Nason Creek Upper White Pine Subreach 2

Basis of Design Report—60%

SUBMITTED TO
US Bureau of Reclamation

FEBRUARY 2015; REVISED APRIL 2015

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SUBMITTED TO
US Bureau of Reclamation
Pacific Northwest Region
1150 N. Curtis Rd., Suite 100
Boise, ID 83706

PREPARED BY
Inter-Fluve, Inc.
501 Portway Ave, Suite 101
Hood River, OR 97031
(541) 386-9003

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1 Introduction

1.1 OVERVIEW

The Nason Creek Upper White Pine (UWP) Subreach 2 Project includes stream habitat enhancement in Subreach 2 of the UWP reach of Nason Creek located upstream from the community of Merritt, WA. A site map is included in Figure 1. This work is being conducted as a collaborative effort between multiple entities including the US Bureau of Reclamation (Reclamation), Chelan County, and the US Forest Service. The project area encompasses the stream channel and floodplain of Nason Creek from river mile (RM) 13.3 to 14.0. Aquatic habitat and geomorphic function in this reach have been heavily impacted by a legacy of human alteration including stream relocation, channelization, bank armoring, levee construction, floodplain grading, and clearing of riparian vegetation. Enhancement activities will include actions to improve floodplain and geomorphic function while also directly enhancing instream habitat conditions critical to support ESA-listed salmonids and other native aquatic and terrestrial species.

This 60% design report accompanies the 60% drawing plans and includes the following: 1) background information on the project, 2) a description of the surveys and technical analyses that have been conducted to support project design, 3) project design criteria that have been used to guide the design process, and 4) a description of each project element.

1.2 BACKGROUND

A considerable amount of background site investigations and analyses have occurred that provide the technical foundation for this project and have led to the current 60% designs. Prior stream valley and reach-scale studies include the Nason Creek Tributary Assessment (USBR 2008) and the Nason Creek Upper White Pine Reach Assessment (USBR 2009). These assessments, conducted by Reclamation, identified the primary geomorphic and habitat limiting factors in the reach and outlined general strategies for restoration. The project reach was further investigated and analyzed as part of the Nason Creek Upper White Pine Restoration Plan (Inter-Fluve and USFS TEAMS 2012), which identified and evaluated specific potential restoration alternatives for all subreaches (1-5) in the UWP reach. Additional more detailed and recent surveys and analyses have been conducted in support of this design effort; this work is presented in this report. The Restoration Plan and Reclamation reports should be referred to for additional detailed background information.

This project is a collaborative effort that has received input and support from numerous partners and stakeholders. The effort is being coordinated by Chelan County Department of Natural Resources. Technical and financial support for design is being provided by Reclamation, with assistance from Inter-Fluve. The US Forest Service, which is the primary landowner, is providing technical and permitting (NEPA) support for the project. Other project collaborators and stakeholders include the Yakama Nation, Chelan County PUD, the Burlington Northern Sante Fe (BNSF) railroad, BPA, WDFW, USFWS, and NOAA fisheries. This effort is being highly coordinated with habitat enhancement work by the Yakama Nation that is occurring just downstream, in subreaches 3 and 4. Implementation for the subreach 3 and 4 work is anticipated to begin summer 2015.

This 60% design is currently being evaluated by the US Forest Service through the NEPA process. Other permitting agency personnel have been informed of the project components and the project team has incorporated their input into the current designs. Other (non-NEPA) federal, state, and local permitting will occur concurrent with the completion of the 60% design. Project implementation is anticipated to begin summer 2016.

Figure 1. Site map of existing conditions.

1.3 PROJECT GOALS

The overall purpose of this project is to enhance stream channel and floodplain conditions to improve aquatic habitat for ESA-listed salmonids. The goals listed below were developed as part of the Restoration Plan. Further refinement of these goals, as well as project objectives developed as part of the Restoration Plan, helped guide the development of more specific project design criteria, which are presented later in this report.

- **Overall Goal:** Reestablish hydrogeomorphic connectivity between Nason Creek and its floodplain to restore and enhance stream channel, riparian, and wetland habitat functions for ESA-listed salmonids.
- **Floodplain and Channel Dynamics:** Restore natural stream channel and floodplain structure and function to increase floodplain connectivity and promote habitat formation and maintenance.
- **Riparian Forest Condition:** Restore and enhance riparian areas to promote a more complex and diverse floodplain that can respond to disturbance and provide habitat functions.
- **Aquatic Habitat:** Rehabilitate and restore aquatic habitat to allow for the opportunity and capacity to support diverse life history strategies and increased growth and survival of fish.

This project aims to achieve habitat restoration priorities for Nason Creek identified by the Upper Columbia Regional Technical Team (RTT) as part of the Upper Columbia Biological Strategy (RTT 2013). These include addressing ecological concerns in the following categories: 1) Peripheral and transition habitats (side-channel and wetland connections), 2) channel structure and form (bed and channel form; instream structural complexity), and 3) riparian condition.

1.4 SUMMARY OF PROJECT COMPONENTS

The project includes the following primary project elements. A site map showing an overview of proposed conditions is included in Figure 2.

Relocation of the CPUD powerlines. This component includes the re-routing of 3,800 feet of the existing Chelan PUD powerlines to a location along White Pine Road that is out of the existing floodplain. Six existing towers will be removed and ten new towers will be placed along the new corridor.

Channel re-alignment. This component includes re-aligning approximately 1,500 feet of channel into a new two-meander alignment north of the existing channel between RM 13.7 and 13.45. The channel will have pool-riffle habitat and large wood placements (discussed below). The re-alignment also includes creating two new backwater alcove habitats within the abandoned channel segment.

High flow channel reconnection. Fill will be removed from the inlet of a high flow river-left channel near RM 13.37 in order to re-activate this channel at annual high flows.

Levee and riprap removal. This component includes the removal of approximately 2,500 feet of the left-bank levee. Upstream of the channel realignment, the levee will be removed up to RM 13.8 and riprap removal will occur along the upper portion of the bank.

Instream structure enhancement. Instream structural complexity will be enhanced via placement of large wood (LW) and boulders at various locations within the existing channel, within the new channel alignment, and within created/enhanced off-channel areas. Structures will serve numerous purposes including geomorphic function, habitat complexity, and streambank stability.

Riparian enhancement. This element includes planting of select riparian and floodplain areas with native vegetation in order to improve long-term habitat functions. Areas include the riparian zone around the newly aligned channel, the existing CPUD powerline corridor to be abandoned, and areas disturbed as part of project implementation.

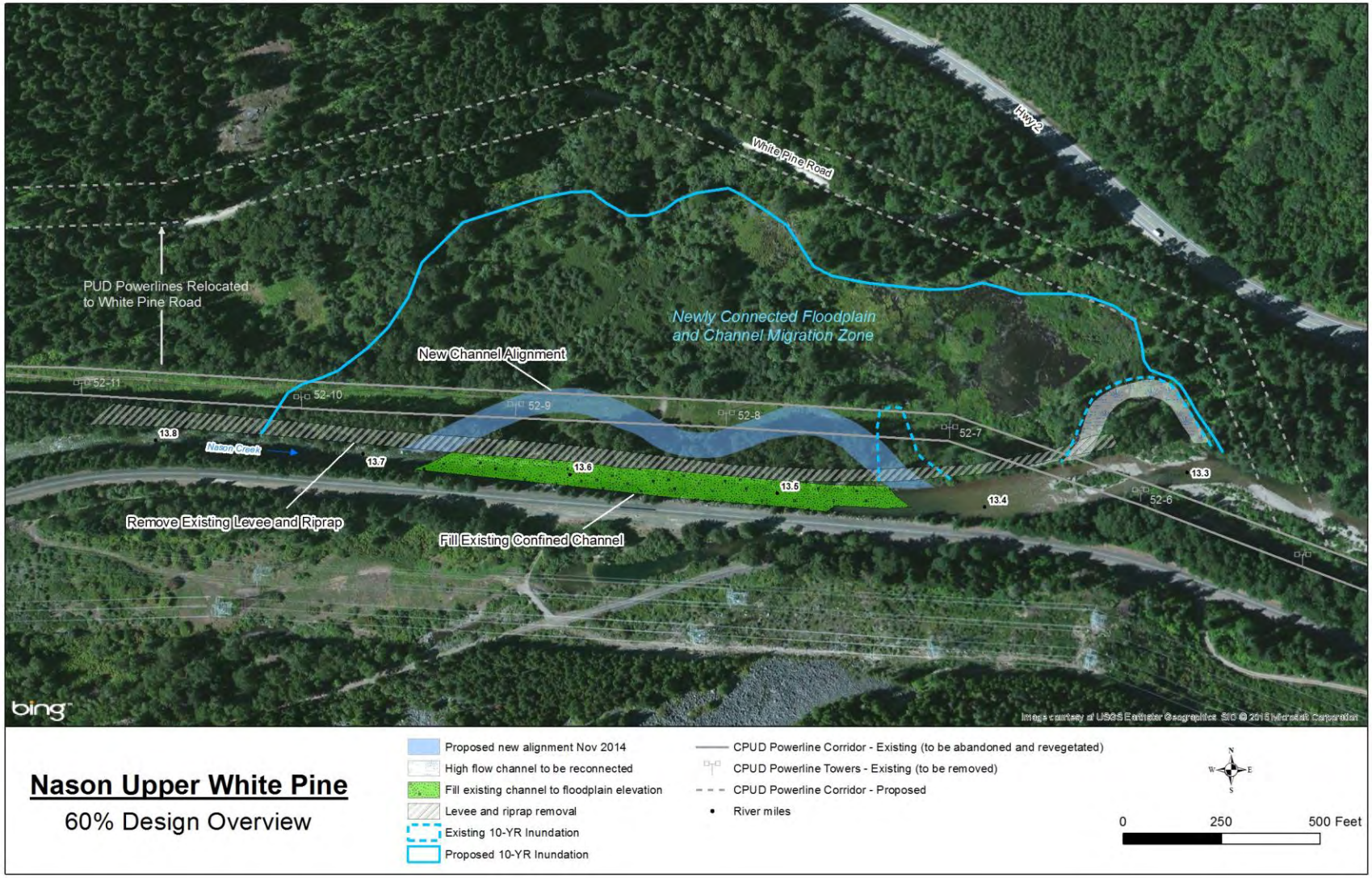


Figure 2. Site map of proposed conditions. See 60% design plans for additional information.

2 Site Analysis

2.1 ANALYSIS METHODS

Analysis of project components has been accomplished through the use of numerous methods. The primary sources of information are hydraulic modeling and reference reach data. Both 1D and 2D hydraulic models were developed based on ground survey and LiDAR data. These models were utilized for determining the degree of floodplain inundation that could be achieved by various re-meander and levee removal/breach configurations. The models were also used to help determine channel geometry, including plan, profile, and cross-section geometry. Hydraulics and sediment information helped to determine bank treatment types and locations. Reference reach data has also been used to help inform the design. Reference reach data were collected by USFS TEAMS and are reported in the Restoration Plan (Inter-Fluve and USFS TEAMS 2012). These data were used in conjunction with hydraulic modeling to verify appropriate channel and planform geometry for proposed conditions.

2.2 SITE SURVEY & DATA COLLECTION

2.2.1 Topographic and Bathymetric Surveys

Site topographic and bathymetric survey data were obtained through field surveys completed in September 2013. Survey data were supplemented with 2007 LiDAR data in select locations in order to build the existing conditions digital terrain model. The survey included main channel cross-sections for bathymetric data, wetland bathymetry to the south and north of the main channel, and topography of prominent features such as the levee to the north of the channel. Additional detailed ground surveys were conducted in areas where project activities are located in order to determine grading quantities and to support other specific components of design and analysis.

2.2.2 Property Line Survey

A property line survey was performed in November 2013 by Landline Surveyors out of Leavenworth, WA. This survey included the BNSF right-of-way and other property boundaries within the project area. Landline had also conducted a previous survey of a portion of the project site in September 2009. This prior survey included profiles of the CPUD powerline corridor and select cross-sections through the site. The Landline Surveyors property boundary survey sheets are included in the design planset.

2.2.3 Soil Test Pits

Site soils conditions were investigated with soils pits on August 25-26, 2014. Five soils pits were excavated to a depth of 1 foot to 3 feet below proposed channel elevation. These soils pits were located within the existing utility corridor and roughly evenly distributed along the length of the proposed channel alignment (including the full length of previous alternative alignments). An additional two soils pits were excavated along the north side of the river-left levee to a few feet below the adjacent floodplain/terrace elevation. Levee pits were located outside of the BNSF right of way. Locations of soils pits are shown in Figure 3. Soils profiles were documented with notes and photographs and the information is provided in Appendix C.

In general, site soils from the proposed alignment are a semi-cohesive loam over a granular layer comprised of sand and gravel with some cobble material. Several of the pits showed that fine and sandy soils extend to considerable depth and that the coarse material encountered was still relatively small compared to existing channel conditions. The soils in the levee were semi-cohesive to cohesive loam with no gravel or cobble material. Based on the levee composition, it is assumed that the levee material was sourced from on-site.

The soils characteristics are an important design consideration. The depth of fine soils in the two up-valley pits were of significant concern for channel construction through this area. If the channel were to be relocated/constructed in this area, the entire channel bed would sit within these fine soils. Comparing soil type with the hydraulic model output in this area suggested that severe channel erosion would likely occur within these sandy soils. Channel relocation in this area was therefore not pursued, and instead was constrained to the down-valley portion of the floodplain where coarse alluvial substrate was closer to the surface.

Regardless, even with the current (60% design) alignment, there still remains significant channel erosion risk due to the small size of the substrate. The granular material below the proposed stream channel elevation is too small to provide adequate channel stability even at frequent floods (i.e. annual event). Import of streambed substrate and prescriptions to provide short-term bank stability are required at least for a time until riparian vegetation matures and can provide long-term natural stability. See the component descriptions in Section 3.2 for more information on bed and bank treatments.

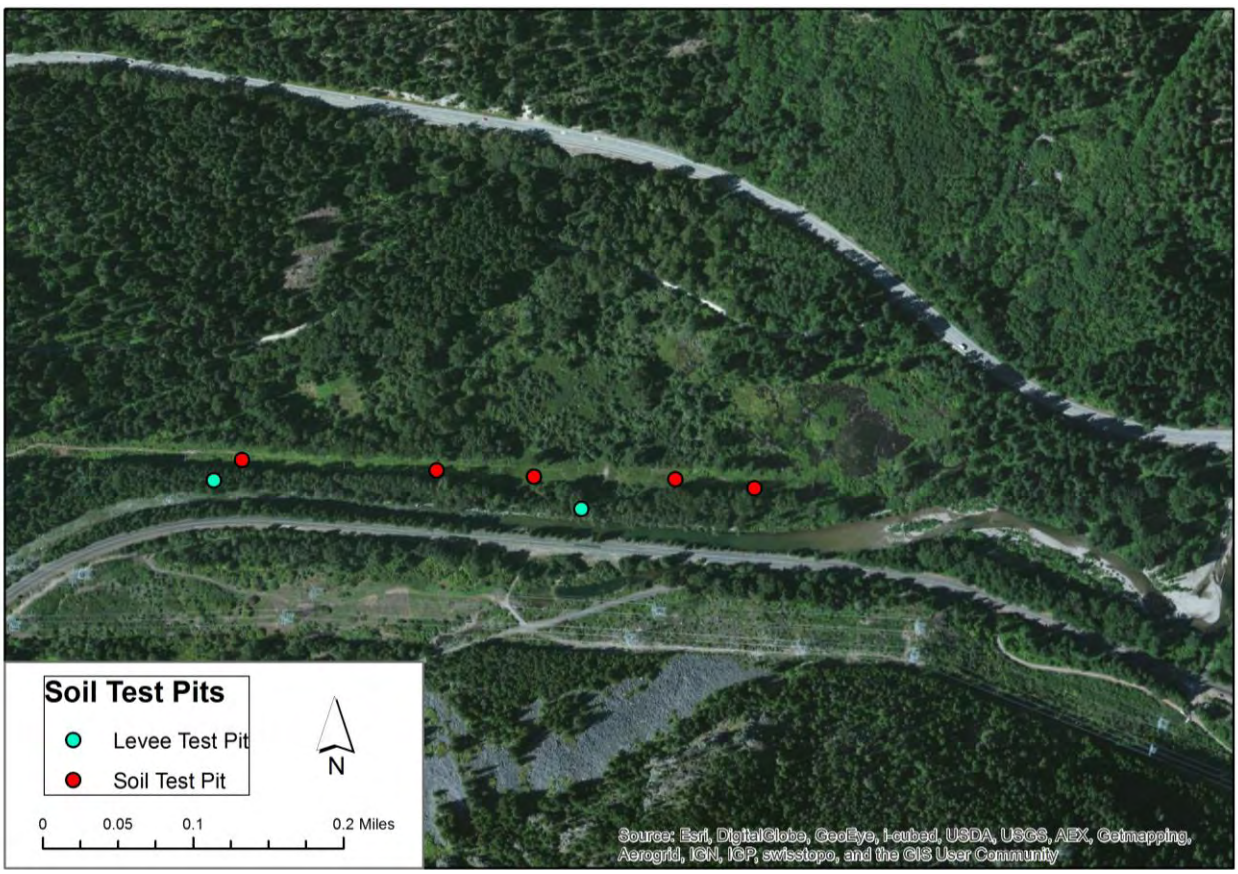


Figure 3. Locations of soils test pits.

2.2.4 Streambed Sediment Sampling

Field sampling of existing streambed substrates included pebble counts of surficial substrate and a bulk sample of the sub-armor layer. The locations of the samples are shown in Figure 4.

Pebble counts measure the number of particles from the stream bed surface – or armor layer – which are within various size classes. A region of the streambed is identified in the field from which 100 particles are randomly, yet systematically, selected by hand and measured. Data are recorded as number of

particles passing pre-defined size ranges. The result is a gradation of the surficial material as percent smaller – versus number of particles within the size classes. The data are summarized in Appendix D. These data were used to estimate sediment mobility with respect to hydraulic conditions and to inform design of streambed substrate and bank treatments.

A sub-armor bulk sample was collected in a region of the stream bed that is representative of typical bedload that is regularly transported by Nason Creek. The bulk sample was collected from the left channel of the island downstream of the proposed meander rejoining the existing mainstem. The top armor layer was selectively removed by hand and set aside. The armor layer is devoid of fine sediments which have been winnowed by flows and is typically a thickness equal to the largest particles (D84-D100). The sub-armor substrate represents the bedload material that passes through the sampled reach once flows are sufficient to mobilize the armor layer. The sub-armor layer contained small gravels, sands, and silts and was sampled by hand using a small shovel and placed in a sample bag. The sub-armor bulk sample was delivered to Carlson Testing, Inc. in Tigard, Oregon for sieve analysis using ASTM C117 and ASTM C136 methods. The resulting gradation of the sub-armor material as percent finer based on weight versus size of particle is summarized in Appendix D.

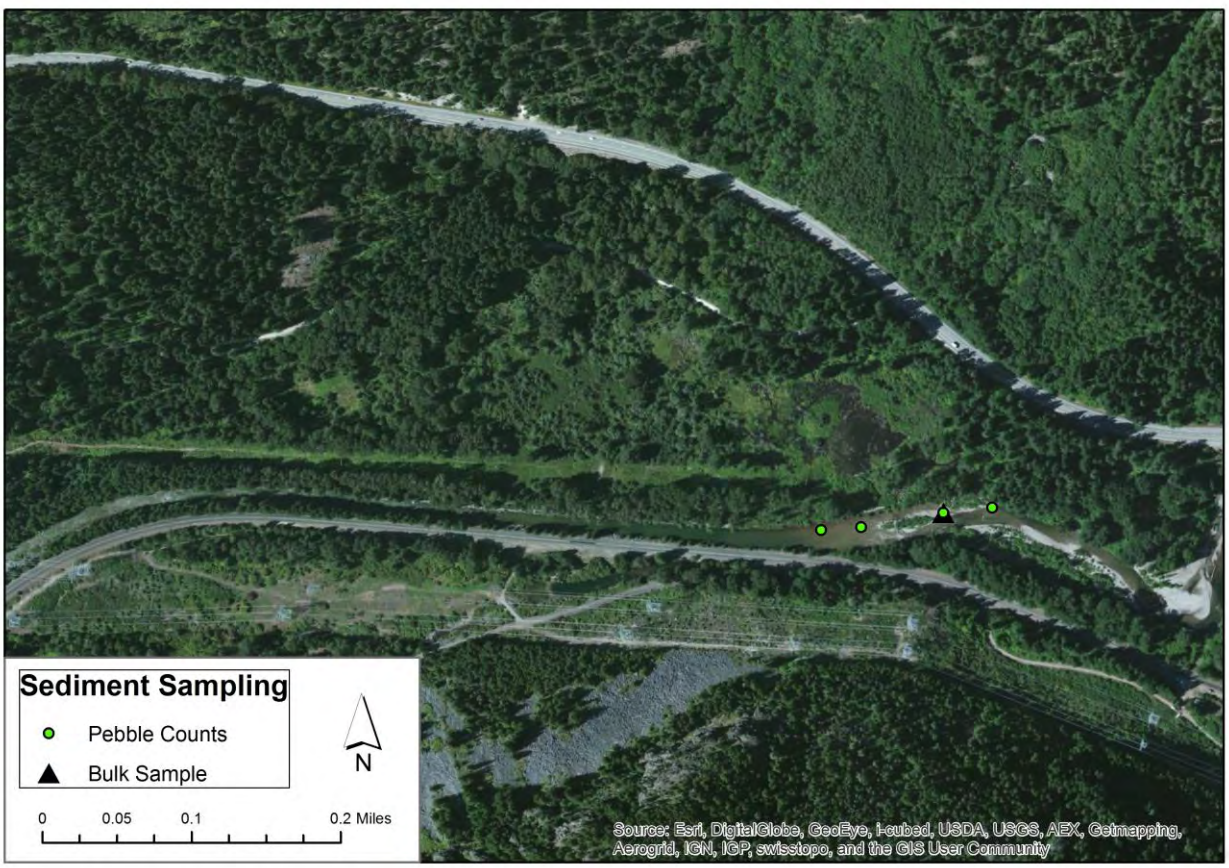


Figure 4. Locations of pebble counts and bulk sample.

2.2.5 Water level Monitoring

Chelan County Natural Resources Department (CCNRD) collected groundwater and surface water data in 2011 and 2012. That data is summarized in a memorandum that is available upon request. There are six perennial tributaries (Rayrock springs) that contribute a cold flowing water source to the floodplain wetland (Figure 5,

Table 1, and Table 2).

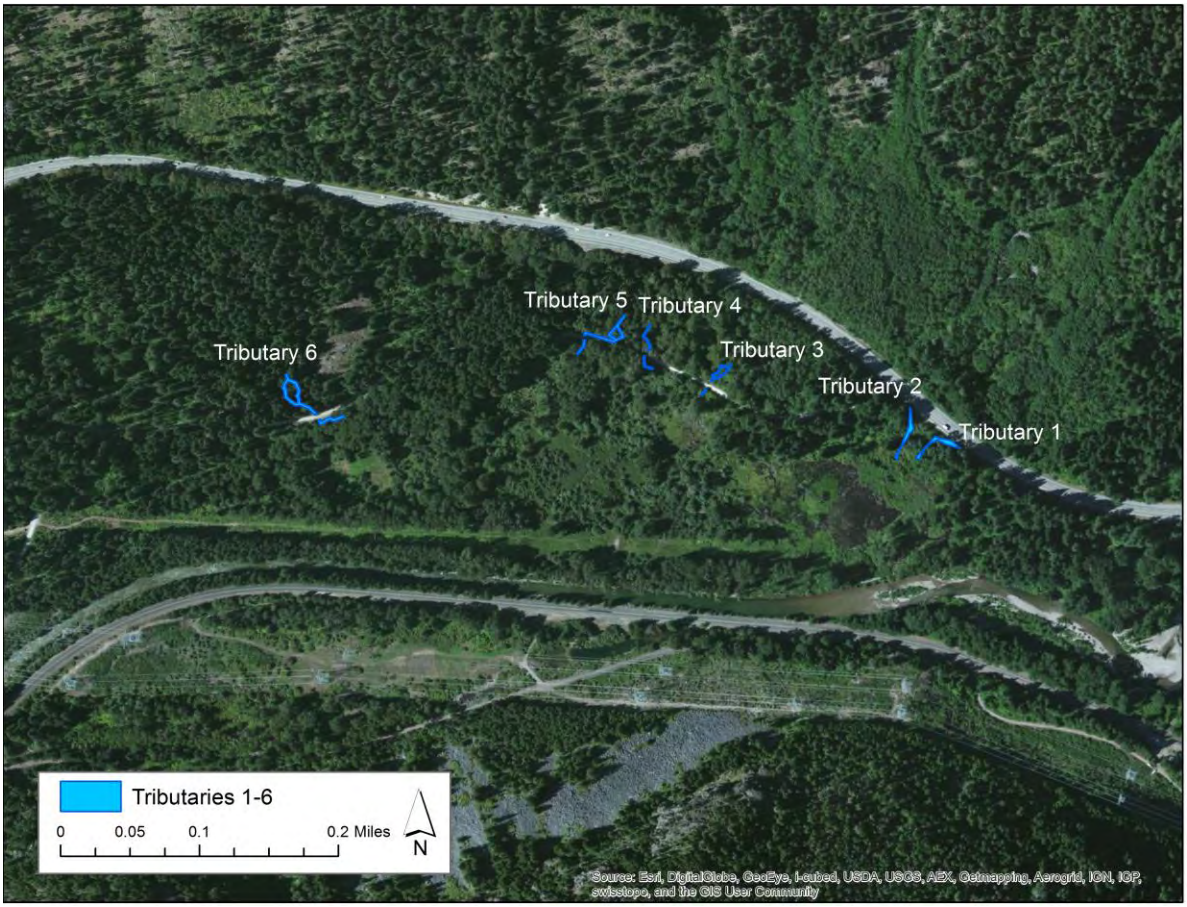


Figure 5. Locations of north side tributaries.

Table 1. Streamflow measurements in northside tribs. Values are cubic feet per second (CCNRD data).

Tributary #	6/6/2012	6/28/2012	7/24/2012	8/30/2012	9/12/2012
1	1.88	2.42	2.22	1.53	1.23
2	not measured - location found in 2014				
3	1.24	1.26	0.64	0.41	0.45
4	0.1	0.1	0.1	0.1	0.1
5	0.49	0.47	0.46	0.28	0.3
6	1.23	1.17	1.03	0.78	0.65

Table 2. Stream temperature measurements in northside tribs. Degrees Celsius (CCNRD data).

Tributary #	7/24/2012	8/30/2012	9/12/2012
1	9.22	8.17	7.72
2	Not measured - location found in 2014		
3	9.06	8.11	7.72
4	Not measured due to low flow		
5	8.72	8.22	7.61
6	8.83	8.22	7.06

2.3 VEGETATION

Vegetation at the site consists of a mix of deciduous trees and shrubs, coniferous trees, and herbaceous vegetation depending on location, extent of hydrologic inundation, and elevation across the site. The interior perched wetland complex in the north floodplain area is comprised of either open water, aquatic vegetation, or emergent vegetation. Other wet areas in the north floodplain, particularly in the downstream portion of the floodplain, have some large mature cottonwoods. At the upstream portion of the site, along the existing north bank levee and extending to the CPUD corridor, there is a dense stand of 40-50 year-old Douglas fir. There are occasional ponderosa pine and western red cedar across the site as well. Smaller trees and shrubs throughout the site include alder, cottonwood, willow, vine maple, red osier dogwood, hawthorn, snowberry, and spirea, among others. There is also invasive reed canary grass, primarily in open areas such as the CPUD powerline corridor. Streambank vegetation along the channel itself is sparse, due in large part to the presence of riprap banks on both sides of the channel. Past and on-going human alterations have effected riparian and floodplain vegetation at the site, including the railroad, CPUD powerlines, BPA powerlines, the levee, and riprap armored banks. A canopy height map, showing the distribution of vegetation sizes across the site, is provided in Figure 6.

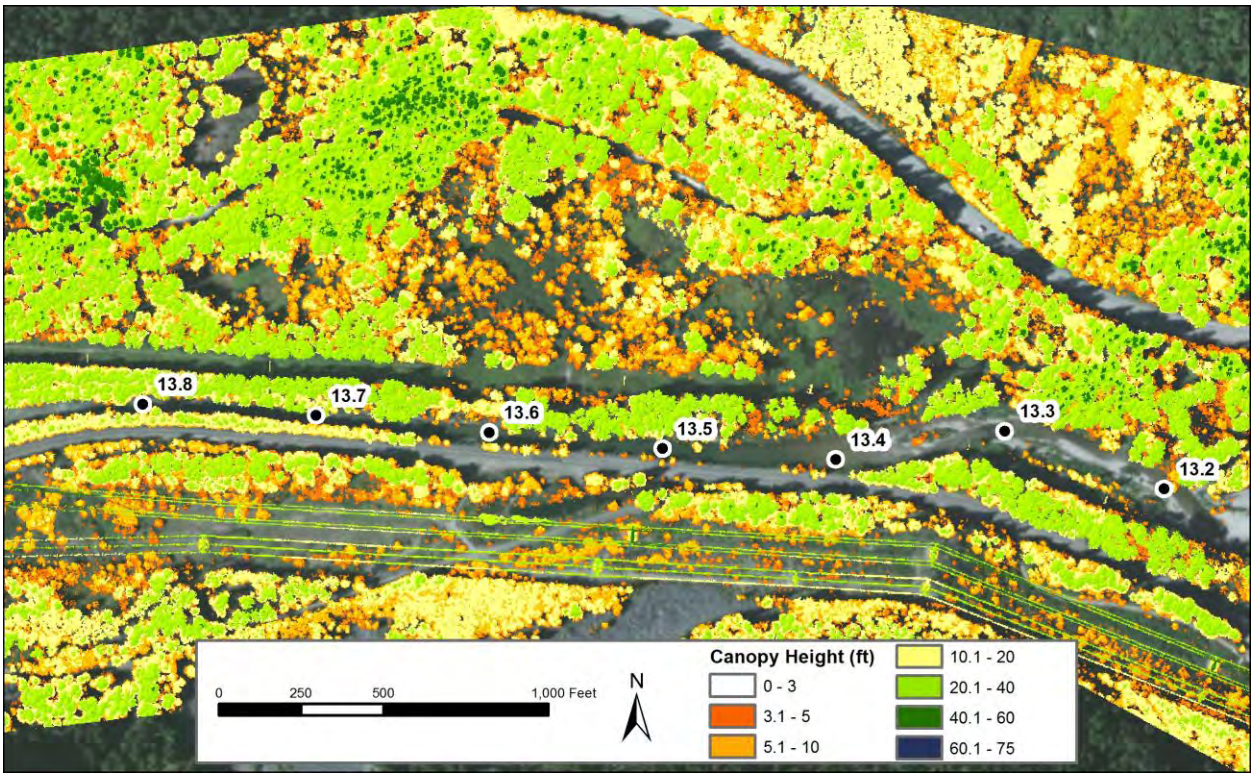


Figure 6. Canopy heights calculated from the difference between the first return and bare earth LiDAR surfaces (2006 LiDAR data).

2.4 HYDROLOGY

2.4.1 Overview

Nason Creek drains high-elevation areas of the Chiwaukum Mountains and has a snowmelt-dominated hydrologic regime. Figure 7 shows modeled median, high, and low exceedence flows for Nason Creek at RM 13, which is just downstream of the project area.

Although peak flows typically occur because of snowmelt in the late spring or early summer, some of the largest floods have occurred from heavy late-fall rain-on-snow events. Large past flood events occurred in May 1948, November 1959, November 1990, November 1995, and November 2006. Past floods have washed out U.S. Highway 2, washed out power poles, and have damaged bridges, houses, and other infrastructure.

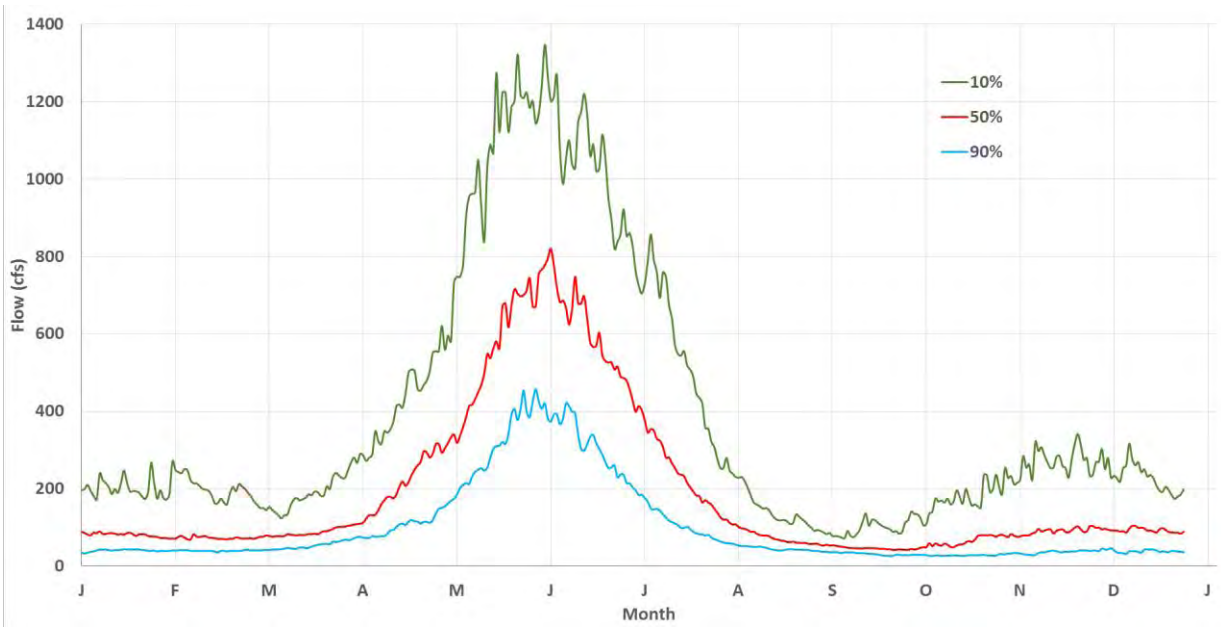


Figure 7. Estimated 10 percent, 50 percent, and 90 percent exceedance flows for RM 13 using data from the Icicle Creek gage scaled to RM 13 of Nason Creek using a basin area correction. Percentile flows represent the daily flow that is equaled or exceeded for the given percentage of time over the available period of record.

2.4.2 Peak and Base Flow Hydrology

Peak flow hydrology was determined following the methods used by the USBR as part of planning for the Lower White Pine project located downstream. Flood magnitudes were estimated using a comparison to peak flows estimated for the Icicle Creek gage (USGS Gage #12458000), which has over 60 years of peak flow records. A direct basin-size correction was used to apply the Icicle Creek flood volumes to RM 13 of Nason Creek, which is just downstream of the Project Reach. The flood magnitudes are presented in Table 3. A Washington Department of Ecology gage has been operating near the mouth of Nason Creek since 2002, and provides valuable information regarding seasonality of flow and low flow dynamics. However, due to the short record, and some evidence of inaccuracy at high flows, the record was not used for peak flow estimation.

Table 3. Flow estimates for Nason Creek Upper White Pine Reach at RM 13. Peak flows were generated using a basin-size comparison with Icicle Creek Gage (USGS #12485000). Values are rounded to the nearest 100 cubic feet per second (cfs). Seasonal and low flow metrics display the highest flow month (June) and the lowest (Sept).

Flow Metric		Estimated flow at RM 13 (cfs)
Peak Flows (Recurrence Interval - years)		
	Annual	800
	1.5	1,400
	2	1,700
	5	2,600
	10	3,400
	25	4,500
	50	5,500

Flow Metric		Estimated flow at RM 13 (cfs)
	100	6,700
	500	10,000
Selected Seasonal and Low Flows		
	June Median (avg of daily medians)	637
	June low flow (avg of daily 90% exceedance)	332
	Sept Median (avg of daily medians)	48
	Sept low flow (avg of daily 90% exceedance)	33

2.5 HYDRAULICS

Existing and proposed channel and floodplain hydraulics were simulated using both 1-dimensional (1-D) and 2-dimensional (2-D) modeling systems. The 1-D modeling, and creation of the existing condition and proposed condition surfaces, was completed by Inter-Fluve; the 2-D modeling was completed by Reclamation. In general, the 1-D model was used for design iterations to narrow down the appropriate planform, cross-section, and profile geometry. The 2-D modeling was then used for a more detailed evaluation of hydraulic conditions. The modeling will continue to be refined in subsequent phases of design.

2.5.1 Model Selection

All numerical models require simplifying assumptions and thus have limitations. The choice of model is often governed by time and budget constraints, access to and knowledge of existing models, and the ability to develop the model. It is important to understand the formulation of the selected model, recognize the model limitations, and apply the model in a manner that takes advantage of the model's strengths. Numerical model predictions will always include some uncertainty because the physical processes being modeled are not completely represented in a numerical fashion.

The numerical models utilized for this study were HEC-RAS (v 4.1.0) and SRH-2D (v 3.0). HEC-RAS is a 1-D backwater step hydraulic model developed by the U.S. Army Corps of Engineers. This model was utilized to simulate cross section averaged river hydraulics for a series of steady, gradually varied flows. The basic computational procedure utilized in this model is based on the solution of the one-dimensional energy equation. Energy losses are represented through friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). HEC-RAS was utilized to inform design criteria as well as to set the downstream boundary condition for the SRH-2D model simulations, which consisted of a water surface elevation. Each modeling effort is described below.

2.5.2 1-Dimensional Hydraulic Modeling

2.5.2.1 Overview

Initial and iterative channel design was accomplished with 1-D hydraulic modeling. An existing conditions model was developed to understand baseline conditions. A working proposed conditions model was then used to iterate various proposed conditions and to inform adjustments in proposed conditions channel geometry prior to subjecting it to 2-D modeling. The working proposed conditions 1-D model was also used to compare with the proposed conditions 2-D results. The 2-D model was used to identify final proposed conditions hydraulics and to inform restoration treatments. Appendix A contains the results of the existing conditions 1-D model. For proposed conditions, see the 2-D model description, below, and Appendix B.

2.5.2.2 Methods

One-dimensional modeling was performed using the U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS 4.1.0; USACE 2010). HEC-RAS is a computer program that models the hydraulics of water flow through natural rivers and other open channels. The program is 1-dimensional, meaning that there is no direct modeling of the hydraulic effects of flow in the lateral or vertical direction, and other 2- and 3-dimensional aspects of flow. The hydraulic model calculates channel and floodplain water surface elevations, velocities, depths, and shear stresses (among other metrics) for various input flows.

The model geometry was developed using topographic and bathymetric data obtained through surveys completed by Inter-Fluve in September 2013. Survey data was supplemented with 2007 LiDAR data in select locations. Model geometry was extracted from existing conditions topography. The model covers approximately RM 12.1 through 14.4 (See Appendix A). In order to include downstream effects on project reach hydraulics in the model, 6,290 feet of subreaches 3-5 (RM 12.1-13.3), located downstream of this project area, are included. Several increments of low flow discharges as well as floods with recurrences of 1.01-, 2-, 5-, 10-, 25-, 50-, and 100-years were modeled. The model for the project reach was integrated into existing models developed for downstream reaches.

Various configurations of proposed conditions were modeled by updating the channel geometry in the model. Numerous iterations were performed based on the results of prior iterations and based on input from stakeholders and landowners. In general, the 1-D model was used to help iterate and modify the channel geometry and proposed conditions DEM prior to subjecting it to 2-D modeling. A few separate runs of 2-D modeling were also performed prior to arriving at the current 60% design configuration.

2.5.2.3 Results

Results of the existing conditions 1-D modeling are presented in Appendix A.

2.5.3 2-Dimensional Hydraulic Modeling

**Reclamation provided the primary authorship of this section*

2.5.3.1 Overview

SRH-2D is 2-D fixed-bed hydraulics model focused on the flow hydraulics of river systems developed by Reclamation at the Technical Service Center (Lai 2008). SRH-2D solves the depth-averaged dynamic wave equations with a depth-averaged parabolic turbulence model using a finite-volume numerical scheme. The model adopts a zonal approach for coupled modeling of channels and floodplains; a river system is broken into modeling zones (delineated based on natural features such as topography, vegetation, and bed roughness), each with unique parameters such as flow resistance. One of the major features of SRH-2D is the adoption of an unstructured hybrid mixed element mesh, which is based on the arbitrarily shaped element method of Lai (2000) for geometric representation. This meshing strategy is flexible enough to facilitate the implementation of the zonal modeling concept; it allows for greater modeling detail in areas of interest that ultimately leads to increased modeling efficiency through a compromise between solution accuracy and computing demand.

2.5.3.2 Methods

To represent the model terrains, multi-resolution three-dimensional surfaces were generated in a Geographic Information System (GIS) using a Triangulated Irregular Network (TIN) methodology. Topographic representations of the existing and proposed design conditions were constructed. This was accomplished using a combination of bathymetric and land survey data along with Light Detection and Ranging (LiDAR) data. The type of LiDAR acquisition used does not have the ability to penetrate through

water. Therefore, bathymetric survey data replaced the LiDAR data in wetted areas. The resulting terrains for the existing and proposed design conditions are shown in Figure 8 and Figure 9, respectively.

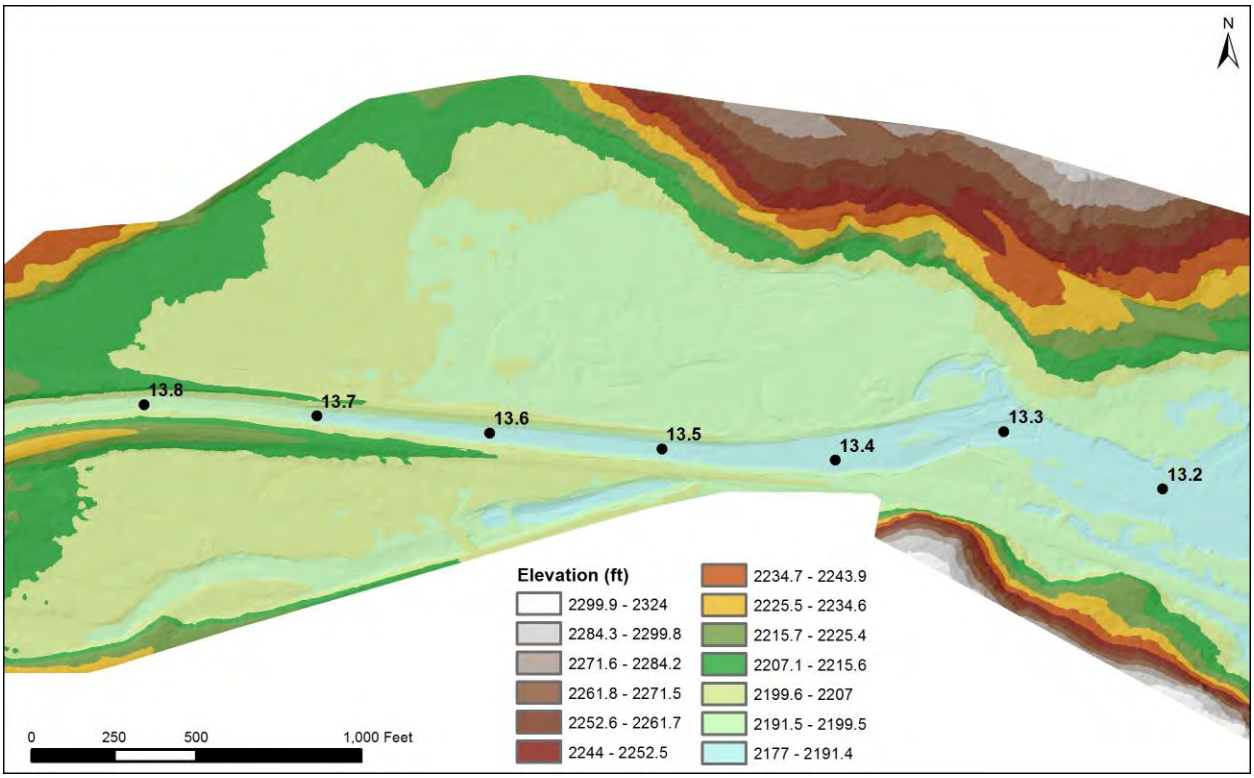


Figure 8. Existing conditions surface provided by Inter-Fluve to Reclamation for 2D modeling.

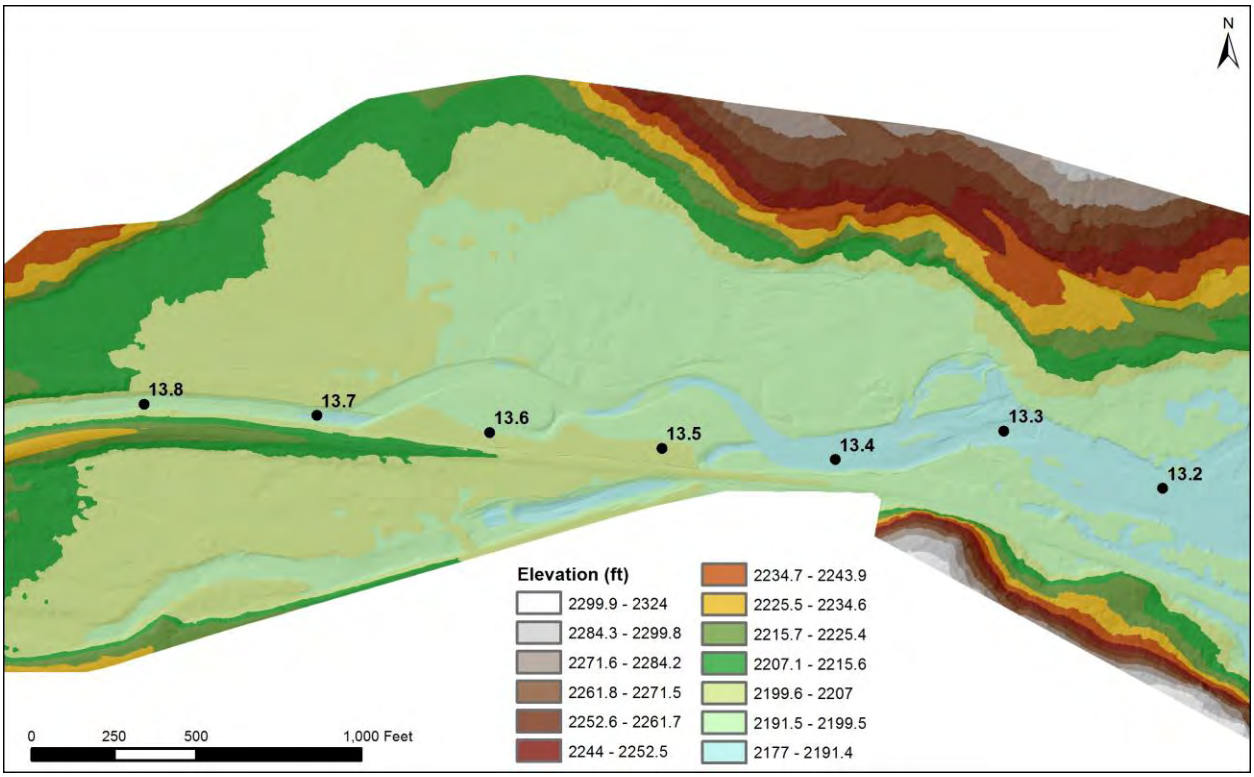


Figure 9. Proposed conditions (60% design) surface provided by Inter-Fluve to Reclamation for 2D modeling.

A 2-D mesh is what defines the SRH-2D model topography and solution spacing. The mesh (nodes) stores ground elevation information from the model surface and consists of quadrilateral and triangular shaped elements. Surface-water Modeling System (SMS) software was used to construct flexible mixed element meshes that allowed for increased definition near areas of interest by using finer mesh cells, while coarser mesh cells were used elsewhere. SMS was also utilized to delineate model roughness areas and assign model boundary conditions.

The fixed bed mesh for this study consisted of primarily quadrilateral elements within the channel, and triangular elements in the floodplain areas. For the existing conditions, the size of the quadrilateral elements was, on average, 10 feet in the lateral (cross stream) direction and 15 feet in the longitudinal (downstream) direction. The shorter dimension in the lateral direction was used to capture the more rapidly changing topography transverse to the stream flow with respect to horizontal distance. The triangular elements in the floodplain areas increased in coarseness as the model approached the domain boundary to a maximum size of 25 feet. To represent the proposed conditions, the mesh was refined to capture the design features of interest. As part of this effort, the overall mesh was increased in density as computational demand was not seen to be a major factor. A total of 32,300 elements were used in the model domain to represent the existing conditions, while approximately 74,300 elements were used to represent the proposed conditions. An example area of the model mesh representing the existing conditions is shown in Figure 10.

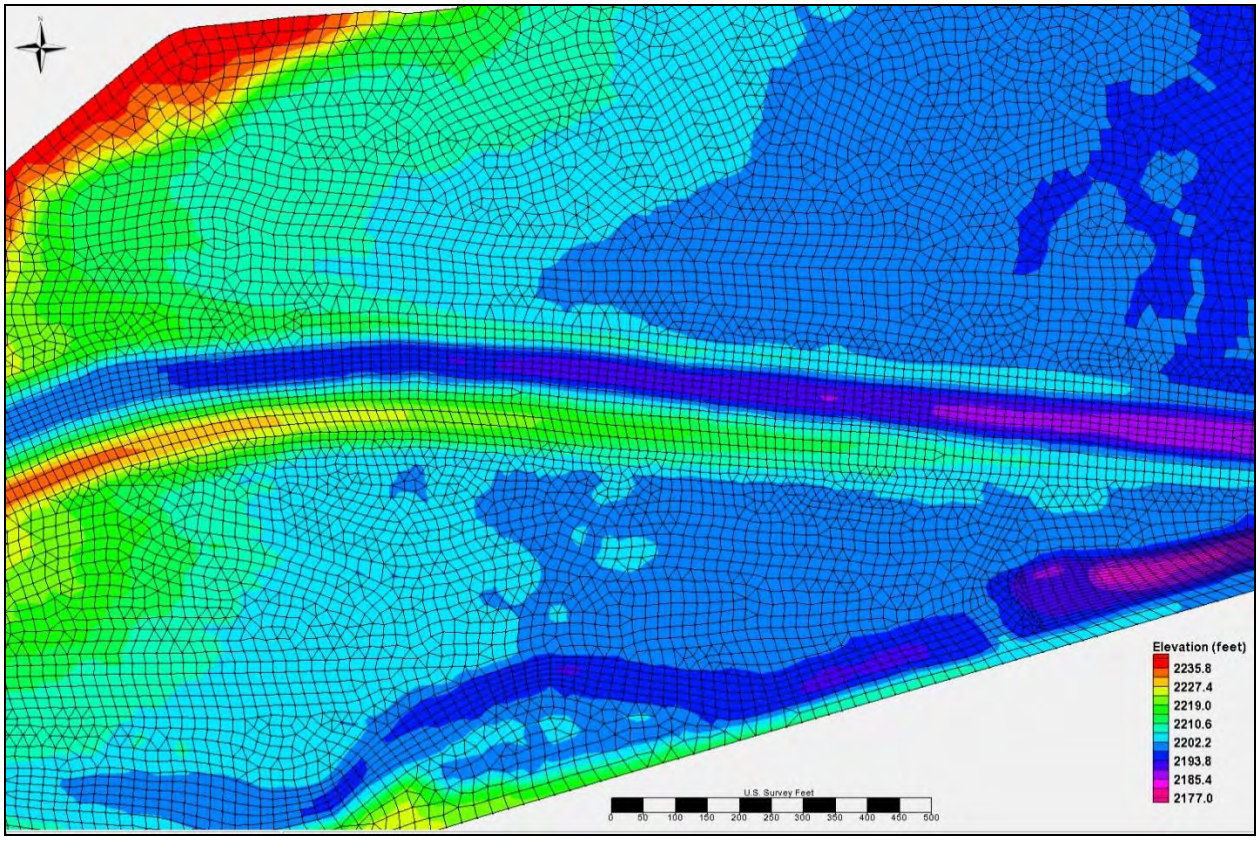


Figure 10. 2-D mesh against existing conditions surface topography (flow is from left-to-right).

Hydraulic roughness is the resistance of the channel and overbank topography to the flow, and is quantified in SRH-2D using the Manning's roughness coefficient. Assuming the channel and floodplain geometry is accurate, roughness is the main calibration parameter for hydraulic modeling. Through SMS, the roughness coefficient was distributed spatially across the model domain according to material type/land cover. Eight distinct roughness zones were implemented, which were delineated based on aerial photography for the existing conditions, and changes to the topographic surface for the proposed conditions. The roughness zone delineations across the model domain for the existing conditions are shown in Figure 11.

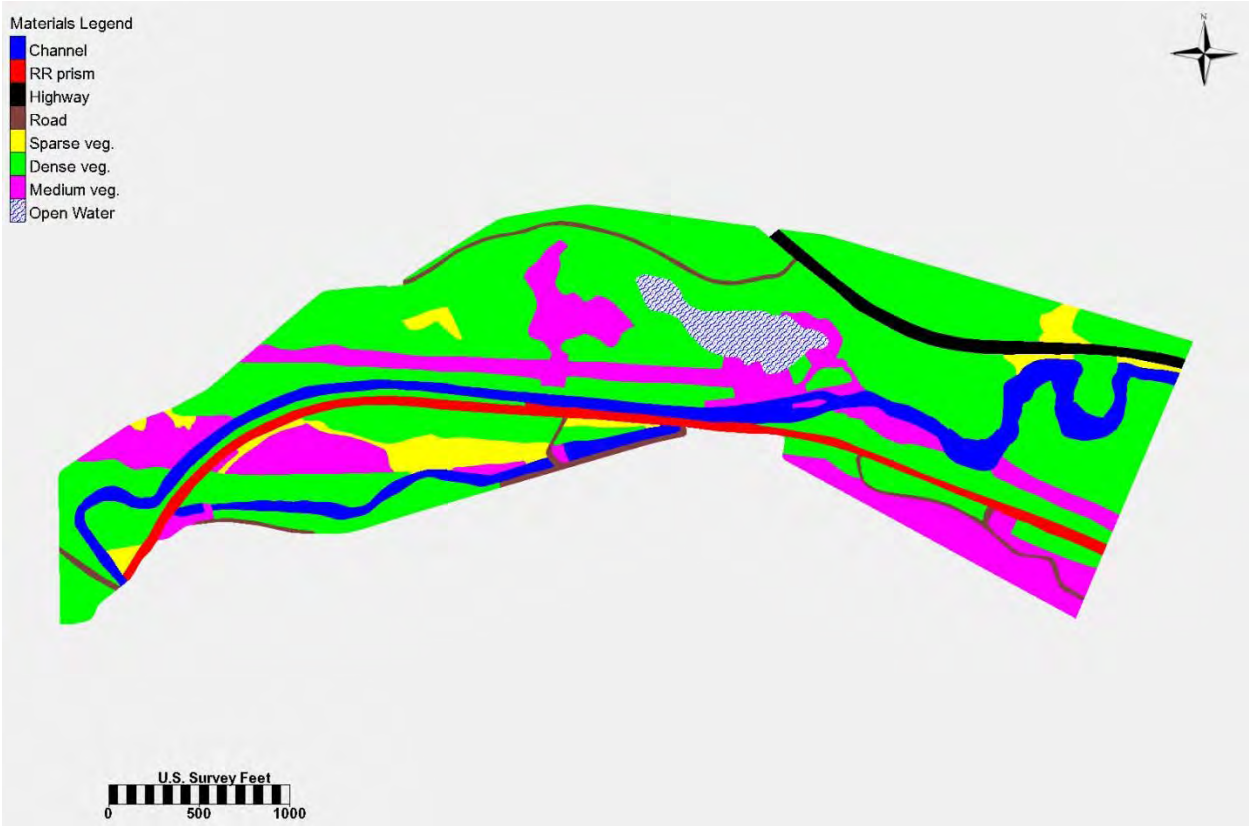


Figure 11. Roughness zone delineations representing the existing conditions.

It's important to note that the SRH-2D model has not yet been calibrated and/or verified. Some calibration data exists from a recent survey in the form of measured water surface elevations. However, the flows that were present at that time were significantly lower than any of the events being analyzed and the resultant roughness values may therefore not fully apply. The corresponding material type roughness values were based on engineering judgment and comparisons to a completed HEC-RAS model along with a previously calibrated SRH-2D model for the Lower White Pine project site, located roughly three river miles downstream. The main channel and overbank roughness used in the HEC-RAS model were 0.04 and 0.08, respectively. Roughness values in a 2-D model however are usually lower than those in a 1-D model because the 2-D model solves for eddy losses independently, as opposed to these losses being lumped into the roughness value or expansion/contraction loss coefficients. The calibrated main channel roughness value from the Lower White Pine modeling was 0.0265 (Sixta 2011). The resultant estimated roughness values for the SRH-2D model are shown in Table 4, which were held constant for all modeled flow events.

Table 4. Material type roughness values for the SRH-2D model.

Material	Roughness Value
Channel	0.035
RR prism	0.03
Highway	0.015
Road	0.02
Sparse Veg.	0.045
Medium Veg.	0.055
Dense Veg.	0.065
Open Water	0.025

Boundary conditions were specified at the upstream and downstream extent of the model domain. The upstream boundary condition was specified as a steady flow input rate; the same as for the HEC-RAS model (see Table 5). Flow rates were selected that bracket a variety of foreseen hydraulic conditions. The corresponding recurrence interval flow values were determined from a pre-existing hydrological analysis that was performed as part of a tributary assessment on 10 river miles of Nason Creek (Sutley 2007). The downstream boundary was set to an event corresponding water surface elevation as determined from the HEC-RAS model (see Table 5). A monitoring line was placed near the model exit to ensure conservation of flow as well as to evaluate model run time; ensuring equilibrium conditions have been met. Monitoring points were also strategically placed throughout the model domain to evaluate the change in hydraulic parameters over time and model stability. A one-second time step was utilized for all model runs.

Table 5. Flow recurrence values and water surface elevations used for SRH-2D boundary conditions.

Event	Q Total (cfs)	W.S. Elev (feet)
annual	800	2179.75
1.5-year	1,400	2181.0
2-year	1,700	2181.5
5-year	2,600	2182.8
10-year	3,400	2183.75
50-year	5,500	2185.6
100-year	6,700	2186.3

2.5.3.3 Results

The 2-D model was run on three surfaces (DTMs): 1) the existing surface, 2) a hypothetical alternative including just the full removal of the entire left-bank levee, and 3) the current preferred scenario including creation of a meander bend and breaching of the left-bank levee at numerous locations. The corresponding depth-inundation maps for these scenarios are included in Appendix B.

2.5.4 Key Conclusions from Hydraulic Modeling

The key results from the hydraulic modeling are listed below:

1) The existing channel is severely disconnected from its floodplain, with flows contained almost entirely within the channel up to the 10-year flood event and up to the 100-year event in the

upstream portion of the project area. This is due to past channel relocation and artificial confinement.

2) Levee removal alone, without modifications to channel planform or profile, has little effect on floodplain inundation levels at flows lower than the 50-year event.
3) The channel re-meander reduces overall stream energy through the site.
4) The channel re-meander (current preferred restoration action), including a raised channel bed in the meander, increases floodplain inundation extents over a range of flows. This is discussed in the section below.

2.6 PROJECT EFFECTS ON FLOODPLAIN INUNDATION

Enhanced frequency of floodplain inundation is one of the primary objectives of the project. The degree of floodplain inundation was examined for the existing condition and for proposed conditions. This was accomplished using output from the 2-D model.

For this analysis, the existing condition was compared to two hypothetical conditions: 1) full levee removal only, and 2) channel realignment. The channel realignment scenario is the two-meander scenario and is what is included in the 60% design. It also includes full levee removal upstream and downstream of the channel re-alignment, including removal of the portion of the levee that obstructs flow into the high flow channel on river-left near RM 13.35. The acres of floodplain inundation from the three scenarios are provided in Table 6, with a chart of the results in Figure 12. The depth-inundation maps for existing and proposed (60%) conditions are presented in Appendix B.

Table 6. Acres of floodplain inundation based on 2-D modeling of existing conditions and two restoration scenarios.

		Acres of floodplain inundation		
Flood recurrence interval	**Discharge (ft^3/sec)**	**Existing**	**Full levee removal only**	**Two-meander Scenario (60% Design)**
Annual	800	0.12	0.13	0.67
2 YR	1,700	0.64	0.65	4.69
5 YR	2,600	0.94	1.03	12.86
10 YR	3,400	1.65	2.25	19.52
50 YR	5,500	8.65	21.72	22.78
100 YR	6,700	10.36	25.64	26.9

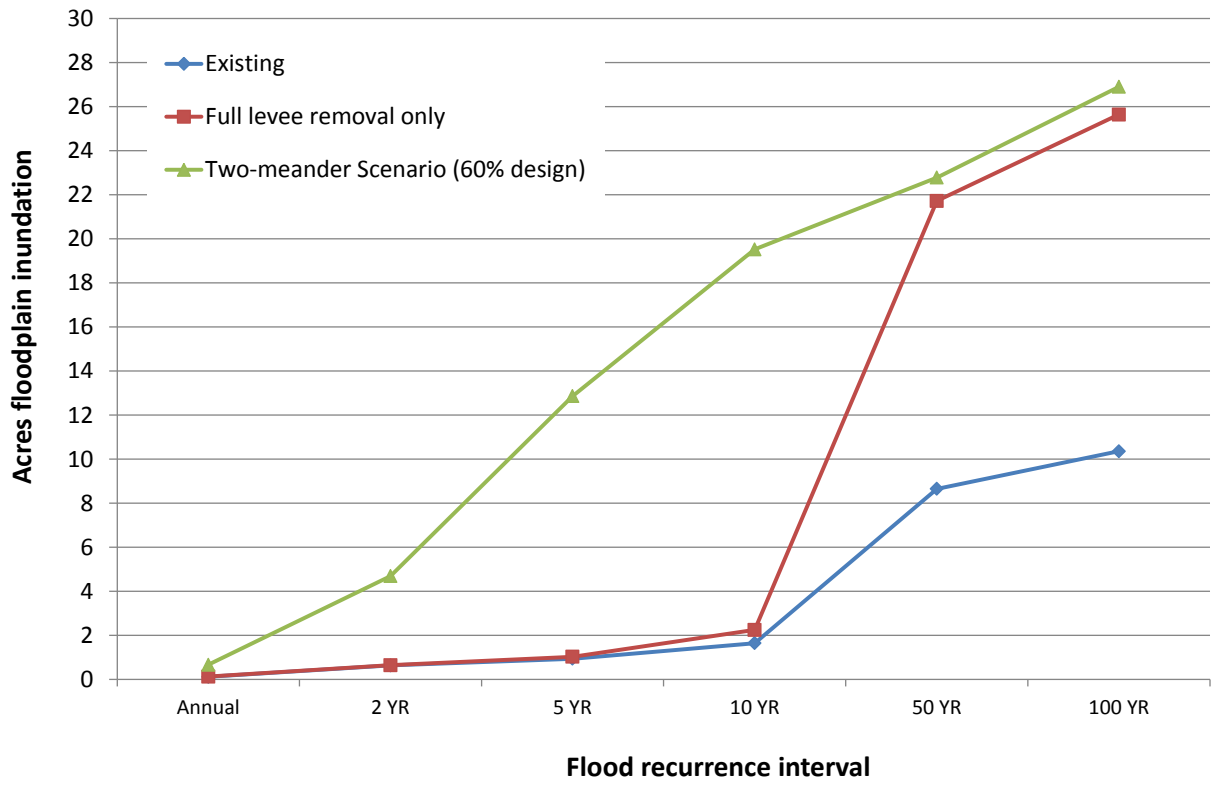


Figure 12. Comparison of inundation extents for existing conditions and two restoration scenarios. Values are based on 2-D modeling output.

2.7 PLANFORM ANALYSIS

Analysis of planform geometry was carried out in support of the channel re-alignment design process. An appropriate range of design values for radius of curvature was the main goal of the analysis. Using aerial photography and LiDAR data, radius of curvature was measured on several meander sequences in an upstream control reach and in adjacent study reaches downstream. These areas represent reference areas within similar geomorphic settings as the project area. To measure bend radius, a best fit circle was drawn along the outside channel margin of a given bend (Figure 13). Bend radius was calculated from the area of the circle. Measurements were made on all bends including actively migrating bends as well as bends constrained by hillslopes and other lateral barriers. Abandoned meanders in floodplain areas (oxbows) were also measured as a means of determining an unstable lower threshold for bend geometry, as these meanders represent a point at which a particular bend avulsed in the past. Design radius of curvature was compared to measured values with the goal of achieving a radius of curvature value within the range of stable bends. The range of values for appropriate radius of curvature ranged from 184 to 713 ft with an average value of 395 ft. The radius of curvatures of two oxbows in the reference reach are 220 and 284 ft. Design radius of curvature is approximately 385 ft, which puts the design geometry near the average measured value.

Figure 13. Example of measurements of radius of curvature for several bends in the reference reach upstream of the project area. All bends analyzed were measured in this way.

3 Design

3.1 DESIGN CRITERIA

Design criteria provide the roadmap for the project and ensure that project components will achieve objectives and address constraints. Design criteria apply to multiple aspects of a project, including habitat objectives, geomorphic considerations, construction logistics, regulations, safety, and feasibility. Design criteria were developed with reference to the project objectives identified in the Restoration Plan. However, some of the criteria differ from these objectives primarily due to this effort only targeting actions in Subreach 2 as opposed to the entire Upper White Pine reach. These design criteria may be revised as the design process proceeds.

3.1.1.1 Biological Objectives

- The primary species targets are steelhead and spring Chinook.
- The primary life-stage target is juvenile rearing (year-round) within the main channel and off-channel areas, and refuge from spring high flows, winter low temperatures, and summer high temperatures.
- Spawning habitat for Chinook and steelhead is not known to be a limiting factor in Nason Creek; therefore creation of spawning habitat is not a primary project goal. However, given that there were no spring Chinook (2003-2012) or steelhead (2005-2012) spawning redds located from RM 13.4 – 14, channel enhancements are likely to increase spawning habitat in this reach.

3.1.1.2 Riparian

- For areas of channel moved away from the railroad grade, re-establish a forested riparian buffer using native and locally-adapted riparian trees, shrubs, and groundcover.
- In areas disturbed by construction and under the existing powerline corridor, restore species composition, seral stage, and structural complexity of riparian areas to be more consistent with the potential native community. Increase riparian tree densities to 350 to 375 trees per acre and increase late seral class (greater than 16 inches in diameter) to 20 to 30 percent per acre (long term greater than 10 years).
- In areas disturbed by construction and under the existing powerline corridor, increase riparian canopy cover from less than 50 percent to greater than 80 percent (long term greater than 10 years).

3.1.1.3 Floodplain and channel dynamics

- Increase the frequency of floodplain inundation above the channel-forming flow through removal of the existing left-bank levee and alterations to channel geometry and structure.
- Avoid or minimize any increase in elevation or energy of the 100-year flood to minimize project risk to the railroad corridor or other nearby existing infrastructure.
- Over the long-term, restore more natural rates of channel migration through removal/modification of bank armoring, restoration of floodplain roughness, and restoration of streambank vegetation, structure, and complexity consistent with reference/historical conditions.
- Ensure that floodplain inundation and draining patterns do not create unnecessary avulsion or erosion risk. Generally strive to achieve synchronous floodplain inundation.
- Ensure that planform, profile, and cross-section geometry will support the desired amount of sediment transport and deposition and will eventually support a dynamic equilibrium of sediment transport through the reach over time.
- Ensure that the new planform geometry will be supported by valley slope and sediment transport conditions and will not result in abrupt changes to geometry in the near-term.
- Use wood structure to provide interim stability to channel in order to match channel "maturity" to riparian/floodplain "maturity" in the near-term.
- Only if necessary in constructed meanders or abandoned channel segments, provide vertical grade control. Utilize on-site salvaged boulder (i.e. riprap) material to the extent possible.

3.1.1.4 Channel geometry and habitat

- Improve parameters of channel pattern, profile, dimension, and structure to be more consistent with habitat-forming processes that lead to pool creation, gravel recruitment, retention, and sorting, and large wood recruitment that are more characteristic of reference/historical conditions
- Restore channel dimensions and increase the quality and quantity of pools to over 12 pools per mile with average maximum residual pool depth greater than 3 feet to increase the availability and quality of adult holding, spawning and juvenile rearing habitat with adequate substrate, velocity, depth, and cover.
- Restore the quantity and distribution of rearing habitat by increasing large wood pieces (12 to 35 inches diameter; greater than 35 feet long) to greater than 29 pieces per mile.
- Following implementation, wood placements should be stable enough to remain in place during flows that overtop the structures.
- To the extent possible given stability criteria, minimize the use of imported boulders and cabling for wood placements.

3.1.1.5 Wetlands and off-channel habitat

- Improve rearing and refuge potential by increasing seasonal off-channel and side channel habitat through active restoration and restored floodplain processes.
- Do not damage existing high quality wetland or off-channel habitat.
- Provide fish passage into existing wetlands to the extent possible given site constraints and anticipated beaver activities.
- Provide off-channel alcove habitat (or potentially flow-through side-channel habitat) within the footprint of abandoned main channel segments.
- Consider the creation of additional connected alcove habitat in the left-bank floodplain area.
- Improve fish access to the historical channel to the south of the railroad corridor near RM 13.5 to provide ingress and egress to backwater habitat that matches the seasonal use by juvenile fish.
- Improve the quality and quantity of the backwater habitat in the historic channel through placement of large wood for cover and complexity.
- Improve riparian conditions along the margins of created and restored backwater habitats via planting native and locally-adapted riparian species. Use riparian criteria to guide riparian restoration plans.

3.1.1.6 General

- This is not a commonly used creek for recreation, but may be used occasionally by experienced whitewater boaters. For wood placements, use the following safety guidelines:
    - For LW structures, avoid single protrusions of large wood that extend out into the channel and that could present a dangerous boating hazard.
    - Any mainstem wood placements placed in major flow paths (i.e. on the outside of bends) should have sufficient line of sight and navigable escape routes to be easily avoided by river users.
    - Mainstem structures shall be configured to shed objects floating along the river and thus minimize risk to recreationists.
- To the extent possible, isolate work areas from flowing water during construction to minimize turbidity impacts.
- Preserve existing trees and other existing native vegetation to the extent possible during construction.
- Ensure protection of existing infrastructure including the BNSF rail corridor, powerlines (BPA and CPUD), and Highway 2.
- Ensure project costs are reasonable given the anticipated habitat benefit.
- Avoid negative impacts to existing spawning habitat near RM 13.3.

3.2 DESIGN COMPONENTS

3.2.1 Alternatives Considered but Not Carried Forward

Several alternatives have been evaluated throughout the planning and design effort. Initial planning level alternatives were described and evaluated as part of the Restoration Plan (Inter-Fluve and USFS TEAMS 2012) and the reader is referred to that document for more information. Following completion of the Restoration Plan, several other alternatives and variations on design have been investigated. The alternatives that were considered by not moved forward to the 60% design stage are described below.

Place channel in historical alignment. Placing the channel in the historical alignment (south of the railroad) was not moved forward for 2 key reasons: 1) considerable expense, logistical issues, and long-term maintenance issues with the stream crossing the railroad in 2 locations, including the need for a

penetration through a 40-foot deep fill at the upstream end; and 2) Due to the proximity of the existing railroad location to the hillslope toe, this alignment would result in less available floodplain that could be reconnected to the channel (approximately half that of the north alignment), and the floodplain is also highly altered as most of it lies within the BPA transmission line corridor.

Levee removal alone. This alternative was discussed in the Restoration Plan but continued to be brought up by stakeholders and evaluated further through modeling, so it is discussed here. Levee removal alone was not moved forward because this action fails to accomplish the floodplain inundation objectives (see the section on Channel Re-alignment below). Because of the ditched nature of the existing constructed channel (constructed in late 1950s/early 1960s when the railroad was moved), removal of the levee does not result in significant floodplain inundation until the 50-year flood.

Other channel relocation scenarios. Various other channel relocation scenarios were investigated, including the one-meander scenario that was included in the 30% design. Based on stakeholder input on the 30% design, various potential versions of a longer, three-meander scenario were investigated. These scenarios included a channel that extended further upstream to the north and west of the current alignment. A two-meander scenario was eventually moved forward to 60%. The two-meander scenario provides more habitat, floodplain connectivity, and long-term ecological function compared to the one-meander scenario included in the 30% designs. Compared to the three-meander scenario, the two-meander scenario presents less risk of severe erosion and channel failure based on soils conditions in the up-valley portion of the floodplain (see Section 2.2.3).

Let river carve its own path. Removing the river-left levee and introducing the river onto the north floodplain surface and letting it carve its own path was considered but not carried forward for several reasons. The primary reason is the risk associated with the erosion of possibly more than 25,000 cubic yards of material (assuming a new channel forms that has similar size as the existing channel), much of it sand and loam, and its subsequent deposition in the channel downstream. This material would aggrade the bed downstream, raising flood water surface elevations and causing lateral erosion in response to the vertical aggradation; responses that could jeopardize existing downstream infrastructure including Hwy 2, the CPUD powerline corridor, and the railroad. The massive input of fine sediments would also have a significant impact to spawning gravels at least for a number of years. A second concern with this approach is the uncertainty with how the new channel would form through the north floodplain area and whether or not biological objectives could be met and over what time frame. It is likely that during the process of new channel development, the channel would form many new temporary paths, some through high quality wetlands, until it eventually coalesced into a single channel. The possibility of avulsion through the wetland complex, re-occupation of the existing channel, or of avulsion through the cleared CPUD powerline corridor (i.e. path of lowest hydraulic roughness) would be significant. If measures were taken to prevent these and other potentially undesirable outcomes, then numerous vertical and lateral controls would need to be put in place, as well as protection of downstream infrastructure, which would increase the cost and engineering requirements. After carefully considering this potential alternative, the landowners and the design team decided that the risk, uncertainty, and potential cost would be too great for the benefits that are likely to be provided.

Replacement of culvert under railroad. The replacement of the culvert under the railroad near RM 13.47 was included in the 30% design plans. This component was not carried forward for a number of reasons: 1) considerable expense and logistical challenges for construction, 2) relatively small amount of off-channel habitat to be reconnected and habitat only of moderate quality, and 3) the existence of some degree of fish passage under current condition (i.e. not a complete barrier). This component could potentially be carried forward as part of a future phase of restoration at the site.

3.2.2 Relocation of the CPUD powerlines

This component includes the re-routing of 3,800 feet of the existing Chelan PUD powerlines to a location along White Pine Road that is out of the existing floodplain. Six existing towers will be removed and ten new towers will be placed along the new corridor. This includes the portion of the powerlines between approximately RM 13.25 and 13.95. The powerlines will be relocated up to White Pine Road and will reconnect downstream near RM 13.25. Removal of these powerlines will allow for channel realignment, levee/riprap removal, and will enhance long-term channel migration and floodplain processes. Assessment of powerline relocation alternatives has been conducted by Chelan County and summarized in a technical memorandum (HDR 2012) that should be consulted for additional information. Powerline re-location design is occurring separately but concurrently.

Re-routing the CPUD powerlines will essentially allow the remaining project elements to occur unhindered, and will also allow for a freely dynamic floodplain and channel migration zone over the long-term without any limitations associated with the CPUD powerline infrastructure.

3.2.3 Channel re-alignment and existing channel fill

3.2.3.1 New channel construction

This is the primary project component and includes re-aligning approximately 1,500 feet of Nason Creek channel into a new alignment north of the existing channel between RM 13.7 and 13.45. The channel will have pool-riffle habitat and large wood placements. Excavated material from the new alignment will be placed in the existing channel segment to be abandoned. The re-alignment also includes creating a new backwater alcove within the abandoned channel segment and creating a connector channel to ensure fish and hydrologic connectivity to the existing culvert under the railroad. These secondary channels are discussed in section 3.2.4 below.

The channel re-alignment will involve excavation of existing ground to proposed channel dimensions and grade. The channel re-alignment takes advantage of floodplain depressions and channel scars, while also minimizing impacts to existing perched wetland habitats. The channel re-alignment will involve levee removal along river-left at the upstream and downstream connection points; near RM 13.7 and RM 13.45, respectively. The inlet bed elevation of the proposed channel will be raised approximately 4 feet to achieve desired gradient and to increase floodplain connectivity. This will create a pool in the main channel upstream of RM 13.7. Over time, this pool will naturally fill with bedload transported from upstream, at which point a more uniform profile will develop through the upstream connection point. The channel profile matches existing grade in the channel at the outlet connection point. The average gradient of the proposed channel bed is 0.44%.

The proposed channel planform, profile, and cross-section geometry is based on numerous data sources. The methods described in Section 2.7, in combination with looking at the historical channel south of the railroad, were used to help determine channel planform shape. Channel cross-section and profile geometry is based on reference to numerous sources including: 1) geometry of the historical channel, 2) geometry of the upstream reference reach, 3) geometry of adjacent upstream and downstream channel segments, 4) the geometry needed to achieve floodplain connection objectives, 5) the geometry needed to achieve sediment competency through the site, and 6) the geometry needed to address erosion and flood risks to nearby infrastructure. The design geometry was achieved through multiple iterations of channel geometry and modeling using 1-D and 2-D models (as described previously in Section 2.5). As designed, the proposed channel provides continuity of stream width, depth, flow velocity, and shear stress from upstream segments, through the project reach, and into downstream reaches.

3.2.3.2 Bed and bank treatments

The proposed design includes lining the bed of the new channel with a layer of coarse bedload (primarily gravels and cobbles with some small boulders) and construction of fabric encapsulated soil (FES) lifts and large wood placements along the banks in order to achieve desired channel stability. This is based on the presence of highly erodible soils that were found during the soils test pits. Providing initial stability is especially important over the short-term, when sediment equilibrium processes will favor erosion of the channel due to the sediment trapping that will initially occur in the mainstem pool upstream of RM 13.7. Once the upstream pool fills, equilibrium sediment processes are expected to become established within the restored reach. The new channel, which by that time would be expected to have mature streambank vegetation, will then be able to naturally adjust in response to dynamic sediment erosion and deposition processes.

The need to line the bed of the new channel was determined through sediment mobility analysis based on the soil types found in the test pits and the hydraulic model output. A bed size gradation for the imported material was selected to achieve bed stability over a range of potential flood volumes. It is assumed that a portion (nearly half) of the in situ bed material that is over-excavated for placement of the liner material can be sorted and re-used in the bed. The placed streambed material will extend beneath the lowest FES lift to provide vertical stability for some degree of lateral channel migration.

FES lifts are proposed for select locations where stream energy would result in significant erosion of channel banks over the short-term. This primarily occurs along the outside of the bends and in straight segments of the new channel. The inside of bends, which are expected to be deposition zones (bars), are not included for FES lift treatment. In general, based on bank heights, it is anticipated that 3 tiers of 1 foot tall lifts would be required, but this could be adjusted based on site conditions and will be further determined as part of final design. The FES lifts will be filled with a mix of salvaged or imported cobble, gravel, and topsoil. The lower tiers will have a greater amount of cobble and gravel than the top lift, which will have a greater percentage of topsoil in the mix in order to support riparian plantings.

Large wood will be incorporated into the banks as partially-buried toe logs beneath the FES lifts and as placements along the surface of the banks. Wood placements will provide immediate habitat cover and complexity, and will also help provide initial stability within the newly constructed channel, which will be prone to erosion following construction. The intent of the bank treatments that use FES lifts combined with large wood is to provide for initial stability following construction but to allow for long-term deformation (including channel migration at natural rates) once riparian vegetation becomes established. These treatments avoid the use of boulders or ferrous anchoring that could potentially affect the rates of long-term channel deformation.

3.2.3.3 Inlet and outlet log jams

At the inlet of the channel re-alignment, a ballasted log jam will be constructed within the upstream end of the existing channel fill. This log jam will be used to stabilize the fill and to divert water into the new channel alignment. The log jam will also provide habitat complexity and cover for salmonids in the newly created pool upstream of the channel inlet. The log jam will be anchored via the partial burial of key log members into the channel fill. Boulders salvaged from the existing riprap bank along the river-left (north) side of the existing channel (see Section 3.2.5 below) will be available to use as ballast within the backfill of the jam. This channel boundary is designed to be stable over the long term in order to prevent the encroachment or reoccupation of the existing channel by Nason Creek.

At the outlet of the channel re-alignment, where the new channel enters back into the existing channel, a log jam will be constructed on river-right to protect the downstream portion of the fill between the

culvert connector channel and the existing riprap bank along the railroad. This jam will be constructed to provide for long-term stability at this location, and will be configured similar to the log jam at the inlet.

3.2.3.4 Channel fill

The channel fill in the existing channel will have a sloped grade that diverts flood waters away from the railroad corridor and back towards the new channel. Fill along the railroad is designed to be above the 100 year flood elevation, which transitions down to a lower grade closer to the new channel. Fill material placed in the existing mainstem is expected to be primarily the sandy loam observed in the soils pits and will require moisture control, restrictions on thickness of lifts, and controlled compaction. Two buried boulder obstructions are proposed to be constructed within the channel fill. One is located at the upstream end of the fill, adjacent to the log jam, and one is located approximately midway through the fill where the new meander channel extends/bends to the south. These are designed to resist the potential for lateral erosion of the new channel to the south, back into the existing alignment along the railroad embankment. These will be constructed using salvaged boulders from the existing riprap bank along the river-left (north) side of the existing channel. The surface of the fill material will be treated with erosion control and/or floodplain roughness measures in order to reduce the risk of erosion of the placed material (details to be determined).

3.2.4 Secondary channel enhancements

3.2.4.1 High flow channel reconnection

A portion of the left-bank levee near RM 13.37 will be removed where it obstructs surface flow into a relic channel meander, which is now a floodplain wetland/beaver pond. The levee blocks surface flow into the upstream end of the channel. There is a beaver dam located at the downstream end of the channel and the channel is currently comprised of beaver pond habitat. No modifications to the beaver dam are proposed. The proposed depth of excavation of the inlet berm matches the extrapolation of the relic meander thalweg profile. Currently, the channel receives surface flow from the upstream end only above the 10-year event. Removal of the levee will provide for activation of the channel at the annual event. A log jam is proposed for the apex of the split flow at the channel entrance. This jam will help to stabilize this bank following excavation of the levee plug and will also encourage scour at the channel inlet to help maintain flow into the high flow channel. Wood placements will be secured using partial burial into banks and bracing against vertical wood pilings.

3.2.4.2 Culvert connector channel

An access channel will be maintained to the culvert under the railroad near RM 13.46. This channel will allow for the continued function of the culvert as an equalization and drainage culvert that connects to the pond on the south side of the railroad and will also allow for continued fish access when water levels in the channel allow. The connector channel to the culvert will be constructed by leaving a portion of the abandoned channel unfilled. The channel would be approximately 180 feet long. This channel will be accessible to fish year-round from the downstream end and will function as a backwater alcove as well as an access channel to the culvert. Wood will be placed in the channel for habitat complexity and cover and will consist of single pieces and small accumulations of wood. Wood placements will be secured using partial burial into banks and bracing against vertical wood pilings. FES lifts will be placed along the margins of the channel to provide temporary soil stability until planted riparian vegetation can establish.

3.2.4.3 Backwater alcove

A new backwater alcove will be constructed along river-right within the footprint of the former channel. The channel is designed to be approximately 100 feet long. This channel will be constructed by leaving a portion of the abandoned channel unfilled. This alcove will be accessible to fish year-round from the

downstream end. Wood will be placed in the alcove for habitat complexity and cover and will consist of single pieces and small accumulations of wood. Wood placements will be secured using partial burial into banks and bracing against vertical wood pilings. FES lifts will be placed along the margins of the alcove to provide temporary soil stability until planted riparian vegetation can establish. Slopes above the FES lifts will be seeded and lined with biodegradable erosion control fabrics.

3.2.5 Levee and riprap removal

3.2.5.1 Levee removal

Approximately 2,500 feet of the existing left-bank (north) levee will be removed. The levee removal extends from approximately RM 13.33 to RM 13.8. This accounts for the portions of the levee that impact floodplain inundation rates up to the 100-year flood event. Levee removal will include removing the levee prism down to existing floodplain elevation, except at the connection points for the new channel and the reconnected high flow channel, where additional material will be removed to activate these channels. Along portions of the levee, particularly at the upstream end of the site, there are mature trees. There is a mix of species, but the oldest trees at the upstream end are primarily Douglas fir. These trees are less than 50 years old and date back to after the construction of the levee in the late 1950s/early 1960s. These trees will be removed as necessary to facilitate levee removal. Trees will be removed with rootwads attached and will be incorporated as large wood habitat placements in the restored channel.

3.2.5.2 Riprap removal

Riprap will be partially or fully removed along the river-left (north) bank through the project area. The primary anticipated benefits of riprap removal are to enhance channel margin habitat and to restore long-term geomorphic function (e.g. lateral channel dynamics and migration). The riprap removal encompasses approximately 2,500 feet of channel. This action extends from approximately RM 13.33 to RM 13.8 although the riprap is discontinuous in the downstream portion. The riprap downstream of the new channel outlet (RM 13.33 to 13.44) will be fully removed. Within the channel fill (RM 13.44 to 13.68), the riprap will be salvaged as required for construction of the buried obstructions or will otherwise be buried in place. Riprap at the channel inlet will be removed down to the elevation of the new constructed bed elevation. Upstream of the inlet (RM 13.69), riprap on the upper bank will be removed but riprap on the lower bank will remain. The intent is to reduce the potential for significant erosion and channel change in the near-term, but to allow for bank deformation over the long term during floods, especially as the channel at this location aggrades to match the grade at the inlet. The current design includes leaving the existing riprap in place below the 2-year flood elevation, which could be revised in later phases of design pending additional analysis and landowner coordination.

3.2.6 Riparian and floodplain vegetation and roughness

3.2.6.1 Riparian and floodplain vegetation

This element includes planting of select riparian and floodplain areas with native vegetation in order to improve long-term ecological function. Species assemblages will include species that exist on site or are likely to exist on site, are valuable habitat species, are resistant to beaver impacts, and are appropriate for the proposed site conditions. Planting areas include the riparian zone around the newly aligned channel, the existing CPUD powerline corridor to be abandoned, and disturbed areas associated with access, staging, and construction of proposed restoration elements. Plants will include native riparian and upland adapted species as appropriate for each planting area. The primary planting zones are designated as: 1) riparian areas, and 2) upland areas. The riparian zone includes areas that are in close proximity to channels or that are otherwise in low and frequently inundated floodplain areas. These areas are targeted to receive native riparian rooted shrubs and trees, live-stake willow and cottonwood plantings, and a

riparian seed mix in disturbed areas. The upland mix includes species that are more adapted to dry or well-drained soils. An upland seed mix is also included for staging areas, temporary access routes, and other areas that will require quick application of a seed mix following construction disturbance. The planting plan will be refined as part of final designs once final construction timing and phasing have been determined.

3.2.6.2 Floodplain roughness

In existing or new floodplain areas subjected to disturbance during construction, it will be necessary to increase floodplain hydraulic roughness. The intent of floodplain roughness is to create a hydraulically rough surface in floodplain areas to be cleared and graded following construction. This roughness can help to limit erosion and channelization of floodplain surfaces until a time when planted vegetation can become established and provide long-term roughness and soil stabilization. The most common method of achieving floodplain roughness is to install downed woody debris. For this site, small woody debris salvaged from onsite will be used for floodplain roughness in selected areas. The wood will consist of brush, slash, and small trees up to 15 inches diameter. This material is intended to mimic the downed wood and organic matter that naturally occurs in floodplains. Larger material will be avoided due to the potential to attract bark beetles. The locations for floodplain roughness wood include portions of the CPUD powerline corridor to be abandoned, areas of levee removal, and potentially portions of the existing channel fill. The specific locations within the channel fill area will be determined based on further coordination with landowners. In some cases, other means may also be employed to achieve floodplain roughness and erosion protection, including the creation of elevated topographic features (e.g. hummocks), placement of erosion control fabric, heavy soil compaction, or import and placement of coarse non-erodible material.

3.3 SUMMARY OF ECOLOGICAL BENEFITS

The proposed channel re-alignment is expected to increase stream habitat complexity compared to existing conditions in the artificially straightened and simplified reach. The proposed meandering planform is expected to support pool-riffle habitat that will maintain pool scour on the outside of bends and deposition of gravel at pool tail-outs and bars. The proposed pool-riffle channel morphology will provide conditions that are more complex and favorable to salmonids than the existing straight and uniform plane-bed morphology. Wood placements within the new channel will further enhance cover and hydraulic complexity, and will provide a degree of interim stability until newly planted riparian vegetation can provide long-term stability. Processes of pool scour, bar deposition, and expected future channel migration at the outside of the proposed meander bends all support natural channel processes that are currently limited in this reach.

The connectivity between channel and floodplain processes will be enhanced by removing the existing levee, elevating the channel bed, increasing hydraulic roughness, and by allowing channel migration and overbank flooding to proceed unhindered by bank armoring, levees, or maintenance of the CPUD powerline infrastructure. With large flood events hydrologically connected to the floodplain, there is increased probability of side-channel formation, off-channel habitat formation, and increased complexity of main channel habitat through channel migration. The elevated channel bed in the new alignment not only increases the degree of floodplain inundation along the re-aligned section, but it is also expected to result in bed aggradation upstream, thereby further increasing floodplain inundation in upstream areas over time, especially given the full levee removal upstream of the inlet. Removing the upper-bank portion of the riprap upstream of the inlet will allow for the establishment of streambank riparian vegetation and will increase the potential for bank deformation in this area over the long-term.

Removal of the inlet berm obstructing flow into the relic meander at RM 13.37 will increase flow access to this side channel. Overtopping at flows above the 10-year event will be changed to overtopping at the annual event. This will increase the seasonal inundation frequency and period of fish access/usage.

Creating a new backwater alcove within the footprint of the abandoned channel segment will address reduced off-channel habitat, which is a limiting factor throughout Nason Creek. The backwater will provide juvenile rearing habitat throughout the year, as well as hydraulic refugia for multiple life-stages during periods of high flow. The new connector channel to the culvert under the railroad will allow fish to continue to access the backwater pond south of the railroad when water levels allow. The connector channel will provide alcove habitat that is connected to the mainstem during all flow levels.

The project segment has no large wood pieces in the current condition. Addition of large wood will increase wood frequency and will help achieve large wood targets. In-stream large wood will provide multiple habitat and geomorphic benefits including hydraulic complexity, pool scour, capture and sorting of spawning gravel, and increased cover.

Restored riparian vegetation is expected to provide multiple benefits. An important role that riparian vegetation will play is in providing bank stability through binding root strength and hydraulic roughness. This will be important in areas of new channel construction and at locations of levee and riprap removal. Mature vegetation will provide multiple habitat benefits as well. Overhanging vegetation on main channel banks and along off-channel areas will provide shade, cover, organic material, and a food source. Taller woody vegetation will also provide shade and a future source of large wood to the channel.

3.4 SAFETY CONSIDERATIONS

A number of potential safety concerns have been and will continue to be considered as part of project design. These considerations primarily apply to the use of large wood, which can pose a potential risk to river recreational users. Safety considerations as part of design follow protocols by the State of Washington and other groups (e.g. American Whitewater) and utilized river recreational use information that was obtained by the Yakama Nation as part of a river use analysis and questionnaire (MIG 2013). The following paraphrases the results of the questionnaire:

> *The questionnaire was online from February through May 2013 with the purpose of gathering information on boater skills and experience, behaviors relative to risks, perceptions of river hazards and preferences towards management and river conditions. The questionnaire was shared with: 1) over twenty contacts with direct experience boating Nason Creek, 2) Chelan County Natural Resources Department, 3) American Whitewater and 4) Wenatchee Outdoors websites for distribution to members and interested parties. There were a total of 13 responses. The general finding was that there is little use of this reach by recreationists. What use there is occurs by experienced to very experienced whitewater boaters.*

Draft designs include large wood placements along the mainstem and as cover wood within existing or created off-channel habitats. The structures on the mainstem have been designed to provide habitat function while minimizing risk to river recreationists, and designs specify sufficient anchor to achieve stability at the design flow. A number of safety guidelines are available and were reviewed and considered during design, including:

- Washington State Department of Transportation. August 9, 2010. Project Delivery Memo #10-01, Geomorphic/Safety Guidance for the use of Large Woody Materials for Mitigation Applications in Bridge Scour Projects.

- Beth Andrus & James Gessford, P.E., Skellenger & Bender Attorneys. 2007. Understanding the Legal Risks Associated with Design and Construction of Engineered Logjams
- River Safety Council. Proposed Safety Guidelines for the Construction and Placement of Large Woody Debris Affecting Streams used for Recreation in Washington State.
- American Whitewater. Integrating Recreational Boating Considerations Into Stream Channel Modification & Design Projects.

In general, these guidelines are aligned with the standard approach taken by Inter-Fluve in design and placement of large wood. These guidelines are also consistent with the guidelines provided in the Safety Appendix of the Washington State Stream Habitat Restoration Guidelines (Cramer 2012). A number of considerations were included in the design to minimize risk consistent with the guidelines, such as:

- This portion of Nason Creek is utilized by experienced recreational river users, with a median experience level of 15 years. Mostly the river is used by hard-shell kayakers (66.7% of respondents), who travel with two or more boats in a group (100% of respondents)
- As a design standard, any mainstem wood placements placed in major flow paths (i.e. out the outside of bends) have sufficient line of sight and navigable escape routes to be easily avoided by river users with limited skills. Smaller habitat wood placements are along channel margins, through straight reaches with high visibility.
- Mainstem structures shall be configured in the field to shed objects floating along the river and thus minimize risk to recreationists. The optimal configuration for safety will be site dependent, but will commonly depend on flow orientation to the bank, bank height, depth of log submersion, line of sight, near bank velocity, near bank shear stress, and near bank depth.
- Mainstem structures will be designed for stability under hydraulic conditions produced by the 100-yr flood with consideration given to buoyancy, depth of burial, anchoring, and ballasting.
- Safety signage warning river users of the presence of log structures may be a viable component of safety measures. This may include signs along the river, at put ins, or on industry websites (e.g. American Whitewater). This is consistent with recommendations by Andrus & Gessford (see above reference); the River Safety Council; and the Washington State Department of Natural Resources.

4 References

Cramer, Michelle L. (managing editor). 2012. Stream Habitat Restoration Guidelines. Co-published by the Washington Departments of Fish and Wildlife, Natural Resources, Transportation and Ecology, Washington State Recreation and Conservation Office, Puget Sound Partnership, and the U.S. Fish and Wildlife Service. Olympia, Washington.

HDR. 2012. Chelan County Transmission Line Relocation – Detailed Alternative Analysis Due to Nason Creek Reconnection. Technical Memo prepared by HDR for CPUD and Chelan County.

Lai, Y.G. 2000. Unstructured grid arbitrarily shaped element method for fluid flow simulation. AIAA Journal. 38(12), 2246-2252.

Lai, Y.G. 2008. SRH-2D version 2: Theory and User's Manual. Sedimentation and River Hydraulics – Two-Dimensional River Flow Modeling. U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center, Denver, CO.

Malmon, D. 2010. Nason Creek Hydrology: Characterization of flow rates in the Lower White Pine Reach based on USGS and DOE stream gages. Technical Memo prepared by CH2M Hill for ICF International.

MIG, Inc. 2013. Recreation Assessment Questionnaire Results Summary, Nason Creek – May 22, 2013 DRAFT.

RTT (Regional Technical Team). 2013. A biological strategy to protect and restore salmonid habitat in the Upper Columbia Region. A Draft Report to the Upper Columbia Salmon Recovery Board. From The Upper Columbia Regional Technical Team. 52 pages plus appendices.

Sixta, M. 2011. Hydraulic Modeling for the Lower White Pine Habitat Reconnection Project, Nason Creek, WA. U.S. Department of Interior. Bureau of Reclamation. Technical Service Center, Sedimentation and River Hydraulics Group, Denver, CO.

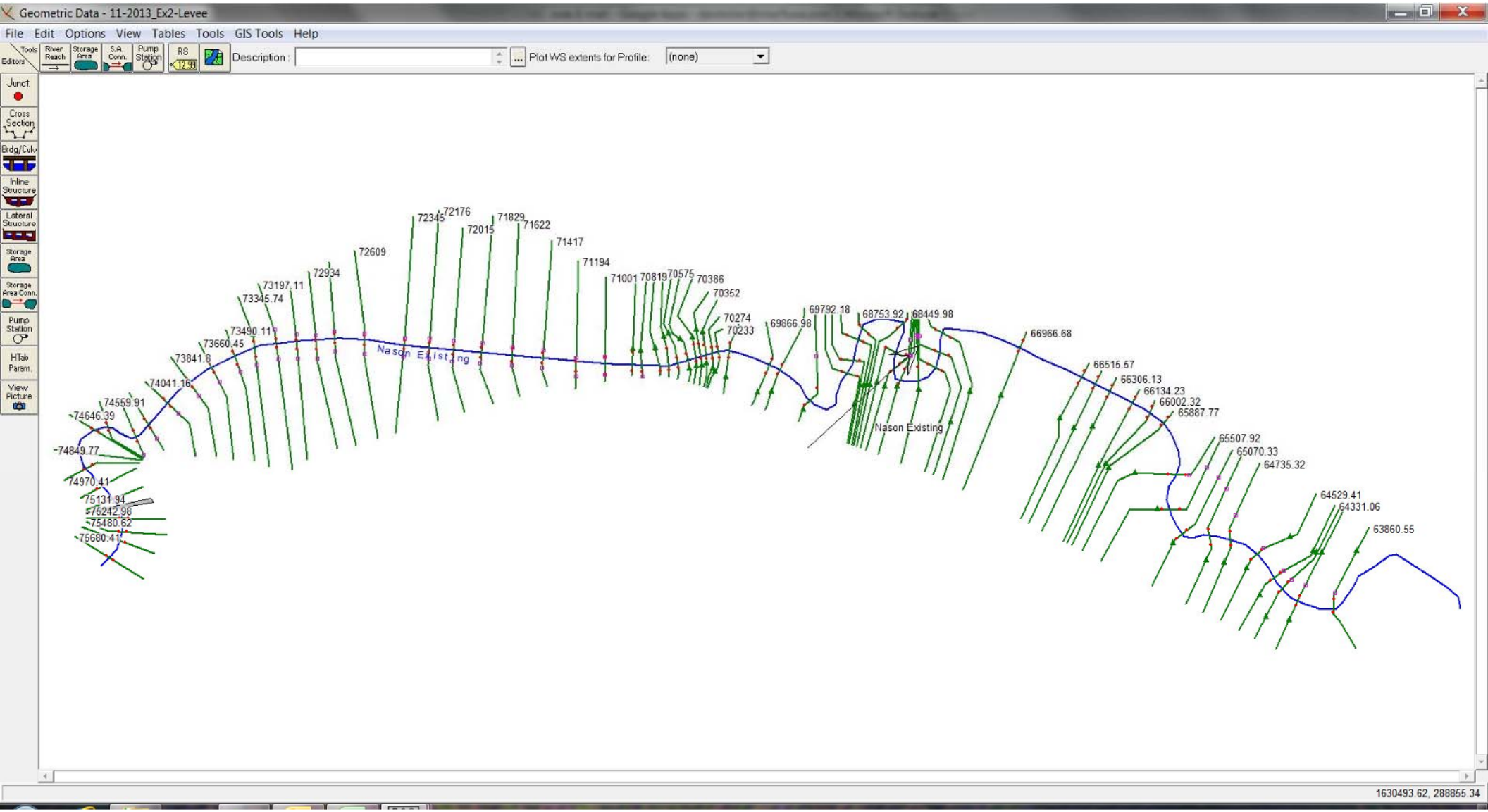
Sutley, D. 2007. Appendix D - Hydrology Analysis and GIS Data. Part of: Nason Creek Tributary Assessment, Chelan County, WA. U.S. Department of Interior. Bureau of Reclamation. Technical Service Center, Sedimentation and River Hydraulics Group, Denver, CO, and Pacific Northwest Regional Office, Boise, ID. July, 2008.

U.S. Bureau of Reclamation (USBR). 2008. Nason Creek Tributary Assessment, Chelan County, WA. USDI USBR Technical Service Center, Denver, CO and Pacific Northwest Regional Office, Boise, Idaho.

U.S. Bureau of Reclamation (USBR). 2009. Nason Creek Lower White Pine Reach Assessment, Chelan County, Washington. USDI USBR Pacific Northwest Regional Office.

Appendix A: 1-D Hydraulic Model Output

This appendix presents results from the 1-D HEC-RAS Hydraulic Model for existing conditions. For proposed conditions, please refer to the 2-D model results presented in Appendix B.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Pump Station
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Plot WS extents for Profile:
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Cross Section
Brdg/Culv
Inline Structure
Lateral Structure
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Pump Station
HTab Param.
View Picture
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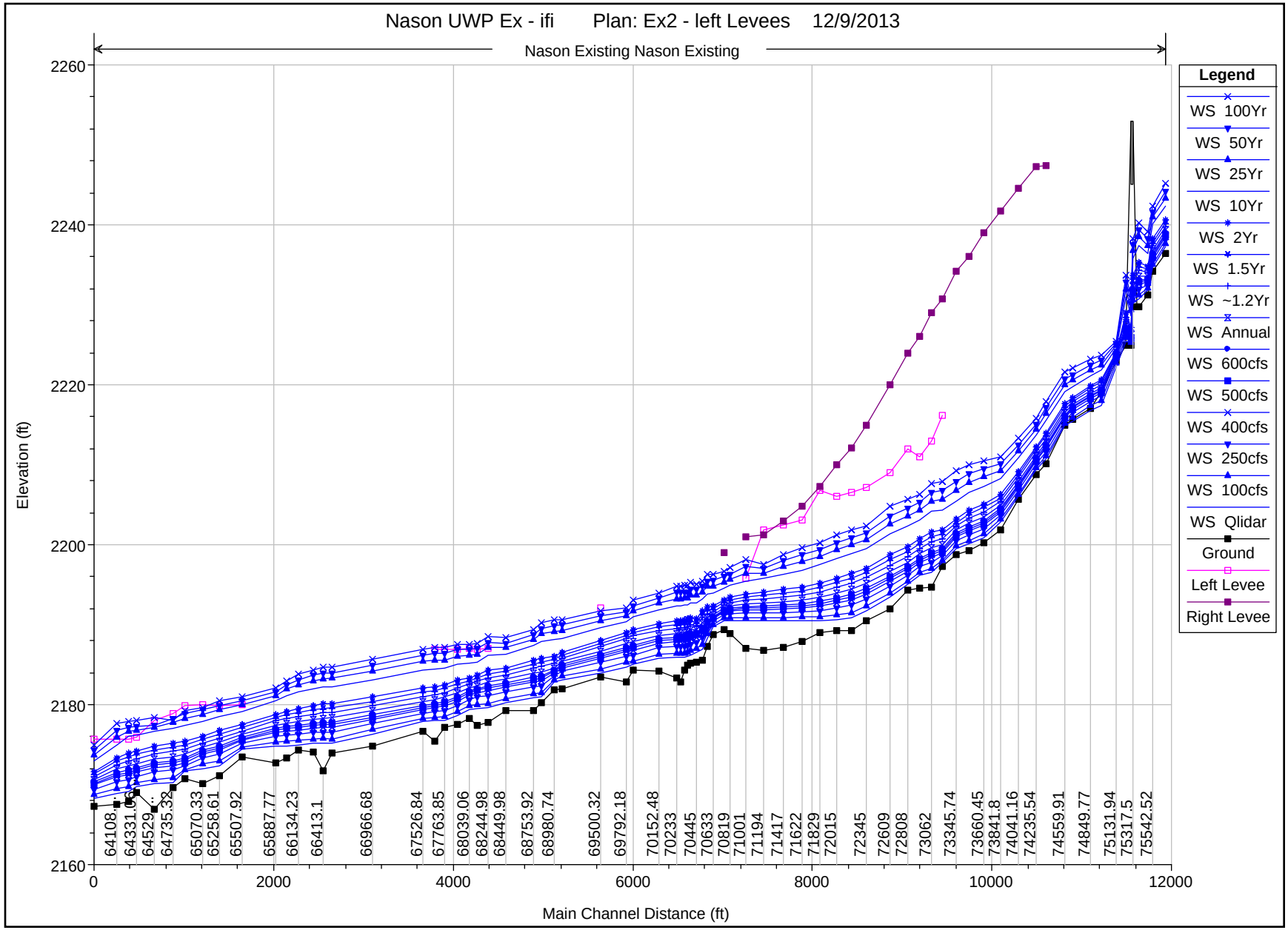
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WS 50Yr
WS 25Yr
WS 10Yr
WS 2Yr
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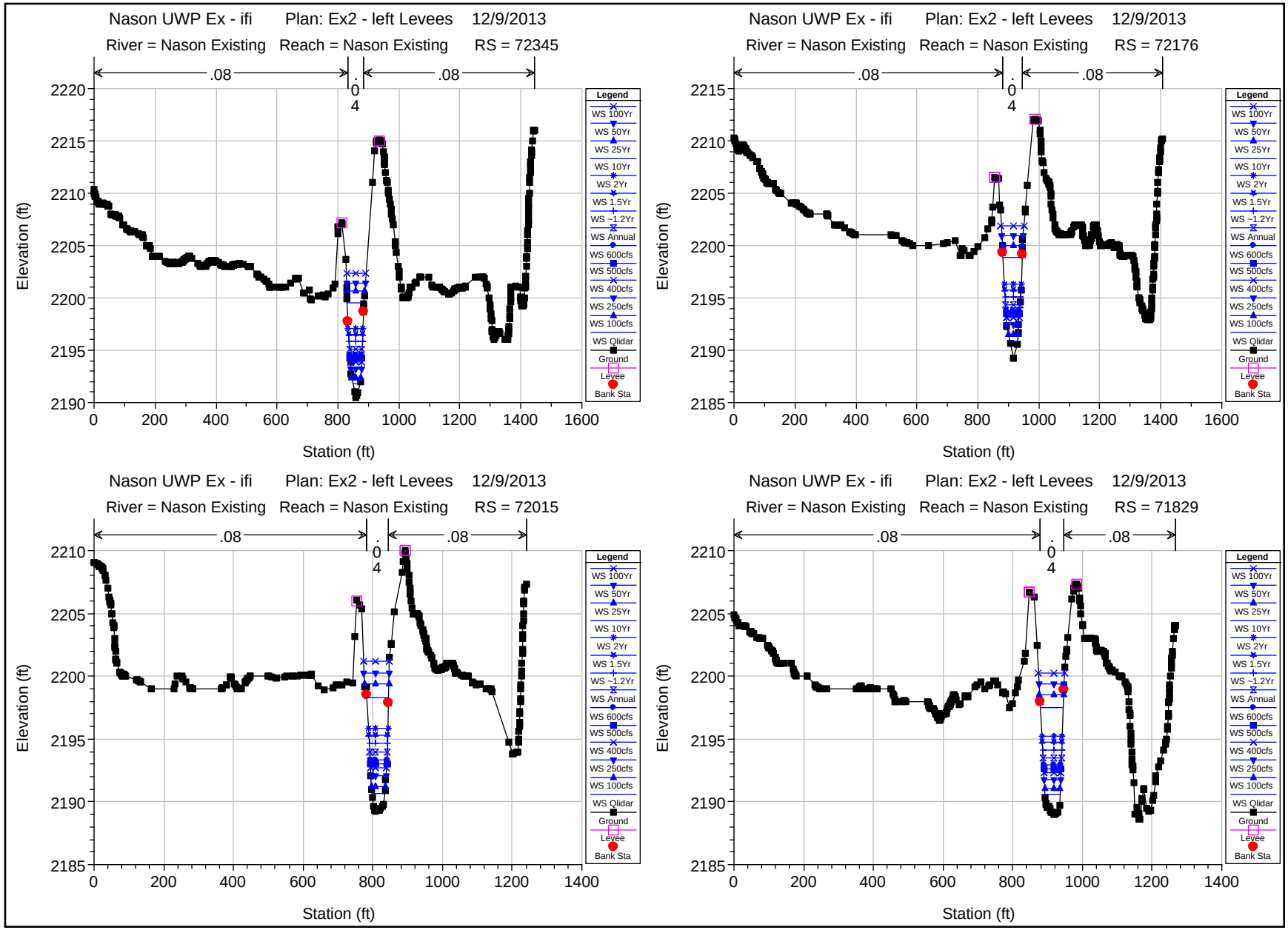
WS Qlidar
Ground
Left Levee
Right Levee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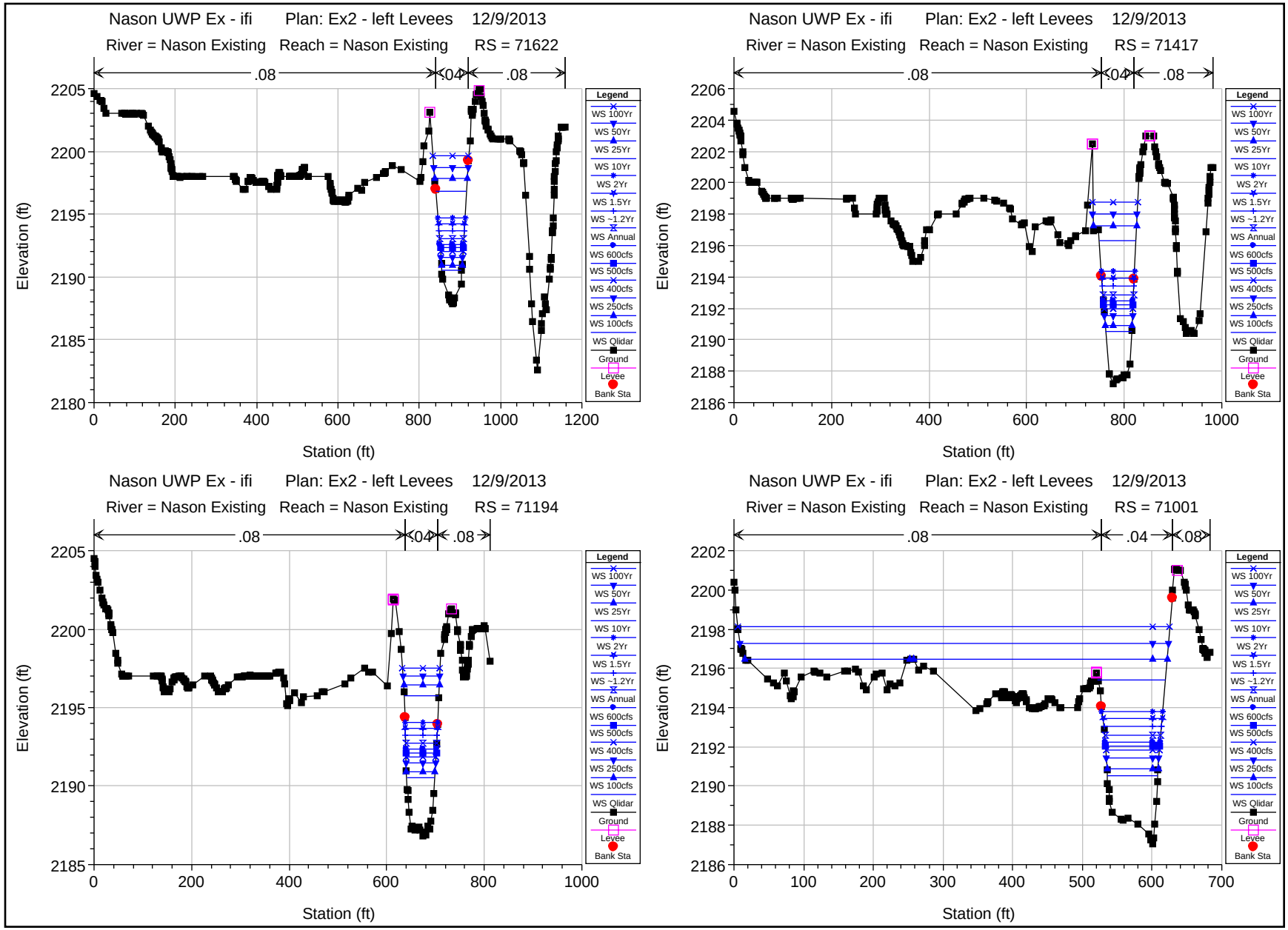
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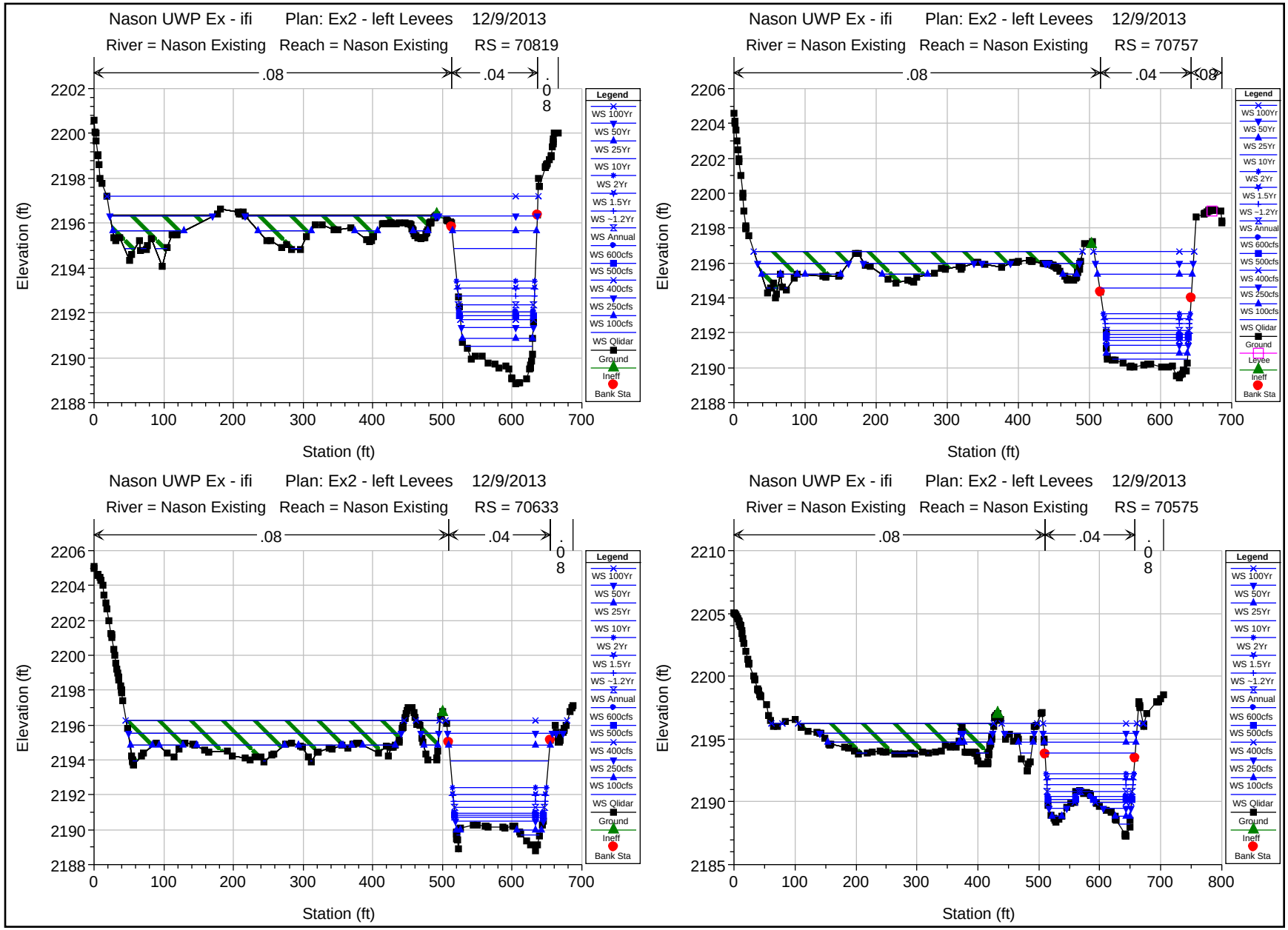
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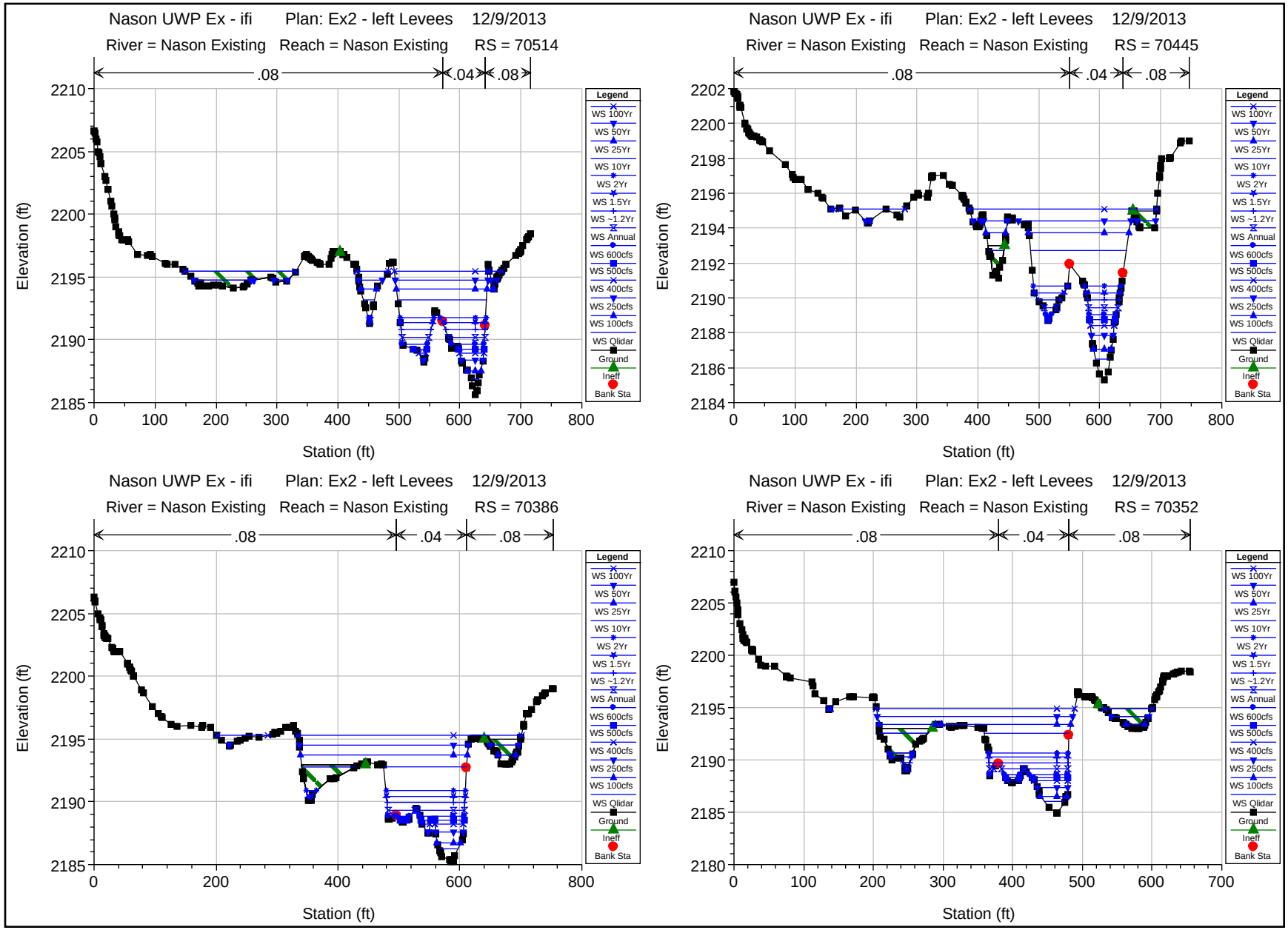
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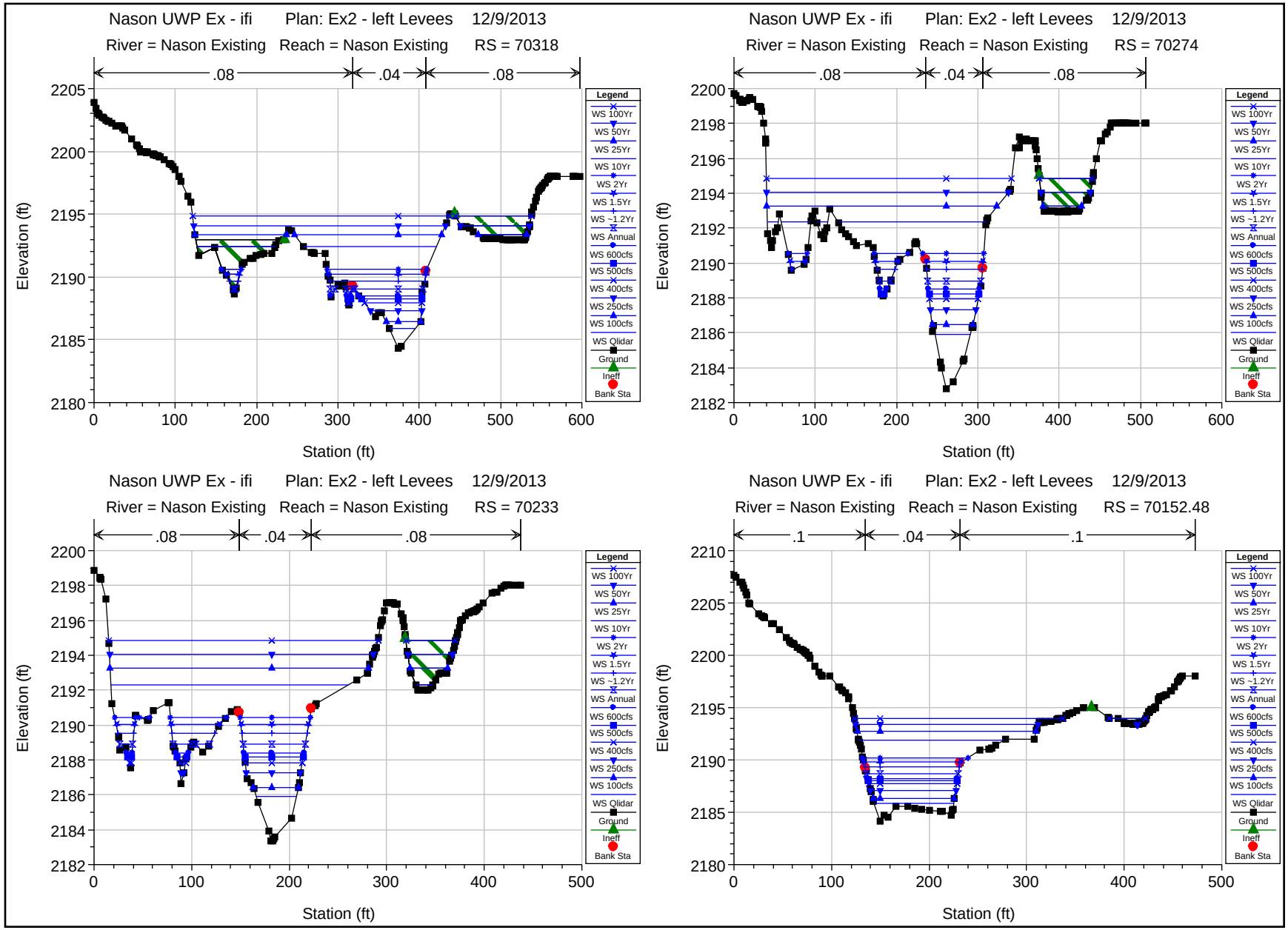
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WS Qlidar
Ground
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Bank Sta

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
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Nason Existing	75480.62	~1.2Yr	1100.00	2231.28	2234.02	2234.84	2236.74	0.051898	13.22	83.20	41.77	1.65
Nason Existing	75480.62	1.5Yr	1400.00	2231.28	2234.41	2235.32	2237.45	0.049107	13.99	100.07	44.17	1.64
Nason Existing	75480.62	2Yr	1700.00	2231.28	2234.76	2235.76	2238.11	0.046763	14.67	115.86	45.76	1.63
Nason Existing	75480.62	10Yr	3400.00	2231.28	2236.48	2237.77	2241.04	0.035862	17.14	198.54	50.64	1.52
Nason Existing	75480.62	25Yr	4500.00	2231.28	2237.42	2238.83	2242.61	0.031176	18.30	247.19	53.14	1.46
Nason Existing	75480.62	50Yr	5500.00	2231.28	2238.21	2239.76	2243.92	0.027969	19.19	290.49	55.21	1.42
Nason Existing	75480.62	100Yr	6700.00	2231.28	2239.10	2240.75	2245.38	0.025452	20.16	340.36	57.49	1.39
Nason Existing	75389.42	Qlidar	40.00	2229.79	2230.80	2230.29	2230.83	0.001701	1.29	30.93	39.66	0.26
Nason Existing	75389.42	Annual	800.00	2229.79	2233.63	2232.32	2234.00	0.004096	4.92	162.61	53.12	0.50
Nason Existing	75389.42	~1.2Yr	1100.00	2229.79	2234.28	2232.84	2234.76	0.004375	5.54	198.55	57.37	0.52
Nason Existing	75389.42	1.5Yr	1400.00	2229.79	2234.83	2233.30	2235.40	0.004462	6.08	231.99	69.16	0.54
Nason Existing	75389.42	2Yr	1700.00	2229.79	2235.32	2233.73	2235.98	0.004421	6.54	269.64	83.78	0.55
Nason Existing	75389.42	10Yr	3400.00	2229.79	2237.47	2235.76	2238.52	0.004329	8.42	463.58	93.23	0.58
Nason Existing	75389.42	25Yr	4500.00	2229.79	2238.51	2236.72	2239.80	0.004477	9.44	561.38	95.46	0.60
Nason Existing	75389.42	50Yr	5500.00	2229.79	2239.35	2237.44	2240.86	0.004586	10.25	642.58	97.30	0.62
Nason Existing	75389.42	100Yr	6700.00	2229.79	2240.27	2238.28	2242.02	0.004692	11.10	733.29	99.41	0.64
Nason Existing	75317.5		Bridge									
Nason Existing	75242.98	Qlidar	40.00	2224.97	2225.49	2225.49	2225.67	0.033707	3.41	11.72	33.06	1.01
Nason Existing	75242.98	Annual	800.00	2224.97	2227.56	2227.56	2228.62	0.018917	8.26	96.83	46.27	1.01
Nason Existing	75242.98	~1.2Yr	1100.00	2224.97	2228.09	2228.09	2229.36	0.017819	9.03	121.88	48.58	1.00
Nason Existing	75242.98	1.5Yr	1400.00	2224.97	2228.55	2228.55	2230.01	0.017173	9.67	144.73	50.39	1.01
Nason Existing	75242.98	2Yr	1700.00	2224.97	2228.97	2228.97	2230.60	0.016664	10.23	166.18	51.80	1.01
Nason Existing	75242.98	10Yr	3400.00	2224.97	2230.95	2230.95	2233.33	0.014821	12.40	274.24	57.61	1.00
Nason Existing	75242.98	25Yr	4500.00	2224.97	2231.98	2231.98	2234.78	0.014154	13.42	335.37	60.49	1.00
Nason Existing	75242.98	50Yr	5500.00	2224.97	2232.81	2232.81	2235.97	0.013725	14.25	386.62	62.71	1.00
Nason Existing	75242.98	100Yr	6700.00	2224.97	2233.72	2233.72	2237.28	0.012998	15.14	445.03	65.85	1.00
Nason Existing	75131.94	Qlidar	40.00	2222.95	2222.26	2221.86	2222.35	0.022570		16.68	20.71	0.00
Nason Existing	75131.94	Annual	800.00	2222.95	2223.82	2223.94	2224.56	0.084562	7.56	115.90	107.14	1.74
Nason Existing	75131.94	~1.2Yr	1100.00	2222.95	2223.93	2224.24	2225.10	0.119594	9.67	127.63	111.05	2.11
Nason Existing	75131.94	1.5Yr	1400.00	2222.95	2224.03	2224.48	2225.63	0.149315	11.49	139.27	120.69	2.39
Nason Existing	75131.94	2Yr	1700.00	2222.95	2224.12	2224.68	2226.15	0.175377	13.08	151.01	129.52	2.62
Nason Existing	75131.94	10Yr	3400.00	2222.95	2224.61	2225.94	2228.85	0.236166	20.51	218.93	146.22	3.28
Nason Existing	75131.94	25Yr	4500.00	2222.95	2225.00	2226.50	2230.43	0.224701	24.12	279.73	166.80	3.35
Nason Existing	75131.94	50Yr	5500.00	2222.95	2225.24	2226.93	2231.67	0.222617	26.31	320.03	173.70	3.41
Nason Existing	75131.94	100Yr	6700.00	2222.95	2225.47	2227.45	2233.07	0.224877	28.62	360.71	176.36	3.50
Nason Existing	74970.41	Qlidar	40.00	2219.17	2217.42		2217.51	0.058777		16.82	36.53	0.00
Nason Existing	74970.41	Annual	800.00	2219.17	2219.69	2218.98	2219.88	0.024775	2.84	229.98	181.17	0.86
Nason Existing	74970.41	~1.2Yr	1100.00	2219.17	2220.05	2219.37	2220.26	0.021371	4.04	297.24	199.91	0.89
Nason Existing	74970.41	1.5Yr	1400.00	2219.17	2220.36	2219.66	2220.60	0.019220	4.63	362.22	214.02	0.88
Nason Existing	74970.41	2Yr	1700.00	2219.17	2220.65	2219.82	2220.91	0.017387	4.98	426.68	226.22	0.86
Nason Existing	74970.41	10Yr	3400.00	2219.17	2221.87	2220.65	2222.28	0.013973	7.07	720.54	257.06	0.87
Nason Existing	74970.41	25Yr	4500.00	2219.17	2222.51	2221.09	2223.05	0.013384	8.31	903.39	297.41	0.89
Nason Existing	74970.41	50Yr	5500.00	2219.17	2223.08	2221.40	2223.68	0.011742	8.83	1076.28	316.50	0.86
Nason Existing	74970.41	100Yr	6700.00	2219.17	2223.75	2221.79	2224.41	0.010299	9.37	1297.42	340.02	0.83
Nason Existing	74849.77	Qlidar	40.00	2217.08	2216.76		2216.78	0.005592		30.08	39.31	0.00
Nason Existing	74849.77	Annual	800.00	2217.08	2218.91		2219.03	0.007007	3.68	318.91	195.29	0.57
Nason Existing	74849.77	~1.2Yr	1100.00	2217.08	2219.27		2219.43	0.006987	4.21	391.45	205.71	0.59
Nason Existing	74849.77	1.5Yr	1400.00	2217.08	2219.59		2219.78	0.006985	4.65	457.54	214.56	0.60
Nason Existing	74849.77	2Yr	1700.00	2217.08	2219.88		2220.11	0.007039	5.03	521.53	226.63	0.62
Nason Existing	74849.77	10Yr	3400.00	2217.08	2221.14		2221.52	0.006744	6.43	837.01	267.96	0.64

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	74849.77	25Yr	4500.00	2217.08	2221.83		2222.30	0.006383	7.10	1040.45	318.93	0.64
Nason Existing	74849.77	50Yr	5500.00	2217.08	2222.42		2222.97	0.006320	7.76	1234.67	356.31	0.66
Nason Existing	74849.77	100Yr	6700.00	2217.08	2223.16		2223.77	0.005684	8.18	1511.30	382.12	0.64
Nason Existing	74646.39	Qlidar	40.00	2215.64	2215.46		2215.50	0.017986		25.55	43.49	0.00
Nason Existing	74646.39	Annual	800.00	2215.64	2217.53		2217.71	0.009026	4.48	292.00	196.84	0.66
Nason Existing	74646.39	~1.2Yr	1100.00	2215.64	2217.86		2218.09	0.009200	5.17	356.60	205.65	0.69
Nason Existing	74646.39	1.5Yr	1400.00	2215.64	2218.15		2218.44	0.009151	5.72	418.25	213.45	0.70
Nason Existing	74646.39	2Yr	1700.00	2215.64	2218.42		2218.76	0.009038	6.18	477.82	221.21	0.71
Nason Existing	74646.39	10Yr	3400.00	2215.64	2219.80		2220.30	0.007483	7.67	801.02	246.32	0.70
Nason Existing	74646.39	25Yr	4500.00	2215.64	2220.56		2221.15	0.006984	8.38	992.03	262.11	0.70
Nason Existing	74646.39	50Yr	5500.00	2215.64	2221.18		2221.85	0.006652	8.93	1161.63	278.30	0.70
Nason Existing	74646.39	100Yr	6700.00	2215.64	2222.04		2222.76	0.005928	9.36	1427.25	343.81	0.68
Nason Existing	74559.91	Qlidar	40.00	2214.91	2214.95	2214.89	2215.07	0.094621	0.94	14.97	47.64	1.08
Nason Existing	74559.91	Annual	800.00	2214.91	2216.54	2216.29	2217.00	0.025228	6.99	188.11	153.21	1.08
Nason Existing	74559.91	~1.2Yr	1100.00	2214.91	2216.93	2216.69	2217.42	0.020483	7.24	250.14	162.85	1.01
Nason Existing	74559.91	1.5Yr	1400.00	2214.91	2217.28	2216.95	2217.81	0.017795	7.45	309.56	172.59	0.96
Nason Existing	74559.91	2Yr	1700.00	2214.91	2217.62		2218.16	0.015757	7.65	368.22	181.23	0.92
Nason Existing	74559.91	10Yr	3400.00	2214.91	2219.16		2219.85	0.010595	8.67	688.20	230.41	0.82
Nason Existing	74559.91	25Yr	4500.00	2214.91	2219.96		2220.74	0.009177	9.27	883.89	253.30	0.79
Nason Existing	74559.91	50Yr	5500.00	2214.91	2220.70		2221.49	0.007646	9.41	1074.92	262.66	0.74
Nason Existing	74559.91	100Yr	6700.00	2214.91	2221.57		2222.43	0.006848	9.91	1322.05	308.85	0.72
Nason Existing	74351.4	Qlidar	40.00	2210.08	2210.68	2210.57	2210.79	0.014171	2.61	15.34	33.78	0.68
Nason Existing	74351.4	Annual	800.00	2210.08	2212.80	2212.63	2213.59	0.014770	7.13	112.27	56.07	0.89
Nason Existing	74351.4	~1.2Yr	1100.00	2210.08	2213.25	2213.11	2214.23	0.015429	7.94	138.47	60.65	0.93
Nason Existing	74351.4	1.5Yr	1400.00	2210.08	2213.65	2213.57	2214.79	0.015654	8.57	163.42	64.57	0.95
Nason Existing	74351.4	2Yr	1700.00	2210.08	2213.99	2213.94	2215.29	0.015844	9.12	186.44	67.66	0.97
Nason Existing	74351.4	10Yr	3400.00	2210.08	2215.57	2215.57	2217.52	0.014753	11.24	307.04	91.92	0.99
Nason Existing	74351.4	25Yr	4500.00	2210.08	2216.47	2216.47	2218.69	0.012835	12.02	392.85	97.52	0.96
Nason Existing	74351.4	50Yr	5500.00	2210.08	2217.15	2217.15	2219.64	0.012242	12.79	459.99	101.07	0.96
Nason Existing	74351.4	100Yr	6700.00	2210.08	2217.90	2217.90	2220.70	0.011699	13.61	537.33	105.26	0.95
Nason Existing	74235.54	Qlidar	40.00	2208.75	2209.36	2209.20	2209.43	0.009819	2.15	18.61	41.67	0.57
Nason Existing	74235.54	Annual	800.00	2208.75	2211.13	2210.98	2211.85	0.014839	6.81	117.45	62.84	0.88
Nason Existing	74235.54	~1.2Yr	1100.00	2208.75	2211.55	2211.40	2212.45	0.014796	7.64	144.05	64.68	0.90
Nason Existing	74235.54	1.5Yr	1400.00	2208.75	2211.93	2211.80	2212.99	0.014913	8.26	169.51	68.49	0.92
Nason Existing	74235.54	2Yr	1700.00	2208.75	2212.25	2212.14	2213.48	0.015089	8.90	191.45	70.29	0.94
Nason Existing	74235.54	10Yr	3400.00	2208.75	2213.67	2213.74	2215.75	0.015704	11.60	296.02	76.53	1.02
Nason Existing	74235.54	25Yr	4500.00	2208.75	2214.39	2214.62	2216.99	0.016113	12.96	352.49	79.09	1.06
Nason Existing	74235.54	50Yr	5500.00	2208.75	2215.06	2215.29	2218.01	0.015373	13.83	405.89	81.34	1.06
Nason Existing	74235.54	100Yr	6700.00	2208.75	2215.84	2216.10	2219.15	0.014367	14.65	470.44	83.96	1.05
Nason Existing	74041.16	Qlidar	40.00	2205.66	2206.07	2206.06	2206.21	0.033519	3.02	13.24	44.63	0.98
Nason Existing	74041.16	Annual	800.00	2205.66	2207.94	2207.84	2208.78	0.016756	7.35	108.86	56.94	0.94
Nason Existing	74041.16	~1.2Yr	1100.00	2205.66	2208.40	2208.33	2209.42	0.016412	8.09	135.93	60.47	0.95
Nason Existing	74041.16	1.5Yr	1400.00	2205.66	2208.80	2208.74	2209.98	0.015964	8.72	160.62	62.46	0.96
Nason Existing	74041.16	2Yr	1700.00	2205.66	2209.18	2209.08	2210.50	0.015491	9.22	184.39	64.32	0.96
Nason Existing	74041.16	10Yr	3400.00	2205.66	2210.89	2210.78	2212.90	0.013567	11.39	299.67	70.19	0.96
Nason Existing	74041.16	25Yr	4500.00	2205.66	2211.78	2211.69	2214.20	0.012967	12.50	363.39	73.15	0.96
Nason Existing	74041.16	50Yr	5500.00	2205.66	2212.49	2212.42	2215.28	0.012609	13.42	416.32	75.48	0.97
Nason Existing	74041.16	100Yr	6700.00	2205.66	2213.34	2213.25	2216.48	0.011908	14.26	481.77	78.28	0.97
Nason Existing	73841.8	Qlidar	40.00	2201.90	2202.86	2202.60	2202.94	0.009614	2.25	17.78	36.48	0.57
Nason Existing	73841.8	Annual	800.00	2201.90	2204.91	2204.71	2205.73	0.013918	7.29	109.79	50.31	0.87
Nason Existing	73841.8	~1.2Yr	1100.00	2201.90	2205.41	2205.21	2206.44	0.013678	8.12	135.49	51.84	0.88
Nason Existing	73841.8	1.5Yr	1400.00	2201.90	2205.86	2205.65	2207.06	0.013471	8.79	159.24	53.20	0.90
Nason Existing	73841.8	2Yr	1700.00	2201.90	2206.28	2206.04	2207.64	0.013267	9.36	181.71	54.47	0.90
Nason Existing	73841.8	10Yr	3400.00	2201.90	2208.26	2207.97	2210.32	0.012362	11.52	295.21	60.47	0.92
Nason Existing	73841.8	25Yr	4500.00	2201.90	2209.31	2209.02	2211.73	0.011846	12.48	360.73	63.96	0.92
Nason Existing	73841.8	50Yr	5500.00	2201.90	2210.13	2209.80	2212.89	0.011331	13.34	414.06	66.76	0.92
Nason Existing	73841.8	100Yr	6700.00	2201.90	2210.96	2210.71	2214.17	0.011229	14.39	471.22	70.13	0.93
Nason Existing	73660.45	Qlidar	40.00	2200.20	2200.91	2200.79	2201.00	0.011916	2.36	16.93	38.02	0.62
Nason Existing	73660.45	Annual	800.00	2200.20	2203.48	2202.73	2203.96	0.006504	5.55	144.16	56.24	0.61
Nason Existing	73660.45	~1.2Yr	1100.00	2200.20	2204.09	2203.20	2204.68	0.006318	6.14	179.17	58.51	0.62
Nason Existing	73660.45	1.5Yr	1400.00	2200.20	2204.63	2203.62	2205.31	0.006197	6.64	210.96	60.13	0.62
Nason Existing	73660.45	2Yr	1700.00	2200.20	2205.11	2204.01	2205.89	0.006131	7.07	240.31	61.47	0.63
Nason Existing	73660.45	10Yr	3400.00	2200.20	2207.33	2205.81	2208.55	0.006019	8.87	383.17	67.59	0.66
Nason Existing	73660.45	25Yr	4500.00	2200.20	2208.52	2206.80	2209.97	0.005884	9.66	465.67	71.04	0.66
Nason Existing	73660.45	50Yr	5500.00	2200.20	2209.51	2207.58	2211.14	0.005654	10.26	537.46	74.32	0.66
Nason Existing	73660.45	100Yr	6700.00	2200.20	2210.50	2208.48	2212.38	0.005559	11.02	613.41	78.91	0.67
Nason Existing	73490.11	Qlidar	40.00	2199.20	2200.07	2199.75	2200.10	0.002909	1.42	28.25	47.40	0.32
Nason Existing	73490.11	Annual	800.00	2199.20	2202.71	2201.52	2203.06	0.004090	4.75	168.26	57.97	0.49
Nason Existing	73490.11	~1.2Yr	1100.00	2199.20	2203.30	2202.01	2203.76	0.004333	5.41	203.51	60.15	0.52
Nason Existing	73490.11	1.5Yr	1400.00	2199.20	2203.83	2202.43	2204.38	0.004509	5.94	235.74	62.13	0.54

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	73490.11	2Yr	1700.00	2199.20	2204.31	2202.79	2204.94	0.004646	6.40	265.79	63.93	0.55
Nason Existing	73490.11	10Yr	3400.00	2199.20	2206.53	2204.63	2207.56	0.004989	8.13	418.46	73.51	0.60
Nason Existing	73490.11	25Yr	4500.00	2199.20	2207.78	2205.60	2208.97	0.004974	8.75	514.30	80.53	0.61
Nason Existing	73490.11	50Yr	5500.00	2199.20	2208.85	2206.41	2210.13	0.004949	9.08	605.40	89.33	0.61
Nason Existing	73490.11	100Yr	6700.00	2199.20	2209.99	2207.31	2211.37	0.004605	9.44	709.86	94.45	0.60
Nason Existing	73345.74	Qlidar	40.00	2198.82	2199.50	2199.27	2199.55	0.005264	1.72	23.28	45.62	0.42
Nason Existing	73345.74	Annual	800.00	2198.82	2201.81	2201.06	2202.30	0.006773	5.58	143.29	56.99	0.62
Nason Existing	73345.74	~1.2Yr	1100.00	2198.82	2202.29	2201.56	2202.93	0.007467	6.43	170.94	58.94	0.67
Nason Existing	73345.74	1.5Yr	1400.00	2198.82	2202.74	2201.97	2203.52	0.007753	7.07	197.98	60.78	0.69
Nason Existing	73345.74	2Yr	1700.00	2198.82	2203.17	2202.36	2204.06	0.007801	7.57	224.63	62.40	0.70
Nason Existing	73345.74	10Yr	3400.00	2198.82	2205.38	2204.17	2206.68	0.007082	9.14	371.90	71.59	0.71
Nason Existing	73345.74	25Yr	4500.00	2198.82	2206.74	2205.07	2208.13	0.006450	9.49	474.07	80.33	0.69
Nason Existing	73345.74	50Yr	5500.00	2198.82	2207.92	2205.95	2209.34	0.005905	9.56	575.49	90.45	0.67
Nason Existing	73345.74	100Yr	6700.00	2198.82	2209.26	2206.88	2210.67	0.005183	9.50	704.93	101.36	0.64
Nason Existing	73197.11	Qlidar	40.00	2197.28	2197.78	2197.78	2197.95	0.031735	3.36	11.89	32.78	0.98
Nason Existing	73197.11	Annual	800.00	2197.28	2199.95	2199.83	2200.81	0.015283	7.43	107.61	51.57	0.91
Nason Existing	73197.11	~1.2Yr	1100.00	2197.28	2200.68	2200.32	2201.56	0.011266	7.52	146.36	54.59	0.81
Nason Existing	73197.11	1.5Yr	1400.00	2197.28	2201.33	2200.73	2202.24	0.009347	7.67	182.45	57.09	0.76
Nason Existing	73197.11	2Yr	1700.00	2197.28	2201.88	2201.14	2202.85	0.008352	7.92	214.63	59.23	0.73
Nason Existing	73197.11	10Yr	3400.00	2197.28	2204.37	2202.97	2205.72	0.005846	9.34	375.39	69.86	0.66
Nason Existing	73197.11	25Yr	4500.00	2197.28	2205.68	2203.97	2207.25	0.005302	10.12	470.49	76.20	0.65
Nason Existing	73197.11	50Yr	5500.00	2197.28	2206.76	2204.76	2208.50	0.004964	10.71	555.98	82.41	0.65
Nason Existing	73197.11	100Yr	6700.00	2197.28	2207.94	2205.71	2209.88	0.004683	11.35	657.54	89.52	0.64
Nason Existing	73062	Qlidar	40.00	2194.74	2196.53	2195.84	2196.55	0.001407	1.19	33.50	41.72	0.23
Nason Existing	73062	Annual	800.00	2194.74	2199.61	2197.93	2199.92	0.002955	4.45	179.73	52.71	0.42
Nason Existing	73062	~1.2Yr	1100.00	2194.74	2200.34	2198.49	2200.73	0.003075	5.02	219.25	55.04	0.44
Nason Existing	73062	1.5Yr	1400.00	2194.74	2201.00	2198.96	2201.46	0.003157	5.47	255.95	57.33	0.46
Nason Existing	73062	2Yr	1700.00	2194.74	2201.57	2199.39	2202.11	0.003120	5.88	289.54	59.20	0.46
Nason Existing	73062	10Yr	3400.00	2194.74	2204.14	2201.32	2205.06	0.003116	7.74	452.71	68.01	0.50
Nason Existing	73062	25Yr	4500.00	2194.74	2205.45	2202.32	2206.61	0.003169	8.68	545.02	72.69	0.51
Nason Existing	73062	50Yr	5500.00	2194.74	2206.53	2203.18	2207.88	0.003195	9.41	625.96	77.26	0.52
Nason Existing	73062	100Yr	6700.00	2194.74	2207.71	2204.12	2209.28	0.003229	10.18	719.59	82.48	0.54
Nason Existing	72934	Qlidar	40.00	2194.59	2196.20	2195.87	2196.25	0.004795	1.79	22.35	38.19	0.41
Nason Existing	72934	Annual	800.00	2194.59	2198.83	2197.96	2199.36	0.006326	5.84	137.00	47.52	0.61
Nason Existing	72934	~1.2Yr	1100.00	2194.59	2199.52	2198.46	2200.17	0.006159	6.45	170.47	49.55	0.61
Nason Existing	72934	1.5Yr	1400.00	2194.59	2200.14	2198.96	2200.89	0.005997	6.93	201.92	51.36	0.62
Nason Existing	72934	2Yr	1700.00	2194.59	2200.71	2199.39	2201.55	0.005777	7.35	231.44	53.11	0.62
Nason Existing	72934	10Yr	3400.00	2194.59	2203.11	2201.40	2204.50	0.005385	9.48	368.88	61.69	0.64
Nason Existing	72934	25Yr	4500.00	2194.59	2204.28	2202.45	2206.03	0.005509	10.65	444.23	67.29	0.66
Nason Existing	72934	50Yr	5500.00	2194.59	2205.25	2203.37	2207.29	0.005545	11.54	512.14	72.36	0.68
Nason Existing	72934	100Yr	6700.00	2194.59	2206.30	2204.39	2208.66	0.005602	12.48	590.88	77.92	0.69
Nason Existing	72808	Qlidar	40.00	2194.36	2195.02	2194.95	2195.16	0.019710	2.93	13.65	32.37	0.80
Nason Existing	72808	Annual	800.00	2194.36	2197.80	2197.13	2198.46	0.008007	6.48	123.43	43.58	0.68
Nason Existing	72808	~1.2Yr	1100.00	2194.36	2198.52	2197.67	2199.30	0.007561	7.08	155.34	45.64	0.68
Nason Existing	72808	1.5Yr	1400.00	2194.36	2199.16	2198.16	2200.05	0.007228	7.55	185.38	47.50	0.67
Nason Existing	72808	2Yr	1700.00	2194.36	2199.75	2198.62	2200.73	0.007029	7.94	213.98	49.56	0.67
Nason Existing	72808	10Yr	3400.00	2194.36	2202.30	2200.84	2203.75	0.006524	9.65	354.50	61.20	0.69
Nason Existing	72808	25Yr	4500.00	2194.36	2203.54	2201.92	2205.27	0.006448	10.58	434.02	67.44	0.70
Nason Existing	72808	50Yr	5500.00	2194.36	2204.57	2202.84	2206.51	0.006343	11.24	505.80	72.62	0.70
Nason Existing	72808	100Yr	6700.00	2194.36	2205.70	2203.84	2207.87	0.006050	11.90	591.47	78.35	0.70
Nason Existing	72609	Qlidar	40.00	2192.03	2193.47	2193.03	2193.54	0.004342	2.03	19.75	26.05	0.41
Nason Existing	72609	Annual	800.00	2192.03	2196.69	2195.53	2197.17	0.004931	5.56	143.77	44.35	0.54
Nason Existing	72609	~1.2Yr	1100.00	2192.03	2197.46	2196.08	2198.05	0.004877	6.16	178.53	46.43	0.55
Nason Existing	72609	1.5Yr	1400.00	2192.03	2198.13	2196.58	2198.82	0.004903	6.65	210.43	48.71	0.56
Nason Existing	72609	2Yr	1700.00	2192.03	2198.73	2197.05	2199.51	0.004939	7.07	240.59	50.99	0.57
Nason Existing	72609	10Yr	3400.00	2192.03	2201.32	2199.27	2202.54	0.005110	8.84	385.01	59.97	0.61
Nason Existing	72609	25Yr	4500.00	2192.03	2202.60	2200.39	2204.07	0.004973	9.76	463.57	63.53	0.62
Nason Existing	72609	50Yr	5500.00	2192.03	2203.63	2201.29	2205.34	0.004860	10.50	531.36	67.39	0.63
Nason Existing	72609	100Yr	6700.00	2192.03	2204.79	2202.23	2206.75	0.004745	11.27	611.75	72.14	0.63
Nason Existing	72345	Qlidar	40.00	2190.51	2191.75	2191.52	2191.87	0.009952	2.73	14.64	22.96	0.60
Nason Existing	72345	Annual	800.00	2190.51	2195.14	2194.12	2195.71	0.006129	6.10	131.17	41.42	0.60
Nason Existing	72345	~1.2Yr	1100.00	2190.51	2195.88	2194.70	2196.59	0.006187	6.75	163.04	44.31	0.62
Nason Existing	72345	1.5Yr	1400.00	2190.51	2196.52	2195.27	2197.35	0.006252	7.28	192.34	46.81	0.63
Nason Existing	72345	2Yr	1700.00	2190.51	2197.09	2195.78	2198.02	0.006340	7.74	219.50	49.02	0.64
Nason Existing	72345	10Yr	3400.00	2190.51	2199.53	2198.01	2201.02	0.006221	9.82	347.58	55.87	0.68
Nason Existing	72345	25Yr	4500.00	2190.51	2200.62	2199.08	2202.54	0.006481	11.12	410.16	58.49	0.71
Nason Existing	72345	50Yr	5500.00	2190.51	2201.46	2199.98	2203.77	0.006816	12.22	460.21	60.92	0.74
Nason Existing	72345	100Yr	6700.00	2190.51	2202.34	2200.98	2205.14	0.007229	13.45	515.19	63.47	0.77
Nason Existing	72176	Qlidar	40.00	2189.20	2190.84	2190.29	2190.90	0.003617	2.03	19.70	22.48	0.38
Nason Existing	72176	Annual	800.00	2189.20	2194.38	2193.05	2194.81	0.004287	5.23	152.85	46.80	0.51

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	72176	~1.2Yr	1100.00	2189.20	2195.14	2193.62	2195.66	0.004372	5.81	189.22	50.01	0.53
Nason Existing	72176	1.5Yr	1400.00	2189.20	2195.79	2194.14	2196.40	0.004435	6.29	222.66	52.69	0.54
Nason Existing	72176	2Yr	1700.00	2189.20	2196.36	2194.59	2197.06	0.004466	6.71	253.41	54.40	0.55
Nason Existing	72176	10Yr	3400.00	2189.20	2198.86	2196.66	2199.99	0.004794	8.52	398.98	61.86	0.59
Nason Existing	72176	25Yr	4500.00	2189.20	2200.02	2197.79	2201.43	0.004956	9.54	472.51	65.89	0.62
Nason Existing	72176	50Yr	5500.00	2189.20	2200.91	2198.66	2202.59	0.005072	10.41	533.34	70.38	0.63
Nason Existing	72176	100Yr	6700.00	2189.20	2201.87	2199.62	2203.87	0.005217	11.35	603.26	75.31	0.66
Nason Existing	72015	Qlidar	40.00	2189.26	2190.64	2189.84	2190.66	0.000743	1.05	37.94	35.37	0.18
Nason Existing	72015	Annual	800.00	2189.26	2193.93	2192.10	2194.23	0.002681	4.42	180.92	49.97	0.41
Nason Existing	72015	~1.2Yr	1100.00	2189.26	2194.66	2192.65	2195.05	0.002908	5.04	218.08	52.17	0.43
Nason Existing	72015	1.5Yr	1400.00	2189.26	2195.29	2193.15	2195.77	0.003095	5.57	251.50	54.08	0.45
Nason Existing	72015	2Yr	1700.00	2189.26	2195.84	2193.59	2196.41	0.003265	6.03	282.05	55.76	0.47
Nason Existing	72015	10Yr	3400.00	2189.26	2198.26	2195.64	2199.25	0.003952	7.99	425.72	62.98	0.54
Nason Existing	72015	25Yr	4500.00	2189.26	2199.38	2196.75	2200.66	0.004187	9.06	499.38	71.33	0.57
Nason Existing	72015	50Yr	5500.00	2189.26	2200.26	2197.64	2201.79	0.004386	9.94	562.35	73.05	0.59
Nason Existing	72015	100Yr	6700.00	2189.26	2201.19	2198.58	2203.03	0.004613	10.91	631.36	74.89	0.62
Nason Existing	71829	Qlidar	40.00	2188.99	2190.55	2189.59	2190.56	0.000376	0.80	50.06	42.02	0.13
Nason Existing	71829	Annual	800.00	2188.99	2193.45	2191.63	2193.74	0.002587	4.30	186.26	51.92	0.40
Nason Existing	71829	~1.2Yr	1100.00	2188.99	2194.13	2192.16	2194.51	0.002902	4.95	222.09	54.23	0.43
Nason Existing	71829	1.5Yr	1400.00	2188.99	2194.71	2192.61	2195.18	0.003150	5.50	254.48	56.23	0.46
Nason Existing	71829	2Yr	1700.00	2188.99	2195.23	2193.06	2195.79	0.003368	5.98	284.09	58.00	0.48
Nason Existing	71829	10Yr	3400.00	2188.99	2197.49	2195.02	2198.49	0.004267	8.03	423.55	65.70	0.56
Nason Existing	71829	25Yr	4500.00	2188.99	2198.55	2196.15	2199.83	0.004694	9.09	495.38	69.33	0.59
Nason Existing	71829	50Yr	5500.00	2188.99	2199.39	2197.02	2200.93	0.004906	9.95	554.81	72.32	0.62
Nason Existing	71829	100Yr	6700.00	2188.99	2200.29	2197.97	2202.13	0.005113	10.90	621.16	75.85	0.64
Nason Existing	71622	Qlidar	40.00	2187.90	2190.52	2188.76	2190.53	0.000085	0.48	83.24	49.16	0.07
Nason Existing	71622	Annual	800.00	2187.90	2193.08	2190.87	2193.28	0.001734	3.63	220.66	59.36	0.33
Nason Existing	71622	~1.2Yr	1100.00	2187.90	2193.69	2191.36	2193.97	0.002071	4.26	258.10	62.06	0.37
Nason Existing	71622	1.5Yr	1400.00	2187.90	2194.24	2191.81	2194.59	0.002333	4.79	292.46	64.45	0.40
Nason Existing	71622	2Yr	1700.00	2187.90	2194.72	2192.22	2195.15	0.002558	5.25	324.03	66.56	0.42
Nason Existing	71622	10Yr	3400.00	2187.90	2196.84	2194.13	2197.64	0.003428	7.15	475.32	75.88	0.50
Nason Existing	71622	25Yr	4500.00	2187.90	2197.87	2195.13	2198.89	0.003750	8.11	555.44	80.30	0.54
Nason Existing	71622	50Yr	5500.00	2187.90	2198.71	2195.93	2199.92	0.003955	8.86	624.11	83.71	0.56
Nason Existing	71622	100Yr	6700.00	2187.90	2199.62	2196.83	2201.06	0.004103	9.63	702.72	87.57	0.58
Nason Existing	71417	Qlidar	40.00	2187.19	2190.52	2187.88	2190.52	0.000018	0.29	138.35	53.52	0.03
Nason Existing	71417	Annual	800.00	2187.19	2192.88	2189.78	2193.01	0.000890	2.90	275.58	62.62	0.24
Nason Existing	71417	~1.2Yr	1100.00	2187.19	2193.44	2190.27	2193.63	0.001175	3.53	311.30	64.70	0.28
Nason Existing	71417	1.5Yr	1400.00	2187.19	2193.94	2190.71	2194.19	0.001419	4.07	343.90	66.52	0.32
Nason Existing	71417	2Yr	1700.00	2187.19	2194.38	2191.13	2194.71	0.001596	4.55	373.94	68.17	0.34
Nason Existing	71417	10Yr	3400.00	2187.19	2196.33	2192.98	2197.03	0.002350	6.74	513.69	75.44	0.43
Nason Existing	71417	25Yr	4500.00	2187.19	2197.24	2194.01	2198.21	0.002804	7.94	586.93	89.29	0.48
Nason Existing	71417	50Yr	5500.00	2187.19	2197.99	2194.75	2199.20	0.003121	8.86	654.61	90.61	0.51
Nason Existing	71417	100Yr	6700.00	2187.19	2198.79	2195.63	2200.28	0.003471	9.88	727.35	92.00	0.55
Nason Existing	71194	Qlidar	40.00	2186.80	2190.52	2187.52	2190.52	0.000011	0.25	162.95	56.75	0.03
Nason Existing	71194	Annual	800.00	2186.80	2192.71	2189.36	2192.83	0.000733	2.70	296.15	64.13	0.22
Nason Existing	71194	~1.2Yr	1100.00	2186.80	2193.21	2189.86	2193.39	0.001006	3.35	328.40	64.85	0.26
Nason Existing	71194	1.5Yr	1400.00	2186.80	2193.65	2190.30	2193.89	0.001258	3.92	357.10	65.49	0.30
Nason Existing	71194	2Yr	1700.00	2186.80	2194.05	2190.70	2194.36	0.001490	4.44	383.32	66.16	0.32
Nason Existing	71194	10Yr	3400.00	2186.80	2195.76	2192.53	2196.49	0.002529	6.84	500.15	70.54	0.44
Nason Existing	71194	25Yr	4500.00	2186.80	2196.47	2193.47	2197.53	0.003266	8.26	551.26	72.95	0.51
Nason Existing	71194	50Yr	5500.00	2186.80	2197.02	2194.27	2198.40	0.003930	9.46	591.56	75.03	0.56
Nason Existing	71194	100Yr	6700.00	2186.80	2197.49	2195.12	2199.33	0.004889	10.92	627.24	76.82	0.63
Nason Existing	71001	Qlidar	40.00	2187.07	2190.51	2188.10	2190.52	0.000015	0.24	163.74	72.42	0.03
Nason Existing	71001	Annual	800.00	2187.07	2192.58	2189.77	2192.68	0.000736	2.49	321.13	80.22	0.22
Nason Existing	71001	~1.2Yr	1100.00	2187.07	2193.04	2190.18	2193.18	0.001005	3.07	358.12	82.42	0.26
Nason Existing	71001	1.5Yr	1400.00	2187.07	2193.44	2190.52	2193.64	0.001262	3.57	391.61	85.10	0.29
Nason Existing	71001	2Yr	1700.00	2187.07	2193.80	2190.85	2194.05	0.001495	4.02	423.01	87.53	0.32
Nason Existing	71001	10Yr	3400.00	2187.07	2195.40	2192.38	2195.96	0.002411	5.99	569.87	97.65	0.43
Nason Existing	71001	25Yr	4500.00	2187.07	2196.45	2193.26	2196.88	0.001832	5.70	1350.07	599.87	0.38
Nason Existing	71001	50Yr	5500.00	2187.07	2197.28	2193.95	2197.65	0.001555	5.58	1852.79	614.33	0.35
Nason Existing	71001	100Yr	6700.00	2187.07	2198.10	2194.70	2198.43	0.001357	5.50	2362.19	619.78	0.34
Nason Existing	70819	Qlidar	40.00	2188.83	2190.51		2190.51	0.000178	0.46	86.70	96.06	0.09
Nason Existing	70819	Annual	800.00	2188.83	2192.35		2192.48	0.001720	2.87	278.34	107.86	0.32
Nason Existing	70819	~1.2Yr	1100.00	2188.83	2192.74		2192.93	0.002065	3.43	321.02	109.41	0.35
Nason Existing	70819	1.5Yr	1400.00	2188.83	2193.09		2193.33	0.002344	3.90	359.16	110.79	0.38
Nason Existing	70819	2Yr	1700.00	2188.83	2193.41		2193.70	0.002565	4.31	394.79	112.06	0.40
Nason Existing	70819	10Yr	3400.00	2188.83	2194.88		2195.44	0.003380	6.03	563.46	175.26	0.49
Nason Existing	70819	25Yr	4500.00	2188.83	2195.66		2196.39	0.003680	6.84	657.49	353.32	0.52
Nason Existing	70819	50Yr	5500.00	2188.83	2196.31		2197.17	0.003838	7.48	738.43	561.14	0.54
Nason Existing	70819	100Yr	6700.00	2188.83	2197.20	2194.73	2198.02	0.003196	7.48	1258.27	619.22	0.50

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	70757	Qlidar	40.00	2189.42	2190.47	2190.19	2190.48	0.002385	0.97	41.32	105.78	0.27
Nason Existing	70757	Annual	800.00	2189.42	2192.15	2191.26	2192.33	0.003449	3.43	233.55	116.96	0.43
Nason Existing	70757	~1.2Yr	1100.00	2189.42	2192.50	2191.54	2192.75	0.003836	3.99	275.58	118.70	0.46
Nason Existing	70757	1.5Yr	1400.00	2189.42	2192.82	2191.79	2193.13	0.004112	4.46	313.68	120.26	0.49
Nason Existing	70757	2Yr	1700.00	2189.42	2193.12	2192.03	2193.49	0.004278	4.86	350.10	121.73	0.50
Nason Existing	70757	10Yr	3400.00	2189.42	2194.55	2193.15	2195.19	0.004609	6.43	528.83	144.41	0.56
Nason Existing	70757	25Yr	4500.00	2189.42	2195.34	2193.77	2196.13	0.004513	7.15	632.51	316.22	0.57
Nason Existing	70757	50Yr	5500.00	2189.42	2195.99	2194.28	2196.91	0.004462	7.72	720.20	505.30	0.57
Nason Existing	70757	100Yr	6700.00	2189.42	2196.68	2194.84	2197.76	0.004483	8.36	815.88	603.68	0.59
Nason Existing	70633	Qlidar	40.00	2188.82	2189.70		2189.83	0.018510	2.89	13.83	31.56	0.77
Nason Existing	70633	Annual	800.00	2188.82	2191.26		2191.60	0.011211	4.70	170.29	129.41	0.72
Nason Existing	70633	~1.2Yr	1100.00	2188.82	2191.64		2192.03	0.009333	5.02	219.00	131.06	0.68
Nason Existing	70633	1.5Yr	1400.00	2188.82	2192.03		2192.44	0.007609	5.17	270.63	132.79	0.64
Nason Existing	70633	2Yr	1700.00	2188.82	2192.39		2192.83	0.006612	5.33	318.80	134.38	0.61
Nason Existing	70633	10Yr	3400.00	2188.82	2193.97		2194.59	0.005016	6.34	536.61	154.17	0.57
Nason Existing	70633	25Yr	4500.00	2188.82	2194.82		2195.55	0.004591	6.82	659.47	479.39	0.56
Nason Existing	70633	50Yr	5500.00	2188.82	2195.53		2196.34	0.004276	7.21	765.39	577.32	0.56
Nason Existing	70633	100Yr	6700.00	2188.82	2196.27	2194.28	2197.18	0.004064	7.68	888.98	609.02	0.55
Nason Existing	70575	Qlidar	40.00	2187.25	2188.23	2188.23	2188.49	0.028844	4.09	9.79	18.56	0.99
Nason Existing	70575	Annual	800.00	2187.25	2190.85		2191.09	0.006532	3.91	204.77	136.14	0.56
Nason Existing	70575	~1.2Yr	1100.00	2187.25	2191.36		2191.61	0.004734	3.97	276.75	140.58	0.50
Nason Existing	70575	1.5Yr	1400.00	2187.25	2191.83		2192.09	0.003801	4.08	343.22	141.98	0.46
Nason Existing	70575	2Yr	1700.00	2187.25	2192.23		2192.51	0.003412	4.25	399.88	143.15	0.45
Nason Existing	70575	10Yr	3400.00	2187.25	2193.88		2194.31	0.002959	5.29	654.85	251.28	0.45
Nason Existing	70575	25Yr	4500.00	2187.25	2194.77		2195.28	0.002760	5.79	805.29	433.39	0.45
Nason Existing	70575	50Yr	5500.00	2187.25	2195.49		2196.08	0.002663	6.20	940.98	480.24	0.45
Nason Existing	70575	100Yr	6700.00	2187.25	2196.25		2196.92	0.002597	6.63	1098.65	554.71	0.45
Nason Existing	70514	Qlidar	40.00	2185.60	2186.92		2187.16	0.016948	3.99	10.01	12.98	0.80
Nason Existing	70514	Annual	800.00	2185.60	2190.19	2189.74	2190.63	0.008030	5.53	176.21	104.38	0.66
Nason Existing	70514	~1.2Yr	1100.00	2185.60	2190.83		2191.26	0.006417	5.56	246.29	113.96	0.61
Nason Existing	70514	1.5Yr	1400.00	2185.60	2191.35		2191.79	0.005774	5.73	307.30	121.99	0.59
Nason Existing	70514	2Yr	1700.00	2185.60	2191.74		2192.23	0.005553	6.07	357.00	134.31	0.59
Nason Existing	70514	10Yr	3400.00	2185.60	2193.20		2194.03	0.006049	8.07	579.66	164.66	0.65
Nason Existing	70514	25Yr	4500.00	2185.60	2194.06		2195.01	0.005683	8.73	727.17	176.40	0.65
Nason Existing	70514	50Yr	5500.00	2185.60	2194.76		2195.81	0.005499	9.28	857.24	318.58	0.65
Nason Existing	70514	100Yr	6700.00	2185.60	2195.49		2196.65	0.005402	9.89	1012.42	407.97	0.65
Nason Existing	70445	Qlidar	40.00	2185.31	2186.51		2186.58	0.004377	2.09	19.17	24.32	0.41
Nason Existing	70445	Annual	800.00	2185.31	2189.43		2190.05	0.008310	6.33	132.89	68.92	0.69
Nason Existing	70445	~1.2Yr	1100.00	2185.31	2189.89	2189.40	2190.69	0.009686	7.26	168.14	86.35	0.76
Nason Existing	70445	1.5Yr	1400.00	2185.31	2190.28	2189.93	2191.22	0.010645	7.93	206.24	105.23	0.80
Nason Existing	70445	2Yr	1700.00	2185.31	2190.70	2190.46	2191.67	0.010675	8.16	253.27	117.00	0.81
Nason Existing	70445	10Yr	3400.00	2185.31	2192.74		2193.58	0.007183	7.91	544.14	183.29	0.69
Nason Existing	70445	25Yr	4500.00	2185.31	2193.72		2194.60	0.005784	8.20	723.37	196.44	0.64
Nason Existing	70445	50Yr	5500.00	2185.31	2194.41		2195.41	0.005647	8.83	867.63	273.08	0.65
Nason Existing	70445	100Yr	6700.00	2185.31	2195.11	2193.65	2196.27	0.005687	9.56	1086.97	419.12	0.67
Nason Existing	70386	Qlidar	40.00	2185.21	2186.22		2186.29	0.005708	2.06	19.41	30.71	0.46
Nason Existing	70386	Annual	800.00	2185.21	2189.34		2189.57	0.004717	3.89	212.08	120.63	0.50
Nason Existing	70386	~1.2Yr	1100.00	2185.21	2189.95		2190.19	0.003588	3.97	289.09	127.30	0.45
Nason Existing	70386	1.5Yr	1400.00	2185.21	2190.44		2190.70	0.003131	4.18	351.92	135.18	0.43
Nason Existing	70386	2Yr	1700.00	2185.21	2190.88		2191.17	0.002878	4.38	408.94	146.15	0.42
Nason Existing	70386	10Yr	3400.00	2185.21	2192.77		2193.22	0.002564	5.51	660.01	221.93	0.43
Nason Existing	70386	25Yr	4500.00	2185.21	2193.72		2194.28	0.002526	6.13	890.14	302.44	0.44
Nason Existing	70386	50Yr	5500.00	2185.21	2194.49		2195.08	0.002357	6.40	1101.71	324.19	0.43
Nason Existing	70386	100Yr	6700.00	2185.21	2195.28		2195.91	0.002263	6.74	1368.46	449.14	0.43
Nason Existing	70352	Qlidar	40.00	2184.91	2186.00		2186.07	0.006881	2.20	18.17	30.01	0.50
Nason Existing	70352	Annual	800.00	2184.91	2189.10		2189.39	0.005470	4.30	188.02	103.07	0.53
Nason Existing	70352	~1.2Yr	1100.00	2184.91	2189.75		2190.05	0.004230	4.38	258.14	123.25	0.49
Nason Existing	70352	1.5Yr	1400.00	2184.91	2190.25		2190.58	0.003726	4.63	314.82	143.38	0.47
Nason Existing	70352	2Yr	1700.00	2184.91	2190.69		2191.06	0.003476	4.88	364.89	149.08	0.46
Nason Existing	70352	10Yr	3400.00	2184.91	2192.51		2193.11	0.003363	6.29	578.46	189.66	0.48
Nason Existing	70352	25Yr	4500.00	2184.91	2193.37		2194.16	0.003604	7.21	725.07	294.61	0.51
Nason Existing	70352	50Yr	5500.00	2184.91	2194.13		2194.96	0.003371	7.54	936.62	333.93	0.51
Nason Existing	70352	100Yr	6700.00	2184.91	2194.93		2195.80	0.003176	7.87	1160.62	356.57	0.50
Nason Existing	70318	Qlidar	40.00	2184.31	2185.89		2185.93	0.002436	1.57	25.43	31.82	0.31
Nason Existing	70318	Annual	800.00	2184.31	2189.03		2189.24	0.002870	3.69	222.95	101.38	0.41
Nason Existing	70318	~1.2Yr	1100.00	2184.31	2189.68		2189.92	0.002621	3.98	294.07	127.33	0.40
Nason Existing	70318	1.5Yr	1400.00	2184.31	2190.18		2190.46	0.002539	4.30	353.57	136.14	0.40
Nason Existing	70318	2Yr	1700.00	2184.31	2190.63		2190.94	0.002498	4.60	407.04	146.64	0.41
Nason Existing	70318	10Yr	3400.00	2184.31	2192.43		2193.00	0.002741	6.18	653.96	260.50	0.45
Nason Existing	70318	25Yr	4500.00	2184.31	2193.34		2194.02	0.002789	6.87	851.24	352.08	0.47
Nason Existing	70318	50Yr	5500.00	2184.31	2194.08		2194.84	0.002785	7.36	1075.37	393.83	0.48

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	70318	100Yr	6700.00	2184.31	2194.89		2195.67	0.002620	7.65	1328.83	409.06	0.47
Nason Existing	70274	Qlidar	40.00	2182.80	2185.91		2185.91	0.000083	0.50	79.40	43.29	0.07
Nason Existing	70274	Annual	800.00	2182.80	2188.99		2189.14	0.001230	3.15	260.59	80.28	0.28
Nason Existing	70274	~1.2Yr	1100.00	2182.80	2189.62		2189.83	0.001441	3.68	314.69	91.38	0.31
Nason Existing	70274	1.5Yr	1400.00	2182.80	2190.11		2190.37	0.001649	4.18	366.23	116.28	0.34
Nason Existing	70274	2Yr	1700.00	2182.80	2190.53		2190.85	0.001806	4.62	420.03	139.06	0.36
Nason Existing	70274	10Yr	3400.00	2182.80	2192.34		2192.88	0.002223	6.26	776.25	244.59	0.42
Nason Existing	70274	25Yr	4500.00	2182.80	2193.27		2193.89	0.002281	6.89	1022.97	330.64	0.43
Nason Existing	70274	50Yr	5500.00	2182.80	2194.05		2194.70	0.002203	7.21	1249.53	358.62	0.43
Nason Existing	70274	100Yr	6700.00	2182.80	2194.85		2195.53	0.002166	7.59	1491.15	367.61	0.43
Nason Existing	70233	Qlidar	40.00	2183.35	2185.90		2185.91	0.000180	0.65	61.66	41.17	0.09
Nason Existing	70233	Annual	800.00	2183.35	2188.89		2189.08	0.001697	3.49	252.14	111.18	0.33
Nason Existing	70233	~1.2Yr	1100.00	2183.35	2189.53		2189.76	0.001852	3.94	328.85	127.17	0.35
Nason Existing	70233	1.5Yr	1400.00	2183.35	2190.02		2190.29	0.002030	4.36	393.74	138.06	0.37
Nason Existing	70233	2Yr	1700.00	2183.35	2190.45		2190.77	0.002179	4.71	456.86	160.30	0.39
Nason Existing	70233	10Yr	3400.00	2183.35	2192.30		2192.76	0.002310	5.98	842.66	260.67	0.42
Nason Existing	70233	25Yr	4500.00	2183.35	2193.25		2193.76	0.002227	6.45	1087.20	303.76	0.42
Nason Existing	70233	50Yr	5500.00	2183.35	2194.03		2194.57	0.002155	6.79	1294.96	315.68	0.42
Nason Existing	70233	100Yr	6700.00	2183.35	2194.82		2195.42	0.002145	7.21	1512.25	327.02	0.43
Nason Existing	70152.48	Qlidar	40.00	2184.19	2185.84	2185.21	2185.84	0.000627	0.72	55.74	81.73	0.15
Nason Existing	70152.48	Annual	800.00	2184.19	2188.68	2186.61	2188.79	0.001056	2.62	305.90	94.03	0.26
Nason Existing	70152.48	~1.2Yr	1100.00	2184.19	2189.30	2186.94	2189.44	0.001150	3.01	364.98	96.66	0.27
Nason Existing	70152.48	1.5Yr	1400.00	2184.19	2189.76	2187.24	2189.95	0.001279	3.42	410.15	99.53	0.29
Nason Existing	70152.48	2Yr	1700.00	2184.19	2190.17	2187.54	2190.39	0.001390	3.79	451.94	107.46	0.31
Nason Existing	70152.48	10Yr	3400.00	2184.19	2191.88	2188.89	2192.34	0.001906	5.47	671.63	148.45	0.38
Nason Existing	70152.48	25Yr	4500.00	2184.19	2192.70	2189.53	2193.30	0.002172	6.33	816.48	183.45	0.42
Nason Existing	70152.48	50Yr	5500.00	2184.19	2193.37	2190.18	2194.10	0.002336	6.97	941.40	187.92	0.44
Nason Existing	70152.48	100Yr	6700.00	2184.19	2194.00	2190.90	2194.90	0.002635	7.79	1065.75	251.60	0.47
Nason Existing	69866.98	Qlidar	40.00	2184.33	2185.05	2185.05	2185.26	0.032053	3.70	10.82	25.97	1.01
Nason Existing	69866.98	Annual	800.00	2184.33	2187.93		2188.20	0.005188	4.17	191.70	97.05	0.52
Nason Existing	69866.98	~1.2Yr	1100.00	2184.33	2188.60		2188.88	0.003846	4.27	257.62	100.38	0.47
Nason Existing	69866.98	1.5Yr	1400.00	2184.33	2189.00		2189.34	0.003885	4.70	298.32	110.84	0.48
Nason Existing	69866.98	2Yr	1700.00	2184.33	2189.35		2189.75	0.003911	5.08	343.54	164.67	0.49
Nason Existing	69866.98	10Yr	3400.00	2184.33	2190.95		2191.58	0.003792	6.52	649.00	257.14	0.52
Nason Existing	69866.98	25Yr	4500.00	2184.33	2191.78		2192.51	0.003695	7.14	832.45	272.69	0.53
Nason Existing	69866.98	50Yr	5500.00	2184.33	2192.36		2193.24	0.003932	7.86	994.36	304.99	0.55
Nason Existing	69866.98	100Yr	6700.00	2184.33	2193.09		2194.02	0.003734	8.24	1223.95	363.05	0.55
Nason Existing	69792.18	Qlidar	40.00	2182.83	2184.75	2183.64	2184.77	0.000728	1.04	38.39	35.73	0.18
Nason Existing	69792.18	Annual	800.00	2182.83	2187.68	2186.06	2187.93	0.002571	4.06	211.02	86.28	0.39
Nason Existing	69792.18	~1.2Yr	1100.00	2182.83	2188.32	2186.51	2188.62	0.003069	4.47	279.50	125.75	0.43
Nason Existing	69792.18	1.5Yr	1400.00	2182.83	2188.68	2186.94	2189.06	0.003453	5.08	326.52	137.02	0.47
Nason Existing	69792.18	2Yr	1700.00	2182.83	2188.99	2187.40	2189.46	0.003789	5.62	370.98	146.81	0.49
Nason Existing	69792.18	10Yr	3400.00	2182.83	2190.38	2189.26	2191.23	0.004963	7.83	609.23	202.45	0.59
Nason Existing	69792.18	25Yr	4500.00	2182.83	2191.07	2190.05	2192.14	0.005420	8.88	738.43	254.95	0.63
Nason Existing	69792.18	50Yr	5500.00	2182.83	2191.58	2190.61	2192.84	0.005885	9.76	861.18	285.98	0.67
Nason Existing	69792.18	100Yr	6700.00	2182.83	2192.12	2191.28	2193.60	0.006379	10.71	1011.35	418.67	0.71
Nason Existing	69500.32	Qlidar	40.00	2183.42	2183.93	2183.93	2184.11	0.033767	3.35	11.95	34.75	1.01
Nason Existing	69500.32	Annual	800.00	2183.42	2186.71	2185.67	2186.94	0.004629	3.85	207.92	110.32	0.49
Nason Existing	69500.32	~1.2Yr	1100.00	2183.42	2187.27	2186.06	2187.51	0.004689	3.91	281.09	146.85	0.50
Nason Existing	69500.32	1.5Yr	1400.00	2183.42	2187.65	2186.43	2187.91	0.004258	4.16	337.97	158.43	0.49
Nason Existing	69500.32	2Yr	1700.00	2183.42	2187.99	2186.81	2188.29	0.003876	4.37	395.01	168.75	0.48
Nason Existing	69500.32	10Yr	3400.00	2183.42	2189.63	2187.94	2190.04	0.002859	5.19	760.07	291.13	0.44
Nason Existing	69500.32	25Yr	4500.00	2183.42	2190.44	2188.49	2190.91	0.002687	5.65	1016.16	376.80	0.44
Nason Existing	69500.32	50Yr	5500.00	2183.42	2191.06	2188.90	2191.57	0.002565	5.97	1236.31	383.61	0.44
Nason Existing	69500.32	100Yr	6700.00	2183.42	2191.71	2189.46	2192.27	0.002508	6.35	1470.21	397.50	0.44
Nason Existing	69076.6	Qlidar	40.00	2182.00	2183.07	2182.36	2183.08	0.000633	0.80	49.78	61.89	0.16
Nason Existing	69076.6	Annual	800.00	2182.00	2185.37	2184.12	2185.53	0.002431	3.22	248.64	104.97	0.37
Nason Existing	69076.6	~1.2Yr	1100.00	2182.00	2185.82	2184.47	2186.03	0.002656	3.72	295.95	107.37	0.39
Nason Existing	69076.6	1.5Yr	1400.00	2182.00	2186.23	2184.76	2186.49	0.002729	4.12	340.17	108.96	0.41
Nason Existing	69076.6	2Yr	1700.00	2182.00	2186.60	2185.01	2186.91	0.002763	4.47	381.34	110.32	0.42
Nason Existing	69076.6	10Yr	3400.00	2182.00	2188.31	2186.21	2188.84	0.002849	5.90	675.52	321.26	0.45
Nason Existing	69076.6	25Yr	4500.00	2182.00	2189.21	2186.87	2189.80	0.002680	6.36	982.57	408.46	0.45
Nason Existing	69076.6	50Yr	5500.00	2182.00	2189.94	2187.49	2190.55	0.002504	6.63	1274.05	441.74	0.45
Nason Existing	69076.6	100Yr	6700.00	2182.00	2190.67	2188.37	2191.31	0.002406	6.95	1611.91	549.50	0.44
Nason Existing	68980.74	Qlidar	40.00	2181.86	2182.79	2182.68	2182.90	0.016270	2.71	14.78	34.19	0.73
Nason Existing	68980.74	Annual	800.00	2181.86	2184.63	2184.39	2185.06	0.012305	5.28	151.54	103.33	0.77
Nason Existing	68980.74	~1.2Yr	1100.00	2181.86	2185.14	2184.68	2185.59	0.008836	5.35	207.19	119.86	0.68
Nason Existing	68980.74	1.5Yr	1400.00	2181.86	2185.63	2184.96	2186.08	0.007028	5.37	268.46	130.66	0.62
Nason Existing	68980.74	2Yr	1700.00	2181.86	2186.08	2185.23	2186.53	0.005891	5.40	331.88	174.32	0.59
Nason Existing	68980.74	10Yr	3400.00	2181.86	2188.12	2186.55	2188.54	0.002906	5.43	742.94	346.38	0.45

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	68980.74	25Yr	4500.00	2181.86	2189.12	2187.10	2189.53	0.002274	5.49	1079.38	505.91	0.41
Nason Existing	68980.74	50Yr	5500.00	2181.86	2189.90	2187.53	2190.30	0.001937	5.53	1404.84	532.15	0.39
Nason Existing	68980.74	100Yr	6700.00	2181.86	2190.66	2188.13	2191.07	0.001771	5.71	1737.24	637.25	0.38
Nason Existing	68839.2	Qlidar	40.00	2180.23	2181.00	2180.83	2181.10	0.010219	2.47	16.18	30.22	0.60
Nason Existing	68839.2	Annual	800.00	2180.23	2184.12	2183.01	2184.28	0.002614	3.21	248.95	112.22	0.38
Nason Existing	68839.2	~1.2Yr	1100.00	2180.23	2184.78	2183.29	2184.96	0.002156	3.40	323.83	116.04	0.36
Nason Existing	68839.2	1.5Yr	1400.00	2180.23	2185.33	2183.56	2185.53	0.001965	3.61	388.05	119.64	0.35
Nason Existing	68839.2	2Yr	1700.00	2180.23	2185.80	2183.80	2186.03	0.001855	3.82	446.60	127.08	0.35
Nason Existing	68839.2	10Yr	3400.00	2180.23	2187.86	2184.99	2188.22	0.001664	4.85	764.59	222.66	0.36
Nason Existing	68839.2	25Yr	4500.00	2180.23	2188.83	2185.61	2189.27	0.001660	5.37	1025.03	399.92	0.36
Nason Existing	68839.2	50Yr	5500.00	2180.23	2189.56	2186.13	2190.05	0.001685	5.79	1324.83	519.70	0.37
Nason Existing	68839.2	100Yr	6700.00	2180.23	2190.30	2186.76	2190.84	0.001678	6.16	1650.80	627.09	0.38
Nason Existing	68753.92	Qlidar	40.00	2179.27	2180.86	2179.96	2180.87	0.001002	1.05	38.07	44.91	0.20
Nason Existing	68753.92	Annual	800.00	2179.27	2183.93	2182.10	2184.10	0.001787	3.33	240.08	76.44	0.33
Nason Existing	68753.92	~1.2Yr	1100.00	2179.27	2184.56	2182.51	2184.78	0.001922	3.81	289.05	79.45	0.35
Nason Existing	68753.92	1.5Yr	1400.00	2179.27	2185.07	2182.90	2185.35	0.002082	4.24	330.41	81.91	0.37
Nason Existing	68753.92	2Yr	1700.00	2179.27	2185.52	2183.25	2185.85	0.002235	4.63	367.40	84.04	0.39
Nason Existing	68753.92	10Yr	3400.00	2179.27	2187.37	2184.75	2188.02	0.002755	6.45	542.55	158.93	0.46
Nason Existing	68753.92	25Yr	4500.00	2179.27	2188.17	2185.63	2189.04	0.003162	7.49	669.88	328.44	0.50
Nason Existing	68753.92	50Yr	5500.00	2179.27	2188.78	2186.30	2189.81	0.003440	8.26	855.64	410.34	0.53
Nason Existing	68753.92	100Yr	6700.00	2179.27	2189.40	2187.03	2190.58	0.003671	9.00	1109.54	518.94	0.55
Nason Existing	68449.98	Qlidar	40.00	2179.25	2180.23	2179.94	2180.27	0.005746	1.64	24.42	54.66	0.43
Nason Existing	68449.98	Annual	800.00	2179.25	2183.18	2181.66	2183.41	0.002907	3.88	206.25	74.66	0.41
Nason Existing	68449.98	~1.2Yr	1100.00	2179.25	2183.71	2182.08	2184.01	0.003389	4.44	247.85	82.22	0.45
Nason Existing	68449.98	1.5Yr	1400.00	2179.25	2184.15	2182.50	2184.52	0.003588	4.91	285.99	91.27	0.47
Nason Existing	68449.98	2Yr	1700.00	2179.25	2184.53	2182.86	2184.98	0.003694	5.34	323.01	100.93	0.49
Nason Existing	68449.98	10Yr	3400.00	2179.25	2186.26	2184.51	2187.02	0.003953	7.12	582.16	227.84	0.54
Nason Existing	68449.98	25Yr	4500.00	2179.25	2187.14	2185.34	2188.01	0.003849	7.76	796.20	325.90	0.54
Nason Existing	68449.98	50Yr	5500.00	2179.25	2187.71	2186.13	2188.72	0.004098	8.48	1000.93	467.53	0.57
Nason Existing	68449.98	100Yr	6700.00	2179.25	2188.37	2186.90	2189.48	0.004122	9.04	1310.31	554.33	0.58
Nason Existing	68244.98	Qlidar	40.00	2177.80	2179.58	2178.88	2179.61	0.001992	1.46	27.49	33.19	0.28
Nason Existing	68244.98	Annual	800.00	2177.80	2182.80	2181.32	2182.91	0.001809	2.59	308.90	145.88	0.31
Nason Existing	68244.98	~1.2Yr	1100.00	2177.80	2183.39	2181.65	2183.51	0.001539	2.79	394.61	148.26	0.30
Nason Existing	68244.98	1.5Yr	1400.00	2177.80	2183.87	2181.96	2184.01	0.001438	3.00	466.90	149.98	0.30
Nason Existing	68244.98	2Yr	1700.00	2177.80	2184.29	2182.22	2184.45	0.001390	3.21	530.74	151.27	0.30
Nason Existing	68244.98	10Yr	3400.00	2177.80	2186.17	2183.27	2186.44	0.001351	4.19	852.25	355.27	0.32
Nason Existing	68244.98	25Yr	4500.00	2177.80	2187.15	2183.80	2187.45	0.001240	4.49	1409.79	722.01	0.31
Nason Existing	68244.98	50Yr	5500.00	2177.80	2187.82	2184.23	2188.13	0.001193	4.71	1847.38	736.67	0.31
Nason Existing	68244.98	100Yr	6700.00	2177.80	2188.57	2184.74	2188.89	0.001126	4.89	2336.57	786.34	0.31
Nason Existing	68133.31	Qlidar	40.00	2177.39	2179.52	2178.30	2179.53	0.000340	0.80	49.85	38.67	0.12
Nason Existing	68133.31	Annual	800.00	2177.39	2182.40	2180.62	2182.65	0.002764	3.97	203.01	73.00	0.40
Nason Existing	68133.31	~1.2Yr	1100.00	2177.39	2182.91	2181.13	2183.24	0.003470	4.62	243.09	86.34	0.46
Nason Existing	68133.31	1.5Yr	1400.00	2177.39	2183.33	2181.57	2183.74	0.003690	5.17	286.90	114.61	0.48
Nason Existing	68133.31	2Yr	1700.00	2177.39	2183.68	2182.00	2184.18	0.003922	5.68	333.18	150.92	0.50
Nason Existing	68133.31	10Yr	3400.00	2177.39	2185.36	2183.98	2186.15	0.004167	7.42	617.81	214.40	0.55
Nason Existing	68133.31	25Yr	4500.00	2177.39	2186.29	2184.74	2187.18	0.003995	8.04	820.09	250.62	0.55
Nason Existing	68133.31	50Yr	5500.00	2177.39	2186.98	2185.46	2187.88	0.003779	8.36	1177.26	490.67	0.55
Nason Existing	68133.31	100Yr	6700.00	2177.39	2187.63	2186.08	2188.63	0.003876	8.98	1503.53	559.44	0.56
Nason Existing	68039.06	Qlidar	40.00	2178.27	2179.41	2179.04	2179.45	0.003179	1.61	24.79	36.26	0.34
Nason Existing	68039.06	Annual	800.00	2178.27	2182.04	2181.26	2182.31	0.004892	4.12	194.78	97.59	0.51
Nason Existing	68039.06	~1.2Yr	1100.00	2178.27	2182.54	2181.57	2182.85	0.004751	4.53	245.06	106.66	0.51
Nason Existing	68039.06	1.5Yr	1400.00	2178.27	2182.97	2181.88	2183.34	0.004641	4.86	296.17	131.53	0.52
Nason Existing	68039.06	2Yr	1700.00	2178.27	2183.35	2182.16	2183.76	0.004465	5.14	348.80	146.96	0.52
Nason Existing	68039.06	10Yr	3400.00	2178.27	2185.20	2183.49	2185.75	0.003413	6.08	682.52	191.14	0.48
Nason Existing	68039.06	25Yr	4500.00	2178.27	2186.18	2184.26	2186.79	0.003087	6.52	870.76	204.16	0.47
Nason Existing	68039.06	50Yr	5500.00	2178.27	2186.89	2184.76	2187.58	0.003064	7.01	1007.84	228.27	0.48
Nason Existing	68039.06	100Yr	6700.00	2178.27	2187.57	2185.29	2188.28	0.002918	7.30	1542.54	542.70	0.48
Nason Existing	67913.59	Qlidar	40.00	2177.47	2178.61	2178.49	2178.71	0.014358	2.53	15.83	36.72	0.68
Nason Existing	67913.59	Annual	800.00	2177.47	2181.48	2180.60	2181.70	0.004605	3.68	217.30	120.76	0.48
Nason Existing	67913.59	~1.2Yr	1100.00	2177.47	2182.09	2181.00	2182.30	0.003660	3.74	293.87	133.79	0.45
Nason Existing	67913.59	1.5Yr	1400.00	2177.47	2182.60	2181.26	2182.83	0.003062	3.83	365.70	142.43	0.42
Nason Existing	67913.59	2Yr	1700.00	2177.47	2183.04	2181.52	2183.29	0.002693	3.98	429.09	146.73	0.40
Nason Existing	67913.59	10Yr	3400.00	2177.47	2185.05	2182.65	2185.38	0.001918	4.66	795.37	349.64	0.37
Nason Existing	67913.59	25Yr	4500.00	2177.47	2186.09	2183.19	2186.45	0.001693	4.94	1083.05	464.65	0.35
Nason Existing	67913.59	50Yr	5500.00	2177.47	2186.87	2183.67	2187.24	0.001576	5.15	1340.44	493.35	0.35
Nason Existing	67913.59	100Yr	6700.00	2177.47	2187.58	2184.25	2187.96	0.001496	5.35	1797.67	657.09	0.34
Nason Existing	67763.85	Qlidar	40.00	2177.15	2178.06	2177.57	2178.09	0.001835	1.32	30.38	40.22	0.27
Nason Existing	67763.85	Annual	800.00	2177.15	2180.93	2179.55	2181.15	0.002959	3.74	214.10	83.16	0.41
Nason Existing	67763.85	~1.2Yr	1100.00	2177.15	2181.53	2179.92	2181.79	0.003139	4.12	266.73	93.23	0.43
Nason Existing	67763.85	1.5Yr	1400.00	2177.15	2182.06	2180.30	2182.36	0.003193	4.40	318.19	102.13	0.44

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	67763.85	2Yr	1700.00	2177.15	2182.51	2180.66	2182.85	0.003049	4.64	366.34	106.35	0.44
Nason Existing	67763.85	10Yr	3400.00	2177.15	2184.55	2182.22	2185.04	0.002551	5.69	678.07	197.98	0.43
Nason Existing	67763.85	25Yr	4500.00	2177.15	2185.60	2182.90	2186.15	0.002379	6.13	930.02	298.88	0.42
Nason Existing	67763.85	50Yr	5500.00	2177.15	2186.37	2183.56	2186.96	0.002269	6.45	1204.95	435.37	0.42
Nason Existing	67763.85	100Yr	6700.00	2177.15	2187.12	2184.32	2187.71	0.002123	6.66	1691.64	792.95	0.41
Nason Existing	67655.91	Qlidar	40.00	2175.48	2178.02	2176.31	2178.03	0.000230	0.69	58.09	42.51	0.10
Nason Existing	67655.91	Annual	800.00	2175.48	2180.59	2178.92	2180.82	0.003197	3.81	211.12	90.20	0.42
Nason Existing	67655.91	~1.2Yr	1100.00	2175.48	2181.19	2179.39	2181.46	0.003055	4.18	267.58	98.21	0.43
Nason Existing	67655.91	1.5Yr	1400.00	2175.48	2181.72	2179.86	2182.03	0.002931	4.46	322.08	107.16	0.43
Nason Existing	67655.91	2Yr	1700.00	2175.48	2182.21	2180.44	2182.54	0.002759	4.68	377.47	121.90	0.42
Nason Existing	67655.91	10Yr	3400.00	2175.48	2184.44	2181.92	2184.79	0.001809	5.06	823.50	266.67	0.36
Nason Existing	67655.91	25Yr	4500.00	2175.48	2185.61	2182.69	2185.91	0.001373	4.92	1146.84	288.31	0.33
Nason Existing	67655.91	50Yr	5500.00	2175.48	2186.43	2183.45	2186.73	0.001236	4.99	1430.88	478.49	0.31
Nason Existing	67655.91	100Yr	6700.00	2175.48	2187.20	2184.28	2187.50	0.001143	5.11	2000.67	888.09	0.31
Nason Existing	67526.84	Qlidar	40.00	2176.71	2177.94	2177.63	2177.96	0.003221	1.13	35.47	90.45	0.32
Nason Existing	67526.84	Annual	800.00	2176.71	2180.39	2178.86	2180.51	0.001511	2.73	293.37	113.33	0.30
Nason Existing	67526.84	~1.2Yr	1100.00	2176.71	2181.02	2179.16	2181.16	0.001397	3.02	369.96	135.37	0.30
Nason Existing	67526.84	1.5Yr	1400.00	2176.71	2181.58	2179.43	2181.74	0.001318	3.26	457.78	166.50	0.29
Nason Existing	67526.84	2Yr	1700.00	2176.71	2182.08	2179.68	2182.27	0.001256	3.46	542.89	170.08	0.29
Nason Existing	67526.84	10Yr	3400.00	2176.71	2184.32	2180.86	2184.60	0.001143	4.36	947.78	234.35	0.30
Nason Existing	67526.84	25Yr	4500.00	2176.71	2185.44	2181.57	2185.77	0.001123	4.80	1269.09	439.36	0.31
Nason Existing	67526.84	50Yr	5500.00	2176.71	2186.22	2182.12	2186.59	0.001149	5.18	1604.99	683.65	0.31
Nason Existing	67526.84	100Yr	6700.00	2176.71	2186.93	2182.68	2187.35	0.001200	5.58	2004.41	785.94	0.33
Nason Existing	66966.68	Qlidar	40.00	2174.84	2176.31	2175.75	2176.34	0.002602	1.52	26.32	36.43	0.32
Nason Existing	66966.68	Annual	800.00	2174.84	2179.23	2177.82	2179.44	0.002456	3.67	217.94	75.60	0.38
Nason Existing	66966.68	~1.2Yr	1100.00	2174.84	2179.88	2178.19	2180.14	0.002419	4.11	267.57	76.96	0.39
Nason Existing	66966.68	1.5Yr	1400.00	2174.84	2180.43	2178.53	2180.75	0.002442	4.51	310.30	78.11	0.40
Nason Existing	66966.68	2Yr	1700.00	2174.84	2180.93	2178.84	2181.29	0.002443	4.85	362.46	113.75	0.41
Nason Existing	66966.68	10Yr	3400.00	2174.84	2183.12	2180.35	2183.68	0.002382	6.20	680.80	266.14	0.43
Nason Existing	66966.68	25Yr	4500.00	2174.84	2184.16	2181.30	2184.85	0.002440	6.92	939.69	555.47	0.44
Nason Existing	66966.68	50Yr	5500.00	2174.84	2184.95	2182.01	2185.69	0.002395	7.32	1237.68	648.60	0.44
Nason Existing	66966.68	100Yr	6700.00	2174.84	2185.64	2182.78	2186.44	0.002460	7.82	1511.59	701.38	0.46
Nason Existing	66515.57	Qlidar	40.00	2173.96	2175.19	2174.69	2175.22	0.002357	1.42	28.17	40.13	0.30
Nason Existing	66515.57	Annual	800.00	2173.96	2178.34	2176.60	2178.49	0.001746	3.13	255.26	87.87	0.32
Nason Existing	66515.57	~1.2Yr	1100.00	2173.96	2179.02	2176.97	2179.21	0.001709	3.47	316.71	92.07	0.33
Nason Existing	66515.57	1.5Yr	1400.00	2173.96	2179.60	2177.32	2179.82	0.001651	3.79	370.83	95.11	0.33
Nason Existing	66515.57	2Yr	1700.00	2173.96	2180.11	2177.61	2180.37	0.001633	4.08	420.10	110.72	0.34
Nason Existing	66515.57	10Yr	3400.00	2173.96	2182.28	2179.08	2182.74	0.001747	5.47	671.80	193.06	0.37
Nason Existing	66515.57	25Yr	4500.00	2173.96	2183.27	2179.80	2183.86	0.001877	6.22	870.28	354.12	0.39
Nason Existing	66515.57	50Yr	5500.00	2173.96	2184.00	2180.42	2184.69	0.001991	6.80	1097.03	564.73	0.41
Nason Existing	66515.57	100Yr	6700.00	2173.96	2184.75	2181.11	2185.43	0.001897	7.03	1706.63	663.61	0.41
Nason Existing	66413.1	Qlidar	40.00	2171.76	2175.21	2172.50	2175.21	0.000015	0.26	155.49	62.98	0.03
Nason Existing	66413.1	Annual	800.00	2171.76	2178.31	2174.41	2178.39	0.000444	2.16	370.78	78.50	0.17
Nason Existing	66413.1	~1.2Yr	1100.00	2171.76	2178.98	2174.84	2179.09	0.000579	2.59	425.06	83.59	0.20
Nason Existing	66413.1	1.5Yr	1400.00	2171.76	2179.56	2175.24	2179.69	0.000679	2.95	478.02	108.40	0.22
Nason Existing	66413.1	2Yr	1700.00	2171.76	2180.07	2175.60	2180.23	0.000752	3.28	528.75	122.10	0.24
Nason Existing	66413.1	10Yr	3400.00	2171.76	2182.22	2177.31	2182.57	0.001050	4.76	808.11	250.60	0.29
Nason Existing	66413.1	25Yr	4500.00	2171.76	2183.22	2178.26	2183.67	0.001197	5.49	1053.35	373.93	0.32
Nason Existing	66413.1	50Yr	5500.00	2171.76	2183.95	2179.05	2184.48	0.001301	6.03	1295.30	502.60	0.34
Nason Existing	66413.1	100Yr	6700.00	2171.76	2184.69	2179.87	2185.24	0.001314	6.36	1965.09	687.26	0.34
Nason Existing	66306.13	Qlidar	40.00	2174.04	2175.19	2174.37	2175.20	0.000368	0.70	57.08	58.36	0.12
Nason Existing	66306.13	Annual	800.00	2174.04	2178.16	2176.03	2178.30	0.001341	3.06	261.57	75.63	0.29
Nason Existing	66306.13	~1.2Yr	1100.00	2174.04	2178.79	2176.44	2178.98	0.001523	3.54	310.44	79.04	0.32
Nason Existing	66306.13	1.5Yr	1400.00	2174.04	2179.33	2176.80	2179.57	0.001669	3.95	360.78	119.54	0.33
Nason Existing	66306.13	2Yr	1700.00	2174.04	2179.82	2177.11	2180.10	0.001761	4.29	413.34	135.57	0.35
Nason Existing	66306.13	10Yr	3400.00	2174.04	2181.95	2178.72	2182.41	0.001832	5.58	789.72	330.25	0.38
Nason Existing	66306.13	25Yr	4500.00	2174.04	2182.96	2179.67	2183.50	0.001864	6.18	1077.47	450.18	0.39
Nason Existing	66306.13	50Yr	5500.00	2174.04	2183.71	2180.43	2184.31	0.001889	6.61	1313.32	611.58	0.40
Nason Existing	66306.13	100Yr	6700.00	2174.04	2184.37	2181.20	2185.05	0.002037	7.21	1520.34	879.62	0.42
Nason Existing	66134.23	Qlidar	40.00	2174.37	2174.95	2174.87	2175.00	0.014277	1.94	20.61	71.15	0.64
Nason Existing	66134.23	Annual	800.00	2174.37	2177.88	2176.21	2178.04	0.001743	3.21	254.23	93.53	0.32
Nason Existing	66134.23	~1.2Yr	1100.00	2174.37	2178.49	2176.56	2178.70	0.001817	3.65	313.49	99.87	0.34
Nason Existing	66134.23	1.5Yr	1400.00	2174.37	2179.02	2176.89	2179.27	0.001891	4.03	367.34	104.98	0.35
Nason Existing	66134.23	2Yr	1700.00	2174.37	2179.49	2177.20	2179.78	0.001950	4.36	418.21	109.29	0.36
Nason Existing	66134.23	10Yr	3400.00	2174.37	2181.56	2178.68	2182.06	0.002203	5.81	684.75	180.05	0.41
Nason Existing	66134.23	25Yr	4500.00	2174.37	2182.52	2179.47	2183.14	0.002309	6.53	916.03	386.31	0.43
Nason Existing	66134.23	50Yr	5500.00	2174.37	2183.13	2180.00	2183.91	0.002607	7.33	1136.04	739.80	0.46
Nason Existing	66134.23	100Yr	6700.00	2174.37	2183.82	2180.82	2184.65	0.002610	7.75	1471.77	847.59	0.46
Nason Existing	66002.32	Qlidar	40.00	2173.36	2174.86	2174.06	2174.87	0.000303	0.63	63.82	65.54	0.11
Nason Existing	66002.32	Annual	800.00	2173.36	2177.69	2175.54	2177.84	0.001333	3.08	260.01	72.07	0.29

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

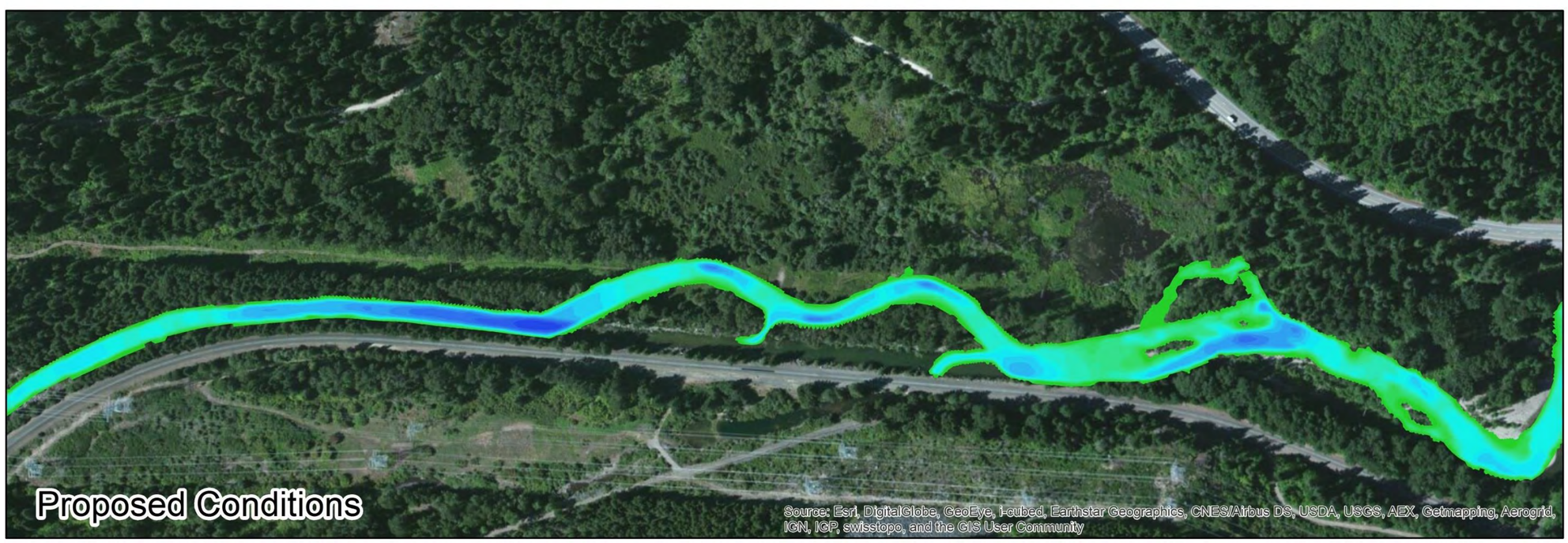
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	66002.32	~1.2Yr	1100.00	2173.36	2178.27	2175.94	2178.48	0.001571	3.64	302.19	73.18	0.32
Nason Existing	66002.32	1.5Yr	1400.00	2173.36	2178.76	2176.27	2179.02	0.001791	4.14	338.12	74.11	0.34
Nason Existing	66002.32	2Yr	1700.00	2173.36	2179.20	2176.64	2179.52	0.001969	4.58	373.88	91.35	0.36
Nason Existing	66002.32	10Yr	3400.00	2173.36	2181.09	2178.21	2181.74	0.002634	6.52	586.08	160.25	0.44
Nason Existing	66002.32	25Yr	4500.00	2173.36	2181.94	2179.06	2182.79	0.002986	7.51	745.75	217.13	0.48
Nason Existing	66002.32	50Yr	5500.00	2173.36	2182.49	2179.88	2183.52	0.003373	8.36	913.89	420.42	0.52
Nason Existing	66002.32	100Yr	6700.00	2173.36	2182.97	2180.76	2184.22	0.003911	9.36	1082.56	486.69	0.56
Nason Existing	65887.77	Qlidar	40.00	2172.70	2174.82	2173.78	2174.82	0.000430	0.74	53.74	55.31	0.13
Nason Existing	65887.77	Annual	800.00	2172.70	2177.46	2175.69	2177.65	0.001925	3.49	228.97	68.98	0.34
Nason Existing	65887.77	~1.2Yr	1100.00	2172.70	2177.99	2176.09	2178.26	0.002275	4.14	265.62	69.78	0.37
Nason Existing	65887.77	1.5Yr	1400.00	2172.70	2178.42	2176.45	2178.77	0.002619	4.73	296.05	70.43	0.41
Nason Existing	65887.77	2Yr	1700.00	2172.70	2178.81	2176.77	2179.24	0.002905	5.25	323.59	71.02	0.43
Nason Existing	65887.77	10Yr	3400.00	2172.70	2180.45	2178.40	2181.34	0.004181	7.62	508.82	179.35	0.54
Nason Existing	65887.77	25Yr	4500.00	2172.70	2181.17	2179.31	2182.33	0.004869	8.82	669.58	336.43	0.59
Nason Existing	65887.77	50Yr	5500.00	2172.70	2181.64	2180.37	2183.02	0.005457	9.75	841.33	402.89	0.63
Nason Existing	65887.77	100Yr	6700.00	2172.70	2182.11	2181.78	2183.73	0.006130	10.77	1035.99	552.56	0.68
Nason Existing	65507.92	Qlidar	40.00	2173.49	2174.44	2174.05	2174.47	0.003219	1.38	28.97	54.54	0.33
Nason Existing	65507.92	Annual	800.00	2173.49	2176.25	2175.57	2176.50	0.005310	4.05	197.69	107.78	0.53
Nason Existing	65507.92	~1.2Yr	1100.00	2173.49	2176.71	2175.88	2177.02	0.005004	4.42	249.02	113.78	0.53
Nason Existing	65507.92	1.5Yr	1400.00	2173.49	2177.12	2176.14	2177.47	0.004702	4.74	296.20	124.36	0.52
Nason Existing	65507.92	2Yr	1700.00	2173.49	2177.50	2176.40	2177.88	0.004414	5.00	344.67	131.33	0.52
Nason Existing	65507.92	10Yr	3400.00	2173.49	2179.19	2177.60	2179.77	0.003706	6.18	624.70	244.85	0.51
Nason Existing	65507.92	25Yr	4500.00	2173.49	2179.97	2178.21	2180.66	0.003607	6.78	813.03	258.38	0.52
Nason Existing	65507.92	50Yr	5500.00	2173.49	2180.52	2178.79	2181.26	0.003543	7.18	1153.65	590.96	0.52
Nason Existing	65507.92	100Yr	6700.00	2173.49	2180.94	2179.51	2181.79	0.003900	7.88	1374.17	600.76	0.55
Nason Existing	65258.61	Qlidar	40.00	2171.13	2172.39	2172.39	2172.56	0.035444	3.26	12.26	38.13	1.01
Nason Existing	65258.61	Annual	800.00	2171.13	2175.29	2174.20	2175.47	0.003212	3.39	235.69	111.34	0.41
Nason Existing	65258.61	~1.2Yr	1100.00	2171.13	2175.85	2174.52	2176.05	0.002924	3.67	300.00	117.32	0.40
Nason Existing	65258.61	1.5Yr	1400.00	2171.13	2176.31	2174.82	2176.55	0.002749	3.94	355.16	118.62	0.40
Nason Existing	65258.61	2Yr	1700.00	2171.13	2176.74	2175.08	2177.01	0.002632	4.18	406.27	119.81	0.40
Nason Existing	65258.61	10Yr	3400.00	2171.13	2178.54	2176.27	2178.98	0.002508	5.39	712.51	375.26	0.42
Nason Existing	65258.61	25Yr	4500.00	2171.13	2179.35	2176.89	2179.88	0.002527	5.96	1016.08	587.73	0.43
Nason Existing	65258.61	50Yr	5500.00	2171.13	2179.92	2177.41	2180.50	0.002556	6.37	1292.41	615.73	0.44
Nason Existing	65258.61	100Yr	6700.00	2171.13	2180.48	2177.99	2181.01	0.002320	6.42	2030.82	843.33	0.42
Nason Existing	65070.33	Qlidar	40.00	2170.10	2172.01	2171.03	2172.03	0.000746	0.99	40.60	42.10	0.18
Nason Existing	65070.33	Annual	800.00	2170.10	2174.65	2173.26	2174.88	0.003033	3.79	211.13	82.38	0.42
Nason Existing	65070.33	~1.2Yr	1100.00	2170.10	2175.18	2173.71	2175.46	0.003283	4.30	256.60	94.81	0.44
Nason Existing	65070.33	1.5Yr	1400.00	2170.10	2175.63	2174.10	2175.98	0.003288	4.72	302.85	107.32	0.45
Nason Existing	65070.33	2Yr	1700.00	2170.10	2176.05	2174.44	2176.45	0.003283	5.08	350.78	144.29	0.46
Nason Existing	65070.33	10Yr	3400.00	2170.10	2177.87	2175.93	2178.45	0.003140	6.37	745.82	375.46	0.48
Nason Existing	65070.33	25Yr	4500.00	2170.10	2178.71	2176.81	2179.36	0.003087	6.93	1114.80	608.12	0.48
Nason Existing	65070.33	50Yr	5500.00	2170.10	2179.34	2177.63	2180.00	0.002944	7.21	1440.97	722.59	0.48
Nason Existing	65070.33	100Yr	6700.00	2170.10	2179.68	2178.00	2180.48	0.003455	8.06	1620.98	767.82	0.52
Nason Existing	64877.74	Qlidar	40.00	2170.76	2171.70	2171.39	2171.74	0.004348	1.60	25.08	47.53	0.39
Nason Existing	64877.74	Annual	800.00	2170.76	2173.81	2173.13	2174.09	0.005653	4.29	186.66	97.22	0.55
Nason Existing	64877.74	~1.2Yr	1100.00	2170.76	2174.44	2173.46	2174.74	0.004342	4.42	249.11	101.55	0.50
Nason Existing	64877.74	1.5Yr	1400.00	2170.76	2174.96	2173.75	2175.29	0.003817	4.61	303.72	105.19	0.48
Nason Existing	64877.74	2Yr	1700.00	2170.76	2175.44	2173.99	2175.79	0.003425	4.80	358.44	137.37	0.46
Nason Existing	64877.74	10Yr	3400.00	2170.76	2177.38	2175.31	2177.88	0.002719	5.79	757.23	402.31	0.44
Nason Existing	64877.74	25Yr	4500.00	2170.76	2178.26	2175.98	2178.81	0.002575	6.25	1038.25	568.98	0.44
Nason Existing	64877.74	50Yr	5500.00	2170.76	2178.87	2176.69	2179.49	0.002641	6.73	1268.23	650.16	0.46
Nason Existing	64877.74	100Yr	6700.00	2170.76	2179.26	2177.50	2179.88	0.002691	7.06	1917.22	778.49	0.47
Nason Existing	64735.32	Qlidar	40.00	2169.65	2170.21	2170.21	2170.35	0.037015	2.99	13.38	48.93	1.01
Nason Existing	64735.32	Annual	800.00	2169.65	2173.51	2171.86	2173.65	0.001655	3.01	265.71	90.67	0.31
Nason Existing	64735.32	~1.2Yr	1100.00	2169.65	2174.17	2172.19	2174.34	0.001639	3.38	325.60	92.27	0.32
Nason Existing	64735.32	1.5Yr	1400.00	2169.65	2174.70	2172.50	2174.91	0.001674	3.74	374.99	93.17	0.33
Nason Existing	64735.32	2Yr	1700.00	2169.65	2175.17	2172.78	2175.43	0.001718	4.06	421.59	108.91	0.34
Nason Existing	64735.32	10Yr	3400.00	2169.65	2177.06	2174.12	2177.54	0.002119	5.62	699.29	417.58	0.39
Nason Existing	64735.32	25Yr	4500.00	2169.65	2177.83	2174.85	2178.45	0.002435	6.46	862.82	495.88	0.43
Nason Existing	64735.32	50Yr	5500.00	2169.65	2178.32	2175.51	2179.09	0.002815	7.26	997.08	634.94	0.46
Nason Existing	64735.32	100Yr	6700.00	2169.65	2178.05	2176.30	2179.32	0.004809	9.27	915.06	621.19	0.60
Nason Existing	64529.41	Qlidar	40.00	2166.92	2170.07	2168.47	2170.08	0.000291	0.69	57.59	48.12	0.11
Nason Existing	64529.41	Annual	800.00	2166.92	2173.19	2170.96	2173.33	0.001483	2.92	273.71	123.57	0.30
Nason Existing	64529.41	~1.2Yr	1100.00	2166.92	2173.84	2171.50	2174.01	0.001562	3.29	334.17	133.45	0.31
Nason Existing	64529.41	1.5Yr	1400.00	2166.92	2174.37	2171.94	2174.57	0.001601	3.63	385.42	138.47	0.32
Nason Existing	64529.41	2Yr	1700.00	2166.92	2174.84	2172.26	2175.08	0.001624	3.94	431.98	142.86	0.33
Nason Existing	64529.41	10Yr	3400.00	2166.92	2176.61	2173.76	2177.10	0.002100	5.62	616.53	398.82	0.40
Nason Existing	64529.41	25Yr	4500.00	2166.92	2177.21	2174.47	2177.92	0.002699	6.77	693.20	510.01	0.46
Nason Existing	64529.41	50Yr	5500.00	2166.92	2177.44	2175.07	2178.42	0.003603	7.99	728.69	513.86	0.53
Nason Existing	64529.41	100Yr	6700.00	2166.92	2178.44	2175.73	2178.58	0.000823	4.17	4144.77	1057.16	0.26

HEC-RAS Plan: Ex2-LtLevees River: Nason Existing Reach: Nason Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Nason Existing	64331.06	Qlidar	40.00	2169.04	2169.76	2169.68	2169.89	0.017717	2.83	14.14	32.62	0.76
Nason Existing	64331.06	Annual	800.00	2169.04	2172.62	2171.57	2172.88	0.003632	4.04	198.18	80.90	0.45
Nason Existing	64331.06	~1.2Yr	1100.00	2169.04	2173.27	2171.93	2173.56	0.003253	4.38	250.93	83.43	0.44
Nason Existing	64331.06	1.5Yr	1400.00	2169.04	2173.77	2172.27	2174.12	0.003191	4.78	293.35	85.46	0.45
Nason Existing	64331.06	2Yr	1700.00	2169.04	2174.22	2172.58	2174.63	0.003146	5.14	332.03	87.48	0.46
Nason Existing	64331.06	10Yr	3400.00	2169.04	2176.14	2174.01	2176.65	0.002583	6.08	942.49	835.29	0.44
Nason Existing	64331.06	25Yr	4500.00	2169.04	2176.77	2174.80	2177.35	0.002793	6.76	1225.54	891.03	0.47
Nason Existing	64331.06	50Yr	5500.00	2169.04	2177.33	2175.53	2177.74	0.002094	6.19	2346.91	1002.52	0.41
Nason Existing	64331.06	100Yr	6700.00	2169.04	2178.02	2176.00	2178.36	0.001744	6.01	3041.32	1007.90	0.38
Nason Existing	64240.94	Qlidar	40.00	2167.91	2169.13	2168.72	2169.18	0.004232	1.83	21.86	32.82	0.40
Nason Existing	64240.94	Annual	800.00	2167.91	2172.31	2170.92	2172.57	0.003279	4.06	197.14	73.19	0.44
Nason Existing	64240.94	~1.2Yr	1100.00	2167.91	2172.96	2171.40	2173.26	0.003444	4.45	247.45	83.00	0.45
Nason Existing	64240.94	1.5Yr	1400.00	2167.91	2173.46	2171.81	2173.82	0.003444	4.82	290.31	86.01	0.46
Nason Existing	64240.94	2Yr	1700.00	2167.91	2173.92	2172.17	2174.33	0.003448	5.15	331.01	95.83	0.47
Nason Existing	64240.94	10Yr	3400.00	2167.91	2176.05	2173.78	2176.41	0.002026	5.33	1184.03	761.62	0.39
Nason Existing	64240.94	25Yr	4500.00	2167.91	2176.68	2174.75	2177.10	0.002192	5.93	1497.13	820.03	0.41
Nason Existing	64240.94	50Yr	5500.00	2167.91	2177.20	2175.48	2177.57	0.001973	5.92	2395.49	1003.11	0.39
Nason Existing	64240.94	100Yr	6700.00	2167.91	2177.92	2176.02	2178.22	0.001613	5.72	3120.43	1005.91	0.36
Nason Existing	64108.09	Qlidar	40.00	2167.59	2168.92	2168.23	2168.94	0.000933	1.01	39.51	46.54	0.19
Nason Existing	64108.09	Annual	800.00	2167.59	2171.94	2170.19	2172.18	0.002491	3.97	201.69	62.10	0.39
Nason Existing	64108.09	~1.2Yr	1100.00	2167.59	2172.50	2170.66	2172.84	0.002959	4.62	238.03	66.58	0.43
Nason Existing	64108.09	1.5Yr	1400.00	2167.59	2172.95	2171.05	2173.37	0.003259	5.24	268.38	72.77	0.46
Nason Existing	64108.09	2Yr	1700.00	2167.59	2173.33	2171.49	2173.85	0.003532	5.79	298.70	83.85	0.49
Nason Existing	64108.09	10Yr	3400.00	2167.59	2174.99	2173.31	2175.98	0.004555	8.14	512.72	214.47	0.58
Nason Existing	64108.09	25Yr	4500.00	2167.59	2175.96	2174.47	2176.74	0.003472	7.84	1086.74	729.76	0.52
Nason Existing	64108.09	50Yr	5500.00	2167.59	2176.79	2175.00	2177.31	0.002396	7.02	2166.59	934.56	0.44
Nason Existing	64108.09	100Yr	6700.00	2167.59	2177.66	2176.00	2178.04	0.001795	6.51	2991.07	963.79	0.39
Nason Existing	63860.55	Qlidar	40.00	2167.26	2168.27	2168.08	2168.38	0.010008	2.66	15.01	24.11	0.60
Nason Existing	63860.55	Annual	800.00	2167.26	2170.62	2170.23	2171.07	0.010003	5.40	148.25	82.60	0.71
Nason Existing	63860.55	~1.2Yr	1100.00	2167.26	2171.01	2170.59	2171.58	0.010003	6.07	181.29	91.70	0.73
Nason Existing	63860.55	1.5Yr	1400.00	2167.26	2171.36	2170.91	2172.04	0.010001	6.63	214.58	99.72	0.75
Nason Existing	63860.55	2Yr	1700.00	2167.26	2171.67	2171.21	2172.45	0.010014	7.13	246.23	105.72	0.76
Nason Existing	63860.55	10Yr	3400.00	2167.26	2173.02	2172.65	2174.34	0.010007	9.32	413.91	143.75	0.81
Nason Existing	63860.55	25Yr	4500.00	2167.26	2173.71	2173.41	2175.30	0.010013	10.35	515.01	148.68	0.83
Nason Existing	63860.55	50Yr	5500.00	2167.26	2174.28	2173.98	2176.10	0.010007	11.14	600.24	152.87	0.85
Nason Existing	63860.55	100Yr	6700.00	2167.26	2174.90	2174.60	2176.98	0.010010	11.99	696.34	157.56	0.87

Appendix B: 2-D Hydraulic Model Output

This appendix presents selected results from the 2-D Hydraulic Model. Images show a comparison of velocity and water depth between existing and proposed conditions at the annual, 2-year, 5-year, 10-year and 100-year flood events. Select cross sections of existing versus proposed conditions (including topography and water surface elevation) are also provided for the 2 and 100 year events. A plan view image of cross section locations is included for reference.



Depth (ft)

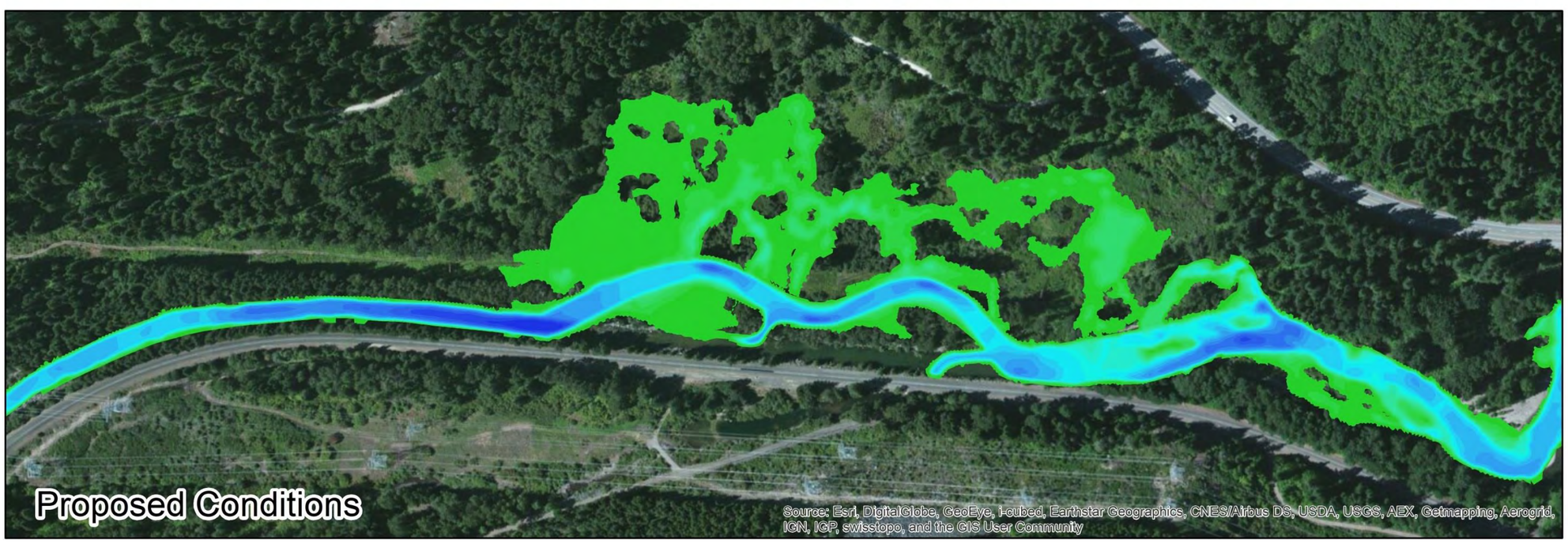
Annual Flood Event

Legend

- 10.8 - 13.6
- 9.3 - 10.8
- 8.2 - 9.3
- 7.3 - 8.2
- 6.4 - 7.3
- 5.6 - 6.4
- 4.8 - 5.6
- 4.1 - 4.8
- 3.5 - 4.1
- 3.0 - 3.5
- 2.6 - 3.0
- 2.2 - 2.6
- 1.9 - 2.2
- 1.6 - 1.9
- 1.3 - 1.6
- 1.0 - 1.3
- 0.8 - 1.0
- 0.5 - 0.8
- 0.01 - 0.5
- 0.0-0.01

N

0 200 400 Feet



Depth (ft)

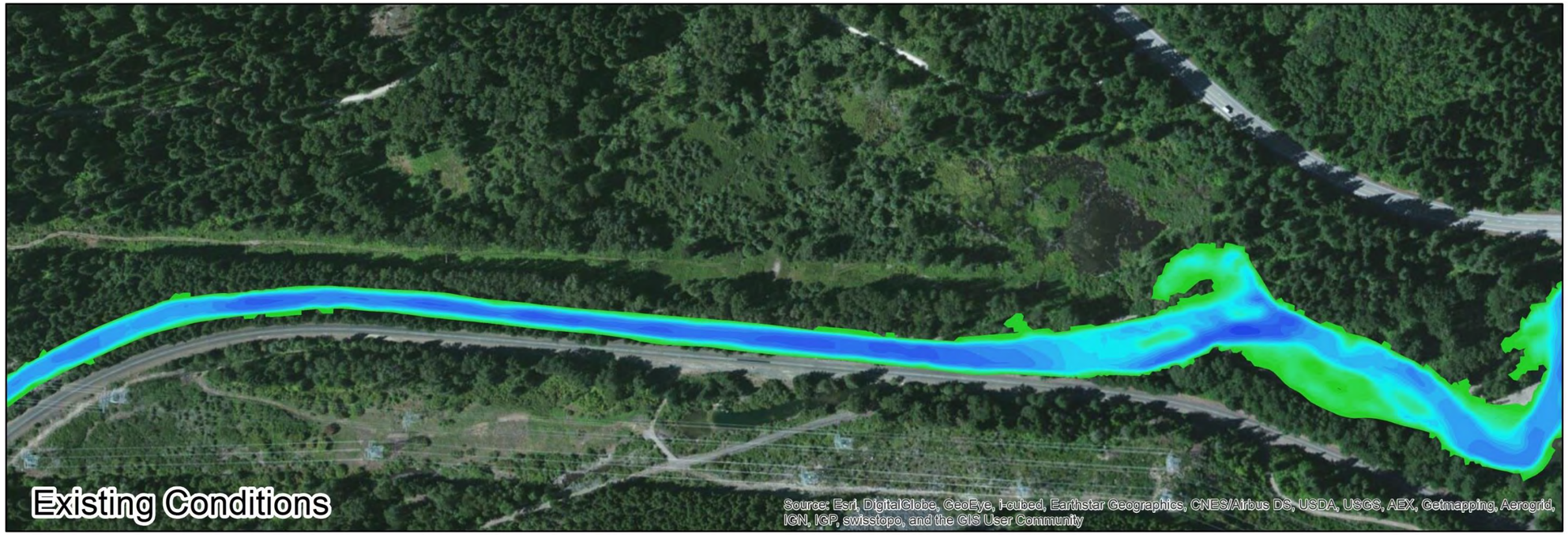
2-YR Flood Event

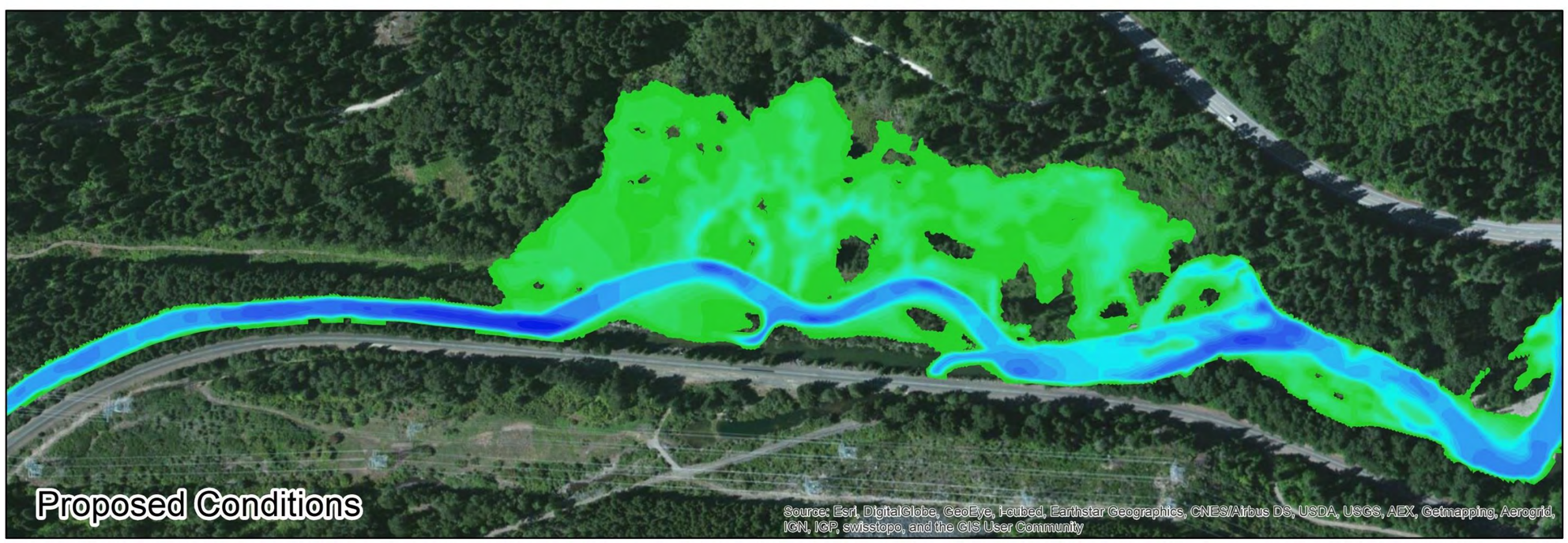
Legend

- 10.8 - 13.6
- 9.3 - 10.8
- 8.2 - 9.3
- 7.3 - 8.2
- 6.4 - 7.3
- 5.6 - 6.4
- 4.8 - 5.6
- 4.1 - 4.8
- 3.5 - 4.1
- 3.0 - 3.5
- 2.6 - 3.0
- 2.2 - 2.6
- 1.9 - 2.2
- 1.6 - 1.9
- 1.3 - 1.6
- 1.0 - 1.3
- 0.8 - 1.0
- 0.5 - 0.8
- 0.01 - 0.5
- 0.0-0.01

N

0 200 400 Feet





Depth (ft)

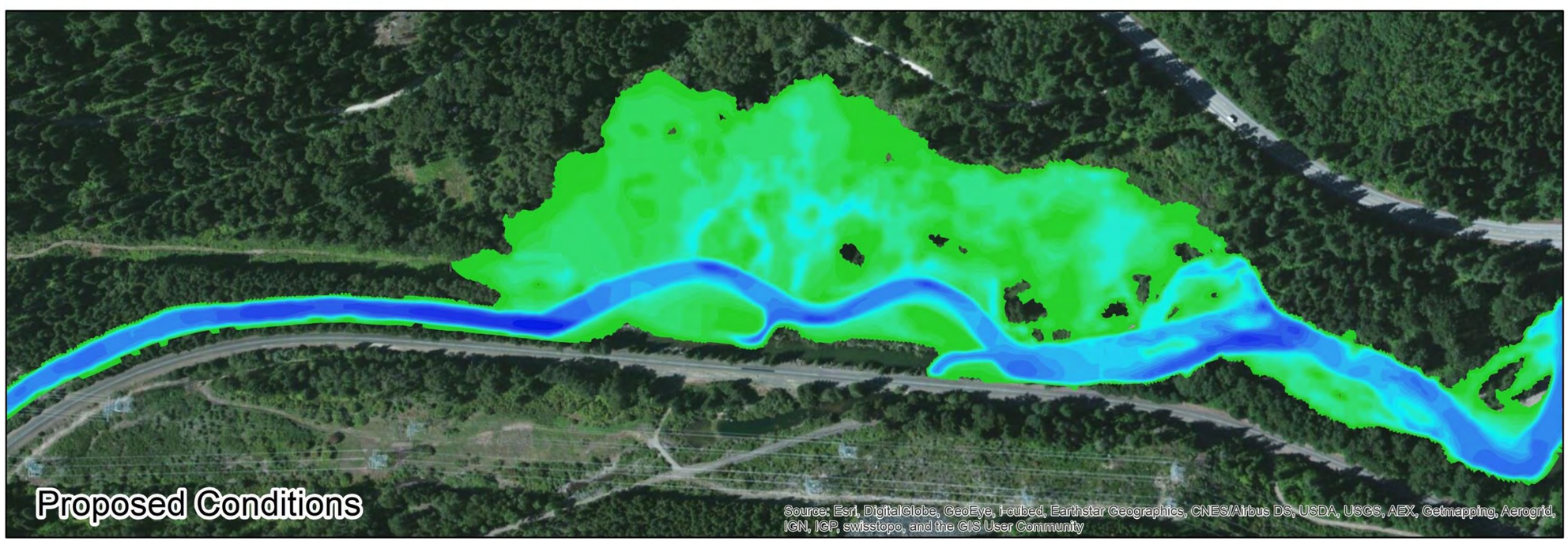
5-YR Flood Event

Legend

- 10.8 - 13.6
- 9.3 - 10.8
- 8.2 - 9.3
- 7.3 - 8.2
- 6.4 - 7.3
- 5.6 - 6.4
- 4.8 - 5.6
- 4.1 - 4.8
- 3.5 - 4.1
- 3.0 - 3.5
- 2.6 - 3.0
- 2.2 - 2.6
- 1.9 - 2.2
- 1.6 - 1.9
- 1.3 - 1.6
- 1.0 - 1.3
- 0.8 - 1.0
- 0.5 - 0.8
- 0.01 - 0.5
- 0.0-0.01

N

0 200 400 Feet



Depth (ft)

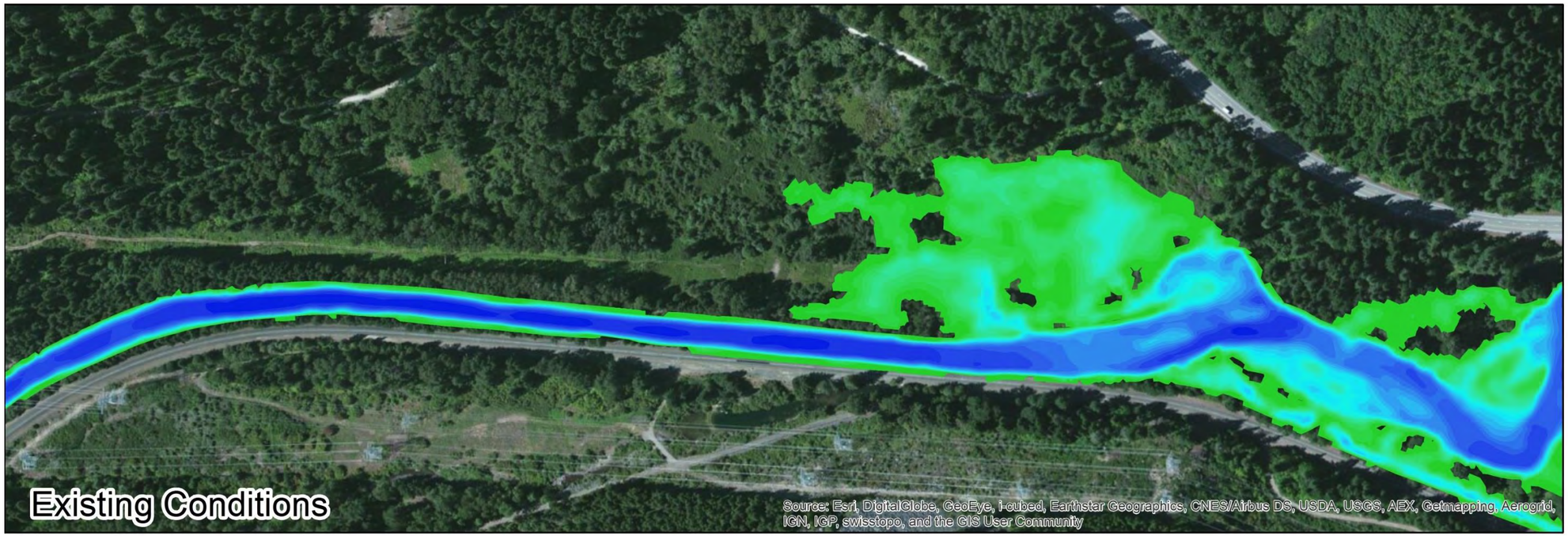
10-YR Flood Event

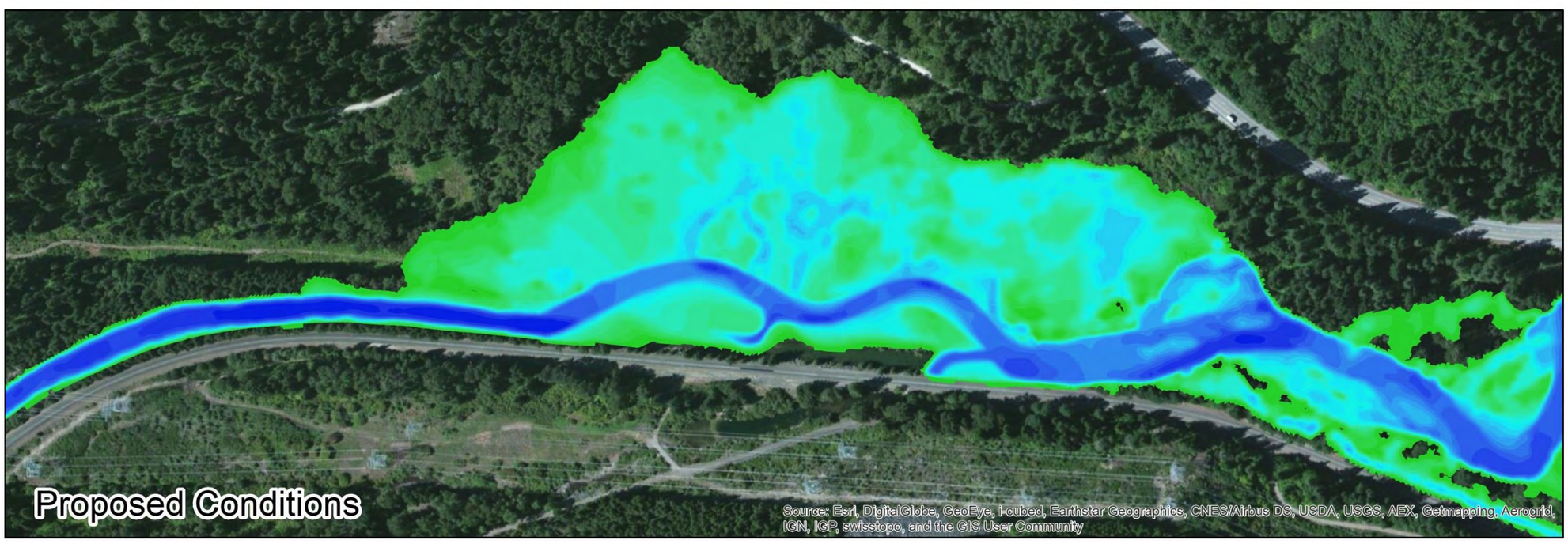
Legend

- 10.8 - 13.6
- 9.3 - 10.8
- 8.2 - 9.3
- 7.3 - 8.2
- 6.4 - 7.3
- 5.6 - 6.4
- 4.8 - 5.6
- 4.1 - 4.8
- 3.5 - 4.1
- 3.0 - 3.5
- 2.6 - 3.0
- 2.2 - 2.6
- 1.9 - 2.2
- 1.6 - 1.9
- 1.3 - 1.6
- 1.0 - 1.3
- 0.8 - 1.0
- 0.5 - 0.8
- 0.01 - 0.5
- 0.0-0.01

N

0 200 400 Feet





Depth (ft)

100-YR Flood Event

Legend

- 10.8 - 13.6
- 9.3 - 10.8
- 8.2 - 9.3
- 7.3 - 8.2
- 6.4 - 7.3
- 5.6 - 6.4
- 4.8 - 5.6
- 4.1 - 4.8
- 3.5 - 4.1
- 3.0 - 3.5
- 2.6 - 3.0
- 2.2 - 2.6
- 1.9 - 2.2
- 1.6 - 1.9
- 1.3 - 1.6
- 1.0 - 1.3
- 0.8 - 1.0
- 0.5 - 0.8
- 0.01 - 0.5
- 0.0-0.01

N

0 200 400 Feet

Velocity (fps)

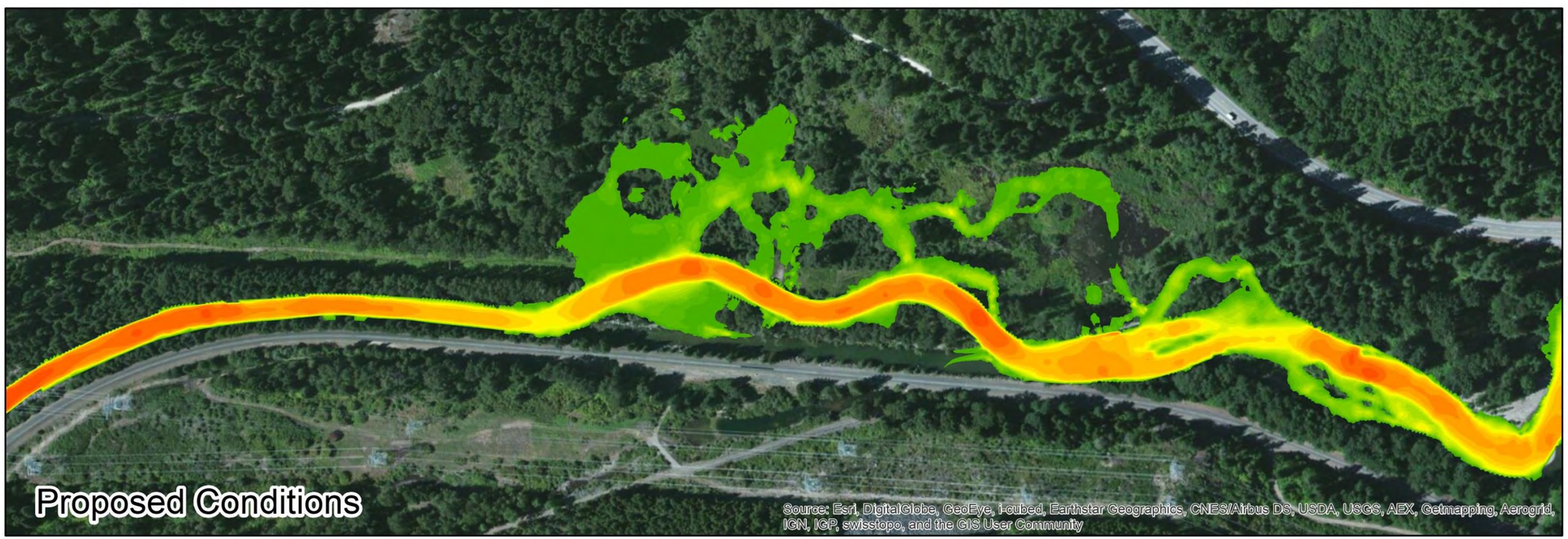
Annual Flood Event

Legend

- 18.7 - 25.3
- 13.9 - 18.7
- 11.1 - 13.9
- 9.1 - 11.1
- 7.6 - 9.1
- 6.3 - 7.6
- 5.2 - 6.3
- 4.4 - 5.2
- 3.7 - 4.4
- 3.1 - 3.7
- 2.7 - 3.1
- 2.3 - 2.7
- 1.9 - 2.3
- 1.5 - 1.9
- 1.2 - 1.5
- 0.9 - 1.2
- 0.7 - 0.9
- 0.4 - 0.7
- 0.1 - 0.4
- 0 - 0.1

N

0 200 400 Feet



Velocity (fps)

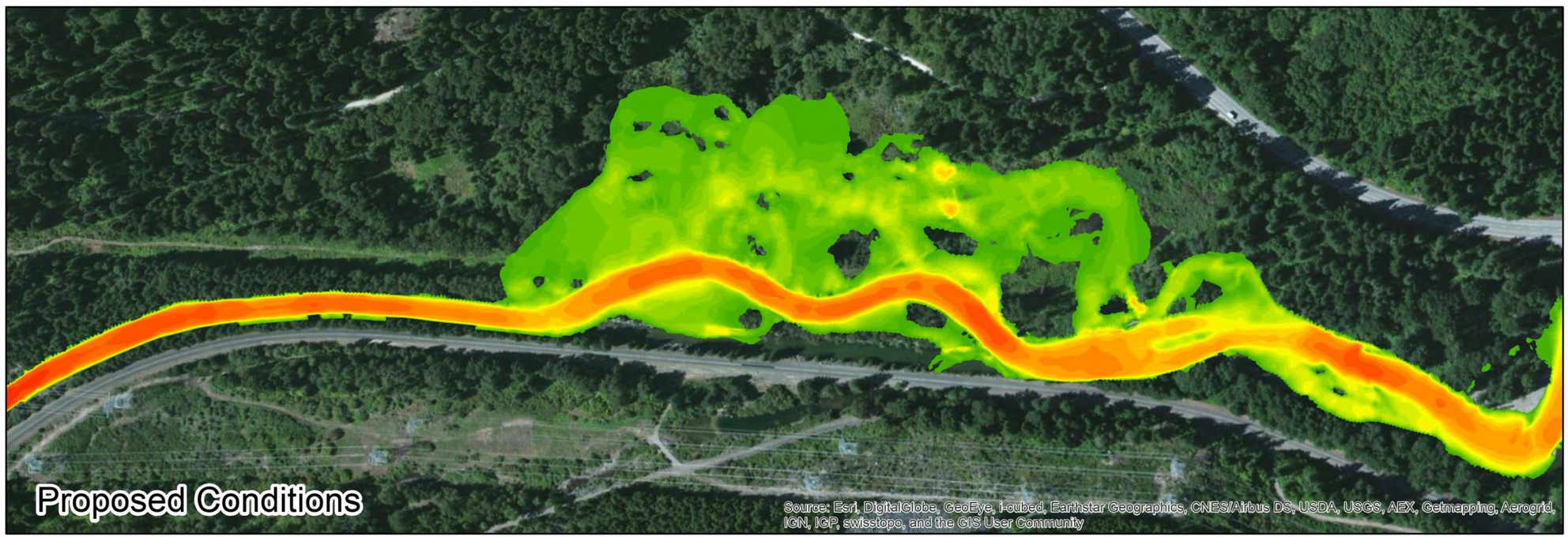
2-YR Flood Event

Legend

- 18.7 - 25.3
- 13.9 - 18.7
- 11.1 - 13.9
- 9.1 - 11.1
- 7.6 - 9.1
- 6.3 - 7.6
- 5.2 - 6.3
- 4.4 - 5.2
- 3.7 - 4.4
- 3.1 - 3.7
- 2.7 - 3.1
- 2.3 - 2.7
- 1.9 - 2.3
- 1.5 - 1.9
- 1.2 - 1.5
- 0.9 - 1.2
- 0.7 - 0.9
- 0.4 - 0.7
- 0.1 - 0.4
- 0 - 0.1

N

0 200 400 Feet



Velocity (fps)

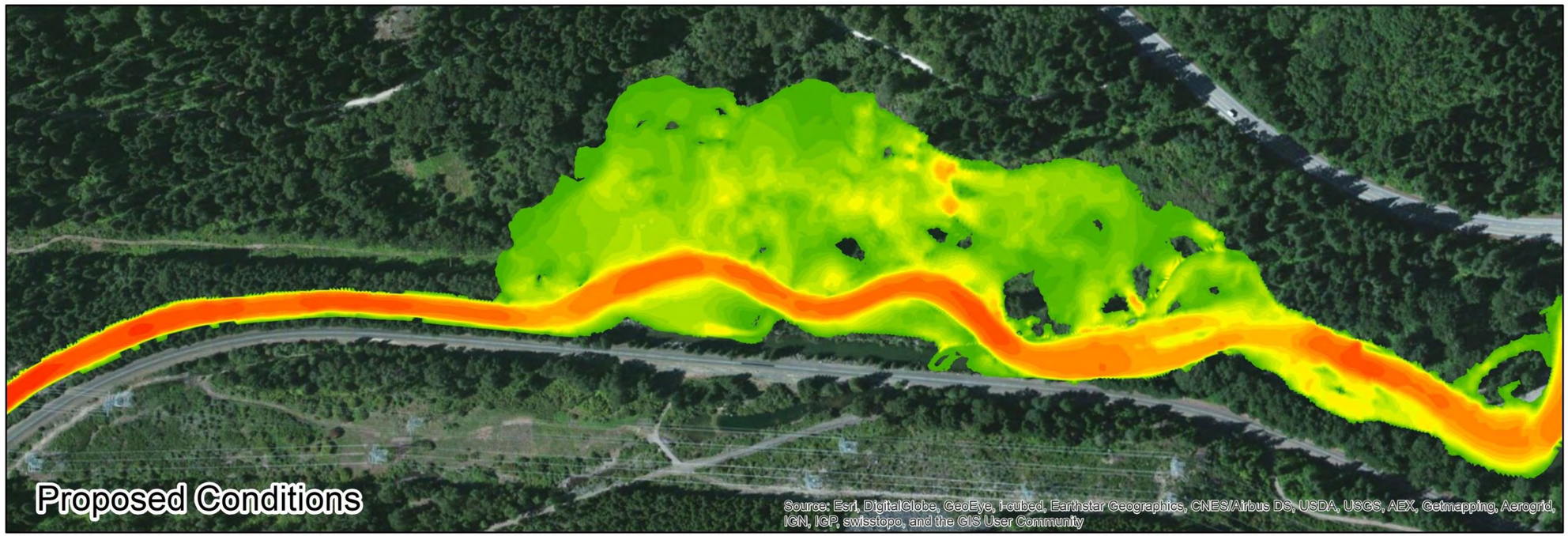
5-YR Flood Event

Legend

- 18.7 - 25.3
- 13.9 - 18.7
- 11.1 - 13.9
- 9.1 - 11.1
- 7.6 - 9.1
- 6.3 - 7.6
- 5.2 - 6.3
- 4.4 - 5.2
- 3.7 - 4.4
- 3.1 - 3.7
- 2.7 - 3.1
- 2.3 - 2.7
- 1.9 - 2.3
- 1.5 - 1.9
- 1.2 - 1.5
- 0.9 - 1.2
- 0.7 - 0.9
- 0.4 - 0.7
- 0.1 - 0.4
- 0 - 0.1

N

0 200 400 Feet



Velocity (fps)

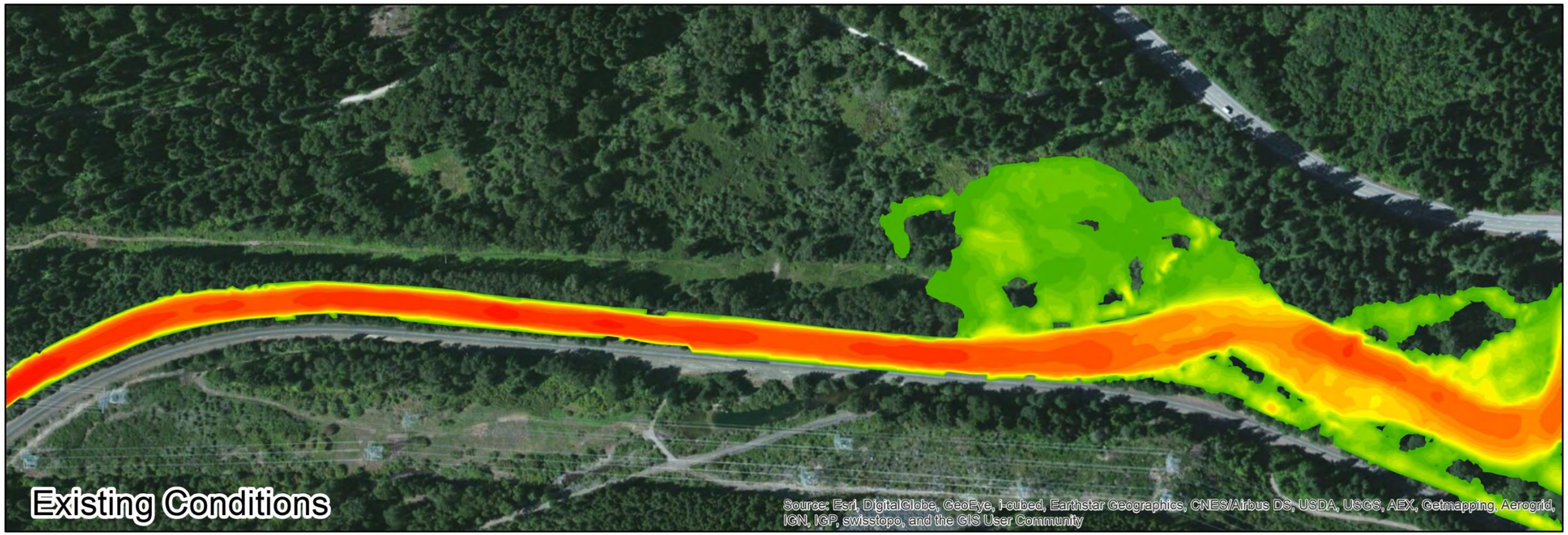
10-YR Flood Event

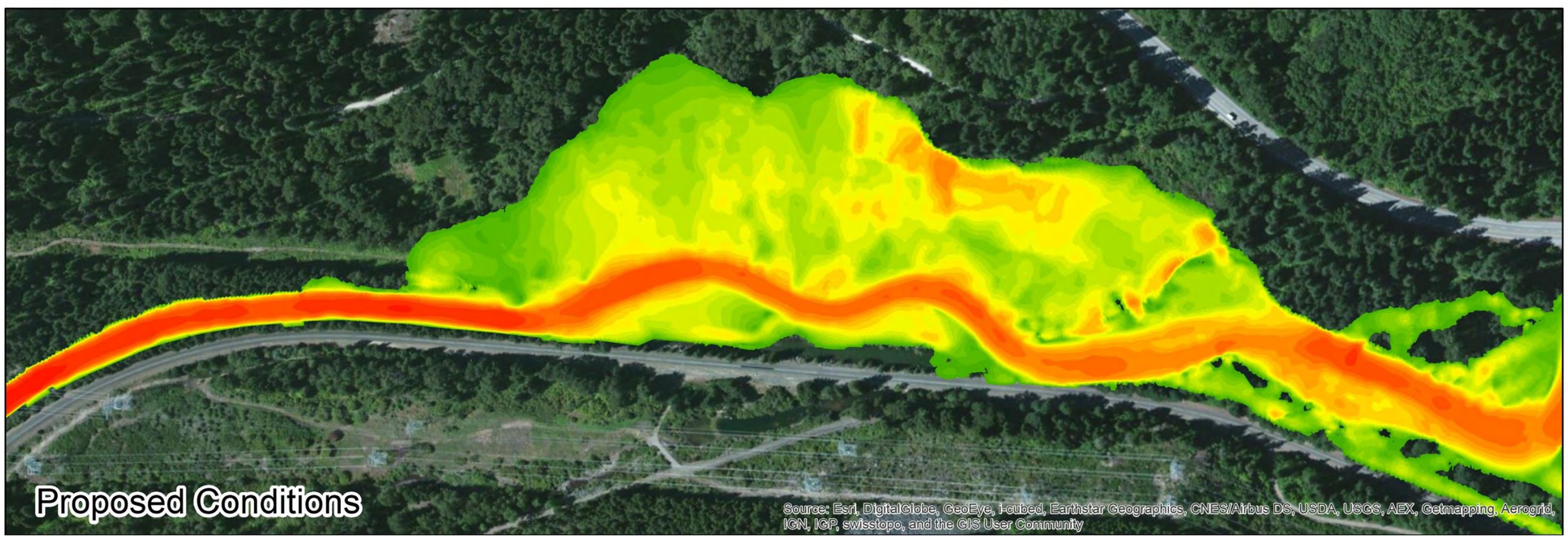
Legend

- 18.7 - 25.3
- 13.9 - 18.7
- 11.1 - 13.9
- 9.1 - 11.1
- 7.6 - 9.1
- 6.3 - 7.6
- 5.2 - 6.3
- 4.4 - 5.2
- 3.7 - 4.4
- 3.1 - 3.7
- 2.7 - 3.1
- 2.3 - 2.7
- 1.9 - 2.3
- 1.5 - 1.9
- 1.2 - 1.5
- 0.9 - 1.2
- 0.7 - 0.9
- 0.4 - 0.7
- 0.1 - 0.4
- 0 - 0.1

N

0 200 400 Feet





Velocity (fps)

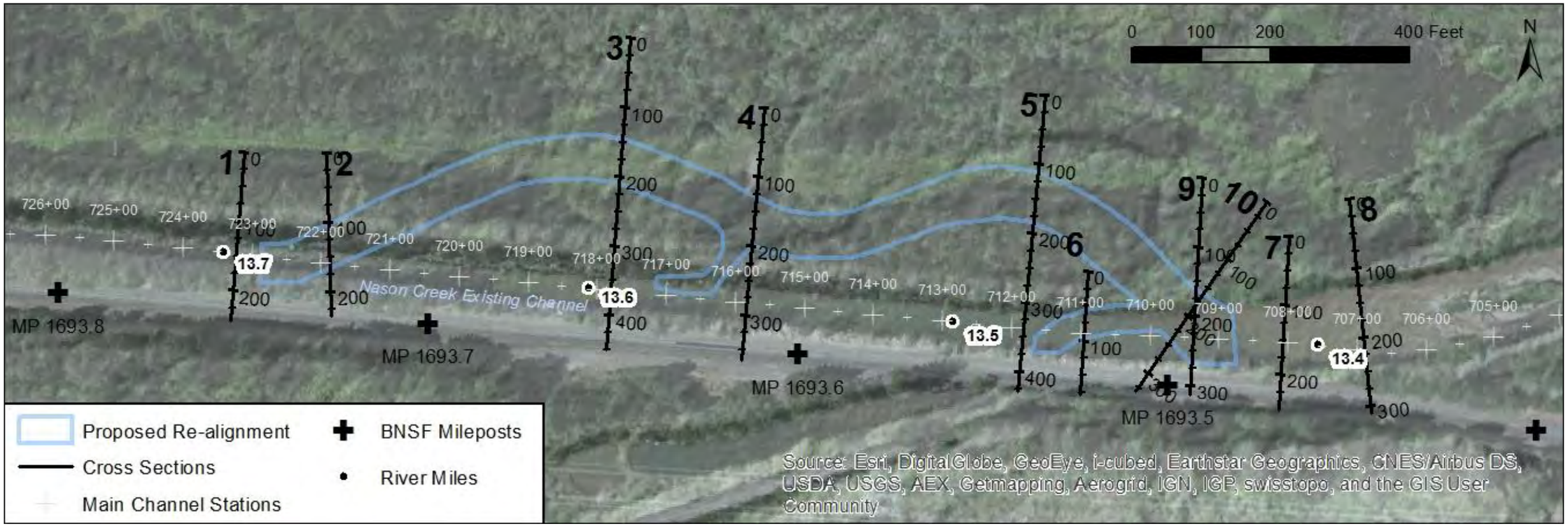
100-YR Flood Event

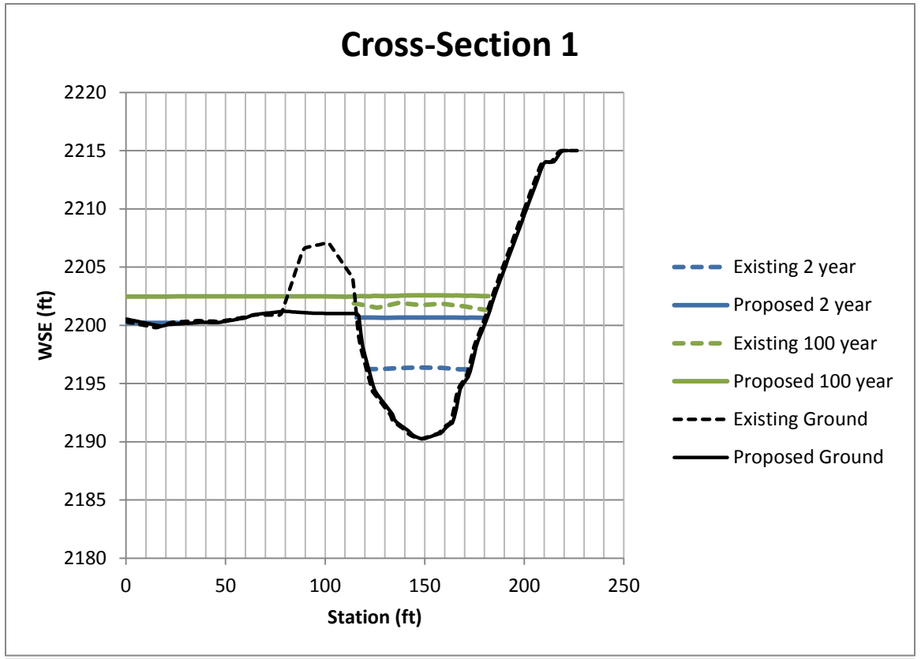
Legend

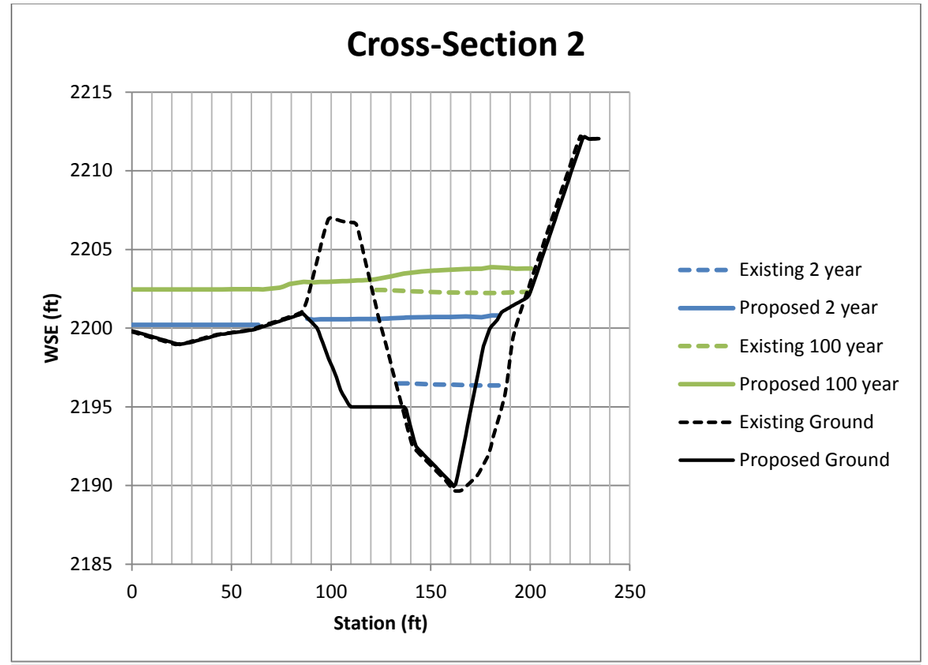
- 18.7 - 25.3
- 13.9 - 18.7
- 11.1 - 13.9
- 9.1 - 11.1
- 7.6 - 9.1
- 6.3 - 7.6
- 5.2 - 6.3
- 4.4 - 5.2
- 3.7 - 4.4
- 3.1 - 3.7
- 2.7 - 3.1
- 2.3 - 2.7
- 1.9 - 2.3
- 1.5 - 1.9
- 1.2 - 1.5
- 0.9 - 1.2
- 0.7 - 0.9
- 0.4 - 0.7
- 0.1 - 0.4
- 0 - 0.1

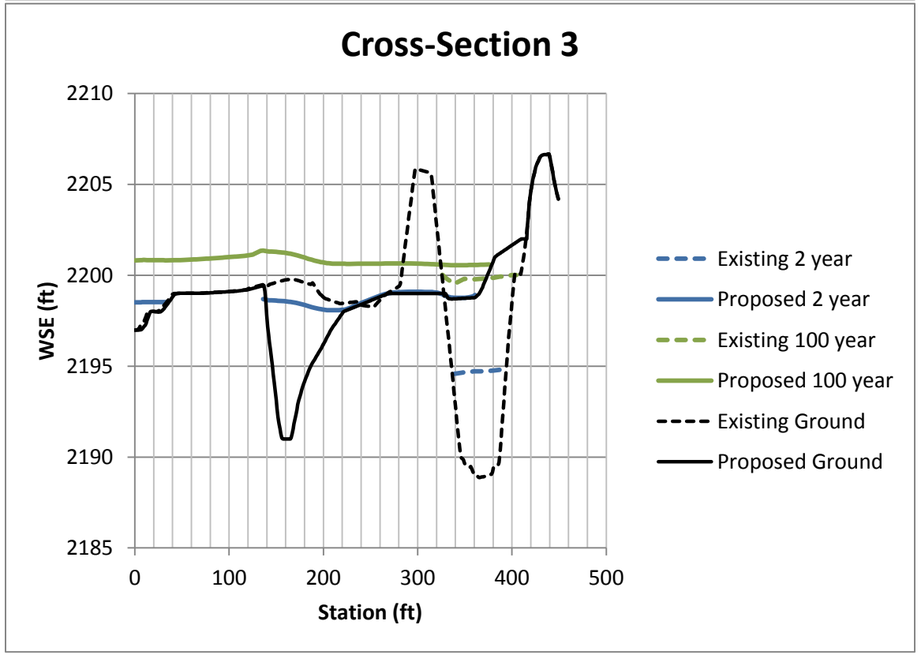
N

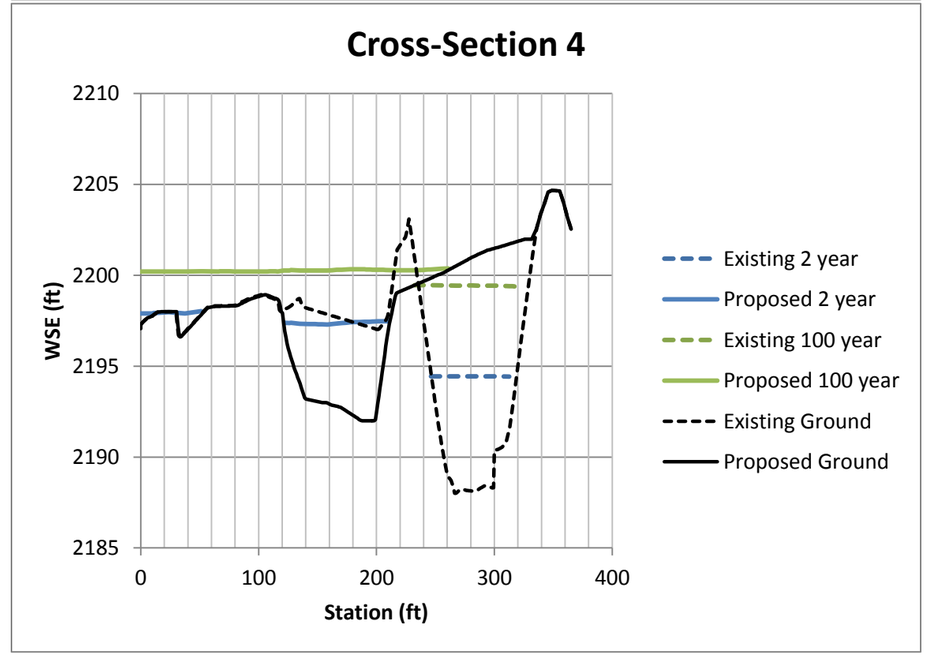
0 200 400 Feet

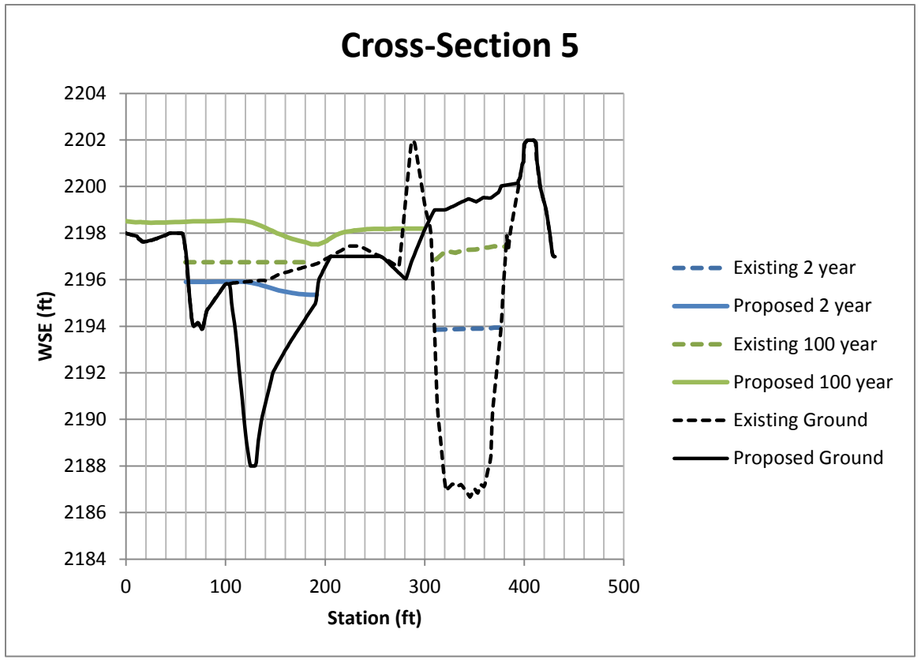

0 100 200 400 Feet
N
1
2
3
4
5
6
7
8
9
10
726+00
725+00
724+00
723+00
722+00
721+00
720+00
719+00
718+00
717+00
716+00
715+00
714+00
713+00
712+00
711+00
710+00
709+00
708+00
707+00
706+00
705+00
13.7
13.6
13.5
13.4
Nason Creek Existing Channel
MP 1693.8
MP 1693.7
MP 1693.6
MP 1693.5
Proposed Re-alignment
Cross Sections
Main Channel Stations
BNSF Mileposts
River Miles
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

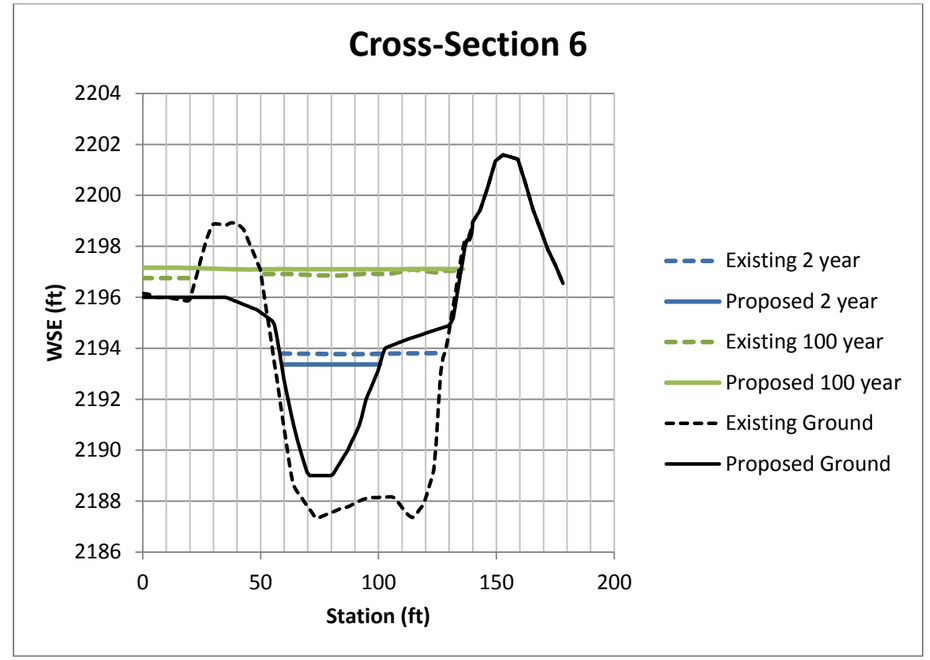

Cross-Section 1
WSE (ft)
2220
2215
2210
2205
2200
2195
2190
2185
2180
0
50
100
150
200
250
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground

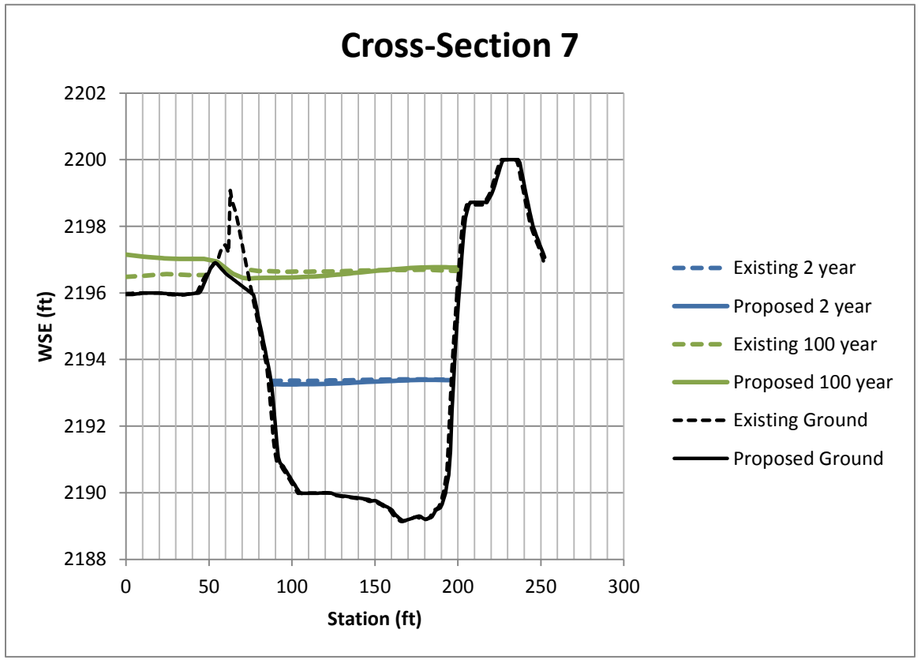

Cross-Section 2
WSE (ft)
2215
2210
2205
2200
2195
2190
2185
0
50
100
150
200
250
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground

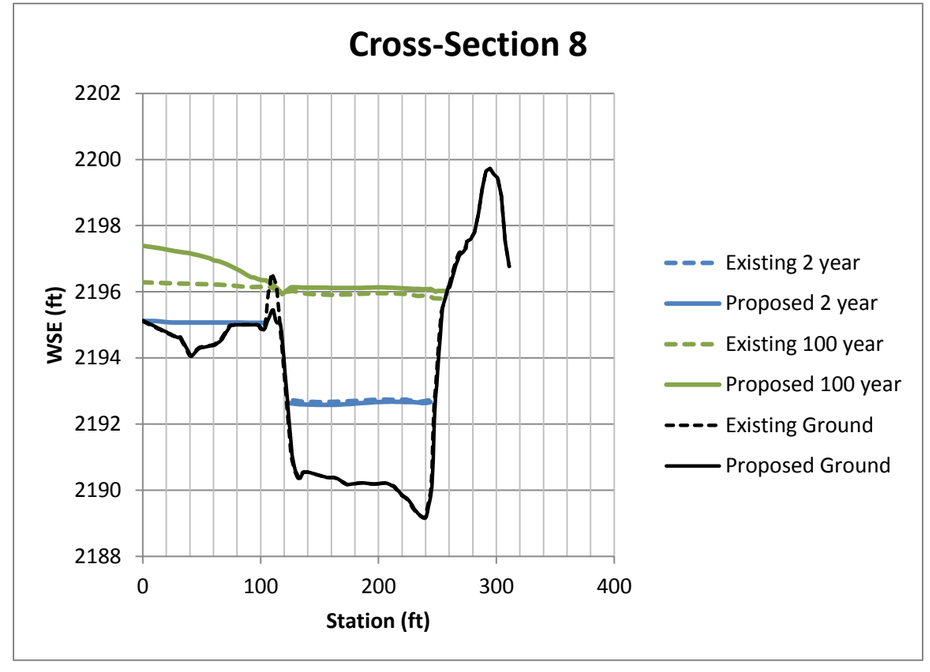

Cross-Section 3
WSE (ft)
2210
2205
2200
2195
2190
2185
0
100
200
300
400
500
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground

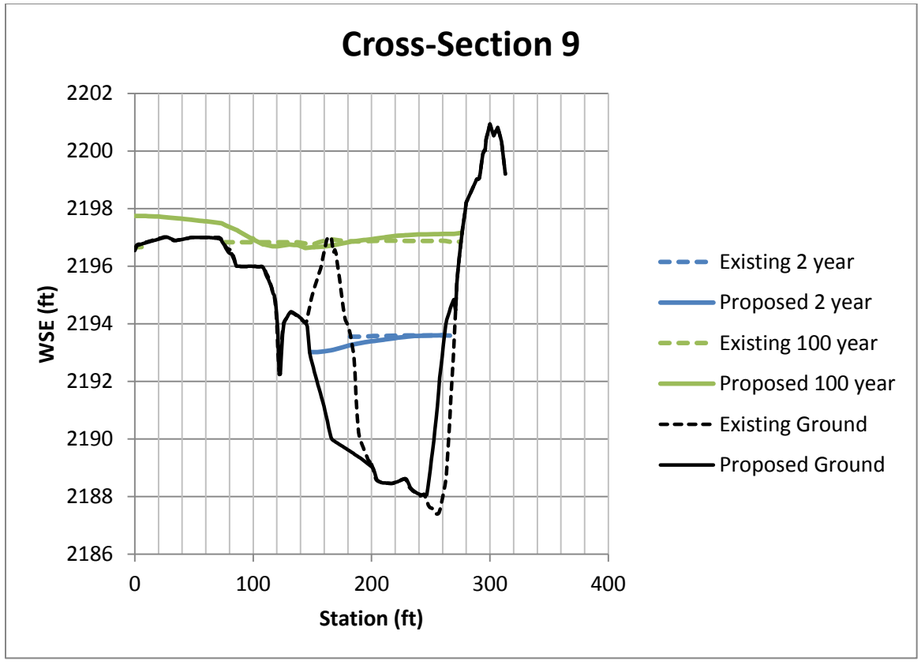

Cross-Section 4
WSE (ft)
2210
2205
2200
2195
2190
2185
0
100
200
300
400
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground

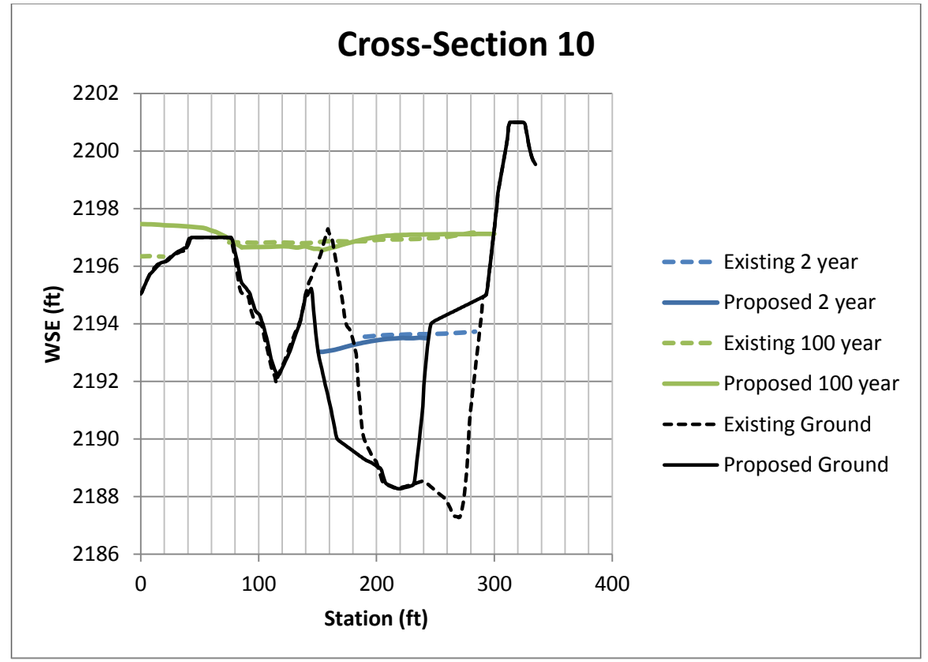

Cross-Section 5
WSE (ft)
2204
2202
2200
2198
2196
2194
2192
2190
2188
2186
2184
0
100
200
300
400
500
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground


Cross-Section 6
WSE (ft)
2204
2202
2200
2198
2196
2194
2192
2190
2188
2186
0
50
100
150
200
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground


Cross-Section 7
WSE (ft)
2202
2200
2198
2196
2194
2192
2190
2188
0
50
100
150
200
250
300
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground


Cross-Section 8
WSE (ft)
2202
2200
2198
2196
2194
2192
2190
2188
0
100
200
300
400
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground


Cross-Section 9
2202
2200
2198
2196
2194
2192
2190
2188
2186
WSE (ft)
0
100
200
300
400
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground


Cross-Section 10
2202
2200
2198
2196
2194
2192
2190
2188
2186
WSE (ft)
0
100
200
300
400
Station (ft)
Existing 2 year
Proposed 2 year
Existing 100 year
Proposed 100 year
Existing Ground
Proposed Ground

Appendix C: Soils Test Pits

SOILS PIT - 1

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2205.9' +/-	DEPTH, FT	NOTES
0'		SILTY SAND WITH ORGANICS	1'	
		FRIABLE DRY SILTY SAND.	2.5'	
		SLIGHTLY COHESIVE SILTY SAND		FG EL = 2199.3 6.6' BELOW GRADE
5'				
			9.5'	DAMP SOILS AT 10' DEPTH. WATER SLOWLY POOLING IN BOTTOM OF PIT
10'		4" MINUS GRAVEL/COBBLE	10.5'	
		BOTTOM ELEV = 2195.0' +/-		
15'				

10' DEPTH

PIT

inter·fluve
501 Portway Avenue, Suite 101
Hood River, OR 97031
541.386.9003
www.interfluve.com

US Bureau of Reclamation
Nason Creek - UWP Subreach 2
Survey: August 27, 2014

SOILS TEST PIT 1

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

SOILS PIT - 2

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2198.9' +/-	DEPTH, FT	NOTES
0'		SILTY SAND WITH ORGANICS	1'	
		SANDY SILT.	2.5'	FG EL = 2195.6 3.3' BELOW GRADE
		SLIGHTLY COHESIVE SANDY SILT. DAMP	4.5'	WATERLOGGED WOODY MAT'L 3.5-3.5' DEPTH
5'			7.3'	
		4-6" MINUS GRAVEL/ COBBLE W/ FEW STONES TO 9"	8.3'	WATER AT 7.75' DEPTH
10'		BOTTOM ELEV = 2190.6' +/-		
15'				

8' DEPTH

PIT

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Hood River, OR 97031
541.386.9003
www.interfluve.com

US Bureau of Reclamation
Nason Creek - UWP Subreach 2
Survey: August 27, 2014

SOILS TEST PIT 2

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

SOILS PIT - 3

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2199' +/-	DEPTH, FT	NOTES
0'		SILTY SAND WITH ORGANICS	1.3'	
		FINE-MED SAND	2.6'	
		SLIGHTLY COHESIVE SILTY SAND	3.3'	FG EL = 2194.7 4.3' BELOW GRADE
		FRIABLE MED SAND	4.3'	
5'		SLIGHTLY COHESIVE SILTY SAND	5.6'	
		GRAVEL/COBBLE W/FEW STONES TO 6"		WATER AT 6.8' DEPTH
			9'	
10'		BOTTOM ELEV = 2190' +/-		
15'				

PIT

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Hood River, OR 97031
541.386.9003
www.interfluve.com

US Bureau of Reclamation
Nason Creek - UWP Subreach 2
Survey: August 27, 2014

SOILS TEST PIT 3

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

SOILS PIT - 4

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2194.3' +/-	DEPTH, FT	NOTES
0'		SEE NOTE 1	1'	FG EL = 2192.4 1.9' BELOW GRADE
		SLIGHTLY COHESIVE SILTY SAND	2.3'	
		SANDY GRAVEL	4.3'	WATER AT 2.5' DEPTH
5'		SANDY GRAVEL W/FEW STONES TO 6"	6.7'	
		BOTTOM ELEV = 2187.6' +/-		
10'				
15'				

NOTE:
1 - SLIGHTLY COHESIVE SILTY SAND W/ORGANICS

PIT - PARTIALLY COMPLETED

3.5' DEPTH

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US Bureau of Reclamation
Nason Creek - UWP Subreach 2
Survey: August 27, 2014

SOILS TEST PIT 4

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

SOILS PIT - 5

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2194.6' +/-	DEPTH, FT	NOTES
0'		SILTY SAND WITH ORGANICS	0.8'	FG EL = 2193.5
		SEE NOTE 1	1.6'	1.1' BELOW GRADE
		SLIGHTLY SMALL GRAVELLY SAND	3.8'	
5'		SANDY - SMALL GRAVEL. MATERIAL IS LOOSE - PIT WALLS EASILY COLLAPSE	8'	SEEP AT 3.8' DEPTH
		BOTTOM ELEV = 2186.6' +/-		
10'		NOTE: 1 - SLIGHTLY COHESIVE SILTY SAND		
15'				

PIT

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SOILS TEST PIT 5

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

LEVEE PIT - 1

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2212' +/-	DEPTH, FT	NOTES
0'		0.3' DUFF OVER SILTY SAND	1.3'	
5'		COMPACT SANDY SILT	9.5'	NO WATER OBSERVED
10'		BOTTOM ELEV = 2202.5' +/-		FG EL = 2199.5 12.5' BELOW GRADE
15'				

PIT

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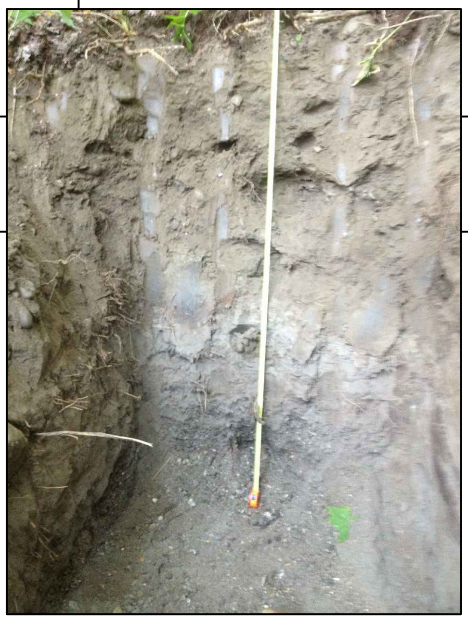
LEVEE TEST PIT 1

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

LEVEE PIT - 2

DEPTH, FT	SYMBOL	DESCRIPTION SURFACE ELEV = 2198.2' +/-	DEPTH, FT	NOTES
0'		SILT AND ORGANICS	0.7'	DRY SOILS. NO WATER OBSERVED. DIFFICULT DIGGING
		COMPACT SILTY SAND	1.8'	
		COMPACT SILTY SAND W/GRAVEL & COBBLE	3.3'	
		COMPACT SILTY SAND	4.4'	
5'		LIGHT COLORED SANDY SILT	5.6'	
		SANDY GRAVEL	6.9'	
		BOTTOM ELEV = 2191.3' +/-		
10'				
15'				



PIT

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Nason Creek - UWP Subreach 2
Survey: August 27, 2014

LEVEE TEST PIT 2

IN: NASON CREEK
NEAR: WENATCHEE RIVER
COUNTY: OKANOGAN STATE: WA
DATE: OCTOBER 2, 2014

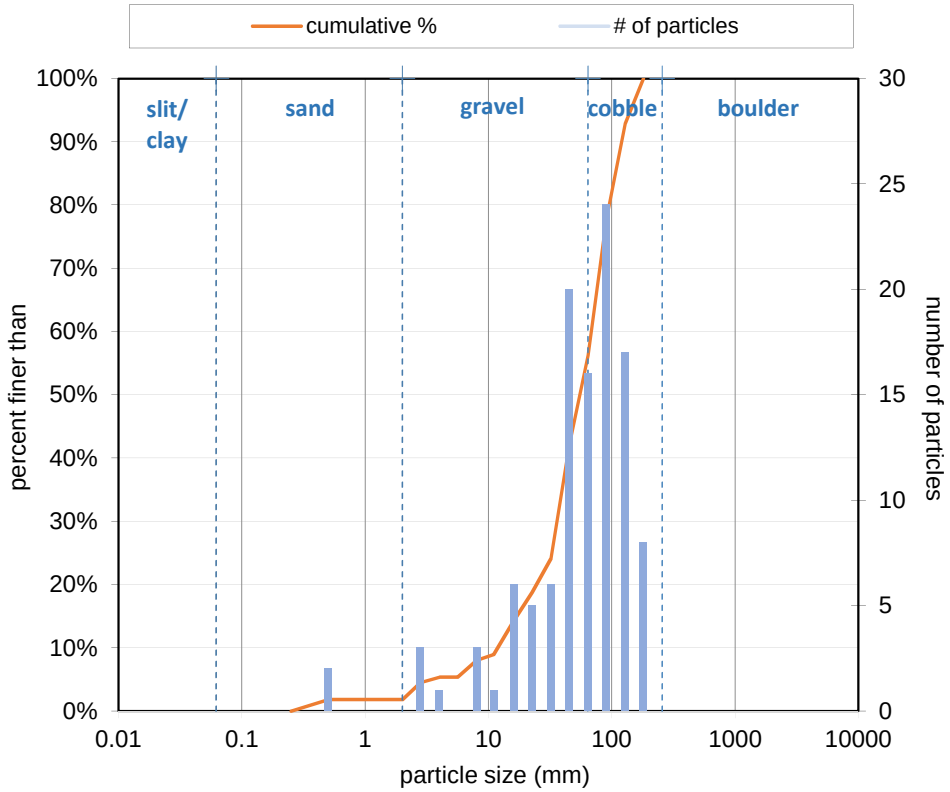
Appendix D: Pebble Counts and Bulk Sample

Pebble count 1 data summary

Counter - R Goetz
Recorder - M Cox
Location - Nason Creek
Project - USBR Nason UWP
Coords -
Date - 9/19/2013

Size class	inches	mm	Type	
D_{16}	0.7	18	silt/clay	0%
D_{35}	1.5	37	sand	2%
D_{50}	2.2	55	gravel	54%
D_{65}	2.9	74	cobble	44%
D_{84}	3.9	100	boulder	0%

Size (mm)	Count
0 - 0.062	
0.062 - 0.125	
0.125 - 0.25	
0.25 - 0.5	2
0.5 - 1	
1 - 2	
2 - 2.8	3
2.8 - 4	1
4 - 5.6	
5.6 - 8	3
8 - 11	1
11 - 16	6
16 - 22.6	5
22.6 - 32	6
32 - 45	20
45 - 64	16
64 - 90	24
90 - 128	17
128 - 180	8
180 - 256	
256 - 362	
362 - 512	
512 - 1024	
1024 - 2048	
2048 - 4096	
Total	**112**
organics	
bedrock	
wood	
clay hardpan	
artificial	
Total	**112**



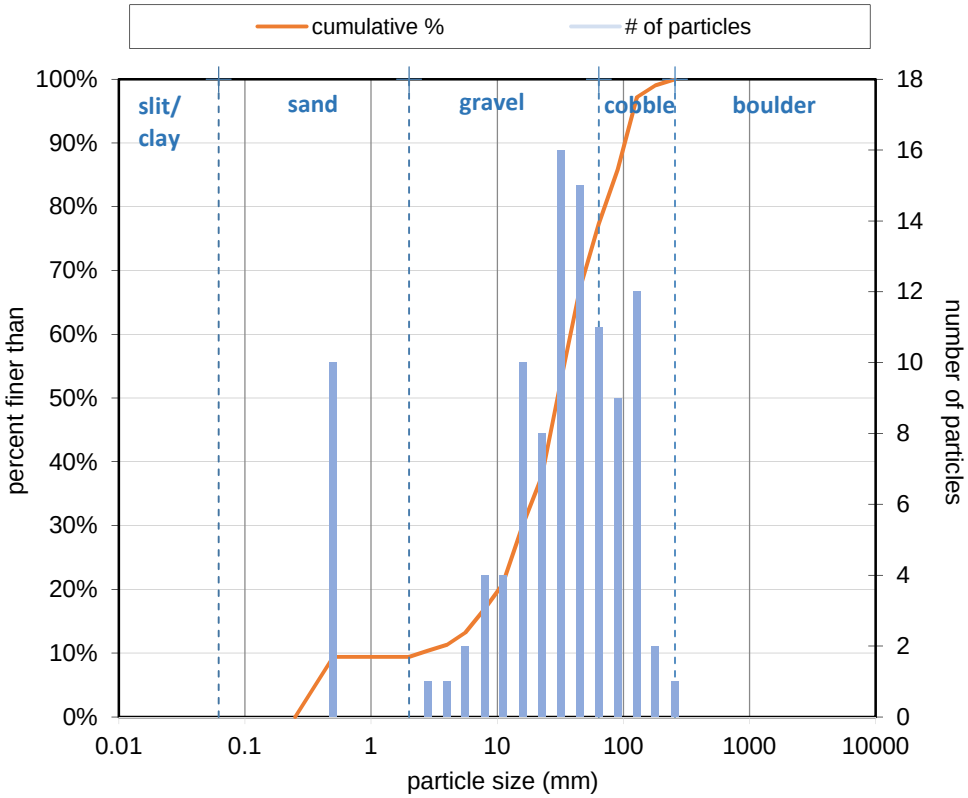
Bankfull Width
Reach Slope
Observations

Pebble count 2 data summary

Counter - M Cox
Recorder - R Goetz
Location - Nason Creek
Project - USBR Nason UWP
Coords -
Date - 9/19/2013

Size class	inches	mm	Type	
D_{16}	0.3	7.3	silt/clay	0%
D_{35}	0.7	17	sand	9%
D_{50}	1.2	30	gravel	68%
D_{65}	1.7	43	cobble	23%
D_{84}	3.3	84	boulder	0%

Size (mm)	Count
0 - 0.062	
0.062 - 0.125	
0.125 - 0.25	
0.25 - 0.5	10
0.5 - 1	
1 - 2	
2 - 2.8	1
2.8 - 4	1
4 - 5.6	2
5.6 - 8	4
8 - 11	4
11 - 16	10
16 - 22.6	8
22.6 - 32	16
32 - 45	15
45 - 64	11
64 - 90	9
90 - 128	12
128 - 180	2
180 - 256	1
256 - 362	
362 - 512	
512 - 1024	
1024 - 2048	
2048 - 4096	
Total	**106**
organics	
bedrock	
wood	
clay hardpan	
artificial	
Total	**106**



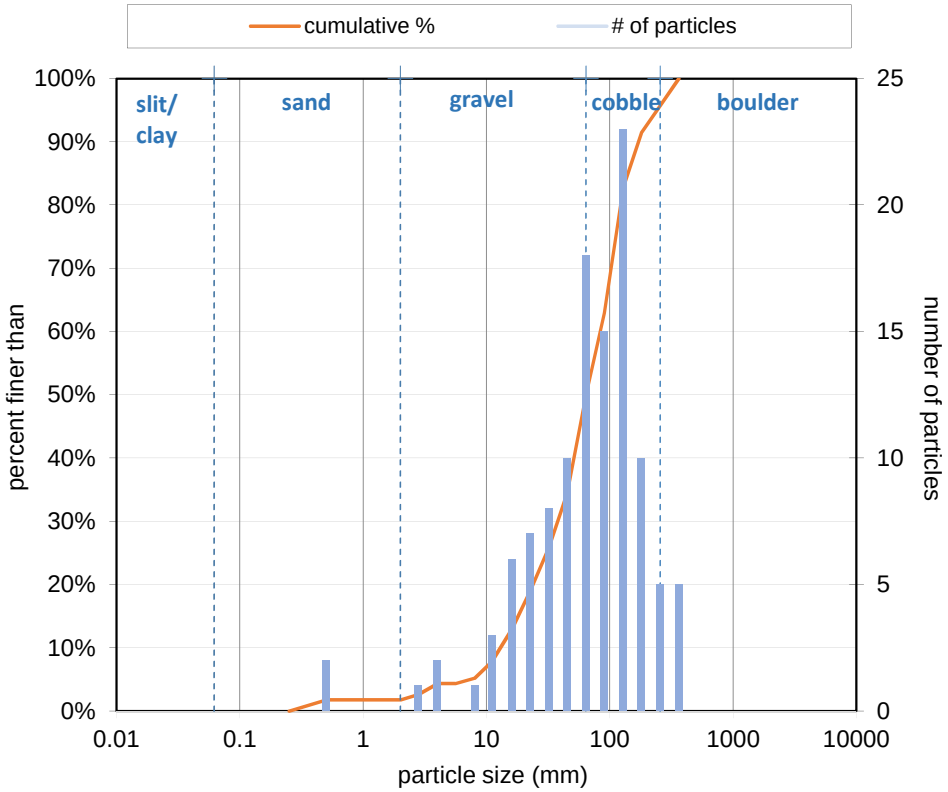
Bankfull Width
Reach Slope
Observations: Bulk sample also

Pebble count 3 data summary

Counter - R Goetz
Recorder - M Cox
Location - Nason Creek
Project - USBR Nason UWP
Coords -
Date - 9/19/2013

Size class	inches	mm	Type	
D_{16}	0.7	19	silt/clay	0%
D_{35}	1.7	43	sand	2%
D_{50}	2.5	64	gravel	48%
D_{65}	3.7	93	cobble	46%
D_{84}	5.1	130	boulder	4%

Size (mm)	Count
0 - 0.062	
0.062 - 0.125	
0.125 - 0.25	
0.25 - 0.5	2
0.5 - 1	
1 - 2	
2 - 2.8	1
2.8 - 4	2
4 - 5.6	
5.6 - 8	1
8 - 11	3
11 - 16	6
16 - 22.6	7
22.6 - 32	8
32 - 45	10
45 - 64	18
64 - 90	15
90 - 128	23
128 - 180	10
180 - 256	5
256 - 362	5
362 - 512	
512 - 1024	
1024 - 2048	
2048 - 4096	
Total	**116**
organics	
bedrock	
wood	
clay hardpan	
artificial	
Total	**116**



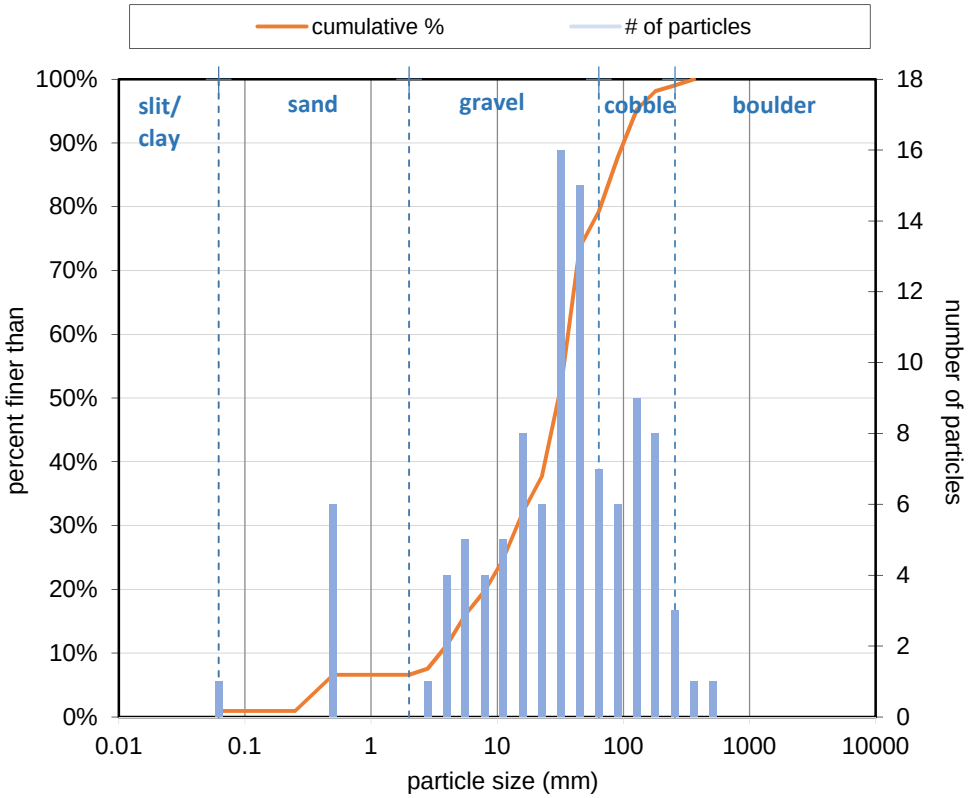
Bankfull Width
Reach Slope
Observations

Pebble count 4 data summary

Counter - M Cox
Recorder - R Goetz
Location - Nason Creek
Project - USBR Nason UWP
Coords -
Date - 9/19/2013

Size class	inches	mm	Type	
D_{16}	0.2	5.6	silt/clay	1%
D_{35}	0.6	16	sand	6%
D_{50}	1.2	31	gravel	73%
D_{65}	1.5	39	cobble	20%
D_{84}	3.0	77	boulder	1%

Size (mm)	Count
0 - 0.062	1
0.062 - 0.125	
0.125 - 0.25	
0.25 - 0.5	6
0.5 - 1	
1 - 2	
2 - 2.8	1
2.8 - 4	4
4 - 5.6	5
5.6 - 8	4
8 - 11	5
11 - 16	8
16 - 22.6	6
22.6 - 32	16
32 - 45	15
45 - 64	7
64 - 90	6
90 - 128	9
128 - 180	8
180 - 256	3
256 - 362	1
362 - 512	1
512 - 1024	
1024 - 2048	
2048 - 4096	
Total	**106**
organics	
bedrock	
wood	
clay hardpan	
artificial	
Total	**106**



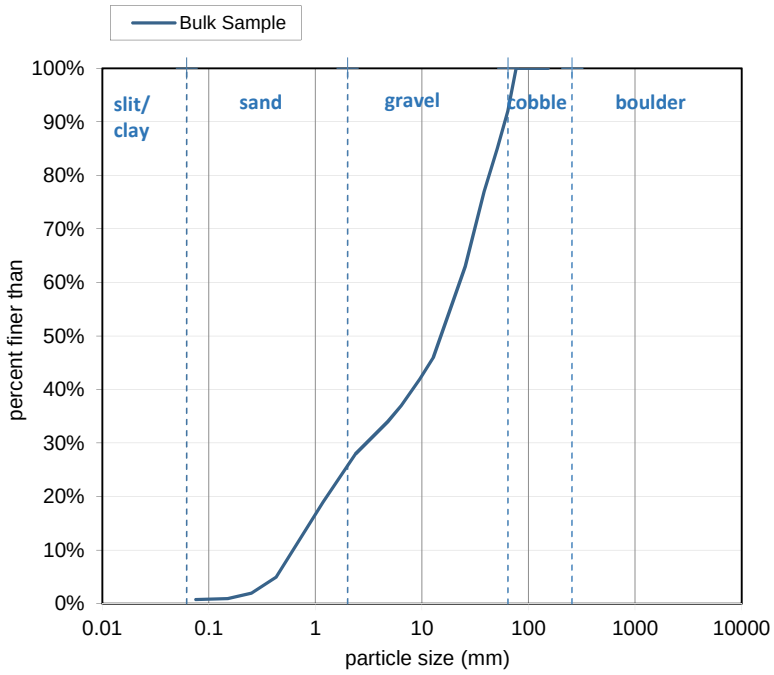
Bankfull Width
Reach Slope
Observations: Bulk sample also

Bulk Sample data summary

Sampler - M Cox, R Goetz
Location - Nason Creek
Project - USBR Nason UWP
Coords -
Date - 9/19/2013

Size class	inches	mm	Type	
D_{16}	0.0	1.0	silt/clay	1%
D_{35}	0.2	5.3	sand	24%
D_{50}	0.6	15.2	gravel	67%
D_{65}	1.1	27.2	cobble	8%
D_{84}	1.9	49.2	boulder	---

Size (mm)				Pf
200	no.	0.075	mm	1%
100	no.	0.15	mm	1%
60	no.	0.25	mm	2%
40	no.	0.425	mm	5%
16	no.	1.18	mm	19%
8	no.	2.36	mm	28%
4	no.	4.75	mm	34%
0.25	in	6.35	mm	37%
0.375	in	9.5	mm	42%
0.5	in	12.7	mm	46%
0.75	in	19.1	mm	56%
1	in	25.4	mm	63%
1.5	in	38.1	mm	77%
2	in	50.8	mm	85%
2.5	in	63.5	mm	92%
3	in	76.2	mm	100%
4	in	101.6	mm	100%
5	in	127	mm	100%
6	in	152	mm	100%



Carlson Testing, Inc.

Bend Office (541) 330-9155
Geotechnical Office (503) 601-8250
Eugene Office (541) 345-0289
Salem Office (503) 589-1252
Tigard Office (503) 684-3460

October 11, 2013
T1309407
Lab Log #13-0772

Inter-Fluve Inc
501 Portway Ave Ste 101
Hood River, OR 97031

RE: INTER-FLUVE INC
UPPER WHITE PINE BEACH 2
SIEVE ANALYSIS TESTING

As requested, Carlson Testing Inc. has completed one (1) sieve analysis test conducted on a sample of River Rock, sampled by your representative on September 19, 2013 from Riverbed and delivered to our Tigard facility on September 24, 2013. Testing was completed on October 8, 2013. Test results are informational only per client's request. Following is the test results:

SIEVE ANALYSIS –ASTM C117 AND ASTM C136:		
SIEVE SIZE	PERCENT PASSING	INFORMATIONAL
6"	100	----
5"	100	----
4"	100	----
3"	100	----
3 1/2"	100	----
3"	100	----
2 1/2"	92	----
2"	85	----
1 1/2"	77	----
1"	63	----
3/4"	56	----
1/2"	46	----
3/8"	42	----
1/4"	37	----
#4	34	----
#8	28	----
#16	19	----
#40	5	----
#60	2	----
#100	1	----
#200	0.8	----

This sample Is informational only.

Our reports pertain to the material tested/inspected only. Information contained herein is not to be reproduced, except in full, without prior authorization from this office. Under all circumstances, the information contained in this report is provided subject to all terms and conditions of CTI's General Conditions in effect at the time this report is prepared. No party other than those to whom CTI has distributed this report shall be entitled to use or rely upon the information contained in this document.

Respectfully submitted,
CARLSON TESTING, INC.

Ty Toller
Laboratory Manager

cs

cc: Inter-Fluve Inc – Dan Miller danmiller@interfluve.com