

E. NEW BUSINESS

3. Conditional Use Permit; PC Resolution 2026-27

Applicant: Tyonek Native Corporation

**Request: Removal of two culverts and replacing them with a 50'
X 14' bridge within the HPD of Tyonek Creek**

KPB Parcel ID # 21115043

Tyonek Area

Multi-Agency Permit Application

Kenai Peninsula Borough

River Center

514 Funny River Road
 Soldotna, Alaska 99669
 KenaiRivCenter@kpb.us

Phone: (907) 714-2460
 Fax: (907) 260-5992

Fees Received: \$ _____

Cash

Check # _____

CREDIT CARDS NOT ACCEPTED
FOR APPLN FEES

PROPERTY OWNER:

Name: Laurie Stuart

Mailing: 101 W Benson Blvd
Anchorage, AK, 99503

Phone: 907-278-1021

Email: lstuart@ttcd.org

AGENT: (if applicable)

Name: Irene Turletes

Mailing: _____

Phone: 907-644-2099

Email: irene.turletes@hdrinc.com

PROJECT LOCATION:

KPB Parcel ID: 21115043

Physical Address: NA

Subdivision: _____

Lot: _____ Block: _____ Addition/No.: _____

WATERBODY INFORMATION:

Waterbody: Tyonek Creek

River Mile: ~8

Riverbank: Left Right *(looking downstream)*

PERMIT FEES: \$50 - Staff Permit **OR** \$300 - Conditional Use or Floodway Analysis

PROJECT: New Project **OR** Extension/Amendment to **RC#** _____

Please select all activities that apply to your project:

- | | | |
|---|--|--|
| <input type="checkbox"/> Bank Stabilization | <input checked="" type="checkbox"/> Fish & Wildlife Management | <input checked="" type="checkbox"/> Road Construction |
| <input type="checkbox"/> Boat Launch | <input type="checkbox"/> Floating Dock | <input type="checkbox"/> Structure (Accessory) |
| <input checked="" type="checkbox"/> Bridge | <input type="checkbox"/> Fuel Storage Green Infrastructure | <input type="checkbox"/> Structure (Residential) |
| <input checked="" type="checkbox"/> Coir Logs | <input type="checkbox"/> In-Stream Structures (Weir) | <input type="checkbox"/> Spruce Tree Revetment |
| <input checked="" type="checkbox"/> Culvert | <input type="checkbox"/> Oil & Gas | <input checked="" type="checkbox"/> Stream Crossing |
| <input type="checkbox"/> ELP Structures | <input type="checkbox"/> On-Site Utilities | <input type="checkbox"/> Utility Line/Easement |
| <input checked="" type="checkbox"/> Equipment Stream Crossing | <input checked="" type="checkbox"/> Prior-Existing Structure | <input checked="" type="checkbox"/> Veg Mat |
| <input checked="" type="checkbox"/> Excavation, Dredging, and/or Fill | <input checked="" type="checkbox"/> Revegetation | <input checked="" type="checkbox"/> Vegetation Removal |
| <input type="checkbox"/> Fence Installation | <input type="checkbox"/> Root Wads | <input type="checkbox"/> Water Withdrawal |
| | | <input type="checkbox"/> Other: _____ |

PROJECT DESCRIPTION: *Provide a detailed description of your project, attach additional pages if necessary.*

Please see attached project description document. This project will remove two existing culverts on upper Tyonek Creek and replace them with a bridge structure.

COST-SHARE: Is this project funded by the ADFG-USFWS Cost-Share Program? Yes No

KPB TAX CREDIT PROGRAM: KPB provides a tax credit as partial reimbursement for new habitat protection and restoration projects within 150 feet of anadromous streams. If you would like to pre-qualify for this credit, please provide your estimated project cost(s) below. Do not include grants or other funding assistance:

Elevated Light-Penetrating Structures \$ _____ Other Activities \$ _____

Habitat Restoration & Protection \$ _____ Green Infrastructure \$ _____

PROJECT QUESTIONS:

- 1. Start date: May 1, 2026 End date: September 31, 2026 Estimated Days of Construction: 90
- 2. Is any portion of the work already complete? If yes, please describe: _____ Yes No
- 3. Is your project located on land or waters of an Alaska State Park? Yes No

If yes, you must fill out an Alaska State Parks application at: dnr.alaska.gov/parks/permit

Ordinary High Water (OHW) and Mean High Water (MHW):

- 4. Is the project located within 50 feet of OHW or MHW a waterbody? Yes No
- 5. Does any portion of the project extend below the OHW or MHW of the waterbody? Yes No
- 6. Does any portion of the project cantilever or extend over the MHW of the waterbody? Yes No
- 7. Will anything be placed below OHW or MHW of the waterbody? Yes No

Regulatory Floodplains:

- 8. Is the property where the project is taking place near or within a regulatory floodplain? Yes No
 - a. Is this project within or adjacent to a regulatory floodway? Yes No
 - b. Is this project within or adjacent to a coastal high hazard zone? Yes No
 - c. For new buildings and/or additions, list all project costs (labor, materials, etc.): \$ _____

Excavation, Dredging, and Fill:

- 9. Will material be excavated or dredged from the site? Yes No
 - a. Type of material(s): See attached project description.
 - b. Area to be dredged below OHW or MHW:
Length: _____ (ft) Width: _____ (ft) Depth: _____ (ft) Total Cubic Yards: _____
 - c. Area to be excavated above OHW or MHW:
Length: _____ (ft) Width: _____ (ft) Depth: _____ (ft) Total Cubic Yards: _____
 - d. Location materials will be deposited: _____
- 10. Will any material (including soils, debris, and/or overburden) be used as fill? Yes No
 - a. Type of material(s): See attached project description.
 - b. Is this fill permanent or temporary? Permanent Temporary
 - c. Area to be filled above OHW or MHW:
Length: _____ (ft) Width: _____ (ft) Depth: _____ (ft) Total Cubic Yards: _____
 - d. Area to be filled below OHW or MHW:
Length: _____ (ft) Width: _____ (ft) Depth: _____ (ft) Total Cubic Yards: 145

Motorized Equipment:

- 11. Will you be using motorized equipment for this project? If yes, please list all equipment: Yes No
Trackhoe, backhoe, dump trucks
- a. Will you be crossing a stream or waterbody? Yes No
- b. How long will equipment be used below OHW or MHW? May 15-July 15

SIGNATURE & CERTIFICATION:

This application is hereby made requesting permit(s) to authorize the work described in this application form. I certify the information in this application is complete and accurate to the best of my knowledge and that my site plans or drawings are attached. If applying for a tax credit, I certify that I have not begun construction of the project and that the project will be constructed to the standards in KPB 5.12 Real Property and Personal Property Taxes, KPB 5.14 Habitat Protection Tax Credit, and other applicable federal, state, and local regulations.

Laurie K. Stuart Digitally signed by Laurie K. Stuart
Date: 2026.03.24 10:32:23 -08'00'

03/24/2026

Owner Signature (required)

Date

Agent Signature (if applicable)

Date



Project Description

To Support Permit Applications

Upper Tyonek Creek Fish Passage Crossing Replacement

Tyonek Creek (ADF&G #20601534)

Near Tyonek, Alaska

Tyonek Tribal Conservation District
101 W Benson Ave,
Anchorage, AK 99503

March 16, 2026



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Acronyms and Abbreviations

ADF&G	Alaska Department of Fish and Game
CMP	corrugated metal pipe
FPID	Fish Passage Inventory Database
ft	foot/feet
H&H	hydrology and hydraulics
HDR	HDR Engineering, Inc.
KPB	Kenai Peninsula Borough
NRCS	Natural Resources Conservation Service
OHW	ordinary high water
TBC	The Boutet Company
Tyonek	Native Village of Tyonek
TTCD	Tyonek Tribal Conservation District
USGS	U.S. Geological Survey

1 Introduction

The Tyonek Tribal Conservation District (TTCD) assists several communities along the northwest side of Cook Inlet with community-led conservation efforts, including the Native Village of Tyonek (Tyonek). The Alaska Department of Fish and Game (ADF&G) has designated several roadway stream crossings as fish passage barriers of varying severity around Tyonek. TTCD has been working systematically to improve fish passage and aquatic connectivity throughout the watersheds surrounding Tyonek. TTCD has secured funding through the U.S. Fish and Wildlife Service (USFWS) to replace one of these roadway crossings on Tyonek Creek (Fish Passage Inventory Database [FPID] #20601534). The upper Tyonek Creek fish passage replacement project aims to improve flood capacity, reconnect aquatic habitat, and improve fish passage.

The Boutet Company, Inc. (TBC), with the assistance of HDR Engineering, Inc. (HDR), has been contracted to design the proposed roadway improvements and culvert replacement at the site. HDR completed a Final Hydrology & Hydraulics (H&H) Report for the project in February 2026 (HDR 2026; Appendix A) and TBC completed 95% design specifications in January 2026 (TBC 2026; Appendix B).

This document is intended to support the following permit applications: US Army Corps of Engineers 404 Nationwide Permit, Kenai River Center Multi-Agency Permit, Alaska Department of Fish and Game (ADF&G) Fish Habitat Permit, and Alaska Department of Natural Resources (ADNR) Temporary Water Use Permit.

2 Proposed Project

2.1 Project Purpose

The purpose of this project is to replace an existing culvert battery (FPID# 20601534) to improve fish passage through the stream crossing (Figure 1). The existing crossing consists of two, approximately 9-foot diameter corrugated metal pipes (CMPs) that convey Tyonek Creek under an unnamed road flowing from northwest to southeast. The existing gravel road is approximately 24 feet wide and located just north of an old airstrip (oil and gas exploration). It receives moderate use providing subsistence, recreation, and oil and gas exploration access. This site was surveyed by Alaska Department of Fish and Game (ADF&G) in 2002 and 2016. During the 2016 ADF&G site visit, the north culvert was noted to be blocked by a beaver dam (ADF&G 2025). ADF&G gave this crossing a green rating, indicating it was likely to provide adequate juvenile fish passage, and has not reevaluated the crossing since. The proposed designs for the replacement of the culverts include a bridge crossing design that would meet the USFWS fish passage design guidelines (TBC 2026, USFWS 2025).

2.2 Location

Tyonek resides on the northwest side of Cook Inlet, across from the Kenai Peninsula, and immediately south of the community of Beluga (Figure 1). The site is located on an unnamed road just north of an old airstrip east of Tyonek. The project site resides within the Kenai Peninsula Borough (KPB), and the Tyonek Native Corporation owns the land, crossing and roadway.

The project is located within the KPB in Township 11 North, Range 12 West, Section 1, Seward Meridian and is located within U.S. Geological Survey Tyonek A-4 Quadrangle. Latitude and longitude (North American Datum 1983) of the crossing location is 61.06517°/-151.32443° (Figure 1, Figure 2).

Access is by charter plane from Anchorage to Tyonek (approximately 45 air-miles southwest of Anchorage), then by vehicle on Airport Road (gravel) traveling west for approximately 6 miles. The crossing is located approximately 500 feet southeast of the intersection of Airport Road and Tyonek Timber Road.

Approximately 3 river miles downstream of the site, Tyonek Creek crosses Tyonek-Beluga Road through a 16.5-foot by 9.9-foot structural steel plate pipe arch (FPID #20601542), installed in July 2014. Another 4.5 river miles further downstream, Tyonek Creek crosses Tyonek Timber Road through a 45-foot 10-inch wide by 22-foot 11-inch tall structural steel plate pipe arch (FPID #20601540), installed in September 2024. Tyonek Creek then flows into Cook Inlet just north of Beshta Bay 0.4 river miles further downstream.

2.3 Existing Conditions

The existing crossing consists of two, approximately 9-foot diameter corrugated metal pipes (CMPs) that convey Tyonek Creek under an unnamed road flowing from northwest to southeast. The existing gravel road is approximately 24 feet wide and located just north of an old airstrip (oil and gas exploration). It receives moderate use providing subsistence, recreation, and oil and gas exploration access. This site (FPID #20601534) was surveyed by Alaska Department of Fish and Game (ADF&G) in 2002 and 2016. During the 2016 ADF&G site visit, the north culvert was noted to be blocked by a beaver dam (ADF&G 2024). ADF&G gave this crossing a green rating, indicating it was likely to provide adequate juvenile fish passage, and has not reevaluated the crossing since.

During the 2022 HDR/TBC site visit, the beaver dam was not encountered, and no obstructions were seen in either culvert. The north culvert had an approximate width of 9.3 feet, rise of 7.0 feet, slope of -0.32 percent, and length of 60.0 feet. The south culvert had an approximate width of 9.0 feet, rise of 7.1 feet, slope of -0.08 percent, and length of 60.0 feet. The culverts were not embedded and appeared to be in fair condition with a slight perch at the inlets that may create a juvenile fish barrier at low flows. The existing gravel roadway varied in width from 9 to 12 feet. The upstream and downstream side slopes of the roadway embankment were eroding with geotextile stabilization fabric visible.

2.4 Existing Site Summary

ADF&G's 2016 site visit information is summarized in Table 1. From the 2022 HDR/TBC site visit, existing culvert information is provided in Table 2. Additional information can be found in the Hydrology and Hydraulics report (Attachment A).



Table 1. General Site Information

Site	Road	Stream	ADF&G FPID	ADF&G Fish Passage Classification	Latitude Longitude
Upper Tyonek Creek Crossing	Unnamed Road	Tyonek Creek	20601534	Green: likely to provide adequate juvenile fish passage	61.07681°, -151.31593°

Notes: ADF&G = Alaska Department of Fish and Game; FPID = Fish Passage Inventory Database; ° = degree(s).

Table 2. Existing Culverts

Culvert	Span (ft)	Rise (ft)	Type	Material	Slope (%)	Length (ft)
North Barrel	9.3	7.0	Round, Corrugated	Steel	-0.32	60.0
South Barrel	9.0	7.1	Round, Corrugated	Steel	-0.08	60.0

Notes: ft = foot/feet; % = percent.

2.5 Project Construction Schedule and Details

The replacement of the culvert battery on upper Tyonek Creek with the proposed bridge design is anticipated to occur during the 2026 construction season. Clearing and grubbing will occur prior to May 1. The in-water work will be completed in early summer to place bridge abutments, reconstruct the stream channel, and place the bridge structure on the abutments. All work below the OHW of the stream will be completed between May 1 and July 15 or as stipulated by the ADF&G Fish Habitat Permit. The total area of disturbance for the project is 0.5 acres.

Construction for the project generally includes the following components:

- Clearing and grubbing of the work area (limits of disturbance).
 - USFWS recommends projects avoid clearing vegetation from May 1 to July 15 to protect nesting migratory birds (USFWS 2009). The project will perform clearing and grubbing prior to May 1. Clearing and grubbing will be limited to the limits of disturbance, minimizing impacts to the stream banks and surrounding area.
- Installation of temporary diversion/dewatering methods to route flows around/through the work area in order to conduct work in-the-dry.
 - A diversion channel will be created to divert water during construction. Water will be diverted into the diversion channel using a supersack cofferdam. Pumps may be used to move additional water out of the construction area if necessary. Pump specifications are not currently known. However, the pump will be screened with < 0.25 inch mesh and follow additional guidance outlined in the project’s ADF&G Fish Habitat Permit.
- Excavation and removal of the two existing culverts and existing bedding/backfill material.

- Excavation and construction of the new stream channel, realigning the stream into the new stream bed.
- Back fill the diversion channel and construct the new road embankment.
- Prepare the abutments and place bridge structure.
- Streambank reconstruction and stabilization up-and down-stream of the bridge location based on surveyed reference reaches (HDR 2024), and site rehabilitation activities. Bank reconstruction may include the use of coir logs, brush layering, and vegetative mat. 2 saplings 1.5' to 2' tall will be planted for any tree that was cut down for construction activities per KPB permit requirements.

3 Wetlands and other Waters of the U.S.

HDR Professional Wetland Scientists prepared web-based wetland and waterbody mapping for the limits of disturbance for the upper Tyonek Creek culvert replacement project. Mapping was based on publicly available data sources. Scientists reviewed the following datasets in a Geographic Information System (GIS) to delineate wetlands and waterbodies at the location of construction.

- Hillshade and 2-foot contours derived from high-resolution LiDAR data
- Alaska High Resolution Imagery
- KPB Imagery
- Esri World Wayback Imagery digital archive of high-resolution satellite and aerial imagery at 1-meter resolution or better
- USFWS National Wetlands Inventory (NWI) mapping
- ADF&G's Freshwater Fish Inventory (2025) and Anadromous Waters Catalog
- U.S. Geological Survey (USGS) National Hydrography Dataset

Waterbodies were delineated at an approximate scale of 1:400 and vegetation boundaries at an approximate scale of 1:1,200. Wetland mapping included the following methods:

- Vegetation clues: Examination of aerial photographs for saturation-adapted vegetation communities, indicative canopy structure and height, and hydrophytic plant species.
- Evidence of soil saturation: A site's proximity to streams, open water habitat, and marshes can be indicative of shallow subsurface water. Scientists therefore look for visible evidence of wetland hydrology, including surface water and darker areas of photographs that indicate surface saturation.
- Topography: Evidence of high points and sloped surfaces that would allow soils to drain supports the classification of those areas as upland. Topographic depressions, toes of slopes, and flat topography serve as indicators of potentially poor soil drainage.

Mapped polygons identifying homogenous wetland and waterbody areas were attributed with NWI mapping codes based on the USFWS's Classification of Wetlands and Deepwater Habitats of the U.S. (Cowardin et al. 1979). Mapped wetland polygons were also assigned a hydrogeomorphic class based on hydrologic and topographic positions (Brinson 1993).

Wetland scientists identified 0.28 acre of wetlands within the Project limits (Figure 2). Wetland types identified include palustrine aquatic bed, palustrine emergent, palustrine forested, and palustrine scrub shrub. The remaining 0.26 acre (49 percent) of the study area was determined to be upland.

Because this project is working in and around a stream, avoidance of all jurisdictional WOTUS is not possible. Fill will need to be placed to construct abutments and to restore the stream channel and banks. Design indicated that approximately 145 cubic yards of permanent fill in WOTUS will be necessary for construction of the new structure and stream channel. Fill will consist of rip rap, abutment bedding, and streambed material. The anticipated acreage of fill discharge into WOTUS is 0.28 acre. TTCD requests authorization to place fill in up to 0.28 acre of WOTUS for the construction of the upper Tyonek Creek bridge to replace the existing culverts.

4 Fish and Essential Fish Habitat

Tyonek Creek (247-20-10040) is nominated in the Anadromous Waters Catalog for coho salmon (rearing and presence) and pink salmon (spawning) (Geifer and Evers 2025). Additionally, slimy sculpin are a common resident fish in southcentral Alaska and are likely present in Tyonek Creek as well. TTCD is requesting authorization to perform in-water work in upper Tyonek Creek from May 15 to July 15 from ADF&G. By following FHP stipulations and timing windows as identified by ADF&G, significant impacts to fish and essential fish habitat will be avoided. During the diversion installation process and dewatering of the work area, any fish remaining within the work area will be captured using either minnow traps, dip nets, or potentially seine nets, and moved outside of the work area. Fish will be identified and released downstream of the work area.

The USFWS – Alaska’s Fish Passage Program Design Guidelines and the KPB Code of Ordinances were used as the design criteria for each crossing (USFWS 2025). Construction of the project will include replacing existing culverts with a bridge, resulting in reduced velocities and increased flood capacity, and will include simulated stream bottom material and reconstructed/rehabilitated stream channels immediately upstream and downstream of the newly installed bridge crossing. The chosen designs and proposed activities will result in an overall benefit to aquatic resources and will improve fish passage capabilities.

5 Endangered Species Act

HDR submitted a query to USFWS’s Information for Planning and Consultation web service on January 21, 2026 (USFWS 2026). Results of the query indicated that no endangered or threatened species or their critical habitats listed under the Endangered Species Act are known to occur in the project area.

6 Cultural Resources

USFWS completed National Historic Preservation Act Section 106 consultation in July 2022 (Appendix C). The NHPA Section 106 finding was that the undertaking occurs within the footprint of an area of previous, extensive, disturbance. There are no known archaeological sites within one mile of the project area. Based on this, the undertaking has a finding of no historic properties affected.

7 Mitigation

TTCD has incorporated the following measures into the design and construction of the project to avoid or reduce impacts:

- The contractor shall wash equipment (including all tracked equipment, excavation equipment, and excavation hauling equipment) prior to mobilization to ensure that the spread of invasive species is minimized.
- Fill materials shall be clean and free of contaminants and materials shall be obtained from noxious weed-free material sites.
- All construction activities completed below the OHW of the stream will occur between May 15, 2026 and July 15, 2026 or as stipulated by the ADF&G Fish Habitat Permit.
- Stream diversion will meet the applicable requirements of ADF&G and all other local, state, and federal laws
- The currently proposed stream diversion method includes temporary diversion channels. The contractor will prepare and submit a final stream diversion and dewatering plan and submit to the project engineer for approval.
- Dewatering of the excavations may be required to complete the work. Discharge of dewatering pumps shall be a minimum of 100 feet from streams and shall be protected with best management practices (BMP's) as required to minimize sediment discharge into receiving waters.
- Fish remaining onsite within any coffer/diversion dams, scour pools or old channels will be salvaged and relocated to the closest pool upstream of the construction area prior to completely dewatering the site. TTCD will acquire an Aquatic Resource Permit in accordance with ADF&G requirements prior to salvage activities.
- Stream bottoms will be constructed out of stable material and will tie into existing material as quickly as possible.
- Simulated streambed material will be placed and simulated stream channel shaped by hand.
- High pressure water will be sprayed on all stream substrate to thoroughly wash fines into the streambed prior to diverting stream into the newly constructed channel.
- Two saplings 1.5-feet to 5.5-feet tall will be planted for every tree cut down as required by KPB permits.
- Revegetation and streambank stabilization will be completed according to ADF&G's 2005 Streambank Revegetation and Protection Guide.
- Reshaped stream channels will have bank faces that are uneven, protrude into the channel, and will be rough in appearance.
- Salvaged vegetative mats will have a minimum thickness of six inches and will be sourced from the disturbed area or the local area to rebuild entire streambank four-foot minimum from the stream channel.
- Potted live saplings will be planted along newly constructed channels spaced 2-foot minimum on-center.

- Eighteen-inch diameter coir logs and brush layering will be installed along top of banks of reconstructed stream sections and willow staking will occur at a rate of 15 stems per linear foot.
- Staging areas and disposal of materials generated from excavations will not occur in mapped WOTUS.
- Fueling will not occur within or adjacent to stream beds or wetlands.
- Heavy machinery operating in the stream channels will be limited to the amount necessary to complete the work. The contractor will minimize the amount of in-stream work to the greatest extent possible.
- The contractor will submit a traffic control plan to the project engineer for approval a minimum of three weeks prior to implementing a road closure.
- Applicable BMP's will be followed for the work being performed; the contractor shall minimize erosion and sedimentation of all waterways by implementing control measures as areas are disturbed by construction.
- Sandbags, silt fences, or straw bales will be installed as necessary to protect the stream and other streams from sediment due to construction. Perimeter fences or sandbag dikes will be installed at construction sites to prevent runoff from being directly discharged into nearby streams.

8 References

- ADF&G Alaska Department of Fish and Game
2025 Fish Passage Inventory Database (FPID) and Fish Resource Interactive Mapping Application. Accessed at <https://www.adfg.alaska.gov/index.cfm?adfg=fishpassage.database> in December 2024.
- Brinson, M. M.
1993 A hydrogeomorphic classification for wetlands. Report No. WES/TR/WRP-DE-4.
- Cowardin, Lewis M.
1979 Classification of wetlands and deepwater habitats of the United States. Fish and Wildlife Service, US Department of the Interior.
- Geifer and Evers
2025 Catalog of waters important for spawning, rearing, or migration of anadromous fishes - Southcentral Region, June 2025. Alaska Department of Fish and Game, Special Publication No. 25-03, Anchorage.
- HDR
2026 Final Hydrology and Hydraulics Report, Upper Tyonek Creek Fish Passage Crossing Replacement, Tyonek Creek (ADF&G #20601534). February 2026.
- TBC The Boutet Company
2026 Upper Tyonek Creek Fish Passage Improvements, ADF&G Site # 20601534. 95% Review. January 2026.
- USFWS U.S. Fish and Wildlife Service - Alaska Fish Passage Program
2025 Culvert Design Guidelines for Ecological Function, Revision 10. Accessed at <https://www.fws.gov/alaska-culvert-design-guidelines> in December 2025.
2026 Information for Planning and Consultation. Accessed on January 28, 2026 at <https://ipac.ecosphere.fws.gov/> .




Figures

Figure 1: Study area vicinity



Tyonek Fish Passage Improvement Project - Upper Tyonek



0 0.7 Miles

HORIZONTAL DATUM: NAD83 AK State Plane Zone 4

- Study Area
- Anadromous Streams
- Alaska Communities



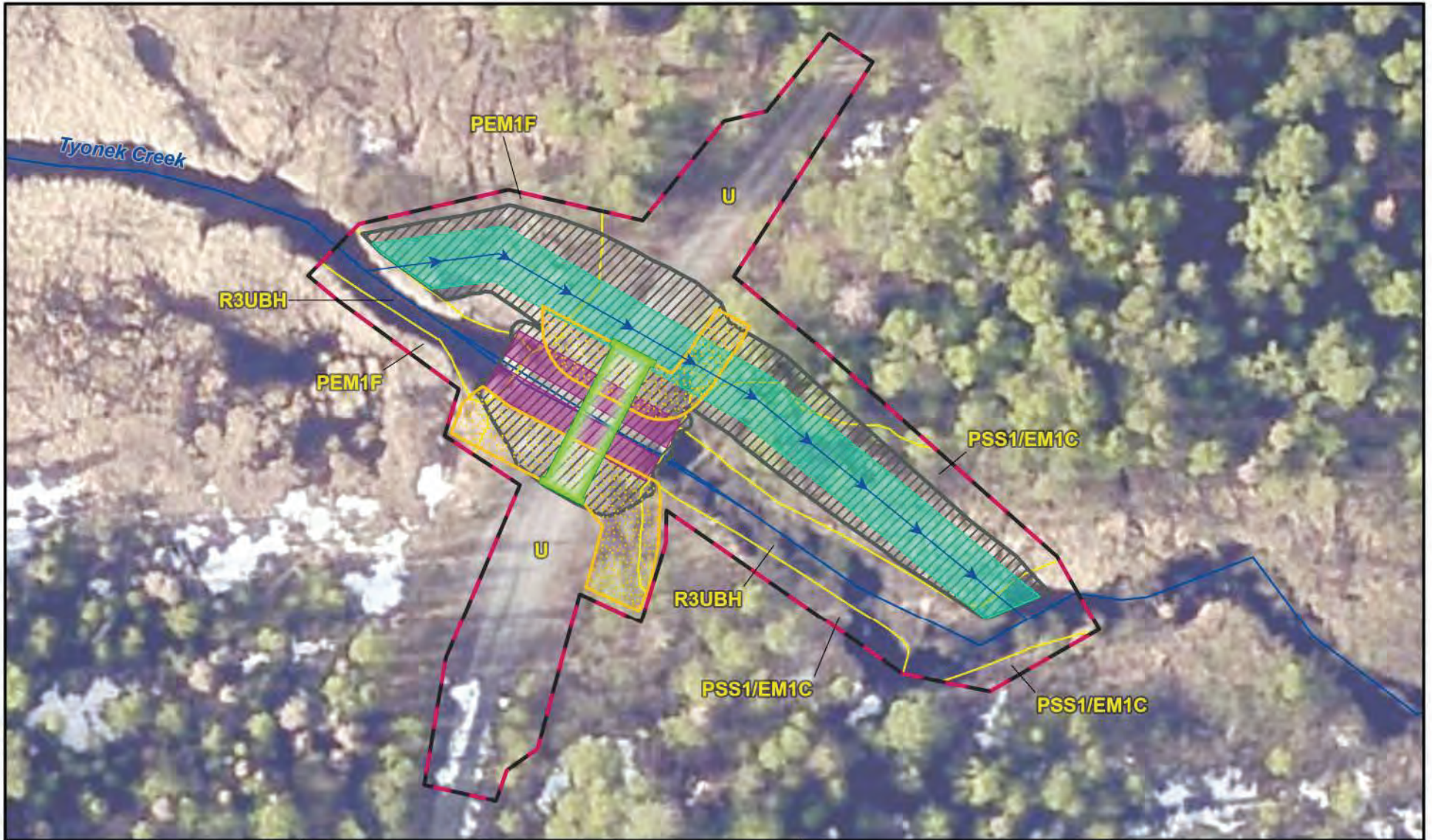
APPLICANT: Tyonek Tribal Conservation District (TTCD)

WATERWAY: Tyonek Creek



LOCATION: 61° 4.695'N 151° 16.413'W
SEC 1, T11N, R12W, SM

DATE: January 30, 2026




Figure 2. Site Location and Details



Tyonek Fish Passage Improvement Project - Upper Tyonek

HORIZONTAL DATUM: NAD83 AK State Plane Zone 4

- | | |
|---|---|
|  Project Limits |  Wetlands Mapping Area |
| Project Elements |  Wetland Mapping |
|  Diverted Stream |  Anadromous Stream |
|  Bridge | |
|  Existing Culvert | |
|  Diversion Channel | |
|  Excavation | |
|  Riprap | |



APPLICANT: Tyonek Tribal Conservation District (TTCD)

WATERWAY: Tyonek Creek

LOCATION: 61° 4.695'N 151° 16.413'W
SEC 1, T11N, R12W, SM

DATE: January 30, 2026



Appendix A – H&H Report



Final Hydrology & Hydraulics Report

Upper Tyonek Creek Fish Passage Crossing Replacement

Tyonek Creek (ADF&G #20601534)

Near Tyonek, Alaska

February 4, 2026

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Appendices

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Appendix B – Cross Sections and Longitudinal Profiles of the Existing Stream

Appendix C – Supplemental Calculations

Appendix D – HY-8 and Hydraulic Toolbox Analyses

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Appendix F – 2024 Alaska USFWS Fish Passage Design Review Checklist

Acronyms and Abbreviations

°F	degrees Fahrenheit
ADF&G	Alaska Department of Fish and Game
AEP	annual exceedance probability
BFW	bankfull width
cfs	cubic feet per second
CMP	corrugated metal pipe
DOT&PF	Alaska Department of Transportation and Public Facilities
D100	maximum streambed material size
FHWA	U.S. Federal Highway Administration
FPID	Fish Passage Inventory Database
fps	feet per second
ft	foot/feet
H&H	hydrology and hydraulics
HDR	HDR Engineering, Inc.
HW/D	headwater to diameter ratio
HEC	Hydraulic Engineering Circular
HY-8	HY-8 Culvert Hydraulic Analysis Program
in.	inch(es)
KPB	Kenai Peninsula Borough
NRCS	Natural Resources Conservation Service
OHW	ordinary high water
PRISM	Parameter-elevation Regressions on Individual Slopes Model
Q100	100-year flood event
SNAP	Scenarios Network for Alaska + Arctic Planning
TBC	The Boutet Company
Tyonek	Native Village of Tyonek
TTCD	Tyonek Tribal Conservation District
UAF	University of Alaska Fairbanks
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VAP	vertical adjustment potential
WSE	Water surface elevation
Yr	Year(s)

1 Introduction and Objectives

The Tyonek Tribal Conservation District (TTCD) assists several communities along the northwest side of Cook Inlet with community-led conservation efforts, including the Native Village of Tyonek (Tyonek). The Alaska Department of Fish and Game (ADF&G) has designated several roadway stream crossings as fish passage barriers of varying severity around Tyonek. TTCD has been working systematically to improve fish passage and aquatic connectivity throughout the watersheds surrounding Tyonek. TTCD has secured funding through the U.S. Fish and Wildlife Service (USFWS) to replace one of these roadway crossings on Tyonek Creek (Fish Passage Inventory Database [FPID] #20601534). The upper Tyonek Creek fish passage replacement project aims to improve flood capacity, reconnect aquatic habitat, and improve fish passage.

The Boutet Company, Inc. (TBC), with the assistance of HDR Engineering, Inc. (HDR), has been contracted to design the proposed roadway improvements and culvert replacement at the upper Tyonek Creek site. Through the design process, a bridge was chosen to replace the existing culverts at this site. This hydrology and hydraulics (H&H) report describes the hydrology, existing conditions, and proposed structure at the site to:

- Evaluate watershed size, conveyance requirements, peak flood flows, floodplain issues, and scour analysis to meet hydrologic and fish passage requirements.
- Determine stream slope and profile for long-term channel stability and fish passage.
- Provide recommendations based on design guidance for the new crossing width, depth, length, structure type, and skew angle.
- Design stream substrate and other grade control structures.
- Provide minimum values of roadway grade, fill height, and width that correspond with the proposed structure requirements.

1.1 Location

Tyonek resides on the northwest side of Cook Inlet across from the Kenai Peninsula, and immediately south of the community of Beluga (Figure 1). The upper Tyonek Creek fish passage improvement site is located on an unnamed road just north of an old airstrip east of Tyonek.

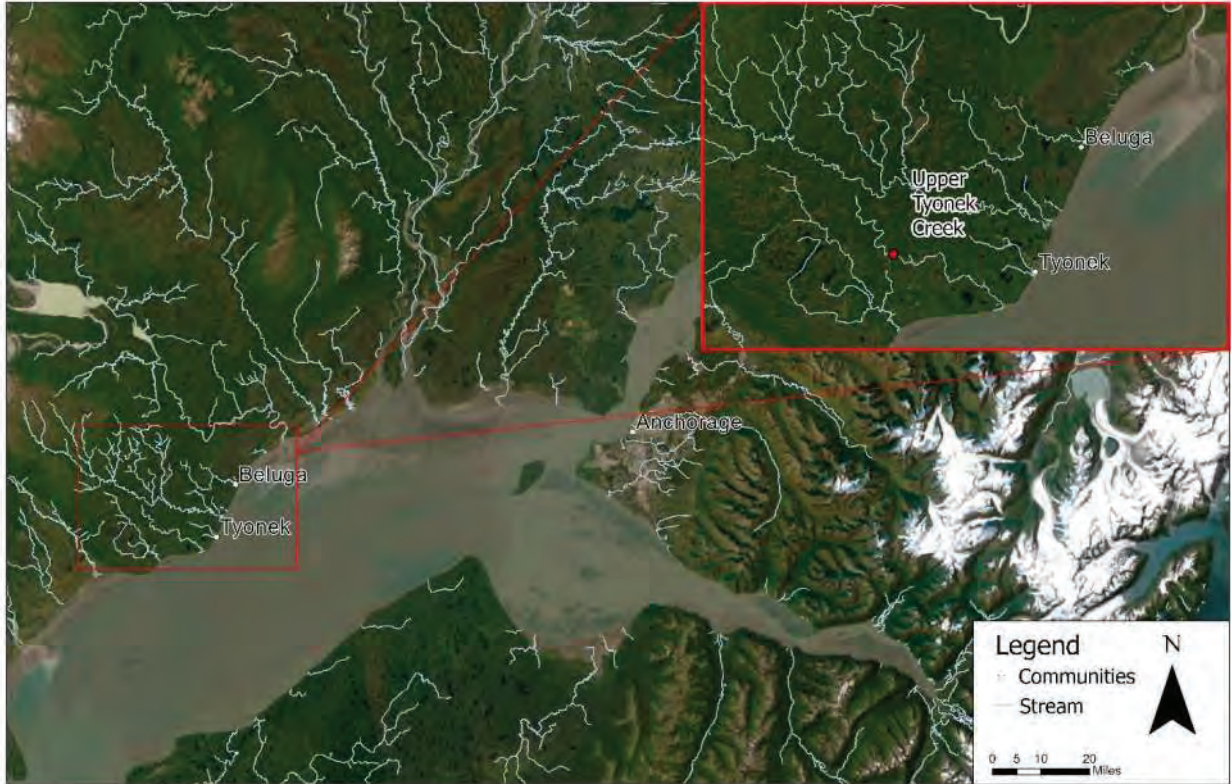


Figure 1. Overview Map

Based on ADF&G’s *Fish Resource Interactive Mapping Application* (ADF&G 2026), the current culvert battery at the upper Tyonek Creek crossing is rated as green, which assumes that the crossing would be adequate for juvenile salmonid or weak swimming fish passage. This site is the furthest upstream road crossing on Tyonek Creek. There are two additional road stream crossings further downstream on Tyonek Creek. Three miles downstream of the upper Tyonek Creek site, the creek is crossed by the Tyonek-Beluga Road through a 16.5-foot by 9.9-foot structural steel plate pipe arch (FPID #20601542) installed in July 2014. Another 4.5 miles downstream of this crossing, Tyonek Creek is crossed by Tyonek Timber Road through a 45-foot 10-inch by 22-foot 11-inch structural steel plate pipe arch (FPID #20601540) installed in September 2024. Tyonek Creek flows into Cook Inlet just north of Beshta Bay another 0.4 miles downstream of this crossing.

1.2 Ownership

The project site is located in the Kenai Peninsula Borough (KPB) and the landowner is the Tyonek Native Corporation (KPB 2024a).

1.3 Design Criteria

The following local guidance was used as the design criteria for this project:

- *KPB Code of Ordinances, Chapter 14.06 – Road Standards* (KPB 2024b).
- *KPB Code of Ordinances, Chapter 21.18, Section 21.18.027* states ADF&G has jurisdiction over anadromous fish and tracking of anadromous waters. Section 21.18.040 establishes an anadromous waters habitat protection district. This district includes all lands within 50 horizontal feet of anadromous waters, measured from the ordinary high water (OHW) mark

or mean high water line in tidal areas. In this district, permits are required for activities that may result in significant erosion, sedimentation, damage to the habitat protection district, an increase in ground or surface water pollution, or damage to the riparian wetlands and riparian ecosystems (KPB 2024b).

- The *USFWS Alaska Fish Passage Program’s Culvert Design Guidelines for Ecological Function* provides a geomorphic analog method to design a culvert crossing based on a representative section of the specific waterbody being crossed. Though the proposed crossing is a bridge, a number of guidelines were still incorporated, including design criteria for streambed material thickness and stability, designing a channel based on reference reach data, streambed features, and design flows (USFWS 2025).
- *Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition, Volume 2. Hydraulic Engineering Circular No. 23.* (FHWA 2009). This guidance was used in the design of the bridge abutment materials and dimensions.
- *Alaska Department of Transportation and Public Facilities (DOT&PF) Highway Drainage Manual, Chapter 10: Bridges* (DOT&PF 1995).

1.4 Flood Hazards or Floodplain Management Requirements

The project site is not located within a Federal Emergency Management Agency (FEMA) mapped floodplain. KPB participates in the National Flood Insurance Program, developing local floodplain ordinances per FEMA requirements. The KPB Code of Ordinances, Chapter 21.06 – Floodplain Management covers the requirements for development within floodplains. Section 21.06.040(A)(2)(b) requires 1 percent annual exceedance probability (AEP) flood (base flood) elevation data, permitting, and review for development greater than 50 lots or 5 acres, whichever is the lesser (KPB 2024b). The project area is less than 5 acres (43,560 square feet) in size, therefore, no floodplain requirements apply. Additionally, the project’s design criteria would be sufficient to maintain flood flows and mitigate floodplain impacts.

1.5 Geotechnical

No geotechnical investigations were performed for this project.

2 Site Visit

On August 11, 2022, HDR water resource engineer Kyle Walker, PE, and engineer-in-training Kacy Grundhauser accompanied TBC project staff to assess the site. The weather was overcast with occasional, light rain, and temperatures ranging from 57 to 65 degrees Fahrenheit (°F).

Survey extents and reference reaches were delineated for survey. The survey extent goes along the stream through the entirety of both upstream and downstream reference reaches and spans the width of the active floodplain. This ground survey was necessary to encompass the floodplain extents, bankfull indicators, and the geometry of the road at the crossing. A reference reach is a section of a stream that is not affected by the crossing and best describes the stream to aid in fish passage design. Reference reaches are chosen by finding the nearest river reach both up and downstream of the existing crossing that are unaffected by the crossing and are stable. HDR

assessed the existing crossing and took stream measurements, field notes, photos, and pebble counts at the identified upstream and downstream reference reaches. A pebble count consists of a particle count of at least 100 particles per reference reach. HDR's site visit notes are provided in Appendix A.

The site visit in 2022 was conducted prior to the implementation of the current USFWS site survey guidelines (USFWS 2025). Therefore, the current reference reach length guidance of 20-times the bankfull width (BFW) of the channel, among others, was not met during the field effort. Once at the reference reach, BFW was identified by examining the streambanks and determining the channel-forming slope break (i.e., the point distinguishing channel flow from overbank flow). Due to the flat floodplain on both sides of the stream channel, bankfull width was identified as the inflection point between relatively steep streambank and flatter floodplain/overbank area. Reference reach longitudinal profiles and representative cross sections with surveyed bankfull indicators can be found in Appendix B.

2.1 Existing Culvert Conditions

The existing crossing is located on an unnamed gravel road that travels northeast from the northern end of an old airstrip that was used for oil and gas exploration. The existing road stream crossing consists of two approximately 9-foot diameter corrugated metal pipes (CMPs) that convey Tyonek Creek which flows from northwest to southeast. The unnamed road and stream crossing receive moderate use, providing access to subsistence, recreation, and oil and gas exploration. This stream crossing site was surveyed by ADF&G in 2002 and 2016. In 2016, ADF&G noted that the north culvert was blocked by a beaver dam (ADF&G 2026). ADF&G rated this crossing as green, indicating it was likely to provide adequate juvenile fish passage. The crossing has not been reevaluated since 2016.

During the 2022 HDR/TBC site visit, the beaver dam was no longer present and no obstructions were seen in either culvert. The north culvert had an approximate width of 9.3 feet, rise of 7.0 feet, slope of -0.32 percent, and length of 60.0 feet. The south culvert had an approximate width of 9.0 feet, rise of 7.1 feet, slope of -0.08 percent, and length of 60.0 feet. The culverts were not embedded and appeared to be in fair condition with a slight perch at the inlets that could create a juvenile fish barrier at low flows. The existing gravel roadway varied in width from 9 to 12 feet. The upstream and downstream side slopes of the roadway embankment were eroding and geotextile stabilization fabric was visible.

2.1.1 Existing Upstream Channel

Directly upstream of the existing crossing, the upstream channel consists of a shallow gradient stream with a primarily silt and mud bottom. This section extends for 300 feet and is likely impacted by backwatering from the existing crossing. The upstream reference reach was identified upstream of this impacted section. The upstream reference reach is 107 feet long containing a well-defined channel with a sand and gravel streambed with frequent boulders and cobbles throughout and steep side slopes (2H:1V or less) that were vegetated with aquatic grasses and occasional willows and alders. The ordinary high water (OHW) was estimated at 12.5 feet wide and 2.0 feet deep. The BFW was estimated at 17.5 feet wide and 4.0 feet deep. The average slope of the reach was -0.42 percent. The floodplain was approximately 200 feet wide and consisted of tall grass with willow and alders throughout.

2.1.2 Existing Downstream

Immediately downstream of the existing crossing, the channel gradient steepens to 2.46 percent for 77 feet. Through this short, steep section numerous cobbles and boulders were observed in the channel, with the largest more than 30 inches in diameter. In several locations, the stream split into braids that consisted of multiple narrow channels around small, vegetated islands. Eroded banks were also observed in several locations. The overbanks were densely vegetated with tall grass, willows, alders, birch trees, and devil's club.

The downstream reference reach was identified 305 feet downstream of the crossing. The reference reach is 90 feet long, with a well-defined channel with frequent boulders and cobbles, gravel bars, and small undercut banks around bends. Side slopes were steep (2H:1V or less) and vegetation on the banks consisted of aquatic grasses with occasional willows and alders. Both the OHW and BFW were estimated at 16.75 feet wide. The OHW depth was estimated at 1.0 feet and the BFW depth was estimated at 3.5 feet. The average slope of the reach was -0.65 percent. The floodplain was estimated to be 50 feet wide, containing the slightly steeper and more sinuous downstream channel. Select site visit photographs are provided in Figure 2.



Figure 2. Tyonek Creek Crossing Site Visit Photos



North Culvert Outlet (facing upstream)



South Culvert Outlet (facing upstream)



Upstream Reference Reach (facing downstream)



Downstream Reference Reach (facing downstream)

Figure 2. Tyonek Creek Crossing Site Visit Photos Continued

2.2 Existing Site Summary

ADF&G’s 2016 site visit information is summarized in Table 1. HDR/TBC’s 2022 site visit information on the existing culverts is provided in Table 2 and reference reach measurements are provided in Table 3.

Table 1. General Site Information

Site	Road	Stream	ADF&G FPID	ADF&G Fish Passage Classification	Latitude Longitude
Upper Tyonek Creek Crossing	Unnamed Road	Tyonek Creek	20601534	Green: likely to provide adequate juvenile fish passage	61.07681°, -151.31593°

Notes: ADF&G = Alaska Department of Fish and Game; FPID = Fish Passage Inventory Database; ° = degree(s).

Table 2. Existing Culverts

Culvert	Span (ft)	Rise (ft)	Type	Material	Slope (%)	Length (ft)
North Barrel	9.3	7.0	Round, Corrugated	Steel	-0.32	60.0
South Barrel	9.0	7.1	Round, Corrugated	Steel	-0.08	60.0

Notes: ft = foot/feet; % = percent.

Table 3. Reference Reach Information

Reach	Length (ft)	Average Slope (%)	Cross Section	Bankfull Width (ft)*	Bankfull Max Depth (ft)*	Bankfull Area (sq. ft.)	Bankfull Mean Depth (ft)^	Floodplain Width (ft)	Location
Upstream Reference Reach	107	-0.42	Upstream XS 1	20.3	2.73	46.2	2.28	200+	300 feet Upstream of Crossing
			Upstream XS 2	12.5	1.93	18.9	1.51		
Downstream Reference Reach	90	-0.65	Downstream XS 1	16.3	2.7	31.9	1.96	50+	300 feet Downstream of Crossing

Notes: ft = foot/feet.; in. = inch(es); % = percent; sq. ft. = square feet.

*Bankfull max depth and width values recorded in field were compared against survey, and after closer inspection the survey values were more representative of the channel. Design bankfull max depth values reported in this table are measured from surveyed top of bank down to surveyed thalweg.

^Bankfull mean depth is equal to the bankfull area divided by the bankfull width.

When designing the proposed cross sections for the channel under the bridge and at transition points, the bankfull parameters shown in Table 3 above should be approximated. Below are the target values for each bankfull parameter to be matched; the design parameter to be matched is either the calculated average value or the calculated median value of the respective parameter, whichever is smaller:

- Bankfull Area:
 - Average Bankfull Area = 32.33 sq. ft.
 - Median Bankfull Area = 31.9 sq. ft.
 - Target bankfull Area = **31.9 sq. ft. (smaller of two)**
- Bankfull Mean Depth:
 - Average Bankfull Mean Depth = 1.92-feet
 - Median Bankfull Mean Depth = 1.96-feet
 - Target Bankfull Mean Depth = **1.92-feet (smaller of two)**
- Bankfull Width:
 - Average Bankfull Width = 16.37-feet
 - Median Bankfull Width = 16.3-feet

- Target Bankfull Width = **16.3-feet (smaller of two)**

3 Hydrologic Analysis

The crossing hydraulics were analyzed to ensure flood capacity of the proposed design. ERSI's ArcGIS Pro (version 3.3.2) was used to visualize publicly available imagery and elevation data and the project survey data. The drainage basin was delineated using ESRI World Imagery and 1-foot contours developed from 2018 US Geological Survey (USGS) 1/3 arc-second (approximately 10 meters) elevation data (USGS 2018). The drainage basin area was determined to be 4,656 acres (202,815,360 square feet), as shown in Figure 3 and provided in Table 4.



Figure 3. Tyonek Creek Drainage Basin

To determine flood flows, several types of historic precipitation data and future estimates were assessed. The 1971-2000 Parameter-elevation Regressions on Individual Slopes Model (PRISM) climate dataset for Alaska was overlain on the drainage basin area and a weighted precipitation average was calculated. While there are newer PRISM datasets available, the 1971 – 2000 dataset is the one applicable to the hydrologic analyses used. Future precipitation estimates using the Medium Emissions scenario were obtained from the University of Alaska Fairbanks (UAF) Scenarios Network for Alaska + Arctic Planning (SNAP) Community Climate Charts for Tyonek, Alaska (UAF 2024).

Flood flows are defined by a recurrence interval or as an AEP. A recurrence interval (or return period) is the average number of years between floods of a certain size and is based on the probability that the given event will be equaled or exceeded in any given year. An AEP is the percent chance of occurrence in any given year and is always provided as a fraction of 1. For example, a 2-year recurrence interval flood is a 0.5 AEP flood (1/2) or has a 50 percent chance of occurring in any

given year. Therefore, a 100-year recurrence interval flood is a 0.01 AEP flood (1/100) or has a 1 percent chance of occurring in any given year. AEP is the preferred terminology, as it reminds the user that a flood event is not related to a specific time interval but instead as a chance of occurrence.

3.1 2016 USGS Regression Equations

The 2016 USGS regression equations were used to estimate flood magnitude and frequency based on the guidance in *Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Based on Data Through Water Year 2012* (USGS 2016). The equations are valid for drainage basins between 0.4 and 1,000 square miles (256 to 640,000 acres) - therefore, these equations are valid for this project’s drainage basin of 4,656 acres. Other commonly used methods for estimating flood magnitude and frequency are not applicable to basins greater than 250 acres in size (USDA 1986).

The 2016 USGS regression equations use basin area and average mean annual precipitation to estimate flood flows. The estimated drainage basin area of 4,656 acres (202,815,360 square feet) and the 1971–2000 PRISM precipitation data were used to estimate flood flows. To account for climate change, the 2016 USGS regressions equations were also applied using the SNAP Community Climate Charts data as an adjustment factor on average mean annual precipitation. The Tyonek SNAP precipitation data for 2030 through 2099 suggests a 12.9 percent increase in precipitation over the 75-year design life of the structure (UAF 2024).

The 2016 USGS regression equations with SNAP adjusted precipitation results were chosen as the design flood flows, as they take into consideration increased flows over the design life of the structure. The design flood flows used are **bolded** in Table 4; the 2% AEP was used as the design event for sizing streambed material, while the 1% AEP event was used for dimensioning and sizing the abutment protection structures as well as for the scour analysis. Further discussion on the abutment protection sizing can be found in Section 4.2.2 and streambed material sizing in Section 4.2.3. Results of the flood flow regression equation calculations have been rounded to the nearest 5 cubic feet per second (cfs) and are provided in Appendix C.

Table 4. Estimated Flood Flows for Proposed Tyonek Creek Crossing

Tyonek Creek Crossing									
Basin Size (ac.)	4,656	% AEP / Recurrence-Interval Flood							
Method	Annual Mean Precipitation (in.)	50%	20%	10%	4%	2%	1%	0.5%	0.2%
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	200-Yr	500-Yr
2016 USGS Regression	33.8	185	305	395	520	615	720	825	975
2016 USGS SNAP Adjusted	38.2	210	340	440	575	675	790	905	1,065

Notes: Flows are rounded to the nearest 5 cfs. Design flood flows shown in **bold**. ac. = acres; AEP = Annual Exceedance Probability; in. = inch(es); Yr = Year(s); % = percent.

Two verifications were used to confirm the 2016 USGS regression equation values accurately estimated current flow values. The two concepts used for verification were USGS gage transfer and comparing the bankfull flow to the 50% AEP event (50-year flood).

For the first, an improved estimate of flood flow magnitude and frequency can be calculated for an ungaged site if there is a gage nearby on the same stream and if the drainage basin area ratio between the ungaged and gaged sites is between 0.5-1.5 (USGS 2016). The two nearest gages to Tyonek Creek are not on Tyonek Creek. The drainage area ratio was calculated to determine if this method was applicable despite the gaged sites being on different streams. However, it was determined that the two nearest gaged streams were not comparable to Tyonek Creek due to differences in the size of the contributing area, stream character, and topography.

The closest stream gage to Tyonek Creek is on the Chuitna River (USGS # 15294450), which has a drainage basin area of 132 square miles, compared to Tyonek Creek's drainage basin area at the crossing of 7.2 square miles. The drainage basin area ratio between the Chuitna River basin and the Tyonek Creek basin was 0.05, therefore, the two basins are not comparable. The next closest gaged stream was the Chakachatna River (USGS # 15294500), which has a larger drainage basin than the Chuitna River and thus does not meet the drainage basin area ratio threshold. Additionally, both rivers are larger in size and are not of the same character as Tyonek Creek. Therefore, the USGS gage transfer method could not be used to verify the accuracy of the regression equation estimate of flood flows.

Another verification tool used to verify the USGS regression equations flood flow estimates is to compare the estimated 2-year flows to the reference reach bankfull indicators (USFWS 2025). The estimated 2-year flood flows should be similar to the bankfull indicators noted during the site visit for Tyonek Creek. The section of stream at the existing culverts is in a transition zone between a wider, shallower sloped section of channel to a narrower, steeper section. When the SNAP 2-year flow (210-cfs) was analyzed within Hydraulic Toolbox given the representative reference reach cross section geometries (one at the start of a riffle in the upstream reach, one at the end of a riffle in the upstream reach, and one at the start of a riffle in the downstream reach), the depth of flow was approximately the same as or slightly larger than bankfull depth, indicating the floodplain is active at the 2-year event. The bankfull discharge (175-cfs) was determined by analyzing the reference reach geometries in Hydraulic Toolbox and determining the flow at which the bankfull channel is completely filled but not overtopping. From upstream to down, bankfull flows are described below:

- the bankfull discharge of the upstream cross section at the start of the riffle was smaller than the 2-year flow (bankfull discharge is 175-cfs).
- the bankfull discharge of the second upstream cross-section, which is at the bottom of the riffle, is smaller than the 2-year flow (bankfull discharge is 84-cfs).
- the bankfull discharge of the downstream reference reach cross section approximately equated the 2-year flow (bankfull discharge is 200-cfs).

Representative cross sections with bankfull indicators are located in Appendix B, and the results of 2-year flow estimate analysis within representative reference reach cross sections are in Appendix D.

Overall, the USGS gage transfer method was not appropriate for use due to the drainage basin area the lack of comparable gaged streams in the vicinity of the crossing. The bankfull flow estimates were used to verify the USGS regression equations and determined that the 2-year flow estimates approximated the bankfull discharge indicators from the reference reaches. Therefore, the 2016 USGS regression equations were determined to be the appropriate method for estimating flood magnitude and frequency for the Tyonek Creek crossing.

Lastly, to verify that the reference reach selection was appropriate, the top of bank longitudinal slope was compared to that of the thalweg in each reference reach. The upstream top of bank longitudinal slope did not match that of the bed slope, though the downstream top of bank longitudinal slope did match the thalweg slope in the reference reach. The upstream results indicated that the channel was not incised, allowing more floodplain usage, while the downstream results indicated that the downstream channel was more incised (Appendix B). This, in combination with the 2-year flow analysis showing general equilibrium, confirms that the reference reaches used were appropriate.

4 Crossing Analysis

A new crossing is proposed to replace the existing culverts, which will accommodate the design flood, improve fish passage, and provide floodplain connectivity. Field measurements including bankfull width and sediment gradations were used to size the proposed crossing. Both the existing culverts and the proposed bridge channel geometry were modeled to see how the proposed channel modifications will improve both flood conveyance capacity and fish passage conditions. The U.S. Federal Highway Administration's (FHWA) HY-8 Culvert Hydraulic Analysis Program (HY-8) (version 8.0.0) was used to model and analyze the existing and proposed crossings. The FHWA Hydraulic Toolbox Program (version 5.4.0) was used to model and analyze the proposed bridge typical section. The modeling inputs and results are reported, showing that the proposed bridge channel successfully improves both flood conveyance and fish passage conditions by fully containing the 1% AEP event to prevent road overtopping, providing adequate flow depth for fish during low-flow conditions, and having the design streambed be stable.

4.1 Existing Conditions

The existing culverts were modeled in HY-8 as CMPs based on their surveyed dimensions (approximately 9 feet wide and 7 feet tall). The hydraulic analysis shows the existing crossing passes the 1 percent AEP flood flow of 790 cfs with a headwater to depth ratio (HW/D) of 1.17 (north culvert) to 1.19 (south culvert). USFWS guidelines recommend that the crossing accommodate at least the BFW and pass the 1 percent AEP with a HW/D equal to or less than 0.8. Based on those criteria and the potential barrier for juvenile fish at low flows, the design team recommends replacing this crossing. The existing channel's upper and lower vertical adjustment potential (VAP) lines were plotted on a longitudinal profile, shown in Figure 4 and in Appendix B. These are used as a measure of how much the channel is expected to degrade/aggrade over time. When plotting these lines on the longitudinal profile, it gives an envelope where the design thalweg can be placed to be in accordance with where the stream naturally wants it to be. This is to ensure the culvert invert will be embedded below the lower VAP line so it will not be in danger of being exposed due to degradation in the channel. The existing conditions HY-8 inputs and results are provided in Appendix D.

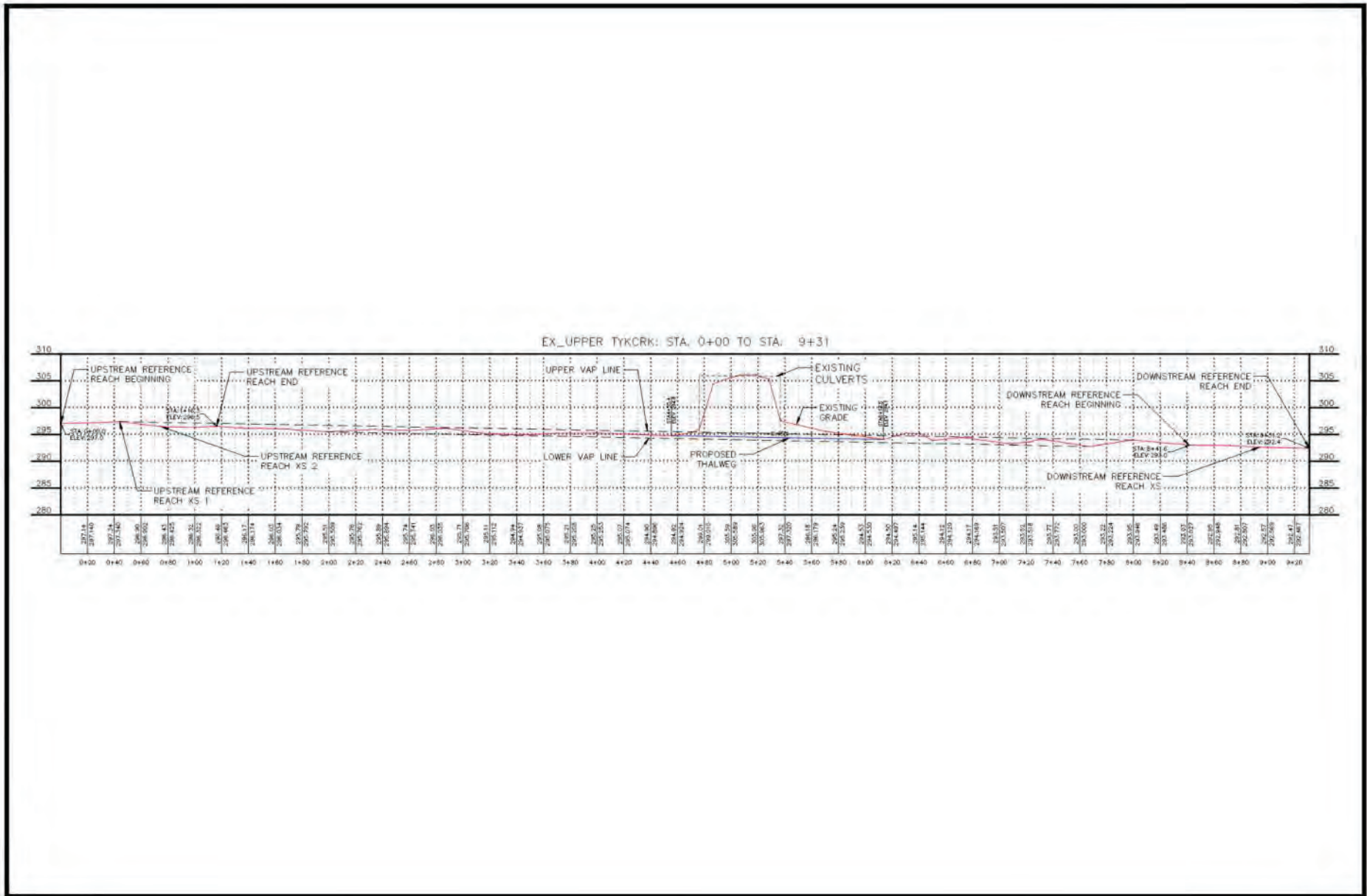
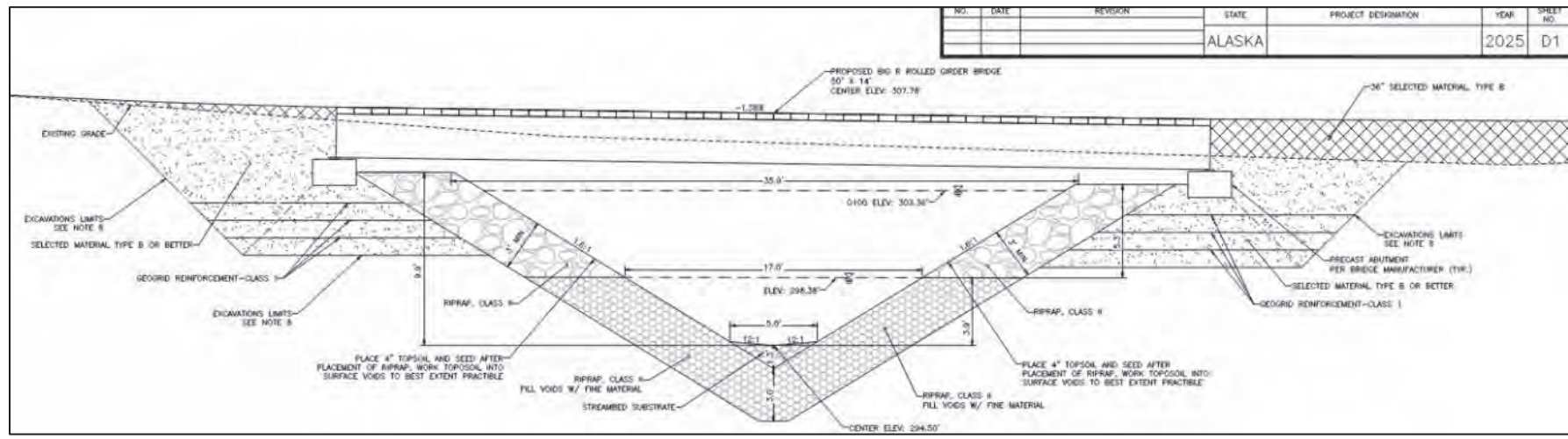


Figure 4. Tyonek Creek Crossing – Existing Longitudinal Profile (5x Vertical Exaggeration)

4.2 Proposed Conditions

Between the 35% and 65% design phases, the proposed crossing changed from a large diameter box culvert to a bridge crossing due to the anticipated level of use. The bridge crossing opening is shown in Figure 5.



Note: At the time of H&H Report submission, the Q100 elevation in the plans was not up to date with the calculations presented in this report. The updated Q100 elevation is 303.03-feet.

Figure 5. Tyonek Creek Crossing – Proposed Bridge Crossing (TBC 2026)

Based on the existing channel's elevations and potential for aggradation and/or degradation, the proposed slope was set at -0.45-percent and proposed elevations for the channel were determined.

This proposed slope falls within the USFWS recommendation of being within 25 percent of the reference reach's slope. The downstream reference reach had a slope of -0.42-percent, the upstream reference reach had a slope of -0.65-percent, for an average slope of -0.54-percent. The proposed crossing will have a minimum stream substrate depth of 4.3-feet (3.0-feet of Class II riprap and 1.3-feet of stream substrate), meeting the USFWS embedment guidelines. The guidelines suggest a substrate depth at least 2-feet thick or 1.5 times the maximum stream material size (D100), whichever is greatest, and substrate placed below the lower VAP line. In this case, the controlling guideline was having the streambed thickness go below the lower VAP line.

4.2.1 HY-8 Modeling Results

The bridge crossing opening geometry was modeled in HY-8 using user defined points. The proposed crossing is estimated to pass 2,007 cubic feet per second (cfs) before overtopping the road. Figure 6 shows the profile of the proposed crossing during the 1 percent AEP flood flow and Table 5 provides results during various discharges. The proposed conditions HY-8 inputs and results are provided in Appendix D.

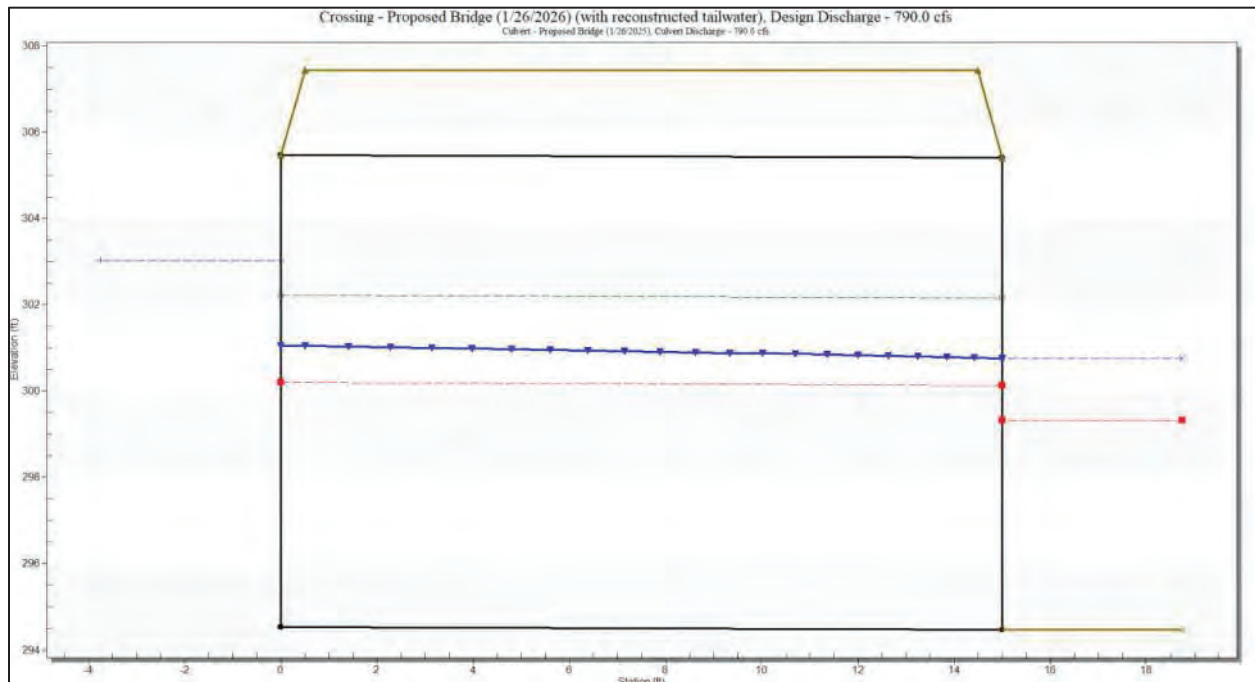


Figure 6. Tyonek Creek Crossing – Proposed Profile at 1 Percent AEP

Table 5. Proposed Bridge Channel HY-8 Hydraulic Results Summary

Discharge Names	Total Discharge (cfs)	Headwater Elevation (ft)	HW/D	Normal Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (fps)	Tailwater Velocity (fps)
40% of 50% AEP	84	297.57	0.28	2.79	2.55	2.54	3.99	3.20
50% AEP	210	299.19	0.43	4.28	3.77	3.77	5.41	3.70
2% AEP	675	302.45	0.72	7.19	6.03	6.03	7.99	4.11
1% AEP	790	303.03	0.78	7.69	6.29	6.29	8.70	4.28

Note: The overtopping flow for the design crossing is 2,007 cfs.

Note: Design flood flows shown in **bold**. ft = feet; AEP = Annual Exceedance Probability; fps = feet per second; cfs = cubic feet per second; % = percent.

HY-8 was not built to model bridge openings, so the bridge opening geometry was also modeled in Hydraulic Toolbox to compare the estimated water depths and velocities in the constructed channel during the design flood between the two software applications.

For streambed sizing calculations, the direct outputs for outlet velocity and outlet depth at the 2% AEP event from HY-8 were used, as these were deemed the most conservative results between the two and incorporated tailwater conditions. For abutment protection sizing, both software results were used to compare stability calculation results using the modeling results from each software. For scour calculations, the Hydraulic Toolbox values for depth and flow top width in the bridge channel were used for computational consistency, as the scour calculations require an upstream cross section in Hydraulic Toolbox. The upstream cross-section for scour calculations was the same geometry as used for tailwater conditions in HY-8. This is because the reconstructed channel typical will be constructed both upstream and downstream of the bridge channel and tie-in to existing ground. These results are provided in Appendix D, and a comparison table of calculated depths and velocities for the HY-8 model and the Hydraulic Toolbox model is included below in Table 6.

Table 6. Comparison of Modeling Flow Through the Proposed Bridge Opening Geometry Using Both HY-8 and Hydraulic Toolbox

Flood Event (% AEP)	Flow Value (cfs)	Model	Velocity (fps)	Depth (ft)
40% of 50% AEP	85	HY-8	4.0	3.1
		Hydraulic Toolbox	3.5	2.8
50% AEP	210	HY-8	5.4	4.7
		Hydraulic Toolbox	4.4	4.3
2% AEP	675	HY-8	8.0	7.6
		Hydraulic Toolbox	5.9	7.2
1% AEP	790	HY-8	8.7	8.5
		Hydraulic Toolbox	6.1	7.7

*Velocity for HY-8 models was the outlet velocity, and depth for HY-8 models was measured as the difference between the headwater elevation and the bottom elevation of the channel (294.5-feet).

The two models generally had similar results; the HY-8 model velocities and depths were both larger than their equivalents in Hydraulic Toolbox. Velocities were greater by 0.5-feet per second (fps) to 2.6-fps and the depths being greater by 0.3-feet to 0.8-feet.

It should be noted that per DOT&PF bridge design requirements, the distance between the water surface elevation (WSE) of the 1% AEP event and the low chord of the bridge should be at least 3 feet (DOT&PF 1995). Using the more conservative depth produced by the HY-8 model in Table 6, the elevation difference between the low chord of the bridge (305.2-feet) and the WSE of the 1% AEP event (303.03-feet) is 2.2-feet. The design team determined that this is not a concern because this is a very low-volume road and not a major roadway. DOT&PF requirements were used as a guideline for this design, but this structure will be owned and maintained by the Native Village of Tyonek, and as such are not required to meet the 3-foot requirement.

4.2.2 Bridge Abutment Protection

To size both the material to be used in the bridge abutment protection and the abutment protection structures, FHWA’s Hydraulic Engineering Circular 23, *Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance* -Third Edition (HEC-23) was used for design guidance (FHWA 2009). The equations used to size the material within the abutment protection structures are included below in Figure 7, while the guidelines used to dimension the abutment protection structures are included below in Figure 8.

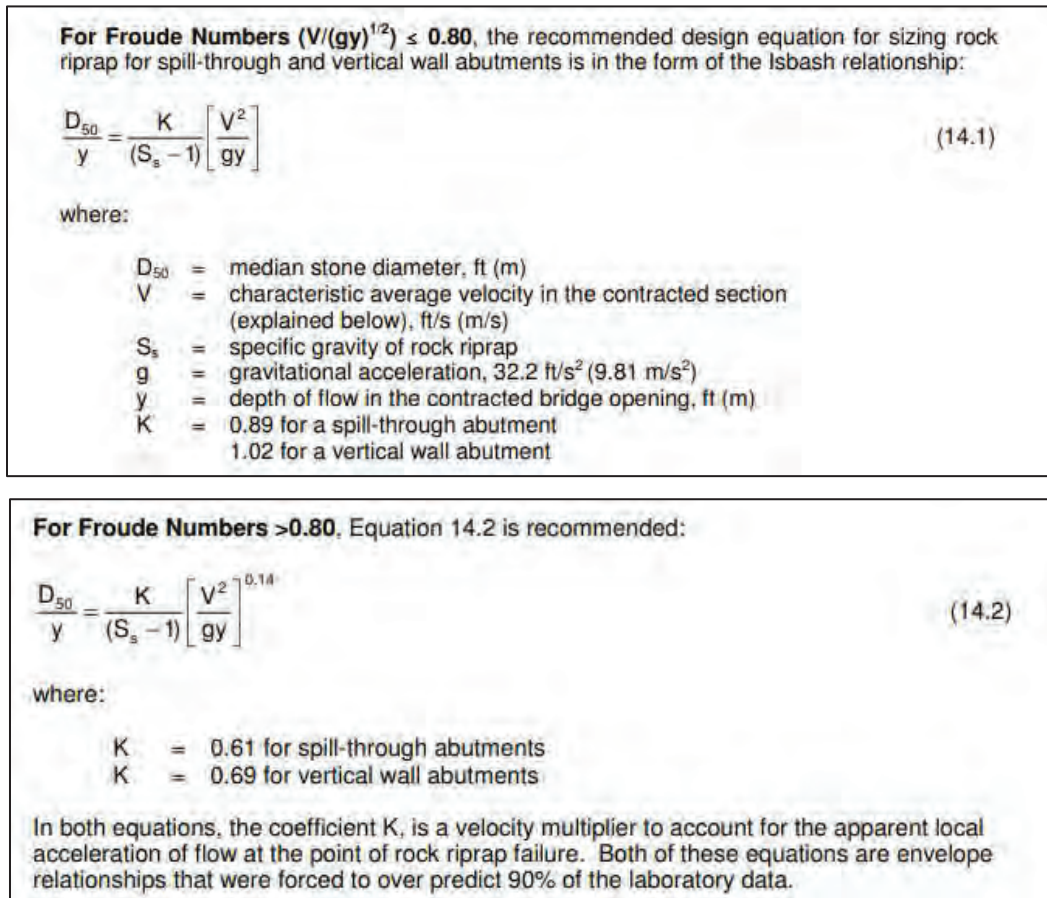


Figure 7. Bridge Abutment Protection Material Sizing Equation based on Froude Number (FHWA 2009)

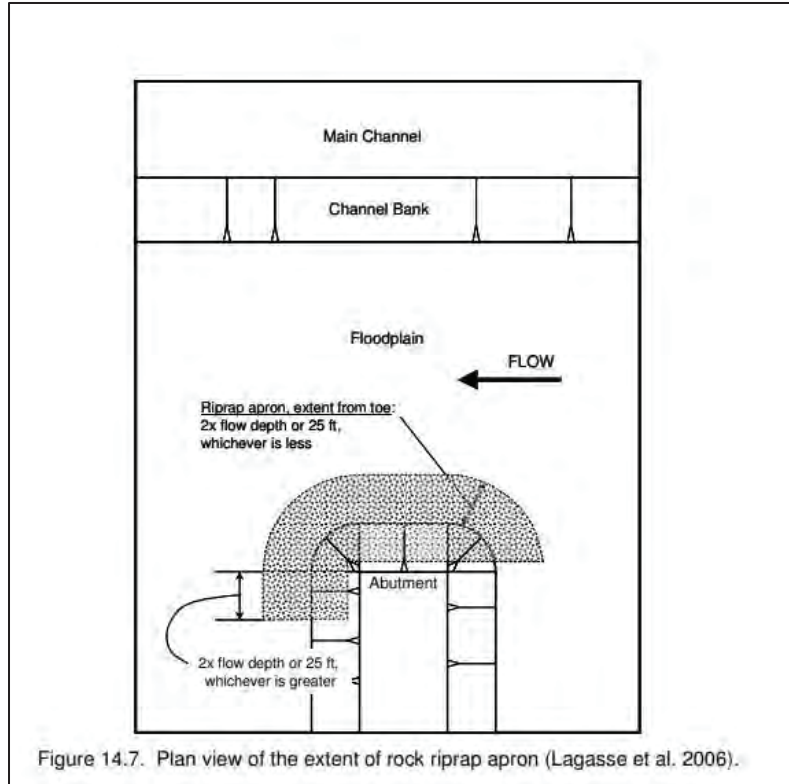


Figure 14.7. Plan view of the extent of rock riprap apron (Lagasse et al. 2006).

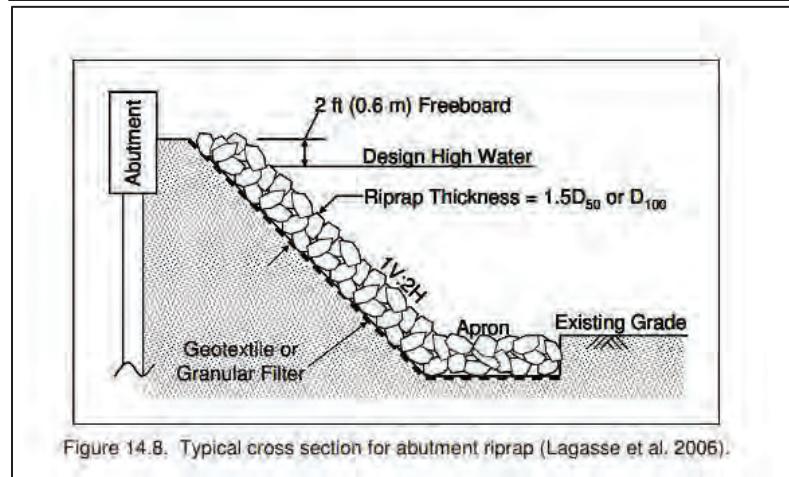


Figure 14.8. Typical cross section for abutment riprap (Lagasse et al. 2006).

Figure 8. Bridge Abutment Protection Dimensioning Guidelines (FHWA 2009)

The results of using the equations in Figure 7 confirm that using Class II riprap will be sufficient to withstand the 1% AEP event. These calculations can be found in Appendix C. The results of applying the dimension guidance from Figure 8 indicate that the abutment protection riprap needs to extend 25-feet parallel to the road on the downstream side of the crossing, and that the thickness of the abutment protection riprap needs to be at least $1.5 \times D_{50}$ or D_{100} of the riprap material, whichever is larger (FHWA 2009). For Class II riprap, the D_{100} is 20-inches while the D_{50} is 17-inches, which means that $1.5 \times D_{50}$ is the controlling criteria, and the minimum thickness needs to be 25.5-inches. Currently, the designed abutment protection structures are 3 feet thick, which exceeds the minimum abutment protection thickness defined by HEC-23. Additionally, the riprap apron needs to extend from the toe of the abutment into the channel a distance of either twice the flow depth or

25 feet, whichever is less (FHWA 2009). Using the more conservative depth for the 1% AEP event in Table 6 (7.7-feet), the abutment needs to be at least 15.4-feet long. The current abutment length measured along the slope is over 20 feet long, meeting this guideline.

4.2.3 Streambed Sizing

To size the streambed material below the bridge crossing, the first design step was to determine if native streambed material within the reference reach was mobile at small magnitude floods. The USFWS guidance says that if the system has an adequate upstream sediment supply (i.e., if the upstream sediment is mobile), then the streambed material should be designed for the 2% AEP event. The upstream sediment supply will replace finer material within the design streambed mix that may be removed during flood events while maintaining the general streambed profile, as delineated by the VAP lines. If the upstream sediment supply is not adequate in the system, the design streambed material should be sized to be stable for the 1% AEP event (USFWS, 2025).

Using critical velocity for particle movement calculations (Laursen, 1963), the results determined that the native streambed material in the upstream reference reach is not mobile during floods ranging in magnitude from the average flow estimate (40% of the 50% AEP event) to the 50% AEP flood estimate using a SNAP adjustment. These calculations can be found in Appendix C. Though the USFWS guidance says that in this scenario the 1% AEP flood event should be used for streambed sizing, the design stream substrate was sized to the 2% AEP event for two reasons:

1. The USFWS guidance is primarily targeted at culvert design and ensuring the streambed material does not scour out of the culvert. Since this crossing is a bridge with separate abutment protection structures underneath the streambed, stability in the streambed material does not affect the stability of the crossing structure.
2. In discussions with USFWS, ADF&G, and TBC on December 23, 2025, it was agreed that if the upstream material were mobile, then matching the design streambed mix with the native material would take priority over meeting sediment stability benchmarks, such as the D30 calculated by the Maynard Equation (USACE 1991). The Maynard Equation computes the necessary D30 of the streambed material gradation for stability at a given flow velocity and flow depth (USACE 1991). The streambed sizing calculations, using the Maynard and Fuller-Thompson Equations, can be found in Appendix C. Because the upstream material is not mobile, having the design streambed mix meet the D30 from the Maynard equation for the 2% AEP flood provides a balance between matching the native material and following the USFWS guidance to size the material to be stable at the 1% AEP flood.

Recommended Streambed Gradation

Based on the determination of non-mobile upstream sediment and balancing the design criteria to approximate between under- and over-sizing the design streambed material, the proposed streambed material mix is proposed to be 33% coarse material and 67% fine material. The coarse material is to consist of Class I riprap (as defined in the DOT&PF Standard Specifications) and the fine material is to consist of equal parts structural fill and ditch lining (as defined in the DOT&PF Standard Specifications). This mix should consist of 1/3 of each material in total. All streambed sizing calculations can be found in Appendix C. The design streambed gradation is plotted below in Figure 9.

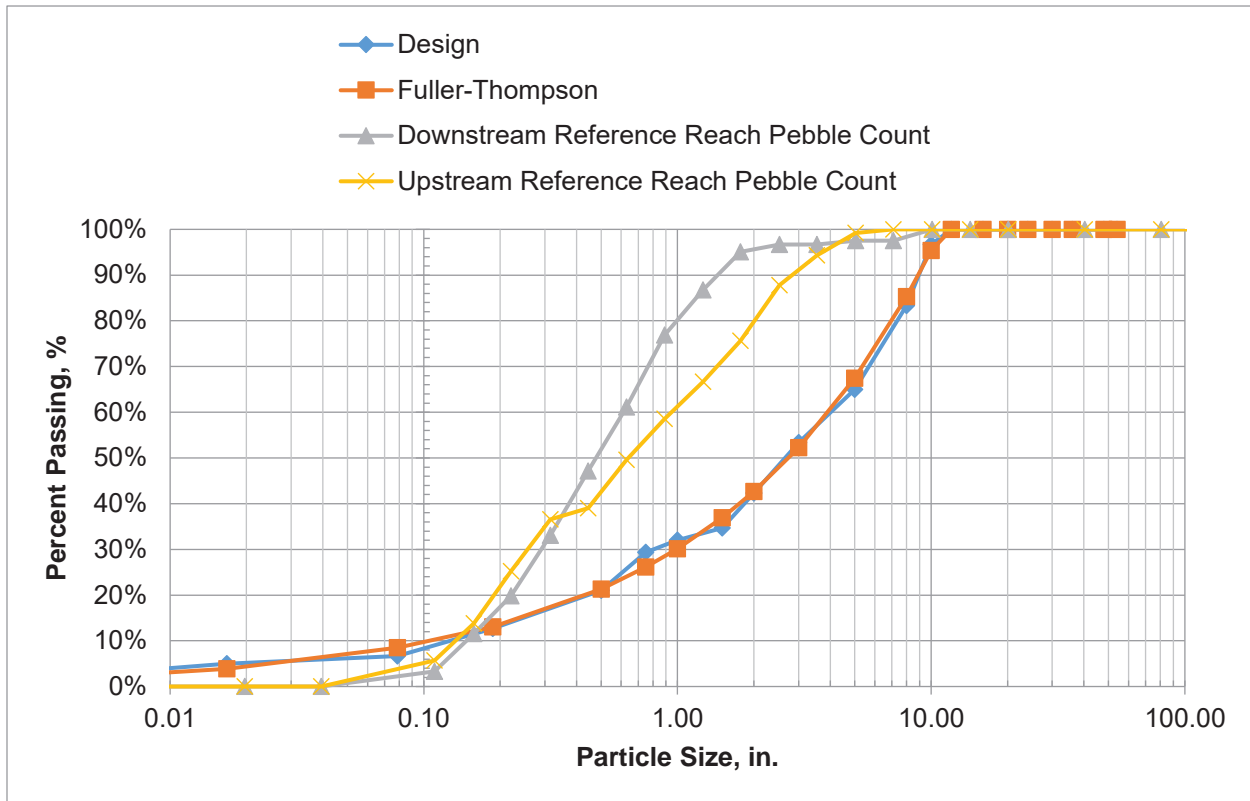


Figure 9. Proposed Stream Material Gradation for Material Stable at the 2% AEP Event

The minimum required D30 calculated by the Maynard Equation is 5 inches, and the D30 of the above gradation is 6 inches. Therefore, the above gradation meets the stability criteria for both the coarse fraction and fine fraction (D30 from the Maynard Equation and Fuller-Thompson, respectively). Though it was noted in the December 23, 2025 discussion with USFWS, ADF&G, and TBC that the use of Class I riprap would not be ideal, the inclusion of Class I riprap will help to keep material on top of the abutment protection structures and resist scour since little material will move from upstream. Agency coordination with regards to streambed material can be found in Appendix E.

4.2.4 Proposed Channel Geometry and Extents

The proposed channel will follow the same alignment as the existing culverts with thalweg elevation and streambed thickness based on VAP lines and existing channel tie-in considerations. Stream regrading will be needed upstream (51-feet) and downstream (50-feet) to tie into the existing channel to provide a smooth transition between the existing and reconstructed channels. A stream diversion will be required during construction; a temporary bypass channel will be constructed north of the proposed crossing that will be backfilled once the proposed stream section is completed and before the bridge is constructed.

Low flows of 40 percent of the 50 percent AEP flow (84 cfs) were analyzed through the proposed channel to ensure an adequate water depth for fish passage would be maintained in all flow conditions. Hydraulic Toolbox results show a water depth of 2.8 feet through the proposed channel at low flows, which is adequate for fish passage. Habitat rocks will be embedded into the proposed streambed. These habitat rocks will consist of Class I riprap (per DOT&PF standard specifications), with each rock less than or equal to the D50 of the standard gradation.

The accompanying 95-percent Plan Set, developed by TBC, provides additional views, details (TBC 2026). Environmental permitting will be conducted in accordance with federal, state, and local regulations.

5 Summary

The proposed Upper Tyonek Creek crossing design meets the USFWS fish passage design guidelines by having the streambed material, slope, and opening dimensions match the reference reaches as much as possible. Additionally, the proposed bridge abutments meet the guidelines in HEC-23 to ensure crossing stability. Though the bridge crossing does not meet the DOT&PF design requirement for 3 feet between the low chord of the bridge and the WSE of the 1% AEP event, this is not a major concern because of the small drainage area and low-volume traffic use of the road. Additionally, the distance between low chord and 1% AEP event WSE was within 0.8-feet of the minimum. The proposed crossing will accommodate fish passage, normal sediment transport, and debris passage. Additional construction details such as detailed invert, slopes, thalweg elevations, and final stream material gradations will be incorporated into the construction drawings produced by TBC.

With regards to the 2024 USFWS Fish Passage Design Review Checklist, the following guidelines within the checklist were not met as a part of the design because this project's initiation and field efforts in 2022 and 2023 predate the implementation of the 2024 Review Checklist. The longitudinal profile at the crossing includes at least 3 stable grade controls upstream and downstream.

- Channel classification.
- Key pieces count.
- Photos of cross-sections.
- Pebble count for full length of reference reach.
- Major land use delineations including upstream sources of sediment if applicable.

The full 2024 Checklist can be found in Appendix F. The items within the 2024 checklist, as well as ones in the draft 2026 checklist, will be consulted and met in future projects with USFWS design requirements.

6 References

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1995 Alaska Highway Drainage Manual, Chapter 10: Bridges. Accessed at https://dot.alaska.gov/stwddes/desbridge/hwy_drainage_manual.shtml in December 2025.
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1991 Hydraulic Design of Flood Control Channels. EM 1110-2-1601. Accessed at https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1601.pdf in December 2025
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2025 Culvert Design Guidelines for Ecological Function, Revision 10. Accessed at <https://www.fws.gov/alaska-culvert-design-guidelines> in December 2025.

USGS U.S. Geological Survey
2016 2016 USGS Regression Equations from, "*Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Based on Data Through Water Year 2012*" Accessed at <https://pubs.usgs.gov/publication/sir20165024> in December 2025.

2018 USGS 1 arc-second n62w152 1 x 1 degree. Accessed at <https://www.sciencebase.gov/catalog/item/5df050d9e4b02caea0f5072f> in December 2025.

Appendix A – HDR Field Notes

8/11/22 Tyonek - Field Notes by Y6

9am @ Spumik Arroyo w/ Kyle Kacy Grundhouser

TBC: Engineers Tim Alley & Shawn

Surveyors: Jason & Cody

9:30 AM Departure in Cessna 207 Skywagon
~30 min flight 1 way.

AT&T has spotty cell coverage.

Took tape, survey rod, goniometer, field notebook, wedges.

10:50 AM Tyonek Cr. -20601534

X2 ~9ft CMP culverts.

Fill / cover DS: S 30" cover

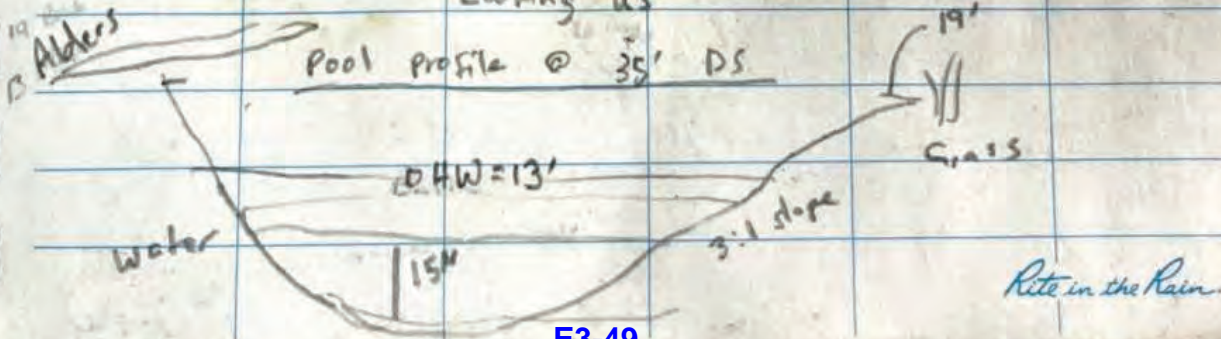
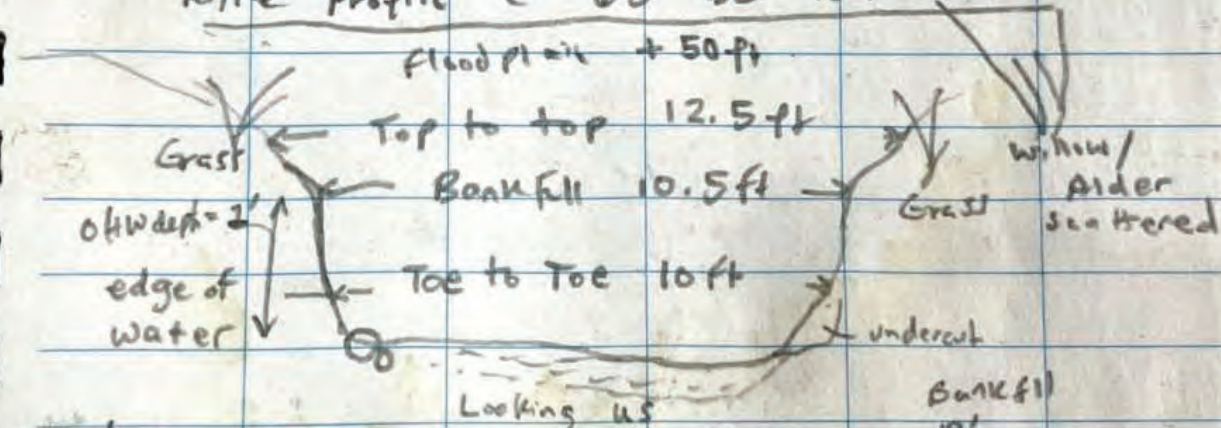
- US of DS ref reach has woody grade breaks
ripples narrower channel.

pools around bends, large rocks
appear to on top.

3.5 ft tall banks.

(see more notes on plan view)

Riffle profile @ 65' DS Ref Reach



Rite in the Rain

3/6

Tyonek us ref reach ~415 ft US of crossing

L 3.5 ft top bank
R 4 ft top bank

Ref start 0'

(Pool wraps around bend)

Island
Bank Full 14'

4" above current water level

18 ft
9" deep

12' wide water
largest rock = 20"

Pool

36 ft DS
OHW = 13'
BF = 23'
OHW depth = 2'
BE depth = 5'

17" deep

Flowplain bench
5 ft wide bench

44 ft

7' deep

44 ft
Start effie

R. flc

Rocks w/ moss, poking out of water

3-4' deep

64 ft
Bank Full = 20'
20" OHW depth

20" veg

Rust line
3 ft up

1 ft

Undercut

9' deep

undercut

Span = 102'

Bend 30" from toe slope

77 ft DS
OHW = 11 ft, BF = 15 ft

2

94 ft DS mid Pool
OHW = 10.5'
BF = 15'

11' deep

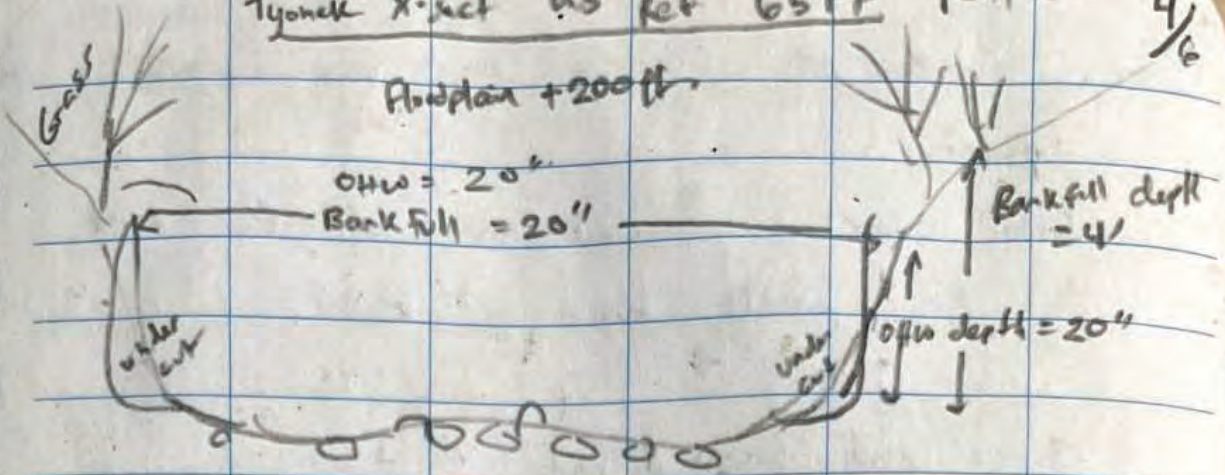
R

OHW depth = 4 ft

108 ft DS, OHW = 15' = BF

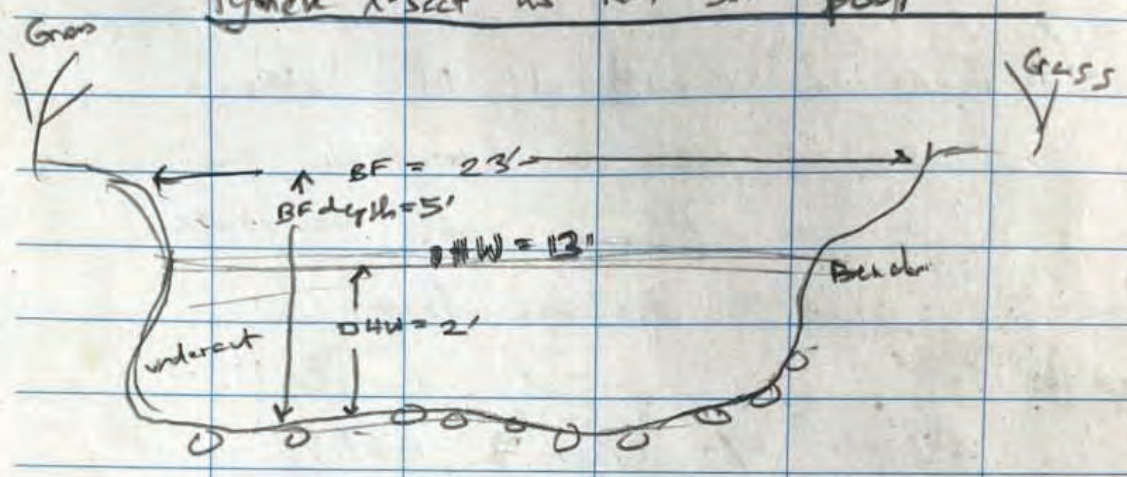
OHW depth 2.5' depth
OHW = 5.5' depth
top bank = 5.5' depth

Tyonek X-sect US Ref 65 FT 4/6



Floodplain
 Grasses, aquatic sage, willows occasionally -
 ↳ in benches
 Spruces line edge of floodplain.

Tyonek X-sect US Ref 30 FT pool



No beaver activity seen @ culvert ends

5/6

2:00pm

finished @ Tyonek. moved to Roberts

culvert

Robert Culvert is not @ ADFEG point.

KG has point bump in road.

- Prains pond from N end to S.

water follows along road embankment to
culvert & crosses over.

- Pond right @ US end of culvert.
Deep & slow. wetlands grasses.

Beaver dam @ end of N lake.

US - no pebble count taken.

no ripples or pools to take
cross sections from.

NOTES

Discuss w/ TTCO & ADFEG about
this wetlands connection.

more crossing? for connectivity.

connection for fish?

current location dissipates energy
from lake.

Beaver activity may affect crossing.

4pm - departed Tyonek.

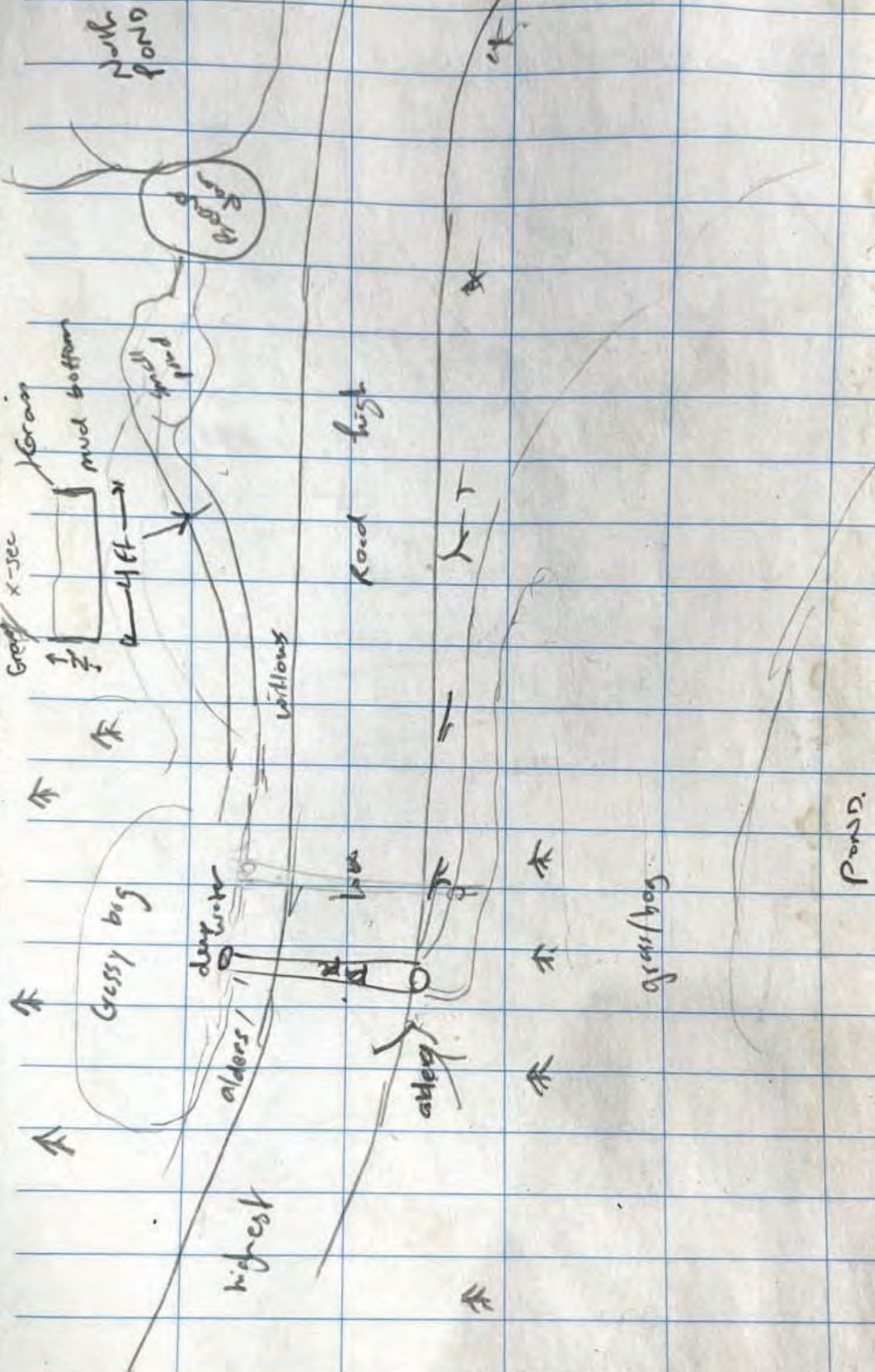
4:35 - returned to Ane.

End of field day.

Roberts plan View

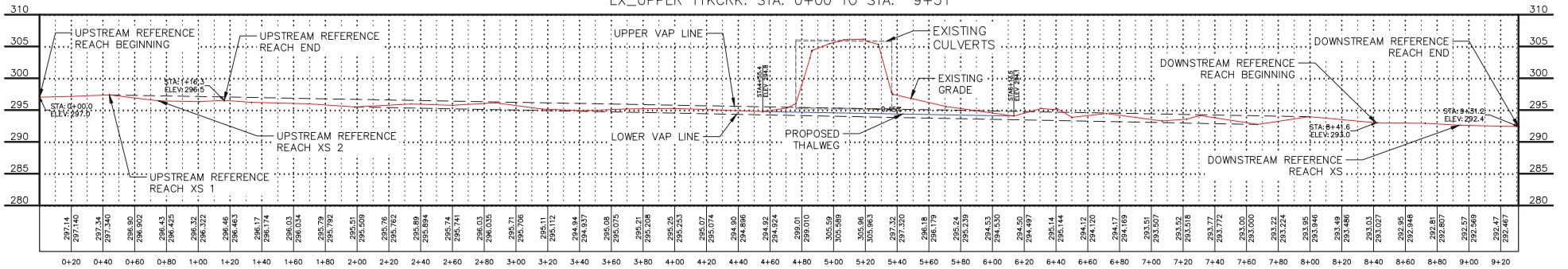
6/6

N ↑

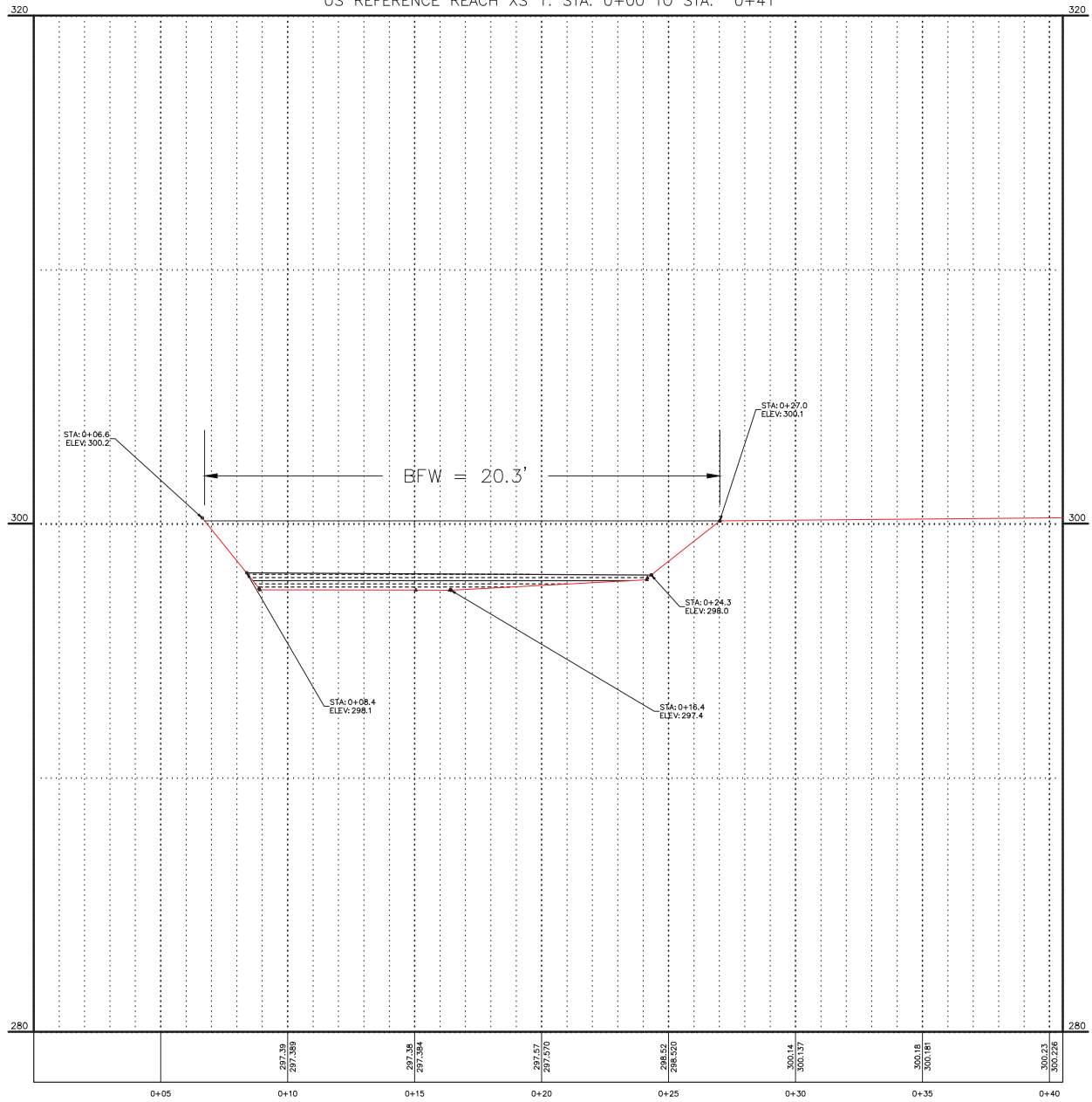


Appendix B – Cross Sections and Longitudinal Profiles of the Existing Stream

EX_UPPER TYKCRK: STA. 0+00 TO STA. 9+31

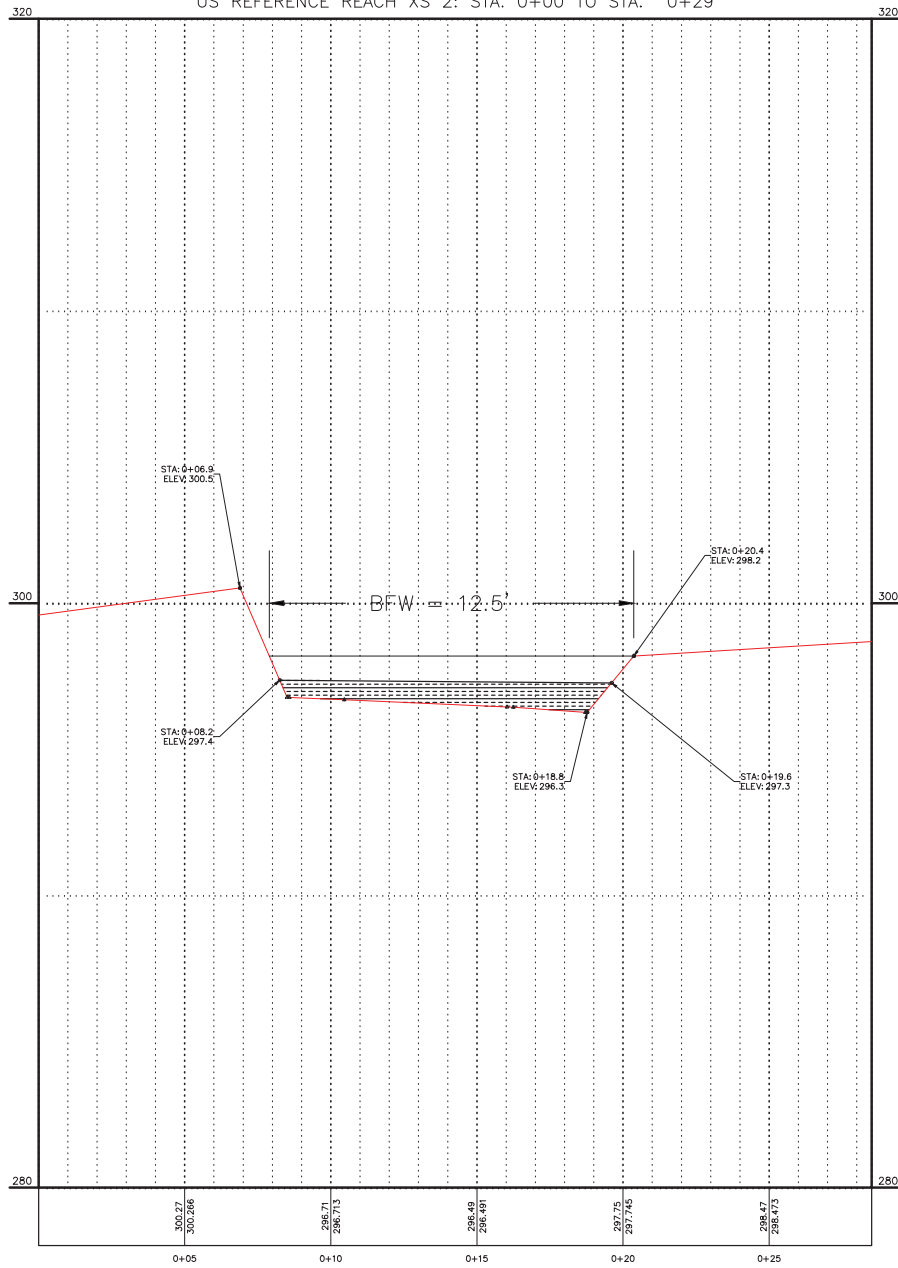


US REFERENCE REACH XS 1: STA. 0+00 TO STA. 0+41

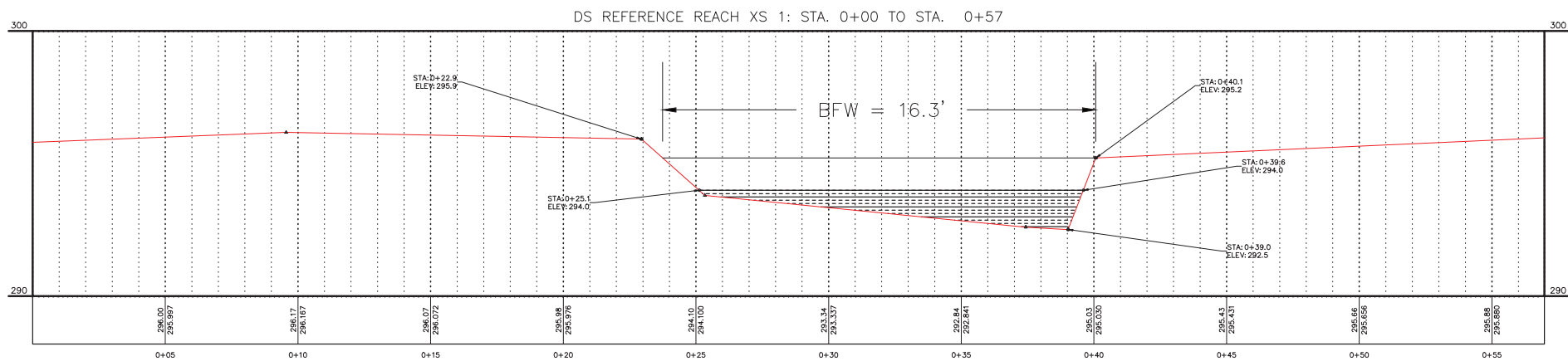


Bankfull Area = 46.2 sq. ft.
ER => 2.2

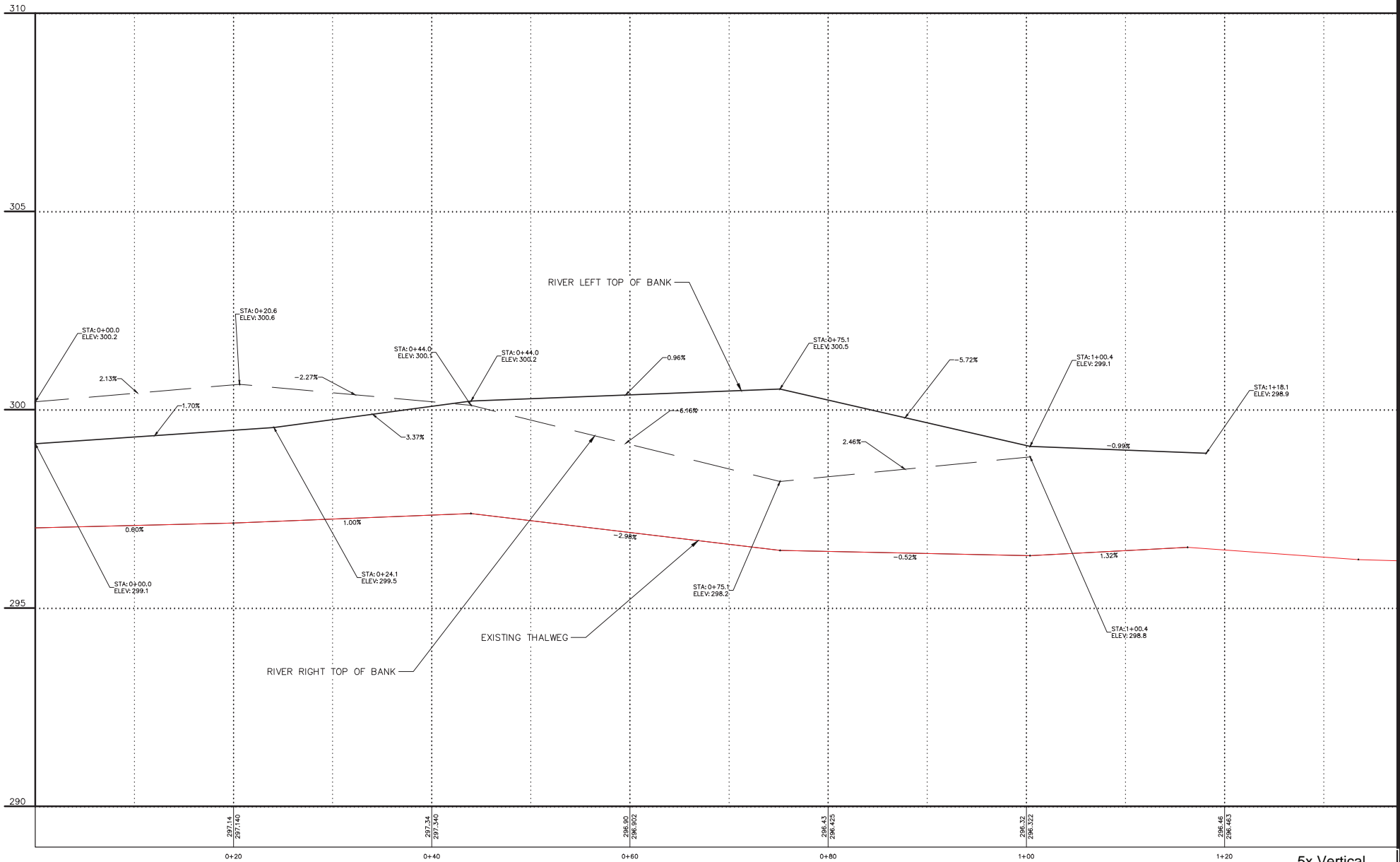
US REFERENCE REACH XS 2: STA. 0+00 TO STA. 0+29



Bankfull Area = 18.9 sq. ft.
ER => 2.2

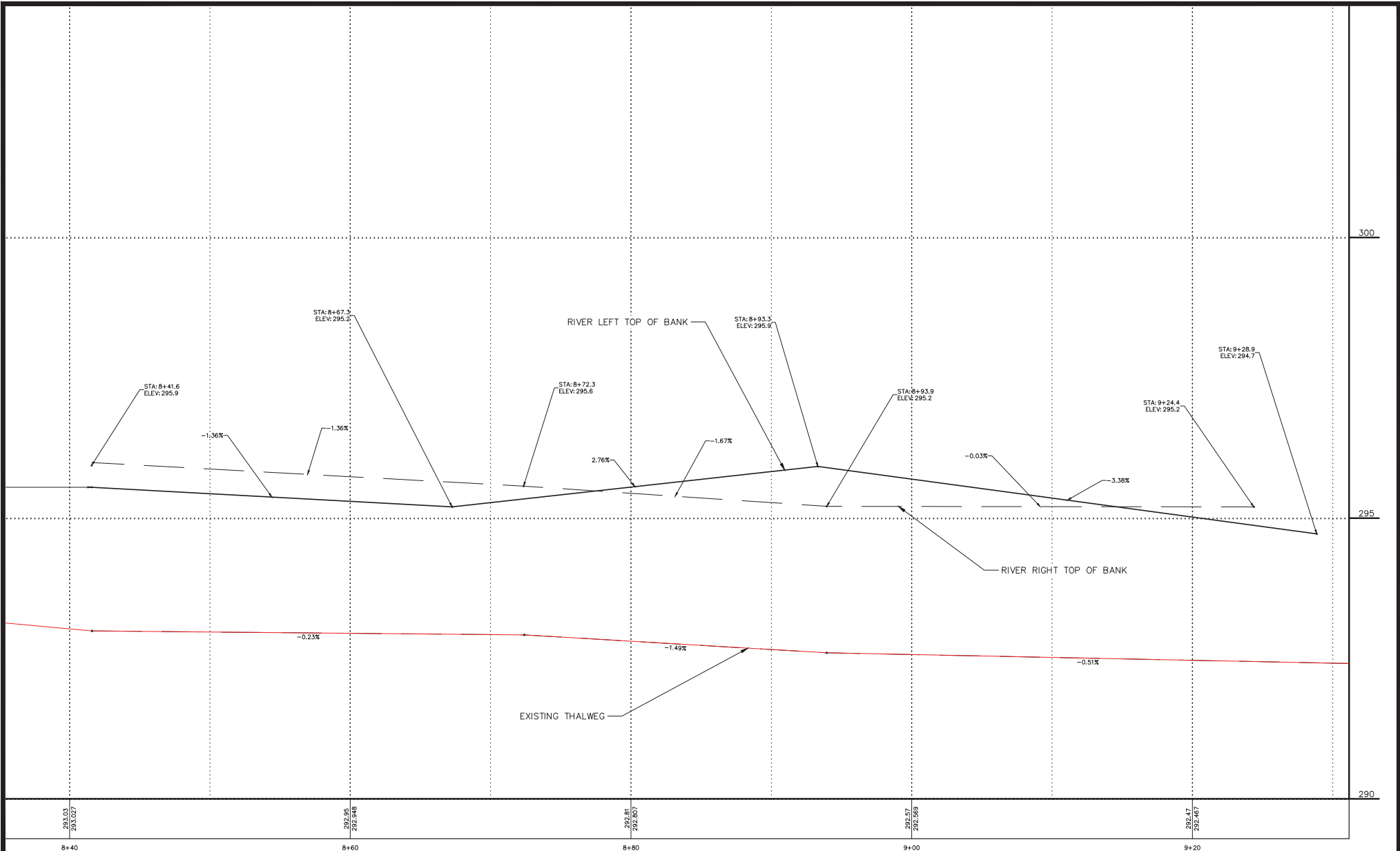


Bankfull Area = 31.1 sq. ft.
 ER => 2.2



Upstream Reference Reach Top of Bank Slope Lines vs. Bed Slope Line

5x Vertical Exaggeration



Downstream Reference Reach Top of Bank Slope Lines vs. Bed Slope Line

5x Vertical Exaggeration

Appendix C – Supplemental Calculations

Project Name: 2024 Upper Tyonek Creek Fish Passage Culvert *Updated: 12/09/24 K. Grundhauser*
 Step 1: Use basin size (ft²) to determine which peak flow calculation methods apply by basin size.

Basin #	Basin Size	Basin Size	Basin Size	Applicable Method
	ft ²	acres	mi ²	
Upper Tyonek Cr.	202,786,482	4655.3	7.274	2016 USGS Regression Equations

Basin falls within 2016 USGS Regression Equation parameters

Basin falls only within NRCS TR-55 Parameters

Basin falls within Rational Method parameters and NRCS TR-55 parameters



Appendix B – Supplemental Calculations

Updated: 12/09/24 K. Grundhauser

Project Name 2024 Upper Tyonek Creek Fish Passage Culvert

Step 2: Calculate flows using 2016 USGS Regression Equations, flows incorporating SNAP Climate Data, and flows adjusting for local gage factors.

2016 USGS Regression Equations					% AEP / Recurrence-Interval Flood							
					50%	20%	10%	4%	2%	1%	0.5%	0.2%
Basin ID	Basin Size	Basin Size	PRISM Precip *	PRISM Precip	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
	ft ²	mi ²	mm*100	in	2016 Regression Flow (cfs)							
Upper Tyonek Cr.	202,786,482	7.27	85,922	33.8	182	301	392	517	614	718	824	973

*Values calculated in GIS using Zonal Statistics tool with basin polygons and 1 m by 1 m resampled rainfall raster.

Source: Mean Precipitation for Alaska 1971-2000

**See SNAP Data

Basin falls within 2016 Regression Equation parameters
Basin falls outside of 2016 USGS Regression Equations

Basin ID	Basin Size	SNAP** Adjusted PRISM Precip	% AEP / Recurrence-Interval Flood								
			50%	20%	10%	4%	2%	1%	0.5%	0.2%	
			2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year	
		mi ²	in	SNAP Adjusted Flow (cfs)							
Upper Tyonek Cr.	7.27	38.2	205.9	336	436	571	675	788	902	1062	

SUMMARY

Tyonek Creek Crossing									
Basin Size (ac.)	4,655	% AEP / Recurrence-Interval Flood							
Method	Annual Mean Precipitation (in.)	50%	20%	10%	4%	2%	1%	0.50%	0.20%
		2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	200-Yr	500-Yr
2016 USGS Regression	33.8	185	305	395	520	615	720	825	975
2016 USGS SNAP Adjusted	38.2	210	340	440	575	675	790	905	1,065

Notes: Flows are rounded to the nearest 5 cfs. Design flood flows shown in **bold**.

Appendix B – Supplemental Calculations

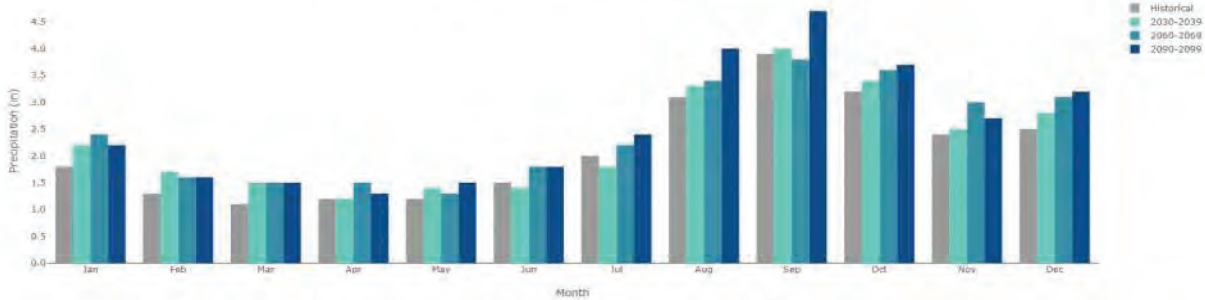
SNAP** Data

Tyonek, AK

Month	Precipitation (in)				2030-2099 % Increase
	Historical	2030-2039	2060-2069	2090-2099	
January	1.77	2.17	2.40	2.24	3.6
February	1.30	1.65	1.61	1.61	-2.4
March	1.14	1.50	1.50	1.54	2.6
April	1.18	1.18	1.54	1.34	13.3
May	1.22	1.42	1.34	1.46	2.8
June	1.50	1.42	1.77	1.81	27.8
July	1.97	1.81	2.20	2.36	30.4
August	3.15	3.35	3.39	4.02	20.0
September	3.94	4.02	3.78	4.72	17.6
October	3.23	3.39	3.58	3.66	8.1
November	2.40	2.52	2.99	2.68	6.3
December	2.52	2.76	3.07	3.23	17.1
Annual	25.31	27.17	29.17	30.67	12.9
			7.4	12.9	

Decimal Increase: 1.129

Average Monthly Precipitation for Tyonek (Qaggeyshiak), Alaska
Historical PRISM and 5-Model Projected Average at 2km resolution, Medium Emissions (RCP 6.0) Scenario



SNAP data collected from UAF Scenarios Network for Alaska + Arctic Planning website:

Data: <https://www.snap.uaf.edu/tools/community-charts>

About: <https://uaf-snap.org/snap-story/community-charts-help-northerners-see-changes/>

Streambed Sizing Calculation

Updated: J. Montoya 1/26/2026

Project: Upper Tyonek Creek Bridge

Step 1 Calculate gradation of the coarse fraction

Depth and velocity values obtained from HEC-RAS or HY-8 model.

FHWA-NHI-09-112: Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition, Volume 2, 2009; Design Guideline 3 Riprap Revetment
 Using U.S. Army Corps of Engineers (USACE) equation EM-1601, starting on page DG4.3.

$$d_{30} = \gamma(S_r C_s C_v C_T) \left[\frac{(V_{des})^2}{K_r (S_g - 1) g} \right]^{2/3}$$

This method is based on the minimum D30 size.
 For revetment riprap sizing (review other riprap calculations for other applications, such as piers, abutments, etc.)

https://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=23&id=143

Local depth of flow, y	6.03	ft for 50-year event
Safety Factor, S _r	1.3	(must be >1.0, 1.1 recommended for bank revetment*, greater values should be considered for ice or large debris impacts, freeze-thaw degradation, or if there is large uncertainty in the design variables.)
Stability Coeff, C _s	0.300	Round or Angular Rock? Angular (0.375 round rock, 0.3 angular rock) = 1.0 for straight channels or the inside of bends = 1.25 - 0.25g(R _o /W) for the outside of bends (1.0 for R _o /W > 25) = 1.55 downstream from concrete channels = 1.25 at the end of dikes
Vertical Velocity Distribution Coeff, C _v	1.0	
Blanket Thickness Coeff, C _T	1.0	(1.0 is recommended due to limited data)
Local depth-average velocity, V _{des} = V _{avg}	7.99	ft/s from 50-year event avg. velocity in pipe (assuming straight channel through pipe)
Channel side slopes	26.6	degrees (1V:1H = 45°, 1V:2H = 26.6°, 1V:3H = 18.4°, 1V:4H = 14°)
Side slope correction factor, K _s	0.87	
Specific gravity of riprap, S _g	2.65	(2.65 usually taken)
Gravitational Acceleration, g	32.2	ft/s ² (English units)

Using NCHRP Report 568's recommended riprap gradations, D30 can be related to recommended D50. The rest of the gradations were related based on their ratio to the recommended D50.
https://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_568.pdf

D15	0.3	ft	4.0	inches
D30	0.4	ft	5.0	inches
D50	0.4	ft	6.0	inches
D85	0.7	ft	9.0	inches
D100	0.9	ft	11.0	inches

Legend

- Inputs
- Common Inputs
- Calculated
- Good
- Check

50-year flood was used for sizing to model scenario with sufficient upstream sediment supply

Culvert

Q50

Results from January 2026 Configuration (01/27/26) (Actual reconstructed stream channel with tie-in to EG for tailwater geometry)

	HY-8		Hydraulic Toolbox	
	Outlet	Tailwater	Outlet	Tailwater
Depth	6.03	6.03	7.21	6.03
Velocity	7.99	4.11	5.88	4.11

Step 2 Calculate Fuller Thompson idealized gradation of the fine fraction

US Forest Service, Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings, 2008
 Adapted from Fuller-Thompson, starting on page 6-40.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054564.pdf

Fuller-Thompson Power, n	0.5	(0.5 produces a maximum density mix when particles are round.)
D15 (calculated in Step 1)	4.0	inches

d in.	d mm	Particle Size Sieve	% passing
12.0	304.8	12	100.0%
10.0	254	10	100.0%
8.0	203.2	8	100.0%
5.0	127	5	100.0%
3.0	76.2	3	86.6%
2.0	50.8	2	70.7%
1.50	38.1	1.5	61.2%
1.00	25.4	1	50.0%
0.75	19.05	0.75	43.3%
0.50	12.7	0.5	35.4%
0.187	4.75	#4	21.6%
0.079	2.00	#10	14.0%
0.017	0.425	#40	6.5%
0.006	0.15	#100	3.8%
0.003	0.075	#200	2.7%

Step 3a Record field pebble count

Name		Downstream Reference Reach Pebble Count		
Particle Size mm	Particle Size in.	Tot #	Item %	% Accumulative
0.062	0.0024		0%	0%
0.125	0.0049		0%	0%
0.25	0.0098		0%	0%
0.5	0.0197		0%	0%
1	0.039		0%	0%
2.8	0.110	4	3%	3%
4	0.157	10	8%	12%
5.6	0.220	10	8%	20%
8	0.315	16	13%	33%
11.3	0.445	17	14%	47%
16	0.630	17	14%	61%
22.6	0.890	19	16%	77%
32	1.26	12	10%	87%
45	1.77	10	8%	95%
64	2.52	2	2%	97%
90	3.54		0%	97%
128	5.04	1	1%	98%
180	7.09		0%	98%
256	10.08	3	2%	100%
362	14.25		0%	100%
512	20.16		0%	100%
1024	40.31		0%	100%
2048	80.63		0%	100%
3000	118.11		0%	100%
SUM		121	100%	100%

D50 (linear interpolation): 0.485

Step 3b Record field pebble count

Name		Upstream Reference Reach Pebble Count		
Particle Size mm	Particle Size in.	Tot #	Item %	% Accumulative
0.062	0.0024		0%	0%
0.125	0.0049		0%	0%
0.25	0.0098		0%	0%
0.5	0.0197		0%	0%
1	0.039		0%	0%
2.8	0.110	7	6%	6%
4	0.157	10	8%	14%
5.6	0.220	14	11%	25%
8	0.315	14	11%	37%
11.3	0.445	3	2%	39%
16	0.630	13	11%	50%
22.6	0.890	11	9%	59%
32	1.26	10	8%	67%
45	1.77	11	9%	76%
64	2.52	15	12%	88%
90	3.54	8	7%	94%
128	5.04	6	5%	99%
180	7.09	1	1%	100%
256	10.08		0%	100%
362	14.25		0%	100%
512	20.16		0%	100%
1024	40.31		0%	100%
2048	80.63		0%	100%
3000	118.11		0%	100%
SUM		123	100%	100%

Notes: Modified channel, not good for design but ok for general comparison. Recorded retained on.

Step 4

Develop design streambed material gradation

Select mix of coarse and fine materials.
 For coarse, use standard riprap or special specifications.
 For fines, use standard aggregate specifications or use fines calculated in step 2 by Fuller-Thompson equation.
 Compare to Pebble Count (if applicable) and Fuller-Thompson Estimating for Maximum Density (step 5).

Min Req'd D30 5.0
 Design D30 6.0

Stability (D30)	Good
Combined Gradation %	100% Good

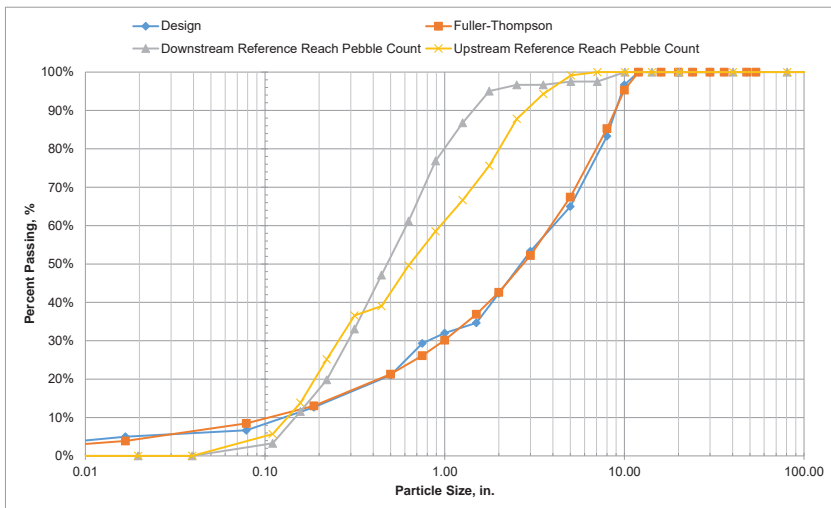
Gradation Tables for Components

		COARSE MATERIAL						FINE MATERIAL		Fine Fraction	Design	Fuller-Thomp. Idealized
		Based on Alaska DOT&PF Specifications					Coarse Fraction	SF	Ditch Lining			
Ditch Lining		Type IV Riprap	Type III Riprap	Type II Riprap	Type I Riprap							
Selected Mix Proportions %		0%	0%	0%	0%	33%	33%	33%	33%	67%	-	-
Size (inches)	Sieve Size	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing
54	54"	100%	100%	100%	100%	100%	100%	100.0%	100%	100%	100%	100.0%
48	48"	100%	90%	100%	100%	100%	100%	100.0%	100%	100%	100%	100.0%
36	36"	100%	50%	100%	100%	100%	100%	100.0%	100%	100%	100%	100.0%
30	30"	100%	35%	90%	100%	100%	100%	100.0%	100%	100%	100%	100.0%
24	24"	100%	25%	50%	100%	100%	100%	100.0%	100%	100%	100%	100.0%
20	20"	100%	15%	43%	90%	100%	100%	100.0%	100%	100%	100%	100.0%
16	16"	100%	0%	36%	50%	100%	100%	100.0%	100%	100%	100%	100.0%
12	12"	100%	0%	29%	39%	100%	100%	100.0%	100%	100%	100%	100.0%
10	10"	100%	0%	22%	27%	90%	90%	100.0%	100%	100%	97%	95.3%
8	8"	100%	0%	15%	15%	50%	50%	100.0%	100%	100%	83%	85.3%
5	5"	75%	0%	0%	0%	20%	20%	100.0%	75%	88%	65%	67.4%
3	3"	50%	0%	0%	0%	10%	10%	100.0%	50%	75%	53%	52.2%
2	2"	30%	0%	0%	0%	0%	0%	97.0%	30%	64%	42%	42.6%
1.5	1.5"	10%	0%	0%	0%	0%	0%	94.0%	10%	52%	35%	36.9%
1	1"	5%	0%	0%	0%	0%	0%	91.0%	5%	48%	32%	30.2%
0.75	0.75"	0%	0%	0%	0%	0%	0%	88.0%	0%	44%	29%	26.1%
0.5	0.5"	0%	0%	0%	0%	0%	0%	63.0%	0%	32%	21%	21.3%
0.187	#4	0%	0%	0%	0%	0%	0%	38.0%	0%	19%	13%	13.0%
0.0787	#10	0%	0%	0%	0%	0%	0%	20.0%	0%	10%	7%	8.5%
0.0167	#40	0%	0%	0%	0%	0%	0%	15.0%	0%	8%	5%	3.9%
0.0059	#100	0%	0%	0%	0%	0%	0%	9.0%	0%	5%	3%	2.3%
0.0030	#200	0%	0%	0%	0%	0%	0%	3.0%	0%	2%	1%	1.6%

Step 5

Graph Pebble Count, Fuller-Thompson Idealized, and Design gradations

Gradation values should be within +/-5% of this gradation (Rice) AND we need to have at least 5% sand size (#10) or smaller (Forest Service) in the combined gradation



Reference Materials		
Riprap by Weight (lbs) (calculation assumes sphere)	Spec. Gravity = <input type="text" value="2.6"/>	AK DOT Riprap Specification: 1. Class I 0-50% weighing up to 25 pounds = 8" 0-10% weighing more than 50 pounds = 10" 2. Class II 50-100% weighing 200 pounds or more = 16" 0-15% weighing up to 25 pounds = 8" 0-10% weighing more than 400 pounds = 20" 3. Class III 50-100% weighing 700 pounds or more = 24" 0-15% weighing up to 25 pounds = 8" 0-10% weighing more than 1400 pounds = 30" 4. Class IV 50-100% weighing 2000 pounds or more = 34" 0-15% weighing up to 400 pounds = 20" 0-10% weighing more than 5400 pounds = 48"
Weight (lbs)	Unit Weight= RADIUS (ft) DIA (IN) 162.24 pcf	
1	0.11	2.7
25	0.33	8.0
30	0.35	8.5
40	0.39	9.3
45	0.40	9.7
50	0.42	10.1
75	0.48	11.5
100	0.53	12.7
150	0.60	14.5
200	0.67	16.0
300	0.76	18.3
400	0.84	20.1
500	0.90	21.7
700	1.01	24.2
800	1.06	25.3
1000	1.14	27.3
1400	1.27	30.5
1500	1.30	31.2
2000	1.43	34.4
2300	1.50	36.0
4000	1.81	43.3
5400	2.00	47.9
6000	2.07	49.6
7800	2.26	54.1

Source: <https://dot.alaska.gov/stwd/des/dcsspecs/assets/pdf/hwyspecs/sshc2020.pdf>

Anchorage Sand and Gravel Riprap Sizes:
Riprap Class I is approx. 1" to 12" in diameter.
Each piece weighs approx. 1 to 75 lbs. = 3"-12"
Riprap Class II is approx. 15" to 21" in diameter.
Each piece weighs approx. 200 to 800 lbs. = 16"-25"
Riprap Class III is approx. 21" to 30" in diameter.
Each piece weighs approx. 800 to 2,300 lbs. = 25"-36"
Riprap Class IV is approx. 33" to 45" in diameter.
Each piece weighs approx. 2,300 to 7,800 lbs. = 36"-54"
Note: Sieve sizes reported do not match calculated diameter.
Source: <https://www.anchsand.com/product-category/aggregate-sand-gravel/rip-rap/>

Critical Velocity Calculation (Determining Upstream Bed Material Mobility)

Legend

Inputs
Common Inputs
Calculated

AEP Event	Flow Value (cfs)	Upstream Reference Reach XS	Average Velocity (fps)	Depth (ft)	D50 (ft)	Vc (fps)	Mobile? (If Vc > Average Velocity - NO; If Vc < Average Velocity - YES)
0.4*Q2	74	XS 1	2.9	1.73	0.052493	4.58243025	NO
		XS 2	2.73	2.39	0.052493	4.83601712	NO
0.4*Q2 SNAP	84	XS 1	3.05	1.87	0.052493	4.64224917	NO
		XS 2	2.87	2.5	0.052493	4.87242147	NO
Q2	185	XS 1	3.96	2.83	0.052493	4.97415429	NO
		XS 2	3.86	3.38	0.052493	5.12358914	NO
Q2 SNAP	210	XS 1	4.16	3.01	0.052493	5.0255384	NO
		XS 2	4.05	3.57	0.052493	5.17050405	NO

HEC-RAS Hydraulic Reference Manual / Estimating Scour at Bridges / Computing Contraction Scour / PDF

Determination of Live-Bed or Clear-Water Contraction Scour

To determine if the flow upstream is transporting bed material (i.e., live-bed contraction scour), the program calculates the critical velocity for beginning of motion Vc (for the D50 size of bed material) and compares it with the mean velocity V of the flow in the main channel or overbank area upstream of the bridge at the approach section. If the critical velocity of the bed material is greater than the mean velocity at the approach section (Vc > V), then clear-water contraction scour is assumed. If the critical velocity of the bed material is less than the mean velocity at the approach section (Vc < V), then live-bed contraction scour is assumed. The user has the option of forcing the program to calculate contraction scour by the live-bed or clear-water contraction scour equation, regardless of the results from the comparison. To calculate the critical velocity, the following equation by Laursen (1963) is used:

$$V_c = K_a y_1^{1/6} D_{50}^{1/3}$$

Symbol	Description	Units
V _c	Critical velocity above which material of size D50 and smaller will be transported	ft/s (m/s)
y ₁	Average depth of flow in the main channel or overbank area at the approach section	ft (m)
D ₅₀	Bed material particle size in a mixture of which 50% are smaller	ft (m)
K _a	11.17 (English Units), 6.19 (S.I. Units)	

Common Alaska DOT&PF Graduations

Based on Alaska DOT Specifications, Table 703-2, version 2020.
 Source: <https://dot.alaska.gov/stwddes/dcsspecs/>

Size (inches)	Sieve Size	C-1	D-1	E-1	F-1	Structural Fill	Ditch Lining
54	54"	100%	100%	100%	100%	100%	100%
48	48"	100%	100%	100%	100%	100%	100%
36	36"	100%	100%	100%	100%	100%	100%
30	30"	100%	100%	100%	100%	100%	100%
24	24"	100%	100%	100%	100%	100%	100%
20	20"	100%	100%	100%	100%	100%	100%
16	16"	100%	100%	100%	100%	100%	100%
12	12"	100%	100%	100%	100%	100%	100%
10	10"	100%	100%	100%	100%	100%	100%
8	8"	100%	100%	100%	100%	100%	100%
5	5"	100%	100%	100%	100%	100%	70%
3	3"	100%	100%	100%	100%	100%	50%
2	2"	100%	100%	100%	100%	97%	33%
1.5	1.5"	100%	100%	100%	100%	94%	18%
1	1"	85%	100%	100%	100%	91%	5%
0.75	0.75"	75%	85%	85%	93%	88%	0%
0.5	0.5"	60%	70%	68%	80%	63%	0%
0.187	#4	45%	50%	50%	68%	38%	0%
0.0787	#10	37%	35%	35%	55%	20%	0%
0.0167	#40	18%	21%	23%	35%	15%	0%
0.0059	#100	11%	12%	17%	25%	9%	0%
0.0030	#200	3%	3%	12%	14%	3%	0%

**TABLE 703-12
 AGGREGATE GRADATION FOR STRUCTURAL FILL**

SIEVE	PERCENT PASSING BY WEIGHT
3 in.	100
3/4 in.	75-100
No. 4	15-60
No. 16	10-30
No. 200	0-6

Percent Passing by Weight

SIEVE	GRADATION			
	BASE COURSE		SURFACE COURSE	
	C-1	D-1	E-1	F-1
1-1/2 in.	100			
1 in.	70-100	100	100	100
3/4 in.	60-90	70-100	70-100	85-100
3/8 in.	45-75	50-80	50-85	60-100
No. 4	30-60	35-65	35-65	50-85
No. 8	22-52	20-50	20-50	40-70
No. 50	6-30	6-30	15-30	25-45
No. 200	0-6	0-6	8-15	8-20

that are sound

Appendix B - Abutment Stability Calculations using HY-8 Model Outputs

Updated: J. Montoya 1/26/2026

Froude Number:	0.515
Q	790 cfs
V	See below
Ss	2.65 (FHWA)
g	32.2 ft/s ²
y (average depth from HY-8)	8.5 ft
K	0.89
Avg Velocity:	
SBR for Left Abutment:	5.4 ft
SBR for Right Abutment:	6.3 ft
V_avg in bridge opening	8.7 ft/s
Per FHWA, use lower value of V through bridge or V through overbanks*:	8.7 ft/s
D50:	1.2679108 ft
D50 for abutments:	1.4 ft
Thickness (larger of 1.5*D50 or D100):	2.1
1.5*D50:	2.1 ft
D100:	1.67 ft
Proposed Thickness:	3 ft
Proposed Extent from toe (smaller of 2x flow depth or 25')	17 ft
Wrap-Around Length (larger of 2x flow depth or 25'):	25 ft

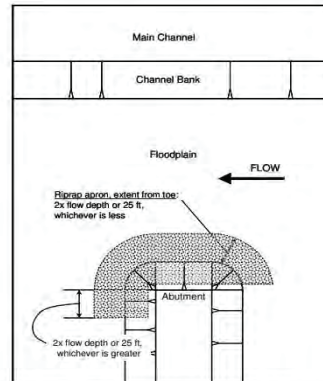
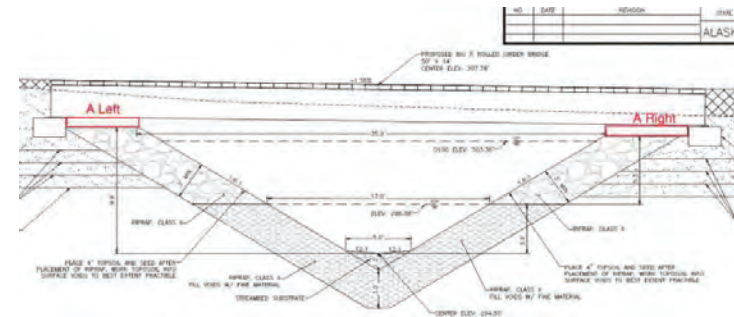


Figure 14.7. Plan view of the extent of rock riprap apron (Lagasse et al. 2006).

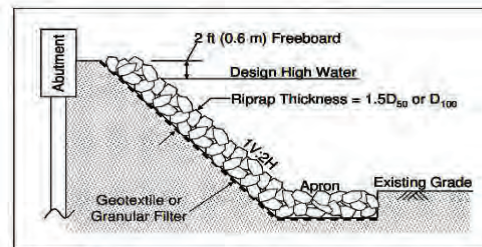


Figure 14.8. Typical cross section for abutment riprap (Lagasse et al. 2006).

For Froude Numbers $(V/(gy)^{1/2}) < 0.80$, the recommended design equation for sizing rock riprap for spill-through and vertical wall abutments is in the form of the Isbash relationship:

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)} \left[\frac{V^2}{gy} \right] \quad (14.1)$$

where:

- D_{50} = median stone diameter, ft (m)
- V = characteristic average velocity in the contracted section (explained below), ft/s (m/s)
- S_s = specific gravity of rock riprap
- g = gravitational acceleration, 32.2 ft/s² (9.81 m/s²)
- y = depth of flow in the contracted bridge opening, ft (m)
- K = 0.89 for a spill-through abutment
1.02 for a vertical wall abutment

For Froude Numbers > 0.80 , Equation 14.2 is recommended:

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)} \left[\frac{V^2}{gy} \right]^{0.14} \quad (14.2)$$

where:

- K = 0.61 for spill-through abutments
- K = 0.69 for vertical wall abutments

In both equations, the coefficient K, is a velocity multiplier to account for the apparent local acceleration of flow at the point of rock riprap failure. Both of these equations are envelope relationships that were forced to over predict 90% of the laboratory data.

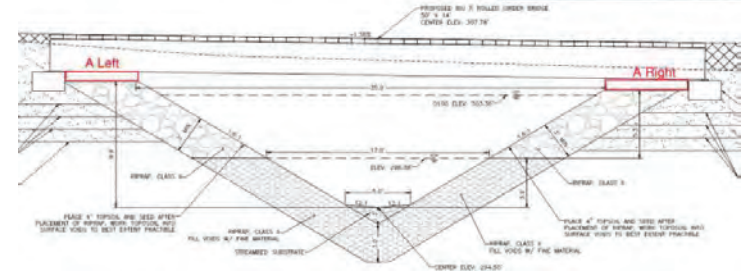
*Unable to accurately calculate overbank flow with the given methods (flow only through red squares in screenshot). Since the velocity through those sections would be higher than the velocity through the entire bridge opening, and the lower velocity is the design value, the velocity through the entire opening was used for design.

Appendix B - Abutment Stability Calculations using Hydraulic Toolbox Model Outputs

Updated: J. Montoya 1/26/2026

Froude Number:	0.515
Q	790 cfs
V	See below
Ss	2.65 (FHWA)
g	32.2 ft/s ²
y _{total}	7.7 ft
Thig	0.89
Avg Velocity:	
SBR for Left Abutment:	5.4 ft
SBR for Right Abutment:	6.3 ft

NO.	DATE	REVISION	BY
			ALASKA



V _{max} in bridge opening (critical velocity in HYD for conservatism) Per FHWA, use lower value of V through bridge or V through overbanks*:	6.1 ft/s
D50:	0.6233183 ft
Proposed D50 for abutments:	1.4 ft
Thickness (larger of 1.5*D50 or D100):	2.1
1.5*D50:	2.1 ft
D100:	1 ft
Proposed Thickness:	3 ft
Proposed Extent from toe (smaller of 2x flow depth or 25')	15.4 ft
Wrap-Around Length (larger of 2x flow depth or 25'):	25 ft

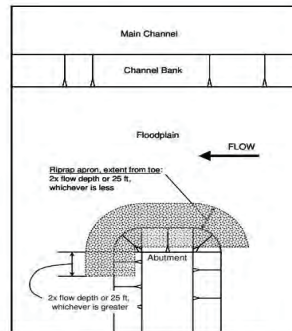


Figure 14.7. Plan view of the extent of rock riprap apron (Lagasse et al. 2006).

For Froude Numbers $(V/(gy))^{1/2} < 0.80$, the recommended design equation for sizing rock riprap for spill-through and vertical wall abutments is in the form of the Isbash relationship:

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)} \left[\frac{V^2}{gy} \right] \quad (14.1)$$

where:

- D₅₀ = median stone diameter, ft (m)
- V = characteristic average velocity in the contracted section (explained below), ft/s (m/s)
- S_s = specific gravity of rock riprap
- g = gravitational acceleration, 32.2 ft/s² (9.81 m/s²)
- y = depth of flow in the contracted bridge opening, ft (m)
- K = 0.89 for a spill-through abutment
1.02 for a vertical wall abutment

*Unable to accurately calculate overbank flow with the given methods (flow only through red squares in screenshot). Since the velocity through those sections would be higher than the velocity through the entire bridge opening, and the lower velocity is the design value, the velocity through the entire opening was used for design.

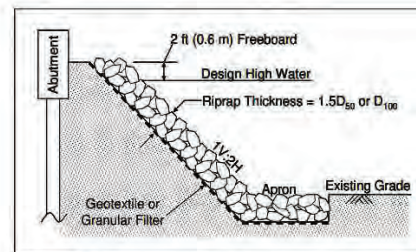


Figure 14.8. Typical cross section for abutment riprap (Lagasse et al. 2006).

For Froude Numbers >0.80, Equation 14.2 is recommended:

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)} \left[\frac{V^2}{gy} \right]^{0.14} \quad (14.2)$$

where:

- K = 0.61 for spill-through abutments
- K = 0.69 for vertical wall abutments

In both equations, the coefficient K₁ is a velocity multiplier to account for the apparent local acceleration of flow at the point of rock riprap failure. Both of these equations are envelope relationships that were forced to over predict 90% of the laboratory data.

Contraction Scour Calcs

Live-Bed vs. Clear-Water Contraction Scour (Laursen 1963): <https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/latest/estimating-scour-at-bridges/computing-contraction-scour/determination-of-live-bed-or-clear-water-contraction-scour>

Assuming Mixture Stable at 2% AEP and Results from 1% AEP in Upstream Reference Reach in Hydraulic Toolbox

y1 (ft)	6.3
D50 (ft)	0.225
Ku	11.17
Vc (ft/s)	7.62206761
Average Velocity in Approach Section* (ft)	4.3
Live-Bed or Clear-Water?	CLEAR-WATER

Determination of Live-Bed or Clear-Water Contraction Scour

To determine if the flow upstream is transporting bed material (i.e., live-bed contraction scour), the program calculates the critical velocity for beginning of motion V_c (for the D50 size of bed material) and compares it with the mean velocity V of the flow in the main channel or overbank area upstream of the bridge at the approach section. If the critical velocity of the bed material is greater than the mean velocity at the approach section ($V_c > V$), then clear-water contraction scour is assumed. If the critical velocity of the bed material is less than the mean velocity at the approach section ($V_c < V$), then live-bed contraction scour is assumed. The user has the option of forcing the program to calculate contraction scour by the live-bed or clear-water contraction scour equation, regardless of the results from the comparison. To calculate the critical velocity, the following equation by Laursen (1963) is used:

$$V_c = K_u y_1^{1/6} D_{50}^{1/2}$$

Symbol	Description	Units
V_c	Critical velocity above which material of size D50 and smaller will be transported	ft/s (m/s)
y_1	Average depth of flow in the main channel or overbank area at the approach section	ft (m)
D_{50}	Bed material particle size in a mixture of which 50% are smaller	ft (m)
K_u	11.17 (English Units), 6.19 (S.I. Units)	

Legend

Inputs
Common Inputs
Calculated
Good
Check

Clear-Water Scour Calculation (Laursen 1963): <https://www.hec.usace.army.mil/confluence/rasdocs/ras1dtechref/latest/estimating-scour-at-bridges/computing-contraction-scour/clear-water-contraction-scour>

Assuming Mixture Stable at 2% AEP and Results from 1% AEP in Bridge Channel in Hydraulic Toolbox

Dm (1.25xD50) (ft)	0.28125
D50 (ft) - 2.7 in	0.225
C	130
Q (cfs) - 1% AEP	790
W (ft) (top width of flow) (Hydraulic Toolbox)	29.3
Scour Flow Depth (ft)	3.00463466
Current Flow Depth (ft)	7.7
Check	GOOD

Clear-Water Contraction Scour

The recommended clear-water contraction scour equation by the HEC No. 18 publication is an equation based on research from Laursen (1963):

$$y_2 = \left[\frac{Q_2^2}{CD_m^{2/3} W_2^2} \right]^{3/7}$$

$$y_s = y_2 - y_0$$

Symbol	Description	Units
D_m	Diameter of the smallest non-transportable particle in the bed material (1.25 D50) in the contracted section	feet (meters)
D_{50}	Median diameter of the bed material	feet (meters)
C	130 for English units (40 for metric)	

Appendix B - Hydraulic Toolbox Results Table for Relevant Flood Events

Hydraulic Toolbox Channel	Flood Event (% AEP)	Design Discharge (cfs)	Depth (ft)	Velocity (fps)
Bridge Channel	50	210	4.3	4.4
	2	675	7.2	5.9
	1	790	7.7	6.1
Tailwater Channel Outside Bridge	50	210	3.8	3.7
	2	675	6	4.1
	1	790	6.3	4.3
US RR Bankfull	0.4*2 (Regression)	74	1.7	2.9
	0.4*2 (Regression + SNAP)	84	1.9	3
	2 (Regression)	185	2.8	4
	2 (Regression + SNAP)	210	3	4.2
US RR Bankfull 2	0.4*2 (Regression)	74	2.4	2.7
	0.4*2 (Regression + SNAP)	84	2.5	2.9
	2 (Regression)	185	3.4	3.9
	2 (Regression + SNAP)	210	3.6	4
DS RR Bankfull	0.4*2 (Regression)	74	2.1	3.5
	0.4*2 (Regression + SNAP)	84	2.2	3.6
	2 (Regression)	185	3.4	3.8
	2 (Regression + SNAP)	210	3.6	3.9

Note: US = upstream; DS = downstream; RR = reference reach; AEP = Annual Exceedance Probability; cfs = cubic feet per second; ft = feet; fps = feet per second.

Appendix D – HY-8 and Hydraulic Toolbox Analyses

Existing Conditions – Upper Tyonek Creek Crossing – Hydraulic Toolbox Analysis of the 2-Year Flow as Compared to Bankfull Discharge (Upstream Reference Reach Head of Riffle at Top, Upstream Reference Reach Bottom of Riffle in Middle, and Downstream Reference Reach Head of Riffle at Bottom)

US RR Bankfull

Type: **Cross Section** Define...

Side Slope 1 (Z1): 2.0 H: 1V
 Side Slope 2 (Z2): 2.0 H: 1V
 Channel Width (B): 5.0 (ft)
 Pipe Diameter (D): 0.0 (ft)
 Longitudinal Slope: 0.03 (ft/ft)
 Manning's Roughness: 0.0400

Enter Flow: 210.000 (cfs)
 Enter Depth: 1.801 (ft)

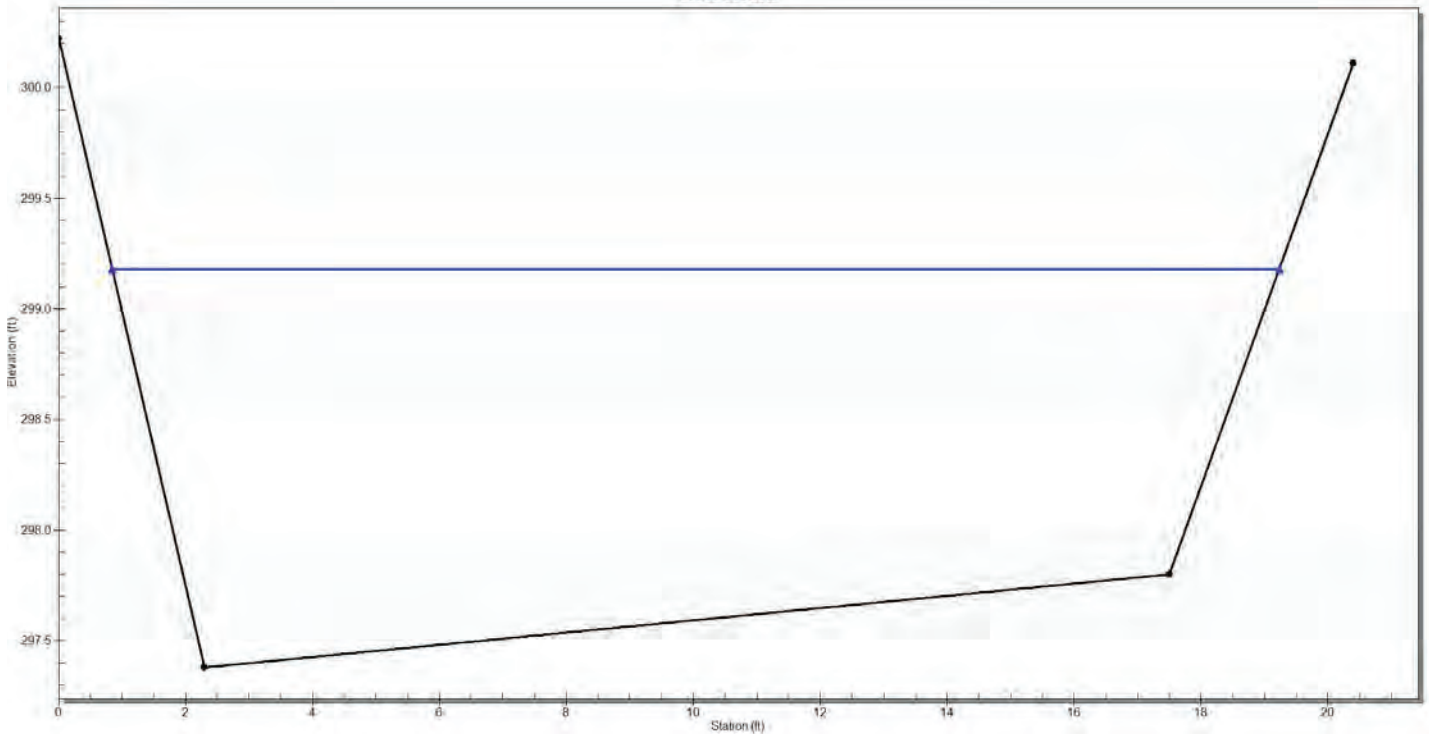
Calculate

Plot... Compute Curves...

Parameter	Value	Units
Flow	210.000	cfs
Depth	1.801	ft
Area of Flow	26.690	sq ft
Wetted Perimeter	19.739	ft
Hydraulic Radius	1.352	ft
Average Velocity	7.868	fps
Top Width (T)	18.392	ft
Froude Number	1.151	
Critical Depth	1.951	ft
Critical Velocity	7.124	fps
Critical Slope	0.02218	ft/ft
Critical Top Width	18.702	ft
Max Shear Stress	3.371	lb/ft ²
Avg Shear Stress	2.531	lb/ft ²
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0400	

OK Cancel

Cross Section



US RR Bankfull 2

Type: **Cross Section** Define...

Side Slope 1 (Z1): 2.0 H : 1V
 Side Slope 2 (Z2): 2.0 H : 1V
 Channel Width (B): 5.0 (ft)
 Pipe Diameter (D): 0.0 (ft)
 Longitudinal Slope: 0.03 (ft/ft)
 Manning's Roughness: 0.0399

Enter Flow: 210.000 (cfs)
 Enter Depth: 2.454 (ft)

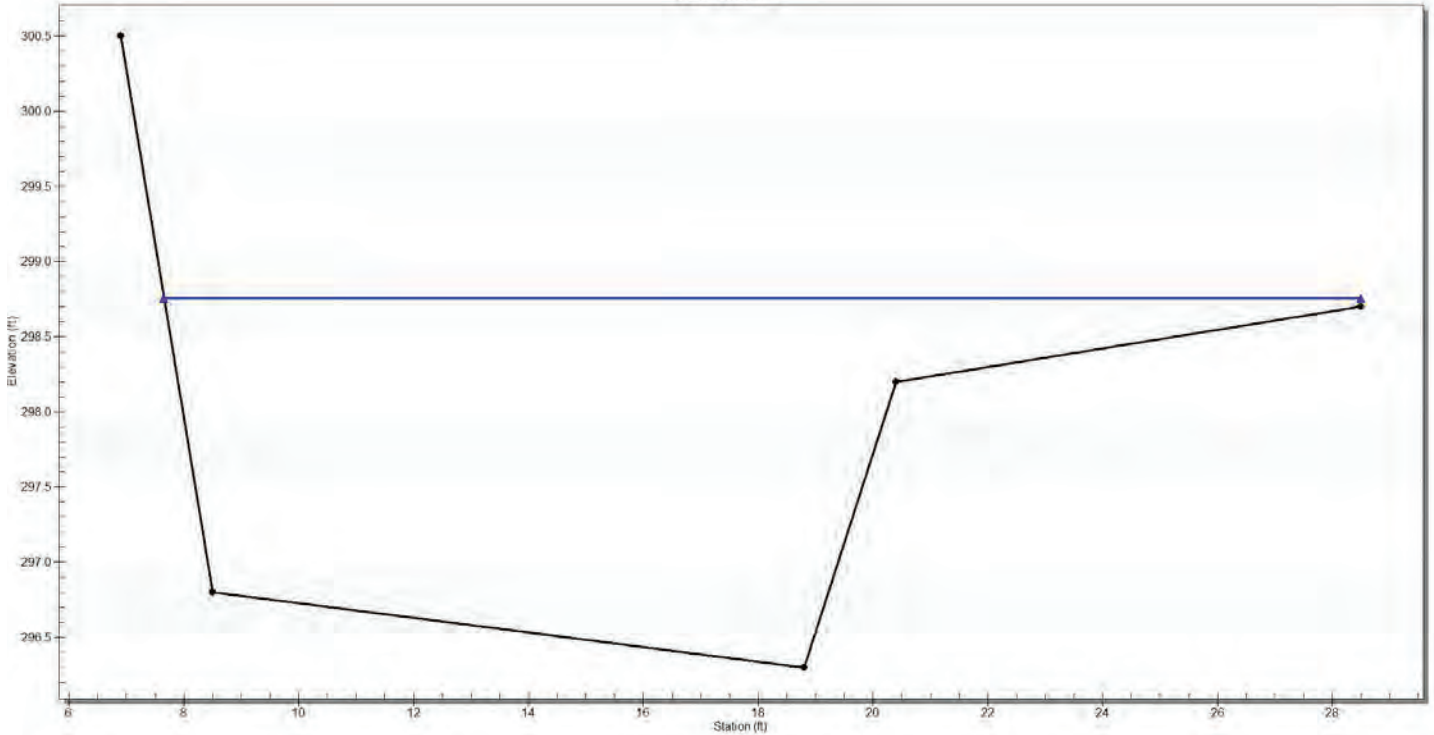
Calculate

Plot... Compute Curves...

Parameter	Value	Units
Flow	210.000	cfs
Depth	2.454	ft
Area of Flow	28.393	sq ft
Wetted Perimeter	23.094	ft
Hydraulic Radius	1.229	ft
Average Velocity	7.396	fps
Top Width (T)	20.845	ft
Froude Number	1.117	
Critical Depth	2.559	ft
Critical Velocity	6.866	fps
Critical Slope	0.02357	ft/ft
Critical Top Width	20.890	ft
Max Shear Stress	4.594	lb/ft ²
Avg Shear Stress	2.302	lb/ft ²
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0399	

OK Cancel

Cross Section



DS RR Bankfull [X]

Type: **Cross Section** [Define...]

Side Slope 1 (Z1): 2.0 H : 1V
 Side Slope 2 (Z2): 2.0 H : 1V
 Channel Width (B): 5.0 (ft)
 Pipe Diameter (D): 0.0 (ft)
 Longitudinal Slope: 0.015 (ft/ft)
 Manning's Roughness: 0.0399

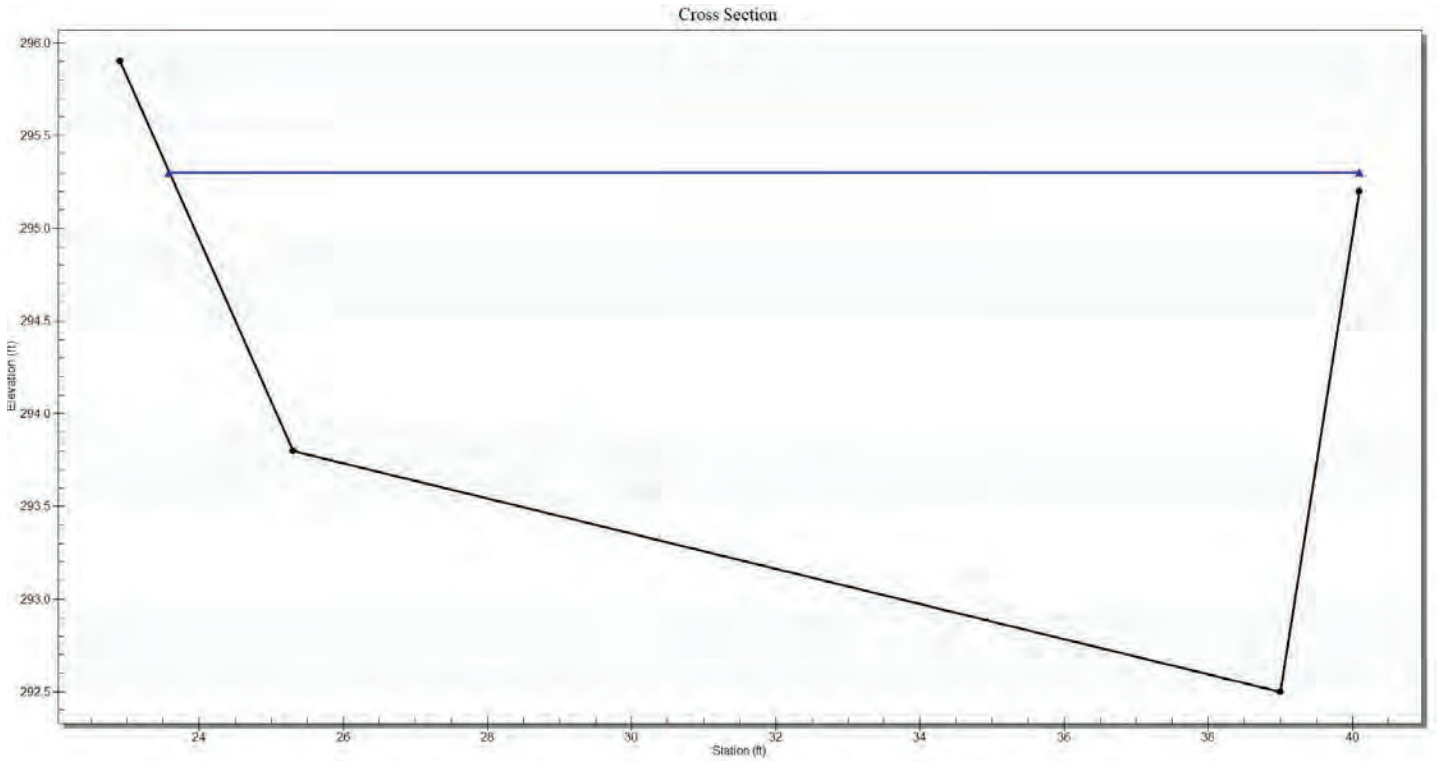
Enter Flow: 210.000 (cfs)
 Enter Depth: 2.800 (ft)

[Calculate]

[Plot...] [Compute Curves...]

Parameter	Value	Units
Flow	210.000	cfs
Depth	2.800	ft
Area of Flow	32.331	sq ft
Wetted Perimeter	19.054	ft
Hydraulic Radius	1.697	ft
Average Velocity	6.495	fps
Top Width (T)	16.514	ft
Froude Number	0.818	
Critical Depth	2.539	ft
Critical Velocity	7.481	fps
Critical Slope	0.02306	ft/ft
Critical Top Width	16.151	ft
Max Shear Stress	2.621	lb/ft ²
Avg Shear Stress	1.588	lb/ft ²
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0399	

[OK] [Cancel]



Existing Conditions – Upper Tyonek Creek Crossing

Parameter	Value
DISCHARGE DATA	
Discharge Method	User-Defined

XY Series Editor

Number	Name	Flow (cfs)
1	40% of 50% AEP	85.0
2	50% AEP	210.0
3	2% AEP	675.0
4	1% AEP	790.0
5	168% of 1% AEP	1325.0

Channel

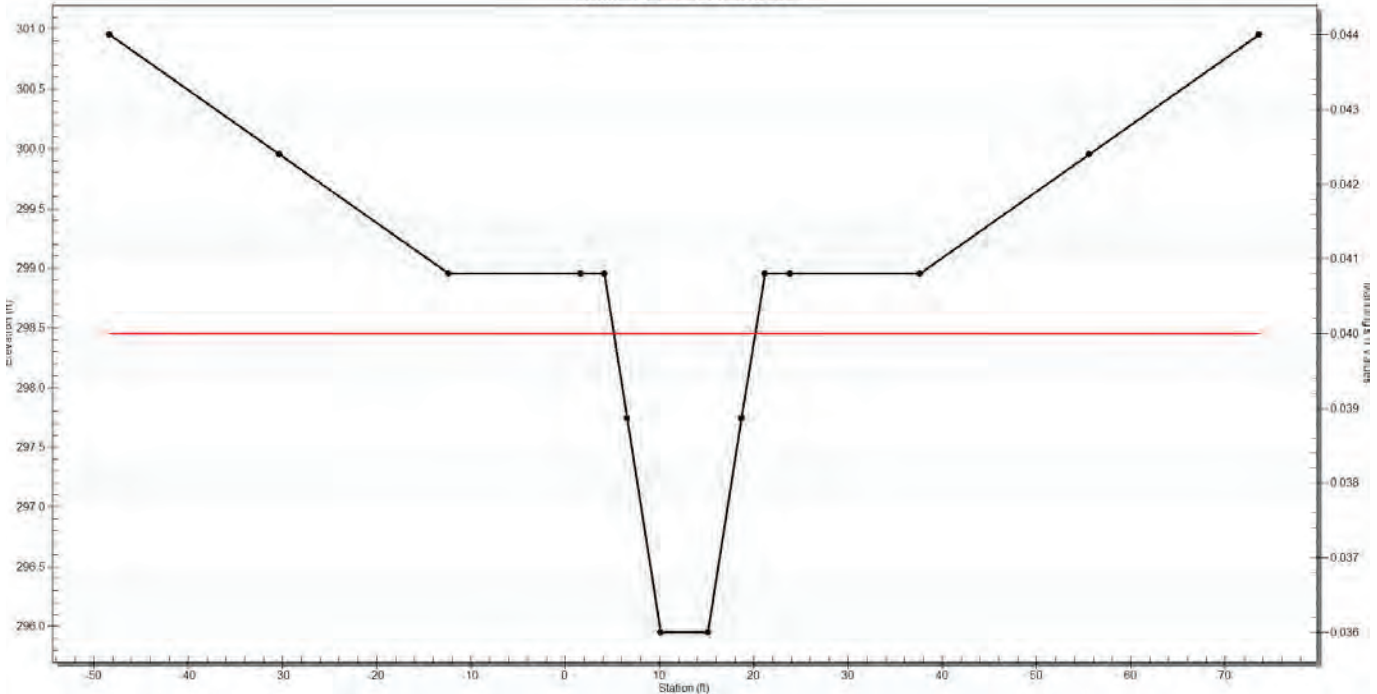
Slope of Channel: ft/ft

Number of Cross-sec Points:

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	-48.346	300.953	0.0400
2	-30.346	299.953	0.0400
3	-12.346	298.953	0.0400
4	1.646	298.953	0.0400
5	4.157	298.953	0.0400
6	6.585	297.739	0.0400
7	10.162	295.950	0.0400
8	15.162	295.950	0.0400
9	18.728	297.739	0.0400
10	21.157	298.953	0.0400
11	23.851	298.953	0.0400
12	37.611	298.953	0.0400
13	55.611	299.953	0.0400
14	73.611	300.953	0.0400

Tailwater/Channel Cross Section



Existing North Culvert – HY-8 Inputs

Culvert Properties

North Culvert
South Culvert

Add Culvert
Duplicate Culvert
Delete Culvert
Alternative Des

Parameter	Value	Units
CULVERT DATA		
Name	North Culvert	
Shape	User Defined	
Material	Corrugated Metal Riveted or Welded	
Coordinates	Define...	
Span	9.300	ft.
Rise	7.040	ft.
Embedment De...	0.000	in.
Manning's n (Top/Sid...	0.030	
Manning's n (Bottom)	0.030	
Culvert Type	Straight	
Inlet Configurat...	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft.
Inlet Elevation	296.210	ft.
Outlet Station	59.970	ft.
Outlet Elevation	296.020	ft.
Number of Barrels	1	
Computed Culvert Slope	0.003168	ft/ft

Culvert Properties

North Culvert
South Culvert

Add Culvert
Duplicate Culvert
Delete Culvert
Alternativ

Parameter	Value
CULVERT DATA	
Name	North Culvert
Shape	User Defined
Material	Corrugated Metal Riveted or Welded

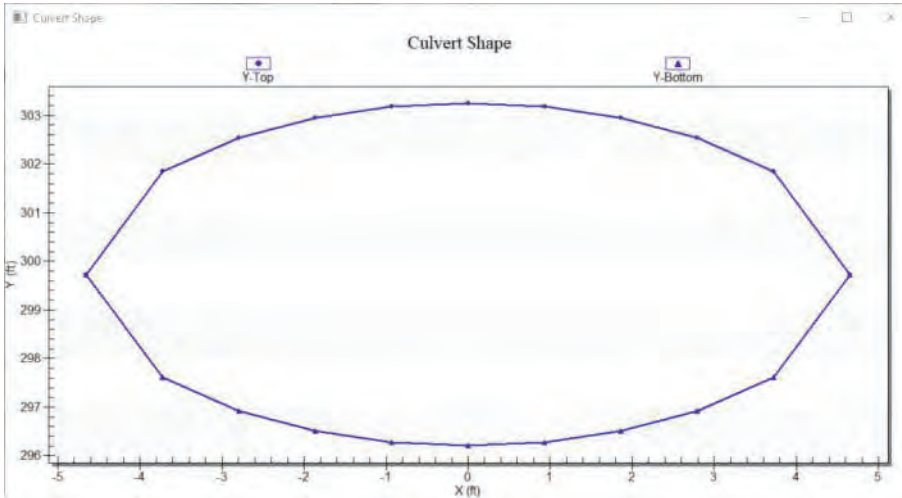
User Defined Culvert Shape

Number of X points: 11

Each X has a Y-top and

Irregular Culvert Cross

Number	X (ft)	Y-Top (ft)	Y-Bottom (ft)
1	-4.6500	299.7300	299.7300
2	-3.7200	301.8420	297.6180
3	-2.7900	302.5460	296.9140
4	-1.8600	302.9561	296.5039
5	-0.9300	303.1789	296.2811
6	0.0000	303.2500	296.2100
7	0.9300	303.1789	296.2811
8	1.8600	302.9561	296.5039
9	2.7900	302.5460	296.9140
10	3.7200	301.8420	297.6180
11	4.6500	299.7300	299.7300



Existing South Culvert – HY-8 Inputs

Culvert Properties

North Culvert
South Culvert

Add Culvert
 Duplicate Culvert
 Alternative Designs
 Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	South Culvert	
Shape	User Defined	
Material	Corrugated Metal Riveted or Welded	
Coordinates	Define...	
Span	8.970	ft
Rise	7.100	ft
Embedment Depth	0.000	in
Manning's n (Top/Sides)	0.030	
Manning's n (Bottom)	0.030	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	296.000	ft
Outlet Station	60.020	ft
Outlet Elevation	295.950	ft
Number of Barrels	1	
Computed Culvert Slope	0.000833	ft/ft

CULVERT DATA

Name: South Culvert

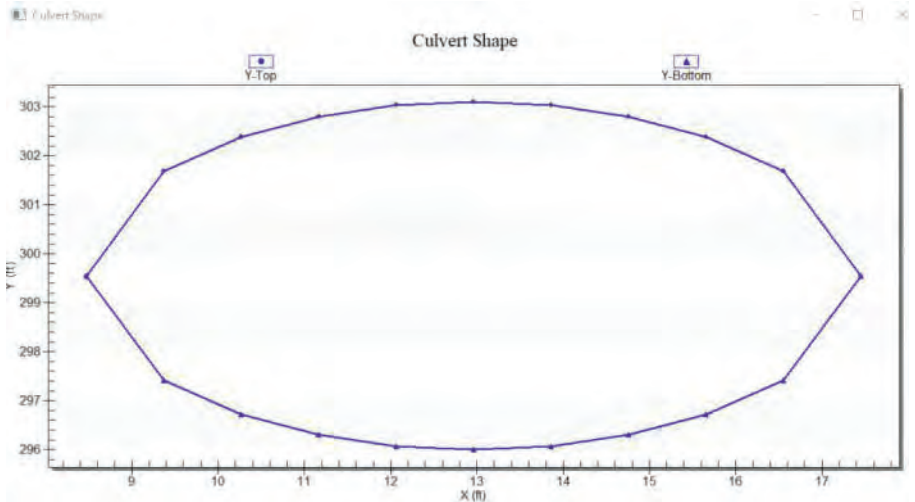
User Defined Culvert Shape

Number of X points: 11

Each X has a Y-top and

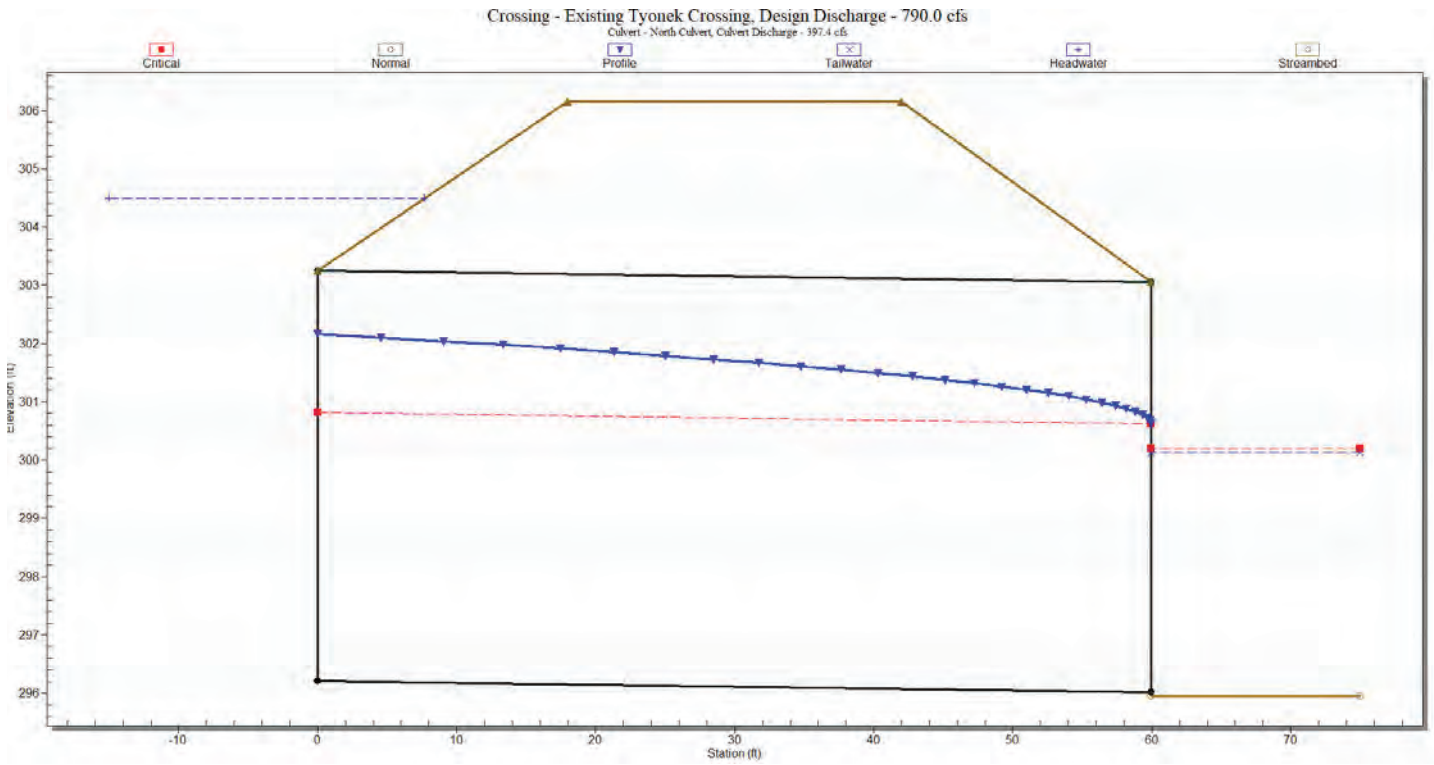
Irregular Culvert Cross

Number	X (ft)	Y-Top (ft)	Y-Bottom (ft)
1	8.4775	299.5500	299.5500
2	9.3745	301.6800	297.4200
3	10.2715	302.3900	296.7100
4	11.1685	302.8036	296.2964
5	12.0655	303.0283	296.0717
6	12.9625	303.1000	296.0000
7	13.8595	303.0283	296.0717
8	14.7565	302.8036	296.2964
9	15.6535	302.3900	296.7100
10	16.5505	301.6800	297.4200
11	17.4475	299.5500	299.5500

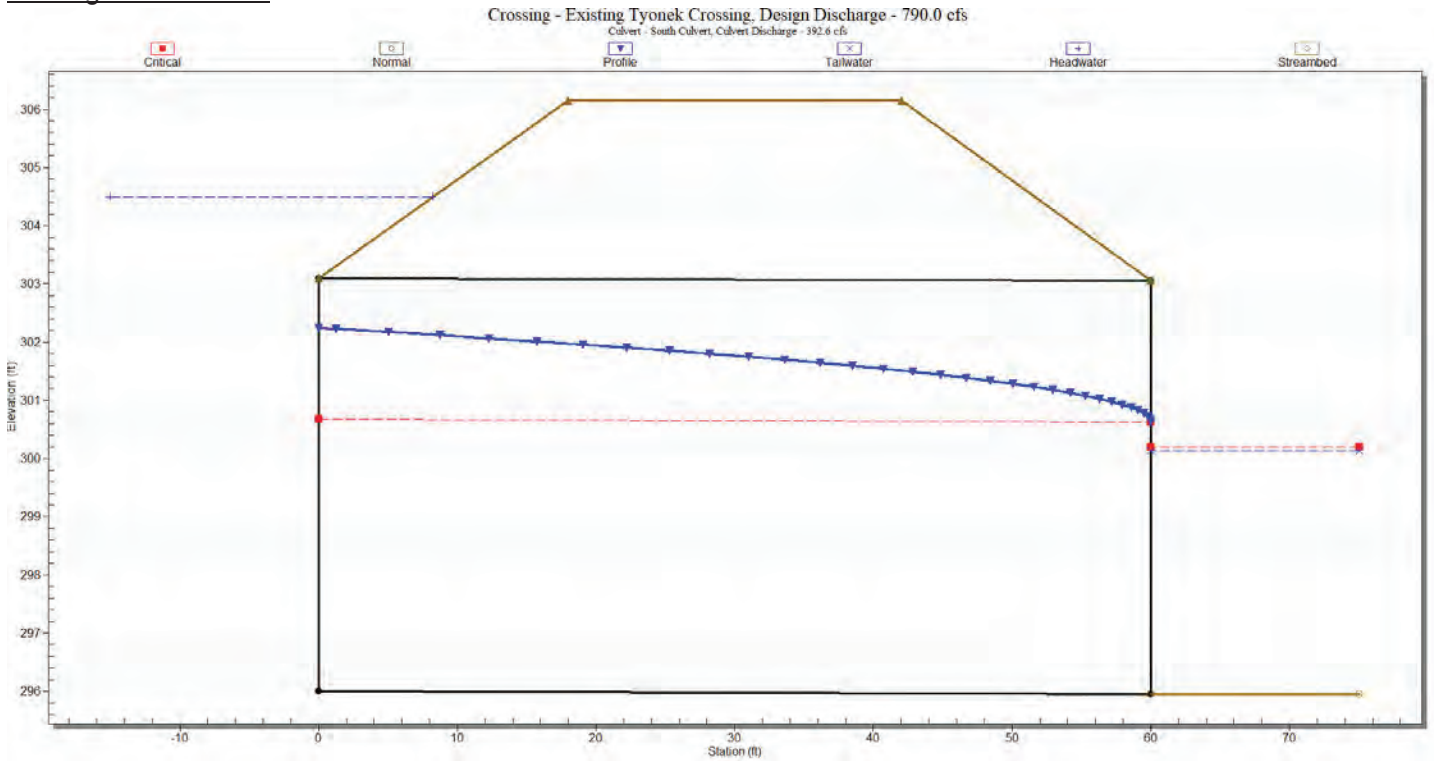


Existing Conditions – Profiles at 1 Percent AEP

Existing North Culvert



Existing South Culvert



Proposed Conditions – Upper Tyonek Creek Crossing – HY-8 Inputs

XY Series Editor		
Number	Names	Flow (cfs)
1	40% of 50% AEP	84.0
2	50% AEP	210.0
3	2% AEP	675.0
4	1% AEP	790.0

Crossing Data - Proposed Bridge (1/26/2026) (with reconstructed tailwater)

Crossing Properties
Name: with reconstructed tailwater

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	User-Defined	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Irregular Channel	
Irregular Channel	Define...	
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	50.000	ft
Crest Elevation	307.440	ft
Roadway Surface	Gravel	
Top Width	14.000	ft

Culvert Properties

Proposed Bridge (1/26/2025)

Add Culvert Duplicate Culvert Alternative Designs Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Proposed Bridge (1/26/2025)	
Shape	User Defined	
Material	Corrugated Metal Riveted or Welded	
Coordinates	Define...	
Span	47.590	ft
Rise	10.940	ft
Embedment Depth	0.000	in
Manning's n (Top/Sides)	0.030	
Manning's n (Bottom)	0.040	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	294.534	ft
Outlet Station	15.000	ft
Outlet Elevation	294.466	ft
Number of Barrels	1	
Computed Culvert Slope	0.004533	ft/ft

Help Click on any ? icon for help on a specific topic Low Flow AOP Energy Dissipation Analyze Crossing OK Cancel

Proposed Conditions – Upper Tyonek Creek Crossing – HY-8 Inputs Continued (Bridge Geometry)

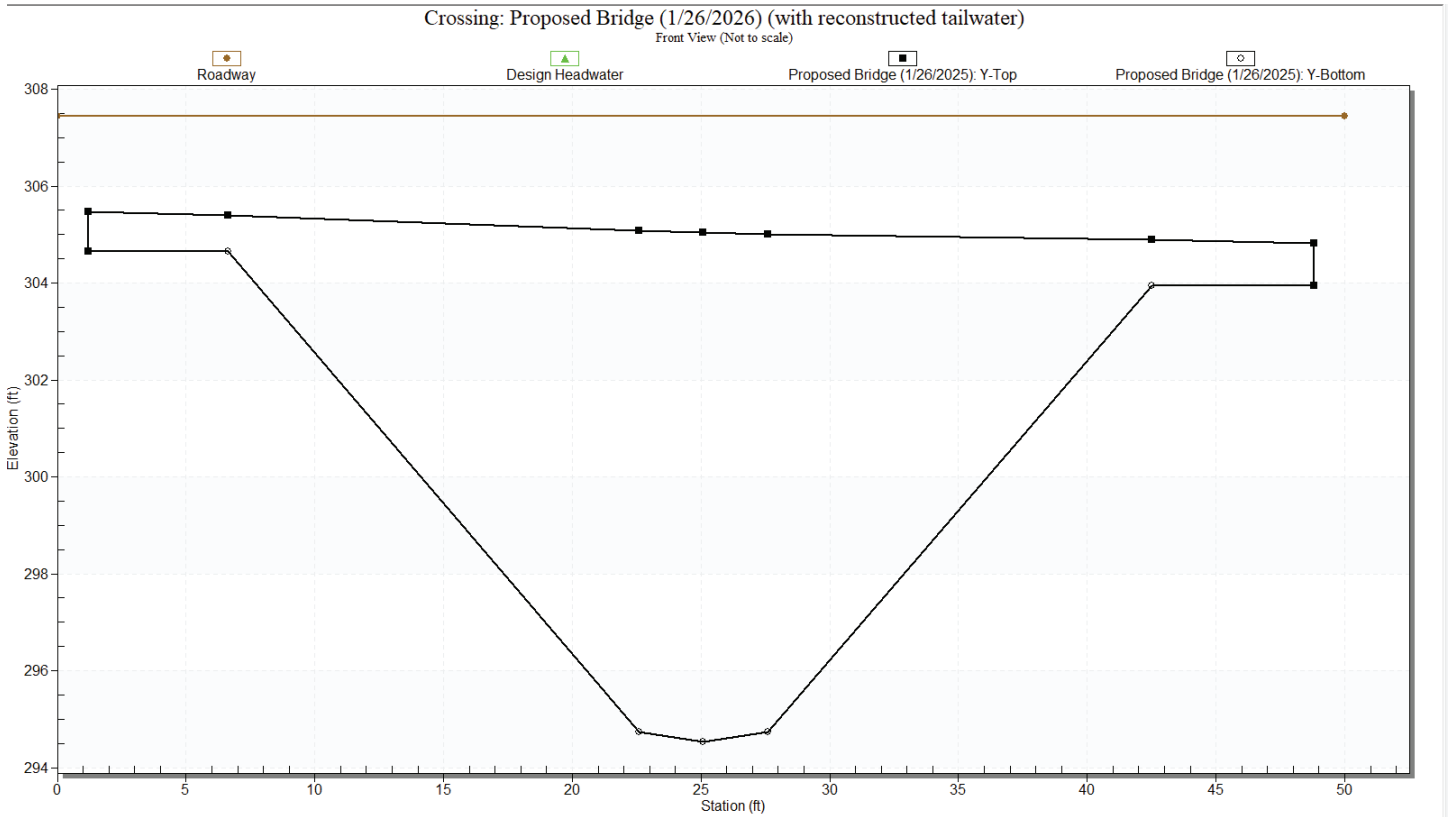
User Defined Culvert Shape

Number of X points (2-19):

Each X has a Y-top and Y-Bottom

Irregular Culvert Cross Section

Number	X (ft)	Y-Top (ft)	Y-Bottom (ft)
1	0.0000	305.4400	304.6100
2	5.4100	305.3700	304.6100
3	21.3800	305.0500	294.7100
4	23.8800	305.0100	294.5000
5	26.3800	304.9800	294.7100
6	41.3100	304.8600	303.9100
7	47.5900	304.7800	303.9100



Proposed Conditions – Upper Tyonek Creek Crossing – HY-8 Inputs Continued (Tailwater Geometry = Reconstructed Channel Typical Geometry Tied-In to Existing Ground)

User-Defined Cross Section

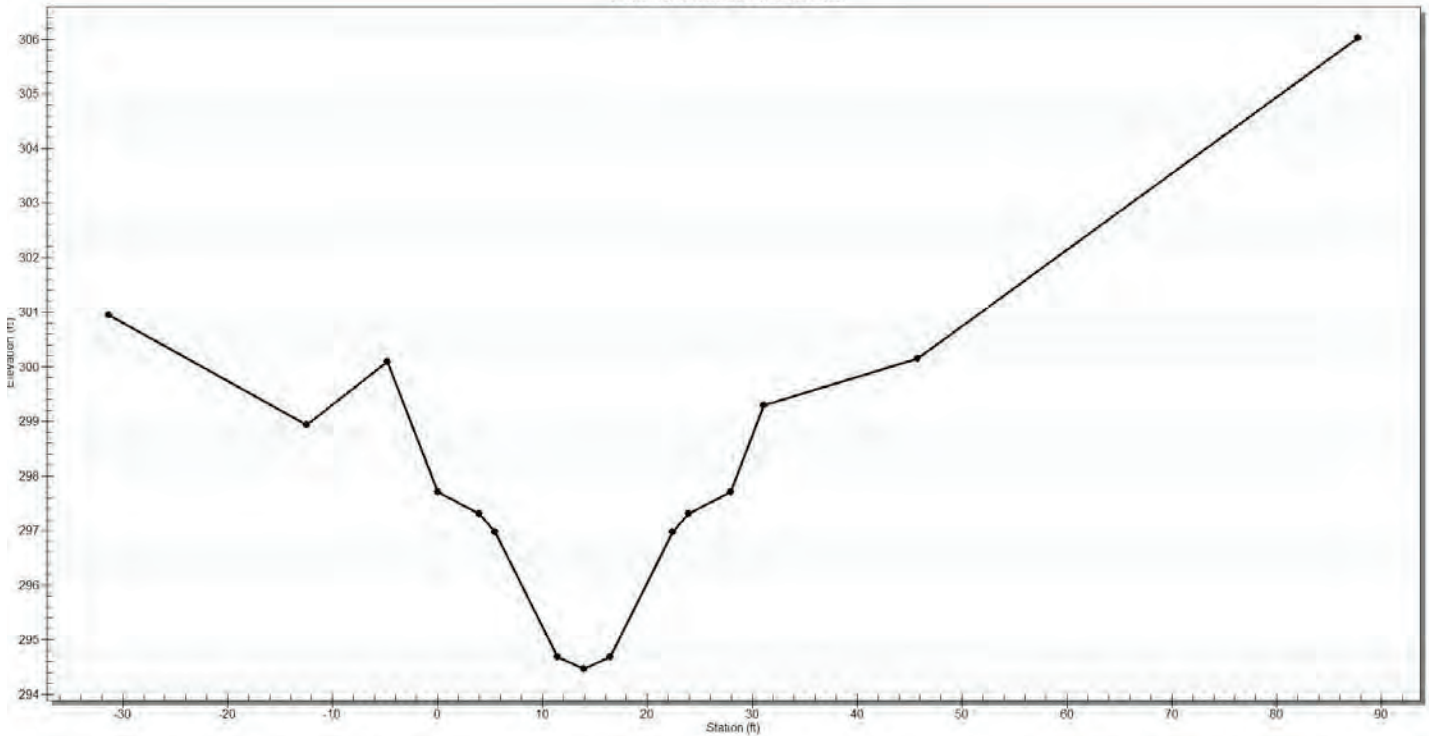
Channel File
Browse for Existing .TW File

Channel
Slope of Channel: ft/ft
Number of Cross-sec Points:

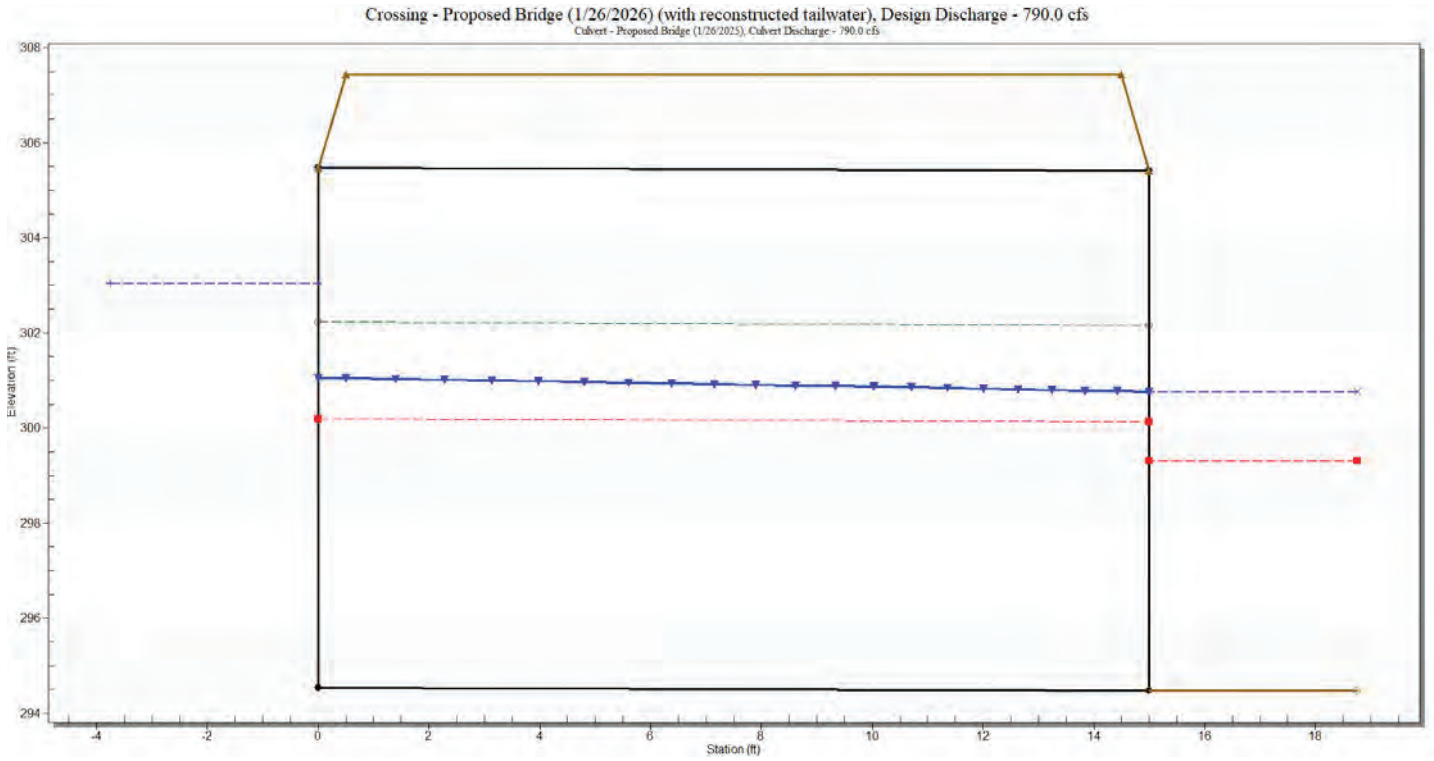
Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	-31.310	300.950	0.0400
2	-12.470	298.930	0.0400
3	-4.760	300.090	0.0400
4	0.000	297.710	0.0400
5	4.000	297.310	0.0400
6	5.500	296.980	0.0400
7	11.450	294.680	0.0400
8	13.950	294.470	0.0400
9	16.450	294.680	0.0400
10	22.430	296.980	0.0400
11	23.930	297.310	0.0400
12	27.930	297.710	0.0400
13	31.080	299.290	0.0400
14	45.780	300.150	0.0400
15	87.710	306.020	

Tailwater/Channel Cross Section



Proposed Conditions – Profile at 1 Percent AEP



Proposed Conditions – Upper Tyonek Creek Crossing – Hydraulic Toolbox Analysis

Bridge Channel
✕

Type: Cross Section Define...

Side Slope 1 (Z1): 2.0 H : 1V

Side Slope 2 (Z2): 2.0 H : 1V

Channel Width (B): 5.0 (ft)

Pipe Diameter (D): 0.0 (ft)

Longitudinal Slope: 0.0045 (ft/ft)

Manning's Roughness: 0.0400

Parameter	Value	Units
Flow	790.000	cfs
Depth	7.712	ft
Area of Flow	129.109	sq ft
Wetted Perimeter	33.558	ft
Hydraulic Radius	3.847	ft
Average Velocity	6.119	fps
Top Width (T)	29.278	ft
Froude Number	0.513	
Critical Depth	5.668	ft
Critical Velocity	10.393	fps
Critical Slope	0.01851	ft/ft
Critical Top Width	22.662	ft
Max Shear Stress	2.166	lb/ft ²
Avg Shear Stress	1.080	lb/ft ²
Composite Manning's n Equ...	Lotter ...	
Manning's Roughness	0.0400	

Enter Flow: 790.000 (cfs)

Enter Depth: 7.712 (ft)

Calculate

Plot...
Compute Curves...

OK
Cancel

User-Defined Cross Section

Channel File
Browse for Existing .TW File

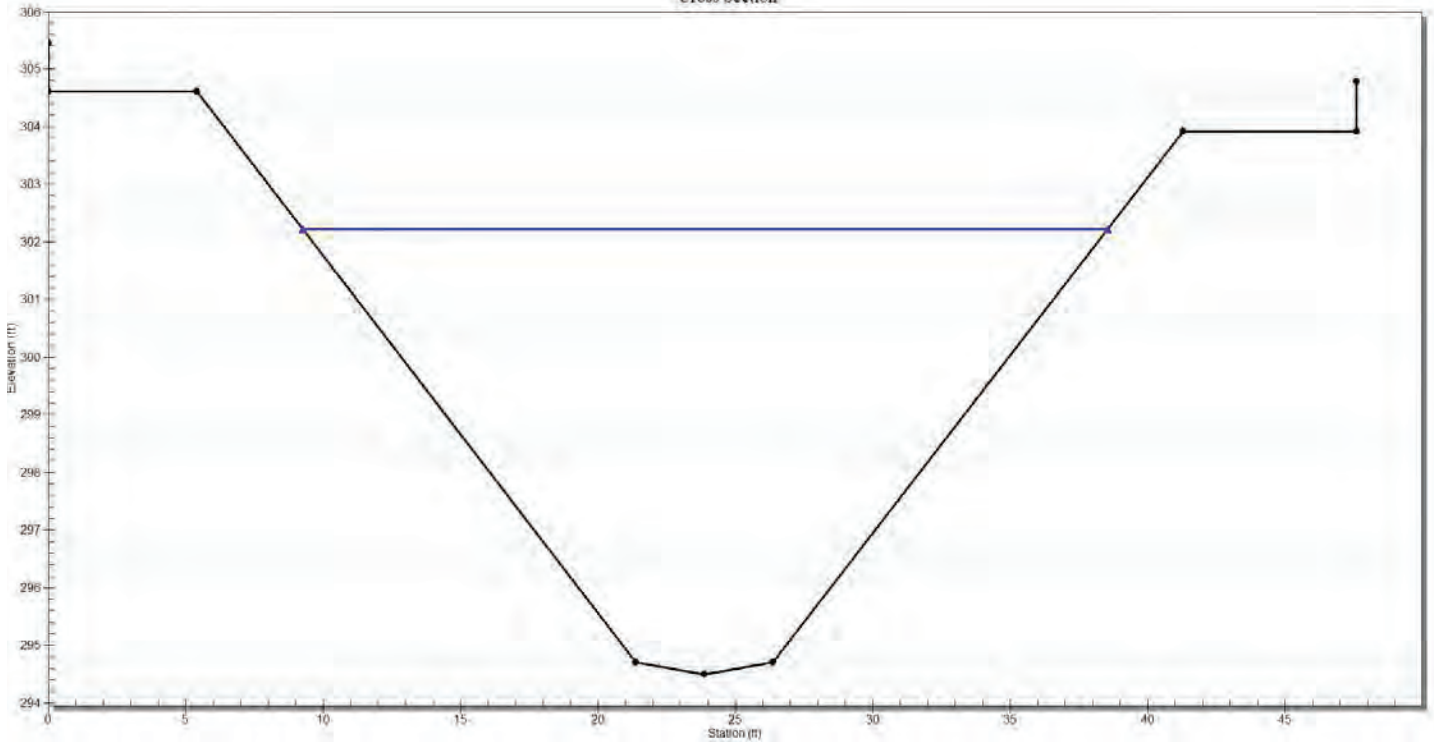
Channel
Slope of Channel: ft/ft
Number of Cross-sec Points:

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	305.440	0.0400
2	0.000	304.610	0.0400
3	5.410	304.610	0.0400
4	21.380	294.710	0.0400
5	23.880	294.500	0.0400
6	26.380	294.710	0.0400
7	41.310	303.910	0.0400
8	47.590	303.910	0.0400
9	47.590	304.780	

Plot Manning's n values

Cross Section



Bridge Channel Geometry

X	Ytop	Ybot
0	305.44	304.61
5.41	305.37	304.61
21.38	305.05	294.71
23.88	305.01	294.5
26.38	304.98	294.71
41.31	304.86	303.91
47.59	304.78	303.91

Reconstructed Tailwater Channel outside of Bridge Geometry

X	Y
-31.31	300.95
-12.47	298.93
-4.76	300.09
0	297.71
4	297.31
5.5	296.98
11.45	294.68
13.95	294.47
16.45	294.68
22.43	296.98
23.93	297.31
27.93	297.71
31.08	299.29
45.78	300.15
87.71	306.02

Bridge Channel Geometry (HYD)

X	Ybot
0	305.44
0	304.61
5.41	304.61
21.38	294.71
23.88	294.5
26.38	294.71
41.31	303.91
47.59	303.91
47.59	304.78

HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Outlet Velocity (ft/s)
Existing Tyonek Crossing	North Culvert	168% of 1% AEP	1325.00	566.62	307.43	10.86	11.217	1.59	7.04	5.58	5.58	13.46
Existing Tyonek Crossing	South Culvert	168% of 1% AEP	1325.00	551.28	307.43	10.91	11.427	1.61	7.10	5.61	5.61	13.49
Proposed Bridge (1/26/2026) (with reconstructed tailwater)	Proposed Bridge (1/26/2025)	1% AEP	790.00	790.00	303.03	5.35	8.499	0.78	7.69	5.67	6.29	8.70

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 2 - Summary of Culvert Flows at crossing: Existing Tyonek Crossing

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	North Culvert Discharge (cfs)	South Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
298.51	40% of 50% AEP	85.00	40.72	44.29	0.00	7
299.97	50% AEP	210.00	103.05	106.95	0.00	5
303.65	2% AEP	675.00	338.36	336.64	0.00	6
304.49	1% AEP	790.00	397.39	392.62	0.00	3
307.43	168% of 1% AEP	1325.00	566.62	551.28	207.09	6
306.15	Overtopping	995.15	503.96	491.19	0.00	Overtopping

Rating Curve Plot for crossing: Existing Tyonek Crossing

Total Rating Curve
Crossing: Existing Tyonek Crossing

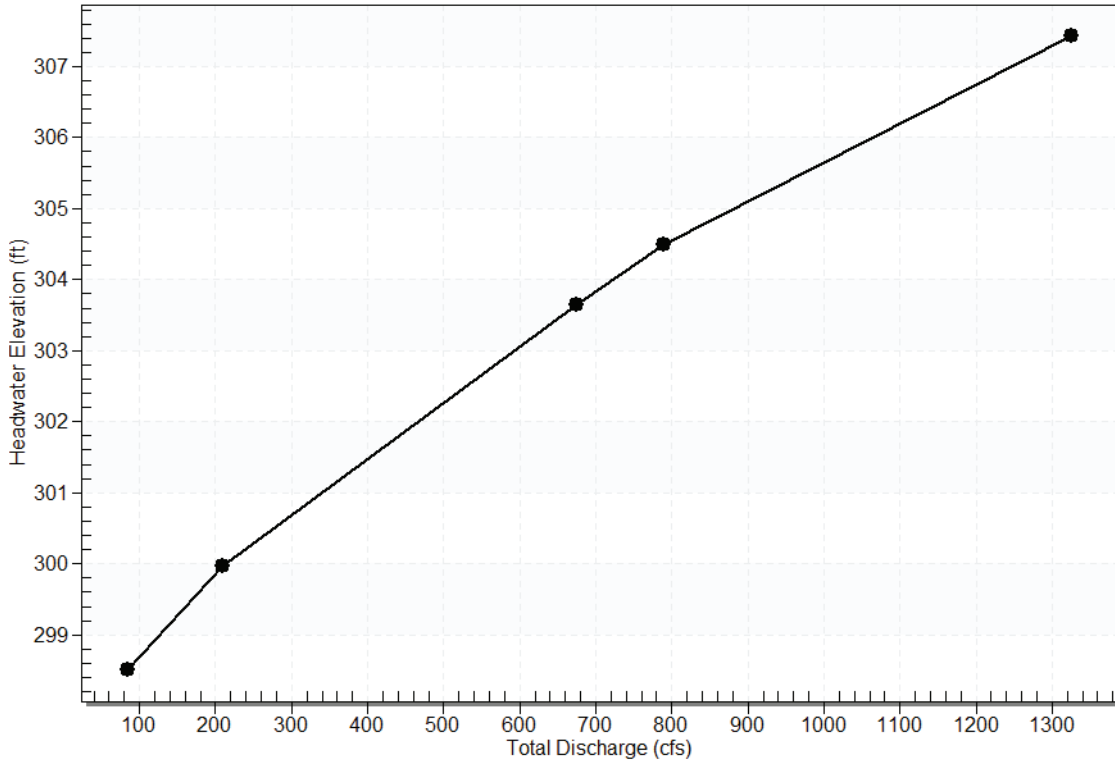


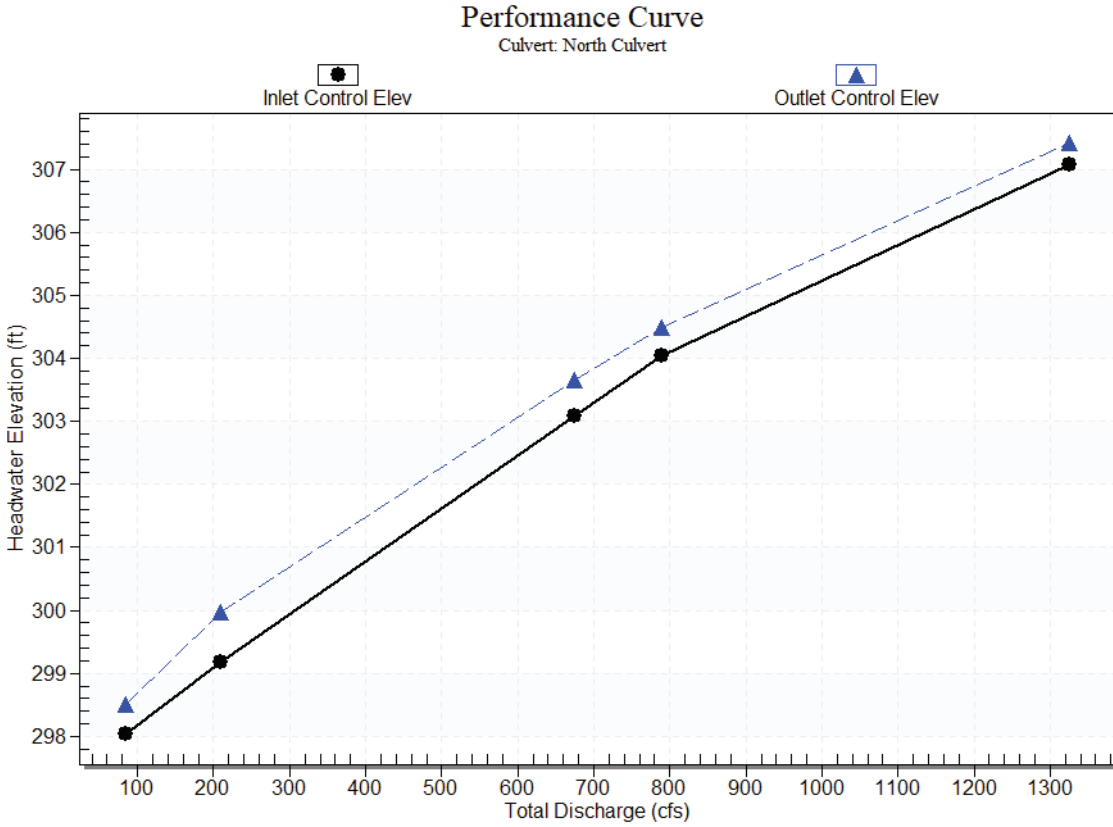
Table 3 - Culvert Summary Table: North Culvert

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40% of 50% AEP	85.00	40.72	298.51	1.82	2.303	0.33	3-M2t	2.07	1.42	1.58	1.65	4.82	6.23
50% AEP	210.00	103.05	299.97	2.97	3.760	0.53	3-M2t	3.42	2.27	2.53	2.60	6.42	7.95
2% AEP	675.00	338.36	303.65	6.89	7.440	1.06	7-M2c	7.04	4.24	4.24	4.04	10.79	6.48
1% AEP	790.00	397.39	304.49	7.83	8.279	1.18	7-M2c	7.04	4.61	4.61	4.18	11.53	6.75
168% of 1% AEP	1325.00	566.62	307.43	10.86	11.217	1.59	7-M2c	7.04	5.58	5.58	4.72	13.46	7.70

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 296.21 ft
Outlet Elevation (invert): 296.02 ft
Culvert Length: 59.97 ft
Culvert Slope: 0.00 ft/ft

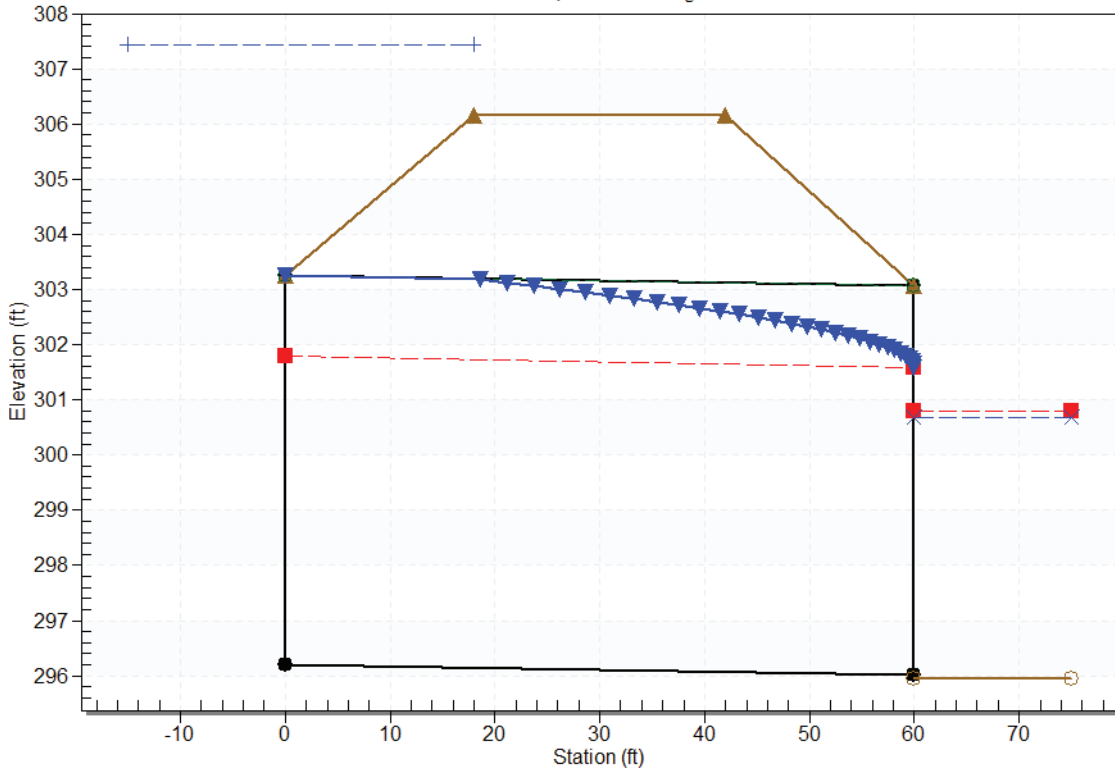
Culvert Performance Curve Plot: North Culvert



Water Surface Profile Plot for Culvert: North Culvert

Crossing - Existing Tyonek Crossing, Design Discharge - 1325.0 cfs

Culvert - North Culvert, Culvert Discharge - 566.6 cfs



Site Data - North Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 296.21 ft

Outlet Station: 59.97 ft

Outlet Elevation: 296.02 ft

Number of Barrels: 1

Culvert Data Summary - North Culvert

Barrel Shape: User Defined

Barrel Span: 9.30 ft

Barrel Rise: 7.04 ft

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 in

Barrel Manning's n: 0.0300 (top and sides)

Manning's n: 0.0300 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

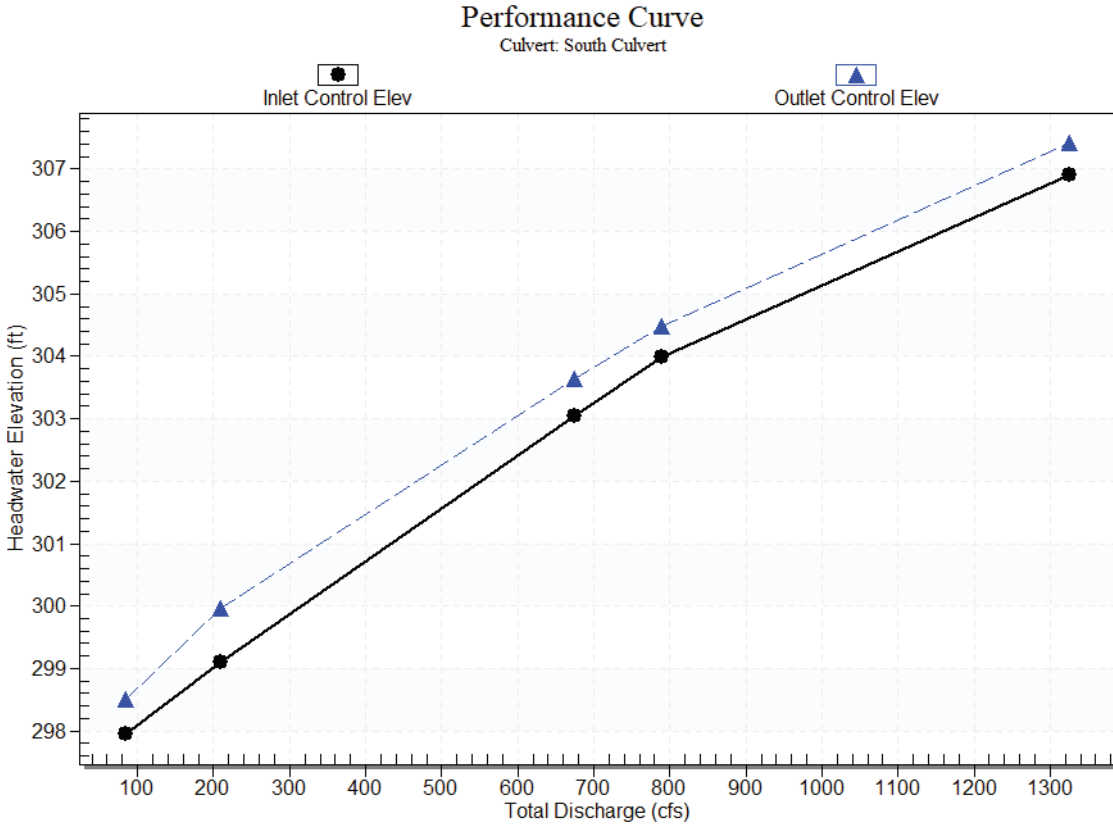
Table 4 - Culvert Summary Table: South Culvert

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40% of 50% AEP	85.00	44.29	298.51	1.94	2.513	0.35	3-M2t	3.19	1.51	1.65	1.65	5.13	6.23
50% AEP	210.00	106.95	299.97	3.10	3.970	0.56	3-M2t	5.71	2.37	2.60	2.60	6.68	7.95
2% AEP	675.00	336.64	303.65	7.05	7.650	1.08	7-M2c	7.10	4.32	4.32	4.04	10.92	6.48
1% AEP	790.00	392.62	304.49	7.98	8.489	1.20	7-M2c	7.10	4.68	4.68	4.18	11.64	6.75
168% of 1% AEP	1325.00	551.28	307.43	10.91	11.427	1.61	7-M2c	7.10	5.61	5.61	4.72	13.49	7.70

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 296.00 ft
Outlet Elevation (invert): 295.95 ft
Culvert Length: 60.02 ft
Culvert Slope: 0.00 ft/ft

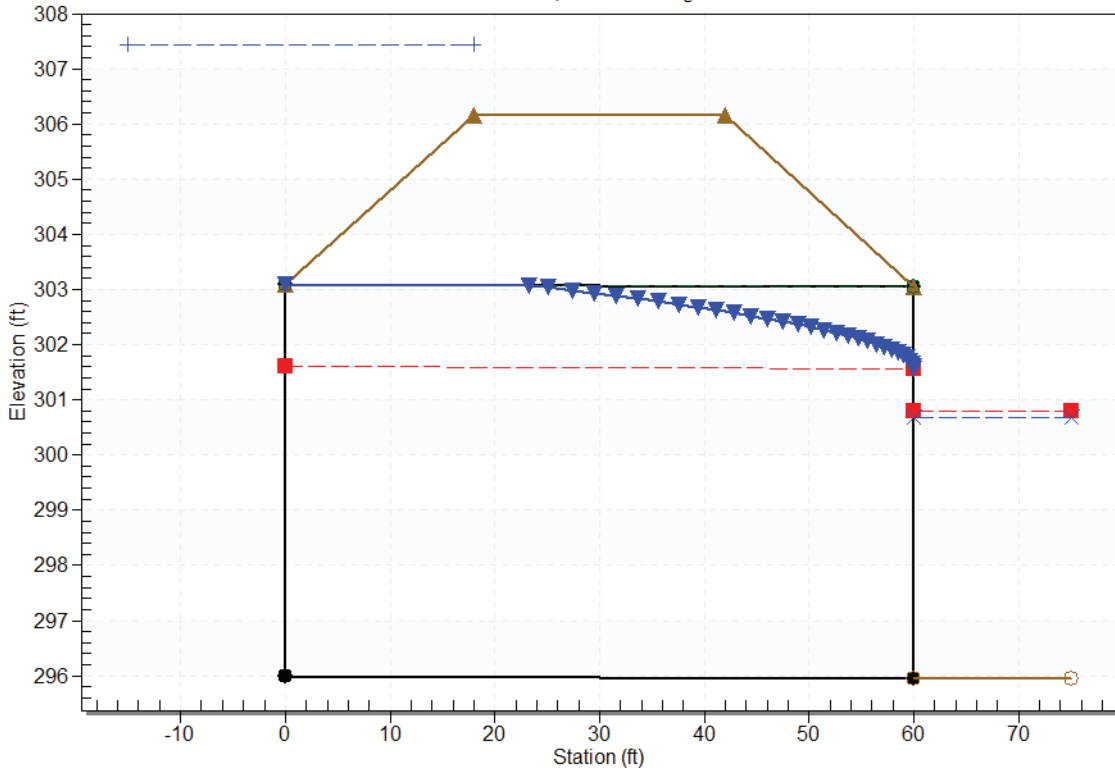
Culvert Performance Curve Plot: South Culvert



Water Surface Profile Plot for Culvert: South Culvert

Crossing - Existing Tyonek Crossing, Design Discharge - 1325.0 cfs

Culvert - South Culvert, Culvert Discharge - 551.3 cfs



Site Data - South Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 296.00 ft

Outlet Station: 60.02 ft

Outlet Elevation: 295.95 ft

Number of Barrels: 1

Culvert Data Summary - South Culvert

Barrel Shape: User Defined

Barrel Span: 8.97 ft

Barrel Rise: 7.10 ft

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 in

Barrel Manning's n: 0.0300 (top and sides)

Manning's n: 0.0300 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Tailwater Channel Data for Crossing: Existing Tyonek Crossing

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.02 ft/ft

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	-48.35	300.95	0.0400
2	-30.35	299.95	0.0400
3	-12.35	298.95	0.0400
4	1.65	298.95	0.0400
5	4.16	298.95	0.0400
6	6.58	297.74	0.0400
7	10.16	295.95	0.0400
8	15.16	295.95	0.0400
9	18.73	297.74	0.0400
10	21.16	298.95	0.0400
11	23.85	298.95	0.0400
12	37.61	298.95	0.0400
13	55.61	299.95	0.0400
14	73.61	300.95	0.0400

Table 5 - Downstream Channel Rating Curve (crossing: Existing Tyonek Crossing)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
85.00	297.60	1.65	6.23	2.53	1.01
210.00	298.55	2.60	7.95	3.98	1.07
675.00	299.99	4.04	6.48	6.20	1.05
790.00	300.13	4.18	6.75	6.42	1.06
1325.00	300.67	4.72	7.70	7.25	1.09

Roadway Data for crossing: Existing Tyonek Crossing

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 306.15 ft

Roadway Surface: Gravel

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 6 - Summary of Culvert Flows at crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater)

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Proposed Bridge (1/26/2025) Discharge (cfs)	Roadway Discharge (cfs)	Iterations
297.57	40% of 50% AEP	84.00	84.00	0.00	1
299.19	50% AEP	210.00	210.00	0.00	1
302.45	2% AEP	675.00	675.00	0.00	1
303.03	1% AEP	790.00	790.00	0.00	1
307.44	Overtopping	2007.32	2007.32	0.00	Overtopping

Rating Curve Plot for crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater)

Total Rating Curve

Crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater)

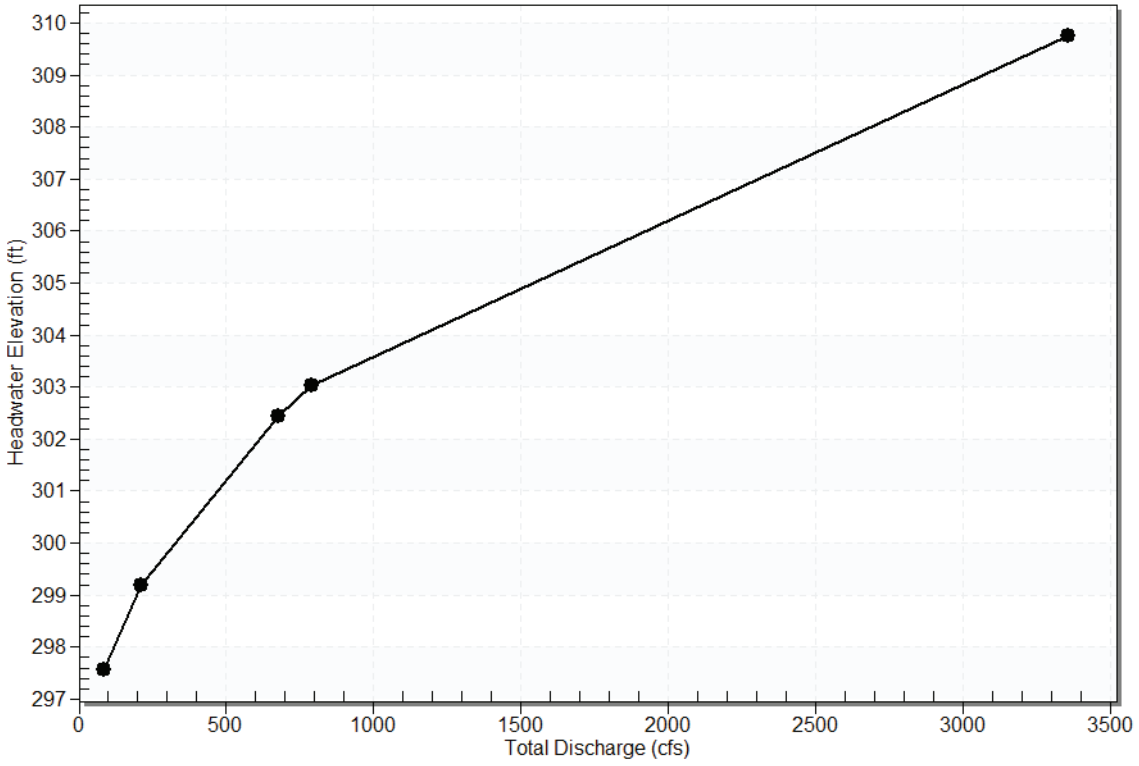


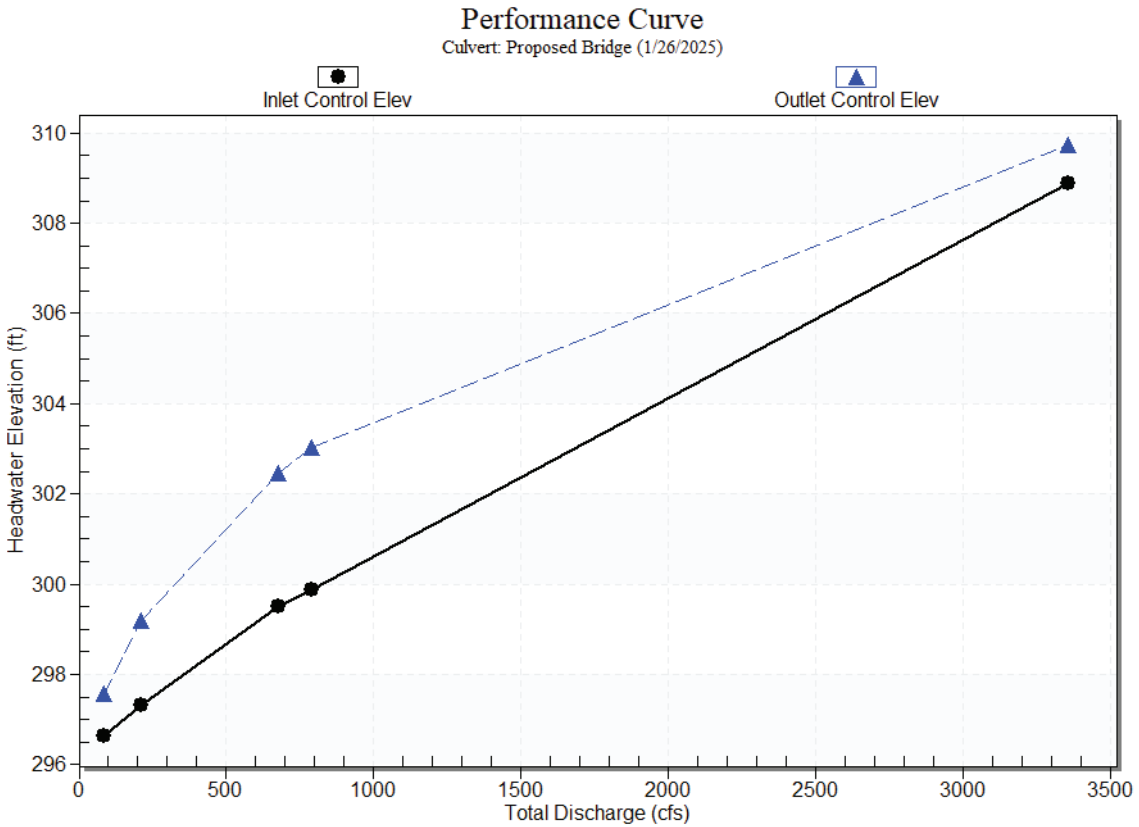
Table 7 - Culvert Summary Table: Proposed Bridge (1/26/2025)

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40% of 50% AEP	84.00	84.00	297.57	2.09	3.035	0.28	3-M2t	2.79	1.85	2.55	2.54	3.99	3.20
50% AEP	210.00	210.00	299.19	2.79	4.655	0.43	3-M2t	4.28	2.98	3.77	3.77	5.41	3.70
2% AEP	675.00	675.00	302.45	4.97	7.916	0.72	3-M2t	7.19	5.26	6.03	6.03	7.99	4.11
1% AEP	790.00	790.00	303.03	5.35	8.499	0.78	3-M2t	7.69	5.67	6.29	6.29	8.70	4.28

Culvert Barrel Data

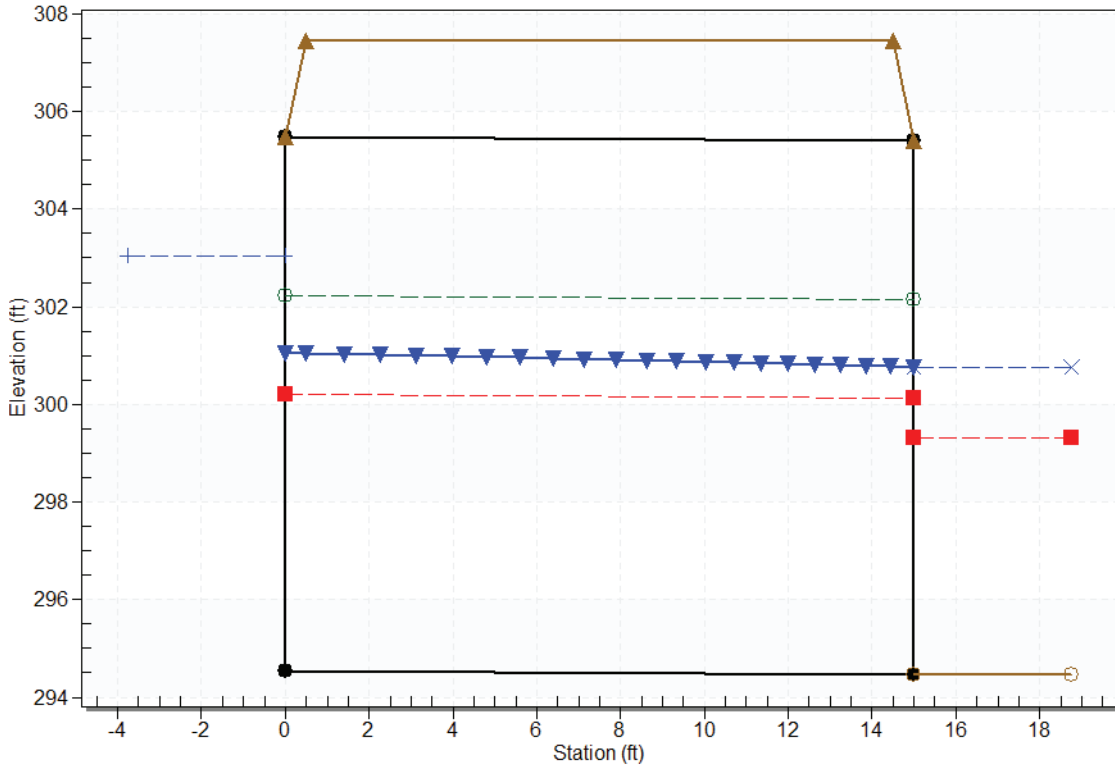
Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 294.53 ft
Outlet Elevation (invert): 294.47 ft
Culvert Length: 15.00 ft
Culvert Slope: 0.00 ft/ft

Culvert Performance Curve Plot: Proposed Bridge (1/26/2025)



Water Surface Profile Plot for Culvert: Proposed Bridge (1/26/2025)

Crossing - Proposed Bridge (1/26/2026) (with reconstructed tailwater), Design Discharge - 790.0 cfs
Culvert - Proposed Bridge (1/26/2025), Culvert Discharge - 790.0 cfs



Site Data - Proposed Bridge (1/26/2025)

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 294.53 ft
Outlet Station: 15.00 ft
Outlet Elevation: 294.47 ft
Number of Barrels: 1

Culvert Data Summary - Proposed Bridge (1/26/2025)

Barrel Shape: User Defined
Barrel Span: 47.59 ft
Barrel Rise: 10.94 ft
Barrel Material: Corrugated Metal Riveted or Welded
Embedment: 0.00 in
Barrel Manning's n: 0.0300 (top and sides)
Manning's n: 0.0400 (bottom)
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting (Ke=0.9)
Inlet Depression: None

Tailwater Channel Data for Crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater)

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.00 ft/ft

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	-31.31	300.95	0.0400
2	-12.47	298.93	0.0400
3	-4.76	300.09	0.0400
4	0.00	297.71	0.0400
5	4.00	297.31	0.0400
6	5.50	296.98	0.0400
7	11.45	294.68	0.0400
8	13.95	294.47	0.0400
9	16.45	294.68	0.0400
10	22.43	296.98	0.0400
11	23.93	297.31	0.0400
12	27.93	297.71	0.0400
13	31.08	299.29	0.0400
14	45.78	300.15	0.0400
15	87.71	306.02	0.0000

Table 8 - Downstream Channel Rating Curve (crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater))

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
84.00	297.01	2.54	3.20	0.71	0.46
210.00	298.24	3.77	3.70	1.06	0.48
675.00	300.50	6.03	4.11	1.69	0.49
790.00	300.76	6.29	4.28	1.77	0.50

Roadway Data for crossing: Proposed Bridge (1/26/2026) (with reconstructed tailwater)

Roadway Profile Shape: Constant Roadway Elevation
 Crest Length: 50.00 ft
 Crest Elevation: 307.44 ft
 Roadway Surface: Gravel
 Roadway Top Width: 14.00 ft

Hydraulic Analysis Report

Project Data

Project Title: Upper Tyonek Creek Fish Passage Improvements

Designer: JM

Project Date: January 29, 2026

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Tailwater Channel Outside Bridge

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
-31.31	300.95	0.0400
-12.47	298.93	0.0400
-4.76	300.09	0.0400
0.00	297.71	0.0400
4.00	297.31	0.0400
5.50	296.98	0.0400
11.45	294.68	0.0400
13.95	294.47	0.0400
16.45	294.68	0.0400
22.43	296.98	0.0400
23.93	297.31	0.0400
27.93	297.71	0.0400
31.08	299.29	0.0400
45.78	300.15	0.0400
87.71	306.02	----

Longitudinal Slope: 0.0045 ft/ft

Flow 675.0000 cfs

Result Parameters

Depth 6.0293 ft

Area of Flow 164.2156 ft²

Wetted Perimeter 77.5225 ft
 Hydraulic Radius 2.1183 ft
 Average Velocity 4.1105 ft/s
 Top Width 75.3811 ft
 Froude Number: 0.4908
 Critical Depth 4.4255 ft
 Critical Velocity 8.7303 ft/s
 Critical Slope: 0.0186 ft/ft
 Critical Top Width 32.66 ft
 Calculated Max Shear Stress 1.6930 lb/ft²
 Calculated Avg Shear Stress 0.5948 lb/ft²
 Composite Manning's n Equation: Lotter method
 Manning's n: 0.0400

Channel Analysis: Bridge Channel

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	305.44	0.0400
0.00	304.61	0.0400
5.41	304.61	0.0400
21.38	294.71	0.0400
23.88	294.50	0.0400
26.38	294.71	0.0400
41.31	303.91	0.0400
47.59	303.91	0.0400
47.59	304.78	-----

Longitudinal Slope: 0.0045 ft/ft

Flow 84.0000 cfs

Result Parameters

Depth 2.7971 ft

Area of Flow 24.2901 ft²

Wetted Perimeter 14.8594 ft

Hydraulic Radius 1.6347 ft

Average Velocity 3.4582 ft/s

Top Width 13.3718 ft

Froude Number: 0.4522

Critical Depth 1.8549 ft

Critical Velocity 6.3991 ft/s

Critical Slope: 0.0242 ft/ft

Critical Top Width 10.32 ft

Calculated Max Shear Stress 0.7854 lb/ft²

Calculated Avg Shear Stress 0.4590 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

Channel Analysis: US RR Bankfull

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	300.22	0.0400
2.30	297.38	0.0400
17.50	297.80	0.0400
20.40	300.11	-----

Longitudinal Slope: 0.0043 ft/ft

Flow 210.0000 cfs

Result Parameters

Depth 3.0127 ft

Area of Flow 50.4327 ft²

Wetted Perimeter 23.0232 ft

Hydraulic Radius 2.1905 ft

Average Velocity 4.1640 ft/s

Top Width 20.4000 ft

Froude Number: 0.4667

Critical Depth 1.9511 ft

Critical Velocity 7.1241 ft/s

Critical Slope: 0.0222 ft/ft

Critical Top Width 18.70 ft

Calculated Max Shear Stress 0.8084 lb/ft²

Calculated Avg Shear Stress 0.5878 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0395

Channel Analysis: US RR Bankfull 2

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
6.90	300.50	0.0400
8.50	296.80	0.0400
18.80	296.30	0.0400
20.40	298.20	0.0400
28.50	298.70	-----

Longitudinal Slope: 0.0043 ft/ft

Flow 210.0000 cfs

Result Parameters

Depth 3.5691 ft

Area of Flow 51.9085 ft²

Wetted Perimeter 25.4243 ft

Hydraulic Radius 2.0417 ft

Average Velocity 4.0456 ft/s

Top Width 21.3272 ft

Froude Number: 0.4570

Critical Depth 2.5589 ft

Critical Velocity 6.8661 ft/s

Critical Slope: 0.0236 ft/ft

Critical Top Width 20.89 ft

Calculated Max Shear Stress 0.9577 lb/ft²

Calculated Avg Shear Stress 0.5478 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0388

Channel Analysis: DS RR Bankfull

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
22.90	295.90	0.0400
25.30	293.80	0.0400
39.00	292.50	0.0400
40.10	295.20	0.0400
57.00	296.00	-----

Longitudinal Slope: 0.0067 ft/ft

Flow 210.0000 cfs

Result Parameters

Depth 3.5806 ft

Area of Flow 53.6787 ft²

Wetted Perimeter 37.0462 ft

Hydraulic Radius 1.4490 ft

Average Velocity 3.9122 ft/s

Top Width 34.1000 ft

Froude Number: 0.5495

Critical Depth 2.5391 ft

Critical Velocity 7.4811 ft/s

Critical Slope: 0.0231 ft/ft

Critical Top Width 16.15 ft

Calculated Max Shear Stress 1.4970 lb/ft²

Calculated Avg Shear Stress 0.6058 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0398

Appendix E – 65% Review Comment Log and Agency Coordination over Streambed Substrate

Comments and Reponses

DATE: 12/16/2025 REVIEWER: US Fish and Wildlife Service	Confirmation of action taken on comment by:
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Swe Item No.	Page No.	Section	Reviewer	Comment	Response
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1)	B1	Road Typicals	FWS KV	Typical sections call for Borrow, Type B, which doesn't cap material size (unless you provide a special provision to). Since there's no surfacing course, do you want to call for restricting it from having any rocks larger than a certain size within the top 6"?	
2)	B1	Road Typicals	FWS KV	Most vehicles are >6' wide, so two 5' travel lanes seem odd. Might make more sense to just call it a single-lane 10' wide road crowned in the middle at 3% except where superelevated; ie eliminate "TRAVEL LANE" from the dimension.	
3)	B1	Reveg notes	FWS KV	Consider rephrasing note 4 to make clear that topsoil and seed goes where the salvaged grubbing material doesn't go, rather than on top of. Maybe something like, "REUSE SALVAGED VEGETATIVE MAT AND GRUBBING MATERIALS AS MUCH AS PRACTICABLE. PLACE 6 INCHES OF TOPSOIL AND SEED TO RESTORE REMAINING AREAS OF DISTURBANCE." Or eliminate entirely; as this is addressed on the revegetation plan as well.	
4)	D1	Stream substrate gradations	FWS KV	<p>Fine material gradation is very detailed and tight; how closely is contractor expected to meet this? While this level of detail is helpful for coming up with a bed mix and great to see in an H&H report, I recommend simplifying and relaxing for purposes of the construction contract. Recommend simplifying to 5 sizes maximum, perhaps 3", 1.5", 0.75", #4, #10. Likewise eliminate 0% passing 3" for the coarse gradation – no need to reject dusty cobbles due to the presence of fines.</p> <p>Also recommend providing tolerance, either in the specifications or by providing a range of acceptable % passing in the table. I think the H&H report states that a substrate mix sufficiently close to the target gradation can be prepared using 30% Class I riprap, 30% Ditch Lining, and 40% structural fill – this info should be provided somewhere in the contract documents.</p>	1/7 HDR: After discussions with USFWS, ADF&G, and TBC on 12/23/2025, it was agreed that the streambed gradation will consist of materials outlined in the Alaska DOT&PF standard specifications.

Comments and Responses

DATE: 12/16/2025 REVIEWER: US Fish and Wildlife Service	Confirmation of action taken on comment by:
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5)	D1	1/D1 Stream typical at bridge	FWS KV	<p>Discuss: Channel typical section under the bridge does not match channel typical section shown in abutment stability calculations in H&H report appendices. Typical as shown in plans appears to be more stable given the Class II riprap extending below the channel bed. Open to discussing a simplified typical section under the bridge (ie simple ~2:1 Class II riprap slopes extending below the bed, no banks). With such a small space available for floodplain benches, I don't have confidence that banks built out of stream substrate material will be stable; could just end up with a wide flat section through here. There isn't enough room to build proper benches with stable material.</p> <p>By installing a bridge that provides bankfull span at the floodplain elevation we're still getting much better ecological outcomes than we would with a slightly wider embedded culvert:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Shorter covered/straightened stream lengths <input checked="" type="checkbox"/> Greater hydraulic capacity <input checked="" type="checkbox"/> Smaller construction footprint 	<p>1/7 HDR: The channel typical sections provided with the abutment stability calculations in the H&H report appendix were not updated along with the rest of the calculations. In next submittal, images and areas of channel typical section will match what is in the plans.</p>	
6)	D1	2/D1 Stream channel plan	FWS KV	<p>H&H report recommends 4'x4' rock clusters, not shown on D2.</p> <p>If rock clusters added, consider using Class I rather than Class II as recommended in H&H report.. In a culvert I would be all-in on Class II for the rock clusters; the idea behind this comment is to make them sacrificially weaker to fail earlier than the abutment protection.</p> <p>Alternatively use Class II pieces more like habitat rocks, have them "float" in the bed rather than tie into the riprap abutment protection. Isolate from the abutment protection with a weaker layer in-between.</p>	<p>1/7 HDR: After discussion with USFWS, ADF&G, and TBC on 12/23/2025, the 4'x4' rock clusters originally called for will be replaced by Class I riprap habitat rocks spread throughout the streambed.</p>	
7)	D1/D2	1/D1 1/D2 Stream typicals	FWS KV	<p>Please provide a non-level bottom to the channel, (ie V-shape) especially if no rock clusters or other forcing features are included.</p> <p>None of the cross sections of the existing stream have level beds, all have a deepest point.</p>	<p>1/7 HDR: After discussion with USFWS, ADF&G, and TBC on 12/23/2025, a slight V-notch will be incorporated to channel bottom.</p>	
8)	D2	1/D2	FWS JL	<p>Sheet D2: No willows are shown planted between top of brush layer and veg mat. Also, Bank Reconstruction Notes reference ADFG's 2005 Streambank Revegetation and Protection Guide pages for reference. This guide has been updated as of 9/2025 (https://www.adfg.alaska.gov/index.cfm?adfg=streambankprotection.main). If the updated guide is used then the page numbers referred to in the Bank Reconstruction notes need to be updated as well.</p>		

Comments and Reponses

DATE: 12/16/2025 REVIEWER: US Fish and Wildlife Service	Confirmation of action taken on comment by:
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9)	D2	1/D2 Built channel dimensio ns	FWS KV	<p>Typical seems to show constructing a 20'+ bankfull width channel whereas plans shown 17' elsewhere. Please provide a vertical dimension from thalweg to top of reconstructed bank. This is very helpful for field verification. Detail showing 3' to the coir log top + brush layer (~15'') + veg mat (~12'' inches) = pretty deep channel.</p> <p>I wanted to verify the final constructed channel bankfull area isn't too large (doesn't exceed bankfull area measured in reference reach); please see comment regarding H&H summary with bankfull areas and depths.</p>	<p>1/19 HDR: The depth from the thalweg to the top of the coir log is 2.5-ft. Depth from thalweg to top of reconstructed bank is 3.5-ft, as the brush layering was removed and the vegetative mat moved down to replace it. The bankfull area of the cross-section (including the vegetative mat above the coir log) is 42.8 sq. ft. It is slightly larger than the median but within the range of measured values.</p>
10)	H&H	Table 3	FWS KV	<p>H&H report provides "Bankfull Mean Depth" based on survey data, replacing field measurements. Thank you for providing this. The definition provided in the footnote sounds like what is typically called "Bankfull Max Depth" ie the vertical distance from the bankfull elevation to the thalweg. Typically "Bankfull mean depth" is a calculated value equal to the bankfull area divided by the bankfull width. A quick-and-dirty field approximation is the vertical distance from bankfull to the edge of the channel bed (ie base of bank).</p> <p>HDR: please provide a target bankfull area and bankfull mean depth (per my definition above) to TBC for use in verifying/adjusting design cross sections. I'd say use the median or average (whichever is lower) for bankfull area unless the smallest typical section is the one specifically selected to replicate. TBC: please try to adjust the channel typical section to get roughly the same bankfull area, bankfull mean depth, and bankfull width. It's OK if the typical section bankfull area is a bit smaller than the cross section area of the reference reach. It's OK if the typical section bankfull width ends up a bit wider than in the reference reach. Sometimes it's impossible to get bankfull mean depth to match (esp in E channels with low W/D ratio), but closer is better if aggradation or incision is a concern.</p>	<p>1/7 HDR: Bankfull width, max depth, area, and mean depth have been calculated for each reference reach design cross section. The average and median of each parameter was calculated, and the smaller of the two is the target value for each parameter to be incorporated into the design cross sections.</p>
11)	D2	1/D2 Veg mat detailing	FWS KV	<p>Uppermost annotation on detail is redundant to dimension provided. Recommend simplifying to: SALVAGED VEGETATIVE MAT, 12" THICK (TYP) or SALVAGED VEGETATIVE MAT, 6" MINIMUM THICKNESS or SALVAGED VEGETATIVE MAT, 6"-15" THICK</p>	

Comments and Reponses

DATE: 12/16/2025 REVIEWER: US Fish and Wildlife Service	Confirmation of action taken on comment by:
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12)	D2	Notes	FWS KV	<p>Note 9: Eliminate “supplement with topsoil to achieve 6”. The topsoil supplementation option came from when veg mat was required to be 12” thick, and contractors were allowed to supplement with topsoil to achieve 12” thick if it was slightly thinner. But we often see banks constructed too high, and since too-low banks are better than too-high banks, I’ve been asking for the topsoil to be eliminated. My vision is:</p> <p>-Engineer designs banks assuming 12” thick veg mat, but provides tolerance allowing +3” to -6” depending on local veg mat.</p> <p>-Contractor tries to salvage 12” thick veg mat, but has permission to roll with anything from 6” to 15”</p> <p>Suggested revising to something like: SALVAGE VEGETATIVE MAT FROM THE DISTURBED AREA OR LOCAL AREA. ACTUAL ALLOWABLE THICKNESS IS 6” TO 15.” INSTALL SALVAGED VEGETATIVE MAT OVER ENTIRE LENGTH OF DISTURBED OR RECONSTRUCTED STREAMBANKS.</p> <p>(coordinate this language with annotation revision)</p>		
13)	D2	Titles	FWS KV	<p>Consider changing both the sheet title and the detail title to “CHANNEL RECONSTRUCTION.” This sheet isn’t at the bridge, and the detail shows more than the bed or the banks: it includes both!</p>		
14)	F1/D1	Pullout	FWS KV	<p>Is there adequate sight distance? Might only need one pullout rather than two. Recommend adding signs: 2x One lane bridge, 1x “yield to oncoming traffic”, and I think 1x that’s the opposite of “yield” like “proceed with caution.” At a very minimum the 1-lane bridge sign for both directions.</p> <p>These pullouts are also quite generously sized. If both are expected to be necessary for construction anyway, may as well show in the plans so that TNC gets to keep both. But you could potentially shorten one of them (probably the one farther from where the contractor will be coming from)</p>		
15)	F1	Riprap	FWS KV	<p>Should riprap extend on upstream end to armor where the diversion channel gets cut through the embankment, or otherwise be included in the “plug”? Or maybe some other, locally available materials, ie some salvaged woody material.</p>		

Comments and Reponses

DATE: 12/16/2025 REVIEWER: US Fish and Wildlife Service	Confirmation of action taken on comment by:
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16)	F2/B1	Alignme nt and super- elevation	FWS KV	<p>F2 – Provide curve data for proposed road alignment and include superelevation.</p> <p>B2 – Once you provide superelevation design, update typical section/notes.</p> <p><i>Road probably isn't as segmented as shown, the segments shown on the basemap are likely just straight lines connecting survey points. Recommend redrawing existing road edges on basemap with a spline. To determine curves, draw short lines connecting the road edge survey points to the nearest survey point on the opposite shoulder in a no-plot layer. Then find best-fit curves through the midpoints. If you can get aerial imagery to match up with your basemap, that can be helpful for looking at the bigger picture of the curves.</i></p> <p><i>Since the road profile will be brought up, it will bury the existing cross slope, which probably represents grading operations more than any original design. Figure out the "ideal" superelevation design for the existing alignment, then adjust so that the bridge isn't within runout or runoff. Figure out what you want built, then provide the information to build it.</i></p>		
17)	F2	Road profile	FWS KV	Design road profile puts lowest point at bridge end, concentrating sheet flows right at the joint/seam with gravel. It would be better to put the lowest point further north as a sag vertical curve, and have the bridge grade match the road grade at the connection.		
18)	Q2	Note 1	FWS KV	To me this reads as though the contractor could or should wait until after substantial completion to install the final stabilization, rather than as each small area of disturbance gets to it's final grading. Note 5 on Q1 already covers this well with "finish-as-you-go." Also "install" doesn't acknowledge that oftentimes much of the final stabilization isn't just installed, it's grown. Recommend revisiting Note 1 on Q2 for clarity.		
19)	Q2	Note 2	FWS KV	This sounds like you're directing the contractor which direction to work (ie starting at embankment and then working upstream and downstream) and providing methods/sequencing. Recommend rephrasing to: INSTALL SALVAGED VEGETATIVE MAT ALONG ALL DISTURBED STREAMBANKS, 4' WIDE MINIMUM OR AS WIDE AS REQUIRED TO UTILIZE ALL STOCKPILED VEGETATIVE MAT. STABILIZE REMAINING AREA OF DISTURBANCE WITH 6" TOPSOIL AND SEED.		
20)	Q2	Note 4	FWS KV	Replace "culvert infill material" with "stream substrate material" since there is no culvert.		
21)	Q2	Note 6	FWS KV	Add, ", MAXIMIZE WOOD-TO-SOIL CONTACT AS FEASIBLE." The purpose, to "aide in reseeded efforts and establishment of riparian habitat" is correct but arguably not necessary; could delete.		

Comments and Reponses

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22)	Q2	Note 7	FWS KV	Not sure what information or instruction this note provides.		
23)	Q2	Note 8	FWS KV	Q2, Note 8: Appreciate this addition. Option to a pay item in the bid schedule & spec for a few hours of operated excavator time (thumb attachment required) to install habitat features not shown on the plans using salvaged or excess materials at the direction of the engineer or onsite habitat restoration specialist.		
24)	Q2	Sapling notes	FWS KV	Sapling notes seem to contradict D1 bank reconstruction note 6 and possibly another note I saw somewhere directing # of saplings to install per 1,000 SF.		
25)	D1/ bridge	Bridge abutment	FWS	The sloped excavation limits below the concrete abutment sills shown on D1 give me pause. I'm more used to seeing a flat bench dug into in-situ soils, whether right below the sill or several feet lower (and wider) for soil improvements. Consider updating if appropriate, and potentially providing additional details for abutment soil preparation.		
26)	Bridge	Bridge info TBD	FWS KV	<p>Discuss: There's lots of information not yet provided regarding the bridge. What will be provided in the final design plans or specifications versus what will the manufacturer be required to provide?</p> <ul style="list-style-type: none"> • Concrete abutment/sill design & dimensions, reinforcing details • Material requirements for bridge (ie structural steel, deck materials, anchor bolts, elastomeric pads, concrete, reinforcement) • Design requirements for bridge (ie AASHTO LRFD) • Design loading/requirements (dead load, live load, wind load, seismic design criteria, rail purpose & loading) • Minimum allowable assumed bearing capacity for abutment soils • Any additional foundation soil improvement required? IE compaction of in-situ soils, replacement of in-situ soils with better soils, placing a layer of geotextile & Select A filled geocell stabilization mat over the prepared abutment soils prior to placing concrete footer. 		

Comments and Reponses

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27)	Bridge	Details	FWS KV	<p>Recommend adding one or more bridge-focused detail sheets. Provide hydraulic summary somewhere in the plans and label low chord elevation on D2 or bridge-focused equivalent. Provide bridge layout points (X, Y, Z) for the four corners of the bridge on F1/F2 or bridge details. Provide detail on the abutments, ie: How to prepare soils for the precast concrete abutment sills. Soils memo recommends improving the top 2 feet with geotextile following the deep patch method. Minimum offset from edge of bench to face of sill. As shown in the details, the riprap slope “kisses” one concrete abutment but is offset from the other, unclear why. Typically there’s a minimum offset distance from bottom of concrete to that grade break; provide dimensions on that bench if it’s required for this application.</p>		
28)	Bridge	Selection	FWS KV	<p>Discuss: The plans and soils memo discuss using a <i>temporary</i> bridge for <i>short-term</i> installation. Why is that?</p>		
29)	Bridge	Components	FWS	<p>Details don’t show any sort of wingwalls at the bridge ends (<i>essentially [shaped concrete pieces that sit astride the sills and sandwich the bridge, retaining road soils from falling in between the girders]</i>). Are they not required for a “temporary” bridge model?</p>		
30)	65% Drawings	Road Design	J. Hunter (NRCS)	<p>The southern approach is on a steep grade. The inclusion of ditches with armored outlets, and steeper cross slope may help reduce the potential for erosion similar to what occurred on the Lower Tyonek build.</p>		
31)	65% Drawings	D1, Bridge Section	J. Hunter (NRCS)	<p>I would like to see the rip rap come right up to the footer. There's a "gap" on the right side.</p>		
32)	65% Drawings	D2	J. Hunter (NRCS)	<p>Clarifying, the streambed material not under the bridge is all native material?</p>	<p>1/16 HDR: The streambed under the bridge and in the sections marked for reconstruction will consist of the design streambed mix.</p>	
33)	65% Drawings	F1	J. Hunter (NRCS)	<p>consider showing transition from designed streambed material to native streambed material.</p>	<p>1/7 HDR: HDR will work with TBC to add a transitional channel cross section.</p>	
34)	65% Drawings	F1	J. Hunter (NRCS)	<p>Is there a better way to transition the downstream stream reconstruction? The 3.33% part will probably not transition well to the existing streambed.</p>		
35)	65% Drawings	Q2	J. Hunter (NRCS)	<p>Include points for the toe of the riprap treatment.</p>		

Comments and Reponses

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36)	H&H	pg. 42, App. B, 1% AEP Sediment Sizing	J. Hunter (NRCS)	<p>40% course and 60% fine is too fine and lowers design D50 to 1.5". Drawings call out "Riprap Class II Fill VOIDS w/..." which is OK as long as there's no intention of specify the gradation represented by this calculation. I would assume the riprap treatment to not be well graded and a fuller thompson calculation unnecessary.</p>	<p>1/7 HDR: After discussions with USFWS, ADF&G, and TBC on 12/23/2025, it was agreed that the proposed streambed material gradation will get overall smaller to resemble the Fuller-Thompson and upstream pebble count gradation. This is to make the design streambed material more like the existing streambed material. Because the streambed material at this crossing does not directly impact the stability of the bridge (since the abutment protection will go under the streambed material), getting the proposed gradation closer to the existing streambed's was preferred. Overall, the aim of the proposed streambed mix is to prepare a gradation that better matches the existing streambed while maintaining a level of stability that prevents the placed material from scouring out.</p> <p>1/28 HDR: After determining that the upstream sediment is not mobile, the streambed gradation was sized to be stable at the 2% AEP event. This strikes a balance between the sizing logic described above and following the USFWS guidance, which states that if there is not a sufficient upstream supply of sediment, the design stream substrate should be sized to the 1% AEP flood.</p>	
37)	65% Drawings	Road Design	J. Hunter (NRCS)	<p>The southern approach is on a steep grade. The inclusion of ditches with armored outlets, and steeper cross slope may help reduce the potential for erosion similar to what occurred on the Lower Tyonek build.</p>		

Montoya, Jacob

From: Valentine, Kirsten R <kirsten_valentine@fws.gov>
Sent: Friday, January 30, 2026 8:07 AM
To: Turletes, Irene; Mazzacavallo, Michael G (DFG)
Cc: Montoya, Jacob; talley; 10436483_TBC Tyonek Fish Passage 2025
Subject: RE: [EXTERNAL] RE: Upper Tyonek Stream Substrate Design

You don't often get email from kirsten_valentine@fws.gov. [Learn why this is important](#)

CAUTION: [EXTERNAL] This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Yes, if the existing bed isn't mobile, I agree that the substrate should be sized to be stable. If this were inside a culvert I would suggest that it be sized to be stable at the Q100. However since we're working under a bridge rather than inside the culvert, I like the idea of the streambed substrate being smaller than the Class II abutment protection riprap (better to "fail" downward which may still fill back in over time or just be a pool, than "fail" outward and lose the abutment protection).

I'm open to other perspectives, but from my first hot take, this is a reasonable approach.

Kirsten Valentine, P.E.

Supervisory Civil Engineer (Fish Passage)

(907) 217-8454

Out of office: 2/19-2/23

Dena'inaq e'inen'aq' gheshtnu ch'q'u yeshdu.

I live and work on Dena'ina land.

From: Turletes, Irene <Irene.Turletes@hdrinc.com>

Sent: Thursday, January 29, 2026 6:20 PM

To: Valentine, Kirsten R <kirsten_valentine@fws.gov>; Mazzacavallo, Michael G (DFG) <michael.mazzacavallo@alaska.gov>

Cc: Montoya, Jacob <Jacob.Montoya@hdrinc.com>; talley <talley@tbcak.com>; 10436483_TBC Tyonek Fish Passage 2025 <10436483_TBCTyonekFishPassage2025@hdrinc.com>

Subject: RE: [EXTERNAL] RE: Upper Tyonek Stream Substrate Design

Hey all,

In our final reporting QC – we found an error in our slope for determining bed mobility. This has been addressed, but now the existing bed is NOT mobile. Because of this, we would like to revise the streambed substrate to be stable in the 2% AEP (50-year). This will change the streambed substrate to a 1/3 each mix of Class I riprap, Ditch lining, and structural fill.

Let us know if this sounds reasonable to you and we'll finalize the report tomorrow. I'll be out of office, but Jacob will be working with others in our office to wrap this up if you have any questions!

Thanks!

Irene Turletes, PE
D 907.644.2099 M 907.306.8342

hdrinc.com/follow-us

From: Valentine, Kirsten R <kirsten_valentine@fws.gov>
Sent: Friday, January 16, 2026 6:29 AM
To: Turletes, Irene <Irene.Turletes@hdrinc.com>; Mazzacavallo, Michael G (DFG) <michael.mazzacavallo@alaska.gov>
Cc: Montoya, Jacob <Jacob.Montoya@hdrinc.com>; talley <talley@tbcak.com>
Subject: RE: [EXTERNAL] RE: Upper Tyonek Stream Substrate Design

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I support this approach.

Kirsten Valentine, P.E.
Supervisory Civil Engineer (Fish Passage)
Acting Habitat Restoration Branch Lead 12/19/25-1/9/26

(907) 217-8454
Out of office: 12/23/25-12/28/25

Dena'inaq e'inen'ag' gheshtnu ch'q'u yeshdu.
I live and work on Dena'ina land.

From: Turletes, Irene <Irene.Turletes@hdrinc.com>
Sent: Thursday, January 15, 2026 6:12 PM
To: Valentine, Kirsten R <kirsten_valentine@fws.gov>; Mazzacavallo, Michael G (DFG) <michael.mazzacavallo@alaska.gov>
Cc: Montoya, Jacob <Jacob.Montoya@hdrinc.com>; talley <talley@tbcak.com>
Subject: [EXTERNAL] RE: Upper Tyonek Stream Substrate Design

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

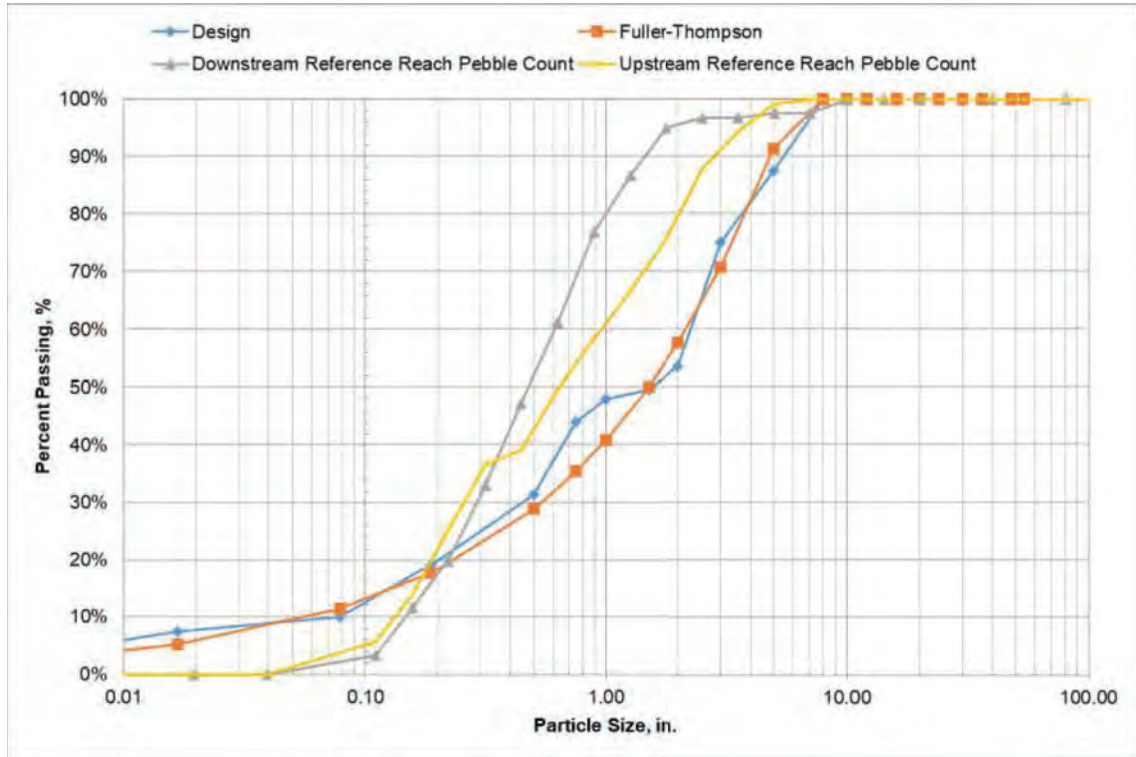
Happy 2026!

Just wanted to follow up with all on our meeting from December 23rd on Upper Tyonek - how is that already three weeks ago?!?

We discussed the stream substrate design and as a group, determined that we were all comfortable decreasing the stream substrate gradation to better match the upstream pebble counts and decrease the types of material needed to create the substrate. This is also supported by the upstream material being mobile at larger events, which will allow mobilized sediment to be replenished.

Please confirm your agreement with the following sediment gradation:

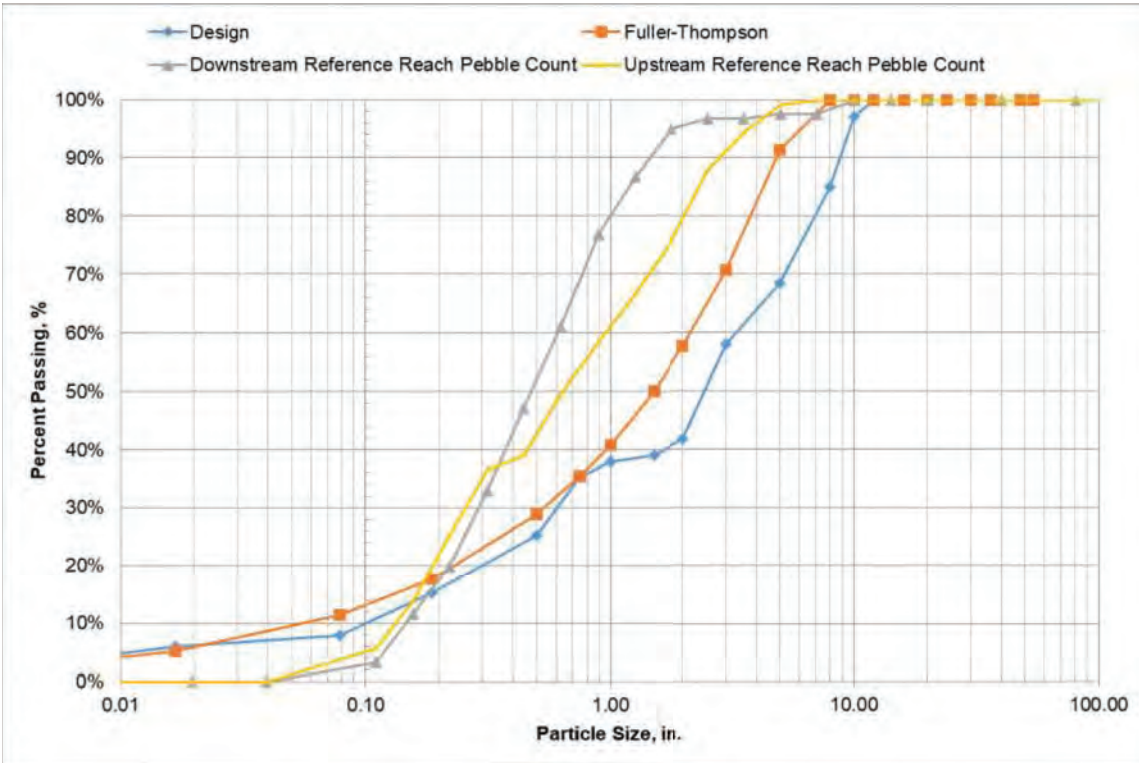
- Mobile at Q50
- 50% Ditch lining
- 50% Structural fill



Selected Mix Proportions %		COARSE MATERIAL					FINE MATERIAL		Fuller-Thompson Fines (Step 2)		
Size (inches)	Sieve Size	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	% Passing	Design	Fuller-Thomp. Idealized	
54	54"	100%	100%	100%	100%	100%	100%	100%	100%	100%	
48	48"	100%	90%	100%	100%	100%	100%	100%	100%	100%	
36	36"	100%	50%	100%	100%	100%	100%	100%	100%	100%	
30	30"	100%	35%	90%	100%	100%	100%	100%	100%	100%	
24	24"	100%	25%	50%	100%	100%	100%	100%	100%	100%	
20	20"	100%	15%	43%	90%	100%	100%	100%	100%	100%	
16	16"	100%	0%	36%	50%	100%	100%	100%	100%	100%	
12	12"	100%	0%	29%	39%	100%	100%	100%	100%	100%	
10	10"	100%	0%	22%	27%	90%	100%	100%	100%	100%	
8	8"	100%	0%	15%	15%	50%	100%	100%	100%	100%	
5	5"	75%	0%	0%	0%	20%	75%	100%	88%	91.3%	
3	3"	50%	0%	0%	0%	10%	50%	100%	75%	79.7%	
2	2"	30%	0%	0%	0%	0%	30%	97%	100%	54%	
1.5	1.5"	10%	0%	0%	0%	0%	10%	94%	88.6%	50%	
1	1"	5%	0%	0%	0%	0%	5%	91%	79.7%	48%	
0.75	0.75"	0%	0%	0%	0%	0%	0%	88%	61.2%	44%	
0.5	0.5"	0%	0%	0%	0%	0%	0%	63%	50%	32%	
0.187	#4	0%	0%	0%	0%	0%	0%	38%	30.6%	19%	
0.0767	#10	0%	0%	0%	0%	0%	0%	20%	19.8%	10%	
0.0167	#100	0%	0%	0%	0%	0%	0%	15%	9.1%	8%	
0.0059	#200	0%	0%	0%	0%	0%	0%	9%	5.4%	5%	
0.0030	#400	0%	0%	0%	0%	0%	0%	3%	3.8%	2%	

As a reminder, this is what we started with:

- Stable at Q50
- 30% Riprap Class I
- 30% Ditch lining
- 40% Structural fill



Selected Mix Proportions %		COARSE MATERIAL Based on Alaska DOT&PF Specifications					FINE MATERIAL		Fuller-Thompson Fines (Step 2)		
Size (inches)	Sieve Size	Ditch Lining	Type IV Riprap	Type II Riprap	Type I Riprap	Type I Riprap	Coarse Fraction	SF	Fuller-Thompson Fines (Step 2)	Design	Fuller-Thomp. Idealized
54	54"	100%	100%	100%	100%	100%	100%	100.0%	100.0%	100%	100.0%
48	48"	100%	100%	100%	100%	100%	100%	100.0%	100.0%	100%	100.0%
36	36"	100%	50%	100%	100%	100%	100%	100.0%	100.0%	100%	100.0%
30	30"	100%	35%	90%	100%	100%	100%	100.0%	100.0%	100%	100.0%
24	24"	100%	25%	50%	100%	100%	100%	100.0%	100.0%	100%	100.0%
20	20"	100%	15%	43%	90%	100%	100%	100.0%	100.0%	100%	100.0%
16	16"	100%	0%	36%	50%	100%	100%	100.0%	100.0%	100%	100.0%
12	12"	100%	0%	29%	39%	100%	100%	100.0%	100.0%	100%	100.0%
10	10"	100%	0%	22%	27%	90%	95%	100.0%	100.0%	97%	100.0%
8	8"	100%	0%	15%	15%	50%	75%	100.0%	100.0%	85%	100.0%
5	5"	75%	0%	0%	0%	20%	48%	100.0%	100.0%	89%	91.3%
3	3"	50%	0%	0%	0%	10%	20%	100.0%	100.0%	58%	70.7%
2	2"	30%	0%	0%	0%	0%	15%	97.0%	100.0%	42%	57.7%
1.5	1.5"	10%	0%	0%	0%	0%	5%	94.0%	86.8%	39%	50.0%
1	1"	5%	0%	0%	0%	0%	3%	91.0%	70.7%	36%	40.8%
0.75	0.75"	0%	0%	0%	0%	0%	0%	88.0%	61.2%	35%	35.4%
0.5	0.5"	0%	0%	0%	0%	0%	0%	63.0%	50.0%	25%	26.9%
0.187	#4	0%	0%	0%	0%	0%	0%	38.0%	30.8%	15%	17.7%
0.0757	#10	0%	0%	0%	0%	0%	0%	20.0%	19.8%	8%	11.5%
0.0167	#40	0%	0%	0%	0%	0%	0%	15.0%	9.1%	6%	5.3%
0.0059	#100	0%	0%	0%	0%	0%	0%	4.0%	5.4%	4%	3.1%
0.0030	#200	0%	0%	0%	0%	0%	0%	3.0%	3.8%	1%	2.2%

Appendix F – 2024 Alaska USFWS Fish Passage Design Review Checklist

Alaska USFWS Fish Passage Design Review Checklist

Document purpose: Provide minimum guidelines for design review of fish passage projects in the state of Alaska by the USFWS. This document is NOT a template, but a checklist of minimum information recommendations for fish passage design documents.

H&H Report:

Introduction and Objectives Information

- Project Introduction and Description
 - Project type and purpose, river name, roadway name, vicinity map
 - Objectives clearly listed

Site Assessment and Existing Conditions Information

- Site Description
 - Existing site location and description of mainstream flow path
 - Stream conditions in immediate vicinity
 - Nearby crossings and utilities
 - Existing crossing condition including size, type, material, slope, length, depth of fill to roadway above culvert, alignment
 - Reconnaissance level map of the stream cross-section, plan, profile, noting representative width and depths, grade control and other geomorphic features.
- Channel Geomorphology
 - Existing culvert setting, long profile long enough to show that the chosen vertical alignment will tie into the stream outside of the area of impact or area of potential instability, what is going on at crossing zoomed out enough to see slopes, sinuosity etc.
 - Long profile at crossing including at least 3 stable grade controls upstream and downstream.
 - Slope at crossing, slope upstream, and slope downstream
 - This can be included in body of report or appendix
 - Stability analysis narrative
 - Discuss lateral and vertical stability. Is the reach stable?
 - If instability is present, is it localized or system-wide?
 - Can the cause and effect relationship of the instability be identified?
 - Is this site suitable for a crossing?
 - Structure treatments to address stability concerns?
- Reference reach information:

- Brief reference reach narrative including location (up or downstream of crossing), valley type, general watershed description, constraints (such as development, historical landuse, landownership, geology etc)
 - Reference reach length, slope, bankfull width measurements, bankfull depth measurements and floodplain width measurements should be clearly listed
- Reference cross section information including dimensions and location
- Bankfull discharge
- Channel classification
- Long Profile (20xwBKF min) with bankfull calls, thalweg and water surface slope
- Key pieces count
- Crossing photos and reference reach photos
- Photos of cross sections
- Field map or sketch
- Existing Sediment Gradation
 - Pebble count for full length of reference reach
 - Pebble count at reference cross section
 - Pebble count upstream of crossing (if the reference reach is upstream of the crossing, then the reference reach pebble count is fine).

Hydrologic Analysis Information

- Watershed Information
 - Basin size and location
 - Major tributaries
 - Major land use including major upstream sources of sediment if applicable
 - Delineation basin map if applicable
- Flood flow predictions Q2 through Q100, minimum.
- Bankfull verification against gage data, Q2, regional curve
- Hydrology calculations and methods should be clearly described with work shown
 - Method/methods used
 - Did analysis consider future development plans?
 - Did analysis consider climate change over structure life?

Hydraulic Analysis Information

- Hydraulic analysis of existing and proposed crossing.
- Culvert sizing analyses and scour
- HW/D ratio of existing and proposed crossing
- Road overtopping flow

Proposed design components

- Determining ultimate stream alignment, channel geometry, slope and profile for long-term stability and habitat.

Jan 10, 2024

- Investigate roadway grade, fill height and width.
- Identify utilities and relocation needs
- Design and locate new crossing and culvert width, length, type, skew.
- Provide recommendations/options for channel complexity elements both through the crossing and outside the crossing (habitat boulders, rock clusters, rock bands, large wood etc..)
- Provide recommendations to project owner and agencies on construction tolerances for culvert invert elevations and channel dimensions to aid in construction.

Substrate design

- Stream substrate gradation for new culvert infill material
- Sizing of material for channel complexity elements such as steps, habitat boulders, rock clusters, rock bands and other grade control structures

Design Sheet Set Review:

15% or 35% Concept Design (often included within the H&H report)

- Culvert or bridge horizontal alignment
- Constructed channel horizontal alignment
- Crossing structure longitudinal profile (include upstream and downstream grade controls and constructed channel tie in locations in the profile).
 - Longitudinal profile to include existing ground and proposed profile
 - Culvert length – confirm this is reasonable. Culverts should be as short as possible. Shorter culverts are better for sediment transport, debris movement, channel morphology and fish passage. Long culverts can cut off side channels especially in wetland complexes.
- Proposed constructed channel cross section with dimensions
- Proposed culvert cross section with road cover requirement
- Topo survey with location of utilities

The purpose of this review is to focus on big picture decisions:

- Does the design approach make sense? Is the project heading in the right direction? Are the tradeoffs acceptable?
- What major decisions remain? How will they be made and who should be involved?
- Challenging stream alignment & profile decisions, are BFW and slope correct?

Jan 10, 2024

- Does the selected structure make sense?
- Who/what will be impacted by the project? (traffic, utilities, landowners, cultural resources)
- What will it take to build the project? (road closure, diversion, crane, specialty materials or equipment)
- Are we going to need way more money than originally expected?

65% Design (include elements of the concept design plus the following):

- Cover sheet with vicinity map
- Legend
- General notes and estimated quantities
- Quantity of fill below the Ordinary High Water Mark (provide revised quantity again within 3 weeks after 65% review meeting and again at 95%)
- Civil site plan
- Construction limits and area of disturbance are clearly identified. Confirm construction limits are reasonable.
- Channel cross sections inside and outside of crossing structure with dimensions and detail
- Streambank reconstruction methods – treatments for lateral stability
- Stream substrate plan with location of Ordinary High Water Mark
- Channel bed features in plan view (eg. rock clusters, rock bands, step-pools)
- Large wood layout when applicable (habitat elements)
- Grade control structures for vertical stability (as needed)
- Revegetation plan
- Detour road plan showing a realistic detour road layout (unless road will be closed)
- Diversion plan showing projected excavation area for new pipe and realistic diversion channel layout. (not stamped)
- Road horizontal alignment and centerline profile
- Site plan with utilities, ROWs, private property, etc.
- Temporary construction easements
- Engineer's cost estimate
- Special provisions

Major decisions have already been made; the purpose of this review is to focus on mechanics:

- Were the concerns and major decisions from the concept design adequately dressed?
- What are the full extents of construction impacts? Is there a plan for all of them?
- Have all conflicts been identified, with an idea of how to address them?

Jan 10, 2024

- Is (or will there be) sufficient detail in place to build and inspect the project?
(Placeholder tables & sheets common)
- Do the specifications meet project goals and objectives?
- What minor decisions remain? Talk about how they will be made and who should be involved.
- Are we ready to start permitting? If not, what needs to be addressed in order to begin?
- Do we need more money?

*This is a good place to start permits on most projects. Recommend that permits should be in place before going to bid if possible.

95% Design (include elements of concept and 65% design plus the following):

- Cover sheet
- Estimate of quantities on drawings (each material gradation should be broken out)
- Survey Control
- Point tables for road, culvert, channel
 - provide stationing of existing and new culvert for field locating tie ins
- Road cross section
- Road surfacing detail
- Streambank details
 - Culvert to streambank transition
 - Cross sections for each streambank treatment
- Channel bed feature details and cross sections (eg. rock clusters, rock bands, step-pools, bankfull bench)
 - Clear dimensions needed for construction
- Large wood structure details when applicable
- Step by step instructions for toewood, rootwads, brush layers, livestakes, etc.
- Seed mix
- Demolition plan
- Erosion and sediment control plan
- Erosion and sediment control details (silt fence, straw wattles, etc).
- General notes
- Sheet notes
- Diversion channel cross section
 - Trash pumps >100ft? from stream
- Collar armor or headwall details

Jan 10, 2024

- Note on filling voids in collar armor
- Guardrail should be used on culverts with headwalls even if not required per code because of public safety perception.
- Thaw pipe details & other details as required (ex: guardrail hardware, concrete footing)
- Engineer's cost estimate
- Bid Schedule
- Special Provisions
- General provisions (if applicable)
- Standard notes: washing in the fines, filling the voids, etc.
- Substrate size tables
- Substrate placement in plan view
- Substrate depth in cross sections
- Quantity of fill below the Ordinary High Water Mark

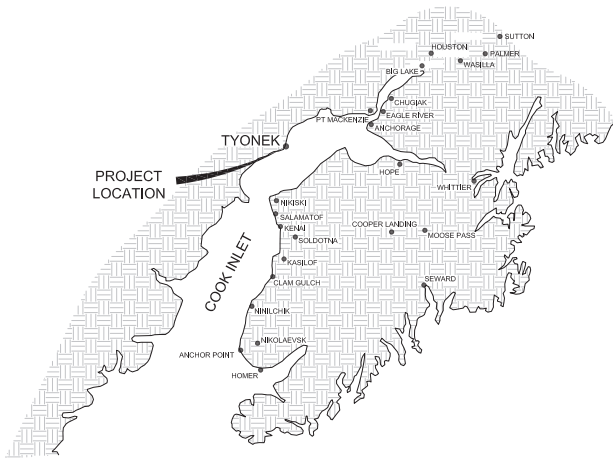
The purpose of this review is to focus on buttoning up the details:

- Were the concerns and decisions from 65% design adequately addressed?
- Have all of the conflicts and impacts been addressed, or are expected to be soon?
 - (ROW needs, utility agreements, permits)
- Do all the details and instructions agree with each other?
- What minor details need to be wrapped up – how will they be addressed?
- Are roles and decision responsibilities clear?
- What will the bidding process look like, what needs to be wrapped up before it bids?
- Do we have enough money?



Appendix B – 95% Design Plans

DRAWING LOCATION: W:\WorkingFiles\Tyonek Tribal Conservation District\2022\Upper Tyonek CCA\TITLE SHEET UPPER TYONEK.dwg
 PLOT DATE: 1/26/2026
 SCALE: N/A
 DESIGNED BY: [blank]
 CHECKED BY: [blank]



VICINITY MAP (NTS)

Tyonek  TRIBAL CONSERVATION DISTRICT



95% REVIEW

UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS

ADF&G SITE # 20601534
 JANUARY 2026

PREPARED BY

 THE BOUTET COMPANY, INC.
 601 E. 57TH PLACE #102
 ANCHORAGE, AK, 99518
 PH. 907-522-6776
 LICENSE NO. AECC957



ENGINEER'S CERTIFICATION:
 TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, JUDGEMENT, AND BELIEF THESE PLANS MEET APPLICABLE NRCS STANDARDS.

TIMOTHY J. ALLEY, P.E.
 DESIGN ENGINEER
 THE BOUTET COMPANY, INC.

DATE: JANUARY 26TH 2026

FILE W:\WASILAFLES\TYONEK TRIBAL CONSERVATION DISTRICT\2022\UPPER TYONEK CRK BRIDGE.DWG DATE/TIME 1/26/2026 LAYOUT DESIGNED CHECKED T.O.A. DRAFTED S.M.J.

NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	A2	A4

SHEET INDEX	
SHEET NO.	CONTENTS
A1	TITLE SHEET
A2	NOTES, INDEX, LEGEND & ABBREVIATIONS
A3	SURVEY CONTROL
A4	DEMOLITION AND EXCAVATION PLAN
B1	TYPICAL SECTION
C1	ESTIMATE OF QUANTITIES
D1-D2	DETAILS AND STREAM CROSS SECTIONS
F1-F2	PLAN AND PROFILE
Q1-Q3	EROSION, SEDIMENT & POLLUTION CONTROL PLAN

ABBREVIATIONS

ADF&G	ALASKA DEPARTMENT OF FISH AND GAME
BM	BENCH MARK
BMP	BEST MANAGEMENT PRACTICE
BVCE	BEGIN VERTICAL CURVE ELEVATION
BVCS	BEGIN VERTICAL CURVE SEGMENT
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CONST	CONSTRUCT
CSP	CORRUGATED STEEL PIPE
DET	DETAIL
DI	DUCTILE IRON
EOP	END OF PROJECT
E	EASTING
ELEV	ELEVATION
EA	EASEMENT LINE
EST	ESTIMATED
ESCP	EROSION & SEDIMENT CONTROL PLAN
EVCE	END VERTICAL CURVE ELEVATION
EVCS	END VERTICAL CURVE SEGMENT
EW	EACH WAY
EX	EXISTING
FG	FINISHED GRADE
FL	FLOW LINE
GB	GRADE BREAK
HDPE	HIGH DENSITY POLYETHYLENE PIPE
HORZ	HORIZONTAL
HTC	HEAT TRACE CHANNEL
IE	INVERT ELEVATION
INT	INTERSECTION
IN	IN ACCORDANCE WITH
KPB	KENAI PENINSULA BOROUGH
L	LENGTH
LF	LINEAR FEET
LOC	LOCATION
LP	LOW POINT
LT	LEFT
LVC	LENGTH OF VERTICAL CURV
MAX	MAXIMUM
MDD	MAXIMUM DRY DENSITY
ME	MATCH EXISTING
MFG	MANUFACTURED
MIN	MINIMUM
MON	MONUMENT
MSL	MEAN SEA LEVEL
N	NORTHING
NC	NOT IN CONTRACT
NTS	NOT TO SCALE
OC	ON CENTER
OHW	ORDINARY HIGH WATER
OSHA	OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION
PAD	PAD ELEVATION
PCC	PORTLAND CEMENT CONCRETE
PC	POINT OF CURVATURE
PI	POINT OF INTERSECTION
PT	POINT OF TANGENCY
PUE	PUBLIC UTILITY EASEMENT
PVI	POINT OF VERTICAL INTERSECTION
R	RADIUS
RR	REMOVE AND REPLACE
ROW	RIGHT-OF-WAY
RP	RADIUS POINT
R	RIGHT
REF	REFERENCE
RET	RETURN
S	SLOPE
SQ FT	SQUARE FOOT
STA	STATION
STD	STANDARD
SWPPP	STORM WATER POLLUTION PREVENTION PLAN
TAN	TANGENT
TEL	TELEPHONE
TBM	TEMPORARY BENCH MARK
TOE	TOE OF SLOPE
TOP	TOP OF SLOPE
TYP	TYPICAL

LEGEND


---	EXISTING GRAVEL ROAD SURFACE
---	NEW GRAVEL ROAD SURFACE
▨	TOPSOIL AND SEED
▨	EXISTING STREAM
▨	EXISTING ROADWAY
▨	PROPOSED ROADWAY
▨	DIVERSION CHANNEL
▨	PROPOSED STREAM SUBSTRATE MATERIAL
▨	RIPRAP ABUTMENT PROTECTION
▨	VEGETATIVE COLLAR
---	PROPOSED BOTTOM OF STREAM BANK
---	PROPOSED BANK FULL WIDTH (BFW)
---	PROPOSED EDGE OF LOW FLOW CHANNEL
---	ROADWAY CENTERLINE
---	STREAM CENTERLINE
---	EXISTING GRADE PROFILE
---	FINISH GRADE PROFILE
---	PROJECT LIMITS
---	CUT LIMIT
---	FILL LIMIT
---	EXISTING MINOR CONTOUR
---	EXISTING MAJOR CONTOUR
---	PROPOSED MINOR CONTOUR
---	PROPOSED MAJOR CONTOUR
---	TOE OF SLOPE
□	PERIMETER CONTROL BMP
---	COIR LOG
▲	SLOPE INDICATOR
▼	PROPOSED SIGN
→	EXISTING DRAINAGE ARROW
→	PROPOSED DRAINAGE ARROW

CIVIL NOTES:

- CIVIL CONSTRUCTION SHALL BE COMPLETED IN ACCORDANCE WITH THE ALASKA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION 2020 EDITION, AS CURRENTLY AMENDED BY THE STANDARD MODIFICATIONS AND THESE CONSTRUCTION DRAWINGS.
 - DRAWING SCALES ON SHEETS WITHIN THESE PLANS MAY VARY AND SHOULD BE NOTED PRIOR TO USE. THESE PLANS WERE CREATED FOR 11X17 PLAN SET AND AT A SPECIFIC DRAWING SCALE. ANY REPRODUCTION OR PUBLISHING OF THESE PLANS MAY RESULT IN DISTORTION OF SCALE AND SHALL BE VERIFIED PRIOR TO USE.
 - SURVEY INFORMATION WAS PROVIDED BY THE BOUTET COMPANY INC. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE EXACT LOCATION OF ALL SITE FEATURES. IF CONDITIONS OTHER THAN THOSE SHOWN ON THE PLANS ARE ENCOUNTERED, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER.
 - CONTRACTOR SHALL MAINTAIN "REDLINE" RECORD DRAWINGS ON A CLEAN SET OF CONSTRUCTION DRAWINGS. THE "REDLINES" SHALL BE KEPT CURRENT ON A DAILY BASIS AND SHALL BE AVAILABLE TO THE ENGINEER FOR INSPECTION ON THE JOBSITE.
 - CONTRACTOR SHALL RECORD SURVEY NOTES FOR SUBMITTAL WITH AS-BUILT PLANS, INCLUDING HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES ENCOUNTERED IN THE FIELD. CONTRACTOR SHALL RECORD ALL DEVIATIONS FROM THE PLANS.
 - OWNER OBTAINED PERMITS OR STATUS THEREOF ARE SUPPLIED IN THE CONTRACT DOCUMENTS. CONTRACTOR SHALL ENSURE ALL PERMITS NECESSARY TO COMPLETE THE WORK ARE OBTAINED PRIOR TO EARTHWORK DISTURBING ACTIVITIES. CONTRACTOR SHALL ENSURE COMPLIANCE WITH ALL PERMITS UNTIL THE PROJECT HAS ACHIEVED FINAL ACCEPTANCE. CONTRACTOR SHALL OBTAIN AN ADF&G AQUATIC RESOURCE PERMIT FOR TRANSPORTING STRANDED FISH WITHIN THE PROJECT LIMITS.
 - THESE NOTES CONTAIN INFORMATION NECESSARY FOR THE PROPER EXECUTION OF THE WORK CONTAINED ON THESE IMPROVEMENT PLANS. THESE NOTES APPLY TO ALL PLAN SHEETS. ADDITIONAL CONSTRUCTION NOTES MAY ALSO BE SHOWN ON INDIVIDUAL PLAN SHEETS. THE CONTRACTOR IS RESPONSIBLE TO READ AND COMPLY WITH ALL NOTES SHOWN ON THIS SET OF PLANS. THE TERM "CONTRACTOR", AS USED IN THESE NOTES AND ELSEWHERE IN THIS PLAN SET, MEANS THE GENERAL CONTRACTOR AND ALL SUBCONTRACTORS AND INDIVIDUALS AUTHORIZED TO PERFORM WORK SHOWN ON THESE PLANS. ALL CONTRACTORS ARE DIRECTED TO CONTACT THE ENGINEER FOR ANY QUESTIONS REGARDING THE STATED OR IMPLIED MEANING OF ANY NOTE OR OTHER INFORMATION CONTAINED ON THESE IMPROVEMENT PLANS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO INSURE THAT HIS/HER CONTRACT FOR SERVICES INCLUDES THE RESPONSIBILITIES DEFINED BY THE APPLICABLE NOTES.
 - ALL QUANTITIES SHOWN HEREIN ARE APPROXIMATE AND DO NOT ACCOUNT FOR SWELL PRIOR TO COMPACTION OR WASTE. CONTRACTOR SHALL VERIFY ALL QUANTITIES.
- EXISTING UTILITIES:**
- PLANS MAY NOT SHOW ALL EXISTING UTILITIES WITHIN THE PROJECT AREA.
 - CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND VERIFYING ALL UTILITIES AND PERFORMING ANY NECESSARY VERIFICATION PRIOR TO CONSTRUCTION. UTILITY LOCATING SHALL BE COMPLETED A MINIMUM OF 10 DAYS TO NO MORE THAN 20 DAYS PRIOR TO COMMENCEMENT OF WORK.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE EXACT LOCATION OF ALL EXISTING UTILITIES WITHIN THE LIMITS OF CONSTRUCTION, WHETHER OR NOT SAID UTILITIES ARE SHOWN ON THE PLANS. THIS RESPONSIBILITY INCLUDES CONTACTING UTILITY COMPANIES FOR LOCATIONS OR POTHOLING PRIOR TO CONSTRUCTION. ANY DAMAGE TO EXISTING UTILITIES DURING CONSTRUCTION IS THE RESPONSIBILITY OF THE CONTRACTOR.
 - THE CONTRACTOR SHALL PROTECT EXISTING UTILITIES TO REMAIN AND COORDINATE WITH UTILITY OWNERS FOR REQUIREMENTS FOR SHORING OR SUPPORTING UNDERMINED UTILITIES DURING CONSTRUCTION. SHORING/SUPPORTING OF UTILITIES SHALL BE CONSIDERED SUBSIDIARY TO THE CONTRACT AND WILL NOT BE MEASURED FOR PAYMENT.

EXCAVATION AND STRUCTURE INSTALLATION:


- CONTRACTOR SHALL EXERCISE EXTREME CAUTION AND OBSERVE ALL APPLICABLE OSHA REQUIREMENTS FOR WORKING IN CONFINED AREAS AND OPEN EXCAVATIONS.
- ORGANIC, OVER SATURATED OR NON-COMPACTABLE MATERIAL SHALL BE REMOVED FROM THE SUBGRADE TO A DEPTH TO BE DETERMINED BY THE ENGINEER. NO ORGANIC MATERIAL OR OTHER DELETERIOUS MATERIAL SHALL BE UTILIZED FOR BACKFILL.
- CONTRACTOR SHALL VERIFY INVERTS OF EXISTING CHANNEL AND ALL PROPOSED STRUCTURES PRIOR TO CONSTRUCTION. REPORT ANY DISCREPANCIES FROM THE PLANS IMMEDIATELY TO THE ENGINEER.
- ALL VEGETATION IN THE AREAS NOT AFFECTED BY THE WORK SHALL BE PRESERVED AND PROTECTED BY THE CONTRACTOR. RESEED ALL DISTURBED AREAS IN CONFORMANCE WITH REVEGETATION PLANS ON SHEETS Q1, Q2, Q3, AND THE SWPPP.
- FINISH GRADE REPRESENTS THE ELEVATION OF THE FINISHED SURFACE. THIS INCLUDES LANDSCAPE AREAS, ROCK RIPRAP SURFACE AND ELEVATION AT EXTERIOR OF STRUCTURE FOUNDATION, UNLESS OTHERWISE DENOTED ON DETAIL OR SPECIAL LABEL. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ADJUST SUBGRADE OR TOPSOIL TO ALLOW FOR FINISHED SURFACE MATERIAL DIMENSIONS.
- DEWATERING OF THE EXCAVATION MAY BE REQUIRED TO COMPLETE THE WORK. DISCHARGE OF DEWATERING PUMPS SHALL BE A MINIMUM OF 100' FROM STREAMS AND SHALL BE PROTECTED WITH BMP'S AS REQUIRED TO MINIMIZE SEDIMENT DISCHARGE INTO RECEIVING WATERS.

 THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6778 LICENSE NO. AEC0367	95% P&E	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		NOTES, INDEX, LEGEND & ABBREVIATIONS
CONSULTANT	SEAL	

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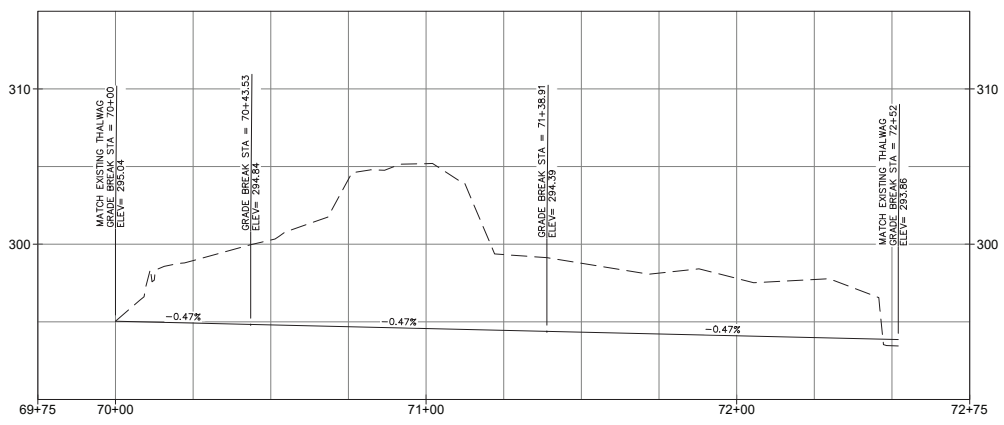
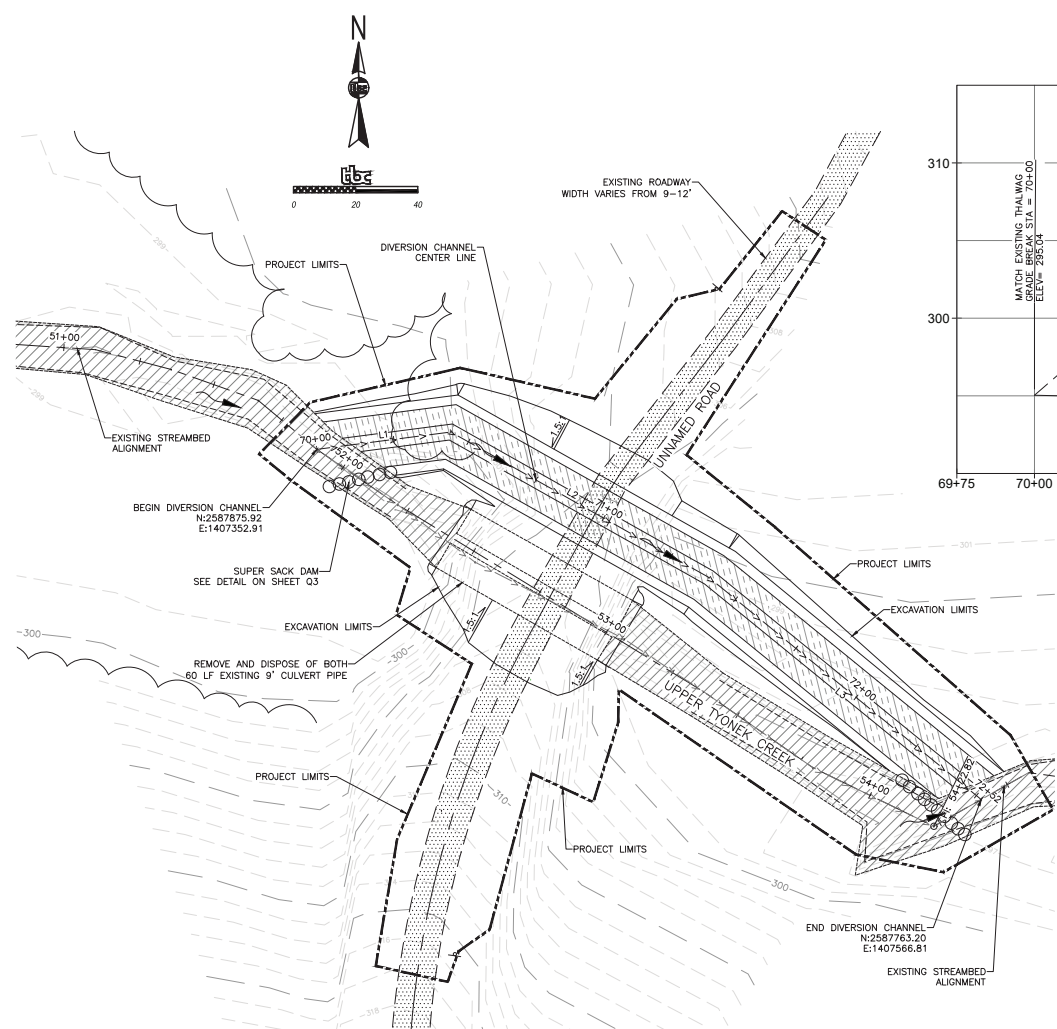
NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	A3	A4

SURVEY CONTROL IN PROGRESS

 THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367	95% PS&E	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		SURVEY CONTROL
CONSULTANT	SEAL	

FILE W:\WASILAFLES\TYONEK CONSERVATION DISTRICT\2022\UPPER TYONEK CRK\UPPER TYONEK CRK BRIDGE.DWG DATE/TIME 1/26/2026 LAYOUT DESIGNED SMJ CHECKED TJA DRAFTED SMJ

NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	A4	A4



DIVERSION CHANNEL PROFILE

DIVERSION CENTER LINE TABLE

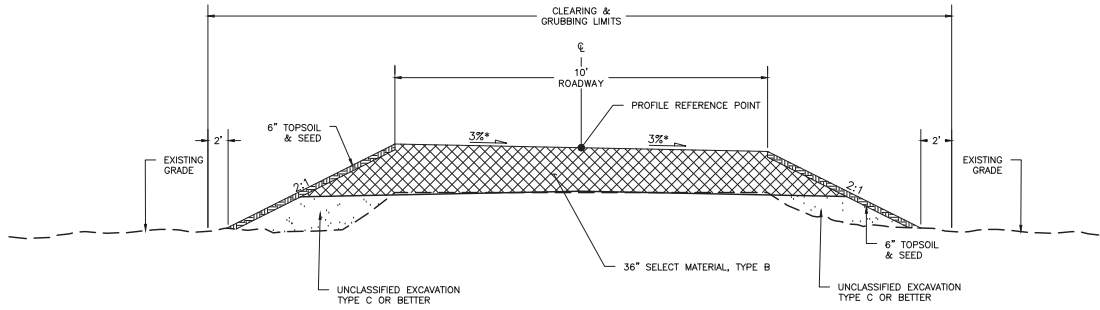
LINE #	LENGTH	DIRECTION
L1	43.53	N82° 36' 33.76"E
L2	95.38	S60° 34' 36.60"E
L3	113.09	S50° 48' 38.46"E

- DEMOLITION PLAN NOTES:**
- TOTAL AREA OF DISTURBANCE IS 0.5 ACRES.
 - LIMITS OF DISTURBANCE SHOWN ARE APPROXIMATE BASED ON FIELD OBSERVATIONS. ACTUAL LIMITS SHALL BE DELINEATED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO CLEARING AND GRUBBING.
 - THE STREAM CHANNEL AND VEGETATION IN AREAS NOT AFFECTED BY WORK SHALL BE PROTECTED AND PRESERVED BY THE CONTRACTOR. RESTORE ALL DISTURBED AREAS IN CONFORMANCE WITH THE REVEGETATION PLAN.

<p>THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367</p>	<p>95% PS&E</p>	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		DEMOLITION AND EXCAVATION PLAN
CONSULTANT	SEAL	

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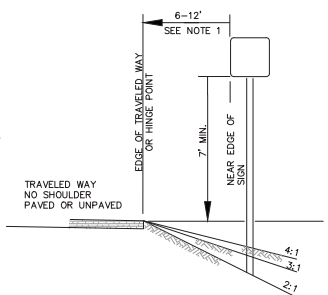
NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	B1	B1



ROAD RECONSTRUCTION TYPICAL SECTION (NTS)

TYPICAL SECTION NOTES:

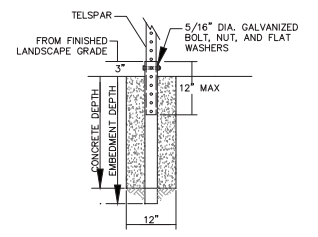
- CONTRACTOR SHALL CLEAR AND GRUB TO FILL/CUT CATCH LIMITS PLUS 2 FEET PER SIDE. SALVAGE GRUBBING MATERIAL FOR REUSE ON THE PROJECT. CLEARING LIMITS SHALL BE APPROVED BY THE ENGINEER PRIOR TO PERFORMING WORK.
- SEE BRIDGE INSTALLATION DETAIL SHEET D1 FOR MATERIAL TO BE PLACED WITHIN BRIDGE EXCAVATION LIMITS.
- OUTSIDE OF BRIDGE EXCAVATION LIMITS, PLACE BORROW, TYPE B ON EXISTING ROADBED AS NECESSARY TO CONSTRUCT NEW ROAD PROFILE.
- BACKFILL SHALL BE COMPACTED TO 95% MDD.
- TOP 6" OF ROAD EMBANKMENT SELECTED MATERIAL, TYPE B SHALL PASS THE 3" SIEVE.



NO SHOULDER

NOTES:

- UNLESS SHOWN OTHERWISE ON THE DRAWINGS, THE STANDARD SIGN OFFSET IS 12". THE MINIMUM IS 6".
- IF SIGNS EXTEND OVER SIDEWALKS, THE MINIMUM VERTICAL CLEARANCE IS 7'-0".
- ADD 6" TO MOUNTING HEIGHT ON UNPAVED ROADS.
- IF SIGNS EXTEND OVER BIKE PATHS, THE MINIMUM VERTICAL CLEARANCE IS 8'-0".
- PAINT ALL SIGN MOUNTING FASTENERS ON SIGN FACE A COLOR MATCHING THE SIGN FACE.
- ATTACH ALL SIGNS ZEES AND BRACES MOUNTED TO THE POSTS WITH 5/16" BOLTS WITH SELF-LOCKING NUTS.

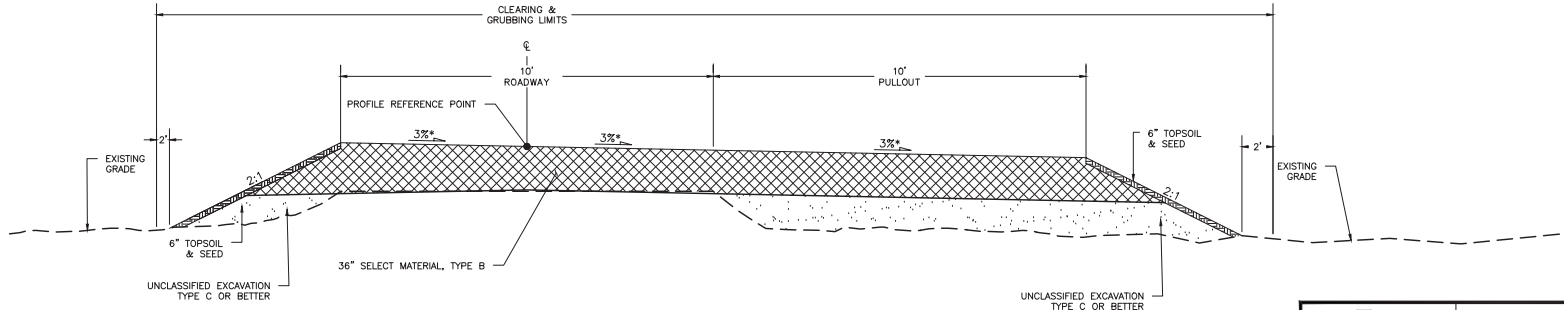


CONCRETE FOUNDATION FOR SIGN POST

PERFORATED STEEL TUBES (P.S.T.) (12ga. - .103" Wall Thickness)			
SIGN SURFACE AREA SQ. FT.	POST SIZE	EMBEDMENT DEPTH	CONCRETE DEPTH
7' OR LESS	2" X 2"	27"	24"
GREATER THAN 7'	2 1/2" X 2 1/2"	33"	30"

**CONCRETE FOUNDATION FOR SIGN POST DETAIL
NTS**

**POST MOUNTED SIGN (NO SHOULDER) DETAIL
NTS**



ROAD PULLOUT TYPICAL SECTION (NTS)

<p>THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6778 LICENSE NO. AEC0367</p>	<p>95% PS&E</p>	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		ROADWAY TYPICAL SECTION
CONSULTANT	SEAL	


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NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	C1	C1

ESTIMATE OF QUANTITIES				
ITEM NO.	ITEM DESCRIPTION	PAY UNIT	QUANTITY	NOTE
201.0009.0000	CLEARING AND GRUBBING	ACRE	0.29	
202.0004.0000	REMOVAL OF CULVERT PIPE	LINEAR FOOT	120	Two 60 LF 9 ft Diameter Pipe
203.0003.0000	UNCLASSIFIED EXCAVATION	CUBIC YARD	1,440	
203.0003.0001	BORROW, TYPE B	CUBIC YARD	357	
602.0004.0001	50' Span by 14' Wide Big R "Temporary" Rolled Steel Girder Bridge	LUMP SUM	ALL REQ'D	
641.0001.0000	RIPRAP, CLASS II	CUBIC YARD	123	
641.0003.0000	STREAM SUBSTRAIGHT	CUBIC YARD	230	
615.0001.0000	STANDARD SIGNAGE	SQUARE FEET	6	
618.0002.0000	SEEDING	POUNDS	52	
620.0001.0000	6" TOPSOIL	SQUARE YARD	226	
621.2012.0000	PLANTING TREES AND SHRUBS	EACH	125	
623.0002.0000	VEGETATIVE MAT SALVAGE AND REPLANTING	SQUARE FOOT	1,174	
640.0001.0000	GEOGRID, REINFORCEMENT - CLASS 1	SQUARE YARD	142	
640.0001.0000	MOBILIZATION AND DEMOBILIZATION	LUMP SUM	ALL REQ'D	
641.0001.0000	EROSION AND POLLUTION CONTROL ADMINISTRATION	LUMP SUM	ALL REQ'D	
641.0003.0000	TEMPORARY EROSION AND POLLUTION CONTROL	LUMP SUM	ALL REQ'D	
642.0001.0000	CONSTRUCTION SURVEYING	LUMP SUM	ALL REQ'D	
643.0002.0000	TRAFFIC MAINTENANCE	LUMP SUM	ALL REQ'D	
671.0001.0000	STREAM BANK RECONSTRUCTION	LINEAR FOOT	314	
671.2001.0000	STREAM DIVERSION & DEWATERING	LUMP SUM	ALL REQ'D	

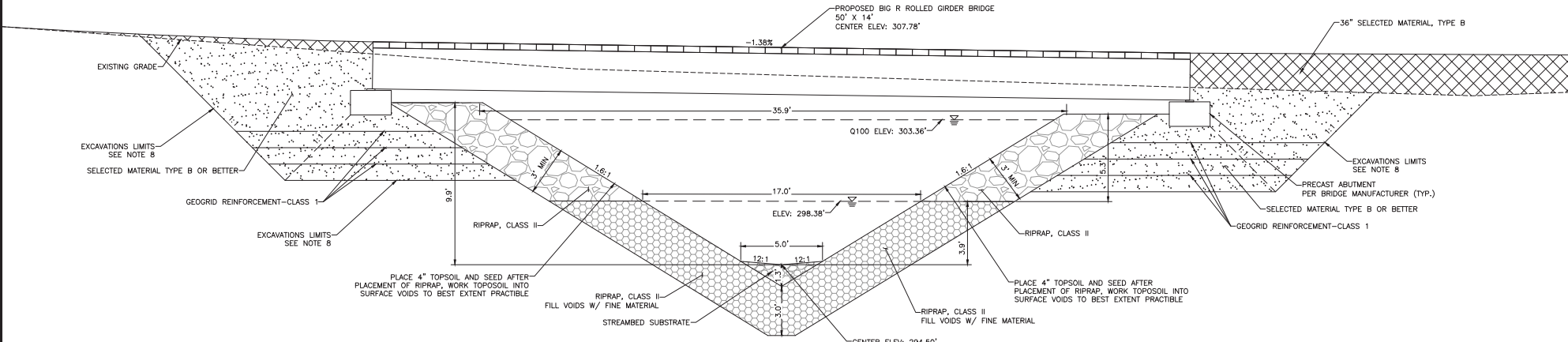
ESTIMATE OF QUANTITIES NOTES:

1. THE ESTIMATE OF QUANTITIES IS PROVIDED FOR INFORMATIONAL PURPOSES ONLY TO DEMONSTRATE THE RELATIVE SCOPE AND MAGNITUDE OF THE PROJECT. BIDDERS SHALL CALCULATE QUANTITIES IN PREPARATION OF BIDS. DISCREPANCY BETWEEN THIS ESTIMATE AND FINAL QUANTITIES DURING CONSTRUCTION SHALL NOT BE A BASIS FOR A CLAIM.

 THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0267	95% PS&E	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		ESTIMATE OF QUANTITIES
CONSULTANT	SEAL	

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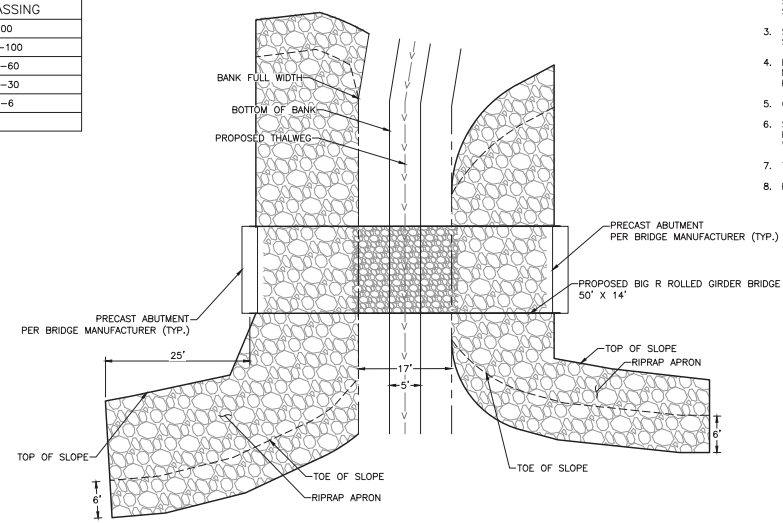
NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	D1	D2



UPPER TYONEK CREEK STREAM SUBSTRATE MATERIAL

COARSE MATERIAL 50% BY WEIGHT		FINE MATERIAL 50% BY WEIGHT	
SIZE	% PASSING	SIZE	% PASSING
8"	100	3 IN	100
3"	50 (MAX)	3/4 IN	75-100
1"	5 (MAX)	NO. 4	15-60
-	-	NO. 16	10-30
-	-	NO. 200	0-6

1
D1
BRIDGE SECTION
STREAM STATION 81+82 TO 81+76



2
D1
STREAM CHANNEL PLAN VIEW
NTS

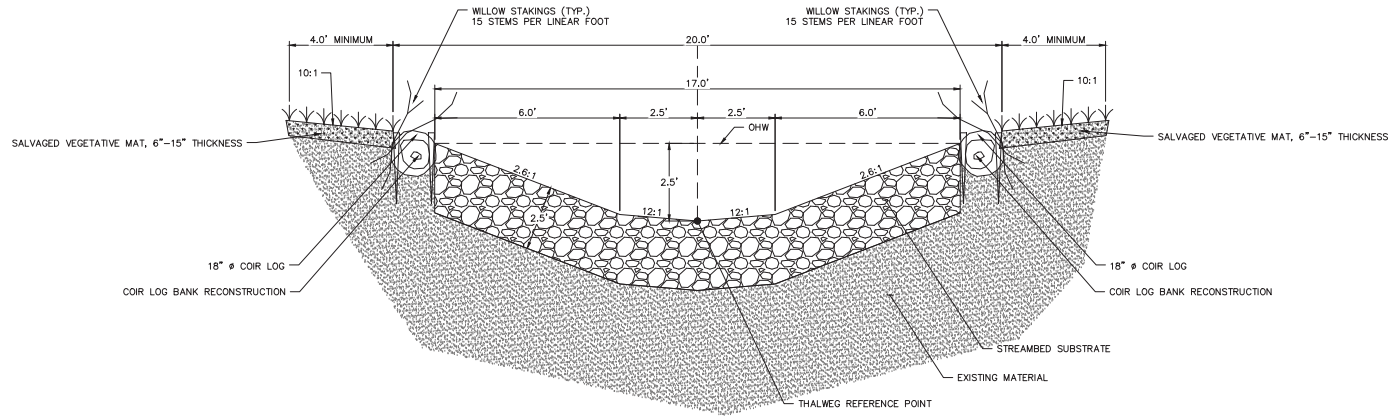
BRIDGE INSTALLATION NOTES:

1. STREAM SUBSTRATE MATERIAL SHALL BE 50% COARSE AND 50% FINE MATERIAL BY WEIGHT MEETING THE GRADATIONS SHOWN HEREIN. COARSE MATERIAL IS MADE UP OF DRAINAGE ROCK PER SECTION 610-2.01 AND FINE MATERIAL IS MADE UP OF STRUCTURAL FILL PER 703-2.13.
2. SALVAGE AND REUSE EXISTING STREAMBED MATERIAL WITHIN THE CUT LIMITS FOR USE AS FINE COMPONENT OF STREAM SUBSTRATE AT THE DIRECTION OF THE ENGINEER. IMPORTED MATERIAL SHALL BE USED IF SUFFICIENT QUANTITY OF EXISTING STREAMBED MATERIAL IS NOT AVAILABLE.
3. STREAM SUBSTRATE MATERIAL SHALL BE INSTALLED IN STRUCTURES ACCORDING TO THE PLANS. MANUAL SHAPING OF THE STREAM CHANNEL IS REQUIRED.
4. ENGINEER TO APPROVE MATERIALS AND METHOD FOR STREAM SUBSTRATE MATERIALS BEFORE MIXING AND PLACING MATERIAL OR RECONSTRUCTING THE STREAM CHANNEL. NOTIFY THE ENGINEER AT LEAST 48 HOURS IN ADVANCE OF PLACING BRIDGE INFILL MATERIAL.
5. CONSTRUCT STREAMBED AND BANKS LEAVING A ROUGH, NON-UNIFORM SURFACE.
6. SPRAY HIGH PRESSURE WATER ON ALL BRIDGE INFILL MATERIAL AND FOOTER PROTECTION ROCK TO THOROUGHLY WASH FINES INTO THE STREAMBED PRIOR TO DIVERTING STREAM INTO NEWLY CONSTRUCTED CHANNEL. FINES SHOULD BE WASHED IN UNTIL WATER POOLS ON SURFACE. ADDITIONAL FINES MAY BE REQUIRED DURING THIS PROCESS.
7. TRENCH WALL SLOPES SHALL CONFORM TO OSHA SAFETY STANDARDS.
8. BACKFILL SHALL BE COMPACTED TO 95% MDD.

 THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367	95% P&E	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		BRIDGE INSTALLATION CROSS SECTION
CONSULTANT	SEAL	

FILE W:\WASILAF\FILES\TYONEK TRIBAL CONSERVATION DISTRICT\2022\UPPER TYONEK CRK\UPPER TYONEK CRK BRIDGE.DWG DATE/TIME 1/26/2026 LAYOUT DESIGNED SNJ CHECKED TJA DRAFTED SNJ

NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	D2	D2



1 TYONEK CREEK CHANNEL RECONSTRUCTION
D2 STA 81+11 TO 81+62 AND STA 81+76 TO 82+27

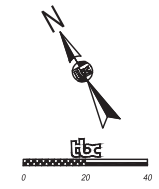
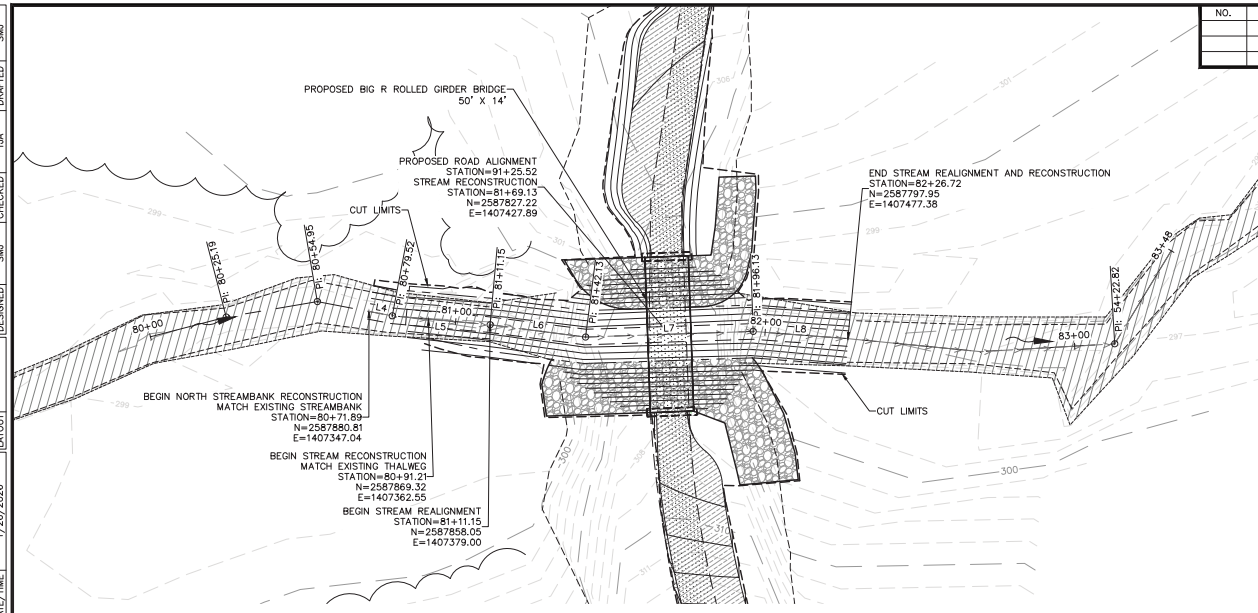
BANK RECONSTRUCTION NOTE:

1. STREAM BOTTOM OUTSIDE OF CROSSING LOCATION TO CONSIST OF NATIVE, INSITU GRAVELS. EXCAVATE TO LIMITS SHOWN.
2. PLANT 2 SAPLINGS 1.5' TO 5.5' TALL FOR EVERY TREE CUT DOWN AS REQUIRED BY KENAI PENINSULA BOROUGH (KPB) PERMITS. SAPLING SELECTION SHALL FOLLOW ADFG'S 2025 STREAMBANK REVEGETATION AND PROTECTION GUIDE, PAGES 31 AND 33 DETAIL ACCEPTABLE SPECIES AND THEIR PLANTING LOCATION REQUIREMENTS. PLANT TREES A MINIMUM OF FIVE FEET APART.
3. REFER TO PAGES 26, 36-38 OF ADFG'S 2025 STREAMBANK REVEGETATION AND PROTECTION GUIDE FOR VEGETATIVE MAT SALVAGE AND/OR HARVEST AND REPLANTING. IF MAT IS NOT PLACED IN FINAL POSITION WITHIN 24 HOURS OF HARVEST STOCKPILE ON PLASTIC SHEETING, ROOTS DOWN AND SURROUND WITH SOIL TO PREVENT ROOTS AROUND THE EDGES FROM DRYING. REGULARLY WATER THE VEGETATIVE MAT UNTIL SITE IS PREPARED FOR PLANTING.
4. SPRAY HIGH PRESSURE WATER ON ALL STREAMBED INFILL MATERIAL TO THOROUGHLY WASH FINES INTO THE STREAMBED PRIOR TO DIVERTING STREAM INTO NEWLY CONSTRUCTED CHANNEL. FINES SHOULD BE WASHED IN UNTIL WATER POOLS ON SURFACE. ADDITIONAL FINES MAY BE REQUIRED. STREAM SHALL NOT BE RE-DIVERTED INTO RECONSTRUCTED STREAM UNTIL ENGINEER HAS APPROVED BED MATERIALS ARE SUFFICIENTLY SEALED.
5. REFER TO PAGES 26-27 ADFG'S 2025 STREAMBANK REVEGETATION FOR SELECTION OF SAPLING PLANT SPECIES. ENGINEER SHALL APPROVE SAPLING SPECIES PRIOR TO PLANTING.
6. REFER TO PAGES 54-57 OF ADFG'S 2025 STREAMBANK REVEGETATION GUIDE FOR LIVE STAKING, PLANTING AND SPACING OF SAPLINGS.
7. REFER TO PAGES 72-74 ADFG'S 2025 STREAMBANK REVEGETATION FOR COIR LOG INFORMATION.
8. SALVAGE VEGETATIVE MAT FROM THE DISTURBED AREA OR LOCAL AREA. ALLOWABLE THICKNESS OF 6 INCHES MINIMUM AND OF 15 INCHES MAXIMUM. INSTALL SALVAGED VEGETATIVE MAT OVER ENTIRE LENGTH OF DISTURBED OR RECONSTRUCTED STREAMBANKS.

<p>THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367</p>	<p>95% PS&E</p>	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		CHANNEL RECONSTRUCTION
CONSULTANT	SEAL	

FILE W:\ASILAFILES\TYONEK TRIBAL CONSERVATION DISTRICT\2022\UPPER TYONEK CRK UPPER TYONEK CRK BRIDGE.DWG DATE/TIME 1/26/2026 LAYOUT DESIGNED SNJ CHECKED TJA DRAFTED SNJ

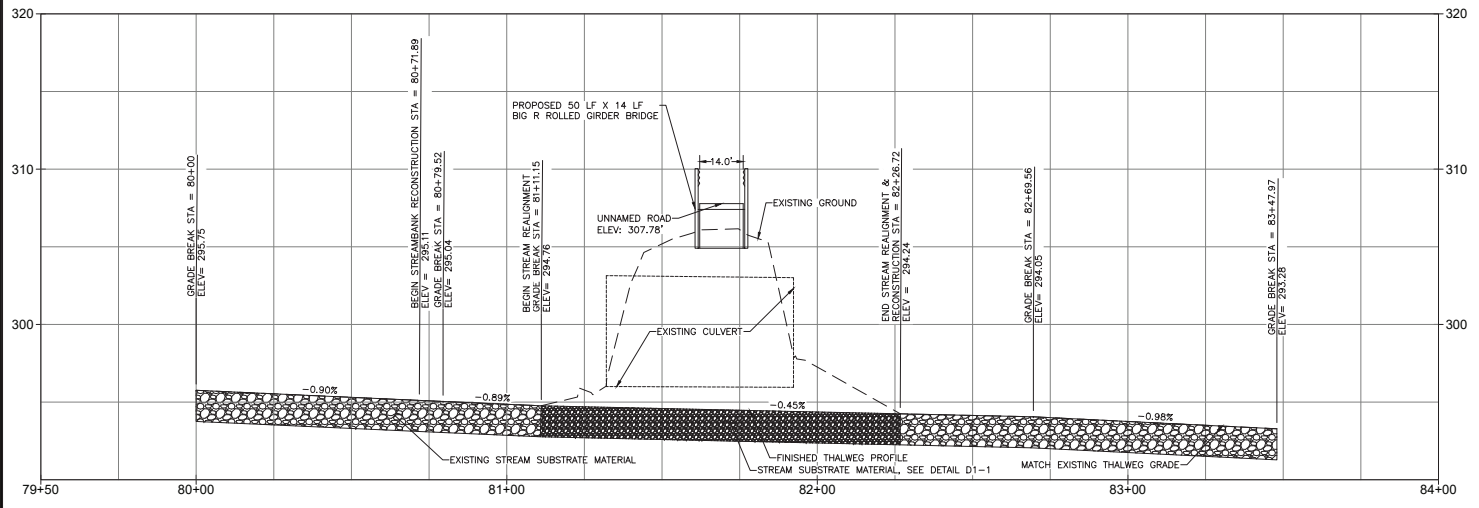
NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	F1	F2



- ### LEGEND
- - - - - EXISTING GRAVEL ROAD SURFACE
 - ▨ NEW GRAVEL ROAD SURFACE
 - ▨ EXISTING STREAM
 - ▨ EXISTING ROADWAY
 - ▨ PROPOSED ROADWAY
 - ▨ PROPOSED STREAM SUBSTRATE MATERIAL
 - ▨ RIPRAP ABUTMENT PROTECTION
 - ▨ PROPOSED BOTTOM OF STREAM BANK
 - ▨ PROPOSED BANK FULL WIDTH (BFW)
 - - - - - PROPOSED EDGE OF LOW FLOW CHANNEL
 - ▨ ROADWAY CENTERLINE
 - ▨ STREAM CENTERLINE
 - - - - - EXISTING GRADE PROFILE
 - - - - - FINISH GRADE PROFILE
 - ▨ CUT LIMIT
 - ▨ FILL LIMIT
 - ▨ EXISTING MINOR CONTOUR
 - 195- EXISTING MAJOR CONTOUR
 - ▨ PROPOSED MINOR CONTOUR
 - 195- PROPOSED MAJOR CONTOUR
 - ▨ TOE OF SLOPE

STREAM CENTER LINE TABLE

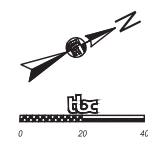
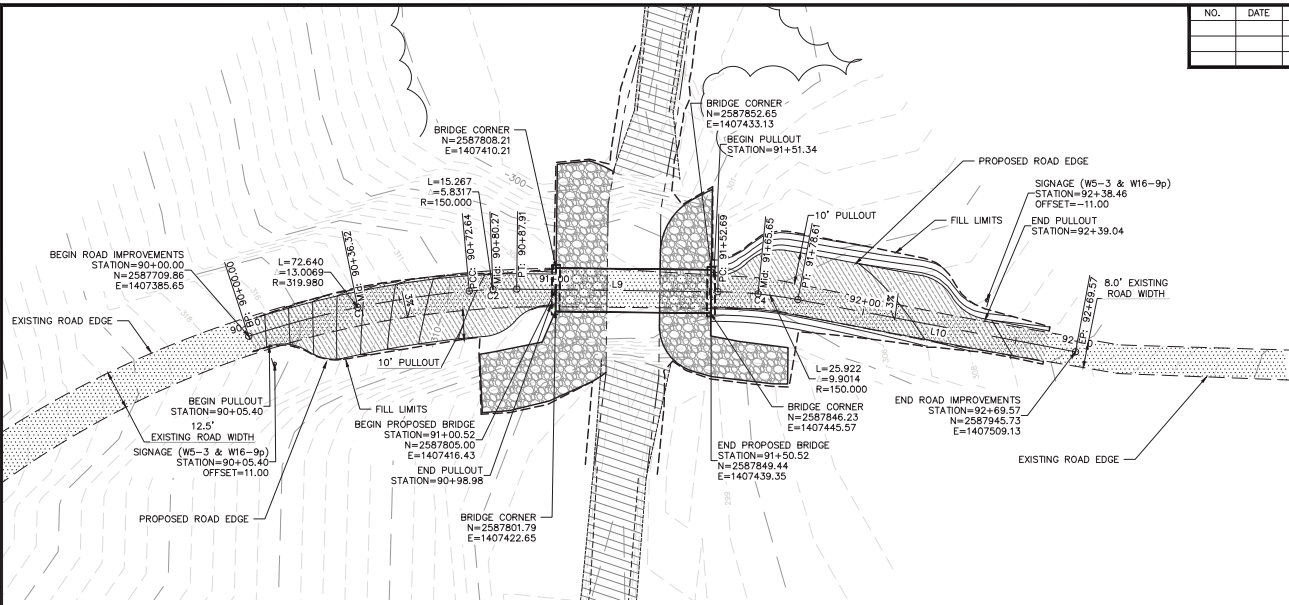
LINE #	LENGTH	DIRECTION
L4	7.64	S50° 12' 09.47"E
L6	30.99	S53° 27' 21.19"E
L7	54.00	S62° 42' 50.89"E
L8	30.58	S56° 28' 07.89"E



<p>THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367</p>	<p>95% PS&E</p>	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		STREAM PLAN AND PROFILE
CONSULTANT	SEAL	

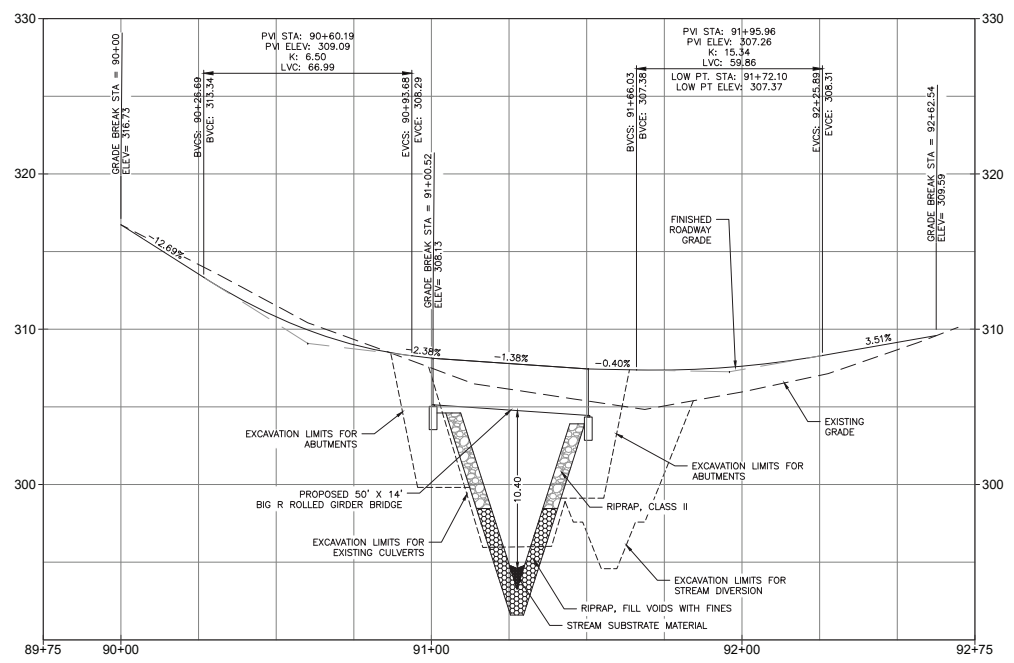
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NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	F2	F2



LINE #	LENGTH	DIRECTION
L9	64.85	N27° 17' 09.11"E
L10	89.04	N37° 11' 14.02"E

CURVE #	LENGTH	RADIUS	DELTA	CHORD DIRECTION	CHORD LENGTH
C1	72.64	319.98	13.01	N14° 57' 03"E	72.48
C2	15.27	150.00	5.83	N24° 22' 12"E	15.26
C4	27.78	150.00	10.61	N32° 35' 26"E	27.74

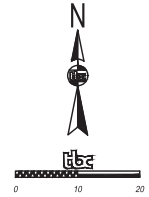


95% PS&E
CONSULTANT

UPPER TYONEK CREEK
FISH PASSAGE IMPROVEMENTS
ROAD PLAN AND PROFILE
SEAL

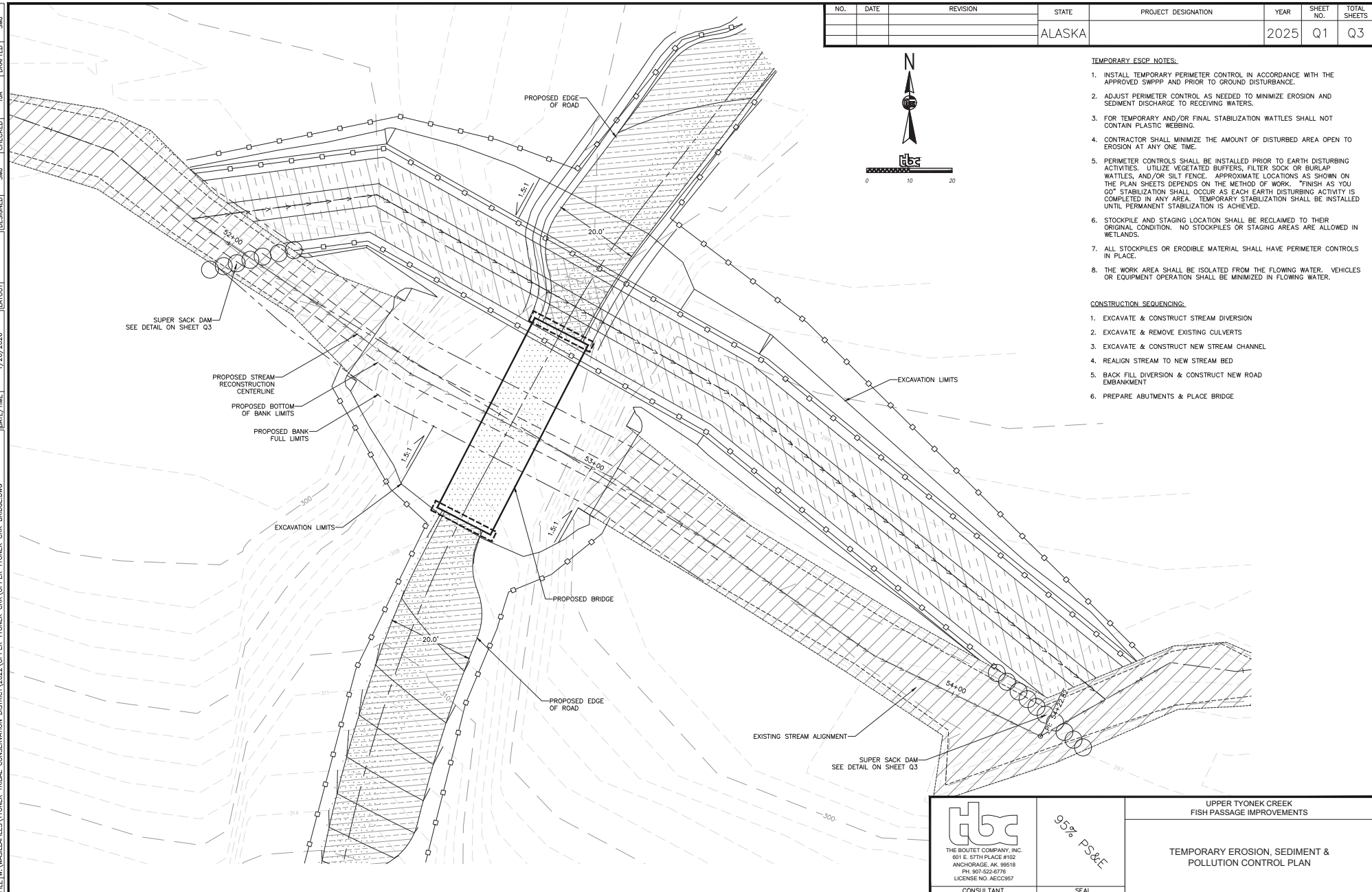
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NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	Q1	Q3



- TEMPORARY ESCP NOTES:**
1. INSTALL TEMPORARY PERIMETER CONTROL IN ACCORDANCE WITH THE APPROVED SWPPP AND PRIOR TO GROUND DISTURBANCE.
 2. ADJUST PERIMETER CONTROL AS NEEDED TO MINIMIZE EROSION AND SEDIMENT DISCHARGE TO RECEIVING WATERS.
 3. FOR TEMPORARY AND/OR FINAL STABILIZATION WATTLES SHALL NOT CONTAIN PLASTIC WEBBING.
 4. CONTRACTOR SHALL MINIMIZE THE AMOUNT OF DISTURBED AREA OPEN TO EROSION AT ANY ONE TIME.
 5. PERIMETER CONTROLS SHALL BE INSTALLED PRIOR TO EARTH DISTURBING ACTIVITIES. UTILIZE VEGETATED BUFFERS, FILTER SOCK OR BURLAP WATTLES, AND/OR SILT FENCE. APPROXIMATE LOCATIONS AS SHOWN ON THE PLAN SHEETS DEPENDS ON THE METHOD OF WORK. FINISH AS YOU GO" STABILIZATION SHALL OCCUR AS EACH EARTH DISTURBING ACTIVITY IS COMPLETED IN ANY AREA. TEMPORARY STABILIZATION SHALL BE INSTALLED UNTIL PERMANENT STABILIZATION IS ACHIEVED.
 6. STOCKPILE AND STAGING LOCATION SHALL BE RECLAIMED TO THEIR ORIGINAL CONDITION. NO STOCKPILES OR STAGING AREAS ARE ALLOWED IN WETLANDS.
 7. ALL STOCKPILES OR ERODIBLE MATERIAL SHALL HAVE PERIMETER CONTROLS IN PLACE.
 8. THE WORK AREA SHALL BE ISOLATED FROM THE FLOWING WATER. VEHICLES OR EQUIPMENT OPERATION SHALL BE MINIMIZED IN FLOWING WATER.

- CONSTRUCTION SEQUENCING:**
1. EXCAVATE & CONSTRUCT STREAM DIVERSION
 2. EXCAVATE & REMOVE EXISTING CULVERTS
 3. EXCAVATE & CONSTRUCT NEW STREAM CHANNEL
 4. REALIGN STREAM TO NEW STREAM BED
 5. BACK FILL DIVERSION & CONSTRUCT NEW ROAD EMBANKMENT
 6. PREPARE ABUTMENTS & PLACE BRIDGE

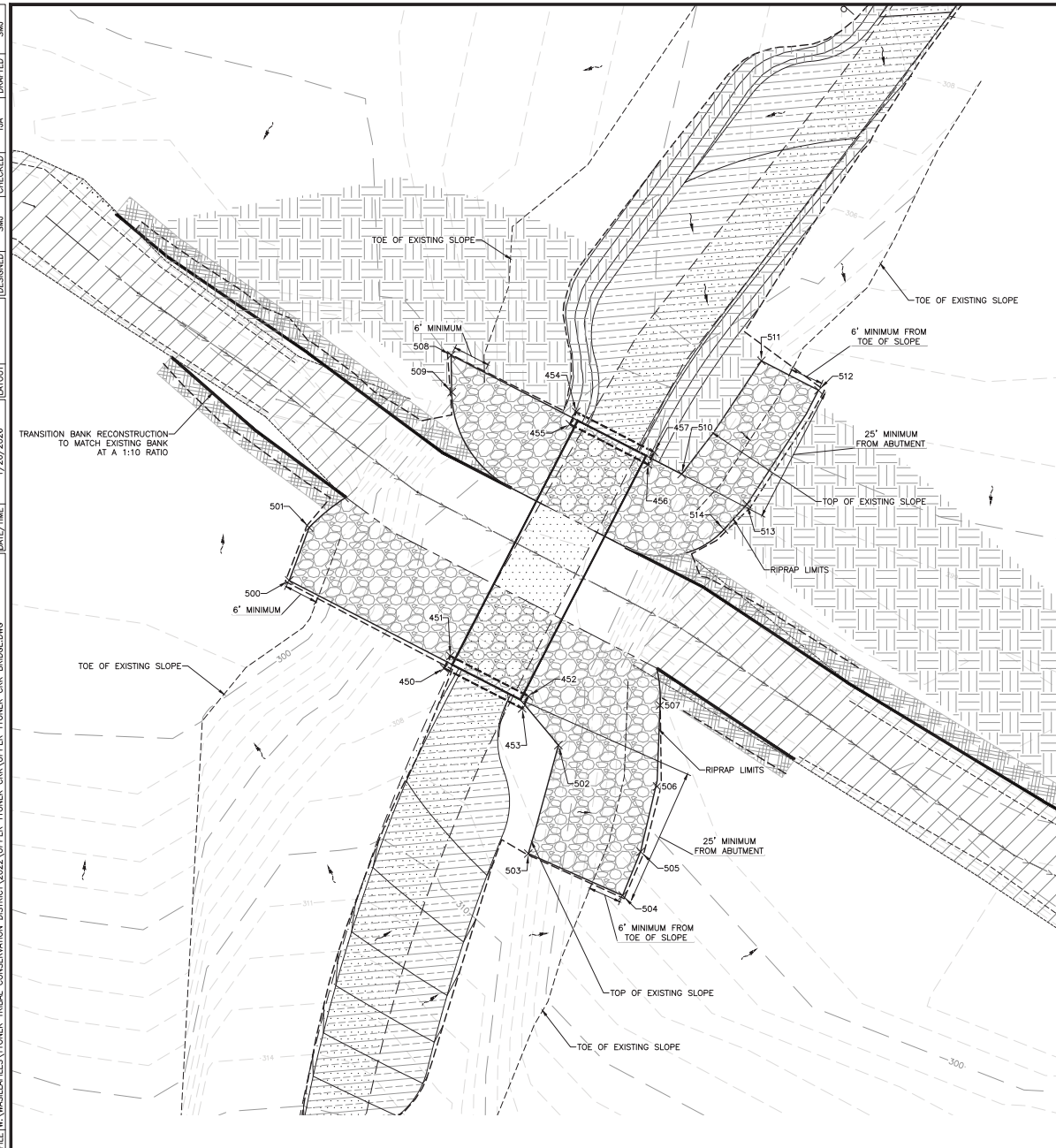
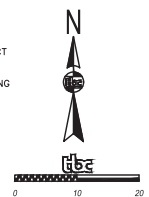


<p>THE BOUTET COMPANY, INC. 801 E. 57TH PLACE #102 ANCHORAGE, AK 99518 PH: 907-522-6776 LICENSE NO. AEC0367</p>	<p>95% PS&E</p>	UPPER TYONEK CREEK FISH PASSAGE IMPROVEMENTS
		<p>TEMPORARY EROSION, SEDIMENT & POLLUTION CONTROL PLAN</p>
CONSULTANT	SEAL	

FILE W:\WASILAFLES\TYONEK TRIBAL CONSERVATION DISTRICT\2022\UPPER TYONEK CRK UPPER TYONEK CRK BRIDGE.DWG DATE/TIME 1/26/2026 LAYOUT DESIGNED SNJ CHECKED TJA DRAFTED SNJ

NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	Q2	Q3

- FINAL STABILIZATION NOTES:**
- INSTALL STABILIZATION BMP'S AS SOON AS PRACTICABLE, "FINISH AS YOU GO".
 - INSTALL SALVAGED VEGETATIVE MAT ALONG ALL DISTURBED STREAMBANKS, MINIMUM 4' WIDE OR AS WIDE AS REQUIRED TO UTILIZE ALL STOCKPILED VEGETATIVE MAT. STABILIZE REMAINING AREA OF DISTURBANCE WITH 6" TOPSOIL AND SEED.
 - PLANT SAPLINGS PER THE REQUIREMENTS WITHIN KPB PERMITS, SELECT SAPLING SPECIES AND SPACING PER ADP&G'S STREAMBANK REVEGETATION AND PROTECTION GUIDE. PLANT TREES AT A DENSITY OF 17 SAPLINGS PER 1000 SQ FT.
 - SPRAY HIGH PRESSURE WATER ON ALL STREAM SUBSTRATE MATERIAL TO THOROUGHLY WASH FINES INTO THE STREAMBED PRIOR TO DIVERTING STREAM INTO NEWLY CONSTRUCTED CHANNEL.
 - PLACE ROLLED EROSION CONTROL PRODUCT (RECP) ON ALL TOPSOIL AND SEEDED SLOPES 2 TO 1 OR STEEPER. HYDROSEEDING WITH FLEX TERRA FLEXIBLE GROWTH MEDIUM MAY BE SUBSTITUTED FOR RECP. APPLY PER MANUFACTURER'S RECOMMENDATIONS.
 - PLACE SLASH AND/OR SALVAGED NATIVE WOODY MATERIAL ON REVEGETATED SLOPES, MAXIMIZE WOOD-TO-SOIL CONTACT AS FEASIBLE.
 - TRANSITION BANKS TO TIE INTO EXISTING NATURAL CHANNEL BANKS. TRANSITIONS CONSTRUCTED TO MATCH INTO EXISTING BANKS AT A 1:10 OFFSET FROM CENTERLINE AS NEEDED.
 - CONTRACTOR SHALL RETAIN ALL RIPRAP AND WOODY DEBRIS LOGS NOT NEEDED FOR CONSTRUCTION UNTIL ACCEPTANCE OF THE STREAMBED. CONTRACTOR COORDINATE WITH ENGINEER FOR USE OF RETAINED EXTRA MATERIAL FOR USE AS MINOR INSTREAM HABITAT FEATURES SUCH AS, BUT NOT LIMITED TO:
 - 2" DIAMETER OR GREATER ROCK
 - 4" MIN DIAMETER LOG PARTIALLY BURIED



Point Table

Point #	Northing	Eastng	Description
450	2587807.56	1407408.75	ABT
451	2587809.78	1407409.89	ABT
452	2587802.45	1407424.11	ABT
453	2587800.22	1407422.97	ABT
454	2587854.22	1407432.81	ABT
455	2587852.00	1407431.67	ABT
456	2587844.66	1407445.89	ABT
457	2587846.88	1407447.03	ABT
500	2587823.52	1407380.53	APL
501	2587833.18	1407384.17	APL
502	2587793.54	1407429.57	APL
503	2587773.79	1407424.09	APL
505	2587774.13	1407444.55	APL
506	2587786.01	1407447.55	APL
507	2587800.78	1407448.10	APL
508	2587864.56	1407410.03	APL
509	2587857.84	1407410.13	APL
510	2587842.90	1407452.02	APL
511	2587863.54	1407466.55	APL
512	2587858.17	1407476.95	APL
513	2587837.40	1407463.93	APL
514	2587832.81	1407459.73	APL

LEGEND

- TOPSOIL AND SEED
- EXISTING STREAM
- EXISTING ROADWAY
- PROPOSED ROADWAY
- DIVERSION CHANNEL
- PROPOSED STREAM SUBSTRATE MATERIAL
- RIPRAP ABUTMENT PROTECTION
- VEGETATIVE COLLAR
- PROPOSED BOTTOM OF STREAM BANK
- PROPOSED BANK FULL WIDTH (BFW)
- FINISH GRADE PROFILE
- PROJECT LIMITS
- CUT LIMIT
- FILL LIMIT
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- TOE OF SLOPE
- PERIMETER CONTROL BMP
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE ARROW

ABBREVIATIONS
 ABT: ABUTMENT
 APL: ABUTMENT PROTECTION LIMITS

SAPLING QUANTITY ESTIMATE TABLE

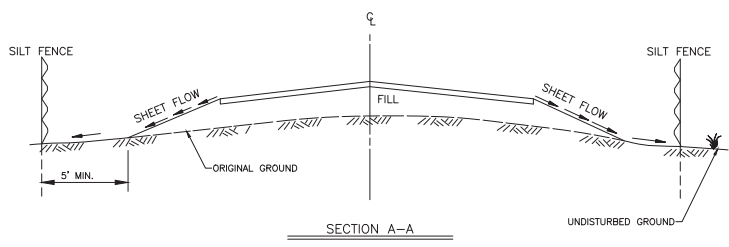
CULVERT LOCATION	NUMBER OF SAPLINGS
UPPER TYONEK CREEK	371

95% PS&E
 CONSULTANT SEAL

UPPER TYONEK CREEK
 FISH PASSAGE IMPROVEMENTS
 EROSION, SEDIMENT &
 POLLUTION CONTROL PLAN
 FINAL STABILIZATION PLAN

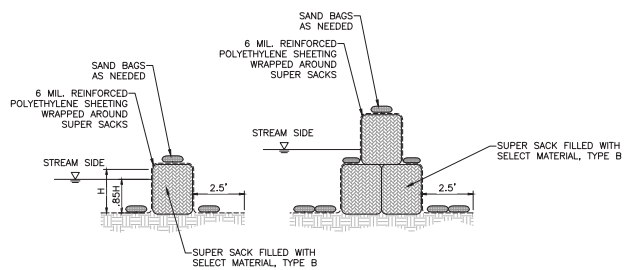
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NO.	DATE	REVISION	STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
			ALASKA		2025	Q3	Q3

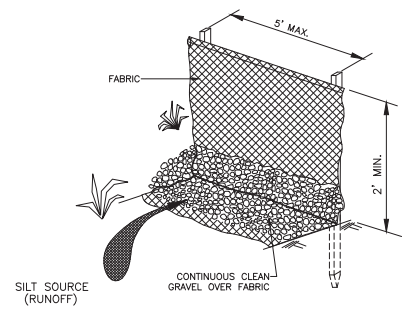


SILT FENCE NOTES:

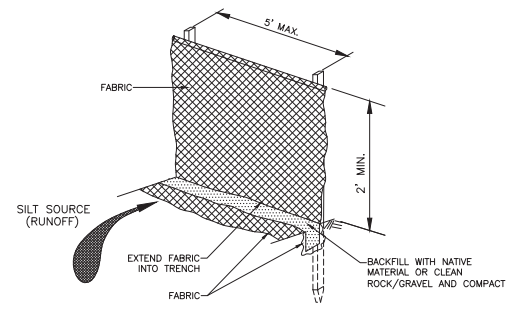
1. INSTALLATION AND APPLICATION SHALL BE IN ACCORDANCE WITH THIS DETAIL AND PER THE MANUFACTURER'S RECOMMENDATION.
2. SILT FENCE FABRIC SHALL BE OVERLAPPED 6" AT FENCE SUPPORTS.
3. SILT FENCE FABRIC SHALL BE TAUT, NOT LOOSE OR FOLDED.
4. THE CONTRACTOR SHALL INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT.
5. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.



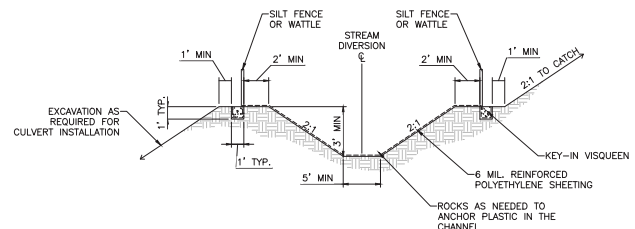
1 SUPER SACK DAM DETAIL
NTS
Q3



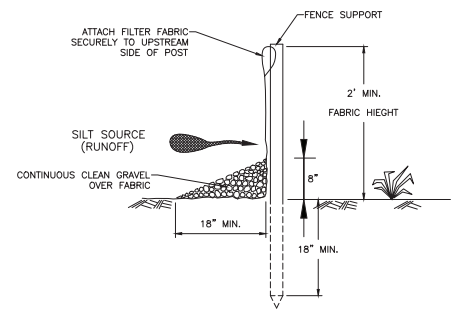
BACKFILL ALTERNATE



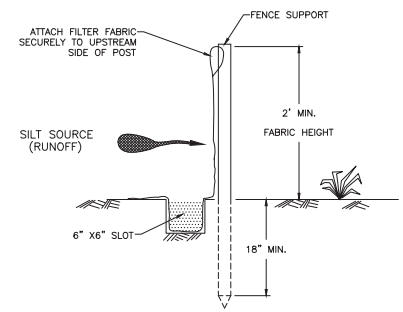
TRENCH ALTERNATE



2 STREAM DIVERSION DETAIL
NTS
Q3



BACKFILL CROSS SECTION



TRENCH CROSS SECTION

SHEET NOTES:

1. SILT FENCE MAY BE SUBSTITUTED FOR WATTLES AS APPROVED BY THE ENGINEER.
2. WATTLES FOR TEMPORARY AND/OR FINAL STABILIZATION SHALL NOT CONTAIN PLASTIC WEBBING.

1. FENCE SHALL BE PLACED AT LEAST 5' FROM THE TOE OF EMBANKMENT OR EXCAVATION AREAS, OR AS DIRECTED BY THE ENGINEER.
2. ACCUMULATION OF SEDIMENT BEHIND SILT FENCE SHALL BE REMOVED WHEN DEPTH REACHES 12". REMOVED SEDIMENT SHALL BE DEPOSITED IN AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.

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		EROSION, SEDIMENT & POLLUTION CONTROL DETAILS
CONSULTANT	SEAL	



Appendix C – Section 106 Documentation

National Historic Preservation Act Section 106 Review of Project

Cultural Resources (CR) Staff Section 106 Review:

Date Request Received: July 1, 2022

Project Name: Tyonek Fish Passage

CR Project Number: 2022-072

CR Staff Reviewer: Jake Adams, Archaeologist

CR Staff Notes: Describe salient points of project description and any other pertinent information

This project will occur at Fish Passage site 20601534 on Tyonek Creek within an existing, active, roadbed. Instream barriers such as rebar and grates will be removed, and the existing culvert will be replaced with an arch culvert in the same location to create continuous instream habitat. There will be no new ground disturbance associated with this project and everything will occur within the original culvert footprint (PL provided detailed photos of the culvert).

Type of Review: Literature/Archival

CR Review Results:

This undertaking occurs within the footprint of an area of previous, extensive, disturbance. There are no known archaeological sites within one mile of the project area. Based on this the undertaking has a finding of no historic properties affected.

Other Instructions:

NHPA Section 106 review is complete.

Section 106 Finding: No Historic Properties Affected

Regional Historic Preservation Officer Use Only:

RHPO Comments:

Section 106 Finding Approved:

Jacob S. Adams
Archaeologist

Date

From: [Swenson, Nicole Y](#)
To: [Adams, Jacob S](#)
Subject: Re: Tyonek TCD Agreements - NHPA Compliance
Date: Tuesday, June 20, 2023 10:09:26 PM
Attachments: [image002.png](#)
[image003.png](#)

Fantastic, thanks, Jacob!

Nicole

Get [Outlook for iOS](#)

From: Adams, Jacob S <jacob_adams@fws.gov>
Sent: Tuesday, June 20, 2023 8:11:53 AM
To: Swenson, Nicole Y <nicole_swenson@fws.gov>
Subject: RE: Tyonek TCD Agreements - NHPA Compliance

Good Morning Nicole-

Looking back at our records and the attachments you provided you are good to go on culverts 20601540 and 20601534. Those culverts were cleared for NHPA Section 106 in 2022. Let me know if you need anything else from me.

Best,
Jake

Jacob S. Adams Ph.D., RPA
Archaeologist
US Fish and Wildlife Service, Alaska Region
1011 E. Tudor Rd.
Anchorage, AK 99503
406-223-5359 or Microsoft Teams
jacob_adams@fws.gov



From: Swenson, Nicole Y <nicole_swenson@fws.gov>
Sent: Friday, June 16, 2023 4:30 PM
To: Adams, Jacob S <jacob_adams@fws.gov>
Subject: Tyonek TCD Agreements - NHPA Compliance

Hi Jacob,

I have two more agreements to process and am requesting your review when you have a moment. (I

am struggling to determine what information or forms are useful to you, so please let me know if you need something more/else!)

I attached previous determination for Lower Tyonek Creek Culvert and Fish Passage Agreement Amendments for your reference.

I am not sure if we need to revisit this, but I thought I would run it by you and make sure the Upper Tyonek Creek site is approved to move forward (construction not starting until 2024 at the earliest)

Both agreements are with the Tyonek Tribal Conservation District doing fish passage/ culvert replacement work.

One agreement is the 3rd year of a 5-year fish passage agreement.

The second agreement is a new BIL FY23 project to support design and construction of two of the larger fish passage culvert replacement projects initiated by the previous agreement.

Both agreements are focused on replacing and installing fish-friendly culverts within the existing roadbed on two projects on Tyonek Creek:

- Lower Tyonek Creek (ADFG [20601540](#)) culvert replacement construction is beginning in 2023 and will be completed in 2024. (Below this email I will paste our conversation from last year about the lower Tyonek Creek Project.)
- Upper Tyonek Creek culvert (circled in the map below, ADFG #[20601534](#)) replacement will be constructed in 2025. This will replace a double barrel culvert with a single, larger culvert within the existing roadbed. No permanent stream diversion is anticipated.

All construction is anticipated to be within the existing road prism.



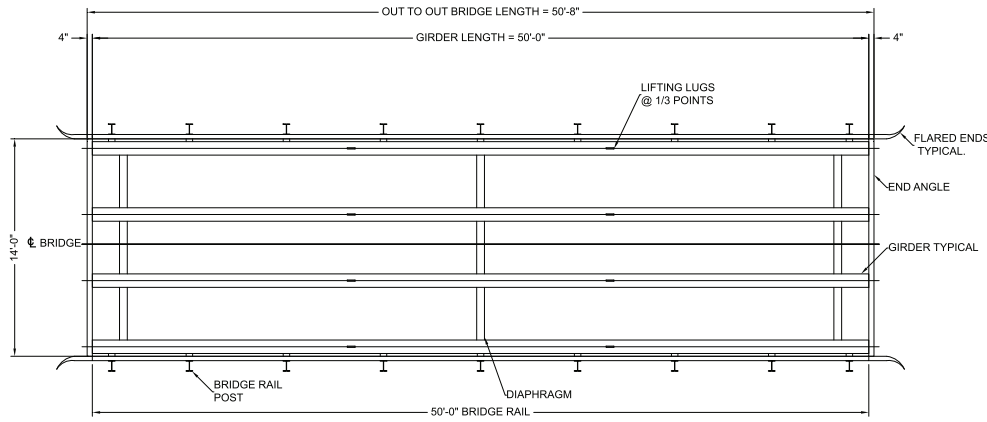
Please let me know what else you might need from me.
Thanks and have a great weekend!

Nicole Swenson

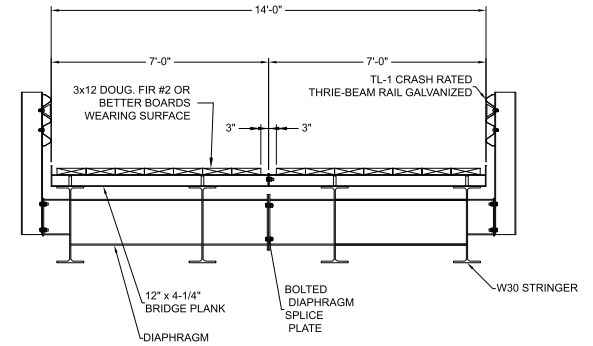
Senior Aquatic Invasive Species Field Biologist
US Fish and Wildlife Service
4700 BLM Rd.
Anchorage, AK 99507
Work Cell: (907) 545-3249

GENERAL NOTES:

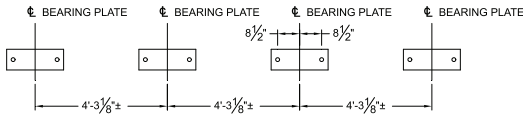
- 1) CONTECH ENGINEERED SOLUTIONS IS RESPONSIBLE FOR THE DESIGN AND SHOP FABRICATION OF THE BRIDGE STRUCTURE ONLY. ALL MEANS, METHODS, AND EQUIPMENT USED FOR FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURE, INCLUDING PREPARATION OR REVIEW AND APPROVAL OF PROJECT SPECIFIC ERECTION PLANS, ARE OUTSIDE OF CONTECH'S RESPONSIBILITY.
- 2) DESIGN IS IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
- 3) MATERIALS (UNLESS NOTED OTHERWISE):
 - a) STRUCTURAL STEEL: ASTM A588 WEATHERING STEEL
 - b) BRIDGE PLANK: ASTM A653 GRADE 50 CLASS 1 (GALV)
 - c) STRUCTURAL BOLTS: ASTM F3125 GRADE A325 (GALV)
 - d) SHEET PILING: ASTM A929 (GALV)
- 4) DESIGN LOADINGS:
 - a) BRIDGE DEAD LOAD PLUS 80 PSF TOTAL WEARING SURFACE.
 - b) VEHICLE LIVE LOAD: HL-93
MAX AVERAGE DAILY TRUCK TRAFFIC (ADTT) = 200
MAX LL DEFLECTION = LENGTH/500
 - c) OWNER SPECIFIED LIVE LOAD: U80
 - d) WIND LOADING PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 3.8.
 - e) SEISMIC LOADING PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 3.10.
- 5) BRIDGE RAIL DESIGNED FOR TL-1 OR TL-2 LOADING IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS APPENDIX A13.2 OR ONLY USED AS A GUIDE RAIL (RAIL HAS NOT BEEN CRASH TESTED). SEE SECTION VIEW FOR RAIL DESIGN.
- 6) BRIDGE TO BE BUILT TO THE REQUIREMENTS OF AWS D1.5.
- 7) ALL EXPOSED SURFACES OF STRUCTURAL STEEL TO BE CLEANED IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL SURFACE PREPARATION SPECIFICATIONS NO. 1, SSPC-SP1 SOLVENT CLEANING. EXPOSED SURFACES OF STEEL SHALL BE DEFINED AS THOSE SURFACES SEEN FROM THE DECK OR FROM THE OUTSIDE OF THE STRUCTURE. ALL OTHER SURFACES TO HAVE STANDARD MILL FINISH.
- 8) MAINTENANCE NOTE: CONTECH RECOMMENDS NOT APPLYING DE-ICING OR DUST PROHIBITIVE CHEMICALS OR SALTS TO ANY PART OF THE BRIDGE STRUCTURE. IF DE-ICING OR DUST PROHIBITIVE CHEMICALS OR SALTS ARE APPLIED TO ANY PART OF THE BRIDGE STRUCTURE, CONTECH WILL NOT BE RESPONSIBLE FOR ANY RESULTANT ACCELERATED CORROSION.
- 9) ELASTOMERIC PADS ARE USED TO PROVIDE A LEVEL BEARING SURFACE ONLY.
- 10) 12" x 4-1/4" BRIDGE PLANKS ARE SHOP WELDED TO THE GIRDERS AND ARE THE STRUCTURAL DECKING SYSTEM. THE WEARING SURFACE IS ONLY TO PROVIDE A SMOOTH RUNNING SURFACE AND NOT REQUIRED STRUCTURALLY.
- 11) DECK MAY BE FINISHED WITH GRAVEL, ASPHALT, CONCRETE, WOOD OR ANY OTHER SUITABLE WEARING SURFACE MATERIAL AT THE OWNERS DISCRETION. TYPICAL WEARING SURFACE LOAD OF 80 PSF WILL ACCOMMODATE UP TO 5 1/4" OF GRAVEL BASE (130 PSF) OR 4 1/4" OF CONCRETE OR ASPHALT (150 PCF) SURFACING ABOVE THE STEEL BRIDGE DECK PLANK CORRUGATIONS. FOR CONCRETE WEARING SURFACES CONTECH RECOMMENDS USING CRACK CONTROL REINFORCING AND IF LATERAL SHIFTING OR UPLIFT OF THE CONCRETE WEARING SURFACE IS A CONCERN, CONTECH RECOMMENDS ATTACHING HEADED ANCHOR STUDS IN THE VALLEYS OF THE CORRUGATIONS.



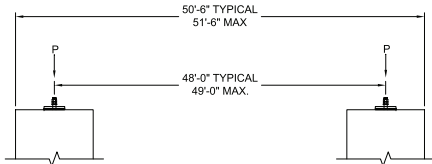
PLAN VIEW



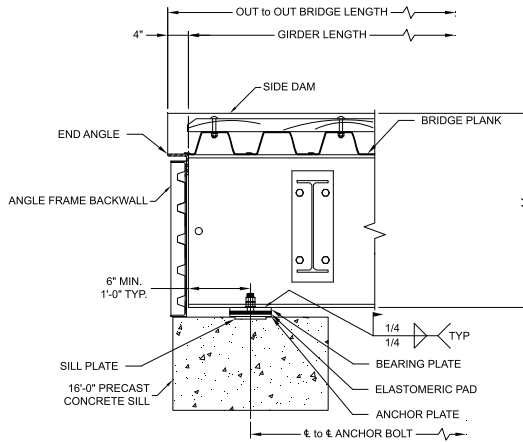
SECTION VIEW



ANCHOR BOLT LAYOUT



ANCHOR BOLT ELEVATION



BEARING ELEVATION

BRIDGE LOADING AND UNFACTORED BEARING REACTIONS IN KIPS	MAX AT INTERIOR GIRDER			MAX AT EXTERIOR GIRDER			TOTAL AT ABUTMENT		
	P	H	L	P	H	L	P	H	L
DEAD LOAD (DC)	3.71			4.31			16.04		
TOTAL WEARING SURFACE (DW) = 80 PSF	8.52			5.48			28.00		
HL-93 DESIGN VEHICLE	LL	42.16		29.99			73.97		
MAX. ADTT = 1025	LL+HM	53.12		37.79			93.20		
U80 OWNER SPECIFIED VEHICLE	LL	58.10		45.43			116.20		
	LL+HM	68.17		53.30			136.34		
WINDLOAD (WS) = 50 PSF		-7.00	1.88	0.00	1.88		-7.00	7.50	
THERMAL LOAD (TU)			2.38			2.38			9.53
BREAKING FORCE (BR)			5.40			5.40			21.60
SEISMIC LOAD (EQ)	CONTACT YOUR CONTECH BRIDGE CONSULTANT FOR SEISMIC INFORMATION								
	MAX MODULE WEIGHT (LBS)								
	18500								

"P": VERTICAL LOAD
 "H": HORIZONTAL LOAD TRANSVERSE TO THE STRUCTURE
 "L": HORIZONTAL LOAD LONGITUDINAL TO THE STRUCTURE
 * WIND LOAD UPLIFT ASSUMES FULL 20 PSF TO DECK AREA IS APPLIED TO ONE STRINGER LINE

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CONTECH
DYOB
 DRAWING

BIG R EXPRESS MODULAR
 50'-0" x 14'-0" PRELIMINARY DRAWING
 50 x 14 Modular
 Tyonek, AK

PROJECT No.: 888471	SEQ. No.: 010	DATE: 2/6/2026
DESIGNED: DYOB	DRAWN: DYOB	
CHECKED:	APPROVED:	
SHEET NO.: 1		

GENERAL NOTES:

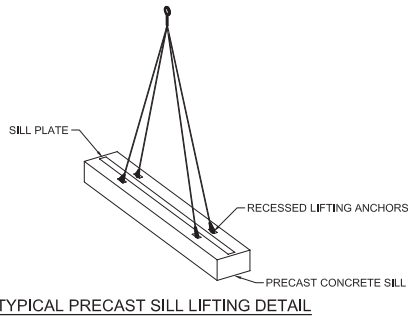
- THE INFORMATION PROVIDED IN THIS GUIDE IS FOR REFERENCE ONLY AND PROVIDES PROVEN PROCEDURES FOR FIELD ASSEMBLY AND INSTALLATION OF BIG R BRIDGES THAT WILL NOT RESULT IN DAMAGE TO THE STRUCTURE. BIG R BRIDGE IS NOT RESPONSIBLE FOR THE MEANS, METHODS AND EQUIPMENT USED FOR FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURES. BIG R BRIDGE WILL NOT BE HELD LIABLE FOR ANY ISSUES THAT ARISE DUE TO FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURES.
- THIS GUIDE IS A GENERIC DOCUMENT FOR THE INSTALLATION OF OUR TYPICAL BRIDGES. THE BIG R BRIDGE PROJECT SPECIFIC PLANS SHOULD BE REFERENCED FOR PROJECT SPECIFIC DETAILS AND FOR ADDITIONAL INFORMATION.
- BIG R BRIDGE IS NOT RESPONSIBLE FOR PROJECT SPECIFIC ERECTION PLANS.
- CONTINUED INSPECTIONS AND MAINTENANCE OF THE BRIDGE STRUCTURE SHOULD BE DONE PER BIG R BRIDGE'S MAINTENANCE GUIDELINES AND IS NOT THE RESPONSIBILITY OF BIG R BRIDGE.
- ON PAINTED, GALVANIZED OR METALIZED BRIDGES, CONTRACTOR IS RESPONSIBLE FOR ALL FINAL FINISH TOUCH UP OR REPAIRS. THIS INCLUDES BUT IS NOT LIMITED TO ALL BOLTS, NUTS, WASHERS AND ANY FINISH DAMAGE DUE TO SHIPPING, HANDLING, ASSEMBLY AND INSTALLATION. WHEN INSTALLING BRIDGES CARE MUST BE TAKEN TO MINIMIZE DAMAGE TO THE FINISH DURING INSTALLATION. PAINTING SHOULD BE USED TO PROTECT THE FINISH FROM CHAIR, CHOKER OR SLING. FOR PAINTED BRIDGES A NOMINAL AMOUNT OF TOUCH UP PAINT WILL BE SUPPLIED. THIS IS OFTEN AN EPOXY SYSTEM AND ATTENTION WILL NEED TO BE GIVEN TO MIXING THE PAINT. TOUCH UP MUST BE APPLIED TO BLEND WITH FACTORY APPLICATION AS MUCH AS POSSIBLE.
- FOR ADDITIONAL INFORMATION PLEASE CONTACT BIG R BRIDGE AT:
 PHONE: 1-970-356-9600
 EMAIL: pm@bigrbridge.com
 WEBSITE: https://www.bigrbridge.com/
 PLEASE INCLUDE THE BIG R BRIDGE PROJECT NUMBER IN ANY CORRESPONDENCE.

UNLOADING INSTRUCTIONS

- BRIDGE SECTIONS WILL ARRIVE ON OVER THE ROAD TRUCKING AND BE DELIVERED AS CLOSE TO THE BRIDGE LOCATION AS POSSIBLE. THE CONTRACTOR WILL BE RESPONSIBLE FOR UNLOADING THE BRIDGE. OCCASIONALLY, IT MAY BE NECESSARY TO UNLOAD OTHER BIG R MATERIAL TO REACH THE BRIDGE, THE CONTRACTOR WILL NEED TO RELOAD SAID MATERIAL IN THIS EVENT.
- LOOSE ITEMS SUCH AS BEARING PLATES AND BOLTS WILL ARRIVE WITH THE BRIDGE. THE CONTRACTOR SHOULD MAKE SURE ALL LOOSE ITEMS ARE UNLOADED WITH THE BRIDGE. REFER TO THE BILL OF LADING.

SILL PLACEMENT INSTRUCTIONS (WHEN REQUIRED)

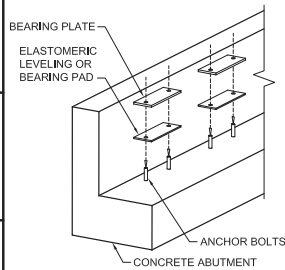
- THE PLACEMENT AREA OF THE SILLS SHALL BE DETERMINED BY THE CONTRACTOR BASED ON THE RELATIVE POSITION OF EACH SILL TO EACH OTHER PER THE ANCHOR BOLT LAYOUT AND ANCHOR BOLT ELEVATION DETAILS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- THE BEARING CAPACITY OF THE SOIL AT THE PLACEMENT AREA OF THE SILLS SHALL MEET OR EXCEED THE REQUIRED LOAD AT SILL PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS. THE ULTIMATE LOAD IS DETERMINED BASED ON FULLY FACTORED LOADS AND THE SERVICE LOAD IS DETERMINED BASED ON UNFACTORED LOADS. IT IS UP TO THE CONTRACTOR TO ASSURE THAT PROPER BEARING CAPACITY IS ACHIEVED AND TO DO ANY SOIL IMPROVEMENT NECESSARY TO ACHIEVE THAT.
- THE PLACEMENT AREA OF THE SILLS SHALL BE GRADED FLAT AND SMOOTH AND AT THE PROPER ELEVATIONS.
- THE SILLS SHALL BE LIFTED FROM THE FOUR RECESSED SPREAD ANCHORS WITH ADEQUATELY SIZED RIGGING HARDWARE AND PLACED ON THE PREPARED SILL PLACEMENT AREAS.
- THE SILLS SHALL BE POSITIONED RELATIVE TO EACH OTHER AS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.



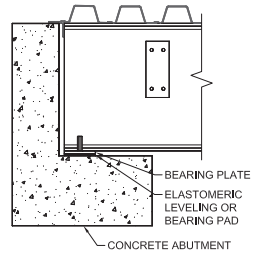
TYPICAL PRECAST SILL LIFTING DETAIL

BEARING PREPARATION INSTRUCTIONS

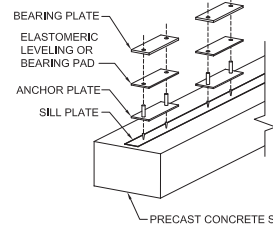
- ALL BEARING PLATES, ELASTOMERIC LEVELING OR BEARING PADS AND ANCHOR PLATES (IF REQUIRED) WILL BE DELIVERED LOOSE ALONG WITH THE BRIDGE. THE BEARING PLATES WILL HAVE HOLES FOR THE FIXED END AND SLOTS FOR THE EXPANSION END OF THE BRIDGE WHICH SHOULD BE CENTERED ON THE ANCHOR BOLTS TO ALLOW FOR PROPER EXPANSION.
- FOR ABUTMENT APPLICATIONS PLACE THE ELASTOMERIC LEVELING OR BEARING PAD ALONG WITH A BEARING PLATE DIRECTLY ON THE ABUTMENT SEAT AT EACH BEARING LOCATION. FOR PRECAST SILL APPLICATIONS, AN ANCHOR PLATE MUST BE POSITIONED ON THE EMBEDDED SILL PLATE PRIOR TO PLACING THE ELASTOMERIC PAD AND BEARING PLATE.
- ASSURE THAT ALL BEARING PLATES ARE AT THE CORRECT ELEVATION, AND THAT THERE IS GOOD BEARING BETWEEN THE ABUTMENT AND THE LEVELING OR BEARING PAD. IF NECESSARY, SHIM THE PLATE OR USE NON-SHRINK GROUT UNDER THE ENTIRE BEARING PAD IN ORDER TO ASSURE 100% BEARING AND PROPER FINAL ELEVATION.
- WHEN LAYERED ELASTOMERIC PADS ARE SPECIFIED, THEY WILL BE SUPPLIED WITHOUT ANCHOR BOLT HOLES AND THE BEARING PLATES WILL INCLUDE WELDED KEEPER BARS TO CAPTURE THE PAD. WHEN POSITIONING THE PADS, BE SURE TO CENTER THEM BETWEEN BOTH THE BEARING PLATE KEEPER BARS AND ANCHOR BOLTS.
- REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BEARINGS.



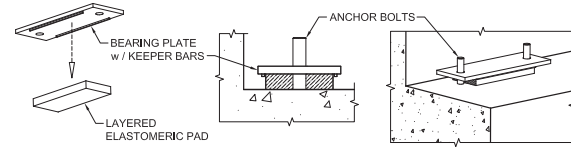
TYPICAL ABUTMENT DETAIL



TYPICAL PRECAST SILL DETAIL

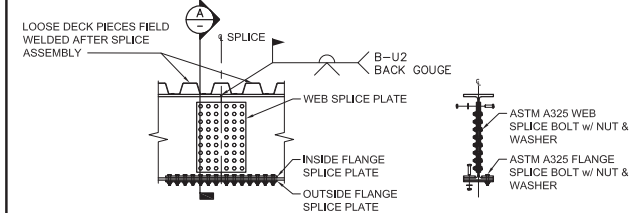


LAYERED ELASTOMERIC PAD DETAIL

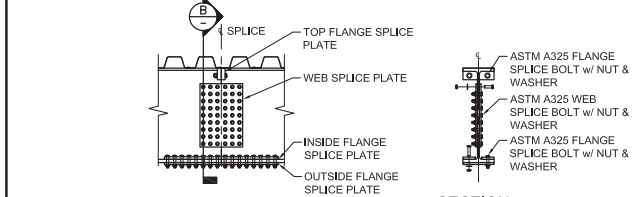


BEAM SPLICE ASSEMBLY INSTRUCTIONS (WHEN REQUIRED)

- DURING THE SHOP FABRICATION PROCESS BEAM SPLICES ARE TYPICALLY SHOP FIT TO ASSURE THAT SECTIONS WILL FIT TOGETHER IN THE FIELD. IF DURING THE SPLICE ASSEMBLY PROCESS ANY MISALIGNMENT APPEARS TO OCCUR, STOP, REMOVE OR LOOSEN ALL SPLICE BOLTS, SHIFT SECTIONS AROUND UNTIL PROPER ALIGNMENT OCCURS AND PROCEED WITH ASSEMBLY.
- THE FIRST PART OF THE BRIDGE SECTION SHALL BE SET ON A RELATIVELY FLAT SURFACE WITH THE SPLICED END CRIBBED UP IN THE AIR AS NEEDED TO ALIGN THE SPLICED PART OF THE SECTION.
- THE SECOND PART OF THE BRIDGE SECTION SHALL BE LINED UP WITH THE FIRST PART AND THE SPLICE PLATES INSTALLED WITH ALL BOLTS FINGER TIGHT. ENSURE THAT THE CORRECT BOLT LENGTH AND DIAMETER PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED. IT MAY BE NECESSARY TO USE DRIFT PINS AND COME-A-LONGS TO GET THE SECTIONS PROPERLY ALIGNED AND ALL BOLTS IN PLACE.
- AFTER ALL BOLTS ARE IN PLACE, THEY SHOULD BE BROUGHT TO SNUG TIGHT CONDITION TO INSURE THAT PLATES AND THE BEAMS ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER.
- IF THE TOP FLANGES REQUIRE FIELD WELDING, THAT SHOULD BE DONE NEXT PER THE DETAILS IN THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- BIG R BRIDGE RECOMMENDS NOT TENSIONING BOLTS UNTIL AFTER ALL SECTIONS ARE SET AND FULLY ASSEMBLED BUT IF ACCESS TO THE SPLICES IS NOT POSSIBLE AFTER ERECTION OF THE BRIDGE SECTIONS, THE SPLICE BOLTS MAY BE TENSIONED BEFORE SETTING BUT ADDITIONAL WORK MAY BE REQUIRED TO ALIGN AND ASSEMBLE BRIDGE SECTIONS TOGETHER. ALL BOLT TENSIONING TO BE DONE PER THE BOLT TENSIONING INSTRUCTIONS ON SHEET 2 OF THIS GUIDE.
- REFER TO BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BEAM SPLICES.



TYPICAL STRINGER SPLICE DETAIL TOP FLANGE WELDED



TYPICAL STRINGER SPLICE DETAIL ALL BOLTED

HEAVY HEX BOLT DIAMETERS AND WRENCH SIZE

BOLT DIAMETER (IN)	WRENCH OR SOCKET SIZE (IN)
1/2	7/8
5/8	1 1/16
3/4	1 1/4
7/8	1 7/16
1	1 5/8
1 1/4	2

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MODULAR BRIDGE WITH BIG R STEEL DECK INSTALLATION GUIDE

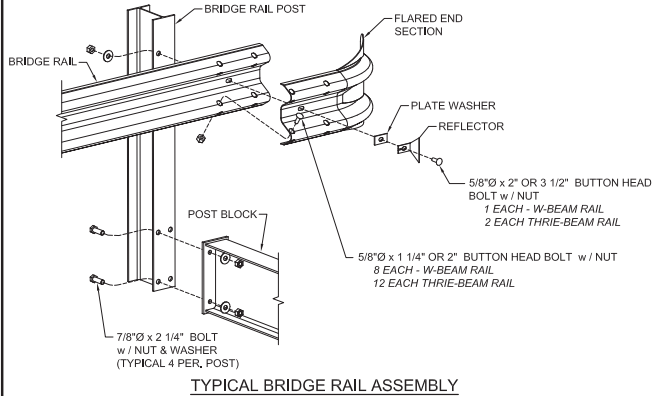
BIG-R BRIDGE

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Install Guide - Modular Big R Steel Deck.dwg

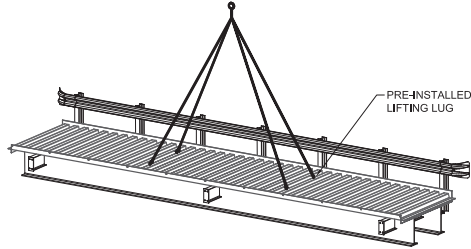
RAIL ASSEMBLY INSTRUCTIONS (WHEN REQUIRED)

- THESE INSTRUCTIONS ARE FOR TYPICAL W-BEAM AND THREE-BEAM STRINGER MOUNTED RAILS SYSTEMS. FOR OTHER SYSTEMS ARE USED PLEASE REFERENCE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ADDITIONAL INFORMATION.
- THE BRIDGE RAIL AND POSTS WILL BE DELIVERED LOOSE ALONG WITH THE BRIDGE SECTIONS AND MAY BE INSTALLED PRIOR TO, OR AFTER SETTING THE BRIDGE SECTIONS. THE JOB SITE WILL DETERMINE WHICH METHOD IS PREFERABLE.
- EACH BRIDGE RAIL POST SHALL BE FASTENED TO A BRIDGE SECTION POST BLOCK WITH HEX HEAD BOLTS. EACH OF THE FOUR HOLE LOCATIONS ON THE LOWER END OF THE POST WILL RECEIVE ONE BOLT, ONE WASHER, AND ONE NUT. ENSURE THAT THE CORRECT BOLT LENGTH AND DIAMETER PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED.
- THE BRIDGE RAIL IS ATTACHED TO THE POSTS WITH EITHER ONE BUTTON HEAD BOLT FOR W-BEAM RAIL OR TWO BUTTON HEAD BOLTS FOR THREE-BEAM RAIL. EACH HOLE LOCATIONS WILL RECEIVE ONE BUTTON HEAD OVAL SHOULDERED BOLT, ONE PLATE WASHER, AND ONE RECESSED NUT. ENSURE THAT THE CORRECT BOLT LENGTH PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED.
- THE OVERLAPPING RAIL SPLICE AND FLARED END SECTIONS SHALL BE FASTENED TOGETHER WITH BUTTON HEAD BOLTS. EACH HOLE LOCATION: EIGHT EACH FOR W-BEAM AND TWELVE EACH FOR THREE-BEAM, SHALL RECEIVE ONE BUTTON HEAD OVAL SHOULDERED BOLT AND ONE RECESSED NUT. ENSURE THAT THE CORRECT BOLT LENGTH PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED. IT MAY BE NECESSARY TO WORK MATERIAL AND OR USE DRIFT PINS TO GET HOLES IN PROPER ALIGNMENT.
- REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BRIDGE RAIL.

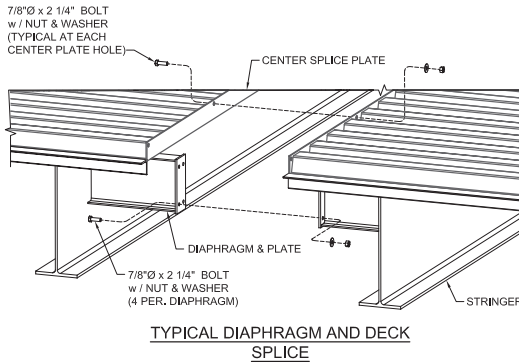


BRIDGE SECTION LIFTING AND SETTING INSTRUCTIONS

- EACH BRIDGE SECTION TO BE LIFTED FROM THE PRE-INSTALLED LIFTING LUGS WITH ADEQUATELY SIZED RIGGING HARDWARE AND PLACED ON THE PREPARED BEARINGS.
- IF BRIDGE HAS MORE THAN 2 SECTIONS OR SECTIONS THAT ARE NOT IDENTICAL, SECTIONS ARE TO BE SET IN NUMERICAL ORDER AS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.



- AFTER PLACING THE BRIDGE, ADJUST STRUCTURE ON THE FOUNDATIONS SO THAT SPACING IS EQUAL AT BOTH ENDS OR AS DIRECTED IN THE BIG R PROJECT SPECIFIC PLANS. THE EXPANSION END GAP DESIGNATED IN THE BIG R PROJECT SPECIFIC PLANS MUST MAINTAINED FOR PROPER EXPANSION. IF THE BRIDGE HAS AN ELEVATION DIFFERENCE, BE SURE TO SET THE HIGH END OF THE BRIDGE ON THE HIGHER FOUNDATION. BEARING PLATES MUST BE FULLY COVERED BY THE BEAM FLANGE UNLESS SHOWN OTHERWISE IN BIG R BRIDGE PROJECT SPECIFIC PLANS. REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR CORRECT ALIGNMENT.
- DIAPHRAGM SPLICE PLATES AND CENTER SPLICE PLATES SHALL BE CONNECTED WITH PASS THROUGH BOLTS, EACH OF THE HOLE LOCATION ON THE SPLICE PLATES WILL RECEIVE ONE BOLT, ONE WASHER, AND ONE NUT.
- BRING ALL BOLTS TO A 'SNUG TIGHT' CONDITION TO INSURE THAT THE PARTS OF THE JOINT ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER. 'SNUG TIGHT' IS DEFINED AS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH.
- WHEN INSTALLING BRIDGES CARE MUST BE TAKEN TO MINIMIZE DAMAGE TO THE FINISH DURING INSTALLATION. PADDING SHOULD BE USED TO PROTECT THE FINISH FROM CHAIN, CHOKER OR SLING.



BEARING ASSEMBLY INSTRUCTIONS

- FIELD WELD ALL BEARING PLATES TO THE BRIDGE STRINGERS. WHEN PRECAST SILLS ARE INCLUDED FIELD WELD ANCHOR PLATES TO THE EMBEDDED SILL PLATE. WELD SIZE AND LENGTHS SHALL BE AS DIRECTED IN THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- ON PAINTED, GALVANIZED OR METALIZED BRIDGES, THE FINISHES WILL BE DAMAGED DUE TO THE FIELD WELDING AND WILL REQUIRE REPAIR. IT WILL BE THE RESPONSIBILITY OF THE ONSITE CONTRACTOR TO PERFORM ALL FINISH REPAIR.
- CARE SHOULD BE TAKEN TO AVOID OVERHEATING THE LEVELING OR BEARING PAD DURING WELDING. THIS IS TYPICALLY NOT AN ISSUE WHEN GOOD WELDING PRACTICES ARE USED BUT IF IT IS A CONCERN HEAT CONTROL CRAYONS CAN BE USED TO MONITOR HEAT IN THE STEEL WHERE IT CONTACTS THE PAD. IT IS RECOMMENDED TO KEEP THE HEAT AT THE PAD AT 200° F OR LESS.
- EACH ANCHOR BOLT WILL RECEIVE (1) WASHER AND (2) NUTS. ONE END OF THE BRIDGE IS DESIGNED TO BE FIXED AND THE NUTS ARE TO BE INSTALLED TIGHT. THE EXPANSION END WILL HAVE THE FIRST NUT TIGHTENED FINGER TIGHT TO THE WASHER PLACED ON THE BEARING PLATE. THE SECOND NUT WILL BE INSTALLED TIGHT TO THE FIRST. REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS TO DETERMINE WHICH END OF THE BRIDGE IS TO BE THE FIXED OR EXPANSION END.

BOLT TENSIONING INSTRUCTIONS

- AFTER BRIDGE IS SET AND ASSEMBLED, ALL BOLTS SHALL BE TENSIONED.
- TIGHTENING OF THE BOLTS SHALL BE IN ACCORDANCE WITH THE "SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS" BY RCSC. WE RECOMMEND USING THE TURN-OF-NUT PROCEDURE DESCRIBED BELOW:

BRING ALL BOLTS TO A 'SNUG TIGHT' CONDITION TO INSURE THAT THE PARTS OF THE JOINT ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER. 'SNUG TIGHT' IS DEFINED AS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH. FOLLOWING THIS INITIAL OPERATION, ALL BOLTS SHALL THEN BE TIGHTENED ADDITIONALLY BY THE APPLICABLE AMOUNT OF NUT ROTATION AS SPECIFIED IN THE TABLE BELOW. WITH THE TIGHTENING PROGRESSING SYSTEMATICALLY FROM THE MOST RIGID PART OF THE JOINT TO ITS FREE EDGES. DURING THIS OPERATION, THERE SHALL BE NO ROTATION OF THE PART NOT TURNED BY THE WRENCH.

NUT ROTATION FROM SNUG TIGHT CONDITION

BOLT LENGTH (AS MEASURED FROM UNDERSIDE OF HEAD TO OUTSIDE FACE OF THE NUT PLUS 5/16 INCH)	DISPOSITION OF OUTER FACES OF BOLTED PARTS	
	BOTH FACES NORMAL TO BOLT AXIS	
NOT MORE THAN 4 DIAMETERS	1/3 TURN	
MORE THAN 4 DIAMETERS BUT NOT MORE THAN 8 DIAMETERS	1/2 TURN	
MORE THAN 8 DIAMETERS BUT NOT MORE THAN 12 DIAMETERS	2/3 TURN	

- NUT ROTATION IS RELATIVE TO BOLT. REGARDLESS OF THE ELEMENT (NUT OR BOLT) BEING TURNED, FOR BOLTS INSTALLED BY 1/2 TURN AND LESS, THE TOLERANCE SHOULD BE PLUS OR MINUS 30°; FOR BOLTS INSTALLED BY 2/3 TURN AND MORE, THE TOLERANCE SHOULD BE PLUS OR MINUS 45°.
- IF ANY BOLTS OR NUTS DO NOT SMOOTHLY ENGAGE UP TO SNUG-TIGHT THERE MAY BE AN OBSTRUCTION WITHIN THE TREADS. THE BOLT OR NUT SHOULD BE REMOVED, THE TREADS ON THE BOLT AND NUT CLEANED AND RETAPPED IF NECESSARY TO ALLOW SMOOTH INSTALLATION.

WEARING SURFACE INSTRUCTIONS

- TYPE AND INSTALLATION OF THE WEARING SURFACE IS NOT BIG R BRIDGE RESPONSIBILITY.
- BIG R BRIDGE'S STEEL BRIDGE DECKING PLANKS ARE THE STRUCTURAL DECKING SYSTEM. THE WEARING SURFACE IS ONLY TO PROVIDE A SMOOTH RUNNING SURFACE AND NOT REQUIRED STRUCTURALLY.
- TYPICAL WEARING SURFACE LOAD OF 80 PSF WILL ACCOMMODATE UP TO 5 1/4" OF GRAVEL BASE (130 PCF) OR 4 1/4" OF CONCRETE OR ASPHALT (150 PCF) SURFACING ABOVE THE STEEL BRIDGE DECK CORRUGATIONS.
- IF GRAVEL WEARING SURFACE IS TO BE USED, THE GRAVEL SHALL BE PLACED ON THE DECK AND GRADED TO THE PROPER THICKNESS.
- REFERENCE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR RECOMMENDATIONS FOR ASPHALT OR CONCRETE WEARING SURFACES.
- TIMBER WEARING SURFACES ARE TYPICALLY INSTALLED BY BIG R BRIDGE DURING FABRICATION. SEE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ADDITIONAL DETAILS.
- OTHER WEARING SURFACE TYPES MAY BE USED AS LONG AS THE TOTAL WEARING SURFACE LOAD IS NOT GREATER THAN THE WEARING SURFACE LOAD PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS.

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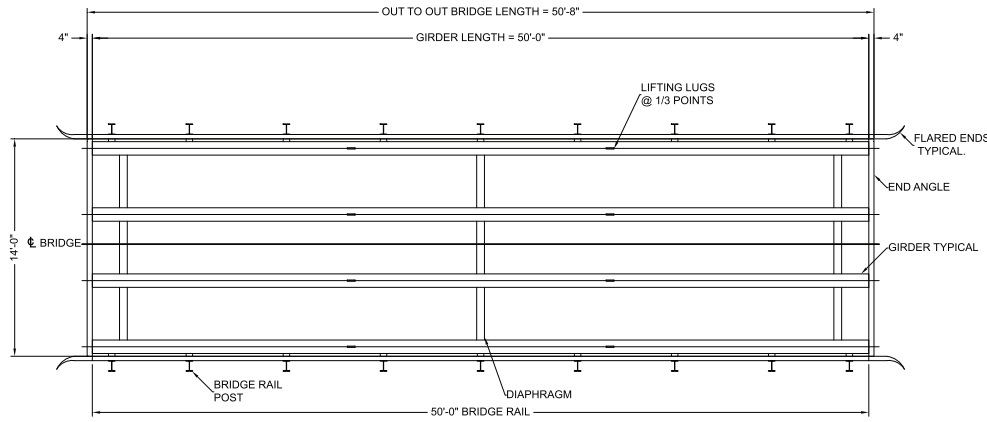
BIG-R BRIDGE

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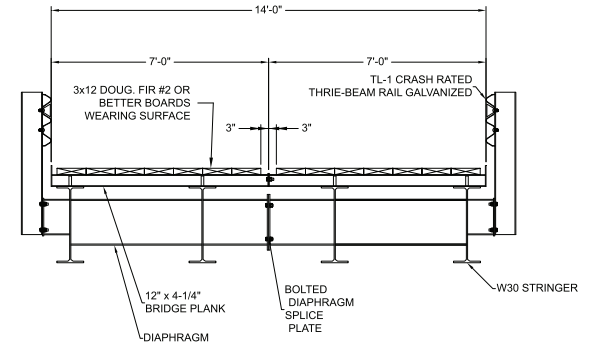
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GENERAL NOTES:

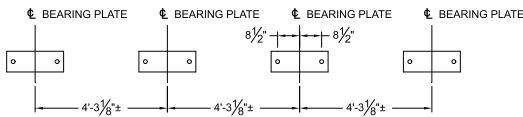
- 1) CONTECH ENGINEERED SOLUTIONS IS RESPONSIBLE FOR THE DESIGN AND SHOP FABRICATION OF THE BRIDGE STRUCTURE ONLY. ALL MEANS, METHODS, AND EQUIPMENT USED FOR FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURE, INCLUDING PREPARATION OR REVIEW AND APPROVAL OF PROJECT SPECIFIC ERECTION PLANS, ARE OUTSIDE OF CONTECH'S RESPONSIBILITY.
- 2) DESIGN IS IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
- 3) MATERIALS (UNLESS NOTED OTHERWISE):
 - a) STRUCTURAL STEEL: ASTM A588 WEATHERING STEEL
 - b) BRIDGE PLANK: ASTM A653 GRADE 50 CLASS 1 (GALV)
 - c) STRUCTURAL BOLTS: ASTM F3125 GRADE A325 (GALV)
 - d) SHEET PILING: ASTM A929 (GALV)
- 4) DESIGN LOADINGS:
 - a) BRIDGE DEAD LOAD PLUS 80 PSF TOTAL WEARING SURFACE.
 - b) VEHICLE LIVE LOAD: HL-93
MAX AVERAGE DAILY TRUCK TRAFFIC (ADTT) = 200
MAX LL DEFLECTION = LENGTH/500
 - c) OWNER SPECIFIED LIVE LOAD: U80
 - d) WIND LOADING PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 3.8.
 - e) SEISMIC LOADING PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 3.10.
- 5) BRIDGE RAIL DESIGNED FOR TL-1 OR TL-2 LOADING IN ACCORDANCE WITH AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS APPENDIX A13.2 OR ONLY USED AS A GUIDE RAIL (RAIL HAS NOT BEEN CRASH TESTED). SEE SECTION VIEW FOR RAIL DESIGN.
- 6) BRIDGE TO BE BUILT TO THE REQUIREMENTS OF AWS D1.5.
- 7) ALL EXPOSED SURFACES OF STRUCTURAL STEEL TO BE CLEANED IN ACCORDANCE WITH STEEL STRUCTURES PAINTING COUNCIL SURFACE PREPARATION SPECIFICATIONS NO. 1, SSPC-SP1 SOLVENT CLEANING. EXPOSED SURFACES OF STEEL SHALL BE DEFINED AS THOSE SURFACES SEEN FROM THE DECK OR FROM THE OUTSIDE OF THE STRUCTURE. ALL OTHER SURFACES TO HAVE STANDARD MILL FINISH.
- 8) MAINTENANCE NOTE: CONTECH RECOMMENDS NOT APPLYING DE-ICING OR DUST PROHIBITIVE CHEMICALS OR SALTS TO ANY PART OF THE BRIDGE STRUCTURE. IF DE-ICING OR DUST PROHIBITIVE CHEMICALS OR SALTS ARE APPLIED TO ANY PART OF THE BRIDGE STRUCTURE, CONTECH WILL NOT BE RESPONSIBLE FOR ANY RESULTANT ACCELERATED CORROSION.
- 9) ELASTOMERIC PADS ARE USED TO PROVIDE A LEVEL BEARING SURFACE ONLY.
- 10) 12" x 4-1/4" BRIDGE PLANKS ARE SHOP WELDED TO THE GIRDERS AND ARE THE STRUCTURAL DECKING SYSTEM. THE WEARING SURFACE IS ONLY TO PROVIDE A SMOOTH RUNNING SURFACE AND NOT REQUIRED STRUCTURALLY.
- 11) DECK MAY BE FINISHED WITH GRAVEL, ASPHALT, CONCRETE, WOOD OR ANY OTHER SUITABLE WEARING SURFACE MATERIAL AT THE OWNERS DISCRETION. TYPICAL WEARING SURFACE LOAD OF 80 PSF WILL ACCOMMODATE UP TO 5 1/4" OF GRAVEL BASE (130 PSF) OR 4 1/4" OF CONCRETE OR ASPHALT (150 PCF) SURFACING ABOVE THE STEEL BRIDGE DECK PLANK CORRUGATIONS. FOR CONCRETE WEARING SURFACES CONTECH RECOMMENDS USING CRACK CONTROL REINFORCING AND IF LATERAL SHIFTING OR UPLIFT OF THE CONCRETE WEARING SURFACE IS A CONCERN, CONTECH RECOMMENDS ATTACHING HEADED ANCHOR STUDS IN THE VALLEYS OF THE CORRUGATIONS.



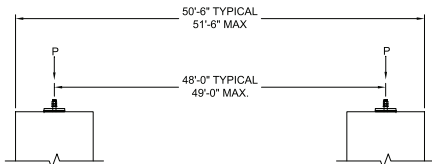
PLAN VIEW



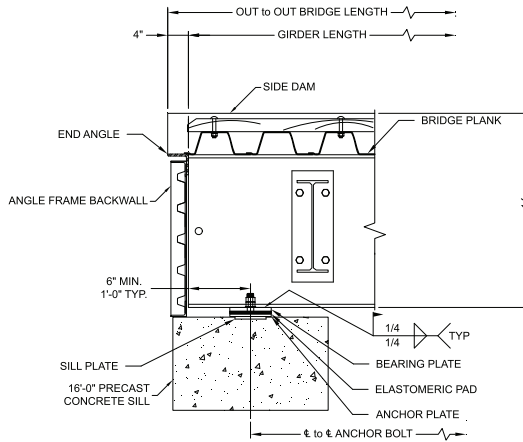
SECTION VIEW



ANCHOR BOLT LAYOUT



ANCHOR BOLT ELEVATION



BEARING ELEVATION

BRIDGE LOADING AND UNFACTORED BEARING REACTIONS IN KIPS	MAX AT INTERIOR GIRDER			MAX AT EXTERIOR GIRDER			TOTAL AT ABUTMENT		
	P	H	L	P	H	L	P	H	L
DEAD LOAD (DC)	3.71			4.31			16.04		
TOTAL WEARING SURFACE (DW) = 80 PSF	8.52			5.48			28.00		
HL-93 DESIGN VEHICLE	LL	42.16		29.99			73.97		
MAX. ADTT = 1025	LL+HM	53.12		37.79			93.20		
U80 OWNER SPECIFIED VEHICLE	LL	58.10		45.43			116.20		
	LL+HM	68.17		53.30			136.34		
WINDLOAD (WS) = 50 PSF		-7.00	1.88	0.00	1.88		-7.00	7.50	
THERMAL LOAD (TU)			2.38			2.38			9.53
BREAKING FORCE (BR)			5.40			5.40			21.60
SEISMIC LOAD (EQ)	CONTACT YOUR CONTECH BRIDGE CONSULTANT FOR SEISMIC INFORMATION								
	MAX MODULE WEIGHT (LBS)								
	18500								

"P": VERTICAL LOAD
 "H": HORIZONTAL LOAD TRANSVERSE TO THE STRUCTURE
 "L": HORIZONTAL LOAD LONGITUDINAL TO THE STRUCTURE
 * WIND LOAD UPLIFT ASSUMES FULL 20 PSF TO DECK AREA IS APPLIED TO ONE STRINGER LINE

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 800-338-1122 513-645-7000 513-645-7993 FAX



CONTECH
DYOB
 DRAWING

BIG R EXPRESS MODULAR
 50'-0" x 14'-0" PRELIMINARY DRAWING
 50 x 14 Modular
 Tyonek, AK

PROJECT No.: 888471	SEQ. No.: 010	DATE: 2/6/2026
DESIGNED: DYOB	DRAWN: DYOB	
CHECKED:	APPROVED:	
SHEET NO.:		1

GENERAL NOTES:

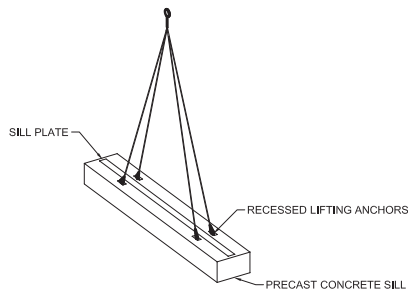
- THE INFORMATION PROVIDED IN THIS GUIDE IS FOR REFERENCE ONLY AND PROVIDES PROVEN PROCEDURES FOR FIELD ASSEMBLY AND INSTALLATION OF BIG R BRIDGES THAT WILL NOT RESULT IN DAMAGE TO THE STRUCTURE. BIG R BRIDGE IS NOT RESPONSIBLE FOR THE MEANS, METHODS AND EQUIPMENT USED FOR FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURES. BIG R BRIDGE WILL NOT BE HELD LIABLE FOR ANY ISSUES THAT ARISE DUE TO FIELD ASSEMBLY AND INSTALLATION OF THE BRIDGE STRUCTURES.
- THIS GUIDE IS A GENERIC DOCUMENT FOR THE INSTALLATION OF OUR TYPICAL BRIDGES. THE BIG R BRIDGE PROJECT SPECIFIC PLANS SHOULD BE REFERENCED FOR PROJECT SPECIFIC DETAILS AND FOR ADDITIONAL INFORMATION.
- BIG R BRIDGE IS NOT RESPONSIBLE FOR PROJECT SPECIFIC ERECTION PLANS.
- CONTINUED INSPECTIONS AND MAINTENANCE OF THE BRIDGE STRUCTURE SHOULD BE DONE PER BIG R BRIDGE'S MAINTENANCE GUIDELINES AND IS NOT THE RESPONSIBILITY OF BIG R BRIDGE.
- ON PAINTED, GALVANIZED OR METALIZED BRIDGES, CONTRACTOR IS RESPONSIBLE FOR ALL FINAL FINISH TOUCH UP OR REPAIRS. THIS INCLUDES BUT IS NOT LIMITED TO ALL BOLTS, NUTS, WASHERS AND ANY FINISH DAMAGE DUE TO SHIPPING, HANDLING, ASSEMBLY AND INSTALLATION. WHEN INSTALLING BRIDGES CARE MUST BE TAKEN TO MINIMIZE DAMAGE TO THE FINISH DURING INSTALLATION. PAINTING SHOULD BE USED TO PROTECT THE FINISH FROM CHAIR, CHOKER OR SLING. FOR PAINTED BRIDGES A NOMINAL AMOUNT OF TOUCH UP PAINT WILL BE SUPPLIED. THIS IS OFTEN AN EPOXY SYSTEM AND ATTENTION WILL NEED TO BE GIVEN TO MIXING THE PAINT. TOUCH UP MUST BE APPLIED TO BLEND WITH FACTORY APPLICATION AS MUCH AS POSSIBLE.
- FOR ADDITIONAL INFORMATION PLEASE CONTACT BIG R BRIDGE AT:
 PHONE: 1-970-356-9600
 EMAIL: pm@bigrbridge.com
 WEBSITE: https://www.bigrbridge.com/
 PLEASE INCLUDE THE BIG R BRIDGE PROJECT NUMBER IN ANY CORRESPONDENCE.

UNLOADING INSTRUCTIONS

- BRIDGE SECTIONS WILL ARRIVE ON OVER THE ROAD TRUCKING AND BE DELIVERED AS CLOSE TO THE BRIDGE LOCATION AS POSSIBLE. THE CONTRACTOR WILL BE RESPONSIBLE FOR UNLOADING THE BRIDGE. OCCASIONALLY, IT MAY BE NECESSARY TO UNLOAD OTHER BIG R MATERIAL TO REACH THE BRIDGE, THE CONTRACTOR WILL NEED TO RELOAD SAID MATERIAL IN THIS EVENT.
- LOOSE ITEMS SUCH AS BEARING PLATES AND BOLTS WILL ARRIVE WITH THE BRIDGE. THE CONTRACTOR SHOULD MAKE SURE ALL LOOSE ITEMS ARE UNLOADED WITH THE BRIDGE. REFER TO THE BILL OF LADING.

SILL PLACEMENT INSTRUCTIONS (WHEN REQUIRED)

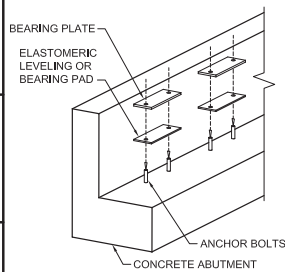
- THE PLACEMENT AREA OF THE SILLS SHALL BE DETERMINED BY THE CONTRACTOR BASED ON THE RELATIVE POSITION OF EACH SILL TO EACH OTHER PER THE ANCHOR BOLT LAYOUT AND ANCHOR BOLT ELEVATION DETAILS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- THE BEARING CAPACITY OF THE SOIL AT THE PLACEMENT AREA OF THE SILLS SHALL MEET OR EXCEED THE REQUIRED LOAD AT SILL PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS. THE ULTIMATE LOAD IS DETERMINED BASED ON FULLY FACTORED LOADS AND THE SERVICE LOAD IS DETERMINED BASED ON UNFACTORED LOADS. IT IS UP TO THE CONTRACTOR TO ASSURE THAT PROPER BEARING CAPACITY IS ACHIEVED AND TO DO ANY SOIL IMPROVEMENT NECESSARY TO ACHIEVE THAT.
- THE PLACEMENT AREA OF THE SILLS SHALL BE GRADED FLAT AND SMOOTH AND AT THE PROPER ELEVATIONS.
- THE SILLS SHALL BE LIFTED FROM THE FOUR RECESSED SPREAD ANCHORS WITH ADEQUATELY SIZED RIGGING HARDWARE AND PLACED ON THE PREPARED SILL PLACEMENT AREAS.
- THE SILLS SHALL BE POSITIONED RELATIVE TO EACH OTHER AS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.



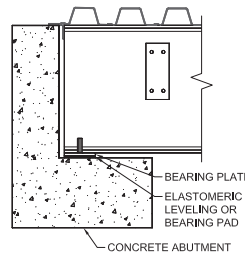
TYPICAL PRECAST SILL LIFTING DETAIL

BEARING PREPARATION INSTRUCTIONS

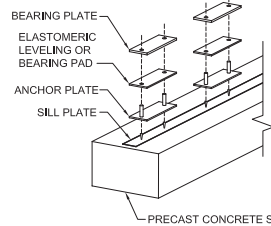
- ALL BEARING PLATES, ELASTOMERIC LEVELING OR BEARING PADS AND ANCHOR PLATES (IF REQUIRED) WILL BE DELIVERED LOOSE ALONG WITH THE BRIDGE. THE BEARING PLATES WILL HAVE HOLES FOR THE FIXED END AND SLOTS FOR THE EXPANSION END OF THE BRIDGE WHICH SHOULD BE CENTERED ON THE ANCHOR BOLTS TO ALLOW FOR PROPER EXPANSION.
- FOR ABUTMENT APPLICATIONS PLACE THE ELASTOMERIC LEVELING OR BEARING PAD ALONG WITH A BEARING PLATE DIRECTLY ON THE ABUTMENT SEAT AT EACH BEARING LOCATION. FOR PRECAST SILL APPLICATIONS, AN ANCHOR PLATE MUST BE POSITIONED ON THE EMBEDDED SILL PLATE PRIOR TO PLACING THE ELASTOMERIC PAD AND BEARING PLATE.
- ASSURE THAT ALL BEARING PLATES ARE AT THE CORRECT ELEVATION, AND THAT THERE IS GOOD BEARING BETWEEN THE ABUTMENT AND THE LEVELING OR BEARING PAD. IF NECESSARY, SHIM THE PLATE OR USE NON-SHRINK GROUT UNDER THE ENTIRE BEARING PAD IN ORDER TO ASSURE 100% BEARING AND PROPER FINAL ELEVATION.
- WHEN LAYERED ELASTOMERIC PADS ARE SPECIFIED, THEY WILL BE SUPPLIED WITHOUT ANCHOR BOLT HOLES AND THE BEARING PLATES WILL INCLUDE WELDED KEEPER BARS TO CAPTURE THE PAD. WHEN POSITIONING THE PADS, BE SURE TO CENTER THEM BETWEEN BOTH THE BEARING PLATE KEEPER BARS AND ANCHOR BOLTS.
- REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BEARINGS.



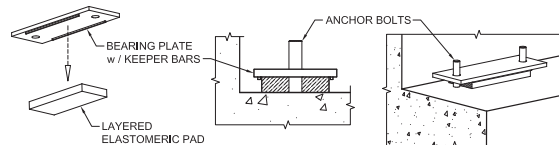
TYPICAL ABUTMENT DETAIL



TYPICAL PRECAST SILL DETAIL

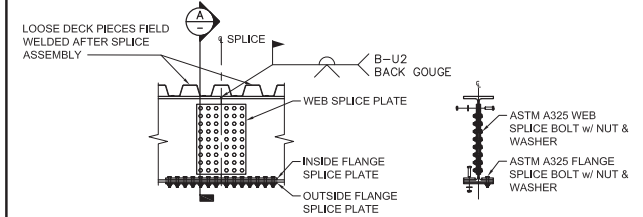


LAYERED ELASTOMERIC PAD DETAIL

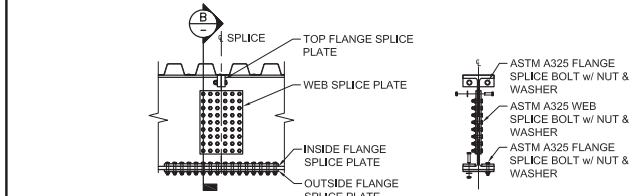


BEAM SPLICE ASSEMBLY INSTRUCTIONS (WHEN REQUIRED)

- DURING THE SHOP FABRICATION PROCESS BEAM SPLICES ARE TYPICALLY SHOP FIT TO ASSURE THAT SECTIONS WILL FIT TOGETHER IN THE FIELD. IF DURING THE SPLICE ASSEMBLY PROCESS ANY MISALIGNMENT APPEARS TO OCCUR, STOP, REMOVE OR LOOSEN ALL SPLICE BOLTS, SHIFT SECTIONS AROUND UNTIL PROPER ALIGNMENT OCCURS AND PROCEED WITH ASSEMBLY.
- THE FIRST PART OF THE BRIDGE SECTION SHALL BE SET ON A RELATIVELY FLAT SURFACE WITH THE SPLICED END CRIBBED UP IN THE AIR AS NEEDED TO ALIGN THE SPLICED PART OF THE SECTION.
- THE SECOND PART OF THE BRIDGE SECTION SHALL BE LINED UP WITH THE FIRST PART AND THE SPLICE PLATES INSTALLED WITH ALL BOLTS FINGER TIGHT. ENSURE THAT THE CORRECT BOLT LENGTH AND DIAMETER PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED. IT MAY BE NECESSARY TO USE DRIFT PINS AND COME-A-LONGS TO GET THE SECTIONS PROPERLY ALIGNED AND ALL BOLTS IN PLACE.
- AFTER ALL BOLTS ARE IN PLACE, THEY SHOULD BE BROUGHT TO SNUG TIGHT CONDITION TO INSURE THAT PLATES AND THE BEAMS ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER.
- IF THE TOP FLANGES REQUIRE FIELD WELDING, THAT SHOULD BE DONE NEXT PER THE DETAILS IN THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- BIG R BRIDGE RECOMMENDS NOT TENSIONING BOLTS UNTIL AFTER ALL SECTIONS ARE SET AND FULLY ASSEMBLED BUT IF ACCESS TO THE SPLICES IS NOT POSSIBLE AFTER ERECTION OF THE BRIDGE SECTIONS, THE SPLICE BOLTS MAY BE TENSIONED BEFORE SETTING BUT ADDITIONAL WORK MAY BE REQUIRED TO ALIGN AND ASSEMBLE BRIDGE SECTIONS TOGETHER. ALL BOLT TENSIONING TO BE DONE PER THE BOLT TENSIONING INSTRUCTIONS ON SHEET 2 OF THIS GUIDE.
- REFER TO BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BEAM SPLICES.



TYPICAL STRINGER SPLICE DETAIL TOP FLANGE WELDED



TYPICAL STRINGER SPLICE DETAIL ALL BOLTED



HEAVY HEX BOLT DIAMETERS AND WRENCH SIZE

BOLT DIAMETER (IN)	WRENCH OR SOCKET SIZE (IN)
1/2	7/8
5/8	1 1/16
3/4	1 1/4
7/8	1 7/16
1	1 5/8
1 1/4	2

REV	STATUS	BY	DATE
A	RELEASED	SLJ	11/14/2019



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MODULAR BRIDGE WITH BIG R STEEL DECK INSTALLATION GUIDE

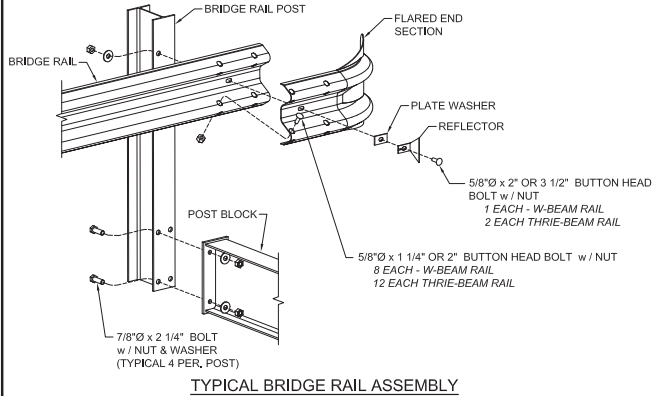
BIG-R BRIDGE

SHEET NO.
1
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2

Install Guide - Modular Big R Steel Deck.dwg

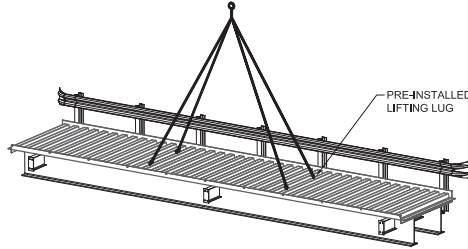
RAIL ASSEMBLY INSTRUCTIONS (WHEN REQUIRED)

- THESE INSTRUCTIONS ARE FOR TYPICAL W-BEAM AND THREE-BEAM STRINGER MOUNTED RAILS SYSTEMS. FOR OTHER SYSTEMS ARE USED PLEASE REFERENCE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ADDITIONAL INFORMATION.
- THE BRIDGE RAIL AND POSTS WILL BE DELIVERED LOOSE ALONG WITH THE BRIDGE SECTIONS AND MAY BE INSTALLED PRIOR TO, OR AFTER SETTING THE BRIDGE SECTIONS. THE JOB SITE WILL DETERMINE WHICH METHOD IS PREFERABLE.
- EACH BRIDGE RAIL POST SHALL BE FASTENED TO A BRIDGE SECTION POST BLOCK WITH HEX HEAD BOLTS. EACH OF THE FOUR HOLE LOCATIONS ON THE LOWER END OF THE POST WILL RECEIVE ONE BOLT, ONE WASHER, AND ONE NUT. ENSURE THAT THE CORRECT BOLT LENGTH AND DIAMETER PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED.
- THE BRIDGE RAIL IS ATTACHED TO THE POSTS WITH EITHER ONE BUTTON HEAD BOLT FOR W-BEAM RAIL OR TWO BUTTON HEAD BOLTS FOR THREE-BEAM RAIL. EACH HOLE LOCATIONS WILL RECEIVE ONE BUTTON HEAD OVAL SHOULDERED BOLT, ONE PLATE WASHER, AND ONE RECESSED NUT. ENSURE THAT THE CORRECT BOLT LENGTH PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED.
- THE OVERLAPPING RAIL SPLICE AND FLARED END SECTIONS SHALL BE FASTENED TOGETHER WITH BUTTON HEAD BOLTS. EACH HOLE LOCATION: EIGHT EACH FOR W-BEAM AND TWELVE EACH FOR THREE-BEAM, SHALL RECEIVE ONE BUTTON HEAD OVAL SHOULDERED BOLT AND ONE RECESSED NUT. ENSURE THAT THE CORRECT BOLT LENGTH PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS IS BEING USED. IT MAY BE NECESSARY TO WORK MATERIAL AND OR USE DRIFT PINS TO GET HOLES IN PROPER ALIGNMENT.
- REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ANY SPECIAL INSTRUCTIONS RELATED TO BRIDGE RAIL.

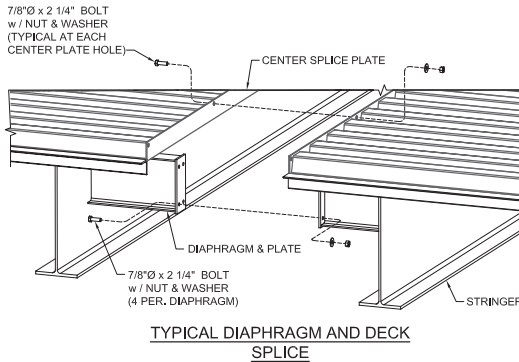


BRIDGE SECTION LIFTING AND SETTING INSTRUCTIONS

- EACH BRIDGE SECTION TO BE LIFTED FROM THE PRE-INSTALLED LIFTING LUGS WITH ADEQUATELY SIZED RIGGING HARDWARE AND PLACED ON THE PREPARED BEARINGS.
- IF BRIDGE HAS MORE THAN 2 SECTIONS OR SECTIONS THAT ARE NOT IDENTICAL, SECTIONS ARE TO BE SET IN NUMERICAL ORDER AS SHOWN ON THE BIG R BRIDGE PROJECT SPECIFIC PLANS.



- AFTER PLACING THE BRIDGE, ADJUST STRUCTURE ON THE FOUNDATIONS SO THAT SPACING IS EQUAL AT BOTH ENDS OR AS DIRECTED IN THE BIG R PROJECT SPECIFIC PLANS. THE EXPANSION END GAP DESIGNATED IN THE BIG R PROJECT SPECIFIC PLANS MUST MAINTAINED FOR PROPER EXPANSION. IF THE BRIDGE HAS AN ELEVATION DIFFERENCE, BE SURE TO SET THE HIGH END OF THE BRIDGE ON THE HIGHER FOUNDATION. BEARING PLATES MUST BE FULLY COVERED BY THE BEAM FLANGE UNLESS SHOWN OTHERWISE IN BIG R BRIDGE PROJECT SPECIFIC PLANS. REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR CORRECT ALIGNMENT.
- DIAPHRAGM SPLICE PLATES AND CENTER SPLICE PLATES SHALL BE CONNECTED WITH PASS THROUGH BOLTS, EACH OF THE HOLE LOCATION ON THE SPLICE PLATES WILL RECEIVE ONE BOLT, ONE WASHER, AND ONE NUT.
- BRING ALL BOLTS TO A 'SNUG TIGHT' CONDITION TO INSURE THAT THE PARTS OF THE JOINT ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER. 'SNUG TIGHT' IS DEFINED AS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH.
- WHEN INSTALLING BRIDGES CARE MUST BE TAKEN TO MINIMIZE DAMAGE TO THE FINISH DURING INSTALLATION. PADDING SHOULD BE USED TO PROTECT THE FINISH FROM CHAIN, CHOKER OR SLING.



BEARING ASSEMBLY INSTRUCTIONS

- FIELD WELD ALL BEARING PLATES TO THE BRIDGE STRINGERS. WHEN PRECAST SILLS ARE INCLUDED FIELD WELD ANCHOR PLATES TO THE EMBEDDED SILL PLATE. WELD SIZE AND LENGTHS SHALL BE AS DIRECTED IN THE BIG R BRIDGE PROJECT SPECIFIC PLANS.
- ON PAINTED, GALVANIZED OR METALIZED BRIDGES, THE FINISHES WILL BE DAMAGED DUE TO THE FIELD WELDING AND WILL REQUIRE REPAIR. IT WILL BE THE RESPONSIBILITY OF THE ONSITE CONTRACTOR TO PERFORM ALL FINISH REPAIR.
- CARE SHOULD BE TAKEN TO AVOID OVERHEATING THE LEVELING OR BEARING PAD DURING WELDING. THIS IS TYPICALLY NOT AN ISSUE WHEN GOOD WELDING PRACTICES ARE USED BUT IF IT IS A CONCERN HEAT CONTROL CRAYONS CAN BE USED TO MONITOR HEAT IN THE STEEL WHERE IT CONTACTS THE PAD. IT IS RECOMMENDED TO KEEP THE HEAT AT THE PAD AT 200° F OR LESS.
- EACH ANCHOR BOLT WILL RECEIVE (1) WASHER AND (2) NUTS. ONE END OF THE BRIDGE IS DESIGNED TO BE FIXED AND THE NUTS ARE TO BE INSTALLED TIGHT. THE EXPANSION END WILL HAVE THE FIRST NUT TIGHTENED FINGER TIGHT TO THE WASHER PLACED ON THE BEARING PLATE. THE SECOND NUT WILL BE INSTALLED TIGHT TO THE FIRST. REFER TO THE BIG R BRIDGE PROJECT SPECIFIC PLANS TO DETERMINE WHICH END OF THE BRIDGE IS TO BE THE FIXED OR EXPANSION END.

BOLT TENSIONING INSTRUCTIONS

- AFTER BRIDGE IS SET AND ASSEMBLED, ALL BOLTS SHALL BE TENSIONED.
- TIGHTENING OF THE BOLTS SHALL BE IN ACCORDANCE WITH THE "SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS" BY RCSC. WE RECOMMEND USING THE TURN-OF-NUT PROCEDURE DESCRIBED BELOW:

BRING ALL BOLTS TO A 'SNUG TIGHT' CONDITION TO INSURE THAT THE PARTS OF THE JOINT ARE BROUGHT INTO GOOD CONTACT WITH EACH OTHER. 'SNUG TIGHT' IS DEFINED AS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH. FOLLOWING THIS INITIAL OPERATION, ALL BOLTS SHALL THEN BE TIGHTENED ADDITIONALLY BY THE APPLICABLE AMOUNT OF NUT ROTATION AS SPECIFIED IN THE TABLE BELOW. WITH THE TIGHTENING PROGRESSING SYSTEMATICALLY FROM THE MOST RIGID PART OF THE JOINT TO ITS FREE EDGES. DURING THIS OPERATION, THERE SHALL BE NO ROTATION OF THE PART NOT TURNED BY THE WRENCH.

NUT ROTATION FROM SNUG TIGHT CONDITION

BOLT LENGTH (AS MEASURED FROM UNDERSIDE OF HEAD TO OUTSIDE FACE OF THE NUT PLUS 5/16 INCH)	DISPOSITION OF OUTER FACES OF BOLTED PARTS	
	BOTH FACES NORMAL TO BOLT AXIS	
NOT MORE THAN 4 DIAMETERS	1/3 TURN	
MORE THAN 4 DIAMETERS BUT NOT MORE THAN 8 DIAMETERS	1/2 TURN	
MORE THAN 8 DIAMETERS BUT NOT MORE THAN 12 DIAMETERS	2/3 TURN	

- NUT ROTATION IS RELATIVE TO BOLT. REGARDLESS OF THE ELEMENT (NUT OR BOLT) BEING TURNED, FOR BOLTS INSTALLED BY 1/2 TURN AND LESS, THE TOLERANCE SHOULD BE PLUS OR MINUS 30°. FOR BOLTS INSTALLED BY 2/3 TURN AND MORE, THE TOLERANCE SHOULD BE PLUS OR MINUS 45°.
- IF ANY BOLTS OR NUTS DO NOT SMOOTHLY ENGAGE UP TO SNUG-TIGHT THERE MAY BE AN OBSTRUCTION WITHIN THE TRENDS. THE BOLT OR NUT SHOULD BE REMOVED, THE THREADS ON THE BOLT AND NUT CLEANED AND RETAPPED IF NECESSARY TO ALLOW SMOOTH INSTALLATION.

WEARING SURFACE INSTRUCTIONS

- TYPE AND INSTALLATION OF THE WEARING SURFACE IS NOT BIG R BRIDGE RESPONSIBILITY.
- BIG R BRIDGE'S STEEL BRIDGE DECKING PLANKS ARE THE STRUCTURAL DECKING SYSTEM. THE WEARING SURFACE IS ONLY TO PROVIDE A SMOOTH RUNNING SURFACE AND NOT REQUIRED STRUCTURALLY.
- TYPICAL WEARING SURFACE LOAD OF 80 PSF WILL ACCOMMODATE UP TO 5 1/4" OF GRAVEL BASE (130 PCF) OR 4 1/4" OF CONCRETE OR ASPHALT (150 PCF) SURFACING ABOVE THE STEEL BRIDGE DECK CORRUGATIONS.
- IF GRAVEL WEARING SURFACE IS TO BE USED, THE GRAVEL SHALL BE PLACED ON THE DECK AND GRADED TO THE PROPER THICKNESS.
- REFERENCE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR RECOMMENDATIONS FOR ASPHALT OR CONCRETE WEARING SURFACES.
- TIMBER WEARING SURFACES ARE TYPICALLY INSTALLED BY BIG R BRIDGE DURING FABRICATION. SEE BIG R BRIDGE PROJECT SPECIFIC PLANS FOR ADDITIONAL DETAILS.
- OTHER WEARING SURFACE TYPES MAY BE USED AS LONG AS THE TOTAL WEARING SURFACE LOAD IS NOT GREATER THAN THE WEARING SURFACE LOAD PER THE BIG R BRIDGE PROJECT SPECIFIC PLANS.

REV	STATUS	BY	DATE
A	RELEASED	SLJ	11/14/2019



PROPRIETARY AND CONFIDENTIAL
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MODULAR BRIDGE WITH BIG R STEEL DECK INSTALLATION GUIDE

BIG-R BRIDGE

SHEET NO.

2
OF
2



Tyonek Creek Bridge

 Project Area

KPB Parcel(s):

..

Project Description:

Vicinity: Tyonek



Map created by Aldridge, Morgan
Friday, March 27, 2026



The information depicted hereon is for a graphical representation only of best available sources. The Kenai Peninsula Borough assumes no responsibility for any errors on this map.

**Conditional Use Permit
Anadromous Waters Habitat Protection District
Staff Report**

PC Res No. 2026-27
Planning Commission Meeting: Monday, May 11, 2026
Applicant Tyonek Tribal Conservation District
Mailing Address 101 W Benson Blvd
Anchorage, AK 99503
Legal Description T 11N R 12W SEC 1 SM AN US SURVEY 1865 ALL OF
SEC 1 LYING WITHIN USS 1865 - MOQUAWKIE
INDIAN RESERVATION
KPB Parcel Number 21115043

Project Description

A Conditional Use Permit is sought pursuant to KPB 21.18 for the construction of bridge within the 50-foot Habitat Protection District of Tyonek Creek, as established in KPB 21.18.040.

Background Information

Improve fish passage on Tyonek Creek by removing barriers caused by undersized culverts and replacing them with a bridge.

Project Details within the 50-foot Habitat Protection District

- Placement of a 50 foot by 14 foot rolled girder bridge
- Excavation of 1,140 cubic yards of materials and placement of 710 cubic yards of fill materials, to include rip rap, gravel and topsoil
- Placement of 314 linear feet of coir logs and willow staking, with an additional 1,174 square feet of vegetative mat
- Planting 125 seedlings

Findings of fact pursuant to KPB 21.18.081 Conditional Use Permit

1. Portions of this proposed project are within the 50-foot habitat protection district as defined by KPB 21.18.040.
2. Pursuant to KPB 21.18.081(B)(5), construction of transportation and utility infrastructure may be approved as a conditional structure/use within the habitat protection district.

3. Pursuant to 21.18.081(D) General Standards, staff finds that the proposed project meets the five general standards.
4. Pursuant to KPB 21.18.020(A), this chapter was established to protect and preserve the stability of anadromous fish through controlling shoreline alterations and disturbances along anadromous waters and to preserve nearshore habitat.
5. Pursuant to KPB 21.18.20(B)(5), one purpose of this chapter was established to separate conflicting land uses.
6. The bridge design has been approved by US Fish and Wildlife Service (USFWS) and Alaska Department of Fish and Game (ADFG).
7. 2022 site visit by HDR/ TDC showed that the culverts had a slight perch that may cause juvenile fish barrier at low flows.
8. Construction work will be timed with USFWS and ADFG to limit disturbance to protect nesting migratory birds and fish spawning seasons.
9. Pursuant to KPB 21.06.081(D)(3), the proposed work will occur on the applicant's property and shall not have an adverse effect on adjoining properties.
10. Pursuance to KPB 21.18.140 ORD 2025-12, the proposed project meets the definition of water dependent.
11. The River Center found the application complete and scheduled a public hearing for Monday, May 11, 2026.
12. Agency review was distributed on Wednesday, April 22, 2026. No comments or objections have been received from resource agencies to date.
13. Pursuant to KPB 21.11.030, public notice was mailed to all property owners within a radius of 300 feet of the project on Wednesday, April 22, 2026. A total of 1 mailing was sent.
14. Pursuant to KPB 01.08.180 (B) (1) (3), public notice was posted.
15. The applicant is currently in compliance with Borough permits and ordinances.

Permit Conditions

1. Construction techniques and best management practices shall be utilized to ensure that land disturbing activities do not result in runoff or sedimentation to Tyonek Creek.
2. The bridge must be designed and installed to meet KPB floodplain requirements.
3. The permittee shall minimize damage to all vegetation and shall revegetate all disturbed areas with native vegetation.
4. For each tree removed, two seedlings less than 5.5-feet tall of a species native to the region will be planted within the 50-foot HPD.
5. Storage or use of fuel is prohibited within 50-feet of any open water.
6. The River Center shall be notified at least 3 days prior to the start of the project.
7. If changes to the approved project described above are proposed prior to or during its siting, construction, or operation, the permittee is required to notify the River Center to determine if additional approval is required.

8. The permittee shall be held responsible for the actions of the contractors, agents, or others who perform work to accomplish the approved plan.
9. The construction or installation phase of this Conditional Use Permit must be completed within three calendar years from the date of the permit's issuance, or the Conditional Use Permit shall expire unless the Planning Commission finds that more time is necessary to effectuate the purposes of this chapter, in which case the commission may extend the deadline for a maximum of six years from the date of issuance. Prior to its expiration date and upon written request, the Planning Director may grant a Conditional Use Permit extension for 12 months (KPB 21.18.081 (H)).
10. In addition to the penalties provided by KPB 21.18.110, and pursuant to KPB 21.50, the permit may be revoked if the permittee fails to comply with the provisions of this chapter or the terms and conditions of a permit issued under this chapter. The Borough Clerk shall provide at least 15 day's written notice to the permittee of a revocation hearing before the hearing officer (KPB 21.18.082).
11. The permittee shall comply with the terms, conditions and requirements of the Kenai Peninsula Borough Code of Ordinances Chapter 21.18, and any regulations adopted pursuant to this chapter.
12. The permittee is responsible for abiding by all other federal, state, and local laws, regulations, and permitting requirements applicable to the project (KPB 21.18.081 (G)).

General Standards

Pursuant to 21.18.081(D) General Standards, the following standards shall be met before conditional use approval may be granted:

1. The use or structure will not cause significant erosion, sedimentation, damage within the habitat protection district, an increase in ground or surface water pollution, and damage to riparian wetlands and riparian ecosystems; **Condition 1 and Finding 6-8 appear to support this standard.**
2. Granting of the conditional use shall be consistent with the purposes of this chapter, the borough comprehensive plan, other applicable chapters of the borough Code, and other applicable planning documents adopted by the borough; **Findings 14, 15 appear to support this standard.**
3. The development of the use or structure shall not physically damage the adjoining property; **Finding 9 appears to support this standard.**
4. The proposed use or structure is water-dependent; **Finding 10 appears to support this standard.**
5. Applicant's or owner's compliance with other borough permits and ordinance requirements; **Condition 11, 12 and Finding 15 appear to support this standard.**

Attachments

Multi-Agency Application
Draft Resolution 2026-27

Recommendation

Based on the findings, staff finds that the proposed project meets the five general standards of KPB 21.18.081. The Planning Commission could consider additional permit conditions to mitigate for any habitat loss if it chooses.

Staff recommends the Planning Commission grant a Conditional Use Permit for the proposed project details subject to adopted conditions as set forth in 2026-27.

Note: An appeal of a decision of the Planning Commission may be filed to the Hearing Officer, in accordance with the requirements of the Kenai Peninsula Borough Code of Ordinances, Chapter 21.20.250. An appeal must be filed with the Borough Clerk within 15 days of date of the notice of the decision using the proper forms and be accompanied by the filing and records preparation fee.

END OF STAFF REPORT

KENAI PENINSULA BOROUGH PLANNING COMMISSION

RESOLUTION 2026-27

A RESOLUTION GRANTING A CONDITIONAL USE PERMIT PURSUANT TO KPB 21.18 FOR THE CONSTRUCTION OF A BRIDGE WITHIN THE 50-FOOT HABITAT PROTECTION DISTRICT OF TYONEK CREEK.

WHEREAS, Chapter 21.18 provides for the approval of Conditional Use Permits for certain activities within the habitat protection district; and

WHEREAS, KPB 21.18.081 provides that a conditional use permit is required for construction not meeting the standards of KPB 21.18.071; and

WHEREAS, KPB 21.18.091 provides for mitigation measures by the planning department staff to address impacts to the Habitat Protection District from a proposed, ongoing, or completed project; and

WHEREAS, public notice was sent to all property owners within a 300-foot radius of the proposed activity as provided in Section 21.11.030; and

WHEREAS, public notice was posted as provided in Section 01.08.180 (B) (1) (3); and

WHEREAS, public testimony was received at the Monday, May 11, 2026 meeting of the Kenai Peninsula Borough Planning Commission;

NOW, THEREFORE, BE IT RESOLVED BY THE PLANNING COMMISSION OF THE KENAI PENINSULA BOROUGH:

That the Planning Commission makes the following findings of fact pursuant to KPB 21.18:

Section 1. Project Details Within the 50-foot Habitat Protection District

- Placement of a 50 foot by 14 foot rolled girder bridge
- Excavation of 1,140 cubic yards of materials and placement of 1,140 cubic yards of fill materials, to include rip rap, gravel and topsoil
- Placement of 314 linear feet of vegetative mat, coir logs and brush layers
- Planting 125 seedlings

Section 2. Findings of fact pursuant to KPB 21.18.081

1. Portions of this proposed project are within the 50-foot habitat protection district as defined by KPB 21.18.040.
2. Pursuant to KPB 21.18.081(B)(5), construction of transportation and utility infrastructure may be approved as a conditional structure/use within the habitat protection district.
3. Pursuant to 21.18.081(D) General Standards, staff finds that the proposed project meets the five general standards.
4. Pursuant to KPB 21.18.020(A), this chapter was established to protect and preserve the stability of anadromous fish through controlling shoreline alterations and disturbances along anadromous waters and to preserve nearshore habitat.
5. Pursuant to KPB 21.18.20(B)(5), one purpose of this chapter was established to separate conflicting land uses.
6. The bridge design has been approved by US Fish and Wildlife Service (USFWS) and Alaska Department of Fish and Game (ADFG).
7. 2022 site visit by HDR/ TDC showed that the culverts had a slight perch that may cause juvenile fish barrier at low flows.
8. Construction work will be timed with USFWS and ADFG to limit disturbance to protect nesting migratory birds and fish spawning seasons.
9. Pursuant to KPB 21.06.081(D)(3), the proposed work will occur on the applicant's property and shall not have an adverse effect on adjoining properties.
10. Pursuant to KPB 21.06.081(D)(3), the proposed work will occur on the applicant's property and shall not have an adverse effect on adjoining properties.
11. The River Center found the application complete and scheduled a public hearing for Monday, May 11, 2026.
12. Agency review was distributed on Wednesday, April 22, 2026. No comments or objections have been received from resource agencies to date.
13. Pursuant to KPB 21.11.030, public notice was mailed to all property owners within a radius of 300 feet of the project on Wednesday, April 22, 2026. A total of 1 mailing was sent.
14. Pursuant to KPB 01.08.180 (B) (1) (3), public notice was posted.
15. The applicant is currently in compliance with Borough permits and ordinances.

Section 3. Permit Conditions

1. Construction techniques and best management practices shall be utilized to ensure that land disturbing activities do not result in runoff or sedimentation to Tyonek Creek.
2. The culvert must be designed and installed to meet KPB floodplain requirements.
3. The permittee shall minimize damage to all vegetation and shall revegetate all disturbed areas with native vegetation.

4. For each tree removed, two seedlings less than 5.5-feet tall of a species native to the region will be planted within the 50-foot HPD.
5. Storage or use of fuel is prohibited within 50-feet of any open water.
6. The River Center shall be notified at least 3 days prior to the start of the project.
7. If changes to the approved project described above are proposed prior to or during its siting, construction, or operation, the permittee is required to notify the River Center to determine if additional approval is required.
8. The permittee shall be held responsible for the actions of the contractors, agents, or others who perform work to accomplish the approved plan.
9. The construction or installation phase of this Conditional Use Permit must be completed within three calendar years from the date of the permit's issuance, or the Conditional Use Permit shall expire unless the Planning Commission finds that more time is necessary to effectuate the purposes of this chapter, in which case the commission may extend the deadline for a maximum of six years from the date of issuance. Prior to its expiration date and upon written request, the Planning Director may grant a Conditional Use Permit extension for 12 months (KPB 21.18.081 (H)).
10. In addition to the penalties provided by KPB 21.18.110, and pursuant to KPB 21.50, the permit may be revoked if the permittee fails to comply with the provisions of this chapter or the terms and conditions of a permit issued under this chapter. The Borough Clerk shall provide at least 15 day's written notice to the permittee of a revocation hearing before the hearing officer (KPB 21.18.082).
11. The permittee shall comply with the terms, conditions and requirements of the Kenai Peninsula Borough Code of Ordinances Chapter 21.18, and any regulations adopted pursuant to this chapter.
12. The permittee is responsible for abiding by all other federal, state, and local laws, regulations, and permitting requirements applicable to the project (KPB 21.18.081 (G)).

Section 4. Pursuant to 21.18.081(D) General Standards, the following standards shall be met before conditional use approval may be granted:

1. The use or structure will not cause significant erosion, sedimentation, damage within the habitat protection district, an increase in ground or surface water pollution, and damage to riparian wetlands and riparian ecosystems; **Conditions 1 and Findings 6-8 appear to support this standard.**
2. Granting of the conditional use shall be consistent with the purposes of this chapter, the borough comprehensive plan, other applicable chapters of the borough Code, and other applicable planning documents adopted by the borough; **Findings 14, 15 appear to support this standard.**

3. The development of the use or structure shall not physically damage the adjoining property; **Finding 9 appear to support this standard.**
4. The proposed use or structure is water-dependent; **Finding 10 appear to support this standard.**
5. Applicant's or owner's compliance with other borough permits and ordinance requirements. **Condition 11, 12 and Finding 14 appears to support this standard.**

THIS CONDITIONAL USE PERMIT EFFECTIVE ON _____ DAY OF _____, 2026.

Jeremy Brantley, Chairperson
Planning Commission

ATTEST:

Ann Shirnberg
Administrative Assistant

Note: An appeal of a decision of the Planning Commission may be filed to the hearing officer, in accordance with the requirements of the KPB Code of Ordinances, Chapter 21.20.250. An appeal must be filed with the Borough Clerk within 15 days of date of the notice of the decision using the proper forms and be accompanied by the filing and records preparation fee.