# Biological Assessment

# Canyon Creek Fish Ladder
# Dungeness Fish Hatchery

**Clallam County, Washington**

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# 1. INTRODUCTION

The Washington Department of Fish and Wildlife (WDFW), is proposing to construct fish passage facilities on the Canyon Creek diversion dam, which is the source of the Dungeness River Fish Hatchery auxiliary water supply. The water supply dam and intake structure located on Canyon Creek is owned and maintained by WDFW. The dam has blocked fish passage since its original construction, possibly as early as 1903. The original timber dam was replaced with a concrete and timber dam in the early 1970's; however, fish passage facilities were not included in the design. Canyon Creek is the Dungeness River's second largest tributary, 8.2 miles long, with a total sub watershed area of 11.9 square miles (WDF 1975). The 1993 Water Resources Inventory Area 18 (WRIA 18) Watershed Plan developed by Entrix, Inc.(Entrix 1993), identified approximately two miles of potential habitat as available upstream of the dam.

The proposed work will be accomplished at the site of the existing Canyon Creek diversion dam, within the stream channel and under the existing Clallam County road bridge on Fish Hatchery Road. At present, the diversion dam completely blocks upstream fish passage to approximately 2 miles of Canyon Creek. The purpose and need of the project is to provide fish passage upstream of the dam while maintaining the fish hatchery's auxiliary water supply. In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, this document examines the potential impacts of this work on species protected by the Act.

## 1.2 Location

The project is located approximately 530 feet upstream from Canyon Creek's confluence with the Dungeness River at River Mile (RM) 10.9 near Sequim in Clallam County (T29N, R4W, Section 12). See figures 1 and 2.

# 2. PROJECT AREA AND ACTION AREA

## 2.1 Project Area

The project area or project site extends from approximately 50 feet upstream of the existing diversion dam to approximately 200 feet downstream of the dam. The concrete and timber diversion dam is located on Canyon Creek, approximately 530 feet upstream from the confluence of Canyon Creek and the Dungeness River. The confluence of Canyon Creek and the Dungeness River is on the left bank of the Dungeness at approximately River Mile 10.8. The dam and auxiliary water supply pipeline provide an additional source of clean water for the hatchery when problems arise with the primary source.

## 2.2 Action Area

For the impacts assessed in this document, the action area of the proposed project extends approximately two miles upstream of the diversion dam, and extends downstream of the diversion dam to the confluence of Canyon Creek and the Dungeness River. It has been determined that the action area should also include the water supply pipe which continues downstream to where it connects to the hatchery. The action area also includes the surrounding aquatic habitat for an approximate 2-mile radius, as the project may potentially impact both Canyon Creek and the Dungeness River. Potential impacts from the project, both short term and long term, to terrestrial resources in the area could extend for approximately a one mile radius. Potential short term impacts could include noise from construction activities, temporarily disrupting wildlife, to long term impacts such as increasing marine derived nutrients in the environment upstream of the existing diversion dam. The potential for an increase in marine derived nutrients would be possible if adult salmon were able to pass upstream of the diversion dam where their carcasses would decay after spawning (Figure 1).

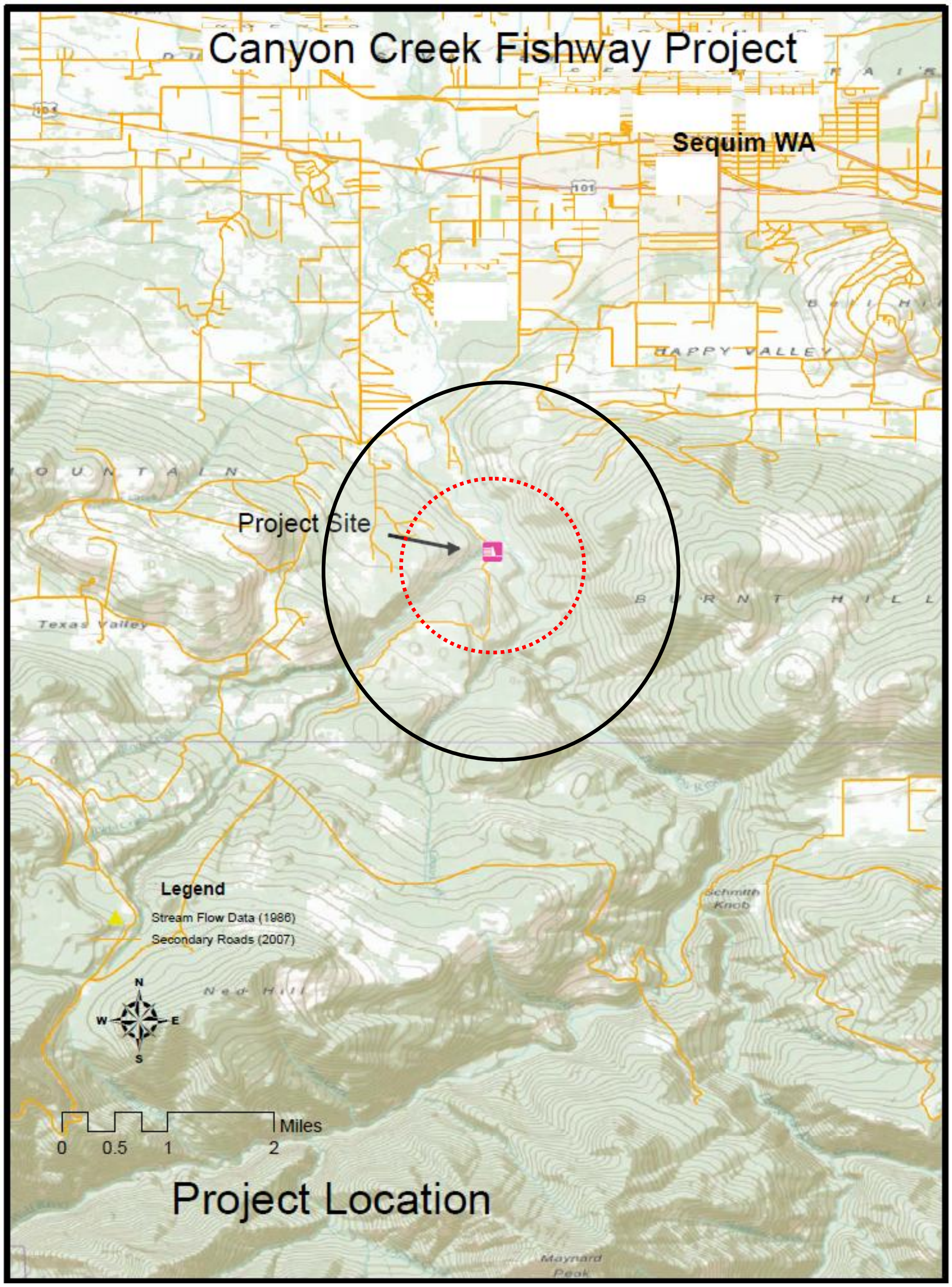


**Figure 1. General Project Location with Both Aquatic (dark circle) and Terrestrial (red dotted circle) Action Areas. Action area circles not to scale.**

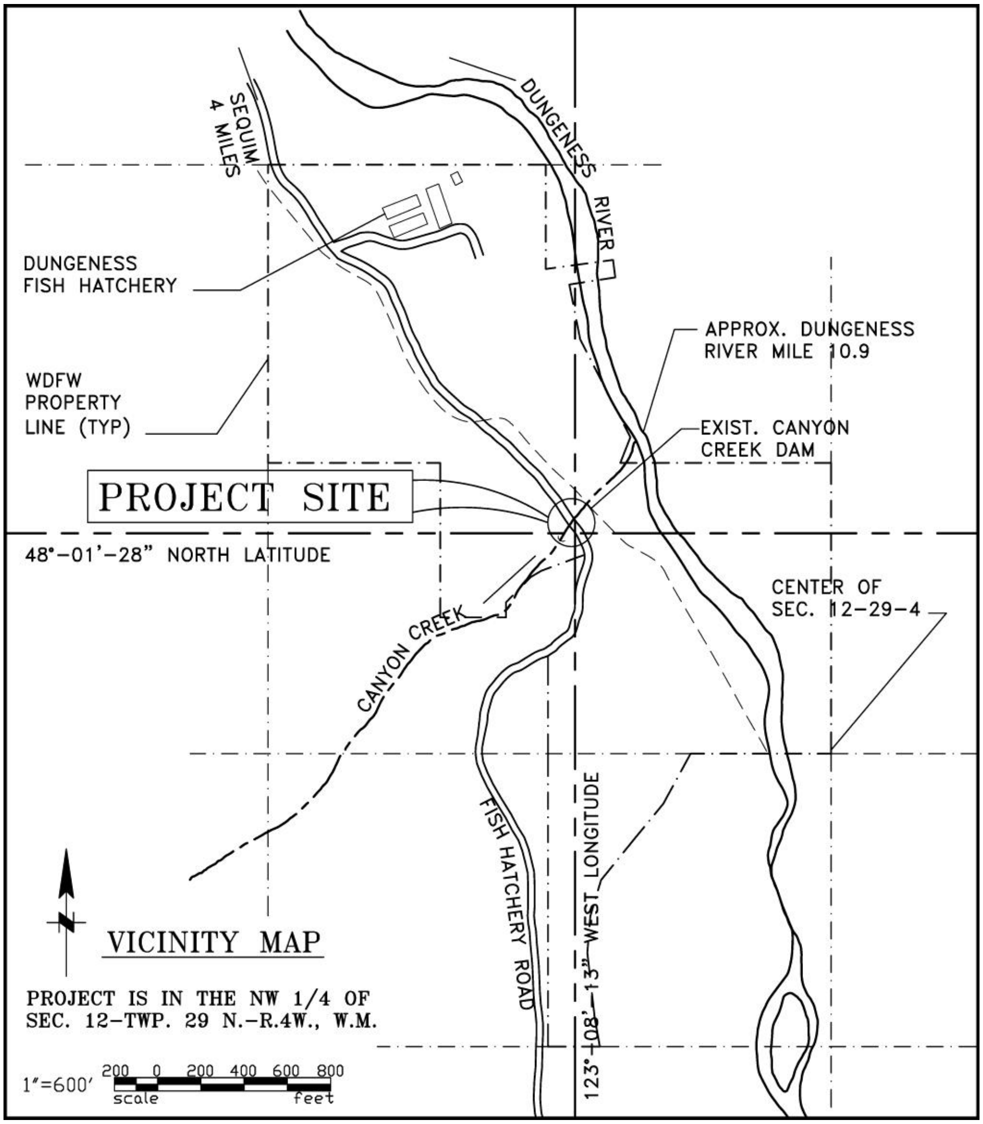


**Figure 2. Detail Project Site Location**

## 3. DESCRIPTION OF THE PROPOSED ACTION

WDFW is proposing to construct a cast-in-place concrete vertical slot fish ladder, and a new water supply intake that meets or exceeds current fish passage criteria at the existing Canyon Creek diversion dam. The proposed project is located 530 feet upstream from Canyon Creek's confluence with the Dungeness River The cast-in-place concrete vertical slot fish ladder will be constructed in the river channel and on the left bank of Canyon creek underneath the existing Clallam County road bridge. The purpose and goal of the proposed project is to provide fish passage at the Canyon Creek diversion dam while maintaining an auxiliary water supply to the Dungeness River Fish Hatchery.

The proposed project includes constructing a fish ladder, replacing the intake and screening, repairing the downstream apron, providing a plunge pool and entrance pools, with the addition of downstream weirs, and lastly, replacing approximately 120 feet of the existing water supply pipeline. The proposed intake is designed so that even the smallest listed fish species (salmonid fry) will not be impinged on the intake screening, greatly reducing the potential for injury or mortality to listed fish. The proposed water supply intake design will also reduce the amount of maintenance required resulting from sedimentation and/or debris loading.

During construction, the proposed project will require river flow to be diverted to bypass the project site. Construction sequencing would be directed by the selected contractor and would be required to meet all project conditions. It is anticipated that all work in the stream bed would be completed in 10 weeks during approved in-water work windows with total project construction requiring six months to complete. Construction would most likely follow the outline below.

It is anticipated that the contractor will construct a flume or supported pipeline from the top of the dam, to approximately 50 feet downstream of the dam, at the downstream end of the flume a revetment will be constructed to continue diverting the stream flow an additional 60 to 70 ft. The revetment will be constructed of sand bags or ecology blocks and sand bags. It is anticipated that approximately 5 days will be required to install the creek diversion bypass, and the diversion will need to be in place for approximately 10 weeks of construction. The stream flow by-pass and revetment will prevent sedimentation of the creek and the Dungeness River and it will allow a much quicker construction pace.

While the river is bypassed, excavation can be conducted both upstream and downstream of the dam, allowing repairs to the existing dam to be completed as well as allowing forms for the ladder and intake structure to be built and poured. Water pumped from excavations of the forebay and tailrace will be placed in settling ponds or temporary settling tanks before being released back to the creek. Portions of the existing trash rack, flume, water intake and associated equipment on the north end of the dam will be demolished, and removed to allow new construction to occur. Approximately 870 cubic yards of rock and soil will be excavated and removed from the left bank of the creek to provide an area suitable for the construction of the proposed fish ladder. Rock excavation will be accomplished by ripping and/or breaking using hydraulic point equipment. All debris will be disposed of at an approved upland disposal site.

As stated in the previous paragraph, rock excavation will likely be conducted using a construction technique known as breaking. Breaking is done with a hydraulic hammer (also known as a breaker or hoe ram), a percussion hammer fitted to an excavator that is typically used for demolishing concrete structures and is shown in Figure 3. It is used to break up rock in areas where blasting is prohibited due to environmental or other constraints, such as the bridge overhead. Like a ripper, a hydraulic hammer can be used in most rock types, although when sculpting a slope face, it works best in soft or moderately- to highly-fractured rock. Existing discontinuities in the rock act as presplit lines, minimizing hammer induced scars and fractures while creating a slope face that appears to be naturally weathered.

To allow for maximum downward pressure, the hammer is positioned perpendicular to the ground surface. Hammering locations are spaced evenly in a grid-like fashion so that the end rock product is fractured into pieces that can be loaded and hauled. For slope excavations, the hammering angle should not be parallel to the major discontinuity orientation, as this may cause fractures into the final slope face
.


**Figure 3. Example of a hydraulic hammer breaking rock, and creating planting areas with a more natural-looking slope variation than can be accomplished with drilling or blasting**

The proposed project will include repairing the existing concrete apron that is located immediately downstream of the dam. The apron is a small diversion dam's equivalent of a spillway tailrace that is present downstream of a large river hydro-electric dam. The primary purpose is to reduce erosion and scour, and secondly to reduce seepage. The concrete apron will be repaired utilizing approximately five cubic yards of new concrete. Voids under the existing apron will be filled with approximately six cubic yards of concrete grout.

After the apron repairs are made, three steel sheet pile weirs will be installed perpendicular to stream flow, across the channel downstream from the dam. The sheet pile wall will be topped by concrete caps, each with a 10 inch deep trapezoidal notch. The installation of the first, most upstream weir will form a plunge pool immediately downstream of the dam. The second and third sheet pile weirs downstream of the dam will create two additional downstream pools. These pools will greatly enhance fish passage by enabling fish to access the fish ladder entrance during a wide range of river flows. As previously stated, the farthest upstream weir pool also provides a much needed plunge pool for juvenile fish passing downstream, or for adult fish that fall back. Structurally this weir also serves as a cutoff wall to prevent further stream bed scour under the dam and apron.

The project site is located in a highly disturbed area, under a county road bridge, with very little vegetation present downstream of the existing dam (Figure 4). The substrate in the location of the existing diversion dam consists of hard basalt with some soil in places, greatly limiting vegetation growth. Access to the site will be possible using the existing fish hatchery access road, limiting disturbance to the existing environment and vegetation.  Access to the area immediately upstream of the dam may require a few shrubs and perhaps two to three small alder trees to be removed.  The project area downstream of the dam is sparsely vegetated, therefore only a few, if any, trees or shrubs will need to be removed. In total, very little vegetation will need to be removed to construct the proposed project.


**Figure 4.  Existing Diversion Dam, Water Supply Intake, Pipeline, and Area to be Enlarged for Fish Ladder Construction. Picture taken while facing upstream.**

Although no new roads will need to be constructed, the existing access road to the dam site will likely be re-graded and improved prior to and after project construction.  Construction will be accomplished using tracked and/or rubber tired equipment, which will be operated outside the margins of the stream bed unless absolutely needed during project construction.

## 4. ENVIRONMENTAL COORDINATION AND CONSERVATION MEASURES

During the design of this project, WDFW engaged in dialogue with multiple state, federal, tribal, and local agencies to discuss design alternatives and the potential impact to the surrounding environment.  The proposed project has been and continues to be supported by a highly diverse group, including numerous natural resource agencies, local, state, and Federal Government, as well as concerned Puget Sound Indian Tribes.

Starting in the 1970's, the Puget Sound Salmon Management Plan (PSSMP 1985) was developed, which established the co-management obligations of the Puget Sound Indian Tribes and WDFW regarding salmon and Puget Sound fishery management. As WDFW has been a co-manager of Washington State salmon, including Puget Sound salmon, since the mid 1970's, it has been directly involved in many landmark fish management and recovery actions, plans, and reports.

Based on the PSSMP framework, the parties to United States v Washington1974 and 1985, with the National Marine Fisheries Service (NMFS), developed the Draft Resource Management Plan, Puget Sound Chinook, Salmon Hatcheries (WDFW 2003 and PSIT 2003), jointly as part of the Comprehensive Chinook Salmon Management Plan (WDFW 2003 and PSIT 2004). The plan is referred to as the Hatchery (4) d plan. The purpose of the Hatchery (4)d plan is to describe the operating procedures for Chinook salmon hatcheries in Puget Sound, their role in achieving the co-managers' resource management goals, and their consistency with the protection given to Puget Sound Chinook salmon by the Endangered Species Act (ESA).

The plan applies to both Tribal and WDFW hatcheries, because these hatcheries are tightly linked as they often operate in the same watersheds, exchange eggs, and share rearing space to maximize the effectiveness of the programs. The benefits of the programs are also shared, including the perpetuation of critically depressed fish populations and the harvest of returning adults.

Providing harvest opportunities is an important, legally defined role for hatcheries. The Hatchery 4(d) Plan builds on a biological assessment of tribal hatchery programs submitted to NMFS by the Bureau of Indian Affairs (BIA) in October, 1999, as required by section 7 of the ESA, and incorporates management alternatives subsequently developed by NMFS and the tribes. It also draws from the recommendations of the Hatchery Scientific Review Group (HSRG), a panel of independent scientists charged by the U.S. Congress with promoting hatchery reform.

The HSRG identified several objectives included in the Hatchery 4(d) plan. These included identifying and analyzing direct demographic impacts from the operation of hatchery facilities.

The proposed project will accomplish the objective of the 2$^{nd}$ most critical concern identified in the plan and by the HSRG which was developed long ago in the beginning stages of the WDFW's effort to restore and maintain Washington State's salmon. These salmon are considered by many to be the state's most valued (both economically and culturally) natural resource. The most critical potential concerns identified and actions undertaken, or capital funding requested, for facility modification under the Hatchery 4(d) plan include:

1) screening all water intakes at Dungeness Hatchery to prevent adverse impacts to listed fish;

2) exploring removal of the Canyon Creek intake to allow passage of juvenile and adult Chinook salmon to available spawning and rearing habitat;

3) building an expanded incubation and early rearing facility at the Elwha Hatchery; and

4) exploring capital improvements to the pollution abatement system and the adult trapping/holding ponds at the Wallace River Hatchery to facilitate sorting of natural and hatchery-origin fish.

WDFW acknowledges that the HSRG and several agencies have identified the need for dam removal to provide passage and restore natural function at Canyon Creek. However, WDFW has determined that the auxiliary water supply at Canyon Creek is still needed for the reliable operation of the Dungeness River Hatchery. WDFW has finally acquired the necessary funding to design the proposed project and anticipates receiving funding for construction once environmental coordination is completed. The proposed project accomplishes WDFW's goal of providing safe fish passage that meets or exceeds NMFS fish passage criteria, reducing maintenance and improving hatchery reliability, while maintaining an auxiliary water supply.

Additionally, as many stocks of salmon continue to decline, the importance of having a reliable water source for operation of the hatchery is now more important than ever. In the early stages of design, the proposed project and the potential effects to listed species that may occur from project implementation and operation were reviewed by both the NMFS fish passage engineering team, and by WDFW fish passage engineers. The staff from both agencies determined that the proposed design they reviewed will meet or exceed all current fish passage criteria and guidelines for both upstream and downstream passage. As juvenile salmonid fry may currently encounter the facility and in the future are anticipated to be present in Canyon Creek, the most restrictive salmonid fry criteria has been used where appropriate.

The proposed project is also supported by Point-No-Point Treaty Council and Clallam County, which participate in the Water Resource Inventory Area 18 (WRIA 18) group. The WRIA 18 Salmon and Steelhead Habitat Limiting Factors Report identifies restoring fish passage in Canyon Creek as a priority project. The WRIA 18 is also supported by the Dungeness River Management Team (DRMT) with members including Property Owners, Irrigation Districts and Companies, Dungeness Flood Control Advisory Board, Sportsman's Group, WDFW, U.S. Fish & Wildlife Service (FWS), U.S. Soil Conservation Services, and the Washington State Department of Ecology.

The Jamestown S'Klallam Tribe is also in support of providing fish passage at Canyon Creek and they developed the "Protecting and Restoring the Waters of the Dungeness" report dated July, 2007, which also identified the removal of the barrier to fish passage on Canyon Creek as a priority project for restoring salmonid populations in the Dungeness River.

Finally, the U.S. Fish and Wildlife Service identified the need for fish passage at Canyon Creek for the recovery of bull trout in their 2004 draft recovery plan (USFWS 2004). The recovery plan identified the WDFW hatchery water intake in Canyon Creek as a complete barrier to upstream fish passage and stated that providing passage is necessary for the recovery of bull trout.

Best Management Practices

The following construction best management practices (BMPs), as suggested by the Washington State Department of Ecology, will be implemented. See Table 1.

**Table 1. BMPs to be implemented during construction.**

| |
|---|
| 1. Equipment that will be used near the water will be cleaned prior to construction. |
| 2. Work is planned to be conducted during a period of Canyon Creek low stream flow. |
| 3. Temporary sediment traps will be used to minimize turbidity where possible. |
| 4. Biodegradable hydraulic fluids will be used for machinery at the site. |
| 5. Refueling will not occur within the river channel or river banks. |
| 6. Construction equipment will be regularly checked for drips or leaks. |
| 7. At least one fuel spill kit with absorbent pads will be onsite at all times. |
| 8. Equipment drive trains will not be operated in the water. |
| 9. A staff member familiar with environmental coordination requirements will be onsite during construction to ensure the project is built as specified in coordination documents. |
| 10. Water quality will be monitored during construction activities that have potential to create elevated turbidity levels. |

Proposed Construction Sequencing

Project construction is expected to proceed according to the following outline:

**<u>Modification of Existing Structure.</u>**

**Creek Bypass**

During construction activity, Canyon Creek water flow will be diverted around the construction area. We anticipate that the contractor will construct a flume or install a pipe with the necessary structural support that will span from the top of the dam to approximately 50 feet downstream of the dam. At the downstream end of the flume or elevated pipeline, the river will be diverted approximately another 60 to 70 feet using sandbags to create a revetment to carry the stream past the project site. The expected procedure for installing the bypass and preparing for construction of the fish ladder is anticipated to be as follows:

- As the entire forebay (area upstream of dam) is completely filled with substrate and only the top few inches hold water, an excavator will remove several bucket loads of substrate upstream of the dam on the right bank.
- Substrate will be placed into trucks and transported to an approved upland disposal area.
- After the substrate has been removed, a portion of the dam’s timber sheathing can be removed to allow a 36 inch diameter corrugated diversion pipe to be installed.
- The bypass pipe will be lifted into place with an excavator or crane and sandbags will be placed all around the bypass pipe to minimize leakage.
- A sandbag or ecology block cofferdam will then be installed to divert the creek into the bypass pipe.
- All sediment upstream of the dam will be excavated.

- Water that collects in the excavated area will be pumped into settling structures and only after sediment has settled out of the water will it be released back into the creek.
- Portions of the existing trash rack, flume, water intake and associated structures at the north end of the dam will be demolished, removed and properly disposed of to allow new construction to take place.
- The forms and reinforcement for the cast-in-place concrete fish ladder and intake structure will be placed.
- Concrete will be poured.
- Intake screening, trash rack, valves, and associated equipment will be installed
- Concrete apron and void will be repaired
- Three sheet pile weirs will be installed.
- Install concrete caps on the sheet pile weirs.
- Water supply pipeline will be installed.

**Earthwork (Excavation and Fill).**

- Approximately 870 C.Y. of rock and soil will be excavated and removed from the left bank as required for construction of the proposed fish ladder. Rock excavation will be accomplished by ripping and/or by hydraulic point equipment. Disposal will be at an approved upland facility.
- The dam's downstream concrete apron will be repaired utilizing approximately 5 C.Y. of new concrete.
- Voids under the existing apron will be filled with approximately 6 C.Y. of concrete grout.

**Grade Control & Fish Passage.**

- Pools will be formed by the installation of three steel sheet pile weirs across the stream bed. The sheet pile will be topped by concrete caps, each with a 10" deep trapezoidal notch to enhance fish passage. Installation of these downstream weirs will form pools to enable fish to access the fish ladder entrance. The farthest upstream weir will form a juvenile plunge pool and serve as a cutoff wall to prevent further stream bed scour under the dam and apron.

## 5. ENVIRONMENTAL BASELINE AND EFFECTS OF THE PROPOSED ACTION

### 5.1 Vegetation

Currently, the vegetation in the project area is sparse as the dam and intake are located under a bridge in a previously disturbed area. As the substrate immediately under the bridge is hard rock, few plants are able to survive. Riparian condition in the river channel is poor downstream of the dam, with sparse deciduous vegetation. Riparian condition is generally good upstream of the dam, as it is located in a deep ravine that has not recently been logged.

### 5.2 Geology/Hydrology

The project site is located on the Olympic Peninsula, at the base of the northern foothills of the Olympic Mountains. The Olympic Mountains are an accreted subduction complex consisting of marine sedimentary rocks surrounded by oceanic basalts. The region has been repeatedly glaciated, most recently by the Puget lobe of the Cordilleran ice sheet during the Fraser Glaciation, 10,000 to 20,000 years ago. This repeated glaciation has scoured some areas to bedrock and covered others with as much as 2,000 feet of unconsolidated sediments, which have subsequently been reworked by surface water (Schasse and Logan, 1998).

The project area geologic maps include the Carlsborg 7.5-minute quadrangle (Othberg and Palmer, 1979), and the adjacent Sequim 7.5-minute quadrangle (Schasse and Logan, 1998). According to the Othberg map, the rock on site is part of the Crescent Formation Basalts, middle to lower Eocene (Tertiary) submarine basalt flows and breccias. Schasse and Logan note that there are subordinate beds of basaltic sandstone. These descriptions agree with the findings of field investigations conducted by PacRim Geotechnical, Inc., which conducted seismic testing during the early stages of project design for the proposed project.

Schasse and Logan show an anticline structure with an axis trending west-northwest through Burnt Hill to the southeast of the project site. This structure appears to continue northwest through Lost Mountain. The project site is located on the northern limb of this structure. According to both sources, the bedrock is covered with a thin veneer of glacial till in the majority of the project. This was confirmed by the site investigation conducted for the proposed project.

The Dungeness River is a dynamic system, typically exhibiting a significant amount of channel migration. However, in the project's reach the river has maintained the current alignment for many years. The levee or bank in the project reach does not appear to have been repaired in many years, whereas just a few miles upstream portions of levees have been repaired recently and often.

Typically the annual Dungeness River hydrology consists of snowmelt in the upper watershed resulting in consistently high flows in the late spring and early summer, and rainfall in the upper watershed causes high and more variable flows in the winter. The lowest flows occur in September and October; from September to mid-November, 25 percent of the daily mean flows over the 67-year record were less than 150 cfs. Flows peak in June, when they exceed 415 cfs in 90 percent of the years, 646 cfs in 50 percent, and 1011 cfs in 10 percent. The 7-day and 30-day Dungeness River low flows are also noted; historic low flows occurred in 1979, and were 65.6 cfs (7-day). However this occurred in February and most likely represents a freeze-over situation. The lowest half-month flow recorded is 73 cfs during October of 1995. Below the RM 11.8 gage on the Dungeness River, several surface tributaries enter the Dungeness River. The most significant of these is Canyon Creek, the site of the proposed project

The Canyon Creek sub-basin has a drainage area of approximately 11.9 square miles and is the tributary that contributes the most significant source of surface water to the Dungeness River below the RM 11.8 gage. Canyon Creek flow could range from 5 to 100 cubic feet per second (cfs). The WRIA 18 Watershed Plan developed by (Entrix, Inc. 2003), stated that in Canyon Creek occasional flow measurements as high as 25 cfs have been observed, however typical flow ranges in the 2 to 8 cfs range. In preparation of the proposed project the design team analyzed the historic annual river flows and determined that 75% of the time flow in Canyon Creek was

10 cfs or more and 95% of the time flow was below 75 cfs. As a result the proposed project was designed to operate in flows ranging from 10-75 cfs which meets NMFS fish passage criteria.

In Canyon Creek from the county road bridge to the mouth, there is little large woody debris (LWD) present and limited riparian vegetation to provide future LWD. Upstream of the dam, Canyon Creek has abundant LWD, with additional LWD contribution potential, as the canyon has not yet been logged. Additionally, the LWD is generally stable, as Canyon Creek typically does not have enough energy to actively move LWD.

## 6. GENERAL PROJECT EFFECTS

### 6.1 Project Impacts

Temporary adverse impacts will occur to terrestrial species, mainly noise and disturbance due to construction and human activity in the vicinity of the work area, and by a temporary loss of cover and habitat. These impacts will be minimized by using existing roads and cleared areas where possible for access and staging areas, and using the best management practices and conservation measures listed in Table 1.

Removal of portions of the dam and construction of the concrete fish ladder will require approximately 10 weeks to complete. During this period, the creek will be diverted into a bypass system for the length of the project area, and will provide little or no fish habitat along the length of the diversion. The construction period will follow the spring high-flow period, so it will avoid impacts to any potential juvenile fish that could be present and migrating downstream during the spring. Most of the construction will occur prior to the adults arriving in the fall. Every effort will be made to complete the project within the preferred in-water work window (July 15 – September 30). However, during the Section 7 Consultation with FWS construction timing and duration will be coordinated to minimize impacts to listed terrestrial species, which may alter construction timing and sequencing.

There will be some temporary adverse impacts to aquatic resources during the construction period as the stream is diverted around the construction area. Upstream of the diversion, water will be pooled to create enough head for the stream to enter the diversion pipe. The pipe will be of sufficient size to carry stream flows typically found during the construction period. The streambed in the project area will be impacted, as equipment will need to operate in the area to install the diversion pipe, and to haul away the approximately 20 to 25 cubic yards of fine sediment, gravel, and large rock that has accumulated behind the existing diversion dam during its years of operation.

Overall, WDFW has determined that fish habitat will be improved or maintained as result of the project. WDFW also determined that the most likely adverse affect that could occur to listed fish species would be the release of sediment and correlating increase in turbidity. The following evaluates the potential affect of increased sediment on listed fish species.

Sediment/Turbidity effects on fish - Most published information on the effects of sediment in streams relates to fish. Four major categories of this relationship are (1) the direct effects of suspended sediment and turbidity, (2) sediment trapped in salmonid redds and its influence on reproductive success, (3) effects on benthic production (food for juveniles and prey species), and (4) effects of deposited sediment on fish habitat.

Suspended sediment - Suspended sediment produces little or no direct mortality on adult fish at levels observed in natural, relatively unpolluted streams. Intensive investigation of direct mortality due to suspended sediment was not undertaken until relatively recently. In an extensive review, Lloyd (1987) quoted a number of unpublished reports that included results as either fatal or lowered survival; most of these included suspended sediment concentrations from 500 to 6,000 mg/L. Sigler et al. (1984) reported some mortality of very young Coho salmon and steelhead trout fry at about 500 to 1,500 mg/L. In laboratory experiments, however, McLeay et al. (1984) reported survival of Arctic grayling underyearlings which had been subjected to prolonged exposure to mining silt in concentrations of 1,000 mg/L. Also, McLeay et al. (1983) reported survival of similar fish acclimated to warm waters in stream cages and subjected to short exposures of concentrations up to 250,000 mg/L.

Much more information is available on sublethal effects of suspended sediment. Most of these reports were based on laboratory experiments, wherein specific effects were observed critically and often quantified. Effects tested in (1) avoidance and distribution, (2) reduced feeding and growth, (3) respiratory impairment, (4) reduced tolerance to disease and toxicants, and (5) physiological stress (review by Lloyd 1987).

Perhaps the most important sublethal effect of suspended sediment is the behavioral avoidance of turbid or silty water, resulting in long reaches or entire streams devoid of fish. Thus, the effect of avoidance may be the total preclusion of resident fish and juvenile anadromous salmonids. This factor destroys a stream as a productive fishery just as surely as if the population were killed. Many published reports have documented such effects.

Avoidance of water muddied from mining silt by spawning adult salmon was observed by Sumner and Smith (1940) in a California river. Avoidance by adult Chinook salmon of a spawning stream that contained volcanic ash was reported by Whitman et al. (1982). In work on the Fraser River, British Columbia, Servizi and Martens (1992) observed avoidance by young Coho salmon of high suspended sediment derived from gold-mining spoils; they pointed out that Coho salmon may move laterally to the sides of a river to avoid high turbidity.

Much research on avoidance of silty water has been conducted in laboratory and field experiments. Juvenile Coho salmon (Bisson and Bilby 1982) and young Arctic grayling (Scannell 1988) avoided high concentrations of suspended sediment (as measured by turbidity in NTU). Coho salmon avoided turbidity greater than 70 NTU, and Artic grayling avoided turbidity greater than 20 NTU. Sigler et al. (1984) also observed that juvenile Coho salmon and steelhead trout avoided turbid water in laboratory experiments. McLeay et al. (1984, 1987) observed Artic grayling that moved in a downstream direction in laboratory streams when subjected to mining silt. Berg and Northcote (1985) observed that juvenile Coho salmon exposed to short-term pulses of suspended sediment dispersed from established territories.

In experimental stream channels related to long-term studies on Coho salmon in the Clearwater River, Washington, Cederholm and Reid (1987) subjected juvenile Coho salmon to three levels of suspended sediment concentrations: clear water (0 mg/L); medium suspended sediment (1,000 - 4,000 mg/L); and high suspended sediment (4,000-12,000 mg/L). They observed that the fish preferred clear and medium conditions, suggesting that juvenile fish preferentially avoid high suspended sediment condition in silty streams. Furthermore, they observed evidence of stress in the fish - an increased rate of opercular movement and "coughing"; sediment accumulations on gill filaments, and declines in prey capture success - at the high suspended sediment concentrations.

In a different approach involving competition between species, Gradall and Swenson (1982) concluded that red-clay turbidity favored the creek chub over brook trout in sympatric populations in small streams. The creek chub preferred the cover provided by suspended sediment turbidity, whereas brook trout preferred clearer water.

One of the major sublethal effects of high suspended sediment is the loss of visual capability, leading to reduced feeding and depressed growth rate. Several researchers have reported decreased feeding and growth by fish in turbid conditions resulting from suspended sediment. For example, Cleary (1956) and Larimore (1975) noted that turbidity in a smallmouth bass stream caused very young fry to be displaced downstream due to the loss of visual orientation. The bass left areas where they fed on the microcrustaceans so important to early fry stages.

Most research on feeding and growth, however, has been experimental. McLeay et al. (1984, 1987) reported impaired feeding ability by Arctic grayling exposed to placer mining silt: Reynolds et al. (1989) reported similar results for Arctic grayling in cage experiments in Alaska streams. Redding et al. (1987) observed little or no feeding by juvenile Coho salmon and steelhead trout exposed to suspended sediment in Oregon laboratory experiments, and Berg and Northcote (1985) reported reduced feeding by juvenile Coho salmon on drift (brine shrimp) in laboratory tests. In most cases, vision impairment due to suspended sediment turbidity was determined to be the factor that reduced the ability of the fish to capture prey (Sykora et al. 1972; Berg 1982).

Despite early speculation about gill damage by suspended sediment (Cordone and Kelley 1961; Herbert and Merkens 1961), few reports indicated gill damage and impairment of respiratory function as a source of morality (McLeay et al. 1987; Redding et al. 1987; Reynolds et al. 1989). Whereas high suspended sediment concentrations may not be immediately fatal, thickening of the gill epithelium may cause some loss of respiratory function (Bell 1973)

Berg and Northcote (1985) reported increased gill-flaring in high turbidities due to suspended sediment; this was viewed as an attempt by fish to cleanse their gill surfaces of suspended sediment particles. Similarly, Servizi and Martens (1992) recorded an eightfold increase in "cough" frequency over controls at suspended sediment concentrations of 230 mg/L. It seems likely that fish have evolved behavioral or physiological adaptations to temporary high concentrations of suspended sediment in order to survive short-term conditions caused by natural spates and floods. Chronic high suspended sediment concentrations that are initiated by anthropogenic sources, however, may not be tolerated.

Studying the effect of Mount St. Helens volcanic ash on Chinook and sockeye salmon smolts, Newcomb and Flagg (1983) reported total mortality at very high ash levels (25% ash by volume) but no mortality at less than 5% ash. Based on the appearance of the gills, they suggested that impaired oxygen exchange was the primary cause of death, but they concluded that most airborne ashfalls would not cause acute mortality.

Effects on redds - The severe effect of sediment upon developing embryos and sac fry in redds has been intensively investigated. A major problem in many circumstances is that the source of oxygen reaching the redd is in the down welling water of the stream itself. Suspended sediment carried by stream water enters the redd where velocities are slowed in the interstitial spaces and sediment particles settle. Consequent effects include the coating of eggs and embryos and the filling of interstitial spaces in the redd gravel so completely that the flow of water containing oxygen through the redd is impeded or stopped. The salmonid redd thus functions as an effective "sediment trap," and the entry of oxygen required for embryo survival and development is prevented.

A second major problem occurs when sedimentation on the streambed or in upper strata of the redd produces a consolidated armor layer through which emerging sac fry cannot penetrate. Even though embryo development and hatching may be successful within the redd, such entombment of fry attempting to emerge from the redd can result in reproductive failure.

Turbidity/Sediment effects on benthic invertebrates - Much is known about the effects of suspended sediment on macroinvertebrates. The most common direct effect observed in experiments with fine sediments has been a pronounced increase in downstream drifting. Such increased drift has been attributed primarily to a decrease in light with consequent drift responses similar to behavioral drift in a diel periodicity. Extraordinary drift under prolonged high levels of suspended sediment may deplete benthic invertebrate populations.

Severe damage to benthic invertebrate populations can be caused by heavy sediment deposits. The affected organisms consist mainly of the insect orders Ephemeroptera, Plecoptera, and Trichoptera, (EPT), which generally are the forms most readily available to foraging fish. Virtually no research has been conducted on the effect of sediment on the meiofauna of streambeds, despite increasing appreciation of the ecological importance of these small organisms to fisheries.

Any effect of sediment input to Canyon Creek and/or the Dungeness River is likely to be of minor consequence since the biological effect of episodic inputs has been found generally to be temporary. Rapid recovery often results from invertebrate drift from upstream reaches. In an Ohio stream, sediments from eroding deposits of glacial lacustrine silt, although natural, simulated episodic events. The glacial silt periodically reduced benthic macroinvertebrates up to 5 km downstream from the site (DeWalt and Olive 1988). However, after one of the glacial silt deposits was completely eroded, sediment input ceased, the stream deposits cleared, and drift from upstream quickly restored benthic populations. In British Columbia, temporary siltation from a pipeline crossing reduced local benthos populations by up to 74% but benthos recovery was rapid after construction stopped (Tsui and McCart 1981).

Sediment effects on Fish habitat - The effect of deposited sediment most often sand, on fish-rearing habitat has been studied within two major subject areas: mortality to fry by elimination of interstitial space in riffles of gravel and cobbles, and loss of juvenile-rearing and adult habitat by filling of pools. Salmonid fry, particularly, often require the protection of streambed "roughness" conditions for winter survival. Severe reductions in year-class strength occur when a Cohort of salmonid fry faces stream riffles heavily embedded by sediment deposits. Presumably, fry of warm water species require similar habitat for survival of early life stages, but little research has been accomplished on sediment relationships for these fishes.

Although not as extensively documented, the effect of deposited sediment on juvenile rearing habitat in pools has been similarly convincing. When heavy deposits eliminate pool habitat, reduced growth and loss of populations often result.

Sedimentation can also increase water temperature of streams (i.e., by filling pools and reducing channel depth, increasing riffle area and channel width, which results in increased solar insulation [MBTSB 1998]). However, after the project the stream habitat should be of better value to listed fish species than before the project. The calculated amount of sedimentation would be insufficient to fill pools, reduce channel depth, or increase riffle area.

Summary of sedimentation affects - Overall, the increase in sedimentation is not expected to have a significant effect. When construction is complete, the stream will be slowly diverted back into the river channel, resulting in a flush of sediment through the project area. There will be a short term downstream impact to aquatic resources from increased turbidity and sedimentation. The timing and duration of this flush will be carefully coordinated with resource agencies and downstream entities. In addition, the newly constructed channel area will need to acquire benthic species and habitat. This will be facilitated as the river carries normal amounts of upstream sediment and associated benthic resources into the project area. Other than construction scars and channel disturbance during construction, long-term channel, riparian or sedimentation effects are not expected.

Upon completion of the project, fish should be able to ascend the project reach and access upstream areas at least 90% of the time. During flood events, flow conditions will be rapid and complex and the fish ladder will not meet fish passage criteria. Although the fish ladder will not meet fish passage criteria during a flood flow event, conditions in the fish passage facility would likely restrict access only to those fish with weaker swimming ability. The proposed project, when completed, will allow access to approximately two miles of suitable salmon habitat (ENTRIX 1993).

The project will have very minor short-term impacts on air quality from the use of heavy equipment during the construction period. However, there should be no significant increase in emissions from construction vehicles during this period that would noticeably change the ambient air quality. There would be no long-term impact on air quality from project construction.

Existing roads will be used for access during project implementation for this restoration activity.

6.2 Project Benefits

In the long term, the restoration of fish passage is intended to benefit both resident and anadromous fish species. The habitat in the watershed upstream of the dam is in good shape and the creek has an abundance of large woody debris (LWD) providing complex cover and habitat for juvenile salmonids and other fish. As the habitat surrounding Canyon Creek is in good condition, the creek is typically very stable, resulting in sufficient LWD present in the channel. The stream is fed mostly by groundwater, so it has a unique capability to maintain both high and low flows and is less vulnerable than many streams to flash floods or devastating droughts.

Providing upstream passage for spawning anadromous fish also provides a critical link in aquatic food webs in the Pacific Northwest. Pacific salmon are considered a “keystone” species upon which producers and consumers from the bottom to the top of the food chain depend (Wilson and Halupka 1995). Rearing in the rich-ocean environment, adult salmon return to nutrient poor streams with a wealth of ocean nutrients, enriching the food web from primary producers to top carnivores. At the top, at least 22 species of wildlife, including black bear, mink, river otter, and bald eagle, feed on salmon carcasses (Cederholm et al. 1989).

At the base of the food web, salmon carcasses provide a significant, if not major amount of nitrogen to streamside vegetation as well as large amounts of carbon and nitrogen to aquatic insects and other macroinvertebrates (Bilby et al. 1996). Juvenile salmon also utilize spawned-out salmon carcasses directly as a food source. Bilby et al. (1998) witnessed increased densities, increased body weight, and improved condition factor of juvenile Coho and steelhead in stream reaches supplemented by the addition of salmon carcasses from a nearby hatchery. Sixty to 96 percent of the food material in the stomachs of juvenile steelhead and Coho consisted of carcass flesh and eggs.

Providing fish passage will allow juvenile salmon and other species access to over-wintering and rearing habitat as well as high flow refugia upstream of the dam. Fish passage will also provide adult salmon with access to habitat upstream of the dam which may contain areas suitable for spawning.

## 7. EVALUATION OF PROJECT EFFECTS ON PROTECTED SPECIES

Four species protected under the Endangered Species Act of 1973 (16 USC 1531-1544) potentially occur in the project vicinity. Table 2 shows a list of species potentially affected by the proposed project, as provided by the U.S. Fish and Wildlife Service (USFWS). The NMFS Northwest Region web site shows species under NMFS jurisdiction which potentially occur in the project area. Table 2 summarizes the information received from USFWS and NMFS. The following sections briefly summarize relevant life history information in the action areas for these species, and then evaluate how the proposed project may affect the species, concluding with a determination of effect.

**Table 2. Protected species potentially occurring in the project vicinity.**

| Species | Listing Status | Critical Habitat |
|---|---|---|
| | | |

| | | |
|---|---|---|
| Coastal/Puget Sound Bull Trout<br>*Salvelinus confluentus* | Threatened | Designated |
| Puget Sound Chinook Salmon<br>*Oncorhynchus tshawytscha* | Threatened | Designated |
| Hood Canal Summer-run Chum Salmon<br>*Oncorhynchus keta* | Threatened | Designated |
| Puget Sound/Steelhead<br>*Oncorhynchus mykiss* | Threatened | — |
| Marbled Murrelet<br>*Brachyramphus marmoratus* | Threatened | Designated |
| Northern Spotted Owl<br>*Strix occidentalis caurina* | Threatened | Designated |

## 7.1 Puget Sound Chinook Salmon

The Puget Sound Evolutionarily Significant Unit Chinook salmon was listed as a threatened species under the Endangered Species Act of 1973, as amended, in March 1999. Chinook are anadromous and semelparous. Within this general life history strategy, Chinook display a wide range of variation in life histories, including variation of age at seaward migration, variation in length of freshwater, estuarine and oceanic residence, variation in ocean distribution and ocean migratory patterns, and variation in age of spawning migrations. There are two predominant life history patterns in the eastern north Pacific populations: stream-type and ocean-type (Healy 1992). Stream type populations may rear as juveniles in streams for up to a year or more prior to migrating out to marine waters. Spring run populations have a wide range of rearing strategies, some fish immediately migrate downstream after emerging from the gravel and rear in estuaries, whereas others rear for 1-6 months in freshwater prior to migrating to estuaries. Summer/fall run populations are typically considered to be ocean-type fish.

Dungeness Chinook salmon have adult return and spawning timings that distinguish them from fall Chinook salmon populations in Puget Sound. Adults may return as early as June in recent years and continue through early September. Spawn timing of Dungeness Chinook currently ranges from early August through the third week in October with the peak number of redds observed around September 5. Analysis of scale samples show that most adults return to spawn at age 4, with smaller percentages at ages 3, 5, and 2.

Most juvenile Dungeness Chinook salmon migrate to sea within their first year of life from mid-June through August. A small component migrates as yearlings. These yearling migrants come from naturally produced fish and from the captive brood program. These fish remain in the river over winter and migrate in the next spring, a year later than fingerlings (Hirschi, R. and M. Reed. 1998).

Both natural and hatchery components of the Dungeness Chinook population are listed as "threatened" under the Endangered Species Act. The co-managers designated Dungeness River

Chinook salmon as a critical stock in the SASSI review (WDF et al, 1993). Natural spawning abundance has ranged between a low of 43 to 453, in 2001.

### 7.1.1 Utilization of the Action Area

The existing diversion dam has blocked fish passage since it was first constructed over 100 years ago, and as a result, no Chinook salmon are present upstream of the project. Chinook salmon have been observed spawning in Canyon Creek downstream of the dam for many years.

### 7.1.2 Effects of the Proposed Action

The primary impact to Chinook, at least in the short-term, will be the temporary increase in turbidity associated with the installation and removal of the water diversion pipeline and noise from construction equipment during most project construction activities.

As water is diverted back into Canyon Creek following construction, a pulse of sediment will be released. This will temporarily increase turbidity downstream of the project area, potentially depositing fine sediments into larger-grained spawning substrate downstream. However, the amount of sediment is not expected to be extensive, and the elevated turbidity levels will be highly localized and short in duration. Should adult Chinook return to Canyon Creek prior to completion of the project, overall spawning success in Canyon Creek will not be greatly affected, as only the area immediately downstream of the existing diversion dam, bypassed by the diversion pipeline, will not be accessible to Chinook.

Short-term and localized construction effects on water quality and waterborne noise will be timed to occur during periods of the year when minimal numbers of anadromous salmonids are expected to be present.

Juvenile salmonids have been shown to avoid areas of unacceptably high turbidities (e.g.,Servizi (1988); they also may seek out areas of moderate turbidity (10 to 80 NTU) presumably as cover against predation (Cyrus and Blaber 1987 a,b). Feeding efficiency of juveniles is also impaired by turbidities in excess of 70 NTU, well below sublethal stress levels (Bisson and Bilby 1982). Reduced preference by adult salmon homing to spawning areas has been demonstrated where turbidities exceed 30 NTU (20 mg/L suspended sediments). However, Chinook exposed to 650 mg/L of suspended volcanic ash were still able to find their natal water (Whitman et al 1982). Based on these data, it is unlikely that the locally elevated turbidities generated by the proposed action would directly affect juvenile or adult salmonids that may be present.

The project is designed to benefit Chinook salmon and other salmon species by restoring passage to upper Canyon Creek. The proposed project when completed will provide access to approximately two miles of habitat with natural cover such as large wood that will be available for juvenile Chinook rearing, high flow refugia, and potentially for Chinook spawning.

### 7.1.3Designated Critical Habitat

NMFS (2005) designated critical habitat for Puget Sound Chinook salmon. The designated critical habitat includes all marine, estuarine and river reaches accessible to Chinook salmon in Puget Sound, which includes the project area. The critical habitat designation includes several

Primary Constituent Elements (PCEs). These are listed below, along with an assessment of project effects on each PCE.

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
*Localized and temporary effects to spawning sites in Canyon Creek from elevated turbidity primarily during diversion removal. Proposed project will allow access to approximately two miles of habitat that may be suitable for spawning that has not been accessible for Chinook for over 100 years. As a result of the proposed project, spawning areas for Chinook will likely be increased.*

(2) Freshwater rearing sites with:
(i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
*The project would increase freshwater rearing areas by restoring connectivity to approximately two miles of Canyon Creek upstream of the existing diversion dam. .*

(ii) Water quality and forage supporting juvenile development;
*The project would improve forage by greatly increasing the amount of freshwater foraging area, providing access to approximately two miles of good habitat in Canyon Creek upstream of the existing diversion dam.*

(iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
*The proposed project will provide access to two miles of habitat with natural cover upstream of the existing diversion dam.*

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
*The proposed project would remove a barrier or obstruction to a freshwater migration corridor.*

(4) Estuarine areas free of obstruction and excessive predation with:
(i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
*No estuarine areas are present, and therefore will not be adversely impacted.*

(ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels;
*No estuarine areas are present, and therefore will not be adversely impacted.*

(iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
*No estuarine areas are present, and therefore will not be adversely impacted.*

(5) Nearshore marine areas free of obstruction and excessive predation with:
(i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation;
*No nearshore marine areas are present, and therefore will not be adversely impacted*.

(ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
*No nearshore marine areas are present, and therefore will not be adversely impacted.*

(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
*No offshore marine areas are present, and therefore will not be adversely impacted.*

### *7.1.4 Effect Determination*

The proposed project **may affect, but is not likely to adversely affect,** Puget Sound Chinook Salmon. This determination is made based upon the limited scope and duration of the project, the low likelihood that Chinook would be present in the action area during construction, the temporary and minor nature of project impacts, and benefits provided by restoring passage. WDFW has determined that this project **may affect, but is not likely to adversely affect,** critical habitat of Puget Sound Chinook. The project is designed to benefit Chinook salmon and other salmon species by restoring passage to Canyon Creek which will provide rearing habitat, high flow event refuge, and possibly provide spawning habitat for Puget Sound Chinook.

## 7.2 Coastal/Puget Sound Bull Trout

The Coastal/Puget Sound bull trout population segment was listed as a threatened species under the Endangered Species Act of 1973, as amended in October 1999. Bull trout populations have declined throughout much of the species' range. Some local populations are extinct, and many other stocks are isolated and may be at risk (Rieman and McIntyre 1993). Combinations of factors including habitat degradation, expansion of exotic species, and exploitation have contributed to the decline and fragmentation of indigenous bull trout populations.

Bull trout are known to exhibit four types of life history strategies. The three freshwater forms include adfluvial, which migrate between lakes and streams; fluvial, which migrate within river systems; and resident, which are non-migratory. The fourth and least common strategy, anadromy, occurs when the fish spawn in fresh water after rearing for some portion of their life in the ocean.

Anadromous sub-adults and non-spawning adults are thought to migrate from marine waters to freshwater areas to spend the winter. Based on research in the Skagit Basin (Kraemer 1994), anadromous bull trout juveniles migrate to the estuary in April-May, then re-enter the river from August through November. Most adult fish entered the estuary in February-March, and returned to the river in May-June. Sub-adults, fish that are not sexually mature but have entered marine waters, move between the estuary and the lower river throughout the year.

Bull trout/Dolly Varden in the Dungeness River have been identified as a distinct stock based on their geographic distribution. Anadromous, fluvial and resident life history forms may be present. Spawning timing and locations are unknown. Anecdotal angler reports state that historically bull trout/Dolly Varden were very common and widespread from the lower to the upper watershed. Angler reports also state bull trout are still widespread, but greatly reduced in numbers (Mongillo 1992).

### *7.2.1 Utilization of the Action Area*

Canyon Creek was a productive salmon stream, has habitat historically occupied by Coho, pink, chum, and Chinook salmon, and has habitat suitable for bull trout (USFWS 2004). Although definitive data on bull trout presence are lacking for this stream, available information suggests that upper Canyon Creek would provide foraging, and rearing habitat and potentially spawning habitat for bull trout if it was accessible to salmon and bull trout. Restoring passage at Canyon Creek was identified as a high priority recovery task by the U.S. Fish and Wildlife Service in the 2009 draft recovery plan (USFWS 2004, USFWS 2009). Once passage is restored and salmon and steelhead recolonize the creek, Canyon Creek will likely contribute to restoring the overall abundance of bull trout in the core area. It is the one remaining high quality stream located in the lower Dungeness River that could be utilized by bull trout.

### *7.2.2 Effects of the Proposed Action*

The primary impact to Coastal/Puget Sound bull trout, at least in the short-term, will be the temporary increase in turbidity associated with the installation and removal of the water diversion pipeline and noise from construction equipment during rock removal and sheet pile installation.

As water is diverted back into Canyon Creek following construction, a pulse of sediment will be released. This will temporarily increase turbidity downstream of the project area, potentially depositing fine sediments into larger-grained substrate downstream. However, the amount of sediment is not expected to be extensive, and the elevated turbidity levels will be highly localized and short in duration. Water temperatures may be warm and exclude bull trout from the project area during the proposed construction period.

The project is designed to benefit bull trout and other salmon species by restoring passage to Canyon Creek. The proposed project when completed will provide access to approximately two miles of habitat with natural cover such as large wood that will be available for bull trout foraging, overwintering, and potentially providing spawning and rearing habitat for the Dungeness River local population.

### *7.2.3 Critical Habitat*

Critical habitat for Coastal/Puget Sound bull trout was designated in 2005 (USFWS 2005), the Dungeness River and its tributaries were identified as being bull trout critical habitat. Several GIS data base programs identify not only the Dungeness river and Canyon Creek downstream of the diversion dam as critical habitat but also include the entire Canyon Creek upstream of the dam which includes the project area. The USFWS (USFWS 2010) revised designated critical habitat for bull trout to include nine Primary Constituent Elements (PCEs). These are listed below, along with an assessment of project effects on each PCE:

(1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.
*The proposed project is not anticipated to have any effect on springs, seeps, groundwater sources, or subsurface water connectivity.*

(2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
*The proposed project will provide access to an additional two miles of migration habitat.*

(3) An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
*The proposed project is anticipated to improve the food base as discussed in Section 6.2.*

(4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.
*The proposed project will provide/restore access to approximately two miles of complex environment that has not been available for over 100 years.*

(5) Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
*The proposed project will have no effect on water temperatures.*

(6) In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
*The proposed project is not anticipated to adversely affect substrate in spawning or rearing areas. No spawning sites for bull trout are known to occur in the Project area or the Action Area, and the diversion dam has blocked access to all but a few hundred feet of Canyon Creek for approximately 100 years. The proposed project is not anticipated to have any effect on substrate but it will allow access to approximately two miles of habitat that are likely to have areas with suitable substrate for bull trout spawning and rearing. Therefore the proposed project will have the effect of increasing suitable substrate for bull trout spawning and rearing.*

(7) A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
*The proposed project will have no effect on the hydrograph or flows.*

(8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
*This project may have a minimal and temporary effect on turbidity but will have no effect on water quantity. WDFW does not anticipate that the temporary and minor changes to turbidity will inhibit water quality or quantity, to the point that it would result in changes to reproduction, growth, or survival of bull trout.*

(9) Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.
*The proposed project is not anticipated to affect the occurrence of nonnative predatory species. No resource agencies have identified or voiced concerns about the proposed project affecting the occurrence of non-native fish.*

#### *7.2.4 Effect Determination*

The proposed project **may affect, but is not likely to adversely affect,** Coastal/Puget Sound bull trout. This determination is made based upon the limited scope and duration of the project, the low likelihood that bull trout would be present in the action area during construction, the temporary and minor nature of project impacts, and benefits provided by restoring passage. The WDFW has determined that this project **may affect, but is not likely to adversely affect,** critical habitat of Coastal/Puget Sound bull trout. The project is designed to benefit bull trout and other salmon species by restoring passage to upper Canyon Creek, allowing access to foraging and overwintering habitat, and possibly providing rearing and spawning habitat.

### 7.3 Hood Canal Summer-Run Chum Salmon

The Hood Canal Summer-Run chum salmon Evolutionarily Significant Unit was listed as a threatened species in March 1999 under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531, et seq). Chum Salmon have evolved to migrate immediately to marine waters upon hatching, limiting their freshwater life history. This life history strategy, which chum salmon share with pink salmon (*Oncorhynchus gorbusch*a), reduces the mortality associated with the variable freshwater environment but makes chum more dependent on estuarine and marine habitats.

Both summer and fall chum salmon are present in the Dungeness River. Dungeness summer chum were recognized as a separate stock in the state-tribal summer chum recovery plan (WDFW 2002 and PNPTT 2000), based on their distinct spawning distribution and early spawning timing. There is no abundance trend data for Dungeness summer chum, therefore, it is not known if population numbers are increasing or decreasing or if the population is stable or healthy. Summer-run chum have been observed in the Dungeness River during spawner surveys for Chinook and pink salmon. The numbers of fish observed are so low that they may not represent a self-sustaining stock but could be strays from other stocks. There is no data prior to 1980 that indicates the presence of a summer chum stock in the Dungeness River. Most spawning takes place in September and October in the lower Dungeness River, however, summer chum have been seen upstream as far as the WDFW Dungeness Hatchery (RM 10.5).

Designated critical habitat for the Hood Canal Summer-Run ESU chum includes the stream channels of the Dungeness River Watershed.

### *7.3.1 Utilization of the Action Area*

The existing diversion dam has blocked fish passage since it was constructed over 100 years ago, and as a result no chum salmon are present upstream of the project. No documents identifying chum salmon using the stretch of Canyon Creek downstream of the dam have been found. If summer chum are present in Canyon Creek downstream of the dam, most spawning would likely occur in September and October as it occurs in the lower Dungeness River.

### *7.3.2 Effects of the Proposed Action*

The vast majority of chum in the Dungeness system will have likely spawned prior to the proposed project construction. If either summer or fall chum successfully spawned in Canyon Creek or in the Dungeness River immediately below its confluence with Canyon Creek, the resulting juvenile chum would likely have migrated out of fresh water to marine waters in the spring. As the proposed project is scheduled to be constructed in July through September, no chum are anticipated to be present in the action area during the proposed construction period. Baseline water quality and habitat conditions will not be degraded by the proposed action. The proposed project will produce only short-term, localized disturbances. During project construction, turbidity is not expected to increase substantially above ambient conditions and likely will only increase during the installation and removal of the bypass pipeline. Furthermore, any increase in turbidity resulting from the project construction will likely be contained to Canyon Creek. Therefore, even if chum redds were present along the left bank of the Dungeness River immediately downstream of the confluence of Canyon Creek and the Dungeness River, it would be very unlikely that turbidity levels would still be elevated above background after flowing through several hundred feet of the Canyon Creek channel.

The proposed project will allow juvenile chum salmon and other species access to approximately two miles of over-wintering and rearing habitat along with providing high flow refugia upstream of the dam. The proposed project will also allow adult chum salmon access to the habitat upstream of the dam which may contain areas suitable for spawning.

### *7.3.3 Designated Critical Habitat*

Designated critical habitat for the Hood Canal Summer-Run Evolutionarily Significant Unit (ESU) chum includes the stream channels of the Dungeness River Watershed.

Within the designated critical habitat for chum in fresh water areas, the primary constituent elements (PCEs) are water quality, freshwater spawning sites with appropriate substrate for spawning, incubation and larval development; freshwater rearing sites that have floodplain connectivity and habitat conditions supporting juvenile growth, mobility, and forage; natural cover; and freshwater migration corridors that are free of obstruction and excessive predation having sufficient water quantity and quality conditions and natural cover which will support juvenile and adult mobility and survival (NMFS 2005). The proposed project would temporarily disturb about one-tenth of an acre of critical habitat due to construction activities, primarily the increase in turbidity during the bypass installation and removal. The other PCEs such as spawning sites, fresh water rearing sites, natural cover such as large wood, aquatic vegetation, and side channels, and freshwater migration corridors will all be increased or improved by the proposed project.

### *7.3.4 Effect Determination*

The proposed project **may affect, but is not likely to adversely affect**, Hood Canal Summer-run chum. This determination is made based upon the limited duration of the project, the low likelihood that chum would be present in the action area during construction, the temporary and minor nature of the project’s negative impacts, and the potential positive effects to chum salmon that will likely occur from providing access to approximately two miles of rearing and potential spawning habitat that has not been utilized by chum salmon for over 100 years. Additionally, WDFW has determined that this project **may affect, but is not likely to adversely affect**, critical habitat of Hood Canal Summer-run chum salmon.

## 7.4 Puget Sound Steelhead

NMFS (2007) listed the Puget Sound steelhead Distinct Population Segment (DPS) as a threatened species effective June 11, 2007. The listing was based on the estimated effects of the following factors on the continued existence of the species: (1) present or future destruction, modification, or curtailment of its habitat or range; (2) overuse for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors. Two stocks of steelhead have been identified within the Dungeness River basin, the summer and winter Dungeness River steelhead stocks (WDFW 2002).

Dungeness summer steelhead have been designated as a distinct stock based on the geographic isolation of the spawning population. Little is known regarding Dungeness summer steelhead (SASSI 2002, Lichatowich 1993). Adult steelhead presence is known as far as the impassable falls on the mainstem (RM 18.7), and to at least 3-Forks on the Gray Wolf River (RM 9.6, Lichatowich 1993). The lowermost extent of spawning is unknown as summer and winter steelhead cannot be distinguished at spawning time, but they are thought to spawn in the upper reaches of the river.

Dungeness winter steelhead spawning distribution is thought to be similar to the Coho spawning distribution (to RM 18.7), extending downstream to the upper extent of tidewater. Winter steelhead distribution is also presumed to be the same as for Coho in Bell, Gierin and tributaries, Cassalery, Cooper, Meadowbrook, Matriotti, Beebe, Lotsgazell, Woodcock, Mud, Bear (trib. to Matriotti), Unnamed tributary to Matriotti at RM 6.0, Hurd, Bear (18.0030), Canyon, and Gold Creeks, and the Gray Wolf River. The stock status has been identified as depressed, but it may actually warrant a change to critical status.

### *7.4.1 Utilization of the Action Area*

Steelhead use of Canyon Creek downstream of the existing diversion dam is unknown. As fish passage has not been available upstream of the diversion dam for over 100 years, no steelhead have been able to migrate upstream of the dam.

### *7.4.2 Effects of the Proposed Action*

The effects of the proposed action on Steelhead will be similar to those described for Chinook and bull trout.

### *7.4.3 Designated Critical Habitat*

Critical habitat has not been designated for the Puget Sound steelhead DPS.

### *7.4.4 Effect Determination*

The proposed project **may affect, but is not likely to adversely affect,** Puget Sound steelhead. This determination is based upon the low likelihood of steelhead spawning adjacent to, or below the project reach during construction, the limited turbidity produced by the project, and the benefits that will likely occur from removing a migration barrier that will provide access to approximately two miles of habitat with abundant cover including large woody debris that may be utilized for rearing, potentially for spawning, and may provide refuge from high water velocities during high flow events.

## 7.5 Marbled Murrelet

The marbled murrelet (*Brachyramphus* marmoratus) was listed as a threatened species in October 1992 under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531, et seq). The primary cause of marbled murrelet population decline is the loss and modification of nesting habitat through commercial timber harvests, human-caused fires, and land conversions, and to a lesser degree, through natural causes such as wild fires and wind storms. Additional causes of decline include oil spills, gill-net fishing, marine pollution, and predation (USFWS 2009).

Marbled murrelets forage in the near-shore marine environment and nest in inland old-growth coniferous forests of at least seven acres in size. Marbled murrelets nest in low-elevation forests with multi-layered canopies; they select large trees with horizontal branches of at least seven inches in diameter and heavy moss growth.

Using data from 137 nests from southern British Columbia to northern Oregon, the nesting season of marbled murrelets in Washington is best defined as the period from April 1 to September 23. However, after September 4, all incubation has been completed and less than 5 percent of murrelets are still nesting (U.S. Fish and Wildlife Service 2012). Adults with young to feed fly between terrestrial nest sites and ocean feeding areas primarily during the dawn and dusk hours.

Marbled murrelets spend most of their lives in the marine environment, where they forage in areas within two miles from shore. Murrelets often aggregate near localized food sources, resulting in a clumped distribution. Prey species include herring, sand lance, anchovy, osmerids, sea perch, sardines, rockfish, capelin, smelt, as well as euphausiids, mysids, and gammarid amphipods. Marbled murrelets also aggregate, loaf, preen, and exhibit wing-stretching behaviors on the water.

Marbled murrelets nest inland in forests that are generally characterized by large trees with large branches or deformities for use as nest platforms. Murrelets nest in stands varying in size from several acres to thousands of acres. However, larger unfragmented stands of old growth appear to be the highest quality habitat. Nesting stands are dominated by mixed conifer in Oregon and Washington and by old-growth redwoods in California.

The FWS originally designated critical habitat for the marbled murrelet in Washington, Oregon, and California on May 24, 1996 (61 FR 26256). The critical habitat designation included only terrestrial nesting habitat. The critical habitat units nearest to the project site are approximately 0.225 miles to the east, within Olympic National Forest/Olympic National Park.

### *7.5.2 Utilization of the Action Area*

Regional patterns of marbled murrelet activity in marine waters tend to be seasonal, and are tied to exposure to winter storm activity. For northern Puget Sound, the seasonal densities and percent occurrence of marbled murrelets were determined for censuses within five broad habitat groups, each in turn subdivided into several more specific habitat types. The "Open Water Greater than 20 m Depth" habitat group, identified marbled murrelet use of marine habitat nearest the project site. In Sequim and Discovery bays, the large sheltered bays at the eastern end of the Strait of Juan de Fuca, marbled murrelets reach peak abundance during the fall period. No other habitat within this habitat group had as high a density, 2.5 birds/km2. The maximum density obtained during the winter period, 0.92 birds/km2, was also from Sequim and Discovery Bays. Concentrations of marbled murrelets were also reported from this area on Audubon Christmas Counts, according to summary statements by Speich and others (1992). Within this habitat group, the proportion of individual censuses with Marbled Murrelets was generally near, and often less than, 20 percent (0.2). The exception was the summer period for Sequim and Discovery Bays where marbled murrelets were observed on 50 percent of all censuses in the area, but the sample size (n = 2) is very small. Within this habitat group, the deep open waters within the San Juan Islands showed peak numbers and occurrence rate during the summer and fall periods (Ralph et al 1995).

Hamer and Nelson (1995) summarized the characteristics of 61 tree nests and nesting stands of the marbled murrelet located from 1974 to 1993 in Alaska, British Columbia, Washington, Oregon, and California. They found that forest types in Washington within the murrelet's breeding range, predominately mixed forests of western red cedar (*Thuja plicata*), western hemlock, Douglas-fir, and Sitka spruce (*Picea sitchensis*), created by the combined forces of fire and wind, covered the majority of the landscape.

All nest trees in the Pacific Northwest were recorded in stands characterized as old-growth and mature forest. These stands were dominated by either Douglas-fir, coast redwood, western hemlock, western red cedar, or Sitka spruce. The one exception was a higher elevation nest stand found in the Caren Range of British Columbia which was dominated by old-growth mountain hemlock (60 percent) with smaller percentages of yellow cedar (20 percent) and silver fir (20 percent). In California, nest stands were dominated by coast redwood and Douglas-fir, with a component of western hemlock and Sitka spruce in some nest stands. In both central and northern California, all nest sites had a higher percentage of redwood trees than Douglas-fir. Forest types in Washington included stands dominated by western hemlock, Douglas-fir, and Sitka spruce. These stands commonly had a large component of western red cedar. Silver fir made up a smaller component of some of the nest stands in Washington.

One record of a nest tree and nest stand was identified on 10 September 1990 as being located at the Dungeness River. A more precise location was not available.

### *7.5.3 Effects of the Proposed Action*

The proposed project would occur adjacent to marbled murrelet critical habitat and the noise associated with the operation of heavy equipment could potentially disrupt nesting and feeding activities. The USFWS guidance suggests that noise above ambient levels is considered to potentially disturb marbled murrelets when it occurs within 0.25 mile of suitable nesting habitat (USFWS 1996). Using the USFWS critical habitat mapping tool, murrelet critical habitat is 0.225 miles from the construction activity, and it should be assumed suitable nesting habitat is 0.225 miles from the project site (Figure 5).

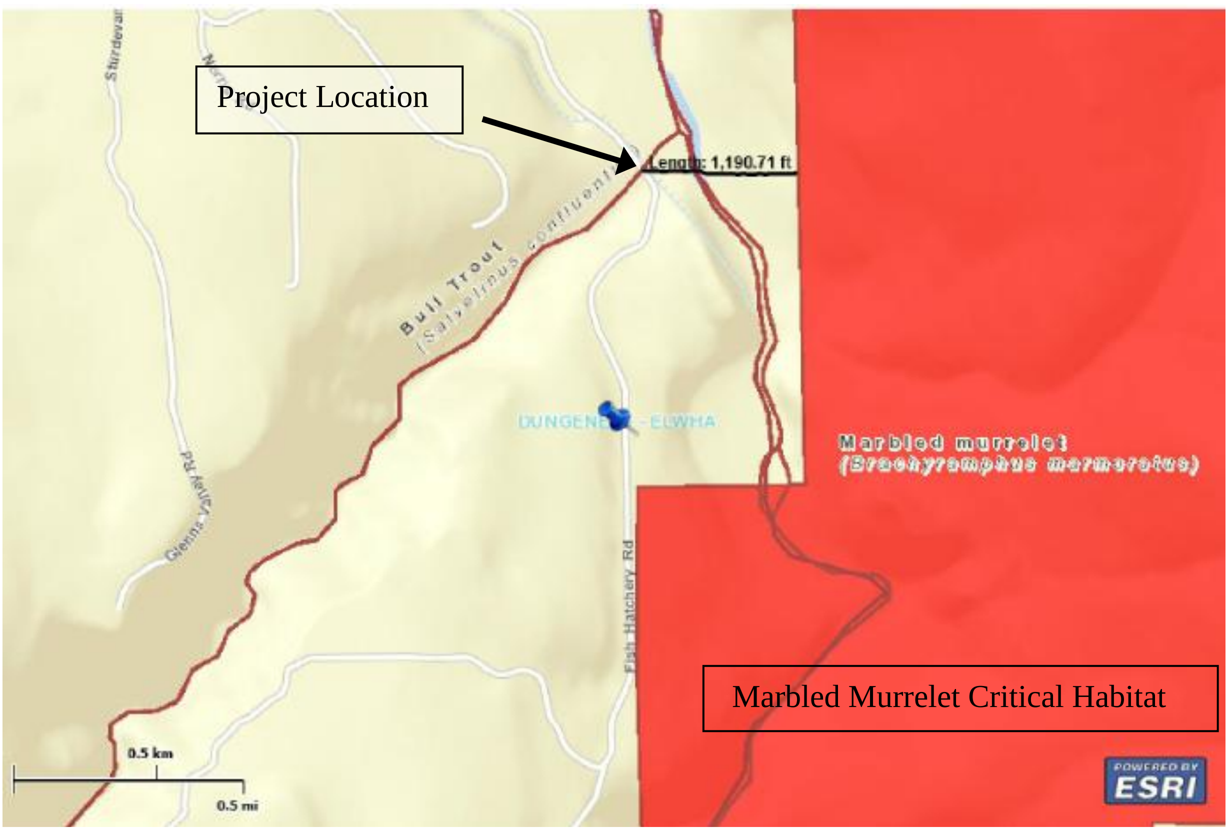


**Figure 5. Distance(1190 ft.) from Project Location to Marbled murrelet Critical Habitat (red area).**

Although construction activities would occur adjacent to suitable nesting habitat, substantial human activity is common at this location as the project is located under a county road bridge, and the project area requires frequent maintenance from hatchery personnel. Many of the construction activities have the potential to disturb murrelets with the rock removal and sheet piling installation having the highest potential for disturbance. Due to the unique construction site with steep channel slopes on two sides, a diversion dam upstream, and a bridge overhead, the vast majority of noise associated with rock removal and sheet piling installation will likely be contained to the immediate project site, greatly reducing the potential of disturbance to nesting or feeding marbled murrelets.

To reduce the risk of disturbance to nesting murrelets, project construction will utilize limited operating periods (LOPs) that will only allow work to occur from 2 hours after sunrise to 2 hours before sunset. Application of these LOPs will be required during the entire nesting season (April 1 to September 23). With these LOPs in place, construction activities such as the use of heavy equipment including rock removal are not anticipated to result in disturbance to nesting murrelets. As the construction period generating high levels of noise is expected to be of short duration, approximately 5 days rock removal, and 3 days for sheet pile installation, the cumulative effect of noise disturbance associated with the proposed project is expected to be minor.

The proposed project is not expected to result in a long term disturbance to marbled murrelet nesting and feeding activities or to marbled murrelet critical habitat. Any disturbance to nesting or habitat that might occur would be expected to subside rapidly upon completion of the construction work.

### *7.5.4 Effects Determination*

The potential to encounter a nesting murrelet during the implementation of the proposed project appears to be extremely low. It may therefore be feasible, with implementation of LOPs, to justify the conclusion that the risk of exposure to murrelets is discountable. Factors that support a discountable determination include low habitat quality (based on consideration of tree size, platform numbers, location, stand size and disturbance history) in the project area, and the type of activity proposed (the proposed activity with the highest potential to disturb murrelets would be the 5 days of rock removal, where the noise will be partially contained under the bridge deck and between the channel slopes and bridge abutments).

Since construction activities would have no direct effect on nesting habitat, long-term effects to the murrelet food base are not anticipated, and the effects of any noise disturbance during construction will be very short in duration, highly localized and therefore expected to be minor, the proposed project **may affect, but is not likely to adversely affec**t the marbled murrelet. Because designated critical habitat is not in the project area, but is very near, the work **may affect, but is not likely to adversely affect** designated critical habitat for this species.

## 7.6 Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) was federally listed as a threatened species throughout its range in June 1990 (USFWS, 1990). The primary reason for this listing was the reduction and fragmentation of habitat that was projected to continue under the forest practices utilized at the time of listing. The northern spotted owl nests in tree cavities, on debris platforms, and in the old nests of other large birds. In Washington, nesting occurs between March 1 and July 31, and fledging occurs between August 1 and September 30. Dispersal of juvenile owls begins in the early fall. Usually juveniles move from their natal area to a breeding site, and occasionally adults move from one breeding site to another.

Spotted owls prey on a broad array of species, such as insects, birds, and small mammals; however, primary prey items are wood rats (*Neotoma fuscipes* and *N. cinerea*) and flying squirrels (*Glaucomys sabrinus*). Although spotted owls are nocturnal, during the day they forage opportunistically and may move short distances to change roosting position in response to changes in ambient temperature or exposure to direct sunlight.

### *7.6.1 Critical Habitat*

Northern spotted owls generally inhabit older forested habitats that contain structures and characteristics required for nesting, roosting, and foraging. Preferred habitat is characterized by forest stands with moderate to high canopy closure (60 to 90 percent), which provides thermal cover and protection from predators; multi-species canopies of several tree species of varying size and age, but with large overstory trees; large standing and fallen dead trees; high incidence of large trees with various deformities; and, sufficient open space among the lower branches to allow flight under the canopy.

Foraging habitat is generally similar to nesting and roosting habitat, but it may not always support successfully nesting pairs. Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities.

Critical habitat was designated for this species in January 1992 (USFWS, 1992b), and revised in August 2008 (USFWS, 2008). The proposed project area does not include critical habitat for northern spotted owl. The closest designated critical habitat is approximately 2 miles away to the South in the Olympic National Forest/Olympic National Park.

### *7.6.2 Utilization of the Action Area*

In Washington, the northern spotted owl occurs in the old growth forested regions of the Olympic Peninsula, in the western lowlands, and in the Cascades, generally below elevations of 4200 feet. These forest types are primarily spruce/fir, mixed conifer and mixed evergreen, and the moist end of the ponderosa pine coniferous forest zones up to approximately 3,900 ft near the northern edge of the range and up to approximately 6,000 ft at the southern edge.

The National Park Service (NPS) has been conducting spotted owl surveys since 1995 and the results of the 2011 survey indicate the overall counts are the lowest since monitoring began here, and are probably due to both the steady decline in the number of owls occupying the study area and an unusually low detection rate because of the extreme weather conditions.

The 52 spotted owl sites monitored in 2011 represented a sample of roughly 23% of the 229 spotted owl territories estimated to occur in the Olympic National Park as of 1995 (Seaman et al., 1996). The mean length of record was 19.4 years (range 16-20), not including years prior to 1992 when monitoring to current protocols began at most sites.

When calculated for a fixed sample of spotted owl sites monitored from 1994-2011 (N = 49), the mean elevation of occupied sites has increased 760’ to 2885’. In 2011 there were no activity centers located below 2150’ elevation. While there is clearly a relationship between elevation and the likelihood that a spotted owl site has remained occupied, models indicate that slope and topographic moisture explain more of the variance in occupancy than elevation alone (Gremel, 2005). However, in this landscape, the steep, dry sites where spotted owls remain tend to occur at higher elevations. The researchers speculate that all of these topographic variables are simply correlates for barred owl occupancy. Regardless of which factors are responsible, spotted owl distribution in the Olympics has changed radically over the course of this study. Remaining spotted owls are increasingly restricted to the drier north and east Olympics, where they persist on sites with steep slopes at higher elevations, often in headwaters and side drainages.

### *7.6.3 Effects Determination*

Northern spotted owl habitat does not typically include lower non-forested elevations of the river valleys; therefore, no critical habitat exists on the project site but is present approximately two miles to the south. As spotted owls are dependent on forested habitat and prefer old growth habitat, they are not expected to occur in the project area, located as it is under an existing road bridge where human activity is common. Since construction activities would have no direct effect on nesting habitat, long-term effects on the northern spotted owl food base are not anticipated, and the effects of any noise disturbance during construction will be very short in duration, highly localized and therefore expected to be minor, the proposed project **may affect, but is not likely to adversely affec**t the northern spotted owl. Because designated critical habitat is not in the project area, but is very near, the work **may affect, but is not likely to adversely affect** designated critical habitat for this species.

# 7 INTERRELATED AND INTERDEPENDENT EFFECTS

There are no known interrelated or interdependent actions identified to be associated with the proposed action at this time.

# 8 CUMULATIVE EFFECTS

WDFW is not aware of any cumulative effects associated with this project at this time.

# 9 CONCLUSION

Table 3 summarizes the effect determinations made for each of the species protected under the Endangered Species Act potentially occurring in the project vicinity.

**Table 3. Determination summary table.**

| Species | Effect Determination | Critical Habitat Determination |
|---|---|---|
| Puget Sound Steelhead | Not likely to adversely affect | — |
| Coastal/Puget Sound Bull Trout | Not likely to adversely affect | Not likely to adversely affect |
| Puget Sound Chinook | Not likely to adversely affect | Not likely to adversely affect |
| Hood Canal Summer-Run Chum Salmon | Not likely to adversely affect | Not likely to adversely affect |
| Marbled Murrelet | Not likely to adversely affect | Not likely to adversely affect |
| Northern spotted owl | Not likely to adversely affect | Not likely to adversely affect |

## 10 ESSENTIAL FISH HABITAT

The project area has been designated as Essential Fish Habitat (EFH) for various life stages of four species of Pacific salmon.

Freshwater Essential Fish Habitat for pacific salmon consists of 4 major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; (4) adult migration corridors and adult holding habitat. Important features of essential habitat for spawning, rearing and migration include adequate (1) substrate composition; (2) water quality (e.g. dissolved oxygen, nutrients, temperature, etc.); (3) water quantity, depth and velocity; (4) channel gradient and stability; (5) food; (6) cover and habitat complexity (e.g. large woody debris, pools, channel complexity, aquatic vegetation, etc.); (7) space; (8) access and passage; and (9) flood plain and habitat connectivity.

Conclusion

WDFW has determined that the proposed action **will not adversely affect** EFH for federally managed fisheries in Puget Sound, Washington. This determination is based on the temporary and minor nature of project impacts and that EFH should likely increase because the proposed project will provide fish passage to approximately two miles of habitat that has been blocked by the diversion dam for over 100 years.

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# APPENDIX A
## Canyon Creek Fish Ladder Drawings