



Chelan County Natural Resources Department

NASON CREEK RIVER MILE 3.3 – 4.6 FEASIBILITY STUDY

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SR 207 MP 0.5 to 2.1 Feasibility Study: Nason Creek RM 3.3 - 4.65

Introduction

1a. Background Information

Washington State Department of Transportation manages State Route (SR) 207 from Coles Corner to the intersection with Chiwawa Loop Road in Chelan County, Washington (Figure 1, all Figures are included in Appendix A). SR 207 provides access to Lake Wenatchee state park which is one of the most popular state parks in Washington in terms of the number of visitors per year. SR 207 is a two lane rural collector highway with 12 foot wide lanes and 6 foot wide shoulders in the vicinity. The posted speed is 55 MPH with an average annual daily traffic of 2,000 vehicles. The roadway is currently built to accommodate this volume of traffic. The existing 5 year accident history shows 11 recorded accidents resulting in 10 injuries and 1 fatality. SR 207 also serves as the detour route when SR 2 is closed through Tumwater canyon due to inclement weather, road repairs, or an accident. The SR 207 detour connects travelers from Stevens Pass to Leavenworth through Plain via the Beaver Valley road and Chumstick Highway.

SR 207 was previously called the Secondary State Highway 15C (SSH 15C) and it was located on the hillside to the east of its current alignment (Figure 2). It was relocated to its current alignment to accommodate traffic at 60 miles per hour (WSDOT memoranda 1964 a-e). The former alignment is now US Forest Service roads 6603 and 6604.

When the new alignment of SR 207 was constructed, Nason creek was nearly 100 feet away from the highway prism at this location (Figure 3). In November 1995, a flood event on Nason Creek washed out a portion of SR 207 approximately ½ mile north of the intersection with SR 2 at Coles Corner (Milepost 0.36 to 0.40) (Photos 1 and 2, all Photos are included in Appendix B). WSDOT repaired the road bed in 1995 and installed riprap along the banks of Nason Creek (Photo 3). The emergency highway repair was constructed during high-water conditions; therefore, the toe of the slope was not constructed below the potential scour depth. Thus, additional rip rap was added to repair additional scouring along the base of the highway riprap protection. This second repair did not fix the toe of slope or the limited width of the highway shoulder. Thus, in 2011, Washington State Department of Transportation (WSDOT) maintenance crews installed additional riprap to reinforce the toe of slope and slightly expand the width of the bank protection to create a 5-foot wide highway shoulder consistent with highway safety standards (Photo 4). This project also included the installation of four rock barbs to help deflect stream flows away from the highway prism.

The 2011 highway repair was the third repair in the last 10 years. Thus, this stream reach has been nominated for the WSDOT Chronic Environmental Deficiency (CED) program. The CED program evaluates sites along the state highway system where recent, frequent, and chronic maintenance repairs to the state transportation system are causing impacts to fish and fish habitat. In 2002, WSDOT established a partnership with the Washington Department of Fish & Wildlife (WDFW) to move away from the repetitive repair of WSDOT highways and instead, concentrate on

long-term solutions that will optimize the improvements for fish and fish habitat, while also addressing transportation needs.

Currently, SR 207 maintenance repairs have been limited to three repairs near RM 4.6 as described in the previous paragraphs. However, evaluation of geomorphic conditions, aerial photograph review, and active stream channel migration indicate that future road maintenance actions within this reach may require more significant repairs to the SR 207 highway prism. The analysis conducted for this feasibility study predicts that the no action alternative will likely result in a 3,000 foot long straightened stream channel locked against the SR 207 highway prism. Thus, a reach scale solution needs to be developed so that each individual future road maintenance action is not implemented separately resulting in further degradation to fish habitat in Nason Creek.

In March 2010, Chelan County Natural Resources Department (CCNRD) obtained grant funds from EcoTrust to evaluate alternatives to improve fish habitat and reduce stream flow velocities against the SR 207 highway prism near River Mile (RM) 4.6. After reviewing site conditions at RM 4.6, this study was expanded to evaluate reach scale alternatives from RM 3.3 through 4.6 (CCNRD 2011). In addition, US Bureau of Reclamation completed an Assessment of Geomorphic and Ecologic Indicators in Lower Nason Creek (RM 0 – 4.6) (USBR 2011). This report builds upon information from both of those previous reports and it further evaluates the feasibility of a highway relocation alternative by considering six relocation options.

1b. Purpose of Project

The purpose of this project is to develop a long-term solution for maintenance repairs to SR 207 while minimizing the impacts of maintenance on fish habitat. The WSDOT CED program typically develops these long term solutions, however, the CED program has limited funds to develop and implement long term maintenance solutions for all stream reaches throughout the state. Therefore, this feasibility study is being developed by CCNRD in close coordination with WSDOT and the US Forest Service. To date, this work has been funded by salmon recovery dollars because restoring natural stream channel processes, such as floodplain connectivity in Nason Creek, is the highest priority for salmon recovery project implementation in the Wenatchee River basin (UCRTT 2009). Salmon habitat enhancement projects, such as floodplain reconnection in Nason Creek, are partially funded by US Bureau of Reclamation and Bonneville Power Administration to help meet commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NOAA 2008).

The purpose of this feasibility study is to document the development and evaluation of project alternatives to resolve long-term maintenance issues and fish habitat enhancement from RM 3.3 to 4.6 on Nason Creek. The goal is to determine which alternative(s) should be carried forward into a Design Report.

Site Conditions

2a. Description of Existing Site Conditions

The project site is located adjacent to SR 207 approximately 0.5 mile north of the intersection with SR 2 near Coles Corner (Figure 1) (Township 26 North, Range 17 East, and Sections 3, 9, and 16). The study area extends from RM 3.3 to RM 4.65 on Nason Creek and includes the instream conditions in Nason Creek and the 77 acre (100 year) floodplain. SR 207 was realigned to its current location in the 1940's.

At the upstream end of the project corridor, near RM 4.6, Nason Creek makes a 90 degree turn against the highway embankment and flows are redirected downstream along the highway prism (Photo 3). WSDOT installed riprap in this area in 1995 when the highway washed out during a flood. Photo 4 shows the additional riprap and rock barbs installed in 2011. East of SR 207, there is a 12.9 acre floodplain that was disconnected when the highway was relocated in the 1940's.

At RM 4.3, the Bonneville Power Administration (BPA) powerlines cross Nason Creek within the project area. In the mid-1990's, Nason Creek started to form a split channel under the powerlines and significant bank erosion occurred (Photos 5 and 6). Bank erosion has not yet reached SR 207 partially due to the natural log jam that has formed near the entrance to the split channel.

In 2007, CCNRD, in cooperation with WSDOT, installed two 12' diameter culverts under the SR 207 highway prism near RM 3.3 and 4.2 to provide fish access at a historic stream oxbow. This oxbow was formerly the mainstem of Nason Creek that was disconnected in the 1940's during the SR 207 realignment construction (Figure 3).

There are four different utility lines located within the project corridor. The Bonneville Power Administration (BPA) Chief Joseph-Snohomish above ground transmission line that crosses Nason Creek near RM 4.3. BPA has a Memorandum of Understanding (MOU) with the Forest Service to operate transmission lines on the Forest. Chelan Public Utilities District (CPUD) has a double circuit above ground transmission line that is parallel to SR 207. This line splits within the project corridor. The Plain Tap transmission line heads east over the ridge and the Lake Wenatchee transmission line continues north along the SR 207 alignment adjacent to the highway. The Chelan County PUD has a Special Use Permit with the Forest Service to operate a transmission line along SR 207 in the project area. Figure 4 shows the location of overhead powerlines within the project area. There are also two fiber optic lines, Sprint and Frontier, buried in the SR 207 right-of-way.

2b. Geology, Geotechnical, and Geomorphology

There is approximately 1,272 feet of relief within the project area based on US Geological Survey topographic mapping. Nason Creek is at an elevation of approximately 1,930 feet above mean sea level (MSL) and the crest of Natapoc Ridge rises to an elevation of 3,222 feet above MSL.

The Nason Creek drainage is located in the North Cascades physiographic province of Washington. The North Cascades consists of a series of rock assemblages, referred to as "terranes," each having

relatively unique geologic relationships. Each terrane consists of a complex of metamorphic and intrusive rocks, generally late Cretaceous in age in the vicinity of the project area. Terranes have been subsequently buried by Tertiary sedimentary and volcanic deposits, faulted, eroded, and subjected to Pleistocene-aged glacial processes and, locally, volcanic activity.

The terrane in the vicinity of the project area, the Nason Creek terrane, is comprised of metamorphic rocks referred to as the Chiwaukum Schist, consisting of mica schist and amphibolites, which have been intruded by granitic rocks of the Mount Stuart batholith. Following emplacement, the Nason Creek terrane was subsequently uplifted, eroded, and covered by Tertiary sedimentary rocks referred to as the Chumstick Formation. Subsequent uplift and erosion removed much of the younger rock layers in this area, depositing them in the downthrown block of the Chiwaukum Graben, in which the project is located. Where exposed, rock underlying the project area consists of weak and friable sandstone that is referred to as the Nahahum member of the Chumstick Formation (Tabor, et. al 1987). These sediments have been folded, faulted, eroded by glacial advances and large-scale flood events, and covered by receding glacial deposits and the reworking of the glacial deposits by stream action (alluvial deposits), including those within the Nason Creek flood plain and the alluvial fans along the valley walls.

The project area contains the following types of terrain zones: steep upper slopes, headwall areas, coalescing alluvial fans, incised ravines, bluffs, and the Nason Creek floodplain (Figure 5). For a more complete description of each zone, see the geologic engineering report prepared by Ken Neal, November 2011. The description of Zone 1a from the geology report is included here to address WSDOT concerns about potential avalanche debris shedding from the steep upper slopes into the project area.

Zone 1a consists of steep, planar to complex slopes within the channels and headwall areas that bisect the upper portions of Natapoc Ridge. The headwalls are inclined from 80 to locally over 150 percent. Vegetation, where present, is similar to that in Zone I. In the headwall areas where slope movement has been prevalent, the sparse vegetation present consists of local brush.

A variety of surficial processes are affecting the headwall areas and adjacent slopes. The sandstone forming Natapoc Ridge is subject to chemical weathering and freeze-thaw action. The resulting sandy soil is eroded and forms the slope wash covering the planar slopes, or collects within the headwall areas near the ridge crest. During major flood and rain-on-snow events, the accumulated soil, along with other debris, flows down the channels and out onto the fans below (Areas B, C, D, E, G, H, L, and M on Figure 5).

Slope movement, which generally occurs in the form of debris flows and slides, has occurred repeatedly in the headwall areas along Natapoc Ridge. Recent slope movement is visible in Area B on the 1949 air photo, and recurring movement is visible on 1968 photos. Massive slope movement is visible over much of Area E in 1949 and 1966 air photos, and recurrent movements on various segments of Area E are visible in photos taken in 1968, 1973, 1981, 1988, 1992, 1998, 2006, and 2009. Recurring slope movements are visible in portions of Area G on 1966, 1968, 1973, and 1988 air photos. Movements in Area H are visible on 1966 and 1988 air photos. Recurring slope movement is visible in Area L, located along and adjacent to the BPA power lines, in 1966, 1968, 1973, 1992, 1994, 1998,

2006, and 2009 air photos. Slope movement in Area M occurred prior to 1966, no evidence of subsequent movement is visible in more recent photos.

Based on conditions observed on historical aerial photographs and existing site conditions adjacent to the old highway, with the exception of Area E, debris from snow avalanches and other unstable slopes along Natapoc Ridge will not be delivered to or downslope from the proposed location of Alternative 6.

Geotechnical test boring at milepost 0.37 and 0.59 within the SR 207 highway prism confirmed that the existing highway prism consists of fine to coarse silty sand with gravel fill materials to a depth of 12 feet below the highway surface (Nelson 2010). The fill has been armored with large blocks of rock (riprap) to protect the highway against erosion by Nason Creek. Additional geotechnical investigation and sampling will be conducted prior to project design once the proposed project design or alignment has been selected.

The existing stream geomorphology has been characterized by the Lower Nason Assessment of Geomorphic and Ecologic Indicators (USBR 2011). The following text is summarized from pages 27-28 of that report:

From River Mile 2.5 – 4.6 Nason Creek is an artificially confined pool-riffle type system. Bedrock controls the extent of westward lateral channel migration near RM 4.45 and restricts both lateral and vertical channel migration near RM 4.15. The following geomorphic channel changes are estimated to have occurred: (1) the channel length has been reduced by about 2,000 feet, (2) the channel gradient has been increased by about 17 percent, and (3) the channel sinuosity has decreased about 17 percent. Channelization and constraints on lateral channel migration have changed the geomorphology of the channel and have resulted in increased stream power and increased sediment transport capacity. These channel changes have reduced channel-floodplain interactions and may have degraded the long-term physical and ecological processes that create and sustain appropriate habitat complexity, connectivity, and variability.

Project Alternatives

The following six alternatives were evaluated to improve fish habitat and reduce stream flow velocity against the SR 207 road prism:

1. SR 207 Relocation
2. Full channel reconnection – causeway
3. Full channel reconnection - two large bridges
4. Partial channel reconnection - culverts
5. Engineered log jams
6. No action alternative

Alternatives 1 through 5 were considered because they have the potential to reduce erosive force along the highway embankment while improving fish habitat. Alternatives 1 through 4 benefit salmonids by providing off-channel habitat, high flow refugia, and an improved surface water

connection to the floodplain. Alternative 1 is the only alternative that restores over 70 acres of floodplain connection and the channel migration zone between Nason Creek and the adjacent floodplain by removing the SR 207 highway embankment prism. Alternative 5 could be implemented as a stand-alone project or in combination with Alternatives 2 through 4. Alternative 5 was developed as an alternative method for hardening SR 207 with additional riprap. Alternative 5 would be difficult to fund using salmon recovery dollars because most funding sources will not fund bank stabilization projects that limit future channel migration. Each alternative and the six road relocation options within Alternative 1 are further described below.

3a. Alternative 1 SR 207 Relocation Options

Alternative 1 proposes to relocate approximately 1.6 miles of existing SR 207 outside of the floodplain. This would reconnect up to 77 acres of floodplain habitat consisting of 12.9 acres near RM 4.6, 9.8 acres of existing roadway embankment fill in the floodplain, and 54.4 acres that is partially connected to Nason Creek by the culverts installed in 2007.

Currently, the SR 207 highway prism confines flows in Nason Creek to the existing channel. When high flow events cannot spread out into the floodplain, the stream channel confinement results in increased stream velocities, and increased bed and bank scour. The existing SR 207 highway embankment is overtopped during the 100-year flood event.

Removal of the existing highway embankment would restore up to 77 acres of floodplain function by removing the structure that is currently confining the stream channel and limiting floodplain connection. Removal of floodplain constrictions allows lateral stream migration, increases stream channel length, increases channel habitat diversity, and maintains large woody debris and gravel recruitment processes. During high flow events, the unconfined stream channel will send water flowing on the adjacent floodplain. As water flows on the floodplain, vegetation slows streamflow velocities and fine grained sediments deposit on the floodplain, providing useful nutrient enriched soil for the riparian and wetland vegetation, while also reducing fine grained soils from depositing in the gravel streambed material used for salmonid spawning.

This alternative would address the channel stability and habitat diversity limiting factors identified in Nason Creek. SR 207 relocation would provide channel connectivity to the floodplain, off-channel habitat, and allow for natural channel reconfiguration. It would reconnect natural stream processes in 77 acres of floodplain (54.4 acres is already partially hydrologically connected and allows for fish passage and off-channel habitat). The relocation would provide an estimated 1.5 miles of additional stream channel length and improve instream conditions in over 1.1 miles of the mainstem. These actions are key to the implementation of the Upper Columbia Spring Chinook Salmon and Steelhead Salmon Recovery Plan (UCSRB 2007). Adding 1.5 miles of stream length achieves 75% of the long term goal for adding 2 miles of stream length in Nason Creek. In addition, reconnecting 77 acres of floodplain in lower Nason Creek would restore 58% of the disconnected floodplain (132 acres) in the lower 4 miles of Nason Creek.

Relocating the highway will meet WSDOT and AASHTO safety design standards for Federal and State Highway with travel speeds of 60 miles per hour (mph). Thus, all of the highway realignment options described in this report meet the Federal and State geometric standards (for grade changes and curvature). All alignments will have an average 60 foot road width that includes two 12 foot

wide travel lanes, two 6 foot wide shoulders, and sufficient area for fill and cut slopes to accommodate future highway maintenance. Thus, for planning purposes, the road ROW has been assumed as 100' wide on average to accommodate areas where the cut or fill slope is wider and to allow for sufficient clearing to meet safety standards for sight distance visibility. The actual width may vary depending upon the final cut and fill design slope requirements, sight distances, and ROW negotiations between USFS and WSDOT.

Table 1 provides an overview of the six highway re-alignment options. Tables 2-7 include cost estimates for each of the road relocation options. Cost estimates were based upon recent estimates from constructed projects are provided in 2011 dollars. At the bottom of each table, there is an estimated increase in cost for future years. All cost estimates include removal of the existing highway embankment and some amount of follow up soil stabilization. Any stream restoration work proposed beyond that would be in addition to the costs outlined. This way, the road alignments can be compared to each other irrespective of the costs of various stream restoration alternatives that might be developed as this project progresses.

The majority of the road relocation occurs on USFS property (Table 1), however, a portion of each alignment crosses private property. Options 1 through 6 provide two different possible alignments near the southern junction with SR 207. One crosses private property and the other fills a portion of the floodplain wetland. Either of these alignments could be paired with any of the six highway realignment options.

The highway re-alignments will require some utility relocation. For example, all of the road relocation options considered would require splicing and relocating both fiber optic lines, Sprint and Frontier, in the new highway prism. All of the highway relocation options would require relocating the CPUD Lake Wenatchee transmission line to the new highway alignment. Some of the highway relocation options may require partial or full relocation of the CPUD Plain Tap transmission line; those details would be worked out in subsequent design stages.

Hydrologic and hydraulic modeling of the 2-year, 100-year, and the anticipated shear forces were also completed to analyze the benefits of highway relocation. The hydraulic modeling utilized a two-dimensional (2D) hydraulic model. This type of model was selected because it is able to simulate the complex flow conditions within the study reach. Specifically, a 2D model is able to simulate flow splits and flow changing directions to follow different paths in the main channel and the floodplain. A 2D model is also able to identify variable flow velocities within a homogeneous conveyance area (e.g., main channel, floodplain) and display the results in plan view for easy interpretation. The 2Dmodel software used for this analysis was SRH-2D version 2.2, a public domain software program developed and maintained by the Bureau of Reclamation, that uses a finite-volume method to solve the 2D depth-averaged dynamic wave equations (i.e., St. Venant equations). SRH-2D provides a robust and stable solution method to the 2D equations, allowing wetting and drying of mesh cells and use of an unstructured arbitrarily-shaped mesh. The input mesh for the SRH-2D model was created using SMS v10.1 software, and the model output was also post-processed with SMS. Ground geometry and channel bathymetry for the model mesh were obtained from a combination of LiDAR data (Reclamation, 2006) and multiple topographic surveys conducted with traditional ground survey equipment. Mesh roughness coefficients were established based on site inspections and aerial photograph interpretation. There was insufficient data available

to fully calibrate the 2D model, however, observed water surface elevations were used to validate the model results were appropriate for the analysis. Figures 6 through 9 provide a graphical depiction of some of the modeling results; additional modeling results are available upon request.

SR 207 relocation Option #1

Option #1 (Figures 10-11) is 9804 feet long and travels along the eastern edge of the existing floodplain and wetland area. The maximum elevation gain is a 1.76 % slope that extends for a couple hundred feet. This option would require approximately 4.5 acres of wetland fill plus 4.0 acres of indirect floodplain wetland impact (ie. disconnection). Thus, this option would re-connect approximately 68.4 acres of floodplain to Nason Creek. Option #1 would require re-location of one BPA tower.

SR 207 relocation Option #2

Option #2 (Figures 12-13) is 8,800 feet long and travels along the east edge of the existing floodplain and wetland area. The maximum elevation gain is a 3.85% slope that extends for approximately 1000 feet. This option would require approximately 1.45 acres of wetland fill plus a small amount of indirect floodplain wetland impact. This option depicts an alignment that minimizes floodplain and wetland fill while also minimizing elevation gain. This option would re-connect approximately 75.55 acres of floodplain to Nason Creek.

SR 207 relocation Option #3

Option #3 (Figures 14-15) is 7,350 feet long and travels along the western edge of the topographic bench above the floodplain. The maximum elevation gain is a 4.00% slope that extends for approximately 1000 feet. This option would require approximately 2 acres of wetland fill and 3.5 acres of indirect floodplain wetland impact. This option would re-connect approximately 71.5 acres of floodplain to Nason Creek.

SR 207 relocation Option #4

Option #4 (Figures 16-17) is 9,996 feet long and travels along the eastern edge of the topographic bench above the floodplain. The maximum elevation gain is a 4.00 % slope that extends for approximately 1000 feet. This option would require approximately 2.3 acres of wetland fill plus a small amount of indirect floodplain wetland impact. This option would re-connect approximately 74.7 acres of floodplain to Nason Creek.

SR 207 relocation Option #5

Option #5 (Figures 18-19) is 9,950 feet long and follows the historic SR 207 alignment from approximately Station 25+00 to 60+00. The maximum elevation gain is a 4.00 % slope that extends for approximately 1000 feet. This option avoids floodplain wetland fill however, it has the largest encroachment on the private property located at the north end of the floodplain reconnection area. This option would re-connect approximately 77 acres of floodplain to Nason Creek.

SR 207 relocation Option #6

Option #6 (Figures 20-21) is 13,300 feet long and follows the pre-1940's SR 207 alignment from approximately Station 25+00 to 80+00. The maximum elevation gain is a 4.01 % slope for over 2000 feet. This option crosses a ravine so there will be a bridge designed to span the ravine near station 75+00. This option avoids floodplain/wetland fill; however, it is the longest alignment, so it will cost more to construct. It crosses private property which is currently a managed forest. This option would re-connect approximately 77 acres of floodplain to Nason Creek.

3b. Instream Alternatives

Alternative 2 Causeway

Alternative 2 (Figure 22) proposes to replace a segment of the SR 207 road prism with a causeway which is an 1800' long and 36' wide bridge supported by concrete piers. Final design would determine the number of piers and placement. However, the minimal distance between piers would be one stream channel width. This would allow future channel migration and minimize the influence on large woody debris transport by the creek if lateral channel migration did occur. This structure would allow the Nason Creek main channel to migrate under the bridge and would reconnect the main channel to the floodplain in the 100-year flood event. It is unlikely that the Creek would avulse beyond the length of the structure because there is a natural topographic high area just downstream of where the causeway ties back into SR 207. The life expectancy of this structure is comparable to that of a typical WSDOT bridge which is 75 to 100 years. Causeway construction would take a few years so it would require construction of a detour route for local access.

Design and construction costs are estimated at \$13 million. This cost is based upon recent costs for the WSDOT construction of a causeway at Gold Creek on Interstate 90 and other similar bridge projects using the cost per square foot of bridge deck as the unit basis.

The biological benefits and consistency with the Recovery Plan (UCSRB 2007) are similar to those described above for the SR 207 relocation because this alternative restores the hydrologic connection between Nason Creek and the floodplain. However, in contrast to Alternative 1, the transportation infrastructure remains in the floodplain and this alternative only reconnects 12.9 acres of floodplain rather than 77 acres. The causeway would require more ongoing maintenance than a standard highway section and it might alter large wood accumulation and sediment deposition processes in lower Nason Creek. An additional benefit of this alternative is that the causeway would improve terrestrial wildlife migration through this area by allowing wildlife to pass under the travel lanes instead of crossing the road, which is expected to reduce wildlife mortality from vehicle strikes, damage to vehicles, and possible personal injuries.

Alternative 3 Full channel/floodplain reconnection – Bridges

Alternative 3 (Figure 23) proposes to reconnect hydrologic processes in Nason Creek to the adjacent floodplain by installing bridges near the existing upstream and downstream culvert connections. Each bridge would be approximately 200 feet long and 36 feet wide.

The bridges would provide a hydrologic connection between Nason Creek and the adjacent 13 acres of floodplain area, but would not allow the main channel to migrate beyond the road prism. There may be ongoing maintenance costs to control the flow distribution. The bridges and foundation excavation associated with their construction would not artificially create a channel with a year round surface water connection because it appears that this type of feature did not exist in this location in the recent past. Thus, limited excavation is proposed in the floodplain area. The upstream portion of the floodplain is currently forested and dominated by native species. A small amount of excavation would be proposed near the upstream bridge to create a high flow channel with a bed elevation of 1957 feet NAVD88 in the upstream portion of the floodplain. This channel would be activated during the 2-year flood event and the floodplain would have a surface water connection to Nason Creek for all flows equal to or greater than the 2-year event. For example, during the 2-year flood event, there would be a floodplain channel ranging in width from 20 to 50 feet with about 100 cfs flowing about 2.5 feet deep. During the 10-year event, about 500 cfs would flow through the floodplain channel with a depth of about 4 feet. At the levels of a 100-year event, about 1,000 cfs would flow through the floodplain channel with a depth of about 5 feet.

Additional stream channel excavation could be proposed at the downstream end of the floodplain because groundwater data collected in 2010 documented a high groundwater table in this area that would support a backwater channel. Taking advantage of an existing opening in the forest canopy, excavation in the downstream portion of the floodplain area would create a 0.9 acre area with an extended period of surface water connection to Nason Creek. The primary function of this excavation would be to provide high flow refugia and off-channel habitat for rearing Spring Chinook and steelhead.

The location of the downstream connection would be shifted slightly downstream from the existing connection. The existing channel located west of SR 207 that connects the 48" diameter culvert to Nason Creek outlets onto a gravel bar. This limits the duration of the surface water connection between Nason Creek and the downstream portion of the floodplain area when stream flows drop below the elevation of the gravel bar. Because of the high groundwater table in the floodplain, the duration of the surface water connection between Nason Creek and the floodplain would be increased by moving the connection slightly downstream to connect to a deep pool in Nason Creek. The proposed connection was located so it would not require tree removal in the riparian area.

The estimated cost for design and construction of two bridges is \$5,720,000. This cost estimate is based upon an average cost per area of bridge deck from the recent WSDOT bridge replacement for SR 2 over the Chiwaukum. For a bridge of this size, when all factors of the construction project are lumped together (e.g., mobilization, excavation, detour route, structure construction, site restoration, etc.) the total cost averages about \$250 per square foot of bridge deck constructed. This average cost can vary with site conditions, and can vary from year to year due to economic conditions affecting the construction industry.

This alternative connects surface water flows in Nason Creek to the floodplain at the 2-year flood event and anything greater. This alternative also creates off-channel habitat and high flow refugia for rearing spring Chinook and steelhead. This alternative does not allow natural stream channel

migration processes to occur because it does not remove the infrastructure confining the stream channel to its current location. Thus, it provides limited reduction in stream channel flow velocity and resulting scour during high flow events. Table 8 summarizes the changes in channel bed shear forces with the installation of two bridges; there is limited change in shear forces following installation of the bridges.

Alternative 4 Partial channel/floodplain reconnection – Culverts

Alternative 4 (Figure 24) proposes the installation of upstream and downstream (Alternative 4a and 4b) or downstream only (Alternative 4a) culvert connections between the floodplain and Nason Creek. Installation of upstream and downstream culverts would create a flow-through channel in the floodplain that is connected to Nason Creek during any flood event exceeding the 2-year flood event. Installing one culvert at the downstream end would provide a 0.9 acre off-channel backwater feature with surface water ponding. This would provide off-channel habitat and high flow refugia for rearing Spring Chinook and steelhead.

The height of the SR 207 highway surface was used to develop the sizes for the culvert connections. Either a 10' diameter corrugated metal pipe (CMP) or 30' diameter box culvert would provide sufficient cover to meet the depth of backfill required by WSDOT on top of each structure, and these structures would be designed to meet WDFW fish passage criteria.

During the 2-year flood event, the culvert would convey about 100 cfs through a floodplain channel, and flows would be about 2 feet deep and 20 to 50 feet wide. For the 10-year event, about 200 cfs would flow through the floodplain channel with a depth of about 3 feet. During the 100-year event, about 300 cfs would flow through the floodplain channel with water a depth slightly more than 3 feet. The location of the culvert connections and associated floodplain excavation is similar for Alternatives 3 and 4.

The cost of installing one 10' CMP (downstream connection only) is approximately \$425,000 and to install two 10' CMP (one at the upstream and one at the downstream) would be approximately \$600,000. The cost of installing one 30' box culvert is approximately \$600,000 and to install two 30' box culverts would be approximately \$800,000. There are cost savings to install two culverts due to the overlap in the design, permitting, contractor mobilization costs, and construction management.

The biological benefits of Alternatives 3 and 4 are similar, however, these alternatives vary in the size of the conveyance structure (10' diameter, 30' diameter, and 200' span). Fish biologists typically prefer larger openings because they allow for more light to enter beneath the structure and larger structures have lower flow velocities inside the structure (compared to similar length smaller diameter structures) during high flow events. For these reasons, fish may be more likely to use larger structures. The diameters (and associated installation criteria) of all three structures would be designed to meet WDFW fish passage criteria (2003) and they would be installed with a similar bed slope and an open bottom configuration designed to mimic stream bed materials. Another consideration is that the 200' span bridges in Alternative 3 would allow for greater floodplain excavation to occur than has been assumed for this assessment and possibly greater associated floodplain flow conveyance if this was determined to be desirable during final design, whereas the culverts are limited to the capacity identified in this Alternative 4 assessment. Larger conveyance

openings might also allow the structures to be used for wildlife and other animal crossings which reduces vehicle strikes, wildlife injury, and personal injury. Installation of the downstream only culvert (Alternative 4a) would not allow flood event flows through the floodplain. Alternatives 1 - 4 provide off-channel habitat and high flow refugia for rearing Spring Chinook and steelhead.

Alternative 5 Installation of large wood

Alternative 5 (Figures 25 and 26) proposes the installation of large wood structures at the upstream and/or downstream ends of the project area. Large wood installation could be implemented in addition to Alternatives 2, 3, or 4 or as a stand-alone project. Figure 25 depicts approximately 165 logs in 5 engineered log jams. Figure 26 shows approximately 48 logs in 2 to 3 log jams plus piles to anchor existing pieces of large wood in the stream. The number of logs, log jams and exact log placement might vary in the final design plans.

The intent of the upstream log structures is to use wood to deflect flows away from the SR 207 road prism and create a zone of low flow velocity along the edge of the channel. Installation of large wood structures could occur with or without the gravel bar removal shown in Figure 25. The elevation of the gravel bar opposite from the rip rap bank is currently at the 10-year flood elevation. Material removed from the gravel bar would remain in the stream and most of it would be used to cover/anchor the large wood structures.

The intent of the downstream log structures is to use wood to maintain stream flows through both channels of the bifurcated stream alignment. In other words, the logs installed would help deflect a large portion of the flow during high flow events away from the highway prism so that the majority of the flow stays in the meandering main stream channel instead of capturing the straight channel that has recently formed adjacent to the SR 207 highway prism. The large wood installed would maintain existing low flows in both stream channels. A buried revetment would likely be installed to prevent channel capture in the event of a log jam failure.

The cost of the upstream large wood structures is approximately \$200,000 and the cost of the downstream large wood structures is approximately \$150,000. Costs do not include engineering design and permitting and would vary with final design.

3c. No action alternative

Alternative 6, the no action alternative, proposes no actions at the site. Without any actions on site, stream channel confinement will influence the stream channel migration processes. Stream channel migration on site is likely occurring as a natural process due to the site location within the reach (at the junction of channel bed slope change), however, it is also exacerbated by channel confinement. As shown in Figure 27, there has been approximately 40 feet of erosion that has occurred just downstream of the riprap between 2006 and 2010. Channel migration has been episodic so the longer term average is closer to 2 feet per year measured from 1973 – 2011.

Downstream channel migration will likely continue and lead to placement of more riprap for protection of the highway prism. In addition, if the large wood is removed from under the BPA powerlines or if high flows cause the mainstem to capture the secondary channel that recently

formed under the BPA powerlines, then Nason Creek could become a 3,000 foot long straightened channel adjacent to the SR 207 road prism from RM 4.6 to 3.85 (Figure 28). This will result in the loss of approximately 0.15 miles of stream channel length, stream sinuosity, habitat complexity, and riparian vegetation. There is no way to estimate the amount of time that it might take for these processes to occur. The log jam that has formed at the upstream end of the bifurcated channel is likely slowing the current stream channel migration processes. If the main channel migrates to the straightened alignment adjacent to SR 207, erosion of the highway prism will likely occur as it has in other locations, and riprap bank protection would likely be placed throughout the riparian area to protect the highway. The channel may re-meander to achieve a new equilibrium or it may stay in a straightened alignment with channel incision.

Alternatives Analysis

4a. Review Process for incorporating landowner and stakeholder input

Chelan County Natural Resources Department (CCNRD) has been working with landowners and stakeholders to develop and review the proposed project alternatives. Table 9 summarizes stakeholder review and input obtained from the February 2011 alternatives analysis.

During 2011, CCNRD had initial meetings with four private landowners who might be directly impacted by the highway re-alignment. If the highway re-alignment option is selected, there would need to be additional contact with each landowner impacted to determine the feasibility of specific alignments. In addition, part of the NEPA process to select the proposed alternative would involve community meetings to evaluate potential direct and indirect project impacts to the community.

During 2011, CCNRD hosted meetings and site visits with several WSDOT and USFS staff. The meeting dates, meeting attendees, and topics discussed are summarized in Table 10. US Forest Service prepared a technical report that evaluated the impacts of the six road relocation options to forest resources (USFS 2011). The findings are summarized in the next section of this report.

4b. Evaluation Criteria

Evaluation criteria were developed for this project to analyze the selected alternatives based upon further analysis and review. The criteria were used by the project team to assess and evaluate the six project alternatives and the highway relocation options. The criteria are divided into five main categories with the following sub-categories:

1. Design standards and maintenance
 - a. Does the project meet AASHTO design safety standards?
 - b. Grade changes
 - c. Maintenance
 - i. Future maintenance costs

- ii. Future maintenance impacts to fish habitat
 - iii. Potential for erosion of highway prism
 - d. Constructability
 - i. Utility relocation
 - ii. Detour and impacts to the traveling public
 - e. Geologic hazards
 - f. Snow-avalanche hazards
- 2. Cost
- 3. Natural environment
 - a. Biological benefit to fish habitat
 - b. Wetland/floodplain impacts
 - c. Floodplain connectivity
- 4. Meets project objectives
 - a. Travel safety
 - b. Reduce current and future road maintenance impacts to fish habitat
 - c. Restoration of natural stream channel processes (floodplain connectivity)
- 5. Landowner willingness
 - a. Public
 - b. Private

4c. Summary of Alternatives

Table 11 describes the parameters for the evaluation criteria. Table 12 assigns a score for each project alternative. As summarized in Table 12, all design alternatives meet AASHTO design and safety standards, however, evaluation of the highway relocation options requires a closer evaluation of the different options in order to determine whether or not that alternative meets project objectives. Table 13 summarizes the highway relocation options. All highway relocation options meet the project objectives, however, Alternatives 1 through 4 do not completely eliminate potential erosion of the highway prism, encroachment of the roadway into the channel migration zone, and future road maintenance impacts to fish (Figure 9).

4d. Geologic Evaluation of Road Relocation Options

The 2011 report by engineering geologist Ken Neal summarizes the terrain characteristics, construction methods, likely impacts of highway construction, and potential mitigation alternatives for each highway relocation option. The following text is excerpted from the conclusions of that report:

Optional locations are being considered as alternatives to the existing alignment of SR 207 to allow for channel migration across the entire Nason Creek flood plain, improving fish habitat. A secondary objective is to provide a stable highway location that is not periodically damaged by stream flow, particularly during flood events.

Option 1 does not appear to meet these objectives, as the location follows along the channel Nason Creek occupied prior to construction along the existing alignment, which means that, during high flow, the new location would be subject to erosional forces similar to the existing fill. The earthwork along the base of the bluff required by Option 1 would likely destabilize the bluff, increasing the financial impact to agencies responsible for road maintenance.

Options 2, 3, and 4 all would require deep excavations into the alluvial fans and through the bluff, as well as construction of bridges across the old channel and, possibly, fill embankments within the flood plain. These options would all, without significant mitigation, likely destabilize slopes along and adjacent to the bluff. These options would also cross a significant part of Parcel 261709110050.

Option 5 would likely result in the fewest impacts on geomorphic processes, since it avoids the Nason Creek channel area and, for much of its length, crosses relatively gentle slopes. Option 5 would also cross a significant part of Parcel 261709110050.

Option 6 avoids areas of potential slope movement and the Nason Creek drainage, however, it is significantly longer than any of the other alternatives, requiring much more removal of vegetation, earthwork, and modification of drainage patterns.

4e. US Forest Service Evaluation of Road Relocation Options

US Forest Service Staff evaluated the road relocation options to determine consistency with management direction in the Northwest Forest Plan as well as land and resource management plan allocations. Their report evaluated soils and hydrology, fisheries and aquatics, wildlife, botany, fire/fuels, vegetation management, scenery, cultural, recreation, special uses, engineering, and scoping and public affairs. The following text summarizes some of the conclusions in this technical report:

The proposed realignment of SR 207 has the potential to provide a long-term solution for maintenance to SR 207 while minimizing the impacts of maintenance on fish habitat. With implementation of the No Action Alternative, current on-site conditions will continue. Typical stream activity paired with high water events poses the risk of further washouts and failures to SR 207, which would result in the need for future repairs to the existing highway segment.

Riparian and floodplain function would continue to be impaired in lower Nason Creek (below RM 5.0), negatively affecting water quality and habitat diversity for threatened, endangered, and native fish communities in the Nason watershed. Protection and maintenance of SR 207 in its current location may have negative direct effects to fish species and habitat.

Most relocation options would be an improvement over the existing condition, however some alignment options would continue to impact riparian and floodplain function to varying degrees and may not be consistent with Forest Plan Standards and Guidelines. For example, Options 1–4 would directly impact riparian and floodplain/wetland function and would not be consistent with the Aquatic Conservation Strategy objectives or Northwest Forest Plan standards, primarily standard *RF-2g. – Avoid wetlands entirely when constructing new roads.* Option 5 or 6 would be the preferred option from a fisheries/aquatic perspective. These options fully realize the Desired Future Condition for

Nason Creek to *Improve Aquatic Conservation Strategy objectives at the watershed scale by functionally connecting Nason Creek to its floodplain*; Options 1-4 do not.

All of the USFS technical report conclusions are not included in this report, however, the key statements were summarized above and several resources would require additional survey and/or mitigation requirements once an alignment was selected. For example, the following text outlines the fire/fuels and cultural resources conclusions:

While re-alignment increases the likelihood of unplanned anthropogenic ignitions propagating along the lower third of Natapoc Mountain, mitigation measures could alleviate these concerns to an acceptable level. An additional component of re-alignment 6 would be the inclusion of the fuels treatments proposed while providing response access behind (downwind/upslope) the subdivision off of Conard road.

The proposed project area is located within an area that is considered a high cultural resources site probability area. Implementation of any of Options 1 through 6 would result in significant ground disturbance. As such, Alternative 6 has the greatest potential to impact cultural resources. The proposed decommissioning of a portion of SR 207 and new construction alternatives would require a cultural resource inventory including at a minimum documentation of a portion of SR 207, block survey of the proposed area of effect, and subsurface testing.

A complete NEPA document and concurrent public outreach effort would be required to select a preferred alternative for this project. The 2011 USFS report outlines future NEPA analysis and reporting requirements.

4f. WSDOT Evaluation of Road Relocation Options

At this time, the WSDOT prefers the lower bench routes, Alternatives 1-4 because of the lower road grade and the potential for avalanche conditions associated with Alternatives 5 or 6. Mike Stanford, WSDOT North Central Region Avalanche Forecaster and Avalanche Control Supervisor evaluated the project area and provided the following input:

Option six and to a lesser extent option 5 could have potential avalanche problems affecting them at some point. Given that the risk is low due to the location east of the crest and that the area does not receive huge amounts of snow, there is evidence that snow slides have occurred here and could potentially affect the road if conditions were just right.

Mike also reviewed the Geology report by Ken Neal and commented that the 1,600 foot long full-bench build associated with Option 6 may create an avalanche problem because the slope angle is 30+ degrees and the upper elevations consist of big open timberland.

There may be ways to mitigate potential avalanche and landslide conditions with final design, however, there would need to be upper level management support, adequate funding, and legislative direction for WSDOT staff to work on SR 207 relocation.

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- Washington State Highway Commission, Department of Highways, 1964b, C.S. 0430 SSH 15-C (SR 207) L-2719 Lake Wenatchee to Coles Corner, Sta. 11+00 to STA. 186+41.10 BK. = Sta. 3+50.2 ahead to Station 49+67.25: letter report, written to Mr. G.E. Mattoon, District Engineer, by C.E. Prahl, P.E., Director of Highways, and Carl E. Minor, P.E., Materials and Research Engineer, dated September 10, 1964, 2 p with attachments and enclosures.
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Appendix A: Figures

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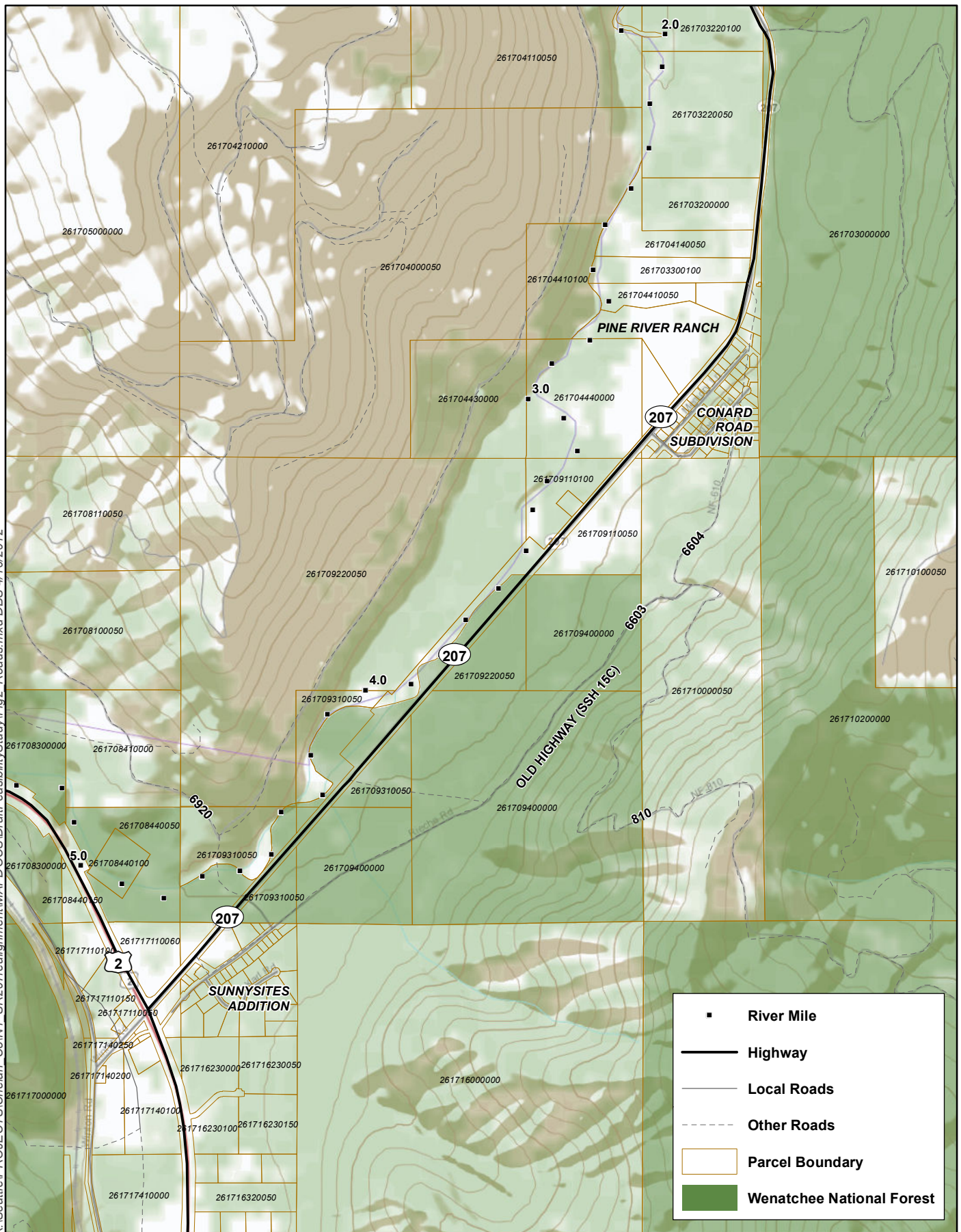
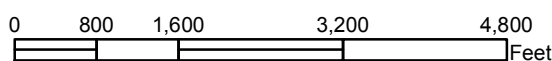
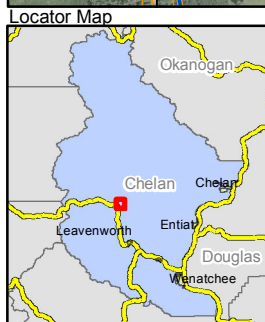
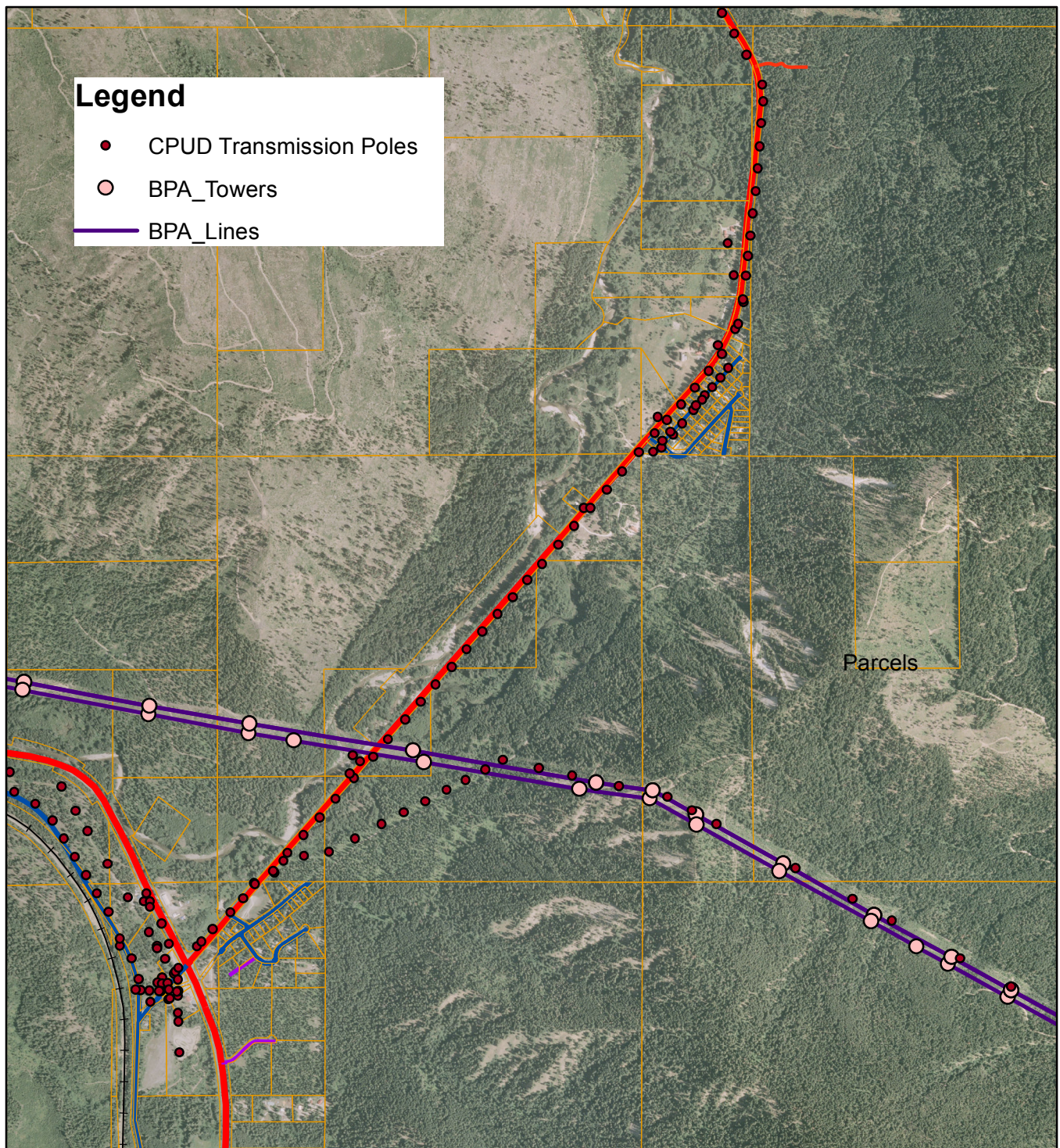


Figure 4 Powerlines in the SR 207 Nason Creek Feasibility Study Area



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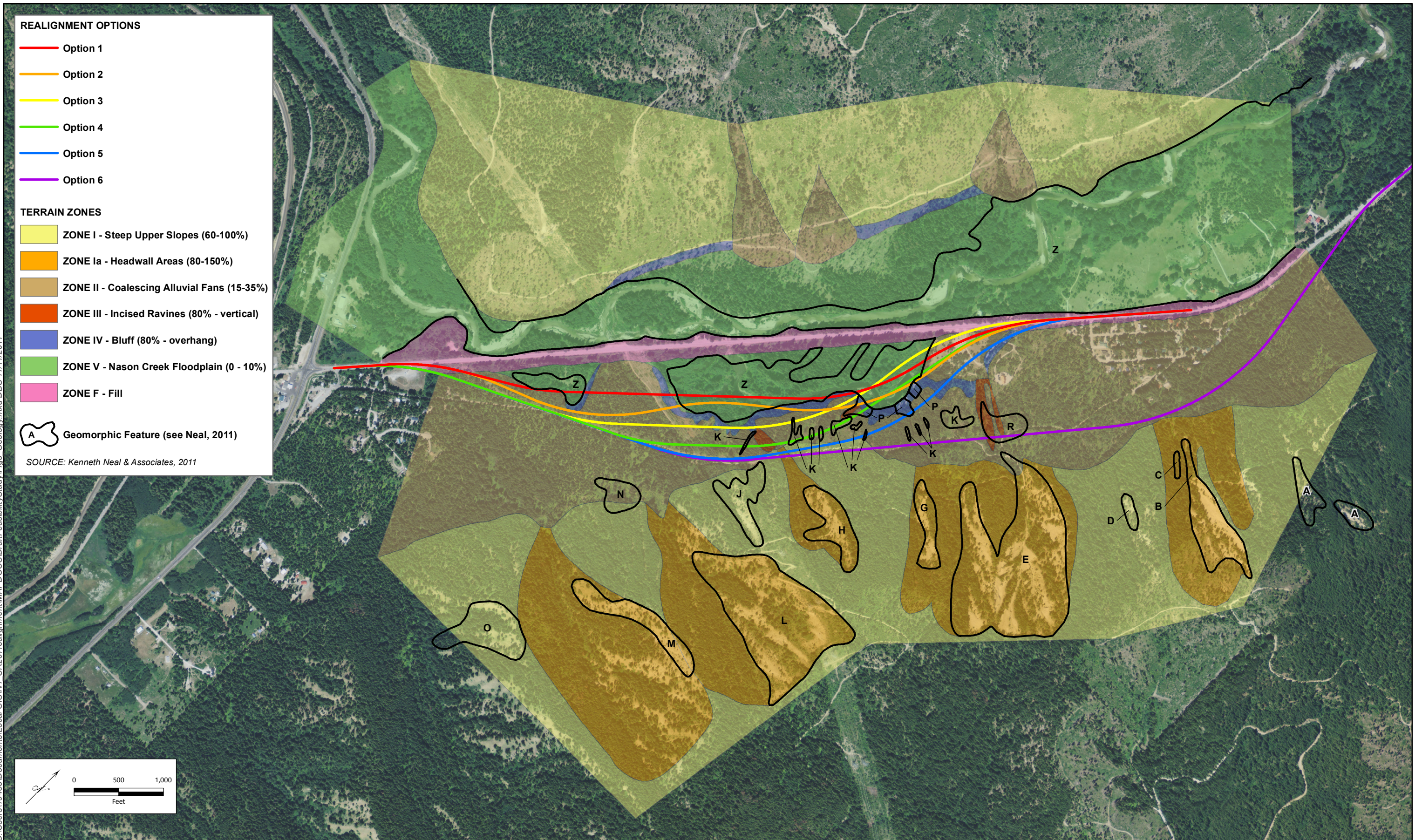


Figure 5
Geomorphic Features Map
Nason Creek SR 207 Feasibility Study

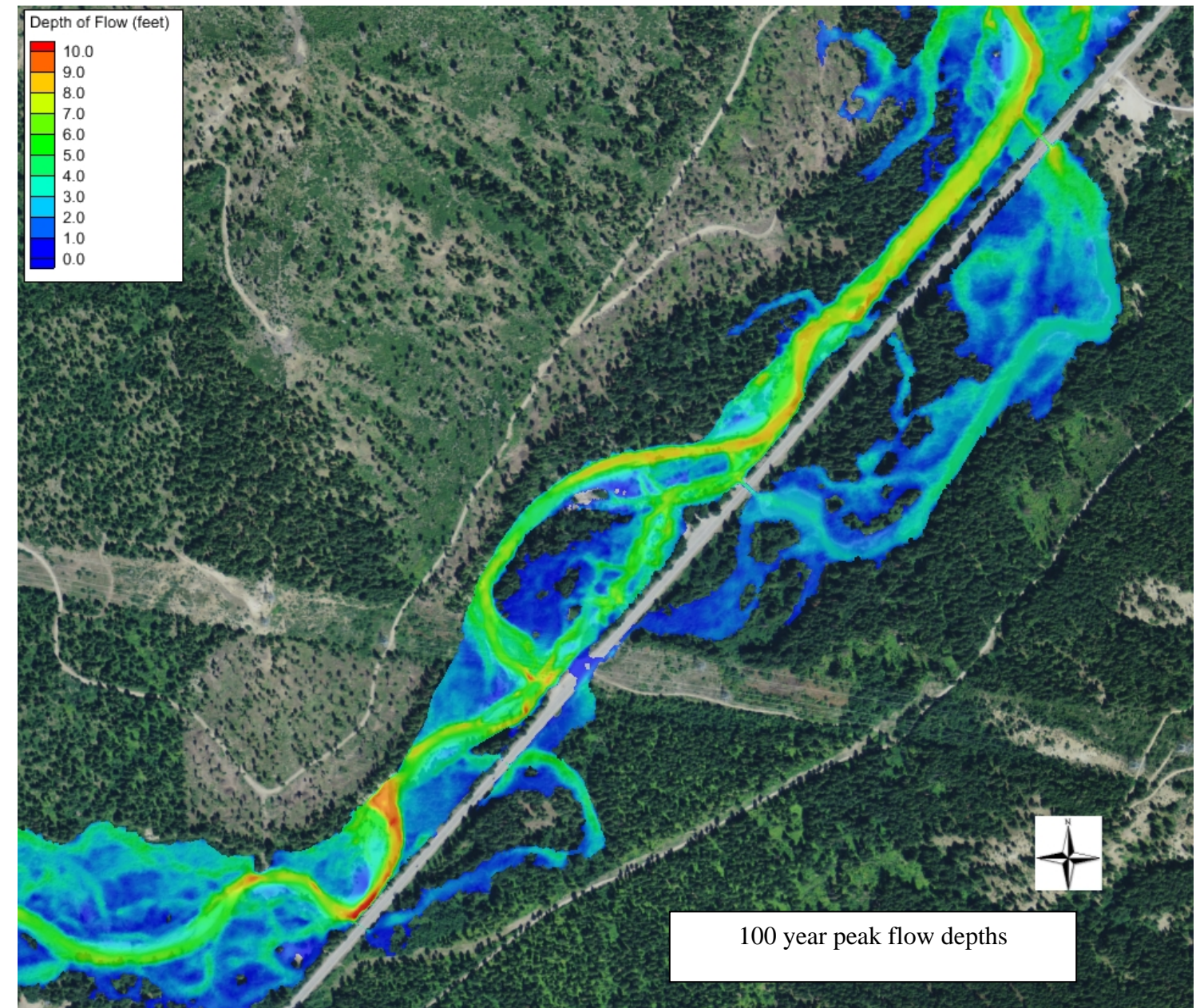
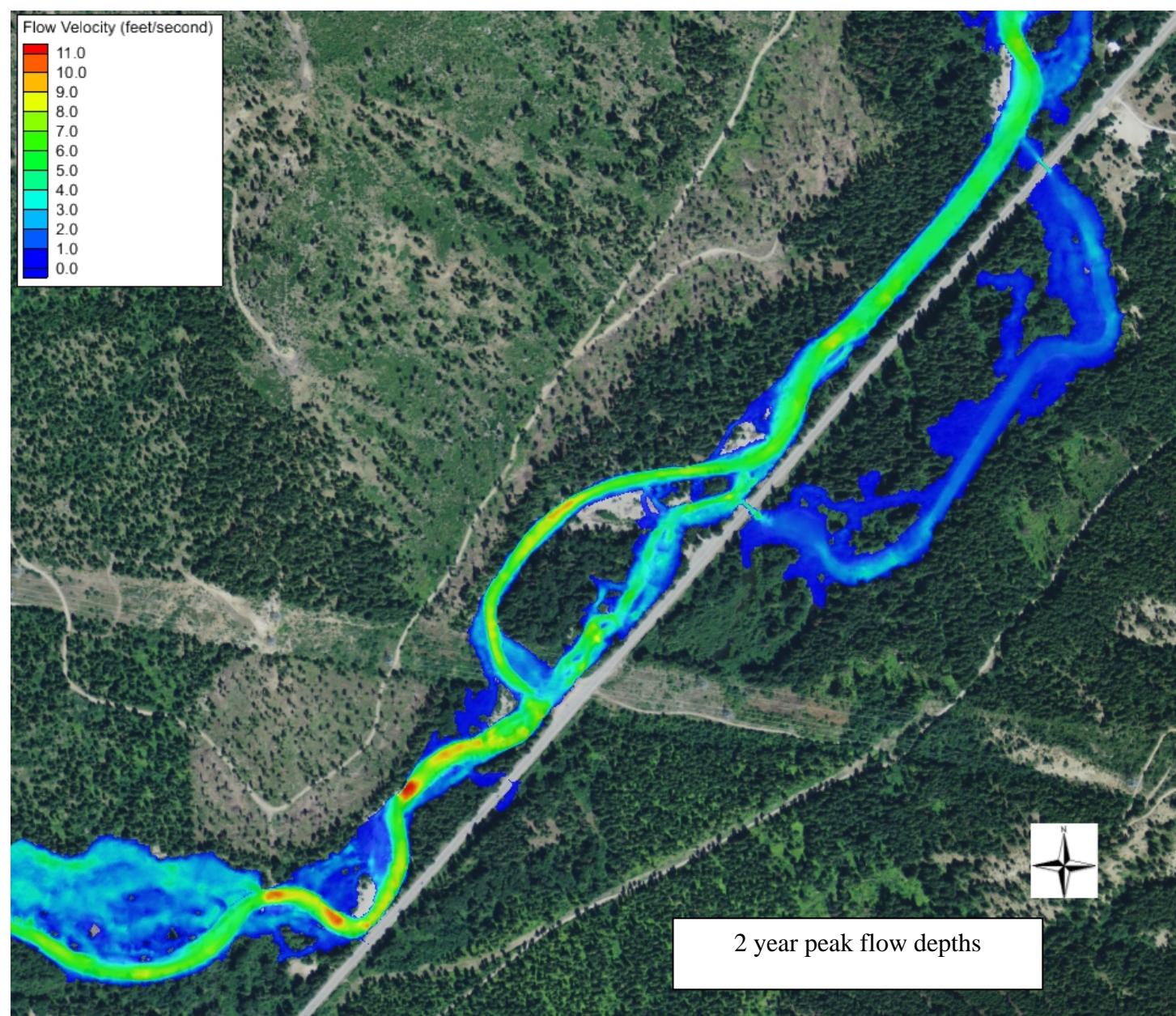


Figure 6: 2 year and 100 year peak flow depths under existing conditions

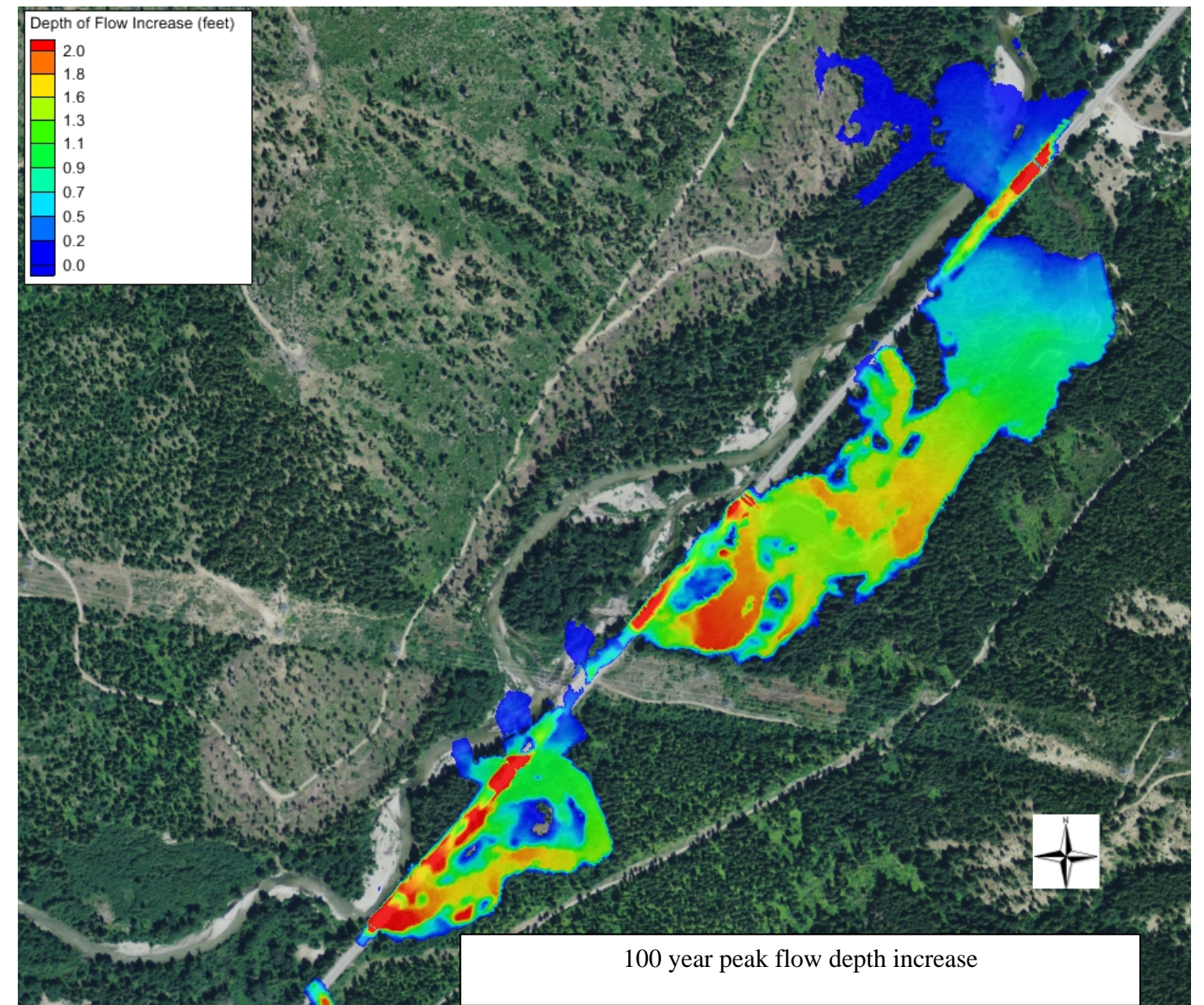
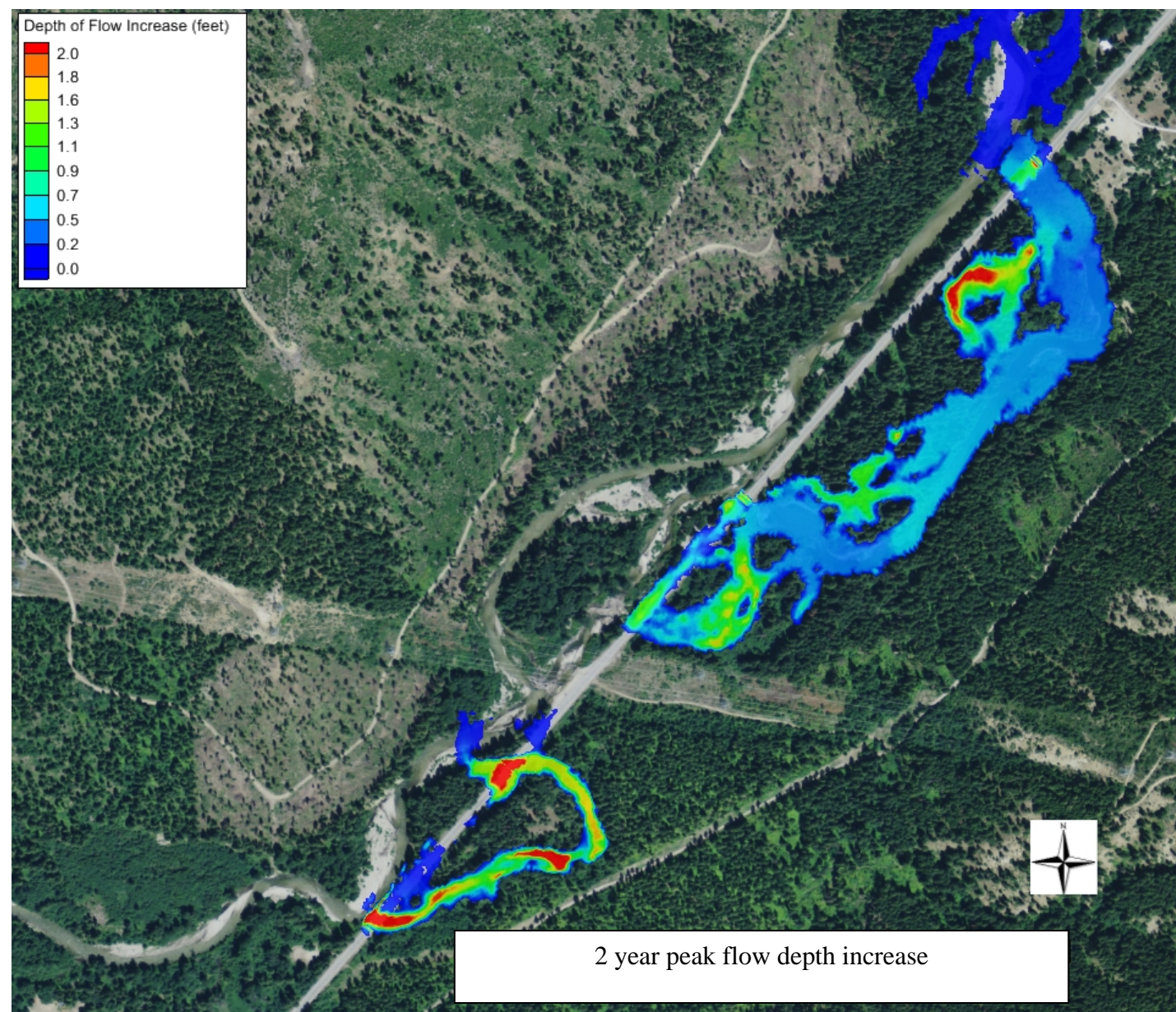


Figure 7: 2 year and 100 year peak flow depth increases following SR 207 relocation

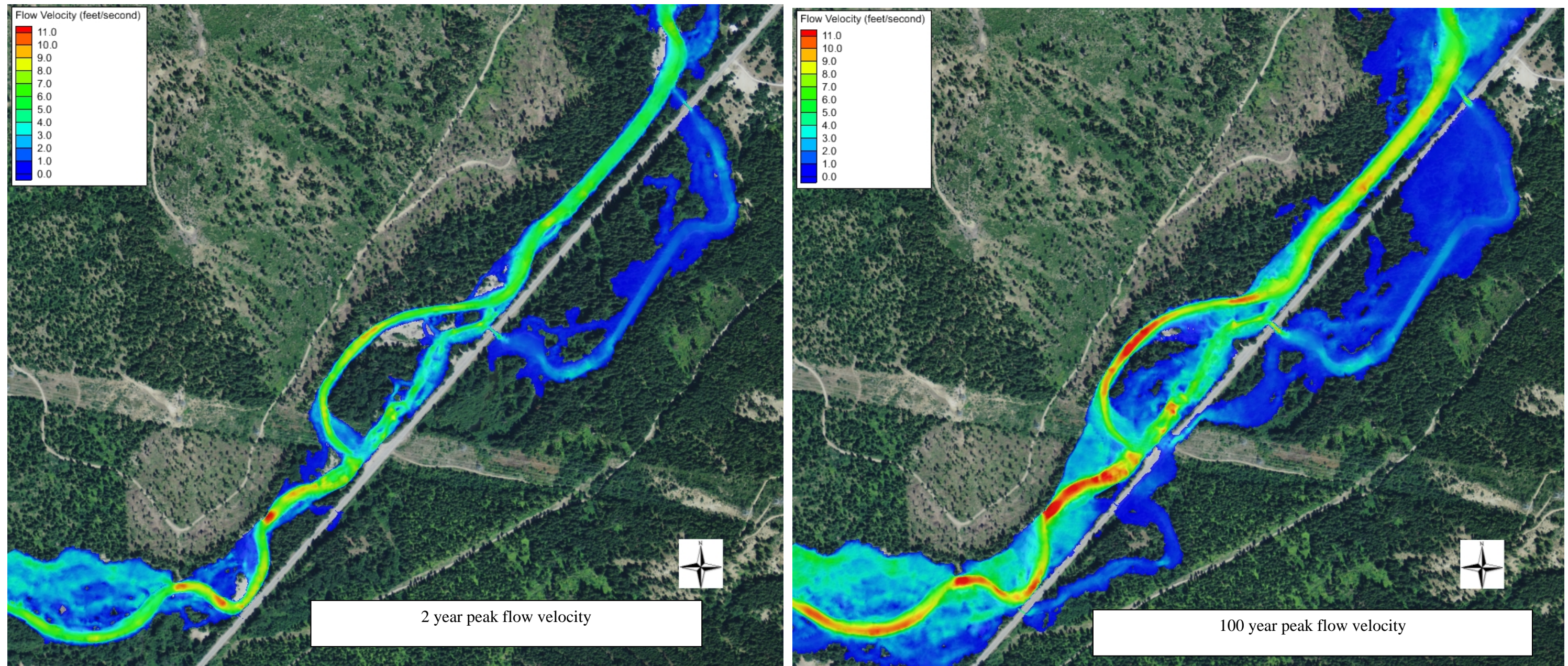


Figure 8: 2 year and 100 year peak flow velocity under existing conditions; note the high velocity rates near the SR 207 prism where three repairs have been made in the last 10 years and under the BPA powerlines in the 100 year event.

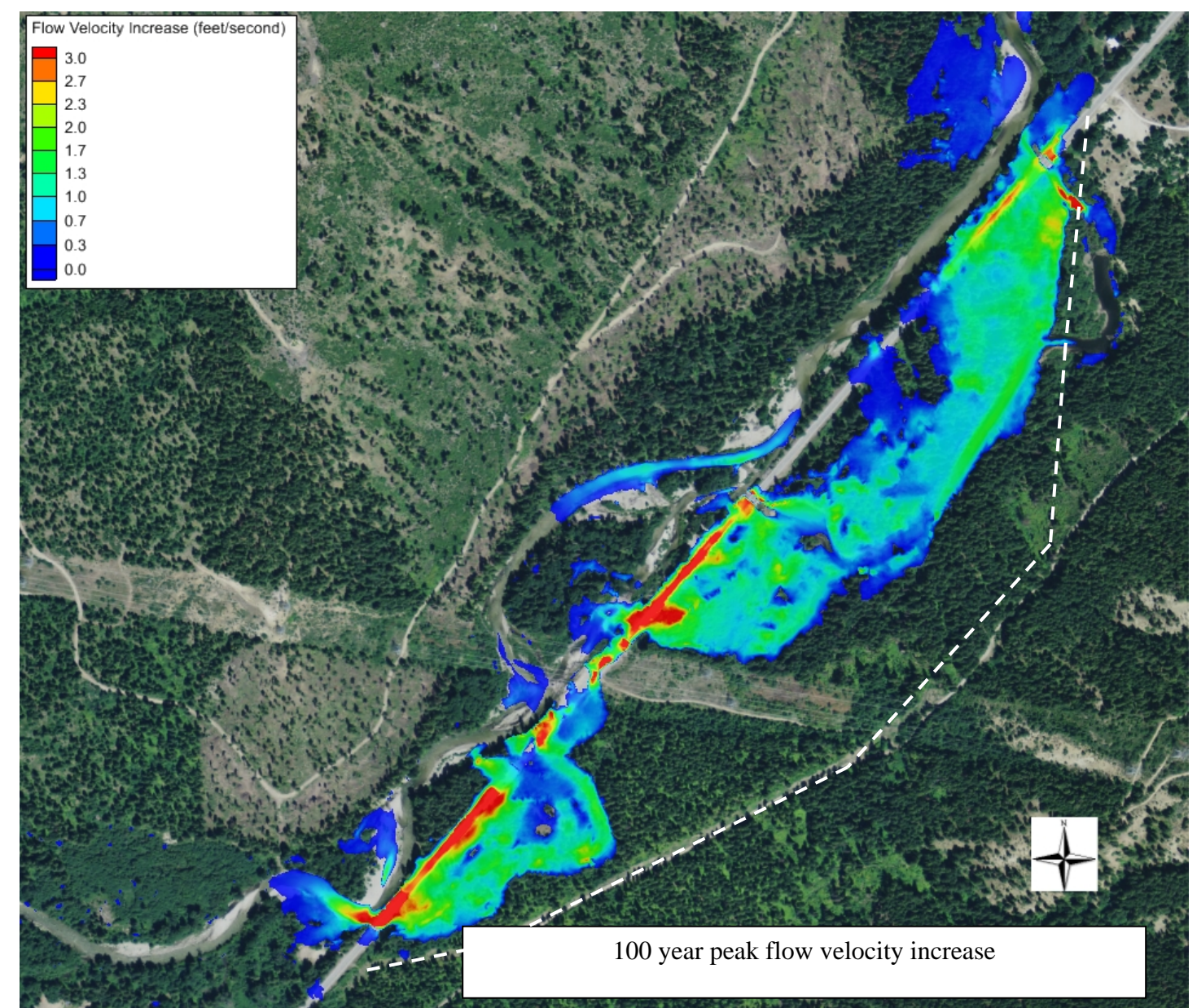
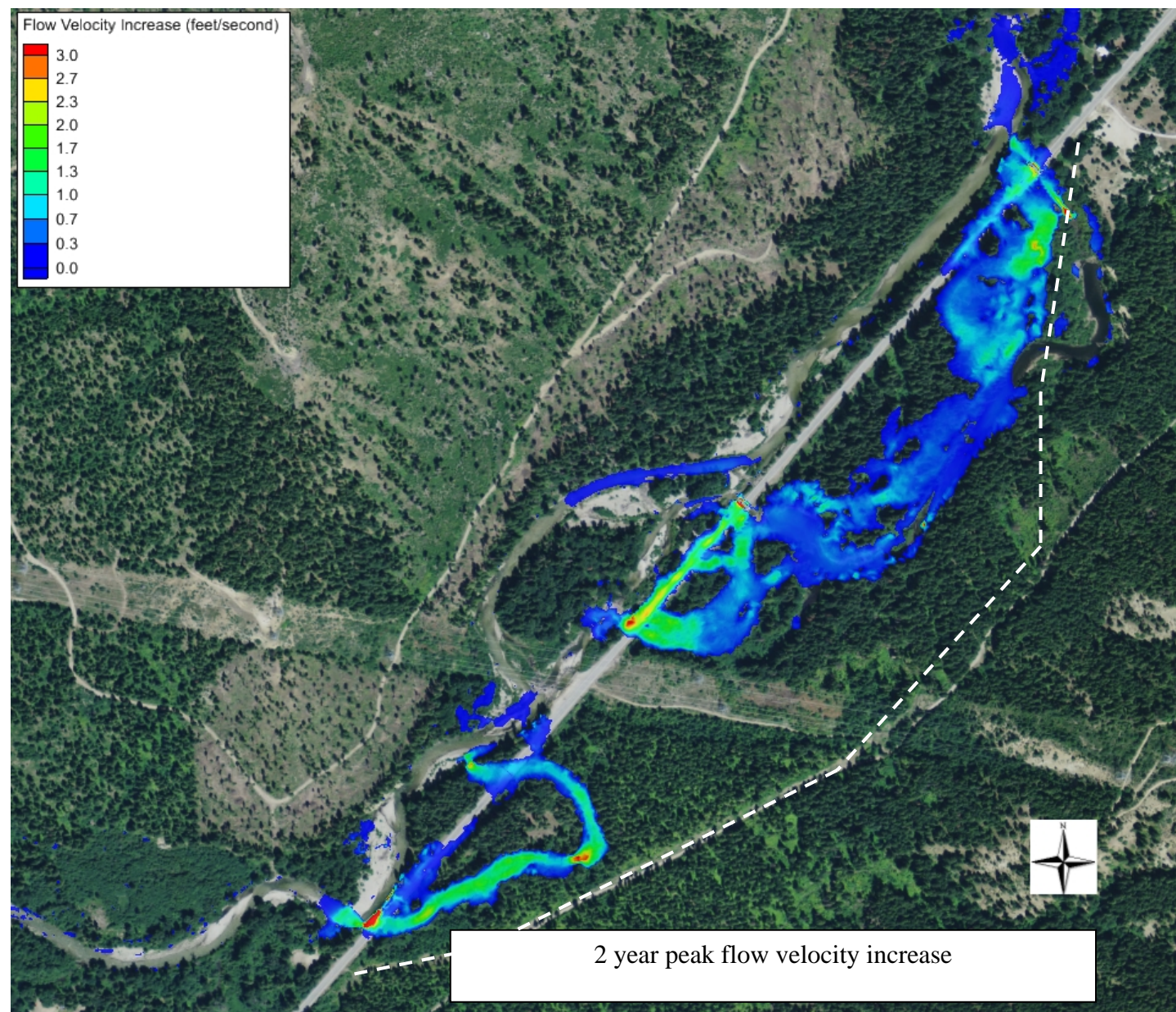
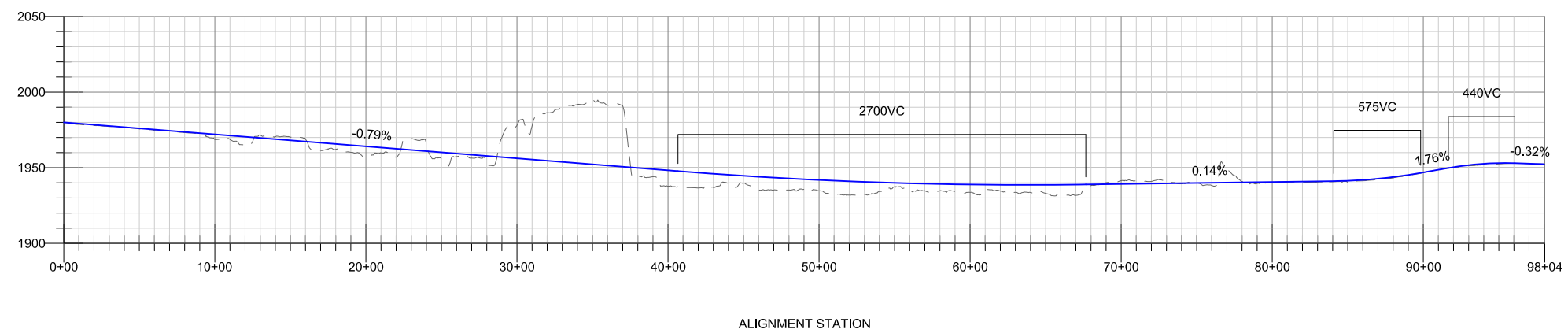
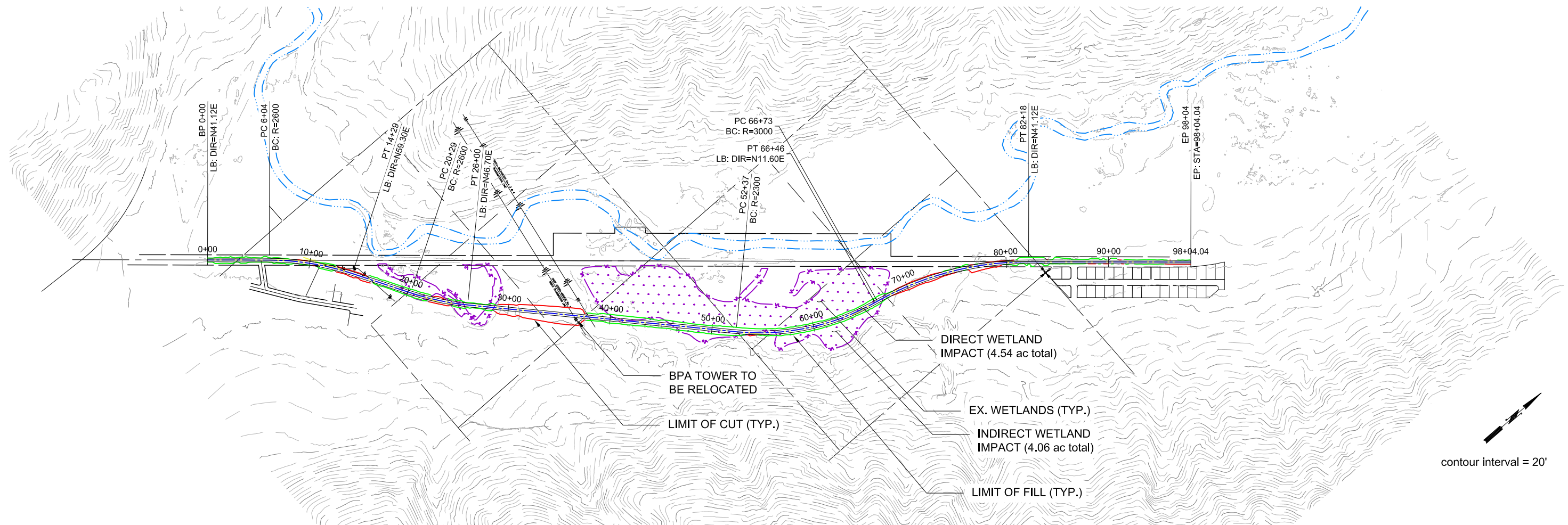
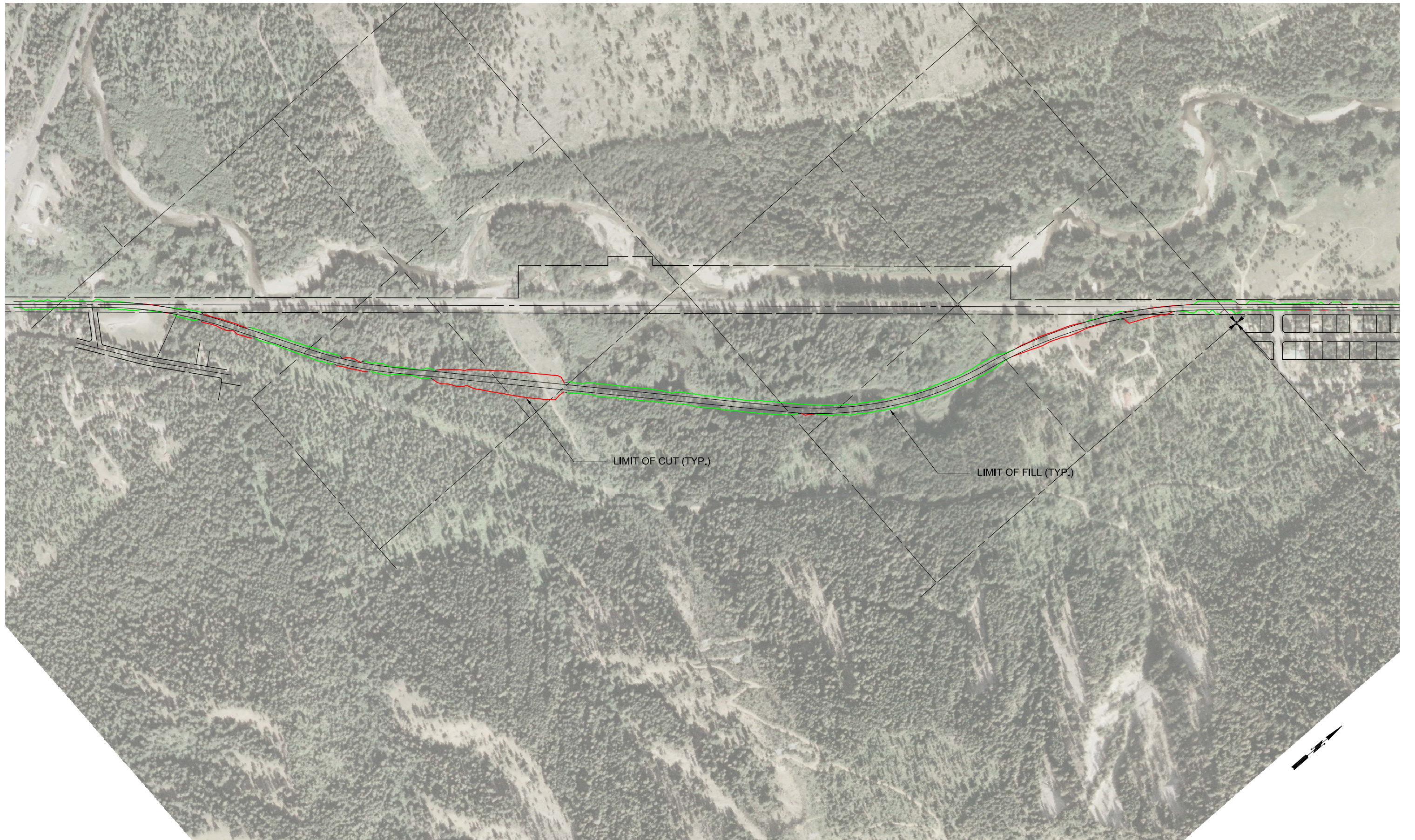
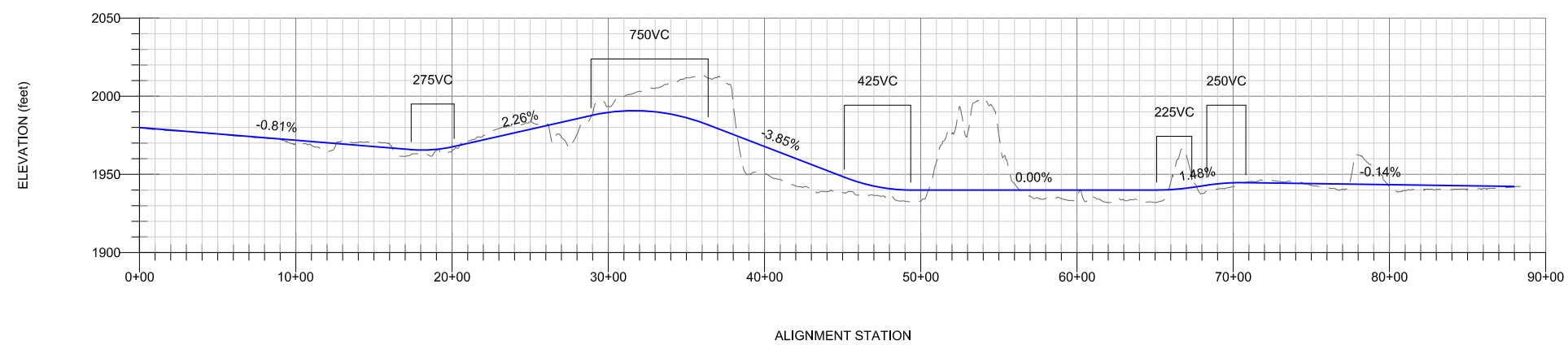
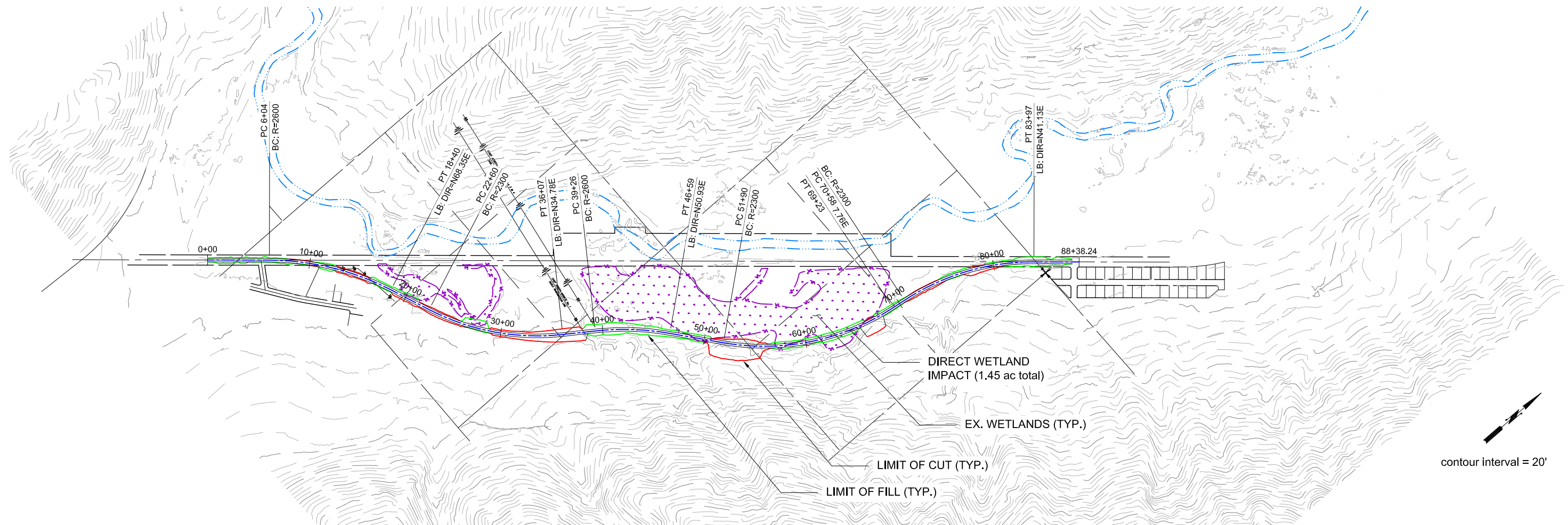


Figure 9: 2 year and 100 year peak flow velocity increase modeled with SR 207 re-location alignment that still impinges on the downstream portion of the floodplain. The white dashed line approximates the proposed road relocation prism. This alignment would be similar to Option 3 or 4. Note the increase in velocity rates near the SR 207 prism where it crosses the downstream portion of the floodplain.

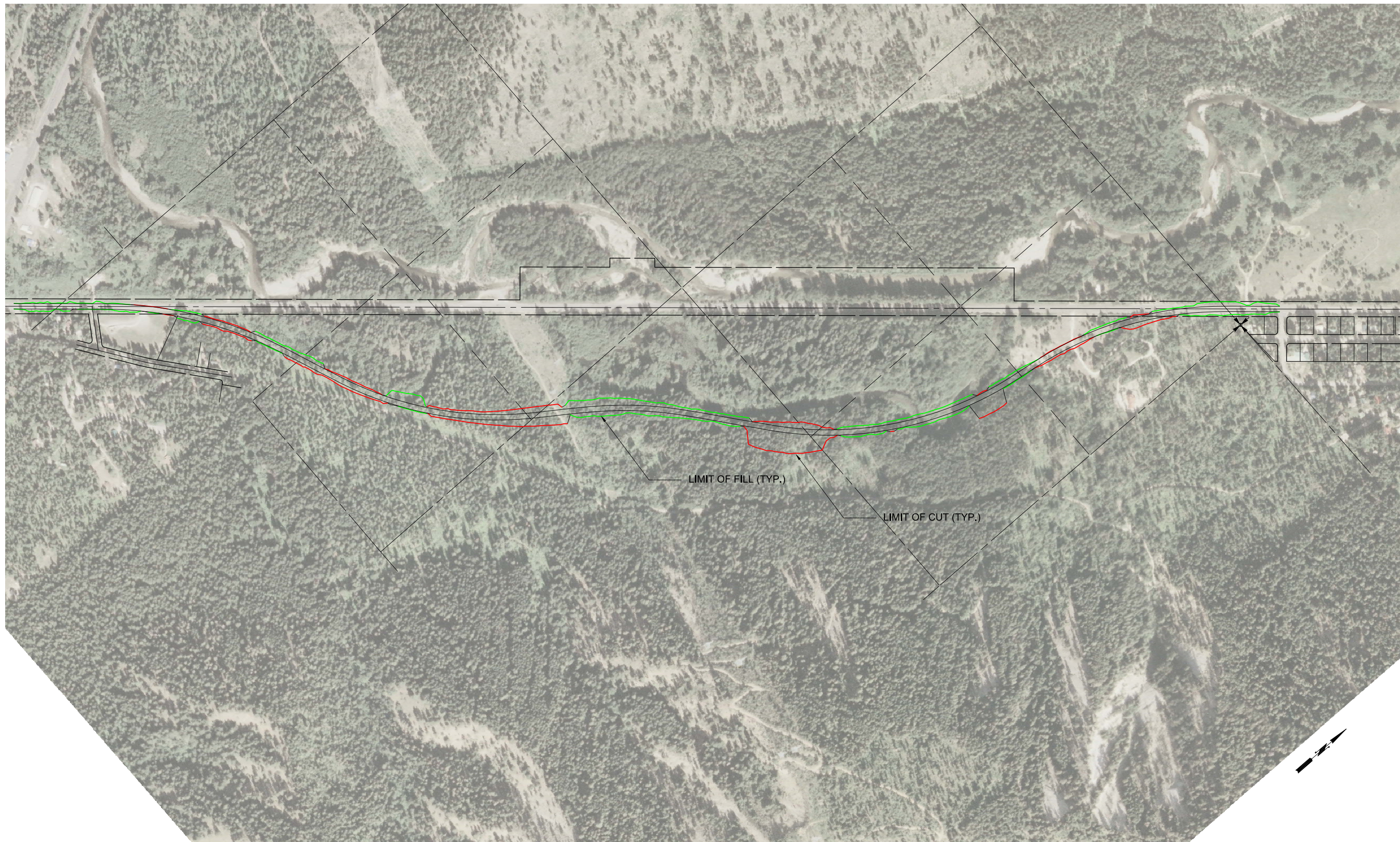


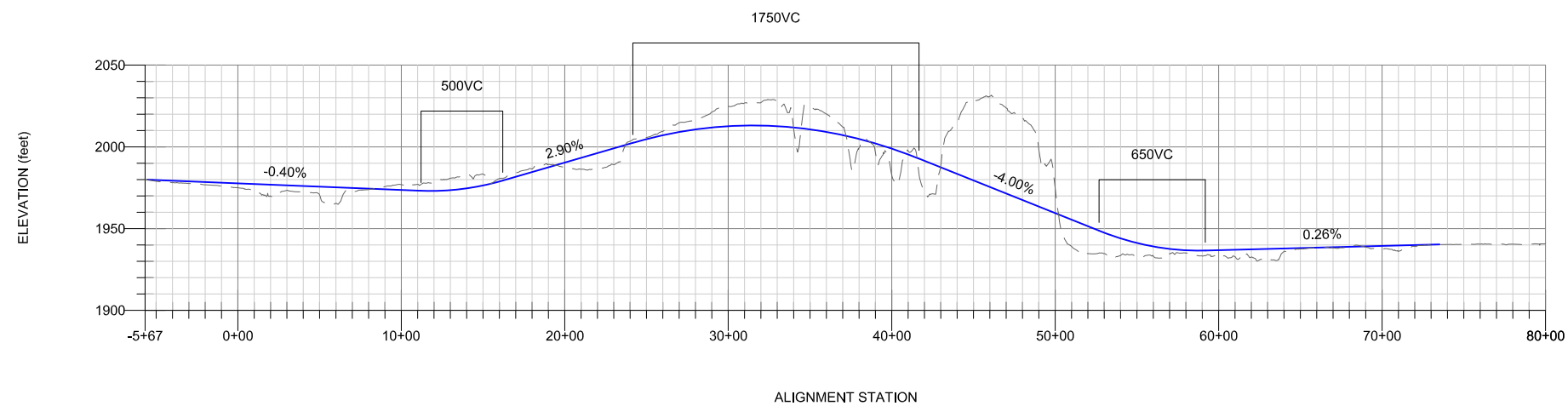
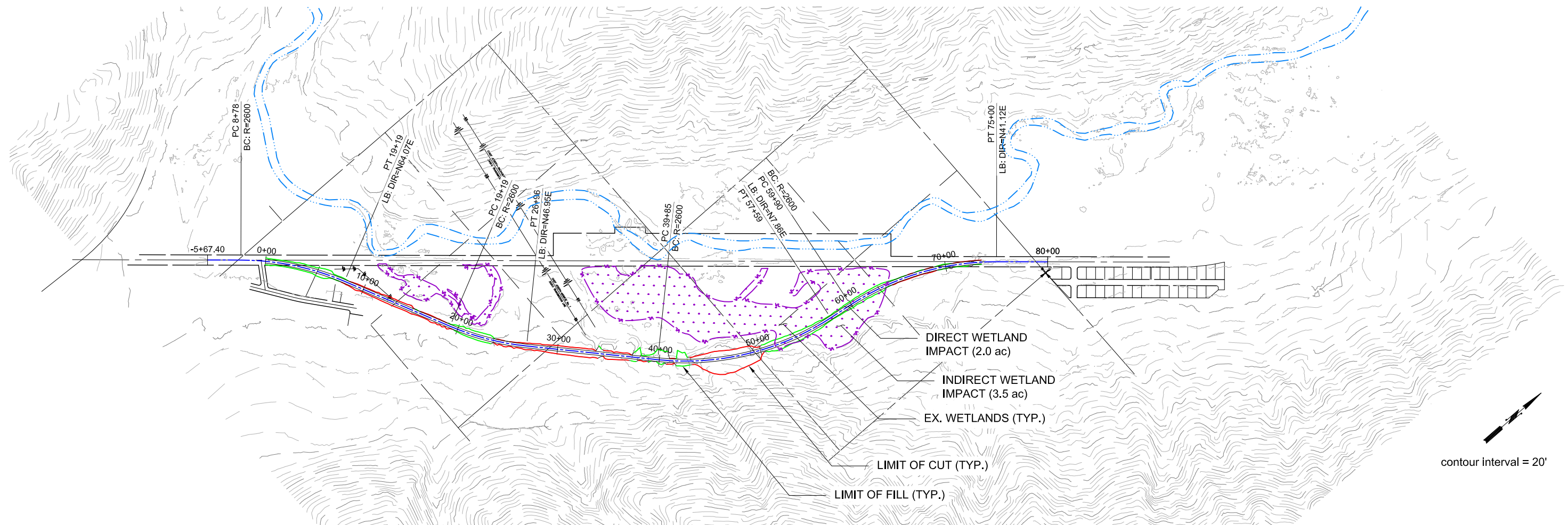
OPTION 1 - PROFILE





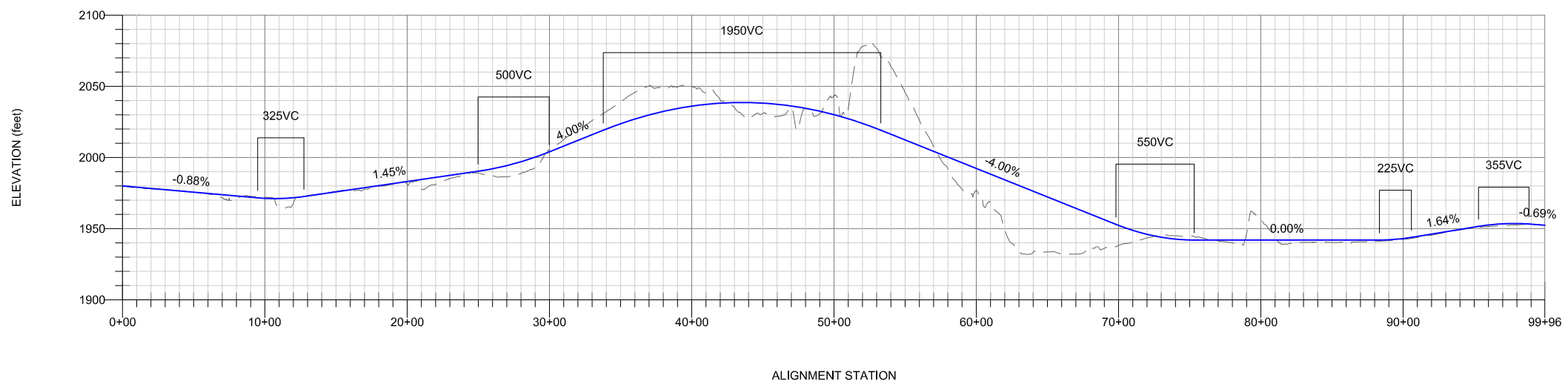
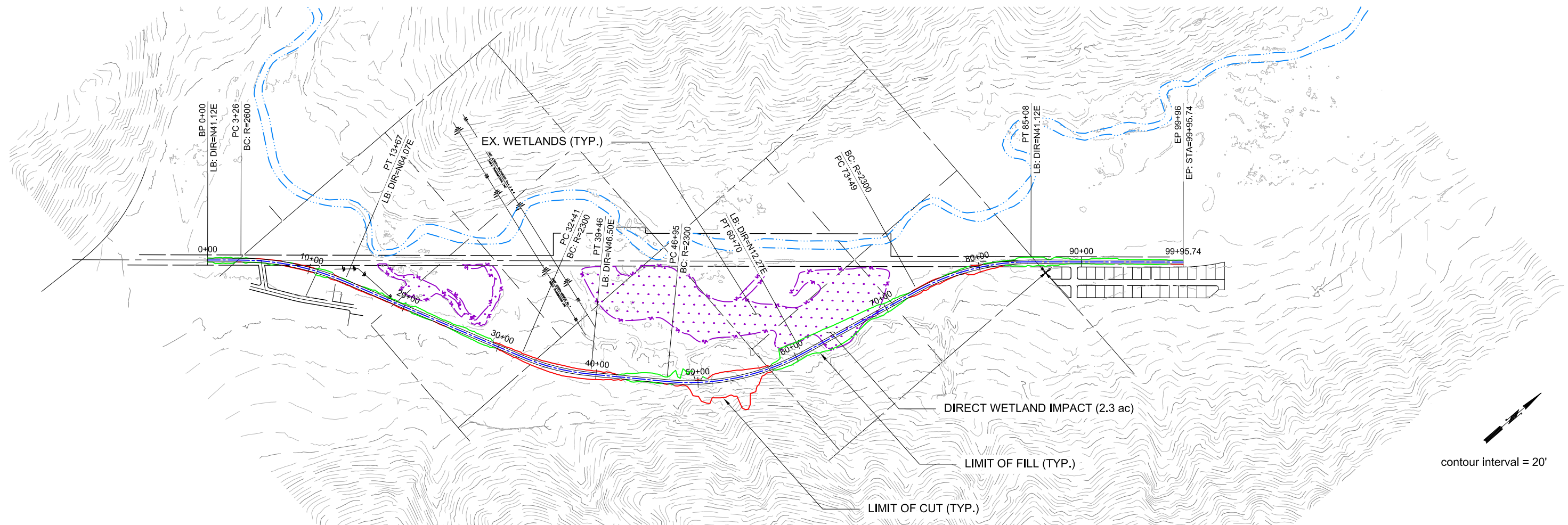
OPTION 2 - PROFILE



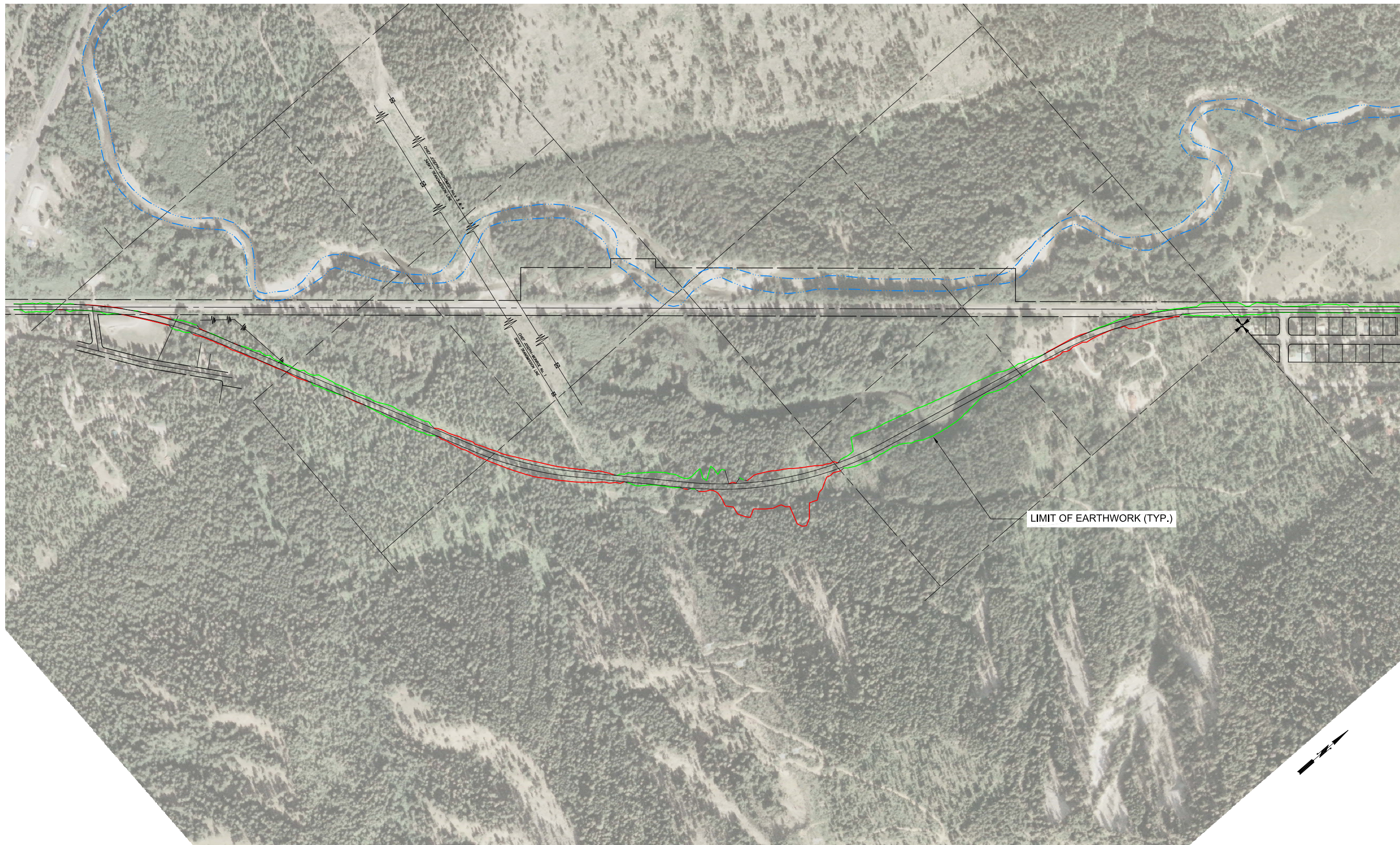


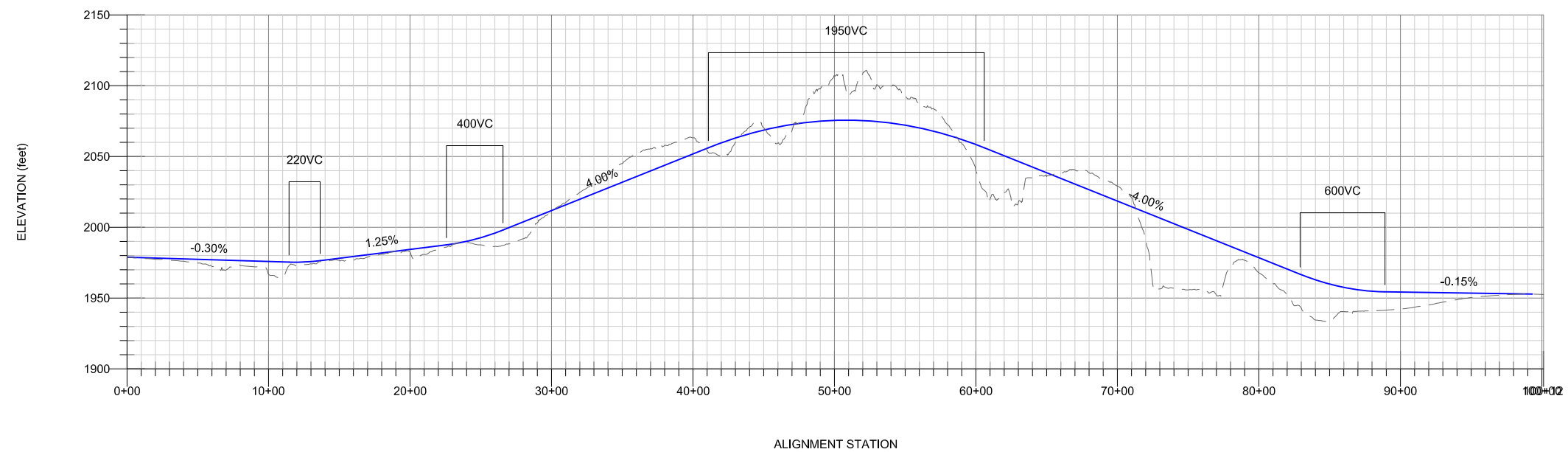
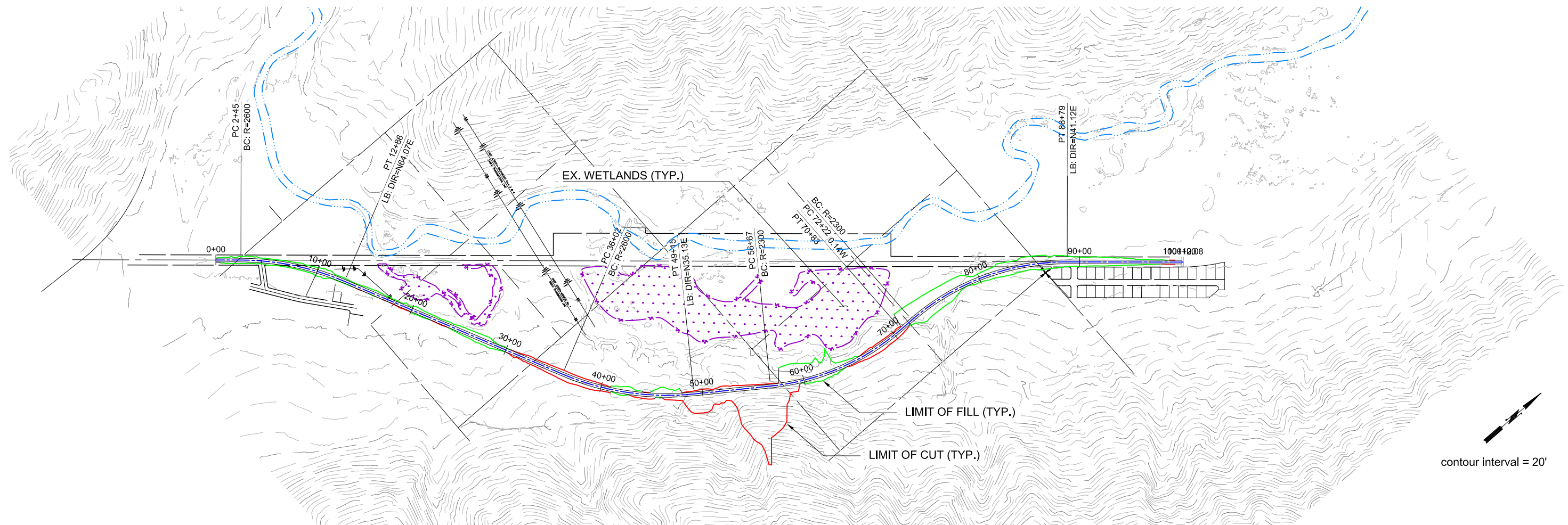
OPTION 3 - PROFILE





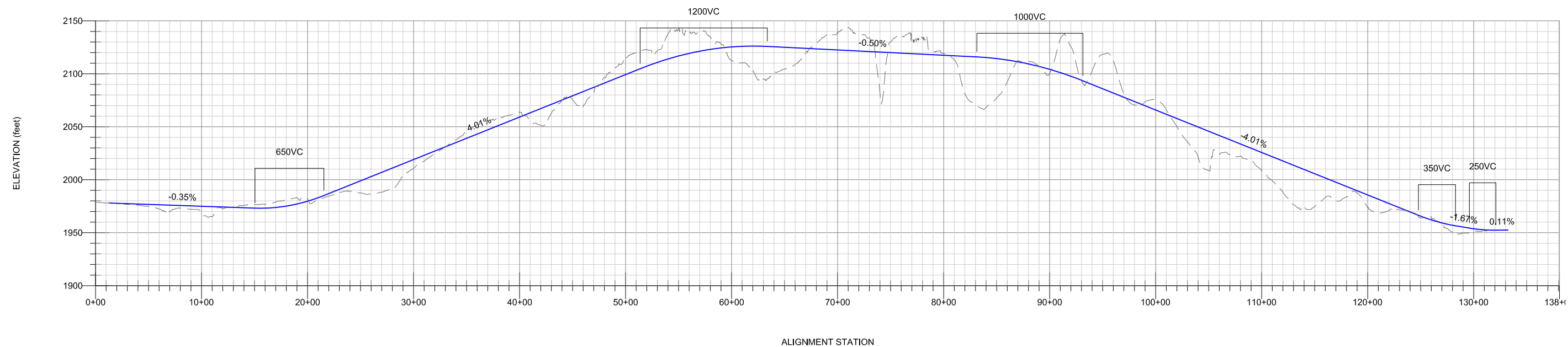
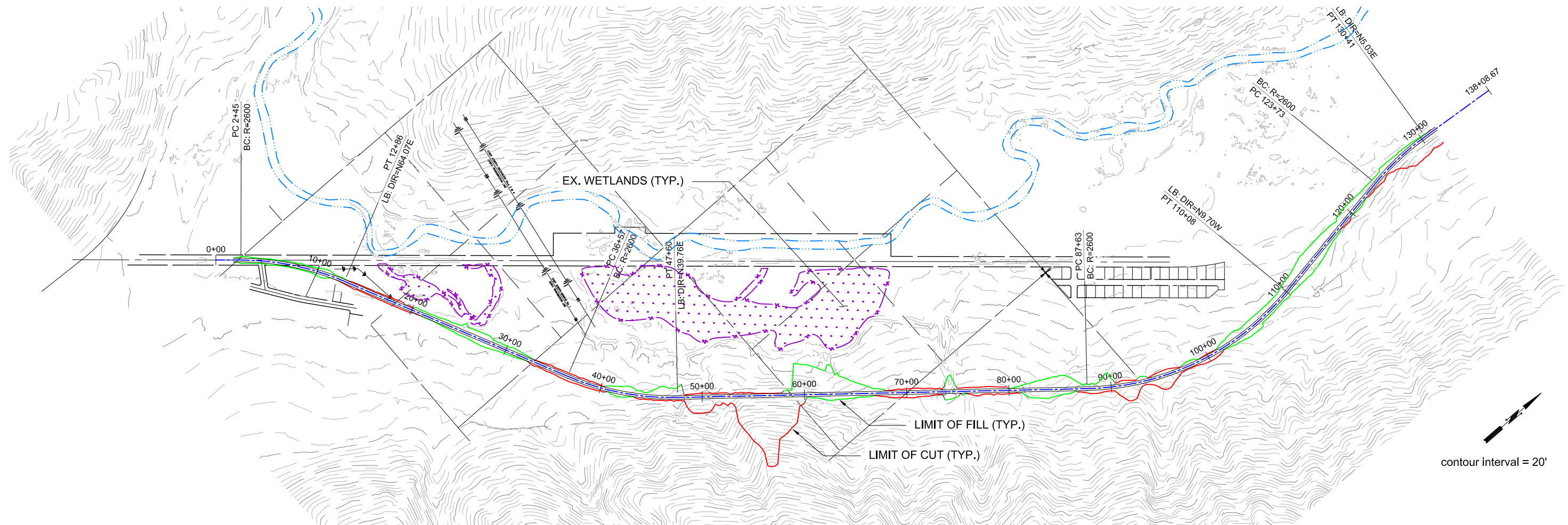
OPTION 4 - PROFILE



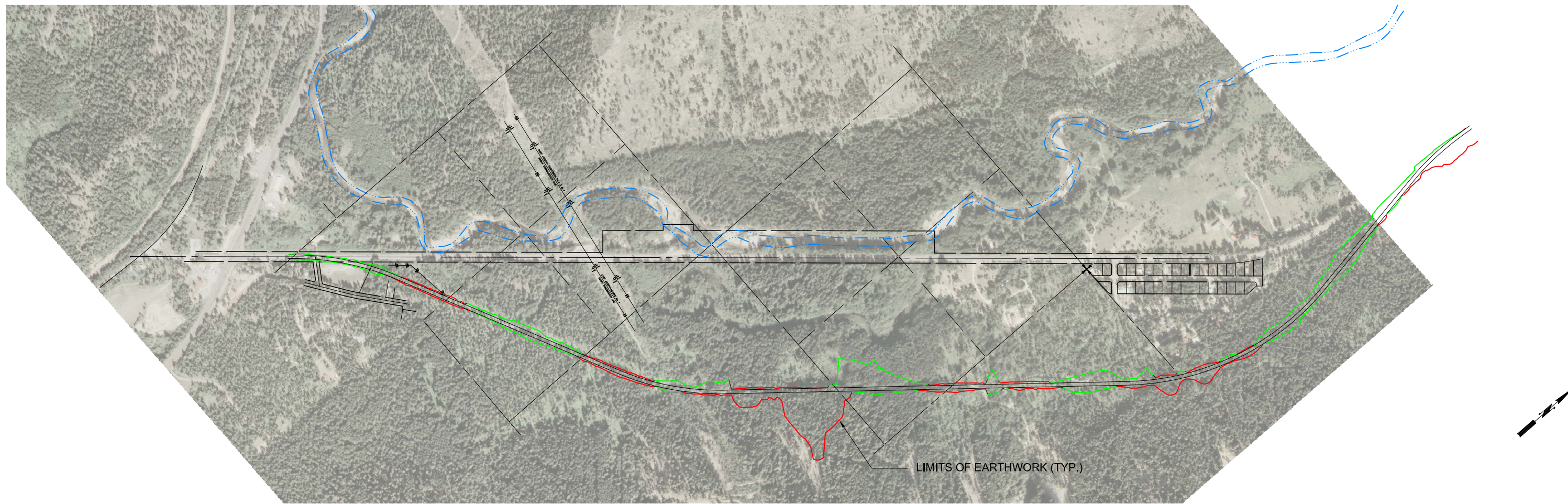


OPTION 5 - PROFILE

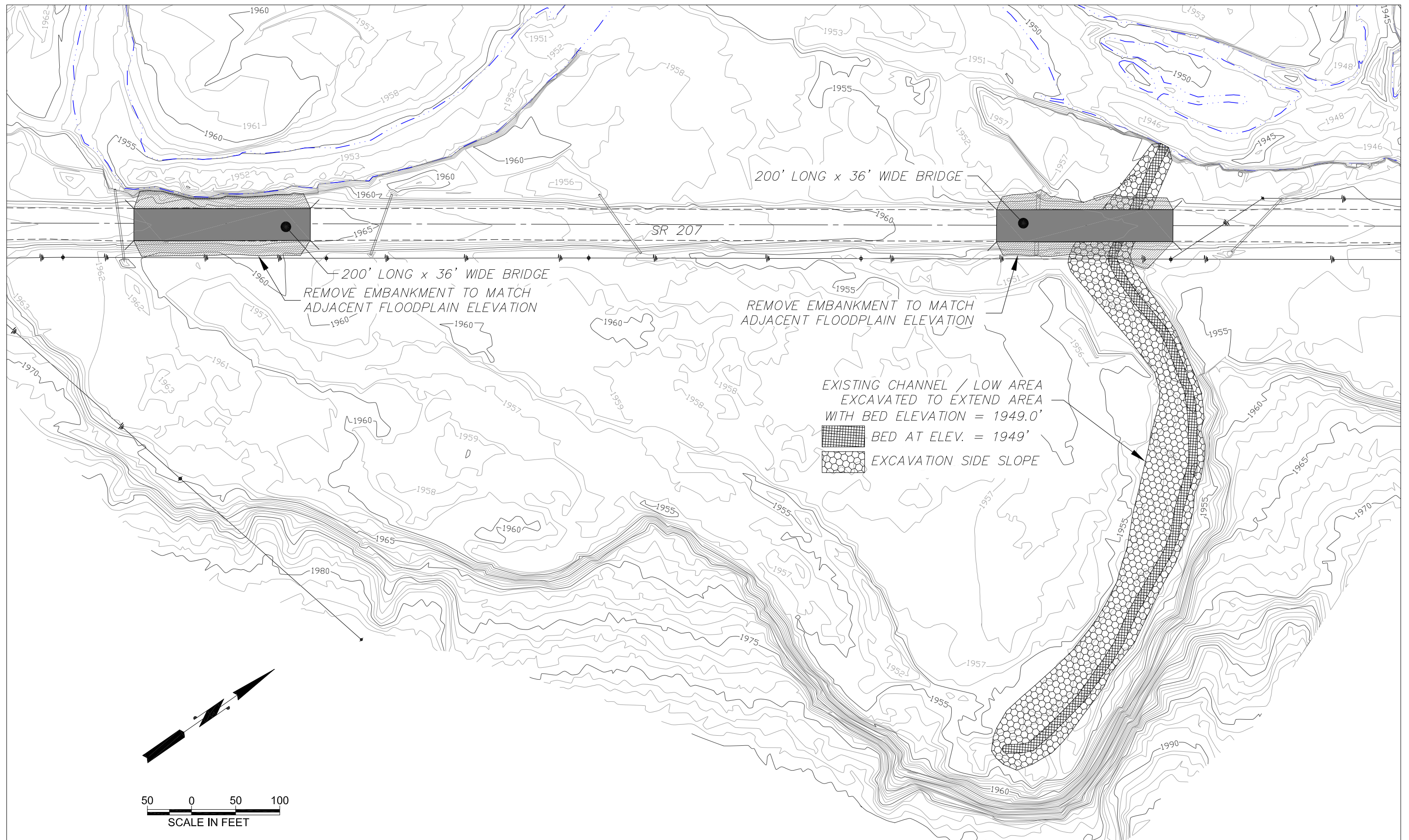


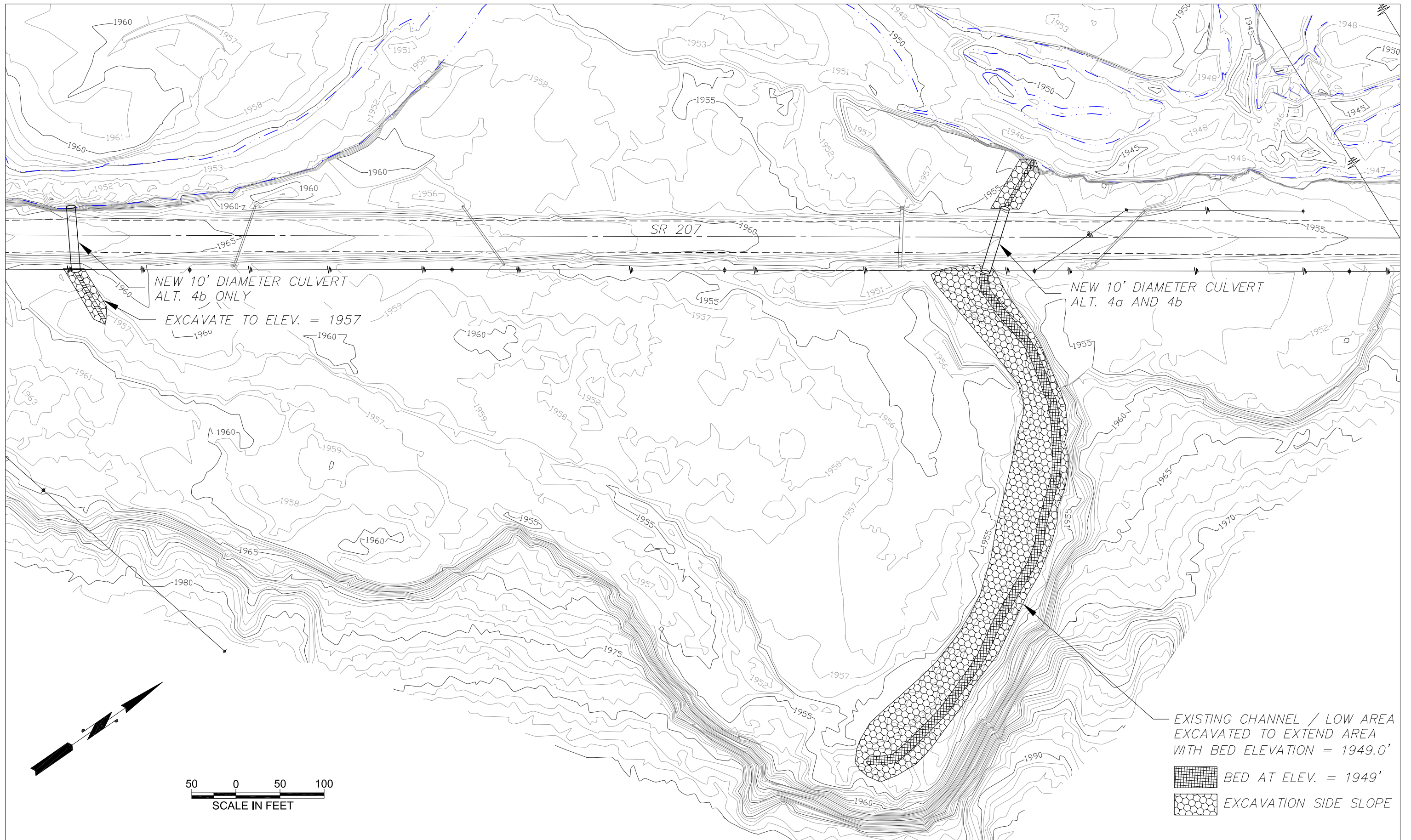


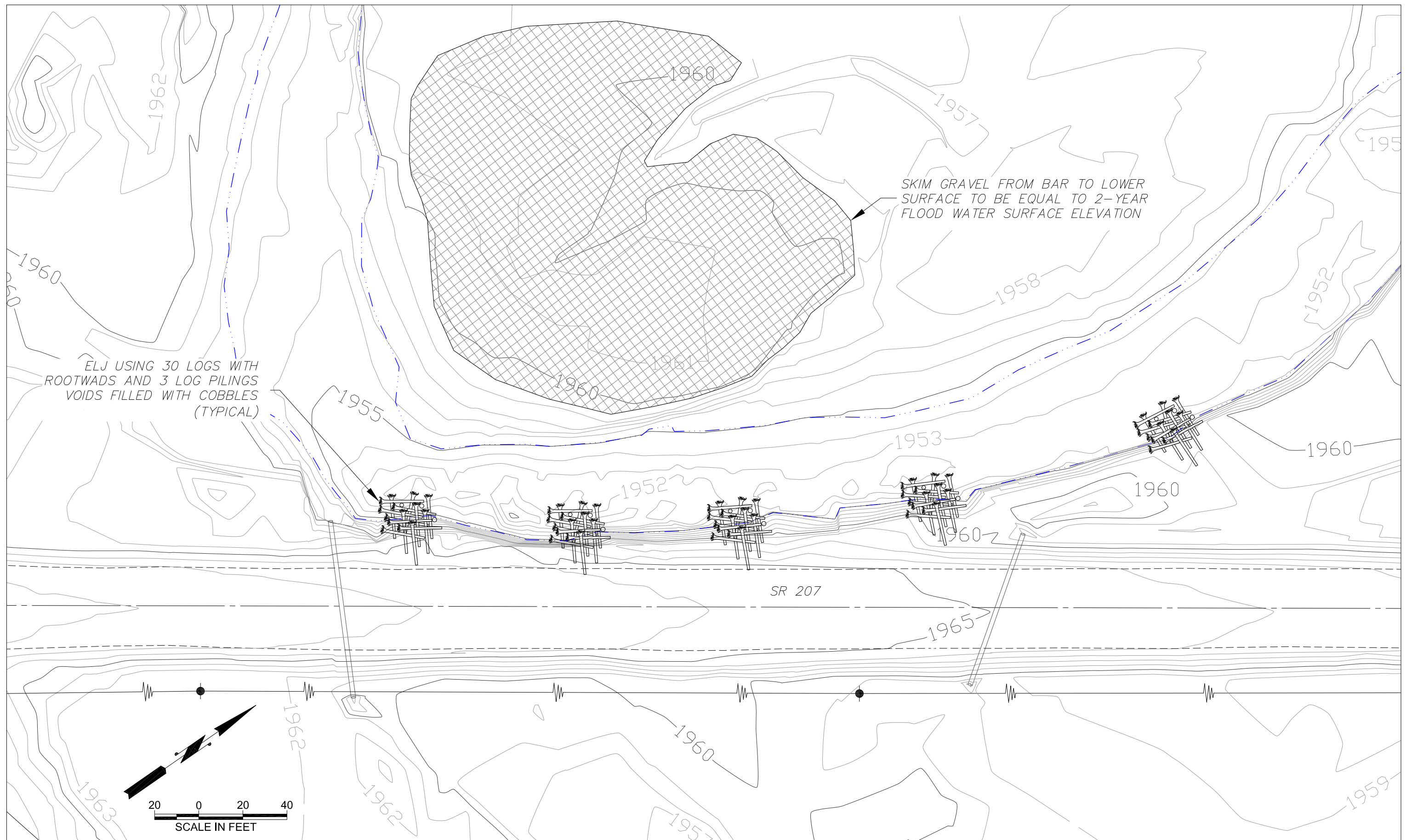
OPTION 6 - PROFILE

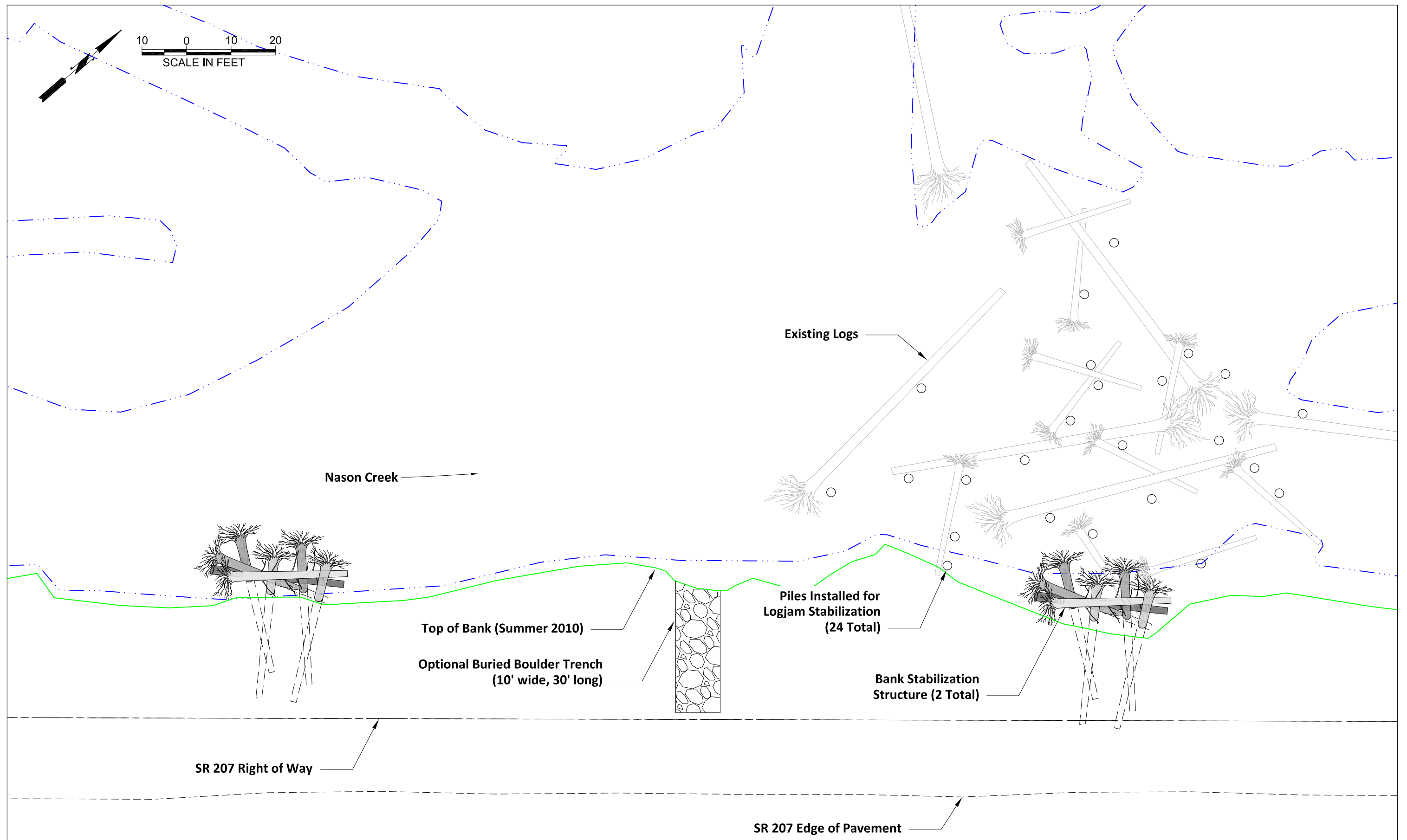


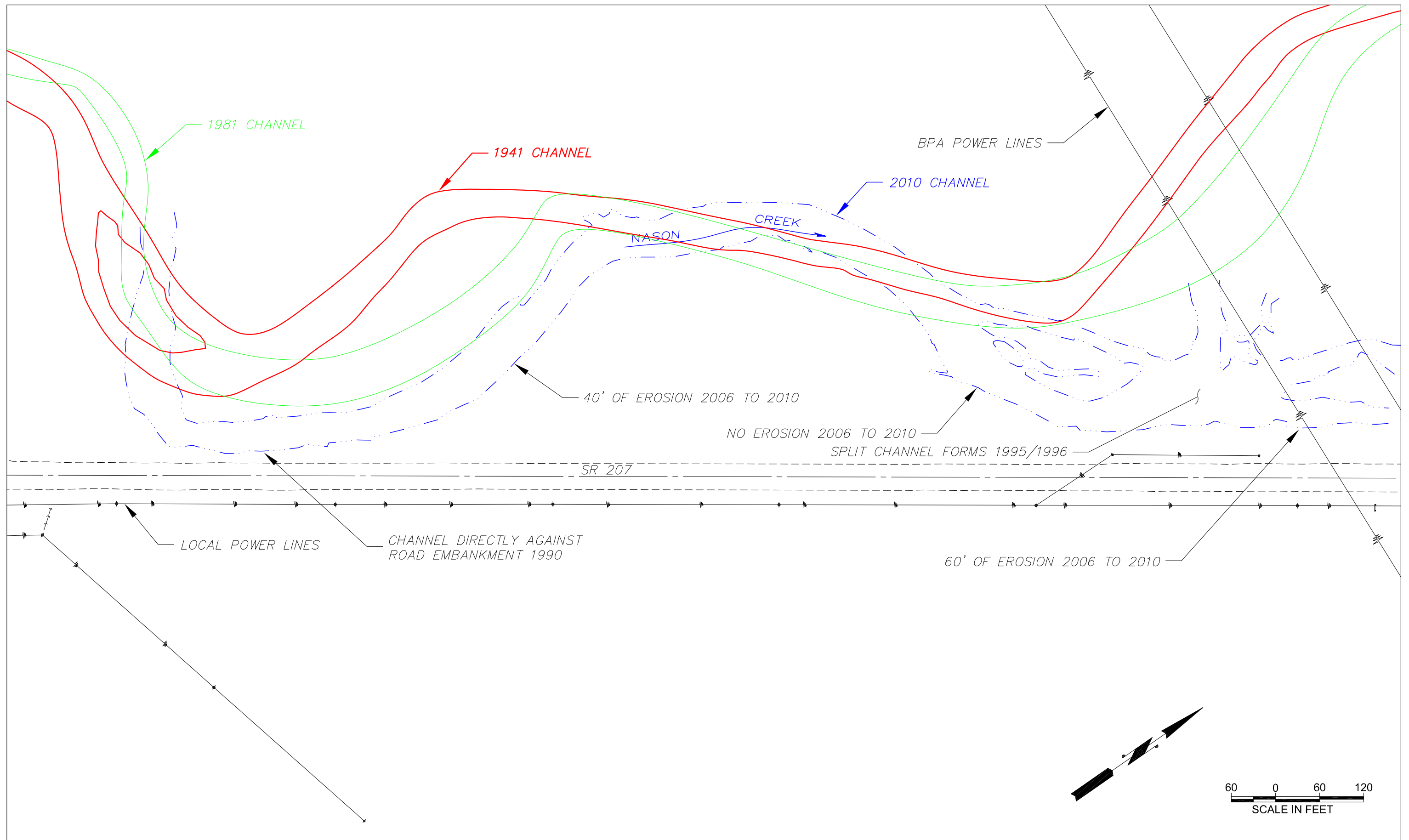












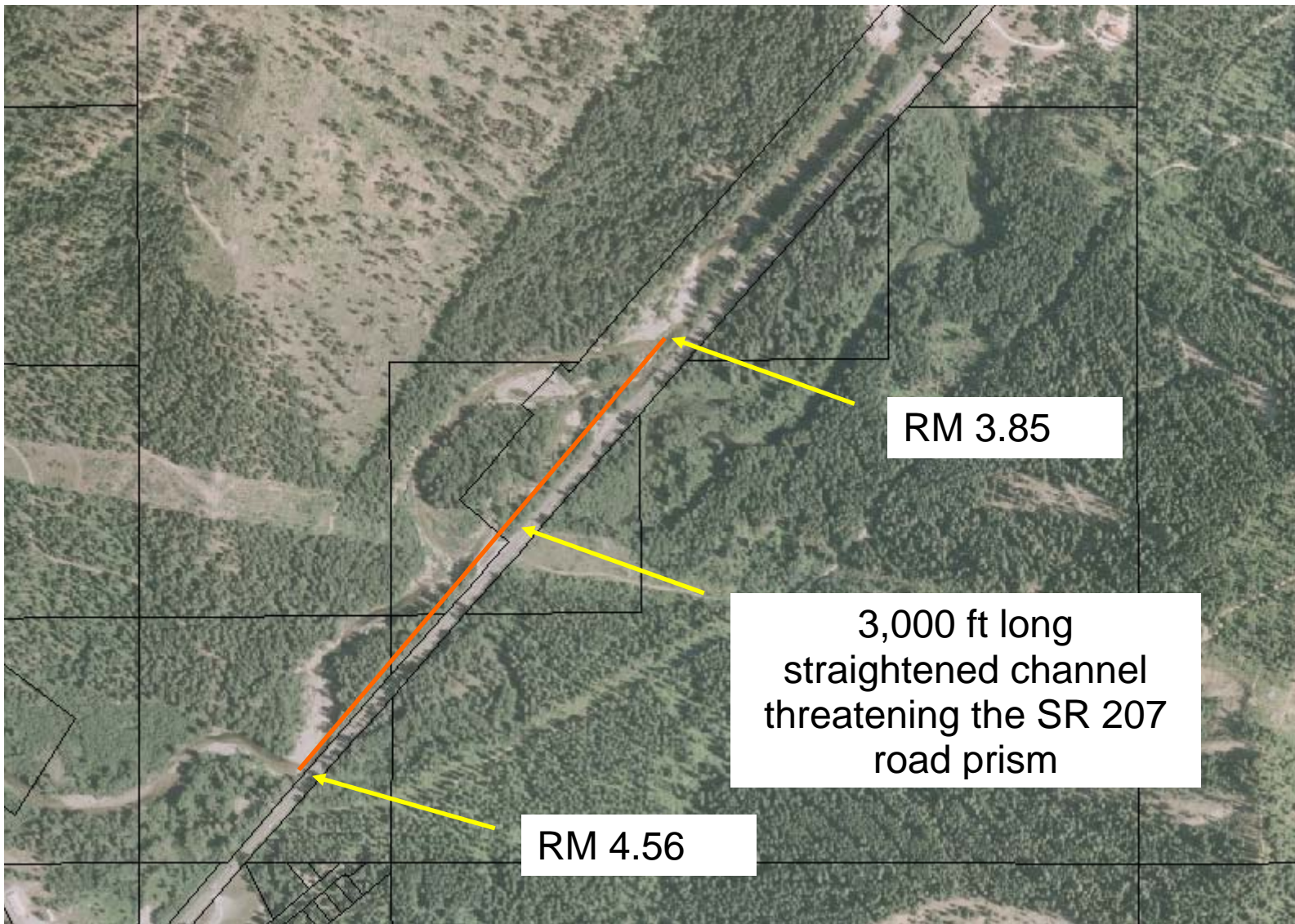


Figure 28: Possible outcome of the No Action Alternative

Appendix B: Photos



Photo 1: 1995 flood that washed out the SR 207 road prism near RM 4.5. Photo taken from the north looking south.

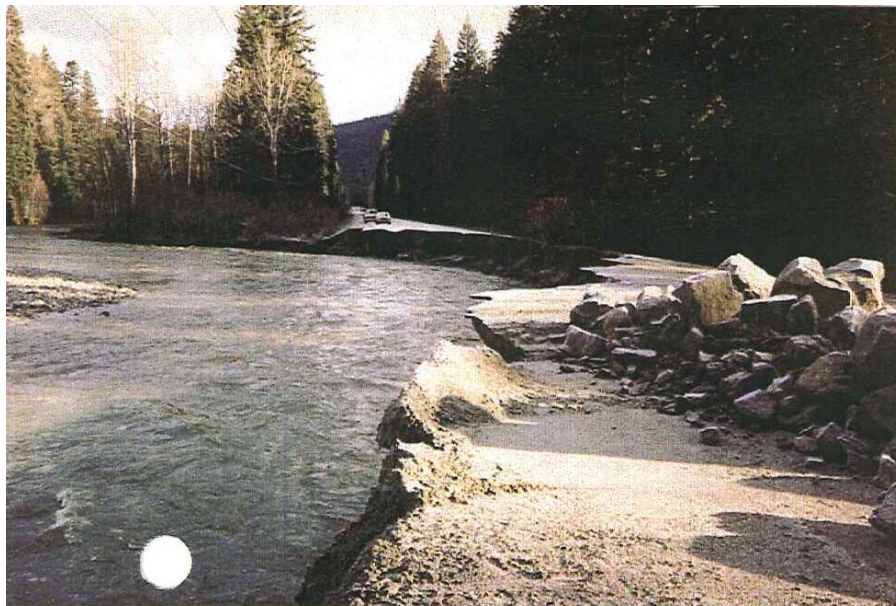


Photo 2: 1995 flood that washed out the SR 207 road prism near RM 4.5. Photo taken from the south looking north.



Photo 3: 2010 site conditions in Nason Creek where there have been 3 road maintenance repairs in the last 10 years.



Photo 4: Fall 2011 site conditions in Nason Creek depicting the additional rip rap and rock barbs installed to protect the road prism.



Photo 5: April 2010 site conditions in Nason Creek under the powerline crossing. Note the powerpole and car and distance from the eroding edge of the creek.



Photo 6: April 2011 site conditions in Nason Creek under the powerline crossing. This photo is taken from the same location as Photo 5, however, note the change in bank erosion by comparing the distance between the car and the edge of the creek.

Appendix C: Tables

Table 1: Road Relocation Option Summary

Option	Length (feet)	Maximum Grade	Direct Wetland Impact (acres)	Indirect Wetland Impact (acres)	Floodplain Reconnected (acres)	Cost*
1	9804	1.76%	4.54	4.06	68.4	\$11,095,943
2	8800	3.85%	1.45	0	75.55	\$12,960,382
3	7350	4.00%	2	3.5	71.5	\$12,163,134
4	9996	4.00%	2.3	0	74.7	\$10,543,990
5	9950	4.00%	0	0	77	\$12,892,300
6	13300	4.01%	0	0	77	\$22,012,805

*See cost estimates for more complete information

Table 2: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 1 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	381,214	381,214
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	200.00	DAY	200	40,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	47,180	47,180
5	SILT FENCE	8,000.00	L.F.	4	32,000
6	HIGH VISIBILITY CONSTRUCTION FENCE	16,000.00	L.F.	4	64,000
7	CLEARING AND GRUBBING	15.00	ACRE	2,500	37,500
8	EXCAVATION HAULED OFF-SITE (NEW ROADWAY)	65,900.00	C.Y.	20	1,318,000
9	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	44,400.00	C.Y.	6	266,400
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	400.00	L.F.	75	30,000
12	CULVERT PIPE, 144" DIAMETER	200.00	L.F.	600	120,000
13	CRUSHED SURFACING BASE COURSE	18,000.00	TON	25	450,000
14	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	8,500.00	TON	90	765,000
15	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	4000.00	L.F.	35	140,000
16	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	8.00	EACH	2,700	21,600
17	PAINT LINE	28,000.00	L.F.	2	56,000
18	SEEDING, FERTILIZING, AND MULCHING	8.00	ACRE	2,000	16,000
19	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	10,000.00	EACH	14	140,000
20	LIVE STAKE	2,000.00	EACH	8	16,000
21	FINE COMPOST	3,200.00	C.Y.	40	128,000
22	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
23	SURVEYING	LUMP SUM	L.S.	50,000	50,000
24	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$5,146,394

Utilities: Chelan County PUD Pole & Line Relocation = \$1,250,000

Utilities: Sprint Fiber Optic Relocation = \$200,000

Utilities: BPA Tower Relocation (1 tower) = \$500,000

Right of Way = \$500,000

Contingencies @ 20% of Construction = \$1,029,279

Geotech Investigation @ 3% of Construction = \$154,392

Design and Construction Administration @ 25% of Construction = \$1,286,599

NEPA & Permits @ 20% of Construction = \$1,029,279

Project Total (in year 2011 dollars) = \$11,095,943

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$13,500,433

Project Total (in year 2021 dollars) = \$16,424,214

Table 3: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 2 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	485,467	485,467
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	200.00	DAY	200	40,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	60,083	60,083
5	SILT FENCE	8,000.00	L.F.	4	32,000
6	HIGH VISIBILITY CONSTRUCTION FENCE	16,000.00	L.F.	4	64,000
7	CLEARING AND GRUBBING	15.90	ACRE	2,500	39,750
8	EXCAVATION HAULED OFF-SITE (NEW ROADWAY)	124,100.00	C.Y.	20	2,482,000
9	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	60,300.00	C.Y.	6	361,800
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	400.00	L.F.	75	30,000
12	CULVERT PIPE, 144" DIAMETER	200.00	L.F.	600	120,000
13	CRUSHED SURFACING BASE COURSE	18,000.00	TON	25	450,000
14	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	8,500.00	TON	90	765,000
15	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	4000.00	L.F.	35	140,000
16	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	8.00	EACH	2,700	21,600
17	PAINT LINE	28,000.00	L.F.	2	56,000
18	SEEDING, FERTILIZING, AND MULCHING	8.90	ACRE	2,000	17,800
19	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	11,000.00	EACH	14	154,000
20	LIVE STAKE	2,000.00	EACH	8	16,000
21	FINE COMPOST	3,520.00	C.Y.	40	140,800
22	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
23	SURVEYING	LUMP SUM	L.S.	50,000	50,000
24	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$6,553,799

Utilities: Chelan County PUD Pole & Line Relocation = \$1,250,000

Utilities: Sprint Fiber Optic Relocation = \$200,000

Right of Way = \$500,000

Contingencies @ 20% of Construction = \$1,310,760

Geotech Investigation @ 3% of Construction = \$196,614

Design and Construction Administration @ 25% of Construction = \$1,638,450

NEPA & Permits @ 20% of Construction = \$1,310,760

Project Total (in year 2011 dollars) = \$12,960,382

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$15,768,897

Project Total (in year 2021 dollars) = \$19,183,958

Table 4: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 3 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	450,315	450,315
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	200.00	DAY	200	40,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	55,732	55,732
5	SILT FENCE	8,000.00	L.F.	4	32,000
6	HIGH VISIBILITY CONSTRUCTION FENCE	16,000.00	L.F.	4	64,000
7	CLEARING AND GRUBBING	13.80	ACRE	2,500	34,500
8	EXCAVATION HAULED OFF-SITE (NEW ROADWAY)	108,100.00	C.Y.	20	2,162,000
9	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	54,000.00	C.Y.	6	324,000
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	400.00	L.F.	75	30,000
12	CULVERT PIPE, 144" DIAMETER	200.00	L.F.	600	120,000
13	CRUSHED SURFACING BASE COURSE	18,000.00	TON	25	450,000
14	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	8,500.00	TON	90	765,000
15	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	4000.00	L.F.	35	140,000
16	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	8.00	EACH	2,700	21,600
17	PAINT LINE	28,000.00	L.F.	2	56,000
18	SEEDING, FERTILIZING, AND MULCHING	6.80	ACRE	2,000	13,600
19	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	8,500.00	EACH	14	119,000
20	LIVE STAKE	2,000.00	EACH	8	16,000
21	FINE COMPOST	2,700.00	C.Y.	40	108,000
22	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
23	SURVEYING	LUMP SUM	L.S.	50,000	50,000
24	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$6,079,247

Utilities: Chelan County PUD Pole & Line Relocation = \$1,250,000

Utilities: Sprint Fiber Optic Relocation = \$200,000

Right of Way = \$500,000

Contingencies @ 20% of Construction = \$1,215,849

Geotech Investigation @ 3% of Construction = \$182,377

Design and Construction Administration @ 25% of Construction = \$1,519,812

NEPA & Permits @ 20% of Construction = \$1,215,849

Project Total (in year 2011 dollars) = \$12,163,134

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$14,798,885

Project Total (in year 2021 dollars) = \$18,003,871

Table 5: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 4 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	378,924	378,924
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	200.00	DAY	200	40,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	46,897	46,897
5	SILT FENCE	8,000.00	L.F.	4	32,000
6	HIGH VISIBILITY CONSTRUCTION FENCE	16,000.00	L.F.	4	64,000
7	CLEARING AND GRUBBING	19.90	ACRE	2,500	49,750
8	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	169,500.00	C.Y.	6	1,017,000
9	EMBANKMENT FILL IMPORTED TO SITE (NEW ROADWAY)	9,800.00	C.Y.	30	294,000
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	400.00	L.F.	75	30,000
12	CULVERT PIPE, 144" DIAMETER	200.00	L.F.	600	120,000
13	CRUSHED SURFACING BASE COURSE	18,900.00	TON	25	472,500
14	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	8,950.00	TON	90	805,500
15	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	4000.00	L.F.	35	140,000
16	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	8.00	EACH	2,700	21,600
17	PAINT LINE	28,000.00	L.F.	2	56,000
18	SEEDING, FERTILIZING, AND MULCHING	12.90	ACRE	2,000	25,800
19	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	16,000.00	EACH	14	224,000
20	LIVE STAKE	2,000.00	EACH	8	16,000
21	FINE COMPOST	5,100.00	C.Y.	40	204,000
22	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
23	SURVEYING	LUMP SUM	L.S.	50,000	50,000
24	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$5,115,470

Utilities: Chelan County PUD Pole & Line Relocation = \$1,250,000

Utilities: Sprint Fiber Optic Relocation = \$200,000

Right of Way = \$500,000

Contingencies @ 20% of Construction = \$1,023,094

Geotech Investigation @ 3% of Construction = \$153,464

Design and Construction Administration @ 25% of Construction = \$1,278,868

NEPA & Permits @ 20% of Construction = \$1,023,094

Project Total (in year 2011 dollars) = \$10,543,990

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$12,828,873

Project Total (in year 2021 dollars) = \$15,607,214

Table 6: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 5 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	466,592	466,592
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	200.00	DAY	200	40,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	57,747	57,747
5	SILT FENCE	8,650.00	L.F.	4	34,600
6	HIGH VISIBILITY CONSTRUCTION FENCE	17,300.00	L.F.	4	69,200
7	CLEARING AND GRUBBING	27.30	ACRE	2,500	68,250
8	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	275,800.00	C.Y.	6	1,654,800
9	EMBANKMENT FILL IMPORTED TO SITE (NEW ROADWAY)	15,500.00	C.Y.	30	465,000
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	500.00	L.F.	75	37,500
12	CRUSHED SURFACING BASE COURSE	19,500.00	TON	25	487,500
13	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	9,200.00	TON	90	828,000
14	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	4300.00	L.F.	35	150,500
15	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	8.00	EACH	2,700	21,600
16	PAINT LINE	30,000.00	L.F.	2	60,000
17	SEEDING, FERTILIZING, AND MULCHING	20.10	ACRE	2,000	40,200
18	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	28,000.00	EACH	14	392,000
19	LIVE STAKE	3,000.00	EACH	8	24,000
20	FINE COMPOST	8,100.00	C.Y.	40	324,000
21	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
22	SURVEYING	LUMP SUM	L.S.	50,000	50,000
23	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$6,298,988

Utilities: Chelan County PUD Pole & Line Relocation = \$1,500,000

Utilities: Sprint Fiber Optic Relocation = \$210,000

Right of Way = \$600,000

Contingencies @ 20% of Construction = \$1,259,798

Geotech Investigation @ 3% of Construction = \$188,970

Design and Construction Administration @ 25% of Construction = \$1,574,747

NEPA & Permits @ 20% of Construction = \$1,259,798

Project Total (in year 2011 dollars) = \$12,892,300

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$15,686,062

Project Total (in year 2021 dollars) = \$19,083,183

Table 7: SR207 MP 0.2 to MP 2.0 Realignment at Nason Creek - Option 6 Cost Estimate

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNITS	ESTIMATED UNIT COST	ITEM COST
1	MOBILIZATION (8% OF CONSTRUCTION ITEMS SUBTOTAL)	LUMP SUM	L.S.	842,275	842,275
2	SPCC PLAN	LUMP SUM	L.S.	2,500	2,500
3	ESC LEAD	250.00	DAY	200	50,000
4	EROSION / WATER POLLUTION CONTROL (1% CONST. SUBTOTAL)	LUMP SUM	L.S.	104,242	104,242
5	SILT FENCE	13,550.00	L.F.	4	54,200
6	HIGH VISIBILITY CONSTRUCTION FENCE	27,100.00	L.F.	4	108,400
7	CLEARING AND GRUBBING	38.00	ACRE	2,500	95,000
8	EXCAVATION USED AS FILL ON-SITE (NEW ROADWAY)	379,300.00	C.Y.	6	2,275,800
9	EMBANKMENT FILL IMPORTED TO SITE (NEW ROADWAY)	58,300.00	C.Y.	30	1,749,000
10	EXCAVATION HAULED OFF-SITE (EXISTING ROADWAY)	50,000.00	C.Y.	20	1,000,000
11	CULVERT PIPE, 24" DIAMETER	800.00	L.F.	75	60,000
12	BRIDGE (200' TOTAL SPAN AT DEBRIS CHUTE)	LUMP SUM	L.S.	1,720,000	1,720,000
13	CRUSHED SURFACING BASE COURSE	30,500.00	TON	25	762,500
14	ASPHALT (HMA CL. 1/2 IN. PG 64-22)	14,400.00	TON	90	1,296,000
15	WEATHERING STEEL BEAM GUARDRAIL TYPE 31	6800.00	L.F.	35	238,000
16	BEAM GUARDRAIL TYPE 31 NON-FLARED TERMINAL	10.00	EACH	2,700	27,000
17	PAINT LINE	47,500.00	L.F.	2	95,000
18	SEEDING, FERTILIZING, AND MULCHING	26.80	ACRE	2,000	53,600
19	PLANT SELECTION (VARIOUS SPECIES), #1 CONT., 12" HT. MIN	35,800.00	EACH	14	501,200
20	LIVE STAKE	4,000.00	EACH	8	32,000
21	FINE COMPOST	5,100.00	C.Y.	40	204,000
22	PROJECT TEMPORARY TRAFFIC CONTROL	LUMP SUM	L.S.	20,000	20,000
23	SURVEYING	LUMP SUM	L.S.	75,000	75,000
24	MINOR CHANGE	5,000.00	DOLLAR	1	5,000

Construction Total = \$11,370,717

Utilities: Chelan County PUD Pole & Line Relocation = \$2,100,000

Utilities: Sprint Fiber Optic Relocation = \$310,000

Right of Way = \$500,000

Contingencies @ 20% of Construction = \$2,274,143

Geotech Investigation @ 3% of Construction = \$341,122

Design and Construction Administration @ 25% of Construction = \$2,842,679

NEPA & Permits @ 20% of Construction = \$2,274,143

Project Total (in year 2011 dollars) = \$22,012,805

Assuming Inflation @ 4%

Project Total (in year 2016 dollars) = \$26,782,980

Project Total (in year 2021 dollars) = \$32,583,354

Table 8: A comparison of channel bed shear as calculated near RM 4.55. Note that installation of culverts or bridges results in very small changes in shear forces (velocity) against the SR 207 prism.

Location	Flow	Average Bed Shear (lbs/sq ft) in Main Channel		
		Existing Conditions	10' diameter or 30' box culvert	200' Bridges
Midpoint of Riprap near RM 4.55	May/June Typ.	0.3	0.3	0.3
	2yr Peak	1.3	1.3	1.3
	100yr Peak	3.2	3.1	3.0

Table 9: Summary of Community Involvement, Stakeholder, and Technical Review for the development of the 6 Alternatives in 2010.

Meeting	Date	Attendees/Notes
Wenatchee Habitat Sub-committee	Monthly April-Sept, November presentation	Monthly project status updates have been provided to the Wenatchee Watershed Action Team which consists of agency staff, interested public, and watershed planning unit members. At the November 17 meeting, the results of the alternatives analysis were presented and attendees were asked to provide comments on the alternatives.
WA Dept. of Transportation	May 6, October 6, December 1 and 22	Meetings with WSDOT regional planners and maintenance staff have indicated that WSDOT would support any of the draft alternatives, however, they do not have funds (or unfunded staff time) to contribute towards this project.
US Forest Service	May 4, May 15, October 4, January 6	Meetings with USFS staff have indicated that the USFS Nason Creek watershed action plan identifies restoration of stream processes as the highest priority. Therefore, USFS supports the road re-location (Alternative 1). USFS can seek funds for project development and permitting, however, they would need project partners to provide financial support for project construction.
Design Team	June 15	Provided a detailed project overview to agency staff and potential future funders including WA Dept. of Fish and Wildlife, Yakama Nation, Upper Columbia Salmon Recovery Board, US Bureau of Reclamation, and US Fish and Wildlife Service
Longview Timber	June 22	Met with Steve Tift, Longview Timber who expressed support for the project, however, the County GIS layer property boundaries are incorrect. Longview only owns the land west of Nason Creek and SR 207. Depending upon the final design plans and staging area locations, they may not be a landowner within the project area.
Salmon Recovery Funding Board (SRFB) Project Tour	June 23	SRFB review panel members, Regional Technical Review Team members, and Citizens Advisory Committee members visited the site and expressed interest in consideration of one additional project alternative, SR 207 relocation. This design alternative will be added to the alternatives analysis for consideration.
Regional Technical Team	July 7, December 17, January 12	July 7 presentation included a project overview and Q/A session with the SRFB review panel members and Regional Technical Team members. Written feedback from both groups indicated that the downstream connection or road relocation will likely be the recommended alternatives. On December 8, RTT members were provided a summary of project alternatives for review and the results of the alternatives analysis were presented on January 12.
Salmon Recovery Funding Board Review Panel	July and October	SRFB provided the following review comments: While relocating Highway 207 may be the ideal alternative from a fish habitat perspective, it is hard to imagine this alternative being considered in the near future.

Table 10. Summary of Community Involvement, Stakeholder, and Technical Review for the development of the SR 207 Nason Creek Alternatives Analysis

Meeting	Date	Attendees/Notes
Wenatchee Habitat Sub-committee	Monthly updates, August presentation	Monthly project status updates have been provided to the Wenatchee Watershed Action Team which consists of agency staff, interested public, and watershed planning unit members. At the August 17 meeting, the SR 207 relocation alternatives were presented.
WA Dept. of Transportation	April 22, June 15 and 29, Sept 6 and 12, March 26	The 2011 office and field meetings with WSDOT regional planners and engineers, Olympia CED office, and maintenance staff have focused on review of the SR 207 relocation options since 2010 meetings covered review of the other 5 alternatives. WSDOT prefers alternatives 1 – 4 due to the steeper slopes and possible avalanche hazards associated with alternatives 5 and 6. WSDOT does not have funding to contribute towards this project.
US Forest Service	April 1 and 22, June 9, 15, and 29, Sept 12 and 15, October 4	USFS owns the majority of the land for the SR 207 relocation alternative. Therefore, office and field meetings with USFS staff focused on reviewing the SR 207 relocation options to determine whether or not this alternative would be consistent with forest plan documents and designations. USFS has indicated that restoring natural stream processes in Nason Creek is a high priority for this watershed. Thus, the USFS Wenatchee River Ranger District supports working collaboratively with other stakeholders to explore in greater detail options for relocation of HWY 207.
BPA	Sept. 27 memo and October 13 meeting	Coordination with BPA engineering department has been to evaluate the construction feasibility of the SR 207 relocation options. On October 13, CCNRD provided a detailed project update to BPA fish and wildlife staff who funded the SR 207 feasibility study as part of the CCNRD-BPA Wenatchee habitat complexity contract.
CPUD	June 29	A June 29 th meeting with CPUD, USFS, and WSDOT staff discussed utility lines within the SR 207 alignment
Private Landowners	March 25, April 12, 19, 28, May 7, June 10, 16, 23 and 24, July 26, October 26	These dates represent phone calls, emails, letters, meetings, and/or field visits with private landowners in the project area and community members in the Nason Creek watershed. Future correspondence with landowners and the community will be necessary to select a preferred alternative.
Regional Technical Team	January 12 and September 14, 2011 and April 11, 2012	The results of the 2010 alternatives analysis were presented on January 12, 2011. The RTT voted to further investigate the feasibility of the SR 207 relocation. On September 14, RTT was updated on the project status with the road relocation alternative alignments and they provided feedback on how to analyze the biological benefit of this project. RTT will review the biological benefit analysis to determine if there is sufficient benefit to support the costs of SR 207 re-alignment.

Table 11: Alternatives Evaluation Summary Criteria

Evaluation Criteria		*	**	***
1. Design Standards and Maintenance				
	Does the project meet AASHTO design standards?	No		Yes
	Grade Changes	Large elevation gain		Little to no elevation gain
	Avalanche bypass structures	One or more		None
	Maintenance			
	Future maintenance cost	High or increased costs	Similar to existing levels	Will decrease the level of future maintenance costs
	Future maintenance impacts to fish habitat	Future maintenance will impact or degrade fish habitat	Future maintenance actions will have little to no impact or neutral impact to fish habitat	This action will reduce future maintenance impacts to fish habitat
	Potential for erosion of road prism	Stream flow velocities, and resulting erosion, will continue and likely increase causing further damage to the road prism		This alternative will reduce stream flow velocities against the road prism
	Constructability			
	Utility relocation (cost considered under cost)	May not be feasible; awaiting BPA response re. moving towers	Likely feasible, however, details need to be worked out with CPUD, Frontier, and Sprint	Not required
	Detour	Detour route undetermined and may have high temporary wetland/floodplain impacts	Temporary (a few days) road closure	Detour would not be required for construction
2. Cost		High > 5million	Moderate 1 - 5 million	Low < 1 million
3. Natural Environment				
	Biological benefit to fish habitat	Negative impacts to fish	Neutral	Improves fish habitat
	Wetland/floodplain impacts	High > 2 acres	Moderate 1 - 2 acres	Minimal < 1 acre
	Floodplain connectivity	Does not reconnect hydrologic or stream channel migration processes	Reconnects hydrologic connection to 13 acres of floodplain	Reconnects natural stream channel migration processes by reconnecting over 70 acres of floodplain
4. Meets Project Objectives				
	Travel safety	May not be safe for the traveling public	Does not meet AASHTO design standards	Meets AASHTO design standards
	Reduce current and future road maintenance impacts to fish habitat	Existing and future maintenance actions will continue to degrade fish habitat	Reduces stream flow velocity against the road prism but locks the mainstem in its current alignment	Reduces stream flow velocity against the road prism by removing the road from the floodplain
	Restoration of natural stream channel processes (floodplain connectivity)	Existing road alignment disconnects Nason Creek from 77 acres of adjacent floodplain which causes channel incision, reduced large wood accumulation, increased flow velocity, reduced channel sinuosity, and reduced instream habitat complexity/diversity	Maintains some channel sinuosity and/or reconnects some of the floodplain hydrology	Reduces stream flow velocity against the road prism by removing the road from the floodplain
5. Landowner Willingness				
	Public (USFS, WSDOT)	This alternative is not likely to be supported by the landowner(s) impacted	To be determined	Remains to be determined, however, preliminary contact indicates that this alternative is likely feasible with mitigation
	Private	This alternative is not likely to be supported by the landowner(s) impacted	To be determined	Remains to be determined, however, preliminary contact indicates that this alternative is likely feasible with mitigation

Table 12: Alternatives Evaluation Summary of Project Alternatives

Evaluation Criteria		Road Relocation	Causeway	Bridges	Culverts	ELJ's	No Action
1. Design Standards and Maintenance							
	Does the project meet AASHTO design safety standards ¹	***	***	***	***	***	N/A
	Grade	Varies	***	***	***	***	***
	Avalanche bypass structures	Varies	***	***	***	***	***
	Maintenance						
	Future maintenance cost	*	*	**	**	**	***
	Future maintenance impacts to fish habitat	***	**	**	**	**	*
	Potential for erosion of road prism	Varies	**	**	**	***	*
	Constructability						
	Utility relocation	Varies	?	***	***	***	***
	Detour	***	*	**	**	***	N/A
2. Cost		*	*	**	***	***	***
3. Natural Environment							
	Biological benefit to fish habitat	***	**	**	**	**	*
	Wetland/floodplain impacts	Varies	***	***	***	***	***
	Floodplain connectivity	***	**	**	**	*	*
4. Meets Project Objectives							
	Travel safety	***	***	***	***	***	**
	Reduce current and future road maintenance impacts to fish habitat	Varies	**	*	*	***	*
	Restoration of natural stream channel processes (floodplain connectivity)	***	**	**	**	**	*
5. Landowner Willingness							
	Public	Varies	*	**	**	**	***
	Private	Varies	N/A	N/A	N/A	N/A	***

¹Preliminary design meets AASHTO standards, thus, it is anticipated that final design would or could also meet those standards

Table 13: Alternatives Evaluation Summary Road Relocation Options

Evaluation Criteria		Road Relocation Options					
		1	2	3	4	5	6
Design Standards and Maintenance							
	Does the project meet AASHTO design safety standards	***	***	***	***	***	***
	Grade Changes	***	***	**	**	*	*
	Avalanche bypass structures	***	***	***	***	*	*
Maintenance							
	Future maintenance cost						
	Future maintenance impacts to fish habitat	*	*	**	**	***	***
	Potential for erosion of road prism	*	*	*	*	***	***
Constructability							
	Utility relocation	*	**	**	**	**	**
	Detour	***	***	***	***	***	***
Cost		*	*	*	*	*	*
Natural Environment							
	Biological benefit to fish habitat	**	**	**	**	***	***
	Wetland/floodplain impacts	*	*	**	**	***	***
	Floodplain connectivity	***	***	***	***	***	***
Meets Project Objectives							
	Travel safety	***	***	***	***	***	***
	Reduce current and future road maintenance impacts to fish habitat	***	***	***	***	***	***
	Restoration of natural stream channel processes (floodplain connectivity)	***	***	***	***	***	***
Landowner Willingness							
	Public USFS	*	*	**	**	***	***
	Public WSDOT	***	***	**	**	**	**
	Private	**	**	**	**	**	***