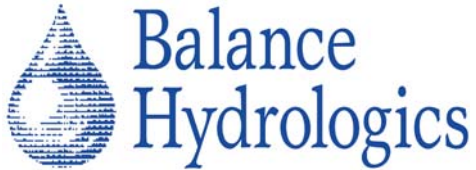


Appendix D

Hydraulic Modeling and Floodplain Analysis



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May 10, 2019

Mr. Caleb Roope
Pacific West Communities, Inc.
430 East State Street, Suite 100
Eagle, Idaho 83616

**RE: Summary of Hydraulic Modeling and Floodplain Impacts for
the Proposed Voices School Site, City of Morgan Hill**

Dear Mr. Roope,

I'd like to begin by again thanking you for contacting Balance Hydrologics for technical support related to assessing potential floodplain impacts related to the proposed Voices School site in the City of Morgan Hill, California. As you are aware, Balance staff regularly work on such assignments throughout the region, and we welcome the opportunity to apply our experience to this project.

We have completed a number of tasks in this regard including a preliminary site reconnaissance, meeting with Valley Water staff, supplemental survey work, and hydraulic modeling per FEMA protocols and standards. This letter report summarizes the work completed, with a focus on the findings as they pertain to protecting the site and adjacent lands from flood hazards originating in West Little Llagas Creek.

Project Background

The project site is located in the City of Morgan Hill at the intersection of Monterey Road and Cosmo Avenue. The westerly side of the site is bounded by West Little Llagas Creek, which has been mapped by the Federal Emergency Management Agency (FEMA) at a detailed study level, with the Zone AE Special Flood Hazard Area (SFHA, colloquially known as the "100-year floodplain") illustrated on Flood Insurance Rate Map Panel No. 06085C0607H having an effective date of May 18, 2009. An excerpt of the FIRM panel is shown as the attached Figure 1.

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The Voices School project proposes to make site improvements that include the placement of fill and construction of structures within the mapped SFHA. Therefore, the City has requested a flood study to evaluate how the site development will account for the flood hazard associated with the creek.

Modeling Approach and Assumptions

The study work plan is based on preparing hydraulic modeling of this reach of the creek to represent both the pre- and post-project (e.g. proposed) conditions at the site. All modeling is completed consistent with FEMA modeling protocols so that the model output can be used to guide the selection of finish grade and lowest floor elevations such that the project complies with local ordinances and National Flood Insurance Program requirements. Modeling the pre- and post-project conditions also generates base flood elevations (e.g. those associated with the 1-percent chance flood event) to quantify the anticipated changes due to the placement of fill in the floodplain.

The baseline modeling used for the study was provided by Valley Water staff as that used for the currently-effective flood hazard mapping. The model file was in U.S. Army Corps of Engineers HEC-2 format consistent with the date of preparation, which is noted as June of 1992. The model files were imported into the U.S. Army Corps of Engineers HEC-RAS software platform (version 5.0.7, the successor to HEC-2). The model files cover the entire length of West Little Llagas Creek of which the local reach is only a small portion. Nonetheless, the model was not truncated, but was converted from the former NGVD 29 elevation datum to the current FEMA-standard NAVD 88 datum using an elevation correction of +2.85 feet as directed by Valley Water.

The file conversion to HEC-RAS worked quite well, though a number of issues were addressed to create the revised historical (or pre-project model). These include:

- *Update of channel crossing information.* For unknown reasons, the model file provided did not include culvert data for the existing twin 54-inch CMP culverts and triple 7-foot by 10-foot box culverts that cross under Cosmo Avenue immediately downstream of the site. Additionally, the depiction of an existing wooden bridge and the triple 7-foot by 10-foot box culverts under Edes Street downstream were clearly inaccurate based on the preliminary site reconnaissance. Therefore, crossing elevations and dimensions were confirmed through supplemental survey completed by Balance staff in April and May 2019.

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- *Update of channel cross-section geometries.* As with the noted channel crossings, the channel cross-section geometries in the model were found to be quite coarse, almost certainly reflective of the topographic mapping data available in 1992 when the modeling was first compiled. Therefore, supplemental survey information for all cross-sections from just downstream of Edes Street to just upstream of the Voices site was also collected and used to refine the model. For increase resolution, this included the addition of several cross-sections in the immediate vicinity of the site.¹ The location of the revised channel cross-sections is provided in the attached Figure 2.
- *Manning's n values.* The original HEC-2 file included assigned Manning's n (roughness) values that field reconnaissance showed were not representative of present-day conditions. Thus, n values were updated as appropriate, generally using 0.03 for the main channel, and either 0.04 or 0.045 for the overbank areas. The latter may well be conservative with respect to flood elevations as the main overbank flow path is presently open space reserved for the future flood control channel project. These areas were found to be covered primarily in annual grasses, with most areas clearly subject to mowing. Additionally, a low roughness recreational trail runs along the right (west) bank of the creek in the study area.

Except for the changes noted above, the parameters in the HEC-2 model files were maintained. This includes the 1-percent flood discharge values which transition from 1,094 cfs above the site to 1,296 cfs just upstream of the Cosmo Avenue crossing (at Section 362).

Modeling Results

The full HEC-RAS model output tables are presented in Appendix A, noting that the project site is located adjacent to Sections 360 to 362.5, with Sections 363 located upstream of the site.

The revised historical or pre-project model results are generally consistent with the with flood profile published in the Flood Insurance Study for Santa Clara County (Flood Profile 162P). Base flood elevations from the updated model are lower downstream from Cosmo Avenue and on the order of 0.10 feet lower upstream of Cosmo Avenue. The modeling indicates that even though the new triple box culverts are in place under Cosmo, the fact that they are not directly connected with an improved channel to their actual bottom elevations limits their conveyance capacity. Therefore, the modeling predicts overtopping of Cosmo Avenue, with the road grade acting as a weir that largely dictates base flood elevations adjacent to the Voices site. That said, the slightly lower flood elevations coupled with more

¹ The refined model reach has a total length of approximately 1,740 feet measured along the channel centerline. Model runs were carried out to verify that refinement of the model further downstream did not impact the results at for the run of channel immediately upstream of Cosmo Avenue. Model results outside the refined channel reach should only be referenced or used with an understanding of the limitations in the original HEC-2 model file that was provided.

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detailed site topography result in a revised pre-project floodplain boundary at the site that shows less of the property within the Zone AE area (see Figure 3).

The post-project modeling included adjustments to the pertinent cross-sections based on the proposed grading configuration provided by Bellecci & Associates, lead civil engineers for the project. The modeling indicates that the proposed fill placement would result in only minor increases in base flood elevations in the vicinity of the site. Those elevations range from 334.04 feet just upstream of Cosmo Avenue to approximately 334.45 feet at the northwest corner of the site (between Sections 362.5 and 363). Pre- and post-project base flood elevations are summarized in Table 1 and show that the largest predicted increase is at Section 363 where the BFE increases by 0.09 feet from 334.48 to 334.57 feet NAVD. The resulting revised floodplain boundary at the project property is illustrated on the attached Figure 4.

Table 1. Summary of modeled base flood elevations adjacent to the Voices site.

RAS Cross-section	Modeled Base Flood Elevation (ft, NAVD)		
	Pre-project	Post-project	Difference
363	334.48	334.57	0.09
362.5	334.33	334.33	0
362	334.08	334.15	0.07
361	334.10	334.09	-0.01
360	334.03	334.04	0.01

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Closing

The results of the modeling show that the actual extents of the floodplain at the project property in the pre-project condition are less than depicted at the scale of the published floodplain map. This implies that the encroachment into the floodplain due to the limited proposed fill can be expected to have only a minor impact on base flood elevations. Indeed, the modeling results confirm this and indicate that flood elevations would increase by just over an inch at most. Furthermore, the proposed finished floor elevations are well above the pertinent base flood elevations, especially in light of the fact that significant flood control channel improvements are planned for the near future that will lower the base flood elevation by roughly four feet in this reach of the creek (Upper Llagas Creek Flood Protection Project Phase 2, Sheet PP-12 as provided by Valley Water).

Thank you again for the opportunity to assist with this matter. Do not hesitate to contact Balance Hydrologics if you have any questions or comments related to the work conducted.

Sincerely,

BALANCE HYDROLOGICS, Inc.



Edward D. Ballman, P.E., CFM
Principal Engineer

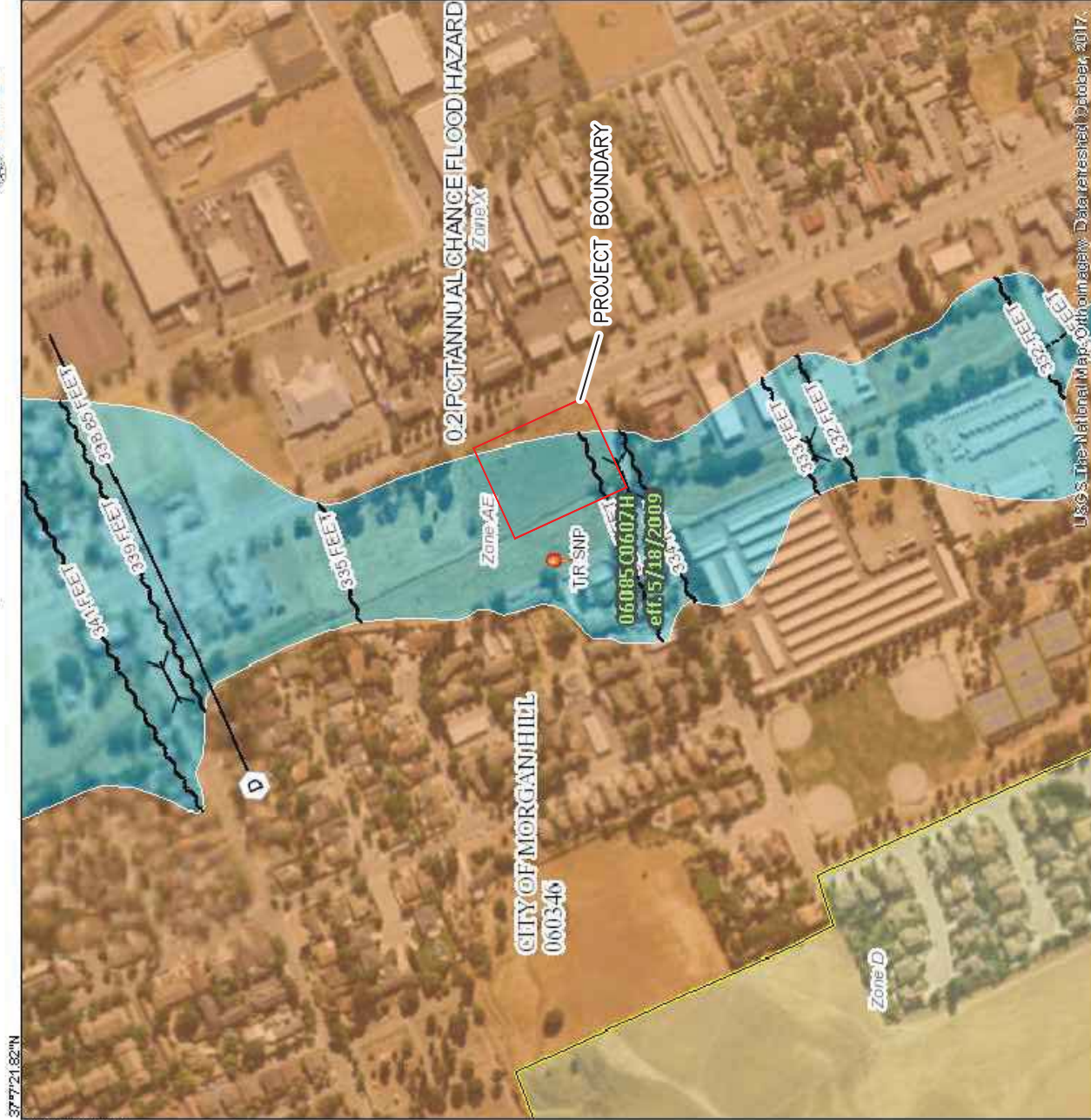


Enclosures: Figures 1 through 4
Appendix A. HEC-RAS Output Report

National Flood Hazard Layer FIRMette

121°39'11.11"W

37°42'1.82"N



USGS National Map One Imagery Data (revised October 2017)
 Feet 0 250 500 1,000 1,500 2,000
 1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INFO MAP FOR FIRM PANEL LOCATION

SPECIAL FLOOD HAZARD AREAS

- With Flood Hazard Elevation (SFE) Zone A, V, X0.5
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Areas with Reduced Flood Risk due to Levee: See Notes Zone X
- Areas with Flood Risk due to Levee Zone D

OTHER AREAS

- NO SOURCE
- Effective LOMRS Zone X
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Occasional Transient
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Occasional Transient Base Line
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/20/2019 at 1:45:24 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

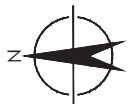
Figure 1.

FEMA FIRMette with Voices School project boundary, West Little Liagas Creek at Voices School site, City of Morgan Hill.



Balance Hydrologics, Inc.

219028 FIGURE 1.dwg 5/10/2019 15:26

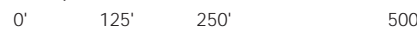


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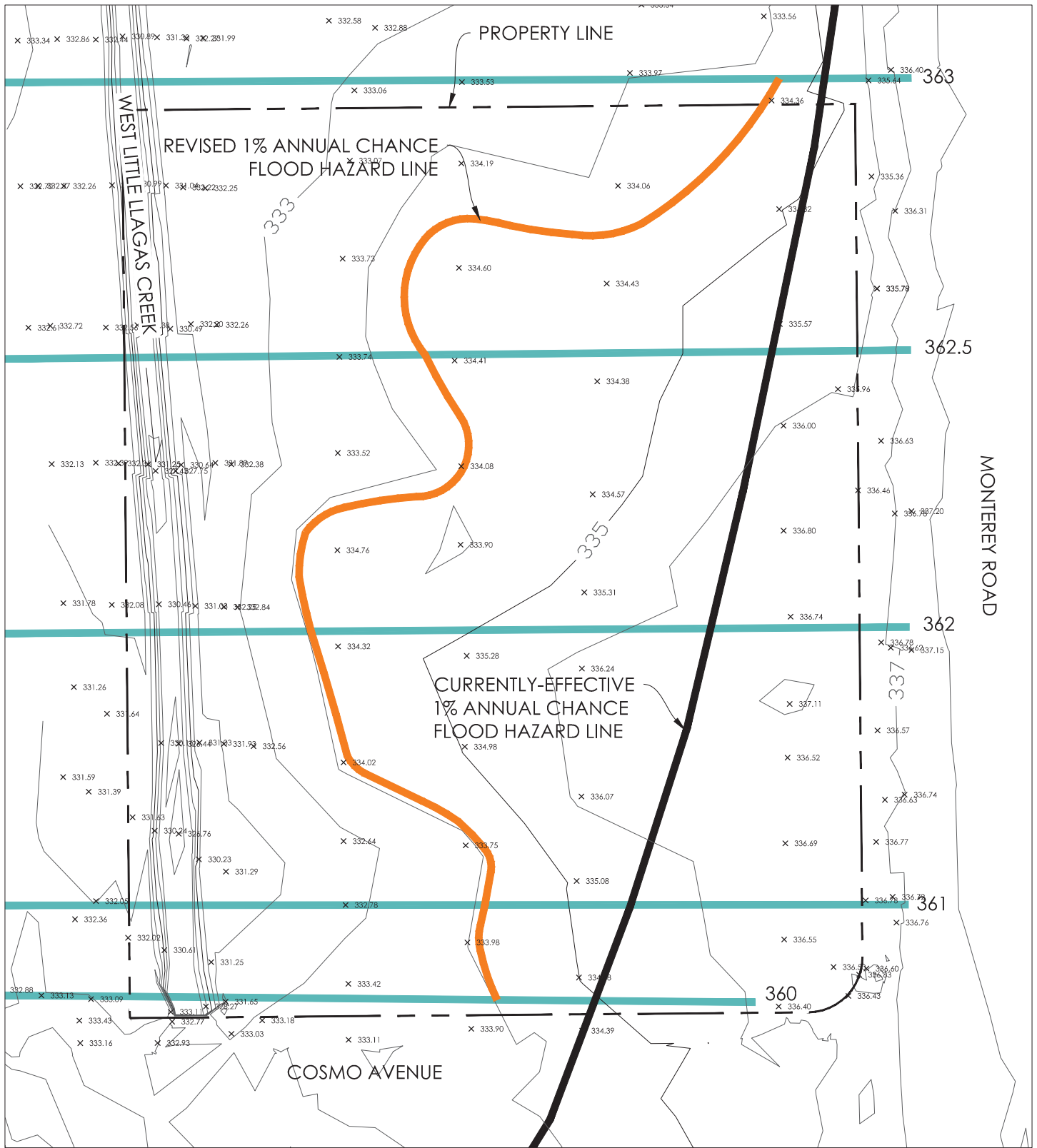
Figure 2.

Revised hydraulic model cross sections,
West Little Llagas Creek at Voices School site,
City of Morgan Hill.



SCALE: 1" = 250'





LEGEND:

- 335 — EXISTING INDEX CONTOUR
- — — EXISTING INTERMEDIATE CONTOUR
- × 335.96 EXISTING SPOT ELEVATION
- - - - - PROPERTY LINE
- 362 MODEL CROSS SECTION

- 1% ANNUAL CHANCE FLOOD HAZARD LINE (CURRENTLY-EFFECTIVE)
- 1% ANNUAL CHANCE FLOOD HAZARD LINE (REVISED)

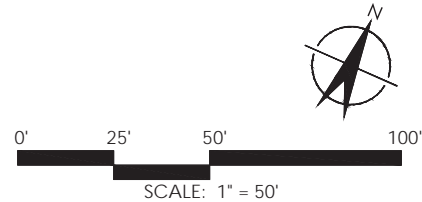


Figure 3. Currently-effective and revised Zone AE boundaries, Voices School site, City of Morgan Hill.
Existing topography data source: Bellecci and Associates



HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	478	PF 1	Rev Hist	100.00	361.15	364.93	362.88	365.11	0.003489	3.40	29.41	7.86	0.31
Reach-1	478	PF 1	Post Proj	100.00	361.15	364.93	362.88	365.11	0.003489	3.40	29.41	7.86	0.31
Reach-1	476	PF 1	Rev Hist	100.00	360.85	364.25	363.12	364.44	0.003172	3.50	28.59	14.11	0.43
Reach-1	476	PF 1	Post Proj	100.00	360.85	364.25	363.12	364.44	0.003172	3.50	28.59	14.11	0.43
Reach-1	474	PF 1	Rev Hist	100.00	357.45	359.57	359.57	360.26	0.018485	6.66	15.01	10.94	1.00
Reach-1	474	PF 1	Post Proj	100.00	357.45	359.57	359.57	360.26	0.018485	6.66	15.01	10.94	1.00
Reach-1	472	PF 1	Rev Hist	400.00	353.15	358.70		358.72	0.000199	1.26	411.49	132.96	0.13
Reach-1	472	PF 1	Post Proj	400.00	353.15	358.70		358.72	0.000199	1.26	411.49	132.96	0.13
Reach-1	470	PF 1	Rev Hist	400.00	352.85	358.57	355.03	358.63	0.000500	2.35	222.72	67.00	0.17
Reach-1	470	PF 1	Post Proj	400.00	352.85	358.57	355.03	358.63	0.000500	2.35	222.72	67.00	0.17
Reach-1	467		Bridge										
Reach-1	464	PF 1	Rev Hist	400.00	352.85	356.69	355.02	357.03	0.003057	4.72	84.70	22.15	0.43
Reach-1	464	PF 1	Post Proj	400.00	352.85	356.69	355.02	357.03	0.003057	4.72	84.70	22.15	0.43
Reach-1	462	PF 1	Rev Hist	400.00	352.05	355.94	355.94	356.28	0.005990	5.73	123.94	173.99	0.63
Reach-1	462	PF 1	Post Proj	400.00	352.05	355.94	355.94	356.28	0.005990	5.73	123.94	173.99	0.63
Reach-1	461	PF 1	Rev Hist	400.00	349.35	354.24		354.24	0.000015	0.24	2519.85	2050.23	0.03
Reach-1	461	PF 1	Post Proj	400.00	349.35	354.24		354.24	0.000015	0.24	2519.85	2050.23	0.03
Reach-1	460	PF 1	Rev Hist	400.00	349.35	354.24	353.11	354.24	0.000161	1.16	2051.06	1972.60	0.09
Reach-1	460	PF 1	Post Proj	400.00	349.35	354.24	353.11	354.24	0.000161	1.16	2051.06	1972.60	0.09
Reach-1	455		Bridge										
Reach-1	450	PF 1	Rev Hist	400.00	346.15	351.68	351.32	353.89	0.023422	11.91	33.58	6.14	0.90
Reach-1	450	PF 1	Post Proj	400.00	346.15	351.68	351.32	353.89	0.023422	11.91	33.58	6.14	0.90
Reach-1	449	PF 1	Rev Hist	500.00	346.15	353.10	348.78	353.24	0.000502	3.05	163.79	26.00	0.21
Reach-1	449	PF 1	Post Proj	500.00	346.15	353.10	348.78	353.24	0.000502	3.05	163.79	26.00	0.21
Reach-1	448	PF 1	Rev Hist	500.00	345.75	352.37	350.44	352.76	0.002189	5.08	139.01	156.00	0.46
Reach-1	448	PF 1	Post Proj	500.00	345.75	352.37	350.44	352.76	0.002189	5.08	139.01	156.00	0.46
Reach-1	446	PF 1	Rev Hist	500.00	345.05	351.27	349.62	351.68	0.002346	5.41	211.99	311.53	0.48
Reach-1	446	PF 1	Post Proj	500.00	345.05	351.27	349.62	351.68	0.002346	5.41	211.99	311.53	0.48

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	444	PF 1	Rev Hist	500.00	344.65	351.13	348.81	351.19	0.000461	2.65	548.65	495.00	0.22
Reach-1	444	PF 1	Post Proj	500.00	344.65	351.13	348.81	351.19	0.000461	2.65	548.65	495.00	0.22
Reach-1	442	PF 1	Rev Hist	500.00	344.15	351.10	348.30	351.11	0.000084	1.24	2760.37	1855.93	0.10
Reach-1	442	PF 1	Post Proj	500.00	344.15	351.10	348.30	351.11	0.000084	1.24	2760.37	1855.93	0.10
Reach-1	440.2	PF 1	Rev Hist	500.00	344.05	351.04	348.61	351.08	0.000437	2.79	693.69	348.70	0.19
Reach-1	440.2	PF 1	Post Proj	500.00	344.05	351.04	348.61	351.08	0.000437	2.79	693.69	348.70	0.19
Reach-1	440	PF 1	Rev Hist	500.00	344.05	350.24	348.61	350.90	0.010777	7.51	197.35	297.64	0.46
Reach-1	440	PF 1	Post Proj	500.00	344.05	350.24	348.61	350.90	0.010777	7.51	197.35	297.64	0.46
Reach-1	436	PF 1	Rev Hist	500.00	343.95	350.00	348.51	350.46	0.002807	6.41	222.59	242.61	0.46
Reach-1	436	PF 1	Post Proj	500.00	343.95	350.00	348.51	350.46	0.002807	6.41	222.59	242.61	0.46
Reach-1	434	PF 1	Rev Hist	500.00	343.55	350.01	347.11	350.19	0.001646	3.58	246.93	204.27	0.29
Reach-1	434	PF 1	Post Proj	500.00	343.55	350.01	347.11	350.19	0.001646	3.58	246.93	204.27	0.29
Reach-1	430.2	PF 1	Rev Hist	650.00	342.65	348.66	347.80	348.75	0.002478	3.68	532.41	305.70	0.27
Reach-1	430.2	PF 1	Post Proj	650.00	342.65	348.66	347.80	348.75	0.002478	3.68	532.41	305.70	0.27
Reach-1	430	PF 1	Rev Hist	650.00	342.65	348.67	347.97	348.74	0.006316	3.33	432.38	284.25	0.15
Reach-1	430	PF 1	Post Proj	650.00	342.65	348.67	347.97	348.74	0.006316	3.33	432.38	284.25	0.15
Reach-1	422	PF 1	Rev Hist	650.00	342.55	348.63	347.44	348.65	0.000689	1.94	1325.37	865.10	0.14
Reach-1	422	PF 1	Post Proj	650.00	342.55	348.63	347.44	348.65	0.000689	1.94	1325.37	865.10	0.14
Reach-1	420.2	PF 1	Rev Hist	700.00	341.85	348.35	347.46	348.39	0.001522	2.85	803.77	471.00	0.20
Reach-1	420.2	PF 1	Post Proj	700.00	341.85	348.35	347.46	348.39	0.001522	2.85	803.77	471.00	0.20
Reach-1	420	PF 1	Rev Hist	700.00	341.85	348.11	348.06	348.33	0.022288	5.77	343.28	404.89	0.26
Reach-1	420	PF 1	Post Proj	700.00	341.85	348.11	348.06	348.33	0.022288	5.77	343.28	404.89	0.26
Reach-1	412	PF 1	Rev Hist	700.00	340.45	348.19	346.67	348.23	0.001263	2.92	901.09	731.79	0.19
Reach-1	412	PF 1	Post Proj	700.00	340.45	348.19	346.67	348.23	0.001263	2.92	901.09	731.79	0.19
Reach-1	411	PF 1	Rev Hist	840.00	340.35	348.10	342.88	348.13	0.000226	1.65	1213.63	545.68	0.11
Reach-1	411	PF 1	Post Proj	840.00	340.35	348.10	342.88	348.13	0.000226	1.65	1213.63	545.68	0.11
Reach-1	410	PF 1	Rev Hist	840.00	339.85	348.01	346.36	348.07	0.001129	2.98	1008.82	711.98	0.18
Reach-1	410	PF 1	Post Proj	840.00	339.85	348.01	346.36	348.07	0.001129	2.98	1008.82	711.98	0.18

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	402	PF 1	Rev Hist	840.00	339.85	347.10	344.46	347.82	0.027980	8.30	277.41	360.70	0.45
Reach-1	402	PF 1	Post Proj	840.00	339.85	347.10	344.46	347.82	0.027980	8.30	277.41	360.70	0.45
Reach-1	394	PF 1	Rev Hist	900.00	338.65	345.76	344.48	345.83	0.001981	3.51	878.29	430.23	0.23
Reach-1	394	PF 1	Post Proj	900.00	338.65	345.76	344.48	345.83	0.001981	3.51	878.29	430.23	0.23
Reach-1	393		Culvert										
Reach-1	392	PF 1	Rev Hist	900.00	337.95	345.83	343.18	345.83	0.000210	0.50	1639.48	1032.49	0.08
Reach-1	392	PF 1	Post Proj	900.00	337.95	345.83	343.18	345.83	0.000210	0.50	1639.48	1032.49	0.08
Reach-1	390.2	PF 1	Rev Hist	980.00	337.35	345.74	344.65	345.76	0.000873	2.67	1979.43	1080.37	0.16
Reach-1	390.2	PF 1	Post Proj	980.00	337.35	345.74	344.65	345.76	0.000873	2.67	1979.43	1080.37	0.16
Reach-1	390	PF 1	Rev Hist	980.00	337.35	345.74	344.70	345.76	0.001641	2.20	1889.89	1061.63	0.06
Reach-1	390	PF 1	Post Proj	980.00	337.35	345.74	344.70	345.76	0.001641	2.20	1889.89	1061.63	0.06
Reach-1	384	PF 1	Rev Hist	980.00	337.15	345.05	344.61	345.46	0.007048	7.18	549.14	436.59	0.45
Reach-1	384	PF 1	Post Proj	980.00	337.15	345.05	344.61	345.46	0.007048	7.18	549.14	436.59	0.45
Reach-1	382	PF 1	Rev Hist	1094.00	336.95	343.74	342.87	344.03	0.003261	5.78	443.88	390.93	0.43
Reach-1	382	PF 1	Post Proj	1094.00	336.95	343.74	342.87	344.03	0.003261	5.78	443.88	390.93	0.43
Reach-1	380	PF 1	Rev Hist	1094.00	336.75	343.37	342.99	343.55	0.007137	5.84	579.19	475.38	0.40
Reach-1	380	PF 1	Post Proj	1094.00	336.75	343.37	342.99	343.55	0.007137	5.84	579.19	475.38	0.40
Reach-1	378		Culvert										
Reach-1	376	PF 1	Rev Hist	1094.00	333.65	341.17	339.86	341.20	0.001160	2.53	983.13	519.52	0.16
Reach-1	376	PF 1	Post Proj	1094.00	333.65	341.17	339.86	341.20	0.001160	2.53	983.13	519.52	0.16
Reach-1	374	PF 1	Rev Hist	1094.00	333.65	340.90	340.18	341.09	0.002465	4.86	431.92	298.20	0.37
Reach-1	374	PF 1	Post Proj	1094.00	333.65	340.90	340.18	341.09	0.002465	4.86	431.92	298.20	0.37
Reach-1	372	PF 1	Rev Hist	1094.00	331.75	341.01	337.72	341.01	0.000011	0.41	5004.56	1713.93	0.03
Reach-1	372	PF 1	Post Proj	1094.00	331.75	341.01	337.72	341.01	0.000011	0.41	5004.56	1713.93	0.03
Reach-1	370.2	PF 1	Rev Hist	1094.00	331.15	341.01	338.02	341.01	0.000030	0.52	3529.51	1389.36	0.03
Reach-1	370.2	PF 1	Post Proj	1094.00	331.15	341.01	338.02	341.01	0.000030	0.52	3529.51	1389.36	0.03
Reach-1	370	PF 1	Rev Hist	1094.00	331.15	340.10	340.10	340.93	0.016897	9.52	319.94	160.00	0.43

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	348	PF 1	Rev Hist	1296.00	323.91	331.81		332.00	0.001402	4.58	551.83	376.15	0.39
Reach-1	348	PF 1	Post Proj	1296.00	323.91	331.81		332.00	0.001402	4.58	551.83	376.15	0.39
Reach-1	346	PF 1	Rev Hist	1296.00	323.16	331.44		331.85	0.001960	6.53	430.98	294.95	0.47
Reach-1	346	PF 1	Post Proj	1296.00	323.16	331.44		331.85	0.001960	6.53	430.98	294.95	0.47
Reach-1	344	PF 1	Rev Hist	1296.00	322.37	330.86		331.20	0.002113	5.78	392.81	245.68	0.47
Reach-1	344	PF 1	Post Proj	1296.00	322.37	330.86		331.20	0.002113	5.78	392.81	245.68	0.47
Reach-1	342	PF 1	Rev Hist	1296.00	322.94	330.67		330.85	0.000955	4.29	513.56	252.07	0.34
Reach-1	342	PF 1	Post Proj	1296.00	322.94	330.67		330.85	0.000955	4.29	513.56	252.07	0.34
Reach-1	340	PF 1	Rev Hist	1296.00	321.74	330.62	325.77	330.76	0.000451	3.33	568.37	204.87	0.22
Reach-1	340	PF 1	Post Proj	1296.00	321.74	330.62	325.77	330.76	0.000451	3.33	568.37	204.87	0.22
Reach-1	339		Culvert										
Reach-1	338	PF 1	Rev Hist	1296.00	321.59	330.30		330.56	0.000646	4.15	350.53	148.42	0.27
Reach-1	338	PF 1	Post Proj	1296.00	321.59	330.30		330.56	0.000646	4.15	350.53	148.42	0.27
Reach-1	336	PF 1	Rev Hist	1296.00	321.92	329.86	328.64	330.34	0.002413	5.83	300.85	198.62	0.52
Reach-1	336	PF 1	Post Proj	1296.00	321.92	329.86	328.64	330.34	0.002413	5.83	300.85	198.62	0.52
Reach-1	334	PF 1	Rev Hist	1296.00	322.55	328.55	328.55	329.36	0.003602	8.26	316.77	203.52	0.65
Reach-1	334	PF 1	Post Proj	1296.00	322.55	328.55	328.55	329.36	0.003602	8.26	316.77	203.52	0.65
Reach-1	332	PF 1	Rev Hist	1296.00	320.75	326.90		327.25	0.001365	4.75	291.35	110.65	0.41
Reach-1	332	PF 1	Post Proj	1296.00	320.75	326.90		327.25	0.001365	4.75	291.35	110.65	0.41
Reach-1	330	PF 1	Rev Hist	1296.00	320.75	326.81	323.75	327.17	0.001201	4.85	266.99	44.16	0.35
Reach-1	330	PF 1	Post Proj	1296.00	320.75	326.81	323.75	327.17	0.001201	4.85	266.99	44.16	0.35
Reach-1	329		Culvert										
Reach-1	328	PF 1	Rev Hist	1296.00	318.15	326.54		326.67	0.000326	3.11	621.02	310.95	0.19
Reach-1	328	PF 1	Post Proj	1296.00	318.15	326.54		326.67	0.000326	3.11	621.02	310.95	0.19
Reach-1	326	PF 1	Rev Hist	1296.00	319.45	326.24		326.57	0.001386	4.58	282.95	69.97	0.40
Reach-1	326	PF 1	Post Proj	1296.00	319.45	326.24		326.57	0.001386	4.58	282.95	69.97	0.40
Reach-1	324	PF 1	Rev Hist	1444.00	319.45	326.16		326.29	0.000629	3.03	533.08	156.21	0.27
Reach-1	324	PF 1	Post Proj	1444.00	319.45	326.16		326.29	0.000629	3.03	533.08	156.21	0.27

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	322	PF 1	Rev Hist	1444.00	318.65	325.76	321.89	325.97	0.000572	3.62	398.46	71.46	0.27
Reach-1	322	PF 1	Post Proj	1444.00	318.65	325.76	321.89	325.97	0.000572	3.62	398.46	71.46	0.27
Reach-1	320	PF 1	Rev Hist	1444.00	318.45	325.61	321.54	325.90	0.000778	4.30	335.80	46.95	0.28
Reach-1	320	PF 1	Post Proj	1444.00	318.45	325.61	321.54	325.90	0.000778	4.30	335.80	46.95	0.28
Reach-1	319		Culvert										
Reach-1	318	PF 1	Rev Hist	1444.00	318.25	325.45	321.35	325.73	0.000765	4.28	337.53	46.97	0.28
Reach-1	318	PF 1	Post Proj	1444.00	318.25	325.45	321.35	325.73	0.000765	4.28	337.53	46.97	0.28
Reach-1	316	PF 1	Rev Hist	1444.00	318.15	325.34		325.67	0.001032	4.65	310.43	58.92	0.36
Reach-1	316	PF 1	Post Proj	1444.00	318.15	325.34		325.67	0.001032	4.65	310.43	58.92	0.36
Reach-1	314	PF 1	Rev Hist	1936.00	317.75	324.22		324.95	0.002871	7.99	352.92	117.34	0.60
Reach-1	314	PF 1	Post Proj	1936.00	317.75	324.22		324.95	0.002871	7.99	352.92	117.34	0.60
Reach-1	312	PF 1	Rev Hist	1936.00	316.55	324.24		324.51	0.000693	4.18	463.45	76.88	0.30
Reach-1	312	PF 1	Post Proj	1936.00	316.55	324.24		324.51	0.000693	4.18	463.45	76.88	0.30
Reach-1	310	PF 1	Rev Hist	1936.00	316.55	324.19	319.81	324.48	0.000698	4.35	445.13	58.38	0.28
Reach-1	310	PF 1	Post Proj	1936.00	316.55	324.19	319.81	324.48	0.000698	4.35	445.13	58.38	0.28
Reach-1	307		Culvert										
Reach-1	304	PF 1	Rev Hist	1936.00	315.95	324.11	319.20	324.37	0.000565	4.07	481.64	128.59	0.25
Reach-1	304	PF 1	Post Proj	1936.00	315.95	324.11	319.20	324.37	0.000565	4.07	481.64	128.59	0.25
Reach-1	302	PF 1	Rev Hist	1936.00	315.75	324.15	319.25	324.28	0.000595	3.02	836.72	518.48	0.21
Reach-1	302	PF 1	Post Proj	1936.00	315.75	324.15	319.25	324.28	0.000595	3.02	836.72	518.48	0.21
Reach-1	300	PF 1	Rev Hist	1936.00	315.35	324.16	320.51	324.17	0.000094	1.15	3326.94	1733.88	0.08
Reach-1	300	PF 1	Post Proj	1936.00	315.35	324.16	320.51	324.17	0.000094	1.15	3326.94	1733.88	0.08
Reach-1	298	PF 1	Rev Hist	1936.00	314.35	324.15	318.04	324.15	0.000036	0.87	4653.61	2134.79	0.05
Reach-1	298	PF 1	Post Proj	1936.00	314.35	324.15	318.04	324.15	0.000036	0.87	4653.61	2134.79	0.05
Reach-1	296	PF 1	Rev Hist	1936.00	314.25	324.12	321.06	324.13	0.000089	1.18	3584.23	2274.15	0.08
Reach-1	296	PF 1	Post Proj	1936.00	314.25	324.12	321.06	324.13	0.000089	1.18	3584.23	2274.15	0.08
Reach-1	294	PF 1	Rev Hist	1936.00	314.05	324.10	321.04	324.10	0.000033	0.76	5586.86	2951.03	0.05

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	294	PF 1	Post Proj	1936.00	314.05	324.10	321.04	324.10	0.000033	0.76	5586.86	2951.03	0.05
Reach-1	292	PF 1	Rev Hist	1936.00	314.05	324.10	319.39	324.10	0.000007	0.33	10071.37	2981.06	0.02
Reach-1	292	PF 1	Post Proj	1936.00	314.05	324.10	319.39	324.10	0.000007	0.33	10071.37	2981.06	0.02
Reach-1	290	PF 1	Rev Hist	1936.00	314.05	324.08	320.84	324.09	0.000131	1.87	3480.94	1136.28	0.10
Reach-1	290	PF 1	Post Proj	1936.00	314.05	324.08	320.84	324.09	0.000131	1.87	3480.94	1136.28	0.10
Reach-1	287		Bridge										
Reach-1	284	PF 1	Rev Hist	1936.00	314.05	324.06	324.07	324.07	0.000137	1.91	3427.30	1134.75	0.11
Reach-1	284	PF 1	Post Proj	1936.00	314.05	324.06	324.07	324.07	0.000137	1.91	3427.30	1134.75	0.11
Reach-1	282	PF 1	Rev Hist	1936.00	314.05	324.01	321.56	324.04	0.000382	2.14	1918.99	682.37	0.14
Reach-1	282	PF 1	Post Proj	1936.00	314.05	324.01	321.56	324.04	0.000382	2.14	1918.99	682.37	0.14
Reach-1	280	PF 1	Rev Hist	1936.00	314.05	323.96	320.49	324.01	0.000390	2.76	1600.70	792.40	0.15
Reach-1	280	PF 1	Post Proj	1936.00	314.05	323.96	320.49	324.01	0.000390	2.76	1600.70	792.40	0.15
Reach-1	279		Culvert										
Reach-1	278	PF 1	Rev Hist	1936.00	313.85	320.54	320.54	321.87	0.009313	10.33	253.28	96.70	0.70
Reach-1	278	PF 1	Post Proj	1936.00	313.85	320.54	320.54	321.87	0.009313	10.33	253.28	96.70	0.70
Reach-1	276	PF 1	Rev Hist	1936.00	313.75	319.87	319.87	320.18	0.005226	6.67	729.74	919.35	0.57
Reach-1	276	PF 1	Post Proj	1936.00	313.75	319.87	319.87	320.18	0.005226	6.67	729.74	919.35	0.57
Reach-1	274	PF 1	Rev Hist	1936.00	313.55	319.45	318.51	319.47	0.000502	2.07	1999.35	1424.06	0.18
Reach-1	274	PF 1	Post Proj	1936.00	313.55	319.45	318.51	319.47	0.000502	2.07	1999.35	1424.06	0.18
Reach-1	272	PF 1	Rev Hist	1936.00	313.05	319.37	317.63	319.38	0.000091	0.97	3634.07	1789.38	0.08
Reach-1	272	PF 1	Post Proj	1936.00	313.05	319.37	317.63	319.38	0.000091	0.97	3634.07	1789.38	0.08
Reach-1	270	PF 1	Rev Hist	1936.00	312.85	319.33	317.12	319.33	0.000091	1.04	3102.91	1176.65	0.08
Reach-1	270	PF 1	Post Proj	1936.00	312.85	319.33	317.12	319.33	0.000091	1.04	3102.91	1176.65	0.08
Reach-1	268	PF 1	Rev Hist	1936.00	312.55	319.30	319.31	319.31	0.000022	0.54	4640.42	1144.23	0.04
Reach-1	268	PF 1	Post Proj	1936.00	312.55	319.30	319.31	319.31	0.000022	0.54	4640.42	1144.23	0.04
Reach-1	266	PF 1	Rev Hist	1936.00	312.25	319.29	314.66	319.30	0.000020	0.48	5472.54	1926.64	0.03
Reach-1	266	PF 1	Post Proj	1936.00	312.25	319.29	314.66	319.30	0.000020	0.48	5472.54	1926.64	0.03

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	264	PF 1	Rev Hist	1936.00	311.45	319.29	319.29	319.29	0.000013	0.43	6334.32	1570.59	0.03
Reach-1	264	PF 1	Post Proj	1936.00	311.45	319.29	319.29	319.29	0.000013	0.43	6334.32	1570.59	0.03
Reach-1	262	PF 1	Rev Hist	1936.00	310.95	319.29	319.29	319.29	0.000002	0.17	15757.66	3468.10	0.01
Reach-1	262	PF 1	Post Proj	1936.00	310.95	319.29	319.29	319.29	0.000002	0.17	15757.66	3468.10	0.01
Reach-1	260	PF 1	Rev Hist	1936.00	310.75	319.23	318.56	319.28	0.000552	3.26	1830.12	2009.70	0.20
Reach-1	260	PF 1	Post Proj	1936.00	310.75	319.23	318.56	319.28	0.000552	3.26	1830.12	2009.70	0.20
Reach-1	259			Culvert									
Reach-1	258	PF 1	Rev Hist	1936.00	310.55	318.92	318.92	319.23	0.003375	6.89	943.71	2114.60	0.42
Reach-1	258	PF 1	Post Proj	1936.00	310.55	318.92	318.92	319.23	0.003375	6.89	943.71	2114.60	0.42
Reach-1	256	PF 1	Rev Hist	1936.00	310.55	315.15	315.15	315.16	0.000495	2.05	2260.61	1889.42	0.19
Reach-1	256	PF 1	Post Proj	1936.00	310.55	315.15	315.15	315.16	0.000495	2.05	2260.61	1889.42	0.19
Reach-1	254	PF 1	Rev Hist	3246.00	309.95	314.42	314.42	314.50	0.002322	4.30	1622.98	1292.57	0.42
Reach-1	254	PF 1	Post Proj	3246.00	309.95	314.42	314.42	314.50	0.002322	4.30	1622.98	1292.57	0.42
Reach-1	252	PF 1	Rev Hist	3246.00	308.65	312.93	312.93	313.07	0.004181	6.27	1427.71	1497.18	0.59
Reach-1	252	PF 1	Post Proj	3246.00	308.65	312.93	312.93	313.07	0.004181	6.27	1427.71	1497.18	0.59
Reach-1	250	PF 1	Rev Hist	3246.00	307.75	312.92	311.85	312.93	0.000512	2.49	3442.80	2505.06	0.19
Reach-1	250	PF 1	Post Proj	3246.00	307.75	312.92	311.85	312.93	0.000512	2.49	3442.80	2505.06	0.19
Reach-1	249			Bridge									
Reach-1	248	PF 1	Rev Hist	3246.00	307.75	312.80	312.80	312.84	0.001986	4.23	3157.49	2471.85	0.33
Reach-1	248	PF 1	Post Proj	3246.00	307.75	312.80	312.80	312.84	0.001986	4.23	3157.49	2471.85	0.33
Reach-1	246	PF 1	Rev Hist	3246.00	307.35	312.71	312.05	312.74	0.001427	3.10	3357.96	2346.00	0.30
Reach-1	246	PF 1	Post Proj	3246.00	307.35	312.71	312.05	312.74	0.001427	3.10	3357.96	2346.00	0.30
Reach-1	244	PF 1	Rev Hist	3246.00	306.45	312.38	311.13	312.41	0.000579	2.98	2695.62	1624.47	0.23
Reach-1	244	PF 1	Post Proj	3246.00	306.45	312.38	311.13	312.41	0.000579	2.98	2695.62	1624.47	0.23
Reach-1	242	PF 1	Rev Hist	3246.00	305.95	312.28	310.29	312.29	0.000254	2.11	3559.20	1696.84	0.16
Reach-1	242	PF 1	Post Proj	3246.00	305.95	312.28	310.29	312.29	0.000254	2.11	3559.20	1696.84	0.16
Reach-1	240	PF 1	Rev Hist	3246.00	305.35	312.21	310.04	312.22	0.000183	1.80	4831.35	2367.19	0.13
Reach-1	240	PF 1	Post Proj	3246.00	305.35	312.21	310.04	312.22	0.000183	1.80	4831.35	2367.19	0.13

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	235			Bridge									
Reach-1	230	PF 1	Rev Hist	3246.00	304.95	312.19	309.86	312.19	0.000089	0.90	6416.36	2700.00	0.08
Reach-1	230	PF 1	Post Proj	3246.00	304.95	312.19	309.86	312.19	0.000089	0.90	6416.36	2700.00	0.08
Reach-1	222	PF 1	Rev Hist	3246.00	304.45	312.15	309.68	312.16	0.000081	1.33	5747.32	1991.00	0.09
Reach-1	222	PF 1	Post Proj	3246.00	304.45	312.15	309.68	312.16	0.000081	1.33	5747.32	1991.00	0.09
Reach-1	220.2	PF 1	Rev Hist	3246.00	303.95	312.15	308.46	312.15	0.000032	0.62	8053.85	2285.59	0.04
Reach-1	220.2	PF 1	Post Proj	3246.00	303.95	312.15	308.46	312.15	0.000032	0.62	8053.85	2285.59	0.04
Reach-1	220.1			Bridge									
Reach-1	220	PF 1	Rev Hist	3246.00	303.95	312.15	308.46	312.15	0.000033	0.62	8048.69	2285.28	0.04
Reach-1	220	PF 1	Post Proj	3246.00	303.95	312.15	308.46	312.15	0.000033	0.62	8048.69	2285.28	0.04
Reach-1	214	PF 1	Rev Hist	3246.00	304.05	312.15	308.71	312.15	0.000030	0.61	8276.13	2246.50	0.04
Reach-1	214	PF 1	Post Proj	3246.00	304.05	312.15	308.71	312.15	0.000030	0.61	8276.13	2246.50	0.04
Reach-1	212	PF 1	Rev Hist	3246.00	303.75	312.15	308.57	312.15	0.000019	0.63	8221.70	2170.09	0.04
Reach-1	212	PF 1	Post Proj	3246.00	303.75	312.15	308.57	312.15	0.000019	0.63	8221.70	2170.09	0.04
Reach-1	210	PF 1	Rev Hist	3246.00	303.75	312.14	308.25	312.15	0.000015	0.55	8560.99	2065.55	0.03
Reach-1	210	PF 1	Post Proj	3246.00	303.75	312.14	308.25	312.15	0.000015	0.55	8560.99	2065.55	0.03
Reach-1	209			Bridge									
Reach-1	208	PF 1	Rev Hist	3246.00	303.75	312.14	308.25	312.14	0.000015	0.55	8560.67	2065.55	0.03
Reach-1	208	PF 1	Post Proj	3246.00	303.75	312.14	308.25	312.14	0.000015	0.55	8560.67	2065.55	0.03
Reach-1	206	PF 1	Rev Hist	3246.00	302.35	312.14	306.84	312.14	0.000009	0.46	9400.79	1737.37	0.03
Reach-1	206	PF 1	Post Proj	3246.00	302.35	312.14	306.84	312.14	0.000009	0.46	9400.79	1737.37	0.03
Reach-1	204	PF 1	Rev Hist	3246.00	301.65	312.14	305.52	312.14	0.000008	0.52	8623.49	1276.70	0.03
Reach-1	204	PF 1	Post Proj	3246.00	301.65	312.14	305.52	312.14	0.000008	0.52	8623.49	1276.70	0.03
Reach-1	202	PF 1	Rev Hist	3246.00	300.15	312.13	305.25	312.14	0.000011	0.65	6775.85	886.06	0.04
Reach-1	202	PF 1	Post Proj	3246.00	300.15	312.13	305.25	312.14	0.000011	0.65	6775.85	886.06	0.04
Reach-1	200	PF 1	Rev Hist	3246.00	299.75	310.58	306.30	311.77	0.002517	8.78	369.69	34.20	0.47
Reach-1	200	PF 1	Post Proj	3246.00	299.75	310.58	306.30	311.77	0.002517	8.78	369.69	34.20	0.47

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	Profile	Plan	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
Reach-1	199			Culvert									
Reach-1	198	PF 1	Rev Hist	3246.00	298.95	305.92	305.92	306.51	0.002803	7.88	868.18	573.70	0.53
Reach-1	198	PF 1	Post Proj	3246.00	298.95	305.92	305.92	306.51	0.002803	7.88	868.18	573.70	0.53