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US Army Corps of Engineers®
Portland District

DESIGN DOCUMENT REPORT NO. XXX

LOWER WILLAMETTE ECOSYSTEM RESTORATION
TRYON CREEK CULVERT
WILLAMETTE RIVER, OREGON

Tryon Creek Culvert Replacement

30 Percent DDR
July 2024

EXECUTIVE SUMMARY

1. INTRODUCTION

The US Army Corps of Engineers (USACE) completed a Biological Opinion report in 2014 authorizing five restoration projects in the Lower Willamette River Watershed to enhance essential fish habitat. These projects are located at Kelley Point Park (Willamette River Mile (RM) 0), the City of Portland Bureau of Environmental Services (BES) Treatment Plant (Columbia Slough RM 7.5), Kenton Cove (Columbia Slough RM 9), Oaks Crossing (Willamette RM 16.2), and the subject of this design documentation report (DDR) – the Tryon Creek-Highway 43 (OR 43) culvert (Tryon Creek RM 0.5). The City of Portland is the local non-Federal sponsor (NFS) and the Tryon Creek site will be initiated first in the Pre-construction Engineering and Design (PED) phase.

The restoration project at Tryon Creek involves replacing an existing 8-foot-by-8-foot box culvert that currently acts as a fish barrier with a new culvert that will provide improved fish passage opportunities upstream of the culvert.

2. PURPOSE

The intent of this project is to replace the culvert under OR 43 and two Union Pacific (UP) rail lines with a fish-passable culvert that meets National Oceanic and Atmospheric Administration (NOAA) fisheries and ODFW fish passage criteria. The new open-bottom arch culvert will simulate the natural stream dimensions, allowing for sediment and debris to pass through and provide fish unhindered refuge and passage beneath the roadway and railroad line. Implementation of this project will allow fish passage into the Tryon Creek State Natural Area, where fish habitat has been restored recently.

3. PROJECT LOCATION

The Tryon Creek culvert is located in Lake Oswego, Oregon, about 6 miles south of downtown Portland. Tryon Creek is a 7-mile-long perennial tributary of the Willamette River with headwaters in the West Hills of Portland. The culvert is located on Tryon Creek about 1,000 feet upstream of the confluence with the Willamette River.

4. DESCRIPTION OF FACILITY

The Tryon Creek culvert passes beneath OR 43 and two active rail lines at the intersection with SW Terwilliger Boulevard. The culvert is an 8-foot-by-8-foot concrete box culvert approximately 400 feet long with a generally northwest-southeast alignment. OR 43 has four lanes of traffic past the intersection of SW Terwilliger Boulevard. The rail lines are located east of the highway on an elevated berm approximately 10 feet above the highway grade and run approximately southwest-northeast. The culvert was constructed in the 1920s beneath highway and railroad timber trestles and then encased by infilling the Tryon Creek ravine and burying the existing timber trestles that had been left in place. In 1963, the City of Portland constructed a sewer line above the concrete box culvert by tunneling under the roadway and track embankments that were created when the ravine and trestles were infilled.

5. CONSTRUCTION ACCESS

Construction access to the upstream and downstream stream channel is limited due to road and rail corridor constraints and limited staging areas adjacent to SW Terwilliger Boulevard to the west of OR 43 and east (downstream) of the rail line. The tunnel outlet area is hindered by a low-clearance rail bridge on Stampher Road.

6. CONSTRUCTION SCHEDULE

[UPDATE FOLLOWING 60% DESIGN]

7. OPERATIONS DURING CONSTRUCTION

Rail and highway traffic will have to be accommodated during construction. [TRAFFIC CONTROL/COORDINATION WITH RAILROAD WILL BE DEVELOPED FURTHER AT 60% MILESTONE]

8. COST

[UPDATE AT 60% MILESTONE]

CONTENTS

APPENDICES

PREVIOUS AND PLANNED REPORTS

Number	Title	Date
N/A	Geotechnical Data Report: Tryon Creek Culvert Replacement Project	March 2024
N/A	ODOT – Tryon Culvert Replacement Project Scoping Report	May 2014
N/A	Endangered Species Act (ESA) BIOP – Lower Willamette River Ecosystem Restoration General Investigation	May 2014

ACRONYMS

Acronym	Description
AASHTO	American Association of State Highway and Transportation Officials
AEP	annual exceedance probability
A-E Team	architecture/engineering team
AREMA	American Railway Engineering and Maintenance-of-Way
ASTM	ASTM International
BDM	Bridge Design Manual
BES	City of Portland Bureau of Environmental Services
BFE	Base Flood Elevations
CE/ICA	Cost-effectiveness and Incremental Cost Analysis
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRBG	Columbia River Basalt Group
CUI	Controlled Unclassified Information
DDR	design documentation report
DEA	David Evans and Associates, Inc.
Delve	Delve Underground, Inc.
DOGAMI	Oregon Department of Geology and Mineral Industries
EO	Executive Order
EPA	Environmental Protection Agency
ER	Engineer Regulation
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
GDM	Geotechnical Design Manual
GDR	Geotechnical Data Report
GRI	Geotechnical Resources, Inc.
HEP	Habitat Evaluation Procedure
H&H	hydrologic and hydraulic
H:V	Horizontal to Vertical
IWW	In-water Work Window
lidar	Light Detection and Ranging
LRFD	Load and Resistance Factor Design
LVAP	Lower Vertical Adjustment Potential
MHO	Minimum Hydraulic Opening
NAVD88	North American Vertical Datum of 1988
NFS	non-Federal sponsor
NHPA	National Historic Preservation Act of 1966

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Northwest Region, Portland District
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OR 43	Highway 43
OSHA	Occupational Safety and Health Administration
pcf	pounds per cubic foot
PDT	Product Development Team
PED	Pre-construction Engineering and Design
PGA	Peak Ground Acceleration
PNWR	Portland and Western Railroad
psf	pounds per square foot
QPL	Qualified Products Lists
RM	River Mile
SEM	Sequential Excavation Method
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Office
SLIDO	Statewide Landslide Information Database for Oregon
SP	Special Provision
TCX	Transportation Center of Expertise
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
VWP	Vibrating Wire Piezometers
WRDA	Water Resources Development Act
WSDOT	Washington State Department of Transportation
WST	Willamette Shore Trolley

SECTION 1 - PROJECT BACKGROUND

1.1 PROJECT HISTORY

The Willamette River watershed was once an extensive and interconnected system of active channels, open slack waters, emergent wetlands, riparian forests, and adjacent upland forests. Modifications needed to provide ship access to Portland Harbor required construction and maintenance of a navigation channel between RM 0 and RM 11.6. The development of navigational channels, docking facilities, and bulkheads reduced the amount and quality of native floodplain habitats. In addition, the river became heavily polluted beginning in the early 1900s from industrial and urban waste discharges.

In the 1960s, the river was targeted for remediation and protection and, more recently, habitat and natural resources restoration efforts have been undertaken. However, the river continues to suffer from poor water and sediment quality, diminished riparian zones, and reduced shallow water and wetland habitat areas. Despite best efforts, fish and wildlife populations, especially those protected under the Endangered Species Act, have undergone dramatic declines.

Based on an assessment of the problems and opportunities in the project area, the following set of goals and objectives was established for a feasibility study (completed in 2015) to address these issues:

- Reestablish riparian and wetland plant communities
- Improve aquatic and riparian habitat complexity and diversity
- Restore floodplain function and connectivity

The following restoration management measures were developed that could be applied to potential sites and achieve project objectives:

- Remove invasive species and minimize disturbance of native habitats
- Revegetate riparian zones and wetlands with an appropriate mix of native species
- Restore hydrological aspects of each site to encourage survival of appropriate plant communities
- Restore streambeds by placing wood and debris jams for habitat diversity
- Encourage or install communities of overhanging streamside vegetation to reduce water temperatures and provide nutrients/food source, stabilize shorelines, and provide wildlife cover

- Reconnect side channels and backwater wetlands to streams and rivers where possible

- Remove barriers to fish access to spawning and rearing areas

- Slope steepened banks to a gentler angle to allow floodwaters to spread out and to provide shallow water and wetland habitat

- Remove revetments and fill by excavation and use bioengineering methods for bank stabilization where possible

Many restoration sites that were included in the conceptual watershed management plans developed by the City of Portland for the Lower Willamette River Basin were initially proposed for restoration in the feasibility study. Of an initial list of approximately 45 sites, after several iterations evaluating and comparing each site's potential for benefits, availability, and cost effectiveness, 5 sites were evaluated, determined to be "best buys", and carried forward into the Recommended Plan.

Given the variety of aquatic, terrestrial, and transitional habitat types present across the spectrum of the 50 original sites under consideration, the Habitat Evaluation Procedure (HEP) model was selected as the most appropriate model to quantify habitat benefits. Habitat benefits were evaluated using a modified HEP for the following six species or groups of species: western pond turtle, beaver, wood duck, yellow warbler, native amphibians, and salmonids. These species were selected to represent the range of riparian, aquatic, and/or shallow water riverine habitats that would be encountered in the study area.

Cost-effectiveness and incremental cost analyses (CE/ICA) were performed using the certified Institute for Water Resources-Planning Suite software version 1.0.11.1. The evaluation identified the most cost-effective alternative plans to reach various levels of restoration output and provided information about whether increasing levels of restoration are worth the added cost. The "best buy" plans, or the alternatives providing the highest habitat value output for the least cost, were considered as final alternatives for evaluation.

Following the iterative evaluation process and CE/ICA, the feasibility study project team identified a Recommended Plan.

It included restoration components at five separate locations, including two on the Willamette River, two on the Columbia Slough, and one at the confluence of the Willamette and Columbia Rivers. Below is a description of the Recommended Plan at Tryon Creek:

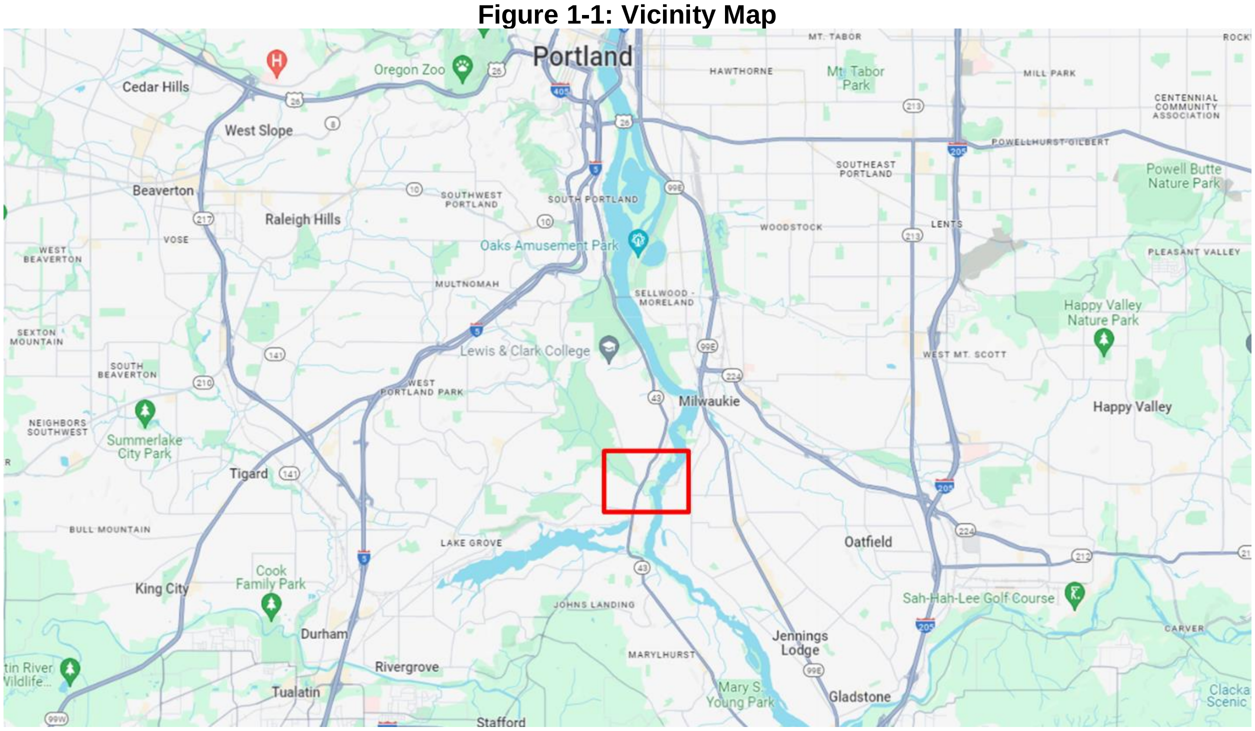
- **Tryon Creek Culvert** (stream and side channel connectivity for fish passage). This site plan would replace the culvert under Highway 43 (OR 43) and the rail line, which is a fish barrier under most flow conditions, and restore fish passage and natural stream functions. The construction area would be revegetated with native riparian species, and rocks would be placed in the streambed to create natural weirs for grade control to reduce velocities and facilitate fish passage. The new culvert would simulate the natural stream dimensions, allowing for sediment and debris to pass through and give fish unhindered passage beneath the roadway and railroad line. Implementation of this project would allow unhindered fish passage into approximately 2.7 miles of stream within Tryon Creek State Natural Area.

Given the large environmental restoration benefits for the Tryon Creek project, the Tryon Creek site was selected to be initiated first in the PED phase.

1.2 PROJECT DESCRIPTION

The Tryon Creek project location is at the intersection of Tryon Creek and OR 43, located in the City of Lake Oswego, Oregon, in Clackamas County.

Figure 1-1: Vicinity Map



Note: Map provided by Google Maps.

The final feasiblity study proposed replacing the existing 8-foot-by-8-foot box culvert located under OR 43 and the Union Pacific Railroad (UPRR) railroad lines with a minimum 32-foot-span, arch culvert. The existing 8-foot-by-8-foot box culvert is currently a fish barrier under most current flow conditions.

This project proposes replacing the existing 8-foot-by-8-foot, 400-foot-long, reinforced concrete box culvert with a wider span (32-foot minimum) that would simulate pre-culvert conditions and facilitate fish passage. The new culvert will improve fish passage and restore the natural stream functions currently impacted. Implementation of this project will allow fish passage into approximately 7 miles of main stem stream within Tryon Creek State Natural Area. The Tryon Creek system has an additional 23 miles of habitat, not all of which is accessible. The feasibility project limits extend approximately 100 feet or more upstream and downstream of the existing culvert. Those limits may be adjusted to optimize channel conditions.

The City of Portland is the non-Federal sponsor (NFS) and has a cooperating agreement with the U.S. Army Corps of Engineers (USACE). The project site has multiple landowners, including the Oregon Department of Transportation (ODOT), UPRR, the Cities of Lake Oswego and Portland, and Oregon State Parks. UPRR owns the eastern track and leases it to Portland and Western Railroad (PNWR). The City of Portland has a Preliminary Engineering Agreement in place with UPRR that defines UPRR's engagement in review of the design for the project. The western line is also owned by UPRR and operated by the Willamette Shore Trolley (WST). USACE and the City of Portland will be engaging UPRR through a formal design review process. The USACE Transportation Center of Expertise (TCX) is supporting the project team for matters related to the railroads.

1.3 AUTHORIZATION FOR WORK

A Chief's report was signed to Congress for the recommended plan in the feasibility study (for the five sites) on December 14, 2015. The project was authorized under the 2016 Water Resources Development Act (WRDA).

1.4 PROJECT TEAM

This DDR is a collaborative effort between the Portland District and a contracted architecture/engineering team (A-E Team) led by Geotechnical Resources, Inc. (GRI), including Delve Underground, Inc. (Delve) and David Evans and Associates (DEA). The A-E Team is responsible for the following disciplines:

- Geotechnical (GRI)
- Structural (Delve)
- Civil (DEA)
- Transportation (DEA)
- Construction Methods (DEA)

In addition to these disciplines, the A-E Team contributed to the development of project models and drawings and provided support to other disciplines during development of this DDR.

SECTION 2 - BASIS OF DESIGN AND DESIGN CRITERIA

This section outlines the fundamental principles, assumptions, and criteria guiding the culvert design. Preliminary project criteria were established in the Lower Willamette River Environmental Dredging and Ecosystem Restoration Project – Integrated Feasibility Study and Environmental Assessment – Draft Final Report dated March 2015. Discipline-specific design criteria, standards, codes, and regulations are referenced in the relevant sections below.

2.1 GENERAL CRITERIA

The following preliminary design and construction criteria have been developed:

- Access to the stream bed elevation upstream of the culvert is along a historic skid road identified by the City of Portland on the Tryon Creek – Trunk Sewer Upgrade 60% design drawings (sheet C03) (June 2014).
- Culvert maintenance access shall be a 12-foot-wide path on the upstream side of the stream.
- Access to the stream bed elevation downstream of the culvert is via Stampher Road or through the existing Tryon Creek Sewer Treatment Plant property. Additional access could be provided through the creek if an open-cut design is selected.
- In-water Work Window (IWW) for Tryon Creek is July 15 to September 30.
- Work above the ordinary highwater of Tryon Creek may be completed outside the IWW.

2.2 STAKEHOLDER REQUIREMENTS

2.2.1 Roadways

Maintain two lanes of traffic in a 28-foot-wide corridor. This criterion was developed during a meeting with representatives from USACE and ODOT Region 1 and considered to have a high likelihood for approval when submitted by a future construction contractor.

2.2.2 Railroad

Both railroad tracks are owned by Union Pacific Railroad (UPRR). The eastern track is operated by Portland and Western Railroad (PNWR). Rail traffic on the UPRR line (east side) is four trains per day, on average. Maximum posted speed is 10 mph. Temporary bridge design for the UPRR railroad must be constructable with no single interruption exceeding 12 hours. The ODOT 2014 Scoping Report (2014) assumed a one-week closure; however, that is unacceptable and will result in a protracted legal remedy. The traffic on the west track is limited to the Lake Oswego Trolley, which runs summer tours and presumably can be temporarily shut down with some mitigation provided by the City of Portland.

2.2.3 Local Stakeholders

Access to local residences via Stampher Road and local businesses along OR 43 will need to be maintained.

To be completed as local stakeholders (City of Lake Oswego, etc.) are involved in future design phases.

2.3 GENERAL SITE CONDITIONS AND CONSTRAINTS

[Will be updated at 60%]

2.4 DESIGN STANDARDS, CODES, AND REGULATIONS

Work will be performed in accordance with applicable Federal, State, and local standards, codes, and regulations. These include, but are not limited to, the current versions of the following:

- State of Oregon Administrative Rule (OAR) 635-412: Fish Passage
- AASHTO Drainage Manual
- AASHTO LRFD Bridge Design Specifications
- ODOT Highway Design Manual
- ODOT Traffic Control Plans Design Manual
- ODOT Geotechnical Design Manual
- AREMA Manual for Railway Engineering
- UPRR Public Projects Manual

2.5 DESIGN ASSUMPTIONS

For this phase of the project, the following assumptions have been made:

- All elevations in this report reference NAVD88 datum unless otherwise noted.

- The railroad embankment consists of random fill placed around a timber trestle. There will be no site-specific geotechnical data to further characterize the railroad embankment collected for this project. Cost estimate should assume portions of railroad embankment and timber trestle are contaminated but non-hazardous until additional environmental disposal profiling is completed. Scope assumes that the “leave surface” is acceptable for contact with urban aquatic habitat requirements.

- Utilities will be relocated by others outside of the temporary shoring area and the upstream and downstream culvert headwall structures. Relocation of utilities will be coordinated with temporary shoring and excavation work sequences.

- The design stream flow for Tryon Creek during the IWW is 10 cubic feet per second (cfs). This represents a low probability of exceedance given the median summer discharge is 1 cfs.

- The culvert bottom will have a span of at least 32.3 feet. The minimum depth below stream grade for footings will be 3 feet of scour depth.

- Bank full elevation at the upstream end of the culvert was previously determined to be elevation 47.2 feet (NAVD88) and the active channel width was previously established as 20.2 feet. These values may be updated as the project progresses.

SECTION 3 - BIOLOGICAL CRITERIA

3.1 REFERENCES AND STANDARDS

- National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. §4321 et seq
- Bald and Golden Eagle Protection Act of 1940, 16 U.S.C. §668 et seq
- Clean Air Act (CAA) of 1970, 42 U.S.C. §7401 et seq.
- Clean Water Act (CWA) of 1972, 33 U.S.C. §1251 et seq.
- Marine Mammal Protection Act (MMPA) of 1972, 16 U.S.C. §1361 et seq.
- Migratory Bird Treaty Act (MBTA) of 1918, 16 U.S.C. §703 et seq.
- Rivers and Harbors Appropriation Act (RHA) of 1899, 33 U.S.C. §401-418
- Executive Order 11988, Floodplain Management, 24 May 1977
- Endangered Species Act (ESA) of 1973, 16 U.S.C. §1531 et seq.
- Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976, 16 U.S.C. §1801 et seq.
- Executive Order 13186, Migratory Birds, 10 January 2001
- Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species, 5 December 2016
- Fish and Wildlife Coordination Act (FWCA) of 1958, 16 U.S.C. §661 et seq.

3.2 PROTECTED SPECIES WITHIN THE PROPOSED ACTION AREA

Fish Species		Lower Columbia	Threatened
Chinook salmon	*Oncorhynchus tshawytscha*	Upper Columbia Spring-run	Endangered
		Upper Willamette	Threatened
		Snake Spring/ Summer-run	Threatened
		Snake Fall-run	Threatened
Chum salmon	*Oncorhynchus keta*	Columbia	Threatened

Coho salmon	*Oncorhynchus kisutch*	Lower Columbia / Southwest Washington	Threatened
Sockeye	*Oncorhynchus nerka*	Snake	Endangered
		Lower Columbia	Threatened
		Middle Columbia	Threatened
Steelhead	*Oncorhynchus mykiss*	Upper Columbia	Threatened
		Upper Willamette	Threatened
		Snake	Threatened
Bull trout	*Salvelinus confluentus*	Willamette Recovery Unit	Threatened
North American green sturgeon	*Acipenser medirostris*	Southern DPS	Threatened
Pacific lamprey	*Lampetra tridentate*	NA	Species of Concern
Coastal cutthroat trout	*Oncorhynchus clarkii clarkii*	NA	Species of Concern
Non-Fish Species			
Golden Eagle	Aquila chrysaetos	NA	Fully Protected, De-listed
Bald eagle	*Haliaeetus leucocephalus*	NA	Fully Protected, De-listed
Northwestern Pond Turtle	*Actinemys marmorata*	NA	Proposed Threatened

MBTA-Protected Avians

Species	Scientific Name	Likely Present	Breeding in Area
Black Swift	Cypseloides niger	Early September	Unlikely
California Gull	Larus californicus	March- July	Highly Unlikely
Cassin's Finch	Haemorhous cassinii	March- September	Likely
Chestnut-backed Chickadee	Poecile rufescens rufescens	Year Round	Likely
Clark's Grebe	Aechmophorus clarkii	Mid-June	Highly Unlikely

Evening Grosbeak	Coccothraustes vespertinus	Year Round	Likely
Lesser Yellowlegs	Tringa flavipes	Late July- Mid August	Unlikely
Olive-sided Flycatcher	Contopus cooperi	April- August	Likely
Oregon Vesper Sparrow	Pooecetes gramineus affinis	Late September	Highly Unlikely
Rufous Hummingbird	Selasphorus rufus	February- September	Likely
Short-billed Dowitcher	Limnodromus griseus	Early August	Highly Unlikely
Western Grebe	aechmophorus occidentalis	Late August- Mid June	Highly Unlikely
Western Gull	Larus occidentalis	September- March	Highly Unlikely
Western Screech-owl	Megascops kennicottii cardonensis	Year Round	Likely

3.3 CRITERIA

In 2014 The Corp of Engineers (USACE) along with a non-Federal partner, The City of Portland, completed an Environmental Assessment (EA) that identified 5 sites for potential restoration along the Lower Willamette River, defined as the river from its confluence with the Columbia to the Willamette Falls at RM 26.0. Between 2014 and 2015 USACE completed a Biological Assessment on each of the sites, and formal Consultation with the NMFS was conducted resulting in a Biological Opinion (BiOp) reference number WCR-2014-633 . A Finding of No Significant Impact (FONSI) was completed by USACE on 19 January 2017. Since that time the scope of the proposed action has narrowed from five sites to one of the initial sites, the Tryon Creek culvert replacement. The current proposed action was reviewed and found to be in compliance with the completed EA/FONSI and BiOp. These documents require USACE to include special conditions within the Specifications.

3.3.1 General Criteria for Minimization of Adverse Environmental Impacts.

In the completed Environmental Assessment, the following minimization and avoidance measures were identified:

1. Incorporate waste minimization and pollution prevention processes into the design and construction of the restoration projects.

2. Require that construction contractors prepare and implement pollution prevention plans with clearly specified lines of authority and responsibility and defined procedures.

3. During preparation of the specifications, a spill control plan will be a required submittal (01 57 19 - Temporary Environmental Controls) that includes the

procedures, instructions, and reporting requirements for emergency response and cleanup measures that would be used in the event of an unforeseen spill of a substance regulated by 40 C.F.R. 68, 40 C.F.R. 302, 40 C.F.R. 355, and/or regulated under State or Local laws and regulations.

4. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing.

5. Segregate hazardous waste from other materials and wastes; protect it from the weather by placing it in a safe covered location and take precautionary measures such as berming or other appropriate secondary containment measures to contain accidental spillage. All storage, packaging, labeling, marking, and placarding of hazardous waste and hazardous material should be in accordance with 49 C.F.R. 171 - 178, State, and local laws and regulations.

6. Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation in accordance with all Federal, State, Regional, and local laws, and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with40 C.F.R. 279, State, and local laws and regulations.

7. Storage of fuel on the project site should be avoided, but if necessary, would be in accordance with all Federal, State, and local laws and regulations.

8. Waste water from construction activities will not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants.

9. Minimize the usage of hazardous materials to the extent practicable by equivalent product substitution.

10. Treat or recycle of hazardous wastes onsite, wherever feasible and allowed by regulations. Transport hazardous wastes to approved off-site recycling, treatment, and disposal facilities.

3.3.2 Wildlife Protection

The design and construction of the culvert will be in accordance with the NMFS, ODFW and USFWS Guidelines References as shown at 4.1 of this Document. In addition, project will follow the special conditions and reasonable and prudent measures of NMFS BiOp NWR 2014-633, specifically:

3.3.2.1 *Reasonable and Prudent Measures.*

1. Minimize adverse effects to fish using work area isolation, relocation and protect water quality and prevent loss of riparian vegetation during construction using the following guidelines:

    a. Work Window. To minimize effects to juvenile salmonids, construction shall be limited to the appropriate in-water work window (Tryon Creek- July 15 to September 30, Mainstem Willamette- July 1 to October 31, Columbia Slough- June 15 to September 15).

    b. Before beginning work, all contractors working on site shall be provided with a complete list of Corps permit special conditions, reasonable and prudent measures, and terms and conditions intended to minimize the amount and extent of take resulting from in-water work.

    c. Minimize Impact Area. Specifications should include a requirement that construction impacts to the minimum area necessary to complete the project, including minimizing effects to native riparian vegetation.

    d. Fish Capture and Release. If practicable, allow listed fish species to migrate out of the work area or remove fish before isolating the area; otherwise remove fish from an exclusion area with methods such as hand or dip-nets, seining, or trapping with minnow traps (or gee-minnow traps).

        i. Capture and relocation will require USACE to obtain an ODFW Scientific Take Permit and NOAA Authorization for removal and relocation of fish. USACE will apply for this permit at the 60% Plans and Specifications phase of design.

        ii. Fish capture will be supervised by a qualified fisheries biologist, with experience in work area isolation and competent to ensure the safe handling of fish.

        iii. Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.

        iv. Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.

        v. Electrofishing will be used during the coolest time of day, and only after other means of fish capture are determined to be not feasible or ineffective.

            1) Follow the most recent version of NMFS (2000) electrofishing guidelines.

2) Do not electrofish when the water appears turbid, e.g., when objects are not visible at depth of 12 inches.

3) Do not intentionally contact fish with the anode.

4) Use direct current (DC) or pulsed direct current within the following ranges:
    a) If conductivity is less than 100 µs, use 900 to 1100 volts.
    b) If conductivity is between 100 and 300 µs, use 500 to 800 volts.
    c) If conductivity greater than 300 µs, use less than 400 volts.

5) Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.

6) Immediately discontinue electrofishing if fish are killed or injured, i.e., dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.

vi. If buckets are used to transport fish:

1) Minimize the time fish are in a transport bucket.

2) Keep buckets in shaded areas or, if no shade is available, covered by a canopy.

3) Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.

4) Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.

5) Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable provided the release site is below the influence of construction.

6) Be careful to avoid mortality counting errors.

vii. Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report to NMFS within 60 days of capture that documents date, time of day, fish handling procedures, air and water temperatures, and total numbers of each salmon and steelhead handled, and numbers of ESA-listed fish injured or killed.

Turbidity

Turbidity Monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when in-water work is being conducted.

1. Representative background point. An observation must be taken every 2 hours at a relatively undisturbed area at least 600 feet up current from in water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, time, and tidal stage must be recorded prior to monitoring down current.

2. Compliance point. Monitoring shall occur every 2 hours approximately 100 feet down current from the point of disturbance and be compared against the background observation. The turbidity, location, time, and tidal stage must be recorded for each sample.

3. Compliance. Results from the compliance points should be compared to the background levels taken during that monitoring interval. Turbidity may not exceed an increase of 10% above background at the compliance point during construction.

4. Exceedance. If an exceedance occurs, the applicant must modify the activity and continue to monitor every 2 hours. If an exceedance over the background level continues after the second monitoring interval, then work must be stopped and NMFS notified so that revisions to the BMPs can be evaluated.

5. If the weather conditions are unsuitable for monitoring (heavy fog, ice/snow, excessive winds, rough water, etc.), then operations must cease until conditions are suitable for monitoring.

6. Copies of daily logs for turbidity monitoring shall be available to NMFS upon request.

Pollution Control Plan (PCP)

A pollution control plan (PCP) will be a contract requirement to be developed and submitted by the Contractor to prevent pollution caused by construction activities from entering the river. The PCP must have the following components and be included as a required submittal in the specifications (01 57 19 – Temporary Environmental Controls):

i. The name and address of the party responsible for accomplishment of the PCP.

ii. Practices to prevent contaminant releases associated with equipment and material storage sites and fueling staging areas.

iii. A description of any regulated or hazardous products or materials that will be used for the project, including procedures for inventory, storage, handling, and monitoring.

iv. A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available on the site, proposed methods for disposal of spilled materials, and employee training for spill containment.

v. Practices to prevent debris from dropping into any stream or waterbody, and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

vi. During construction activities, monitoring will be done as often as necessary to ensure the controls discussed above are working properly. If monitoring or inspection shows that the controls are ineffective, work crews will be mobilized immediately to make repairs, install replacements, or install additional controls as necessary.

vii. The applicant will maintain an absorptive boom during all in-water activities to capture contaminants that may be floating on the water surface as a consequence of construction activities.

The applicant will follow proposed actions #1 through #5 and their associated design criteria as listed in the proposed action section of this biological opinion (from NMFS's PROJECTS biological opinion (NMFS 2013a)).

NFMS Coordination

Ensure NMFS has opportunities for formal involvement in the pre-construction, engineering, and design (PED) phases of the project to allow for NMFS review and input into final project design.

a. Notify NMFS within 90 days of execution of the pre-construction, engineering, and design phase (PED) agreement and invite NMFS staff to participate in design development.

b. As part of design development, the Corps and NMFS will mutually agree on:

   i. Frequency and timing of involvement in development of project designs.
   ii. Timing of delivery and review of draft project designs related to NMFS fish passage criteria (NMFS 2011c).

c. For all projects undertaken pursuant to the proposed action, the Corps will provide (at least 60 days before construction) site plans and other pertinent information to NMFS for review to ensure the consistency of the action with this opinion.

Ensure completion of a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

a. Reporting. The Corps reports all monitoring items, including a fish salvage report, turbidity observations, dates of initiation and completion of in-water work, and compliance with all relevant project design criteria from the PROJECTS biological opinion (NMFS 2013a) to NMFS within 60 days of the close of any work window that had in-water work within it. Any exceedance of take covered by this opinion must be reported to NMFS immediately. The report will include a discussion of implementation of the terms and conditions in #1.

Monitoring Reports will be submitted to:
National Marine Fisheries Service
Oregon Washington Coastal Area Office
Attn: WCR-2014-633
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232-2778

3.3.2.2 *Amount of incidental Take ESA Listed Fish*

In the Biological Opinion NMFS placed the following limits on incidental take of ESA listed fish:

The amount of take for this action is 500 ESA-listed fish captured during fish salvage for all five projects. This take was for the all initially-scoped projects, therefore the limit for this Tryon Creek project is 100 listed fish.

In addition NMFS stated that “The best available indicator for the extent of take is the extent of suspended sediment plumes. This feature best integrates the likely take pathways associated with this action, is proportional to the anticipated amount of take, and is the most practical and feasible indicator to measure. Thus, the extent of take indicator that will be used as a reinitiation trigger for this consultation is: increased suspended sediment from construction activities with suspended sediment plumes 100 feet from the boundary of construction activities at 10% over the background level. The increase in suspended sediment and the number of fish captured are thresholds for reinitiating consultation. Exceeding either for the amount or extent of take will trigger the reinitiation provisions of this opinion.”

In addition to NMFS requirements Specifications will require the use of NMFS-approved screens on all pumps utilized to move surface water on site.

3.3.3 Adverse Effects to Essential Fish Habitat (EFH)

NMFS concluded that the proposed action would have adverse effects on EFH designated for Chinook and coho salmon. These effects include a temporary reduction in riparian vegetation, a temporary reduction in water quality from sediment disturbance, and harassment and/or displacement from disturbance caused by construction. There will also be many long- term beneficial effects from habitat restoration due to the proposed action.

To avoid and minimize impacts to EFH NMFS recommended:

1. Implementation of all terms and conditions as presented in the ESA portion of this document.

2. NMFS noted that the effectiveness of stream restoration actions is not well documented, partly because decisions about which restoration actions deserve support do not always address the underlying processes that led to habitat loss. NMFS recommended that USACE encourage applicants to use species' recovery plans to help ensure that their actions will address those underlying processes that limit fish recovery.

3. NMFS expects that fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.3 above, approximately 30 acres of designated EFH for Pacific coast salmon.

3.4 IN WATER WORK WINDOW

The Work Window. To minimize effects to juvenile salmonids, construction shall be limited to the appropriate in-water work window (Tryon Creek- July 15 to September 30, Mainstem Willamette- July 1 to October 31, Columbia Slough- June 15 to September 15).

3.5 WATER QUALITY

The Criterial for compliance with Water Quality protection will be based on: Sections 401, 402 and 404 of the Clean Water Act CWA as well as Special Conditions Identified in the NMFS BiOp WCR-2014-633. When there is a difference between CWA and BiOp requirements the more stringent requirement will apply.

3.5.1 Biological Opinion Special Conditions relating to Water Quality

The proposed action will have impacts to water quality. To avoid, reduce and minimize the impacts the Specifications will address:

Turbidity- Maximum turbidity will be either the maximum sediment load as specified in the final WQC or per the Special Conditions of the NMFS BiOp, with the more stringent of the two being applied.

Stormwater Runoff - Runoff from ground disturbance will be avoided through the use of Best Management Practices (BMPs) as identified the National Pollution Discharge Elimination System Permit (see Section 3.5.3 of this Document) . The Specifications will require the Contractor to submit these BMPs for review and follow any additional requirements identified by USACE. Stormwater protection systems such as silt fencing, bioswales and settling ponds will be monitored and maintained until site restoration is complete and plants sufficiently mature to prevent soil erosion.

Hazardous Materials - Specifications will require Contractor to limit on site Hazardous Materials to the extent possible. Contractor will be required to store all chemicals in accordance with Federal and state laws and provide containment to avoid discharge. In the event of any discharge the Contractor will be required to contain and clean up spill and inform USACE as soon as it is safe to do so. In the event of a reportable spill The Contractor will be required to perform all notifications required by law and regulation.

In the event of hazardous materials being identified on site the Contractor is to cease operations that could allow material to enter waterway and inform USACE as soon as it is safe to do so. No existing hazardous material are known of on site at this time.

3.5.2 Clean Water Act Section 401

Under Section 401 of the Clean Water Act (CWA), a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into waters of the United States unless a Section 401 water quality certification (WQC) is issued, or certification is waived. In this location the WQC issuing agency is the Oregon Department of Environmental Quality (ODEQ). The project is anticipated to fall under the Nationwide Permit (NWP) 27: Aquatic Habitat Restoration.

USACE will begin the CWA 401 CWA NWP 27 application at the 60% Plans and Specifications phase of design. This will include completion of a Memorandum of Land Use Compatibility (LUCs) for the Counties where the Proposed Action is to occur.

The WQC will be included in entirety in the final Specifications and compliance with the WQC will be a Contract requirement. All required monitoring and reporting will be completed by the Contractor and reports will be submitted daily to USACE during construction.

3.5.3 Clean Water Act Section 402/ NPDES Permit

For any construction activity, materials or equipment staging and stockpiling that will disturb 5 or more acres of land are required to obtain a National Pollution Discharge Elimination System (NPDES) Permit. This will be obtained by the Contractor before performing any ground disturbing work. This requirement will be in final Specifications.

3.5.4 Clean Water Act Section 404

USACE does not self-permit Section 404 for the placement of dredged or fill materials to waters of the United States. USACE will perform an evaluation to ensure that the proposed action is in compliance with Section 404 of the Clean Water Act. Evaluation will begin at the 60% Plans and Specifications phase of the design process.

3.6 POST-CONSTRUCTION EVALUATION

Plans and Specifications will include site restoration replanting of disturbed areas. Restoration is an essential aspect of meeting the goals of the action. Plans will show final grades and slopes of disturbed areas and planting schedule of sufficient specificity to ensure adequate regrowth. Contractor will be required to perform plantings in accordance with guidelines established by the Design Botanist. The Contractor will be required to irrigate plants through the first summer after planting and guarantee all plants for one year. USACE and Contractor will perform inspection 9 months after plants and any diseased or dead plants will be replaced at no additional cost to the Government.

During this time the Contractor will monitor and repair stormwater runoff control systems needed to prevent sediment from entering the water way. In the event of failure of these systems the Contractor will inform USACE and repair or replace the systems at no additional cost to the Government.

SECTION 4 - HYDROLOGIC AND HYDRAULIC DESIGN

This section describes the hydrologic and hydraulic (H&H) design considerations and criteria used for the design of the Tryon Creek Culvert Replacement project. The purpose of this section is to support the PDT effort by providing basis of design flows (hydrology), return frequency flow rates, and estimates for river relevant hydraulic parameters such as water stage and flow velocities. The H&H design will also provide estimates of Tryon Creek hydraulics (i.e., via the “stream simulation” method) in the vicinity of the cross culvert replacement. The H&H analyses will also confirm that there are no transferred risks downstream and that project will not create an adverse impact to the FEMA Special Flood Hazard Area (SFHA), Zone A. Per FEMA, “A Zones are flood hazard areas where the specific elevations of 100-year flood events, or Base Flood Elevations (BFEs), have not been studied and mapped.”

4.1 DESIGN REFERENCES

NOAA Fisheries. 2023. Anadromous Salmonid Passage Facility Design Manual. https://www.fisheries.noaa.gov/resource/document/anadromous-salmonid-passage-facility-design-manual.

NOAA Fisheries. 2022. NOAA Fisheries Guidelines for Salmonid Stream Crossings in WA, OR and ID. https://media.fisheries.noaa.gov/2022-06/guidelines-salmonid-passage-stream-crossings-2022.pdf.

Oregon Department of Fish and Wildlife. (no date). ODFW Fish Passage. https://dfw.state.or.us/fish/passage/index.asp.

USFWS. 2019. Fish Passage Engineering Design Criteria. Hadley, Massachusetts: USFWS, Northeast Region R5.

USACE. 2024. Hydrologic Engineering Center. HEC-RAS River Analysis System User’s Manual, for Version 6.5. https://www.hec.usace.army.mil/confluence/rasdocs/rasum/latest.

4.2 DESIGN ASSUMPTIONS

- The intent of this project is to replace the existing 8-foot-by-8-foot concrete box culvert under OR 43 and the PNWR rail line with a fish-passable (bottomless arch) culvert.

- The PDT researched Pacific Northwest precast suppliers starting with vendors on the WSDOT and ODOT Qualified Products Lists (QPL). Their research has identified two regionally based vendors that are able to meet the requirements for this project: Oldcastle in Portland and Contech Engineering Solutions. Their proposed products specifications are attached. Oldcastle recommended their FC40 WSDOT arched culvert system. Contech recommended their BEBO C-series precast arch system. Key culvert replacement criteria provided to the vendor included the following:

    - Minimum 32.3 feet wide and 12 feet high

  - Open bottom with 40 feet of overburden loading

- All road/stream crossing structures shall adhere to the most recent version of National Marine Fisheries Service (NMFS) fish passage criteria, (e.g., “NOAA Fisheries Guidelines for Salmonid Crossings in WA, OR, and ID – 2022”), which are as follows:

  - The Stream Simulation Design method (Forest Service Stream-Simulation Working Group 2008; Barnard et al. 2013) is intended to mimic the natural stream processes through a stream crossing and produce a design where fish passage, sediment transport, and flood and debris conveyance function as they would in a natural channel. Determining high and low fish passage design flows, water velocity, and water depth are not required for Stream Simulation. The specific criteria include the following:

    - This method requires additional information on hydrology and geomorphology (e.g., the topography of the stream channel).

    - The minimum crossing span should be 1.5 times the bankfull width. For design and analysis purposes, bankfull is taken to be synonymous with active channel width.

    - When a culvert is used, the culvert slope should approximate the slope of the stream through the reach in which it is being placed.

    - The minimum vertical clearance between the crossing bed and the culvert or bridge deck soffit elevation should be no less than 6 feet to allow access for debris removal.

    - Inverts, abutments, footings, and other foundation types should be designed for the total anticipated scour depth. The minimum embedment depth of inverts, footings, and abutments should be 3 feet. Pipe inverts (inlet and outlet) should be buried into the streambed not less than 30% and not more than 50% of the culvert height.

    - Fill materials should be composed of materials of similar size composition to natural bed materials that form the natural stream channels adjacent to the road crossing.

    - The designer should demonstrate to NMFS that the streambed of the crossing will be stable over time. This can be accomplished by assessing hydraulic conditions through the passage corridor over the range of fish passage design flow and whether enough bed material will be transported through the crossing to maintain the integrity of the streambed over time. NMFS may agree that incorporating large fill material into the design would maintain grade and provide resting areas for migratory fish.

    - Maintain the scour prism as a clear, unobstructed opening (i.e., free of embankment fill, bed retention sills, scour countermeasure, and structural material). The horizontal dimension of the scour prism is defined as 1.5 times the bankfull width, and the vertical dimension is defined as the total scour depth elevation or the criteria embedment depth, whichever is greater. Embedment depth criteria are listed below.

Additional crossing criteria from “NOAA Fisheries Guidelines for Salmonid Crossings in WA, OR, and ID – 2022” include the following:

- Stream crossing structures should be oriented to eliminate skew relative to the adjacent stream channel. Structures should be aligned to eliminate abrupt changes in flow direction upstream or downstream of the crossing.

- Aligning the crossing structure so there are no abrupt changes in flow direction.

- Excessively elongating the culvert should be weighed against a better crossing alignment and modifying transition sections upstream and downstream of the crossing. Excessive culvert length can also increase the risk of debris accumulation and plugging.

- When the culvert length-to-span ratio is greater than 10, a bridge should be selected (Barnard et al. 2013). Note: This is not a feasible design criterion for this project.

- Relative risk of culvert failure due to plugging is commonly assessed in the context of large wood. A deterministic presence or absence of large wood is the most frequent method of assessing this failure.

- All culverts should be designed to withstand the 100-year-recurrence peak flood flow without failure of the crossing. Stream crossings located in areas where there is significant risk of plugging by flood-borne debris should be designed to pass the 100-year peak flood with a minimum of 1 foot of freeboard (Barnard et al. 2013).

- A number of culvert design manuals originating in the Pacific Northwest recommend culverts be designed to pass the 100-year flood (Barnard et al. 2013) (Love and Bates 2009) (Cafferata et al. 2017). This capacity should help reduce the risk of crossing failure during flood flows.

- Bed width will be greater than bankfull channel width and of sufficient vertical clearance to allow ease of maintenance activities.

- Span is determined by the crossing width at the proposed streambed grade. Single span structures will maintain a clear, unobstructed opening above the general scour elevation that is at least as wide as 1.5 times the active channel width.

  - Vertical clearance between the culvert bed and ceiling will be more than 6 feet to allow for debris removal.
  - Slope will be equal to the slope of, and at elevations continuous with, the surrounding long-channel streambed profile. Culvert will be open-bottomed so footings will be keyed into the underlying bedrock.
  - Culvert will be more than 150 feet long, but a bridge is not possible at this location due project authorization limits.
  - Fill materials will match native substrate. Average water depth and velocities will simulate those in the surrounding stream channel.
  - Designs shall maintain the general scour prism as a clear, unobstructed opening (i.e., free of any fill, embankment, scour countermeasure, or structural material to include abutments, footings, and culvert inverts). No scour or stream stability countermeasure may be applied above the general scour elevation.
  - All culvert footings and inverts shall be placed below the thalweg at a depth of 3 feet, or the Lower Vertical Adjustment Potential (LVAP) line, whichever is deeper. LVAP shall be as calculated in Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road Crossings (USDA-Forest Service 2008).
  - In addition to embedment depth, embedment of closed bottom culverts shall be between 30% and 50% of the culvert rise.
  - NMFS fish passage review and approval. NMFS will review crossing structure designs if the span width is determined to be less than the criteria established above or if the design is inconsistent with criteria in Anadromous Salmonid Passage Facility Design (NMFS 2011c).

- IWW for Tryon Creek is July 15 to September 30.

- Work above the ordinary highwater of Tryon Creek may be completed outside the IWW. However, ground disturbance in the flood zone upstream will need to account for potential inundation in the winter months as storm flows can cause rapid shifts in flow and bank level.

- Design stream flows for Tryon Creek during the IWW is 10 cfs. This represents a low probability of exceedance given that the median summer discharge is only 1 cfs.

- Culvert bottom span of at least 30 feet. This width meets all the stream criteria developed in the feasibility study. Span may be increased if it optimizes foundation design (e.g., footings placed at similar elevation or all on bedrock). The minimum depth below stream grade for footings is 3 feet or scour depth, which in our case is bedrock.

- Bankfull elevation at the upstream end of the culvert was previously determined to be 47.2 feet (NAVD88) and the active channel width previously established as 20.2 feet (Source: Feasibility Study, Appendix B: Hydrology and Hydraulics Technical Memo). These values may be updated as the project progresses.

- Assume sewer lines will be “re-located by others” outside of the temporary shoring area including all design there-in. The feasibility study assumed a horizontal directional drilling operation. In this case, “others” is assumed to be the City of Portland.

- Care and diversion of Tryon Creek. Design assuming cofferdam upstream/downstream with gravity discharge piping. Develop some drawing details of the cofferdam, conduit slope, and length. USACE will perform hydraulic calculations for conduit size.

- The Tryon Creek Culvert Replacement project is designed specifically for NMFS-jurisdictional species, and NMFS will be actively involved in the design and implementation of measures as required under NMFS Biological Opinion (NMFS 2013).

- Hollow pipes will be capped to prevent trapping small birds and mammals.

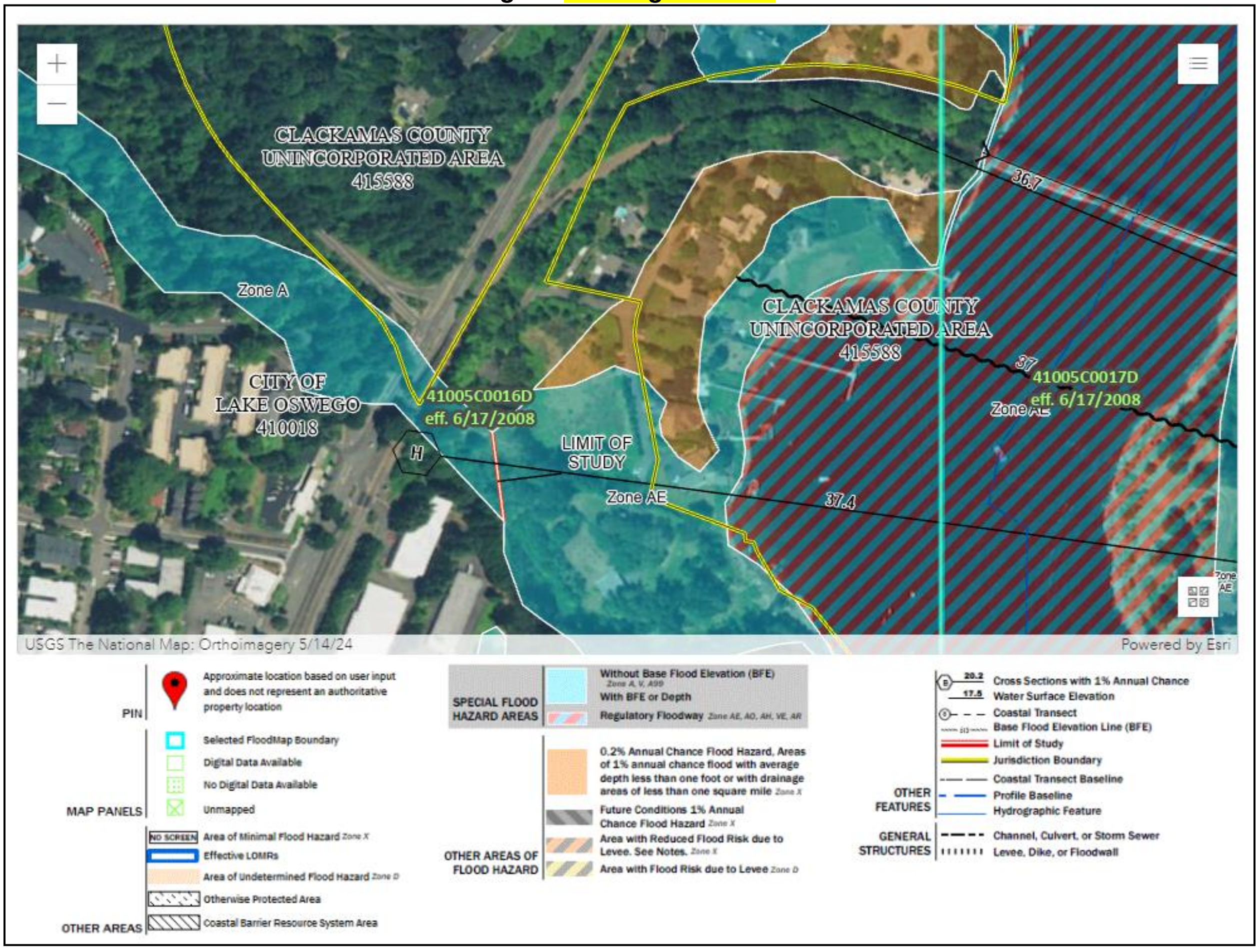
4.3 FEMA FLOODPLAIN

Per Executive Order (EO) 11988, all federal agencies shall adhere to the National Flood Insurance Program. Per the EO, “Each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget request reflect consideration of flood hazards and floodplain management; and to prescribe procedures to implement the policies and requirements of this Order.”

The impact area for the Tryon Creek Highway 43 culvert replacement project is located within a FEMA Flood Zone A. Zone A is defined as, “Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones” (https://www.fema.gov/glossary/zona).

There are no BFEs associated with this SFHA. To date, no FEMA base flows (e.g.,1% and 0.2% annual exceedance probability [AEP]) have been identified for this reach.

Figure X-X. Figure Title.



Note: Sourced from FEMA: FIRM 41005C0016D.

The potential impacts to the floodplain will be determined via HEC-RAS analyses. The analyses will consist of simulating two HEC-RAS plans: one with current conditions assumptions and the second with proposed alterations modeled. The resultant water surface profiles will be compared to assess potential increase or decrease in water surface elevations and/or velocity or shear stresses that may adversely impact upstream or downstream portions of the project affected Tryon Creek.

4.4 DESIGN FLOWS

At 30% DDR, the best available frequency-runoff peak flow estimates are those provided by the City of Portland. The derivation of the City of Portland flows is documented in the Memorandum titled, “Hydrologic Modeling of the Tryon Creek Watershed” (June 30, 2016). The City of Portland peak flows are summarized in the table below.

Table X-X. Modeled Peak Flows for Selected Design Storm Events.

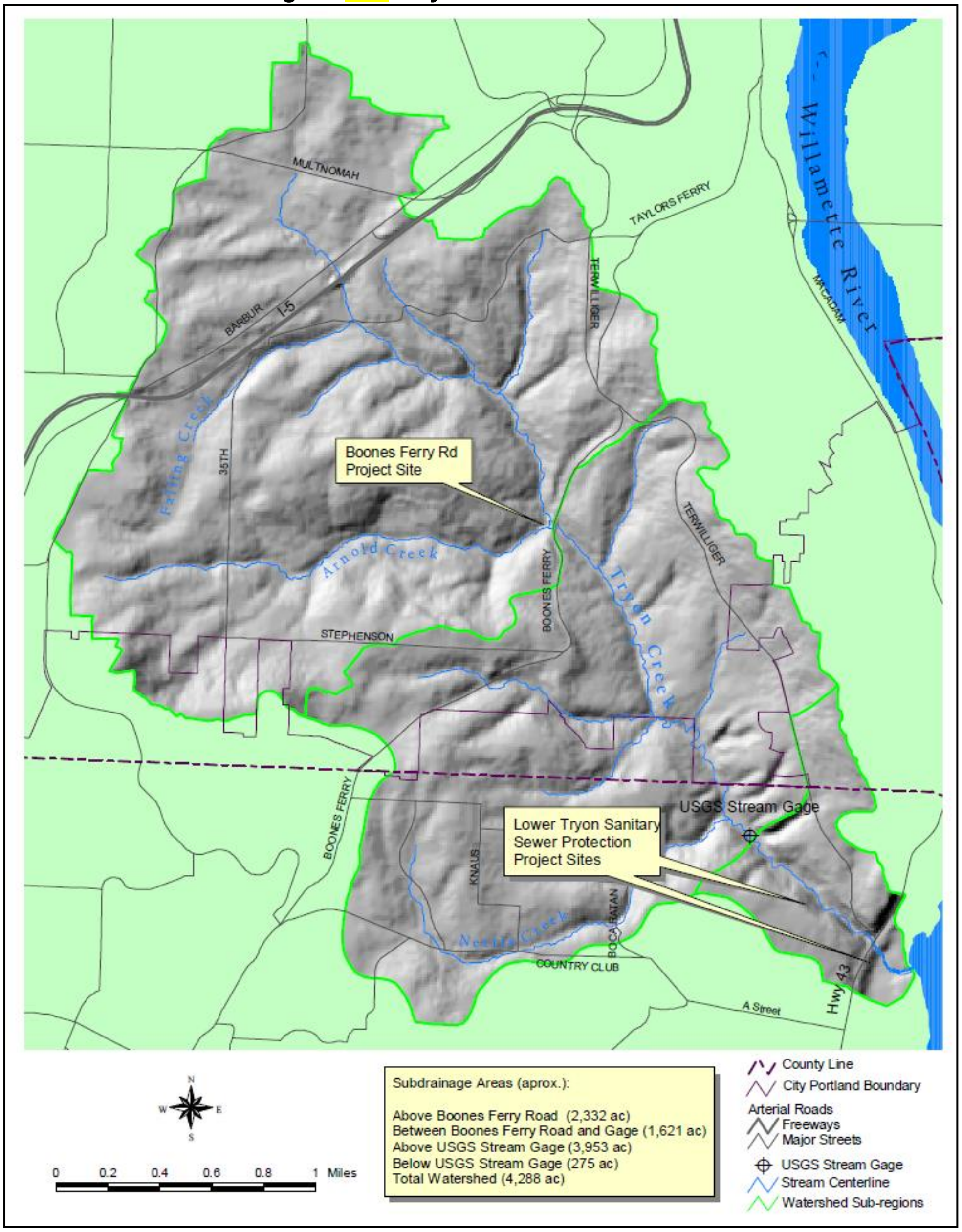
Return Period (years)	Peak Flow, Tryon Cr at Lake Oswego (below Nettle)
2	316
5	485
10	659
25	860
100	1081

Note: Sourced from City of Portland Memorandum dated June 30, 2016.

Tryon Creek below Nettle Creek is situated upstream of the OR 43 crossing (Figure X-X). These frequency flows are likely to be adjusted to reflect additional drainage area contributing to the OR 43 crossing. A simple area ratio factor is the preferred adjustment method for design and flood risk assessment purposes.

As of 30% DDR, no FEMA base flows (e.g., 1 and 0.2% AEP) have been identified for this reach.

Figure X-X. Tryon Creek Watershed.



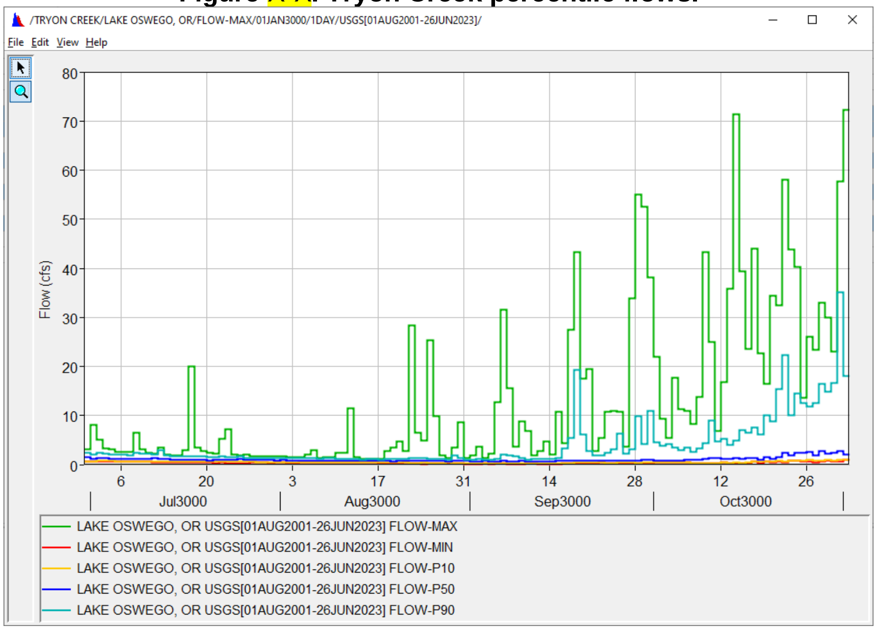
Note: Sourced from City of Portland Memorandum dated June 30, 2016.

During the DDR scope-of-work period, NWP provided preliminary streamflows for Tryon Creek (Figure X-X). The IWW flow was given as 10 cfs. This represents a low probability of exceedance given the median summer discharge is only 1 cfs.

Tryon Creek drainage can experience a wide range of peak flows. They may also occur over a short period of time. The steep channel gradients (over 20%) in the upper reach, extending through the culvert itself, can translate to very high peak flows. The dry summer conditions can result in flows as low as 1 cfs or less.

The project is expected to take more than 1 season (year) to complete. Therefore, any temporary diversion works will need to address the full range of flows likely to occur over a typical water year. Diversion will need to account for downstream passage of listed species during restriction. Volitional passage may be requird unless an exception is granted.

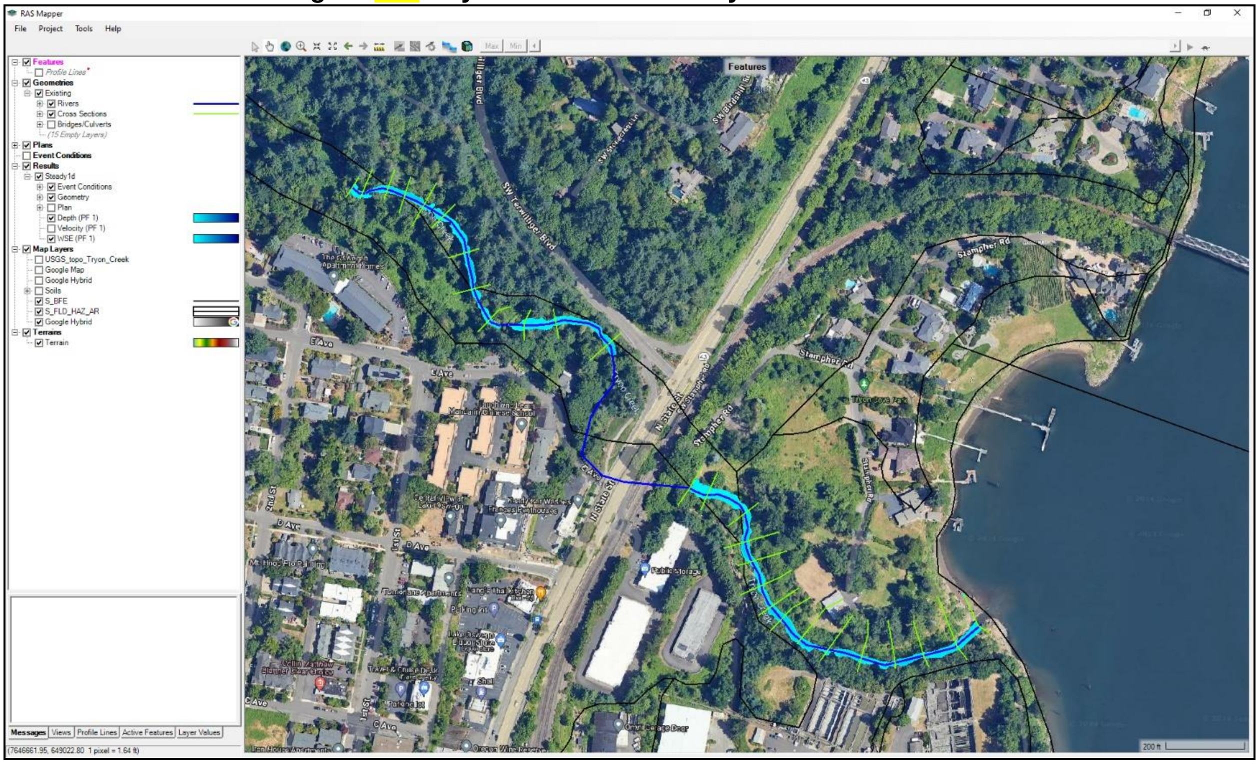
Figure X-X. Tryon Creek percentile flows.



4.5 HYDRAULIC ANALYSES

As of the 30% DDR, no hydraulic model analyses have been carried out. A preliminary HEC-RAS model has been set up (Figure X-X). As the culvert replacement design progresses, the PDT shall prepare stream simulation analyses and a floodplain impact assessment. Both analyses will be performed with HEC-RAS 6.5. To meet PDT design needs, preliminary HEC-RAS analyses will be performed in 1-D steady-state modes. However, the modeling may be expanded in scope to address other DDR requirements.

Figure X-X. Tryon Creek Preliminary HEC-RAS model.

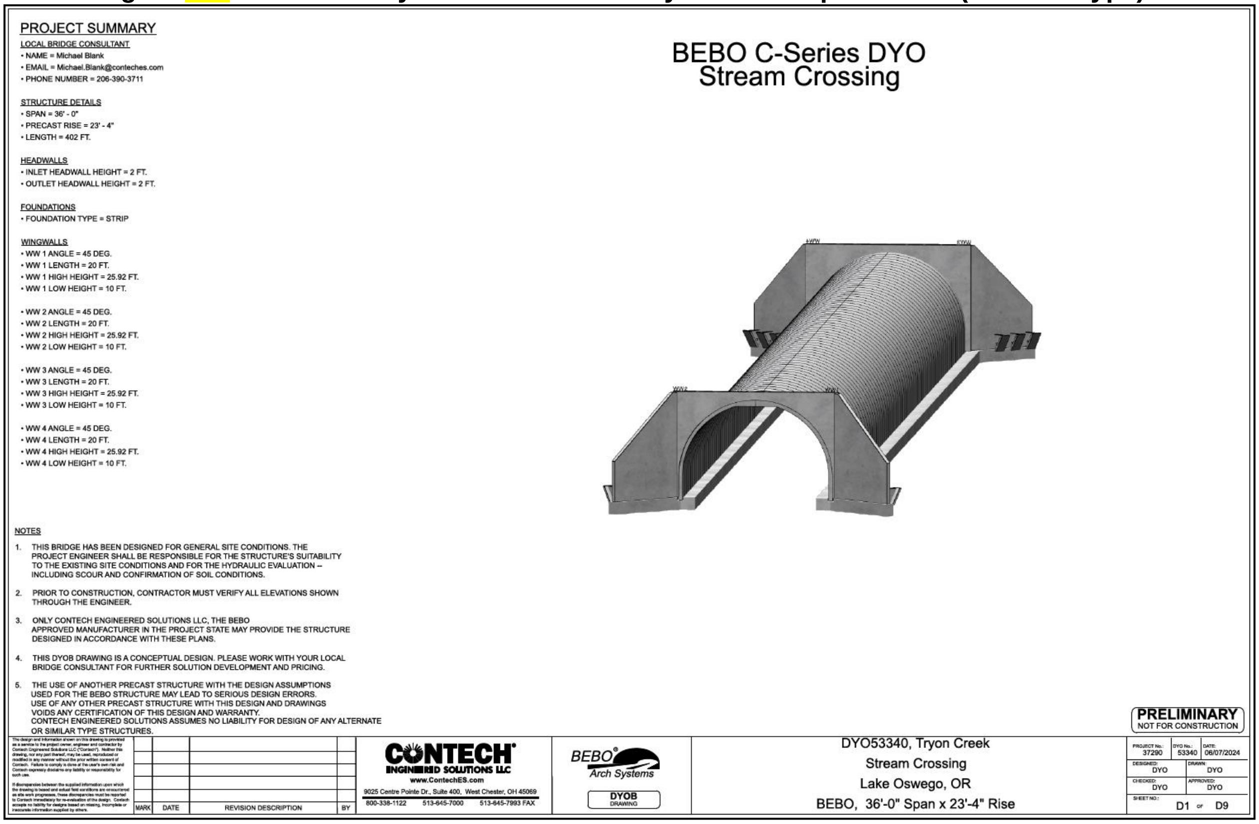


The “Lower Willamette River Environmental Dredging and Ecosystem Restoration” report, Volume 2, Appendix B, page 17, states the following:

> The State of Oregon fish passage criteria used to guide the culvert sizing and hydraulic analysis requires that the culvert be wide enough to accommodate the active channel width which according to OAR (2013a) can be defined as the stream width between the channel bankfull elevations. The existing conditions model was used to estimate upstream hydraulic conditions for the 2-year discharge corresponding to an approximate the bankfull elevation (OAR 2013b) of 47.2 feet NAVD88. Using the estimated bankfull elevation an active channel width of 20.2 feet was determined.

As of the 30% DDR, PDT has decided to accept the active channel estimate of 20.2 feet, as previously determined. Based on NOAA-NMFS criteria, the culvert replacement opening shall be a minimum of 1.5 x 20.2 = 30.3 feet wide. It is likely that an additional 2 feet of bottom width will be added to accommodate a low flow channel. This width may be adjusted (expanded) as the design progresses. The current culvert section configuration is illustrated in Figure X-X, below.

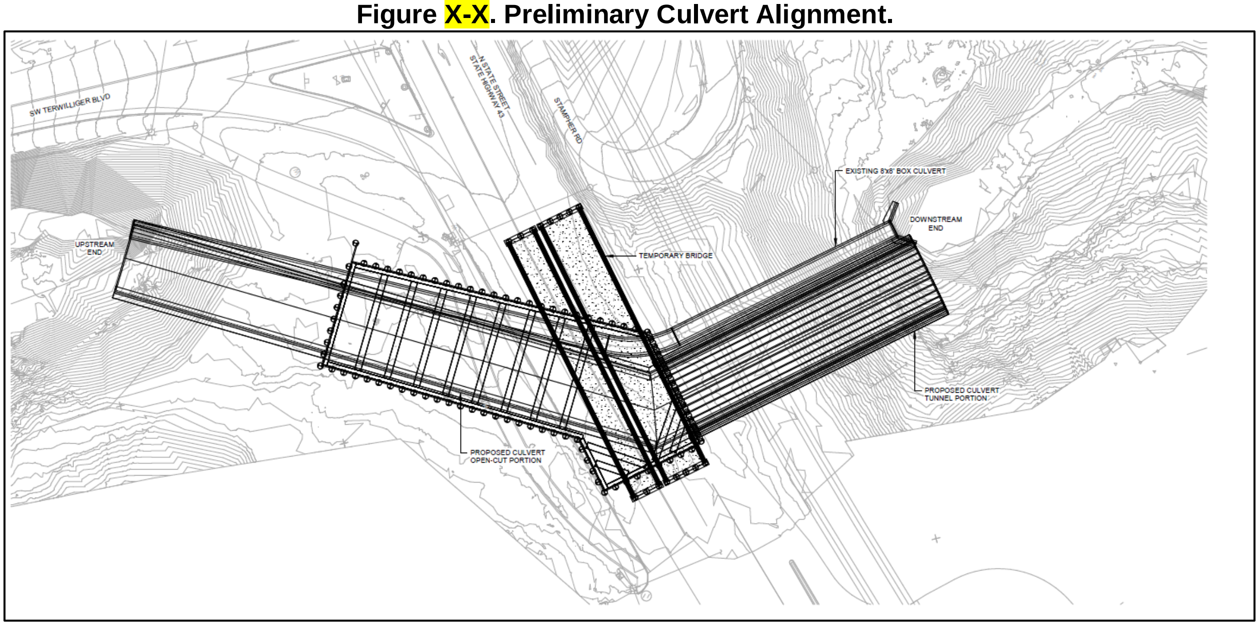
Figure X-X. 30% DDR Tryon Creek Preliminary Culvert Replacement (Contech type).



Note: Sourced from July 8, 2024, email from Mark Havekost, PE, DELVE, Principal Engineer **|** Northwest Regional Manager).

The 30% DDR, preliminary alignment is illustrated as Figure X-X, below.

Figure X-X. Preliminary Culvert Alignment.



Note: Preliminary concept developed for 30% DDR by PDT.

SECTION 5 - GEOTECHNICAL DESIGN

5.1 INTRODUCTION

5.1.1 General

The design and construction of the proposed replacement culvert are complex and involve significant geotechnical engineering challenges. The primary geotechnical considerations for this project include the following:

- Highway 43, railroad, and local resident access will need to be maintained throughout all phases of construction.

- The currently available geotechnical information for the project site has significant data gaps that could result in future design changes, conservative assumptions from potential bidders, and/or differing site condition claims during construction. Additional explorations are recommended to reduce risk and better characterize the subsurface conditions, including better characterizing soil layers, estimating bedrock locations, and identifying potential obstructions.

- The existing highway and railroad embankments consist of variable undocumented fill, including gravel, sand, silt, clay, cobbles, boulders, debris (wood, concrete, brick), buried wood bridge trestles, and buried concrete bridge foundations (Shannon & Wilson, 2024). The currently available subsurface information for these embankments is limited and additional obstructions or soil variability may be present. The extent of the fill that is not considered “clean fill” and/or is contaminated to the extent that it requires special handling or significant additional disposal costs is not currently characterized. The contract specifications will require the Contractor to develop and submit a plan to monitor, identify and report hazardous material encountered during construction. The Contractor NPDES permit will identify this and develop Best Management Practices (BMP’s) to prevent hazardous material from entering waterway.

- Deep foundations and shoring systems for temporary bridge(s) will likely be installed in variable soil conditions that include variable fill with cobbles and boulders, rock, historic trestles, and other obstructions that are not currently characterized.

- Installation of the replacement culvert will likely require significant rock excavation in a sloping, variably weathered, and previously modified rock surface.

- Equipment access to the upstream and downstream ends of the culvert is extremely limited. Temporary access roads will need to be constructed, which will involve steep slopes, forested slopes, in-water work restrictions, obtaining permission to work on public and private property, railroad crossings, traffic control, and maintaining access for nearby residents.

- Tryon Creek will need to be channelized during construction of the new culvert and fish passage regulations will need to be followed. Additional groundwater control will also likely be required.

- Some existing grades are over-steepened and likely do not have commonly accepted factors of safety. Final grades will be required to meet current factor of safety standards from various stakeholders, which may need to be accomplished by constructing new retaining structures or flattening existing slopes.

The following sections of this report summarize the available site historical information, previous geotechnical exploration programs, and subsurface conditions, as well as provide geotechnical seismic design recommendations and culvert design recommendations.

5.1.2 Geotechnical Design Criteria

The geotechnical design criteria will be further evaluated at the 60% DDR submittal after the design charette occurs and additional proposed structure information has been developed.

Geotechnical design of the culvert will follow the ODOT GDM, which references the AASHTO LRFD BDM.

5.1.3 Historical Information

The A-E Team reviewed the following reports, drawings, and documents as part of the geotechnical design effort for this project. Copies of these documents are presented in Appendix J, As-Builts and Historical Information.

- 1919, Oregon State Highway Department, Map & Profile: 12-19' Frame Bents over Tryon Creek at Sta. 301+50 Near Oswego – Clackamas Co. Pacific Highway, Sheet No. 1

- 1919, Oregon State Highway Department, Standard Wooden Trestles, Drawing No. 983

- 1919, Oregon State Highway Department, Standard Framed Trestles, Drawing No. 989

- 1929, Oregon State Highway Commission, Tryon Creek Culvert over Tryon Creek – Clackamas Co. on Pacific Highway, General Drawing (No. 3849)

- 2013, City of Portland Bureau of Environmental Services, E10251 Tryon Creek Trunk Sewer Upgrade Lake Oswego, Oregon. GRI et al. August, 2013

- 2013, Shannon & Wilson, Inc., SW Terwilliger Blvd Sanitary Sewer Extension, B-4 Boring Log

- 2018, Shannon & Wilson, Inc., Tryon Creek Interceptor, Boring Logs and Site Plan
- 2019, Shannon & Wilson, Inc., Tryon Creek Interceptor, Boring Logs and Site Plan
- 2019, Danielle Goodrich and Tryon Creek Watershed Council, Watershed Assessment of Tryon Creek of Oregon

5.1.4 Previous Geotechnical Explorations

Previous geotechnical work for this project was performed by Shannon & Wilson, Inc. (S&W), and documented in a GDR dated March 2024. The GDR is included in this report as Appendix D. The work included a surface reconnaissance of the railroad embankment, drilling of three geotechnical borings, installing groundwater monitoring systems, and performing laboratory testing.

In addition to the borings drilled for the project GDR, S&W also previously drilled nearby borings for other projects in 2013, 2018, and 2019. These other reports were also reviewed for this report preparation. Copies of these nearby boring logs are included in this report as Appendix J.

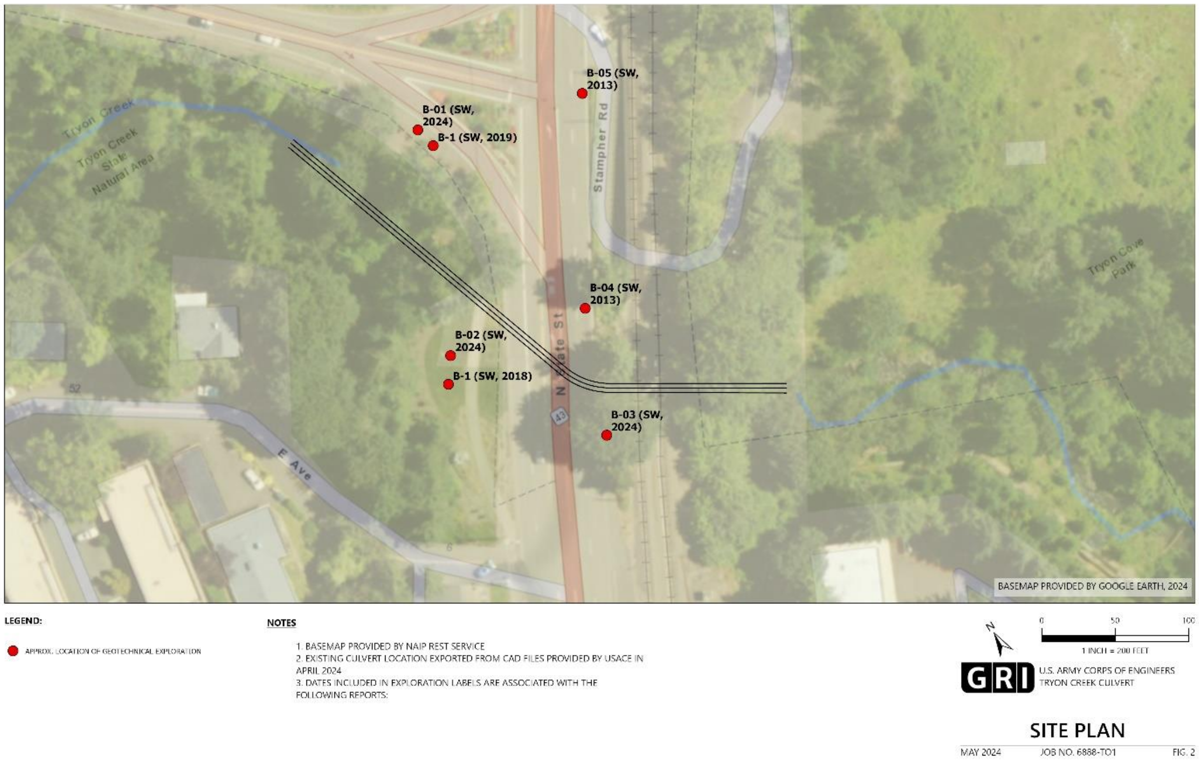
5.2 SUMMARY OF SUBSURFACE CONDITIONS

5.2.1 General

The project site is located northeast of Lake Oswego, Oregon. Regionally, Lake Oswego lies within a structural gap near the southern terminus of the Tualatin Mountains, between the Portland Basin and the Tualatin Basin. The regional geology is characterized by a foundation of ancient Basalt of Waverly Heights and associated sedimentary rocks, overlain by the CRBG basalt flows. Bedrock units in the region are typically overlain by sediments deposited by the Missoula floods and Alluvium generated from local sources. Locally, Beeson and others (1989) map bedrock formations including the Basalt of Ginkgo, Sentinel Bluffs unit of the Grande Ronde Basalt, and the Basalt of Waverly Heights, with overlying deposits from catastrophic floods and alluvial processes. Detailed descriptions of the regional geology, local geology, and specific subsurface units encountered during the geotechnical explorations are provided in the project GDR included in Appendix D.

Geotechnical explorations completed for this project and previous geotechnical explorations from other nearby projects are shown on Figure 5-1.

Figure 5-1. Site Plan of Geotechnical Explorations



Note: Update format for 60%

The following sections of this report summarize the documented geologic units at the project site that are likely to be encountered by construction of the proposed improvements. Descriptions of these units are based on the project GDR, information from other nearby borings, and historical records. If available, soil and rock descriptions terms and symbols associated with the subsurface information are included in Appendix D and Appendix J.

5.2.2 Fill

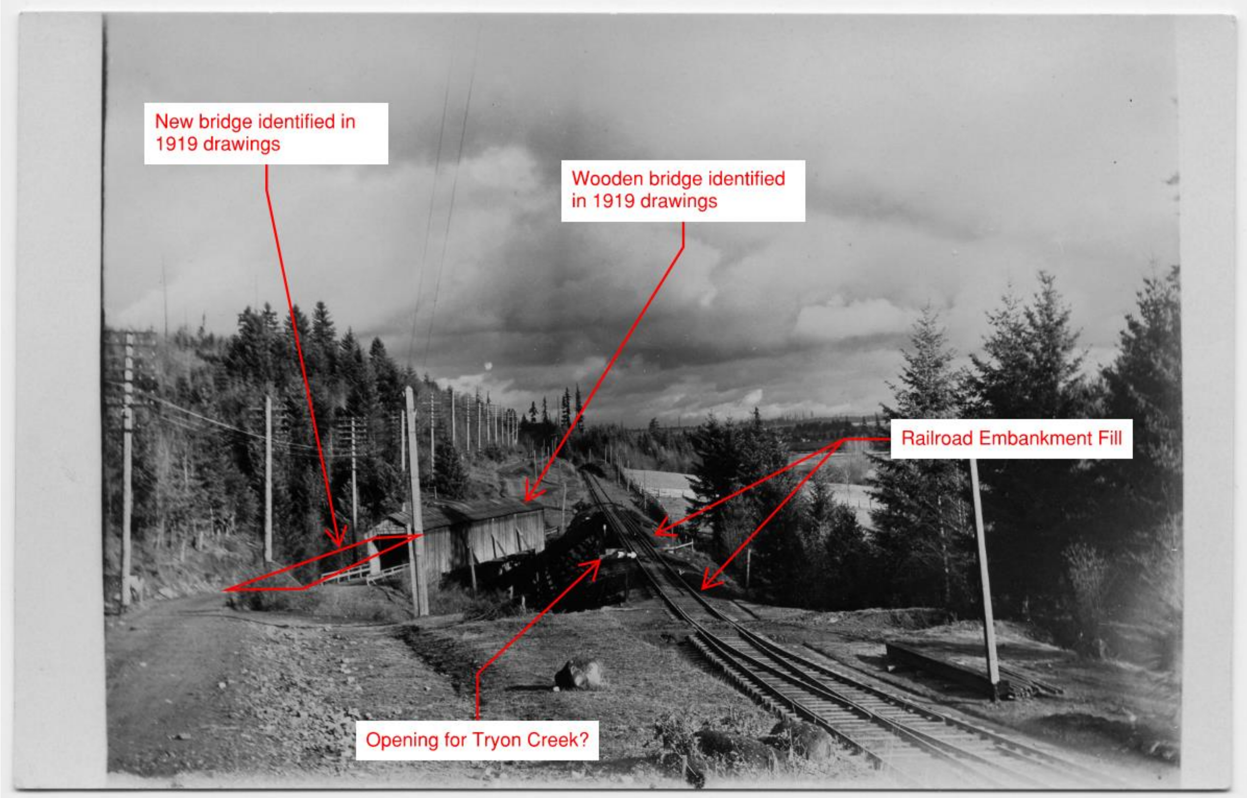
The project site has been highly modified by infrastructure projects and channel modifications dating back to at least the late 1800s. Geotechnical explorations and historical drawings indicate that significant undocumented fill of variable composition is present within the adjacent Highway 43 and railroad embankments. The fill may contain buried remnants of the previous highway and railroad bridge trestles and their foundations, which are described below. The GDR notes that the embankment material primarily consists of a mixture of gravel, sand, silt, and clay, but also notes that cobbles and boulders were commonly encountered during drilling in the embankments. Other materials encountered in the borings include wood debris, brick fragments, asphalt fragments, and concrete debris at various elevations. Borings drilled in the embankments also frequently noted a loss of drilling mud or circulation at various depths, including approximately 1,000 gallons of drilling mud lost in boring B-03 (2024) between depths of 20 feet to 40 feet that communicated through the fill material and into the culvert/creek. The loss of drilling mud and circulation typically indicates the presence of voids, open-graded, coarse-grained soil, or debris.

5.2.2.1 *History of Highway Structures and Embankment Fills*

A 1919 drawing and the historical photograph shown in Figure 5-2 indicate that the earliest documented highway crossing consisted of a covered wooden bridge west of the railroad line. Figure 5-2 appears to show that the covered bridge was supported on trestles. The 1919 drawing for the new proposed highway bridge west of the covered bridge shows a profile view of an 11-bent trestle structure supported on block-style spread footings. The 1929 drawing also indicates a new highway alignment just east of the highway trestle, but no further details are provided. It is not known if the wood trestles from these previous bridges were demolished along with the bridges, or if they were buried in place within the existing embankment fill.

The available information indicates the existing Tryon Creek culvert was installed as part of the new highway alignment project shown in the 1929 plans by the Oregon State Highway Commission. This culvert is shown on the plans to be a reinforced concrete box culvert measuring 8 feet by 8 feet in size and having a slope of 2.50%. Notes on the plans indicate that the bottom of the culvert was anticipated to be installed in solid bedrock. The 1929 drawings were later modified in August 1955 and show that a 100-foot-long culvert extension was to be installed on the upstream side of the existing culvert. The culvert extension segment is shown to be 8 feet by 8 feet in size and to have a slope of 5.93%. The plans show the culvert extension segment was designed for 50 feet of fill.

Figure 5-2. Tryon Creek Wooden Bridge and Railroad Crossing (1903–1919?)



Note: Photograph part of collection taken by William Bickner from 1903 to 1919, exact date of photo unknown. Photograph taken facing north.

5.2.2.2 *History of Railroad Embankment Fill*

A narrow-gauge rail line was constructed over Tryon Creek in 1887 by the Portland and Willamette Valley Railway. The line was later purchased by Southern Pacific Company, which widened the line in 1914 (ref). Based on the 1929 drawing, the original crossing consisted of a 12-bent trestle structure. Figure 5-2 appears to show an embankment on the north and south approaches, with possible openings for Tryon Creek and Stampher Road. The 1929 drawing indicates the existing culvert was constructed between bents 7 and 8. The GDR documents a surface reconnaissance of the embankment, with shallow test holes generally indicating 6 inches to 12 inches of organic soil overlying 3-inch to 4-inch minus crushed rock. Surficial cobbles and boulders more than 3 feet in diameter were observed intermixed in the embankment.

5.2.3 Native Soil and Rock

5.2.3.1 *Native Soil Units*

The only native soil unit described in the GDR is Alluvium encountered in B-02 (2024) from elevation 53.3 feet to 58.2 feet, consisting of very soft lean clay with sand (CL). Boring B-04 (2013) from the SW Terwilliger Blvd Sanitary Sewer Extension project notes Alluvium consisting of silt with sand from elevation 39.1 feet to 49.6 feet, as well as Alluvium consisting of gravel from elevation 32.1 feet to 39.1 feet. Boring B-1 (2018) from the Tryon Creek Interceptor project, advanced at approximately the same location as B-02 (2024), indicates fine-grained Missoula flood deposits consisting of silt with sand (ML) from elevation 51.8 feet to 54.8 feet, followed by coarse-grained Missoula flood deposits consisting of gravel with sand, silt, cobbles, and boulders from elevation 37.8 feet to 51.8 feet. It is noted that the native soil types and elevations discussed in this paragraph vary significantly over short distances, which contributes to the uncertainty regarding the subsurface conditions at the project site. It is also noted that there could be some discrepancies between elevation numbers from different borings and historical drawings, since the vertical datum associated with some of the elevations is not known. Elevations used for this project will generally be based on the NAVD88.

5.2.3.2 *Native Rock Units*

The GDR describes two rock formations that were encountered in the borings at the site: the Sentinel Bluffs Member of the Grande Ronde Basalt and the Basalt of Waverly Heights.

The Sentinel Bluffs Member is a flow that is part of the CRBG. The boring logs separate the Sentinel Bluffs Member into three separate units based on weathering. The Decomposed Sentinel Bluffs Member unit is predominantly decomposed basalt that is described as a soil consisting of silt, sand, and clay with varying amounts of gravel- to boulder-sized rock fragments. The Weathered Sentinel Bluffs Member unit is highly weathered basalt that is described as a soil consisting of sandy lean clay to clayey gravel with varying amounts of clay, sand, and gravel- to boulder-sized rock fragments. The Sentinel Bluffs Member unit consists of moderately weathered to fresh, medium strong to extremely strong (R3 to R6) basalt. In boring B-01 (2024), a 6.5-foot-thick layer of slightly weathered, weak to medium strong (R2 to R3) basalt breccia was encountered.

The boring logs separate the Basalt of Waverly Heights into two separate units based on weathering. The Decomposed Basalt of Waverly Heights unit is predominantly decomposed basalt that is described as a soil consisting of silt and clay, with varying amounts of sand, gravel, cobbles, and boulders. The Basalt of Waverly Heights unit ranges from weathered basalt to basalt. The weathered basalt consists of highly weathered to predominantly decomposed, extremely weak to weak (R0 to R2) basalt that remolds to sandy lean clay (CL) and clayey sand (SC). The basalt consists of moderately weathered, medium strong to strong (R3 to R4) basalt.

5.2.4 Groundwater

Groundwater readings were collected during the exploration program for the project GDR. Boring B-01 (2024) and boring B-02 (2024) each contained two VWPs and dataloggers that automatically measured groundwater levels as well as an open piezometer that allowed for the manual collection of groundwater levels. Boring B-1 (2019) and boring B-04 (2013) also contained piezometers. Boring B-03 (2024), boring B-1 (2018), and boring B-05 (2013) did not contain piezometers and groundwater was not measured during drilling. A summary of the currently available groundwater readings is provided in Table 5-1.

Table 5-1. Summary of Groundwater Readings

Boring ID	Maximum Groundwater Elevation (feet)	Minimum Groundwater Elevation (feet)
B-01 (2024), upper VWP	74.4	67.5
B-01 (2024), lower VWP	71.1	65.0
B-01 (2024), manual reading	74.0	74.0
B-02 (2024), upper VWP	56.7	52.8
B-02 (2024), lower VWP	56.3	54.7
B-02 (2024), manual reading	56.7	56.7
B-03 (2024)	Groundwater not measured	Groundwater not measured
B-1 (2019)	< 52.7[a]	< 52.7[a]
B-1 (2018)	Groundwater not measured	Groundwater not measured
B-04 (2013)	37.0	37.0
B-05 (2013)	Groundwater not measured	Groundwater not measured

Notes:

a) A piezometer was installed in the borehole at this elevation. Piezometer readings indicate the hole was not saturated at this elevation, which indicates that groundwater is deeper.

< = less than

The currently available groundwater data indicates that groundwater elevations are highly variable throughout the project site. For example, B-01 (2024) and B-1 (2019) were drilled adjacent to each other, but encountered very different groundwater levels, as noted in Table 5-1. Interpretation of the variable data indicates that groundwater is flowing down the infilled banks of the historic Tryon Creek channel toward the base of the channel where Tryon Creek and the existing culvert are located. For reference, the west (upstream) end of the culvert is at an elevation of approximately 39.8 feet and the east (downstream) end of the culvert is at an elevation of approximately 24.8 feet. The data indicates that groundwater is frequently located near the interface between alluvial soil and bedrock. Perched groundwater should also be anticipated based on the variable topography, soils, and fill.

USACE has indicated that the VWPs installed in boring B-01 (2024) and boring B-02 (2024) are still operational and data are still being collected. It is recommended that groundwater data from these borings continue to be collected and provided to the design team for review.

5.3 SLOPE STABILITY HAZARDS

The project site consists of three areas with distinct topography: the upstream Tryon Creek channel, the highway and railroad fill area, and the downstream Tryon Creek channel. Each area is described in more detail below.

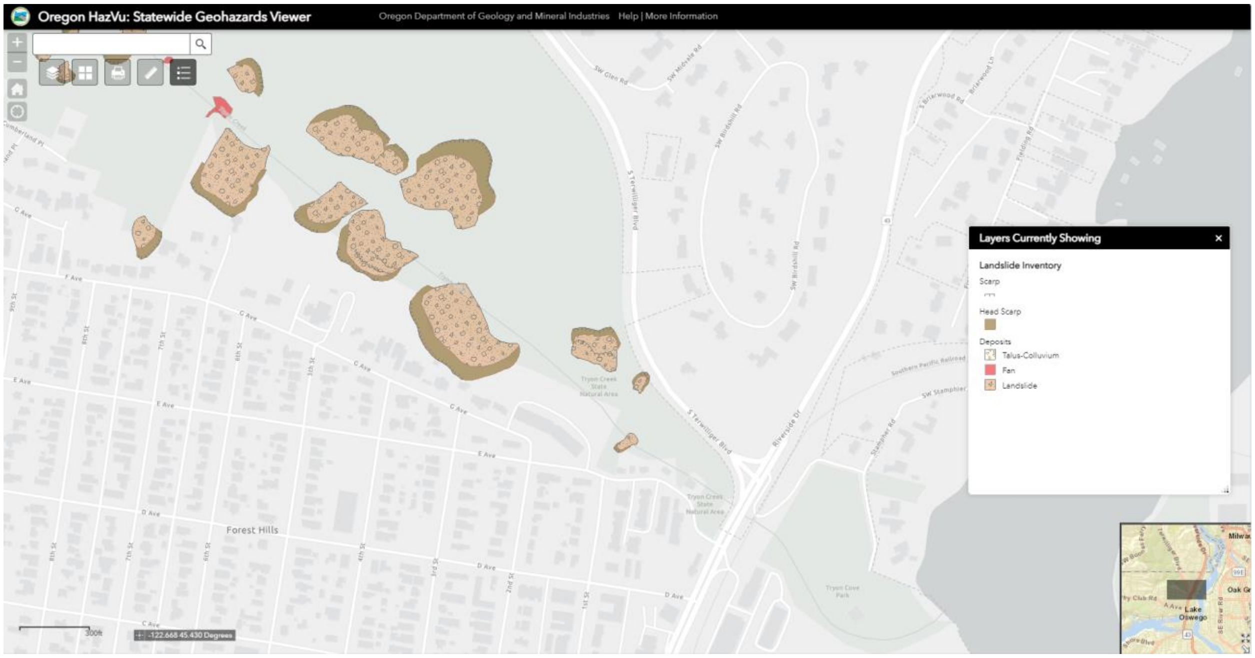
The upstream channel can generally be characterized as a ravine; it has steep sidewalls and a narrow creek channel at the base. Exposed rock is visible on portions of the sidewalls, especially to the north/northeast of the channel.

The fill area is characterized by steep embankment slopes at the upstream and downstream ends of the culvert. The upstream fill slope is about 2H:1V, steepening to 1H:2V just above the culvert inlet. The downstream railroad embankment slope is generally 1.2H:1V. The project GDR discusses the composition of the railroad embankment in further detail.

A plunge pool is located immediately downstream of the culvert outlet and has relatively steep sides, with the north side supported in part by a retaining wall. Further downstream, the topography flattens out, with the steepest areas consisting of the creek banks. USACE (2015) reports that localized bank failures were observed.

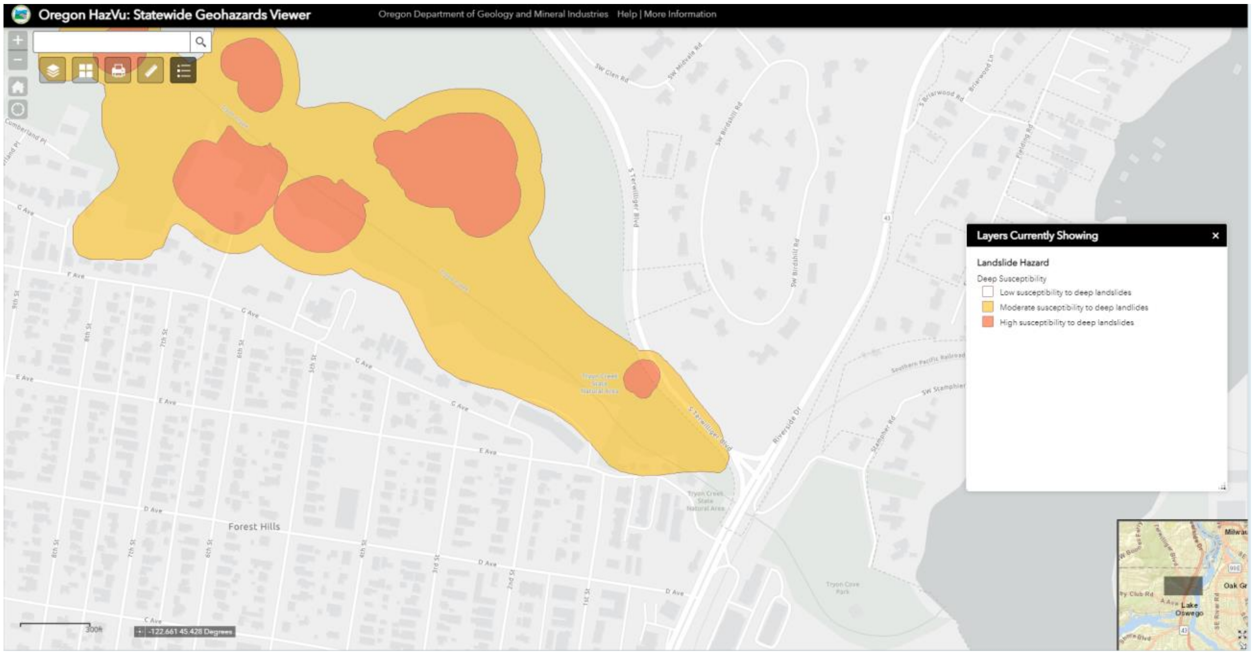
DOGAMI is the state agency responsible for geologic hazard mapping for the State of Oregon and maintains SLIDO (version 4.4), a spatial database of mapped landslides and landslide susceptible terrain (DOGAMI, 2021). Mapped landslides are documented landslides that have previously occurred. Landslide susceptibility maps predict where future landslides may occur and are based on terrain steepness, soil type, and other factors. Numerous landslides are mapped within the Tryon Creek channel upstream of the project site; however, no documented landslides are mapped within the limits of the project site. The project area upstream of the culvert is mapped as having moderate to high deep landslide susceptibility. Excluding the flat portions of the highway and railroad fill, the entire project area is mapped as having moderate to high shallow landslide susceptibility. Figures 5-3, 5-4, and 5-5 show the mapped landslides, deep landslide susceptibility, and shallow landslide susceptibility, respectively, in the vicinity of the project site.

Figure 5-3. SLIDO Mapped Landslides



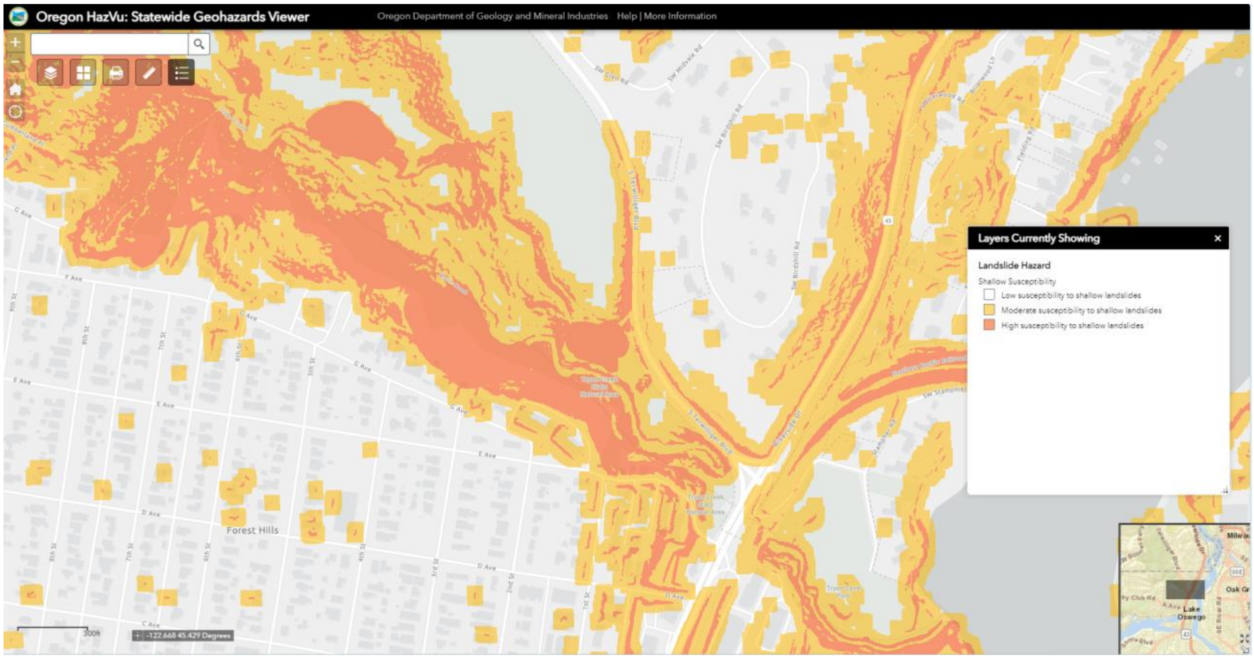
Note: Update format for 60%

Figure 5-4. SLIDO Deep Landslide Susceptibility



Note: Update format for 60%

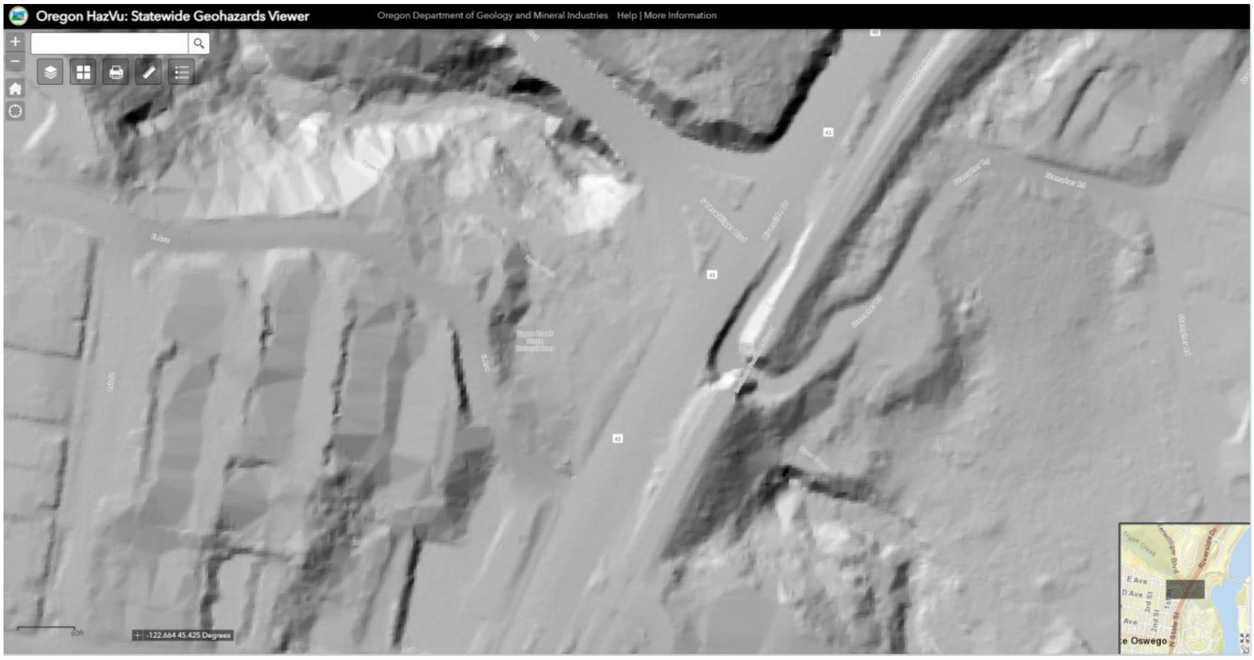
Figure 5-5. SLIDO Shallow Landslide Susceptibility



Note: Update format for 60%

DOGAMI also maintains a bare earth lidar hillshade layer, accessible through SLIDO or other web mapping services (DOGAMI, 2024). Due to the large volume of laser measurements used by lidar systems to map topography, enough measurements can penetrate the surface vegetation to develop a detailed terrain model with the vegetation removed. This is referred to as a “bare earth” model and uncovers many topographic and landslide features that would normally be obscured by vegetation. The bare earth lidar hillshade is shown below in Figure 5-6. Within the project area, numerous steep slopes are visible, especially on the north side of the upstream creek channel and the north side of the plunge pool. No obvious signs of active, unstable slopes were observed from the available lidar data.

Figure 5-6. Bare Earth Lidar Hillshade of Project Vicinity



Note: Update format for 60%

5.4 DATA GAPS

Three geotechnical borings were completed specifically for this project and an additional four geotechnical borings were completed for other nearby projects. Of the four additional borings, two are located adjacent to borings completed for this project and provide minimal additional data.

The limited existing geotechnical data indicate that fill thicknesses, bedrock elevations, and groundwater elevations vary significantly throughout the project area. The data gaps will result in significant uncertainties related to items such as estimates of rock excavation. The data gaps include limited subsurface data for the existing highway embankment and no subsurface data for the railroad embankment, which results in limited understanding of potential obstructions that may be present within the existing embankments, including the amount of debris (wood, concrete, brick, asphalt, or other deleterious material), cobbles, boulders, and whether historic wood trestles are buried within the embankments. Some of the construction methods currently being considered for this project include various methods of anchored shoring and tunneling, which commonly require a more thorough exploration program for owner- and bidder-designed features. For reference, the ODOT geotechnical design manual recommends that, for culverts longer than 100 feet, geotechnical borings should have a maximum spacing of 50 feet and there should be borings at each end, but that the spacing between borings may need to be as short as 20 feet in complex geologic conditions.

Based on the highly variable geology at the project site, the significant earthwork, and the proposed underground construction required for this project, a robust additional geotechnical exploration program is recommended to better understand design and construction risks, reduce construction bid costs, and meet the intent of agency partner design guidance for similar projects.

It is also likely that some of the existing embankment material is contaminated or would not be considered “clean fill.” Where potential excavation and disposal are anticipated for ODOT projects, explorations are typically completed to evaluate contamination and help inform material handling and disposal. In this regard, additional environmental characterization will likely be required as the project progresses.

5.5 SEISMIC DESIGN

5.5.1 Seismic Setting

The site is in a seismically active region that has the potential for a large-scale subduction zone earthquake, as well as smaller intraplate earthquakes and shallow earthquakes on local crustal faults. Subduction of the Juan de Fuca Plate beneath the western margin of the North American Plate presents the potential for large plate-interface earthquakes (magnitude greater than 8). Paleoseismic investigations indicate that plate interface earthquakes have an average recurrence of 500 to 600 years (Atwater and Hemphill-Haley, 1997; Goldfinger et al., 2003) and that the last subduction zone earthquake occurred in the year 1700 (Satake et al., 1996). Moderate intensity and long duration ground shaking would be expected at the site in the event of a large magnitude Cascadia plate-interface earthquake.

Northwest-striking crustal faults have been mapped in bedrock exposures surrounding the Portland Basin and inferred below sedimentary cover (Blakely et al., 2000; Personius, 2002). These faults are related to the compressional, right-lateral tectonics dominating the region around the Portland Basin. The closest mapped fault to the site is the Oatfield fault, which is located approximately 0.37 mile north of the project site (USGS, 2024).

5.5.2 Recommended Seismic Design Parameters

Due to the culvert width and location under OR43, it is anticipated that seismic design will be performed in accordance with ODOT design standards. Construction drawings indicate that the base of the existing culvert and proposed new culvert will be supported on bedrock that is likely site class B, but the culvert excavation will potentially be backfilled with soil structural fill that would be considered site class C or D. For preliminary evaluations, it is recommended that the culvert design be based on site class C parameters to bracket the anticipated soil conditions at the site. It is possible that this site class recommendation could change once additional details about the site geology and the construction methods are known. A summary of the seismic design parameters that should be used for preliminary design of the culvert are presented in Table 5-2. These values were obtained from the ODOT Design Response Spectrum Program spreadsheet for an earthquake with a 1,000-year return period (ODOT, 2024). It should be noted that these seismic design parameters are only recommended for culvert design and may not be appropriate to use when designing other structures for this project. Additional recommendations for other structures will be provided at a later date. ODOT does not require seismic design for temporary bridge structures.

Table 5-2. Preliminary Seismic Design Parameters

Seismic Parameters	1,000-Year Return Period Response Spectra Values
Site class	C
Bedrock PGA	0.2667 g
0.2-second period spectral response acceleration, S_S	0.5842 g
1.0-second period spectral response acceleration, S_1	0.2123 g
PGA site coefficient, F_{PGA}	1.2000
0.2 second period site coefficient, F_a	1.2663
1.0 second period site coefficient, F_v	1.5000
Design ground acceleration, A_S	0.3200 g
0.2-second period design spectral response acceleration, S_{DS}	0.7398 g
1.0-second period design spectral response acceleration, S_{D1}	0.3185 g

5.5.3 Liquefaction/Cyclic Softening

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Hazard mapping does not show a liquefaction hazard at the project site (DOGAMI, 2018). Groundwater appears to be located relatively deeply at the new culvert location, near the base of the historic Tryon Creek channel and at the interface between soil and bedrock. Most of the new culvert is anticipated to be supported on bedrock, which is not susceptible to liquefaction. Drainage will also likely be incorporated into aspects of construction to reduce the risk of perched groundwater contributing to the risk of liquefaction in the existing fill. In addition, all new fill above the culvert will be placed as structural fill, which will be sufficiently dense that it will not liquefy. As a result, it is anticipated that the risk of liquefaction for the proposed project is low.

5.5.4 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. Because the risk of liquefaction at the site is low, it is also anticipated that the risk of lateral spreading is low.

5.5.5 Fault Rupture

There are no active faults mapped as crossing the project site (USGS, 2024). Therefore, it is anticipated that the risk of surface fault rupture beneath the site is low.

5.5.6 Seismically Induced Slope Movements

Earthquake-induced landslides and slope movements generally occur in steeper slopes comprising relatively weak soil deposits. There is currently not enough geotechnical data to accurately evaluate this potential hazard. The project site does contain relatively steep embankment fill slopes, especially near the upstream and downstream ends of the existing culvert. Based on the steepness of the slopes and the relatively poor compaction methods typically used in the early 1900s, it is anticipated that these fill slopes could be susceptible to movement during a design-level earthquake. The preferred alternative for this project is still being defined, and some of these slopes may be removed and rebuilt as part of this project. It is recommended that this hazard be considered during the design phase of the project and that this hazard be further evaluated once the scope of construction has been defined and additional geotechnical borings have been drilled.

5.6 CULVERT GEOTECHNICAL DESIGN RECOMMENDATIONS

5.6.1 General

The following sections of this report provide geotechnical recommendations for replacement culvert foundation support, lateral pressures, water control, structural fill, temporary and permanent slopes, and global slope stability. Additional geotechnical recommendations for other permanent and temporary improvements will be provided in the 60% DDR.

5.6.2 Foundation Support

Based on the information in the project GDR and the existing culvert construction drawings, it appears the base of the new culvert will be supported primarily on intact bedrock. Preliminary concepts indicate that the replacement culvert will be a pre-cast open-bottom structure supported on continuous strip footings. Culvert foundation loads are not currently known; however, based on the planned culvert size and depth, it is anticipated that loading at the foundation level will be approximately 100 kips per foot. Actual design loads will need to be refined later, once more project details are known, such as traffic loading and the thickness of soil cover above the new structures.

It is recommended that the new culvert be supported on spread footings that are underlain by intact bedrock. If native soil or fill is encountered during construction at the footing subgrade elevation, it is recommended that this unsuitable material be over-excavated and replaced with crushed rock structural fill that extends to intact bedrock. If desired, a crushed rock leveling course up to 6 inches thick may be placed beneath the footings. The recommended minimum culvert footing width is 2 feet. Footings supported on intact bedrock should be sized using a preliminary service limit bearing resistance of 20,000 psf.

If used, crushed rock placed beneath footings to backfill over-excavated material or as a leveling course should consist of durable, well-graded, crushed ¾-inch- or 1½-inch-minus rock containing no organic or other deleterious material; should have at least two mechanically fractured faces; and should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T-180 and/or ASTM D1557. The crushed rock should extend at least 6 inches beyond the margins of the footings for every foot of depth.

All footing subgrades should be evaluated by the project geotechnical engineer or their representative to evaluate bearing conditions and whether all loose or soft material, organic material, unsuitable fill, prior topsoil zones, and softened subgrade (if present) have been removed. Localized deepening of footing excavations may be required to penetrate unsuitable material.

The risk of excessive consolidation settlement is low for the bedrock encountered at the planned footing depths; however, total and differential settlement estimates will be further evaluated during the 60% DDR design phase. Post-construction settlement of the ground surface can be reduced by placing approved structural fill over the culvert in accordance with the recommendations provided in the “Structural Fill” section of this report.

Lateral loads can be resisted by friction on the base of the footings and by passive earth pressure on the sides of footings. The frictional resistance at the interface between the base of the footing and the underlying soil is calculated as the normal force times the interface coefficient of friction. The normal force is the sum of the vertical forces (dead load plus real live load). For concrete strip footings or culvert bases supported on granular structural fill or intact bedrock, it is recommended that a coefficient of friction value of 0.5 be assumed. If additional lateral resistance is required, passive earth pressures against embedded footings can be preliminarily estimated on the basis of an equivalent fluid having a unit weight of 350 pcf. The lateral pressure calculated using this recommended equivalent fluid unit weight value should be referenced to the ground surface above the culvert. This design passive earth pressure value includes a factor of safety and assumes up to ½ inch of lateral movement of the structure will occur in order for the soil to develop this resistance. These recommended values are based on the assumptions that the edges of footings are at least 5 feet from the face of any slope and that groundwater remains below the base of the footings. These values should be reevaluated during the 60% DDR design phase as the project is further defined.

5.6.3 Lateral Pressures

Design lateral earth pressures for the embedded culvert will depend on the drainage conditions behind the culvert walls and the ability of the culvert walls to yield. The following two conditions regarding the drainage condition behind the culvert walls are possible:

- Backfill that is fully drained and therefore does not induce hydrostatic forces on the structure
- Backfill that is saturated and may induce hydrostatic forces on the structure.

There are two possible conditions regarding the ability of the culvert walls to yield:

- Laterally restrained walls that are unable to rotate or move horizontally
- Culvert walls that yield by tilting about their base or displacing laterally.

The selection of appropriate lateral earth pressures for design of the culvert will depend on how the culvert is designed.

Based on the assumption that backfill around the culvert will consist of imported granular structural fill, at-rest earth pressures on embedded structures can be evaluated on the basis of a hydrostatic pressure using an equivalent fluid unit weight of 60 pcf for fully drained backfill conditions or 90 pcf for saturated backfill conditions, respectively, for non-yielding walls with horizontal backfill. For yielding walls with horizontal backfill, active earth pressures on embedded walls can be evaluated on the basis of a hydrostatic pressure using an equivalent fluid unit weight of 40 pcf for fully drained backfill conditions or 80 pcf for saturated backfill conditions, respectively. The lateral pressures calculated using these recommended equivalent fluid unit weight values should be referenced to the ground surface above the culvert. The pressure on the roof of the culvert due to the weight of the fill and pavement section may be estimated assuming a bulk unit weight of about 130 pcf. An additional vertical live load of 250 psf should be applied at the ground surface above the culvert to model vehicle traffic. A vertical live load based on Cooper E80 loading should be applied at the ground surface above the culvert to model railroad traffic.

Seismically induced earth pressures will be evaluated during the 60% DDR design phase as more specific information about structure types and backfill is provided. Additionally, recommended lateral earth pressure values for sloping backfill conditions can also be provided in the 60% DDR, if appropriate.

5.6.4 Water Control

The existing Tryon Creek will need to be channelized during construction to allow the water from the creek to flow through the project site. This can be accomplished by allowing the creek water to continue to flow through the existing culvert, by installing a new temporary pipe, or through a combination of these methods. Modifications to these methods may be needed during construction if portions of Tryon Creek are temporarily filled to create additional construction access or staging areas. The use of temporary cofferdams, such as sandbags, supersacks, or earthen berms, may be necessary to help control the flow of water. The appropriate method of water control will depend on actual water levels at the time of construction. All applicable federal, state, and local regulations pertaining to fish passage should be followed during construction, which may include additional mitigation steps if the creek flow is temporarily diverted into a pipe.

Even with the channelization of the existing Tryon Creek, the contractor should assume that perched water and groundwater will be encountered in the excavations for this project and that dewatering will be required to maintain dry excavations and stable sidewalls. Dewatering methods may consist of pumping water from excavation sumps, which should be adequate for most excavations. Water generated during dewatering operations should be treated, if necessary, and pumped to a suitable disposal point. It is recommended that construction of the deepest excavations be scheduled for the driest months of the year, which typically occur in late summer and early fall. As noted previously, it is recommended that additional groundwater data be collected to better estimate groundwater levels throughout the project site.

Depending on the depth of the excavations and groundwater levels at the time of construction, groundwater seepage could also be encountered in the excavations, which could create the potential for unstable trench sidewalls or slopes and instability or softening in the base of the excavations. If unstable excavation sidewalls or slopes are encountered, it may be possible to control these conditions by providing lateral support for the sidewalls or placing a layer of free-draining granular fill against the slopes. Where groundwater seepage occurs and saturates the excavation base material, it is recommended that at least 1 foot of stabilization material be placed at the base of the excavations. The stabilization material should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The material should have a maximum particle size of 6 inches, should have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and should have at least two mechanically fractured faces. The material should be free of organic material and other deleterious material.

Regardless of the method used by the contractor, any proposed dewatering system should be capable of maintaining water levels below or away from the base of the footing excavation to maintain a stable excavation subgrade. It is noted that these recommendations are for guidance only. Dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select the appropriate dewatering system based on their means and methods.

5.6.5 Structural Fill

Structural fill will be required for this project to re-construct the highway and railroad embankments above the replacement culvert. The structural fill used for this project can consist of imported granular material, imported fine-grained material, or existing on-site material that is reused. Considerations associated with the use of each type of fill material are presented in the following paragraphs.

Imported granular material consisting of crushed rock can be used for this project and has the advantages of being able to be compacted to a dense condition relatively easily, is readily available from commercial sources in a range of sizes, and can be installed in dry and wet weather. Crushed rock up to approximately 1.5 inches in size can be compaction tested with a nuclear density gauge and/or a proof roll; larger crushed rock can be evaluated with a proof roll only. It is recommended that ¾-inch-minus or 1-inch-minus crushed rock be used to backfill over-excavated zones beneath footings, as a leveling course, and to backfill the sides of the replacement culvert. Larger granular material up to approximately 12 inches in size can be used to backfill most of the zone above the culvert, if desired, provided the material is well graded so that it can lock together during compaction without leaving voids. At least the upper 4 feet of embankment should consist of ¾-inch-minus or 1-inch-minus crushed rock that is easier to level during grading, is easier to dig through when installing future utilities or other improvements, and will provide strong pavement support. Imported granular material should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is angular, fairly well graded between coarse and fine material, has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, and has at least two fractured faces. All granular material must be durable such that there is no degradation of the material during and after installation as structural fill. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T-180 and/or ASTM D1557.

Imported fine-grained soil such as silt or clay can also be used as structural fill, especially in the zone between the top of the replacement culvert and the base of the pavement base rock. Fine-grained soil could be less expensive than crushed rock, especially if one of the project owners has a source of fine-grained soil they need to dispose of. The main disadvantage of fine-grained soil is that it is highly moisture-sensitive and can only be adequately placed and compacted during dry weather when it can be moisture conditioned. Fine-grained soil is sensitive to small changes in moisture content and may be difficult, if not impossible, to compact adequately during wet weather or when the moisture content is more than a few percentage points above optimum. This material will only be suitable for use as fill during the dry season. Fine-grained soil may require extensive drying if it is used as structural fill. Drying is typically accomplished by spreading out the soil in thin lifts, which is only feasible if there is space available to perform this work. If not properly compacted, fine-grained soil can also become saturated and soft during wet weather. If desired, fine-grained soil can be cement amended to add strength and allow for easier compaction during wet weather. Fine-grained soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by AASHTO T-180 and/or ASTM D1557. Imported granular material should be used for structural fill if the moisture content of available fine-grained soil cannot be reduced.

It may be possible to reuse the existing embankment material, but this option cannot be properly evaluated until additional explorations are performed to better characterize the existing embankment material. If the existing embankment material includes significant amounts of fine-grained soil, it may not be possible to use it during wet weather, as discussed above. If the existing embankment material is a mixture of coarse- and fine-grained soil, it may be difficult to test the material’s compaction during construction due to the soil variability. If the existing embankment material contains significant cobbles, boulders, debris, organics, or other deleterious material, it will be necessary to screen out this material and discard it, which could be time consuming. If the existing embankment material is contaminated, it may need to be disposed of off site. There are also handling considerations associated with reusing on-site material. After the soil is excavated, it will need to be stored and moisture conditioned at the site, which may not be feasible if space is limited.

For this project, it is currently recommended that structural fill consist of imported granular material. This material can be compacted in both dry and wet weather relatively easily, which will save schedule time and result in less uncertainty. Imported granular material can also be imported to the site when it is needed, avoiding the need to store large stockpiles on the constricted site where space is limited. This approach also avoids the hassle and uncertainty of needing to spend time selectively removing cobbles, boulders, debris, organics, and other deleterious material from on-site soil.

Fill placed adjacent to the replacement culvert and directly above the replacement culvert should be compacted in accordance with recommendations provided by the culvert designer, which will likely include the use of hand-operated equipment only and slightly reduced compaction requirements to avoid damaging the new concrete culvert. Embankment structural fill should be placed in accordance with the lift thicknesses and compaction levels recommended above. Structural fill should be placed and compacted using material that is within approximately three percent of the material's optimum moisture content.

Care should be taken to raise the level of the fill equally on both sides of the replacement culvert when backfilling. Where fills are to be placed on existing slopes steeper than about 5H:1V, the area to be filled should be terraced or benched to provide a relatively level surface for fill placement. Structural fill placed on slopes should be overbuilt by approximately 2 feet, then trimmed back to final grade to minimize the risk of having loose soil at the slope surface.

5.6.6 Temporary and Permanent Slopes

Temporary cut or fill soil slopes should not exceed a gradient of 1½H:1V and should not exceed a maximum vertical height of 10 feet unless specifically evaluated for stability. Steeper temporary slopes may be possible where bedrock is exposed, but these should be evaluated on a case-by-case basis. The stability of temporary slopes should be monitored regularly during construction. If slope erosion, raveling, seepage, or other sign of instability is observed, the project geotechnical engineer should be contacted immediately to evaluate the current conditions and provide additional recommendations. If instability is observed, it may be necessary to flatten slopes or install shoring. During periods of heavy rainfall, it may be beneficial to protect slopes from erosion by covering them with plastic. Surface runoff water should be collected and directed away from slopes to prevent water from running down the face of the slope. All excavations should be in accordance with applicable OSHA and state regulations.

Permanent cut or fill soil slopes should not exceed a gradient of 2H:1V and a maximum vertical height of 10 feet unless specifically evaluated for stability. Steeper permanent slopes may be possible where bedrock is exposed, but these should be evaluated on a case-by-case basis. Steeper slopes may also be possible if they are reinforced with geogrid or constructed using cement-amended soil. Roads, hardscapes, and other similar improvements should be set back a minimum of 5 feet from the crest of such slopes. Slopes should be planted with appropriate vegetation to provide protection from erosion as soon as possible after grading. Surface runoff water should be collected and directed away from slopes to prevent water from running down the face of the slope.

5.6.7 Global Slope Stability

Global slope stability evaluations will be performed for this project once a preferred concept is selected, and draft construction grading plans have been developed. The stability evaluations will consider temporary conditions during construction as well as final grades. These evaluations will evaluate both static and seismic conditions, as appropriate. Additional geotechnical borings will likely need to be drilled to facilitate some of these evaluations.

5.7 GEOTECHNICAL RECOMMENDATIONS FOR TEMPORARY EXCAVATIONS AND SHORING

[To be completed for the 60% DDR.]

5.8 GEOTECHNICAL RECOMMENDATIONS FOR CONSTRUCTION

[To be completed for the 60% DDR.]

SECTION 6 - CIVIL DESIGN

[To be completed for the 60% DDR.]

SECTION 7 - ENVIRONMENTAL DESIGN AND COMPLIANCE

[To be completed for the 60% DDR.]

SECTION 8 - STRUCTURAL DESIGN

Preliminary information included below for 30%. To be updated for 60% DDR.

8.1 GENERAL

Buried arch culvert structures and associated headwalls and wingwalls shall be designed and constructed in accordance with the ODOT Bridge Design Manual, which references City of Portland Special Provision (SP) 00595, for guidance. SP 00595, “Reinforced Concrete Box Culverts,” cites AASHTO LRFD Bridge Design Specifications, 9th Edition, as the governing standard.

The buried arch culvert structure shall include seismic design in accordance with the AASHTO LRFD Road Tunnel Design and Construction Guide Specifications. Seismic analyses shall include the loading effects resulting from ground shaking and permanent ground deformations.

All headwall and wingwalls shall meet the seismic design requirements in accordance with the ODOT Bridge Design Manual and AASHTO LRFD Bridge Design Specifications.

8.2 HYDRAULIC DESIGN CRITERIA

No part of the structure should be placed within the Minimum Hydraulic Opening (MHO). An MHO needs to be specified to substantiate the overall size (span/height) of the structure.

Buried arch culvert structures and associated headwalls and wingwalls shall be designed for scour from the design flood in accordance with the ODOT Bridge Design Manual and AASHTO LRFD Bridge Design Specifications unless additional site-specific design criteria are considered.

8.3 GEOTECHNICAL DESIGN CRITERIA

Fill depth is defined as the total backfill and surfacing depth above the top of the buried culvert and total backfill above the top of the culvert when not supporting a roadway.

Structural backfill and/or any existing soil within the shored excavation need friction angle and unit weight. At-rest, lateral earth pressures (or coefficients).

Control the backfill specifications to obtain desirable material properties for specific structural design objectives (i.e., using geogrid reinforcement layers to increase arching effects and reduce vertical loading on culvert).

Foundation (or native subgrade) soil/rock bearing capacities assume resistance factors, φb, are 1.0 for Service, 0.45 for Strength, and 0.90 for Extreme Limit States.

Portal headwalls are designed for at-rest lateral earth pressures (or coefficients).

8.4 SEISMIC DESIGN

Peak seismic ground acceleration coefficients (modified by short-period site factor), As.

Headwalls structurally restrained against movement; therefore, a seismic horizontal acceleration coefficient equal to the full design As.

Seismic racking analyses: Effective Shear Modulus, Gm, and with Poisson’s Ratio, v. 1D racking displacement profile through structure height.

8.5 PRECAST CONCRETE ARCH CULVERT SYSTEMS (TBD)

Potential Pacific Northwest precast concrete arch culvert suppliers were identified, starting with vendors on the WSDOT and ODOT QPL. The research identified two regional vendors with products that can meet the project requirements: Oldcastle in Portland and Contech Engineering Solutions. Oldcastle recommended their FC40 WSDOT arched culvert system. Contech recommended their BEBO C-series precast arch system.

SECTION 9 - CONSTRUCTION AND TEMPORARY WORKS

9.1 GENERAL

Preliminary narrative for discussion

The design and construction approach is developed almost exclusively around the goal of minimizing the impact of the work on the traveling public, railroad, existing utilities, and stakeholders adjacent to each creek, including the residential neighborhood accessed by Stampher Road.

Tryon Creek construction staging and sequencing is the biggest challenge on the project relative to minimizing impacts to the traveling public and the active railroad. This is due to the culvert depth and limited access to the creek channel on both sides of the crossing. The general construction and temporary works approach is considering a pre-cast arch culvert system that would be installed and backfilled using the top-down construction method beneath the roadway. This method uses drilled piles, a temporary pre-cast bridge deck, tie-backs/internal bracing, lagging, and excavation and removal of the existing culvert structure from the west while the roadway is maintained.

For the railroad crossing, the general construction and temporary works approach is considering the installation of a concrete arch structure using the Sequential Excavation Method (SEM) initially supported by a pipe arch canopy, structural steel sets, and shotcrete. An open-cut excavation with temporary shoring is also being considered. The final lining beneath the railroad crossing segment will be either precast or cast-in-place concrete arch units matching the shape used for the roadway crossing segment.

It is anticipated that construction of the roadway crossing segment will close traffic with single-lane nighttime closures to install drilled piles, with 28-foot-wide travel lanes open for 2-way traffic. This will require temporary roadway improvements to the shoulders, but limits impacts to traffic relative to a full closure. Two staggered weekend full closures of the highway may be needed to place temporary bridge structures. Installation of temporary bridges in stages (allowing traffic to remain on part of the highway, only a partial closure) may be technically feasible, but at increased cost. Traffic control expectations will be further addressed as part of future coordination with ODOT. No roadway or railroad closures will be required for the SEM construction beneath the railroad embankment.

[To be updated for the 60% DDR.]

9.2 EXCAVATIONS AND SHORING

[To be completed for the 60% DDR.]

9.3 RAILROADS

[To be completed for the 60% DDR.]

9.4 BRIDGES

[To be completed for the 60% DDR.]

9.5 GRADING

[To be completed for the 60% DDR.]

9.6 STAGING AND ACCESS

[To be completed for the 60% DDR.]

9.7 TRAFFIC CONTROL

[To be completed for the 60% DDR.]

9.8 UTILITY RELOCATION

[To be completed for the 60% DDR.]

9.9 STREAM DIVERSION

[To be completed for the 60% DDR.]

SECTION 10 - CULTURAL RESOURCES

Compliance with all applicable cultural resources laws and regulations will be required before implementing the Tryon Creek Culvert Replacement project. Per Section 106 of the National Historic Preservation Act of 1966 (NHPA) and its implementing regulations 36 CFR 800, any federal undertaking that may directly or indirectly affect historic properties, archaeological sites, historic resources, or significant cultural resources will require consultation with the Oregon State Historic Preservation Office (SHPO), affected Native American Tribes/Tribal Historic Preservation Officers, and other interested parties, as appropriate, prior to commencement of any physical alterations or ground disturbing work activities. All proposed repair, maintenance, alteration, replacement, ground reconfiguration, staging, and associated work activities and locations within the currently existing (or to-be-determined) Tryon Creek Culvert Replacement project replacement area of potential affect (APE) must be evaluated to determine if and how such activities may affect the historic significance of any cultural resources, historic properties, or areas of cultural significance that are or may be located in the immediate vicinity.

Efforts will be made to ensure evaluation and protection of significant cultural and historic resources that may be present within the APE and/or those that may be impacted by any proposed Tryon Creek undertaking plans or redesigns, structural modifications, anticipated ground disturbances, and all associated project work activities (i.e., updated plans and possible APE revisions may be forthcoming in subsequent 60% and 90% DDRs). As appropriate, all design and repair work, locations, potential impact perimeters, and determinations of effect expected to result from planned and/or updated project activities will be consulted per NHPA regulations. The USACE will ensure that concurrence with all work plans and determinations of effect have been achieved prior to project implementation and that necessary cultural/historic resources avoidance or agreed-upon mitigation measures are implemented throughout the course of the project.

The USACE initiated consultation regarding preliminary APE determinations for the five proposed *Lower Willamette River Ecosystem Restoration Study* areas (including initial plans for the Tryon Creek Culvert Replacement project) with SHPO and seven affected Tribes (i.e., Confederated Tribes of the Grand Ronde Community of Oregon, Confederated Tribes of Siletz Indians, Cowlitz Tribe, Confederated Tribes of the Warm Springs Reservation of Oregon, Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe) on April 24, 2015 (Oregon SHPO Case No. 150705). SHPO concurred with the preliminary APE determinations in an official letter dated May 19, 2015. No Tribal comments or concerns were received. The USACE continued consultations regarding the project and effects determinations in official letters dated June 18, 2015. SHPO concurred with the USACE's "no historic properties affected" determination for the proposed undertaking, pursuant to CFR 800.4[d](1), in an official letter dated July 16, 2015. No comments or concerns were received from any of the consulted Tribes during the mandatory 30-day consultation period, pursuant to 36 CFR 800.3(c)(4), which ended on July 19, 2015.
If the proposed Tryon Creek culvert replacement activities, impact perimeters, locations, and associated construction details remain the same as those previously consulted in

2015, the USACE has, therefore, completed NHPA obligations and requirements related to this project and no further Section 106 considerations are required. However, if *any* scope of work changes and/or APE revisions are determined necessary or prudent, the USACE will resume and continue consultations with SHPO and affected Tribes throughout all forthcoming project phases to ensure there will be no adverse effects to historic properties, cultural resources, and areas of substantial cultural interest.

SECTION 11 - SURVEYS – DATA COLLECTION

[To be completed for the 60% DDR.]

SECTION 12 - REAL ESTATE

12.1 GENERAL

The Tryon Creek Highway 43 Culvert site, which is part of the greater Lower Willamette River Ecosystem Restoration study, is authorized by Section 206 of the 1996 WRDA, as amended, also referred to as Section 206 under the Continuing Authorities Program.

Engineer Regulation (ER) 405-1-12, Chapter 12-9 makes clear that fee title is required on lands for (1) fish and wildlife mitigation lands, ecosystem restoration, and other environmental purposes; (2) permanent easements; and (3) temporary easements, including access and work areas required during construction of the project.

It is anticipated that UPRR and ODOT will not accept our existing standard estates language to allow real estate to be taken in fee. Therefore, non-standard estate language will have to be developed and approved by HQ once those lands have been more thoroughly identified and survey and legal descriptions have been created.

12.2 NON-FEDERAL SPONSOR COORDINATION

As sponsor for the project, the City of Portland will be responsible for all real estate acquisitions. The Government, after consultation with the NFS, shall determine the real property interests needed for construction, operation, and maintenance of the project; shall provide the NFS with general written descriptions and maps of the real property interests that the Government determines the NFS must provide for construction, operation, and maintenance of the project; and shall provide the NFS with a written notice to proceed with acquisition. The NFS shall acquire the real property interests and shall provide the Government with authorization for entry thereto in accordance with the Government's schedule for construction of the project.

12.3 UTILITY AND FACILITY RELOCATIONS

ER 405-1-12, Chapter 12-8 states that a functionally equivalent facility be provided to the owner of an existing utility, highway, railroad, or other eligible public facility should the project design require that an existing facility be altered, lowered, raised, or replaced. One of the design objectives is to minimize, if not prevent, service impacts to the railroad tracks. If required for construction, temporary relocation of the tracks would increase real estate requirements for the project.

The City of Portland owns a sewer/storm line main at the Tyron Creek Culvert site. Given the proximity of the sewer/storm line main to the proposed new culvert, it is expected that at least portions of these systems will be impacted by construction. The extent of the impacts will become clearer as design progresses.

Utility companies typically design and estimate the cost of relocations and prepare a design to be reviewed by the NFS. The NFS will be afforded credit for the reasonable and allowable relocation costs toward the NFS's share of LEERD's.

12.4 LAND OWNERS

The City of Portland owns .76 acre of this 2.7-acre site; the Oregon Parks and Recreation Department owns .70 acre of proposed project lands; the City of Lake Oswego owns .11 acre of proposed project lands; the METRO owns .26 acre; .09 acre is privately owned; the State of Oregon owns .67 acre; and the UPRR right-of-way is estimated to be .10 acre.

SECTION 13 - OPERATIONS AND MAINTENANCE

[To be completed for the 60% DDR.]

SECTION 14 - COST AND VALUE

14.1 COST

[To be completed at 60% DDR]

14.2 VALUE ENGINEERING

A Value Engineering (VE) study will be completed following the 60% design. The VE team should consider all aspects of the project and consider alternative methods that can reduce cost and overall risk during construction. Construction of a permanent bridge for this project was discussed during 30% design and although it was determined there could be potential benefits, there are several programmatic limitations that prevent this alternative from being considered. Additionally, a permanent bridg option would likely require relocation of the existing interceptor sewer line which could add significant cost to the project. The VE study should consider the cost and effort required to relocate the sewer line in their alternatives analysis.

SECTION 15 - CONCLUSIONS AND RECOMMENDATIONS

15.1 CONCLUSIONS

[TO BE DEVELOPED AT 60%]

15.2 RECOMMENDATIONS

[TO BE DEVELOPED AT 60%]

SECTION 16 - REFERENCES

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[WILL BE UPDATED AT 60%]

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