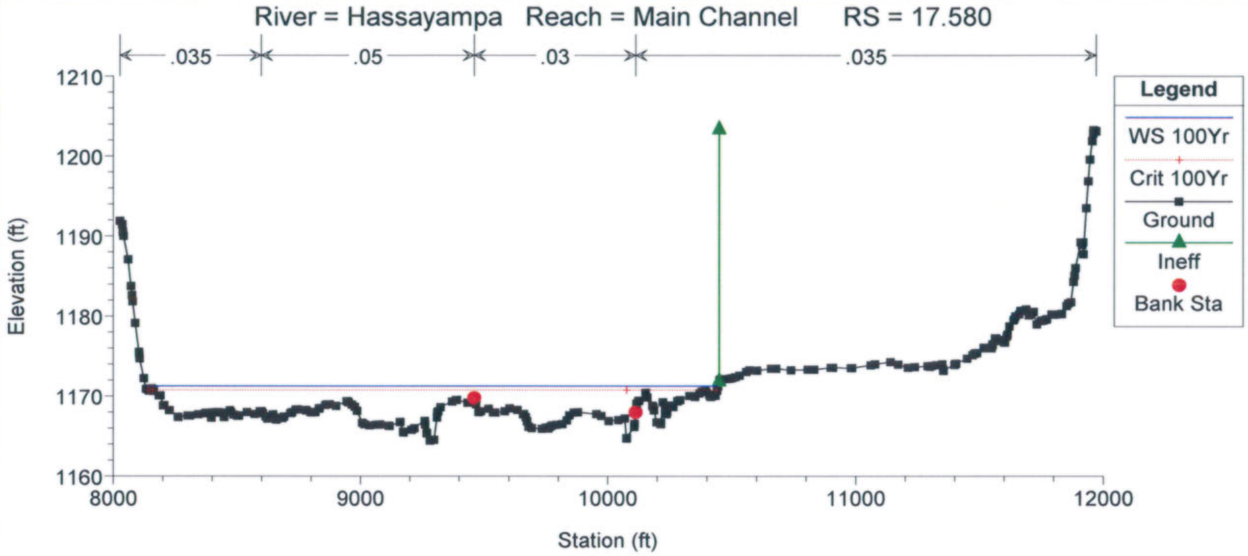

River = Hassayampa Reach = Main Channel RS = 18.240
.035
.03
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

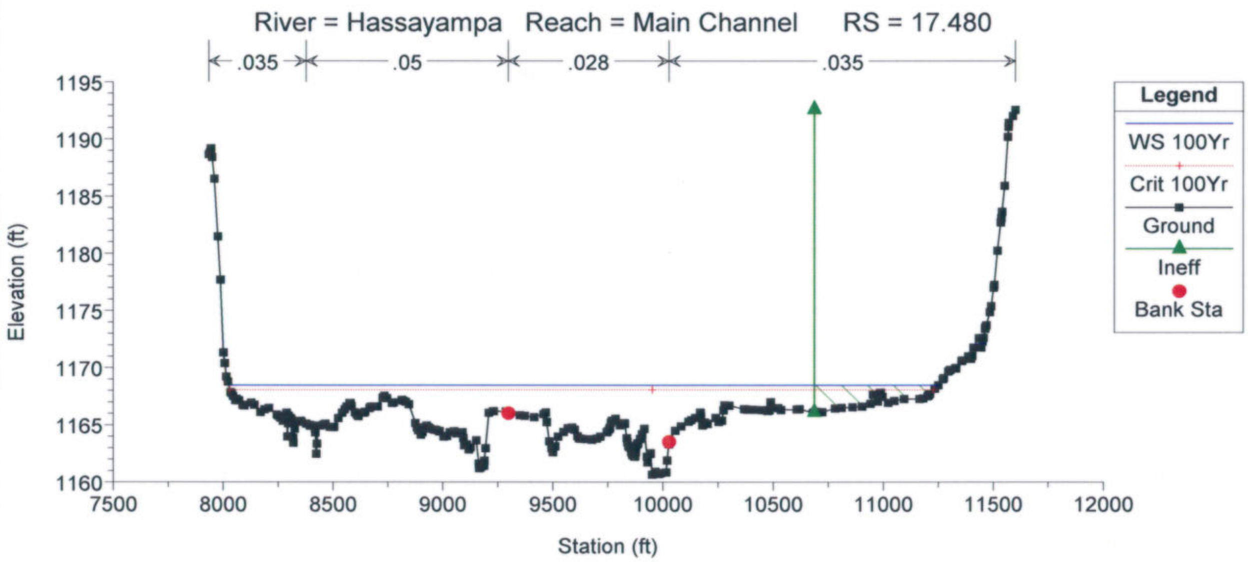

River = Hassayampa Reach = Main Channel RS = 18.140
.035
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 18.050
.035
.05
.027
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 17.950
.035
.05
.036
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

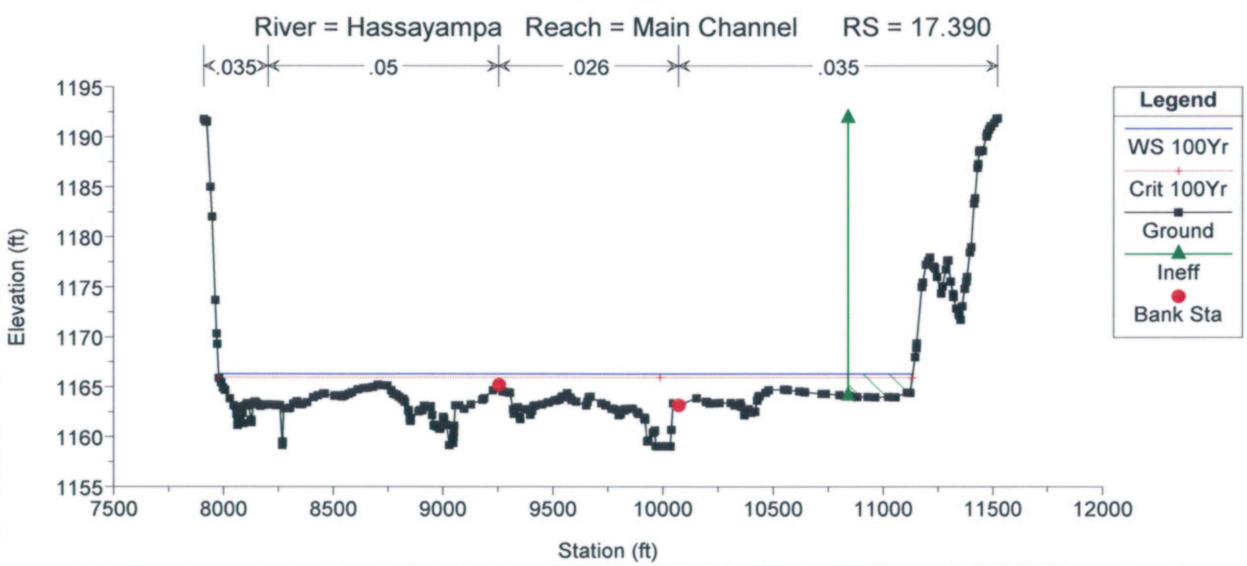

River = Hassayampa Reach = Main Channel RS = 17.860
.035
.05
.038
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1220
1210
1200
1190
1180
1170
7000
8000
9000
10000
11000
12000
Station (ft)

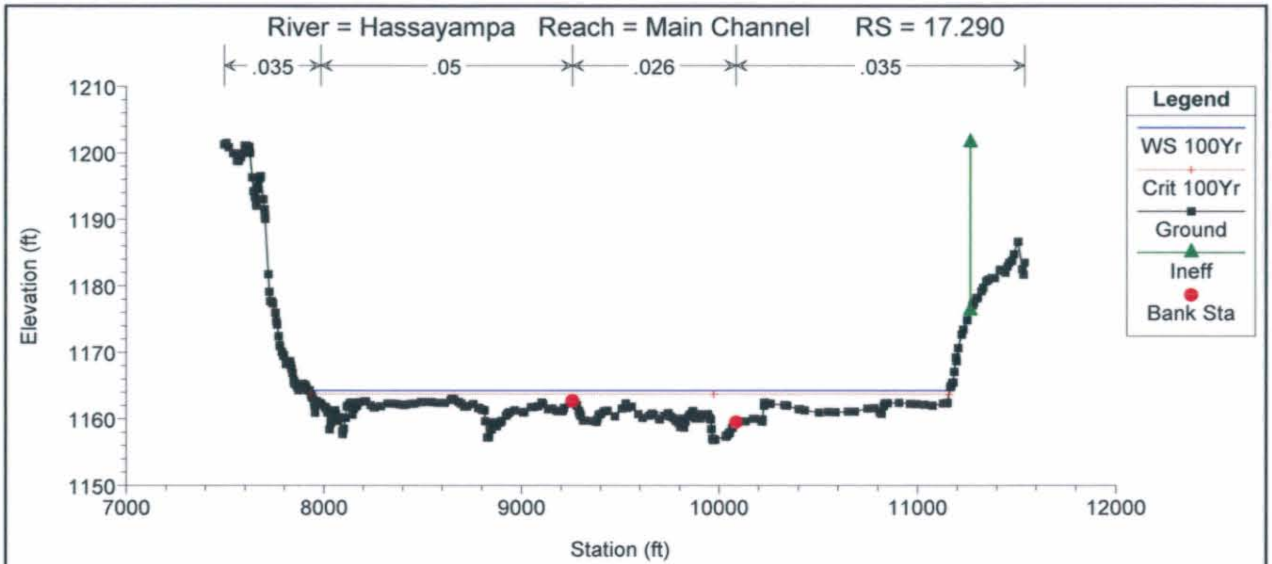

River = Hassayampa Reach = Main Channel RS = 17.770
.035
.05
.037
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1210
1200
1190
1180
1170
1160
7000
8000
9000
10000
11000
12000
Station (ft)

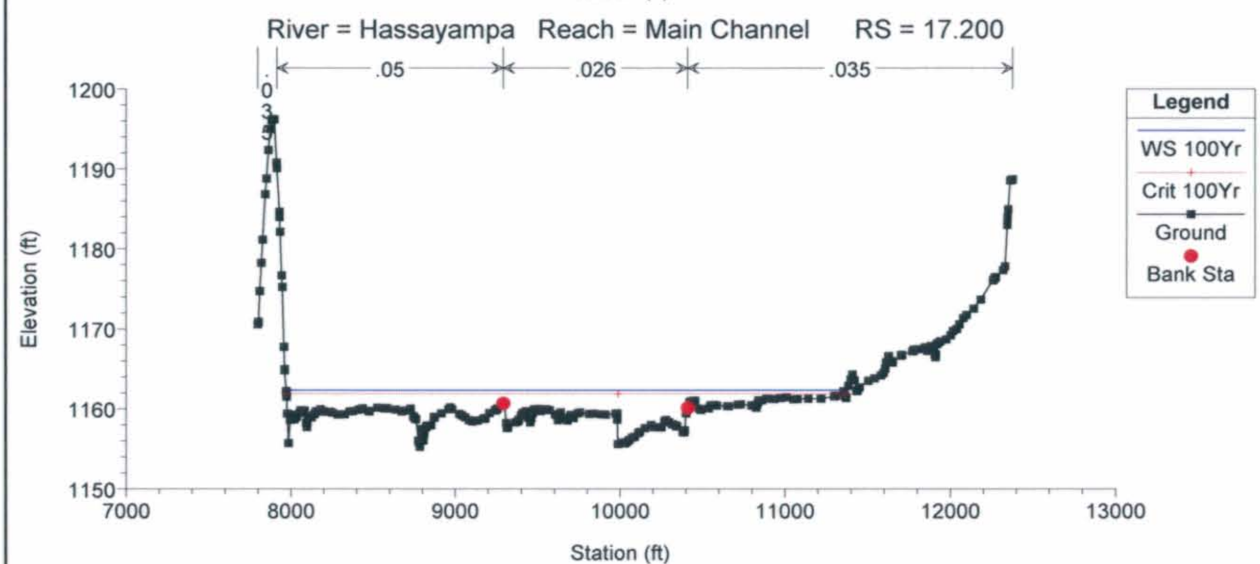

River = Hassayampa Reach = Main Channel RS = 17.670
.035
.05
.036
.025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1210
1200
1190
1180
1170
1160
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

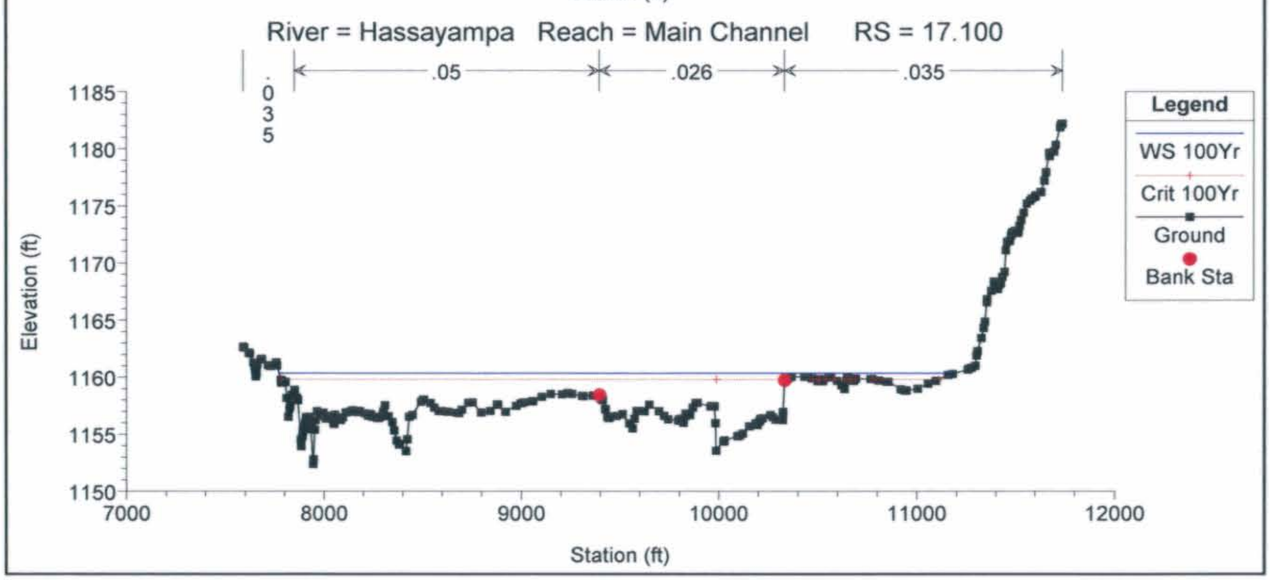

River = Hassayampa Reach = Main Channel RS = 17.580
.035
.05
.03
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1210
1200
1190
1180
1170
1160
8000
9000
10000
11000
12000
Station (ft)

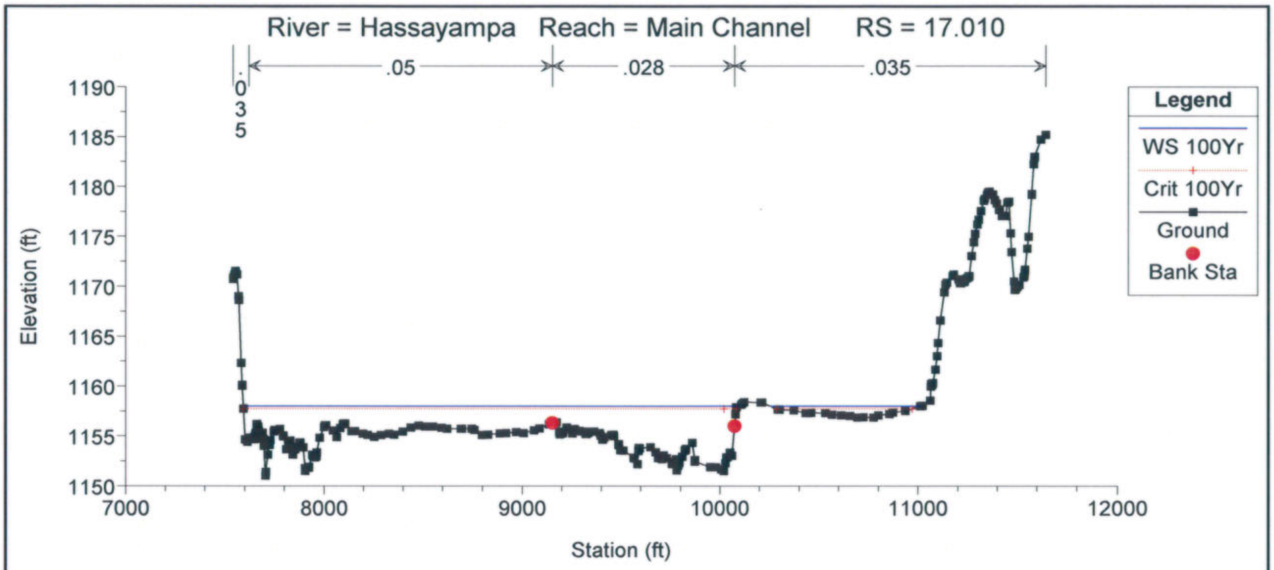

River = Hassayampa Reach = Main Channel RS = 17.480
.035
.05
.028
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1195
1190
1185
1180
1175
1170
1165
1160
7500
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

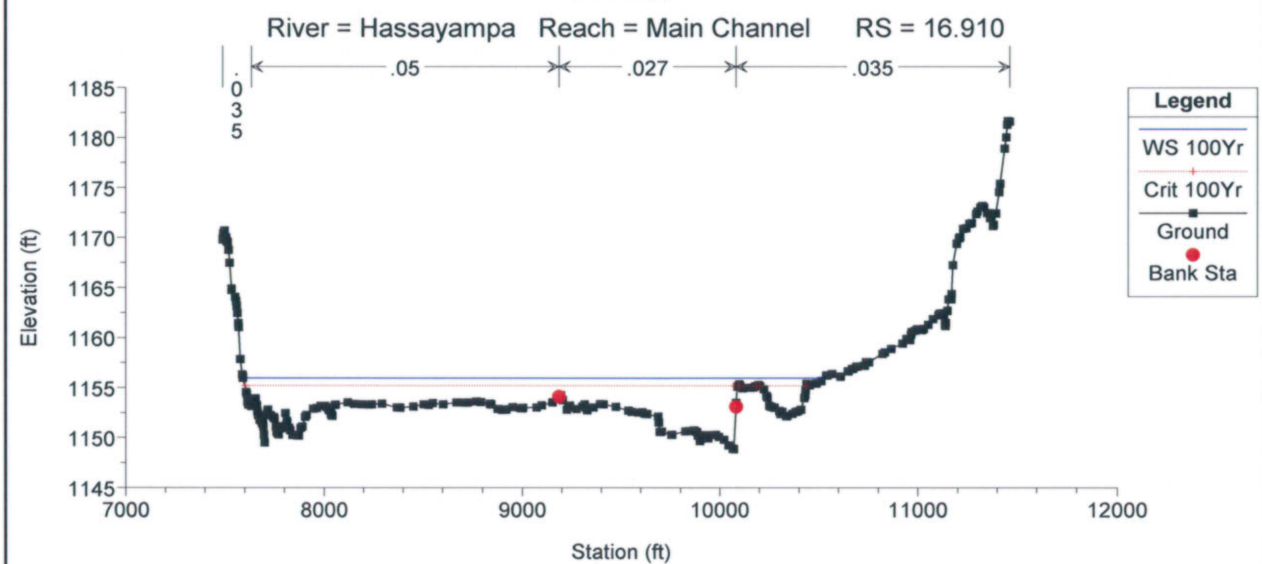

River = Hassayampa Reach = Main Channel RS = 17.390
.035
.05
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1195
1190
1185
1180
1175
1170
1165
1160
1155
7500
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

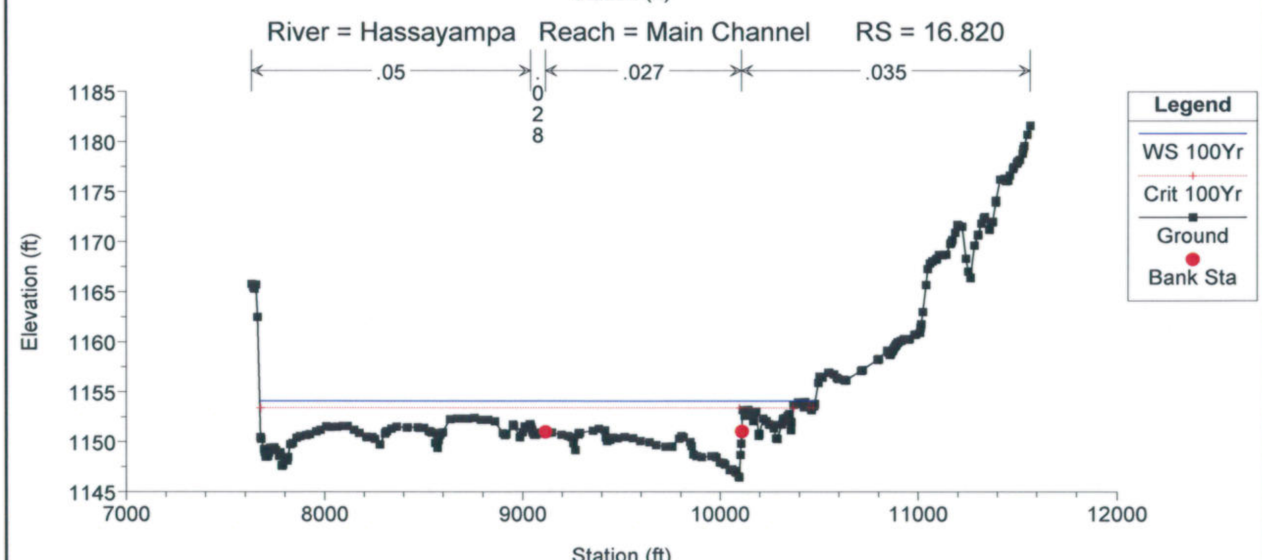

River = Hassayampa Reach = Main Channel RS = 17.290
.035
.05
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1210
1200
1190
1180
1170
1160
1150
7000
8000
9000
10000
11000
12000
Station (ft)

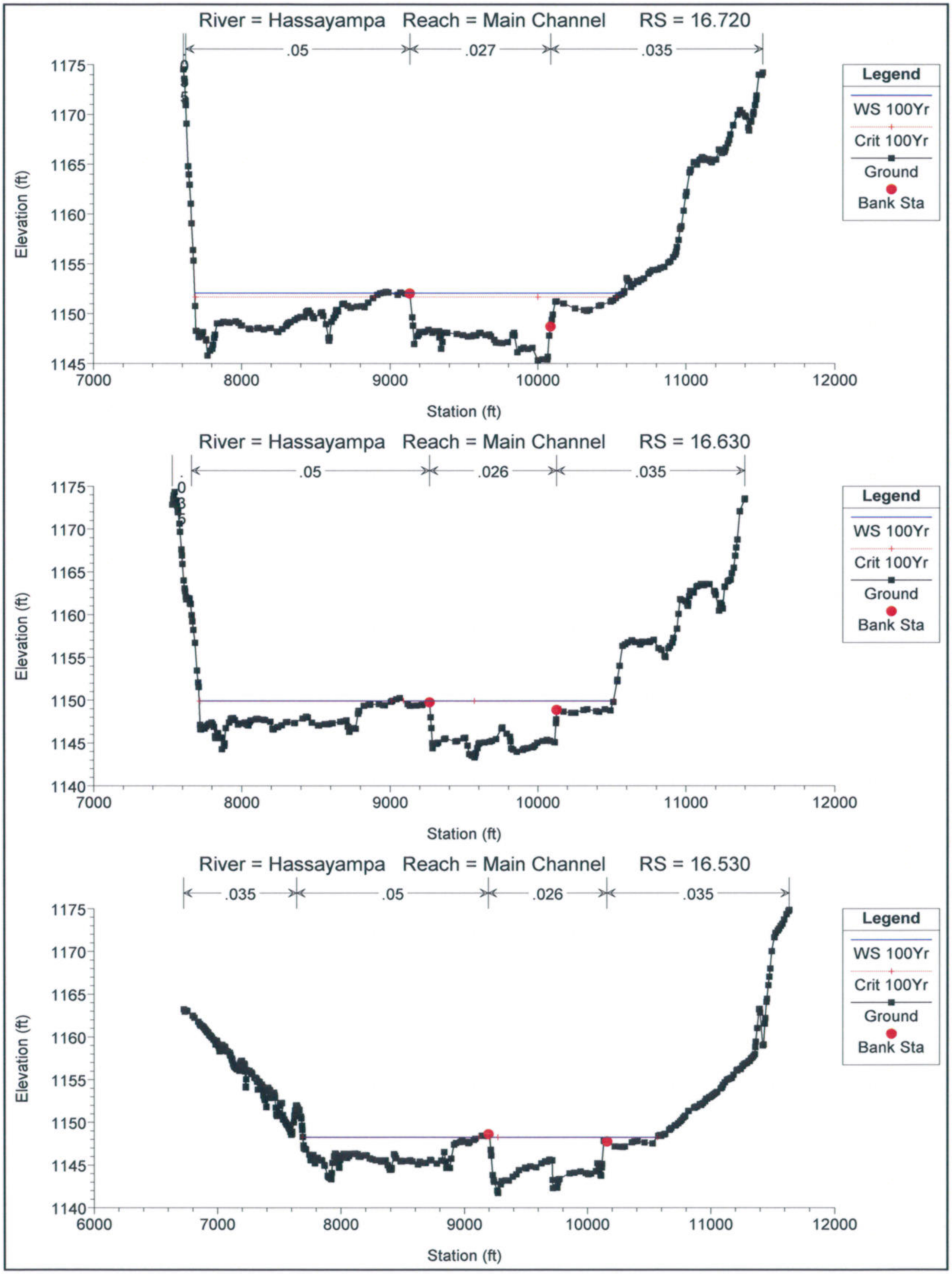

River = Hassayampa Reach = Main Channel RS = 17.200
.035
.05
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1200
1190
1180
1170
1160
1150
7000
8000
9000
10000
11000
12000
13000
Station (ft)


River = Hassayampa Reach = Main Channel RS = 17.100
.035
.05
.026
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1185
1180
1175
1170
1165
1160
1155
1150
7000
8000
9000
10000
11000
12000
Station (ft)

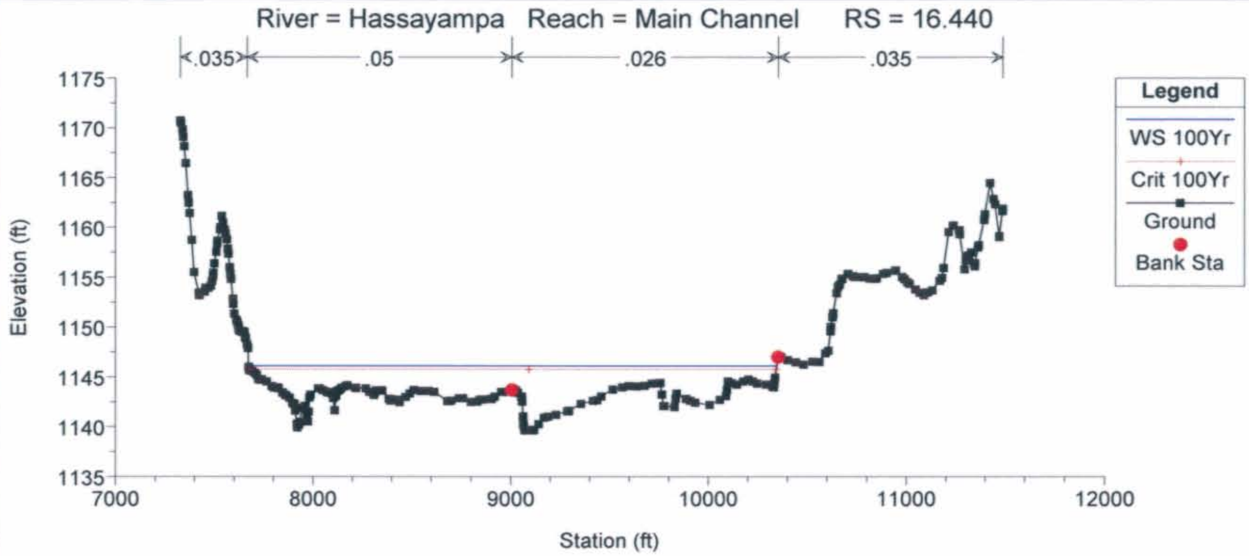

River = Hassayampa Reach = Main Channel RS = 17.010
.035
.05
.028
.035
1190
1185
1180
1175
1170
1165
1160
1155
1150
Elevation (ft)
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

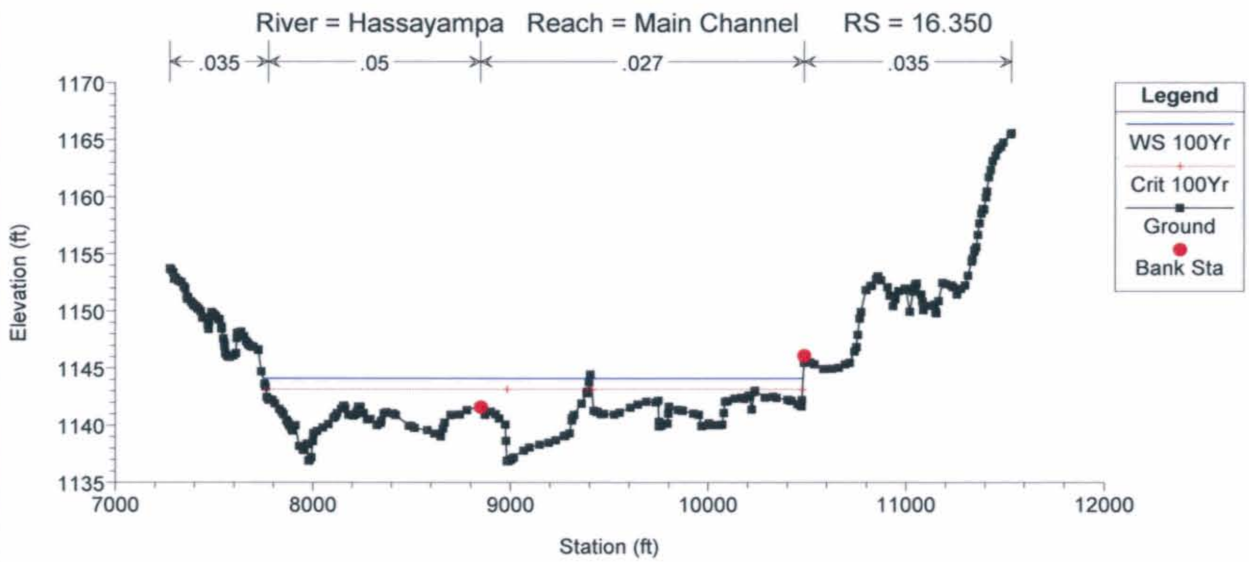

River = Hassayampa Reach = Main Channel RS = 16.910
.035
.05
.027
.035
1185
1180
1175
1170
1165
1160
1155
1150
1145
Elevation (ft)
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

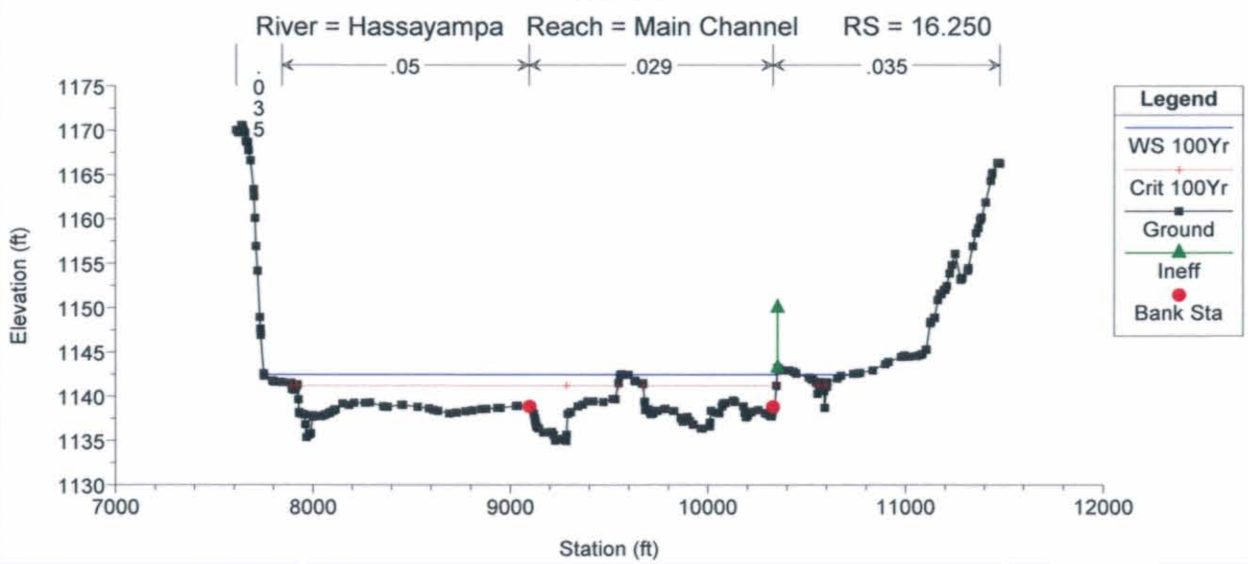

River = Hassayampa Reach = Main Channel RS = 16.820
.05
.028
.027
.035
1185
1180
1175
1170
1165
1160
1155
1150
1145
Elevation (ft)
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

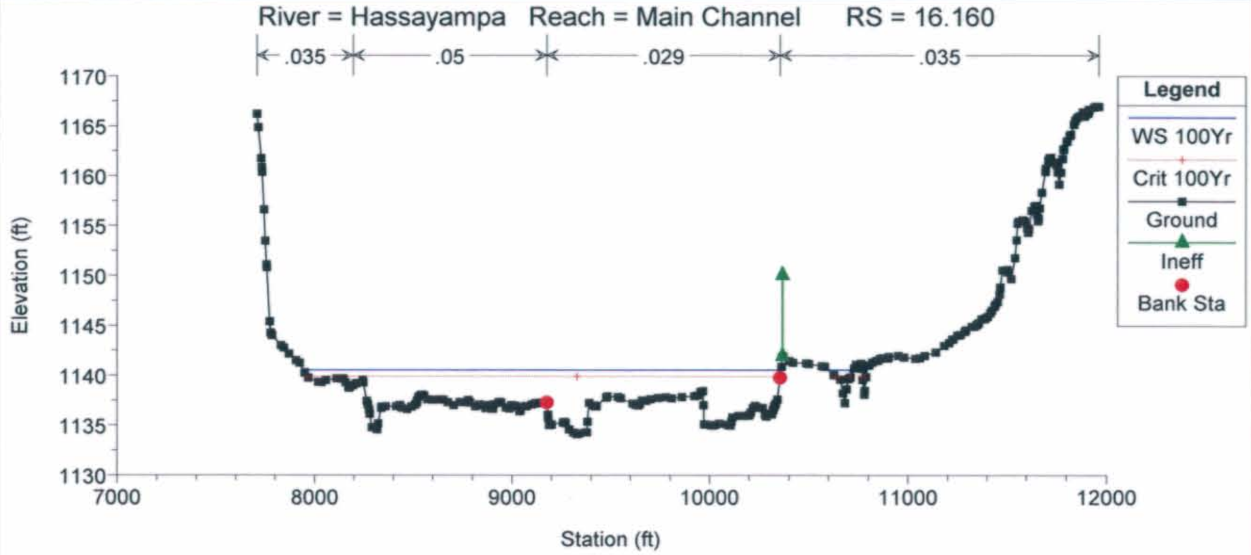


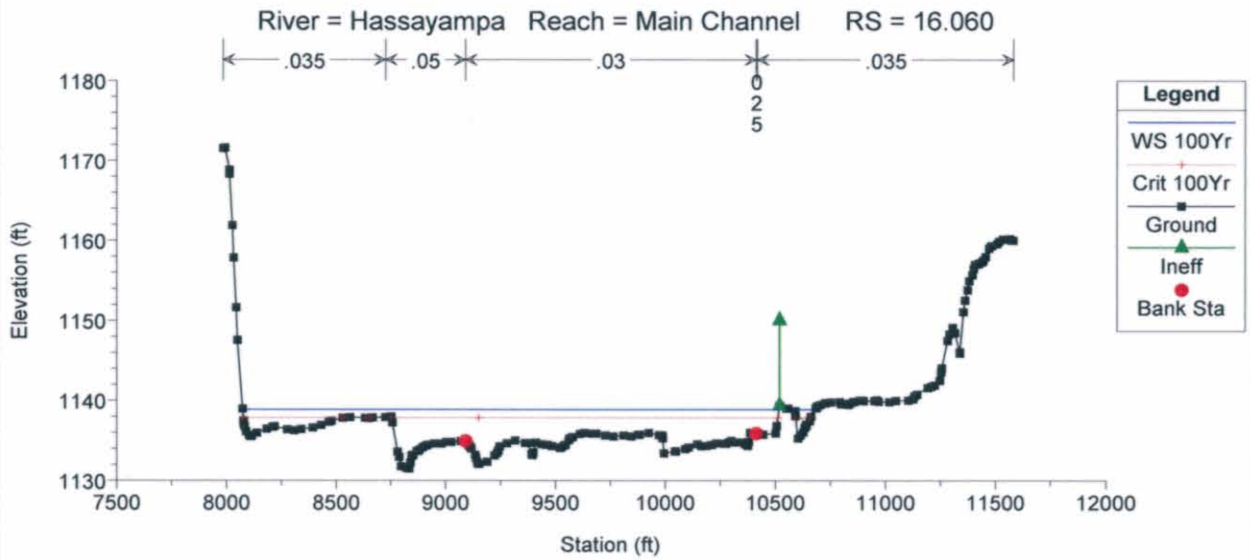
River = Hassayampa Reach = Main Channel RS = 16.720
.05
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 16.630
.05
.026
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 16.530
.035
.05
.026
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

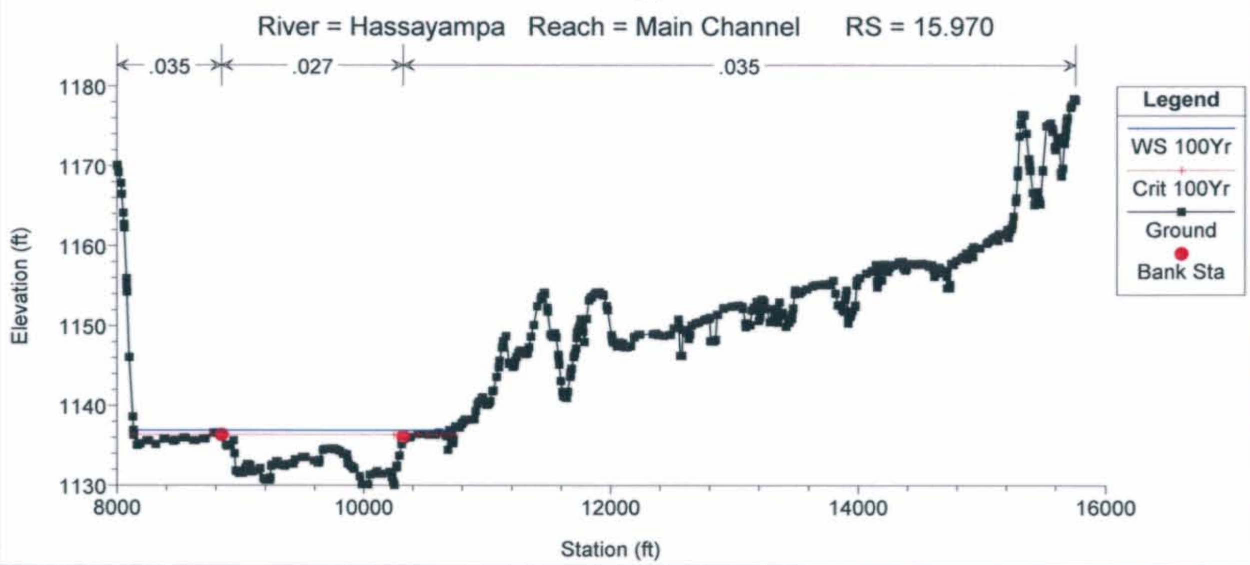

River = Hassayampa Reach = Main Channel RS = 16.440
.035
.05
.026
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

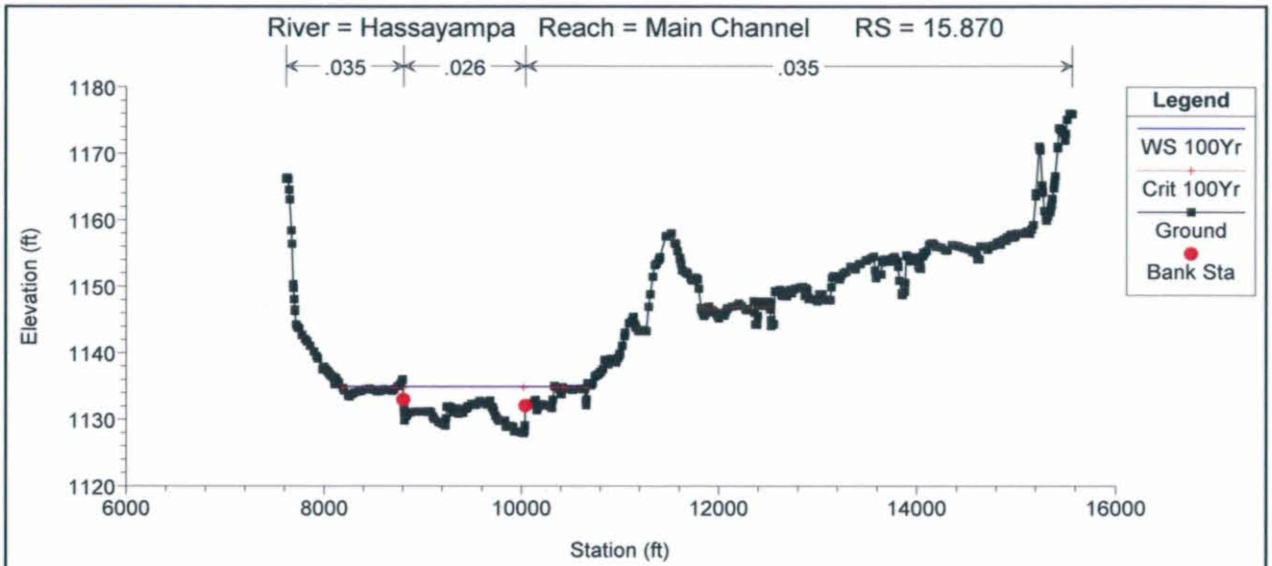

River = Hassayampa Reach = Main Channel RS = 16.350
.035
.05
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

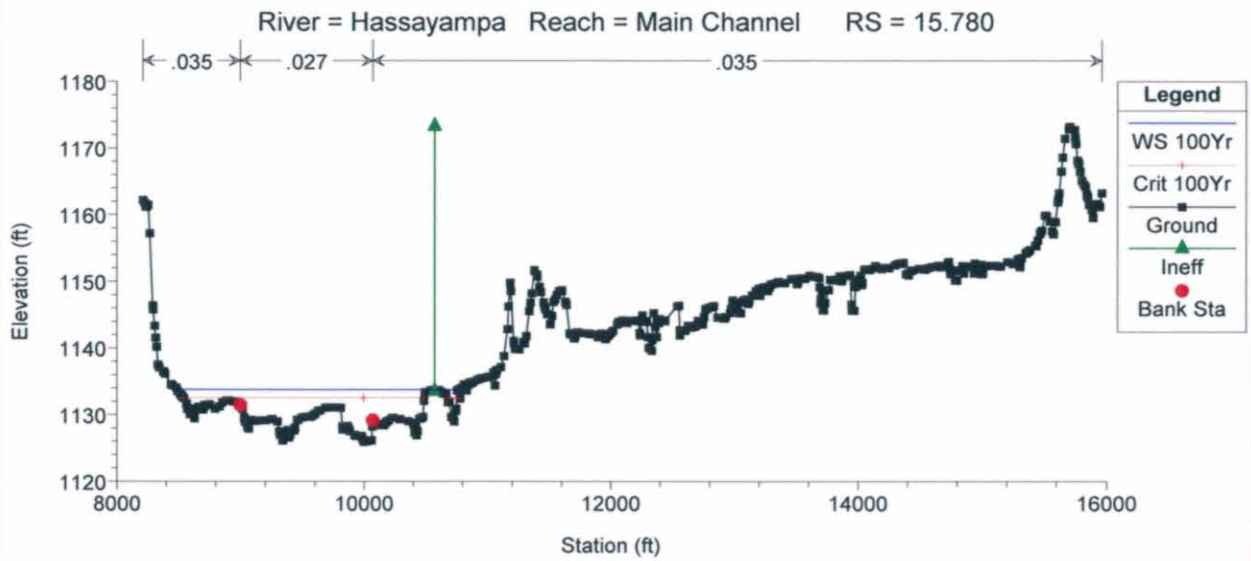

River = Hassayampa Reach = Main Channel RS = 16.250
.035
.05
.029
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

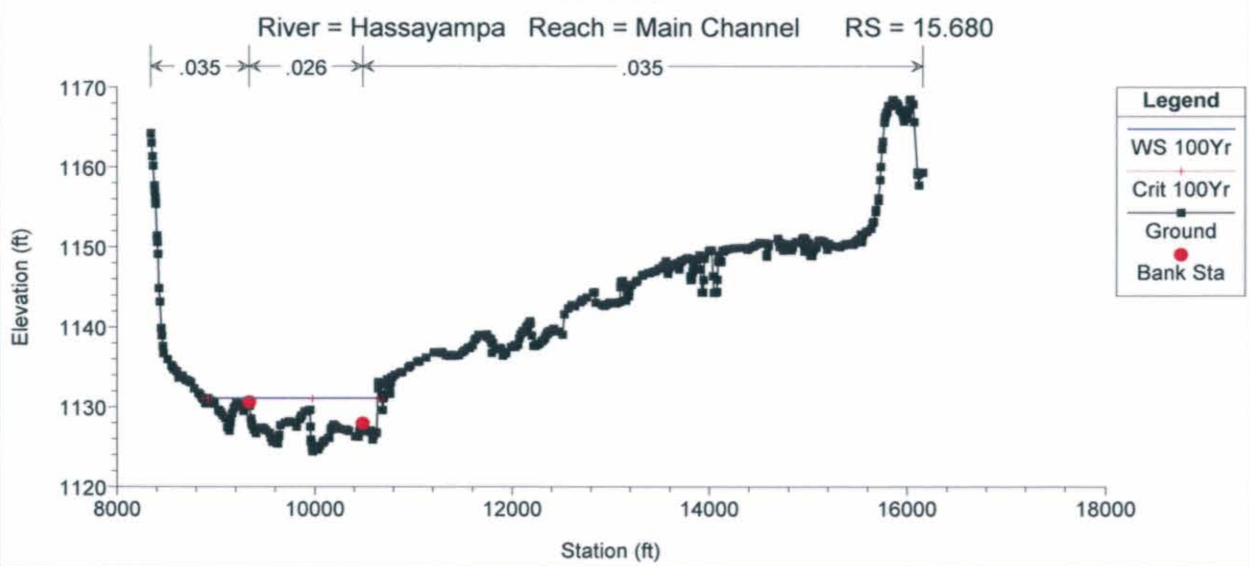

River = Hassayampa Reach = Main Channel RS = 16.160
.035
.05
.029
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

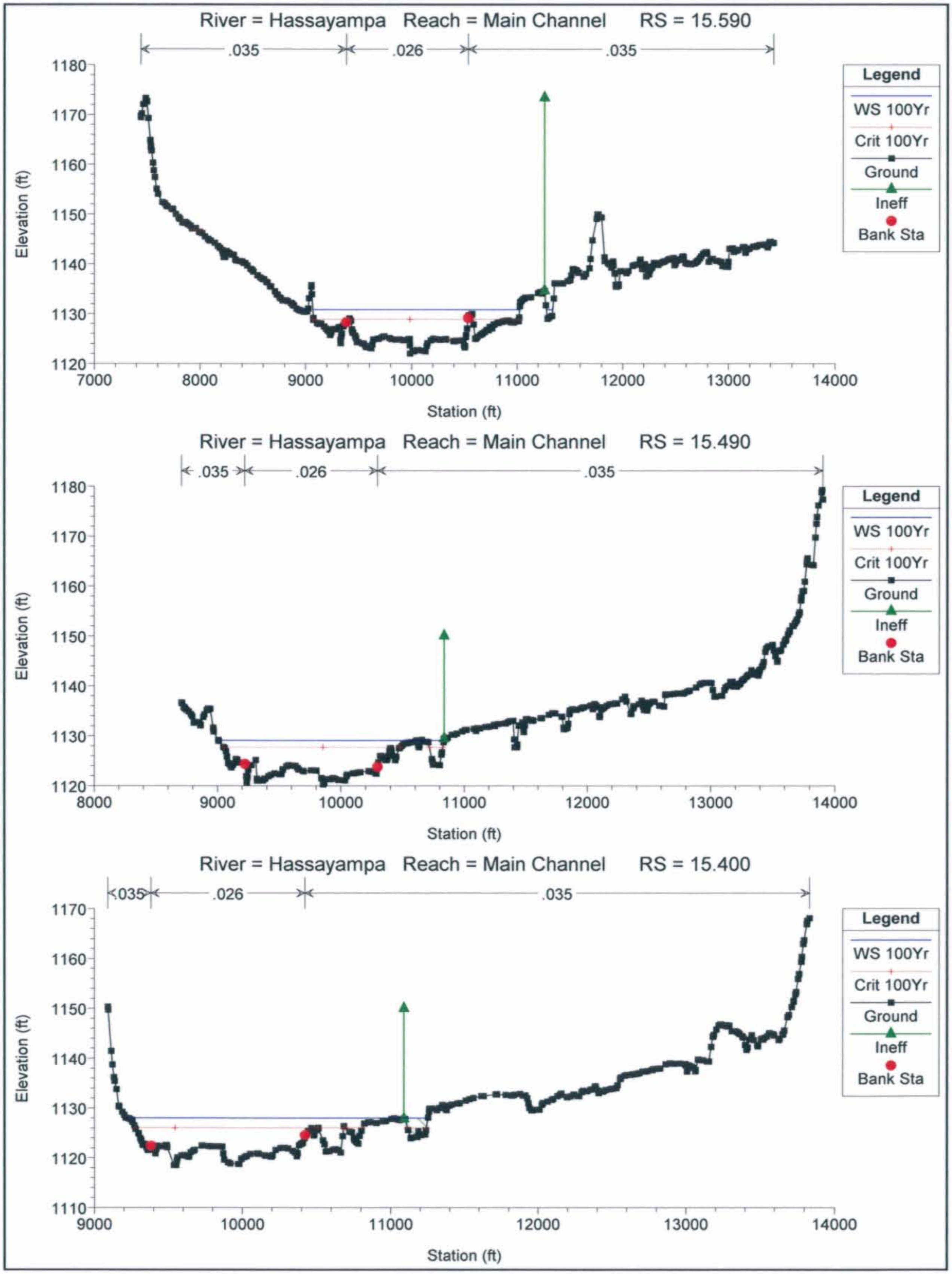

River = Hassayampa Reach = Main Channel RS = 16.060
.035
.05
.03
.035
0
2
5
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

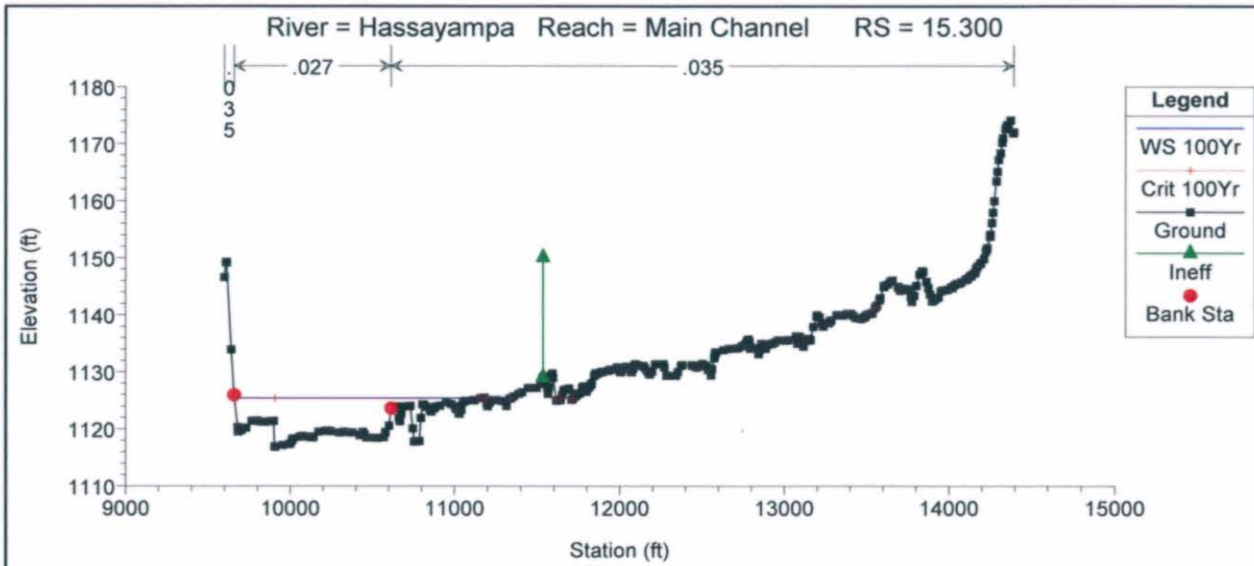

River = Hassayampa Reach = Main Channel RS = 15.970
.035
.027
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

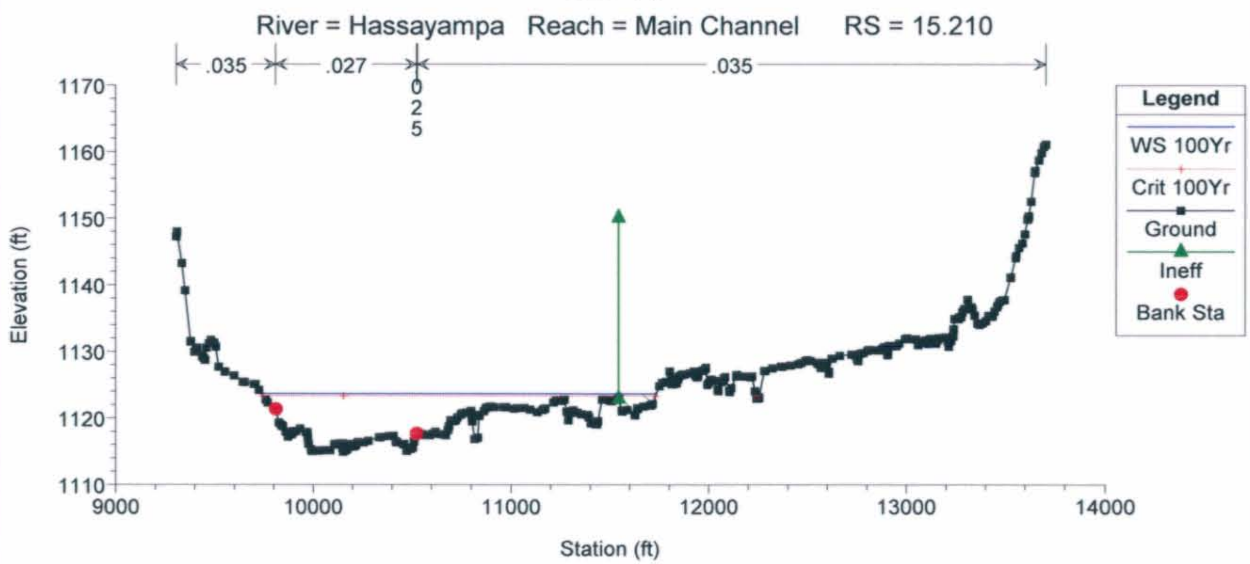

River = Hassayampa Reach = Main Channel RS = 15.870
.035
.026
.035
Elevation (ft)
1180
1170
1160
1150
1140
1130
1120
6000
8000
10000
12000
14000
16000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

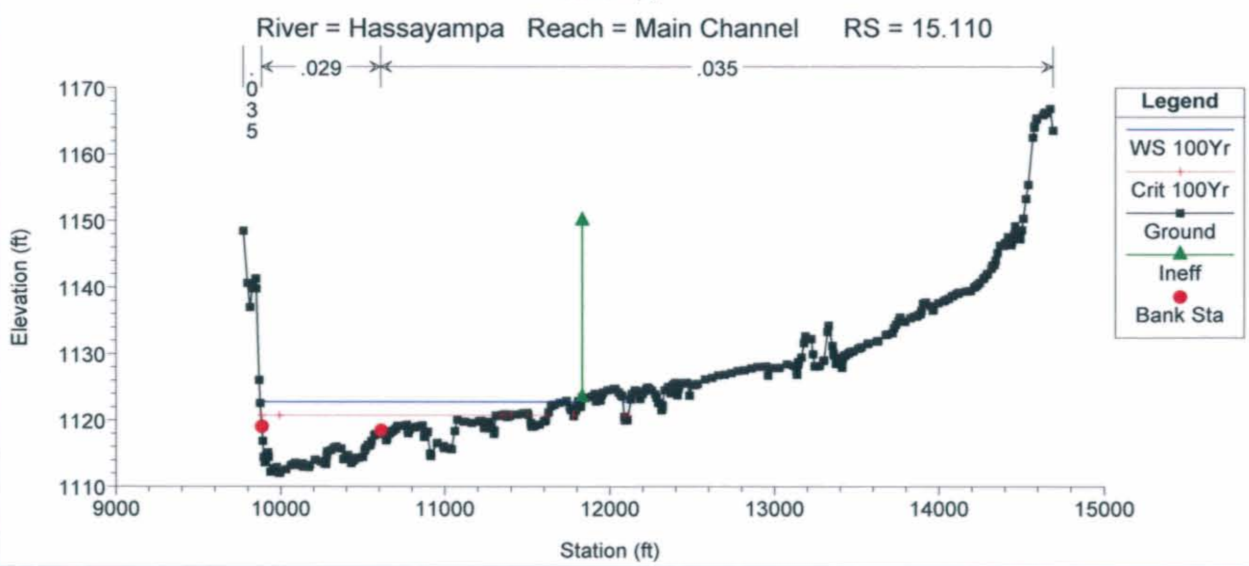

River = Hassayampa Reach = Main Channel RS = 15.780
.035
.027
.035
Elevation (ft)
1180
1170
1160
1150
1140
1130
1120
8000
10000
12000
14000
16000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

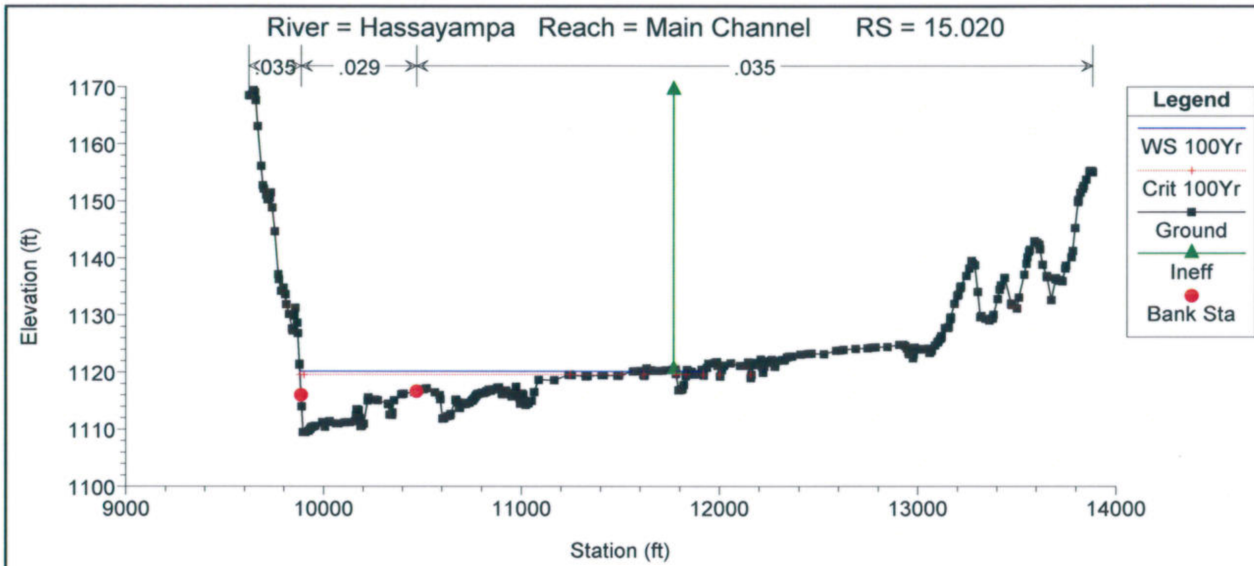

River = Hassayampa Reach = Main Channel RS = 15.680
.035
.026
.035
Elevation (ft)
1170
1160
1150
1140
1130
1120
8000
10000
12000
14000
16000
18000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

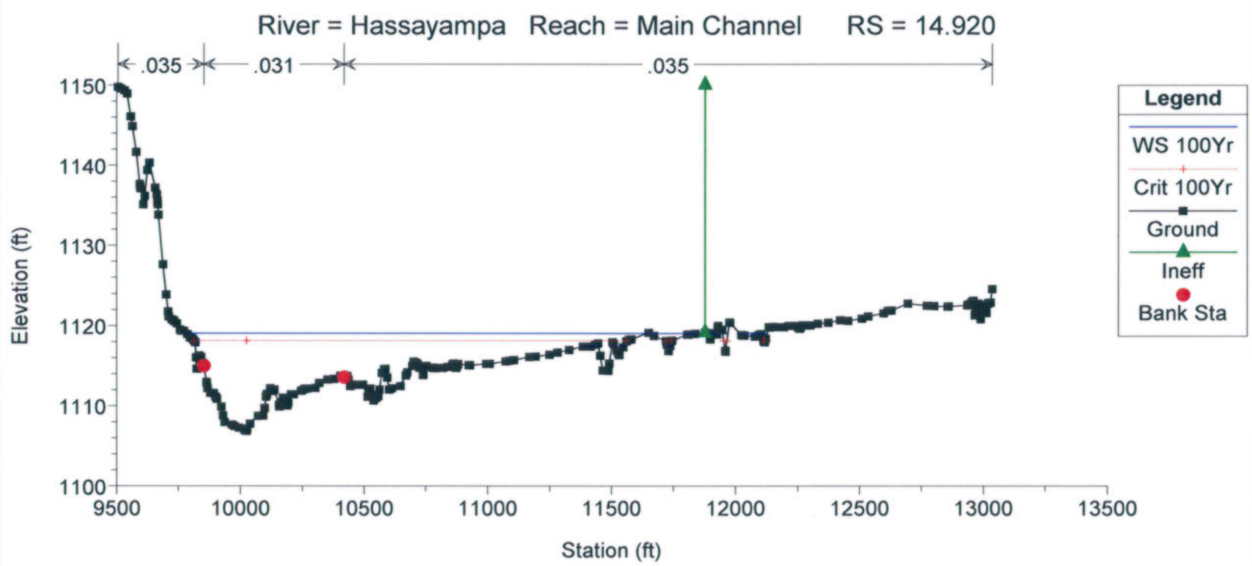

River = Hassayampa Reach = Main Channel RS = 15.590
.035 .026 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 15.490
.035 .026 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 15.400
.035 .026 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

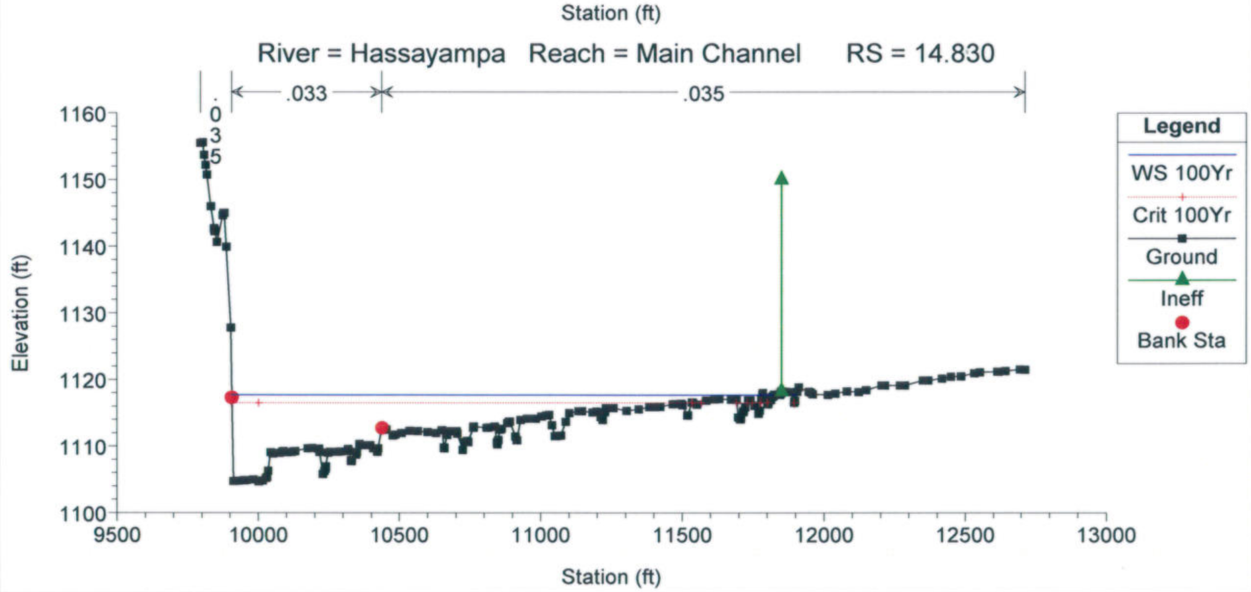

River = Hassayampa Reach = Main Channel RS = 15.300
.035
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

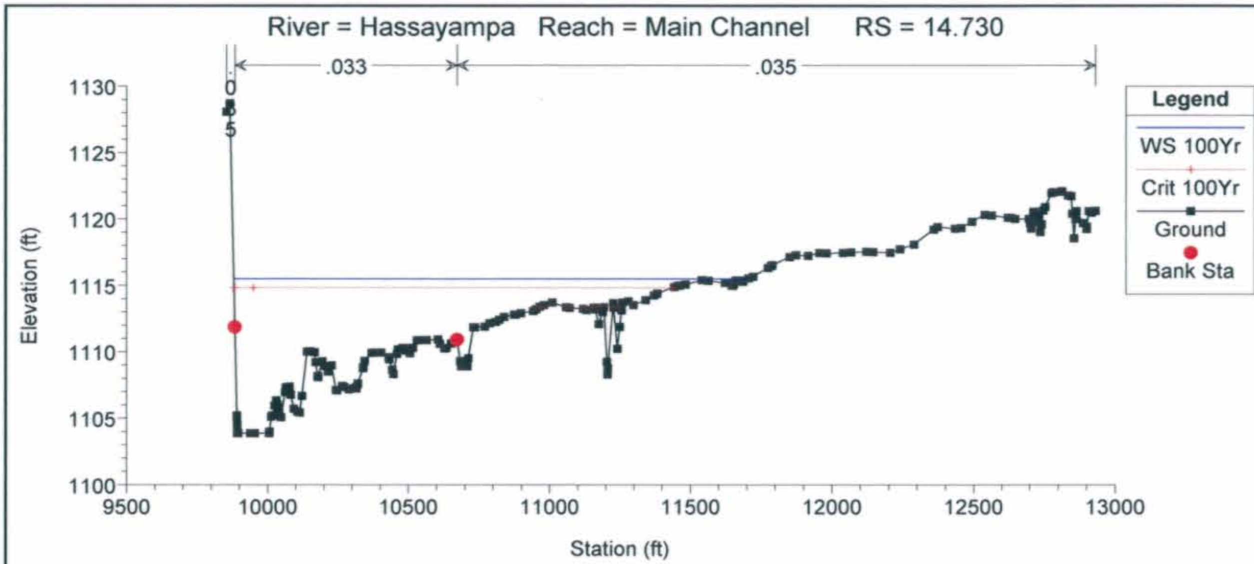

River = Hassayampa Reach = Main Channel RS = 15.210
.035
.027
.025
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

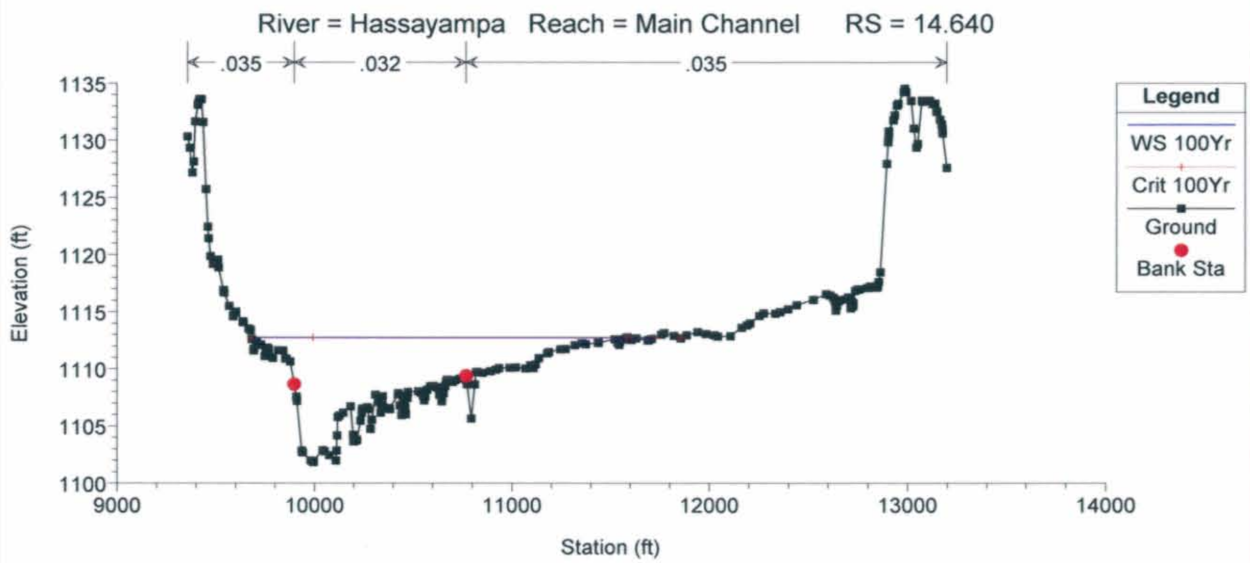

River = Hassayampa Reach = Main Channel RS = 15.110
.035
.029
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

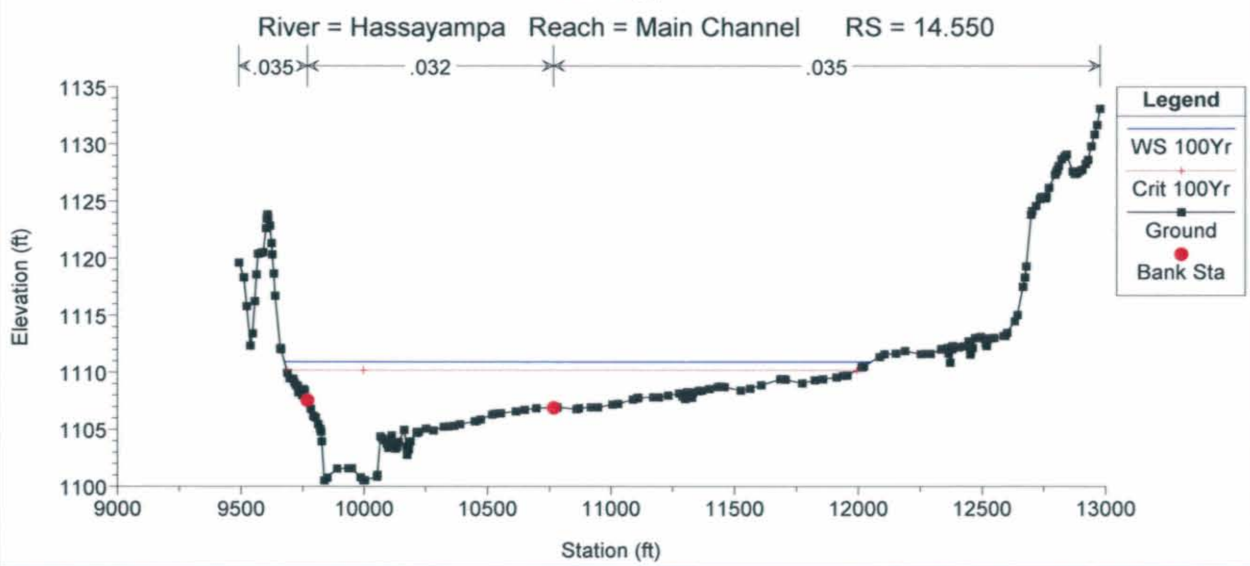

River = Hassayampa Reach = Main Channel RS = 15.020
.035
.029
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

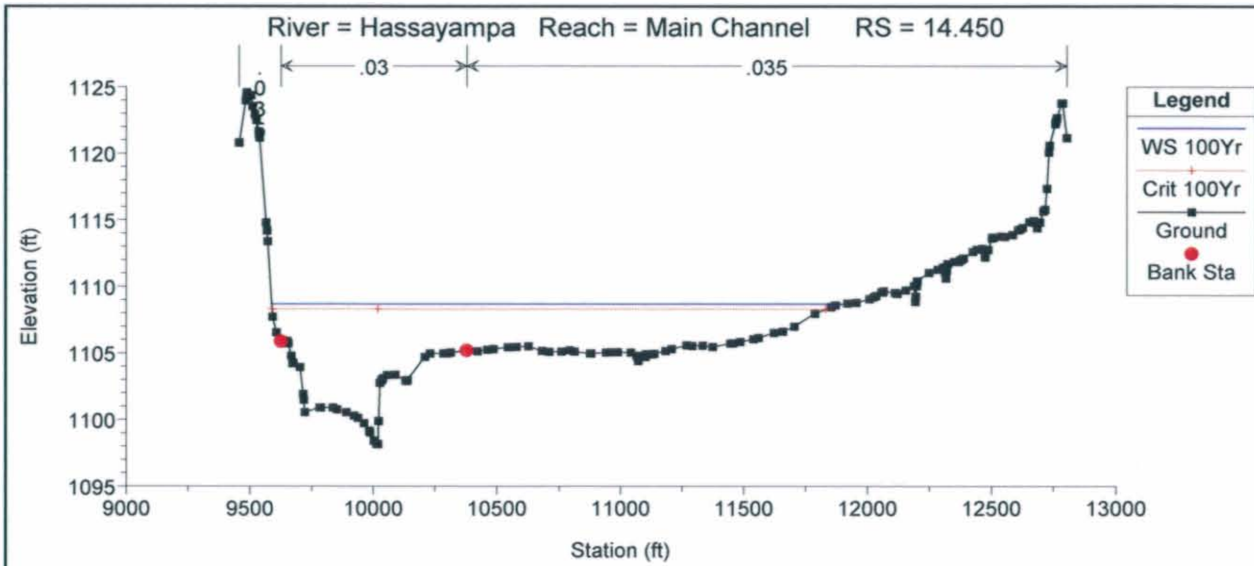

River = Hassayampa Reach = Main Channel RS = 14.920
.035
.031
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

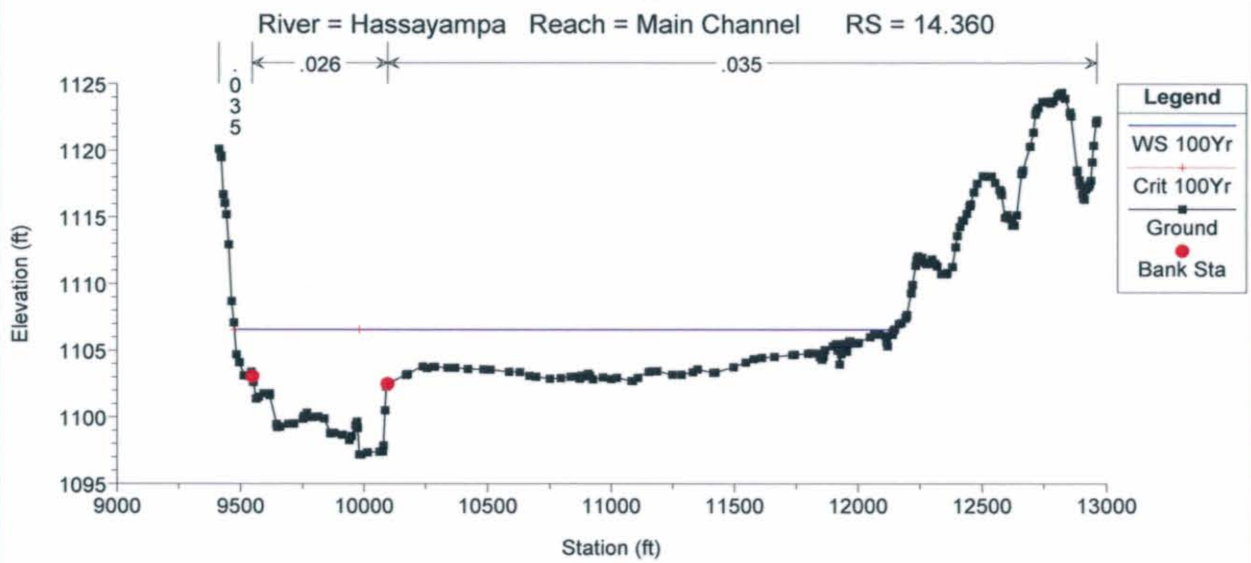

River = Hassayampa Reach = Main Channel RS = 14.830
.035
.033
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

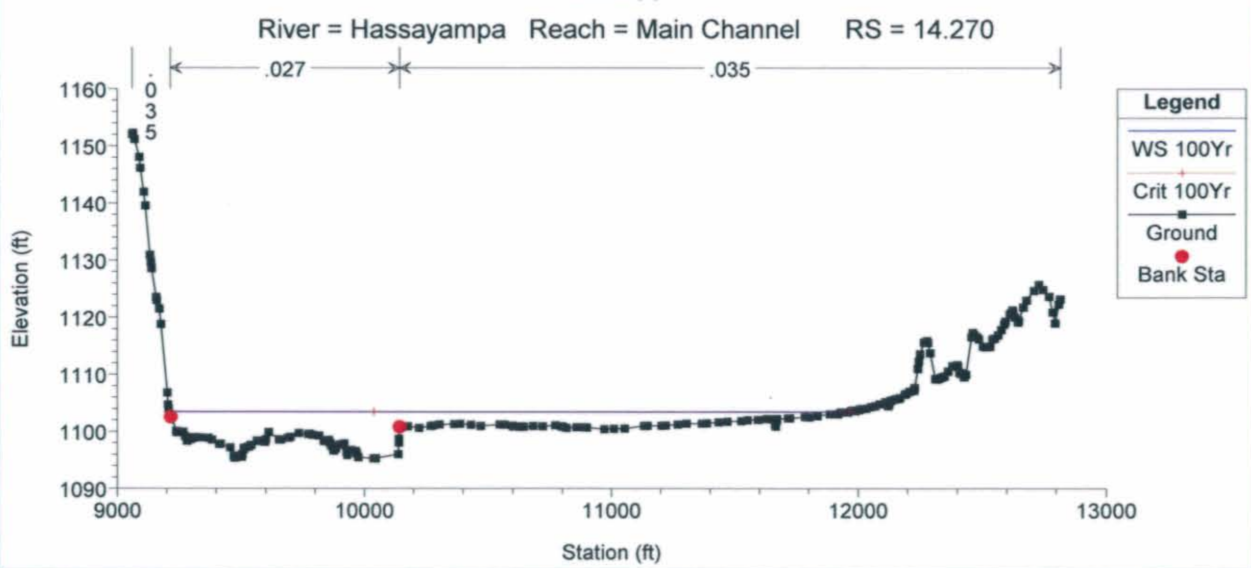

River = Hassayampa Reach = Main Channel RS = 14.730
.033
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

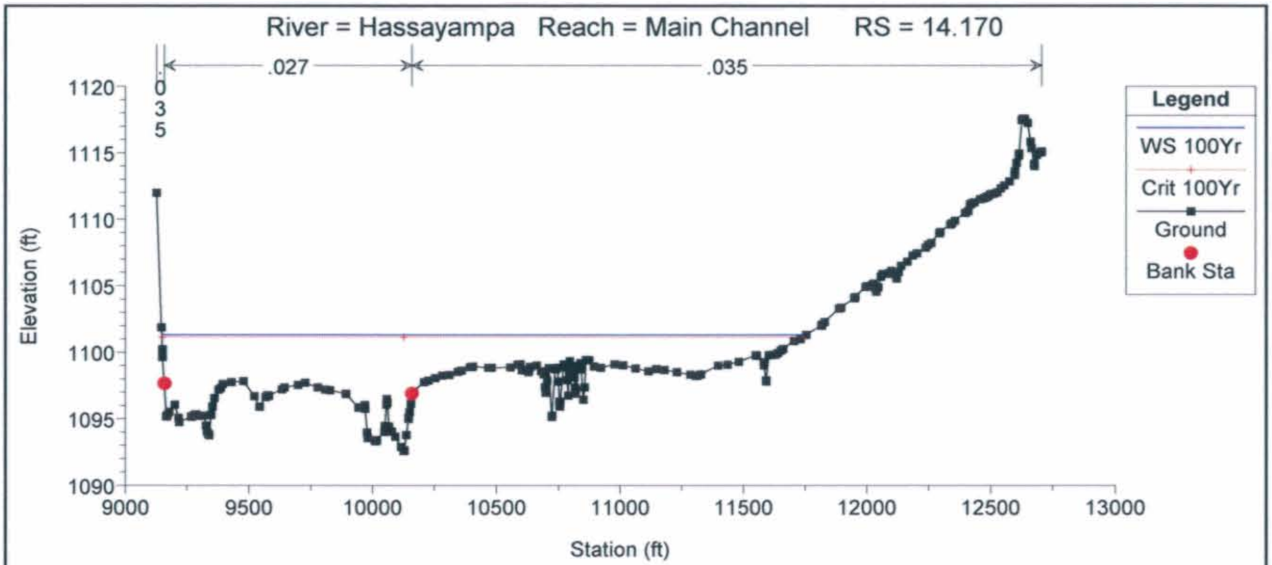

River = Hassayampa Reach = Main Channel RS = 14.640
.035
.032
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

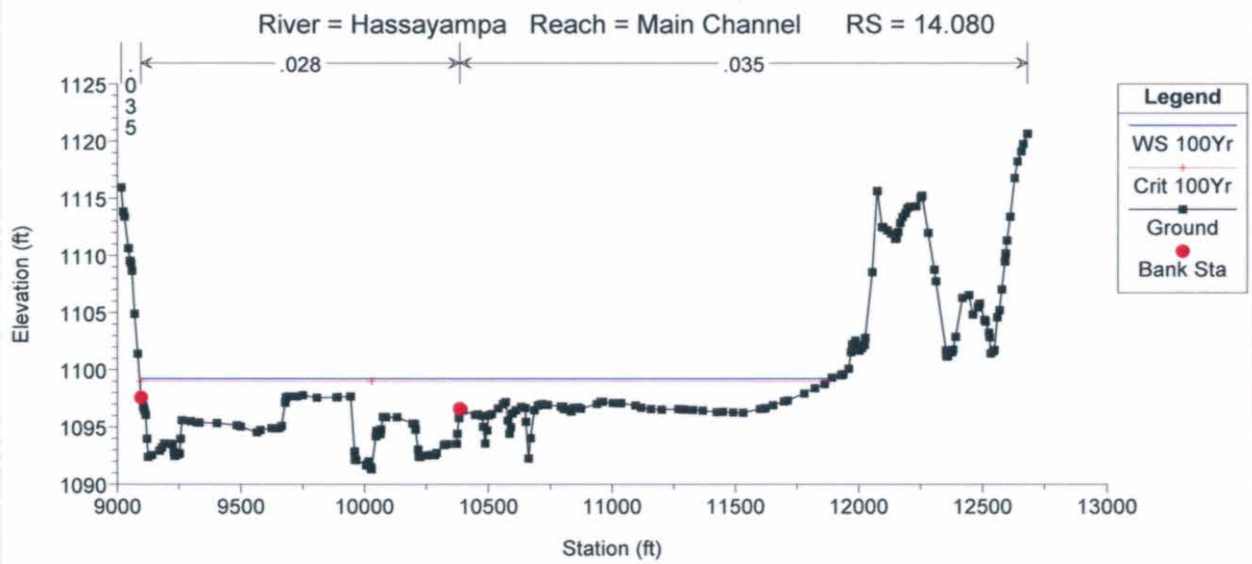

River = Hassayampa Reach = Main Channel RS = 14.550
.035
.032
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

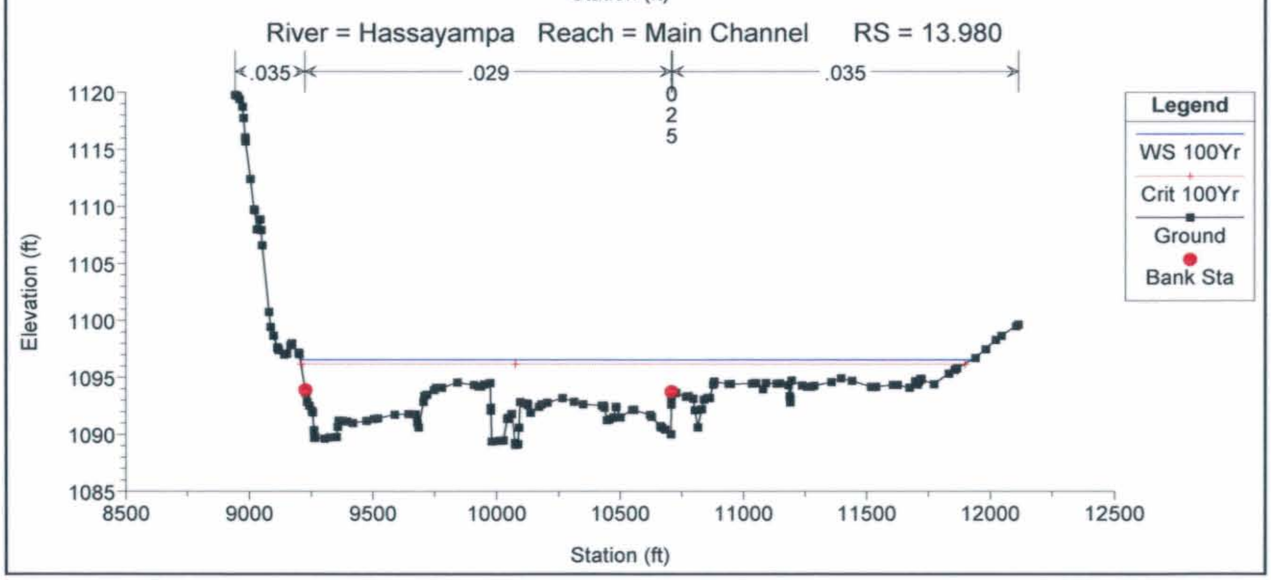

River = Hassayampa Reach = Main Channel RS = 14.450
.03
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

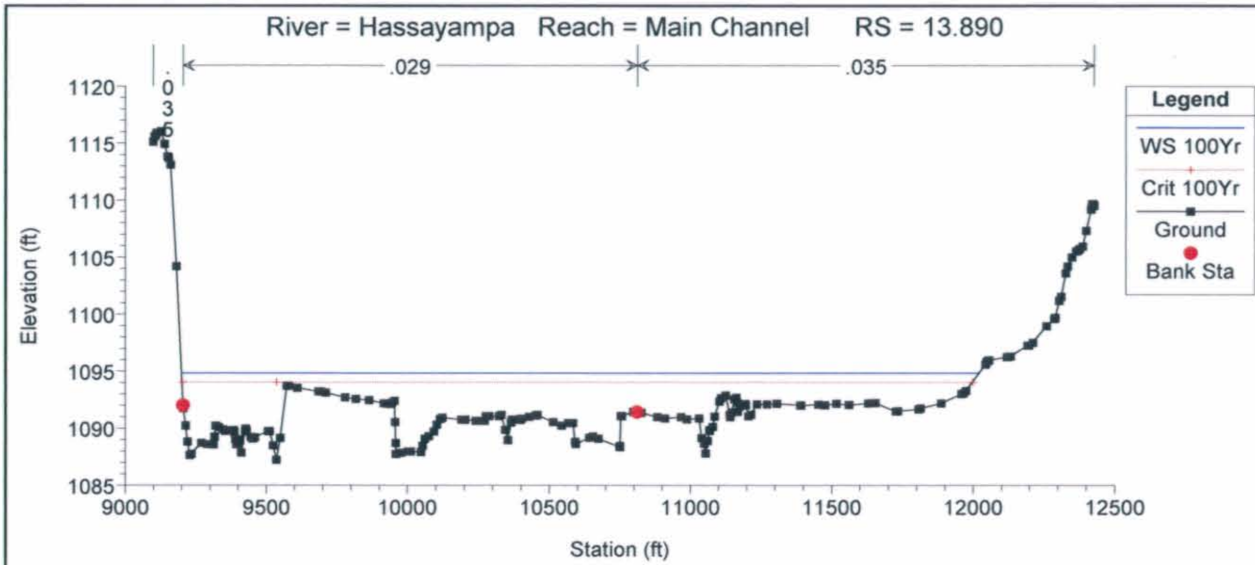

River = Hassayampa Reach = Main Channel RS = 14.360
.035
.026
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

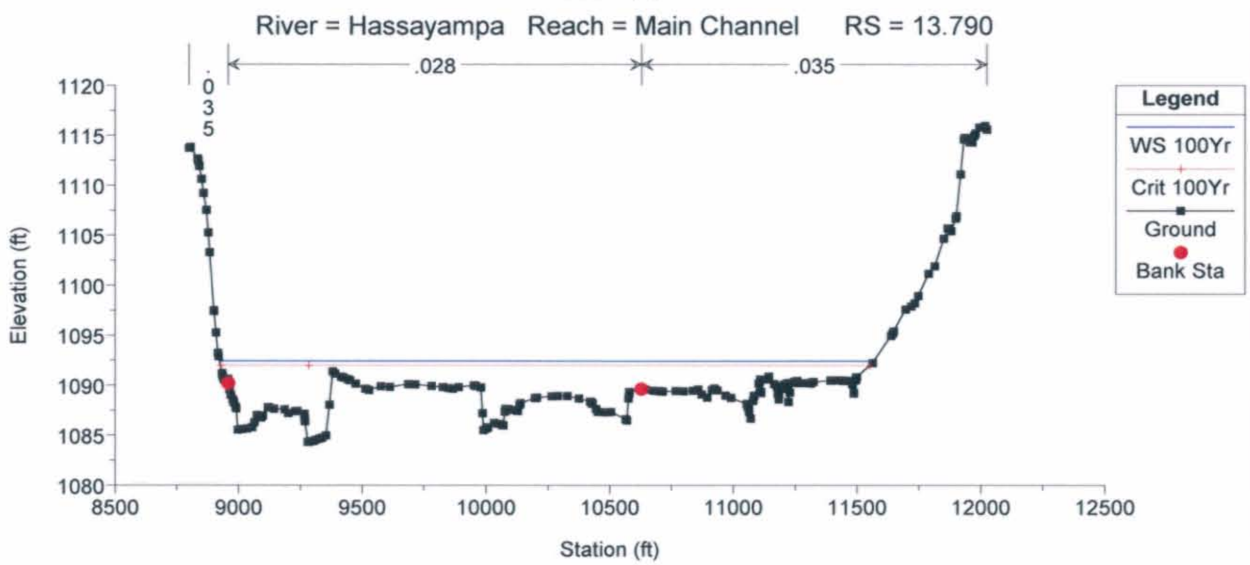

River = Hassayampa Reach = Main Channel RS = 14.270
.035
.027
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

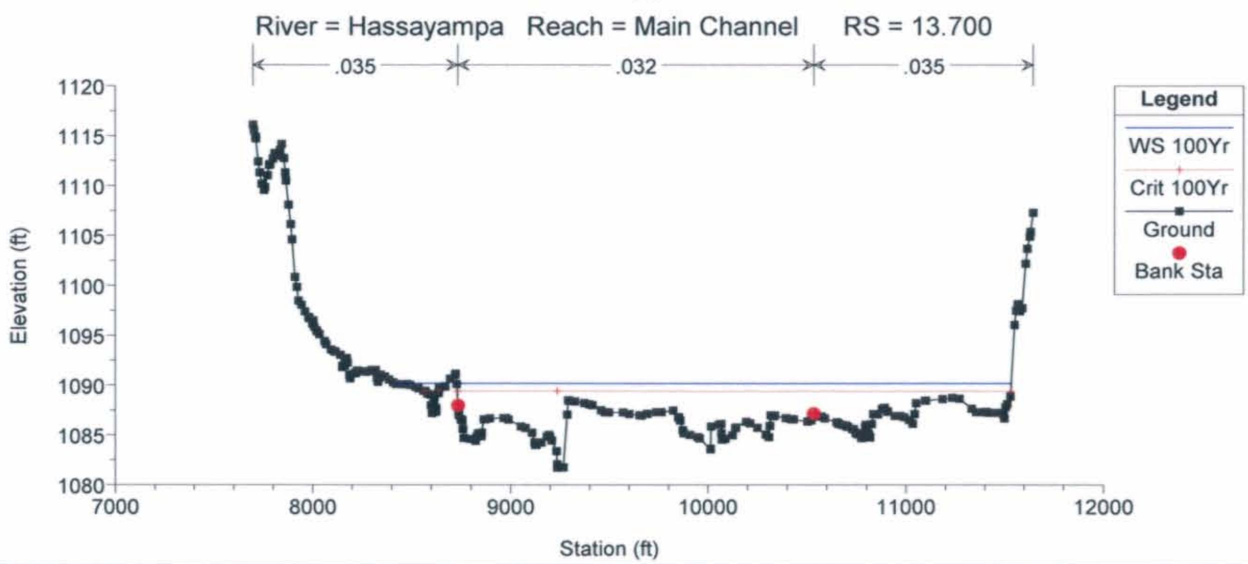

River = Hassayampa Reach = Main Channel RS = 14.170
.035
.027
.035
Elevation (ft)
1090
1095
1100
1105
1110
1115
1120
Station (ft)
9000
9500
10000
10500
11000
11500
12000
12500
13000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

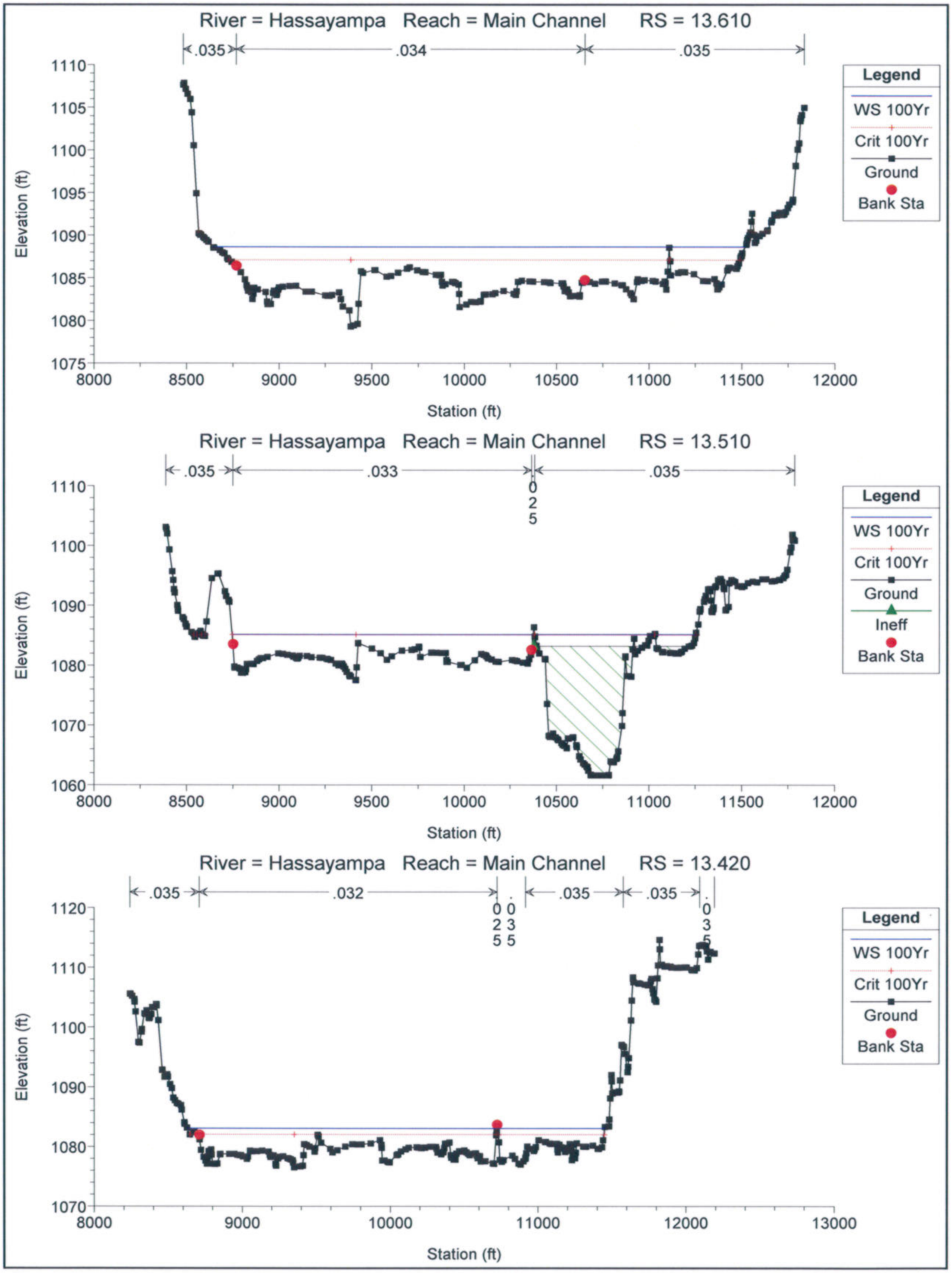

River = Hassayampa Reach = Main Channel RS = 14.080
.035
.028
.035
Elevation (ft)
1090
1095
1100
1105
1110
1115
1120
1125
Station (ft)
9000
9500
10000
10500
11000
11500
12000
12500
13000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

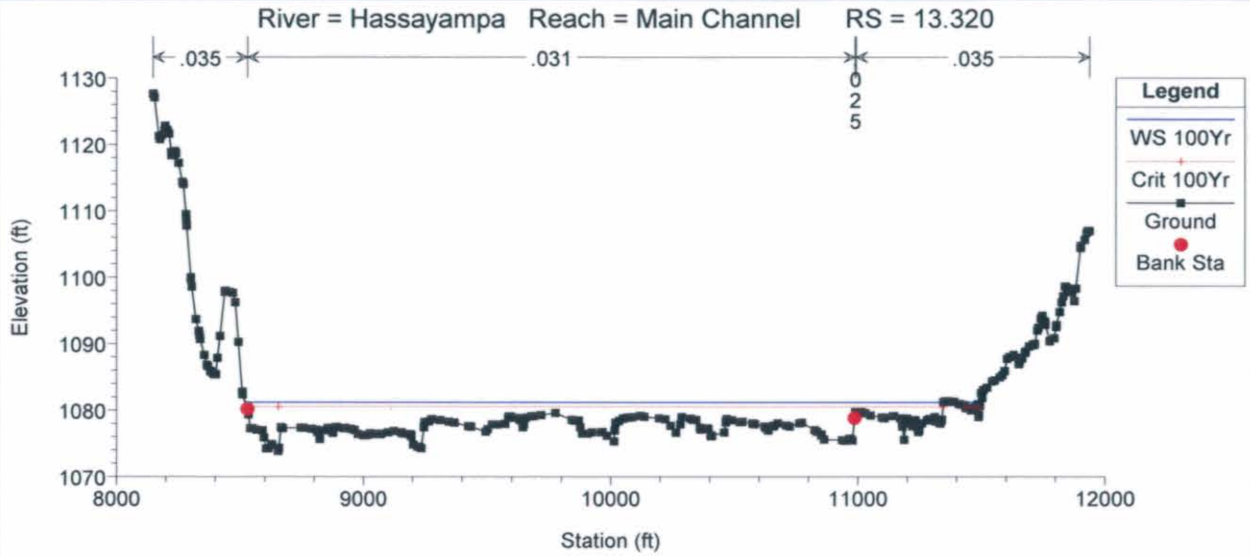

River = Hassayampa Reach = Main Channel RS = 13.980
.035
.029
025
.035
Elevation (ft)
1085
1090
1095
1100
1105
1110
1115
1120
Station (ft)
8500
9000
9500
10000
10500
11000
11500
12000
12500
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 13.890
.036
.029
.035
Elevation (ft)
Station (ft)
1120
1115
1110
1105
1100
1095
1090
1085
9000
9500
10000
10500
11000
11500
12000
12500
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

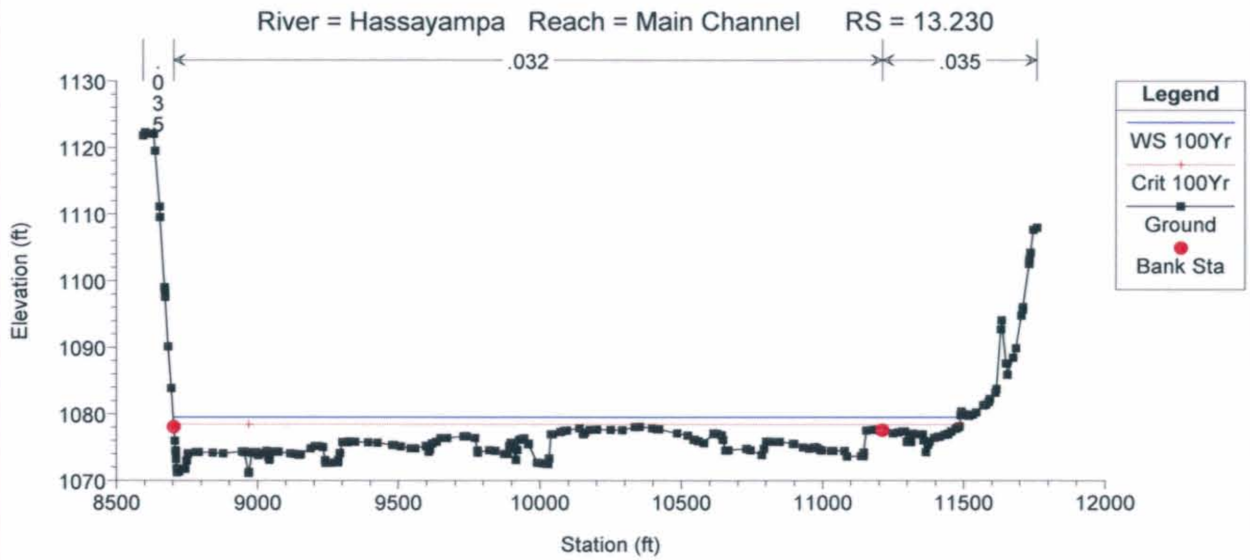

River = Hassayampa Reach = Main Channel RS = 13.790
.035
.028
.035
Elevation (ft)
Station (ft)
1120
1115
1110
1105
1100
1095
1090
1085
1080
8500
9000
9500
10000
10500
11000
11500
12000
12500
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 13.700
.035
.032
.035
Elevation (ft)
Station (ft)
1120
1115
1110
1105
1100
1095
1090
1085
1080
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

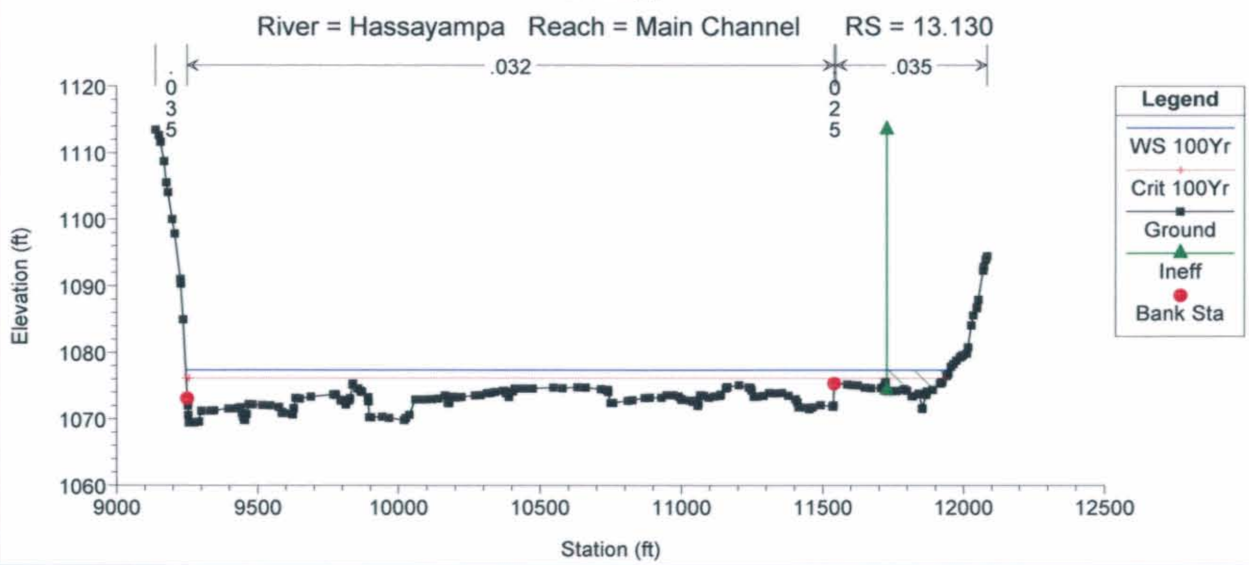

River = Hassayampa Reach = Main Channel RS = 13.610
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 13.510
.035
.033
.025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 13.420
.035
.032
.025
.035
.035
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)



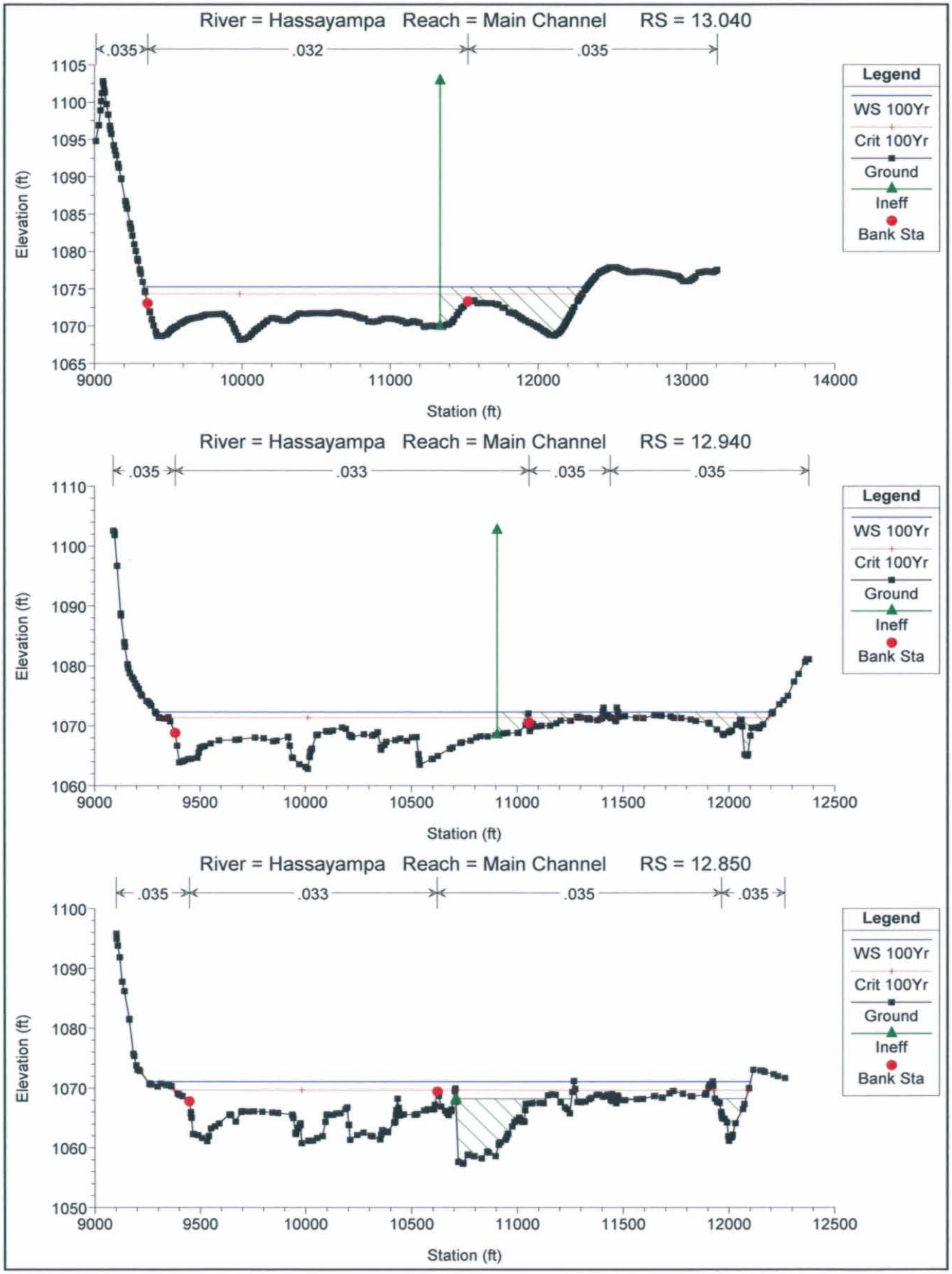
River = Hassayampa Reach = Main Channel RS = 13.320
.035
.031
0 2 5
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

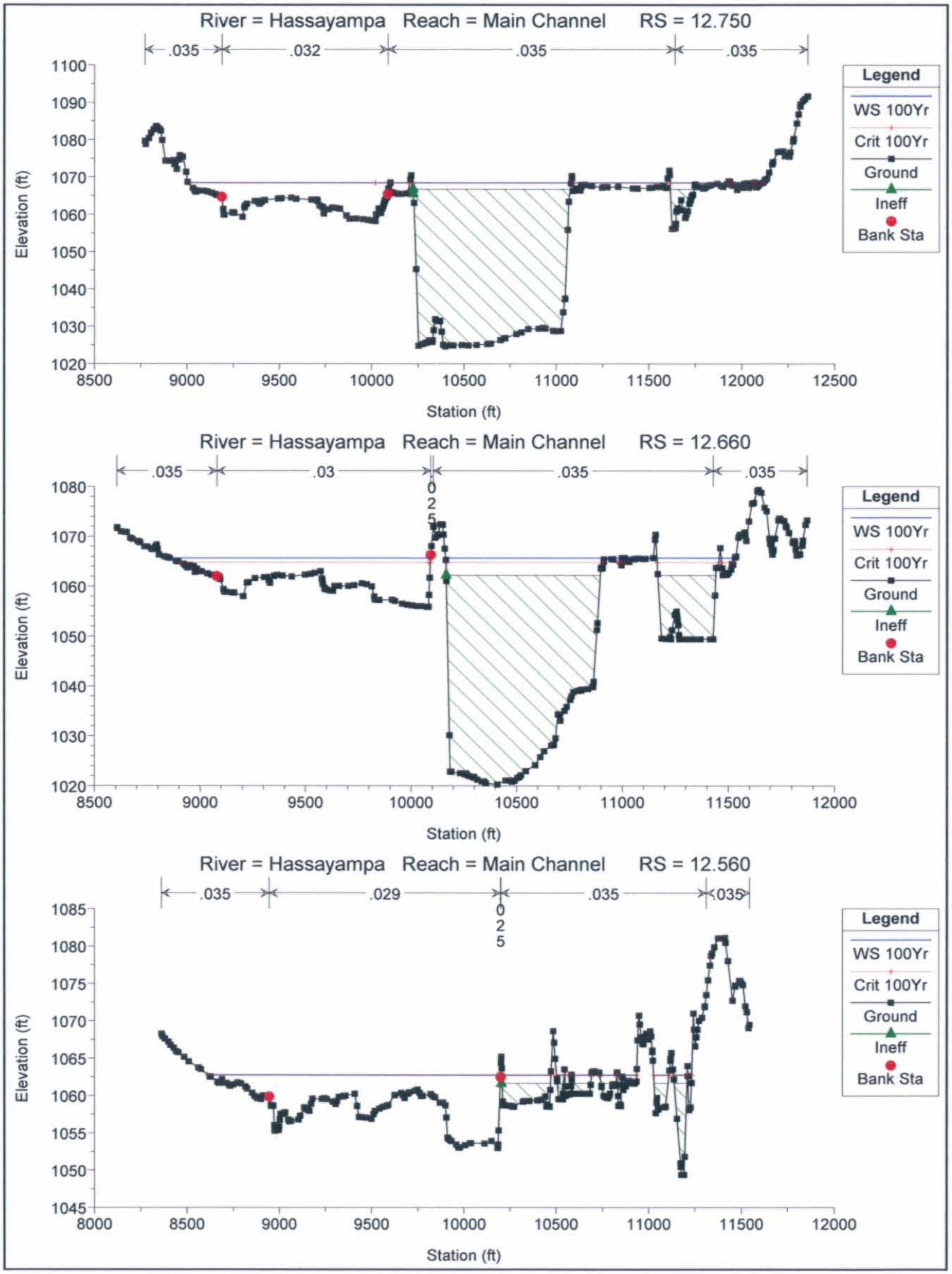


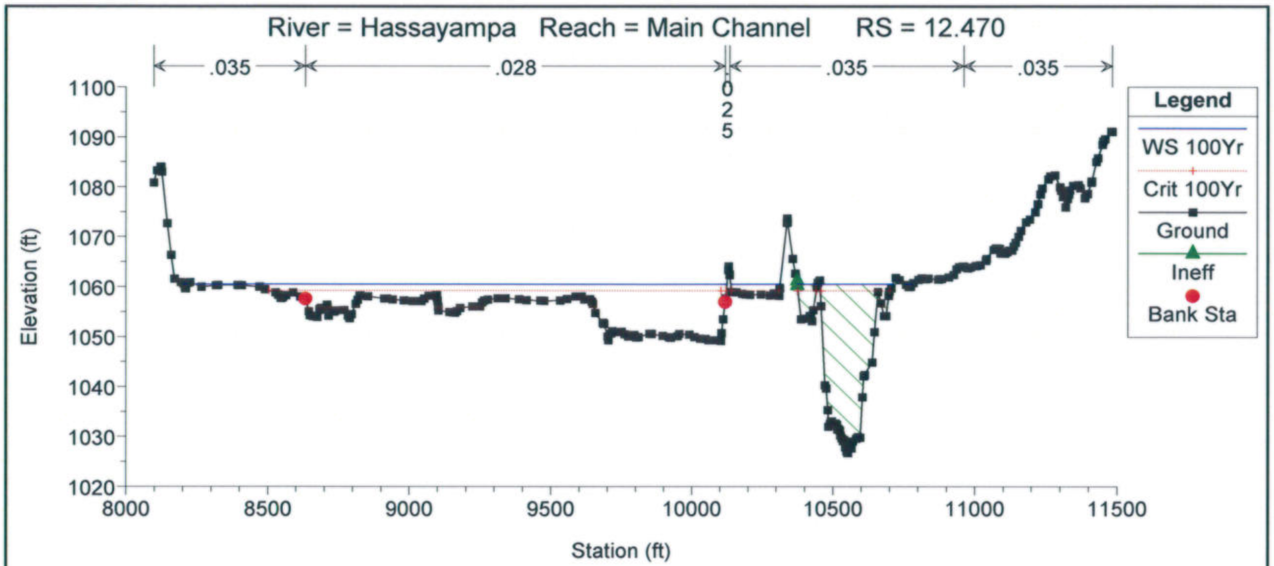
River = Hassayampa Reach = Main Channel RS = 13.230
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)



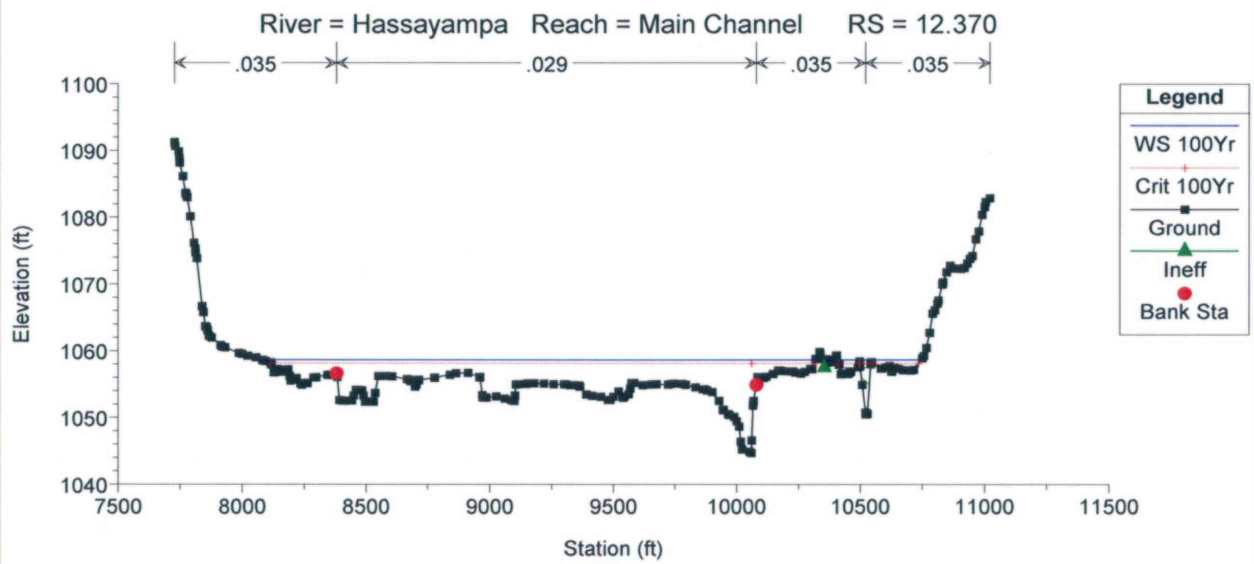
River = Hassayampa Reach = Main Channel RS = 13.130
.035
.032
0 2 5
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 13.040
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 12.940
.035
.033
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 12.850
.035
.033
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

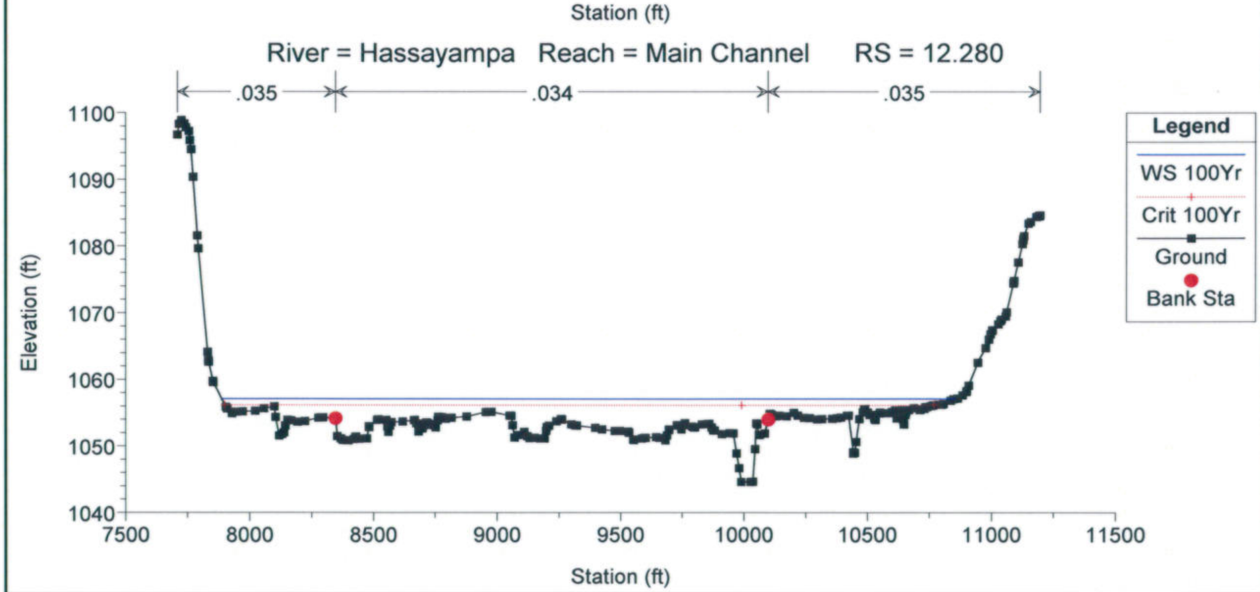

River = Hassayampa Reach = Main Channel RS = 12.750
.035
.032
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 12.660
.035
.03
.035
.035
025
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 12.560
.035
.029
.035
.035
025
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta



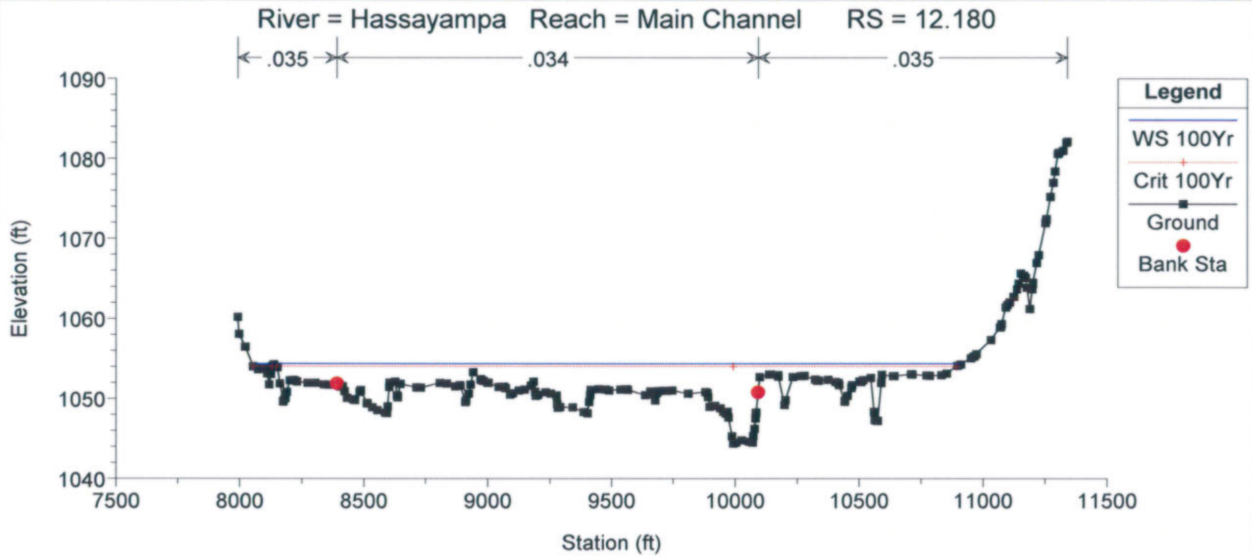
River = Hassayampa Reach = Main Channel RS = 12.470
.035
.028
0
2
5
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

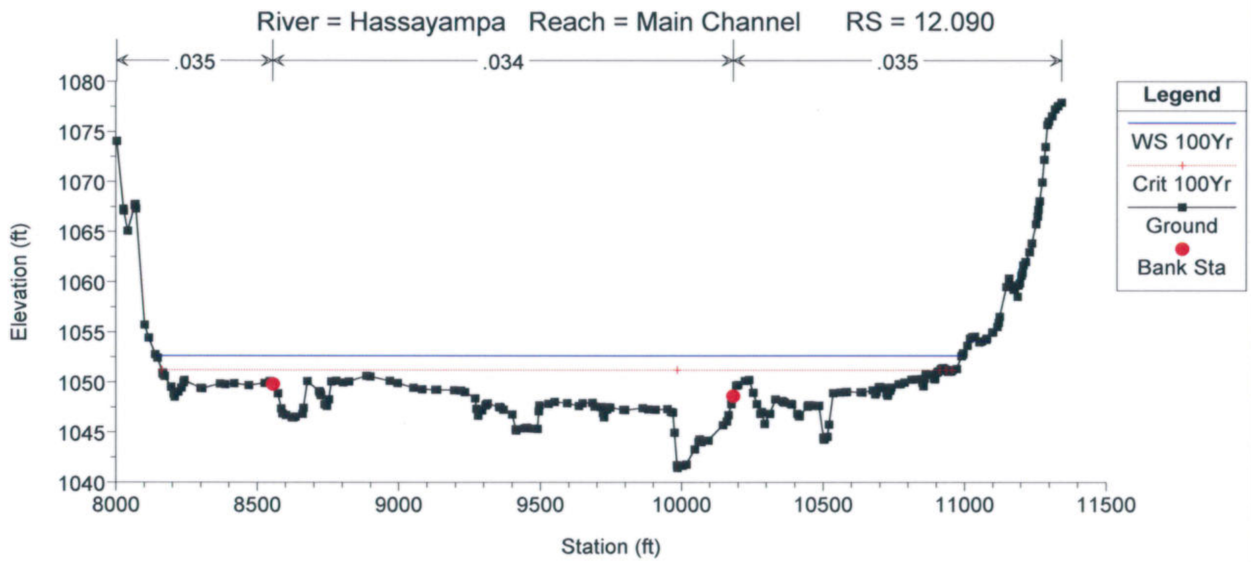


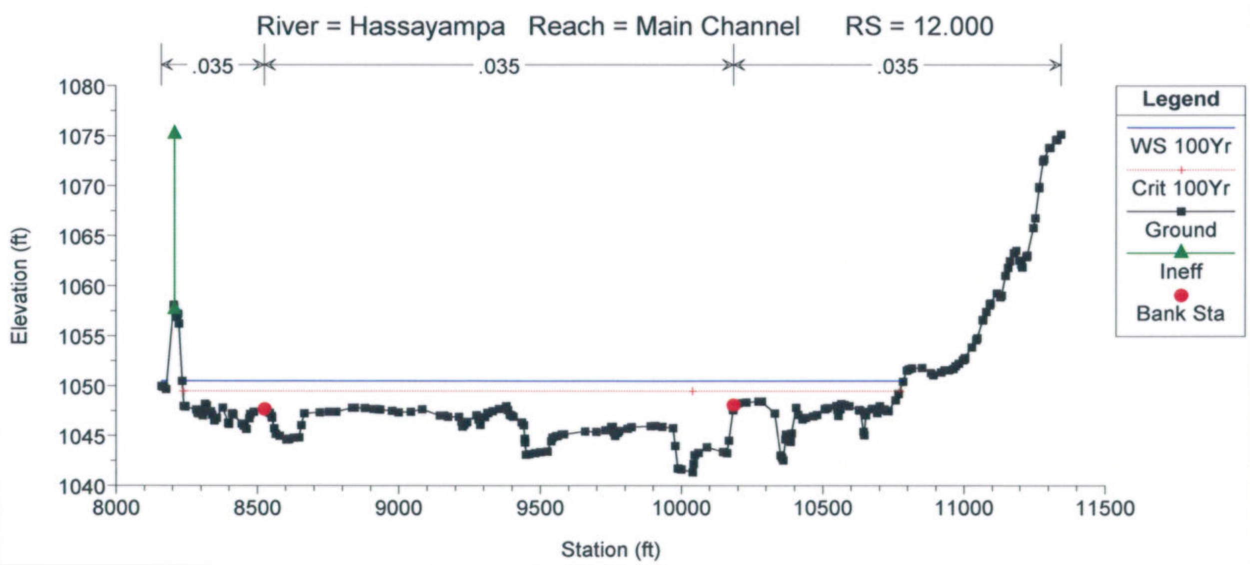
River = Hassayampa Reach = Main Channel RS = 12.370
.035
.029
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

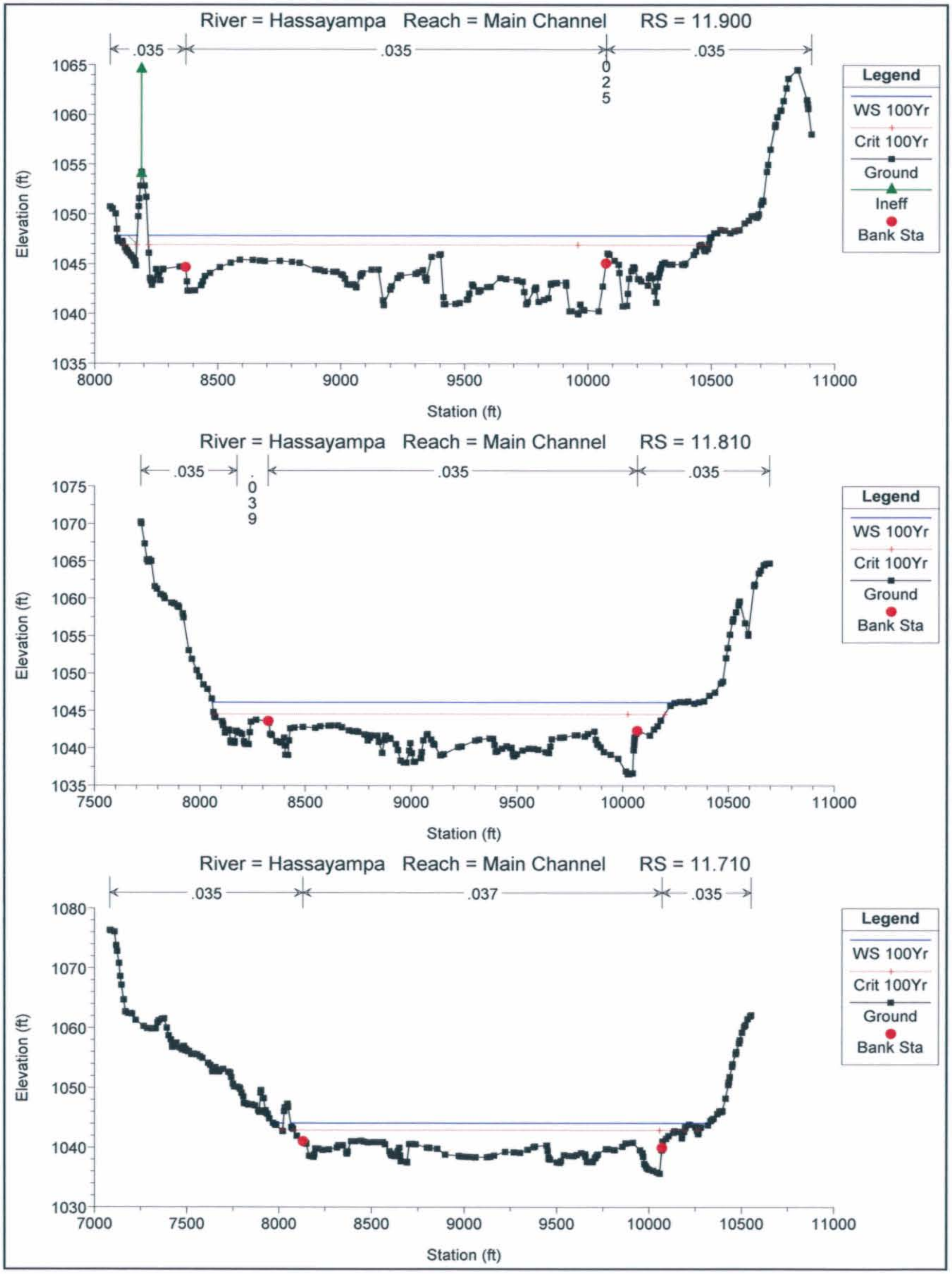


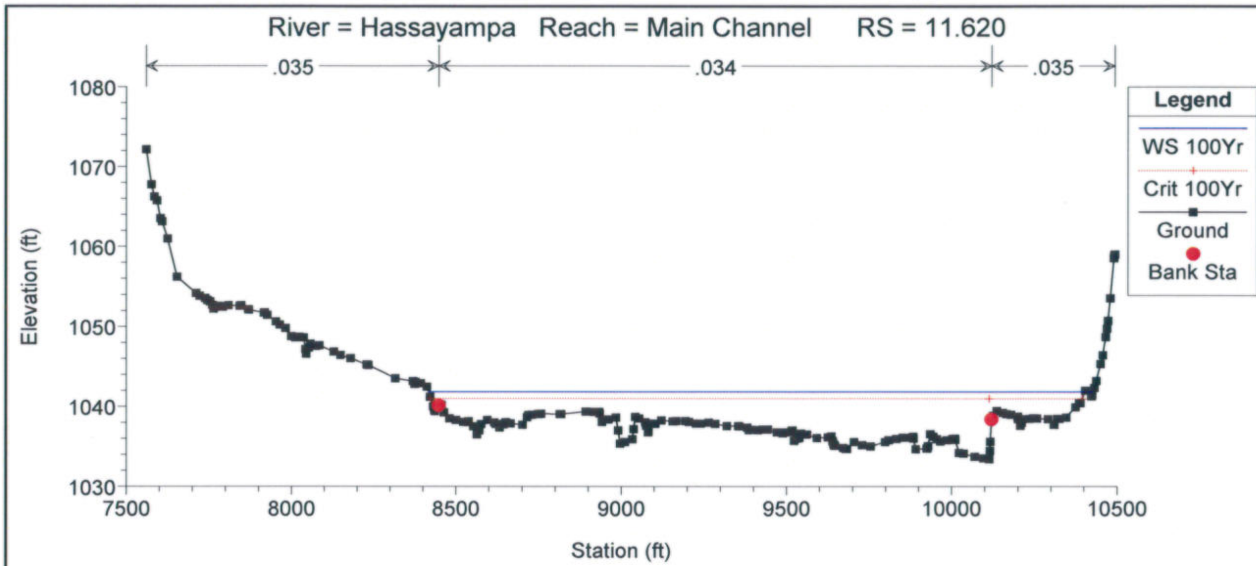
River = Hassayampa Reach = Main Channel RS = 12.280
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

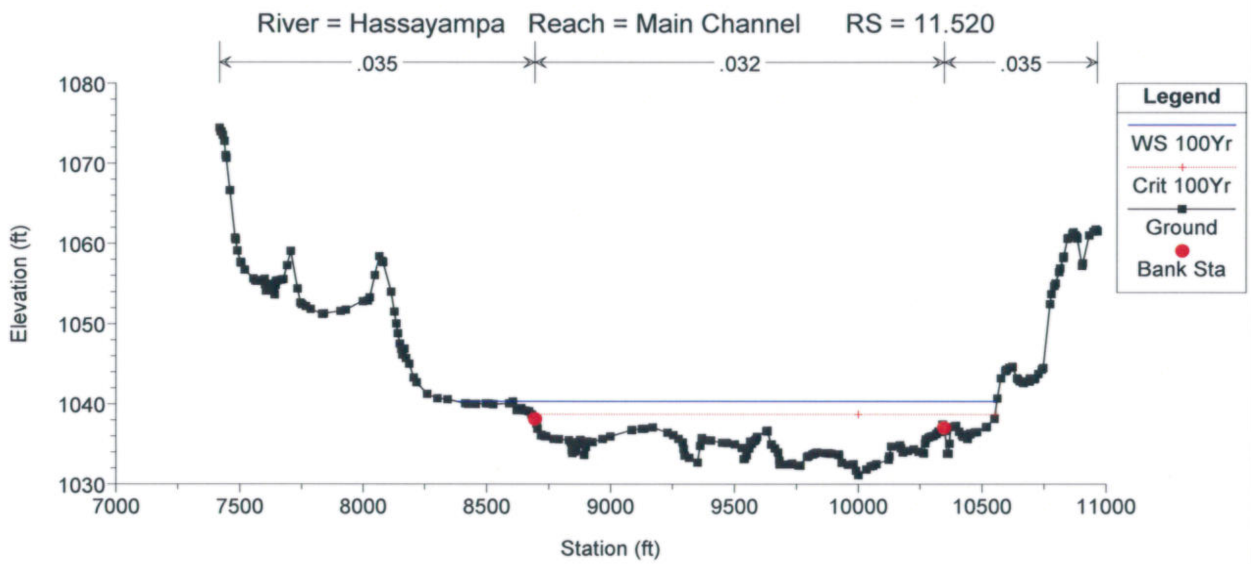

River = Hassayampa Reach = Main Channel RS = 12.180
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

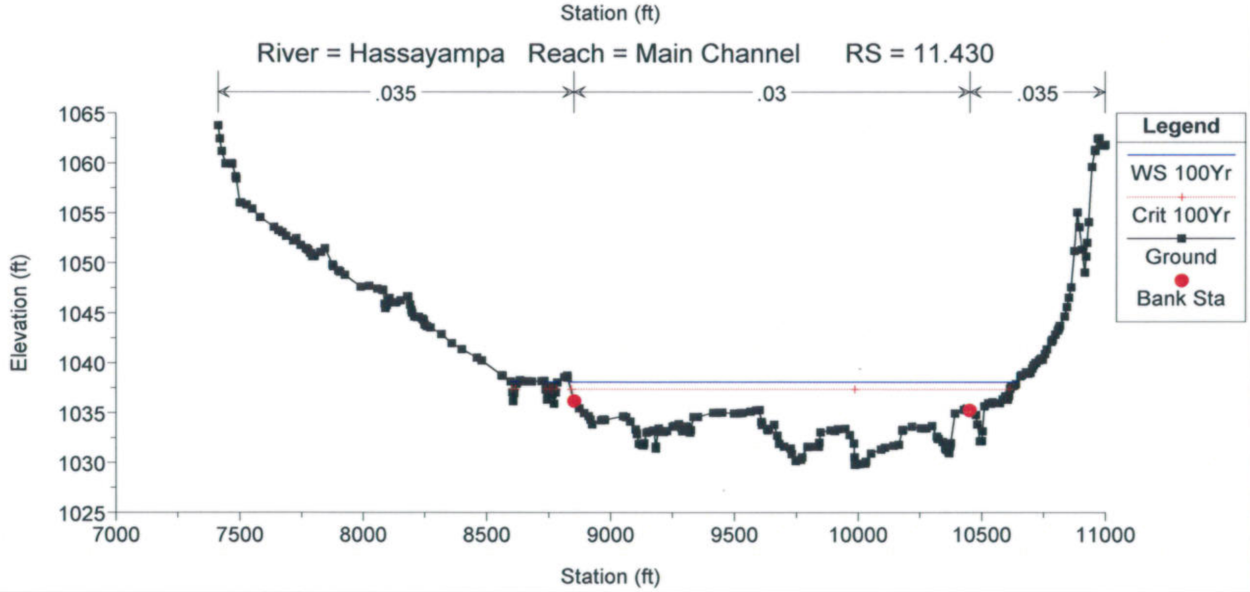

River = Hassayampa Reach = Main Channel RS = 12.090
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

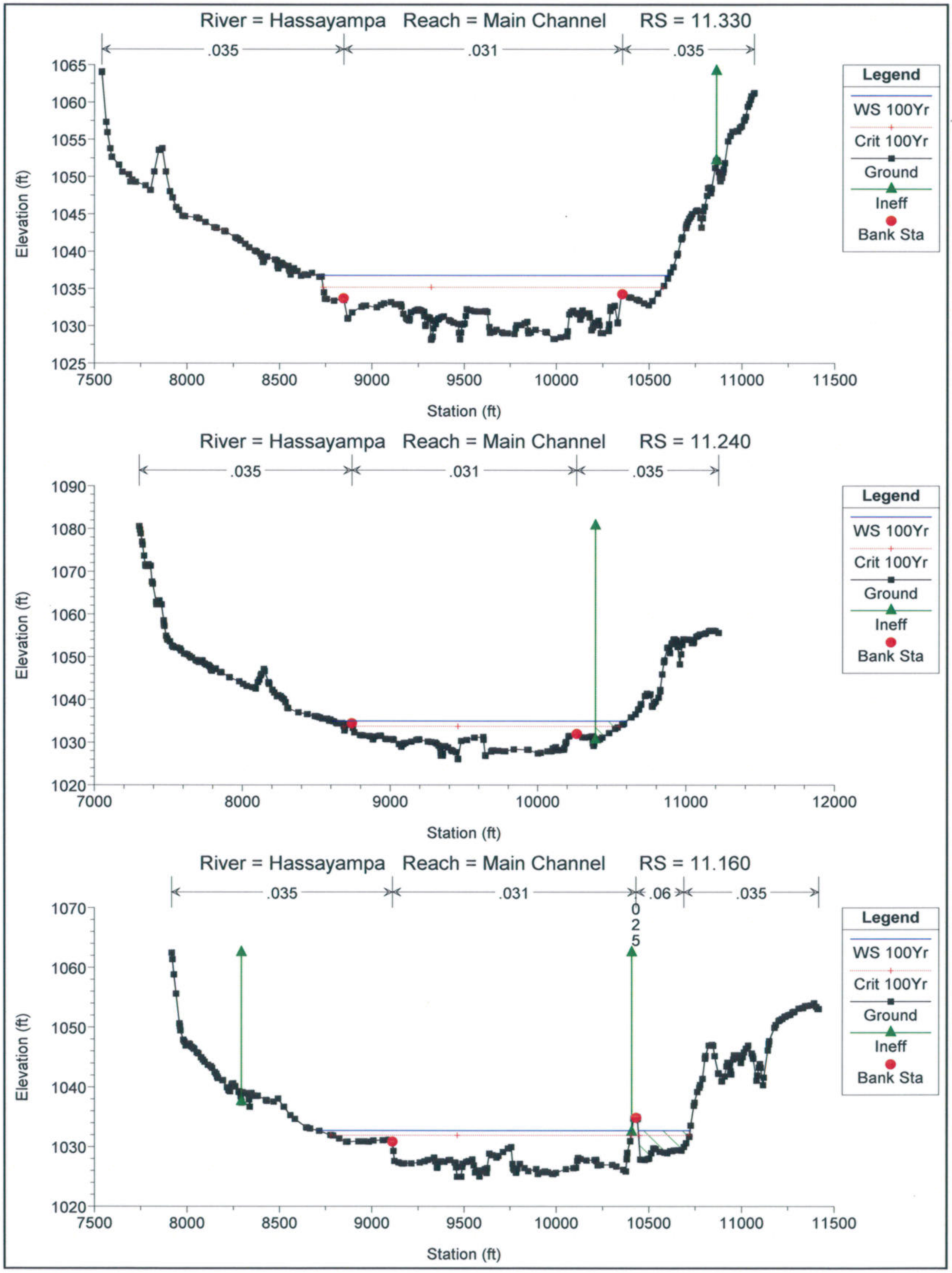

River = Hassayampa Reach = Main Channel RS = 12.000
.035
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 11.900
.035
.035
025
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 11.810
.035
.039
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 11.710
.035
.037
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

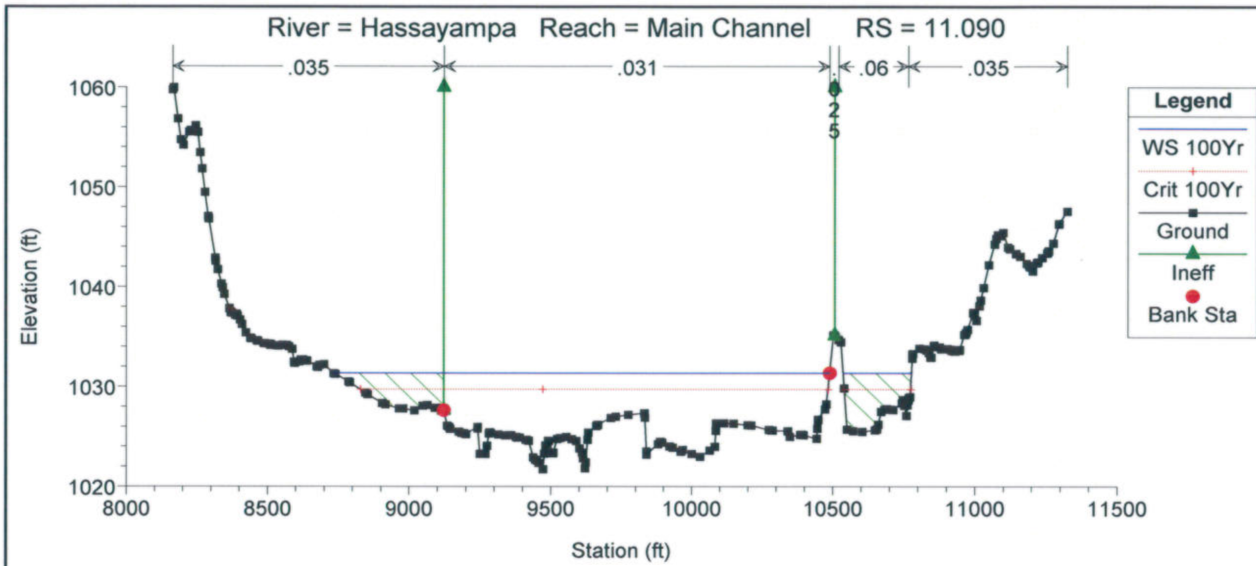

River = Hassayampa Reach = Main Channel RS = 11.620
.035
.034
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1080
1070
1060
1050
1040
1030
7500
8000
8500
9000
9500
10000
10500
Station (ft)

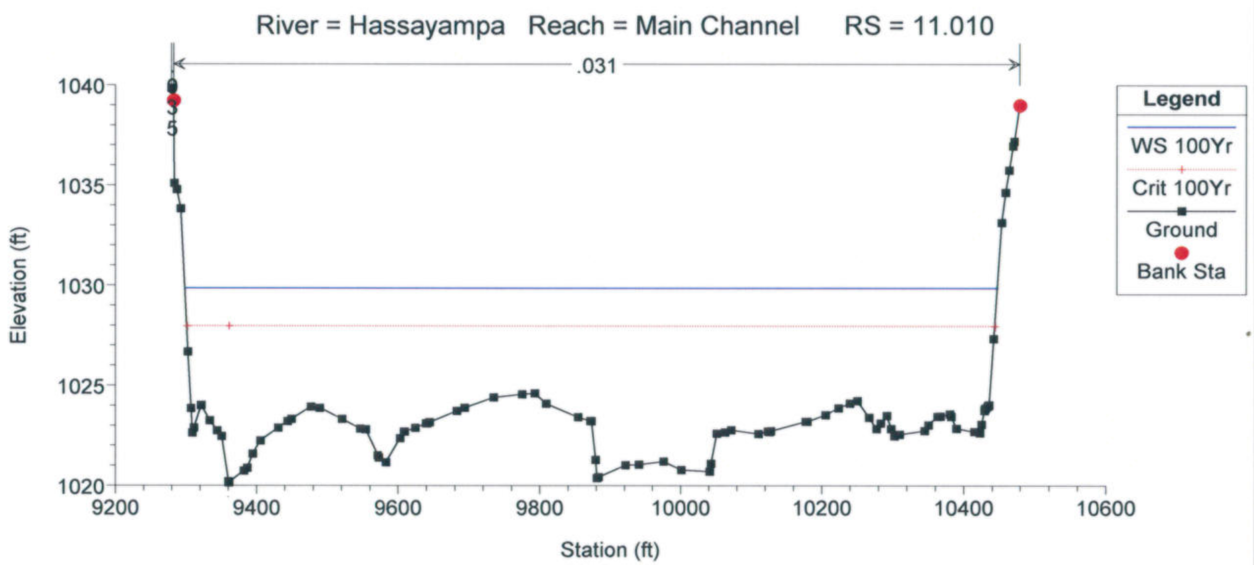

River = Hassayampa Reach = Main Channel RS = 11.520
.035
.032
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1080
1070
1060
1050
1040
1030
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

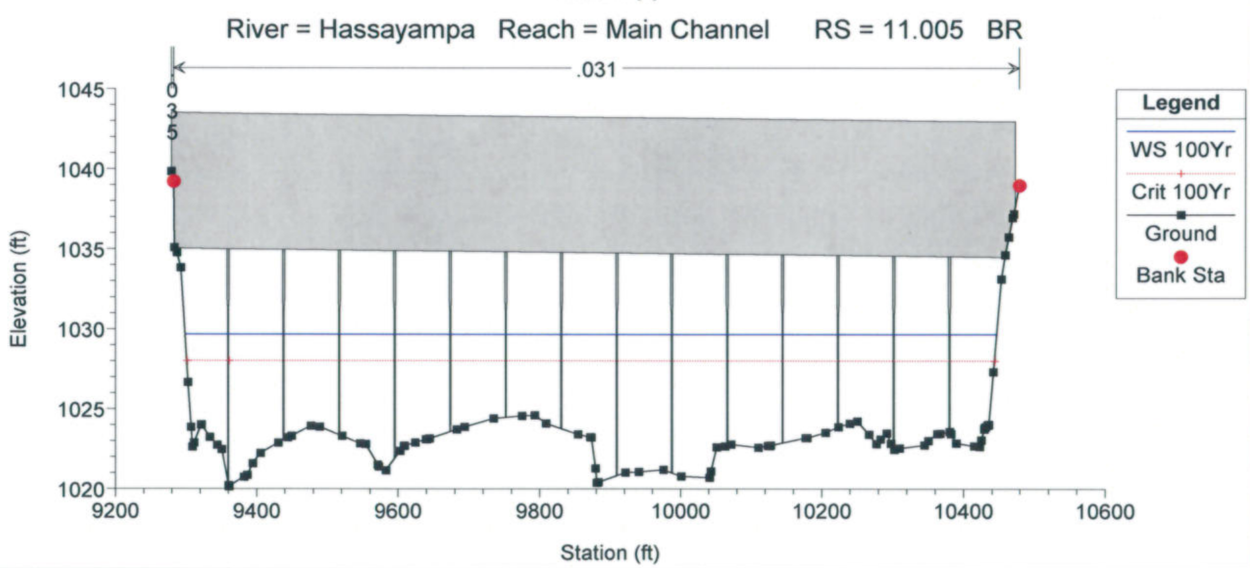

River = Hassayampa Reach = Main Channel RS = 11.430
.035
.03
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
1065
1060
1055
1050
1045
1040
1035
1030
1025
7000
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

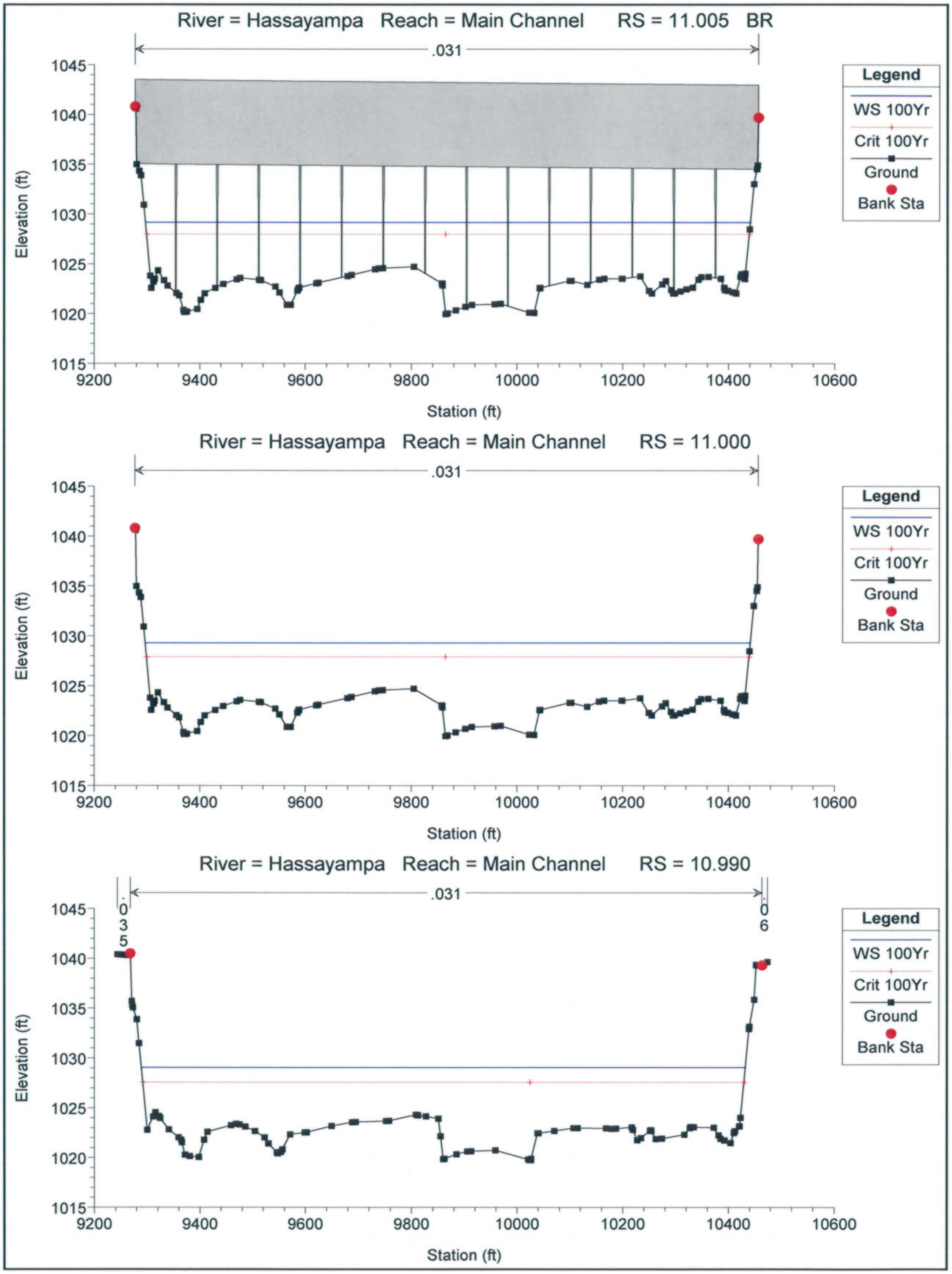


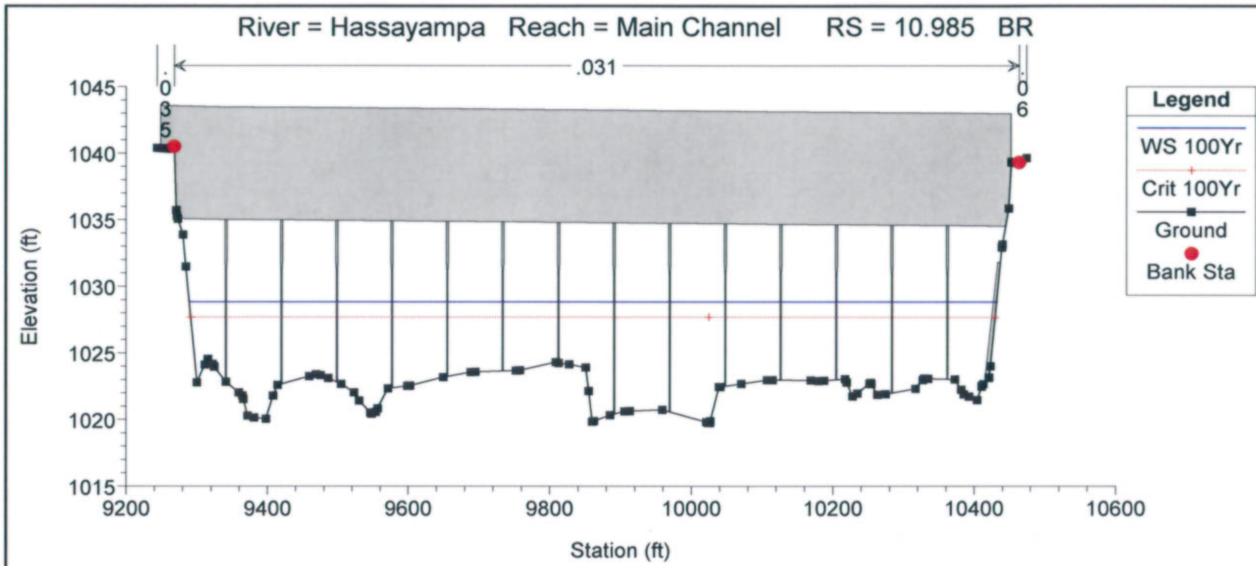
River = Hassayampa Reach = Main Channel RS = 11.330
.035
.031
.035
Elevation (ft)
1065
1060
1055
1050
1045
1040
1035
1030
1025
7500
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 11.240
.035
.031
.035
Elevation (ft)
1090
1080
1070
1060
1050
1040
1030
1020
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 11.160
.035
.031
0
2
5
.06
.035
Elevation (ft)
1070
1060
1050
1040
1030
1020
7500
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

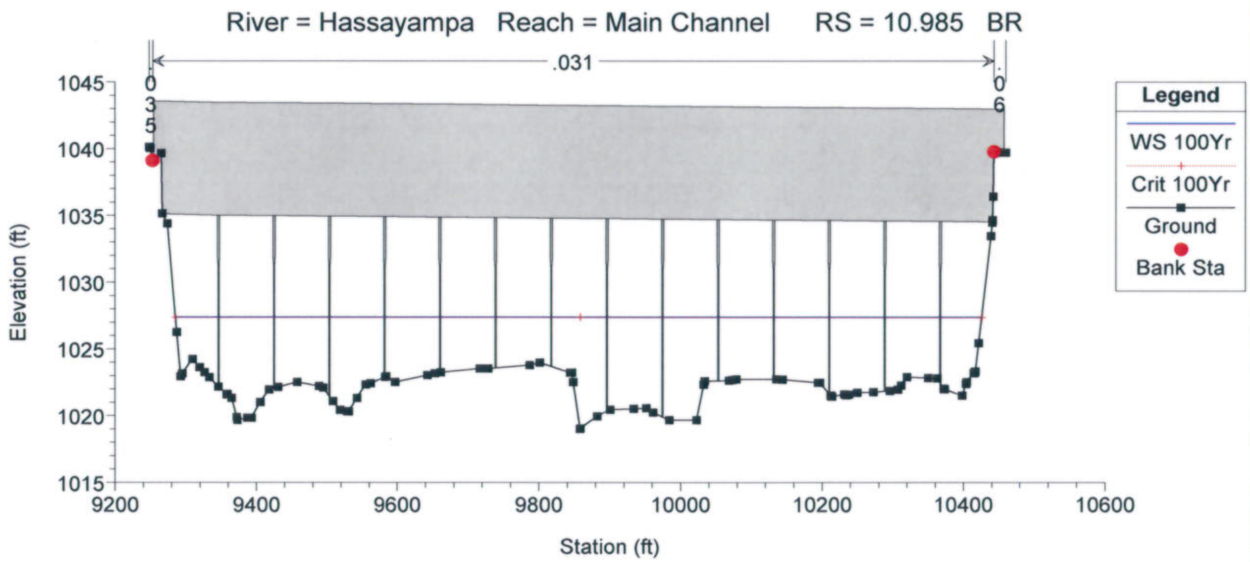

River = Hassayampa Reach = Main Channel RS = 11.090
.035
.031
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

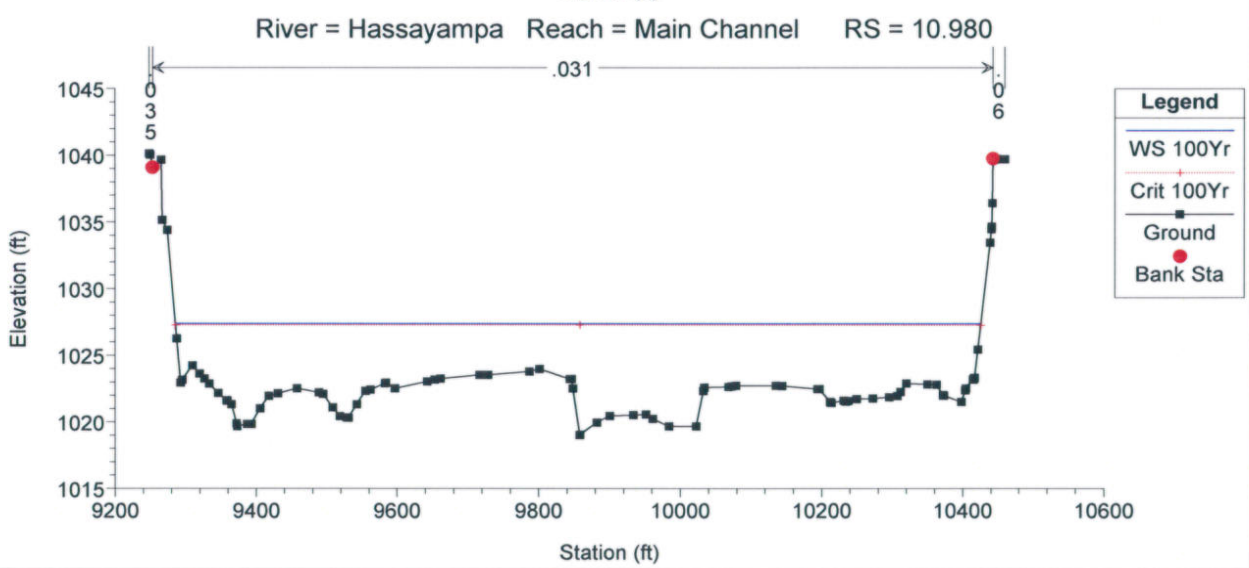

River = Hassayampa Reach = Main Channel RS = 11.010
.031
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

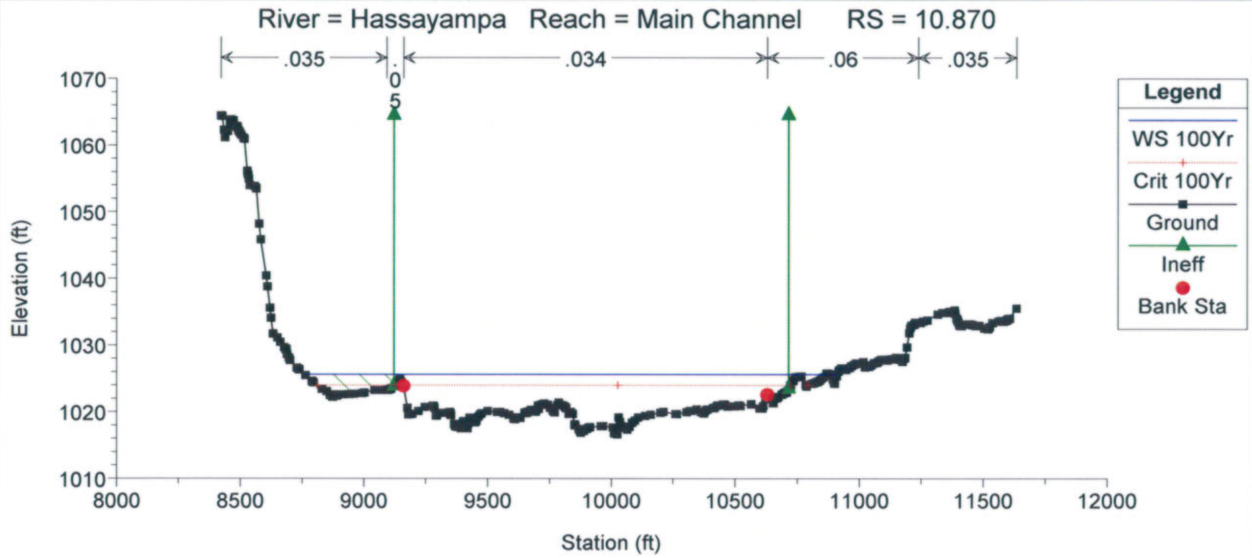

River = Hassayampa Reach = Main Channel RS = 11.005 BR
.031
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

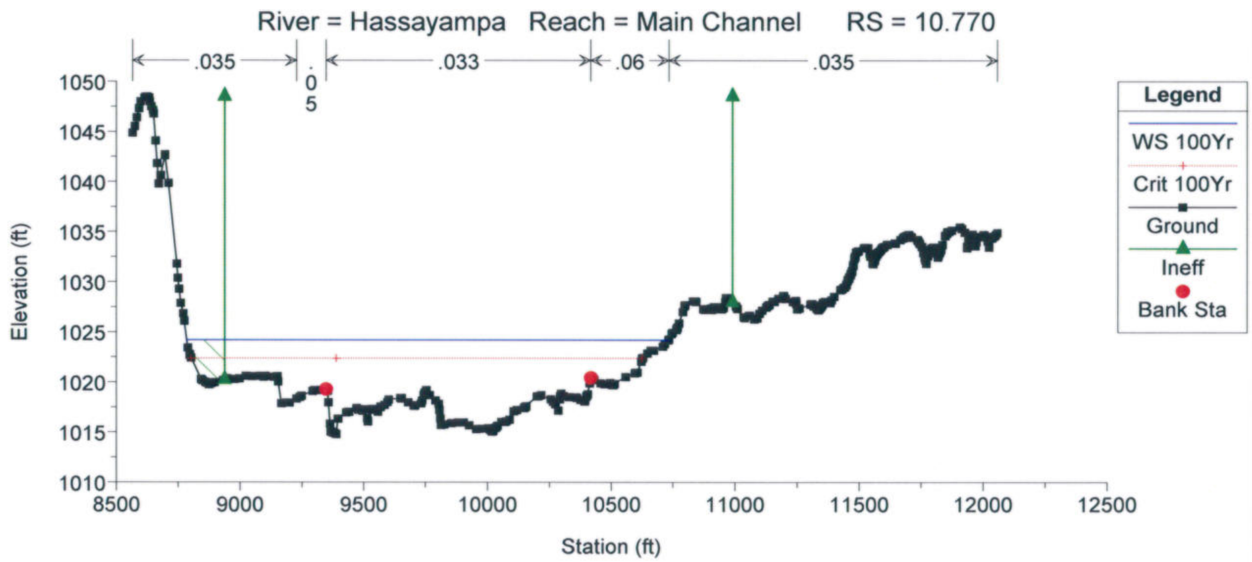

River = Hassayampa Reach = Main Channel RS = 11.005 BR
.031
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 11.000
.031
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 10.990
.031
.035
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

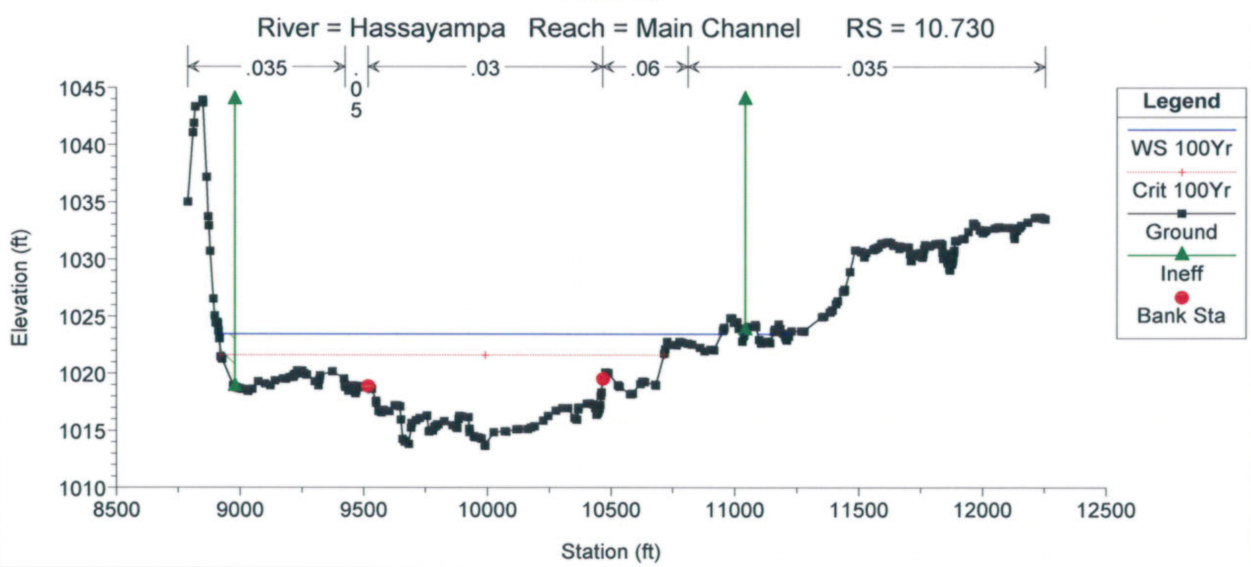

River = Hassayampa Reach = Main Channel RS = 10.985 BR
.031
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

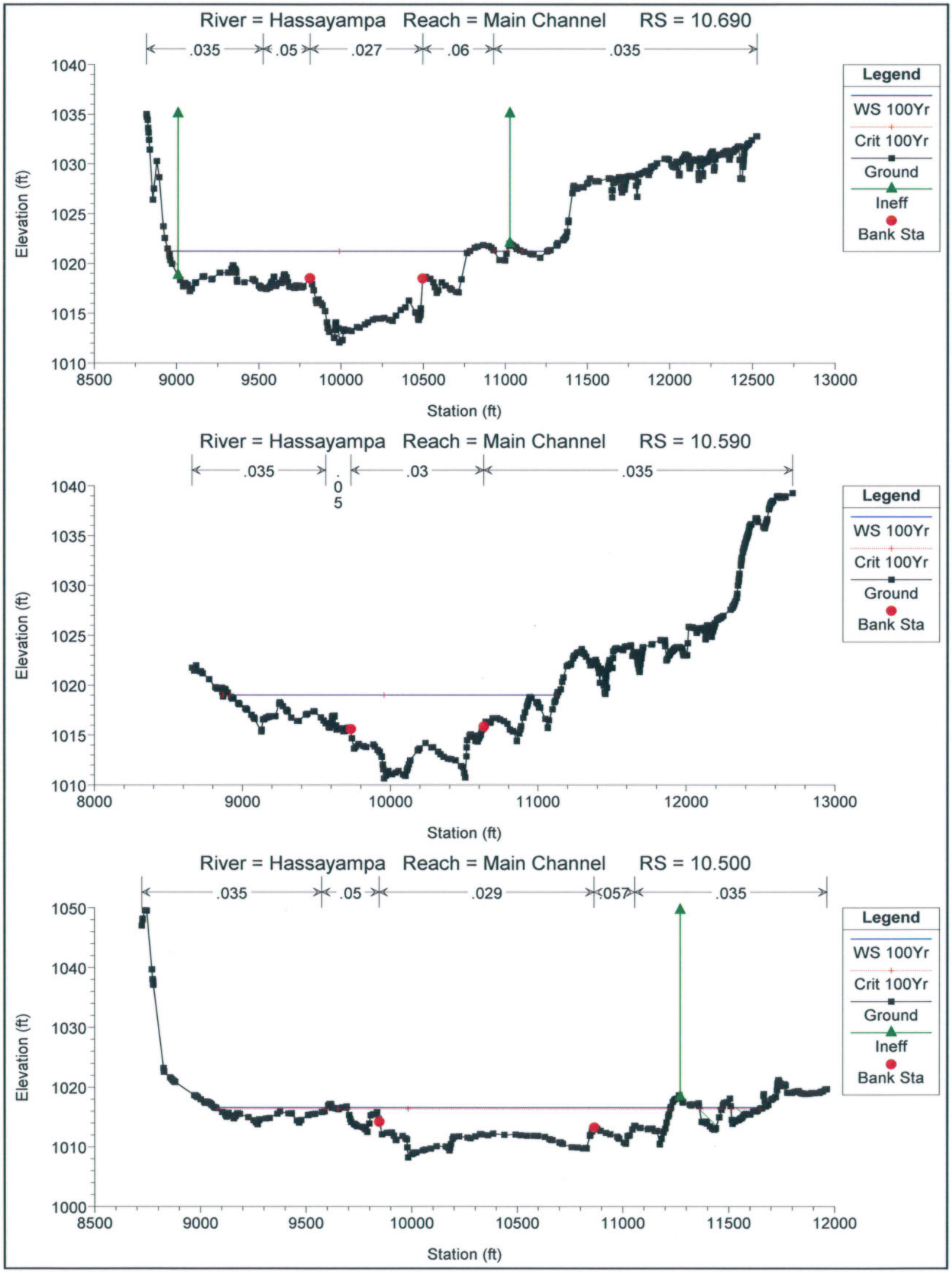

River = Hassayampa Reach = Main Channel RS = 10.985 BR
.031
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

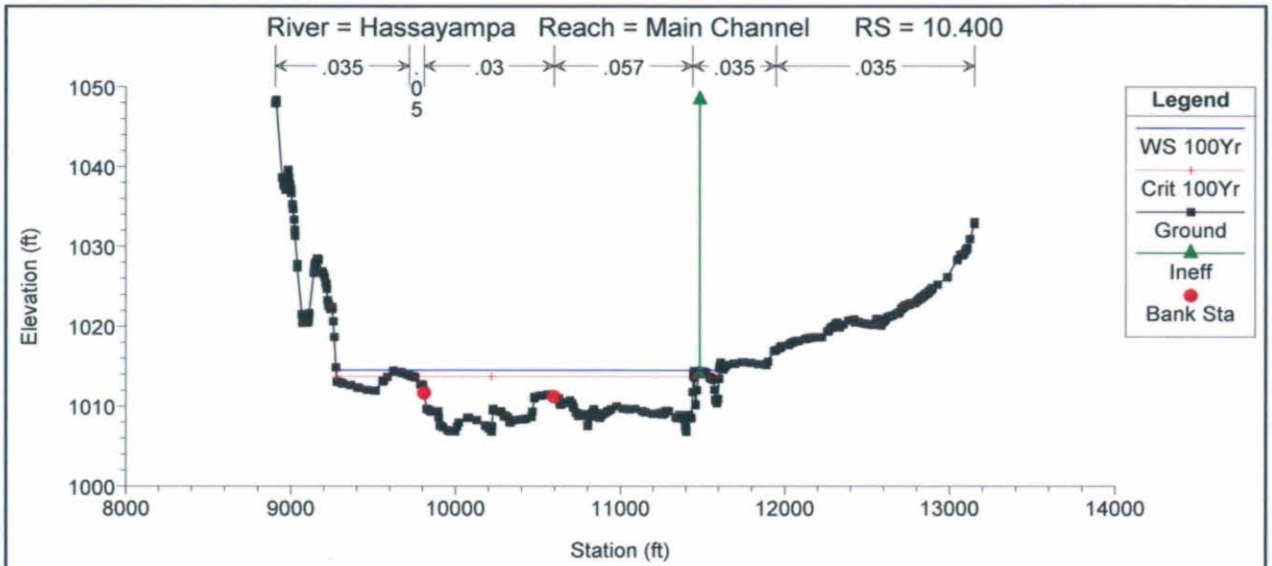

River = Hassayampa Reach = Main Channel RS = 10.980
.031
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

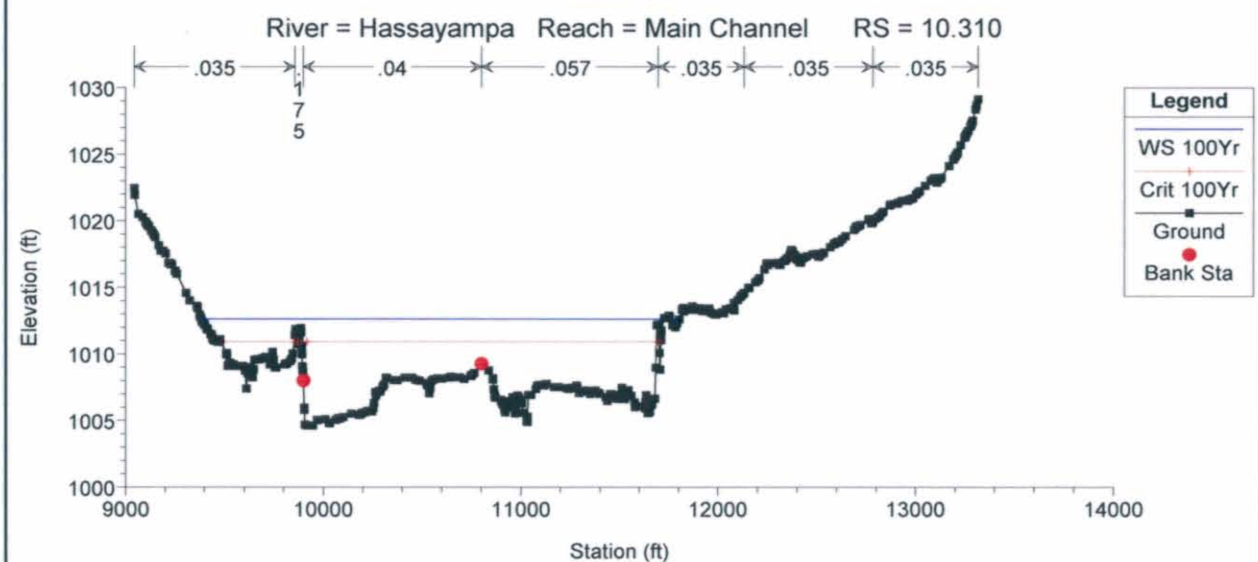

River = Hassayampa Reach = Main Channel RS = 10.870
.035
.0
5
.034
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

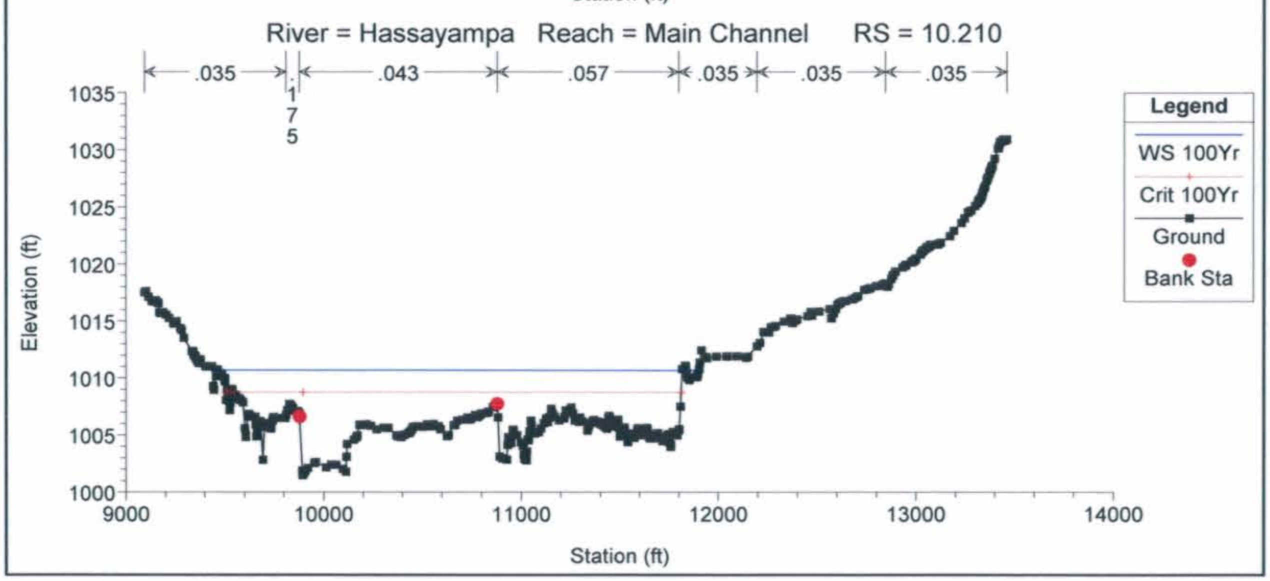

River = Hassayampa Reach = Main Channel RS = 10.770
.035
.0
5
.033
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

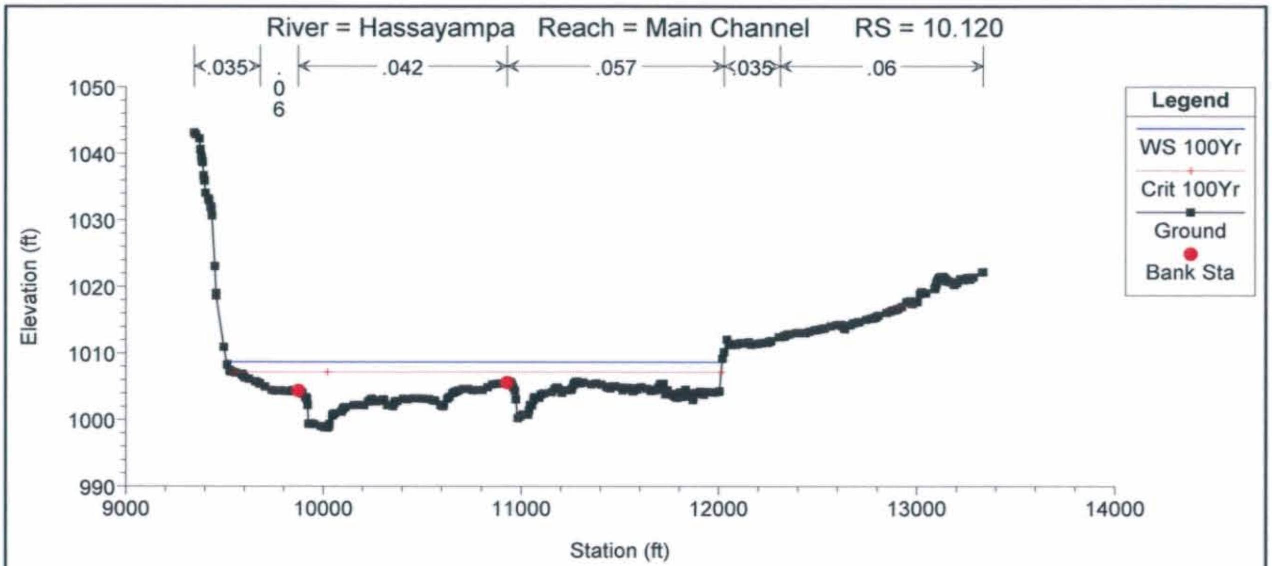

River = Hassayampa Reach = Main Channel RS = 10.730
.035
.0
5
.03
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

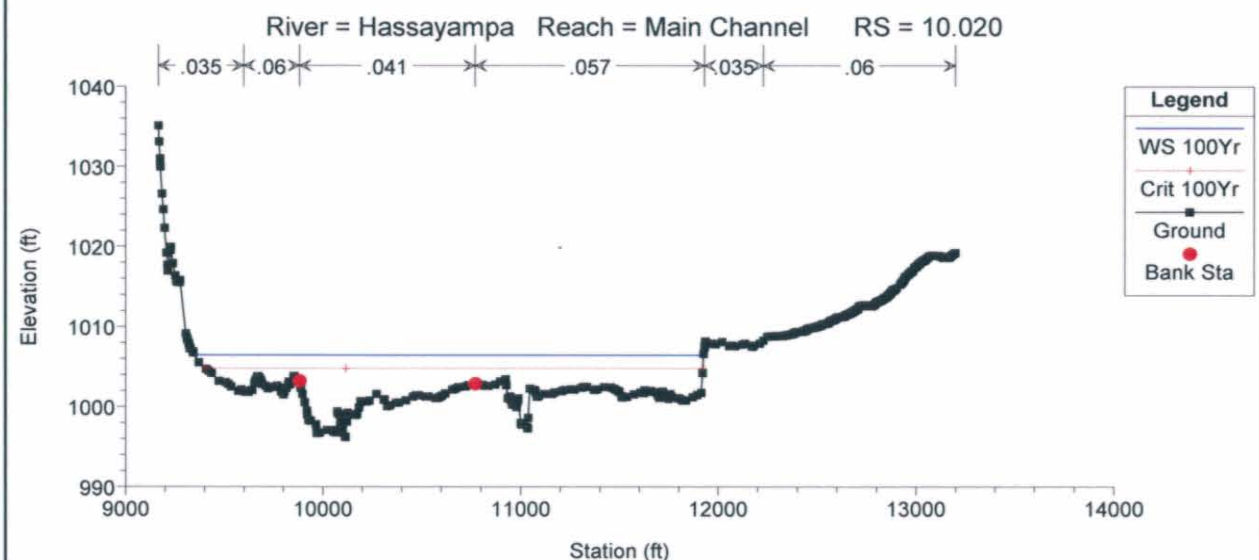

River = Hassayampa Reach = Main Channel RS = 10.690
.035
.05
.027
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 10.590
.035
.05
.03
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 10.500
.035
.05
.029
.057
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

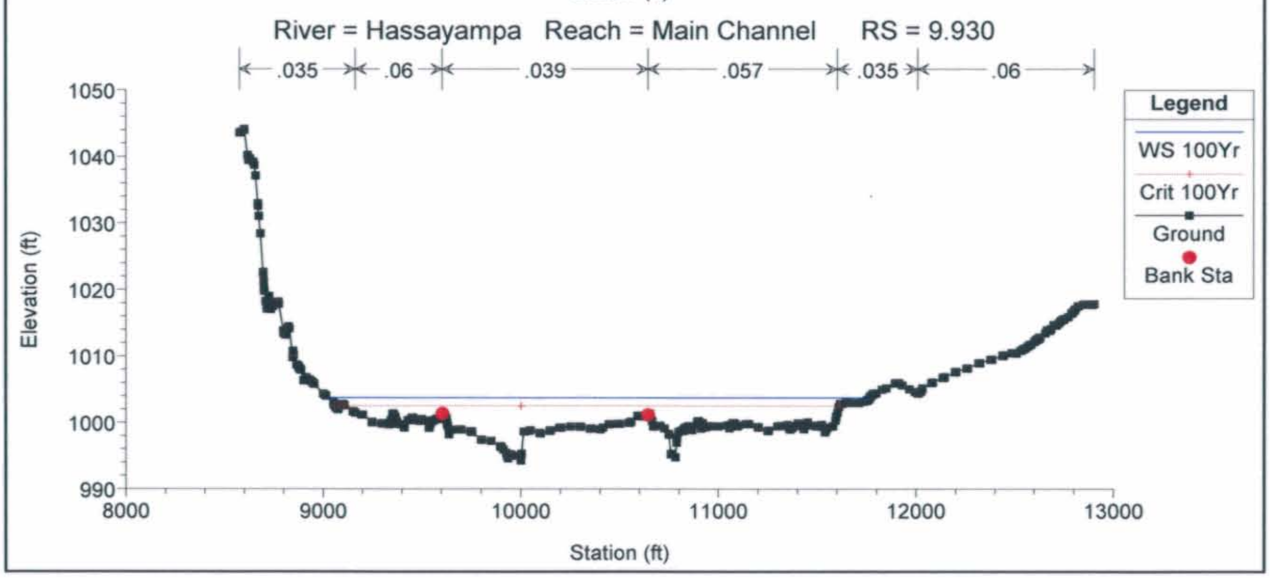

River = Hassayampa Reach = Main Channel RS = 10.400
.035
.05
.03
.057
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

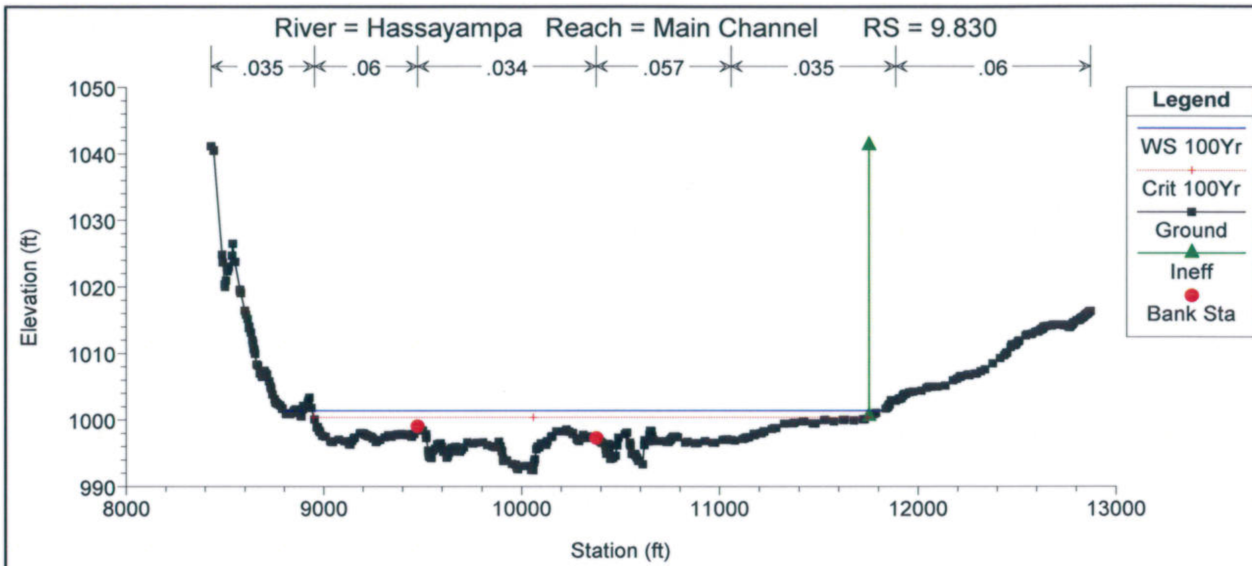

River = Hassayampa Reach = Main Channel RS = 10.310
.035
.175
.04
.057
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 10.210
.035
.175
.043
.057
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

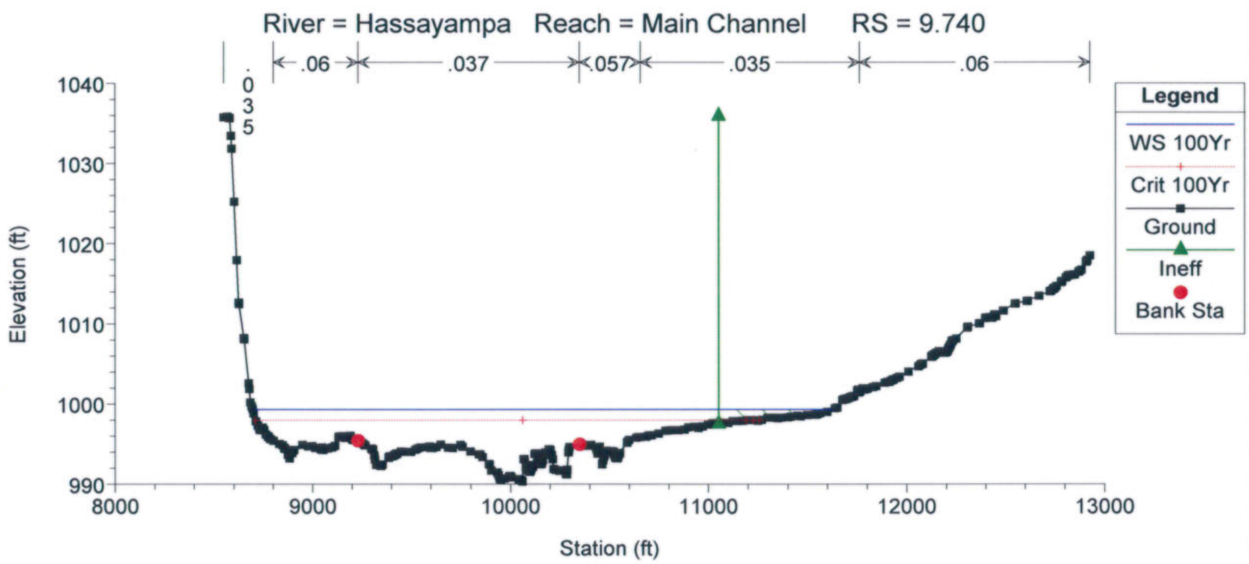

River = Hassayampa Reach = Main Channel RS = 10.120
.035
.06
.042
.057
.035
.06
Elevation (ft)
1050
1040
1030
1020
1010
1000
990
9000
10000
11000
12000
13000
14000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 10.020
.035
.06
.041
.057
.035
.06
Elevation (ft)
1040
1030
1020
1010
1000
990
9000
10000
11000
12000
13000
14000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

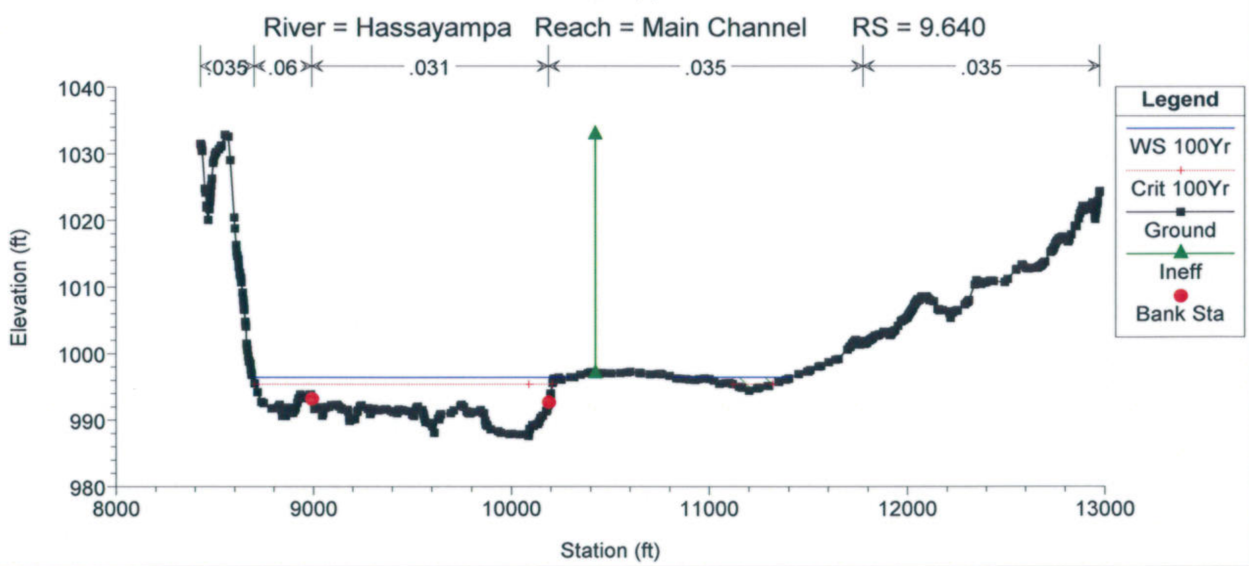

River = Hassayampa Reach = Main Channel RS = 9.930
.035
.06
.039
.057
.035
.06
Elevation (ft)
1050
1040
1030
1020
1010
1000
990
8000
9000
10000
11000
12000
13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta



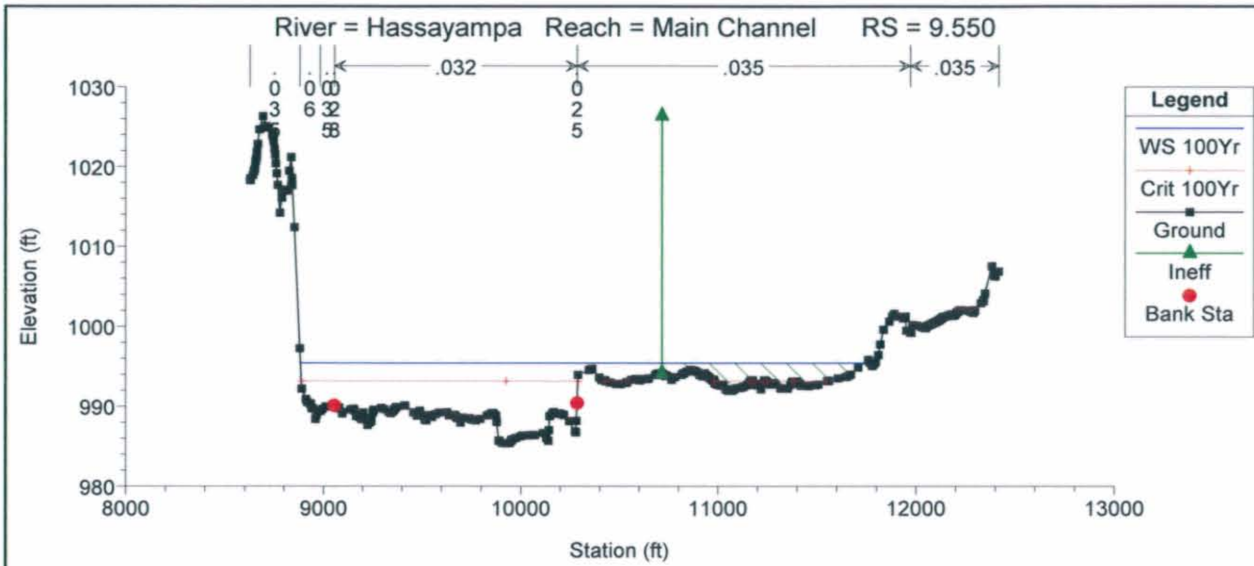
River = Hassayampa Reach = Main Channel RS = 9.830
.035
.06
.034
.057
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

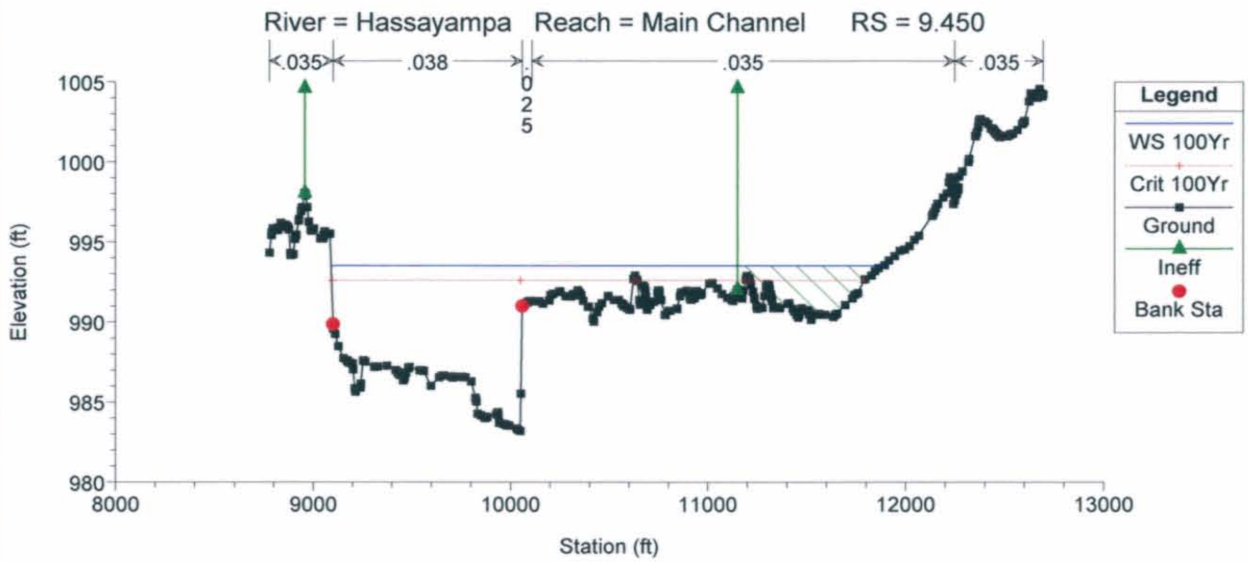


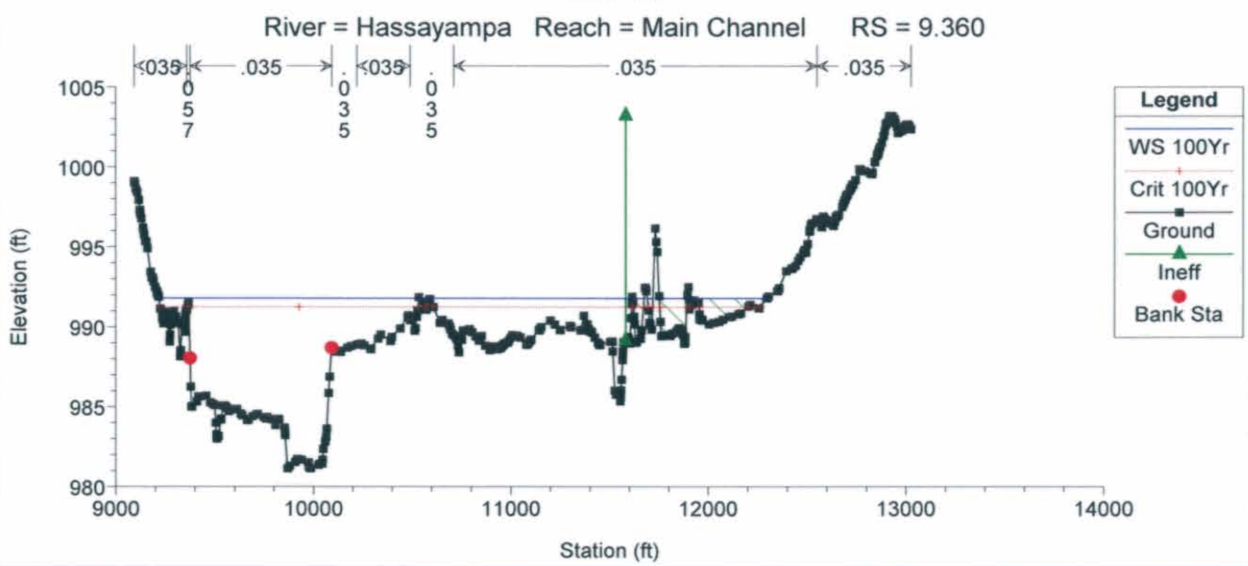
River = Hassayampa Reach = Main Channel RS = 9.740
.06
.037
.057
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

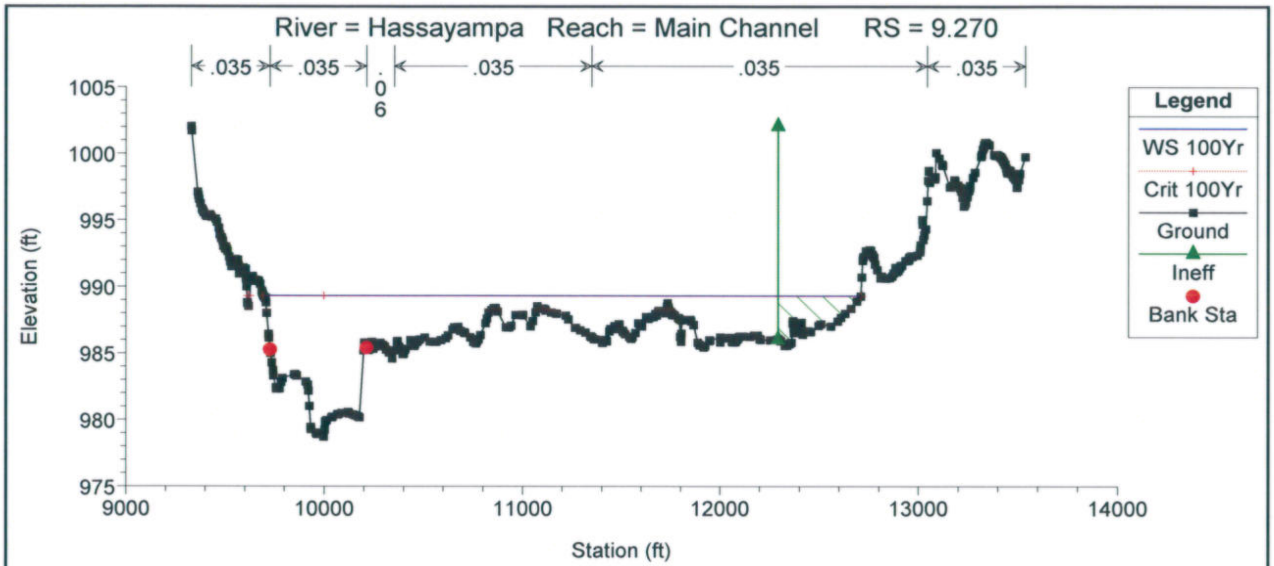


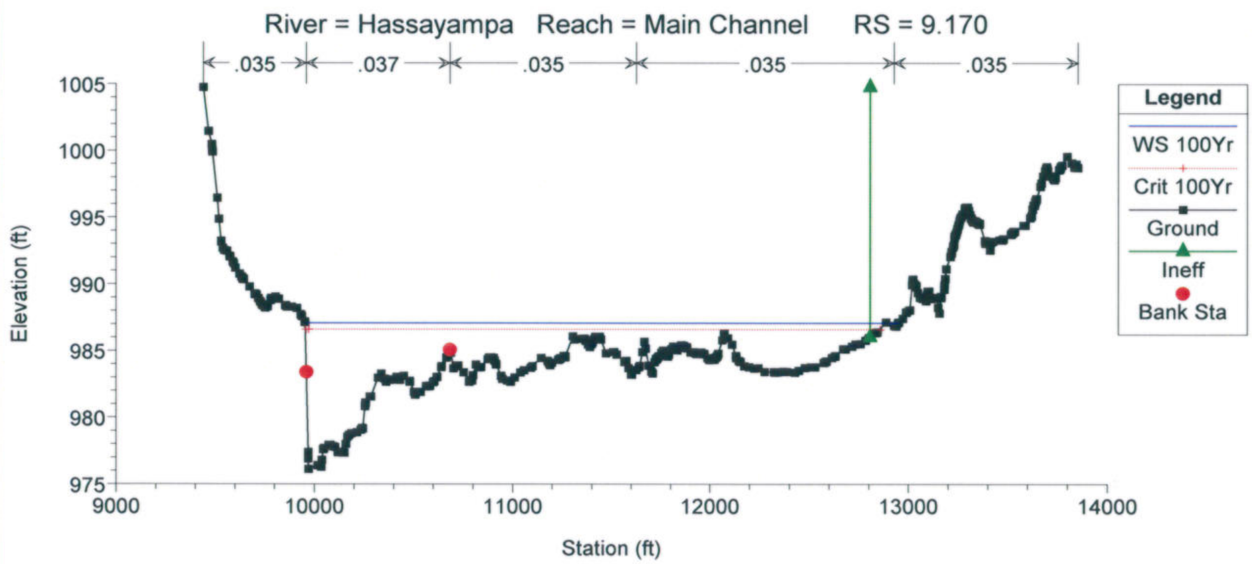
River = Hassayampa Reach = Main Channel RS = 9.640
.035
.06
.031
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

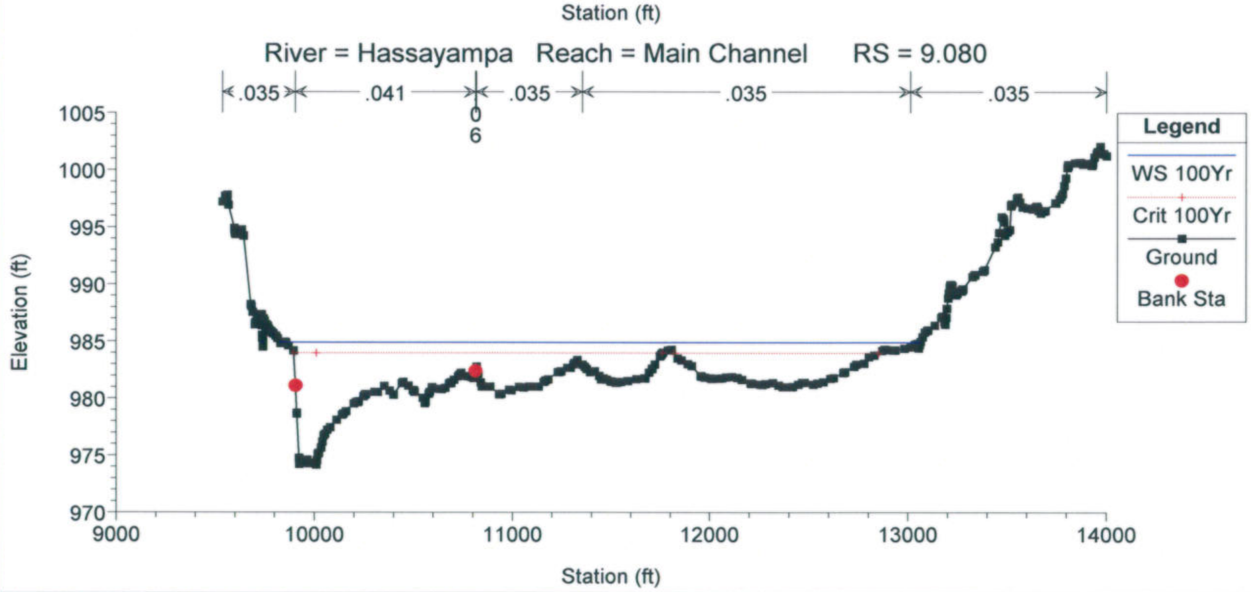

River = Hassayampa Reach = Main Channel RS = 9.550
.032
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

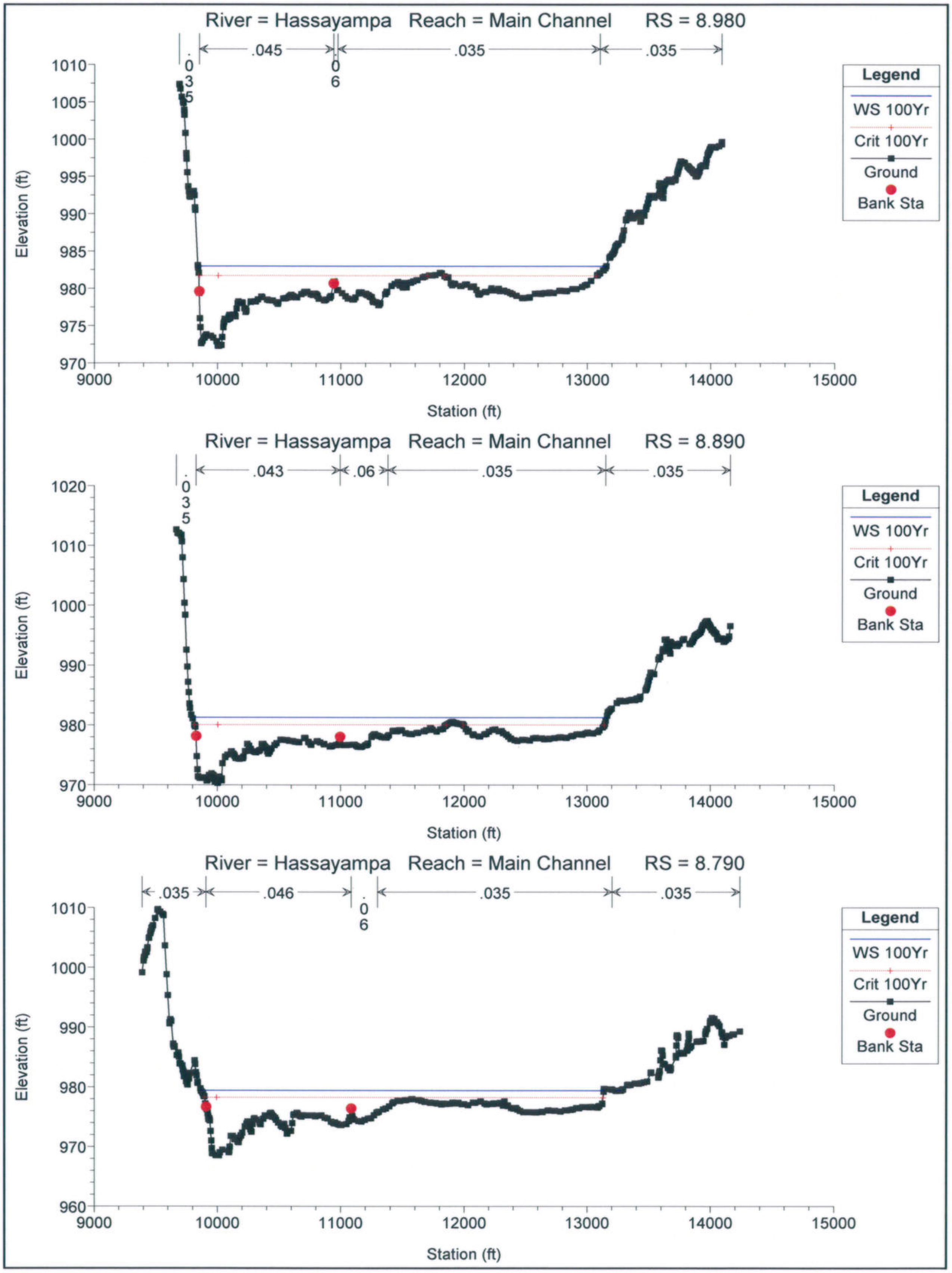

River = Hassayampa Reach = Main Channel RS = 9.450
.035
.038
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

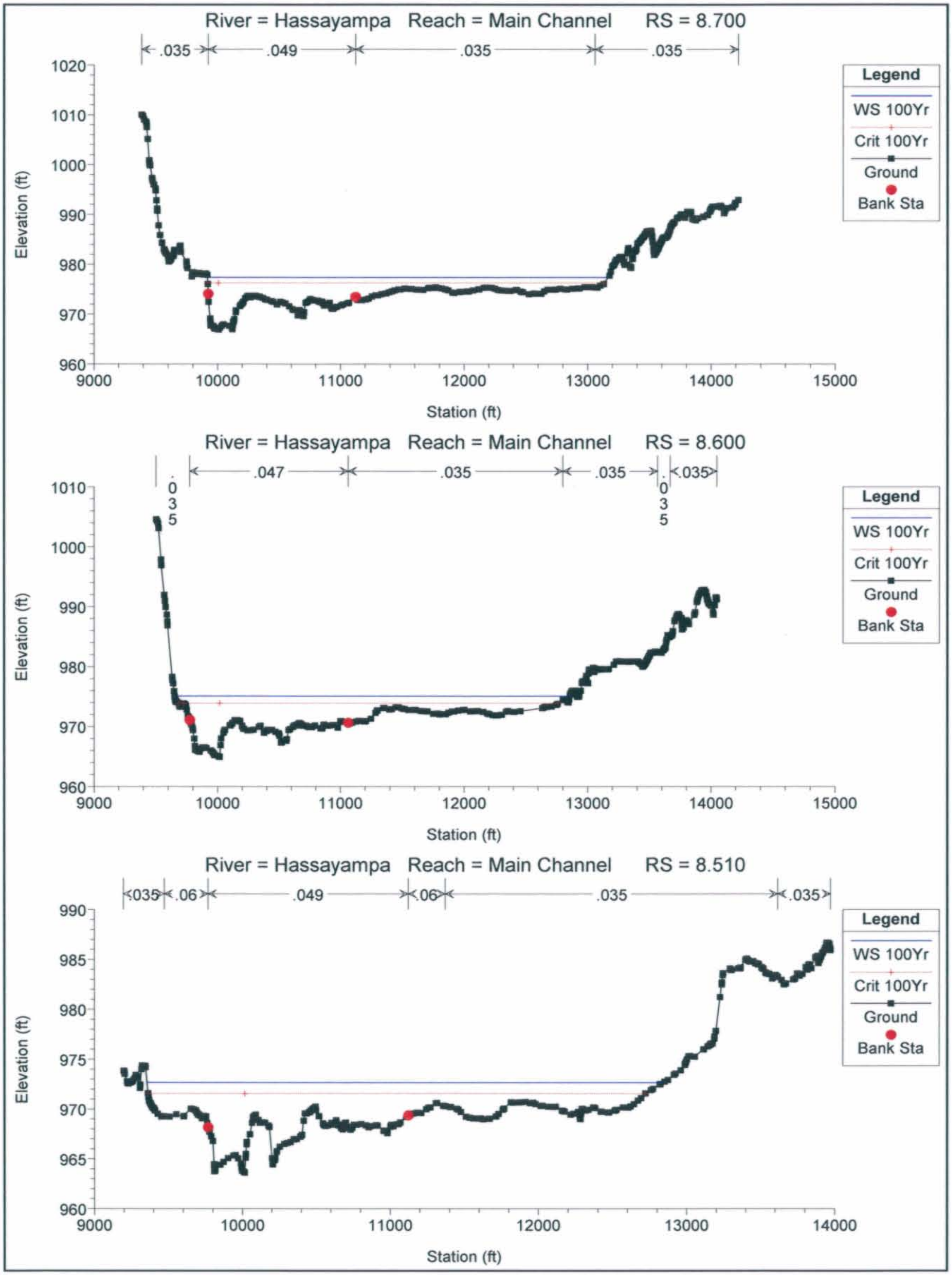

River = Hassayampa Reach = Main Channel RS = 9.360
.035
.035
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

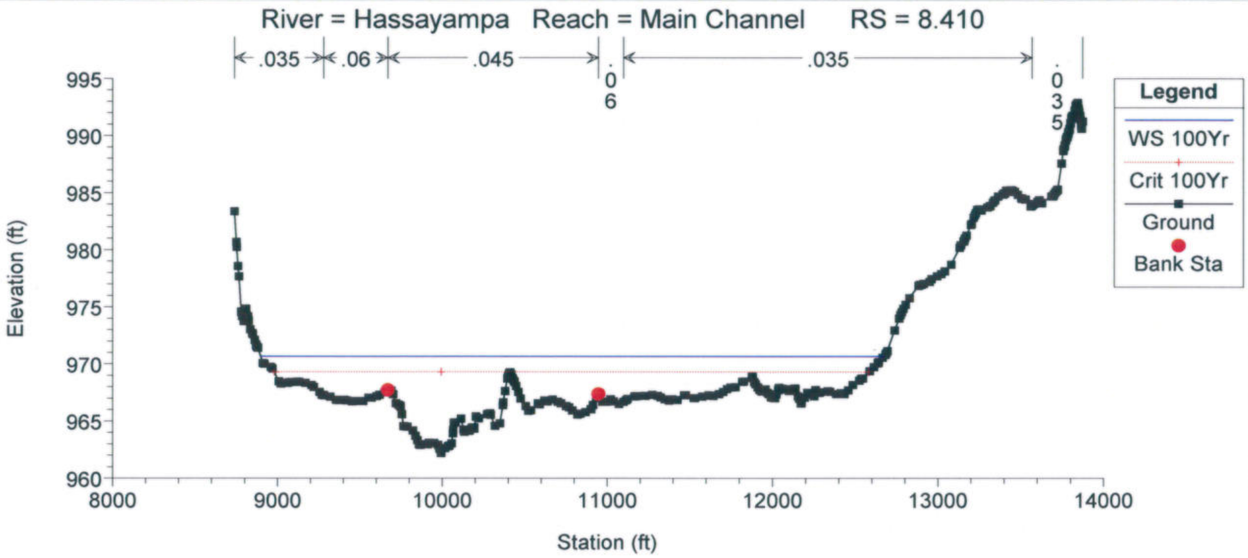

River = Hassayampa Reach = Main Channel RS = 9.270
.035
.035
.06
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

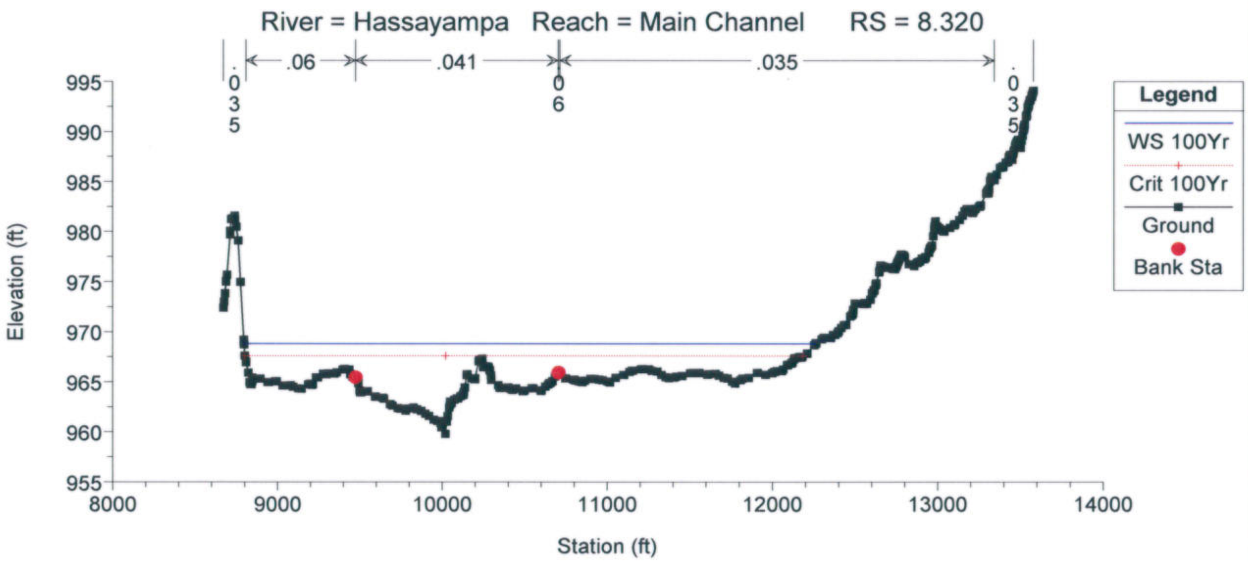

River = Hassayampa Reach = Main Channel RS = 9.170
.035
.037
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

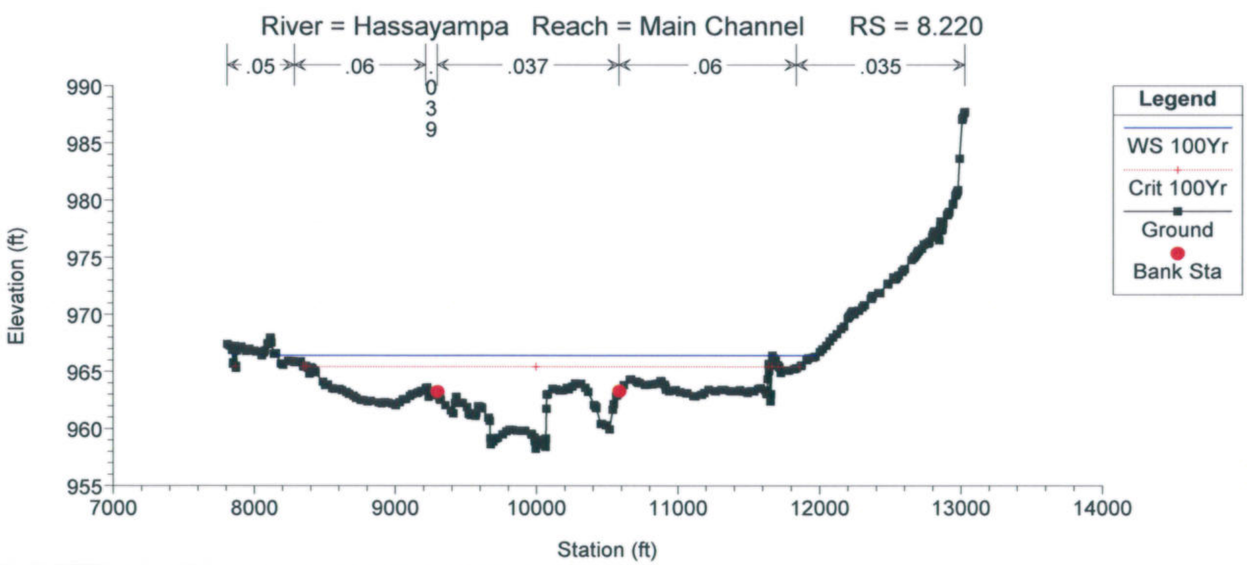

River = Hassayampa Reach = Main Channel RS = 9.080
.035
.041
.06
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

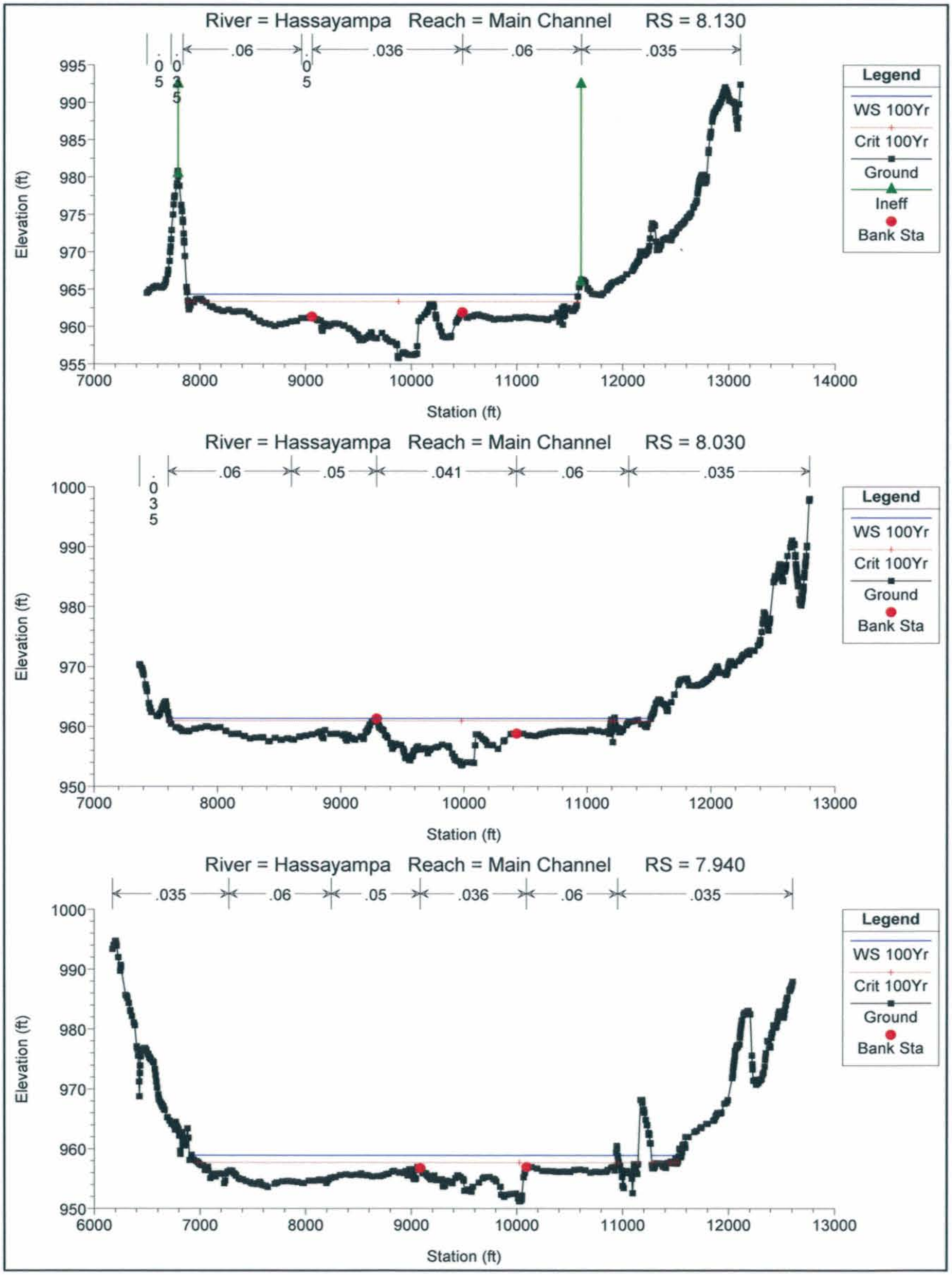

River = Hassayampa Reach = Main Channel RS = 8.980
.045
.035
.035
.035
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 8.890
.043
.06
.035
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 8.790
.035
.046
.06
.035
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 8.700
.035 .049 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 8.600
.035 .047 .035 .035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 8.510
.035 .06 .049 .06 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

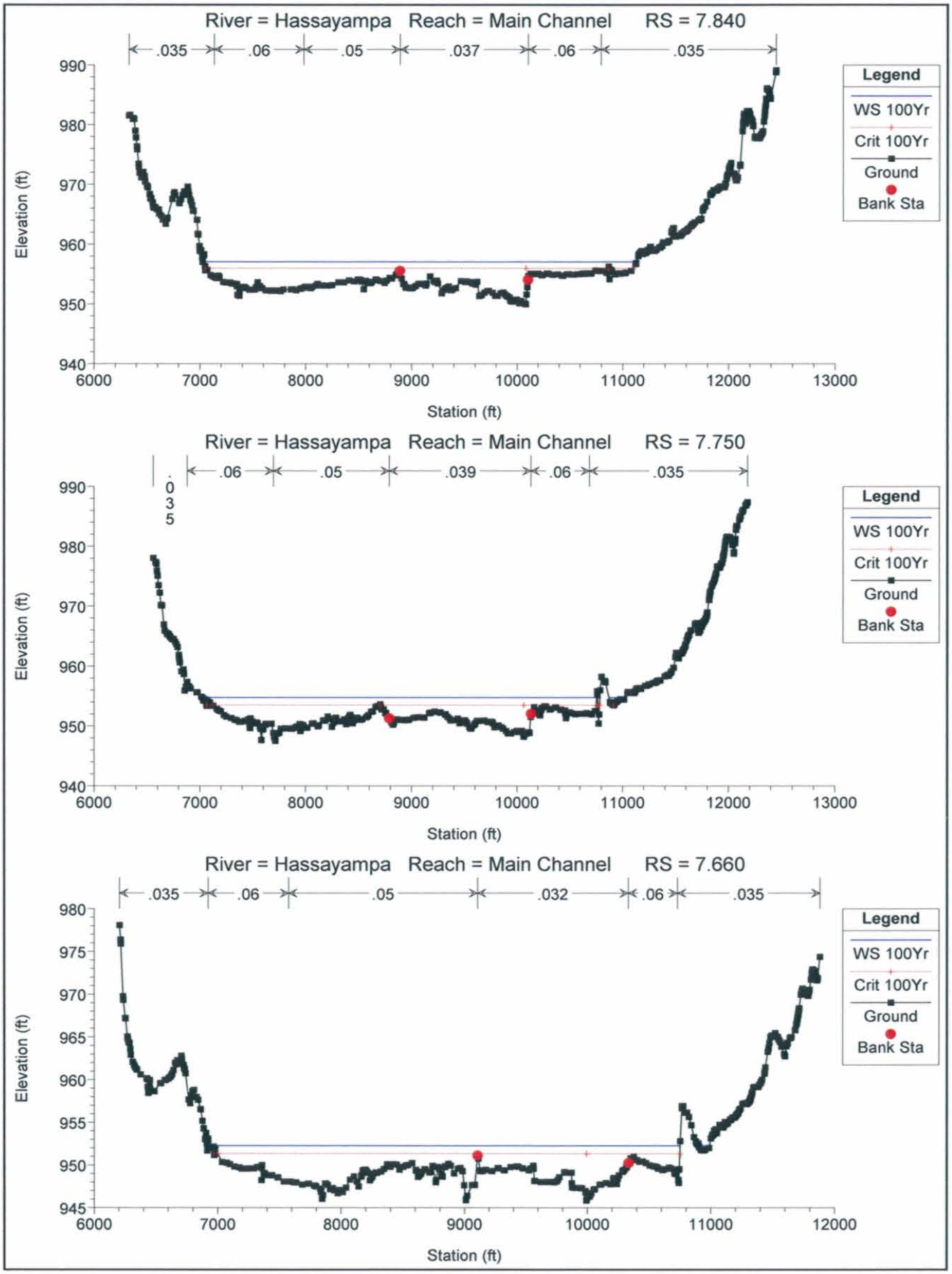

River = Hassayampa Reach = Main Channel RS = 8.410
.035
.06
.045
.06
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

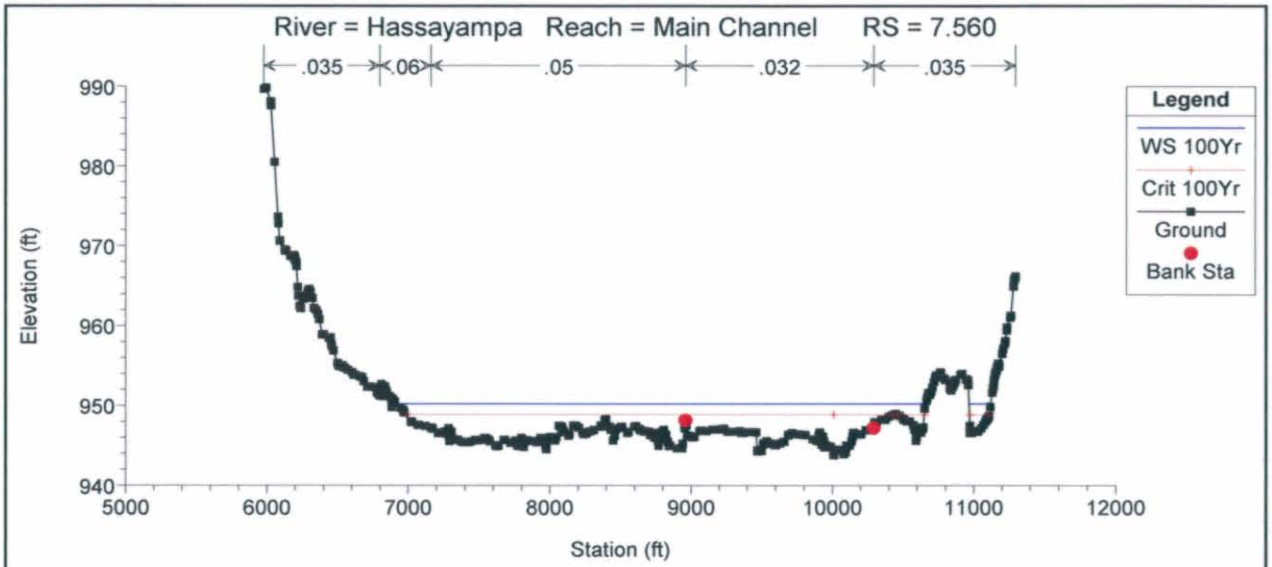

River = Hassayampa Reach = Main Channel RS = 8.320
.035
.06
.041
.06
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

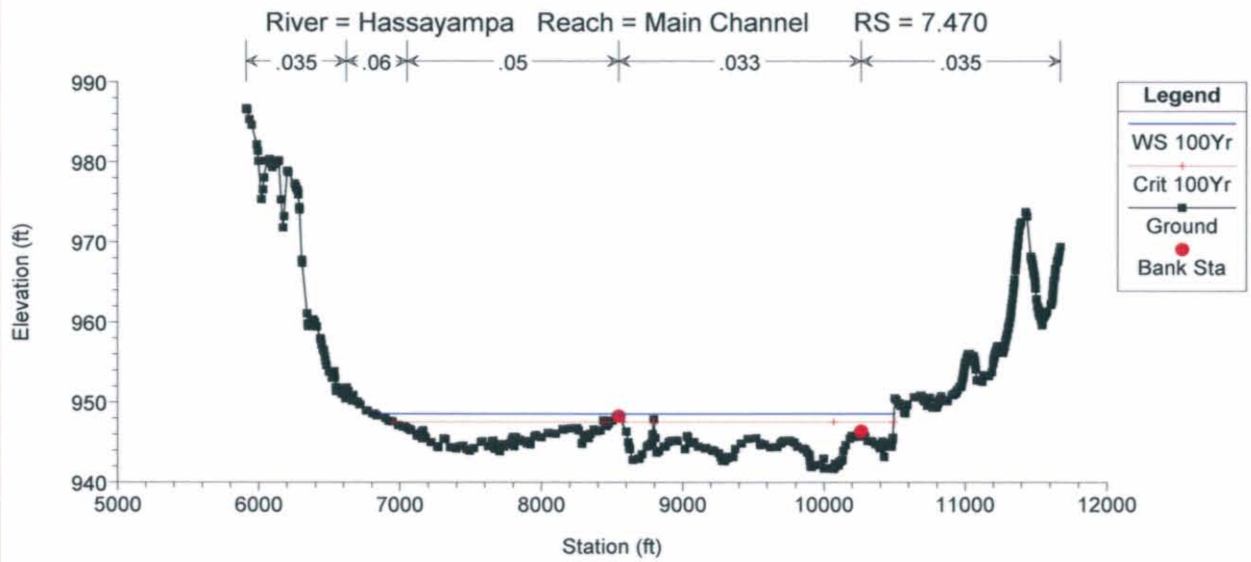

River = Hassayampa Reach = Main Channel RS = 8.220
.05
.06
.039
.037
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

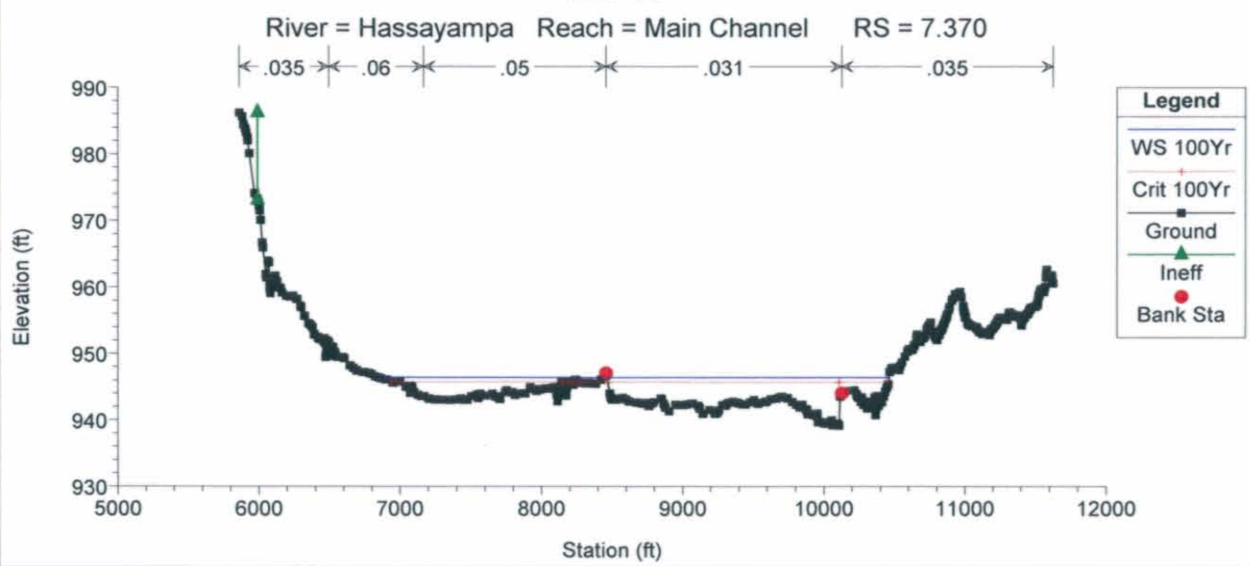


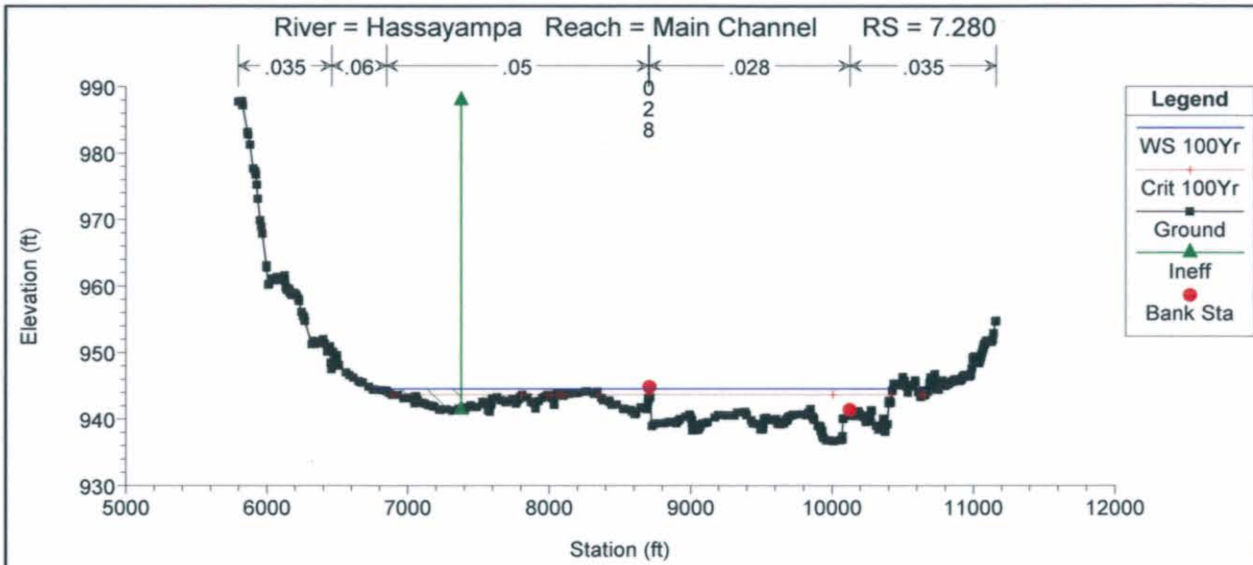
River = Hassayampa Reach = Main Channel RS = 8.130
.06
.036
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 8.030
.06
.05
.041
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 7.940
.035
.06
.05
.036
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

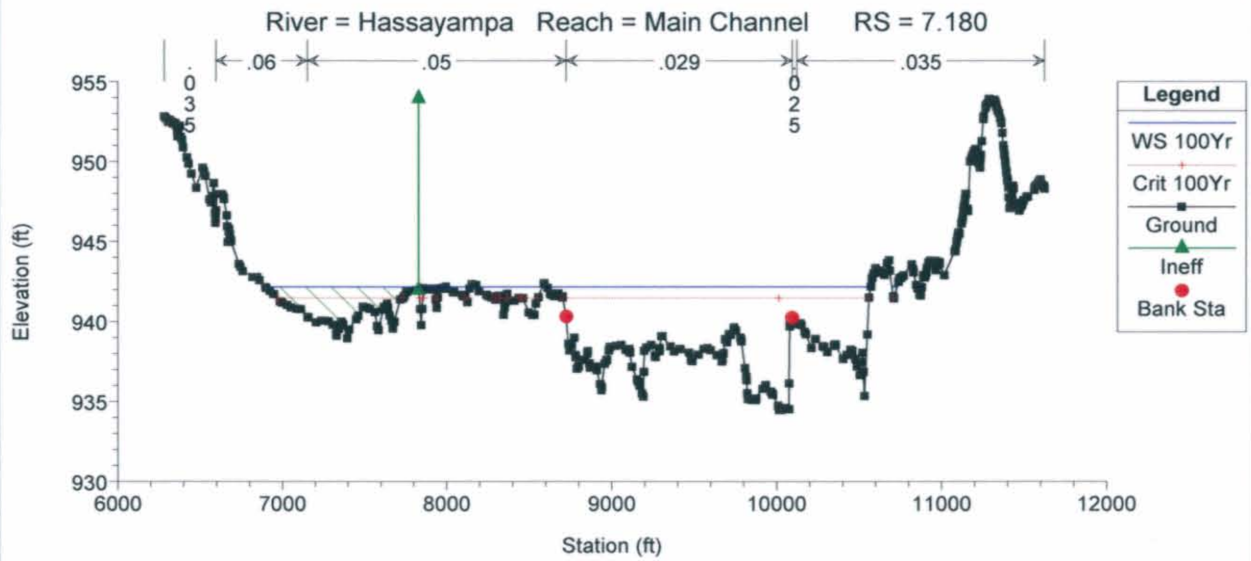

River = Hassayampa Reach = Main Channel RS = 7.840
.035
.06
.05
.037
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 7.750
.035
.06
.05
.039
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 7.660
.035
.06
.05
.032
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

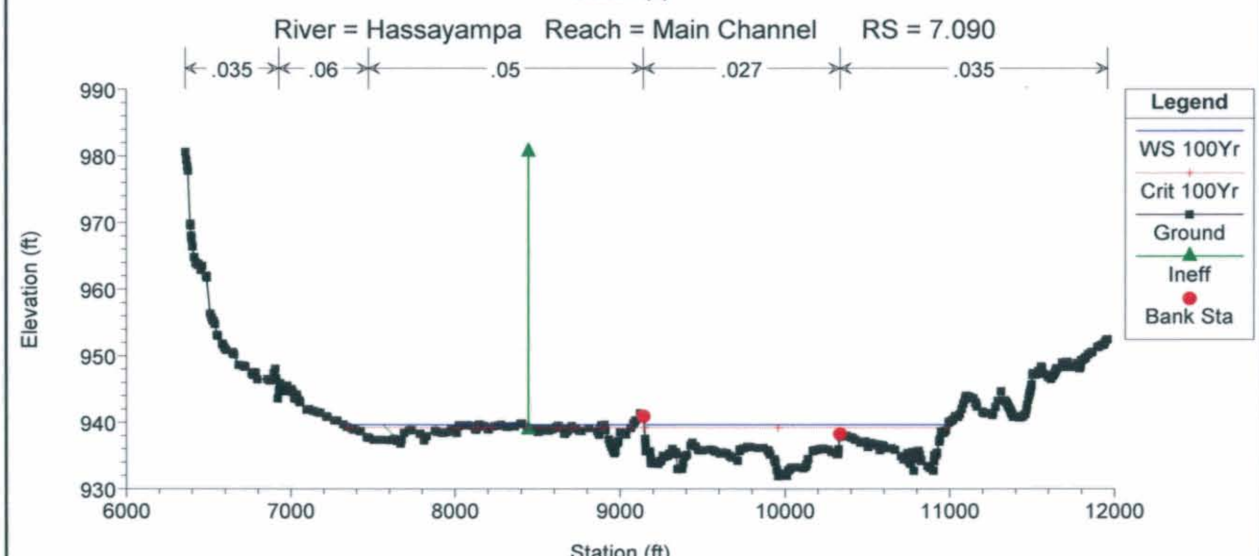

River = Hassayampa Reach = Main Channel RS = 7.560
.035
.06
.05
.032
.035
Elevation (ft)
990
980
970
960
950
940
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

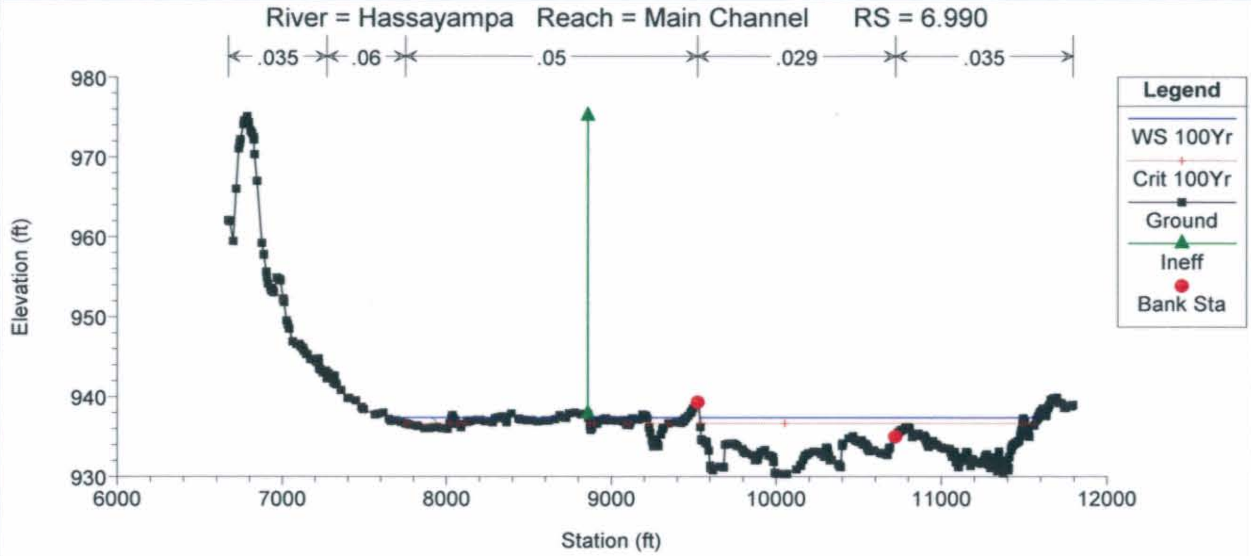

River = Hassayampa Reach = Main Channel RS = 7.470
.035
.06
.05
.033
.035
Elevation (ft)
990
980
970
960
950
940
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 7.370
.035
.06
.05
.031
.035
Elevation (ft)
990
980
970
960
950
940
930
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

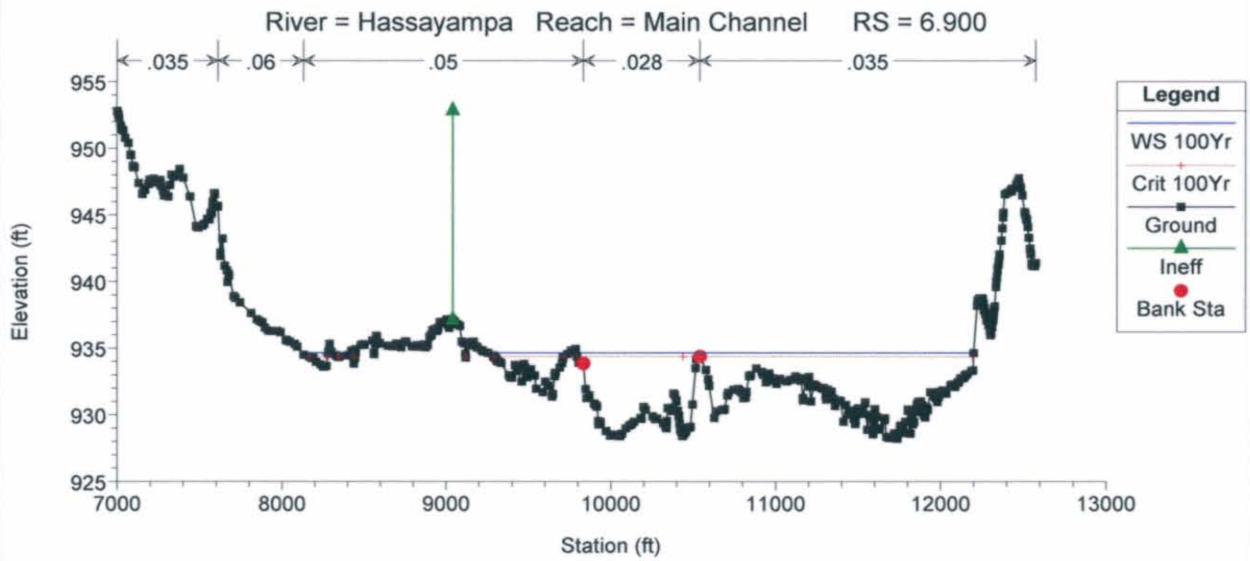

River = Hassayampa Reach = Main Channel RS = 7.280
.035
.06
.05
.028
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 7.180
.06
.05
.029
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

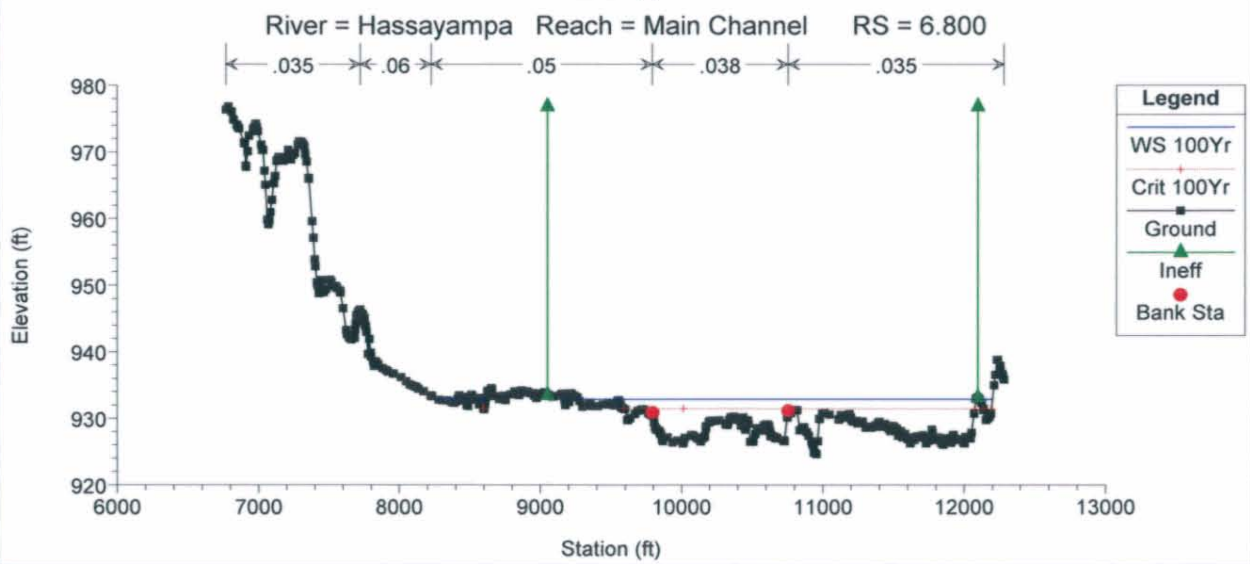

River = Hassayampa Reach = Main Channel RS = 7.090
.035
.06
.05
.027
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



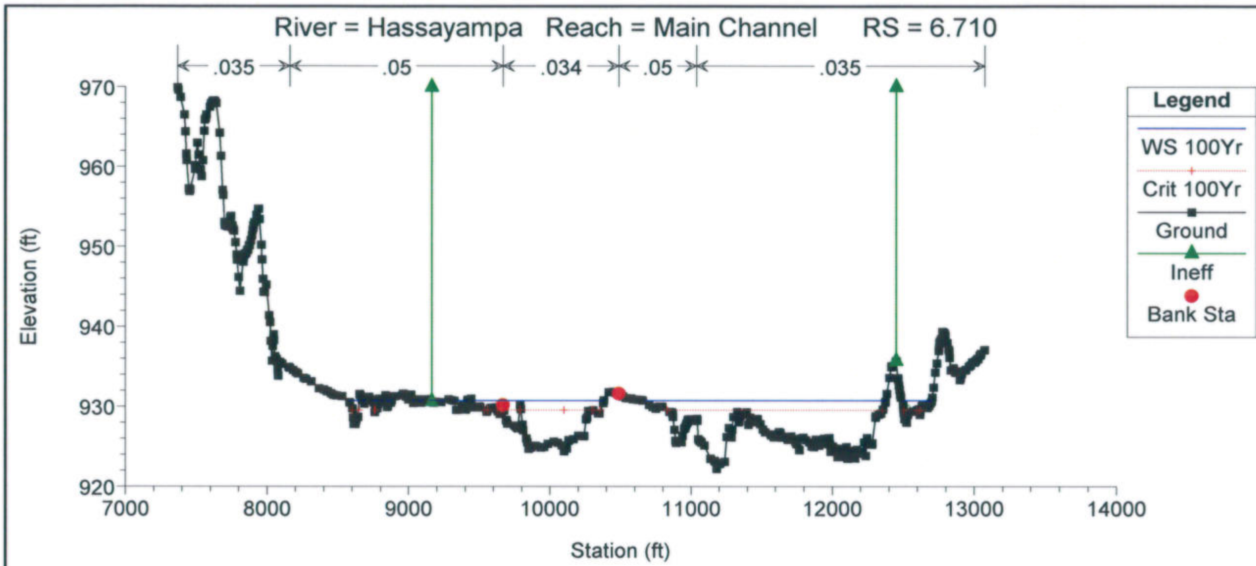
River = Hassayampa Reach = Main Channel RS = 6.990
.035 .06 .05 .029 .035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

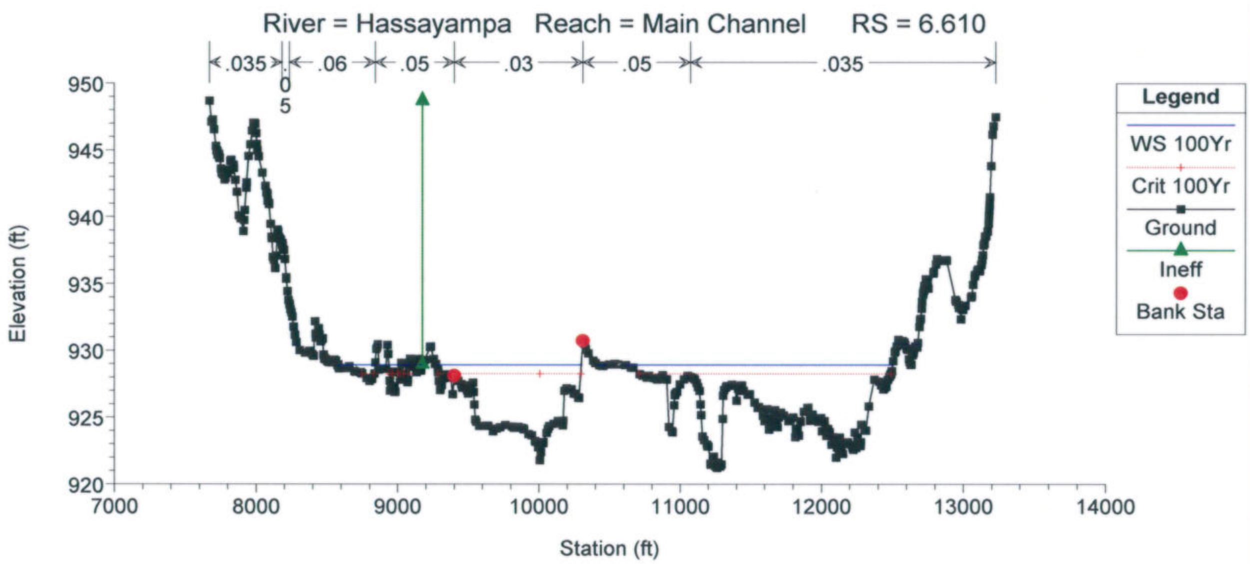


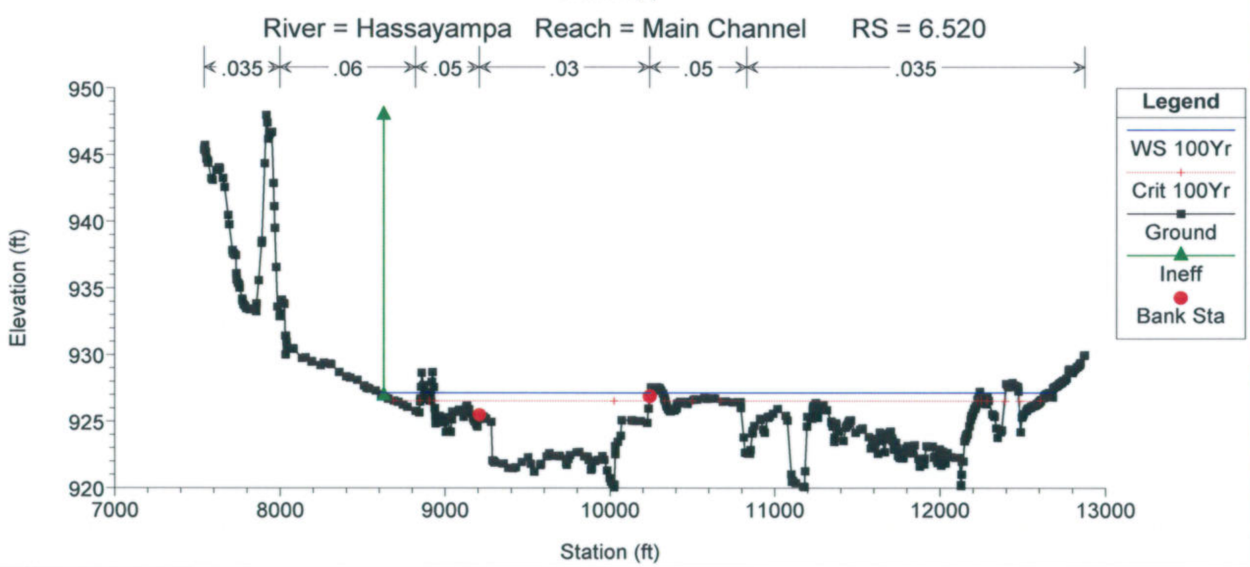
River = Hassayampa Reach = Main Channel RS = 6.900
.035 .06 .05 .028 .035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

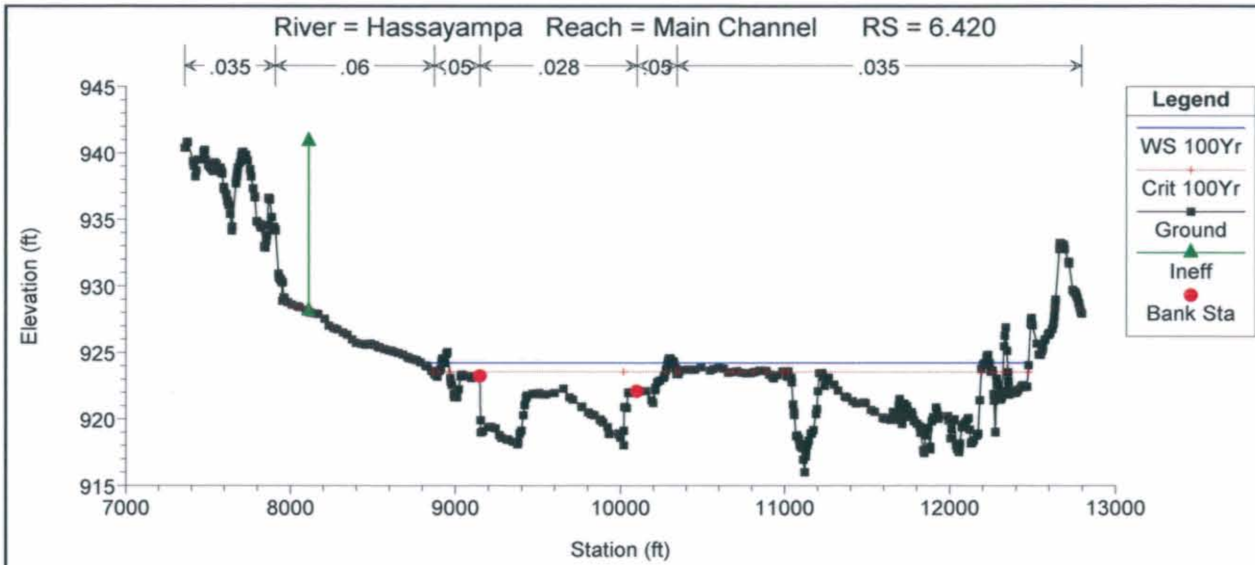


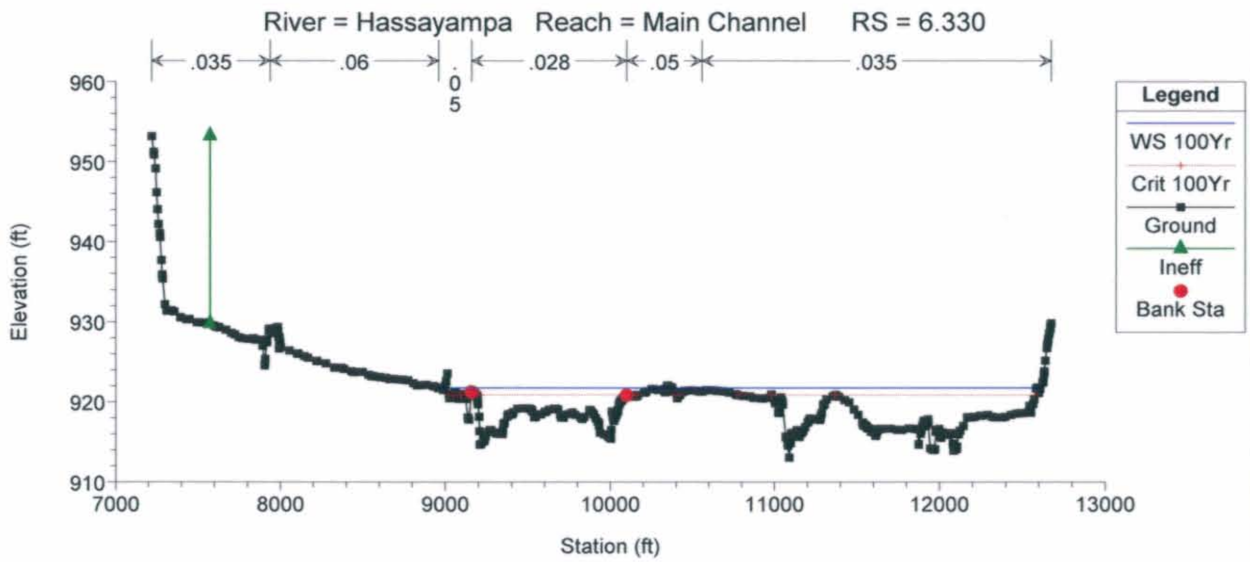
River = Hassayampa Reach = Main Channel RS = 6.800
.035 .06 .05 .038 .035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

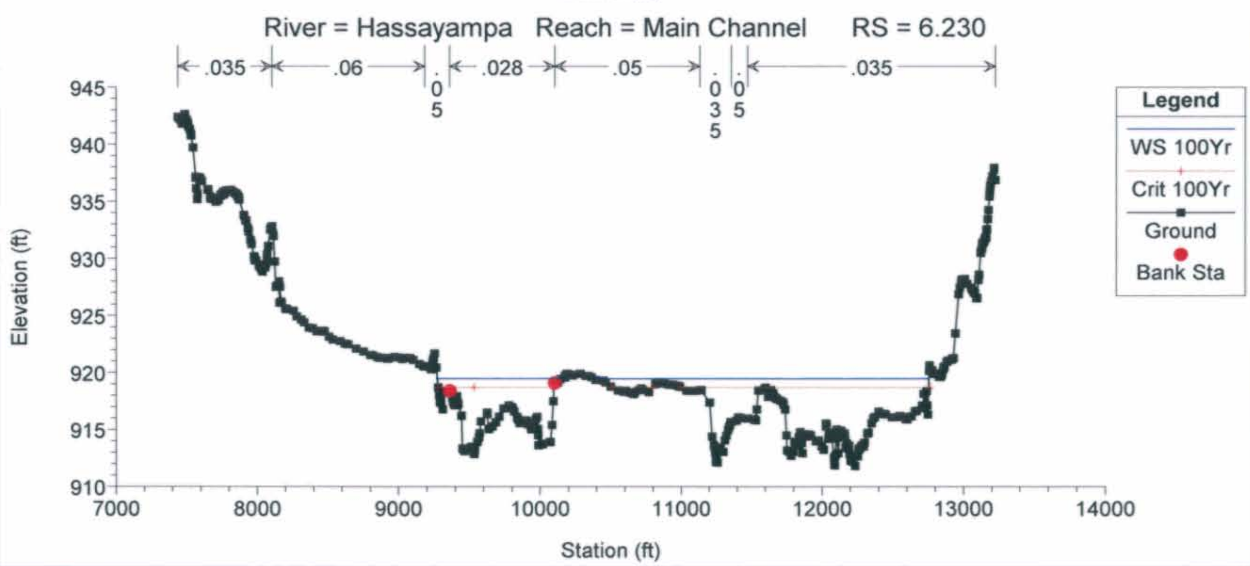

River = Hassayampa Reach = Main Channel RS = 6.710
.035
.05
.034
.05
.035
Elevation (ft)
970
960
950
940
930
920
7000
8000
9000
10000
11000
12000
13000
14000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

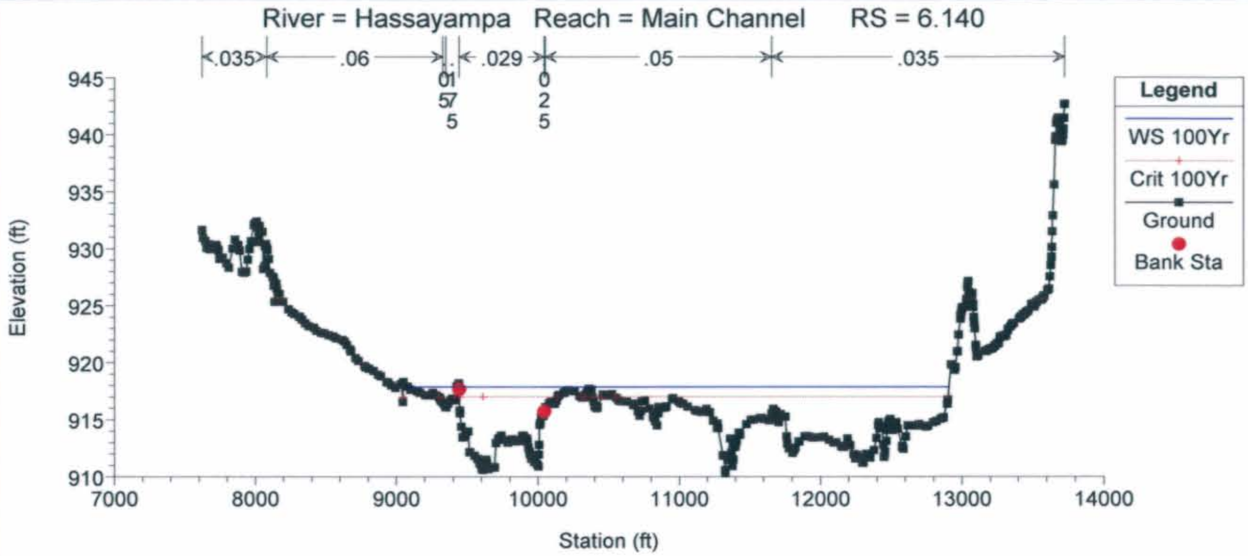

River = Hassayampa Reach = Main Channel RS = 6.610
.035
.06
.05
.03
.05
.035
Elevation (ft)
950
945
940
935
930
925
920
7000
8000
9000
10000
11000
12000
13000
14000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

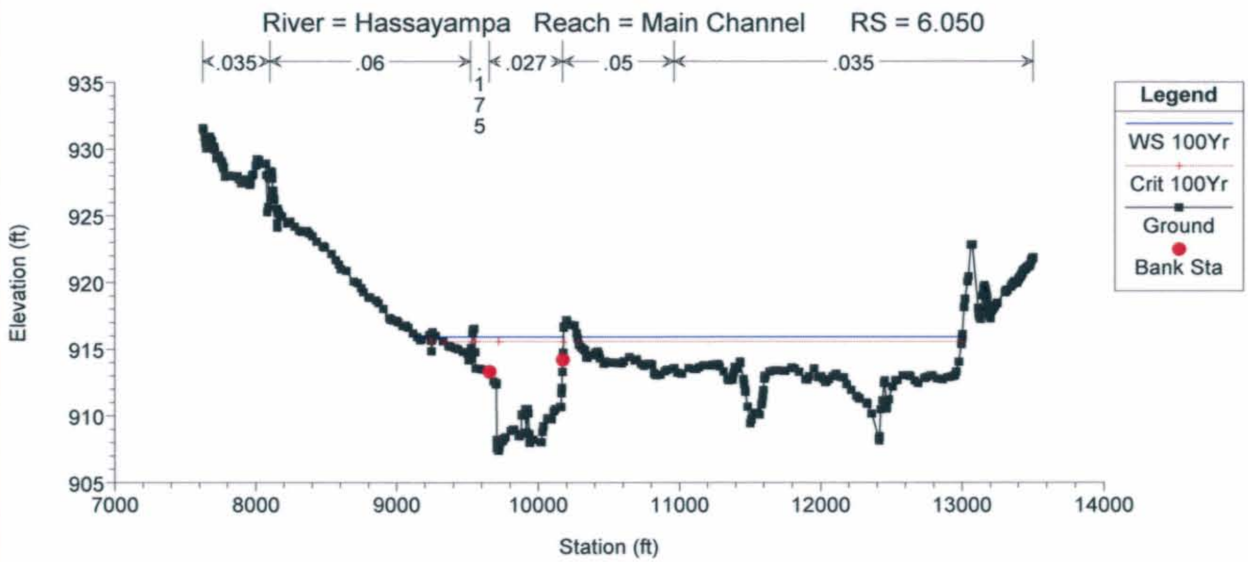

River = Hassayampa Reach = Main Channel RS = 6.520
.035
.06
.05
.03
.05
.035
Elevation (ft)
950
945
940
935
930
925
920
7000
8000
9000
10000
11000
12000
13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

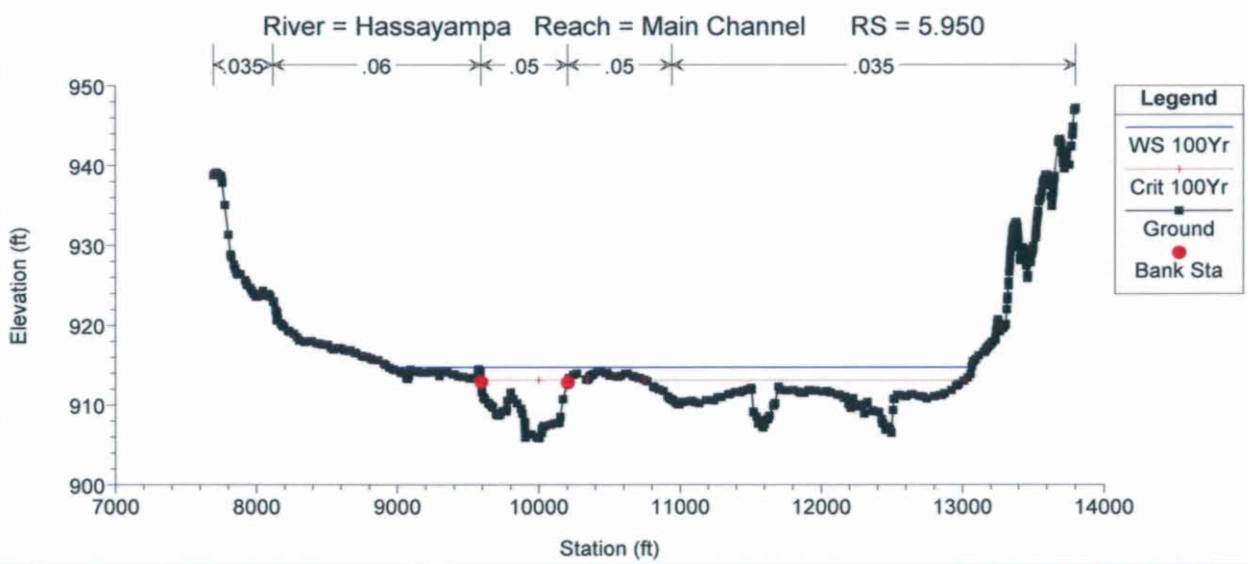

River = Hassayampa Reach = Main Channel RS = 6.420
.035
.06
.05
.028
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

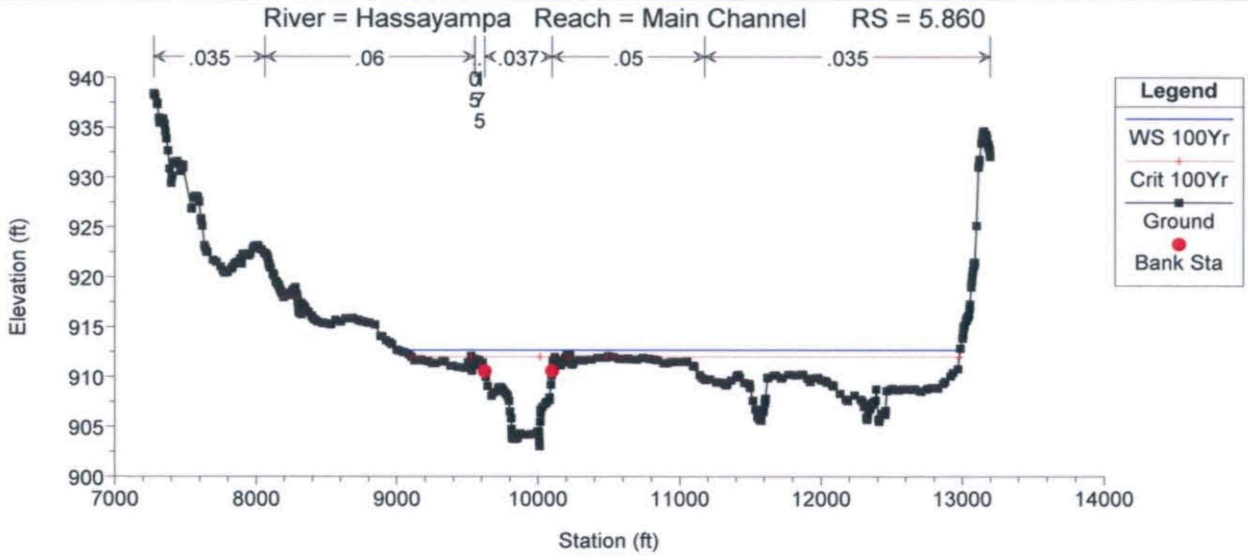

River = Hassayampa Reach = Main Channel RS = 6.330
.035
.06
.05
.028
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

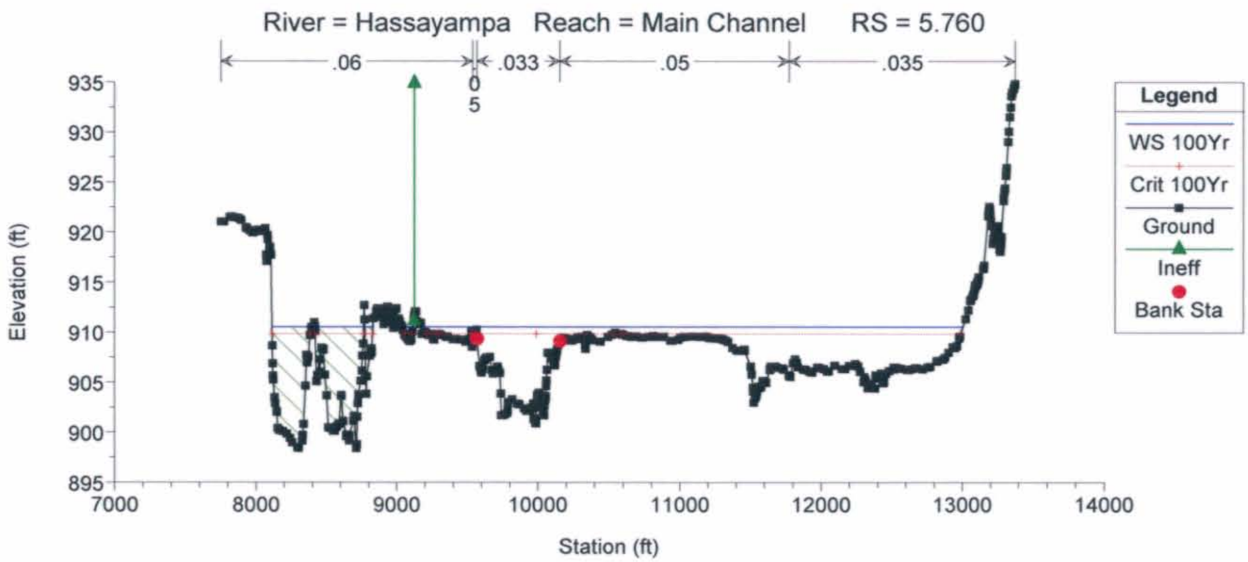

River = Hassayampa Reach = Main Channel RS = 6.230
.035
.06
.05
.028
.05
.035
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

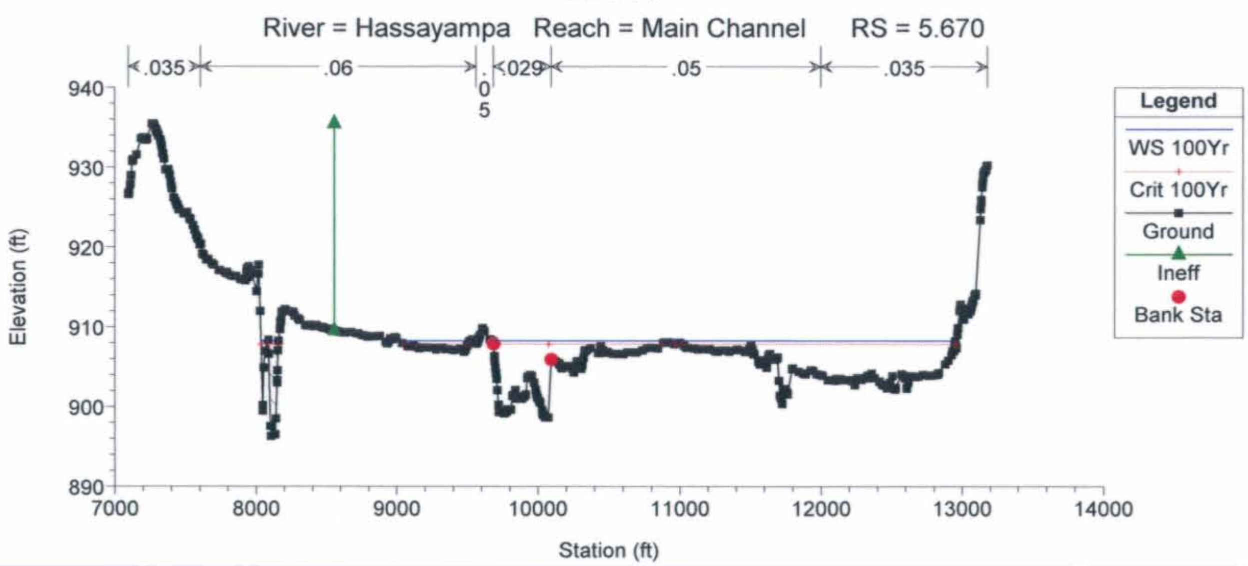

River = Hassayampa Reach = Main Channel RS = 6.140
.035
.06
.029
.05
.035
945
940
935
930
925
920
915
910
7000
8000
9000
10000
11000
12000
13000
14000
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

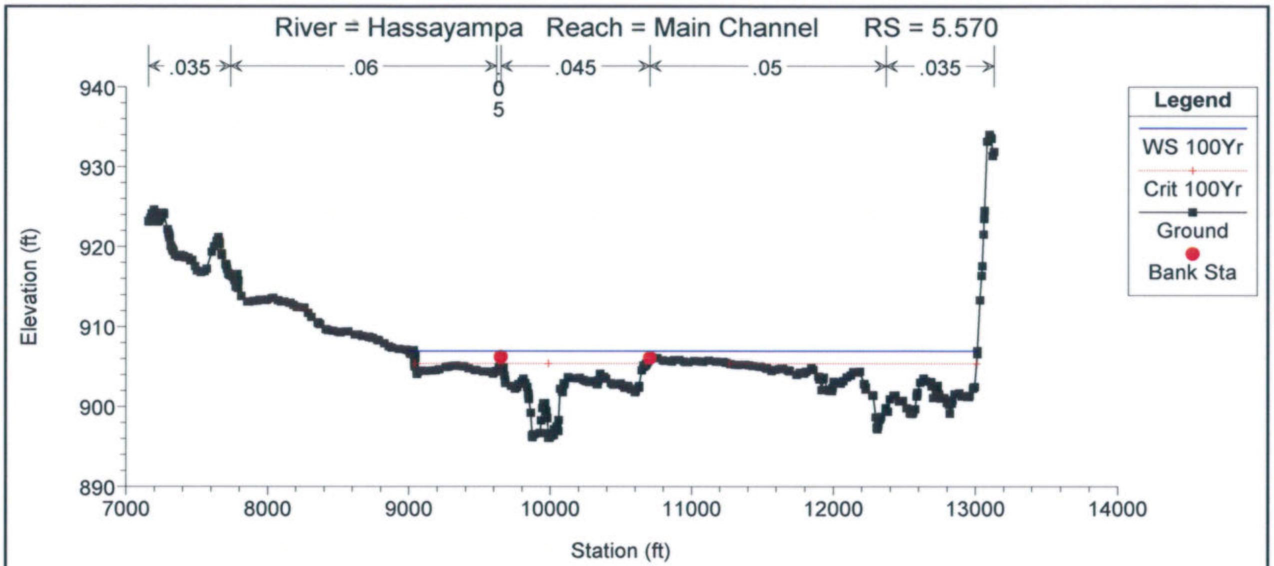

River = Hassayampa Reach = Main Channel RS = 6.050
.035
.06
.175
.027
.05
.035
935
930
925
920
915
910
905
7000
8000
9000
10000
11000
12000
13000
14000
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

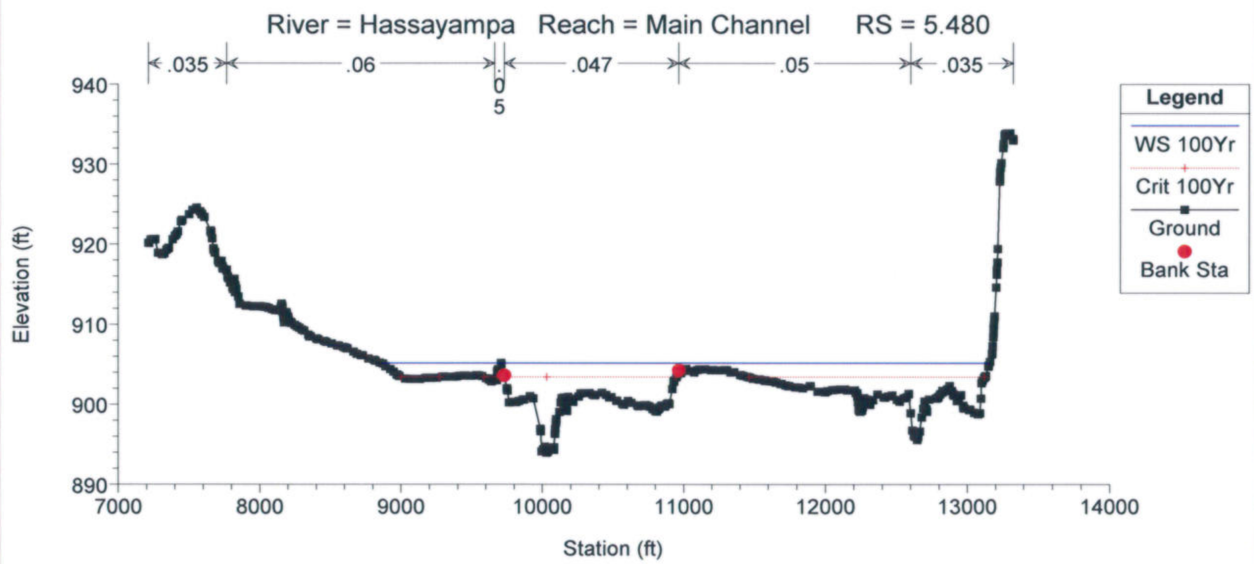

River = Hassayampa Reach = Main Channel RS = 5.950
.035
.06
.05
.05
.035
950
940
930
920
910
900
7000
8000
9000
10000
11000
12000
13000
14000
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

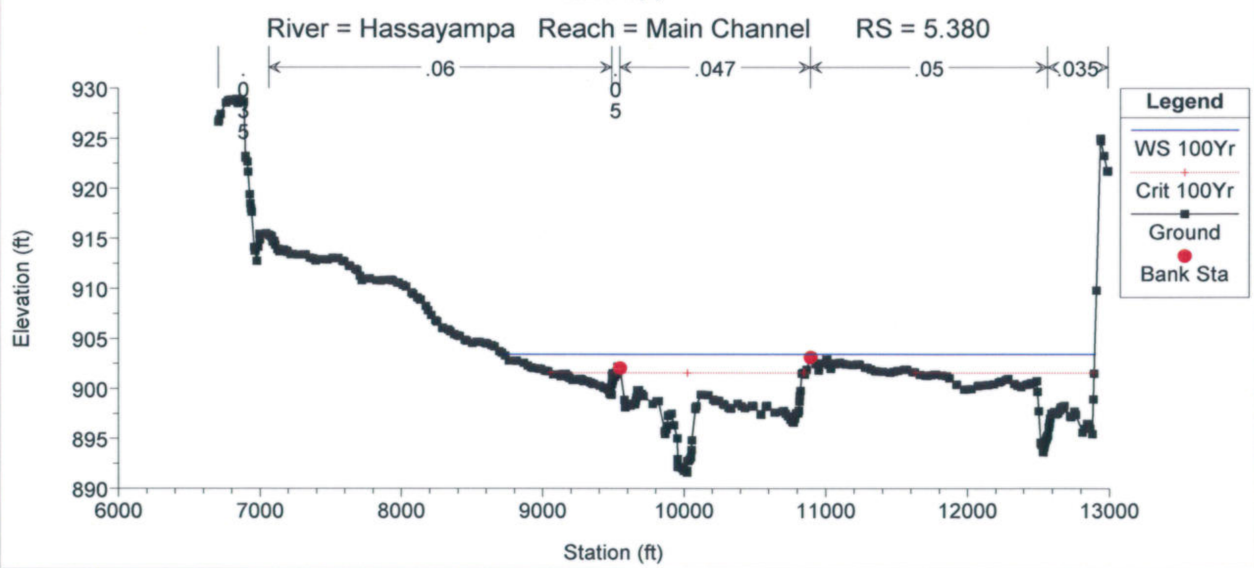

River = Hassayampa Reach = Main Channel RS = 5.860
.035
.06
.037
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

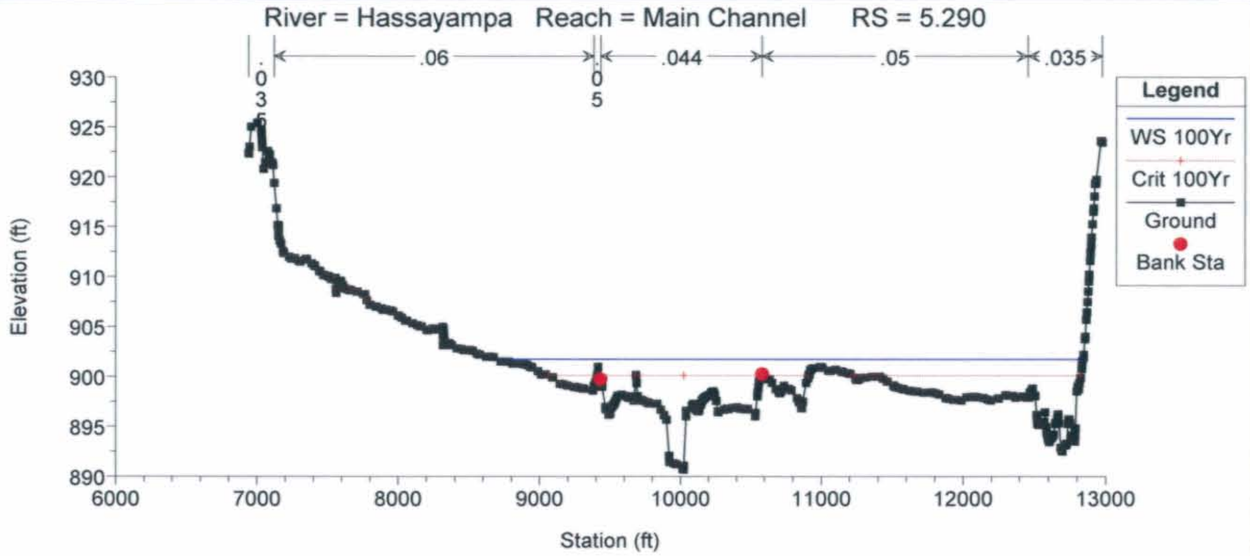

River = Hassayampa Reach = Main Channel RS = 5.760
.06
.033
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

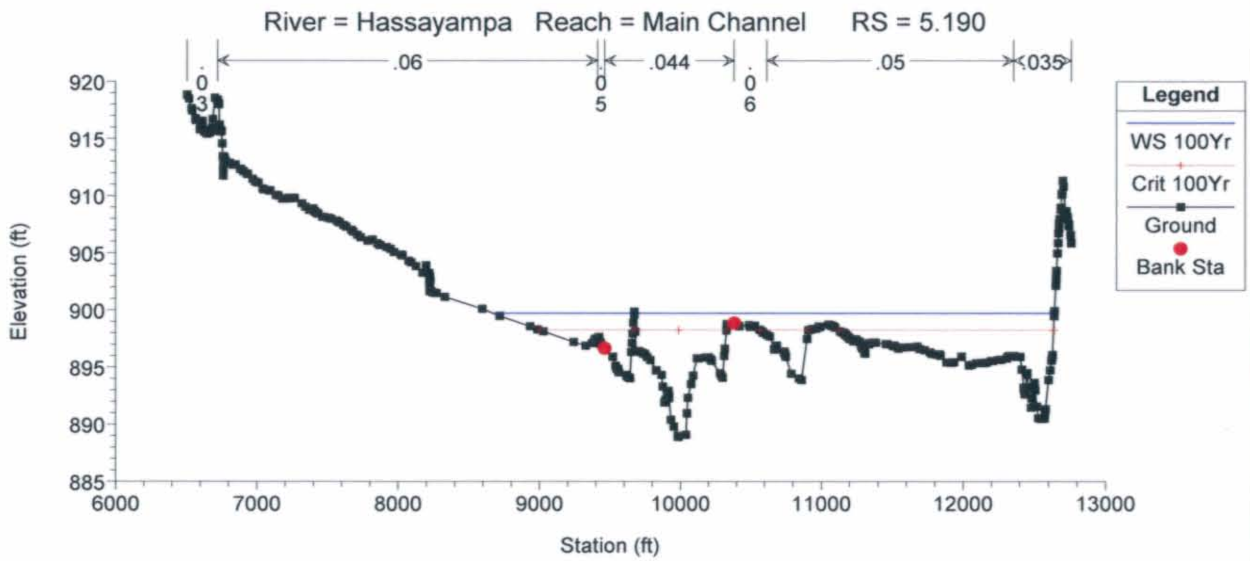

River = Hassayampa Reach = Main Channel RS = 5.670
.035
.06
.029
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

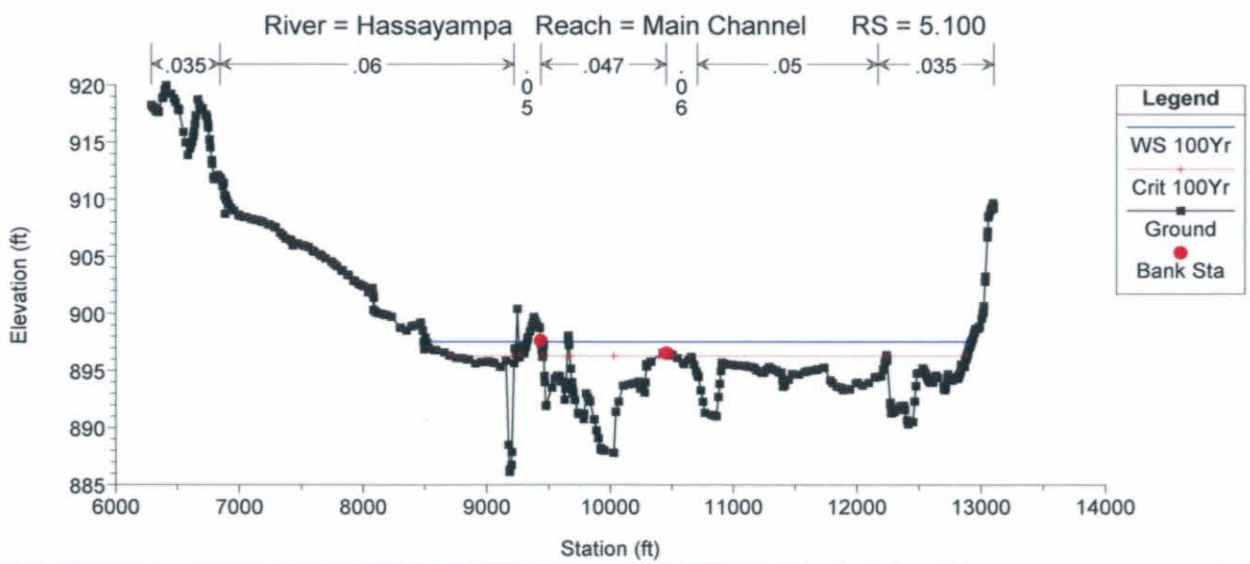

River = Hassayampa Reach = Main Channel RS = 5.570
.035
.06
.05
.045
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
940
930
920
910
900
890
7000
8000
9000
10000
11000
12000
13000
14000

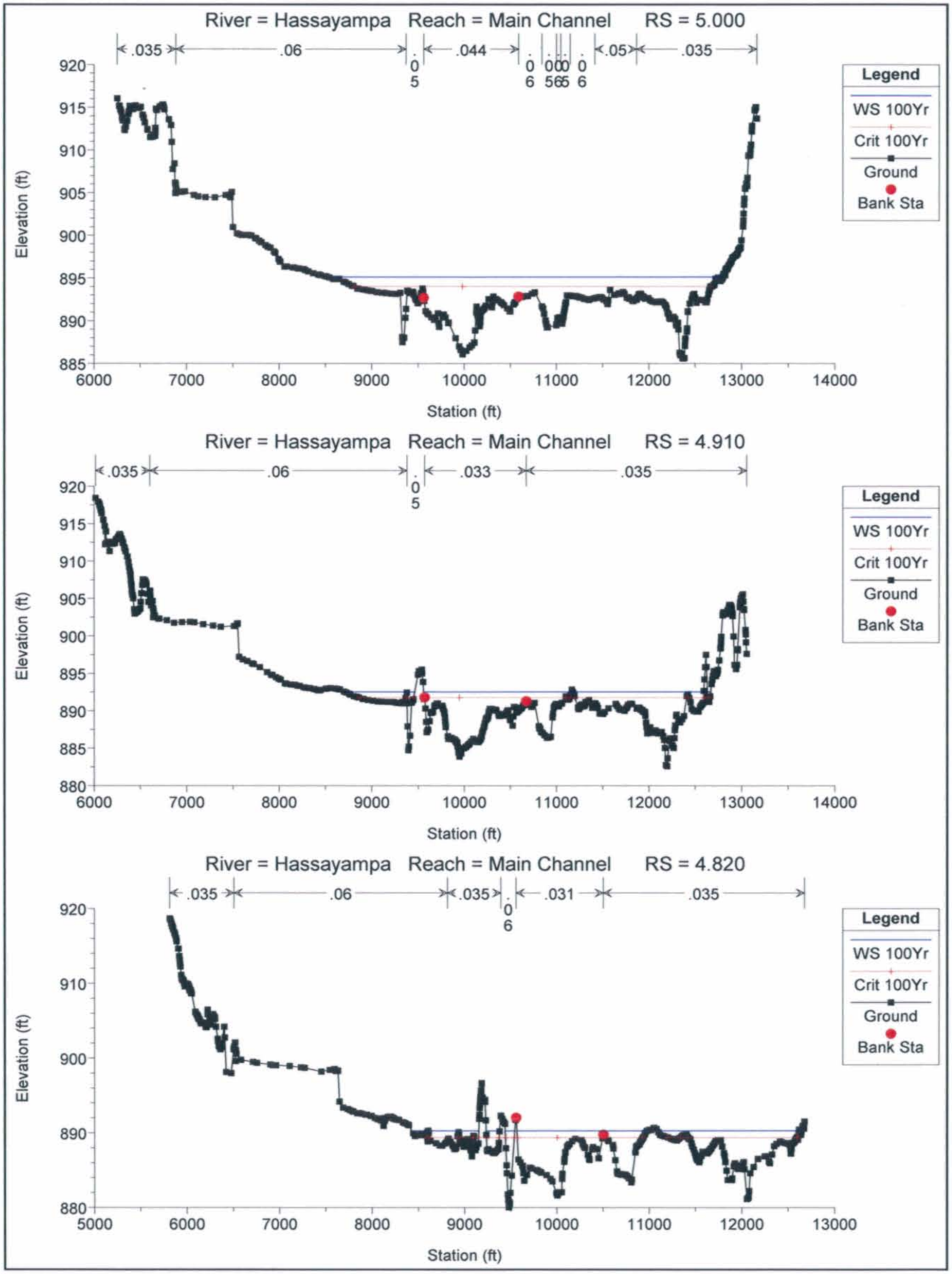

River = Hassayampa Reach = Main Channel RS = 5.480
.035
.06
.05
.047
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
940
930
920
910
900
890
7000
8000
9000
10000
11000
12000
13000
14000

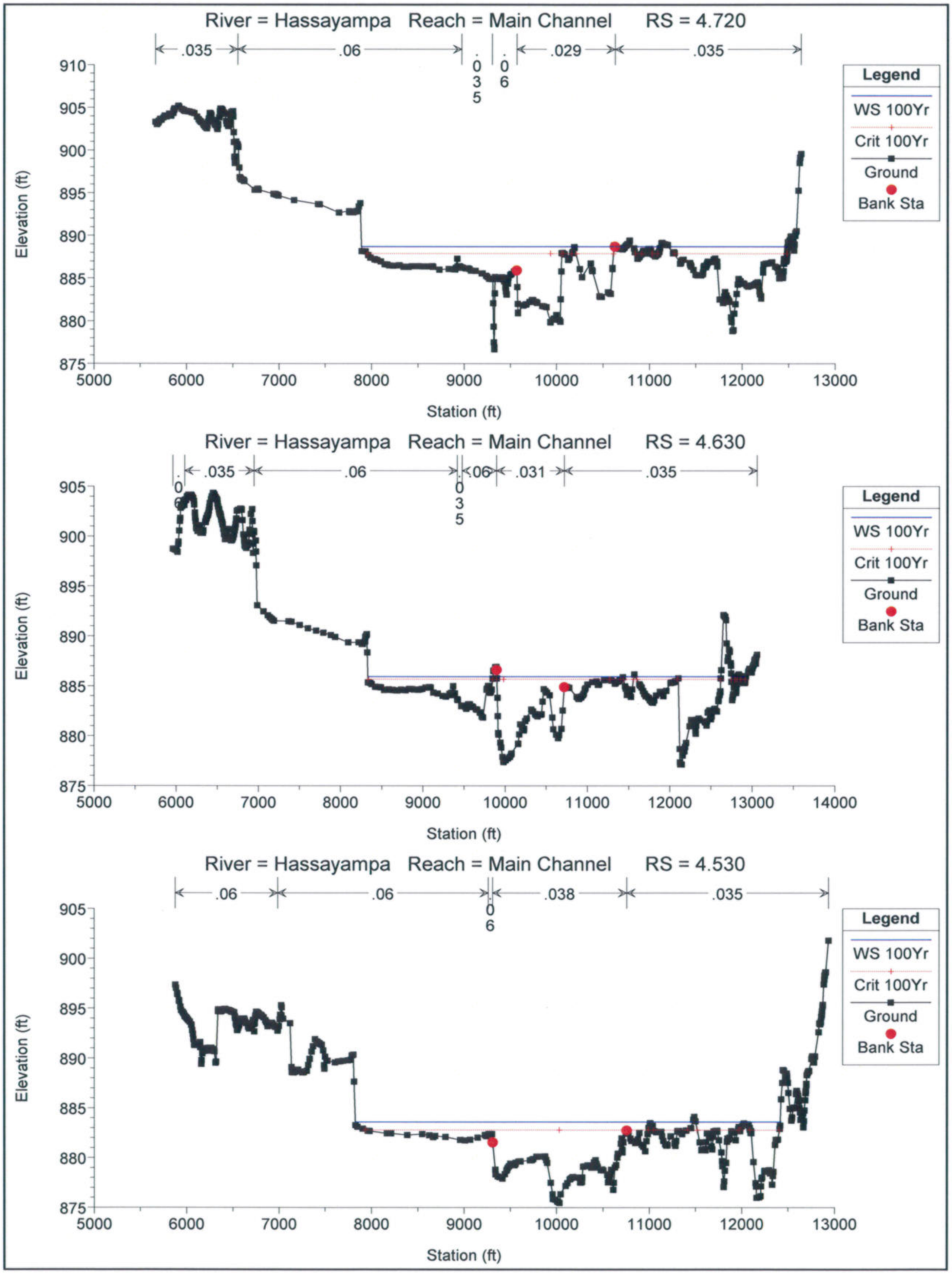

River = Hassayampa Reach = Main Channel RS = 5.380
.035
.06
.05
.047
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
930
925
920
915
910
905
900
895
890
6000
7000
8000
9000
10000
11000
12000
13000


River = Hassayampa Reach = Main Channel RS = 5.290
.035
.06
.05
.044
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

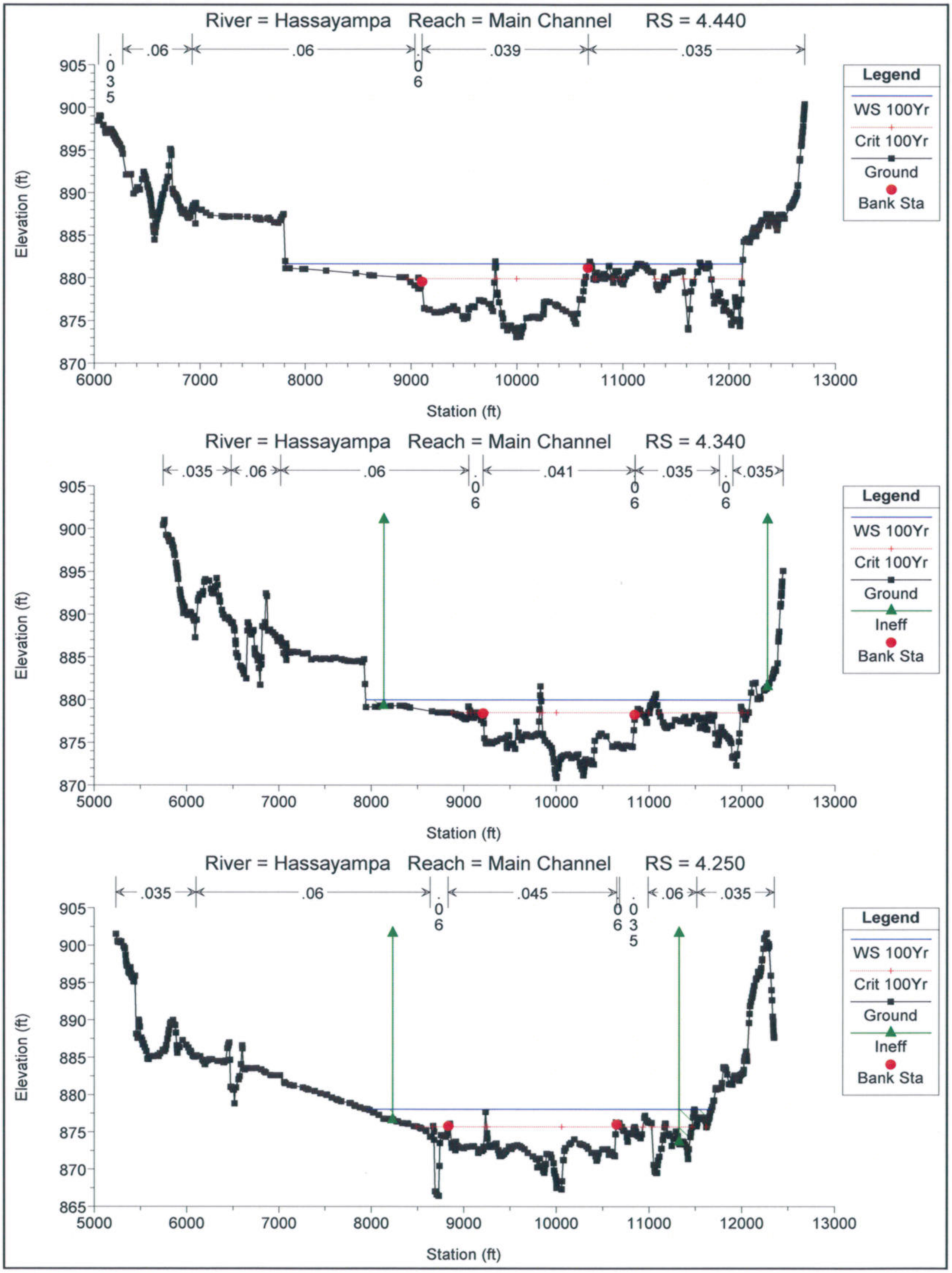

River = Hassayampa Reach = Main Channel RS = 5.190
.03
.06
.05
.044
.06
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 5.100
.035
.06
.05
.047
.06
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

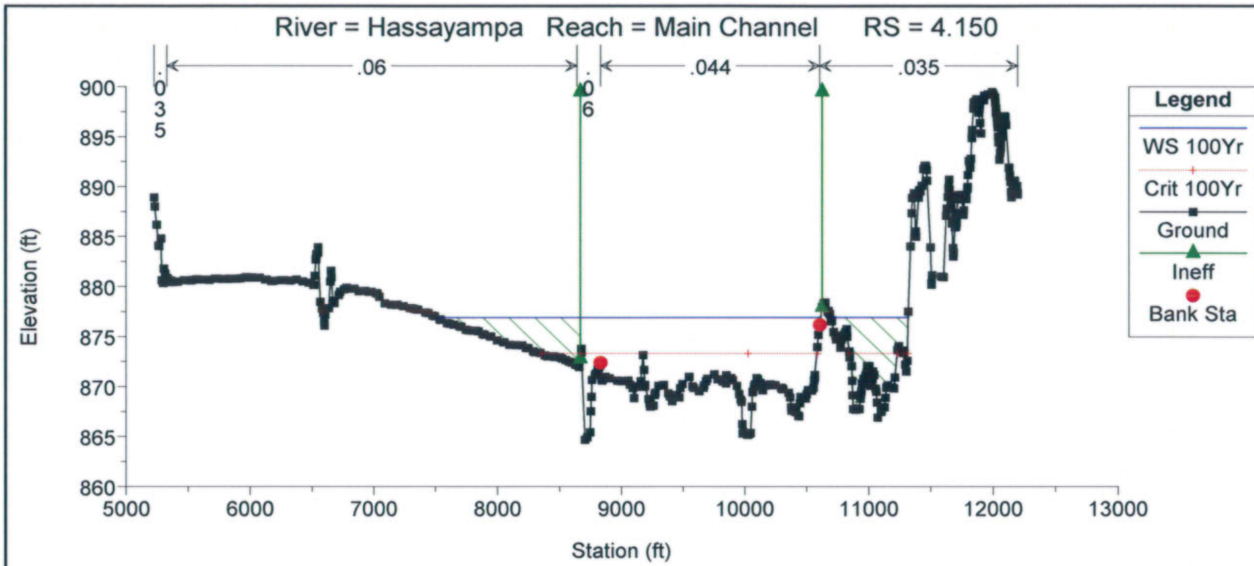

River = Hassayampa Reach = Main Channel RS = 5.000
.035
.06
.044
.05
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.910
.035
.06
.033
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.820
.035
.06
.035
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

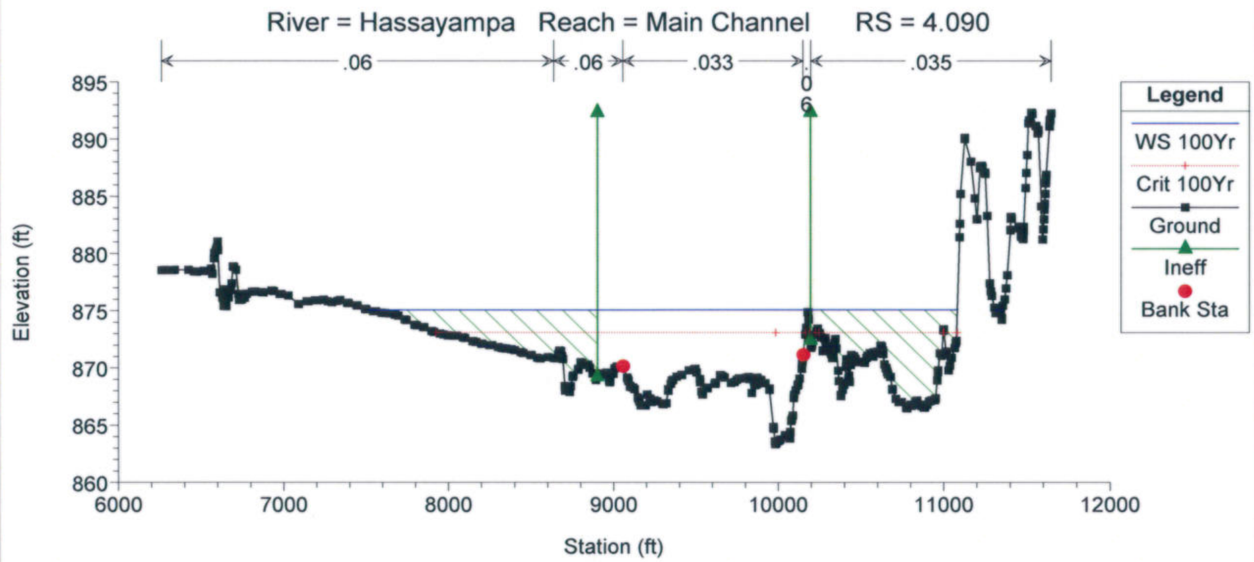


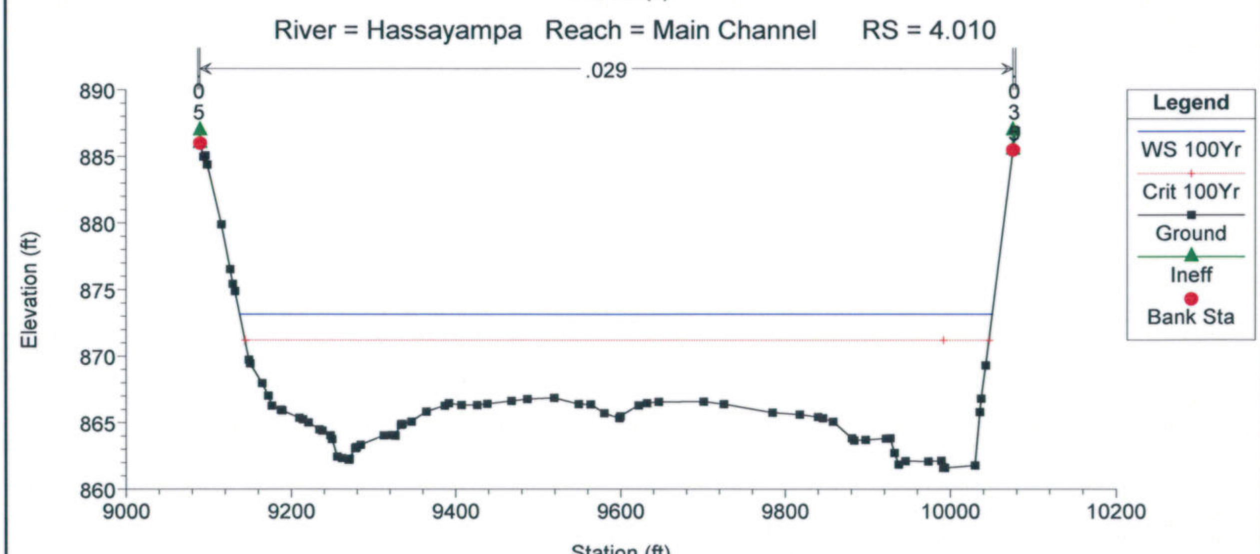
River = Hassayampa Reach = Main Channel RS = 4.720
.035
.06
.035
.06
.029
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.630
.06
.035
.06
.035
.06
.031
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.530
.06
.06
.06
.038
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

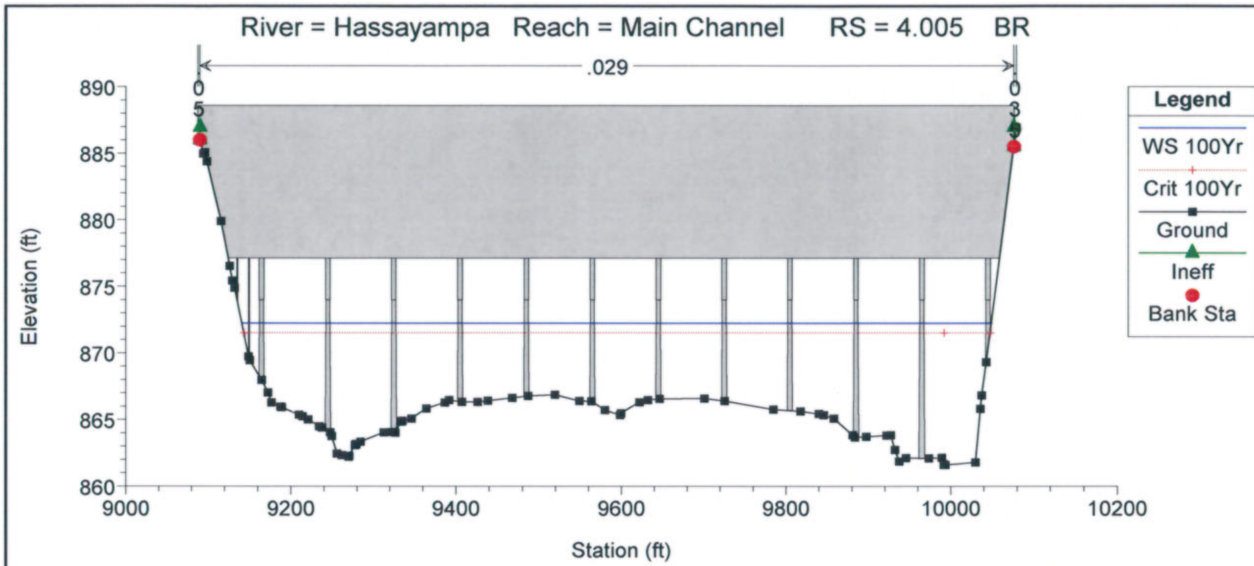


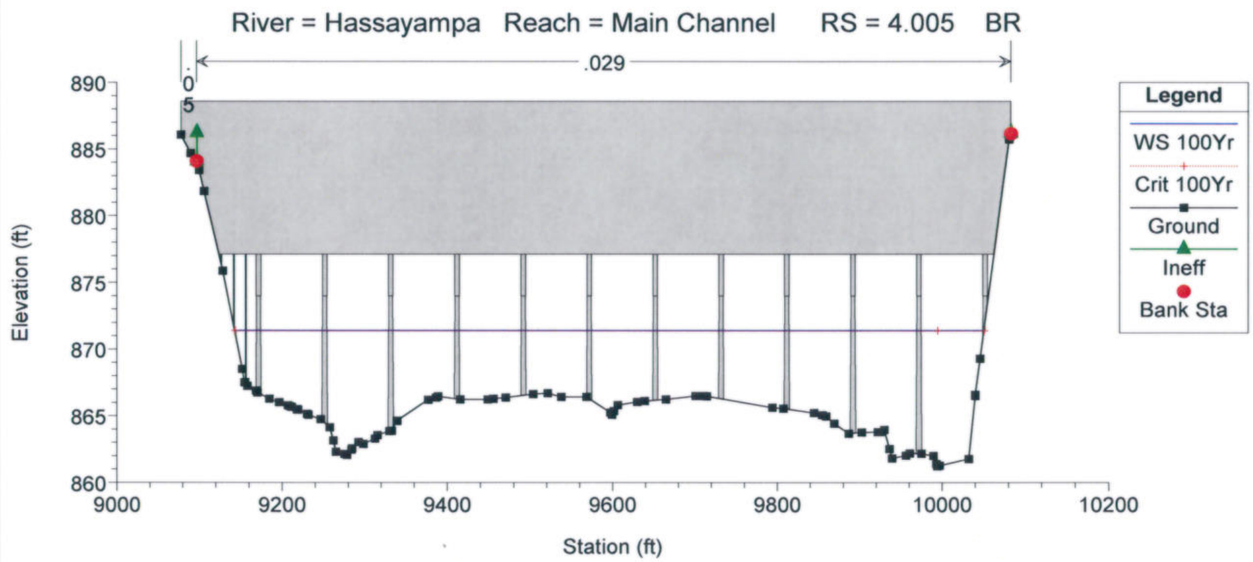
River = Hassayampa Reach = Main Channel RS = 4.440
.035
.06
.06
.06
.039
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.340
.035
.06
.06
.06
.041
.06
.035
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 4.250
.035
.06
.06
.045
.06
.035
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

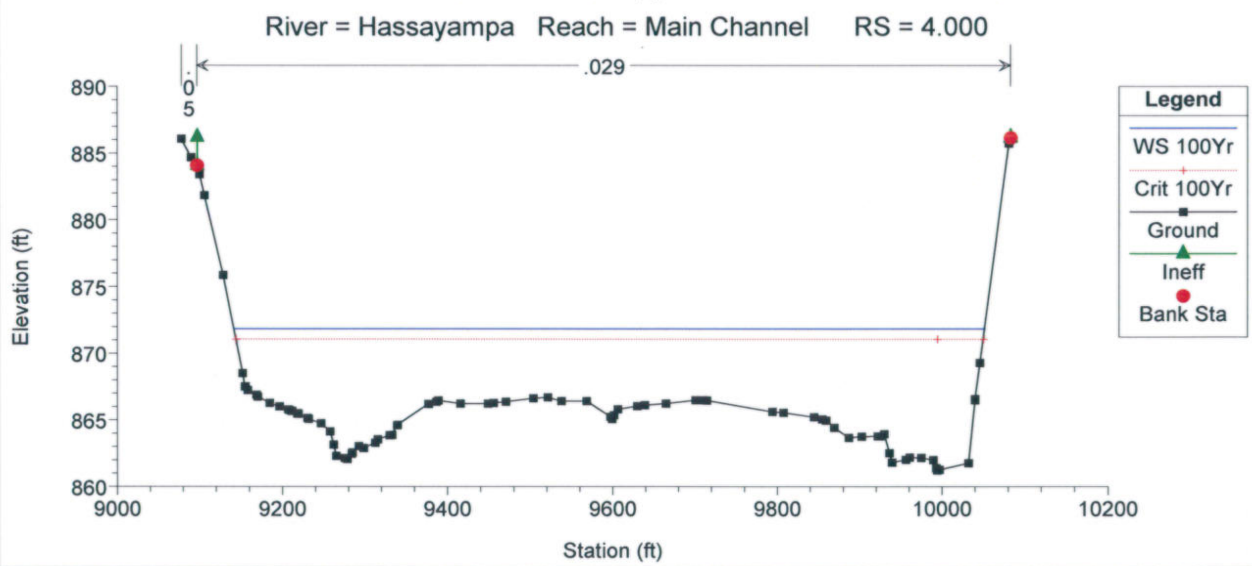

River = Hassayampa Reach = Main Channel RS = 4.150
.06
.044
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

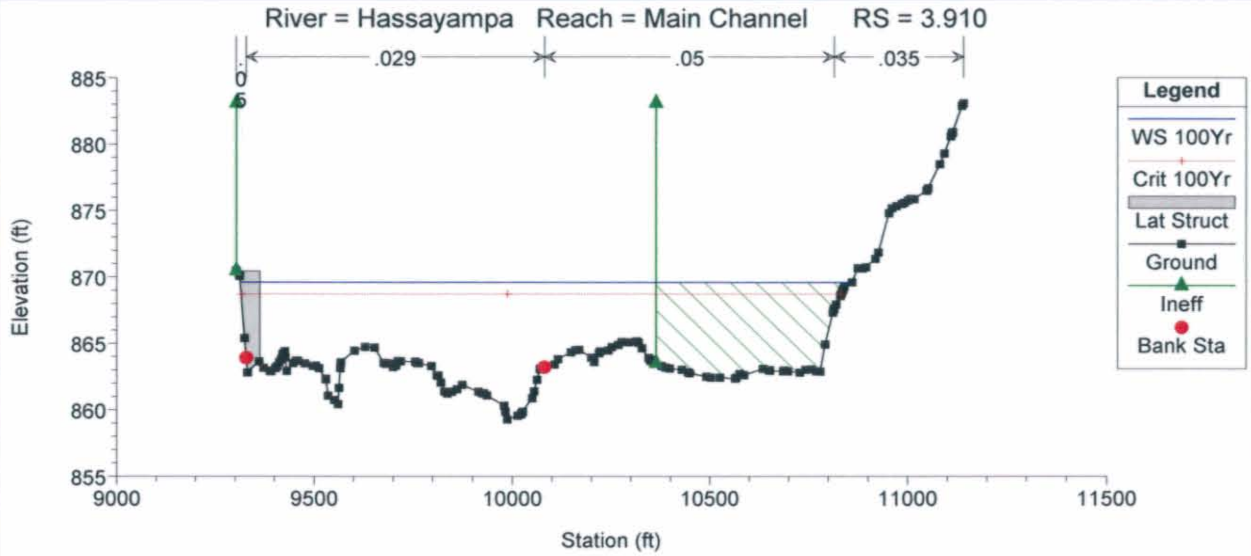

River = Hassayampa Reach = Main Channel RS = 4.090
.06
.06
.033
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa Reach = Main Channel RS = 4.010
.029
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

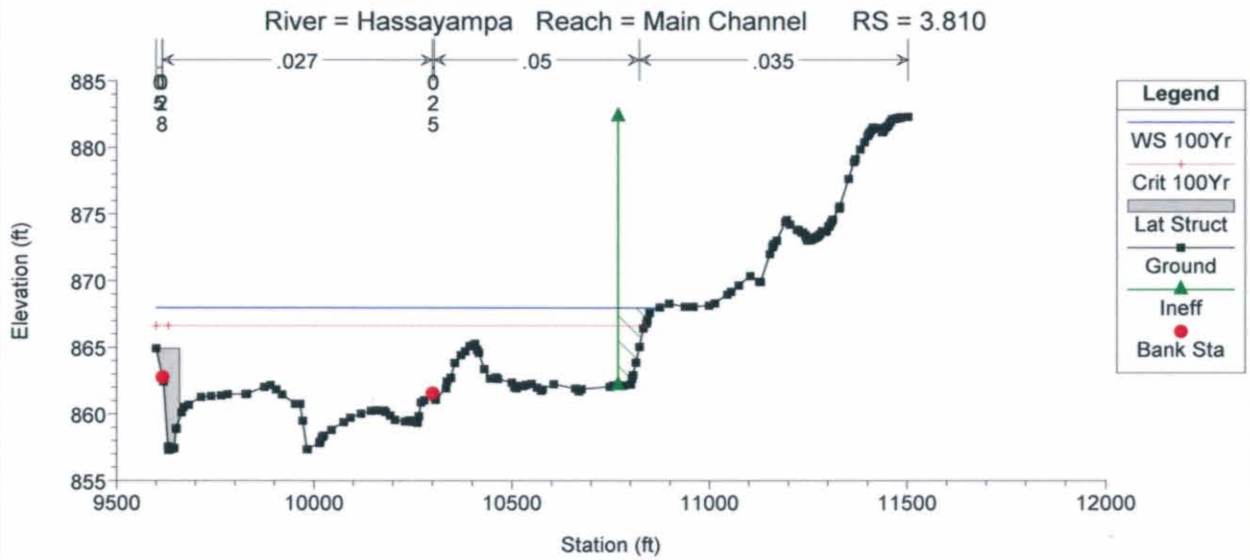

River = Hassayampa Reach = Main Channel RS = 4.005 BR
.029
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa Reach = Main Channel RS = 4.005 BR
.029
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

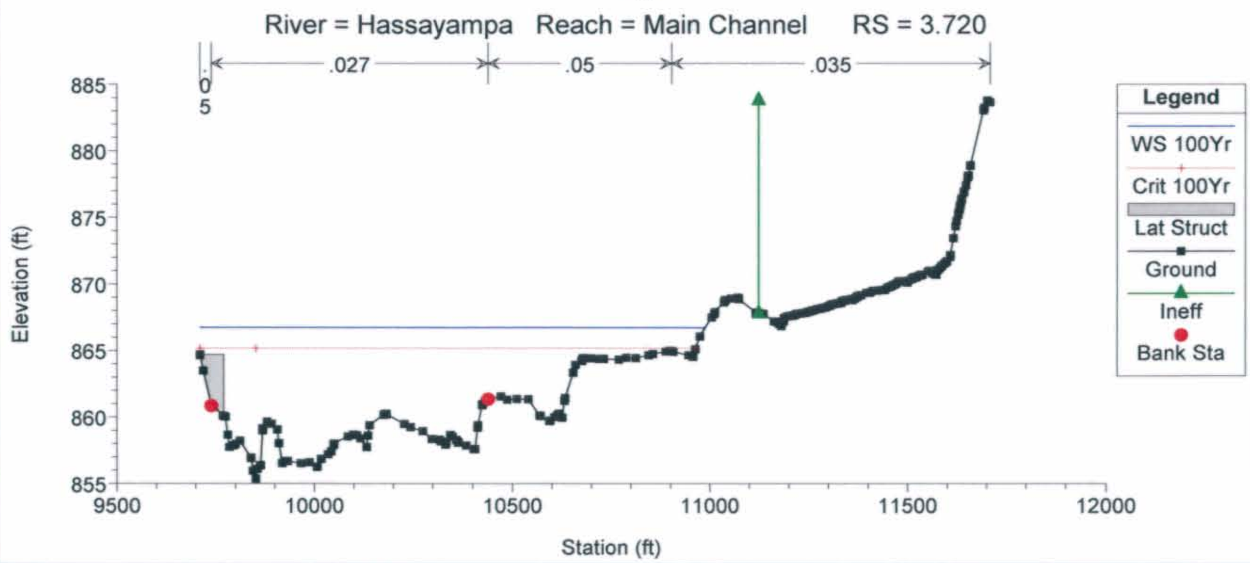

River = Hassayampa Reach = Main Channel RS = 4.000
.029
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta



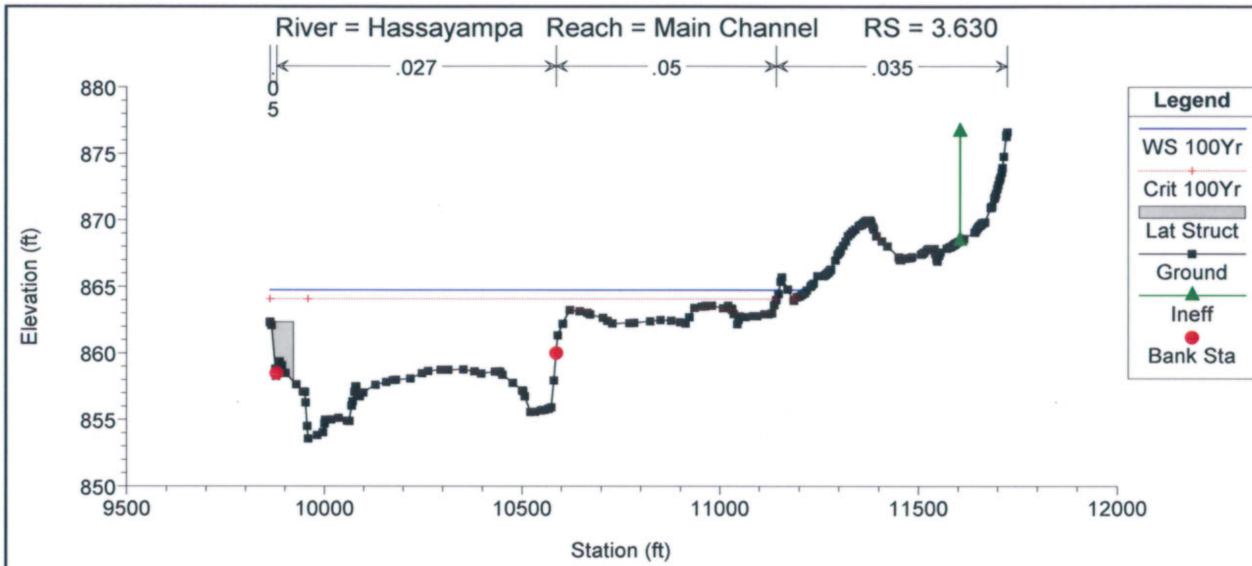
River = Hassayampa Reach = Main Channel RS = 3.910
.029
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

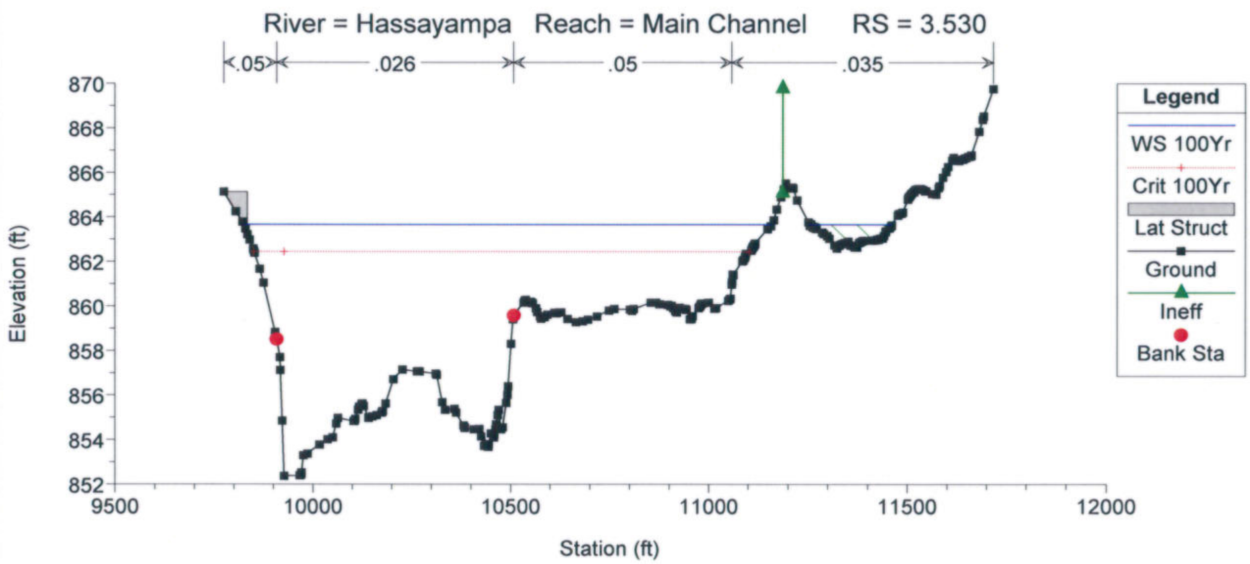


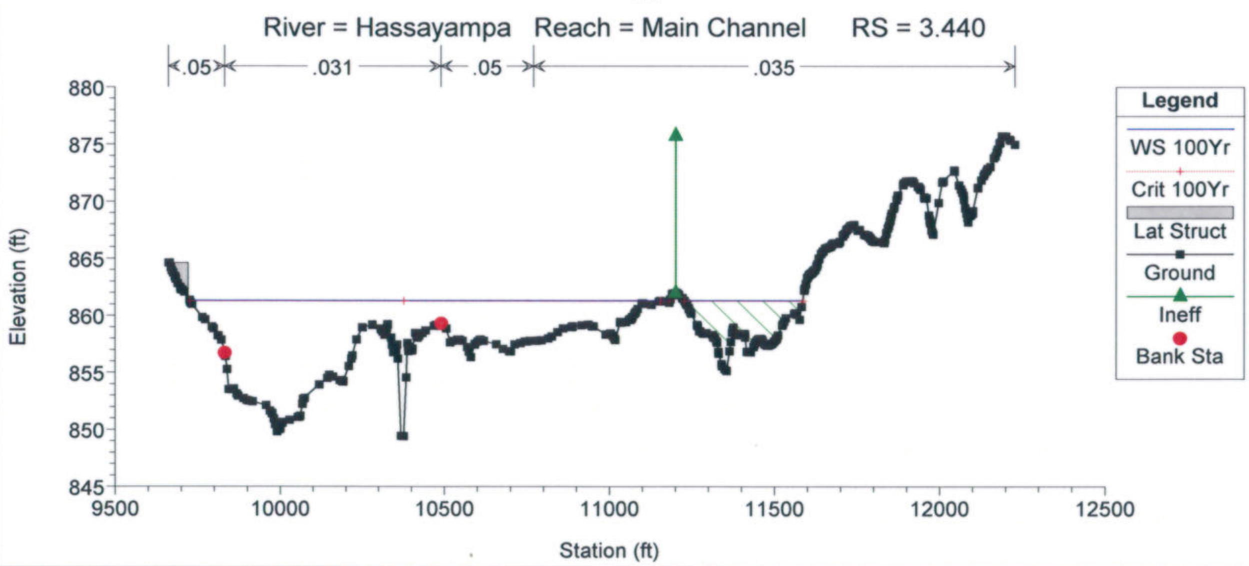
River = Hassayampa Reach = Main Channel RS = 3.810
.027
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

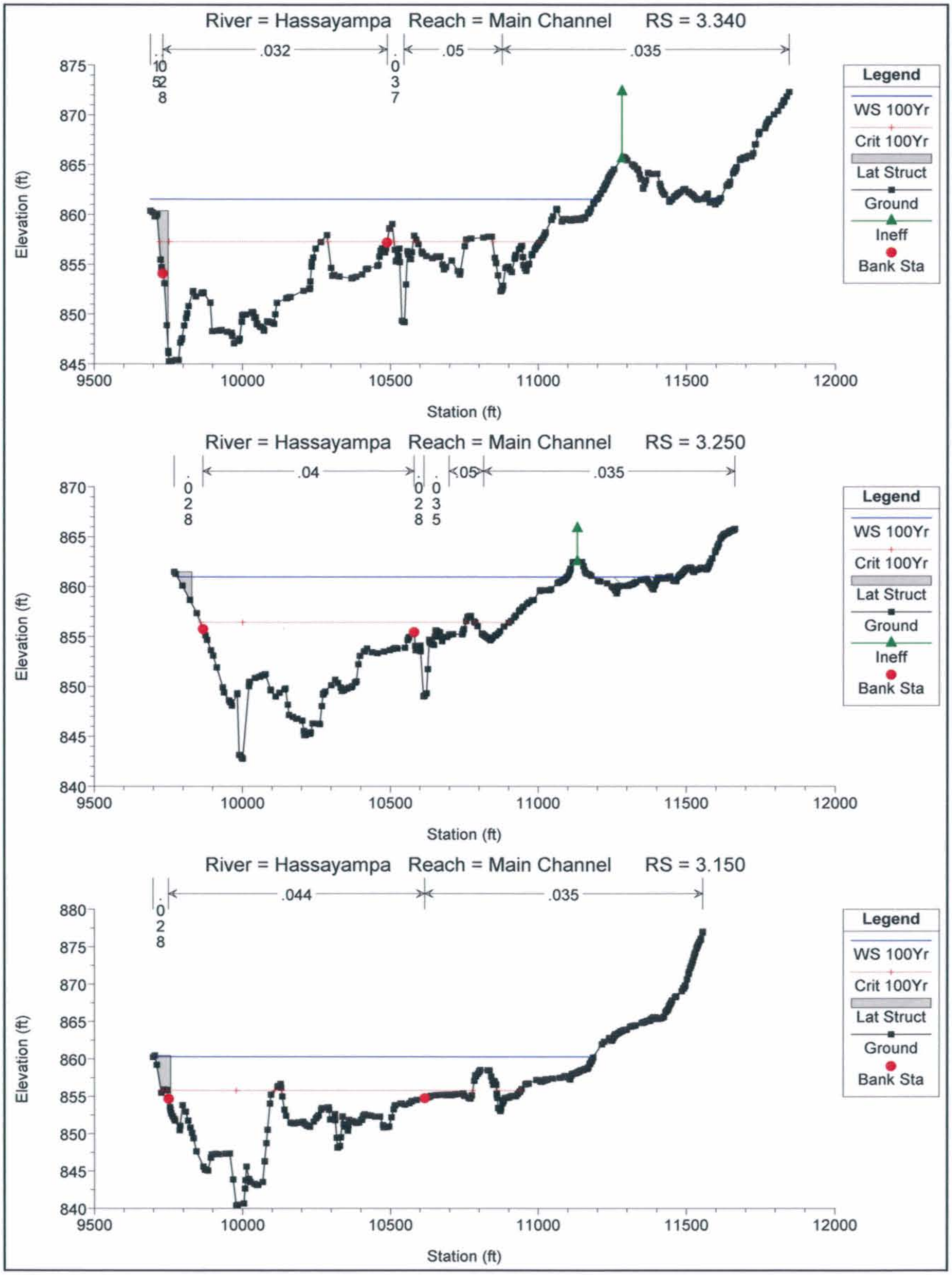


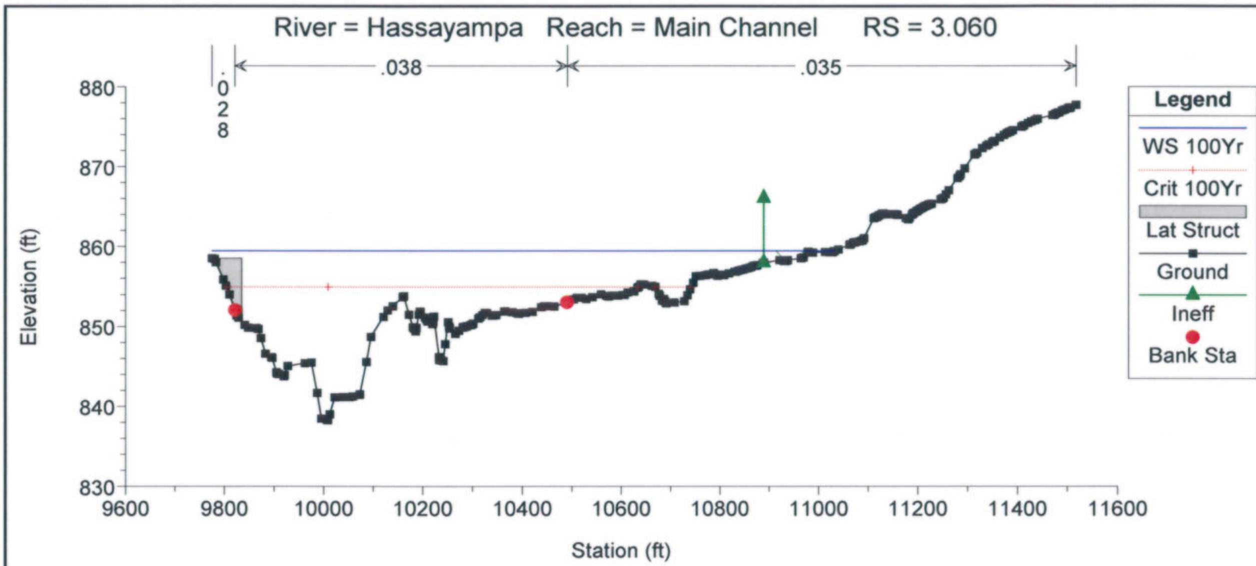
River = Hassayampa Reach = Main Channel RS = 3.720
.027
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

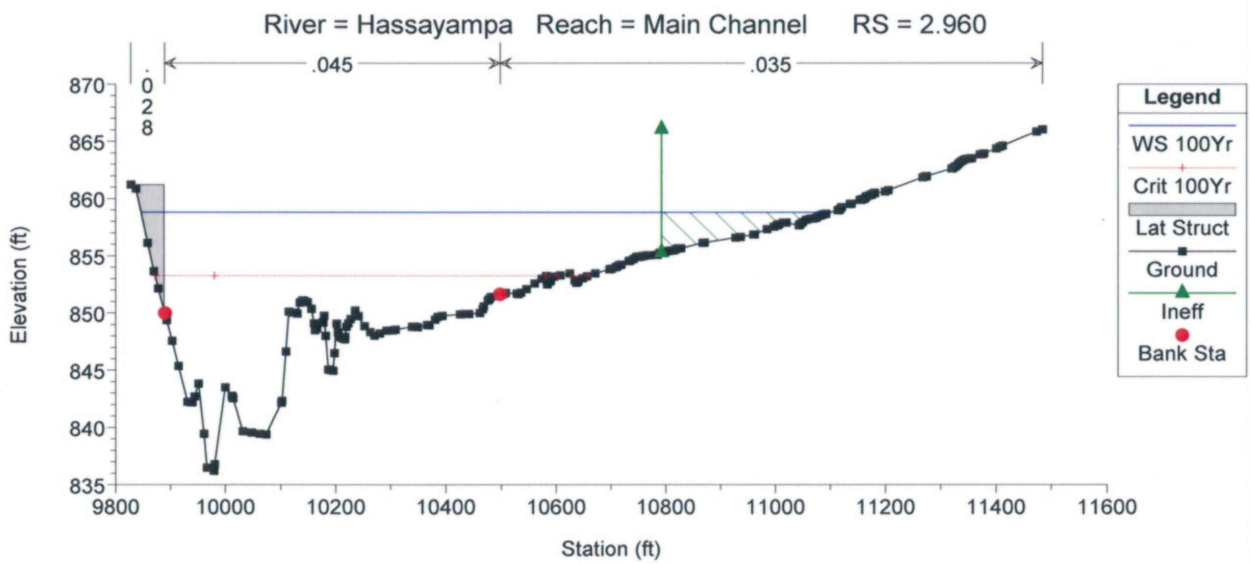

River = Hassayampa Reach = Main Channel RS = 3.630
.027
.05
.035
0
5
Elevation (ft)
880
875
870
865
860
855
850
9500
10000
10500
11000
11500
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

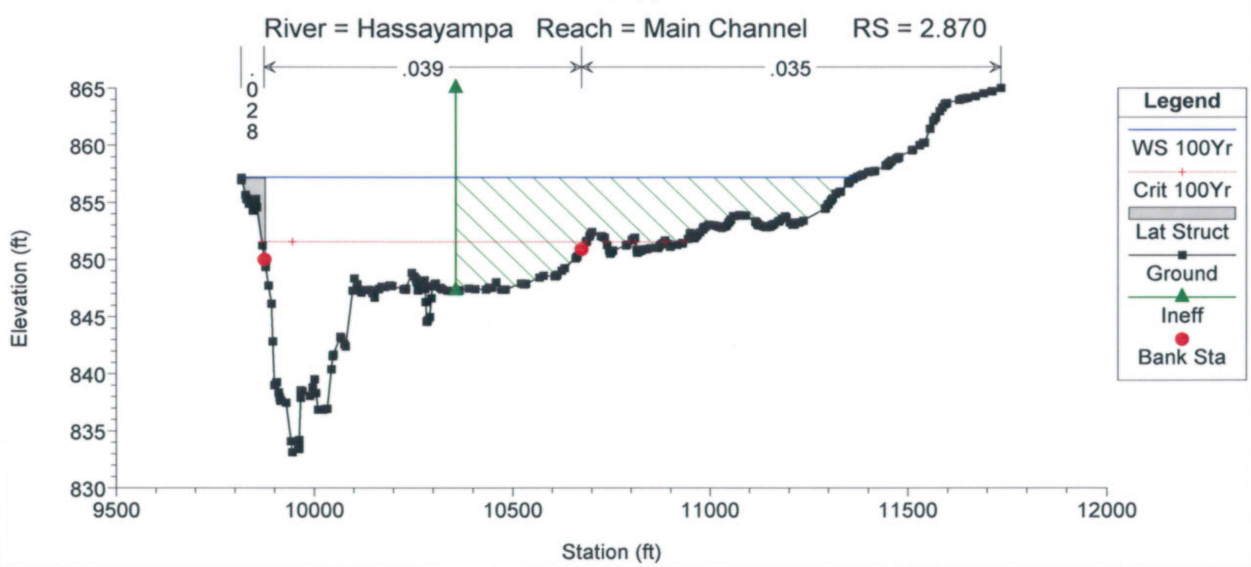

River = Hassayampa Reach = Main Channel RS = 3.530
.05
.026
.05
.035
Elevation (ft)
870
868
866
864
862
860
858
856
854
852
9500
10000
10500
11000
11500
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

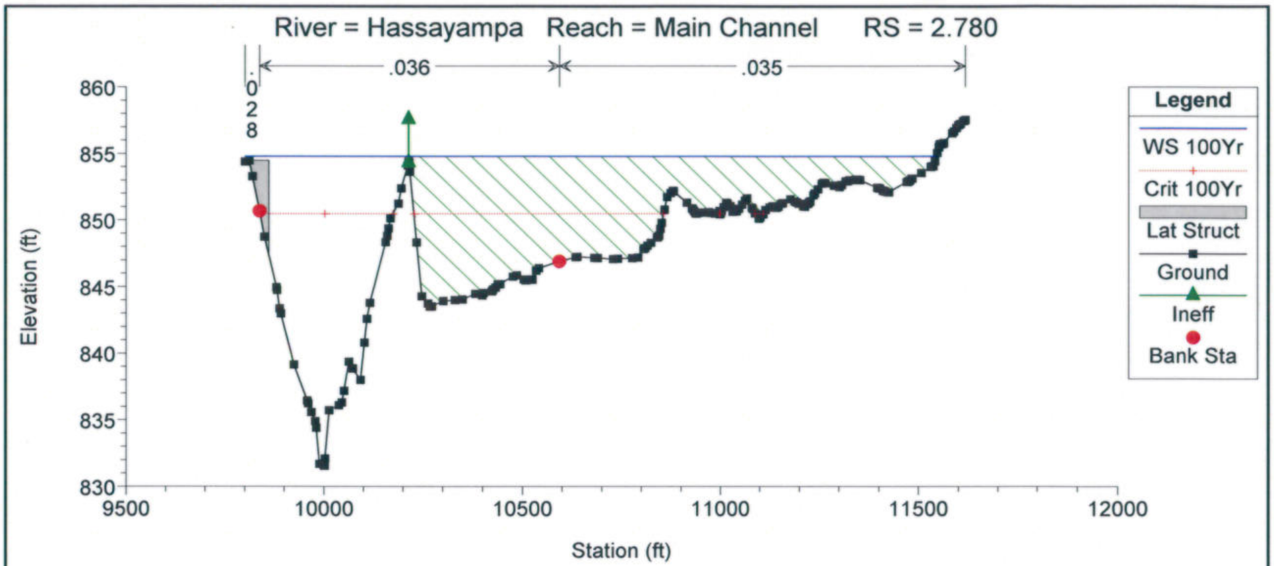

River = Hassayampa Reach = Main Channel RS = 3.440
.05
.031
.05
.035
Elevation (ft)
880
875
870
865
860
855
850
845
9500
10000
10500
11000
11500
12000
12500
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

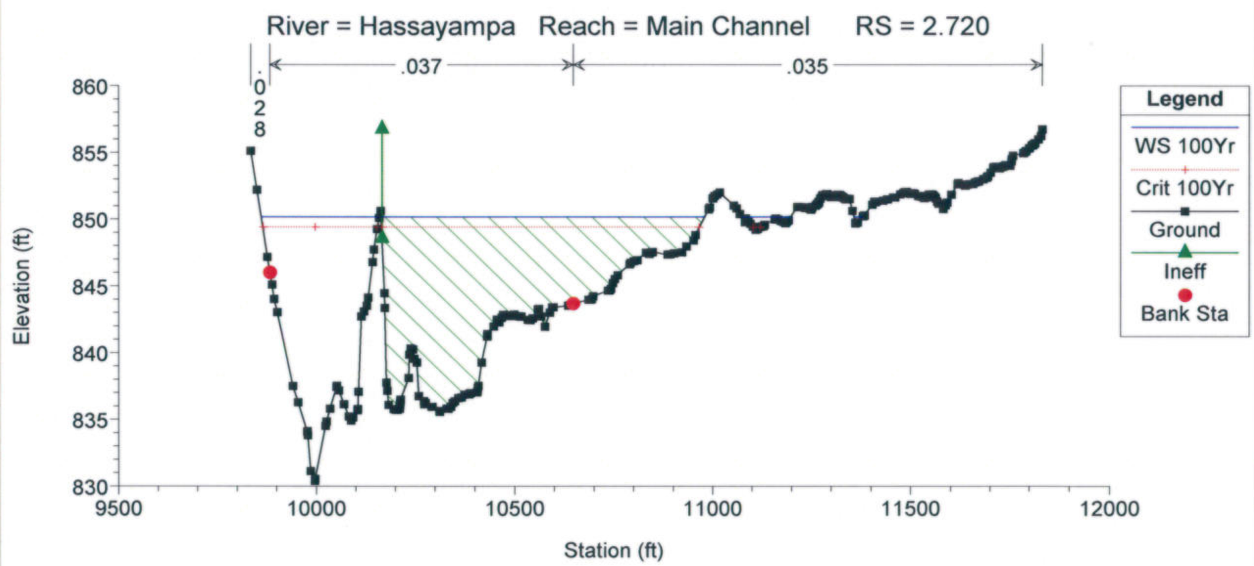

River = Hassayampa Reach = Main Channel RS = 3.340
.032
.05
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 3.250
.04
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Main Channel RS = 3.150
.044
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Bank Sta

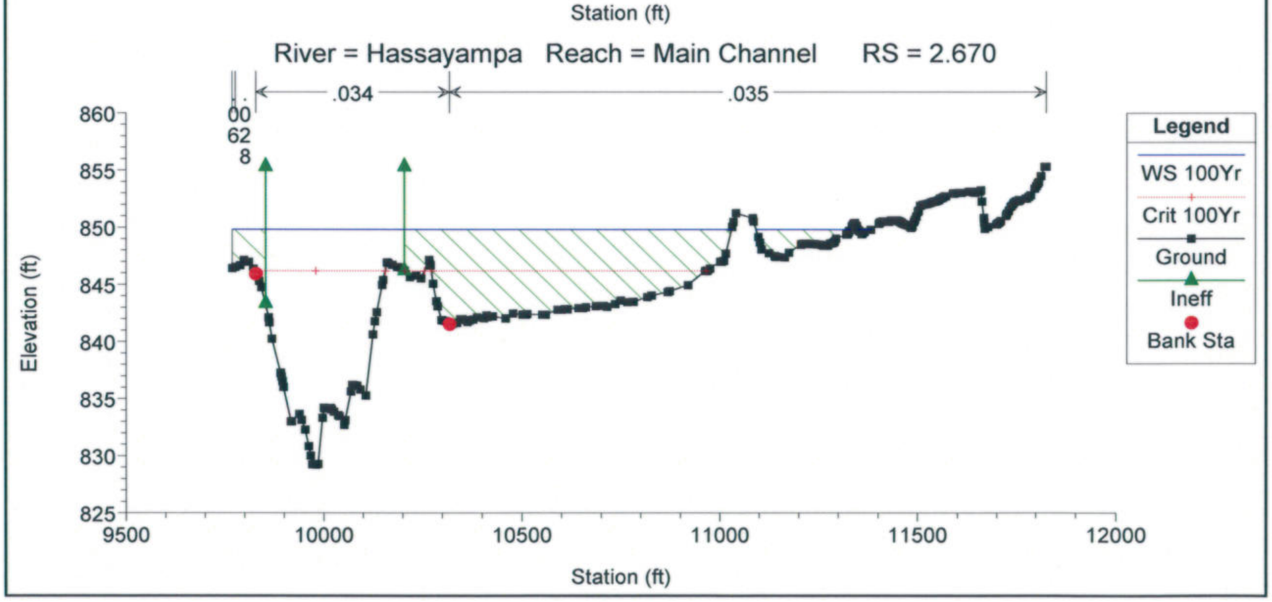

River = Hassayampa Reach = Main Channel RS = 3.060
.028
.038
.035
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
880
870
860
850
840
830
9600
9800
10000
10200
10400
10600
10800
11000
11200
11400
11600

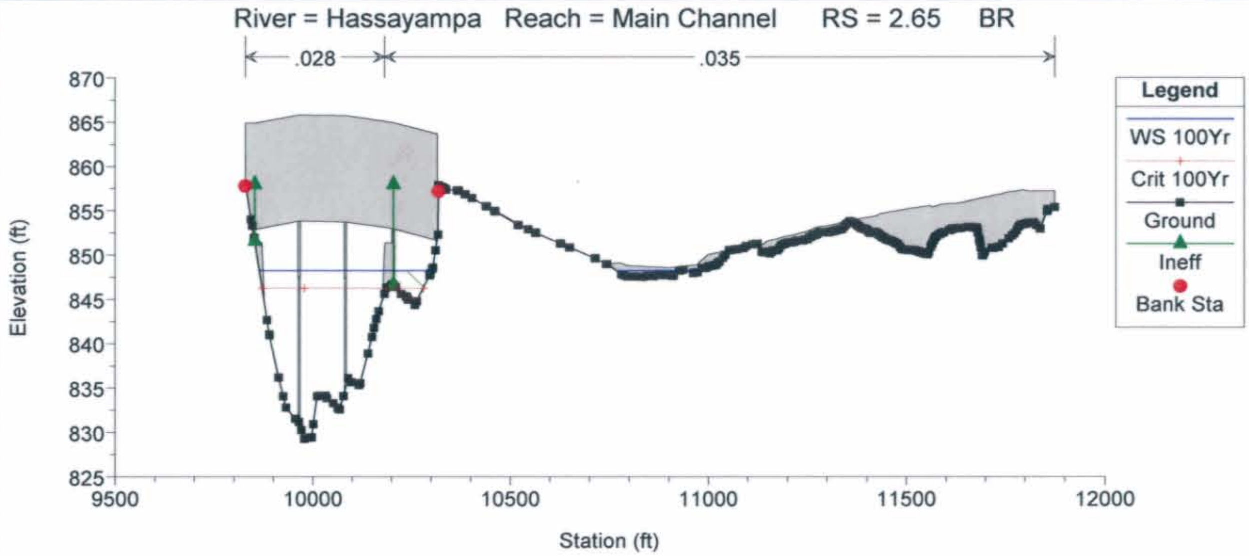

River = Hassayampa Reach = Main Channel RS = 2.960
.028
.045
.035
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
870
865
860
855
850
845
840
835
9800
10000
10200
10400
10600
10800
11000
11200
11400
11600

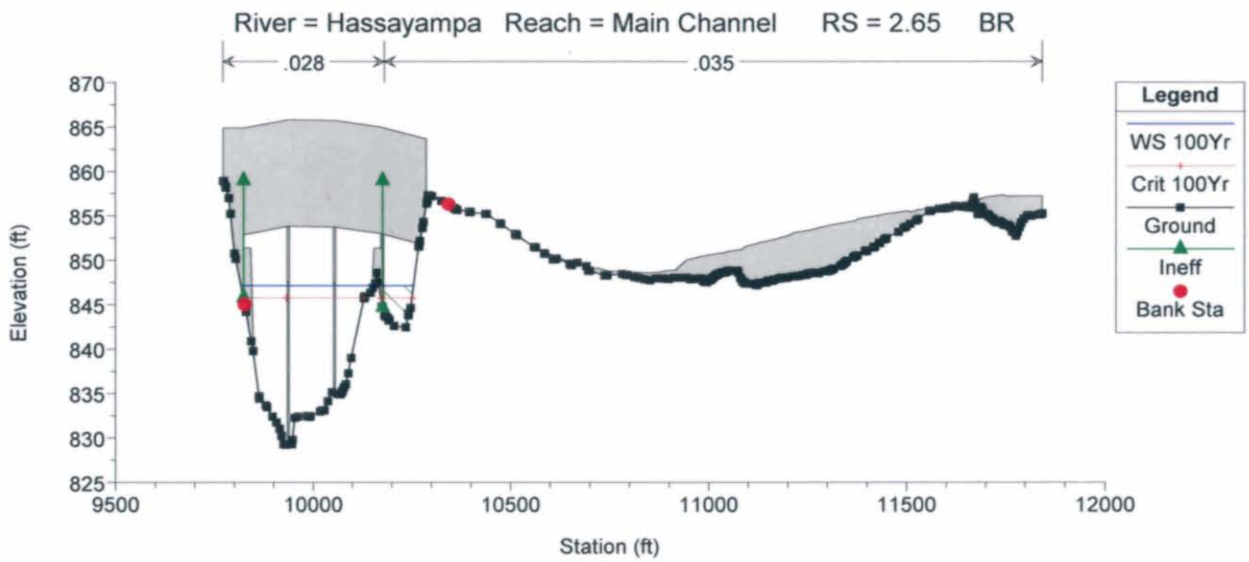

River = Hassayampa Reach = Main Channel RS = 2.870
.028
.039
.035
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
865
860
855
850
845
840
835
830
9500
10000
10500
11000
11500
12000

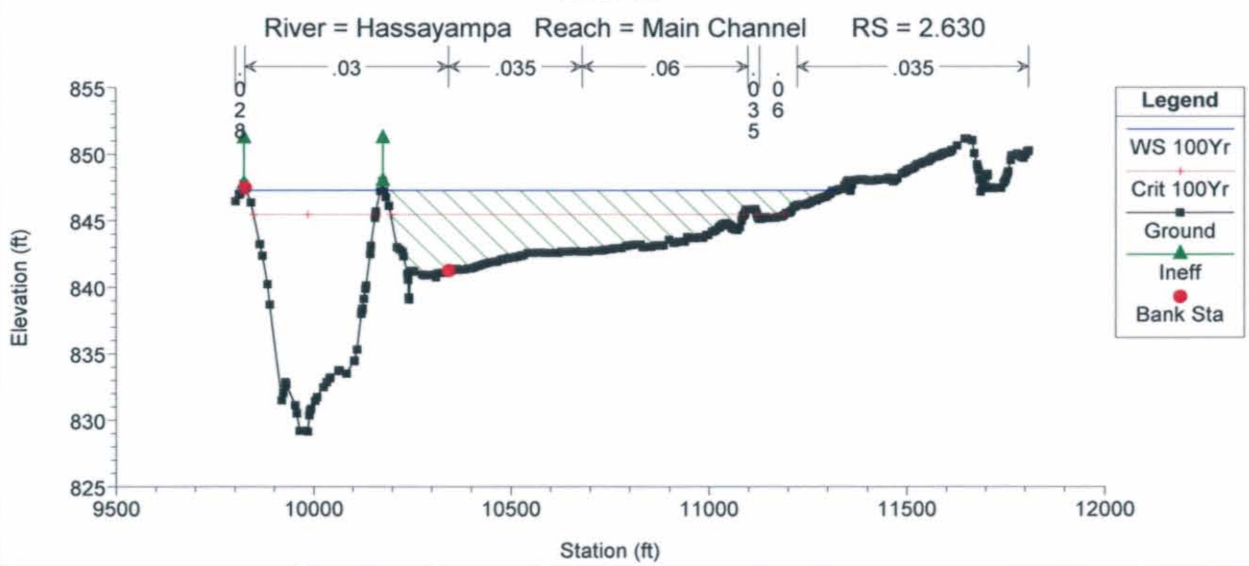

River = Hassayampa Reach = Main Channel RS = 2.780
.028
.036
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Ineff
Bank Sta

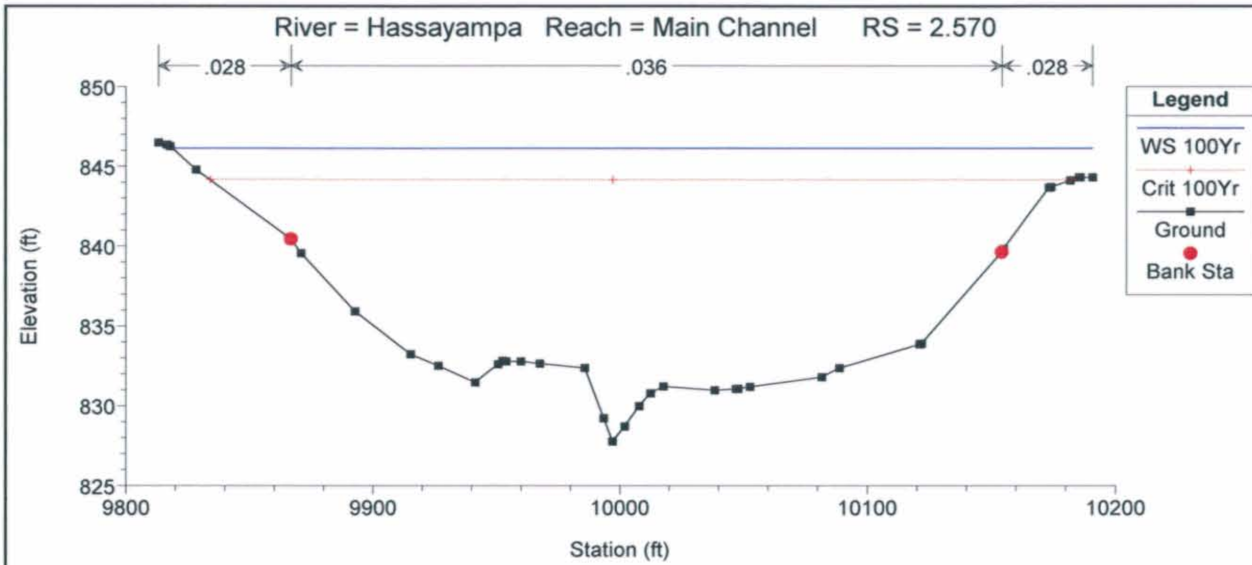

River = Hassayampa Reach = Main Channel RS = 2.720
.028
.037
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

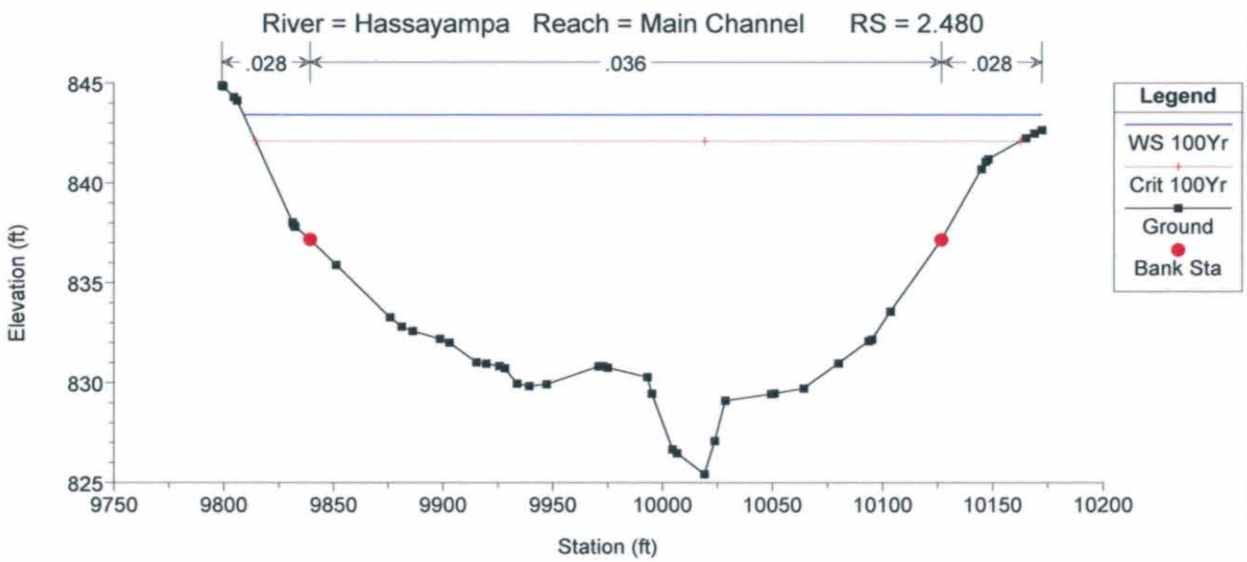

River = Hassayampa Reach = Main Channel RS = 2.670
.034
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

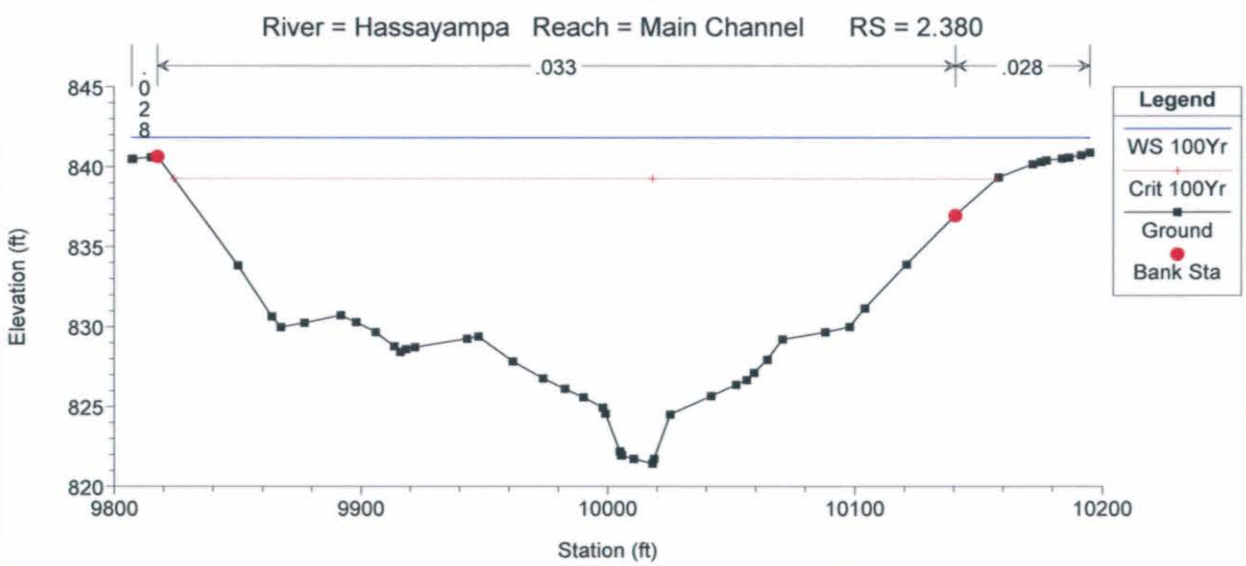

River = Hassayampa Reach = Main Channel RS = 2.65 BR
.028
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

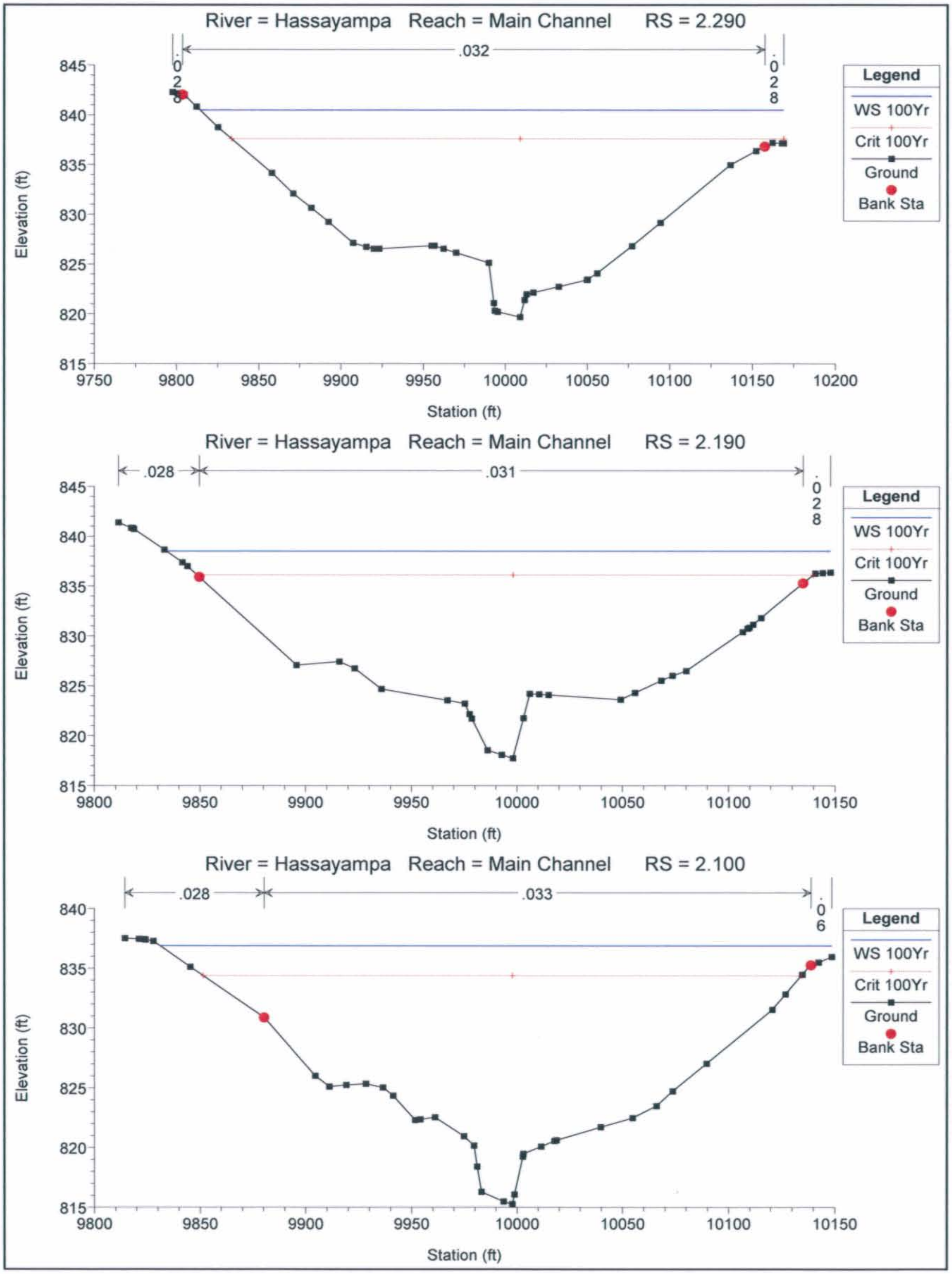

River = Hassayampa Reach = Main Channel RS = 2.65 BR
.028
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

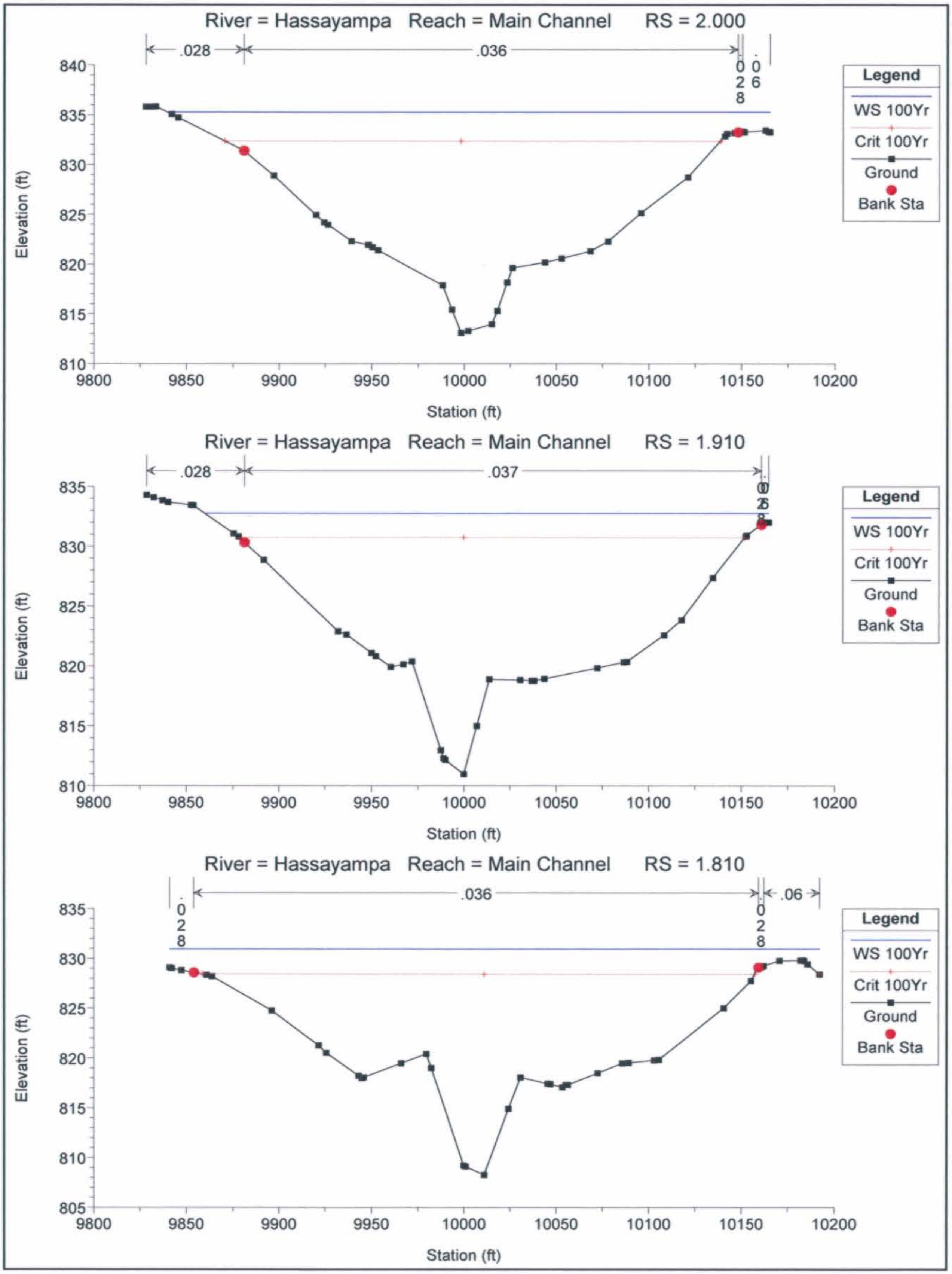

River = Hassayampa Reach = Main Channel RS = 2.630
.028
.03
.035
.06
.035
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

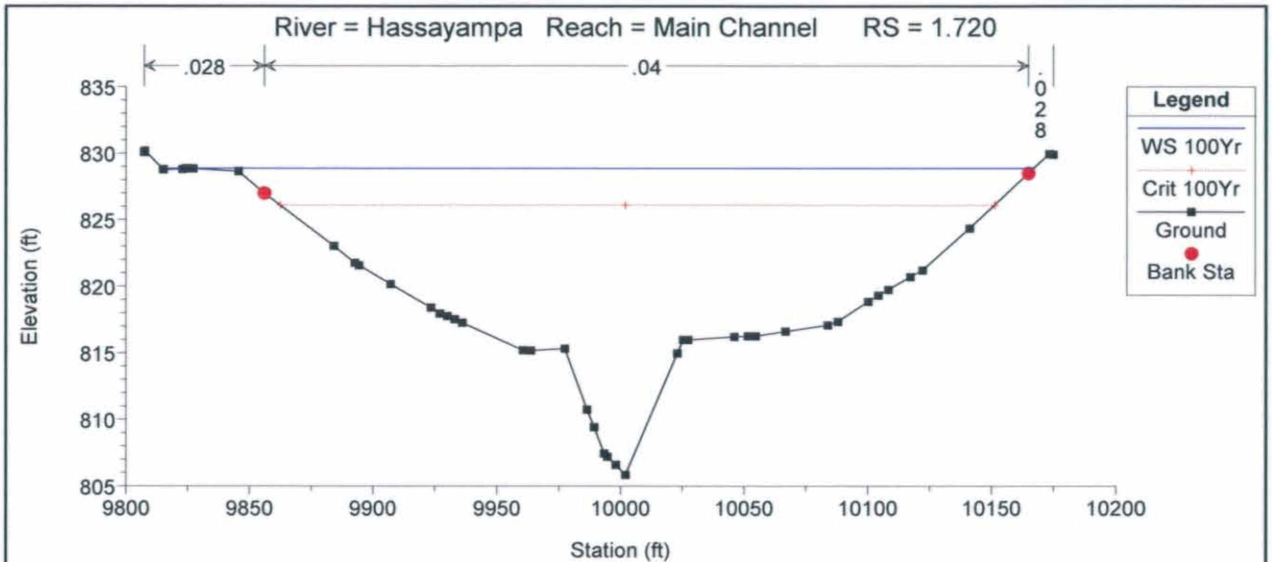

River = Hassayampa Reach = Main Channel RS = 2.570
.028
.036
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

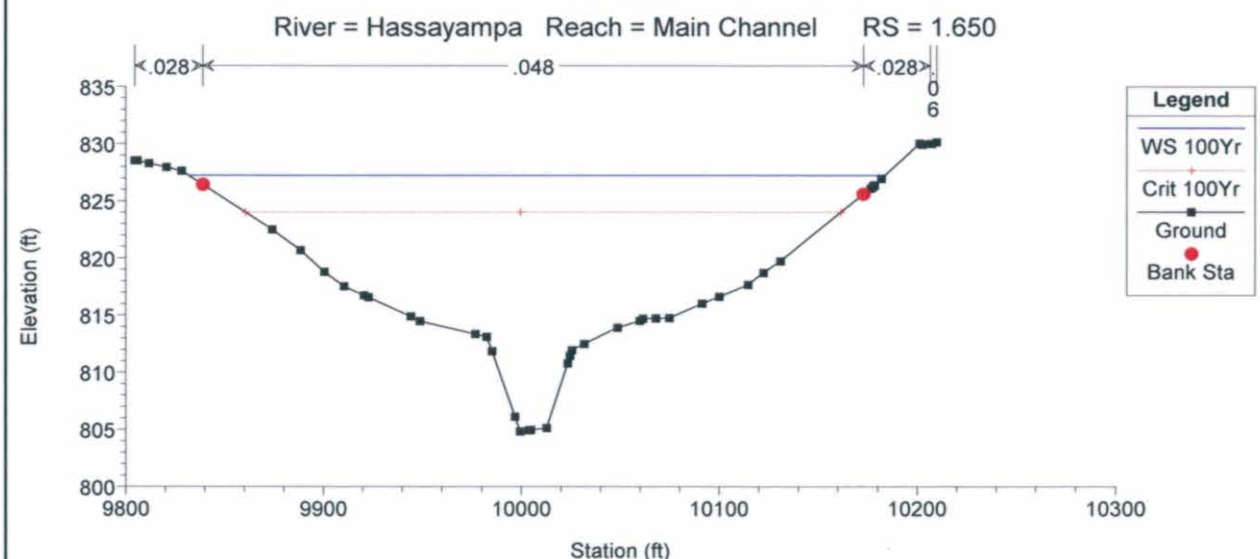

River = Hassayampa Reach = Main Channel RS = 2.480
.028
.036
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

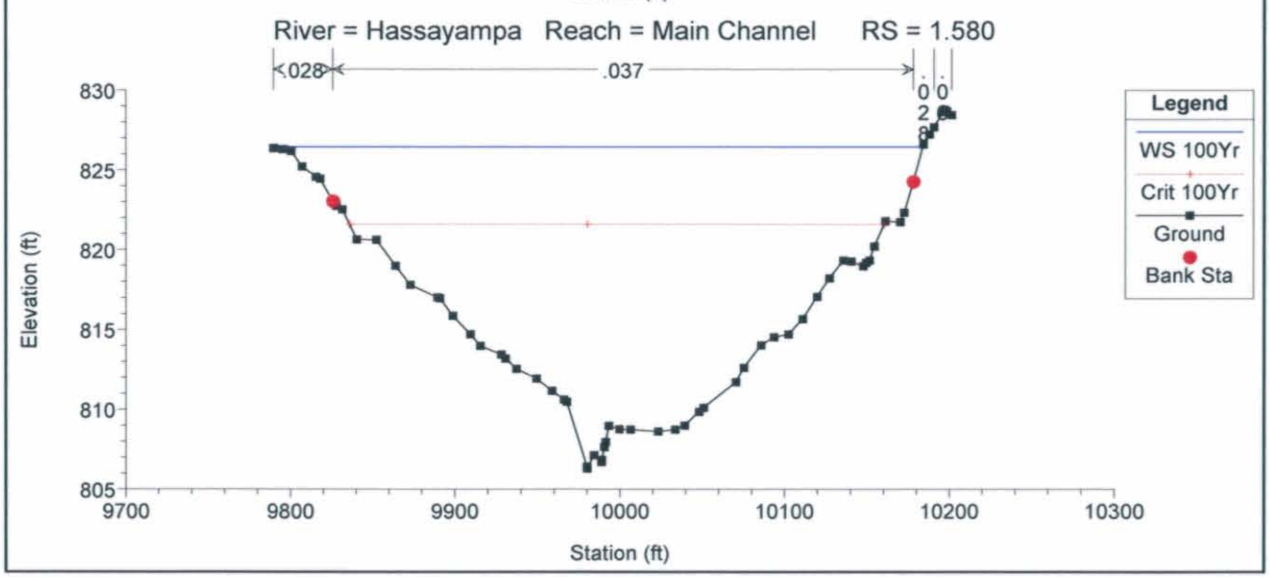

River = Hassayampa Reach = Main Channel RS = 2.380
.028
.033
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

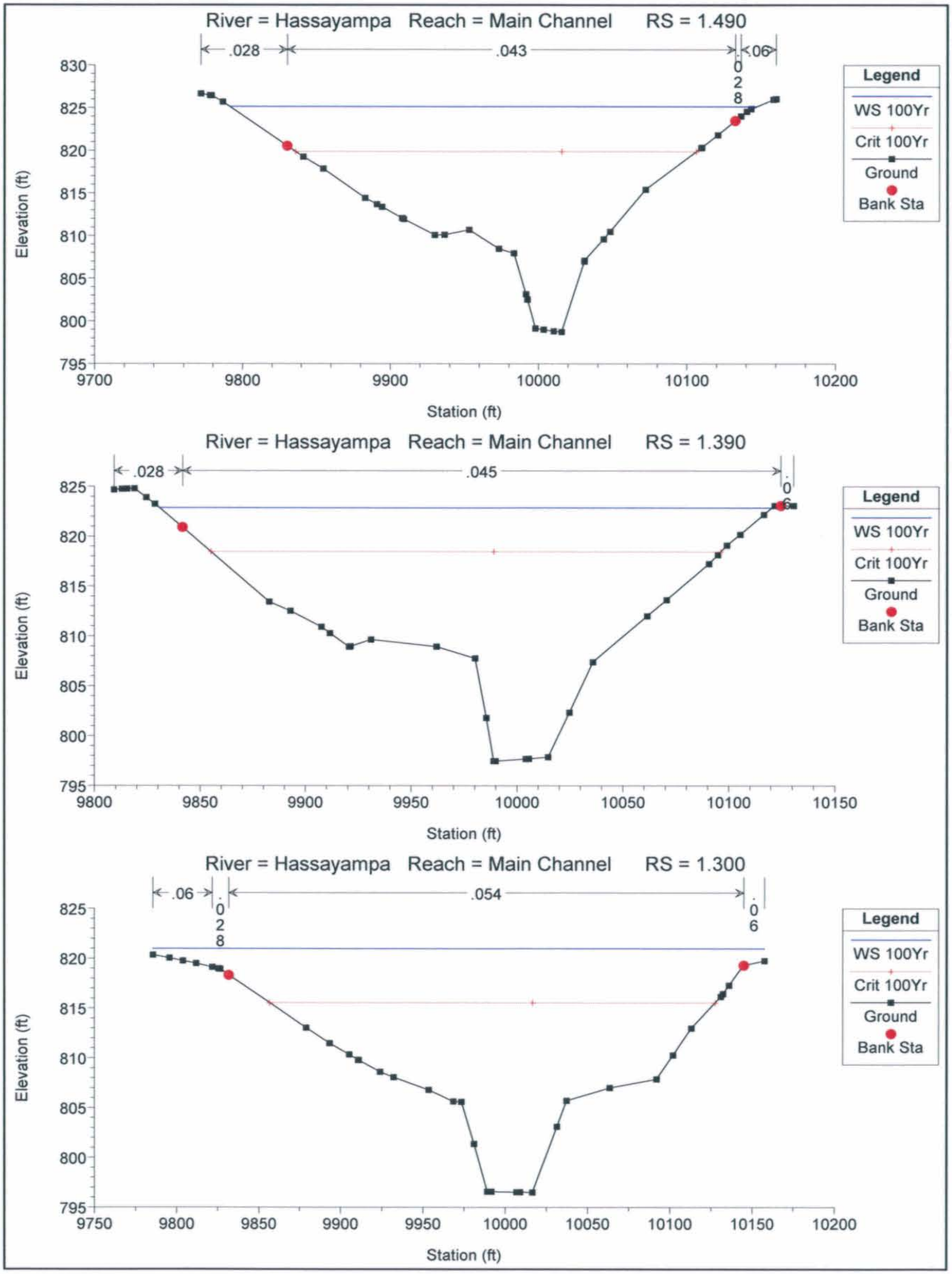

River = Hassayampa Reach = Main Channel RS = 2.290
.032
.028
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 2.190
.028
.031
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 2.100
.028
.033
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 2.000
.028
.036
.028
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 1.910
.028
.037
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Main Channel RS = 1.810
.028
.036
.028
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Main Channel RS = 1.720
.028
.04
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

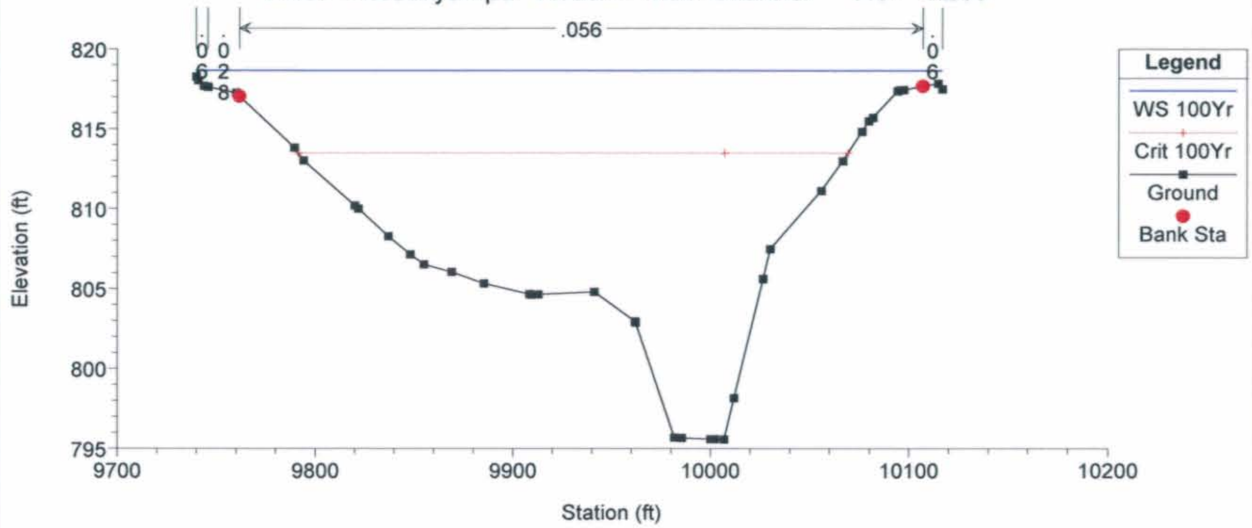

River = Hassayampa Reach = Main Channel RS = 1.650
.028
.048
.028
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta


River = Hassayampa Reach = Main Channel RS = 1.580
.028
.037
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

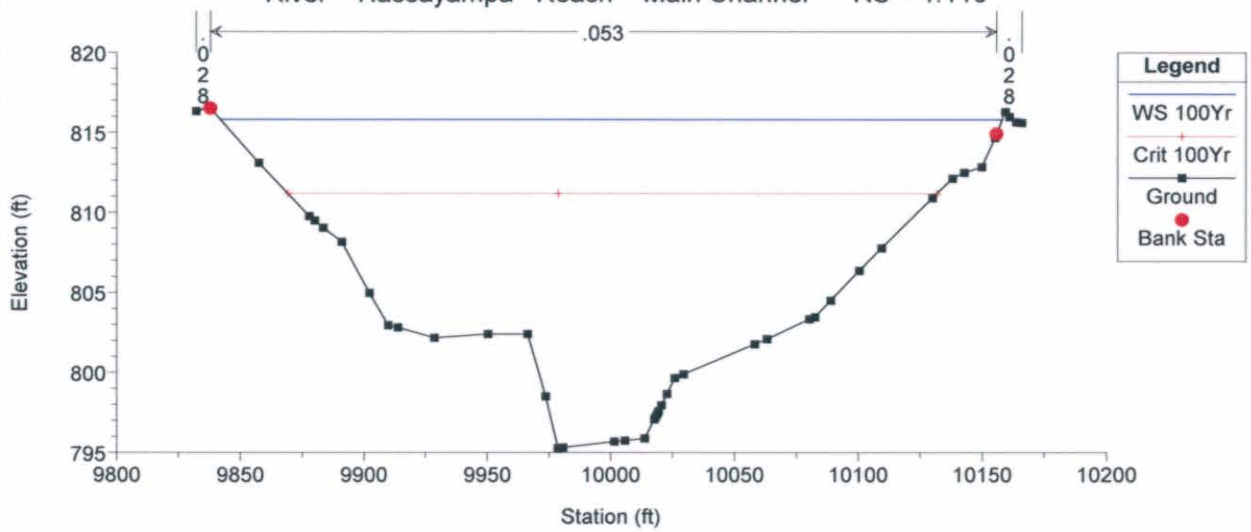


River = Hassayampa Reach = Main Channel RS = 1.490
.028
.043
.028
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 1.390
.028
.045
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
River = Hassayampa Reach = Main Channel RS = 1.300
.06
.028
.054
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

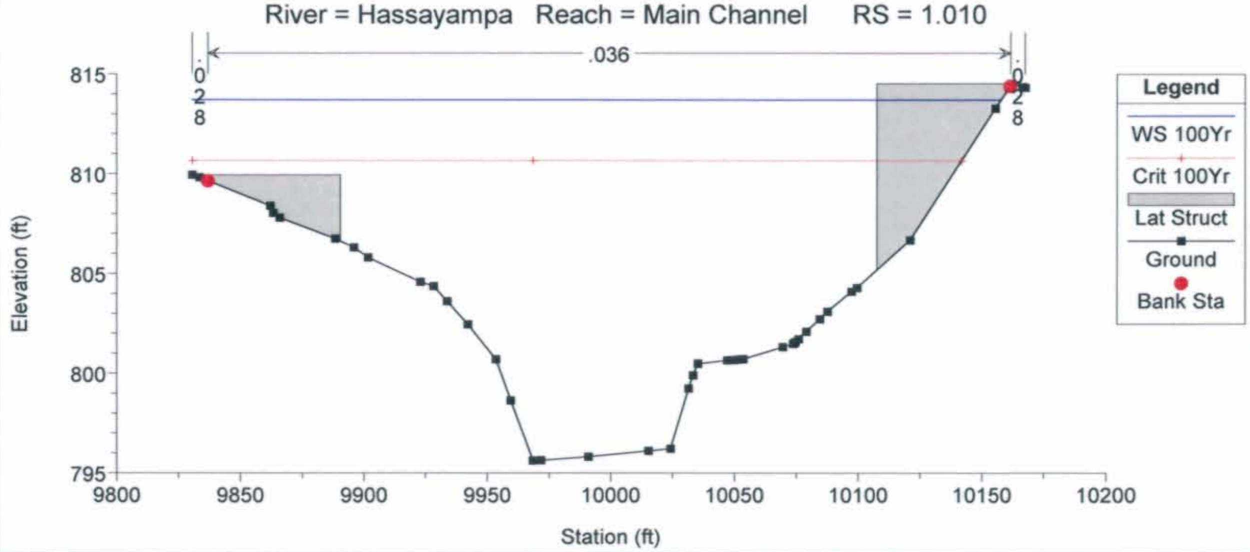
River = Hassayampa Reach = Main Channel RS = 1.200

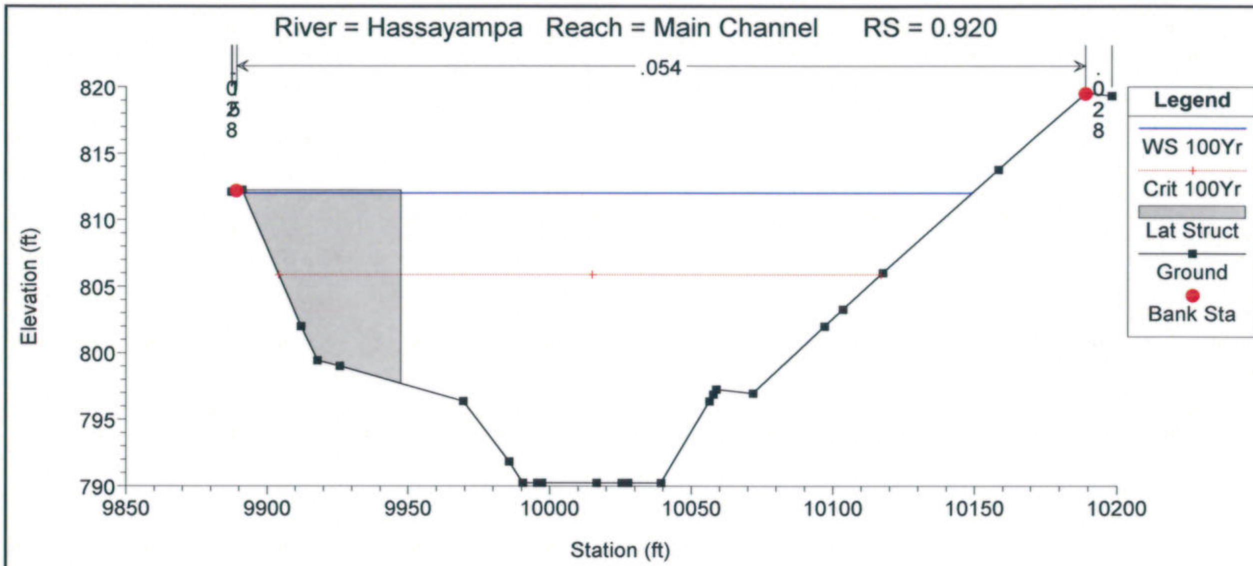


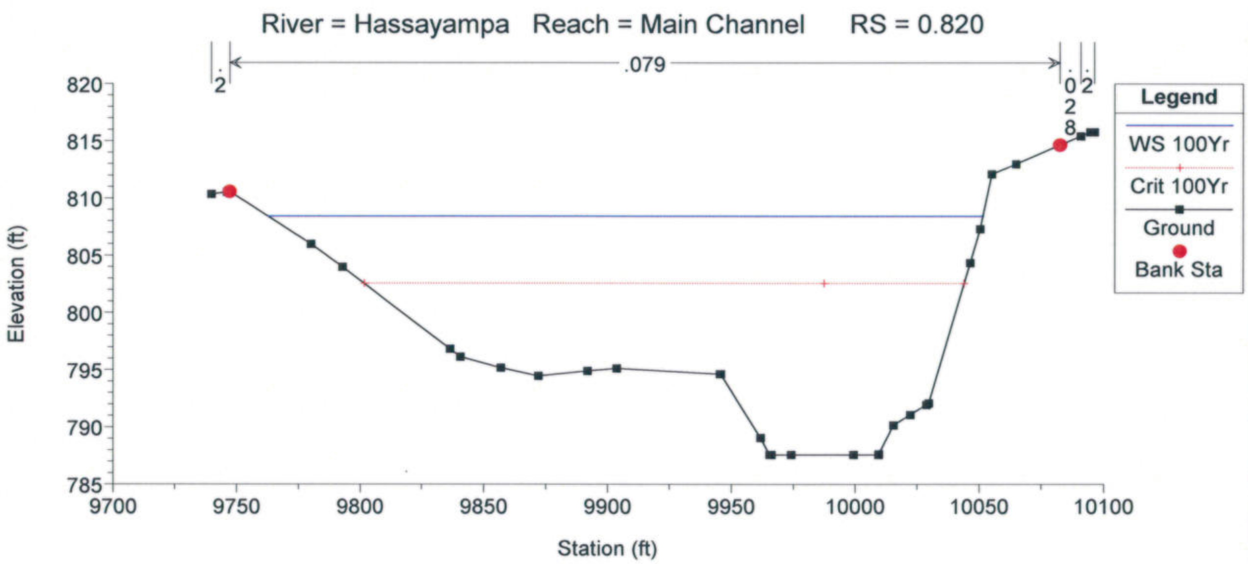
River = Hassayampa Reach = Main Channel RS = 1.110

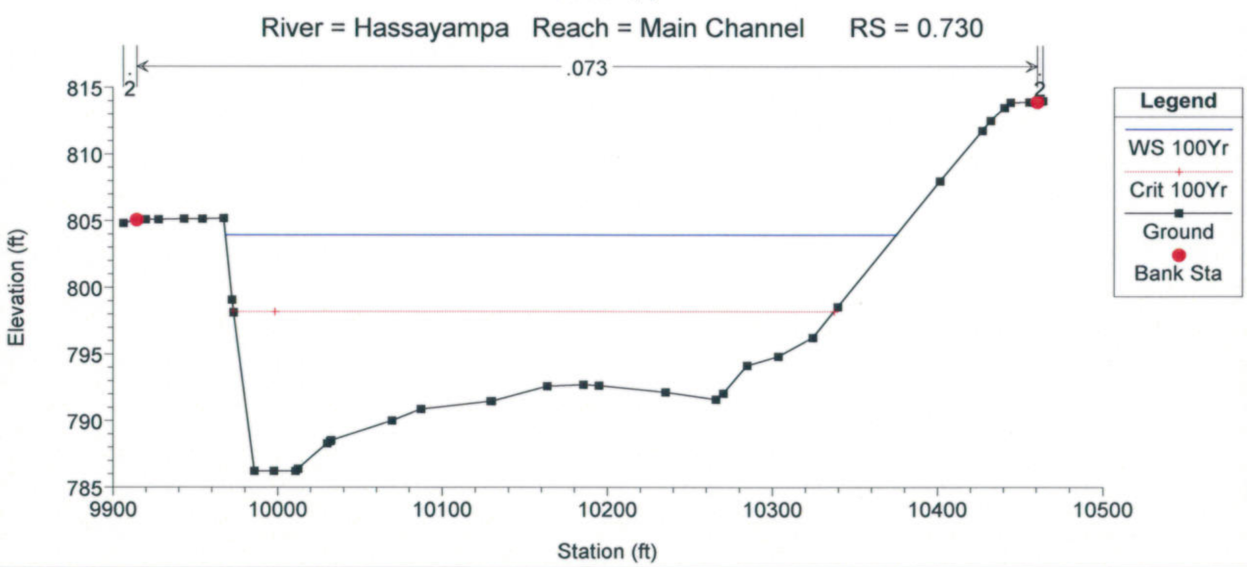


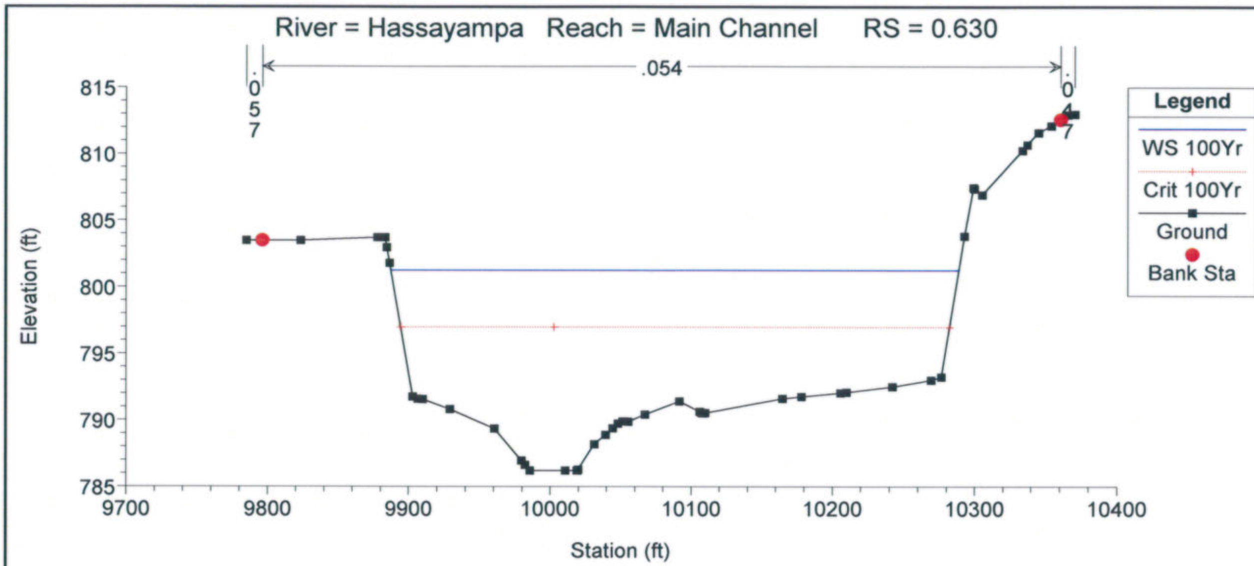
River = Hassayampa Reach = Main Channel RS = 1.010

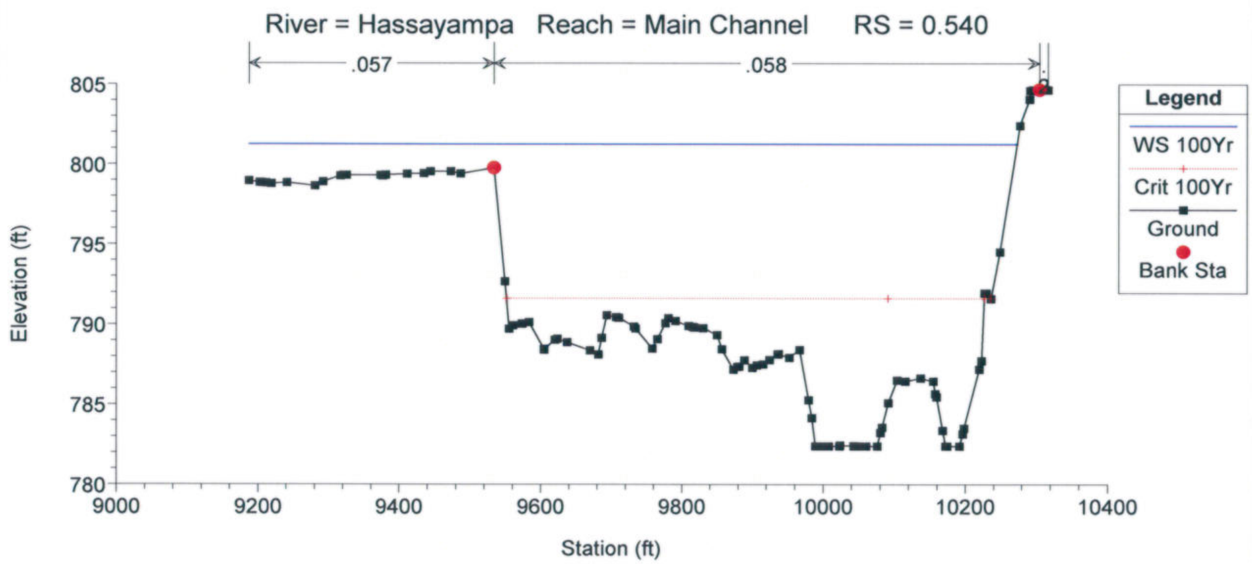


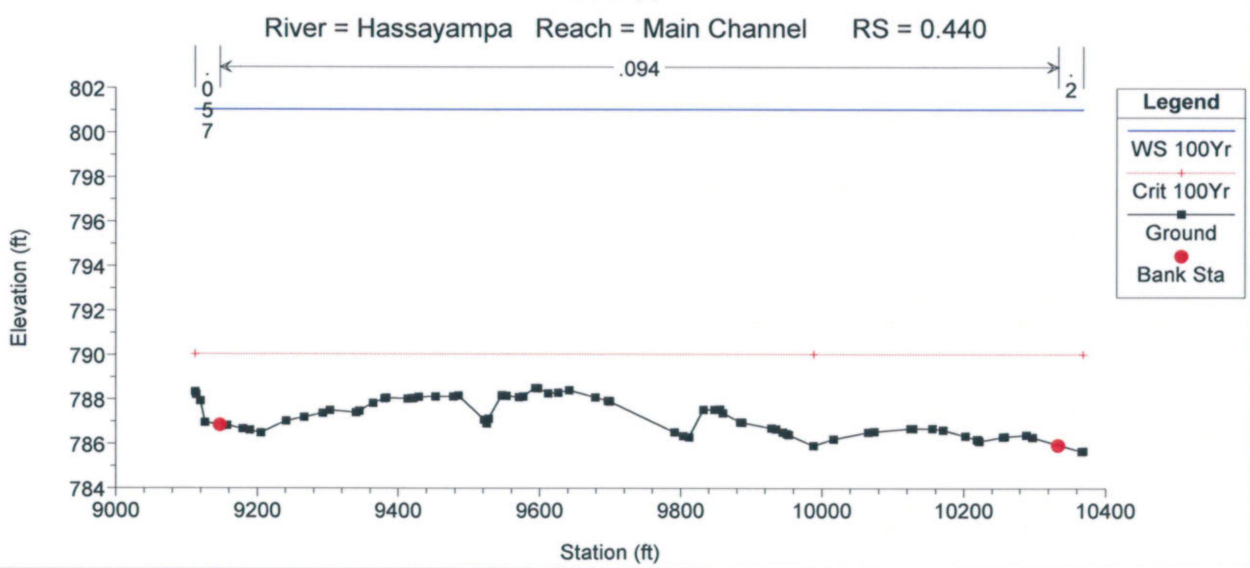

River = Hassayampa Reach = Main Channel RS = 0.920
.054
0 2 5 8
0 2 8
Legend
WS 100Yr
Crit 100Yr
Lat Struct
Ground
Bank Sta
Elevation (ft)
820
815
810
805
800
795
790
9850
9900
9950
10000
10050
10100
10150
10200
Station (ft)

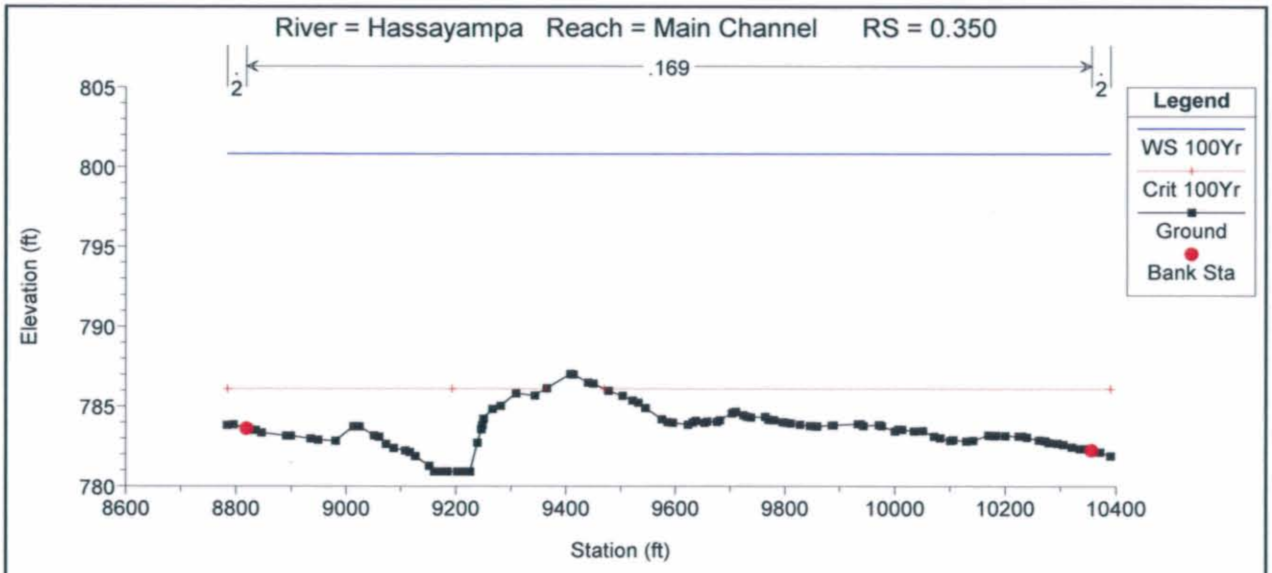

River = Hassayampa Reach = Main Channel RS = 0.820
.2
.079
0 2 8
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
820
815
810
805
800
795
790
785
9700
9750
9800
9850
9900
9950
10000
10050
10100
Station (ft)


River = Hassayampa Reach = Main Channel RS = 0.730
.2
.073
2
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
815
810
805
800
795
790
785
9900
10000
10100
10200
10300
10400
10500
Station (ft)

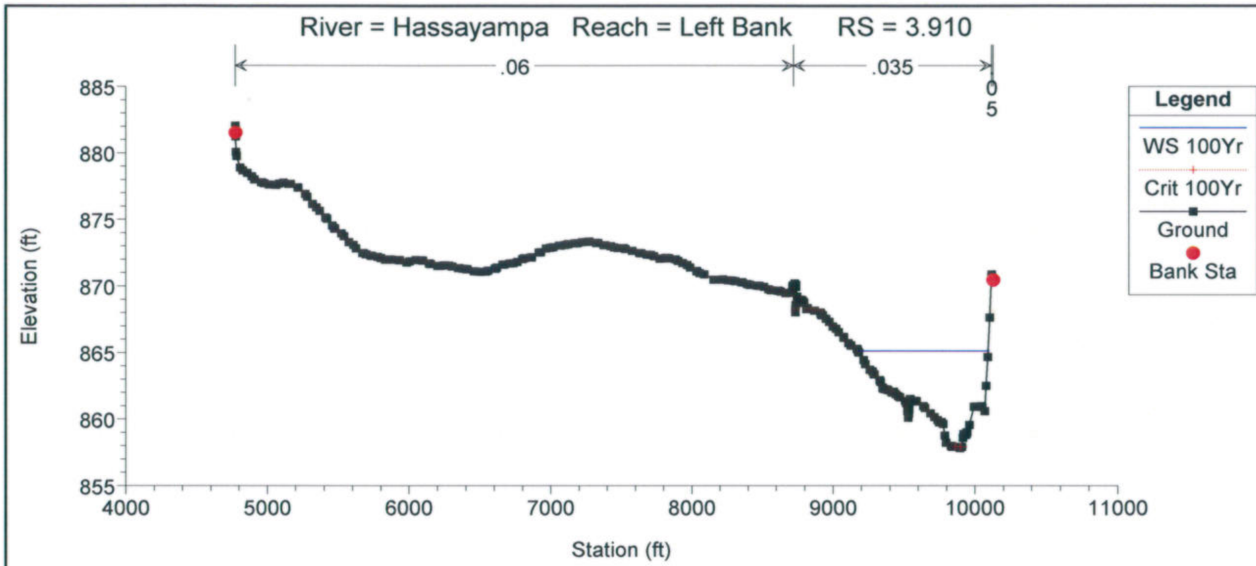

River = Hassayampa Reach = Main Channel RS = 0.630
.057
.054
.047
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
815
810
805
800
795
790
785
9700
9800
9900
10000
10100
10200
10300
10400
Station (ft)

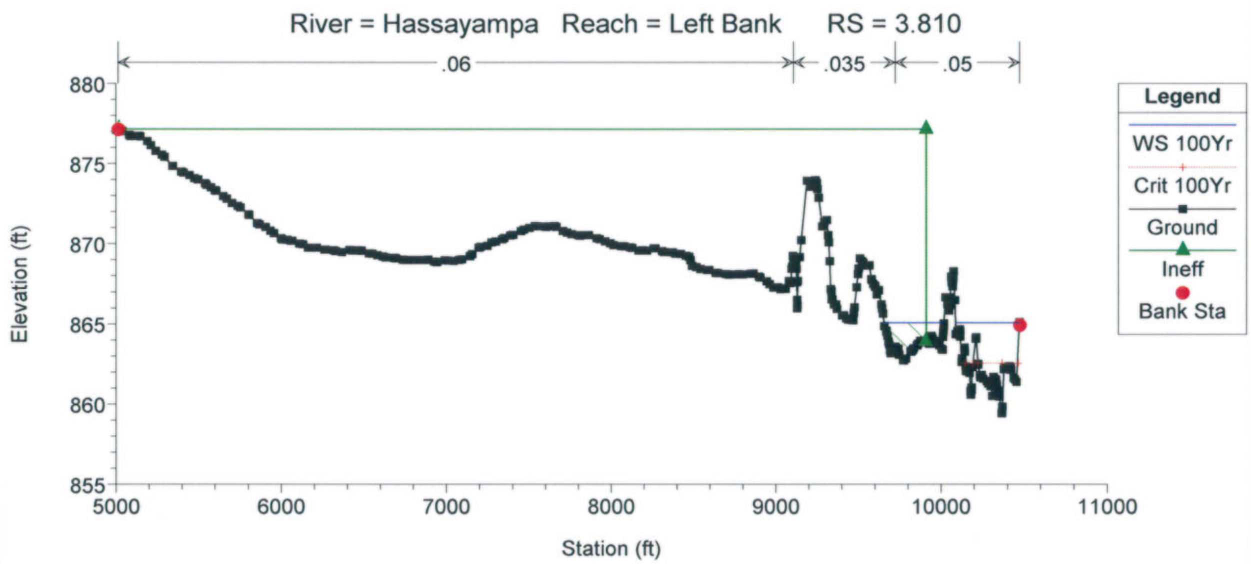

River = Hassayampa Reach = Main Channel RS = 0.540
.057
.058
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
805
800
795
790
785
780
9000
9200
9400
9600
9800
10000
10200
10400
Station (ft)

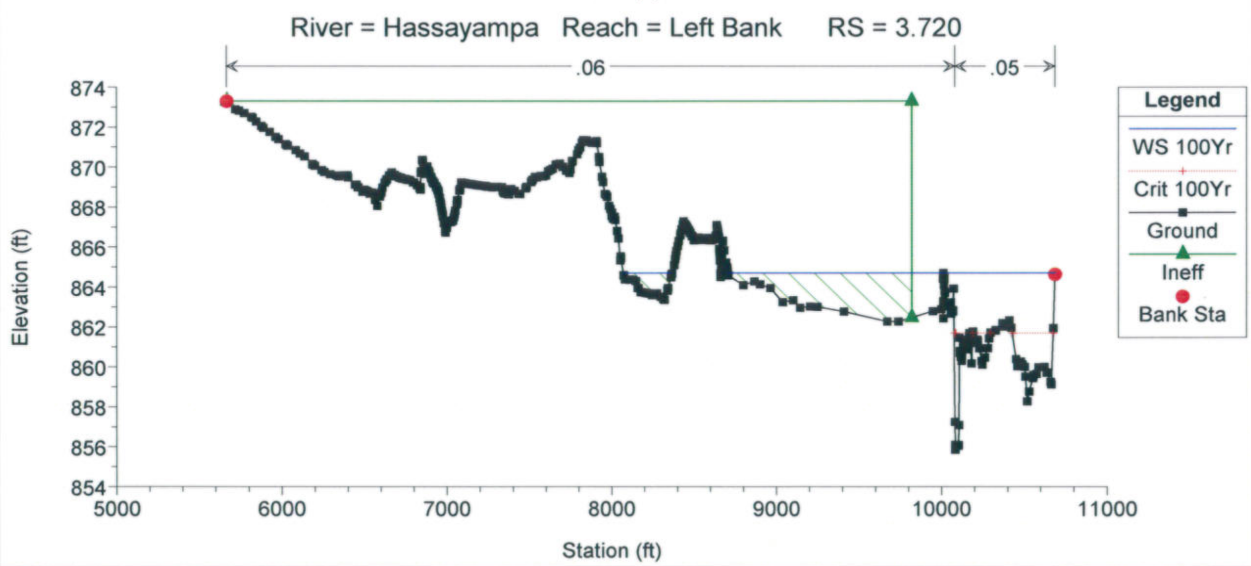

River = Hassayampa Reach = Main Channel RS = 0.440
.057
.094
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
802
800
798
796
794
792
790
788
786
784
9000
9200
9400
9600
9800
10000
10200
10400
Station (ft)

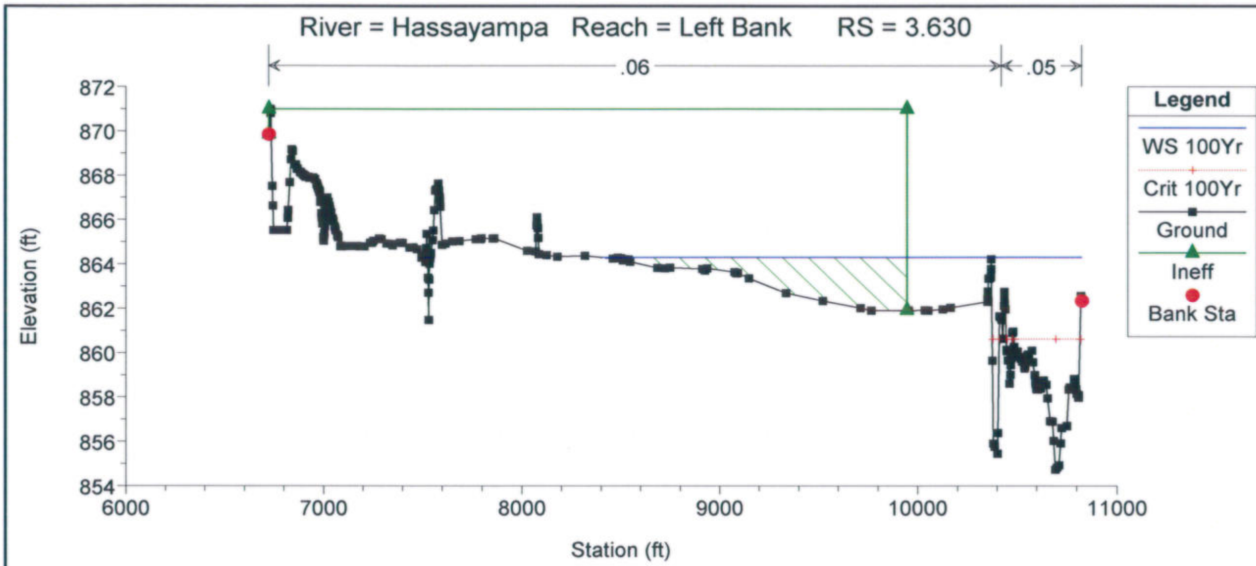


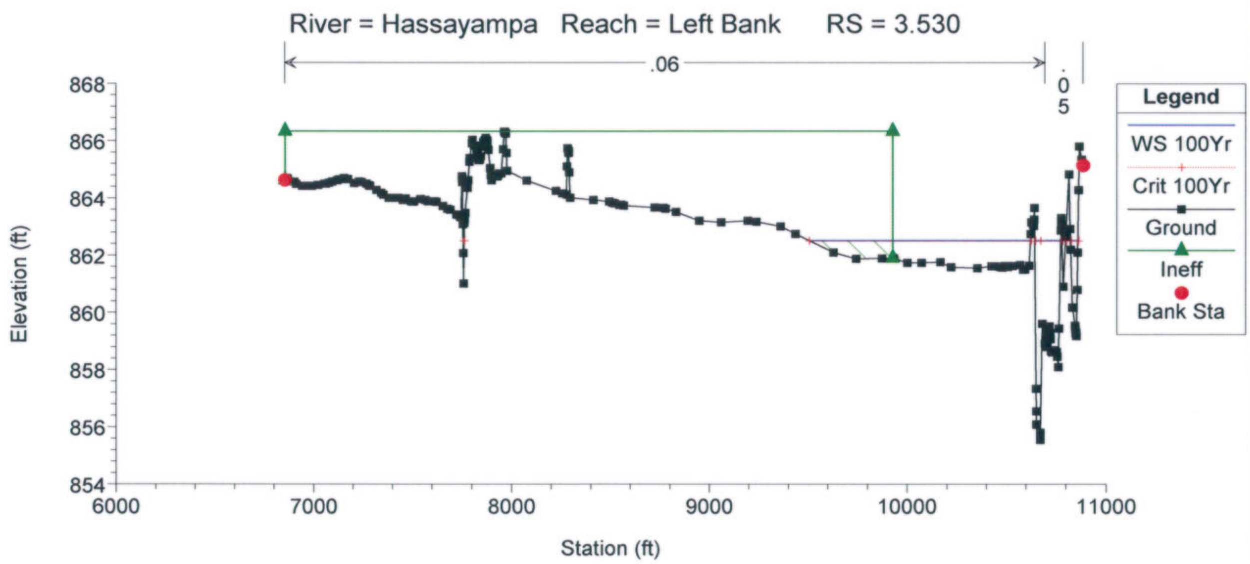
River = Hassayampa   Reach = Main Channel   RS = 0.350
.2
.169
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
805
800
795
790
785
780
8600
8800
9000
9200
9400
9600
9800
10000
10200
10400
Station (ft)

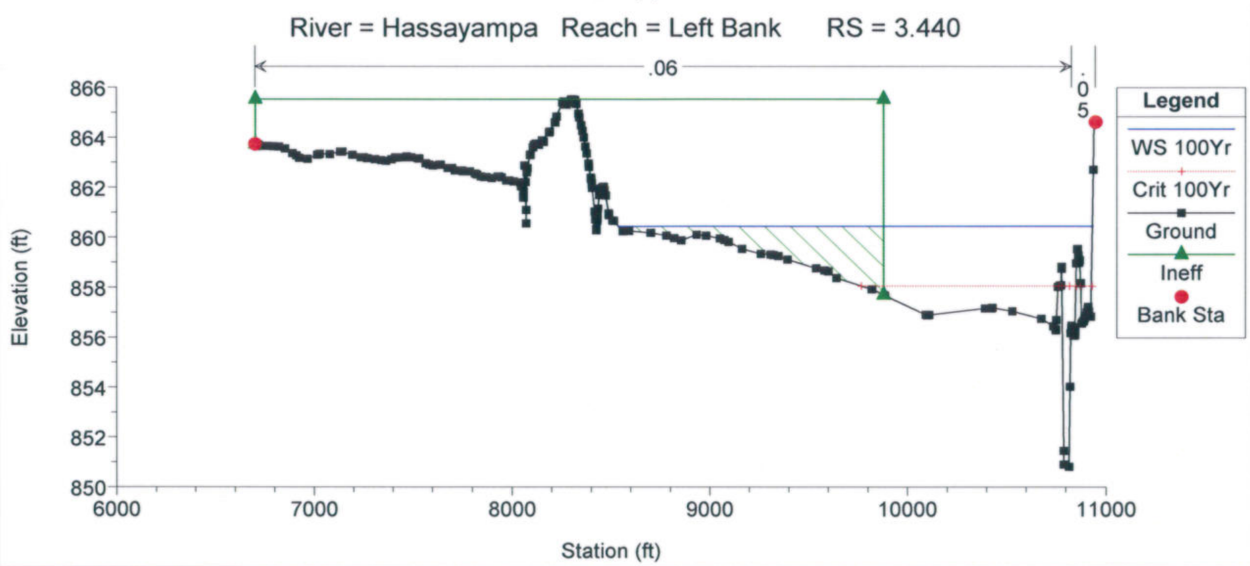

River = Hassayampa Reach = Left Bank RS = 3.910
.06
.035
0
5
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta

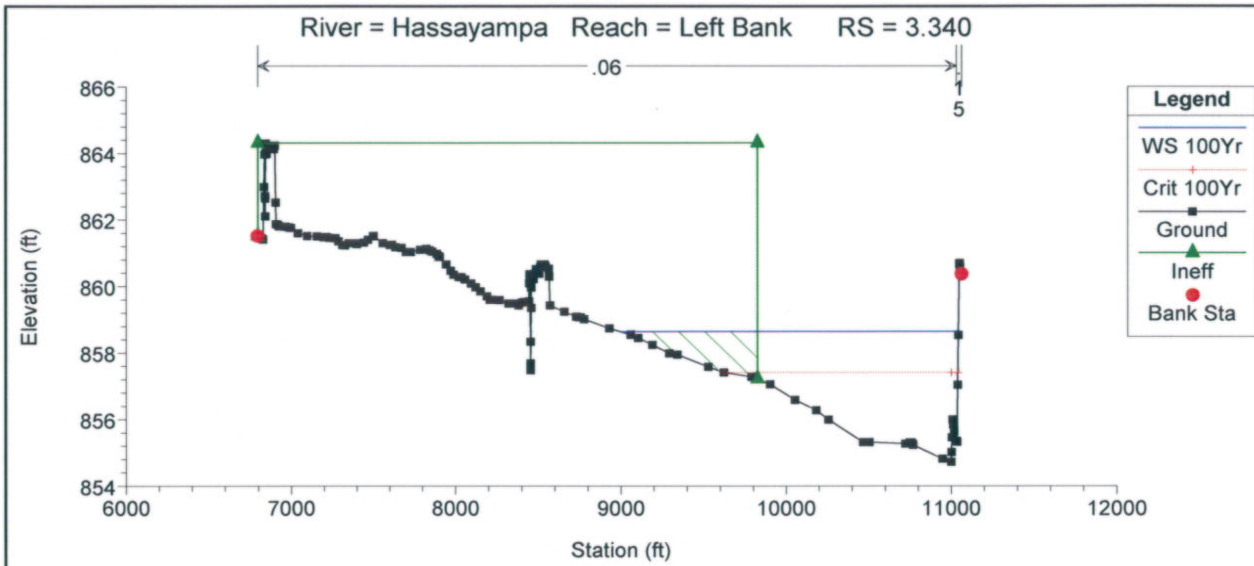

River = Hassayampa Reach = Left Bank RS = 3.810
.06
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

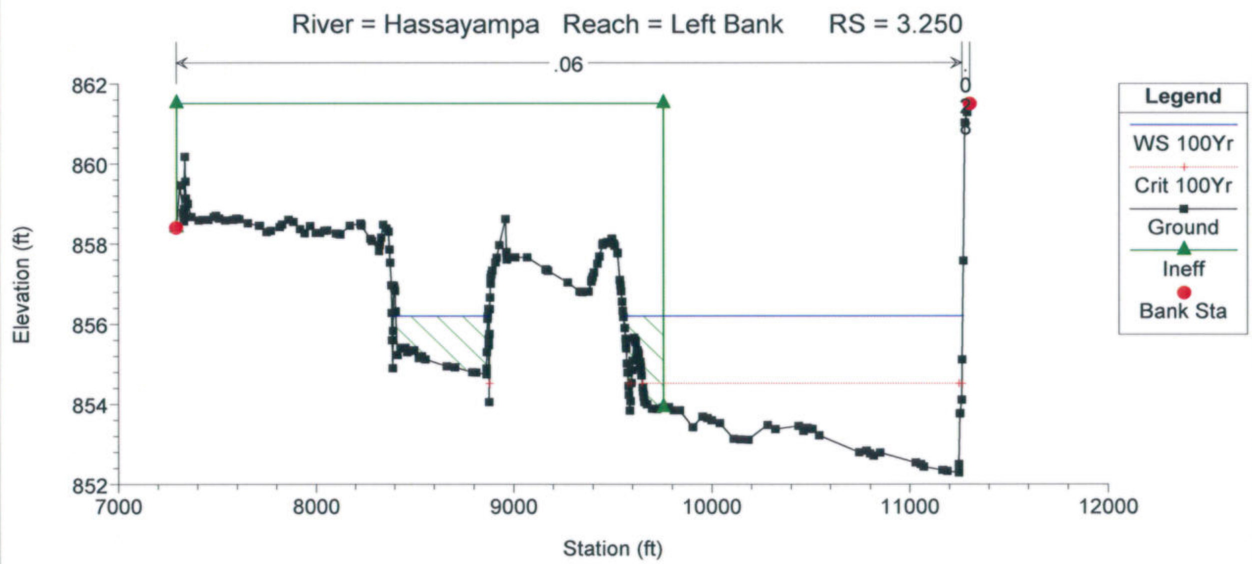

River = Hassayampa Reach = Left Bank RS = 3.720
.06
.05
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

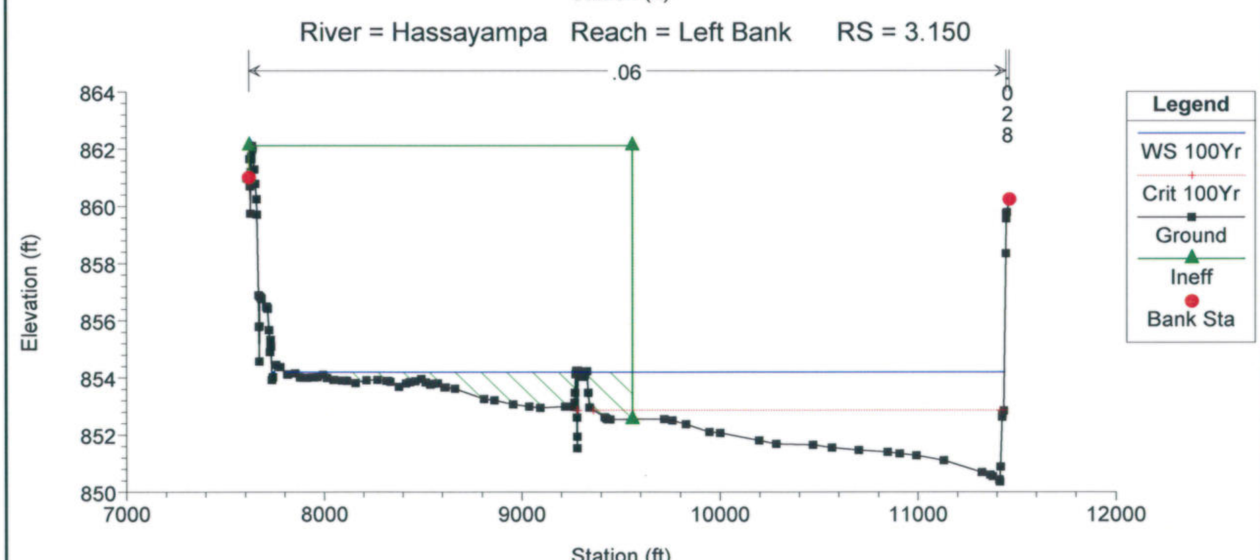

River = Hassayampa Reach = Left Bank RS = 3.630
.06
.05
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

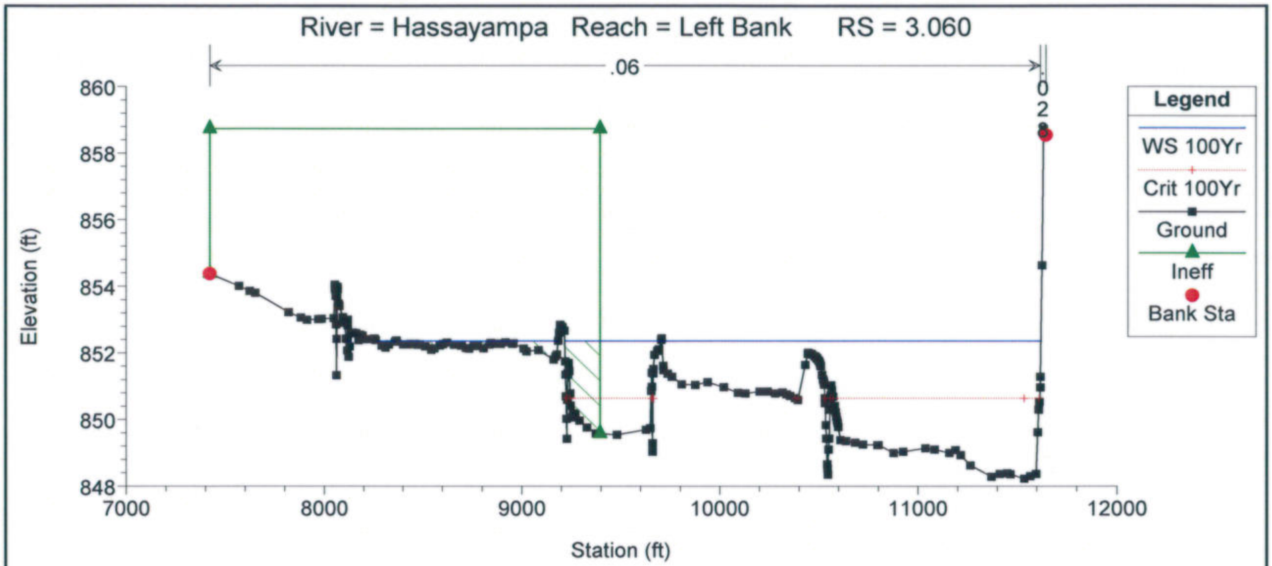

River = Hassayampa Reach = Left Bank RS = 3.530
.06
.05
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

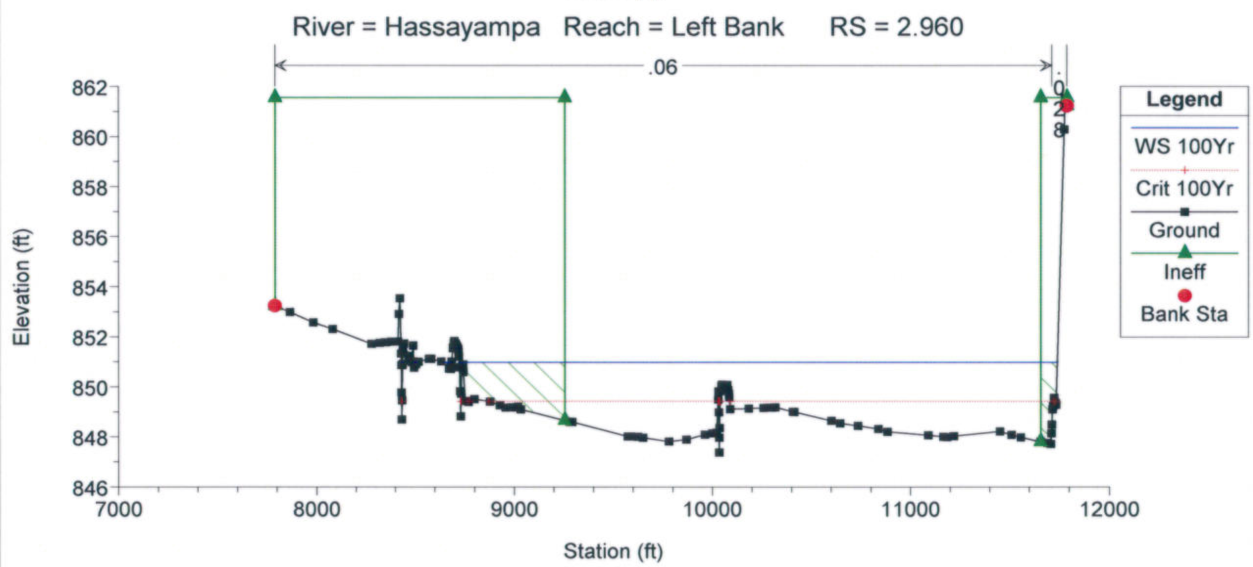

River = Hassayampa Reach = Left Bank RS = 3.440
.06
.05
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

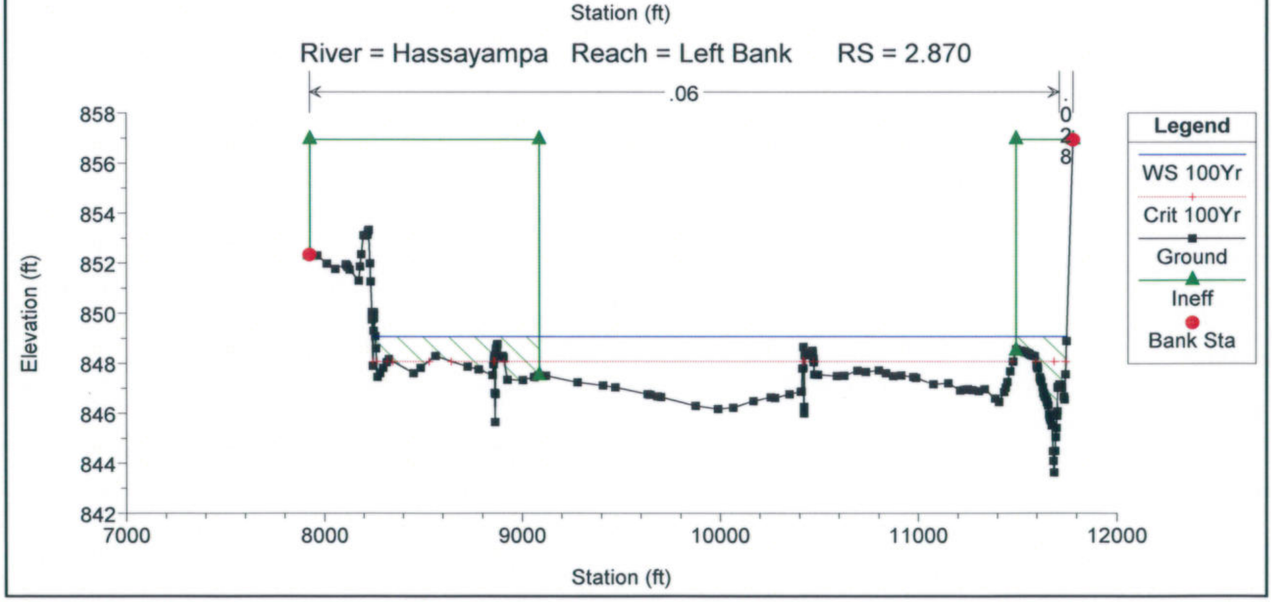

River = Hassayampa Reach = Left Bank RS = 3.340
.06
1
5
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

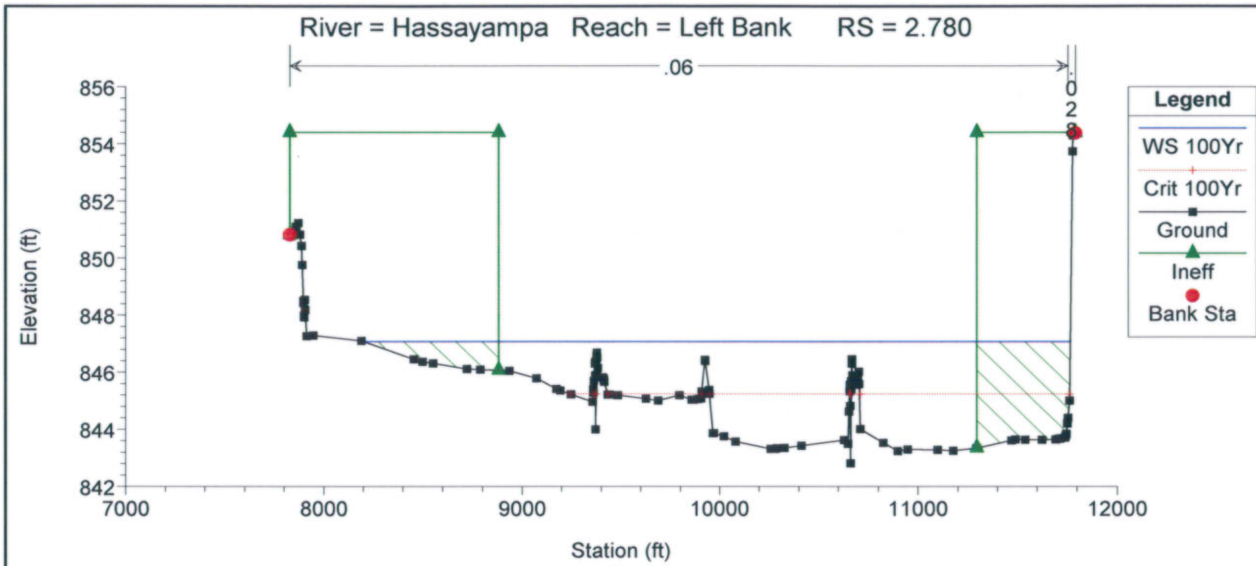

River = Hassayampa Reach = Left Bank RS = 3.250
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

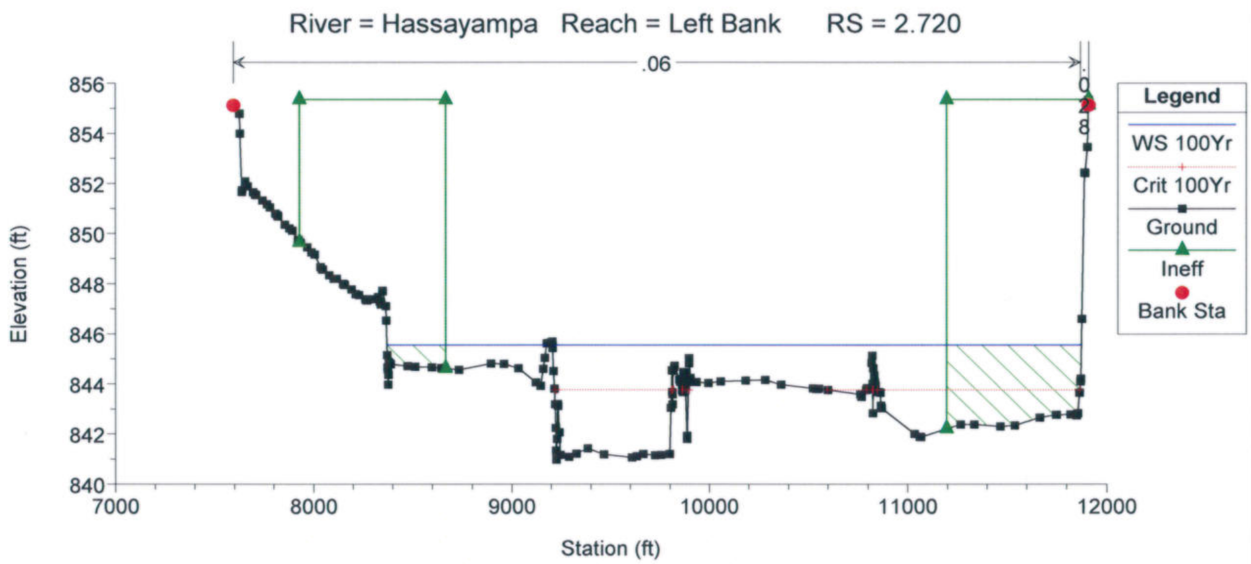

River = Hassayampa Reach = Left Bank RS = 3.150
.06
0
2
8
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

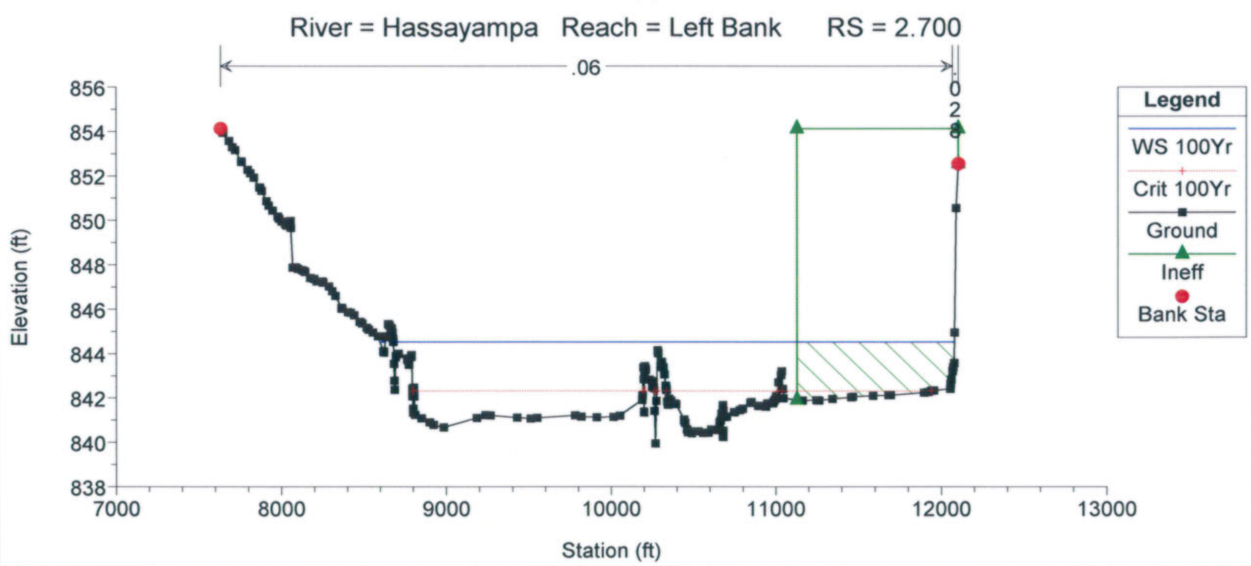

River = Hassayampa Reach = Left Bank RS = 3.060
.06
.028
Elevation (ft)
Station (ft)
860
858
856
854
852
850
848
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

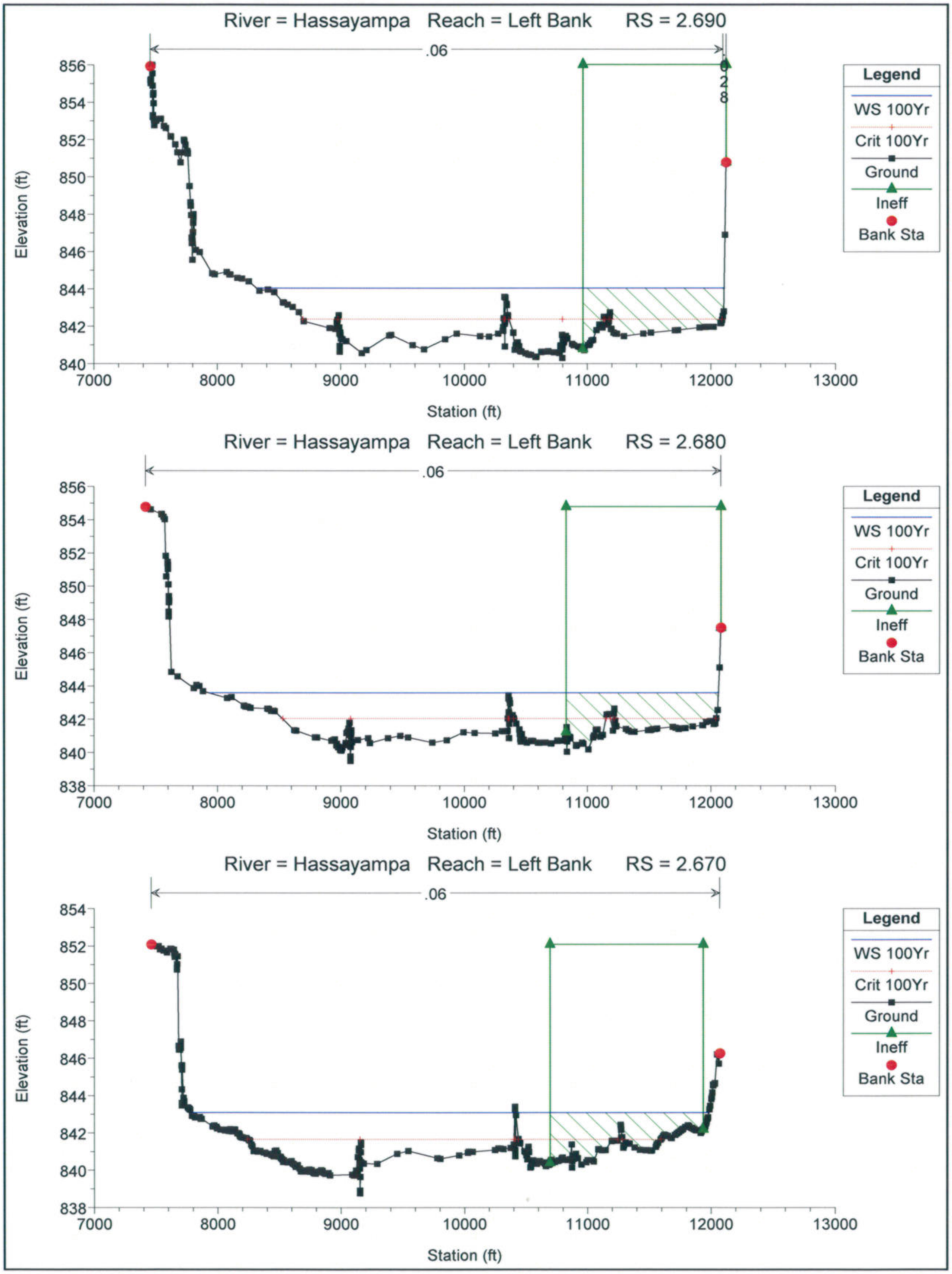

River = Hassayampa Reach = Left Bank RS = 2.960
.06
.028
Elevation (ft)
Station (ft)
862
860
858
856
854
852
850
848
846
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa Reach = Left Bank RS = 2.870
.06
.028
Elevation (ft)
Station (ft)
858
856
854
852
850
848
846
844
842
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

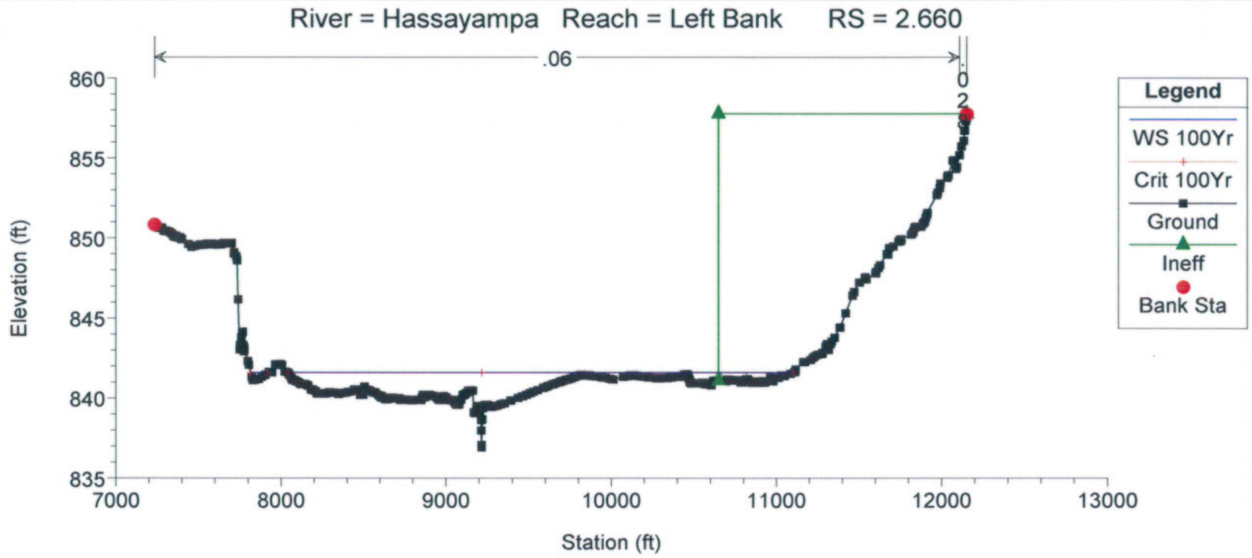

River = Hassayampa Reach = Left Bank RS = 2.780
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
856
854
852
850
848
846
844
842
7000
8000
9000
10000
11000
12000


River = Hassayampa Reach = Left Bank RS = 2.720
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
856
854
852
850
848
846
844
842
840
7000
8000
9000
10000
11000
12000

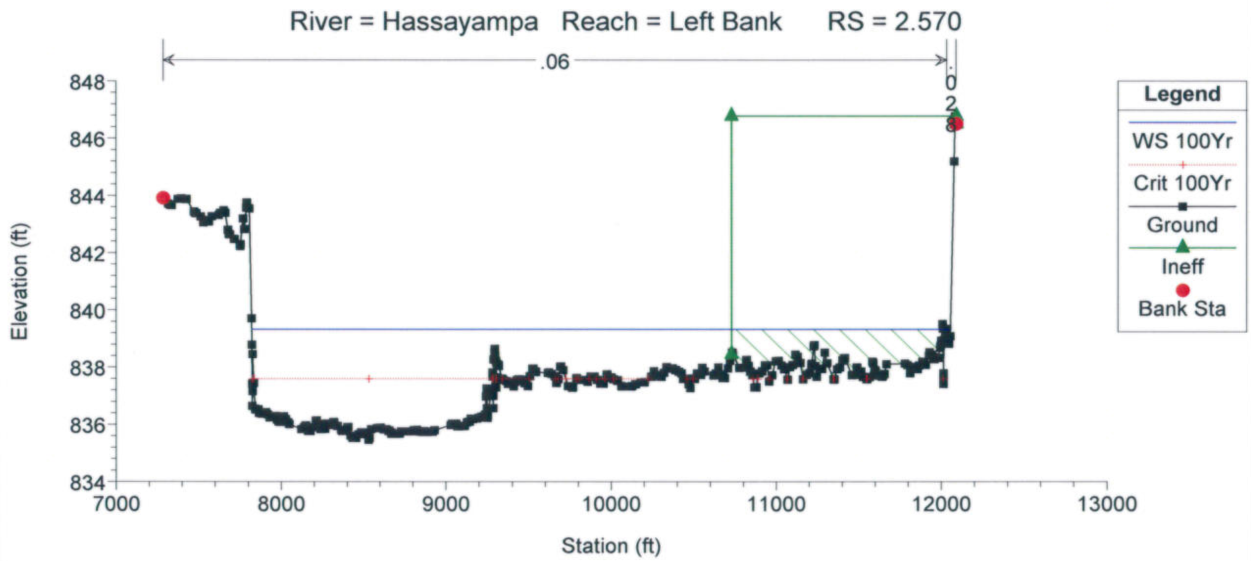

River = Hassayampa Reach = Left Bank RS = 2.700
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
856
854
852
850
848
846
844
842
840
838
7000
8000
9000
10000
11000
12000
13000



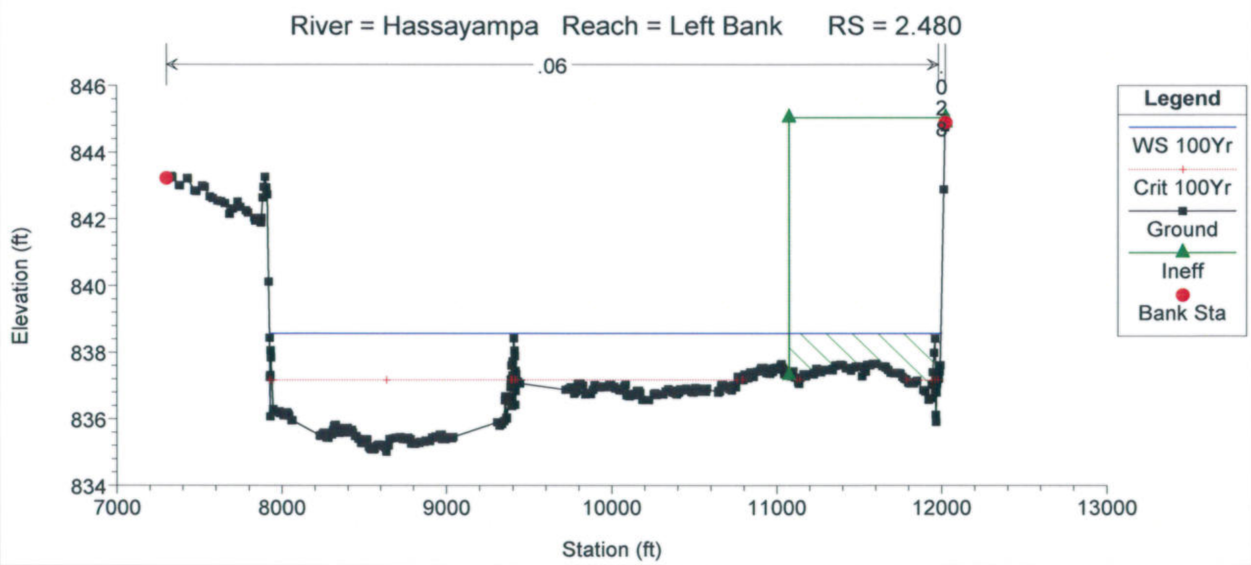
River = Hassayampa Reach = Left Bank RS = 2.690
.06
856
854
852
850
848
846
844
842
840
Elevation (ft)
7000 8000 9000 10000 11000 12000 13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Left Bank RS = 2.680
.06
856
854
852
850
848
846
844
842
840
838
Elevation (ft)
7000 8000 9000 10000 11000 12000 13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Left Bank RS = 2.670
.06
854
852
850
848
846
844
842
840
838
Elevation (ft)
7000 8000 9000 10000 11000 12000 13000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta



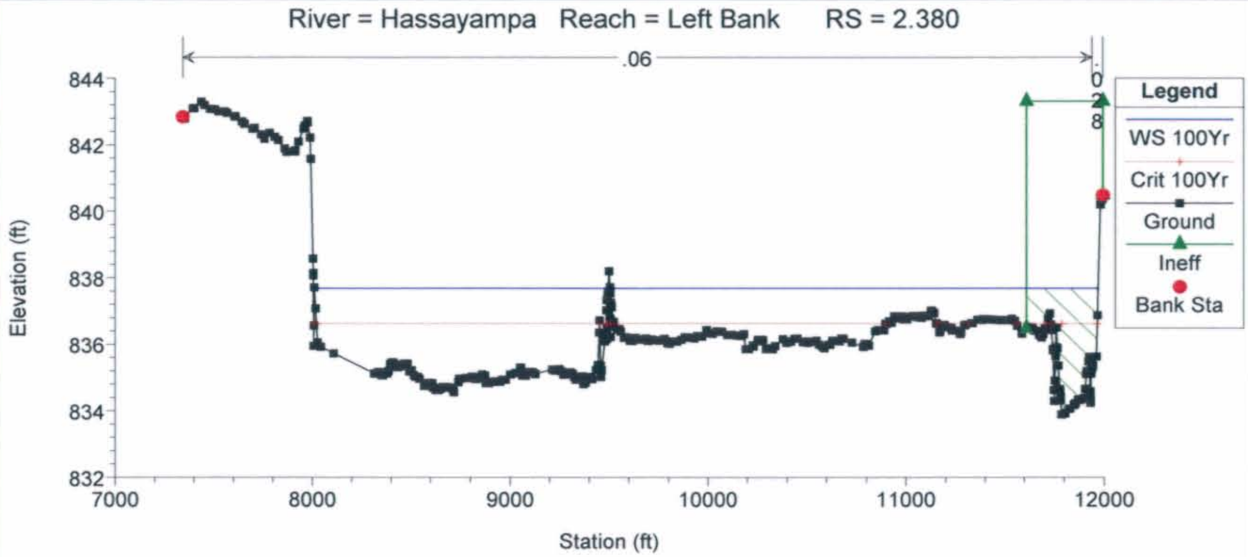
River = Hassayampa Reach = Left Bank RS = 2.660
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

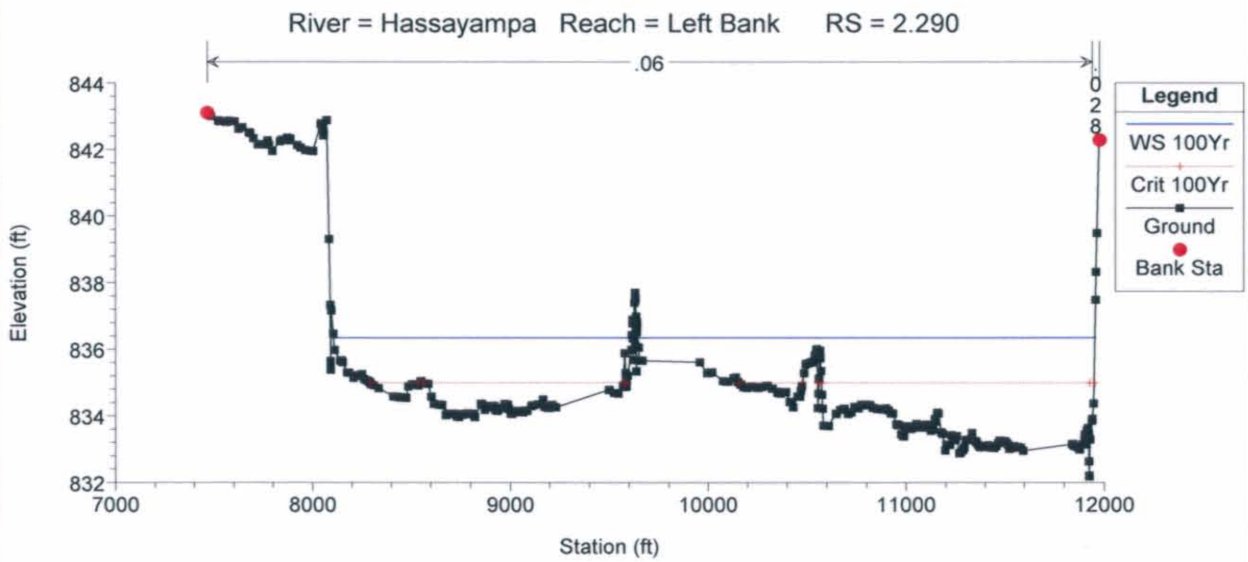


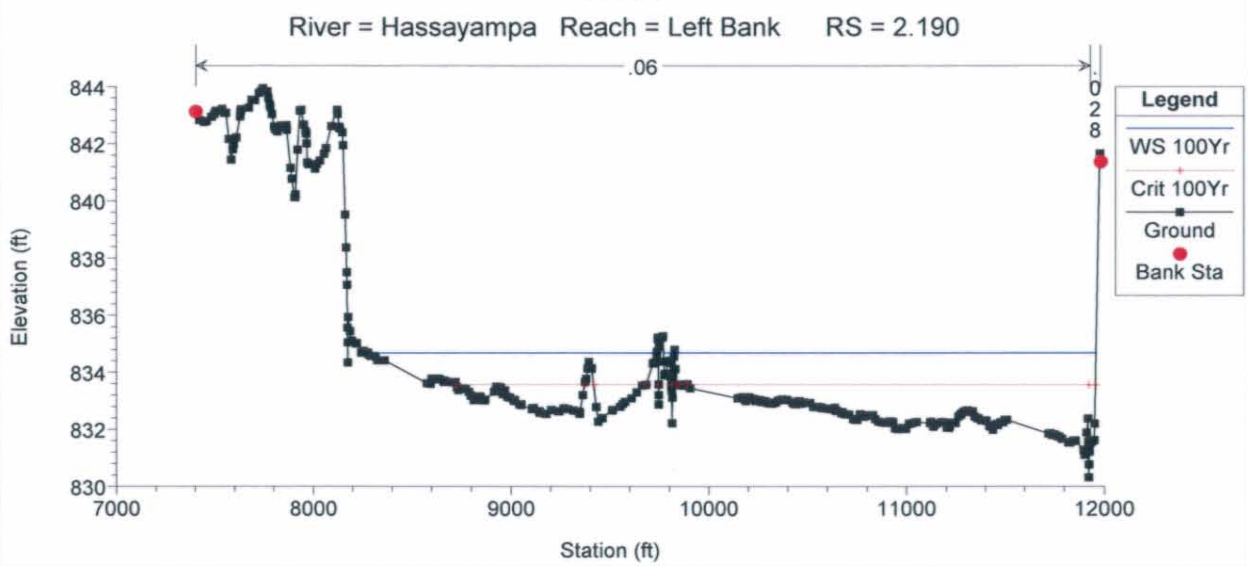
River = Hassayampa Reach = Left Bank RS = 2.570
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

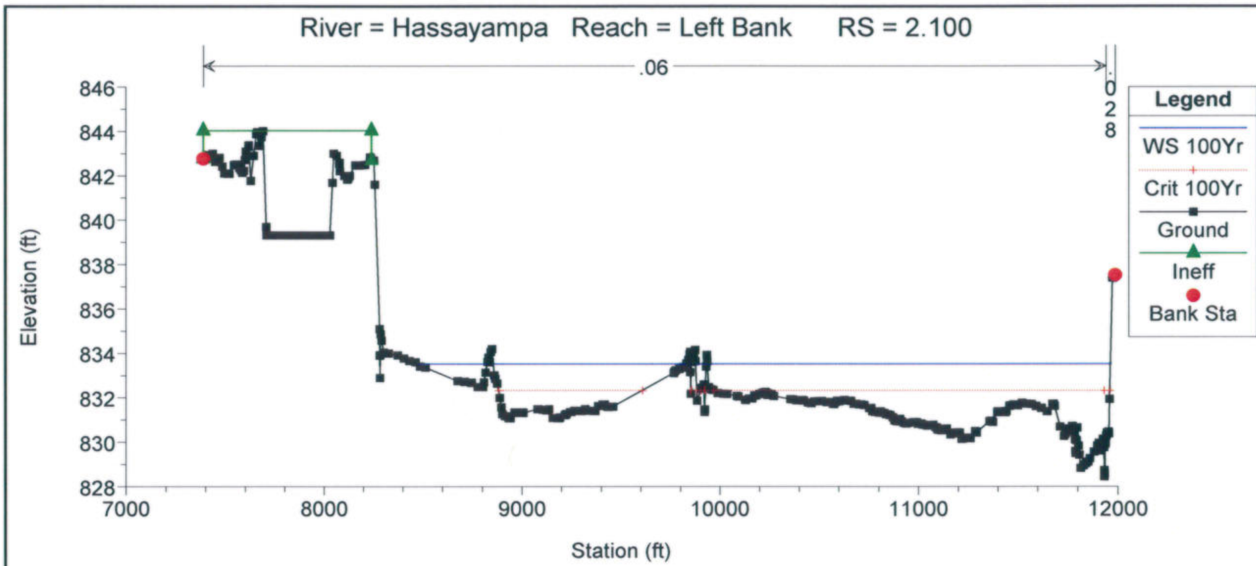


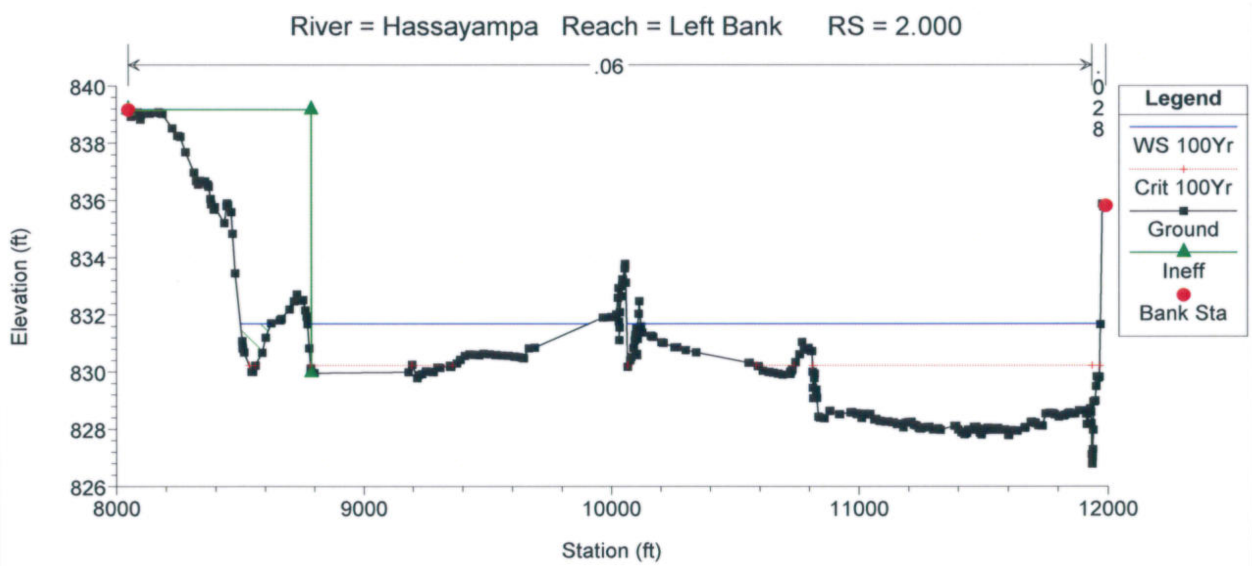
River = Hassayampa Reach = Left Bank RS = 2.480
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

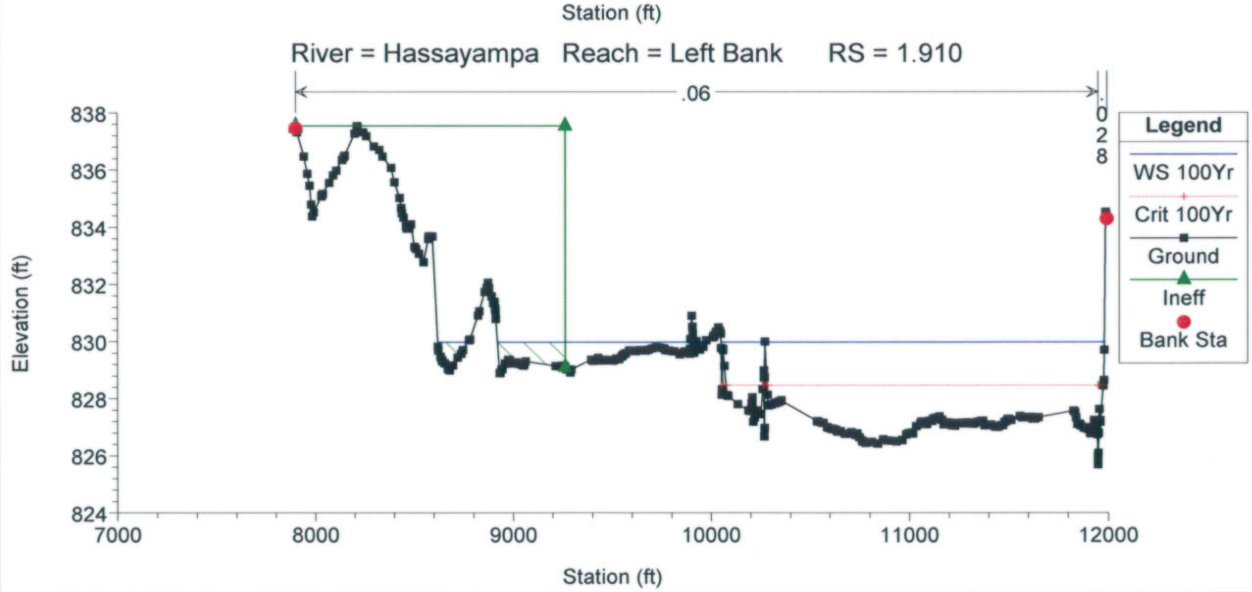

River = Hassayampa Reach = Left Bank RS = 2.380
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
844
842
840
838
836
834
832
7000
8000
9000
10000
11000
12000

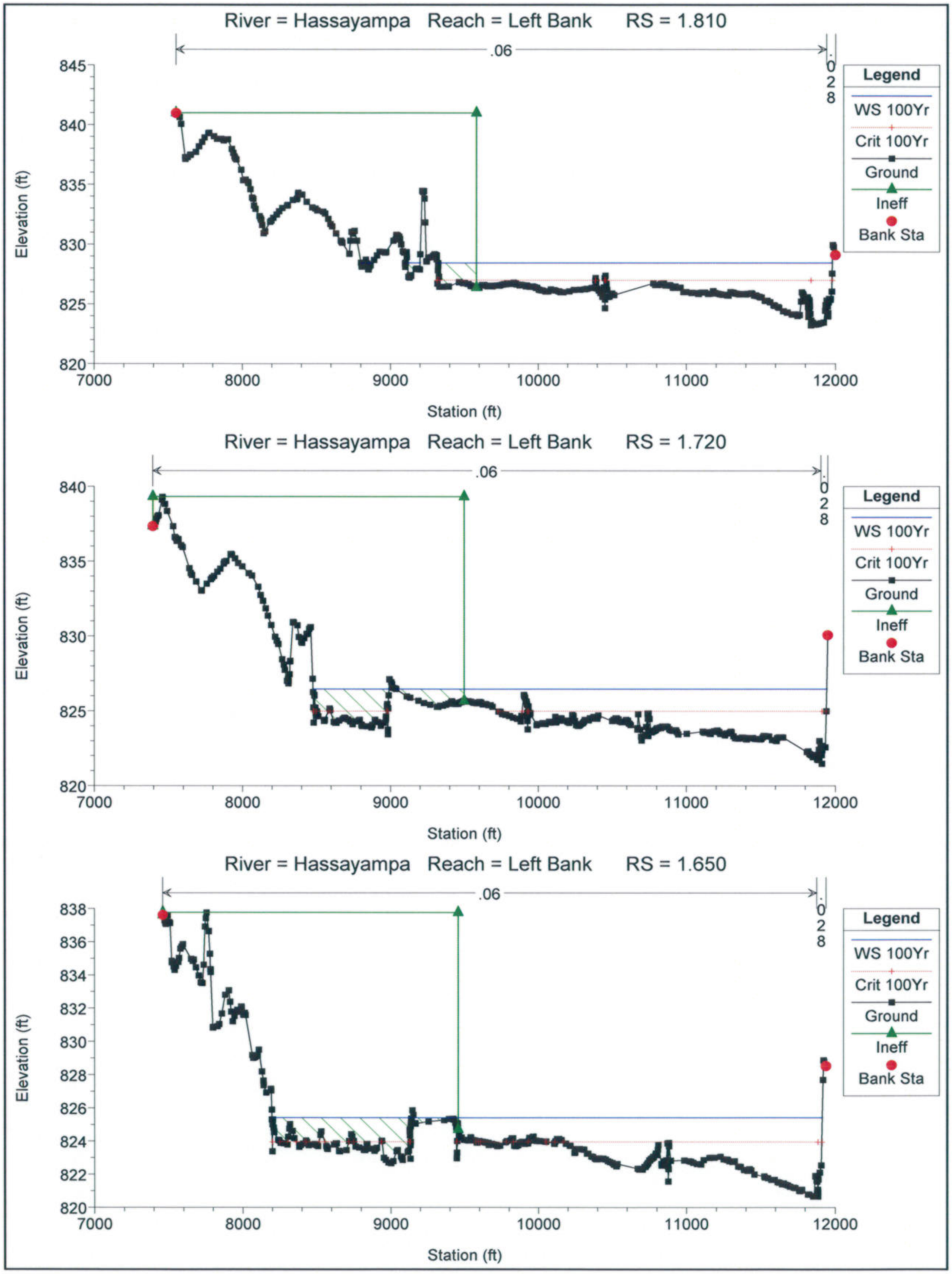

River = Hassayampa Reach = Left Bank RS = 2.290
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
844
842
840
838
836
834
832
7000
8000
9000
10000
11000
12000

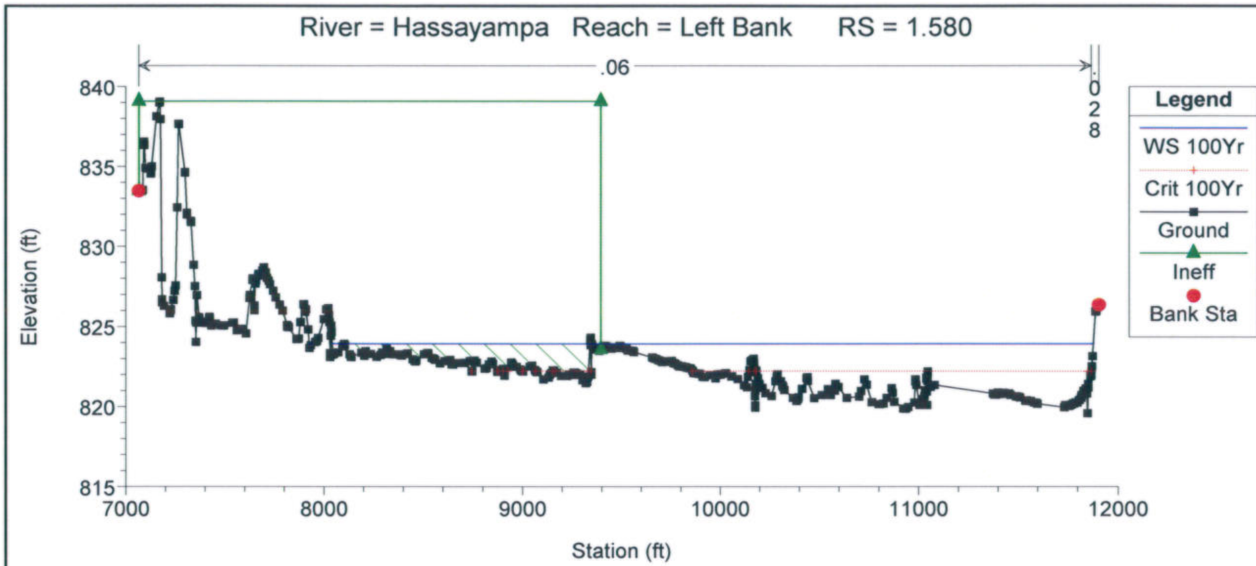

River = Hassayampa Reach = Left Bank RS = 2.190
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
844
842
840
838
836
834
832
830
7000
8000
9000
10000
11000
12000

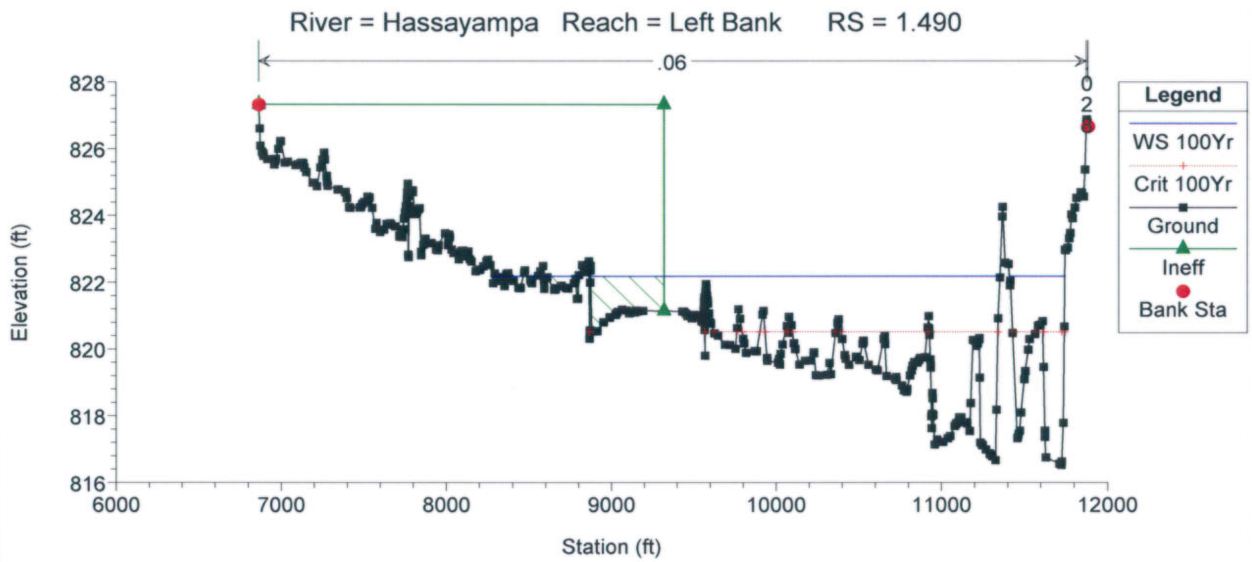

River = Hassayampa Reach = Left Bank RS = 2.100
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

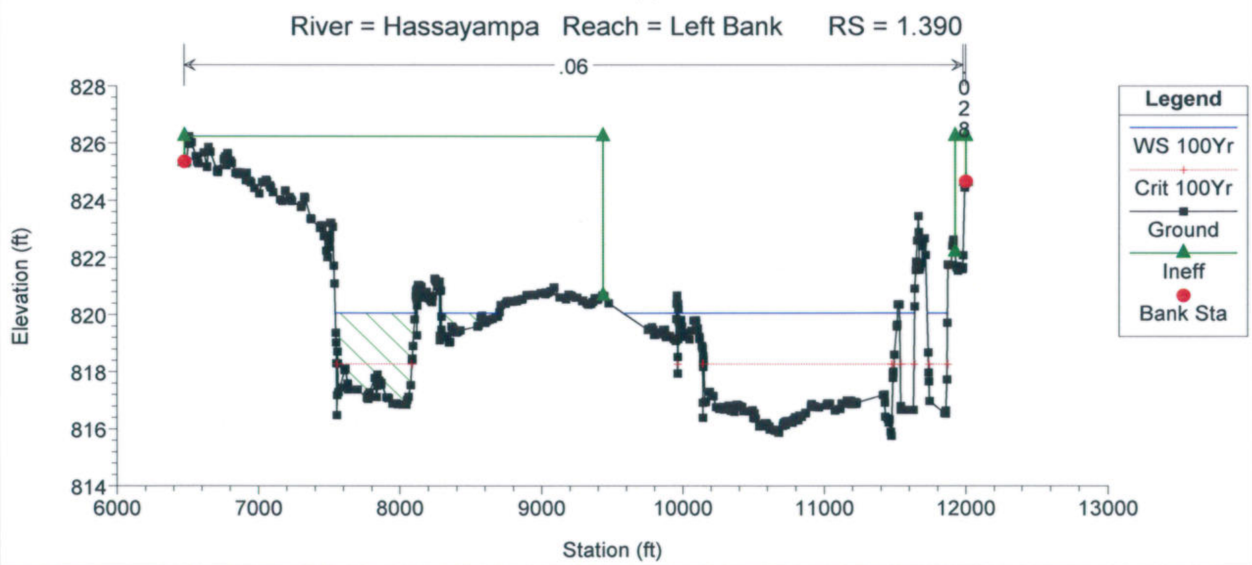

River = Hassayampa Reach = Left Bank RS = 2.000
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

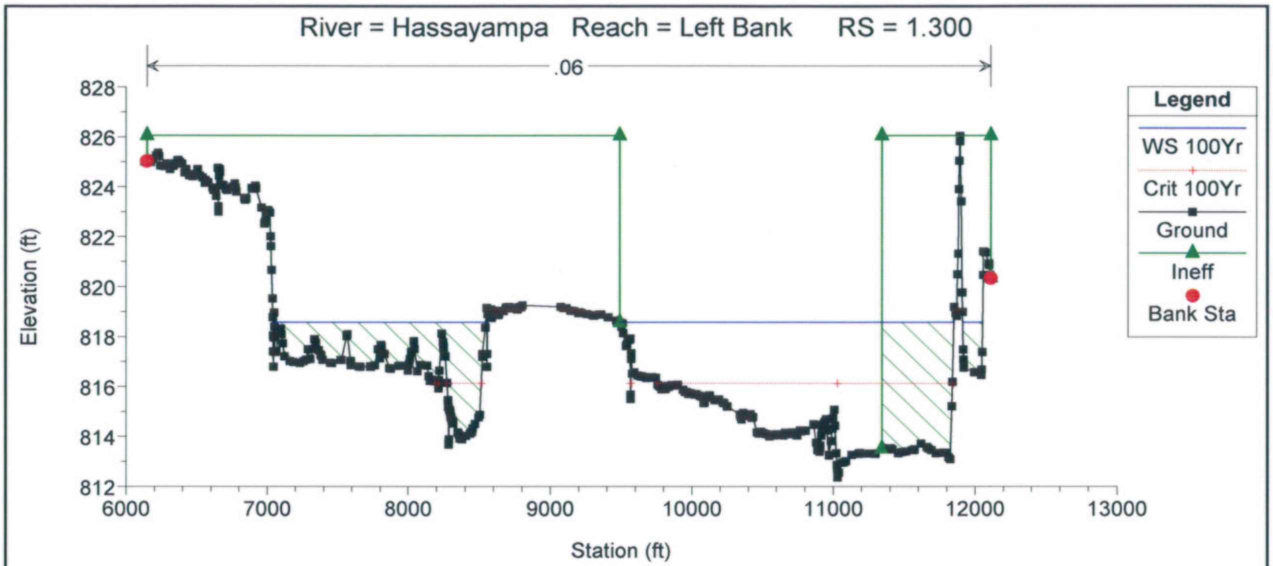

River = Hassayampa Reach = Left Bank RS = 1.910
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

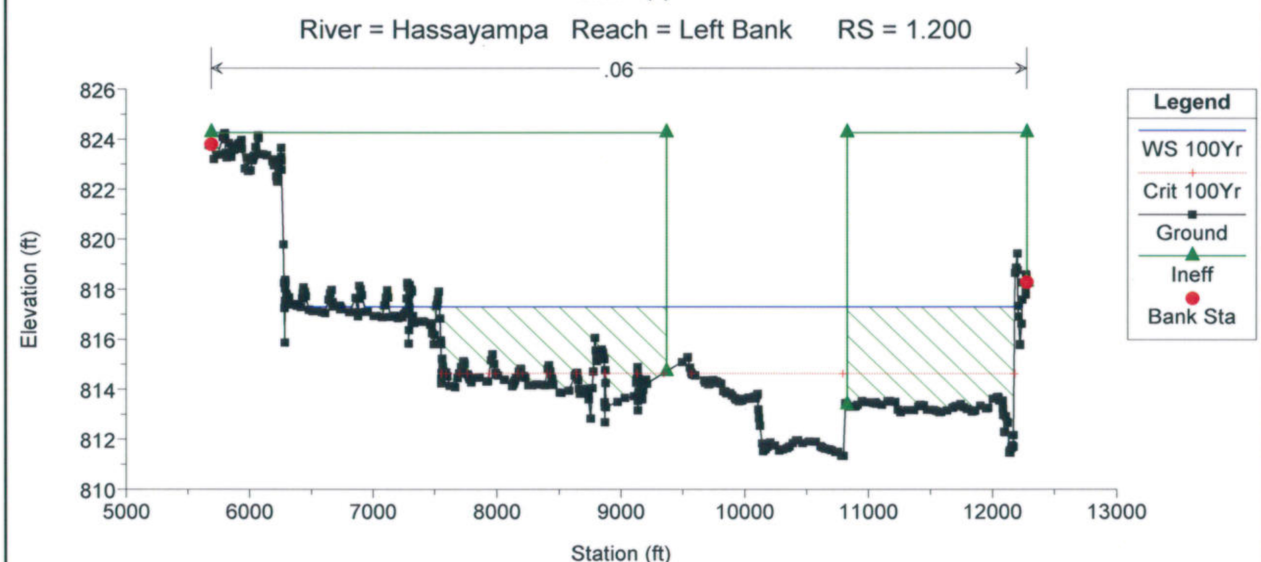

River = Hassayampa Reach = Left Bank RS = 1.810
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Left Bank RS = 1.720
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Left Bank RS = 1.650
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

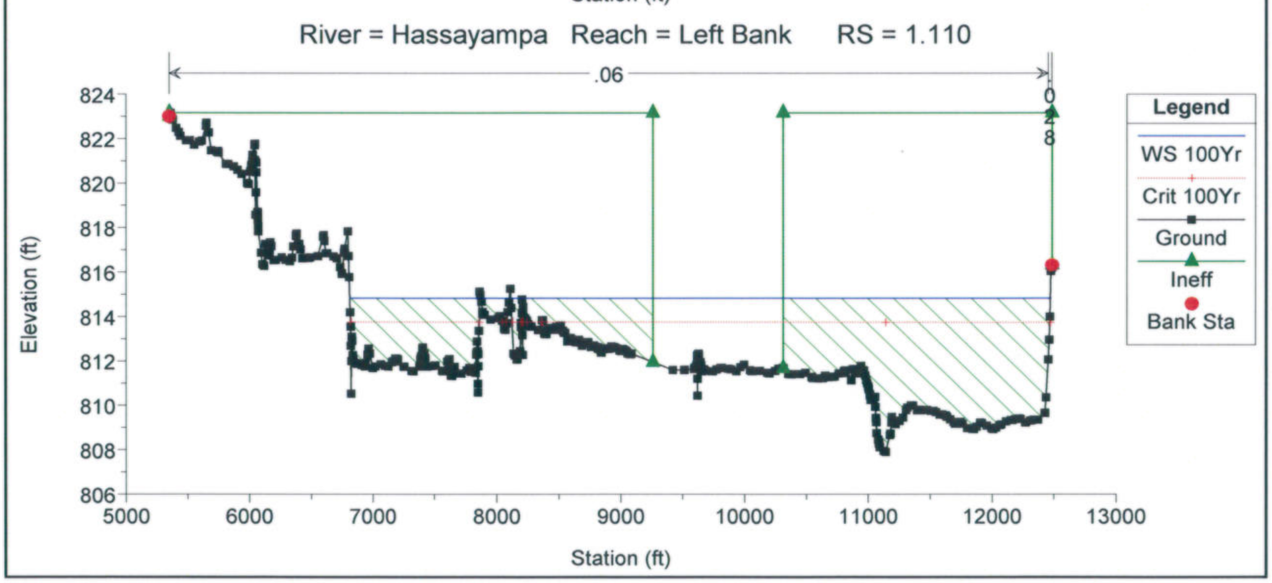

River = Hassayampa Reach = Left Bank RS = 1.580
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
840
835
830
825
820
815
7000
8000
9000
10000
11000
12000

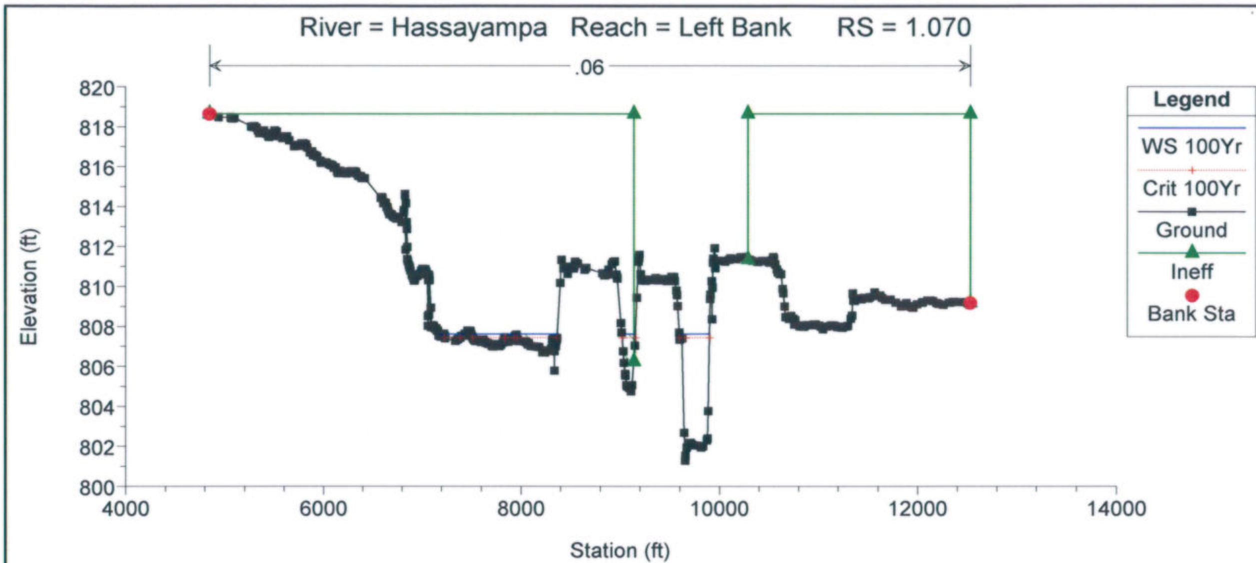

River = Hassayampa Reach = Left Bank RS = 1.490
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
828
826
824
822
820
818
816
6000
7000
8000
9000
10000
11000
12000

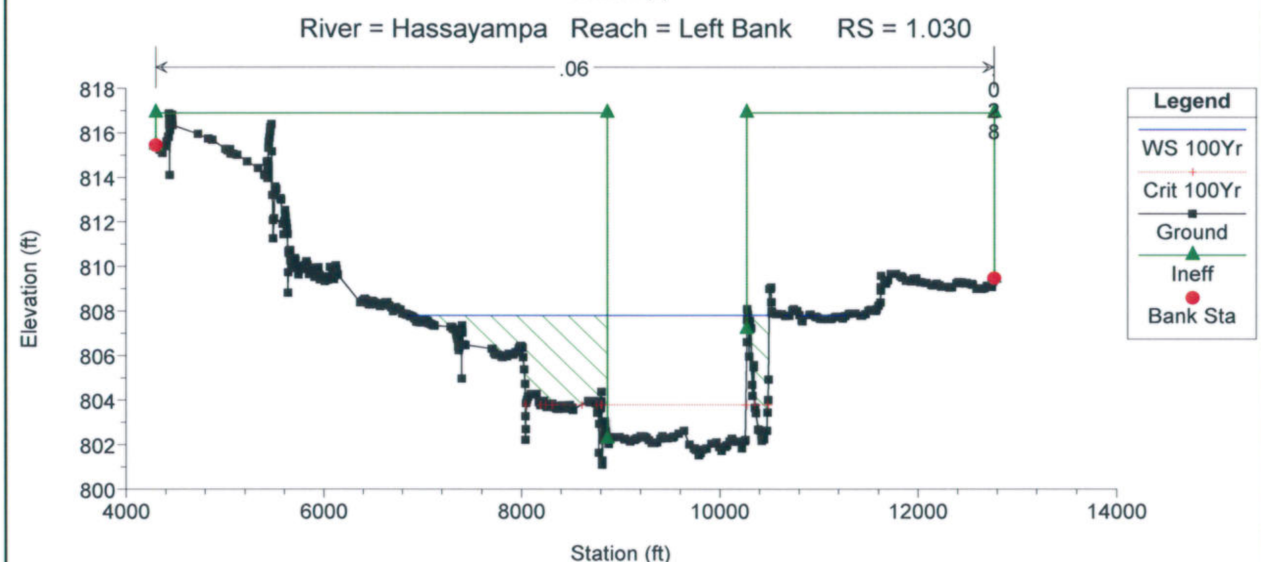

River = Hassayampa Reach = Left Bank RS = 1.390
.06
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
828
826
824
822
820
818
816
814
6000
7000
8000
9000
10000
11000
12000
13000

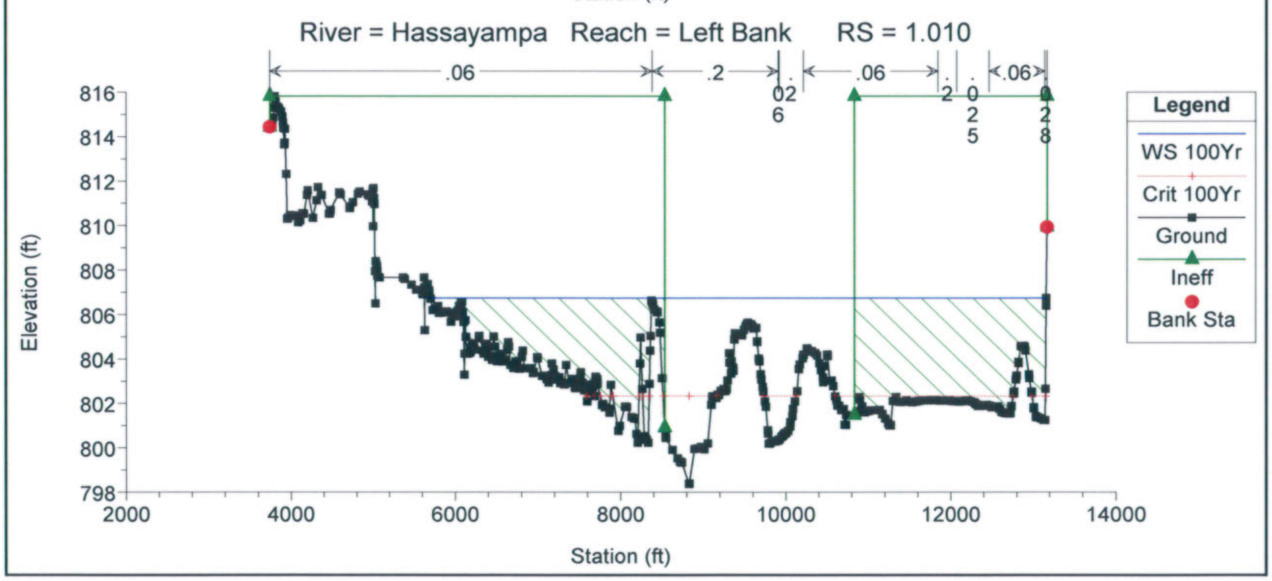

River = Hassayampa Reach = Left Bank RS = 1.300
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

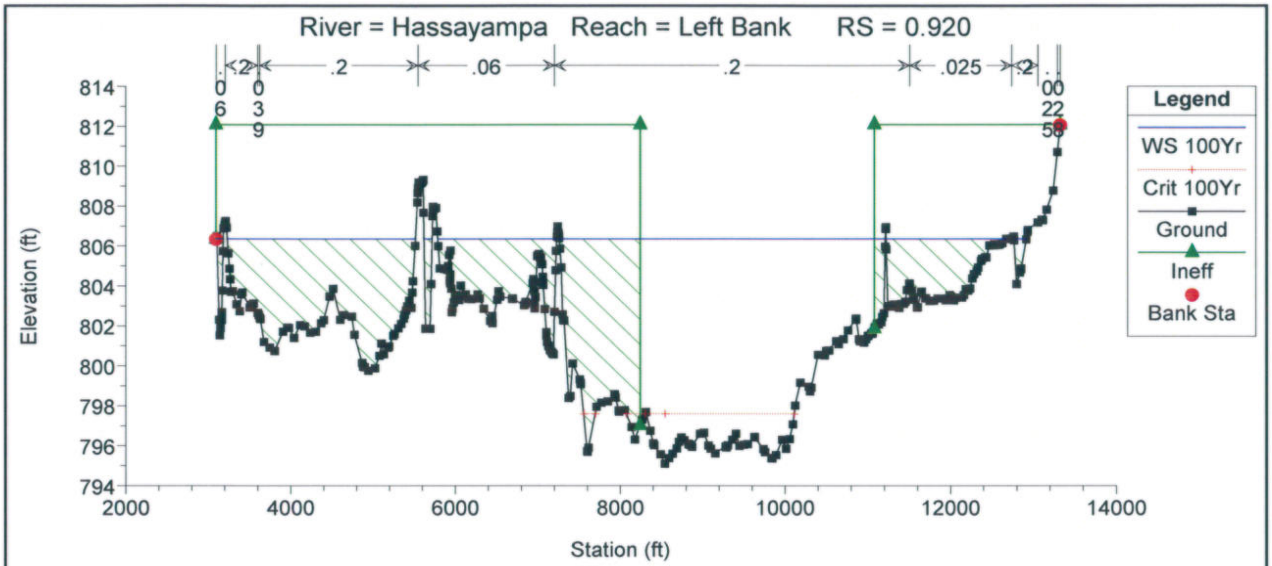

River = Hassayampa Reach = Left Bank RS = 1.200
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

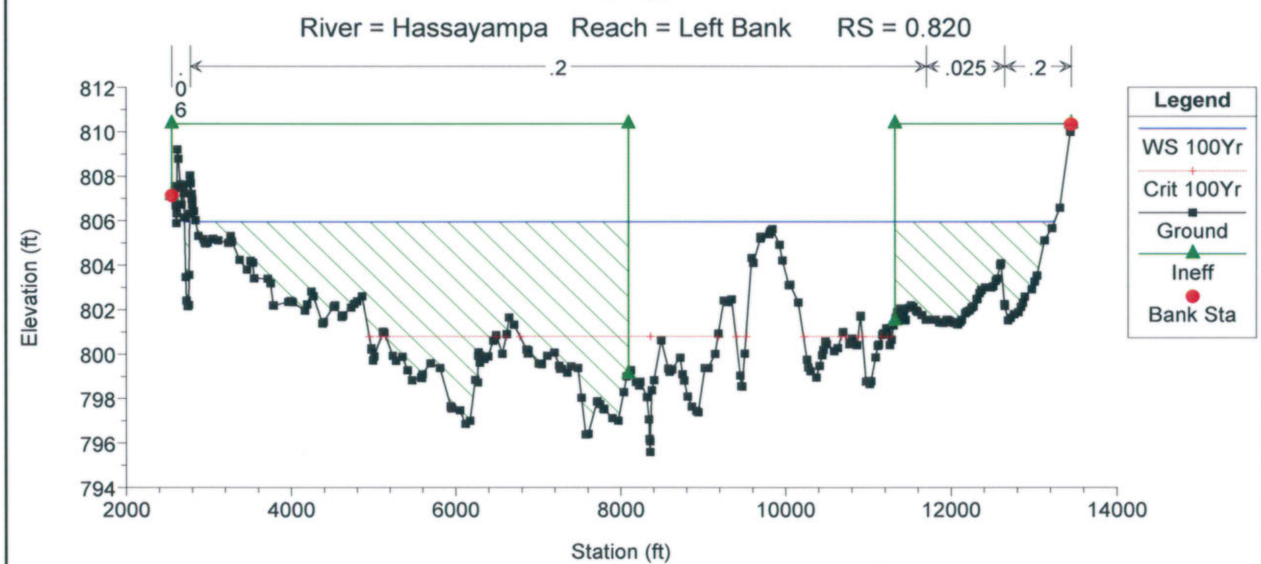

River = Hassayampa Reach = Left Bank RS = 1.110
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

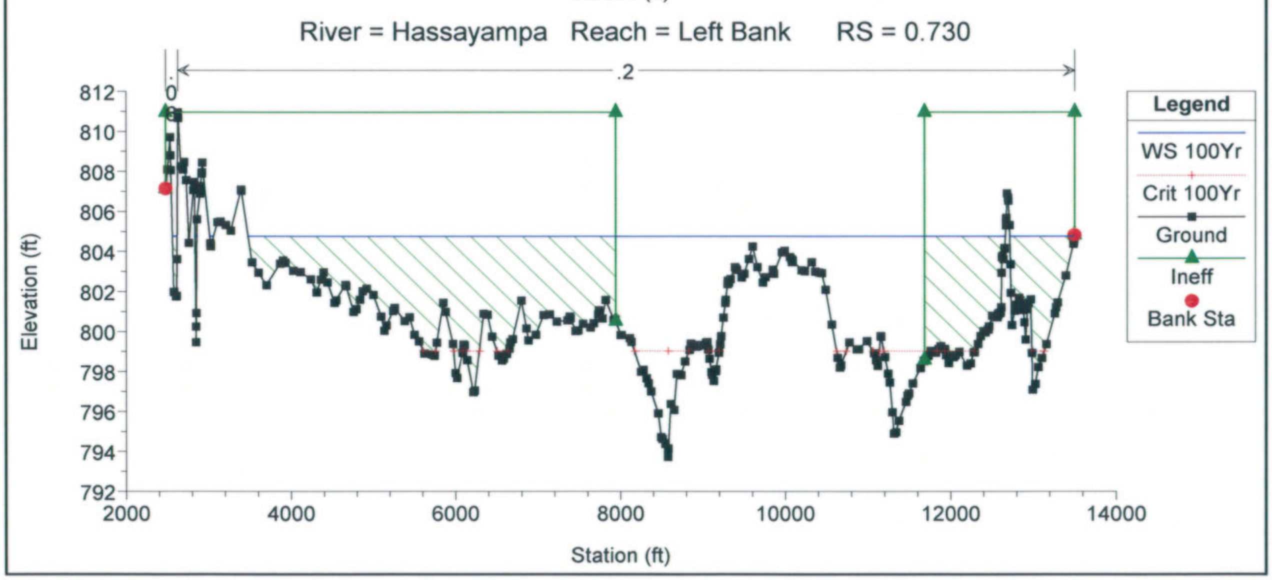

River = Hassayampa Reach = Left Bank RS = 1.070
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

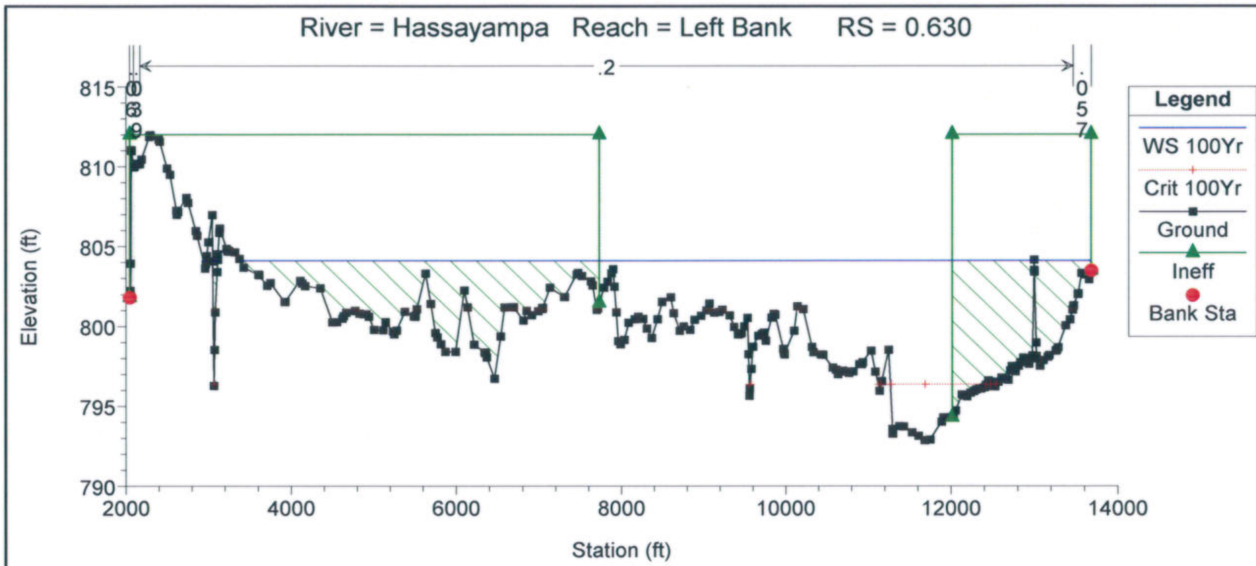

River = Hassayampa Reach = Left Bank RS = 1.030
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

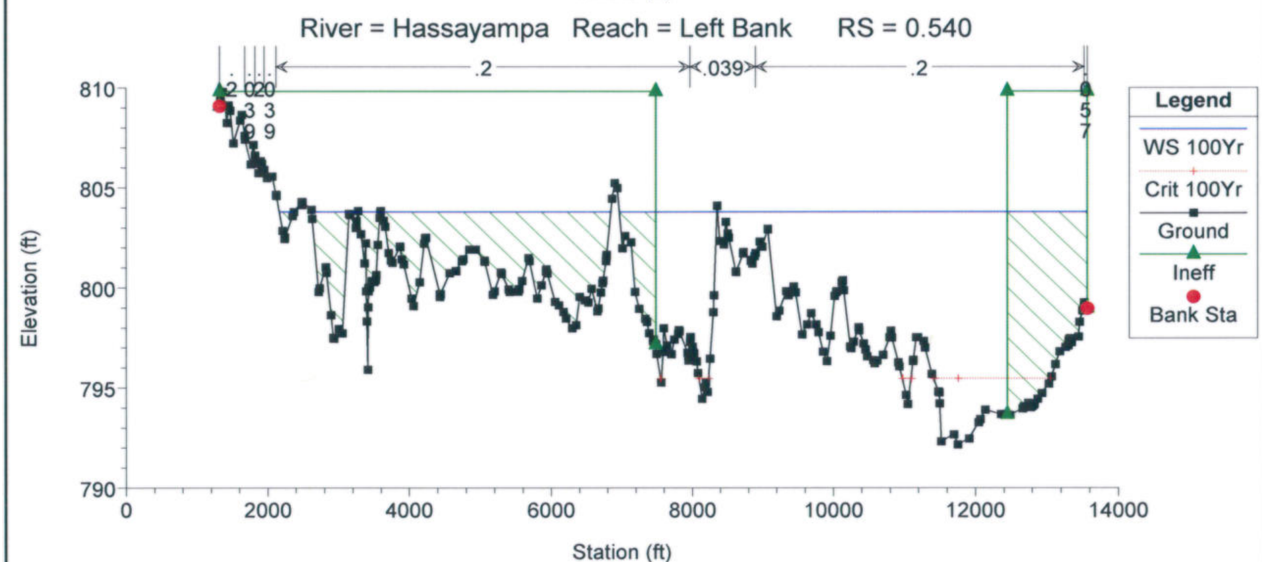

River = Hassayampa Reach = Left Bank RS = 1.010
.06
.2
.06
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

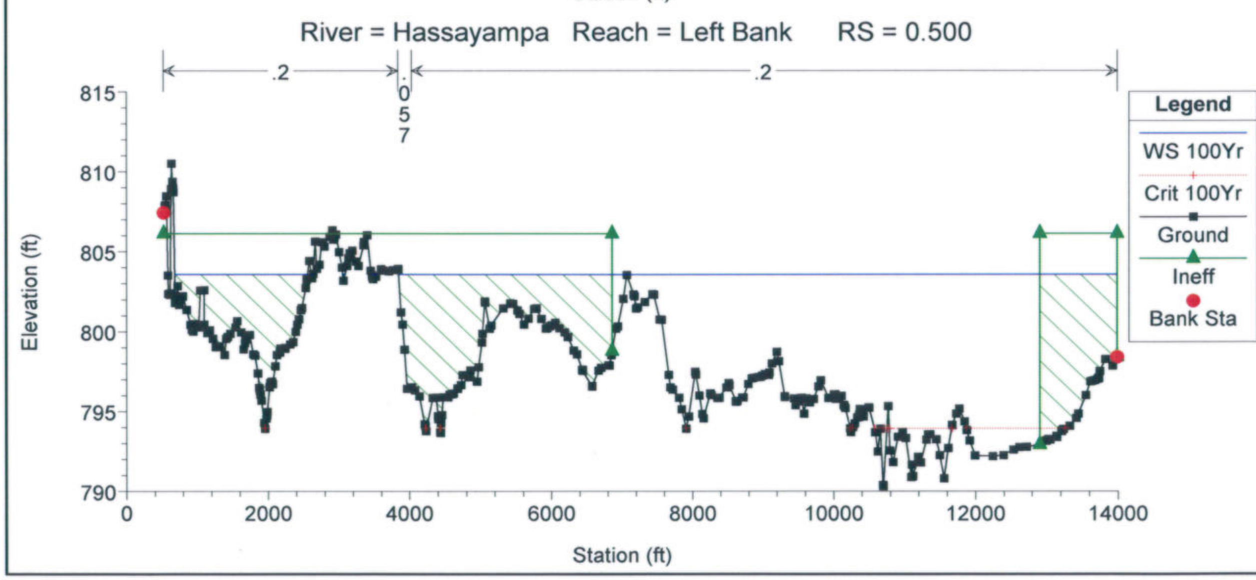

River = Hassayampa Reach = Left Bank RS = 0.920
.2
.2
.06
.2
.025
.2
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

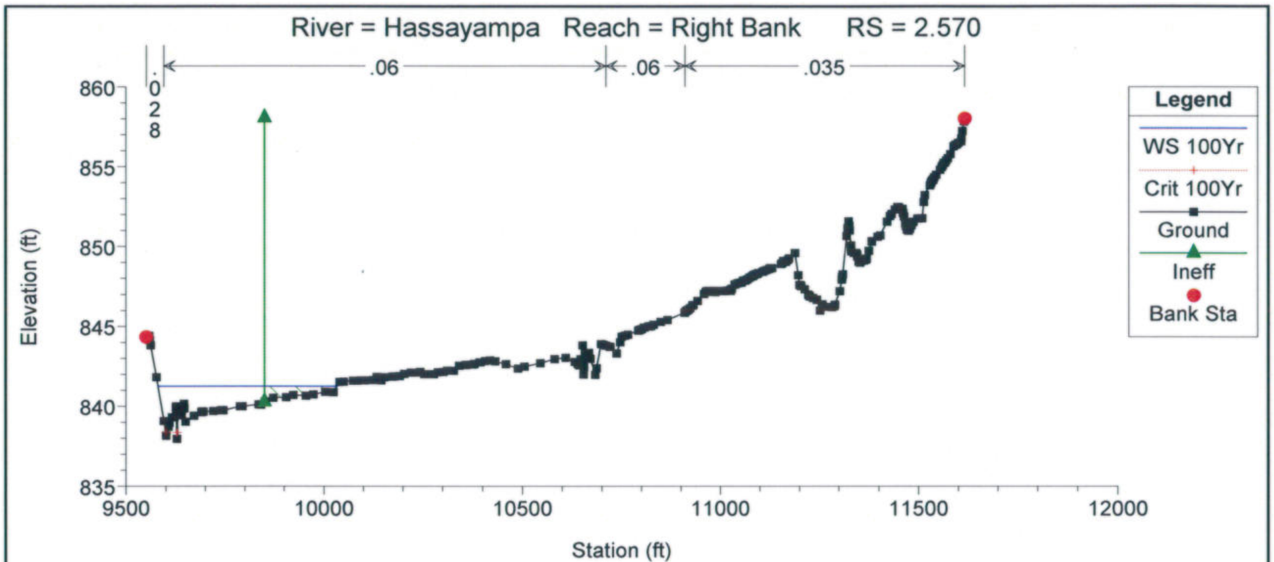

River = Hassayampa Reach = Left Bank RS = 0.820
.2
.025
.2
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

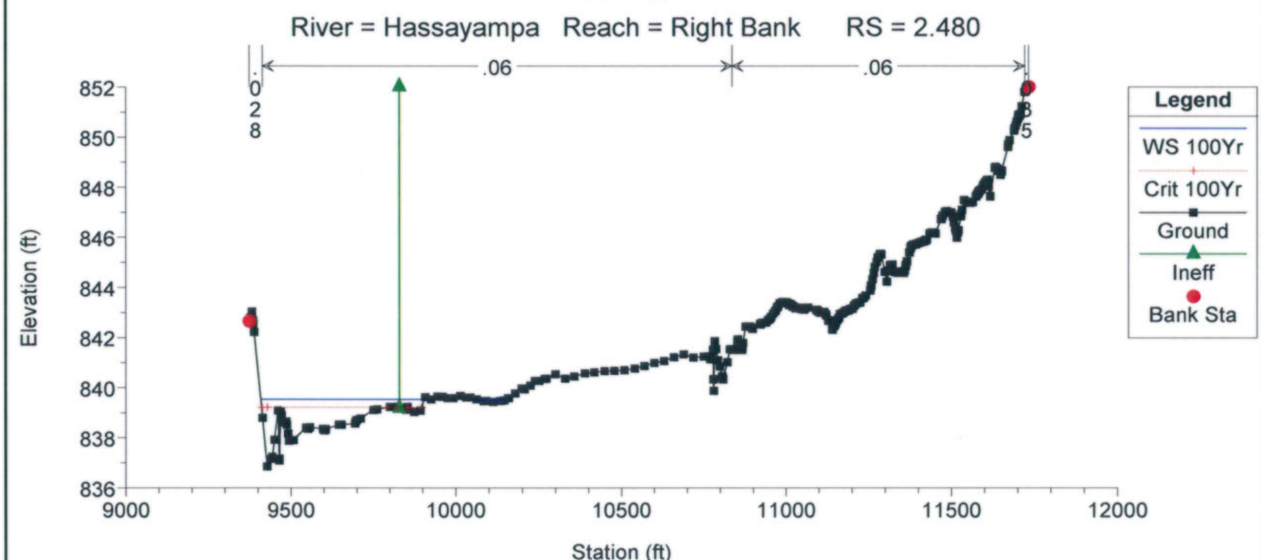

River = Hassayampa Reach = Left Bank RS = 0.730
.2
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

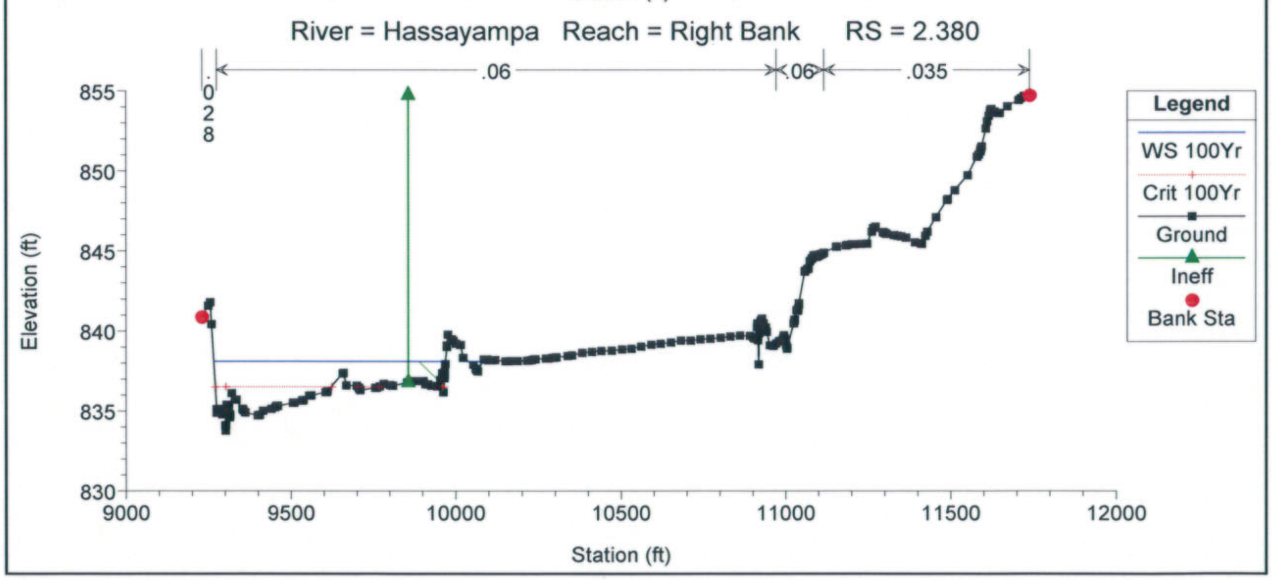

River = Hassayampa Reach = Left Bank RS = 0.630
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
790
795
800
805
810
815
2000
4000
6000
8000
10000
12000
14000

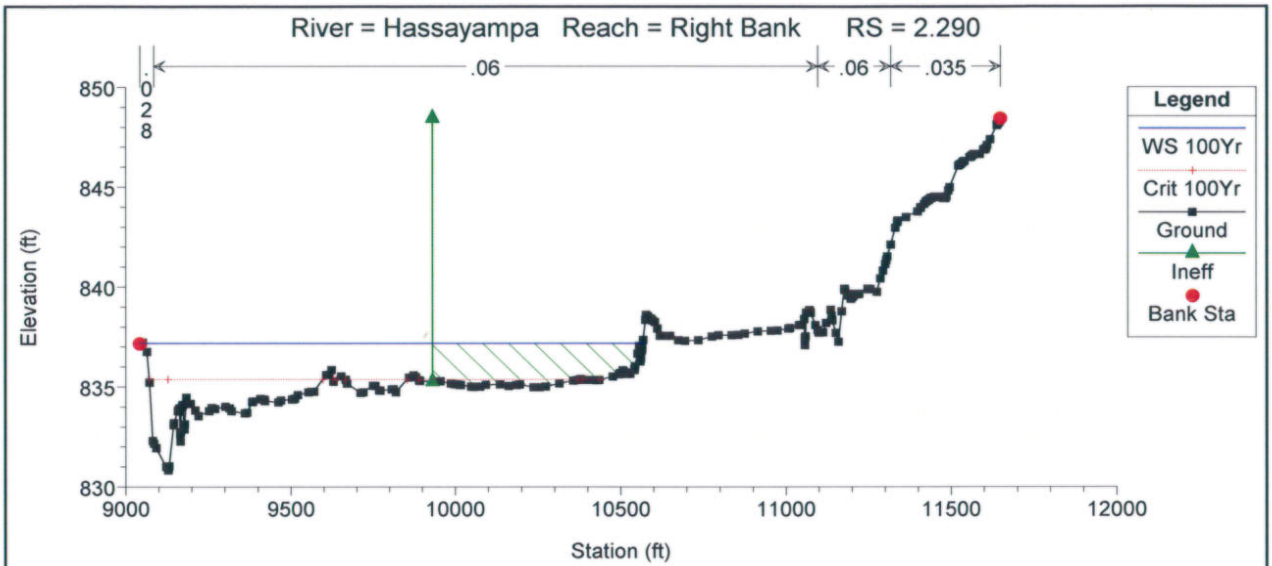

River = Hassayampa Reach = Left Bank RS = 0.540
.2
.039
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
790
795
800
805
810
0
2000
4000
6000
8000
10000
12000
14000

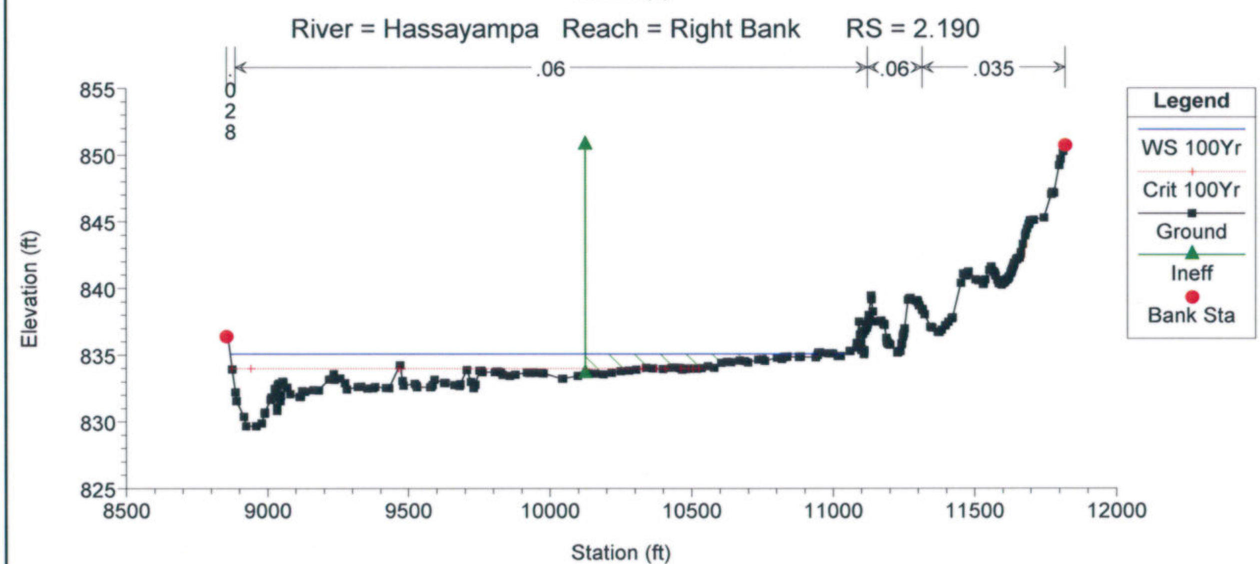

River = Hassayampa Reach = Left Bank RS = 0.500
.2
.057
.2
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
790
795
800
805
810
815
0
2000
4000
6000
8000
10000
12000
14000

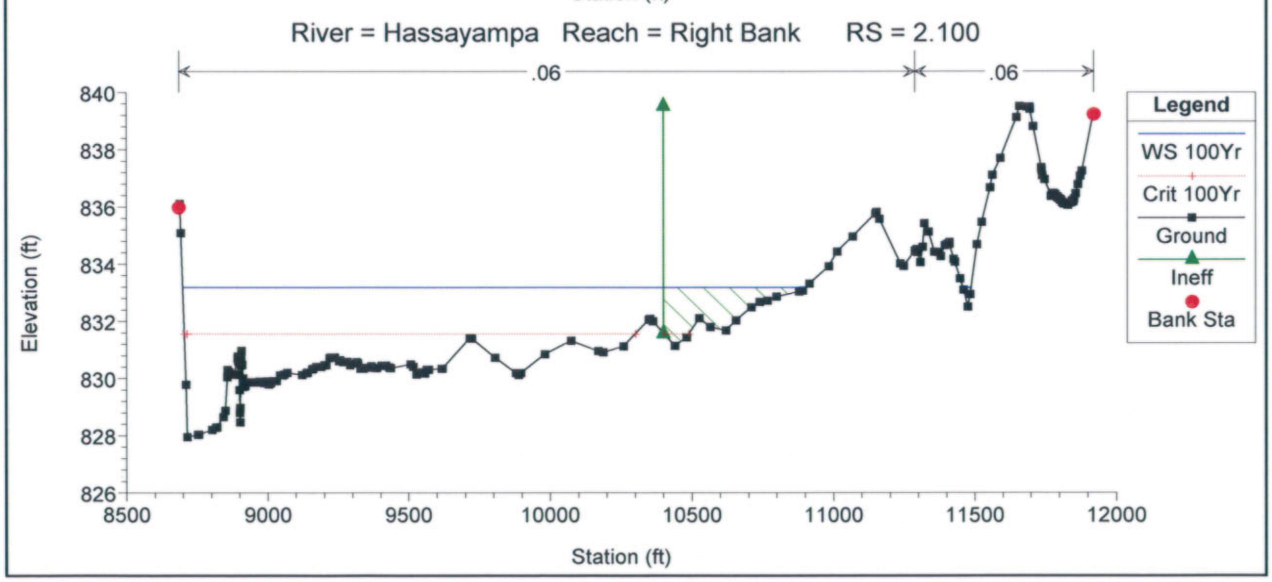

River = Hassayampa Reach = Right Bank RS = 2.570
.06
.06
.035
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

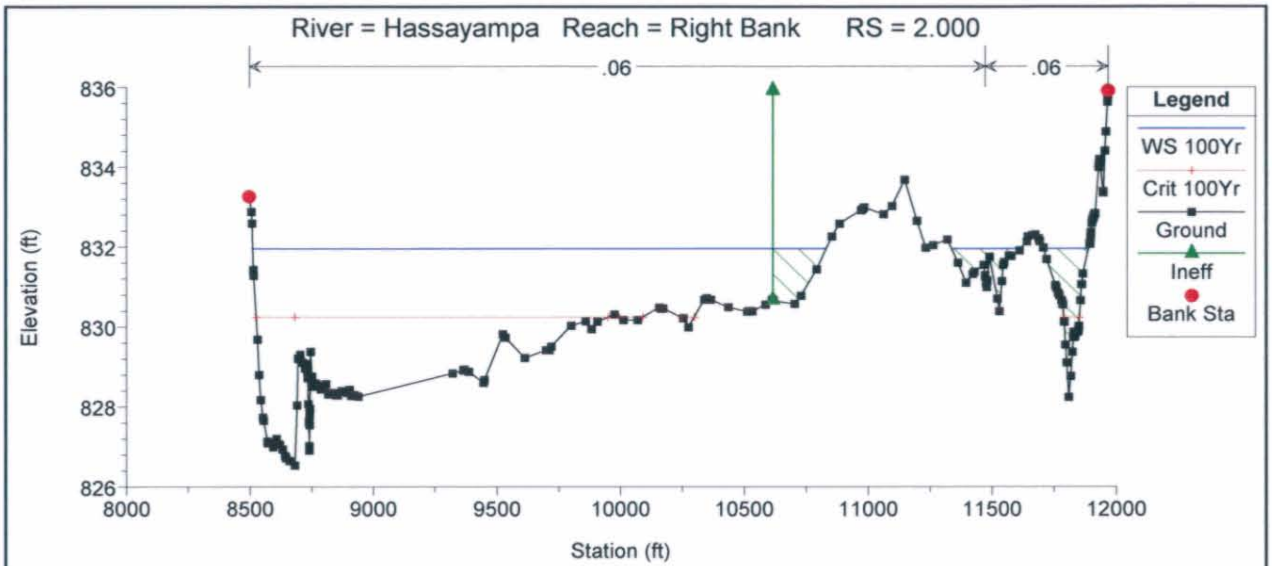

River = Hassayampa Reach = Right Bank RS = 2.480
.06
.06
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

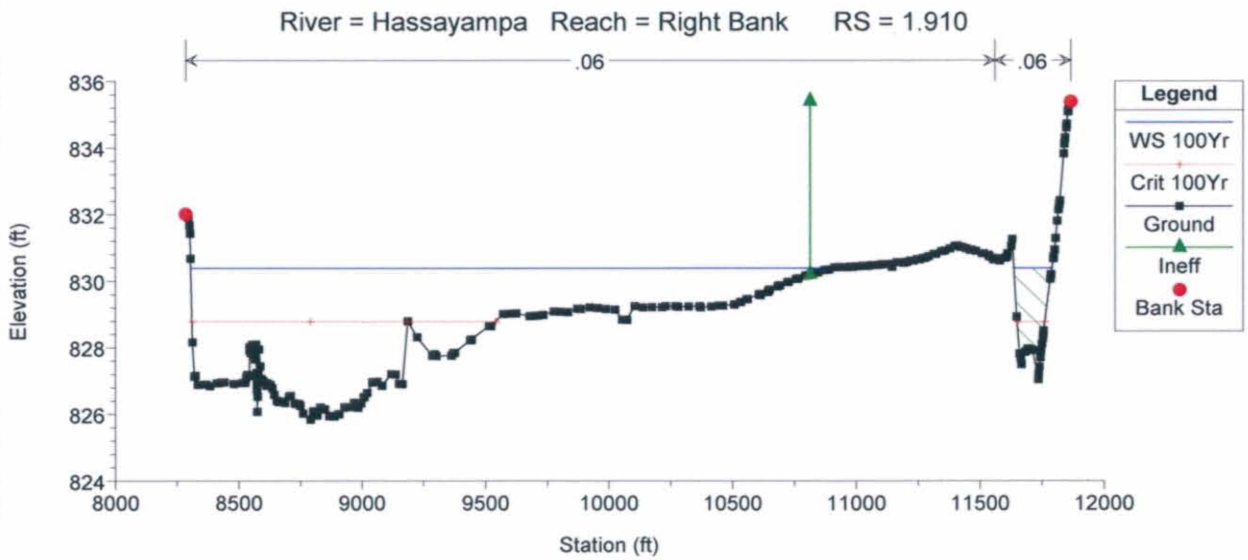

River = Hassayampa Reach = Right Bank RS = 2.380
.06
.06
.035
.028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

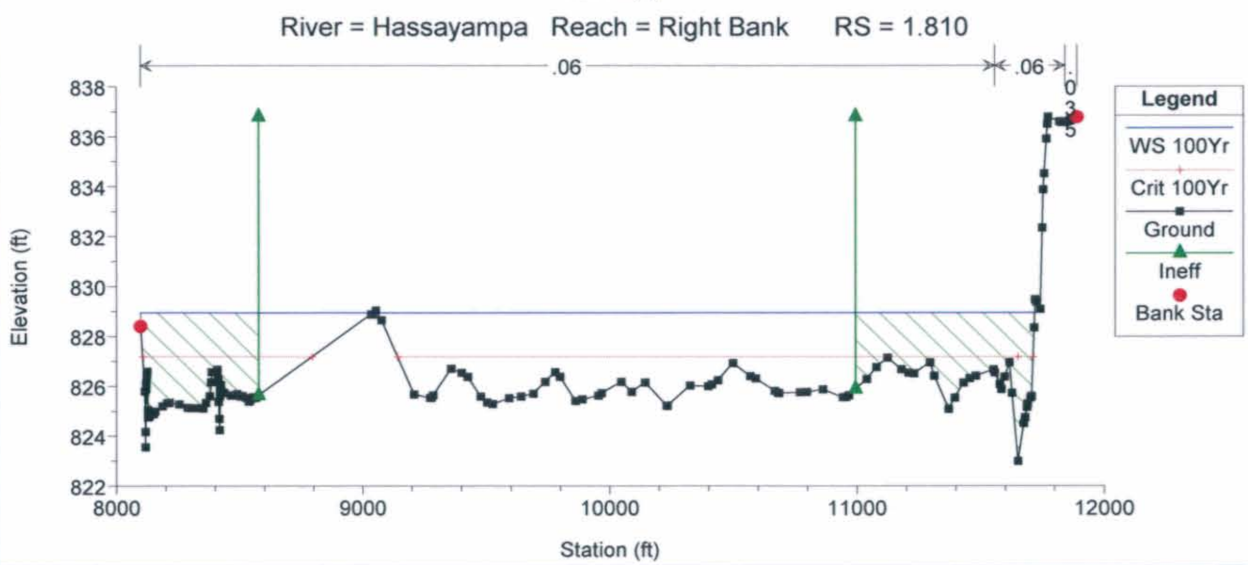

River = Hassayampa Reach = Right Bank RS = 2.290
.06
.06
.035
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

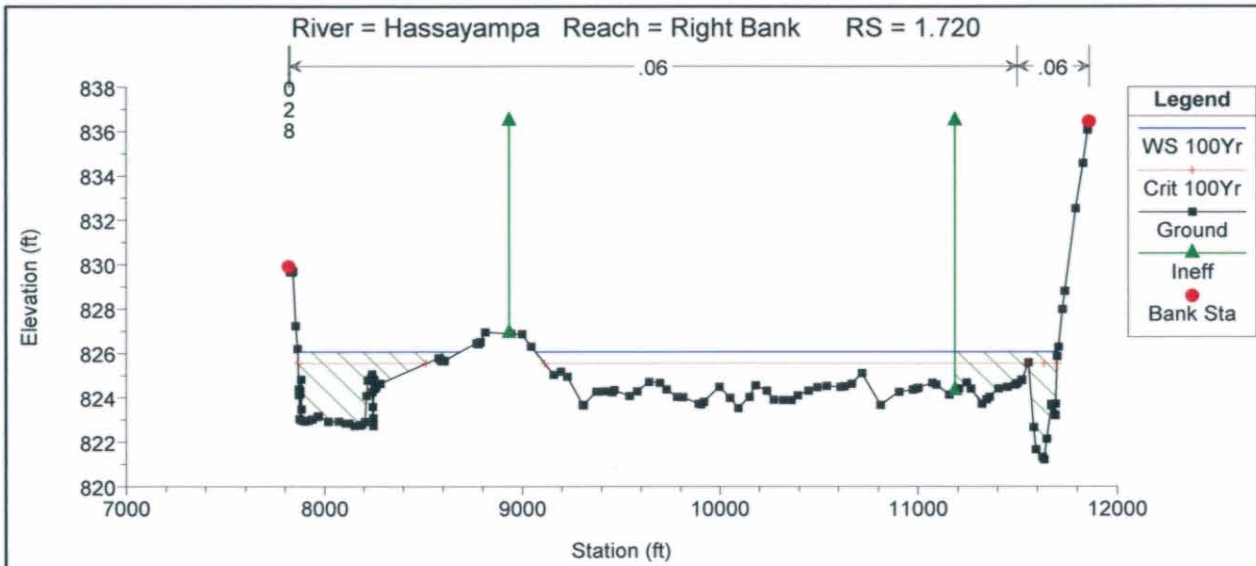

River = Hassayampa Reach = Right Bank RS = 2.190
.06
.06
.035
.028
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa Reach = Right Bank RS = 2.100
.06
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

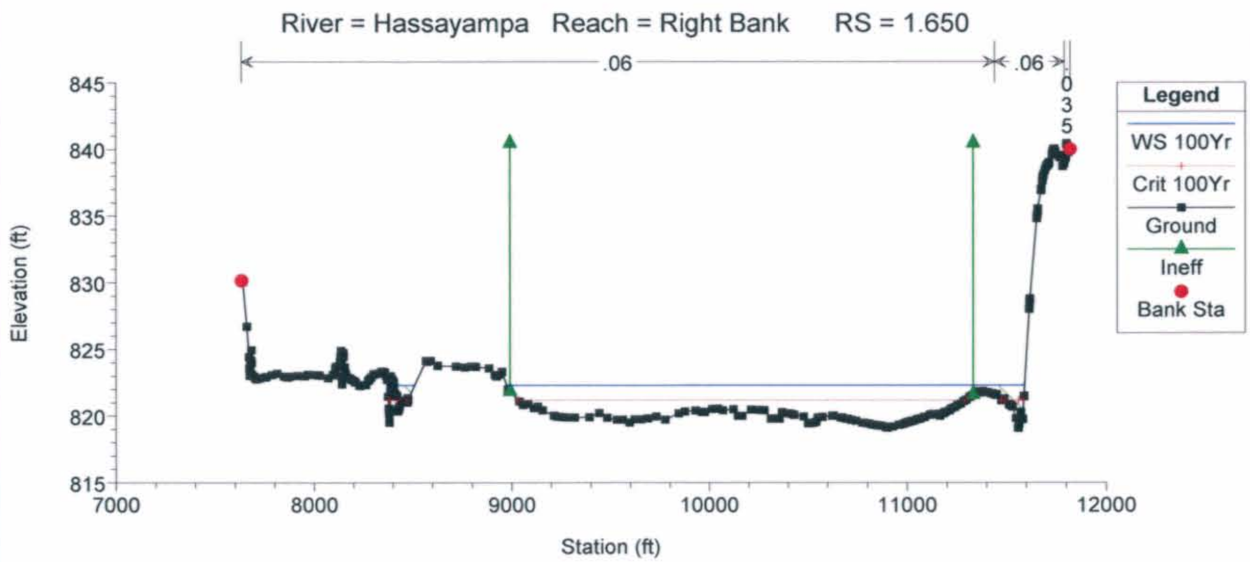

River = Hassayampa   Reach = Right Bank   RS = 2.000
.06
.06
Elevation (ft)
836
834
832
830
828
826
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa   Reach = Right Bank   RS = 1.910
.06
.06
Elevation (ft)
836
834
832
830
828
826
824
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

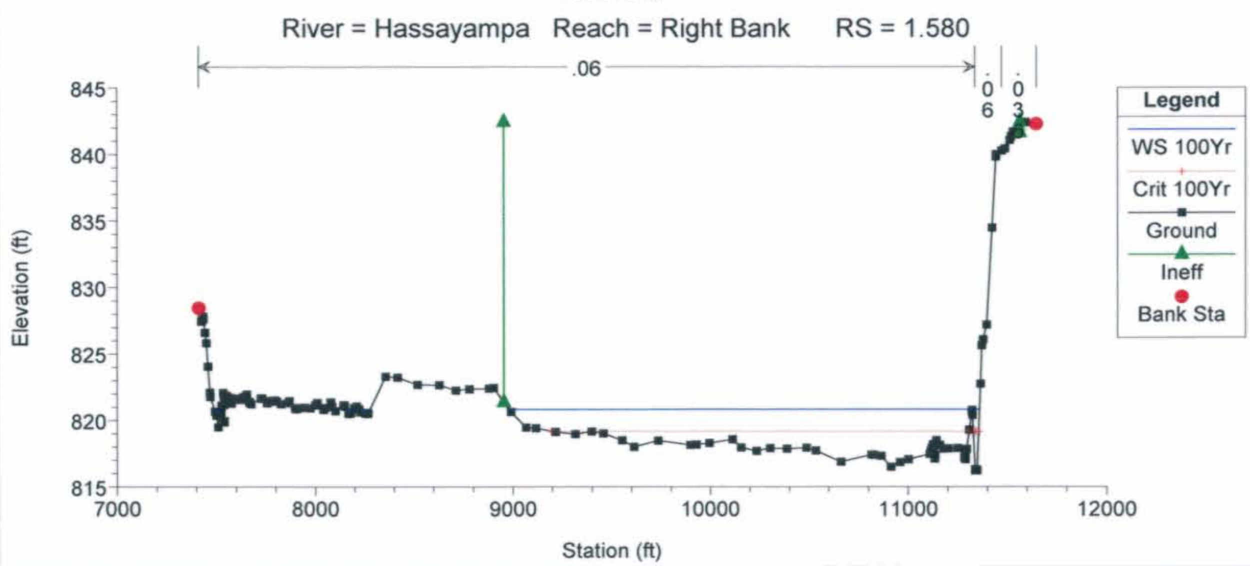

River = Hassayampa   Reach = Right Bank   RS = 1.810
.06
.06
.035
Elevation (ft)
838
836
834
832
830
828
826
824
822
8000
9000
10000
11000
12000
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta



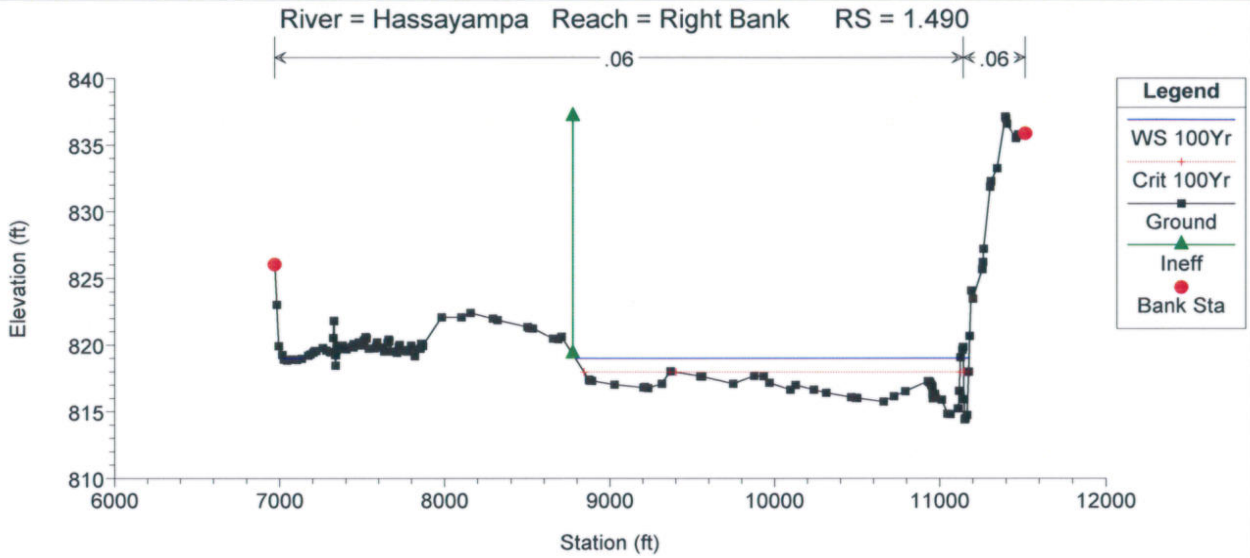
River = Hassayampa Reach = Right Bank RS = 1.720
.06
.06
028
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

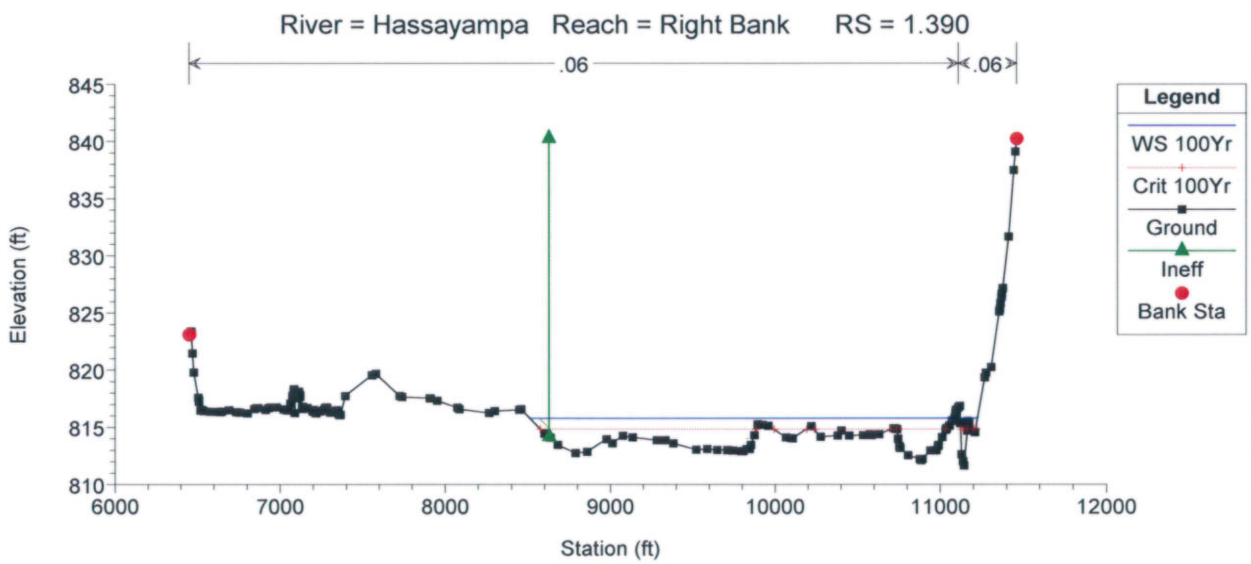


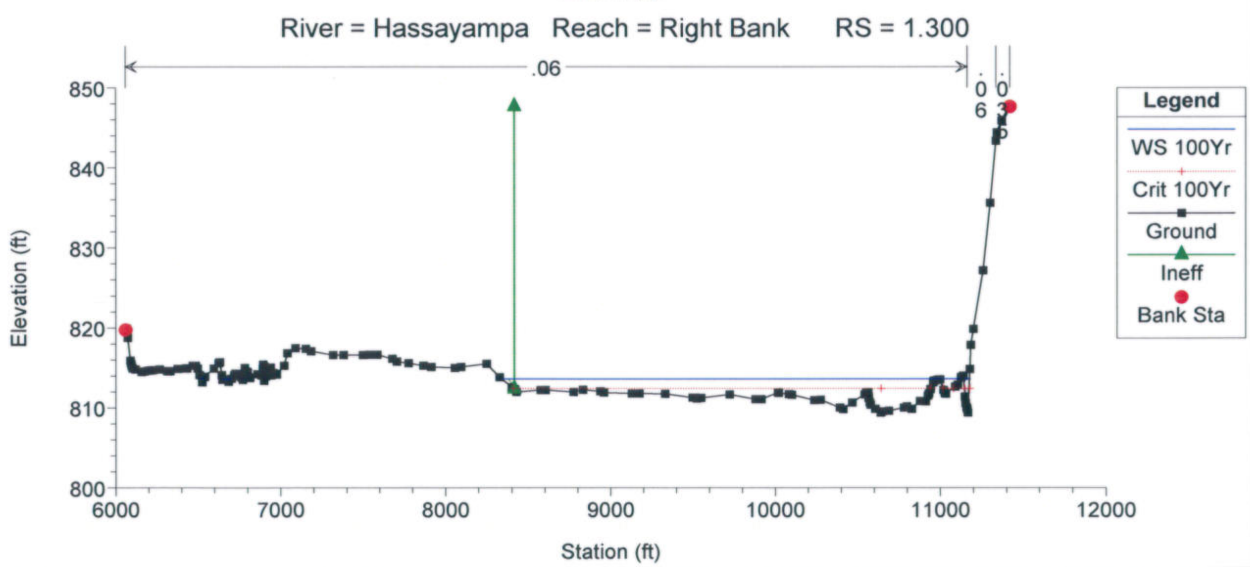
River = Hassayampa Reach = Right Bank RS = 1.650
.06
.06
035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

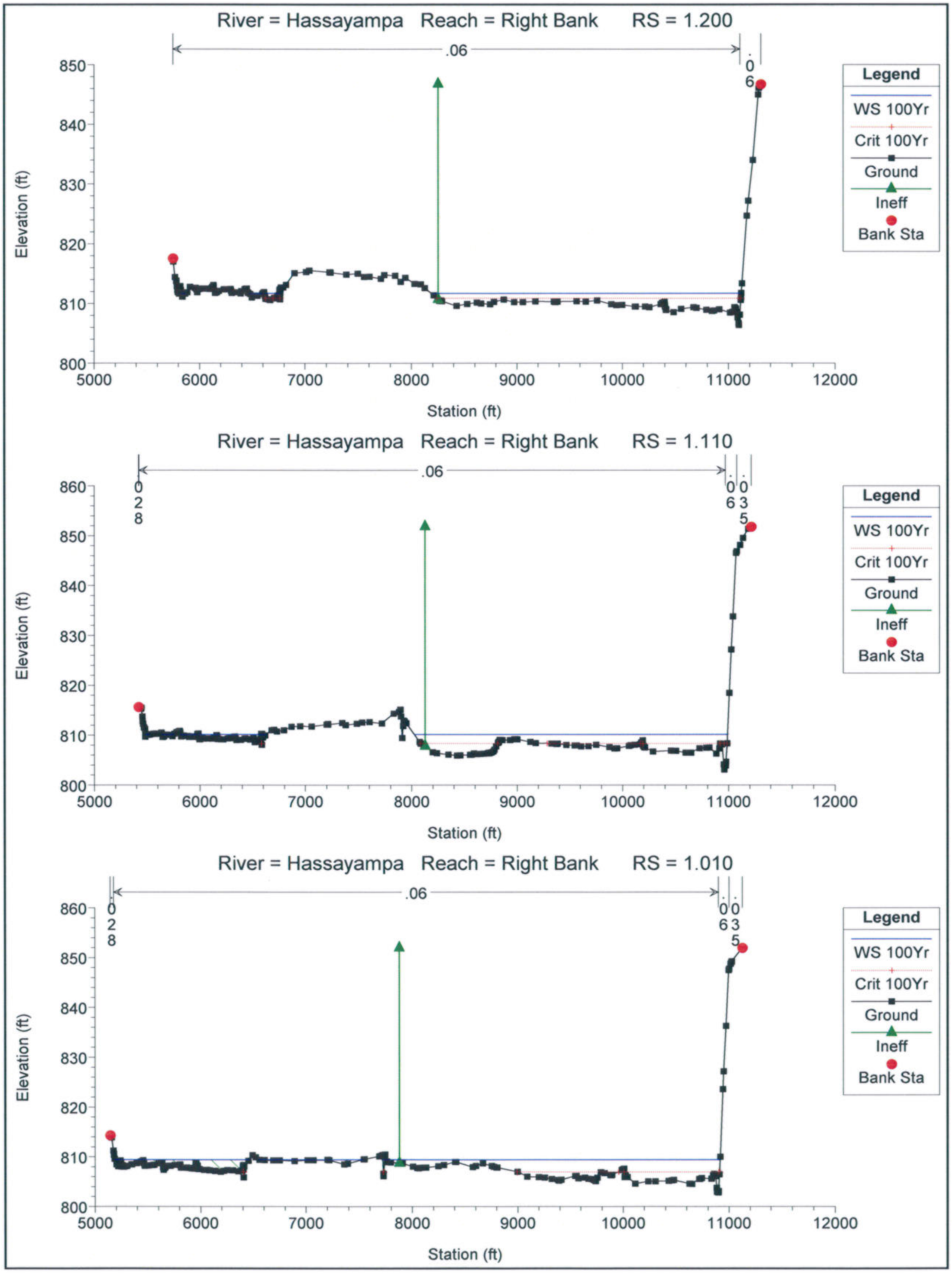


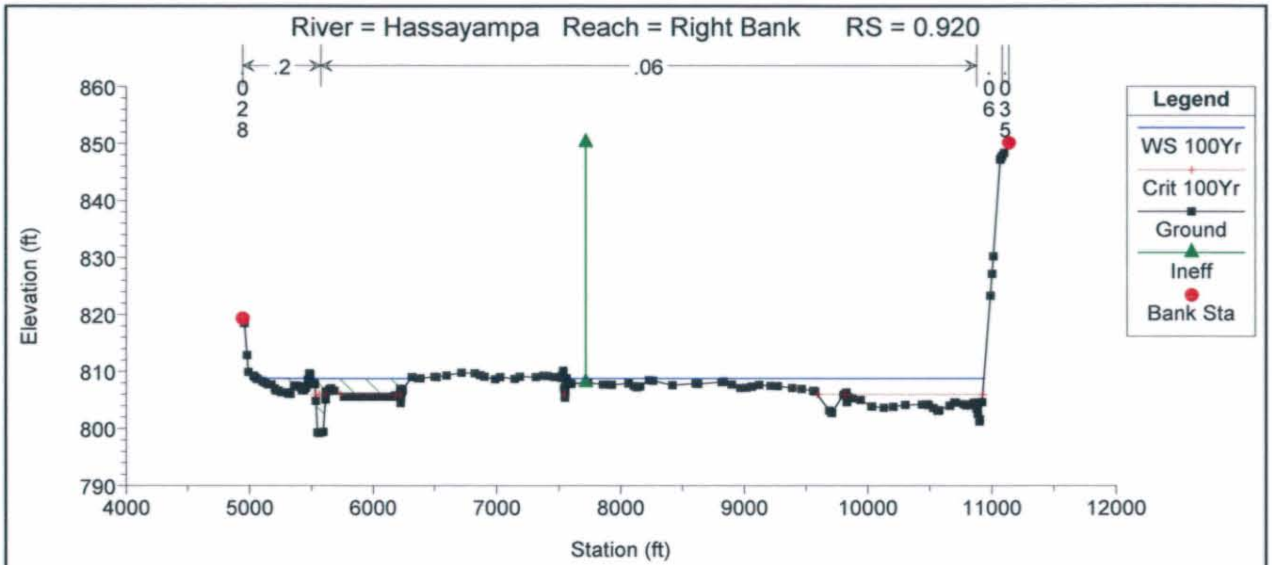
River = Hassayampa Reach = Right Bank RS = 1.580
.06
.06
.03
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

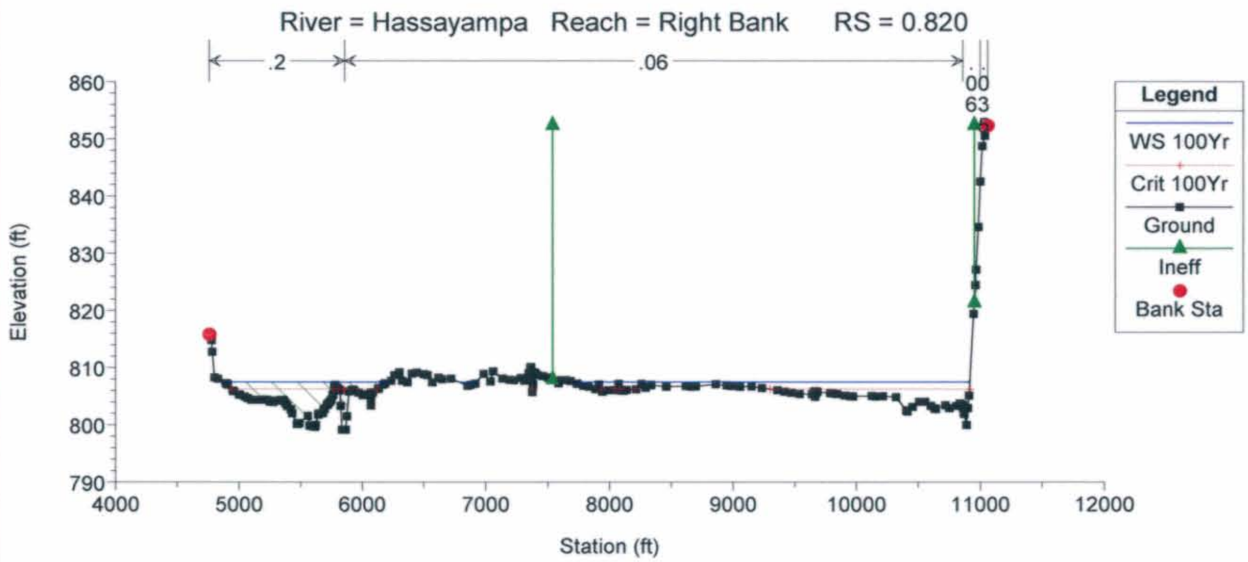

River = Hassayampa Reach = Right Bank RS = 1.490
.06
.06
Elevation (ft)
Station (ft)
840
835
830
825
820
815
810
6000
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

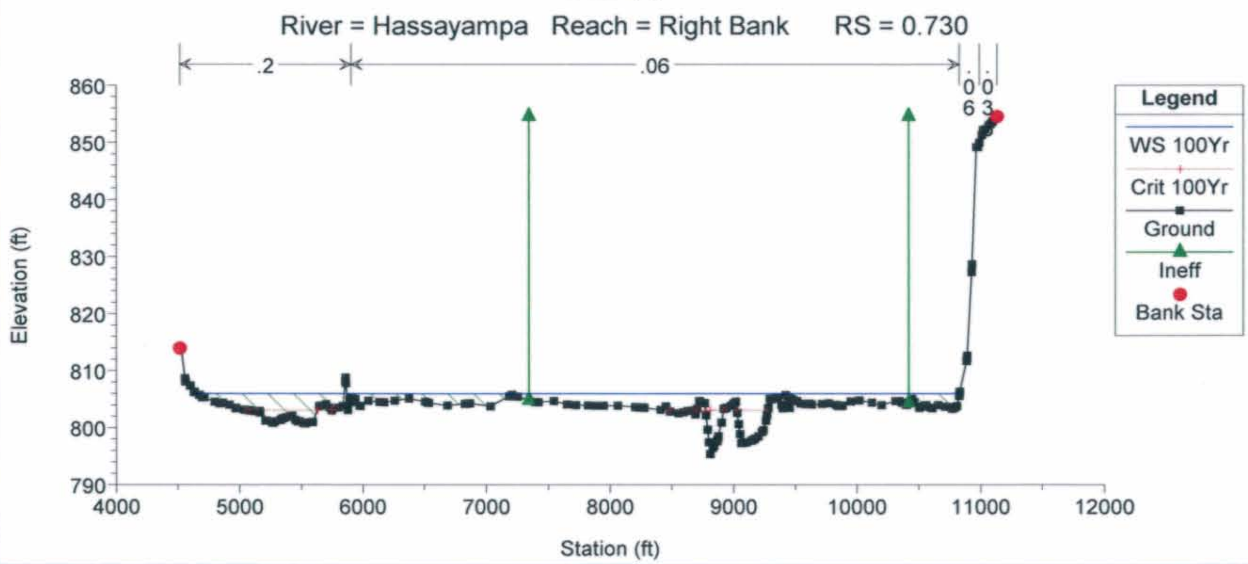

River = Hassayampa Reach = Right Bank RS = 1.390
.06
.06
Elevation (ft)
Station (ft)
845
840
835
830
825
820
815
810
6000
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

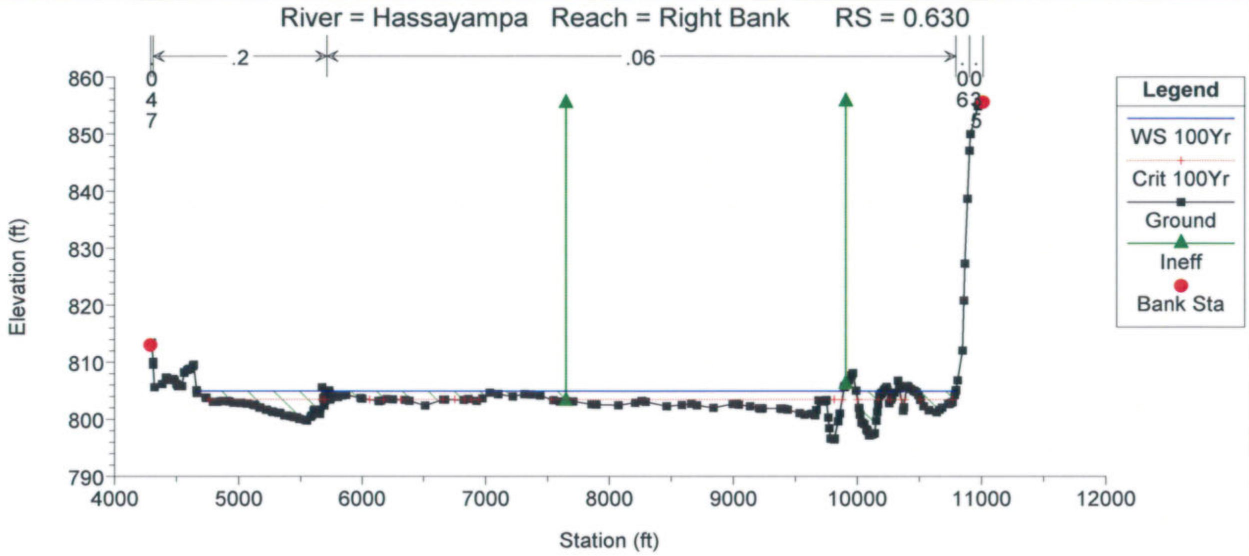

River = Hassayampa Reach = Right Bank RS = 1.300
.06
.06
.035
Elevation (ft)
Station (ft)
850
840
830
820
810
800
6000
7000
8000
9000
10000
11000
12000
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

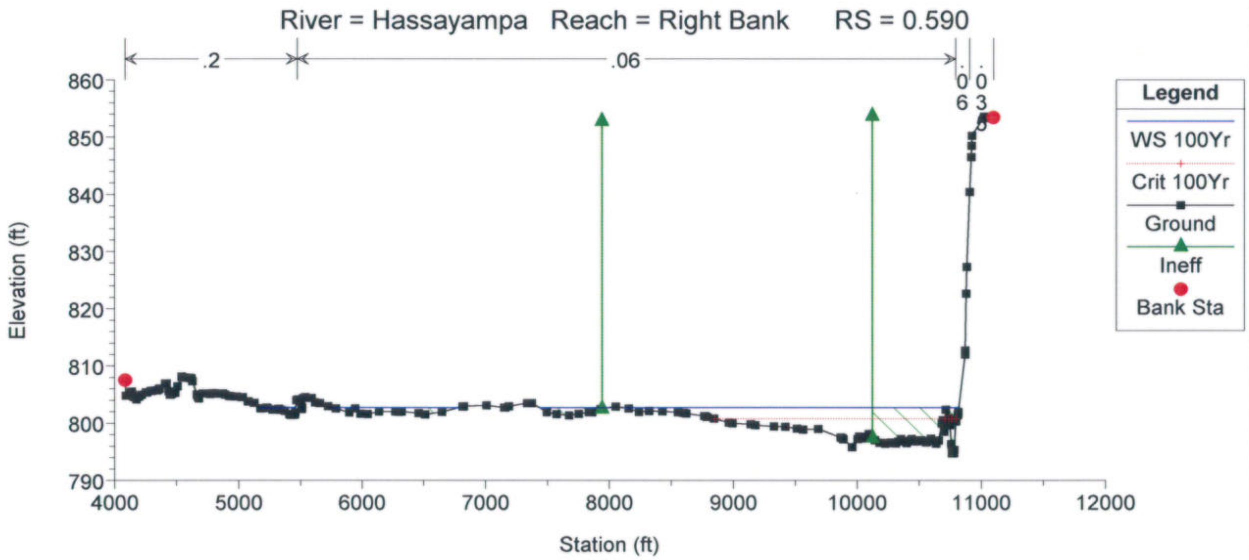

River = Hassayampa Reach = Right Bank RS = 1.200
.06
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Right Bank RS = 1.110
.028
.06
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
River = Hassayampa Reach = Right Bank RS = 1.010
.028
.06
.06
.035
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

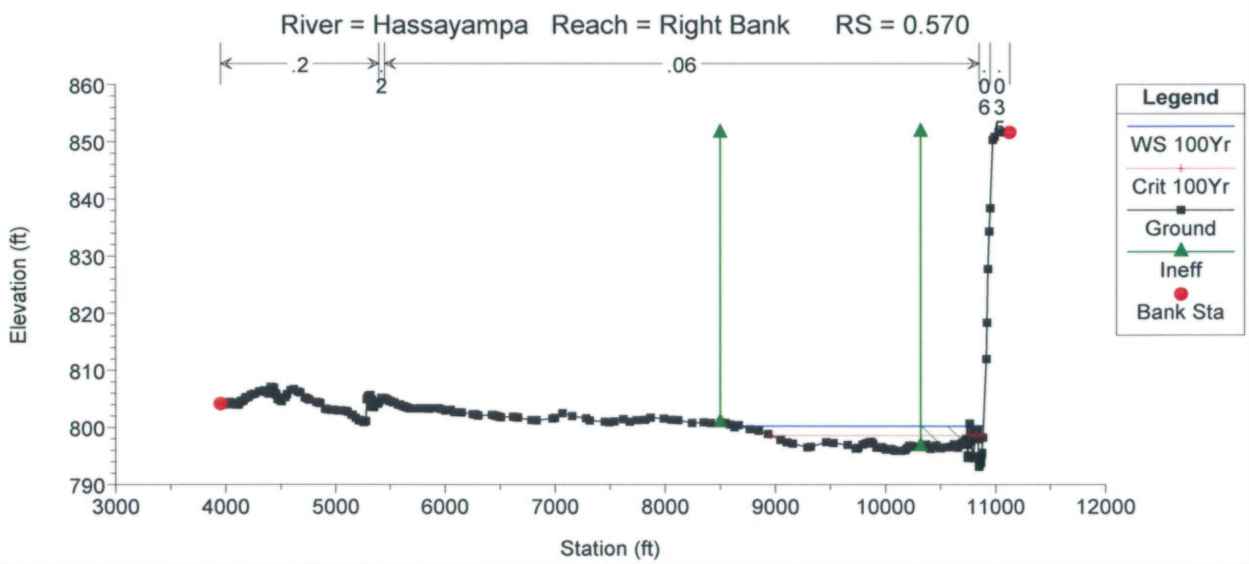

River = Hassayampa Reach = Right Bank RS = 0.920
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

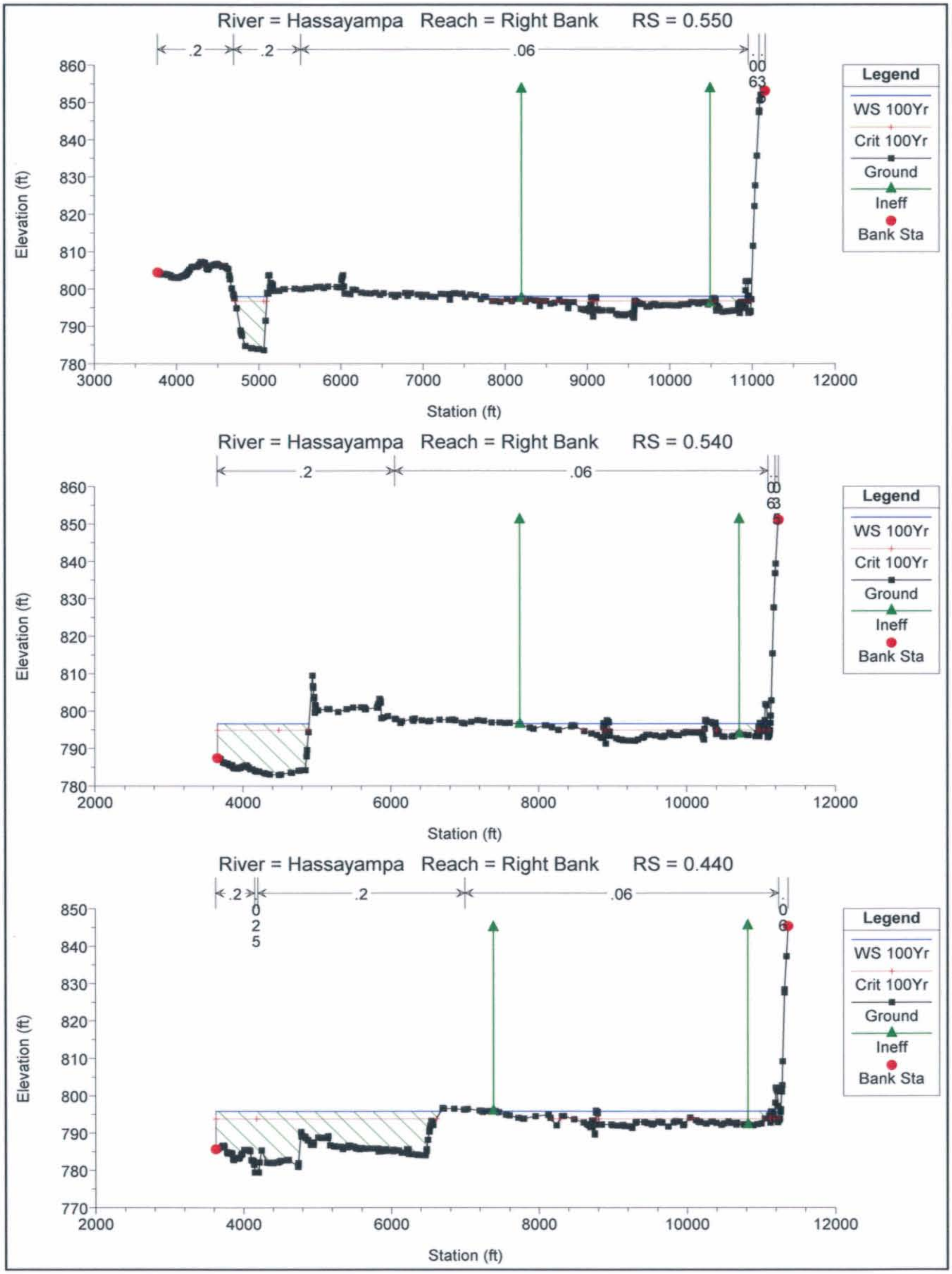

River = Hassayampa Reach = Right Bank RS = 0.820
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

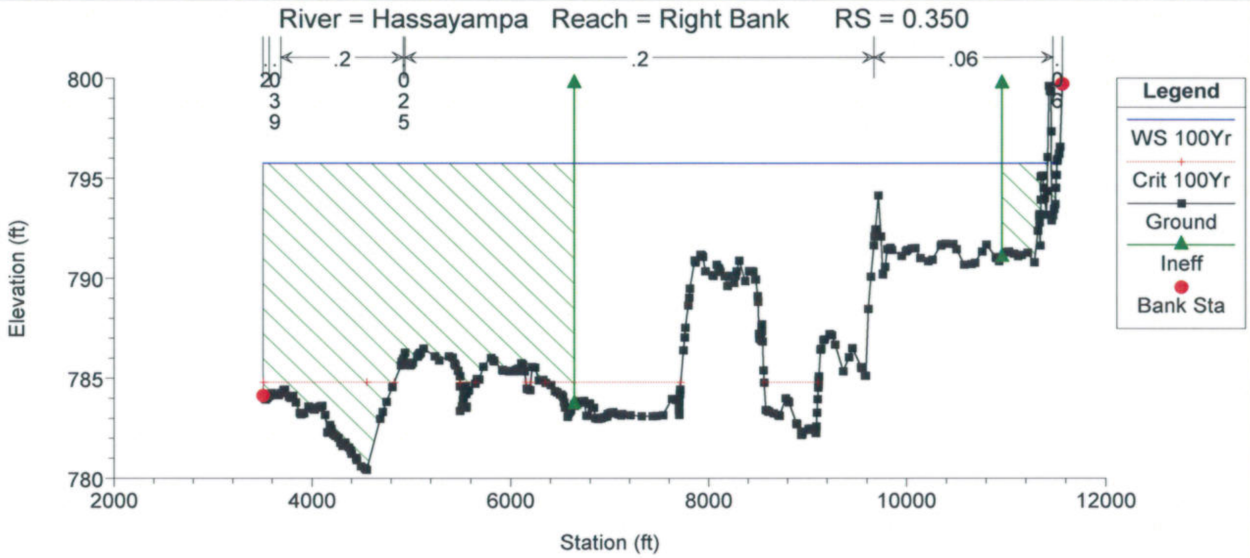

River = Hassayampa Reach = Right Bank RS = 0.730
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta


River = Hassayampa Reach = Right Bank RS = 0.630
.2
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Right Bank RS = 0.590
.2
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Right Bank RS = 0.570
.2
.06
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


River = Hassayampa Reach = Right Bank RS = 0.550
.2
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Right Bank RS = 0.540
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta
River = Hassayampa Reach = Right Bank RS = 0.440
.2
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta



River = Hassayampa Reach = Right Bank RS = 0.350
.2
.2
.06
Elevation (ft)
Station (ft)
Legend
WS 100Yr
Crit 100Yr
Ground
Ineff
Bank Sta

D. Spreadsheets

Ineffective Flow Area Elevation Determination for Pit Areas in Lower Hassayampa (XID 12.85, 12.75, 12.66, 12.56, 12.47, 12.37 & 13.51)
Bold numbers at the bottom of the elevation columns are average overbank elevations or predominant heights used to set the ineffective flow area elevations in HEC-RAS

12.85		12.75		12.66		12.56		12.47		12.37		13.51	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
11161.82	1068.95	11083.74	1070.3	11156.81	1070.36	10483.98	1068.64	10705.64	1059.71	10542.51	1058.31	11027.3	1084.9
11180.82	1068.88	11084.72	1069.81	11166.71	1062.44	10489.88	1067.09	10721.76	1061.77	10545.38	1058.24	11032.26	1085.28
11204.57	1067.64	11092.12	1066.28	11185.72	1049.53	10495.01	1064.93	10734.09	1061.34	10582.97	1057.35	11034.22	1085.22
11225.15	1066.77	11102.94	1066.68	11206.73	1049.42	10505.63	1062.26	10758.33	1060.37	10587.07	1057.37	11042.32	1082.9
11235.4	1066.45	11111.48	1066.96	11225.14	1049.85	10506.22	1062.11	10767.31	1059.95	10604.49	1057.53	11043.33	1082.88
11247.62	1065.79	11124	1066.58	11229.65	1049.38	10507.04	1061.92	10774.8	1060.02	10617.67	1057.75	11044.12	1082.88
11260.75	1069.36	11129.49	1066.39	11234.81	1051.22	10514.92	1059.56	10784.29	1060.78	10625.64	1056.97	11050.01	1082.73
11267.49	1071.18	11133.49	1067.34	11248.67	1054.25	10524.45	1059.5	10802.25	1061.4	10626.72	1056.9	11071.98	1082.24
11273.62	1069.87	11135.72	1067.83	11252.09	1054.35	10531.88	1059.5	10813.6	1061.71	10628.57	1056.97	11074.42	1082.16
11284.23	1067.67	11137.06	1067.85	11256.74	1054.92	10536.18	1059.5	10827.59	1061.49	10636.7	1057.5	11077.3	1082.17
11302.29	1067.64	11145.34	1067.89	11259.07	1054.02	10537.58	1060.26	10836.95	1061.6	10653.92	1057.3	11078.37	1082.17
11321.45	1067.77	11152.24	1067.81	11261.29	1053.25	10545.94	1063.54	10872.22	1061.45	10673.24	1057.12	11115.06	1082.1
11339.22	1068.13	11157.57	1067.75	11264.02	1052.19	10550.18	1061.24	10877.3	1061.55	10702.92	1057.05	11119.39	1082.06
11348.97	1068.38	11191.82	1067.59	11268.19	1050.23	10551.96	1059.98	10883.31	1061.54	10715.49	1057.18	11136.36	1082.08
11374.33	1068.83	11246.69	1067.15	11269.83	1049.38	10570.53	1060.17	10908.42	1061.91	10749.13	1058.88	11144.56	1081.98
11382.9	1068.91	11257.22	1067.33	11272.75	1049.38	10578.09	1060.3	**Average:**	**1061.106**	**Average:**	**1057.495**	11160.17	1081.98
11385.26	1068.9	11275.3	1067.25	11276.04	1049.38	10580.7	1061.29					11171.72	1082.18
11387.61	1068.86	11332.34	1067.41	11277.34	1049.38	10583.45	1062.79					11177.65	1082.28
11405.86	1068.53	11333.3	1067.41	11279.92	1049.38	10584.71	1062.19					11192.97	1082.82
11412.79	1068.67	11412.46	1066.96	11282.12	1049.38	10590.48	1060.27					11215.23	1083.15
11425.6	1068.93	11424.91	1066.94	11284.37	1049.38	10592.91	1060.27					11224.88	1083.21
11441.23	1068.08	11437.2	1066.91	11285.27	1049.38	10594.16	1060.27					11232.46	1083.33
11443.77	1067.95	11503.21	1067.1	11307.36	1049.38	10599.07	1060.27					11243.24	1083.74
11447.27	1069.01	11515.27	1067.14	11309.58	1049.38	10633.73	1060.27					11249.6	1084.52
11447.31	1069.02	11544.16	1067.34	11316.69	1049.38	10668.8	1060.27					11254.79	1085.47
11447.32	1069.01	11568.68	1067.32	11317.16	1049.38	10681.78	1060.27					11266.54	1086.84
11451.03	1067.88	11573.19	1067.49	11319.23	1049.38	10686.72	1061.45					**Average:**	**1083.203**
11455.36	1067.78	11593.09	1067.1	11319.72	1049.38	10692.35	1063.04						
11467.54	1067.47	11600.55	1069.66	11323.15	1049.38	10695.84	1063.2						
11467.78	1067.54	11609.75	1071.62	11345.57	1049.38	10703.1	1063.27						
11472.66	1068.76	11610.19	1071.74	11364.6	1049.38	10709.73	1063.22						
11473.93	1068.64	11611.2	1070.61	11369.6	1049.38	10729.3	1063.09						
11478.06	1068.41	11624.04	1056.13	11414.2	1049.38	10732.2	1063.05						
11479.5	1067.97	11635.41	1056.24	11415.04	1049.38	10745.09	1061.32						
11508.78	1067.99	11639.71	1056.281	11424.44	1049.38	10745.46	1061.18						
11564.75	1068.14	11642.79	1056.31	11426.44	1049.38	10756.88	1059.99						
11592.14	1068.18	11644.31	1057.52	11427.21	1049.38	10763.74	1059.82						

12.85		12.75		12.66		12.56	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
11645.14	1068.66	11648.16	1060.75	11428.58	1049.38	10772.14	1059.78
11648.91	1068.68	11654.53	1061.63	11429.15	1049.38	10778.84	1059.68
11681.87	1068.4	11673.45	1063.82	11429.23	1049.38	10787.24	1059.95
11685.97	1068.36	11680.32	1061.15	11437.62	1058.18	10790.72	1060.28
11719.08	1069.14	11696.32	1059.08	11442.58	1063.71	10804.69	1061.29
11734.63	1069.52	11701.13	1059.85	11450.31	1063.66	10807.35	1061.51
11737.44	1069.52	11708.7	1060.8	11453.72	1063.8	10808.52	1061.52
11781.21	1069.06	11718.03	1062.91	11461.86	1067.68	10823.3	1061.32
11820.64	1068.64	11723.38	1063.83	11461.89	1067.69	10828.77	1063.11
11823.27	1068.62	11724.85	1063.84	11471.44	1063.6	10830.58	1063.01
11825.74	1068.6	11730	1064.81	11474.3	1062.23	10834.94	1059.94
11886.97	1068.88	11736.07	1065.24	11480.1	1062.29	10836.86	1058.65
11889.47	1068.9	11746.09	1067.71	11492.45	1062.3	10846.57	1058.81
11892.64	1069.14	11747.55	1068	11501.78	1062.69	10849.62	1058.59
11903.15	1070.12	11763.69	1067.42	11513.01	1063.36	10852.98	1061.45
11908.65	1070.55	11765.24	1067.36	11517.04	1064.47	10856.61	1062.56
11912.42	1070.69	11766.02	1067.42	11522.14	1064.33	10858.98	1062.4
11923.39	1071.13	11790.91	1066.95	11531.76	1065.78	10863.02	1060.77
11925.53	1070.38	11800.37	1067.07	11535.95	1066	10875.98	1061.28
11933.13	1068.22	11804.79	1067.33	11547.9	1069.75	10885.29	1061.65
11943.5	1067.68	11816.22	1067.58	11553.74	1070.33	10892.39	1062
11955.32	1067.52	11817.82	1067.6	11560.44	1070.39	10913.45	1061.83
11962.57	1065.99	11833.13	1067.83	11576.33	1070.81	10915.01	1061.79
11965.16	1065.428	11866.36	1068.2	11579.2	1070.12	10921.44	1061.62
11967.41	1064.94	11887.98	1067.65	11584.69	1069.07	10925.89	1061.78
11977.65	1064.85	11898.68	1067.41	11596.46	1073.02	10933.28	1061.89
11990.43	1064.23	11917.86	1068.08	11611.62	1076.55	10936.24	1063.6
11996.28	1061.92	11928.2	1068.89	11619.94	1076.74	10940.52	1067.4
11999.63	1061.16	11935.2	1068.76	11636.65	1079.07	10947.25	1070.71
12011.44	1061.71	11946.73	1067.95	11639.62	1079.31	10951.08	1069.56
12014.97	1061.92	11949.77	1067.82	11640.87	1079.32	10959.26	1067.86
12017.15	1062.18	11952.09	1067.72	11642.41	1079.32	10966.63	1066.95
12030.3	1064.12	11973.63	1066.59	11654.51	1078.79	10971.86	1066.89
12065.76	1066.49	11981.43	1067.52	11670.81	1075.78	10982.49	1067.79
12072.69	1067.33	11983.81	1067.84	11681.01	1075.07	10984.32	1068.06
12094.85	1069.97	11986.04	1067.84	11695.19	1069.59	10986.07	1068.3
12115.27	1073.04	11998.16	1067.84	11697.52	1068.62	10996.34	1067.87
12149.18	1072.93	12005.63	1067.22	11699.48	1068.53	10998.83	1067.5
12160.13	1072.88	12006.63	1067.12	11704.22	1068.15	11008.39	1068.6
12169.38	1072.7	12013.42	1068.16	11706.17	1067.33	11013.54	1067.91
12211.84	1072.31	12013.56	1068.19	11708.68	1066.36	11019.4	1065.84

12.85		**12.75**		**12.66**		**12.56**	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
12232.79	1072	12014.71	1068.2	11710.35	1066.9	11019.8	1066.04
12265.63	1071.67	12026.9	1068.38	11712.84	1067.29	11022.52	1064.69
Average:	**1068.226**	12032.77	1067.61	11720.08	1069.54	11038.25	1057.67
		12036.7	1067.13	11737.25	1073.21	11042.76	1059.03
		12038.4	1067.33	11740.26	1073.6	11044.75	1059.69
		12043.65	1067.87	11743.21	1073.61	11049.29	1058.39
		12044.97	1068.01	11746.82	1073.35	11050.2	1058.15
		12045.55	1068.02	11763.88	1073.1	11052.11	1058.18
		12058.92	1068.41	11772.06	1072.08	11086.79	1058.46
		12067.83	1068.61	11774.78	1071.84	11087.66	1058.47
		12069.48	1068.31	11786.29	1070.7	11090.81	1058.54
		12074.92	1067.45	11804.42	1068.81	11111.95	1063.37
		12076.85	1067.3	11806.14	1068.71	11117.3	1064.7
		12079.91	1067.31	11812.35	1069.09	11118.59	1065
		12085.15	1067.59	11815.05	1068.69	11123.29	1065.73
		12089.82	1067.86	11818.51	1067.42	11130.77	1063.48
		12096.84	1068.25	11823.46	1066.29	11135.33	1062.19
		12104.55	1068.34	11824.23	1066.17	11152.92	1056.9
		12110.32	1068.44	11837.08	1066.4	11171.91	1050.97
		12115.27	1068.53	11837.28	1066.38	11173.39	1050.44
		12122.89	1068.95	11837.47	1066.35	11176.81	1049.38
		12124.55	1069.19	11848.91	1068.16	11182.08	1049.38
		12126.9	1069.35	11851.88	1069.2	11190.67	1049.38
		12136.46	1069.62	11864.5	1072.34	11193.93	1051.83
		12148.06	1071.22	11870.41	1073.24	11210.37	1063.95
		Average:	**1066.719**	**Average:**	**1062.19**	11210.96	1062.62
						11217.26	1058.08
						11219.79	1058.25
						11226.3	1058.43
						11230.85	1061.7
						11241.64	1070.99
						Average:	**1061.639**

E. Survey Notes

HLS
Hersey Land Surveying

August 9, 2005

Leo Kreymborg
West Consultants, Inc.
960 W. Elliot Road
Suite 201
Tempe, Arizona 85284

Regarding: Lower Hassaympa River Topographic Survey

Dear Leo,
In October of 2004, Hersey Land Surveying under contract with West Consultants performed topographic surveys of 3 bridge locations along the Lower Hassaympa River. This letter is to confirm that the vertical datum used to perform those surveys was the North Atlantic Vertical Datum of 1988(NAVD 88).

Sam Hersey
President,
Hersey Land Surveying

5025 S. Ash Ave. Suite B/3
Tempe, Az. 85282
Email: Shersey@cox.net

(480) 897-0018
Fax: (480) 897-9688
Cell: (602) 377-7400

HLS

HERSEY LAND SURVEYING, L.L.C.
5025 S. Ash Ave. Suite B/3
Tempe, Arizona 85282
Phone: (480) 897-0018
Fax: (480) 897-9688

LETTER OF TRANSMITTAL

TO: West Consultants, Inc.
960 West Elliot Rd.
Suite 201
Tempe, AZ. 85284

DATE: 11/8/04 PROJECT # 4187

ATTENTION: Leo Kreymborg

RE: Hassayampa River Bridges

WE ARE SENDING ☒ ATTACHED VIA: ☐ UNDER SEPARATE COVER
THE FOLLOWING ITEMS:

☐ SHOP ☐ PRINTS ☐ PLAN ☐ SAMPLES ☐ SPECIFICATIONS ☐ COPY OF
☐ CHANGE ORDER ☒ Field Data

COPIES	DATE	NO.	DESCRIPTION
1	11/1/04		Point Coordinates & Field Sketches for Hassayampa River Bridges

THESE ARE TRANSMITTED AS CHECKED

☐ FOR APPROVAL ☐ APPROVED AS SUBMITTED ☐ RESUBMIT COPIES FOR
☒ FOR YOUR USE ☐ APPROVED AS NOTED ☐ SUBMIT COPIES FOR DISTRIBUTION
☒ AS REQUESTED ☐ RETURNED FOR CORRECTIONS ☐ RETURN CORRECTED PRINTS
☐
☐ FOR REVIEW AND COMMENT
☐ FOR BIDS DUE ☐ PRINTS RETURNED AFTER LOAN

REMARKS:

COPY TO: cont.

SIGNED: Sam Hersey

IF ENCLOSURES ARE NOT AS NOTED, KINDLY NOTIFY US AT ONCE.

Dear Sam,

I've striken-through the items we no longer need, and added comments in capital letters. The changes are mostly based on the drawings we just received for the railroad bridges. The hand-written comments on the item list we gave you at yesterday's meeting still apply, unless they refer to a crossed-out item or are overridden here.

See the comments for the I-10 bridges also.

Leo Kreymborg
July 22, 2004

Measurements needed for Railroad bridge:

(1) (a) x-y coordinates of the west abutments, upstream and downstream faces (at the corners) (2 coordinates) (see page 2, 3)
(b) x-y coordinates where the ground meets the wood trestle on the east side, on both upstream and downstream sides of the bridge (2 coordinates) (see page 6)

(2) x-y coordinates at the upstream side for every trestle (wood) pier (visually estimate the center of the pier) ~~and every concrete pier~~. (1 coordinate for each wooden pier) (see page 5) DON'T NEED COORDINATES AT EVERY CONCRETE PIER, JUST THE EASTMOST AND WESTMOST PIERS WHICH IS DESCRIBED IN #6.

(3) The trestle (wood) pier widths (looking north / south) (if not all the same width, measure the different widths and identify which piers have which width). (1 width, unless the widths vary) (see page 6)

~~(4) At concrete pier that supports steel structure (westmost pier is easiest to access at the top):~~
~~(a) Length and width at top. (see page 8)~~
~~(b) Length and width 12 feet below the top (can't use the westmost pier for this since it's buried at 12 feet below the top, use another pier). (see page 4)~~ #4 NO LONGER NEEDED

(5) The low chord at (all taken on upstream side):
(a) The east abutment (under the wood trestle) (see page 7)
(b) The wood trestle where it meets the steel structure. (see page 7)

(6) x-y-z coordinates at the upstream ~~and downstream~~ top center of eastmost and westmost concrete piers (the eastmost pier is where the steel structure meets the wood trestle). (see page 7, page 8) DON'T NEED THE DOWNSTREAM COORDINATES

~~(7) Elevation of the bottom of the steel structure at the concrete pier on west side where steel structure and wood trestle meet. (see page 7)~~
#7 NO LONGER NEEDED

~~(8) The elevation at top of the steel structure at the westmost pier (the easiest to access). (see page 3)~~ #8 NO LONGER NEEDED

~~(9) Elevation at bottom of the steel structure just east of the west most pier (where the structure becomes flat underneath until the next pier). (see page 3)~~ #9 NO LONGER NEEDED

(10) Elevation at the top of the guard rail for the westmost pier. (see page 3)

(11) n/a

~~(12) Same measurements as #4 for the concrete pier that supports the wood trestle.~~ #12 NO LONGER NEEDED

I-10 Bridges:

(1): The x,y and the low chord elevation on the upstream (OR DOWNSTREAM) side at the westmost pier of each of the two bridges. IN THE OUR MEETING ON 7/21 WE HAD AGREED THAT YOU WOULD TAKE THE TOP OF THE CURB ELEVATION, HOWEVER LET'S GO BACK TO TAKING THE LOW CHORD AS DESCRIBED HERE, AND NO TOP OF CURB. BASED ON OUR TELEPHONE CONVERSATION, IT SHOULDN'T BE THAT MUCH MORE DIFFICULT. I HAVE ALSO NOW GIVEN YOU THE OPTION OF SHOOTING EITHER THE UPSTREAM OR DOWNSTREAM SIDE (CAN EVEN SHOOT UPSTREAM ON ONE BRIDGE AND DOWNSTREAM ON THE OTHER IF DESIRED), WHICH MIGHT MAKE IT A LITTLE EASIER.

Old US-80 bridge:

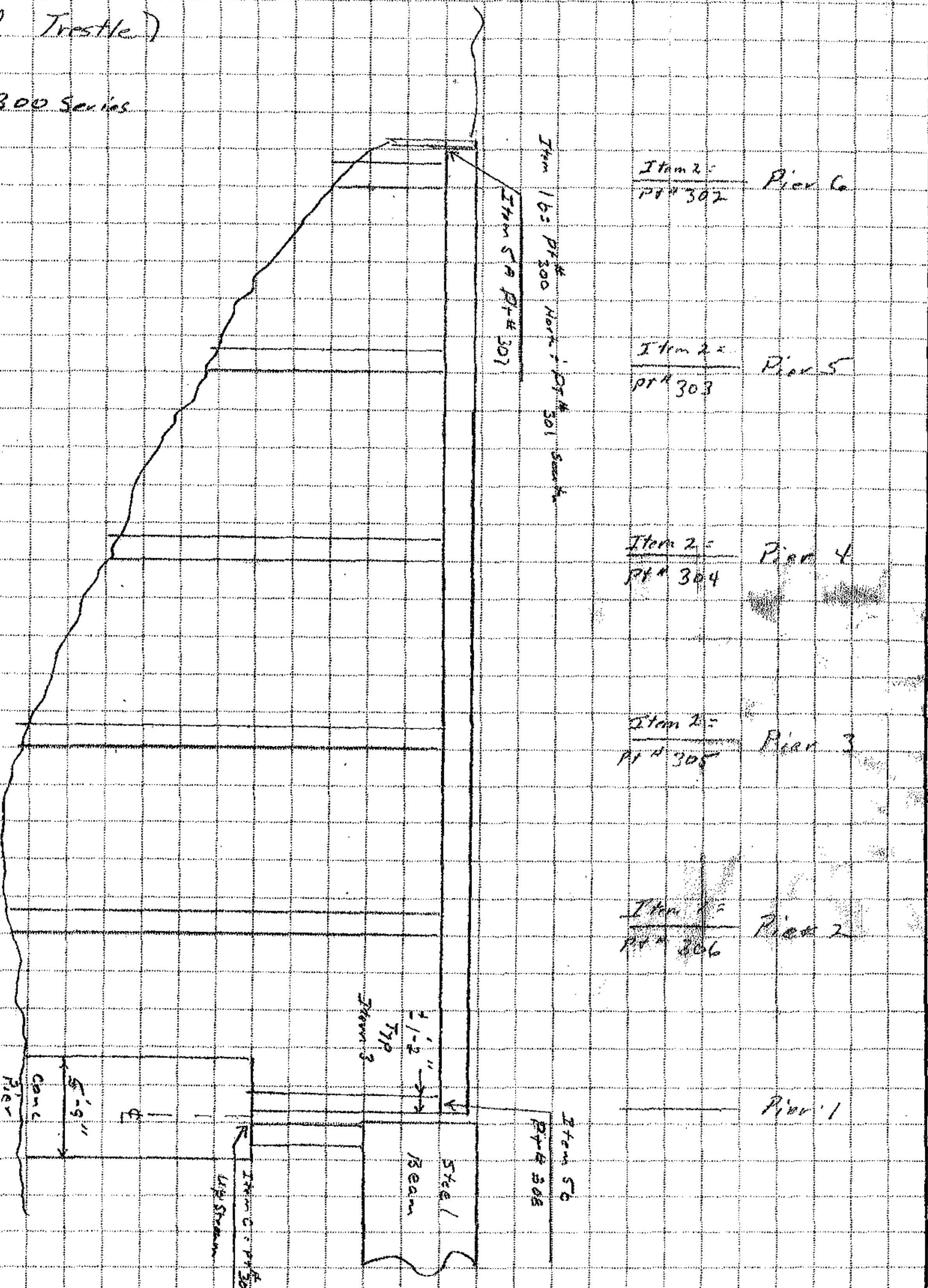
(1) x, y and elevation of the low chord on both the upstream and downstream sides of the west pier, where the west pier meets the girders.
(2) Elevation of top of concrete, on the top of bridge, north side, just over the western pier
(3) Elevation of top of fence, on the north side, just over the western pier.

Hersey Land Surveying
304 West Jeanine Drive
Tempe, AZ. 85284
Phone (480) 897-0018
Fax (480) 897-0018

SHEET NO. 1 OF 2
CALCULATED BY RWL DATE 11-1-04
CHECKED BY ______ DATE ______
SCALE ______

Hassayampa RR Bridge
Looking South
(Wood Trestle)

Location 300 Series



Hersey Land Surveying
304 West Jeanine Drive
Tempe, AZ. 85284
Phone (480) 897-0018
Fax (480) 897-0018

SHEET NO. 2 OF 2
CALCULATED BY RWL DATE 11-1-04
CHECKED BY ______ DATE ______
SCALE ______

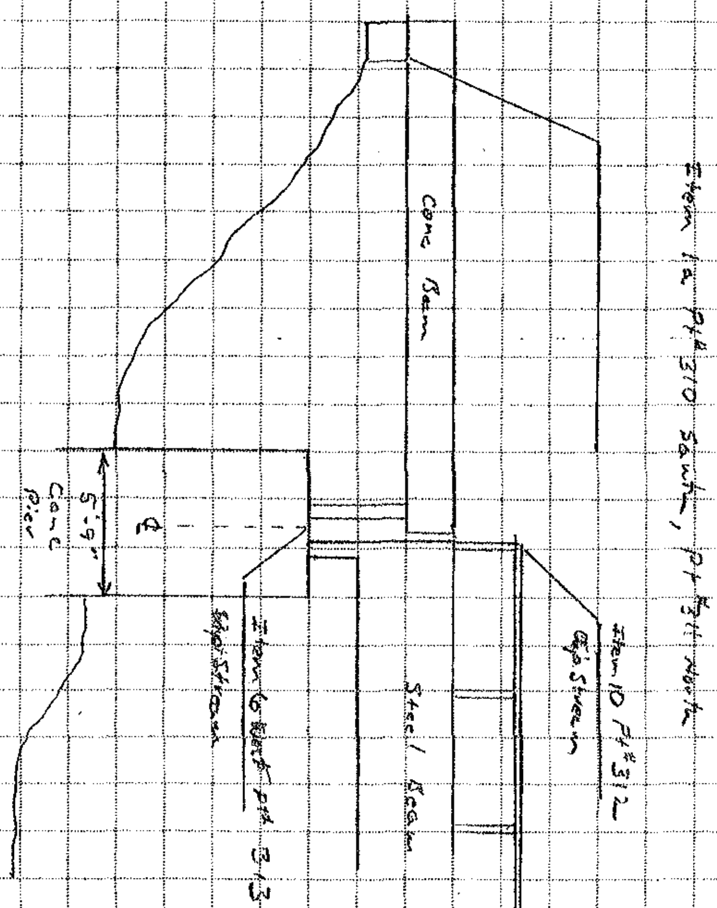
Hassayampa RR Bridge
Looking North

Control

#109	861,011.129	450,198.193	867.245	M2 HST
#110	861,213.092	450,124.567	868.089	M2 HST
#111	861,437.510	451,054.063	883.082	M2 HST

Location 300 Series

Horiz Control Pt # 109 & 110



Subject: Hassayampa Topo
From: "Sam Hersey" <shersey@cox.net>
Date: Thu, 11 Nov 2004 13:38:40 -0700
To: leok@westconsultants.com

Number	Northing	Easting	Elevation	Raw Desc
OLD US80 BRIDGE				
200	855160.65	453859.54	852.99	Item No. 1 NORTH
201	855164.47	453858.38	860.77	Item No. 2 NORTH
202	855164.07	453858.54	864.99	Item No. 3 NORTH
203	855093.05	453885.91	853.25	Item No. 1 SOUTH
RAILROAD BRIDGE				
300	861409.06	451058.89	885.26	Item No. 1b NORTH
301	861393.49	451062.71	885.38	Item No. 1b SOUTH
302	861409.52	451057.70	881.95	Item No. 2
303	861403.08	451044.18	877.04	Item No. 2
304	861400.78	451029.73	876.96	Item No. 2
305	861397.96	451014.60	875.71	Item No. 2
306	861394.88	451000.57	872.84	Item No. 2
307	861408.93	451057.40	883.98	Item No. 5a
308	861390.51	450986.78	884.13	Item No. 5b
309	861390.91	450986.01	875.68	Item No. 6 EAST
310	861154.59	450105.67	883.14	Item No. 1a SOUTH
311	861168.90	450102.16	883.04	Item No. 1a NORTH
312	861177.05	450129.93	890.37	Item No. 10
313	861176.89	450129.62	875.32	Item No. 6 WEST
I-10 BRIDGES				
400	895146.62	442484.06	1034.61	Item No. 1 EB SOUTH
401	895261.89	442495.06	1035.17	Item No. 1 WB SOUTH

Part 1.1	Content-Type: C Content-Encoding: 7bit

4187.txt	Content-Type: text/plain Content-Encoding: 7bit

