November 2020
Kittitas County Conservation District
The Ranch on Swauk Creek Diversion Improvement and Restoration Project

ANCHOR QEA

Design Report

Prepared for Kittitas County Conservation District

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ABBREVIATIONS

cfs	cubic foot per second
CMP	corrugated metal pipe
CPE	corrugated high-density polyethylene
ESA	Endangered Species Act
fps	feet per second
KCCD	Kittitas County Conservation District
NAVD88	North American Vertical Datum of 1988
NMFS	National Marine Fisheries Service
project	The Ranch on Swauk Creek Diversion Improvement and Restoration Project
RCO	Washington Recreation and Conservation Office
RM	River Mile
SRFB	Salmon Recovery Funding Board
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSEL	water surface elevation
YTAHP	Yakima Tributary Access and Habitat Program

1 Introduction

This Design Report was prepared for The Ranch on Swauk Creek Diversion Improvement and Restoration Project (project). The project is being implemented by Kittitas County Conservation District (KCCD), with the support of the Washington Department of Fish and Wildlife (WDFW) and with grant funding from the Washington Recreation and Conservation Office (RCO) through the Salmon Recovery Funding Board (SRFB).

KCCD proposes to restore fish passage and conserve instream flow in a reach of Swauk Creek by consolidating two gravity irrigation diversions that serve The Ranch on Swauk Creek to a single point of diversion. The project will also pipe portions of the irrigation conveyance ditch on the ranch to reduce evaporation and infiltration losses, and it will include planting cottonwood copses in strategic locations to provide shade and future woody debris for the stream and floodplain. This report outlines project objectives and constraints, summarizes how the project objectives have been addressed through the key elements incorporated into the design of the project, and includes analyses completed as a basis for the design of the project.

1.1 Project Background

The Yakima River basin has been modified by a complex array of reservoirs, diversion dams, canals, and drains used to divert and convey water for over 100 years. Humans have modified the timing and quantity of river and streamflows in the Yakima River and several of its tributaries. Tributaries to the Yakima River, especially those that do not have large dams and are not subject to storage reservoir operations, offer excellent opportunities to improve salmonid rearing habitat. KCCD has been working with the Yakima Tributary Access and Habitat Program (YTAHP) technical group, local agencies, and irrigators to improve fish passage on tributaries to the Yakima River in Kittitas County.

The proposed project is located on Swauk Creek, northwest of Ellensburg in Kittitas County. Swauk Creek is a tributary to the Yakima River. The Swauk Creek watershed drains an area of about 100 square miles before entering the Yakima River at River Mile (RM) 170. Swauk Creek is an important and productive spawning and rearing stream for Endangered Species Act (ESA)-listed steelhead, spring Chinook salmon, coho salmon, ESA-listed bull trout, and other species. Like other tributaries to the upper Yakima River, flow in Swauk Creek is largely derived from snow during the winter months and snowmelt in the spring. The upper Yakima River limiting factors analysis (Haring 2001) identified that low flows (or sometimes no flows) in lower Swauk Creek severely limit steelhead production and may preclude coho salmon spawning because flows are typically lowest in the fall.

Two irrigation diversions draw water from Swauk Creek at RM 7.71 and RM 7.92 to supply The Ranch on Swauk Creek, just upstream of where the creek crosses under U.S. Highway 97. The irrigation diversions are not screened in accordance with current National Marine Fisheries Service (NMFS) and

WDFW screening guidelines, resulting in mortality of fish when they are trapped in the irrigation systems. The diversions also represent partial barriers to fish migration.

The proposed project will consolidate the irrigation diversions into a single point of diversion with a fish screen that meets current WDFW fish-screening guidelines. The project will also correct fish passage barriers at the two existing points of diversion, convert a portion of an earthen delivery ditch to a buried pipeline to reduce evaporation and infiltration, and restore riparian areas by planting cottonwood copses in key locations to provide shade and future woody debris for the stream.

1.2 Prior Work

The current irrigation headgate and screen system was replaced in 2010 to reduce entrainment of fish in the irrigation ditch system. A short, steep rock ramp was installed at that time to raise the water elevation in the creek to allow for diversion at the upper headgate. This rock ramp shifted during high flows and no longer holds Swauk Creek to a sufficient elevation to maintain irrigation diversions throughout the irrigation season. A vertical flat plate screen with a propeller-driven mechanical brush was also installed in 2010, but the hydraulic conditions at the screen have not provided the appropriate velocities needed to move fish and debris past the screen and through the bypass back to the creek. In addition, the outlet of the fish bypass pipeline frequently becomes buried in sediment and is difficult to maintain.

1.3 Project Purpose

The overall purpose of the project is to improve fish passage and conserve instream flows in Swauk Creek by consolidating two gravity irrigation diversions on Swauk Creek to a single point of diversion, piping an irrigation conveyance channel to reduce evaporation and infiltration, and planting cottonwood copses in strategic locations to provide shade and future woody debris for the stream and floodplain. The design and implementation of key project elements are intended to achieve the following specific project objectives:

1. Eliminate irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.71 and significantly reduce the irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.92.
2. Restore year-round fish passage for all life stages of salmonids at Swauk Creek RM 7.71 and RM 7.92.
3. Improve summer rearing conditions for juvenile steelhead, coho, and Chinook salmon in Swauk Creek by increasing irrigation efficiency, resulting in up to 0.25 cubic foot per second (cfs) of conserved water (approximately 8% of the water right) available for instream flow benefits.

4. Increase canopy cover, provide shade, and produce a source of future large woody debris for Swauk Creek and its floodplain by planting up to approximately 3.5 acres with cottonwood copses.

1.4 Report Organization

This report includes the following sections:

- **Section 2, Project Location and Existing Conditions:** Describes existing conditions at the proposed project site and summarizes the design criteria and requirements for the project.
- **Section 3, Proposed Improvements:** Describes the proposed improvements at the project site.
- **Section 4, Design Criteria:** Lists the design criteria used in the development of project improvements.
- **Section 5, Design Analyses:** Summarizes the analyses completed to evaluate project alternatives, select a preferred project alternative, and develop the design of the project.
- **Section 6, Summary of Proposed Improvements:** Summarizes the key facilities included in the design of the project.
- **Section 7, Opinion of Probable Construction Cost:** Includes the opinions of probable project costs developed as part of the design and identifies cost considerations that have been evaluated and refined as part of the final design phase of the project.
- **Section 8, Summary and Recommendations:** Provides an overall summary and recommendations for design development and implementation.

2 Project Location and Existing Conditions

This section includes a brief description of the project site and its existing conditions.

2.1 Location

The proposed project is located on Swauk Creek (Water Resource Inventory Area [WRIA] 39), northwest of Ellensburg, Washington, in Kittitas County (Figure 2-1). The two irrigation diversions are located in the northwest quarter of Section 27, Township 20N, Range 17E, just upstream of where Swauk Creek crosses U.S. Highway 97 near the intersection of U.S. Highway 97 and Washington State Route 970.

2.2 Existing Conditions

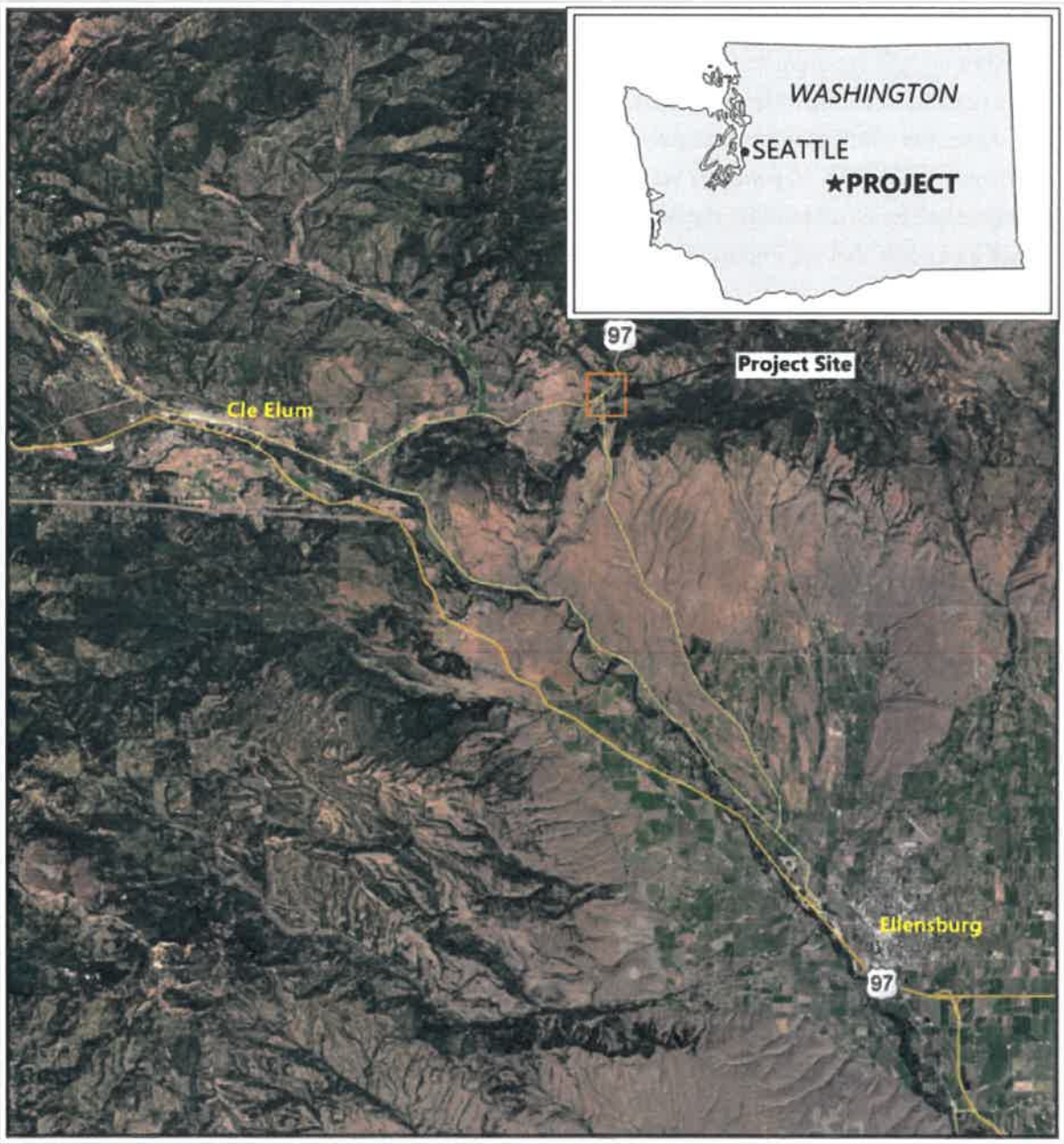
Existing conditions were observed during a site visit on April 29, 2020. Notes and photographs taken during the site visit are included as Appendix A. Key characteristics of Swauk Creek and the existing irrigation facilities at the site are summarized as follows.

2.2.1 Swauk Creek

Swauk Creek originates in the Wenatchee Mountains (a northwest-southeast trending spur of the Cascade Mountains) near Diamond Head peak (elevation 5,915 feet), just south of Blewett Pass. It flows for approximately 23 miles to its confluence with the Yakima River near RM 170. The Swauk Creek watershed is approximately 100 square miles. Swauk Creek drains approximately 83 square miles upstream of the project site. The upstream diversion is at an elevation of 2,191 feet (North American Vertical Datum of 1988 [NAVD88]). The basin is fed by multiple small tributaries. Like other tributaries to the upper Yakima River, the hydrology of Swauk Creek is defined by high spring and early summer flows driven by snowmelt, with low late summer and early fall flows. Although the drainage area of Swauk Creek is fairly large, precipitation in the Swauk Creek watershed is low, with the majority coming in the form of snow during the winter months. Late-summer low flow in lower Swauk Creek limits steelhead production and may preclude coho salmon spawning.

Aerial photography shows that most of the basin is forest canopy with no development. Previous logging is evident by the location of forest roads and drag marks. The creek channel in the upper portions of the drainage basin is steep, at an average grade of greater than 20%. However, the channel becomes flatter at approximately 2% grade through the last 10 miles of the basin upstream from the project site. The mean basin slope is approximately 33.6%.

Figure 2-1
Location Map



SOURCE: Basemap from ESRI

HORIZONTAL DATUM: Washington State Plane North Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet

0 4
Miles

A substantial number of commercial and private interests conducted gold prospecting throughout the upper Swauk Creek watershed in the late 1800s and early 1900s. The resulting impacts of mining activities are still apparent today. The relatively high degree of fine sediment within the system is a likely result of the long history of suction dredging. In addition, many of the coarse materials (boulders and cobbles) were dredged out of the creek and placed in mounds adjacent to the creek. In the mid-1950s, U.S. Highway 97 was constructed, and Swauk Creek was channelized and straightened to accommodate the highway. The cumulative effect of these actions has reduced large wood and pools that are important components of stream function and aquatic habitat.

2.2.1.1 Out-of-Stream Water Needs and Water Rights

The Ranch at Swauk Creek relies on Swauk Creek to provide stock water and irrigation water for up to 118.2 acres of pasture for raising of horses and livestock. The Ranch at Swauk Creek currently has water rights that allow for diversion of surface water from Swauk Creek of up to 2.0 cfs at RM 7.92 and up to 1.5 cfs at RM 7.71.

2.2.1.2 Fish Species Present

The primary fish species of concern in Swauk Creek listed under the ESA is mid-Columbia summer steelhead trout. Swauk Creek also provides habitat for ESA-listed spring Chinook salmon, ESA-listed bull trout, coho salmon, Pacific lamprey, cutthroat trout, and rainbow trout. NMFS identified the upper Yakima local steelhead population as being at high risk (NMFS 2011). Radio telemetry data from 2002 to 2014 indicate that 13% of upper Yakima steelhead spawn in Swauk Creek (USBR 2006; Temple et al. 2015). Table 2-1 provides a summary of the key fish species that may be present at the site.

Table 2-1
Key Fish Species Potentially Present at Project Site

Species	Endangered Species Act Coverage	Adult Migratory Season	Juvenile Migratory Season
Middle Columbia Summer Steelhead	Yes, Threatened	April to May	March to May
Coho Salmon	No	October to November	April to May
Spring Chinook Salmon	No	September	October to November
Columbia River Bull Trout	Yes, Threatened	October to November	Year-round
Pacific Lamprey	No	April to July	November or March to April

Upper Yakima steelhead hold in the mainstem river during the winter months and migrate to tributaries for spawning in the spring, possibly related to water temperature (Yakima Subbasin Fish

and Wildlife Planning Board 2004). Steelhead would thus be migrating through the creek during or just following the spring snowmelt runoff.

2.2.2 *Irrigation Diversion at RM 7.92*

The irrigation diversion at RM 7.92 consists of the following key components:

- **Headgate Structure**: Flow from Swauk Creek to the irrigation system is controlled by a 4-foot-wide slide gate mounted on a reinforced-concrete inlet structure on the right bank (looking downstream) of the creek. The existing headgate and inlet structure appear to be in good condition and operate as designed.
- **Fish Screen**: The headgate controls flow through a short segment of unlined ditch to the existing fish screen. The fish screen is a vertical flat plate screen mounted in a fabricated metal structure that was originally provided by WDFW. The screen is self-cleaning with a mechanical brush that is driven by a propeller that rotates in the irrigation water as it discharges through the structure downstream of the screen. The screen appears to consistently keep fish from being entrained in the irrigation ditch but frequently backwaters. The hydraulic conditions at the screen do not maintain consistent sweeping velocities to move fish and debris past the screen and through the bypass back to the creek. During the irrigation season, the existing screen requires very frequent cleaning (as often as every 2 hours).
- **Fish Bypass**: An 8-inch fish bypass pipeline conveys excess water, fish, and debris back to the creek. The bypass outlet at the creek frequently becomes buried in sediment and it appears, at times, that water backs up in the bypass and flows toward the screen.
- **Roughened Channel**: A previous project constructed in 2010 created a small roughened channel and rock weir structure immediately downstream from the intake to back the water up into the intake. Streambed boulders were placed in the channel to create the weir. However, it appears that some streambed boulders have shifted or settled and are not able to maintain adequate hydraulic conditions to keep the appropriate depth or flow of water needed in the diversion during the late summer.

To operate the current diversion system and maintain diversions during the late summer, the property owner currently installs an aluminum pole across the stream channel with a plastic tarp attached to it and anchored to the streambed to back up the water. These materials placed in the channel create a complete fish passage barrier while in place.

2.2.3 *Diversion at RM 7.71*

The diversion at RM 7.71 consists of the following key components:

- **Headgate Structure**: Flow from Swauk Creek to the irrigation system is controlled through a 16-inch canal gate mounted on a reinforced-concrete inlet structure on the left bank of the creek. The existing headgate and inlet structure appear to operate as designed.

- **Diversion Pipeline:** The headgate controls flow to a 16-inch-diameter steel pipeline that conveys water to the irrigation system. A combination of buried pipeline and open ditch conveys water from the point of diversion to the fish screen.
- **Fish Screen:** This diversion includes a vertical flat plate screen mounted in a fabricated metal structure that was originally provided by WDFW, similar to the fish screen at the upper diversion. However, the screen is far off-channel and downstream of the diversion, approximately 500 feet from the point of diversion, between the headgate structure and Burke Road. The screen is self-cleaning with a mechanical brush that is driven by a propeller that rotates in the irrigation water as it discharges through the structure. Because the fish screen is far downstream of the diversion on the ditch system, fish become entrained in the diversion system and cannot easily be returned to the creek. In addition, the existing fish screen appears to overtop multiple times a year when diverted flows exceed the capacity of the fish screen. A fish bypass pipeline returns bypass flows and fish to Swauk Creek at a discharge point near the U.S. Highway 97 bridge. The bypass pipe does not meet current fish passage guidelines and, during low flow conditions, drops water more than 3 feet into the rocky stream channel at the outlet.

The diversion facilities, diversion pipeline and ditch, fish screen, and bypass are not located on property owned by The Ranch at Swauk Creek. These facilities are also much less accessible than the diversion facilities at RM 7.92.

The gradient of the stream channel at this location is very steep and does not provide adequate depth or flow conditions during the late summer to maintain irrigation diversions. In addition, the diversion pipe inlet is high relative to the channel, so it is difficult to divert water, even when there is some depth in the creek adjacent to the diversion. Currently the property owner installs cattle fencing with a plastic tarp attached to it and temporary pipe extending up the left bank of the creek to maintain diversions during the late summer low-flow period. The owner deploys these materials to the creek as early as July to maintain diversions through the irrigation season.

The temporary materials placed in the channel at this diversion create a fish passage barrier. In addition, there are two drops over boulders in the channel adjacent to the headgate that are at least 12 inches high and may preclude passage by some fish species and juvenile fish.

2.2.4 Irrigation Delivery System

The existing delivery system conveys water to points of use primarily through a system of open, unlined earthen ditches and culverts. Up to 2.0 cfs flows through the upstream diversion to an open ditch that extends more than 850 feet west, where it then crosses under U.S. Highway 97 through an existing 36-inch corrugated metal pipe (CMP) culvert. Approximately 360 feet west of U.S. Highway 97, the ditch branches. The main flow continues west to irrigate pasture on ranch property north and west of Swauk Creek. Excess water flows in the other branch of the ditch south

along Burke Road, where it crosses through a series of culverts under an access driveway and Ranch Road, before discharging to Swauk Creek.

Up to 1.5 cfs flows through the downstream diversion to a 16-inch steel pipeline. A combination of pipelines and open ditches conveys diverted water to the fish screen, which is approximately 500 feet downstream of the point of diversion. Water for irrigation passes through the fish screen and is conveyed via a combination of buried pipelines, culverts, and open ditches to a structure on the east side of Burke Road. The structure controls flow through a culvert under Burke Road and allows for overflow through a branching ditch and culvert to Swauk Creek. Water conveyed for irrigation continues under Burke Road through a 24-inch corrugated high-density polyethylene (CPE) culvert to an open ditch that conveys water to a pond located on ranch property south of Burke Road. Water from the pond is used to irrigate pasture south and east of Swauk Creek.

3 Proposed Improvements

The proposed improvement project is shown on the design drawings included as Appendix B. These drawings represent design of a preferred alternative that was selected after evaluation of other potential design alternatives considered and summarized in Section 5 of this report. The project will consolidate the two gravity irrigation diversions on Swauk Creek at RM 7.92 and RM 7.71 to a single point of diversion, at the location of the existing upstream point of diversion (RM 7.92). The diversion facilities at RM 7.92 will be upgraded to handle the combined flow and address existing deficiencies. Improvements will also be made to the roughened channel at that location. The fish screen and bypass pipeline will also be replaced. The diversion facilities at RM 7.71 will be removed and the left bank of the stream channel will be restored. Segments of open irrigation ditches will be piped to conserve water. Cottonwood copses will be planted to enhance the riparian area along the creek west of Burke Road. These improvements are summarized as follows.

3.1 Diversion at RM 7.92

The diversion facilities at RM 7.92 will be upgraded to include a new rotating drum fish screen and fish bypass pipeline. Immediately downstream of the diversion, a roughened channel will be constructed to improve fish passage. The roughened channel design will include a low-flow channel approximately 80 feet long with a constructed slope of 2.5%. A gravel-cobble-boulder mix will be installed approximately 42 inches deep along the roughened channel section. Disturbed bank slopes and other areas will be revegetated by hydroseeding.

3.2 Diversion at RM 7.71

The diversion facilities at RM 7.71 will be abandoned by removing the structures in the stream, removing the first 20 feet of diversion piping, and plugging the remaining pipe with non-shrink grout. Disturbed bank slopes and other areas will be graded to a 2:1 slope and revegetated by hydroseeding.

3.3 Irrigation Delivery System

Portions of the existing open, unlined ditch conveyance system will be replaced with buried delivery pipelines to conserve water. The pipelines will deliver water from the upgraded diversion at RM 7.92 to locations south of Burke Road. The first section of conveyance pipeline will follow the general alignment of the existing ditch on the north side of Swauk Creek for approximately 850 feet from the intake to U.S. Highway 97 where it will discharge water under the highway through the existing culvert. Water conveyed under U.S. Highway 97 in the culvert will flow into a pipeline on the other side of the highway which will terminate approximately 360 feet downstream in a manhole, where the flow will be split. Up to 2.0 cfs will be conveyed to the west through a short segment of pipe to an open ditch that delivers water for irrigation of pasture on ranch property north and west of Swauk

Creek. Up to 1.5 cfs will be conveyed to the south through a pipeline that will cross Swauk Creek and deliver water to an open ditch that conveys water to a pond on ranch property south and east of Swauk Creek.

3.4 Riparian Planting

Up to approximately 3.5 acres of cottonwood copses will be planted in gaps in the riparian growth along Swauk Creek west of Burke Road. The cottonwood copses will provide shade and a future source of large woody debris for Swauk Creek and its floodplain. This work will be done by a volunteer crew or under a separate contract than the construction contract used to complete the diversion and irrigation system improvements.

4 Design Criteria

4.1 Design Flow Rates

Based on the analysis of available hydrologic data and WDFW fish passage design requirements, the following key flow rates and velocity criteria were identified for use in designing intake, piping, fish passage, and channel restoration improvements.

- Design flow rate for combined irrigation diversion = 3.5 cfs
- Design flow rate to pasture on north/west side of Swauk Creek = 2.0 cfs
- Design flow rate to pasture on south/east side of Swauk Creek = 1.5 cfs
- Low design flow for upstream adult fish passage = 4.6 cfs (80% overall exceedance flow)
- High design flow for upstream adult fish passage = 264 cfs (10% exceedance flow during the month of April for steelhead migratory season)
- 2-year flow = 356 cfs (channel-forming flow to inform design of channel restoration)
- 100-year flow = 1,180 cfs (peak flow to ensure channel stability, prevent upstream flooding)
- Maximum average channel velocity during high design flow (264 cfs) = 4.0 feet per second (fps)

4.2 Intake and Fish Screening Facilities

Fish screening facilities are required to meet the most current requirements for screening of diversions from WDFW and NMFS *Anadromous Salmonid Passage Facility Design Guidelines* (NMFS 2011), developed by the NMFS Northwest Region. The criteria applicable to the sizing and design of new screening facilities for the project include the following:

- Maximum approach velocity: 0.4 fps (assumes an active screen)
- Effective screen area: maximum screen flow/allowable approach velocity
- Submergence: 65% to 85% of drum diameter (for rotating drum screens)
- Sweeping velocity: 0.8 to 3.0 fps
- Screen material: corrosion-resistant and sufficiently durable to maintain a smooth, uniform surface with long-term use
- Maximum opening size
  - 0.087 inch for woven wire mesh (6 to 14 mesh)
  - 1.75 millimeters for slotted screens
  - 3/32-inch-diameter for circular screen openings (includes perforated plate)
  - 3/32 inch on diagonal for square screen openings
- Minimum open area: 27%

The project will use an existing screen that WDFW has already fabricated and is storing at its screen shop in Yakima, Washington. The screen will meet all of these criteria.

4.3 Delivery Pipelines

Pipelines will replace two sections of open, unlined conveyance ditches and will be designed to convey water from the intake to earthen conveyance ditches closer to the points of use. The pipelines will generally be designed to flow partially full by gravity. However, the profile of the segment of pipeline that crosses Swauk Creek will need to rise and fall in elevation and will be designed to flow full. The following requirements and criteria apply to the design of these pipelines:

- **Sizing of Gravity Flow Pipelines:** Gravity pipelines will be designed to convey the full flow rate while flowing less than 75% full. Pipe will be sized to maximize velocities while ensuring that pipelines have adequate capacity and do not flow full.
- **Sizing of Closed Pipelines:** As a general guideline, closed pipelines will be sized to limit velocities to a maximum of 5 fps and to limit pressure loss.
- **Pipe Roughness:** For completing hydraulic analysis of the proposed delivery system, a Manning's formula roughness coefficient (n) of 0.012 was used to estimate hydraulic loss in each delivery pipeline, consistent with recommendations of HDPE pipe manufacturers.
- **Trenching and Backfill:** Where possible, delivery pipelines will be designed with a minimum burial cover of at least 30 inches. Imported bedding and select backfill will be used to provide a solid foundation and protection for the pipeline.

5 Design Analyses

This section summarizes the analyses completed to support the selection of a preferred design alternative and design of the project.

5.1 Alternatives Considered

RCO Manual 18 provides guidance for funding of salmon recovery projects. Appendix D-2 of Manual 18 provides guidance for deliverables needed to demonstrate that salmon recovery funding goals are achieved by proposed design and construction projects. One of the key elements required for SRFB-funded projects is consideration and evaluation of alternatives to demonstrate that the design alternative selected provides the best overall solution for achieving stated salmon recovery project goals. The goals for this project, as stated in Section 1 of this report, include the following:

1. Eliminate irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.71 and significantly reduce the irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.92.
2. Restore year-round fish passage for all life stages of salmonids at Swauk Creek RM 7.71 and RM 7.92.
3. Improve summer rearing conditions for juvenile steelhead, coho, and Chinook salmon in Swauk Creek by increasing irrigation efficiency, resulting in up to 0.25 cfs of conserved water (approximately 8% of the water right) available for instream flow benefits.
4. Increase canopy cover, provide shade, and produce a source of future large woody debris for Swauk Creek and its floodplain by planting up to approximately 3.5 acres with cottonwood copses.

An initial review of the preliminary design report for the project by the SRFB Review Panel identified the need to document the design alternatives considered and provide an evaluation of alternatives sufficient to demonstrate that the selected design alternative is the best overall option for meeting the salmon recovery goals of the project. This section of the report outlines the alternatives that were considered, describes the benefits and challenges of each alternative considered, documents why the preferred alternative was selected as the best option for meeting the goals of the project, and provides detailed analysis to support the design of the preferred alternative.

The following alternatives were considered by KCCD for improving fish passage and habitat conditions along Swauk Creek through the project reach:

- **Alternative 1** is the preferred alternative described in detail in this report. It would consolidate the two gravity irrigation diversions on Swauk Creek at RM 7.92 and RM 7.71 to a single point of diversion, at the location of the existing upstream point of diversion (RM 7.92). The diversion facilities at RM 7.92 would be upgraded to handle the combined flow and address existing

deficiencies. Improvements would also be made to the roughened channel at that location. The fish screen and bypass pipeline would also be replaced. The diversion facilities at RM 7.71 would be removed and the left bank of the stream channel would be restored. Segments of open irrigation ditches would be piped to conserve water. Cottonwood copses would be planted to enhance the riparian area along the creek west of Burke Road.

- **Alternative 2** would maintain and upgrade diversion facilities at both RM 7.92 and RM 7.71. The design of new diversion facilities would be completed with the intent of reducing the scale and impact of the facilities on the stream channel, while ensuring that the facilities have the capacity to divert the full water right at each point of diversion to The Ranch at Swauk Creek. Improvements would include roughening the channel or installing rock weirs to ensure sufficient water surface elevations exist in the stream channel to maintain diversions of up to 2 cfs at RM 7.92 and up to 1.5 cfs at RM 7.71 throughout the irrigation season. Screening and bypass facilities would be upgraded to address deficiencies. Segments of open irrigation ditches would be piped to conserve water. Cottonwood copses would be planted to enhance the riparian area along the creek west of Burke Road.
- **Alternative 3** would consolidate the two gravity irrigation diversions on Swauk Creek at RM 7.92 and RM 7.71 to a single point of diversion at the location of the existing downstream point of diversion (RM 7.71). The diversion facilities at RM 7.71 would be upgraded to handle the combined flow and address existing deficiencies. Improvements would also be made to the stream channel at this location to ensure that the water surface elevations would be sufficient to maintain diversions. The fish screen and bypass would be replaced. The diversion at RM 7.92 would be removed and the right bank of the stream channel would be restored. Segments of open irrigation ditches would be piped to conserve water. Cottonwood copses would be planted to enhance the riparian area along the creek west of Burke Road.
- **Alternative 4** would be similar to Alternative 1, with the following variations:
  - Rather than installing a piped fish bypass to return fish from the screen to Swauk Creek, an open channel would be constructed to allow fish bypass/return at the point of diversion.
  - Rather than replacing open segments of ditch with buried pipelines, portions of the canal system would be selectively lined or partially piped to avoid removing native trees and shrubs and small patches of cattails near or within the existing irrigation ditch on the right bank of Swauk Creek.

Each of these alternatives would be designed and constructed to minimize or avoid dewatering of the stream channel and remove barriers to fish passage in Swauk Creek. For each alternative, the fish screen replacements and diversion facilities would be designed to minimize the size and impact of these facilities.

5.2 Alternatives Evaluation and Comparison

The alternatives were evaluated and compared to select a preferred alternative for design. Table 5-1 summarizes the key characteristics, challenges, and constraints associated with each alternative. Alternative 1 was selected as the preferred alternative based on evaluation and comparison of these key characteristics, challenges, and constraints. The following provides key conclusions from the evaluation that demonstrate why Alternative 1 was selected as the preferred design alternative:

- The invert elevation of the inlet to the diversion pipeline (2,178.8 feet) at the lower diversion (RM 7.71) is substantially higher than the invert of the stream channel adjacent to the diversion. Consequently, under low flow conditions, the ranch operator installs temporary pipe to extend the inlet up the channel to a location where the water surface elevation can be elevated to consistently divert water into the pipeline.
- The lower diversion (RM 7.71) is lower than the invert of the canal that delivers water from the upper diversion to the pasture north and west of Swauk Creek. The invert of the diversion pipeline is 2,178.8 feet and the invert of the culvert on the irrigation canal at Burke Road on the north side of Swauk Creek is just under 2,183.9 feet. Consequently, Alternative 3, which proposes to consolidate diversions at the location of the lower diversion, would not be feasible without pumping.
- The channel is steep both upstream and downstream of the lower diversion. Establishing stream conditions at the lower point of diversion that would be suitable for diverting water would require more extensive in-channel work than would be needed at the upper diversion location.
- The potential for fish to be entrapped in the existing lower diversion facilities is very high. The screening location is far (approximately 500 feet) downstream of the point of diversion at the left bank of Swauk Creek, and fish are easily entrapped in the diversion pipe and ditch segments between the creek and the fish screen.
- Fish that are entrained in the ditch will often remain in the ditch when irrigation water is shut off and can be left stranded in the segments of pipe and ditch between the creek and the fish screen, resulting in fish mortality.
- The upper diversion (RM 7.92) includes facilities that are much more consolidated, easier to access, and offer less opportunity for fish entrapment, injury, and mortality.
- The fish screen at the lower diversion does not function well and does not meet current WDFW and NMFS fish screening criteria. The screen is not as accessible as the upstream screen, and so it cannot be as easily adjusted to address problems that occur. The fish screen experiences inadequate sweeping velocity and overtops under high flow conditions.

Table 5-1
Comparison of Alternatives

Key Design Characteristic	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Proposed Improvements:				
Diversion at RM 7.92	Diversions to be consolidated at RM 7.92. Diversion to be upgraded to deliver 3.5 cfs without placing plastic and other materials in the creek.	Diversion to be upgraded so that full water right (2 cfs) can be diverted without placing plastic and other materials in the creek.	Diversion to be removed.	Diversions to be consolidated at RM 7.92. Diversion to be upgraded to deliver 3.5 cfs without placing plastic and other materials in the creek.
Diversion at RM 7.71	Diversion to be removed.	Diversion to be upgraded so that full water right (1.5 cfs) can be diverted without placing plastic and other materials in the creek.	Diversions to be consolidated at RM 7.71. Diversion to be upgraded to deliver 3.5 cfs without placing plastic and other materials in the creek.	Diversion to be removed.
In Channel	Install boulders and cobbles to create roughened channel rock ramp downstream of diversion at RM 7.92. No revisions to channel near diversion at RM 7.71.	Install boulders and cobbles to create roughened channel rock ramp downstream of diversion at RM 7.92. Install boulders and cobbles to create roughened channel from upstream of diversion at RM 7.71 downstream to US Highway 97 bridge.	No revisions to channel near diversion at RM 7.92. Install boulders and cobbles to create roughened channel from upstream of diversion at RM 7.71 downstream to US Highway 97 bridge.	Install boulders and cobbles to create roughened channel rock ramp downstream of diversion at RM 7.92.
Fish Screening	New rotating drum fish screen to be installed near RM 7.92. Fish screen on lower diversion system to be abandoned.	New rotating drum fish screen to be installed near RM 7.92. New fish screen to be installed closer to point of diversion at RM 7.71.	Fish screen on upper diversion system to be removed or abandoned. New fish screen to be installed closer to point of diversion at RM 7.71.	New rotating drum fish screen to be installed near RM 7.92. Fish screen on lower diversion system to be abandoned.

Key Design Characteristic	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Bypass	New bypass pipe to be installed from new fish screen near RM 7.92 to pool upstream of boulder on right bank of creek. Existing bypass pipe from screen on lower diversion to be removed or abandoned.	New bypass pipe to be installed from new fish screen near RM 7.92 to pool upstream of boulder on right bank of creek. Existing bypass pipe from screen on lower diversion to be abandoned. New bypass pipe to be installed from new fish screen location near RM 7.71.	Existing bypass pipe from screen on upper diversion to be removed or abandoned. Existing bypass pipe from screen on lower diversion to be removed or abandoned. New bypass pipe to be installed from new fish screen location near RM 7.71.	New bypass channel (open channel) to be installed from new fish screen near RM 7.92 to pool upstream of boulder on right bank of creek. Existing bypass pipe from screen on lower diversion to be removed or abandoned.
Irrigation Conveyance	Open ditches to be replaced with buried pipelines.	Open ditches to be replaced with buried pipelines.	Open ditches to be replaced with buried pipelines.	Open ditches to be partially lined or partially piped to preserve key riparian plants along ditch bank.
Challenges and Constraints:				
Diversion at RM 7.92	In-channel improvements would be needed to maintain diversion of 3.5 cfs. Improvements need to consider potential for flooding upstream.	In-channel improvements would be needed to maintain diversion of 2.0 cfs. Improvements need to consider potential for flooding upstream.	The existing diversion structure and headgate would need to be removed.	In-channel improvements would be needed to maintain diversion of 3.5 cfs. Improvements need to consider potential for flooding upstream.

Key Design Characteristic	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Diversion at RM 7.71	The diversion is less accessible. Approximately 500 feet of diversion pipeline and ditch between the point of diversion and the fish screen is not screened. Fish entrainment in the diversion facilities is a problem. Existing diversion facilities would need to be removed or abandoned.	The diversion is less accessible. Approximately 500 feet of diversion pipeline and ditch between the point of diversion and the fish screen is not screened. Fish entrainment in the diversion facilities is a problem. The diversion pipe inlet is high relative to the invert of the existing creek at RM 7.71. In-channel improvements would be needed to maintain diversion of 1.5 cfs. Improvements need to consider impact to US Highway 97 bridge.	The diversion is less accessible. Approximately 500 feet of diversion pipeline and ditch between the point of diversion and the fish screen is not screened. Fish entrainment in the diversion facilities is a problem. The diversion pipe inlet is high relative to the invert of the existing creek at RM 7.71. Diversion elevations are not high enough to deliver water by gravity to pasture on the north side of Swauk Creek. Replacement of the diversion structure and pipeline would be needed to increase capacity to 3.5 cfs. In-channel improvements would be needed to maintain diversion of 3.5 cfs. Improvements need to consider impact to US Highway 97 bridge.	The diversion is less accessible. Approximately 500 feet of diversion pipeline and ditch between the point of diversion and the fish screen is not screened. Fish entrainment in the diversion facilities is a problem. Existing diversion facilities would need to be removed or abandoned.

Key Design Characteristic	Alternative 1	Alternative 2	Alternative 3	Alternative 4
In Channel	Plastic draped over a metal rod is installed in the channel to maintain diversions at RM 7.92 in the late summer. It is a barrier to fish passage. In-channel improvements would be needed. Cattle rail with plastic draped over it and temporary pipe are installed to maintain diversions at RM 7.71. It is a barrier to fish passage. The diversion would be removed or abandoned.	Plastic draped over a metal rod is installed in the channel to maintain diversions at RM 7.92 in the late summer. It is a barrier to fish passage. In-channel improvements would be needed. Cattle rail with plastic draped over it and temporary pipe are installed to maintain diversions at RM 7.71. It is a barrier to fish passage. In-channel improvements would be needed.	Plastic draped over a metal rod is installed in the channel to maintain diversions at RM 7.92 in the late summer. It is a barrier to fish passage. The diversion would be removed or abandoned. Cattle rail with plastic draped over it and temporary pipe are installed to maintain diversions at RM 7.71. It is a barrier to fish passage. The diversion would be removed or abandoned.	Plastic draped over a metal rod is installed in the channel to maintain diversions at RM 7.92 in the late summer. It is a barrier to fish passage. In-channel improvements would be needed. Cattle rail with plastic draped over it and temporary pipe are installed to maintain diversions at RM 7.71. It is a barrier to fish passage. The diversion would be removed or abandoned.
Fish Screening	The existing fish screen at RM 7.92 is only sized for a diversion of 2.0 cfs. A new screen would be needed. Hydraulic conditions at the fish screen do not maintain sweeping velocities and the screen requires a lot of cleaning and maintenance. The existing fish screen for the diversion at RM 7.71 would be removed or abandoned.	Hydraulic conditions at the fish screen at RM 7.92 do not maintain sweeping velocities and the screen requires a lot of cleaning and maintenance. A new screen would be needed. The existing fish screen for the diversion at RM 7.71 is less accessible, too far (~500 feet) from the point of diversion; hydraulic conditions do not maintain appropriate sweeping velocities, and the screen is overtopped multiple times each season. A new screen would be needed closer to the point of diversion.	The existing fish screen for the diversion at RM 7.92 would be removed or abandoned. The existing fish screen for the diversion at RM 7.71 is only sized for a diversion of 1.5 cfs, is less accessible, and is too far (~500 feet) from the point of diversion. Hydraulic conditions do not maintain appropriate sweeping velocities, and the screen is overtopped multiple times each season. A new screen would be needed closer to the point of diversion.	The existing fish screen at RM 7.92 is only sized for a diversion of 2.0 cfs. A new screen would be needed. Hydraulic conditions at the fish screen do not maintain sweeping velocities and the screen requires a lot of cleaning and maintenance. The existing fish screen for the diversion at RM 7.71 would be removed or abandoned.

Key Design Characteristic	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Bypass	The existing fish bypass pipe outlet from the diversion at RM 7.92 frequently becomes buried in the creek bank. It would need to be relocated. The existing fish bypass pipe outlet from the diversion at RM 7.71 is perched 3 feet above a rocky bank with no plunge pool below. It would be removed or abandoned.	The existing fish bypass pipe outlet from the diversion at RM 7.92 frequently becomes buried in the creek bank. It would need to be relocated. The existing fish bypass pipe outlet from the diversion at RM 7.71 is perched 3 feet above a rocky bank with no plunge pool below. It would need to be relocated with the screen.	The existing fish bypass pipe outlet from the diversion at RM 7.92 frequently becomes buried in the creek bank. It would be removed or abandoned. The existing fish bypass pipe outlet from the diversion at RM 7.71 is perched 3 feet above a rocky bank with no plunge pool below. It would need to be relocated with the screen.	The existing fish bypass pipe outlet from the diversion at RM 7.92 frequently becomes buried in the creek bank. It would need to be relocated. The existing fish bypass pipe outlet from the diversion at RM 7.71 is perched 3 feet above a rocky bank with no plunge pool below. It would need to be relocated with the screen.
Irrigation Conveyance	The existing ditch on the right bank, supplied by the diversion at RM 7.92, is constructed in permeable alluvial material. The existing pipeline and ditch on the left bank, supplied by diversion at RM 7.71, is also constructed in alluvial material, is less accessible, and is not on property owned by the ranch.	The existing ditch on the right bank, supplied by the diversion at RM 7.92, is constructed in permeable alluvial material. The existing pipeline and ditch on the left bank, supplied by diversion at RM 7.71, is also constructed in alluvial material, is less accessible, and is not on property owned by the ranch.	The existing ditch on the right bank, supplied by the diversion at RM 7.92, is constructed in permeable alluvial material. The existing pipeline and ditch on the left bank, supplied by diversion at RM 7.71, is also constructed in alluvial material, is less accessible, and is not on property owned by the ranch.	The existing ditch on the right bank, supplied by the diversion at RM 7.92, is constructed in permeable alluvial material. The existing pipeline and ditch on left bank, supplied by diversion at RM 7.71, is also constructed in alluvial material, is less accessible, and is not on property owned by the ranch.

- The fish bypass at the lower diversion does not function well and does not meet current WDFW NMFS guidelines. The bypass has been blocked at times to keep the screen functioning and delivering the flow rate needed by the ranch. The outlet of the fish bypass is perched 3 feet above the rocky bank of Swauk Creek with no plunge pool to safely return fish to the creek, causing injury and mortality to fish.
- The lower diversion, pipeline, ditch, fish screen, and bypass are not located on The Ranch at Swauk Creek property and access to the facilities is much more challenging.
- The lower point of diversion is just upstream of the U.S. Highway 97 bridge. The work required in the Swauk Creek channel to make the diversion reliable and operable without deploying barriers to the stream channel each summer could adversely affect the bridge structure downstream and would require additional analysis and potentially additional work at the bridge.
- Consolidating the irrigation points of diversion at the upper diversion location (RM 7.92) would eliminate a significant source of fish entrainment, injury, and mortality.
- Constructing an open channel bypass at the upstream diversion (RM 7.92) would be challenging due to the topography along the right bank of the creek. The channel would have to be relatively deep with a very gentle slope. Under high flows, water could back up into the diversion channel, and under peak flow conditions, the water surface would overtop the right bank and there would be risk of washing out the narrow bank that would remain between the fish bypass channel and the creek. A buried, piped bypass would reduce the risk of damage at high flows.
- Selectively lining and/or partially piping the canal, rather than fully replacing the open irrigation canal on the right bank of the creek with piping, may be feasible for the sake of preserving riparian vegetation that has developed adjacent to the canal. However, the following are benefits for replacing the canal with pipe:
  - The material between Swauk Creek and the irrigation canal is generally coarse, highly permeable alluvial sands, gravels, and cobbles. Consequently, groundwater levels generally correspond closely with creek levels and groundwater is relatively shallow, especially when the creek levels are high.
  - It is unlikely that groundwater levels adjacent to the canal are wholly influenced by the canal alone, but are also hydraulically connected to the adjacent creek.
  - In the late part of the irrigation season, when creek levels are low, it has become extremely difficult to divert water to the irrigation canal and keep enough flow in the canal for irrigation.
  - In the early part of the irrigation season, when the creek is high, the canal can also gain water via high groundwater that seeps into the canal from the creek.
- Based on these considerations, KCCD recommended piping the canal to potentially conserve up to 0.25 cfs by reducing seepage. KCCD determined that the water conservation savings would be worth the potential risk to riparian vegetation. The conserved water would reduce the amount diverted, providing a flow benefit to the creek. Final calculations of conserved water that would

result from converting the open ditch to a pipeline for delivery will be completed after additional assessment (continued flow measurement and potential the use of the U.S. Department of Agriculture Natural Resources Conservation Service ditch loss calculator).

Overall, resolving the issues at the lower point of diversion would require a complete reconfiguration of the diversion system, which would require much more effort and cost. As a result, Alternatives 2 and 3, which would require continued use of the lower diversion at RM 7.71, were not selected as the preferred alternative.

Providing an open bypass canal, which was identified as part of Alternative 4, would expose the right bank to potential damage and washout at the diversion under high flow conditions and was not considered a preferred option. Likewise, lining or partial piping of the irrigation ditch was considered feasible but would not provide the same level of conservation savings as replacing the irrigation ditch with piping and was not recommended as a preferred option.

Based on this analysis and comparison of potential alternatives, Alternative 1 was identified as the preferred alternative and best option for meeting the salmon recovery goals for the project and improving the operation of the irrigation system that serves The Ranch at Swauk Creek.

5.3 Hydrologic Analysis

The hydrology of Swauk Creek was evaluated to determine likely flow conditions at the project site. To the extent possible, the project will be designed to maintain diversions throughout the irrigation season and provide fish passage during critical migratory periods for key fish species. This section provides a summary of that analysis.

5.3.1 Existing Flow Data

The Swauk Creek watershed drains approximately 83 square miles upstream of the project site and is predominately a snowmelt-dominated system. The U.S. Geological Survey (USGS) StreamStats (USGS 2020) program estimates that the mean annual precipitation in the watershed is approximately 27 inches per year, but precipitation varies widely throughout the watershed, depending on location and elevation. Flows in the creek are continuously monitored at the following location:

- **Ecology Gage No. 39M130, Swauk Creek Below First Creek:** This gage is located approximately 0.5 mile northeast of the intersection of U.S. Highways 97 and 970 at latitude 47°12'30", longitude 120°42'2", approximately 0.4 mile upstream from the proposed project site. Flows have been monitored at this location since May 2014.

5.3.2 *Annual Variation in Flow Rates*

Peak flows in Swauk Creek typically correspond with winter and spring storm events and snowmelt. Because peak flows occur outside the irrigation season, it is unlikely that diversions have a significant impact on peak streamflow rates measured at the gage on Swauk Creek.

The peak 15-minute flow rates measured on Swauk Creek at Ecology Gage No. 39M130 were 498 cfs (recorded December 10, 2015; February 15, 17, and 18, 2016). Because the period of flow measurement covers only 6 years, a precise estimate of the 100-year flood flow rate cannot be made from the data available. The StreamStats program estimates the 100-year flow at 1,180 cfs. Because a precise estimate of the 100-year flood flow rate could not be made from the gage data available, the StreamStats estimated 100-year flow was used as a peak flow rate for design of the proposed improvements.

Flow statistics for daily mean flows recorded at Ecology Gage No. 39M130 are plotted in Figure 5-1. The 10%, 50%, and 90% daily mean exceedance values are plotted to show the variability of flows throughout the year. The 10% exceedance values represent wet conditions, the 90% exceedance values represent dry conditions, and the 50% exceedance values represent the median. These are plotted against the 10%, 50%, and 90% overall exceedance values for the full record of daily mean flows recorded at this gage.

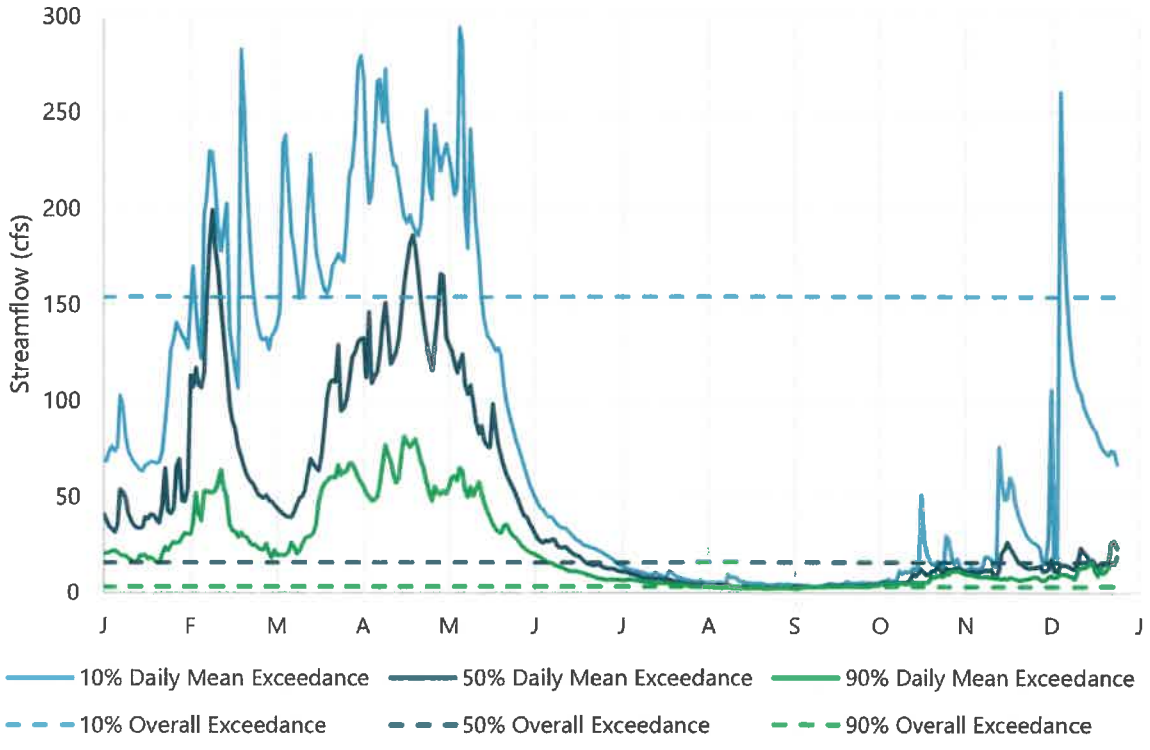
Streamflow statistics are summarized in Table 5-2. As shown in Figure 5-1 and in Table 5-2, for wetter than normal years, flows at the Ecology gage are typically greater than 3.0 cfs throughout the irrigation season. However, daily mean flows measured at the Ecology gage typically drop below 3.0 cfs during the late summer in normal to drier than normal years.

WDFW fish passage design guidance (WDFW 2013) indicates that the high design flow should be the 10% exceedance flow for the month(s) of migration for the species of interest, in this case summer steelhead. From data on adult fish tracking in Swauk Creek, April sees the majority of adult steelhead passing through the system. The 10% exceedance flow for April is 264 cfs. For the low-flow design, WDFW (2013) recommends using either the 2-year, 7-day low flow, or a zero flow. However, the 80% exceedance flow was chosen because it is a very low flow when accounting for irrigation withdrawals of up to 3.5 cfs. As an illustration, the 90% exceedance flow of 3.2 cfs is less than the water right.

Low flows naturally occur during the late summer and early fall, when irrigation demand is the highest. Table 5-3 summarizes average late-summer 2-week average flow rates in Swauk Creek, based on the flows measured at Ecology Gage No. 39M130. The data indicate that flows in late August and early September may be less than the total 3.5 cfs surface water right at The Ranch at Swauk Creek, which suggests that during the late summer, the ranch may not be able to fulfill its water right. A detailed trust water right analysis, as summarized following Table 5-3, was completed

by KCCD as part of this study to demonstrate that the probability of dewatering the creek at the proposed diversion is very low.

Figure 5-1
Daily Mean Flow Exceedance Probability – Swauk Creek at First Creek



Ecology Gage No.: 39M130
Period of Record: May 2014 to June 2020

Table 5-2
Swauk Creek Streamflow Statistics

Parameter	Streamflow (cfs)							
	2014 (Partial)	2015	2016	2017	2018	2019	2020 (Partial)	All Years
Maximum	227	236	498	311	411	255	99.8	498
Minimum	3.0	1.6	1.6	2.3	1.7	1.4	2.6	1.4
Average	34.9	33.9	80.5	62.6	53.8	28.9	33.3	48.8

Parameter	Streamflow (cfs)							
	2014 (Partial)	2015	2016	2017	2018	2019	2020 (Partial)	All Years
10% Exceedance	125	120	210	213	191	101	162	154
90% Exceedance	3.9	5.2	3.2	3.0	3.0	3.6	3.1	3.2

Note: Streamflow data from Ecology Gage No. 39M130

Table 5-3
Summary of Irrigation Season 2-Week Flow Rates

Date Range	Average Flow (cfs)
April 1 to April 15	145.9
April 15 to April 30	141.7
May 1 to May 15	133.8
May 15 to May 31	76.8
June 1 to June 15	31.0
June 15 to June 30	18.1
July 1 to July 15	10.0
July 15 to July 31	6.4
August 1 to August 15	4.2
August 15 to August 31	3.3
September 1 to September 15	3.1
September 15 to September 30	3.8

Note: Streamflow data from Ecology Gage No. 39M130

5.3.3 Trust Water Right Analysis

A trust water right analysis was completed by KCCD to more closely evaluate water availability for both irrigation and maintaining instream flows below the proposed consolidated diversion for The Ranch at Swauk Creek at RM 7.92. That analysis is included in Appendix C.

In addition to the irrigation diversions on Swauk Creek,, another irrigation diversion was located at RM 3.9 on First Creek, which is a left-bank tributary that joins Swauk Creek at RM 8.4, upstream of The Ranch at Swauk Creek. The water right on First Creek has the senior water right in the watershed, with a priority date of 1877. The water rights for The Ranch at Swauk Creek are next in priority, with a priority date of 1878. Portions of these water rights have since been put into trust to maintain instream flows. Trust water quantities associated with these diversions restrict the quantity of water that can be diverted for irrigation depending on the flow conditions in First Creek and Swauk Creek.

Trust water right quantities associated with the water rights on First Creek and on Swauk Creek at The Ranch on Swauk Creek vary based on the month of the irrigation season. The quantity of trust water on First Creek is established at the point of diversion at RM 3.9 on First Creek and is expected to remain as instream flow in First Creek and downstream in Swauk Creek, beyond the diversions at either RM 7.92 or RM 7.71. The quantity of trust water in First Creek may be adjusted if the flow from First Creek to Swauk Creek, as measured at the mount of First Creek, is below the trust water quantity. The quantity of water diverted to The Ranch at Swauk Creek is also subject to a trust water right on Swauk Creek.

Due to natural fluctuations in flows in First and Swauk Creeks, trust water quantities and the quantity of water available for irrigation diversions are typically impacted most frequently during the mid to late summer months, when natural flows are lowest. During low flow conditions, when flows in First Creek and Swauk Creek are less than the combined trust water and irrigation water rights, the following adjustments are made:

- The trust water quantity in First Creek is reduced to the flow rate measured at the mouth.
- The flow rate measured at the mouth of First Creek (the trust water quantity) is expected to pass The Ranch at Swauk Creek diversion at RM 7.92 and continue down Swauk Creek.
- The flow in Swauk Creek is reduced by the trust water quantity from First Creek and then prorated based on the trust water quantity for Swauk Creek, which is a percentage of the total water right on Swauk Creek. For example, in August, the flow measured at the mouth of First Creek would be subtracted from the total flow in Swauk Creek as the instream quantity for First Creek. The remaining flow would be multiplied by 89.74% to accommodate the trust water quantity associated with the water right on Swauk Creek. The resulting flow would be available for diversion to The Ranch at Swauk Creek.

KCCD completed an analysis of flow rates recorded at the Ecology flow monitoring gage on Swauk Creek to determine what quantities of water would have been available for irrigation diversion to The Ranch at Swauk Creek and what flow rates would have been passed downstream as instream flows through the period of historical flow record. The results indicate that the reach of Swauk Creek downstream of the diversion would not have been dewatered during this period. Flows downstream of the diversions to The Ranch at Swauk Creek would have dropped to approximately 0.92 cfs in the summer of 2018. Flows available for diversion to the ranch would have dropped to 2.1 cfs late in the summer of 2018.

5.4 Hydraulic Analysis

5.4.1 Intake Hydraulics

Existing and proposed stream channel conditions were modeled using the U.S. Army Corps of Engineers (USACE) Hydrologic Modeling System software one-dimensional hydraulic model (HEC-RAS; USACE 2017) to determine velocities, flow depths, and shear stresses on the channel and to compare existing and proposed channel conditions. The following topographic data were used for modeling existing conditions:

- **Surveyed Topography (2020):** As part of this project, KCCD subcontracted with HLA Engineering and Land Surveying, Inc., to collect topographic data of the creek, diversion ditch, intake facilities, and adjacent upland areas.
- **LiDAR Data:** For areas beyond the extents of these two datasets, contours generated from LiDAR data from the Washington Department of Natural Resources LiDAR Portal were incorporated into the surface to complete the topography.

The proposed design contours and channel sections were used to modify existing channel sections, and to model proposed conditions. The existing conditions and alternatives were modeled using the following design flow conditions:

- Q_{low} = 4.6 cfs (80% overall exceedance flow)
- Q_{high} = 264 cfs (10% exceedance flow during April steelhead migratory season)
- $Q_{2\text{-year}}$ = 356 cfs (channel-forming flow to inform the design of channel restoration elements)
- $Q_{100\text{-year}}$ = 1,180 cfs (peak flow to ensure stability of design elements)

A Manning's roughness coefficient (n) of 0.045 was used to model all but the low-flow condition. Given the depth of flow relative to the rock size during the low-flow condition, a much higher n value of 0.25 was used. The low-flow roughness coefficient was selected based on guidance in the U.S. Forest Service technical report *Photographic Guidance for Selecting Flow Resistance Coefficients in High-Gradient Channels* (Yochum 2014).

The 2-year flow was included as the channel-forming flow, during which velocities and shear stresses will have a high impact on the geomorphic response of the channel. The 100-year flow estimated by the StreamStats program was modeled to evaluate channel stability under peak flow conditions.

Table 5-4 summarizes the average channel velocities at key cross sections for both existing and proposed conditions at the 100-year, 2-year, 10% April exceedance, and 80% overall exceedance flows. More detailed HEC-RAS results are included as Appendix D.

Table 5-4
Summary of Hydraulic Analysis Results at Key Sections

Channel Cross Section Location Relative to Intake	Model Station (feet)	Channel Manning's Roughness (n) Used	Flow	Average Velocity, Existing Conditions (fps)	Average Velocity, Proposed Conditions (fps)
104 feet upstream	5069.13	0.045	100-Year	11.36	11.60
		0.045	2-Year	7.40	7.35
		0.045	April 10% Exceedance	6.36	6.27
		0.25	80% Exceedance	0.31	0.33
79 feet upstream	5043.89	0.045	100-Year	9.73	7.39
		0.045	2-Year	6.91	5.37
		0.045	10% Exceedance (April)	6.03	4.95
		0.25	80% Exceedance	0.34	0.73
32 feet upstream	4997.51	0.045	100-Year	9.61	5.94
		0.045	2-Year	6.8	3.03
		0.045	10% Exceedance (April)	6.17	2.56
		0.25	80% Exceedance	2.26	0.11
Intake	4965.06	0.045	100-Year	8.11	9.27
		0.045	2-Year	5.21	4.51
		0.045	10% Exceedance (April)	4.74	4.14
		0.25	80% Exceedance	0.35	0.45
21 feet downstream	4943.60	0.045	100-Year	6.16	7.01
		0.045	2-Year	4.51	6.68
		0.045	10% Exceedance (April)	3.93	5.89
		0.25	80% Exceedance	0.22	0.54
57 feet downstream	4908.09	0.045	100-Year	6.65	8.83
		0.045	2-Year	4.8	6.56
		0.045	10% Exceedance (April)	4.46	5.75
		0.25	80% Exceedance	0.34	0.81
94 feet downstream	4871.20	0.045	100-Year	6.27	7.11
		0.045	2-Year	4.18	4.84
		0.045	10% Exceedance (April)	3.86	4.59
		0.25	80% Exceedance	0.41	0.47

Channel Cross Section Location Relative to Intake	Model Station (feet)	Channel Manning's Roughness (n) Used	Flow	Average Velocity, Existing Conditions (fps)	Average Velocity, Proposed Conditions (fps)
118 feet downstream	4847.25	0.045	100-Year	4.12	4.95
		0.045	2-Year	2.73	3.24
		0.045	10% Exceedance (April)	2.47	3.00
		0.25	80% Exceedance	0.17	0.24

Notes:
1. The 100-year flow was 1,180 cfs
2. The 2-year flow was 356 cfs
3. The 10% exceedance flow for April was 264 cfs
4. The 80% overall exceedance flow is 4.6 cfs.

Potential changes in average channel velocity were estimated between existing and proposed conditions during the 10% April and 80% low flows (fish passage design flows) to identify fish passability of the proposed roughened channel. For the most part, velocities upstream of the diversion are slightly lower for the proposed condition under the 10% exceedance flows and slightly higher for the 80% exceedance flows. Velocities downstream of the intake along the roughened channel are estimated to be higher under the proposed conditions, with average velocities along the roughened channel for the 10% exceedance flows ranging from 3.0 to 5.9 fps. WDFW guidance recommends that the average flow velocities in the channel during migration should not exceed 4 fps for culverts and other crossings (WDFW 2013). The estimated velocities under the proposed conditions exceed this value; however, they are similar to velocities in the creek channel both upstream and downstream of the roughened channel and are well within the swimming capabilities of both adult steelhead and coho salmon that can swim at sustained speeds of 4 to 10 fps (Bell 1991). During the low design flow, average velocities are below 1 fps. Because the roughened channel will have large rock spaced throughout the ramp that would create hydraulic shadows (low-velocity areas behind the rocks), it is likely that juvenile fish would be able to pass upstream during low flows.

Potential changes in velocity were also compared for existing and proposed conditions at the 2-year flow event and the 100-year flow event (Table 5-4). These flows both contribute to channel-forming and geomorphic processes, but fish would not likely be attempting to migrate upstream during these peak flows. The velocities during the 100-year event are additionally important for channel stability, and the proposed design generally shows similar velocities overall, with some cross sections showing higher velocities and some showing lower velocities. The sections showing a reduction in the 100-year velocities indicate that channel stability will improve once the project is constructed. Sections showing increased velocities are mainly along the roughened channel which was designed to withstand higher velocities.

The HEC-RAS model indicates that under the modeled 100-year flow conditions, the water surface in the creek would overtop the intake structure by almost 1 foot. Flow conditions approaching the 1,180-cfs flow modeled as the 100-year flow were not observed in the period of record at Ecology Gage No. 39M130. The highest flow recorded at the gage was 498 cfs during the winter of 2015 to 2016. The model indicates the water surface in the creek would overtop the intake structure by approximately 0.3 foot at this flow rate. We are not aware of conditions that were observed during this event, but the aerial photographs indicate that the stream has shifted course upstream of the intake location over the last 10 years. Table 5-5 summarizes the water surface elevations calculated in the model for the 100-year flow conditions near the intake. The greatest increase in water surface elevation occurs nearest the intake structure. The modeled 100-year water surface elevation does not appear to impact any houses or other structures and is likely similar to the conditions before the previous rock ramp shifted.

Table 5-5
Modeled 100-Year Water Surface Elevations at Key Sections

Channel Cross Section Location Relative to Intake	Model Station (feet)	Water Surface Elevation, Existing Conditions (ft)	Water Surface Elevation, Proposed Conditions (ft)	Difference (ft) [Proposed]-[Existing]
104 feet upstream	5069.13	2196.22	2196.19	-0.03
79 feet upstream	5043.89	2195.84	2196.56	0.72
32 feet upstream	4997.51	2194.88	2196.44	1.56
Intake	4965.06	2194.67	2195.46	0.79
21 feet downstream	4943.60	2194.76	2195.42	0.66
57 feet downstream	4908.09	2194.34	2194.39	0.05
94 feet downstream	4871.20	2194.18	2193.62	-0.56
118 feet downstream	4847.25	2194.30	2193.77	-0.53

5.4.2 Fish Screen Analysis

As noted in Section 4.2, fish screening facilities will need to be designed to meet the most current requirements for screening of diversions from the WDFW and NMFS *Anadromous Salmonid Passage Facility Design Guidelines* (NMFS 2011). Based on discussions with KCCD and WDFW, it is proposed that a modular rotating drum screen that has already been fabricated by WDFW and is being stored at WDFW's Yakima Screen Shop will be used for this project. Information about the proposed fish screen to be used for this project is included in Appendix E.

It is our understanding that WDFW will furnish and deliver the rotating drum screen and will assist with installation in generally the same location as the existing screen. The project contractor will be required to perform the earthwork needed to accommodate the new screen, and to place and

compact foundation material for the screen. The screen is a 24-inch-diameter, 6-foot-long modular rotating drum screen and has been designed by WDFW for a maximum flow rate of approximately 3.6 cfs. For the screen to operate properly, the hydraulic conditions need to maintain proper submergence, which means that the screen needs to stay 65% to 85% submerged relative to the height of the screen while in operation.

5.4.3 Hydraulic Analysis of Delivery Pipeline

Hydraulic calculations were also completed to support the sizing and design of the delivery pipelines proposed to replace open gravity ditches. Gravity pipelines were evaluated using a backwater spreadsheet model that calculates hydraulic losses in a pipeline based on Manning's equation. The calculations also estimate velocities and the profile of the water surface in the pipeline. The calculations assume smooth-walled CPE pipe with a Manning's n value of 0.012 for delivery pipelines that will operate partially full under gravity flow conditions. For delivery pipelines that run full, the analysis assumed that butt-fused, solid-wall HDPE pipe would be used, also with an n value of 0.012. These calculations are included as Appendix F.

The proposed pipeline will mostly operate as gravity flow, running partially full. Pipeline segments have been designed so that pipelines will flow generally less than 75% full under design flow conditions. These segments of pipeline will be watertight CPE pipe. The segment of pipeline that extends south from Ranch Road along the south side of Burke Road will have a profile with low points and high points, as required to cross the bridge over Swauk Creek and maintain appropriate depths of cover elsewhere. This segment of pipe will be designed to run full by filling the upstream manhole to an elevation that is above the crown of the pipe and discharging to a downstream manhole that is full above the elevation of the crown of the pipe. Because this segment of pipe will run full, it will need to be designed to accommodate low pressures, so solid-wall, butt-fused HDPE pipe is recommended. Based on the results of the analysis, pipe sizes will vary from 10-inch diameter for the pipeline extending south along Burke Road to 15-inch diameter for the pipeline that conveys water from the intake facilities to the manhole at Burke Road.

5.5 Geology and Geomorphology

The geology of the watershed is predominantly Tertiary-era, nonmarine sedimentary rocks and basalts in the Swauk and Wenatchee Formations and related ash-flow tuffs, and Miocene-era basalt flows from the Columbia River basalts overlaying much older metamorphic schists. These layers were folded and uplifted as the Cascade Range rose and the Columbia Plateau subsided (Tabor et al. 1982). Surficial deposits include glacial morainal deposits and glacial till, particularly the deposits that created Swauk Prairie, which has two layers of glacial till with glacial lake deposits of clay and sand between the till layers. More recent alluvial deposits are present along Swauk Creek and from tributaries at deltaic fans.

The *Soil Survey of Kittitas County Area, Washington* (NRCS 2010) indicates that the predominant soils along the steeper upland slopes upstream of the project area include Sapkin-Rubble land complex (slopes 30% to 75%) that are derived from basalt and to a lesser extent loess (wind-blown glacial materials), and Keechelus gravelly ashy loam (slopes 30% to 60%) that are derived from basalt, brecchia, and pyroclastic rock with some volcanic ash in the upper part. Farther upstream in the watershed are complexes of Keechelus-Nard-Kafing soils. Nard soils are derived from sandstone and old alluvium with volcanic ash in the upper part. Kafing soils are derived from sandstone and siltstone with volcanic ash in the upper part. Kiper stony ashy sandy loams (slopes of 30% to 65%) are also present, derived from sandstone with volcanic ash in the upper part. There are numerous dredged placer mining spoils piles along the creek within the project area and for several miles upstream of the project area (see Figure 5-2).

In the floodplain of the project area, soils are primarily alluvial, including Quicksell loam (0% to 5% slopes); Patnish-Mippon-Myzel complex (0% to 3% slopes); and Teanaway ashy loam (3% to 10% slopes) derived from loess over glacial till with volcanic ash in the upper part.

Swauk Creek and its tributaries have cut their channels down through the glacial and bedrock materials, resulting in confined valleys until about RM 8 where Swauk Creek enters Swauk Prairie. In this area the creek was likely historically more complex with wetlands and a wide floodplain. Downstream of Swauk Prairie, the creek enters a confined valley as it approaches the Yakima River. Government Land Office mapping from 1892 (Figure 5-3) shows Swauk Creek with a slightly sinuous course and does not note wetlands or multiple channels. It is striking to see the number of mining claims and placer mining areas already in place by 1892.

Extensive mining, including placer mining in the creeks, has occurred in the watershed for over a century. Mining removed large wood and natural substrates and contributed to channel incision and confinement. Bedrock outcrops occur along the banks and bed of the creek in numerous locations (Figure 5-4). The construction of U.S. Highway 97 also straightened and channelized Swauk Creek in numerous locations. In Swauk Prairie, the creek has also likely been straightened along property lines, and beaver dams and riparian habitats have been removed. Interfluve (2010) estimated that an upstream reach of Swauk Creek was incised by 2.5 to 4 feet. Within the project area, the creek appears to have been excavated down at least 2 feet as evidenced by the dredged spoils piles adjacent to the creek.

The stream gradient through the project area is typically about 1.5%. The river substrates in the project reach are a mixture of gravel, cobbles, and some boulders and patches of sands and silts. The watershed has many natural sources of sediment that can be contributed via landslides, roads, and forestry or rural residential land uses (Figures 5-5 and 5-6). No substantial accumulations of sediment were noted in the creek channel in the vicinity of the irrigation diversion structures, although seasonal accumulation of sands and silts may occur in low-velocity areas. The fish bypass return pipe

downstream of the upper diversion becomes buried in sediment seasonally. Higher streamflows would transport gravels. Upstream of the upper diversion, the creek changed course and abandoned a meander bend during and after the high flows in 2009 (Figures 5-7, 5-8, and 5-9) as a result of gravel and debris deposition in the old channel.

Figure 5-2
Placer Mining Spoils Pile

Figure 5-3
General Land Office Map (1892)

Figure 5-4
Swauk Creek Confined Between Bedrock and Road Fill Near RM 10

Figure 5-5
Scree Slopes in Upstream Watershed

Figure 5-6
Siltstone in Upper Watershed

Figure 5-7
Swauk Creek Location in 2006 (Google Earth)

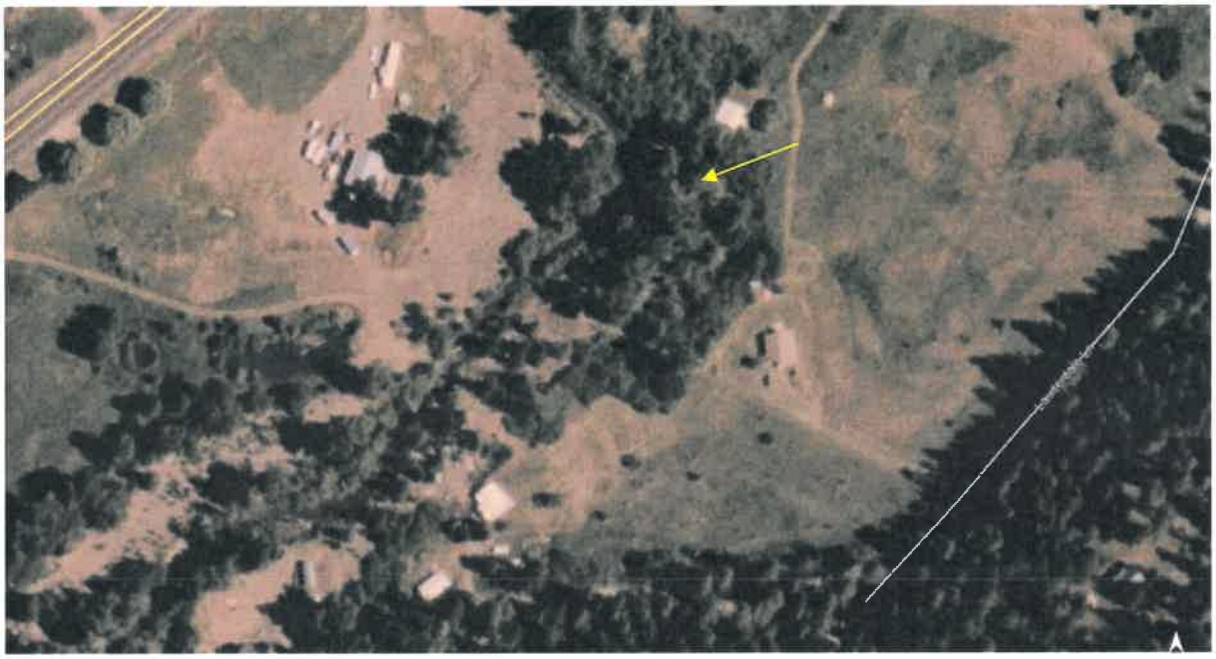


Figure 5-8
Swauk Creek Location in 2011 (Google Earth)

Figure 5-9
Swauk Creek in 2017 (Google Earth)

The Swauk Creek channel is fairly uniform in dimensions and gradient both upstream and downstream of the project reach, with bankfull dimensions ranging from 35 to 45 feet and slopes ranging from 1.5% to 2%. This is likely a legacy of the dredge mining that has generally confined the channel in its existing alignment and dimensions.

A roughened channel can accommodate passage of sediment and wood without changing its overall configuration because it generally replicates a natural slope and substrate conditions. It is likely that gravel will periodically accumulate near the diversion headgate structure (just upstream of the ramp), so gravel may need to be removed periodically, such as when the irrigation diversion is first opened each season.

The fish bypass return from the proposed screen would be located to discharge back into the creek further downstream of the existing bypass. The new alignment would discharge adjacent to a large rock and scour pool, reducing the potential for burial of the pipe outlet. The current bypass pipe discharges into a segment of the creek with the lowest gradient and most potential for sediment deposition.

6 Summary of Proposed Improvements

This section provides a detailed summary of the key facilities for the proposed project.

6.1 Stream Channel Improvements

Stream channel improvements will include the construction of a roughened channel immediately downstream of the intake to create improved fish passage and ensure the adequate submergence depth of the fish screen and bypass facilities. The roughened channel will be created by placing 3-man to 5-man boulders immediately downstream of the intake to create a grade control. The roughened channel fishway will extend downstream at a 2.5% slope for 80 feet to meet a flatter section of the creek. The fishway will be composed of a well-graded gravel and cobble mix with boulders interspersed throughout. This slope is similar to the average slope along the entire creek. The roughened channel will include a low-flow channel designed to maintain depths and suitable velocity conditions during periods of low flows. The remainder of the channel was designed to withstand and pass the 100-year recurrence interval flow.

Bed material was sized using guidance in the U.S. Bureau of Reclamation Rock Ramp Design Guidelines (USBR 2007). Using methods cited in the guidelines, multiple sizing calculations were performed and the threshold shear stress required to move bed materials was calculated. The most conservative of these methods was used to decide on a median grain size (D_{50}) of 18 inches. The guidance suggests using 1.5 times the D_{85} (85th percentile rock size) for the depth of the streambed material, which yielded a depth of approximately 42 inches.

The area near the downstream diversion to be removed will be graded, and the large boulders will be reworked to remove any drops larger than 6 inches. As necessary, the same gravel and cobble mix used upstream will be used to fill in void spaces in the boulders and minimize channel and bank erosion. The bank in the immediate vicinity of the removed diversion structure will be regraded, mixing in the gravel and cobble mix, then hydroseeded.

6.2 Fish Screen Replacement

Fish screening facilities will be designed to meet the most current requirements for screening of diversions from WDFW and the NMFS *Anadromous Salmonid Passage Facility Design Guidelines* (NMFS 2008). Those criteria are outlined in Section 4.2. Based on discussions with KCCD and WDFW, it is proposed that a modular rotating drum fish screen will be used that has already been fabricated by WDFW and is being stored at their Yakima Screen Shop.

It is our understanding that WDFW has committed to furnish and deliver the rotating drum screen and will oversee installation of the screen. The screen will be installed at generally the same location as the existing screen. The project contractor will be required to perform the earthwork needed to

accommodate the new screen, and to place and compact foundation material for the screen. Key characteristics of the screen and recommended water surface elevations (WSELs) are as follows:

- Screen diameter: 24 inches
- Screen length: 6 feet
- WDFW design flow rate: 3.6 cfs maximum
- Screen bottom elevation: 2,190.27 feet (NAVD 88)
- WSEL needed for 65% submergence: 2,191.57 feet (NAVD 88)
- WSEL needed for 70% submergence (target for design flow): 2,191.67 feet (NAVD 88)
- WSEL needed for 85% submergence: 2,191.97 feet (NAVD 88)

For the screen to operate properly, the hydraulic conditions need to maintain proper submergence, which means that the screen needs to stay 65% to 85% submerged relative to the height of the screen while in operation. To ensure that the water surface is well within that targeted range, WDFW has recommended that the design target a submergence of 70% at the design flow of 3.5 cfs.

A new 8-inch solid-wall, butt-fused DR 32.5 HDPE fish bypass pipeline is recommended to replace the existing fish bypass. As noted earlier, the existing fish bypass pipeline outlets to a portion of the screen that accrues sediment and regularly becomes buried. Extending the outlet of the pipeline farther downstream, along with proposed channel improvements designed to maintain appropriate water levels at the screen, will allow for improved flow and outlet conditions through the fish bypass pipeline to ensure that the fish bypass pipeline does not backwater.

6.3 Delivery Pipeline

Installation of the following segments of pipeline is recommended to replace open ditches and convey water from the intake facilities to points of delivery to The Ranch on Swauk Creek on both the north and south sides of Swauk Creek:

- Approximately 857 feet of 15-inch CPE pipe is recommended to convey 3.5 cfs from the intake facilities to the culvert under U.S. Highway 97.
- Approximately 364 feet of 15-inch CPE pipe is recommended to convey 3.5 cfs from the culvert under U.S. Highway 97 to a manhole near Burke Road where flows will be split.
- Approximately 10 feet of 12-inch CPE pipe is recommended to discharge up to 2.0 cfs from the manhole near Burke Road to the open ditch that extends west to irrigate pasture within the ranch north and west of Swauk Creek.
- Approximately 340 feet of 10-inch CPE pipe is recommended to convey up to 1.5 cfs along the south side of Burke Road from the first manhole to a second manhole near Ranch Road.
- The flow will fill the manhole at Ranch Road and the pipeline downstream of this manhole will operate completely full. Approximately 919 feet of 10-inch DR 32.5 solid-wall, butt-fused HDPE

pipe is recommended to convey water from the manhole at Ranch Road across Swauk Creek to a manhole near the outlet to the open ditch south of Swauk Creek.

- Approximately 23 feet of 12-inch CPE pipe is recommended to discharge up to 1.5 cfs from the manhole south of Swauk Creek to the open ditch that conveys water to the pond on ranch property south and east of Swauk Creek.

6.4 Riparian Plantings

Areas disturbed by the removal of the downstream irrigation diversion headwall and installation of the roughened channel areas will be graded to smooth slopes and seeded with native grass species (see Table 6-1) and red osier dogwood cuttings (*Cornus stolonifera*).

Table 6-1
Recommended Native Grass Seed Mix

Species Name	Common Name	Pounds/Acre
Agrostis idahoensis	Idaho redtop	3
Elymus glaucus	Blue wildrye	5
Elymus lanceolatus	Streambank wheatgrass	5
Festuca idahoensis	Idaho fescue	7

Downstream of the irrigation infrastructure improvements, approximately 3.5 acres of riparian habitat will be planted with cottonwood poles (*Populus balsamifera*) to supplement prior riparian plantings. Cottonwood poles should be 1.5 to 3 inches in diameter (butt end) and 8 to 12 feet in length, with all lateral branches cut off. Poles should be cut with a 45-degree angle on the butt end. The growing end should be cut flat and treated with tree paint or other suitable plant sealant to prevent desiccation. Poles should be harvested from within the watershed, kept in cold storage prior to delivery to the site, and then placed to soak the lower half for a minimum of 24 hours prior to planting. Cottonwood poles should be harvested and planted during the dormant season, preferably in March. Poles should be installed at 10-foot spacing using an auger or waterjet to create a hole for planting to a minimum depth of 4 feet.

7 Opinion of Probable Construction Cost

An opinion of the probable construction costs was developed for the proposed project (Table 7-1). A detailed breakdown of materials, work, and related costs is included in Appendix G.

The opinion of probable construction costs incorporates the following:

- 10% allowance for mobilization/demobilization
- 8.0% sales tax rate

The total construction cost includes a 10% construction contingency to reflect uncertainty in the schedule for bidding and items that may change prior to or during construction. The design has been developed to the 90% design level. The costs in Table 7-1 only include an opinion of the probable construction cost that would be borne by the construction contractor. Engineering, permitting, and administration costs are not included in this opinion of probable cost. Most of the engineering, permitting, and administration work to be completed during the design phase has already been funded. Additional funding may be needed to administer and manage the project through construction.

Costs were divided into base bid items and the following optional bid items:

- **Option A Bid Items** – Includes modification to the stream channel at the lower point of diversion, including reworking of boulders to eliminate drops in the channel upstream of RM 7.71. This work may not be required or desired as part of the final bid package.
- **Option B Bid Items** – This includes installation of corrugated polyethylene pipe to replace the irrigation ditch east of U.S. Highway 97. KCCD may decide not to construct this segment of pipeline if there is not budget to support the work.
- **Option C Bid Items** – This includes cottonwood copse planting. KCCD anticipates that this work may be completed by volunteers or others under a separate contract.

7.1.1 Assumptions

The following assumptions are reflected in the opinion of costs:

- The pipeline installed from the intake to Burke Road will be installed within an existing ditch easement. No additional easements or property acquisition will be required for this pipeline.
- The pipeline along Burke Road will be installed entirely within Kittitas County right-of-way and will be subject to a franchise agreement being developed between the ranch owner and the County. Any costs associated with that franchise agreement are assumed to be the responsibility of the ranch owner and are not included.
- WDFW will furnish and oversee installation of the rotating drum fish screen. The costs include contractor labor to transport the screen to the site from the Yakima Screen Shop, remove the

existing fish screen, excavate to accommodate the new fish screen, prepare subgrade, place and compact foundation material, and assist WDFW with screen installation.

- The contractor will also trench, place and compact backfill, and install the fish bypass pipeline and connect that pipeline to the modular fish screen.
- One-third of streambed boulders will be sourced on site.
- No export of streambed materials will be required.

The opinion of probable construction cost will be refined through the detailed design.

Table 7-1
Opinion of Probable Construction Costs

Item	Opinion of Probable Cost
Base Bid Items:	
Division 1 – General Requirements	$48,000
Division 2 – Existing Conditions	$18,000
Division 31 – Earthwork	$86,000
Division 32 – Exterior Improvements	$46,000
Division 33 – Utilities	$57,000
Construction Subtotal – Base Bid Items	**$255,000**
Sales Tax (8.0%)	$20,400
Subtotal – Construction Contract – Base Bid Items	**$275,000**
Contingency (10%)	$27,500
Total Construction Cost – Base Bid Items	**$303,000**
Option A Bid Items (Channel Restoration at RM 7.71):	
Division 31 – Earthwork	$5,000
Division 32 – Exterior Improvements	$8,000
Construction Subtotal – Option A Bid Items	**$13,000**
Sales Tax (8.0%)	$1,040
Subtotal – Construction Contract – Option A Bid Items	**$14,000**
Contingency (10%)	$1,400
Total Construction Cost – Option A Bid Items	**$15,000**
Option B Bid Items (Irrigation Pipeline East of Highway 97)	
Division 31 – Earthwork	$21,000
Division 33 – Utilities	$31,000
Construction Subtotal – Option B Bid Items	**$52,000**
Sales Tax (8.0%)	$4,160
Subtotal – Construction Contract – Option B Bid Items	**$56,000**
Contingency (10%)	$5,600
Total Construction Cost - Option B Bid Items	**$62,000**

Item	Opinion of Probable Cost
Option C Bid Items (Cottonwood Copse Planting):	
Division 32 – Exterior Improvements	$11,000
Construction Subtotal – Option C Bid Items	**$11,000**
Sales Tax (8.0%)	$880
Subtotal – Construction Contract – Option C Bid Items	**$12,000**
Contingency (10%)	$1,200
Total Construction Cost – Option C Bid Items	**$13,000**
Total – Base Bid and All Optional Bid Items:	
Construction Subtotal	**$331,000**
Sales Tax (8.0%)	$26,480
Subtotal – Construction Contract	**$357,000**
Contingency (10%)	$35,700
Total Construction Cost	**$393,000**

Notes:

1. Intake facilities include preparing the screen structure for screen installation.
2. Pipeline costs include trenching; furnishing and installing pipe, fittings, and appurtenances; backfilling; compaction of backfill; surface repair; and hanging pipeline on bridge.
3. Subtotals and totals are rounded up to the nearest $1,000.
4. Costs are in 2020 dollars.

8 Summary and Recommendations

This report summarizes the design of The Ranch on Swauk Creek Diversion Improvement and Restoration Project. The project will convert a portion of the existing open, unlined delivery ditch to a buried pipeline, upgrade the fish screen and bypass at the existing intake facility, and construct a roughened stream channel downstream from existing intake. The project will also remove a second, downstream intake structure and restore the channel in that location. Downstream of the irrigation infrastructure improvements, approximately 3.5 acres of riparian habitat will be planted with cottonwood poles to supplement prior riparian plantings. These improvements are intended to achieve the following objectives:

- Eliminate irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.71 and significantly reduce the irrigation-related mortality of steelhead, coho, and Chinook salmon at Swauk Creek RM 7.92.
- Restore year-round fish passage for all life stages of salmonids at Swauk Creek RM 7.71 and RM 7.92.
- Improve summer rearing conditions for juvenile steelhead, coho, and Chinook salmon in Swauk Creek by increasing irrigation efficiency, resulting in up to 0.25 cfs of conserved water available for instream flow benefits.
- Increase canopy cover, shade, and a source of future large woody debris for Swauk Creek and its floodplain by planting up to approximately 3.5 acres with cottonwood copses.

9 References

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Appendix A
Site Visit Notes and Photographs

Meeting Minutes

Kick-off Meeting/Site Visit

The Ranch on Swuak Creek Project

1:00 PM; April 29, 2020; Project Site

Attendees

David Rice, P.E.	Anchor QEA
Merri Martz	Anchor QEA
Ryan Roberts, P.E.	Kittitas County Conservation District
Cassandra Weekes	Washington Department of Fish and Wildlife

Meeting Minutes/Site Visit Notes

WDFW Screen and Coordination

- Josh from WDFW's screen shop was not able to attend the site visit.
- Dave will contact Josh and/or Danny at WDFW's screen shop and schedule some time to talk through screening options over the phone.
- The existing screen at the upstream diversion seems to do a decent job of keeping fish out of the irrigation canal, but it backwaters and does not offer consistent sweeping velocity to move fish past the screen and through the bypass back to the creek. The bypass sometimes appears to flow backwards towards the screen.
- At the time of the site visit, the water level in the creek appeared to be higher than the invert of the bypass at the screen, but there did not appear to be water backing up into the screen through the bypass, which would suggest that the bypass was plugged or has some kind of check feature.
- They are considering different options but there are two modular rotating drum screens available in the shop. If one of these screens looks like it is the correct size, this may be a good option.
- The ranch owner maintains the screen and the rest of the diversion system. The existing screen requires very frequent cleaning during the irrigation season (e.g. every 2 hours).

Kittitas County Conservation District (KCCD) Restoration Goals, Extents

- Streambed boulders were placed in channel at the upstream diversion in an effort to establish appropriate hydraulic head conditions when the screen was replaced about 10 years ago.

- The streambed boulders have either shifted or settled and are not maintaining the appropriate hydraulic conditions to keep water in the diversion during the late summer and to keep water moving past the screen with sweeping velocity.
- The ranch owner currently installs an aluminum pole across the stream channel with a plastic tarp draped over it and anchored to the stream bed to check up the water in the late summer to maintain diversions at the upstream diversion.
- The ranch owner currently installs cattle fencing with a plastic tarp draped over it and some temporary pipe extending up the left bank of the creek to capture enough water for the downstream diversion during the late summer low-flow period.
- The downstream diversion is not screened and entrains fish into the system.
- The ranch owner has to put the materials in the creek early in the season (sometimes as early as the first half of July) to get water.
- Both diversions are barriers to fish passage.
- KCCD and the ranch owner would like to see a fish-passable rock weir that maintains the appropriate hydraulic conditions to keep water in the diversion during the late summer low-flow period and maintains appropriate depth and sweeping velocity conditions at the new screen.
- Additional restoration work could include planting up to 1 acre of cottonwood copses in the riparian area downstream of Burke Road, where some previous restoration work occurred, but there are breaks in the riparian coverage.

Irrigation Operations

- The ranch uses the water as follows:
  - The upstream diversion conveys water to a canal that extends south, crossing Highway 97 and Burke Road, and delivers up to approximately 2 cfs to pasture that is south of Burke Road and west of Swauk Creek. The small ditch that extends east along Burke Road to Swauk Creek from the main canal spills excess water back to Swauk Creek.
  - The downstream diversion conveys water through pipes and open canal to a pond on the ranch property south of Burke Road and east of Swauk Creek. The ranch then irrigates pasture on the east side of Swauk Creek from the pond.
  - The total combined peak flow rate for the two diversions is 3.5 cfs. The upstream diversion has two water rights that each allow for diversion of up to 2 cfs, but the water rights are rotating, so the maximum diversion rate at any time is 2 cfs. The downstream diversion has a water right that allows for diversion of up to 1.5 cfs.

Franchise Agreement, Coordination with County Public Works

- The ranch owner has indicated that they are negotiating to obtain a franchise agreement with the County for domestic water and it would be ideal if the agreement also included irrigation water.
- Ryan indicated that it is not clear yet whether the franchise agreement exists and whether it will allow for burial of irrigation pipe along the edge of Burke Road.
- The proposed crossing at Swauk Creek would consist of hanging the pipe on the County's bridge where Burke Road crosses Swauk Creek. Ryan is not sure yet whether the County will allow this.
- If the pipe cannot be hung from the bridge, the downstream diversion may need to be supplied by a pipe crossing under Swauk Creek near the location of the diversion to send water through the upstream diversion into the existing lower pipe/canal system.
- Any property owner coordination would go through Ryan at KCCD.

Schedule, Timeline for Implementation

- If possible, they would like to start construction this fall when the irrigation season ends to avoid having another irrigation season with fish mortality and fish barriers.
- That would require permitting on a very short timeline (would need permits in hand by September).
- Cassandra will verify the in-water work window (verified after the meeting as July 15 to September 30). An extension into October is likely to be feasible.
- They will use BPA as the federal lead for permitting, but with the Covid-19 situation, there have been some delays in Section 106 consultations.
- If needed, maybe we can consider doing the out-of-channel work in the spring before the irrigation season starts.
- Typically, they would like to submit permits with a 60% complete design to ensure that things do not change significantly as the permits are reviewed, but in this case the 30% design (with sufficient details) would likely need to be used for permitting.

Action Items

- Anchor QEA
    - Call Josh and Danny to discuss screen configurations and pin down the screen type and approach for installing it.
    - Look at the CAD survey file to verify the limitations on the data near Burke Road. Send request for additional survey data to Ryan.

  - Review background information to verify what we have received and what we have not received. Request additional information, if needed.

- Ryan
  - Coordinate with the ranch owner and the County Public Works Department to clarify the status of the franchise agreement between the County and the ranch owner, confirm whether the agreement will include irrigation water infrastructure, and determine whether pipe can be hung from the Burke Road Bridge over Swauk Creek.
  - Coordinate and contract with HLA to collect additional survey data, if needed.
  - Provide any other background information requested by Anchor QEA, if available.
- Cassandra
  - Verify in-water work window. DONE, EMAILED TO ANCHOR QEA ON 4/30.
  - Clarify level of design needed to initiate permitting. DONE. EMAILED TO ANCHOR QEA ON 4/30.
  - Send WSDOT Report with additional flow information for upstream fish passage project. DONE. EMAIL TO ANCHOR QEA ON 4/30.

Site Photographs

Photograph 1 - Diversion Structure with Slide Gate at Creek

Photograph 2 – Fish Screen and Irrigation Canal from Diversion Structure

Photograph 3 – Fish Screen with Paddle Wheel

Photograph 4 – Channel at Diversion with Streambed Boulders

Photograph 5 – Diversion Structure and Channel Looking Downstream

Photograph 6 – Irrigation Canal Downstream of Fish Screen on West Side of Creek

Photograph 7 – Downstream Irrigation Diversion Structure

Photograph 8 – Culvert Inlet on Irrigation Canal on West Side of Creek at Highway 97

Photograph 9 – Upstream end of Culvert on West Side of Creek at Burke Road

Photograph 10 – Flow Control Structure on East Canal/Pipeline N Side of Burke Road

Photograph 11 – Pond at Downstream End of Canal on East Side of Swauk Creek

Photograph 12 – S Side of Burke Road Bridge Over Swauk Creek

Appendix B
Design Drawings

90% DESIGN SUBMITTAL

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

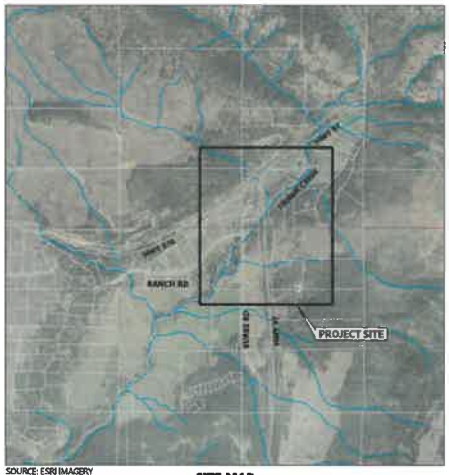
KITTITAS COUNTY CONSERVATION DISTRICT

SOURCE: ESRI WORLD STREET MAP

VICINITY MAP

SCALE IN MILES 0 2 4

NORTH



SOURCE: ESRI IMAGERY

SITE MAP

SCALE IN FEET 0 1000 2000

NORTH

DRAWING INDEX		
SHEET #	DRAWING #	TITLE
1	G01	COVER SHEET
2	G02	GENERAL NOTES, ABBREVIATIONS, AND LEGENDS
3	G03	BPA HIP III GENERAL CONSERVATION & IMPLEMENTATION MEASURES
4	G04	BPA HIP III GENERAL CONSERVATION & IMPLEMENTATION MEASURES
5	G05	OVERALL SITE PLAN
6	G06	SURVEY CONTROL PLAN
7	T01	TEMPORARY ACCESS AND STAGING PLAN
8	T02	TEMPORARY EROSION, SEDIMENT, AND WATER CONTROL PLAN
9	T03	TESC NOTES
10	T04	TESC DETAILS
11	C01	DIVERSION IMPROVEMENT AND RESTORATION PLAN (RM 7.92)
12	C02	DIVERSION IMPROVEMENT AND RESTORATION PLAN (RM 7.71)
13	C03	STREAM CHANNEL PROFILES
14	C04	STREAM CHANNEL SECTIONS
15	* C05	RESTORATION AND FISH BYPASS DETAILS
16	C06	RESTORATION PLANTING PLAN AND DETAILS
17	C11	IRRIGATION PIPELINE PLAN AND PROFILE (STA 0+00 TO STA 11+20)
18	C12	IRRIGATION PIPELINE PLAN AND PROFILE (STA 11+20 TO STA 22+80)
19	C13	IRRIGATION PIPELINE PLAN AND PROFILE (STA 22+80 TO END)
20	C14	IRRIGATION PIPELINE TYPICAL SECTIONS AND DETAILS
21	C15	IRRIGATION PIPELINE DETAILS
22	C16	IRRIGATION PIPELINE DETAILS

PROJECT DATA

PROJECT LOCATION: THE RANCH AT SWAUK CREEK
KITTITAS CO. PARCELS 827336, 195335, 949697
SECTIONS 27 AND 28, T 20N R 17E

CONTRACTING AGENCY: ANNA LAEL, DISTRICT MANAGER
KITTITAS COUNTY CONSERVATION DISTRICT
2211 W DOLARWAY ROAD, SUITE 4
ELLENSBERG, WA 98926
(509) 925-3352 EXT 7

FISH SCREENING/PERMITTING: CASSANDRA WEEKS
WASHINGTON DEPT. OF FISH AND WILDLIFE
(509) 406-3206

DESIGN ENGINEER: DAVID RICE, P.E.
ANCHOR QEA, LLC
720 OLIVE WAY, SUITE 1900
SEATTLE, WA 98101
(206) 219-5902

IF THIS MEASURES 1" ON THIS SHEET ADJUST SCALES ACCORDINGLY

ITEMS INTENDED TO BE SHOWN IN COLOR ARE SHOWN IN BLUE

90% DESIGN: NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS

NO.	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: D. RICE
DRAWN BY: T. GREGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

COVER SHEET

G01

SHEET # 1 OF 22

LEGEND (EXISTING)

— 1170 —	EXISTING SURVEYED CONTOURS
— 1170 —	EXISTING LIDAR CONTOURS
	IRRIGATION MANHOLE
	TELEPHONE PED
	UTILITY POLE
— x —	FENCE
— CULV —	CULVERT
— IRR —	IRRIGATION PIPE
	DECIDUOUS TREE
	EVERGREEN TREE
	STUMP
	ASPHALT AREA
	CONCRETE AREA
	MISCELLANEOUS

LEGEND (PROPOSED)

	PROPOSED IRRIGATION PIPELINE
	GATE VALVE
	HDPE BEND
	SILT FENCE
	CLEARING LIMITS

SOURCE OF DATA:	TOPOGRAPHIC SURVEY PROVIDED BY HLA ENGINEERING AND LAND SURVEYING, INC. SURVEY PERFORMED JANUARY AND JUNE 2020.
	AERIAL PHOTOGRAPHY - 2018 BING MAPS
HORIZONTAL DATUM:	WASHINGTON STATE PLANE NORTH ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83), U.S. SURVEY FEET.
VERTICAL DATUM:	ELEVATIONS BASED ON WASHINGTON STATE REFERENCE NETWORK (WSRN), THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

GENERAL CONSTRUCTION NOTES

1. CONTRACT DOCUMENTS REFER TO THESE DRAWINGS, THE PROJECT SPECIFICATIONS, THE BIDDING DOCUMENTS, AND THE CONSTRUCTION CONTRACT. ALL COMPONENTS OF THE CONTRACT DOCUMENTS SHALL FULLY APPLY TO THE WORK WHETHER SPECIFICALLY REFERENCED ON THE DRAWINGS OR NOT. ANY ITEMS NOT SPECIFICALLY REFERENCED IN THE NOTES ON THE DRAWINGS SHALL BE AS DESCRIBED IN THE SPECIFICATIONS.
2. THE CONTRACTOR SHALL HAVE A COPY OF THE APPROVED CONTRACT AND PERMIT DOCUMENTS ON THE JOBSITE AT ALL TIMES.
3. A PRE-CONSTRUCTION MEETING BETWEEN THE CONTRACTOR, KITTITAS COUNTY CONSERVATION DISTRICT, AND WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE SHALL BE REQUIRED PRIOR TO ANY ON-SITE WORK. SEE THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS
4. THE CONTRACTOR SHALL VISIT THE JOB SITE PRIOR TO CONSTRUCTION AND SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITIONS AND DIMENSIONS, AND CONFIRMING THAT THE WORK CAN BE ACCOMPLISHED AS SHOWN ON THESE CONTRACT DOCUMENTS. ANY DISCREPANCIES BETWEEN THE EXISTING FIELD CONDITIONS AND THE DRAWINGS OR ANY INCONSISTENCIES OR AMBIGUITIES BETWEEN THE DRAWINGS AND OTHER CONTRACT DOCUMENTS SHALL BE REPORTED IN WRITING TO KITTITAS COUNTY CONSERVATION DISTRICT PRIOR TO PROCEEDING WITH THE WORK. WORK DONE BY THE CONTRACTOR INVOLVING SUCH DISCREPANCIES WITHOUT A WRITTEN REPORT AND RESPONSE FROM KITTITAS COUNTY CONSERVATION DISTRICT SHALL BE DONE AT THE CONTRACTOR'S SOLE RISK AND EXPENSE.
5. THE CONTRACTOR SHALL RECEIVE, IN WRITING, AUTHORIZATION TO PROCEED BEFORE STARTING WORK ON ANY ITEM NOT CLEARLY DEFINED OR IDENTIFIED BY THE CONTRACT DOCUMENTS.
6. ALL WORK SHALL BE IN ACCORDANCE WITH EXISTING LABOR LAWS, SAFETY REQUIREMENTS, AND OTHER REGULATIONS, AS REQUIRED BY KITTITAS COUNTY, THE STATE OF WASHINGTON, AND THE FEDERAL GOVERNMENT. THE CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS.
7. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK UNDER THIS CONTRACT.
8. THE DETAILS PROVIDED ON THE CONTRACT DOCUMENTS ARE INTENDED TO SHOW THE FINAL RESULT OF THE DESIGN. MINOR MODIFICATIONS MAY BE REQUIRED TO SUIT JOB SITE DIMENSIONS OR CONDITIONS. SUCH MODIFICATIONS SHALL BE CONSIDERED INCIDENTAL TO OTHER ITEMS INCLUDED IN THE BID SCHEDULE FOR THE WORK.
9. THE CONTRACTOR SHALL MAKE ALL NECESSARY PROVISIONS TO PROTECT EXISTING STRUCTURES, IMPROVEMENTS, GROUNDWATER WELLS, SIGNS, FENCES, GATES, CURBS, ROADWAYS, DRAINAGE WAYS, CULVERTS, AND VEGETATION UNTIL SUCH ITEMS ARE TO BE DISTURBED OR REMOVED AS INDICATED ON THE CONTRACT DOCUMENTS. IF SUCH ITEMS ARE DAMAGED OR NEED TO BE REMOVED OR MODIFIED TO FACILITATE CONSTRUCTION, THE CONTRACTOR SHALL FIRST NOTIFY THE KITTITAS COUNTY CONSERVATION DISTRICT AND THEN REPLACE OR REPAIR THE ITEMS TO EQUAL OR BETTER CONDITION AT THE CONTRACTOR'S EXPENSE AND TO THE SATISFACTION OF THE OWNER.
10. THE CONTRACTOR SHALL NOT DISTURB OR DESTROY ANY EXISTING SURVEY MONUMENT OR BENCHMARK. ANY SURVEY MONUMENT OR BENCHMARK DISTURBED OR DESTROYED BY THE CONTRACTOR SHALL BE REPLACED AS DIRECTED BY THE KITTITAS COUNTY CONSERVATION DISTRICT AT THE CONTRACTOR'S SOLE EXPENSE.
11. REPRESENTATIONS OF TRUE NORTH SHALL NOT BE USED TO IDENTIFY OR ESTABLISH THE BEARING OF TRUE NORTH AT THE JOB SITE. THE CONTRACTOR IS ADVISED THAT NORTH ARROWS AND ORIENTATION OF THE PLAN VIEW SHEETS VARY TO ALLOW FOR LEFT-TO-RIGHT STATIONING AND STATIONING IN THE DIRECTION OF FLOW.
12. WHERE A CONSTRUCTION DETAIL IS NOT SHOWN OR NOTED, THE DETAIL SHALL BE THE SAME AS FOR OTHER SIMILAR WORK.
13. THE NOTES, DETAILS AND SPECIFICATIONS ON THE CONTRACT DOCUMENTS SHALL TAKE PRECEDENCE OVER THESE GENERAL NOTES.
14. DIMENSION CALL-OUTS SHALL TAKE PRECEDENCE OVER SCALES SHOWN ON THE CONTRACT DOCUMENTS.
15. STATIONING, DISTANCES, AND LENGTHS SHOWN ON THE DRAWINGS ARE BASED ON HORIZONTAL MEASUREMENTS ALONG THE PIPE CENTERLINE.
16. THE CONTRACTOR SHALL BE REQUIRED TO CONTROL ON-SITE STORM WATER RUNOFF BY USING TEMPORARY OR PERMANENT DRAINAGE EROSION/SILTATION CONTROL PROCEDURES. TEMPORARY EROSION AND SEDIMENT CONTROL (TESC) SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS INCLUDED IN THE CONTRACT DRAWINGS.
17. THE CONTRACTOR SHALL MAINTAIN HAND DRAWN REDLINES, FIELD NOTES AND PHOTOGRAPHS ("FIELD DOCUMENTATION") OF ALL IMPROVEMENTS AS THE WORK PROGRESSES. THE CONTRACTOR SHALL ALSO TAKE PHOTOGRAPHS AND VIDEO TO DOCUMENT CONDITIONS PRIOR TO CONSTRUCTION. THE CONTRACTOR'S FIELD DOCUMENTATION SHALL BE MAINTAINED ON SITE AND SHALL BE AVAILABLE FOR REVIEW BY KITTITAS COUNTY CONSERVATION DISTRICT AT ALL TIMES. THE CONTRACTOR SHALL PROVIDE FIELD DOCUMENTATION TO KITTITAS COUNTY CONSERVATION DISTRICT FOR THE PREPARATION OF CERTIFIED RECORD DRAWINGS PRIOR TO PROJECT ACCEPTANCE.
18. THESE DRAWINGS AND SPECIFICATIONS DO NOT VALIDATE THE CONDITION OF ANY EXISTING OR USED PART OF THE EXISTING IRRIGATION SYSTEM. FAILURE OF ANY PART OF THE EXISTING IRRIGATION SYSTEM WILL BE REPAIRED AT THE PROPERTY OWNER'S EXPENSE.

STANDARD CIVIL NOTES

1. ALL MATERIALS SHALL BE NEW AND UNDAMAGED, UNLESS OTHERWISE APPROVED BY THE CONTRACTING ORGANIZATION'S REPRESENTATIVE AND THE ENGINEER. THE SAME MANUFACTURER OF EACH ITEM SHALL BE USED THROUGHOUT THE WORK UNLESS OTHERWISE APPROVED BY KITTITAS COUNTY CONSERVATION DISTRICT AND THE ENGINEER.
2. ALL SITE WORK SHALL BE AS INDICATED ON THE CONTRACT DOCUMENTS. DO NOT EXCAVATE AND DISTURB BEYOND THE CLEARING LIMITS SHOWN ON THE CONTRACT DOCUMENTS UNLESS OTHERWISE APPROVED BY KITTITAS COUNTY CONSERVATION DISTRICT.
3. RUBBISH, DEBRIS, AND GARBAGE SHALL BE REMOVED FROM THE JOB SITE AND DISPOSED OF LEGALLY, AS REQUIRED BY THE PROJECT SPECIFICATIONS.
4. THE AREAS OF THE JOB SITE DISTURBED BY THE WORK SHALL BE GRADED SMOOTH AND PROTECTED AND/OR REVEGETATED AS SPECIFIED HEREIN.
5. PIPE MATERIALS SHALL BE AS INDICATED ON THESE DRAWINGS AND IN THE SPECIFICATIONS.

UTILITY NOTES

1. THE LOCATIONS OF EXISTING UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE.
2. UTILITY SERVICES HAVE NOT BEEN SHOWN ON THE PLAN AND PROFILE DRAWINGS. THE CONTRACTOR SHALL TAKE CARE NOT TO DISRUPT BURIED UTILITY SERVICES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL CONTACT THE UTILITY LOCATION REQUEST CENTER (ONE-CALL CENTER) AT 1-800-424-5555 FOR UTILITY LOCATIONS NOT LESS THAN TWO (2) BUSINESS DAYS BEFORE THE SCHEDULED DATE FOR EARTHWORK OR TRENCHING THAT MAY IMPACT EXISTING UTILITIES.
4. ALL ABANDONED UTILITIES WHICH INTERFERE WITH THE EXECUTION OF THE WORK SHALL BE VERIFIED BY THE CONTRACTING ORGANIZATION'S REPRESENTATIVE AND THE UTILITY OWNER PRIOR TO DISTURBANCE OR MODIFICATION. ONLY AFTER WRITTEN APPROVAL HAS BEEN RECEIVED FROM THE UTILITY OWNER BY THE KITTITAS COUNTY CONSERVATION DISTRICT, MAY THE CONTRACTOR TAKE ACTION.
5. THE SIZE, LOCATION, AND TYPE OF UNDERGROUND UTILITIES EXPOSED OR MODIFIED BY THE CONTRACTOR SHALL BE ACCURATELY NOTED AND PLACED ON THE CONTRACTOR'S AS-BUILT DRAWINGS. SEE GENERAL CONSTRUCTION NOTE 17 FOR ADDITIONAL REQUIREMENTS RELATED TO THE CONTRACTOR'S AS-BUILT DRAWINGS AND FIELD DOCUMENTATION.
6. THE CONTRACTOR SHALL ENSURE THAT OPERATION OF EXISTING DRAINAGE, POTABLE WATER, POWER, COMMUNICATIONS, AND OTHER UTILITY SYSTEMS IS NOT DISRUPTED DURING CONSTRUCTION WITHOUT PRIOR AUTHORIZATION OF THE UTILITY OWNER AND CONTRACTING ORGANIZATION'S REPRESENTATIVE.

ABBREVIATIONS

'	FEET, MINUTES
"	INCHES, SECONDS
°	DEGREES
⌀	DIAMETER
#	NUMBER
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BM	BENCHMARK
BMP	BEST MANAGEMENT PRACTICE
BPA	BONNEVILLE POWER ADMINISTRATION
CFS	CUBIC FEET PER SECOND
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
CPE	CORRUGATED POLYETHYLENE
CPLG	COUPLING
CSBC	CRUSHED SURFACING BASE COURSE
CSTC	CRUSHED SURFACING TOP COURSE
CY	CUBIC YARDS
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST, EASTING
ELEV	ELEVATION
EX	EXISTING
FG	FINISHED GRADE
FL	FLOW LINE, FLANGE
FPS	FEET PER SECOND
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
HPDE	HIGH-DENSITY POLYETHYLENE
HOR	HORIZONTAL
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
KCCD	KITTITAS COUNTY CONSERVATION DISTRICT
L	LENGTH
LF	LINEAR FEET
MAX	MAXIMUM
MIN	MINIMUM
MLLW	MEAN LOWER LOW WATER
N	NORTH, NORTHING
NAD	NORTH AMERICAN DATUM
NAVD	NORTH AMERICAN VERTICAL DATUM
NTS	NOT TO SCALE
OC	ON CENTERS
OD	OUTSIDE DIAMETER
P	POWER
P.E.	PROFESSIONAL ENGINEER
PED	PEDESTAL
R, RAD	RADIUS
REINF	REINFORCED, REINFORCEMENT
RM	RIVER MILE
ROW	RIGHT-OF-WAY
S	SLOPE, SOUTH
SS	SANITARY SEWER
ST	STORM
STA	STATION
SY	SQUARE YARD
TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
T	TELEPHONE
TOW	TOP OF WALL
TYP	TYPICAL
W	WEST, WATER
W/	WITH
WFDW	WASHINGTON STATE DEPARTMENT OF FISH AND WILDLIFE
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
WSEL	WATER SURFACE ELEVATION
YR	YEAR

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

GENERAL NOTES, ABBREVIATIONS, AND LEGENDS

G02

SHEET # 2 OF 22

BPA HIP 3 GENERAL AQUATIC CONSERVATION MEASURES APPLICABLE TO ALL ACTIONS

THE ACTIVITIES COVERED UNDER THE HIPIII ARE INTENDED TO PROTECT AND RESTORE FISH AND WILDLIFE HABITAT WITH LONG-TERM BENEFITS TO ESA-LISTED SPECIES. TO MINIMIZE THESE SHORT-TERM ADVERSE EFFECTS AND MAKE THEM PREDICTABLE FOR THE PURPOSES OF PROGRAMMATIC ANALYSIS, BPA WILL INCLUDE IN ALL PROJECTS IMPLEMENTED UNDER THIS HIP III PROPOSED ACTION THE FOLLOWING GENERAL CONSERVATION MEASURES (DEVELOPED IN COORDINATION WITH USFWS AND NMFS).

PROJECT DESIGN AND SITE PREPARATION

1. STATE AND FEDERAL PERMITS. ALL APPLICABLE REGULATORY PERMITS AND OFFICIAL PROJECT AUTHORIZATIONS WILL BE OBTAINED BEFORE PROJECT IMPLEMENTATION. THESE PERMITS AND AUTHORIZATIONS INCLUDE, BUT ARE NOT LIMITED TO, NATIONAL ENVIRONMENTAL POLICY ACT, NATIONAL HISTORIC PRESERVATION ACT, HYDRAULIC PROJECT APPROVAL, USACE CLEAN WATER ACT (CWA) 404 PERMITS, AND CWA SECTION 401 WATER QUALITY CERTIFICATIONS.
2. TIMING OF IN-WATER WORK. APPROPRIATE STATE (OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW), WASHINGTON DEPARTMENT OF FISH AND WILDLIFE (WDFW), IDAHO DEPARTMENT OF FISH AND GAME (IDFG), AND MONTANA FISH WILDLIFE AND PARKS (MFWP)) GUIDELINES FOR TIMING OF IN-WATER WORK WINDOWS (IWW) WILL BE FOLLOWED.
   - A. BULL TROUT - WHILE UTILIZING THE APPROPRIATE STATE DESIGNATED IN-WATER WORK PERIOD WILL LESSEN THE RISK TO BULL TROUT, THIS ALONE MAY NOT BE SUFFICIENT TO ADEQUATELY PROTECT LOCAL BULL TROUT POPULATIONS. THIS IS ESPECIALLY TRUE IF WORK IS OCCURRING IN SPAWNING AND REARING AREAS BECAUSE EGGS, ALEVIN, AND FRY ARE IN THE SUBSTRATE OR CLOSELY ASSOCIATED HABITATS NEARLY YEAR ROUND. SOME AREAS MAY NOT HAVE DESIGNATED IN-WATER WORK WINDOWS FOR BULL TROUT OR IF THEY DO, THEY MAY CONFLICT WITH WORK WINDOWS FOR SALMON AND STEELHEAD. IF THIS IS THE CASE, OR IF PROPOSED WORK IS TO OCCUR WITHIN BULL TROUT SPAWNING AND REARING HABITATS, PROJECT PROPONENTS WILL CONTACT THE APPROPRIATE USFWS FIELD OFFICE TO INSURE THAT ALL REASONABLE IMPLEMENTATION MEASURES ARE CONSIDERED AND AN APPROPRIATE IN-WATER WORK WINDOW IS BEING USED TO MINIMIZE PROJECT EFFECTS.
   - B. LAMPREY - THE PROJECT SPONSOR AND/OR THEIR CONTRACTORS WILL AVOID WORKING IN STREAM OR RIVER CHANNELS THAT CONTAIN PACIFIC LAMPREY FROM MARCH 1 TO JULY 1 IN LOW TO MID ELEVATION REACHES (<5,000 FEET). IN HIGH ELEVATION REACHES (>5,000 FEET), THE PROJECT SPONSOR WILL AVOID WORKING IN STREAM OR RIVER CHANNELS FROM MARCH 1 TO AUGUST 1. IF EITHER TIMEFRAME IS INCOMPATIBLE WITH OTHER OBJECTIVES, THE AREA WILL BE SURVEYED FOR NESTS AND LAMPREY PRESENCE, AND AVOIDED IF POSSIBLE. IF LAMPREYS ARE KNOWN TO EXIST, THE PROJECT SPONSOR WILL UTILIZE DEWATERING AND SALVAGE PROCEDURES OUTLINED IN US FISH AND WILDLIFE SERVICE BEST MANAGEMENT PRACTICES TO MINIMIZE ADVERSE EFFECTS TO PACIFIC LAMPREY (2010).
   - C. EXCEPTIONS TO ODFW, WDFW, MFWP, OR IDFG IN-WATER WORK WINDOWS WILL BE REQUESTED THROUGH THE VARIANCE PROCESS (PAGE 2).
3. CONTAMINANTS. THE PROJECT SPONSOR WILL COMPLETE A SITE ASSESSMENT WITH THE FOLLOWING ELEMENTS TO IDENTIFY THE TYPE, QUANTITY, AND EXTENT OF ANY POTENTIAL CONTAMINATION FOR ANY ACTION THAT INVOLVES EXCAVATION OF MORE THAN 20 CUBIC YARDS OF MATERIAL:
   - A. A REVIEW OF AVAILABLE RECORDS, SUCH AS FORMER SITE USE, BUILDING PLANS, AND RECORDS OF ANY PRIOR CONTAMINATION EVENTS;
   - B. A SITE VISIT TO INSPECT THE AREAS USED FOR VARIOUS INDUSTRIAL PROCESSES AND THE CONDITION OF THE PROPERTY;
   - C. INTERVIEWS WITH KNOWLEDGEABLE PEOPLE, SUCH AS SITE OWNERS, OPERATORS, AND OCCUPANTS, NEIGHBORS, OR LOCAL GOVERNMENT OFFICIALS; AND
   - D. A SUMMARY, STORED WITH THE PROJECT FILE THAT INCLUDES AN ASSESSMENT OF THE LIKELIHOOD THAT CONTAMINANTS ARE PRESENT AT THE SITE, BASED ON ITEMS 4(A) THROUGH 4(C).
4. SITE LAYOUT AND FLAGGING. PRIOR TO CONSTRUCTION, THE ACTION AREA WILL BE CLEARLY FLAGGED TO IDENTIFY THE FOLLOWING:
   - A. SENSITIVE RESOURCE AREAS, SUCH AS AREAS BELOW ORDINARY HIGH WATER, SPAWNING AREAS, SPRINGS, AND WETLANDS;
   - B. EQUIPMENT ENTRY AND EXIT POINTS;
   - C. ROAD AND STREAM CROSSING ALIGNMENTS;
   - D. STAGING, STORAGE, AND STOCKPILE AREAS; AND
   - E. NO-SPRAY AREAS AND BUFFERS.
5. TEMPORARY ACCESS ROADS AND PATHS.
   - A. EXISTING ACCESS ROADS AND PATHS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER AND LENGTH OF TEMPORARY ACCESS ROADS AND PATHS THROUGH RIPARIAN AREAS AND FLOODPLAINS WILL BE MINIMIZED TO LESSEN SOIL DISTURBANCE AND COMPACTION, AND IMPACTS TO VEGETATION.
   - B. TEMPORARY ACCESS ROADS AND PATHS WILL NOT BE BUILT ON SLOPES WHERE GRADE, SOIL, OR OTHER FEATURES SUGGEST A LIKELIHOOD OF EXCESSIVE EROSION OR FAILURE. IF SLOPES ARE STEEPER THAN 30%, THEN THE ROAD WILL BE DESIGNED BY A CIVIL ENGINEER WITH EXPERIENCE IN STEEP ROAD DESIGN.
   - C. THE REMOVAL OF RIPARIAN VEGETATION DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS WILL BE MINIMIZED. WHEN TEMPORARY VEGETATION REMOVAL IS REQUIRED, VEGETATION WILL BE CUT AT GROUND LEVEL (NOT GRUBBED).
   - D. AT PROJECT COMPLETION, ALL TEMPORARY ACCESS ROADS AND PATHS WILL BE OBLITERATED, AND THE SOIL WILL BE STABILIZED AND REVEGETATED. ROAD AND PATH OBLITERATION REFERS TO THE MOST COMPREHENSIVE DEGREE OF DECOMMISSIONING AND INVOLVES DECOMPACTING THE SURFACE AND DITCH, PULLING THE FILL MATERIAL ONTO THE RUNNING SURFACE, AND RESHAPING TO MATCH THE ORIGINAL CONTOUR.
   - E. TEMPORARY ROADS AND PATHS IN WET AREAS OR AREAS PRONE TO FLOODING WILL BE OBLITERATED BY THE END OF THE IN-WATER WORK WINDOW.
6. TEMPORARY STREAM CROSSINGS.
   - A. EXISTING STREAM CROSSINGS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER OF TEMPORARY STREAM CROSSINGS WILL BE MINIMIZED.
   - B. TEMPORARY BRIDGES AND CULVERTS WILL BE INSTALLED TO ALLOW FOR EQUIPMENT AND VEHICLE CROSSING OVER PERENNIAL STREAMS DURING CONSTRUCTION. TREATED WOOD SHALL NOT BE USED ON TEMPORARY BRIDGE CROSSINGS OR IN LOCATIONS IN CONTACT WITH OR OVER WATER.
   - C. EQUIPMENT AND VEHICLES WILL CROSS THE STREAM IN THE WET ONLY WHERE:
   - D. THE STREAMBED IS BEDROCK; OR
   - E. MATS OR OFF-SITE LOGS ARE PLACED IN THE STREAM AND USED AS A CROSSING.
   - F. VEHICLES AND MACHINERY WILL CROSS STREAMS AT RIGHT ANGLES TO THE MAIN CHANNEL WHEREVER POSSIBLE.
   - G. THE LOCATION OF THE TEMPORARY CROSSING WILL AVOID AREAS THAT MAY INCREASE THE RISK OF CHANNEL RE-ROUTING OR AVULSION.
   - H. POTENTIAL SPAWNING HABITAT (I.E., POOL TAILOUTS) AND POOLS WILL BE AVOIDED TO THE MAXIMUM EXTENT POSSIBLE.
   - I. NO STREAM CROSSINGS WILL OCCUR AT ACTIVE SPAWNING SITES, WHEN HOLDING ADULT LISTED FISH ARE PRESENT, OR WHEN EGGS OR ALEVINS ARE IN THE GRAVEL. THE APPROPRIATE STATE FISH AND WILDLIFE AGENCY WILL BE CONTACTED FOR SPECIFIC TIMING INFORMATION.
   - J. AFTER PROJECT COMPLETION, TEMPORARY STREAM CROSSINGS WILL BE OBLITERATED AND THE STREAM CHANNEL AND BANKS RESTORED.
7. STAGING, STORAGE, AND STOCKPILE AREAS.
   - A. STAGING AREAS (USED FOR CONSTRUCTION EQUIPMENT STORAGE, VEHICLE STORAGE, FUELING, SERVICING, AND HAZARDOUS MATERIAL STORAGE) WILL BE 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND, OR ON AN ADJACENT, ESTABLISHED ROAD AREA IN A LOCATION AND MANNER THAT WILL PRECLUDE EROSION INTO OR CONTAMINATION OF THE STREAM OR FLOODPLAIN.
   - B. NATURAL MATERIALS USED FOR IMPLEMENTATION OF AQUATIC RESTORATION, SUCH AS LARGE WOOD, GRAVEL, AND BOULDERS, MAY BE STAGED WITHIN THE 100-YEAR FLOODPLAIN.
   - C. ANY LARGE WOOD, TOPSOIL, AND NATIVE CHANNEL MATERIAL DISPLACED BY CONSTRUCTION WILL BE STOCKPILED FOR USE DURING SITE RESTORATION AT A SPECIFICALLY IDENTIFIED AND FLAGGED AREA.
   - D. ANY MATERIAL NOT USED IN RESTORATION, AND NOT NATIVE TO THE FLOODPLAIN, WILL BE REMOVED TO A LOCATION OUTSIDE OF THE 100-YEAR FLOODPLAIN FOR DISPOSAL.
8. EQUIPMENT. MECHANIZED EQUIPMENT AND VEHICLES WILL BE SELECTED, OPERATED, AND MAINTAINED IN A MANNER THAT MINIMIZES ADVERSE EFFECTS ON THE ENVIRONMENT (E.G., MINIMALLY-SIZED, LOW PRESSURE TIRES; MINIMAL HARD-TURN PATHS FOR TRACKED VEHICLES; TEMPORARY MATS OR PLATES WITHIN WET AREAS OR ON SENSITIVE SOILS). ALL VEHICLES AND OTHER MECHANIZED EQUIPMENT WILL BE:
   - A. STORED, FUELED, AND MAINTAINED IN A VEHICLE STAGING AREA PLACED 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND OR ON AN ADJACENT, ESTABLISHED ROAD AREA;
   - B. REFUELED IN A VEHICLE STAGING AREA PLACED 150 FEET OR MORE FROM A NATURAL WATERBODY OR WETLAND, OR IN AN ISOLATED HARD ZONE, SUCH AS A PAVED PARKING LOT OR ADJACENT, ESTABLISHED ROAD (THIS MEASURE APPLIES ONLY TO GAS-POWERED EQUIPMENT WITH TANKS LARGER THAN 5 GALLONS);
   - C. BIODEGRADABLE LUBRICANTS AND FLUIDS SHALL BE USED ON EQUIPMENT OPERATING IN AND ADJACENT TO THE STREAM CHANNEL AND LIVE WATER.
   - D. INSPECTED DAILY FOR FLUID LEAKS BEFORE LEAVING THE VEHICLE STAGING AREA FOR OPERATION WITHIN 150 FEET OF ANY NATURAL WATER BODY OR WETLAND; AND
   - E. THOROUGHLY CLEANED BEFORE OPERATION BELOW ORDINARY HIGH WATER, AND AS OFTEN AS NECESSARY DURING OPERATION, TO REMAIN GREASE FREE.
9. EROSION CONTROL. EROSION CONTROL MEASURES WILL BE PREPARED AND CARRIED OUT, COMMENSURATE IN SCOPE WITH THE ACTION, THAT MAY INCLUDE THE FOLLOWING:
   - A. TEMPORARY EROSION CONTROLS.
     - I. TEMPORARY EROSION CONTROLS WILL BE IN PLACE BEFORE ANY SIGNIFICANT ALTERATION OF THE ACTION SITE AND APPROPRIATELY INSTALLED DOWNSLOPE OF PROJECT ACTIVITY WITHIN THE RIPARIAN BUFFER AREA UNTIL SITE REHABILITATION IS COMPLETE.
     - II. IF THERE IS A POTENTIAL FOR ERODED SEDIMENT TO ENTER THE STREAM, SEDIMENT BARRIERS WILL BE INSTALLED AND MAINTAINED FOR THE DURATION OF PROJECT IMPLEMENTATION.
     - III. TEMPORARY EROSION CONTROL MEASURES MAY INCLUDE FIBER WATTLES, SILT FENCES, JUTE MATTING, WOOD FIBER MULCH AND SOIL BINDER, OR GEOTEXTILES AND GEOSYNTHETIC FABRIC.
     - IV. SOIL STABILIZATION UTILIZING WOOD FIBER MULCH AND TACKIFIER (HYDRO-APPLIED) MAY BE USED TO REDUCE EROSION OF BARE SOIL IF THE MATERIALS ARE NOXIOUS WEED FREE AND NONTOXIC TO AQUATIC AND TERRESTRIAL ANIMALS, SOIL MICROORGANISMS, AND VEGETATION.
     - V. SEDIMENT WILL BE REMOVED FROM EROSION CONTROLS ONCE IT HAS REACHED 1/3 OF THE EXPOSED HEIGHT OF THE CONTROL.
     - VI. ONCE THE SITE IS STABILIZED AFTER CONSTRUCTION, TEMPORARY EROSION CONTROL MEASURES WILL BE REMOVED.
   - B. EMERGENCY EROSION CONTROLS. THE FOLLOWING MATERIALS FOR EMERGENCY EROSION CONTROL WILL BE AVAILABLE AT THE WORK SITE:
     - I. A SUPPLY OF SEDIMENT CONTROL MATERIALS; AND
     - II. AN OIL-ABSORBING FLOATING BOOM WHENEVER SURFACE WATER IS PRESENT.
10. DUST ABATEMENT. THE PROJECT SPONSOR WILL DETERMINE THE APPROPRIATE DUST CONTROL MEASURES BY CONSIDERING SOIL TYPE, EQUIPMENT USAGE, PREVAILING WIND DIRECTION, AND THE EFFECTS CAUSED BY OTHER EROSION AND SEDIMENT CONTROL MEASURES. IN ADDITION, THE FOLLOWING CRITERIA WILL BE FOLLOWED:
    - A. WORK WILL BE SEQUENCED AND SCHEDULED TO REDUCE EXPOSED BARE SOIL SUBJECT TO WIND EROSION.
    - B. DUST-ABATEMENT ADDITIVES AND STABILIZATION CHEMICALS (TYPICALLY MAGNESIUM CHLORIDE, CALCIUM CHLORIDE SALTS, OR LIGNINSULFONATE) WILL NOT BE APPLIED WITHIN 25 FEET OF WATER OR A STREAM CHANNEL AND WILL BE APPLIED SO AS TO MINIMIZE THE LIKELIHOOD THAT THEY WILL ENTER STREAMS. APPLICATIONS OF LIGNINSULFONATE WILL BE LIMITED TO A MAXIMUM RATE OF 0.5 GALLONS PER SQUARE YARD OF ROAD SURFACE, ASSUMING A 50:50 (LIGNINSULFONATE TO WATER) SOLUTION.
    - C. APPLICATION OF DUST ABATEMENT CHEMICALS WILL BE AVOIDED DURING OR JUST BEFORE WET WEATHER, AND AT STREAM CROSSINGS OR OTHER AREAS THAT COULD RESULT IN UNFILTERED DELIVERY OF THE DUST ABATEMENT MATERIALS TO A WATERBODY (TYPICALLY THESE WOULD BE AREAS WITHIN 25 FEET OF A WATERBODY OR STREAM CHANNEL; DISTANCES MAY BE GREATER WHERE VEGETATION IS SPARSE OR SLOPES ARE STEEP).
    - D. SPILL CONTAINMENT EQUIPMENT WILL BE AVAILABLE DURING APPLICATION OF DUST ABATEMENT CHEMICALS.
    - E. PETROLEUM-BASED PRODUCTS WILL NOT BE USED FOR DUST ABATEMENT.
11. SPILL PREVENTION, CONTROL, AND COUNTER MEASURES. THE USE OF MECHANIZED MACHINERY INCREASES THE RISK FOR ACCIDENTAL SPILLS OF FUEL, LUBRICANTS, HYDRAULIC FLUID, OR OTHER CONTAMINANTS INTO THE RIPARIAN ZONE OR DIRECTLY INTO THE WATER. ADDITIONALLY, UNCURED CONCRETE AND FORM MATERIALS ADJACENT TO THE ACTIVE STREAM CHANNEL MAY RESULT IN ACCIDENTAL DISCHARGE INTO THE WATER. THESE CONTAMINANTS CAN DEGRADE HABITAT, AND INJURE OR KILL AQUATIC FOOD ORGANISMS AND ESA-LISTED SPECIES. THE PROJECT SPONSOR WILL ADHERE TO THE FOLLOWING MEASURES:
    - A. A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.
    - B. WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.
    - C. SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.
    - D. WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.
    - E. ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.
12. INVASIVE SPECIES CONTROL. THE FOLLOWING MEASURES WILL BE FOLLOWED TO AVOID INTRODUCTION OF INVASIVE PLANTS AND NOXIOUS WEEDS INTO PROJECT AREAS:
    - A. PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.
    - B. WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.
    - C. WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES.

(CONTINUES ON G04)

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA	KITTITAS COUNTY CONSERVATION DISTRICT	RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION	G03
		BPA HIP III GENERAL CONSERVATION & IMPLEMENTATION MEASURES	SHEET # 3 OF 22

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. SEXTON
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

(BPA NOTES CONTINUED FROM G03)

13. SPILL PREVENTION, CONTROL, AND COUNTER MEASURES. THE USE OF MECHANIZED MACHINERY INCREASES THE RISK FOR ACCIDENTAL SPILLS OF FUEL, LUBRICANTS, HYDRAULIC FLUID, OR OTHER CONTAMINANTS INTO THE RIPARIAN ZONE OR DIRECTLY INTO THE WATER. ADDITIONALLY, UNCURED CONCRETE AND FORM MATERIALS ADJACENT TO THE ACTIVE STREAM CHANNEL MAY RESULT IN ACCIDENTAL DISCHARGE INTO THE WATER. THESE CONTAMINANTS CAN DEGRADE HABITAT, AND INJURE OR KILL AQUATIC FOOD ORGANISMS AND ESA-LISTED SPECIES. THE PROJECT SPONSOR WILL ADHERE TO THE FOLLOWING MEASURES:
    A. A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.
    B. WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.
    C. SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.
    D. WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.
    E. ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.

14. INVASIVE SPECIES CONTROL. THE FOLLOWING MEASURES WILL BE FOLLOWED TO AVOID INTRODUCTION OF INVASIVE PLANTS AND NOXIOUS WEEDS INTO PROJECT AREAS:
    A. PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.
    B. WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.
    C. WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES.

WORK AREA ISOLATION & FISH SALVAGE

ANY WORK AREA WITHIN THE WETTED CHANNEL WILL BE ISOLATED FROM THE ACTIVE STREAM WHENEVER ESA-LISTED FISH ARE REASONABLY CERTAIN TO BE PRESENT, OR IF THE WORK AREA IS LESS THAN 300-FEET UPSTREAM FROM KNOWN SPAWNING HABITATS. WHEN WORK AREA ISOLATION IS REQUIRED, DESIGN PLANS WILL INCLUDE ALL ISOLATION ELEMENTS, FISH RELEASE AREAS, AND, WHEN A PUMP IS USED TO DEWATER THE ISOLATION AREA AND FISH ARE PRESENT, A FISH SCREEN THAT MEETS NMFS'S FISH SCREEN CRITERIA (NMFS 2011, OR MOST CURRENT). WORK AREA ISOLATION AND FISH CAPTURE ACTIVITIES WILL OCCUR DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS AND DEATH OF SPECIES PRESENT.

- NATIONAL MARINE FISHERIES SERVICE. 2011. ANADROMOUS SALMONID PASSAGE FACILITY DESIGN. NORTHWEST REGION. AVAILABLE ONLINE AT: **HTTP://WWW.NWR.NOAA.GOV/SALMON-HYDROPOWER/FERC/UPLOAD/ FISH-PASSAGE-DESIGN.PDF**
- U.S. FISH AND WILDLIFE SERVICE. 2010. BEST MANAGEMENT PRACTICES TO MINIMIZE ADVERSE EFFECTS TO PACIFIC LAMPREY. **HTTP://WWW.FWS.GOV/PACIFIC/FISHERIES/SPHABCON/LAMPREY/PDF/BEST MANAGEMENT PRACTICES FOR 20PACIFIC LAMPREY APRIL 2010 VERSION.PDF**

FOR SALVAGE OPERATIONS IN KNOWN BULL TROUT SPAWNING AND REARING HABITAT, ELECTRO FISHING SHALL ONLY OCCUR FROM MAY 1 TO JULY 31. NO ELECTRO FISHING WILL OCCUR IN ANY BULL TROUT OCCUPIED HABITAT AFTER AUGUST 15. BULL TROUT ARE VERY TEMPERATURE SENSITIVE AND GENERALLY SHOULD NOT BE ELECTRO SHOCKED OR OTHERWISE HANDLED WHEN TEMPERATURES EXCEED 15 DEGREES CELSIUS. SALVAGE ACTIVITIES SHOULD TAKE PLACE DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS TO FISH SPECIES PRESENT. SALVAGE OPERATIONS WILL FOLLOW THE ORDERING, METHODOLOGIES, AND CONSERVATION MEASURES SPECIFIED BELOW IN STEPS 1 THROUGH 6. STEPS 1 AND 2 WILL BE IMPLEMENTED FOR ALL PROJECTS WHERE WORK AREA ISOLATION IS NECESSARY ACCORDING TO CONDITIONS ABOVE. ELECTRO FISHING (STEP 3) CAN BE IMPLEMENTED TO ENSURE ALL FISH HAVE BEEN REMOVED FOLLOWING STEPS 1 AND 2, OR WHEN OTHER MEANS OF FISH CAPTURE MAY NOT BE FEASIBLE OR EFFECTIVE. DEWATERING AND REWATERING (STEPS 4 AND 5) WILL BE IMPLEMENTED UNLESS WETTED IN-STREAM WORK IS DEEMED TO BE MINIMALLY HARMFUL TO FISH, AND IS BENEFICIAL TO OTHER AQUATIC SPECIES. DEWATERING WILL NOT BE CONDUCTED IN AREAS KNOWN TO BE OCCUPIED BY LAMPREY, UNLESS LAMPREYS ARE SALVAGED USING GUIDANCE SET FORTH IN US FISH AND WILDLIFE SERVICE (2010)3

1. ISOLATE.
    A. BLOCK NETS WILL BE INSTALLED AT UPSTREAM AND DOWNSTREAM LOCATIONS AND MAINTAINED IN A SECURED POSITION TO EXCLUDE FISH FROM ENTERING THE PROJECT AREA.
    B. BLOCK NETS WILL BE SECURED TO THE STREAM CHANNEL BED AND BANKS UNTIL FISH CAPTURE AND TRANSPORT ACTIVITIES ARE COMPLETE. BLOCK NETS MAY BE LEFT IN PLACE FOR THE DURATION OF THE PROJECT TO EXCLUDE FISH.
    C. IF BLOCK NETS REMAIN IN PLACE MORE THAN ONE DAY, THE NETS WILL BE MONITORED AT LEAST DAILY TO ENSURE THEY ARE SECURED TO THE BANKS AND FREE OF ORGANIC ACCUMULATION. IF THE PROJECT IS WITHIN BULL TROUT SPAWNING AND REARING HABITAT, THE BLOCK NETS MUST BE CHECKED EVERY FOUR HOURS FOR FISH IMPINGEMENT ON THE NET. LESS FREQUENT INTERVALS MUST BE APPROVED THROUGH A VARIANCE REQUEST.
    D. NETS WILL BE MONITORED HOURLY ANYTIME THERE IS INSTREAM DISTURBANCE.

2. SALVAGE. AS DESCRIBED BELOW, FISH TRAPPED WITHIN THE ISOLATED WORK AREA WILL BE CAPTURED TO MINIMIZE THE RISK OF INJURY, THEN RELEASED AT A SAFE SITE.
    A. REMOVE AS MANY FISH AS POSSIBLE PRIOR TO DEWATERING.
    B. DURING DEWATERING, ANY REMAINING FISH WILL BE COLLECTED BY HAND OR DIP NETS.
    C. SEINES WITH A MESH SIZE TO ENSURE CAPTURE OF THE RESIDING ESA-LISTED FISH WILL BE USED.
    D. MINNOW TRAPS WILL BE LEFT IN PLACE OVERNIGHT AND USED IN CONJUNCTION WITH SEINING.
    E. IF BUCKETS ARE USED TO TRANSPORT FISH:
    I. THE TIME FISH ARE IN A TRANSPORT BUCKET WILL BE LIMITED, AND WILL BE RELEASED AS QUICKLY AS POSSIBLE;
    II. THE NUMBER OF FISH WITHIN A BUCKET WILL BE LIMITED BASED ON SIZE, AND FISH WILL BE OF RELATIVELY COMPARABLE SIZE TO MINIMIZE PREDATION;
    III. AERATORS FOR BUCKETS WILL BE USED OR THE BUCKET WATER WILL BE FREQUENTLY CHANGED WITH COLD CLEAR WATER AT 15 MINUTE OR MORE FREQUENT INTERVALS.
    IV. BUCKETS WILL BE KEPT IN SHADED AREAS OR WILL BE COVERED BY A CANOPY IN EXPOSED AREAS.
    V. DEAD FISH WILL NOT BE STORED IN TRANSPORT BUCKETS, BUT WILL BE LEFT ON THE STREAM BANK TO AVOID MORTALITY COUNTING ERRORS.
    F. AS RAPIDLY AS POSSIBLE (ESPECIALLY FOR TEMPERATURE-SENSITIVE BULL TROUT), FISH WILL BE RELEASED IN AN AREA THAT PROVIDES ADEQUATE COVER AND FLOW REFUGE. UPSTREAM RELEASE IS GENERALLY PREFERRED, BUT FISH RELEASED DOWNSTREAM WILL BE SUFFICIENTLY OUTSIDE OF THE INFLUENCE OF CONSTRUCTION.
    G. SALVAGE WILL BE SUPERVISED BY A QUALIFIED FISHERIES BIOLOGIST EXPERIENCED WITH WORK AREA ISOLATION AND COMPETENT TO ENSURE THE SAFE HANDLING OF ALL FISH.

3. ELECTROFISHING. ELECTROFISHING WILL BE USED ONLY AFTER OTHER SALVAGE METHODS HAVE BEEN EMPLOYED OR WHEN OTHER MEANS OF FISH CAPTURE ARE DETERMINED TO NOT BE FEASIBLE OR EFFECTIVE. IF ELECTROFISHING WILL BE USED TO CAPTURE FISH FOR SALVAGE, THE SALVAGE OPERATION WILL BE LED BY AN EXPERIENCED FISHERIES BIOLOGIST AND THE FOLLOWING GUIDELINES WILL BE FOLLOWED:
    A. THE NMFS'S ELECTROFISHING GUIDELINES (NMFS 2000).
    B. ONLY DIRECT CURRENT (DC) OR PULSED DIRECT CURRENT (PDC) WILL BE USED AND CONDUCTIVITY MUST BE TESTED.
    I. IF CONDUCTIVITY IS LESS THAN 100 MS, VOLTAGE RANGES FROM 900 TO 1100 WILL BE USED.
    II. FOR CONDUCTIVITY RANGES BETWEEN 100 TO 300 MS, VOLTAGE RANGES WILL BE 500 TO 800.
    III. FOR CONDUCTIVITY GREATER THAN 300 MS, VOLTAGE WILL BE LESS THAN 400.
    C. ELECTROFISHING WILL BEGIN WITH A MINIMUM PULSE WIDTH AND RECOMMENDED VOLTAGE AND THEN GRADUALLY INCREASE TO THE POINT WHERE FISH ARE IMMOBILIZED.
    D. THE ANODE WILL NOT INTENTIONALLY CONTACT FISH.
    E. ELECTROFISHING SHALL NOT BE CONDUCTED WHEN THE WATER CONDITIONS ARE TURBID AND VISIBILITY IS POOR. THIS CONDITION MAY BE EXPERIENCED WHEN THE SAMPLER CANNOT SEE THE STREAM BOTTOM IN ONE FOOT OF WATER.
    F. IF MORTALITY OR OBVIOUS INJURY (DEFINED AS DARK BANDS ON THE BODY, SPINAL DEFORMATIONS, DE-SCALING OF 25% OR MORE OF BODY, AND TORPIDITY OR INABILITY TO MAINTAIN UPRIGHT ATTITUDE AFTER SUFFICIENT RECOVERY TIME) OCCURS DURING ELECTROFISHING, OPERATIONS WILL BE IMMEDIATELY DISCONTINUED, MACHINE SETTINGS, WATER TEMPERATURE AND CONDUCTIVITY CHECKED, AND PROCEDURES ADJUSTED OR ELECTROFISHING POSTPONED TO REDUCE MORTALITY.

4. DEWATER. DEWATERING, WHEN NECESSARY, WILL BE CONDUCTED OVER A SUFFICIENT PERIOD OF TIME TO ALLOW SPECIES TO NATURALLY MIGRATE OUT OF THE WORK AREA AND WILL BE LIMITED TO THE SHORTEST LINEAR EXTENT PRACTICABLE.
    A. DIVERSION AROUND THE CONSTRUCTION SITE MAY BE ACCOMPLISHED WITH A COFFER DAM AND A BY-PASS CULVERT OR PIPE, OR A LINED, NON-ERODIBLE DIVERSION DITCH. WHERE GRAVITY FEED IS NOT POSSIBLE, A PUMP MAY BE USED, BUT MUST BE OPERATED IN SUCH A WAY AS TO AVOID REPETITIVE DEWATERING AND REWATERING OF THE SITE. IMPOUNDMENT BEHIND THE COFFERDAM MUST OCCUR SLOWLY THROUGH THE TRANSITION, WHILE CONSTANT FLOW IS DELIVERED TO THE DOWNSTREAM REACHES.
    B. ALL PUMPS WILL HAVE FISH SCREENS TO AVOID JUVENILE FISH IMPINGEMENT OR ENTRAINMENT, AND WILL BE OPERATED IN ACCORDANCE WITH NMFS'S CURRENT FISH SCREEN CRITERIA (NMFS 20114, OR MOST RECENT VERSION). IF THE PUMPING RATE EXCEEDS 3 CUBIC FEET SECOND (CFS), A NMFS HYDRO FISH PASSAGE REVIEW WILL BE NECESSARY.
    C. DISSIPATION OF FLOW ENERGY AT THE BYPASS OUTFLOW WILL BE PROVIDED TO PREVENT DAMAGE TO RIPARIAN VEGETATION OR STREAM CHANNEL.
    D. SAFE REENTRY OF FISH INTO THE STREAM CHANNEL WILL BE PROVIDED, PREFERABLY INTO POOL HABITAT WITH COVER, IF THE DIVERSION ALLOWS FOR DOWNSTREAM FISH PASSAGE.
    E. SEEPAGE WATER WILL BE PUMPED TO A TEMPORARY STORAGE AND TREATMENT SITE OR INTO UPLAND AREAS TO ALLOW WATER TO PERCOLATE THROUGH SOIL OR TO FILTER THROUGH VEGETATION PRIOR TO REENTERING THE STREAM CHANNEL.

    4 NATIONAL MARINE FISHERIES SERVICE. 2011. ANADROMOUS SALMONID PASSAGE FACILITY DESIGN. NORTHWEST REGION. AVAILABLE ONLINE AT: **HTTP://WWW.NWR.NOAA.GOV/SALMON-HYDROPOWER/FERC/UPLOAD/ FISH-PASSAGE-DESIGN.PDF**

5. SALVAGE NOTICE. MONITORING AND RECORDING OF FISH PRESENCE, HANDLING, AND MORTALITY MUST OCCUR DURING THE DURATION OF THE ISOLATION, SALVAGE, ELECTROFISHING, DEWATERING, AND REWATERING OPERATIONS. ONCE OPERATIONS ARE COMPLETED, A SALVAGE REPORT WILL DOCUMENT PROCEDURES USED, ANY FISH INJURIES OR DEATHS (INCLUDING NUMBERS OF FISH AFFECTED), AND CAUSES OF ANY DEATHS.

CONSTRUCTION AND POST-CONSTRUCTION CONSERVATION MEASURES.

1. FISH PASSAGE. FISH PASSAGE WILL BE PROVIDED FOR ANY ADULT OR JUVENILE FISH LIKELY TO BE PRESENT IN THE ACTION AREA DURING CONSTRUCTION, UNLESS PASSAGE DID NOT EXIST BEFORE CONSTRUCTION OR THE STREAM IS NATURALLY IMPASSABLE AT THE TIME OF CONSTRUCTION. IF THE PROVISION OF TEMPORARY FISH PASSAGE DURING CONSTRUCTION WILL INCREASE NEGATIVE EFFECTS ON AQUATIC SPECIES OF INTEREST OR THEIR HABITAT, A VARIANCE CAN BE REQUESTED FROM THE NMFS BRANCH CHIEF AND THE FWS FIELD OFFICE SUPERVISOR. PERTINENT INFORMATION, SUCH AS THE SPECIES AFFECTED, LENGTH OF STREAM REACH AFFECTED, PROPOSED TIME FOR THE PASSAGE BARRIER, AND ALTERNATIVESCONSIDERED, WILL BE INCLUDED IN THE VARIANCE REQUEST.
2. CONSTRUCTION AND DISCHARGE WATER.
    A. SURFACE WATER MAY BE DIVERTED TO MEET CONSTRUCTION NEEDS, BUT ONLY IF DEVELOPED SOURCES ARE UNAVAILABLE OR INADEQUATE.
    B. DIVERSIONS WILL NOT EXCEED 10% OF THE AVAILABLE FLOW.
    C. ALL CONSTRUCTION DISCHARGE WATER WILL BE COLLECTED AND TREATED USING THE BEST AVAILABLE TECHNOLOGY APPLICABLE TO SITE CONDITIONS
    D. TREATMENTS TO REMOVE DEBRIS, NUTRIENTS, SEDIMENT, PETROLEUM HYDROCARBONS, METALS AND OTHER POLLUTANTS LIKELY TO BE PRESENT WILL BE PROVIDED.

PLAN INTENDED TO BE VIEWED IN COLOR, ADJACENT BLOCK IS "BLUE"

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY
CONSERVATION DISTRICT

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

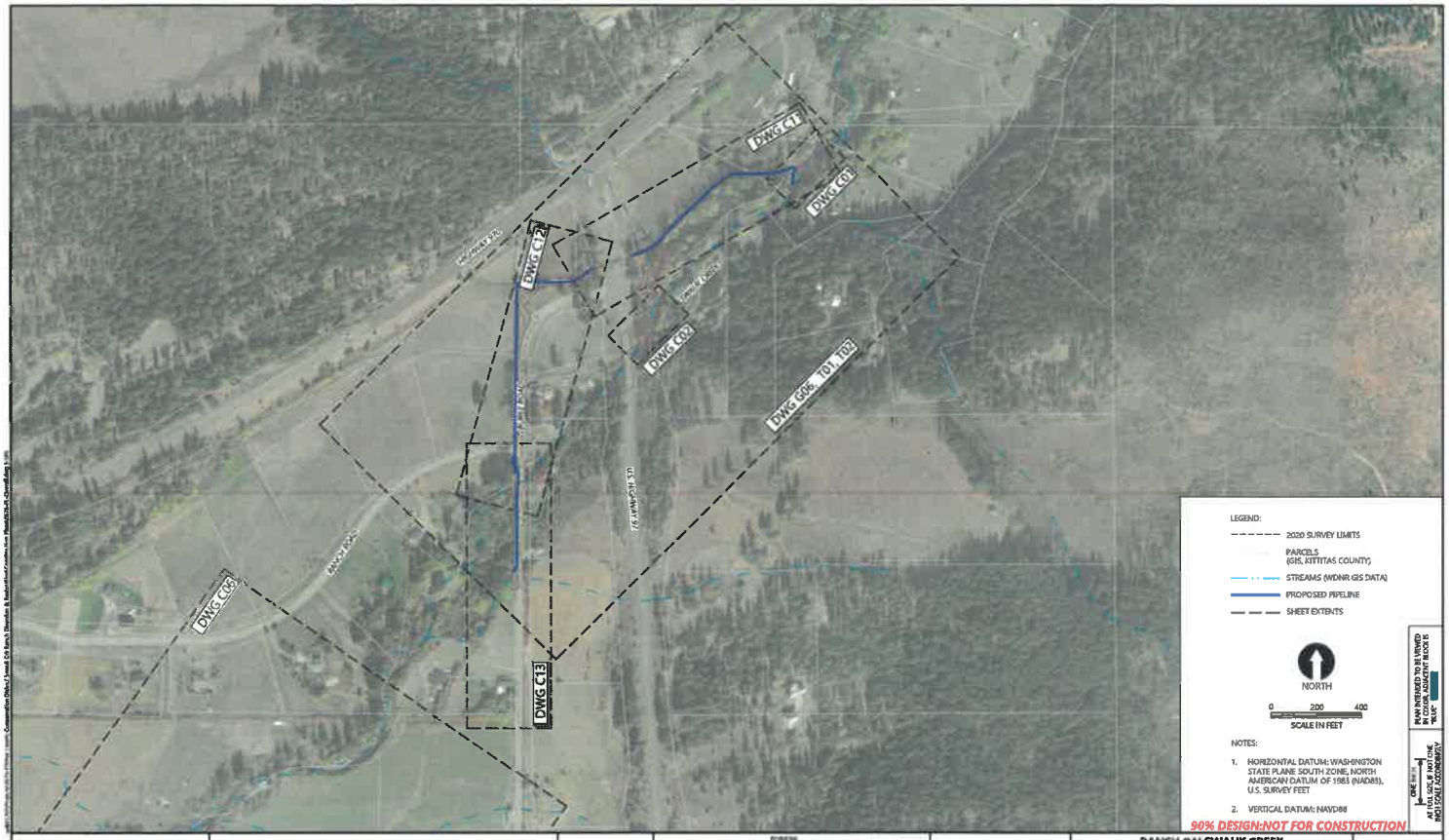
DESIGNED BY: J. SEXTON
DRAWN BY: J. GAIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

BPA HIP III GENERAL
CONSERVATION &
IMPLEMENTATION MEASURES

G04

SHEET # 4 OF 22



ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

ADV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. EDTON
DRAWN BY: T. GREA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

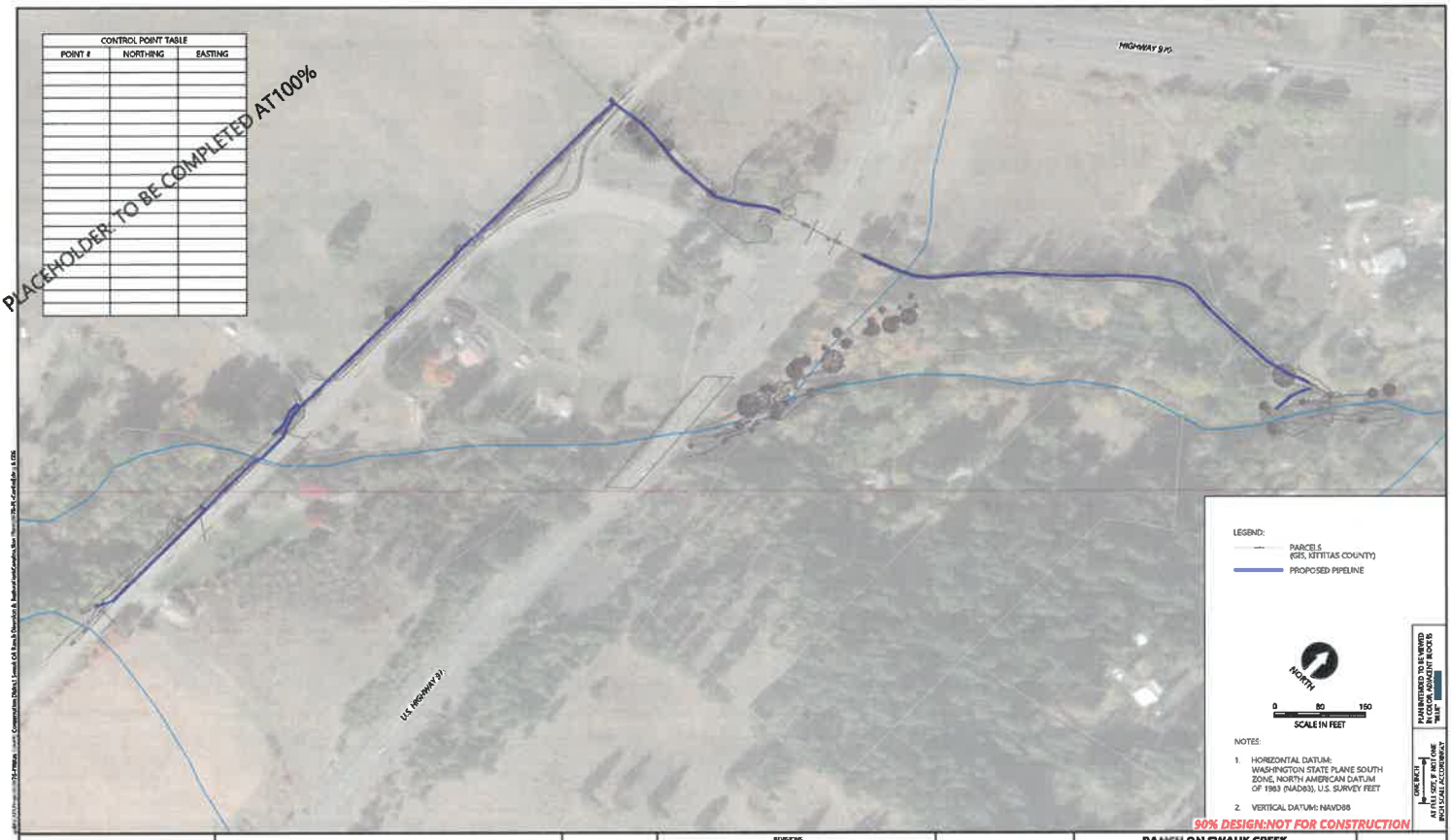
OVERALL SITE PLAN

G05

SHEET # 5 OF 22

CONTROL POINT TABLE		
POINT #	NORTHING	EASTING

PLACEHOLDER: TO BE COMPLETED AT100%



LEGEND:

PARCELS (GIS, KITTITAS COUNTY)

PROPOSED PIPELINE

NORTH

0 80 150

SCALE IN FEET

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83), U.S. SURVEY FEET
2. VERTICAL DATUM: NAVD88

PLAN INTENDED TO BE VIEWED FULL SIZE ON 24X36 SHEETS "ARCH D"

ORIGINAL AT FULL SIZE, IF NOT ONE INCH LONG ADJUST SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS

NO.	DATE	BY	APP'D	DESCRIPTION

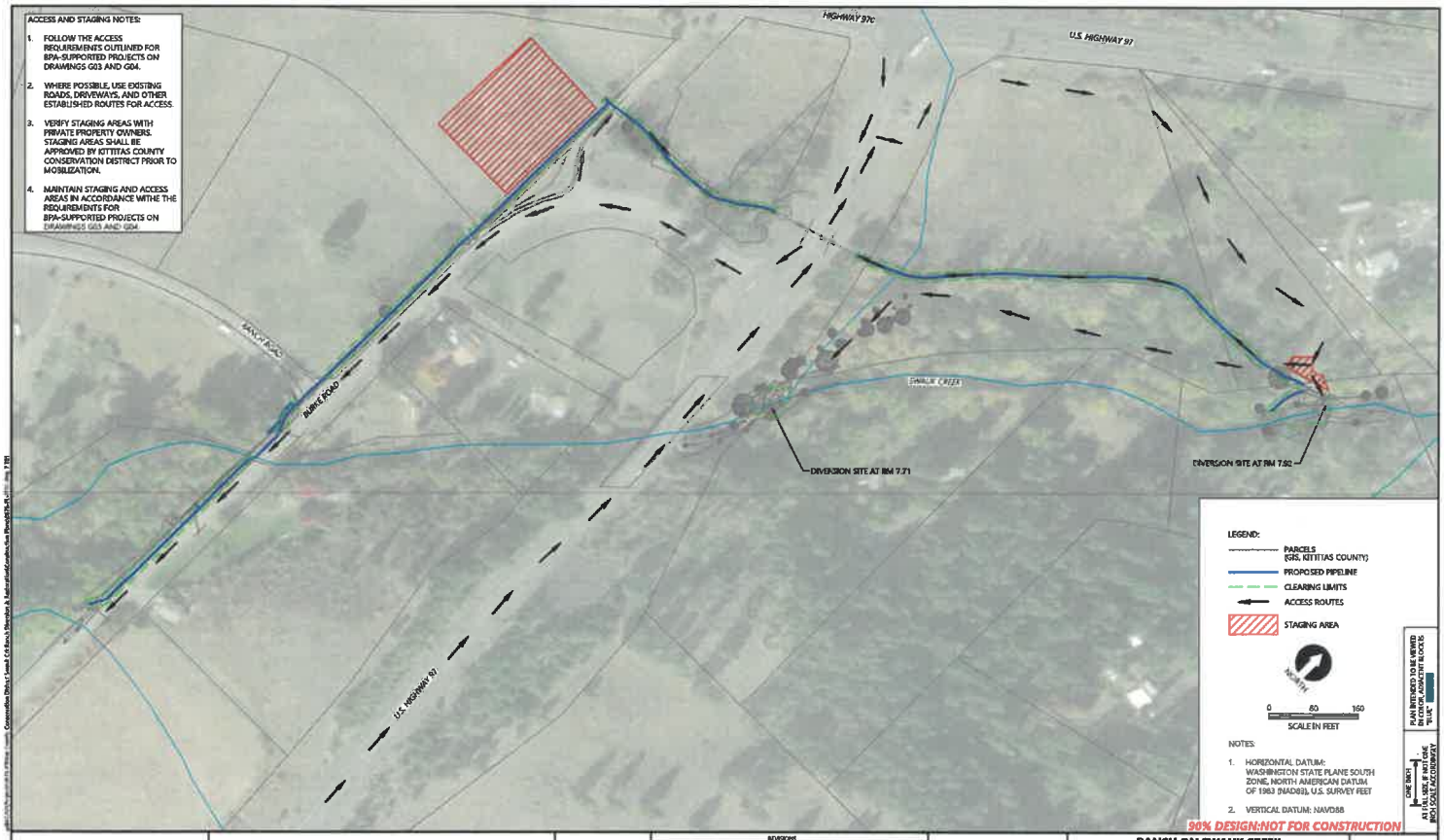
DESIGNED BY: J. SOUTON
DRAWN BY: T. GINOA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

SURVEY CONTROL PLAN

G06

SHEET # 6 OF 22



90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS

REV	DATE	BY	DESCRIPTION

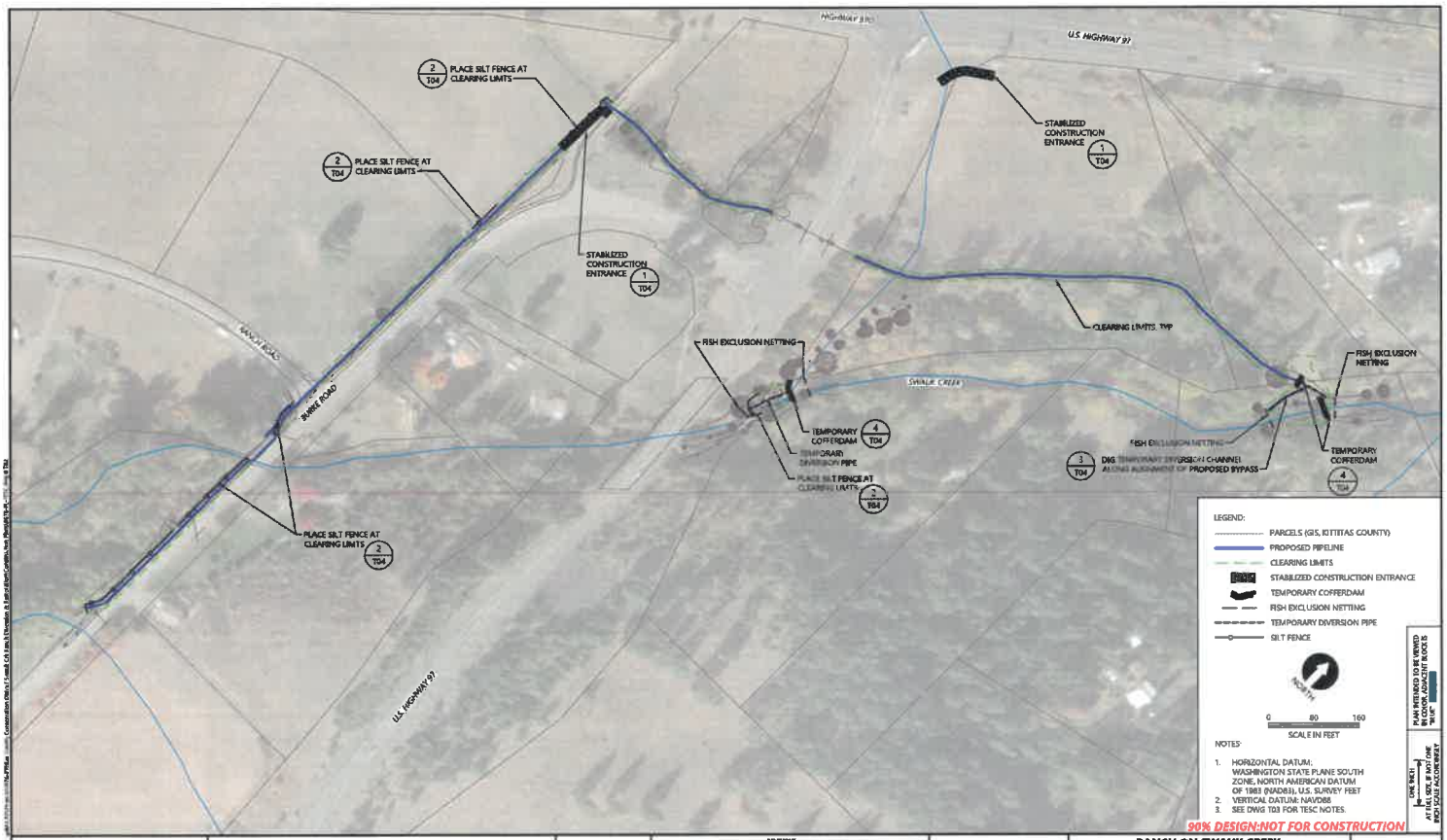
DESIGNED BY: J. SEXTON
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

TEMPORARY ACCESS AND STAGING PLAN

T01

SHEET # 7 OF 22



90% DESIGN-NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. KOTOSKI
DRAWN BY: T. NAGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

TEMPORARY EROSION, SEDIMENT, AND WATER CONTROL PLAN

T02

SHEET # 8 OF 22

GENERAL TEMPORARY EROSION AND SEDIMENT CONTROL (TESC) NOTES:

1. THE CONTRACTOR SHALL PROVIDE A CERTIFIED EROSION AND SEDIMENT CONTROL LEAD (CESCL) TO MANAGE AND MAINTAIN TEMPORARY EROSION AND SEDIMENT CONTROL FOR THE PROJECT. THE NAMED PERSON OR FIRM SHALL BE ON-SITE OR ON-CALL AT ALL TIMES.
2. THE IMPLEMENTATION OF THESE TESC DRAWINGS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE TESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
3. THE CLEARING LIMIT BOUNDARIES SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
4. THE TESC FACILITIES SHOWN ON THESE DRAWINGS MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT ENTER ANY DRAINAGE SYSTEMS, STREAMS, OR SURFACE WATER BODIES.
5. THE TESC FACILITIES SHOWN ON THESE DRAWINGS ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE TESC FACILITIES SHALL BE UPGRADED AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE
6. THE TESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED, REPAIRED, OR AUGMENTED AS NECESSARY, TO ENSURE THEIR CONTINUED FUNCTIONING.
7. STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO ENSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
8. FROM OCTOBER 1 THROUGH JUNE 30, NO SOILS SHALL REMAIN EXPOSED AND UNWORKED FOR MORE THAN 5 DAYS. FROM JULY 1 TO SEPTEMBER 30, NO SOILS SHALL REMAIN EXPOSED AND UNWORKED FOR MORE THAN 10 DAYS. SOILS SHALL BE STABILIZED AT THE END OF THE SHIFT BEFORE A HOLIDAY OR WEEKEND IF NEEDED BASED ON THE WEATHER FORECAST. THESE STABILIZATION REQUIREMENTS APPLY TO ALL SOILS ON SITE, WHETHER AT FINAL GRADE OR NOT. KCCD'S REPRESENTATIVE MAY ADJUST THESE TIME LIMITS IF IT CAN BE SHOWN THAT A DEVELOPMENT SITE'S EROSION OR RUNOFF POTENTIAL JUSTIFIES A DIFFERENT STANDARD.
9. FROM OCTOBER 1 THROUGH JUNE 30, THE CONTRACTOR SHALL TAKE ADDITIONAL CARE TO CLEARLY DEMONSTRATE THAT CLEARING, GRADING, AND OTHER SOIL-DISTURBING ACTIVITIES WILL BE COMPLETED IN A WAY THAT WILL PREVENT THE TRANSPORT OF SEDIMENT FROM THE CONSTRUCTION SITE TO RECEIVING WATERS.
10. SOIL AND OTHER STOCKPILES MUST BE STABILIZED AND PROTECTED WITH SEDIMENT-TRAPPING MEASURES.
11. ALL POLLUTANTS, INCLUDING WASTE MATERIALS AND DEMOLITION DEBRIS, THAT OCCUR ON SITE DURING CONSTRUCTION SHALL BE HANDLED AND DISPOSED OF IN A MANNER THAT DOES NOT CAUSE CONTAMINATION OF STORMWATER.
12. MAINTENANCE AND REPAIR OF HEAVY EQUIPMENT AND VEHICLES AND OTHER ACTIVITIES WHICH MAY RESULT IN DISCHARGE OR SPILLAGE OF POLLUTANTS TO THE GROUND OR INTO STORMWATER RUNOFF MUST BE CONDUCTED USING SPILL PREVENTION MEASURES APPROVED BY KCCD'S REPRESENTATIVE. REPORT ALL SPILLS TO 911.
13. WATER FROM MOST DEWATERING OPERATIONS SHALL BE DISPERSED IN AN ADJACENT FIELD, OR VACANT PROPERTY, AS APPROVED BY KCCD AND THE PROPERTY OWNER. THE CONTRACTOR SHALL PROTECT PRIVATE PROPERTY, EXISTING DITCHES, AND EXISTING DRAINAGE CHANNELS FROM SCOUR AND EROSION RESULTING FROM DEWATERING OPERATIONS. HIGHLY TURBID OR CONTAMINATED DEWATERING WATER SHALL BE HANDLED SEPARATELY FROM STORMWATER AND PROPERLY DISPOSED.
14. THE CONTRACTOR SHALL PRESERVE NATURAL LANDSCAPE, AND PRESERVE AND PROTECT EXISTING VEGETATION NOT REQUIRED OR OTHERWISE AUTHORIZED TO BE REMOVED, AS OUTLINED IN THE SPECIFICATIONS.
15. REPAIR OR TREAT INJURED TREES AND VEGETATION AS REQUIRED BY THE SPECIFICATIONS.
16. REMOVE AND DISPOSE OF TREES AND VEGETATION THAT ARE INJURED OR DAMAGED BEYOND SAVING AND NOT REQUIRED OR OTHERWISE AUTHORIZED FOR REMOVAL AS REQUIRED IN THE SPECIFICATIONS. REPLACE THE INJURED TREE OR SHRUB AS DIRECTED BY KCCD'S REPRESENTATIVE.

PROJECT SPECIFIC TESC NOTES:

1. THE TESC PLAN DRAWINGS SHOWN ARE CONCEPTUAL. THE CONTRACTOR IS REQUIRED TO SUBMIT DETAILED TESC PLANS AND A CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP) TO KCCD'S REPRESENTATIVE FOR APPROVAL PER THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.
2. THE CONTRACTOR IS RESPONSIBLE FOR THE CARE AND DIVERSION OF WATER DURING CONSTRUCTION IN ACCORDANCE WITH LOCAL, STATE, AND FEDERAL WATER QUALITY STANDARDS AND PROJECT PERMIT REQUIREMENTS.
3. THE CONTRACTOR SHALL ENSURE NECESSARY PRECAUTIONS SHALL BE TAKEN TO PREVENT ANY CEMENT CONCRETE OR BYPRODUCTS, ASPHALT CONCRETE OR BYPRODUCTS, OR ANY DISCHARGE FROM SAW CUTTING AND PLANING FROM BEING DISCHARGED INTO ANY STORM DRAIN OR SURFACE WATER SYSTEM.
4. TESC IMPLEMENTATION AND MAINTENANCE SHALL COMPLY WITH ALL PROJECT PERMIT REQUIREMENTS.
5. THE CONTRACTOR SHALL NOT FUEL EQUIPMENT OR STORE FUEL AT ELEVATIONS LOWER THAN 5 FEET ABOVE THE ORDINARY HIGH WATER (OHW) OF THE NEAREST STREAM OR SURFACE WATER BODY.
6. WASHING OF EQUIPMENT ON THE PROJECT SITE SHALL NOT BE ALLOWED UNLESS AUTHORIZED IN WRITING BY KCCD'S REPRESENTATIVE.

CONSTRUCTION SEQUENCE:

1. SCHEDULE AND CONDUCT A PRE-CONSTRUCTION CONFERENCE WITH KCCD, THE CONTRACTOR, SUB-CONTRACTOR SUPERINTENDENTS, THE CONTRACTOR'S CESCL, THE ENGINEER, AND LOCAL JURISDICTION REPRESENTATIVES. THIS MEETING SHALL BE HELD A MINIMUM OF 48 HOURS PRIOR TO THE START OF WORK.
2. FLAG CLEARING LIMITS AND EXISTING TREES TO REMAIN.
3. CONSTRUCT STABILIZED CONSTRUCTION ENTRANCES.
4. INSTALL SILT FENCE.
5. COMPLETE CLEARING AND REMOVAL OF EXISTING STRUCTURES AND OBSTRUCTIONS ABOVE THE OHWM, INCLUDING THE EXISTING FISH SCREEN AND OTHER IRRIGATION EQUIPMENT TO BE REPLACED.
6. INSTALL TEMPORARY WATER DIVERSION FACILITIES AND DEWATER THE PORTION OF THE EXISTING STREAM CHANNEL TO BE MODIFIED.
7. COMPLETE IN-CHANNEL WORK, INCLUDING MOVING AND PLACING IN-CHANNEL ROCK AND OTHER MATERIALS.
8. REMOVE TEMPORARY WATER DIVERSION FACILITIES ONCE IN-CHANNEL WORK IS COMPLETE.
9. EXCAVATE FOR FISH SCREENING AND BYPASS FACILITIES.
10. INSTALL FISH SCREENING AND BYPASS FACILITIES.
11. EXCAVATE AND TRENCH FOR INSTALLATION OF IRRIGATION DELIVERY PIPELINE.
12. INSTALL DELIVERY PIPE AND APPURTENANCES.
13. BACKFILL TRENCHES AND EXCAVATIONS AS SOON AS POSSIBLE AFTER INSTALLATION OF BURIED PIPE AND APPURTENANCES.
14. COMPLETE SURFACE REPAIR AND PLANTING.
15. DURING CONSTRUCTION, MAINTAIN AND UPGRADE TESC BMPS AS NEEDED TO PREVENT SEDIMENT FROM LEAVING THE SITE.
16. REMOVE TESC BMPS AFTER SURFACE IS REPAIRED AND/OR SEEDED AND GROWING.
17. SEQUENCE SHALL BE ADAPTED, AS NEEDED, FOR OPTIONAL ITEMS INCLUDED DURING CONSTRUCTION.

PLAN INTENDED TO BE VIEWED ELECTRONICALLY. NOT TO SCALE.

ONE INCH
AT 11X17 SIZE, IF NOT ONE INCH SCALE INCORRECT

90% DESIGN-NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY
CONSERVATION DISTRICT

REVISIONS

NO.	DATE	BY	CHKD	ISSUE DESCRIPTION

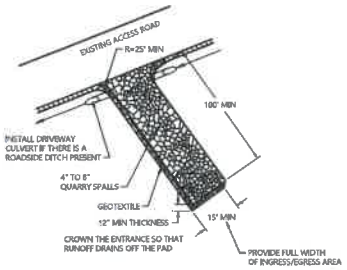
DESIGNED BY: J. MEDDOCK
DRAWN BY: T. GRIGG
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2019

RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

TESC NOTES

T03

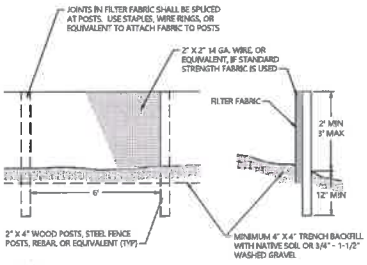
SHEET # 9 OF 22



1 T02 STABILIZED CONSTRUCTION ENTRANCE
SCALE: NOT TO SCALE

STABILIZED CONSTRUCTION ENTRANCE MAINTENANCE STANDARDS

1. QUARRY SPALLS (OR HOG FUEL) SHALL BE ADDED IF THE PAD IS NO LONGER IN ACCORDANCE WITH THE SPECIFICATIONS.
2. IF THE ENTRANCE IS NOT PREVENTING SEDIMENT FROM BEING TRACKED ONTO PAVEMENT, THEN ALTERNATIVE MEASURES TO KEEP THE STREETS FREE OF SEDIMENT SHALL BE USED. THIS MAY INCLUDE STREET SWEEPING, AN INCREASE IN THE DIMENSIONS OF THE ENTRANCE, OR THE INSTALLATION OF A WHEEL WASH. IF WASHING IS USED, IT SHALL BE DONE ON AN AREA COVERED WITH CRUSHED ROCK, ASPHALT OR CONCRETE AND WASH WATER SHALL DRAIN TO A SEDIMENT TRAP OR POND. WHEEL WASH WASTEWATER SHOULD NOT BE COMMINGLED WITH STORM WATER OR DISCHARGED TO THE STORM WATER TREATMENT SYSTEM.
3. ANY SEDIMENT THAT IS TRACKED ONTO PAVEMENT SHALL BE REMOVED IMMEDIATELY BY SWEEPING. THE SEDIMENT COLLECTED BY SWEEPING SHALL BE REMOVED OR STABILIZED ON SITE. THE PAVEMENT SHALL NOT BE CLEANED BY WASHING DOWN THE STREET, EXCEPT WHEN SWEEPING IS INEFFECTIVE AND THERE IS A THREAT TO PUBLIC SAFETY. IF IT IS NECESSARY TO WASH THE STREETS, THE CONSTRUCTION OF A SMALL SUMP SHALL BE CONSIDERED. THE SEDIMENT WOULD THEN BE WASHED INTO THE SUMP WHERE IT CAN BE CONTROLLED.
4. ANY QUARRY SPALLS THAT ARE LOOSENED FROM THE PAD AND END UP ON THE ROADWAY SHALL BE REMOVED IMMEDIATELY.
5. IF VEHICLES ARE ENTERING OR EXITING THE SITE AT POINTS OTHER THAN THE CONSTRUCTION ENTRANCE(S), FENCING SHALL BE INSTALLED TO CONTROL TRAFFIC.



NOTE:

FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE.

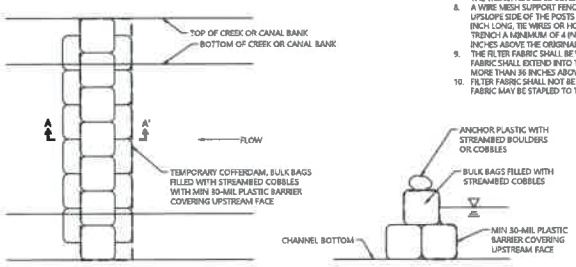
2 T02 SILT FENCE
SCALE: NOT TO SCALE

FILTER FABRIC FENCE INSTALLATION

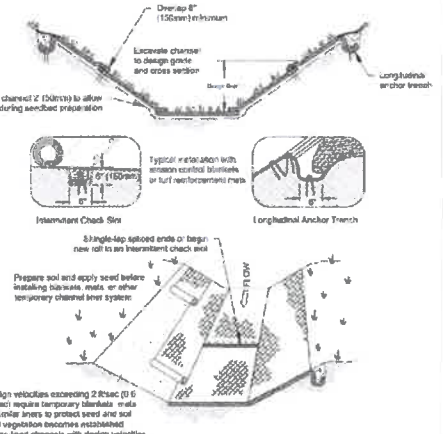
1. MAXIMUM SLOPE STEEPNESS (NORMAL (PERPENDICULAR) TO FENCE LINE): 1H:1V
2. MAXIMUM SHEET OR OVERLAND FLOW PATH LENGTH TO THE FENCE: 100 FEET
3. NO CONCENTRATED FLOWS GREATER THAN 0.5 CFS.
4. FILTER FABRIC: MIRAFI 100X, OR APPROVED EQUAL
5. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM 6-INCH OVERLAP, AND BOTH ENDS SECURELY FASTENED TO THE POST.
6. POSTS SHALL BE SPACED A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 18 INCHES. A MINIMUM DEPTH OF 12 INCHES IS ALLOWED IF TOPSOIL OR OTHER SOFT SOIL IS NOT PRESENT AND A MINIMUM DEPTH OF 18 INCHES CANNOT BE REACHED. FENCE POST DEPTHS SHALL BE INCREASED BY 6 INCHES IF THE FENCE IS LOCATED ON SLOPES OF 3:1 OR STEEPER.
7. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 4 INCHES WIDE AND 4 INCHES DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER. THE TRENCH SHALL BE CONSTRUCTED TO FOLLOW THE CONTOUR.
8. A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH LONG, TIE WIRES OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
9. THE FILTER FABRIC SHALL BE WIRED TO THE FENCE, AND 4 INCHES OF THE FABRIC SHALL EXTEND INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
10. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES. OTHER TYPES OF FABRIC MAY BE STAPLED TO THE FENCE.

SILT FENCE MAINTENANCE STANDARDS:

1. ANY DAMAGE SHALL BE REPAIRED IMMEDIATELY.
2. IF CONCENTRATED FLOWS ARE EVIDENT UPHILL OF THE FENCE, THEY MUST BE INTERCEPTED AND CONVEYED TO A SEDIMENT TRAP OR POND.
3. IT IS IMPORTANT TO CHECK THE UPHILL SIDE OF THE FENCE FOR SIGNS OF THE FENCE CLOGGING AND ACTING AS A BARRIER TO FLOW AND THEN CAUSING CHANNELIZATION OF FLOWS PARALLEL TO THE FENCE. IF THIS OCCURS, REPLACE THE FENCE OR REMOVE THE TRAPPED SEDIMENT.
4. SEDIMENT MUST BE REMOVED WHEN THE SEDIMENT IS 6 INCHES HIGH.
5. IF THE FILTER FABRIC (GEOTEXTILE) HAS DETERIORATED DUE TO ULTRAVIOLET BREAKDOWN, IT SHALL BE REPLACED.



4 T02 TEMPORARY COFFERDAM
SCALE: NTS



Notes:

1. Design velocities exceeding 2 ft/sec (0.6 m/sec) require temporary blankets, mats or similar liners to protect seed and soil until vegetation becomes established.
2. Grass-lined channels with design velocities exceeding 6 ft/sec (2 m/sec) should include turf reinforcement mats.

NOT TO SCALE

SOURCE: ECOLOGY STORMWATER MANAGEMENT MANUAL FOR EASTERN WASHINGTON, FIGURE 7.13

APPLICATION NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DIVERTING SWAUK CREEK DURING COMPLETION OF IN-CHANNEL WORK. THIS DETAIL PROVIDES ONE SUGGESTED OPTION FOR A TEMPORARY DIVERSION CHANNEL ALONG THE ALIGNMENT OF THE EXISTING DITCH AND BYPASS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTING AND MAINTAINING THE CHANNEL TO ACCOMMODATE THE FULL RANGE OF FLOWS ANTICIPATED WHILE THE TEMPORARY DIVERSION CHANNEL IS IN OPERATION.
2. THE CONTRACTOR SHALL LINE THE CHANNEL AS SHOWN WITH EROSION CONTROL BLANKETS AND GRASS OR WITH GEOTEXTILE AND RIP-RAP TO PREVENT EROSION OF THE TEMPORARY CHANNEL AND TRANSPORT OF SEDIMENT TO SWAUK CREEK.
3. THE CONTRACTOR MAY PROPOSE AN ALTERNATE METHOD OF DIVERTING FLOWS IN SWAUK CREEK DURING CONSTRUCTION. THE ALTERNATE DIVERSION METHOD SHALL BE SUBMITTED TO KITTITAS COUNTY CONSERVATION DISTRICT AS PART OF THE CONTRACTOR'S DIVERSION AND CONTROL OF WATER SUBMITTAL AND SHALL BE APPROVED BY THE DISTRICT'S DESIGNATED ENGINEER PRIOR TO IMPLEMENTATION.

3 T02 TEMPORARY DIVERSION CHANNEL
SCALE: NTS

PLAN INTENDED TO BE VIEWED IN COLOR. ASPHALT BLOCKS TYP.

ONE INCH AT FULL SIZE IF NOT ONE INCH SCALE ACCORDINGLY

90% DESIGN: NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS					
REV	DATE	BY	APP'D	DESCRIPTION	

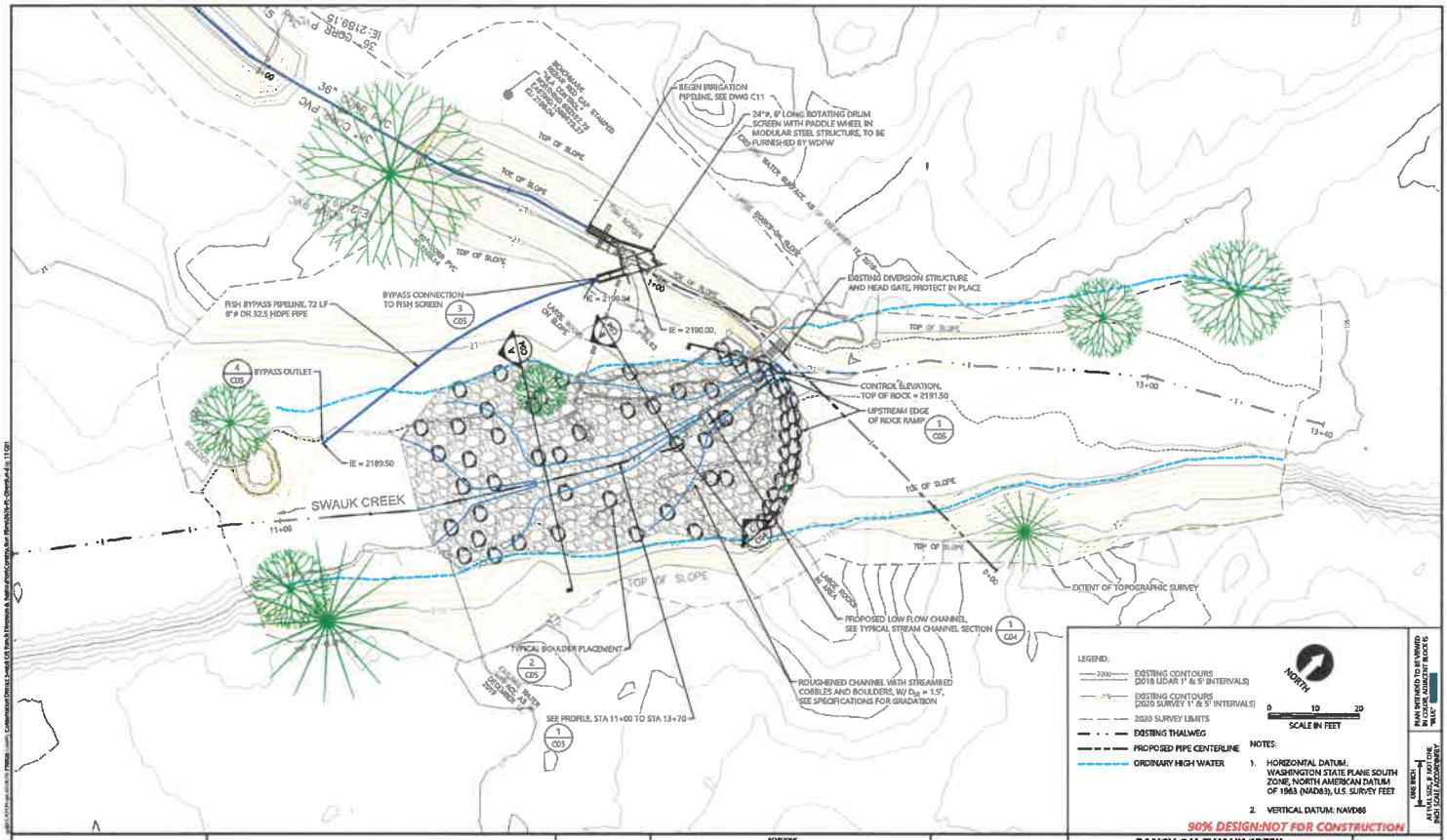
DESIGNED BY: J. SZETO
DRAWN BY: J. GREGA
CHECKED BY: D. NICE
APPROVED BY: D. NICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

TESC DETAILS

T04

SHEET # 10 OF 22



ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

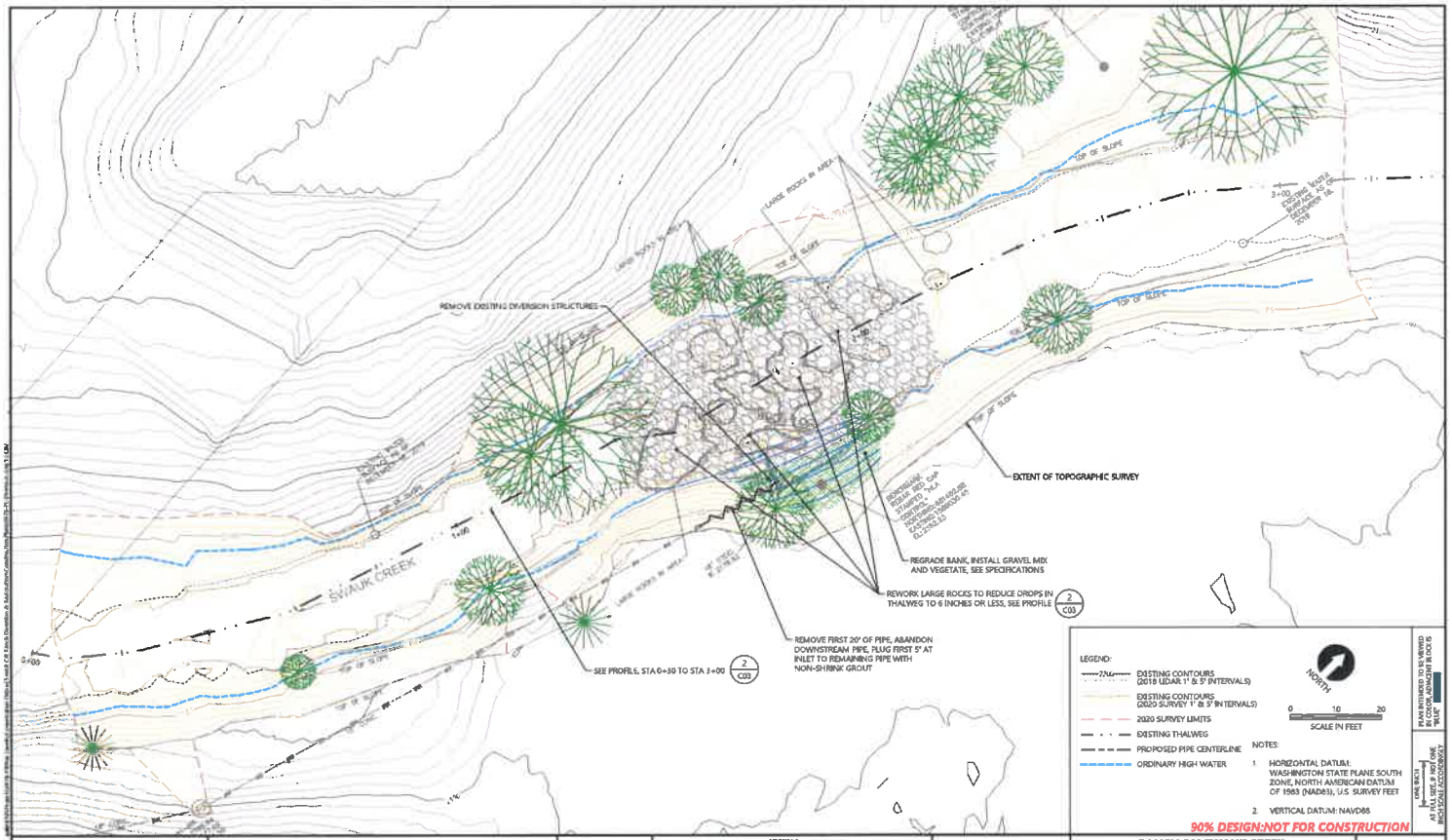
DESIGNED BY: J. EDYTON
DRAWN BY: T. GRIGG
CHECKED BY: B. RICE
APPROVED BY: B. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

DIVERSION IMPROVEMENT AND RESTORATION PLAN (RM 7.92)

C01

SHEET # 11 OF 22



ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

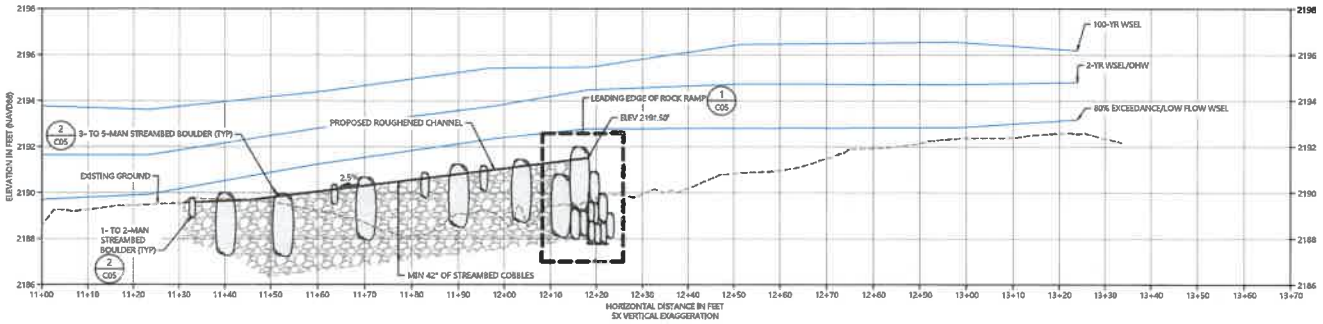
DESIGNED BY: J. SLOTTON
DRAWN BY: T. GRAGA
CHECKED BY: D. RIFE
APPROVED BY: D. RIFE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

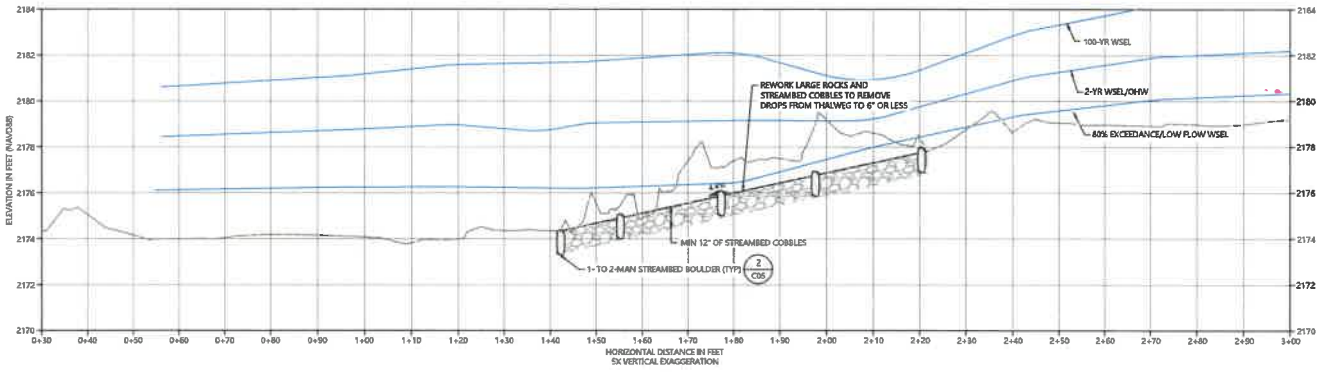
DIVERSION IMPROVEMENT AND RESTORATION PLAN (RM 7.71)

C02

SHEET # 12 OF 22



1 C01 UPSTREAM SWAUK CREEK (RM 7.92) PROFILE



2 C02 DOWNSTREAM SWAUK CREEK (RM 7.71) PROFILE

PLAN INTENDED TO BE VIEWED AT FULL SCALE. NOT TO SCALE IF "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH, SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
NO.	DATE	BY	APP'D	DESCRIPTION

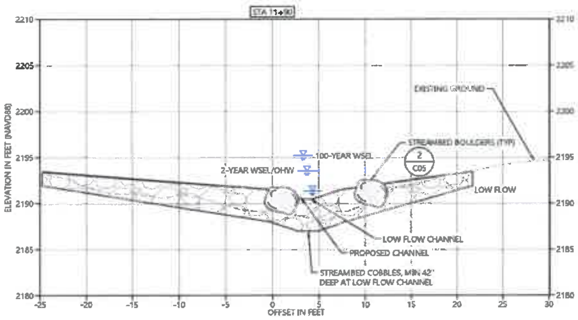
DESIGNED BY: J. KOTON
DRAWN BY: T. GREA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

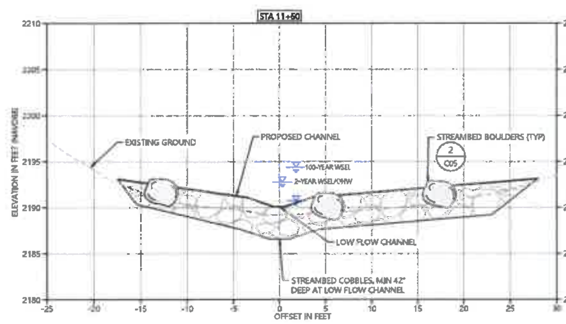
STREAM CHANNEL PROFILES

C03

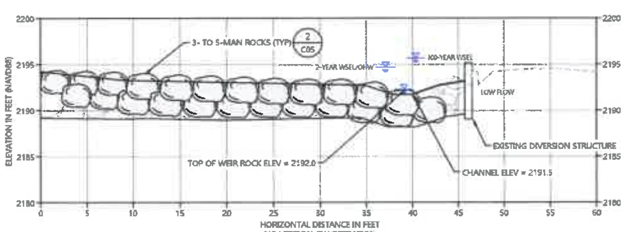
SHEET # 13 OF 22



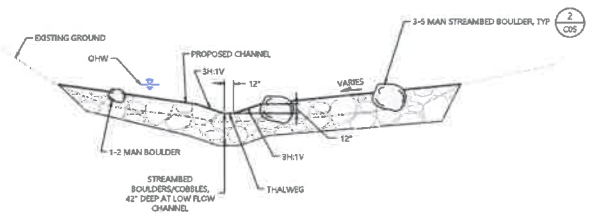
A SECTION
C01 SCALE: 1" = 5'



B SECTION
C01 SCALE: 1" = 5'



C SECTION
C01 SCALE: 1" = 5'



1 TYPICAL CHANNEL SECTION DETAIL
C01

PLAN INTENDED TO BE VIEWED IN COLOR. ADJACENT BLOCK IS "BLUE"

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REV	DATE	BY	APP'D	DESCRIPTION

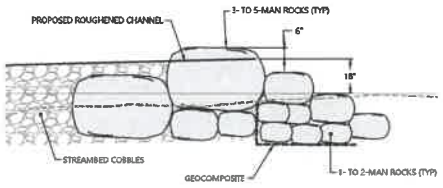
DESIGNED BY: J. SEXTON
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

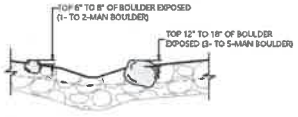
STREAM CHANNEL SECTIONS

C04

SHEET # 14 OF 22



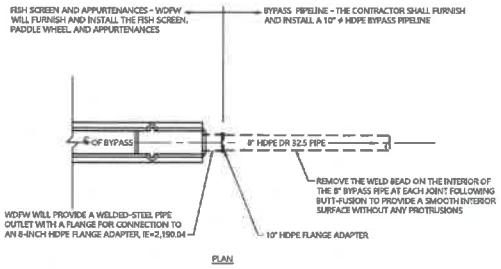
1 C03 UPSTREAM EDGE OF ROCK RAMP
SCALE: 1" = 10'



NOTES:

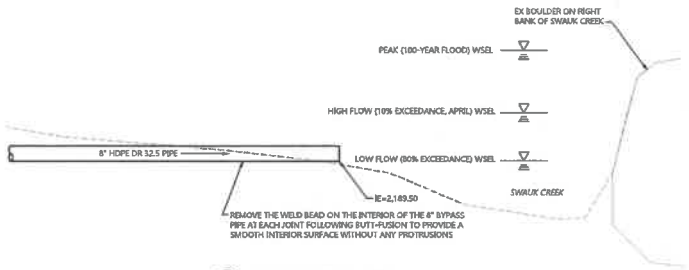
1. BOULDER EXPOSURE HEIGHT APPLIES TO MISCELLANEOUS STREAMBED BOULDERS AND NOT TO THOSE PLACED AS PART OF THE LEADING EDGE OF THE ROCK RAMP.
2. BOULDER PLACEMENT AND EXPOSURE HEIGHT SHALL BE CONFIRMED IN THE FIELD WITH THE ENGINEER.

2 C01 TYPICAL BOULDER PLACEMENT
SCALE: NTS



PLAN

3 C01 BYPASS CONNECTION TO FISH SCREEN
SCALE: NTS



4 CD1 BYPASS OUTLET TO CREEK
SCALE: NTS

PLAN INTENDED TO BE VIEWED AT 22x34 INCH RECORDS "BLUE"

ONE INCH
IF THIS SIZE IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY
CONSERVATION DISTRICT

REVISIONS

REV	DATE	BY	APPD	DESCRIPTION

DESIGNED BY: M.LEWITZ
DRAWN BY: J.GREGA
CHECKED BY: D.RICE
APPROVED BY: D.RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

RESTORATION AND FISH BYPASS DETAILS

C05

SHEET 15 OF 22

COTTONWOOD PLANTING NOTES:

1. PREPARE AREAS FOR COTTONWOOD POLE PLANTINGS BY DIGGING OUT INVASIVE SPECIES SUCH AS RUBUS ARMENIACUS, CIRSIUM ARVENSE, JACOBAEA VULGARIS, CENTAUREA STOEBE.
2. COTTONWOOD POLES TO BE HARVESTED ON SITE OR COMMERCIALLY OBTAINED DURING THE DORMANT SEASON. POLES MUST BE A MINIMUM OF 2.5 INCHES IN DIAMETER AND 8 FEET IN LENGTH AND ALL BRANCHES WILL BE REMOVED. CUTS SHALL HAVE A STRAIGHT TOP IMMEDIATELY ABOVE A BUD. CUTS ON LOW OR "BUTT" END SHALL BE AT A 45-DEGREE ANGLE. SPLIT STAKE CUTTINGS SHALL BE REJECTED.
3. STAKES SHALL BE DRIVEN BUTT END IN THE GROUND TO A MINIMUM DEPTH OF 4 FEET. USE OF A WATERJET STINGER TO FACILITATE PLANTING IS RECOMMENDED
4. CUTTINGS SHALL BE KEPT MOIST AND IN SHADED CONDITIONS AFTER CUTTING AND WILL BE PLANTED NO MORE THAN THREE DAYS AFTER CUTTING OR DELIVERY.
5. POLES SHALL BE DRIVEN ON 10 FOOT CENTERS OR AT SIMILAR SPACING AROUND EXISTING TREES.

LEGEND:

PARCELS (GIS, KITTITAS COUNTY)

SUPPLEMENTAL COTTONWOOD RIPARIAN PLANTINGS

NORTH

0 100 200

SCALE IN FEET

GENERAL NOTES

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE SOUTH ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83), U.S. SURVEY FEET
2. VERTICAL DATUM: NAVD88
3. AERIAL: BING MAPS

PLAN PREPARED TO BE VIEWED ON 22" X 34" SHEETS

ONE INCH AT FULL SIZE PRINTOUT. ADJUST SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REV	DATE	BY	APP'D	DESCRIPTION

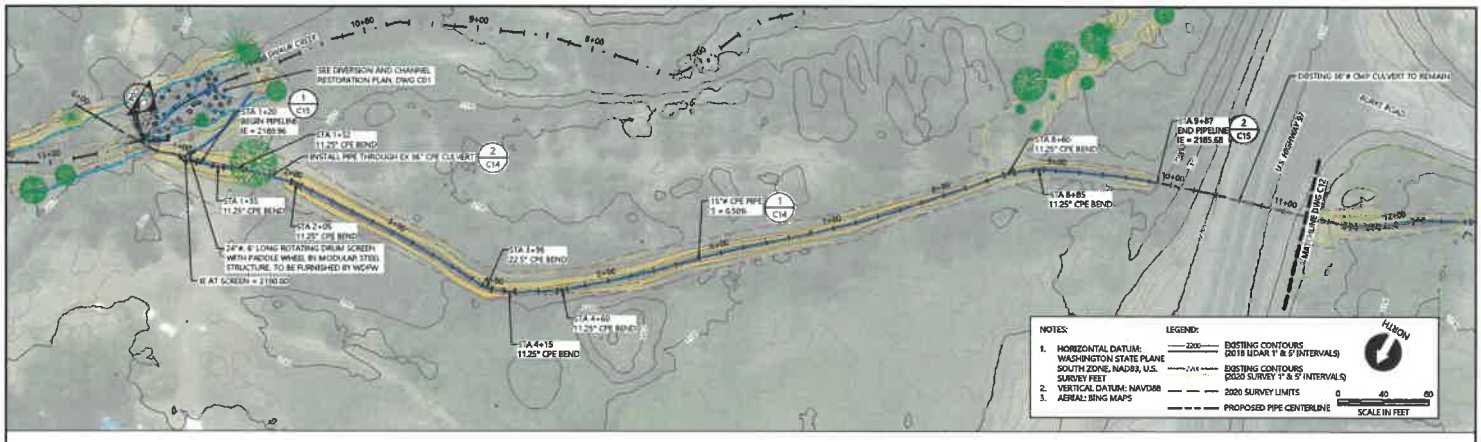
DESIGNED BY: M. HARTZ
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

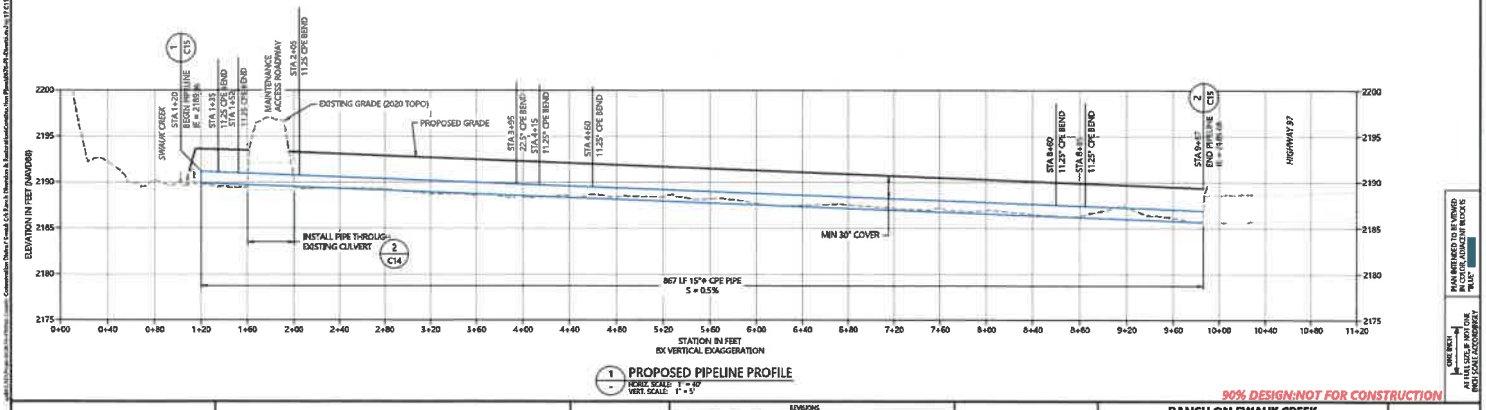
RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

RESTORATION PLANTING PLAN AND DETAILS

C06

SHEET # 16 OF 22





1 PROPOSED PIPELINE PROFILE
HORIZ. SCALE: 1" = 80'
VERT. SCALE: 1" = 5'

PLAN INTENDED TO BE VIEWED AT 22"x34" PAPER SIZE

ONE INCH

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

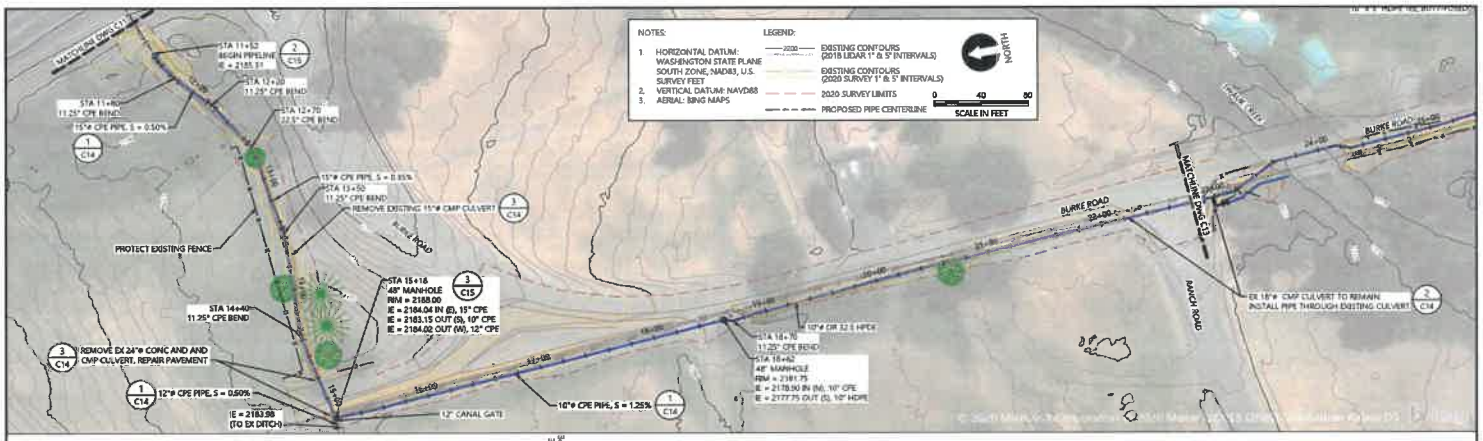
DESIGNED BY: J. EDITION
DRAWN BY: T. GRIGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

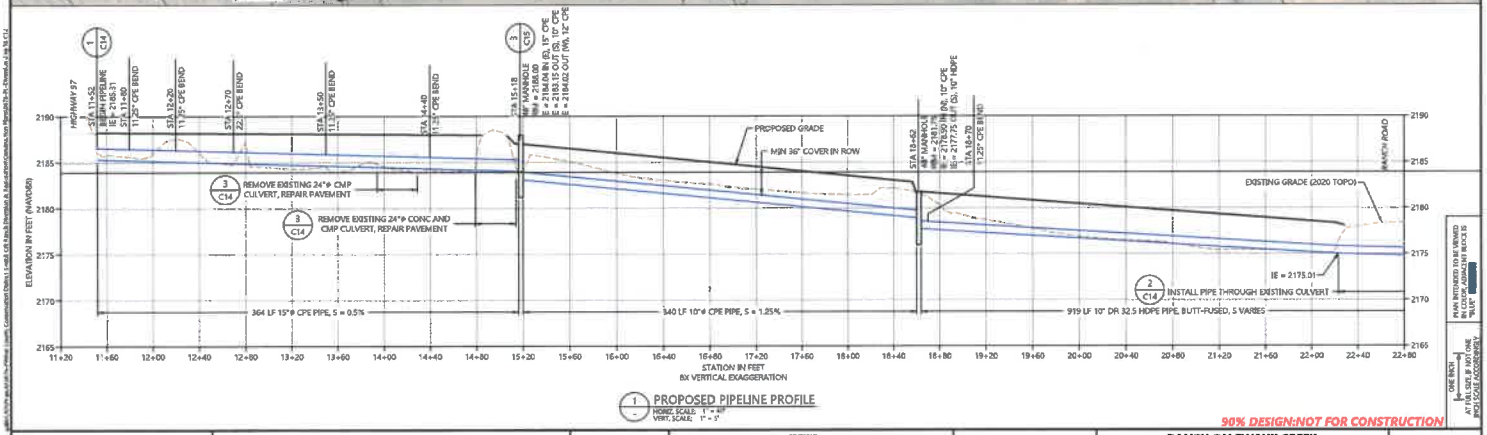
RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

IRRIGATION PIPELINE PLAN AND PROFILE
(STA 0+00 TO STA 11+20)

C11

SHEET 17 OF 22





1 C14 PROPOSED PIPELINE PROFILE
HORIZ. SCALE: 1" = 40'
VERT. SCALE: 1" = 5'

90% DESIGN: NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
NO.	DATE	BY	APP'D	DESCRIPTION

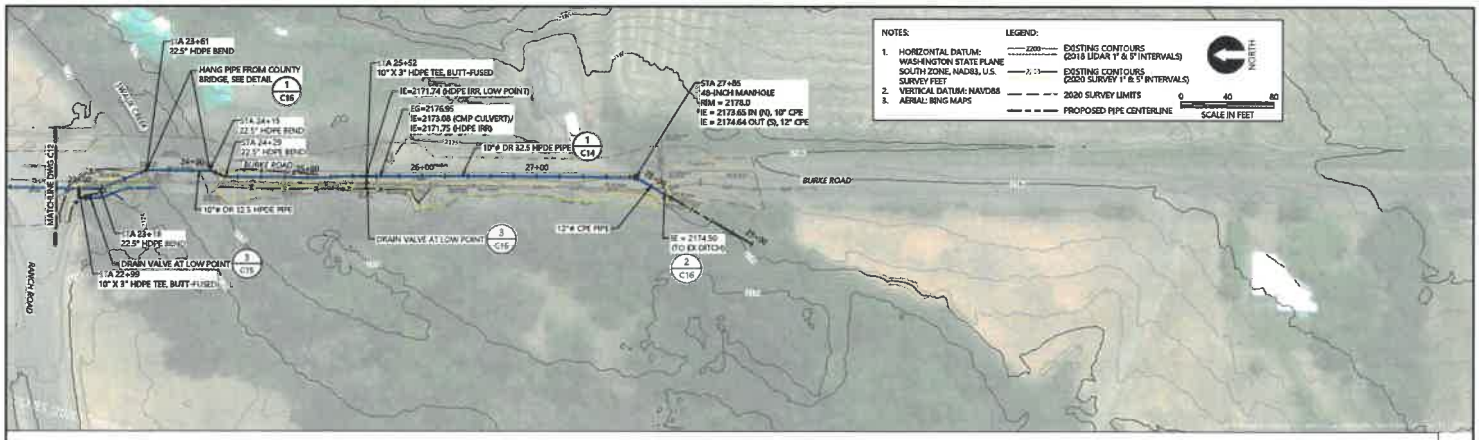
DESIGNED BY: J. SENTON
DRAWN BY: T. GIBSON
CHECKED BY: D. NICE
APPROVED BY: D. NICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

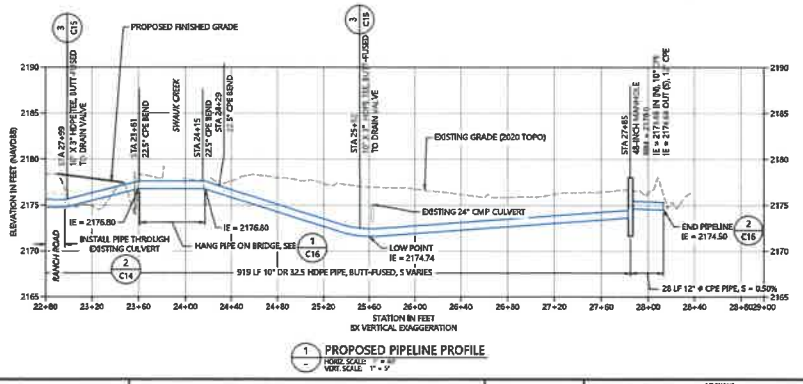
RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

IRRIGATION PIPELINE PLAN AND PROFILE (STA 11+20 TO STA 22+80)

C12

SHEET # 18 OF 22





1/- PROPOSED PIPELINE PROFILE
HORIZ. SCALE: 1" = 80'
VERT. SCALE: 1" = 5'

PLAN INTENDED TO BE VIEWED AT 11"X17" PAPER SIZE

ONE INCH
IF THIS SIZE IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY

90% DESIGN: NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

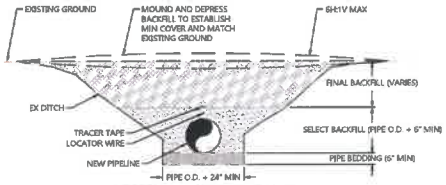
DESIGNED BY: S SEXTON
DRAWN BY: T GRIGA
CHECKED BY: D RICE
APPROVED BY: D RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

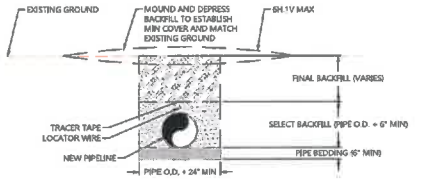
IRRIGATION PIPELINE PLAN AND PROFILE (STA 22+80 TO END)

C13

SHEET # 19 OF 22



(FOR PIPE INSTALLED IN EX DITCH ALIGNMENT)

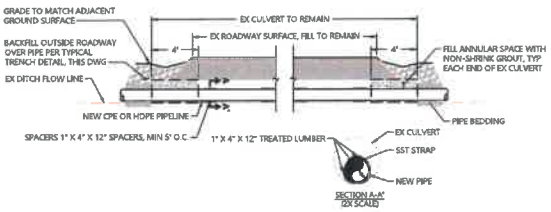


(FOR PIPE INSTALLED OUTSIDE EX DITCH ALIGNMENT)

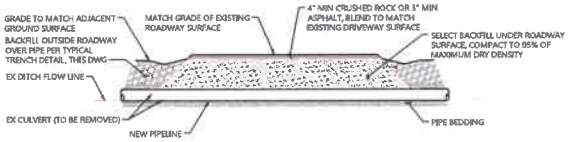
1 C11 TYPICAL TRENCH SECTIONS
SCALE: NTS

TYPICAL TRENCH SECTION NOTES:

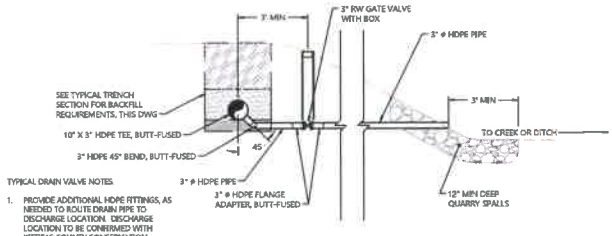
1. COVER - MINIMUM COVER FOR ALL IRRIGATION MAINS SHALL BE THIRTY INCHES (30") FROM TOP OF PIPE TO FINISH GRADE UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR APPROVED BY THE ENGINEER. MINIMUM COVER FOR ALL IRRIGATION MAINS IN THE PUBLIC RIGHT-OF-WAY SHALL BE THIRTY-SIX INCHES (36") FROM TOP OF PIPE TO FINISH GRADE UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR APPROVED BY THE ENGINEER. THE MAXIMUM COVER SHALL NOT EXCEED SIX FEET (6') UNLESS OTHERWISE APPROVED BY THE ENGINEER.
2. PIPE BEDDING - PIPE BEDDING SHALL BE AT LEAST 6 INCHES DEEP AND SHALL MEET THE REQUIREMENTS OF SECTION 9-03.12(3) OF THE STANDARD SPECIFICATIONS. IF EXCAVATED TRENCH BOTTOM IS UNSTABLE OR NOT SUITABLE, THE CONTRACTOR SHALL EXCAVATE TO A DEPTH REQUIRED BY THE ENGINEER AND BACKFILL WITH PIPE BEDDING. PLACE PIPE BEDDING IN MAXIMUM 6-INCH LIFTS AND COMPACT TO 90% OF MAXIMUM DRY DENSITY.
3. SELECT BACKFILL - SELECT FILL SHALL ALSO MEET THE REQUIREMENTS OF SECTION 9-03.12(2) OF THE STANDARD SPECIFICATIONS. PLACE SELECT BACKFILL IN 6-INCH LIFTS TO A MINIMUM DEPTH OF 6 INCHES ABOVE THE CROWN OF THE PIPE AND COMPACT TO 90% OF MAXIMUM DRY DENSITY.
4. FINAL BACKFILL - THE CONTRACTOR SHALL BACKFILL THE REMAINING PORTION OF THE TRENCH TO THE LINES AND GRADES SHOWN WITH EXCAVATED NATIVE MATERIAL THAT HAS A MAXIMUM PARTICLE SIZE OF 3 INCHES AND IS FREE FROM ORGANIC MATERIAL. WHERE NATIVE MATERIAL IS UNAVAILABLE FOR USE AS FINAL BACKFILL, IMPORTED SELECT BACKFILL MATERIAL SHALL BE USED. THE BACKFILL SHALL BE WELL DRAINED AND SUITABLE FOR PLACEMENT AND COMPACTION. PLACE BACKFILL IN IN MAXIMUM 6-INCH LIFTS AND COMPACT TO 90% OF MAXIMUM DRY DENSITY.
5. TRACER TAPE AND LOCATOR WIRE - TRACER TAPE SHALL MEET THE REQUIREMENTS OF SECTION 9-15.18 OF THE STANDARD SPECIFICATIONS. LOCATOR WIRE SHALL BE 12 GA. COPPER MULTI-STRAND RHW, CERTIFIED FOR DIRECT BURIAL. THE TRACER TAPE AND LOCATOR WIRE SHALL BE INSTALLED ALONG THE ENTIRE PROFILE OF THE PIPE.
6. SAFETY - THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF WORKERS. THE CONTRACTOR SHALL PROVIDE SHORING AND OTHER NECESSARY SAFETY SYSTEMS TO PROTECT WORKERS FROM SOIL, ROCKS AND DEBRIS THAT MAY FALL INTO THE TRENCH.
7. EXISTING SOIL CONDITIONS - NO SUBSURFACE EXPLORATION HAS BEEN DONE ALONG THE ALIGNMENT OF THE PROPOSED PIPELINE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ASSESSING EXISTING SOIL CONDITIONS BEFORE TRENCH EXCAVATION.



2 C11 TYPICAL INSTALLATION IN EXISTING CULVERT
SCALE: NTS



3 C12,C13 TYPICAL CULVERT REMOVAL AND SURFACE REPAIR DETAIL
SCALE: NTS



TYPICAL DRAIN VALVE NOTES

1. PROVIDE ADDITIONAL HDPE FITTINGS, AS NEEDED TO ROUTE DRAIN PIPE TO DISCHARGE LOCATION. DISCHARGE LOCATION TO BE CONFIRMED WITH KITTITAS COUNTY CONSERVATION DISTRICT PRIOR TO INSTALLATION.
2. TRENCHING AND BACKFILL FOR ALL PIPE SHALL BE PER THE TYPICAL TRENCH SECTION ON THIS DRAWING.

4 C13 TYPICAL DRAIN VALVE
SCALE: NTS

90% DESIGN:NOT FOR CONSTRUCTION

IF DRAWING IS NOT 36"X24" THEN DRAWING IS REDUCED

IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

PLANS NEEDED TO BE VIEWED IN COLOR TO SEE BLOCKS "BLUE"

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS				
REV	DATE	BY	APPD	DESCRIPTION

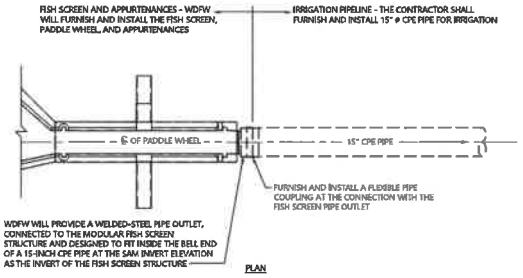
DESIGNED BY: J. SEXTON
DRAWN BY: T. GRIGA
CHECKED BY: D. NOLF
APPROVED BY: D. NOLF
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

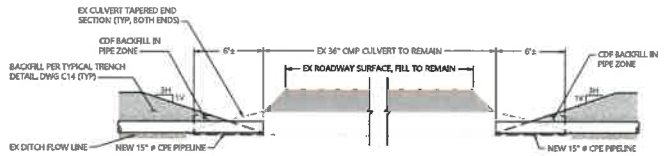
IRRIGATION PIPELINE TYPICAL SECTIONS AND DETAILS

C14

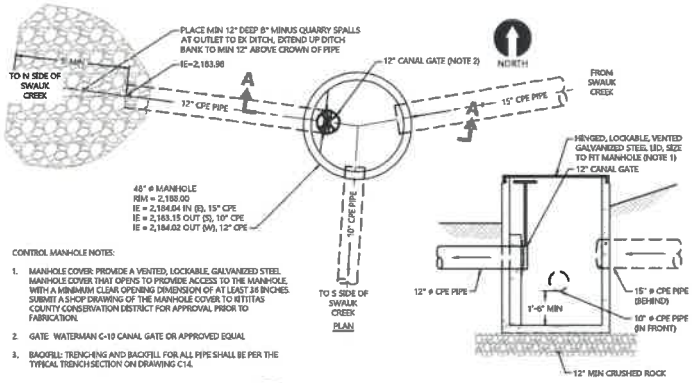
SHEET # 20 OF 22



1 C11 PIPE CONNECTION TO FISH SCREEN
SCALE: NTS



2 C11 TYPICAL INSTALLATION AT HIGHWAY 97 CULVERT
SCALE: NTS



CONTROL MANHOLE NOTES:

1. MANHOLE COVER: PROVIDE A VENTED, LOCKABLE, GALVANIZED STEEL MANHOLE COVER THAT OPENS TO PROVIDE ACCESS TO THE MANHOLE WITH A MINIMUM CLEAR OPENING DIMENSION OF AT LEAST 36 INCHES. SUBMIT A SHOP DRAWING OF THE MANHOLE COVER TO KITTITAS COUNTY CONSERVATION DISTRICT FOR APPROVAL PRIOR TO FABRICATION.
2. GATE: WATERMAN C-10 CANAL GATE OR APPROVED EQUAL
3. BACKFILL: TRENCHING AND BACKFILL FOR ALL PIPE SHALL BE PER THE TYPICAL TRENCH SECTION ON DRAWING C14.

3 C12 FLOW CONTROL MANHOLE
SCALE: NTS

PLANS INTENDED TO BE VIEWED ON 22"x34" SHEETS. SCALE AS NOTED "BLUE"

ONE INCH AT FULL SCALE IF NOT PROPERLY ACCOMPANY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY CONSERVATION DISTRICT

REVISIONS

NO.	DATE	BY	APP'D	DESCRIPTION

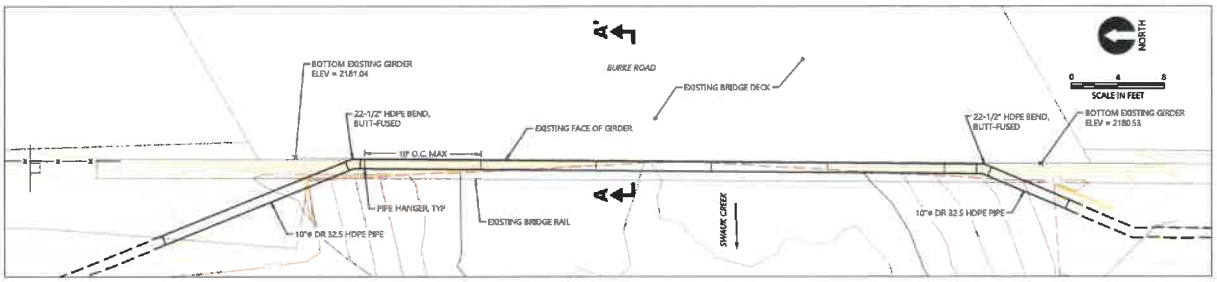
DESIGNED BY: J. DUCKEN
DRAWN BY: T. GINGA
CHECKED BY: D. RICE
APPROVED BY: D. RICE
SCALE: AS NOTED
DATE: SEPTEMBER 2020

RANCH ON SWAUK CREEK IRRIGATION DIVERSION IMPROVEMENT AND RESTORATION

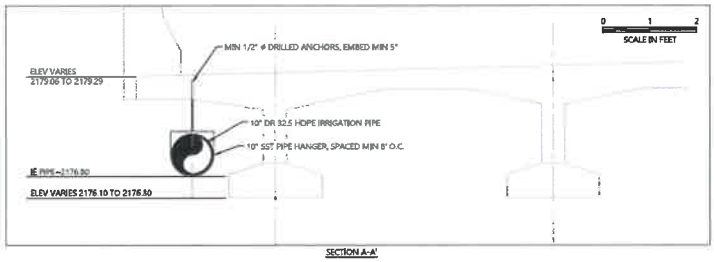
IRRIGATION PIPELINE DETAILS

C15

SHEET 21 OF 22

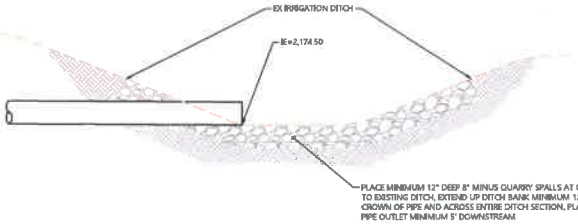


PLAN



SECTION A-A'

1 C13 PIPE INSTALLATION AT SWAUK CREEK BRIDGE
SCALE: AS NOTED



2 C13 PIPE OUTLET AT EXISTING DITCH
SCALE: NTS

PLAN INTENDED TO BE VIEWED ON 36"x24" ARCH D SHEETS

ONE INCH
AT FULL SIZE, IF NOT ONE INCH ADJUST SCALE ACCORDINGLY

90% DESIGN:NOT FOR CONSTRUCTION

ANCHOR QEA

KITTITAS COUNTY
CONSERVATION DISTRICT

REVISIONS				
NO.	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY J. SEXTON
DRAWN BY T. GINGA
CHECKED BY D. NICE
APPROVED BY D. NICE
SCALE AS NOTED
DATE SEPTEMBER 2020

RANCH ON SWAUK CREEK
IRRIGATION DIVERSION
IMPROVEMENT AND RESTORATION

IRRIGATION PIPELINE DETAILS

C16

SHEET # 22 OF 22

Appendix C
Trust Water Right Analysis

The Ranch on Swauk Creek (The Ranch) currently has rights to divert up to 3.5 CFS of flow from Swauk Creek between two diversions at RM 7.92 and 7.71. The current SRFB application for The Ranch proposes to consolidate these diversion to the upper location. A detailed trust water analysis at this location had previously not been defined which left some questions as to the possibility of dewatering the creek between the diversions. After researching the water rights that affect diversion quantities at the upper location, the likelihood of dewatering the creek between the diversions appears to be very low. Justification for this conclusion is summarized below.

Summary of trust water rights at Swauk Creek RM 7.92 and in the upper watershed

Historic irrigation diversions from within the Swauk Creek watershed consist of one diversion from First Creek, a left bank tributary to Swauk Creek at approximately RM 8.4 and two diversions from Swauk Creek, which are the target of the current SRFB application. The First Creek diversion is located at approximately RM 3.9. The water rights within the Swauk watershed have priority dates ranging from Nov 2, 1877 to Oct 31 1889. The First Creek water rights are all from the 1877 date and have seniority over all others. The water rights for the diversion at Swauk RM 7.92 & 7.71 are from 1878 junior only to First Creek rights. Due to that fact, only water rights from 1877 and 1878 have an effect on trust water passing the subject diversion and will be the only rights addressed in this summary.

Table 1 describes the water rights from 1877 and 1878. Appendix A provides greater detail for the individual rights that make up each of the three columns in Table 1.

Priority Date	1877	1878		1878
Owner	Suncadia/Roan	The Ranch		Suncadia
Purpose	Instream/Mitigation	Irrigation		Instream
Creek	**First**	**Swauk**		**Swauk**
April	3.23	3.50	91.15%	0.34
May	3.45	3.50	89.97%	0.39
June	3.51	3.50	89.74%	0.40
July	3.61	3.50	89.29%	0.42
August	3.55	3.50	89.74%	0.40
September	3.39	3.50	90.44%	0.37
October	3.04	3.50	91.86%	0.31

Table 1

Trust quantities are shown in cubic feet per second (CFS) and vary based upon the month of the irrigation season. The 1877 trust water is composed of water from four different trust applications from two owners and the 1878 trust and irrigation water is composed of water from five different applications and two owners.

First Creek Trust Quantity

The amount of First Creek trust water is established at the point of diversion at RM 3.9 and is expected to remaining within the system well below the Swauk Creek diversion at RM 7.92. The amount of trust water may be adjusted if the flow within First Creek, as measured at the mouth, is below the trust quantity in Table 1. At that point, the measured quantity is expected to pass the Swauk RM 7.92 diversion.Swauk Creek Trust Quantity

Due to identical priority dates and diversion locations for the irrigation and trust water from 1878, the water within Swauk Creek is prorated to each use. The percentage of water diverted to The Ranch for irrigation purposes is shown in Table 1.

Trust Calculation Scenarios

Due to flow variation within First and Swauk Creeks, the amount of trust water can be significantly affected as low flows occur during the mid to later summer months. Below are potential flow scenarios, but do not represent all possible combination of creek flows between First and Swauk Creeks. These scenarios represent the most likely outcomes during periods of low flow.

1. Flow within First and Swauk Creeks are at or above the combined water quantities for trust water and irrigation. Under this scenario, the full quantity of First Creek trust water and full quantity of Swauk Creek trust water is expected to pass the Swauk RM 7.92 diversion. The full quantity of irrigation water may be diverted from Swauk Creek.

2. Flow within First Creek is below the quantities listed in Table 1 while flow within Swauk Creek remains at or above the combined 1878 quantities from Table 1 after subtracting First Creek flows. Under this scenario, the trust water from First Creek is reduced to the flow quantity measured at the mouth. This quantity plus the full Swauk trust quantity is expected to pass the RM 7.92 diversion. The full quantity of irrigation rights can be diverted, but only provided by Swauk Creek flows.

3. Flows within both First and Swauk Creeks are below the trust quantities and combined irrigation and trust quantities, respectively, provided in Table 1. Under this scenario, the trust water from First Creek is again reduced to the flow quantity measured at the mouth. The flow within Swauk Creek is reduced by the quantity measured at First Creek and then prorated based upon the percentages in Table 1. The full flow from First Creek is now considered trust water and expected to pass RM 7.92 diversion while the Swauk trust water will be prorated per Table 1. The quantity of irrigation water diverted is based on the prorated factor applied to Swauk Creek flows only.

Minor changes in Swauk Creek flows may occur between the mouth of First Creek and the Swauk RM 7.92 diversion, but are assumed to insignificant in the above scenarios.

In-stream flows based on historical flow data

Starting in 2014, the DOE has been tracking flows at the mouth of First Creek and in Swauk Creek immediately downstream of the confluence via remote gaging stations. Based upon those numbers and applying the appropriate scenario described above, Table 2 shows how much trust water would have been expected to pass the Swauk Creek RM 7.92 diversion.

Water (CFS) Passing Diversions Based on Trust Water & DOE Flow Stations						
Month / Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
April	No Data	28.8	200.3	243.3	194.3	131.3
May		12.9	78.6	162.0	165.0	58.6
June		4.6	12.8	36.6	19.5	9.9
July	4.7	2.03	3.8	6.2	2.8	4.3
August	1.9	1.5	No Data	1.3	0.92	1.77
Sept	1.52	1.68		0.96	1.01	1.69
Oct	1.7	2.9		5.7	2.01	No Data

Table 2

The DOE stations and data can be found at the following web addresses.

Mouth of First Creek

https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=39S050

Swauk Creek below First Creek

https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=39M130

If the proposed project is successfully implemented, including all piping, there is a possibility of increasing existing trust water passing the Swauk RM 7.92 diversion by 0.25 CFS. Swauk Creek between RM 7.92 and the confluence with the Yakima River may be flow limited based upon levels of yearly precipitation. Additional trust water would improve the potential for minimizing those periods during low water years.

Appendix A

Claimant Name	New Suncadia LLC	J.P. Roan	New Suncadia LLC	J.P. Roan
Claim #	00648	00648	00648	0648
Certificate #	S4-84770-J	S4-85121-J	S4-85193-J	S4-85197-J
Source	First Creek	First Creek	First Creek	First Creek
Use	Instream flow & mitigation	Instream flow & mitigation	Instream flow & mitigation	Instream flows
Period of Use	April 1 thru Oct 15	April 1 thru Oct 15	April 1 thru Oct 15	April 1 thru Oct 15
Month				
April	1.18	0.11	0.55	1.394
May	1.33	0.11	0.62	1.394
June	1.37	0.11	0.64	1.394
July	1.44	0.11	0.67	1.394
August	1.40	0.11	0.65	1.394
September	1.29	0.11	0.60	1.394
October	1.03	0.11	0.51	1.394
Priority Date	Nov 2, 1877	Nov 2, 1877	Nov 2, 1877	Nov 2, 1877
POD	First Creek RM 3.9	First Creek RM 3.9	First Creek RM 3.9	First Creek RM 3.9

Claimant Name	The Ranch on Swauk	The Ranch on Swauk	The Ranch on Swauk	New Suncadia LLC	New Suncadia LLC
Claim #	01475	01475	01475	01685	01685
Certificate #	S4-83887-J	S4-83890-J	S4-84343-J	S4-83893-J	S4-85211-J
Source	Swauk Crk & Two Wells	Swauk Creek	Swauk Creek	Swauk Creek	Swauk Creek
Use	Irrigation 18.37 ac	Irrigation 78.4 ac & Stockwater	Irrigation 19.8 ac & Stockwater	Instream flows	Instream flows
Period of Use	April 1 thru Oct 31	April 1 thru Oct 31	April 1 thru Oct 31	April 1 thru Oct 15	April 1 thru Oct 15
Month					
April	1.50	2.00	1.50	0.23	0.11
May	1.50	2.00	1.50	0.26	0.13
June	1.50	2.00	1.50	0.27	0.13
July	1.50	2.00	1.50	0.28	0.14
August	1.50	2.00	1.50	0.27	0.13
September	1.50	2.00	1.50	0.25	0.12
October	1.50	2.00	1.50	0.21	0.10
Priority Date	June 30, 1878	June 30, 1878	June 30, 1878	June 30, 1878	June 30, 1878
POD	NW1/4, NW1/4, Sec 27	Lower Diversion	Upper Diversion	Upper Diversion	Upper Diversion

Appendix D
Swauk Creek Hydraulic Analysis

Kittitas Conservation District
The Ranch at Swauk Creek Diversion Improvement and Restoration Project

Existing Conditions

River Sta	Q Total	Manning n	Min Ch El	Max Chl Dpth	W.S. Elev	Vel Chnl	Shear Chan	Flow Area	Top Width	Froude # Chl
	(cfs)		(ft)	(ft)	(ft)	(ft/s)	(lb/sq ft)	(sq ft)	(ft)	
7165.97	1180	0.045	2218.25	4.24	2222.49	4.65	0.84	309.51	172.07	0.45
7165.97	498	0.045	2218.25	3.27	2221.52	4.98	1.08	102.07	114.39	0.58
7165.97	356	0.045	2218.25	2.88	2221.13	4.32	0.86	82.86	93.22	0.55
7165.97	264	0.045	2218.25	2.59	2220.84	3.77	0.69	70.05	84.01	0.52
7165.97	4.6	0.045	2218.25	0.62	2218.87	0.81	0.06	5.71	19.95	0.27
7165.97	3.5	0.045	2218.25	0.57	2218.82	0.74	0.05	4.74	18.38	0.26
6877.12	1180	0.045	2216.21	3.45	2219.66	8.09	2.6	150.57	78.42	0.82
6877.12	498	0.045	2216.21	2.22	2218.43	5.81	1.6	85.77	48.31	0.76
6877.12	356	0.045	2216.21	1.87	2218.08	5.16	1.35	68.93	47.09	0.75
6877.12	264	0.045	2216.21	1.58	2217.79	4.76	1.22	55.51	46.1	0.76
6877.12	4.6	0.045	2216.21	0.19	2216.4	1.87	0.42	2.46	22.61	1
6877.12	3.5	0.045	2216.21	0.17	2216.38	1.75	0.39	2	21.69	1.02
6650.42	1180	0.045	2213.29	3.75	2217.04	7.35	2.12	172.25	74.51	0.73
6650.42	498	0.045	2213.29	2.6	2215.89	5.11	1.19	98.14	51.81	0.63
6650.42	356	0.045	2213.29	2.24	2215.54	4.44	0.95	80.26	47.63	0.6
6650.42	264	0.045	2213.29	1.94	2215.23	3.99	0.8	66.14	43.96	0.57
6650.42	4.6	0.045	2213.29	0.28	2213.57	0.76	0.06	6.07	30.46	0.3
6650.42	3.5	0.045	2213.29	0.25	2213.54	0.67	0.05	5.23	30.32	0.28
6424.86	1180	0.045	2210.75	4.91	2215.66	5.88	1.25	227.01	84.8	0.52
6424.86	498	0.045	2210.75	3.21	2213.96	5.09	1.13	99.4	48.42	0.59
6424.86	356	0.045	2210.75	2.73	2213.48	4.6	0.99	77.62	44.08	0.6
6424.86	264	0.045	2210.75	2.35	2213.11	4.29	0.92	61.56	40.49	0.61
6424.86	4.6	0.045	2210.75	0.24	2210.99	2.14	0.51	2.15	15.42	1.01
6424.86	3.5	0.045	2210.75	0.21	2210.96	2.09	0.51	1.68	14.68	1.09

6259.81	1180	0.045	2209.7	4.25	2213.95	8.17	2.43	152.2	46.27	0.73
6259.81	498	0.045	2209.7	3.35	2213.05	4.6	0.84	112.07	42.49	0.47
6259.81	356	0.045	2209.7	2.95	2212.65	3.82	0.61	95.61	40.83	0.41
6259.81	264	0.045	2209.7	2.65	2212.35	3.23	0.45	83.47	39.5	0.37
6259.81	4.6	0.045	2209.7	0.51	2210.21	0.48	0.02	9.53	28.83	0.15
6259.81	3.5	0.045	2209.7	0.46	2210.16	0.43	0.02	8.23	28.57	0.14
6079.35	1180	0.045	2209.43	2.6	2212.03	6.25	1.82	216.54	193.59	0.81
6079.35	498	0.045	2209.43	1.72	2211.15	5.68	1.85	87.72	88.79	1
6079.35	356	0.045	2209.43	1.52	2210.95	5.1	1.61	69.83	87.36	1.01
6079.35	264	0.045	2209.43	1.34	2210.77	4.87	1.55	54.16	79.56	1.04
6079.35	4.6	0.045	2209.43	0.21	2209.64	1.62	0.33	2.84	30.53	0.94
6079.35	3.5	0.045	2209.43	0.19	2209.62	1.52	0.31	2.3	30.23	0.97
5902.35	1180	0.045	2205.98	3.43	2209.41	5.44	1.2	255.12	146.15	0.57
5902.35	498	0.045	2205.98	2.54	2208.52	4.08	0.76	138.5	112.14	0.51
5902.35	356	0.045	2205.98	2.22	2208.2	3.72	0.67	105.12	97.05	0.51
5902.35	264	0.045	2205.98	2.01	2207.99	3.25	0.54	86.19	84.64	0.48
5902.35	4.6	0.045	2205.98	0.5	2206.48	0.66	0.04	7	30.87	0.24
5902.35	3.5	0.045	2205.98	0.48	2206.46	0.53	0.03	6.55	30.25	0.2
5773.55	1180	0.045	2205.46	2.06	2207.52	6.94	2.37	170.95	112.61	0.97
5773.55	498	0.045	2205.46	1.39	2206.85	5.12	1.55	97.24	106.61	0.95
5773.55	356	0.045	2205.46	1.28	2206.74	4.14	1.05	86.01	105.38	0.81
5773.55	264	0.045	2205.46	1.13	2206.59	3.75	0.92	70.43	103.72	0.8
5773.55	4.6	0.045	2205.46	0.3	2205.76	0.95	0.11	4.86	41.45	0.49
5773.55	3.5	0.045	2205.46	0.21	2205.67	1.82	0.4	1.92	18.74	1
5598.93	1180	0.045	2201.13	3.48	2204.61	6.69	1.9	176.9	73.13	0.75
5598.93	498	0.045	2201.13	2.23	2203.36	5.25	1.39	94.84	63.35	0.76
5598.93	356	0.045	2201.13	1.84	2202.97	5.09	1.44	69.89	62.67	0.85
5598.93	264	0.045	2201.13	1.64	2202.77	4.57	1.22	57.74	60.86	0.83
5598.93	4.6	0.045	2201.13	0.21	2201.34	1.93	0.43	2.38	18.93	0.96
5598.93	3.5	0.045	2201.13	0.28	2201.41	0.95	0.09	3.69	21.1	0.4

5245.6	1180	0.045	2194.98	4.69	2199.67	8.84	2.89	148.91	93.05	0.79
5245.6	498	0.045	2194.98	3.08	2198.06	6.63	1.91	75.16	31.82	0.76
5245.6	356	0.045	2194.98	2.74	2197.72	5.53	1.38	64.39	30.51	0.67
5245.6	264	0.045	2194.98	2.27	2197.25	5.2	1.29	50.74	28.12	0.68
5245.6	4.6	0.045	2194.98	0.21	2195.19	2.05	0.49	2.24	18.44	1.04
5245.6	3.5	0.045	2194.98	0.2	2195.18	1.77	0.38	1.98	18.37	0.95
5069.13	1180	0.045	2192.22	4	2196.22	11.36	4.94	133.46	83.86	1.06
5069.13	498	0.045	2192.22	3.17	2195.39	7.6	2.41	75.01	53.39	0.81
5069.13	356	0.045	2192.22	2.58	2194.8	7.4	2.48	50.25	33.61	0.89
5069.13	264	0.045	2192.22	2.31	2194.53	6.36	1.91	41.92	28.44	0.81
5069.13	4.6	0.045	2192.22	0.61	2192.83	0.62	0.03	7.39	18.01	0.17
5069.13	3.5	0.045	2192.22	0.58	2192.8	0.52	0.02	6.73	17.8	0.15
5043.89	1180	0.045	2192.55	3.29	2195.84	9.73	3.85	132.19	61.51	1
5043.89	498	0.045	2192.55	1.92	2194.47	8.64	3.65	58.34	42.66	1.18
5043.89	356	0.045	2192.55	1.75	2194.3	6.91	2.4	51.51	33.54	0.98
5043.89	264	0.045	2192.55	1.51	2194.06	6.03	1.92	43.78	33.05	0.92
5043.89	4.6	0.045	2192.55	0.2	2192.75	1.13	0.13	4.08	25.7	0.5
5043.89	3.5	0.045	2192.55	0.17	2192.72	1.01	0.11	3.46	25.6	0.48
4997.51	1180	0.045	2191.29	3.59	2194.88	9.61	3.63	128.38	50.49	0.95
4997.51	498	0.045	2191.29	2.14	2193.43	7.57	2.74	66.42	38.48	1
4997.51	356	0.045	2191.29	1.78	2193.07	6.8	2.37	52.72	37.77	1
4997.51	264	0.045	2191.29	1.53	2192.82	6.17	2.08	43.05	37.25	1
4997.51	4.6	0.045	2191.29	0.26	2191.55	2.26	0.55	2.03	12.89	1.01
4997.51	3.5	0.045	2191.29	0.23	2191.52	2.11	0.5	1.66	12.24	1.01
4965.06	1180	0.045	2189.59	5.08	2194.67	8.11	2.25	164.36	52.08	0.65
4965.06	498	0.045	2189.59	3.53	2193.12	5.84	1.33	95.25	40.02	0.57
4965.06	356	0.045	2189.59	3.05	2192.64	5.21	1.11	76.5	37.55	0.55
4965.06	264	0.045	2189.59	2.67	2192.26	4.74	0.97	62.71	36.05	0.54
4965.06	4.6	0.045	2189.59	0.65	2190.24	0.78	0.05	5.87	14.21	0.21

4965.06	3.5	0.045	2189.59	0.61	2190.2	0.66	0.03	5.3	14.11	0.19
4943.6	1180	0.045	2189.7	5.06	2194.76	6.16	1.37	207.15	59.68	0.53
4943.6	498	0.045	2189.7	3.29	2192.99	5.26	1.14	95.43	36.69	0.56
4943.6	356	0.045	2189.7	2.83	2192.53	4.51	0.88	79.08	34.32	0.52
4943.6	264	0.045	2189.7	2.47	2192.17	3.93	0.7	67.11	32.47	0.48
4943.6	4.6	0.045	2189.7	0.54	2190.24	0.37	0.01	12.49	24.39	0.09
4943.6	3.5	0.045	2189.7	0.5	2190.2	0.3	0.01	11.56	24.23	0.08
4908.09	1180	0.045	2189.59	4.75	2194.34	6.65	1.74	177.35	55.77	0.66
4908.09	498	0.045	2189.59	3.12	2192.71	5.21	1.21	95.55	44.41	0.63
4908.09	356	0.045	2189.59	2.62	2192.21	4.8	1.09	74.1	40.79	0.63
4908.09	264	0.045	2189.59	2.24	2191.83	4.46	0.99	59.16	37.94	0.63
4908.09	4.6	0.045	2189.59	0.61	2190.2	0.81	0.07	5.66	29.14	0.33
4908.09	3.5	0.045	2189.59	0.58	2190.17	0.74	0.06	4.76	28.94	0.32
4871.2	1180	0.045	2189.43	4.75	2194.18	6.27	1.39	203.57	61.02	0.53
4871.2	498	0.045	2189.43	3.1	2192.53	4.6	0.88	112.87	48.89	0.49
4871.2	356	0.045	2189.43	2.57	2192	4.18	0.78	87.88	45.1	0.5
4871.2	264	0.045	2189.43	2.16	2191.59	3.86	0.7	70.03	42.37	0.5
4871.2	4.6	0.045	2189.43	0.22	2189.65	2.06	0.49	2.23	17.95	1.03
4871.2	3.5	0.045	2189.43	0.2	2189.63	1.87	0.42	1.87	16.55	0.98
4847.25	1180	0.045	2189.05	5.25	2194.3	4.12	0.64	286.22	79.19	0.38
4847.25	498	0.045	2189.05	3.52	2192.57	3.04	0.39	163.75	62.8	0.33
4847.25	356	0.045	2189.05	2.97	2192.02	2.73	0.33	130.51	58.03	0.32
4847.25	264	0.045	2189.05	2.54	2191.59	2.47	0.28	106.8	54.49	0.31
4847.25	4.6	0.045	2189.05	0.5	2189.55	0.36	0.01	12.85	37.3	0.11
4847.25	3.5	0.045	2189.05	0.46	2189.51	0.31	0.01	11.43	36.98	0.1
4775.33	1180	0.045	2189.21	3.97	2193.09	8.26	2.66	154.82	71.29	0.79
4775.33	498	0.045	2189.21	2.64	2191.76	6.04	1.64	82.44	37.69	0.72
4775.33	356	0.045	2189.21	2.2	2191.33	5.34	1.35	66.61	35.05	0.68
4775.33	264	0.045	2189.21	1.86	2190.98	4.81	1.15	54.83	33.78	0.67

4775.33	4.6	0.045	2189.21	0.3	2189.42	1.24	0.18	3.7	30.86	0.63
4775.33	3.5	0.045	2189.21	0.28	2189.4	1.1	0.15	3.17	30.8	0.61
4646.06	1180	0.045	2187.16	3.71	2190.87	7.6	2.73	155.37	85.48	0.99
4646.06	498	0.045	2187.16	2	2189.16	7.42	2.67	67.14	39.19	1
4646.06	356	0.045	2187.16	1.65	2188.81	6.66	2.3	53.49	38.79	1
4646.06	264	0.045	2187.16	1.43	2188.59	5.86	1.88	45.09	38.54	0.95
4646.06	4.6	0.045	2187.16	0.32	2187.48	1.03	0.11	4.47	26.31	0.44
4646.06	3.5	0.045	2187.16	0.29	2187.45	0.94	0.1	3.71	25.57	0.44
4540.24	1180	0.045	2185.06	4.13	2189.19	6.83	1.86	172.88	57.67	0.69
4540.24	498	0.045	2185.06	2.58	2187.64	5.41	1.32	92	44.27	0.66
4540.24	356	0.045	2185.06	2.14	2187.2	4.85	1.12	73.43	41.3	0.64
4540.24	264	0.045	2185.06	1.67	2186.73	4.84	1.2	54.59	38.81	0.72
4540.24	4.6	0.045	2185.06	0.16	2185.22	1.83	0.41	2.51	24.21	1
4540.24	3.5	0.045	2185.06	0.14	2185.2	1.6	0.33	2.18	23.88	0.94
4447.62	1180	0.045	2183.23	4.94	2188.17	7.08	1.99	166.76	53.12	0.7
4447.62	498	0.045	2183.23	3.26	2186.49	5.78	1.54	86.12	43.31	0.72
4447.62	356	0.045	2183.23	2.78	2186.02	5.38	1.41	66.19	38.94	0.73
4447.62	264	0.045	2183.23	2.25	2185.48	5.25	1.3	50.31	26.97	0.68
4447.62	4.6	0.045	2183.23	0.4	2183.63	0.86	0.07	5.33	21.43	0.31
4447.62	3.5	0.045	2183.23	0.36	2183.59	0.77	0.06	4.56	21.32	0.29
4321.17	1180	0.045	2182.22	5.02	2187.24	6.29	1.48	187.56	49.1	0.57
4321.17	498	0.045	2182.22	3.18	2185.4	4.86	1.03	102.45	43.16	0.56
4321.17	356	0.045	2182.22	2.61	2184.83	4.51	0.93	78.95	38.95	0.56
4321.17	264	0.045	2182.22	2.16	2184.38	4.25	0.86	62.14	34.19	0.56
4321.17	4.6	0.045	2182.22	0.25	2182.47	1.34	0.21	3.43	28.62	0.68
4321.17	3.5	0.045	2182.22	0.23	2182.45	1.23	0.19	2.84	28.21	0.68
4177.43	1180	0.045	2180.64	4.76	2185.4	8.31	2.72	141.93	43.36	0.81
4177.43	498	0.045	2180.64	3.13	2183.77	6.32	1.76	78.86	34.03	0.73
4177.43	356	0.045	2180.64	2.66	2183.3	5.6	1.43	63.58	30.68	0.69

4177.43	264	0.045	2180.64	2.29	2182.93	5.01	1.19	52.69	28.46	0.65
4177.43	4.6	0.045	2180.64	0.35	2180.99	0.9	0.08	5.1	22.19	0.33
4177.43	3.5	0.045	2180.64	0.32	2180.96	0.8	0.06	4.36	22.12	0.32
4050.15	1180	0.045	2179.81	4.75	2184.56	6.52	1.54	188.73	59.16	0.57
4050.15	498	0.045	2179.81	2.9	2182.71	5.04	1.09	99.22	42.31	0.57
4050.15	356	0.045	2179.81	2.38	2182.19	4.57	0.96	77.97	39.75	0.57
4050.15	264	0.045	2179.81	2.01	2181.82	4.16	0.84	63.53	37.7	0.56
4050.15	4.6	0.045	2179.81	0.21	2180.02	1.02	0.11	4.52	29.48	0.46
4050.15	3.5	0.045	2179.81	0.18	2179.99	0.92	0.1	3.79	29.39	0.45
4019.45	1180	0.045	2179.46	4.8	2184.26	6.87	1.74	172.93	47.09	0.61
4019.45	498	0.045	2179.46	2.98	2182.44	5.25	1.19	94.83	38.61	0.59
4019.45	356	0.045	2179.46	2.46	2181.92	4.73	1.03	75.27	37	0.58
4019.45	264	0.045	2179.46	2.08	2181.54	4.28	0.89	61.66	36.09	0.58
4019.45	4.6	0.045	2179.46	0.28	2179.74	0.92	0.08	5	26.92	0.38
4019.45	3.5	0.045	2179.46	0.25	2179.71	0.84	0.07	4.19	26.51	0.37
3989.98	1180	0.045	2179.22	3.79	2183.01	10.06	3.94	119.27	40.27	0.97
3989.98	498	0.045	2179.22	2.22	2181.44	7.93	2.94	62.79	32.62	1.01
3989.98	356	0.045	2179.22	1.86	2181.08	6.96	2.39	51.14	31.51	0.96
3989.98	264	0.045	2179.22	1.57	2180.79	6.25	2.03	42.25	30.56	0.94
3989.98	4.6	0.045	2179.22	0.19	2179.41	1.27	0.17	3.63	24.31	0.58
3989.98	3.5	0.045	2179.22	0.17	2179.39	1.1	0.14	3.18	24.21	0.53
3957.3	1180	0.045	2178.47	3.2	2181.67	11.46	5.43	103.71	39.34	1.21
3957.3	498	0.045	2178.47	2.09	2180.56	7.95	3.03	62.65	34.97	1.05
3957.3	356	0.045	2178.47	1.77	2180.24	6.92	2.43	51.43	34.49	1
3957.3	264	0.045	2178.47	1.55	2180.02	6	1.92	44.02	34.18	0.93
3957.3	4.6	0.045	2178.47	0.3	2178.77	1.37	0.2	3.37	21.29	0.6
3957.3	3.5	0.045	2178.47	0.26	2178.73	1.32	0.2	2.66	20.56	0.65
3929.03	1180	0.045	2177.38	4.8	2182.19	6.62	1.61	191.8	63.74	0.58
3929.03	498	0.045	2177.38	2.4	2179.78	7.68	2.92	64.84	40.12	1.07

3929.03	356	0.045	2177.38	2.1	2179.48	6.71	2.35	53.06	38.9	1.01
3929.03	264	0.045	2177.38	1.85	2179.23	6.11	2.08	43.18	38.55	1.02
3929.03	4.6	0.045	2177.38	0.42	2177.8	2.54	0.65	1.81	9.8	1.04
3929.03	3.5	0.045	2177.38	0.39	2177.77	2.24	0.51	1.56	8.56	0.92
3894.78	1180	0.045	2175.66	5.86	2181.52	8.36	2.35	151.37	35.55	0.65
3894.78	498	0.045	2175.66	3.92	2179.58	5.94	1.39	87.22	30.84	0.59
3894.78	356	0.045	2175.66	3.34	2179	5.26	1.16	69.73	29.43	0.57
3894.78	264	0.045	2175.66	2.89	2178.55	4.77	1.02	56.58	28.32	0.57
3894.78	4.6	0.045	2175.66	0.31	2175.97	2.06	0.47	2.23	15.32	0.95
3894.78	3.5	0.045	2175.66	0.27	2175.93	1.99	0.47	1.75	15.23	1.04
3866.61	1180	0.045	2175.35	5.95	2181.3	8.28	2.29	149.86	33.28	0.63
3866.61	498	0.045	2175.35	4.1	2179.45	5.49	1.16	92.54	29.11	0.51
3866.61	356	0.045	2175.35	3.53	2178.88	4.71	0.91	76.36	27.67	0.48
3866.61	264	0.045	2175.35	3.08	2178.43	4.14	0.74	64.11	26.48	0.46
3866.61	4.6	0.045	2175.35	0.44	2175.8	0.74	0.04	6.25	18.31	0.22
3866.61	3.5	0.045	2175.35	0.4	2175.75	0.65	0.04	5.36	18.19	0.21
3843.82	1180	0.045	2175.35	5.74	2181.09	8.32	2.38	146.21	33.95	0.65
3843.82	498	0.045	2175.35	3.95	2179.3	5.52	1.21	90.28	28.26	0.54
3843.82	356	0.045	2175.35	3.4	2178.75	4.73	0.94	75.21	26.6	0.5
3843.82	264	0.045	2175.35	2.96	2178.31	4.13	0.74	63.89	25.23	0.46
3843.82	4.6	0.045	2175.35	0.41	2175.76	0.62	0.03	7.47	19.28	0.17
3843.82	3.5	0.045	2175.35	0.37	2175.72	0.53	0.02	6.6	19.18	0.16
3803.77	1180	0.045	2175.34	5.28	2180.62	8.75	2.67	141.38	36.15	0.71
3803.77	498	0.045	2175.34	3.61	2178.96	5.86	1.38	85.85	30.03	0.59
3803.77	356	0.045	2175.34	3.1	2178.44	5.05	1.09	70.87	28.52	0.56
3803.77	264	0.045	2175.34	2.69	2178.03	4.46	0.9	59.26	27.5	0.53
3803.77	4.6	0.045	2175.34	0.32	2175.66	0.93	0.08	4.92	20.17	0.33
3803.77	3.5	0.045	2175.34	0.28	2175.62	0.84	0.07	4.17	20.09	0.33
3763.5	1180	0.045	2175.12	5.53	2180.66	6.94	1.66	183.25	47.82	0.55

3763.5	498	0.045	2175.12	3.66	2178.78	5.16	1.06	101.77	39.25	0.51
3763.5	356	0.045	2175.12	3.11	2178.23	4.59	0.89	80.94	36.57	0.49
3763.5	264	0.045	2175.12	2.69	2177.81	4.12	0.75	65.94	34.36	0.47
3763.5	4.6	0.045	2175.12	0.35	2175.47	0.83	0.06	5.52	22.73	0.3
3763.5	3.5	0.045	2175.12	0.31	2175.43	0.75	0.05	4.69	22.68	0.29
3520.45	1180	0.045	2174	4.72	2178.72	7.76	2.15	159.93	51.16	0.66
3520.45	498	0.045	2174	3.17	2177.17	5.31	1.17	94.34	36.8	0.57
3520.45	356	0.045	2174	2.66	2176.66	4.68	0.97	76.09	34.77	0.55
3520.45	264	0.045	2174	2.27	2176.27	4.21	0.83	62.73	33.35	0.54
3520.45	4.6	0.045	2174	0.33	2174.33	0.85	0.07	5.41	25.29	0.32
3520.45	3.5	0.045	2174	0.3	2174.3	0.76	0.06	4.58	25.12	0.32
3328.42	1180	0.045	2172.65	4.47	2177.13	7.86	2.21	174.58	75.31	0.68
3328.42	498	0.045	2172.65	3.03	2175.68	5.66	1.32	90.28	38.25	0.6
3328.42	356	0.045	2172.65	2.55	2175.2	4.93	1.06	73.1	34.76	0.57
3328.42	264	0.045	2172.65	2.19	2174.84	4.36	0.88	60.89	33.11	0.55
3328.42	4.6	0.045	2172.65	0.23	2172.88	1.11	0.13	4.16	23.94	0.47
3328.42	3.5	0.045	2172.65	0.2	2172.85	1	0.11	3.49	23.76	0.46
3027.98	1180	0.045	2169.26	3.67	2172.93	9.72	3.66	127.86	46.27	0.95
3027.98	498	0.045	2169.26	2.3	2171.56	7.54	2.63	67.61	41	0.96
3027.98	356	0.045	2169.26	1.96	2171.22	6.63	2.17	54.17	38.46	0.93
3027.98	264	0.045	2169.26	1.69	2170.96	5.92	1.84	44.59	34.15	0.91
3027.98	4.6	0.045	2169.26	0.3	2169.56	1.18	0.13	3.9	18.91	0.46
3027.98	3.5	0.045	2169.26	0.26	2169.52	1.06	0.12	3.29	18.29	0.44
2983.9	1180	0.045	2168.33	3.29	2171.62	10.41	4.59	115.32	51.97	1.16
2983.9	498	0.045	2168.33	2.83	2171.16	5.44	1.34	92.04	48.23	0.67
2983.9	356	0.045	2168.33	2.46	2170.79	4.76	1.1	74.82	45.1	0.65
2983.9	264	0.045	2168.33	2.14	2170.47	4.32	0.95	61.04	42	0.63
2983.9	4.6	0.045	2168.33	0.26	2168.6	2.41	0.59	1.91	10.61	1
2983.9	3.5	0.045	2168.33	0.23	2168.56	2.29	0.55	1.53	9.52	1.01

2823.31	1180	0.045	2166.92	4.28	2171.2	5.41	1.12	261.93	140.81	0.52
2823.31	498	0.045	2166.92	3.23	2170.15	4.07	0.72	129.73	91.42	0.48
2823.31	356	0.045	2166.92	2.88	2169.8	3.52	0.57	103.11	62.57	0.45
2823.31	264	0.045	2166.92	2.57	2169.49	3.15	0.48	84.88	55.95	0.43
2823.31	4.6	0.045	2166.92	0.47	2167.39	0.72	0.05	6.43	24.04	0.24
2823.31	3.5	0.045	2166.92	0.43	2167.35	0.64	0.04	5.47	23.53	0.23
2472.76	1180	0.045	2164.51	2.91	2167.42	8.05	2.73	156.47	80.21	0.89
2472.76	498	0.045	2164.51	1.78	2166.29	6.55	2.19	76.75	57.91	0.97
2472.76	356	0.045	2164.51	1.47	2165.98	6.03	2.01	59.11	54.37	1.01
2472.76	264	0.045	2164.51	1.25	2165.77	5.51	1.77	47.91	49.93	0.99
2472.76	4.6	0.045	2164.51	0.18	2164.69	1.77	0.39	2.61	27.88	1.02
2472.76	3.5	0.045	2164.51	0.16	2164.67	1.68	0.38	2.08	27.1	1.07
2151.63	1180	0.045	2159.74	3.5	2163.24	5.21	1.1	242.45	148	0.55
2151.63	498	0.045	2159.74	2.3	2162.04	3.99	0.78	126.75	84.31	0.55
2151.63	356	0.045	2159.74	2.05	2161.79	3.38	0.59	106.14	81.36	0.51
2151.63	264	0.045	2159.74	1.83	2161.57	3.01	0.49	88.3	78.73	0.49
2151.63	4.6	0.045	2159.74	0.4	2160.14	0.88	0.07	5.24	22.85	0.32
2151.63	3.5	0.045	2159.74	0.34	2160.08	0.87	0.07	4	17.23	0.32
1781.43	1180	0.045	2155.44	3.06	2158.5	8.71	3.22	136.98	59.9	0.97
1781.43	498	0.045	2155.44	2.09	2157.53	6.02	1.78	82.79	52.11	0.84
1781.43	356	0.045	2155.44	1.65	2157.09	5.87	1.84	60.63	48.41	0.92
1781.43	264	0.045	2155.44	1.4	2156.84	5.39	1.64	48.94	46.3	0.93
1781.43	4.6	0.045	2155.44	0.23	2155.67	1.71	0.36	2.69	26.55	0.95
1781.43	3.5	0.045	2155.44	0.21	2155.65	1.63	0.34	2.15	23.76	0.96
1289.9	1180	0.045	2149.26	3.75	2153.01	6.54	1.63	183.09	56.93	0.62
1289.9	498	0.045	2149.26	2.26	2151.52	4.92	1.11	101.42	52.12	0.62
1289.9	356	0.045	2149.26	1.98	2151.24	4.08	0.8	87.32	51.1	0.55
1289.9	264	0.045	2149.26	1.7	2150.96	3.62	0.66	73.02	50.06	0.53
1289.9	4.6	0.045	2149.26	0.28	2149.54	0.69	0.05	6.64	43.14	0.31
1289.9	3.5	0.045	2149.26	0.26	2149.52	0.62	0.04	5.65	42.86	0.3

1002.97	1180	0.045	2145.6	3.24	2148.84	9.32	3.56	127.79	49.29	0.98
1002.97	498	0.045	2145.6	2.23	2147.83	6.19	1.81	80.51	44.6	0.81
1002.97	356	0.045	2145.6	1.69	2147.29	6.25	2.03	56.92	41.91	0.95
1002.97	264	0.045	2145.6	1.42	2147.02	5.74	1.82	45.96	40.59	0.95
1002.97	4.6	0.045	2145.6	0.2	2145.8	1.73	0.38	2.66	28.02	0.99
1002.97	3.5	0.045	2145.6	0.18	2145.78	1.6	0.34	2.19	27.17	1
719.85	1180	0.045	2142.91	3.66	2146.57	5.25	1.08	241.68	104.26	0.52
719.85	498	0.045	2142.91	2.38	2145.29	4.03	0.76	124.68	71.42	0.52
719.85	356	0.045	2142.91	2.23	2145.14	3.14	0.47	114.14	70.07	0.42
719.85	264	0.045	2142.91	1.97	2144.88	2.75	0.38	96.11	67.41	0.4
719.85	4.6	0.045	2142.91	0.29	2143.2	0.58	0.03	7.96	36.42	0.22
719.85	3.5	0.045	2142.91	0.25	2143.16	0.52	0.03	6.72	35.27	0.21
460	1180	0.045	2141.32	2.12	2143.44	7.55	2.68	159.61	135.2	0.99
460	498	0.045	2141.32	1.63	2142.95	4.44	1.03	112.98	89.89	0.68
460	356	0.045	2141.32	1.12	2142.44	5.12	1.6	69.53	83.67	0.99
460	264	0.045	2141.32	0.97	2142.29	4.66	1.4	56.71	81.06	0.98
460	4.6	0.045	2141.32	0.21	2141.53	1.43	0.27	3.23	38.56	0.87
460	3.5	0.045	2141.32	0.19	2141.51	1.33	0.24	2.64	35.58	0.86
135.22	1180	0.045	2134.32	2.99	2137.31	4.39	0.96	269.52	178.9	0.62
135.22	498	0.045	2134.32	2.56	2136.88	5.8	1.88	85.86	162.73	0.98
135.22	356	0.045	2134.32	2.69	2137.01	3.71	0.74	96.09	164.62	0.6
135.22	264	0.045	2134.32	2.48	2136.8	3.31	0.63	79.78	161.69	0.58
135.22	4.6	0.045	2134.32	0.96	2135.28	1.54	0.2	3	39.41	0.48
135.22	3.5	0.045	2134.32	0.9	2135.23	1.41	0.17	2.49	38.34	0.47

Kittitas Conservation District
The Ranch at Swauk Creek Diversion Improvement and Restoration Project

Proposed Conditions

River Sta	Q Total	Manning n	Min Ch El	Max Chl Dpth	W.S. Elev	Vel Chnl	Shear Chan	Flow Area	Top Width	Froude # Chl
	(cfs)		(ft)	(ft)	(ft)	(ft/s)	(lb/sq ft)	(sq ft)	(ft)	
7165.97	1180	0.045	2218.25	4.24	2222.49	4.65	0.84	309.59	172.08	0.45
7165.97	498	0.045	2218.25	3.27	2221.52	4.99	1.08	102.03	114.33	0.58
7165.97	356	0.045	2218.25	2.88	2221.13	4.33	0.87	82.69	93.11	0.55
7165.97	264	0.045	2218.25	2.59	2220.84	3.79	0.7	69.77	83.79	0.52
7165.97	4.6	0.045	2218.25	0.62	2218.87	0.81	0.06	5.71	19.95	0.27
7165.97	3.5	0.045	2218.25	0.57	2218.82	0.74	0.05	4.74	18.38	0.26
6877.12	1180	0.045	2216.21	3.45	2219.66	8.09	2.6	150.48	78.37	0.82
6877.12	498	0.045	2216.21	2.22	2218.44	5.81	1.59	85.84	48.31	0.76
6877.12	356	0.045	2216.21	1.88	2218.09	5.14	1.34	69.23	47.11	0.75
6877.12	264	0.045	2216.21	1.59	2217.8	4.72	1.2	55.93	46.13	0.76
6877.12	4.6	0.045	2216.21	0.19	2216.4	1.87	0.42	2.46	22.61	1
6877.12	3.5	0.045	2216.21	0.17	2216.38	1.75	0.39	2	21.69	1.02
6650.42	1180	0.045	2213.29	3.75	2217.04	7.35	2.11	172.38	74.53	0.72
6650.42	498	0.045	2213.29	2.6	2215.89	5.12	1.19	97.9	51.78	0.63
6650.42	356	0.045	2213.29	2.23	2215.53	4.46	0.96	79.79	47.5	0.61
6650.42	264	0.045	2213.29	1.92	2215.21	4.03	0.82	65.5	43.84	0.58
6650.42	4.6	0.045	2213.29	0.28	2213.57	0.76	0.06	6.07	30.46	0.3
6650.42	3.5	0.045	2213.29	0.25	2213.54	0.67	0.05	5.23	30.32	0.28
6424.86	1180	0.045	2210.75	4.9	2215.65	5.89	1.26	226.35	84.74	0.52
6424.86	498	0.045	2210.75	3.22	2213.97	5.06	1.11	100.03	48.57	0.58
6424.86	356	0.045	2210.75	2.75	2213.5	4.56	0.97	78.44	44.25	0.59
6424.86	264	0.045	2210.75	2.38	2213.13	4.21	0.88	62.67	40.75	0.6
6424.86	4.6	0.045	2210.75	0.24	2210.99	2.14	0.51	2.15	15.42	1.01
6424.86	3.5	0.045	2210.75	0.21	2210.96	2.09	0.51	1.68	14.68	1.09

6259.81	1180	0.045	2209.7	4.25	2213.95	8	2.37	151.94	46.24	0.73
6259.81	498	0.045	2209.7	3.35	2213.05	4.49	0.82	112.33	42.52	0.47
6259.81	356	0.045	2209.7	2.98	2212.68	3.7	0.58	96.81	40.95	0.41
6259.81	264	0.045	2209.7	2.67	2212.37	3.13	0.44	84.37	39.6	0.37
6259.81	4.6	0.045	2209.7	0.51	2210.21	0.48	0.02	9.54	28.84	0.15
6259.81	3.5	0.045	2209.7	0.46	2210.16	0.42	0.02	8.28	28.58	0.14
6079.35	1180	0.045	2209.43	2.62	2212.05	6.19	1.77	221.27	194.05	0.79
6079.35	498	0.045	2209.43	1.74	2211.17	5.64	1.8	89.08	88.9	0.98
6079.35	356	0.045	2209.43	1.52	2210.95	5.15	1.63	69.54	87.34	1.01
6079.35	264	0.045	2209.43	1.35	2210.78	4.79	1.48	55.31	80.45	1.01
6079.35	4.6	0.045	2209.43	0.21	2209.64	1.62	0.33	2.83	30.53	0.94
6079.35	3.5	0.045	2209.43	0.19	2209.62	1.54	0.32	2.28	30.21	0.99
5902.35	1180	0.045	2205.98	3.45	2209.43	5.23	1.13	257.89	148.45	0.56
5902.35	498	0.045	2205.98	2.57	2208.55	3.88	0.71	141.77	113.12	0.51
5902.35	356	0.045	2205.98	2.25	2208.23	3.57	0.63	108.36	98.42	0.51
5902.35	264	0.045	2205.98	2.03	2208.01	3.17	0.52	88.1	85.71	0.48
5902.35	4.6	0.045	2205.98	0.53	2206.51	0.58	0.03	7.86	32.19	0.21
5902.35	3.5	0.045	2205.98	0.48	2206.46	0.54	0.03	6.53	30.21	0.2
5773.55	1180	0.045	2205.46	2.07	2207.53	6.9	2.34	171.97	112.7	0.97
5773.55	498	0.045	2205.46	1.39	2206.85	5.09	1.53	97.76	106.67	0.94
5773.55	356	0.045	2205.46	1.28	2206.74	4.14	1.05	85.9	105.37	0.81
5773.55	264	0.045	2205.46	1.13	2206.59	3.79	0.94	69.65	103.63	0.82
5773.55	4.6	0.045	2205.46	0.23	2205.69	1.86	0.43	2.47	24.36	1.03
5773.55	3.5	0.045	2205.46	0.21	2205.67	1.82	0.4	1.92	18.74	1
5598.93	1180	0.045	2201.13	3.35	2204.48	7.13	2.11	167.65	71.03	0.78
5598.93	498	0.045	2201.13	2.22	2203.35	5.3	1.41	94.03	63.34	0.76
5598.93	356	0.045	2201.13	1.84	2202.97	5.08	1.43	70.02	62.71	0.85
5598.93	264	0.045	2201.13	1.65	2202.78	4.54	1.2	58.18	60.32	0.81
5598.93	4.6	0.045	2201.13	0.31	2201.44	1.04	0.11	4.41	22.22	0.41
5598.93	3.5	0.045	2201.13	0.28	2201.41	0.92	0.09	3.79	21.39	0.39

5245.6	1180	0.045	2194.98	4.71	2199.69	8.91	2.88	150.63	95.19	0.78
5245.6	498	0.045	2194.98	3.05	2198.03	6.7	1.94	74.44	31.92	0.76
5245.6	356	0.045	2194.98	2.73	2197.71	5.53	1.39	64.35	30.68	0.67
5245.6	264	0.045	2194.98	2.25	2197.23	5.25	1.32	50.24	28.11	0.69
5245.6	4.6	0.045	2194.98	0.22	2195.2	1.94	0.43	2.37	18.48	0.95
5245.6	3.5	0.045	2194.98	0.19	2195.17	1.88	0.43	1.86	18.33	1.04
5069.13	1180	0.045	2192.22	3.96	2196.19	11.6	5.17	130.38	82.98	1.09
5069.13	498	0.045	2192.22	3.17	2195.39	7.6	2.41	75.01	53.39	0.81
5069.13	356	0.045	2192.22	2.59	2194.81	7.35	2.44	50.66	33.85	0.88
5069.13	264	0.045	2192.22	2.34	2194.56	6.27	1.85	42.71	28.97	0.8
5069.13	4.6	0.045	2192.22	0.61	2192.83	0.62	0.03	7.41	18.01	0.17
5069.13	3.5	0.045	2192.22	0.57	2192.79	0.53	0.02	6.63	17.69	0.15
5043.89	1180	0.045	2192.55	4.01	2196.56	7.39	2.03	178.6	66.78	0.67
5043.89	498	0.045	2192.55	2.64	2195.19	5.74	1.43	93.62	55.88	0.65
5043.89	356	0.045	2192.55	2.16	2194.71	5.37	1.34	68.64	46.01	0.68
5043.89	264	0.045	2192.55	1.8	2194.35	4.95	1.22	53.44	36.72	0.69
5043.89	4.6	0.045	2192.55	0.13	2192.68	1.88	0.44	2.45	25.42	1.07
5043.89	3.5	0.045	2192.55	0.12	2192.67	1.64	0.35	2.13	25.37	1
4997.51	1180	0.045	2191.29	5.15	2196.44	5.94	1.23	218.98	71.9	0.48
4997.51	498	0.045	2191.29	3.9	2195.19	3.6	0.5	144.04	52.86	0.34
4997.51	356	0.045	2191.29	3.43	2194.72	3.03	0.37	120.37	49.24	0.31
4997.51	264	0.045	2191.29	3.08	2194.37	2.56	0.28	103.9	42.86	0.28
4997.51	4.6	0.045	2191.29	0.83	2192.12	0.26	0.01	17.5	35.83	0.07
4997.51	3.5	0.045	2191.29	0.74	2192.03	0.24	0	14.5	35.67	0.07
4969.06	1180	0.045	2189.69	6.77	2196.46	5	0.81	265.81	65.13	0.36
4969.06	498	0.045	2189.69	5.5	2195.19	2.85	0.29	189.93	55.52	0.23
4969.06	356	0.045	2189.69	5.04	2194.73	2.32	0.19	164.62	52.94	0.2
4969.06	264	0.045	2189.69	4.68	2194.37	1.9	0.13	147.15	46.93	0.17
4969.06	4.6	0.045	2189.69	2.43	2192.12	0.08	0	55.04	35.52	0.01

4969.06	3.5	0.045	2189.69	2.34	2192.03	0.07	0	52.08	35.18	0.01
4965.06	1180	0.045	2191.5	3.96	2195.46	9.27	3.47	135.52	57.12	0.96
4965.06	498	0.045	2191.5	3.41	2194.91	5.02	1.09	104.93	54.61	0.58
4965.06	356	0.045	2191.5	2.98	2194.48	4.51	0.94	82.31	49.82	0.58
4965.06	264	0.045	2191.5	2.64	2194.15	4.14	0.85	66.11	48.16	0.58
4965.06	4.6	0.045	2191.5	0.55	2192.05	1.95	0.3	2.36	5.97	0.55
4965.06	3.5	0.045	2191.5	0.48	2191.98	1.82	0.27	1.93	5.5	0.54
4943.6	1180	0.045	2191	4.82	2195.42	7.01	1.93	175.36	61.95	0.7
4943.6	498	0.045	2191	3.54	2194.14	7.39	2.55	69.49	42.28	0.95
4943.6	356	0.045	2191	3.17	2193.78	6.68	2.24	54.34	39.97	0.96
4943.6	264	0.045	2191	2.95	2193.55	5.89	1.85	45.37	38.54	0.92
4943.6	4.6	0.045	2191	0.94	2191.54	3.02	0.75	1.52	4.4	0.9
4943.6	3.5	0.045	2191	0.88	2191.48	2.77	0.66	1.26	4.04	0.87
4908.09	1180	0.045	2190.07	4.8	2194.39	8.83	3.31	134.88	56.27	0.99
4908.09	498	0.045	2190.07	3.43	2193.02	7.8	3.15	63.94	47.17	1.17
4908.09	356	0.045	2190.07	3.22	2192.81	6.56	2.33	54.29	45.79	1.06
4908.09	264	0.045	2190.07	3.03	2192.62	5.75	1.88	45.89	44.56	1
4908.09	4.6	0.045	2190.07	1.15	2190.74	2.28	0.41	2.02	5.02	0.63
4908.09	3.5	0.045	2190.07	1.07	2190.66	2.16	0.38	1.62	4.52	0.64
4871.2	1180	0.045	2189.43	4.19	2193.62	7.11	1.91	171.39	56.93	0.66
4871.2	498	0.045	2189.43	2.71	2192.14	5.22	1.23	95.38	46.13	0.64
4871.2	356	0.045	2189.43	2.22	2191.65	4.84	1.13	73.57	42.84	0.65
4871.2	264	0.045	2189.43	1.84	2191.27	4.59	1.08	57.56	40.24	0.68
4871.2	4.6	0.045	2189.43	0.2	2189.63	2.12	0.53	2.17	18.36	1.09
4871.2	3.5	0.045	2189.43	0.18	2189.61	1.79	0.38	1.96	17.63	0.95
4847.25	1180	0.045	2189.05	4.72	2193.77	4.95	0.89	246.2	73.94	0.44
4847.25	498	0.045	2189.05	3.11	2192.16	3.57	0.55	139.58	59.53	0.41
4847.25	356	0.045	2189.05	2.59	2191.65	3.24	0.48	109.85	55.14	0.4
4847.25	264	0.045	2189.05	2.19	2191.24	3	0.43	88.13	51.69	0.4

4847.25	4.6	0.045	2189.05	0.34	2189.39	0.65	0.04	7.03	35.97	0.26
4847.25	3.5	0.045	2189.05	0.31	2189.36	0.58	0.03	6.04	35.73	0.25
4775.33	1180	0.045	2188.71	4.09	2192.71	8.1	2.46	163.48	73.67	0.74
4775.33	498	0.045	2188.71	2.82	2191.44	5.62	1.36	89.26	38.79	0.63
4775.33	356	0.045	2188.71	2.39	2191.01	4.87	1.09	73.19	36.08	0.6
4775.33	264	0.045	2188.71	2.03	2190.65	4.35	0.91	60.68	33.95	0.57
4775.33	4.6	0.045	2188.71	0.33	2188.95	1.01	0.11	4.55	30.96	0.46
4775.33	3.5	0.045	2188.71	0.3	2188.92	0.93	0.1	3.75	30.87	0.47
4646.06	1180	0.045	2187.16	3.53	2190.69	8.92	3.16	141.2	68.53	0.88
4646.06	498	0.045	2187.16	2	2189.16	7.42	2.68	67.08	39.18	1
4646.06	356	0.045	2187.16	1.66	2188.82	6.6	2.26	53.92	38.8	0.99
4646.06	264	0.045	2187.16	1.43	2188.59	5.86	1.88	45.09	38.54	0.95
4646.06	4.6	0.045	2187.16	0.32	2187.48	1.04	0.11	4.41	26.25	0.45
4646.06	3.5	0.045	2187.16	0.29	2187.45	0.92	0.09	3.8	25.67	0.42
4540.24	1180	0.045	2185.06	3.94	2189	7.62	2.2	161.67	56.71	0.72
4540.24	498	0.045	2185.06	2.55	2187.61	5.49	1.35	90.89	44.06	0.66
4540.24	356	0.045	2185.06	2.14	2187.2	4.85	1.12	73.45	41.31	0.64
4540.24	264	0.045	2185.06	1.67	2186.73	4.84	1.2	54.59	38.81	0.72
4540.24	4.6	0.045	2185.06	0.16	2185.22	1.77	0.38	2.6	24.3	0.95
4540.24	3.5	0.045	2185.06	0.14	2185.2	1.72	0.38	2.04	23.74	1.04
4447.62	1180	0.045	2183.23	4.77	2188	7.71	2.26	157.77	52.02	0.72
4447.62	498	0.045	2183.23	3.24	2186.48	5.84	1.56	85.37	43.21	0.72
4447.62	356	0.045	2183.23	2.78	2186.02	5.38	1.41	66.2	38.97	0.73
4447.62	264	0.045	2183.23	2.25	2185.48	5.25	1.3	50.31	26.97	0.68
4447.62	4.6	0.045	2183.23	0.4	2183.64	0.83	0.06	5.51	21.46	0.29
4447.62	3.5	0.045	2183.23	0.37	2183.6	0.74	0.05	4.75	21.35	0.28
4321.17	1180	0.045	2182.22	4.93	2187.15	6.59	1.56	183.16	48.83	0.57
4321.17	498	0.045	2182.22	3.16	2185.38	4.92	1.05	101.29	43.03	0.56
4321.17	356	0.045	2182.22	2.61	2184.83	4.51	0.93	78.96	38.95	0.56

4321.17	264	0.045	2182.22	2.16	2184.38	4.25	0.86	62.17	34.2	0.56
4321.17	4.6	0.045	2182.22	0.23	2182.45	1.49	0.27	3.08	28.42	0.8
4321.17	3.5	0.045	2182.22	0.21	2182.43	1.42	0.26	2.47	27.64	0.84
4177.43	1180	0.045	2180.64	4.6	2185.24	9.11	3.07	135.05	42.38	0.81
4177.43	498	0.045	2180.64	3.1	2183.74	6.41	1.78	77.9	33.84	0.72
4177.43	356	0.045	2180.64	2.66	2183.3	5.6	1.44	63.54	30.67	0.69
4177.43	264	0.045	2180.64	2.29	2182.93	5.02	1.2	52.6	28.45	0.65
4177.43	4.6	0.045	2180.64	0.36	2181	0.86	0.07	5.34	22.21	0.31
4177.43	3.5	0.045	2180.64	0.33	2180.97	0.77	0.06	4.57	22.14	0.3
4050.15	1180	0.045	2179.81	4.74	2184.55	6.54	1.55	188.17	59.03	0.57
4050.15	498	0.045	2179.81	2.9	2182.71	5.05	1.1	99.01	42.29	0.57
4050.15	356	0.045	2179.81	2.39	2182.2	4.55	0.95	78.32	39.79	0.57
4050.15	264	0.045	2179.81	2.02	2181.83	4.13	0.83	63.91	37.75	0.56
4050.15	4.6	0.045	2179.81	0.19	2180	1.12	0.14	4.11	29.43	0.53
4050.15	3.5	0.045	2179.81	0.17	2179.98	1.02	0.12	3.43	29.35	0.53
4019.45	1180	0.045	2179.46	4.75	2184.21	7.08	1.81	170.64	46.86	0.61
4019.45	498	0.045	2179.46	2.97	2182.43	5.26	1.19	94.63	38.59	0.59
4019.45	356	0.045	2179.46	2.47	2181.93	4.69	1.01	75.88	37.04	0.58
4019.45	264	0.045	2179.46	2.11	2181.57	4.23	0.86	62.43	36.15	0.57
4019.45	4.6	0.045	2179.46	0.31	2179.77	0.79	0.06	5.81	27.32	0.3
4019.45	3.5	0.045	2179.46	0.27	2179.73	0.73	0.05	4.82	26.83	0.3
3989.98	1180	0.045	2179.22	3.79	2183.01	10.06	3.94	119.27	40.27	0.97
3989.98	498	0.045	2179.22	2.22	2181.44	7.93	2.93	62.8	32.62	1.01
3989.98	356	0.045	2179.22	1.81	2181.03	7.17	2.56	49.63	31.36	1.01
3989.98	264	0.045	2179.22	1.5	2180.72	6.57	2.27	40.19	30.12	1
3989.98	4.6	0.045	2179.22	0.13	2179.35	2.03	0.52	2.26	23.98	1.17
3989.98	3.5	0.045	2179.22	0.12	2179.34	1.68	0.36	2.08	23.94	1
3957.3	1180	0.045	2177.27	3.29	2180.56	13.58	7.96	86.91	34.97	1.52
3957.3	498	0.045	2177.27	2.15	2179.42	10.42	5.57	47.8	33.28	1.53

3957.3	356	0.045	2177.27	1.86	2179.14	9.27	4.71	38.42	32.85	1.51
3957.3	264	0.045	2177.27	1.66	2178.93	8.29	4	31.83	32.53	1.48
3957.3	4.6	0.045	2177.27	0.29	2177.56	1.75	0.31	2.63	14.74	0.73
3957.3	3.5	0.045	2177.27	0.26	2177.53	1.6	0.27	2.19	14.35	0.72
3929.03	1180	0.045	2176.05	6.12	2182.17	5.51	1.04	229.68	63.67	0.44
3929.03	498	0.045	2176.05	3.75	2179.8	4.76	0.96	104.67	40.23	0.52
3929.03	356	0.045	2176.05	3.1	2179.16	4.49	0.92	79.36	38.46	0.55
3929.03	264	0.045	2176.05	2.6	2178.65	4.39	0.95	60.1	37.7	0.61
3929.03	4.6	0.045	2176.05	0.39	2176.44	2.48	0.61	1.86	9.7	1
3929.03	3.5	0.045	2176.05	0.35	2176.4	2.42	0.59	1.44	7.92	1
3894.78	1180	0.045	2174.56	7.16	2181.71	7.07	1.62	178.67	36.03	0.5
3894.78	498	0.045	2174.56	5.1	2179.65	4.71	0.83	109.58	31.02	0.41
3894.78	356	0.045	2174.56	4.48	2179.04	4.02	0.63	91	29.52	0.38
3894.78	264	0.045	2174.56	4	2178.56	3.49	0.5	77.02	28.35	0.36
3894.78	4.6	0.045	2174.56	1.21	2175.77	0.26	0	17.48	16.95	0.05
3894.78	3.5	0.045	2174.56	1.17	2175.72	0.21	0	16.67	16.91	0.04
3866.61	1180	0.045	2174	7.59	2181.59	6.95	1.56	178.56	34.25	0.48
3866.61	498	0.045	2174	5.59	2179.59	4.4	0.71	115.35	29.4	0.37
3866.61	356	0.045	2174	4.99	2178.99	3.67	0.52	98.03	27.98	0.33
3866.61	264	0.045	2174	4.51	2178.51	3.12	0.39	85.04	26.69	0.3
3866.61	4.6	0.045	2174	1.77	2175.77	0.19	0	24.52	18.32	0.03
3866.61	3.5	0.045	2174	1.72	2175.72	0.15	0	23.65	18.21	0.02
3843.82	1180	0.045	2175.35	5.74	2181.09	8.32	2.38	146.21	33.95	0.65
3843.82	498	0.045	2175.35	3.95	2179.3	5.52	1.21	90.28	28.26	0.54
3843.82	356	0.045	2175.35	3.4	2178.75	4.73	0.94	75.21	26.6	0.5
3843.82	264	0.045	2175.35	2.96	2178.31	4.13	0.74	63.89	25.23	0.46
3843.82	4.6	0.045	2175.35	0.41	2175.76	0.62	0.03	7.47	19.28	0.17
3843.82	3.5	0.045	2175.35	0.37	2175.72	0.53	0.02	6.6	19.18	0.16
3803.77	1180	0.045	2175.34	5.28	2180.62	8.75	2.67	141.38	36.15	0.71

3803.77	498	0.045	2175.34	3.61	2178.96	5.86	1.38	85.85	30.03	0.59
3803.77	356	0.045	2175.34	3.1	2178.44	5.05	1.09	70.87	28.52	0.56
3803.77	264	0.045	2175.34	2.69	2178.03	4.46	0.9	59.26	27.5	0.53
3803.77	4.6	0.045	2175.34	0.32	2175.66	0.93	0.08	4.92	20.17	0.33
3803.77	3.5	0.045	2175.34	0.28	2175.62	0.84	0.07	4.17	20.09	0.33
3763.5	1180	0.045	2175.12	5.53	2180.66	6.94	1.66	183.25	47.82	0.55
3763.5	498	0.045	2175.12	3.66	2178.78	5.16	1.06	101.77	39.25	0.51
3763.5	356	0.045	2175.12	3.11	2178.23	4.59	0.89	80.94	36.57	0.49
3763.5	264	0.045	2175.12	2.69	2177.81	4.12	0.75	65.94	34.36	0.47
3763.5	4.6	0.045	2175.12	0.35	2175.47	0.83	0.06	5.52	22.73	0.3
3763.5	3.5	0.045	2175.12	0.31	2175.43	0.75	0.05	4.69	22.68	0.29
3520.45	1180	0.045	2174	4.72	2178.72	7.76	2.15	159.93	51.16	0.66
3520.45	498	0.045	2174	3.17	2177.17	5.31	1.17	94.34	36.8	0.57
3520.45	356	0.045	2174	2.66	2176.66	4.68	0.97	76.09	34.77	0.55
3520.45	264	0.045	2174	2.27	2176.27	4.21	0.83	62.73	33.35	0.54
3520.45	4.6	0.045	2174	0.33	2174.33	0.85	0.07	5.41	25.29	0.32
3520.45	3.5	0.045	2174	0.3	2174.3	0.76	0.06	4.58	25.12	0.32
3328.42	1180	0.045	2172.65	4.47	2177.13	7.86	2.21	174.58	75.31	0.68
3328.42	498	0.045	2172.65	3.03	2175.68	5.66	1.32	90.28	38.25	0.6
3328.42	356	0.045	2172.65	2.55	2175.2	4.93	1.06	73.1	34.76	0.57
3328.42	264	0.045	2172.65	2.19	2174.84	4.36	0.88	60.89	33.11	0.55
3328.42	4.6	0.045	2172.65	0.23	2172.88	1.11	0.13	4.16	23.94	0.47
3328.42	3.5	0.045	2172.65	0.2	2172.85	1	0.11	3.49	23.76	0.46
3027.98	1180	0.045	2169.26	3.67	2172.93	9.72	3.66	127.86	46.27	0.95
3027.98	498	0.045	2169.26	2.3	2171.56	7.54	2.63	67.61	41	0.96
3027.98	356	0.045	2169.26	1.96	2171.22	6.63	2.17	54.17	38.46	0.93
3027.98	264	0.045	2169.26	1.69	2170.96	5.92	1.84	44.59	34.15	0.91
3027.98	4.6	0.045	2169.26	0.3	2169.56	1.18	0.13	3.9	18.91	0.46
3027.98	3.5	0.045	2169.26	0.26	2169.52	1.06	0.12	3.29	18.29	0.44

2983.9	1180	0.045	2168.33	3.29	2171.62	10.41	4.59	115.32	51.97	1.16
2983.9	498	0.045	2168.33	2.83	2171.16	5.44	1.34	92.04	48.23	0.67
2983.9	356	0.045	2168.33	2.46	2170.79	4.76	1.1	74.82	45.1	0.65
2983.9	264	0.045	2168.33	2.14	2170.47	4.32	0.95	61.04	42	0.63
2983.9	4.6	0.045	2168.33	0.26	2168.6	2.41	0.59	1.91	10.61	1
2983.9	3.5	0.045	2168.33	0.23	2168.56	2.29	0.55	1.53	9.52	1.01
2823.31	1180	0.045	2166.92	4.28	2171.2	5.41	1.12	261.93	140.81	0.52
2823.31	498	0.045	2166.92	3.23	2170.15	4.07	0.72	129.73	91.42	0.48
2823.31	356	0.045	2166.92	2.88	2169.8	3.52	0.57	103.11	62.57	0.45
2823.31	264	0.045	2166.92	2.57	2169.49	3.15	0.48	84.88	55.95	0.43
2823.31	4.6	0.045	2166.92	0.47	2167.39	0.72	0.05	6.43	24.04	0.24
2823.31	3.5	0.045	2166.92	0.43	2167.35	0.64	0.04	5.47	23.53	0.23
2472.76	1180	0.045	2164.51	2.91	2167.42	8.05	2.73	156.47	80.21	0.89
2472.76	498	0.045	2164.51	1.78	2166.29	6.55	2.19	76.75	57.91	0.97
2472.76	356	0.045	2164.51	1.47	2165.98	6.03	2.01	59.11	54.37	1.01
2472.76	264	0.045	2164.51	1.25	2165.77	5.51	1.77	47.91	49.93	0.99
2472.76	4.6	0.045	2164.51	0.18	2164.69	1.77	0.39	2.61	27.88	1.02
2472.76	3.5	0.045	2164.51	0.16	2164.67	1.68	0.38	2.08	27.1	1.07
2151.63	1180	0.045	2159.74	3.5	2163.24	5.21	1.1	242.45	148	0.55
2151.63	498	0.045	2159.74	2.3	2162.04	3.99	0.78	126.75	84.31	0.55
2151.63	356	0.045	2159.74	2.05	2161.79	3.38	0.59	106.14	81.36	0.51
2151.63	264	0.045	2159.74	1.83	2161.57	3.01	0.49	88.3	78.73	0.49
2151.63	4.6	0.045	2159.74	0.4	2160.14	0.88	0.07	5.24	22.85	0.32
2151.63	3.5	0.045	2159.74	0.34	2160.08	0.87	0.07	4	17.23	0.32
1781.43	1180	0.045	2155.44	3.06	2158.5	8.71	3.22	136.98	59.9	0.97
1781.43	498	0.045	2155.44	2.09	2157.53	6.02	1.78	82.79	52.11	0.84
1781.43	356	0.045	2155.44	1.65	2157.09	5.87	1.84	60.63	48.41	0.92
1781.43	264	0.045	2155.44	1.4	2156.84	5.39	1.64	48.94	46.3	0.93
1781.43	4.6	0.045	2155.44	0.23	2155.67	1.71	0.36	2.69	26.55	0.95
1781.43	3.5	0.045	2155.44	0.21	2155.65	1.63	0.34	2.15	23.76	0.96

1289.9	1180	0.045	2149.26	3.75	2153.01	6.54	1.63	183.09	56.93	0.62
1289.9	498	0.045	2149.26	2.26	2151.52	4.92	1.11	101.42	52.12	0.62
1289.9	356	0.045	2149.26	1.98	2151.24	4.08	0.8	87.32	51.1	0.55
1289.9	264	0.045	2149.26	1.7	2150.96	3.62	0.66	73.02	50.06	0.53
1289.9	4.6	0.045	2149.26	0.28	2149.54	0.69	0.05	6.64	43.14	0.31
1289.9	3.5	0.045	2149.26	0.26	2149.52	0.62	0.04	5.65	42.86	0.3
1002.97	1180	0.045	2145.6	3.24	2148.84	9.32	3.56	127.79	49.29	0.98
1002.97	498	0.045	2145.6	2.23	2147.83	6.19	1.81	80.51	44.6	0.81
1002.97	356	0.045	2145.6	1.69	2147.29	6.25	2.03	56.92	41.91	0.95
1002.97	264	0.045	2145.6	1.42	2147.02	5.74	1.82	45.96	40.59	0.95
1002.97	4.6	0.045	2145.6	0.2	2145.8	1.73	0.38	2.66	28.02	0.99
1002.97	3.5	0.045	2145.6	0.18	2145.78	1.6	0.34	2.19	27.17	1
719.85	1180	0.045	2142.91	3.66	2146.57	5.25	1.08	241.68	104.26	0.52
719.85	498	0.045	2142.91	2.38	2145.29	4.03	0.76	124.68	71.42	0.52
719.85	356	0.045	2142.91	2.23	2145.14	3.14	0.47	114.14	70.07	0.42
719.85	264	0.045	2142.91	1.97	2144.88	2.75	0.38	96.11	67.41	0.4
719.85	4.6	0.045	2142.91	0.29	2143.2	0.58	0.03	7.96	36.42	0.22
719.85	3.5	0.045	2142.91	0.25	2143.16	0.52	0.03	6.72	35.27	0.21
460	1180	0.045	2141.32	2.12	2143.44	7.55	2.68	159.61	135.2	0.99
460	498	0.045	2141.32	1.63	2142.95	4.44	1.03	112.98	89.89	0.68
460	356	0.045	2141.32	1.12	2142.44	5.12	1.6	69.53	83.67	0.99
460	264	0.045	2141.32	0.97	2142.29	4.66	1.4	56.71	81.06	0.98
460	4.6	0.045	2141.32	0.21	2141.53	1.43	0.27	3.23	38.56	0.87
460	3.5	0.045	2141.32	0.19	2141.51	1.33	0.24	2.64	35.58	0.86
135.22	1180	0.045	2134.32	2.99	2137.31	4.39	0.96	269.52	178.9	0.62
135.22	498	0.045	2134.32	2.56	2136.88	5.8	1.88	85.86	162.73	0.98
135.22	356	0.045	2134.32	2.69	2137.01	3.71	0.74	96.09	164.62	0.6
135.22	264	0.045	2134.32	2.48	2136.8	3.31	0.63	79.78	161.69	0.58
135.22	4.6	0.045	2134.32	0.96	2135.28	1.54	0.2	3	39.41	0.48
135.22	3.5	0.045	2134.32	0.9	2135.23	1.41	0.17	2.49	38.34	0.47

Kittitas Conservation District
The Ranch at Swauk Creek Diversion Improvement and Restoration Project

Proposed Conditions - Low Flow

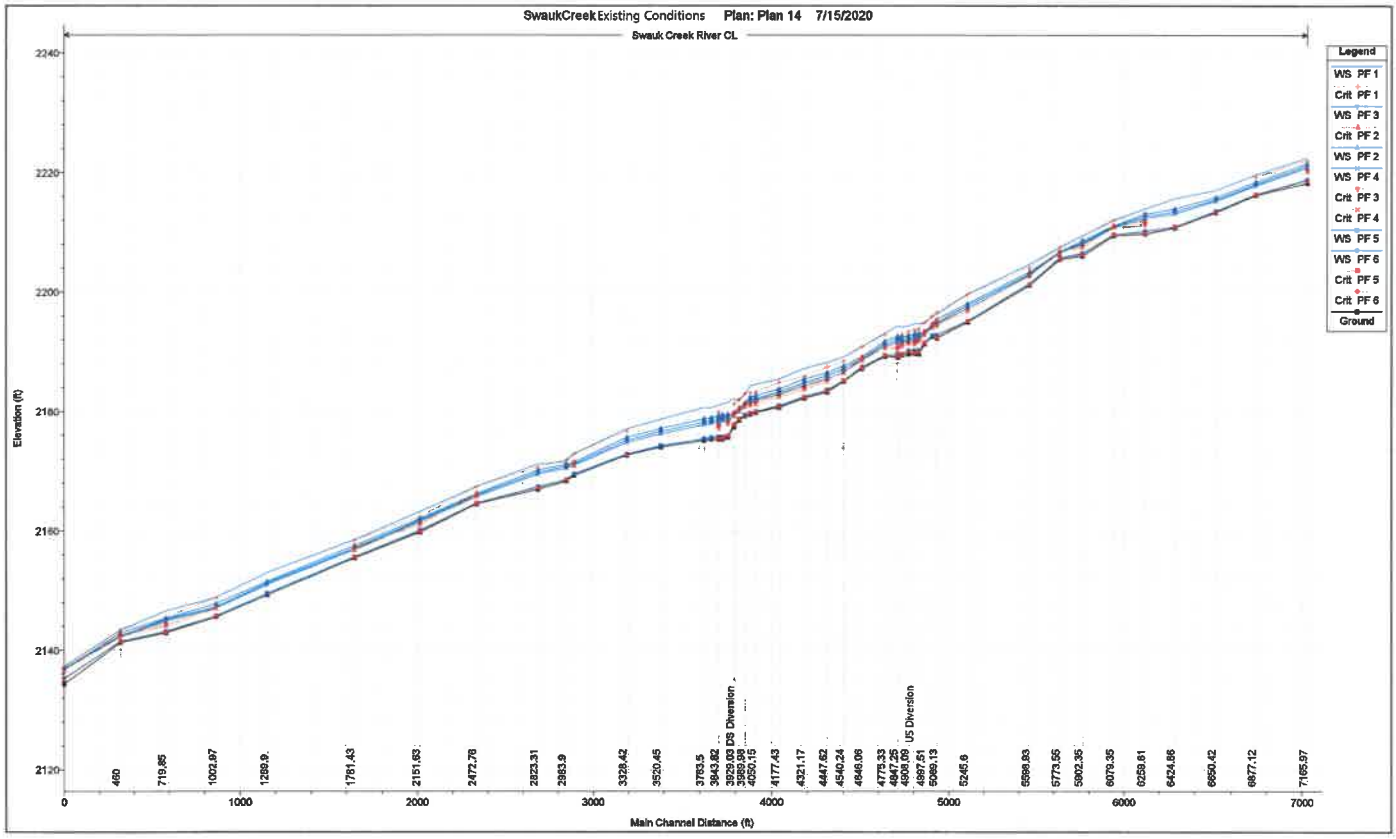
River Sta	Q Total	Manning n	Min Ch El	Max Chl Dpth	W.S. Elev	Vel Chnl	Shear Chan	Flow Area	Top Width	Froude # Chl
	(cfs)		(ft)	(ft)	(ft)	(ft/s)	(lb/sq ft)	(sq ft)	(ft)	
7165.97	4.6	0.25	2218.25	1.08	2219.33	0.28	0.16	16.7	27.36	0.06
7165.97	3.5	0.25	2218.25	0.99	2219.24	0.24	0.13	14.37	26.11	0.06
6877.12	4.6	0.25	2216.21	0.43	2216.64	0.5	0.67	9.18	31.07	0.16
6877.12	3.5	0.25	2216.21	0.35	2216.56	0.52	0.76	6.78	28.5	0.19
6650.42	4.6	0.25	2213.29	0.59	2213.88	0.29	0.19	15.94	32.09	0.07
6650.42	3.5	0.25	2213.29	0.53	2213.82	0.25	0.14	14.03	31.78	0.07
6424.86	4.6	0.25	2210.75	0.58	2211.33	0.55	0.72	8.36	20.22	0.15
6424.86	3.5	0.25	2210.75	0.47	2211.22	0.57	0.83	6.19	19.25	0.18
6259.81	4.6	0.25	2209.7	0.99	2210.69	0.19	0.07	24.21	31.68	0.04
6259.81	3.5	0.25	2209.7	0.89	2210.59	0.17	0.06	20.92	31.02	0.04
6079.35	4.6	0.25	2209.43	0.21	2209.64	1.62	10.29	2.83	30.53	0.94
6079.35	3.5	0.25	2209.43	0.19	2209.62	1.54	9.88	2.28	30.21	0.99
5902.35	4.6	0.25	2205.98	0.92	2206.9	0.2	0.09	22.96	42.7	0.05
5902.35	3.5	0.25	2205.98	0.85	2206.83	0.18	0.07	19.86	41.26	0.04
5773.55	4.6	0.25	2205.46	0.33	2205.79	0.79	2.14	5.85	44.2	0.38
5773.55	3.5	0.25	2205.46	0.22	2205.69	1.51	8.65	2.32	22.79	0.84
5598.93	4.6	0.25	2201.13	0.67	2201.8	0.32	0.23	14.45	30.83	0.08
5598.93	3.5	0.25	2201.13	0.62	2201.75	0.27	0.17	12.91	30.2	0.07
5245.6	4.6	0.25	2194.98	0.42	2195.4	0.75	1.48	6.11	19.56	0.24

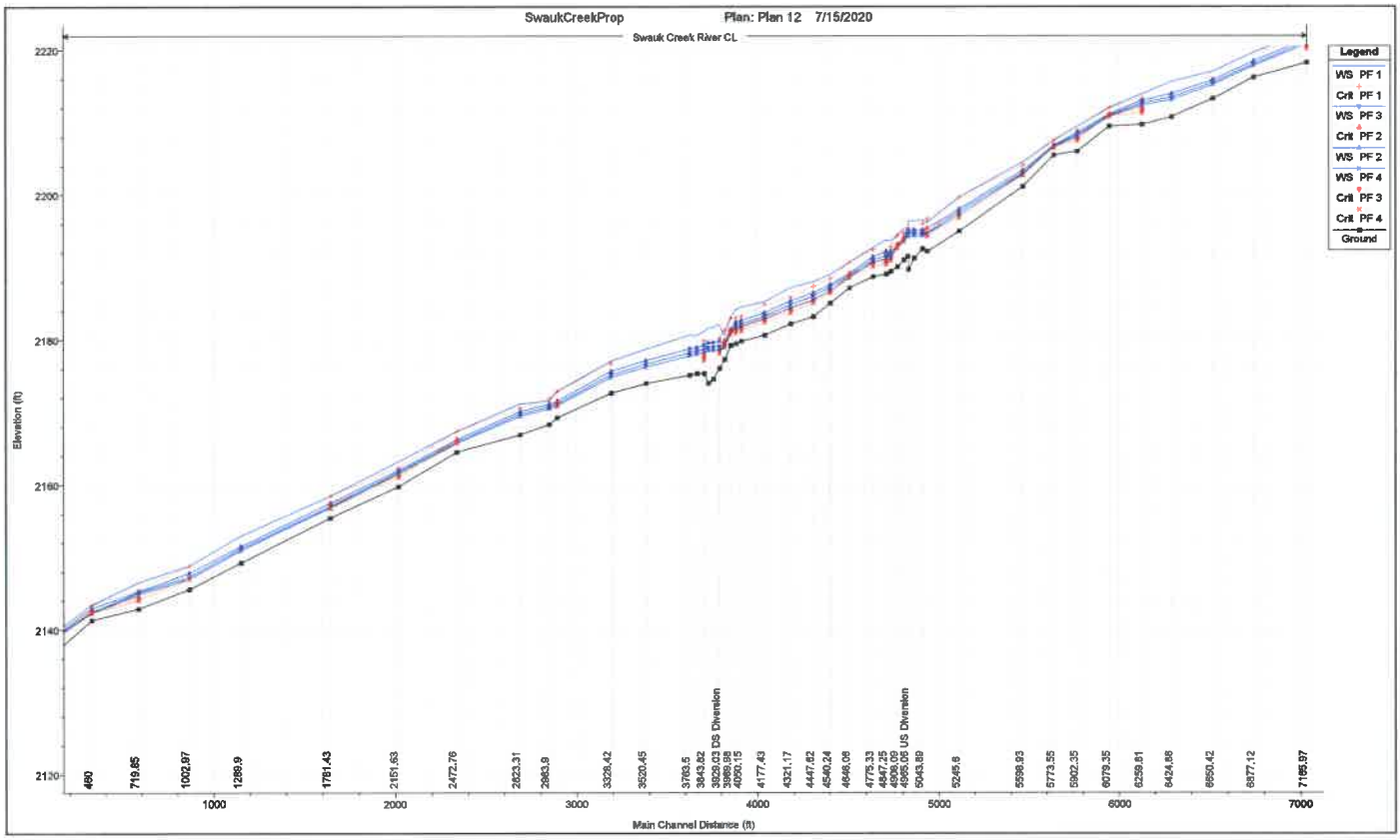
5245.6	3.5	0.25	2194.98	0.31	2195.29	0.88	2.3	3.99	18.95	0.34
5069.13	4.6	0.25	2192.22	0.96	2193.18	0.33	0.22	13.79	19.01	0.07
5069.13	3.5	0.25	2192.22	0.88	2193.1	0.28	0.17	12.29	18.85	0.06
5043.89	4.6	0.25	2192.55	0.28	2192.83	0.73	1.53	6.27	26.06	0.26
5043.89	3.5	0.25	2192.55	0.14	2192.69	1.29	6.26	2.7	25.47	0.7
4997.51	4.6	0.25	2191.29	1.5	2192.79	0.11	0.02	41.89	37.08	0.02
4997.51	3.5	0.25	2191.29	1.38	2192.67	0.09	0.02	37.4	36.85	0.02
4969.06	4.6	0.25	2189.69	3.09	2192.79	0.05	0	79.62	38.29	0.01
4969.06	3.5	0.25	2189.69	2.97	2192.66	0.04	0	75.02	37.72	0.01
4965.06	4.6	0.25	2191.5	1.28	2192.78	0.45	0.48	10.24	24.03	0.12
4965.06	3.5	0.25	2191.5	1.16	2192.66	0.45	0.48	7.73	17.44	0.12
4943.6	4.6	0.25	2191	1.76	2192.36	0.54	0.65	8.58	17.29	0.13
4943.6	3.5	0.25	2191	1.62	2192.22	0.54	0.67	6.42	13.34	0.14
4908.09	4.6	0.25	2190.07	1.66	2191.25	0.81	1.49	5.68	11.68	0.2
4908.09	3.5	0.25	2190.07	1.58	2191.17	0.73	1.19	4.82	9.57	0.18
4871.2	4.6	0.25	2189.43	0.49	2189.92	0.47	0.56	9.81	29.58	0.14
4871.2	3.5	0.25	2189.43	0.42	2189.85	0.45	0.55	7.83	29.4	0.15
4847.25	4.6	0.25	2189.05	0.65	2189.7	0.24	0.13	18.82	38.67	0.06
4847.25	3.5	0.25	2189.05	0.58	2189.63	0.22	0.11	16.15	38.08	0.06
4775.33	4.6	0.25	2188.71	0.61	2189.23	0.34	0.28	13.4	31.99	0.09
4775.33	3.5	0.25	2188.71	0.53	2189.15	0.32	0.25	11.03	31.72	0.09
4646.06	4.6	0.25	2187.16	0.6	2187.76	0.34	0.28	13.69	36.57	0.1
4646.06	3.5	0.25	2187.16	0.55	2187.71	0.29	0.22	11.88	35.19	0.09

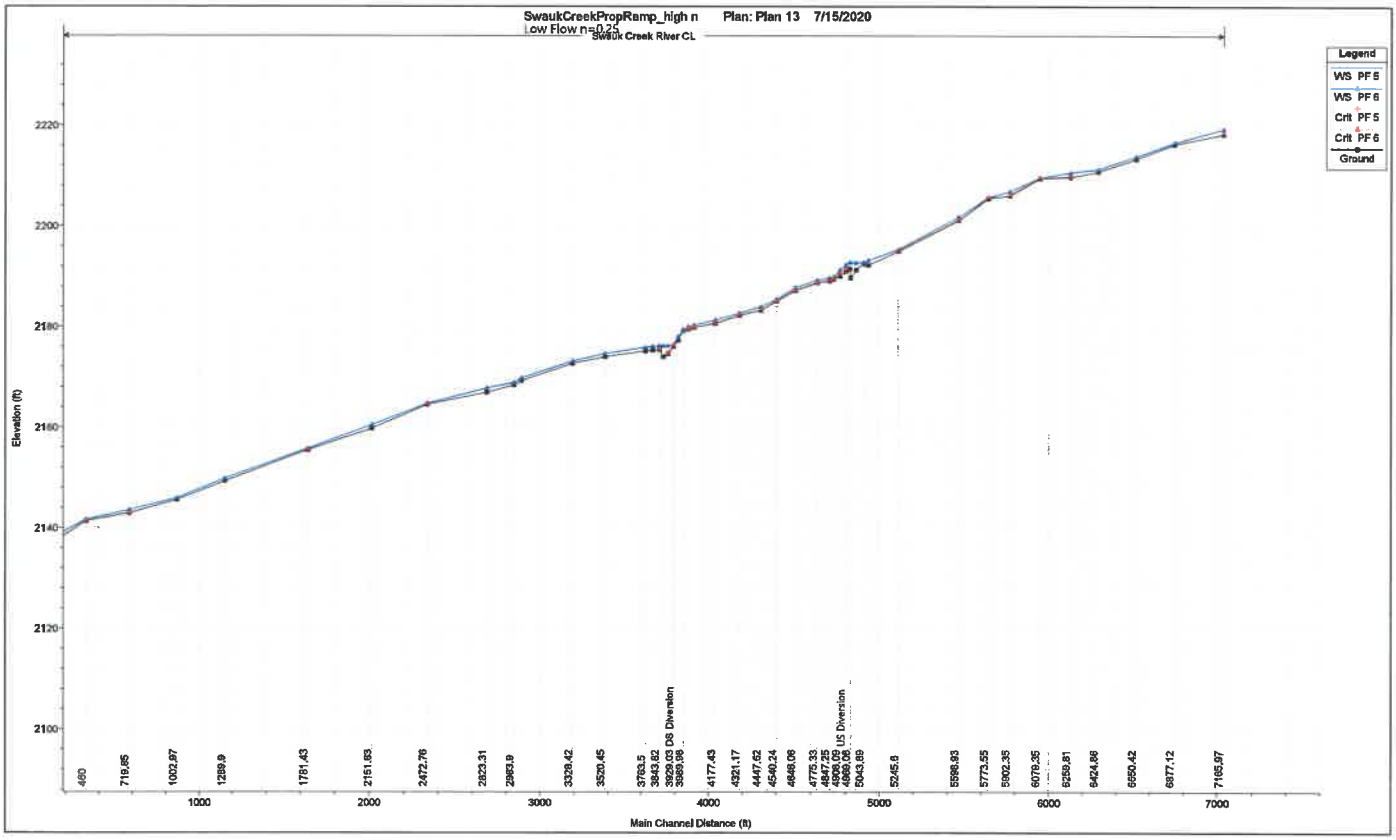
4540.24	4.6	0.25	2185.06	0.36	2185.42	0.57	0.89	8.12	31.29	0.2
4540.24	3.5	0.25	2185.06	0.29	2185.35	0.57	0.97	6.13	29.67	0.22
4447.62	4.6	0.25	2183.23	0.75	2183.99	0.35	0.26	13.21	22.58	0.08
4447.62	3.5	0.25	2183.23	0.68	2183.91	0.31	0.21	11.43	22.33	0.08
4321.17	4.6	0.25	2182.22	0.54	2182.76	0.38	0.35	11.98	29.46	0.11
4321.17	3.5	0.25	2182.22	0.47	2182.69	0.35	0.32	9.86	29.33	0.11
4177.43	4.6	0.25	2180.64	0.71	2181.35	0.35	0.26	13.26	22.91	0.08
4177.43	3.5	0.25	2180.64	0.63	2181.27	0.31	0.21	11.38	22.74	0.08
4050.15	4.6	0.25	2179.81	0.52	2180.33	0.33	0.26	13.82	30.36	0.09
4050.15	3.5	0.25	2179.81	0.44	2180.25	0.3	0.23	11.49	30.16	0.09
4019.45	4.6	0.25	2179.46	0.62	2180.09	0.31	0.22	14.79	29.14	0.08
4019.45	3.5	0.25	2179.46	0.56	2180.02	0.27	0.17	12.91	28.99	0.07
3989.98	4.6	0.25	2179.22	0.19	2179.41	1.23	5	3.74	24.34	0.55
3989.98	3.5	0.25	2179.22	0.15	2179.37	1.25	5.62	2.81	24.11	0.64
3957.3	4.6	0.25	2177.27	0.71	2177.98	0.47	0.49	9.81	18.9	0.11
3957.3	3.5	0.25	2177.27	0.62	2177.9	0.42	0.41	8.31	18.44	0.11
3929.03	4.6	0.25	2176.05	0.39	2176.44	2.48	18.83	1.86	9.7	1
3929.03	3.5	0.25	2176.05	0.35	2176.4	2.42	18.32	1.44	7.92	1
3894.78	4.6	0.25	2174.56	1.72	2176.28	0.18	0.05	26.27	17.51	0.03
3894.78	3.5	0.25	2174.56	1.6	2176.16	0.14	0.03	24.17	17.36	0.02
3866.61	4.6	0.25	2174	2.27	2176.27	0.14	0.03	33.98	19.61	0.02
3866.61	3.5	0.25	2174	2.15	2176.15	0.11	0.02	31.7	19.27	0.02

3843.82	4.6	0.25	2175.35	0.9	2176.25	0.27	0.13	17.22	20.36	0.05
3843.82	3.5	0.25	2175.35	0.79	2176.14	0.23	0.11	14.92	20.11	0.05
3803.77	4.6	0.25	2175.34	0.77	2176.11	0.32	0.21	14.24	21.13	0.07
3803.77	3.5	0.25	2175.34	0.66	2176	0.29	0.18	12.02	20.91	0.07
3763.5	4.6	0.25	2175.12	0.81	2175.93	0.29	0.17	16	23.35	0.06
3763.5	3.5	0.25	2175.12	0.7	2175.82	0.26	0.14	13.53	23.21	0.06
3520.45	4.6	0.25	2174	0.68	2174.68	0.32	0.22	14.55	27.11	0.08
3520.45	3.5	0.25	2174	0.6	2174.6	0.28	0.18	12.46	26.71	0.07
3328.42	4.6	0.25	2172.65	0.58	2173.23	0.35	0.28	13.09	26.09	0.09
3328.42	3.5	0.25	2172.65	0.5	2173.15	0.32	0.25	10.83	25.64	0.09
3027.98	4.6	0.25	2169.26	0.63	2169.89	0.4	0.38	11.49	27.36	0.11
3027.98	3.5	0.25	2169.26	0.57	2169.83	0.35	0.31	9.94	26.84	0.1
2983.9	4.6	0.25	2168.33	0.65	2168.98	0.51	0.66	9.02	26.68	0.15
2983.9	3.5	0.25	2168.33	0.56	2168.89	0.52	0.73	6.71	23.2	0.17
2823.31	4.6	0.25	2166.92	0.94	2167.86	0.24	0.12	18.83	29.07	0.05
2823.31	3.5	0.25	2166.92	0.84	2167.76	0.22	0.1	16.13	28.11	0.05
2472.76	4.6	0.25	2164.51	0.33	2164.84	0.62	1.13	7.46	35.45	0.24
2472.76	3.5	0.25	2164.51	0.28	2164.79	0.62	1.25	5.61	33.85	0.27
2151.63	4.6	0.25	2159.74	0.78	2160.52	0.23	0.13	19.63	48.55	0.06
2151.63	3.5	0.25	2159.74	0.72	2160.46	0.21	0.11	16.59	45.56	0.06
1781.43	4.6	0.25	2155.44	0.4	2155.84	0.59	0.99	7.79	31.89	0.21
1781.43	3.5	0.25	2155.44	0.34	2155.78	0.58	1.02	6.05	30.86	0.23
1289.9	4.6	0.25	2149.26	0.57	2149.83	0.24	0.13	19.24	44.67	0.06

1289.9	3.5	0.25	2149.26	0.51	2149.77	0.21	0.11	16.61	44.36	0.06
1002.97	4.6	0.25	2145.6	0.34	2145.94	0.7	1.45	6.56	30.08	0.26
1002.97	3.5	0.25	2145.6	0.28	2145.88	0.71	1.6	4.93	28.6	0.3
719.85	4.6	0.25	2142.91	0.64	2143.55	0.2	0.09	22.97	45.78	0.05
719.85	3.5	0.25	2142.91	0.57	2143.48	0.18	0.07	19.61	45.08	0.05
460	4.6	0.25	2141.32	0.37	2141.69	0.4	0.5	11.41	60.34	0.16
460	3.5	0.25	2141.32	0.34	2141.66	0.37	0.44	9.48	58.54	0.16
135.22	4.6	0.25	2134.32	1.48	2135.8	0.35	0.28	13.32	76.15	0.09
135.22	3.5	0.25	2134.32	1.4	2135.72	0.32	0.25	10.91	71.62	0.09


SwaukCreek Existing Conditions Plan: Plan 14 7/15/2020
Swauk Creek River CL
Legend
WS PF 1
Crit PF 1
WS PF 3
Crit PF 2
WS PF 2
WS PF 4
Crit PF 3
Crit PF 4
WS PF 5
WS PF 6
Crit PF 5
Crit PF 6
Ground
Elevation (ft)
2240
2220
2200
2180
2160
2140
2120
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)
460
719.95
1002.97
1289.9
1781.43
2151.63
2472.78
2823.31
2983.9
3328.42
3520.45
3763.5
3843.82
3929.03 DS Diversion
3988.98
4050.15
4177.43
4321.17
4447.62
4540.24
4646.06
4775.33
4847.25
4908.09 US Diversion
4987.51
5089.13
5245.6
5598.83
5773.55
5902.35
6079.35
6259.61
6424.86
6650.42
6877.12
7165.97


SwaukCreekProp
Plan: Plan 12 7/15/2020
Swauk Creek River CL
Legend
WS PF 1
Crit PF 1
WS PF 3
Crit PF 2
WS PF 2
WS PF 4
Crit PF 3
Crit PF 4
Ground
Elevation (ft)
2220
2200
2180
2160
2140
2120
480
719.85
1002.97
1289.9
1781.43
2151.63
2472.76
2823.31
2983.9
3328.42
3520.45
3763.5
3843.82
3929.03 DS Diversion
3969.98
4050.15
4177.43
4321.17
4447.62
4540.24
4646.08
4775.33
4847.25
4906.09
4965.05 US Diversion
5043.89
5245.8
5598.93
5773.55
5902.35
6079.35
6259.81
6424.88
6650.42
6877.12
7185.97
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)


SwaukCreekPropRamp_high n Plan: Plan 13 7/15/2020
Low Flow n=0.25
Swauk Creek River CL
Legend
WS PF 5
WS PF 6
Crit PF 5
Crit PF 6
Ground
Elevation (ft)
2220
2200
2180
2160
2140
2120
2100
460
719.85
1002.97
1289.9
1781.43
2151.83
2472.76
2823.31
2963.9
3328.42
3520.45
3763.5
3843.82
3929.03 DS Diversion
3985.98
4177.43
4321.17
4447.62
4540.24
4648.06
4775.33
4847.25
4908.09 US Diversion
4968.06
5043.09
5245.8
5598.93
5773.55
5902.35
6079.35
6259.81
6424.86
6650.42
6877.12
7165.97
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)

Appendix E
Fish Screen Information

The 24" diameter by 6' length modular drum screen has a max diversion amount of ~3.6 cfs.

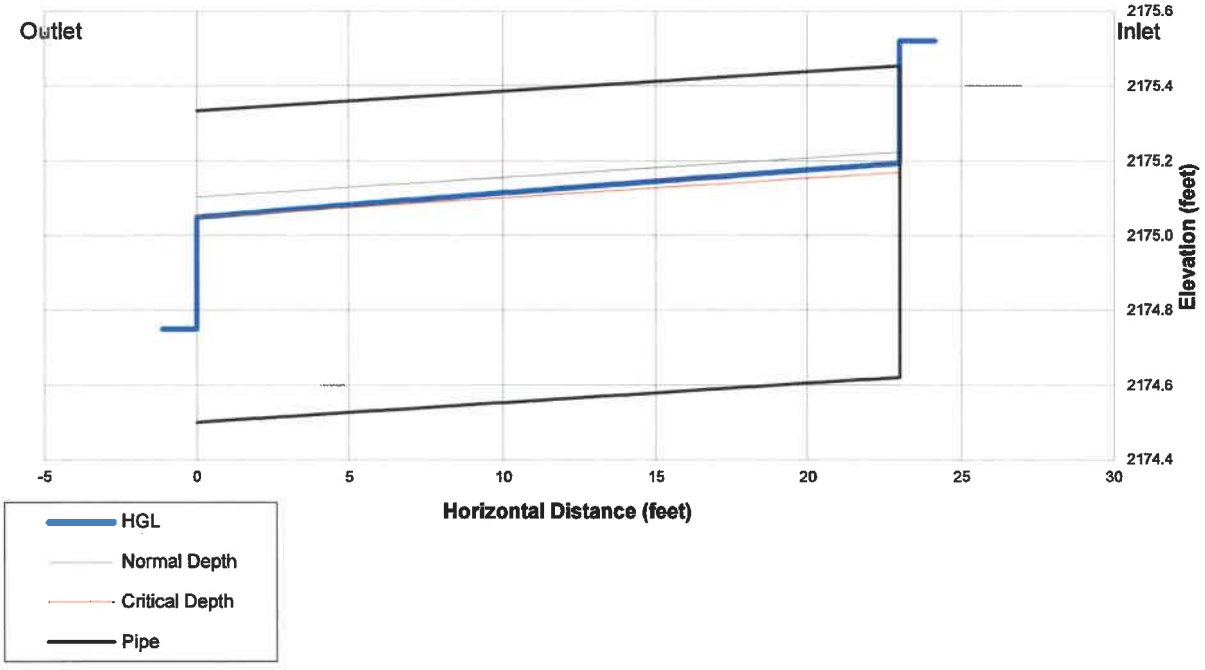
Appendix F
Delivery Pipeline Hydraulic Analysis

Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Burke Road Pipeline, MH #3 to Ditch**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	DITCH	MH #3
Station	28+10	27+87
Rim/Overflow Elev. (ft)	2176.00	2177.10
Invert Elevation (ft)	2174.50	2174.62
Water Surf. Elev. (ft)	2174.75	**2175.52**
Discharge (cfs)	1.50	
Diameter (inches)	10	
Ineffective Depth(ft)	0.00	
Length (feet)	23.0	
Manning n	0.012	
Entrance Vel. (fps)	0.00	
Entrance Loss (Ke)	0.50	
Slope	0.0052	

Normal Depth (ft)	0.60
Critical Depth (ft)	0.55
Froude No.	0.83
Avg. Velocity (fps)	3.83
Min. Velocity (fps)	3.75
Max. Velocity (fps)	3.94
Normal Velocity (fps)	3.55
Crit. Velocity (fps)	3.94
freeboard @ outlet	1.25
freeboard @ inlet	1.58
Normal EGL (ft)	0.80
Hyd.Jump d/s E	0.80

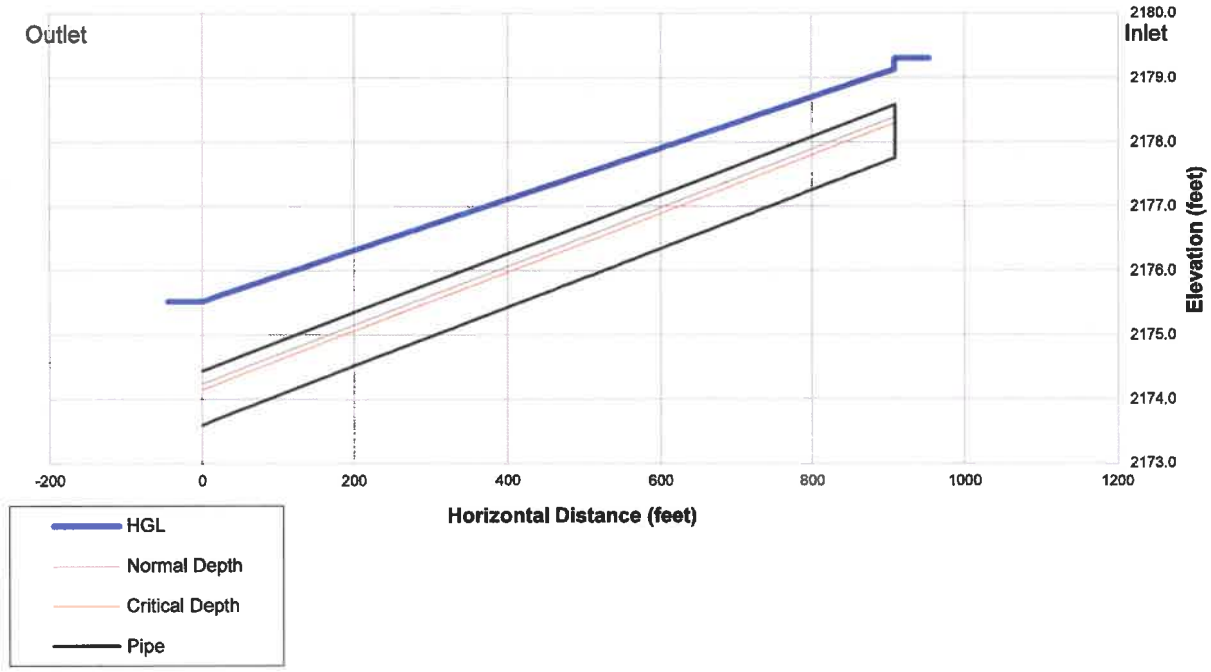


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Burke Road Pipeline, MH #2 to MH #3 (Crosses Swauk Creek)**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	MH #3	MH #2
Station	27+83	18+74
Rim/Overflow Elev. (ft)	2177.10	2181.75
Invert Elevation (ft)	2173.60	2177.75
Water Surf. Elev. (ft)	2175.52	**2179.31**
Discharge (cfs)	1.50	
Diameter (inches)	10	
Ineffective Depth(ft)	0.00	
Length (feet)	909.0	
Manning n	0.012	
Entrance Vel. (fps)	0.00	
Entrance Loss (Ke)	0.50	
Slope	0.0046	

Normal Depth (ft)	0.64
Critical Depth (ft)	0.55
Froude No.	0.74
Avg. Velocity (fps)	2.75
Min. Velocity (fps)	2.75
Max. Velocity (fps)	2.75
Normal Velocity (fps)	3.35
Crit. Velocity (fps)	3.94
freeboard @ outlet	1.58
freeboard @ inlet	2.44
Normal EGL (ft)	0.81
Hyd.Jump d/s E	0.82

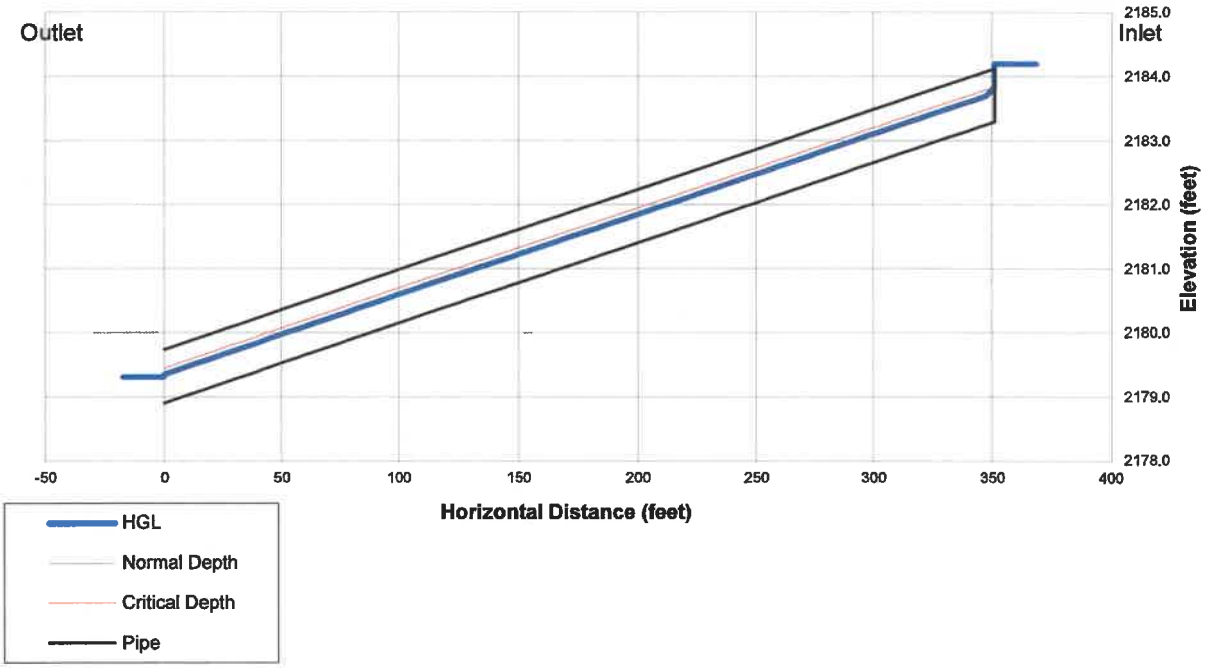


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Burke Road Pipeline, MH #1 to MH #2 (Crosses Swauk Creek)**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	MH #2	MH #1
Station	18+70	15+19
Rim/Overflow Elev. (ft)	2181.75	2185.25
Invert Elevation (ft)	2178.90	2183.29
Water Surf. Elev. (ft)	2179.31	**2184.20**
Discharge (cfs)	1.50	
Diameter (inches)	10	
Ineffective Depth(ft)	0.00	
Length (feet)	351.0	
Manning n	0.012	
Entrance Vel. (fps)	0.00	
Entrance Loss (Ke)	0.50	
Slope	0.0125	

Normal Depth (ft)	0.45
Critical Depth (ft)	0.55
Froude No.	1.48
Avg. Velocity (fps)	5.01
Min. Velocity (fps)	3.94
Max. Velocity (fps)	5.03
Normal Velocity (fps)	5.03
Crit. Velocity (fps)	3.94
freeboard @ outlet	2.44
freeboard @ inlet	1.05
Normal EGL (ft)	0.84
Hyd.Jump d/s E	0.82

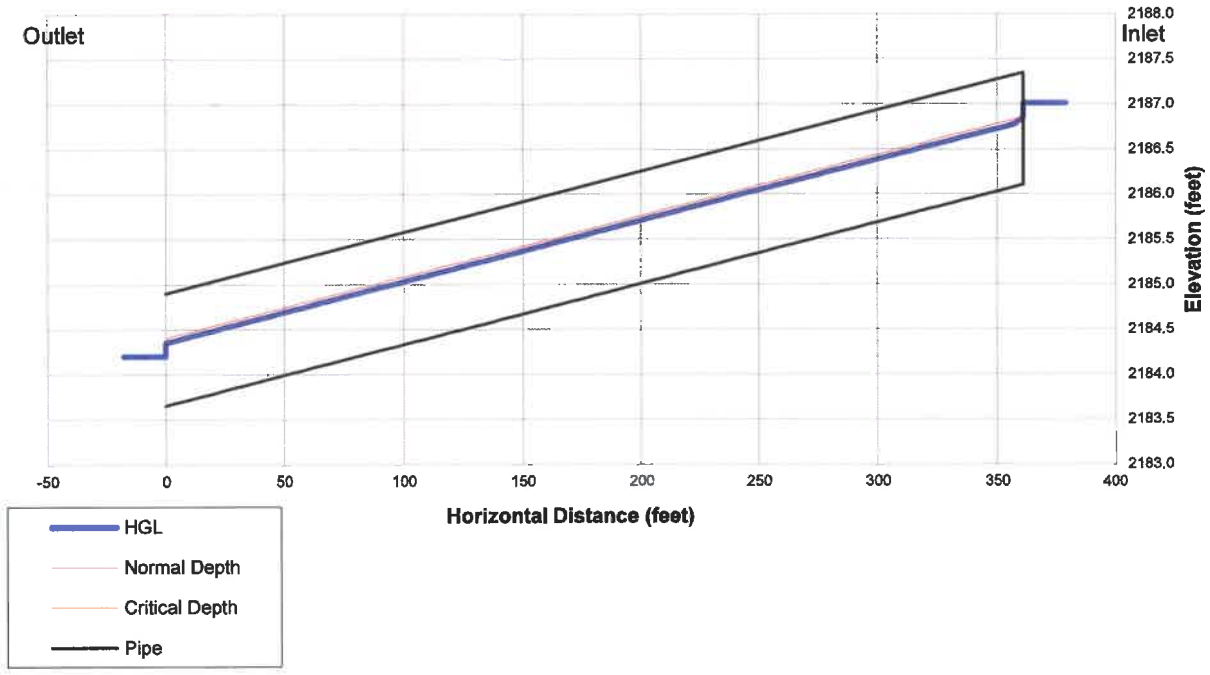


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Main Pipeline, Highway 97 Culvert to MH #1**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	MH #1	D/S CULV
Station	15+15	11+54
Rim/Overflow Elev. (ft)	2185.25	2189.10
Invert Elevation (ft)	2183.65	2186.10
Water Surf. Elev. (ft)	2184.20	**2187.01**
Discharge (cfs)	3.50	
Diameter (inches)	15	
Ineffective Depth(ft)	0.00	
Length (feet)	361.0	
Manning n	0.012	
Entrance Vel. (fps)	4.52	
Entrance Loss (Ke)	0.50	
Slope	0.0068	

Normal Depth (ft)	0.70
Critical Depth (ft)	0.75
Froude No.	1.15
Avg. Velocity (fps)	4.93
Min. Velocity (fps)	4.52
Max. Velocity (fps)	4.93
Normal Velocity (fps)	4.93
Crit. Velocity (fps)	4.52
freeboard @ outlet	1.05
freeboard @ inlet	2.09
Normal EGL (ft)	1.08
Hyd.Jump d/s E	1.08

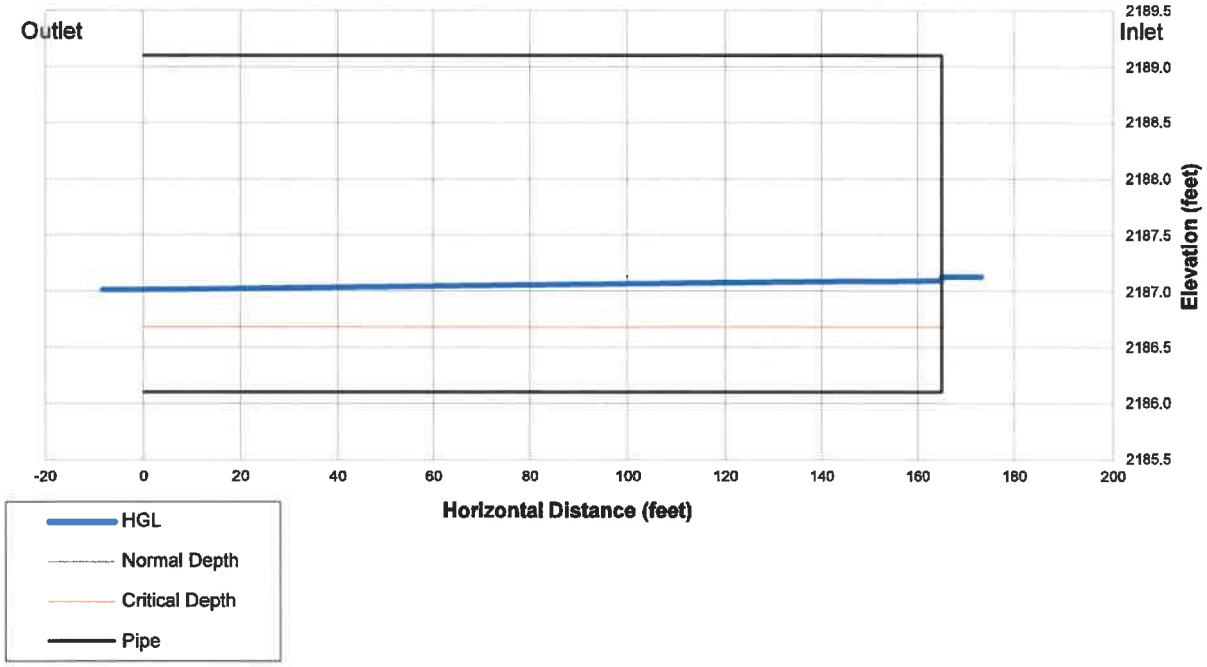


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Main Pipeline, Existing Highway 97 Culvert**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	D/S CULV	U/S CULV
Station	11+54	9+89
Rim/Overflow Elev. (ft)	2189.10	2189.10
Invert Elevation (ft)	2186.10	2186.10
Water Surf. Elev. (ft)	2187.01	**2187.13**
Discharge (cfs)	3.50	
Diameter (inches)	36	
Ineffective Depth(ft)	0.00	
Length (feet)	165.0	
Manning n	0.012	
Entrance Vel. (fps)	0.50	
Entrance Loss (Ke)	0.25	
Slope	0.0000	

Normal Depth (ft)	3.00
Critical Depth (ft)	0.58
Froude No.	1.00
Avg. Velocity (fps)	1.81
Min. Velocity (fps)	1.71
Max. Velocity (fps)	1.92
Normal Velocity (fps)	0.50
Crit. Velocity (fps)	3.62
freeboard @ outlet	2.09
freeboard @ inlet	1.97
Normal EGL (ft)	3.00
Hyd.Jump d/s E	3.00

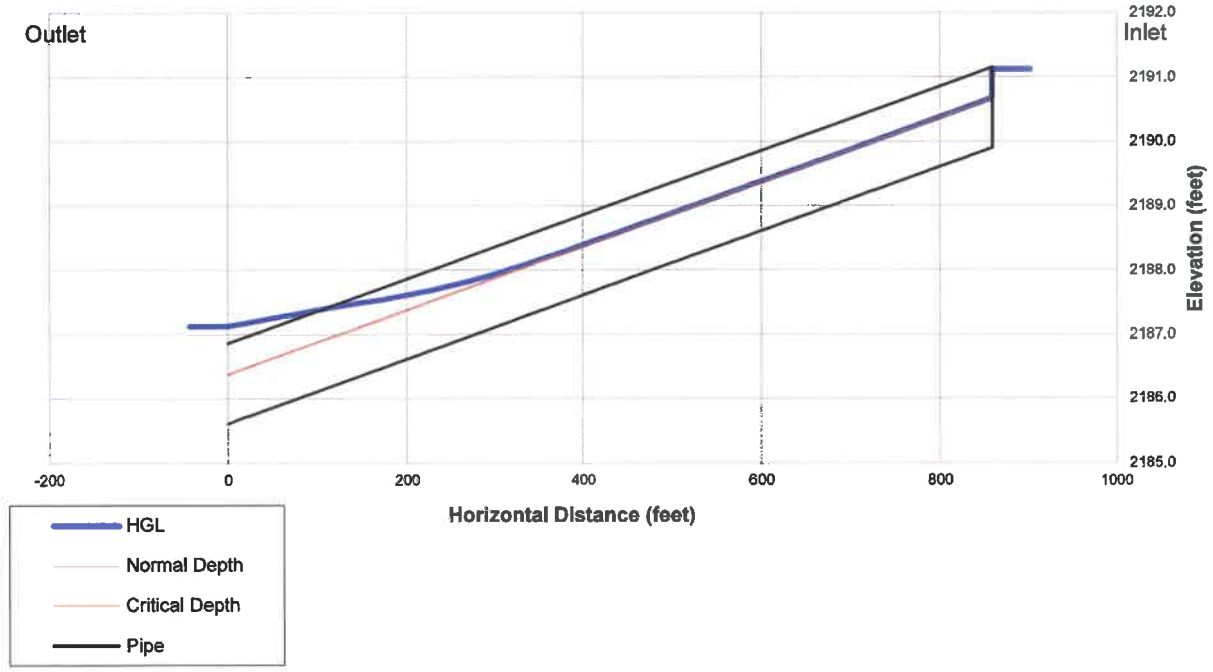


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Main Pipeline, Inlet (D/S of Fish Screen) to Highway 97 Culvert**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	U/S CULV	INLET
Station	9+89	1+30
Rim/Overflow Elev. (ft)	2189.10	2192.40
Invert Elevation (ft)	2185.61	2189.90
Water Surf. Elev. (ft)	2187.13	**2191.12**
Discharge (cfs)	3.50	
Diameter (inches)	15	
Ineffective Depth(ft)	0.00	
Length (feet)	859.0	
Manning n	0.012	
Entrance Vel. (fps)	0.00	
Entrance Loss (Ke)	0.50	
Slope	0.0050	

Normal Depth (ft)	0.77
Critical Depth (ft)	0.75
Froude No.	0.95
Avg. Velocity (fps)	3.94
Min. Velocity (fps)	2.85
Max. Velocity (fps)	4.38
Normal Velocity (fps)	4.38
Crit. Velocity (fps)	4.52
freeboard @ outlet	1.97
freeboard @ inlet	1.28
Normal EGL (ft)	1.07
Hyd.Jump d/s E	1.07

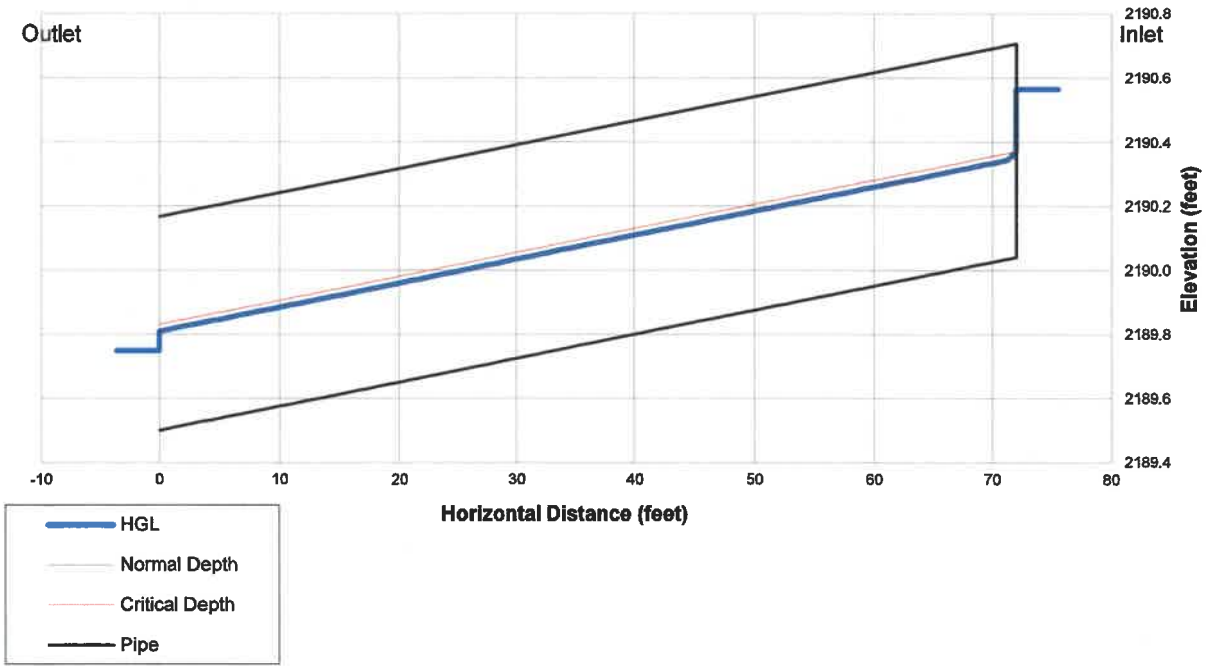


Standard Step Backwater Analysis

System: **The Ranch at Swauk Creek**
Reach: **Fish Bypass Pipeline**
Design Event: **Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

	Outlet	Inlet
Identification	CREEK	FISH SCRN
Station	+72	+
Rim/Overflow Elev. (ft)	2192.36	2192.40
Invert Elevation (ft)	2189.50	2190.04
Water Surf. Elev. (ft)	2189.75	**2190.57**
Discharge (cfs)	0.50	
Diameter (inches)	8	
Ineffective Depth(ft)	0.00	
Length (feet)	72.0	
Manning n	0.012	
Entrance Vel. (fps)	0.00	
Entrance Loss (Ke)	0.50	
Slope	0.0075	

Normal Depth (ft)	0.31
Critical Depth (ft)	0.33
Froude No.	1.14
Avg. Velocity (fps)	3.15
Min. Velocity (fps)	2.89
Max. Velocity (fps)	3.15
Normal Velocity (fps)	3.15
Crit. Velocity (fps)	2.89
freeboard @ outlet	2.61
freeboard @ inlet	1.83
Normal EGL (ft)	0.46
Hyd.Jump d/s E	0.46



Hydraulic Analysis

System:	**The Ranch at Swauk Creek**
Reach:	**Fish Screen Hydraulics**
Design Event:	**Late Summer, Low Creek - 4 cfs Diversion (3.5 cfs to Ranch + 0.5 cfs Bypass)**

BYPASS WEIR FLOW (Weir Gate or Stop Logs):

Weir Elev. (ft)	2191.38	Adjust so that HW WSEL~WSEL US of Screen
Weir Width (in)	12	Adjust so that Discharge~Design Bypass Flow
H (ft)	0.29	Set at minimum required for fish passage
TW WSEL (ft)	**2190.57**	
HW WSEL (ft)	**2191.67**	
Discharge (cfs)	**0.5**	

DIVERSION WEIR FLOW (Over Stop Logs Through Paddle Wheel to Irrigation Pipe):

Weir Elev. (ft)	2190.17	Adjust so that Discharge~Design Flow to Irrigators
Weir Width (in)	12	Requested by Irrigators/USBR
H (ft)	**1.25**	
TW WSEL (ft)	**2191.12**	**WEIR IS BACKWATERED**
HW WSEL (ft)	**2191.42**	
Discharge (cfs)	**3.5**	

SCREEN:

Bottom Elev. (ft)	2190.27	Adjust so that Submergence is >65% and <85%
Diam (ft)	2.0	Per Screen Shop
Top Elev. (ft)	**2192.27**	
Min. WSEL (ft)	**2191.57**	65% Submergence
Max. WSEL (ft)	**2191.97**	85% Submergence
Screen Loss (ft)	0.25	Assumed
WSEL DS of Screen (ft)	**2191.42**	
Channel IE @ Screen (ft)	**2189.90**	

AT FISH SCREEN:

WSEL US of Screen (ft)	2191.67	Set so that WSEL at inlet of Diversion Channel~HEC-RAS Results
Screen Submergence	**70%**	
Flow In (cfs)	**4.0**	
Flow Out (cfs)	**4.0**	

DIVERSION CHANNEL:

Channel Length (ft)	30.00
Ave Bottom Widtch (ft)	2.00
Ave Sideslope (V ft/1 H ft)	1.50
Manning n:	0.03
IE at Screen (ft):	2,189.50
IE at Diversion (ft):	2,189.55
Depth at Screen (ft):	2.17
Flow Rate (cfs):	**4.0**
Depth, d (ft):	2.17
Flow Area, A (sf):	11.40
Wetted Perimeter, P (ft):	9.82
Hydraulic Radius, R (ft):	1.16
Velocity, V (fps):	0.35
Chanel Slope, $S_{o\ (ft)}$:	0.00167
Energy Slope, S_f (ft/ft):	0.00004
Velocity Head, $V^2/2g$ (ft):	0.00019
Estimated Headloss:	0.00121

Min. WSEL at Creek (feet): 2,191.67 This is what we need the roughened channel to produce at the creek to make this work.

Appendix G
Opinion of Probable Construction Cost

Kittitas County Conservation District 9/17/2020
The Ranch at Swauk Creek Diversion Improvement and Restoration Project
Opinion of Probable Construction Cost - 90% Design

Bid Item	Description	Specificaiton	Quantity	Unit	Unit Cost	Cost
Division 1 - General Requirements						
1	Mobilization/Demobilization (7.5%)	017113	1	LS	$24,825	$26,700
2	Traffic Control	015526	1	LS	$5,000	$5,000
3	Locate and Protect Existing Utilities	015615	1	LS	$1,000	$1,000
4	Temporary Erosion and Sediment Control	015713	1	LS	$15,000	$15,000
Subtotal - General Requirements						***$48,000***
Division 2 - Existing Conditions						
5	Construction Surveying	022100	1	LS	$12,000	$12,000
6	Removal of Structures and Obstructions	024100	1	LS	$3,500	$3,500
7	Plug Pipe and Decomission Diversion at RM 7.71	024100	1	LS	$2,500	$2,500
Subtotal - General Requirements						***$18,000***
Division 31 - Earthwork						
8	Clearing and Grubbing	311100	1.1	AC	$5,000	$5,500
9	Channel Excavation - River Mile (RM) 7.92	312300	1	LS	$10,000	$10,000
10	Channel Excavation - RM 7.71 (Option A Bid Item)	312300	1	LS	$5,000	$5,000
11	Excavation for Fish Screen Replacement	312300	1	LS	$400	$400
12	Structural Backfill for Fish Screen Replacement	312300	4.4	TN	$35	$154
13	Assistance with Fish Screen Installation	312300	1	LS	$7,000	$7,000
14	Installation of Transducer for Diversion Metering	312300	1	LS	$3,000	$3,000
15	Trench Excavation - Fish Bypass Pipeline	312300	1	LS	$300	$300
16	Pipe Bedding - Fish Bypass Pipeline	312300	11	CY	$44	$484
17	Select Backfill - Fish Bypass Pipeline	312300	7	CY	$44	$308
18	Final Backfill - Fish Bypass Pipeline	312300	1	LS	$200	$200
19	Trench Excavation - Irrigation Pipeline West of Highway 97	312300	1	LS	$4,000	$4,000
20	Pipe Bedding - Irrigation Pipeline West of Highway 97	312300	291	CY	$44	$12,804
21	Select Backfill - Irrigation Pipeline West of Highway 97	312300	188	CY	$44	$8,272
22	Final Backfill - Irrigation Pipeline West of Highway 97	312300	1	LS	$4,200	$4,200

Kittitas County Conservation District 9/17/2020
The Ranch at Swauk Creek Diversion Improvement and Restoration Project
Opinion of Probable Construction Cost - 90% Design

Bid Item	Description	Specificaiton	Quantity	Unit	Unit Cost	Cost
23	Controlled-Density Fill (CDF) Backfill - Irrigation Pipe West of Highway 97	312300	1.3	CY	$250	$325
24	Trench Excavation - Irrigation Pipeline East of Highway 97 (Option B Bid Item)	312300	1	LS	$1,000	$1,000
25	Pipe Bedding - Irrigation Pipeline East of Highway 97 (Option B Bid Item)	312300	227	CY	$44	$9,988
26	Select Backfill - Irrigation Pipeline East of Highway 97 (Option B Bid Item)	312300	154	CY	$44	$6,776
27	Final Backfill - Irrigation Pipeline East of Highway 97 (Option B Bid Item)	312300	1	LS	$2,900	$2,900
28	CDF Backfill - Irrigation Pipe East of Highway 97 (Option B Bid Item)	312300	1.3	CY	$250	$325
29	Diversion and Care of Water	312320	1	LS	$24,850	$24,850
30	Geomembrane Liner	313220	100	SY	$15	$1,500
31	Excavation Support and Protection	315000	1	LS	$3,000	$3,000
Subtotal - Earthwork (Base Bid)						***$86,000***
Subtotal - Earthwork (Option A Bid Items)						***$5,000***
Subtotal - Earthwork (Option B Bid Items)						***$21,000***
Subtotal - Earthwork (Base Bid and All Optional Bid Items)						***$112,000***
Division 32 - Exterior Improvements						
32	Crushed Surfacing Base Course	321123	133	TN	$35	$4,655
33	Asphalt Paving	321216	5	TN	$150	$750
34	Imported Gravel-Cobble Mix - RM 7.92	325000	190	TN	$75	$14,250
35	Place Native Gravel-Cobble Mix - RM 7.92	325000	1	LS	$9,500	$9,500
36	Place Imported Streambed Boulders - RM 7.92	325000	91	TN	$125	$11,375
37	Remove and Rework Native Streabed Boulders - RM 7.92	325000	1	LS	$2,400	$2,400
38	Place Native Gravel-Cobble Mix - RM 7.71 (Option A Bid Item)	325000	1	LS	$2,900	$2,900
39	Remove and Rework Native Streabed Boulders - RM 7.71 (Option A Bid Item)	325000	1	LS	$4,000	$4,000
40	Cottonwood Copse Planting (Option C Bid Item)	329000	3.5	AC	$3,000	$10,500
41	Streambank Revegetation - RM 7.92	329219	0.1	AC	$10,000	$1,000
42	Streambank Revegetation - RM 7.71 (Option A Bid Item)	329219	0.1	AC	$10,000	$1,000
43	Hydroseeding	329219	0.8	AC	$3,000	$2,400
Subtotal - Exterior Improvements (Base Bid)						***$46,000***
Subtotal - Exterior Improvements (Option A Bid Items)						***$8,000***
Subtotal - Exterior Improvements (Option C Bid Items)						***$11,000***
Subtotal - Exterior Improvements (Base Bid and All Optional Bid Items)						***$65,000***

Kittitas County Conservation District 9/17/2020
The Ranch at Swauk Creek Diversion Improvement and Restoration Project
Opinion of Probable Construction Cost - 90% Design

Bid Item	Description	Specificaiton	Quantity	Unit	Unit Cost	Cost
Division 33 - Utilities						
44	15-inch Corrugated Polyehtylene (CPE) Irrigation Pipe - West of Highway 97	331115	364	LF	$35	$12,740
45	12-inch CPE Irrigation Pipe - West of Highway 97	331115	36	LF	$25	$900
46	10-inch CPE Irrigation Pipe - West of Highway 97	331115	340	LF	$20	$6,800
47	15-inch CPE Irrigaiton Pipe - East of Highway 97 (Option B Bid Item)	331115	877	LF	$35	$30,695
48	8-inch HDPE DR 32.5 Pipe for Fish Bypass	331117	72	LF	$15	$1,080
49	10-inch HDPE DR 32.5 Irrigation Pipe	331117	919	LF	$22	$20,218
50	Hang 10-inch HDPE Pipe on County Bridge	331117	1	LS	$4,000	$4,000
51	48-inch Pre-cast Concrete Manhole	331215	2	EA	$3,500	$7,000
52	Drain Valve Assembly	331217	2	EA	$1,500	$3,000
53	Canal Gate	331218	1	EA	$1,500	$1,500
Subtotal - Utilities (Base Bid)						***$57,000***
Subtotal - Utilities (Option B Bid Items)						***$31,000***
Subtotal - Utilities (Base Bid and All Optional Bid Items)						***$88,000***

TOTALS - BASE BID ITEMS			
Construction Subtotal			**$255,000**
Sales Tax	8.0%		$20,400
Construction Subtotal			**$275,000**
Construction Contingency	10.0%		$27,500
Construction Subtotal			**$303,000**

TOTALS - OPTION A BID ITEMS (CHANNEL RESTORATION AT RM 7.71)			
Construction Subtotal			**$13,000**
Sales Tax	8.0%		$1,040
Construction Subtotal			**$14,000**
Construction Contingency	10.0%		$1,400
Construction Subtotal			**$15,000**

Kittitas County Conservation District 9/17/2020
The Ranch at Swauk Creek Diversion Improvement and Restoration Project
Opinion of Probable Construction Cost - 90% Design

Bid Item	Description	Specificaiton	Quantity	Unit	Unit Cost	Cost
TOTALS - OPTION B BID ITEMS (IRRIGATION PIPELINE EAST OF HIGHWAY 97)						
Construction Subtotal						**$52,000**
	Sales Tax		8.0%			$4,160
Construction Subtotal						**$56,000**
	Construction Contingency		10.0%			$5,600
Construction Subtotal						**$62,000**
TOTALS - OPTION C BID ITEMS (COTTONWOOD COPSE PLANTING)						
Construction Subtotal						**$11,000**
	Sales Tax		8.0%			$880
Construction Subtotal						**$12,000**
	Construction Contingency		10.0%			$1,200
Construction Subtotal						**$13,000**
TOTALS - BASE BID AND ALL OPTIONAL BID ITEMS						
Construction Subtotal						**$331,000**
	Sales Tax		8.0%			$26,480
Construction Subtotal						**$357,000**
	Construction Contingency		10.0%			$35,700
Construction Subtotal						**$393,000**

Notes:
1) Subtotals and totals are rounded to the nearest $1,000.
2) Costs are in 2020 dollars. Actual construction costs may vary based on materials and labor costs at time of bidding.