# Lewis River Bull Trout (*Salvelinus confluentus*) Annual Operations Plan – FINAL

## *North Fork Lewis River – 2016*

Merwin Hydroelectric Project (P-935)
Yale Hydroelectric Project (P-2071)
Swift No. 1 Hydroelectric Project (P-2111)
Swift No. 2 Hydroelectric Project (P-2213)

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# I. INTRODUCTION

Monitoring of bull trout populations in the North Fork Lewis River (Figure 1.0) has occurred annually since 1989. Monitoring activities are a collaborative effort between PacifiCorp and the Public Utility District No. 1 of Cowlitz County, Washington (Cowlitz PUD), federal, and state resource agencies.

On September 15, 2006, the U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BiOp) including associated Incidental Take Statement for the operation of the Lewis River hydroelectric projects. Though there are no specific Annual Operating Plan requirements included within the BiOp, there are specified annual monitoring activities and reporting requirements with respect to bull trout within the basin.

On June 26, 2008 (effective date), the Federal Energy Regulatory Commission (FERC) issued new 50-year operating licenses for all Lewis River hydroelectric projects. Article 401(a) of the new licenses requires completion of an all encompassing Monitoring & Evaluation Plan (M&E Plan) for the North Fork Lewis River. The M&E Plan was finalized and implementation begun in 2010. Within this M&E Plan are provisions for the annual monitoring of bull trout specifically addressed by 9.6.2 of the Lewis River Settlement Agreement (SA) which states,

"The Licensees shall include in the M&E Plan elements to monitor and evaluate PM&E Measures relating to bull trout, including specific methods and measures to be used in monitoring bull trout populations, including, but not limited to, tagging and snorkel surveys."

As required under section 2.18, Objective 18 of the Lewis River M&E Plan, the Utilities are to develop an Annual Operating Plan (AOP) that contains at minimum, specific elements to address the following four objectives:

- Provide an "unbiased" estimate of bull trout spawner abundance in Swift Reservoir.
- Collect and transport bull trout from within the Yale tailrace, Swift Power Canal or the Swift Bypass Reach and transport to an area as directed by the USFWS, to promote spawning availability and success of these fish within the Lewis River local populations.
- Monitor bull trout abundance or presence/absence in key Lewis River tributaries as identified during AOP development.
- Meet acceptable precision levels as established by the USFWS for recovery of bull trout identified during AOP development.

The AOP is developed each year in consultation with the USFWS and may adaptively change per their direction or as new scientific information becomes available.

For 2016, the following six programs are proposed.

1. Swift Reservoir Bull Trout Migration, Effective Population (Ne), and Survival (S) Estimates
2. Yale Tailrace Collection and Transportation
3. Swift Bypass Reach Collection and Transportation
4. Fixed Half-duplex Passive Integrated Transponder (PIT) Antenna Arrays in Drift, Pine, Rush, P8, and Cougar Creeks
5. Cougar Creek Spawning Population Estimate
6. Comprehensive Bull Trout Redd Surveys of Pine Creek Mainstem, Pine Creek Tributary P8, and Rush Creek

A schedule of activities and estimated effort to complete each task is provided in the task descriptions below. Many of the tasks or programs are designed to estimate the number of bull trout present in either known spawning locations (e.g. Cougar Creek) or in tailrace areas (e.g. Yale). Spawner survey data are used to identify population risks (e.g., sharp declines in numbers) and, if necessary, to help develop appropriate management actions to protect these populations and stem any declines.

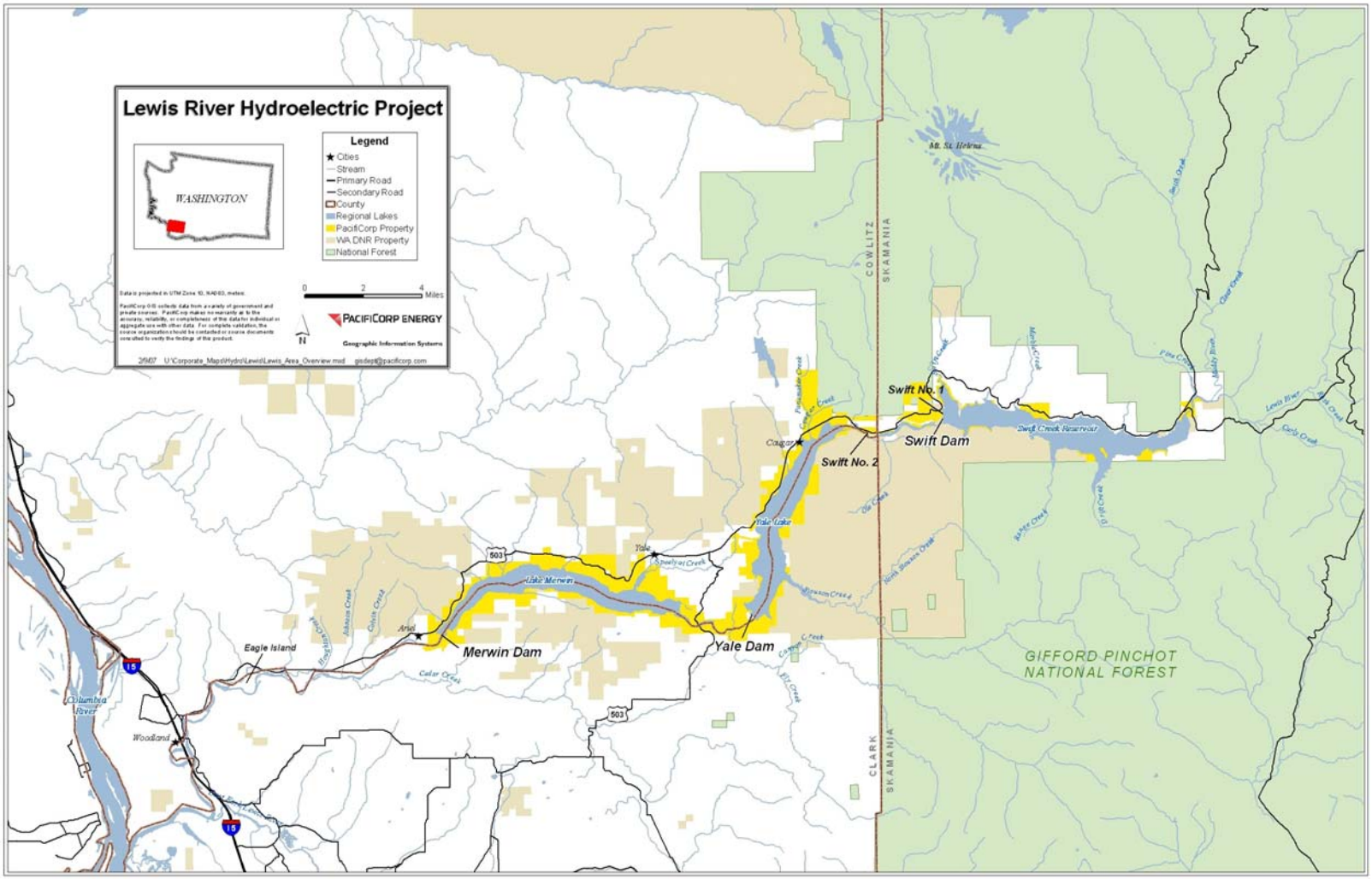


**Figure 1.0 – Map of study area**

# II. PROPOSED MONITORING PROGRAMS

## 2.1 SWIFT RESERVOIR ADULT BULL TROUT ESTIMATES

### Annual Swift Reservoir Adult Bull Trout Migration Estimate

Radio tracking studies in 1990, 1991 and 1994 revealed a pre-migrant congregation of bull trout at the Swift Reservoir headwaters (Eagle Cliffs). The studies further indicated that most tagged bull trout migrated into either Rush or Pine Creeks (tributaries to the Lewis River mainstem), with Rush Creek being preferred. These behavioral patterns have allowed the use of a Peterson type estimator to document the number of migrants ascending the North Fork Lewis River (Lewis River) from the Eagle Cliffs area. Historically the annual estimate of bull trout migrants has been a joint effort between PacifiCorp, the U.S. Forest Service (USFS), the Washington Department of Fish and Wildlife (WDFW) and the USFWS.

The Peterson type estimator uses software program NOREMARK® developed by Gary White of Colorado State University to estimate migratory abundance. NOREMARK® computes estimates of population size for a closed population with a known number of marked animals and one or more re-sighting surveys (White 1996). To fulfill the marking aspect of the estimator, pre-migrant bull trout are captured and tagged in May, June, and July using tangle nets consisting of dyed green 6# monofilament, with depths of approximately 2 meters (m), varying lengths of 25 – 40 m, and varying mesh sizes of 2.5 – 7.5 centimeter (cm) stretch. With the use of boats, nets are either drifted along the bottom in the Eagle Cliffs area (Figure 2.1-1) or set and allowed to passively fish unattended for up to 10 minutes. Angling, when appropriate, may also be employed to capture staging bull trout.

Once a bull trout becomes entangled in the net, the net is retrieved and the captured bull trout is released from the net and placed in a live well. New in 2016 to further address potential bias of non-migrating tagged fish, only bull trout **450 mm** or larger (or as stipulated by the USFWS) will be marked with **two** Kelly green colored 3-inch Floy® anchor tags (six-year Floy® tag color rotation: Kelly green, white, chartreuse, orange, fluorescent yellow and fluorescent pink). Historically bull trout as small as 360 mm have been Floy® tagged as part of this Program. Through the use of instream Passive Integrated Transponder (PIT) tag antennas at various sites throughout the basin since 2002, researchers now know that the occurrence of bull trout less than 450 mm in fork length making spawning migrations is extremely infrequent, yet the addition of the 360 mm – 449 mm size-class within the migration estimate can greatly skew the estimates precision from one year to the next. Care will be taken during re-sight snorkel surveys to only count marked and unmarked bull trout that are greater than 450 mm in fork length.

The goal of the two Floy® tags is to test the assumption of tag loss which currently is included within an all-encompassing 10 percent reduction from the total which accounts for non-migration, mortality, and in-season tag loss. During snorkel activities, sample crews will pay special attention to the amount of Kelly green tags observed on bull trout (NOREMARK® recapture survey methodology) to directly assess any in-season tag loss.

The goal of these activities is to capture and Floy® tag 100 individual bull trout larger than 450mm. This collection goal may be adaptively managed mid-season based on extenuating circumstances or collection constraints (e.g. surveys called off based on high number of in-season recaptures or high water volume in collection area limiting the number of bull trout available to be caught for tagging purposes). Depending on unforeseen factors, the 100-fish collection goal may not be achieved from one year to the next.

In addition to floy tagging, the WDFW initiated a PIT-tagging program for captured bull trout in 2002. Historically, bull trout larger than 120 mm were tagged with a full-duplex (FDX) 12 mm PIT-tag in the dorsal sinus. Since 2011, to coincide with half-duplex (HDX) PIT antennas installed in upper North Fork Lewis River tributary's, all captured bull trout larger than 300 mm have been tagged with a half-duplex PIT-tag. Bull trout greater than 300 mm fork-length (FL) will be tagged with a 23 mm half-duplex PIT-tag in the dorsal sinus, while bull trout 120 mm to 299 mm fork length will be tagged with a 12 mm FDX PIT-tag in the dorsal sinus in hopes of later recapture.

To tag bull trout greater than 300 mm FL with a 23 mm HDX PIT tag, a small incision just wide enough to accommodate the diameter of the tag (appr. 3.85 mm) will be made with a scalpel just anterior to the dorsal sinus and the tag will then gently be pushed toward the caudal peduncle into the sinus (Tranquilli et. al 2003). Captured bull trout less than 300 mm FL will be tagged with a 12 mm FDX PIT tag in the dorsal sinus by means of a syringe type PIT tag injector.

Bull trout recaptures greater than 300 mm previously tagged with a full-duplex PIT tag in their dorsal sinus will be tagged with an additional half-duplex PIT tag in the sinus on the opposite side of the fish and posterior to the original FDX tagging location. This tagging location has been identified since 2010 as being a suitable long-term tagging location where the two different types of PIT tag signals will not interfere with one another. If the recaptured FDX PIT tagged bull trout is less than 300 mm no additional tag will be inserted. PIT-tags are an alternative marking tool for captured bull trout with the intent to provide long-term survival, abundance, biological, and migratory data for individual fish.

In conjunction with tangle netting activities, PacifiCorp will weigh each captured bull trout larger than 120 mm. This information will serve three purposes: First, weight-length ratios can be calculated (K factors) for each fish; secondly, this information can be compared to previous years to determine if changes in the annual average K-factor exist and whether these changes can be correlated with any population trends observed; and thirdly, with previously PIT-tagged bull trout, researchers will be able to determine individual length and weight gain which may provide information on reservoir conditions and productivity since an individual's last capture. Also, as part of the biological data handling process, captured bull trout will have either scales taken from 3-6 rows up from the lateral line between the dorsal and the anal fin for a minimum of 3 scales, or the first three fin rays will be collected from the pectoral fin. These two collection methods will be incorporated to determine age composition of bull trout captured at Eagle Cliffs. Analysis will be conducted by a lab at a later date.

Depending on river flow conditions, weekly snorkel surveys will be conducted eight times from August through September of the confluences of Rush Creek, Muddy River, and Pine Creek with the North Fork Lewis River (Figure 2.1-1). During each snorkel count, biologists will be equally

spaced and trained to follow the methods used to snorkel the "Rush Creek Hole" to alleviate double-counting fish. To estimate migration escapement to the re-sight areas, individual survey results are combined and then averaged. A 10 percent in-season tag loss is assumed in the estimate.

**Annual Swift Reservoir Adult Bull Trout Survival (S) Estimate**

Detections of previously tagged bull trout at fixed PIT antenna arrays located in Drift, Rush, Pine, and P8 Creeks, the Swift Floating Surface Collector (FSC), as well as recaptures during Eagle Cliffs netting activities in the late spring and early summer will be used to assess migration patterns, preferred habitat and to generate estimates of the following using the population structure software program MARK (White and Burham 1999):

- Probability of participating in a spawning migration
- Probability of detection during spawning
- Annual Survival (S)

**Swift Reservoir Effective Population ($N_e$) Size Evaluation**

The Effective Population ($N_e$) size of bull trout within Swift Reservoir will be evaluated in 2016 in order to fulfill bull trout objective number one within the M&E Plan which states, "Provide an "unbiased" estimate of bull trout spawner abundance in Swift Reservoir".

Estimation of effective population size can provide information on the level of genetic variation within a population and how fast genetic variation may be lost through genetic drift (Luikart et al. 2010). The effective population size represents the size of an ideal population that would have the same rate of loss of genetic variation as the observed population (Wright 1931). Although general guidelines for minimum effective population sizes have been suggested (e.g., the 50/500 rule; Franklin 1980), evaluating temporal trends in estimates of $N_e$ are often more useful than determining whether a population meets some minimum threshold number. For example, a population that shows a large decrease in $N_e$ over the course of one or two generations could be experiencing a genetic bottleneck or decline in abundance. Alternatively, an increase in effective size following implementation of new management actions could be one indication that the population is responding positively (Pers. Comm. Pat DeHaan, USFWS).

To evaluate $N_e$ it is anticipated genetic tissue from 30-50 juvenile bull trout from the same cohort (presumably age 1) will need to be attained from utilized spawning tributaries (Pine and Rush Creeks, Figure 2.1-1). In order to get maximum genetic representation, fish captures will also need to be spatially balanced along the length of usable habitat within the stream (Pers Comm. Pat DeHaan, USFWS).

To collect tissue samples from juvenile bull trout, two biologists will conduct electrofishing surveys with a Smith-Root® model LR-24 backpack electrofisher. All electrofishing activities will follow protocols as recommended by the electrofishing unit manufacturer and the National Marine Fisheries Service's (NMFS) Guidelines for Electrofishing Waters Containing Salmonids listed under the Endangered Species Act (NOAA 2000). To minimize impact and incidental

injury to collected juvenile bull trout, the electrofisher will be set to straight DC current and voltage settings will be turned to the lowest output possible to capture fish.

A small clip of tissue from the upper lobe of each bull trout's caudal fin will be preserved in labeled vials filled with 95 percent ethanol. The size of fin clip will be relative to the size of fish captured. Regardless of fish size, at no time will the tissue sample be greater than 1 square centimeter. All captured fish will also be measured to their caudal fork and capture location recorded. Tissue samples will then be sent to the USFWS Abernathy Conservation Genetics Lab for genotypic and $N_e$ analysis.

Also, during bull trout juvenile collection of Pine and Rush Creeks, all encountered coho juveniles captured during electrofishing surveys will be enumerated and recorded to get a proportion of coho juveniles to bull trout juveniles residing within the same habitat. A sub-sample of captured coho will also be measured to their caudal fork.

Table 2.1-1 Proposed Schedule, Tasks and Effort for the Swift Reservoir estimates

| Task | Schedule | Effort (person days) |
|---|---|---|
| Capture, mark and release pre-migrant bull trout at the head of Swift Reservoir | 1 May- 15 July | 20 (or as needed to mark sufficient number of migrants) |
| Conduct snorkel surveys in the Lewis River at the confluences with Rush, Muddy and Pine creeks. | 10 Aug – 28 Sep | 24 |
| Electrofish Pine, Rush, and Cougar creeks for bull trout juveniles | July | 8 (or as needed to capture sufficient number of same brood year juveniles) |
| Total Effort = 52 person days | | |

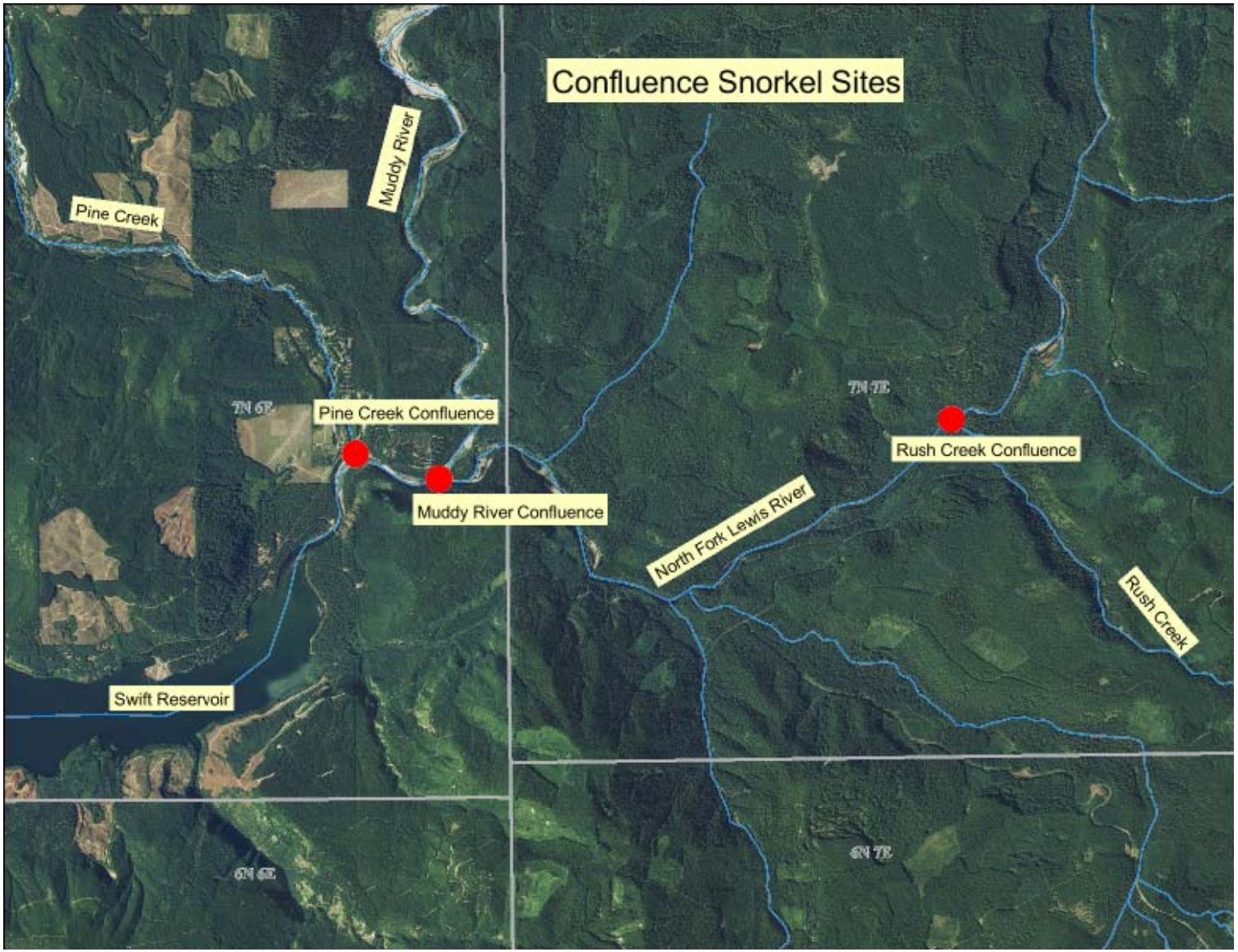


**Figure 2.1-1.** Snorkel sites (recapture) associated with the Swift Reservoir bull trout migration estimate

## 2.2 YALE TAILRACE COLLECTION AND TRANSPORTATION

PacifiCorp annually collects and transports bull trout from the Yale powerhouse tailrace (Merwin Reservoir) to the mouth of Cougar Creek, a Yale Reservoir tributary. A total of 151 bull trout have been captured at the Yale tailrace since the program began in 1995. Of these, 118 have been transferred to Cougar Creek, twenty were left in Merwin Reservoir for various monitoring efforts, nine were mortalities while being held at Merwin Hatchery during 2003 capture efforts and two were transported to Swift Reservoir per their laboratory assessed genetic assignment.

To capture bull trout from the Yale tailwaters, monofilament tangle nets (6.5 cm stretch), trammel nets, beach seines, and angling have all been used. Tangle nets have proven to be the most effective and remain the method employed to date. Tangle nets are tied to the powerhouse wall or shoreline and then stretched across the tailrace area using a jet boat. The nets are then allowed to sink to the bottom (about 30 feet). Depending on conditions or capture rate, the nets are held by hand on one end or allowed to fish passively. The maximum time nets are allowed to fish is 10 minutes.

Upon capture of a bull trout, the fish is immediately removed from the net (usually by cutting the monofilament strands) and placed in a live well. Once biological information is gathered (length, weight, general fish condition) and a PIT-tag is inserted using the same methods and protocols as described in Section 2.1 of this Plan, the bull trout is placed in either an aerated holding box, or a live cart in the stream. After collection activities are completed for the day, the captured bull trout are transported to a waiting truck with transport tank.

All maiden Yale tailrace bull trout captures in 2016 will be transported to Merwin Hatchery and held while rapid response genetic analysis of each individual fish is performed at the USFWS Abernathy Conservation Genetics Lab (Abernathy Lab).

Bull trout captures transported to Merwin Hatchery will be held in circular tanks while awaiting genetic assignment. Circular tanks will be watered up with continually circulating fresh-water. Tank diameter is approximately three meters (m) wide and 1.5 meters deep; troughs will be covered completely with two centimeter thick plywood affixed with clamps to prohibit bull trout from jumping out. Based on past activities, the longest anticipated holding time will be 72 hours. The average time bull trout were held during 2015 was less than 48 hours. Water temperature of holding tanks is anticipated to be less than 10° C during the entire sampling period (June – August). Only like-sized bull trout will be held in the same tanks. Fish less than 250 millimeters will be held in separate tanks from larger fish.

In order to determine disposition of captured bull trout, tissue samples will be sent to the Abernathy Lab and compared to the most current Lewis River genetic baseline. Tissue samples will be analyzed using the program GENECLASS2 which assigns the sample a probability score concerning its Greatest Likelihood of Origin. Bull trout found to be genetically endemic to either the Rush or Pine Creek local population at a Greatest Likelihood of Origin analysis score of greater than or equal to 0.99 will be transported upstream and released into Swift Reservoir. Bull trout with a score of less than 0.99 to the Rush or Pine Creek local population (or combination thereof) will be released to Yale Reservoir. A sheet detailing genetic analysis of all

previously captured fish that were sampled and released will be on board the sampling vessel so as to determine real-time origin of any recaptured fish. If origin of recaptured fish is known, that fish will not be held at Merwin Hatchery, but instead taken to one of the release points described above as determined by its Greatest Likelihood of Origin analysis score. Materials and methods concerning lab genetic analysis of Lewis River bull trout can be found in the report titled "Rapid Response Genetic Analysis of Bull Trout Collected in the Lewis River, WA" (DeHaan and Adams 2011).

Catch rate of bull trout within the Yale Tailrace has been on the decline in recent years (one fish in 2014 and 2015). Due to this, it is proposed in 2016 to curtail the amount of effort expended for these activities. Netting activities typically begin the first week of June and continue on a weekly basis until August 1st for a total of eight netting days. It is proposed for 2016 to continue netting during the same time-frame (June – August), but only net at the frequency of once per month for a total of three bull trout netting events (Table 2.2-1).

Netting typically occurs between the hours of 0800 and 1200; however, powerhouse generation schedules may cause netting activities to occur in the afternoon. During fish collection, powerhouse generators are taken off-line to enable deployment of nets. In years past biologists have netted for longer periods, however, capture efficiency drops substantially and very few if any fish are captured after about two hours of effort in the tailrace.

Alternative Capture Methodology

At this time no other capture method has been as feasible or efficient as tangle nets in capturing bull trout from the Yale tailrace waters. PacifiCorp continues research on possible alternative methods of effective capture and transport. However, upon investigation of each concept or pilot tests conducted at other Northwestern dams, PacifiCorp has not been successful in finding a better alternative to the current method. Therefore, future capture techniques will continue to use tangle nets as the preferred method unless a better method emerges or formal fish passage is constructed at Yale dam.

Table 2.2-1 Proposed Schedule, Task and Effort for the Yale Tailrace Netting and Transportation Program

| Task | Schedule | Effort (person days) |
|---|---|---|
| Netting and Transportation of bull trout from the Yale tailrace to Yale Reservoir | June 1 – Aug 15 | 6 |
| Total Effort = 6 person days | | |

## 2.3 SWIFT BYPASS REACH COLLECTION AND TRANSPORTATION

In 1999, PacifiCorp and the WDFW began netting the Swift No. 2 powerhouse tailrace as part of Yale enhancement measures filed with the Yale license application to the FERC in April 1999. However, due to the canal breach in May 2002 and subsequent low reservoir conditions, there was no netting at the Swift No. 2 powerhouse from 2001-2005; netting resumed in 2006. Due to

the low capture numbers at Swift No. 2 (two fish in 1999 and zero since then) and large numbers of bull trout in the Swift Bypass Reach from July through October, the Swift No. 2 tailrace netting effort was relocated to the Swift Bypass Reach in 2007.

Since the onset of netting activities in the Swift Bypass Reach (Figure 2.3-1) in 2007, 209 bull trout have been captured and tagged. The Utilities propose sampling the Swift Bypass Reach in 2016 consistent with efforts conducted in 2015. Weekly or bi-weekly surveys (depending on catch rate) using a combination of tangle nets, beach seines, and angling will be performed from June through August (Table 2.3-1). Biological information (length, weight, and general condition) will be recorded for all captured bull trout. In addition, tissue sampling for genetic assignment and marking with a uniquely coded 23 mm HDX or 12 mm FDX PIT tag (dependent on fish size, as stipulated in Section 2.1 of this Plan) will occur to assist in transportation activities. Specific tagging methods and protocol are also included in Section 2.1 of this Plan.

Since 2011, with the completion of the Lewis River bull trout genetic baseline, all new bypass reach bull trout captures have been transported to either Speelyai or Merwin Hatchery and held while rapid response genetic analysis of each fish is performed at the Abernathy Lab. Given the success of these activities, the Utilities propose to continue this protocol in 2016. Specific methods and protocol for determining transportation disposition of captured bull trout, as well as methods and protocols concerning the holding of bull trout during the rapid response genetic analysis can be found in Section 2.2 of this Plan. Materials and methods concerning lab genetic analysis of Lewis River bull trout can be found in the report titled "Rapid Response Genetic Analysis of Bull Trout Collected in the Lewis River, WA" (DeHaan and Adams 2011).


**Figure 2.3-1 Area map showing location of bull trout capture sites within the Swift Bypass Reach.**

Table 2.3-1 Proposed Schedule, Task and Effort of the Swift Bypass Reach Survey Program

| Task | Schedule | Effort (person days) |
|---|---|---|
| Netting of areas within the Swift Bypass Reach | June - August | 16 |
| Total Effort = 16 person days | | |

## 2.4 HALF-DUPLEX PASSIVE INTEGRATED TRANSPONDER TAG - FIXED ANTENNA ARRAYS

Fixed PIT tag antenna arrays will be used to further evaluate Lewis River bull trout spatial and temporal distribution, migration patterns related to spawning events, survival (S), and spawning site fidelity. Arrays will be constructed near the mouths of Pine, Rush, P8, Drift and Cougar Creeks in 2016 (Figures 2.5-1 and 2.5-2).

Due to the greater read-range, flexible antenna construction scenarios, lower power consumption, and more affordable cost, an HDX system will be utilized in each identified stream. Depending on stream flow conditions, antennas will be placed in each creek in July and taken out of the creek the first week of November, in an attempt to capture the entire bull trout spawn time-frame.

Each stream PIT antenna system will consist of two stream-width HDX PIT tag antennas. Conducive to higher detection efficiencies and as much as practically possible, antennas will be placed in a shallow area of each stream. Each PIT-tag array will have two antennas multiplexed (synchronized) and spaced approximately two meters apart. Each antenna will consist of a rubber-coated 1/0-gauge welding cable or 10 gauge speaker wire. Antennas will be either looped along the stream bottom (flat-plate design) or designed as a swim thru loop, depending on location. An Oregon RFID RI-Acc-008B antenna tuner box will be attached to each 1/0-gauge copper welding cable or 10-gauge copper wire. Copper coax from each tuner box will then connect to an Oregon RFID RI-RFM-008 reader board and data logger. The antenna at Cougar Creek will be hooked up to electricity on-site which will then be passed through a 110-volt AC to 12-volt DC converter for continuous power. The antennas at the remaining sites will be powered by two or three 12-volt deep-cycle batteries in parallel which will require replacement every two-three weeks. Some sites, if location is conducive, will also receive power from one or two 90-120 watt solar panels. Solar panels will be run to a charge controller which will then be connected to 12-volt batteries.

Attempts to quantify fixed antenna detection efficiency will be performed during 2016 field activities. Given that each antenna site consists of two antennas multiplexed together, this detection efficiency number will most likely come from directionality detection events of tagged fish at each site (e.g. downstream antenna interrogates tagged fish as it migrates upstream, while the upstream antenna misses the interrogation. Subsequently, the upstream antenna interrogates the same tagged fish later during the downstream migration).

Table 2.5-1 Proposed Schedule, Task and Effort for fixed HDX antennae arrays in Pine, Rush, P8, Drift, and Cougar Creeks.

| Task | Schedule | Effort (person days) |
|---|---|---|
| PIT-tag antenna set-up and weekly download/battery change | July-November | 60 |
| Total Effort = 60 person days | | |

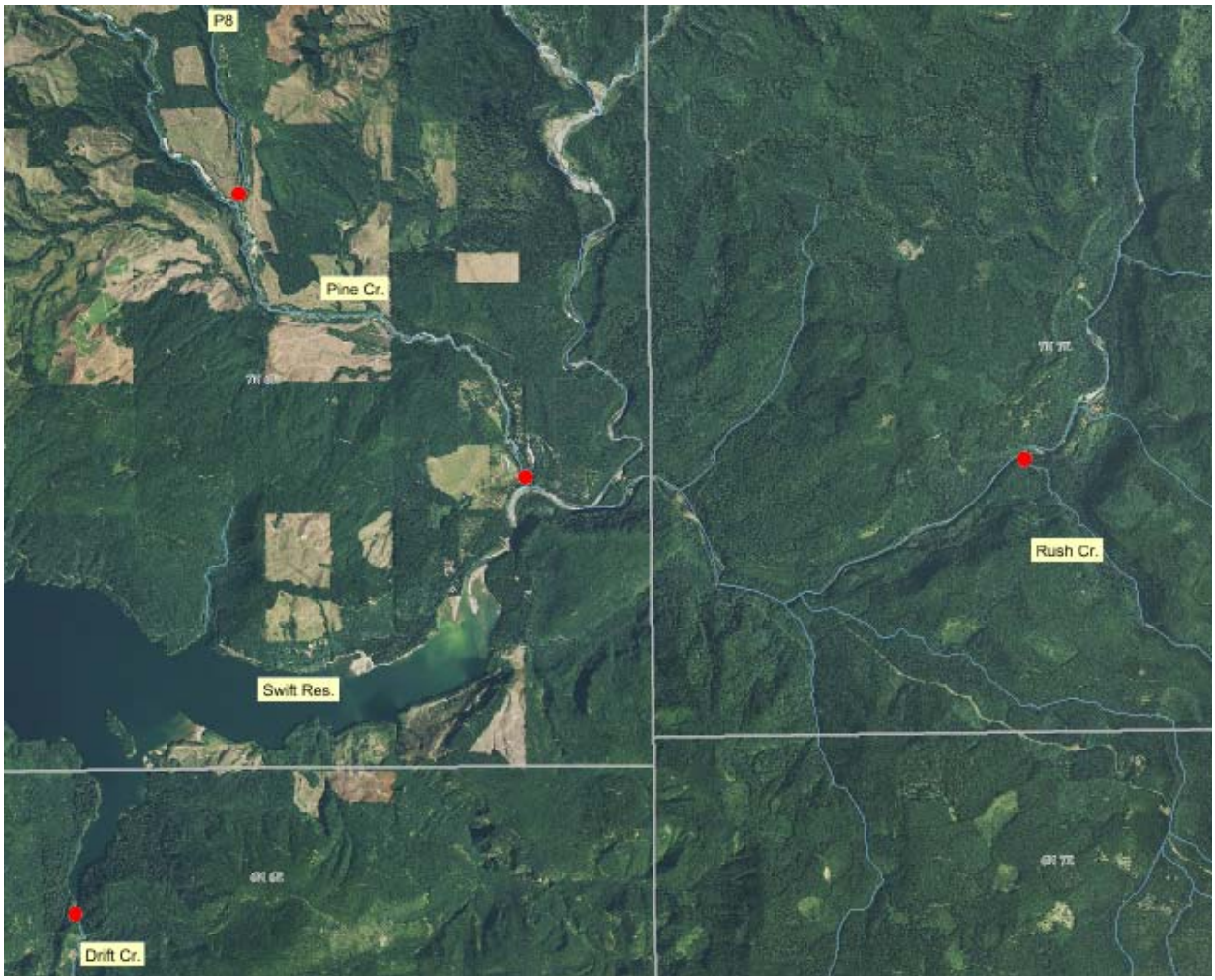


**Figure 2.5-1. Fixed PIT-tag antenna stream sites upstream of Swift Reservoir planned for 2016.**

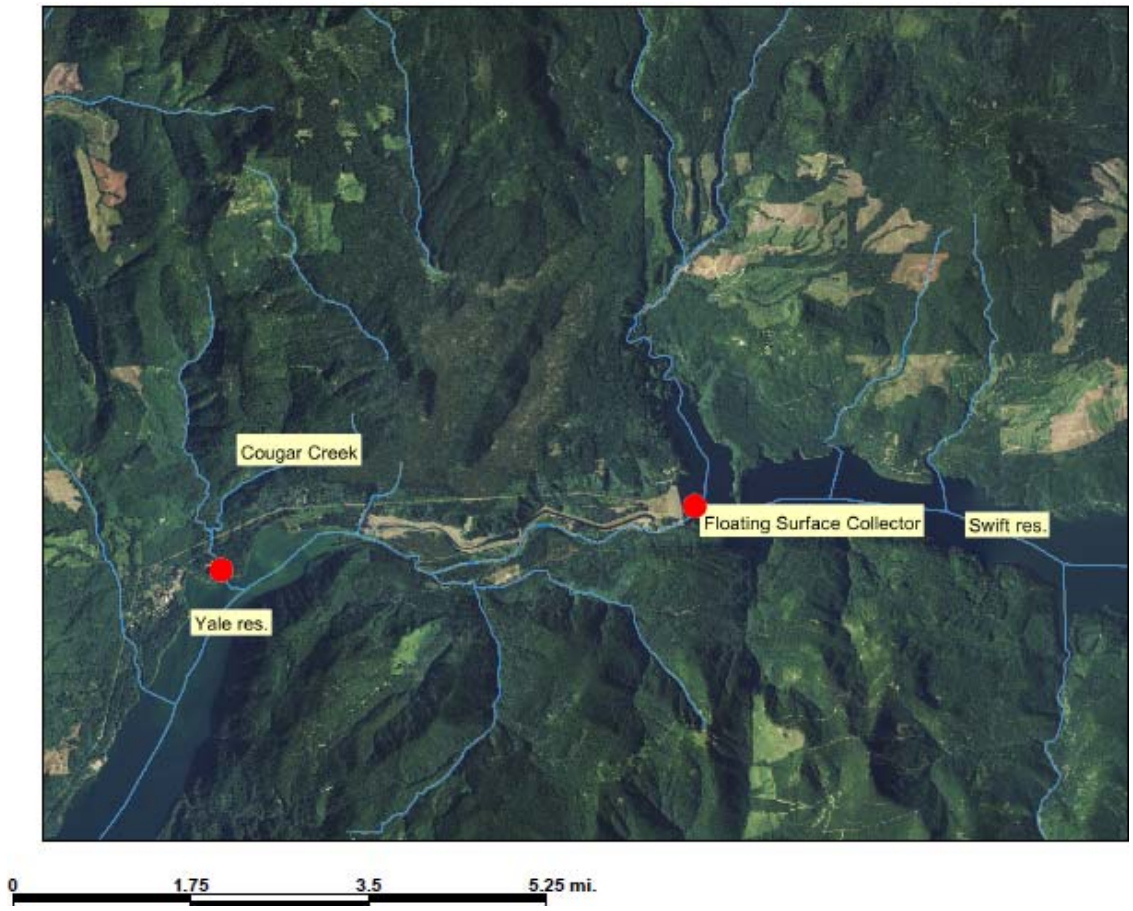


**Figure 2.5-2. Fixed PIT-tag antenna sites downstream from the head of Swift Reservoir planned for 2016**

## 2.6 COUGAR CREEK SPAWNING ESTIMATE

Since 1979, PacifiCorp biologists, along with various state and federal agencies, have conducted annual surveys to estimate spawning escapement of kokanee (*Oncorhynchus nerka)* in Cougar Creek, a tributary to Yale Reservoir. Along with the kokanee counts, bull trout (since 1979) and bull trout redds (since 2007) are also counted, as their spawn-time overlaps with that of kokanee.

Surveys are performed by one or two biologists, and the entire length of Cougar Creek is surveyed – a distance of about 2400 m. Bull trout spawner population estimates have ranged from 0 to 40 fish from foot surveys (since 1979) and between 38 and 58 fish based on redd counts (since 2007). This variability is due in part to sampling error, but is also indicative of a low spawning run size. Results of Cougar Creek kokanee surveys are reported annually and provided in the Aquatic Coordination Committee/Terrestrial Coordination Committee Annual Report.

Sampling effort in 2016 will be consistent with that of 2015. Surveys will consist of weekly bull trout redd counts from September thru October; or until bull trout or new redds are no longer observed (Table 2.6-1). Live bull trout within the stream will continue to be enumerated, but the surveys will focus on locating redds. Redds will be mapped using a GPS and flagged until no longer visible to avoid double counts. Along with a population estimate, these surveys will also allow for a better understanding of bull trout spawning habitat characteristics.

Table 2.6-1 Proposed Schedule, Task and Effort of the Cougar Creek Survey Program

| Task | Schedule | Effort (person days) |
|---|---|---|
| Redd surveys of Cougar Creek (weekly) | Sep – Oct | 16 |
| Additional surveys if "new redds" are present in the creek. | November | 2 |
| Total Effort = 18 person days | | |

## 2.7 COMPREHENSIVE BULL TROUT REDD SURVEYS OF PINE CREEK MAINSTEM, PINE CREEK TRIBUTARY P8, AND RUSH CREEK

The Utilities propose to continue bull trout redd surveys within P8 (Figure 2.7-1) in 2016 in order to build upon existing abundance trend data. As during 2015 activities, 2016 surveys will be conducted within the first one mile of the stream and performed once every ten days in September and October (Table 2.7-1). All redd surveys will be consistent with methodologies performed on Cougar Creek for bull trout (Section 2.6).

New in 2016 will be the addition of including all known bull trout spawning locations within Pine Creek mainstem and Rush Creek within planned P8 redd surveys. Along with the ten day rotation of surveys within P8, Pine Creek and Rush Creek will also be surveyed on a ten day rotation for bull trout redds. Pine Creek surveys will encompass the entire creek to its anadromous fish barrier at approximately river mile 8, while surveys within Rush Creek will extend from the stream mouth upstream to the Forest Road Bridge at approximately river mile

0.5 (Figure 2.7-1). As this will be a census count of redds, survey methodology will follow methods identified within Section 2.6 of this Plan.
Objective 19 of the Monitoring and Evaluation Plan highlights the need for information to be collected concerning resident and anadromous fish interactions. A portion of Objective 19 specifically seeks an assessment of later spawning coho (*O. kisutch*) superimposing their redds over previously constructed bull trout redds. To evaluate this, bull trout redds observed during P8 redd surveys in 2016 will be uniquely visually marked within the stream in order to assess if and any disturbance occurs to the bull trout redd egg pocket by later spawning coho.

Along with standard flagging and taking of a GPS point of each identified bull trout redd during 2016 surveys, bull trout redd egg pockets( redd mound) will also be visually marked by driving one thin piece of rebar into the stream substrate at the head of the egg pocket. Along with detailed notes, the rebar will give a visual cue to where within the stream the egg pocket lies even after natural hydrologic and biological processes have returned the stream bottom to a more natural appearance. Redd surveys of P8 will be extended through the middle of November to encompass the early-run coho spawn timeframe and each bull trout redd recorded from earlier surveys will be re-visited and assessed for new excavation over the egg pocket.

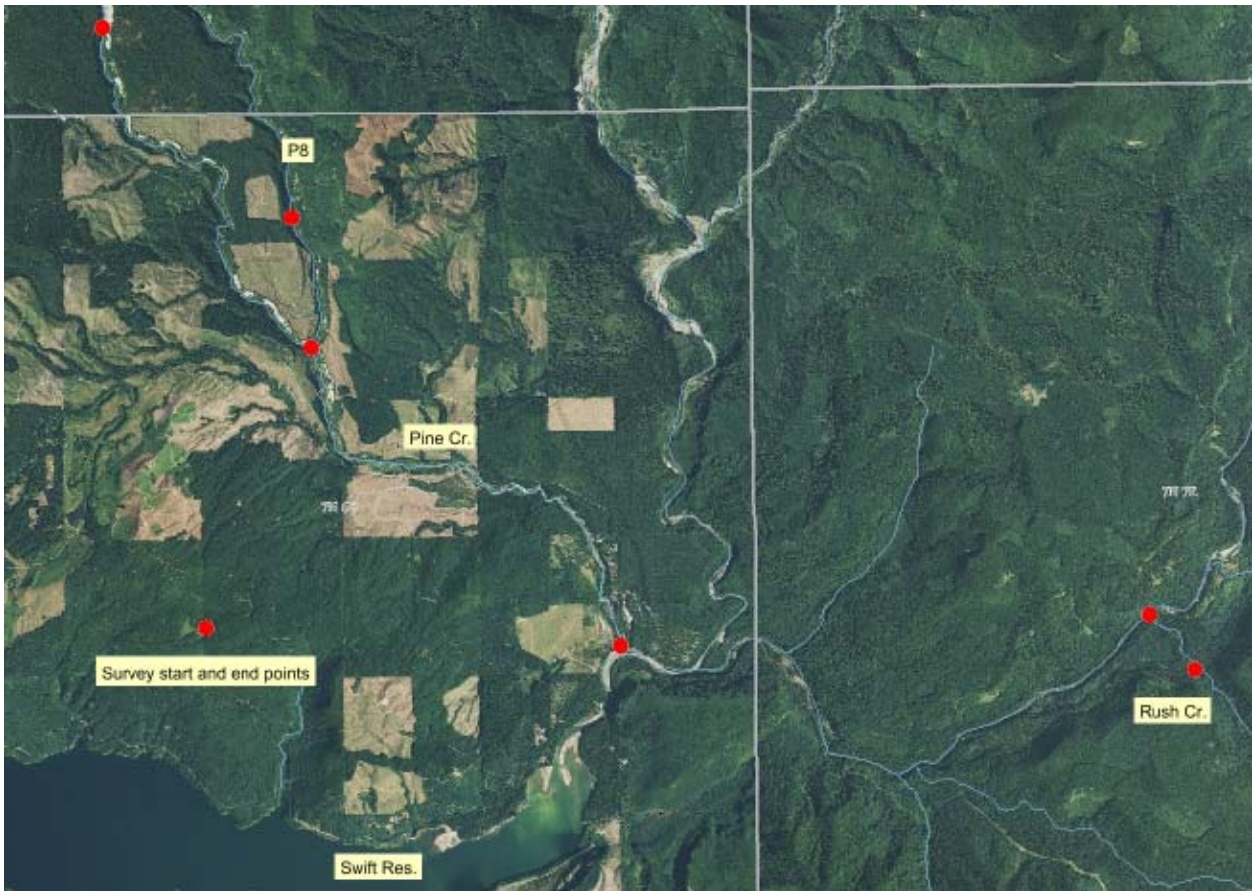


**Figure 2.7-1**

Table 2.7-1 Proposed Schedule, Tasks and Effort for P8 bull trout redd surveys.

| Task | Schedule | Effort (person days) |
|---|---|---|
| Bull trout redd surveys of P8, Pine and Rush Creeks | September - November | 38 |
| Total Effort = 38 person days | | |

# III. Reporting

An Annual Report detailing all activities and corresponding data gathered, concerning this 2016 Annual Bull Trout Operating Plan, will be included in the Aquatic Coordination Committee/Terrestrial Coordination Committee Annual Report submitted to the FERC in the spring of 2017.

# IV. References


DeHaan. P., B. Adams. 2011. Analysis of Genetic Variation and Assessment of Population Assignment Methods for Lewis River Bull Trout. United States Fish and Wildlife Service Abernathy Fish Technology Center. Longview, WA.

Franklin, I. R. 1980. Evolutionary changes in small populations. Pages 135-149 *in* M. E. Soule, and B. A. Wilcox, editors. Conservation Biology: an Evolutionary-Ecological Perspective. Sinauer, Sunderland, MA.

Luikart, G., N. Ryman, D. A. Tallmon, M. K. Schwartz, and F. W. Allendorf. 2010. Estimation of census and effective population sizes: the increasing usefulness of DNA-based approaches. Conservation Genetics 11(2, Sp. Iss. SI):355-373.

NOAA. 2000. Guidelines for Electrofishing Waters Containing Salmonids listed under the Endangered Species Act.

Personal Communication, Pat DeHaan, United States Fish and Wildlife Service Abernathy Conservation Genetics Lab. November 22, 2013.

Tranquilli, J.V., M.G. Wade, C.K. Helms. 2003. Minimizing risks and mitigation of impacts to bull trout *Salvelinus confluentus* from construction of temperature control facilities at Cougar Reservoir, Oregon. Oregon Department of Fish and Wildlife. Salem, OR.

USFWS. 2006. Biological Opinion for the Lewis River.

White, G.C. 1996. NOREMARK: Population estimation from mark-resighting surveys. Wildlife Society Bulletin. 24: 50-52.

White, G. C., and K. P. Burham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46:120-139.

Wright, S. 1931. Evolution in mendelian populations. Genetics 16:97-159.

# V 2016 Bull Trout Handling Protocols

PACIFICORP ENERGY
A DIVISION OF PACIFICORP

## 2016 Handling Protocol's for Lewis River Bull Trout

**Eagle Cliffs Collection Site (Swift reservoir)**

All captured bull trout regardless of size will be measured to fork length, weighed, examined for general condition and signs of hooking injury, and scanned for PIT tag and or Floy tag. A small tissue clip (appr. 1 square cm) from the upper lobe of the caudal fin will also be taken from each new bull trout capture. Tagging procedures can be found in the 2015 Operating Plan.

- Newly captured bull trout ≥450mm fork length (FL) will be tagged with two (2) Kelly green Floy tags near the posterior rays of the dorsal fin.
- Captured bull trout ≥300mm FL **NOT** previously handled and inserted with an HDX PIT tag, will be tagged with a 23mm HDX PIT tag in the dorsal sinus.
- Captured bull trout <300mm FL **NOT** previously handled and inserted with an FDX PIT tag, will be tagged with a 12mm FDX PIT tag in the dorsal sinus.
- 2016 bull trout recaptures will be examined for the presence of Floy® tags as well as scanned for PIT tag retention and then released.

**Swift Floating Surface Collector Collection Site (Swift Reservoir)**

All captured bull trout regardless of size will be measured to fork length, weighed, examined for general condition and signs of hooking injury, and scanned for PIT tag and or Floy® tag. A small tissue clip (appr. 1 square cm) from the upper lobe of the caudal fin will also be taken from each new bull trout capture. Tagging procedures can be found in the 2015 Operating Plan.

- All bull trout collected within the general smolt (<250mm FL) population tank on the Floating Surface Collector (approximately 90 percent of total number collected) will not be handled or quantified, and will be transported for release into the lower Lewis River downstream of Merwin Dam.
- All bull trout diverted to the adult or sub-sample (10 percent) holding tanks will be examined for Floy® and PIT tags. If no PIT tag is present, fish <300mm FL will be tagged with a 12mm FDX PIT tag in the dorsal sinus, fish ≥300mm FL will be tagged with a 23mm HDX PIT tag in the dorsal sinus. A small tissue clip (appr. 1 square cm) from the upper lobe of the caudal fin will also be taken from all bull trout handled in the adult or sub-sample tanks.
- All **handled** bull trout on the Floating Surface Collector, after tag and biological sample, will be released back to Swift Reservoir, or alternate location as directed by the USFWS.

**Swift Bypass Reach Collection Site (Yale Reservoir)**

All captured bull trout regardless of size will be measured to fork length, weighed, examined for general condition and signs of hooking injury, and scanned for PIT tag and or Floy® tag. A small tissue clip (appr. 1 square cm) from the upper lobe of the caudal fin will also be taken from each new bull trout capture. Tagging procedures can be found in the 2016 Operating Plan.

- PIT # from recaptured bull trout will be compared to on-site list of previously genetically analyzed bull trout samples in order to evaluate greatest likelihood of origin score. If the likelihood score of the recaptured bull trout is ≥ 0.99 for being endemic to Rush or Pine Creek origin, that fish will be transported to an awaiting fish tank truck and transported upstream for release into Swift Reservoir at the Swift Forest Campground boat launch.

- New captures will be tagged with an HDX PIT tag in the dorsal sinus and a paper-hole punch genetic sample taken from the upper lobe of the caudal fin. After tagging, captured bull trout will be transported to an awaiting fish tank truck and transported to Merwin Hatchery and held while awaiting genetic assignment.

- After genetic assignment of held bull trout, disposition of fish will be determined by the greatest likelihood of origin score. If likelihood score is ≥0.99 to either Rush or Pine Creek populations, those bull trout will be transported upstream for release into Swift Reservoir. If likelihood score is <0.99 to either Rush or Pine Creeks or ≥0.99 to the Cougar Creek Population, those will be transported and released into Yale Reservoir.

**Yale Tailrace Collection Site (Merwin Reservoir)**

All captured bull trout regardless of size will be measured to fork length, weighed, examined for general condition and signs of hooking injury, and scanned for PIT tag and or Floy® tag. A small tissue clip (appr. 1 square cm) from the upper lobe of the caudal fin will also be taken from each new bull trout capture. Tagging procedures can be found in the 2016 Operating Plan.

- PIT # from recaptured bull trout will be compared to on-site list of previously genetically analyzed bull trout samples in order to determine release location. If the likelihood score of the recaptured bull trout is ≥ 0.99 assignment to Rush or Pine Creek origin, that fish will be placed in a fish tank truck and transported upstream for release into Swift Reservoir.

- New captures will be tagged with an HDX PIT tag in the dorsal sinus and a paper-hole punch genetic sample taken from the upper lobe of the caudal fin. After tagging, captured bull trout will be transported to an awaiting fish tank truck and transported to Merwin Hatchery and held while awaiting genetic assignment.

- After genetic assignment of held bull trout, disposition of fish will be determined by the greatest likelihood of origin score. If likelihood score is ≥0.99 to either Rush or Pine Creek populations, that individual bull trout will be transported upstream for release into

Swift Reservoir. If likelihood score is <0.99 to either Rush or Pine Creeks or ≥0.99 to the Cougar Creek Population, that fish will be transported and released into Yale Reservoir.

# APPENDIX A

## ACC COMMENTS RECEIVED BY THE DUE DATE OF APRIL 1, 2016

| Agency | Comment | Utility Response |
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| USFWS | In order to potentially capture earlier arriving large fish at Eagle Cliffs, effort should be made to start these collection activities as early as conditions will allow. | Agreed. Changes incorporated within the Plan. |
| USFWS | Migration patterns and behavior of early arriving spawners to spawning tributaries may not be captured under current timeline for implementation of PIT antennas. Antennas should be deployed as soon as is feasibly possible in the summer. | Agreed. Changes incorporated within the Plan. |
| WDFW | In order to analyze important age composition, length at age, and length at first maturity, scales or fin rays (if feasible) should be taken from bull trout captured during Eagle Cliff netting activities. | Agreed. Changes incorporated within the Plan. |
| WDFW | The primary purpose of quantifying tag loss for mark-recapture estimators is to test one of the assumptions of the estimator (fish do not lose their marks) and to make adjustments in the number of marks available for recapture (or, in this case, resight) if necessary. So, the main interest is to determine the probability that a fish has lost both tags- the fish has lost it's mark. The probability that a fish has lost both floy tags is (# of single tagged fish observed/# of marked fish observed) squared. Using the 2015 as an example - the probability that a fish lost both tags using the Aug 27 data is (1/7)^2 = 2.0%). For the entire data set, this number is 0.1%. No issues with tag loss. | Comment Noted |

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| WDFW | FDX tags not detected in P-Corp arrays. Older larger more fecund fish are not detected. | FDX tags have not been inserted into fish >300mm since 2010. Bull trout tagged with HDX PIT tags since 2010, if still alive, are older and more fecund and are detected at the passive PIT arrays. Proposal to tag fish <300mm with FDX tags comes from the fact that fish smaller than this do not retain the larger HDX tags well and so in order to have a unique marker in the event of a recapture we've decided to tag with an FDX now in hopes of double-tagging with an HDX at a later date. This likely will be a non-issue as we capture <5 fish <300mm annually. |
| WDFW | Annual Swift Reservoir Adult Bull Trout Survival Estimate The assumptions of this model need to be evaluated, especially array detection probability. See my comments in the 2015 report. | Agreed and comment noted. Being located in remote areas, these arrays do not have access to hard power and at times will be subject to loss of power. During these times the antenna goes offline until the next visit and any tagged bull trout that transits past will not be recorded. Power loss is minimized and mitigated by frequent checks and recording of power usage, but ensuring complete power loss during the entire sampling timeframe is not possible. In 2014 the antenna configuration was changed to a much more efficient swim through loop as opposed to the old configuration of a loop on the stream bottom. This new configuration has led to higher detection efficiencies when the antenna is powered up. Couple this with the synchronized dual antennas and sites that had no power issues had detection efficiencies of >95% when the raw data is analyzed. The Antenna at Rush Creek in 2014 experienced an unusually high level of power loss as well as unforeseen technical difficulties with the motherboard within the antenna itself, which led to very few days of operation and extremely low detection efficiencies, all of which was documented in the 2014 Annual Report. |

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| WDFW | Concerning Yale Tailrace Collection and Transport<br>I think we are reaching a point of diminishing returns on this phase. I would favor putting the time into something more useful juvenile scale and genetic collections or redd surveys. | Agreed and Comment noted. Unfortunately this activity is a License Article and as such some version of it needs to be performed annually. Based off of Consultation with USFWS, it is being tapered back in 2016. |
| WDFW | Concerning PIT Antenna Arrays<br>The feasibility of running the arrays year round should be explored. | This may be feasible during low water years, but given the unpredictable nature of determining those events it does not seem likely. For the last couple of years most of the antennas have washed out during the first large storm of the season in late October or early November. Given antenna configurations there is no feasible way to anticipate large water events and take the antenna out just to be reinstalled shortly thereafter. |
| WDFW | Concerning PIT antenna detection efficiency<br>Detection efficiency is critical. In one year of head to head tests the P-Corp unit was only 22% as effective as WDFW unit. If this is true for all their units data is severely discounted. | The Antenna at Rush Creek in 2014 experienced an unusually high level of power loss as well as unforeseen technical difficulties with the motherboard within the antenna itself, which led to very few days of operation and extremely low detection efficiencies, all of which was documented in the 2014 Annual Report. Head to head tests were also conducted at this same site the year prior in 2013 and both the antenna operated by WDFW and the HDX antenna interrogated the same tags throughout the season, all of which was also documented in the 2013 Annual Report. |
| WDFW | Concerning redd surveys of P8<br>in P-8 or mainstem Pine<br>Creek? | In P8, the mile long index established since 2007. |

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| WDFW | Concerning bull trout spawning surveys in Rush Creek Bull trout build redds above this point. Redds have been reported as far as the barrier falls plunge pool. This would be very difficult to do even though the total linear distance is about 1.5 miles. It is not a census count unless all spawning areas are covered for each stream. | Agreed. Given safety concerns to access this area, we will not be surveying. This does not mean that bull trout cannot or will not utilize the creek above the bridge. It will be noted in the 2016 Annual Report that the redd surveys within Rush Creek are not a census count. |