



# RESILIENT NEW YORK FLOOD MITIGATION INITIATIVE

Buffalo Creek, NY

This document was prepared for the New York State Department of Environmental Conservation, in cooperation with the New York State Office of General Services, Highland Planning, LLC, and Gomez & Sullivan Engineers, DPC.

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**IN NOVEMBER 2018, NEW YORK STATE GOVERNOR ANDREW CUOMO COMMITTED FUNDING TO UNDERTAKE ADVANCED MODELING TECHNIQUES AND FIELD ASSESSMENTS OF 48 FLOOD-PRONE STREAMS TO IDENTIFY PRIORITY PROJECTS AND ACTIONS TO REDUCE COMMUNITY FLOOD AND ICE JAM RISKS, WHILE IMPROVING HABITAT. THE OVERALL GOAL OF THE PROGRAM IS TO MAKE NEW YORK STATE MORE RESILIENT TO FUTURE FLOODING.**

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## ABBREVIATIONS/ACRONYMS

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1-D	1-Dimensional
2-D	2-Dimensional
ACE	Annual Chance Exceedance
CFA	Consolidated Funding Applications
CFS	Cubic Feet per Second (ft <sup>3</sup> /s)
CMIP5	5th Phase of the Coupled Model Intercomparison Project
CRISSP	Comprehensive River Ice Simulation System
CRRA	Community Risk and Resiliency Act
CSC	Climate Smart Communities
CWSRF	Clean Water State Revolving Fund
DEM	Digital Elevation Model
DHS	Department of Homeland Security
ECSWCD	Erie County Soil and Water Conservation District
EPA	Environmental Protection Agency
EPG	Engineering Planning Grant
ESD	Empire State Development Corporation
EWP	Emergency Watershed Protection
FDD	Freezing Degree-Day
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FT	Feet
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HEC	Hydrologic Engineering Center
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HMA	Hazard Mitigation Assistance
HSGP	Homeland Security Grant Program
LiDAR	Light Detection and Ranging
NAD 27	North American Datum of 1927
NAVD 88	North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NRCS	Natural Resources Conservation Service

NYSDEC	New York State Department of Environmental Conservation
NYS DHSES	New York State Division of Homeland Security and Emergency Services
NYS DOT	New York State Department of Transportation
NYSEFC	New York State Environmental Facilities Corporation
NYSOEM	New York State Office of Emergency Management
NYSOGS	New York State Office of General Services
OBG	OBG, Part of Ramboll
PDM	Pre-Disaster Mitigation
R <sub>C</sub>	Circularity Ratio
RCP	Representative Concentration Pathways
R <sub>E</sub>	Elongation Ratio
R <sub>F</sub>	Form Factor
RF	Radio Frequency
RL	Repetitive Loss
ROM	Rough Order of Magnitude
SQ MI	Square Miles (mi <sup>2</sup> )
SMS	Surface Modeling System
SRL	Severe Repetitive Loss
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Service
USSCS	United States Soil Conservation Service
WCRP	World Climate Research Programme
WGCM	Working Group Coupled Modelling
WQIP	Water Quality Improvement Project
WRI	Water Resources Investigations

## INTRODUCTION

### HISTORICAL INITIATIVES

Flood mitigation has historically been an initiative in western New York and in the Buffalo Creek watershed. In response to periodic and repetitive flood losses along Buffalo Creek, the U.S. Congress authorized a program of farmland treatment, retirement, and reforestation of sub-marginal land for the Buffalo Creek watershed. The program was in effect from 1946 to 1963 and was designed to reduce runoff and erosion from farms and stabilize channel banks. The principal conservation measures applied to the channel banks were bank protection, channel improvement, levees, and water control structures in the Towns of Elma and West Seneca. This also included bank protection by the United States Soil Conservation Service (USSCS) on both banks of Buffalo Creek beginning upstream of the Lexington Green neighborhood and extending to the confluence with Cayuga Creek.

In the summer of 1963, Erie County excavated a channel in the rock channel bottom of Buffalo Creek upstream of the Winspear Road bridge. The excavated channel was approximately 18-feet wide, 800-feet long, and varied in depth from 1.5 to 6 feet. The excavated channel was designed to concentrate flow into the narrow channel and reduce the amount of ice that can form (USACE 1966). Numerous studies were conducted from 1966 to 1992 to assess the feasibility of flood control projects in Buffalo Creek in the Town of West Seneca. Each assessment concluded either that the proposed project did not warrant federal participation or that the economic benefit to the community did not outweigh the project cost (USACE 2016a).

In response to recent flooding in 2014, residents and homeowners petitioned local leaders and state/federal agencies for assistance. In the Lexington Green neighborhood in West Seneca, for example, homeowners used sandbags along the channel banks in an effort to prevent flood waters from reaching their homes. Additionally, local interest groups constructed a temporary levee (using recycled concrete) downstream of another levee in the upstream portion of the neighborhood to prevent future flood losses. Neither of the levees are accredited by the Federal Emergency Management Agency (FEMA), meaning flood insurance is still required for homes that reside within the FEMA 100-year flood zone. As a result of the flood issues in this area, the United States Army Corps of Engineers (USACE) completed an initial determination report that evaluated the eligibility with proceeding to a feasibility study investigation for the Lexington Green neighborhood in February of 2016, which would have recommended a cost-effective flood mitigation plan. It was concluded in the initial determination report that project costs would be greater than the economic benefits achieved, and the study was never pursued (USACE 2016a).

### FLOODPLAIN DEVELOPMENT

General recommendations for high risk floodplain development follow three basic strategies:

1. Remove the flood prone facilities from the floodplain.
2. Adapt the facilities to be flood resilient under repetitive inundation scenarios.
3. Develop nature-based mitigation measures (e.g., floodplain benches, constructed wetlands, etc.) and right size bridges and culverts to lower flood stages in effected areas.

In order to effectively mitigate flooding along substantial lengths of a watercourse corridor, floodplain management should restrict the encroachment on natural floodplain areas. Floodplains act to convey floodwaters downstream, mitigate damaging velocities, and provide areas for sediment to accumulate



safely. The reduction in floodplain width of one reach of a stream often leads to the increase in flooding upstream or downstream. During a flood event, a finite amount of water with an unchanging volume must be conveyed and, as certain conveyance areas are encroached upon, floodwaters will often expand into other sensitive areas.

A critical evaluation of existing floodplain law and policies should be undertaken to evaluate the effectiveness of current practices and requirements. Local floodplain regulations should be consistent with the National Flood Insurance Program (NFIP) and FEMA regulations and should involve a floodplain coordinator and a site plan review process for all proposed developments. This review should determine if the proposed development could impact the floodplain or floodway and should not allow any fill in the floodplain or floodway of any watercourse.

### **RESILIENT NY INITIATIVE**

In November of 2018, New York State Governor Andrew Cuomo announced the Resilient NY Initiative in response to devastating flooding in communities across the State in the preceding years. High-priority watersheds were selected based on several factors, such as frequency and severity of flooding and ice jams, extent of previous flood damage, and susceptibility to future flooding and ice jam formations (NYSGPO 2018). The Buffalo Creek watershed was chosen as a study site for this initiative.

The New York State Department of Environmental Conservation and Office of General Services implemented the studies. High-priority watersheds were selected based on several factors, such as frequency and severity of flooding and ice jams, extent of previous flood damage, and susceptibility to future flooding and ice jam formations (NYSGPO 2018).

The Resilient NY flood studies identified the causes of flooding within each watershed and developed, evaluated, and recommended effective and ecologically sustainable flood and ice-jam hazard mitigation projects. Proposed flood mitigation measures were identified and evaluated using hydrologic and hydraulic modeling to quantitatively determine flood mitigation recommendations that would result in the greatest flood reductions benefits. In addition, the flood mitigation studies incorporated the latest climate change forecasts and assessed ice jam hazards where jams have been identified as a threat to public health and safety.

The goals of the Resilient NY Initiative are to:

1. Perform comprehensive flood and ice jam studies to identify known and potential flood risks in flood-prone watersheds.
2. Incorporate climate change predictions into future flood models.
3. Develop and evaluate flood hazard mitigation alternatives for each flood-prone stream area with a focus on ice-jam hazards.

The overarching purpose of the initiative is to recommend a suite of flood and ice jam mitigation projects that local municipalities can undertake to make their community more resilient to future floods. The projects should be affordable, attainable through grant funding programs, able to be implemented either individually or in combination in phases over the course of several years, achieve measurable improvement at the completion of each phase, and fit with the community way of life.

The flood mitigation and resiliency study for Buffalo Creek began in March of 2019 and is planned to be completed in early 2020.

## DATA COLLECTION

### INITIAL DATA COLLECTION

Hydrological and meteorological data were obtained from readily available state and federal government databases, including ortho-imagery, flood zone maps, streamflow, precipitation, flooding and ice jam reports. Historical flood reports, newspaper articles, social media posts, community engagement meeting notes, and geographic information system (GIS) mapping were used to identify stakeholder concerns, produce watershed maps, and identify current high-risk areas. United States Geologic Service (USGS) *FutureFlow* Explorer v1.5 (Burns et al. 2015) and *StreamStats* v4.3.1 (Ries et al. 2017) software were used to develop current and future potential discharges and bankfull widths and depths at various points along the stream channel. Hydrologic and hydraulic (H&H) modeling was performed previously, as part of a FEMA Flood Insurance Study (FIS) using USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS) to predict water stage at potential future high-risk areas and evaluate the effectiveness of flood mitigation strategies. These studies were obtained and used, all or in part, as part of this effort. Appendix A is a summary listing of data and reports collected.

### PUBLIC OUTREACH

An initial project kickoff meeting was held on May 1, 2019, with representatives of the New York State Department of Environmental Conservation (NYSDEC), New York State Office of General Services (NYSOGS), OBG, Part of Ramboll (OBG), Gomez & Sullivan Engineers, Highland Planning, LLC, Town of West Seneca, Town of Elma, Erie County Soil and Water Conservation District (SWCD), USACE, Buffalo-Niagara Waterkeepers, and applicable local residents (Appendix D). Discussions included a variety of topics, including:

- Firsthand accounts of past flooding events
- Identification of specific areas that flooded in each community, and the extent and severity of flood damage
- Information on post-flood efforts, such as temporary floodwalls

This outreach effort assisted in the identification of current high-risk areas to focus on during the flood risk assessment tasks.

### FIELD ASSESSMENT

Following the initial data gathering and agency meetings, field staff from OBG and Gomez and Sullivan undertook field data collection efforts with special attention given to high-risk areas in the Towns of West Seneca and Elma as identified in the initial data collection process. Initial field assessments of Buffalo Creek were conducted in May 2019. Information collected during field investigations included the following:

- Rapid "windshield" river corridor inspection
- Photo documentation of inspected areas
- Measurement and rapid hydraulic assessment of bridges, culverts, and dams
- Geomorphic classification and assessment, including measurement of bankfull channel widths and depths at key cross sections
- Field identification of potential flood storage areas

- Wolman pebble counts
- Characterization of key bank failures, head cuts, bed erosion, aggradation areas, and other unstable channel features
- Preliminary identification of potential flood hazard mitigation alternatives, including those requiring further analysis

Included in Appendix B is a copy of the Stream Channel Classification Form, Field Observation Form for the inspection of bridges and culverts, and Wolman Pebble Count Form, as well as a location map of where field work was completed. Appendix C is a photo log of select locations within the river corridor. The collected field data was categorized, summarized, indexed, and geographically located within a GIS database. This GIS database will be made available to the NYSDEC and NYSOGS upon completion of the project.

All references to “right bank” and “left bank” in this report refer to “river right” and “river left,” meaning the orientation assumes that the reader is standing in the river looking downstream.

## WATERSHED CHARACTERISTICS

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### STUDY AREA

The Buffalo Creek watershed lies primarily within Erie County, NY, but a portion of the upper basin is located in Wyoming County as well (Figure 1). The creek flows in a general west/northwest direction. The headwaters are in the Town of Sardinia, then the creek flows through the Towns of Holland, Java, Sheldon, Wales, Marilla, Elma, and West Seneca until it reaches the confluence of Cayuga Creek. Of the tributaries that form the Buffalo River watershed, Buffalo Creek has the largest drainage area, with the other two major tributaries being Cayuga and Cazenovia Creeks (USACE 1966). Within the Buffalo Creek watershed, the Towns of Elma to West Seneca were chosen as target areas due to their historical flood records and the hydrologic conditions of the creek in these areas. Figures 2-1 and 2-2 depict the stream stationing along Buffalo Creek in Erie County, NY, and the study area in the Towns of Elma to West Seneca, NY, respectively.

### WATERSHED LAND USE

The Buffalo Creek stream corridor is largely comprised of cultivated (44%) and forested lands (39%) within the upper basin, and similarly through the middle reaches. As the creek approaches the confluence with Cayuga Creek, the corridor is comprised of developed land, with heavily developed land in the lower reaches due to the close proximity of the study area to the City of Buffalo (Yang et al. 2018).

### GEOMORPHOLOGY

The floodplain is relatively narrow and well defined with shale outcrops in several locations in the steep valley walls which run along the creek for almost its entire length. There are exposed rock formations in the channel bottom at several of the bridges crossing the creek. Through the study area, Buffalo Creek has a relatively steep average slope of 14 feet per mile (USACE 1966).

Figure 3 is a profile of the Buffalo Creek streambed elevation versus channel distance from the confluence with Cayuga Creek to its headwaters developed by interpolating values from the FEMA FIS flood profile data (FEMA 2019b). Buffalo Creek has an average slope of 0.27% over the profile stream length of 18.7 miles. The slope is relatively consistent and flat through this reach of Buffalo Creek. The creek's streambed lowers approximately 262 vertical feet over this reach from an elevation of 835 feet above sea level (NAVD 88) at the limit of the detailed study (near the border of East Aurora, NY), to 573 feet above sea level at the confluence of Buffalo Creek and Cayuga Creek (in West Seneca, NY).

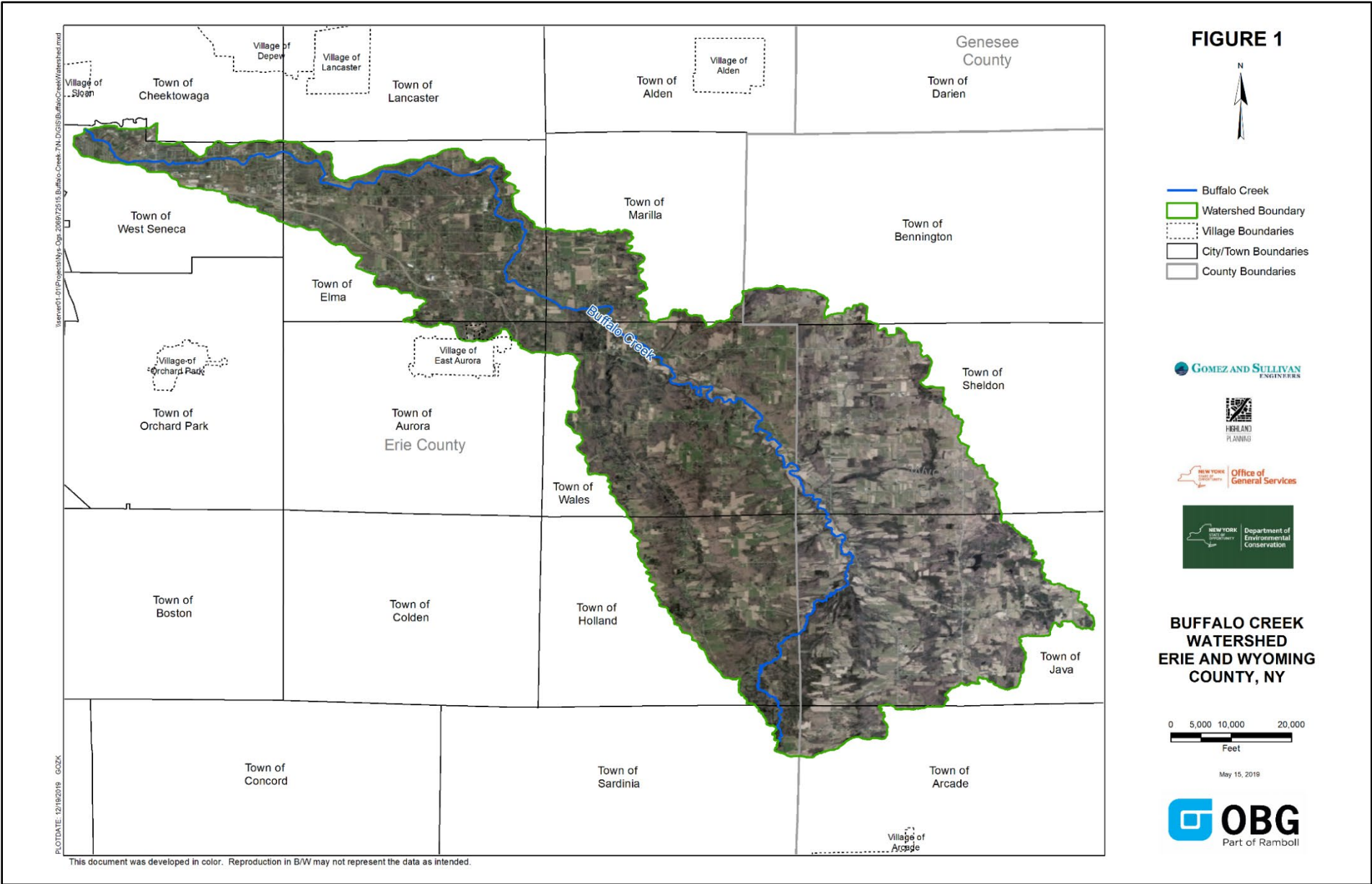






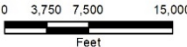
FIGURE 2-1



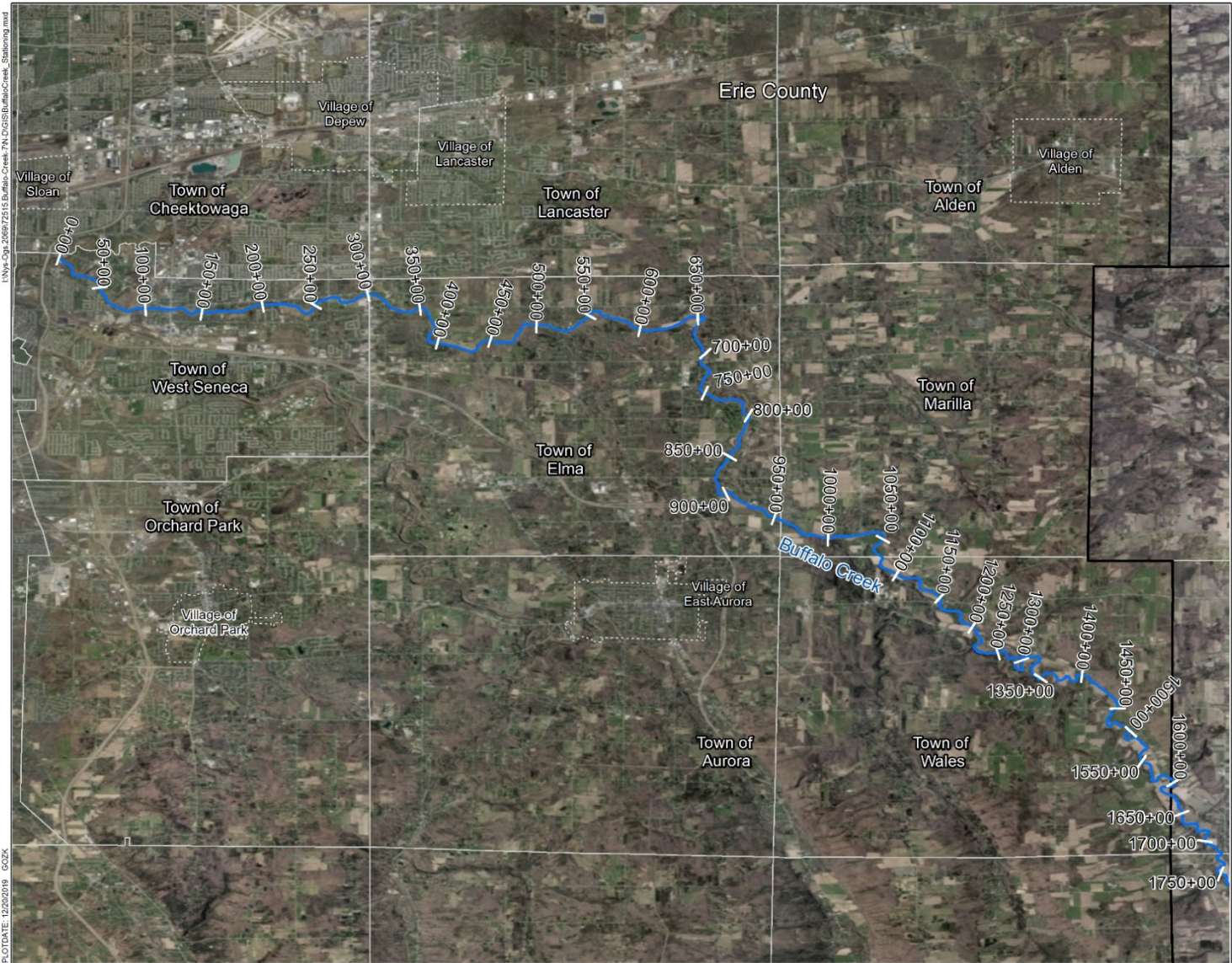
-  Buffalo Creek
-  Village Boundaries
-  City/Town Boundaries
-  County Boundaries



**BUFFALO CREEK STATIONING**  
**ERIE COUNTY, NY**



May 15, 2019



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FIGURE 2-2



-  Buffalo Creek
-  Village Boundaries
-  City/Town Boundaries
-  County Boundaries

GOMEZ AND SULLIVAN ENGINEERS

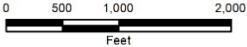


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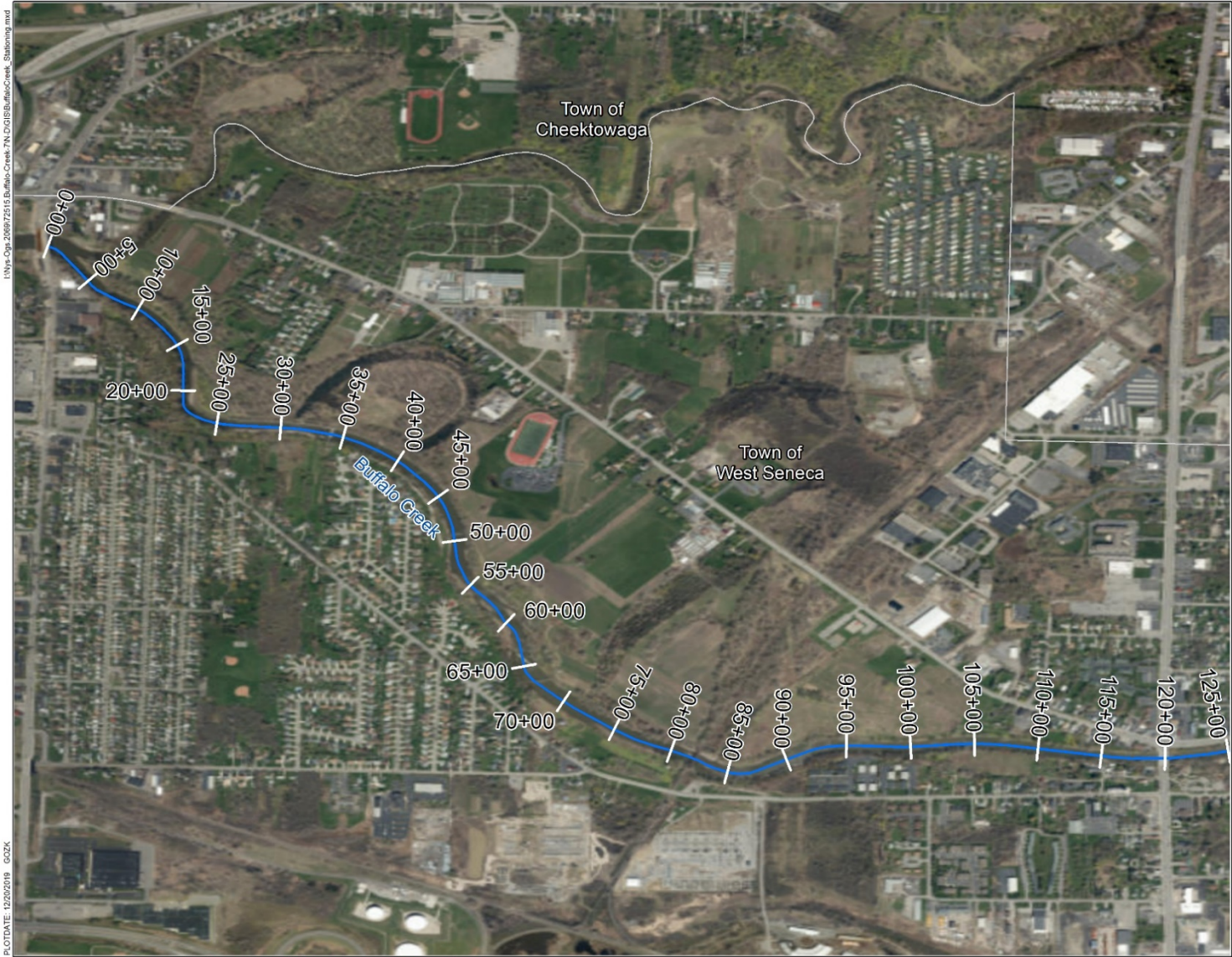


**BUFFALO CREEK STUDY AREA STATIONING**

ERIE COUNTY, NY



May 15, 2019



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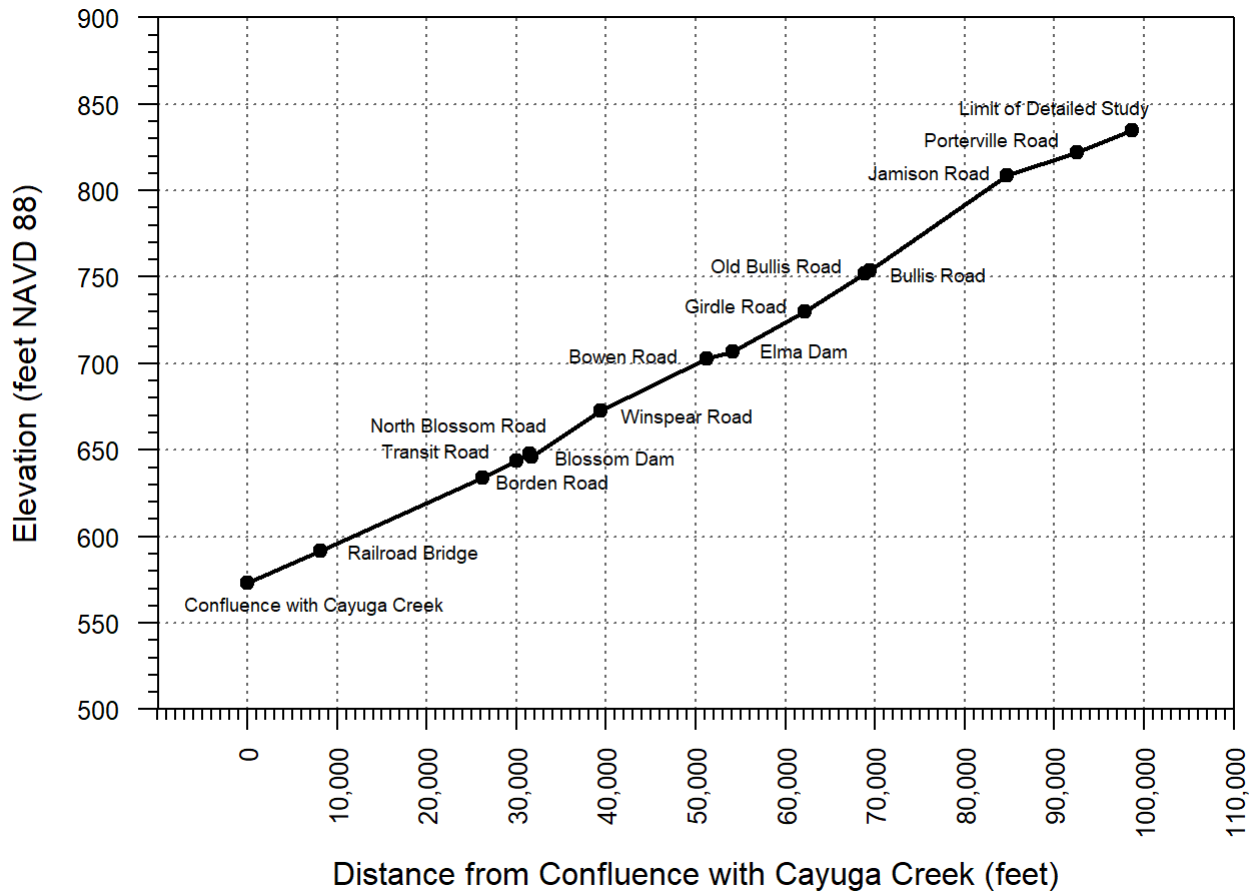


Figure 4. Buffalo Creek profile. River stationing and elevation data were interpolated from the FEMA FIS flood profiles (FEMA 2019b).

**HYDROLOGY**

Buffalo Creek forms a fan-shaped tributary area in Wyoming County near the Town of Java on the north slope of the Alleghany Plateau. Numerous source tributaries join the main stream channel as the creek flows in a general northwest direction to the confluence with Cayuga Creek. The largest tributary of Buffalo Creek is Hunter Creek, which joins the creek from the southwest at Wales Center, NY (USACE 1966).

The watershed is long and narrow with a total drainage area of approximately 150 square miles along a 43-mile stream length from the source to the confluence with Cayuga Creek. After the confluence with Cayuga Creek, Buffalo Creek continues to flow westward another two miles to the confluence with Cazenovia Creek, and an additional six miles as the Buffalo River to its mouth at Lake Erie (USACE 1966).

Table 1 is a summary of the basin characteristic formulas and calculated values for the Buffalo Creek watershed, where  $A$  is the drainage area of the basin in square miles,  $B_L$  is the basin length in miles, and  $B_P$  is the basin parameter in miles.



**Table 1. Buffalo Creek Basin Characteristics Factors**

<b>(Source: USGS 1978)</b>		
<b>Factor</b>	<b>Formula</b>	<b>Value</b>
<b>Form Factor (R<sub>F</sub>)</b>	$A / B_L^2$	0.17
<b>Circularity Ratio (R<sub>C</sub>)</b>	$4 * \pi * A / B_p^2$	0.14
<b>Elongation Ratio (R<sub>E</sub>)</b>	$2 * (A / \pi)^{0.5} / B_L$	0.47

Form Factor (R<sub>F</sub>) describes the shape of the basin (e.g., circular or elongated) and the intensity of peak discharges over a given duration of time. Circularity Ratio (R<sub>C</sub>) gives an indication of topography where the higher the circularity ratio, the lower the relief and less disturbance to drainage systems by structures within the channel. Elongation Ratio (R<sub>E</sub>) gives an indication of ground slope where values less than 0.7 correlate to steeper ground slopes and elongated basin shapes. Based on the basin characteristics factors, the Buffalo Creek watershed can be characterized as an elongated basin with lower peak discharges of longer durations, high relief topography with structural controls on drainage, and steep ground slopes (Waikar and Nilawar 2014).

There are two USGS stream gaging stations on Buffalo Creek, USGS 04214500 at Gardenville, NY and USGS 04214400 near Wales Hollow, NY (Figure 4). The USGS Gage 04214500 at Gardenville, NY was used as the representative hydrologic dataset due to the robustness of the data collected at this site, and the extended time period over which the data was collected. The gage station at Gardenville provided the hydrologic data used by FEMA to develop regional drainage area/mean annual discharge curves for areas along Buffalo Creek (USGS 2019). An effective FEMA FIS for Erie County was issued on June 7, 2019 and included drainage area and discharge information for Buffalo Creek. Table 2 lists the FEMA FIS drainage area and peak discharges, in cubic feet per second, for various locations along Buffalo Creek (FEMA 2019b).

Table 2. Buffalo Creek FEMA FIS Peak Discharges

<b>(Source: FEMA 2019b)</b>						
<b>Location</b>	<b>Drainage Area (sq. mi.)</b>	<b>River Station (ft)</b>	<b>Peak Discharges (cfs)</b>			
			<b>10-Percent</b>	<b>2-Percent</b>	<b>1-Percent</b>	<b>0.2-Percent</b>
<b>Upstream of Confluence of Cayuga Creek</b>	146.0	0+00	*	*	16,000	*
<b>Approximately 100 ft downstream of towns of Elma, Marilla corporate limit</b>	106.0	952+00	9,200	12,000	13,100	15,800
<b>Approximately 1,300 ft upstream of towns of Elma, Marilla corporate limit</b>	104.0	966+00	9,000	11,700	12,800	15,400
<b>Approximately 5,050 ft upstream of towns of Elma, Marilla corporate limit</b>	102.0	1003+50	8,900	11,500	12,600	15,200
<b>Approximately 400 ft upstream of towns of Marilla, Wales corporate limit</b>	100.0	1079+00	8,700	11,400	12,400	14,900
<b>At Strykersville Road</b>	81.0	1209+00	7,300	9,600	10,500	12,700
<b>Approximately 300 ft upstream of confluence with Stony Bottom Creek</b>	74.0	1214+00	6,800	8,900	9,800	11,800
<b>Upstream limit of study</b>	57.0	1595+00	5,500	7,200	8,000	9,700
* Data not available						

The FEMA FIS peak discharges were determined in accordance with Water Resources Investigations (WRI) 79-83 methodology using the Buffalo River ungaged sites on gaged streams equation:

$$Q = K(DA)^x(ST + 10)^{-Y}$$

where Q is the stream discharge;

DA is the drainage area;

ST is the percent of total drainage area stored in lakes, ponds and swamps; and

K, x and y are variables associated with frequency.

For Buffalo Creek, a value of 49,900 was used for K; a value of 0.733 was used for x; and a value of 2.03 was used for y. Calculated peak discharges were then adjusted using regression equations calculated at the gage station at Gardenville (FEMA 2019b).

For this study, the USGS *StreamStats* software was used to calculate the peak discharges for Buffalo Creek. The *StreamStats* application was selected due to the fact that the program uses regionally specific full regression equations developed by the USGS to estimate streamflow statistics that take into account multiple basin characteristics, including drainage area, main channel slope, and mean annual precipitation. These additional characteristics increase accuracy and decrease standard errors by approximately 10% for a 100-year recurrence interval discharge when compared to the drainage-area only regression equation (Lumia et al. 2006; Ries et al. 2017).

The *StreamStats* application uses a more modern approach with site specific data to calculate peak discharges, while the FEMA FIS discharge calculations use equations developed in the 1970's for ungaged streams on the Buffalo River. Buffalo Creek has had a USGS gage collecting streamflow data continuously since 1939 (USGS 2019). Table 3 is the summary output of peak discharges calculated by the USGS *StreamStats* software for Buffalo Creek at the same locations as the FEMA FIS peak discharges.

In addition, *StreamStats* calculates bankfull statistics by using stream survey data and discharge records from 281 cross-sections at 82 streamflow-gaging stations in a linear regression analyses to relate drainage area to bankfull discharge and bankfull-channel width, depth, and cross-sectional area for streams across New York State. This regionally specific model of calculating bankfull statistics was determined to be more accurate when compared to a statewide (or pooled) model (Mulvihill et al. 2009).

Table 3. USGS StreamStats Peak Discharge for Buffalo Creek at the FEMA FIS Locations

Source: (Ries et al. 2017)						
Location	Drainage Area (sq. mi.)	River Station (ft)	Peak Discharges (cfs)			
			10-Percent	2-Percent	1-Percent	0.2-Percent
Upstream of Confluence of Cayuga Creek	146.0	0+00	7,990	11,800	13,600	18,000
Approximately 100 ft downstream of towns of Elma, Marilla corporate limit	111.0	952+00	7,130	10,700	12,400	16,500
Approximately 1,300 ft upstream of towns of Elma, Marilla corporate limit	110.0	966+00	7,060	10,600	12,300	16,400
Approximately 5,050 ft upstream of towns of Elma, Marilla corporate limit	107.0	1003+50	6,980	10,500	12,100	16,200
Approximately 400 ft upstream of towns of Marilla, Wales corporate limit	106.0	1079+00	6,990	10,600	12,200	16,300
At Strykersville Road	85.7	1209+00	6,100	9,300	10,800	14,500
Approximately 300 ft upstream of confluence with Stony Bottom Creek	78.7	1214+00	5,630	8,580	9,920	13,400
Upstream limit of study	55.6	1595+00	5,200	8,160	9,530	13,100

The bankfull width and depth of Buffalo Creek is important in understanding the distribution of available energy within the channel and the ability of various discharges occurring within the channel to erode, deposit, and move sediment (Rosgen and Silvey 1996). Table 4 lists the estimated bankfull discharge, width, and depth at select locations along Buffalo Creek as derived from the USGS *StreamStats* program (Ries et al. 2017).

Table 4. Estimated Bankfull Discharge, Width, and Depth

<b>(Source: Ries et al. 2017)</b>					
<b>Location</b>	<b>River Station (ft)</b>	<b>Watershed Area (sq. mi.)</b>	<b>Discharge (cfs)</b>	<b>Bankfull Width (ft)</b>	<b>Bankfull Depth (ft)</b>
<b>Railroad</b>	81+50	146	3,190	136	3.51
<b>USGS Gage 04214500</b>	110+00	142	3,120	135	3.48
<b>Transit Road</b>	300+00	137	3,020	133	3.45
<b>Bowen Rd Bridge</b>	512+00	130	2,890	130	3.41
<b>Girdle Road Bridge</b>	621+00	121	2,720	126	3.35
<b>Porterville Rd Bridge</b>	924+00	111	2,530	122	3.28

## INFRASTRUCTURE

There are numerous dams along Buffalo Creek and its tributaries that interact with the flow of the creek. Of the seven dams along Buffalo Creek, four are purposed as “other,” while two are irrigation dams, and one dam is hydroelectric. Only the Rowley Dam, located in the Town of Elma upstream of the Elma Village Green, has a hazard rating of Class A or “low hazard” dam. The remaining dams along Buffalo Creek are classified as “negligible or no hazard” dams (NYSDEC 2019b).

Major bridge crossings over Buffalo Creek include Routes 20, 20A, 78, and 277 in the Towns of Wales, Marilla, Elma, and West Seneca. In the Town of West Seneca, an abandoned railroad bridge (downstream of Union Road), and its associated topography restricts the stream channel and creates an impediment to flow, especially during the winter months, leading to numerous reported ice jams. Bridge lengths and surface widths for New York State Department of Transportation (NYSDOT) bridges were revised as of February 2019. Table 5 summarizes the NYSDOT bridge data for bridges that cross Buffalo Creek in both Erie and Wyoming Counties with bankfull widths from the USGS *StreamStats* program (NYSDOT 2016; Ries et al. 2017).

Table 5. Summary of NYSDOT Bridges Crossing Buffalo Creek

Source: (NYSDOT 2016; Ries et al. 2017, FEMA 2019b)

County Name	Roadway Carried	River Station (ft)	NYSDOT Bin	Bridge Length (ft)	Width (ft)	Bankfull Width (ft)	Hydraulic Capacity (% Annual Chance)
Erie	Route 277	119+00	1044250	127	68.2	135	1 *only available data
Erie	Borden Road	262+00	3327020	162	40.4	133	1 *only available data
Erie	Route 20	300+00	1015540	198	68.9	133	Insufficient for all storms
Erie	North Blossom Road	314+00	3327240	148	24	132	1
Erie	Winspear Road	394+00	3327250	134	28	132	0.2
Erie	Bowen Road	512+00	3327100	124	34	130	0.2
Erie	Girdle Road	621+00	3327310	220	30	126	0.2
Erie	Bullis Road	689+00	3327260	524	28	126	0.2
Erie	Old Bullis Road	694+00	2260680	128	21.4	126	1
Erie	Jamison Road	847+00	1048310	174	28.7	123	0.2
Erie	Porterville Road	924+00	3327900	225	41	122	2
Erie	Two Rod Road	997+00	3328290	300	29.5	120	Not included in 2019 Erie County FEMA FIS
Erie	Route 20a	1064+00	1016100	106	44	119	0.2
Erie	Route 78	1111+00	1030180	163	40	109	0.2
Erie	Merlau Road	1187+00	3328150	155	29	104	0.2
Erie	East Creek Road	1304+00	3328210	155	30	102	0.2
Erie	Centerline Road	1349+00	3328200	100	28.1	101	Not included in 2019 Erie County FEMA FIS

**Table 5. Summary of NYSDOT Bridges Crossing Buffalo Creek**

Source: (NYSDOT 2016; Ries et al. 2017, FEMA 2019b)

County Name	Roadway Carried	River Station (ft)	NYSDOT Bin	Bridge Length (ft)	Width (ft)	Bankfull Width (ft)	Hydraulic Capacity (% Annual Chance)
Erie	Chester Road	1565+00	3328160	97	13.7	91	Not included in 2019 Erie County FEMA FIS
Wyoming	Factory Road	1654+00	3320180	97	23	86	Not included in 2019 Erie County FEMA FIS
Wyoming	Sanders Road	1695+00	3320190	83	28	84	Not included in 2019 Erie County FEMA FIS
Wyoming	Holland Road	1815+00	3319930	84	38	79	Not included in 2019 Erie County FEMA FIS
Wyoming	Sheehe Road	1883+00	3319900	40	22.3	47	Not included in 2019 Erie County FEMA FIS

Bankfull widths were derived from the USGS *StreamStats* software for bridge crossing locations that were considered high risk for potentially being constriction points based on the FEMA Flood Insurance Rate Maps (FIRMs). Table 5 indicates that in Erie County, NY, the Bowen Road, Route 277 (Union Road), Route 20a, and Centerline Road bridges in the Towns of Elma, West Seneca, and Wales respectively, are not wide enough to span the bankfull width of Buffalo Creek. According to the USACE Flood Plain Information, Buffalo Creek, NY report, in March of 1962, flooding occurred causing property damages to twelve residential, three commercial, and four public units along Bowen Road after high discharges from the Elma Dam combined with an ice jam on Buffalo Creek in the vicinity of Bowen Road (USACE 1966). Figure 4 displays the locations of the high and low-risk constriction point bridges that cross Buffalo Creek in Erie County, NY.

FIGURE 4

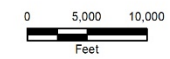


- Buffalo Creek
- ▲ High-Risk Constriction Point Bridges
- ▲ Low-Risk Constriction Point Bridges
- USGS Gages
- Village Boundaries
- City/Town Boundaries
- County Boundaries

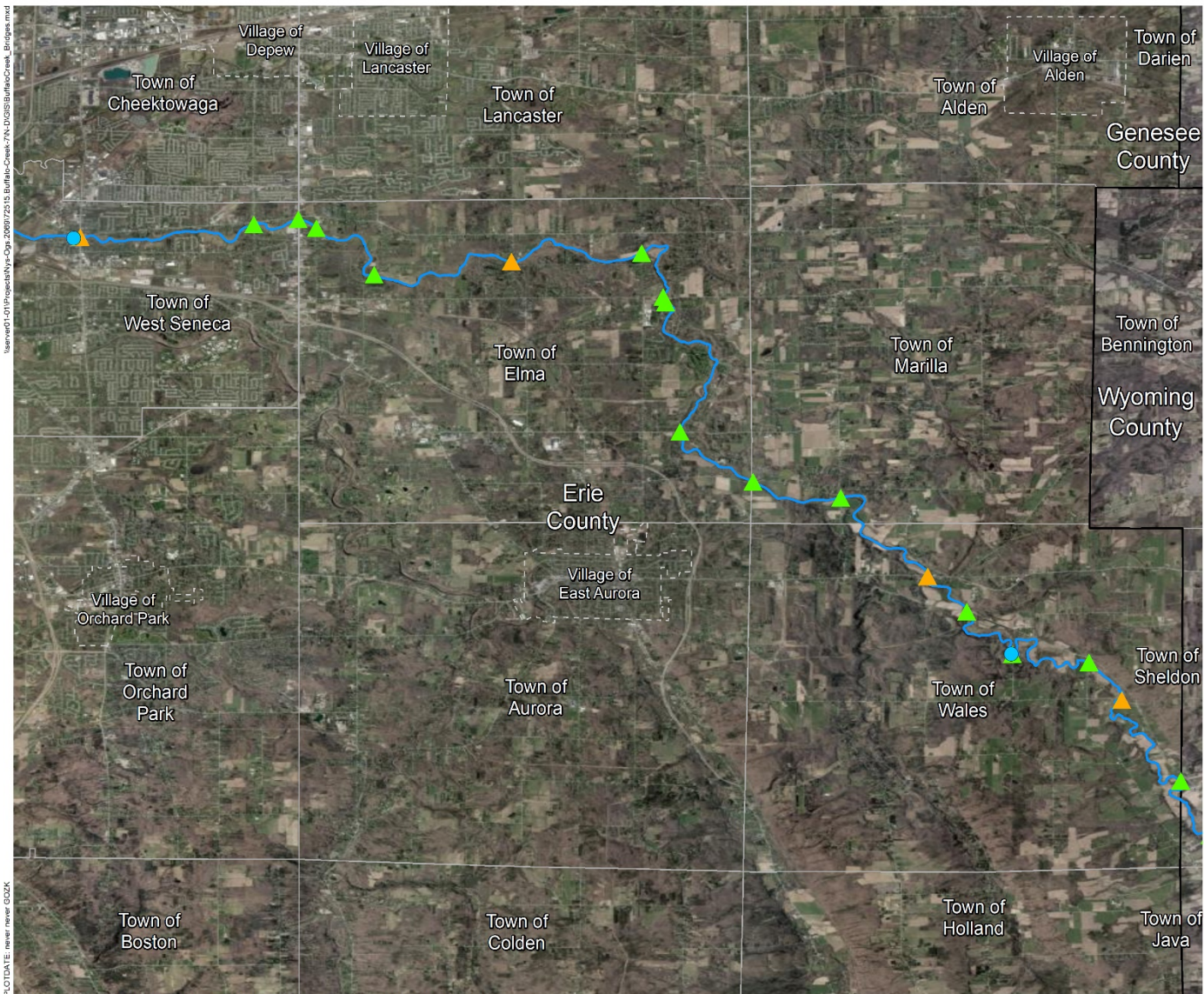


**BUFFALO CREEK  
BRIDGE CONSTRICTION POINTS**

ERIE COUNTY, NY



May 16, 2019



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Hydraulic capacity is the measure of the amount of water that can pass through a structure or watercourse. Hydraulic design is an essential function of structures in watersheds. Exceeding the capacity can result in damages or flooding to surrounding areas and infrastructure (Zevenbergen et al. 2012). In New York State, the hydraulic and hydrologic regulations for bridge low chord elevations is 2-feet over the 2-percent annual chance flood elevation for normal bridges, and 3-feet for critical bridges according to the NYSDOT.

In assessing hydraulic capacity of the high-risk constriction point bridges along Buffalo Creek, the FEMA FIS profile of Buffalo Creek was used to determine the highest annual chance flood elevation to flow under the low chord of a bridge (Table 5) (FEMA 2019b). In addition, USGS *StreamStats* was used to calculate the bankfull discharge and then compared to the annual chance flood event discharges to determine the potential for backwater and flooding at these bridges. Table 6 summarizes the results from USGS *StreamStats* for the bankfull discharge required for the water surface to reach the bankfull width of the high-risk constriction point bridges along Buffalo Creek. Since the high-risk bridges' bankfull widths exceed their lengths, which when coupled with the fact that the bankfull discharges for each bridge is equivalent to a 67-percent annual chance flood event or greater, the likelihood that relatively low to moderate flows potentially causing backwater and flooding at these bridges is fairly high.

**Table 6. Bankfull Discharge of High-Risk Constriction Point Bridges Using USGS StreamStats**

**Source: (Ries et al. 2017)**

<b>Roadway Carried</b>	<b>River Station (ft)</b>	<b>Bankfull Discharge (cfs)</b>	<b>Annual Chance Flood Event Equivalent</b>
Route 277	119+00	3,120	67-Percent
Bowen Road	512+00	2,890	80-Percent
Route 20a	1064+00	2,420	80-Percent
Centerline Road	1349+00	1,760	80-Percent

## CLIMATE CHANGE IMPLICATIONS

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### FUTURE PROJECTED DISCHARGE IN BUFFALO CREEK

In New York State, climate change is expected to exacerbate flooding due to projected increases of 1-8% in total annual precipitation coupled with increases in the frequency, intensity, and duration of extreme precipitation events (events with more than 1, 2, or 4 inches of rainfall) (Rosenzweig et al. 2011). In response to these projected changes in climate, NYS passed the Community Risk and Resiliency Act (CRRRA) in 2014. In accordance with the guidelines of the CRRRA, the NYSDEC released the *New York State Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act* (2018) draft report. In this report, the NYSDEC outlined infrastructure guidelines, most notably that the new low chord elevation recommendation for normal bridges is 2-foot freeboard over the base flood elevation for a 1-percent annual chance flood event and 3-foot over for a critical structure (NYSDEC 2018).

To account for climate change in the potential flood mitigation strategies, projected future streamflow values were obtained from the USGS *FutureFlow* software. The USGS *FutureFlow* software is an extension of the *StreamStats* software where regionally specific peak flow regression equations are used to estimate the magnitude of future floods for any stream or river in New York State (excluding Long Island) and the Lake Champlain basin in Vermont. The USGS *FutureFlow* software substitutes a new climate variable (either precipitation or runoff) to the peak flow regression equations. This climate variable is obtained from five climate models that were reviewed by the World Climate Research Programme's (WCRP) Working Group Coupled Modelling (WGCM) team during the 5th Phase of the Coupled Model Intercomparison Project (CMIP5). These five climate models were chosen because they best represent past trends in precipitation for the region (Burns et al. 2015).

Climate variable data is evaluated under two future scenarios, termed "Representative Concentration Pathways" (RCP) in CMIP5, that provide estimates of the extent to which greenhouse-gas concentrations in the atmosphere are likely to change through the 21st-century. RCP refers to potential future emissions trajectories of greenhouse gases, such as carbon dioxide. Two scenarios, RCP 4.5 and RCP 8.5, were evaluated for each climate model in CMIP5. RCP 4.5 is considered a midrange-emissions scenario, and RCP 8.5 is a high-emissions scenario (Taylor et al. 2011).

Results are averaged for three future periods, from 2025 to 2049, 2050 to 2074, and 2075 to 2099. The downscaled climate data for each model and the RCP scenario averaged over these 25-year periods were obtained from the developers of the USGS Climate Change Viewer. The USGS *FutureFlow* software calculates results based on all five climate models for any of the two greenhouse-gas scenarios, and the three time periods. These available results are meant to reflect a range of variation predicted from among the five models, and two greenhouse-gas scenarios (Alder and Hostetler 2017). Table 7 provides the current peak stream flows calculated using the USGS *StreamStats* software and the mean predicted future discharge calculated using the USGS *FutureFlow* software at the USGS Gage 04214500 at Gardenville, NY.

**Table 7. Current and Projected Discharge with Percent Difference and Change in Water Surface Elevations at the Confluence with Cayuga Creek****(Source: Ries et al. 2017; Burns et al. 2015)**

<b>Annual Chance Flood Event</b>	<b>Current Discharge (cfs)</b>	<b>Mean Predicted Future Discharge (cfs)</b>	<b>Percent Difference (%)</b>	<b>Change in Water Surface Elevation (ft)</b>
80-Percent	3,030	3,743	+ 23.5%	+ 0.6
50-Percent	4,340	5,142	+ 18.5%	+ 0.8
20-Percent	6,450	7,337	+ 13.8%	+ 0.7
10-Percent	7,990	8,922	+ 11.7%	+ 0.7
2-Percent	11,800	12,887	+ 9.2%	+ 0.6
1-Percent	13,600	14,648	+ 7.7%	+ 0.6
0.2-Percent	18,000	19,099	+ 6.1%	+ 0.5

Climate change is projected to increase peak discharges in Buffalo Creek in all reaches, and at all recurrence intervals; however, low-flow peak discharges at higher annual chance flood events are expected to be significantly influenced by climate change. In addition, these higher annual chance flood events are predicted to have the highest increases in water surface elevations in Buffalo Creek at the confluence with Cayuga Creek as well.

Appendix E contains the HEC-RAS simulation summary sheets for the proposed and future condition simulations. The HEC-RAS model simulation results for the future condition model parameters using the future projected discharge values are similar to the base condition model output, with the only difference being future projected water surface elevations are 0.2 to 0.6-feet higher due to the increased discharges.

## FLOODING CHARACTERISTICS

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### FLOODING HISTORY

Flooding along Buffalo Creek generally occurs in the late winter and early spring due to rapid snowmelt and spring rains. The situation is compounded by restrictive bridges, which cause ice jams along the stream channel, and continued development in the floodplain, exposing greater numbers of assets to potential flood damages.

Most major floods have historically occurred during the months of January to March. The greatest flood of historical record occurred in June 1937, while other damaging discharges occurred in the summer of 1928, March 1942, March 1955, March 1956, January 1959, March 1962, January 1996, December 2008, and January 2014. Minor flooding events also occurred in March 2004, February 2014, and February 2019. The June 1937 flood is generally considered to be the maximum flood of record and is the only major flooding event to have occurred during the summer months. Heavy rainfall was recorded throughout western New York on June 17, and again during June 20-21. The rainfall of June 20-21 was centered in the eastern suburbs of Buffalo and fell on wet, saturated ground in a period of around six hours. The maximum recorded rainfall was 3.00 inches at the Buffalo Airport, 2.06 inches at the downtown Buffalo station, and 1.50 inches at South Wales. There were no observations of rainfall available for the Buffalo Creek watershed; however, the few high-water marks obtained indicate that the storm caused the highest water levels along the creek for open channel conditions. Damages were primarily agricultural and largely due to erosion along the creek (USACE 1966; URS 2015).

More recently on January 18, 1996, a rapid snowmelt of 8 to 12 inches, heavy rainfall of around one inch, and unseasonably warm temperatures combined to produce a major ice jam on Buffalo Creek between Borden and Transit Streets in the Town of West Seneca, NY. The nearly 1-mile long ice jam caused numerous road closures and water damage to nearly two hundred homes. In total, reported damages exceeded \$2.2 million with \$1.7 million in property damages, and \$500,000 in crop damages (URS 2015). On February 4, 2019, rapid temperature warming occurred across the Buffalo, NY area resulting in record high temperatures. As a consequence, rapid snowmelt occurred resulting in high volumes of meltwater and ice breakups on local waterways. Ice jams formed on Cazenovia and Buffalo Creek near the Town of West Seneca causing roads, businesses, and residences to flood, and resulting in approximately \$13,000 in reported property damages (NCEI 2019).

FEMA FIRMs are available for Buffalo Creek from FEMA. Figures 5-1, 5-2, and 5-3 display the floodway and 1- and 0.2-percent annual chance flood event boundaries for Buffalo Creek as determined by FEMA for the Towns of West Seneca, Elma, and Wales, respectively. The maps indicate that flooding generally occurs in the downstream portions of Buffalo Creek, primarily in the Towns of West Seneca and Elma in Erie, County, NY. The Town of West Seneca has experienced the largest impacts from flooding along Buffalo Creek, with Gardenville and Lexington Green neighborhoods experiencing repetitive losses due to flood damages from ice jams along the creek (FEMA 2019a).

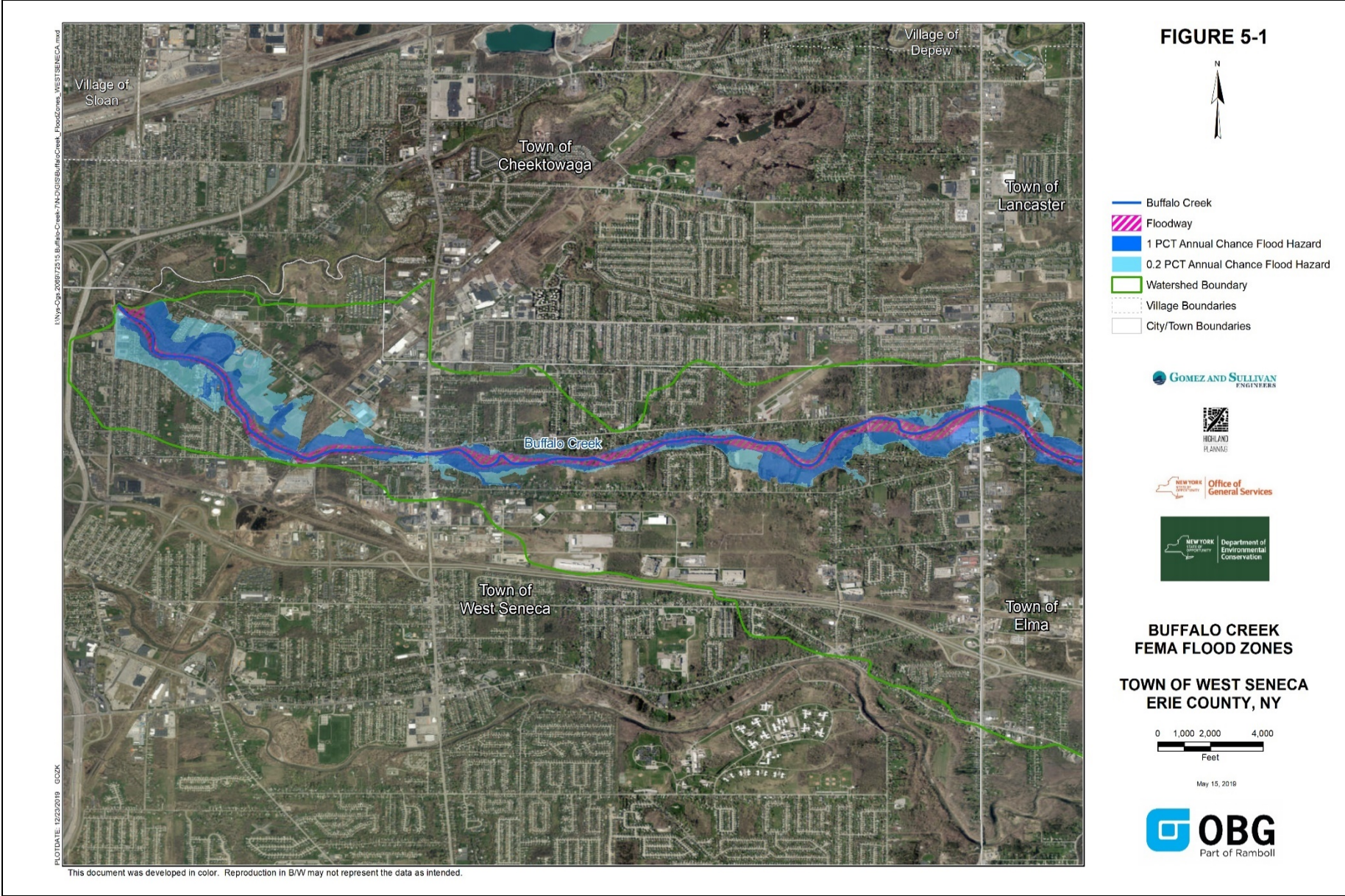


FIGURE 5-2

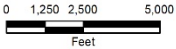


- Buffalo Creek
- Floodway
- 1 PCT Annual Chance Flood Hazard
- 0.2 PCT Annual Chance Flood Hazard
- Watershed Boundary
- Village Boundaries
- City/Town Boundaries

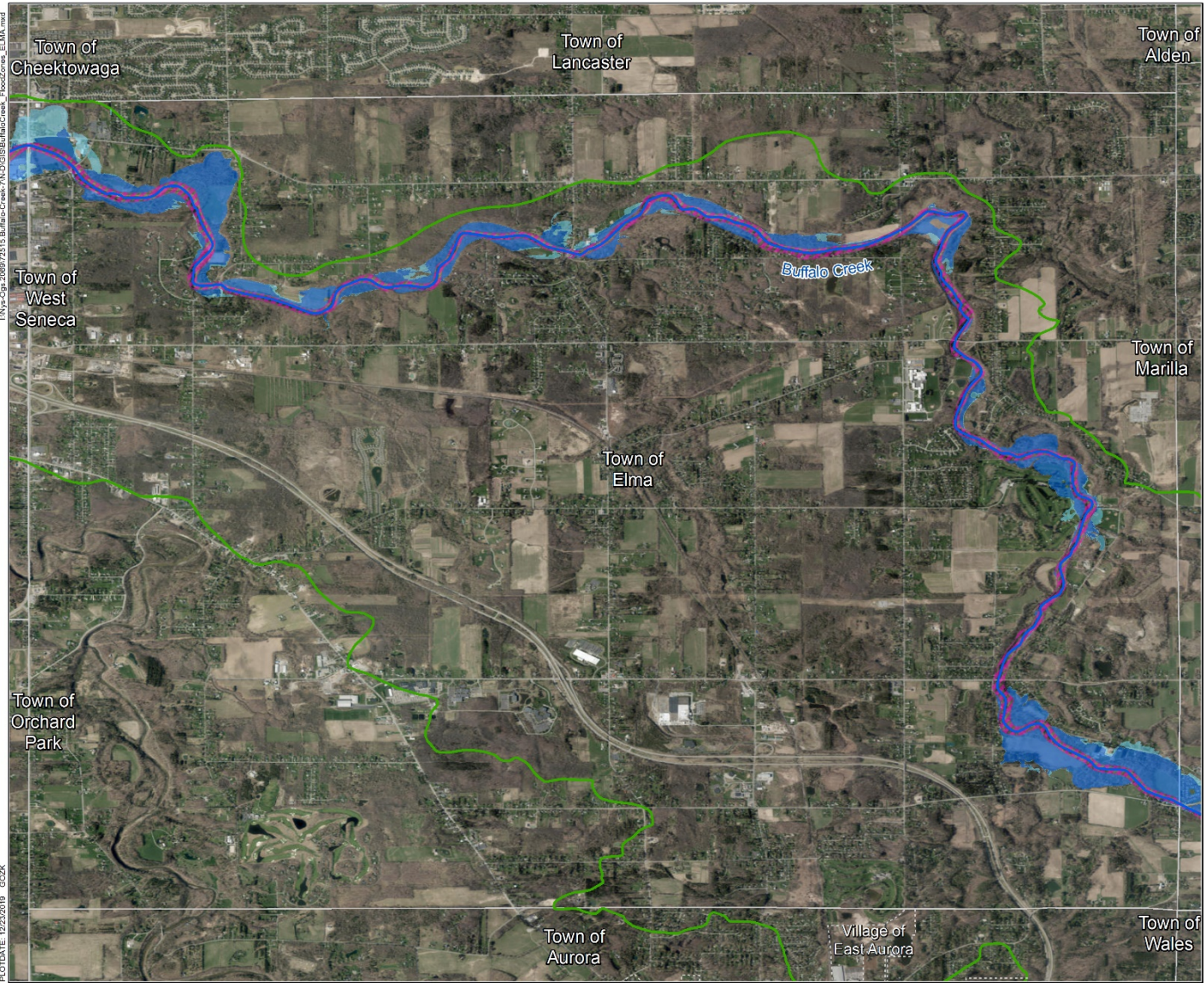


**BUFFALO CREEK  
FEMA FLOOD ZONES**

**TOWN OF ELMA  
ERIE COUNTY, NY**



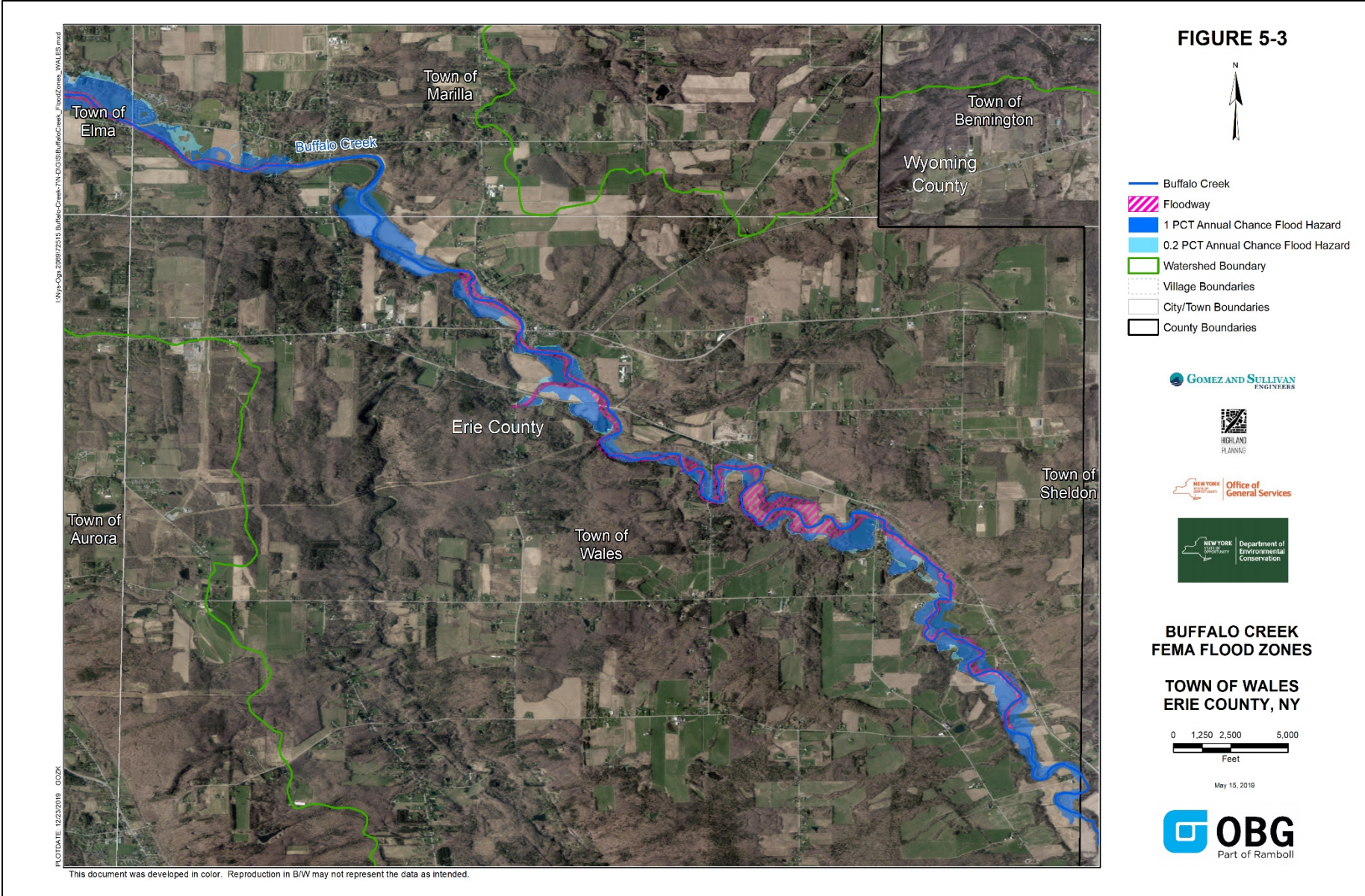
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## FLOOD RISK ASSESSMENT

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### FLOOD MITIGATION ANALYSIS

Hydraulic analysis of Buffalo Creek was conducted using the HEC-RAS program. The HEC-RAS computer program was written by the USACE Hydrologic Engineering Center (HEC) and is considered to be the industry standard for riverine flood analysis. The model is used to compute water surface profiles for one-dimensional, steady-state, or time-varied flow. Water surface profiles are computed from one cross section to the next by solving the one-dimensional energy equation with an iterative procedure (i.e. standard step backwater method). Energy losses are evaluated by friction (Manning's Equation) and the contraction/expansion of flow through the channel. The momentum equation is used in situations where the water surface profile is rapidly varied, such as hydraulic jumps, mixed-flow regime calculations, hydraulics of dams and bridges, and evaluating profiles at a river confluence (USACE 2016b).

Hydraulic modeling of Buffalo Creek in the Towns of Elma and West Seneca were completed by FEMA in 1976. The effective FEMA H&H data was produced in a non-georeferenced HEC-2 format and began at the confluence of Buffalo Creek with Cayuga Creek (river station 0+00), and extended upstream to the Pleasant View Lane neighborhood in the Town of West Seneca (river station 203+99), which included the target study area. Included within this reach is the Route 277 (Union Road) bridge hydraulic obstruction. Hydraulic obstructions outside of the target area were not evaluated as part of this report.

In order to use the data in the more advanced HEC-RAS program, the data was formatted into a HEC-RAS input format, then geo-referenced using GIS and ortho-imagery of the Buffalo Creek watershed. Using the updated HEC-RAS input data, a duplicate model was developed without any changes to the original H&H data and run in HEC-RAS. Next, a base condition model was produced, which corrected errors and updated the original H&H data based on field assessments of Buffalo Creek. The following changes were made in the development of the base condition model:

- Updated the vertical datum of the H&H data from NAD 27 to NAVD 88
- Updated the terrain with the most current available 2-meter light detection and ranging (LiDAR) digital elevation model (DEM) from the NYSDEC
- Adjusted cross-section geometry for areas outside of the stream channel using the updated terrain
- Adjusted left and right bank stations to match the 2-yr annual chance flood event water surface elevations
- Updated Manning n-values to better reflect channel, bank, and floodplain roughness
- Identified and added ineffective flow areas to cross section geometry

The base condition model was then compared to the duplicate model, past flood events with known water surface elevations, and the effective FEMA FIS elevation profiles to validate the model. After the base condition model was verified, it was then used to develop proposed condition models to simulate potential flood mitigation strategies. The simulation results of the proposed conditions were evaluated based on their reduction in water surface elevations.

### COST ESTIMATE ANALYSIS

Rough order of magnitude (ROM) cost estimates were prepared for each mitigation alternative. In order to reflect current construction market conditions, a semi-analogous cost estimating procedure



was used by considering costs of a recently completed, similar scope construction project performed in Upstate New York. Phase I of the Sauquoit Creek Channel and Floodplain Restoration Project in Whitestown, NY contained many elements similar to those found in the proposed mitigation alternatives; namely floodplain benches and associated stabilization measures.

Where recent construction cost data was not readily available, *RSMeans CostWorks 2019* was used to determine accurate and timely information (RSMeans Data Online 2019). Additionally, a 2016 USACE report focused on flood mitigation measures in the Lexington Green area (USACE 2016a) was used for pricing information for some of the mitigation alternatives. Costs were adjusted for inflation and verified against current market conditions and trends.

### **HIGH RISK AREA #1: ABANDONED RAILROAD BRIDGE, WEST SENECA, NY**

High Risk Area #1 is the abandoned railroad bridge crossing Buffalo Creek in Gardenville (a hamlet of the Town of West Seneca), and the topographic features that support the railroad on the northern (right) bank. The railroad bridge is located approximately three-quarters of a mile east of the Indian Church Road and Route 277 (Union Road) junction (Figure 6).

The effective FEMA FIRMs show the abandoned railroad and its topography constricting flow, which results in backwater upstream. During winter and early spring, ice flowing along the creek is constricted by the large piers of the railroad bridge and the topography supporting the bridge on both channel banks, which causes the ice to collect at the base of the piers. As the ice builds, water flow in the creek channel is restricted and rises, which causes backwater to overflow the creek banks onto nearby streets, properties, etc. (NYSDEC 2019a).

### **HIGH RISK AREA #2: LEXINGTON GREEN NEIGHBORHOOD, WEST SENECA, NY**

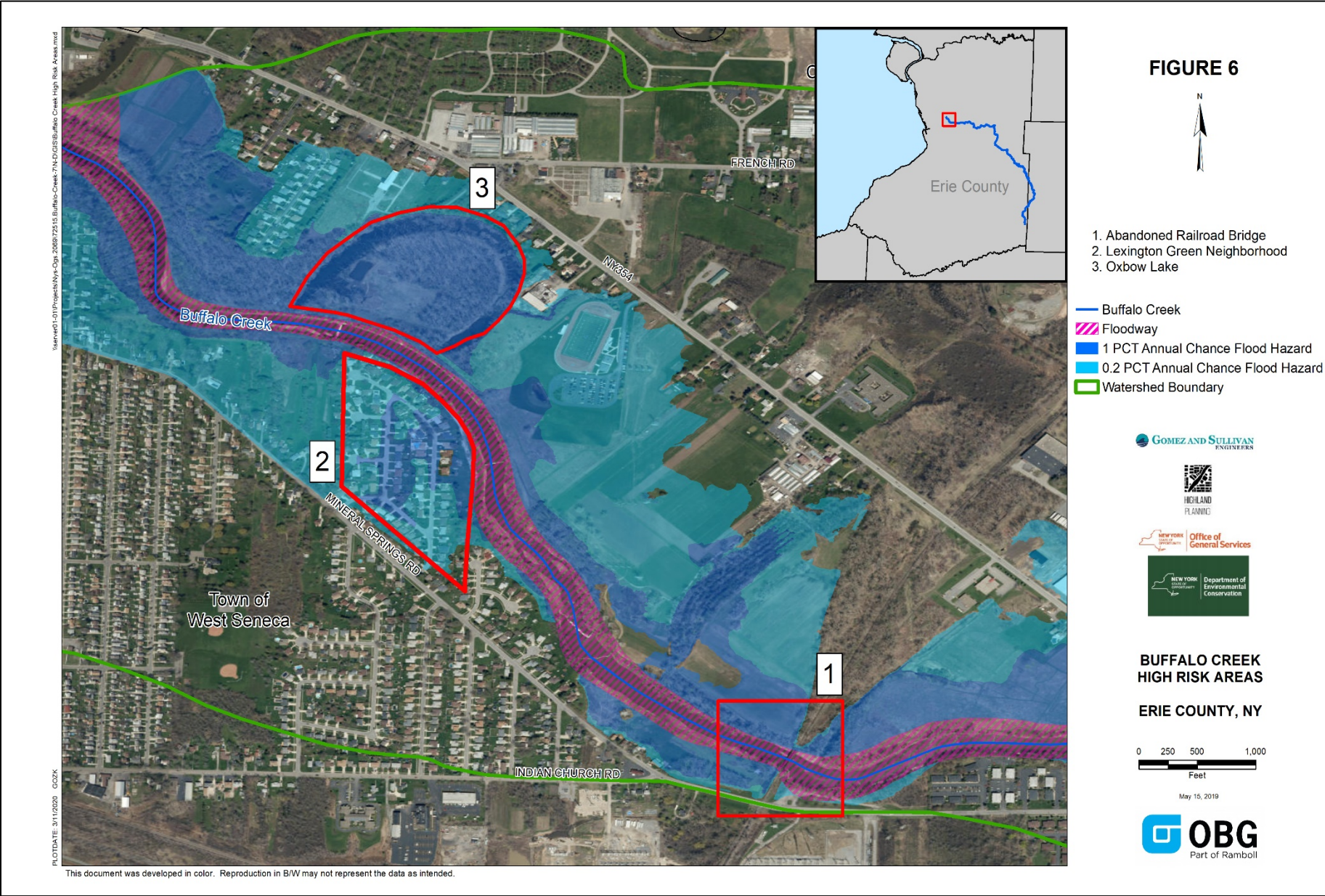
High Risk Area #2 is the neighborhood of Lexington Green in the Town of West Seneca. The residential community of Lexington Green (approximately 71 residences) is located on the south side (left bank) of Buffalo Creek a short distance downstream from the abandoned railroad bridge (Figure 6). The neighborhood sits atop the old creek channel, which was filled with gravel and excavated material by the USSCS in the 1960s. As a result, precipitation driven overbank flooding can occur at the 2 percent Annual Chance Exceedance (ACE - 50-year recurrence interval flow) level, and ice-jam flooding can occur at much lower flows during periods of ice and snow melt in the late winter to early spring (USACE 2016a).

In addition to runoff and ice-jam flooding, the old channels under the neighborhood are thought to have a high groundwater conductivity and connection to the existing creek, potentially providing for a significant flux of water from the creek to the groundwater beneath the neighborhood. These groundwater fluxes, combined with sanitary sewer surcharges due to malfunction or improper operation of the gate during highly wet weather and high flow periods, contribute to localized flooding on roadways. The sewer outlet from the neighborhood has been identified as one of the main potential causes of flooding from malfunction or improper operation of the gate on the sewer outlet to Buffalo Creek (USACE 2016a).

### **HIGH RISK AREA #3: OXBOW LAKE, WEST SENECA, NY**

High Risk Area #3 is Oxbow Lake, located downstream of the Lexington Green neighborhood in the Town of West Seneca (Figure 6). Oxbow Lake was originally part of the natural channel path of Buffalo Creek. In the 1950s, the USSCS, now known as the Natural Resources Conservation Service (NRCS), implemented a sediment control project aimed at addressing potential sediment load contributions to the commercial navigation channels of the lower Buffalo River and Lake Erie (USACE 1979). This

project included the straightening of Buffalo Creek and removing the meander near the Lexington Green neighborhood. The project included creating the oxbow lake, constructing a soil berm to separate the oxbow from normal high-water recharge of Buffalo Creek, and installing an outfall pipe from the oxbow into Buffalo Creek. At the time, the channel re-alignment of the creek and grade controls were seen as a means to alleviate seasonal ice jam flooding and soil erosion along Buffalo Creek in this reach. Since the creation of the oxbow lake, nature has reclaimed the area and it has developed into a wetland habitat for many varieties of fish and wildlife (Ecology and Environment Inc. 2010). In 2012, the NYSDEC passed an amendment in Erie County designating approximately 50% of the oxbow lake area as a Class 2 Freshwater Wetland. A Class 2 wetland is defined by the NYSDEC as a wetland that provides important wildlife habitat and open space benefits in an urbanized area. The significance of Class 2 wetlands is substantially enhanced by their urban locations due to the important natural, recreational, educational, scientific, open space, and aesthetic benefits provided by such wetlands (NYSDEC 2012).



## ICE JAM ANALYSIS

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### ICE JAM FORMATION

An ice jam occurs in the late winter and early spring in ice covered streams when ice accumulate at man-made (e.g. bridge piers, dams) or natural narrower or shallower sections or meanders of a river slowing down or blocking the incoming ice by bridging the ice across the width of the river.

As the air temperature drops, the water temperature reaches freezing temperatures and starts to form frazil ice crystals in the water column. These ice crystals travel in the water column (suspended ice) with the river currents, growing and concentration, and losing heat while traveling. They float on the surface (Surface ice), and as the crystals grow in size, they form surface frazil ice. As the air temperature drops more, temperature losses from the water and frazil ice create more surface ice, and thicken the existing surface frazil ice, increasing the surface ice concentrations on the river as it approaches colder winter temperatures. The presence of surface and suspended frazil ice increases resistance to the flow, thus increasing the water levels of rivers in the wintertime. Increasing concentrations leads to ice jams and ice jams effects both upstream and downstream water levels.

When an ice jam first forms it starts form a single layer inter blocking of small surface ice called a juxtaposed ice cover. With time and increased incoming surface ice volumes, a single layer ice cover grows into a thick ice jam, which is referred to as a freeze-up ice jam. A single layer ice jam can grow in length and at some point, the incoming ice will overturn at the leading edge of the ice cover and pass under the juxtapose cover to form multi-layered ice jams. These ice jams are often called as hanging ice jams and they tend to reduce the area of the river cross section thus reducing the flow. This creates significant backwater effects and causes upstream flooding. With the thickening of the ice jam the local water level also rises and suddenly breaks the ice jam. This ice jam break-up is called a mechanical break-up. This will release larger flows in downstream, which occurs usually during the springtime. The higher water temperatures during the springtime or direct sunlight can weaken the ice cover deteriorates and melt in place without significant movement of ice tend to break up the jam, which is called a thermal break-up.

A thermal or mechanical breakup can happen during the cold wintertime while the water levels of the river increase due to rain or high flows from upstream or locally breaking the existing ice cover which makes break-up ice jam flooding in winter unique from other flooding during the summertime.

An existing ice jam can break-up and travel downstream with larger ice particles with the higher flows of a flash flood and accumulate at a constricted downstream location creating another break-up ice jam or damage downstream riverbanks or downstream infrastructures severely. Ice jam flooding presents a complex problem for scientists and engineers since the resulting flood stage can be significantly higher than the flood stage caused from streamflow alone. In other words, a relatively minor discharge of streamflow can result in a major flooding event during an ice jam (USACE 1966).

### ICE JAM FLOODING MITIGATION ALTERNATIVES

There are several widely accepted and practiced standards for ice jam controls to mitigate the ice jam related flooding. These are referred to as ice jam mitigation strategies and each strategy is very much site dependent. A strategy that works for a certain reach of a river wouldn't work for another reach in the same river due to river morphology and hydrodynamics. Therefore, each of these strategies need to be analyzed with numerical modeling and simulations to check if they work for a considered area/reach of a river before implementing or recommending with the previous observational

experience alone. The standard strategies that are widely accepted and practiced in cold region engineering are described below;

### **Ice booms**

Ice booms are the most widely used ice jam control strategy to control ice movement and minimizes surface ice transport. They can be both permanent and temporary structures depending on the emergency measure in high-risk situations. They mainly consist of a series of timber beams or pontoons connected and strung across a river. Once the ice disappears, the booms can be removed if needed and transported elsewhere for storage during the summer months. Ice booms are flexible and can be designed to release ice gradually when overloaded. They can be a relatively cost-effective intervention and can be placed seasonally to reduce potential negative environmental impacts. Ice booms can also be deployed relatively rapidly, rendering them effective as an emergency response measure.

However, the removal of ice booms can be costly since the components of each boom must be disconnected, cleaned, transported and stored until their next deployment. Ice booms can also be ineffective given that ice jams have the potential to circumvent the booms by moving underneath them. Ice booms do not suit all river environments and require low river flow velocity and adequate upstream ice storage capacity.

### **Ice breaking using explosives**

Thermally grown ice is relatively easy to break up by blasting, while frazil ice is more difficult because it absorbs much of the blast energy. Ice blasting using dynamite is being widely used in rivers where very thick ice jams are formed. It is a very efficient method that can be performed within minutes. It is easily transported to remote locations and does not require any maintenance. Holes are drilled in the ice and dynamite is inserted to blow the ice apart. The most effective results can be achieved by placing the charges underneath the ice surface.

Using dynamite to clear ice can, however, be harmful to the environment. It is also a dangerous method to employ with potentially fatal consequences. Dynamite is not a sustainable solution and can require multiple treatments during extreme cold. It also requires the containment of large areas, which might have to be repeated several times.

### **Ice breaking using ice-breaker ferries and Cutters**

Ice breakers are specialized vessels designed to break ice jams in wide rivers. They represent a non-structural ice jam mitigation method that is used internationally, in lakes, wide rivers, and oceans. Ice breakers are generally operated when temperatures start to rise, before it reaches the peak cold. They are most suitable for ice sheet breaking (juxtaposed type ice jams), as there are limitations for the ice thickness that they are capable of breaking.

Cutting thick ice covers can also mechanically weaken the ice jams and help relieve the internal pressure of an ice-covered channel due to the thick ice cover. A thick ice cover increases the resistance to flow and slowdown the discharge under the ice covers and increase the backwater effects upstream. By cutting the ice cover this pressure can be relieved and the backwater effects can be minimized to reduce upstream flooding potentials. This can also help to control the ice jam breakup and control large ice pieces release from the break-up.

Ice breakers can typically break thick ice covers of up to three to ten feet. Ice breakers have proven to be effective tools for breaking up ice cover on rivers. There are multiple types of ice breakers and, being a mobile solution, they can be flexibly targeted at areas with the most need. Operating ice breakers requires a highly skilled command and crew and are not suitable in all environments. Transporting ice breakers is also relatively difficult, making it a time-consuming and potentially cost-intensive solution.

### **Installing inflatable dams (Obermeyer Spillways)**

Removing permanent run-of-river low head dams that are prone to ice jams and replacing them with floatable dams can be a good solution for flow control for all seasons. Since the crest elevation can be altered, they allow for a controlled release of incoming ice, allowing it to spillover without jamming. Also, in case of a sudden freeze-up jam that leads to an overnight thick jam, it can also be broken by frequent or oscillatory movement of lowering and raising the crest to break or weaken the ice jam.

Obermeyer Spillway gates are recommended in areas where it is more prone to ice accumulation and flow control is still essential during all seasons. Obermeyer Spillway Gates consist of a row of steel gate panels installed either at the top of dams or as free-standing structures. The system utilizes a combination of metal flap-gate panels supported by multiple small inflatable “bladders” that adjust the panels’ angle and elevation. By controlling the pressure in the bladders, the water flow can be infinitely adjusted within the system control range. Panels can also be designed to include heated abutment plates to prevent ice formation.

### **Mixing heated effluent to the cold water**

The release of warm water waves into a river from nearby treatment plants or additions of heated water mixing can help mitigate ice jam formations where the above mentioned alternatives won’t work. Provided that the effluent is added to the river prior to ice jam formation, the additional water volume can increase the river flow velocities and prevent ice jam creation in the first place. The wastewater can also be used for the thermal control of ice, as the released warm water can melt or thin ice jams.

### **Removal of Bridge Piers or Heated bridge piers or heated riverbank dikes**

Bridge piers are a hotspot for capturing surface and suspended frazil ice. When surface ice floes are adhered to the bridge piers and abutments the lateral growth of ice rapidly increases thus snagging more ice on the surface creating an ice bridge across the river. When there are more piers across the river the potential of ice bridging between piers increases due to a series of small ice bridging between two piers can be rapidly formed than between longer pier spans.

Removing bridge piers can lead to high cost construction projects with inconvenience to the daily traffic through the bridge and the structural integrity. Therefore, heated bridge piers can be a good alternative to the existing piers that are prone to more ice cohesion and that can lead to high cost of removing the piers. This will limit the ice adhesion to the bridge and pass through the surface and suspended ice without encouraging snagging, capturing and flocculation of surface ice at bridge piers avoiding the possible ice jams.

Also, the heating of piers can heat the surrounding water and mix with the ambient cold water that will lead to the melt existing surface and suspended ice in the water. This reduces any extra ice generation in the water column.

However, heating bridge piers involves careful installation of the wiring and maintenance of the heating elements and energy costs. More frequent inspections of the bridge piers are also needed since the temperature can affect the concrete composition or special treatment for the concrete is needed.

### **Ice retention Structures**

Ice retention structures are used to control ice jams by actively initiating jams in more suitable locations where they are less damaging. Ice is captured and retained upstream of residential areas.

Ice retention structures are cost-effective, installation methods are simple, however the design is highly customizable according to the site. A retention structure can be associated with a flood bench so that increased water levels due to ice accumulation can be compromised by allowing more storage in the flood bench. The retention structures don't increase the water level during normal flows.

However, the structures do require ongoing maintenance to remove debris. Channel bed scour is a concern for these structures, therefore, a scour analysis needed to perform in the vicinity of the structure to make sure the ice mitigation strategy will not adversely affect the normal river flow.

### **Ice Forecasting Systems and Ice Management**

Visual monitoring of the ice formation, and ice cover progressions and water levels are good elements of monitoring the ice conditions of a river during the wintertime, but not sufficient to accurately predict the upstream back water effects or ice jam formations or ice jam break-ups. Ice condition and ice jam monitoring system is a useful tool for emergency ice management but limited in ice forecasting ability.

Ice long-term forecasting and short-term freeze-up and ice jam breakup predictions is a complicated process and challenging due to several reasons. Ice forecasting needs geomorphological, meteorological, coupled thermodynamics and hydrodynamics to identify the factors effecting an ice jam condition. Therefore, an ice forecasting simulation will not be able to be carried out in a timely manner to help making emergency decisions.

Therefore, a good forecasting system that will recommend an ice management plan would and customized ice monitoring strategy would be the most appropriate alternative to follow. An annual ice jam simulation with that accounts for forecasted meteorological and hydrological conditions and simulated ice control strategy that is suitable for the upcoming winter can identify the flood prone areas and enable to calculate the associated risk beforehand. These annual studies can also suggest the type of monitoring that is needed in different reaches or areas. For example, if an area needed to visually monitor the ice formation and ice transport through web-cams or need to perform a calculation procedure such as "Freezing-Degree-Day" (FDD) method to predict the thickness of an ice jam to break to make decision when to start breaking. This will help officials to manage the resources and order the equipment and staff available before an emergency occur.

Ramboll suggests that to perform a freeze-up or a break-up ice simulation study before implement or recommend any of the above discussed strategies. The basic data needs and steps involved in an ice simulation analysis is also outlined below.

### **ICE FORECASTING MODEL SIMULATIONS**

Freeze-up ice simulation is a complex simulation carried out to predict ice generation, movement and coagulation with the change of air temperature, water temperature and water flow over a period of time. Usually these simulations are carried out for a two to three-month time period. A calibration

and validation is also needed to ensure accuracy. A freeze-up or ice jam simulation needs the following input data:

- Accurate river bathymetry created from LiDAR survey or hydro-corrected bathymetric data from the state agencies.
- Weather data such as air temperature, wind condition, cloud cover, snowfall and precipitation data.
- Flow conditions, from gauge data or measured data. (e.g. upstream discharge and downstream water level data).
- Ice conditions data, such as water temperature data, incoming ice concentration, and initial ice cover thickness or initial ice floe concentration's and ice floe thickness.
- Visual observation data that are useful to calibrate the model, such as ice cover leading edge propagation locations, water temperature and ice thickness measurements.

The results of such a simulation, when the results are in agreement with observational data, can lead to a better understanding of ice behavior and associated ice jam flooding in the simulated areas that will aid officials and emergency responders in developing better ice management plans.

### ICE JAM PRONE AREAS

The Buffalo Creek watershed is highly susceptible to ice jam formation and backwater flooding. Since 1939, there have been 42 reported ice jam events on Buffalo Creek (CRREL 2019). Since 2014, there have been 4 ice jam flooding events on Buffalo Creek, which has resulted in approximately \$820,000 in reported property damages (NCEI 2019). Based on historical flood reports and public outreach, the Town of Elma to West Seneca were identified to be the most adversely affected communities by ice jam flooding in the Buffalo Creek basin. Ice jam flooding on Buffalo Creek occurs primarily in the following locations:

- City of Buffalo and Town of West Seneca downstream the Interstate-90 bridge crossing after Buffalo Creek becomes the Buffalo River;
- Town of West Seneca downstream of the Union Road Bridge in the vicinity of the Lexington Green neighborhood, the Transit Road/US-20 bridge, and the confluence with Cayuga Creek; and
- Town of Elma upstream of the Winspear Road Bridge and in the vicinity of Centennial Park (NYSDEC 2019a).

The HEC-RAS model data available for this report focused on the Town of West Seneca and, more specifically, the areas downstream the Union Road bridge towards the confluence of Buffalo Creek with Cayuga Creek. This area is highly vulnerable to flooding, and in particular ice jam flooding, as a result of urban development and prior channelization projects of Buffalo Creek in this reach. The recent flooding of 2014 and 2019 in the neighborhood of Lexington Green, which is located in between the oxbow lake and Union Road bridge, highlights the vulnerability of this reach of Buffalo Creek to flooding.

### DOWNSTREAM OF INTERSTATE-90 BRIDGE CROSSING

Buffalo Creek converged with Cayuga Creek to form the headwaters of the Buffalo River in the Town of West Seneca, NY. Downstream the confluence is the Interstate-90 bridge crossing of the Buffalo River. Buffalo River continues downstream, converging with Cazenovia Creek, before emptying into the Lake



Erie. This reach of Buffalo River flows through the City of Buffalo where the river has been channelized and meanders greatly and often. This meandering causes water velocity slowdowns and the river bends become hotspots to capture and accumulate ice, which increases the potential of ice jam formations along the Buffalo River (Figure 7).



**Figure 2. Buffalo River meanders downstream the Interstate-90 bridge crossing in the Town of West Seneca and City of Buffalo, NY.**

During the early winter months Lake Erie will start freezing up and producing more ice, which is pushed by the winds over the lake towards the mouth of the Buffalo River. This causes an increase of ice concentration at the mouth of the Buffalo River. The increased ice concentrations at the mouth of the Buffalo River affects the overall ice transport in the river and initiates more frazil ice generation from downstream to upstream of the river. The wider river width also increases the potential of ice generation due to larger surface area enabling more heat transfer between water and cold air. The combination of these two actions decreases the water temperature downstream and through mixing cools the upstream warmer water making it colder and generating more ice. The generation of more ice in the downstream reach of Buffalo River changes the flow hydrodynamics and affects the upstream flow through backwater effects. These changes in the upstream of Buffalo River affect the hydraulic conditions of Buffalo Creek at the confluence with Cayuga Creek and the downstream boundary limit of this study.

It is evident that the ice conditions and geomorphology of the Buffalo River affects ice jam formation and associated flooding within the vicinity of the Buffalo Creek and Cayuga Creek confluence. Therefore, Ramboll recommends a freeze-up 2-D ice simulation using the Comprehensive River Ice Simulation System (CRISSP2D) to evaluate and understand the existing ice dynamics and associated hydrodynamic changes due to presence of ice during the winter versus open water conditions during the summer. Ramboll recommends following the modeling approach outlined in the aforementioned

section regarding ice modeling. Ramboll suggests including the downstream mouth of the Buffalo River to upstream of Buffalo Creek and Cayuga Creeks confluence including Cayuga creek as an auxiliary input to the model domain. Depending on the ice simulation results, ice mitigation strategies can be evaluated to determine the more appropriate ice control plan to mitigate the ice jam related flooding in this highly residential area.

#### **CONFLUENCE WITH CAYUGA CREEK, WEST SENECA, NY**

In the Town of West Seneca, the reach between the oxbow lake and confluence of Buffalo Creek with Cayuga Creek was identified as a potential ice jam location. A preliminary ice jam analysis was performed on this location using available FIS profiles and spatial GIS data.

According to the FEMA FIS profile, the Harlem Road and Interstate 90 bridges' low chord is above the 10, 1, and 0.2-percent annual chance flood water surface elevations, which is immediately in the vicinity of the confluence (FEMA 2019b). In 2017, the Harlem Road bridge was re-designed and had two of the three bridge piers removed. Since the re-design, there have been no reported ice jam formations in this reach. However, ice jams have formed between the oxbow lake and Harlem Road bridge. This is most likely caused by the meanders in the creek channel in this reach and slowed down water velocities. The meanders cause water flow to decrease and deposition to occur, evidenced by the sand bar (Figure 8). During an ice breakup event upstream, ice pieces flowing through this reach have a higher probability of getting caught on the sand bars as they travel downstream. These ice pieces will continue to get caught at the meander and eventually form an ice jam, obstructing the flow of water downstream, which increases the chances of backwater flooding.



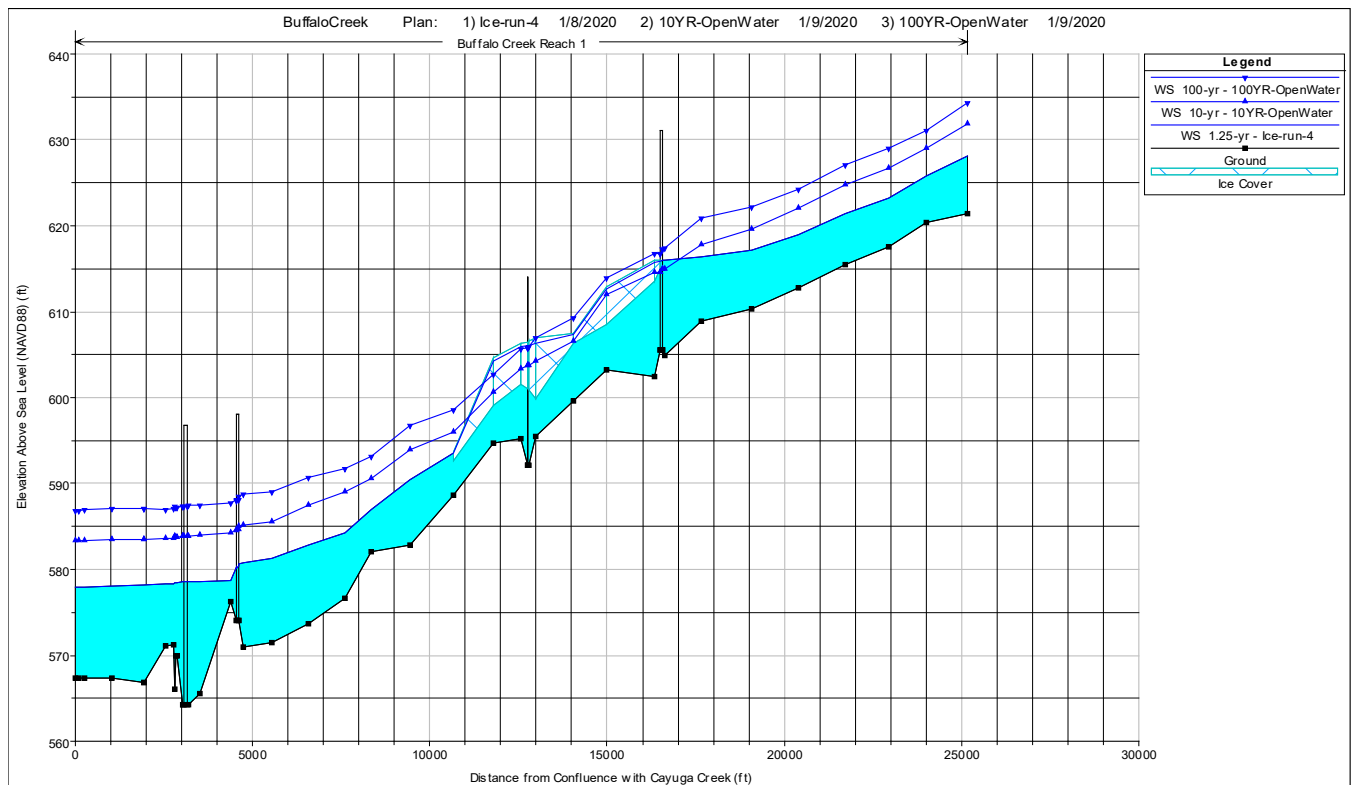
Figure 3. Sand Bar formation downstream the oxbow lake in Town of West Seneca, NY.

Possible ice jam mitigation measures for the Harlem Road bridge would include: ice management and ice break-up at the confluence and upstream Buffalo Creek at a very early stage; or straightening the reach from the oxbow lake to the Harlem Road bridge at the confluence with Cayuga Creek. Further analysis, including the collection of detailed topographic and bathymetric survey data, would be required to quantify the benefit of any project.

Additional field observations, data collection, and H&H modeling is required before any possible ice jam mitigation measure should be pursued for the Winspear Road bridge.

**UNION ROAD BRIDGE, WEST SENECA, NY**

The Union Road Bridge was identified as a potential ice jam location along Buffalo Creek. Using the H&H model data from FEMA, ice jam scenarios were simulated in the HEC-RAS modeling software to evaluate the ice jam potential of the Union Road bridge. Using the HEC-RAS modeling software, an ice cover simulation of 1-foot thick was initiated with 0.3 ice porosity, about 2,000-feet downstream of the abandoned railroad with 80-percent annual chance flood conditions (1.25-year return period). The Ice cover was extended to the upstream face of the Union Street bridge, while using the dynamic ice cover computation options for the bridges in HEC-RAS model allowing HEC-RAS to compute the dynamic ice cover thickness at each cross section within the specified length, depending on hydrodynamics conditions at each cross section. The simulation indicated that the back water generated from an ice jam with an 80-percent annual chance flood condition initiated at Lexington Green area can raise the water level at upstream of the Union Street bridge (616.1 ft NAVD 88) close to an open water 10-percent annual chance flood conditions (617.8 ft NAVD 88) water level. This shows the significance of ice jamming at the Lexington Green Area to the upstream flooding (Figure 9).



**Figure 4. HEC-RAS dynamic ice cover model simulation output for the Union Road bridge. Water surface elevations (feet) for 80, 10, and 1-percent annual chance flood conditions near the abandoned railroad bridge in the Town of West Seneca, NY.**

The existence of the sand bars upstream and downstream of the railroad bridge are good evidence of slowed down flow in this area (Figure 10) due to the railroad bridge. The railroad bridge opening and the center pier act as flow constrictions to the flow, so the backwater effects from that slow down the inflow of water passing the bridge. The abrupt flatness of this area also is a factor for the slowed down flow making this location an ideal point for ice jam initiation as a freeze-up or break-up jam. The

combination of existing sand bars with the slowed down flows increases the potential to accumulate incoming ice flows and form an ice jam.

By removing the abandoned railroad bridge, the flow restriction can be reduced, decreasing the potential of flocculation of ice flows near the bridge piers and abutments. Also, by removing the sand bars, grading the bathymetry to natural slope, and widening the flow areas between Lexington Green and the abandoned railroad bridge, the probability of incoming ice flows passing downstream without jamming can be increased. Ice control structures and flood benches can also help this process by directing ice pieces out of the channel and providing additional storage area for water and ice during ice breakup events, respectively. These recommendations will reduce the potential for ice jam flooding in the vicinity of the Union Road bridge.



Figure 5. Sand Bar formation at the abandoned railroad bridge in the Town of West Seneca, NY.

#### TRANSIT ROAD/US-20 BRIDGE, WEST SENECA, NY

The Transit Road/US-20 bridge was also identified as a potential ice jam location in the Town of West Seneca. A preliminary ice jam analysis was performed on this area using available FIS profiles and spatial GIS data.

According to the FEMA FIS profile, the Transit Road bridge low chord is below the 10, 1, and 0.2-percent annual chance flood water surface elevations (FEMA 2019b). The bridge is well below the required 2-feet of freeboard over the 1-percent annual chance flood elevation, recommended by the CRRRA. In addition, the North Blossom Road bridge and dam are in close proximity to the Transit Road bridge. The North Blossom Road bridge low chord is only 1-foot above the 1-percent annual chance flood elevation, which is also below the required 2-feet of freeboard. The Blossom Dam is located approximately 1,700-feet upstream of the Transit Road bridge. The dam is engineered to slow water flows of up to the 0.2-percent annual chance flood elevation (Figure 11). Slowing water flow with structures increases the chances of ice accumulation and formation of freeze-up jams. If an ice cover forms, the ice break-up increases the potential for downstream break-up ice jam potential. The North Blossom and Transit Road bridges are the two most immediate downstream bridges, so they have the highest probability of initiating an ice jam.

Possible ice jam mitigation measures for the Transit Road bridge would include: ice management and ice break-up at the Blossom Dam and/or the North Blossom and Transit Road bridges at a very early stage; widening and/or raising the bridge; or installing a flood bench with an ice control structure on the right bank of Buffalo Creek upstream the Blossom Dam. Further analysis, including the collection of detailed topographic and bathymetric survey would be required to quantify the benefit of any project.

Additional field observations, data collection, and H&H modeling is required before any possible ice jam mitigation measure should be pursued for the Transit Road/US-20 bridge.

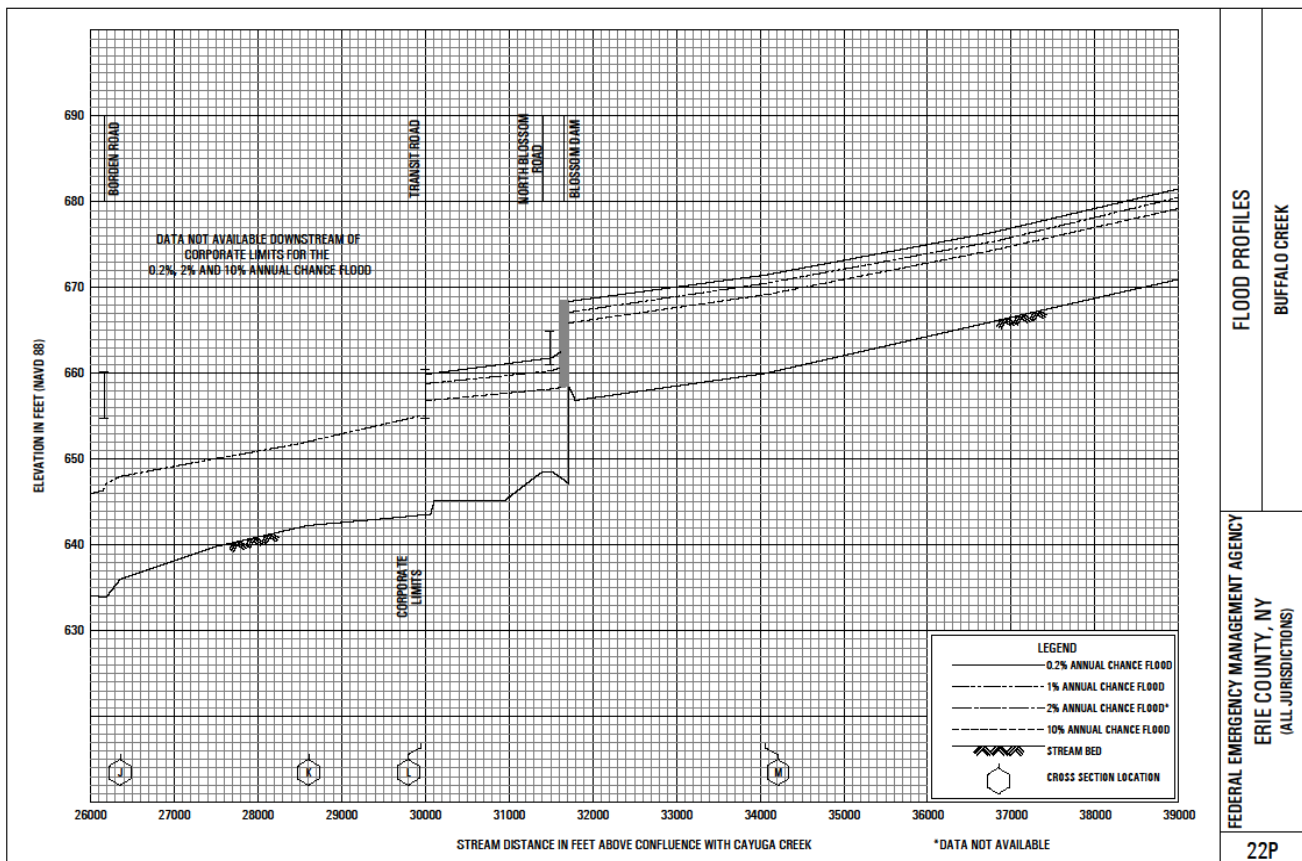


Figure 6. FEMA FIS profile of Buffalo Creek at the Transit Road/US-20 bridge (FEMA 2019b).

**WINSPEAR ROAD BRIDGE, ELMA, NY**

In the Town of Elma, the Winspear Road Bridge was identified as potential ice jam location along Buffalo Creek. A preliminary ice jam analysis was performed on this location using available FIS profiles and spatial GIS data.

According to the FEMA FIS profile, the Winspear Road bridge is above the required 2-feet of freeboard over the 1-percent annual chance flood elevation (FEMA 2019b). The Winspear Road bridge is located in a relatively stable reach of Buffalo Creek with no major topographic features in the vicinity of the bridge. The most probable cause of ice jam formation in and around the bridge is the creek channel on the left bank along the bridge abutment. There is a small but pronounced meander in the channel as water flows downstream under the bridge. Recent ortho-imagery of the area displays the formation of a sandbar on the right bank of the channel (Figure 12). This meander causes water flow to decrease and deposition to occur, evidenced by the sand bar. During an ice breakup event upstream, ice pieces flowing through the meander have a higher probability of getting caught on the left bank of the creek as it meanders around the bridge abutment. These ice pieces will continue to get caught at the meander and eventually form an ice jam, obstructing the flow of water downstream, which increases the chances of backwater flooding.



Figure 7. Ice buildup and sand bar locations upstream the Winspear Road bridge in the Town of Elma, NY.

Potential ice jam mitigation measures in the Winspear Road bridge area would include: ice management and breakup on the upstream reach of the bridge; installing a flood bench with an ice control structure on the left bank of Buffalo Creek upstream of the bridge. There is area, on both the left and right over bank upstream of the bridge, to construct a floodplain bench. Further analysis, including the collection of detailed topographic and bathymetric survey, would be required to quantify the benefit of any project.

Additional field observations, data collection, and H&H modeling is required before any possible ice jam mitigation measure should be pursued for the Winspear Road bridge.

### **CENTENNIAL PARK, ELMA, NY**

The Centennial Park area in the hamlet of Elma Center, NY was also identified as a potential ice jam location along Buffalo Creek. A preliminary ice jam analysis was performed on this location using available FIS profiles and spatial GIS data.

According to the FEMA FIS, the Centennial Park area is located in a relatively stable reach of Buffalo Creek with no major topographic features in the vicinity of the bridge (FEMA 2019b). The most probable cause of ice jam formation in and around the park area is the near 90° meander in the creek channel downstream of the park. The meander causes water flow to slow, as evidenced by the large sand bars that have developed in the middle of the channel (Figure 13). When an ice breakup event occurs upstream, the ice pieces will get caught on the sand bars and outside (right) bank of the meander. This buildup of ice pieces will initiate an ice jam and obstruct the flow of water downstream increasing the chances of backwater flooding.

Potential ice jam mitigation measures in the Centennial Park area would include: ice management and removal around the sand bar island; dredging and deepening the creek channel to remove sediment deposits and increase the cross-sectional area of the channel; installing a flood bench with an ice control structure on the right bank upstream of the park; and straighten the channel downstream of the park to remove the meander. Further analysis, including the collection of detailed topographic and bathymetric survey would be required to quantify the benefit of any project.

Additional field observations, data collection, and H&H modeling is required before any possible ice jam mitigation measure should be pursued for the Winspear Road bridge.



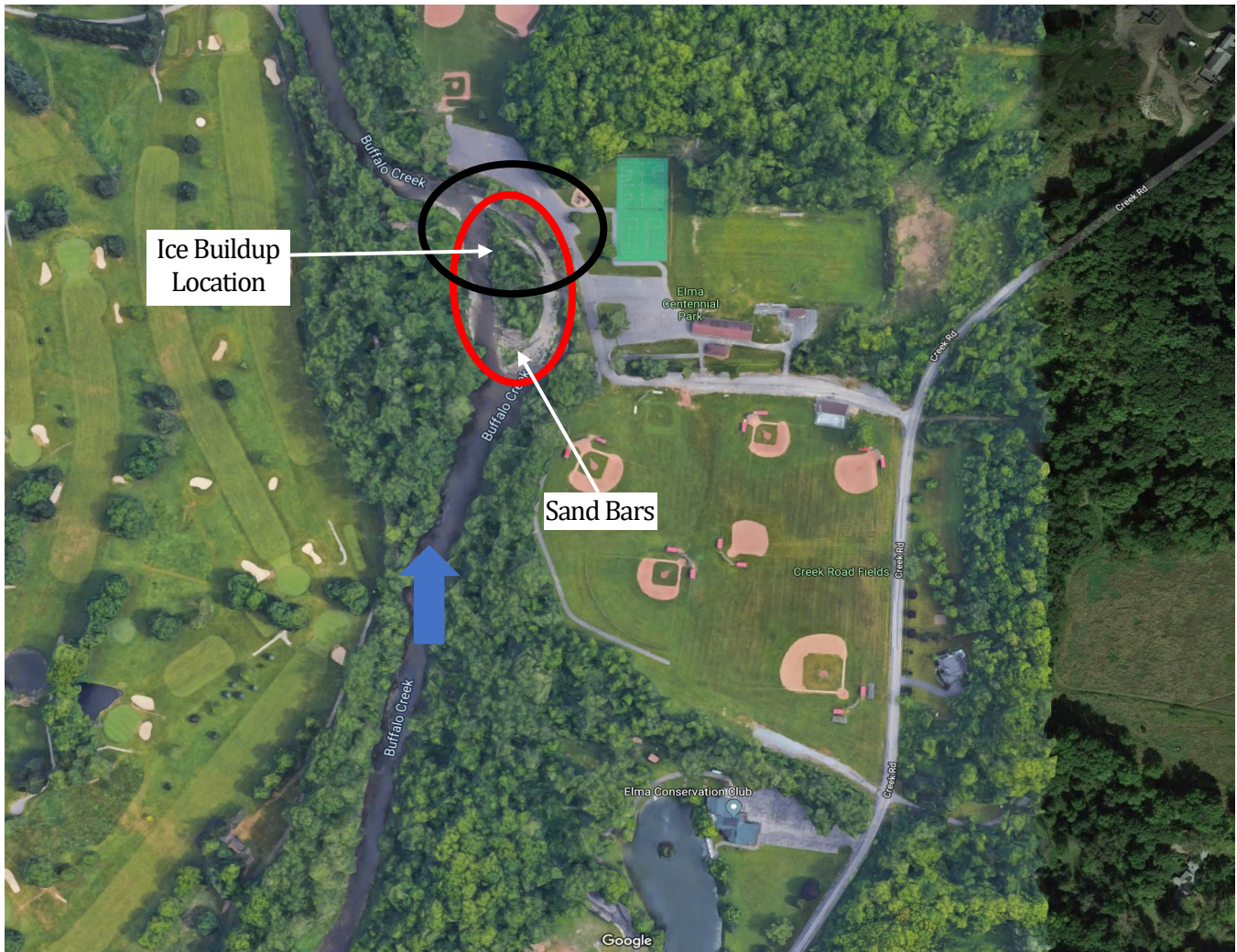


Figure 8. Ice buildup and sand bar locations downstream the Centennial Park area in the Town of Elma, NY.

## MITIGATION RECOMMENDATIONS

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### ALTERNATIVE #1: REMOVE ABANDONED RAILROAD BRIDGE

This measure is intended to increase the channel flow area by removing the abandoned railroad bridge located approximately three-quarters of a mile west of the Indian Church Road and Route 277 (Union Road) junction. Removing the railroad bridge, approach abutments, and associated piers that support the bridge would remove in-channel impediments to flow of water, sediment, debris, and ice. Removal of these impediments would reduce constriction at the railroad bridge, which has historically caused ice jam floods in this area (Figure 6).

The proposed condition modeling confirmed that the abandoned railroad bridge is a constriction point along Buffalo Creek. The simulation output results indicate the railroad bridge and its piers restricts flow causing the water to contract and flow downstream under the bridge. At higher flows, this causes backwater and increased water surface elevations of up to 0.5 ft immediately upstream of the bridge. Without the railroad bridge and its piers, the backwater effect is removed, and water surface elevations are reduced in this reach (Figure 14). Uniformity of flow also has the potential to reduce for the chances of ice jam formation.

To assess the influence of ice jams on the railroad bridge and its piers, a blocked obstruction simulation with varying ice cover thicknesses was performed. This simulation was intended to mimic the effects of ice formations on the banks and piers in the event of an ice jam upstream of the railroad bridge, which would reduce the cross-sectional area of the channel for water to flow. The simulation results indicated for a 10-year flood event with approximately 8,000 cfs and a 1.5-ft thick ice cover, water surface elevations would increase 1-2 feet immediately upstream of the railroad bridge compared to non-ice jam water surface elevations for a 10-year flood event discharge (Figure 15). This would be the case if the railroad were removed or left in place for flows below the 1-percent annual chance flood; however, at flows greater than the 1-percent annual chance flood levels, the removal of the railroad bridge reduced water surface elevations from the resulting ice jam when compared to water surface elevations if the railroad bridge was not removed.

The railroad bridge has a large pier near the center of the stream channel. When ice forms in the creek and reaches the railroad bridge, this pier acts as a barrier to and restricts flow in the channel increasing the potential for ice jam formation and flooding. Therefore, by removing the railroad bridge, and its piers, the potential for ice jamming and associated water level rises in the area can be reduced. The potential benefits of removing the railroad would affect water surface elevations only in the vicinity of the bridge at river stations 75+00 and 95+00.

The Rough Order Magnitude cost for this measure is \$480,000.

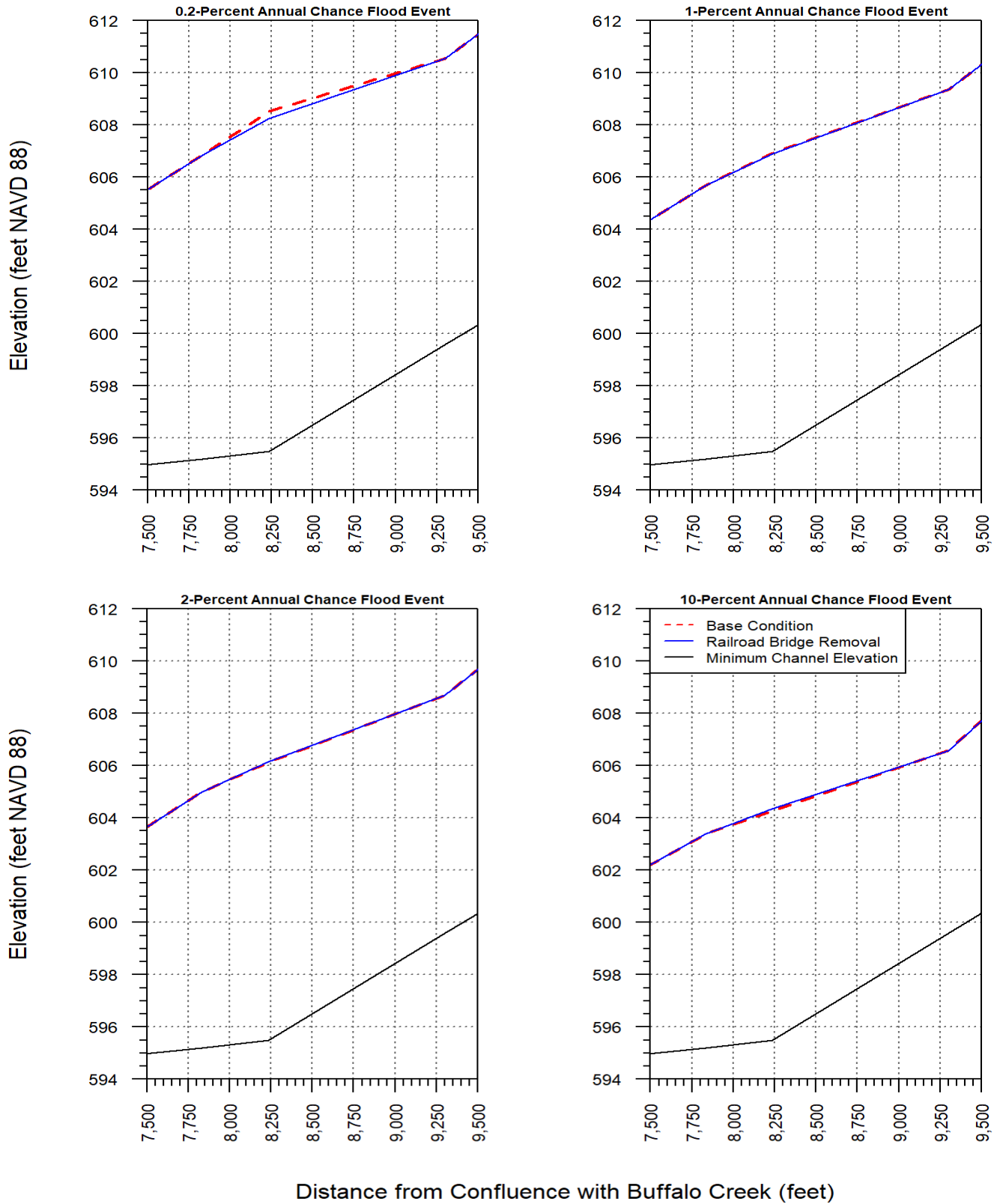


Figure 9. Alternative #1 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the railroad removal (blue) and base condition (red) simulations.

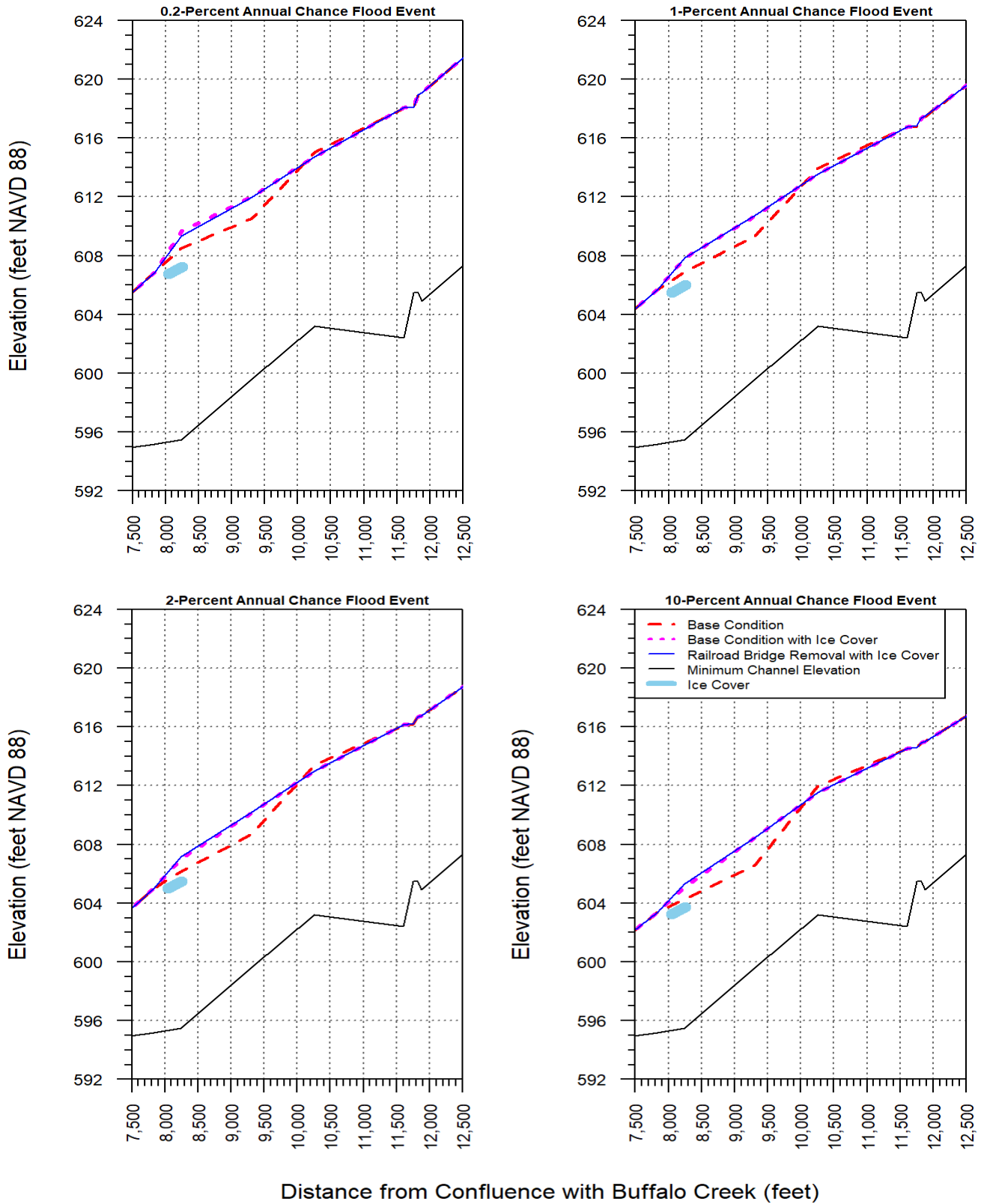
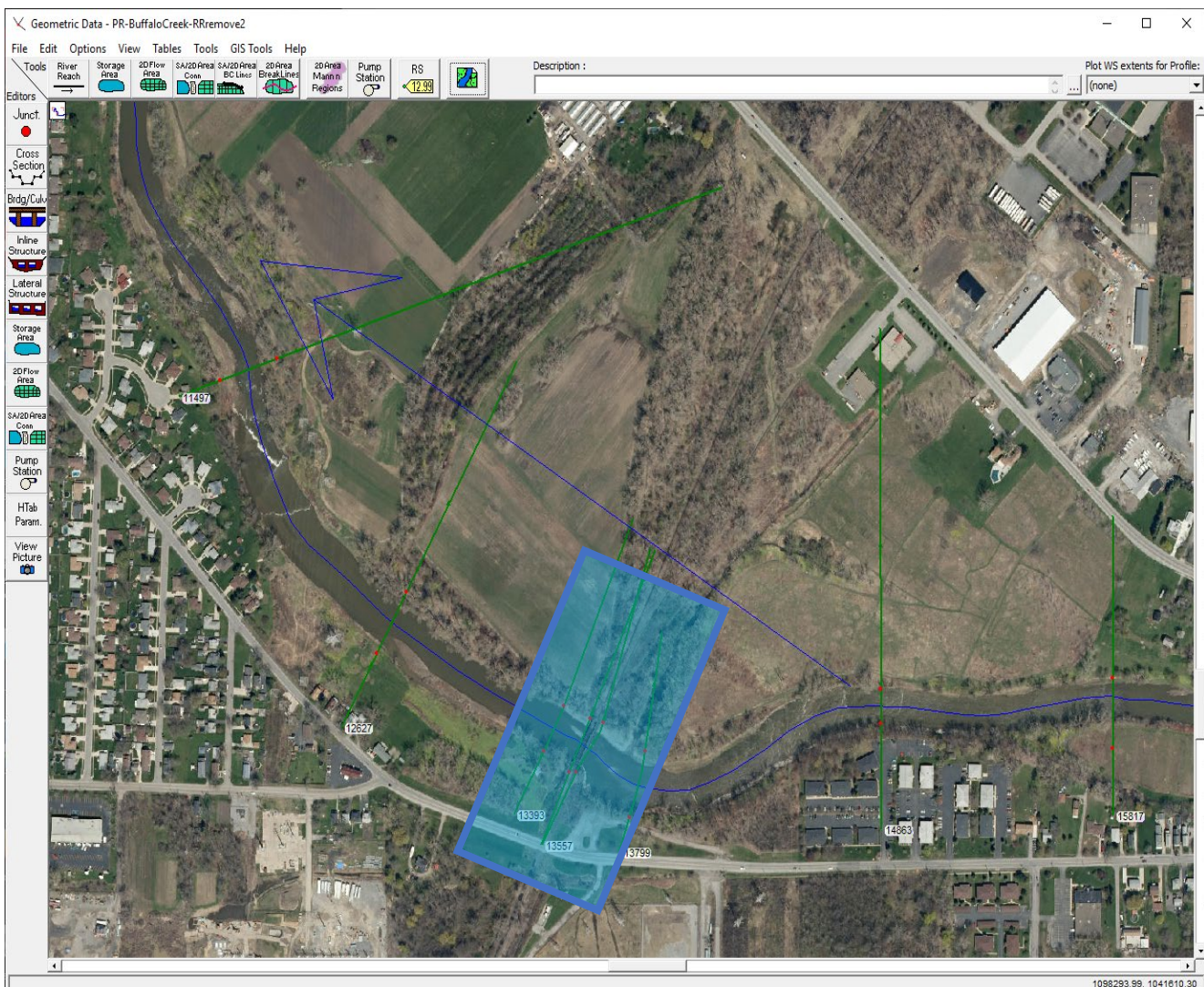


Figure 10. Alternative #1 HEC-RAS ice cover model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the railroad bridge removal with ice cover (blue), base condition with ice cover (red dashed), and base condition (red) simulations.

**ALTERNATIVE #2: REMOVE ABANDONED RAILROAD BRIDGE AND ASSOCIATED TOPOGRAPHY**

This measure is intended to increase the channel flow area by removing the abandoned railroad bridge and the topography supporting the railroad bridge. The elevated landscape that was built on both banks of the creek to support the railroad bridge crossing, constrict water as it flows downstream under the bridge. During high flow and ice jam events, this compressing causes backwater, which increases water surface elevations upstream and the potential for backwater and/or ice jam flooding. By removing the railroad bridge and the associated support topography and returning the landscape to a more natural and subdued elevation, the bankfull and overbank widths in this reach can be increased, providing additional storage and floodplain width. In addition, this alternative would include the benefits of alternative #1 since the railroad bridge removal would be included in this alternative (Figure 16).



**Figure 11. Alternative #2 location map. Railroad bridge removal and associated topography are located between river stations 70+00 and 85+00.**

The proposed condition modeling confirmed that the abandoned railroad bridge and its topographic features are a constriction point along Buffalo Creek. The proposed condition simulation results indicate that the railroad bridge topography constricts flow but does not have a large influence on

flooding within the reach. The simulation determined water surface elevation increases of up to 0.3-ft immediately upstream of the railroad bridge with a small decrease of up to 0.1-ft further upstream of the bridge for low flow events. However, for high flow events above the 1-percent annual chance flood levels, the model results indicated decreased water surface elevations of up to 1-ft. The future conditions modeling displayed similar results with starting water surface elevations 0.1-0.5 ft higher due to the increased discharges associated with predicted future flows (Figure 17).

To assess the influence of ice jams on the railroad bridge and its embankment, a blocked obstruction simulation with a 1-foot ice cover thickness was performed. This simulation was intended to mimic the effects of ice formations on the banks and piers in the event of an ice jam in the vicinity of the railroad bridge, which would reduce the cross-sectional area of the channel for water to flow. The simulation results indicated for a 10-year flood event with approximately 8,000 cfs and a 1.5-ft thick ice cover, water surface elevations would increase up to 6-feet compared to non-ice jam water surface elevations for a 10-year flood event discharge (Figure 18). The increases in water surface elevation varied for the proposed condition simulation and base condition with ice cover. The proposed condition water surface increase occurs upstream of the railroad bridge then water levels decrease as they approach the Lexington Green neighborhood almost returning to non-ice cover water surface elevations. The base condition with ice cover water surface elevations peak downstream of the railroad bridge and then return to near non-ice cover water levels as they approach the neighborhood.

Water surface elevations increased in the reach after removing the topography due to the narrow topography of Buffalo Creek in this reach as a whole. Upstream of the railroad bridge, the topography of the creek is narrow with steep banks. Water is constricted as it moves through this reach until it passes the railroad bridge, then the channel banks flatten and widen causing water to expand, slow down, and increase water depth. Although removing the railroad topography does not simulate a significant reduction in water surface elevations, there are important benefits of removing the railroad bridge and associated topography with regards to reducing ice jam flooding potential. The potential benefits of removing the railroad bridge and associated topography would affect the areas in the vicinity of the railroad bridge at river stations 60+00 and 120+00.

The Rough Order Magnitude cost for this measure is \$3.5 Million.

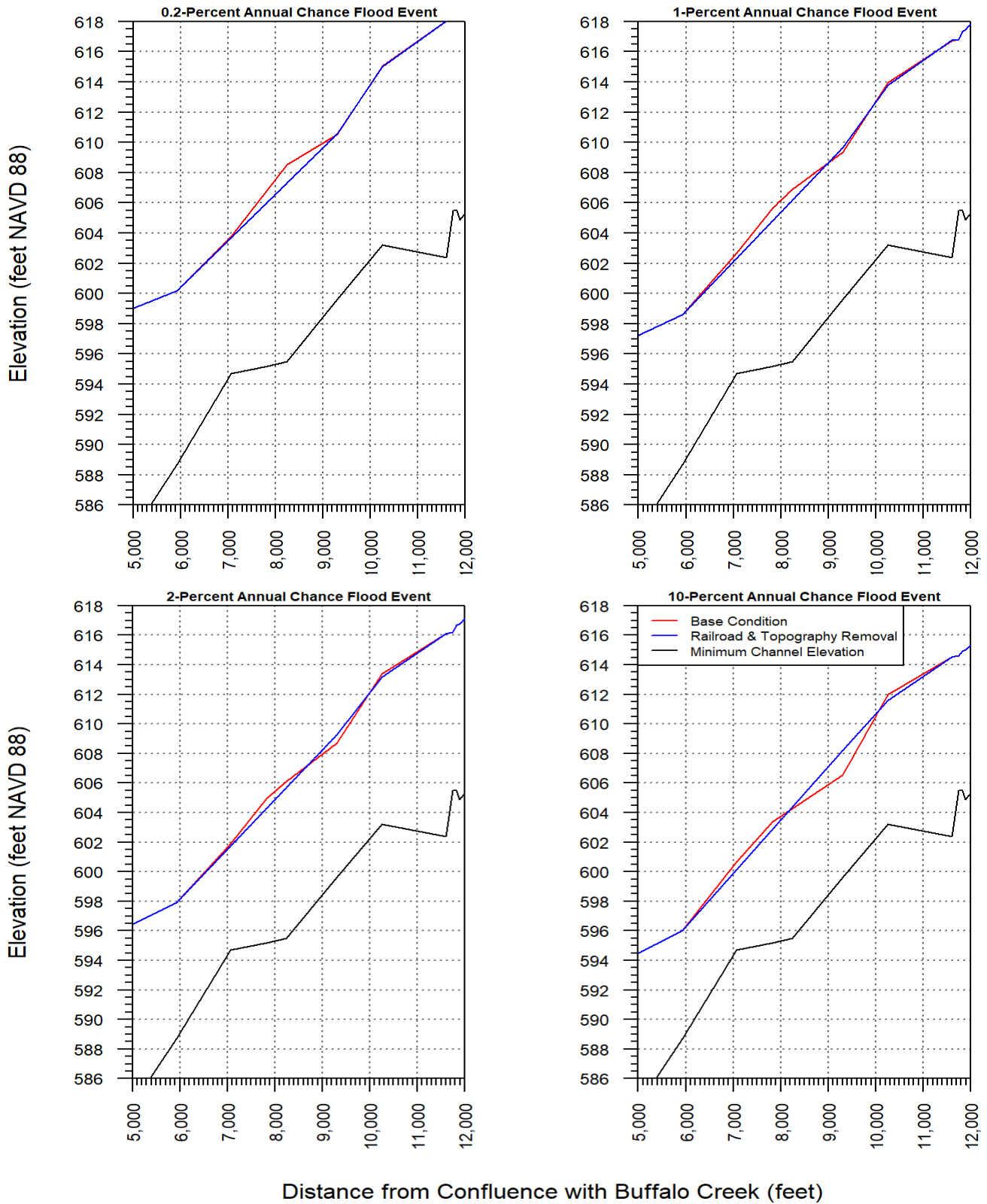


Figure 12. Alternative #2 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the railroad bridge and associated topography removal (blue) and base condition (red) simulations.

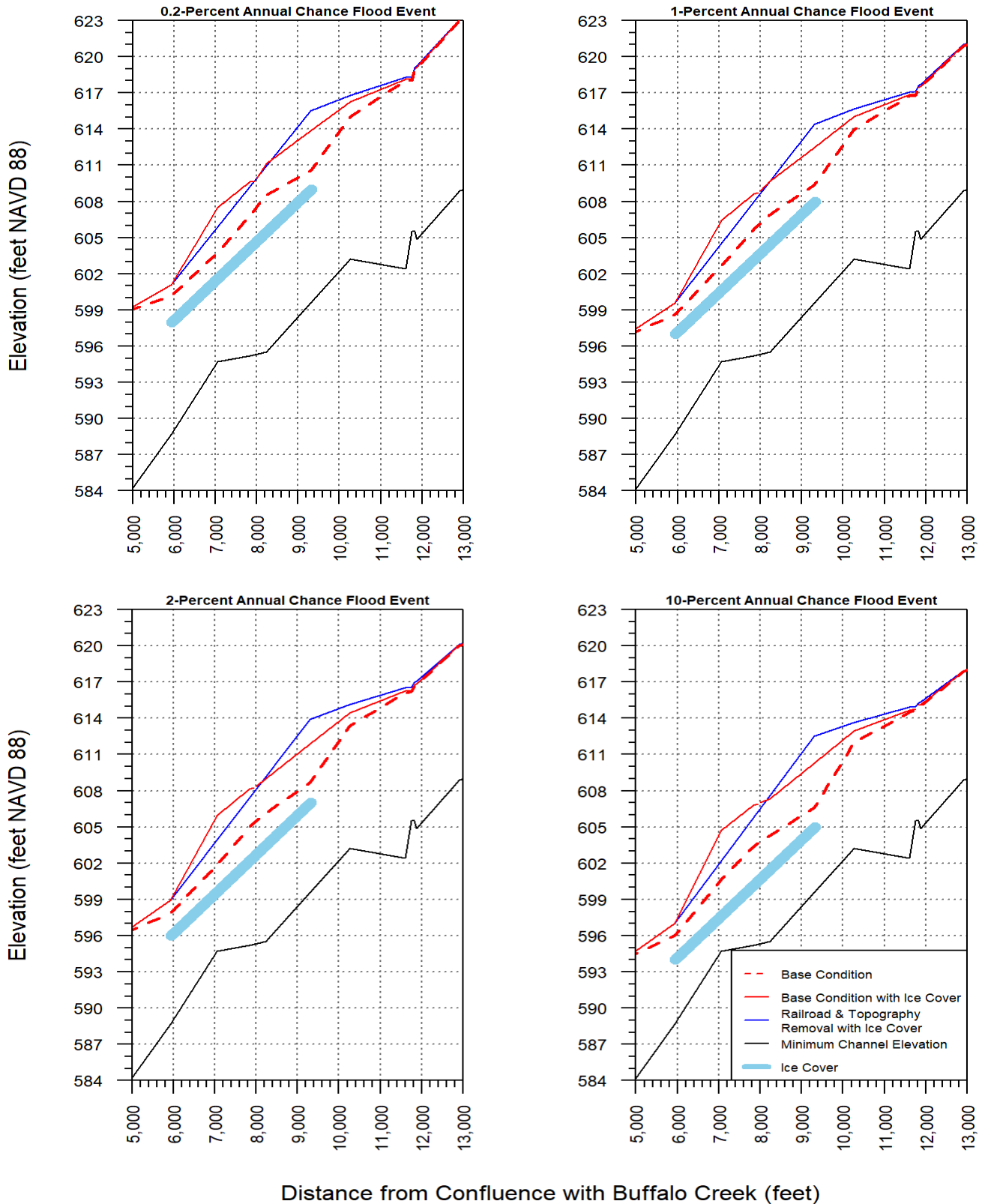


Figure 13. Alternative #2 HEC-RAS ice cover model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the railroad bridge and topography removal with ice cover (blue), base condition with ice cover (red dashed), and base condition (red) simulations.



**ALTERNATIVE #3: REPLACE RAILROAD BRIDGE AND ASSOCIATED TOPOGRAPHY WITH FLOOD BENCH**

This measure is intended to increase the channel flow area by removing the abandoned railroad bridge and the topography supporting the railroad bridge and replacing these features with a flood bench, which would increase the cross-sectional area of the floodplain. By building a flood bench, additional storage and floodplain width can be achieved, which could potentially reduce even more damages in the event of flooding when compared to alternatives #1 and #2, while still achieving the same benefits of alternatives #1 and #2 (Figure 19).

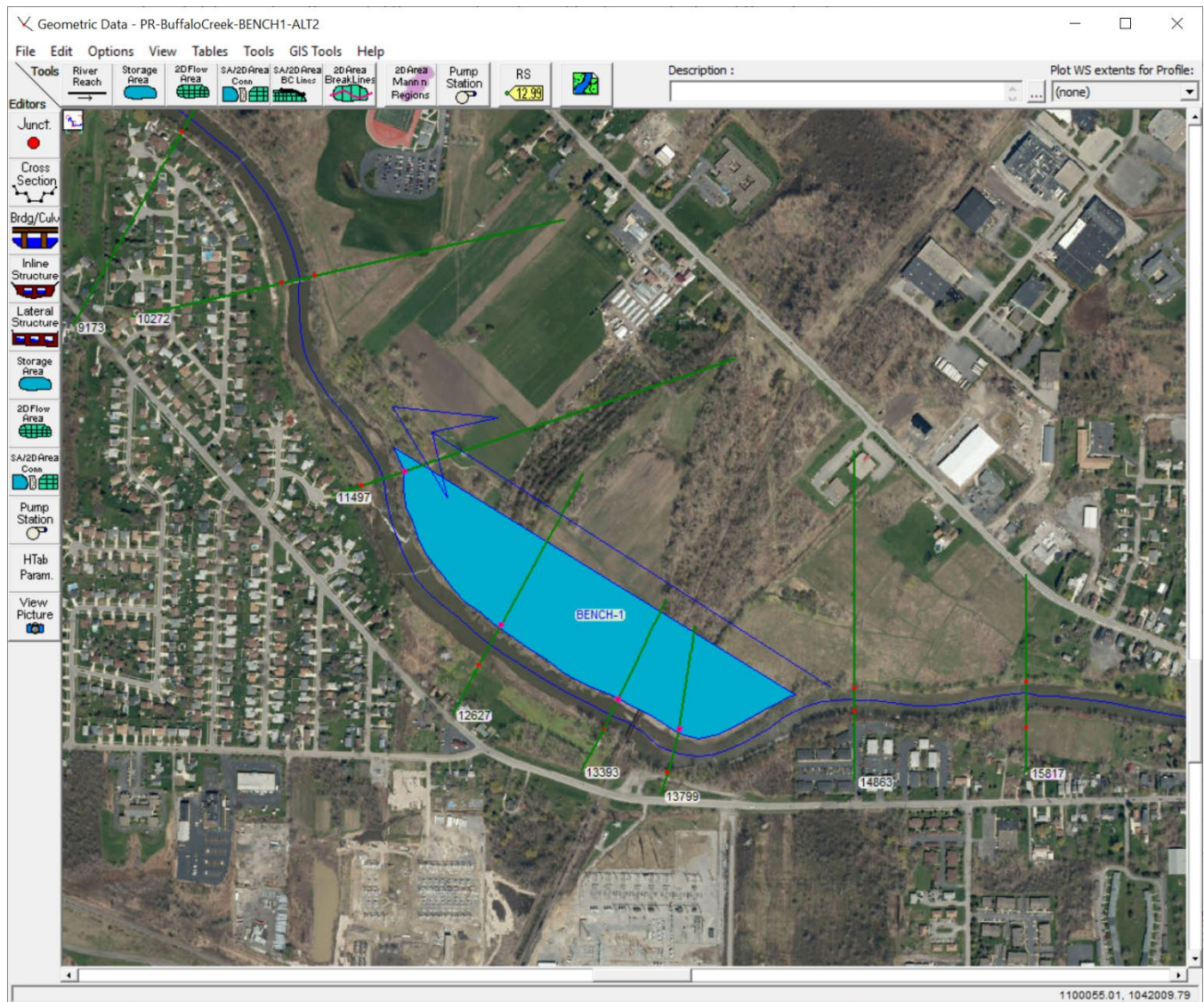


Figure 14. Alternative #3 location map. Flood bench (blue) would be location between river stations 55+00 and 95+00.

In the proposed condition simulation when a flood bench with varying depths was added in place of the railroad topography, there was a measurable reduction in the water surface elevation. When flood benches of 3-6 feet were simulated, the potential reduction in water surface elevations were 2-3 feet according to the model results (Figure 20). The modeling output for future conditions predict slightly smaller reductions (1.5 to 2.5 ft) due to the increased discharges associated with predicted future flows in Buffalo Creek.

By removing the railroad bridge, its piers, and incorporating a flood bench, the potential for flooding and ice jams in the area can be reduced. The potential benefits of a flood bench are limited to the areas immediately upstream and downstream of the bridge, specifically between river stations 55+00 to 95+00.

The Rough Order Magnitude cost for this measure is \$12.6 Million.

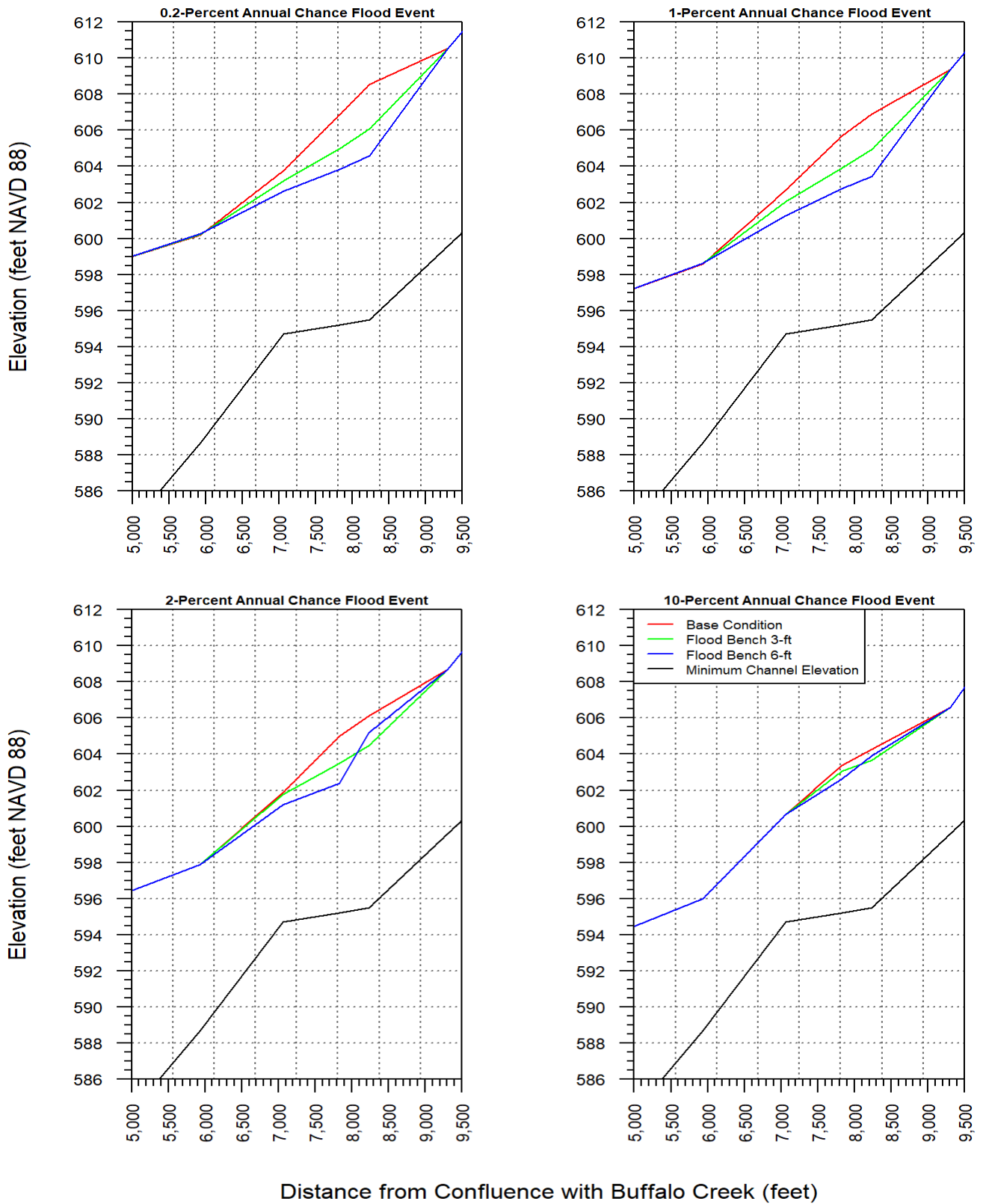


Figure 15. Alternative #3 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the 3-ft (green) and 6-ft (blue) flood bench and base condition (red) simulations.

**ALTERNATIVE #4: RECONNECT THE OXBOW LAKE**

This measure is intended to increase the cross-sectional flow and potential storage area for high flows by reconnecting a portion of Buffalo Creek with the oxbow lake. The need for and function of the sills would need to be analyzed, including the possibility of worsening submerged hydraulic jump conditions. The oxbow lake could provide valuable additional acreage for water during high flows and ice jam overflows. Reconnecting the oxbow would reduce the need for large construction projects, while maintaining the natural habitats and aesthetics the oxbow wetlands provide to the community (Figure 121).

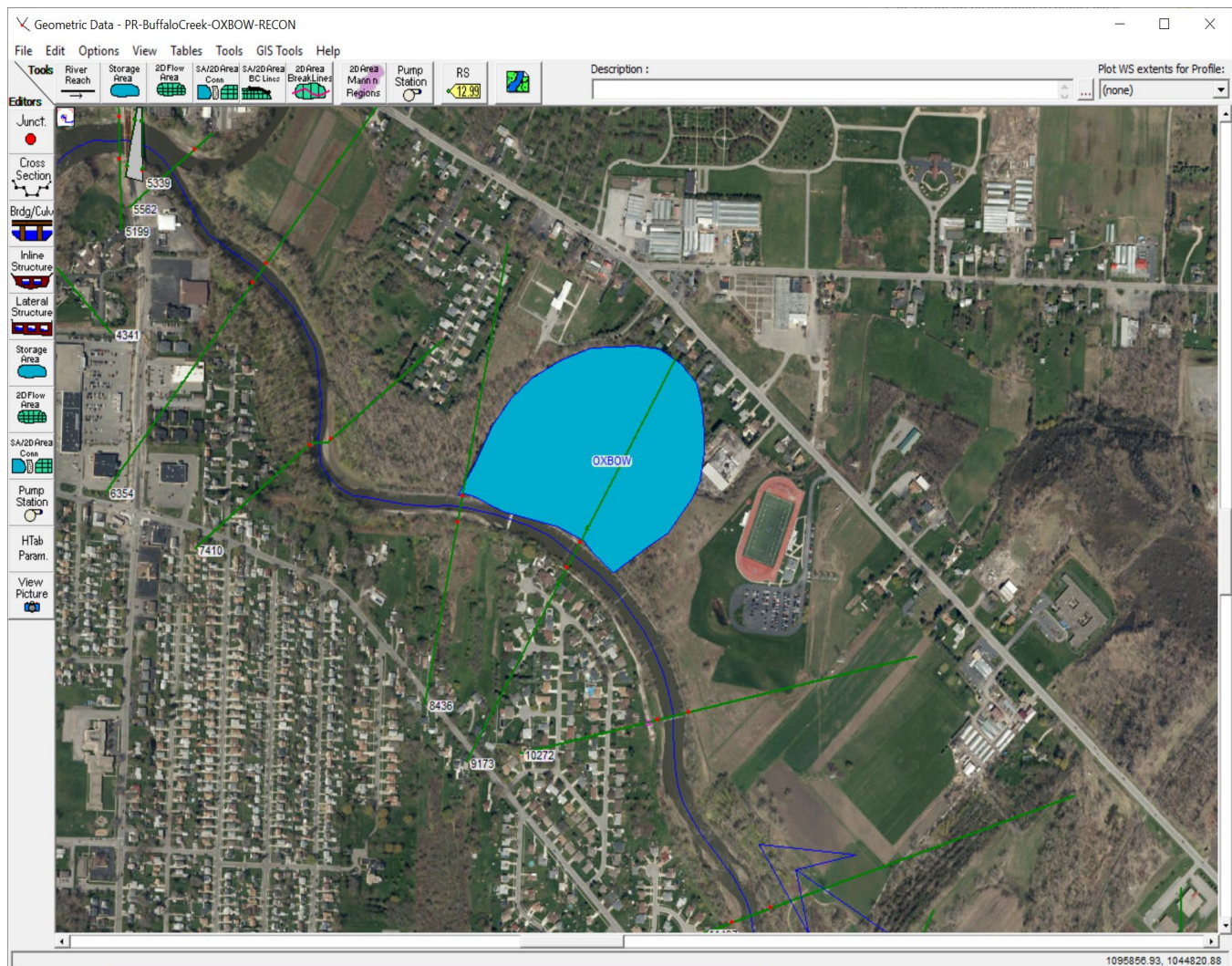


Figure 16. Alternative #4 location map. The oxbow lake (blue) is located between river stations 30+00 and 50+00.

The topography between Buffalo Creek's main channel and the oxbow lake has been built up with sediment so high flows currently do not engage the oxbow lake's additional storage area. The topography between the creek and the oxbow would need to be reduced to below the 1-percent annual chance flood event water surface elevation in order to utilize the additional storage area of the oxbow lake for high flow events.

The proposed hydraulic modeling confirmed that reconnecting the oxbow provides additional storage during high flow events in Buffalo Creek. Potential water surface reductions of up to 1.6-ft was

simulated. The future conditions modeling predict slightly smaller reductions, due to the increased discharges associated with predicted future flows (Figure 22).

The simulation output results indicate that reconnecting the oxbow lake to Buffalo Creek would provide valuable additional water storage area during high flow events. Since the oxbow lake is designated as a freshwater wetland, construction of any kind would present numerous regulatory challenges in addition to temporarily displacing many natural habitats. In addition, for any changes or tie-ins to the oxbow lake, permission must be sought from the NRCS and Erie-Wyoming Joint Conservation Board prior to construction. The potential benefits of reconnecting the oxbow lake are limited to areas immediately upstream of the oxbow, specifically between river stations 35+00 to 70+00.

The Rough Order Magnitude cost for this measure is \$6.4 Million.

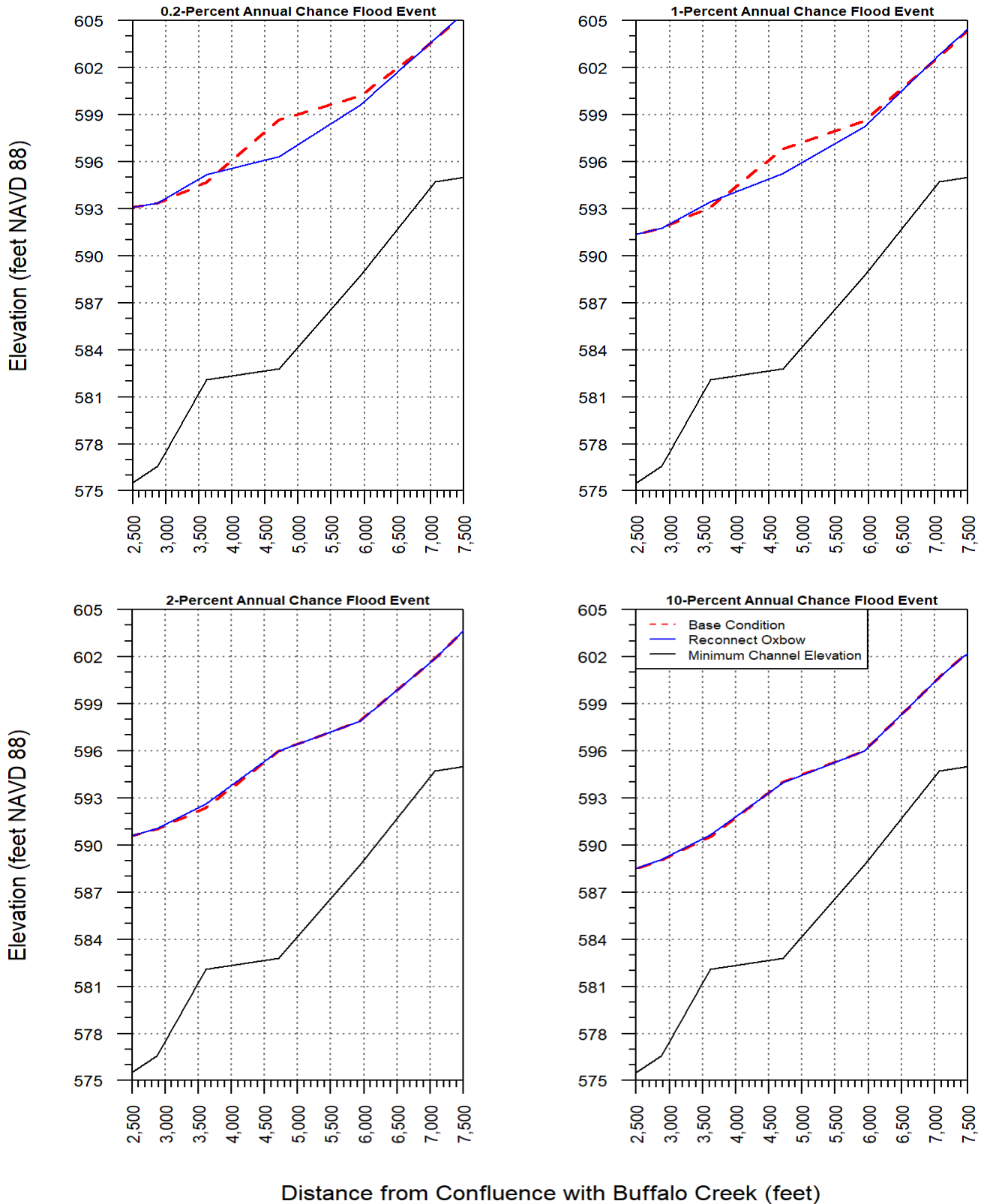


Figure 17. Alternative #4 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the oxbow reconnection (blue) and base condition (red) simulations.

**ALTERNATIVE #5: RECONNECT THE OXBOW LAKE AND INSTALL FLOOD BENCH**

This measure is intended to increase the cross-sectional flow and potential storage area for high flows by reconnecting a portion of Buffalo Creek with the oxbow lake and installing flood benches in the oxbow lake. The oxbow lake could provide valuable additional acreage for water during high flows and ice jam overflows. Reconnecting the oxbow and installing flood benches would reduce the need for large construction projects, while maintaining the natural habitats and aesthetics the oxbow wetlands provide to the community since the flood benches would allow the natural habitats to reclaim the area after construction. This project would include the benefits of alternative #4 and would be located in the same reach along Buffalo Creek between river stations 30+00 and 50+00 (Figure 21).

The proposed hydraulic modeling confirmed that reconnecting the oxbow provides additional storage during high flow events in Buffalo Creek. The proposed condition simulation considered scenarios of reconnecting the oxbow and then adding a 3-9-foot flood bench. Potential water surface reductions of 2-4 feet were simulated. The future conditions modeling predict slightly smaller reductions, due to the increased discharges associated with predicted future flows (Figure 23).

The simulation output results indicate that reconnecting the oxbow lake to Buffalo Creek and installing flood benches would provide valuable additional water storage area during high flow events. Since the oxbow lake is designated as a freshwater wetland, construction of a flood bench would present numerous regulatory challenges in addition to temporarily displacing many natural habitats. The potential benefits of reconnecting the oxbow lake are limited to areas immediately upstream of the oxbow, specifically between river stations 35+00 to 70+00.

The Rough Order Magnitude cost for this measure is \$22.1 Million.

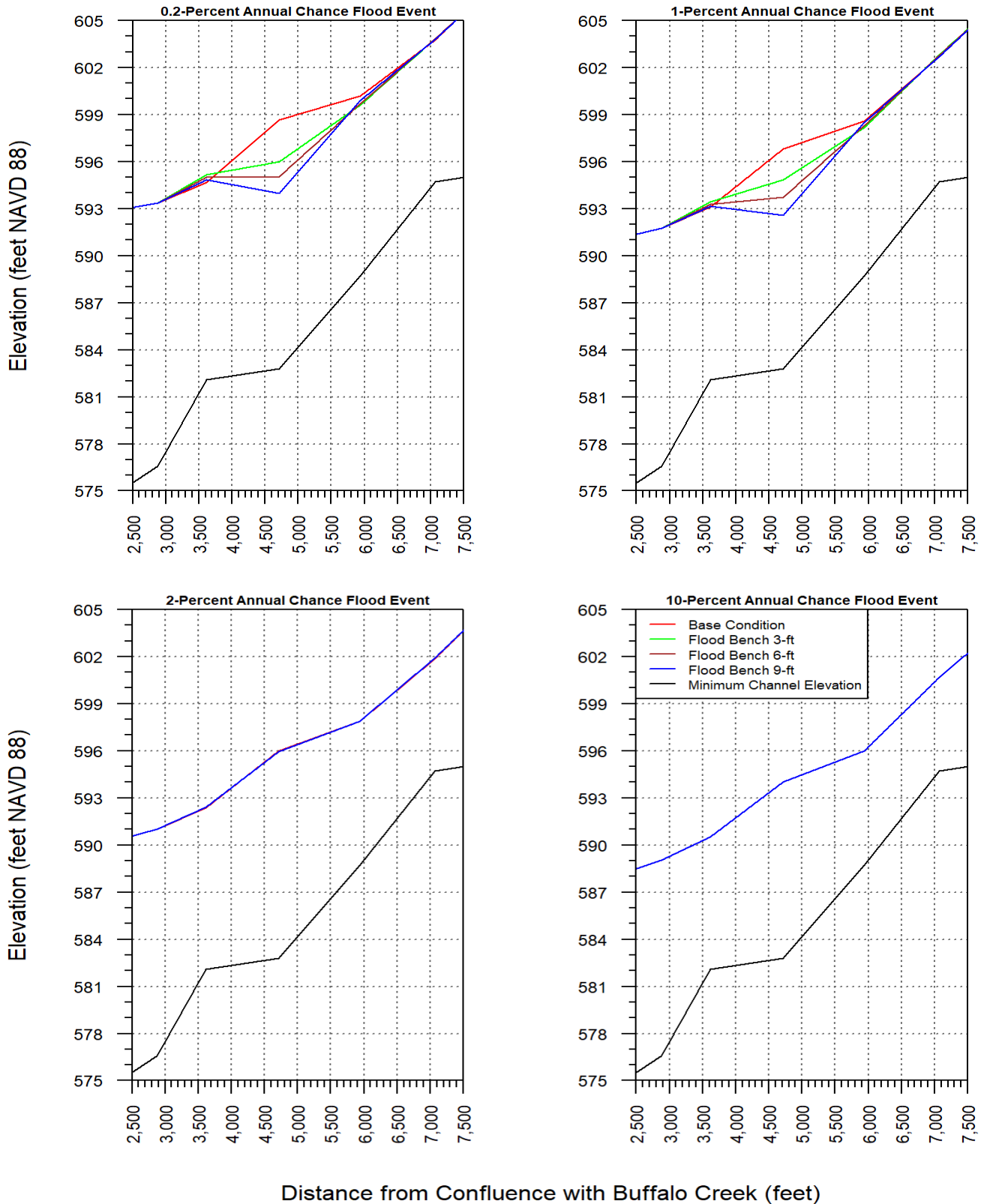


Figure 18. Alternative #5 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the 3-ft (green), 6-ft (brown), and 9-ft (blue) flood benches and base condition (red) simulations.



**ALTERNATIVE #6: FLOOD BENCH**

This strategy is intended to increase the cross-sectional flow and potential storage area for high flows by constructing flood benches along the right bank of Buffalo Creek downstream of the abandoned railroad bridge and extending to the oxbow lake. This strategy would require excavating approximately 4,000 linear feet of channel banks (Figure 24).

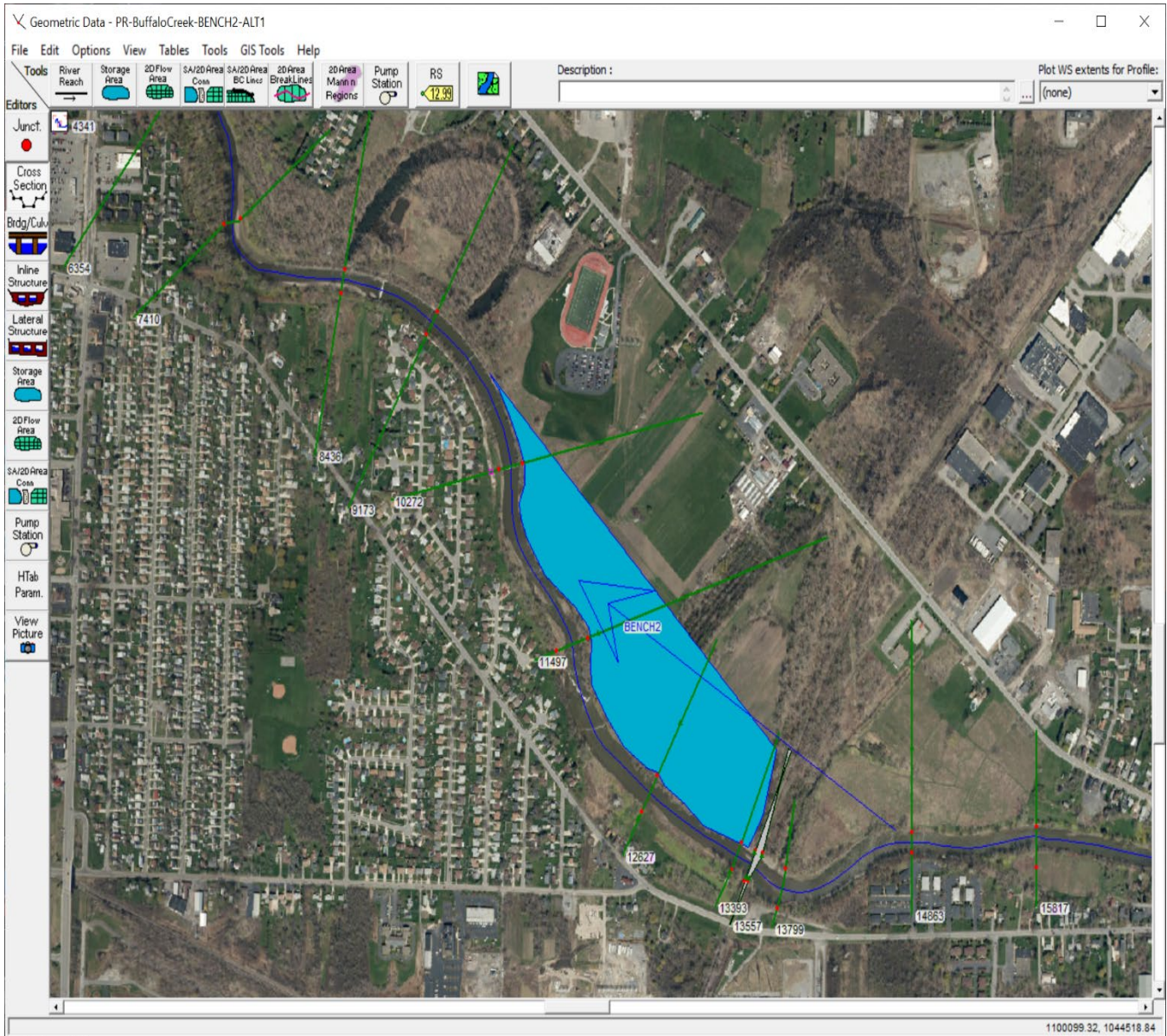


Figure 19. Alternative #6 location map. The flood bench (blue) is located between river stations 42+00 and 80+00.

The proposed condition simulation resulted in measurable reductions in water surface elevations along the 4,000 ft long reach of Buffalo Creek. Water surface reductions for a 3-6-foot bench were modeled to be 1-2 feet. The future conditions modeling output predict slightly smaller reductions in water surface elevations due to discharges associated with predicted future flows (Figure 25).

The model results indicate this strategy would provide a reduction in water surface elevations across a longer portion of Buffalo Creek, including upstream of the railroad bridge. The potential benefits of the flood bench are immediately upstream and in the vicinity of the bench at river stations 60+00 and 90+00.

The Rough Order Magnitude cost for this measure is \$16.2 Million.

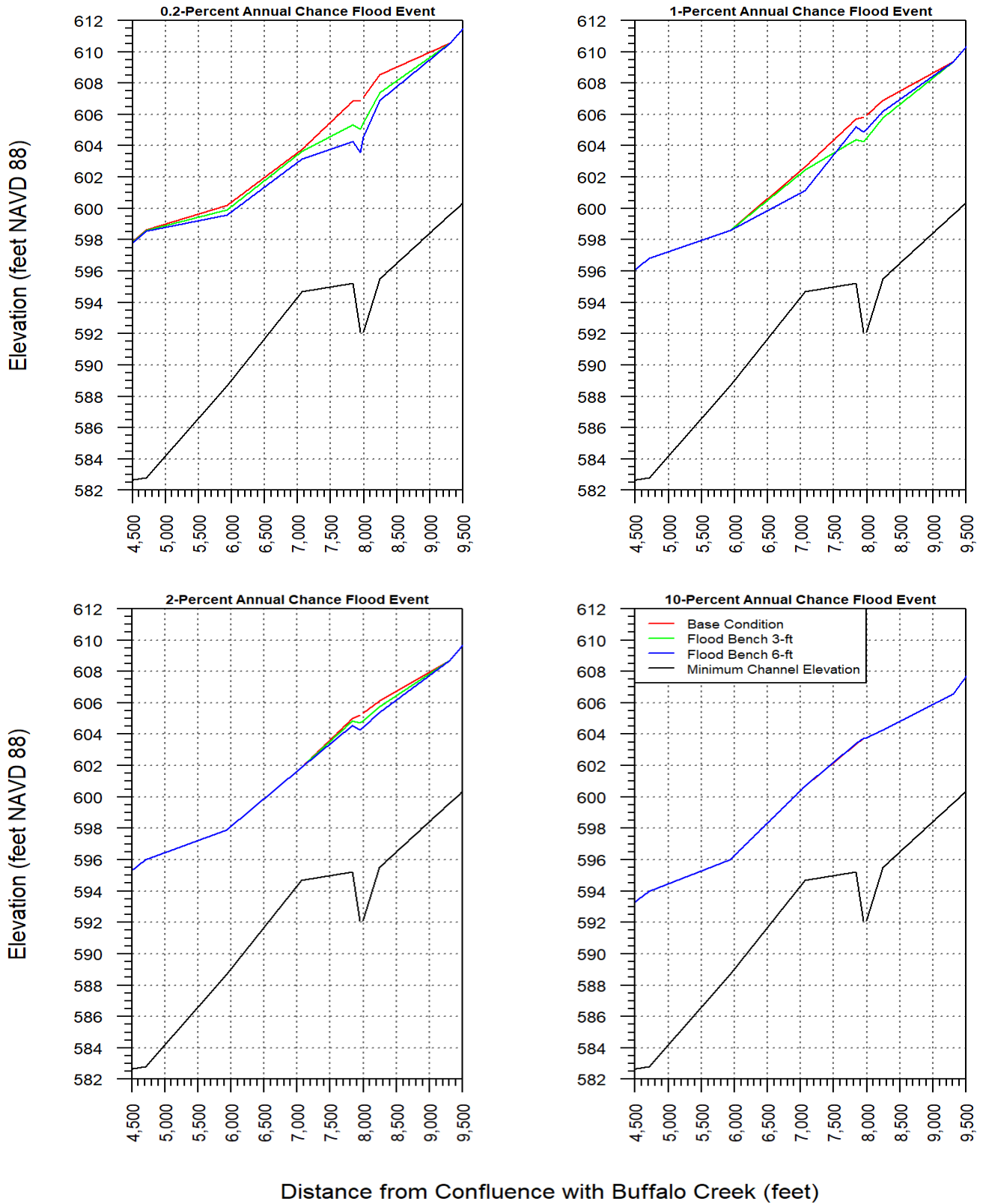
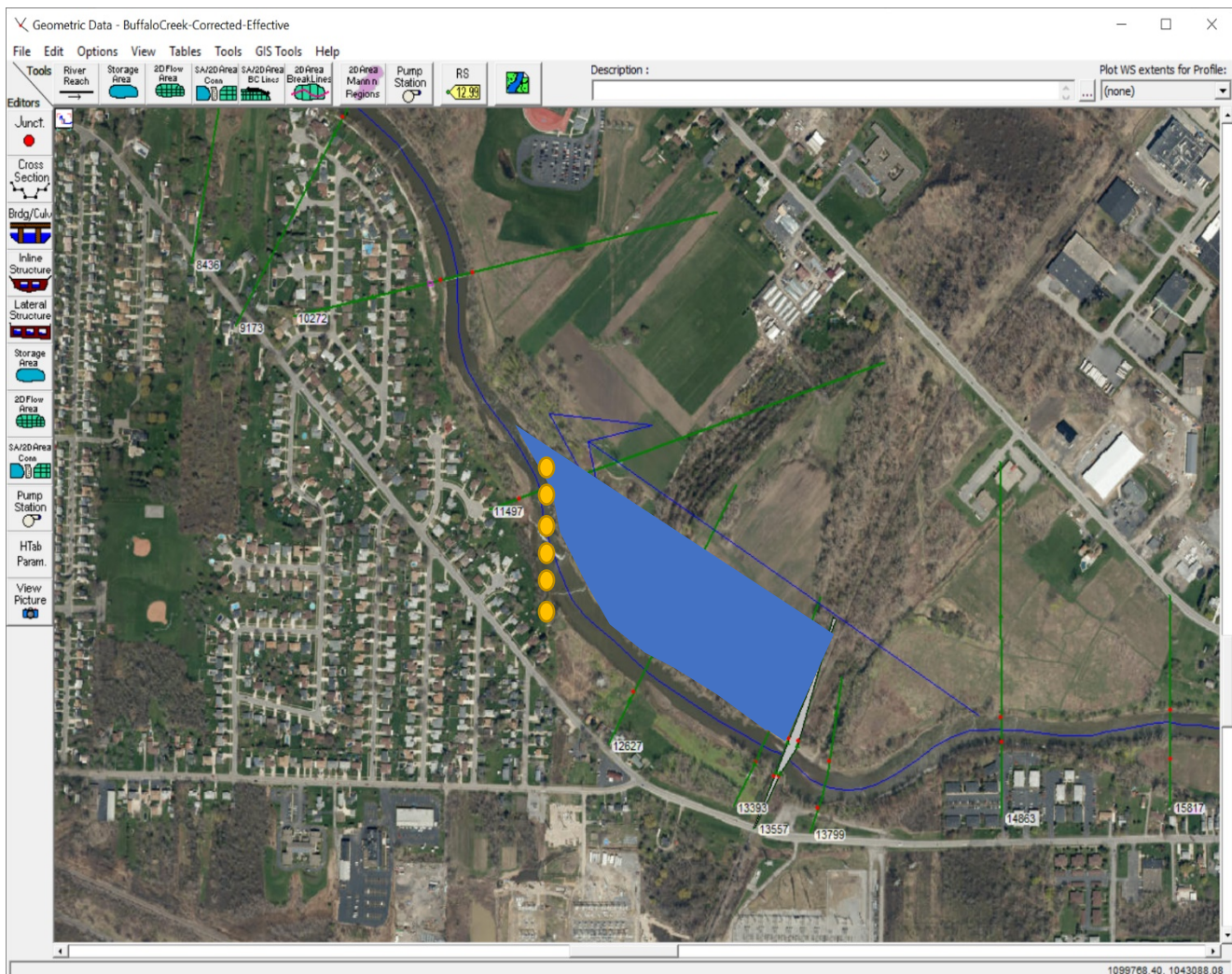


Figure 20. Alternative #6 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the 3-ft (green) and 6-ft (blue) flood benches and base condition (red) simulations.

**ALTERNATIVE #7: ICE CONTROL STRUCTURE**

The addition of a flood bench increases the water storage volume to the river, making it more susceptible to capture and generating ice during the winter time. Therefore, ice cover break-up is needed to avoid freeze-up jams. Some ice control structures should also be considered downstream of the bench and across or on either side of the river to capture or divert incoming ice flows or broken ice pieces flowing downstream. Ice control structures are constructed within the stream channel at a sufficient height where ice blocks within the channel are captured while still allowing for water to flow around the structures and captured ice blocks (Lever et al. 2000). The structures direct ice into a flood bench that provides the required area to accommodate increased flows during an ice jam event. The flood bench would be located on the right bank of Buffalo Creek opposite the Lexington Green neighbor (Figure 26).



**Figure 21. Alternative #7 location map. Flood bench (blue) and ice control structure (orange circles) would be located between river stations 55+00 and 80+00.**

Due to the complexity of ice jam modeling and the limited scope of this study, hydraulic modeling was not performed to assess the impact of this strategy. The frazil ice and surface ice flow are complicated due to the number of variables such as water depths, surface area, air temperature, flow velocity, etc.

Therefore, any suggested ice control structure in the river or in flood benches would need to go through a dynamic ice freeze-up and break-up computer modeling (2-dimensional River ice dynamic simulation) simulation to understand the ice transport and ice generation mechanism with and without the structures to support the proposed design. Poorly designed structures may result in worsening the flooding potential instead of mitigating the ice jam related flooding (USACE 2016a).

The Rough Order cost for this measure is approximately \$11.2 Million, including construction costs for a flood bench.

**ALTERNATIVE #8: LEVEE**

This strategy is intended to restrict high flow events from overtopping channel banks and flooding homes, properties, etc. in the high-risk area of the Lexington Green neighborhood by constructing a permanent levee along the neighborhood. The levee would be approximately 2,300-5,100 feet long and a height of 2 feet above the future flood flow stage for the projected 1-percent annual chance flood elevation (596-608 ft NAVD 88). Compaction and the possibility of using cut material as fill has not been accounted for at this point. Downstream and opposite bank effects of the levee were modelled, and the levee was determined to have no measurable effects on upstream or downstream water surface elevations (Figure 27).

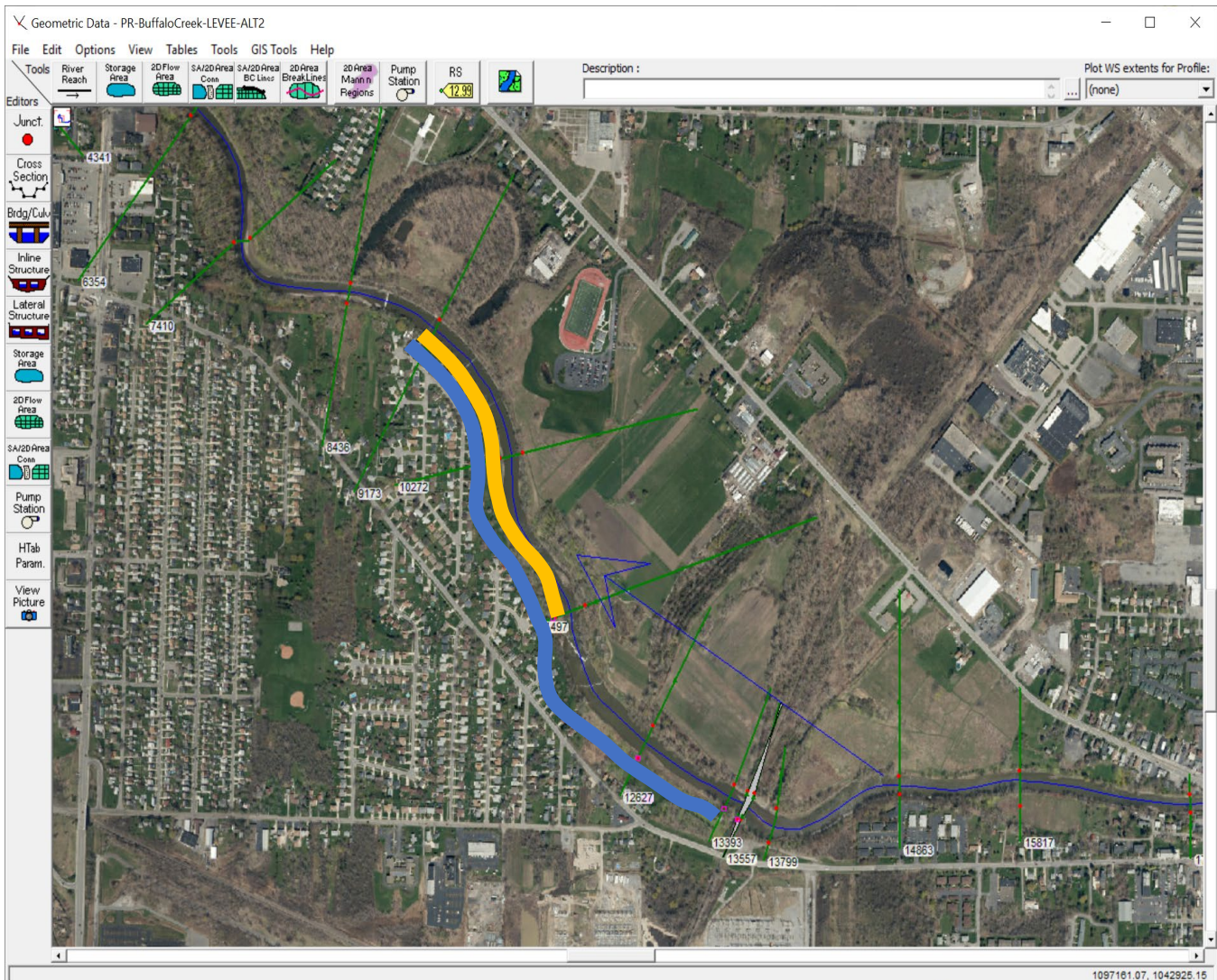


Figure 22. Alternative #8 location map. Two different levee lengths, 2,300 ft (orange) and 5,100 ft (blue) were simulated along the left bank of Buffalo Creek from river station 35+00 to 60+00 and 35+00 to 115+00, respectively.

The proposed and future hydraulic modeling confirmed that constructing a levee along Buffalo Creek in the reach adjacent to the Lexington Green neighborhood would decrease the flood risk of the neighborhood, while leaving the flood potential of downstream and opposite bank areas unaffected (Figure 28).

Both levee structures provide protection to the Lexington Green neighborhood. The 5,100 ft levee structure provides additional protection to residences and businesses on the left bank immediately downstream the railroad bridge along Mineral Springs and Indian Church Roads. A cost-benefit analysis would be recommended to determine which levee structure would best for this alternative. The potential benefits of the flood benches are immediately upstream and in the vicinity of the levees at river stations 30+00 and 75+00.

The Rough Order Magnitude cost for this strategy is approximately \$5.5 Million for the 2,300 ft levee.

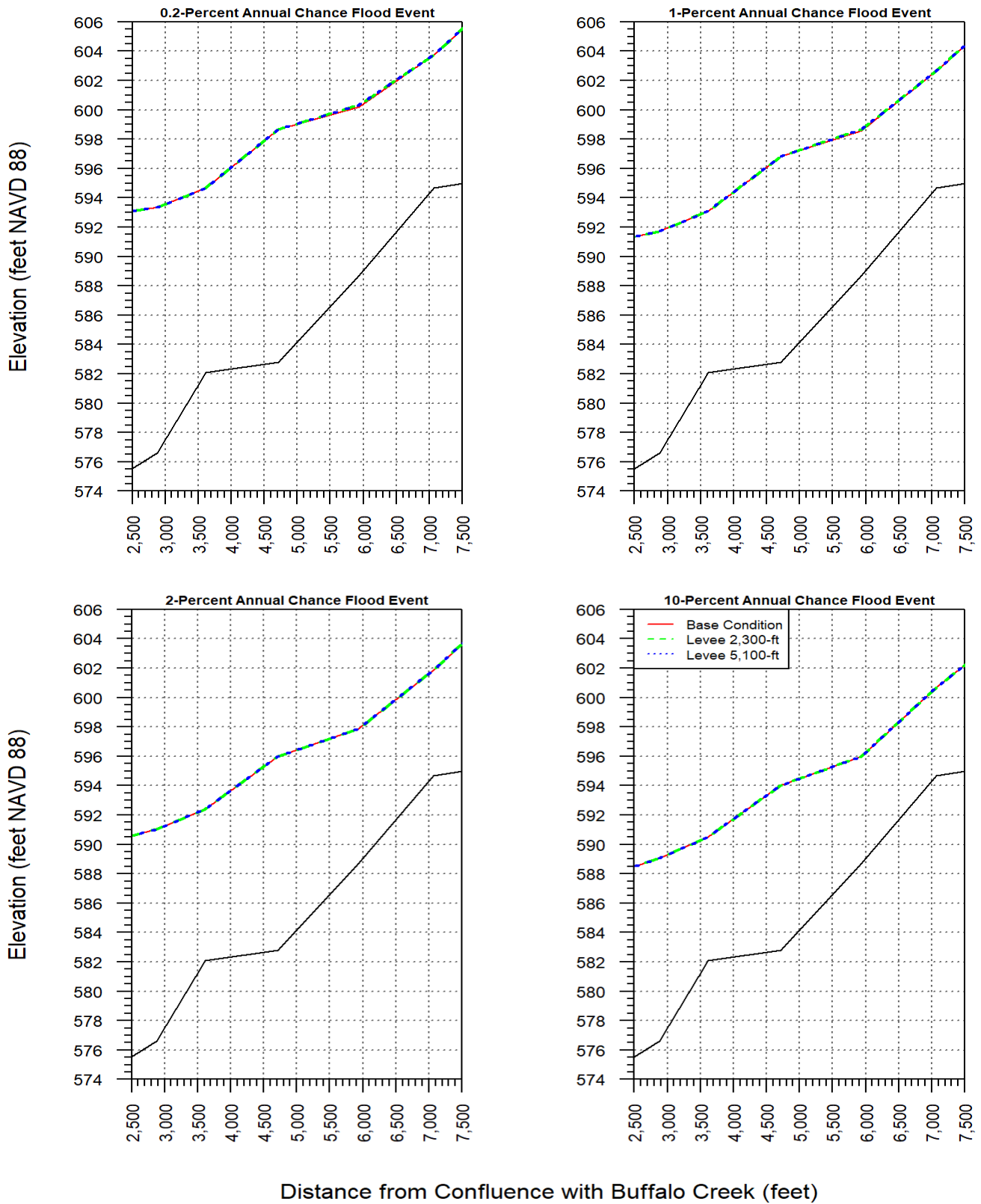


Figure 23. Alternative #8 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the 2,300 ft (green), 5,100 ft (blue), and base condition (red) simulations.



**ALTERNATIVE #9: PILOT CHANNEL**

This strategy is intended to divert high flow events from the main channel of Buffalo Creek into a pilot channel, which would flow parallel to the creek and outflow into the oxbow lake. The pilot channel would begin diverting flow immediately downstream of the railroad bridge and would require using the oxbow as additional storage and construction of a connection between the oxbow lake and the main channel of Buffalo Creek. This measure would also require the acquisition of private lands bordering the right bank of Buffalo Creek in this reach in order to construct the pilot channel (Figure 29).

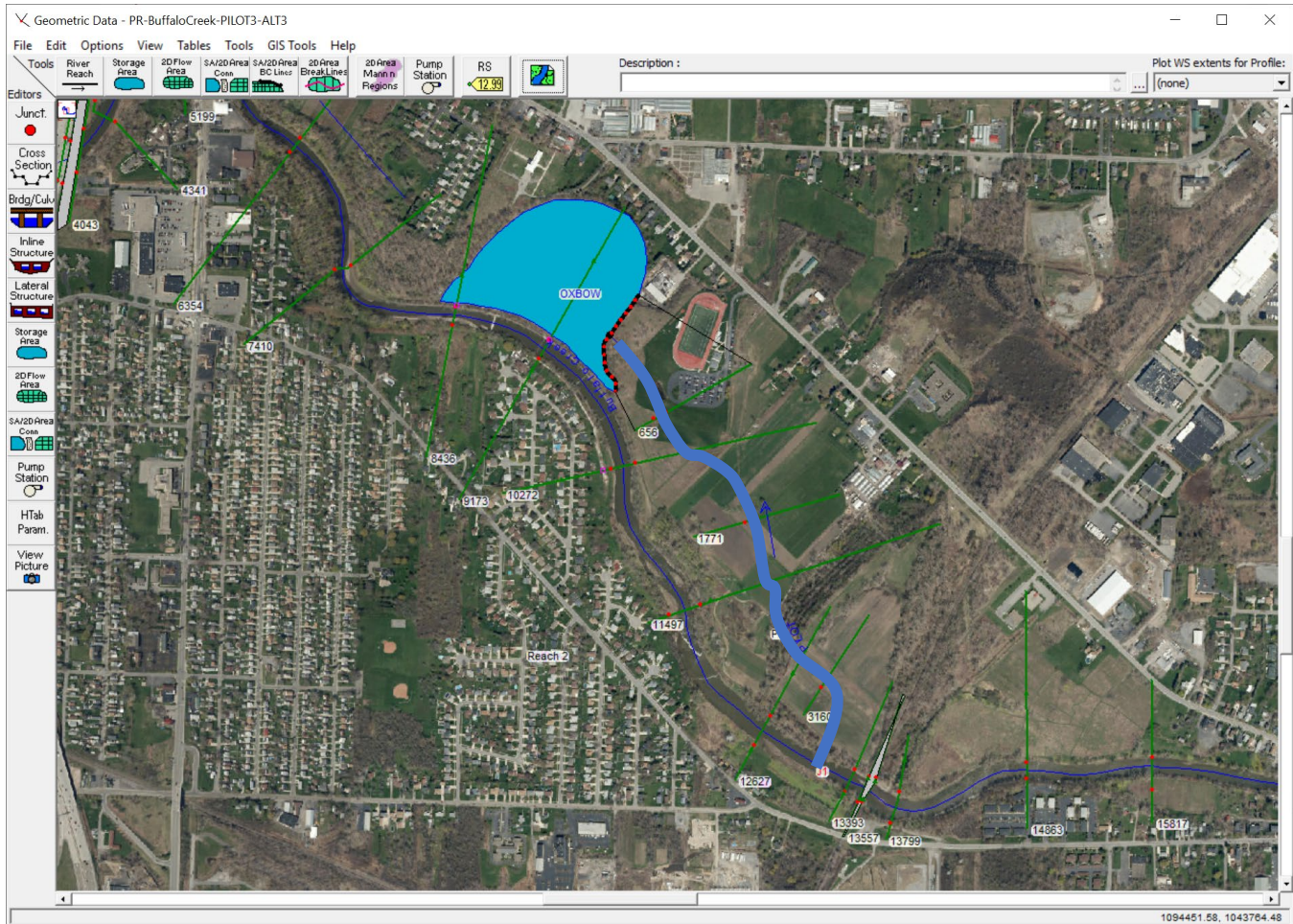


Figure 24. Alternative #9 location map. The pilot channel would be location at river station 75+00 and flow parallel to the main channel of Buffalo Creek into the oxbow lake at 40+00.

Due to the complex multi-directional flow that would occur with the addition of a pilot channel to Buffalo Creek, the 1-dimensional (1-D) HEC-RAS model output results are not the definitive results. In order to more accurately simulate the impact of a pilot channel, a high resolution 2-dimensional (2-D) HEC-RAS model should be performed before recommending this measure as a mitigation strategy.

The proposed and future hydraulic modeling results for a pilot channel indicate that diverting high flows through the pilot channel would reduce water surface elevations in this portion of Buffalo Creek. Various channel width and minimum channel elevations were used to assess the optimal channel width to depth ratio. Channel widths of 100-200 feet and minimum channel elevations of 586-590 ft NAVD 88 were simulated. Predicted resultant reductions in water surface were 1-4 feet in the main

channel of Buffalo Creek, while pilot channel water surface elevations ranged from 590-603 feet NAVD 88. The future conditions modeling output displayed similar results only with water surface elevations being 0.1-0.4 feet higher than proposed condition results (Figures 30 and 31). The potential benefits of the flood benches are immediately upstream and in the vicinity of the pilot channel at river stations 30+00 and 95+00.

The introduction of another shallow channel does not increase the freeze-up conditions in the main channel. In fact, the pilot channel itself will freeze-up prior to the main channel. Therefore, flow diversion to the pilot channel will not occur as anticipated during the winter time. Therefore, observation and early detection of any freeze-up jams within the pilot channel is necessary. Breaking up the ice covers, if possible, would help control the ice jamming issues and blockage in the pilot channel during the winter time. A hot air curtain bubbling from the pilot channel bottom can also keep the pilot channel from freezing and generating more frazil ice (USACE 2006). A freeze-up dynamic 2-D ice simulation is necessary to understand the freeze-up flow condition if this alternative is considered.

The pilot channel simulation results indicate that this measure would reduce main channel water surface elevations, while maintaining high flows within the pilot channel banks. This measure presents numerous challenges that would need to be overcome before being considered as a viable mitigation strategy, including reconnecting and using the oxbow lake as additional storage, acquiring lands to build the pilot channel, and additional 2-D hydraulic modeling to determine the optimal channel width and depth for the pilot channel.

The Rough Order Magnitude cost for this measure is \$8.3 Million.

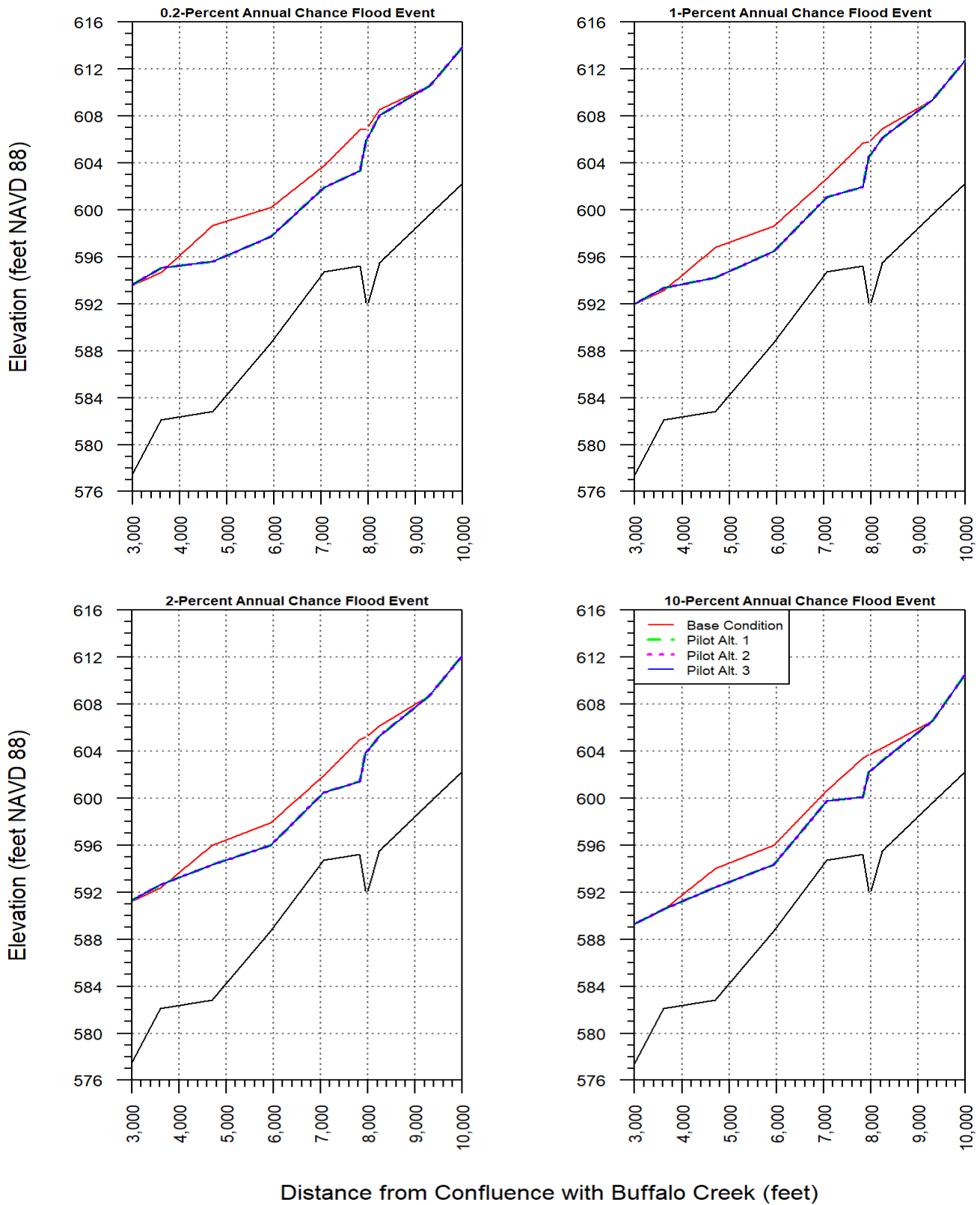


Figure 25. Alternative #9 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the main reach of Buffalo Creek for the pilot alternative #1 (green), pilot alternative #2 (magenta) and pilot alternative #3 (blue) and the base condition (red) simulations.

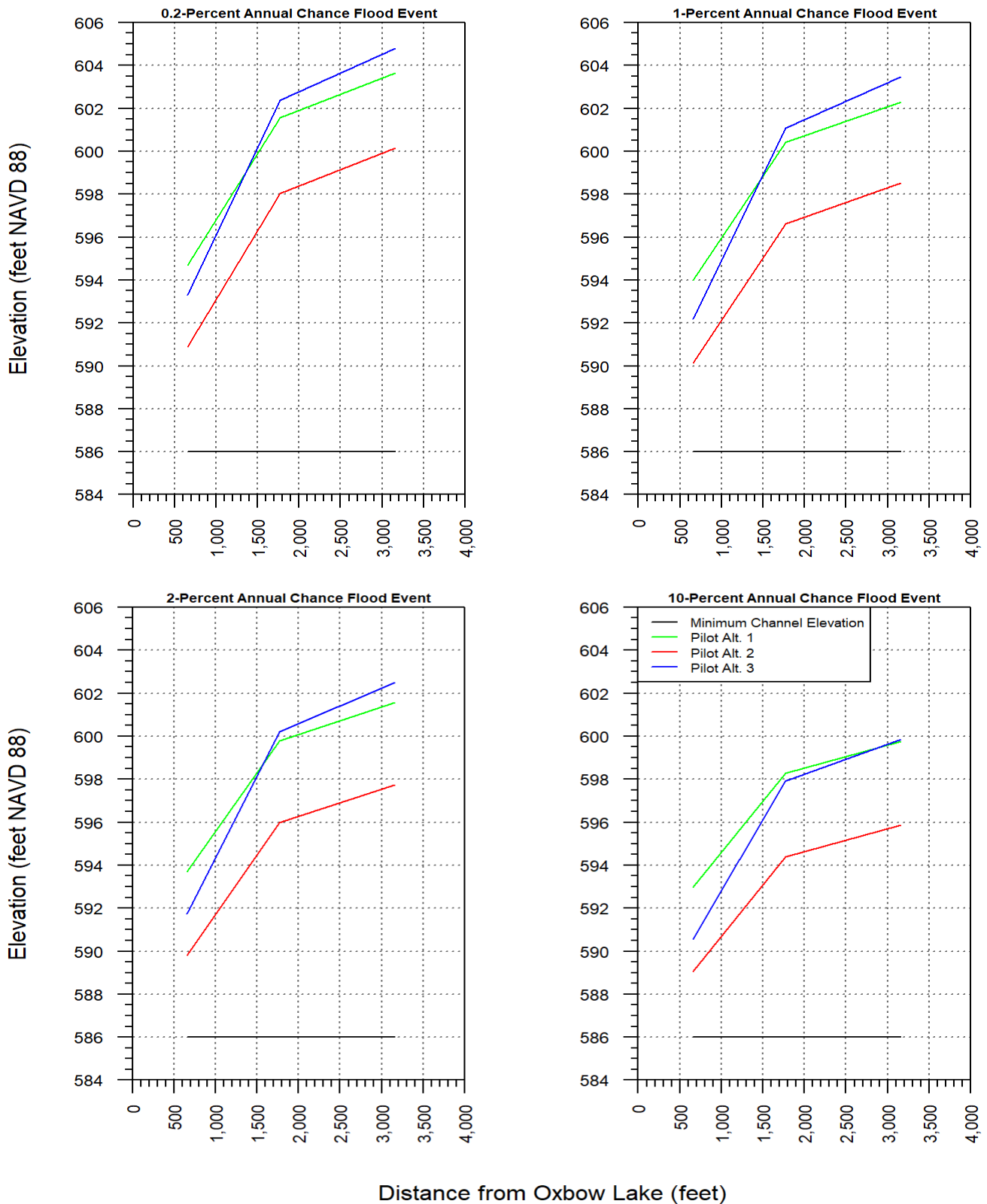


Figure 26. Alternative #9 HEC-RAS proposed condition model output results for the 10, 2, 1, and 0.2-Percent annual chance flood events for the pilot channel reach of Buffalo Creek for the pilot alternative #1 (green), pilot alternative #2 (magenta), and pilot alternative #3 (blue) and the base condition (red) simulations.

**ALTERNATIVE #10: FLOOD EARLY WARNING DETECTION SYSTEM**

Non-structural measures attempt to avoid flood damages by modifying or removing properties currently located within flood prone areas. These measures do not affect the frequency or level of flooding within the floodplain; rather, they affect floodplain activities. In considering the range of non-structural measures, the community needs to assess the type of flooding which occurs (depth of water, velocity, duration) prior to determining which measure best suits its needs (USACE 2016a).

Flood early warning detection systems can be implemented which can provide communities with more advance warning of potential flood conditions. Early forecast and warning involve the identification of imminent flooding, implementation of a plan to warn the public, and assistance in evacuating persons and some personal property. A typical low-cost flood early warning system consists of commercially available off-the-shelf-components. The major components of a flood early warning system are a sensor connected to a data acquisition device with built-in power supply or backup, some type of notification or warning equipment, and a means of communication. For ice jam warning systems, condition is generally monitored using a pressure transducer. The data acquisition system performs two functions: it collects and stores real-time flood stage data from the pressure transducer and initiates the notification process once predetermined flood stage conditions are met (USACE 2016a). This method can also be supplemented by the freezing degree-day (FDD) method to forecast the ice thickness at critical locations to inform early action to control ice.

The system can be powered from an alternating current source via landline or by batteries that are recharged by solar panels. The notification process can incorporate standard telephone or cellular telephone. Transfer of data from the system can be achieved using standard or cellular telephone, radio frequency (RF) telemetry, wireless internet, or satellite transceivers. Emergency management notification techniques can be implemented through the use of radio, siren, individual notification, or a reverse 911 system. More elaborate means include remote sensors that detect water levels and automatically warn residents. These measures normally serve to reduce flood hazards to life and damage to portable personal property (USACE 2016a).

The Rough Order Magnitude cost for this strategy is approximately \$100,000.

**ALTERNATIVE #11: ICE MANAGEMENT**

This strategy is intended to control ice jam formation by maintaining ice coverage in high risk sections of Buffalo Creek. Ice management strategies include various methods of preventing ice jams by breaking ice using various ice cutting patterns and techniques, as well as various equipment and personnel. Suggested locations for ice cutting operations would be provided based on anticipated effectiveness, site accessibility, and historical occurrences of ice jams. Criteria and scheduling would be provided by county and/or state agencies and determined based on environmental conditions (*e.g.* temperature, ice thickness, weather forecast) (USACE 2016a).

Possible ice management strategies would include:

- Ice cutting – cut ice free from banks or cross cut ice to hasten the release of ice in order to prevent ice jam formations
- Trenchers and special design trenching equipment – used to dig ditches customarily, but can be used to cut ice to hasten release downstream
- Channeling plow – plow mounted to a sledge drawn by a tractor that breaks and clears ice from channel
- Water jet and thermal cutting – supersonic water streams and thermal cutting tools to separate the ice and move it downstream
- Hole cutting – drill large holes into the ice to reduce the integrity of the ice cover and curtail ice formation
- Ice breakers – ships, hovercrafts, amphibious hydraulic excavators, construction equipment, and blasting techniques designed to break up ice and move ice downstream
- Air bubbler and flow systems – release air bubbles and warm water from the water bottom to suppress ice growth (USACE 2006)

Generally, the FDD method is a good technique to first predict the ice thickness at critical locations such as bridges or any flow constriction structures using the forecasted air temperature. This method will let the community officers know the severity of any possible ice jams based on future air temperature and have the equipment and labor ready for the forthcoming ice jam. A small computer program could be used to do the iterative calculations faster, so that any non-technical user can use it to foresee the ice jam (Shen and Yapa 2011).

Another technique is maintaining a calibrated ice model to predict possible ice jam locations using forecasted air temperature and flow. This will be a comprehensive 1-D or 2-D ice dynamics coupled hydrodynamic model that predicts the freeze-up location, ice cover thicknesses and water levels (Su et al. 1997).

The Rough Order Magnitude cost for this measure ranges from \$20,000 to \$1.83 Million, not including annual operational costs.

## NEXT STEPS

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Before selecting a flood mitigation strategy, securing funding, or commencing an engineering design phase, OBG recommends that additional modeling simulations and wetland investigations be performed.

### ADDITIONAL DATA MODELING

Additional data modeling would be necessary to more precisely model water surface elevations and the extent of potential flooding in overbank areas and the floodplain. 2-D unsteady flow modeling using the HEC-RAS program would incorporate additional spatial information in model simulations producing more robust results with a higher degree of confidence than the currently modeled 1-D steady flow simulations.

### STATE/FEDERAL WETLANDS INVESTIGATION

The oxbow lake is identified by both the NYSDEC and the U.S Fish & Wildlife Service (USFWS) as a freshwater wetland. Any flood mitigation strategy that proposes using the oxbow lake in any capacity needs to be evaluated based on federal and state wetland criteria before that mitigation strategy can be recommended for final consideration.

### ICE EVALUATION

Due to the complex interaction of ice jams and water flow through a river, it is difficult to draw conclusions regarding proposed flood mitigation strategies and ice jam formations based on observational data alone. The river bathymetry and channel meanders can complicate the ice dynamics and freeze-up jams. Spring runoff is affected by multiple environmental factors, including:

- Available moisture
- Air temperature
- Land cover
- Precipitation
- Snowmelt intensity

The impact of these factors will be amplified by climate change. Projected increases in precipitation across New York State, indicates the potential for increases in spring runoff, which in turn would increase water levels and velocities in nearby streams and rivers (Rosenzweig et al. 2011). In theory, the increased velocities would move ice blocks and frazil ice down the river channel quicker, possibility preventing ice jam formations. However, due to the limited available research in this area, additional data collection and modeling needs to be performed before a recommendation can be made regarding a flood mitigation strategy and its specific influence on ice jam formations.

### EXAMPLE FUNDING SOURCES

There are numerous potential funding programs and grants for flood mitigation projects that may be used to offset municipal financing, including:

- New York State Revolving Funds
- NYS Office of Emergency Management (OEM)
- Regional Economic Development Councils/Consolidated Funding Applications (CFA)
- Natural Resources Conservation Service Emergency Watershed Protection (EWP) Program

- U.S. Federal Emergency Management Agency Unified Hazard Mitigation Assistance (HMA) Program

### **New York State Revolving Funds**

The Clean Water State Revolving Fund (CWSRF) provides interest-free or low-interest rate financing for water quality improvement projects to municipalities throughout New York State. The Federal Environmental Protection Agency (EPA) annually provides the state with a grant to capitalize the CWSRF program. EFC uses this federal money, along with the required State match to fund projects for the purpose of preserving, protecting, or improving water quality.

### **NYS Office of Emergency Management**

The NYS Office of Emergency Management, through the U.S. Department of Homeland Security (DHS), offers several funding opportunities under the Homeland Security Grant Program (HSGP). The priority for these programs is to provide resources to strengthen national preparedness for catastrophic events. These include improvements to cybersecurity, economic recovery, housing, infrastructure systems, natural and cultural resources, and supply chain integrity and security. In 2018, there was no cost share or match requirement.

### **Regional Economic Development Councils/Consolidated Funding Applications**

The Consolidated Funding Application is a single application for state economic development resources from numerous state agencies. The ninth round of the CFA was offered in 2019.

#### Water Quality Improvement Project (WQIP) Program

The Water Quality Improvement Project Program, administered through the NYSDEC, is a statewide reimbursement grant program to address documented water quality impairments. Eligible parties include local governments and not-for-profit corporations. Funding is available for construction/implementation projects; projects exclusively for planning are not eligible. Match for WQIP is a percentage of the award amount, not the total project cost. Deadlines are in accordance with the CFA application cycle.

#### Wastewater Infrastructure Engineering Planning Grant (EPG) Program

The Wastewater Infrastructure Engineering Planning Grant program is offered by the NYSDEC in conjunction with the New York State Environmental Facilities Corporation (EFC). The EPG program is available to municipalities to help fund initial planning of eligible CWSRF water quality projects. Grants of up to \$100,000 are available to finance engineering and planning services for the production of an engineering report. The goal is to advance water quality projects to construction, which will allow successful applicants to use the engineering report to seek financing through the CWSRF program, Water Quality Improvement Project program, or other funding entities to further pursue the identified solution.

The eligible activities under the EPG program include planning activities to determine the scope of water quality issues, evaluation of alternatives, and the recommendation of a capital improvement project. The costs to conduct an environmental review for the recommended alternative are eligible. Design and construction costs are not eligible. All grants require a local match equal to 20 percent of the requested grant amount. The grant will be disbursed in two or more payments based on the municipality's progress toward completion of an acceptable engineering report, with the first disbursement sent as an advance payment once the grant



agreement is executed and the final disbursement made once the engineering report has been completed and accepted by the DEC and EFC. Deadlines are in accordance with the CFA cycle.

### Climate Smart Communities (CSC) Grant Program

The Climate Smart Communities Grant Program is a 50/50 matching grant program for municipalities under the New York State Environmental Protection Fund, offered through the CFA by the NYS Office of Climate Change. The purpose of the program is to fund climate change adaptation and mitigation projects and includes support for projects that are part of a strategy to become a Certified Climate Smart Community. The eligible project types that may be relevant include the following:

- The construction of natural resiliency measures, conservation or restoration of riparian areas and tidal marsh migration areas
- Nature-based solutions such as wetland protections to address physical climate risk due to water level rise, and/or storm surges and/or flooding
- Relocation or retrofit of facilities to address physical climate risk due to water level rise, and/or storm surges and/or flooding
- Flood risk reduction
- Climate change adaptation planning and supporting studies

Eligible projects include implementation and certification projects. Deadlines are in accordance with the CFA cycle.

### **NRCS Emergency Watershed Protection Program**

The Emergency Watershed Protection Program is allocated through the Hurricane Irene and Tropical Storm Lee Flood Mitigation Grant Program, administered by the Empire State Development Corporation (ESD) in collaboration with the NYSDEC. Through the EWP, the U.S. Department of Agriculture's Natural Resources Conservation Service can assist communities in addressing watershed impairments that pose imminent threats to lives and property. Most EWP projects involve the protection of threatened infrastructure from continued stream erosion. Projects must have a project sponsor, defined as a legal subdivision of the State, such as a city, county, general improvement district, or conservation district, or an Indian Tribe or Tribal organization. Sponsors are responsible for providing land rights to do repair work, securing necessary permits, furnishing the local cost share (25 percent), and performing any necessary operation and maintenance for a ten-year period. Through EWP, the NRCS may pay up to 75 percent of the construction costs of emergency measures, with up to 90 percent paid for projects in limited-resource areas. The remaining costs must come from local services. Eligible projects include, but are not limited to, debris-clogged stream channels, undermined and unstable streambanks, and jeopardized water control structures and public infrastructures.

### **FEMA Unified Hazard Mitigation Assistance Program**

The FEMA Unified Hazard Mitigation Program, offered by the New York State Division of Homeland Security and Emergency Services (NYS DHSES), provides funding for creating/updating hazard mitigation plans and implementing hazard mitigation projects. The HMA program consolidates the application process for FEMA's annual mitigation grant programs not tied to a State's Presidential disaster declaration. Funds are available under the Pre-Disaster Mitigation (PDM) Program and the Flood Mitigation Assistance (FMA) Program.

For flood mitigation measures that are being considered for funding through FEMA grant programs, a benefit-to-cost analysis will be required. In order to qualify for FEMA grants and/or funding, the benefit to cost ratio must be greater than one.

#### Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation Grant Program provides resources to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding from future disasters. Federal funding is available for up to 75 percent of eligible activity costs. The PDM project funding categories include Advance Assistance (up to \$200,000 total of federal share funding), Resilient Infrastructure (up to \$10 million total of federal share funding), and Projects (up to \$4 million per project).

#### Flood Mitigation Assistance Program

The Flood Mitigation Assistance Program provides resources to reduce or eliminate long-term risk of flood damage to structures insured under the National Flood Insurance Program. The FMA project funding categories include Community Flood Mitigation – Advance Assistance (up to \$200,000 total federal share funding) and Community Flood Mitigation Projects (up to \$10 million total). Federal funding is available for up to 75 percent of the eligible activity costs. FEMA may contribute up to 100 percent federal cost share for severe repetitive loss (SRL) properties, and up to 90 percent cost share for repetitive loss (RL) properties. Eligible project activities include the following:

- Infrastructure protective measures
- Floodwater storage and diversion
- Utility protective measures
- Stormwater management
- Wetland restoration/creation
- Aquifer storage and recovery
- Localized flood control to protect critical facility
- Floodplain and stream restoration
- Water and sanitary sewer system protective measures

## SUMMARY & CONCLUSION

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### SUMMARY

The Town of West Seneca, NY has had a long history of flooding events along Buffalo Creek. Flooding in the Town primarily occurs during the late winter and early spring months and is exacerbated by ice jams. In response to persistent flooding, the State of New York in conjunction with the Town of West Seneca and Erie County are studying, addressing, and recommending potential flood mitigation projects for Buffalo Creek as part of the Resilient NY Initiative.

This report analyzed the historical and present day causes of flooding in the Buffalo Creek watershed. Hydraulic and hydrologic data was used to model potential flood mitigation measures. The model simulation results indicated that there are flood mitigation measures that have the potential to reduce water surface elevations along high-risk areas of Buffalo Creek, which could potentially reduce flood related damages in areas adjacent to the creek. Constructing multiple flood mitigation measures would increase the overall flood reduction potential along Buffalo Creek by combining the reduction potential of the mitigation measures being constructed.

Based on the flood mitigation analyses performed in this report, the mitigation measures that provided the greatest reductions in water surface elevations were the flood bench and pilot channel alternatives. The most cost effective of these alternatives would be the pilot channel; however, there would be an overall greater effect in water surface elevations if multiple flood bench alternatives were built along Buffalo Creek in different phases, rather than a single pilot channel project.

Other alternatives that should be considered are reconnecting the oxbow lake to the main channel of Buffalo Creek and constructing a levee along the Lexington Green neighborhood. Regulatory constraints regarding the oxbow lake and its wetland status may prohibit the application of this alternative, but the benefits of reconnecting the oxbow lake for high flow events are evident, and the possibility of using the oxbow should be explored further. The levee along the left bank of Buffalo Creek would protect the residences along the Lexington Green neighborhood, which have suffered from flood damages for many years, while minimally impacting water surface elevations downstream. However, the levees do not reduce water surface elevations or provide any additional benefits other than protecting the assets behind them.

The ice control structure would address both flooding from high flows and potential ice jam flooding along Buffalo Creek. An ice control structure and associated flood bench would provide the greatest protection from both types of flooding that occur on Buffalo Creek by combining the benefits of a flood bench with the ice management of the ice control structures.

Ice management to control ice buildup at critical points along Buffalo Creek would be recommended for areas upstream of known flood prone zones. For example, ice breakup using amphibious excavators, such as the Amphibex 400 by Normrock Industries, Inc., is highly effective at preventing ice jams and potential flooding at key infrastructure points by separating ice pack and moving ice pieces downstream. In addition, these types of equipment can provide a wide variety of functions for all seasons, including: restoration and cleaning of contaminated rivers; placements of water conduits, pipelines, and underwater cables; cleaning waste water treatment basins; vegetation control; creation of animal habitats; and recovery and dredging of mining waste, coal ash, and tailings (Normrock Industries, Inc. 2019). To alleviate costs, the County and local Townships could share ownership of the equipment. Recurring maintenance and staffing required in order to operate the equipment should be factored into any cost analysis.

For flood mitigation measures that are being considered for funding through FEMA grant programs, a benefit-to-cost analysis will be required. In order to qualify for FEMA grants and/or funding, the benefit to cost ratio must be greater than one. Table 8 provides a summary of the flood mitigation alternatives, their modeled influence on water surface elevations, and associated ROM costs.

**Table 8. Summary of Flood Mitigation Measures**

Alternative No.	Description	Change in Water Surface Elevation (ft)	Potential Benefited Area by River Station	ROM cost (U.S. dollars)
1	Remove Abandoned Railroad Bridge	Up to - 2.0 ft	75+00 - 95+00	\$480,000
2	Remove Abandoned Railroad Bridge and Associated Topography	Up to - 0.5 ft	60+00 - 120+00	\$3.5 Million
3	Replace Railroad Bridge and Associated Topography with Flood Bench	Up to - 3.0 ft	55+00 - 95+00	\$12.6 Million
4	Reconnect the Oxbow Lake	Up to - 1.5 ft	35+00 - 70+00	\$6.4 Million
5	Reconnect the Oxbow Lake and Install Flood Bench	Up to - 4.0 ft	35+00 - 70+00	\$22.1 Million
6	Flood Bench	Up to - 2.0 ft	60+00 - 95+00	\$16.2 Million
7	Ice Control Structure	N/A	N/A	\$11.2 Million
8	Levee	Up to + 0.4 ft	30+00 - 75+00	\$5.5 Million
9	Pilot Channel	Up to - 4.0 ft	30+00 - 95+00	\$8.3 Million
10	Flood Early Warning Detection System	N/A	N/A	\$100,000
11	Ice Management	N/A	N/A	Up to \$1.83 Million (not including annual operational costs)

## CONCLUSION

Municipalities affected by flooding along Buffalo Creek can use this report to support flood mitigation initiatives within their communities. This report is intended to be a high-level overview of proposed flood mitigation strategies and their potential impacts on water surface elevations in Buffalo Creek. The research and analysis that went into each proposed strategy should be considered preliminary, and additional research, field observations, and modeling are recommended before final mitigation strategies are chosen.

In order to implement the flood mitigation strategies proposed in this report, communities should engage in a process that follows the following steps:

1. Obtain stakeholder and public input to assess the feasibility and public support of each mitigation strategy presented in this report.
2. Identify any additional mitigation strategies based on stakeholder and public input.
3. Complete additional data collection and modeling efforts to assess the effectiveness of the proposed flood mitigation strategies.
4. Develop a list of final flood mitigation strategies based on the additional data collection and modeling results.
5. Select a final flood mitigation strategy or series of strategies to be completed for Buffalo Creek based on feasibility, permitting, effectiveness, and available funding.
6. Develop a preliminary engineering design report and cost estimate for each selected mitigation strategy.
7. Assess funding sources for the selected flood mitigation strategy.

Once funding has been secured and the engineering design has been completed for the final mitigation strategy, construction and/or implementation of the measure should begin.

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## APPENDICES



**APPENDIX A**  
**Summary of Data and**  
**Reports Collected**

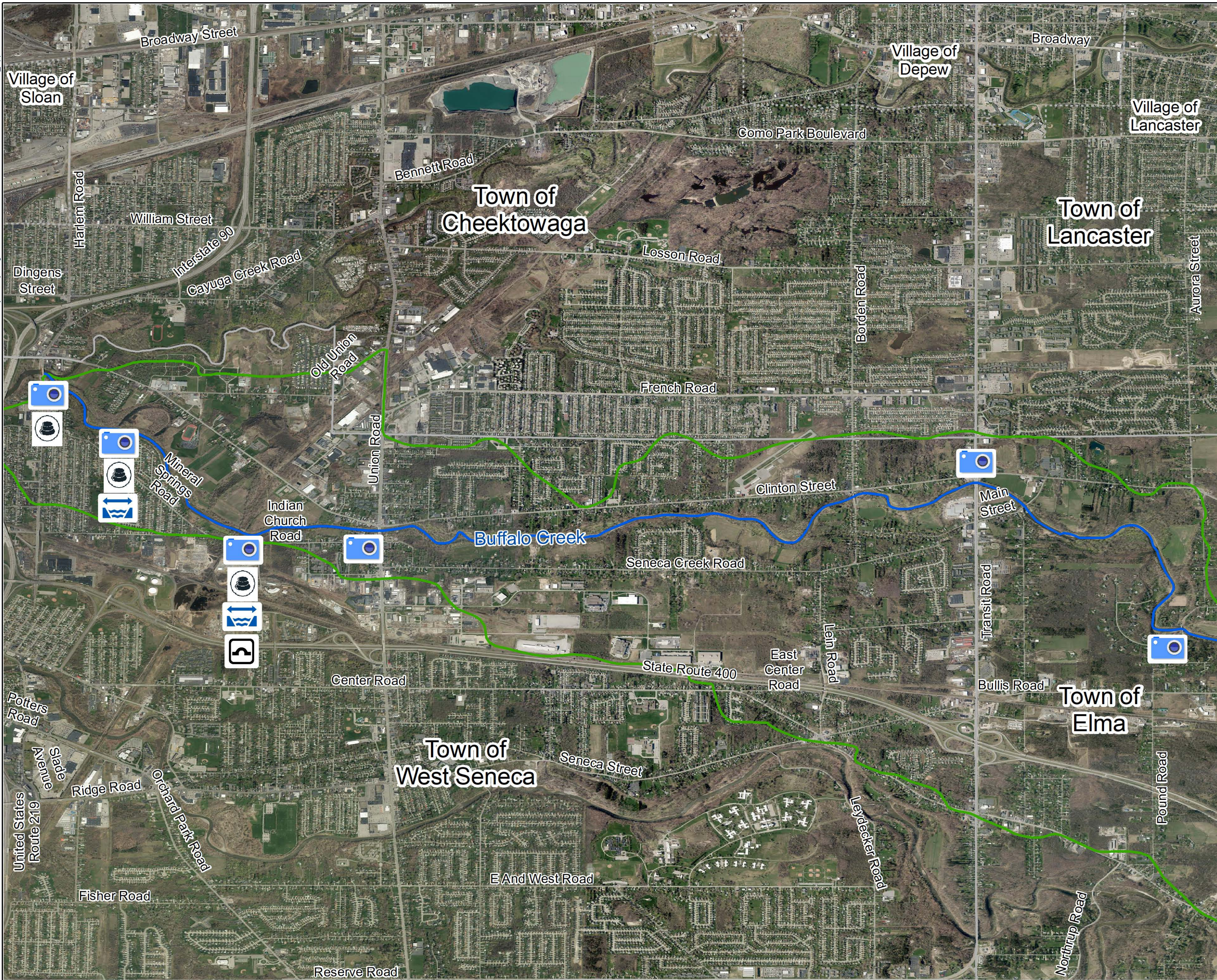
<b>Appendix A. Summary of Data and Reports Collected</b>			<b>NYSOGS Project # SC498</b>
<b>Resilient New York Flood Mitigation Initiative</b>			<b>OBG Project # SC804</b>
<b>Buffalo Creek - Erie and Wyoming Counties, New York</b>			<b>June 18, 2019</b>
<b>Year</b>	<b>Data Type</b>	<b>Document Title</b>	<b>Author</b>
1966	Report	Flood Plain Information: Buffalo Creek, NY	United States Army Corps of Engineers (USACE)
1978	Report	National Handbook of Recommended Methods for Water-Data Acquisition	U.S. Geological Survey (USGS)
1979	Report	Flood Plain Management Planning Assistance For The Town of West Seneca New York: Buffalo Creek	United States Army Corps of Engineers (USACE)
1992	Report	Flood Insurance Study (FIS), Erie County, NY (All Jurisdictions)	Federal Emergency Management Agency (FEMA)
2010	Report	Oxbow Habitat Restoration Plan: Buffalo Creek, West Seneca	Ecology and Environment Inc.
2011	Report	Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation	New York State Energy Research and Development Authority (NYSERDA)
2014	Report	Emergency Transportation Infrastructure Recovery Water Basin Assessment and Flood Hazard Mitigation Alternatives, Mud Creek, Oneida County, New York	Milone & MacBroom, Inc.
2015	Report	Erie County, New York Multi-Jurisdictional Hazard Mitigation Plan Update	URS Engineering (AECOM)
2016	Report	HEC-RAS River Analysis System User's Manual Version 5.0	U.S. Geological Survey (USGS) Hydrologic Engineering Center (HEC)
2016	Report	Buffalo Creek- Lexington Green CAP 205 - P2#400718	United States Army Corps of Engineers (USACE)
2019	Report	Preliminary Flood Insurance Study (FIS), Erie County	Federal Emergency Management Agency (FEMA)
2018	Data	A New Generation of the United States National Land Cover Database: Requirements, Research Priorities, Design, and Implementation Strategies	U.S. Geological Survey (USGS) Multi-Resolution Land Characteristics (MRLC)
2019	Data	National Flood Hazard Layer: Erie County, NY	Federal Emergency Management Agency (FEMA)
2019	Data	FIRM Flood Insurance Rate Map Erie County, NY (All Jurisdictions)	Federal Emergency Management Agency (FEMA)
2019	Data	Storm Events Database: Erie County, NY	National Centers for Environmental Information (NCEI)
2019	Data	Dams, Hydrography	New York State Department of Environmental Conservation (NYSDEC)
2019	Data	Bridges, Streets, Railroads	New York State Department of Transportation (NYSDOT)
2019	Data	City/Town Boundaries, County Boundaries	New York State Office of Information Technology Services (NYSOITS)
2019	Data	Tax Parcels, Parks, Public Schools, Sheriff Stations	New York State Office of Real Property Tax Services (NYSORPTS)
2019	Data	Development of flood regressions and climate change scenarios to explore estimates of future peak flows	U.S. Geological Survey (USGS)
2019	Data	StreamStats, version 4.3.8	U.S. Geological Survey (USGS)
2019	Data	USGS 04214500 Buffalo Creek at Gardenville, NY	U.S. Geological Survey (USGS)
2019	Data	Ice Jam Database	U.S. Geological Survey (USGS) Cold Regions Research and Engineering Laboratory (CRREL)



**APPENDIX B**  
**Field Data Collection Form**  
**Examples**

I:\server01-01\Projects\Nys-Ogs-2069\72515\Buffalo-Creek-7N-DIGIS\BuffaloCreek\_AppendixB.mxd

PLOTDATE: 1/13/2020 GOZK



## APPENDIX B



- Buffalo Creek
- Watershed Boundary
- Village Boundaries
- City/Town Boundaries
- Bridge/Culvert Measurement
- Phase I Assessment
- Photo Log Location
- Wobble Pebble Count

GOMEZ AND SULLIVAN  
ENGINEERS

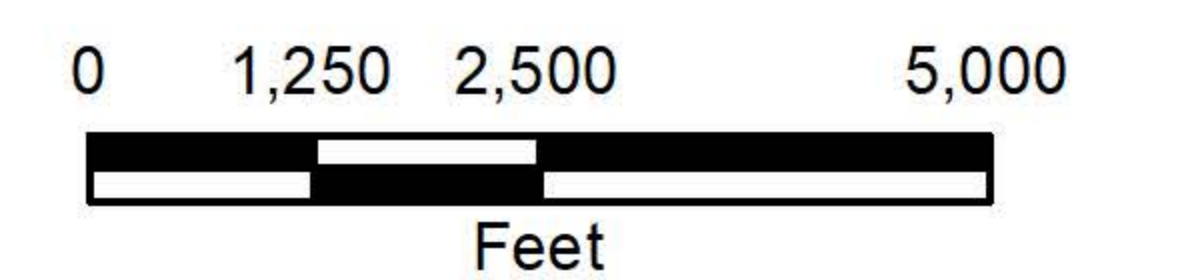
HIGHLAND  
PLANNING

NEW YORK STATE OF OPPORTUNITY  
Office of General Services

NEW YORK STATE OF OPPORTUNITY  
Department of Environmental Conservation

### BUFFALO CREEK DATA COLLECTION POINTS

ERIE COUNTY, NY



May 15, 2019

OBG  
Part of Ramboll



# Stream Channel Classification (Level II)

## Wisconsin Job Sheet 811

Natural Resources Conservation Service (NRCS) Wisconsin

Project: \_\_\_\_\_ Date: \_\_\_\_\_  
 County: \_\_\_\_\_ Stream: \_\_\_\_\_  
 Reach No.: \_\_\_\_\_ Logged By: \_\_\_\_\_

Horizontal Datum: NAD \_\_\_\_\_ Projection: Transverse Mercator Lambert Conformal Conical  
 Coordinate System: \_\_\_\_\_ County Coordinates WTM State Plane Coordinates UTM  
 Units: Meters Feet Horizontal Control: N or Lat. \_\_\_\_\_ E or Long. \_\_\_\_\_  
 Elevation: \_\_\_\_\_ Assumed DOT NAVD (29 / 88) Units: Meters Feet

### Fluvial Geomorphology Features (3 Cross Sections) for Stream Classification

Bankfull Width ( $W_{bkt}$ ): _____ ft. _____ ft. _____ ft.		<b>Average</b>	_____ ft.
<i>Width of the stream channel, at bankfull stage elevation, in a riffle section.</i>			
Mean Depth ( $d_{bkt}$ ): _____ ft. _____ ft. _____ ft.			_____ ft.
<i>Mean depth of the stream channel cross section, at bankfull stage elevation, in a riffle section. (<math>d_{bkt} = A_{bkt} / W_{bkt}</math>)</i>			
Bankfull X-Section Area ( $A_{bkt}$ ): _____ sq. ft. _____ sq. ft. _____ sq. ft.			_____ sq. ft.
<i>Area of the stream channel cross section, at bankfull stage elevation, in a riffle section.</i>			
Width / Depth Ratio ( $W_{bkt} / d_{bkt}$ ): _____ ft. _____ ft. _____ ft.			_____ ft.
<i>Bankfull width divided by bankfull mean depth, in a riffle section.</i>			
Maximum Depth ( $d_{mbkt}$ ): _____ ft. _____ ft. _____ ft.			_____ ft.
<i>Maximum depth of the Bankfull channel cross section, or distance between the bankfull stage and thalweg elevations, in a riffle section.</i>			
Width of Flood-Prone Area ( $W_{fpa}$ ): _____ ft. _____ ft. _____ ft.			_____ ft.
<i>Twice maximum depth, or (<math>2 \times d_{mbkt}</math>) = the stage/elevation at which flood-prone area width is determined (riffle section).</i>			
Entrenchment Ratio (ER): _____ ft. _____ ft. _____ ft.			_____ ft.
<i>The ratio of flood-prone area width divided by bankfull channel width. (<math>W_{fpa} / W_{bkt}</math>) (riffle section)</i>			

---

**Reach Characteristics**

Channel Materials (Particle Size Index) D50: \_\_\_\_\_ mm

*The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.*

Water Surface Slope (S): \_\_\_\_\_ ft./ft.

*Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.*

Channel Sinuosity (K): \_\_\_\_\_.

*Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).*

Distance to Up-Stream Structures: \_\_\_\_\_.

---

**Stream Type:** \_\_\_\_\_ (For reference, note Stream Type Chart and Classification Key)

---

**Dominant Channel Soils at an Eroding Bank Location**

Bed Material: \_\_\_\_\_ Left Bank: \_\_\_\_\_ Right Bank: \_\_\_\_\_

Description of Soil Profiles (from base of bank to top):

Left: \_\_\_\_\_  
\_\_\_\_\_

Right: \_\_\_\_\_  
\_\_\_\_\_

---

**Riparian Vegetation at an Eroding Bank Location**

Left Bank: \_\_\_\_\_ Right Bank: \_\_\_\_\_

Percent Total Area (Mass): Left: \_\_\_\_\_ Right: \_\_\_\_\_

Percent Total Height with Roots: Left: \_\_\_\_\_ Right: \_\_\_\_\_

---

**Other Bank Features at an Eroding Bank Location**

Actual Bank Height: \_\_\_\_\_ Bankfull Height: \_\_\_\_\_

Bank Slope (Horizontal to Vertical):	Left:	0-20° (flat) 21-60° (moderate) 61-80° (steep) 81-90° (vertical) 90°+ (undercut)	Right:	0-20° (flat) 21-60° (moderate) 61-80° (steep) 81-90° (vertical) 90°+ (undercut)
--------------------------------------	-------	---	--------	---

Visible Seepage in Bank? Yes No Where? \_\_\_\_\_

Thalweg Location: Near 1/3 Mid 1/3 Far 1/3





# Pebble Count (Data Collection)

## Wisconsin Job Sheet 810

**Natural Resources Conservation Service (NRCS) Wisconsin**

Project: _____	Date: _____
County: _____	Stream: _____
Reach No.: _____	Logged By: _____

Horizontal Datum: NAD \_\_\_\_\_ Projection:  Transverse Mercator  Lambert Conformal Conical  
 Coordinate System:  \_\_\_\_\_ County Coordinates  WTM  State Plane Coordinates  UTM  
 Units:  Meters  Feet Horizontal Control: N or Lat. \_\_\_\_\_ E or Long. \_\_\_\_\_  
 Elevation: \_\_\_\_\_  Assumed  DOT  NAVD (29 / 88) Units:  Meters  Feet

Inches	Millimeters	Particle	Particle Count			
			1	Total #	2	Total #
<.002	<.062	Silt/Clay				
.002 - .005	.062 - .125	Very Fine Sand				
.005 - .01	.125 - .25	Fine Sand				
.01 - .02	.25 - .50	Medium Sand				
.02 - .04	.50 - 1.0	Coarse Sand				
.04 - .08	1.0 - 2	Very Coarse Sand				
.08 - .16	2 - 4	Very Fine Gravel				
.16 - .22	4 - 5.7	Fine Gravel				
.22 - .31	5.7 - 8	Fine Gravel				
.31 - .44	8 - 11.3	Medium Gravel				
.44 - .63	11.3 - 16	Medium Gravel				
.63 - .89	16 - 22.6	Coarse Gravel				
.89 - 1.26	22.6 - 32	Coarse Gravel				
1.26 - 1.77	32 - 45	Very Coarse Gravel				
1.77 - 2.5	45 - 64	Very Coarse Gravel				
2.5 - 3.5	64 - 90	Small Cobbles				
3.5 - 5.0	90 - 128	Small Cobbles				
5.0 - 7.1	128 - 180	Large Cobbles				
7.1 - 10.1	180 - 256	Large Cobbles				
10.1 - 14.3	256 - 362	Small Boulders				
14.3 - 20	362 - 512	Small Boulders				
20 - 40	512 - 1024	Medium Boulders				
40 - 80	1024 - 2048	Large-Very Large Boulders				
		Bedrock				





## Field Observation Form

By: \_\_\_\_\_ Date: \_\_\_\_\_ Project Name: \_\_\_\_\_  
Project Number: \_\_\_\_\_

Location/Description

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Sketches (Include flow depth, channel bed material, Manning values, flow direction, etc.)

Plan View:

Section View:

Structure Data

Bridge

Culvert

Height: \_\_\_\_\_ Width: \_\_\_\_\_  Box # Sides: \_\_\_\_\_  Pipe  Arch  Other

Length in direction of flow: \_\_\_\_\_ Manning Value Top: \_\_\_\_\_ Bottom: \_\_\_\_\_

Description:

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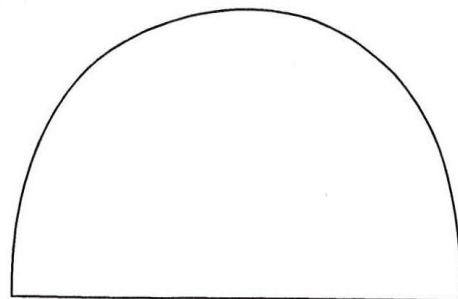
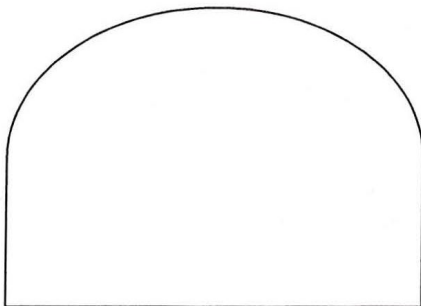
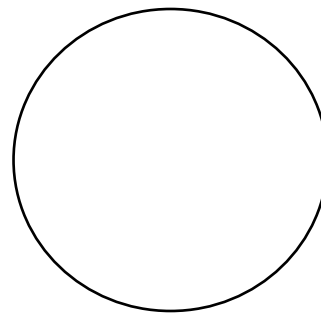
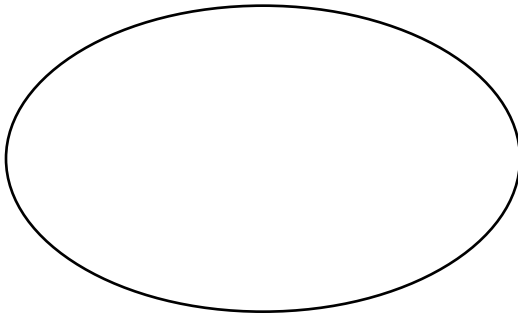
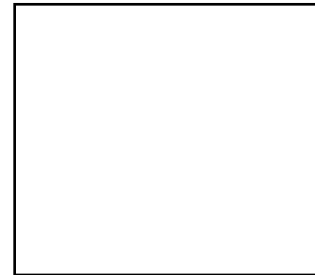


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Typical Culvert Shapes (fill in dimensions)





**APPENDIX C**  
**Photo Logs**

## APPENDIX C. PHOTO LOG

### Photo log of select locations within the Buffalo Creek corridor.

#### Photo No. 1

##### Description:

Confluence of Buffalo Creek and Cayuga Creek to form the upstream portion of the Buffalo River.



#### Photo No. 2

##### Description:

Facing downstream from dam structures adjacent to the oxbow and Lexington Green neighborhood.



#### Photo No. 3

##### Description:

Upstream from abandoned railroad bridge crossing Buffalo Creek near Indian Church Road looking downstream of the creek.



**Photo No. 4**

**Description:**

Facing upstream  
from USGS Gage  
04214500 at  
Gardenville, NY at  
the Union Road  
bridge across Buffalo  
Creek.



**Photo No. 5**

**Description:**

Facing upstream  
from bridge over  
Highway 20 (Transit  
Road).




**Photo No. 6**

**Description:**

Facing downstream  
from bridge over  
Winspear Road.





**APPENDIX D**  
**Agency and Stakeholder**  
**Meeting Sign-in Sheet**

# Sign-in Sheet

Last	First	Attending?
Beres	Joe	<i>Joe Beres</i>
Butcher	Gregory	
Clark	Wayne	<i>Wayne Clark</i>
Cogswell	John	
TACKLEY	DAVE	
Debella	Habtamu	
Denno	Matthew	
English	Matthew	
Farnum	Ryan	
Fiegl	Joe	
Fry	Christopher	
Gannon	Shaun	
Gaston	Mark	<i>Mark Gaston</i>
Geary	William	
Henry	Rich	
Hopkins	Susan	
Kahi	Ramsey	
Konsella	Jeff	<i>Jeff Konsella</i>



Lawrence	Bonnie	
Lt. Col. Toth	Jason	
Meegan	Sheila	
Melski	Emily	
Myers	Ted	
Neaverth Jr.	Daniel	
Nicholson	Jane	
Panasiewicz	Joanna	
Powers	Dennis	
Schulenburg	Dave	
Serafin	Brian	
Snow, Jr.	Thomas R.	
Sorbaro	Kristin	
Spisiak Jedlicka	Jill	
Tanner	Steve	
Tomko	Ryan	
Trimper	Paula	
Whitfield Jr.	Garnell	
Winkler	Katherine	

*Handwritten signatures and initials:*  
 (Large scribble)  
 Laura Lawrence  
 Emily Melski  
 Ted

*Handwritten note:*  
 Laura Ortiz  
 USACE - Buffalo

*Handwritten note:*  
 Johnson, Dave - WS, Eng, Floodplains

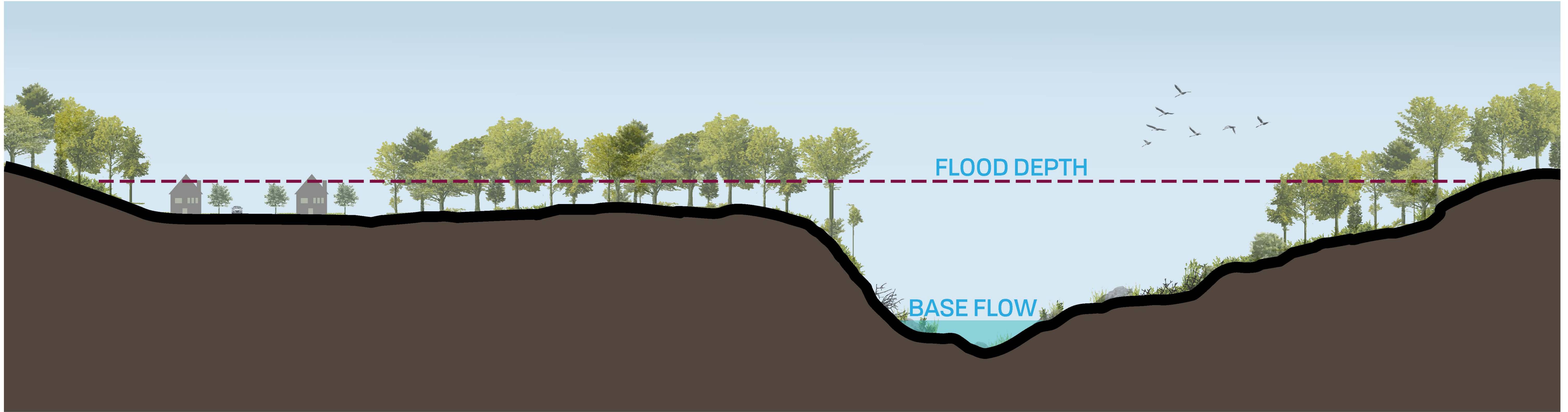
*Handwritten initials:*  
 RT

*Handwritten names and signatures:*  
 O'Keefe Kerrie  
 Clarke David  
 Hastings Ryan  
 (Signature)  
 (Signature)  
 Ryan Ryan  
 (Signature)

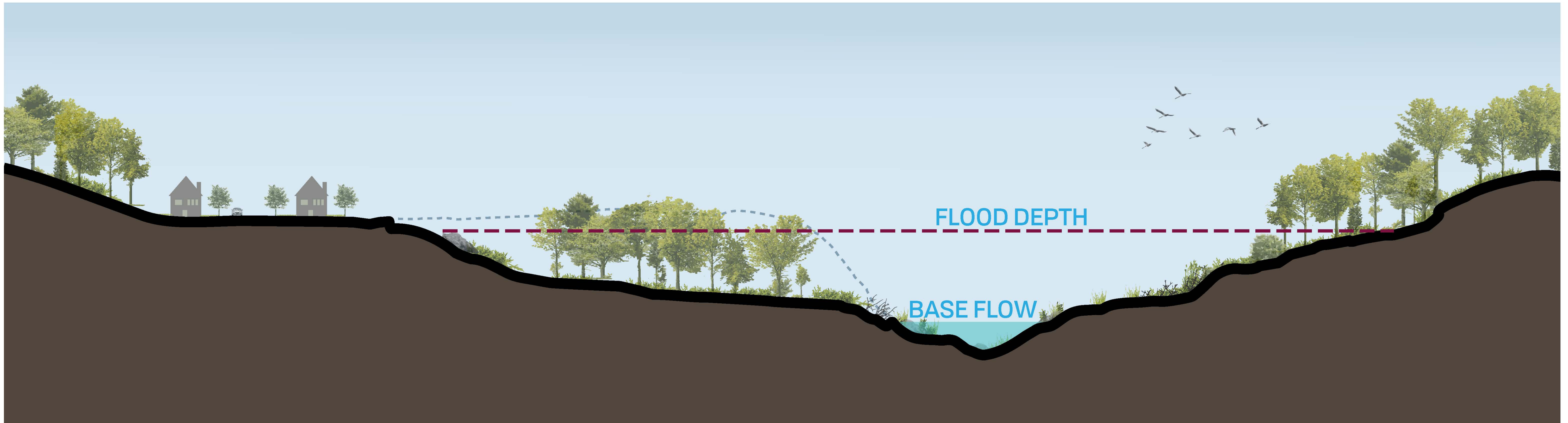




**APPENDIX E**  
**Mitigation Renderings**



Existing Condition

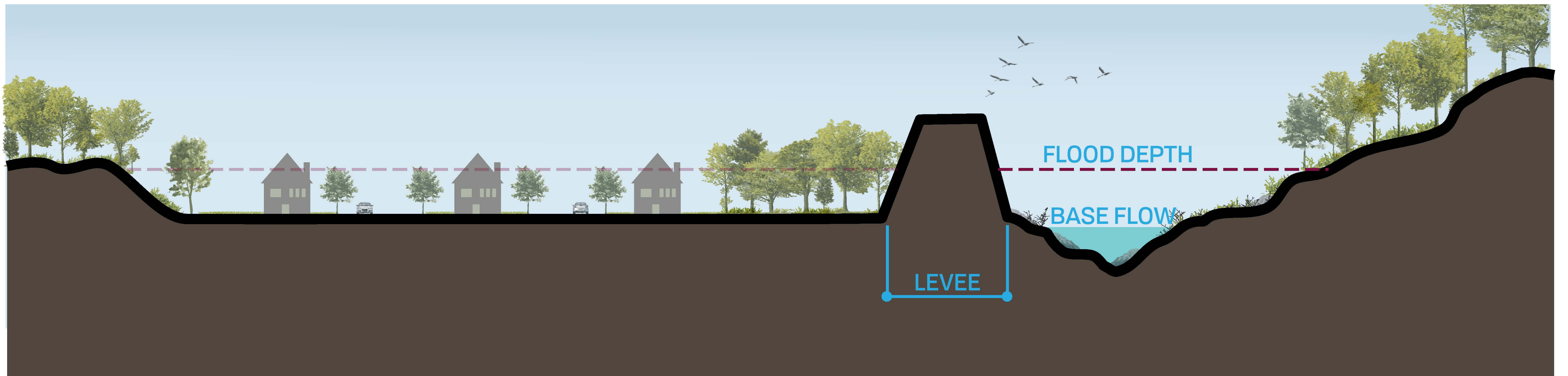


Future Condition

**FLOODPLAIN BENCH**

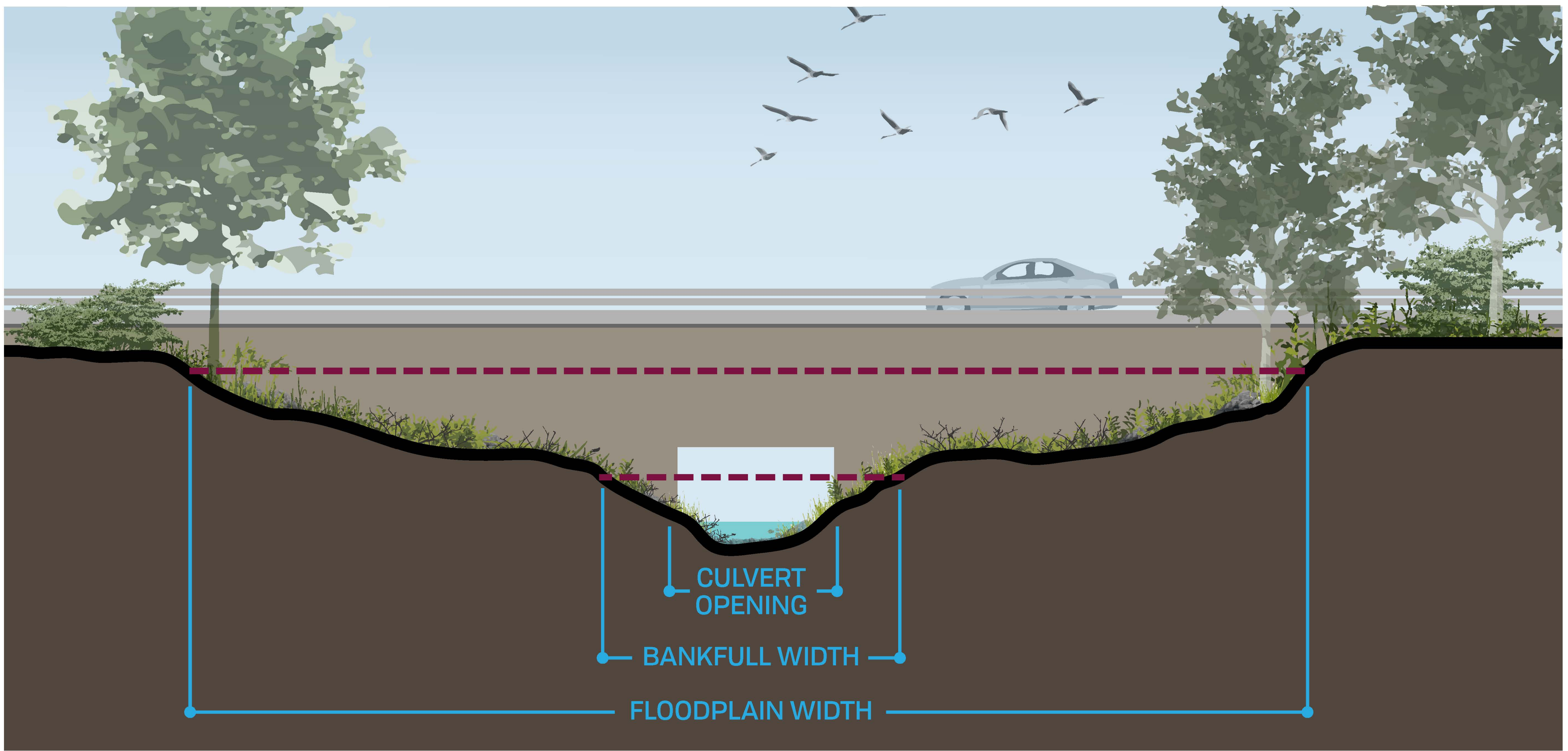


Existing Condition

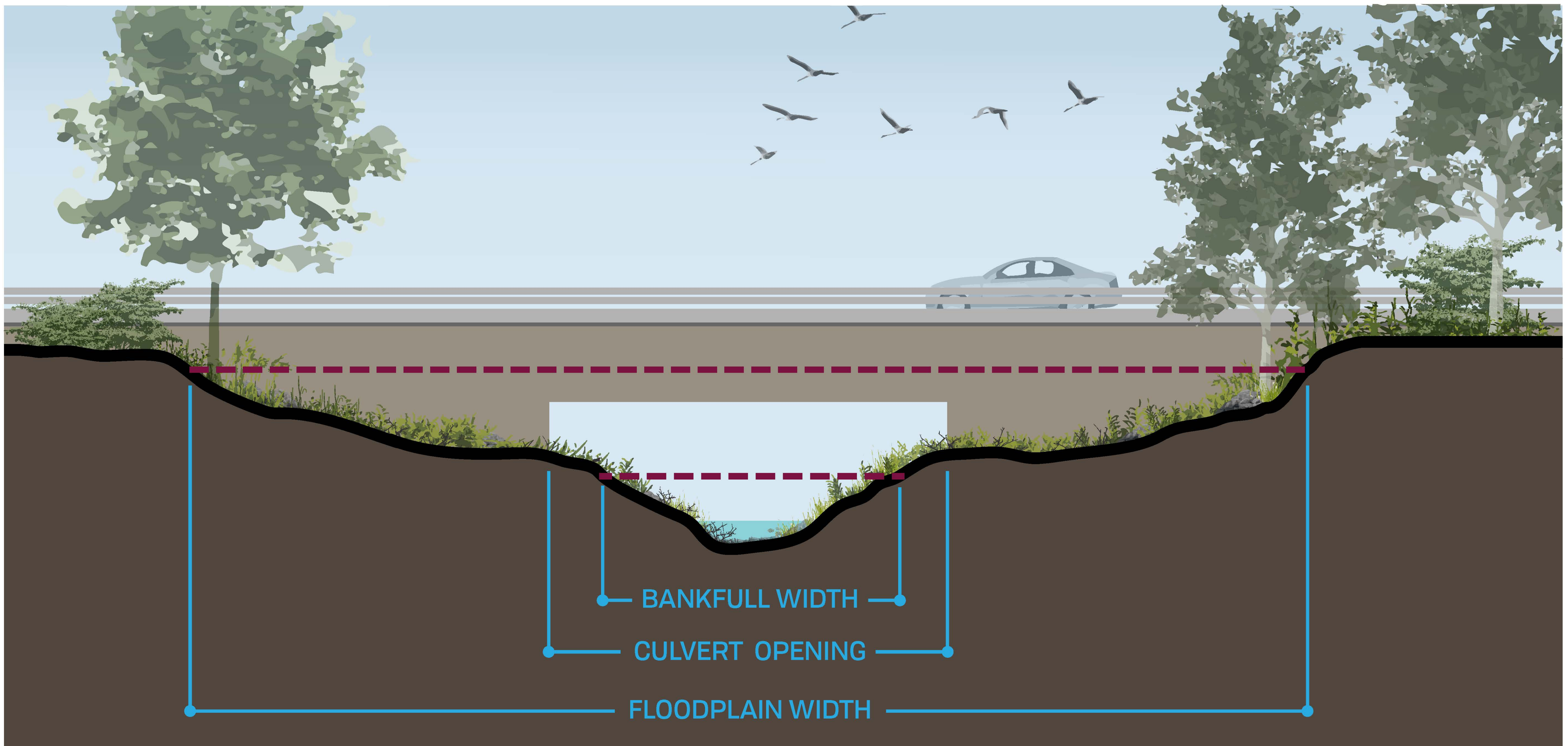


Future Condition

**PROTECTIVE LEVEE**




Existing Condition



Future Condition

**RIGHT SIZING CULVERTS**



**APPENDIX F**  
**HEC-RAS Simulation**  
**Output**



Appendix F-1a

Duplicate and Base Condition Model Comparison

HEC-RAS Proposed Condition Model Summary

Project BuffaloCreek  
 Plan FEMA-DuplicateEffective  
 FEMA-CorrectedEffective  
 Geometry BuffaloCreek-DuplicateEffective  
 BuffaloCreek-CorrectedEffective  
 Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 100-year  
 Discharge: 13,600 cfs  
 Directory <\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Duplicate Model

FEMA Effective FIS peak streamflow for Buffalo Creek - Upstream of Confluence of Cayuga Creek

Peak streamflow calculated using Regression equations based on drainage area only for estimating peak discharges for rural, unregulated streams in each of six hydrologic regions of New York, excluding Long Island in (USGS SIR2006-5112)

Base Condition Model

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10.

Peak streamflow data calculated using USGS StreamStats v4.3.8. which uses Full-regression equations for estimating peak discharges for rural, unregulated streams in each of six hydrologic regions of New York, excluding Long Island (USGS SIR2006-5112).

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elev. (ft) (NAVD88)	
			Duplicate	Base Condition
	836	-4726	591.2	586.9
	930	-4632	591.4	586.9
	1098	-4464	591.5	586.9
	1881	-3681	591.6	587.1
	2764	-2798	591.6	587.1
	2788	-2774	591.5	587.1
	3371	-2191	591.6	587.0
	3602	-1960	591.6	587.1
	3642	-1920	591.9	587.3
	3686	-1876	591.9	587.3
	3727	-1835	591.9	587.3
	3859	-1703	592.0	587.4
	3898	-1664	592.0	587.4
Bridge	3970.5	-1591.5		
	4043	-1519	592.1	587.4
	4341	-1221	592.1	587.5
	5199	-363	592.4	587.8
	5270	-292	592.6	588.1
Bridge	5304.5	-257.5		
	5339	-223	593.1	588.5
	5562	0	593.1	588.8
	6354	792	593.4	589.0
	7410	1848	594.0	590.7
	8436	2874	594.7	591.7
Oxbow	9173	3611	595.6	593.1
	10272	4710	598.7	596.8
	11497	5935	600.4	598.6
	12627	7065	603.9	602.7
	13393	7831	606.9	605.7
	13514	7952	607.2	605.8
Railroad Bridge	13535.3	7973.3		
	13557	7995	607.3	605.9
	13799	8237	607.1	606.9
	14863	9301	610.5	609.4
	15817	10255	615.5	613.9
	17170	11608	618.1	616.7
	17314	11752	618.2	616.8
Union Rd Bridge	17350	11788		
	17386	11824	619.0	617.4
	17442	11880	619.1	617.5
	18472	12910	622.8	620.9
	19887	14325	624.2	622.2
	21220	15658	625.6	624.3
	22540	16978	628.1	627.2
	23751	18189	629.9	629.0
	24800	19238	631.6	631.1
	25961	20399	635.3	634.3



Appendix F-1a

Duplicate and Base Condition Model Comparison

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-DuplicateEffective River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1 # Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 47 # Plans = 1

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
836	100-yr	21560		567.3	591.2	577.59	591.57	0.000211	4.95	17680.59	2773.6	0.2
930	100-yr	21560		567.3	591.39		591.6	0.000118	3.7	15180.77	3077.98	0.15
1098	100-yr	21560		567.4	591.49		591.62	0.000084	3.02	21347.6	4118.7	0.13
1881	100-yr	21560		567.4	591.61		591.68	0.000063	2.67	32546.91	5095.11	0.11
2764	100-yr	21560		566.9	591.56		591.81	0.00015	4.34	34947.88	5448.62	0.19
2788	100-yr	21560		566.9	591.54	579.6	591.82	0.00017	4.55	31979.18	5461.29	0.2
3371	100-yr	21560		571.1	591.62	580.46	591.95	0.000229	4.92	23349.93	5172.47	0.23
3602	100-yr	21560		571.2	591.58	580.54	592.12	0.000297	5.87	3672.91	5371.4	0.26
3642	100-yr	21560		566	591.92		592.15	0.000094	3.9	5699.61	372.25	0.16
3686	100-yr	21560		570	591.9		592.17	0.000122	4.17	5244.99	353.67	0.18
3727	100-yr	21560		570	591.89	580.59	592.19	0.000201	4.4	4902.71	2444.54	0.19
3859	100-yr	21560		564.2	592		592.22	0.000131	3.73	5855.74	440.62	0.16
3898	100-yr	21560		564.2	592.01		592.22	0.000091	3.73	5857.36	441.15	0.16
3970.5	Bridge											
4043	100-yr	21560		564.2	592.07	577.59	592.28	0.00023	3.72	5883.86	449.7	0.16
4341	100-yr	21560		565.6	592.09		592.43	0.000333	4.88	6153.23	666.44	0.19
5199	100-yr	21560		576.3	592.38		592.89	0.000738	6.06	4864.78	649.09	0.28
5270	100-yr	21560		574	592.6	582.51	593.02	0.000488	5.19	4152.79	370.64	0.23
5304.5	Bridge											
5339	100-yr	21560		574	593.07	582.51	593.47	0.000443	5.04	4276.55	372.82	0.22
5562	100-yr	21560		571	593.14		593.53	0.000409	5.11	4602.96	289.65	0.21
6354	100-yr	16000		571.5	593.44		593.91	0.00051	6.02	8431.28	1450.15	0.26
7410	100-yr	16000		573.7	593.98		594.6	0.000756	7.11	7000.28	1241.88	0.29
8436	100-yr	16000		576.6	594.69		595.57	0.001152	7.9	3497.12	918.33	0.35
9173	100-yr	16000		582.1	595.6		597.18	0.003595	10.08	5594.76	928.85	0.56
10272	100-yr	16000		582.8	598.66		599.31	0.001125	6.6	4823.92	1556.47	0.33
11497	100-yr	16000		588.7	600.41		601.25	0.00223	7.38	2398.3	593.09	0.44
12627	100-yr	16000		594.7	603.87	602.36	605.25	0.005861	9.51	2987.53	1113.28	0.65
13393	100-yr	16000		595.2	606.92		607.96	0.002269	8.25	3808.85	981.6	0.45
13514	100-yr	16000		592.1	607.19	601.48	608.13	0.00043	7.77	2059.62	1132.58	0.39
13535.3	Bridge											
13557	100-yr	16000		592.1	607.33	601.48	608.25	0.000414	7.68	2083.58	1133.37	0.38
13799	100-yr	16000		595.5	607.06		608.85	0.002276	11.78	4104.71	576.34	0.62
14863	100-yr	16000		599.6	610.48	610.2	612.97	0.006835	13.16	2063.12	599.24	0.77
15817	100-yr	16000		603.2	615.53		616.45	0.002076	8.23	3684.4	586.46	0.44
17170	100-yr	16000		602.4	618.06		619.71	0.002482	10.55	1793.26	177.07	0.5
17314	100-yr	16000		605.5	618.21	614.88	620.48	0.003847	12.09	1323.12	139.17	0.61
17350	Bridge											
17386	100-yr	16000		605.5	618.95	614.89	620.97	0.003149	11.39	1405.04	140.62	0.56
17442	100-yr	16000		604.9	619.1		621.23	0.003678	11.73	1400.13	126.31	0.59
18472	100-yr	16000		608.9	622.79		623.16	0.000968	6.28	6540.73	944.87	0.3
19887	100-yr	16000		610.3	624.18		624.57	0.001003	6.31	5559.95	796.59	0.32
21220	100-yr	16000		612.8	625.58		626.47	0.00192	8.06	2684.74	384.49	0.43
22540	100-yr	16000		615.5	628.11		628.7	0.001443	7.15	3985.81	687.45	0.37
23751	100-yr	16000		617.6	629.87		630.44	0.001502	7.37	3951.46	631.62	0.38
24800	100-yr	16000		620.4	631.58	629.58	633.27	0.004231	10.78	1954.13	490.67	0.62
25961	100-yr	16000		621.4	635.33		636.28	0.001659	8.47	2721.66	349.21	0.41

Appendix F-1a

Duplicate and Base Condition Model Comparison

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-CorrectedEffective River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Hydraulic Reaches = 1

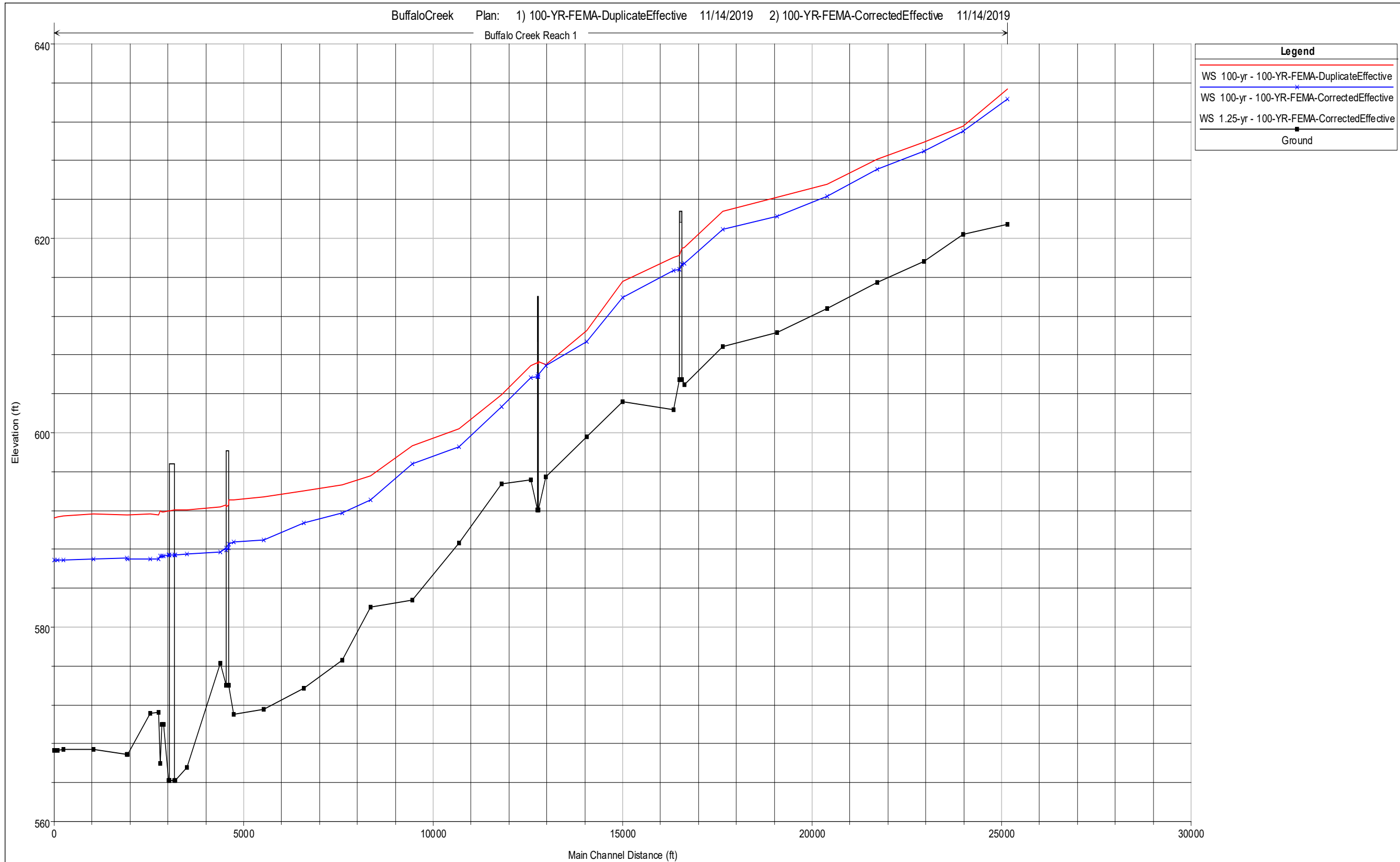
# Profiles = 1

# River Stations = 47

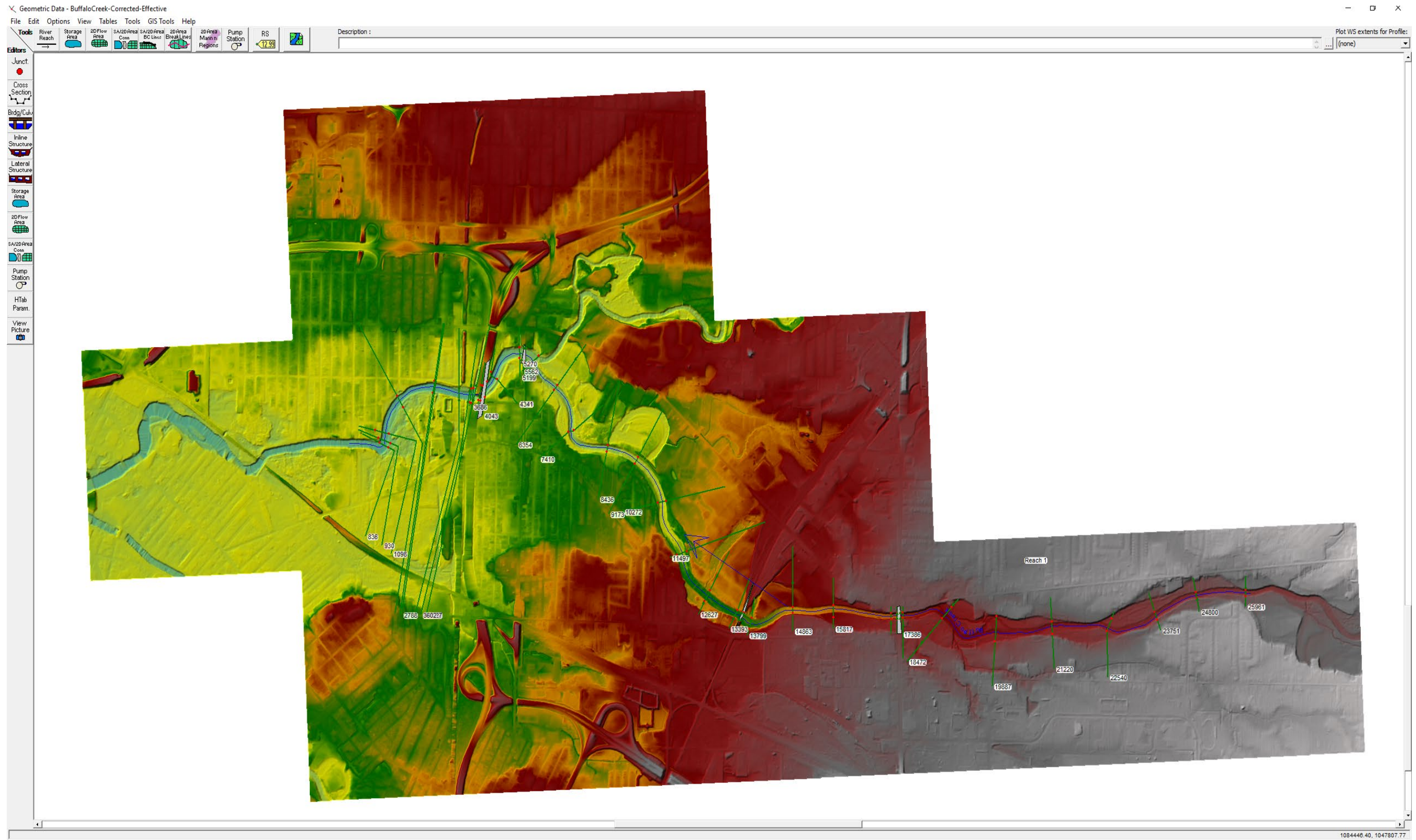
# Plans = 1

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	
836	100-yr	13600		567.3	586.87	575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600		567.3	586.86		587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600		567.4	586.92		587.03	0.000099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600		567.4	587.05		587.09	0.000059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600		566.9	587.08		587.17	0.000105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600		566.9	587.05	577.01	587.18	0.000132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600		571.1	586.98	578.38	587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600		571.2	587.05	578.46	587.45	0.000302	5.09	2670.81	325.62	0.25
3642	100-yr	13600		566	587.31		587.48	0.000103	3.36	4062.44	326.48	0.16
3686	100-yr	13600		570	587.29		587.5	0.000148	3.69	3681.31	318.5	0.19
3727	100-yr	13600		570	587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
3859	100-yr	13600		564.2	587.39		587.55	0.000125	3.19	4262.17	302.8	0.15
3898	100-yr	13600		564.2	587.39		587.55	0.000087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600		564.2	587.44	575.22	587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600		565.6	587.49		587.71	0.000308	3.74	3925.99	357.58	0.18
5199	100-yr	13600		576.3	587.75		588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600		574	588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600		574	588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
5562	100-yr	13600		571	588.75		588.95	0.000577	3.58	4069.8	382.31	0.18
6354	100-yr	13600		571.5	588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600		573.7	590.71		591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600		576.6	591.74	586.46	592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600		582.1	593.12	591.47	595.14	0.004837	11.4	1193.26	1126.26	0.72
10272	100-yr	13600		582.8	596.81	591.39	597.49	0.001099	6.69	2484.27	881.53	0.36
11497	100-yr	13600		588.7	598.6	596.01	599.58	0.002685	7.95	1724.55	278.78	0.53
12627	100-yr	13600		594.7	602.68	601.26	604.15	0.006303	9.83	1565.91	636.18	0.74
13393	100-yr	13600		595.2	605.69	601.95	606.52	0.001733	7.57	2607.75	814.76	0.44
13514	100-yr	13600		592.1	605.81	600.82	606.67	0.000463	7.44	1827.83	279.49	0.4
13535.3	Bridge											
13557	100-yr	13600		592.1	605.94	600.82	606.78	0.000444	7.35	1850.27	249.26	0.39
13799	100-yr	13600		595.5	606.91	602.03	607.09	0.00064	3.93	4867.76	665.97	0.23
14863	100-yr	13600		599.6	609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600		603.2	613.94		614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600		602.4	616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600		605.5	616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600		605.5	617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600		604.9	617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600		608.9	620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600		610.3	622.23		622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600		612.8	624.29		624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600		615.5	627.15		627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600		617.6	629.01		629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600		620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600		621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41

Appendix F-1a  
Duplicate and Base Condition Model Comparison



Appendix F-1a  
Duplicate and Base Condition Model Comparison



Appendix F-2a

Alternative #1: Remove Abandoned Railroad Bridge

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FEMA-PR-BFCK-Railroad-Removal

Geometry

PR-BFCK-Railroad-Removal

Steady Flow USGS StreamStats Full Flows

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Removed Railroad (Black) Bridge at RS 13535.3.  
 Removed X-S at RS 13557, 13393, 13514  
 Increased Manning n value to 0.03 in channel  
 and removed ineffective flow areas for RS13514.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			Base Condition	Railroad Bridge Removal
	836	-4726	586.9	586.9
	930	-4632	586.9	586.9
	1098	-4464	586.9	586.9
	1881	-3681	587.1	587.1
	2764	-2798	587.1	587.1
	2788	-2774	587.1	587.1
	3371	-2191	587.0	587.0
	3602	-1960	587.1	587.1
	3642	-1920	587.3	587.3
	3686	-1876	587.3	587.3
	3727	-1835	587.3	587.3
	3859	-1703	587.4	587.4
	3898	-1664	587.4	587.4
Bridge	3970.5	-1591.5		
	4043	-1519	587.4	587.4
	4341	-1221	587.5	587.5
	5199	-363	587.8	587.8
	5270	-292	588.1	588.1
Bridge	5304.5	-257.5		
	5339	-223	588.5	588.5
	5562	0	588.8	588.8
	6354	792	589.0	589.0
	7410	1848	590.7	590.7
	8436	2874	591.7	591.7
Oxbow	9173	3611	593.1	593.1
	10272	4710	596.8	596.8
	11497	5935	598.6	598.6
	12627	7065	602.7	602.7
	13393	7831	605.7	605.7
	13514*	7952	605.8	606.2
Railroad Bridge	13535.3*	7973.3		
	13557*	7995	605.9	
	13799	8237	606.9	606.9
	14863	9301	609.4	609.4
	15817	10255	613.9	613.9
	17170	11608	616.7	616.7
	17314	11752	616.8	616.8
Union Rd Bridge	17350	11788		
	17386	11824	617.4	617.4
	17442	11880	617.5	617.5
	18472	12910	620.9	620.9
	19887	14325	622.2	622.2
	21220	15658	624.3	624.3
	22540	16978	627.2	627.2
	23751	18189	629.0	629.0
	24800	19238	631.1	631.1
	25961	20399	634.3	634.3

\*Removed from profile plot in report to represent a uniform water surface elevation

Appendix F-2a

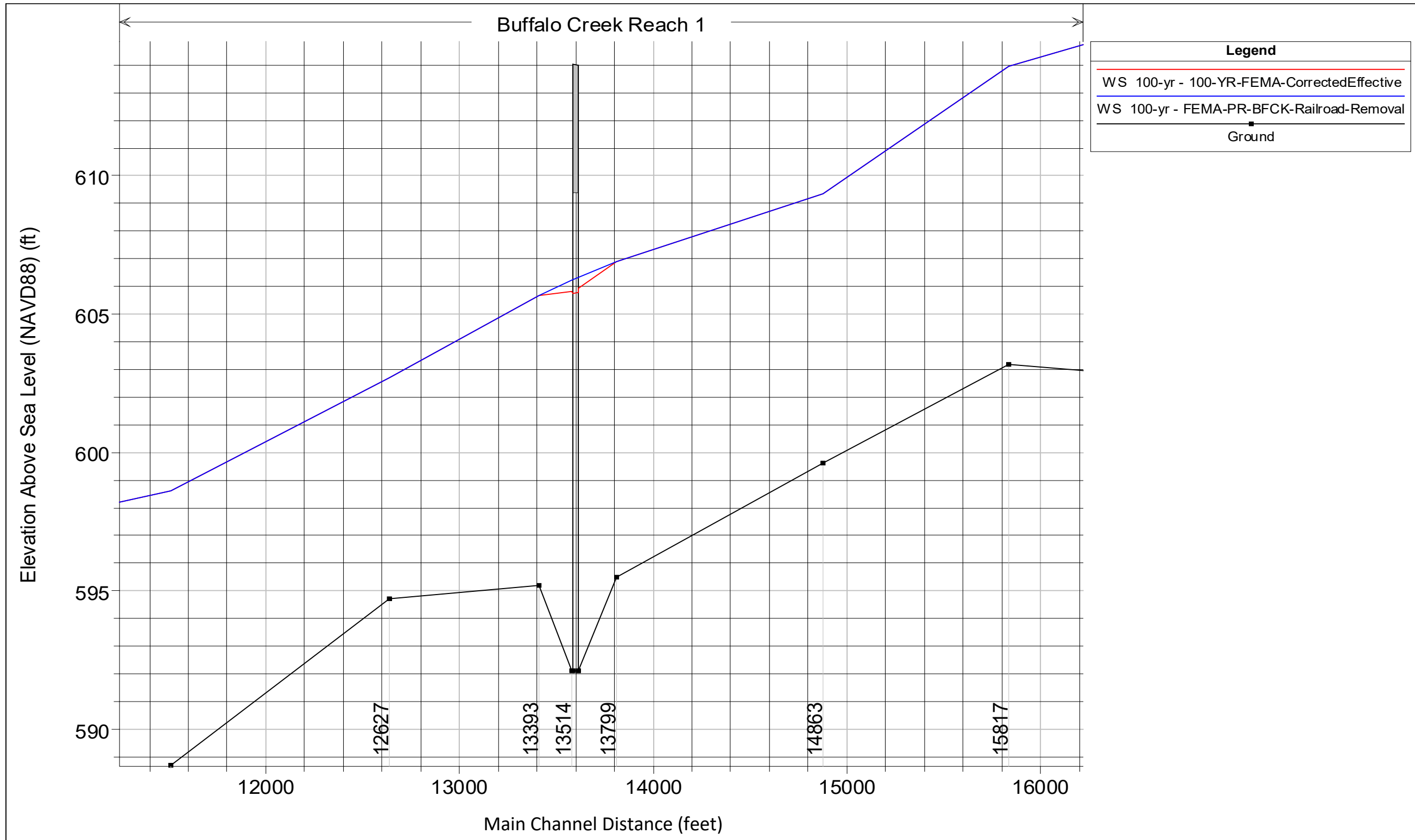
Alternative #1: Remove Abandoned Railroad Bridge

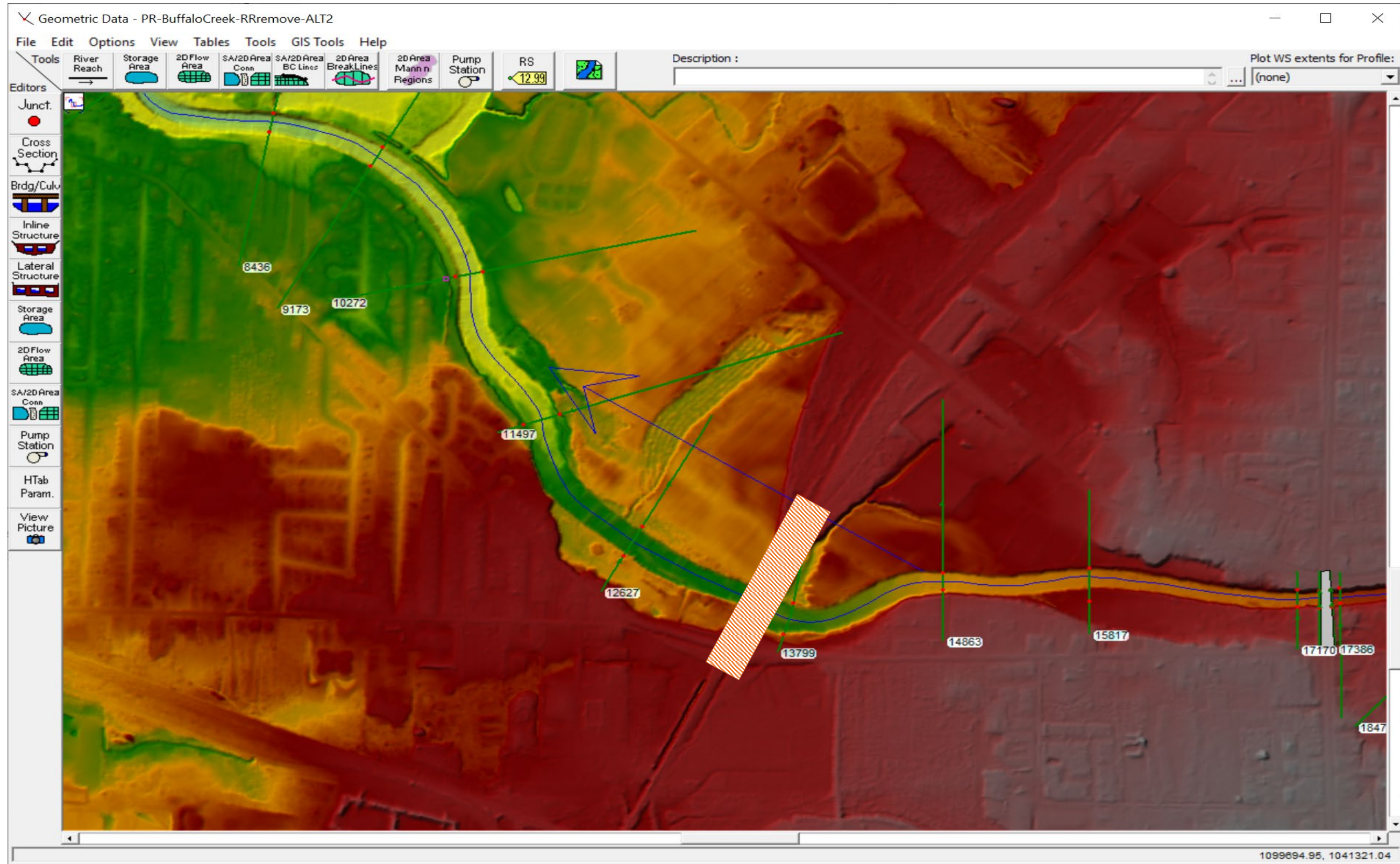
Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-Railroad-Removal River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1 # Plans = 1  
 # Hydraulic Reaches = 1 # Profiles = 1  
 # River Stations = 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
Reach 1	836	100-yr	13600	567.3	586.87	575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
Reach 1	930	100-yr	13600	567.3	586.86		587.01	0.00012	3.13	4995.46	935.76	0.15
Reach 1	1098	100-yr	13600	567.4	586.92		587.03	0.000099	2.68	8028.25	1443.12	0.13
Reach 1	1881	100-yr	13600	567.4	587.05		587.09	0.000059	2.14	15755.33	2500.49	0.1
Reach 1	2764	100-yr	13600	566.9	587.08		587.17	0.000105	2.98	14856.69	3707.83	0.15
Reach 1	2788	100-yr	13600	566.9	587.05	577.01	587.18	0.000132	3.34	12096.3	3428.02	0.17
Reach 1	3371	100-yr	13600	571.1	586.98	578.38	587.38	0.00034	5.07	2682.96	1749.34	0.26
Reach 1	3602	100-yr	13600	571.2	587.05	578.46	587.45	0.000302	5.09	2670.81	325.62	0.25
Reach 1	3642	100-yr	13600	566	587.31		587.48	0.000103	3.36	4062.44	326.48	0.16
Reach 1	3686	100-yr	13600	570	587.29		587.5	0.000148	3.69	3681.31	318.5	0.19
Reach 1	3727	100-yr	13600	570	587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
Reach 1	3859	100-yr	13600	564.2	587.39		587.55	0.000125	3.19	4262.17	302.8	0.15
Reach 1	3898	100-yr	13600	564.2	587.39		587.55	0.000087	3.19	4262.98	302.81	0.15
Reach 1	3970.5	Bridge										
Reach 1	4043	100-yr	13600	564.2	587.44	575.22	587.6	0.00022	3.18	4277.24	303.02	0.15
Reach 1	4341	100-yr	13600	565.6	587.49		587.71	0.000308	3.74	3925.99	357.58	0.18
Reach 1	5199	100-yr	13600	576.3	587.75		588.25	0.001097	5.74	2440.18	257.18	0.32
Reach 1	5270	100-yr	13600	574	588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
Reach 1	5304.5	Bridge										
Reach 1	5339	100-yr	13600	574	588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
Reach 1	5562	100-yr	13600	571	588.75		588.95	0.000577	3.58	4069.8	382.31	0.18
Reach 1	6354	100-yr	13600	571.5	588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
Reach 1	7410	100-yr	13600	573.7	590.71		591.05	0.001147	5.38	4747.73	910.28	0.26
Reach 1	8436	100-yr	13600	576.6	591.74	586.46	592.53	0.002037	7.36	2278.55	564.21	0.38
Reach 1	9173	100-yr	13600	582.1	593.12	591.47	595.14	0.004837	11.4	1193.26	1126.26	0.72
Reach 1	10272	100-yr	13600	582.8	596.81	591.38	597.49	0.001099	6.69	2484.27	881.53	0.36
Reach 1	11497	100-yr	13600	588.7	598.6	596.01	599.58	0.002685	7.95	1724.55	278.78	0.53
Reach 1	12627	100-yr	13600	594.7	602.68	601.26	604.15	0.006303	9.83	1565.91	636.18	0.74
Reach 1	13393	100-yr	13600	595.2	605.69	601.95	606.52	0.001733	7.57	2607.75	814.76	0.44
Reach 1	13514	100-yr	13600	592.1	606.23		606.81	0.001432	6.17	2319.94	289.23	0.34
Reach 1	13799	100-yr	13600	595.5	606.89	602.03	607.06	0.000646	3.94	4850.86	665.57	0.23
Reach 1	14863	100-yr	13600	599.6	609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
Reach 1	15817	100-yr	13600	603.2	613.94		614.53	0.001793	6.45	2851.92	616.22	0.41
Reach 1	17170	100-yr	13600	602.4	616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
Reach 1	17314	100-yr	13600	605.5	616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63
Reach 1	17350	Bridge										
Reach 1	17386	100-yr	13600	605.5	617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
Reach 1	17442	100-yr	13600	604.9	617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1	18472	100-yr	13600	608.9	620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
Reach 1	19887	100-yr	13600	610.3	622.23		622.39	0.000984	3.27	4287.21	642.31	0.21
Reach 1	21220	100-yr	13600	612.8	624.29		624.86	0.004079	6.19	2382.01	364.37	0.39
Reach 1	22540	100-yr	13600	615.5	627.15		627.5	0.001158	4.9	3464.3	606.97	0.29
Reach 1	23751	100-yr	13600	617.6	629.01		629.46	0.002382	5.98	3113.75	527.9	0.34
Reach 1	24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
Reach 1	25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41







Appendix F-2a

Blocked Obstruction / Ice Jam Simulation - Railroad bridge

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FEMA-CorrectedEffective  
 FEMA-CORR-BFCK-Railroad-ICE  
 FEMA-PR-BFCK-Railroad-Removal-ICE  
 Geometry  
 BuffaloCreek-CorrectedEffective  
 CORR-BFCK-Railroad-ICE  
 PR-BFCK-Railroad-Removal-ICE  
 Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 10-year  
 Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Base Condition with ice cover:  
 Ice cover around railroad bridge piers of 1.5 feet thickness.  
 Bridge/culvert ice jam computation option: ice remains constant throughout the bridge.  
 Blocked obstructions on left and right bank of RS13799 to simulate reduced cross-sectional area of ice jam.

Railroad Remove with Ice Cover:  
 Removed Railroad (Black) Bridge.  
 Removed X-S at RS 13557.  
 Increased Manning n value to 0.03 in channel and removed ineffective flow areas for RS13514.  
 Ice cover around railroad bridge piers of 1.5 feet thickness.  
 Bridge/culvert ice jam computation option: ice remains constant throughout the bridge.  
 Blocked obstructions on left and right bank of RS13799 to simulate reduced cross-sectional area of ice jam.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Base Condition (10 yr)	Base Condition with Ice Cover at RR	RR Remove with Ice Cover
	836	-4726	583.3	583.3	583.3
	930	-4632	583.4	583.4	583.4
	1098	-4464	583.4	583.4	583.4
	1881	-3681	583.5	583.5	583.5
	2764	-2798	583.5	583.5	583.5
	2788	-2774	583.5	583.5	583.5
	3371	-2191	583.6	583.6	583.6
	3602	-1960	583.7	583.7	583.7
	3642	-1920	583.8	583.8	583.8
	3686	-1876	583.8	583.8	583.8
	3727	-1835	583.8	583.8	583.8
	3859	-1703	583.9	583.9	583.9
	3898	-1664	583.9	583.9	583.9
Bridge	3970.5	-1591.5			
	4043	-1519	583.9	583.9	583.9
	4341	-1221	584.0	584.0	584.0
	5199	-363	584.2	584.2	584.2
	5270	-292	584.6	584.6	584.6
Bridge	5304.5	-257.5			
	5339	-223	585.0	585.0	585.0
	5562	0	585.2	585.2	585.2
	6354	792	585.5	585.5	585.5
	7410	1848	587.6	587.6	587.6
	8436	2874	589.1	589.1	589.1
Oxbow	9173	3611	590.5	590.5	590.5
	10272	4710	594.0	594.0	594.0
	11497	5935	596.0	596.0	596.0
	12627	7065	600.7	600.7	600.7
	13393	7831	603.4	603.4	603.4
	13514*	7952	603.7	603.7	604.0
Railroad Bridge	13535.3*	7973.3			
	13557*	7995	603.8	603.8	
	13799	8237	604.3	605.1	605.3
	14863	9301	606.6	608.5	608.5
	15817	10255	612.0	611.6	611.6
	17170	11608	614.5	614.5	614.5
	17314	11752	614.6	614.6	614.6
Union Rd Bridge	17350	11788			
	17386	11824	614.9	614.9	614.9
	17442	11880	615.0	615.0	615.0
	18472	12910	617.8	617.8	617.8
	19887	14325	619.6	619.6	619.6
	21220	15658	622.1	622.1	622.1
	22540	16978	624.8	624.8	624.8
	23751	18189	626.7	626.7	626.7
	24800	19238	629.0	629.0	629.0
	25961	20399	631.9	631.9	631.9

\*Removed from profile plot in report to represent a uniform water surface elevation and remove hydraulic jump

Appendix F-2a

Blocked Obstruction / Ice Jam Simulation - Railroad bridge

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-CORR-BFCK-Railroad-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

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	
Reach 1	836	10-yr	7990	567.3		583.33	573.45	583.44	0.00012	2.82	5183.48	1029.86	0.14
Reach 1	930	10-yr	7990	567.3		583.36		583.45	0.000099	2.44	3318.37	350.71	0.13
Reach 1	1098	10-yr	7990	567.4		583.4		583.47	0.0001	2.21	4005.7	723.84	0.13
Reach 1	1881	10-yr	7990	567.4		583.49		583.54	0.000083	2.12	7792.16	1874.07	0.12
Reach 1	2764	10-yr	7990	566.9		583.51		583.68	0.000193	3.38	3982.1	1262.62	0.19
Reach 1	2788	10-yr	7990	566.9		583.49	574.52	583.69	0.000226	3.66	2185.99	858.71	0.21
Reach 1	3371	10-yr	7990	571.1		583.6	576.61	583.85	0.000253	4.02	1986.05	195.95	0.22
Reach 1	3602	10-yr	7990	571.2		583.66	576.69	583.91	0.000254	4.03	1984.09	196.13	0.22
Reach 1	3642	10-yr	7990	566		583.82		583.93	0.000088	2.65	3016.97	286.58	0.14
Reach 1	3686	10-yr	7990	570		583.8		583.94	0.000142	3.05	2623.36	290.58	0.18
Reach 1	3727	10-yr	7990	570		583.8	576.78	583.96	0.000247	3.24	2463.47	285.76	0.19
Reach 1	3859	10-yr	7990	564.2		583.89		583.99	0.000101	2.47	3230.23	287.16	0.13
Reach 1	3898	10-yr	7990	564.2		583.9		583.99	0.00007	2.47	3230.85	287.17	0.13
Reach 1	3970.5												
Reach 1	4043	10-yr	7990	564.2		583.93	573.13	584.02	0.000178	2.47	3240.63	287.32	0.13
Reach 1	4341	10-yr	7990	565.6		583.98		584.11	0.00027	2.96	2774.36	297.3	0.16
Reach 1	5199	10-yr	7990	576.3		584.24		584.65	0.001438	5.12	1577.65	235.51	0.34
Reach 1	5270	10-yr	7990	574		584.63	579.21	584.86	0.000672	3.84	2080.17	292.38	0.24
Reach 1	5304.5												
Reach 1	5339	10-yr	7990	574		584.99	579.21	585.2	0.000578	3.67	2175.56	297.43	0.22
Reach 1	5562	10-yr	7990	571		585.18		585.32	0.000659	3.03	2735.78	363.21	0.18
Reach 1	6354	10-yr	7990	571.5		585.51	580.81	586.27	0.001553	7	1154	177.36	0.41
Reach 1	7410	10-yr	7990	573.7		587.55		587.92	0.001527	5.17	2149.79	613.03	0.29
Reach 1	8436	10-yr	7990	576.6		589.05	583.94	589.56	0.0018	5.82	1539.46	243.04	0.34
Reach 1	9173	10-yr	7990	582.1		590.52	589.39	592.04	0.005506	9.88	808.34	683.93	0.73
Reach 1	10272	10-yr	7990	582.8		594	589.35	594.47	0.001114	5.53	1458.44	217.23	0.35
Reach 1	11497	10-yr	7990	588.7		596	594.44	596.85	0.003657	7.39	1081.91	220.02	0.59
Reach 1	12627	10-yr	7990	594.7		600.67	599.43	601.8	0.005194	8.52	937.93	206.46	0.67
Reach 1	13393	10-yr	7990	595.2		603.38	600.11	604.01	0.001737	6.36	1291.02	287.04	0.43
Reach 1	13514	10-yr	7990	592.1		603.72	599	604.17	0.000326	5.41	1476.07	234.68	0.32
Reach 1	13535.3												
Reach 1	13557	10-yr	7990	592.1		603.81	600.57	604.46	0.004244	6.5	1230.75	218.8	0.45
Reach 1	13799	10-yr	7990	595.5		605.1	602.3	605.4	0.004158	4.82	2080.73	400.91	0.33
Reach 1	14863	10-yr	7990	599.6		608.47	606.57	609.6	0.003224	8.72	1198.65	432.22	0.58
Reach 1	15817	10-yr	7990	603.2		611.56		612.11	0.0021	6.01	1484.99	463.57	0.47
Reach 1	17170	10-yr	7990	602.4		614.52	609.67	615.17	0.002394	6.46	1244.07	137.48	0.37
Reach 1	17314	10-yr	7990	605.5		614.63	611.66	615.77	0.002385	8.6	929.26	131.87	0.52
Reach 1	17350												
Reach 1	17386	10-yr	7990	605.5		614.93	611.65	616	0.002116	8.3	963.21	130.87	0.49
Reach 1	17442	10-yr	7990	604.9		615.02	612.1	616.19	0.002554	8.68	926.5	115.48	0.53
Reach 1	18472	10-yr	7990	608.9		617.84	613.62	618.04	0.001238	3.68	2383.59	888.98	0.25
Reach 1	19887	10-yr	7990	610.3		619.6		619.73	0.001122	2.94	2739.63	557.31	0.23
Reach 1	21220	10-yr	7990	612.8		622.05		622.47	0.00452	5.23	1593.21	339.7	0.39
Reach 1	22540	10-yr	7990	615.5		624.82		625.08	0.001088	4.14	2125.82	509.24	0.28
Reach 1	23751	10-yr	7990	617.6		626.71		627.1	0.002739	5.31	1957.56	490.69	0.35
Reach 1	24800	10-yr	7990	620.4		629.04	626.42	629.94	0.002402	7.64	1187.72	371.84	0.5
Reach 1	25961	10-yr	7990	621.4		631.87	627.21	632.44	0.001868	6.05	1359.93	186.22	0.35

Appendix F-2a

Blocked Obstruction / Ice Jam Simulation - Railroad bridge

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-Railroad-Removal-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

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	
Reach 1	836	10-yr	7990	567.3		583.33	573.45	583.44	0.00012	2.82	5183.48	1029.86	0.14
Reach 1	930	10-yr	7990	567.3		583.36		583.45	0.000099	2.44	3318.37	350.71	0.13
Reach 1	1098	10-yr	7990	567.4		583.4		583.47	0.0001	2.21	4005.7	723.84	0.13
Reach 1	1881	10-yr	7990	567.4		583.49		583.54	0.000083	2.12	7792.16	1874.07	0.12
Reach 1	2764	10-yr	7990	566.9		583.51		583.68	0.000193	3.38	3982.1	1262.62	0.19
Reach 1	2788	10-yr	7990	566.9		583.49	574.52	583.69	0.000226	3.66	2185.99	858.71	0.21
Reach 1	3371	10-yr	7990	571.1		583.6	576.61	583.85	0.000253	4.02	1986.05	195.95	0.22
Reach 1	3602	10-yr	7990	571.2		583.66	576.69	583.91	0.000254	4.03	1984.09	196.13	0.22
Reach 1	3642	10-yr	7990	566		583.82		583.93	0.000088	2.65	3016.97	286.58	0.14
Reach 1	3686	10-yr	7990	570		583.8		583.94	0.000142	3.05	2623.36	290.58	0.18
Reach 1	3727	10-yr	7990	570		583.8	576.78	583.96	0.000247	3.24	2463.47	285.76	0.19
Reach 1	3859	10-yr	7990	564.2		583.89		583.99	0.000101	2.47	3230.23	287.16	0.13
Reach 1	3898	10-yr	7990	564.2		583.9		583.99	0.00007	2.47	3230.85	287.17	0.13
Reach 1	3970.5												
		Bridge											
Reach 1	4043	10-yr	7990	564.2		583.93	573.13	584.02	0.000178	2.47	3240.63	287.32	0.13
Reach 1	4341	10-yr	7990	565.6		583.98		584.11	0.00027	2.96	2774.36	297.3	0.16
Reach 1	5199	10-yr	7990	576.3		584.24		584.65	0.001438	5.12	1577.65	235.51	0.34
Reach 1	5270	10-yr	7990	574		584.63	579.21	584.86	0.000672	3.84	2080.17	292.38	0.24
Reach 1	5304.5												
		Bridge											
Reach 1	5339	10-yr	7990	574		584.99	579.21	585.2	0.000578	3.67	2175.56	297.43	0.22
Reach 1	5562	10-yr	7990	571		585.18		585.32	0.000659	3.03	2735.78	363.21	0.18
Reach 1	6354	10-yr	7990	571.5		585.51	580.81	586.27	0.001553	7	1154	177.36	0.41
Reach 1	7410	10-yr	7990	573.7		587.55		587.92	0.001527	5.17	2149.79	613.03	0.29
Reach 1	8436	10-yr	7990	576.6		589.05	583.94	589.56	0.0018	5.82	1539.46	243.04	0.34
Reach 1	9173	10-yr	7990	582.1		590.52	589.39	592.04	0.005506	9.88	808.34	683.93	0.73
Reach 1	10272	10-yr	7990	582.8		594	589.35	594.47	0.001114	5.53	1458.44	217.23	0.35
Reach 1	11497	10-yr	7990	588.7		596	594.44	596.85	0.003657	7.39	1081.91	220.02	0.59
Reach 1	12627	10-yr	7990	594.7		600.67	599.43	601.8	0.005194	8.52	937.93	206.46	0.67
Reach 1	13393	10-yr	7990	595.2		603.38	600.11	604.01	0.001737	6.36	1291.02	287.04	0.43
Reach 1	13514	10-yr	7990	592.1		604.04		604.53	0.005216	5.61	1427.02	221.56	0.38
Reach 1	13799	10-yr	7990	595.5		605.32	602.29	605.59	0.003699	4.63	2166.98	400.91	0.31
Reach 1	14863	10-yr	7990	599.6		608.46	606.57	609.59	0.003238	8.74	1195.36	431.09	0.58
Reach 1	15817	10-yr	7990	603.2		611.56		612.11	0.002099	6.01	1485.44	463.65	0.47
Reach 1	17170	10-yr	7990	602.4		614.52	609.67	615.17	0.002394	6.46	1244.06	137.48	0.37
Reach 1	17314	10-yr	7990	605.5		614.63	611.66	615.77	0.002385	8.6	929.25	131.87	0.52
Reach 1	17350												
		Bridge											
Reach 1	17386	10-yr	7990	605.5		614.93	611.65	616	0.002117	8.3	963.18	130.87	0.49
Reach 1	17442	10-yr	7990	604.9		615.02	612.1	616.19	0.002554	8.68	926.47	115.48	0.53
Reach 1	18472	10-yr	7990	608.9		617.84	613.62	618.04	0.001238	3.68	2383.49	888.91	0.25
Reach 1	19887	10-yr	7990	610.3		619.6		619.73	0.001122	2.94	2739.6	557.31	0.23
Reach 1	21220	10-yr	7990	612.8		622.05		622.47	0.00452	5.23	1593.21	339.7	0.39
Reach 1	22540	10-yr	7990	615.5		624.82		625.08	0.001088	4.14	2125.82	509.24	0.28
Reach 1	23751	10-yr	7990	617.6		626.71		627.1	0.002739	5.31	1957.56	490.69	0.35
Reach 1	24800	10-yr	7990	620.4		629.04	626.42	629.94	0.002402	7.64	1187.72	371.84	0.5
Reach 1	25961	10-yr	7990	621.4		631.87	627.21	632.44	0.001868	6.05	1359.93	186.22	0.35

Appendix F-2a

Blocked Obstruction / Ice Jam Simulation - Railroad bridge

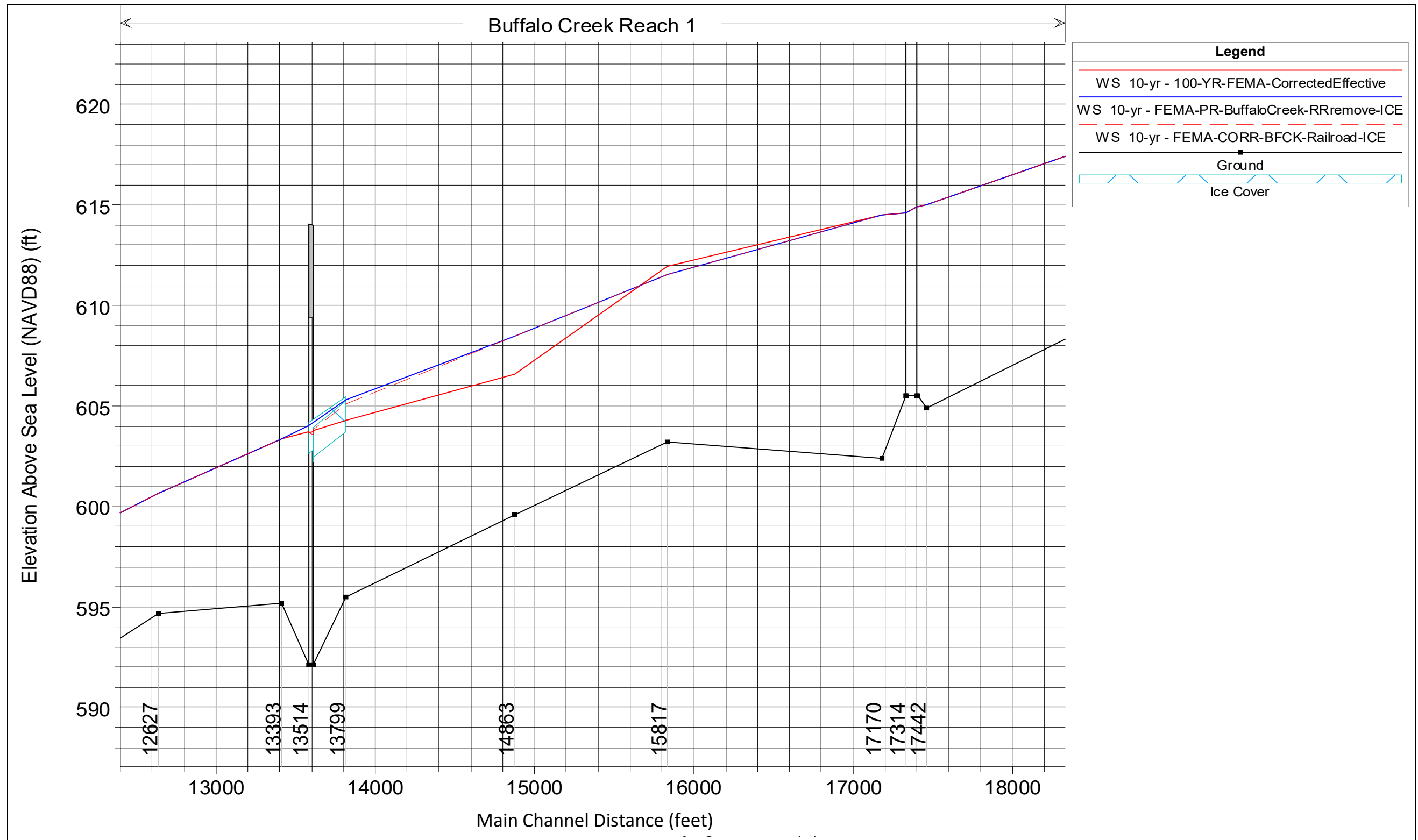
Profile Output Table - Standard Table 1

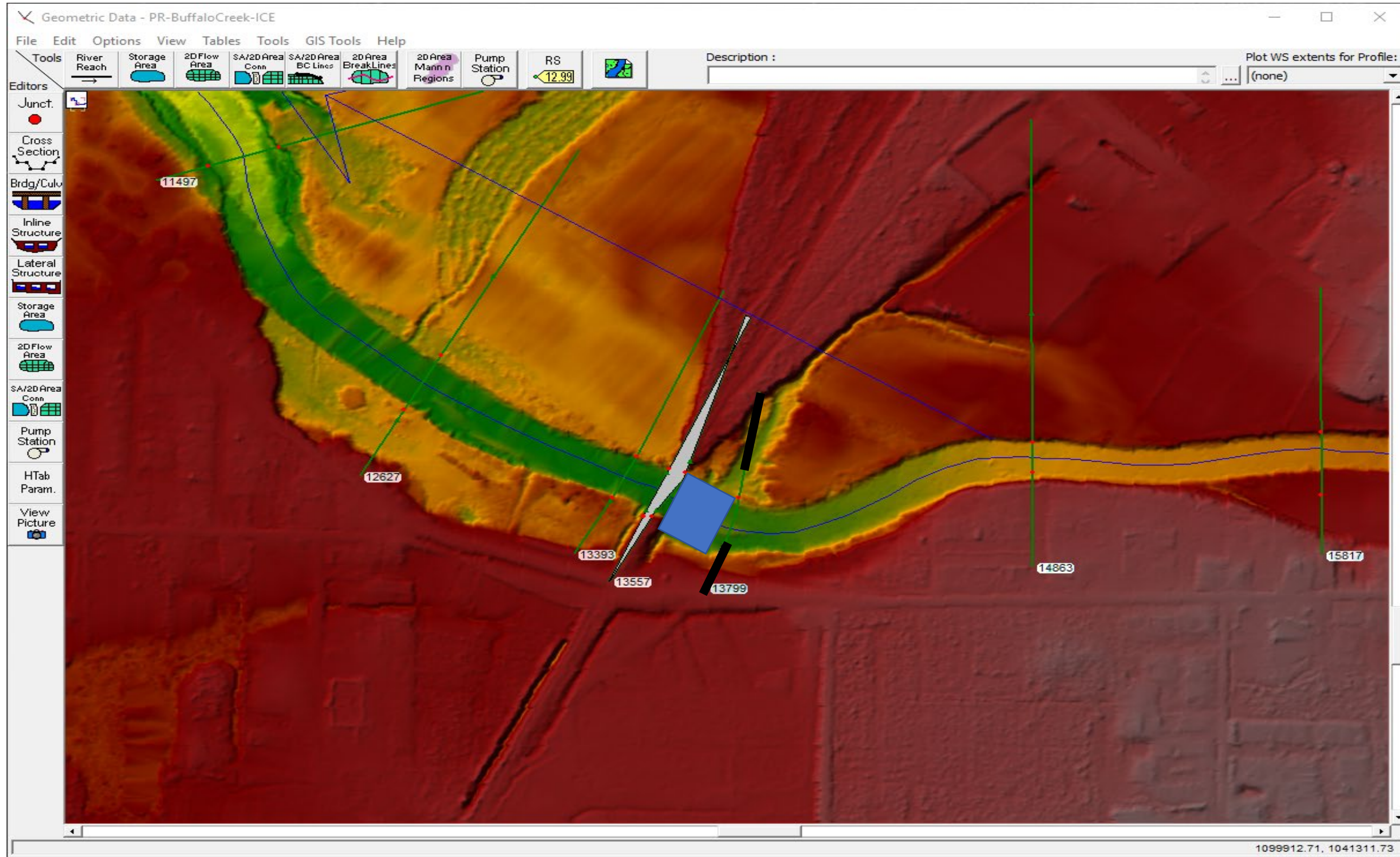
HEC-RAS Plan: FEMA-CorrectedEffective River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1 # River Stations = 47 # Profiles = 1

# Hydraulic Reaches = 1 # Plans = 1

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	
Reach 1	836	10-yr	7990	567.3		583.33	573.44	583.44	0.00012	2.82	5183.48	1029.86	0.14
Reach 1	930	10-yr	7990	567.3		583.36		583.45	0.000099	2.44	3318.37	350.71	0.13
Reach 1	1098	10-yr	7990	567.4		583.4		583.47	0.0001	2.21	4005.7	723.84	0.13
Reach 1	1881	10-yr	7990	567.4		583.49		583.54	0.000083	2.12	7792.16	1874.07	0.12
Reach 1	2764	10-yr	7990	566.9		583.51		583.68	0.000193	3.38	3982.1	1262.62	0.19
Reach 1	2788	10-yr	7990	566.9		583.49	574.52	583.69	0.000226	3.66	2185.99	858.71	0.21
Reach 1	3371	10-yr	7990	571.1		583.6	576.61	583.85	0.000253	4.02	1986.05	195.95	0.22
Reach 1	3602	10-yr	7990	571.2		583.66	576.69	583.91	0.000254	4.03	1984.09	196.13	0.22
Reach 1	3642	10-yr	7990	566		583.82		583.93	0.000088	2.65	3016.97	286.58	0.14
Reach 1	3686	10-yr	7990	570		583.8		583.94	0.000142	3.05	2623.36	290.58	0.18
Reach 1	3727	10-yr	7990	570		583.8	576.78	583.96	0.000247	3.24	2463.47	285.76	0.19
Reach 1	3859	10-yr	7990	564.2		583.89		583.99	0.000101	2.47	3230.23	287.16	0.13
Reach 1	3898	10-yr	7990	564.2		583.9		583.99	0.00007	2.47	3230.85	287.17	0.13
Reach 1	3970.5		Bridge										
Reach 1	4043	10-yr	7990	564.2		583.93	573.13	584.02	0.000178	2.47	3240.63	287.32	0.13
Reach 1	4341	10-yr	7990	565.6		583.98		584.11	0.00027	2.96	2774.36	297.3	0.16
Reach 1	5199	10-yr	7990	576.3		584.24		584.65	0.001438	5.12	1577.65	235.51	0.34
Reach 1	5270	10-yr	7990	574		584.63	579.21	584.86	0.000672	3.84	2080.17	292.38	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	10-yr	7990	574		584.99	579.21	585.2	0.000578	3.67	2175.56	297.43	0.22
Reach 1	5562	10-yr	7990	571		585.18		585.32	0.000659	3.03	2735.78	363.21	0.18
Reach 1	6354	10-yr	7990	571.5		585.51	580.81	586.27	0.001553	7	1154	177.36	0.41
Reach 1	7410	10-yr	7990	573.7		587.55		587.92	0.001527	5.17	2149.79	613.03	0.29
Reach 1	8436	10-yr	7990	576.6		589.05	583.94	589.56	0.0018	5.82	1539.46	243.04	0.34
Reach 1	9173	10-yr	7990	582.1		590.52	589.39	592.04	0.005506	9.88	808.34	683.93	0.73
Reach 1	10272	10-yr	7990	582.8		594	589.35	594.47	0.001114	5.53	1458.44	217.23	0.35
Reach 1	11497	10-yr	7990	588.7		596	594.44	596.85	0.003657	7.39	1081.91	220.02	0.59
Reach 1	12627	10-yr	7990	594.7		600.67	599.43	601.8	0.005194	8.52	937.93	206.46	0.67
Reach 1	13393	10-yr	7990	595.2		603.38	600.11	604.01	0.001737	6.36	1291.02	287.04	0.43
Reach 1	13514	10-yr	7990	592.1		603.72	599	604.17	0.000326	5.41	1476.07	234.68	0.32
Reach 1	13535.3		Bridge										
Reach 1	13557	10-yr	7990	592.1		603.78	599	604.23	0.000318	5.37	1487.15	233.4	0.32
Reach 1	13799	10-yr	7990	595.5		604.26	600.89	604.41	0.000746	3.59	3151.04	633.07	0.25
Reach 1	14863	10-yr	7990	599.6		606.57	606.57	609.01	0.010011	12.55	651.58	155	0.98
Reach 1	15817	10-yr	7990	603.2		611.97		612.43	0.001673	5.51	1682.76	500.49	0.41
Reach 1	17170	10-yr	7990	602.4		614.52	609.67	615.17	0.002394	6.46	1244.07	137.48	0.37
Reach 1	17314	10-yr	7990	605.5		614.63	611.66	615.77	0.002385	8.6	929.26	131.87	0.52
Reach 1	17350		Bridge										
Reach 1	17386	10-yr	7990	605.5		614.93	611.65	616	0.002116	8.3	963.21	130.87	0.49
Reach 1	17442	10-yr	7990	604.9		615.02	612.1	616.19	0.002554	8.68	926.5	115.48	0.53
Reach 1	18472	10-yr	7990	608.9		617.84	613.62	618.04	0.001238	3.68	2383.59	888.98	0.25
Reach 1	19887	10-yr	7990	610.3		619.6		619.73	0.001122	2.94	2739.63	557.31	0.23
Reach 1	21220	10-yr	7990	612.8		622.05		622.47	0.00452	5.23	1593.21	339.7	0.39
Reach 1	22540	10-yr	7990	615.5		624.82		625.08	0.001088	4.14	2125.82	509.24	0.28
Reach 1	23751	10-yr	7990	617.6		626.71		627.1	0.002739	5.31	1957.56	490.69	0.35
Reach 1	24800	10-yr	7990	620.4		629.04	626.42	629.94	0.002402	7.64	1187.72	371.84	0.5
Reach 1	25961	10-yr	7990	621.4		631.87	627.21	632.44	0.001868	6.05	1359.93	186.22	0.35





Appendix F-3a

Alternative #2: Remove Abandoned Railroad Bridge and Associated Topography

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FEMA-PR-BFCK-Railroad-Topo-Remove

Geometry

FEMA-PR-BFCK-Railroad-Topo-Remove

Steady Flow USGS StreamStats Full Flows

Reach 1

Profile 100-year RR & Topo removal

10-year Ice Cover

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Removed Railroad (Black) Bridge at RS 13593.3.

Removed X-Ss at RS 12627, 13393, 13514, 13535.3, 13557, 13799.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			Base Condition 100-year	RR Bridge/ Embankment Removal
	836	-4726	586.9	586.9
	930	-4632	586.9	586.9
	1098	-4464	586.9	586.9
	1881	-3681	587.1	587.1
	2764	-2798	587.1	587.1
	2788	-2774	587.1	587.1
	3371	-2191	587.0	587.0
	3602	-1960	587.1	587.1
	3642	-1920	587.3	587.3
	3686	-1876	587.3	587.3
	3727	-1835	587.3	587.3
	3859	-1703	587.4	587.4
	3898	-1664	587.4	587.4
Bridge	3970.5	-1591.5		
	4043	-1519	587.4	587.4
	4341	-1221	587.5	587.5
	5199	-363	587.8	587.8
	5270	-292	588.1	588.1
Bridge	5304.5	-257.5		
	5339	-223	588.5	588.5
	5562	0	588.8	588.8
	6354	792	589.0	589.0
	7410	1848	590.7	590.7
	8436	2874	591.7	591.7
Oxbow	9173	3611	593.1	593.1
	10272	4710	596.8	596.8
	11497	5935	598.6	598.6
	12627	7065	602.7	
	13393	7831	605.7	
	13514*	7952	605.8	
Railroad Bridge	13535.3*	7973.3		
	13557*	7995	605.9	
	13799	8237	606.9	
	14863	9301	609.4	609.7
	15817	10255	613.9	613.8
	17170	11608	616.7	616.8
	17314	11752	616.8	616.8
Union Rd Bridge	17350	11788		
	17386	11824	617.4	617.4
	17442	11880	617.5	617.5
	18472	12910	620.9	620.9
	19887	14325	622.2	622.2
	21220	15658	624.3	624.3
	22540	16978	627.2	627.2
	23751	18189	629.0	629.0
	24800	19238	631.1	631.1
	25961	20399	634.3	634.3

\*Removed from profile plot in report to represent a uniform water surface elevation and remove hydraulic jump

Appendix F-3a

Alternative #2: Remove Abandoned Railroad Bridge and Associated Topography

Profile Output Table - Standard Table 1

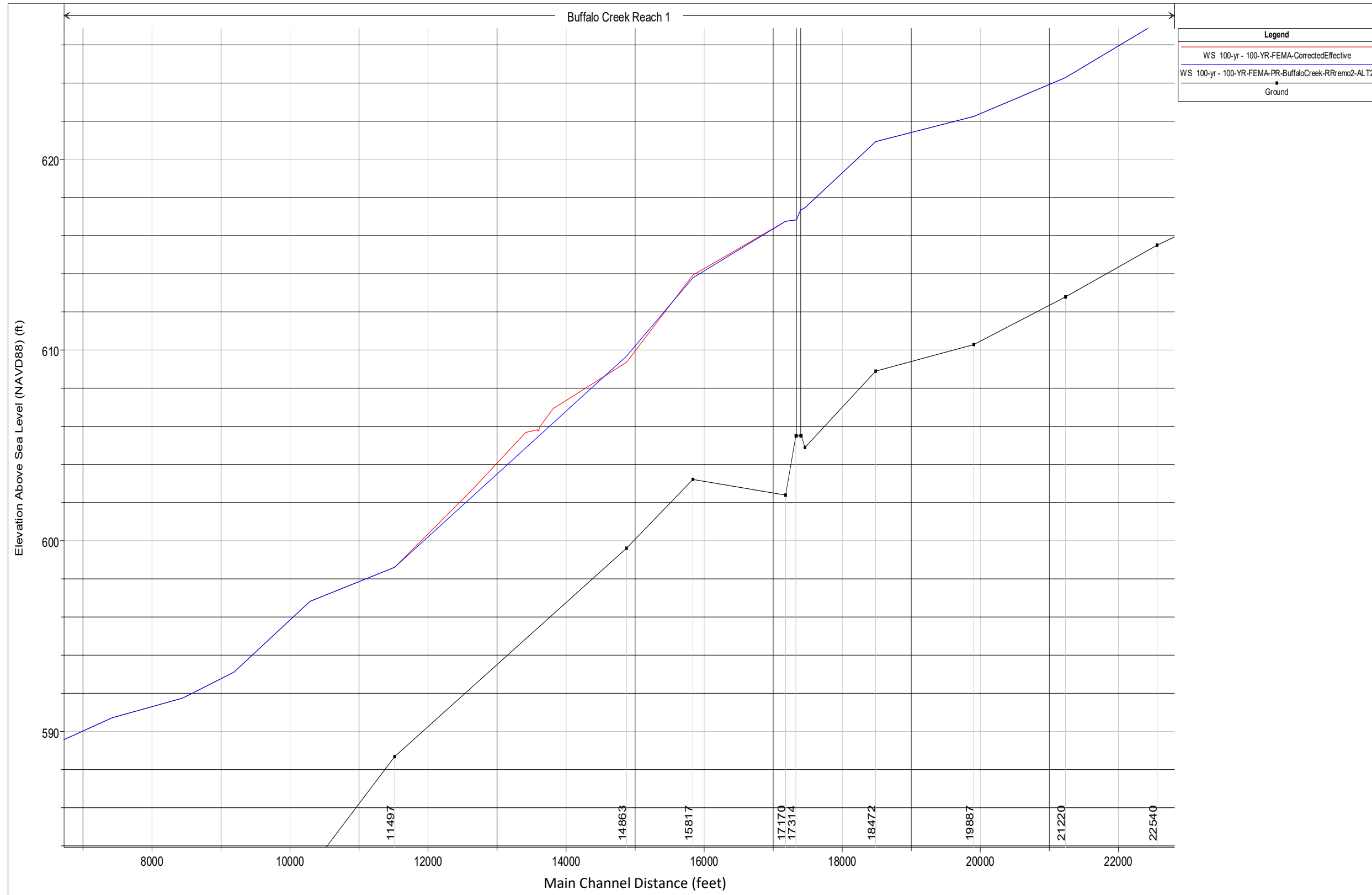
HEC-RAS Plan: FEMA-PR-BFCK-Railroad-Topo-Remove River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

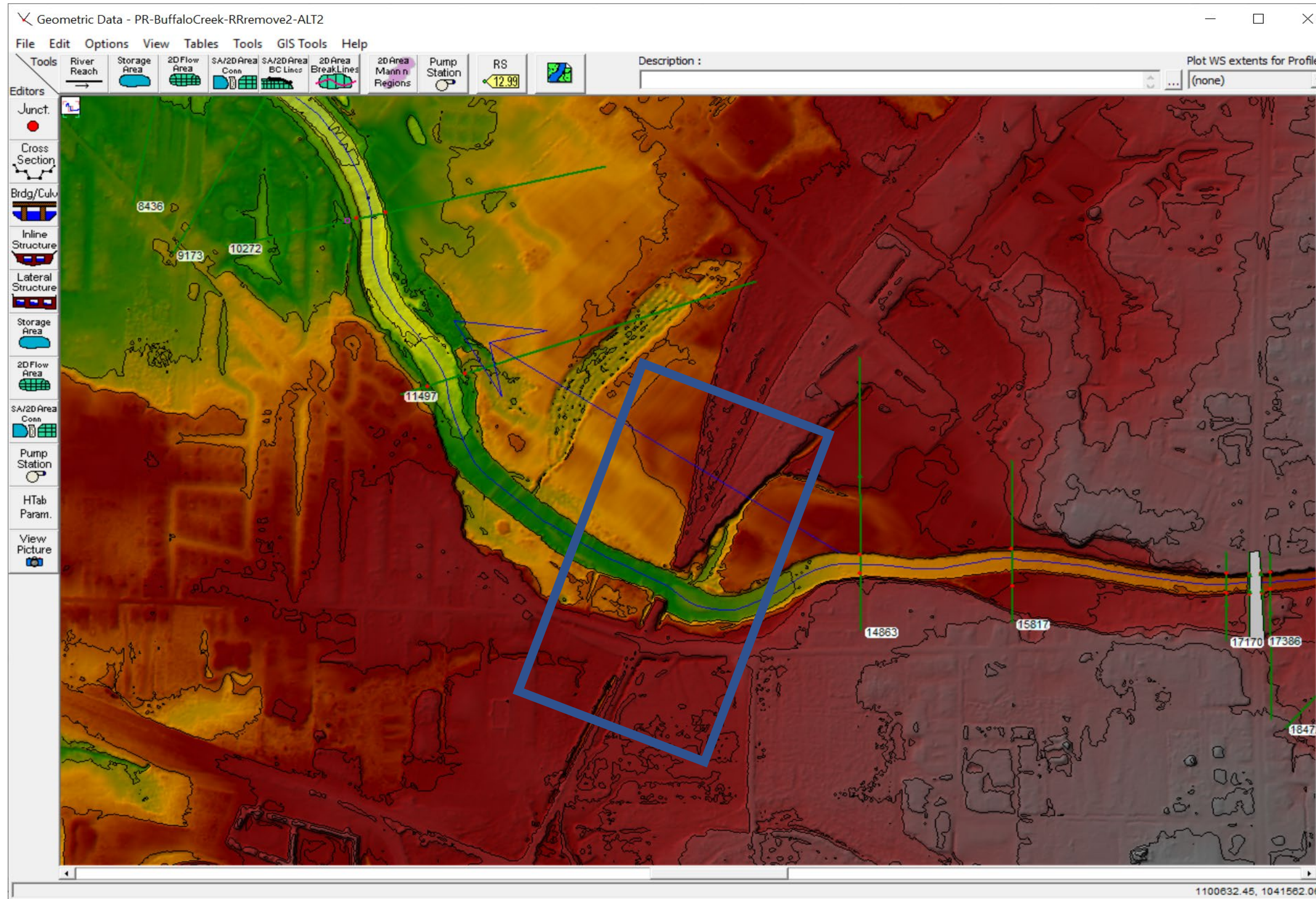
# Rivers = 1 # Plans = 1  
 # Hydraulic Reaches = 1 # Profiles = 1  
 # River Stations = 44

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	
Reach 1	836	100-yr	13600	567.3	586.87	575.44	586.99	0.00012		3.2	8999.39	1169.72	0.15
Reach 1	930	100-yr	13600	567.3	586.86		587.01	0.00012		3.13	4995.46	935.76	0.15
Reach 1	1098	100-yr	13600	567.4	586.92		587.03	0.000099		2.68	8028.25	1443.12	0.13
Reach 1	1881	100-yr	13600	567.4	587.05		587.09	0.000059		2.14	15755.33	2500.49	0.1
Reach 1	2764	100-yr	13600	566.9	587.08		587.17	0.000105		2.98	14856.69	3707.83	0.15
Reach 1	2788	100-yr	13600	566.9	587.05	577.01	587.18	0.000132		3.34	12096.3	3428.02	0.17
Reach 1	3371	100-yr	13600	571.1	586.98	578.38	587.38	0.00034		5.07	2682.96	1749.34	0.26
Reach 1	3602	100-yr	13600	571.2	587.05	578.46	587.45	0.000302		5.09	2670.81	325.62	0.25
Reach 1	3642	100-yr	13600	566	587.31		587.48	0.000103		3.36	4062.44	326.48	0.16
Reach 1	3686	100-yr	13600	570	587.29		587.5	0.000148		3.69	3681.31	318.5	0.19
Reach 1	3727	100-yr	13600	570	587.28	578.66	587.52	0.000244		3.9	3490.11	303.38	0.2
Reach 1	3859	100-yr	13600	564.2	587.39		587.55	0.000125		3.19	4262.17	302.8	0.15
Reach 1	3898	100-yr	13600	564.2	587.39		587.55	0.000087		3.19	4262.98	302.81	0.15
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	13600	564.2	587.44	575.22	587.6	0.00022		3.18	4277.24	303.02	0.15
Reach 1	4341	100-yr	13600	565.6	587.49		587.71	0.000308		3.74	3925.99	357.58	0.18
Reach 1	5199	100-yr	13600	576.3	587.75		588.25	0.001097		5.74	2440.18	257.18	0.32
Reach 1	5270	100-yr	13600	574	588.11	580.74	588.43	0.000583		4.55	2986.06	341.81	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	13600	574	588.53	580.74	588.83	0.000517		4.39	3095.38	347.24	0.22
Reach 1	5562	100-yr	13600	571	588.75		588.95	0.000577		3.58	4069.8	382.31	0.18
Reach 1	6354	100-yr	13600	571.5	588.99	583.47	589.76	0.001211		7.5	3207.13	933.05	0.38
Reach 1	7410	100-yr	13600	573.7	590.71		591.05	0.001147		5.38	4747.73	910.28	0.26
Reach 1	8436	100-yr	13600	576.6	591.74	586.46	592.53	0.002037		7.36	2278.55	564.21	0.38
Reach 1	9173	100-yr	13600	582.1	593.12	591.47	595.14	0.004837		11.4	1193.26	1126.26	0.72
Reach 1	10272	100-yr	13600	582.8	596.81	591.38	597.49	0.001099		6.69	2484.27	881.53	0.36
Reach 1	11497	100-yr	13600	588.7	598.6	596.01	599.58	0.002685		7.95	1724.55	278.78	0.53
Reach 1	14863	100-yr	13600	599.6	609.68	609.35	611.56	0.004682		11.69	1847.3	633.53	0.72
Reach 1	15817	100-yr	13600	603.2	613.8		614.42	0.001912		6.6	2766.56	613.36	0.43
Reach 1	17170	100-yr	13600	602.4	616.75	611.96	617.97	0.003417		8.88	1559.05	144.94	0.46
Reach 1	17314	100-yr	13600	605.5	616.8	614	618.91	0.003216		11.63	1168.99	135.65	0.63
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	13600	605.5	617.35	613.99	619.26	0.002718		11.06	1229.41	133.86	0.58
Reach 1	17442	100-yr	13600	604.9	617.47	614.48	619.49	0.003127		11.4	1216.49	121.23	0.61
Reach 1	18472	100-yr	13600	608.9	620.94	615.06	621.12	0.000815		3.66	5165.69	1271.38	0.21
Reach 1	19887	100-yr	13600	610.3	622.23		622.4	0.000983		3.27	4287.61	642.34	0.21
Reach 1	21220	100-yr	13600	612.8	624.29		624.87	0.004079		6.19	2382.08	364.37	0.39
Reach 1	22540	100-yr	13600	615.5	627.15		627.5	0.001158		4.9	3464.34	606.97	0.29
Reach 1	23751	100-yr	13600	617.6	629.01		629.46	0.002382		5.98	3113.75	527.9	0.34
Reach 1	24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604		9.4	1975.19	436.99	0.55
Reach 1	25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289		7.84	2057.3	348.43	0.41



Appendix F-3a  
Alternative #2: Remove Abandoned Railroad Bridge and Associated Topography





Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FEMA-PR-BFCK-Railroad-Topo-Remove-ICE  
 FEMA-CORR-BFCK-Railroad-Topo-ICE  
 Geometry  
 FEMA-PR-BFCK-Railroad-Topo-Remove-ICE  
 FEMA-CORR-BFCK-Railroad-Topo-ICE  
 Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 10-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Removed Railroad (Black) Bridge at RS 13593.3.

Removed X-Ss at RS 12627, 13393, 13514, 13535.3, 13557, 13799.

Ice Cover Simulation:

Ice cover of 1.5 feet and Manning n value of 0.045 at RS 11497 upstream to RS 14863.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Base Condition 10-year	Base Condition RR/Topo Ice Jam Simulation	RR/Topo Ice Jam Simulation
	836	-4726	583.3	583.3	583.3
	930	-4632	583.4	583.4	583.4
	1098	-4464	583.4	583.4	583.4
	1881	-3681	583.5	583.5	583.5
	2764	-2798	583.5	583.5	583.5
	2788	-2774	583.5	583.5	583.5
	3371	-2191	583.6	583.6	583.6
	3602	-1960	583.7	583.7	583.7
	3642	-1920	583.8	583.8	583.8
	3686	-1876	583.8	583.8	583.8
	3727	-1835	583.8	583.8	583.8
	3859	-1703	583.9	583.9	583.9
	3898	-1664	583.9	583.9	583.9
Bridge	3970.5	-1591.5			
	4043	-1519	583.9	583.9	583.9
	4341	-1221	584.0	584.0	584.0
	5199	-363	584.2	584.2	584.2
	5270	-292	584.6	584.6	584.6
Bridge	5304.5	-257.5			
	5339	-223	585.0	585.0	585.0
	5562	0	585.2	585.2	585.2
	6354	792	585.5	585.5	585.5
	7410	1848	587.6	587.6	587.6
	8436	2874	589.1	589.1	589.1
Oxbow	9173	3611	590.5	590.5	590.5
	10272	4710	594.0	594.0	594.0
	11497	5935	596.0	597.0	597.0
	12627	7065	600.7	604.7	
	13393	7831	603.4	606.8	
	13514*	7952	603.7	606.9	
Railroad Bridge	13535.3*	7973.3			
	13557*	7995	603.8	607.0	
	13799	8237	604.3	607.4	
	14863	9301	606.6	610.3	612.5
	15817	10255	612.0	613.0	613.7
	17170	11608	614.5	614.7	614.9
	17314	11752	614.6	614.8	615.0
Union Rd Bridge	17350	11788			
	17386	11824	614.9	615.1	615.3
	17442	11880	615.0	615.1	615.3
	18472	12910	617.8	617.9	617.9
	19887	14325	619.6	619.6	619.6
	21220	15658	622.1	622.1	622.1
	22540	16978	624.8	624.8	624.8
	23751	18189	626.7	626.7	626.7
	24800	19238	629.0	629.0	629.0
	25961	20399	631.9	631.9	631.9

\*Removed from profile plot in report to represent a uniform water surface elevation and remove hydraulic jump

Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-Railroad-Topo-Remove-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# Plans = 1

# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	10-yr	7990	567.3		583.33	573.45	583.44	0.00012	2.82	5183.48	1029.86	0.14
Reach 1	930	10-yr	7990	567.3		583.36		583.45	0.000099	2.44	3318.37	350.71	0.13
Reach 1	1098	10-yr	7990	567.4		583.4		583.47	0.0001	2.21	4005.7	723.84	0.13
Reach 1	1881	10-yr	7990	567.4		583.49		583.54	0.000083	2.12	7792.16	1874.07	0.12
Reach 1	2764	10-yr	7990	566.9		583.51		583.68	0.000193	3.38	3982.1	1262.62	0.19
Reach 1	2788	10-yr	7990	566.9		583.49	574.52	583.69	0.000226	3.66	2185.99	858.71	0.21
Reach 1	3371	10-yr	7990	571.1		583.6	576.61	583.85	0.000253	4.02	1986.05	195.95	0.22
Reach 1	3602	10-yr	7990	571.2		583.66	576.69	583.91	0.000254	4.03	1984.09	196.13	0.22
Reach 1	3642	10-yr	7990	566		583.82		583.93	0.000088	2.65	3016.97	286.58	0.14
Reach 1	3686	10-yr	7990	570		583.8		583.94	0.000142	3.05	2623.36	290.58	0.18
Reach 1	3727	10-yr	7990	570		583.8	576.78	583.96	0.000247	3.24	2463.47	285.76	0.19
Reach 1	3859	10-yr	7990	564.2		583.89		583.99	0.000101	2.47	3230.23	287.16	0.13
Reach 1	3898	10-yr	7990	564.2		583.9		583.99	0.00007	2.47	3230.85	287.17	0.13
Reach 1	3970.5												
		Bridge											
Reach 1	4043	10-yr	7990	564.2		583.93	573.13	584.02	0.000178	2.47	3240.63	287.32	0.13
Reach 1	4341	10-yr	7990	565.6		583.98		584.11	0.00027	2.96	2774.36	297.3	0.16
Reach 1	5199	10-yr	7990	576.3		584.24		584.65	0.001438	5.12	1577.65	235.51	0.34
Reach 1	5270	10-yr	7990	574		584.63	579.21	584.86	0.000672	3.84	2080.17	292.38	0.24
Reach 1	5304.5												
		Bridge											
Reach 1	5339	10-yr	7990	574		584.99	579.21	585.2	0.000578	3.67	2175.56	297.43	0.22
Reach 1	5562	10-yr	7990	571		585.18		585.32	0.000659	3.03	2735.78	363.21	0.18
Reach 1	6354	10-yr	7990	571.5		585.51	580.81	586.27	0.001553	7	1154	177.36	0.41
Reach 1	7410	10-yr	7990	573.7		587.55		587.92	0.001527	5.17	2149.79	613.03	0.29
Reach 1	8436	10-yr	7990	576.6		589.05	583.94	589.56	0.0018	5.82	1539.46	243.04	0.34
Reach 1	9173	10-yr	7990	582.1		590.52	589.39	592.04	0.005506	9.88	808.34	683.93	0.73
Reach 1	10272	10-yr	7990	582.8		594	589.35	594.47	0.001114	5.53	1458.44	217.23	0.35
Reach 1	11497	10-yr	7990	588.7		597.03	595.84	598.01	0.015271	7.95	1005.42	218.64	0.65
Reach 1	14863	10-yr	7990	599.6		612.54	607.98	612.8	0.002034	4.75	2979.3	954.74	0.27
Reach 1	15817	10-yr	7990	603.2		613.66		613.88	0.000706	3.98	2679.24	610.42	0.26
Reach 1	17170	10-yr	7990	602.4		614.92	609.67	615.51	0.002085	6.2	1299.24	138.82	0.35
Reach 1	17314	10-yr	7990	605.5		615	611.66	616.05	0.002064	8.23	970.4	132.52	0.49
Reach 1	17350												
		Bridge											
Reach 1	17386	10-yr	7990	605.5		615.26	611.65	616.25	0.001875	8	998.78	131.27	0.47
Reach 1	17442	10-yr	7990	604.9		615.33	612.1	616.42	0.00226	8.36	962.6	116.21	0.5
Reach 1	18472	10-yr	7990	608.9		617.93	613.62	618.13	0.001179	3.61	2461.97	949.58	0.25
Reach 1	19887	10-yr	7990	610.3		619.63		619.76	0.001101	2.92	2758.76	557.67	0.23
Reach 1	21220	10-yr	7990	612.8		622.05		622.47	0.004519	5.23	1593.27	339.7	0.39
Reach 1	22540	10-yr	7990	615.5		624.82		625.08	0.001088	4.14	2125.86	509.26	0.28
Reach 1	23751	10-yr	7990	617.6		626.71		627.1	0.002739	5.31	1957.56	490.69	0.35
Reach 1	24800	10-yr	7990	620.4		629.04	626.42	629.94	0.002402	7.64	1187.72	371.84	0.5
Reach 1	25961	10-yr	7990	621.4		631.87	627.21	632.44	0.001868	6.05	1359.93	186.22	0.35

Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-CORR-BFCK-Railroad-Topo-Remove-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

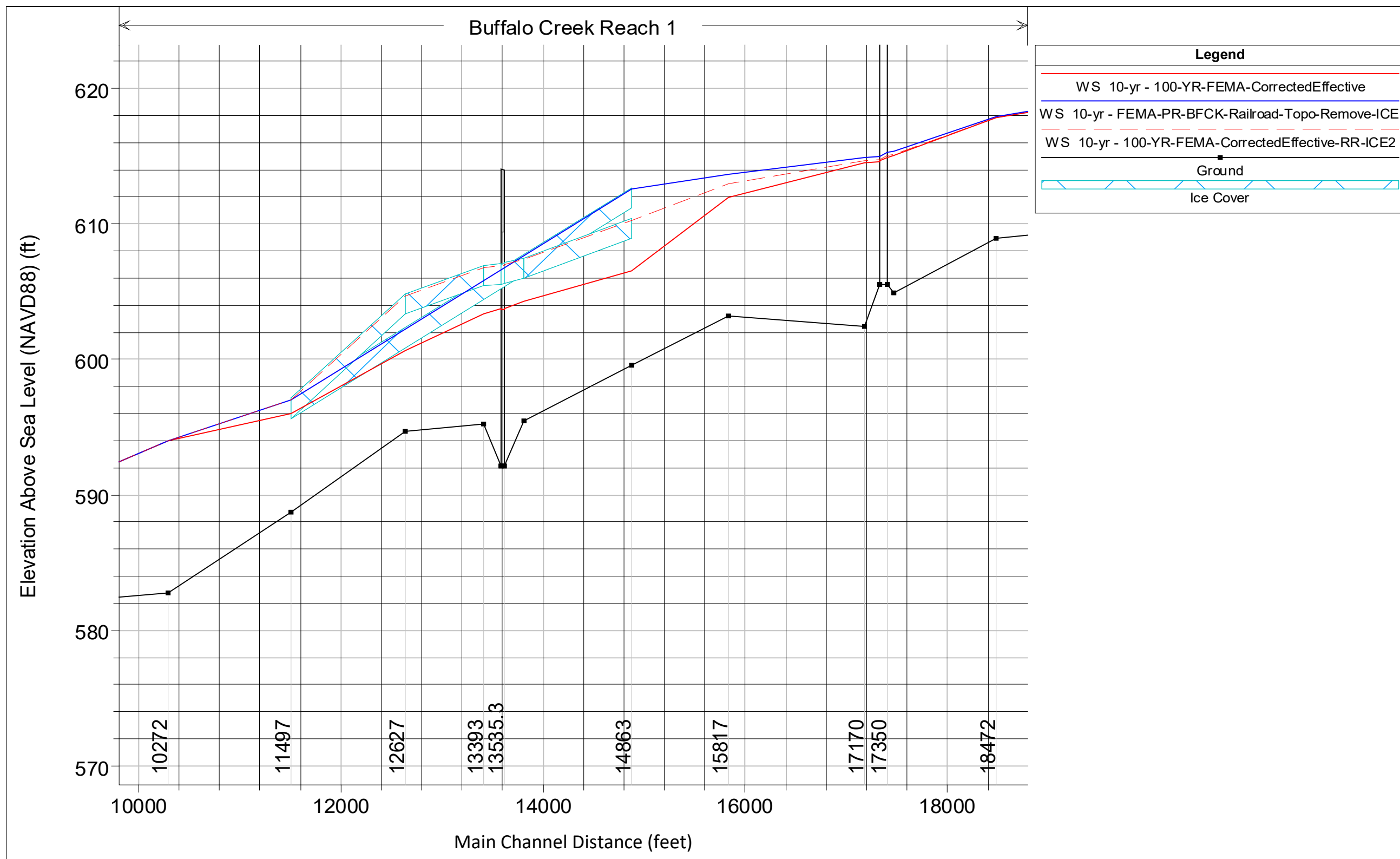
# Plans = 1

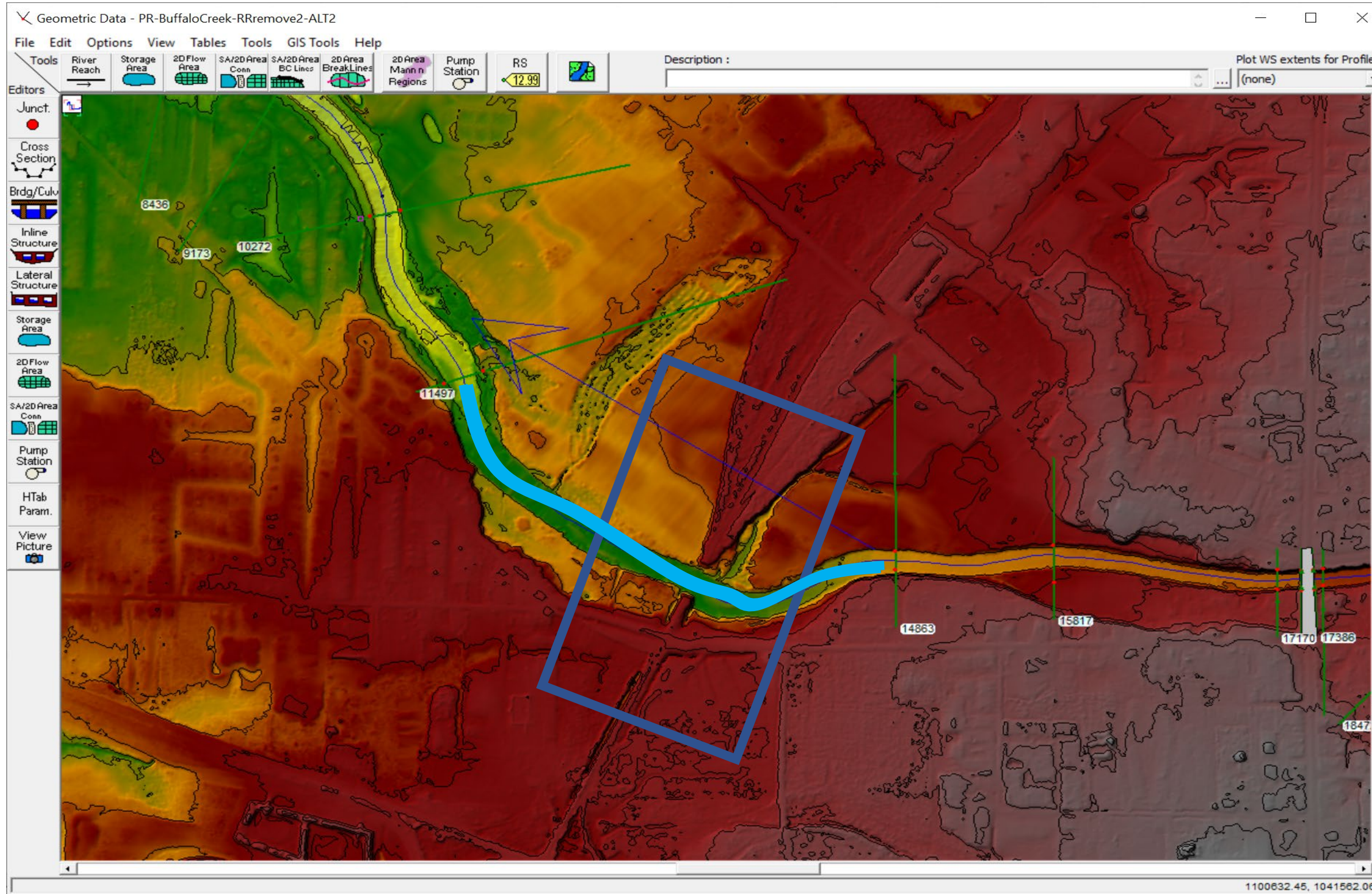
# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	10-yr	7990	567.3		583.33	573.45	583.44	0.00012	2.82	5183.48	1029.86	0.14
Reach 1	930	10-yr	7990	567.3		583.36		583.45	0.000099	2.44	3318.37	350.71	0.13
Reach 1	1098	10-yr	7990	567.4		583.4		583.47	0.0001	2.21	4005.7	723.84	0.13
Reach 1	1881	10-yr	7990	567.4		583.49		583.54	0.000083	2.12	7792.16	1874.07	0.12
Reach 1	2764	10-yr	7990	566.9		583.51		583.68	0.000193	3.38	3982.1	1262.62	0.19
Reach 1	2788	10-yr	7990	566.9		583.49	574.52	583.69	0.000226	3.66	2185.99	858.71	0.21
Reach 1	3371	10-yr	7990	571.1		583.6	576.61	583.85	0.000253	4.02	1986.05	195.95	0.22
Reach 1	3602	10-yr	7990	571.2		583.66	576.69	583.91	0.000254	4.03	1984.09	196.13	0.22
Reach 1	3642	10-yr	7990	566		583.82		583.93	0.000088	2.65	3016.97	286.58	0.14
Reach 1	3686	10-yr	7990	570		583.8		583.94	0.000142	3.05	2623.36	290.58	0.18
Reach 1	3727	10-yr	7990	570		583.8	576.78	583.96	0.000247	3.24	2463.47	285.76	0.19
Reach 1	3859	10-yr	7990	564.2		583.89		583.99	0.000101	2.47	3230.23	287.16	0.13
Reach 1	3898	10-yr	7990	564.2		583.9		583.99	0.00007	2.47	3230.85	287.17	0.13
Reach 1	3970.5												
		Bridge											
Reach 1	4043	10-yr	7990	564.2		583.93	573.13	584.02	0.000178	2.47	3240.63	287.32	0.13
Reach 1	4341	10-yr	7990	565.6		583.98		584.11	0.00027	2.96	2774.36	297.3	0.16
Reach 1	5199	10-yr	7990	576.3		584.24		584.65	0.001438	5.12	1577.65	235.51	0.34
Reach 1	5270	10-yr	7990	574		584.63	579.21	584.86	0.000672	3.84	2080.17	292.38	0.24
Reach 1	5304.5												
		Bridge											
Reach 1	5339	10-yr	7990	574		584.99	579.21	585.2	0.000578	3.67	2175.56	297.43	0.22
Reach 1	5562	10-yr	7990	571		585.18		585.32	0.000659	3.03	2735.78	363.21	0.18
Reach 1	6354	10-yr	7990	571.5		585.51	580.81	586.27	0.001553	7	1154	177.36	0.41
Reach 1	7410	10-yr	7990	573.7		587.55		587.92	0.001527	5.17	2149.79	613.03	0.29
Reach 1	8436	10-yr	7990	576.6		589.05	583.94	589.56	0.0018	5.82	1539.46	243.04	0.34
Reach 1	9173	10-yr	7990	582.1		590.52	589.39	592.04	0.005506	9.88	808.34	683.93	0.73
Reach 1	10272	10-yr	7990	582.8		594	589.35	594.47	0.001114	5.53	1458.44	217.23	0.35
Reach 1	11497	10-yr	7990	588.7		597.03	595.84	598.01	0.015271	7.95	1005.42	218.64	0.65
Reach 1	12627	10-yr	7990	594.7		604.72	600.81	605.07	0.003357	4.92	2163.35	866.97	0.35
Reach 1	13393	10-yr	7990	595.2		606.8	601.49	607.09	0.002085	4.5	2431.82	786.61	0.27
Reach 1	13514	10-yr	7990	592.1		606.93	600.38	607.24	0.000434	4.48	1784.61	273.47	0.24
Reach 1	13535.3												
		Bridge											
Reach 1	13557	10-yr	7990	592.1		607.01	600.38	607.31	0.000424	4.44	1797.72	246.96	0.24
Reach 1	13799	10-yr	7990	595.5		607.35	602.29	607.51	0.001697	3.51	3041.07	651.29	0.23
Reach 1	14863	10-yr	7990	599.6		610.29	607.98	611.14	0.007778	7.78	1404.07	497.75	0.5
Reach 1	15817	10-yr	7990	603.2		612.96		613.26	0.000993	4.52	2259.28	596.08	0.31
Reach 1	17170	10-yr	7990	602.4		614.67	609.67	615.3	0.002269	6.36	1265.1	137.99	0.36
Reach 1	17314	10-yr	7990	605.5		614.77	611.66	615.88	0.002256	8.46	944.91	132.11	0.51
Reach 1	17350												
		Bridge											
Reach 1	17386	10-yr	7990	605.5		615.06	611.65	616.1	0.002021	8.18	976.55	131.02	0.48
Reach 1	17442	10-yr	7990	604.9		615.14	612.1	616.28	0.002438	8.56	939.99	115.75	0.52
Reach 1	18472	10-yr	7990	608.9		617.87	613.62	618.08	0.001217	3.65	2410.88	910.5	0.25
Reach 1	19887	10-yr	7990	610.3		619.61		619.74	0.001114	2.93	2746.37	557.44	0.23
Reach 1	21220	10-yr	7990	612.8		622.05		622.47	0.004519	5.23	1593.23	339.7	0.39
Reach 1	22540	10-yr	7990	615.5		624.82		625.08	0.001088	4.14	2125.82	509.24	0.28
Reach 1	23751	10-yr	7990	617.6		626.71		627.1	0.002739	5.31	1957.56	490.69	0.35
Reach 1	24800	10-yr	7990	620.4		629.04	626.42	629.94	0.002402	7.64	1187.72	371.84	0.5
Reach 1	25961	10-yr	7990	621.4		631.87	627.21	632.44	0.001868	6.05	1359.93	186.22	0.35





Appendix F-4a

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FEMA-PR-BFCK-Railroad-Removal  
 FEMA-PR-BFCK-BENCH1-ALT1  
 FEMA-PR-BFCK-BENCH1-ALT2  
 Geometry  
 PR-BFCK-Railroad-Removal  
 PR-BFCK-BENCH1-ALT1  
 PR-BFCK-BENCH1-ALT2  
 Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 100-year  
 Directory

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Description:

Adjusted X-Ss that intersect SA to include Flood Bench 3, 6 ft below flood plain SA Minimum Elevation = 588 ft SA Area = 30, 60 acres  
 Removed Railroad Bridge and two adjacent cross-sections

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)			
			Base Condition	Railroad Bridge Removal	ALT1 Flood Bench = 3 ft	ALT2 Flood Bench = 6 ft
	836	-4726	586.9	586.9	586.9	586.9
	930	-4632	586.9	586.9	586.9	586.9
	1098	-4464	586.9	586.9	586.9	586.9
	1881	-3681	587.1	587.1	587.1	587.1
	2764	-2798	587.1	587.1	587.1	587.1
	2788	-2774	587.1	587.1	587.1	587.1
	3371	-2191	587.0	587.0	587.0	587.0
	3602	-1960	587.1	587.1	587.1	587.1
	3642	-1920	587.3	587.3	587.3	587.3
	3686	-1876	587.3	587.3	587.3	587.3
	3727	-1835	587.3	587.3	587.3	587.3
	3859	-1703	587.4	587.4	587.4	587.4
	3898	-1664	587.4	587.4	587.4	587.4
Bridge	3970.5	-1591.5				
	4043	-1519	587.4	587.4	587.4	587.4
	4341	-1221	587.5	587.5	587.5	587.5
	5199	-363	587.8	587.8	587.8	587.8
	5270	-292	588.1	588.1	588.1	588.1
Bridge	5304.5	-257.5				
	5339	-223	588.5	588.5	588.5	588.5
	5562	0	588.8	588.8	588.8	588.8
	6354	792	589.0	589.0	589.0	589.0
	7410	1848	590.7	590.7	590.7	590.7
	8436	2874	591.7	591.7	591.7	591.7
Oxbow	9173	3611	593.1	593.1	593.1	593.1
	10272	4710	596.8	596.8	596.8	596.8
	11497	5935	598.6	598.6	598.6	598.6
	12627	7065	602.7	602.7	602.1	601.3
	13393	7831	605.7	605.7	603.9	602.8
	13514	7952	605.8			
Railroad Bridge	13535.3	7973.3				
	13557	7995	605.9			
	13799	8237	606.9	606.9	604.9	603.5
	14863	9301	609.4	609.4	609.4	609.4
	15817	10255	613.9	613.9	613.9	613.9
	17170	11608	616.7	616.7	616.7	616.7
	17314	11752	616.8	616.8	616.8	616.8
Union Rd Bridge	17350	11788				
	17386	11824	617.4	617.4	617.4	617.4
	17442	11880	617.5	617.5	617.5	617.5
	18472	12910	620.9	620.9	620.9	620.9
	19887	14325	622.2	622.2	622.2	622.2
	21220	15658	624.3	624.3	624.3	624.3
	22540	16978	627.2	627.2	627.2	627.2
	23751	18189	629.0	629.0	629.0	629.0
	24800	19238	631.1	631.1	631.1	631.1
	25961	20399	634.3	634.3	634.3	634.3



Appendix F-4a

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-Railroad-Removal River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Plans = 1

# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 44

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)	Froude # Chl	Top Width (ft)
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	0.15
2788	100-yr	13600	566.9	587.05	577.01		587.18	0.000132	3.34	12096.3	0.17
3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	0.26
3602	100-yr	13600	571.2	587.05	578.46		587.45	0.000302	5.09	2670.81	0.25
3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	0.16
3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	0.19
3727	100-yr	13600	570	587.28	578.66		587.52	0.000244	3.9	3490.11	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	0.15
3970.5	Bridge										
4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	0.32
5270	100-yr	13600	574	588.11	580.74		588.43	0.000583	4.55	2986.06	0.24
5304.5	Bridge										
5339	100-yr	13600	574	588.53	580.74		588.83	0.000517	4.39	3095.38	0.22
5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	0.18
6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	0.26
8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	0.38
9173	100-yr	13600	582.1	593.12	591.47		595.14	0.004837	11.4	1193.26	0.72
10272	100-yr	13600	582.8	596.81	591.39		597.49	0.001099	6.69	2484.27	0.36
11497	100-yr	13600	588.7	598.6	596.01		599.58	0.002685	7.95	1724.55	0.53
12627	100-yr	13600	594.7	602.68	601.26		604.15	0.006303	9.83	1565.91	0.74
13393	100-yr	13600	595.2	605.69	601.95		606.52	0.001733	7.57	2607.75	0.44
13799	100-yr	13600	595.5	606.94	602.03		607.11	0.000634	3.92	4882.68	0.23
14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	0.41
17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	0.46
17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	0.63
17350	Bridge										
17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	0.58
17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	0.61
18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	0.34
24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	0.55
25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	0.41

## Appendix F-4a

## Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench

## Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-BENCH1-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1 # Plans = 1 Flood Bench Depth = 3 ft

# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 44

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	
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600	566.9	587.05	577.01		587.18	0.000132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600	571.2	587.05	578.46		587.45	0.000302	5.09	2670.81	325.62	0.25
3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	326.48	0.16
3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	318.5	0.19
3727	100-yr	13600	570	587.28	578.66		587.52	0.000244	3.9	3490.11	303.38	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	302.8	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	357.58	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600	574	588.11	580.74		588.43	0.000583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74		588.83	0.000517	4.39	3095.38	347.24	0.22
5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	382.31	0.18
6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600	582.1	593.12	591.47		595.14	0.004837	11.4	1193.26	1126.26	0.72
10272	100-yr	13600	582.8	596.81	591.39		597.49	0.001099	6.69	2484.27	881.53	0.36
11497	100-yr	13600	588.7	598.62	596		599.42	0.002343	7.43	2299.26	453.68	0.5
12627	100-yr	13600	594.7	602.05	601.11		602.58	0.003448	7.02	3382.34	843.93	0.55
13393	100-yr	13600	595.2	603.9	601.96		604.33	0.001618	6.43	3874.94	780.41	0.42
13799	100-yr	13600	595.5	604.94	602.42		605.12	0.000917	4.14	4776.48	803.13	0.27
14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41

Appendix F-4a

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench

Profile Output Table - Standard Table 1

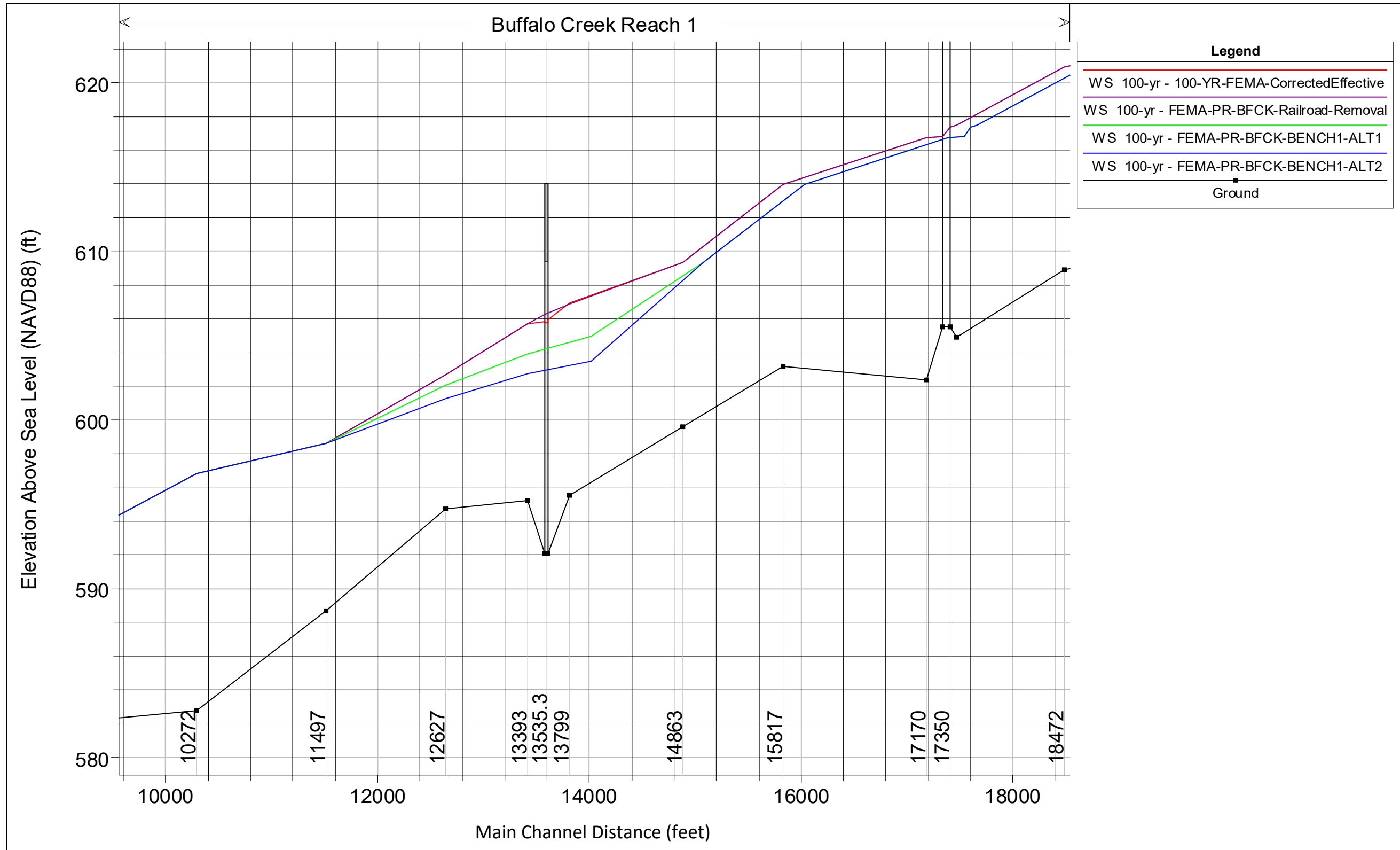
HEC-RAS Plan: FEMA-PR-BFCK-BENCH1-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

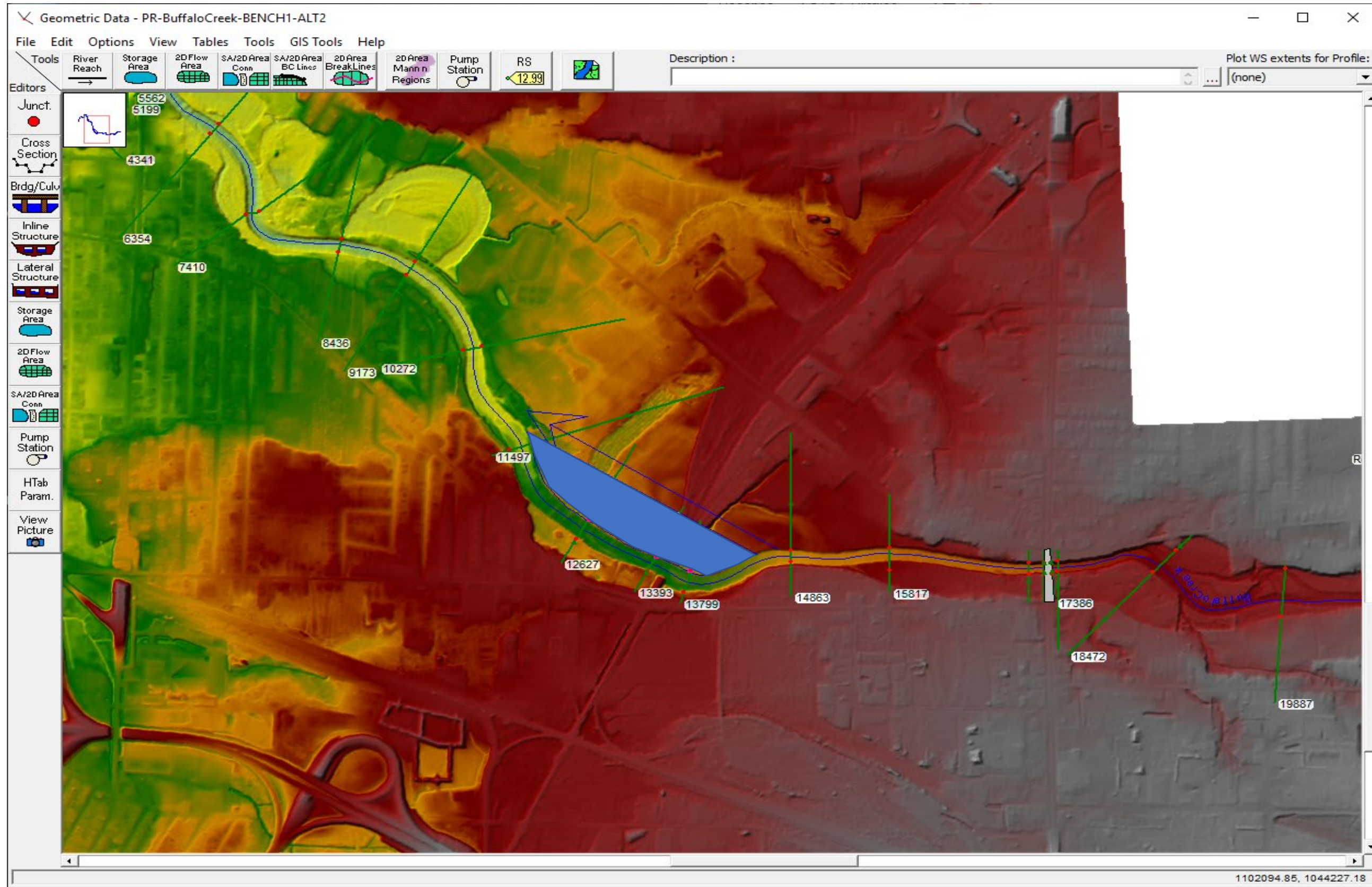
# Rivers = 1 # Plans = 1 Flood Bench Depth = 6 ft

# Hydraulic Reaches = 1 # Profiles = 1

# River Stations = 44

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	
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600	566.9	587.05	577.01		587.18	0.000132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600	571.2	587.05	578.46		587.45	0.000302	5.09	2670.81	325.62	0.25
3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	326.48	0.16
3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	318.5	0.19
3727	100-yr	13600	570	587.28	578.66		587.52	0.000244	3.9	3490.11	303.38	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	302.8	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	357.58	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600	574	588.11	580.74		588.43	0.000583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74		588.83	0.000517	4.39	3095.38	347.24	0.22
5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	382.31	0.18
6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600	582.1	593.12	591.47		595.14	0.004837	11.4	1193.26	1126.26	0.72
10272	100-yr	13600	582.8	596.81	591.39		597.49	0.001099	6.69	2484.27	881.53	0.36
11497	100-yr	13600	588.7	598.64	596		599.2	0.001828	6.57	2854.13	455.06	0.44
12627	100-yr	13600	594.7	601.27	601.1		601.5	0.002348	5.23	4338.31	783.76	0.44
13393	100-yr	13600	595.2	602.75	601.96		602.97	0.001244	5.1	4743.34	778.28	0.36
13799	100-yr	13600	595.5	603.46	602.42		603.58	0.000809	3.52	5183.9	802.6	0.26
14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41





Appendix F-5a

Alternative #4: Reconnect the Oxbow Lake

HEC-RAS Model Summary

Project Buffalo Creek

Plan

FEMA-PR-BFCK-OXBOW-RECON

Geometry

PR-BFCK-OXBOW-RECON

Steady Flow USGS StreamStats Full Flows

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Adjusted X-S 9173 and 8436 elevations on right bank down to 100-yr WSE to include oxbow lake storage.

Added ineffective flow areas were necessary.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			Base Condition	Reconnected Oxbow
	836	-4726	586.9	586.9
	930	-4632	586.9	586.9
	1098	-4464	586.9	586.9
	1881	-3681	587.1	587.1
	2764	-2798	587.1	587.1
	2788	-2774	587.1	587.1
	3371	-2191	587.0	587.0
	3602	-1960	587.1	587.1
	3642	-1920	587.3	587.3
	3686	-1876	587.3	587.3
	3727	-1835	587.3	587.3
	3859	-1703	587.4	587.4
	3898	-1664	587.4	587.4
Bridge	3970.5	-1591.5		
	4043	-1519	587.4	587.4
	4341	-1221	587.5	587.5
	5199	-363	587.8	587.8
	5270	-292	588.1	588.1
Bridge	5304.5	-257.5		
	5339	-223	588.5	588.5
	5562	0	588.8	588.8
	6354	792	589.0	589.0
	7410	1848	590.7	590.7
	8436	2874	591.7	591.7
Oxbow	9173	3611	593.1	593.5
	10272	4710	596.8	595.3
	11497	5935	598.6	598.2
	12627	7065	602.7	602.8
	13393	7831	605.7	605.7
	13514	7952	605.8	605.8
Railroad Bridge	13535.3	7973.3		
	13557	7995	605.9	605.9
	13799	8237	606.9	606.9
	14863	9301	609.4	609.4
	15817	10255	613.9	613.9
	17170	11608	616.7	616.7
	17314	11752	616.8	616.8
Union Rd Bridge	17350	11788		
	17386	11824	617.4	617.4
	17442	11880	617.5	617.5
	18472	12910	620.9	620.9
	19887	14325	622.2	622.2
	21220	15658	624.3	624.3
	22540	16978	627.2	627.2
	23751	18189	629.0	629.0
	24800	19238	631.1	631.1
	25961	20399	634.3	634.3

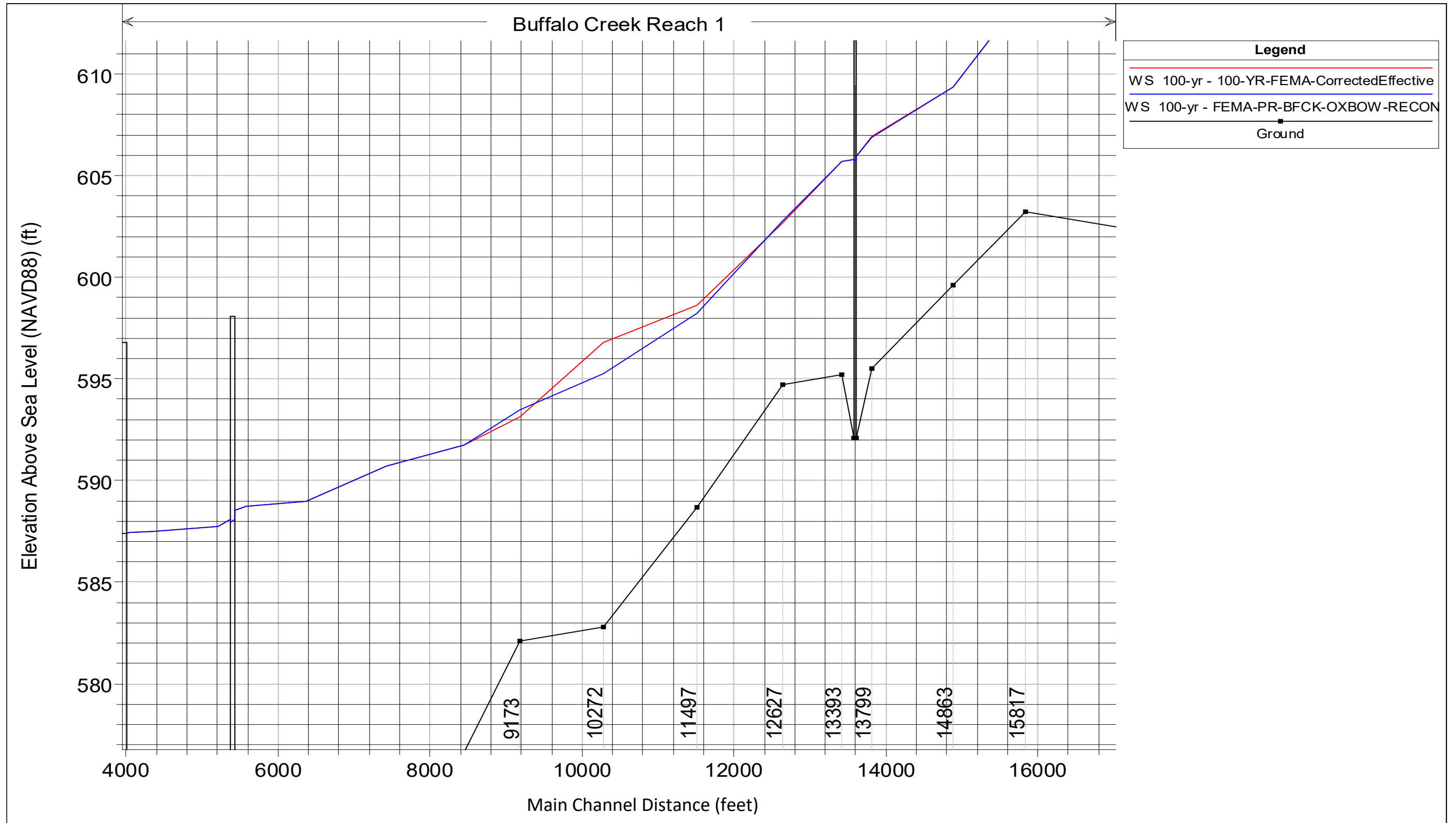
## Appendix F-5a

## Alternative #4: Reconnect the Oxbow Lake

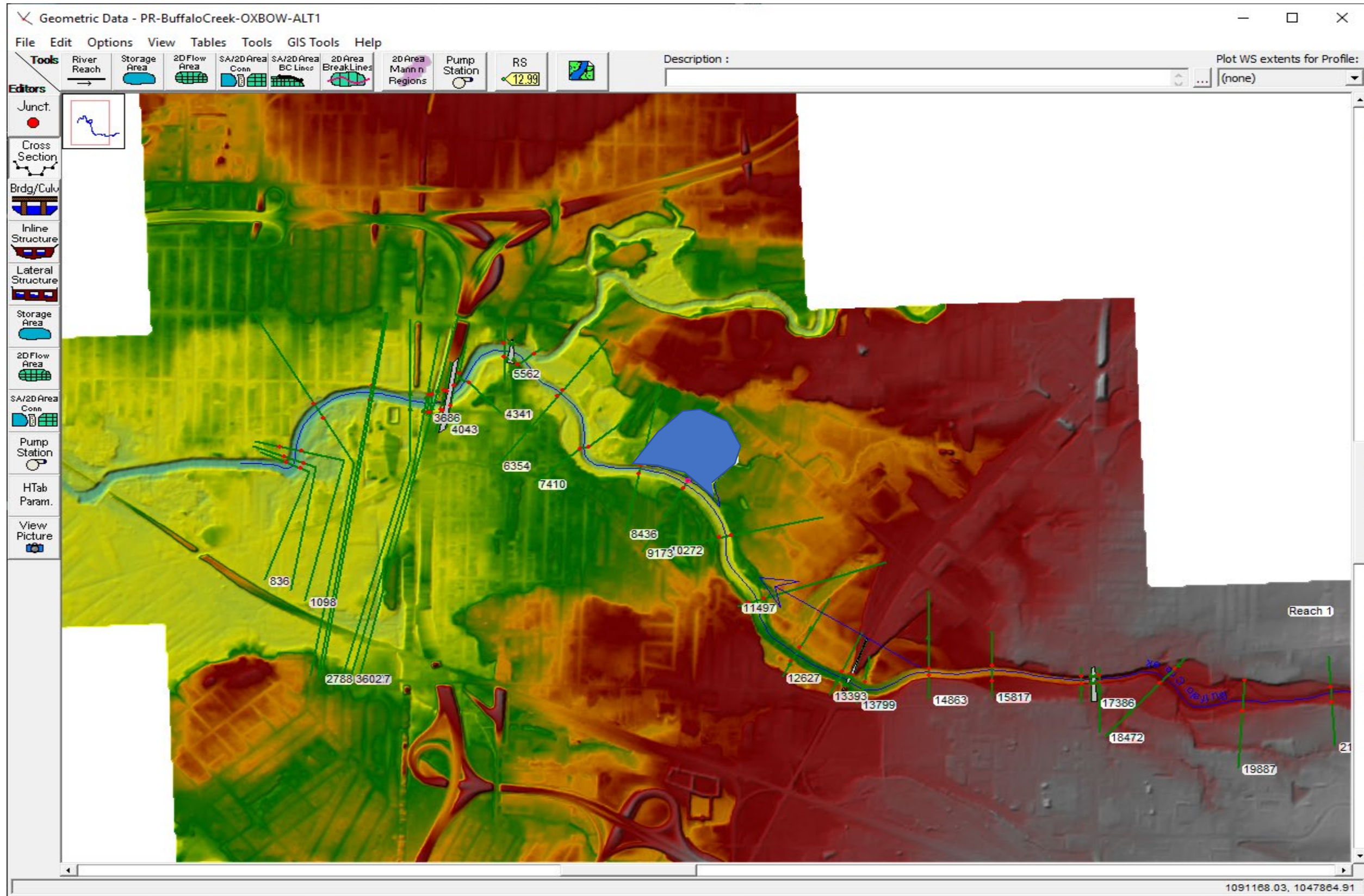
## Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-OXBOW-RECON River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers	1		# Plans		1		# River Stations		47					
# Hydraulic Reaches	1		# Profiles		1									
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	
Reach 1	836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15	
Reach 1	930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15	
Reach 1	1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	1443.12	0.13	
Reach 1	1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	2500.49	0.1	
Reach 1	2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	3707.83	0.15	
Reach 1	2788	100-yr	13600	566.9	587.05	577.01		587.18	0.000132	3.34	12096.3	3428.02	0.17	
Reach 1	3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26	
Reach 1	3602	100-yr	13600	571.2	587.05	578.46		587.45	0.000302	5.09	2670.81	325.62	0.25	
Reach 1	3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	326.48	0.16	
Reach 1	3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	318.5	0.19	
Reach 1	3727	100-yr	13600	570	587.28	578.66		587.52	0.000244	3.9	3490.11	303.38	0.2	
Reach 1	3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	302.8	0.15	
Reach 1	3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	302.81	0.15	
Reach 1	3970.5													
Reach 1	4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15	
Reach 1	4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	357.58	0.18	
Reach 1	5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32	
Reach 1	5270	100-yr	13600	574	588.11	580.74		588.43	0.000583	4.55	2986.06	341.81	0.24	
Reach 1	5304.5													
Reach 1	5339	100-yr	13600	574	588.53	580.74		588.83	0.000517	4.39	3095.38	347.24	0.22	
Reach 1	5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	382.31	0.18	
Reach 1	6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38	
Reach 1	7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26	
Reach 1	8436	100-yr	13600	576.6	591.74	586.39		592.52	0.002022	7.33	2314.84	576.24	0.38	
Reach 1	9173	100-yr	13600	582.1	593.46	591.47		593.98	0.001806	7.09	4752.57	1291.28	0.44	
Reach 1	10272	100-yr	13600	582.8	595.25	591.38		596.25	0.001977	8.06	1757.95	257.32	0.48	
Reach 1	11497	100-yr	13600	588.7	598.23	596.01		599.32	0.003222	8.41	1627.11	258.91	0.58	
Reach 1	12627	100-yr	13600	594.7	602.8	601.26		604.2	0.005872	9.61	1614.5	675.44	0.72	
Reach 1	13393	100-yr	13600	595.2	605.68	601.95		606.51	0.001742	7.58	2600.24	813.57	0.44	
Reach 1	13514	100-yr	13600	592.1	605.8	600.82		606.66	0.000464	7.45	1826.2	279.26	0.4	
Reach 1	13535.3													
Reach 1	13557	100-yr	13600	592.1	605.93	600.82		606.78	0.000446	7.36	1848.68	249.19	0.39	
Reach 1	13799	100-yr	13600	595.5	606.91	602.03		607.08	0.000642	3.93	4862.6	665.85	0.23	
Reach 1	14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79	
Reach 1	15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41	
Reach 1	17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46	
Reach 1	17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63	
Reach 1	17350													
Reach 1	17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58	
Reach 1	17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61	
Reach 1	18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21	
Reach 1	19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21	
Reach 1	21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39	
Reach 1	22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29	
Reach 1	23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34	
Reach 1	24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55	
Reach 1	25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41	







Appendix F-6a

Alternative #5: Reconnect the Oxbow Lake and Install Flood Bench

HEC-RAS Model Summary

Project Buffalo Creek  
Plan

FEMA-PR-BFCK-OXBOW-BENCH-ALT1  
FEMA-PR-BFCK-OXBOW-BENCH-ALT2  
FEMA-PR-BFCK-OXBOW-BENCH-ALT3

Geometry  
PR-BFCK-OXBOW-BENCH-ALT1  
PR-BFCK-OXBOW-BENCH-ALT2  
PR-BFCK-OXBOW-BENCH-ALT3

Steady Flow USGS StreamStats Full Flows

Reach 1

Profile 100-year

SA Min. Elevation 576 ft

SA Area 30 acres  
60 acres  
90 acres

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Adjusted X-S 9173 that intersects SA to include Flood Bench 3, 6, 9 ft below 100-yr WSE SA Minimum Elevation = 576 ft SA Area = 30, 60, 90 acres

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)			
			Base Condition	ALT1 Flood Bench=3ft	ALT2 Flood Bench=6ft	ALT3 Flood Bench=9ft
	836	-4726	586.9	586.9	586.9	586.9
	930	-4632	586.9	586.9	586.9	586.9
	1098	-4464	586.9	586.9	586.9	586.9
	1881	-3681	587.1	587.1	587.1	587.1
	2764	-2798	587.1	587.1	587.1	587.1
	2788	-2774	587.1	587.1	587.1	587.1
	3371	-2191	587.0	587.0	587.0	587.0
	3602	-1960	587.1	587.1	587.1	587.1
	3642	-1920	587.3	587.3	587.3	587.3
	3686	-1876	587.3	587.3	587.3	587.3
	3727	-1835	587.3	587.3	587.3	587.3
	3859	-1703	587.4	587.4	587.4	587.4
	3898	-1664	587.4	587.4	587.4	587.4
Bridge	3970.5	-1591.5				
	4043	-1519	587.4	587.4	587.4	587.4
	4341	-1221	587.5	587.5	587.5	587.5
	5199	-363	587.8	587.8	587.8	587.8
	5270	-292	588.1	588.1	588.1	588.1
Bridge	5304.5	-257.5				
	5339	-223	588.5	588.5	588.5	588.5
	5562	0	588.8	588.8	588.8	588.8
	6354	792	589.0	589.0	589.0	589.0
	7410	1848	590.7	590.7	590.7	590.7
	8436	2874	591.7	591.7	591.7	591.7
Oxbow	9173	3611	593.1	593.5	593.3	593.1
	10272	4710	596.8	594.8	593.7	592.6
	11497	5935	598.6	598.2	598.3	598.5
	12627	7065	602.7	602.8	602.8	602.7
	13393	7831	605.7	605.7	605.7	605.7
	13514	7952	605.8	605.8	605.8	605.8
Railroad Bridge	13535.3	7973.3				
	13557	7995	605.9	605.9	605.9	605.9
	13799	8237	606.9	606.9	606.9	606.9
	14863	9301	609.4	609.4	609.4	609.4
	15817	10255	613.9	613.9	613.9	613.9
	17170	11608	616.7	616.7	616.7	616.7
	17314	11752	616.8	616.8	616.8	616.8
Union Rd Bridge	17350	11788				
	17386	11824	617.4	617.4	617.4	617.4
	17442	11880	617.5	617.5	617.5	617.5
	18472	12910	620.9	620.9	620.9	620.9
	19887	14325	622.2	622.2	622.2	622.2
	21220	15658	624.3	624.3	624.3	624.3
	22540	16978	627.2	627.2	627.2	627.2
	23751	18189	629.0	629.0	629.0	629.0
	24800	19238	631.1	631.1	631.1	631.1
	25961	20399	634.3	634.3	634.3	634.3

Appendix F-6a

Alternative #5: Reconnect the Oxbow Lake and Install Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: 100-YR-FEMA-PR-BufferCreek-OXBOW-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers	1	# Plans		1	Flood Bench Depth = 3 ft							
# Hydraulic Reache	s = 1	# Profiles		1	# River Stations							
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	
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600	566.9	587.05		577.01	587.18	0.000132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600	571.1	586.98		578.38	587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600	571.2	587.05		578.46	587.45	0.000302	5.09	2670.81	325.62	0.25
3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	326.48	0.16
3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	318.5	0.19
3727	100-yr	13600	570	587.28		578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	302.8	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44		575.22	587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	357.58	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600	574	588.11		580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600	574	588.53		580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	382.31	0.18
6354	100-yr	13600	571.5	588.99		583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600	576.6	591.74		586.46	592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600	582.1	593.46		591.47	593.78	0.001285	5.97	5776.59	1291.29	0.37
10272	100-yr	13600	582.8	594.83		591.39	595.94	0.002334	8.48	1659.52	416.74	0.51
11497	100-yr	13600	588.7	598.19		596.01	599.3	0.003277	8.45	1618.4	257.46	0.58
12627	100-yr	13600	594.7	602.81		601.26	604.2	0.005817	9.58	1621.14	680.71	0.72
13393	100-yr	13600	595.2	605.68		601.95	606.51	0.001743	7.58	2599.38	813.43	0.44
13514	100-yr	13600	592.1	605.8		600.82	606.66	0.000464	7.45	1826.01	279.23	0.4
13535.3	Bridge											
13557	100-yr	13600	592.1	605.93		600.82	606.77	0.000446	7.36	1848.5	249.18	0.39
13799	100-yr	13600	595.5	606.9		602.03	607.08	0.000642	3.93	4861.99	665.84	0.23
14863	100-yr	13600	599.6	609.35		609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600	602.4	616.74		611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600	605.5	616.8		614	618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600	605.5	617.35		613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600	604.9	617.47		614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600	608.9	620.93		615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600	620.4	631.07		628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600	621.4	634.3		629.31	635.22	0.002289	7.84	2057.3	348.43	0.41

Appendix F-6a

Alternative #5: Reconnect the Oxbow Lake and Install Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: 100-YR-FEMA-PR-Buffer-Creek-OXBOW-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers	1	# Plans	1	Flood Bench Depth = 6 ft								
# Hydraulic Reaches	s = 1	# Profiles	1	# River Stations		47						
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	
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.00099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.00059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.00105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600	566.9	587.05	577.01		587.18	0.00132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600	571.2	587.05	578.46		587.45	0.00302	5.09	2670.81	325.62	0.25
3642	100-yr	13600	566	587.31			587.48	0.00103	3.36	4062.44	326.48	0.16
3686	100-yr	13600	570	587.29			587.5	0.00148	3.69	3681.31	318.5	0.19
3727	100-yr	13600	570	587.28	578.66		587.52	0.00244	3.9	3490.11	303.38	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.00125	3.19	4262.17	302.8	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.00087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.00308	3.74	3925.99	357.58	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600	574	588.11	580.74		588.43	0.00583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74		588.83	0.00517	4.39	3095.38	347.24	0.22
5562	100-yr	13600	571	588.75			588.95	0.00577	3.58	4069.8	382.31	0.18
6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600	582.1	593.27	591.47		593.38	0.00062	4.09	8121.65	1289.64	0.26
10272	100-yr	13600	582.8	593.73	591.39		595.21	0.003589	9.75	1401.55	263.06	0.62
11497	100-yr	13600	588.7	598.28	596.01		599.36	0.003143	8.34	1640.02	261.56	0.57
12627	100-yr	13600	594.7	602.78	601.26		604.19	0.005931	9.64	1607.52	669.87	0.72
13393	100-yr	13600	595.2	605.68	601.95		606.51	0.001741	7.58	2601.27	813.73	0.44
13514	100-yr	13600	592.1	605.8	600.82		606.66	0.00464	7.45	1826.42	279.29	0.4
13535.3	Bridge											
13557	100-yr	13600	592.1	605.94	600.82		606.78	0.00446	7.36	1848.88	249.19	0.39
13799	100-yr	13600	595.5	606.91	602.03		607.08	0.00642	3.93	4863.29	665.87	0.23
14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41

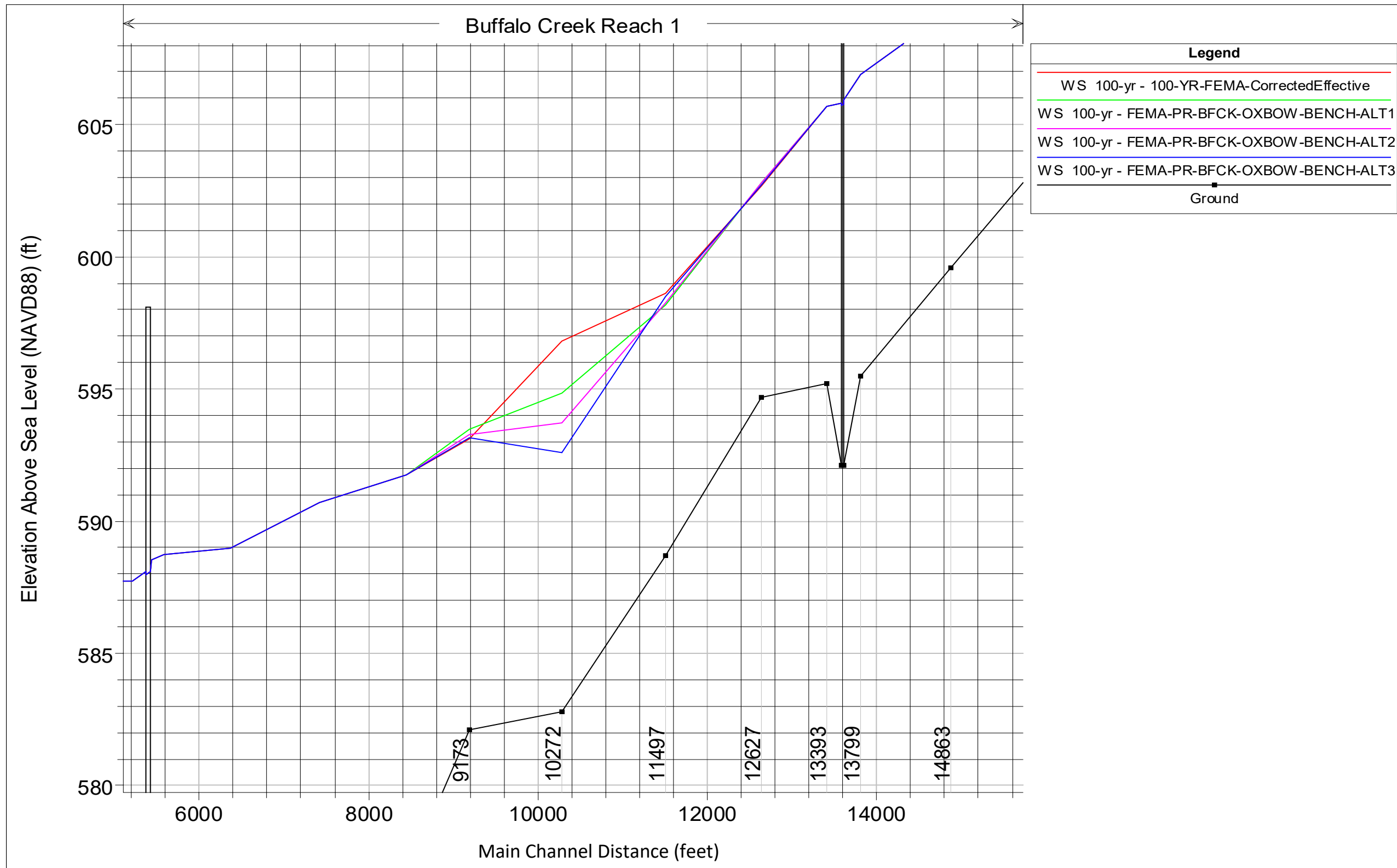
Appendix F-6a

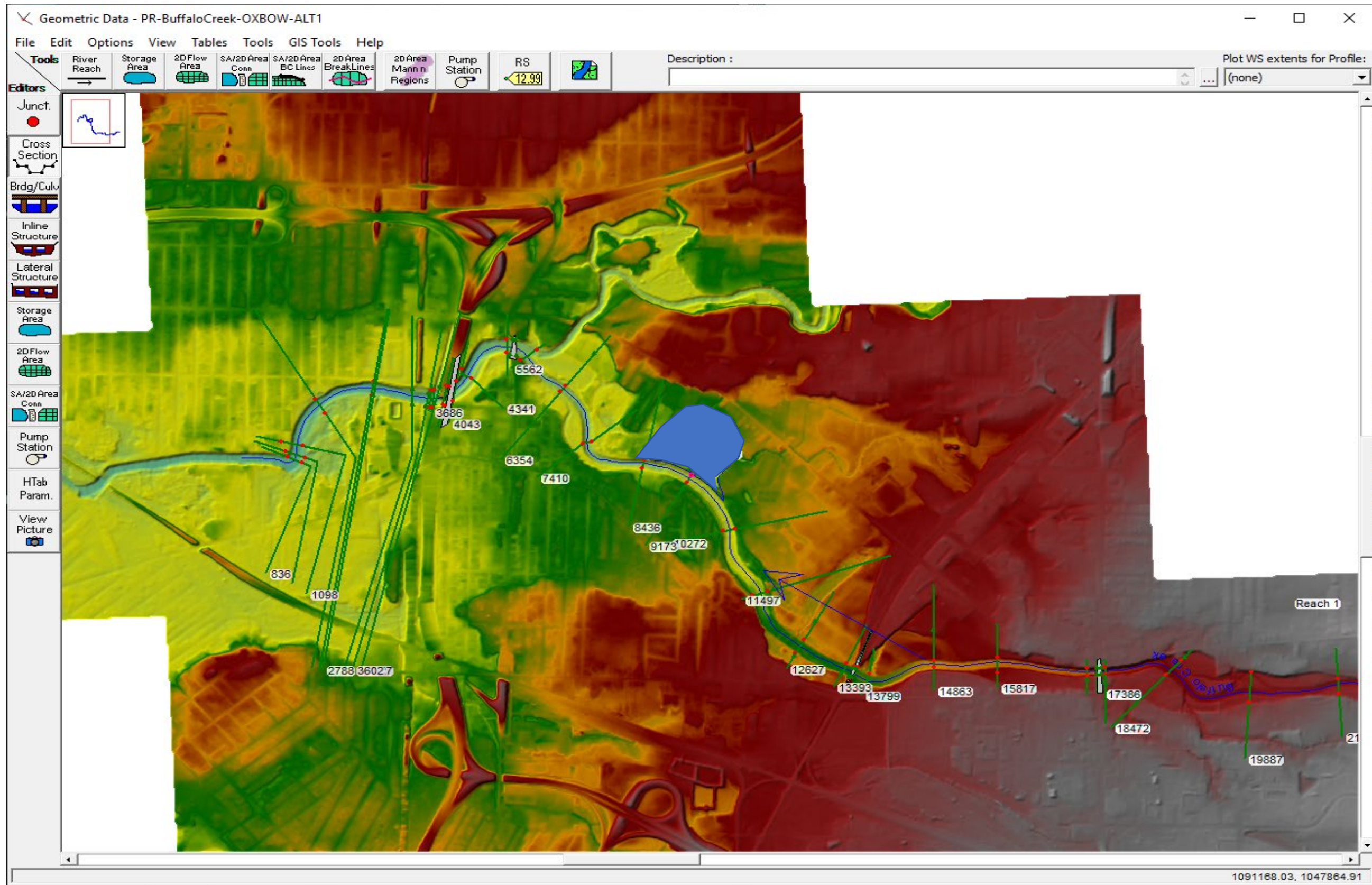
Alternative #5: Reconnect the Oxbow Lake and Install Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: 100-YR-FEMA-PR-Buffer-Creek-OXBOW-ALT3 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers	1	# Plans	1	Flood Bench Depth = 9 ft								
# Hydraulic Reaches	s = 1	# Profiles	1	# River Stations		47						
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	
836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
1098	100-yr	13600	567.4	586.92			587.03	0.00099	2.68	8028.25	1443.12	0.13
1881	100-yr	13600	567.4	587.05			587.09	0.00059	2.14	15755.33	2500.49	0.1
2764	100-yr	13600	566.9	587.08			587.17	0.00105	2.98	14856.69	3707.83	0.15
2788	100-yr	13600	566.9	587.05	577.01		587.18	0.00132	3.34	12096.3	3428.02	0.17
3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26
3602	100-yr	13600	571.2	587.05	578.46		587.45	0.00302	5.09	2670.81	325.62	0.25
3642	100-yr	13600	566	587.31			587.48	0.00103	3.36	4062.44	326.48	0.16
3686	100-yr	13600	570	587.29			587.5	0.00148	3.69	3681.31	318.5	0.19
3727	100-yr	13600	570	587.28	578.66		587.52	0.00244	3.9	3490.11	303.38	0.2
3859	100-yr	13600	564.2	587.39			587.55	0.00125	3.19	4262.17	302.8	0.15
3898	100-yr	13600	564.2	587.39			587.55	0.00087	3.19	4262.98	302.81	0.15
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15
4341	100-yr	13600	565.6	587.49			587.71	0.00308	3.74	3925.99	357.58	0.18
5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
5270	100-yr	13600	574	588.11	580.74		588.43	0.00583	4.55	2986.06	341.81	0.24
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74		588.83	0.00517	4.39	3095.38	347.24	0.22
5562	100-yr	13600	571	588.75			588.95	0.00577	3.58	4069.8	382.31	0.18
6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38
7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	564.21	0.38
9173	100-yr	13600	582.1	593.14	591.47		593.18	0.000271	2.68	11127.04	1292.8	0.17
10272	100-yr	13600	582.8	592.59	591.39		594.62	0.005745	11.43	1189.71	175.68	0.77
11497	100-yr	13600	588.7	598.5	596.01		599.51	0.00282	8.07	1697.65	273.32	0.54
12627	100-yr	13600	594.7	602.71	601.26		604.16	0.006188	9.77	1578.32	646.32	0.74
13393	100-yr	13600	595.2	605.68	601.95		606.52	0.001737	7.58	2604.2	814.2	0.44
13514	100-yr	13600	592.1	605.81	600.82		606.67	0.000464	7.44	1827.05	279.38	0.4
13535.3	Bridge											
13557	100-yr	13600	592.1	605.94	600.82		606.78	0.000445	7.35	1849.51	249.22	0.39
13799	100-yr	13600	595.5	606.91	602.03		607.08	0.000641	3.93	4865.28	665.92	0.23
14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79
15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46
17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58
17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61
18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21
19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55
25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41





Appendix F-7a

Alternative #6: Flood Bench

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FEMA-PR-BFCK-BENCH2-ALT1  
 FEMA-PR-BFCK-BENCH2-ALT2

Geometry  
 PR-BFCK-BENCH2-ALT1  
 PR-BFCK-BENCH2-ALT2

Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 100-year  
 Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Adjusted X-Ss RS 10272 - 13393  
 that intersect SA to include Flood  
 Bench 3,6 ft below flood plain  
 SA Minimum Elevation = 590 ft  
 SA Area = 120, 240 acres

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Base Condition	ALT1 Flood Bench = 3 ft	ALT2 Flood Bench = 6 ft
	836	-4726	586.9	586.9	586.9
	930	-4632	586.9	586.9	586.9
	1098	-4464	586.9	586.9	586.9
	1881	-3681	587.1	587.1	587.1
	2764	-2798	587.1	587.1	587.1
	2788	-2774	587.1	587.1	587.1
	3371	-2191	587.0	587.0	587.0
	3602	-1960	587.1	587.1	587.1
	3642	-1920	587.3	587.3	587.3
	3686	-1876	587.3	587.3	587.3
	3727	-1835	587.3	587.3	587.3
	3859	-1703	587.4	587.4	587.4
	3898	-1664	587.4	587.4	587.4
Bridge	3970.5	-1591.5			
	4043	-1519	587.4	587.4	587.4
	4341	-1221	587.5	587.5	587.5
	5199	-363	587.8	587.8	587.8
	5270	-292	588.1	588.1	588.1
Bridge	5304.5	-257.5			
	5339	-223	588.5	588.5	588.5
	5562	0	588.8	588.8	588.8
	6354	792	589.0	589.0	589.0
	7410	1848	590.7	590.7	590.7
	8436	2874	591.7	591.7	591.7
Oxbow	9173	3611	593.1	593.1	593.1
	10272	4710	596.8	596.8	596.8
	11497	5935	598.6	598.6	598.6
	12627	7065	602.7	602.5	601.2
	13393	7831	605.7	604.4	605.2
	13514	7952	605.8	604.3	604.9
Railroad Bridge	13535.3	7973.3			
	13557	7995	605.9	604.5	605.1
	13799	8237	606.9	605.8	606.2
	14863	9301	609.4	609.4	609.4
	15817	10255	613.9	613.9	613.9
	17170	11608	616.7	616.7	616.7
	17314	11752	616.8	616.8	616.8
Union Rd Bridge	17350	11788			
	17386	11824	617.4	617.4	617.4
	17442	11880	617.5	617.5	617.5
	18472	12910	620.9	620.9	620.9
	19887	14325	622.2	622.2	622.2
	21220	15658	624.3	624.3	624.3
	22540	16978	627.2	627.2	627.2
	23751	18189	629.0	629.0	629.0
	24800	19238	631.1	631.1	631.1
	25961	20399	634.3	634.3	634.3



Appendix F-7a

Alternative #6: Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-BENCH2-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Plans = 1

# River Stations = 44

# Hydraulic Reaches = 1

# Profiles = 1

Flood Bench Depth = 3 ft

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
Reach 1	836	100-yr	13600	567.3	586.87		575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15
Reach 1	930	100-yr	13600	567.3	586.86			587.01	0.00012	3.13	4995.46	935.76	0.15
Reach 1	1098	100-yr	13600	567.4	586.92			587.03	0.000099	2.68	8028.25	1443.12	0.13
Reach 1	1881	100-yr	13600	567.4	587.05			587.09	0.000059	2.14	15755.33	2500.49	0.1
Reach 1	2764	100-yr	13600	566.9	587.08			587.17	0.000105	2.98	14856.69	3707.83	0.15
Reach 1	2788	100-yr	13600	566.9	587.05	577.01		587.18	0.000132	3.34	12096.3	3428.02	0.17
Reach 1	3371	100-yr	13600	571.1	586.98	578.38		587.38	0.00034	5.07	2682.96	1749.34	0.26
Reach 1	3602	100-yr	13600	571.2	587.05	578.46		587.45	0.000302	5.09	2670.81	325.62	0.25
Reach 1	3642	100-yr	13600	566	587.31			587.48	0.000103	3.36	4062.44	326.48	0.16
Reach 1	3686	100-yr	13600	570	587.29			587.5	0.000148	3.69	3681.31	318.5	0.19
Reach 1	3727	100-yr	13600	570	587.28	578.66		587.52	0.000244	3.9	3490.11	303.38	0.2
Reach 1	3859	100-yr	13600	564.2	587.39			587.55	0.000125	3.19	4262.17	302.8	0.15
Reach 1	3898	100-yr	13600	564.2	587.39			587.55	0.000087	3.19	4262.98	302.81	0.15
Reach 1	3970.5												
Reach 1	4043	100-yr	13600	564.2	587.44	575.22		587.6	0.00022	3.18	4277.24	303.02	0.15
Reach 1	4341	100-yr	13600	565.6	587.49			587.71	0.000308	3.74	3925.99	357.58	0.18
Reach 1	5199	100-yr	13600	576.3	587.75			588.25	0.001097	5.74	2440.18	257.18	0.32
Reach 1	5270	100-yr	13600	574	588.11	580.74		588.43	0.000583	4.55	2986.06	341.81	0.24
Reach 1	5304.5												
Reach 1	5339	100-yr	13600	574	588.53	580.74		588.83	0.000517	4.39	3095.38	347.24	0.22
Reach 1	5562	100-yr	13600	571	588.75			588.95	0.000577	3.58	4069.8	382.31	0.18
Reach 1	6354	100-yr	13600	571.5	588.99	583.47		589.76	0.001211	7.5	3207.13	933.05	0.38
Reach 1	7410	100-yr	13600	573.7	590.71			591.05	0.001147	5.38	4747.73	910.28	0.26
Reach 1	8436	100-yr	13600	576.6	591.74	586.46		592.53	0.002037	7.36	2278.55	564.21	0.38
Reach 1	9173	100-yr	13600	582.1	593.12	591.47		595.14	0.004837	11.4	1193.26	1126.26	0.72
Reach 1	10272	100-yr	13600	582.8	596.81	591.38		597.49	0.001099	6.69	2484.27	1189.87	0.36
Reach 1	11497	100-yr	13600	588.7	598.6	596.01		599.58	0.002685	7.95	1724.55	260.92	0.53
Reach 1	12627	100-yr	13600	594.7	602.47	601.15		603.05	0.003582	7.23	3507.74	1051.35	0.56
Reach 1	13393	100-yr	13600	595.2	604.37	601.95		604.92	0.001759	6.93	3842.12	824	0.44
Reach 1	13514	100-yr	13600	592.1	604.25	600.82		605.42	0.000776	8.69	1565.57	242.96	0.5
Reach 1	13535.3												
Reach 1	13557	100-yr	13600	592.1	604.48	600.82		605.59	0.000716	8.48	1603.57	238.48	0.48
Reach 1	13799	100-yr	13600	595.5	605.77	602.03		606.02	0.001027	4.65	4118.65	648.02	0.29
Reach 1	14863	100-yr	13600	599.6	609.35	609.35		611.54	0.005661	12.51	1638.94	592.59	0.79
Reach 1	15817	100-yr	13600	603.2	613.94			614.53	0.001793	6.45	2851.92	616.22	0.41
Reach 1	17170	100-yr	13600	602.4	616.74	611.96		617.97	0.003422	8.89	1558.35	144.93	0.46
Reach 1	17314	100-yr	13600	605.5	616.8	614		618.91	0.00322	11.64	1168.49	135.65	0.63
Reach 1	17350												
Reach 1	17386	100-yr	13600	605.5	617.35	613.99		619.25	0.002721	11.07	1229.03	133.85	0.58
Reach 1	17442	100-yr	13600	604.9	617.47	614.48		619.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1	18472	100-yr	13600	608.9	620.93	615.06		621.12	0.000815	3.66	5164.67	1271.26	0.21
Reach 1	19887	100-yr	13600	610.3	622.23			622.39	0.000984	3.27	4287.21	642.31	0.21
Reach 1	21220	100-yr	13600	612.8	624.29			624.86	0.004079	6.19	2382.01	364.37	0.39
Reach 1	22540	100-yr	13600	615.5	627.15			627.5	0.001158	4.9	3464.3	606.97	0.29
Reach 1	23751	100-yr	13600	617.6	629.01			629.46	0.002382	5.98	3113.75	527.9	0.34
Reach 1	24800	100-yr	13600	620.4	631.07	628.77		632.33	0.002604	9.4	1975.19	436.99	0.55
Reach 1	25961	100-yr	13600	621.4	634.3	629.31		635.22	0.002289	7.84	2057.3	348.43	0.41

Appendix F-7a

Alternative #6: Flood Bench

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-BENCH2-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Plans = 1

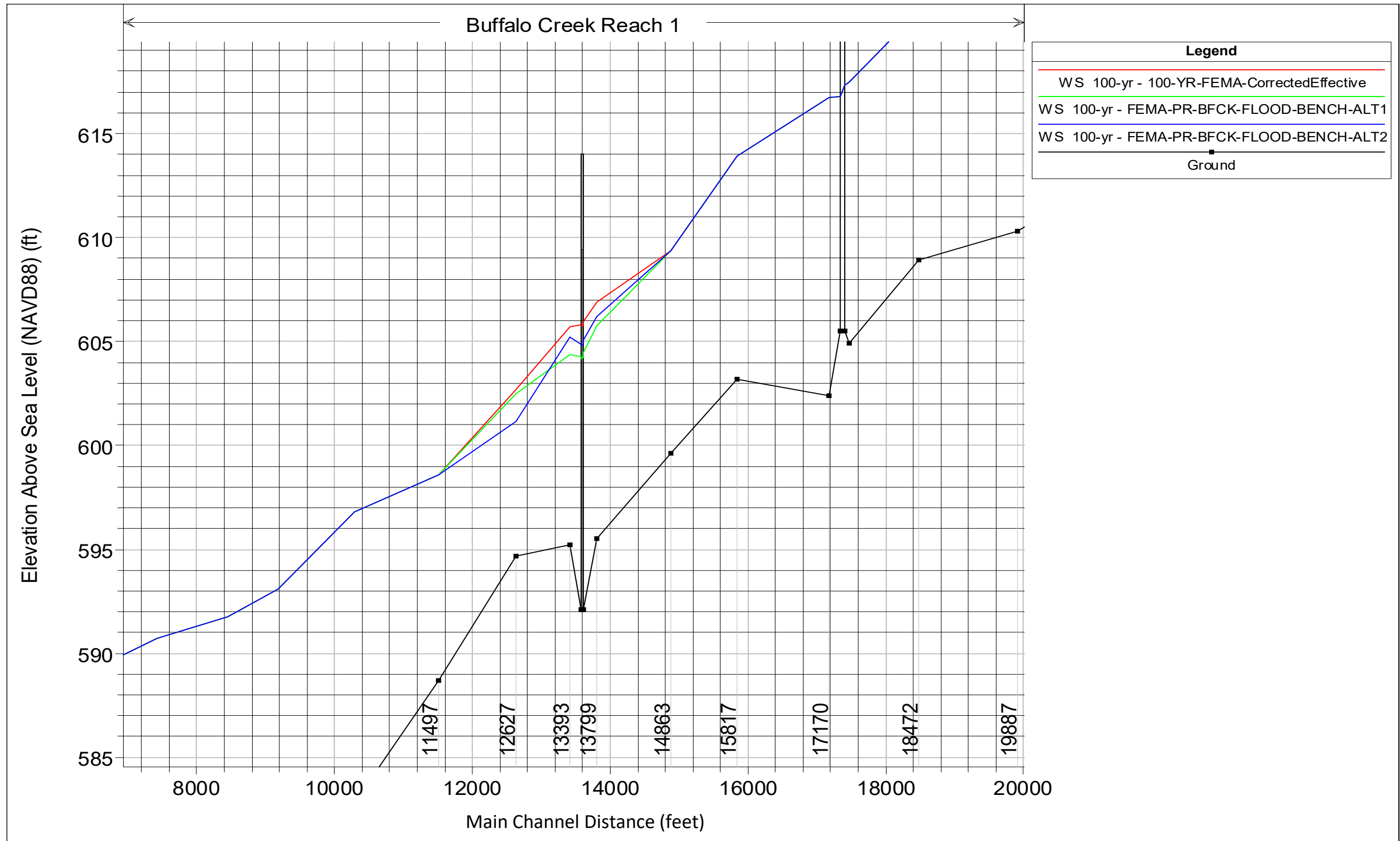
Flood Bench Depth = 6 ft

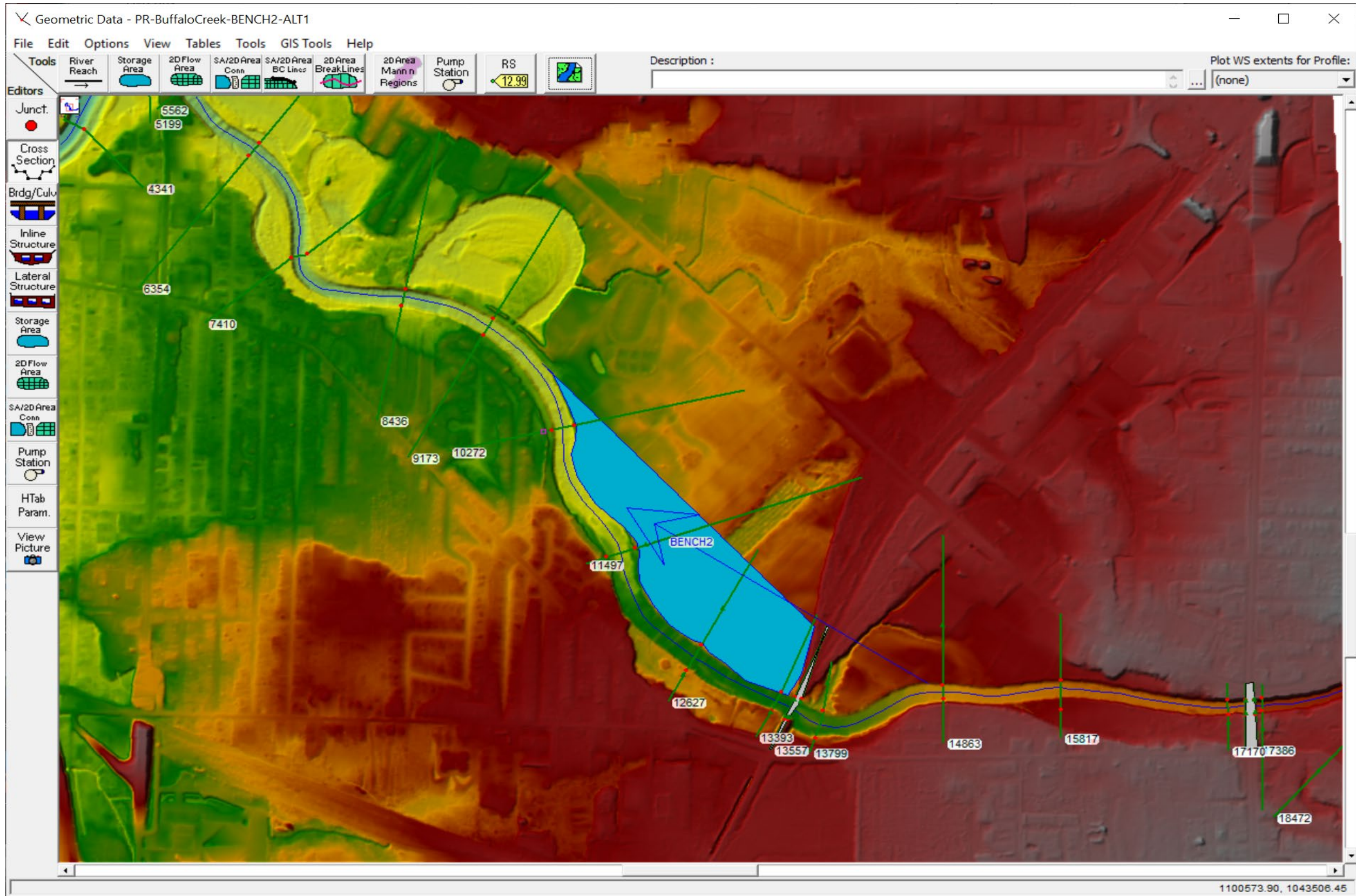
# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	100-yr	13600	567.3	586.87	575.44	586.99	0.00012		3.2	8999.39	1169.72	0.15
Reach 1	930	100-yr	13600	567.3	586.86		587.01	0.00012		3.13	4995.46	935.76	0.15
Reach 1	1098	100-yr	13600	567.4	586.92		587.03	0.000099		2.68	8028.25	1443.12	0.13
Reach 1	1881	100-yr	13600	567.4	587.05		587.09	0.000059		2.14	15755.33	2500.49	0.1
Reach 1	2764	100-yr	13600	566.9	587.08		587.17	0.000105		2.98	14856.69	3707.83	0.15
Reach 1	2788	100-yr	13600	566.9	587.05	577.01	587.18	0.000132		3.34	12096.3	3428.02	0.17
Reach 1	3371	100-yr	13600	571.1	586.98	578.38	587.38	0.00034		5.07	2682.96	1749.34	0.26
Reach 1	3602	100-yr	13600	571.2	587.05	578.46	587.45	0.000302		5.09	2670.81	325.62	0.25
Reach 1	3642	100-yr	13600	566	587.31		587.48	0.000103		3.36	4062.44	326.48	0.16
Reach 1	3686	100-yr	13600	570	587.29		587.5	0.000148		3.69	3681.31	318.5	0.19
Reach 1	3727	100-yr	13600	570	587.28	578.66	587.52	0.000244		3.9	3490.11	303.38	0.2
Reach 1	3859	100-yr	13600	564.2	587.39		587.55	0.000125		3.19	4262.17	302.8	0.15
Reach 1	3898	100-yr	13600	564.2	587.39		587.55	0.000087		3.19	4262.98	302.81	0.15
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	13600	564.2	587.44	575.22	587.6	0.00022		3.18	4277.24	303.02	0.15
Reach 1	4341	100-yr	13600	565.6	587.49		587.71	0.000308		3.74	3925.99	357.58	0.18
Reach 1	5199	100-yr	13600	576.3	587.75		588.25	0.001097		5.74	2440.18	257.18	0.32
Reach 1	5270	100-yr	13600	574	588.11	580.74	588.43	0.000583		4.55	2986.06	341.81	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	13600	574	588.53	580.74	588.83	0.000517		4.39	3095.38	347.24	0.22
Reach 1	5562	100-yr	13600	571	588.75		588.95	0.000577		3.58	4069.8	382.31	0.18
Reach 1	6354	100-yr	13600	571.5	588.99	583.47	589.76	0.001211		7.5	3207.13	933.05	0.38
Reach 1	7410	100-yr	13600	573.7	590.71		591.05	0.001147		5.38	4747.73	910.28	0.26
Reach 1	8436	100-yr	13600	576.6	591.74	586.46	592.53	0.002037		7.36	2278.55	564.21	0.38
Reach 1	9173	100-yr	13600	582.1	593.12	591.47	595.14	0.004837		11.4	1193.26	1126.26	0.72
Reach 1	10272	100-yr	13600	582.8	596.81	591.38	597.49	0.001099		6.69	2484.27	1199.27	0.36
Reach 1	11497	100-yr	13600	588.7	598.6	596.01	599.58	0.002685		7.95	1724.55	1277.37	0.53
Reach 1	12627	100-yr	13600	594.7	601.15	601.15	603.87	0.011402		13.24	1027.39	905.06	1
Reach 1	13393	100-yr	13600	595.2	605.21	601.95	605.37	0.000613		4.35	6374.38	950.89	0.26
Reach 1	13514	100-yr	13600	592.1	604.88	600.82	605.91	0.000623		8.14	1671.64	257.74	0.45
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	13600	592.1	605.06	600.82	606.05	0.000587		7.99	1701.76	242.77	0.44
Reach 1	13799	100-yr	13600	595.5	606.21	602.03	606.42	0.000851		4.35	4402.03	654.87	0.26
Reach 1	14863	100-yr	13600	599.6	609.35	609.35	611.54	0.005661		12.51	1638.94	592.59	0.79
Reach 1	15817	100-yr	13600	603.2	613.94		614.53	0.001793		6.45	2851.92	616.22	0.41
Reach 1	17170	100-yr	13600	602.4	616.74	611.96	617.97	0.003422		8.89	1558.35	144.93	0.46
Reach 1	17314	100-yr	13600	605.5	616.8	614	618.91	0.00322		11.64	1168.49	135.65	0.63
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	13600	605.5	617.35	613.99	619.25	0.002721		11.07	1229.03	133.85	0.58
Reach 1	17442	100-yr	13600	604.9	617.47	614.48	619.48	0.003131		11.4	1216.09	121.22	0.61
Reach 1	18472	100-yr	13600	608.9	620.93	615.06	621.12	0.000815		3.66	5164.67	1271.26	0.21
Reach 1	19887	100-yr	13600	610.3	622.23		622.39	0.000984		3.27	4287.21	642.31	0.21
Reach 1	21220	100-yr	13600	612.8	624.29		624.86	0.004079		6.19	2382.01	364.37	0.39
Reach 1	22540	100-yr	13600	615.5	627.15		627.5	0.001158		4.9	3464.3	606.97	0.29
Reach 1	23751	100-yr	13600	617.6	629.01		629.46	0.002382		5.98	3113.75	527.9	0.34
Reach 1	24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604		9.4	1975.19	436.99	0.55
Reach 1	25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289		7.84	2057.3	348.43	0.41





Appendix F-8a

Alternative #8: Levee

HEC-RAS Model Summary

Project

Plan

FEMA-PR-BFCK-LEVEE-ALT1

FEMA-PR-BFCK-LEVEE-ALT2

Geometry

PR-BFCK-LEVEE-ALT1

PR-BFCK-LEVEE-ALT2

Steady Flow

USGS StreamStats Full Flows

Reach

1

Profile

100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

BuffaloCreek

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Base Condition	ALT1 Levee Distance: 2324 ft	ALT2 Levee Distance: 5078 ft
	836	-4726	586.9	586.9	586.9
	930	-4632	586.9	586.9	586.9
	1098	-4464	586.9	586.9	586.9
	1881	-3681	587.1	587.1	587.1
	2764	-2798	587.1	587.1	587.1
	2788	-2774	587.1	587.1	587.1
	3371	-2191	587.0	587.0	587.0
	3602	-1960	587.1	587.1	587.1
	3642	-1920	587.3	587.3	587.3
	3686	-1876	587.3	587.3	587.3
	3727	-1835	587.3	587.3	587.3
	3859	-1703	587.4	587.4	587.4
	3898	-1664	587.4	587.4	587.4
Bridge	3970.5	-1591.5			
	4043	-1519	587.4	587.4	587.4
	4341	-1221	587.5	587.5	587.5
	5199	-363	587.8	587.8	587.8
	5270	-292	588.1	588.1	588.1
Bridge	5304.5	-257.5			
	5339	-223	588.5	588.5	588.5
	5562	0	588.8	588.8	588.8
	6354	792	589.0	589.0	589.0
	7410	1848	590.7	590.7	590.7
	8436	2874	591.7	591.7	591.7
Oxbow	9173	3611	593.1	593.1	593.1
	10272	4710	596.8	596.8	596.8
	11497	5935	598.6	598.7	598.7
	12627	7065	602.7	602.7	602.7
	13393	7831	605.7	605.7	605.7
	13514	7952	605.8	605.8	605.8
Railroad Bridge	13535.3	7973.3			
	13557	7995	605.9	606.0	606.0
	13799	8237	606.9	606.9	606.9
	14863	9301	609.4	609.4	609.4
	15817	10255	613.9	613.9	613.9
	17170	11608	616.7	616.7	616.7
	17314	11752	616.8	616.8	616.8
Union Rd Bridge	17350	11788			
	17386	11824	617.4	617.4	617.4
	17442	11880	617.5	617.5	617.5
	18472	12910	620.9	620.9	620.9
	19887	14325	622.2	622.2	622.2
	21220	15658	624.3	624.3	624.3
	22540	16978	627.2	627.2	627.2
	23751	18189	629.0	629.0	629.0
	24800	19238	631.1	631.1	631.1
	25961	20399	634.3	634.3	634.3

Description:

Levees were added to select cross sections on the left bank of Lexington Green Neighborhood for 100-yr water surface elevations plus 2-foot of free board at varying distances along reach.

Appendix F-8a

Alternative #8: Levee

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-LEVEE-ALT1

River: Buffalo Creek

Reach: Reach 1

Profile: 100-yr

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
836	100-yr	13600	567.3	586.87	575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15	
930	100-yr	13600	567.3	586.86		587.01	0.00012	3.13	4995.46	935.76	0.15	
1098	100-yr	13600	567.4	586.92		587.03	0.000099	2.68	8028.25	1443.12	0.13	
1881	100-yr	13600	567.4	587.05		587.09	0.000059	2.14	15755.33	2500.49	0.1	
2764	100-yr	13600	566.9	587.08		587.17	0.000105	2.98	14856.69	3707.83	0.15	
2788	100-yr	13600	566.9	587.05	577.01	587.18	0.000132	3.34	12096.3	3428.02	0.17	
3371	100-yr	13600	571.1	586.98	578.38	587.38	0.00034	5.07	2682.96	1749.34	0.26	
3602	100-yr	13600	571.2	587.05	578.46	587.45	0.000302	5.09	2670.81	325.62	0.25	
3642	100-yr	13600	566	587.31		587.48	0.000103	3.36	4062.44	326.48	0.16	
3686	100-yr	13600	570	587.29		587.5	0.000148	3.69	3681.31	318.5	0.19	
3727	100-yr	13600	570	587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2	
3859	100-yr	13600	564.2	587.39		587.55	0.000125	3.19	4262.17	302.8	0.15	
3898	100-yr	13600	564.2	587.39		587.55	0.000087	3.19	4262.98	302.81	0.15	
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22	587.6	0.00022	3.18	4277.24	303.02	0.15	
4341	100-yr	13600	565.6	587.49		587.71	0.000308	3.74	3925.99	357.58	0.18	
5199	100-yr	13600	576.3	587.75		588.25	0.001097	5.74	2440.18	257.18	0.32	
5270	100-yr	13600	574	588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24	
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22	
5562	100-yr	13600	571	588.75		588.95	0.000577	3.58	4069.8	382.31	0.18	
6354	100-yr	13600	571.5	588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38	
7410	100-yr	13600	573.7	590.71		591.05	0.001147	5.38	4747.73	910.28	0.26	
8436	100-yr	13600	576.6	591.74	586.46	592.53	0.002037	7.36	2278.55	564.21	0.38	
9173	100-yr	13600	582.1	593.12	591.44	595.14	0.004837	11.4	1193.25	1126.26	0.72	
10272	100-yr	13600	582.8	596.82	591.38	597.52	0.001124	6.77	2212.81	367.49	0.37	
11497	100-yr	13600	588.7	598.65	596.01	599.61	0.00263	7.9	1735.92	281.08	0.53	
12627	100-yr	13600	594.7	602.67	601.26	604.14	0.006351	9.85	1560.86	632.04	0.75	
13393	100-yr	13600	595.2	605.69	601.95	606.52	0.001731	7.57	2609.56	815.05	0.44	
13514	100-yr	13600	592.1	605.81	600.82	606.67	0.000463	7.44	1828.23	279.54	0.4	
13535.3	Bridge											
13557	100-yr	13600	592.1	605.95	600.82	606.79	0.000444	7.35	1850.63	249.27	0.39	
13799	100-yr	13600	595.5	606.91	602.03	607.09	0.00064	3.93	4868.94	666	0.23	
14863	100-yr	13600	599.6	609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79	
15817	100-yr	13600	603.2	613.94		614.53	0.001793	6.45	2851.92	616.22	0.41	
17170	100-yr	13600	602.4	616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46	
17314	100-yr	13600	605.5	616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63	
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58	
17442	100-yr	13600	604.9	617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61	
18472	100-yr	13600	608.9	620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21	
19887	100-yr	13600	610.3	622.23		622.39	0.000984	3.27	4287.21	642.31	0.21	
21220	100-yr	13600	612.8	624.29		624.86	0.004079	6.19	2382.01	364.37	0.39	
22540	100-yr	13600	615.5	627.15		627.5	0.001158	4.9	3464.3	606.97	0.29	
23751	100-yr	13600	617.6	629.01		629.46	0.002382	5.98	3113.75	527.9	0.34	
24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55	
25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41	

Appendix F-8a

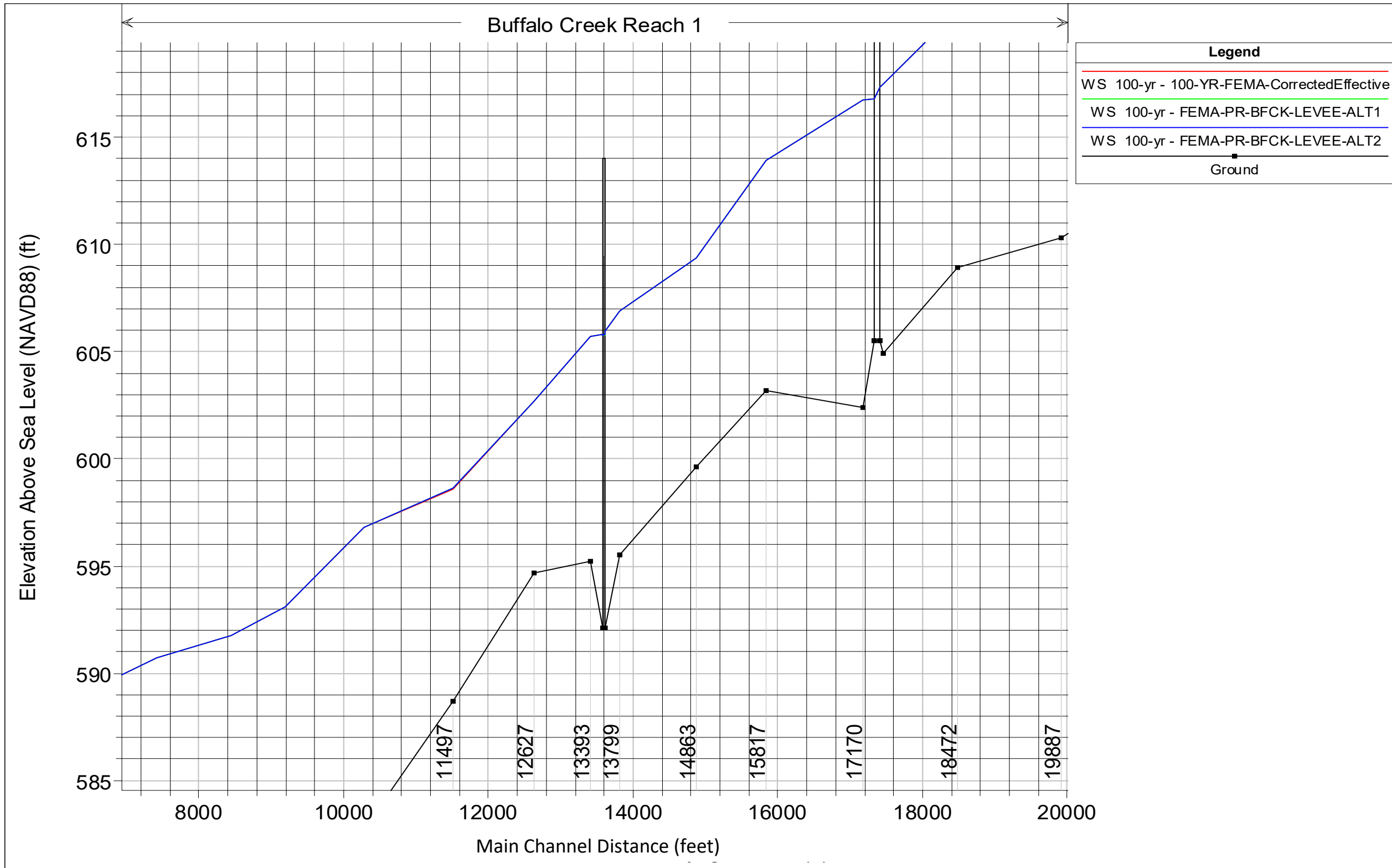
Alternative #8: Levee

Profile Output Table - Standard Table 1

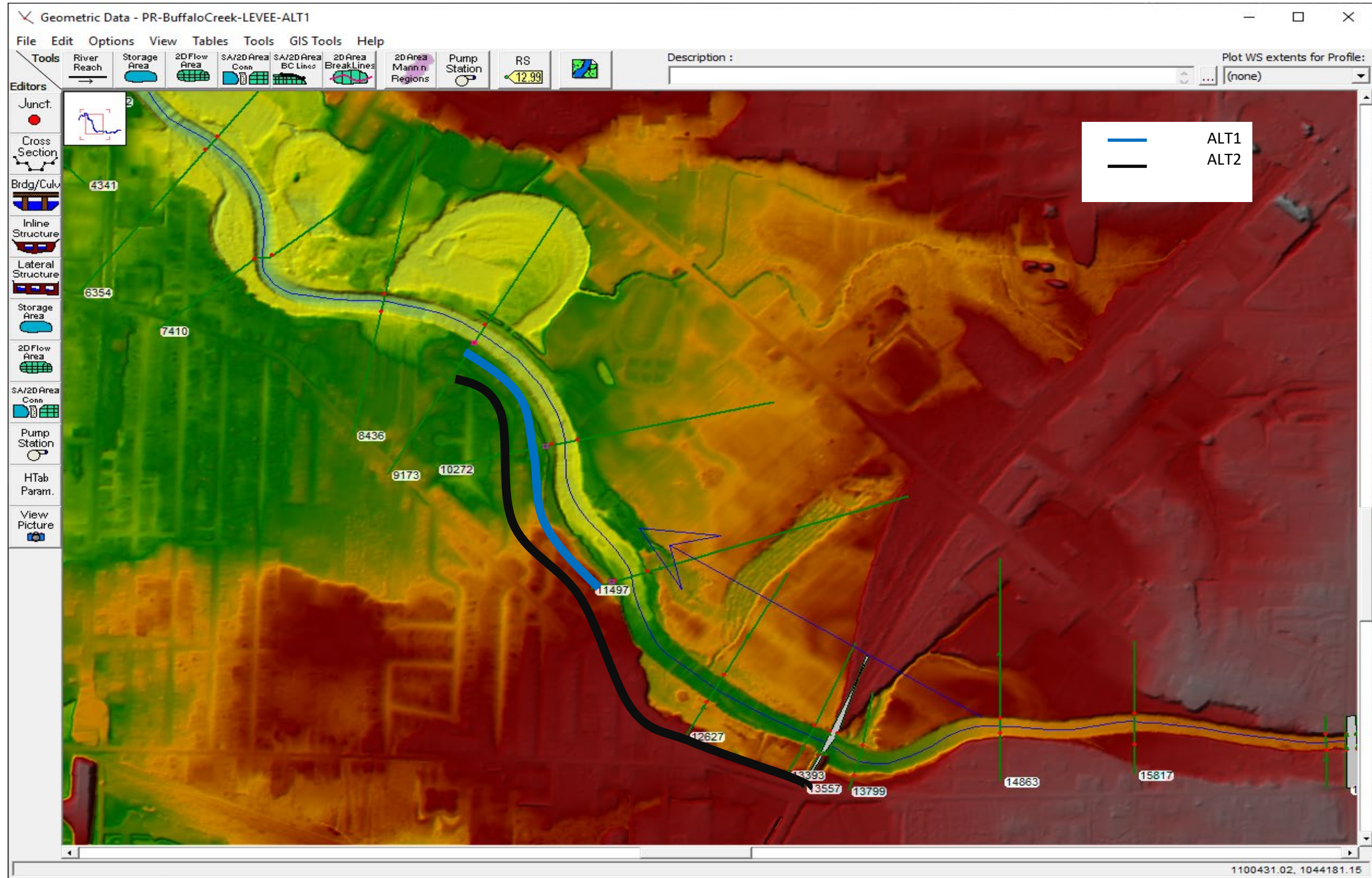
HEC-RAS Plan: FEMA-PR-BFCK-LEVEE-ALT2

River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

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
836	100-yr	13600	567.3	586.87	575.44	586.99	0.00012	3.2	8999.39	1169.72	0.15	
930	100-yr	13600	567.3	586.86		587.01	0.00012	3.13	4995.46	935.76	0.15	
1098	100-yr	13600	567.4	586.92		587.03	0.000099	2.68	8028.25	1443.12	0.13	
1881	100-yr	13600	567.4	587.05		587.09	0.000059	2.14	15755.33	2500.49	0.1	
2764	100-yr	13600	566.9	587.08		587.17	0.000105	2.98	14856.69	3707.83	0.15	
2788	100-yr	13600	566.9	587.05	577.01	587.18	0.000132	3.34	12096.3	3428.02	0.17	
3371	100-yr	13600	571.1	586.98	578.38	587.38	0.00034	5.07	2682.96	1749.34	0.26	
3602	100-yr	13600	571.2	587.05	578.46	587.45	0.000302	5.09	2670.81	325.62	0.25	
3642	100-yr	13600	566	587.31		587.48	0.000103	3.36	4062.44	326.48	0.16	
3686	100-yr	13600	570	587.29		587.5	0.000148	3.69	3681.31	318.5	0.19	
3727	100-yr	13600	570	587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2	
3859	100-yr	13600	564.2	587.39		587.55	0.000125	3.19	4262.17	302.8	0.15	
3898	100-yr	13600	564.2	587.39		587.55	0.000087	3.19	4262.98	302.81	0.15	
3970.5	Bridge											
4043	100-yr	13600	564.2	587.44	575.22	587.6	0.00022	3.18	4277.24	303.02	0.15	
4341	100-yr	13600	565.6	587.49		587.71	0.000308	3.74	3925.99	357.58	0.18	
5199	100-yr	13600	576.3	587.75		588.25	0.001097	5.74	2440.18	257.18	0.32	
5270	100-yr	13600	574	588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24	
5304.5	Bridge											
5339	100-yr	13600	574	588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22	
5562	100-yr	13600	571	588.75		588.95	0.000577	3.58	4069.8	382.31	0.18	
6354	100-yr	13600	571.5	588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38	
7410	100-yr	13600	573.7	590.71		591.05	0.001147	5.38	4747.73	910.28	0.26	
8436	100-yr	13600	576.6	591.74	586.46	592.53	0.002037	7.36	2278.55	564.21	0.38	
9173	100-yr	13600	582.1	593.12	591.44	595.14	0.004837	11.4	1193.25	1126.26	0.72	
10272	100-yr	13600	582.8	596.82	591.38	597.52	0.001124	6.77	2212.81	367.49	0.37	
11497	100-yr	13600	588.7	598.65	596.01	599.61	0.00263	7.9	1735.92	281.08	0.53	
12627	100-yr	13600	594.7	602.67	601.26	604.14	0.006351	9.85	1560.86	539.84	0.75	
13393	100-yr	13600	595.2	605.69	601.95	606.52	0.001732	7.56	2611.16	672.74	0.44	
13514	100-yr	13600	592.1	605.82	600.81	606.67	0.000462	7.44	1828.68	266.31	0.4	
13535.3	Bridge											
13557	100-yr	13600	592.1	605.95	600.82	606.79	0.000444	7.35	1851.08	249.29	0.39	
13799	100-yr	13600	595.5	606.92	602.03	607.09	0.000639	3.93	4870.44	666.04	0.23	
14863	100-yr	13600	599.6	609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79	
15817	100-yr	13600	603.2	613.94		614.53	0.001793	6.45	2851.92	616.22	0.41	
17170	100-yr	13600	602.4	616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46	
17314	100-yr	13600	605.5	616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63	
17350	Bridge											
17386	100-yr	13600	605.5	617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58	
17442	100-yr	13600	604.9	617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61	
18472	100-yr	13600	608.9	620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21	
19887	100-yr	13600	610.3	622.23		622.39	0.000984	3.27	4287.21	642.31	0.21	
21220	100-yr	13600	612.8	624.29		624.86	0.004079	6.19	2382.01	364.37	0.39	
22540	100-yr	13600	615.5	627.15		627.5	0.001158	4.9	3464.3	606.97	0.29	
23751	100-yr	13600	617.6	629.01		629.46	0.002382	5.98	3113.75	527.9	0.34	
24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55	
25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41	







Appendix F-9a

Alternative #9: Pilot Channel

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FEMA-PR-BFCK-PILOT-CHNL-ALT1

FEMA-PR-BFCK-PILOT-CHNL-ALT2

FEMA-PR-BFCK-PILOT-CHNL-ALT3

Geometry

PR-BFCK-PILOT-CHNL-ALT1

PR-BFCK-PILOT-CHNL-ALT2

PR-BFCK-PILOT-CHNL-ALT3

Steady Flow Pilot Channel Flows 35%

Reach 1, 2, P1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10. Peak streamflow data calculated using USGS StreamStats v4.3.8. which uses Full-regression equations for estimating peak discharges for rural, unregulated streams in each of six hydrologic regions of New York, excluding Long Island (USGS SIR2006-5112).

Pilot channel joined to reach 1 downstream RS 13393.

Width = 100, 200 ft;

Min Elev. = 586, 590 ft.

SA created at oxbow intersecting RS 9173 and 8436 and joining pilot channel with reach 1 and adjusted X-Ss to below 100-yr WSE with levees.

Area = 30 ac.

Min Elev = 585 ft.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)			
			Base Condition	ALT1 Chnl width = 200 ft	ALT2 Chnl width = 200 ft	ALT3 Chnl width = 100 ft
	836	-4726	586.9	586.9	586.87	586.9
	930	-4632	586.9	586.9	586.86	586.9
	1098	-4464	586.9	586.9	586.92	586.9
	1881	-3681	587.1	587.1	587.05	587.1
	2764	-2798	587.1	587.1	587.08	587.1
	2788	-2774	587.1	587.1	587.05	587.1
	3371	-2191	587.0	587.0	586.98	587.0
	3602	-1960	587.1	587.1	587.05	587.1
	3642	-1920	587.3	587.3	587.31	587.3
	3686	-1876	587.3	587.3	587.29	587.3
	3727	-1835	587.3	587.3	587.28	587.3
	3859	-1703	587.4	587.4	587.39	587.4
	3898	-1664	587.4	587.4	587.39	587.4
Bridge	3970.5	-1591.5				
	4043	-1519	587.4	587.4	587.44	587.4
	4341	-1221	587.5	587.5	587.49	587.5
	5199	-363	587.8	587.8	587.75	587.8
	5270	-292	588.1	588.1	588.11	588.1
Bridge	5304.5	-257.5				
	5339	-223	588.5	588.5	588.53	588.5
	5562	0	588.8	588.8	588.75	588.8
	6354	792	589.0	589.0	588.99	589.0
	7410	1848	590.7	590.7	590.71	590.7
	8436	2874	591.7	591.7	591.74	591.7
Oxbow	9173	3611	593.1	593.3	593.34	593.3
	10272	4710	596.8	594.2	594.23	594.2
	11497	5935	598.6	596.5	596.46	596.5
	12627	7065	602.7	601.1	601.07	601.1
	13393	7831	605.7	602.0	601.95	602.0
	13514	7952	605.8	604.6	604.55	604.6
Railroad Bridge	13535.3	7973.3				
	13557	7995	605.9	604.8	604.75	604.8
	13799	8237	606.9	606.1	606.14	606.1
	14863	9301	609.4	609.4	609.35	609.4
	15817	10255	613.9	613.9	613.94	613.9
	17170	11608	616.7	616.7	616.74	616.7
	17314	11752	616.8	616.8	616.8	616.8
Union Rd Bridge	17350	11788				
	17386	11824	617.4	617.4	617.35	617.4
	17442	11880	617.5	617.5	617.47	617.5
	18472	12910	620.9	620.9	620.93	620.9
	19887	14325	622.2	622.2	622.23	622.2
	21220	15658	624.3	624.3	624.29	624.3
	22540	16978	627.2	627.2	627.15	627.2
	23751	18189	629.0	629.0	629.01	629.0
	24800	19238	631.1	631.1	631.07	631.1
	25961	20399	634.3	634.3	634.3	634.3
P1	656	4647		594.0	590.15	592.2
P1	1771	5762		600.4	596.63	601.1
P1	3160	7151		602.3	598.51	603.5

	USGS Streamstats	Main Channel 65% discharge	Pilot Channel 35% discharge
Q1.25	3030	1969.5	1060.5
Q2	4340	2821	1519
Q5	6450	4192.5	2257.5
Q10	7990	5193.5	2796.5
Q50	11800	7670	4130
Q100	13600	8840	4760
Q500	18000	11700	6300

Appendix F-9a  
Alternative #9: Pilot Channel

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-PILOT-CHNL-ALT1 Profile: 100-yr

# Rivers		1		# Plans			1	Channel width = 200 ft		Min elev = 590 ft			
# Hydraulic Reaches = 1		s = 1		# Profiles			1	# River Stations = 47					
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
Reach 2		836 100-yr	13600	567.3		586.87	575.46	586.99	0.00012	3.2	8999.31	1169.72	0.15
Reach 2		930 100-yr	13600	567.3		586.86		587.01	0.00012	3.13	4995.4	935.72	0.15
Reach 2		1098 100-yr	13600	567.4		586.92		587.03	0.000099	2.68	8028.16	1443.11	0.13
Reach 2		1881 100-yr	13600	567.4		587.05		587.09	0.000059	2.14	15755.18	2500.48	0.1
Reach 2		2764 100-yr	13600	566.9		587.08		587.17	0.000105	2.98	14856.46	3707.82	0.15
Reach 2		2788 100-yr	13600	566.9		587.05	577.01	587.18	0.000132	3.34	12096.09	3427.99	0.17
Reach 2		3371 100-yr	13600	571.1		586.98	578.38	587.38	0.00034	5.07	2682.95	1749.32	0.26
Reach 2		3602 100-yr	13600	571.2		587.05	578.46	587.45	0.000302	5.09	2670.8	325.6	0.25
Reach 2		3642 100-yr	13600	566		587.31		587.48	0.000103	3.36	4062.42	326.48	0.16
Reach 2		3686 100-yr	13600	570		587.29		587.5	0.000148	3.69	3681.31	318.5	0.19
Reach 2		3727 100-yr	13600	570		587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
Reach 2		3859 100-yr	13600	564.2		587.39		587.55	0.000125	3.19	4262.17	302.8	0.15
Reach 2		3898 100-yr	13600	564.2		587.39		587.55	0.000087	3.19	4262.98	302.81	0.15
Reach 2		3970.5											
Reach 2		4043 100-yr	13600	564.2		587.44	575.2	587.6	0.00022	3.18	4277.24	303.02	0.15
Reach 2		4341 100-yr	13600	565.6		587.49		587.71	0.000308	3.74	3925.99	357.58	0.18
Reach 2		5199 100-yr	13600	576.3		587.75		588.25	0.001097	5.74	2440.18	257.18	0.32
Reach 2		5270 100-yr	13600	574		588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
Reach 2		5304.5											
Reach 2		5339 100-yr	13600	574		588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
Reach 2		5562 100-yr	13600	571		588.75		588.95	0.000577	3.58	4069.8	382.31	0.18
Reach 2		6354 100-yr	13600	571.5		588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
Reach 2		7410 100-yr	13600	573.7		590.71		591.05	0.001147	5.38	4747.73	910.28	0.26
Reach 2		8436 100-yr	13600	576.6		591.74	586.4	592.52	0.00202	7.33	2317.95	576.22	0.38
Reach 2		9173 100-yr	8840	582.1		593.34	589.71	593.58	0.000801	4.72	4671.96	1290.3	0.29
Reach 2		10272 100-yr	8840	582.8		594.23	589.7	594.78	0.001246	5.94	1510.44	226.94	0.37
Reach 2		11497 100-yr	8840	588.7		596.46	594.72	597.32	0.003715	7.46	1184.99	240.15	0.59
Reach 2		12627 100-yr	8840	594.7		601.07	599.71	602.25	0.005028	8.72	1034.75	260.57	0.66
Reach 1		13393 100-yr	13600	595.2		601.95	601.95	604.82	0.010183	13.6	1000.2	173.77	1
Reach 1		13514 100-yr	13600	592.1		604.55	600.82	605.65	0.000697	8.41	1616.58	250.07	0.48
Reach 1		13535.3											
Reach 1		13557 100-yr	13600	592.1		604.75	600.82	605.81	0.000651	8.24	1650.41	240.53	0.46
Reach 1		13799 100-yr	13600	595.5		606.14	602.03	606.36	0.000877	4.4	4356.46	653.77	0.27
Reach 1		14863 100-yr	13600	599.6		609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
Reach 1		15817 100-yr	13600	603.2		613.94		614.53	0.001793	6.45	2851.92	616.22	0.41
Reach 1		17170 100-yr	13600	602.4		616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
Reach 1		17314 100-yr	13600	605.5		616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63
Reach 1		17350											
Reach 1		17386 100-yr	13600	605.5		617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
Reach 1		17442 100-yr	13600	604.9		617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1		18472 100-yr	13600	608.9		620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
Reach 1		19887 100-yr	13600	610.3		622.23		622.39	0.000984	3.27	4287.21	642.31	0.21
Reach 1		21220 100-yr	13600	612.8		624.29		624.86	0.004079	6.19	2382.01	364.37	0.39
Reach 1		22540 100-yr	13600	615.5		627.15		627.5	0.001158	4.9	3464.3	606.97	0.29
Reach 1		23751 100-yr	13600	617.6		629.01		629.46	0.002382	5.98	3113.75	527.9	0.34
Reach 1		24800 100-yr	13600	620.4		631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
Reach 1		25961 100-yr	13600	621.4		634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41

Appendix F-9a

Alternative #9: Pilot Channel

P1	656	100-yr	4760	590	594.01	594.01	595.5	0.024567	9.8	485.58	162.63	1
P1	1771	100-yr	4760	590	600.42		600.57	0.001782	3.19	1493.74	196.26	0.2
P1	3160	100-yr	4760	590	602.3		602.41	0.001016	2.69	1770.43	195.91	0.16

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-PILOT-CHNL-ALT2 Profile: 100-yr

# Rivers		1		# Plans		1		Channel width = 200 ft		Min elev = 586 ft			
# Hydraulic Reache	s = 1			# Profiles		1		# River Stations = 47					
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	
Reach 2		836 100-yr	13600	567.3		586.87	575.46	586.99	0.00012	3.2	8999.31	1169.72	0.15
Reach 2		930 100-yr	13600	567.3		586.86		587.01	0.00012	3.13	4995.4	935.72	0.15
Reach 2		1098 100-yr	13600	567.4		586.92		587.03	0.000099	2.68	8028.16	1443.11	0.13
Reach 2		1881 100-yr	13600	567.4		587.05		587.09	0.000059	2.14	15755.18	2500.48	0.1
Reach 2		2764 100-yr	13600	566.9		587.08		587.17	0.000105	2.98	14856.46	3707.82	0.15
Reach 2		2788 100-yr	13600	566.9		587.05	577.01	587.18	0.000132	3.34	12096.09	3427.99	0.17
Reach 2		3371 100-yr	13600	571.1		586.98	578.38	587.38	0.00034	5.07	2682.95	1749.32	0.26
Reach 2		3602 100-yr	13600	571.2		587.05	578.46	587.45	0.000302	5.09	2670.8	325.6	0.25
Reach 2		3642 100-yr	13600	566		587.31		587.48	0.000103	3.36	4062.42	326.48	0.16
Reach 2		3686 100-yr	13600	570		587.29		587.5	0.000148	3.69	3681.31	318.5	0.19
Reach 2		3727 100-yr	13600	570		587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
Reach 2		3859 100-yr	13600	564.2		587.39		587.55	0.000125	3.19	4262.17	302.8	0.15
Reach 2		3898 100-yr	13600	564.2		587.39		587.55	0.000087	3.19	4262.98	302.81	0.15
Reach 2	3970.5	Bridge											
Reach 2	4043 100-yr		13600	564.2		587.44	575.21	587.6	0.00022	3.18	4277.24	303.02	0.15
Reach 2	4341 100-yr		13600	565.6		587.49		587.71	0.000308	3.74	3925.99	357.58	0.18
Reach 2	5199 100-yr		13600	576.3		587.75		588.25	0.001097	5.74	2440.18	257.18	0.32
Reach 2	5270 100-yr		13600	574		588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
Reach 2	5304.5	Bridge											
Reach 2	5339 100-yr		13600	574		588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
Reach 2	5562 100-yr		13600	571		588.75		588.95	0.000577	3.58	4069.8	382.31	0.18
Reach 2	6354 100-yr		13600	571.5		588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
Reach 2	7410 100-yr		13600	573.7		590.71		591.05	0.001147	5.38	4747.73	910.28	0.26
Reach 2	8436 100-yr		13600	576.6		591.74	586.4	592.52	0.00202	7.33	2317.95	576.22	0.38
Reach 2	9173 100-yr		8840	582.1		593.34	589.71	593.58	0.000801	4.72	4671.96	1290.3	0.29
Reach 2	10272 100-yr		8840	582.8		594.23	589.7	594.78	0.001246	5.94	1510.44	226.94	0.37
Reach 2	11497 100-yr		8840	588.7		596.46	594.72	597.32	0.003715	7.46	1184.99	240.15	0.59
Reach 2	12627 100-yr		8840	594.7		601.07	599.71	602.25	0.005028	8.72	1034.75	260.57	0.66
Reach 1	13393 100-yr		13600	595.2		601.95	601.95	604.82	0.010183	13.6	1000.2	173.77	1
Reach 1	13514 100-yr		13600	592.1		604.55	600.82	605.65	0.000697	8.41	1616.58	250.07	0.48
Reach 1	13535.3	Bridge											
Reach 1	13557 100-yr		13600	592.1		604.75	600.82	605.81	0.000651	8.24	1650.41	240.53	0.46
Reach 1	13799 100-yr		13600	595.5		606.14	602.03	606.36	0.000877	4.4	4356.46	653.77	0.27
Reach 1	14863 100-yr		13600	599.6		609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
Reach 1	15817 100-yr		13600	603.2		613.94		614.53	0.001793	6.45	2851.92	616.22	0.41
Reach 1	17170 100-yr		13600	602.4		616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
Reach 1	17314 100-yr		13600	605.5		616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63
Reach 1	17350	Bridge											
Reach 1	17386 100-yr		13600	605.5		617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
Reach 1	17442 100-yr		13600	604.9		617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1	18472 100-yr		13600	608.9		620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
Reach 1	19887 100-yr		13600	610.3		622.23		622.39	0.000984	3.27	4287.21	642.31	0.21
Reach 1	21220 100-yr		13600	612.8		624.29		624.86	0.004079	6.19	2382.01	364.37	0.39
Reach 1	22540 100-yr		13600	615.5		627.15		627.5	0.001158	4.9	3464.3	606.97	0.29
Reach 1	23751 100-yr		13600	617.6		629.01		629.46	0.002382	5.98	3113.75	527.9	0.34

Appendix F-9a

Alternative #9: Pilot Channel

Reach 1	24800	100-yr	13600	620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
Reach 1	25961	100-yr	13600	621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41
P1	656	100-yr	4760	586	590.15	590.15	591.82	0.023225	10.35	459.76	138.05	1
P1	1771	100-yr	4760	586	596.63		596.81	0.001764	3.41	1396.01	170.81	0.21
P1	3160	100-yr	4760	586	598.51		598.63	0.001014	2.85	1667.64	173.65	0.16

Profile Output Table - Standard Table 1

HEC-RAS Plan: FEMA-PR-BFCK-PILOT-CHNL-ALT3 Profile: 100-yr

# Rivers		1	# Plans	1		Channel width = 100 ft			Min elev = 586 ft				
# Hydraulic Reache		s = 1	# Profiles	1		# River Stations = 47							
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	
Reach 2		836 100-yr	13600	567.3		586.87	575.46	586.99	0.00012	3.2	8999.31	1169.72	0.15
Reach 2		930 100-yr	13600	567.3		586.86		587.01	0.00012	3.13	4995.4	935.72	0.15
Reach 2		1098 100-yr	13600	567.4		586.92		587.03	0.000099	2.68	8028.16	1443.11	0.13
Reach 2		1881 100-yr	13600	567.4		587.05		587.09	0.000059	2.14	15755.18	2500.48	0.1
Reach 2		2764 100-yr	13600	566.9		587.08		587.17	0.000105	2.98	14856.46	3707.82	0.15
Reach 2		2788 100-yr	13600	566.9		587.05	577.01	587.18	0.000132	3.34	12096.09	3427.99	0.17
Reach 2		3371 100-yr	13600	571.1		586.98	578.38	587.38	0.00034	5.07	2682.95	1749.32	0.26
Reach 2		3602 100-yr	13600	571.2		587.05	578.46	587.45	0.000302	5.09	2670.8	325.6	0.25
Reach 2		3642 100-yr	13600	566		587.31		587.48	0.000103	3.36	4062.42	326.48	0.16
Reach 2		3686 100-yr	13600	570		587.29		587.5	0.000148	3.69	3681.31	318.5	0.19
Reach 2		3727 100-yr	13600	570		587.28	578.66	587.52	0.000244	3.9	3490.11	303.38	0.2
Reach 2		3859 100-yr	13600	564.2		587.39		587.55	0.000125	3.19	4262.17	302.8	0.15
Reach 2		3898 100-yr	13600	564.2		587.39		587.55	0.000087	3.19	4262.98	302.81	0.15
Reach 2		3970.5											
Reach 2		4043 100-yr	13600	564.2		587.44	575.21	587.6	0.00022	3.18	4277.24	303.02	0.15
Reach 2		4341 100-yr	13600	565.6		587.49		587.71	0.000308	3.74	3925.99	357.58	0.18
Reach 2		5199 100-yr	13600	576.3		587.75		588.25	0.001097	5.74	2440.18	257.18	0.32
Reach 2		5270 100-yr	13600	574		588.11	580.74	588.43	0.000583	4.55	2986.06	341.81	0.24
Reach 2		5304.5											
Reach 2		5339 100-yr	13600	574		588.53	580.74	588.83	0.000517	4.39	3095.38	347.24	0.22
Reach 2		5562 100-yr	13600	571		588.75		588.95	0.000577	3.58	4069.8	382.31	0.18
Reach 2		6354 100-yr	13600	571.5		588.99	583.47	589.76	0.001211	7.5	3207.13	933.05	0.38
Reach 2		7410 100-yr	13600	573.7		590.71		591.05	0.001147	5.38	4747.73	910.28	0.26
Reach 2		8436 100-yr	13600	576.6		591.74	586.4	592.52	0.00202	7.33	2317.95	576.22	0.38
Reach 2		9173 100-yr	8840	582.1		593.34	589.71	593.58	0.000801	4.72	4671.96	1290.3	0.29
Reach 2		10272 100-yr	8840	582.8		594.23	589.7	594.78	0.001246	5.94	1510.44	226.94	0.37
Reach 2		11497 100-yr	8840	588.7		596.46	594.72	597.32	0.003715	7.46	1184.99	240.15	0.59
Reach 2		12627 100-yr	8840	594.7		601.07	599.71	602.25	0.005028	8.72	1034.75	260.57	0.66
Reach 1		13393 100-yr	13600	595.2		601.95	601.95	604.82	0.010183	13.6	1000.2	173.77	1
Reach 1		13514 100-yr	13600	592.1		604.55	600.82	605.65	0.000697	8.41	1616.62	250.07	0.48
Reach 1		13535.3											
Reach 1		13557 100-yr	13600	592.1		604.75	600.82	605.81	0.000651	8.24	1650.45	240.53	0.46
Reach 1		13799 100-yr	13600	595.5		606.14	602.03	606.36	0.000877	4.4	4356.82	653.78	0.27
Reach 1		14863 100-yr	13600	599.6		609.35	609.35	611.54	0.005661	12.51	1638.94	592.59	0.79
Reach 1		15817 100-yr	13600	603.2		613.94		614.53	0.001793	6.45	2851.92	616.22	0.41
Reach 1		17170 100-yr	13600	602.4		616.74	611.96	617.97	0.003422	8.89	1558.35	144.93	0.46
Reach 1		17314 100-yr	13600	605.5		616.8	614	618.91	0.00322	11.64	1168.49	135.65	0.63
Reach 1		17350											
Reach 1		17386 100-yr	13600	605.5		617.35	613.99	619.25	0.002721	11.07	1229.03	133.85	0.58
Reach 1		17442 100-yr	13600	604.9		617.47	614.48	619.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1		18472 100-yr	13600	608.9		620.93	615.06	621.12	0.000815	3.66	5164.67	1271.26	0.21
Reach 1		19887 100-yr	13600	610.3		622.23		622.39	0.000984	3.27	4287.21	642.31	0.21
Reach 1		21220 100-yr	13600	612.8		624.29		624.86	0.004079	6.19	2382.01	364.37	0.39

Appendix F-9a  
 Alternative #9: Pilot Channel

Reach 1	22540 100-yr	13600	615.5	627.15		627.5	0.001158	4.9	3464.3	606.97	0.29
Reach 1	23751 100-yr	13600	617.6	629.01		629.46	0.002382	5.98	3113.75	527.9	0.34
Reach 1	24800 100-yr	13600	620.4	631.07	628.77	632.33	0.002604	9.4	1975.19	436.99	0.55
Reach 1	25961 100-yr	13600	621.4	634.3	629.31	635.22	0.002289	7.84	2057.3	348.43	0.41
P1	656 100-yr	4760	586	592.19	592.19	594.61	0.04731	12.48	381.56	79.65	1
P1	1771 100-yr	4760	586	601.08		601.36	0.002158	4.26	1189.22	547.84	0.23
P1	3160 100-yr	4760	586	603.45		603.65	0.001301	3.61	1480.48	477.41	0.18

Steady Flow Data - Pilot Channel Flows 35%

File Options Help

Description : USGS StreamStats Peak Flow Statistics Parameters [2006 Region 5 - Full Regression Equation] with 35% reduction in flows at

Enter/Edit Number of Profiles (32000 max):

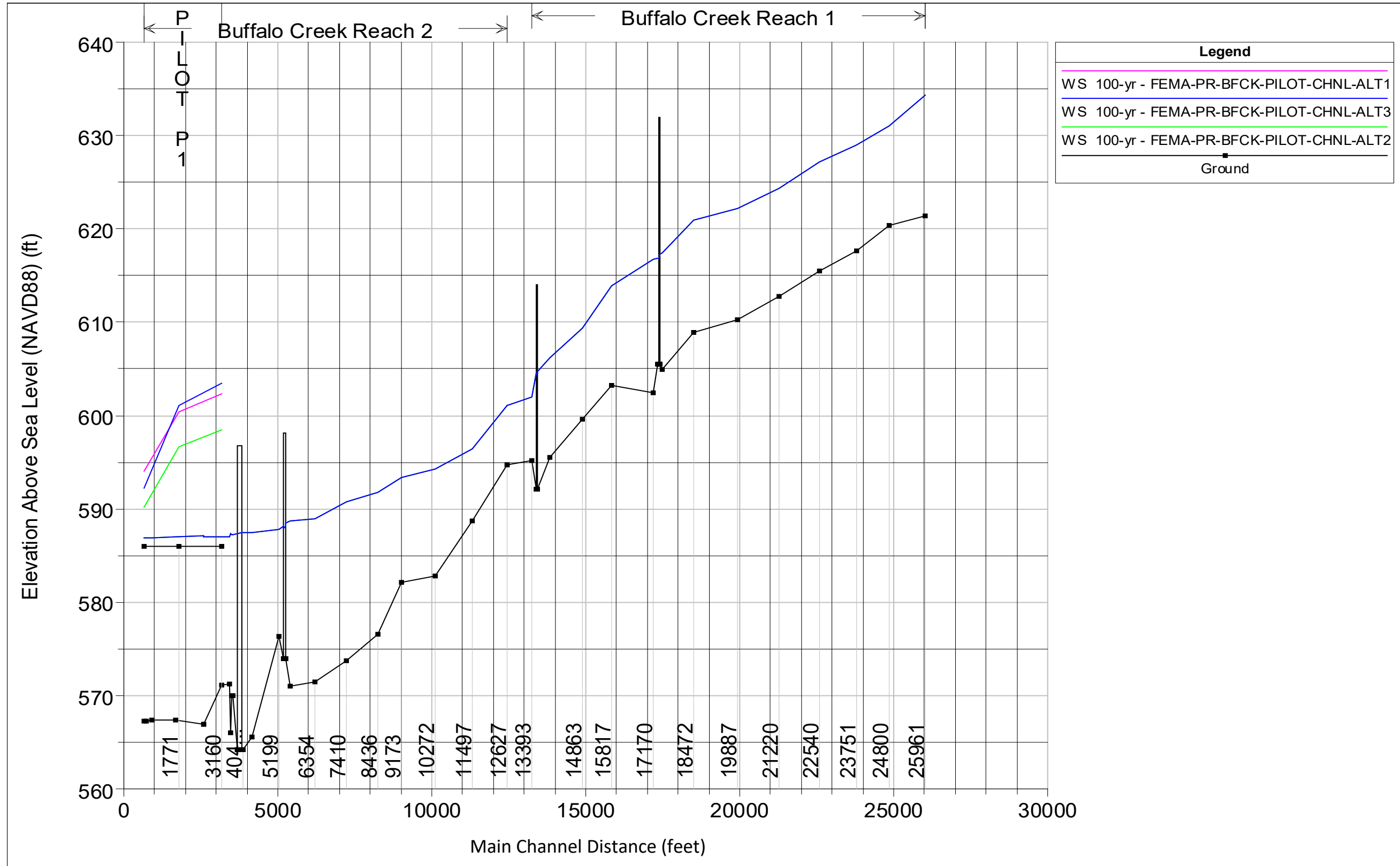
Locations of Flow Data Changes

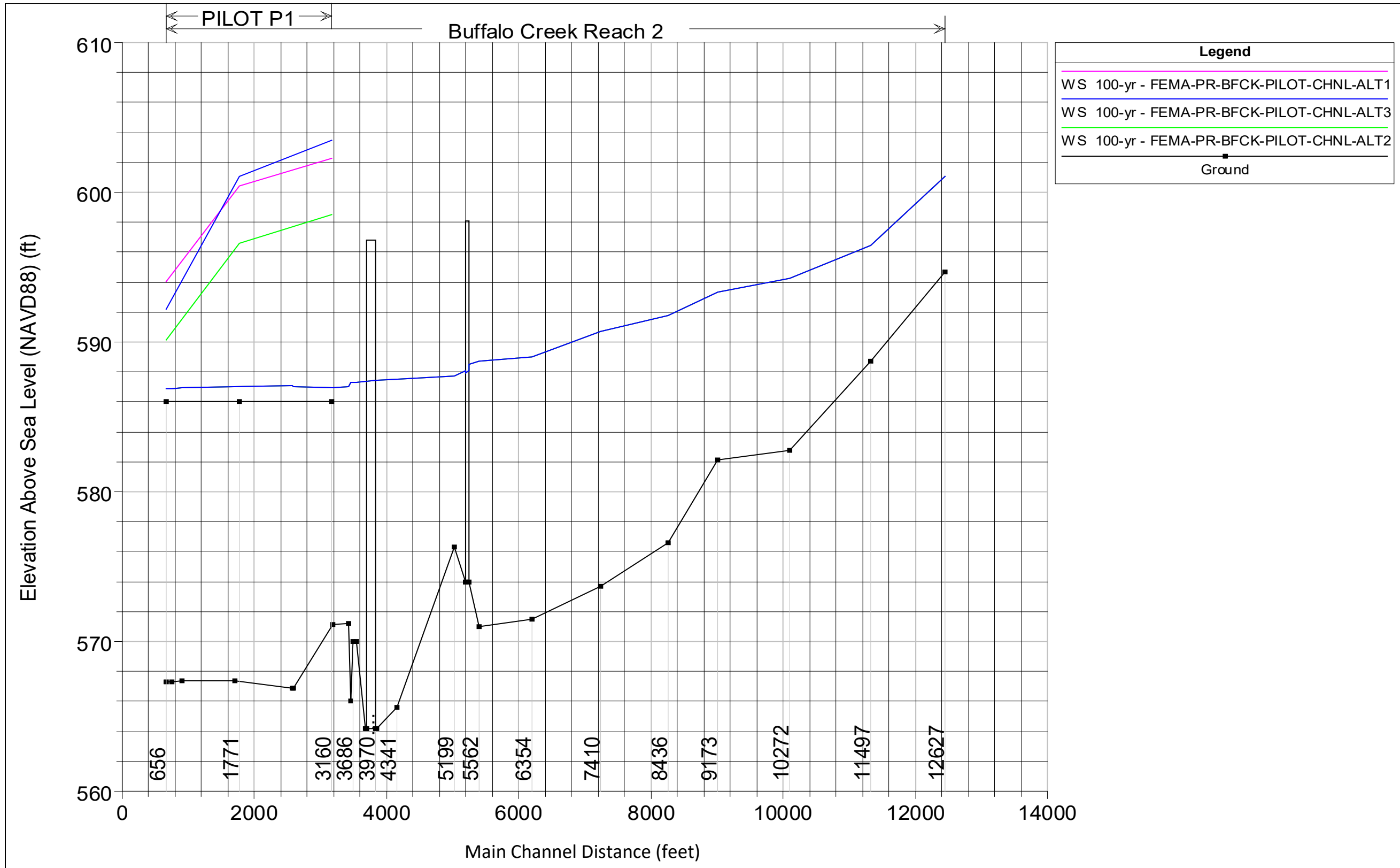
River:

Reach:  River Sta.:

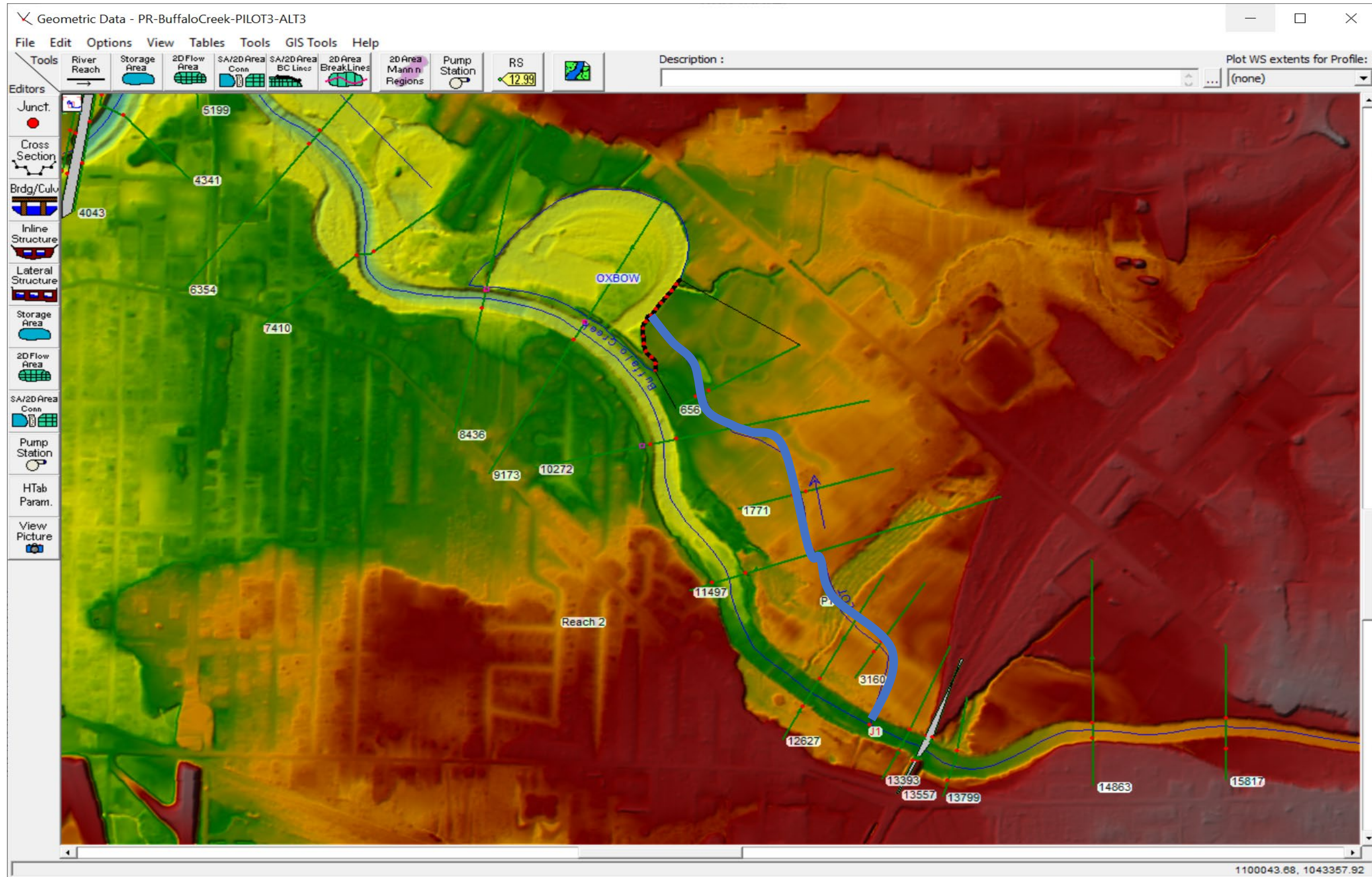
Flow Change Location				Profile Names and Flow Rates						
	River	Reach	RS	1.25-yr	2-yr	5-yr	10-yr	50-yr	100-yr	500-yr
1	Buffalo Creek	Reach 1	25961	3030	4340	6450	7990	11800	13600	18000
2	Buffalo Creek	Reach 2	12627	1969.5	2821	4192.5	5193.5	7670	8840	11700
3	Buffalo Creek	Reach 2	8436	3030	4340	6450	7990	11800	13600	18000
4	PILOT	P1	3160	1060.5	1519	2257.5	2796.5	4130	4760	6300

Edit Steady flow data for the profiles (cfs)











Appendix F-1b

Base and Future Flow Condition Model Comparison

HEC-RAS Future Flow Model Summary

Project BuffaloCreek

Plan

FEMA-CorrectedEffective

FutureFlow-CorrectedEffective

Geometry BuffaloCreek-CorrectedEffective

Steady Flow

USGS StreamStats Full Flows

USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

Discharge

Base Condition 13600 cfs

Future Flow Condition 14648 cfs

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Base Condition

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10.

Peak streamflow data calculated using USGS StreamStats v4.3.8. which uses Full-regression equations for estimating peak discharges for rural, unregulated streams in each of six hydrologic regions of New York, excluding Long Island (USGS SIR2006-5112).

Future Flow Condition

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10.

Mean predicted future discharge (cfs) calculated using USGS FutureFlow software based on aggregation of 5 regional climate models [BNU\_ESM, CNRM\_CM5, CESM1\_BGC, IPSL\_CM5A, NorESM1\_M] using the RCP 8.5 greenhouse gas emissions scenario for the time period 2075-2099 in Region 5 (USGS 2015-1235).

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			Base Condition	Future Flow Condition
	836	-4726	586.87	587.41
	930	-4632	586.86	587.4
	1098	-4464	586.92	587.47
	1881	-3681	587.05	587.6
	2764	-2798	587.08	587.63
	2788	-2774	587.05	587.61
	3371	-2191	586.98	587.5
	3602	-1960	587.05	587.58
	3642	-1920	587.31	587.85
	3686	-1876	587.29	587.83
	3727	-1835	587.28	587.82
	3859	-1703	587.39	587.94
	3898	-1664	587.39	587.94
Bridge	3970.5	-1591.5		
	4043	-1519	587.44	587.99
	4341	-1221	587.49	588.05
	5199	-363	587.75	588.3
	5270	-292	588.11	588.66
Bridge	5304.5	-257.5		
	5339	-223	588.53	589.1
	5562	0	588.75	589.33
	6354	792	588.99	589.58
	7410	1848	590.71	591.18
	8436	2874	591.74	592.13
Oxbow	9173	3611	593.12	593.51
	10272	4710	596.81	597.27
	11497	5935	598.6	599
	12627	7065	602.68	602.95
	13393	7831	605.69	605.99
	13514	7952	605.81	606.09
Railroad Bridge	13535.3	7973.3		
	13557	7995	605.94	606.24
	13799	8237	606.91	607.32
	14863	9301	609.35	609.8
	15817	10255	613.94	614.16
	17170	11608	616.74	617.08
	17314	11752	616.8	617.12
Union Rd Bridge	17350	11788		
	17386	11824	617.35	617.73
	17442	11880	617.47	617.86
	18472	12910	620.93	621.46
	19887	14325	622.23	622.69
	21220	15658	624.29	624.68
	22540	16978	627.15	627.54
	23751	18189	629.01	629.39
	24800	19238	631.07	631.4
	25961	20399	634.3	634.67

Appendix F-1b

Base and Future Flow Condition Model Comparison

Profile Output Table - Standard Table 1

HEC-RAS Plan: 100-YR-FEMA-CorrectedEffective River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

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
Reach 1		836 100-yr	13600		567.3	586.87			0.00012	3.2	8999.39	1169.72	0.15
Reach 1		930 100-yr	13600		567.3	586.86		575.44	0.00012	3.13	4995.46	935.76	0.15
Reach 1		1098 100-yr	13600		567.4	586.92			0.000099	2.68	8028.25	1443.12	0.13
Reach 1		1881 100-yr	13600		567.4	587.05			0.000059	2.14	15755.33	2500.49	0.1
Reach 1		2764 100-yr	13600		566.9	587.08			0.000105	2.98	14856.69	3707.83	0.15
Reach 1		2788 100-yr	13600		566.9	587.05		577.01	0.000132	3.34	12096.3	3428.02	0.17
Reach 1		3371 100-yr	13600		571.1	586.98		578.38	0.00034	5.07	2682.96	1749.34	0.26
Reach 1		3602 100-yr	13600		571.2	587.05		578.46	0.000302	5.09	2670.81	325.62	0.25
Reach 1		3642 100-yr	13600		566	587.31			0.000103	3.36	4062.44	326.48	0.16
Reach 1		3686 100-yr	13600		570	587.29			0.000148	3.69	3681.31	318.5	0.19
Reach 1		3727 100-yr	13600		570	587.28		578.66	0.000244	3.9	3490.11	303.38	0.2
Reach 1		3859 100-yr	13600		564.2	587.39			0.000125	3.19	4262.17	302.8	0.15
Reach 1		3898 100-yr	13600		564.2	587.39			0.000087	3.19	4262.98	302.81	0.15
Reach 1		3970.5		Bridge									
Reach 1		4043 100-yr	13600		564.2	587.44		575.22	0.00022	3.18	4277.24	303.02	0.15
Reach 1		4341 100-yr	13600		565.6	587.49			0.000308	3.74	3925.99	357.58	0.18
Reach 1		5199 100-yr	13600		576.3	587.75			0.001097	5.74	2440.18	257.18	0.32
Reach 1		5270 100-yr	13600		574	588.11		580.74	0.000583	4.55	2986.06	341.81	0.24
Reach 1		5304.5		Bridge									
Reach 1		5339 100-yr	13600		574	588.53		580.74	0.000517	4.39	3095.38	347.24	0.22
Reach 1		5562 100-yr	13600		571	588.75			0.000577	3.58	4069.8	382.31	0.18
Reach 1		6354 100-yr	13600		571.5	588.99		583.47	0.001211	7.5	3207.13	933.05	0.38
Reach 1		7410 100-yr	13600		573.7	590.71			0.001147	5.38	4747.73	910.28	0.26
Reach 1		8436 100-yr	13600		576.6	591.74		586.46	0.002037	7.36	2278.55	564.21	0.38
Reach 1		9173 100-yr	13600		582.1	593.12		591.47	0.004837	11.4	1193.26	1126.26	0.72
Reach 1		10272 100-yr	13600		582.8	596.81		591.39	0.001099	6.69	2484.27	881.53	0.36
Reach 1		11497 100-yr	13600		588.7	598.6		596.01	0.002685	7.95	1724.55	278.78	0.53
Reach 1		12627 100-yr	13600		594.7	602.68		601.26	0.006303	9.83	1565.91	636.18	0.74
Reach 1		13393 100-yr	13600		595.2	605.69		601.95	0.001733	7.57	2607.75	814.76	0.44
Reach 1		13514 100-yr	13600		592.1	605.81		600.82	0.000463	7.44	1827.83	279.49	0.4
Reach 1		13535.3		Bridge									
Reach 1		13557 100-yr	13600		592.1	605.94		600.82	0.000444	7.35	1850.27	249.26	0.39
Reach 1		13799 100-yr	13600		595.5	606.91		602.03	0.00064	3.93	4867.76	665.97	0.23
Reach 1		14863 100-yr	13600		599.6	609.35		609.35	0.005661	12.51	1638.94	592.59	0.79
Reach 1		15817 100-yr	13600		603.2	613.94			0.001793	6.45	2851.92	616.22	0.41
Reach 1		17170 100-yr	13600		602.4	616.74		611.96	0.003422	8.89	1558.35	144.93	0.46
Reach 1		17314 100-yr	13600		605.5	616.8		614	0.00322	11.64	1168.49	135.65	0.63
Reach 1		17350		Bridge									
Reach 1		17386 100-yr	13600		605.5	617.35		613.99	0.002721	11.07	1229.03	133.85	0.58
Reach 1		17442 100-yr	13600		604.9	617.47		614.48	0.003131	11.4	1216.09	121.22	0.61
Reach 1		18472 100-yr	13600		608.9	620.93		615.06	0.000815	3.66	5164.67	1271.26	0.21
Reach 1		19887 100-yr	13600		610.3	622.23			0.000984	3.27	4287.21	642.31	0.21
Reach 1		21220 100-yr	13600		612.8	624.29			0.004079	6.19	2382.01	364.37	0.39
Reach 1		22540 100-yr	13600		615.5	627.15			0.001158	4.9	3464.3	606.97	0.29
Reach 1		23751 100-yr	13600		617.6	629.01			0.002382	5.98	3113.75	527.9	0.34
Reach 1		24800 100-yr	13600		620.4	631.07		628.77	0.002604	9.4	1975.19	436.99	0.55
Reach 1		25961 100-yr	13600		621.4	634.3		629.31	0.002289	7.84	2057.3	348.43	0.41

Appendix F-1b

Base and Future Flow Condition Model Comparison

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-CorrectedEffective River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

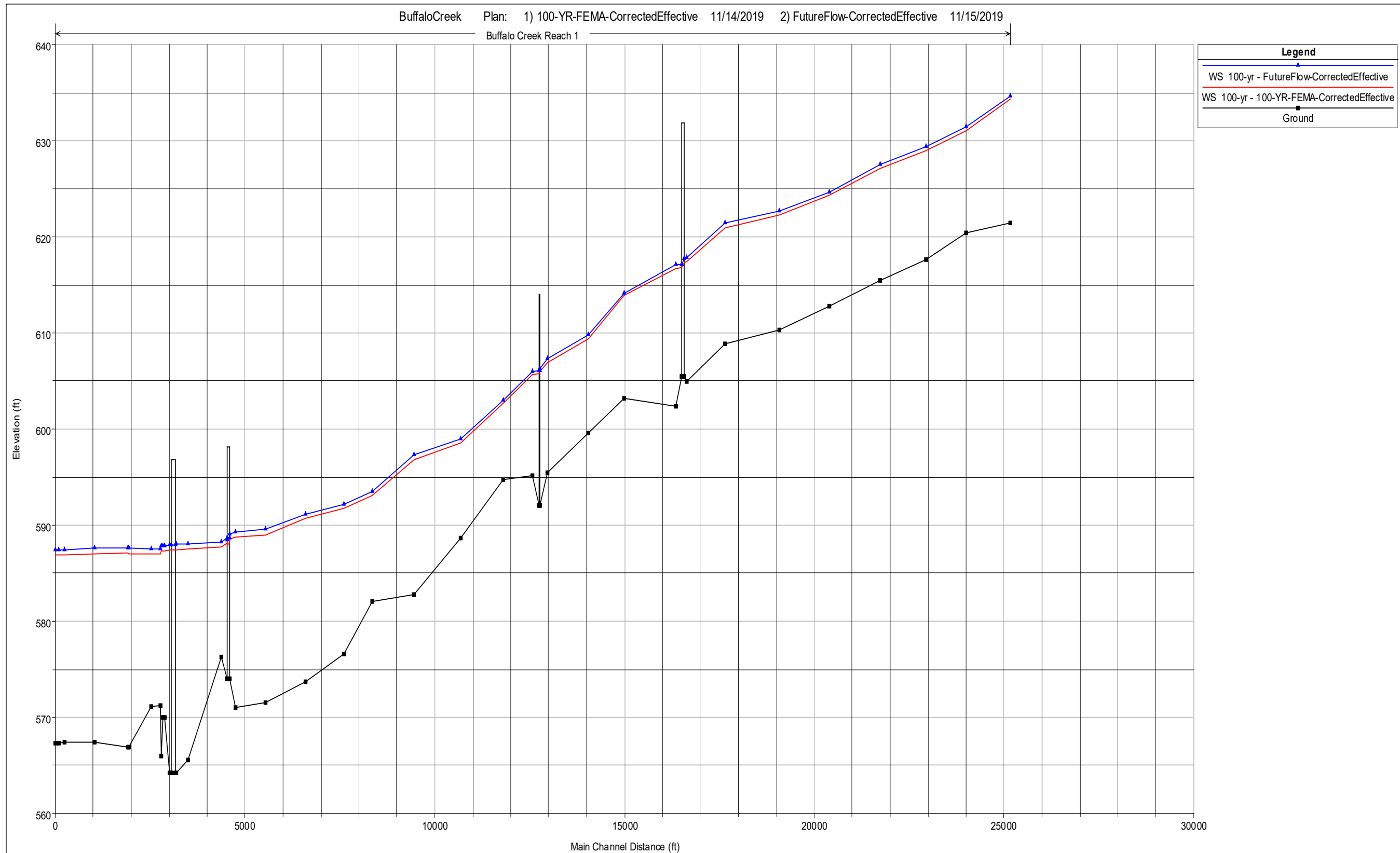
# Profiles = 1

# Hydraulic Reaches = 1

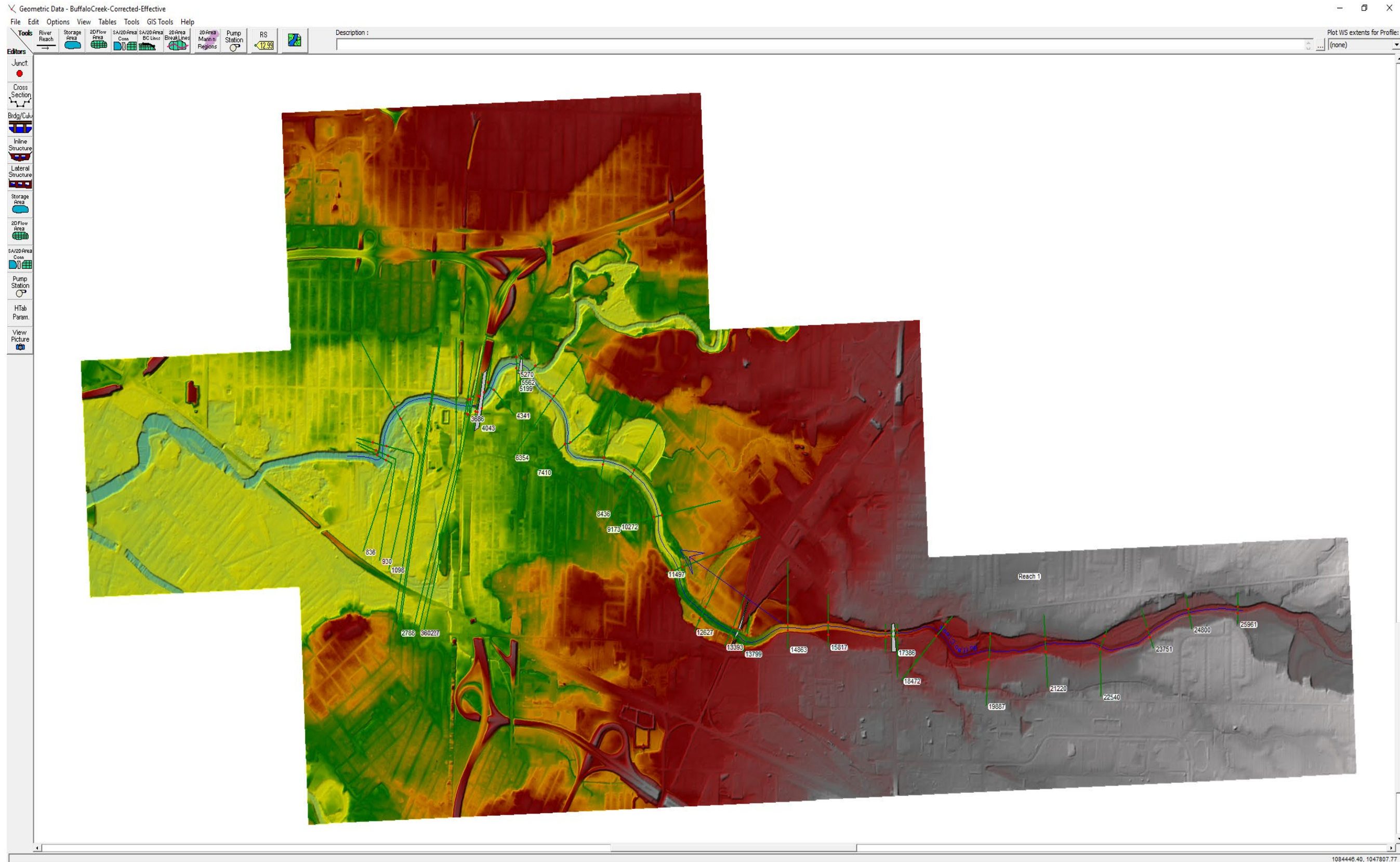
# Plans = 1

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
Reach 1		836 100-yr	14648		567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1		930 100-yr	14648		567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1		1098 100-yr	14648		567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1		1881 100-yr	14648		567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1		2764 100-yr	14648		566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1		2788 100-yr	14648		566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1		3371 100-yr	14648		571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1		3602 100-yr	14648		571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1		3642 100-yr	14648		566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1		3686 100-yr	14648		570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1		3727 100-yr	14648		570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1		3859 100-yr	14648		564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1		3898 100-yr	14648		564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1		3970.5	Bridge										
Reach 1		4043 100-yr	14648		564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1		4341 100-yr	14648		565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1		5199 100-yr	14648		576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1		5270 100-yr	14648		574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1		5304.5	Bridge										
Reach 1		5339 100-yr	14648		574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1		5562 100-yr	14648		571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1		6354 100-yr	14648		571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1		7410 100-yr	14648		573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1		8436 100-yr	14648		576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1		9173 100-yr	14648		582.1	593.51	591.81	595.63	0.004833	11.68	1253.6	1138.25	0.72
Reach 1		10272 100-yr	14648		582.8	597.27	591.71	597.97	0.001082	6.83	2758.9	999.22	0.36
Reach 1		11497 100-yr	14648		588.7	599	596.32	600.02	0.00259	8.09	1829.81	299.98	0.53
Reach 1		12627 100-yr	14648		594.7	602.95	601.6	604.47	0.00622	10.05	1680.16	729.09	0.74
Reach 1		13393 100-yr	14648		595.2	605.99	602.26	606.86	0.001758	7.79	2813.58	847.01	0.45
Reach 1		13514 100-yr	14648		592.1	606.09	601.12	607.04	0.000493	7.81	1875.39	286.11	0.41
Reach 1		13535.3	Bridge										
Reach 1		13557 100-yr	14648		592.1	606.24	601.12	607.17	0.000471	7.71	1900.61	251.45	0.4
Reach 1		13799 100-yr	14648		595.5	607.32	602.19	607.5	0.000637	4.01	5137.72	672.33	0.23
Reach 1		14863 100-yr	14648		599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1		15817 100-yr	14648		603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1		17170 100-yr	14648		602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1		17314 100-yr	14648		605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1		17350	Bridge										
Reach 1		17386 100-yr	14648		605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1		17442 100-yr	14648		604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1		18472 100-yr	14648		608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1		19887 100-yr	14648		610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1		21220 100-yr	14648		612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1		22540 100-yr	14648		615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1		23751 100-yr	14648		617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1		24800 100-yr	14648		620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1		25961 100-yr	14648		621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-1b  
Base and Future Flow Condition Model Comparison



Appendix F-1b  
Base and Future Flow Condition Model Comparison



Appendix F-2b

Alternative #1: Remove Abandoned Railroad Bridge (Future)

HEC-RAS Future Flow Model Summary

Project BuffaloCreek

Plan

FutureFlow-CorrectedEffective

FutureFlow-BufferCreek-RRremove

Geometry

BufferCreek-CorrectedEffective

PR-BufferCreek-RRremove

Steady Flow 1

USGS FutureFlows R 100-year

Reach

Profile

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffer-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Removed Railroad (Black) Bridge and two adjacent cross-sections.

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Predicted Water Surface Elevations (feet) (NAVD88)	
			Future Flow RR Bridge Removal	Future Flow Condition
	836	-4726	587.4	587.4
	930	-4632	587.4	587.4
	1098	-4464	587.5	587.5
	1881	-3681	587.6	587.6
	2764	-2798	587.6	587.6
	2788	-2774	587.6	587.6
	3371	-2191	587.5	587.5
	3602	-1960	587.6	587.6
	3642	-1920	587.9	587.9
	3686	-1876	587.8	587.8
	3727	-1835	587.8	587.8
	3859	-1703	587.9	587.9
	3898	-1664	587.9	587.9
Bridge	3970.5	-1591.5		
	4043	-1519	588.0	588.0
	4341	-1221	588.1	588.1
	5199	-363	588.3	588.3
	5270	-292	588.7	588.7
Bridge	5304.5	-257.5		
	5339	-223	589.1	589.1
	5562	0	589.3	589.3
	6354	792	589.6	589.6
	7410	1848	591.2	591.2
	8436	2874	592.1	592.1
Oxbow	9173	3611	593.5	593.5
	10272	4710	597.3	597.3
	11497	5935	599.0	599.0
	12627	7065	603.0	603.0
	13393	7831	606.0	606.0
	13514*	7952		606.1
Railroad Bridge	13535.3*	7973.3		
	13557*	7995		606.2
	13799	8237	607.3	607.3
	14863	9301	609.8	609.8
	15817	10255	614.2	614.2
	17170	11608	617.1	617.1
	17314	11752	617.1	617.1
Union Rd Bridge	17350	11788		
	17386	11824	617.7	617.7
	17442	11880	617.9	617.9
	18472	12910	621.5	621.5
	19887	14325	622.7	622.7
	21220	15658	624.7	624.7
	22540	16978	627.5	627.5
	23751	18189	629.4	629.4
	24800	19238	631.4	631.4
	25961	20399	634.7	634.7

\*Removed from profile plot in report to represent a uniform water surface elevation



## Appendix F-2b

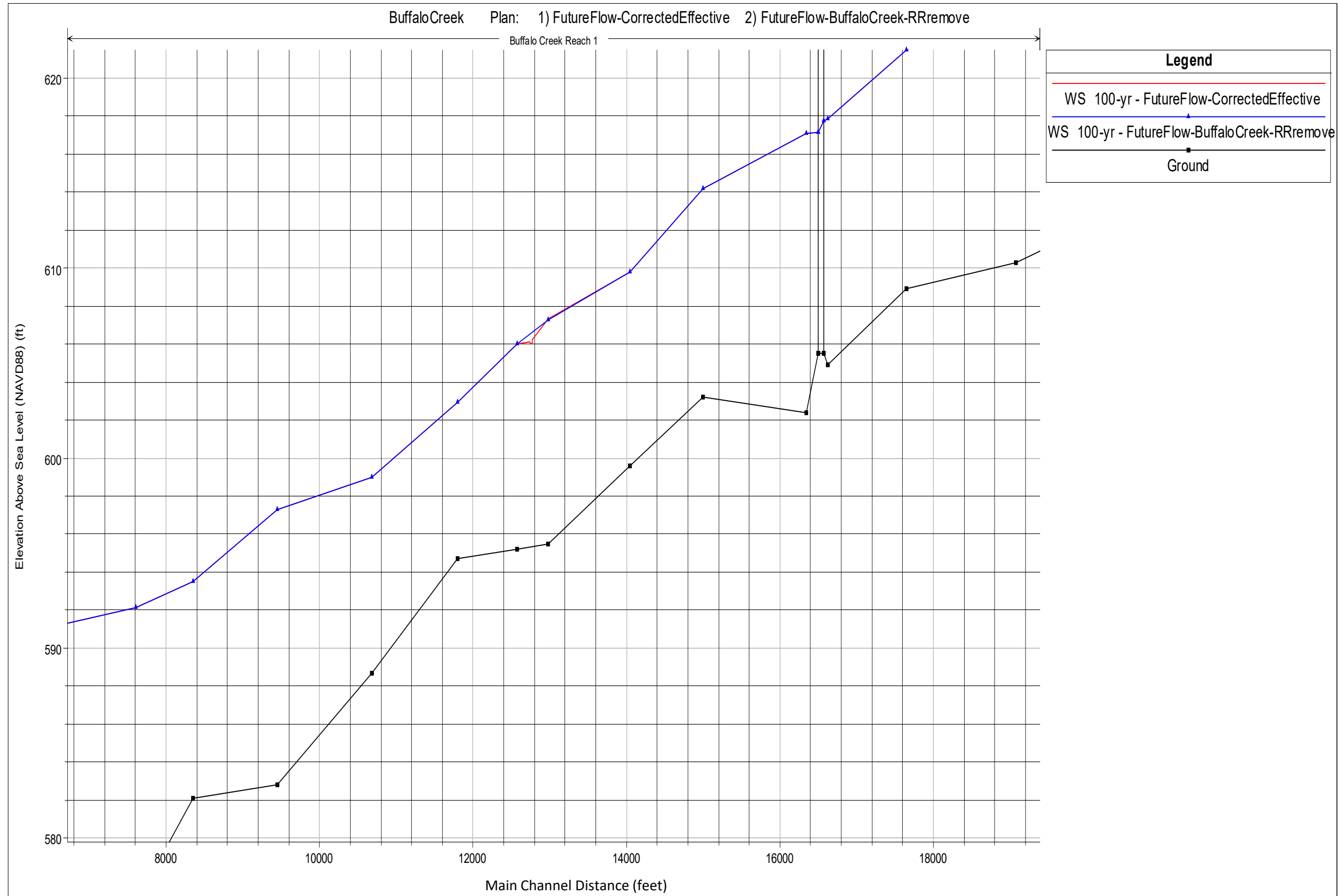
## Alternative #1: Remove Abandoned Railroad Bridge (Future)

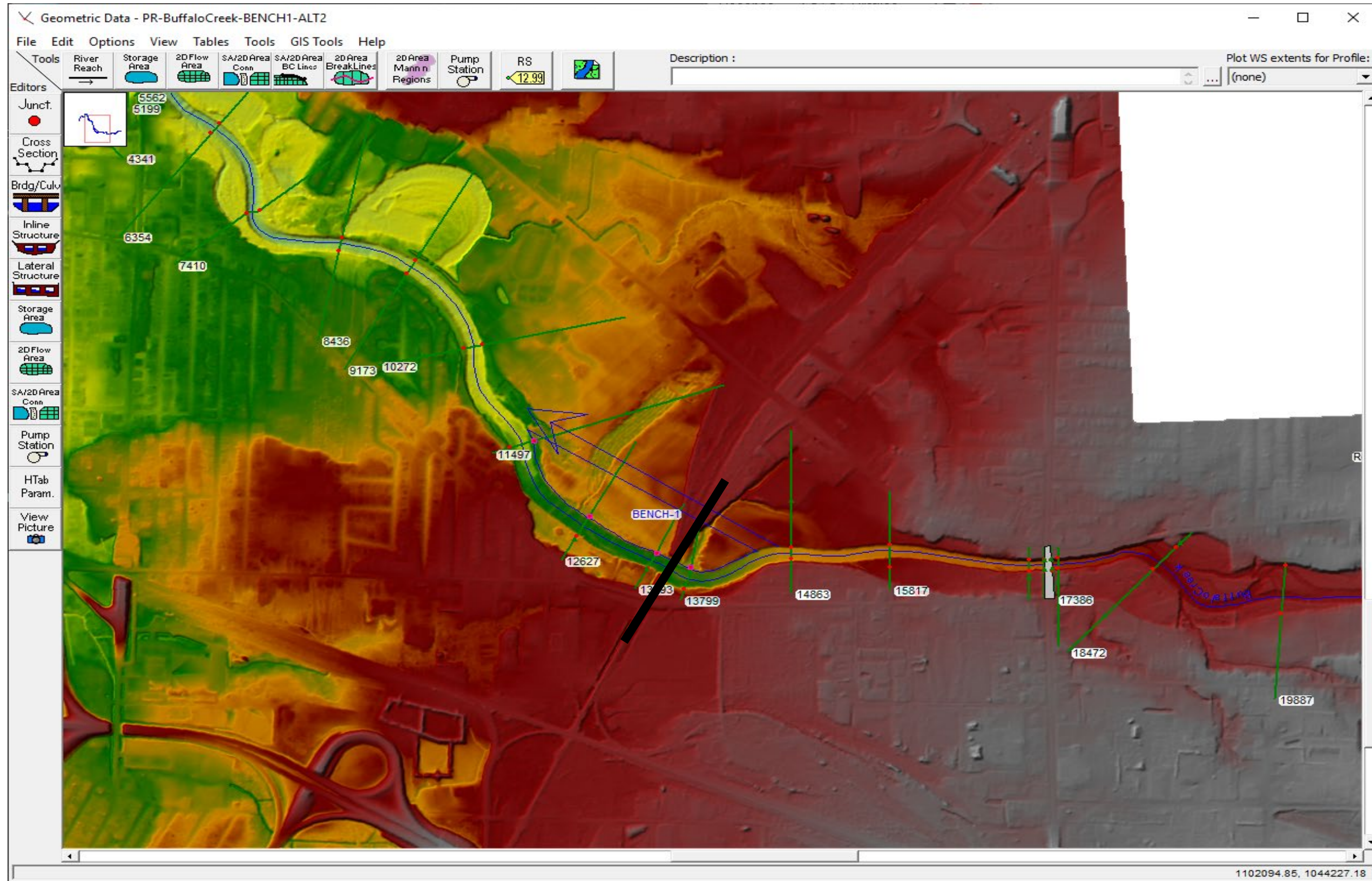
Profile Output Table - Standard # River Stations = 44

HEC-RAS Plan: FutureFlow-Buff: # Plans = 1

# Profiles = 1

# Rivers = 1	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	
# Hydraulic Reaches = 1													
Reach	836	100-yr	14648	567.3	587.41		575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
	930	100-yr	14648	567.3	587.4			587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47			587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6			587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63			587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61	577.38		587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5	578.65		587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58	578.75		588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85			588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83			588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82	578.98		588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94			588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94			588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5	Bridge											
Reach 1	4043	100-yr	14648	564.2	587.99	576.08		588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05			588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3			588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66	580.99		589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5	Bridge											
Reach 1	5339	100-yr	14648	574	589.1	580.99		589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33			589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58	583.92		590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18			591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13	586.89		592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51	591.81		595.63	0.004833	11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.27	591.71		597.97	0.001082	6.83	2758.9	999.22	0.36
Reach 1	11497	100-yr	14648	588.7	599	596.32		600.02	0.00259	8.09	1829.81	299.98	0.53
Reach 1	12627	100-yr	14648	594.7	602.95	601.6		604.47	0.00622	10.05	1680.16	729.09	0.74
Reach 1	13393	100-yr	14648	595.2	605.99	602.26		606.86	0.001758	7.79	2813.58	847.01	0.45
Reach 1	13799	100-yr	14648	595.5	607.28	602.19		607.46	0.000645	4.03	5113.81	671.77	0.23
Reach 1	14863	100-yr	14648	599.6	609.8	609.8		611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16			614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08	612.35		618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12	614.39		619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350	Bridge											
Reach 1	17386	100-yr	14648	605.5	617.73	614.39		619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86	614.88		620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46	615.27		621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69			622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68			625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54			627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39			629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4	629.35		632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67	629.64		635.64	0.002342	8.1	2187.06	350.27	0.41





Appendix F-2b

Blocked Obstruction / Ice Jam Simulation - Railroad bridge (Future)

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FutureFlow-CorrectedEffective

FutureFlow-BufferCreek-ICE-ALT1

FutureFlow-BufferCreek-Railroad-ICE

Geometry

PR-BFCK-Railroad-Removal-ICE

BufferCreek-CorrectedEffective

CORR-BFCK-Railroad-ICE

Steady Flow USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 10-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Future Flow Condition with ice cover:

Ice cover around railroad bridge piers of 1.5 feet thickness.

Bridge/culvert ice jam computation option: ice remains constant throughout the bridge.

Blocked obstructions on left and right bank of RS13799 to simulate reduced cross-sectional area of ice jam.

Railroad Remove with Ice Cover:

Removed Railroad (Black) Bridge.

Removed X-S at RS 13557.

Increased Manning n value to 0.03 in channel and removed ineffective flow areas for RS13514.

Ice cover around railroad bridge piers of 1.5 feet thickness.

Bridge/culvert ice jam computation option: ice remains constant throughout the bridge.

Blocked obstructions on left and right bank of RS13799 to simulate reduced cross-sectional area of ice jam.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			FutureFlow Condition (10 yr)	FutureFlow Condition with Ice Cover at RR	RR Remove with Ice Cover
	836	-4726	584.0	584.0	584.0
	930	-4632	584.0	584.0	584.0
	1098	-4464	584.1	584.1	584.1
	1881	-3681	584.2	584.2	584.2
	2764	-2798	584.2	584.2	584.2
	2788	-2774	584.1	584.1	584.1
	3371	-2191	584.3	584.3	584.3
	3602	-1960	584.3	584.3	584.3
	3642	-1920	584.5	584.5	584.5
	3686	-1876	584.5	584.5	584.5
	3727	-1835	584.5	584.5	584.5
	3859	-1703	584.6	584.6	584.6
	3898	-1664	584.6	584.6	584.6
Bridge	3970.5	-1591.5			
	4043	-1519	584.6	584.6	584.6
	4341	-1221	584.7	584.7	584.7
	5199	-363	584.9	584.9	584.9
	5270	-292	585.3	585.3	585.3
Bridge	5304.5	-257.5			
	5339	-223	585.7	585.7	585.7
	5562	0	585.8	585.8	585.8
	6354	792	586.1	586.1	586.1
	7410	1848	588.2	588.2	588.2
	8436	2874	589.6	589.6	589.6
Oxbow	9173	3611	591.0	591.0	591.0
	10272	4710	594.5	594.5	594.5
	11497	5935	596.6	596.6	596.6
	12627	7065	601.1	601.1	601.1
	13393	7831	603.8	603.8	603.8
	13514	7952	604.2	604.2	604.2
Railroad Bridge	13535.3	7973.3			
	13557	7995	604.2	604.3	604.5
	13799	8237	604.8	605.6	605.8
	14863	9301	607.0	608.9	608.9
	15817	10255	612.4	612.0	612.0
	17170	11608	615.0	615.0	615.0
	17314	11752	615.1	615.1	615.1
Union Rd Bridge	17350	11788			
	17386	11824	615.4	615.4	615.4
	17442	11880	615.5	615.5	615.5
	18472	12910	618.4	618.4	618.4
	19887	14325	620.1	620.1	620.1
	21220	15658	622.5	622.5	622.5
	22540	16978	625.3	625.3	625.3
	23751	18189	627.2	627.2	627.2
	24800	19238	629.4	629.4	629.4
	25961	20399	632.4	632.4	632.4

Appendix F-2b

Blocked Obstruction / Ice Jam Simulation - Railroad bridge (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-CorrectedEffective River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

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
Reach 1	836	10-yr	8922	567.3	584.02	584.02	584.11	0.00012	2.9	5874.65	1039.49	0.14
Reach 1	930	10-yr	8922	567.3	584.02	584.02	584.12	0.000103	2.57	3559.34	379.54	0.13
Reach 1	1098	10-yr	8922	567.4	584.06	584.06	584.14	0.000102	2.3	4541.88	1022.92	0.13
Reach 1	1881	10-yr	8922	567.4	584.16	584.16	584.21	0.000077	2.12	9113.06	2108.43	0.11
Reach 1	2764	10-yr	8922	566.9	584.18	584.18	584.34	0.00019	3.43	5126.93	2822.91	0.19
Reach 1	2788	10-yr	8922	566.9	584.14	574.98	584.36	0.000236	3.81	2339.26	2197.51	0.22
Reach 1	3371	10-yr	8922	571.1	584.25	576.93	584.53	0.00026	4.22	2114.43	1109.64	0.23
Reach 1	3602	10-yr	8922	571.2	584.31	577	584.59	0.000261	4.22	2112.92	198.36	0.23
Reach 1	3642	10-yr	8922	566	584.49		584.61	0.000091	2.78	3209.85	290.24	0.15
Reach 1	3686	10-yr	8922	570	584.47		584.62	0.000142	3.16	2819.22	295.44	0.18
Reach 1	3727	10-yr	8922	570	584.47	577.11	584.64	0.000244	3.36	2655.53	289.14	0.2
Reach 1	3859	10-yr	8922	564.2	584.56		584.67	0.000105	2.61	3423.7	290.15	0.13
Reach 1	3898	10-yr	8922	564.2	584.57		584.67	0.000073	2.61	3424.35	290.16	0.13
Reach 1	3970.5	Bridge										
Reach 1	4043	10-yr	8922	564.2	584.6	573.55	584.71	0.000185	2.6	3434.88	290.33	0.13
Reach 1	4341	10-yr	8922	565.6	584.65		584.8	0.000277	3.1	2978.43	308.84	0.16
Reach 1	5199	10-yr	8922	576.3	584.91		585.33	0.001331	5.21	1736.71	239.65	0.33
Reach 1	5270	10-yr	8922	574	585.29	579.48	585.53	0.000643	3.96	2251.85	301.61	0.24
Reach 1	5304.5	Bridge										
Reach 1	5339	10-yr	8922	574	585.66	579.48	585.88	0.000559	3.8	2348.26	306.89	0.22
Reach 1	5562	10-yr	8922	571	585.84		586	0.000635	3.13	2980.11	367.23	0.18
Reach 1	6354	10-yr	8922	571.5	586.12	581.3	586.94	0.001557	7.28	1288.54	316.47	0.42
Reach 1	7410	10-yr	8922	573.7	588.19		588.56	0.001439	5.23	2588.51	726.53	0.28
Reach 1	8436	10-yr	8922	576.6	589.6	584.39	590.16	0.00182	6.09	1675	252.09	0.35
Reach 1	9173	10-yr	8922	582.1	591.02	589.77	592.62	0.005264	10.13	880.94	797.84	0.72
Reach 1	10272	10-yr	8922	582.8	594.53	589.75	595.05	0.001132	5.77	1580.64	238.89	0.35
Reach 1	11497	10-yr	8922	588.7	596.57	594.75	597.41	0.003565	7.36	1212.72	243.8	0.58
Reach 1	12627	10-yr	8922	594.7	601.08	599.75	602.28	0.0051	8.79	1036.74	261.06	0.67
Reach 1	13393	10-yr	8922	595.2	603.82	600.45	604.5	0.001771	6.66	1438.11	427.56	0.43
Reach 1	13514	10-yr	8922	592.1	604.15	599.35	604.67	0.000346	5.76	1548.85	240.64	0.33
Reach 1	13535.3	Bridge										
Reach 1	13557	10-yr	8922	592.1	604.22	599.35	604.73	0.000337	5.71	1561.4	236.64	0.33
Reach 1	13799	10-yr	8922	595.5	604.78	601.15	604.93	0.000708	3.62	3480.33	636.34	0.24
Reach 1	14863	10-yr	8922	599.6	607.03	607.03	609.56	0.009376	12.8	736.87	212.47	0.96
Reach 1	15817	10-yr	8922	603.2	612.42		612.89	0.001644	5.62	1939.41	584.93	0.4
Reach 1	17170	10-yr	8922	602.4	614.97	610.09	615.7	0.002558	6.89	1305.99	138.98	0.38
Reach 1	17314	10-yr	8922	605.5	615.07	612.07	616.36	0.00251	9.12	977.79	132.63	0.54
Reach 1	17350	Bridge										
Reach 1	17386	10-yr	8922	605.5	615.41	612.07	616.61	0.002215	8.79	1015.17	131.45	0.51
Reach 1	17442	10-yr	8922	604.9	615.5	612.55	616.8	0.002645	9.16	981.79	116.6	0.54
Reach 1	18472	10-yr	8922	608.9	618.41	613.88	618.61	0.001147	3.69	2882.04	1042.77	0.24
Reach 1	19887	10-yr	8922	610.3	620.08		620.21	0.001091	3	3008.21	562.36	0.22
Reach 1	21220	10-yr	8922	612.8	622.45		622.9	0.004453	5.43	1729.24	344.08	0.39
Reach 1	22540	10-yr	8922	615.5	625.26		625.54	0.001111	4.3	2360.32	549.62	0.28
Reach 1	23751	10-yr	8922	617.6	627.15		627.54	0.002638	5.43	2172.5	494.52	0.35
Reach 1	24800	10-yr	8922	620.4	629.42	626.8	630.39	0.002462	8	1330.91	382.77	0.52
Reach 1	25961	10-yr	8922	621.4	632.35	627.59	632.98	0.001954	6.4	1451	196.71	0.37

Appendix F-2b

Blocked Obstruction / Ice Jam Simulation - Railroad bridge (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-ICE-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

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
Reach 1	836	10-yr	8922	567.3	584	573.82	584.11	0.00012	2.9	5874.65	1039.49	0.14
Reach 1	930	10-yr	8922	567.3	584.02		584.12	0.000103	2.57	3559.34	379.54	0.13
Reach 1	1098	10-yr	8922	567.4	584.06		584.14	0.000102	2.3	4541.88	1022.92	0.13
Reach 1	1881	10-yr	8922	567.4	584.16		584.21	0.000077	2.12	9113.06	2108.43	0.11
Reach 1	2764	10-yr	8922	566.9	584.18		584.34	0.00019	3.43	5126.93	2822.91	0.19
Reach 1	2788	10-yr	8922	566.9	584.14	574.98	584.36	0.000236	3.81	2339.26	2197.51	0.22
Reach 1	3371	10-yr	8922	571.1	584.25	576.93	584.53	0.00026	4.22	2114.43	1109.64	0.23
Reach 1	3602	10-yr	8922	571.2	584.31	577	584.59	0.000261	4.22	2112.92	198.36	0.23
Reach 1	3642	10-yr	8922	566	584.49		584.61	0.000091	2.78	3209.85	290.24	0.15
Reach 1	3686	10-yr	8922	570	584.47		584.62	0.000142	3.16	2819.22	295.44	0.18
Reach 1	3727	10-yr	8922	570	584.47	577.11	584.64	0.000244	3.36	2655.53	289.14	0.2
Reach 1	3859	10-yr	8922	564.2	584.56		584.67	0.000105	2.61	3423.7	290.15	0.13
Reach 1	3898	10-yr	8922	564.2	584.57		584.67	0.000073	2.61	3424.35	290.16	0.13
Reach 1	3970.5	Bridge										
Reach 1	4043	10-yr	8922	564.2	584.6	573.55	584.71	0.000185	2.6	3434.88	290.33	0.13
Reach 1	4341	10-yr	8922	565.6	584.65		584.8	0.000277	3.1	2978.43	308.84	0.16
Reach 1	5199	10-yr	8922	576.3	584.91		585.33	0.001331	5.21	1736.71	239.65	0.33
Reach 1	5270	10-yr	8922	574	585.29	579.48	585.53	0.000643	3.96	2251.85	301.61	0.24
Reach 1	5304.5	Bridge										
Reach 1	5339	10-yr	8922	574	585.66	579.48	585.88	0.000559	3.8	2348.26	306.89	0.22
Reach 1	5562	10-yr	8922	571	585.84		586	0.000635	3.13	2980.11	367.23	0.18
Reach 1	6354	10-yr	8922	571.5	586.12	581.3	586.94	0.001557	7.28	1288.54	316.47	0.42
Reach 1	7410	10-yr	8922	573.7	588.19		588.56	0.001439	5.23	2588.51	726.53	0.28
Reach 1	8436	10-yr	8922	576.6	589.6	584.39	590.16	0.00182	6.09	1675	252.09	0.35
Reach 1	9173	10-yr	8922	582.1	591.02	589.77	592.62	0.005264	10.13	880.94	797.84	0.72
Reach 1	10272	10-yr	8922	582.8	594.53	589.75	595.05	0.001132	5.77	1580.64	238.89	0.35
Reach 1	11497	10-yr	8922	588.7	596.57	594.75	597.41	0.003565	7.36	1212.72	243.8	0.58
Reach 1	12627	10-yr	8922	594.7	601.08	599.75	602.28	0.0051	8.79	1036.74	261.06	0.67
Reach 1	13393	10-yr	8922	595.2	603.82	600.45	604.5	0.001771	6.66	1438.11	427.56	0.43
Reach 1	13514	10-yr	8922	592.1	604.49		605.03	0.005224	5.87	1528.86	227.23	0.39
Reach 1	13799	10-yr	8922	595.5	605.8	602.53	606.09	0.003595	4.73	2360.93	400.91	0.31
Reach 1	14863	10-yr	8922	599.6	608.86	607.03	610.04	0.003208	9.02	1378.3	490.01	0.59
Reach 1	15817	10-yr	8922	603.2	611.98		612.55	0.00208	6.14	1685.02	500.9	0.46
Reach 1	17170	10-yr	8922	602.4	614.96	610.09	615.7	0.002558	6.89	1305.96	138.98	0.38
Reach 1	17314	10-yr	8922	605.5	615.07	612.07	616.36	0.00251	9.12	977.77	132.63	0.54
Reach 1	17350	Bridge										
Reach 1	17386	10-yr	8922	605.5	615.41	612.07	616.61	0.002215	8.79	1015.16	131.45	0.51
Reach 1	17442	10-yr	8922	604.9	615.5	612.55	616.8	0.002646	9.16	981.78	116.6	0.54
Reach 1	18472	10-yr	8922	608.9	618.41	613.88	618.61	0.001147	3.69	2881.99	1042.77	0.24
Reach 1	19887	10-yr	8922	610.3	620.08		620.21	0.001091	3	3008.21	562.36	0.22
Reach 1	21220	10-yr	8922	612.8	622.45		622.9	0.004453	5.43	1729.24	344.08	0.39
Reach 1	22540	10-yr	8922	615.5	625.26		625.54	0.001111	4.3	2360.32	549.62	0.28
Reach 1	23751	10-yr	8922	617.6	627.15		627.54	0.002638	5.43	2172.5	494.52	0.35
Reach 1	24800	10-yr	8922	620.4	629.42	626.8	630.39	0.002462	8	1330.91	382.77	0.52
Reach 1	25961	10-yr	8922	621.4	632.35	627.59	632.98	0.001954	6.4	1451	196.71	0.37

Appendix F-2b

Blocked Obstruction / Ice Jam Simulation - Railroad bridge (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-Railroad-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

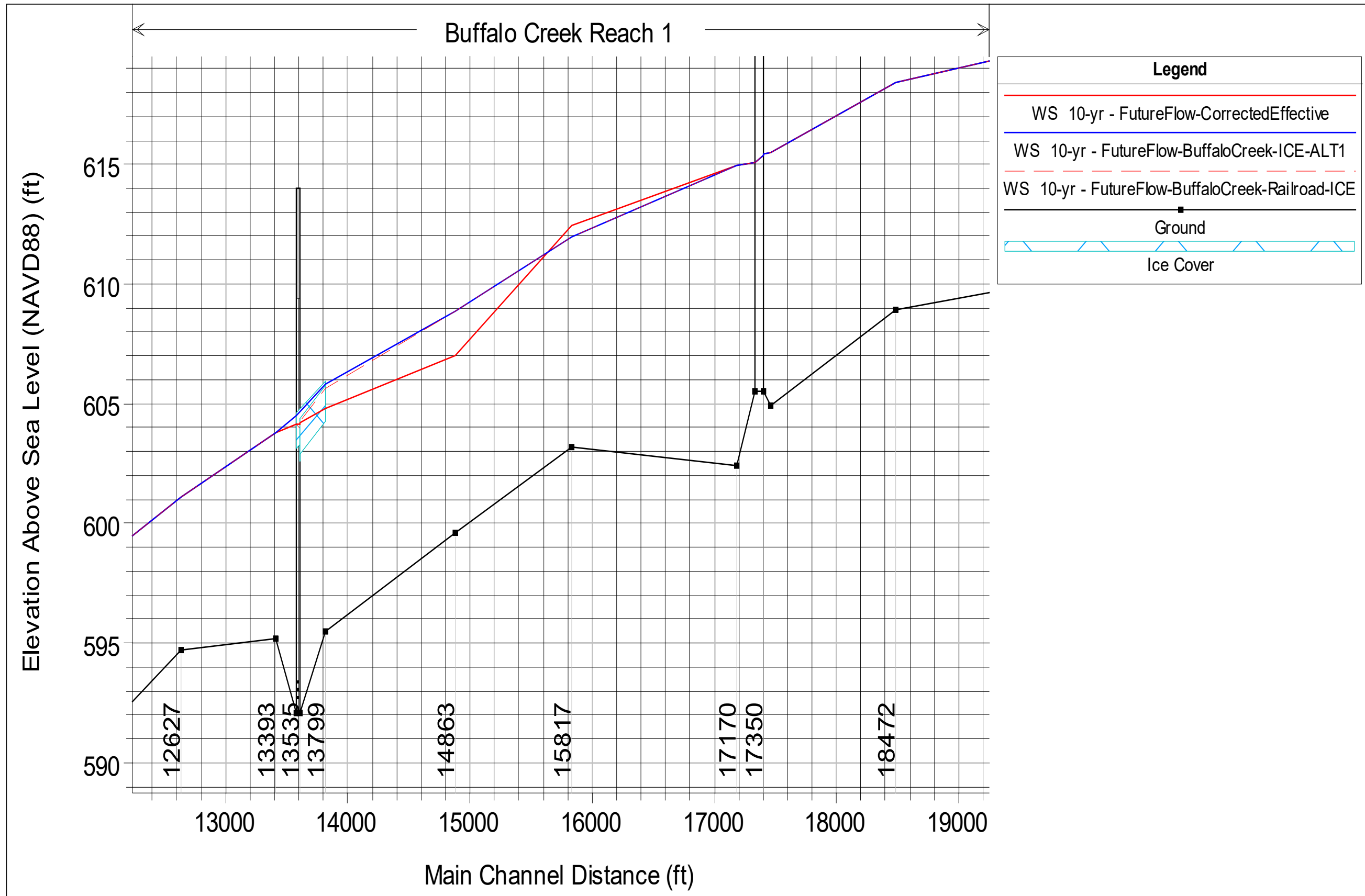
# River Stations = 47

# Profiles = 1

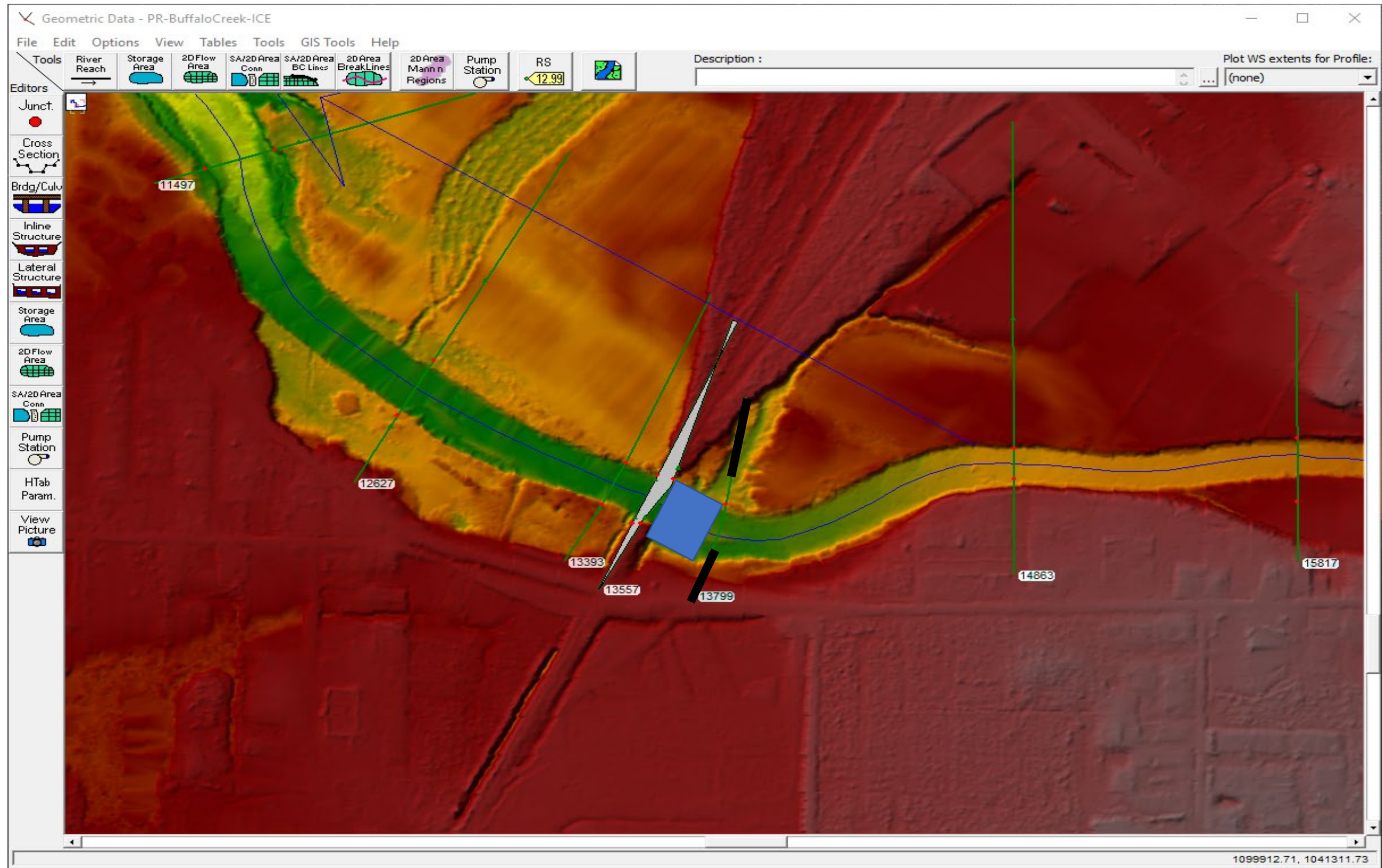
# Hydraulic Reaches = 1

# Plans = 1

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	
Reach 1	836	10-yr	8922	567.3		584	573.82	584.11	0.00012	2.9	5874.65	1039.49	0.14
Reach 1	930	10-yr	8922	567.3		584.02		584.12	0.000103	2.57	3559.34	379.54	0.13
Reach 1	1098	10-yr	8922	567.4		584.06		584.14	0.000102	2.3	4541.88	1022.92	0.13
Reach 1	1881	10-yr	8922	567.4		584.16		584.21	0.000077	2.12	9113.06	2108.43	0.11
Reach 1	2764	10-yr	8922	566.9		584.18		584.34	0.00019	3.43	5126.93	2822.91	0.19
Reach 1	2788	10-yr	8922	566.9		584.14	574.98	584.36	0.000236	3.81	2339.26	2197.51	0.22
Reach 1	3371	10-yr	8922	571.1		584.25	576.93	584.53	0.00026	4.22	2114.43	1109.64	0.23
Reach 1	3602	10-yr	8922	571.2		584.31	577	584.59	0.000261	4.22	2112.92	198.36	0.23
Reach 1	3642	10-yr	8922	566		584.49		584.61	0.000091	2.78	3209.85	290.24	0.15
Reach 1	3686	10-yr	8922	570		584.47		584.62	0.000142	3.16	2819.22	295.44	0.18
Reach 1	3727	10-yr	8922	570		584.47	577.11	584.64	0.000244	3.36	2655.53	289.14	0.2
Reach 1	3859	10-yr	8922	564.2		584.56		584.67	0.000105	2.61	3423.7	290.15	0.13
Reach 1	3898	10-yr	8922	564.2		584.57		584.67	0.000073	2.61	3424.35	290.16	0.13
Reach 1	3970.5		Bridge										
Reach 1	4043	10-yr	8922	564.2		584.6	573.55	584.71	0.000185	2.6	3434.88	290.33	0.13
Reach 1	4341	10-yr	8922	565.6		584.65		584.8	0.000277	3.1	2978.43	308.84	0.16
Reach 1	5199	10-yr	8922	576.3		584.91		585.33	0.001331	5.21	1736.71	239.65	0.33
Reach 1	5270	10-yr	8922	574		585.29	579.48	585.53	0.000643	3.96	2251.85	301.61	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	10-yr	8922	574		585.66	579.48	585.88	0.000559	3.8	2348.26	306.89	0.22
Reach 1	5562	10-yr	8922	571		585.84		586	0.000635	3.13	2980.11	367.23	0.18
Reach 1	6354	10-yr	8922	571.5		586.12	581.3	586.94	0.001557	7.28	1288.54	316.47	0.42
Reach 1	7410	10-yr	8922	573.7		588.19		588.56	0.001439	5.23	2588.51	726.53	0.28
Reach 1	8436	10-yr	8922	576.6		589.6	584.39	590.16	0.00182	6.09	1675	252.09	0.35
Reach 1	9173	10-yr	8922	582.1		591.02	589.77	592.62	0.005264	10.13	880.94	797.84	0.72
Reach 1	10272	10-yr	8922	582.8		594.53	589.75	595.05	0.001132	5.77	1580.64	238.89	0.35
Reach 1	11497	10-yr	8922	588.7		596.57	594.75	597.41	0.003565	7.36	1212.72	243.8	0.58
Reach 1	12627	10-yr	8922	594.7		601.08	599.75	602.28	0.0051	8.79	1036.74	261.06	0.67
Reach 1	13393	10-yr	8922	595.2		603.82	600.45	604.5	0.001771	6.66	1438.11	427.56	0.43
Reach 1	13514	10-yr	8922	592.1		604.15	599.35	604.67	0.000346	5.76	1548.85	240.64	0.33
Reach 1	13535.3		Bridge										
Reach 1	13557	10-yr	8922	592.1		604.28	600.93	604.99	0.004203	6.77	1322.97	226.14	0.45
Reach 1	13799	10-yr	8922	595.5		605.62	602.54	605.92	0.003952	4.89	2285.59	400.91	0.32
Reach 1	14863	10-yr	8922	599.6		608.86	607.03	610.04	0.003215	9.03	1376.29	489.4	0.59
Reach 1	15817	10-yr	8922	603.2		611.98		612.55	0.00208	6.14	1685.38	500.96	0.46
Reach 1	17170	10-yr	8922	602.4		614.96	610.09	615.7	0.002558	6.89	1305.95	138.98	0.38
Reach 1	17314	10-yr	8922	605.5		615.07	612.07	616.36	0.00251	9.12	977.76	132.63	0.54
Reach 1	17350		Bridge										
Reach 1	17386	10-yr	8922	605.5		615.41	612.07	616.61	0.002215	8.79	1015.15	131.45	0.51
Reach 1	17442	10-yr	8922	604.9		615.5	612.55	616.8	0.002646	9.16	981.77	116.6	0.54
Reach 1	18472	10-yr	8922	608.9		618.41	613.88	618.61	0.001147	3.69	2882.04	1042.77	0.24
Reach 1	19887	10-yr	8922	610.3		620.08		620.21	0.001091	3	3008.21	562.36	0.22
Reach 1	21220	10-yr	8922	612.8		622.45		622.9	0.004453	5.43	1729.24	344.08	0.39
Reach 1	22540	10-yr	8922	615.5		625.26		625.54	0.001111	4.3	2360.32	549.62	0.28
Reach 1	23751	10-yr	8922	617.6		627.15		627.54	0.002638	5.43	2172.5	494.52	0.35
Reach 1	24800	10-yr	8922	620.4		629.42	626.8	630.39	0.002462	8	1330.91	382.77	0.52
Reach 1	25961	10-yr	8922	621.4		632.35	627.59	632.98	0.001954	6.4	1451	196.71	0.37







Appendix F-3a

Alternative #2: Remove Abandoned Railroad Bridge and Associated Topography (Future)

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FutureFlow-BFCK-Railroad-Topo-Remove  
 Geometry  
 FEMA-PR-BFCK-Railroad-Topo-Remove  
 Steady Flow USGS FutureFlows RCP8.5 2075-2099  
 Reach 1  
 Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Removed Railroad (Black) Bridge at RS 13593.3.

Removed X-Ss at RS 12627, 13393, 13514, 13535.3, 13557, 13799.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			FutureFlow Condition (100-year)	RR Bridge/ Embankment Removal
	836	-4726	587.4	587.4
	930	-4632	587.4	587.4
	1098	-4464	587.5	587.5
	1881	-3681	587.6	587.6
	2764	-2798	587.6	587.6
	2788	-2774	587.6	587.6
	3371	-2191	587.5	587.5
	3602	-1960	587.6	587.6
	3642	-1920	587.9	587.9
	3686	-1876	587.8	587.8
	3727	-1835	587.8	587.8
	3859	-1703	587.9	587.9
	3898	-1664	587.9	587.9
Bridge	3970.5	-1591.5		
	4043	-1519	588.0	588.0
	4341	-1221	588.1	588.1
	5199	-363	588.3	588.3
	5270	-292	588.7	588.7
Bridge	5304.5	-257.5		
	5339	-223	589.1	589.1
	5562	0	589.3	589.3
	6354	792	589.6	589.6
	7410	1848	591.2	591.2
	8436	2874	592.1	592.1
Oxbow	9173	3611	593.5	593.5
	10272	4710	597.3	597.3
	11497	5935	599.0	599.0
	12627	7065	603.0	
	13393	7831	606.0	
	13514*	7952	606.1	
Railroad Bridge	13535.3*	7973.3		
	13557*	7995	606.2	
	13799	8237	607.3	
	14863	9301	609.8	609.9
	15817	10255	614.2	614.1
	17170	11608	617.1	617.1
	17314	11752	617.1	617.1
Union Rd Bridge	17350	11788		
	17386	11824	617.7	617.7
	17442	11880	617.9	617.9
	18472	12910	621.5	621.5
	19887	14325	622.7	622.7
	21220	15658	624.7	624.7
	22540	16978	627.5	627.5
	23751	18189	629.4	629.4
	24800	19238	631.4	631.4
	25961	20399	634.7	634.7

\*Removed from profile plot in report to represent a uniform water surface elevation and remove hydraulic jump

Appendix F-3a

Alternative #2: Remove Abandoned Railroad Bridge and Associated Topography (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-RRremove2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

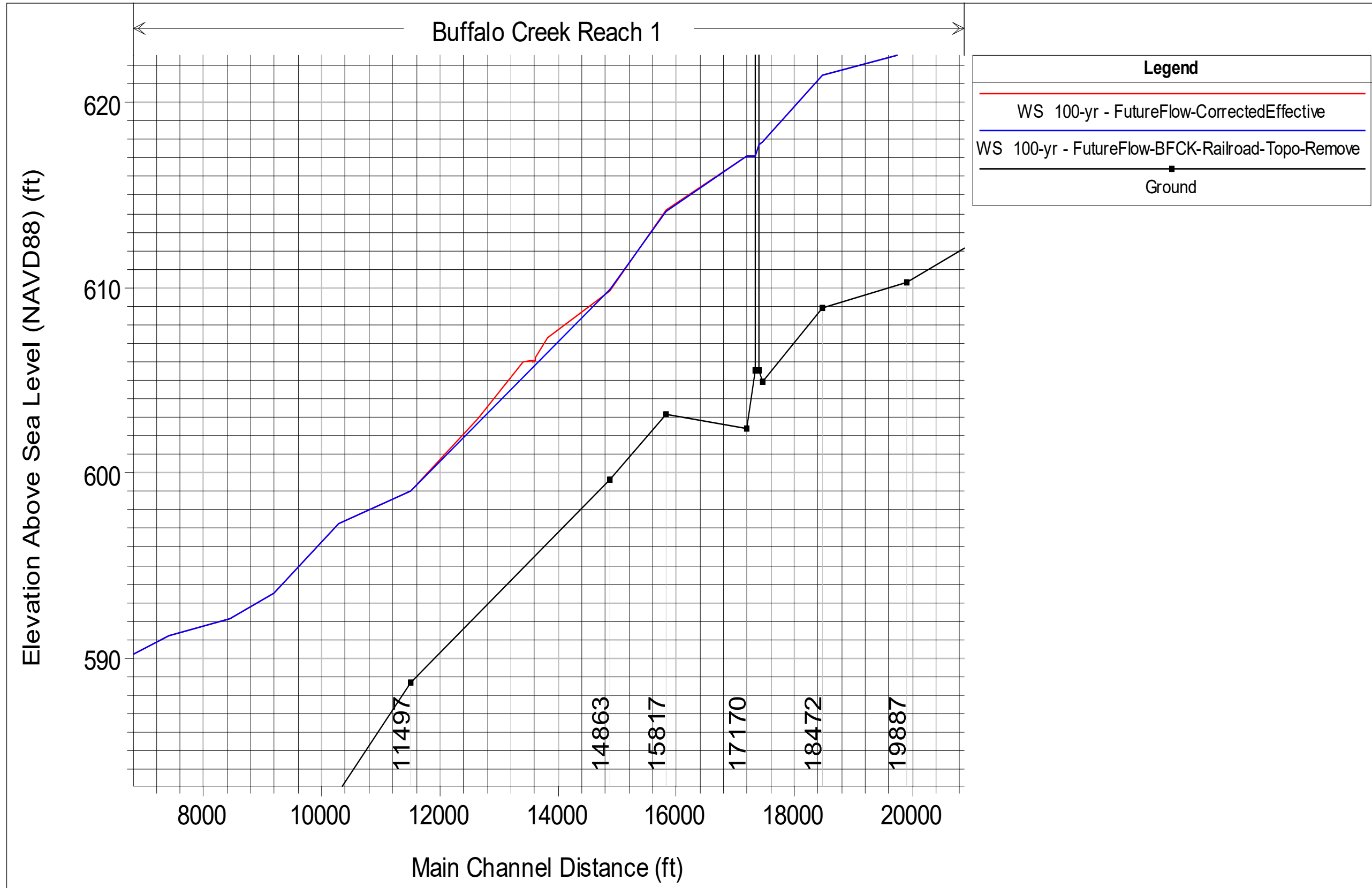
# Plans = 1

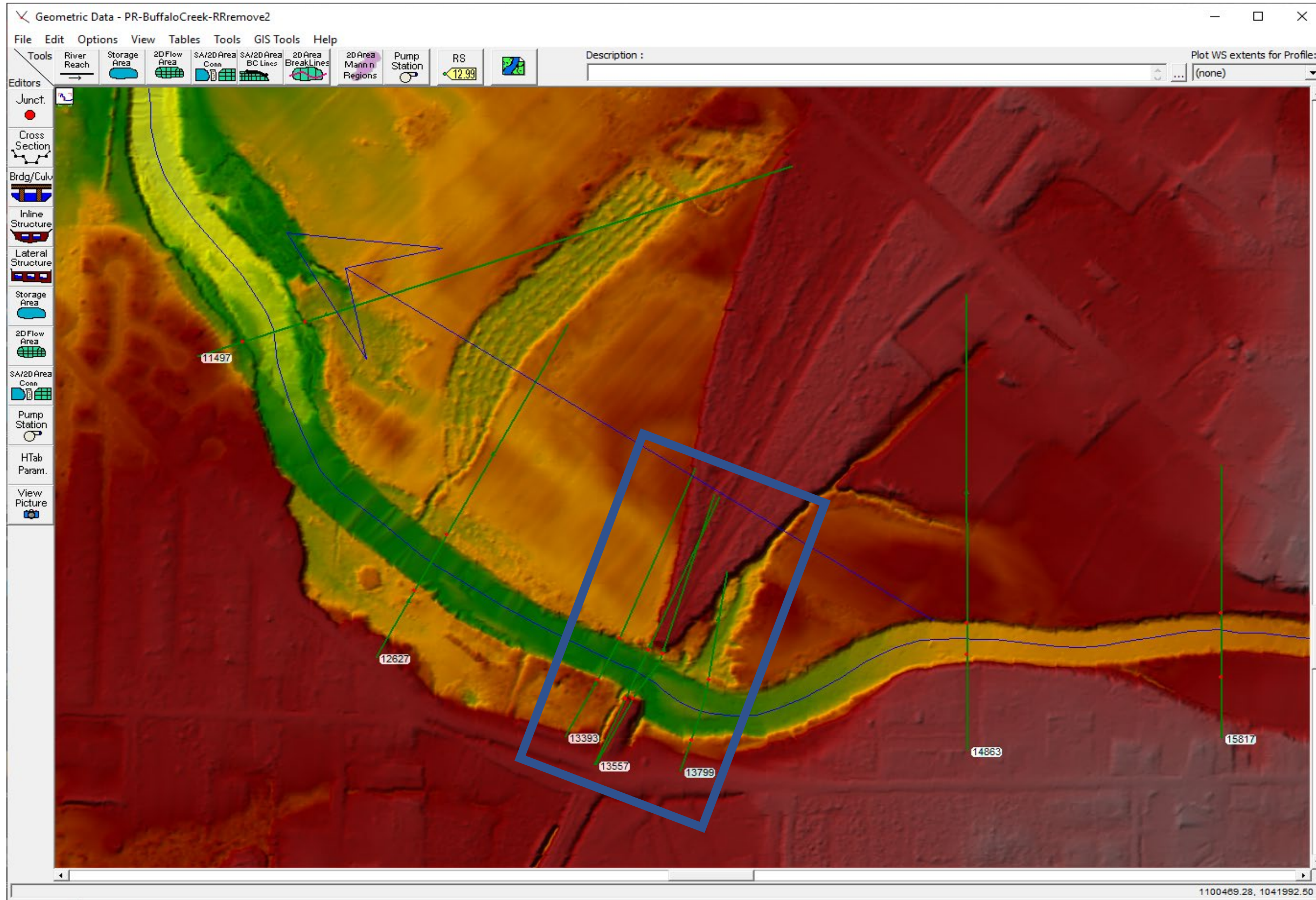
# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	100-yr	14648	567.3		587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3		587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4		587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4		587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9		587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9		587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1		587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2		587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566		587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570		587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570		587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2		587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2		587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648	564.2		587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6		588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3		588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574		588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648	574		589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571		589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5		589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7		591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6		592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1		593.51	591.81	595.63	0.004833	11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8		597.27	591.73	597.97	0.001082	6.83	2758.9	999.22	0.36
Reach 1	11497	100-yr	14648	588.7		599	596.32	600.02	0.00259	8.09	1829.81	299.98	0.53
Reach 1	14863	100-yr	14648	599.6		609.91	609.8	611.86	0.004767	12.02	1993.6	638.3	0.73
Reach 1	15817	100-yr	14648	603.2		614.11		614.75	0.00192	6.74	2961.31	621.74	0.43
Reach 1	17170	100-yr	14648	602.4		617.08	612.35	618.42	0.003607	9.3	1607.54	146.06	0.47
Reach 1	17314	100-yr	14648	605.5		617.12	614.39	619.42	0.003379	12.16	1204.18	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648	605.5		617.73	614.39	619.8	0.00282	11.52	1271.29	134.33	0.6
Reach 1	17442	100-yr	14648	604.9		617.86	614.88	620.03	0.003223	11.85	1263.61	122.2	0.62
Reach 1	18472	100-yr	14648	608.9		621.46	615.27	621.63	0.000766	3.66	5655.91	1327.11	0.2
Reach 1	19887	100-yr	14648	610.3		622.69		622.86	0.000957	3.32	4586.52	664.51	0.2
Reach 1	21220	100-yr	14648	612.8		624.68		625.27	0.003998	6.33	2523.7	368.62	0.39
Reach 1	22540	100-yr	14648	615.5		627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6		629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4		631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4		634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41





Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

HEC-RAS Model Summary  
 Project BuffaloCreek  
 Plan  
 FutureFlow-BFCK-Railroad-Topo-Remove-ICE  
 FutureFlow-BFCK-Railroad-Topo-ICE  
 Geometry  
 FutureFlow-BFCK-Railroad-Topo-Remove-ICE  
 FutureFlow-BFCK-Railroad-Topo-ICE  
 Steady Flow USGS StreamStats Full Flows  
 Reach 1  
 Profile 10-year  
 Directory

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Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Removed Railroad (Black) Bridge at RS 13593.3.

Removed X-Ss at RS 12627, 13393, 13514, 13535.3, 13557, 13799.

Ice Cover Simulation:

Ice cover of 1.5 feet and Manning n value of 0.045 at RS 11497 upstream to RS 14863.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			FutureFlow Condition 10-year	FutureFlow Condition RR/Topo Ice Jam Simulation	RR/Topo Ice Jam Simulation
	836	-4726	587.4	584.0	584.0
	930	-4632	587.4	584.0	584.0
	1098	-4464	587.5	584.1	584.1
	1881	-3681	587.6	584.2	584.2
	2764	-2798	587.6	584.2	584.2
	2788	-2774	587.6	584.1	584.1
	3371	-2191	587.5	584.3	584.3
	3602	-1960	587.6	584.3	584.3
	3642	-1920	587.9	584.5	584.5
	3686	-1876	587.8	584.5	584.5
	3727	-1835	587.8	584.5	584.5
	3859	-1703	587.9	584.6	584.6
	3898	-1664	587.9	584.6	584.6
Bridge	3970.5	-1591.5			
	4043	-1519	588.0	584.6	584.6
	4341	-1221	588.1	584.7	584.7
	5199	-363	588.3	584.9	584.9
	5270	-292	588.7	585.3	585.3
Bridge	5304.5	-257.5			
	5339	-223	589.1	585.7	585.7
	5562	0	589.3	585.8	585.8
	6354	792	589.6	586.1	586.1
	7410	1848	591.2	588.2	588.2
	8436	2874	592.1	589.6	589.6
Oxbow	9173	3611	593.5	591.0	591.0
	10272	4710	597.3	594.5	594.5
	11497	5935	599.0	597.5	597.5
	12627	7065	603.0	605.0	
	13393	7831	606.0	607.2	
	13514*	7952	606.1	607.3	
Railroad Bridge	13535.3*	7973.3			
	13557*	7995	606.2	607.4	
	13799	8237	607.3	607.8	
	14863	9301	609.8	610.7	612.9
	15817	10255	614.2	613.4	614.0
	17170	11608	617.1	615.1	615.3
	17314	11752	617.1	615.2	615.4
Union Rd Bridge	17350	11788			
	17386	11824	617.7	615.5	615.7
	17442	11880	617.9	615.6	615.8
	18472	12910	621.5	618.4	618.5
	19887	14325	622.7	620.1	620.1
	21220	15658	624.7	622.5	622.5
	22540	16978	627.5	625.3	625.3
	23751	18189	629.4	627.2	627.2
	24800	19238	631.4	629.4	629.4
	25961	20399	634.7	632.4	632.4

\*Removed from profile plot in report to represent a uniform water surface elevation and remove hydraulic jump

Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BFCK-Railroad-Topo-Remove-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# Plans = 1

# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	10-yr	8922	567.3		584	573.82	584.11	0.00012	2.9	5874.65	1039.49	0.14
Reach 1	930	10-yr	8922	567.3		584.02		584.12	0.000103	2.57	3559.34	379.54	0.13
Reach 1	1098	10-yr	8922	567.4		584.06		584.14	0.000102	2.3	4541.88	1022.92	0.13
Reach 1	1881	10-yr	8922	567.4		584.16		584.21	0.000077	2.12	9113.06	2108.43	0.11
Reach 1	2764	10-yr	8922	566.9		584.18		584.34	0.00019	3.43	5126.93	2822.91	0.19
Reach 1	2788	10-yr	8922	566.9		584.14	574.98	584.36	0.000236	3.81	2339.26	2197.51	0.22
Reach 1	3371	10-yr	8922	571.1		584.25	576.93	584.53	0.00026	4.22	2114.43	1109.64	0.23
Reach 1	3602	10-yr	8922	571.2		584.31	577	584.59	0.000261	4.22	2112.92	198.36	0.23
Reach 1	3642	10-yr	8922	566		584.49		584.61	0.000091	2.78	3209.85	290.24	0.15
Reach 1	3686	10-yr	8922	570		584.47		584.62	0.000142	3.16	2819.22	295.44	0.18
Reach 1	3727	10-yr	8922	570		584.47	577.11	584.64	0.000244	3.36	2655.53	289.14	0.2
Reach 1	3859	10-yr	8922	564.2		584.56		584.67	0.000105	2.61	3423.7	290.15	0.13
Reach 1	3898	10-yr	8922	564.2		584.57		584.67	0.000073	2.61	3424.35	290.16	0.13
Reach 1	3970.5												
		Bridge											
Reach 1	4043	10-yr	8922	564.2		584.6	573.55	584.71	0.000185	2.6	3434.88	290.33	0.13
Reach 1	4341	10-yr	8922	565.6		584.65		584.8	0.000277	3.1	2978.43	308.84	0.16
Reach 1	5199	10-yr	8922	576.3		584.91		585.33	0.001331	5.21	1736.71	239.65	0.33
Reach 1	5270	10-yr	8922	574		585.29	579.48	585.53	0.000643	3.96	2251.85	301.61	0.24
Reach 1	5304.5												
		Bridge											
Reach 1	5339	10-yr	8922	574		585.66	579.48	585.88	0.000559	3.8	2348.26	306.89	0.22
Reach 1	5562	10-yr	8922	571		585.84		586	0.000635	3.13	2980.11	367.23	0.18
Reach 1	6354	10-yr	8922	571.5		586.12	581.3	586.94	0.001557	7.28	1288.54	316.47	0.42
Reach 1	7410	10-yr	8922	573.7		588.19		588.56	0.001439	5.23	2588.51	726.53	0.28
Reach 1	8436	10-yr	8922	576.6		589.6	584.39	590.16	0.00182	6.09	1675	252.09	0.35
Reach 1	9173	10-yr	8922	582.1		591.02	589.77	592.62	0.005264	10.13	880.94	797.84	0.72
Reach 1	10272	10-yr	8922	582.8		594.53	589.75	595.05	0.001132	5.77	1580.64	238.89	0.35
Reach 1	11497	10-yr	8922	588.7		597.54	596.12	598.53	0.01355	7.98	1117.71	220.61	0.63
Reach 1	14863	10-yr	8922	599.6		612.88	608.5	613.15	0.002095	4.93	3319.3	1046.56	0.27
Reach 1	15817	10-yr	8922	603.2		614.03		614.28	0.000739	4.16	2911.23	618.75	0.27
Reach 1	17170	10-yr	8922	602.4		615.34	610.09	616.02	0.002262	6.64	1357.94	140.23	0.36
Reach 1	17314	10-yr	8922	605.5		615.42	612.07	616.61	0.002208	8.78	1016.15	133.24	0.51
Reach 1	17350												
		Bridge											
Reach 1	17386	10-yr	8922	605.5		615.7	612.07	616.83	0.001992	8.51	1047.92	131.82	0.49
Reach 1	17442	10-yr	8922	604.9		615.79	612.55	617.01	0.002377	8.87	1015.34	117.27	0.52
Reach 1	18472	10-yr	8922	608.9		618.5	613.88	618.7	0.001094	3.63	2962.07	1053.79	0.24
Reach 1	19887	10-yr	8922	610.3		620.11		620.25	0.001073	2.98	3027.3	562.72	0.22
Reach 1	21220	10-yr	8922	612.8		622.45		622.9	0.004449	5.43	1729.83	344.1	0.39
Reach 1	22540	10-yr	8922	615.5		625.26		625.54	0.001111	4.3	2360.52	549.64	0.28
Reach 1	23751	10-yr	8922	617.6		627.15		627.54	0.002638	5.43	2172.53	494.52	0.35
Reach 1	24800	10-yr	8922	620.4		629.42	626.8	630.39	0.002463	8	1330.89	382.77	0.52
Reach 1	25961	10-yr	8922	621.4		632.35	627.59	632.98	0.001954	6.4	1451	196.71	0.37

Appendix F-3a

Blocked Obstruction / Ice Jam Simulation - Railroad Bridge and Associated Topography

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BFCK-Railroad-Topo-ICE River: Buffalo Creek Reach: Reach 1 Profile: 10-yr

# Rivers = 1

# Plans = 1

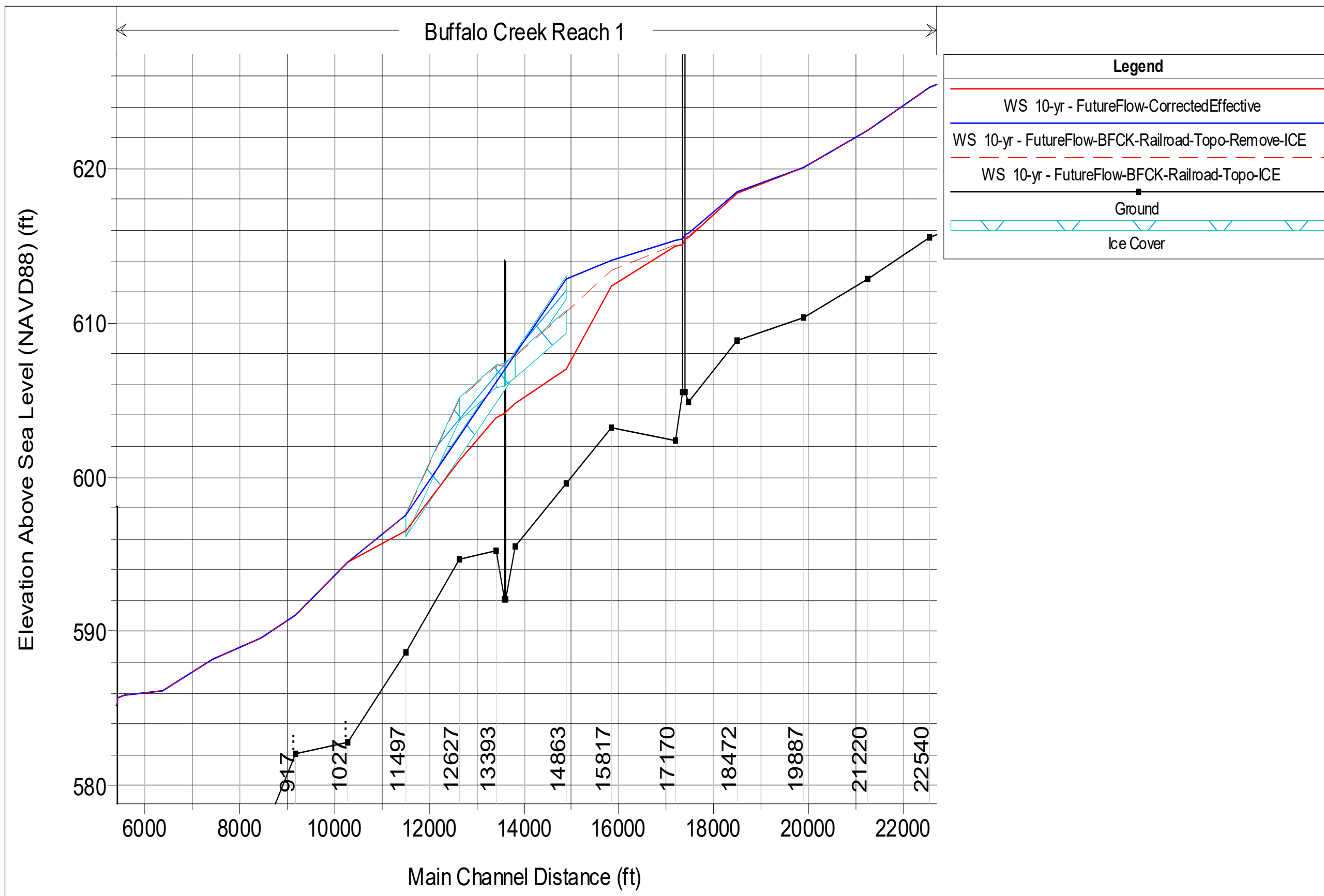
# Hydraulic Reaches = 1

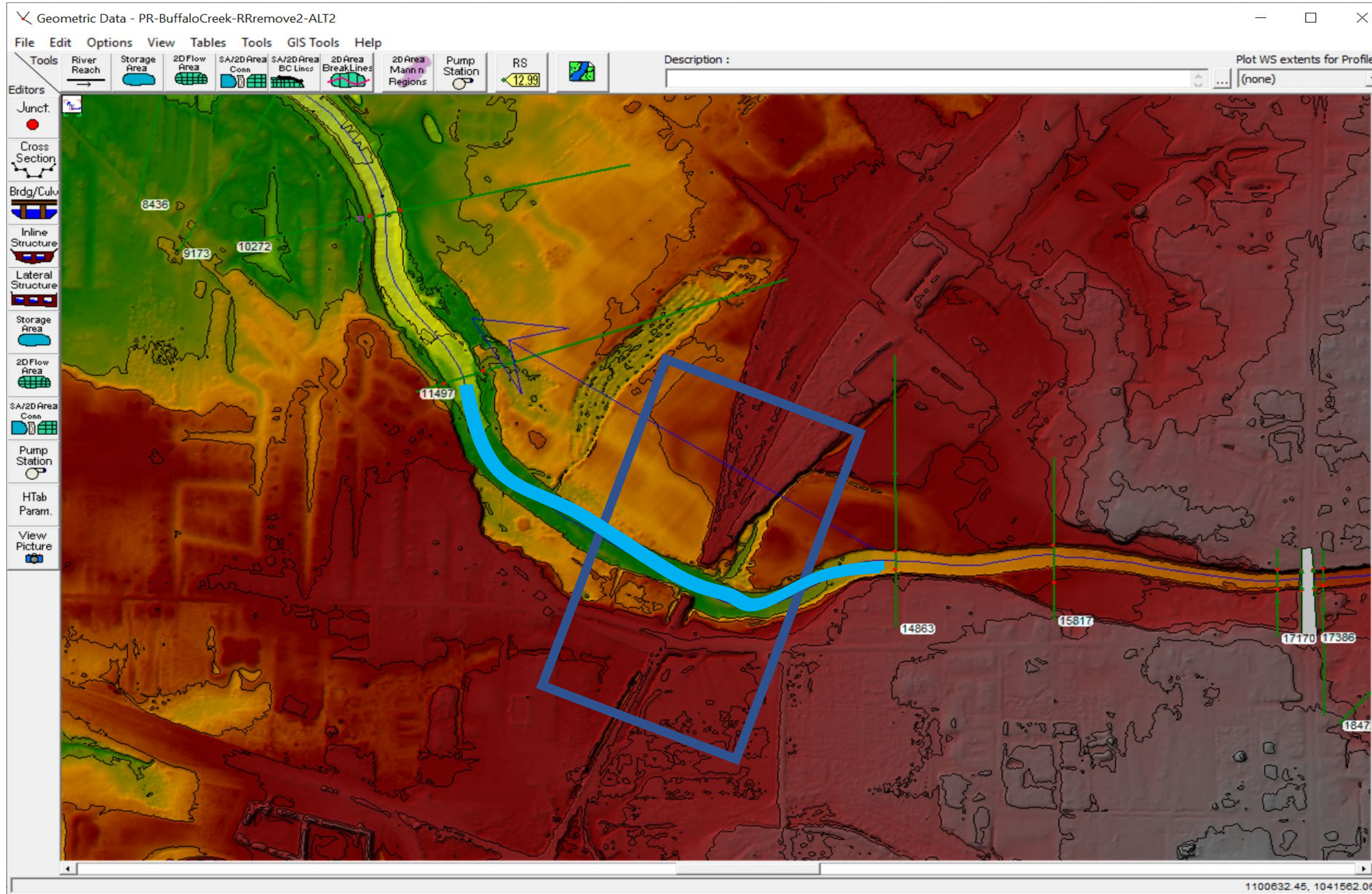
# Profiles = 1

# River Stations = 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
Reach 1	836	10-yr	8922	567.3		584	573.82	584.11	0.00012	2.9	5874.65	1039.49	0.14
Reach 1	930	10-yr	8922	567.3		584.02		584.12	0.000103	2.57	3559.34	379.54	0.13
Reach 1	1098	10-yr	8922	567.4		584.06		584.14	0.000102	2.3	4541.88	1022.92	0.13
Reach 1	1881	10-yr	8922	567.4		584.16		584.21	0.000077	2.12	9113.06	2108.43	0.11
Reach 1	2764	10-yr	8922	566.9		584.18		584.34	0.00019	3.43	5126.93	2822.91	0.19
Reach 1	2788	10-yr	8922	566.9		584.14	574.98	584.36	0.000236	3.81	2339.26	2197.51	0.22
Reach 1	3371	10-yr	8922	571.1		584.25	576.93	584.53	0.00026	4.22	2114.43	1109.64	0.23
Reach 1	3602	10-yr	8922	571.2		584.31	577	584.59	0.000261	4.22	2112.92	198.36	0.23
Reach 1	3642	10-yr	8922	566		584.49		584.61	0.000091	2.78	3209.85	290.24	0.15
Reach 1	3686	10-yr	8922	570		584.47		584.62	0.000142	3.16	2819.22	295.44	0.18
Reach 1	3727	10-yr	8922	570		584.47	577.11	584.64	0.000244	3.36	2655.53	289.14	0.2
Reach 1	3859	10-yr	8922	564.2		584.56		584.67	0.000105	2.61	3423.7	290.15	0.13
Reach 1	3898	10-yr	8922	564.2		584.57		584.67	0.000073	2.61	3424.35	290.16	0.13
Reach 1	3970.5												
		Bridge											
Reach 1	4043	10-yr	8922	564.2		584.6	573.55	584.71	0.000185	2.6	3434.88	290.33	0.13
Reach 1	4341	10-yr	8922	565.6		584.65		584.8	0.000277	3.1	2978.43	308.84	0.16
Reach 1	5199	10-yr	8922	576.3		584.91		585.33	0.001331	5.21	1736.71	239.65	0.33
Reach 1	5270	10-yr	8922	574		585.29	579.48	585.53	0.000643	3.96	2251.85	301.61	0.24
Reach 1	5304.5												
		Bridge											
Reach 1	5339	10-yr	8922	574		585.66	579.48	585.88	0.000559	3.8	2348.26	306.89	0.22
Reach 1	5562	10-yr	8922	571		585.84		586	0.000635	3.13	2980.11	367.23	0.18
Reach 1	6354	10-yr	8922	571.5		586.12	581.3	586.94	0.001557	7.28	1288.54	316.47	0.42
Reach 1	7410	10-yr	8922	573.7		588.19		588.56	0.001439	5.23	2588.51	726.53	0.28
Reach 1	8436	10-yr	8922	576.6		589.6	584.39	590.16	0.00182	6.09	1675	252.09	0.35
Reach 1	9173	10-yr	8922	582.1		591.02	589.77	592.62	0.005264	10.13	880.94	797.84	0.72
Reach 1	10272	10-yr	8922	582.8		594.53	589.75	595.05	0.001132	5.77	1580.64	238.89	0.35
Reach 1	11497	10-yr	8922	588.7		597.54	596.12	598.53	0.01355	7.98	1117.71	220.61	0.63
Reach 1	12627	10-yr	8922	594.7		605.02	601.11	605.4	0.003422	5.13	2454.25	996.55	0.36
Reach 1	13393	10-yr	8922	595.2		607.16	601.81	607.47	0.002143	4.69	2793.67	825.55	0.27
Reach 1	13514	10-yr	8922	592.1		607.29	600.73	607.65	0.000485	4.84	1844.75	281.84	0.26
Reach 1	13535.3												
		Bridge											
Reach 1	13557	10-yr	8922	592.1		607.38	600.7	607.73	0.000472	4.8	1859.9	249.68	0.25
Reach 1	13799	10-yr	8922	595.5		607.8	602.53	607.95	0.001702	3.59	3329.53	658.23	0.23
Reach 1	14863	10-yr	8922	599.6		610.7	608.5	611.57	0.007535	7.95	1630.17	589.07	0.5
Reach 1	15817	10-yr	8922	603.2		613.38		613.69	0.001006	4.67	2510.07	604.68	0.31
Reach 1	17170	10-yr	8922	602.4		615.11	610.09	615.82	0.002439	6.79	1325.77	139.46	0.38
Reach 1	17314	10-yr	8922	605.5		615.2	612.07	616.46	0.002389	8.99	992.37	132.86	0.53
Reach 1	17350												
		Bridge											
Reach 1	17386	10-yr	8922	605.5		615.52	612.07	616.69	0.002128	8.68	1027.47	131.59	0.5
Reach 1	17442	10-yr	8922	604.9		615.61	612.55	616.88	0.002541	9.05	994.34	116.85	0.53
Reach 1	18472	10-yr	8922	608.9		618.44	613.88	618.64	0.001128	3.67	2910.7	1046.72	0.24
Reach 1	19887	10-yr	8922	610.3		620.09		620.23	0.001085	2.99	3014.93	562.49	0.22
Reach 1	21220	10-yr	8922	612.8		622.45		622.9	0.004452	5.43	1729.43	344.08	0.39
Reach 1	22540	10-yr	8922	615.5		625.26		625.54	0.001111	4.3	2360.36	549.63	0.28
Reach 1	23751	10-yr	8922	617.6		627.15		627.54	0.002638	5.43	2172.5	494.52	0.35
Reach 1	24800	10-yr	8922	620.4		629.42	626.8	630.39	0.002462	8	1330.91	382.77	0.52
Reach 1	25961	10-yr	8922	621.4		632.35	627.59	632.98	0.001954	6.4	1451	196.71	0.37







Appendix F-4b

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench (Future)

HEC-RAS Future Flow Model Summary

Project BuffaloCreek

Plan

FutureFlow-BufferoCreek-RRremove

FutureFlow-BufferoCreek-BENCH1-ALT1

FutureFlow-BufferoCreek-BENCH1-ALT2

Geometry

PR-BufferoCreek-RRremove

PR-BufferoCreek-BENCH1-ALT1

PR-BufferoCreek-BENCH1-ALT2

Steady Flow

USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffero-Creek-7\N-D\1.7 H&H-Modeling>

SA Min Elev 588 ft

SA Area 30 acres

60 acres

Description:

Removed Railroad (Black) Bridge and two adjacent cross-sections.

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow Adjusted X-Ss that intersect SA to include Flood Bench 3, 6 ft below flood plain SA Minimum Elevation = 588 ft SA Area = 30, 60 acres Removed Railroad Bridge and two adjacent cross-sections Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Predicted Water Surface Elevations (feet) (NAVD88)				
			RR Bridge Removal	Future Flow RR Bridge Removal	Future Flow Condition	ALT1 FB Depth = 3 ft	ALT2 FB Depth = 6 ft
	836	-4726	586.9	587.4	587.4	587.4	587.4
	930	-4632	586.9	587.4	587.4	587.4	587.4
	1098	-4464	586.9	587.5	587.5	587.5	587.5
	1881	-3681	587.1	587.6	587.6	587.6	587.6
	2764	-2798	587.1	587.6	587.6	587.6	587.6
	2788	-2774	587.1	587.6	587.6	587.6	587.6
	3371	-2191	587.0	587.5	587.5	587.5	587.5
	3602	-1960	587.1	587.6	587.6	587.6	587.6
	3642	-1920	587.3	587.9	587.9	587.9	587.9
	3686	-1876	587.3	587.8	587.8	587.8	587.8
	3727	-1835	587.3	587.8	587.8	587.8	587.8
	3859	-1703	587.4	587.9	587.9	587.9	587.9
	3898	-1664	587.4	587.9	587.9	587.9	587.9
Bridge	3970.5	-1591.5					
	4043	-1519	587.4	588.0	588.0	588.0	588.0
	4341	-1221	587.5	588.1	588.1	588.1	588.1
	5199	-363	587.8	588.3	588.3	588.3	588.3
	5270	-292	588.1	588.7	588.7	588.7	588.7
Bridge	5304.5	-257.5					
	5339	-223	588.5	589.1	589.1	589.1	589.1
	5562	0	588.8	589.3	589.3	589.3	589.3
	6354	792	589.0	589.6	589.6	589.6	589.6
	7410	1848	590.7	591.2	591.2	591.2	591.2
	8436	2874	591.7	592.1	592.1	592.1	592.1
Oxbow	9173	3611	593.1	593.5	593.5	593.5	593.5
	10272	4710	596.8	597.3	597.3	597.3	597.3
	11497	5935	598.6	599.0	599.0	599.0	599.1
	12627	7065	602.7	603.0	603.0	602.3	601.6
	13393	7831	605.7	606.0	606.0	604.2	602.9
	13514	7952			606.1		
Railroad Bridge	13535.3	7973.3					
	13557	7995			606.2		
	13799	8237	606.9	607.3	607.3	605.2	603.7
	14863	9301	609.4	609.8	609.8	609.8	609.8
	15817	10255	613.9	614.2	614.2	614.2	614.2
	17170	11608	616.7	617.1	617.1	617.1	617.1
	17314	11752	616.8	617.1	617.1	617.1	617.1
Union Rd Bridge	17350	11788					
	17386	11824	617.4	617.7	617.7	617.7	617.7
	17442	11880	617.5	617.9	617.9	617.9	617.9
	18472	12910	620.9	621.5	621.5	621.5	621.5
	19887	14325	622.2	622.7	622.7	622.7	622.7
	21220	15658	624.3	624.7	624.7	624.7	624.7
	22540	16978	627.2	627.5	627.5	627.5	627.5
	23751	18189	629.0	629.4	629.4	629.4	629.4
	24800	19238	631.1	631.4	631.4	631.4	631.4
	25961	20399	634.3	634.7	634.7	634.7	634.7

Appendix F-4b

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-RRremove River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 44

# Hydraulic Reaches = 1

# Plans = 1

# Profiles = 1

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	
Reach 1	836	100-yr	14648	567.3	587.41	575.74	587.54	0.00012		3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3	587.4		587.56	0.000124		3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47		587.58	0.000099		2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6		587.64	0.000057		2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63		587.71	0.000094		2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61	577.38	587.72	0.000119		3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5	578.65	587.93	0.000357		5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58	578.75	588.01	0.000311		5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85		588.04	0.000105		3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83		588.05	0.000149		3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82	578.98	588.07	0.000246		4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94		588.11	0.000139		3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94		588.11	0.000097		3.3	4433.54	323.85	0.16
Reach 1	3970.5	Bridge											
Reach 1	4043	100-yr	14648	564.2	587.99	576.08	588.16	0.000245		3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05		588.27	0.000314		3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3		588.82	0.001071		5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66	580.99	589	0.000578		4.68	3129.53	348.94	0.24
Reach 1	5304.5	Bridge											
Reach 1	5339	100-yr	14648	574	589.1	580.99	589.41	0.000514		4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33		589.53	0.000571		3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58	583.92	590.3	0.001101		7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18		591.5	0.001102		5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13	586.89	592.98	0.002094		7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51	591.81	595.63	0.004833		11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.27	591.71	597.97	0.001082		6.83	2758.9	999.22	0.36
Reach 1	11497	100-yr	14648	588.7	599	596.32	600.02	0.00259		8.09	1829.81	299.98	0.53
Reach 1	12627	100-yr	14648	594.7	602.95	601.6	604.47	0.00622		10.05	1680.16	729.09	0.74
Reach 1	13393	100-yr	14648	595.2	605.99	602.26	606.86	0.001758		7.79	2813.58	847.01	0.45
Reach 1	13799	100-yr	14648	595.5	607.28	602.19	607.46	0.000645		4.03	5113.81	671.77	0.23
Reach 1	14863	100-yr	14648	599.6	609.8	609.8	611.85	0.005074		12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16		614.79	0.00188		6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08	612.35	618.42	0.003609		9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12	614.39	619.42	0.003381		12.17	1203.97	136.21	0.65
Reach 1	17350	Bridge											
Reach 1	17386	100-yr	14648	605.5	617.73	614.39	619.8	0.002822		11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86	614.88	620.03	0.003225		11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46	615.27	621.63	0.000766		3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69		622.86	0.000957		3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68		625.27	0.003998		6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54		627.89	0.00116		5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39		629.84	0.002347		6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4	629.35	632.71	0.002617		9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67	629.64	635.64	0.002342		8.1	2187.06	350.27	0.41

Appendix F-4b

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-BENCH1-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 44

# Hydraulic Reaches = 1

# Plans = 1

# Profiles = 1

Flood Bench Depth = 3 ft

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	
Reach 1	836	100-yr	14648	567.3	587.41	575.74	587.54	0.00012		3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3	587.4		587.56	0.000124		3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47		587.58	0.000099		2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6		587.64	0.000057		2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63		587.71	0.000094		2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61	577.38	587.72	0.000119		3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5	578.65	587.93	0.000357		5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58	578.75	588.01	0.000311		5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85		588.04	0.000105		3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83		588.05	0.000149		3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82	578.98	588.07	0.000246		4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94		588.11	0.000139		3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94		588.11	0.000097		3.3	4433.54	323.85	0.16
Reach 1	3970.5	Bridge											
Reach 1	4043	100-yr	14648	564.2	587.99	576.08	588.16	0.000245		3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05		588.27	0.000314		3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3		588.82	0.001071		5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66	580.99	589	0.000578		4.68	3129.53	348.94	0.24
Reach 1	5304.5	Bridge											
Reach 1	5339	100-yr	14648	574	589.1	580.99	589.41	0.000514		4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33		589.53	0.000571		3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58	583.92	590.3	0.001101		7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18		591.5	0.001102		5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13	586.89	592.98	0.002094		7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51	591.81	595.63	0.004833		11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.27	591.71	597.97	0.001082		6.83	2758.9	999.22	0.36
Reach 1	11497	100-yr	14648	588.7	599.02	596.33	599.84	0.002215		7.5	2483.65	457.4	0.49
Reach 1	12627	100-yr	14648	594.7	602.31	601.11	602.85	0.003343		7.13	3588.8	859.77	0.54
Reach 1	13393	100-yr	14648	595.2	604.15	602.25	604.6	0.001639		6.6	4068.55	781.76	0.42
Reach 1	13799	100-yr	14648	595.5	605.21	602.43	605.4	0.000932		4.25	4993.6	804.42	0.28
Reach 1	14863	100-yr	14648	599.6	609.8	609.8	611.85	0.005074		12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16		614.79	0.00188		6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08	612.35	618.42	0.003609		9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12	614.39	619.42	0.003381		12.17	1203.97	136.21	0.65
Reach 1	17350	Bridge											
Reach 1	17386	100-yr	14648	605.5	617.73	614.39	619.8	0.002822		11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86	614.88	620.03	0.003225		11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46	615.27	621.63	0.000766		3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69		622.86	0.000957		3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68		625.27	0.003998		6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54		627.89	0.00116		5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39		629.84	0.002347		6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4	629.35	632.71	0.002617		9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67	629.64	635.64	0.002342		8.1	2187.06	350.27	0.41

Appendix F-4b

Alternative #3: Replace Railroad Bridge and Associated Topography with Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-BENCH1-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 44

# Hydraulic Reaches = 1

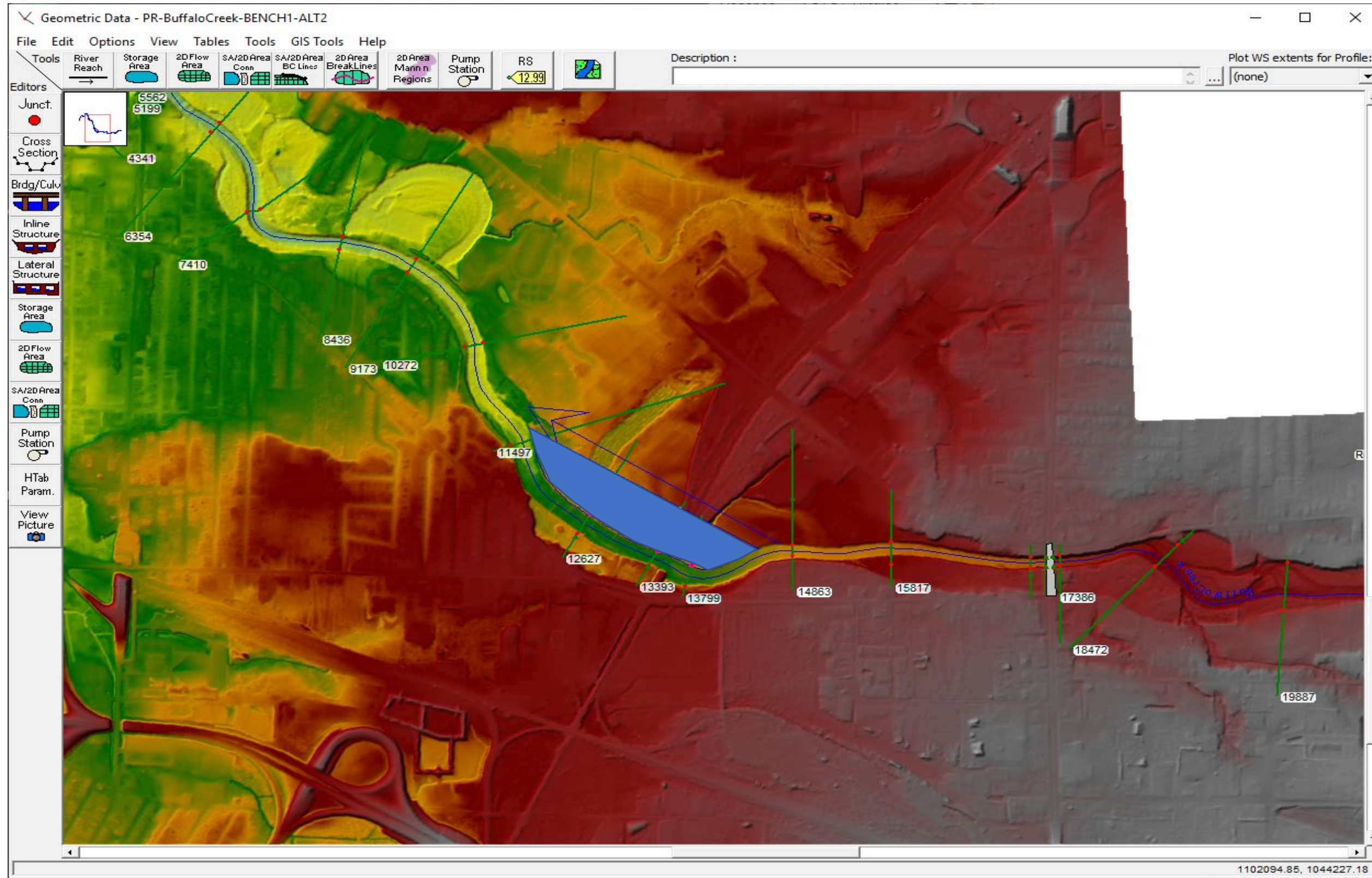
# Plans = 1

# Profiles = 1

Flood Bench Depth = 6 ft

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	
Reach 1	836	100-yr	14648	567.3	587.41	575.74	587.54	0.00012		3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3	587.4		587.56	0.000124		3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47		587.58	0.000099		2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6		587.64	0.000057		2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63		587.71	0.000094		2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61	577.38	587.72	0.000119		3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5	578.65	587.93	0.000357		5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58	578.75	588.01	0.000311		5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85		588.04	0.000105		3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83		588.05	0.000149		3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82	578.98	588.07	0.000246		4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94		588.11	0.000139		3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94		588.11	0.000097		3.3	4433.54	323.85	0.16
Reach 1	3970.5	Bridge											
Reach 1	4043	100-yr	14648	564.2	587.99	576.08	588.16	0.000245		3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05		588.27	0.000314		3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3		588.82	0.001071		5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66	580.99	589	0.000578		4.68	3129.53	348.94	0.24
Reach 1	5304.5	Bridge											
Reach 1	5339	100-yr	14648	574	589.1	580.99	589.41	0.000514		4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33		589.53	0.000571		3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58	583.92	590.3	0.001101		7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18		591.5	0.001102		5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13	586.89	592.98	0.002094		7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51	591.81	595.63	0.004833		11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.27	591.71	597.97	0.001082		6.83	2758.9	999.22	0.36
Reach 1	11497	100-yr	14648	588.7	599.05	596.33	599.63	0.001739		6.66	3042.79	458.49	0.43
Reach 1	12627	100-yr	14648	594.7	601.58	601.1	601.83	0.00225		5.35	4584.92	785.02	0.44
Reach 1	13393	100-yr	14648	595.2	602.89	602.25	603.13	0.001343		5.36	4849.69	778.91	0.37
Reach 1	13799	100-yr	14648	595.5	603.65	602.42	603.78	0.000857		3.67	5337.99	803.34	0.27
Reach 1	14863	100-yr	14648	599.6	609.8	609.8	611.85	0.005074		12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16		614.79	0.00188		6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08	612.35	618.42	0.003609		9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12	614.39	619.42	0.003381		12.17	1203.97	136.21	0.65
Reach 1	17350	Bridge											
Reach 1	17386	100-yr	14648	605.5	617.73	614.39	619.8	0.002822		11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86	614.88	620.03	0.003225		11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46	615.27	621.63	0.000766		3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69		622.86	0.000957		3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68		625.27	0.003998		6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54		627.89	0.00116		5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39		629.84	0.002347		6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4	629.35	632.71	0.002617		9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67	629.64	635.64	0.002342		8.1	2187.06	350.27	0.41







Appendix F-5b

Alternative #4: Reconnect the Oxbow Lake (Future)

HEC-RAS Model Summary

Project Buffalo Creek

Plan

FutureFlow-BufferCreek-OXBOW-RECON

Geometry

PR-BufferCreek-OXBOW-RECON

Steady Flow USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Adjusted X-S 9173 and 8436 elevations on right bank down to 100-yr WSE to include oxbow lake storage. Added ineffective flow areas were necessary.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)	
			Future Flow Condition	Reconnected Oxbow
	836	-4726	587.4	587.4
	930	-4632	587.4	587.4
	1098	-4464	587.5	587.5
	1881	-3681	587.6	587.6
	2764	-2798	587.6	587.6
	2788	-2774	587.6	587.6
	3371	-2191	587.5	587.5
	3602	-1960	587.6	587.6
	3642	-1920	587.9	587.9
	3686	-1876	587.8	587.8
	3727	-1835	587.8	587.8
	3859	-1703	587.9	587.9
	3898	-1664	587.9	587.9
Bridge	3970.5	-1591.5		
	4043	-1519	588.0	588.0
	4341	-1221	588.1	588.1
	5199	-363	588.3	588.3
	5270	-292	588.7	588.7
Bridge	5304.5	-257.5		
	5339	-223	589.1	589.1
	5562	0	589.3	589.3
	6354	792	589.6	589.6
	7410	1848	591.2	591.2
	8436	2874	592.1	592.1
Oxbow	9173	3611	593.5	593.9
	10272	4710	597.3	595.5
	11497	5935	599.0	598.6
	12627	7065	603.0	603.1
	13393	7831	606.0	606.0
	13514	7952	606.1	606.1
Railroad Bridge	13535.3	7973.3		
	13557	7995	606.2	606.2
	13799	8237	607.3	607.3
	14863	9301	609.8	609.8
	15817	10255	614.2	614.2
	17170	11608	617.1	617.1
	17314	11752	617.1	617.1
Union Rd Bridge	17350	11788		
	17386	11824	617.7	617.7
	17442	11880	617.9	617.9
	18472	12910	621.5	621.5
	19887	14325	622.7	622.7
	21220	15658	624.7	624.7
	22540	16978	627.5	627.5
	23751	18189	629.4	629.4
	24800	19238	631.4	631.4
	25961	20399	634.7	634.7

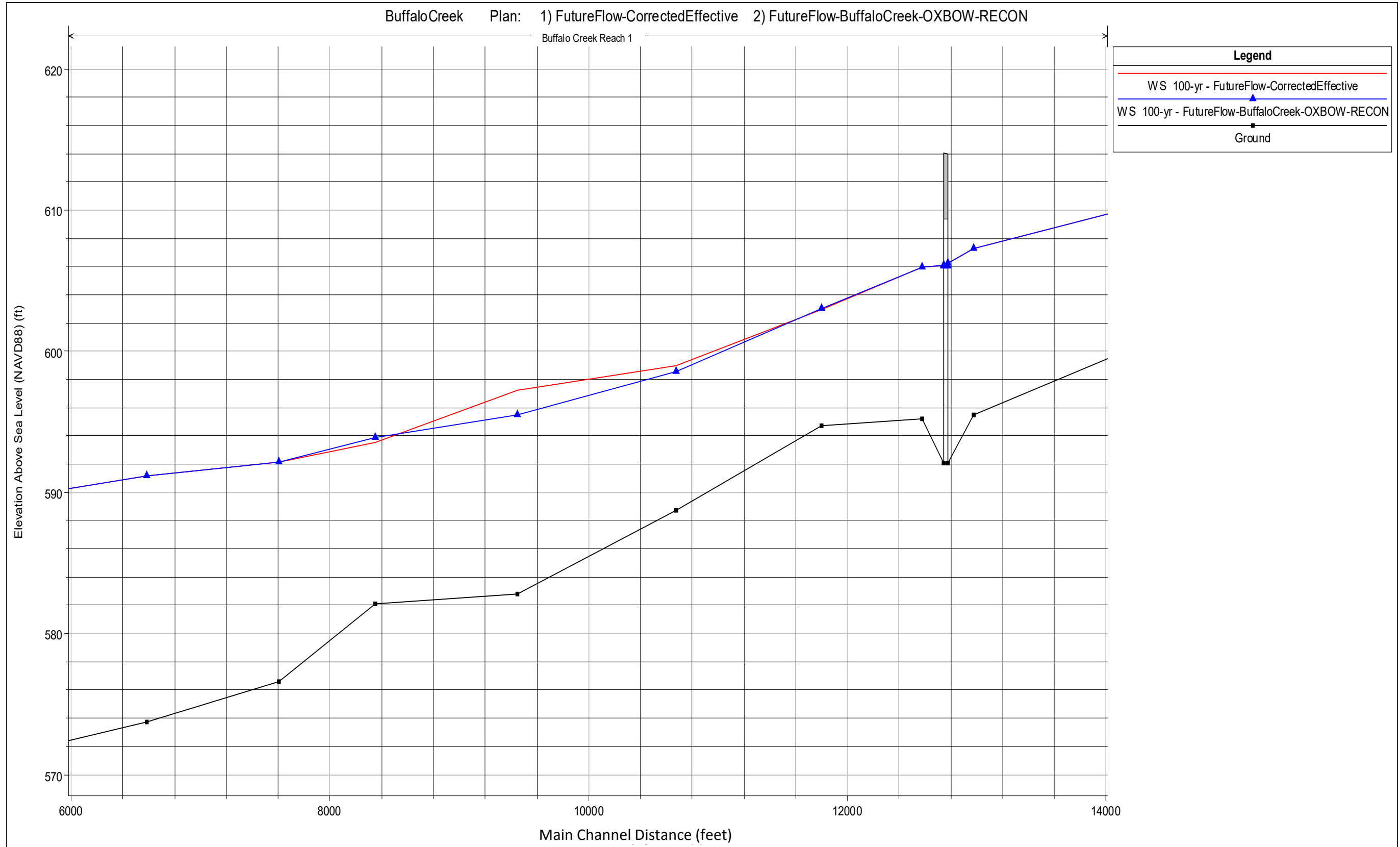
Appendix F-5b

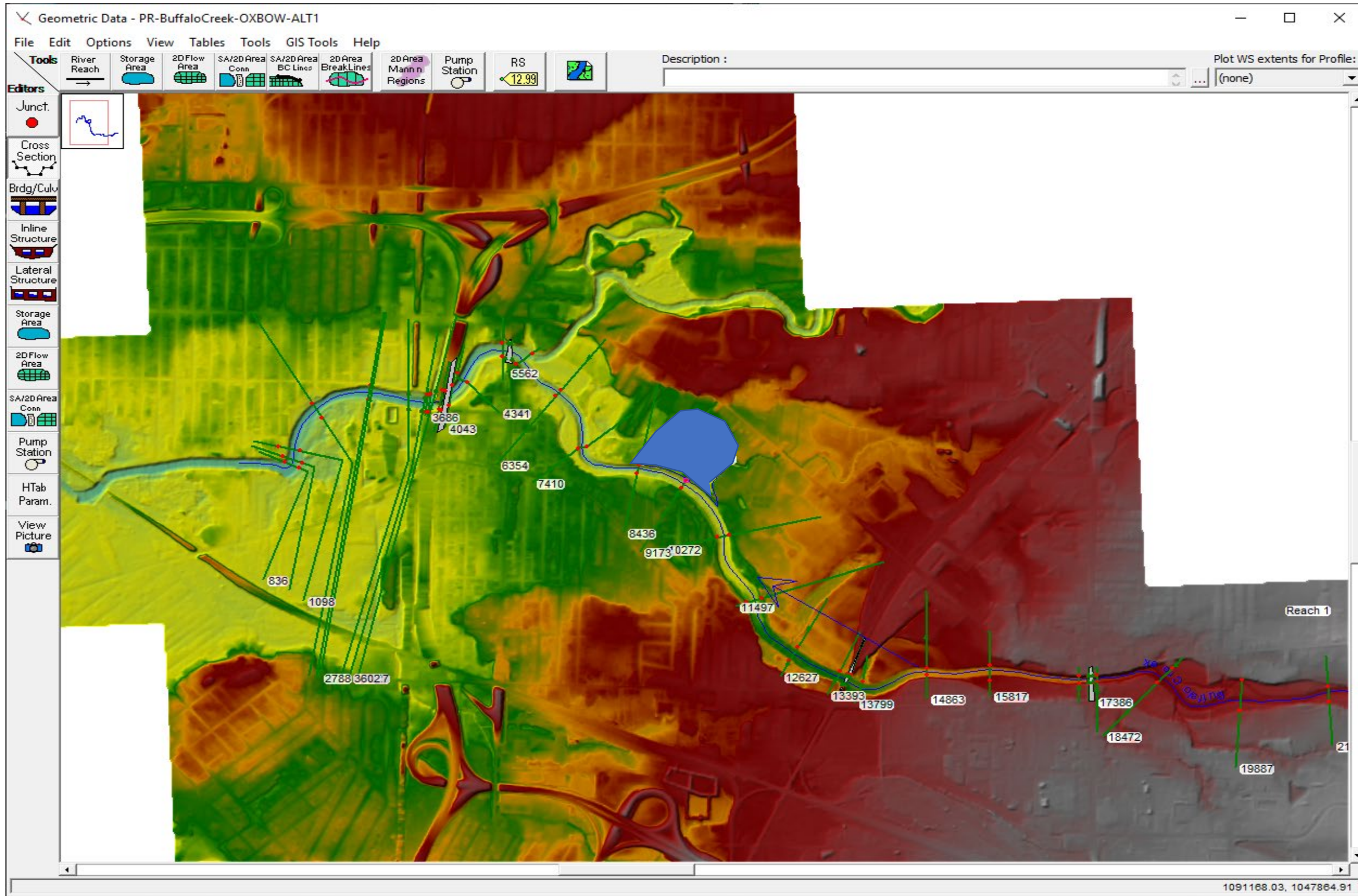
Alternative #4: Reconnect the Oxbow Lake (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-OXBOW-RECON River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers	1		# Plans		1		# River Stations		47				
# Hydraulic Reaches	1		# Profiles		1		# River Stations		47				
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
Reach 1	836	100-yr	14648	567.3		587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3		587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4		587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4		587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9		587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9		587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1		587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2		587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566		587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570		587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570		587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2		587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2		587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648	564.2		587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6		588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3		588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574		588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648	574		589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571		589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5		589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7		591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6		592.13	586.73	592.96	0.002071	7.58	2451.04	641.45	0.38
Reach 1	9173	100-yr	14648	582.1		593.89	591.82	594.36	0.001613	6.91	5306.3	1294.9	0.42
Reach 1	10272	100-yr	14648	582.8		595.51	591.73	596.6	0.002075	8.42	1826.39	264.09	0.49
Reach 1	11497	100-yr	14648	588.7		598.57	596.32	599.72	0.003158	8.6	1716.95	277.24	0.58
Reach 1	12627	100-yr	14648	594.7		603.06	601.6	604.52	0.005812	9.83	1731.62	770.7	0.72
Reach 1	13393	100-yr	14648	595.2		605.98	602.26	606.85	0.001768	7.81	2804.1	845.54	0.45
Reach 1	13514	100-yr	14648	592.1		606.08	601.12	607.03	0.000495	7.82	1873.37	285.83	0.41
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648	592.1		606.23	601.12	607.16	0.000473	7.71	1898.68	251.37	0.4
Reach 1	13799	100-yr	14648	595.5		607.31	602.19	607.49	0.000639	4.01	5131.4	672.18	0.23
Reach 1	14863	100-yr	14648	599.6		609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2		614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4		617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5		617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648	605.5		617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9		617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9		621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3		622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8		624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5		627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6		629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4		631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4		634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41





Appendix F-6b

Alternative #5: Reconnect the Oxbow Lake and install Flood Bench (Future)

HEC-RAS Model Summary

Project Buffalo Creek

Plan

FutureFlow-BufferoCreek-OXBOW-ALT1

FutureFlow-BufferoCreek-OXBOW-ALT2

FutureFlow-BufferoCreek-OXBOW-ALT3

Geometry

PR-BufferoCreek-OXBOW-ALT1

PR-BufferoCreek-OXBOW-ALT2

PR-BufferoCreek-OXBOW-ALT3

Steady Flow

USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

SA Min. Elevation 576 ft

SA Area 30 acres

60 acres

90 acres

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffero-Creek-7\N-D\1.7 H&H-Modeling>

Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Adjusted X-S 9173 that intersects SA to include Flood Bench 3, 6, 9 ft below 100-yr WSE SA Minimum Elevation = 576 ft SA Area = 30, 60, 90 acres

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Predicted Water Surface Elevations (feet) (NAVD88)			
			Future Flow Condition	ALT1 FB Depth = 3 ft	ALT2 FB Depth = 6 ft	ALT3 FB Depth = 9 ft
	836	-4726	587.4	587.4	587.4	587.4
	930	-4632	587.4	587.4	587.4	587.4
	1098	-4464	587.5	587.5	587.5	587.5
	1881	-3681	587.6	587.6	587.6	587.6
	2764	-2798	587.6	587.6	587.6	587.6
	2788	-2774	587.6	587.6	587.6	587.6
	3371	-2191	587.5	587.5	587.5	587.5
	3602	-1960	587.6	587.6	587.6	587.6
	3642	-1920	587.9	587.9	587.9	587.9
	3686	-1876	587.8	587.8	587.8	587.8
	3727	-1835	587.8	587.8	587.8	587.8
	3859	-1703	587.9	587.9	587.9	587.9
	3898	-1664	587.9	587.9	587.9	587.9
Bridge	3970.5	-1591.5				
	4043	-1519	588.0	588.0	588.0	588.0
	4341	-1221	588.1	588.1	588.1	588.1
	5199	-363	588.3	588.3	588.3	588.3
	5270	-292	588.7	588.7	588.7	588.7
Bridge	5304.5	-257.5				
	5339	-223	589.1	589.1	589.1	589.1
	5562	0	589.3	589.3	589.3	589.3
	6354	792	589.6	589.6	589.6	589.6
	7410	1848	591.2	591.2	591.2	591.2
	8436	2874	592.1	592.1	592.1	592.1
Oxbow	9173	3611	593.5	593.9	593.7	593.5
	10272	4710	597.3	595.1	594.1	592.8
	11497	5935	599.0	598.6	598.6	598.9
	12627	7065	603.0	603.1	603.0	603.0
	13393	7831	606.0	606.0	606.0	606.0
	13514	7952	606.1	606.1	606.1	606.1
Railroad Bridge	13535.3	7973.3				
	13557	7995	606.2	606.2	606.2	606.2
	13799	8237	607.3	607.3	607.3	607.3
	14863	9301	609.8	609.8	609.8	609.8
	15817	10255	614.2	614.2	614.2	614.2
	17170	11608	617.1	617.1	617.1	617.1
	17314	11752	617.1	617.1	617.1	617.1
Union Rd Bridge	17350	11788				
	17386	11824	617.7	617.7	617.7	617.7
	17442	11880	617.9	617.9	617.9	617.9
	18472	12910	621.5	621.5	621.5	621.5
	19887	14325	622.7	622.7	622.7	622.7
	21220	15658	624.7	624.7	624.7	624.7
	22540	16978	627.5	627.5	627.5	627.5
	23751	18189	629.4	629.4	629.4	629.4
	24800	19238	631.4	631.4	631.4	631.4
	25961	20399	634.7	634.7	634.7	634.7

Appendix F-6b

Alternative #5: Reconnect the Oxbow Lake and install Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-OXBOW-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

Flood bench depth = 3 ft

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	
Reach 1	836	100-yr	14648		567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648		567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648		567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648		567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648		566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648		566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648		571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648		571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648		566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648		570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648		570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648		564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648		564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648		564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648		565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648		576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648		574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648		574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648		571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648		571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648		573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648		576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648		582.1	593.88	591.83	594.18	0.001172	5.88	6322.58	1294.85	0.36
Reach 1	10272	100-yr	14648		582.8	595.1	591.71	596.31	0.002426	8.83	1737.7	462.83	0.53
Reach 1	11497	100-yr	14648		588.7	598.55	596.32	599.7	0.003193	8.63	1710.85	276	0.58
Reach 1	12627	100-yr	14648		594.7	603.07	601.6	604.52	0.005789	9.82	1734.75	773.03	0.72
Reach 1	13393	100-yr	14648		595.2	605.97	602.26	606.85	0.001769	7.81	2803.64	845.47	0.45
Reach 1	13514	100-yr	14648		592.1	606.08	601.12	607.03	0.000495	7.82	1873.27	285.81	0.41
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648		592.1	606.23	601.12	607.16	0.000473	7.72	1898.57	251.37	0.4
Reach 1	13799	100-yr	14648		595.5	607.31	602.19	607.49	0.000639	4.01	5131.08	672.17	0.23
Reach 1	14863	100-yr	14648		599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648		603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648		602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648		605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648		605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648		604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648		608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648		610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648		612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648		615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648		617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648		620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648		621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-6b

Alternative #5: Reconnect the Oxbow Lake and install Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-OXBOW-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

Flood bench depth = 6 ft

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	
Reach 1	836	100-yr	14648		567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648		567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648		567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648		567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648		566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648		566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648		571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648		571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648		566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648		570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648		570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648		564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648		564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648		564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648		565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648		576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648		574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648		574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648		571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648		571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648		573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648		576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648		582.1	593.69	591.81	593.81	0.000587	4.11	8675.07	1293.26	0.25
Reach 1	10272	100-yr	14648		582.8	594.05	591.71	595.62	0.003677	10.08	1468.7	300.79	0.63
Reach 1	11497	100-yr	14648		588.7	598.64	596.32	599.77	0.003057	8.51	1734.9	280.88	0.57
Reach 1	12627	100-yr	14648		594.7	603.04	601.6	604.51	0.005881	9.87	1722.49	763.88	0.72
Reach 1	13393	100-yr	14648		595.2	605.98	602.26	606.85	0.001767	7.81	2805.36	845.73	0.45
Reach 1	13514	100-yr	14648		592.1	606.08	601.12	607.03	0.000494	7.82	1873.64	285.87	0.41
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648		592.1	606.23	601.12	607.16	0.000473	7.71	1898.92	251.38	0.4
Reach 1	13799	100-yr	14648		595.5	607.31	602.19	607.49	0.000638	4.01	5132.23	672.2	0.23
Reach 1	14863	100-yr	14648		599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648		603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648		602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648		605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648		605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648		604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648		608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648		610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648		612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648		615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648		617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648		620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648		621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-6b

Alternative #5: Reconnect the Oxbow Lake and install Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-OXBOW-ALT3 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

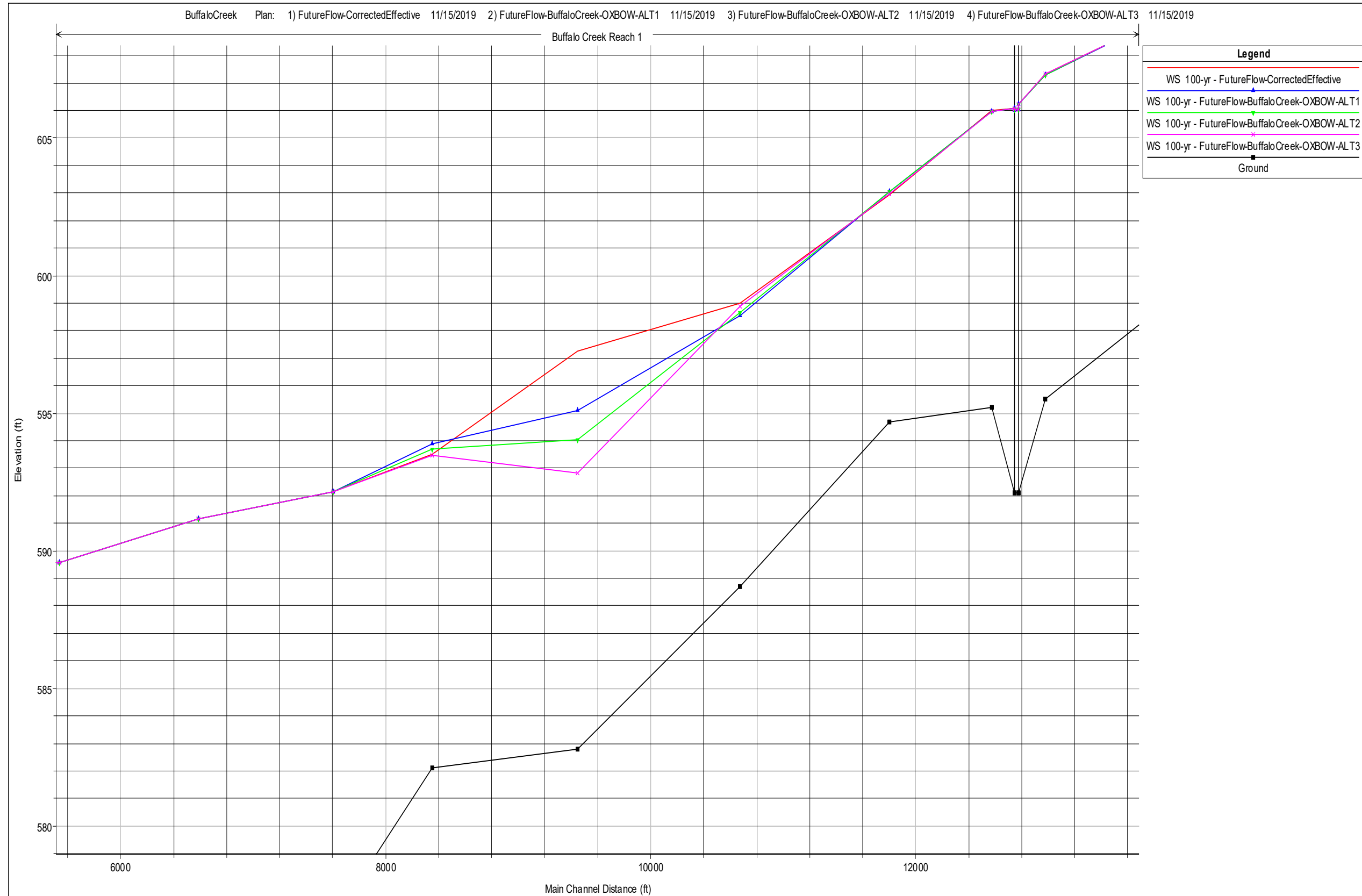
# Hydraulic Reaches = 1

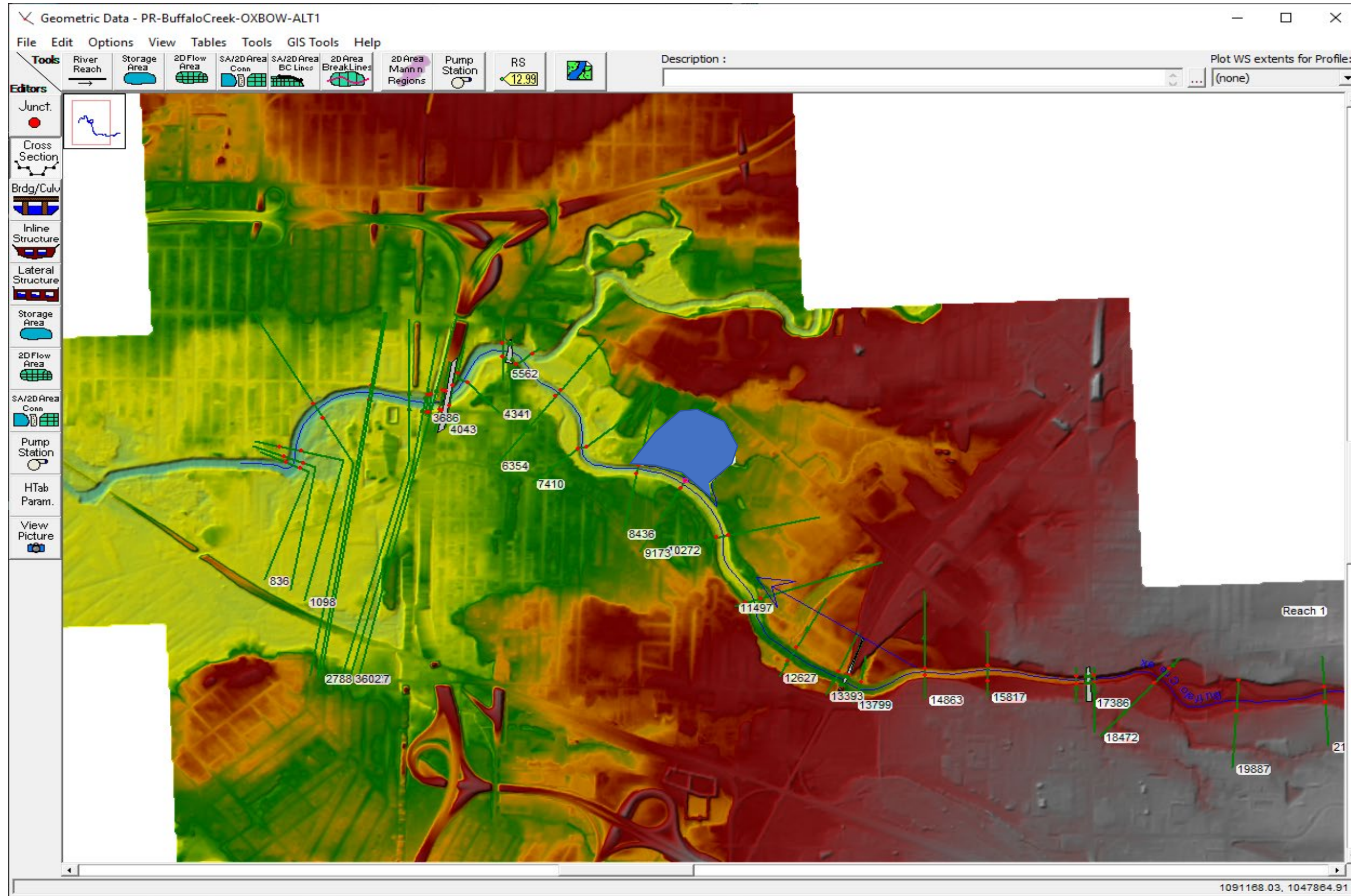
# Plans = 1

Flood bench depth = 9 ft

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	
Reach 1	836	100-yr	14648		567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648		567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648		567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648		567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648		566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648		566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648		571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648		571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648		566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648		570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648		570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648		564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648		564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648		564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648		565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648		576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648		574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648		574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648		571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648		571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648		573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648		576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648		582.1	593.46	591.81	593.51	0.000278	2.78	11545.79	1295.22	0.17
Reach 1	10272	100-yr	14648		582.8	592.83	591.71	595.03	0.006034	11.9	1231.34	177.65	0.8
Reach 1	11497	100-yr	14648		588.7	598.88	596.32	599.93	0.002737	8.23	1797.43	293.49	0.54
Reach 1	12627	100-yr	14648		594.7	602.98	601.6	604.48	0.006111	9.99	1693.43	740.73	0.74
Reach 1	13393	100-yr	14648		595.2	605.98	602.26	606.86	0.001762	7.8	2809.54	846.38	0.45
Reach 1	13514	100-yr	14648		592.1	606.09	601.12	607.04	0.000494	7.81	1874.54	285.99	0.41
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648		592.1	606.24	601.12	607.16	0.000472	7.71	1899.8	251.42	0.4
Reach 1	13799	100-yr	14648		595.5	607.31	602.19	607.49	0.000637	4.01	5135.02	672.27	0.23
Reach 1	14863	100-yr	14648		599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648		603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648		602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648		605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648		605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648		604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648		608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648		610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648		612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648		615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648		617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648		620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648		621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41







Appendix F-7b

Alternative #6: Flood Bench (Future)

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FutureFlow-BufferCreek-BENCH2-ALT1

FutureFlow-BufferCreek-BENCH2-ALT2

Geometry

PR-BufferCreek-RRremove

100YR FEMA-PR-BufferCreek-BENCH2-ALT1

100YR FEMA-PR-BufferCreek-BENCH2-ALT2

Steady Flow USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.BufferCreek-7\N-D\1.7 H&H-Modeling>

Description:

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10.

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Adjusted X-Ss RS 10272 - 13393 that intersect SA to include Flood Bench 3,6 ft below flood plain SA Minimum Elevation = 590 ft SA Area = 120, 240 acres

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Future Flow Condition	ALT1 Flood Bench = 3 ft	ALT2 Flood Bench = 6 ft
	836	-4726	587.4	587.4	587.4
	930	-4632	587.4	587.4	587.4
	1098	-4464	587.5	587.5	587.5
	1881	-3681	587.6	587.6	587.6
	2764	-2798	587.6	587.6	587.6
	2788	-2774	587.6	587.6	587.6
	3371	-2191	587.5	587.5	587.5
	3602	-1960	587.6	587.6	587.6
	3642	-1920	587.9	587.9	587.9
	3686	-1876	587.8	587.8	587.8
	3727	-1835	587.8	587.8	587.8
	3859	-1703	587.9	587.9	587.9
	3898	-1664	587.9	587.9	587.9
Bridge	3970.5	-1591.5			
	4043	-1519	588.0	588.0	588.0
	4341	-1221	588.1	588.1	588.1
	5199	-363	588.3	588.3	588.3
	5270	-292	588.7	588.7	588.7
Bridge	5304.5	-257.5			
	5339	-223	589.1	589.1	589.1
	5562	0	589.3	589.3	589.3
	6354	792	589.6	589.6	589.6
	7410	1848	591.2	591.2	591.2
	8436	2874	592.1	592.1	592.1
Oxbow	9173	3611	593.5	593.5	593.5
	10272	4710	597.3	597.3	597.2
	11497	5935	599.0	598.8	599.0
	12627	7065	603.0	602.8	602.2
	13393	7831	606.0	604.6	605.6
	13514	7952	606.1	604.4	605.3
Railroad Bridge	13535.3	7973.3			
	13557	7995	606.2	604.7	605.5
	13799	8237	607.3	606.2	606.7
	14863	9301	609.8	609.8	609.8
	15817	10255	614.2	614.2	614.2
	17170	11608	617.1	617.1	617.1
	17314	11752	617.1	617.1	617.1
Union Rd Bridge	17350	11788			
	17386	11824	617.7	617.7	617.7
	17442	11880	617.9	617.9	617.9
	18472	12910	621.5	621.5	621.5
	19887	14325	622.7	622.7	622.7
	21220	15658	624.7	624.7	624.7
	22540	16978	627.5	627.5	627.5
	23751	18189	629.4	629.4	629.4
	24800	19238	631.4	631.4	631.4
	25961	20399	634.7	634.7	634.7

Appendix F-7b

Alternative #6: Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-BENCH2-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Plans = 1

# River Stations = 44

# Hydraulic Reaches = 1

# Profiles = 1

Flood Bench Depth = 3 ft

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
Reach 1	836	100-yr	14648	567.3	587.41		575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3	587.4			587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47			587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6			587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63			587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61		577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5		578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58		578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85			588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83			588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82		578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94			588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94			588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648	564.2	587.99		576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05			588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3			588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66		580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648	574	589.1		580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33			589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58		583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18			591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13		586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51		591.81	595.63	0.004833	11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.25		591.73	597.85	0.000984	6.51	3639.5	1303.68	0.35
Reach 1	11497	100-yr	14648	588.7	598.82		596.32	599.89	0.002812	8.3	1781.9	1239.71	0.55
Reach 1	12627	100-yr	14648	594.7	602.77		601.46	603.34	0.00334	7.22	3796.89	1070.59	0.54
Reach 1	13393	100-yr	14648	595.2	604.6		602.27	605.19	0.001805	7.15	4036.89	826.39	0.44
Reach 1	13514	100-yr	14648	592.1	604.44		601.12	605.75	0.00084	9.16	1598.32	247.52	0.52
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648	592.1	604.71		601.12	605.94	0.000767	8.92	1642.71	240.19	0.5
Reach 1	13799	100-yr	14648	595.5	606.16		602.19	606.41	0.001009	4.72	4368.4	654.06	0.29
Reach 1	14863	100-yr	14648	599.6	609.8		609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16			614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08		612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12		614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648	605.5	617.73		614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86		614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46		615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69			622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68			625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54			627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39			629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4		629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67		629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-7b

Alternative #6: Flood Bench (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BufferCreek-BENCH2-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# Plans = 1

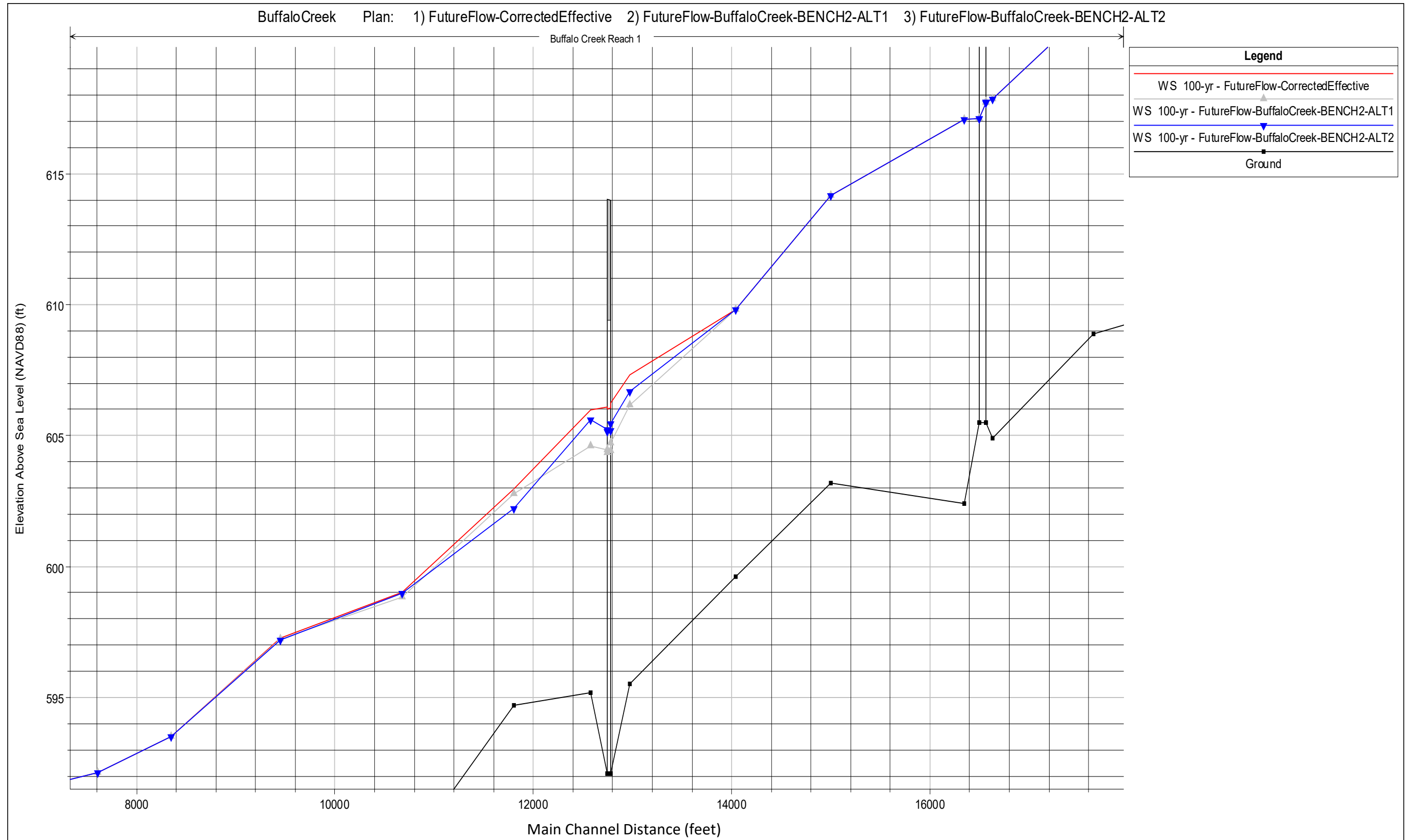
Flood Bench Depth = 6 ft

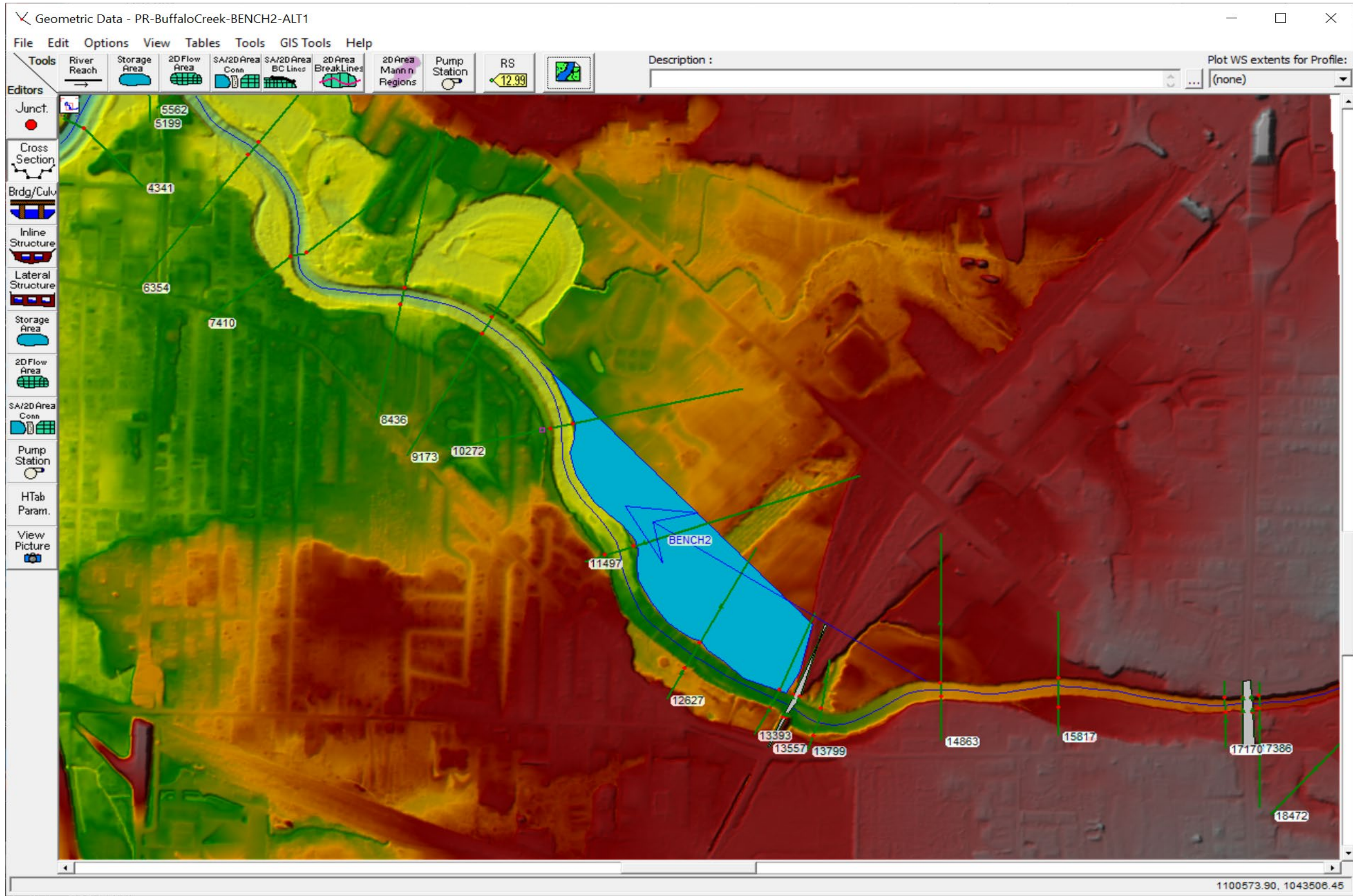
# Hydraulic Reaches = 1

# Profiles = 1

# River Stations = 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
Reach 1	836	100-yr	14648	567.3	587.41	575.74	587.54	0.00012		3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr	14648	567.3	587.4		587.56	0.000124		3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr	14648	567.4	587.47		587.58	0.000099		2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr	14648	567.4	587.6		587.64	0.000057		2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr	14648	566.9	587.63		587.71	0.000094		2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr	14648	566.9	587.61	577.38	587.72	0.000119		3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr	14648	571.1	587.5	578.65	587.93	0.000357		5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr	14648	571.2	587.58	578.75	588.01	0.000311		5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr	14648	566	587.85		588.04	0.000105		3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr	14648	570	587.83		588.05	0.000149		3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr	14648	570	587.82	578.98	588.07	0.000246		4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr	14648	564.2	587.94		588.11	0.000139		3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr	14648	564.2	587.94		588.11	0.000097		3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr	14648	564.2	587.99	576.08	588.16	0.000245		3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr	14648	565.6	588.05		588.27	0.000314		3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr	14648	576.3	588.3		588.82	0.001071		5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr	14648	574	588.66	580.99	589	0.000578		4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr	14648	574	589.1	580.99	589.41	0.000514		4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr	14648	571	589.33		589.53	0.000571		3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr	14648	571.5	589.58	583.92	590.3	0.001101		7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr	14648	573.7	591.18		591.5	0.001102		5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr	14648	576.6	592.13	586.89	592.98	0.002094		7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr	14648	582.1	593.51	591.81	595.63	0.004833		11.68	1253.6	1138.25	0.72
Reach 1	10272	100-yr	14648	582.8	597.18	591.73	597.89	0.001119		6.91	2699.92	1298.02	0.37
Reach 1	11497	100-yr	14648	588.7	598.97	596.32	599.99	0.002632		8.13	1820.3	1286.29	0.53
Reach 1	12627	100-yr	14648	594.7	602.21	601.46	604.4	0.009436		11.86	1235.54	1026.15	0.91
Reach 1	13393	100-yr	14648	595.2	605.61	602.27	605.78	0.000605		4.45	6714.68	978.68	0.26
Reach 1	13514	100-yr	14648	592.1	605.25	601.12	606.36	0.000641		8.45	1733.55	266.36	0.46
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr	14648	592.1	605.45	601.12	606.51	0.000602		8.29	1766.48	245.6	0.45
Reach 1	13799	100-yr	14648	595.5	606.69	602.19	606.91	0.00081		4.37	4719.99	662.47	0.26
Reach 1	14863	100-yr	14648	599.6	609.8	609.8	611.85	0.005074		12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr	14648	603.2	614.16		614.79	0.00188		6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr	14648	602.4	617.08	612.35	618.42	0.003609		9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr	14648	605.5	617.12	614.39	619.42	0.003381		12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr	14648	605.5	617.73	614.39	619.8	0.002822		11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr	14648	604.9	617.86	614.88	620.03	0.003225		11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr	14648	608.9	621.46	615.27	621.63	0.000766		3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr	14648	610.3	622.69		622.86	0.000957		3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr	14648	612.8	624.68		625.27	0.003998		6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr	14648	615.5	627.54		627.89	0.00116		5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr	14648	617.6	629.39		629.84	0.002347		6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr	14648	620.4	631.4	629.35	632.71	0.002617		9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr	14648	621.4	634.67	629.64	635.64	0.002342		8.1	2187.06	350.27	0.41





Appendix F-8b

Alternative #8: Levee (Future)

HEC-RAS Future Flow Model Summary

Project BuffaloCreek

Plan

FutureFlow-BufferCreek-LEVEE-ALT1

FutureFlow-BufferCreek-LEVEE-ALT2

Geometry

PR-BufferCreek-LEVEE-ALT1

PR-BufferCreek-LEVEE-ALT2

Steady Flow

USGS FutureFlows RCP8.5 2075-2099

Reach 1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.BufferCreek-7\N-D\1.7 H&H-Modeling>

Description:

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software.

Levees were added to select cross sections on the left bank of Buffalo Creek near the Lexington Green Neighborhood for 100-yr water surface elevations plus 2-foot of free board at varying distances along reach.

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)		
			Future Flow Condition	ALT1 Levee Distance: 2324 ft	ALT2 Levee Distance: 5078 ft
	836	-4726	587.4	587.4	587.4
	930	-4632	587.4	587.4	587.4
	1098	-4464	587.5	587.5	587.5
	1881	-3681	587.6	587.6	587.6
	2764	-2798	587.6	587.6	587.6
	2788	-2774	587.6	587.6	587.6
	3371	-2191	587.5	587.5	587.5
	3602	-1960	587.6	587.6	587.6
	3642	-1920	587.9	587.9	587.9
	3686	-1876	587.8	587.8	587.8
	3727	-1835	587.8	587.8	587.8
	3859	-1703	587.9	587.9	587.9
	3898	-1664	587.9	587.9	587.9
Bridge	3970.5	-1591.5			
	4043	-1519	588.0	588.0	588.0
	4341	-1221	588.1	588.1	588.1
	5199	-363	588.3	588.3	588.3
	5270	-292	588.7	588.7	588.7
Bridge	5304.5	-257.5			
	5339	-223	589.1	589.1	589.1
	5562	0	589.3	589.3	589.3
	6354	792	589.6	589.6	589.6
	7410	1848	591.2	591.2	591.2
	8436	2874	592.1	592.1	592.1
Oxbow	9173	3611	593.5	593.5	593.5
	10272	4710	597.3	597.3	597.3
	11497	5935	599.0	599.1	599.1
	12627	7065	603.0	602.9	602.9
	13393	7831	606.0	606.0	606.0
	13514	7952	606.1	606.1	606.1
Railroad Bridge	13535.3	7973.3			
	13557	7995	606.2	606.3	606.3
	13799	8237	607.3	607.3	607.3
	14863	9301	609.8	609.8	609.8
	15817	10255	614.2	614.2	614.2
	17170	11608	617.1	617.1	617.1
	17314	11752	617.1	617.1	617.1
Union Rd Bridge	17350	11788			
	17386	11824	617.7	617.7	617.7
	17442	11880	617.9	617.9	617.9
	18472	12910	621.5	621.5	621.5
	19887	14325	622.7	622.7	622.7
	21220	15658	624.7	624.7	624.7
	22540	16978	627.5	627.5	627.5
	23751	18189	629.4	629.4	629.4
	24800	19238	631.4	631.4	631.4
	25961	20399	634.7	634.7	634.7



Appendix F-8b

Alternative #8: Levee (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-LEVEE-ALT1 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

# Hydraulic Reaches = 1

# Plans = 1

Levee distance = 2324 ft

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
Reach 1	836	100-yr		14648	567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr		14648	567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr		14648	567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr		14648	567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr		14648	566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr		14648	566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr		14648	571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr		14648	571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr		14648	566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr		14648	570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr		14648	570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr		14648	564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr		14648	564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5	Bridge											
Reach 1	4043	100-yr		14648	564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr		14648	565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr		14648	576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr		14648	574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5	Bridge											
Reach 1	5339	100-yr		14648	574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr		14648	571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr		14648	571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr		14648	573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr		14648	576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr		14648	582.1	593.51	591.82	595.63	0.004833	11.68	1253.59	1138.24	0.72
Reach 1	10272	100-yr		14648	582.8	597.28	591.71	598.01	0.001118	6.95	2394.74	421.46	0.37
Reach 1	11497	100-yr		14648	588.7	599.07	596.34	600.06	0.002516	8.02	1846.86	303.39	0.52
Reach 1	12627	100-yr		14648	594.7	602.93	601.6	604.47	0.006275	10.08	1673.66	723.36	0.75
Reach 1	13393	100-yr		14648	595.2	605.99	602.26	606.86	0.001755	7.79	2815.48	847.3	0.45
Reach 1	13514	100-yr		14648	592.1	606.1	601.12	607.04	0.000493	7.81	1875.81	286.17	0.41
Reach 1	13535.3	Bridge											
Reach 1	13557	100-yr		14648	592.1	606.25	601.12	607.17	0.000471	7.71	1901.01	251.47	0.4
Reach 1	13799	100-yr		14648	595.5	607.32	602.19	607.5	0.000636	4.01	5138.96	672.36	0.23
Reach 1	14863	100-yr		14648	599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr		14648	603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr		14648	602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr		14648	605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350	Bridge											
Reach 1	17386	100-yr		14648	605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr		14648	604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr		14648	608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr		14648	610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr		14648	612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr		14648	615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr		14648	617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr		14648	620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr		14648	621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-8b

Alternative #8: Levee (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-LEVEE-ALT2 River: Buffalo Creek Reach: Reach 1 Profile: 100-yr

# Rivers = 1

# River Stations = 47

# Profiles = 1

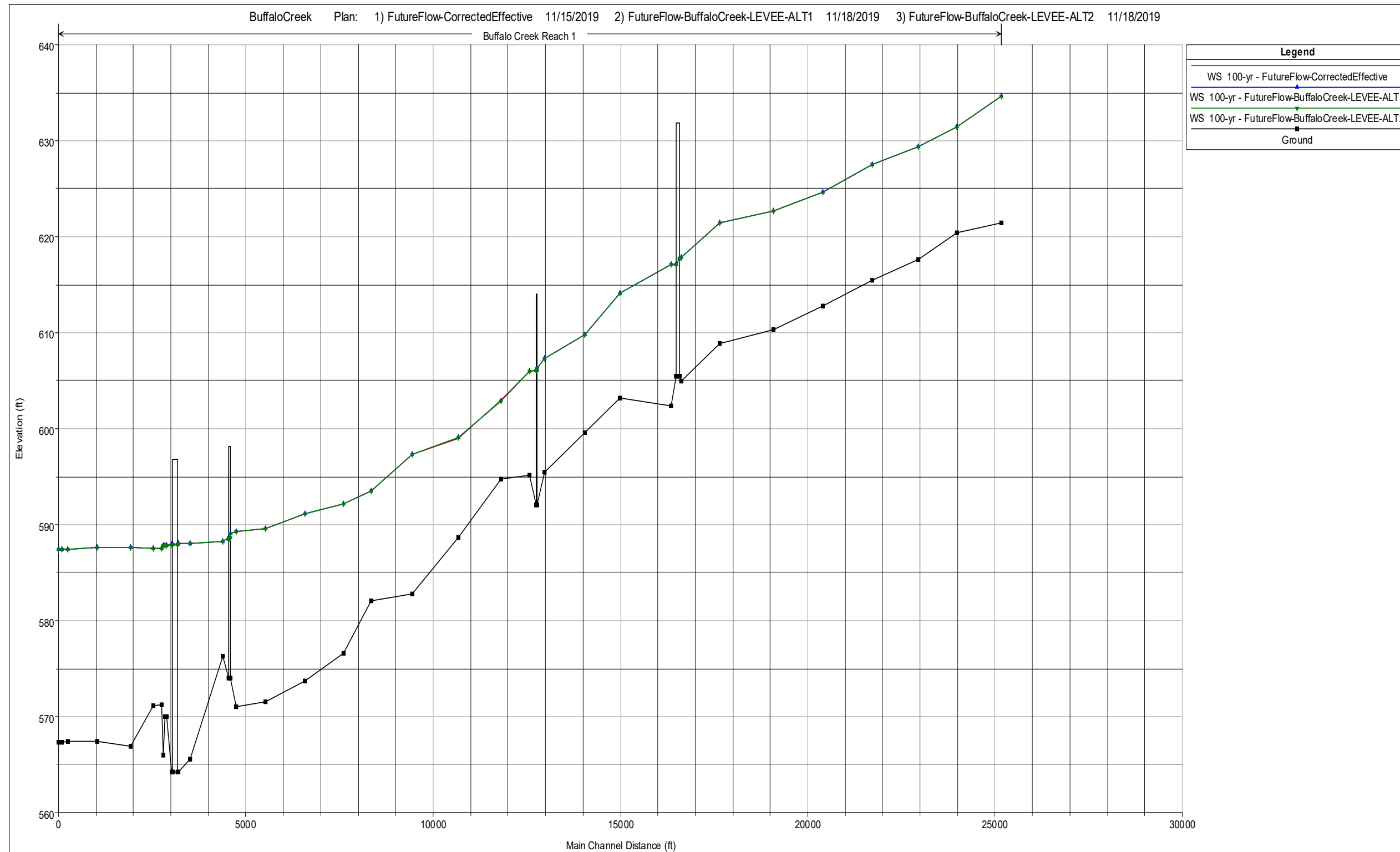
# Hydraulic Reaches = 1

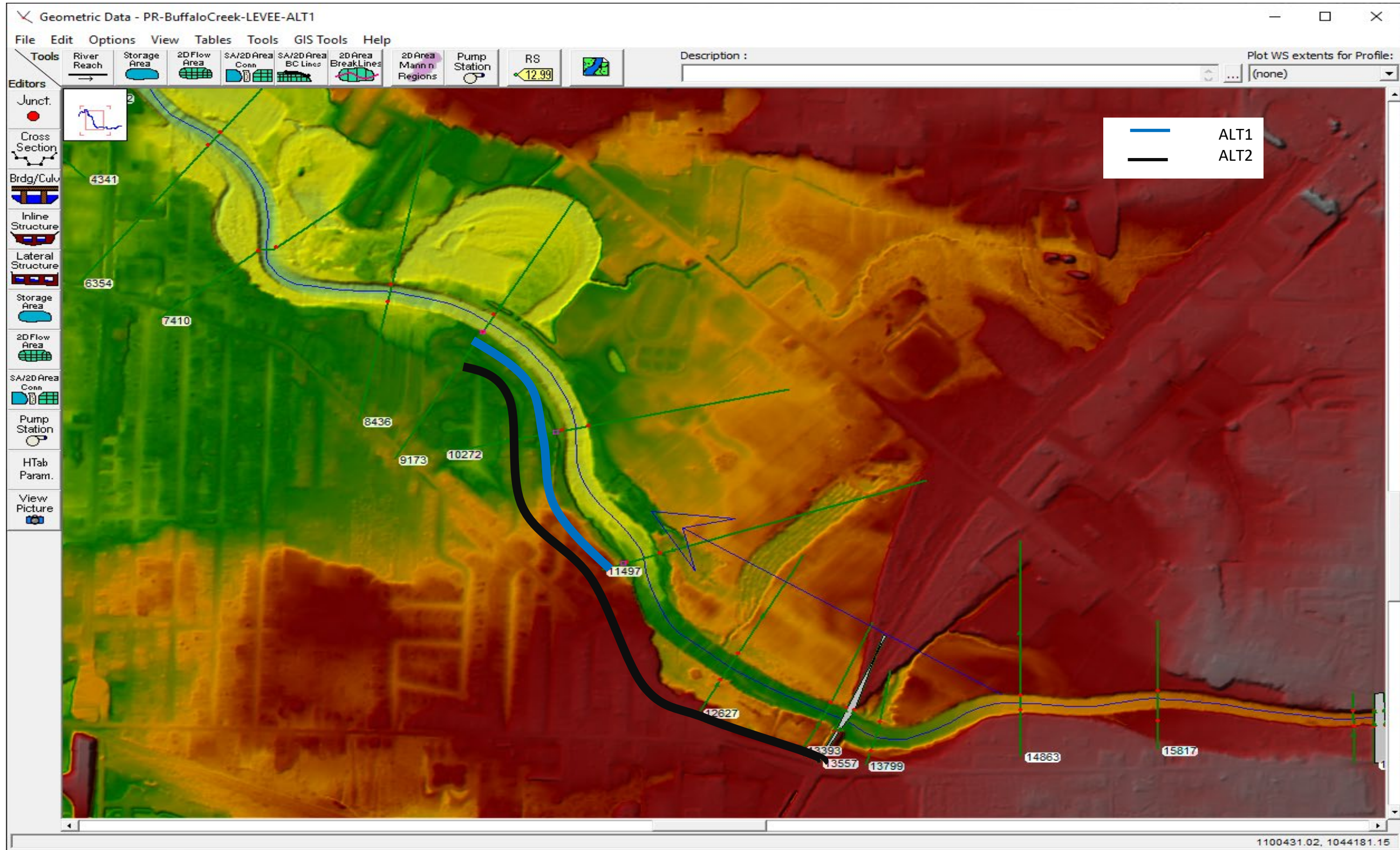
# Plans = 1

Levee distance = 5078 ft

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
Reach 1	836	100-yr		14648	567.3	587.41	575.74	587.54	0.00012	3.26	9648.5	1211.62	0.15
Reach 1	930	100-yr		14648	567.3	587.4		587.56	0.000124	3.25	5579.23	1231.37	0.15
Reach 1	1098	100-yr		14648	567.4	587.47		587.58	0.000099	2.75	8841.36	1539.84	0.13
Reach 1	1881	100-yr		14648	567.4	587.6		587.64	0.000057	2.15	17155.38	2578.87	0.1
Reach 1	2764	100-yr		14648	566.9	587.63		587.71	0.000094	2.9	16929.98	3785.02	0.14
Reach 1	2788	100-yr		14648	566.9	587.61	577.38	587.72	0.000119	3.26	14061.48	3655.36	0.16
Reach 1	3371	100-yr		14648	571.1	587.5	578.65	587.93	0.000357	5.22	2808.27	1954.05	0.27
Reach 1	3602	100-yr		14648	571.2	587.58	578.75	588.01	0.000311	5.27	2781.74	370.12	0.26
Reach 1	3642	100-yr		14648	566	587.85		588.04	0.000105	3.47	4243.5	340.99	0.16
Reach 1	3686	100-yr		14648	570	587.83		588.05	0.000149	3.8	3856.42	327.25	0.19
Reach 1	3727	100-yr		14648	570	587.82	578.98	588.07	0.000246	4.01	3655.24	306.11	0.2
Reach 1	3859	100-yr		14648	564.2	587.94		588.11	0.000139	3.3	4432.55	323.84	0.16
Reach 1	3898	100-yr		14648	564.2	587.94		588.11	0.000097	3.3	4433.54	323.85	0.16
Reach 1	3970.5		Bridge										
Reach 1	4043	100-yr		14648	564.2	587.99	576.08	588.16	0.000245	3.29	4449.93	323.99	0.16
Reach 1	4341	100-yr		14648	565.6	588.05		588.27	0.000314	3.86	4126.61	367.07	0.18
Reach 1	5199	100-yr		14648	576.3	588.3		588.82	0.001071	5.85	2610.72	361.59	0.32
Reach 1	5270	100-yr		14648	574	588.66	580.99	589	0.000578	4.68	3129.53	348.94	0.24
Reach 1	5304.5		Bridge										
Reach 1	5339	100-yr		14648	574	589.1	580.99	589.41	0.000514	4.52	3242.61	354.56	0.23
Reach 1	5562	100-yr		14648	571	589.33		589.53	0.000571	3.67	4290.63	385.3	0.18
Reach 1	6354	100-yr		14648	571.5	589.58	583.92	590.3	0.001101	7.39	3763.14	960.71	0.37
Reach 1	7410	100-yr		14648	573.7	591.18		591.5	0.001102	5.39	5171.23	920.97	0.26
Reach 1	8436	100-yr		14648	576.6	592.13	586.89	592.98	0.002094	7.63	2410.64	633.11	0.39
Reach 1	9173	100-yr		14648	582.1	593.51	591.82	595.63	0.004833	11.68	1253.59	1138.24	0.72
Reach 1	10272	100-yr		14648	582.8	597.28	591.71	598.01	0.001118	6.95	2394.74	421.46	0.37
Reach 1	11497	100-yr		14648	588.7	599.07	596.34	600.06	0.002516	8.02	1846.86	303.39	0.52
Reach 1	12627	100-yr		14648	594.7	602.93	601.6	604.47	0.006275	10.08	1673.61	615.36	0.75
Reach 1	13393	100-yr		14648	595.2	605.99	602.26	606.86	0.001761	7.78	2815.15	684.76	0.45
Reach 1	13514	100-yr		14648	592.1	606.1	601.12	607.05	0.000492	7.81	1876.15	271.96	0.41
Reach 1	13535.3		Bridge										
Reach 1	13557	100-yr		14648	592.1	606.25	601.12	607.17	0.000471	7.7	1901.34	251.49	0.4
Reach 1	13799	100-yr		14648	595.5	607.32	602.19	607.5	0.000636	4.01	5140.06	672.38	0.23
Reach 1	14863	100-yr		14648	599.6	609.8	609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1	15817	100-yr		14648	603.2	614.16		614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1	17170	100-yr		14648	602.4	617.08	612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1	17314	100-yr		14648	605.5	617.12	614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1	17350		Bridge										
Reach 1	17386	100-yr		14648	605.5	617.73	614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1	17442	100-yr		14648	604.9	617.86	614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1	18472	100-yr		14648	608.9	621.46	615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1	19887	100-yr		14648	610.3	622.69		622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1	21220	100-yr		14648	612.8	624.68		625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1	22540	100-yr		14648	615.5	627.54		627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1	23751	100-yr		14648	617.6	629.39		629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1	24800	100-yr		14648	620.4	631.4	629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1	25961	100-yr		14648	621.4	634.67	629.64	635.64	0.002342	8.1	2187.06	350.27	0.41

Appendix F-8b  
Alternative #8: Levee (Future)





Appendix F-9b

Alternative #9: Pilot Channel (Future)

HEC-RAS Model Summary

Project BuffaloCreek

Plan

FutureFlow-BufferCreek-PILOT3-ALT1

FutureFlow-BufferCreek-PILOT3-ALT2

Geometry

PR-BufferCreek-PILOT3-ALT1

PR-BufferCreek-PILOT3-ALT2

Steady Flow Pilot Channel Future Flows 35%

Reach 1, 2, P1

Profile 100-year

Directory

<\\server29-01\projects\Nys-Ogs.2069\72515.Buffalo-Creek-7\N-D\1.7 H&H-Modeling>

Channel Width 100 ft

200 ft

Min Elev. 586 ft

590 ft

Description:

Cross-section geometry was updated to follow more closely the topographic profile of terrain. Manning n-values adjusted for channel banks to 0.10 from 100/10.

Used mean predicted future discharge (cfs) calculated using USGS FutureFlow software. Aggregate of 5 climate models for RCP8.5 2075-2099.

Pilot channel joined to reach 1 downstream RS 13393. Width = 200 ft; Min elev. = 590 ft; depth = 6.5,11,13 ft. Removed inactive railroad bridge. SA created at oxbow intersecting RS 9173 and 8436 and joining pilot channel with reach 1 and adjsuted X-Ss to below 100-yr WSE with levees. Area = 30 ac. Min Elev = 585 ft.

	USGS Streamstats	65% discharge	35% discharge
Q1.25	3743	2432.95	1310.05
Q2	5142	3342.3	1799.7
Q5	7337	4769.05	2567.95
Q10	8922	5799.3	3122.7
Q50	12887	8376.55	4510.45
Q100	14648	9521.2	5126.8
Q500	19099	12414.35	6684.65

River Structure	River Station (ft)	Distance from Confluence with Cayuga Creek (ft)	Water Surface Elevations (feet) (NAVD88)			
			Future Flow Condition	ALT1 Chnl width = 200 ft	ALT2 Chnl width = 200 ft	ALT3 Chnl width = 100 ft
	836	-4726	587.4	587.4	587.4	587.4
	930	-4632	587.4	587.4	587.4	587.4
	1098	-4464	587.5	587.5	587.5	587.5
	1881	-3681	587.6	587.6	587.6	587.6
	2764	-2798	587.6	587.6	587.6	587.6
	2788	-2774	587.6	587.6	587.6	587.6
	3371	-2191	587.5	587.5	587.5	587.5
	3602	-1960	587.6	587.6	587.6	587.6
	3642	-1920	587.9	587.9	587.9	587.9
	3686	-1876	587.8	587.8	587.8	587.8
	3727	-1835	587.8	587.8	587.8	587.8
	3859	-1703	587.9	587.9	587.9	587.9
	3898	-1664	587.9	587.9	587.9	587.9
Bridge	3970.5	-1591.5				
	4043	-1519	588.0	588.0	588.0	588.0
	4341	-1221	588.1	588.1	588.1	588.1
	5199	-363	588.3	588.3	588.3	588.3
	5270	-292	588.7	588.7	588.7	588.7
Bridge	5304.5	-257.5				
	5339	-223	589.1	589.1	589.1	589.1
	5562	0	589.3	589.3	589.3	589.3
	6354	792	589.6	589.6	589.6	589.6
	7410	1848	591.2	591.2	591.2	591.2
	8436	2874	592.1	592.1	592.1	592.1
Oxbow	9173	3611	593.5	593.8	593.8	593.8
	10272	4710	597.3	594.6	594.6	594.6
	11497	5935	599.0	596.8	596.8	596.8
	12627	7065	603.0	601.3	601.3	601.3
	13393	7831	606.0	602.3	602.3	602.3
	13514	7952	606.1			
Railroad Bridge	13535.3	7973.3				
	13557	7995	606.2			
	13799	8237	607.3	606.7	606.7	606.7
	14863	9301	609.8	609.8	609.8	609.8
	15817	10255	614.2	614.2	614.2	614.2
	17170	11608	617.1	617.1	617.1	617.1
	17314	11752	617.1	617.1	617.1	617.1
Union Rd Bridge	17350	11788				
	17386	11824	617.7	617.7	617.7	617.7
	17442	11880	617.9	617.9	617.9	617.9
	18472	12910	621.5	621.5	621.5	621.5
	19887	14325	622.7	622.7	622.7	622.7
	21220	15658	624.7	624.7	624.7	624.7
	22540	16978	627.5	627.5	627.5	627.5
	23751	18189	629.4	629.4	629.4	629.4
	24800	19238	631.4	631.4	631.4	631.4
	25961	20399	634.7	634.7	634.7	634.7
P1	656	4647		594.2	590.3	592.5
P1	1771	5762		600.8	597.0	601.4
P1	3160	7151		602.7	598.9	603.8

Appendix F-9b  
Alternative #9: Pilot Channel (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-PILOT3-ALT1 Profile: 100-yr

# Rivers		1	# Plans		1		Channel width = 200 ft		Min elev = 590 ft				
# Hydraulic React s = 1			# Profiles		1		# River Stations = 47						
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
Reach 2		836 100-yr	14648	567.3	587.41		575.78	587.54	0.00012	3.26	9647.98	1211.59	0.15
Reach 2		930 100-yr	14648	567.3	587.39			587.56	0.000124	3.25	5578.78	1231.17	0.15
Reach 2		1098 100-yr	14648	567.4	587.47			587.58	0.000099	2.75	8840.7	1539.76	0.13
Reach 2		1881 100-yr	14648	567.4	587.6			587.64	0.000057	2.15	17154.28	2578.81	0.1
Reach 2		2764 100-yr	14648	566.9	587.63			587.71	0.000094	2.9	16928.36	3784.96	0.14
Reach 2		2788 100-yr	14648	566.9	587.61	577.38		587.72	0.000119	3.26	14059.91	3655.18	0.16
Reach 2		3371 100-yr	14648	571.1	587.5	578.65		587.93	0.000357	5.22	2808.17	1953.92	0.27
Reach 2		3602 100-yr	14648	571.2	587.58	578.75		588.01	0.000311	5.27	2781.66	370.11	0.26
Reach 2		3642 100-yr	14648	566	587.85			588.04	0.000105	3.47	4243.38	340.98	0.16
Reach 2		3686 100-yr	14648	570	587.83			588.05	0.000149	3.8	3856.3	327.24	0.19
Reach 2		3727 100-yr	14648	570	587.82	578.98		588.07	0.000246	4.01	3655.11	306.11	0.2
Reach 2		3859 100-yr	14648	564.2	587.94			588.11	0.000139	3.3	4432.41	323.84	0.16
Reach 2		3898 100-yr	14648	564.2	587.94			588.11	0.000097	3.3	4433.4	323.85	0.16
Reach 2		3970.5	Bridge										
Reach 2		4043 100-yr	14648	564.2	587.99	576.09		588.16	0.000245	3.29	4449.81	323.99	0.16
Reach 2		4341 100-yr	14648	565.6	588.05			588.27	0.000314	3.86	4126.48	367.06	0.18
Reach 2		5199 100-yr	14648	576.3	588.3			588.82	0.001071	5.85	2610.56	361.57	0.32
Reach 2		5270 100-yr	14648	574	588.66	580.99		589	0.000578	4.68	3129.45	348.94	0.24
Reach 2		5304.5	Bridge										
Reach 2		5339 100-yr	14648	574	589.1	580.99		589.41	0.000514	4.52	3242.52	354.55	0.23
Reach 2		5562 100-yr	14648	571	589.33			589.53	0.000571	3.67	4290.49	385.3	0.18
Reach 2		6354 100-yr	14648	571.5	589.58	583.92		590.3	0.001101	7.39	3762.79	960.64	0.37
Reach 2		7410 100-yr	14648	573.7	591.18			591.5	0.001103	5.39	5171.06	920.97	0.26
Reach 2		8436 100-yr	14648	576.6	592.13	586.73		592.96	0.002068	7.58	2454.17	641.43	0.38
Reach 2		9173 100-yr	9521.2	582.1	593.77	590.01		593.98	0.000716	4.6	5216.27	1293.86	0.28
Reach 2		10272 100-yr	9521.2	582.8	594.56	589.96		595.14	0.001275	6.13	1586.73	239.55	0.38
Reach 2		11497 100-yr	9521.2	588.7	596.79	594.92		597.67	0.003535	7.53	1265.17	245.61	0.58
Reach 2		12627 100-yr	9521.2	594.7	601.28	599.93		602.54	0.005166	9.02	1092.08	274.35	0.68
Reach 1		13393 100-yr	14648	595.2	602.26	602.26		605.26	0.010023	13.89	1054.77	175.34	1
Reach 1		13799 100-yr	14648	595.5	606.67	602.19		606.88	0.000818	4.38	4703.86	662.09	0.26
Reach 1		14863 100-yr	14648	599.6	609.8	609.8		611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1		15817 100-yr	14648	603.2	614.16			614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1		17170 100-yr	14648	602.4	617.08	612.35		618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1		17314 100-yr	14648	605.5	617.12	614.39		619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1		17350	Bridge										
Reach 1		17386 100-yr	14648	605.5	617.73	614.39		619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1		17442 100-yr	14648	604.9	617.86	614.88		620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1		18472 100-yr	14648	608.9	621.46	615.27		621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1		19887 100-yr	14648	610.3	622.69			622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1		21220 100-yr	14648	612.8	624.68			625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1		22540 100-yr	14648	615.5	627.54			627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1		23751 100-yr	14648	617.6	629.39			629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1		24800 100-yr	14648	620.4	631.4	629.35		632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1		25961 100-yr	14648	621.4	634.67	629.64		635.64	0.002342	8.1	2187.06	350.27	0.41
P1		656 100-yr	5126.8	590	594.16	594.16		595.73	0.024719	10.04	510.81	165.38	1.01
P1		1771 100-yr	5126.8	590	600.76			600.93	0.001835	3.28	1561.9	199.61	0.21
P1		3160 100-yr	5126.8	590	602.7			602.82	0.001047	2.77	1850.28	199.2	0.16

Appendix F-9b

Alternative #9: Pilot Channel (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-PILOT3-ALT2 Profile: 100-yr

# Rivers		1		# Plans		1		Channel width = 200 ft		Min elev = 586 ft			
# Hydraulic Reachs = 1				# Profiles		1		# River Stations = 47					
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
Reach 2		836 100-yr	14648	567.3	587.41		575.77	587.54	0.00012	3.26	9648.06	1211.6	0.15
Reach 2		930 100-yr	14648	567.3	587.39			587.56	0.000124	3.25	5578.86	1231.2	0.15
Reach 2		1098 100-yr	14648	567.4	587.47			587.58	0.000099	2.75	8840.79	1539.77	0.13
Reach 2		1881 100-yr	14648	567.4	587.6			587.64	0.000057	2.15	17154.43	2578.82	0.1
Reach 2		2764 100-yr	14648	566.9	587.63			587.71	0.000094	2.9	16928.59	3784.96	0.14
Reach 2		2788 100-yr	14648	566.9	587.61		577.38	587.72	0.000119	3.26	14060.14	3655.21	0.16
Reach 2		3371 100-yr	14648	571.1	587.5		578.65	587.93	0.000357	5.22	2808.18	1953.94	0.27
Reach 2		3602 100-yr	14648	571.2	587.58		578.75	588.01	0.000311	5.27	2781.67	370.11	0.26
Reach 2		3642 100-yr	14648	566	587.85			588.04	0.000105	3.47	4243.4	340.98	0.16
Reach 2		3686 100-yr	14648	570	587.83			588.05	0.000149	3.8	3856.32	327.24	0.19
Reach 2		3727 100-yr	14648	570	587.82		578.98	588.07	0.000246	4.01	3655.13	306.11	0.2
Reach 2		3859 100-yr	14648	564.2	587.94			588.11	0.000139	3.3	4432.43	323.84	0.16
Reach 2		3898 100-yr	14648	564.2	587.94			588.11	0.000097	3.3	4433.42	323.85	0.16
Reach 2		3970.5											
Reach 2		4043 100-yr	14648	564.2	587.99		576.09	588.16	0.000245	3.29	4449.81	323.99	0.16
Reach 2		4341 100-yr	14648	565.6	588.05			588.27	0.000314	3.86	4126.48	367.06	0.18
Reach 2		5199 100-yr	14648	576.3	588.3			588.82	0.001071	5.85	2610.56	361.57	0.32
Reach 2		5270 100-yr	14648	574	588.66		580.99	589	0.000578	4.68	3129.45	348.94	0.24
Reach 2		5304.5											
Reach 2		5339 100-yr	14648	574	589.1		580.99	589.41	0.000514	4.52	3242.52	354.55	0.23
Reach 2		5562 100-yr	14648	571	589.33			589.53	0.000571	3.67	4290.49	385.3	0.18
Reach 2		6354 100-yr	14648	571.5	589.58		583.92	590.3	0.001101	7.39	3762.79	960.64	0.37
Reach 2		7410 100-yr	14648	573.7	591.18			591.5	0.001103	5.39	5171.06	920.97	0.26
Reach 2		8436 100-yr	14648	576.6	592.13		586.73	592.96	0.002068	7.58	2454.17	641.43	0.38
Reach 2		9173 100-yr	9521.2	582.1	593.77		590.01	593.98	0.000716	4.6	5216.27	1293.86	0.28
Reach 2		10272 100-yr	9521.2	582.8	594.56		589.96	595.14	0.001275	6.13	1586.73	239.55	0.38
Reach 2		11497 100-yr	9521.2	588.7	596.79		594.92	597.67	0.003535	7.53	1265.17	245.61	0.58
Reach 2		12627 100-yr	9521.2	594.7	601.28		599.93	602.54	0.005166	9.02	1092.08	274.35	0.68
Reach 1		13393 100-yr	14648	595.2	602.26		602.26	605.26	0.010023	13.89	1054.77	175.34	1
Reach 1		13799 100-yr	14648	595.5	606.67		602.19	606.88	0.000818	4.38	4703.86	662.09	0.26
Reach 1		14863 100-yr	14648	599.6	609.8		609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1		15817 100-yr	14648	603.2	614.16			614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1		17170 100-yr	14648	602.4	617.08		612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1		17314 100-yr	14648	605.5	617.12		614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1		17350											
Reach 1		17386 100-yr	14648	605.5	617.73		614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1		17442 100-yr	14648	604.9	617.86		614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1		18472 100-yr	14648	608.9	621.46		615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1		19887 100-yr	14648	610.3	622.69			622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1		21220 100-yr	14648	612.8	624.68			625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1		22540 100-yr	14648	615.5	627.54			627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1		23751 100-yr	14648	617.6	629.39			629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1		24800 100-yr	14648	620.4	631.4		629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1		25961 100-yr	14648	621.4	634.67		629.64	635.64	0.002342	8.1	2187.06	350.27	0.41
P1		656 100-yr	5126.8	586	590.32		590.32	592.07	0.023287	10.61	483.06	139.8	1.01
P1		1771 100-yr	5126.8	586	596.99			597.18	0.001817	3.51	1458.69	173.35	0.21
P1		3160 100-yr	5126.8	586	598.93			599.06	0.001046	2.94	1741.87	176.26	0.17

Appendix F-9b

Alternative #9: Pilot Channel (Future)

Profile Output Table - Standard Table 1

HEC-RAS Plan: FutureFlow-BuffaloCreek-PILOT3-ALT3 Profile: 100-yr

# Rivers		1		# Plans		1		Channel width = 100 ft		Min elev = 586 ft			
# Hydraulic React s = 1		1		# Profiles		1		# River Stations = 47					
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
Reach 2		836 100-yr	14648	567.3	587.41		575.77	587.54	0.00012	3.26	9648.13	1211.6	0.15
Reach 2		930 100-yr	14648	567.3	587.39			587.56	0.000124	3.25	5578.93	1231.23	0.15
Reach 2		1098 100-yr	14648	567.4	587.47			587.58	0.000099	2.75	8840.89	1539.79	0.13
Reach 2		1881 100-yr	14648	567.4	587.6			587.64	0.000057	2.15	17154.59	2578.83	0.1
Reach 2		2764 100-yr	14648	566.9	587.63			587.71	0.000094	2.9	16928.82	3784.97	0.14
Reach 2		2788 100-yr	14648	566.9	587.61		577.38	587.72	0.000119	3.26	14060.36	3655.23	0.16
Reach 2		3371 100-yr	14648	571.1	587.5		578.65	587.93	0.000357	5.22	2808.2	1953.96	0.27
Reach 2		3602 100-yr	14648	571.2	587.58		578.75	588.01	0.000311	5.27	2781.69	370.11	0.26
Reach 2		3642 100-yr	14648	566	587.85			588.04	0.000105	3.47	4243.42	340.98	0.16
Reach 2		3686 100-yr	14648	570	587.83			588.05	0.000149	3.8	3856.34	327.24	0.19
Reach 2		3727 100-yr	14648	570	587.82		578.98	588.07	0.000246	4.01	3655.17	306.11	0.2
Reach 2		3859 100-yr	14648	564.2	587.94			588.11	0.000139	3.3	4432.47	323.84	0.16
Reach 2		3898 100-yr	14648	564.2	587.94			588.11	0.000097	3.3	4433.46	323.85	0.16
Reach 2		3970.5											
Reach 2		4043 100-yr	14648	564.2	587.99		576.09	588.16	0.000245	3.29	4449.85	323.99	0.16
Reach 2		4341 100-yr	14648	565.6	588.05			588.27	0.000314	3.86	4126.53	367.07	0.18
Reach 2		5199 100-yr	14648	576.3	588.3			588.82	0.001071	5.85	2610.63	361.58	0.32
Reach 2		5270 100-yr	14648	574	588.66		580.99	589	0.000578	4.68	3129.5	348.94	0.24
Reach 2		5304.5											
Reach 2		5339 100-yr	14648	574	589.1		580.99	589.41	0.000514	4.52	3242.55	354.56	0.23
Reach 2		5562 100-yr	14648	571	589.33			589.53	0.000571	3.67	4290.54	385.3	0.18
Reach 2		6354 100-yr	14648	571.5	589.58		583.92	590.3	0.001101	7.39	3762.91	960.66	0.37
Reach 2		7410 100-yr	14648	573.7	591.18			591.5	0.001103	5.39	5171.06	920.97	0.26
Reach 2		8436 100-yr	14648	576.6	592.13		586.73	592.96	0.002068	7.58	2454.17	641.43	0.38
Reach 2		9173 100-yr	9521.2	582.1	593.77		590.01	593.98	0.000716	4.6	5216.27	1293.86	0.28
Reach 2		10272 100-yr	9521.2	582.8	594.56		589.96	595.14	0.001275	6.13	1586.73	239.55	0.38
Reach 2		11497 100-yr	9521.2	588.7	596.79		594.92	597.67	0.003535	7.53	1265.17	245.61	0.58
Reach 2		12627 100-yr	9521.2	594.7	601.28		599.93	602.54	0.005166	9.02	1092.08	274.35	0.68
Reach 1		13393 100-yr	14648	595.2	602.26		602.26	605.26	0.010023	13.89	1054.77	175.34	1
Reach 1		13799 100-yr	14648	595.5	606.67		602.19	606.88	0.000818	4.38	4703.62	662.08	0.26
Reach 1		14863 100-yr	14648	599.6	609.8		609.8	611.85	0.005074	12.29	1923.2	636.04	0.75
Reach 1		15817 100-yr	14648	603.2	614.16			614.79	0.00188	6.69	2990.69	623.49	0.42
Reach 1		17170 100-yr	14648	602.4	617.08		612.35	618.42	0.003609	9.3	1607.25	146.05	0.47
Reach 1		17314 100-yr	14648	605.5	617.12		614.39	619.42	0.003381	12.17	1203.97	136.21	0.65
Reach 1		17350											
Reach 1		17386 100-yr	14648	605.5	617.73		614.39	619.8	0.002822	11.52	1271.13	134.32	0.6
Reach 1		17442 100-yr	14648	604.9	617.86		614.88	620.03	0.003225	11.85	1263.45	122.2	0.62
Reach 1		18472 100-yr	14648	608.9	621.46		615.27	621.63	0.000766	3.66	5655.51	1327.06	0.2
Reach 1		19887 100-yr	14648	610.3	622.69			622.86	0.000957	3.32	4586.36	664.5	0.2
Reach 1		21220 100-yr	14648	612.8	624.68			625.27	0.003998	6.33	2523.66	368.62	0.39
Reach 1		22540 100-yr	14648	615.5	627.54			627.89	0.00116	5.01	3698.43	616.04	0.29
Reach 1		23751 100-yr	14648	617.6	629.39			629.84	0.002347	6.09	3315.43	557.24	0.34
Reach 1		24800 100-yr	14648	620.4	631.4		629.35	632.71	0.002617	9.65	2108.42	497.36	0.55
Reach 1		25961 100-yr	14648	621.4	634.67		629.64	635.64	0.002342	8.1	2187.06	350.27	0.41
P1		656 100-yr	5126.8	586	592.48		592.48	594.97	0.046755	12.67	404.7	81.15	1
P1		1771 100-yr	5126.8	586	601.44			601.73	0.002164	4.36	1402.84	611.86	0.23
P1		3160 100-yr	5126.8	586	603.84			604.05	0.001317	3.71	1681.33	553.36	0.18



Steady Flow Data - Pilot Channel FutureFlows 35%

File Options Help

Description : USGS FutureFlow Mean Predicted Discharge [2006 Region 5 - Full Regression Equation] with 35% reduction in flows at RS12627 Apply Data

Enter/Edit Number of Profiles (32000 max): 7 Reach Boundary Conditions ...

**Locations of Flow Data Changes**

River: Buffalo Creek Add Multiple...

Reach: Reach 1 River Sta.: 25961 Add A Flow Change Location

Flow Change Location			Profile Names and Flow Rates							
	River	Reach	RS	1.25-yr	2-yr	5-yr	10-yr	50-yr	100-yr	500-yr
1	Buffalo Creek	Reach 1	25961	3743	5142	7337	8922	12887	14648	19099
2	Buffalo Creek	Reach 2	12627	2432.95	3342.3	4769.05	5799.3	8376.55	9521.2	12414.35
3	Buffalo Creek	Reach 2	8436	3743	5142	7337	8922	12887	14648	19099
4	PILOT	P1	3160	1310.05	1799.7	2567.95	3122.7	4510.45	5126.8	6684.65

Edit Steady flow data for the profiles (cfs)

Appendix F-9b  
Alternative #9: Pilot Channel (Future)

