

EAST KITSAP PENINSULA TRIBUTARIES STEELHEAD POPULATION MONITORING PLAN

PREPARED BY:

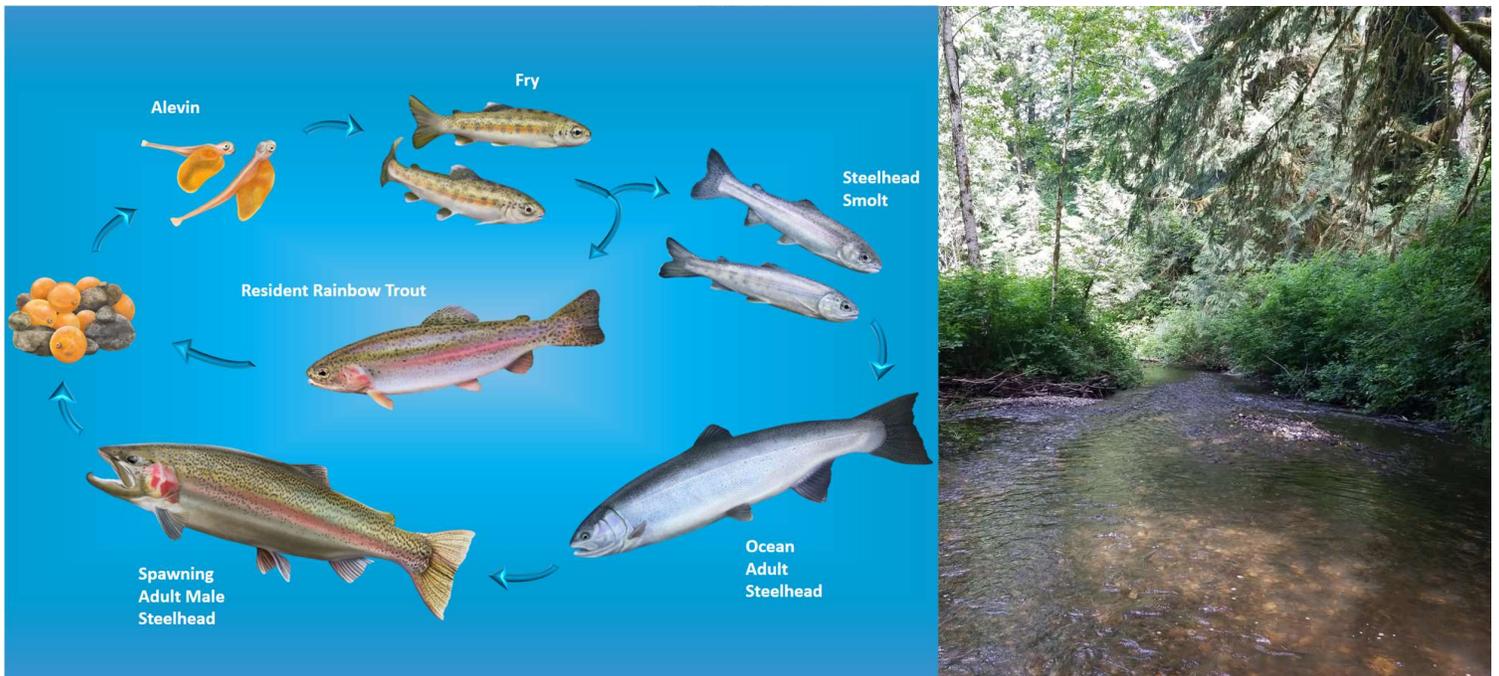
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December 2025



Sources: Life Cycle Diagram – Morro Bay National Estuary Program; Curley Creek Photo – Great Peninsula Conservancy

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1. INTRODUCTION

The Suquamish Tribe initiated the preparation of this population monitoring plan for the East Kitsap Peninsula Tributaries Winter Run Steelhead Demographically Independent Population (East Kitsap Steelhead DIP) to assess the status and trends of steelhead (*Oncorhynchus mykiss*) in the region. The development and implementation of a population monitoring plan was identified in the *East Kitsap Steelhead DIP Recovery Plan* (ESA 2020) as a critical component of adaptive management to support evaluating and tracking the population's progress towards recovery. This lack of data to assess population status and thereby inform management is also noted in *Steelhead at Risk Report: Assessment of Washington's Steelhead Populations* (Cram et al. 2018) and *Viability Criteria for Steelhead within the Puget Sound Distinct Population Segment* (Hard et al. 2015).

The goal of this project is to develop a population monitoring plan that identifies sampling to be conducted to inform estimates of the East Kitsap Steelhead DIP population viability and distribution. Of critical importance is gaining an improved understanding of the native steelhead genetic diversity in the East Kitsap Steelhead DIP. The four Viable Salmonid Populations (VSP) criteria originally described by McElhany et al. (2000) will be used to track progress towards recovery. The Plan is “scalable” based on realistic considerations of funding levels available for the work now and in the future.

That is, the monitoring recommendations are presented in a way that supports effort expansion or contraction depending on funding level.

“The lack of robust monitoring data was one of the most ubiquitous impediments to conducting the wild steelhead status assessments statewide and therefore poses a risk of harm to populations because of the high uncertainty of management action effectiveness.”
Steelhead At Risk Report by Cram et al. (2018)

1.1 Background

The National Marine Fisheries Service (NMFS) listed Puget Sound Steelhead as a threatened species under the Endangered Species Act (ESA) on May 11, 2007 (Federal Register 72(91):26722–26735). The East Kitsap Steelhead DIP is one of 32 populations comprising the Puget Sound Steelhead Distinct Population Segment. In response to the listing, NMFS published a Recovery Plan for Puget Sound Steelhead (“Regional Plan”) in 2019 (NMFS 2019). The *East Kitsap Steelhead DIP Recovery Plan* (“East Kitsap Plan”) completed in 2020 (ESA 2020) was prepared to constitute a “chapter” for one of the



steelhead populations to be included as an addendum to the Regional Plan and direct local recovery efforts. The East Kitsap Plan identifies many pressures and stressors affecting all life stages of East Kitsap Steelhead, including numerous habitat and hatchery-related pressures. The East Kitsap Steelhead DIP geography is shown in **Figure 1**.

Population viability – and therefore population recovery – can be assessed according to the VSP criteria described by McElhany et

al. (2000). The four parameters McElhany et al. (2000) identified for evaluating population viability are: abundance, population growth rate (productivity), population spatial structure, and diversity. These interrelated parameters collectively inform an evaluation of a population's ability to sustain itself as an independent population.

Very limited data on steelhead in the area have led to differences between the population abundance goals in the Regional Plan and the East Kitsap Plan. The Regional Plan estimated an East Kitsap Steelhead DIP historical abundance of 12,448 based on a habitat proportion calculation in the area relative to the full Puget Sound DPS area and associated historical abundance estimate. This approach informed an abundance recovery goal in the Regional Plan as being 2,600 assuming high productivity and 8,700 assuming low productivity (NMFS 2019). The East Kitsap Plan noted that the Regional Plan historical abundance estimates were based on an overestimate of historical habitat availability resulting from applying larger river suitability factors to small independent streams. The East Kitsap Plan presents seven historic abundance estimates that ranged between 1,557 and 17,709. The East Kitsap Plan established a steelhead population goal of 1,000 to 3,000 steelhead spawners. Due to the lack of information on the current steelhead population size, population monitoring was identified as a critical component of adaptive management that will aid in refining and validating long-term population goals for the East Kitsap Steelhead DIP.

The East Kitsap Plan assigned streams in the East Kitsap Steelhead DIP to priority tiers based on estimates of historic stream miles considered suitable for steelhead based on an intrinsic potential¹ analysis by Nash (2017). Tier 1 streams have more than 7.5 miles of historically suitable steelhead stream habitat. Tier 2 streams have between 3 and 7.5 miles of historically suitable steelhead stream habitat. Tier 3 streams contain historically suitable habitat for steelhead, but that habitat is less than 3 miles. There are 6 Tier 1 streams, 8 Tier 2 streams, and 15 Tier 3 streams (**Table 1**).

¹ Intrinsic potential is the estimated relative suitability of a habitat for spawning and rearing of anadromous salmonid species – in this case steelhead – under historical conditions inferred from stream characteristics. Nash (2017) conducted the intrinsic potential analysis using stream width, stream gradient, and habitat type.

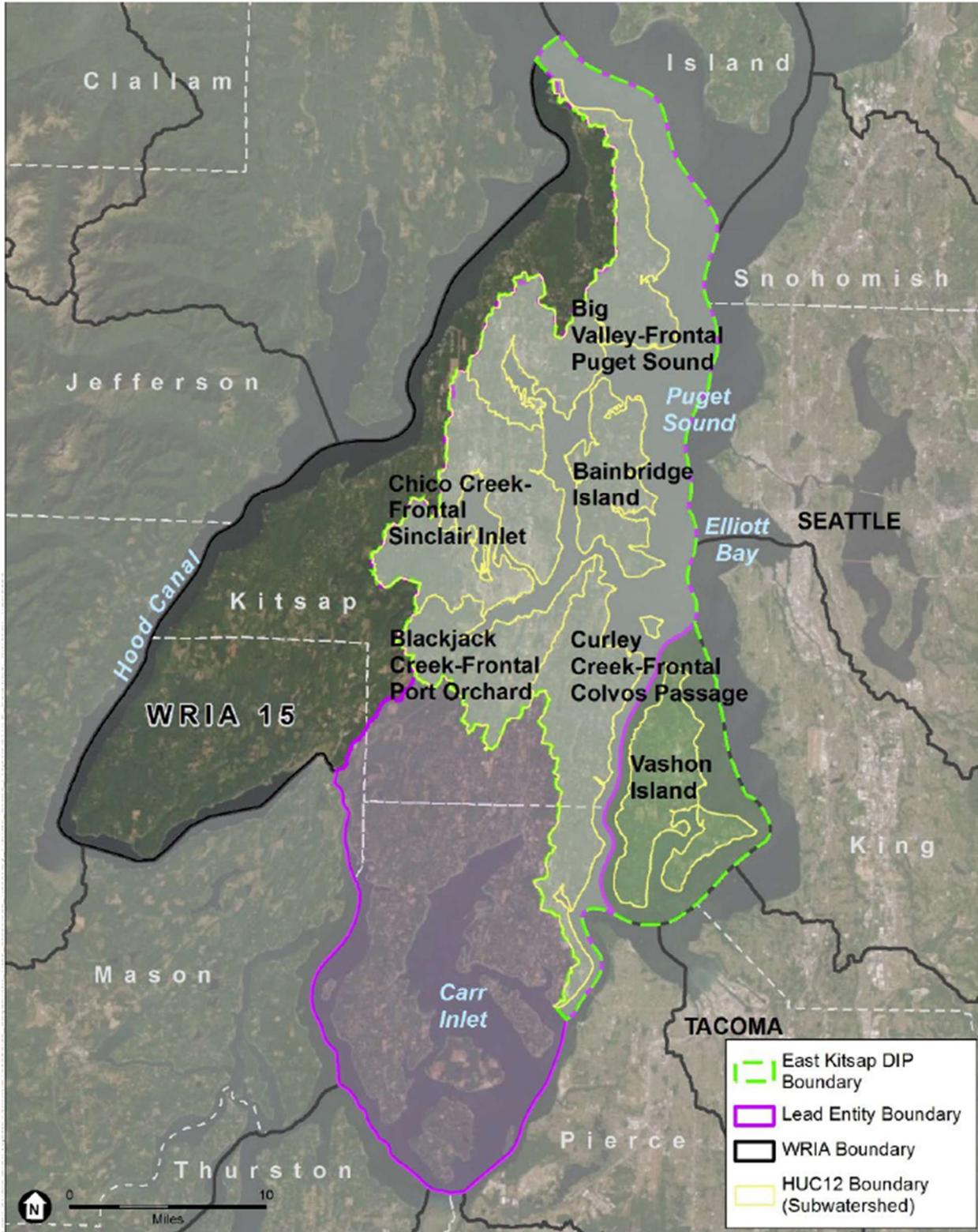


Figure 1. East Kitsap Steelhead DIP and Planning Boundaries (from ESA 2020)

Table 1. East Kitsap Steelhead Stream Priority Tiers (from ESA 2020)

SUBWATERSHED	TIER 1	TIER 2	TIER 3
Big Valley – Dogfish	Grovers	Dogfish Big Scandia	Carpenter Doe-Kag-Wats Lemolo Thompson/Kleabel Bliss Cowling
Barker – Dyes	Clear	Barker Steele Strawberry	n/a
Bainbridge Island	n/a	n/a	Springbrook/Fletcher Issei
Chico – Frontal Sinclair	Chico	n/a	n/a
Blackjack	Blackjack Gorst	Ross	Anderson Baileys Karcher/Annapolis
Curley – Colvos	Curley/Salmonberry	Olalla Crescent	North/Donkey North Fork (NF) Olalla
Vashon Island	n/a	n/a	Judd Christensen

1.2 Methods for Developing Steelhead Population Monitoring Plan

The first step taken to develop a Plan was to assemble a focus group of experts in steelhead ecology, population monitoring, and/or the watersheds of East Kitsap. The focus group met twice in Spring 2025 to discuss population monitoring and will review this draft of the Plan. Focus group participants included:

- ▶ Steve Todd, Suquamish Tribe, Salmon Recovery Biologist and Project Manager
- ▶ Alison O’Sullivan, Suquamish Tribe, Ecosystem Recovery Program Manager
- ▶ Casey Schmidt, Suquamish Tribe, Natural Resources Director
- ▶ Samantha Rae, Suquamish Tribe, Marine Fish Program Manager
- ▶ Barry Berejikian, NOAA, Fisheries Enhancement and Conservation Manager, Manchester Station Chief
- ▶ Brittany Gordon, Kitsap County, Natural Resources Coordinator
- ▶ Joy Lee Waltermire, Long Live the Kings, Senior Fisheries Biologist
- ▶ Marty Ereth, Pierce County, Senior Fisheries Biologist
- ▶ Neala Kendall, Washington Department of Fish and Wildlife (WDFW), Research Scientist

In addition to the focus group who participated in meetings, information was provided by and/or a review of a draft version of this report was provided by Jon Oleyar, Suquamish Tribe; Jamie Glasgow, Wild Fish Conservancy (WFC); Joe Anderson, WDFW; and George Pess, retired from NOAA.

Relevant information for developing a population monitoring plan was compiled. The information sources identified, and a summary of input received from the focus group meetings is provided in Appendix A. This population monitoring plan incorporates this information to identify an approach that informs all VSP parameters and can be scaled to available funding/staffing levels through adjustment of monitoring intensity.

1.3 Terminology

Steelhead and rainbow trout are the same species (*O mykiss*). This document focuses on steelhead, the anadromous form. The authors acknowledge that there are instances where steelhead are referenced when an *O. mykiss* is identified in samples but it may be a rainbow trout, the resident form, instead.

In addition, references to steelhead observations are more correctly termed putative steelhead or *O. mykiss* given both the potential misidentification of species – notably due to known hybridization with cutthroat trout (*O. clarkii*) – and the life history uncertainty described above. For brevity, putative is not repeatedly used in all instances in the document.



2. EXISTING DATA SOURCES FOR EAST KITSAP STEELHEAD DIP POPULATION STATUS

There is limited information on the East Kitsap Steelhead DIP population and all of the four VSP parameters (Hard et al. 2015, Cram et al. 2018). Five recent sources of data were available:

- ▶ Outmigrant trap sampling in Lost and Wildcat Creeks in the Chico Creek watershed by the Suquamish Tribe
- ▶ Genetic analysis of *O. mykiss* tissue samples collected in multiple streams throughout the area by WDFW
- ▶ Environmental DNA (eDNA) collected in streams throughout the area by WFC
- ▶ Water typing fish sampling by WFC
- ▶ Spawning ground surveys in multiple streams throughout the area conducted by WDFW and the Suquamish Tribe

These data sources are described below.

Given the paucity of data, efforts to identify other potential data sources are recommended. Potential data and/or observation sources include commercial, tribal, and recreational fishery data (including historic punch cards), hatchery traps/weirs, traditional ecological knowledge from tribal elders, and other ongoing activities that may involve fish observations/handling (e.g., fish exclusion efforts at construction sites). Past documentation from these efforts could provide information on *O. mykiss* observations and changes to documentation requirements for future activities of this type would provide additional information on this species for whom all observations are informative given the current lack of data.

2.1 Outmigrant Trap Sampling

The Suquamish Tribe has operated outmigrant traps on Lost and Wildcat Creek in the Chico Creek watershed each spring since 2011. Outmigrant traps are described in more detail in Section 4.2.3. Wildcat Creek is connected to Wildcat Lake near the headwaters, whereas Lost Creek is predominantly fed by groundwater. The traps are located at the downstream end of both creeks before they flow into Chico Creek. The traps operate annually from the first week of April through mid-June to standardize methods with other studies in the region (Suquamish Tribe 2025). The target species for the sampling is juvenile coho salmon, but small numbers of putative *O. mykiss* are also collected. The traps collect small numbers of putative *O. mykiss* with more detected in Wildcat Creek than Lost Creek. Since 2020, between 10 and 20 *O. mykiss* have been collected as follows: 5 in 2020, 5 in 2021, and 1 or 2 per year through 2025 (Oleyar pers comm. 2025a)

2.2 Genetic Analysis

The Suquamish Tribe collected tissue samples for genetic analysis from putative *O. mykiss* captured in Wildcat, Lost, Chico, Curley, and Grover's Creeks. These samples were submitted to WDFW's Molecular Genetics Laboratory for genetic analysis. The results presented here are based on a 2020 email from Todd Seamons (WDFW) to Jon Oleyar (Suquamish Tribe) (Seamons pers. comm. 2020; Appendix A). Single nucleotide polymorphism (SNP) genetic analysis was conducted on 173 putative *O. mykiss* or *O. mykiss-O. clarkii* tissue samples collected between 2014 and 2017. The majority of the samples (95) were identified as *O. mykiss-O. clarkii* hybrids.

There are no clear indications of endemic native steelhead among the samples, but it is possible that the native steelhead is similar to a hatchery signal found in the samples tested (Seamons pers. comm. 2020; Appendix A). The origins of fish identified as *O. mykiss* were found to be of either Puget Sound ancestry or hatchery rainbow trout. The Puget Sound *O. mykiss* were likely early winter hatchery ancestry fish that are naturally spawning, but it is possible that this is the signal of the native East Kitsap steelhead. The hatchery rainbow trout were considered to have also included putative intraspecific hybrids. All but two of the *O. mykiss*-*O. clarkii* hybrids appeared to be between Puget Sound ancestry *O. mykiss* and *O. clarkii*. The other two individuals appeared to be hybrids between hatchery rainbow trout and cutthroat. Hybridization between rainbow trout and cutthroat trout to produce “cutbows” that involves hatchery-origin rainbow trout is a recognized threat to genetic diversity (Young et al. 2016) as is spawning between hatchery and native *O. mykiss*.

2.3 eDNA Sampling

In recent years, WFC has collected eDNA samples in streams located throughout the East Kitsap Steelhead DIP area (WFC 2025a) (**Figure 2**). Most of the sampling occurred in 2021 with some sampling also reported in 2017, 2019, and 2022. Sampling was conducted primarily in April with a few samples collected in March. Results from the quantitative polymerase chain reaction (qPCR) genetic analysis are presented later in this document as part of the analysis to inform location selection for future eDNA sampling. The Suquamish Tribe has been collecting eDNA samples every three months at regular spatial intervals in multiple tributaries of the Doe-Kag-Wats watershed in 2024 and 2025. No *O. mykiss* have been detected from the Suquamish Tribe’s sampling efforts. Sampling is planned for 2026.

2.4 Water Typing

WFC has conducted water typing in many of the streams comprising the East Kitsap Steelhead DIP area in multiple project efforts (WFC 2025b). WFC conducted water type surveys using the protocols and definitions provided in Washington Administrative Code (WAC) 222-16-031 and Section 13 of the Forest Practices Board Manual (WDNR 2002). Fish use observations included putative *O. mykiss*. Results from the sampling are presented later in this document as part of the analysis to inform location selection for future eDNA sampling.

2.5 Spawning Ground Surveys

WDFW maintains a database of spawning ground survey results in streams and rivers throughout the state. Spawner surveys in the East Kitsap Steelhead DIP have been conducted by Suquamish Tribe and WDFW biologists. The spawning ground survey database (WDFW 2025a) includes steelhead entries from as early as 1984, but no steelhead surveys have been conducted since 2010 and fewer than 10 since 2004. Currently, WDFW does not have any spawning ground survey index reaches in the East Kitsap Steelhead DIP area, so no surveys are conducted or planned (Madel pers. comm. 2025). The database includes fields for information on fin clips and coded wire tags (CWT) but the observations in East Kitsap streams only included two datapoints. One was a steelhead in Gorst Creek in 2010 with an intact adipose fin and no CWT beep. The other was a steelhead in Steele Creek in 2006 with an intact adipose fin but no CWT beep. **Table 2** presents data on the years and months of surveys, as well as the number of surveys conducted in Tier 1 and Tier 2 streams. There are no spawning ground survey data for Tier 3 streams. Grovers Creek is the only Tier 1 stream where no spawning ground surveys have been conducted. Ross and Strawberry Creeks are the only Tier 2 streams where no spawning ground surveys have been conducted.

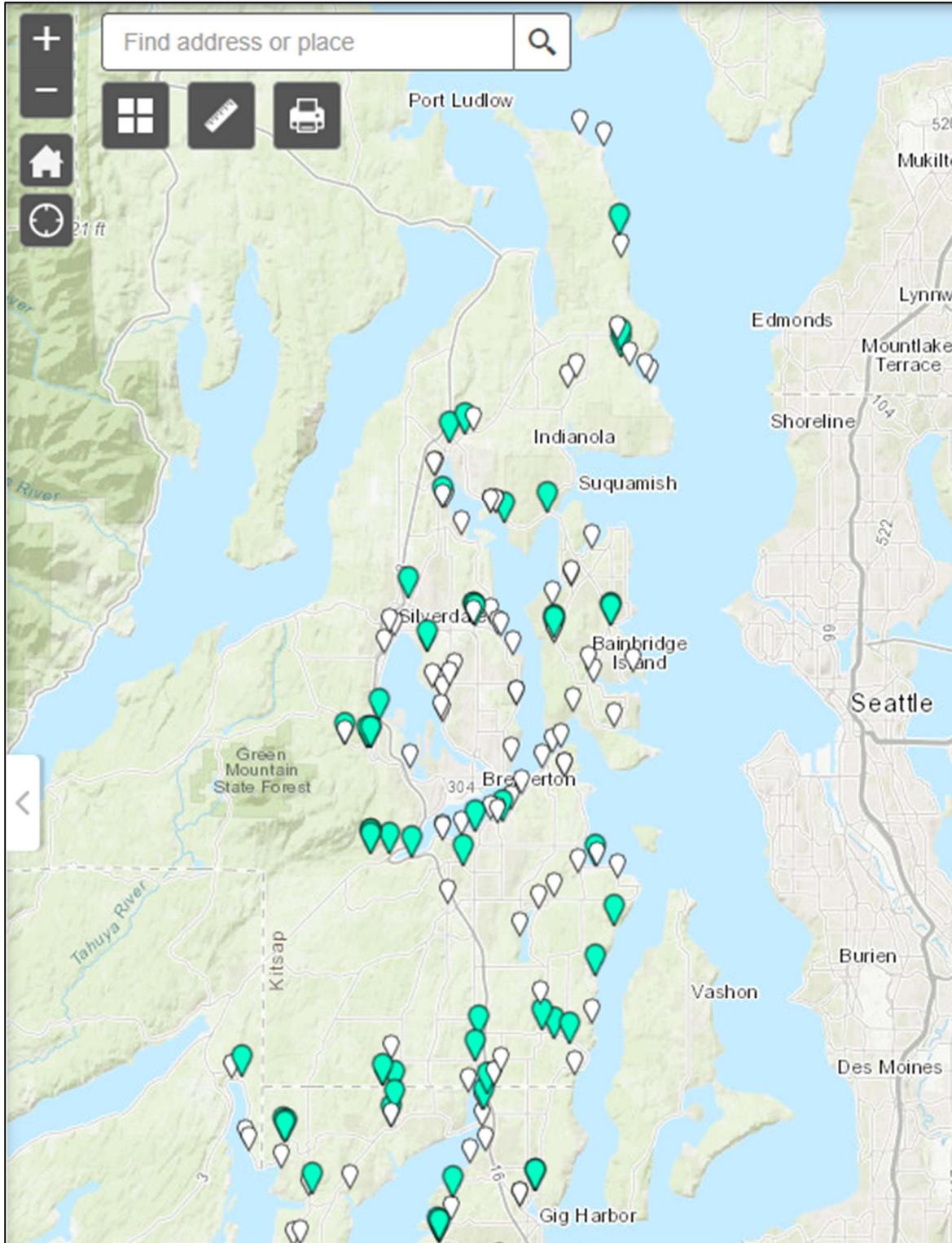


Figure 2. *O. mykiss* Detections in eDNA Sampling by the WFC

www.wildfishconservancy.org) Green points represent positive detections. White points represent sample locations without detection.

Table 2. Steelhead Spawning Ground Survey Results for Tier 1 and Tier 2 Streams (WDFW 2025a)

STREAM	TOTAL NUMBER OF SURVEYS	MAXIMUM RIVER MILE EXTENT OF SURVEYS	EARLIEST AND LATEST YEARS OF OBSERVATION (# OF YEARS)	MONTHS SURVEYED	MONTHS STEELHEAD OBSERVED	LIVE STEELHEAD AMONG ALL SURVEYS	DEAD STEELHEAD AMONG ALL SURVEYS	NEW REDDS
Blackjack Creek	25	0 to 3.1, 5.2 to 6.3	1984 and 2004 (9)	Sept to April	Jan to Feb	13	2	24
Chico Creek	26	0 to 5.2	1987 and 2005 (11)	Nov to April	Nov to April	18	0	26
Dickerson (trib.)	9	0 to 1.0	1986 and 2001 (6)	Dec to April	Dec to Feb	4	0	0
Kitsap (trib.)	2	0 to 0.8	1999 (1)	March	March	1	0	0
Lost (trib.)	11	0 to 2.0	1995 and 2003 (6)	Feb to April	March to April	3	0	5
Clear Creek	5	0 to 1.0	1999 and 2001 (3)	March to April	March to April	3	0	10
Curley/ Salmonberry	13	0 to 2.2	1984 and 2003 (9)	Jan to April	Jan to April	15	0	17
Gorst Creek	39	0 to 1.9	1985 and 2010 (14)	July to April	Dec to April, Aug to Sept	36	3	7
Parish (trib.)	11	0 to 0.1	2000 and 2004 (5)	Feb to May	n/a	0	0	0
Grovers Creek	0	<i>Not surveyed</i>						
Barker Creek	2	0 to 1.4	1995 and 2000 (4)	March to April	March	1	0	5
Big Scandia Creek	2	0 to 1.3	1999 and 2000 (2)	April to May	n/a	0	0	5
Crescent Creek	2	0 to 1.4	1992 and 1999 (2)	Nov and Jan	Nov to Jan	1	2	0
Dogfish Creek	3	0 to 0.8	1995 and 2003 (4)	Nov to March	Nov	0	1	0
NF Dogfish (trib.)	3	0 to 1.1	1995 and 2000 (3)	Feb to Mar	n/a	0	0	2
Olalla Creek	1	0.8 to 1.3	1984 and 2006 (4)	Jan	Jan	3	1	0
Ross Creek	0	<i>Not surveyed</i>						
Steele Creek	3	0 to 0.3	1998 and 2006 (3)	Dec to April	Dec	1	1	0
Strawberry	0	<i>Not surveyed</i>						
Anderson Creek	2	0 to 1.0	1980 and 1988 (2)	Dec to Jan	Dec to Jan	2	1	0

3. OVERVIEW OF MONITORING TECHNIQUES RELATED TO VSP PARAMETERS

There are many types of monitoring techniques that could be implemented to collect information on the East Kitsap Steelhead DIP. The identification of techniques to pursue in this Plan was based on the ability of the sampling to provide data on VSP parameters, an interest in minimizing the risk to steelhead through handling/sampling, and the costs of the sampling. The three main sampling techniques selected for this plan are environmental DNA, outmigrant traps, and spawning ground surveys. Additional approaches considered are seining, snorkeling and electrofishing. The VSP parameters informed by each sampling technique are summarized in **Table 3**. As noted above, additional potential data sources include commercial, tribal, and recreational fishery data, traditional ecological knowledge from tribal elders, and other ongoing activities that may involve fish observations/handling (e.g., fish exclusion efforts at construction sites). Past documentation from these efforts could provide information on *O. mykiss* observations and changes to documentation requirements for future fish exclusion activities would provide additional information on this species for whom all observations are informative given the current lack of data.

Environmental DNA sampling can provide information on the spatial structure of *O. mykiss* based on presence/absence of species-specific DNA, however eDNA cannot currently distinguish between steelhead and rainbow trout which reduces the certainty of applying the data to interpret steelhead distributions. With enough sampling frequency, eDNA results could inform the timing of different life stages occurrence in streams such as when adult *O. mykiss* are returning to a stream and when smolts are leaving. Currently, eDNA does not inform any of the other VSP parameters, but as the technology improves some inferences on relative abundance may be possible. It is a low effort and low-cost way to collect data on whether steelhead are present upstream of a collection point. It does not require handling fish and does not risk harming them. Environmental DNA sampling is also a screening tool to plan where and when to sample using conventional approaches that do inform other VSP parameters.

Outmigrant traps are used to collect small to mid-sized fish that are moving downstream. More information on the outmigrant traps that the Suquamish Tribe is currently operating in Lost and Wildcat Creeks is provided in Section 4.2. Depending on the mesh size of the wing walls, very small fish such as fry may pass through the trap mesh without being captured for sampling. Downstream migrating kelts may also be captured. The traps collect fish in a live box which allows for the collection of tissue and/or scale samples and the measurement of multiple parameters prior to returning fish to the stream. Genetic testing of tissue collected at traps is useful for confirming species identity, determining population origin, and estimating effective population size, hatchery introgression, and hybridization. Outmigrant traps provide a count which can be used to inform abundance and productivity estimates. Genetic sampling of tissue samples could also inform an abundance estimate. The “fish out” data provided by outmigrant traps can be paired with “fish in” data collected during spawning ground surveys to allow for estimation of productivity. The ability to measure the length of fish and evaluate age through scale analysis, and outmigration timing data, supports assessment of population diversity. Genetic testing of tissue collected at traps is useful for confirming species identity, determining population origin, and estimating effective population size, hatchery introgression, and hybridization. Outmigrant traps do not provide much information on spatial structure except for possibly informing the relative numbers of steelhead in different stream systems. Outmigrant traps are very labor intensive and can be harmful to fish during trapping and during handling. Diligent oversight of outmigrant traps is necessary to minimize risk of harm to fish.

Spawning ground surveys allow for observations of live and dead steelhead in streams, plus the identification of redds. Steelhead are notoriously cryptic and difficult to see which makes visual observations challenging to rely on for accurately estimating the number of spawners. Nevertheless, spawning ground surveys allow for a count of fish and redds to inform an abundance estimate. When coupled with outmigrant trap sampling, spawning ground surveys can contribute to population productivity estimates. Abundance and productivity estimates based on spawning ground surveys would need to account for the potential to underestimate the number of spawners due to the difficulty in visually observing steelhead on spawning grounds. Spawning ground surveys identify which streams steelhead are spawning in, where, and when. Carcasses can be sampled for length, determination of sex, hatchery-origin (adipose fin clip) vs. natural origin recruit, spawning success (female pre-spawning mortality assessment), presence of CWT or other tags, presence of disease or parasites, collection of otoliths and/or scales to support age analysis and whether they are repeat spawners, and tissue samples for genetic testing. This is useful information about population diversity. Spawning ground surveys are low to moderate effort sampling techniques when conducted in a subset of potential spawning areas, i.e., index reaches, can be good indicators of spawning throughout the area's streams. Spawning ground surveys aiming to survey all streams and spawning reaches would be very time intensive and is unrealistic. Surveys do not require handling live fish and cause minimal risk associated with their behavioral response to the survey crew in close proximity.

Snorkeling can be used to inform spatial structure by identifying locations in watersheds that are used by juvenile *O. mykiss*. The visual observations will include uncertainty in interpreting the observations as steelhead due to similarity in appearance of juvenile rainbow trout and steelhead, as well as difficulty distinguishing *O. mykiss* from cutthroat trout and *O. mykiss-O. clarkii* hybrids. The effectiveness of snorkeling will depend on stream conditions, notably water depth and turbidity. In shallow systems and/or turbulent waters, snorkel surveys may not provide sufficient range of view to rely on. Snorkel counts can provide a relative estimate of abundance that can be compared to other snorkeling locations. With an understanding of available habitats in the stream system, intensive snorkeling that includes a "mark-resight" component to improve unique count confidence could be complete enough to estimate abundance and in turn contribute to "fish out" estimates for a productivity calculation. Snorkeling also provides data on length of fish and timing to inform population diversity. Snorkel surveys are low to moderate effort sampling techniques unless a high effort, more complete survey program to estimate abundance is undertaken. Surveys do not require handling live fish and cause minimal risk associated with their behavioral response to the snorkel crew in close proximity.

Electrofishing and seining are two sampling techniques that provide similar information on VSP parameters. Both techniques collect data to inform spatial structure by identifying locations in watersheds that are used by juvenile steelhead. Both techniques entail fish handling which makes tagging individuals possible. Tagging could be used in combination with the outmigrant trap to support the "fish out" part of a fish in/fish out productivity analysis. Electrofishing and seining also allow for the collection of tissue samples and scales which can be analyzed for genetic composition and age analysis, respectively, to inform population diversity. Both sampling techniques are moderately labor-intensive. Both techniques entail fish handling which can be harmful to fish. Electrofishing has a higher likelihood of lethal or non-lethal injury to captured fish than any other sampling technique described here. Given the potential risk to the expected low numbers of *O. mykiss* associated with electrofishing and seining, these sampling techniques are less desirable for use in steelhead population monitoring efforts in the East Kitsap DIP area.

Table 3. Viable Salmonid Population Parameters Informed By Potential Population Monitoring Techniques

SAMPLING METHOD	ABUNDANCE	PRODUCTIVITY	SPATIAL STRUCTURE	DIVERSITY
Environmental DNA	Not currently, but potentially fish density could be interpreted as the technology continues to develop.	No	Yes, indicates which stream systems <i>O. mykiss</i> are present in and where in those streams.	Possibly, a limited amount of information on timing of presence could inform spawn timing and rearing timing.
Outmigrant Traps	Yes, count of “fish out,” including smolts and kelts. Genetic analysis would also provide estimate of effective population size (N_{eff}).	Yes, provides “fish out” numbers that could be used with adult return numbers (“fish in”) to provide some estimate of productivity.	Possibly, a limited amount of information is gained on spatial distribution if few trap locations, but some information on relative numbers between sites and stream systems.	Yes, allows measurement of size and collection of scales for age structure analysis, tissue sampling for genetic analysis, and information on outmigration timing.
Spawning Ground Surveys	Yes, provides incomplete counts of the number of returning adults (“fish in”). Genetic analysis would also provide estimate of effective population size (N_{eff}).	Yes, provides an estimate of “fish in” numbers that could be used with outmigrant trap numbers (“fish out”) to provide some estimate of productivity.	Yes, indicates which stream systems steelhead spawn in and where in those streams.	Yes, otoliths from carcasses can be analyzed to inform age structure. Surveys document run timing, and hatchery vs native origin fish.
Snorkeling	Relative densities of juveniles and possibly total abundance if sampling is intensive enough (mark-resight or mark-recapture study).	Possibly, if sampling is intensive enough to support estimation of total number of outmigrants in year class to use with adult return estimates from other sampling methods.	Can be used to identify locations used by juveniles in watersheds known to have steelhead.	Not generally except for length distribution and timing.
Electrofishing				Yes, allows for collection of tissue or scales.
Seining				Yes, allows for collection of tissue or scales.

4. RECOMMENDED CORE MONITORING TECHNIQUES

The recommendations presented in this section assume that in the foreseeable future there will be limited funding available for monitoring. Since there is not a dedicated “steelhead monitoring program” underway that would support a robust sampling program, this plan places an emphasis on monitoring techniques ranging from relatively low cost to higher levels of intensity. The recommended techniques could be implemented to slowly build a dataset to inform population characteristics per VSP parameters or accelerated to develop a database more quickly for population analysis. It is hoped that in the future a partnership forms to conduct a more complete sampling program to more fully inform population status and trends for all VSP parameters.

Environmental DNA sampling, outmigrant traps, and spawning ground surveys are the recommended core population monitoring techniques to implement. This recommendation is informed by input from the focus group, the VSP parameters each technique can inform, and consideration of sampling cost and potential risk of harming fish. The following sections provide details on each sampling technique.

Some of the sampling techniques provide beneficial opportunities to coordinate data collection with efforts targeting other salmonid and non-salmonid fish populations. Adjusting coho sampling efforts to include steelhead could provide cost and effort efficiencies compared to new efforts. Likewise, new efforts focused on steelhead should consider whether expansion to provide data on other species – notably coho salmon – could efficiently and effectively be achieved.

Estimated sampling costs are provided for each of the core monitoring techniques. These costs were estimated by Suquamish Tribe biologists and are not expected to be based on the same rates or cost assumptions that other entities may require. Additional costs for site access outreach, equipment (other than filters), data management, reporting, and project management are not included in this estimate. Rate adjustments and contingencies should be considered if the sampling is conducted by anyone other than the Suquamish Tribe and to account for inflation. Population monitoring planning and implementation should emphasize data quality while developing full cost estimates in an effort to ensure valid data are collected and managed during each component of the monitoring program. At a minimum, the costs presented provide a relative comparison of funding requirements for the various monitoring techniques.

4.1 Environmental DNA Sampling

4.1.1 Purpose and Desired Data

Environmental DNA (eDNA) sampling is a cost-effective technique to investigate the current distribution of *O. mykiss* in the East Kitsap area.

Environmental DNA can improve our understanding of spatial structure of the *O. mykiss* population. These data can also inform which streams in the East Kitsap area are used by steelhead, and when and where within those streams the utilization occurs (or at least identify that use occurred upstream of or at the sampling point within the days preceding the sample collection).

However, there are some limitations of current eDNA analysis capabilities that need to be acknowledged. Environmental DNA cannot distinguish between rainbow trout and steelhead. This sampling plan interprets positive *O. mykiss* detections as steelhead unless the stream is known to have recent or legacy (i.e., in past and no longer occurring) hatchery rainbow trout stocking. In streams with recent or legacy hatchery rainbow trout stocking, interpretation of eDNA findings of *O. mykiss* will be

less clear on whether steelhead are present unless accompanied by genetic testing of fish origin. Another confounding factor affecting the certainty of interpretation of eDNA results is the documented hybridization of *O. mykiss* and *O. clarkii* which cannot be distinguished from *O. mykiss* currently in eDNA genetic analysis.

4.1.2 eDNA Sampling Priorities

The decision tree presented in **Figure 3** includes a series of questions to guide which streams listed in the East Kitsap Steelhead Recovery Plan (ESA 2020) are included for eDNA sampling as part of this plan, and where to focus sampling within each stream. The decision tree uses information on the known presence of hatchery rainbow trout, documentation of *O. mykiss* in the streams, and the tiering assignments from the East Kitsap Steelhead Recovery Plan (ESA 2020).

Hatchery rainbow trout are a key factor in developing a sampling strategy because they are the same species as steelhead and genetically indistinguishable from steelhead in eDNA testing. Per the *Statewide Steelhead Management Plan* (WDFW 2008), state policy to protect wild steelhead stocks from potential interactions with hatchery-origin rainbow trout, hatchery-origin rainbow trout are not released in anadromous waters or in lakes where the release would have a significant negative impact to wild steelhead. WDFW manages the hatchery plants of rainbow trout to minimize potential interactions with wild steelhead (Downen pers. comm. 2025). However, the potential for genetic material from hatchery fish to occur downstream impacts interpretation of eDNA results. In addition to documented stocking by WDFW, it is possible that undocumented plantings have occurred by private landowners who may have stocked ponds/impoundments with hatchery rainbow trout.

The decision tree distinguishes between documented ongoing/recent stocking of hatchery rainbow trout (i.e., within the last 5 years) and legacy stocking of hatchery rainbow trout (i.e., has not occurred in more than 5 years). Environmental DNA sampling is not recommended in streams with ongoing/recent hatchery rainbow trout stocking that occurs in locations that are expected to affect the entire stream system. This is because it is assumed that there are *O. mykiss* in the stream system and the information needed in those systems is genetic testing to distinguish between steelhead and rainbow trout. However, eDNA sampling of tributaries in larger stream systems, including those with large tributaries, with ongoing/recent hatchery rainbow trout stocking may be useful for detecting *O. mykiss* and conducting subsequent tissue sample collection and genetic testing to investigate *O. mykiss* genetics. Environmental DNA sampling in streams with legacy stocking can also be useful for detecting *O. mykiss* and conducting subsequent tissue sample collection and genetic testing to investigate *O. mykiss* origins in the stream.

Steelhead presence is documented in many streams in the East Kitsap DIP area according to SWIFD (NWIFC and WDFW 2025) ; however, the low viability status of Puget Sound steelhead documented in the Steelhead Recovery Plan (NMFS 2019) reflects the potential that steelhead distributions in the area may have changed (contracted) in recent years. The decision tree includes an evaluation of whether steelhead have been documented in streams since 2000. Streams with documentation of *O. mykiss* since 2000 are of lower priority in an effort to focus initial eDNA sampling efforts to expand the geographic extent of streams with documentation of their presence. The data sources for this evaluation are WDFW's spawning ground survey database (WDFW 2025a), WFC (2025b) water typing observations, and eDNA sampling in 2021 and 2022 by WFC (2025a). Both of these data sources include data for only a portion of the streams.

The decision tree prioritizes investigating the spatial distribution of steelhead in the area (i.e., which streams have *O. mykiss* present) by sampling in streams where steelhead presence has not been

documented. Secondly, additional sampling is recommended to focus on documenting the full extent of steelhead distributions in streams with confirmed presence.

The information needed to apply the decision tree in **Figure 3** for each creek included in the recovery plan and the eDNA sampling priority recommendation is presented in **Table 4**. As eDNA and other sampling techniques proceed, the resulting data may lead to adjustments in the sampling strategy. In addition, the currently available information in the decision tree could be supplemented by habitat surveys to assess existing steelhead habitat quality in streams to further prioritize where to sample.

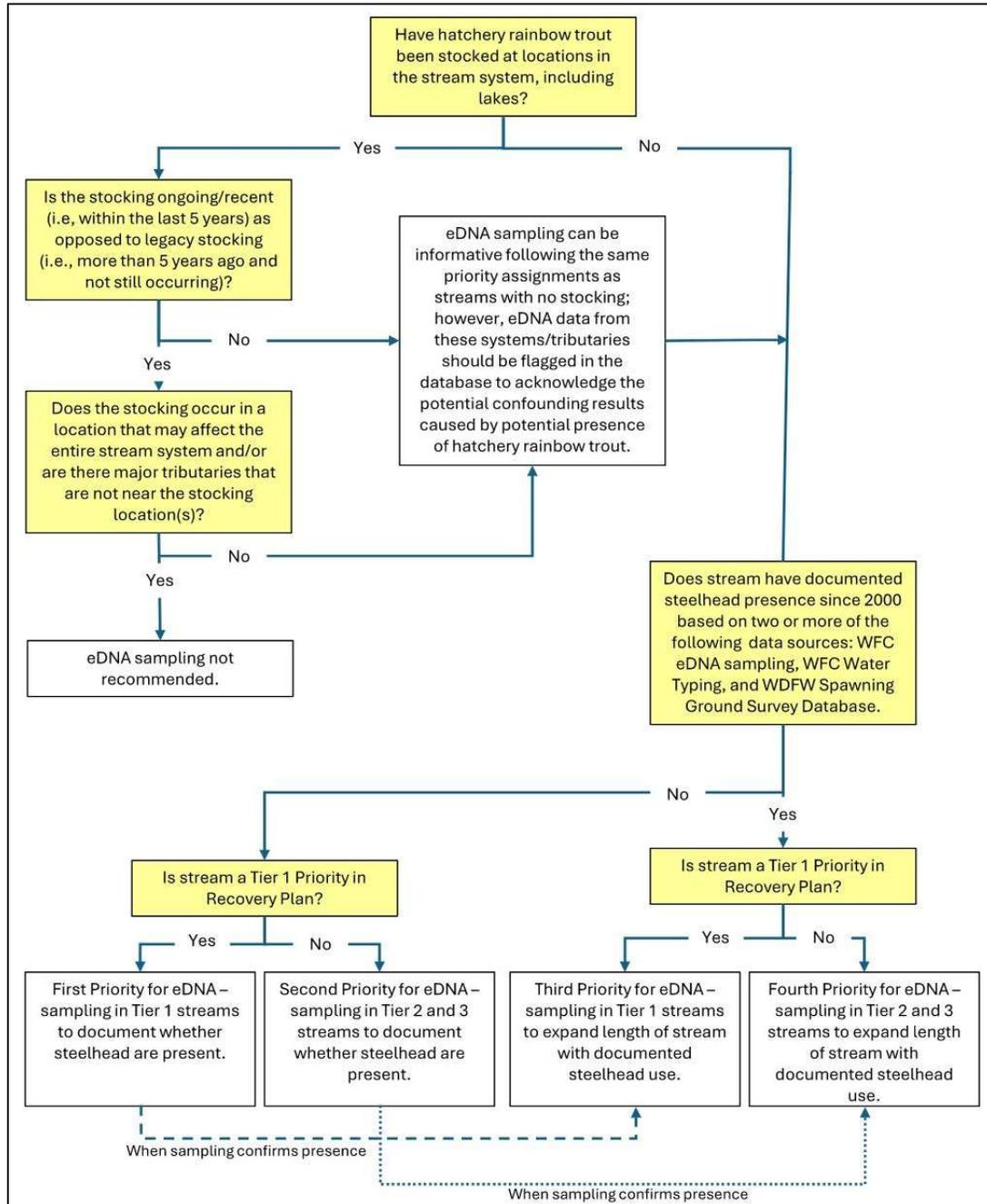


Figure 3. Decision Tree for eDNA Sampling Strategy

Table 4. Summary of Steelhead or *O. mykiss* Distribution Information and Recommended eDNA Sampling Priorities

STREAM	RECOVERY PLAN PRIORITY TIER	WDFW STOCKING OF HATCHERY RAINBOW TROUT	SWIFD WINTER STEELHEAD PRESENCE	SPAWNING SURVEYS FOUND STEELHEAD (MOST RECENT SITING)	WFC WATER TYPING PUTATIVE <i>O. mykiss</i> SITING (YEAR)	WFC eDNA <i>O. mykiss</i> (# POSITIVE FOR TOTAL #)	RECOMMENDED ENVIRONMENTAL DNA SAMPLING PRIORITY
Blackjack Creek	1		Documented	Yes (2004)		2 for 2	Third priority - expand distribution
Chico Creek	1	Yes, ongoing	Documented	Yes (2005)		4 for 7	Third priority – expand distribution in Dickerson and Lost Creeks; eDNA sampling is not recommended in remainder of system
Clear Creek	1		Documented	Yes (2000)		1 for 2	Third priority - expand distribution
Curley/ Salmonberry Creek	1	Yes, but not recently (not since 2001)	Documented	Yes (2003)		0 for 4	First priority - confirm presence
Gorst Creek	1		Documented	Yes (2010)		3 for 3	Third priority - expand distribution
Grovers Creek	1		Documented	Not surveyed	Yes (2010)	0 for 2	First priority - confirm presence
Barker Creek	2	Yes, ongoing	Documented	Yes (2000)		1 for 2	eDNA sampling is not recommended
Big Scandia Creek	2		Documented	Yes (2000)		1 for 2	Fourth priority - expand distribution
Crescent Creek	2	Yes, ongoing	Documented	Yes (1999)		2 for 2	eDNA sampling is not recommended
Dogfish Creek	2		Documented	Yes (2003)		2 for 3	Fourth priority - expand distribution
Olalla Creek	2		Documented	Yes (1984)		3 for 4	Fourth priority - expand distribution
Ross Creek	2		Documented	Not surveyed		0 for 2	Second priority - confirm presence
Steele Creek	2		Documented	Yes (2006)		3 for 4	Fourth priority - expand distribution

STREAM	RECOVERY PLAN PRIORITY TIER	WDFW STOCKING OF HATCHERY RAINBOW TROUT	SWIFD WINTER STEELHEAD PRESENCE	SPAWNING SURVEYS FOUND STEELHEAD (MOST RECENT SITING)	WFC WATER TYPING PUTATIVE <i>O. mykiss</i> SITING (YEAR)	WFC eDNA <i>O. mykiss</i> (# POSITIVE FOR TOTAL #)	RECOMMENDED ENVIRONMENTAL DNA SAMPLING PRIORITY
Strawberry Creek	2		Documented	Not surveyed		0 for 2	Second priority - confirm presence
Anderson Creek	3		Documented	Yes, (1988)		1 for 1	Fourth priority - expand distribution
Baileys Creek	3		Not documented	Not surveyed		Not sampled	Second priority - confirm presence
Bliss Creek	3		Not documented	Not surveyed		Not sampled	Second priority - confirm presence
Carpenter Creek	3		Not documented	Not surveyed	Yes (2012)	2 for 3	Fourth priority - expand distribution
Christiansen Creek	3		Documented	Not surveyed		Not sampled	Second priority - confirm presence
Cowling Creek	3		Not documented	Not surveyed		Not sampled	Second priority - confirm presence
Doe-Kag-Wats Creek	3		Not documented	Not surveyed	Yes (2012)	No detects ^a	Second priority - confirm presence
Issei Creek	3		Not documented	Not surveyed	Yes (2013)	0 for 1	Second priority - confirm presence
Judd Creek	3		Documented	Not surveyed		Not sampled	Second priority - confirm presence
Karcher/ Annapolis Creek	3		Not documented	Not surveyed		0 for 2	Second priority - confirm presence
Lemolo Creek	3		Presumed presence	Not surveyed		0 for 2	Second priority - confirm presence
NF Olalla Creek	3		Not documented	Not surveyed		Not sampled	Second priority - confirm presence
North/ Donkey Creek	3		Documented	Not surveyed		0 for 2	Second priority - confirm presence
Springbrook/ Fletcher Creek	3		Documented	Not surveyed		3 for 4	Second priority - confirm presence

STREAM	RECOVERY PLAN PRIORITY TIER	WDFW STOCKING OF HATCHERY RAINBOW TROUT	SWIFD WINTER STEELHEAD PRESENCE	SPAWNING SURVEYS FOUND STEELHEAD (MOST RECENT SITING)	WFC WATER TYPING PUTATIVE <i>O. mykiss</i> SITING (YEAR)	WFC eDNA <i>O. mykiss</i> (# POSITIVE FOR TOTAL #)	RECOMMENDED ENVIRONMENTAL DNA SAMPLING PRIORITY
Thompson/ Kleabel Creek	3		Not documented	Not surveyed		1 for 1	Second priority - confirm presence

Note: a) Several small streams and the estuary of the Doe-Kat-Wats watershed have been sampled intensively for eDNA in 2024 and 2025 by the Suquamish Tribe. No *O. mykiss* have been detected during this effort. WFC did not collect eDNA samples in Doe-Kag-Wats streams.

Sources:

East Kitsap Plan – Recovery Priority Tier from ESA (2020)

Catchable Trout Planting reports for 2022 through 2025 (WDFW 2025b)

SWIFD from NWIFC and WDFW (2025)

Spawning ground surveys from WDFW database which includes surveys by Suquamish Tribe and WDFW (WDFW 2025a)

WFC (2025a) eDNA data from online map

Water typing data from WFC (2025b)

Based on WDFW stocking reports (WDFW 2025b), hatchery rainbow trout have been planted in recent years in lakes in the Chico Creek (Tier 1), Barker Creek (Tier 2), and Crescent Creek (Tier 2) systems. Given the presence of hatchery rainbow trout which prevents clear interpretation of whether *O. mykiss* detections are steelhead or rainbow trout, no eDNA sampling is recommended for Barker and Crescent Creeks. In Chico Creek, hatchery rainbow trout continue to be planted in Wildcat Lake and Kitsap Lake which are part of Wildcat Creek and Kitsap Creek tributaries, respectively. Environmental DNA sampling is not recommended in Chico, Wildcat, or Kitsap Creeks, but sampling in Dickerson and Lost Creeks could be conducted to assess *O. mykiss* presence and distribution.

Per the decision tree, the first priority for eDNA sampling is in Tier 1 streams where steelhead presence has not been confirmed since 2000 based on two of the three data sources identified (Spawning Ground Surveys, WFC eDNA, and WFC water typing). This applies to Grovers Creek based on it having no spawning ground surveys and no positive eDNA results in recent WFC (2025a) sampling, but putative *O. mykiss* documented during water typing. Also, since no steelhead have been documented in Curley/Salmonberry since 2000, the stream system is also included in this first priority grouping. Sampling in Grovers and Curley/Salmonberry Creeks should be focused low in the system near the mouth (upstream of tidal influence) and/or in locations that appear to be just downstream of favorable steelhead habitat. Sampling in Curley/Salmonberry should include some sampling near the mouth of Salmonberry Creek (i.e., upstream of Long Lake where there is a legacy of hatchery rainbow trout stocking (2001 and earlier).

The second priority is in Tier 2 and Tier 3 streams where steelhead presence has not been previously documented or has not been confirmed since 2000. The Tier 2 streams in the group are Ross and Strawberry Creeks. The Tier 3 streams in the group are Baileys, Bliss, Christiansen, Cowling, Doe-Kag-Wats, Issei, Judd, Karcher/Annapolis, Lemolo, NF Olalla, North/Donkey, Springbrook/Fletcher, and Thompson/Kleabel Creeks. Environmental DNA sampling in these streams should be focused low in the system near the mouth (upstream of tidal influence) and/or in locations that appear to be just downstream of favorable steelhead habitat.

The third priority for eDNA sampling is in Tier 1 streams where steelhead presence has been confirmed since 2020. This includes Blackjack, Chico, Clear, and Gorst Creeks. Environmental DNA sampling in these streams should focus on documenting the full extent of steelhead distribution in streams by expanding the distribution identified in SWIFD. Due to the hatchery rainbow trout stocking in Chico tributaries, eDNA sampling is only recommended in those tributaries where stocking does not occur (e.g., Lost and Dickerson creeks). Sampling is recommended near the upstream extent of steelhead presence documented in SWIFD. If steelhead are not documented upstream of the reaches identified in SWIFD, then some sampling should be completed in the SWIFD documented reaches to assess whether the previously documented areas are still used by steelhead.

The fourth priority for eDNA sampling is in Tier 2 and Tier 3 streams where steelhead presence has been confirmed since 2020. The Tier 2 streams in the group are Big Scandia, Dogfish, Olalla, and Steele Creeks. The Tier 3 streams in the group are Anderson, Carpenter, Springbrook/Fletcher, and Thompson/Kleabel Creeks. Environmental DNA sampling in these streams should focus on documenting the full extent of steelhead distributions in streams by expanding the distribution identified in SWIFD. Sampling is recommended near the upstream extent of steelhead presence documented in SWIFD (NWIFC and WDFW 2025). If steelhead are not documented upstream of the reaches identified in SWIFD, then some sampling should be completed in the SWIFD documented reaches to assess whether the previously documented areas are still used by steelhead.

4.1.3 Sampling Approach

Since eDNA sampling will be specifically aimed at studying the presence of *O. mykiss*, qPCR eDNA assay testing is highly recommended rather than metabarcoding. The qPCR analysis allows for a greater detection probability of DNA from species that are at a low abundance relative to other species' DNA in the sample.

The analysis will detect the presence of *O. mykiss* but cannot distinguish between rainbow trout and steelhead or "cut-bow" hybrids. The sampling strategy described above avoids sampling in stream systems with ongoing hatchery rainbow trout planting by WDFW (WDFW 2025b) and otherwise assumes positive *O. mykiss* detections indicating steelhead presence.

All eDNA sampling should be conducted in freshwater, upstream of tidal influence. USFWS (2022) describes best management practices for eDNA studies, including sampling design. (Carim et al. 2016) presents an eDNA protocol with sampling techniques to avoid sample contamination and how to collect a sample. The laboratory analysis for eDNA includes the potential for concluding that a species is absent when it is present (false negative) and concluding that a species is present when it is absent (false positive) (Carim et al. 2016). Laboratory techniques and field techniques can contribute to these erroneous results. USFWS (2022) provides best management practices for minimizing the potential for false negative and false positive results. Laboratory results with control samples should be included in interpretation of results and decisions about future sampling in an effort to ensure that an adequate number of samples are collected to establish *O. mykiss* presence or absence during sampling.

Depending on the availability of funding, a less intensive survey for detections or a full study with estimated probability of detections may be implemented. The type and intensity of the survey effort will affect the extent to which sample replicates, field control samples, and laboratory control samples are included in the sampling design.

The spacing of sampling sites is an important consideration for detecting fish. Carim et al. (2016) expects high detection probabilities from even a single individual in small streams if it is located within 100 m of the sample location. Carim et al. (2016) report some level of detectability as far as 1 km downstream of a single individual. Wilcox et al. (2016) report a detection probability of 0.18 at densities of one brook trout per stream kilometer and very high detection probabilities (>0.99) at densities of ≥ 3 fish per 100 m. Sampling plans that are able to sample at shorter distances between sites will have increased likelihood of detecting steelhead, especially if in small numbers, than longer distances between sites.

Environmental DNA is not uniformly distributed in the water column. Research by Wood et al. (2021) suggests that eDNA is released in concentration from fish and does not mix evenly downstream. Wood et al. (2021) studied eDNA plume dynamics downstream from sources and found that eDNA was initially concentrated and transported midstream, then progressively dispersed laterally to stream margins with time and distance. A hypothesized graphic from Wood et al. (2021) showing lateral dispersion with distance downstream and more evenly distributed but lower concentrations is shown in **Figure 4**.

These eDNA dispersal patterns will be considered when selecting sampling sites in East Kitsap streams, especially in larger streams. If multiple samples are collected from sites, sampling water in slightly different locations (e.g., one near bank and one closer to center) may increase the likelihood of steelhead detection.

If possible, sampling sites multiple times will increase the likelihood of detecting steelhead. Although steelhead rear in freshwater for multiple years and are therefore present year-round, sampling in the late winter and early spring when both adults and juveniles could be present will maximize the

likelihood of detection. Steelhead in East Kitsap streams likely return as adults from December to April and spawn between February and May (ESA 2020 based on (Haring 2000), (PSP and WDFW 2011)). Sampling in March, April, and May would be favorable months to sample to have the possibility of detecting eDNA from adult and juvenile steelhead.

Glasgow (pers. comm. 2025) recommends that eDNA sampling is not conducted during or immediately after significant rain events. WFC further recommend not conducting eDNA sampling within a week of when others were known to be wading upstream of the sample site (spawning surveyors, etc.).

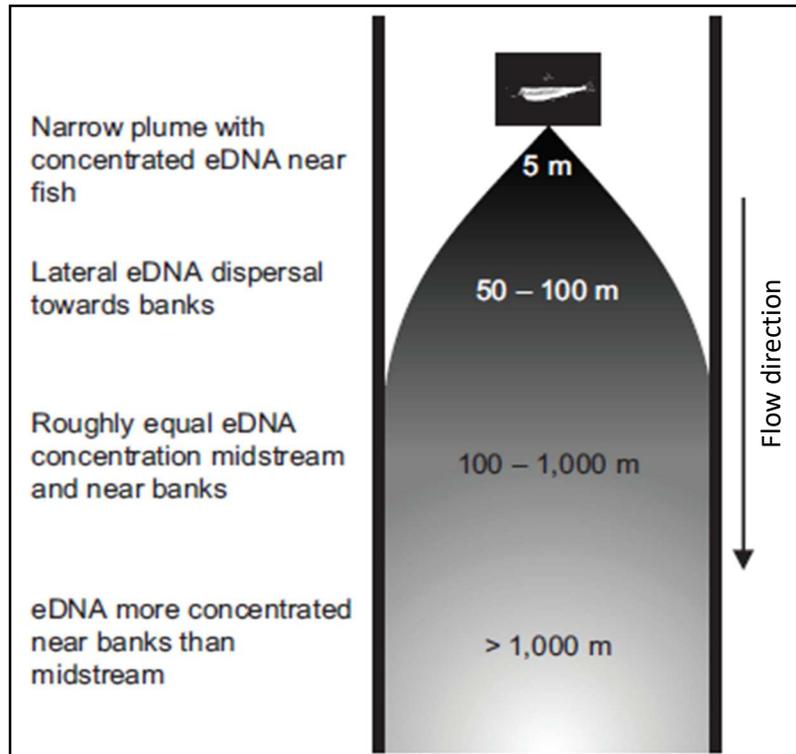


Figure 4. Hypothesized eDNA Plume (from Wood et al. 2021)

Recommended eDNA Sampling to Confirm *O. mykiss* Presence in Streams

Sampling to confirm *O. mykiss* presence in streams should collect samples low in stream systems where water flows will transport eDNA from steelhead in upstream locations. Since eDNA degrades over time, eDNA from steelhead located several kilometers upstream from the mouth may not be detectable when it reaches the stream mouth. Additional eDNA sampling in locations further upstream in the watershed, but downstream of favorable steelhead habitat, would increase the likelihood of detecting *O. mykiss* that may be present in the stream.

Depending on the amount of sampling that can be conducted, sampling should aim to include collection from multiple locations in each target stream at multiple times. As a general target, collecting 4 to 6 samples over 3 to 4 sampling events during the late winter and spring would provide a good opportunity to detect *O. mykiss* presence in the system. Although laboratory analysis may take a long time, when possible positive *O. mykiss* detections should be used to adapt future sampling efforts.

Recommended eDNA Sampling to Investigate the Extent of Distribution in Streams

Environmental DNA sampling focusing on documenting the full extent of *O. mykiss* distributions in streams by expanding the distribution identified in SWIFD should focus near the upstream of the documented extent of steelhead presence in SWIFD (NWIFC and WDFW 2025). For this sampling, the eDNA detection probabilities described in Carim et al. (2016), i.e., high probability within 100 m of source and decreasing over distance to a low probability as far as 1 km from the source, should be factored in when deciding upon spacing between sampling locations.

Before establishing a sampling plan in a stream, an office-based and field-based reconnaissance is recommended to observe the suitability of habitat conditions upstream for steelhead. Information on fish passage barriers and/or fixed barriers, SWIFD distributions of other salmon species extending upstream of steelhead, presence of flowing water, intrinsic potential mapping in Nash (2017), and instream habitat conditions etc. can help guide the anticipated reaches of interest for sampling.

With this information and depending on the amount of sampling that can be conducted, sample spacing and sampling locations should be mapped out. As possible, shorter distances between samples would be preferred to increase the likelihood of detecting any steelhead present in the area. As a general target, collecting samples at 0 m, 200 m and 400 m upstream of the end of previously documented steelhead distribution over 3 to 4 sampling events is recommended in an initial sampling effort. In stream systems with multiple forks or tributaries with suitable steelhead habitat, this general target could be applied to each fork and tributary.

Sampling results from completed eDNA sampling with adequate understanding of the likelihood of false negatives and false positives (USFWS 2022) should be used to inform future sampling. If positive detections occur, then future sampling should shift to locations further upstream at 200 m increments unless the stream reconnaissance indicates no steelhead presence should be expected upstream. If no steelhead are detected in sampling, then future sampling should either focus on a more favorable time of year or flow conditions or shift to more downstream locations to attempt to confirm if the upstream extent documented in SWIFD is still used by steelhead.

4.1.4 Approximate Costs (Materials and Labor)

As noted above, estimated sampling costs are provided for each of the core monitoring techniques based on estimates provided by Suquamish Tribe biologists. Additional costs for site access outreach, equipment (other than filters), data management, reporting, and project management are not included in this estimate. At a minimum, the costs presented provide a relative comparison of funding requirements for the various monitoring techniques.

Confirmation of steelhead presence in streams –

Based on 2025 cost and labor rate information provided by the Suquamish Tribe, it would cost approximately \$5,100 per stream to collect samples and complete the laboratory testing on 4 samples during 4 sampling events (i.e., 16 total samples). Additional costs for site access outreach, equipment (other than filters), data management, reporting, and project management are not included in this estimate. Rate adjustments and contingencies should be considered if the sampling is conducted by anyone other than the Suquamish Tribe and to account for inflation.

Full extent of steelhead distribution in streams –

Based on 2025 cost and labor rate information provided by the Suquamish Tribe, it would cost approximately \$3,900 per stream to collect samples and complete the laboratory testing on 3 samples

during 4 sampling events (i.e., 12 total samples). This is expected to be an iterative sampling approach in which the results of one round of sampling information inform the sampling location of subsequent rounds. Additional costs for site access outreach, equipment (other than filters), data management, reporting, and project management are not included in this estimate. Rate adjustments and contingencies should be considered if the sampling is conducted by anyone other than the Suquamish Tribe and to account for inflation.

4.2 Outmigrant Sampling

4.2.1 Purpose and Desired Data

Outmigrant sampling captures downstream migrating steelhead and focus on juvenile smolts. This allows for counting and measuring the length of each individual, as well as collecting scale and/or tissue samples. The *O. mykiss* counts provide information on run timing and peak timing of downstream migration. Scales can be read to provide information on fish age to better understand life history diversity in the East Kitsap Steelhead DIP area. Tissue samples can be analyzed to determine species (*O. mykiss* vs hybrid *O. mykiss-O. clarkii*) and determine origin (hatchery vs. wild vs. hybrids). Analysis of 30 to 50 tissue samples could support evaluation of native steelhead diversity and effective population size (Luikart pers. comm. 2025). This would require first establishing the population-specific DNA marker sets for each population and hatchery of interest. WDFW may have this library already or establishing new population-specific DNA markers would require 40 to 50 samples from each population and hatchery of interest (Luikart pers. comm. 2025).

Outmigrant traps provide a count which can be used to inform a population abundance estimate for the specific stream or tributary being sampled. The “fish out” data provided by outmigrant traps can be paired with “fish in” data collected in spawning ground surveys to allow for estimation of productivity. The ability to measure the length of fish, collect tissue samples, and evaluate age through scale analysis supports assessment of population diversity. Outmigrant traps do not provide much information on spatial structure except for possibly informing the relative numbers of steelhead in different stream systems.

4.2.2 Outmigrant Trap Sampling Priorities

Given the paucity of steelhead outmigrant data and expectation that numbers are low, outmigrant trap sampling is recommended to occur in those stream systems considered most likely to support steelhead. The East Kitsap Steelhead Recovery Plan identified six Tier 1 streams based on stream length suitable for steelhead. These streams are the first priority for outmigrant traps with the caveat the eDNA data collection could further inform trapping priorities, potentially including in other streams. Among the six, steelhead presence was recently confirmed in Blackjack, Chico, Clear, and Gorst Creeks. The other two Tier 1 streams, Curley/Salmonberry and Grovers Creeks have not had steelhead presence confirmed in recent years. These two streams are recommended for eDNA sampling to confirm steelhead presence before investing in outmigrant trap sampling. Once such confirmation is complete, then those two streams would also be recommended for outmigrant trap sampling. In Chico Creek, an additional outmigrant trap near the mouth would provide additional fish out data to supplement the information from the ongoing sampling in Lost and Wildcat Creeks further upstream. Preferably, spawner surveys in Chico Creek and its tributaries could be conducted and paired with the outmigrant data to provide fish in/fish out data for the entire watershed.

4.2.3 Sampling Approach

Outmigrant traps require around-the-clock access and monitoring to respond to conditions that may occur during the sampling period. Locations that are locked at night or where neighbors would be disturbed by nighttime activity are unsuitable. Preferred sampling sites would also have low risk of attracting theft or disturbance of sampling equipment.

Outmigrant traps often include wing walls that span the entire creek channel to function like a weir. The wing walls are positioned at a sharp angle to flow and funnel fish into the trap via a narrow slot or PVC pipe. A holding refugia box holds the catch until sampled by biologists. Trap parts are sometimes wood-framed and kept in place with fence posts to provide structural stability against normal flows encountered at the site. The holding refugia box includes flow shelter at the upstream end so that fish in the trap are not forced to swim against the full current. **Figure 5** shows the Suquamish Tribe's outmigrant trap on Lost Creek in the Chico Creek system.

Traps are checked at least once per day every day while sampling. Outmigrant traps spanning the creek channel are assumed to likely capture all outmigrants except the small numbers that may migrate downstream before or after the sampling period of the trap (Suquamish Tribe 2025). For the Suquamish Tribe's outmigrant traps at Lost and Wildcat Creeks, they have developed a correction factor to estimate the total number of coho salmon outmigrants which is based on their 14 years of sampling and uses data on the number of coho captured in the first and last weeks of sampling (Suquamish Tribe 2025).



Figure 5. Lost Creek Outmigrant Trap

Recommended Outmigrant Trap Sampling Locations in Selected Streams

To maximize the catch of steelhead produced in the stream system, the outmigrant trap should be positioned low in the stream, but upstream from tidal influence. Ideally, the trap can be positioned downstream of all forks and tributaries expected to potentially produce steelhead and downstream of mainstem spawning reaches. Sampling low in the watershed increases the likelihood of capturing steelhead migrating into saltwater rather than those fish who may be moving to habitats lower in the system, but not yet outmigrating.

Outmigrant traps work best in locations where flows produce velocities through the funneling slot that exceed what fish of the target size can swim upstream against for a sustained distance. The live box needs to be in a location where sufficient flow and depth is provided to keep captured fish in the water with reasonable space and with cycling water providing ambient water quality conditions.

Traps should be monitored and managed to limit the potential for blocking or delaying the upstream migration of adult steelhead and other salmonid and non-salmonid fish species. Temporary trap openings to allow upstream passage may be warranted to allow for upstream passage.

Recommended Outmigrant Trap Sampling Timing in Selected Streams

Based on current understanding of steelhead outmigration timing in the area, sampling is recommended to be conducted from March through July at first, then consider reducing based on the gained understanding of outmigration timing. Of note, the early sampling date may result in intercepting upstream migrating adult steelhead which would need to be captured and passed upstream of the trap.

Recommended Data to Collect from Captured Outmigrant Steelhead

Captured fish should be identified to species level and additional data collected for steelhead at a minimum, but ideally all salmonids. Data on length, a fin clip tissue sample, and a scale sample should be collected from every steelhead to provide key information on the steelhead population (described in Section 4.2.1). Additional data that could be collected from steelhead are weight, condition factor, and evidence of parasites, disease, or injury.

Sampling of other fish species could help inform pressures affecting steelhead populations. Counting, measuring, and dietary analysis of other species would provide information on predators and competitors in the fish community.

Permitting Considerations for Outmigrant Trap Sampling

Outmigrant traps entail handling of protected species so collection permits from NOAA and WDFW are required, as well as a Hydraulic Project Approval (HPA) from WDFW. The Suquamish Tribe has a collection permit that can cover their activities at trap sites. Their existing permit would need to be modified to include new sites, target species, and more specifics of the sampling. Sampling conducted by other partners would require additional collection permits. Sampling crews need qualified biologists and appropriate sampling gear to ensure all catches are handled properly and to allow catches to be released back to the stream safely after data collection. Sampling crews need to be prepared to handle non-target species as well, including potentially additional protected species.

4.2.4 Approximate Costs (Materials and Labor)

As noted above, estimated sampling costs are provided for each of the core monitoring techniques based on estimates provided by Suquamish Tribe biologists. Additional costs for site access outreach,

equipment (other than filters), data management, reporting, and project management are not included in this estimate. At a minimum, the costs presented provide a relative comparison of funding requirements for the various monitoring techniques.

Outmigrant traps are a very labor-intensive sampling technique. Substantial budget and crew availability and commitment is needed to properly run a trap that minimizes harm to fish. The Suquamish Tribe provided level of effort and material costs to inform the following cost estimates.

The start-up costs for the trap include materials, assembly, and installation. Trap building and installation is estimated to cost \$6,300. This includes \$1,000 for materials and 80 hours of labor for a two-person crew (i.e., 160 hours total).

The sampling crew needs to be available at all times to tend the trap, if needed, during high flow events. The traps are checked at least once per day, every day throughout the sampling period. The length of time needed depends on the number of fish captured and the data collected, ranging from 1 to 5 hours per day. Assuming an average of 2.5 hours per day and the trap in place for up to 5 months, operating the trap is estimated to cost \$41,000 per year.

The combined estimated cost is \$32,600 per year. This assumes that the materials and labor for installation will be the same each year due to equipment wear. Additional costs for site access outreach, equipment, data management, reporting, and project management are not included in this estimate. Permitting, if necessary, based on who is operating the trap is not included. Rate adjustments and contingencies should be considered if the sampling is conducted by anyone other than the Suquamish Tribe and to account for inflation.

4.3 Spawning Ground Surveys

4.3.1 Purpose and Desired Data

Spawning ground surveys allow for visual observations of live and dead adult steelhead and redds. Dead adult steelhead allow for measurement of fork length, collection of scale samples, collection of tissue samples, assessment of spawning success (females), origin (natural origin versus hatchery origin), assessment of CWT presence, and determination of sex. Collection of a scale or otolith can support age structure analysis and provide information on population diversity. Otolith analysis informs age in years in freshwater and years in saltwater, as well as an estimate of fork length at time of outmigration to saltwater. No handling of live fish is included in spawning ground surveys.

Spawning ground surveys allow for a count of fish and redds to inform an abundance estimate. When coupled with outmigrant trap sampling, spawning ground surveys can contribute to population productivity estimates. Spawning ground surveys inform which streams steelhead are spawning in, where in the stream steelhead spawning occurs, and run timing.

4.3.2 Sampling Strategy

As described for outmigrant traps, due to the limited amount of recent data and the expectation that steelhead numbers are low, spawning ground surveys are recommended to occur in those stream systems considered most likely to support steelhead. The East Kitsap Steelhead Recovery Plan identified six Tier 1 streams based on stream length. These streams are the first priority for spawning ground surveys. Among the six, steelhead presence was recently confirmed in Blackjack, Chico, Clear, and Gorst Creeks. The other two Tier 1 streams, Curley/Salmonberry and Grovers Creeks have not had steelhead presence confirmed in recent years, although WFC captured one putative *O. mykiss* in Grovers Creek in

2010. These two streams are recommended for eDNA sampling to confirm steelhead presence before investing in spawning ground surveys. If eDNA confirms presence, then those two streams would also be recommended for spawning ground surveys. In Chico Creek, spawner surveys in the Lost and Wildcat systems would complement the outmigrant trap data collection that is ongoing and provide fish in/fish out data for these tributaries. Preferably, additional spawning ground surveys in Chico Creek as well as an outmigrant trap near the mouth would provide fish in-fish out data for the entire stream system.

Recommended Spawning Ground Survey Locations in Selected Streams

Spawning ground surveys should be conducted in reaches with suitable spawning habitat. Habitat surveys are recommended in advance of spawner surveys to assess the distribution of suitable spawning habitats in target streams and to identify survey reaches. Site access can also be evaluated during initial habitat surveys. The maximum extent in river miles of spawning ground surveys reported in WDFW (2025a) spawning ground survey database is presented in **Table 1**. Of note, many of the surveys in the database only covered a portion of the maximum extent covered by all data entries.

Estimates of the full length of stream that provides suitable spawning habitat allow for extrapolation of counts from the spawning ground survey reach to estimate total count in the stream. This would be a rough estimate based on assumptions informed by the habitat surveys on how best to extrapolate subset survey area (e.g., index reach) data. A full census spawning ground survey of a stream during the peak of spawning would further inform what proportion of steelhead spawning occurs in the reach surveyed regularly throughout the spawning period.

Recommended Spawning Ground Survey Timing in Selected Streams

Spawning ground surveys should be conducted in reaches with suitable spawning habitat and occur repeatedly – recommended weekly– throughout the spawning season. Based on current understanding of steelhead spawn timing in the area, sampling is recommended to be conducted over a long time period (i.e., multiple months) at first, then consider reducing based on the gained understanding of spawn timing. The WDFW (2025a) spawning ground survey database indicates that nearly all of the historical surveys occurred between November and April (see **Table 1**). Based on data spanning from 1980 until 2012 (with nearly all from 1988 through 2004), the highest numbers of live steelhead observations occurred in January and the peak number of new redds were observed in March (**Figure 6**). Initially, spawning ground surveys are recommended at a minimum for January through April, with surveys also in November and December ideally. Timing can be adjusted based on observations.

Recommended Data to Collect During Spawning Ground Surveys

Live steelhead and redds should be counted. Dead steelhead allow for additional data collection, including count, fork length, determination of sex, collection of a tissue sample, collection of a scale sample, and collection of an otolith. Otolith analysis inform age in years in freshwater and years in saltwater, as well as an estimate of fork length at time of outmigration to saltwater.

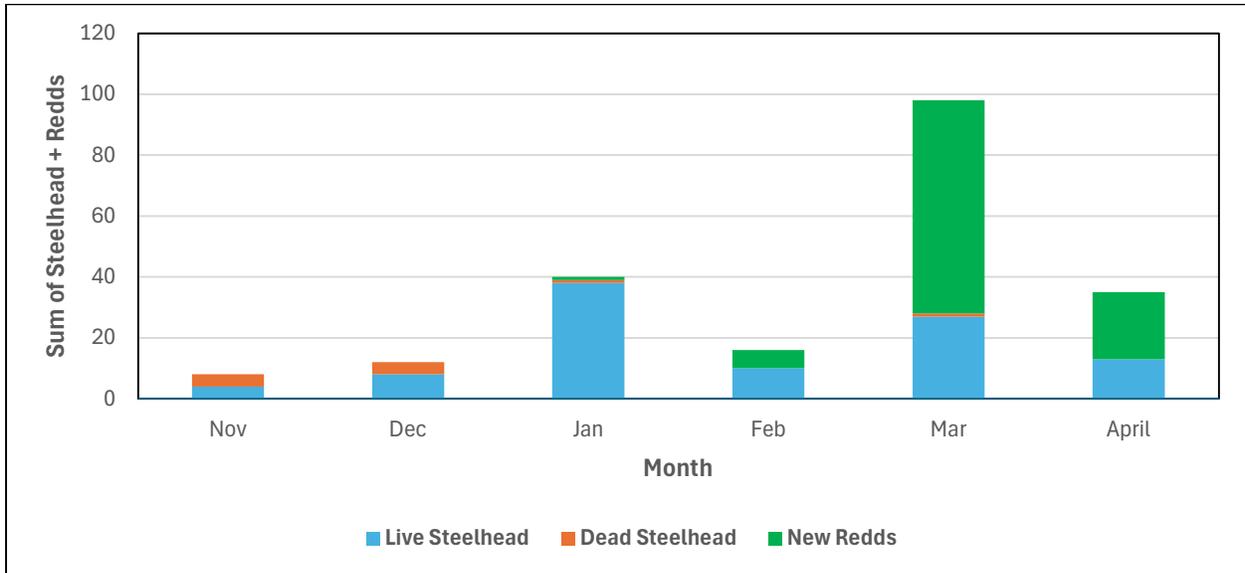


Figure 6. Spawning Ground Observations of Steelhead and Steelhead Redds between 1980 and 2012 (WDFW 2025a)

4.3.3 Approximate Costs (Materials and Labor)

As noted above, estimated sampling costs are provided for each of the core monitoring techniques based on estimates provided by Suquamish Tribe biologists. Additional costs for site access outreach, equipment (other than filters), data management, reporting, and project management are not included in this estimate. At a minimum, the costs presented provide a relative comparison of funding requirements for the various monitoring techniques.

Spawning ground surveys on small streams with few fish are a moderately intensive sampling technique. Crew availability throughout the survey period is needed to collect the desired data. The Suquamish Tribe provided level of effort and material costs to inform the following cost estimate.

The cost estimate is based on a one-mile survey reach. The time necessary depends on the terrain and number of fish (Oleyar pers. comm. 2025b). For planning purposes, it is assumed that one mile of survey will take three hours by a crew of two. Assuming that the one-mile survey reach is surveyed 20 times over a 5-month period, spawner surveys will cost approximately \$6,000 per year.

This rate can be scaled up on a per mile basis. Additional costs for site access outreach, equipment, data management, reporting, and project management are not included in this estimate. Rate adjustments and contingencies should be considered if the sampling is conducted by anyone other than the Suquamish Tribe and to account for inflation.

4.4 Additional Potential Sampling Techniques

This section describes additional sampling techniques that could be included in a population monitoring program. See Table 3 for information on the VSP information each technique could provide.

4.4.1 Snorkeling

Snorkeling could be used to observe habitat selection by steelhead and identify areas of high density use within a small watershed or section of stream. Snorkeling can be used to estimate relative and total abundance, although the total abundance estimates are generally less accurate than some other methods. Snorkeling can also be used to assess fish distribution within a stream or across a watershed and specifically, to identify the types of habitats that are preferentially selected by fish within a reach or stream length. Use of snorkeling in the East Kitsap Steelhead Monitoring Plan would likely be targeted at increasing the accuracy of fish distribution information in areas where steelhead are known or suspected to occur. These efforts could expand the distribution information gained through eDNA sampling and be conducted above areas with outmigrant traps. Juvenile fish observed using snorkeling cannot be differentiated between rainbow trout and steelhead unless the steelhead are close to smolting, so it is best to use an additional method to determine life history patterns.

Snorkeling can be used in areas where other methods cannot, such as deep clear rivers where conductivity is too low for electrofishing or habitats are too deep for seining. Additionally, snorkeling can be used in very remote locations and without disturbing fish behavior. Site selection for snorkel surveys should include considerations for safety, as well as visibility and depth. Depths less than 20 cm and visibility less than 1.5 m are not suitable for snorkel surveys (O'Neal 2007). The shallow conditions in many of the East Kitsap DIP streams make them less suitable for effective snorkeling observations.

4.4.2 Electrofishing

Electrofishing is one of the most widely used methods for sampling salmonids. Data are generally noted as “catch per unit effort” and can provide relative abundance estimates assuming that netting of fish is efficient and that areas are block netted to prevent fish from leaving the reach. Multiple pass mark-recapture or removal studies can also be used to determine abundance in a smaller area. Additionally, electrofishing allows netting and handling of the fish, so it could provide opportunities to collect additional genetic information and tissue samples to try to differentiate subpopulations within East Kitsap and provide further information on diversity. Similar to snorkeling, use of electrofishing in the East Kitsap Steelhead Monitoring Plan would likely be targeted at increasing the accuracy of fish distribution information in areas where steelhead are known or suspected to occur. These efforts could expand the distribution information gained through eDNA sampling and be conducted above areas with outmigrant traps.

Electrofishing requires temperatures between 6 and 18 °C and conductivity between 40 and 250 mmhos (Temple and Pearsons 2007). Efficiency is also affected by the amount of wood or root wads in the reach, discharge, and velocity, as well as large substrate. This approach also works better with larger fish as they are easier to spot and net. This method could be applied using backpack electrofishing in wadable areas with lower velocity that do not contain large amounts of wood which would impede capture (Temple and Pearsons 2007).

With fish in hand, the same data collected at outmigrant traps could be collected from fish captured by electrofishing. Electrofishing entails handling of protected species so collection permits from NOAA and WDFW are required.

4.4.3 Seining

Pole or beach seining is an efficient method for capturing salmonids in a variety of habitats including rivers, streams, and estuarine habitats. Seining is effective at capturing fish for sample collection,

species diversity and presence, and relative abundance. Multiple seining efforts could also be used to add information on fish distribution and since this method can be used in salt water, could be used in estuary areas, unlike electrofishing. Seining is a good approach for capturing small salmonids and data are often reported as “catch per unit effort.” This method can also be used in a mark-recapture study for estimates of abundance.

Seining is most effective when used in relatively shallow water with few obstructions and is generally applied to fish that are weaker swimmers (i.e., smaller fish), so larger steelhead may evade the seine. Sites with firm sloping beaches are the easiest to seine, but collections can be made in almost any habitat type. Current velocity and depth influence the best areas to seine and which type and size of seine to use. Temperature and water clarity can also affect how well seining works in a given habitat as fish move more slowly in very cold environments and clear water allows fish to see the net more easily. Additional information on seining techniques and gear selection can be found in (Hahn et al. 2007).

With fish in hand, the same data collected at outmigrant traps could be collected from fish captured by seining. Seining entails handling of protected species so collection permits from NOAA and WDFW are required.

5. RECOMMENDED SCALABLE MONITORING STRATEGY

As presented in Table 3 and described above, sampling techniques that allow for collection of tissue, scale, and/or otolith samples – i.e., outmigrant traps and spawning ground surveys – can provide the most information on the four VSP parameters. Outmigrant trap and spawning ground surveys conducted for multiple years in the same streams can provide fish in-fish out data to support population abundance and productivity estimates. In addition, the tissue sampling provides key genetic information to determine species (*O. mykiss* vs hybrid *O. mykiss-O. clarkii*) and origin (hatchery vs. wild vs. hybrids) to expand upon the population analysis by Seamons (pers. comm. 2020). As these are more costly and labor-intensive sampling techniques, the expectation is that in the early years of the population monitoring, there may not be sufficient funding available to support these efforts.

The recommendations provided here are based on an expectation that in the foreseeable future there will be limited funding available for monitoring. The recommendations are geared toward the goal of adding basic information on spatial structure and rough information on abundance which could then inform subsequent larger monitoring efforts. The primary monitoring techniques provide different VSP parameter data and have different costs and staffing demands. If funding allows, a sampling strategy is recommended that includes outmigrant traps and spawner surveys in Tier 1 stream(s), supplemented by an eDNA sampling strategy to confirm/establish which streams in the East Kitsap Steelhead DIP area support steelhead. The priorities for which streams to focus on for each of these sampling techniques are provided in Section 4. The outmigrant trap and spawner survey data collection is maximized by having multiple years of data collection rather than implementing sampling for just a single year.

The sampling strategy for eDNA each successive year and each successive sampling event should be adjusted based on the results of the earlier sampling. **Table 5** shows the recommended priorities for sampling in Years 1 to 3 depending on the funding level that is available. This is informed by the sampling cost information provided in Section 4. The specific streams to focus sampling efforts in are prioritized for each sampling technique in Section 4.

Table 5. Recommended Population Monitoring Strategy Based on Funding and Year

FUNDING LEVEL	YEAR 1	YEAR 2	YEAR 3
<\$50,000	<ul style="list-style-type: none"> eDNA to confirm presence in First Priority streams 	<ul style="list-style-type: none"> Same as Year 1; sample different streams for eDNA (Second Priority) 	<ul style="list-style-type: none"> 1 outmigrant trap 1 stream spawning ground survey eDNA to expand length of streams with documented presence
\$50,000 to \$100,000	<ul style="list-style-type: none"> eDNA to confirm presence in First Priority streams 1 outmigrant trap 1 stream spawning ground survey 	<ul style="list-style-type: none"> Same as Year 1; sample different streams for eDNA (Second Priority) 	<ul style="list-style-type: none"> 1-3 outmigrant traps 1-3 stream spawning ground surveys eDNA to expand length of streams with documented presence
\$100,000 to \$200,000	<ul style="list-style-type: none"> eDNA to confirm presence in First Priority streams 1-3 outmigrant traps 1-3 stream spawning ground surveys 	<ul style="list-style-type: none"> Same as Year 1; sample different streams for eDNA (Second Priority) 	<ul style="list-style-type: none"> 3-5 outmigrant traps 3-5 stream spawning ground surveys eDNA to expand length of streams with documented presence
>\$200,000	<ul style="list-style-type: none"> eDNA to confirm presence in First Priority streams 3-5 outmigrant traps 3-5 stream spawning ground surveys 	<ul style="list-style-type: none"> Same as Year 1; sample different streams for eDNA (Second Priority) 	<ul style="list-style-type: none"> 4-6 outmigrant traps 4-6 stream spawning ground surveys eDNA to expand length of streams with documented presence

6. DATA MANAGEMENT, ANALYSIS, AND REPORTING

Data management is a critical component of any monitoring plan and should be planned in advance rather than an afterthought once the data have been collected. Data management systems do not need to be complex but should be designed to facilitate efficient output of monitoring metrics which will be tracked throughout the study. The organization responsible for managing and archiving all data needs to be established. The data clearinghouse needs to be actively managed to ensure no data are lost and that full documentation of data collection sources, methods, and reports are maintained.

Data forms should be designed (either electronic or hard copy) to ensure that collected data are consistent in format and values to minimize the need for clean up after collection. Data management in Excel or a more complex Access or SQL database should be considered to maintain consistency in entry and file structure over several years. Several of these systems can provide direct input files for “R” code or other statistical software to facilitate analysis.

Analytical approaches should also be determined ahead of sampling to ensure that all needed data are collected while in the field. Standard metrics for eDNA will be produced by processing labs, but additional metrics can also be generated. Many studies of abundance look at initial status and trends through time for specific reaches, streams, or watersheds. Abundance metrics can include total abundance (e.g., area under the curve for spawner surveys) or relative abundance (e.g., catch per unit effort). Specific statistical tests for trends through time can be used once several years of data are collected to determine if significant changes in population levels are occurring. “R” scripts or other software can be used to automate the generation of graphics with repeated data sets.

Similarly, analyses for productivity, distribution, and diversity should be determined prior to sampling and may be limited based on cost and available funding. Mapping of sampling locations can generate comparative metrics for distribution, while the ratio of smolts outgoing to adults returning (smolt to adult returns) can provide information on productivity. Ocean conditions can drastically affect the number of returning adults, so variability in spawner survey numbers should be expected. Diversity can be reflected by using a number of metrics including timing of returns, age structure, and genetic diversity.

7. PARTNER COORDINATION

The sampling plan includes multiple sampling techniques that can be implemented and/or supported by multiple partners among the West Sound Partners for Ecosystem Recovery. Partner support could come via financial contributions, grant writing for funding, equipment, site access, and involvement in sampling, management, and reporting. WDFW's role in managing stocks and their ongoing efforts to monitor coho populations in the area make the agency a strong partner for the steelhead monitoring. There may be opportunities to combine coho and steelhead monitoring efforts to benefit management of both species.

Maximizing the outcomes of available resources for population monitoring will require coordination among participating partners. The certainty, duration, and level of commitment of each participating partner is essential to implementing the monitoring in order to develop the multiple years of data across the East Kitsap Steelhead DIP geography to work towards a good database of the steelhead population baseline and eventually trends.

Monitoring coordination discussions (e.g., regular or annual meetings) are recommended among potentially participating partners to establish the types of support that each partner will be able to provide. Depending on the level of participation and support, coordination will be necessary to avoid duplicative efforts and the risk of gaps in effort. Consistency of the data collected among multiple partners will help with establishing a master database and analyzing results. Depending on how active multiple partners are, uniform datasheets may be advantageous. It is recommended that data are compiled in real-time or at the end of each year into a master database to support analysis. This compilation may also identify adjustments to data collection notetaking or file formats that would support analysis.

The eDNA sampling strategy is recommended to be adaptive such that data in one sampling round informs subsequent sampling rounds. Depending on how broad the participating partner group is on eDNA sampling, coordination on decision-making for upcoming sampling could be beneficial to ensure consistency of decision-making among participants. Also, given the sensitivity of eDNA sampling and risk of sample contamination, it should be scheduled to avoid times when other organizations are doing instream work.

Data reporting and data sharing expectations and processes should be established among partners. For example, identifying one organization that compiles and maintains all data and data reports.

8. REFERENCES

- Carim, K.J., K.S. McKelvey, M.K. Young, T.M. Wilcox, and M.K. Schwartz. 2016. A Protocol for Collecting Environmental DNA Samples from Streams. U.S. Forest Service, Rocky Mountain Research Station.
- Cram, J., N. Kendall, A. Marshall, T. Buehrens, T. Seamons, B. Leland, K. Ryding, and E. Neatherlin. 2018. Steelhead At Risk Report: Assessment of Washington’s Steelhead Populations.
- ESA. 2020. Puget Sound Steelhead East Kitsap DIP Recovery Plan. Prepared for the Suquamish Indian Tribe.
- Glasgow, J. pers. comm. 2025. Comments from Jamie Glasgow, WFC Science Director, to Paul Schlenger, Natural Systems Design, regarding eDNA sampling recommendations. October 30, 2025.
- Hahn, P.K.J., R.E. Bailey, and A. Ritchie. 2007. “Beach Seining.” In *Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations*, Bethesda, Maryland: American Fisheries Society, 267–324.
- Hard, J.J., J.M. Myers, E.J. Connor, R.A. Hayman, R.G. Kope, G. Lucchetti, A.R. Marshall, G.R. Pess, and B.E. Thompson. 2015. Viability Criteria for Steelhead Within the Puget Sound Distinct Population Segment. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-129.
- Haring, D. 2000. Salmonid Habitat Limiting Factors - Water Resource Inventory Area 15 (East) - Final Report. Washington State Conservation Commission.
- Luikart, G. pers. comm. 2025. Email from Gordon Luikart, University of Montana, to Jamie Glasgow, WFC, regarding East Kitsap Steelhead Genetics Questions. November 25, 2025.
- Madel, G. pers. comm. 2025. Email from Gabe Madel, WDFW Fisheries Biologist, to Paul Schlenger, Natural Systems Design, regarding steelhead spawning ground survey index reaches. September 30, 2025.
- McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42,156 p.
- Nash, D. 2017. East Kitsap Steelhead Habitat Evaluation Project. Prepared for the West Sound Watersheds Council.
- NMFS. 2019. ESA Recovery Plan for the Puget Sound Steelhead Distinct Population Segment (*Oncorhynchus mykiss*). National Marine Fisheries Service Office of Protected Resources and West Coast Region.
- NWIFC and WDFW. 2025. SWIFD (Statewide Washington Integrated Fish Distribution). https://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0/explore (February 11, 2025).

- Oleyar pers. comm. 2025a. Information from Jon Oleyar, Suquamish Tribe, to Steve Todd, Suquamish Tribe, regarding putative *O. mykiss* samples collected in recent years.
- Oleyar pers. comm. 2025b. Email from Jon Oleyar, Suquamish Tribe, to Steve Todd, Suquamish Tribe, regarding estimated sampling costs for outmigrant traps.
- O’Neal, J.S. 2007. “Snorkel Surveys.” In *Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations*, Bethesda, MD: American Fisheries Society, 325–39.
- PSP, and WDFW. 2011. Puget Sound Steelhead Foundations: A Primer for Recovery Planning. Puget Sound Partnership and Washington Department of Fish and Wildlife.
- Seamons pers. comm. 2020. Email from Todd Seamons, WDFW, to Jon Oleyar, Suquamish Tribe, regarding Steelhead DNA. January 31, 2020.
- Suquamish Tribe. 2025. Annual Performance Report East Kitsap County Coho Smolt Productivity Monitoring Study. FY 2024 Monitoring Report. June 6, 2025.
- Temple, G.M. and T.N. Pearsons. 2007. “Electrofishing: Backpack and Drift Boat.” In *Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations*, Bethesda, MD: American Fisheries Society, 95–132.
- USFWS. 2022. Environmental DNA (eDNA) Best Management Practices for Project Planning, Deployment, and Application.
- WDFW. 2008. Statewide Steelhead Management Plan: Statewide Policies, Strategies, and Actions. February 29, 2008.
- WDFW. 2025a. Spawning Ground Surveys Database. WDFW. https://data.wa.gov/Natural-Resources-Environment/WDFW-Spawning-Ground-Surveys/97am-y7xm/about_data.
- WDFW. 2025b. Catchable Trout Plant Reports. <https://wdfw.wa.gov/fishing/reports/stocking/trout-plants/archive>.
- WDNR. 2002. Forest Practices Board Manual, Section 13 Guidelines for Determining Fish Use for the Purpose of Typing Waters.
- Wilcox, T.M., K.S. McKelvey, M.K. Young, A.J. Sepulveda, B.B. Shepard, S.F. Jane, A.R. Whiteley, W.H. Lowe, and M.K. Schwartz. 2016. Understanding Environmental DNA Detection Probabilities: A Case Study Using a Stream-Dwelling Char *Salvelinus fontinalis*. *Biological Conservation* 2016: 209–16.
- WFC. 2025a. Online Mapper Showing WFC eDNA Results. Available at <https://Wildfish.Maps.Arcgis.Com/Apps/Webappviewer/Index.Html?Id=2e397fb6c22c44b99b98c0e069acdf01>.

- WFC. 2025b. Water Typing Assessments, WRIA 15, West Sound Watersheds, Kitsap Peninsula. Available at: <https://wildfishconservancy.org/our-priorities/protecting-and-restoring-habitat/water-typing/water-typing-assessments/#wria15>. Accessed November 25, 2025.
- Wood, Z.T., A. Lacoursiere-Roussel, F. LeBlanc, M. Trudel, M.T. Kinnison, C.G. McBrine, S.A. Pavey, and N. Gagne. 2021. Spatial Heterogeneity of eDNA Transport Improves Stream Assessment of Threatened Salmon Presence, Abundance, and Location. *Frontiers in Ecology and Evolution* 9: 1–16.
- Young, M.K., D.J. Isaak, K.S. McKelvey, T.M. Wilcox, K.L. Pilgrim, K.J. Carim, M.R. Campbell, M.P. Corsi, D.L. Horan, D.E. Nagel, and M.K. Schwartz. 2016. Climate, demography, and zoogeography predict introgression thresholds in salmonid hybrid zones in Rocky Mountain streams. *PLoS ONE* 11 (11): e0163563.doi:10.1371/journal.pone.0163563.