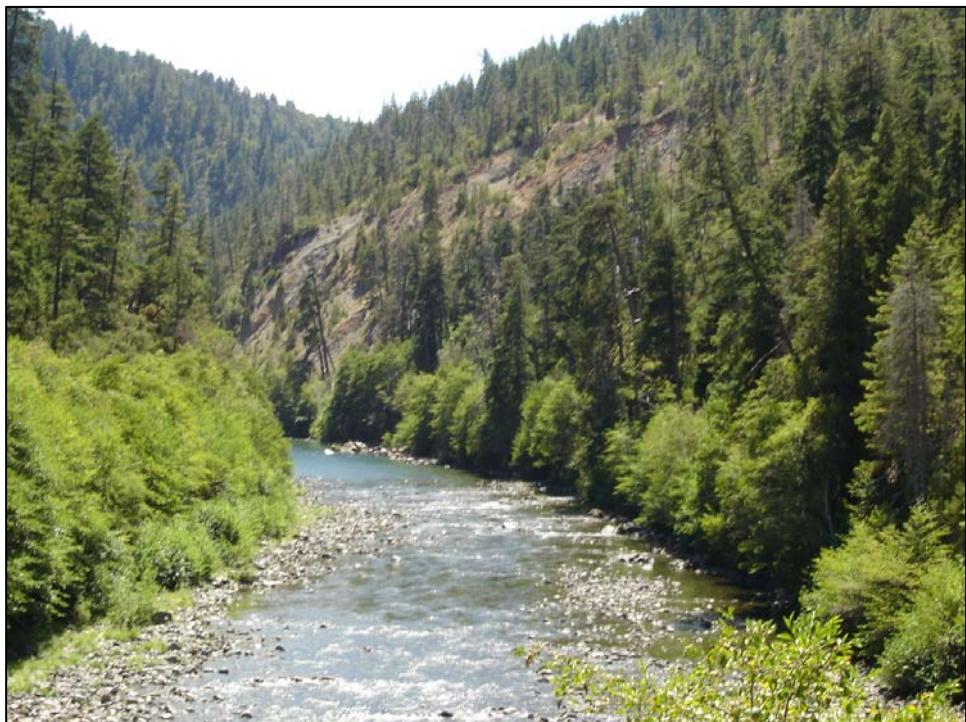


FINAL HYDRAULICS REPORT

**STEVEN MEMORIAL BRIDGE
(SOUTH FORK SMITH RIVER)
HURDY GURDY CREEK BRIDGE
ROCK CREEK BRIDGE
BOULDER CREEK BRIDGE**

**SIX RIVERS NATIONAL FOREST, CALIFORNIA
CA PFH 112-1(2) SMITH RIVER ROAD**



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EXECUTIVE SUMMARY

Four bridges on the South Fork Road, within Six Rivers National Forest, are proposed for replacement. In support of the new bridge designs and associated environmental assessments a hydraulic analysis was completed by the FHWA Central Federal Lands Highway Division (CFLHD) Hydraulics Team to provide recommendations regarding bridge opening and elevation, and scour protection. Design flows for the analysis, determined using USGS regression equations for the project area, are summarized in Table 3 of the report that follows.

One-dimensional hydraulic models (HEC-RAS) were developed for each of the four bridges, which cross the South Fork of the Smith River and three of its tributaries. The four bridges include; Steven Memorial Bridge, Rock Creek Bridge, Boulder Creek Bridge, and Hurdy Gurdy Creek Bridge. All are single span bridges except for Steven Memorial, which is a three span bridge over the South Fork (SF) Smith River. To limit impacts, all of the proposed bridges span the respective channels without encroachment into the channel, except for that associated with the Steven Memorial Bridge piers. Water surface profiles generated along each channel by the hydraulic model were used to determine the following minimum bridge elevations, which are based on FHWA's 50-year discharge design standard plus a 2-ft freeboard criterion.

Steven Memorial	555.8 ft
Rock Creek Bridge	405.5 ft
Boulder Creek Bridge	461.4 ft
Hurdy Gurdy Creek Bridge	597.3 ft

Of the four bridges, three have low chord elevations that are considerably higher than the 50-yr elevations listed above and safely pass the 100-year flow with adequate capacity to accommodate potential debris and ice flow. The existing Rock Creek Bridge elevation is not higher than the 50-yr elevation and is constrained by the adjacent roadway profile and nearby private access road elevations. The proposed bridge design is raised a few feet, to the extent possible without adversely impacting local access roads, but the lowest low chord elevation is still 1.7 ft below the 50-yr flow elevation. However, this condition is driven by the 50-yr event in the SF Smith River, and fairly independent of the flow in Rock Creek. When flows are less than a 50-yr event in the SF Smith River, flood flow elevations at the Rock Creek Bridge are significantly less and the design standard and freeboard criterion are satisfied. Regardless of the SF Smith River flow, the 100- and 500-yr events in Rock Creek will pass under the proposed bridge without overtopping the roadway.

Bridge scour is only anticipated at the Steven Memorial Bridge, as the other three bridges will not induce scour since they do not have piers and do not cause channel constriction. The maximum 100-year scour predicted for the Steven Memorial Bridge is 6.0 ft, resulting in a minimum channel elevation of 527.0 ft.

Since the proposed bridges do not constrict flood flows within the channels, contraction scour at the abutments is not expected. Consequently, to minimize environmental impacts within the channels, abutment slope protection is only recommended where bank erosion has been observed or the native material does not provide sufficient erosion protection. This recommendation assumes that the existing channel banks within the 100-year flood limits will not be disturbed during construction. The sites where riprap is required, regardless of construction disturbance include; the west bank of Boulder Creek and the west bank of the South Fork Smith River at the Steven Memorial Bridge.

INTRODUCTION

This report summarizes the results of hydraulic analyses and designs completed by the Central Federal Lands Highway Division (CFLHD) Hydraulics Team to support the final design of four planned bridge replacements along the South Fork Road, which parallels the South Fork Smith River, in Six Rivers National Forest, Del Norte County, California. A map showing the location of the project area is included as **Figure 1**. A detailed vicinity map showing the location of each bridge is provided as **Figure 2**. For reference, the geographic coordinates for each bridge are listed below:

Boulder Creek Bridge	Lat. 41°43'28.06"N	Long. 123°58'23.96"W
Rock Creek Bridge	Lat. 41°44'8.23"N	Long. 123°59'3.79"W
Steven Memorial Bridge	Lat. 41°41'36.28"N	Long. 123°55'45.38"W
Hurdy Gurdy Bridge	Lat. 41°41'7.18"N	Long. 123°54'45.09"W

The Average Daily Traffic (ADT) estimates for 2008 and 2028 are 211 and 314, which classify this road as a low standard road, as per the FHWA PDDM (June 1996). The design standards for this classification specify a 50-year capacity design with a minimum freeboard of 2 ft, and a 100-yr stability design for scour protection. This project site is not located within a Federal Emergency Management Agency (FEMA) designated floodplain area and therefore, FEMA regulations do not apply to these bridge locations.

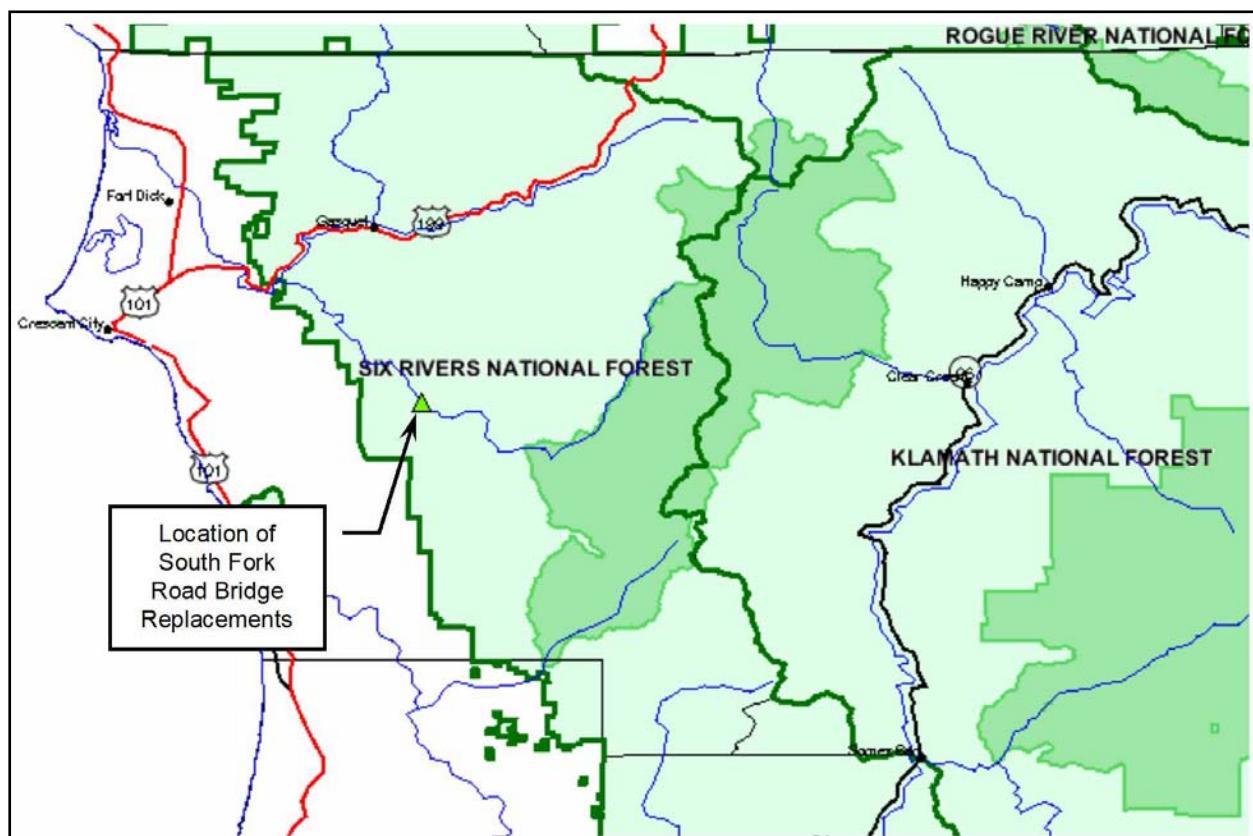


Figure 1. Project location map

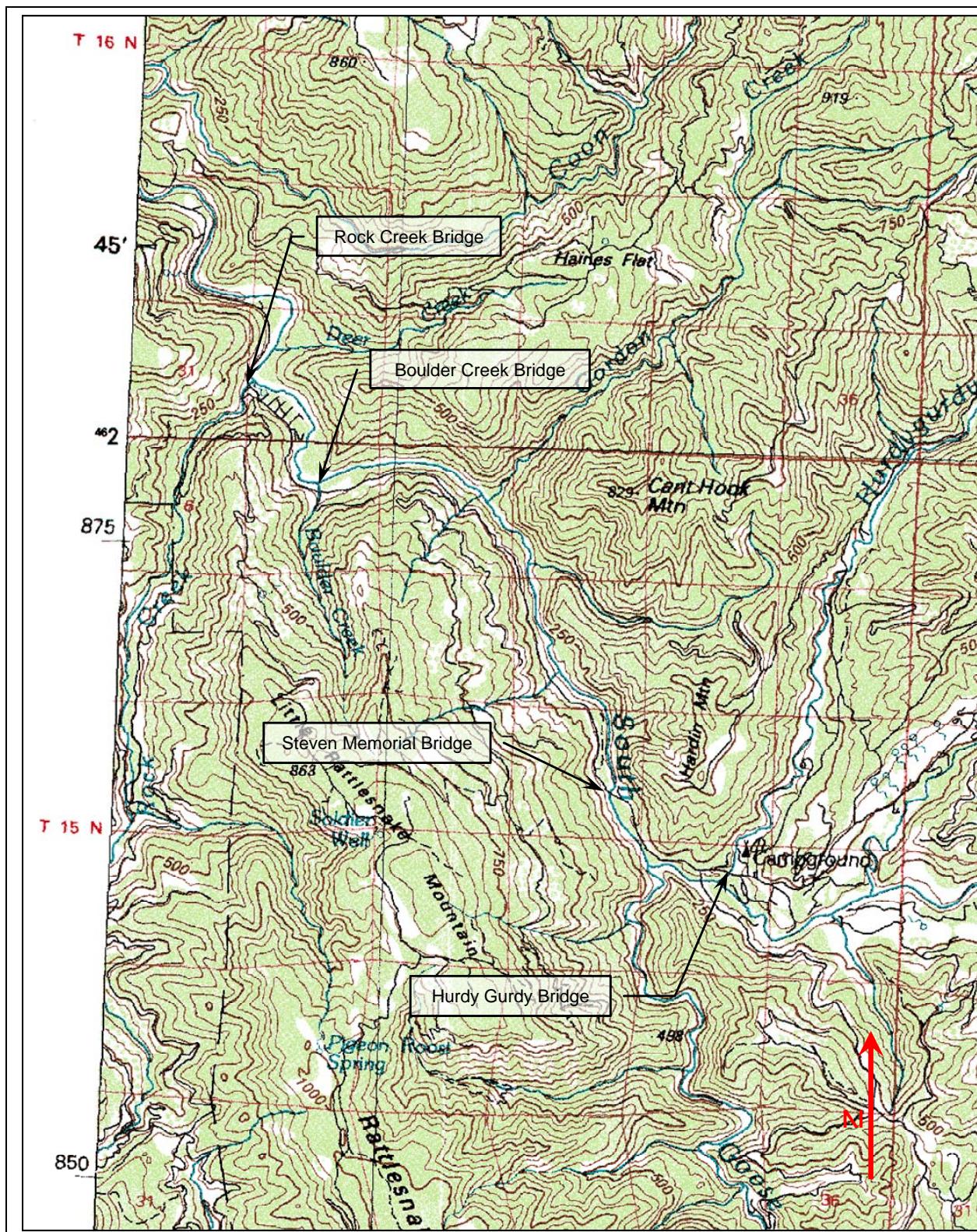


Figure 2. Project vicinity map showing the four bridge replacement locations

A site review was performed by members of the cross functional team (CFT) and representatives from Del Norte County, on February 15, 2007, to discuss various design elements and verify the hydraulic assumptions and conclusions presented in the following sections.

The analyses and design information presented in the following sections include; bridge descriptions, drainage basin hydrology, bridge hydraulics, bridge scour estimates, channel stability assessment, channel erosion countermeasures design, and fish and wildlife passage. Results summaries are included in the main document while additional details and supporting information are included in the Appendices.

BRIDGE AND CHANNEL DESCRIPTIONS

The Steven Memorial Bridge spans the South Fork (SF) Smith River, while the other three bridges span tributaries to the SF Smith River. The dimensions of the existing bridges and proposed replacements along with roadway stationing associated with the roadway improvements are listed in **Table 1**. The proposed bridge spans are greater than the existing spans and offer improved hydraulic conditions. Each of the proposed bridge alignments is located immediately upstream or downstream of the existing bridge to accommodate traffic during construction. The specific offset distances for each bridge are included in Table 1.

Table 1. South Fork Road Proposed Bridge Replacements

Bridge	Existing Bridge Length / Width (ft)	Proposed Bridge Length Bridge Width (ft)	Proposed Roadway Station Begin (ft)	Proposed Roadway Station End (ft)	Proposed Bridge Location Relative to Existing Centerline (CL) to CL
Rock Creek	100 / 15	115 (single span) 35'4" wide	207+80	208+95	16 ft upstream
Boulder Creek	60 / 15	105 (single span) 35'4" wide	408+20	409+25	13 ft upstream
Steven Memorial	325 / 14	370 (3-span) 31'4" wide	608+44	612+14	70 ft downstream
Hurdy Gurdy	170 / 14	190 (single span) 31'4" wide	808+10	810+00	40 ft upstream

Rock Creek

The existing Rock Creek Bridge is a single span structure comprised of vertical concrete abutments, steel truss, and concrete decking. The bridge is substandard with a single lane width of 15 ft. The bridge deck spans Rock Creek at a length of 100 ft and is approximately 26 ft above the channel invert. A photo of the existing bridge is shown in **Figure 3**. The proposed replacement bridge span is 115 ft (~35 ft longer), and located just upstream (approximately 15 ft from current centerline (CL) to proposed CL). The proposed bridge structure consists of concrete girders, cast in place deck, and concrete abutments with drilled shaft foundations.

The Rock Creek channel in the vicinity of the bridge appears to be quite stable, lined with large cobbles and boulders with a median particle size (D_{50}) of roughly 1 ft. The channel banks are steep, but covered with large rock and thick vegetation. There is no evidence of bank erosion or instability in the vicinity of the bridge and bedrock is exposed in several locations. The channel in this reach is fairly steep, with an average slope of nearly 2 percent. The bridge crossing is located less than 100 ft upstream of the confluence with the SF Smith River. As a result, the water surface profiles through the bridge are significantly influenced by the water surface elevations in the SF Smith River



Figure 3 - View downstream across Rock Creek Bridge

Boulder Creek

The existing Boulder Creek Bridge is a single span structure with vertical concrete piers/abutments, steel girders, and concrete decking. The bridge is substandard with a single lane width of 15 ft. The bridge deck spans Boulder Creek at a length of 60 ft and is approximately 20 ft above the channel invert. A photo of the existing bridge is shown in **Figure 4**. The proposed replacement bridge span is longer at 105 ft, wider (~35 ft), and located just upstream (approximately 20 ft CL to CL). The proposed bridge superstructure consists of concrete girders and a cast in place deck.

The Boulder Creek channel in the vicinity of the bridge is lined predominantly with fairly uniform sized boulders having an estimated median particle size (D_{50}) of roughly 1.5 ft. The channel appears to be stable, but there are signs of significant bank erosion along the west bank, in the vicinity of the bridge. The banks are lined with moderately dense vegetation, but are comprised of much finer, erodible material. The channel in this reach is the steepest of all four bridge crossings, having an average slope greater than 13 percent.



Figure 4 - View upstream of Boulder Creek Bridge

South Fork Smith River (Steven Memorial Bridge)

The proposed Steven Memorial Bridge over the SF Smith River, will replace an existing substandard, 14 ft wide, triple span structure at the same location. The existing structure spans the channel with a 15 degree skew, nearly 60 ft above the channel invert, over a length of 325 ft and is supported by two round nosed concrete piers. The vertical concrete abutments and wing walls are partially protected by native rock and vegetation. A photo of the existing bridge is shown in **Figure 5**. The proposed replacement bridge consists of three spans, having a length of 370 ft, and a width of approximately 31 ft. The proposed bridge superstructure consists of steel plate girders and a cast in place deck. It will be located approximately 70 ft downstream of the existing bridge (CL to CL). The proposed bridge will parallel the existing bridge and will require skewed abutments and piers to align with the river flow.

The SF Smith River in the vicinity of the bridge has an average channel slope of 0.6 percent and the bed material is primarily comprised of medium sized cobles, with an estimated D_{50} of 6 to 9 inches. Based on the gravel/cobble bars observed up and downstream of the bridge, it appears that the bed material load during high flows could be significant. The channel appears to be reasonably stable, and considering the steepness and high of the banks and surrounding topography any lateral channel migration is unlikely. The bridge is located along a right bend, which forces flow against the left bank and makes it more susceptible to erosion. Bedrock outcrops along the toe and large boulder size riprap protect the left bankline through the bridge.



Figure 5 - View upstream toward Steven Memorial Bridge

Hurdy Gurdy Creek

The existing Hurdy Gurdy Creek Bridge is a single span structure with vertical concrete abutments, steel girders, and concrete decking. The bridge is substandard with a single lane width of 14 ft. The bridge deck spans the creek with a length of 170 ft at approximately 52 ft above the channel invert. A photo of the existing bridge is shown in **Figure 6**. The proposed replacement bridge superstructure incorporates a 31 ft wide, 190 ft long single span of steel plate girders with a cast-in-place deck, located approximately 60 ft upstream of the current bridge location (CL to CL).

Hurdy Gurdy Creek in the vicinity of the bridge is very stable, with continuous exposed bedrock along the left bank, armored cobbles on the right bank, and dense vegetation on both banks above normal water levels. The exposed portion of the channel bed is lined medium to large sized cobbles (3-12 inches) with an estimated median particle size (D_{50}) of roughly 6 inches. The average channel slope in the reach is 1.8 percent.



Figure 6 - View downstream of Hurdy Gurdy Creek Bridge

HYDROLOGY

The Watershed Modeling System, (WMS) version 8.0 was used to delineate the tributary drainage basin for each bridge crossing and estimate the associated discharges using the United States Geological Service (USGS) regression equations for the California North Coast Region, listed below, with the following variable parameters shown in **Table 2**. Additional supporting data and information is provided in **Appendix A**.

$$\begin{aligned} Q_2 &= 3.52 A^{0.90} P^{0.89} H^{-0.47} \\ Q_5 &= 5.04 A^{0.89} P^{0.91} H^{-0.35} \\ Q_{10} &= 6.21 A^{0.88} P^{0.93} H^{-0.27} \\ Q_{25} &= 7.64 A^{0.87} P^{0.94} H^{-0.17} \\ Q_{50} &= 8.57 A^{0.87} P^{0.96} H^{-0.08} \\ Q_{100} &= 9.23 A^{0.87} P^{0.97} \end{aligned}$$

Where: $Q_?$ = estimated peak discharge
 A = basin drainage area in square miles
 P = mean annual precipitation in inches
 H = altitude index (average altitude in thousands of feet)

Table 2. Hydrologic parameters used in USGS regression equations

Watershed	Drainage Area (square miles)	Mean Annual Precipitation (inches)	Altitude Index (thousand ft)
Rock Creek	16.1	110	1.2
Boulder Creek	1.5	110	1.2
SF Smith River at Steven Memorial Bridge	215.6	110	1.2
Hurdy Gurdy Creek	29.8	110	1.2

No recording stream gages were identified along this reach of the South Fork Smith River and its tributaries that could be used to verify the computed flows. The results from the hydrologic analysis for the 2- through 500-year peak flows are summarized below in **Table 3**.

Table 3. USGS regression equation computed peak discharges for the South Fork Smith River and its tributaries.

Recurrence Interval (yrs)	Peak discharge estimates (cfs)			
	Rock Creek	Boulder Creek	South Fork Smith River	Hurdy Gurdy Creek
2	2581	309	26696	4499
5	4036	494	40674	6991
10	5392	676	52943	9282
25	6887	884	65888	11782
50	8627	1108	82537	14760
100	9881	1269	94540	16906
500	14246	1859	133949	24272

The results of the hydrologic analysis provided the input boundary conditions used in the hydraulic analysis to develop water surface profiles through the project reach.

BRIDGE HYDRAULICS

The US Army Corps of Engineers (USACE) HEC-RAS River Analysis System, Version 3.1.3 was used to evaluate the bridge hydraulics for each of the four proposed bridge replacements. Plan and cross section views for the bridge configurations (TS&Ls), provided by the bridge design team, are included in **Appendix B**.

A separate HEC-RAS model was developed for each of the four bridge crossing locations. The limits of each model were established based on available mapping data and upstream and downstream boundary conditions to provide water surface profile estimates for each of the return period flows. The cross sections used to compile each model were extracted from a digital terrain model (DTM) of the reach that was based on overbank LiDAR mapping and limited in channel cross section surveys. Aerial views of each bridge location, showing the cross section locations for each model are included in **Appendix C**.

The Manning's n values identified to represent the channel roughness along each reach are presented in **Table 4**, along with the average channel slope computed for each reach, and the starting water surface boundary condition used in the models. The Manning's n values were estimated by comparing conditions observed in the field with photos and calibrated roughness coefficients for similar channels evaluated by the USGS (Water Supply Paper 1849).

The HEC-RAS subcritical analysis option was sufficient for two of the four channels with moderate slopes and subcritical flow (Rock Creek and SF Smith River), while the mixed flow option was needed to model the steep Boulder Creek supercritical flow and localized steep sections (hydraulic jump) along Hurdy Gurdy Creek. A normal depth downstream boundary condition was assumed for all models, except Boulder creek, using the average channel slope to approximate the energy slope. For the Boulder Creek and Hurdy Gurdy Creek models, critical depth was assumed for the upstream boundary condition in the supercritical profile computations. The proposed configurations for all of the bridges have less encroachment on the channels than the existing bridges and will consequently cause no increase in flood level elevations upstream of each bridge.

Table 4. Summary of channel roughness values and boundary conditions used in the hydraulic models for each bridge replacements

Model	Channel Roughness (Manning's <i>n</i>) Main channel / Overbanks	Average Channel Slope (ft/ft)	Reach Boundary Condition (US and/or DS)	Comments
Rock Creek	0.07 / 0.10	0.020	Normal depth (S=0.0020)*	* Normal depth computed in SF Smith River cross section at confluence for starting DS Boundary Condition
Boulder Creek	0.075 / 0.08	0.122	Critical depth (US and DS)	
South Fork Smith River	0.04 / 0.08	0.007	Normal depth (S=0.0065)	
Hurdy Gurdy Creek	0.05 / 0.10	0.018	Normal depth (S=.0056)* DS Critical Depth US	* Normal depth computed in SF Smith River cross section at confluence for starting DS Boundary Condition
S = channel slope used for normal depth calculation US = upstream DS = downstream				

The evaluation of downstream boundary conditions (tail water) for each of the three tributary models had to consider the effect of water surface elevations in the SF Smith River, considering the close proximity of the bridge crossings to the main channel. This aspect further complicates the analysis in that the frequency of coincident flows also needs to be considered. For instance, while the tributary drainage is experiencing a 50-year event, the main channel drainage will not likely experience the same event, or even in the case that it is (widespread storm), the flood peak at the confluence from one drainage would not likely coincide with the other. Current design guidance on this matter is limited and additional research and design guidance is under development. Consequently, for this analysis, several return period flows and tailwater assumption combinations were evaluated to determine a reasonable design elevation. The analysis results for each bridge are summarized in **Table 5**. Additional graphical and tabular water surface profile data are included in Appendix C. The Type, Size, and Location (TS&L) dates provided in the table denote the latest bridge design information provided by the bridge design team.

Flood flow elevations at the Rock Creek and Hurdy Gurdy Creek bridges are significantly influenced by water surface elevations in the SF Smith River, while the flow elevations at the Boulder Creek Bridge are not. The Boulder Creek channel is much steeper than the others and the bridge location is higher, relative to the main channel. Hence, it is above the tailwater influence. Channel cross sections for SF Smith River immediately downstream of the confluences were added to the Rock Creek and Hurdy Gurdy Creek models to allow normal depth computations for the tailwater conditions.

Table 5. Summary of HEC-RAS estimated water surface elevations, minimum freeboard, and average flow velocities for the proposed bridges.

Recurrence Interval (yrs)	Estimated Peak Discharge (cfs)	Water Surface Elevation immediately US of bridge (ft)	Minimum Bridge Low Chord Elevation (ft)	Minimum Freeboard for 50-yr design event (ft)	Average cross section velocity (fps)
Rock Creek Bridge					
2 / 2*	2581	388.23	402.0 (TS&L dated 9/10/07 Bridge design raised 2/08)	-1.7	5.31
5 / 5*	4036	392.72			6.06
10 / 50*	5392	403.74			3.35
25 / 25*	6887	399.56			5.33
50 / 10*	8627	395.69			8.56
50 / 25*	8627	399.35			6.76
50 / 50*	8627	403.53			5.42
100 / 50*	9881	403.42			6.24
500 / 100*	14246	406.26			7.90
Boulder Creek Bridge					
2	309	457.73	466.7 (TS&L dated 6/1/05)	7.9	8.74
5	494	458.17			10.30
10	676	458.55			11.49
25	884	458.96			12.44
50	1108	459.39			13.16
100	1269	459.67			13.62
500	1859	460.55			15.26
South Fork Smith River (Steven Memorial Bridge)					
2	26696	537.65	571.2 (TS&L dated 8/27/07)	17.7	10.18
5	40674	542.42			11.13
10	52943	546.08			11.87
25	65888	549.58			12.58
50	82537	553.75			13.35
100	94540	556.54			13.85
500	133949	564.83			15.24
Hurdy Gurdy Creek Bridge					
2 / 2*	4499	585.88	627.3 (TS&L dated 9/10/07)	33.2	7.81
5 / 5*	6991	588.70			8.79
10 / 10*	9282	590.86			9.59
10 / 50*	9282	595.46			6.91
25 / 25*	11782	592.99			10.33
50 / 10*	14760	595.32			11.08
50 / 50*	14760	595.32			11.08
100 / 50*	16906	596.88			11.57
500 / 100*	24272	601.70			12.99

* Second number indicates return period flow assumed for SF Smith River in determining tailwater boundary condition
Bold text denotes design condition

As demonstrated by the results for Rock Creek, the SF Smith River tailwater elevation has a significant influence on the water surface elevation at the Rock Creek Bridge. A 50-yr flow in SF Smith River generates water surface elevations (WSELs) at the Rock Creek Bridge in the range of 403.4 ft to 403.7 ft for the range of flood flows in Rock Creek. However, when flows in the SF Smith River are less than a 50-yr event (closer to a 25-yr event), flood flow elevations in Rock Creek are considerably lower (~ 8 ft).

The elevation of the existing bridge is more than 3 ft below the SF Smith River 50-yr flood elevation, and the profile of the adjacent road section is fairly constrained by adjacent private property access roads. The proposed bridge has been raised to the extent possible without having significant impacts on the access roads, but the lowest low chord elevation (downstream face) is still 1.7 ft below the 50-yr WSEL at 402.0 ft. During high flows in the SF Smith River, debris or ice may temporarily get caught by the bridge, but they should pass once flows recede. With high tailwater conditions, the velocities through the bridge during high flows are relatively low (5-6 ft/s). With low tailwater conditions, the 50-year WSEL at the Rock Creek Bridge is approximately 395.7 ft, which provides more than 6 ft of freeboard and exceeds the design standard and criterion. Regardless of the SF Smith River flow, all events equal to and less than a 500-yr event in Rock Creek will pass under the proposed bridge without overtopping the roadway.

The bridge design elevations for Boulder Creek Bridge, Steven Memorial Bridge, and Hurdy Gurdy Bridge provide much more freeboard than required. The 50-year WSEL at each of these bridges is 459.4 ft, 553.8 ft, and 595.3 ft, respectively. The low chords of these three bridges are well above the estimated design water surface elevations and no debris or ice problems should be anticipated.

STREAM STABILITY

The SF Smith River and its three tributaries of interest are located in a mountain region with significant relief, steep side slopes, narrow floodplains, and coarse bed materials. With the exception of minor bank erosion at the Boulder Creek crossing, no channel stability concerns were noted during the site field review or subsequently by other parties involved. Each of the channels is generally armored with large bed material, ranging from smaller cobbles in the SF Smith River to large boulders in Boulder Creek. Channel bank stability is enhanced with well rooted, fairly dense vegetation. Large bedrock outcrops are also evident along the SF Smith River.

The proposed bridge replacements will essentially replace the existing bridges, but will be offset a short distance from the existing bridges to allow continuous operation of the South Fork Road during construction. Once the new bridges and road improvements are complete, the old bridge structures will be removed and should be replaced with the riprap gradation specified for each bridge or vegetated and maintained with adequate erosion protection. The only adverse stability impacts associated with the new bridges will be those resulting from minor disturbances during construction. The channel hydraulic conditions are actually improved, with longer spans and less encroachment into the channels. Although the channels at each crossing are noted as stable, bank/abutment revetment is recommended at certain locations to provide added erosion protection.

As shown in Figure 2, the left bank of Boulder Creek, upstream of the existing abutment, is being eroded, and a moderate scour hole near the toe of the bank was also noted. The

channel bed consists of large cobbles/boulders and is quite stable, but the upper bank is comprised of finer earth material that is very erodible. When the existing bridge abutments are removed the disturbed bank areas will need to be protected with Class 6 riprap.

SCOUR

Of the four bridges, scour estimates are only applicable to the Steven Memorial Bridge, as the other three bridges span the entire 100-year floodplain with a single span and the abutments do not cause a constriction in the channel. This does assume that any abutment protection at each bridge will be constructed to conform to the existing grade to avoid encroachment into the channel.

Scour evaluations for the Steven Memorial Bridge were performed using HEC-18 methodology and HEC-RAS modeling results for a 100-year event. The scour analysis assumptions included; 6 ft pier widths, round nose configuration, and pier alignment parallel to the flow. A summary of the scour estimates is presented below in **Table 6**. Detailed computations and supporting information are included in **Appendix D**

Table 6. Summary of scour estimates for Steven Memorial Bridge (SF Smith River).

Scour Summary							
Pier	Location along Cross Section (Station from left)	Ground Elevation at Pier (ft)	Assumed Channel Degradation (ft)	Computed Contraction Scour (ft)	Computed Local Pier Scour (ft)	Total Scour (ft)	Scour Elevation (ft)
1	107	538.0	0	0	5.6	0*	538.0
2	296	533.0	0	0	5.9	5.9	527.1
* Bedrock at the pier 1 location will prevent pier scour							

Although maximum scour depths of 5.6 ft and 5.9 ft are predicted for piers 1 and 2, during a 100-year event, a bedrock outcrop exists at pier 1 that will prevent scour at the pier. As a check, 500-year scour estimates were also computed. The estimates for Piers 1 and 2 were 9.3 ft and 6.6 ft, respectively.

BRIDGE PIER SCOUR PROTECTION

The Steven Memorial Bridge pier foundations will be designed to accommodate the estimated pier scour depths. Hence, riprap countermeasures are not necessary.

BRIDGE ABUTMENT SLOPE PROTECTION

The need for abutment slope protection at each bridge was evaluated using the HEC-RAS 100-year simulation results and FHWA HEC-18 and HEC-23 methodology for sizing rock riprap at abutments. The recommendations provided below in **Table 7** are based on hydraulic conditions estimated for the proposed bridge at each crossing and do not account for erosion protection offered by the existing channel material. Since three of the four proposed bridges span the tributaries without piers or encroaching abutments, it is preferable to limit the channel disturbance to the extent possible while still ensuring adequate abutment protection. If construction disturbance can be avoided below the upper limit for slope protection design (Table 7) and the existing channel section is stable, abutment protection may not be necessary.

Abutment protection should extend longitudinally a minimum of one bank height upstream and downstream of the bridge, and vertically from the toe of the bank slope to an elevation 2 ft above the 50-yr design water surface elevation (as specified in Table 7). At the locations where existing bridge abutments are being removed, the abutment protection should extend one bank height beyond the limits of the existing bridge. To provide favorable flow transitions, the revetment should be transitioned (tapered) at 45 degrees down to the toe of the slope. Specific recommendations for each bridge are summarized below.

Rock Creek Bridge

At the Rock Creek Bridge, the existing bank slopes are nearly 1H:1V and the estimated average velocities along the abutments are around 8 fps. The existing banks appear to be stable and well protected with native rock and vegetation, and should be left undisturbed during construction. This approach is preferable with regards to minimizing impacts, but will require regular maintenance and review in conjunction with the routine bridge inspections. Following any sign of bank slope erosion, Class 4 riprap bank revetment should be placed along the toe and slope as necessary to provide adequate abutment protection.

Boulder Creek Bridge

The left (west) bank of Boulder Creek will require riprap revetment protection through the bridge section. The existing bank shows significant signs of erosion, and once the existing bridge abutments are removed, the left bank down stream of the bridge will be more vulnerable. For the 100-year event, the average channel velocity is over 13 fps, and the channel makes a right bend in the vicinity of the bridge, causing the left bank to be more susceptible to erosion. Class 6 riprap abutment protection is recommended through the bridge section, and considering the extent of the bank erosion, the abutment protection should extend a minimum of 50 ft upstream to preserve the bankline upstream of the bridge. The bank protection should also be 'keyed' into the channel bed a minimum of 5 ft.

Steven Memorial Bridge

The SF Smith River makes a right bend through the bridge section, causing a concentration of flow along the left bank. The existing left bankline is protected with large boulders/riprap, as well as a notable bedrock outcrop along the toe of the slope. With the new bridge construction, the existing rock should be left in place, and additional Class 7 riprap should be added through the new, downstream bridge alignment. The right bank, located on the inside of the bend is less vulnerable, and should not need abutment protection. Based on observations of the

existing bridge, the bridge height is sufficient to allow significant vegetation to establish on the embankment under the bridge, which should provide sufficient erosion protection.

Hurdy Gurdy Bridge

In the case of Hurdy Gurdy Bridge, the proposed abutments are well above the design flow elevation and outside of the 100-year flood limits. The left bank is composed of vertical bedrock and the right bank is well armored with cobbles. Riprap abutment protection is not recommended, as long as the existing channel remains undisturbed. Avoiding impacts in the channel below the 597.5 ft elevation should be feasible.

Table 7. Recommended bridge abutment slope protection.

	Rock Creek	Boulder Creek	Steven Memorial	Hurdy Gurdy
Maximum abutment slope (H:V)	1.5:1	1.5:1	2:1	1.5:1
Upper limit of rock, Elev (ft)	405.8	464.4	556.0	597.3
Lower limit of rock, Elev (ft)	375.0	455.0	520.0	572.0
Rock thickness, ft (min)	2.3	3.7	6.0	2.3
Minimum median rock size, D ₅₀ (ft)	1.1	1.6	3.3	1.1
CFLHD FP-03 Rock Gradation	Class 4*	Class 6*	Class 7*	Class 4*
Comments	**Both banks if disturbed	West bank required Extend 75 ft upstream and 20 ft downstream **East bank if disturbed	West bank required **East bank if disturbed	**Both banks, if disturbed
<p>* Geotextile or equivalent filter design required for all revetments</p> <p>** To minimize impacts to the existing channel, the need for abutment protection may be avoided if construction disturbances do not extend below the noted upper revetment limit elevation. If riprap revetment is constructed, it should be sub excavated in to the bankline, providing a finished surface that does not protrude beyond the upstream and downstream bank topography.</p>				

In all cases the abutment protection outside of the bridge limits may be buried with soil material and planted with local vegetation species to provide a better aesthetics and limit net impacts.

FISH AND WILDLIFE PASSAGE

Impacts to fish and wildlife passage associated with the hydraulics of the four bridge crossings have been limited to the extent possible. The bridge sections are elevated well above the channels and ordinary high water level to avoid impacts to the natural channel flow as well as wildlife passage under each bridge. Additionally, riprap abutment protection has only been recommended where it is absolutely necessary to provide erosion protection.

The only crossings with anticipated impacts within the channel are Boulder Creek Bridge and Steven Memorial Bridge. Both crossings require large riprap protection along the left channel bank. Steven Memorial Bridge will have two piers within the channel, located near the outer limits of the 2-year flow water level. Consequently, flows within the ordinary high water mark should not be impacted by the presence of the bridge piers.

SUMMARY AND RECOMMENDATIONS

The hydraulic analyses of the four bridges indicate that three of the four are located well above the minimum design elevations for the 50-yr event and safely pass the 100-year event without overtopping. The proposed Rock Creek Bridge design, due to adjacent elevation constraints, does not meet the minimum design standard and freeboard criterion when the SF Smith River flow is equal to or greater than a 50-yr event. Due to the close proximity to the SF Smith River, high tailwater conditions significantly influence water surface elevations at the bridge. The low chord of the proposed bridge is roughly 2 ft below the water surface elevation when there is a 50-yr flow in the SF Smith River. However, for flows less than a 50-yr event in the SF Smith River, the 50-yr flood elevations in Rock Creek are more than 6 ft below the bridge.

Considering that the proposed bridge design meets the hydraulic design standard for all flows condition in Rock Creek when the SF Smith River flow is less than a 50-yr event, the design is practical and reasonable. Given that the design standard is not met at the 50-yr flow in the SF Smith River, a design variance should be acknowledged by all parties involved.

To limit environmental impacts within the channels, riprap abutment protection was only recommended for locations where erosion is apparent or scour is anticipated. Although this approach does significantly limit impacts, maintenance and monitoring will be necessary to detect and address erosion of the bankline in the vicinity of each of the bridges. In locations where riprap is not recommended, the existing bankline was observed to be stable and should be left untouched during construction. If disturbance is unavoidable, rock riprap protection should be added along the bankline through the bridge, extending a minimum of one bank height up- and downstream. In the future, if erosion is observed, it should be monitored and toe/slope protection should be added as needed.

Bridge scour evaluations were necessary for the Steven Memorial Bridge, as the other three bridges will not induce scour since they do not have piers or cause a channel constriction. The maximum 100-year scour predicted for the Steven Memorial Bridge is 6.0 ft, resulting in a minimum expected channel elevation of 527.0 ft.

REFERENCES

Federal Lands Highway Project Development and Design Manual (PDDM), Federal Highway Administration, FHWA-DF-88-003, June 1996.

Hydrologic Watershed Modeling System, Version 8, Brigham Young University, Utah.

Hydrologic Engineering Center River Analysis System, HEC-RAS, Version 3.1.3, U.S. Army Corps of Engineers (USACE), May 2005.

National Summary of U.S. Geological Regional Regression Equations for Estimating Magnitude and Frequency of Floods for Ungaged Sites, 1993, USGS WRIR 94-4002.

Evaluating Scour at Bridges, HEC 18, Fourth Edition, Publication No. FHWA NHI 01-001, May 2001.

Stream Stability at Highway Structures HEC-20, Third Edition, Publication No. FHWA NHI 01-002, March 2001.

Bridge Scour and Stream Instability Countermeasures, HEC-23, Second Edition, Publication No. FHWA NHI 01-003, March 2001.

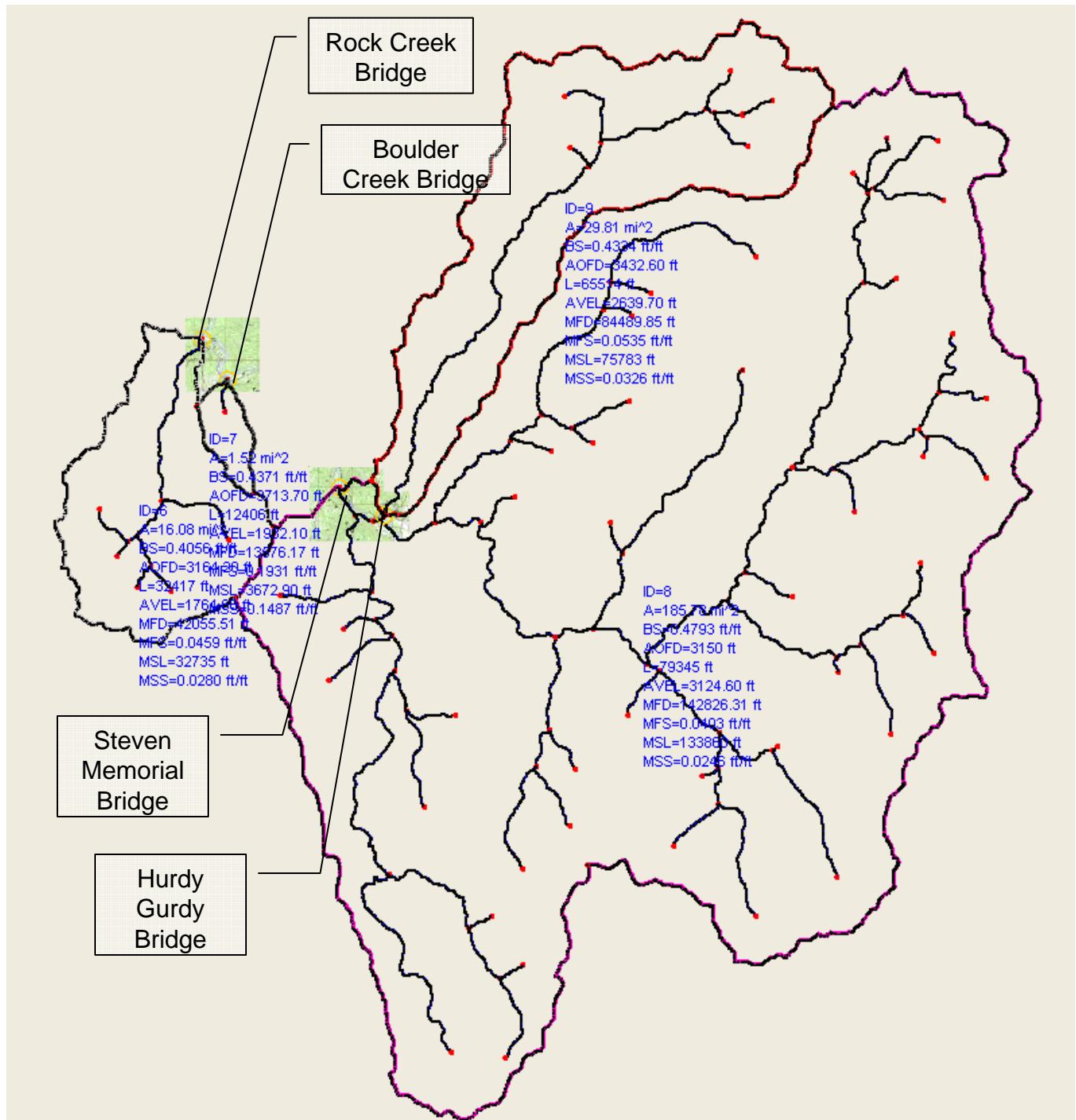
Roughness Characteristics of Natural Channels, United States Geological Survey Water Supply Paper 1849, Washington D.C., 1967.

APPENDIX A

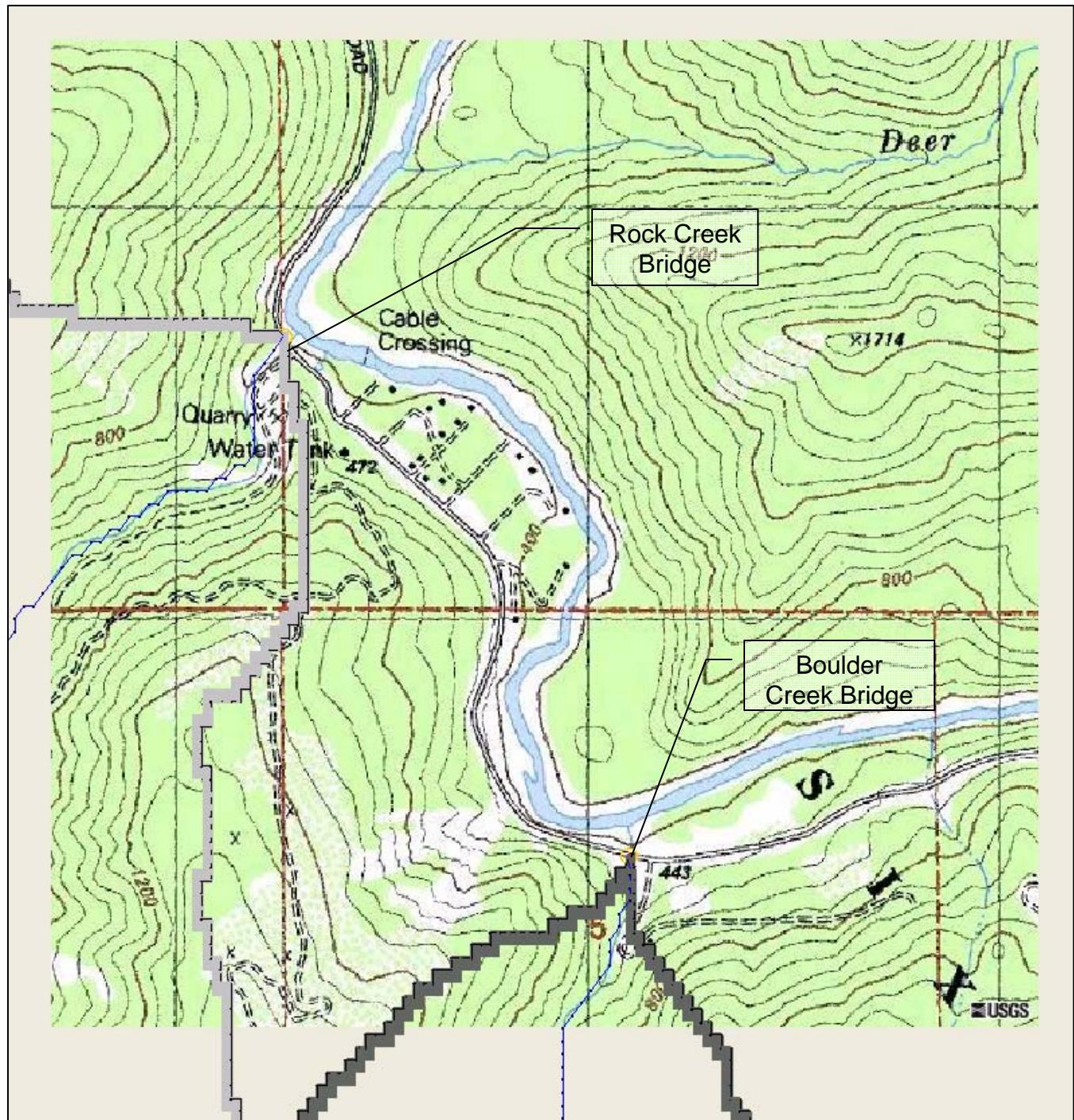
HYDROLOGY

Enclosed:

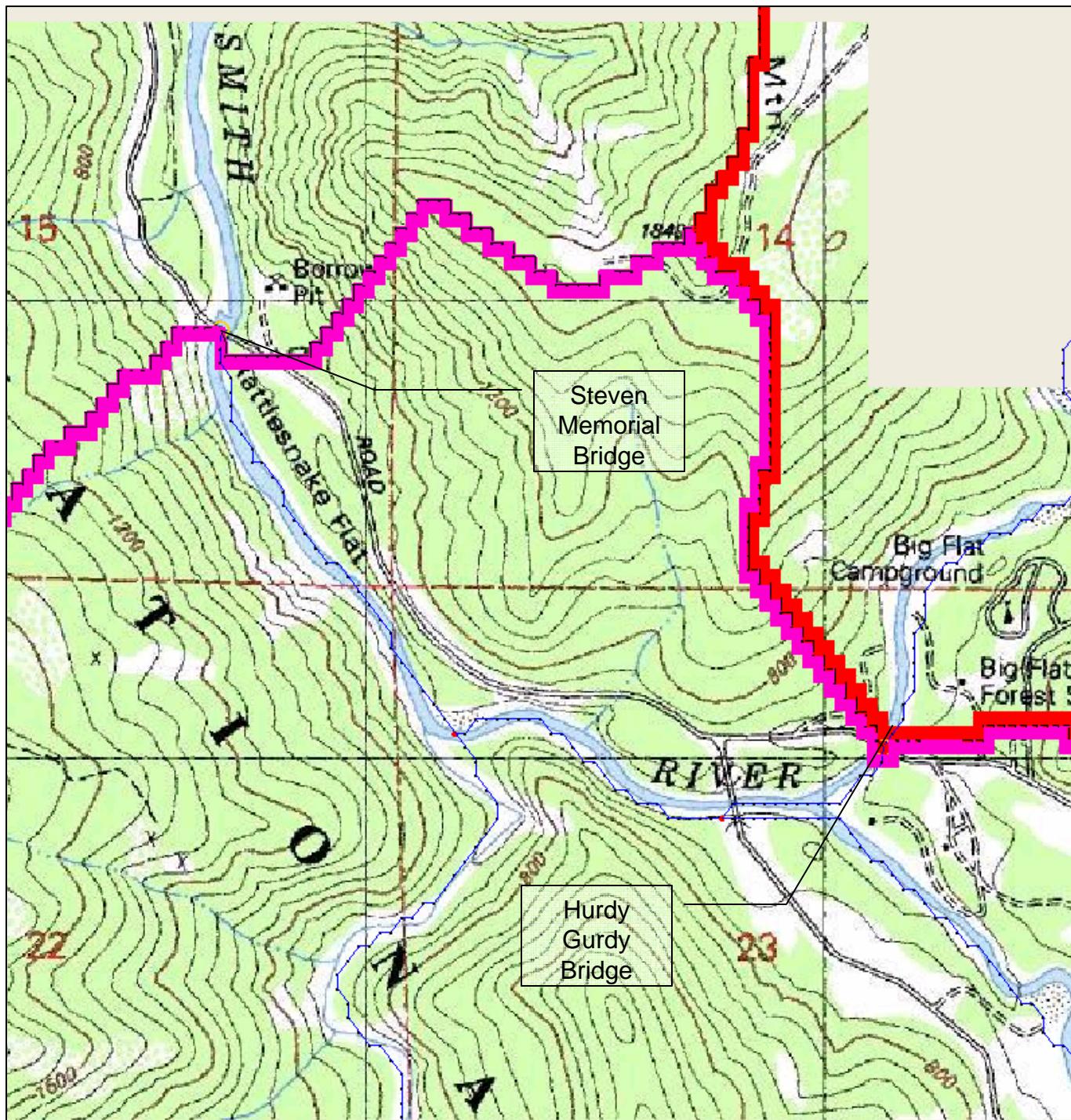
Drainage basin delineations
USGS Regression Equation input parameters and analysis results



WMS drainage basin delineation

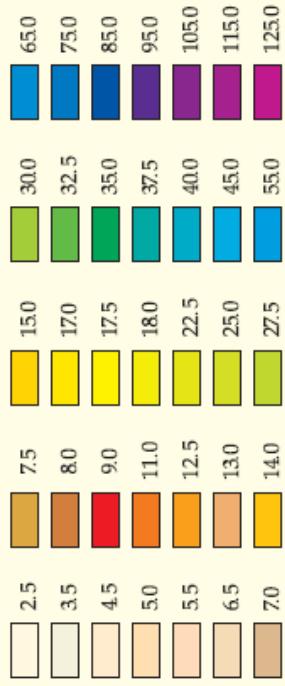


Close up view of WMS drainage basin delineation at bridge crossings



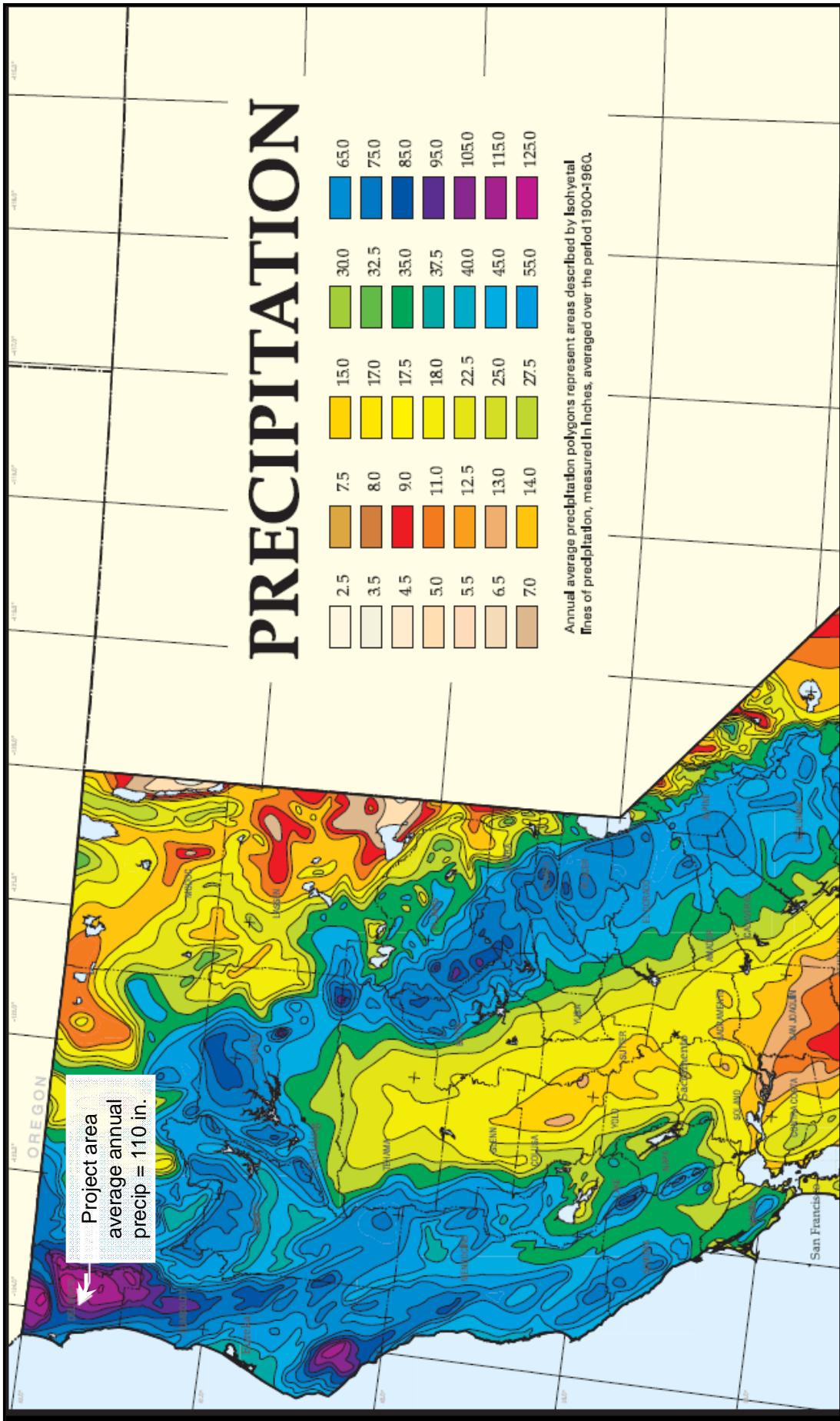
Close up view of WMS drainage basin delineation at bridge crossings

PRECIPITATION



Annual average precipitation polygons represent areas described by Ischayetal.
Times of precipitation, measured in inches, averaged over the period 1900-1980.

Project area
average annual
precip = 110 in.



WMS 8.0 USGS National Flood Frequency Regression Equation Analysis

Drainage Design Location: Rock Creek

Input Parameters:

State: California

Crippen and Bue Region: None

Region: North Coast
Region

Variable values:

Variable Name	Abbreviation	Value	Units	Minimum	Maximum
Drainage Area	DRNAREA	16.079943	mi ²	0.13	3113
Mean Annual Precipitation	PRECIP	110	in thousand	19	104
Altitude Index	ALTIND	1.2	feet	1	5.7

Output:

Type	Peak [cfs]	Recurrence [years]	Equivalent Years	Error [%]
Rural	2581	2	0	66
Rural	4036	5	0	60
Rural	5392	10	0	60
Rural	6887	25	0	60
Rural	8627	50	0	63
Rural	9881	100	0	66
Rural	14245	500	0	0

WMS 8.0 USGS National Flood Frequency Regression Equation Analysis

Drainage Design Location: Boulder Creek

Input Parameters:

State: California

Crippen and Bue Region: None

Region: North Coast
Region

Variable values:

Variable Name	Abbreviation	Value	Units	Minimum	Maximum
Drainage Area	DRNAREA	1.519274	mi ²	0.13	3113
Mean Annual Precipitation	PRECIP	110	in	19	104
Altitude Index	ALTIND	1.2	thousand feet	1	5.7

Output:

Type	Peak [cfs]	Recurrence [years]	Equivalent	
			Years	Error [%]
Rural	309	2	0	66
Rural	494	5	0	60
Rural	676	10	0	60
Rural	884	25	0	60
Rural	1108	50	0	63
Rural	1269	100	0	66
Rural	1859	500	0	0

WMS 8.0 USGS National Flood Frequency Regression Equation Analysis

Drainage Design Location: Steven Memorial

Input Parameters:

State: California

Crippen and Bue Region: None

Region: North Coast
Region

Variable values:

Variable Name	Abbreviation	Value	Units	Minimum	Maximum
Drainage Area	DRNAREA	215.594	mi ²	0.13	3113
Mean Annual Precipitation	PRECIP	110	in	19	104
Altitude Index	ALTIND	1.2	thousand feet	1	5.7

Output:

Type	Peak [cfs]	Recurrence [years]	Equivalent	
			Years	Error [%]
Rural	26696	2	0	66
Rural	40674	5	0	60
Rural	52943	10	0	60
Rural	65888	25	0	60
Rural	82537	50	0	63
Rural	94540	100	0	66
Rural	133949	500	0	0

WMS 8.0 USGS National Flood Frequency Regression Equation Analysis

Drainage Design Location: Hurdy Gurdy

Input Parameters:

State: California

Crippen and Bue Region: None

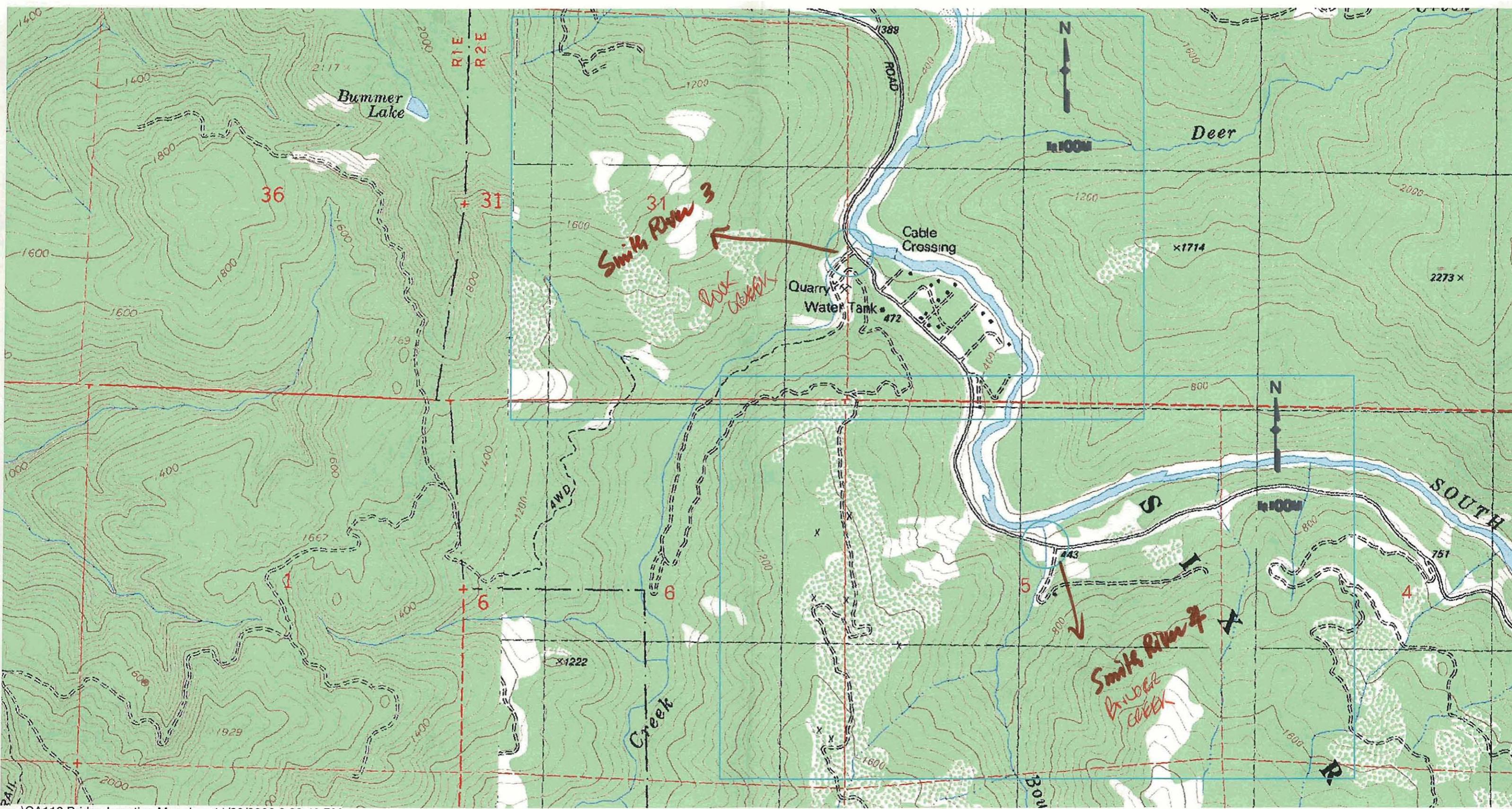
Region: North Coast
Region

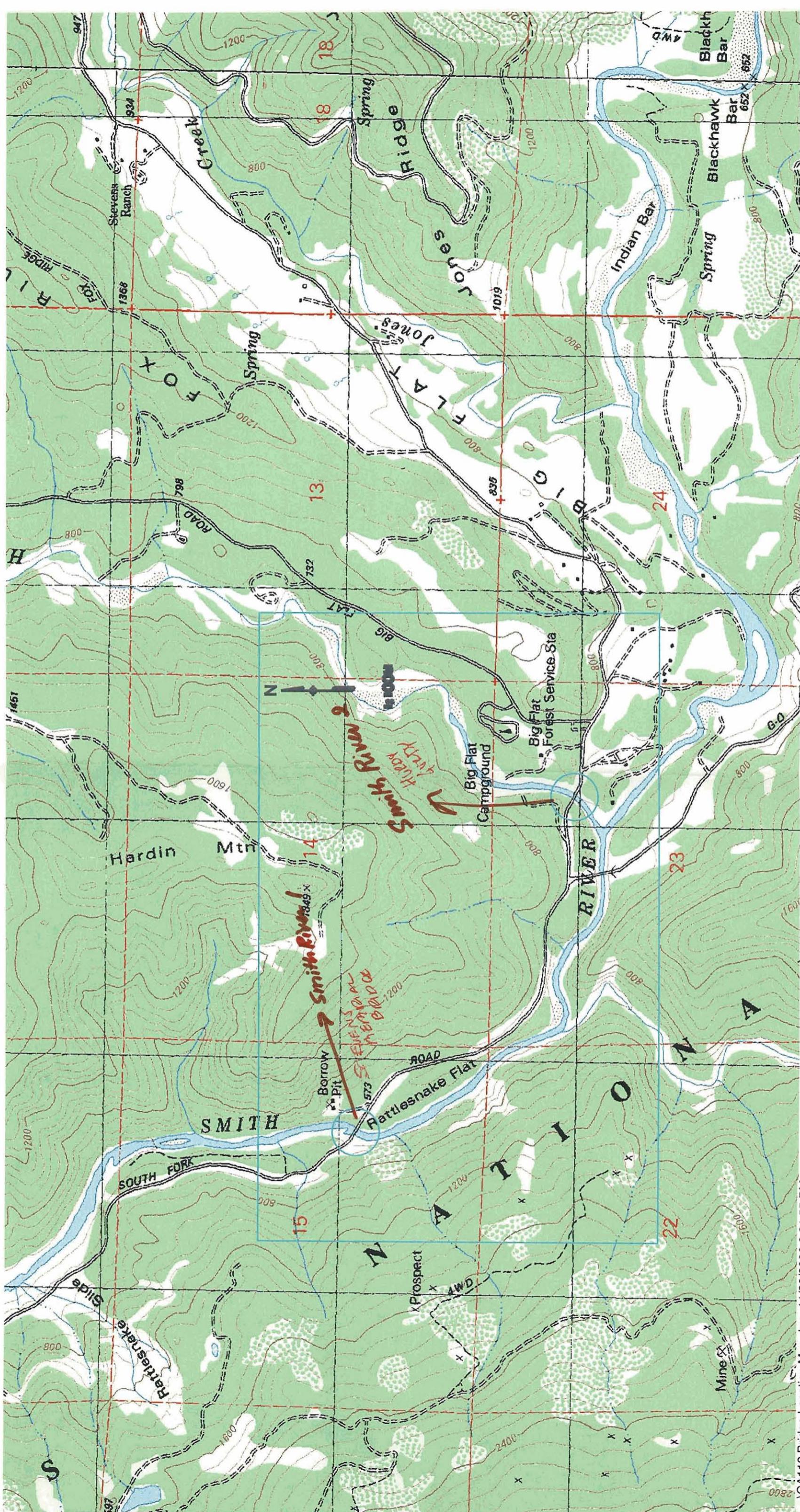
Variable values:

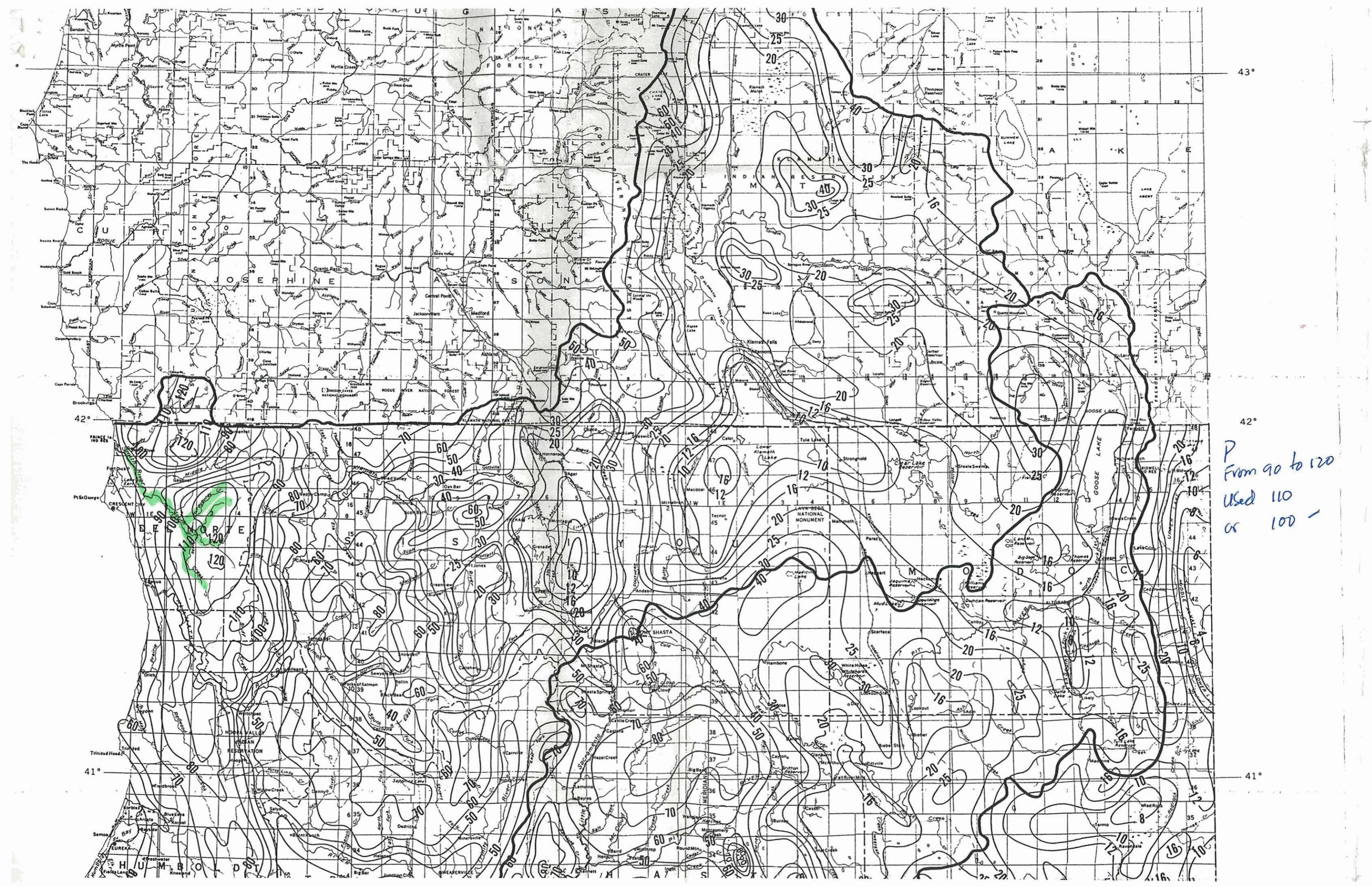
Variable Name	Abbreviation	Value	Units	Minimum	Maximum
Drainage Area	DRNAREA	29.809544	mi ²	0.13	3113
Mean Annual Precipitation	PRECIP	110	in	19	104
Altitude Index	ALTIND	1.2	thousand feet	1	5.7

Output:

Type	Peak [cfs]	Recurrence [years]	Equivalent	
			Years	Error [%]
Rural	4499	2	0	66
Rural	6991	5	0	60
Rural	9282	10	0	60
Rural	11782	25	0	60
Rural	14759	50	0	63
Rural	16906	100	0	66
Rural	24272	500	0	0









The following documentation was taken from:

U.S. Geological Survey Water-Resources Investigations Report 94-4002:
Nationwide summary of U.S. Geological Survey regional regression equations for estimating magnitude and frequency of floods for ungaged sites, 1993

CALIFORNIA

STATEWIDE RURAL

Summary

California is divided into six hydrologic regions (fig. 1). The regression equations developed for these regions are for estimating peak discharges (Q_T) having recurrence intervals T that range from 2 to 100 years. The explanatory basin variables used in the equations are drainage area (A), in square miles; mean annual precipitation (P), in inches; and an altitude index (H), which is the average of altitudes in thousands of feet at points along the main channel at 10 percent, and 85 percent of the distances from the site to the divide. The variables A and H may be measured from topographic maps. Mean annual precipitation (P) is determined from a map in Rantz (1969). The regression equations were developed from peak-discharge records of 10 years or longer, available as of 1975, at more than 700 gaging stations throughout the State. The regression equations are applicable to unregulated streams but are not applicable to some parts of the State (see fig. 1). The standard errors of estimate for the regression equations for various recurrence intervals and regions range from 60 to over 100 percent. The report by Waananen and Crippen (1977) includes an approximate procedure for increasing a rural discharge to account for the effect of urban development. The influences of fire and other basin changes on flood magnitudes are also discussed.

Procedure

Topographic maps, the hydrologic regions map (fig. 1), the mean annual precipitation from Rantz (1969), and the following equations are used to estimate the needed peak discharges Q_T , in cubic feet per second, having selected recurrence intervals T .

North Coast Region

Q2 = $3.52 A^{0.90} P^{0.89} H^{-0.47}$
 Q5 = $5.04 A^{0.89} P^{0.91} H^{-0.35}$
 Q10 = $6.21 A^{0.88} P^{0.93} H^{-0.27}$
 Q25 = $7.64 A^{0.87} P^{0.94} H^{-0.17}$
 Q50 = $8.57 A^{0.87} P^{0.96} H^{-0.08}$
 Q100 = $9.23 A^{0.87} P^{0.97}$

Northeast Region

Q2 = $22 A^{0.40}$
 Q5 = $46 A^{0.45}$
 Q10 = $61 A^{0.49}$
 Q25 = $84 A^{0.54}$
 Q50 = $103 A^{0.57}$
 Q100 = $125 A^{0.59}$

Sierra Region

Q2 = $0.24 A^{0.88} P^{1.58} H^{-0.80}$
 Q5 = $1.20 A^{0.82} P^{1.37} H^{-0.64}$
 Q10 = $2.63 A^{0.80} P^{1.25} H^{-0.58}$
 Q25 = $6.55 A^{0.79} P^{1.12} H^{-0.52}$
 Q50 = $10.4 A^{0.78} P^{1.06} H^{-0.48}$
 Q100 = $15.7 A^{0.77} P^{1.02} H^{-0.43}$

Central Coast Region

Q2 = $0.0061 A^{0.92} P^{2.54} H^{-1.10}$
 Q5 = $0.118 A^{0.91} P^{1.95} H^{-0.79}$
 Q10 = $0.583 A^{0.90} P^{1.61} H^{-0.64}$
 Q25 = $2.91 A^{0.89} P^{1.26} H^{-0.50}$
 Q50 = $8.20 A^{0.89} P^{1.03} H^{-0.41}$
 Q100 = $19.7 A^{0.88} P^{0.84} H^{-0.33}$

South Coast Region

Q2 = $0.14 A^{0.72} P^{1.62}$
 Q5 = $0.40 A^{0.77} P^{1.69}$
 Q10 = $0.63 A^{0.79} P^{1.75}$
 Q25 = $1.10 A^{0.81} P^{1.81}$
 Q50 = $1.50 A^{0.82} P^{1.85}$
 Q100 = $1.95 A^{0.83} P^{1.87}$

South Lahontan-Colorado Desert Region

Q2	=	7.3A ^{0.30}
Q5	=	53A ^{0.44}
Q10	=	150A ^{0.53}
Q25	=	410A ^{0.63}
Q50	=	700A ^{0.68}
Q100	=	1080A ^{0.71}

In the North Coast region, use a minimum value of 1.0 for the altitude index (H). Equations are defined only for basins of 25 mi² or less in the Northeast and South Lahontan-Colorado Desert regions.

Reference

Waananen, A.O., and Crippen, J.R., 1977, *Magnitude and frequency of floods in California: U.S. Geological Survey Water-Resources Investigations Report 77-21*, 96 p.

Additional Reference

Rantz, S.E., 1969, *Mean annual precipitation in the California region: U.S. Geological Survey Open-File Map (Reprinted 1972, 1975)*.



Figure 1. Flood-frequency region map for California. ([PostScript file of Figure 1.](#))

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Page Contact Information: gcomfort@usgs.gov

Page Last Modified: Tuesday, 31-Oct-2006 17:38:30 EST



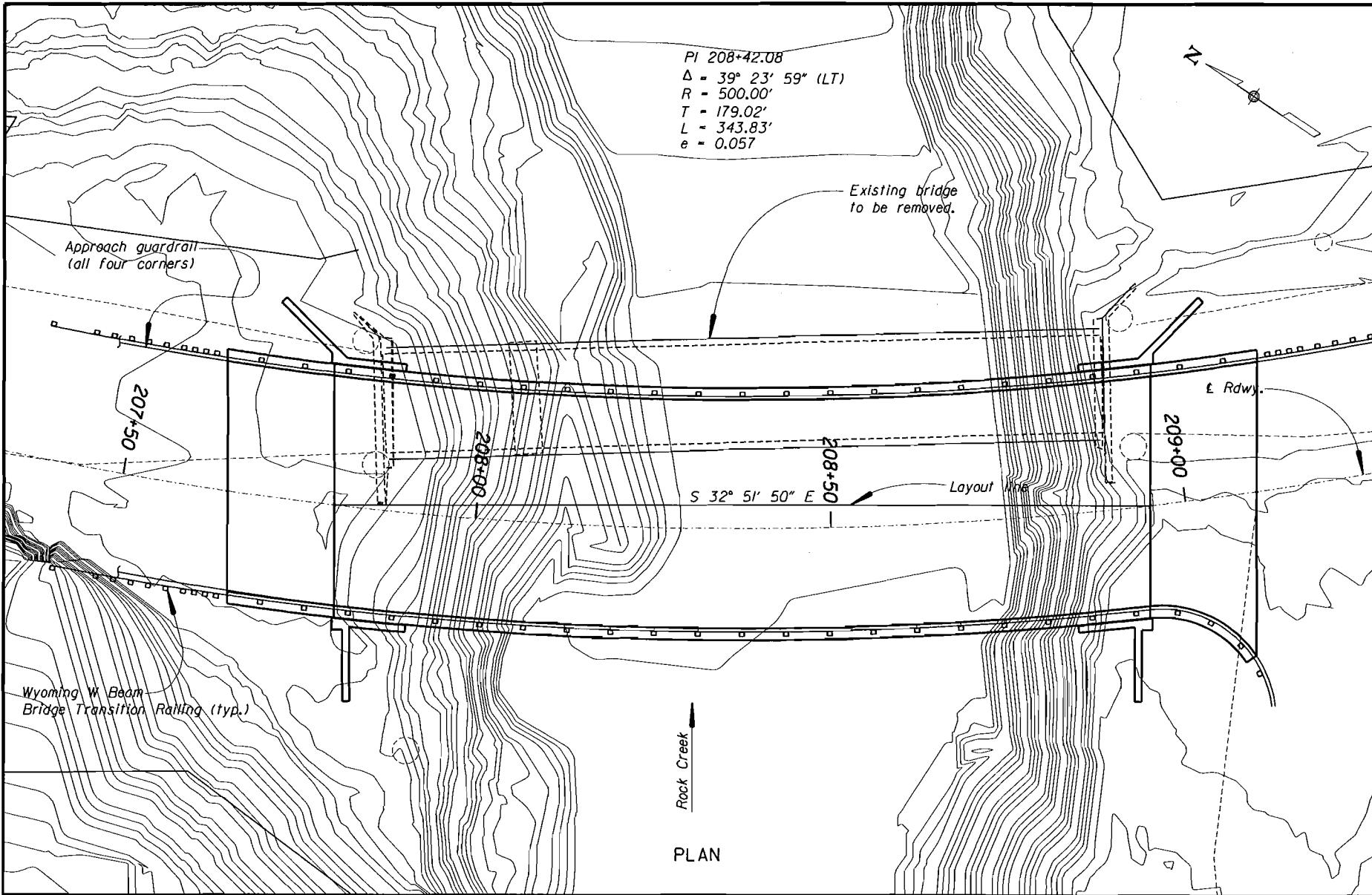
U.S. Geological Survey
National Flood Frequency Program
Water-Resources Investigations Report 94-4002



Figure 1. Flood-frequency region map for California.

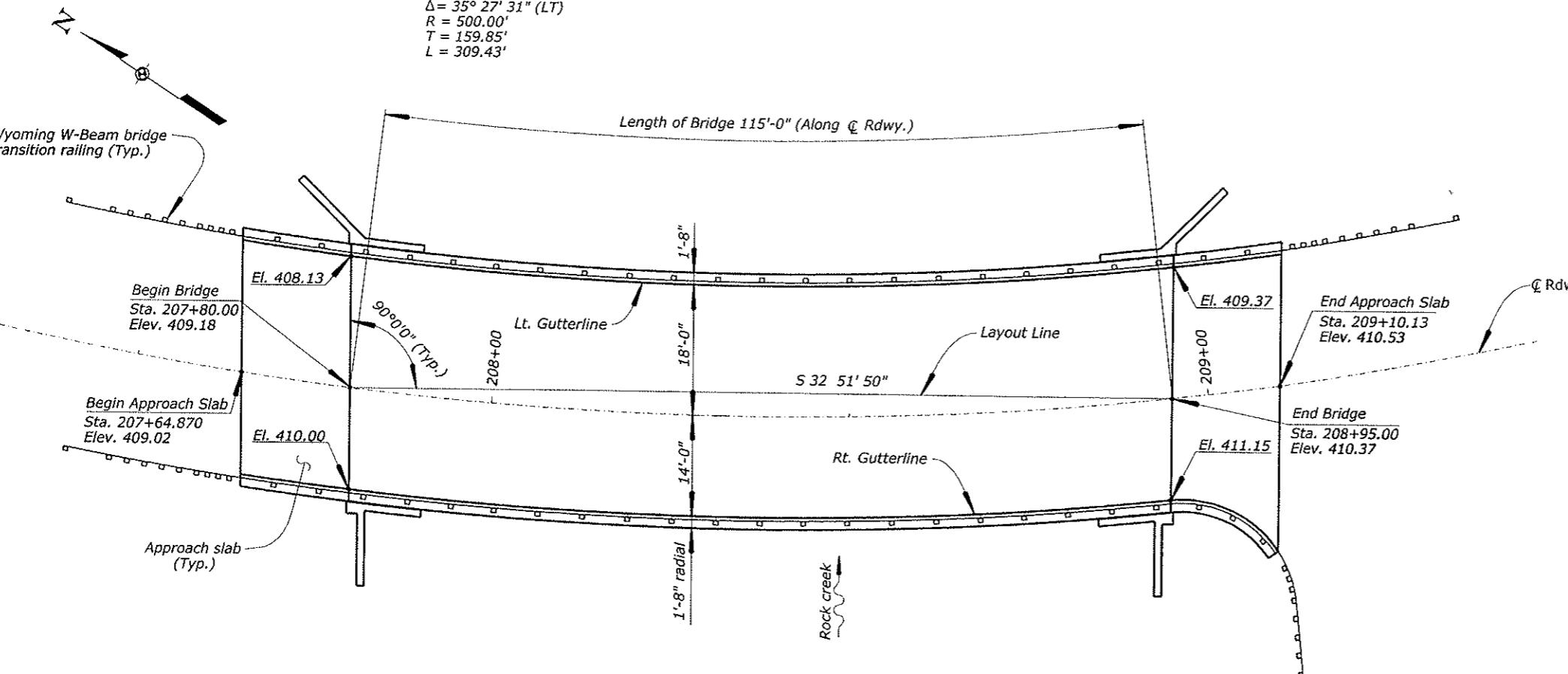
APPENDIX B

BRIDGE DESIGNS

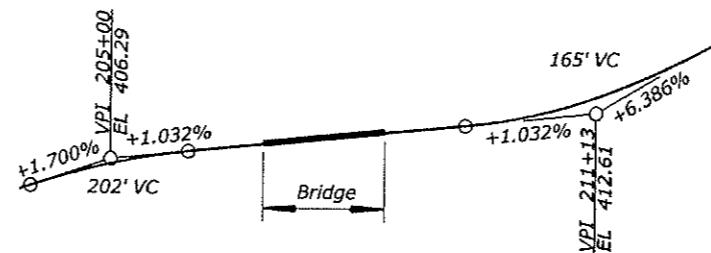


GEOMETRICS																	
<p>TYPICAL ROADWAY SECTION SUPER ROTATED ABOUT ℓ Rdwy STA. 207+80.00 RATE .0570 ft/ft STA. 208+95.00 RATE .0570 ft/ft</p> <p>See revised profile - next page</p>																	
<p>PROFILE GRADE DIAGRAM No Scale Elevations are at profile grade @ ℓ Rdwy.</p>																	
HYDRAULICS																	
<table border="1"> <thead> <tr> <th>Q</th> <th>Vm</th> <th>WS EL.</th> </tr> </thead> <tbody> <tr> <td>Q₂</td> <td>2581</td> <td>5.31 388.23</td> </tr> <tr> <td>Q₅₀</td> <td>8627</td> <td>5.35 403.81</td> </tr> <tr> <td>Q₁₀₀</td> <td>9881</td> <td>6.13 403.79</td> </tr> <tr> <td>Q</td> <td></td> <td></td> </tr> </tbody> </table> <p>REMARKS Q = cubic feet per second Vm = feet per second WS EL. = feet</p>			Q	Vm	WS EL.	Q ₂	2581	5.31 388.23	Q ₅₀	8627	5.35 403.81	Q ₁₀₀	9881	6.13 403.79	Q		
Q	Vm	WS EL.															
Q ₂	2581	5.31 388.23															
Q ₅₀	8627	5.35 403.81															
Q ₁₀₀	9881	6.13 403.79															
Q																	
SCOUR																	
<p>SLOPE PROTECTION TYPE: CLASS: DEPTH:</p> <p>TOP EL.: BOTTOM EL.: SLOPE:</p> <p>SCOUR</p> <p>REMARKS</p>																	
<p>HYDRAULICS REPORT NO. RECEIVED GEOTECHNICAL REPORT NO. RECEIVED</p>																	
<p>TYPICAL BRIDGE SECTION</p> <p>LIVE LOAD HL-93 OVERLOAD None SPECIAL LOADS None SUPERSTRUCTURE Caltrans P/S bulb-tee girder with cast-in-place deck CONCRETE F'C 4000 psi EPOXY REINFORCEMENT Superstructure only RAIL Wyoming 2-Tube Steel Railing (TL-3) TRANSITION Wyoming W Beam Transition Bridge Railing SIDEWALKS None DRAINS None UTILITIES Water Line REMARKS A = 0.4g</p>																	
<p>U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION CENTRAL FEDERAL LANDS HIGHWAY DIVISION, DENVER, COLORADO</p> <p>PRELIMINARY LAYOUT</p> <p>BRIDGE NAME Rock Creek Bridge STREAM NAME Rock Creek ROUTE NAME AND NUMBER CA PHF 112-1(1) South Fork Smith River Road STATE California COUNTY Del Norte FOREST/PARK/OTHER Six Rivers National Forest ACCOUNT NO. RG NO. 2803 PREPARED BY V. Jacobson ESTIMATED STRUCTURE COST \$815,000 (\$200/sf) SCALE: 1" = 20'-0" DATE: 9/13/07</p>																	

Horizontal Curve Data
 PT 208+57.29
 $\Delta = 35^\circ 27' 31''$ (LT)
 $R = 500.00'$
 $T = 159.85'$
 $L = 309.43'$



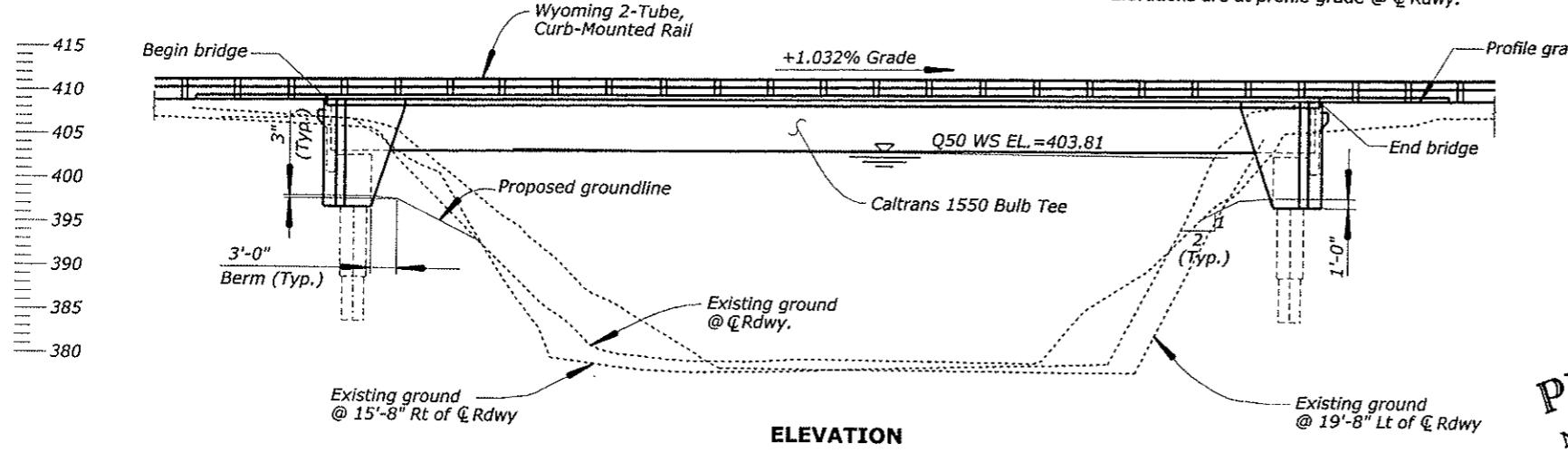
PLAN



PROFILE GRADE DIAGRAM

No Scale

Elevations are at profile grade @ C Rdwy.



ELEVATION

HYDRAULIC DATA

	Q ft/s	Vm ft/s	WS Elev. ft.
Q ₂	2581	5.31	388.23
Q ₅₀	8627	5.35	403.81
Q ₁₀₀	9881	6.13	403.78

PRELIMINARY
NOT FOR CONSTRUCTION

0 $\frac{1}{2}$ " 1 "

REGION	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
W	CA	PFH CA 112-1(i)		

BRIDGE DRAWING INDEX

Drawing No.	Description
RG2803-A	PLAN AND ELEVATION
RG2803-B	GENERAL NOTES
RG2803-C	FOUNDATION PLAN
RG2803-D	STAGE CONSTRUCTION
RG2803-E	DRILLED SHAFT DETAILS
RG2803-F	ABUTMENT 1
RG2803-G	ABUTMENT 1 DETAILS
RG2803-H	WINGWALL 1
RG2803-I	WINGWALL 2
RG2803-J	CHEEKWALLS 1 & 2
RG2803-K	ABUTMENT 2
RG2803-L	ABUTMENT 2 DETAILS
RG2803-M	WINGWALL 3
RG2803-N	WINGWALL 4
RG2803-O	CHEEKWALLS 3 & 4
RG2803-P	FRAMING PLAN
RG2803-Q	GIRDER DETAILS 1
RG2803-R	GIRDER DETAILS 2
RG2803-S	DIAPHRAGM DETAILS 1
RG2803-T	DIAPHRAGM DETAILS 2
RG2803-U	EXPANSION JOINT & BEARING DETAILS
RG2803-V	TYPICAL SECTION & SLAB DETAILS
RG2803-W	APPROACH SLAB 1
RG2803-X	APPROACH SLAB 2
RG2803-Y	BRIDGE RAILING 1 OF 3
RG2803-Z	BRIDGE RAILING 2 OF 3
RG2803-AA	BRIDGE RAILING 3 OF 3
RG2803-BB	STRUCTURE TRANSITION RAILING
RG2803-CC	UTILITY DETAILS
RG2803-DD	REBAR LIST (1 OF 9)
RG2803-EE	REBAR LIST (2 OF 9)
RG2803-FF	REBAR LIST (3 OF 9)
RG2803-GG	REBAR LIST (4 OF 9)
RG2803-HH	REBAR LIST (5 OF 9)
RG2803-II	REBAR LIST (6 OF 9)
RG2803-JJ	REBAR LIST (7 OF 9)
RG2803-KK	REBAR LIST (8 OF 9)
RG2803-LL	REBAR LIST (9 OF 9)

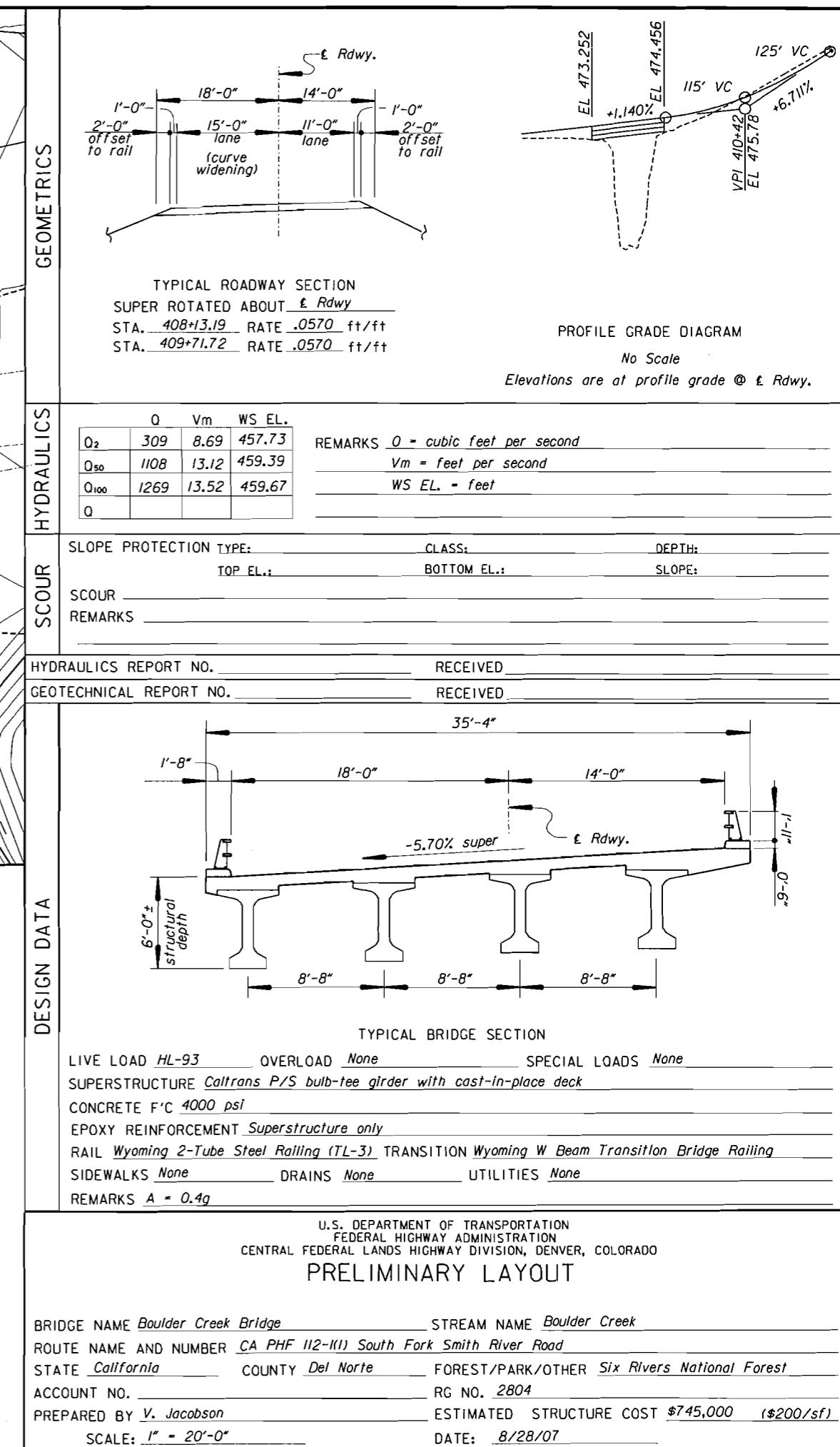
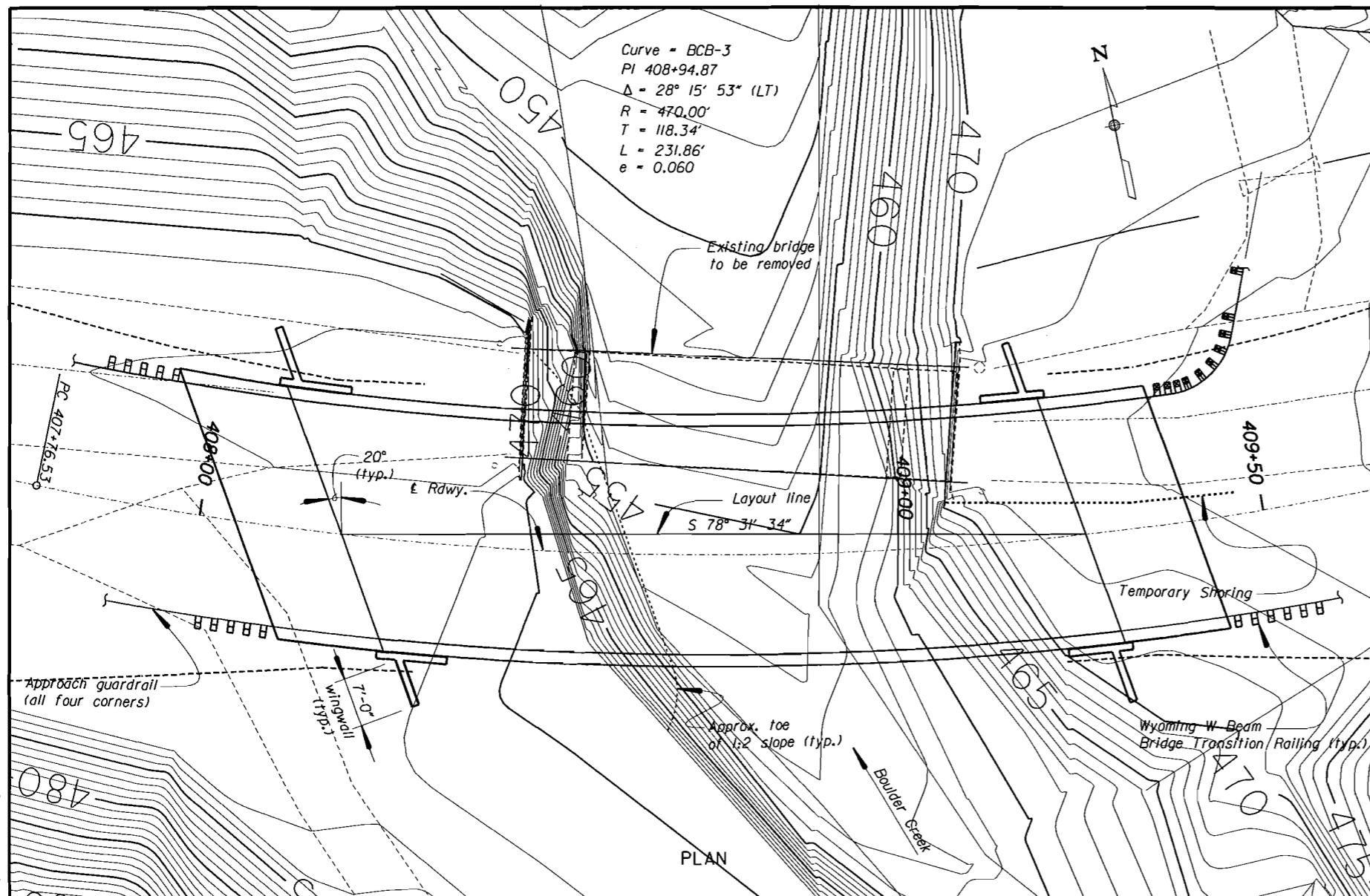
U.S. DEPARTMENT OF TRANSPORTATION
 FEDERAL HIGHWAY ADMINISTRATION
 CENTRAL FEDERAL LANDS HIGHWAY DIVISION

ROCK CREEK BRIDGE
 SIX RIVERS NATIONAL FOREST
 DEL NORTE COUNTY, CALIFORNIA

Revised Profile

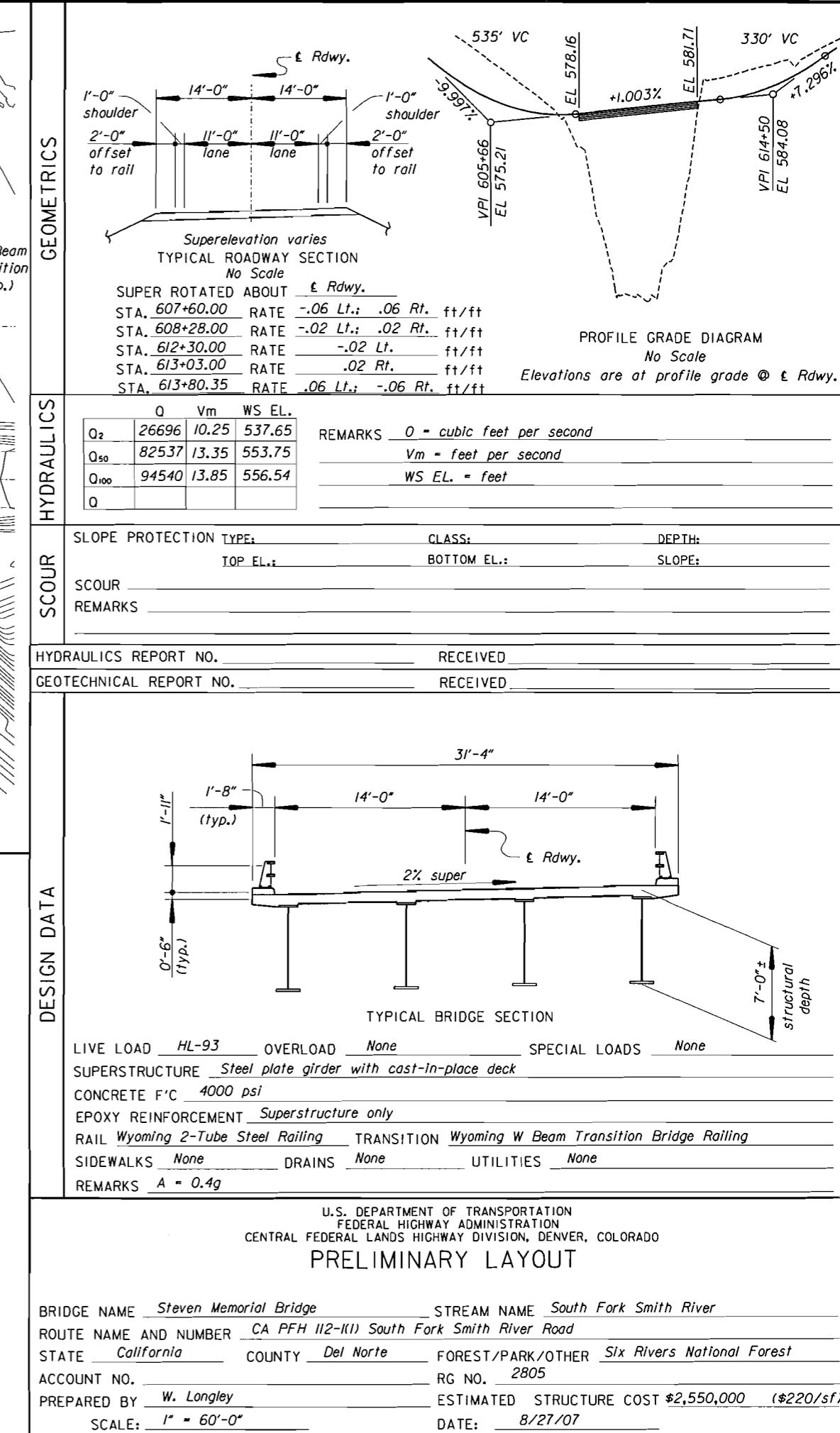
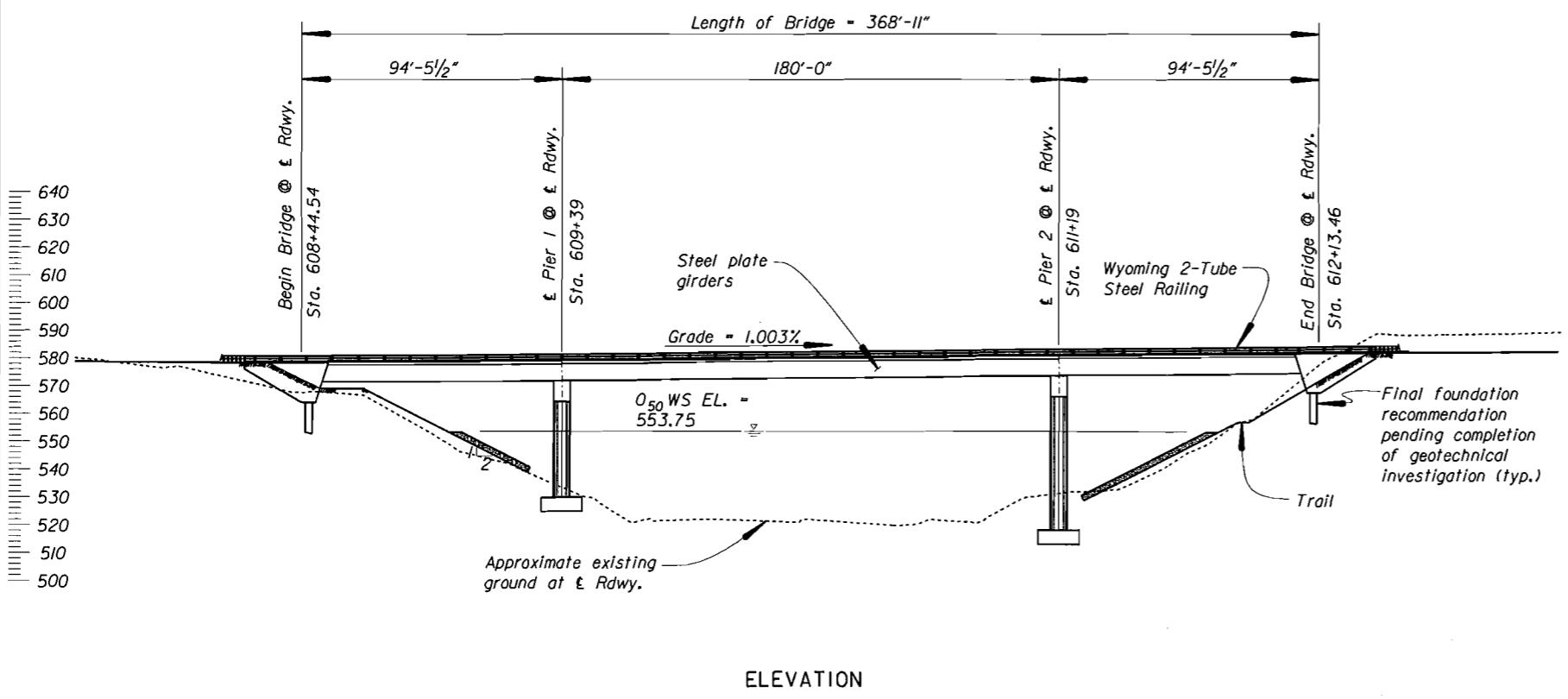
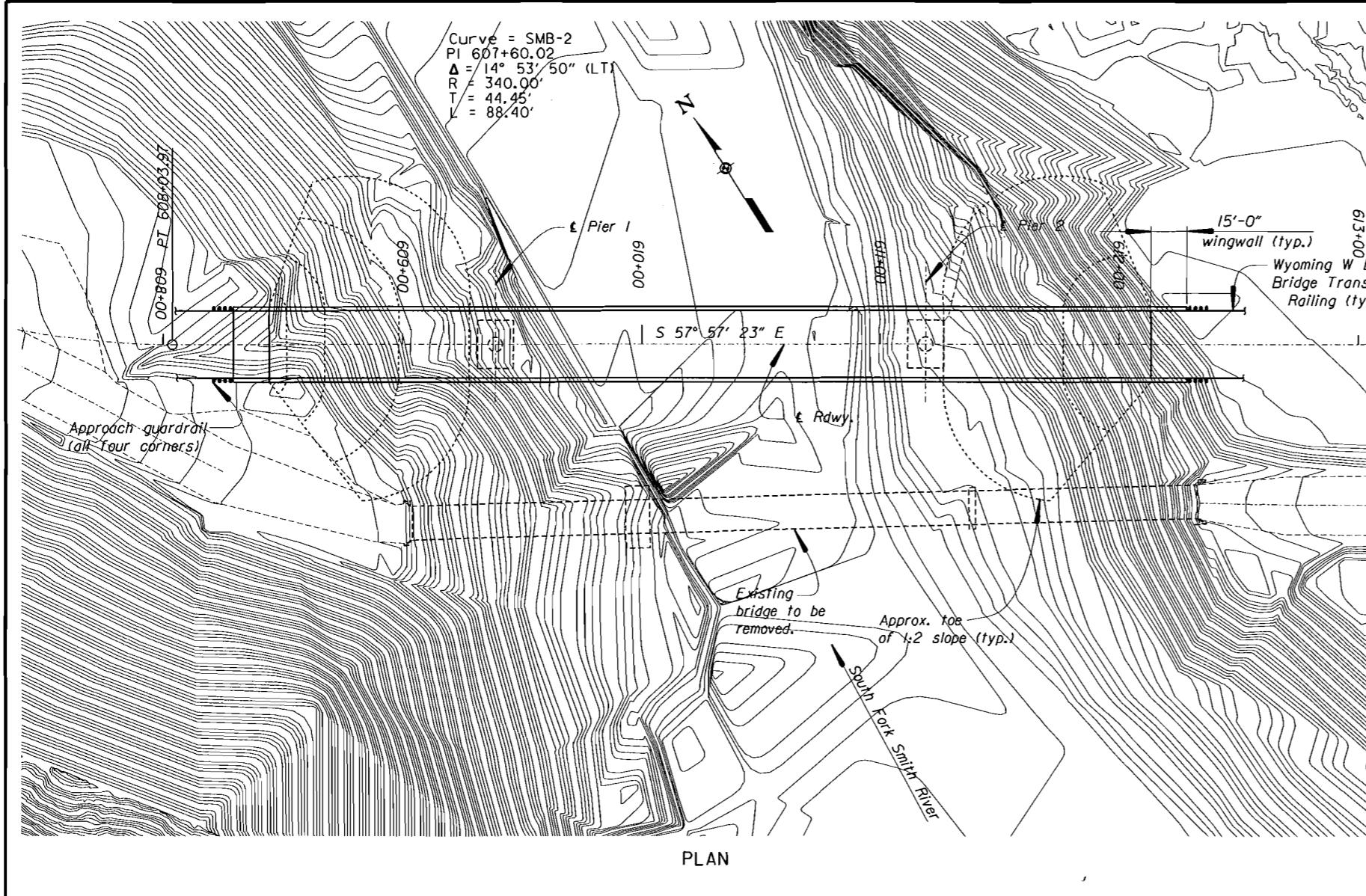
PLAN AND ELEVATION

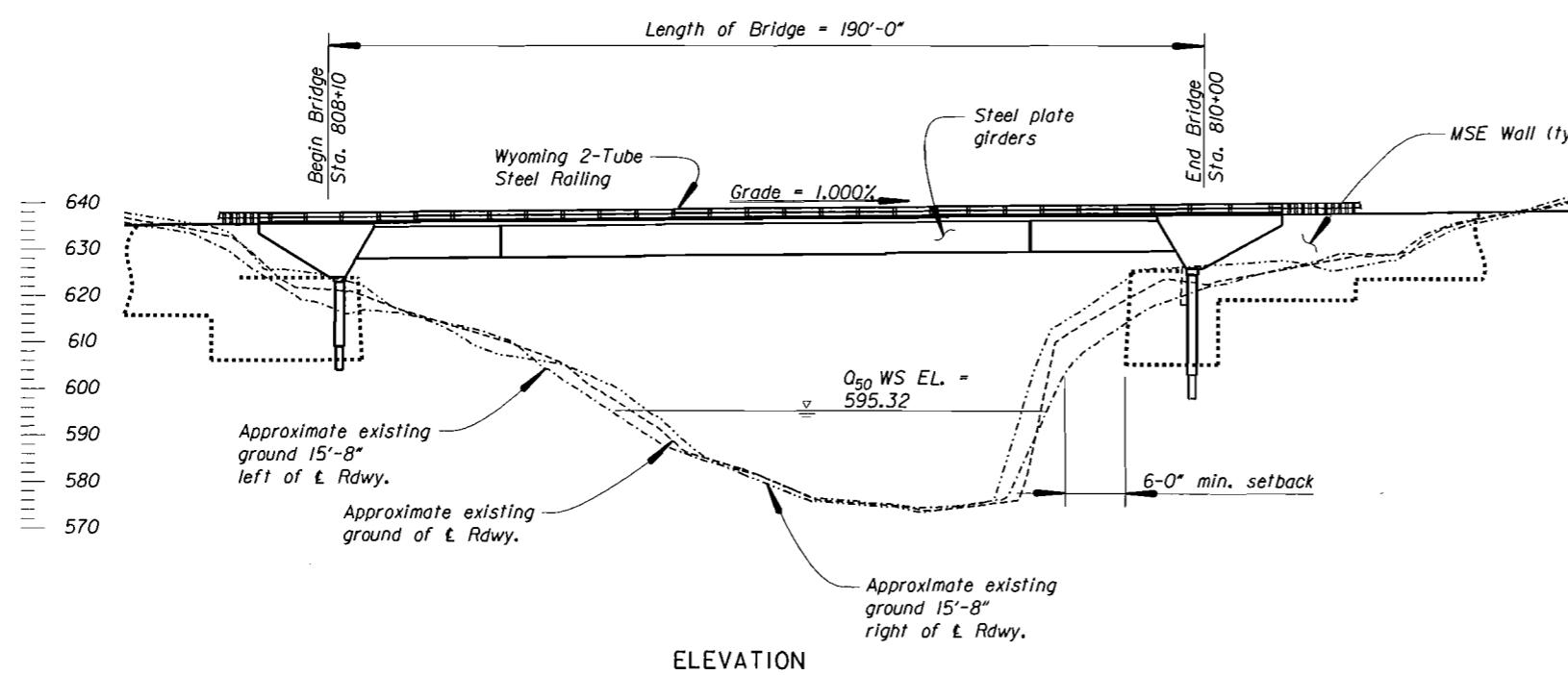
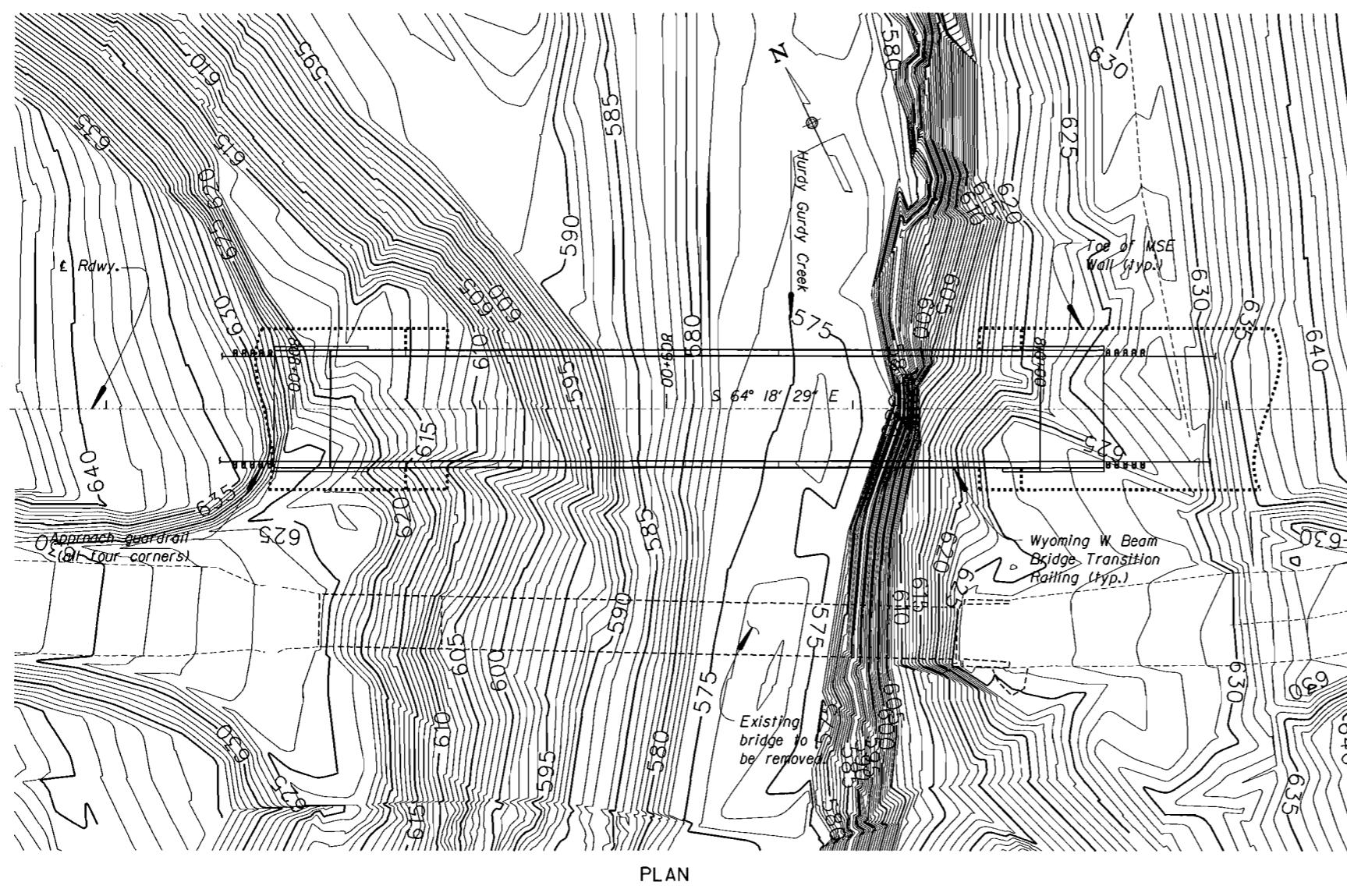
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								J.K. Penrod	J.K. Penrod	Y.M.	1"-20' UNLESS NOTED	Hong Chen	I of 38	JUNE 2008	RG2803-A



HINCA0012-UNB1998RG2804-Boulder Creek(CADD) EllesNT SandI Vr92804+388/000

3/13/2007





GEOMETRICS																				
<p>Superelevation varies TYPICAL ROADWAY SECTION No Scale SUPER ROTATED ABOUT E Rdwy. STA. 806+76.885 RATE .060 LT; -.060 RT ft/ft STA. 808+10.00 RATE -.020 LT; .020 RT ft/ft STA. 811+06.280 RATE -.020 LT; .020 RT ft/ft STA. 811+82.947 RATE -.060 LT; .060 RT ft/ft</p>																				
<p>PROFILE GRADE DIAGRAM No Scale Elevations are at profile grade @ E Rdwy.</p>																				
HYDRAULICS																				
<table border="1"> <thead> <tr> <th>Q</th> <th>Vm</th> <th>WS EL.</th> </tr> </thead> <tbody> <tr> <td>Q₂</td> <td>4499</td> <td>7.81</td> <td>585.88</td> </tr> <tr> <td>Q₅₀</td> <td>14760</td> <td>11.08</td> <td>595.32</td> </tr> <tr> <td>Q₁₀₀</td> <td>16906</td> <td>11.57</td> <td>596.88</td> </tr> <tr> <td>Q</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>REMARKS Q - cubic feet per second Vm - feet per second WS El. - feet</p>		Q	Vm	WS EL.	Q ₂	4499	7.81	585.88	Q ₅₀	14760	11.08	595.32	Q ₁₀₀	16906	11.57	596.88	Q			
Q	Vm	WS EL.																		
Q ₂	4499	7.81	585.88																	
Q ₅₀	14760	11.08	595.32																	
Q ₁₀₀	16906	11.57	596.88																	
Q																				
SCOUR																				
<p>SLOPE PROTECTION TYPE: CLASS: DEPTH: TOP EL.: BOTTOM EL.: SLOPE:</p> <p>SCOUR REMARKS</p>																				
HYDRAULICS REPORT NO. RECEIVED																				
GEOTECHNICAL REPORT NO. RECEIVED																				
DESIGN DATA																				
<p>TYPICAL BRIDGE SECTION</p>																				
<p>LIVE LOAD HL-93 OVERLOAD None SPECIAL LOADS None SUPERSTRUCTURE Steel plate girder with cast-in-place deck CONCRETE F'C 4000 psi EPOXY REINFORCEMENT Superstructure only RAIL Wyoming 2-Tube Steel Railing (TL-3) TRANSITION Wyoming W Beam Transition Bridge Railing SIDEWALKS None DRAINS None UTILITIES None</p>																				
<p>REMARKS A = 0.4g</p>																				
<p>U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION CENTRAL FEDERAL LANDS HIGHWAY DIVISION, DENVER, COLORADO</p>																				
<p>PRELIMINARY LAYOUT</p>																				
<p>BRIDGE NAME Hurdy Gurdy Creek Bridge STREAM NAME Hurdy Gurdy Creek ROUTE NAME AND NUMBER CA PFH 112-(1) South Fork Smith River Road STATE California COUNTY Del Norte FOREST/PARK/OTHER Six Rivers National Forest ACCOUNT NO. RG NO. 2806 PREPARED BY W. Longley ESTIMATED STRUCTURE COST \$905,000 (\$180/sf) SCALE: 1" = 40'-0" DATE: 9/10/07</p>																				

APPENDIX C

HYDRAULICS

Enclosed for each bridge:

Cross section location and layout for each HEC-RAS model

Water surface profiles for a range of flow conditions

Tabular model results (highlighting design conditions)

Channel cross section at upstream face of proposed bridge

Water surface profile for design flow condition

(with comparison to existing water surface profile – if sufficient information was available to
model the existing bridge)



N

Scale: 1" = 100'

754-00

755-00

756-00

757-00

758-00

759-00

564.3

624.3

688.3

732.1

767.1

813.2

871.6

909.0

961.1

468.7

413.4

349.2

266.0

225.5

193.2

162.2

143.2

116.1

89.6

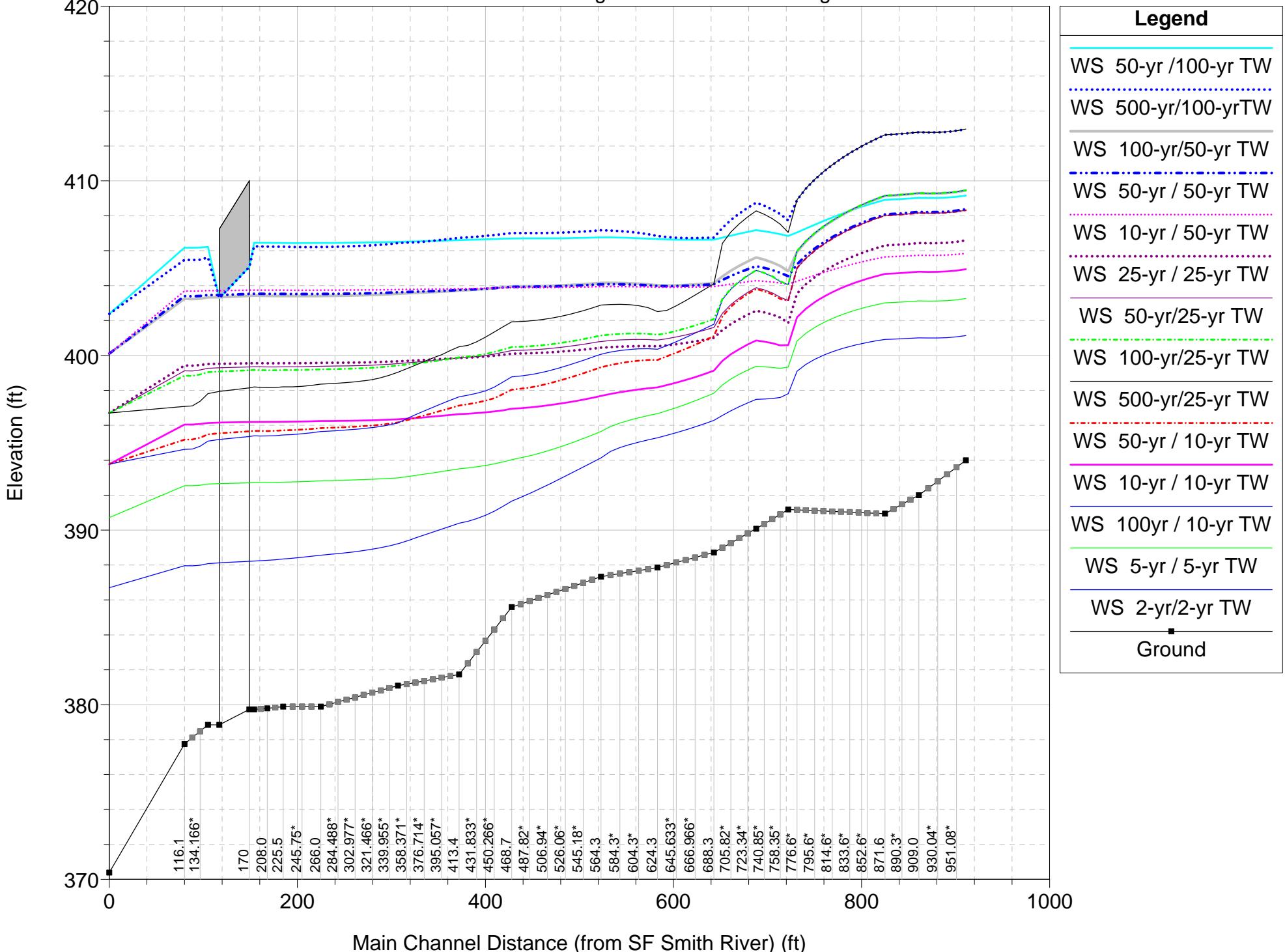
66.4

41.4

14.2

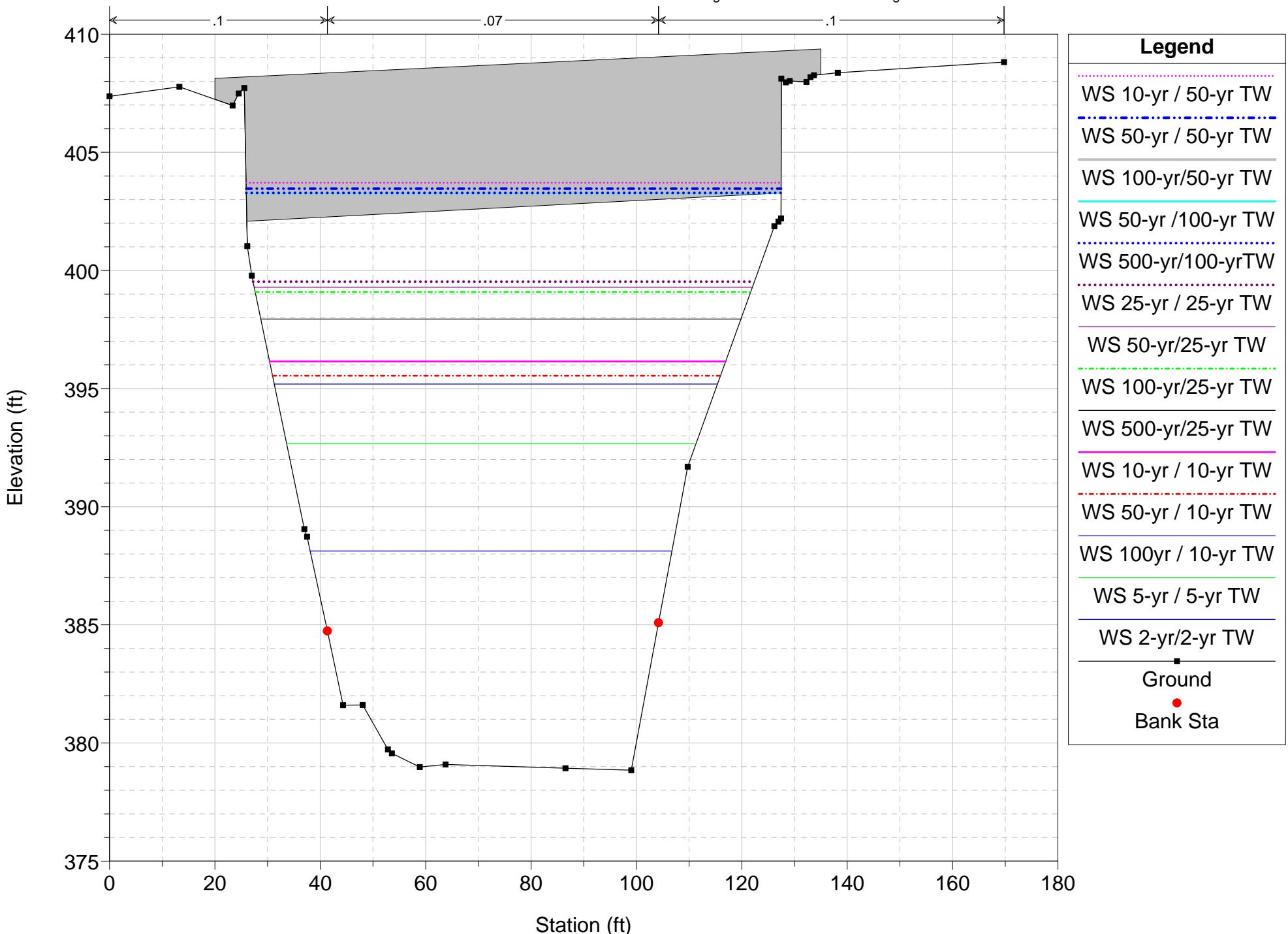
ROCK CREEK
HEC-RAS MODEL
CROSS SECTION LOCATIONS

Rock Creek Bridge Plan: Raised Bridge



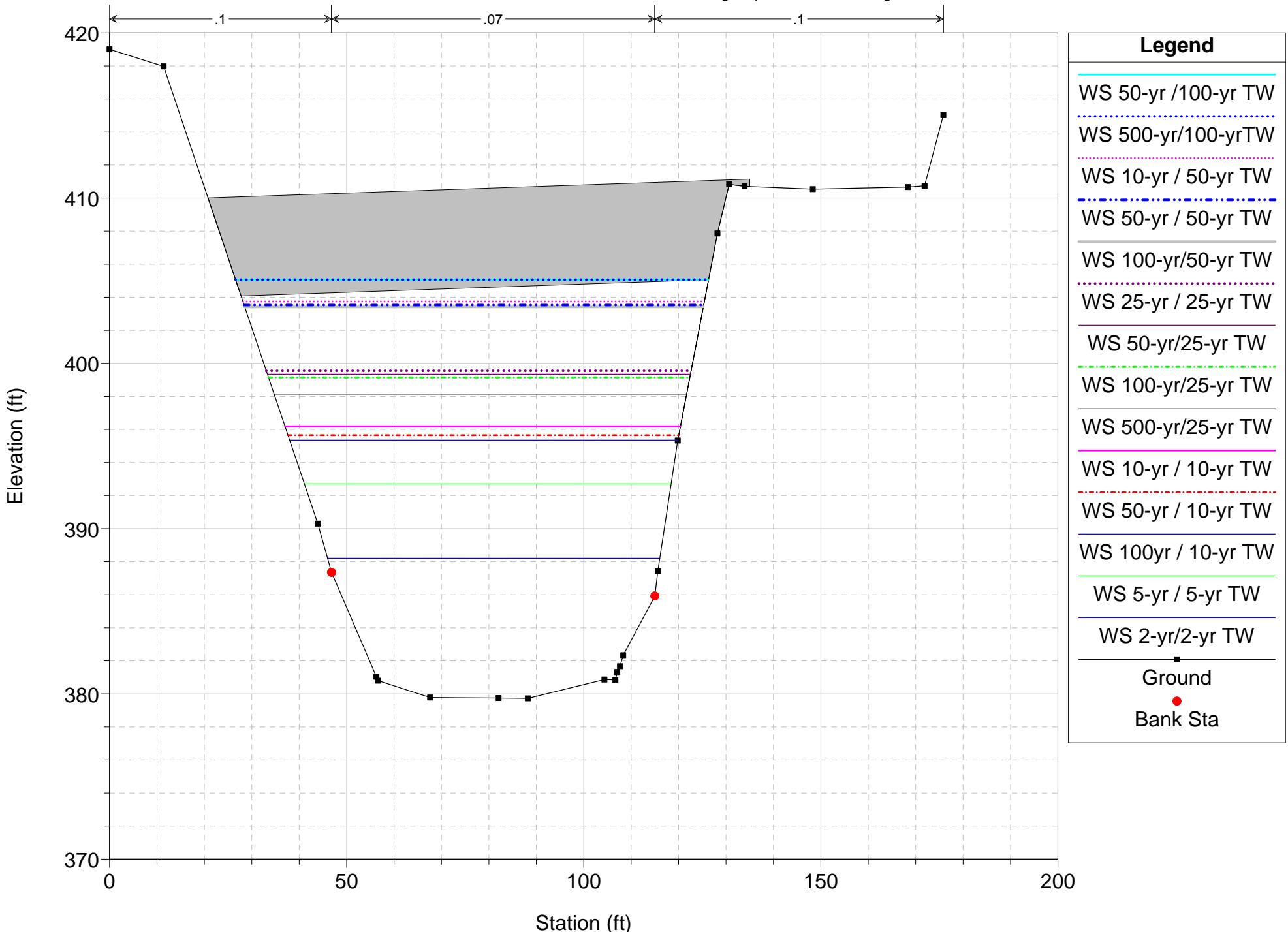
Rock Creek Bridge Plan: Raised Bridge

River = Rock Creek Reach = Trib Rock Creek Bridge Downstream Face of Bridge



Rock Creek Bridge Plan: Raised Bridge

River = Rock Creek Reach = Trib Rock Creek Bridge Upstream Face of Bridge



HEC-RAS HYDRAULIC SUMMARY FOR PROPOSED BRIDGE

HEC-RAS Plan: Rasiend Bridge River: Rock Creek Reach: Trib

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	961.6	2-yr/2-yr TW	2581.00	394.00	401.14	398.48	401.87	0.010529	6.87	375.95	58.23	0.48
Trib	961.6	5-yr / 5-yr TW	4036.00	394.00	403.26	399.92	404.27	0.010791	8.04	501.91	60.44	0.49
Trib	961.6	10-yr / 10-yr TW	5392.00	394.00	404.94	401.09	406.18	0.011088	8.91	604.85	62.18	0.50
Trib	961.6	25-yr / 25-yr TW	6887.00	394.00	406.59	402.27	408.06	0.011377	9.72	708.83	63.90	0.51
Trib	961.6	50-yr /100-yr TW	8627.00	394.00	409.16	403.53	410.66	0.009594	9.85	876.05	66.54	0.48
Trib	961.6	100-yr/50-yr TW	9881.00	394.00	409.45	404.38	411.34	0.011695	11.03	895.65	66.84	0.53
Trib	961.6	500-yr/100-yrTW	14246.00	394.00	412.96	407.07	415.43	0.011228	12.61	1136.40	70.38	0.54
Trib	961.6	50-yr / 10-yr TW	8627.00	394.00	408.32	403.53	410.04	0.011683	10.51	820.81	65.70	0.52
Trib	961.6	50-yr / 50-yr TW	8627.00	394.00	408.38	403.53	410.08	0.011528	10.46	824.63	65.76	0.52
Trib	961.6	10-yr / 50-yr TW	5392.00	394.00	405.85	401.09	406.88	0.008527	8.15	661.57	63.13	0.44
Trib	961.6	100yr / 10-yr TW	9881.00	394.00	409.46	404.38	411.35	0.011661	11.02	896.43	66.85	0.53
Trib	961.6	50-yr/25-yr TW	8627.00	394.00	408.32	403.53	410.04	0.011683	10.51	820.81	65.70	0.52
Trib	961.6	100-yr/25-yr TW	9881.00	394.00	409.46	404.38	411.35	0.011661	11.02	896.43	66.85	0.53
Trib	961.6	500-yr/25-yr TW	14246.00	394.00	412.96	407.07	415.43	0.011218	12.61	1136.74	70.38	0.54
Trib	909.0	2-yr/2-yr TW	2581.00	392.00	401.01	396.09	401.40	0.004195	5.03	512.65	59.63	0.30
Trib	909.0	5-yr / 5-yr TW	4036.00	392.00	403.13	397.49	403.74	0.005290	6.30	640.24	60.88	0.34
Trib	909.0	10-yr / 10-yr TW	5392.00	392.00	404.80	398.65	405.62	0.005978	7.26	742.79	61.91	0.37
Trib	909.0	25-yr / 25-yr TW	6887.00	392.00	406.44	399.81	407.47	0.006396	8.16	845.49	63.34	0.39
Trib	909.0	50-yr /100-yr TW	8627.00	392.00	409.03	401.05	410.17	0.005615	8.58	1012.81	65.73	0.38
Trib	909.0	100-yr/50-yr TW	9881.00	392.00	409.29	401.89	410.74	0.006987	9.68	1029.80	65.97	0.42
Trib	909.0	500-yr/100-yrTW	14246.00	392.00	412.79	404.58	414.83	0.007606	11.48	1267.86	70.42	0.45
Trib	909.0	50-yr / 10-yr TW	8627.00	392.00	408.16	401.05	409.44	0.006749	9.07	956.00	64.93	0.41
Trib	909.0	50-yr / 50-yr TW	8627.00	392.00	408.22	401.05	409.49	0.006661	9.04	959.95	64.99	0.41
Trib	909.0	10-yr / 50-yr TW	5392.00	392.00	405.74	398.65	406.44	0.004668	6.73	801.59	62.70	0.33
Trib	909.0	100yr / 10-yr TW	9881.00	392.00	409.30	401.89	410.75	0.006970	9.67	1030.61	65.98	0.42
Trib	909.0	50-yr/25-yr TW	8627.00	392.00	408.16	401.05	409.44	0.006749	9.07	956.00	64.93	0.41
Trib	909.0	100-yr/25-yr TW	9881.00	392.00	409.30	401.89	410.75	0.006970	9.67	1030.61	65.98	0.42
Trib	909.0	500-yr/25-yr TW	14246.00	392.00	412.79	404.58	414.83	0.007599	11.47	1268.20	70.42	0.45
Trib	871.6	2-yr/2-yr TW	2581.00	390.94	400.92	395.25	401.25	0.003069	4.65	555.50	60.67	0.27
Trib	871.6	5-yr / 5-yr TW	4036.00	390.94	403.01	396.69	403.56	0.003805	5.93	684.44	62.45	0.31
Trib	871.6	10-yr / 10-yr TW	5392.00	390.94	404.67	397.87	405.41	0.004304	6.91	789.11	63.86	0.34
Trib	871.6	25-yr / 25-yr TW	6887.00	390.94	406.30	399.04	407.25	0.004726	7.83	894.32	65.26	0.36
Trib	871.6	50-yr /100-yr TW	8627.00	390.94	408.91	400.26	409.97	0.004264	8.30	1071.52	69.63	0.35
Trib	871.6	100-yr/50-yr TW	9881.00	390.94	409.14	401.11	410.49	0.005353	9.38	1087.25	69.90	0.40
Trib	871.6	500-yr/100-yrTW	14246.00	390.94	412.63	403.71	414.55	0.005985	11.20	1338.91	74.33	0.43
Trib	871.6	50-yr / 10-yr TW	8627.00	390.94	408.01	400.26	409.20	0.005109	8.77	1009.52	68.56	0.38
Trib	871.6	50-yr / 50-yr TW	8627.00	390.94	408.08	400.26	409.26	0.005043	8.73	1013.85	68.63	0.38
Trib	871.6	10-yr / 50-yr TW	5392.00	390.94	405.64	397.87	406.28	0.003379	6.42	851.70	64.69	0.30
Trib	871.6	100yr / 10-yr TW	9881.00	390.94	409.15	401.11	410.51	0.005339	9.37	1088.15	69.91	0.39
Trib	871.6	50-yr/25-yr TW	8627.00	390.94	408.01	400.26	409.20	0.005109	8.77	1009.52	68.56	0.38
Trib	871.6	100-yr/25-yr TW	9881.00	390.94	409.15	401.11	410.51	0.005339	9.37	1088.15	69.91	0.39
Trib	871.6	500-yr/25-yr TW	14246.00	390.94	412.64	403.71	414.56	0.005980	11.20	1339.29	74.33	0.43
Trib	767.1	2-yr/2-yr TW	2581.00	391.18	397.81	397.81	399.97	0.050156	11.80	218.67	50.58	1.00
Trib	767.1	5-yr / 5-yr TW	4036.00	391.18	399.34	399.34	402.19	0.047034	13.55	298.08	53.47	1.01
Trib	767.1	10-yr / 10-yr TW	5392.00	391.18	400.59	400.59	403.98	0.043038	14.79	366.76	56.04	0.99
Trib	767.1	25-yr / 25-yr TW	6887.00	391.18	401.87	401.79	405.77	0.039542	15.88	440.04	58.61	0.98
Trib	767.1	50-yr /100-yr TW	8627.00	391.18	406.84	403.15	409.08	0.012170	12.11	755.70	67.74	0.59
Trib	767.1	100-yr/50-yr TW	9881.00	391.18	404.83	404.05	409.03	0.028365	16.54	622.12	64.39	0.88
Trib	767.1	500-yr/100-yrTW	14246.00	391.18	407.74	406.89	413.00	0.026394	18.64	816.74	68.57	0.88
Trib	767.1	50-yr / 10-yr TW	8627.00	391.18	403.15	403.15	407.67	0.037867	17.13	516.59	61.11	0.98
Trib	767.1	50-yr / 50-yr TW	8627.00	391.18	404.54	403.15	407.92	0.023678	14.85	603.49	63.83	0.80
Trib	767.1	10-yr / 50-yr TW	5392.00	391.18	404.09	400.59	405.53	0.010703	9.70	574.84	62.94	0.53
Trib	767.1	100yr / 10-yr TW	9881.00	391.18	404.05	404.05	408.95	0.036367	17.85	572.60	62.87	0.98
Trib	767.1	50-yr/25-yr TW	8627.00	391.18	403.15	403.15	407.67	0.037867	17.13	516.59	61.11	0.98
Trib	767.1	100-yr/25-yr TW	9881.00	391.18	404.05	404.05	408.95	0.036367	17.85	572.60	62.87	0.98
Trib	767.1	500-yr/25-yr TW	14246.00	391.18	407.04	406.89	412.93	0.031492	19.68	769.26	67.92	0.95
Trib	732.1	2-yr/2-yr TW	2581.00	390.08	397.49	395.98	398.48	0.018057	7.98	323.33	61.81	0.62
Trib	732.1	5-yr / 5-yr TW	4036.00	390.08	399.38	397.35	400.68	0.016314	9.15	441.14	62.87	0.61
Trib	732.1	10-yr / 10-yr TW	5392.00	390.08	400.86	398.44	402.44	0.015439	10.11	534.75	63.62	0.61
Trib	732.1	25-yr / 25-yr TW	6887.00	390.08	402.56	399.53	404.36	0.013739	10.76	643.72	64.51	0.59
Trib	732.1	50-yr /100-yr TW	8627.00	390.08	407.18	400.71	408.51	0.006207	9.27	948.78	68.30	0.42
Trib	732.1	100-yr/50-yr TW	9881.00	390.08	405.62	401.50	407.80	0.011813	11.88	843.59	66.50	0.57
Trib	732.1	500-yr/100-yrTW	14246.00	390.08	408.75	404.05	411.70	0.012071	13.82	1057.56	70.11	0.60
Trib	732.1	50-yr / 10-yr TW	8627.00	390.08	403.81	400.71	406.05	0.014684	12.01	724.64	65.18	0.62
Trib	732.1	50-yr / 50-yr TW	8627.00	390.08	405.11	400.71	406.92	0.010241	10.78	810.36	66.03	0.53
Trib	732.1	10-yr / 50-yr TW	5392.00	390.08	404.29	398.44	405.09	0.005005	7.21	755.89	65.44	0.37
Trib	732.1	100yr / 10-yr TW	9881.00	390.08	404.87	401.50	407.32	0.014345	12.59	793.99	65.84	0.63
Trib	732.1	50-yr/25-yr TW	8627.00	390.08	403.89	400.71	406.09	0.014354	11.93	729.74	65.22	0.62
Trib	732.1	100-yr/25-yr TW	9881.00	390.08	404.88	401.50	407.33	0.014285	12.58	795.04	65.85	0.63
Trib	732.1	500-yr/25-yr TW	14246.00	390.08	408.28	404.05	411.42	0.013304	14.24	1024.87	69.57	0.63
Trib	688.3	2-yr/2-yr TW	2581.00	388.72	396.28	394.89	397.59	0.021439	9.18	281.10	50.52	0.69
Trib	688.3	5-yr / 5-yr TW	4036.00	388.72	397.84	396.54	399.76	0.025071	11.13	362.55	54.03	0.76

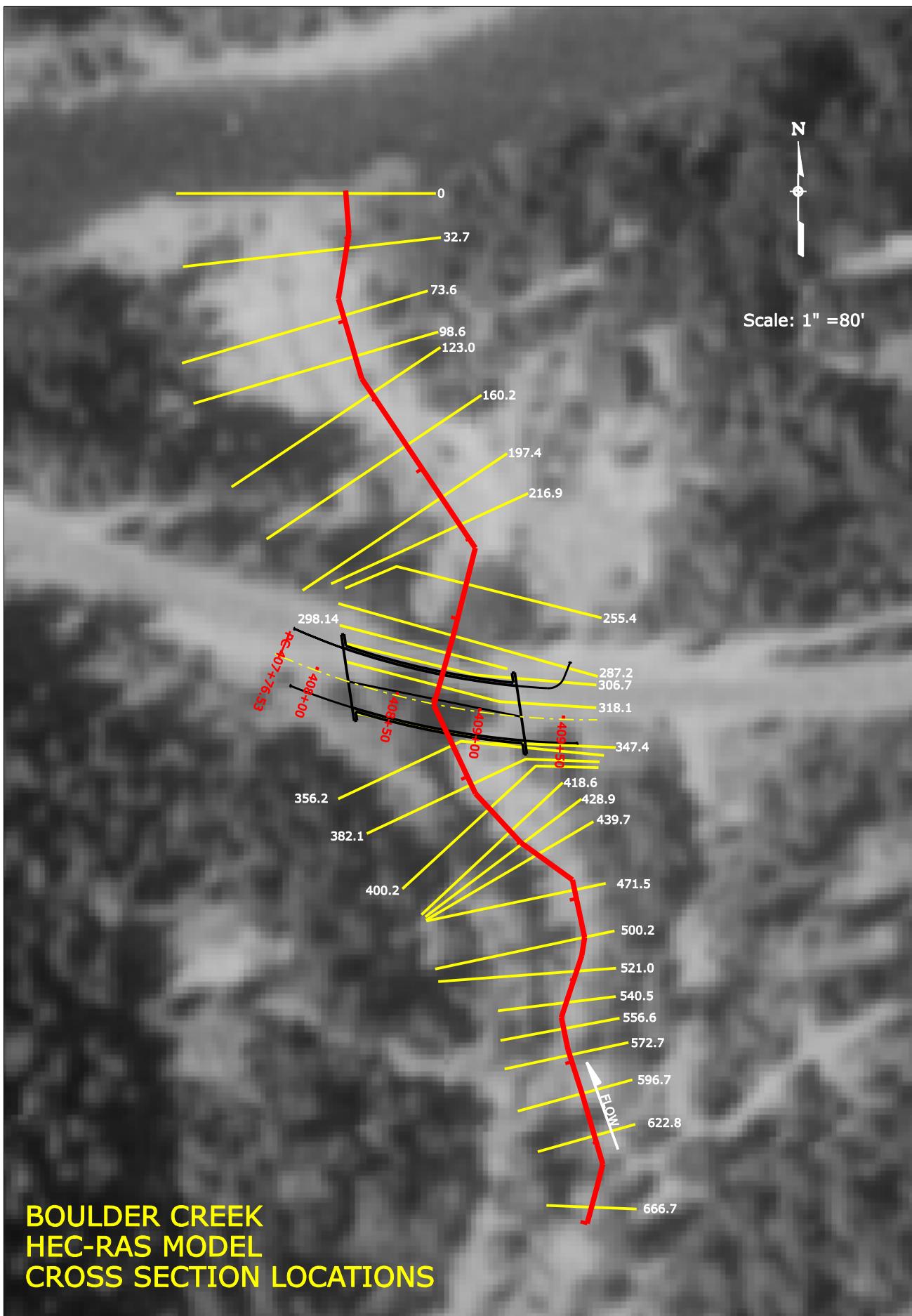
HEC-RAS Plan: Rasiend Brdg River: Rock Creek Reach: Trib (Continued)

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)	
Trib	688.3	10-yr / 10-yr TW	5392.00	388.72	399.13	397.87	401.54	0.025036	12.45	433.94	56.13	0.78
Trib	688.3	25-yr / 25-yr TW	6887.00	388.72	401.01	399.10	403.57	0.020086	12.84	541.98	58.96	0.72
Trib	688.3	50-yr / 100-yr TW	8627.00	388.72	406.64	400.39	408.20	0.006794	10.10	897.58	67.46	0.45
Trib	688.3	100-yr/50-yr TW	9881.00	388.72	404.15	401.29	407.12	0.016207	13.88	734.62	63.71	0.68
Trib	688.3	500-yr/100-yrTW	14246.00	388.72	406.75	404.11	410.94	0.018063	16.55	905.31	67.63	0.74
Trib	688.3	50-yr / 10-yr TW	8627.00	388.72	401.11	400.39	405.04	0.030471	15.93	547.84	59.11	0.89
Trib	688.3	50-yr / 50-yr TW	8627.00	388.72	404.07	400.39	406.37	0.012604	12.19	729.76	63.59	0.60
Trib	688.3	10-yr / 50-yr TW	5392.00	388.72	403.94	397.87	404.86	0.005099	7.70	721.40	63.39	0.38
Trib	688.3	100yr / 10-yr TW	9881.00	388.72	401.79	401.29	406.29	0.031971	17.05	588.48	60.14	0.92
Trib	688.3	50-yr/25-yr TW	8627.00	388.72	401.61	400.39	405.16	0.025849	15.15	577.45	59.86	0.83
Trib	688.3	100-yr/25-yr TW	9881.00	388.72	402.09	401.29	406.34	0.029119	16.58	606.48	60.59	0.88
Trib	688.3	500-yr/25-yr TW	14246.00	388.72	404.11	404.11	410.32	0.034050	20.07	732.03	63.65	0.98
Trib	624.3	2-yr/2-yr TW	2581.00	387.86	395.28	393.65	396.33	0.017239	8.19	315.14	58.31	0.62
Trib	624.3	5-yr / 5-yr TW	4036.00	387.86	396.67	395.16	398.27	0.020522	10.17	397.05	59.98	0.69
Trib	624.3	10-yr / 10-yr TW	5392.00	387.86	398.17	396.31	400.08	0.018574	11.08	488.70	61.85	0.68
Trib	624.3	25-yr / 25-yr TW	6887.00	387.86	400.52	397.47	402.38	0.012967	10.95	642.64	71.92	0.60
Trib	624.3	50-yr /100-yr TW	8627.00	387.86	406.66	398.68	407.73	0.004142	8.41	1115.63	83.15	0.36
Trib	624.3	100-yr/50-yr TW	9881.00	387.86	404.02	399.51	406.07	0.009928	11.60	903.36	77.54	0.55
Trib	624.3	500-yr/100-yrTW	14246.00	387.86	406.84	402.30	409.67	0.010873	13.72	1130.73	83.53	0.59
Trib	624.3	50-yr / 10-yr TW	8627.00	387.86	399.75	398.68	403.16	0.026396	14.85	587.61	66.64	0.84
Trib	624.3	50-yr / 50-yr TW	8627.00	387.86	403.98	398.68	405.55	0.007643	10.16	900.29	77.46	0.48
Trib	624.3	10-yr / 50-yr TW	5392.00	387.86	403.91	396.31	404.53	0.003038	6.39	894.85	77.31	0.30
Trib	624.3	100yr / 10-yr TW	9881.00	387.86	400.36	399.51	404.31	0.028167	15.97	630.81	71.68	0.87
Trib	624.3	50-yr/25-yr TW	8627.00	387.86	400.88	398.68	403.59	0.018144	13.25	668.52	72.45	0.71
Trib	624.3	100-yr/25-yr TW	9881.00	387.86	401.19	399.51	404.54	0.021638	14.74	690.81	72.90	0.78
Trib	624.3	500-yr/25-yr TW	14246.00	387.86	402.51	402.30	407.98	0.030583	18.88	788.77	74.85	0.94
Trib	564.3	2-yr/2-yr TW	2581.00	387.33	394.14	393.32	395.21	0.025279	8.33	309.75	76.09	0.73
Trib	564.3	5-yr / 5-yr TW	4036.00	387.33	395.65	394.51	397.04	0.022134	9.46	426.71	78.30	0.71
Trib	564.3	10-yr / 10-yr TW	5392.00	387.33	397.68	395.46	399.00	0.013833	9.22	588.90	81.39	0.59
Trib	564.3	25-yr / 25-yr TW	6887.00	387.33	400.44	396.38	401.58	0.007900	8.58	819.57	85.71	0.47
Trib	564.3	50-yr /100-yr TW	8627.00	387.33	406.77	397.42	407.42	0.002430	6.55	1400.42	98.10	0.28
Trib	564.3	100-yr/50-yr TW	9881.00	387.33	404.16	398.13	405.39	0.005725	8.97	1151.19	92.98	0.42
Trib	564.3	500-yr/100-yrTW	14246.00	387.33	407.17	400.33	408.86	0.006098	10.54	1440.46	98.90	0.45
Trib	564.3	50-yr / 10-yr TW	8627.00	387.33	399.32	397.42	401.58	0.018276	12.09	724.54	83.88	0.70
Trib	564.3	50-yr / 50-yr TW	8627.00	387.33	404.08	397.42	405.03	0.004448	7.88	1143.88	92.83	0.37
Trib	564.3	10-yr / 50-yr TW	5392.00	387.33	403.94	395.46	404.32	0.001796	4.97	1131.41	92.57	0.24
Trib	564.3	100yr / 10-yr TW	9881.00	387.33	400.08	398.13	402.60	0.018386	12.78	788.11	85.03	0.71
Trib	564.3	50-yr/25-yr TW	8627.00	387.33	400.81	397.42	402.47	0.011031	10.38	850.75	86.41	0.56
Trib	564.3	100-yr/25-yr TW	9881.00	387.33	401.15	398.13	403.19	0.013017	11.51	880.19	87.08	0.61
Trib	564.3	500-yr/25-yr TW	14246.00	387.33	402.89	400.33	406.02	0.016446	14.27	1034.72	90.49	0.70
Trib	468.7	2-yr/2-yr TW	2581.00	385.59	391.66	390.65	392.80	0.023078	8.57	301.06	66.85	0.71
Trib	468.7	5-yr / 5-yr TW	4036.00	385.59	394.03	391.99	395.21	0.013775	8.70	470.60	76.03	0.59
Trib	468.7	10-yr / 10-yr TW	5392.00	385.59	396.95	393.05	397.90	0.007128	7.94	726.65	93.40	0.45
Trib	468.7	25-yr / 25-yr TW	6887.00	385.59	400.10	394.11	400.91	0.004265	7.41	1032.51	100.78	0.36
Trib	468.7	50-yr /100-yr TW	8627.00	385.59	406.71	395.37	407.18	0.001503	5.80	1754.44	118.02	0.23
Trib	468.7	100-yr/50-yr TW	9881.00	385.59	403.96	396.14	404.86	0.003418	7.90	1440.49	110.78	0.34
Trib	468.7	500-yr/100-yrTW	14246.00	385.59	407.01	398.40	408.25	0.003870	9.40	1790.79	118.74	0.37
Trib	468.7	50-yr / 10-yr TW	8627.00	385.59	398.04	395.37	399.95	0.012481	11.28	830.18	95.79	0.60
Trib	468.7	50-yr / 50-yr TW	8627.00	385.59	403.93	395.37	404.62	0.002623	6.91	1437.13	110.70	0.30
Trib	468.7	10-yr / 50-yr TW	5392.00	385.59	403.89	393.05	404.16	0.001034	4.33	1432.29	110.58	0.19
Trib	468.7	100yr / 10-yr TW	9881.00	385.59	398.78	396.14	400.93	0.012945	12.01	901.26	97.46	0.62
Trib	468.7	50-yr/25-yr TW	8627.00	385.59	400.28	395.37	401.51	0.006371	9.14	1050.45	101.24	0.45
Trib	468.7	100-yr/25-yr TW	9881.00	385.59	400.48	396.14	402.04	0.007914	10.29	1070.76	101.75	0.50
Trib	468.7	500-yr/25-yr TW	14246.00	385.59	401.93	398.40	404.46	0.011339	13.20	1220.59	105.45	0.61
Trib	413.4	2-yr/2-yr TW	2581.00	381.73	390.39	388.70	391.43	0.017591	8.16	316.30	60.44	0.63
Trib	413.4	5-yr / 5-yr TW	4036.00	381.73	393.51	390.33	394.48	0.009124	7.90	518.47	69.69	0.49
Trib	413.4	10-yr / 10-yr TW	5392.00	381.73	396.64	391.45	397.51	0.005396	7.54	751.96	79.58	0.39
Trib	413.4	25-yr / 25-yr TW	6887.00	381.73	399.86	392.56	400.67	0.003668	7.34	1024.51	89.75	0.34
Trib	413.4	50-yr /100-yr TW	8627.00	381.73	406.61	393.80	407.09	0.001403	5.85	1788.99	125.99	0.22
Trib	413.4	100-yr/50-yr TW	9881.00	381.73	403.72	394.62	404.66	0.003229	8.05	1434.26	119.04	0.33
Trib	413.4	500-yr/100-yrTW	14246.00	381.73	406.73	397.22	408.03	0.003742	9.59	1804.52	126.30	0.37
Trib	413.4	50-yr / 10-yr TW	8627.00	381.73	397.13	393.80	399.15	0.011923	11.52	791.41	81.13	0.59
Trib	413.4	50-yr / 50-yr TW	8627.00	381.73	403.75	393.80	404.47	0.002443	7.01	1438.51	119.12	0.29
Trib	413.4	10-yr / 50-yr TW	5392.00	381.73	403.82	391.45	404.10	0.000940	4.36	1447.03	119.29	0.18
Trib	413.4	100yr / 10-yr TW	9881.00	381.73	397.63	394.62	400.05	0.013530	12.62	832.60	82.72	0.63
Trib	413.4	50-yr/25-yr TW	8627.00	381.73	399.86	393.80	401.13	0.005752	9.19	1024.75	89.76	0.42
Trib	413.4	100-yr/25-yr TW	9881.00	381.73	399.89	394.62	401.54	0.007490	10.50	1027.47	89.86	0.48
Trib	413.4	500-yr/25-yr TW	14246.00	381.73	400.50	397.22	403.63	0.013466	14.47	1082.73	91.78	0.65
Trib	349.2	2-yr/2-yr TW	2581.00	381.09	389.21	387.49	390.31	0.017155	8.42	306.73	54.70	0.62
Trib	349.2	5-yr / 5-yr TW	4036.00	381.09	392.99	389.08	393.93	0.007461	7.81	537.64	71.49	0.45
Trib	349.2	10-yr / 10-yr TW	5392.00	381.09	396.34	390.32	397.18	0.004558	7.47	799.56	86.18	0.37
Trib	349.2	25-yr / 25-yr TW	6887.00	381.09	399.67	391.57	400.43	0.003173	7.27	1102.08	94.76	0.32

HEC-RAS Plan: Raised Bridge River: Rock Creek Reach: Trib (Continued)

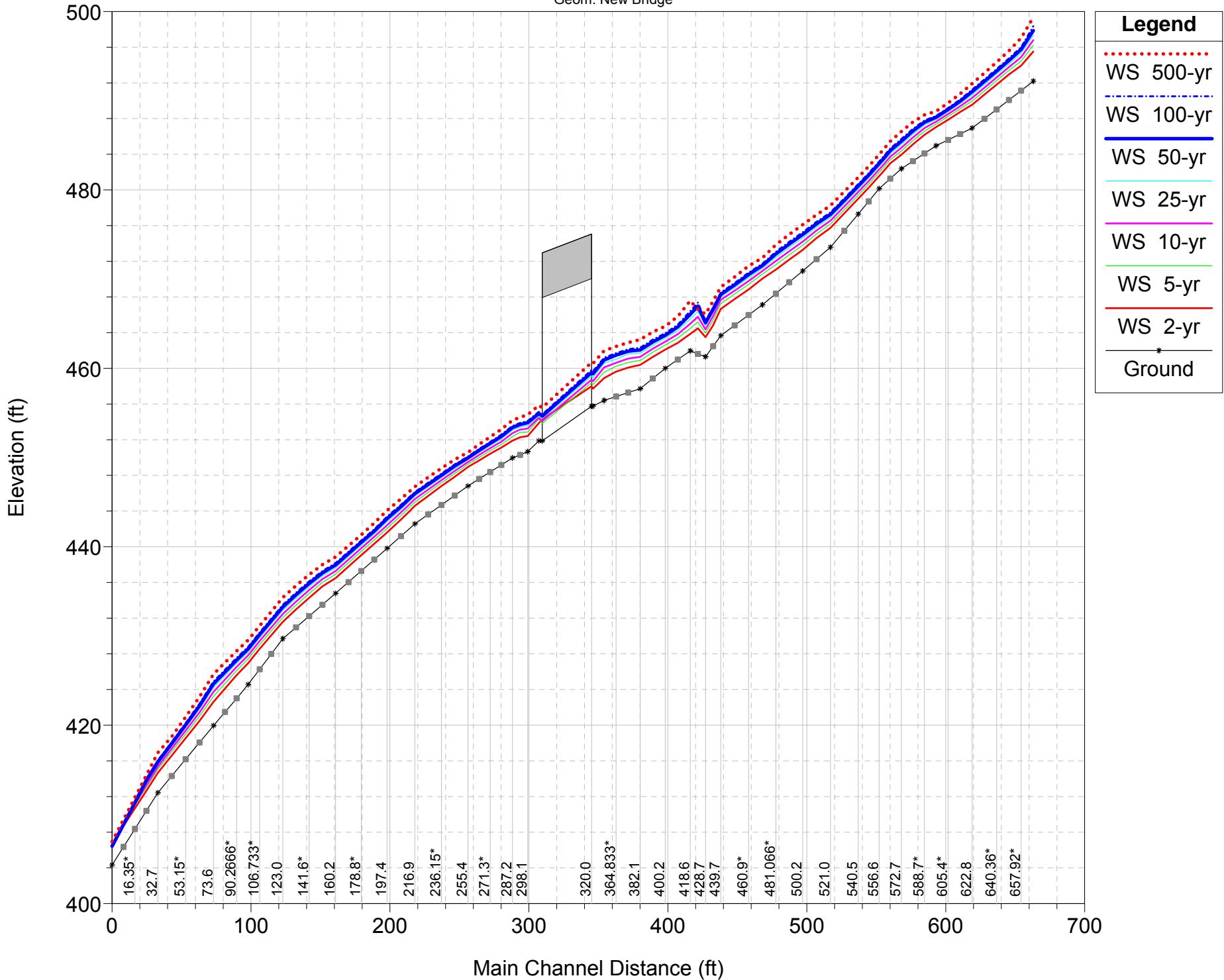
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	349.2	50-yr /100-yr TW	8627.00	381.09	406.51	392.93	407.00	0.001328	5.96	1803.97	110.34	0.22
Trib	349.2	100-yr/50-yr TW	9881.00	381.09	403.54	393.82	404.45	0.002930	8.07	1485.72	103.51	0.32
Trib	349.2	500-yr/100-yrTW	14246.00	381.09	406.44	396.78	407.77	0.003668	9.88	1795.33	110.16	0.36
Trib	349.2	50-yr / 10-yr TW	8627.00	381.09	396.16	392.93	398.37	0.012270	12.14	784.30	85.08	0.60
Trib	349.2	50-yr / 50-yr TW	8627.00	381.09	403.62	392.93	404.30	0.002200	7.01	1494.24	103.70	0.28
Trib	349.2	10-yr / 50-yr TW	5392.00	381.09	403.77	390.32	404.04	0.000835	4.34	1510.30	104.05	0.17
Trib	349.2	100yr / 10-yr TW	9881.00	381.09	396.14	393.82	399.05	0.016220	13.94	782.01	84.91	0.69
Trib	349.2	50-yr/25-yr TW	8627.00	381.09	399.54	392.93	400.76	0.005131	9.20	1089.66	94.46	0.41
Trib	349.2	100-yr/25-yr TW	9881.00	381.09	399.42	393.82	401.06	0.006909	10.62	1079.11	94.21	0.47
Trib	349.2	500-yr/25-yr TW	14246.00	381.09	399.03	396.78	402.65	0.015753	15.78	1042.45	93.32	0.71
Trib	266.0	2-yr/2-yr TW	2581.00	379.89	388.57	385.30	389.18	0.007469	6.31	409.68	61.36	0.42
Trib	266.0	5-yr / 5-yr TW	4036.00	379.89	392.82	386.81	393.38	0.003600	6.04	691.05	69.91	0.32
Trib	266.0	10-yr / 10-yr TW	5392.00	379.89	396.24	388.02	396.81	0.002566	6.10	939.32	75.08	0.28
Trib	266.0	25-yr / 25-yr TW	6887.00	379.89	399.58	389.15	400.17	0.002055	6.26	1197.98	80.08	0.26
Trib	266.0	50-yr /100-yr TW	8627.00	379.89	406.44	390.43	406.89	0.001038	5.52	1785.23	92.45	0.20
Trib	266.0	100-yr/50-yr TW	9881.00	379.89	403.41	391.27	404.20	0.002154	7.29	1514.40	85.87	0.28
Trib	266.0	500-yr/100-yrTW	14246.00	379.89	406.21	393.88	407.46	0.002926	9.21	1764.03	92.14	0.33
Trib	266.0	50-yr / 10-yr TW	8627.00	379.89	395.84	390.43	397.38	0.007233	10.04	909.20	74.47	0.47
Trib	266.0	50-yr / 50-yr TW	8627.00	379.89	403.53	390.43	404.12	0.001612	6.33	1524.32	86.15	0.24
Trib	266.0	10-yr / 50-yr TW	5392.00	379.89	403.74	388.02	403.97	0.000609	3.92	1542.83	86.66	0.15
Trib	266.0	100yr / 10-yr TW	9881.00	379.89	395.64	391.27	397.72	0.009960	11.68	894.44	74.17	0.55
Trib	266.0	50-yr/25-yr TW	8627.00	379.89	399.38	390.43	400.33	0.003348	7.93	1182.50	79.86	0.33
Trib	266.0	100-yr/25-yr TW	9881.00	379.89	399.21	391.27	400.48	0.004545	9.18	1168.65	79.67	0.39
Trib	266.0	500-yr/25-yr TW	14246.00	379.89	398.36	393.88	401.30	0.011214	13.95	1101.66	78.27	0.60
Trib	225.5	2-yr/2-yr TW	2581.00	379.89	388.35	384.82	388.88	0.006236	5.85	442.74	65.17	0.39
Trib	225.5	5-yr / 5-yr TW	4036.00	379.89	392.75	386.29	393.22	0.002953	5.57	747.67	73.48	0.29
Trib	225.5	10-yr / 10-yr TW	5392.00	379.89	396.21	387.44	396.69	0.002127	5.64	1013.28	80.03	0.26
Trib	225.5	25-yr / 25-yr TW	6887.00	379.89	399.56	388.52	400.06	0.001715	5.80	1292.69	86.64	0.24
Trib	225.5	50-yr /100-yr TW	8627.00	379.89	406.45	389.73	406.83	0.000870	5.11	1925.77	96.31	0.18
Trib	225.5	100-yr/50-yr TW	9881.00	379.89	403.41	390.52	404.08	0.001799	6.75	1639.05	92.58	0.25
Trib	225.5	500-yr/100-yrTW	14246.00	379.89	406.23	393.08	407.29	0.002445	8.52	1904.84	96.04	0.30
Trib	225.5	50-yr / 10-yr TW	8627.00	379.89	395.71	389.73	397.05	0.006114	9.35	974.20	79.10	0.43
Trib	225.5	50-yr / 50-yr TW	8627.00	379.89	403.53	389.73	404.03	0.001346	5.86	1649.78	92.72	0.22
Trib	225.5	10-yr / 50-yr TW	5392.00	379.89	403.74	387.44	403.93	0.000508	3.62	1669.67	92.99	0.13
Trib	225.5	100yr / 10-yr TW	9881.00	379.89	395.45	390.52	397.27	0.008553	10.92	953.19	78.60	0.51
Trib	225.5	50-yr/25-yr TW	8627.00	379.89	399.35	389.73	400.16	0.002800	7.35	1274.71	86.25	0.31
Trib	225.5	100-yr/25-yr TW	9881.00	379.89	399.16	390.52	400.25	0.003810	8.51	1258.61	85.93	0.36
Trib	225.5	500-yr/25-yr TW	14246.00	379.89	398.20	393.08	400.77	0.009606	13.03	1176.76	84.05	0.56
Trib	208.0	2-yr/2-yr TW	2581.00	379.79	388.27	384.52	388.76	0.005835	5.65	457.17	65.52	0.37
Trib	208.0	5-yr / 5-yr TW	4036.00	379.79	392.72	385.95	393.16	0.002744	5.36	777.61	76.36	0.28
Trib	208.0	10-yr / 10-yr TW	5392.00	379.79	396.20	387.15	396.64	0.001983	5.44	1053.14	82.26	0.25
Trib	208.0	25-yr / 25-yr TW	6887.00	379.79	399.55	388.26	400.02	0.001606	5.60	1339.84	88.48	0.23
Trib	208.0	50-yr /100-yr TW	8627.00	379.79	406.45	389.42	406.81	0.000820	4.95	1994.17	101.33	0.17
Trib	208.0	100-yr/50-yr TW	9881.00	379.79	403.41	390.26	404.04	0.001694	6.53	1694.93	95.68	0.24
Trib	208.0	500-yr/100-yrTW	14246.00	379.79	406.24	392.74	407.23	0.002305	8.25	1972.66	100.93	0.29
Trib	208.0	50-yr / 10-yr TW	8627.00	379.79	395.68	389.42	396.92	0.005731	9.03	1010.71	81.38	0.42
Trib	208.0	50-yr / 50-yr TW	8627.00	379.79	403.53	389.42	404.00	0.001268	5.67	1706.02	95.89	0.21
Trib	208.0	10-yr / 50-yr TW	5392.00	379.79	403.74	387.15	403.92	0.000479	3.51	1726.58	96.29	0.13
Trib	208.0	100yr / 10-yr TW	9881.00	379.79	395.39	390.26	397.09	0.008053	10.56	987.52	80.89	0.49
Trib	208.0	50-yr/25-yr TW	8627.00	379.79	399.34	389.42	400.10	0.002624	7.10	1321.21	88.09	0.29
Trib	208.0	100-yr/25-yr TW	9881.00	379.79	399.15	390.26	400.17	0.003570	8.22	1304.48	87.73	0.34
Trib	208.0	500-yr/25-yr TW	14246.00	379.79	398.16	392.74	400.56	0.009041	12.60	1218.44	85.89	0.54
50-yr design with low SF Smith River flow												
Trib	193.2	2-yr/2-yr TW	2581.00	379.73	388.23	384.38	388.67	0.004878	5.31	487.60	70.10	0.35
Trib	193.2	5-yr / 5-yr TW	4036.00	379.73	392.72	385.77	393.11	0.002315	5.06	817.78	77.35	0.26
Trib	193.2	10-yr / 10-yr TW	5392.00	379.73	396.20	386.87	396.61	0.001694	5.16	1097.42	83.41	0.23
Trib	193.2	25-yr / 25-yr TW	6887.00	379.73	399.56	387.91	399.99	0.001384	5.33	1388.34	89.61	0.22
Trib	193.2	50-yr /100-yr TW	8627.00	379.73	406.46	389.04	406.79	0.000717	4.74	2049.94	102.32	0.17
Trib	193.2	100-yr/50-yr TW	9881.00	379.73	403.42	389.77	404.00	0.001471	6.24	1748.05	96.73	0.23
Trib	193.2	500-yr/100-yrTW	14246.00	379.73	406.26	392.22	407.18	0.002010	7.90	2029.51	101.95	0.28
Trib	193.2	50-yr / 10-yr TW	8627.00	379.73	395.69	389.04	396.81	0.004880	8.56	1054.90	82.47	0.39
Trib	193.2	50-yr / 50-yr TW	8627.00	379.73	403.53	389.04	403.97	0.001102	5.42	1758.99	96.94	0.20
Trib	193.2	10-yr / 50-yr TW	5392.00	379.73	403.74	386.87	403.91	0.000417	3.35	1779.25	97.32	0.12
Trib	193.2	100yr / 10-yr TW	9881.00	379.73	395.40	389.77	396.94	0.006846	10.00	1031.59	81.94	0.47
Trib	193.2	50-yr/25-yr TW	8627.00	379.73	399.35	389.04	400.05	0.002257	6.76	1369.85	89.23	0.28
Trib	193.2	100-yr/25-yr TW	9881.00	379.73	399.17	389.77	400.10	0.003068	7.82	1353.25	88.89	0.32
Trib	193.2	500-yr/25-yr TW	14246.00	379.73	398.20	392.22	400.37	0.007716	11.96	1267.89	87.10	0.51
Trib	170	Rock Creek Bridge										
50-yr design with high SF Smith River flow (>50-yr)												
Trib	143.2	2-yr/2-yr TW	2581.00	378.85	388.08	383.38	388.45	0.003479	4.91	533.30	68.59	0.30
Trib	143.2	5-yr / 5-yr TW	4036.00	378.85	392.63	384.76	393.00	0.001937	4.90	865.30	77.60	0.24
Trib	143.2	10-yr / 10-yr TW	5392.00	378.85	396.13	385.85	396.52	0.001507	5.07	1152.46	86.52	0.22
Trib	143.2	25-yr / 25-yr TW	6887.00	378.85	399.51	386.96	399.92	0.001272	5.28	1458.88	95.11	0.21

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Trib	143.2	50-yr /100-yr TW	8627.00	378.85	406.22	388.12	406.54	0.000700	4.76	2131.00	101.77	0.16
Trib	143.2	100-yr/50-yr TW	9881.00	378.85	403.33	388.93	403.89	0.001390	6.20	1837.68	101.50	0.23
Trib	143.2	500-yr/100-yr TW	14246.00	378.85	405.61	391.45	406.55	0.002073	8.06	2069.53	101.71	0.28
Trib	143.2	50-yr / 10-yr TW	8627.00	378.85	395.48	388.12	396.57	0.004444	8.47	1096.52	84.85	0.38
Trib	143.2	50-yr / 50-yr TW	8627.00	378.85	403.46	388.12	403.89	0.001038	5.38	1851.33	101.51	0.19
Trib	143.2	10-yr / 50-yr TW	5392.00	378.85	403.72	385.85	403.88	0.000390	3.32	1876.85	101.53	0.12
Trib	143.2	100yr / 10-yr TW	9881.00	378.85	395.10	388.93	396.60	0.006357	9.97	1063.92	83.87	0.45
Trib	143.2	50-yr/25-yr TW	8627.00	378.85	399.27	388.12	399.93	0.002085	6.70	1435.89	94.49	0.27
Trib	143.2	100-yr/25-yr TW	9881.00	378.85	399.04	388.93	399.94	0.002849	7.77	1414.95	93.93	0.31
Trib	143.2	500-yr/25-yr TW	14246.00	378.85	397.82	391.45	399.99	0.007468	12.04	1301.58	90.80	0.50
Trib	116.1	2-yr/2-yr TW	2581.00	377.75	387.96	382.57	388.34	0.003089	4.93	534.40	62.81	0.28
Trib	116.1	5-yr / 5-yr TW	4036.00	377.75	392.54	384.07	392.94	0.001929	5.08	840.73	70.93	0.24
Trib	116.1	10-yr / 10-yr TW	5392.00	377.75	396.04	385.24	396.47	0.001580	5.34	1114.14	92.62	0.23
Trib	116.1	25-yr / 25-yr TW	6887.00	377.75	399.43	386.46	399.87	0.001337	5.54	1458.60	104.85	0.21
Trib	116.1	50-yr /100-yr TW	8627.00	377.75	406.18	387.71	406.51	0.000731	4.94	2251.24	152.80	0.17
Trib	116.1	100-yr/50-yr TW	9881.00	377.75	403.24	388.60	403.83	0.001457	6.47	1873.62	114.88	0.23
Trib	116.1	500-yr/100-yrTW	14246.00	377.75	405.48	391.32	406.47	0.002202	8.42	2145.78	140.94	0.29
Trib	116.1	50-yr / 10-yr TW	8627.00	377.75	395.18	387.71	396.41	0.004841	9.04	1040.31	82.44	0.39
Trib	116.1	50-yr / 50-yr TW	8627.00	377.75	403.40	387.71	403.84	0.001084	5.60	1891.84	115.65	0.20
Trib	116.1	10-yr / 50-yr TW	5392.00	377.75	403.69	385.24	403.86	0.000405	3.45	1925.75	117.06	0.12
Trib	116.1	100yr / 10-yr TW	9881.00	377.75	394.62	388.60	396.37	0.007156	10.75	995.31	79.45	0.47
Trib	116.1	50-yr/25-yr TW	8627.00	377.75	399.12	387.71	399.85	0.002218	7.06	1427.02	104.36	0.27
Trib	116.1	100-yr/25-yr TW	9881.00	377.75	398.84	388.60	399.83	0.003066	8.22	1397.56	103.91	0.32
Trib	116.1	500-yr/25-yr TW	14246.00	377.75	397.08	391.32	399.70	0.008977	13.24	1217.11	101.07	0.54
Trib	0	2-yr/2-yr TW	26696.00	370.39	386.70	380.77	388.07	0.002000	9.41	2870.66	213.31	0.44
Trib	0	5-yr / 5-yr TW	40674.00	370.39	390.71	383.44	392.63	0.002001	11.13	3743.05	221.31	0.46
Trib	0	10-yr / 10-yr TW	52943.00	370.39	393.77	385.54	396.12	0.002004	12.35	4430.15	229.02	0.47
Trib	0	25-yr / 25-yr TW	65888.00	370.39	396.71	387.57	399.49	0.002000	13.46	5119.41	240.94	0.48
Trib	0	50-yr /100-yr TW	94540.00	370.39	402.38	391.64	406.04	0.002001	15.50	6549.27	260.46	0.50
Trib	0	100-yr/50-yr TW	82537.00	370.39	400.11	390.02	403.41	0.002003	14.70	5961.94	254.71	0.49
Trib	0	500-yr/100-yrTW	94540.00	370.39	402.38	391.67	406.04	0.002001	15.50	6549.27	260.46	0.50
Trib	0	50-yr / 10-yr TW	52943.00	370.39	393.77	385.51	396.12	0.002004	12.35	4430.17	229.02	0.47
Trib	0	50-yr / 50-yr TW	82537.00	370.39	400.11	390.02	403.41	0.002003	14.70	5961.94	254.71	0.49
Trib	0	10-yr / 50-yr TW	82537.00	370.39	400.11	390.02	403.41	0.002003	14.70	5961.94	254.71	0.49
Trib	0	100yr / 10-yr TW	52943.00	370.39	393.77	385.54	396.12	0.002004	12.35	4430.14	229.02	0.47
Trib	0	50-yr/25-yr TW	65888.00	370.39	396.71	387.59	399.49	0.002000	13.46	5119.40	240.94	0.48
Trib	0	100-yr/25-yr TW	65888.00	370.39	396.71	387.59	399.49	0.002000	13.46	5119.40	240.94	0.48
Trib	0	500-yr/25-yr TW	65888.00	370.39	396.71	387.59	399.49	0.002000	13.46	5119.40	240.94	0.48



Boulder Creek Bridge Plan: New Bridge 9/6/2007

Geom: New Bridge



HEC-RAS Plan: New Bridge River: Boulder Creek Reach: Trib (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	439.7	2-yr	309.00	463.67	466.66	466.89	467.77	0.113115	8.44	36.60	24.13	1.21
Trib	439.7	5-yr	494.00	463.67	467.25	467.57	468.62	0.113738	9.38	52.70	29.91	1.24
Trib	439.7	10-yr	676.00	463.67	467.68	468.08	469.30	0.117587	10.20	66.33	34.85	1.29
Trib	439.7	25-yr	884.00	463.67	468.00	468.52	470.02	0.121660	11.44	78.19	38.65	1.34
Trib	439.7	50-yr	1108.00	463.67	468.29	468.97	470.75	0.126519	12.64	89.55	39.73	1.39
Trib	439.7	100-yr	1269.00	463.67	468.50	469.25	471.23	0.127030	13.34	97.92	40.47	1.41
Trib	439.7	500-yr	1859.00	463.67	469.12	470.21	472.88	0.134766	15.73	123.39	41.38	1.51
Trib	428.7	2-yr	309.00	461.29	463.50	464.11	465.44	0.261155	11.20	27.59	23.16	1.81
Trib	428.7	5-yr	494.00	461.29	463.96	464.73	466.45	0.244878	12.67	39.00	25.71	1.81
Trib	428.7	10-yr	676.00	461.29	464.36	465.26	467.24	0.229729	13.61	49.68	27.87	1.80
Trib	428.7	25-yr	884.00	461.29	464.75	465.79	468.02	0.217769	14.51	60.95	29.86	1.79
Trib	428.7	50-yr	1108.00	461.29	465.12	466.26	468.77	0.207992	15.33	72.34	31.74	1.78
Trib	428.7	100-yr	1269.00	461.29	465.36	466.60	469.28	0.204015	15.89	80.04	32.95	1.78
Trib	428.7	500-yr	1859.00	461.29	466.08	467.58	470.99	0.198674	17.81	105.03	37.45	1.82
Trib	418.6	2-yr	309.00	461.96	463.86	463.86	464.68	0.074700	7.23	42.73	26.44	1.00
Trib	418.6	5-yr	494.00	461.96	464.48	464.48	465.55	0.069269	8.32	59.38	28.10	1.01
Trib	418.6	10-yr	676.00	461.96	465.00	465.00	466.28	0.065099	9.11	74.37	29.50	1.00
Trib	418.6	25-yr	884.00	461.96	465.53	465.53	467.02	0.061610	9.82	90.45	31.03	1.00
Trib	418.6	50-yr	1108.00	461.96	466.06	466.06	467.74	0.055841	10.42	107.99	35.21	0.98
Trib	418.6	100-yr	1269.00	461.96	466.42	466.42	468.20	0.052265	10.77	121.28	38.08	0.96
Trib	418.6	500-yr	1859.00	461.96	467.58	467.64	469.65	0.044144	11.78	170.60	47.06	0.92
Trib	400.2	2-yr	309.00	460.00	462.11	462.20	463.01	0.088030	7.64	40.44	26.37	1.09
Trib	400.2	5-yr	494.00	460.00	462.61	462.81	463.89	0.093102	9.08	54.49	29.38	1.16
Trib	400.2	10-yr	676.00	460.00	463.00	463.33	464.64	0.093829	10.30	66.37	31.92	1.20
Trib	400.2	25-yr	884.00	460.00	463.37	463.85	465.41	0.096304	11.53	78.63	34.34	1.24
Trib	400.2	50-yr	1108.00	460.00	463.71	464.39	466.17	0.099752	12.70	90.67	36.56	1.29
Trib	400.2	100-yr	1269.00	460.00	463.95	464.70	466.66	0.099845	13.37	99.61	38.13	1.31
Trib	400.2	500-yr	1859.00	460.00	464.71	465.68	468.21	0.099345	15.36	129.95	40.55	1.35
Trib	382.1	2-yr	309.00	457.72	460.39	460.53	461.35	0.095418	7.87	39.27	26.16	1.13
Trib	382.1	5-yr	494.00	457.72	460.89	461.14	462.24	0.095755	9.32	53.34	29.64	1.18
Trib	382.1	10-yr	676.00	457.72	461.29	461.66	462.99	0.094611	10.50	65.68	31.77	1.21
Trib	382.1	25-yr	884.00	457.72	461.69	462.14	463.75	0.093688	11.61	78.51	32.51	1.24
Trib	382.1	50-yr	1108.00	457.72	462.07	462.65	464.50	0.094059	12.67	90.83	33.19	1.27
Trib	382.1	100-yr	1269.00	457.72	462.33	462.95	465.00	0.093024	13.30	99.59	33.68	1.28
Trib	382.1	500-yr	1859.00	457.72	463.23	464.09	466.63	0.087194	15.09	130.91	36.09	1.29
Trib	356.2	2-yr	309.00	456.40	458.90	458.90	459.75	0.074309	7.36	41.97	25.47	1.01
Trib	356.2	5-yr	494.00	456.40	459.56	459.56	460.62	0.069185	8.28	59.65	28.49	1.01
Trib	356.2	10-yr	676.00	456.40	460.10	460.10	461.34	0.062135	8.93	76.29	32.70	0.98
Trib	356.2	25-yr	884.00	456.40	460.58	460.64	462.05	0.058026	9.75	92.84	36.11	0.99
Trib	356.2	50-yr	1108.00	456.40	460.94	461.15	461.44	0.056026	10.83	106.01	37.33	1.04
Trib	356.2	100-yr	1269.00	456.40	461.20	461.44	462.49	0.054026	11.44	115.76	37.87	1.05
Trib	356.2	500-yr	1859.00	456.40	461.97	462.49	462.49	0.052026	13.53	145.57	39.47	1.13
Trib	347.4	2-yr	309.00	455.76	457.73	458.02	458.91	0.144738	8.74	35.35	27.49	1.36
Trib	347.4	5-yr	494.00	455.76	458.17	458.61	459.82	0.143404	10.30	47.97	29.19	1.41
Trib	347.4	10-yr	676.00	455.76	458.55	459.10	460.59	0.136001	11.49	59.24	30.84	1.42
Trib	347.4	25-yr	884.00	455.76	458.96	459.63	461.35	0.124798	12.44	72.32	32.66	1.40
Trib	347.4	50-yr	1108.00	455.76	459.39	460.15	462.04	0.112654	13.16	86.76	34.55	1.36
Trib	347.4	100-yr	1269.00	455.76	459.67	460.52	462.50	0.106457	13.62	96.81	35.81	1.35
Trib	347.4	500-yr	1859.00	455.76	460.55	461.55	464.02	0.096575	15.26	131.23	42.83	1.34
Trib	320.0		Bridge									
Trib	306.7	2-yr	309.00	451.86	453.86	453.86	454.57	0.079704	6.77	45.68	32.98	1.01
Trib	306.7	5-yr	494.00	451.86	454.33	454.38	455.34	0.078645	8.09	61.16	33.48	1.05
Trib	306.7	10-yr	676.00	451.86	454.46	454.82	456.11	0.115990	10.31	65.75	33.62	1.29
Trib	306.7	25-yr	884.00	451.86	454.69	455.28	456.95	0.137069	12.06	73.59	33.85	1.43
Trib	306.7	50-yr	1108.00	451.86	454.95	455.74	457.80	0.149501	13.55	82.28	34.11	1.52
Trib	306.7	100-yr	1269.00	451.86	455.13	456.05	458.37	0.154766	14.45	88.47	34.29	1.56
Trib	306.7	500-yr	1859.00	451.86	455.86	457.03	460.10	0.147773	16.58	113.58	35.01	1.59
Trib	298.1	2-yr	309.00	450.66	452.41	452.75	453.63	0.173772	8.87	34.85	30.19	1.45
Trib	298.1	5-yr	494.00	450.66	452.86	453.27	454.43	0.162049	10.07	49.06	32.87	1.45
Trib	298.1	10-yr	676.00	450.66	453.26	453.73	455.09	0.139115	10.85	62.33	33.37	1.39
Trib	298.1	25-yr	884.00	450.66	453.59	454.18	455.85	0.138325	12.06	73.48	33.73	1.43

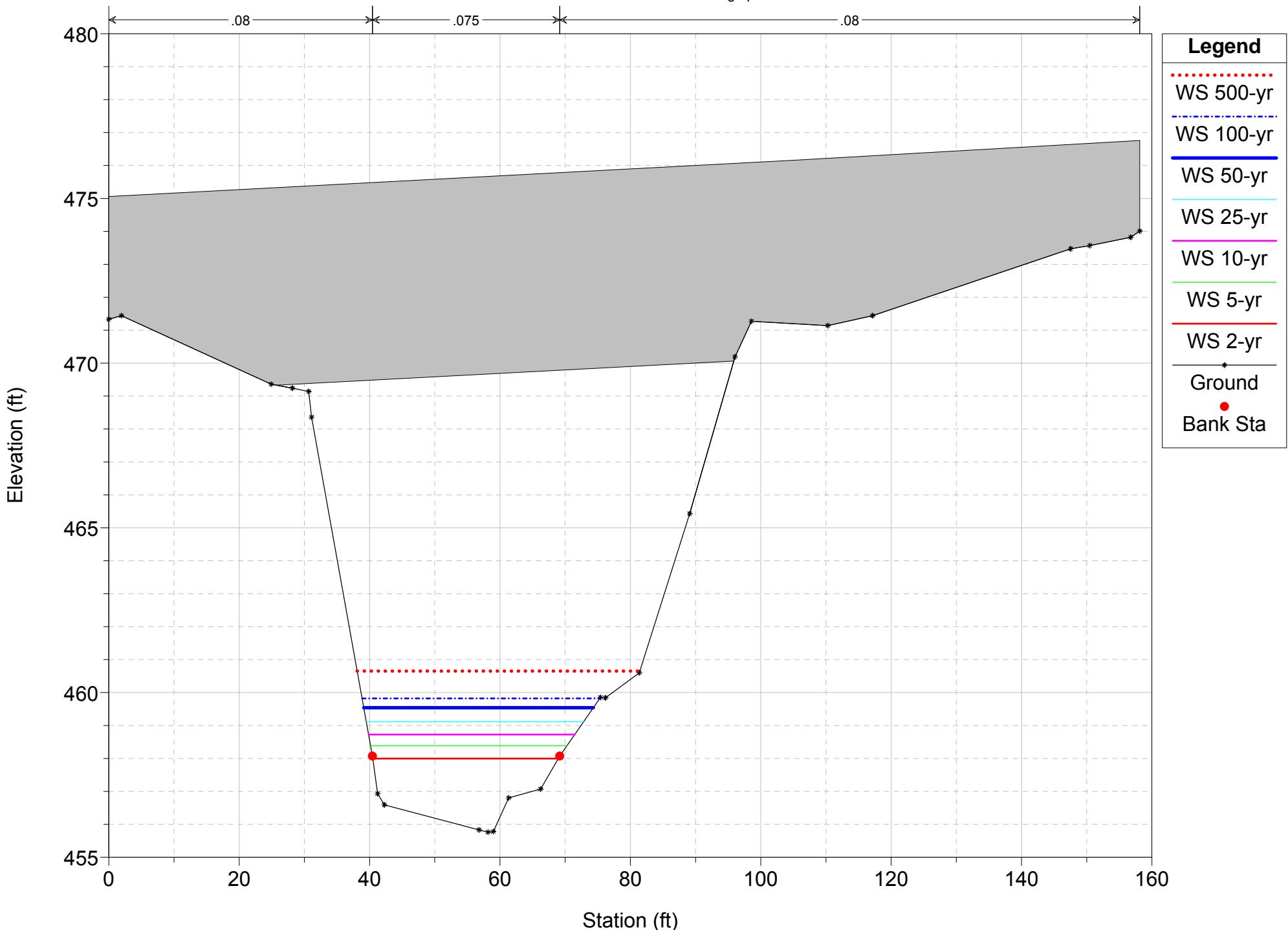
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	298.1	50-yr	1108.00	450.66	453.90	454.64	456.62	0.139984	13.24	84.04	34.07	1.47
Trib	298.1	100-yr	1269.00	450.66	454.11	454.96	457.16	0.141587	14.03	91.02	34.29	1.50
Trib	298.1	500-yr	1859.00	450.66	454.80	455.98	458.93	0.141863	16.34	115.15	35.04	1.55
Trib	287.2	2-yr	309.00	449.95	451.89	451.94	452.63	0.086182	6.87	44.99	34.65	1.06
Trib	287.2	5-yr	494.00	449.95	452.35	452.44	453.37	0.081670	8.08	61.16	35.46	1.08
Trib	287.2	10-yr	676.00	449.95	452.73	452.87	454.01	0.080206	9.09	74.55	36.03	1.10
Trib	287.2	25-yr	884.00	449.95	453.07	453.31	454.69	0.082712	10.21	87.02	36.54	1.15
Trib	287.2	50-yr	1108.00	449.95	453.36	453.75	455.39	0.089115	11.42	97.74	36.97	1.22
Trib	287.2	100-yr	1269.00	449.95	453.55	454.04	455.87	0.093675	12.24	104.67	37.25	1.26
Trib	287.2	500-yr	1859.00	449.95	454.16	455.05	457.54	0.106165	14.79	127.73	38.15	1.39
Trib	255.4	2-yr	309.00	446.81	448.94	448.99	449.54	0.094999	6.19	50.02	49.66	1.07
Trib	255.4	5-yr	494.00	446.81	449.26	449.39	450.14	0.100405	7.56	65.93	51.80	1.15
Trib	255.4	10-yr	676.00	446.81	449.50	449.75	450.67	0.108191	8.73	78.60	53.42	1.23
Trib	255.4	25-yr	884.00	446.81	449.75	450.09	451.22	0.112608	9.78	92.13	54.54	1.28
Trib	255.4	50-yr	1108.00	446.81	449.97	450.42	451.77	0.119231	10.86	104.42	55.72	1.34
Trib	255.4	100-yr	1269.00	446.81	450.12	450.64	452.15	0.122231	11.54	112.87	56.12	1.37
Trib	255.4	500-yr	1859.00	446.81	450.58	451.40	453.46	0.135245	13.79	139.13	57.32	1.49
Trib	216.9	2-yr	309.00	442.56	444.59	444.72	445.38	0.110034	7.12	43.38	38.11	1.18
Trib	216.9	5-yr	494.00	442.56	445.00	445.21	446.06	0.108541	8.25	59.91	41.78	1.21
Trib	216.9	10-yr	676.00	442.56	445.35	445.60	446.61	0.106231	9.03	74.89	44.82	1.23
Trib	216.9	25-yr	884.00	442.56	445.67	445.99	447.17	0.105788	9.83	89.93	47.67	1.25
Trib	216.9	50-yr	1108.00	442.56	445.97	446.36	447.73	0.106294	10.66	104.26	50.22	1.28
Trib	216.9	100-yr	1269.00	442.56	446.15	446.62	448.11	0.107338	11.24	113.48	51.76	1.30
Trib	216.9	500-yr	1859.00	442.56	446.74	447.44	449.35	0.105960	13.01	145.62	56.33	1.35
Trib	197.4	2-yr	309.00	439.82	441.62	441.87	442.66	0.133350	8.20	37.70	30.86	1.31
Trib	197.4	5-yr	494.00	439.82	442.07	442.42	443.45	0.131036	9.44	52.32	34.35	1.34
Trib	197.4	10-yr	676.00	439.82	442.44	442.87	444.10	0.125069	10.37	65.45	37.08	1.35
Trib	197.4	25-yr	884.00	439.82	442.81	443.33	444.75	0.120049	11.19	79.72	39.84	1.36
Trib	197.4	50-yr	1108.00	439.82	443.16	443.77	445.36	0.116536	11.93	94.27	42.47	1.36
Trib	197.4	100-yr	1269.00	439.82	443.39	444.03	445.76	0.115353	12.42	104.10	44.16	1.37
Trib	197.4	500-yr	1859.00	439.82	444.07	444.91	447.09	0.115425	14.09	135.89	48.76	1.41
Trib	160.2	2-yr	309.00	434.77	436.49	436.76	437.56	0.139506	8.30	37.21	30.91	1.33
Trib	160.2	5-yr	494.00	434.77	436.93	437.31	438.36	0.139089	9.60	51.47	34.27	1.38
Trib	160.2	10-yr	676.00	434.77	437.28	437.76	439.01	0.138637	10.56	64.03	36.80	1.41
Trib	160.2	25-yr	884.00	434.77	437.63	438.21	439.66	0.138325	11.43	77.31	39.30	1.44
Trib	160.2	50-yr	1108.00	434.77	437.96	438.63	440.28	0.138043	12.21	90.72	41.67	1.46
Trib	160.2	100-yr	1269.00	434.77	438.18	438.91	440.68	0.137871	12.70	99.93	43.22	1.47
Trib	160.2	500-yr	1859.00	434.77	438.86	439.80	441.99	0.138678	14.19	131.02	48.09	1.52
Trib	123.0	2-yr	309.00	429.69	431.58	431.89	432.77	0.144252	8.76	35.26	27.43	1.36
Trib	123.0	5-yr	494.00	429.69	432.06	432.49	433.63	0.139239	10.05	49.16	30.21	1.39
Trib	123.0	10-yr	676.00	429.69	432.46	432.97	434.33	0.135587	10.96	61.67	32.54	1.40
Trib	123.0	25-yr	884.00	429.69	432.86	433.47	435.02	0.131933	11.79	74.96	34.64	1.41
Trib	123.0	50-yr	1108.00	429.69	433.24	433.94	435.67	0.128633	12.51	88.55	36.67	1.42
Trib	123.0	100-yr	1269.00	429.69	433.49	434.24	436.10	0.126591	12.95	97.97	38.01	1.42
Trib	123.0	500-yr	1859.00	429.69	434.31	435.19	437.44	0.120155	14.21	130.85	42.35	1.42
Trib	98.6	2-yr	309.00	424.55	426.94	427.40	428.45	0.201591	9.85	31.37	24.50	1.53
Trib	98.6	5-yr	494.00	424.55	427.43	428.04	429.38	0.191063	11.20	44.10	27.37	1.56
Trib	98.6	10-yr	676.00	424.55	427.82	428.54	430.15	0.187690	12.24	55.24	29.70	1.58
Trib	98.6	25-yr	884.00	424.55	428.20	429.03	430.91	0.187379	13.19	67.00	32.25	1.61
Trib	98.6	50-yr	1108.00	424.55	428.56	429.50	431.63	0.182781	14.08	78.76	34.43	1.63
Trib	98.6	100-yr	1269.00	424.55	428.79	429.81	432.11	0.177135	14.64	86.92	35.56	1.62
Trib	98.6	500-yr	1859.00	424.55	429.53	430.85	433.70	0.162061	16.42	114.75	39.01	1.61
Trib	73.6	2-yr	309.00	419.94	422.61	423.11	424.27	0.161269	10.35	29.85	18.75	1.45
Trib	73.6	5-yr	494.00	419.94	423.23	423.83	425.32	0.156150	11.59	42.62	22.05	1.47
Trib	73.6	10-yr	676.00	419.94	423.73	424.44	426.17	0.147496	12.55	53.86	23.49	1.46
Trib	73.6	25-yr	884.00	419.94	424.20	425.13	427.05	0.137426	13.56	65.51	26.17	1.45
Trib	73.6	50-yr	1108.00	419.94	424.63	425.71	427.92	0.131138	14.60	77.44	29.81	1.45
Trib	73.6	100-yr	1269.00	419.94	424.91	426.11	428.49	0.128326	15.28	86.26	37.16	1.45
Trib	73.6	500-yr	1859.00	419.94	425.72	427.22	430.26	0.126379	17.47	115.75	50.87	1.50
Trib	32.7	2-yr	309.00	412.42	414.66	415.12	416.15	0.205267	9.81	31.51	47.82	1.59
Trib	32.7	5-yr	494.00	412.42	415.06	415.72	417.12	0.206894	11.55	43.23	66.22	1.66
Trib	32.7	10-yr	676.00	412.42	415.34	416.08	418.01	0.214141	13.17	52.70	78.37	1.74

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Trib	32.7	25-yr	884.00	412.42	415.62	416.09	418.91	0.220236	14.72	62.58	92.15	1.80
Trib	32.7	50-yr	1108.00	412.42	415.88	416.22	419.81	0.226536	16.15	72.37	105.94	1.87
Trib	32.7	100-yr	1269.00	412.42	416.05	416.38	420.41	0.229812	17.07	79.06	111.17	1.90
Trib	32.7	500-yr	1859.00	412.42	416.91	416.91	417.91	0.049353	9.63	253.49	127.52	0.93
Trib	0	2-yr	309.00	404.32	406.28	406.28	406.34	0.008840	1.43	156.94	143.07	0.30
Trib	0	5-yr	494.00	404.32	406.29	406.29	406.45	0.022148	2.28	158.01	143.34	0.47
Trib	0	10-yr	676.00	404.32	406.29	406.29	406.59	0.041473	3.12	158.01	143.34	0.65
Trib	0	25-yr	884.00	404.32	406.29	406.29	406.80	0.070922	4.09	158.01	143.34	0.85
Trib	0	50-yr	1108.00	404.32	406.44	406.44	407.06	0.074987	4.76	180.55	152.54	0.90
Trib	0	100-yr	1269.00	404.32	406.58	406.58	407.23	0.069843	5.08	202.62	154.11	0.89
Trib	0	500-yr	1859.00	404.32	406.96	406.96	407.79	0.068204	6.21	261.41	154.11	0.92

Boulder Creek Bridge Plan: New Bridge 9/6/2007

Geom: New Bridge

River = Boulder Creek Reach = Trib RS = 320.0 BR Bridge profile based on TSL dated 6/1/05



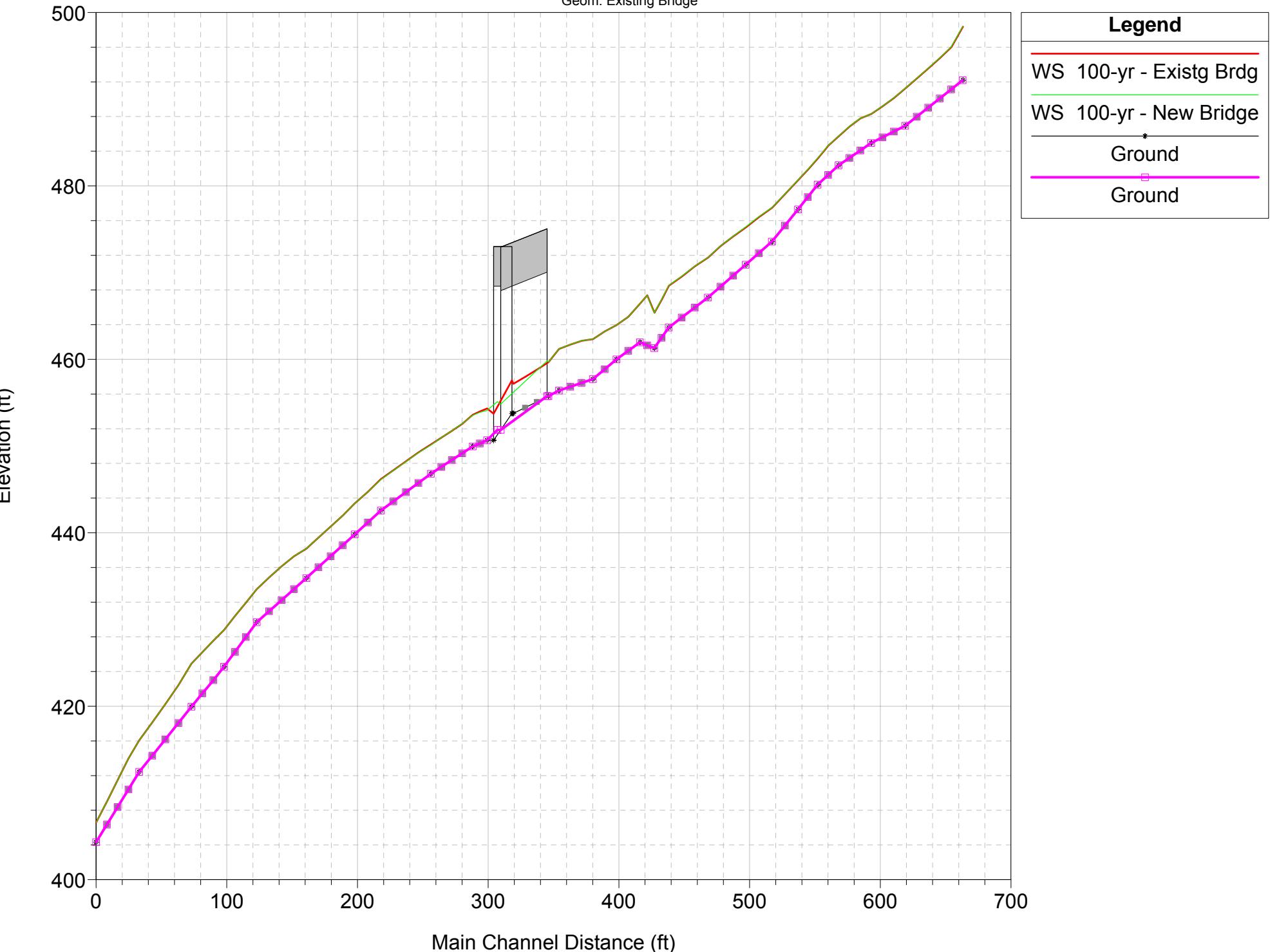
Legend

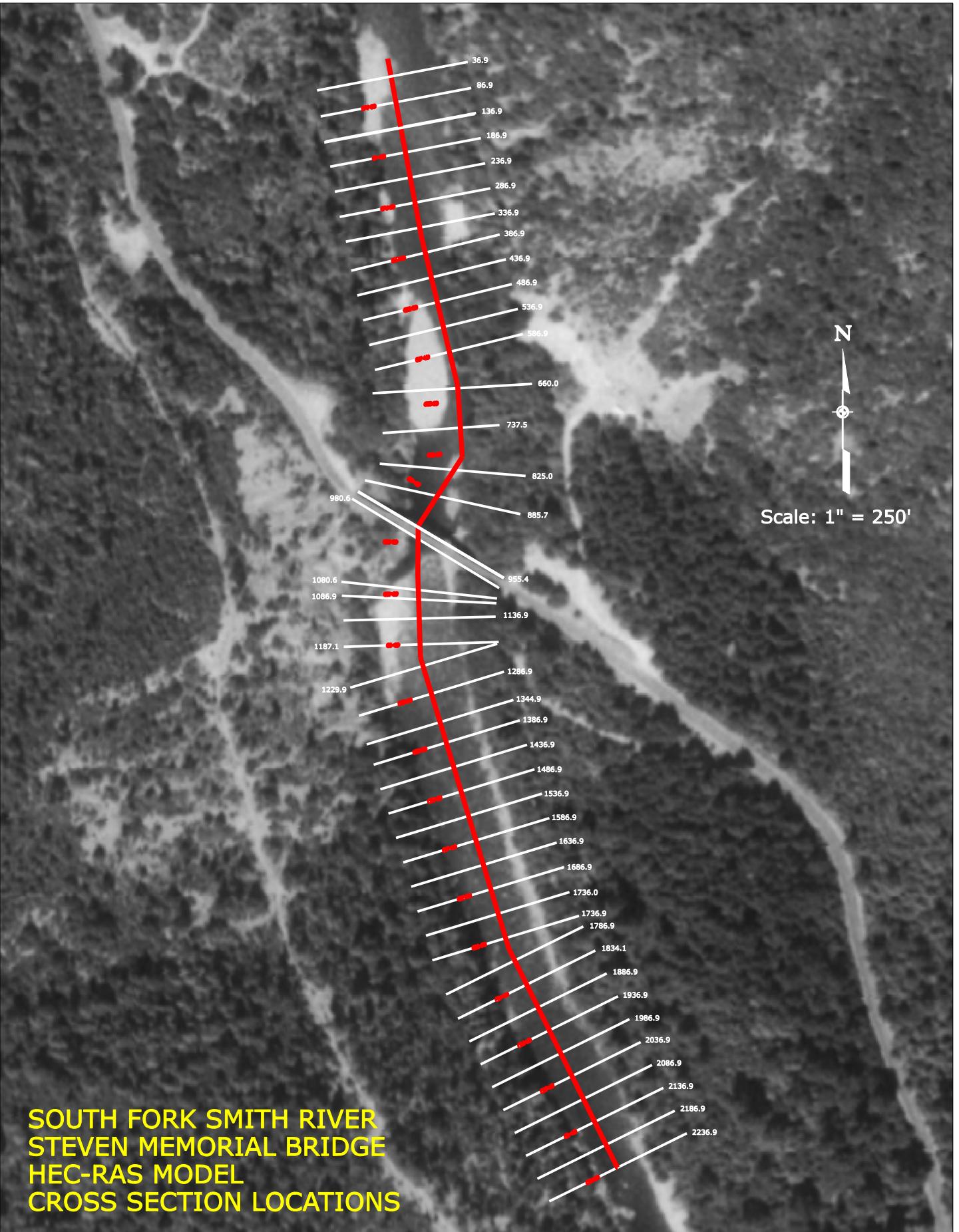
- WS 500-yr
- WS 100-yr
- WS 50-yr
- WS 25-yr
- WS 10-yr
- WS 5-yr
- WS 2-yr
- *
- Ground
- Bank Sta

Boulder Creek Bridge

Plan: 1) Existg Brdg 9/6/2007 2) New Bridge 9/6/2007

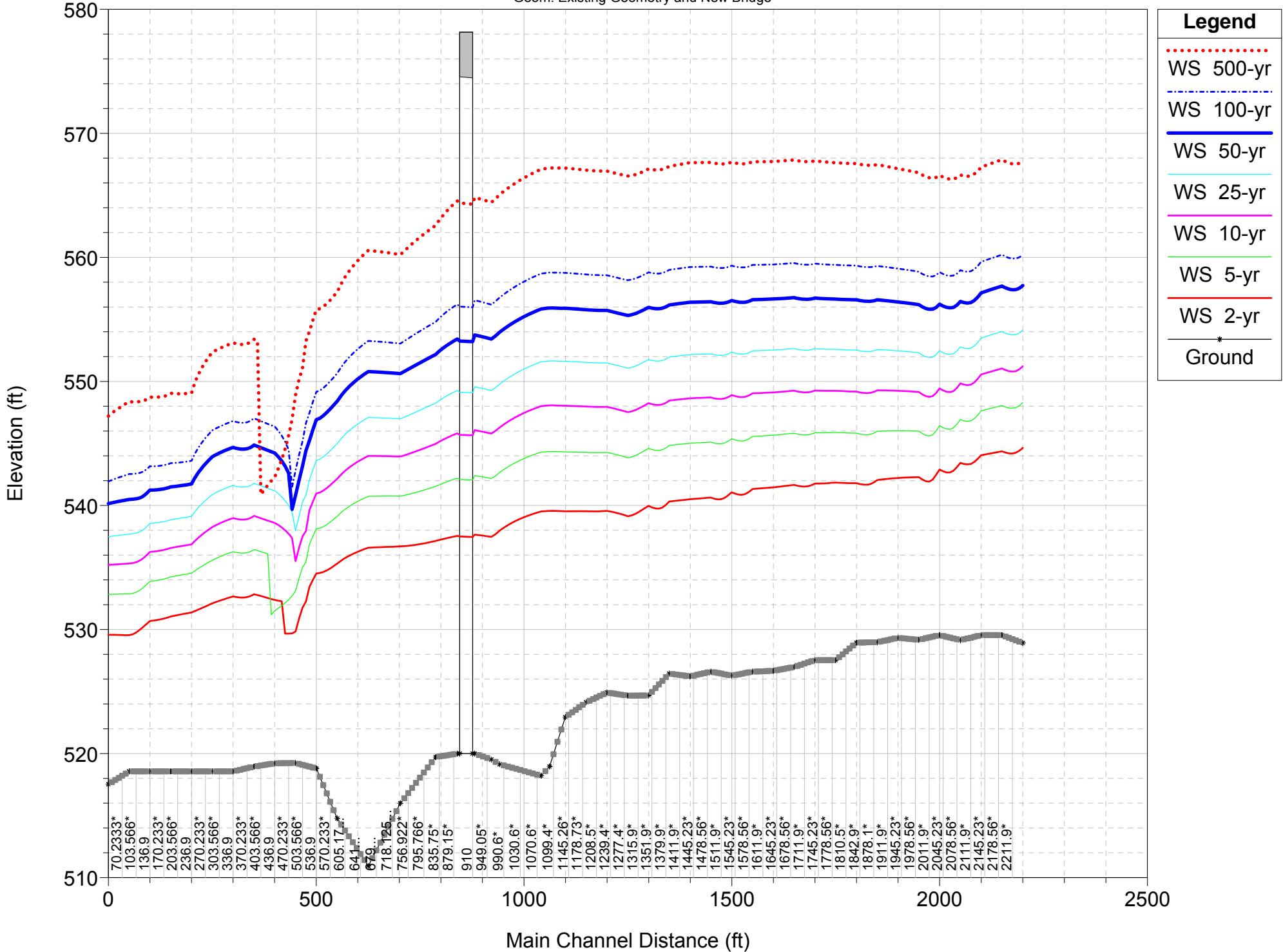
Geom: Existing Bridge





Stevens Memorial Bridge Plan: New Bridge 9/6/2007

Geom: Existing Geometry and New Bridge



Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)
South Fork	1344.9	500-yr	133949.00	524.68	567.13	550.12	0.001233	14.52	293.14	0.41	2.86	2.35
South Fork	1286.9	2-yr	26696.00	524.67	539.13	535.37	0.004206	11.66	215.26	0.62	2.80	2.70
South Fork	1286.9	5-yr	40674.00	524.67	543.84	538.69	0.002949	12.38	243.76	0.55	2.80	2.46
South Fork	1286.9	10-yr	52943.00	524.67	547.52	540.80	0.002439	12.95	257.36	0.52	2.86	2.44
South Fork	1286.9	25-yr	65888.00	524.67	551.07	542.83	0.002124	13.51	270.68	0.50	2.94	2.44
South Fork	1286.9	50-yr	82537.00	524.67	555.32	545.25	0.001856	14.14	284.21	0.48	3.04	2.47
South Fork	1286.9	100-yr	94540.00	524.67	558.16	546.82	0.001725	14.57	292.51	0.47	3.12	2.51
South Fork	1286.9	500-yr	133949.00	524.67	566.56	551.64	0.001466	15.82	314.06	0.45	3.40	2.64
South Fork	1229.9	2-yr	26696.00	524.92	539.57	533.83	0.002080	9.08	229.95	0.45	1.61	1.61
South Fork	1229.9	5-yr	40674.00	524.92	544.28	536.44	0.001698	10.11	244.75	0.43	1.80	1.68
South Fork	1229.9	10-yr	52943.00	524.92	547.95	538.53	0.001518	10.85	256.18	0.42	1.95	1.75
South Fork	1229.9	25-yr	65888.00	524.92	551.49	540.42	0.001395	11.53	267.17	0.41	2.09	1.82
South Fork	1229.9	50-yr	82537.00	524.92	555.73	542.63	0.001281	12.27	279.30	0.40	2.24	1.89
South Fork	1229.9	100-yr	94540.00	524.92	558.56	544.18	0.001222	12.76	288.68	0.40	2.35	1.94
South Fork	1229.9	500-yr	133949.00	524.92	566.95	548.82	0.001097	14.13	323.48	0.39	2.66	2.05
South Fork	1187.1	2-yr	26696.00	524.13	539.54	533.50	0.001893	8.71	236.89	0.43	1.48	1.48
South Fork	1187.1	5-yr	40674.00	524.13	544.28	536.08	0.001552	9.70	248.92	0.41	1.65	1.56
South Fork	1187.1	10-yr	52943.00	524.13	547.98	538.09	0.001391	10.42	258.28	0.40	1.79	1.63
South Fork	1187.1	25-yr	65888.00	524.13	551.53	539.96	0.001282	11.09	269.03	0.39	1.93	1.70
South Fork	1187.1	50-yr	82537.00	524.13	555.78	542.16	0.001181	11.82	281.35	0.39	2.08	1.77
South Fork	1187.1	100-yr	94540.00	524.13	558.62	543.62	0.001129	12.29	289.48	0.38	2.18	1.82
South Fork	1187.1	500-yr	133949.00	524.13	567.03	548.16	0.001020	13.65	313.91	0.38	2.49	1.96
South Fork	1136.9	2-yr	26696.00	522.93	539.53	532.91	0.001671	8.26	248.87	0.40	1.32	1.32
South Fork	1136.9	5-yr	40674.00	522.93	544.32	535.54	0.001367	9.16	267.81	0.38	1.47	1.37
South Fork	1136.9	10-yr	52943.00	522.93	548.04	537.54	0.001218	9.82	275.26	0.37	1.59	1.44
South Fork	1136.9	25-yr	65888.00	522.93	551.63	539.45	0.001119	10.44	281.60	0.37	1.70	1.51
South Fork	1136.9	50-yr	82537.00	522.93	555.90	541.64	0.001030	11.12	289.00	0.36	1.83	1.59
South Fork	1136.9	100-yr	94540.00	522.93	558.75	543.06	0.000985	11.58	293.96	0.36	1.92	1.65
South Fork	1136.9	500-yr	133949.00	522.93	567.19	547.38	0.000894	12.89	310.38	0.36	2.21	1.80
South Fork	1086.9	2-yr	26696.00	518.96	539.56	531.54	0.001270	7.54	249.56	0.35	1.08	1.08
South Fork	1086.9	5-yr	40674.00	518.96	544.35	534.18	0.001119	8.58	261.59	0.35	1.27	1.21
South Fork	1086.9	10-yr	52943.00	518.96	548.07	536.27	0.001040	9.32	269.50	0.35	1.41	1.30
South Fork	1086.9	25-yr	65888.00	518.96	551.65	538.23	0.000983	9.99	276.77	0.34	1.54	1.39
South Fork	1086.9	50-yr	82537.00	518.96	555.92	540.40	0.000928	10.74	285.43	0.34	1.69	1.49
South Fork	1086.9	100-yr	94540.00	518.96	558.78	541.85	0.000900	11.22	291.53	0.34	1.80	1.55
South Fork	1086.9	500-yr	133949.00	518.96	567.21	546.19	0.000840	12.60	306.49	0.34	2.10	1.74
South Fork	1080.6	2-yr	26696.00	518.21	539.52	531.49	0.001259	7.59	248.36	0.35	1.09	1.07
South Fork	1080.6	5-yr	40674.00	518.21	544.30	534.14	0.001119	8.67	260.40	0.35	1.29	1.21
South Fork	1080.6	10-yr	52943.00	518.21	548.01	536.22	0.001046	9.43	268.17	0.35	1.44	1.31
South Fork	1080.6	25-yr	65888.00	518.21	551.58	538.20	0.000994	10.13	275.64	0.35	1.58	1.40
South Fork	1080.6	50-yr	82537.00	518.21	555.84	540.39	0.000941	10.89	284.55	0.35	1.74	1.50
South Fork	1080.6	100-yr	94540.00	518.21	558.69	541.80	0.000914	11.38	290.52	0.35	1.84	1.57
South Fork	1080.6	500-yr	133949.00	518.21	567.11	546.25	0.000857	12.80	305.87	0.35	2.16	1.77
South Fork	980.6	2-yr	26696.00	519.14	537.97	533.63	0.003419	11.13	201.50	0.56	2.48	2.44
South Fork	980.6	5-yr	40674.00	519.14	542.66	536.71	0.002662	12.16	223.35	0.52	2.66	2.41
South Fork	980.6	10-yr	52943.00	519.14	546.29	538.94	0.002315	12.93	238.84	0.51	2.81	2.44
South Fork	980.6	25-yr	65888.00	519.14	549.79	540.98	0.002084	13.64	249.32	0.49	2.97	2.51
South Fork	980.6	50-yr	82537.00	519.14	553.97	543.51	0.001878	14.42	264.43	0.48	3.14	2.57
South Fork	980.6	100-yr	94540.00	519.14	556.77	545.17	0.001773	14.94	274.71	0.47	3.27	2.61
South Fork	980.6	500-yr	133949.00	519.14	565.06	550.12	0.001549	16.36	298.98	0.46	3.62	2.79
South Fork	955.4	2-yr	26696.00	519.52	537.47	533.89	0.004195	12.05	195.08	0.62	2.94	2.84
South Fork	955.4	5-yr	40674.00	519.52	542.17	536.97	0.003138	13.04	221.42	0.57	3.07	2.69
South Fork	955.4	10-yr	52943.00	519.52	545.80	539.25	0.002696	13.80	231.38	0.54	3.22	2.76
South Fork	955.4	25-yr	65888.00	519.52	549.27	541.47	0.002420	14.54	241.95	0.53	3.39	2.83
South Fork	955.4	50-yr	82537.00	519.52	553.42	543.97	0.002176	15.35	257.25	0.51	3.58	2.89
South Fork	955.4	100-yr	94540.00	519.52	556.19	545.62	0.002176	15.35	267.88	0.51	3.72	2.94
South Fork	955.4	500-yr	133949.00	519.52	564.43	550.72	0.002176	15.35	296.55	0.49	4.10	3.10
South Fork	930	2-yr	26696.00	520.00	537.65	532.35	0.002721	10.18	211.58	0.51	2.04	2.04
South Fork	930	5-yr	40674.00	520.00	542.42	535.56	0.002184	11.13	227.33	0.48	2.21	2.12
South Fork	930	10-yr	52943.00	520.00	546.08	537.71	0.001910	11.87	239.75	0.46	2.36	2.15
South Fork	930	25-yr	65888.00	520.00	549.58	539.77	0.001736	12.58	251.63	0.45	2.51	2.21
South Fork	930	50-yr	82537.00	520.00	553.75	542.13	0.001579	13.35	269.49	0.44	2.68	2.24
South Fork	930	100-yr	94540.00	520.00	556.54	543.65	0.001498	13.85	281.73	0.44	2.80	2.27
South Fork	930	500-yr	133949.00	520.00	564.83	548.50	0.001322	15.24	317.58	0.43	3.13	2.38
South Fork	910			Bridge								

50-year water surface upstream of new bridge

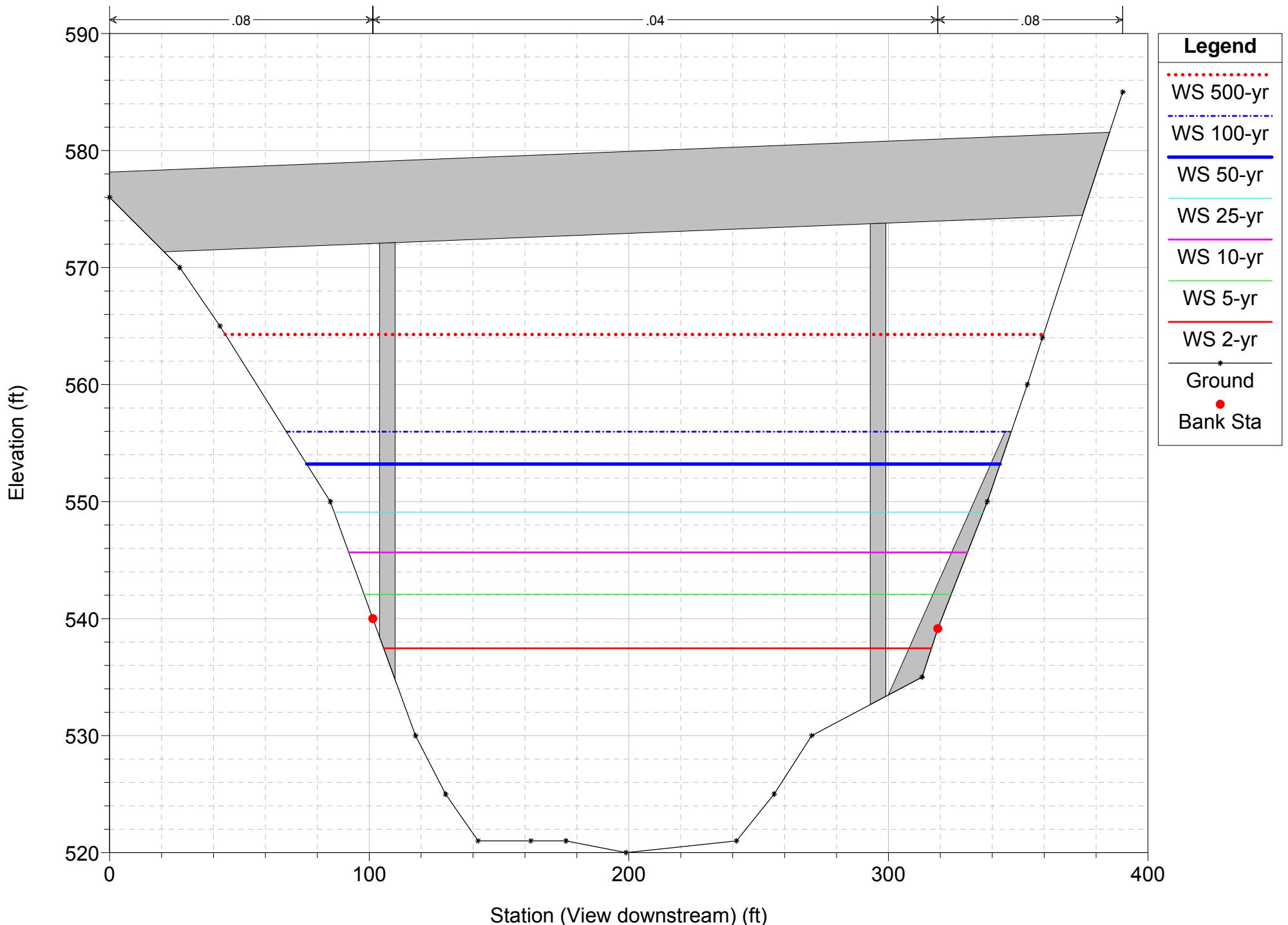
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)
South Fork	890.0	2-yr	26696.00	520.00	537.55	531.05	0.002119	9.42	211.93	0.45	1.71	1.71
South Fork	890.0	5-yr	40674.00	520.00	542.20	534.25	0.001871	10.57	233.17	0.45	1.97	1.86
South Fork	890.0	10-yr	52943.00	520.00	545.81	536.53	0.001686	11.37	250.73	0.44	2.14	1.91
South Fork	890.0	25-yr	65888.00	520.00	549.27	538.64	0.001559	12.10	269.05	0.43	2.31	1.95
South Fork	890.0	50-yr	82537.00	520.00	553.42	541.08	0.001434	12.87	287.11	0.42	2.48	2.02
South Fork	890.0	100-yr	94540.00	520.00	556.20	542.60	0.001367	13.37	300.26	0.42	2.59	2.06
South Fork	890.0	500-yr	133949.00	520.00	564.54	547.45	0.001206	14.69	333.27	0.41	2.89	2.19
South Fork	824.9	2-yr	26696.00	519.71	537.14	531.04	0.002396	10.19	187.86	0.48	1.98	1.97
South Fork	824.9	5-yr	40674.00	519.71	541.54	534.18	0.002237	11.80	204.79	0.48	2.43	2.23
South Fork	824.9	10-yr	52943.00	519.71	544.97	536.60	0.002133	12.91	220.04	0.49	2.75	2.37
South Fork	824.9	25-yr	65888.00	519.71	548.25	538.83	0.002051	13.90	225.72	0.49	3.04	2.58
South Fork	824.9	50-yr	82537.00	519.71	552.17	541.40	0.001963	14.97	233.10	0.49	3.36	2.79
South Fork	824.9	100-yr	94540.00	519.71	554.80	543.20	0.001916	15.67	238.48	0.49	3.58	2.93
South Fork	824.9	500-yr	133949.00	519.71	562.58	548.48	0.001808	17.62	254.43	0.49	4.21	3.30
South Fork	737.5	2-yr	26696.00	515.99	536.69	530.28	0.002461	10.75	159.43	0.48	2.16	2.16
South Fork	737.5	5-yr	40674.00	515.99	540.75	533.59	0.002653	12.95	188.55	0.52	2.92	2.50
South Fork	737.5	10-yr	52943.00	515.99	543.95	536.12	0.002682	14.40	196.95	0.53	3.43	2.85
South Fork	737.5	25-yr	65888.00	515.99	546.99	538.63	0.002700	15.71	202.32	0.55	3.92	3.21
South Fork	737.5	50-yr	82537.00	515.99	550.63	541.60	0.002690	17.13	208.74	0.56	4.45	3.58
South Fork	737.5	100-yr	94540.00	515.99	553.05	543.58	0.002684	18.04	213.02	0.56	4.81	3.82
South Fork	737.5	500-yr	133949.00	515.99	560.21	549.27	0.002669	20.60	225.67	0.58	5.86	4.49
South Fork	660.0	2-yr	26696.00	510.94	536.59	530.63	0.002456	10.19	183.01	0.47	2.00	2.00
South Fork	660.0	5-yr	40674.00	510.94	540.73	533.60	0.002505	12.00	192.18	0.50	2.56	2.48
South Fork	660.0	10-yr	52943.00	510.94	543.99	535.97	0.002441	13.22	199.72	0.50	2.95	2.74
South Fork	660.0	25-yr	65888.00	510.94	547.09	538.21	0.002399	14.35	206.09	0.51	3.32	2.98
South Fork	660.0	50-yr	82537.00	510.94	550.80	540.83	0.002340	15.57	214.21	0.52	3.73	3.23
South Fork	660.0	100-yr	94540.00	510.94	553.27	542.48	0.002311	16.36	219.67	0.52	4.00	3.39
South Fork	660.0	500-yr	133949.00	510.94	560.56	547.87	0.002243	18.59	237.21	0.53	4.81	3.85
South Fork	586.9	2-yr	26696.00	514.77	535.32	531.75	0.004665	12.80	166.18	0.64	3.30	3.30
South Fork	586.9	5-yr	40674.00	514.77	539.13	535.05	0.004490	14.94	172.68	0.65	4.12	3.94
South Fork	586.9	10-yr	52943.00	514.77	542.15	537.44	0.004309	16.39	177.76	0.66	4.69	4.32
South Fork	586.9	25-yr	65888.00	514.77	544.99	539.69	0.004212	17.75	182.53	0.66	5.26	4.71
South Fork	586.9	50-yr	82537.00	514.77	548.40	542.53	0.004085	19.23	188.25	0.67	5.88	5.10
South Fork	586.9	100-yr	94540.00	514.77	550.65	544.42	0.004032	20.21	192.03	0.68	6.31	5.37
South Fork	586.9	500-yr	133949.00	514.77	557.22	550.06	0.003945	23.03	202.47	0.69	7.64	6.18
South Fork	536.9	2-yr	26696.00	518.80	534.52	531.88	0.005581	13.95	159.59	0.71	3.93	3.88
South Fork	536.9	5-yr	40674.00	518.80	538.12	535.13	0.005430	16.37	165.57	0.73	4.96	4.67
South Fork	536.9	10-yr	52943.00	518.80	540.97	537.59	0.005266	18.01	174.70	0.74	5.68	5.09
South Fork	536.9	25-yr	65888.00	518.80	543.63	540.00	0.005188	19.55	183.97	0.75	6.40	5.49
South Fork	536.9	50-yr	82537.00	518.80	546.92	542.90	0.004988	21.10	199.63	0.75	7.10	5.74
South Fork	536.9	100-yr	94540.00	518.80	549.17	544.85	0.004839	22.04	203.48	0.75	7.52	6.01
South Fork	536.9	500-yr	133949.00	518.80	555.80	550.78	0.004522	24.69	214.09	0.75	8.77	6.75
South Fork	486.9	2-yr	26696.00	519.24	529.83	531.22	0.018769	20.91	145.07	1.24	9.76	9.76
South Fork	486.9	5-yr	40674.00	519.24	533.10	534.58	0.016345	23.08	152.80	1.20	10.93	10.93
South Fork	486.9	10-yr	52943.00	519.24	535.51	537.09	0.014810	24.82	158.56	1.17	11.89	11.43
South Fork	486.9	25-yr	65888.00	519.24	537.96	539.58	0.013315	26.23	164.24	1.14	12.58	11.62
South Fork	486.9	50-yr	82537.00	519.24	540.81	542.48	0.012159	27.91	171.65	1.12	13.50	11.93
South Fork	486.9	100-yr	94540.00	519.24	542.82	544.52	0.011405	28.88	177.75	1.11	13.98	11.99
South Fork	486.9	500-yr	133949.00	519.24	548.89	550.51	0.009696	31.50	195.73	1.06	15.30	12.18
South Fork	436.9	2-yr	26696.00	519.22	532.38	530.58	0.006783	14.42	174.04	0.78	4.33	4.33
South Fork	436.9	5-yr	40674.00	519.22	531.52	533.75	0.020230	23.88	170.79	1.33	12.14	12.14
South Fork	436.9	10-yr	52943.00	519.22	538.59	536.08	0.005942	17.74	194.97	0.78	5.72	5.41
South Fork	436.9	25-yr	65888.00	519.22	541.18	538.22	0.005584	18.99	203.04	0.77	6.24	5.69
South Fork	436.9	50-yr	82537.00	519.22	544.23	540.88	0.005274	20.41	212.28	0.77	6.85	6.03
South Fork	436.9	100-yr	94540.00	519.22	546.36	542.65	0.005046	21.24	218.29	0.77	7.20	6.20
South Fork	436.9	500-yr	133949.00	519.22	542.30	547.96	0.018992	36.41	206.44	1.44	22.49	20.23
South Fork	386.9	2-yr	26696.00	518.95	532.85	528.85	0.003843	11.85	179.96	0.59	2.80	2.80
South Fork	386.9	5-yr	40674.00	518.95	536.45	531.91	0.004019	13.95	188.25	0.62	3.62	3.58
South Fork	386.9	10-yr	52943.00	518.95	539.16	534.30	0.003988	15.47	194.24	0.64	4.22	4.01
South Fork	386.9	25-yr	65888.00	518.95	541.79	536.52	0.003941	16.82	205.47	0.65	4.76	4.30
South Fork	386.9	50-yr	82537.00	518.95	544.88	539.05	0.003889	18.31	215.88	0.66	5.39	4.68
South Fork	386.9	100-yr	94540.00	518.95	547.03	540.87	0.003816	19.20	220.26	0.66	5.77	4.92
South Fork	386.9	500-yr	133949.00	518.95	553.39	546.24	0.003646	21.70	233.25	0.67	6.85	5.61
South Fork	336.9	2-yr	26696.00	518.56	532.67	528.38	0.003578	11.52	182.62	0.57	2.64	2.64
South Fork	336.9	5-yr	40674.00	518.56	536.27	531.42	0.003718	13.63	189.50	0.60	3.43	3.36

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude # Chl	Shear Chan (lb/sq ft)	Shear Total (lb/sq ft)
South Fork	336.9	10-yr	52943.00	518.56	538.98	533.78	0.003735	15.16	195.75	0.62	4.03	3.81
South Fork	336.9	25-yr	65888.00	518.56	541.62	535.96	0.003724	16.53	202.59	0.63	4.58	4.18
South Fork	336.9	50-yr	82537.00	518.56	544.69	538.50	0.003718	18.06	209.63	0.64	5.23	4.62
South Fork	336.9	100-yr	94540.00	518.56	546.81	540.24	0.003681	19.00	214.47	0.65	5.63	4.88
South Fork	336.9	500-yr	133949.00	518.56	553.12	545.61	0.003586	21.62	233.14	0.66	6.78	5.52
South Fork	286.9	2-yr	26696.00	518.56	532.11	528.57	0.004312	12.41	176.89	0.63	3.09	3.09
South Fork	286.9	5-yr	40674.00	518.56	535.58	531.71	0.004525	14.64	186.26	0.66	4.00	3.93
South Fork	286.9	10-yr	52943.00	518.56	538.26	534.09	0.004540	16.14	193.55	0.68	4.64	4.46
South Fork	286.9	25-yr	65888.00	518.56	540.88	536.36	0.004404	17.45	200.71	0.69	5.18	4.79
South Fork	286.9	50-yr	82537.00	518.56	543.93	538.99	0.004295	18.95	208.15	0.69	5.82	5.20
South Fork	286.9	100-yr	94540.00	518.56	546.05	540.70	0.004189	19.84	213.17	0.70	6.20	5.43
South Fork	286.9	500-yr	133949.00	518.56	552.36	546.02	0.003951	22.36	228.80	0.70	7.31	6.03
South Fork	236.9	2-yr	26696.00	518.56	531.37	528.75	0.005438	13.52	170.71	0.70	3.72	3.72
South Fork	236.9	5-yr	40674.00	518.56	534.54	531.86	0.005730	16.14	180.34	0.74	4.92	4.71
South Fork	236.9	10-yr	52943.00	518.56	536.86	534.24	0.005920	18.10	187.82	0.78	5.89	5.43
South Fork	236.9	25-yr	65888.00	518.56	539.12	536.52	0.006015	19.83	195.80	0.80	6.78	6.04
South Fork	236.9	50-yr	82537.00	518.56	541.73	539.24	0.006125	21.79	201.61	0.82	7.85	6.83
South Fork	236.9	100-yr	94540.00	518.56	543.60	541.12	0.006076	22.93	205.50	0.83	8.45	7.25
South Fork	236.9	500-yr	133949.00	518.56	549.07	546.59	0.006003	26.18	217.93	0.85	10.28	8.45
South Fork	186.9	2-yr	26696.00	518.56	531.05	528.62	0.005759	13.66	174.22	0.72	3.83	3.83
South Fork	186.9	5-yr	40674.00	518.56	534.24	531.75	0.005966	16.15	182.65	0.76	4.97	4.85
South Fork	186.9	10-yr	52943.00	518.56	536.58	534.09	0.006051	18.02	188.56	0.78	5.88	5.54
South Fork	186.9	25-yr	65888.00	518.56	538.86	536.32	0.006067	19.67	194.85	0.80	6.71	6.14
South Fork	186.9	50-yr	82537.00	518.56	541.50	538.96	0.006105	21.55	202.73	0.82	7.71	6.82
South Fork	186.9	100-yr	94540.00	518.56	543.41	540.78	0.006002	22.62	208.40	0.83	8.25	7.15
South Fork	186.9	500-yr	133949.00	518.56	549.05	546.25	0.005759	25.60	224.79	0.84	9.84	8.08
South Fork	136.9	2-yr	26696.00	518.56	530.68	528.49	0.006056	13.80	176.23	0.73	3.94	3.94
South Fork	136.9	5-yr	40674.00	518.56	533.88	531.54	0.006246	16.21	183.06	0.77	5.06	5.02
South Fork	136.9	10-yr	52943.00	518.56	536.25	533.88	0.006333	18.00	188.03	0.79	5.94	5.77
South Fork	136.9	25-yr	65888.00	518.56	538.56	536.06	0.006266	19.58	192.20	0.80	6.72	6.36
South Fork	136.9	50-yr	82537.00	518.56	541.24	538.69	0.006229	21.37	197.04	0.82	7.65	7.05
South Fork	136.9	100-yr	94540.00	518.56	543.16	540.45	0.006093	22.41	200.51	0.82	8.17	7.39
South Fork	136.9	500-yr	133949.00	518.56	548.74	545.80	0.005882	25.45	211.29	0.84	9.80	8.45
South Fork	86.9	2-yr	26696.00	518.56	529.55	528.59	0.008692	15.34	178.90	0.87	5.06	5.06
South Fork	86.9	5-yr	40674.00	518.56	532.87	531.57	0.007798	17.36	187.91	0.86	5.93	5.78
South Fork	86.9	10-yr	52943.00	518.56	535.32	533.82	0.007388	18.92	193.51	0.86	6.65	6.32
South Fork	86.9	25-yr	65888.00	518.56	537.70	536.01	0.007020	20.33	197.35	0.86	7.32	6.80
South Fork	86.9	50-yr	82537.00	518.56	540.49	538.54	0.006706	21.93	202.52	0.86	8.10	7.33
South Fork	86.9	100-yr	94540.00	518.56	542.54	540.32	0.006368	22.78	206.42	0.85	8.47	7.52
South Fork	86.9	500-yr	133949.00	518.56	548.37	545.61	0.005843	25.47	217.57	0.85	9.80	8.30
South Fork	36.9	2-yr	26696.00	517.52	529.57	527.58	0.006502	14.11	173.40	0.75	4.15	4.15
South Fork	36.9	5-yr	40674.00	517.52	532.83	530.61	0.006502	16.49	180.21	0.78	5.24	5.14
South Fork	36.9	10-yr	52943.00	517.52	535.21	532.95	0.006511	18.33	184.61	0.80	6.15	5.86
South Fork	36.9	25-yr	65888.00	517.52	537.48	535.16	0.006507	19.99	188.97	0.82	7.00	6.51
South Fork	36.9	50-yr	82537.00	517.52	540.15	537.85	0.006504	21.86	194.69	0.84	8.00	7.23
South Fork	36.9	100-yr	94540.00	517.52	541.94	539.60	0.006503	23.07	198.55	0.85	8.68	7.70
South Fork	36.9	500-yr	133949.00	517.52	547.20	545.11	0.006511	26.48	209.85	0.88	10.67	9.04

Stevens Memorial Bridge Plan: New Bridge 9/6/2007

Geom: Existing Geometry and New Bridge

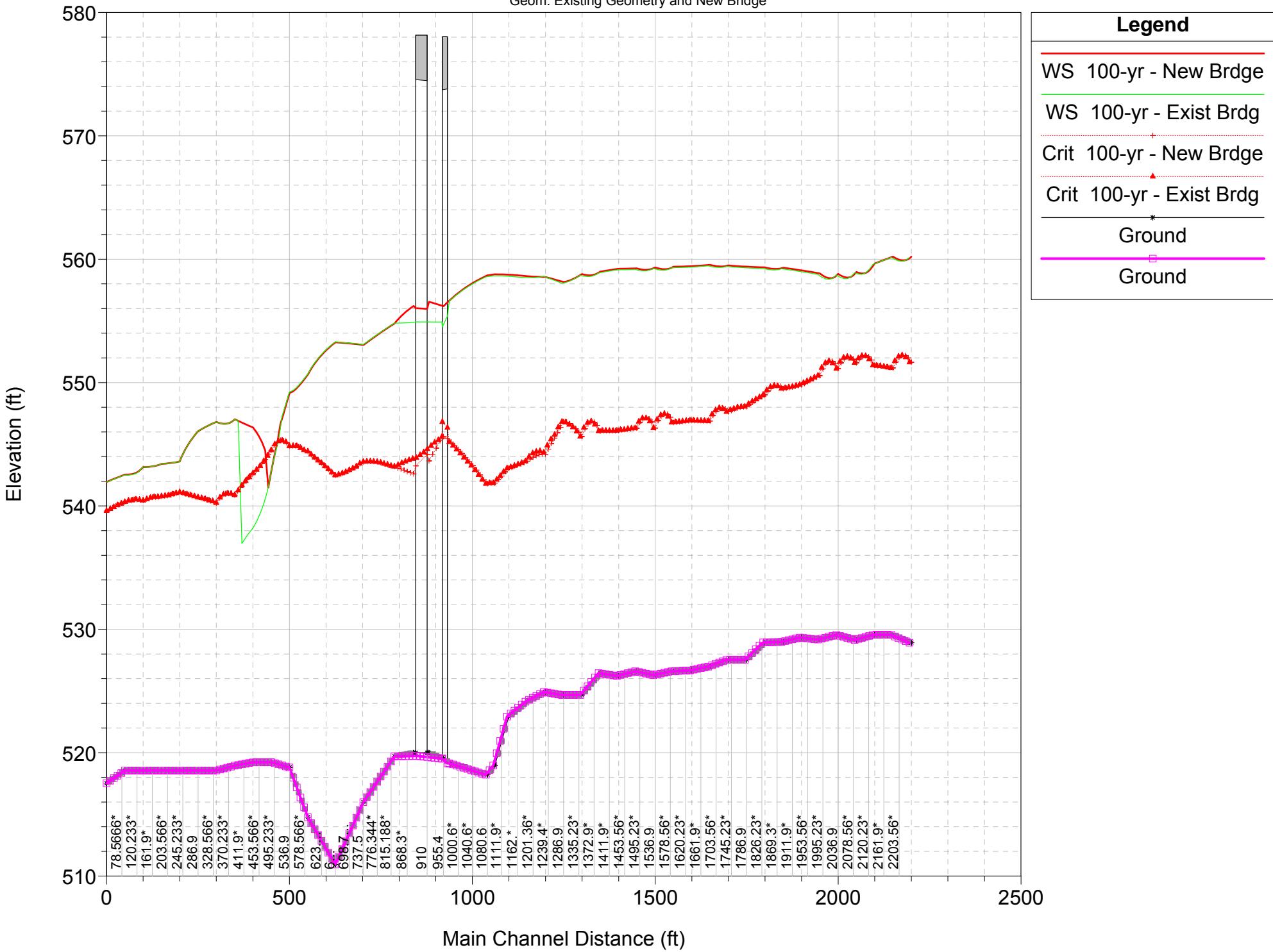
River = Smiths River Reach = South Fork RS = 910 BR

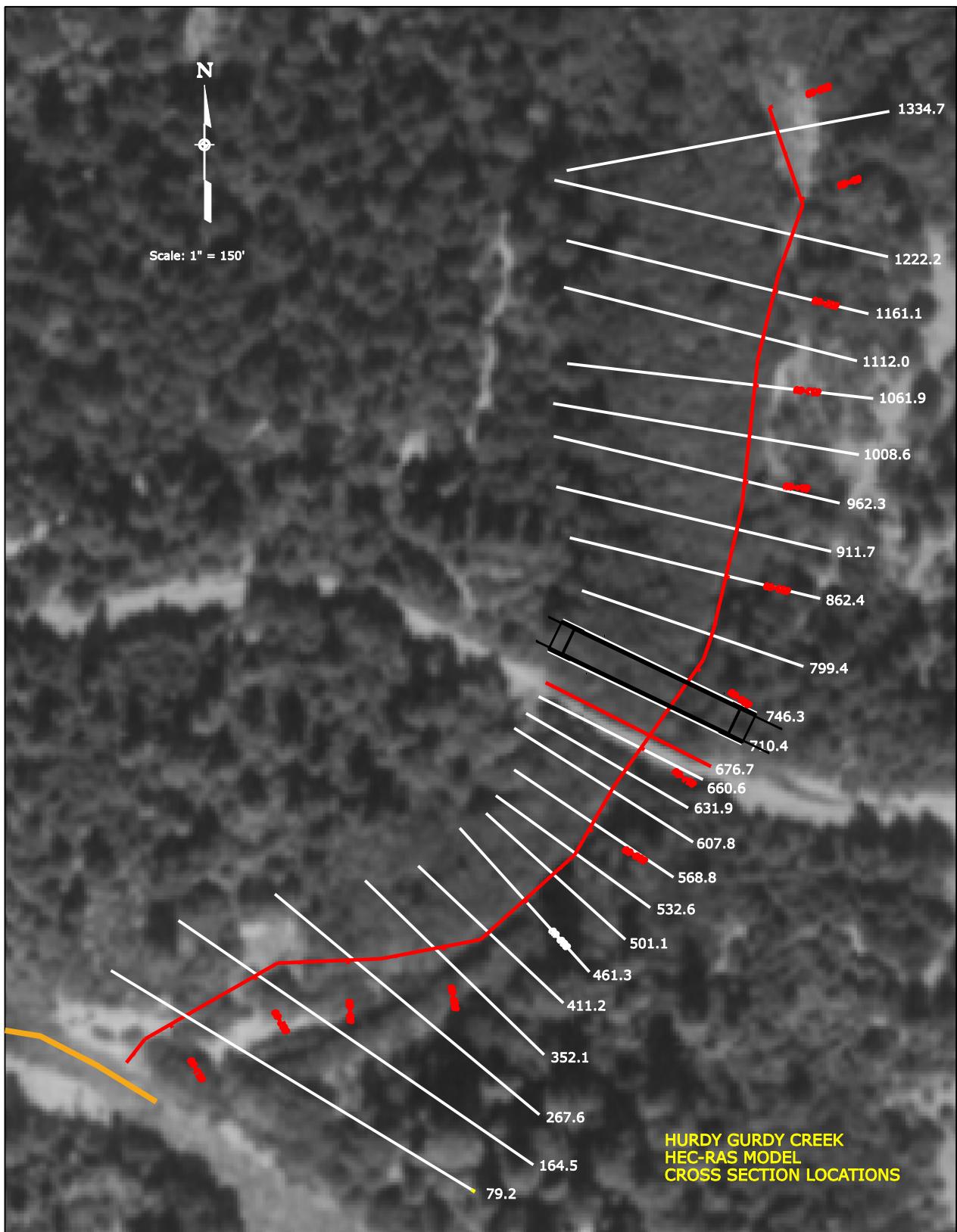


Stevens Memorial Bridge

Plan: 1) New Brdg 9/6/2007 2) Exist Brdg 9/6/2007

Geom: Existing Geometry and New Bridge

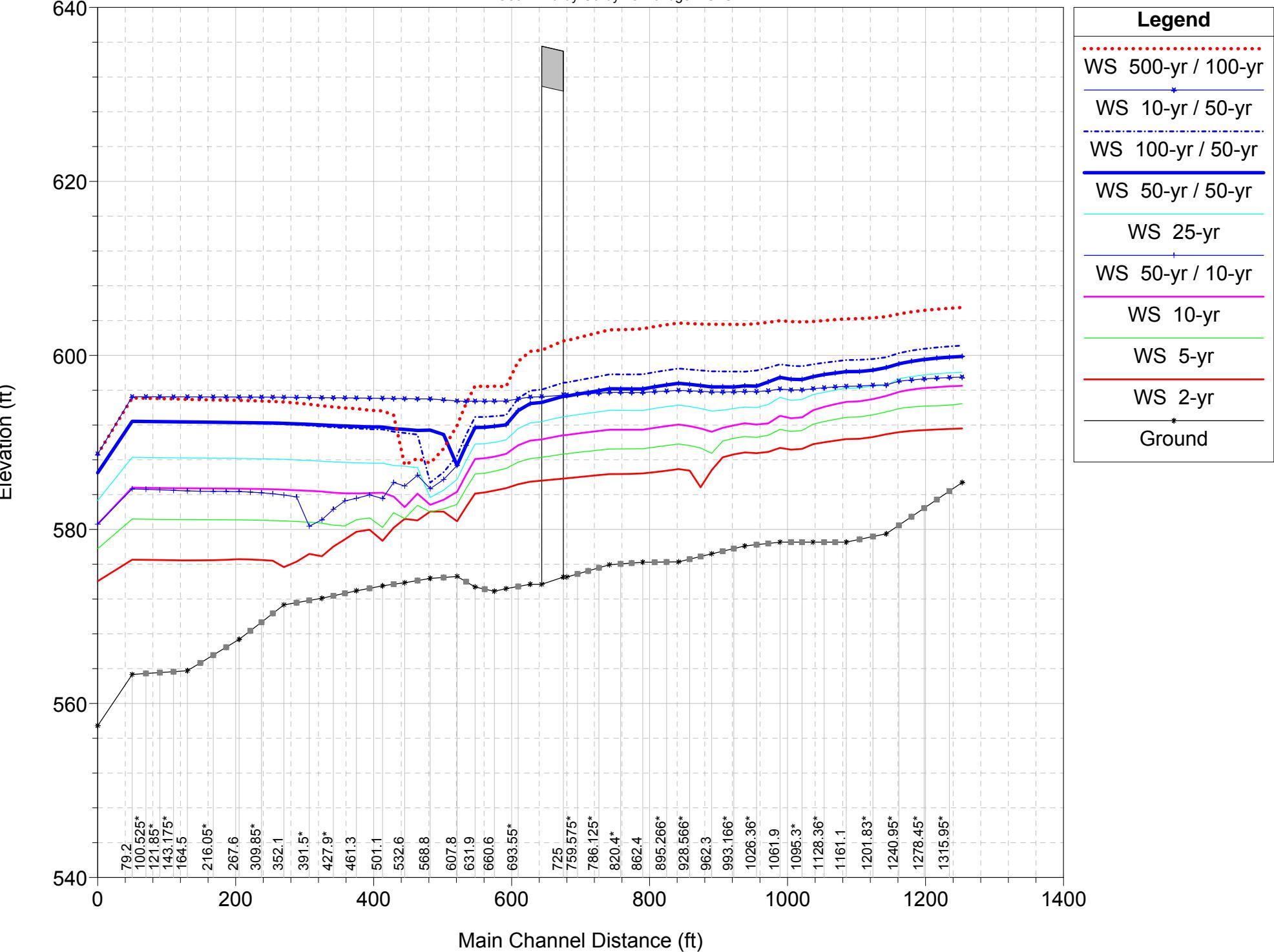




Hurdy Gurdy Bridge

Plan: New Bridge w/ SFSR TW 9/07/2007

Geom: Hurdy Gurdy new bridge + SFSM TW



HEC-RAS Plan: New Bridge + River: Hurdy Gurdy Reach: Trib (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	
Trib	820.4*	500-yr / 100-yr	24272.00	576.04	602.96	593.20	604.57	0.002205	10.54	2768.62	167.81	0.39	
Trib	820.4*	50-yr / 10-yr	14760.00	576.04	596.15	589.13	597.54	0.002923	9.59	1694.01	145.87	0.42	
Trib	820.4*	10-yr / 50-yr	9282.00	576.04	595.74	586.40	596.33	0.001266	6.21	1635.25	144.38	0.28	
Trib	799.4	2-yr	4499.00	575.94	586.36	582.76	587.13	0.004185	7.05	638.19	83.91	0.45	
Trib	799.4	5-yr	6991.00	575.94	589.24	584.54	590.19	0.003870	7.83	892.60	92.68	0.44	
Trib	799.4	10-yr	9282.00	575.94	591.46	585.94	592.56	0.003546	8.42	1112.54	125.32	0.44	
Trib	799.4	25-yr	11782.00	575.94	593.69	587.31	594.90	0.003124	8.88	1398.74	130.32	0.42	
Trib	799.4	50-yr / 50-yr	14760.00	575.94	596.16	588.78	597.47	0.002761	9.31	1728.45	136.91	0.41	
Trib	799.4	100-yr / 50-yr	16906.00	575.94	597.82	589.71	599.20	0.002573	9.58	1959.45	141.34	0.40	
Trib	799.4	500-yr / 100-yr	24272.00	575.94	602.94	592.80	604.53	0.002179	10.42	2719.24	156.12	0.38	
Trib	799.4	50-yr / 10-yr	14760.00	575.94	596.16	588.78	597.47	0.002761	9.31	1728.45	136.91	0.41	
Trib	799.4	10-yr / 50-yr	9282.00	575.94	595.75	585.94	596.30	0.001195	6.02	1672.31	135.81	0.27	
Trib	786.125*	2-yr	4499.00	575.59	586.24	582.67	587.06	0.004414	7.24	621.03	81.36	0.46	
Trib	786.125*	5-yr	6991.00	575.59	589.11	584.52	590.12	0.004118	8.06	867.45	90.23	0.46	
Trib	786.125*	10-yr	9282.00	575.59	591.32	585.96	592.49	0.003723	8.69	1075.66	99.53	0.45	
Trib	786.125*	25-yr	11782.00	575.59	593.52	587.36	594.84	0.003367	9.26	1305.61	110.65	0.44	
Trib	786.125*	50-yr / 50-yr	14760.00	575.59	595.93	588.84	597.41	0.003055	9.81	1589.78	123.75	0.43	
Trib	786.125*	100-yr / 50-yr	16906.00	575.59	597.57	589.78	599.14	0.002872	10.14	1797.60	128.68	0.42	
Trib	786.125*	500-yr / 100-yr	24272.00	575.59	602.63	592.68	604.47	0.002472	11.10	2485.70	143.74	0.41	
Trib	786.125*	50-yr / 10-yr	14760.00	575.59	595.93	588.84	597.41	0.003055	9.81	1589.78	123.75	0.43	
Trib	786.125*	10-yr / 50-yr	9282.00	575.59	595.67	585.96	596.27	0.001278	6.28	1557.11	122.48	0.28	
Trib	772.85*	2-yr	4499.00	575.23	586.12	582.55	586.98	0.004649	7.44	604.97	78.84	0.47	
Trib	772.85*	5-yr	6991.00	575.23	588.98	584.48	590.05	0.004311	8.29	843.14	87.64	0.47	
Trib	772.85*	10-yr	9282.00	575.23	591.18	585.97	592.43	0.003909	8.97	1043.37	94.64	0.46	
Trib	772.85*	25-yr	11782.00	575.23	593.35	587.40	594.78	0.003574	9.60	1256.23	101.09	0.45	
Trib	772.85*	50-yr / 50-yr	14760.00	575.23	595.74	588.88	597.35	0.003292	10.22	1506.80	108.87	0.44	
Trib	772.85*	100-yr / 50-yr	16906.00	575.23	597.35	589.84	598.94			1686.05	114.10	0.44	
Trib	772.85*	500-yr / 100-yr	24272.00	575.23	602.32	592.81				2292.51	129.00	0.43	
Trib	772.85*	50-yr / 10-yr	14760.00	575.23	595.74	588.88				1506.80	108.87	0.44	
Trib	772.85*	10-yr / 50-yr	9282.00	575.23	595.60	585.97				1491.64	108.41	0.28	
Trib	759.575*	2-yr	4499.00	574.88	586.00	582.41	586.90	0.004882	7.63	590.00	76.32	0.48	
Trib	759.575*	5-yr	6991.00	574.88	588.84	584.43	589.98	0.004518	8.54	819.83	85.54	0.48	
Trib	759.575*	10-yr	9282.00	574.88	591.02	585.98	592.36	0.004116	9.27	1011.52	90.48	0.47	
Trib	759.575*	25-yr	11782.00	574.88	593.18	587.45	594.71	0.003805	9.95	1211.85	95.24	0.47	
Trib	759.575*	50-yr / 50-yr	14760.00	574.88	595.54	588.91	597.28	0.003543	10.64	1443.41	100.92	0.46	
Trib	759.575*	100-yr / 50-yr	16906.00	574.88	597.13	589.87	599.01	0.003402	11.08	1606.59	104.80	0.46	
Trib	759.575*	500-yr / 100-yr	24272.00	574.88	602.02	592.91				12.36	2149.55	117.37	0.45
Trib	759.575*	50-yr / 10-yr	14760.00	574.88	595.54	588.91				10.64	1443.41	100.92	0.46
Trib	759.575*	10-yr / 50-yr	9282.00	574.88	595.54	585.98				6.69	1442.77	100.91	0.29
Trib	746.3	2-yr	4499.00	574.52	585.88	582.26	586.82	0.005109	7.81	576.25	73.85	0.49	
Trib	746.3	5-yr	6991.00	574.52	588.70	584.38	589.90	0.004731	8.79	797.55	82.59	0.49	
Trib	746.3	10-yr	9282.00	574.52	590.86	585.93	592.28	0.004343	9.59	979.97	86.54	0.48	
Trib	746.3	25-yr	11782.00	574.52	592.99	587.41	594.64	0.004065	10.33	1168.75	90.45	0.48	
Trib	746.3	50-yr / 50-yr	14760.00	574.52	595.32	588.92	597.21	0.003828	11.08	1384.76	94.93	0.48	
Trib	746.3	100-yr / 50-yr	16906.00	574.52	596.88	589.89	598.94	0.003701	11.57	1535.68	98.05	0.48	
Trib	746.3	500-yr / 100-yr	24272.00	574.52	601.70	593.02	604.26	0.003416	12.99	2031.60	108.30	0.48	
Trib	746.3	50-yr / 10-yr	14760.00	574.52	595.32	588.92	597.21	0.003828	11.08	1384.76	94.93	0.48	
Trib	746.3	10-yr / 50-yr	9282.00	574.52	595.46	585.93	596.20	0.001471	6.91	1398.32	95.22	0.30	
Trib	725	Bridge											
Trib	710.4	2-yr	4499.00	573.69	585.48	581.89	586.54	0.005376	8.24	545.99	64.77	0.50	
Trib	710.4	5-yr	6991.00	573.69	588.15	584.00	589.60	0.005723	9.65	724.48	69.14	0.53	
Trib	710.4	10-yr	9282.00	573.69	590.21	585.66	591.98	0.005759	10.67	870.18	72.34	0.54	
Trib	710.4	25-yr	11782.00	573.69	592.25	587.21	594.34	0.005544	11.61	1020.53	75.20	0.54	
Trib	710.4	50-yr / 50-yr	14760.00	573.69	594.46	588.92	596.91	0.005364	12.57	1190.72	78.89	0.55	
Trib	710.4	100-yr / 50-yr	16906.00	573.69	595.94	590.02	598.64	0.005264	13.19	1309.60	81.38	0.55	
Trib	710.4	500-yr / 100-yr	24272.00	573.69	600.47	593.37	603.94	0.005070	15.03	1694.63	89.72	0.56	
Trib	710.4	50-yr / 10-yr	14760.00	573.69	594.46	588.92	596.91	0.005364	12.57	1190.72	78.89	0.55	
Trib	710.4	10-yr / 50-yr	9282.00	573.69	595.21	585.66	596.09	0.001827	7.56	1250.28	80.15	0.32	
Trib	693.55*	2-yr	4499.00	573.45	585.20	581.88	586.42	0.006135	8.88	506.46	59.29	0.54	
Trib	693.55*	5-yr	6991.00	573.45	587.73	584.10	589.46	0.006916	10.56	662.12	63.73	0.58	
Trib	693.55*	10-yr	9282.00	573.45	589.66	585.82	591.83	0.006950	11.80	788.82	66.96	0.59	
Trib	693.55*	25-yr	11782.00	573.45	591.58	587.51	594.18	0.006887	12.94	920.14	70.14	0.61	
Trib	693.55*	50-yr / 50-yr	14760.00	573.45	593.66	589.20	596.74	0.006814	14.10	1070.68	74.23	0.62	
Trib	693.55*	100-yr / 50-yr	16906.00	573.45	595.06	590.33	598.46	0.006767	14.85	1175.94	76.88	0.62	
Trib	693.55*	500-yr / 100-yr	24272.00	573.45	599.31	593.97	603.74	0.006674	17.03	1528.72	90.28	0.64	
Trib	693.55*	50-yr / 10-yr	14760.00	573.45	593.66	589.20	596.74	0.006814	14.10	1070.68	74.23	0.62	

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	693.55*	10-yr / 50-yr	9282.00	573.45	595.01	585.82	596.05	0.002056	8.17	1172.76	76.80	0.34
Trib	676.7	2-yr	4499.00	573.20	584.74	581.95	586.27	0.007884	9.91	453.78	53.62	0.60
Trib	676.7	5-yr	6991.00	573.20	587.00	584.30	589.26	0.009419	12.06	579.89	58.05	0.67
Trib	676.7	10-yr	9282.00	573.20	588.68	586.13	591.61	0.009995	13.74	680.02	61.53	0.70
Trib	676.7	25-yr	11782.00	573.20	590.30	587.83	593.93	0.010457	15.31	782.46	64.89	0.74
Trib	676.7	50-yr / 50-yr	14760.00	573.20	592.02	589.64	596.46	0.010916	16.95	897.33	68.56	0.77
Trib	676.7	100-yr / 50-yr	16906.00	573.20	593.12	590.90	598.15	0.011295	18.06	974.67	72.86	0.79
Trib	676.7	500-yr / 100-yr	24272.00	573.20	596.42	594.96	603.34	0.012294	21.31	1238.98	86.22	0.85
Trib	676.7	50-yr / 10-yr	14760.00	573.20	592.02	589.64	596.46	0.010916	16.95	897.33	68.56	0.77
Trib	676.7	10-yr / 50-yr	9282.00	573.20	594.75	586.13	595.99	0.002453	8.97	1100.03	80.59	0.37
Trib	660.6	2-yr	4499.00	572.90	584.46	581.94	586.11	0.008839	10.30	436.87	53.86	0.64
Trib	660.6	5-yr	6991.00	572.90	586.68	584.38	589.08	0.010393	12.43	562.85	59.56	0.70
Trib	660.6	10-yr	9282.00	572.90	588.36	586.22	591.42	0.010837	14.04	666.56	64.35	0.74
Trib	660.6	25-yr	11782.00	572.90	590.00	587.89	593.73	0.011057	15.53	776.55	70.69	0.76
Trib	660.6	50-yr / 50-yr	14760.00	572.90	591.85	589.71	596.26	0.010981	16.92	912.16	74.97	0.78
Trib	660.6	100-yr / 50-yr	16906.00	572.90	593.01	591.00	597.93	0.011118	17.90	1000.51	77.84	0.79
Trib	660.6	500-yr / 100-yr	24272.00	572.90	596.46	594.78	603.03	0.011618	20.85	1288.89	89.65	0.83
Trib	660.6	50-yr / 10-yr	14760.00	572.90	591.85	589.71	596.26	0.010981	16.92	912.16	74.97	0.78
Trib	660.6	10-yr / 50-yr	9282.00	572.90	594.75	586.22	595.93	0.002345	8.81	1140.78	83.82	0.37
Trib	646.25*	2-yr	4499.00	573.14	584.25	582.08	585.98	0.009581	10.54	426.94	55.22	0.67
Trib	646.25*	5-yr	6991.00	573.14	586.47	584.47	588.93	0.010611	12.58	556.93	62.25	0.72
Trib	646.25*	10-yr	9282.00	573.14	588.19	586.21	591.27	0.010680	14.11	667.37	66.67	0.75
Trib	646.25*	25-yr	11782.00	573.14	589.85	587.83	593.58	0.010730	15.53	783.77	73.25	0.76
Trib	646.25*	50-yr / 50-yr	14760.00	573.14	591.73	589.65	596.09	0.010532	16.85	925.93	77.59	0.77
Trib	646.25*	100-yr / 50-yr	16906.00	573.14	592.92	590.90	597.75	0.010565	17.78	1019.56	80.25	0.79
Trib	646.25*	500-yr / 100-yr	24272.00	573.14	596.42	594.65	602.82	0.010891	20.61	1317.51	90.60	0.83
Trib	646.25*	50-yr / 10-yr	14760.00	573.14	591.73	589.65	596.09	0.010532	16.85	925.93	77.59	0.77
Trib	646.25*	10-yr / 50-yr	9282.00	573.14	594.74	586.21	595.89	0.002185	8.69	1170.03	85.13	0.36
Trib	631.9	2-yr	4499.00	573.38	584.12	582.10	585.84	0.009883	10.53	427.11	57.37	0.68
Trib	631.9	5-yr	6991.00	573.38	586.36	584.40	588.77	0.010166	12.49	565.11	65.13	0.72
Trib	631.9	10-yr	9282.00	573.38	588.09	586.07	591.10	0.010123	13.95	682.21	69.59	0.74
Trib	631.9	25-yr	11782.00	573.38	589.79	587.71	593.40	0.010077	15.30	805.99	76.55	0.75
Trib	631.9	50-yr / 50-yr	14760.00	573.38	591.71	589.49	595.90	0.009788	16.54	956.69	80.34	0.76
Trib	631.9	100-yr / 50-yr	16906.00	573.38	592.93	590.68	597.54	0.009769	17.42	1055.60	82.72	0.77
Trib	631.9	500-yr / 100-yr	24272.00	573.38	596.50	594.38	602.58	0.009976	20.14	1366.53	92.11	0.80
Trib	631.9	50-yr / 10-yr	14760.00	573.38	591.71	589.49	595.90	0.009788	16.54	956.69	80.34	0.76
Trib	631.9	10-yr / 50-yr	9282.00	573.38	594.75	586.07	595.84	0.002024	8.52	1209.85	86.85	0.36
Trib	619.85*	2-yr	4499.00	573.99	582.58	582.58	585.53	0.022211	13.80	326.05	55.31	1.00
Trib	619.85*	5-yr	6991.00	573.99	584.71	584.71	588.46	0.021032	15.54	450.16	61.12	1.00
Trib	619.85*	10-yr	9282.00	573.99	586.27	586.27	590.77	0.019635	17.04	548.26	64.63	1.00
Trib	619.85*	25-yr	11782.00	573.99	587.89	587.89	593.07	0.018116	18.28	657.56	69.48	0.99
Trib	619.85*	50-yr / 50-yr	14760.00	573.99	589.65	589.65	595.56	0.016929	19.57	784.83	76.34	0.98
Trib	619.85*	100-yr / 50-yr	16906.00	573.99	590.88	590.88	597.21	0.016073	20.31	880.84	80.17	0.97
Trib	619.85*	500-yr / 100-yr	24272.00	573.99	594.47	594.47	602.26	0.014692	22.70	1184.20	88.45	0.96
Trib	619.85*	50-yr / 10-yr	14760.00	573.99	589.65	589.65	595.56	0.016929	19.57	784.83	76.34	0.98
Trib	619.85*	10-yr / 50-yr	9282.00	573.99	594.71	586.27	595.82	0.002046	8.55	1205.89	89.14	0.36
Trib	607.8	2-yr	4499.00	574.60	580.94	581.86	585.04	0.037846	16.24	277.00	54.27	1.27
Trib	607.8	5-yr	6991.00	574.60	582.88	583.96	587.98	0.034439	18.11	385.98	58.69	1.24
Trib	607.8	10-yr	9282.00	574.60	584.32	585.53	590.31	0.032809	19.63	473.29	61.86	1.24
Trib	607.8	25-yr	11782.00	574.60	585.75	587.13	592.60	0.030587	21.01	563.40	64.26	1.23
Trib	607.8	50-yr / 50-yr	14760.00	574.60	587.36	588.77	595.10	0.027877	22.35	670.27	68.95	1.20
Trib	607.8	100-yr / 50-yr	16906.00	574.60	588.47	590.08	596.75	0.026198	23.14	748.28	71.16	1.19
Trib	607.8	500-yr / 100-yr	24272.00	574.60	591.95	593.71	601.82	0.022386	25.40	1022.94	85.10	1.14
Trib	607.8	50-yr / 10-yr	14760.00	574.60	587.36	588.77	595.10	0.027877	22.35	670.27	68.95	1.20
Trib	607.8	10-yr / 50-yr	9282.00	574.60	594.77	585.53	595.76	0.001814	8.09	1270.79	91.19	0.33
Trib	588.3*	2-yr	4499.00	574.48	582.04	581.47	584.28	0.016814	12.01	374.50	63.61	0.87
Trib	588.3*	5-yr	6991.00	574.48	582.35	583.45	587.23	0.035035	17.74	394.11	64.60	1.27
Trib	588.3*	10-yr	9282.00	574.48	583.41	584.90	589.60	0.038093	19.96	465.18	68.31	1.34
Trib	588.3*	25-yr	11782.00	574.48	584.52	586.39	591.88	0.037981	21.78	542.26	70.92	1.37
Trib	588.3*	50-yr / 50-yr	14760.00	574.48	590.91	587.96	594.28	0.007975	14.84	1059.40	91.97	0.69
Trib	588.3*	100-yr / 50-yr	16906.00	574.48	586.58	589.10	596.05	0.035895	24.72	693.95	76.62	1.38
Trib	588.3*	500-yr / 100-yr	24272.00	574.48	589.29	592.48	601.11	0.032634	27.70	914.39	86.91	1.37
Trib	588.3*	50-yr / 10-yr	14760.00	574.48	585.73	587.96	594.38	0.036855	23.61	630.34	74.51	1.38
Trib	588.3*	10-yr / 50-yr	9282.00	574.48	594.89	584.90	595.66	0.001339	7.17	1452.63	105.97	0.30
Trib	568.8	2-yr	4499.00	574.37	582.05	581.06	583.85	0.013589	10.78	417.44	71.82	0.79
Trib	568.8	5-yr	6991.00	574.37	582.01	582.97	586.42	0.033422	16.86	414.68	71.62	1.23

HEC-RAS Plan: New Bridge + River: Hurdy Gurdy Reach: Trib (Continued)

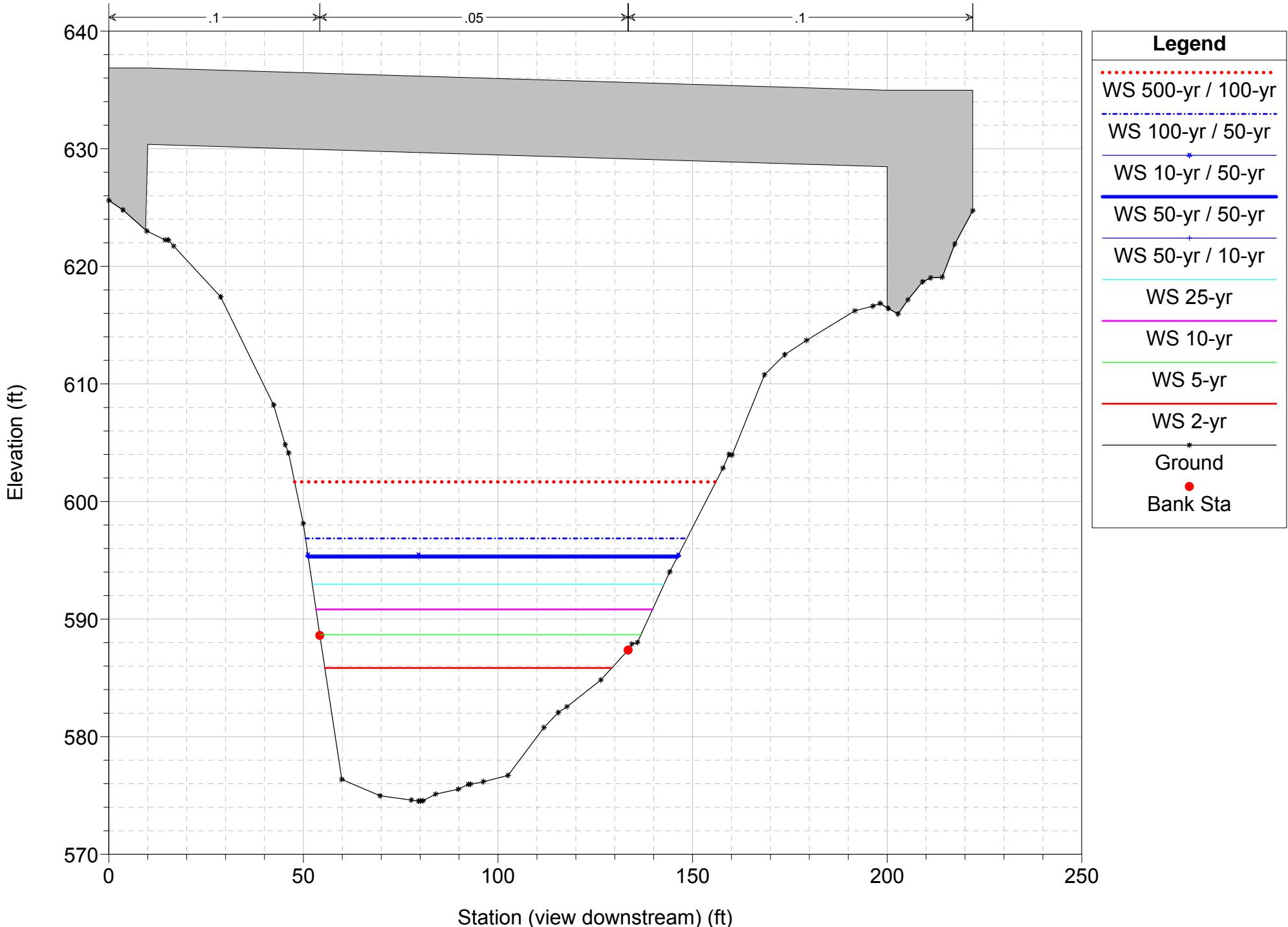
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	568.8	10-yr	9282.00	574.37	582.83	584.33	588.76	0.040084	19.53	475.20	75.79	1.37
Trib	568.8	25-yr	11782.00	574.37	583.67	585.71	591.09	0.043068	21.86	539.95	78.49	1.45
Trib	568.8	50-yr / 50-yr	14760.00	574.37	591.41	587.20	593.88	0.005480	12.76	1278.45	118.68	0.58
Trib	568.8	100-yr / 50-yr	16906.00	574.37	585.38	588.21	595.24	0.043016	25.23	679.06	84.78	1.50
Trib	568.8	500-yr / 100-yr	24272.00	574.37	587.61	591.62	600.32	0.041203	28.72	877.97	93.48	1.52
Trib	568.8	50-yr / 10-yr	14760.00	574.37	584.68	587.20	593.58	0.043346	23.96	620.60	82.12	1.49
Trib	568.8	10-yr / 50-yr	9282.00	574.37	595.00	584.33	595.58	0.000997	6.29	1727.55	131.65	0.26
Trib	550.7*	2-yr	4499.00	574.12	581.03	580.95	583.48	0.021457	12.55	358.45	70.50	0.98
Trib	550.7*	5-yr	6991.00	574.12	582.77	582.77	585.98	0.020787	14.38	486.52	76.92	1.00
Trib	550.7*	10-yr	9282.00	574.12	584.11	584.11	587.97	0.019604	15.77	593.31	82.45	1.00
Trib	550.7*	25-yr	11782.00	574.12	587.10	585.50	590.26	0.010468	14.33	855.99	93.68	0.77
Trib	550.7*	50-yr / 50-yr	14760.00	574.12	591.38	586.97	593.75	0.005119	12.54	1321.06	122.42	0.57
Trib	550.7*	100-yr / 50-yr	16906.00	574.12	590.90	587.98	594.26	0.007536	14.89	1263.03	120.37	0.69
Trib	550.7*	500-yr / 100-yr	24272.00	574.12	588.17	591.36	599.12	0.032023	26.71	959.63	99.21	1.37
Trib	550.7*	50-yr / 10-yr	14760.00	574.12	586.22	586.97	592.15	0.021948	19.60	775.65	90.15	1.10
Trib	550.7*	10-yr / 50-yr	9282.00	574.12	595.00	584.11	595.56	0.000930	6.17	1790.48	136.82	0.25
Trib	532.6	2-yr	4499.00	573.87	581.22	580.18	582.96	0.012981	10.61	424.19	72.62	0.77
Trib	532.6	5-yr	6991.00	573.87	581.24	582.02	585.42	0.030933	16.41	426.08	72.70	1.19
Trib	532.6	10-yr	9282.00	573.87	582.55	583.42	587.43	0.029028	17.74	524.59	78.87	1.19
Trib	532.6	25-yr	11782.00	573.87	587.26	584.81	589.94	0.008136	13.20	937.64	97.03	0.68
Trib	532.6	50-yr / 50-yr	14760.00	573.87	591.49	586.27	593.58	0.004297	11.81	1426.66	128.73	0.52
Trib	532.6	100-yr / 50-yr	16906.00	573.87	591.08	587.25	594.00	0.006195	13.93	1374.29	126.76	0.63
Trib	532.6	500-yr / 100-yr	24272.00	573.87	587.38	590.71	598.50	0.033338	26.91	949.39	98.01	1.39
Trib	532.6	50-yr / 10-yr	14760.00	573.87	584.99	586.27	591.63	0.026854	20.73	728.78	87.68	1.20
Trib	532.6	10-yr / 50-yr	9282.00	573.87	595.02	583.42	595.52	0.000817	5.89	1938.26	156.50	0.24
Trib	516.85*	2-yr	4499.00	573.70	580.19	580.19	582.63	0.022783	12.52	359.25	74.42	1.00
Trib	516.85*	5-yr	6991.00	573.70	581.93	581.93	585.04	0.021238	14.16	493.77	80.47	1.00
Trib	516.85*	10-yr	9282.00	573.70	583.78	583.28	586.99	0.015988	14.38	651.48	88.69	0.90
Trib	516.85*	25-yr	11782.00	573.70	587.35	584.59	589.73	0.007257	12.44	992.98	104.75	0.65
Trib	516.85*	50-yr / 50-yr	14760.00	573.70	591.58	585.98	593.45	0.003810	11.12	1498.02	136.14	0.50
Trib	516.85*	100-yr / 50-yr	16906.00	573.70	591.24	586.99	593.80	0.005395	13.04	1452.12	130.03	0.59
Trib	516.85*	500-yr / 100-yr	24272.00	573.70	593.14	590.17	597.17	0.007341	16.45	1719.83	148.91	0.70
Trib	516.85*	50-yr / 10-yr	14760.00	573.70	585.39	585.98	590.92	0.021594	18.92	798.29	94.33	1.08
Trib	516.85*	10-yr / 50-yr	9282.00	573.70	595.04	583.28	595.50	0.000729	5.56	2012.44	156.78	0.22
Trib	501.1	2-yr	4499.00	573.52	578.70	579.46	582.06	0.038173	14.72	305.64	72.72	1.27
Trib	501.1	5-yr	6991.00	573.52	580.23	581.18	584.49	0.036075	16.56	422.25	80.32	1.27
Trib	501.1	10-yr	9282.00	573.52	584.22	582.52	586.51	0.010151	12.15	771.42	94.97	0.73
Trib	501.1	25-yr	11782.00	573.52	587.61	583.77	589.47	0.005341	10.98	1122.45	110.72	0.56
Trib	501.1	50-yr / 50-yr	14760.00	573.52	591.77	585.16	593.29	0.003012	10.05	1642.21	141.41	0.44
Trib	501.1	100-yr / 50-yr	16906.00	573.52	591.50	586.09	593.58	0.004198	11.73	1603.93	140.47	0.52
Trib	501.1	500-yr / 100-yr	24272.00	573.52	593.62	588.94	596.81	0.005532	14.63	1913.85	152.08	0.61
Trib	501.1	50-yr / 10-yr	14760.00	573.52	583.55	585.16	590.37	0.033602	20.96	708.27	92.60	1.31
Trib	501.1	10-yr / 50-yr	9282.00	573.52	595.08	582.52	595.47	0.000609	5.12	2139.02	156.64	0.20
Trib	481.2*	2-yr	4499.00	573.23	579.96	579.24	581.70	0.014986	10.57	425.79	83.18	0.82
Trib	481.2*	5-yr	6991.00	573.23	581.33	580.91	583.91	0.017341	12.88	542.88	88.04	0.91
Trib	481.2*	10-yr	9282.00	573.23	584.17	582.20	586.28	0.008735	11.67	808.61	99.96	0.69
Trib	481.2*	25-yr	11782.00	573.23	587.62	583.42	589.33	0.004656	10.59	1179.38	115.78	0.53
Trib	481.2*	50-yr / 50-yr	14760.00	573.23	591.78	584.79	593.21	0.002677	9.74	1735.76	159.24	0.42
Trib	481.2*	100-yr / 50-yr	16906.00	573.23	591.52	585.70	593.46	0.003721	11.35	1693.97	155.98	0.50
Trib	481.2*	500-yr / 100-yr	24272.00	573.23	593.69	588.64	596.64	0.004863	14.11	2055.11	174.71	0.58
Trib	481.2*	50-yr / 10-yr	14760.00	573.23	583.96	584.79	589.56	0.023880	19.01	788.16	98.94	1.13
Trib	481.2*	10-yr / 50-yr	9282.00	573.23	595.09	582.20	595.45	0.000541	4.94	2302.56	179.68	0.20
Trib	461.3	2-yr	4499.00	572.94	579.73	579.02	581.39	0.014806	10.34	434.99	87.08	0.82
Trib	461.3	5-yr	6991.00	572.94	581.10	580.61	583.55	0.016173	12.57	558.38	93.66	0.88
Trib	461.3	10-yr	9282.00	572.94	584.15	581.81	586.07	0.007516	11.15	863.95	110.52	0.64
Trib	461.3	25-yr	11782.00	572.94	587.66	583.04	589.20	0.004003	10.08	1289.29	130.85	0.50
Trib	461.3	50-yr / 50-yr	14760.00	572.94	591.85	584.42	593.11	0.002314	9.25	1918.64	177.93	0.40
Trib	461.3	100-yr / 50-yr	16906.00	572.94	591.61	585.39	593.32	0.003194	10.77	1876.90	174.90	0.46
Trib	461.3	500-yr / 100-yr	24272.00	572.94	593.89	588.09	596.43	0.004109	13.29	2308.36	200.00	0.54
Trib	461.3	50-yr / 10-yr	14760.00	572.94	583.58	584.42	589.11	0.023518	18.92	802.53	105.49	1.13
Trib	461.3	10-yr / 50-yr	9282.00	572.94	595.11	581.81	595.42	0.000472	4.69	2553.46	200.00	0.18
Trib	444.6*	2-yr	4499.00	572.66	578.86	578.86	581.04	0.023001	11.85	379.55	87.09	1.00
Trib	444.6*	5-yr	6991.00	572.66	580.40	580.39	583.22	0.020970	13.46	520.10	94.16	1.00
Trib	444.6*	10-yr	9282.00	572.66	584.14	581.58	585.90	0.006709	10.67	907.76	114.22	0.61
Trib	444.6*	25-yr	11782.00	572.66	587.69	582.80	589.09	0.003580	9.65	1349.27	134.09	0.47
Trib	444.6*	50-yr / 50-yr	14760.00	572.66	591.88	584.11	593.05	0.002099	8.90	1976.96	183.32	0.38
Trib	444.6*	100-yr / 50-yr	16906.00	572.66	591.65	585.03	593.24	0.002888	10.35	1936.68	174.94	0.44

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Trib	444.6*	500-yr / 100-yr	24272.00	572.66	593.96	587.78	596.31	0.003697	12.75	2391.47	202.12	0.51
Trib	444.6*	50-yr / 10-yr	14760.00	572.66	583.28	584.11	588.71	0.023530	18.75	811.57	108.90	1.13
Trib	444.6*	10-yr / 50-yr	9282.00	572.66	595.12	581.58	595.41	0.000432	4.53	2625.59	202.12	0.18
Trib	427.9*	2-yr	4499.00	572.37	578.03	578.35	580.57	0.029708	12.79	351.63	87.15	1.12
Trib	427.9*	5-yr	6991.00	572.37	580.48	579.90	582.75	0.015298	12.08	580.91	99.57	0.86
Trib	427.9*	10-yr	9282.00	572.37	584.23	581.05	585.72	0.005362	9.84	991.87	119.73	0.55
Trib	427.9*	25-yr	11782.00	572.37	587.76	582.27	588.99	0.003001	9.02	1446.45	138.11	0.43
Trib	427.9*	50-yr / 50-yr	14760.00	572.37	591.94	583.53	592.97	0.001810	8.40	2082.72	178.73	0.35
Trib	427.9*	100-yr / 50-yr	16906.00	572.37	591.74	584.44	593.14	0.002473	9.74	2047.64	173.01	0.41
Trib	427.9*	500-yr / 100-yr	24272.00	572.37	594.07	587.11	596.17	0.003203	12.06	2511.53	204.23	0.48
Trib	427.9*	50-yr / 10-yr	14760.00	572.37	582.32	583.53	588.23	0.028208	19.55	772.76	109.50	1.22
Trib	427.9*	10-yr / 50-yr	9282.00	572.37	595.13	581.05	595.40	0.000384	4.32	2726.80	204.23	0.17
Trib	411.2	2-yr	4499.00	572.09	576.92	577.60	579.94	0.039750	13.97	322.14	86.67	1.28
Trib	411.2	5-yr	6991.00	572.09	580.73	579.14	582.36	0.009346	10.26	687.61	106.91	0.68
Trib	411.2	10-yr	9282.00	572.09	584.35	580.30	585.55	0.003985	8.85	1109.89	125.42	0.48
Trib	411.2	25-yr	11782.00	572.09	587.85	581.48	588.88	0.002396	8.30	1577.14	142.56	0.39
Trib	411.2	50-yr / 50-yr	14760.00	572.09	592.00	582.73	592.91	0.001512	7.83	2231.75	179.52	0.32
Trib	411.2	100-yr / 50-yr	16906.00	572.09	591.83	583.61	593.04	0.002053	9.07	2200.80	177.79	0.38
Trib	411.2	500-yr / 100-yr	24272.00	572.09	594.21	586.25	596.05	0.002694	11.28	2663.49	206.35	0.44
Trib	411.2	50-yr / 10-yr	14760.00	572.09	581.11	582.73	587.64	0.034872	20.53	728.58	108.95	1.33
Trib	411.2	10-yr / 50-yr	9282.00	572.09	595.14	580.30	595.38	0.000333	4.08	2856.21	206.35	0.16
Trib	391.5*	2-yr	4499.00	571.84	577.18	577.18	579.23	0.023514	11.47	392.37	96.22	1.00
Trib	391.5*	5-yr	6991.00	571.84	580.81	578.63	582.12	0.006766	9.19	778.35	116.46	0.59
Trib	391.5*	10-yr	9282.00	571.84	584.43	579.72	585.43	0.003087	8.08	1241.93	138.91	0.43
Trib	391.5*	25-yr	11782.00	571.84	587.93	580.88	588.79	0.001912	7.63	1756.69	157.26	0.35
Trib	391.5*	50-yr / 50-yr	14760.00	571.84	592.08	582.09	592.84	0.001228	7.23	2487.31	189.65	0.29
Trib	391.5*	100-yr / 50-yr	16906.00	571.84	591.93	582.97	592.95	0.001658	8.36	2459.70	189.60	0.34
Trib	391.5*	500-yr / 100-yr	24272.00	571.84	594.38	585.56	595.91	0.002163	10.36	2949.79	208.05	0.40
Trib	391.5*	50-yr / 10-yr	14760.00	571.84	580.37	582.09	586.98	0.037042	20.66	727.39	114.85	1.37
Trib	391.5*	10-yr / 50-yr	9282.00	571.84	595.16	579.72	595.36	0.000277	3.80	3116.59	219.42	0.14
Trib	371.8*	2-yr	4499.00	571.58	576.30	576.68	578.69	0.032231	12.41	362.45	100.16	1.15
Trib	371.8*	5-yr	6991.00	571.58	580.89	578.04	581.93	0.004893	8.21	885.59	125.50	0.51
Trib	371.8*	10-yr	9282.00	571.58	584.51	579.14	585.33	0.002400	7.36	1392.21	153.15	0.38
Trib	371.8*	25-yr	11782.00	571.58	588.00	580.23	588.72	0.001532	7.01	1953.93	170.25	0.32
Trib	371.8*	50-yr / 50-yr	14760.00	571.58	592.14	581.40	592.78	0.001006	6.68	2777.18	215.37	0.27
Trib	371.8*	100-yr / 50-yr	16906.00	571.58	592.02	582.25	592.87	0.001350	7.70	2751.23	212.85	0.31
Trib	371.8*	500-yr / 100-yr	24272.00	571.58	594.53	584.83	595.80	0.001751	9.52	3302.79	222.09	0.36
Trib	371.8*	50-yr / 10-yr	14760.00	571.58	583.73	581.40	586.15	0.007717	12.61	1275.64	147.98	0.67
Trib	371.8*	10-yr / 50-yr	9282.00	571.58	595.18	579.14	595.35	0.000229	3.51	3447.70	223.04	0.13
Trib	352.1	2-yr	4499.00	571.33	575.67	576.09	578.07	0.035143	12.44	361.51	105.56	1.19
Trib	352.1	5-yr	6991.00	571.33	580.97	577.39	581.79	0.003576	7.33	1007.80	135.35	0.44
Trib	352.1	10-yr	9282.00	571.33	584.57	578.48	585.24	0.001880	6.71	1560.71	168.10	0.34
Trib	352.1	25-yr	11782.00	571.33	588.06	579.53	588.66	0.001234	6.43	2170.06	181.83	0.29
Trib	352.1	50-yr / 50-yr	14760.00	571.33	592.20	580.66	592.73	0.000832	6.17	3085.72	236.47	0.24
Trib	352.1	100-yr / 50-yr	16906.00	571.33	592.09	581.33	592.81	0.001113	7.11	3061.34	235.95	0.28
Trib	352.1	500-yr / 100-yr	24272.00	571.33	594.64	583.98	595.70	0.001440	8.77	3670.22	239.68	0.33
Trib	352.1	50-yr / 10-yr	14760.00	571.33	583.96	580.66	585.87	0.005692	11.28	1459.66	163.40	0.58
Trib	352.1	10-yr / 50-yr	9282.00	571.33	595.19	578.48	595.34	0.000192	3.25	3801.99	240.19	0.12
Trib	330.975*	2-yr	4499.00	570.34	576.41	575.38	577.58	0.011513	8.70	516.89	111.62	0.71
Trib	330.975*	5-yr	6991.00	570.34	581.02	576.74	581.70	0.002691	6.66	1109.52	141.36	0.39
Trib	330.975*	10-yr	9282.00	570.34	584.61	577.77	585.19	0.001513	6.22	1680.34	170.44	0.31
Trib	330.975*	25-yr	11782.00	570.34	588.08	578.87	588.62	0.001041	6.05	2324.60	200.35	0.26
Trib	330.975*	50-yr / 50-yr	14760.00	570.34	592.23	579.99	592.70	0.000713	5.83	3275.24	244.89	0.23
Trib	330.975*	100-yr / 50-yr	16906.00	570.34	592.13	580.75	592.77	0.000952	6.71	3252.39	244.77	0.26
Trib	330.975*	500-yr / 100-yr	24272.00	570.34	594.70	583.25	595.65	0.001242	8.30	3885.15	247.92	0.31
Trib	330.975*	50-yr / 10-yr	14760.00	570.34	584.10	579.99	585.70	0.004411	10.33	1594.30	166.59	0.52
Trib	330.975*	10-yr / 50-yr	9282.00	570.34	595.20	577.77	595.33	0.000167	3.09	4009.25	248.56	0.11
Trib	309.85*	2-yr	4499.00	569.34	576.48	574.71	577.34	0.007023	7.42	606.47	114.74	0.57
Trib	309.85*	5-yr	6991.00	569.34	581.06	576.04	581.63	0.002075	6.08	1217.57	149.56	0.34
Trib	309.85*	10-yr	9282.00	569.34	584.64	577.10	585.14	0.001234	5.77	1811.35	173.84	0.28
Trib	309.85*	25-yr	11782.00	569.34	588.11	578.11	588.59	0.000883	5.69	2489.06	214.77	0.24
Trib	309.85*	50-yr / 50-yr	14760.00	569.34	592.25	579.31	592.68	0.000621	5.52	3474.62	261.13	0.21
Trib	309.85*	100-yr / 50-yr	16906.00	569.34	592.16	580.04	592.73	0.000828	6.35	3452.37	261.04	0.24
Trib	309.85*	500-yr / 100-yr	24272.00	569.34	594.75	582.55	595.60	0.001083	7.86	4131.34	263.70	0.29
Trib	309.85*	50-yr / 10-yr	14760.00	569.34	584.20	579.31	585.56	0.003511	9.52	1735.54	172.05	0.47
Trib	309.85*	10-yr / 50-yr	9282.00	569.34	595.21	577.10	595.33	0.000147	2.93	4251.68	264.18	0.11

Hurdy Gurdy Bridge Plan: New Bridge w/ SFSR TW 9/7/2007

Geom: Hurdy Gurdy new bridge + SFSR TW

River = Hurdy Gurdy Reach = Trib RS = 725 BR New Bridge Based on TS&L dated 7/28/05



Legend

- WS 500-yr / 100-yr
- WS 100-yr / 50-yr
- WS 10-yr / 50-yr
- WS 50-yr / 50-yr
- WS 50-yr / 10-yr
- WS 25-yr
- WS 10-yr
- WS 5-yr
- WS 2-yr
- Ground
- Bank Sta

APPENDIX D

SCOUR AND ABUTMENT PROTECTION CALCULATIONS

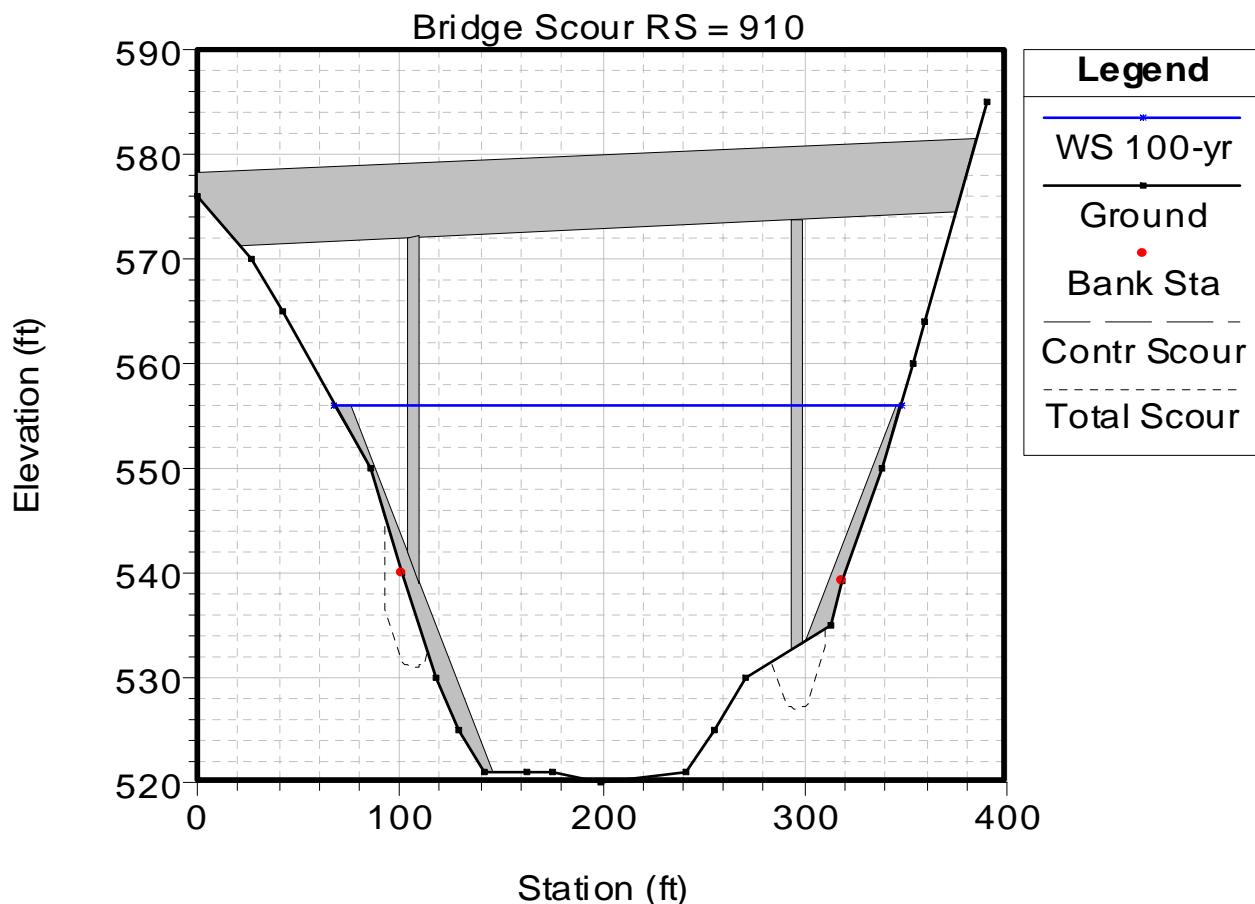
Enclosed:

Summary of scour calculations for Steven Memorial Bridge
Riprap sizing calculations for all bridges

SUMMARY OF SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE

Reference for methodology: HEC-18 4th Edition Chapter 6

Scour Summary (100-year event)							
Pier	Location (Station)	Ground Elevation at Pier (ft)	Assumed Channel Degradation (ft)	Contraction Scour (ft)	Local Pier Scour (ft)	Total Scour (ft)	Scour Elevation (ft)
1	107	538.0	0	0	5.58	5.58	532.4
2	296	533.0	0	0	5.96	5.96	527.0



**50-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 1 STA 107

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{0.43}$$

y_1 (ft) **20.26** = flow depth directly upstream of pier

K_1 1 = correction factor for pier nose shape

K_2 1 = correction factor for angle of attack fo flow

K_3 1.1 = correction factor for bed condition

K_4 0.40 = correction factor for armoring of the bed

a (ft) 6 = pier width

V_1 **9.71** = mean velocity of flow directly upstream of the pier

Fr_1 0.38 = Froude Number directly upstream of the pier

D_{50} 0.50 = Median bed material size (ft)

D_{95} 1.00 = 95 percent finer than material size (ft)

y_s = **5.33** ft **Estimated pier scour depth**

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3} \quad V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

$K_u = 11.17$ (English Units)

= 14.64

$K_u = 11.17$

= 18.44

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x \\ = 8.28$$

$$V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x \\ = 10.82$$

$$V_R = (V_p - V_{cD50}) / (V_{c50} - V_{ic95}) \\ = 0.38$$

$$K4 = .4 * V_R^{0.15} \\ = 0.35$$

$K4 min = 0.4$

South Fork RS: 930		Profile: 50-yr						
Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
1 LOB	60.85	81.14	5.77	8.07	7.17	0.01	1.19	0.72
2 LOB	81.14	101.42	364.31	155.54	23.32	0.44	7.67	2.34
3 Chan	101.42	123.18	4279.6	440.89	25.04	5.19	20.26	9.71
4 Chan	123.18	144.95	8757.54	654.16	22.94	10.61	30.06	13.39
5 Chan	144.95	166.71	10463.8	712.7	21.76	12.68	32.75	14.68
6 Chan	166.71	188.47	10544.88	716.16	21.77	12.78	32.91	14.72
7 Chan	188.47	210.23	10900.91	730.59	21.77	13.21	33.57	14.92
8 Chan	210.23	231.99	10718.29	723.13	21.77	12.99	33.23	14.82
9 Chan	231.99	253.75	9846.58	692.96	22.22	11.93	31.84	14.21
10 Chan	253.75	275.52	6870.38	563.31	22.72	8.32	25.89	12.2
11 Chan	275.52	297.28	5316.07	476.03	21.91	6.44	21.87	11.17
12 Chan	297.28	319.04	3994.68	409.91	23.15	4.84	18.84	9.75
13 ROB	319.04	333.28	427.89	150.19	16.39	0.52	10.55	2.85
14 ROB	333.28	347.52	46.31	35.41	12.42	0.06	3.34	1.31
15 ROB	347.52	361.76	0.03	0.15	0.8	0	0.22	0.2

**100-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 1 STA 107

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{0.43}$$

y_1 (ft) **23.05** = flow depth directly upstream of pier

K_1 1 = correction factor for pier nose shape

K_2 1 = correction factor for angle of attack fo flow

K_3 1.1 = correction factor for bed condition

K_4 0.40 = correction factor for armoring of the bed

a (ft) 6 = pier width

V_1 **10.35** = mean velocity of flow directly upstream of the pier

Fr_1 0.38 = Froude Number directly upstream of the pier

D_{50} 0.50 = Median bed material size (ft)

D_{95} 1.00 = 95 percent finer than material size (ft)

y_s = **5.58** ft **Estimated pier scour depth**

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3} \quad V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

$K_u = 11.17$ (English Units) $K_u = 11.17$

= 14.96 = 18.84

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x \quad V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x$$

= 8.46 = 11.05

$$V_R = (V_p - V_{cD50}) / (V_{c50} - V_{ic95}) \quad K4 = .4 * V_R^{0.15}$$

= 0.49 = **0.36**

$K4 min = 0.4$

Pos	Plan: New Brdge Smiths River South Fork RS: 930				Profile: 100-yr			
	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
1 LOB	60.85	81.14	43.18	38.02	15.57	0.05	2.59	1.14
2 LOB	81.14	101.42	579.23	212.21	23.32	0.61	10.46	2.73
3 Chan	101.42	123.18	5192.49	501.69	25.04	5.49	23.05	10.35
4 Chan	123.18	144.95	9935.12	714.96	22.94	10.51	32.85	13.9
5 Chan	144.95	166.71	11732.93	773.5	21.76	12.41	35.54	15.17
6 Chan	166.71	188.47	11816.35	776.96	21.77	12.5	35.7	15.21
7 Chan	188.47	210.23	12183.86	791.39	21.77	12.89	36.37	15.4
8 Chan	210.23	231.99	11995.58	783.93	21.77	12.69	36.02	15.3
9 Chan	231.99	253.75	11082.07	753.77	22.22	11.72	34.64	14.7
10 Chan	253.75	275.52	7973.19	624.12	22.72	8.43	28.68	12.78
11 Chan	275.52	297.28	6354.14	536.84	21.91	6.72	24.67	11.84
12 Chan	297.28	319.04	4921	470.72	23.15	5.21	21.63	10.45
13 ROB	319.04	333.28	613.87	189.97	16.39	0.65	13.34	3.23
14 ROB	333.28	347.52	116.94	70.89	16.77	0.12	4.98	1.65
15 ROB	347.52	361.76	0.03	0.15	0.8	0	0.22	0.2

**100-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 1 STA 107

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{0.43}$$

y_1 (ft) **23.05** = flow depth directly upstream of pier

K_1 1 = correction factor for pier nose shape

K_2 1 = correction factor for angle of attack fo flow

K_3 1.1 = correction factor for bed condition

K_4 0.40 = correction factor for armoring of the bed

a (ft) 6 = pier width

V_1 **10.35** = mean velocity of flow directly upstream of the pier

Fr_1 0.38 = Froude Number directly upstream of the pier

D_{50} 0.50 = Median bed material size (ft)

D_{95} 1.00 = 95 percent finer than material size (ft)

y_s = **5.58** ft **Estimated pier scour depth**

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3} \quad V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

$K_u = 11.17$ (English Units) $K_u = 11.17$
 $= 14.96$ $= 18.84$

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x \quad V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x$$

$= 8.46$ $= 11.05$

$$V_R = (V_p - V_{cD50}) / (V_{c50} - V_{ic95}) \quad K4 = .4 * V_R^{0.15}$$

$= 0.49$ $= 0.36$

$K4 min = 0.4$

Pos	Plan: New Brdge Smiths River South Fork RS: 930				Profile: 100-yr			
	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
1 LOB	60.85	81.14	43.18	38.02	15.57	0.05	2.59	1.14
2 LOB	81.14	101.42	579.23	212.21	23.32	0.61	10.46	2.73
3 Chan	101.42	123.18	5192.49	501.69	25.04	5.49	23.05	10.35
4 Chan	123.18	144.95	9935.12	714.96	22.94	10.51	32.85	13.9
5 Chan	144.95	166.71	11732.93	773.5	21.76	12.41	35.54	15.17
6 Chan	166.71	188.47	11816.35	776.96	21.77	12.5	35.7	15.21
7 Chan	188.47	210.23	12183.86	791.39	21.77	12.89	36.37	15.4
8 Chan	210.23	231.99	11995.58	783.93	21.77	12.69	36.02	15.3
9 Chan	231.99	253.75	11082.07	753.77	22.22	11.72	34.64	14.7
10 Chan	253.75	275.52	7973.19	624.12	22.72	8.43	28.68	12.78
11 Chan	275.52	297.28	6354.14	536.84	21.91	6.72	24.67	11.84
12 Chan	297.28	319.04	4921	470.72	23.15	5.21	21.63	10.45
13 ROB	319.04	333.28	613.87	189.97	16.39	0.65	13.34	3.23
14 ROB	333.28	347.52	116.94	70.89	16.77	0.12	4.98	1.65
15 ROB	347.52	361.76	0.03	0.15	0.8	0	0.22	0.2

**500-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 2 STA 296

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{0.43}$$

y_1 (ft)	32.96	=	flow depth directly upstream of pier
K_1	1	=	correction factor for pier nose shape
K_2	1	=	correction factor for angle of attack fo flow
K_3	1.1	=	correction factor for bed condition
K_4	0.41	=	correction factor for armoring of the bed
a (ft)	6	=	pier width
V_1	13.59	=	mean velocity of flow directly upstream of the pier
Fr_1	0.42	=	Froude Number directly upstream of the pier
D_{50}	0.50	=	Median bed material size (ft)
D_{95}	1.00	=	95 percent finer than material size (ft)
y_s =	6.69	ft	Estimated pier scour depth

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3}$$

Ku = 11.17(English Units)
= 15.87

$$V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

Ku = 11.17
= 20.00

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x$$

= 8.98

$$V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x$$

= 11.73

$$V_R = (V_p - V_{cD50}) / (V_{cD50} - V_{icD95})$$

= 1.11

$$K4 = .4 * V_R^{0.15}$$

= **0.41**

K4 min = 0.4

Pos	Plan: New Brdge		Smiths River	South Fork	RS: 930	Profile: 500-yr		
	Left Sta	Right Sta	Flow	Area	W.P.	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
	(ft)	(ft)	(cfs)	(sq ft)	(ft)			
1 LOB	40.57	60.85	67.55	56.43	18.96	0.05	3.16	1.2
2 LOB	60.85	81.14	514.36	200.64	21.51	0.38	9.89	2.56
3 LOB	81.14	101.42	1415.32	380.38	23.32	1.06	18.75	3.72
4 Chan	101.42	123.18	8203.62	682.11	25.04	6.12	31.34	12.03
5 Chan	123.18	144.95	13687.26	895.37	22.94	10.22	41.14	15.29
6 Chan	144.95	166.71	15755.3	953.91	21.76	11.76	43.83	16.52
7 Chan	166.71	188.47	15845.04	957.38	21.77	11.83	43.99	16.55
8 Chan	188.47	210.23	16244.42	971.8	21.77	12.13	44.66	16.72
9 Chan	210.23	231.99	16040.5	964.34	21.77	11.98	44.31	16.63
10 Chan	231.99	253.75	15004.33	934.18	22.22	11.2	42.93	16.06
11 Chan	253.75	275.52	11526.53	804.53	22.72	8.61	36.97	14.33
12 Chan	275.52	297.28	9750.84	717.25	21.91	7.28	32.96	13.59
13 Chan	297.28	319.04	8001.54	651.13	23.15	5.97	29.92	12.29
14 ROB	319.04	333.28	1262.17	308.02	16.39	0.94	21.63	4.1
15 ROB	333.28	347.52	550.52	188.93	16.77	0.41	13.27	2.91
16 ROB	347.52	361.76	79.69	57.69	15.69	0.06	4.43	1.38

**500-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 2 STA 296

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{0.43}$$

y_1 (ft) **32.96** = flow depth directly upstream of pier

K_1 1 = correction factor for pier nose shape

K_2 1 = correction factor for angle of attack fo flow

K_3 1.1 = correction factor for bed condition

K_4 0.41 = correction factor for armoring of the bed

a (ft) 6 = pier width

V_1 **13.59** = mean velocity of flow directly upstream of the pier

Fr_1 0.42 = Froude Number directly upstream of the pier

D_{50} 0.50 = Median bed material size (ft)

D_{95} 1.00 = 95 percent finer than material size (ft)

y_s = **6.69** ft **Estimated pier scour depth**

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3} \quad V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

$K_u = 11.17$ (English Units) $K_u = 11.17$

= 15.87 = 20.00

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x \quad V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x$$

= 8.98 = 11.73

$$V_R = (V_p - V_{cD50}) / (V_{cD50} - V_{icD95}) \quad K4 = .4 * V_R^{0.15}$$

= 1.11 = 0.41

K4 min = 0.4

Pos	Plan: New Brdge			Smiths River		South Fork		RS: 930	Profile: 500-yr		
	Left Sta	Right Sta	Flow	Area	W.P.	Percent	Hydr				
	(ft)	(ft)	(cfs)	(sq ft)	(ft)	Conv	Depth(ft)	(ft/s)			
1 LOB	40.57	60.85	67.55	56.43	18.96	0.05	3.16	1.2			
2 LOB	60.85	81.14	514.36	200.64	21.51	0.38	9.89	2.56			
3 LOB	81.14	101.42	1415.32	380.38	23.32	1.06	18.75	3.72			
4 Chan	101.42	123.18	8203.62	682.11	25.04	6.12	31.34	12.03			
5 Chan	123.18	144.95	13687.26	895.37	22.94	10.22	41.14	15.29			
6 Chan	144.95	166.71	15755.3	953.91	21.76	11.76	43.83	16.52			
7 Chan	166.71	188.47	15845.04	957.38	21.77	11.83	43.99	16.55			
8 Chan	188.47	210.23	16244.42	971.8	21.77	12.13	44.66	16.72			
9 Chan	210.23	231.99	16040.5	964.34	21.77	11.98	44.31	16.63			
10 Chan	231.99	253.75	15004.33	934.18	22.22	11.2	42.93	16.06			
11 Chan	253.75	275.52	11526.53	804.53	22.72	8.61	36.97	14.33			
12 Chan	275.52	297.28	9750.84	717.25	21.91	7.28	32.96	13.59			
13 Chan	297.28	319.04	8001.54	651.13	23.15	5.97	29.92	12.29			
14 ROB	319.04	333.28	1262.17	308.02	16.39	0.94	21.63	4.1			
15 ROB	333.28	347.52	550.52	188.93	16.77	0.41	13.27	2.91			
16 ROB	347.52	361.76	79.69	57.69	15.69	0.06	4.43	1.38			

**500-YEAR EVENT
LOCAL PIER SCOUR COMPUTATIONS
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

Reference for methodology: HEC-18 4th Edition Chapter 6

PIER 2 STA 296

Scour Calculations

$$y_s/a = 2 K_1 K_2 K_3 K_4 (y_1/a)^{0.35} Fr_1^{-0.43}$$

y_1 (ft) **32.96** = flow depth directly upstream of pier

K_1 1 = correction factor for pier nose shape

K_2 1 = correction factor for angle of attack fo flow

K_3 1.1 = correction factor for bed condition

K_4 0.41 = correction factor for armoring of the bed

a (ft) 6 = pier width

V_1 **13.59** = mean velocity of flow directly upstream of the pier

Fr_1 0.42 = Froude Number directly upstream of the pier

D_{50} 0.50 = Median bed material size (ft)

D_{95} 1.00 = 95 percent finer than material size (ft)

y_s = **6.69** ft **Estimated pier scour depth**

K_4 Calculations

$$V_c D_{50} = K_u y_p^{1/6} D_x^{1/3} \quad V_c D_{95} = K_u y_p^{1/6} D_x^{1/3}$$

$$K_u = 11.17 (\text{English Units}) \quad K_u = 11.17$$

$$= 15.87 \quad = 20.00$$

$$V_{icD50} = 0.645(D_x/a)^{0.53} * V_c D_x \quad V_{icD95} = .645(D_x/a)^{0.53} * V_c D_x$$

$$= 8.98 \quad = 11.73$$

$$V_R = (V_p - V_{cD50}) / (V_{c50} - V_{ic95}) \quad K4 = .4 * V_R^{0.15}$$

$$= 1.11 \quad = 0.41$$

$$K4 min = 0.4$$

Pos	Plan: New Brdge Smiths River South Fork RS: 930					Profile: 500-yr		
	Left Sta	Right Sta	Flow	Area	W.P.	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
1 LOB	40.57	60.85	67.55	56.43	18.96	0.05	3.16	1.2
2 LOB	60.85	81.14	514.36	200.64	21.51	0.38	9.89	2.56
3 LOB	81.14	101.42	1415.32	380.38	23.32	1.06	18.75	3.72
4 Chan	101.42	123.18	8203.62	682.11	25.04	6.12	31.34	12.03
5 Chan	123.18	144.95	13687.26	895.37	22.94	10.22	41.14	15.29
6 Chan	144.95	166.71	15755.3	953.91	21.76	11.76	43.83	16.52
7 Chan	166.71	188.47	15845.04	957.38	21.77	11.83	43.99	16.55
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13 Chan	297.28	319.04	8001.54	651.13	23.15	5.97	29.92	12.29
14 ROB	319.04	333.28	1262.17	308.02	16.39	0.94	21.63	4.1
15 ROB	333.28	347.52	550.52	188.93	16.77	0.41	13.27	2.91
16 ROB	347.52	361.76	79.69	57.69	15.69	0.06	4.43	1.38

**RECOMMENDED RIPRAP SIZING FOR ABUTMENTS/REVETMENT
FOR
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
ROCK CREEK**

September 2007

The following computations are made using Equation 6 in HEC-11:

$$D_{50} = \frac{0.001V^3}{y^{0.5} K_1^{1.5}} \left(\frac{1.61SF^{1.5}}{(S_s - 1)^{1.5}} \right) \quad K_1 = \left[1 - \frac{\sin^2 \Theta}{\sin^2 \Phi} \right]^{0.5}$$

	LEFT	RIGHT
	ABUTMENT ABUTMENT	
AVG. VELOCITY NEAR ABUTMENT (fps), V	10	10
DEPTH NEAR ABUTMENT (ft), Y ₁	14.3	14.3
ANGLE OF REPOSE (degrees)	41	41
ABUTMENT SIDE SLOPE (H:V)	1.5	1.5
STABILITY FACTOR, SF	1.6	1.6
PIER/ABUTMENT CORRECTION	1	1
SPECIFIC GRAVITY, S _s	2.65	2.65
K1	0.53	0.53
MIN. MEDIAN STONE DIAMETER (ft), D₅₀	1.04	1.04
DESIGN RIPRAP SIZE (ft), D₅₀	1.40	1.40
	Class 4	Class 4
OVERBANK DEPTH NEAR ABUTMENT (ft), Y _{ob}	14.30	10.00
EXTEND RIPRAP INTO CHANNEL (ft), W _m	28.60	20.00
MIMIMUM MAT THICKNESS (ft), Y _m (2*D ₅₀)	2.8	

CONSTRUCTION CONSIDERATIONS

1. The rock riprap thickness should not be less than the **larger of the diameter of D₁₀₀ or 1.5 times D₅₀**.
Riprap thickness **should not be less than 12 in** for practical placement.
The rock riprap thickness should be **increased by 50 percent** when it is placed under water to provide for the uncertainties associated with this type of placement.
An **increase in riprap thickness of 6 to 12 in**, accompanied by an appropriate increase in stone sizes, should be provided where riprap revetment will be subject to attack by floating debris or ice, or by waves from boat wakes, wind, or bedforms.
2. The apron at the toe of the abutment slope should extend along the entire length of the abutment toe, around the curved portions of the abutment to the point of tangency with the plane of the embankment slopes.
3. The apron should extend from the toe of the abutment **into the bridge waterway** a distance equal to **twice the flow depth in the overbank** area near the embankment, but **need not exceed 25 ft**
4. Spill through abutment slopes should be protected to an elevation **0.5 ft above expected high water** elevation for the design flood. Upstream and downstream coverage should agree with step 3 except that the **downstream coverage should extend back from the abutment 2 flow depths or 25 ft whichever is greater** to protect the approach embankment.
5. The **volume of rock required for the for the toe must be equal to or or exceed 150%** of the volume required to extend the riprap blanket (**at its design thickness and on a slope of 2H:1V**) to the design scour depth.
6. The rock riprap gradation and the potential need for underlying filter material must be considered.

**RECOMMENDED RIPRAP SIZING FOR ABUTMENTS/REVETMENT
FOR
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
BOULDER CREEK**

September 2007

The following computations are made using Equation 6 in HEC-11:

$$D_{50} = \frac{0.001V^3}{y^{0.5} K_1^{1.5}} \left(\frac{1.61SF^{1.5}}{(S_s - 1)^{1.5}} \right) \quad K_1 = \left[1 - \frac{\sin^2 \Theta}{\sin^2 \Phi} \right]^{0.5}$$

	LEFT	RIGHT
	ABUTMENT ABUTMENT	
AVG. VELOCITY NEAR ABUTMENT (fps), V	10	7
DEPTH NEAR ABUTMENT (ft), Y ₁	2.8	2.2
ANGLE OF REPOSE (degrees)	41	41
ABUTMENT SIDE SLOPE (H:V)	1.5	1.5
STABILITY FACTOR, SF	1.6	1.6
PIER/ABUTMENT CORRECTION	1	1
SPECIFIC GRAVITY, S _s	2.65	2.65
K1	0.53	0.53
MIN. MEDIAN STONE DIAMETER (ft), D₅₀	2.36	0.91
DESIGN RIPRAP SIZE (ft), D₅₀	2.30 Natural Bank Material (existing)	
Class 6 Riprap		
OVERBANK DEPTH NEAR ABUTMENT (ft), Y _{eb}	2.80	7.00
EXTEND RIPRAP INTO CHANNEL (ft), W _m	5.60	14.00
MIMIMUM MAT THICKNESS (ft), Y _m (2*D ₅₀)	4.6	

CONSTRUCTION CONSIDERATIONS

1. The rock riprap thickness should not be less than the **larger of the diameter of D₁₀₀ or 1.5 times D₅₀**.
Riprap thickness **should not be less than 12 in** for practical placement.
The rock riprap thickness should be **increased by 50 percent** when it is placed under water to provide for the uncertainties associated with this type of placement.
An **increase in riprap thickness of 6 to 12 in**, accompanied by an appropriate increase in stone sizes, should be provided where riprap revetment will be subject to attack by floating debris or ice, or by waves from boat wakes, wind, or bedforms.
2. The apron at the toe of the abutment slope should extend along the entire length of the abutment toe, around the curved portions of the abutment to the point of tangency with the plane of the embankment slopes.
3. The apron should extend from the toe of the abutment **into the bridge waterway** a distance equal to **twice the flow depth in the overbank** area near the embankment, but **need not exceed 25 ft**
4. Spill through abutment slopes should be protected to an elevation **0.5 ft above expected high water** elevation for the design flood. Upstream and downstream coverage should agree with step 3 except that the **downstream coverage should extend back from the abutment 2 flow depths or 25 ft whichever is greater** to protect the approach embankment.
5. The **volume of rock required for the for the toe must be equal to or or exceed 150%** of the volume required to extend the riprap blanket (at its design thickness and on a slope of 2H:1V) to the design scour depth.
6. The rock riprap gradation and the potential need for underlying filter material must be considered.

Calc. By:	SAH	Date:	9/7/2007
Check By:		Date:	

**RECOMMENDED RIPRAP SIZING FOR ABUTMENTS
FOR
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
STEVEN MEMORIAL BRIDGE**

September 2007

The following computations are made using Equation 6 in HEC-11:

$$D_{50} = \frac{0.001V^3}{y^{0.5} K_1^{1.5}} \left[\frac{1.61SF^{1.5}}{(S_s - 1)^{1.5}} \right] \quad K_1 = \left[1 - \frac{\sin^2 \Theta}{\sin^2 \Phi} \right]^{0.5}$$

	LEFT ABUTMENT	RIGHT ABUTMENT
AVG. VELOCITY NEAR ABUTMENT (fps), V	14.1	6.4
DEPTH NEAR ABUTMENT (ft), Y ₁	25	25
ANGLE OF REPOSE (degrees)	41	41
ABUTMENT SIDE SLOPE (H:V)	1.5	1.5
STABILITY FACTOR, SF	2	2
PIER/ABUTMENT CORRECTION	1	1
SPECIFIC GRAVITY, S _s	2.65	2.65
K1	0.53	0.53
MIN. MEDIAN STONE DIAMETER (ft), D₅₀	3.09	0.29
DESIGN RIPRAP SIZE (ft), D₅₀	3.30	0.50
	Class 7	Class 1
OVERBANK DEPTH NEAR ABUTMENT (ft), Y _{ob}	19.20	18.10
EXTEND RIPRAP INTO CHANNEL (ft), W _m	38.40	36.20
MIMIMUM MAT THICKNESS (ft), Y _m (2*D ₅₀)	6.60	1.00

CONSTRUCTION CONSIDERATIONS

1. The rock riprap thickness should not be less than the **larger of the diameter of D₁₀₀ or 1.5 times D₅₀**.
Riprap thickness **should not be less than 12 in** for practical placement.
The rock riprap thickness should be **increased by 50 percent** when it is placed under water to provide for the uncertainties associated with this type of placement.
An **increase in riprap thickness of 6 to 12 in**, accompanied by an appropriate increase in stone sizes, should be provided where riprap revetment will be subject to attack by floating debris or ice, or by waves from boat wakes, wind, or bedforms.
2. The apron at the toe of the abutment slope should extend along the entire length of the abutment toe, around the curved portions of the abutment to the point of tangency with the plane of the embankment slopes.
3. The apron should extend from the toe of the abutment **into the bridge waterway** a distance equal to **twice the flow depth in the overbank area** near the embankment, but **need not exceed 25 ft**
4. Spill through abutment slopes should be protected to an elevation **0.5 ft above expected high water** elevation for the design flood. Upstream and downstream coverage should agree with step 3 except that the **downstream coverage should extend back from the abutment 2 flow depths or 25 ft whichever is greater** to protect the approach embankment.
5. The **volume of rock required for the toe must be equal to or exceed 150%** of the volume required to extend the riprap blanket (**at its design thickness and on a slope of 2H:1V**) to the design scour depth.
6. The rock riprap gradation and the potential need for underlying filter material must be considered.

Calc. By:	SAH	Date:	9/7/2007
Check By:		Date:	

**RECOMMENDED RIPRAP SIZING FOR ABUTMENTS
FOR
CA PFH 112-1(2) SOUTH FORK SMITH RIVER
HURDY GURDY BRIDGE**

September 2007

No abutment protection designed for Hurdy Gurdy Bridge. Abutments are significantly above 100-year water surface and well beyond floodplain limits.

