Humboldt Redwood™

# Class I Stream Aquatic Habitat Trends Monitoring

# 2020 Annual Report

**June 30, 2021**

## Project Description:

**Title:** Class I Stream Aquatic Habitat Trends Monitoring

**Purpose:** Habitat Conservation Plan Aquatic Monitoring

**Dates Initiated:** February 1999 (HCP §6.3.5.3 Class I Aquatic Trend Monitoring Program; October 1999 (NCRWQCB Bear Creek Monitoring Plan, NCRWQCB North Fork Elk River Monitoring Plan)

**Projected End Date:** Ongoing

**Project Manager:** Keith Lackey

## Executive Summary:

Long-term monitoring of fish-bearing (Class I) streams was initiated with adoption of the Habitat Conservation Plan (HCP) in 1999 with the goal to collect data to determine if salmonid habitat conditions across the property meet or are trending towards Aquatic Properly Functioning Conditions (APFC). The Pacific Lumber Company had an ongoing stream monitoring program when the HCP was adopted in 1999, and many of the existing sites were included in the newly created Aquatic Trends Monitoring (ATM) program. Sites were selected with the advice and approval of HCP signatory agencies and the North Coast Regional Water Quality Control Board (NCRWQCB). Representative stream reaches included in the ATM program were chosen for a variety of factors that included access, distribution, gradient, percentage of HCP coverage in the watershed, and watershed interest. Currently, habitat conditions are assessed at 44 sites and stream temperature is recorded at 49 sites.

Unlike *effectiveness* monitoring, *trend* monitoring is not intended to evaluate specific management practices. Trend monitoring results may, over time, corroborate the findings of effectiveness monitoring but are also strongly influenced and constrained by inherent watershed conditions and processes, apart from management, including drainage area, geology and geomorphology, topography, vegetation, and climate. Due to improvements in timber harvest practices required by the California Forest Practice Rules and Humboldt Redwood Company's (HRC) HCP, recovery of aquatic habitat, where currently impaired, is expected to occur over time to the extent provided for by inherent watershed conditions. HRC's ATM program is designed to test this hypothesis as it tracks watershed trends over time.

ATM sites are distributed across HRC's ownership and situated in all eight (8) HCP-designated Watershed Analysis Units (WAU). Monitoring sites are currently more tightly clustered in three watersheds of special interest - Elk River, Freshwater Creek, and Bear Creek - to better understand conditions of impairment and trends. All three of these watersheds, listed as impaired water bodies under section 303(d) of the Federal Clean Water Act, provide important aquatic habitat for salmonids including coho, and are currently of particular interest to the NCRWQCB.

HRC simplifies the presentation of habitat status by taking a pass/fail approach to the APFC target criteria, resulting in habitat composite scores for each WAU. The following is a brief summary of survey results in 2020:

In both the Freshwater Creek and Elk River WAUs, the greatest improvements in habitat composite scores were observed in bed surface, pool characteristics, and mid-channel canopy cover. The composite scores for LWD piece frequency remained lower than the baseline records, as they did in 2017. Stream temperatures remained below the target limit of 16.8˚C at all ATM stations, as they did in 2017. Juvenile coho salmon were observed within 7/7 Freshwater Creek ATM stations and 5/7 Elk River ATM stations in 2020.

In the Upper Eel River WAU, stable habitat composite scores were observed in bed surface, pool characteristics, and stream temperature. LWD piece frequency and mid-channel canopy cover remained below baseline records in 2020. Juvenile coho salmon were not observed in any of the Upper Eel River ATM stations in 2020.

In the Lower Eel WAU, for Bear Creek, the greatest improvement in habitat composite score was observed in mid-channel canopy cover. Stable habitat composite scores were observed in pool characteristics and stream temperature. The bed surface score dropped in 2020 but was still above the baseline record. The LWD piece frequency score dropped -67% in 2020 from the 2019 record. Juvenile coho salmon were not observed in any of the ATM stations in Bear Creek in 2020

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# INTRODUCTION

HRC manages nearly 210,000 acres of redwood and Douglas-fir forests in Humboldt County, California for long-term production of forest products with a high level of environmental stewardship. These timberlands, located in the erosive sedimentary terrain of the northern coast of California, have been extensively roaded and periodically logged since the 1860's. Intensive watershed and property-wide studies have documented ecological impacts from past management activities. One hundred and fifty years of management has increased sedimentation to streams and disturbed riparian forests as documented throughout the Pacific coast region. Streams within the timberlands are important freshwater spawning and rearing habitat for salmonids including coho (*Oncorhynchus kisutch*), Chinook (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*). These species (covered under the HRC HCP) have been federally listed as threatened within much of coastal northern California, including watersheds where HRC has ownership, due in part to impairment of freshwater habitat.

## PROGRAM OVERVIEW

Beginning in 1999 with the establishment of a multi-species HCP, first the Pacific Lumber Company, and then HRC beginning in July of 2008, has managed the timberlands utilizing new sediment control and riparian forest management strategies to improve the aquatic habitat for covered species. HRC's current forest practices are designed to protect and restore aquatic habitats by reducing timber harvest-related erosion rates and sediment supply to the stream and to manage riparian forests to enhance their ecological values. Management activities are guided by the Aquatics Conservation Plan (ACP), part of the HCP (Section 6.3), developed with state and federal agencies, and through various permits issued by the NCRWQCB.

HRC has been steadily working to reduce sediment with a combination of state-of-the-art road construction practices, a commitment to reconstruction or decommissioning of older roads, and use limitations that prevent damage to roads and prevent sediment delivery to streams. Harvest-related sediment is controlled through geologic hazard identification and geologist field investigation during Timber Harvesting Plan (THP) layout. Riparian forests are left relatively undisturbed to provide shade and large woody debris to streams. The company's silvicultural policies utilize uneven-aged silviculture and exclude harvest of any remaining large old growth trees on the property that meet HRC's Old Growth Tree Policy.

The primary goal of the ACP is to maintain, or achieve over time, a properly functioning aquatic habitat condition that will ensure the long-term viability of anadromous salmonids that utilize rivers and streams

on the property, many of which are considered keystone to regional recovery efforts. To assess progress towards this goal, an APFC matrix of habitat variables defining important freshwater habitat characteristics for salmonids compiled by the National Marine Fisheries Service (NMFS) is referenced in the HCP. APFC criteria were derived from laboratory and field research conducted throughout the Pacific Northwest, and while they define generalized target values, they have not been calibrated for HRC lands necessarily. Similar criteria have also been developed by the NCRWCB to meet requirements of the Clean Water Act (NCRWCB 2004).

## MONITORING PROGRAM DESIGN

Long-term monitoring of fish-bearing (Class I) streams was initiated with adoption of the HCP in 1999 with the goal to collect data to determine if salmonid habitat conditions across the property meet, or are trending towards, APFC matrix target conditions during the 50-year span of the HCP (1999-2049). The basic design of this monitoring program is to repeatedly measure the habitat characteristics of stream reaches within the portion of watersheds utilized by anadromous salmonids. Permanent sites are located within "response reaches" that contain less than 4% gradient (Montgomery and Buffington, 1998) on fish-bearing streams (Class I streams). Sites are distributed throughout HRC property. All of these streams currently or historically provided habitat for anadromous salmonids, including coho and Chinook salmon and steelhead trout, although species dominance has traditionally varied within the watersheds.

**Figure 1. Class I stream, Elk River**

A sampling site is a stream reach that is at least 30 channel widths long. The sampling length of most sites is approximately 200 to 400 meters (approximately 600 to 1200 feet) in length. The location of the sampling reach is permanently benchmarked to facilitate repeated measurement.

## TREND MONITORING SITES

HRC's ownership includes land in nine major drainages including the Yager, Lawrence, Freshwater and Larabee Creeks, and the Bear, Elk, Eel, Van Duzen, and Mattole Rivers. Ownership is generally blocked within these basins. HRC owns most of the area in some watersheds while company ownership is a small

portion of others. To facilitate analysis of this extensive property, HRC has divided its ownership into eight Watershed Analysis Units (WAU). Watershed analysis has been completed on each of these areas, including Freshwater Creek, Elk River, Van Duzen River, Yager/Lawrence, Upper Eel, Lower Eel and Eel Delta, Bear River, and Mattole River watersheds. These WAUs were delineated, in part using the boundaries of the state of California's Planning Watersheds. A description of the location, physical characteristics, major watercourses, and dominant vegetation within each WAU in detail can be found in the Watershed Analysis documents prepared for each watershed.

A site location map of currently active ATM sites is provided in Figure 2 which shows the active monitoring stations, organized by WAU and arranged by drainage area. Currently, there are 44 habitat monitoring sites and 49 temperature monitoring sites.

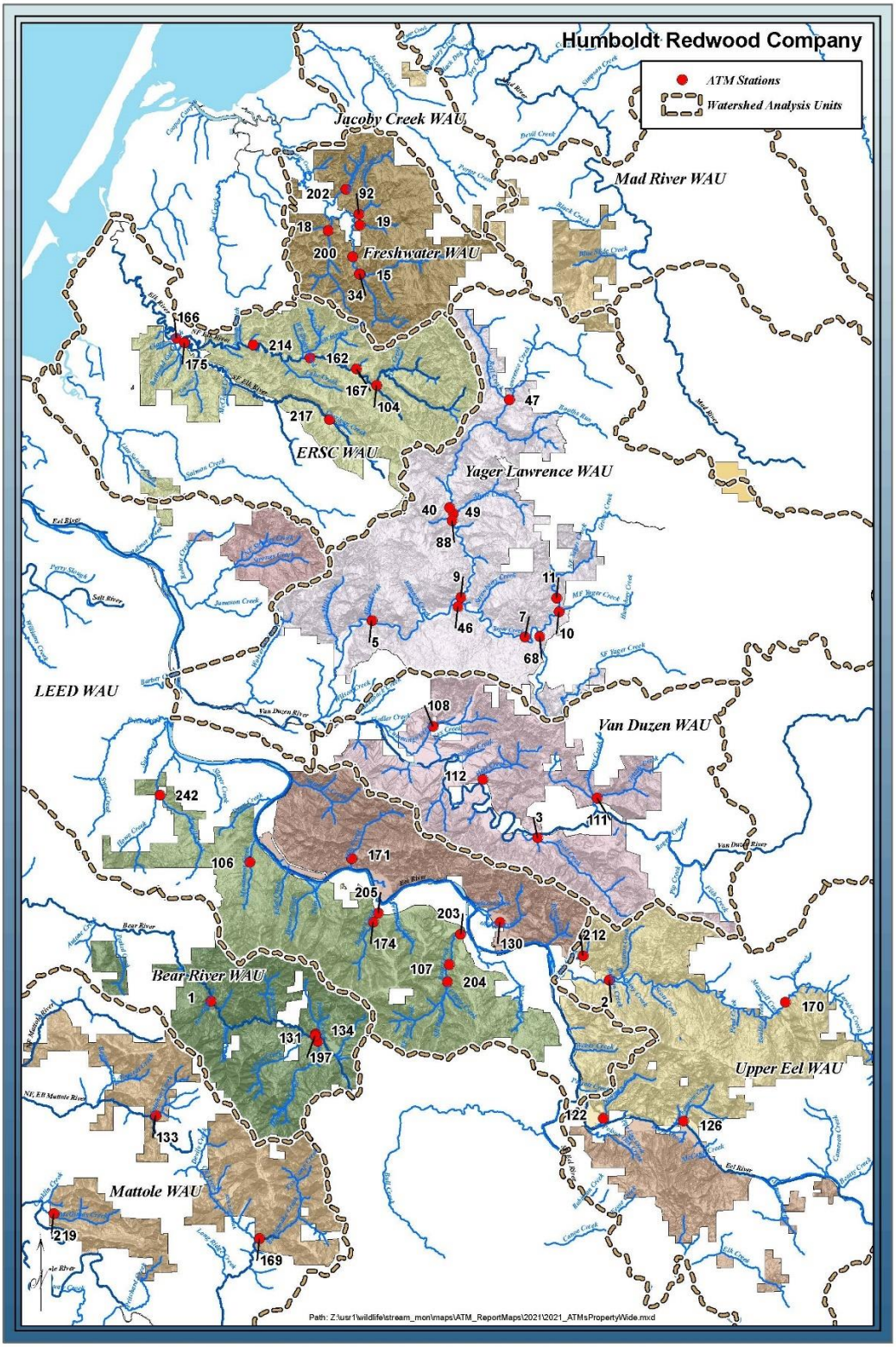



**Figure 2. Location map of HRC ATM sites**

**Table 1. Site statistics and sampling rotation of active ATM sites. Cells marked with an "X" indicate current monitoring activities and rotation year in which monitoring will be conducted.**

| Station ID | Stream Name | Upstream Watershed Acreage[1] | Upstream Area ($mi^2$) | Township Range Section | Reach Gradient (%) | Elevation (ft) | Temperature (Annual) | Stream Habitat Parameters | Rotation Schedule | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 2020 | 2021 | 2022 |
| ***HUMBOLDT BAY WAU*** | | | | | | | | | | | |
| | ***Freshwater Creek Drainage*** | | | | | | | | | | |
| 34 | Freshwater Creek | 5,609 | 8.8 | 04N 01E 15 | 0.9 | 190 | X (+Air) | X | X | | |
| 15 | South Fork Freshwater Creek | 2,019 | 3.2 | 04N 01E 15 | 1.7 | 183 | X | X | X | | |
| 200 | Freshwater Creek | 7,911 | 12.4 | 04N 01E 10 | 0.4 | 134 | X | X | X | | |
| 19 | Graham Gulch | 1,588 | 2.5 | 04N 01E 03 | 1.4 | 95 | X | X | X | | |
| 92 | Cloney Gulch | 2,968 | 4.6 | 04N 01E 03 | 0.9 | 85 | X | X | X | | |
| 202 | McCready Gulch | 1,084 | 1.7 | 05N 01E 34 | 2.3 | 111 | X | X | X | | |
| 18 | Little Freshwater Creek | 2,980 | 4.7 | 04N 01E 04 | 0.8 | 65 | X | X | X | | |
| | ***Elk River Drainage*** | | | | | | | | | | |
| 104 | South Branch NF Elk River | 1,207 | 1.9 | 04N 01E 35 | 2.8 | 360 | every 9 years (next = 2023) | | | | |
| 167 | North Fork Elk River | 7,230 | 11.3 | 04N 01E 34 | 2.1 | 262 | X | X | X | | |
| 162 | North Fork Elk River | 8,738 | 13.7 | 04N 01E 28 | 0.6 | 134 | X | X | X | | |
| 214 | North Fork Elk River | 12,302 | 19.2 | 04N 01E 30 | 0.2 | 80 | X | X | X | | |
| 217 | South Fork Elk River | 4,030 | 6.4 | 03N 01E 3 | 1.6 | 510 | X | X | X | | |
| 175 | South Fork Elk River | 12,200 | 19.1 | 04N 01W 26 | 0.0 | 39 | X | X | X | | |
| 166 | Elk River | 26,393 | 41.2 | 04N 01W 26 | 0.1 | 39 | X | X | X | | |
| ***YAGER WAU*** | | | | | | | | | | | |
| | ***Lawrence Creek Drainage*** | | | | | | | | | | |
| 47 | Lawrence Creek | 7,477 | 11.7 | 03N 02E 04 | 3.5 | 1111 | X | | | | |
| 49 | Lawrence Creek | 18,332 | 28.6 | 03N 02E 19 | 1.1 | 587 | X | X | | X | |
| 40 | Shaw Creek | 3,431 | 5.4 | 03N 02E 19 | 1.4 | 577 | X | X | | X | |
| 88 | Corner Creek | 1,252 | 2.0 | 03N 02E 30 | 8.7 | 567 | X | | | | |
| 9 | Lawrence Creek | 26,676 | 41.7 | 02N 02E 06 | 0.2 | 432 | X (+Air) | X | | X | |
| | ***Yager Creek Drainage*** | | | | | | | | | | |
| 11 | North Fork Yager Creek | 29,869 | 46.7 | 02N 02E 02 | 1.0 | 596 | X | | | | |
| 10 | Middle Fork Yager Creek | 5,985 | 9.4 | 02N 02E 02 | 1.7 | 577 | X | | | | |
| 68 | South Fork Yager Creek | 6,807 | 10.6 | 02N 02E 10 | 2.0 | 551 | X (+Air) | | | | |
| 7 | Yager Creek | 44,060 | 68.8 | 02N 02E 10 | 0.8 | 511 | X | X | | X | |
| 46 | Yager Creek | 48,394 | 75.6 | 02N 02E 06 | 0.5 | 429 | X | X | | X | |
| 5 | Yager Creek | 80,623 | 126.0 | 02N 01E 11 | 1.3 | 246 | X | X | | X | |
| ***VAN DUZEN WAU*** | | | | | | | | | | | |
| 111 | Grizzly Creek | 7,181 | 11.2 | 01N 02E 01 | 1.6 | 390 | X (+Air) | X | | | X |
| 3 | Root Creek | 3,771 | 5.9 | 01N 02E 15 | 0.3 | 314 | X | X | | | X |
| 112 | Hely Creek | 2,306 | 3.6 | 01N 02E 05 | 1.7 | 239 | X | X | | | X |
| 108 | Cummings Creek | 1,894 | 3.0 | 02N 02E 30 | 2.5 | 383 | X | X | | | X |

**Table 1 (continued). Site statistics and sampling rotation of active ATM sites. Cells marked with an "X" indicate current monitoring activities and rotation year in which monitoring will be conducted.**

| Station ID | Stream Name | Upstream Watershed Acreage[1] | Upstream Area ($mi^2$) | Township Range Section | Reach Gradient (%) | Elevation (ft) | Temperature (Annual) | Stream Habitat Parameters | *Rotation Schedule* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 2020 | 2021 | 2022 |
| ***EEL RIVER WAU*** | | | | | | | | | | | |
| | ***Upper Eel River Drainage*** | | | | | | | | | | |
| 126 | Thompson Creek | 2,463 | 3.8 | 01S 03E 29 | 4.1 | 154 | X | X | X | | |
| 122 | Newman Creek | 1,878 | 2.9 | 01S 02E 25 | 2.3 | 131 | X | X | X | | |
| | ***Larabee Creek Drainage*** | | | | | | | | | | |
| 170 | Larabee Creek | 39,709 | 62.0 | 01S 03E 12 | 0.4 | 738 | X | X | X | | |
| 212 | Chris Creek | 835 | 1.3 | 01W 02E 35 | 0.9 | 180 | X | X | X | | |
| 2 | Larabee Creek | 53,633 | 83.8 | 01S 02E 01 | 0.9 | 137 | X (+Air) | X | X | | |
| | ***Lower Eel River Drainage*** | | | | | | | | | | |
| 106 | Middle Monument Creek | 2,851 | 4.5 | 01N 01E 18 | 2.8 | 154 | X | X | | | X |
| 174 | Middle Jordan Creek | 2,791 | 4.4 | 01N 01E 26 | 3.5 | 164 | X | X | | | X |
| 205 | Lower Jordan Creek | 2,895 | 4.5 | 01N 01E 26 | 2.2 | 120 | | X | | | X |
| 130 | Shively Creek | 1,403 | 2.2 | 01N 02E 28 | 0.9 | 157 | X | X | | | X |
| | ***Bear Creek Drainage*** | | | | | | | | | | |
| 204 | Bear Creek | 4,302 | 6.7 | 01S 02E 06 | 3.8 | 320 | X | X | X | X | X |
| 107 | Bear Creek | 5,026 | 7.9 | 01N 02E 31 | 1.7 | 232 | X (+Air) | X | X | X | X |
| 203 | Bear Creek | 5,449 | 8.5 | 01N 02E 31 | 1.4 | 120 | X | X | X | X | X |
| | ***Eel River Delta Drainage*** | | | | | | | | | | |
| 171 | Stitz Creek | 2,519 | 3.9 | 01N 01E 15 | -- | 148 | X | | | | |
| 242 | Atwell Creek | 2,747 | 4.3 | 01N 01W 3 | 1.5 | 170 | X | X | | | X |
| ***BEAR RIVER WAU*** | | | | | | | | | | | |
| 131 | Harmonica Creek | 2,625 | 4.1 | 01S 01E 16 | 1.6 | 1302 | X | X | | X | |
| 134 | Pullen Creek | 1,673 | 2.6 | 01S 01E 16 | 1.7 | 1302 | X | X | | X | |
| 197 | Bear River | 1,935 | 3.0 | 01S 01E 16 | 1.4 | 1280 | X (+Air) | X | | X | |
| 1 | Bear River | 15,103 | 23.6 | 01S 01W 12 | 1.0 | 924 | X | X | | X | |
| ***MATTOLE RIVER WAU*** | | | | | | | | | | | |
| 133 | Sulphur Creek | 2,452 | 3.8 | 01S 01W 27 | 2.1 | 1105 | X | X | | X | |
| 169 | Upper NF Mattole River | 5,507 | 8.6 | 02S 01E 19 | 2.2 | 596 | X (+Air) | X | | X | |
| 219 | McGinnis Creek | 3,789 | 5.9 | 02S 01W 35 | 1.2 | 135 | X | X | | X | |

# METHODS

## Sampling Schedule

ATM sites in Bear Creek within the Lower Eel – Eel Delta (LEED) WAU have been sampled each year at the request of the NCRWQCB. Habitats at the remaining ATM sites are re-surveyed every three (3) years, except for ATM site 104 within the Elk River drainage, which will be monitored once every nine (9) years per verbal request from staff at California Department of Fish and Wildlife (Nick Simpson, pers comm, 2016). See Table 1 above for the general habitat monitoring schedule. Water temperature is monitored annually at nearly all ATM stations, including some stations where habitat sampling has been discontinued.

Habitat sampling frequency is increased following significant storm events. Out-of-sequence sampling is triggered by the occurrence of a 10-year flood in either the Eel River or the Van Duzen River as measured at USGS gages at Scotia (11477000) and Bridgeville (11478500), respectively. Monitoring may also be triggered by a 25-year recurrence precipitation event as recorded at National Weather Service weather stations at either Scotia or Eureka. Both flood and precipitation events were exceeded in Freshwater and Elk River in December 2002 and have not been observed since.

## Sampling Methods

Table 2 lists the primary parameters reported in the ATM program, and references HRC's detailed measurement protocols (Standard Operating Protocols) for collecting data. Methods are summarized very briefly here.

**Table 2. Parameters measured in the HRC ATM monitoring program.**

| Characteristic | Measurement Parameters | Standard Operating Protocol |
|---|---|---|
| Channel dimensions | Channel gradient<br>Channel width<br>Cross-sectional area | SOP-15: *Aquatic trends monitoring site selection, monumenting and documentation*<br>SOP-31: *Surveying with total station* |
| Particle-size distribution within bed surface substrate | Particle-size classes: ($D_5$, $D_{16}$, $D_{50}$, $D_{84}$) | SOP-13: *Surface and sub-surface sediment sampling* |
| Pool dimensions and wood association | Pool area<br>Pool spacing<br>Residual pool depth<br>% Pools associated with wood | SOP-14: *Stream Habitat Typing* |
| LWD frequency and distribution | Frequency (# pieces/100 ft.)<br>Total piece count | SOP currently in progress |
| Water temperature | Maximum Weekly Average Temperature MWAT (˚C) | SOP-09: *Temperature instrumentation and deployment* |
| Riparian canopy cover | % Canopy cover over the stream (mid-channel canopy cover)<br>% Canopy cover in the riparian forest (riparian overstory canopy cover) | SOP-12: *Stream and riparian canopy cover measurement* |

## Bed Surface Particle Size

Pebble count measurements collected at riffles are used to assess the APFC matrix target for $D_{50}$ (diameter of the median [50th of 100] particle) and three additional size classes ($D_{5,}$ $D_{16}$, $D_{84}$). These sediment measures can be tracked over time to determine whether bedload sediments in a watercourse are generally becoming coarser or finer, in response to in-channel erosion and changes in sediment loading rates from hillslope sources including cumulative effects from management activities.

**Figure 3. Measuring particle size (mm) of the streambed surface**

The first three (3) riffles are sampled within each monitoring reach by transecting back and forth over the entire riffle within the active channel. The intermediate axes of 200 pebbles are measured at each riffle (Figure 3). The median particle size is determined for each of the D parameters, although APFC target values have only been established for $D_{50}$. Results are reported as mean values within the APFC report card, as well as cumulative particle size frequency plots (Figure 4), which serve to provide a visual aid for improved interpretation. Over time, it is expected that trends will develop that will suggest an overall fining or coarsening of the channel substrate towards APFC target values to the extent provided for by inherent watershed conditions.

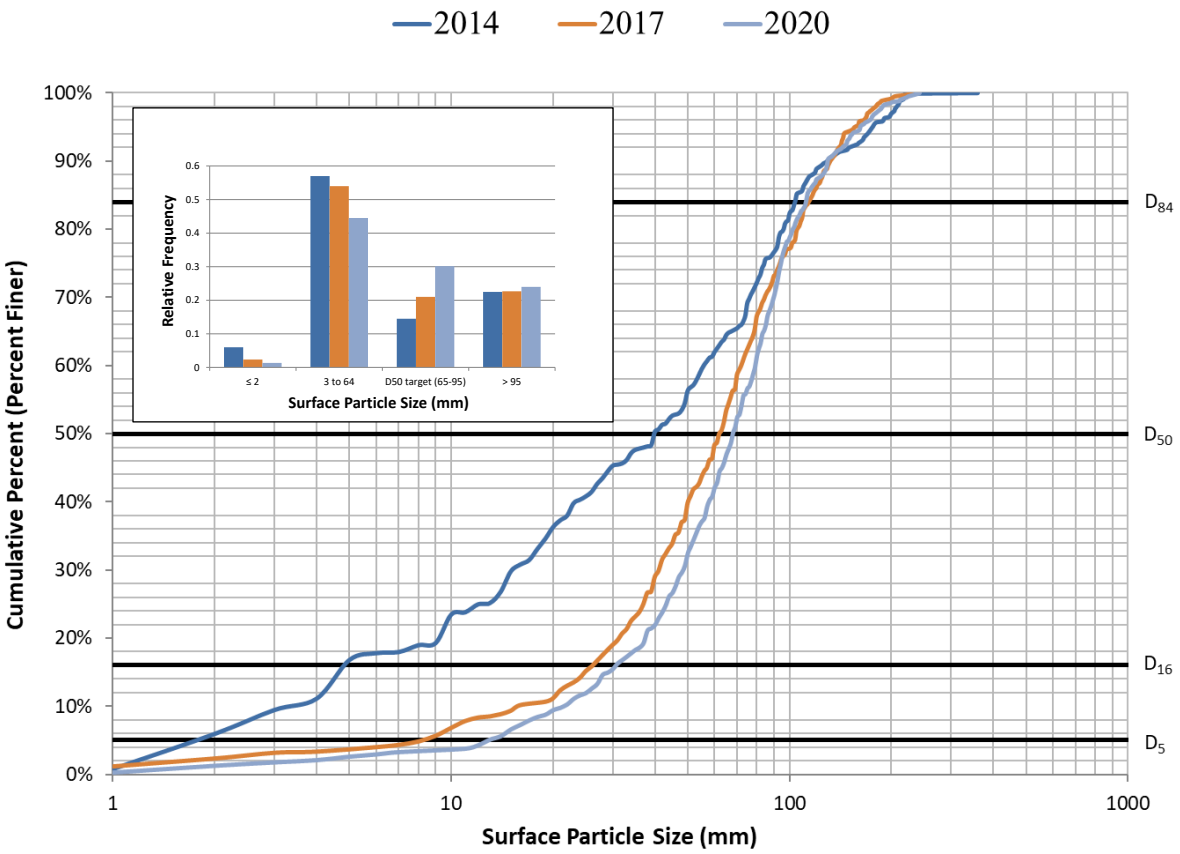



**Figure 4. Example of a cumulative frequency (percent finer) plot of the mean surface particle sizes (mm) of three riffles measured within an ATM survey reach.**

## Channel Dimensions

Cross-sectional streambed surveys are conducted to determine streambed elevation and area changes over time (Figure 5). Adjustments in channel dimensions may be sensitive to sediment and LWD loading within the stream channel and are expected to be correlated to habitat type characteristics. Streambed profiles indicate changes in channel dimensions and streambed scour or fill. Streambed topography is measured using standardized total station survey techniques (Topcon Positioning Systems, Inc.). This instrument was first deployed in 2003 to increase the accuracy and repeatability of streambed surveys that had previously been measured with an auto level. Permanent critical points (left/right bank cross-section pins) are installed at each monitoring station.

Each reach has a minimum of five (5) permanently benchmarked cross-sections that are measured in years when habitats are surveyed. The cross-sections are measured at each change in topography across

the channel. Cross-sectional area is determined below a reference elevation. This elevation is typically set at a channel feature associated with bank-full depth.

Data processing has been streamlined with electronic data collection, transfer, and processing. HRC has developed an Excel® spreadsheet to process cross-section data from x, y, z coordinates into standard measurements in the x-z plane. An additional spreadsheet computes channel area ($m^2$), width (m) and depth (m).

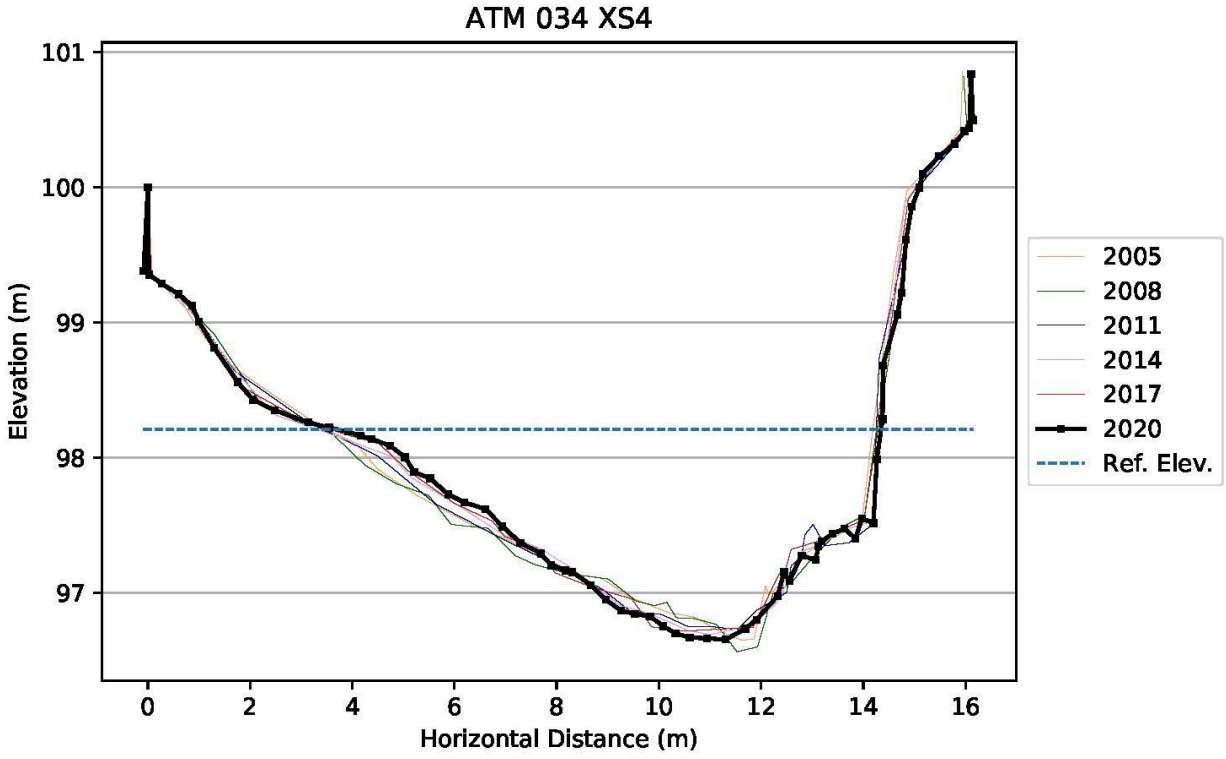



**Figure 5. Example of a typical cross-sectional profile within an ATM survey reach**

## Large Woody Debris

LWD pieces within the bank-full stream channel of each ATM reach are counted to determine the total piece frequency of large wood available for creating fish habitat and molding channel morphology. To constitute a countable piece of LWD, individual pieces must be within the height of the bank-full channel and be a minimum of 20 cm in diameter and 2 meters in length. LWD data address APFC targets which are calculated from site-specific channel dimensions. The percent of pools associated with LWD parameter will continue to be collected as part of pool habitat measurements.

## Pools

The primary rearing habitat parameters measured in the ATM program are pool characteristics. HRC conducts habitat typing on stream reaches to assess the frequency (i.e., the percentage of channel length composed of pools), size, and depth of pools. Measurements are performed at each habitat unit in the sampling reach. Habitat units are broken down to pool, riffle, or flat-water categories. Basic physical measurements such as length, width and residual depth are measured and observations of LWD influence are recorded.

Habitat typing addresses APFC matrix targets of pool-to-pool spacing based on bank-full channel width (CW), percent of surface area comprised of pool habitat, number of pools associated with LWD, and average residual pool depth. Residual pool depth is equal to the difference between maximum depth and pool tail crest depth.

## Riparian Overstory

Canopy cover measurements (percent) are used to document growth and/or stability of riparian forests, as well as to identify streams that may be subject to higher thermal loading from sunlight. Canopy cover addresses the APFC matrix target for mid-channel canopy closure (Figure 6) and within the riparian forest (Figure 7). The mid-channel canopy cover is measured as an influence of the forest on maintaining cool water temperatures, taken mid-channel at 25m intervals throughout the sampling reach using a convex spherical densiometer (model A).

**Figure 6. Pool habitat with overhead canopy**

**Figure 7. Redwood riparian forest overstory**

Overstory canopy closure data in the riparian forest adjacent to the stream channel is also collected using the densiometer on a systematic grid pattern. While overstream canopy closure is measured every ATM survey cycle, beginning in 2015, no riparian forest canopy measurements are required in stands where ≥85% riparian forest closure was documented in the prior ATM survey *unless* significant disturbance (i.e., timber harvest, blow down, landslide, high mortality, fire) is evident.

## Water Temperature

Stream temperature (℃) is tracked during the warmest part of the year (typically June through September). Temperature is monitored with continuous recording data loggers (Onset HOBO® Water Temp Pro v2). Temperature data loggers are inserted into protective PVC cases (Figure 8) and placed in the stream at a location that meets requirements for sufficient mixing, adequate cover, and consistent flows during the summer months to ensure data integrity by reducing the likelihood of thermal stratification. Temperature data are used to calculate the maximum weekly average temperature (MWAT), or the average of the daily mean temperature measured during the warmest seven consecutive days each year. The APFC target value for MWAT at all ATM stations is ≤16.8℃. Figure 9 illustrates a typical temperature profile as measured at ATM stations property wide.

**Figure 8. Stream temperature logger with protective PVC case**

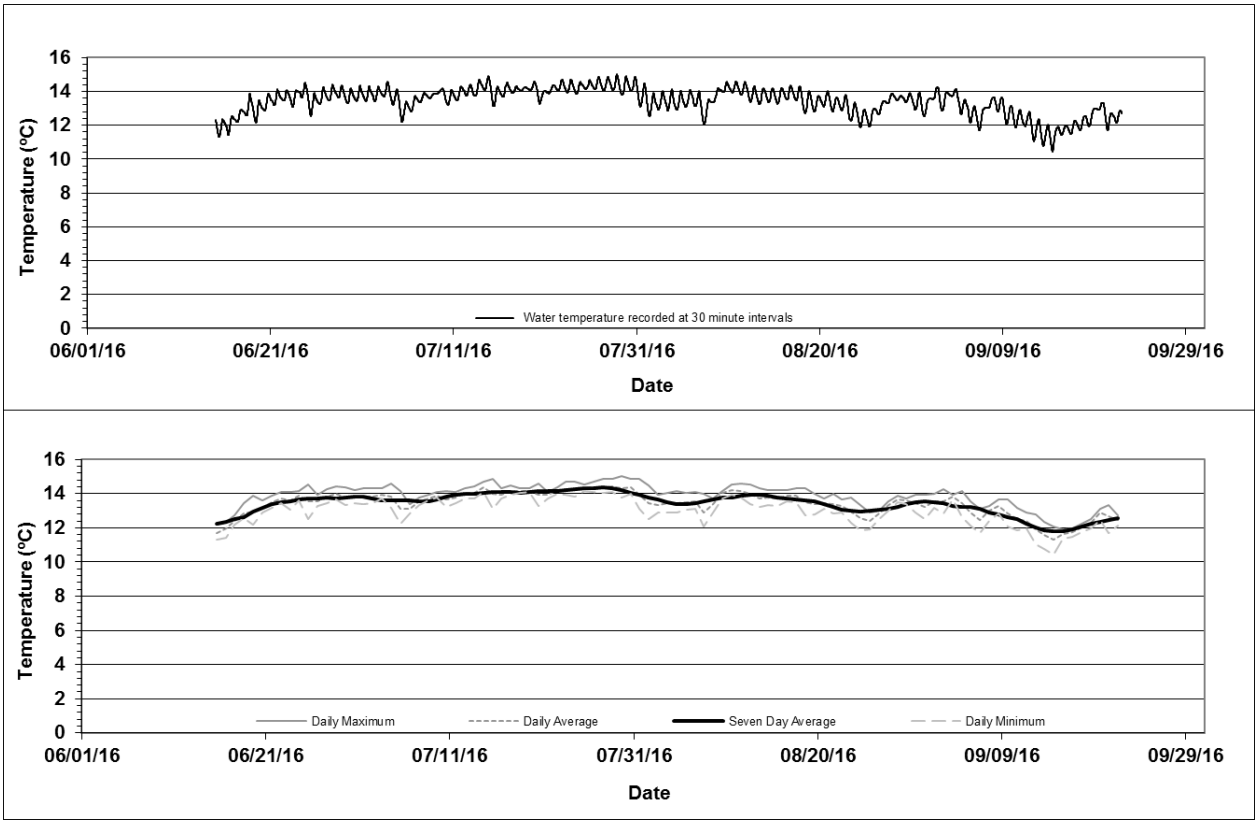



**Figure 9. Example of a stream temperature profile generated from a continuously-recording temperature data logger deployed at most ATM stations annually.**

# PROGRAM IMPLEMENTATION - 2020

In this section, we report on program implementation, including field activity, program milestones, quality assurance, and methods implementation. The monitoring program objectives are:

- Complete all yearly scheduled measurement activities.
- Report trends relative to APFC criteria.
- Complete all field data collection procedures in an efficient and timely manner, following all applicable Standard Operating Protocols (SOP).
- Complete all QA/QC goals for each project within the monitoring program.
- Provide data summaries and periodic analyses to HCP Signatory Agencies, NCRWQCB and make publicly available.
- Provide habitat and channel morphology information to the HRC Watershed Analysis Process and THP cumulative effects analyses.

## LOCATIONS OF FIELD MEASUREMENTS

Table 3 lists the field activity scheduled for 2020 and accomplishments against this plan. Pebble count, canopy closure, habitat typing, and streambed surveys were conducted at 21 stations in the Freshwater Creek. Elk River, Upper Eel River, and Bear Creek drainages. Stream temperature loggers were deployed at 49 sites property wide, however, 1 was lost in the field due to probable theft. All fieldwork was completed within the scheduled time period. All other habitat data collection occurred prior to any major storm events.

**Table 3. 2020 measurement activity in the ATM Program**

| Watershed | Habitat | | Temperature | |
|---|---|---|---|---|
| | Scheduled | Completed | Scheduled | Completed |
| Freshwater Creek | 7 | 7 | 7 | 7 |
| Elk River | 6 | 6 | 7 | 7 |
| Yager Creek | None | None | 6 | 6 |
| Lawrence Creek | None | None | 5 | 5 |
| Van Duzen River | None | None | 4 | 4 |
| Eel River Delta | None | None | 2 | 2 |
| Lower Eel Tributaries | None | None | 3 | 2 |
| Bear Creek | 3 | 3 | 3 | 3 |
| Upper Eel Tributaries | 2 | 2 | 2 | 2 |
| Larabee Creek | 3 | 3 | 3 | 3 |
| Mattole River | None | None | 3 | 3 |
| Bear River | None | None | 4 | 4 |
| **TOTAL** | **21** | **21** | **49** | **48** |

## UPDATES TO METHODS

Updates to pebble count analysis methodology were made in 2015 which expanded the parameters to include three (3) additional classes ($D_5$, $D_{16}$, and $D_{84}$). This was initiated as a substitute for the discontinued streambed subsurface particle size monitoring. Fining of the streambed is a concern property-wide and is a process that can be observed through pebble counts alone. If fining of the bed surface is observed, then one can assume that a similar trend is occurring in the subsurface. Results were reported as mean values within the APFC matrix, although an APFC target value has only been established for $D_{50}$. Additionally, cumulative frequency plots were developed to provide a visual aid for improved interpretation of the particle size distributions.

Method updates in 2014 related to the frequency of riparian canopy cover measurements conducted within a survey reach. The changes instituted in 2015 limit the riparian canopy measurements to only those ATM stations that had observed ≤85% canopy closure during the previous survey year.

APFC targets for LWD are based on a bank-full width, as measurement of LWD is limited to the bank-full channel. These measurement limits require all field observers to consistently identify bank-full throughout each stream reach. This identification has proven to be inconsistent in previous years across individual surveyors. In order to address this issue, the HRC hydrologist and aquatic biologist will mutually delineate bank-full in the field throughout the monitoring reach and periodically re-flag said location prior to LWD surveys so that a greater degree of consistency can be extended into the future. Beginning in 2015, LWD measurements of diameter, length, volume, and key pieces were discontinued. Instead, total LWD pieces were counted within the survey reach to determine the total piece frequency (#/100 feet).

Beginning in 2015, the annual sampling regime in Elk River was changed from an annual to a three-year sampling rotation, as is applied elsewhere property-wide except for Bear Creek. This three-year rotation will provide adequate resolution to detect changes in river processes. Additionally, ATM sites 90 (Upper North Fork), 91 (North Branch North Fork), and 14 (North Fork) were discontinued and ATM site 104 (South Branch North Fork) will be monitored on a nine-year rotation as per a verbal request from staff at CDFW, scheduled to resume in 2023.

Beginning in 2012, snorkel survey counts have been conducted at each active ATM station to document fish species abundance within the first 5 pools of the monitoring reach. These surveys do not, nor do they intended to, estimate total fish populations within each watercourse. Rather, these snorkel surveys serve as an index to infer salmonid spawning success during the previous winter and track the spread of aquatic, non-native invasive species. Beginning in 2019, snorkel survey results have been provided with each annual ATM report.

## QUALITY ASSURANCE ACTIVITIES

QA/QC activities have been implemented in the ATM program to varying degrees since 2002. Many of these activities are described within pertinent SOP's. Three stations were revisited in 2020 for QA/QC purposes.

All instruments and equipment used for sampling were inspected and maintained daily. Any instrument repairs and/or calibrations were made either by the manufacturer or following manufacturer guidelines.

Calibration of equipment was done on a regular schedule and upon any mishandling or questionable performance of the instrument.

QA/QC results are presented beginning on page 132 of this document.

## PRESENTATION OF RESULTS

Current data derived from long-term stream habitat monitoring stations are provided and a simplified method for tracking habitat conditions and trends is presented below.

The basic compilation of data measured at each ATM station is provided in a "report card", an example of which is illustrated in Table 4. Each of the 44 active ATM stations have up to nine (9) APFC parameters with targets addressing habitat factors related to streambed substrate, pools, LWD, forest canopy and water temperature. The table cell is colored blue if the parameter met or exceeded the APFC target, white if it did not meet the target, green if there are no established APFC targets, and grey if there are no data associated with the parameter. These tables are used as the primary metric in which to evaluate current data collection. Parameters without assigned APFC target values are not included in the total number of opportunities for success.

The report card groups ATM stations by WAU and provides the measured value for each of the nine parameters from each year of measurement. Stations included in this report were monitored in 2020. Previous measurements from WAUs not monitored in 2020 can be found in previously submitted ATM annual reports.

**Table 4. Example watershed report card**

| 2020 | Parameter | Target Value (# no target) | Station 1 | Station 2 | Station 3 | Station 4 | Station 5 | Station 6 | Station 7 | Station 8 | Station 9 | Station 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 66 | 88 | 98 | 98 | 114 | 110 | 94 | 126 | 93 | 77 |
| | $D_{50}$ (mm) | 65-95 | 30 | 38 | 28 | 42 | 46 | 56 | 39 | 68 | 65 | 31 |
| | $D_{16}$ (mm) | # | 12 | 8 | 2 | 6 | 4 | 20 | 12 | 25 | 9 | 6 |
| | $D_5$ (mm) | # | 8 | 1 | 1 | 1 | 1 | 4 | 3 | 4 | 2 | 1 |
| Pool Characteristics | Pool Area (%) | ≥25 | 22 | 61 | 32 | 32 | 26 | 35 | 47 | 37 | 26 | 11 |
| | Pool Spacing (CW/pool) | ≤6.0 | 5.0 | 5.5 | 3.3 | 2.6 | 4.8 | 3.2 | 2.6 | 4.1 | 3.9 | 7.3 |
| | Residual Pool Depth (m) | ≥0.91 | 0.42 | 0.61 | 0.60 | 0.57 | 0.67 | 0.57 | 0.49 | 0.52 | 0.62 | 0.53 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | 100 | 100 | 100 | 85 | 88 | 100 | 100 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | ≥5.1 | 12.9 | 12.7 | 6.2 | 6.3 | 5.6 | 7.3 | 4.7 | 4.7 | 8.6 | 7.4 |
| | Total Piece Count | # | 148 | 145 | 71 | 72 | 65 | 87 | 57 | 46 | 70 | 85 |
| Water Temperature | MWAT (°C) | ≤16.8 | | 17.9 | 19.5 | 18.7 | 18.1 | 17.9 | 15.9 | 15.5 | 15.5 | 17.2 |
| Riparian Overstory | Canopy Over Stream (%) | ≥90 | 24 | 38 | 35 | 26 | 57 | 40 | 97 | 80 | 77 | 83 |
| | Canopy of Rip Forest (%) | ≥85 | 90 | 96 | 97 | 85 | | | | 96 | 99 | 96 |

HRC synthesizes and simplifies presentation of habitat status by taking a pass/fail approach to the APFC target criteria. A "success" can be considered when a habitat parameter meets or exceeds APFC criteria. Each station/parameter combination is considered an opportunity for "success". If a certain WAU contains ten (10) stations, there are ten (10) opportunities for success for each individual parameter. If here are nine (9) parameters and 10 stations, there are 90 opportunities for success. Note that in Table 4 there are two (2) stations that do not have total LWD piece counts and four (4) stations that do not have riparian forest canopy measurements, reducing the total number of opportunities to 84.

The "Composite Habitat Score" is equal to the success rate, which is calculated as:

$$\text{Composite Habitat Score} = \frac{Number\ of\ Successes}{Number\ of\ Opportunities}$$

Within each WAU report card, the total number of blue cells equals the total number of successes documented for an individual year. This allows for a relatively standardized and streamlined approach to evaluate each watershed. In Table 4, there are 48 successes, yielding a watershed composite habitat score of 0.56 (out of 1.00) for the WAU's ten stations.

One of the benefits of this scoring approach is that there is a great deal of flexibility in computing the habitat score for any number of "groupings". A score can be computed for all parameters at an individual station, for all the stations in a WAU (as shown in Table 4) or for the entire HRC property. We can also create groups of the parameters related to key habitat factors. There is one (1) parameter related to bed surface substrate, four (4) related to pool characteristics, one (1) related to large woody debris, two (2) related to canopy cover, and one (1) related to water temperature. We combine the status of a habitat factor by grouping like-parameters. For example, we group all pool characteristics (n=4) and stations (n=10), providing (n= [4 x 10] = 40) opportunities for success for achieving pool-related goals in the watershed. This type of grouping allows progress in habitat factors to be tracked independently.

The habitat scoring method currently in use is a very flexible presentation of data. A composite score can be computed for any grouping of stations and parameters and the fundamental meaning does not change. This composite can be tracked through time to indicate improvement towards APFC targets. The goal is 100% success in meeting all habitat conditions at all stations or a composite score of 1.0, regardless of groupings.

In summary, the composite habitat score contains the following characteristics:

- The focus is on achieving salmonid habitat goals.
- Habitat status is simple to depict.
- Many parameters that are derived from unique measurement techniques can be considered together.
- All parameters are treated equally.
- The method is relatively insensitive to the different measurement dates for stations and parameters as well as sample size.
- The analysis is not heavily weighted by parameter values at the beginning of the data record or outliers within the data record.
- Large changes in one parameter in one year will have a minimal effect on the composite score**.** The bulk of parameters or all the sites must change to move the score, depending on groupings.
- Intermediate levels of progress may be missed.

The calculation and utilization of composite scoring helps satisfy the need to quantify progress towards achieving habitat goals, but it is not considered a replacement for future statistical analyses of individual parameters as the data record lengthens. We also note that there is likely to be ongoing debate over time as to the appropriateness of specific APFC targets currently in use as scientific information increases. As long as there are specific target levels identified, the method can be accommodated to report status

relative to them. Individual data values will be reported in the results that follow but the habitat scoring approach will also be used extensively.

# WATERSHED HABITAT RESULTS

## WEATHER IN 2020

Precipitation is calculated by the "hydrologic year" that runs from October 1 through September 30 and is numbered for the year in which it ends. Rainfall data collected at the Woodley Island National Weather Station (NWS) in Eureka, CA, indicate an average total annual rainfall of 39.22 inches[1] with roughly 90% of the annual precipitation falling as rain during the months of October through May. Rainfall amounts in hydrologic year 2020 (October 1, 2019 through September 30, 2020) were moderately lower than average throughout HRC property.

The Eureka long-term National Weather Service station is indicative of climate for HRC property north of the Van Duzen River. Total annual rainfall at the NWS station in Eureka was 30.51 inches, approximately 29% lower than the long-term average. Maximum daily rainfall was 1.44 inches, suggesting that peak flows were likely not substantially high across most watersheds. The previous rainfall year that could be considered relatively large in Eureka was 2006, when rainfall was well above average (58.67 inches or 49% greater than the long-term average).

Total annual rainfall at the NWS station in Scotia, CA in HY2020 was 29.45 inches, which is approximately 60% below the long-term average for this station. The maximum peak flow measured at the gaging station at the Eel River near Scotia equaled 50,200 cubic feet per second (cfs), with a corresponding maximum daily mean of 30,900 cfs occurring on January 26, 2020. The previous rainfall year that could be considered relatively large in Scotia was 2006, when rainfall was well above average (70.80 inches or 49% greater than the long-term average). Long-term annual precipitation records at the Woodley Island and Scotia NWS stations are provided in Figure 10.

Annual peak flows that represent the northern extent of HRC property are recorded at Graham Gulch (hydrologic monitoring station 505) in Freshwater Creek, and at Bear Creek (hydrologic monitoring station 530) which represent the southern extent of HRC property (Figure 11). Peak flow is expressed in cubic meters per second per unit area (cms/km$^2$) at HRC gaging stations. A value of 1 is approximately equal to a bank-full event. Along with rainfall distribution, peak flow magnitude is relatively variable across the range of HRC property.

[1] California Date Exchange Center (http://cdec.water.ca.gov/cgi-progs/profile?s=SCA&type=precip)

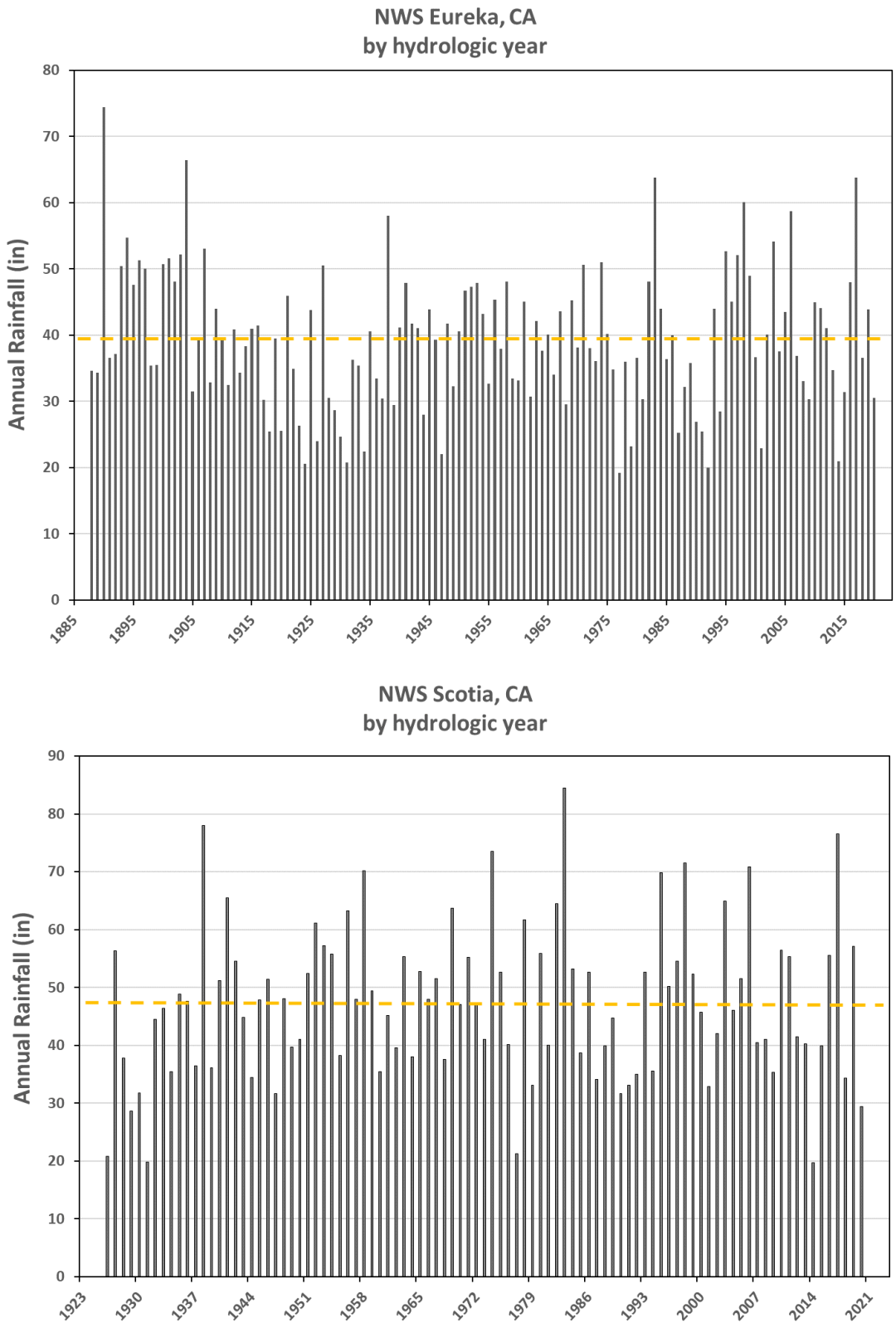



**Figure 10. Annual rainfall by hydrologic year at Eureka and Scotia, CA. Dotted lines represent the running averages (all years)**

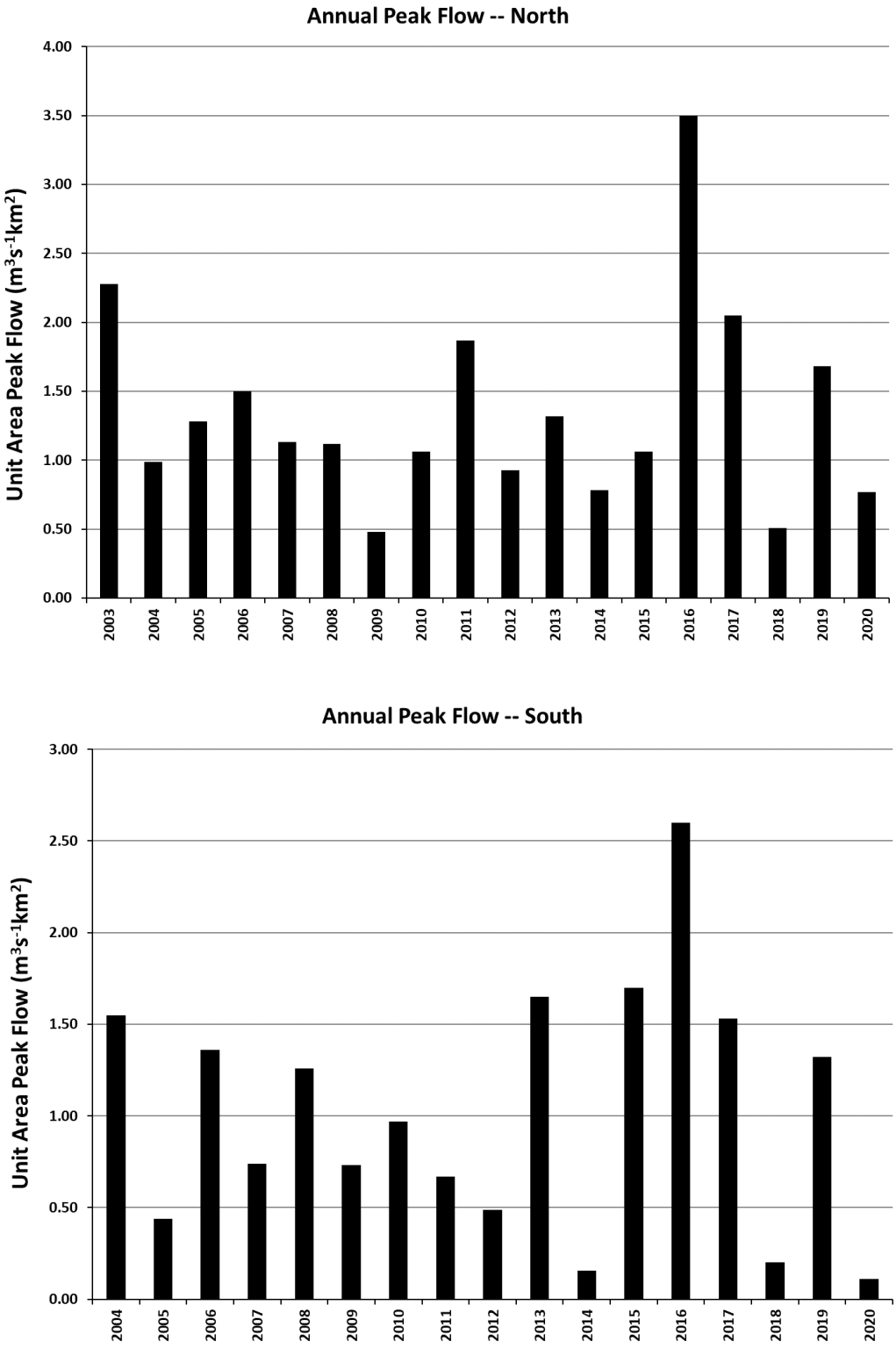



**Figure 11. Reference streamflow sites are represented by Graham Gulch (site 505) in Freshwater Creek (north) and by Bear Creek (site 530) in the south**

## WATERSHED HABITAT STATUS

Table 5 illustrates the most recent collection of aquatic habitat data for each of HRC's eight WAUs. Stream temperature is measured annually in all watersheds within HRC property. The most recent data collected at each ATM site are provided in the form of the composite score card organized by WAU and individual site score cards within each WAU.

Annual variance may be relatively high within certain measured parameters as a result of fluctuation in storm magnitude, inherent sampling error, or unexplained variance that is not easy to determine. It should be noted that even large annual changes often do not persist from year to year, and therefore, only the more long-term deviations should receive greater attention when assessing habitat trends.

The full record of data collection for each ATM site sampled in 2019 including yearly snapshot report cards are provided in this report so that trends and associated sample variability can be assessed for each measured APFC target parameter.

**Table 5. Year of most recent habitat data collection by watershed**

| WAU | 2020 | 2021 | 2022 |
|---|---|---|---|
| **Freshwater Creek 015, 018, 019, 034, 092, 202, 200** | X | | |
| **Elk River**<br>**104**<br>**162, 214, 175, 166, 167, 217** | X | | |
| **Yager /Lawrence 049, 040, 009, 007, 046, 005** | | X | |
| **Van Duzen 003, 108, 111, 112** | | | X |
| **Upper Eel (Larabee, tributaries to mainstem Eel River from Newman Cr south) 002, 122, 126, 170, 212** | X | | |
| **Lower Eel and Eel Delta (tributaries to mainstem Eel River north of Perrot Cr)**<br>**203, 107, 204**<br>**106, 174, 205, 130, 242** | X | X | X<br>X<br>X |
| **Bear River 001, 131, 134, 197** | | X | |
| **Mattole River 133, 169, 219** | | X | |

## FRESHWATER CREEK WAU

Freshwater Creek is the northernmost watershed located on HRC's ownership. The watershed, approximately 31 miles$^2$ in size, drains to the northern end of Humboldt Bay near Eureka, CA. Native fishes found in the WAU include Chinook salmon, coho salmon, chum salmon (*O. keta*), pacific lamprey (*Entosphenus tridentatus*), pacific brook lamprey (*Lampetra pacifica*), coastal cutthroat trout (*O. clarkii clarkii*), prickly and coast range sculpin (*Cottus asper, C. aleuticus*), and threespine stickleback (*Gasterosteus aculeatus*). Amphibians and reptiles known to occupy the basin include southern torrent salamanders (*Rhyacotriton variegatus*), pacific giant salamanders (*Dicamptodon ensatus*), northern red-legged frogs (*Rana aurora*), foothill yellow-legged frogs (*Rana boylii*), and western pond turtles (*Clemmys marmorata*). The Freshwater watershed contains three major geologic terrains: Wildcat Group, Yager, and Franciscan Central Belt. **Error! Reference source not found.**Figure 12 shows the location of the seven Freshwater Creek WAU ATM sites. These sites were measured in 2020, and typical conditions are illustrated in Figure 13. There are currently seven habitat monitoring sites in Freshwater Creek: Mainstem Freshwater Creek (034), SF Freshwater Creek (015), Mainstem Freshwater Creek (200), Graham Gulch (019), Cloney Gulch (092), McCready Gulch (202), and Little Freshwater Creek (018).

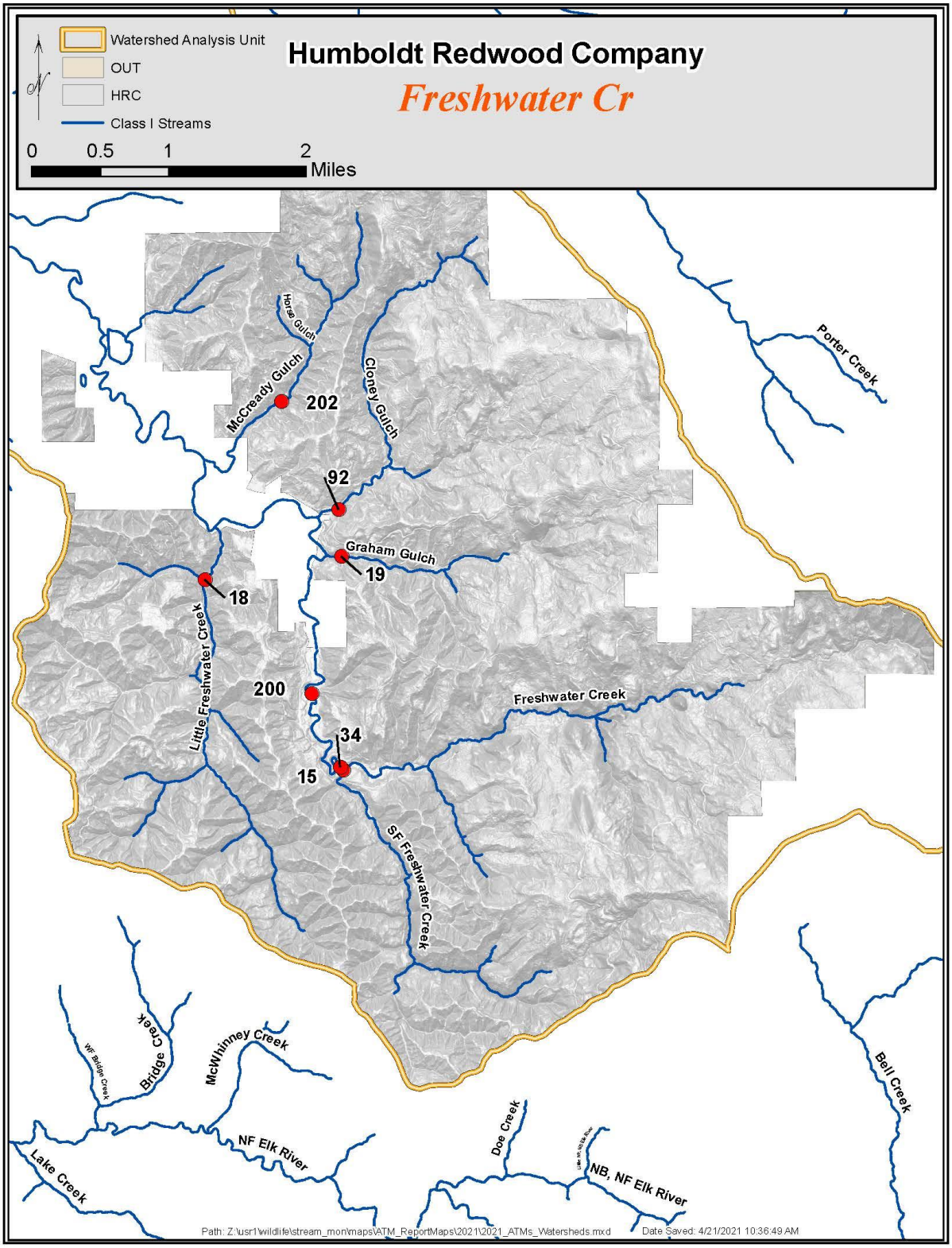
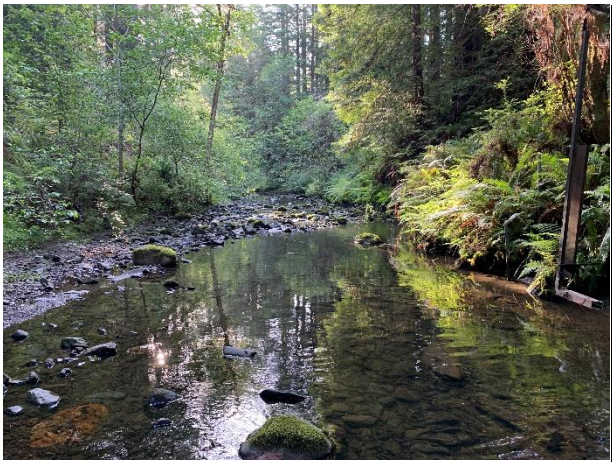



**Figure 12. Location map of ATM stations in the Freshwater Creek WAU**



**Mainstem Freshwater Creek 034**

**SF Freshwater Creek 015**

**Mainstem Freshwater Creek 200**

**Graham Gulch 019**

**Cloney Gulch 092**

**McCready Gulch 202**

**Figure 13. ATM stations within the Freshwater Creek WAU**

**Little Freshwater Creek 018**

**Figure 13 (continued). ATM stations within the Freshwater Creek WAU**

## ATM Station 034 – Mainstem Freshwater Creek [Underlying Geology: Early Tertiary age Yager terrane (Ty)]

Data for all ATM parameters at site 034 (Figure 13) are summarized in the APFC report card found in Table 6. The bed surface APFC target was met at this site in 2020 as the data suggest a coarsening of the substrate across most particle size classes since 2017 (Figure 14). Pool characteristics suggest stable habitat conditions since 2017 despite residual pool depth remaining below the target for the eight consecutive survey year. Total LWD pieces declined in 2020, as total LWD piece frequency decreased by roughly 170% since 2017. Water temperature met the target for the sixth consecutive year since 2015 and over stream canopy cover met the target for the first time since 2003.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (see appendix). Aggradation was observed at 3/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 1 (-0.26$m^2$). The greatest degree of channel scour occurred at cross-section 4 where the channel area increased +0.22$m^2$.

A snorkel survey conducted on 6/19/2020 identified juvenile coho salmon and trout of various size classes in each of the five pools sampled (Figure 15). Also identified in this ATM reach were threespine stickleback and pacific giant salamanders.

**Table 6. Individual site report card for ATM station 034, Freshwater Creek (2003-2020)**

| **Site 034 Freshwater Mainstem** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 41 | 150 | 120 | | | 167 | | | 139 | | | 104 | | | 113 | | | 112 |
| | $D_{50}$ (mm) | 65-95 | 25 | 61 | 36 | | | 58 | | | 53 | | | 41 | | | 62 | | | 69 |
| | $D_{16}$ (mm) | # | 7 | 12 | 10 | | | 4 | | | 18 | | | 7 | | | 27 | | | 29 |
| | $D_5$ (mm) | # | 1 | 2 | 1 | | | 1 | | | 4 | | | 3 | | | 5 | | | 12 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 29 | 31 | 17 | | | 31 | | | 43 | | | 32 | | | 51 | | | 45 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.3 | 6.1 | 9.6 | | | 5.9 | | | 4.3 | | | 5.0 | | | 4.0 | | | 4.0 |
| | Residual Pool Depth (m) | ≥0.91 | 0.53 | 0.57 | 0.46 | | | 0.54 | | | 0.53 | | | 0.53 | | | 0.56 | | | 0.51 |
| | Pools Assoc. w/wood (%) | ≥50 | 86 | 100 | 33 | | | 40 | | | 86 | | | 33 | | | 75 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥6.84 | 5.00 | 4.81 | 3.69 | | | 1.04 | | | 2.01 | | | 3.35 | | | 3.10 | | | 1.15 |
| | Total Piece Count | # | 54 | 46 | 42 | | | 9 | | | 22 | | | 35 | | | 35 | | | 12 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 17.2 | 17.6 | 16.6 | 16.9 | 16.9 | 16.4 | 16.1 | 15.3 | 15.8 | 15.1 | 17.2 | | 16.5 | 16.0 | 16.8 | 16.2 | 16.6 | 16.1 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 76 | 78 | | | | 75 | | | 83 | | | 77 | | | 87 | | | 94 |
| | Canopy of Rip Forest (%) | ≥85 | 88 | 93 | | | | | | | 94 | | | 90 | | | | | | |

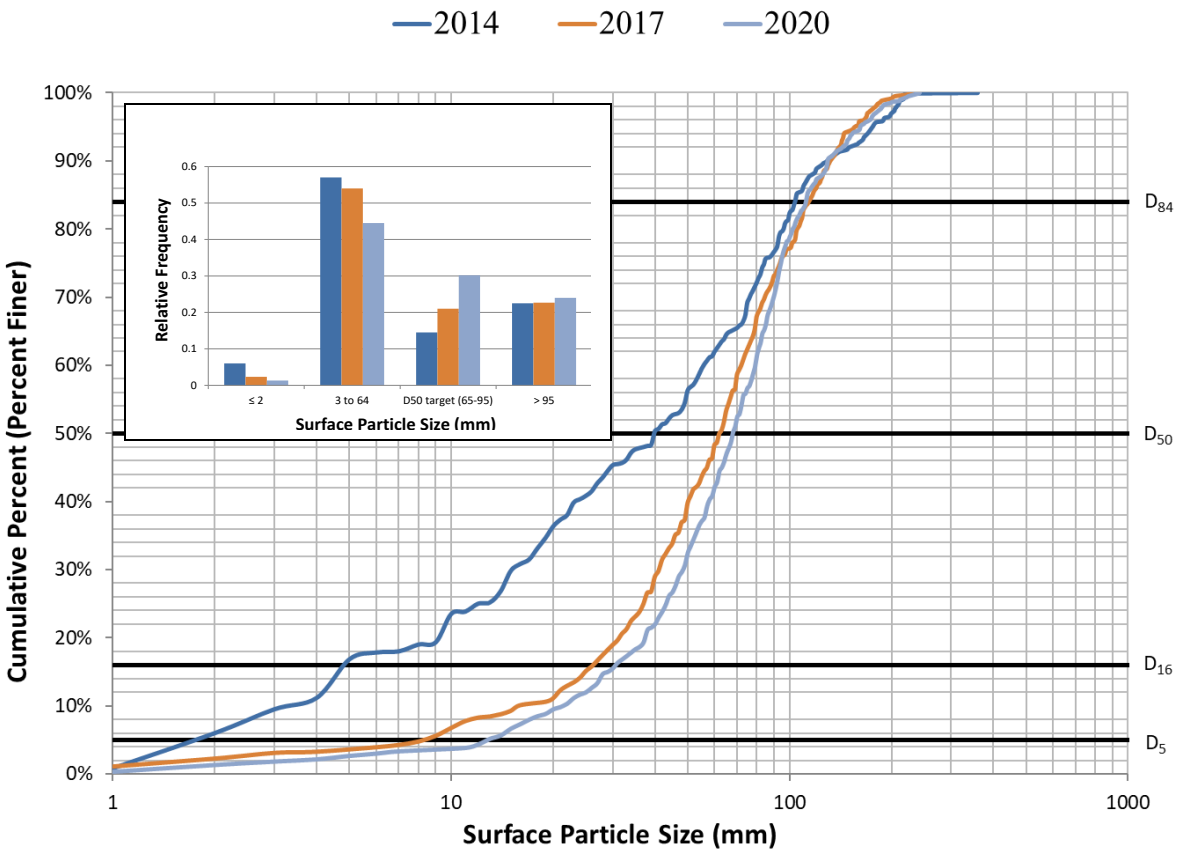



**Figure 14. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Freshwater Creek ATM 034 monitoring reach (2014-2020)**

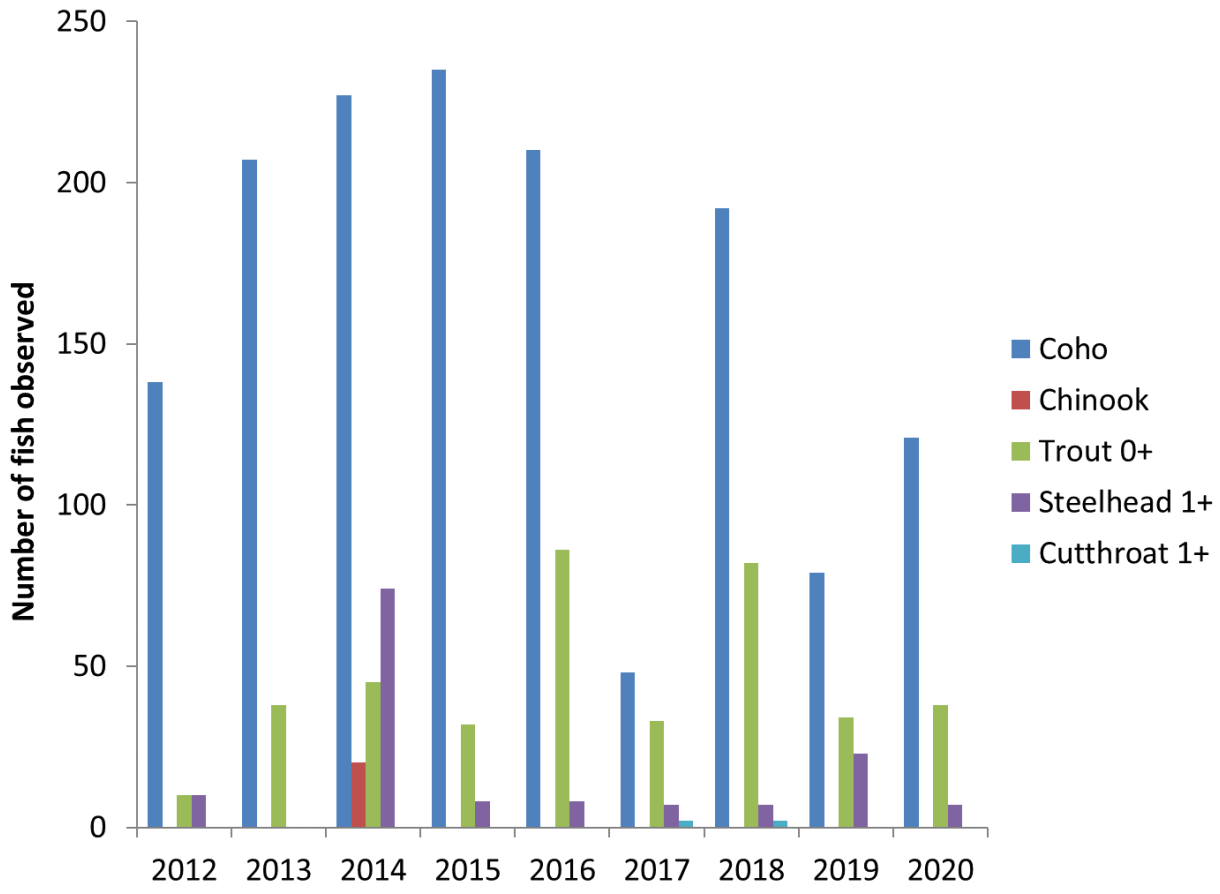



**Figure 15. Results of annual snorkel survey fish counts of the first 5 pools within the Freshwater Creek ATM 034 monitoring reach (2012-2020)**

## ATM Station 015 – SF Freshwater Creek [Underlying Geology: Early Tertiary age Yager terrane (Ty)]

Data for all ATM parameters at site 015 (Figure13) are summarized in the APFC report card found in Table 7. The bed surface APFC target was not met at this site in 2020 as the data suggest a fining across all the particle size classes since 2017 (Figure 16). Pool characteristics suggest a slight improvement in habitat conditions with pool spacing (CW/pool) meeting its target. The total LWD piece frequency within the surveyed reach remained below the APFC target, as total LWD pieces decreased by 72% since 2017. Water temperature met the target goal for the eighteenth consecutive year on record, and mid-channel canopy cover met the target for the second straight survey year since 2017.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (see appendix). Aggradation was observed at 4/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 1 (-0.53$m^2$). The greatest degree of channel scour occurred at cross-section 2 where the channel area increased +0.02$m^2$.

A snorkel survey conducted on 6/19/2020 identified juvenile coho salmon and steelhead and cutthroat trout of various size classes in each of the five pools sampled (Figure 17). Also identified were threespine stickleback.

**Table 7. Individual site report card for ATM station 015, SF Freshwater Creek (2003-2020)**

| Site 015 SF Freshwater Creek | Parameter | Target Value (# no target) | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 29 | 77 | 93 | | | 68 | | | 85 | | | 82 | | | 68 | | | 57 |
| | $D_{50}$ (mm) | 65-95 | 16 | 27 | 28 | | | 28 | | | 43 | | | 31 | | | 40 | | | 32 |
| | $D_{16}$ (mm) | # | 5 | 5 | 4 | | | 3 | | | 16 | | | 6 | | | 20 | | | 15 |
| | $D_5$ (mm) | # | 1 | 1 | 3 | | | 1 | | | 6 | | | 2 | | | 11 | | | 7 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 46 | 51 | 44 | | | 52 | | | 44 | | | 64 | | | 54 | | | 66 |
| | Pool Spacing (CW/pool) | ≤6.0 | 6.5 | 8.0 | 3.0 | | | 3.2 | | | 5.6 | | | 4.3 | | | 7.5 | | | 4.4 |
| | Residual Pool Depth (m) | ≥0.91 | 0.81 | 0.90 | 0.63 | | | 0.59 | | | 0.66 | | | 0.5 | | | 0.81 | | | 0.69 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 56 | | | 60 | | | 100 | | | 71 | | | 75 | | | 86 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥10.40 | 14.69 | 14.57 | 7.16 | | | 7.63 | | | 7.44 | | | 13.46 | | | 9.70 | | | 5.66 |
| | Total Piece Count | # | 93 | 103 | 75 | | | 44 | | | 53 | | | 93 | | | 67 | | | 39 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 16.2 | 16.7 | 15.9 | 15.7 | 15.9 | 14.4 | 14.2 | 13.9 | 15.0 | 14.6 | 15.6 | 15.9 | 15.3 | 15.1 | 15.9 | 14.9 | 15.6 | 15.0 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥92 | 92 | 93 | | | | 84 | | | 94 | | | 81 | | | 93 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | 85 | 96 | | | | | | | 92 | | | 95 | | | | | | |

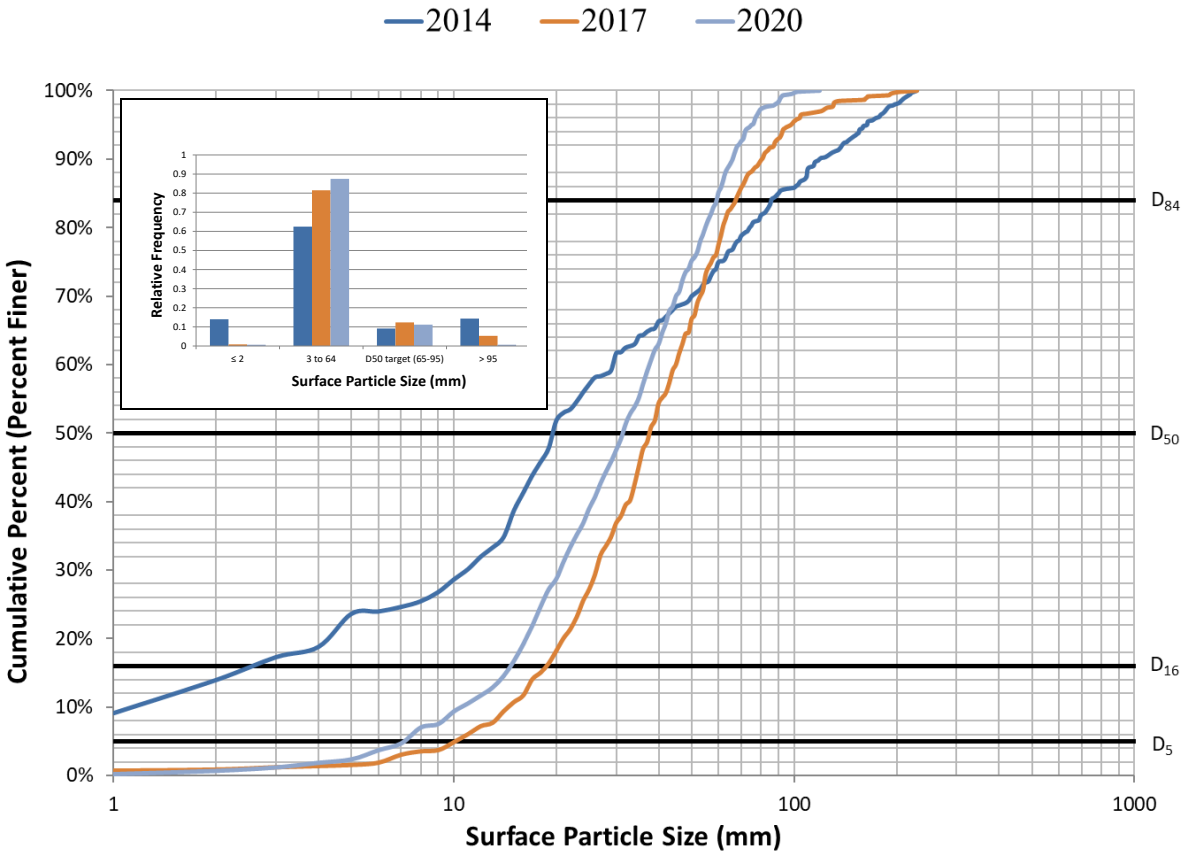



**Figure 16. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Freshwater Creek ATM 015 monitoring reach (2014-2020)**

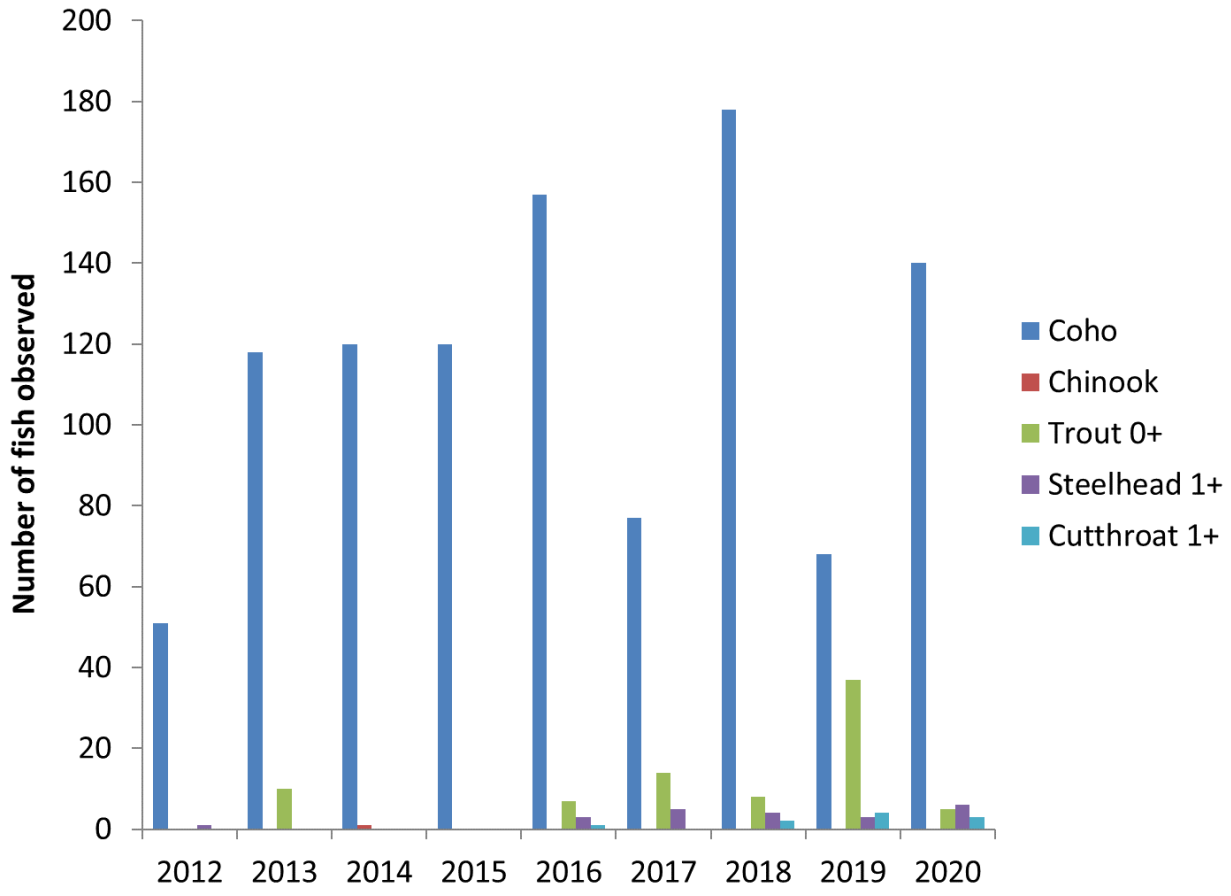



**Figure 17. Results of annual snorkel survey fish counts of the first 5 pools within the SF Freshwater Creek ATM 015 monitoring reach (2012-2020)**

## ATM Station 200 – Mainstem Freshwater Creek [Underlying Geology: Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 200 (Figure 13) are summarized in the APFC report card found in Table 8. The bed surface APFC target was met in 2020 for the first time on record, as the data suggest a coarsening of the substrate across all particle size classes (Figure 18). Pool characteristics suggest stable habitat conditions since 2014, with residual pool depth failing to meet the target for the third survey year straight. The total LWD piece frequency within the survey reach failed to meet the APFC target, as total LWD pieces decreased by 140% since 2017. Water temperature met the target for the fifteenth consecutive survey year while mid-channel canopy cover met its target for the sixth survey year in a row since 2004.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 2 (-0.31$m^2$). The greatest degree of channel scour occurred at cross-section 5 where the channel area increased +2.26$m^2$.

A snorkel survey conducted on 6/19/2020 identified juvenile coho salmon and trout of various size classes in each of the five pools sampled (Figure 19). Also identified were threespine stickleback and pacific giant salamanders.

**Table 8. Individual site report card for ATM station 200, Mainstem Freshwater Creek (2003-2020)**

| **Site 200 Freshwater Mainstem** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 92 | 106 | 92 | | | 89 | | | 111 | | | 97 | | | 81 | | | 105 |
| | $D_{50}$ (mm) | 65-95 | 53 | 49 | 41 | | | 42 | | | 60 | | | 41 | | | 56 | | | 71 |
| | $D_{16}$ (mm) | # | 20 | 12 | 4 | | | 13 | | | 25 | | | 9 | | | 30 | | | 38 |
| | $D_5$ (mm) | # | 3 | 1 | 1 | | | 1 | | | 10 | | | 2 | | | 16 | | | 20 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 45 | 79 | 55 | | | 65 | | | 59 | | | 32 | | | 84 | | | 78 |
| | Pool Spacing (CW/pool) | ≤6.0 | 7.4 | 8.1 | 5.1 | | | 4.7 | | | 6.2 | | | 5.0 | | | 3.8 | | | 5.0 |
| | Residual Pool Depth (m) | ≥0.91 | 0.89 | 1.16 | 0.86 | | | 0.92 | | | 0.98 | | | 0.81 | | | 0.81 | | | 1.00 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 50 | | | 29 | | | 80 | | | 83 | | | 63 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥5.88 | 3.87 | 4.83 | 2.00 | | | 1.42 | | | 0.64 | | | 1.20 | | | 1.00 | | | 0.44 |
| | Total Piece Count | # | 40 | 54 | 24 | | | 17 | | | 7 | | | 14 | | | 12 | | | 5 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | | 17.6 | 16.5 | 16.2 | 16.7 | 16.5 | 15.7 | 15.1 | | 15.0 | 16.7 | 16.5 | 16.3 | 15.7 | 16.4 | 15.7 | 16.5 | 15.8 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥89 | 87 | 96 | | | | 95 | | | 98 | | | 95 | | | 98 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | 92 | 94 | | | | | | | 95 | | | 93 | | | | | | |

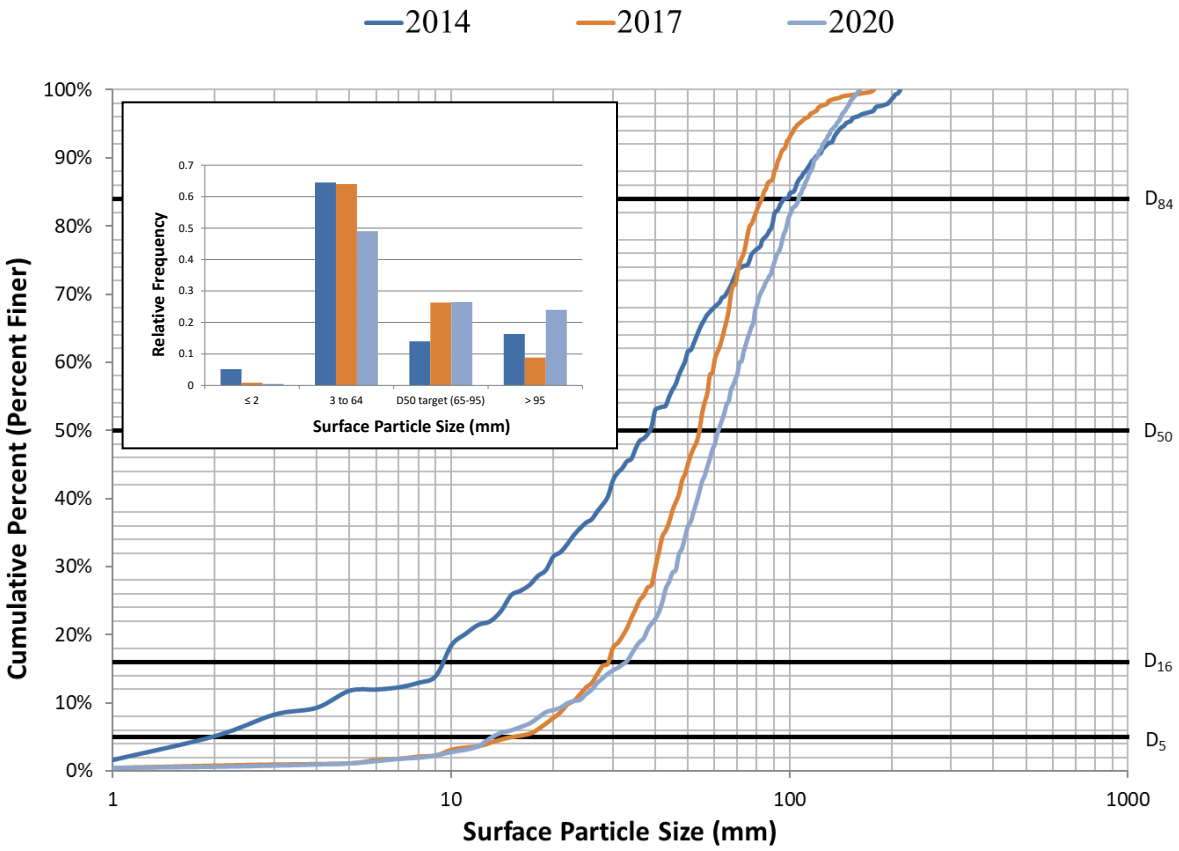



**Figure 18. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Mainstem Freshwater Creek ATM 200 monitoring reach (2014-2020)**

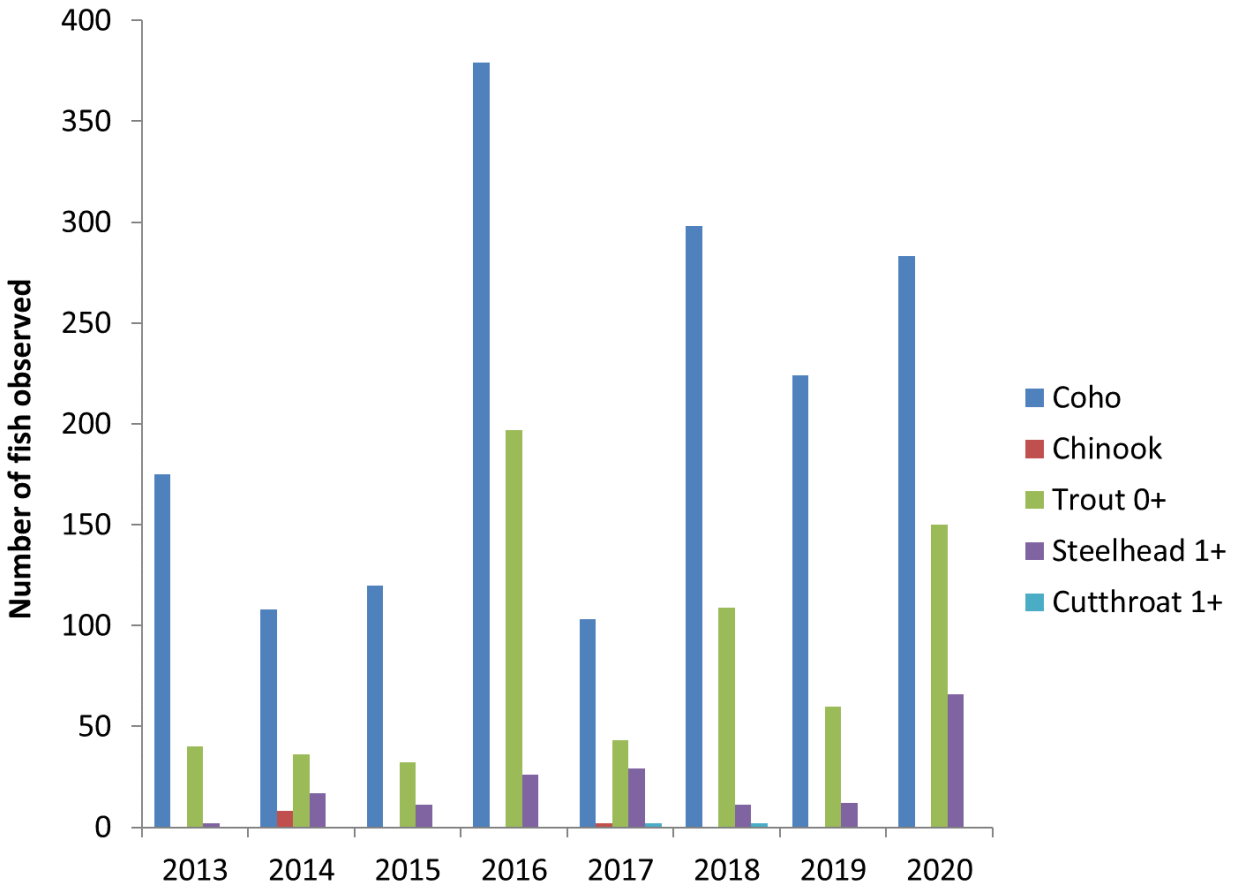



**Figure 19. Results of annual snorkel survey fish counts of the first 5 pools within the Mainstem Freshwater Creek ATM 200 monitoring reach (2013-2020)**

## ATM Station 019 – Graham Gulch [Underlying Geology: Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 019 (Figure 13) are summarized in the APFC report card found in Table 9. The bed surface APFC target was not met in 2020, though the data suggest stability within the $D_{50}$ particle size class (Figure 20). Pool characteristics suggest stable habitat conditions, with only residual pool depth failing to meet the target for the eighth consecutive survey year. Total LWD piece frequency within the surveyed reach remained below the APFC target, as total LWD pieces decreased 110% since 2017. Water temperature met the target for the eighteenth consecutive year, as mid-channel canopy cover met the target for the fourth survey year straight.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (see appendix). Aggradation was observed at 1/5 cross-sections between survey years 2017 and 2020, which occurred at cross-section 3 (-0.46$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +0.89$m^2$.

A snorkel survey conducted on 6/19/2020 identified coho salmon and trout of various size classes in each of the five pools sampled (Figure 21). Also identified were pacific giant salamanders.

**Table 9. Individual site report card for ATM station 019, Graham Gulch (2003-2020)**

| **Site 019 Graham Gulch** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 54 | 64 | 67 | | | 109 | | | 91 | | | 60 | | | 78 | | | 95 |
| | $D_{50}$ (mm) | 65-95 | 21 | 27 | 27 | | | 45 | | | 46 | | | 26 | | | 55 | | | 55 |
| | $D_{16}$ (mm) | # | 1 | 6 | 1 | | | 7 | | | 18 | | | 10 | | | 33 | | | 27 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | | | 1 | | | 2 | | | 4 | | | 20 | | | 8 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 49 | 43 | 47 | | | 40 | | | 47 | | | 49 | | | 44 | | | 48 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.1 | 6.3 | 3.6 | | | 4.9 | | | 3.6 | | | 3.3 | | | 3.8 | | | 3.3 |
| | Residual Pool Depth (m) | ≥0.91 | 0.61 | 0.53 | 0.66 | | | 0.44 | | | 0.48 | | | 0.41 | | | 0.52 | | | 0.43 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | | | 100 | | | 90 | | | 41 | | | 88 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥8.90 | 11.17 | 6.99 | 4.09 | | | 2.97 | | | 3.85 | | | 4.68 | | | 5.50 | | | 2.67 |
| | Total Piece Count | # | 93 | 53 | 35 | | | 22 | | | 30 | | | 37 | | | 44 | | | 21 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 15.6 | 15.7 | 15.6 | 15.4 | 15.5 | 14.0 | 15.1 | 14.1 | 14.6 | 14.2 | 14.9 | 15.1 | 15.0 | 15.1 | 15.3 | 14.8 | 15.7 | 15.4 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥92 | 89 | 95 | | | | 84 | | | 94 | | | 95 | | | 97 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | 94 | 100 | | | | | | | 92 | | | 95 | | | | | | |

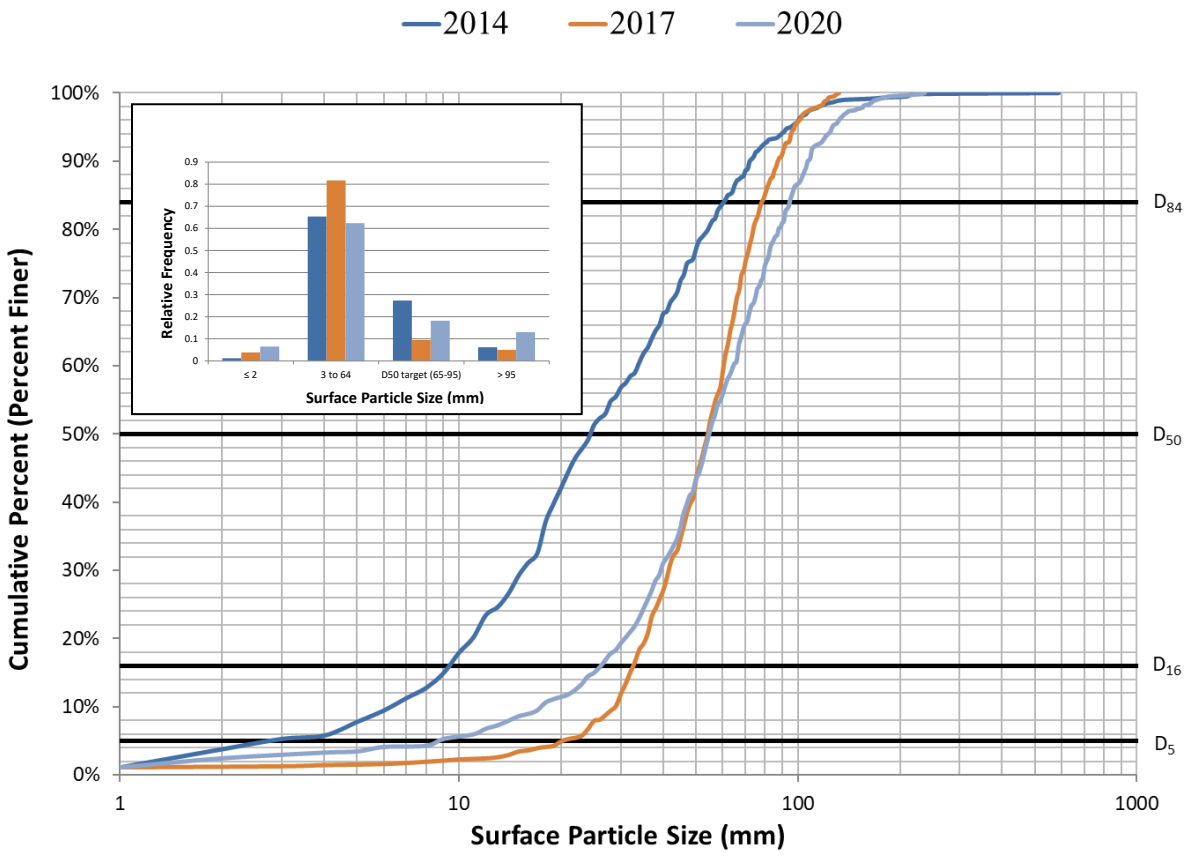



**Figure 20. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Graham Gulch ATM 019 monitoring reach (2014-2020)**

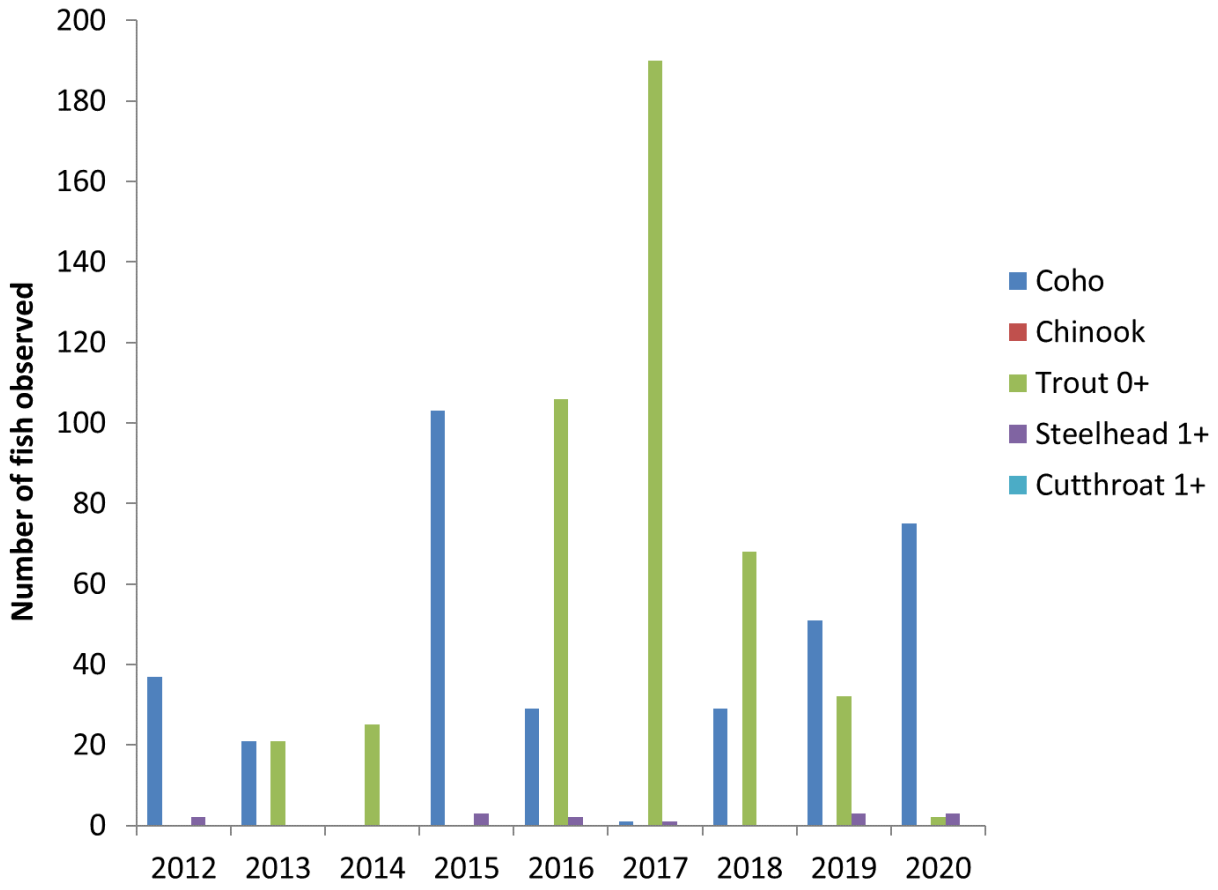



**Figure 21. Results of annual snorkel survey fish counts of the first 5 pools within the Graham Gulch ATM 019 monitoring reach (2012-2020)**

## ATM Station 092 – Cloney Gulch [Underlying Geology: Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 092 (Figure 13) are summarized in the APFC report card found in Table 10. The bed surface APFC target was not met in 2020, as the data suggest a fining of the substrate across all particle size classes since 2017 (Figure 22). Pool characteristics suggest stable habitat conditions despite residual pool depth failing to meet the target for the fifth consecutive survey year. Total LWD piece frequency within the survey reach failed to meet the APFC target, as total LWD pieces decreased 126% since 2017. Water temperature met the target for the fourteenth consecutive survey year, and mid-channel canopy cover met the target for the fourth straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (see appendix). Aggradation was observed at 1/5 cross-sections between survey years 2017 and 2020, which occurred at cross-section 3 (-0.46$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +0.89$m^2$.

A snorkel survey conducted on 6/17/2020 identified juvenile coho salmon and steelhead & cutthroat trout of various size classes in each of the five pools sampled (Figure 23). Also identified were threespine stickleback and pacific giant salamanders.

**Table 10. Individual site report card for ATM station 092, Cloney Gulch (2003-2020)**

| **Site 092 Cloney Gulch** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 117 | 119 | 108 | | | 108 | | | 124 | | | 96 | | | 98 | | | 97 |
| | $D_{50}$ (mm) | 65-95 | 58 | 58 | 51 | | | 40 | | | 72 | | | 38 | | | 64 | | | 56 |
| | $D_{16}$ (mm) | # | 5 | 13 | 14 | | | 7 | | | 28 | | | 9 | | | 39 | | | 26 |
| | $D_5$ (mm) | # | 1 | 6 | 1 | | | 1 | | | 11 | | | 2 | | | 23 | | | 11 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 39 | 27 | 45 | | | 44 | | | 57 | | | 44 | | | 59 | | | 65 |
| | Pool Spacing (CW/pool) | ≤6.0 | 6.8 | 10.0 | 5.7 | | | 5.2 | | | 5.5 | | | 7.5 | | | 4.4 | | | 4.3 |
| | Residual Pool Depth (m) | ≥0.91 | 0.72 | 0.90 | 0.92 | | | 0.62 | | | 0.58 | | | 0.63 | | | 0.71 | | | 0.58 |
| | Pools Assoc. w/wood (%) | ≥50 | 75 | 100 | 60 | | | 83 | | | 100 | | | 50 | | | 86 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥7.80 | 8.77 | 4.19 | 11.11 | | | 4.23 | | | 4.62 | | | 4.58 | | | 6.20 | | | 2.78 |
| | Total Piece Count | # | 68 | 57 | 125 | | | 43 | | | 41 | | | 38 | | | 52 | | | 23 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 16.8 | 16.4 | 16.5 | 16.0 | 16.4 | 16.5 | | 14.3 | 15.1 | 14.5 | | | 15.8 | 14.7 | 14.9 | 14.9 | | 14.6 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥92 | 88 | 91 | | | | 83 | | | 94 | | | 97 | | | 97 | | | 100 |
| | Canopy of Rip Forest (%) | ≥85 | 91 | 94 | | | | | | | 96 | | | 98 | | | | | | |

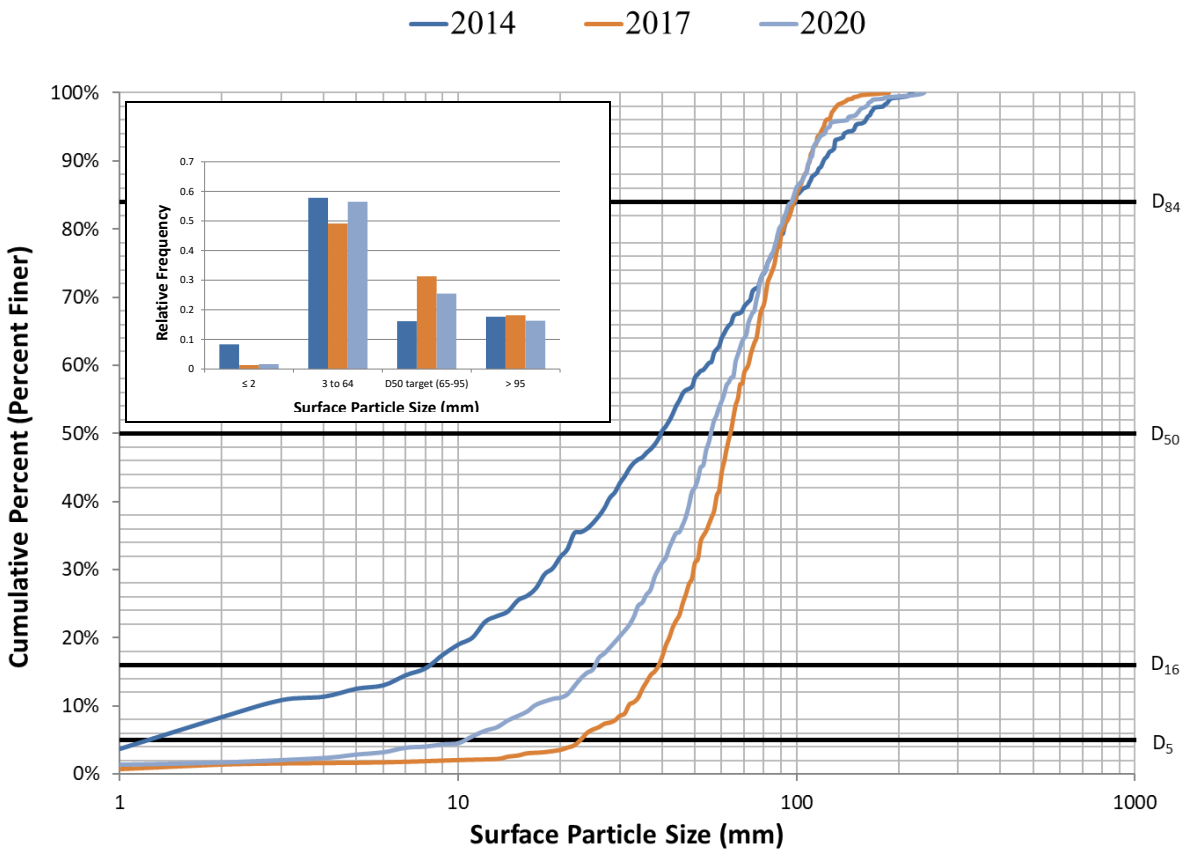



**Figure 22. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Cloney Gulch ATM 092 survey reach (2014-2020)**

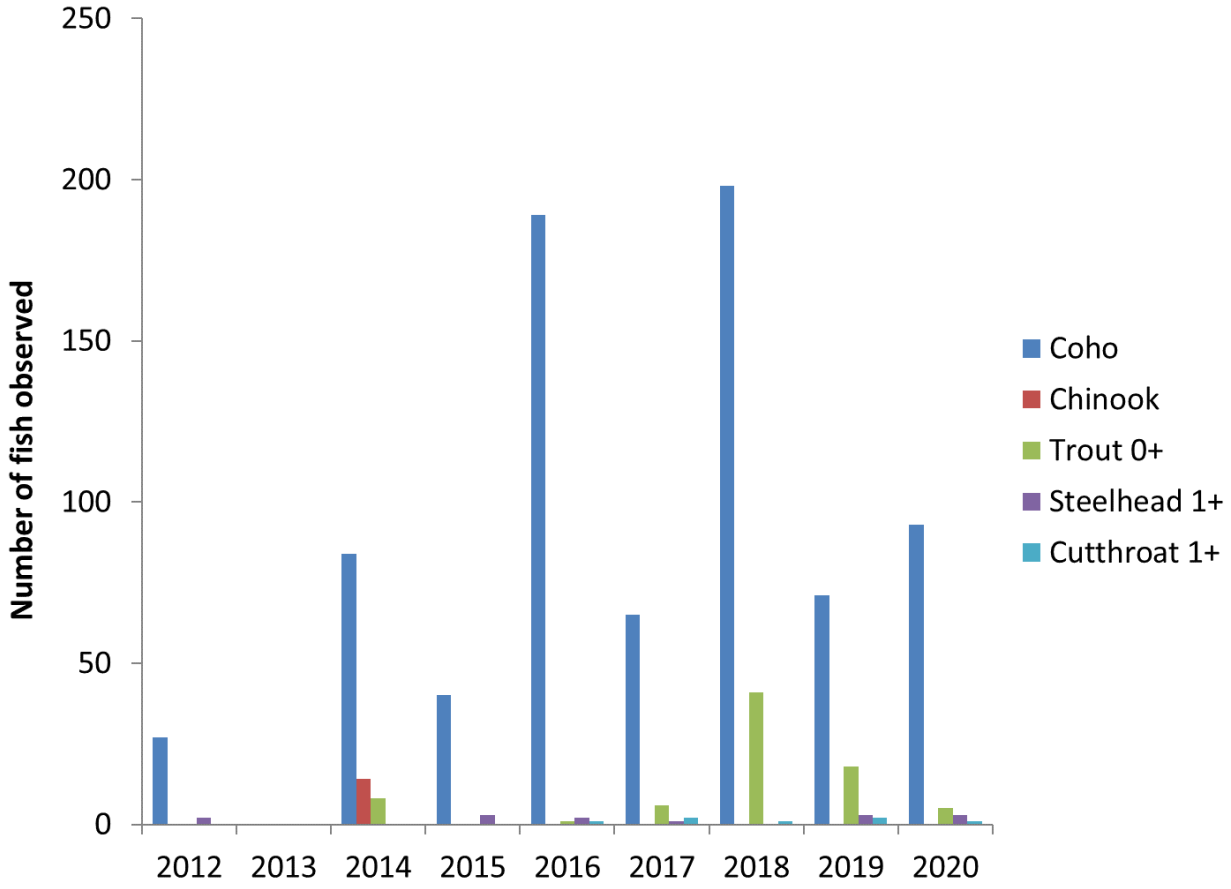



**Figure 23. Results of annual snorkel survey fish counts of the first 5 pools within the Cloney Gulch ATM 092 monitoring reach (2012-2020)**

## ATM Station 202 – McCready Gulch [Underlying Geology: Cretaceous/ Jurassic age Central Belt of the Franciscan Complex (sedimentary rocks) (KJfs); Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 202 (Figure 13) are summarized in the APFC report card found in Table 11. The bed surface APFC target was not met in 2020, though the data suggest a coarsening of the substrate across all particle size classes (Figure 24). Pool characteristics suggest stable habitat conditions despite half of the parameters remaining below their respective targets. Total LWD piece frequency within the survey reach remained below the APFC target, as total LWD pieces decreased 250% since 2017. Water temperature met the target for the sixteenth consecutive year, as mid-channel canopy cover met the target for the fourth straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 3 (-0.83$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +0.85$m^2$.

A snorkel survey conducted on 6/17/2020 identified juvenile coho salmon and trout of various size classes in each of the five pools sampled (Figure 25). Also identified were pacific giant salamanders.

**Table 11. Individual site report card for ATM station 202, McCready Gulch (2005-2020)**

| **Site 202 McCready Gulch** | **Parameter** | **Target Value** (# no target) | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 64 | | | 61 | | | 65 | | | 44 | | | 65 | | | 70 |
| | $D_{50}$ (mm) | 65-95 | 23 | | | 18 | | | 28 | | | 14 | | | 34 | | | 38 |
| | $D_{16}$ (mm) | # | 1 | | | 3 | | | 11 | | | 4 | | | 16 | | | 18 |
| | $D_5$ (mm) | # | 1 | | | 1 | | | 2 | | | 2 | | | 6 | | | 7 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 45 | | | 47 | | | 38 | | | 35 | | | 30 | | | 46 |
| | Pool Spacing (CW/pool) | ≤6.0 | 2.4 | | | 4.6 | | | 6.2 | | | 5.0 | | | 6.1 | | | 5.2 |
| | Residual Pool Depth (m) | ≥0.91 | 0.46 | | | 0.45 | | | 0.48 | | | 0.42 | | | 0.47 | | | 0.45 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | | | 100 | | | 83 | | | 100 | | | 80 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥13.70 | 15.76 | | | 7.82 | | | 6.25 | | | 9.94 | | | 5.30 | | | 1.53 |
| | Total Piece Count | # | 192 | | | 86 | | | 42 | | | 52 | | | 28 | | | 8 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 14.5 | 13.5 | 14.9 | 14.2 | 14.1 | 12.9 | 14.1 | 13.4 | 16.4 | 14.8 | 14.3 | 14.0 | 15.2 | 14.1 | 14.6 | 14.7 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥93 | | | | 85 | | | 96 | | | 96 | | | 96 | | | 99 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | | 94 | | | 98 | | | | | | |

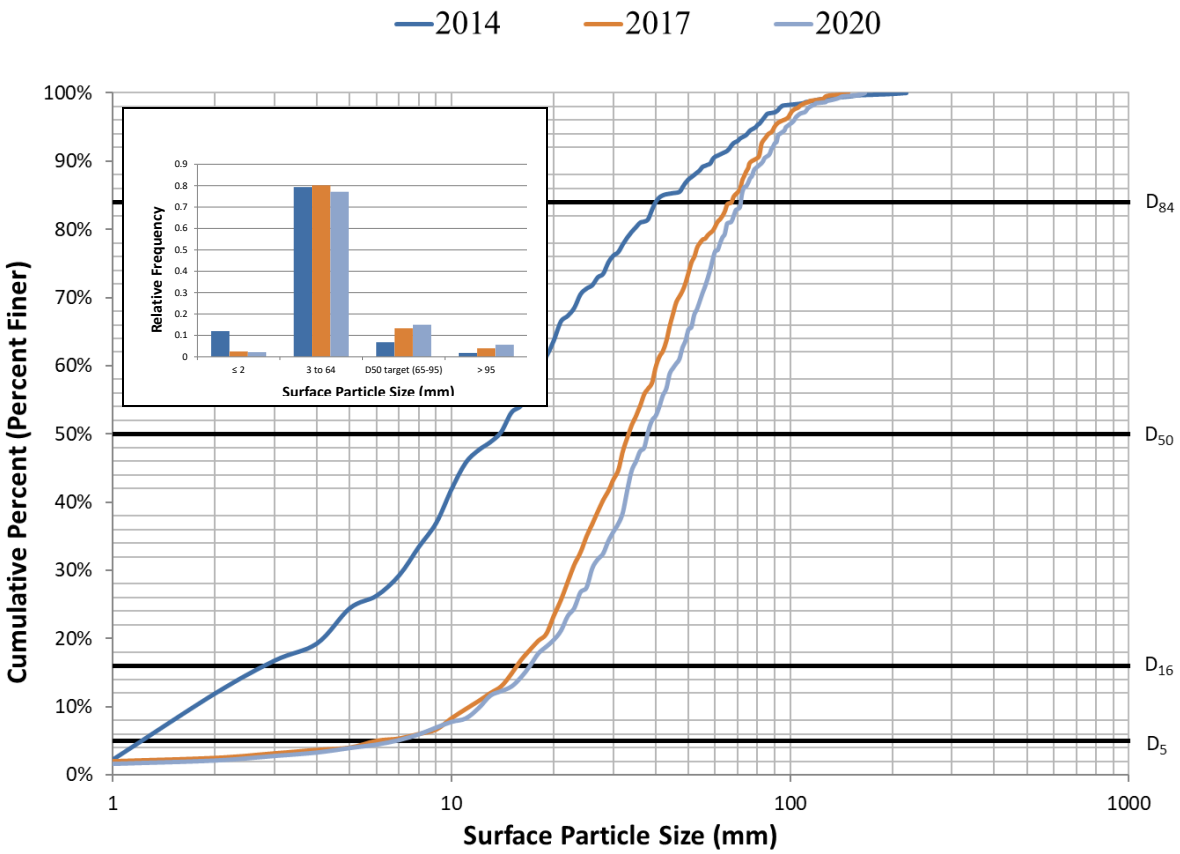



**Figure 24. Cumulative frequency plot of the mean surface particle size of three riffles measured within the McCready Gulch ATM 202 survey reach (2014-2020)**

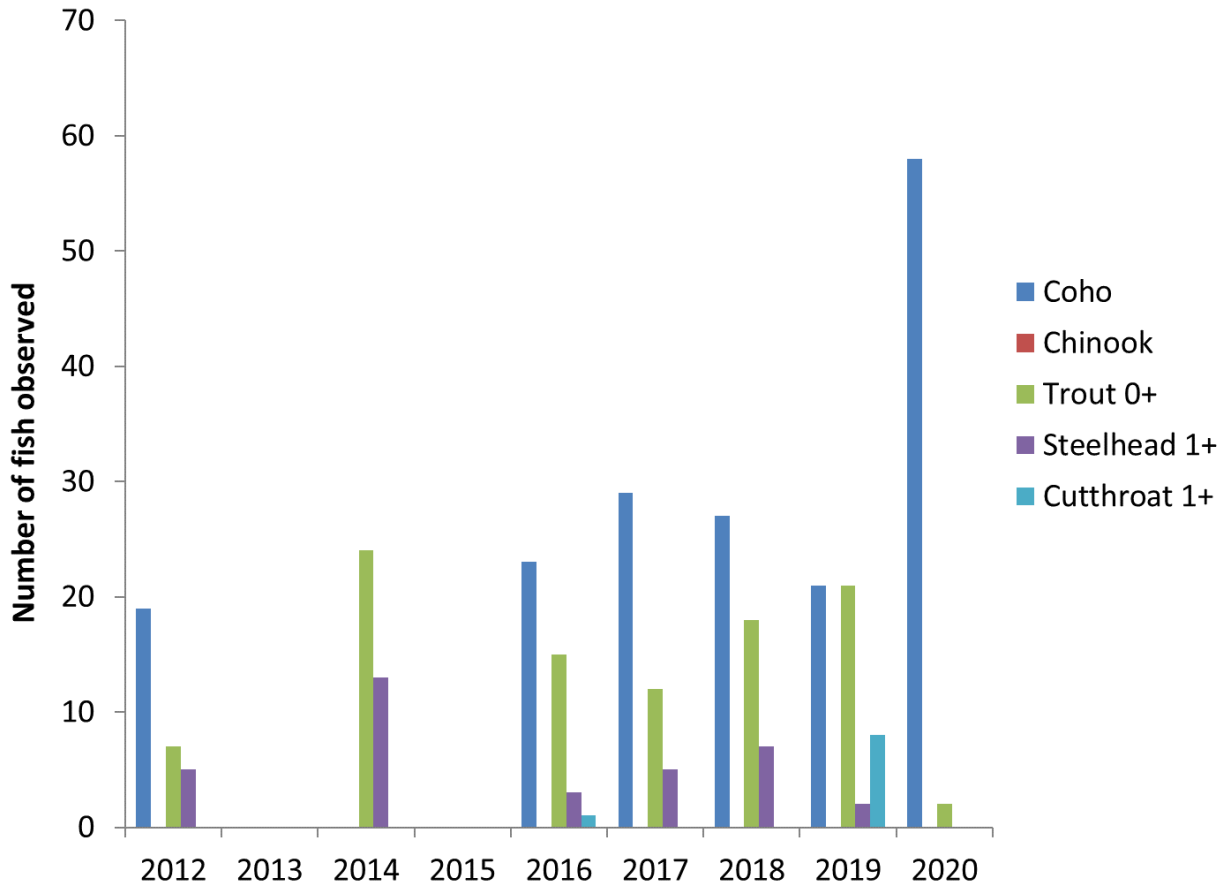



**Figure 25. Results of annual snorkel survey fish counts of the first 5 pools within the McCready Gulch ATM 202 monitoring reach (2012-2020)**

## ATM Station 018 – Little Freshwater Creek [Underlying Geology: Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 018 (Figure 13) are summarized in the APFC report card found in Table 12. The bed surface APFC target was not met in 2020, as the data suggest a fining of the substrate across most particle size classes (Figure 26). Pool characteristics suggest stable habitat conditions despite residual pool depth remaining below the target for the eighth consecutive survey year. Total LWD piece frequency within the surveyed reach remained below the APFC target, as total LWD pieces decreased 230% since 2017. Water temperature met the target for the eighteenth consecutive year, as mid-channel canopy cover met the target for the fourth straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 5 (-0.14$m^2$). The greatest degree of channel scour occurred at cross-section 2 where the channel area increased +0.84$m^2$.

A snorkel survey conducted on 6/18/2020 identified juvenile coho salmon and steelhead & cutthroat trout of various size classes in each of the five pools sampled (Figure 27). Also identified were threespine stickleback and pacific giant salamanders.

**Table 12. Individual site report card for ATM station 018, Little Freshwater Creek (2003-2020)**

| Site 018 Little Freshwater Creek | Parameter | Target Value (# no target) | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 89 | 83 | 84 | | | 100 | | | 98 | | | 61 | | | 89 | | | 91 |
| | $D_{50}$ (mm) | 65-95 | 53 | 42 | 39 | | | 48 | | | 56 | | | 20 | | | 65 | | | 59 |
| | $D_{16}$ (mm) | # | 14 | 2 | 5 | | | 10 | | | 27 | | | 5 | | | 42 | | | 29 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | | | 1 | | | 13 | | | 2 | | | 31 | | | 13 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 71 | 72 | 61 | | | 53 | | | 68 | | | 35 | | | 84 | | | 85 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.9 | 5.0 | 3.0 | | | 5.2 | | | 6.2 | | | 7.5 | | | 3.9 | | | 4.4 |
| | Residual Pool Depth (m) | ≥0.91 | 0.51 | 0.53 | 0.59 | | | 0.53 | | | 0.53 | | | 0.46 | | | 0.44 | | | 0.49 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | | | 71 | | | 100 | | | 46 | | | 88 | | | 86 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥11.90 | 6.83 | 4.98 | 6.30 | | | 2.27 | | | 3.29 | | | 3.74 | | | 4.90 | | | 1.56 |
| | Total Piece Count | # | 43 | 33 | 52 | | | 18 | | | 21 | | | 24 | | | 33 | | | 10 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 15.8 | 15.8 | 15.3 | 15.0 | 16.0 | 15.1 | 14.8 | 13.6 | 14.9 | 14.0 | 15.2 | 14.6 | 15.0 | 14.4 | 15.6 | 14.2 | 15.6 | 15.2 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥92 | 85 | 94 | | | | 84 | | | 90 | | | 96 | | | 94 | | | 97 |
| | Canopy of Rip Forest (%) | ≥85 | 89 | 96 | | | | | | | 89 | | | 97 | | | | | | |

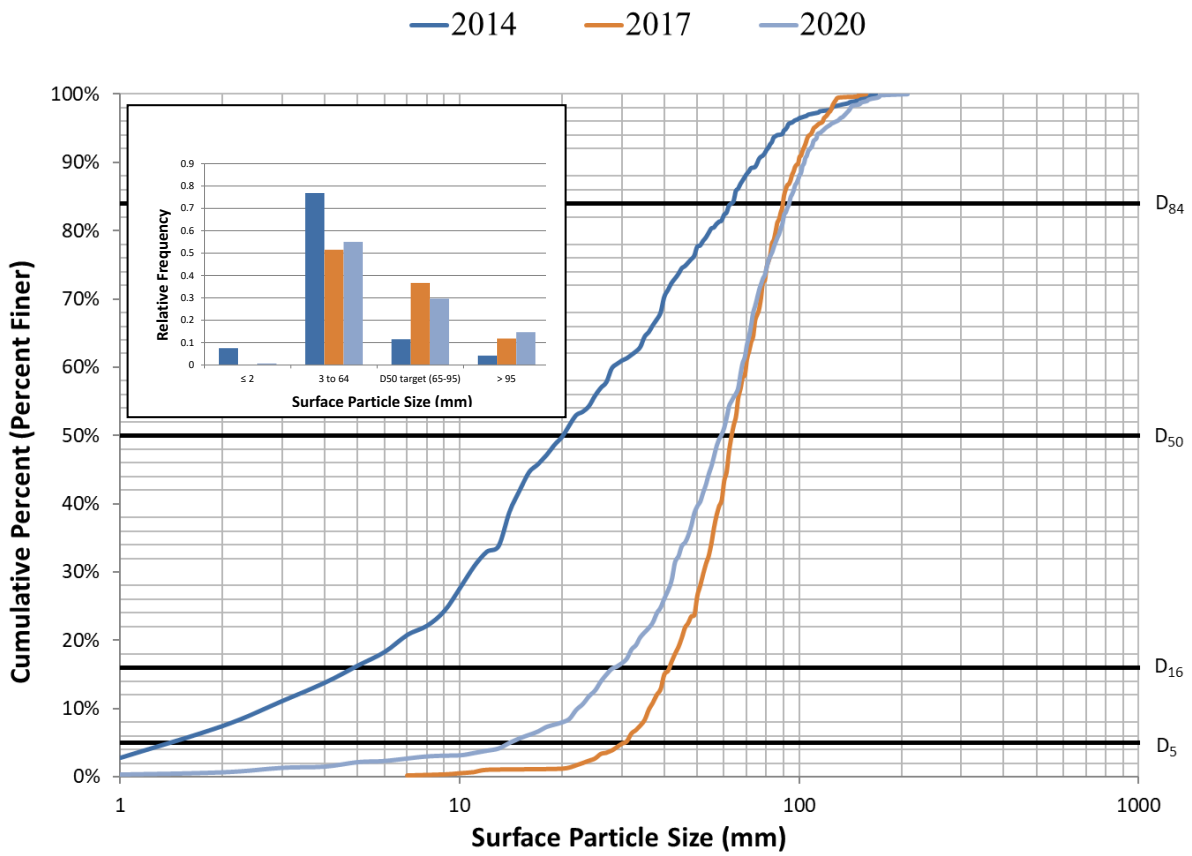



**Figure 26. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Little Freshwater Creek ATM 018 survey reach (2014-2020)**

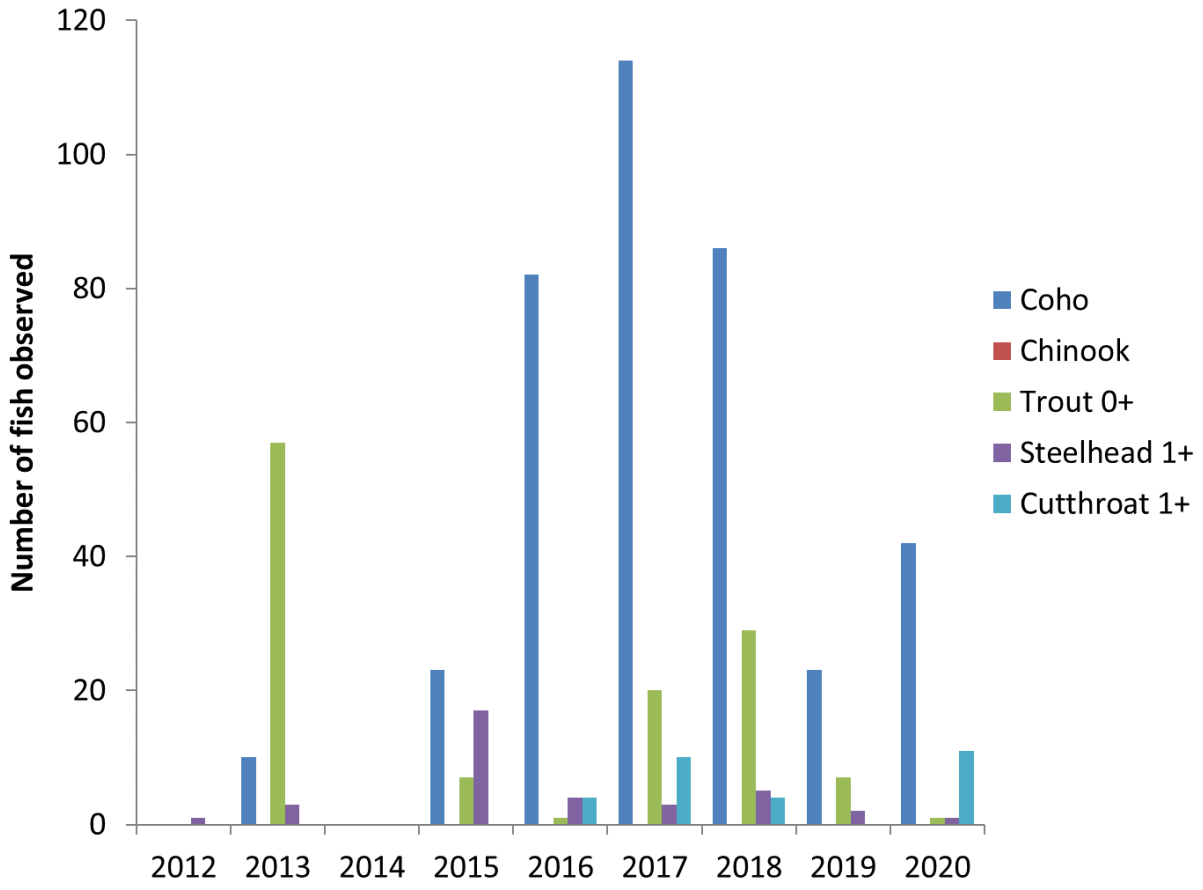



**Figure 27. Results of annual snorkel survey fish counts of the first 5 pools within the Little Freshwater Creek ATM 018 monitoring reach (2012-2020)**

## Summary of ATM Trends in the Freshwater Creek WAU

A summary of the Freshwater Creek habitat characteristics from 2020 is provided in an APFC report card (Table 13). Results of habitat composite scores from 2020 and 2017 are compared to baseline (2003) data (Figure 28). Overall, the greatest improvements in habitat composite scores were observed in bed surface, pool characteristics, and over stream canopy cover. The LWD piece frequency composite score remained zero, while stream temperature score remained 1.0 for the second straight survey year.

**Table 13. The most recent habitat measures for the Freshwater Creek WAU (2020)**

| Current Status | Parameter | Target Value (# no target) | 034 Freshwater Mainstem | 015 S. Fork Freshwater Cr | 200 Freshwater Mainstem | 019 Graham Gulch | 092 Cloney Gulch | 202 McCready Gulch | 018 Little Freshwater Cr |
|---|---|---|---|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 112 | 57 | 105 | 95 | 97 | 70 | 91 |
| | $D_{50}$ (mm) | 65-95 | 69 | 32 | 71 | 55 | 56 | 38 | 59 |
| | $D_{16}$ (mm) | # | 29 | 15 | 38 | 27 | 26 | 18 | 29 |
| | $D_{5}$ (mm) | # | 12 | 7 | 20 | 8 | 11 | 7 | 13 |
| Pool Characteristics | Pool Area (%) | ≥25 | 45 | 66 | 78 | 48 | 65 | 46 | 85 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.0 | 4.4 | 5.0 | 3.3 | 4.3 | 5.2 | 4.4 |
| | Residual Pool Depth (m) | ≥0.91 | 0.51 | 0.69 | 1.00 | 0.43 | 0.58 | 0.45 | 0.49 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 86 | 100 | 100 | 100 | 100 | 86 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | f(CW) | 1.15 | 5.66 | 0.44 | 2.67 | 2.78 | 1.53 | 1.56 |
| | Total Piece Count | # | 12 | 39 | 5 | 21 | 23 | 8 | 10 |
| Water Temperature | MWAT (°C) | ≤16.8 | 16.1 | 15.0 | 15.8 | 15.4 | 14.6 | 14.7 | 15.2 |
| Riparian Overstory | Canopy Over Stream (%) | f(CW) | 94 | 98 | 98 | 98 | 100 | 99 | 97 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | | |
| Watershed Area | Upstream Acreage | # | 5609 | 2019 | 7911 | 1588 | 2968 | 1084 | 2980 |
| Reach Gradient | Reach Gradient (%) | # | 0.9 | 1.7 | 0.4 | 1.4 | 0.9 | 2.3 | 0.8 |

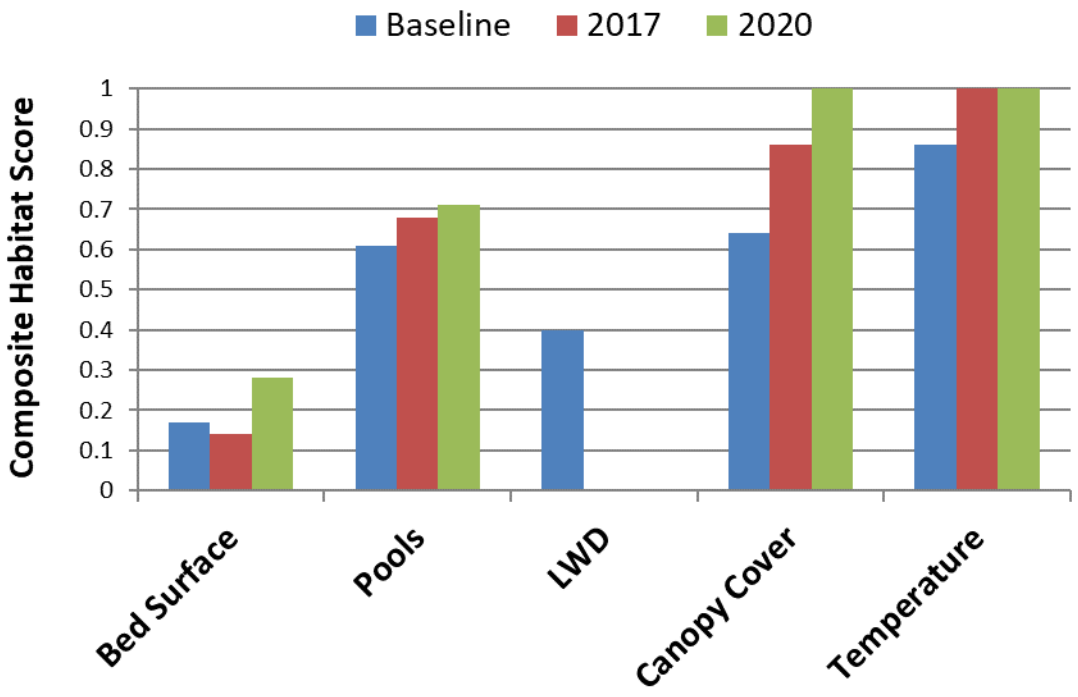



**Figure 28. The composite scores for habitat characteristics in the Freshwater Creek WAU in 2020 and 2017 relative to baseline (2003) data**

## ELK RIVER WAU

Elk River drains to the southern end of Humboldt Bay. It is comprised of a mainstem and two major forks, the South Fork and North Fork. HRC owns nearly all of the land in the North Fork Elk River. Ownership in the South Fork is shared with the Bureau of Land Management and Green Diamond Resource Company. HRC owns one small section of the mainstem below the confluence of these two forks, and several tributaries of South Fork Elk River on the lower and upper ends.

The upper Elk River watershed is underlain by four lithologic units: The Cretaceous aged Central belt of the Franciscan Complex, Cretaceous aged Yager terrane (Coastal belt of the Franciscan Complex), Quaternary – Tertiary aged undifferentiated Wildcat Group, and the Quaternary aged Hookton Formation. Franciscan Complex materials including Yager terrane are generally situated east of the Freshwater Fault in upper portions of the watershed, while Wildcat Group sediments are more extensive and underlie a majority of the middle and lower reaches of the North and South Fork Elk River basins. Hookton Formation sediments are restricted to upland areas in McCloud, Shaw, Clapp, and Railroad Gulches, which are all tributaries to the lower sections of the South Fork Elk River.

Bedrock (principally undifferentiated Wildcat Group sediments) underlying the two lowest active ATM stations (166 and 175) is mapped as being covered with a variably thick veneer of Holocene age alluvium. This package of material includes present-day, in-channel alluvial sediments and older stream terrace deposits.

Bedrock in the Elk River watershed is commonly separated into two distinct substrate groups: “hard” (all Franciscan Complex bedrock) and “soft” (Wildcat Group and Hookton Formation sediments). Group differentiation is based on bedrock/soil properties such as hardness, texture, structure, permeability, and erodibility. The response of these properties to mechanical/chemical weathering can and does influence topographic relief, erosion rates, vegetation, mass-wasting, sediment supply, and geomorphological processes of the fluvial systems within this watershed.

Consequently, there is often a recognizable difference in sediment transport, channel hydraulics, and slope evolution between the landscapes underlain by “hard” and “soft” substrates. For example, drainages underlain by “soft” substrate sediments are commonly associated with low to moderate relief, higher erosion and slope instability rates, and springs. These variations in the response of the physical landscape between the substrate groups result, especially in reaches downstream of Hookton Formation deposits, in the inability of some ATMs to achieve APFC standards as they related to sediment.

Figure 29 shows the location of the 7 active ATM stations in Elk River. Figure 30 shows typical site conditions at each of the seven stations surveyed in 2020. Variation and influence of underlying geology, and the presence of Holocene age alluvium at the lower monitoring reaches (ATM 166 and 175), can be seen in the photographs.

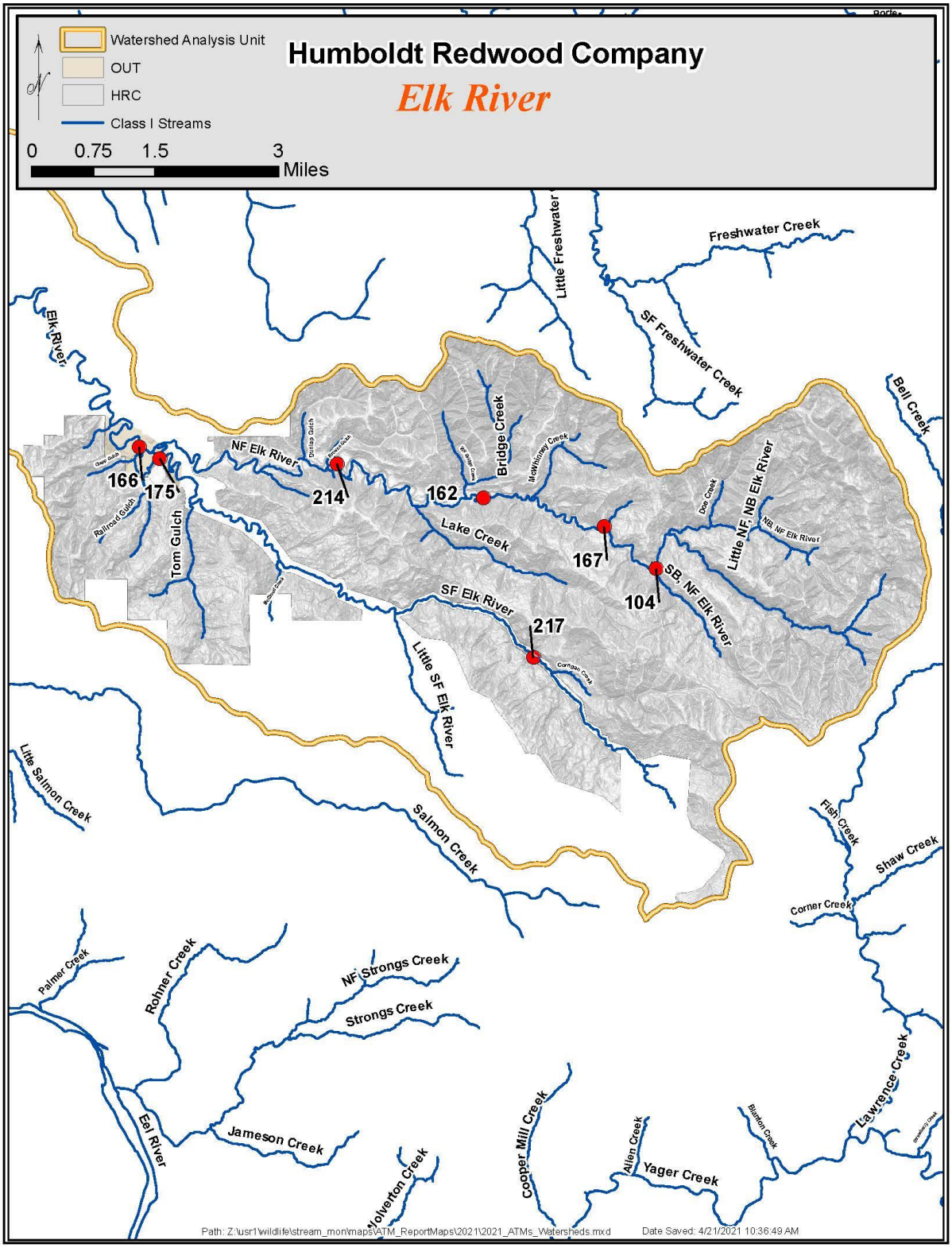
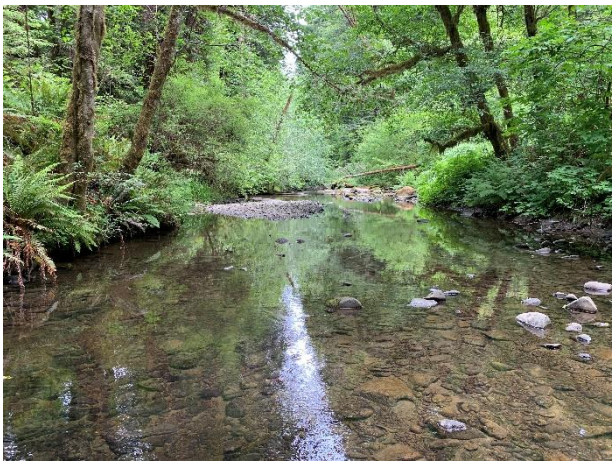



**Figure 29. Location map of ATM stations in the Elk River WAU**

**NF Elk River 167**



**NF Elk River 162**

**NF Elk River 214**

**SF Elk River 217**

**SF Elk River 175**

**Elk River 166**

**Figure 30. ATM Station within the Elk River WAU**

## ATM Station 167 – NF Elk River [Underlying Geology: Yager Terrane]

Data for all ATM parameters at site 167 (Figure 30) are summarized in the APFC report card found in Table 14. The bed surface target was not met in 2020, though the data suggest a slight coarsening of the $D_{50}$ and $D_{84}$ substrate particle size classes (Figure 31). Pool characteristics suggest stable habitat conditions since 2014 despite residual pool depth failing to meet its target for the fourteenth consecutive survey year. Total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 100% since 2017. Water temperature met the target for the fourteenth consecutive survey year, as mid-channel canopy cover met its target the sixth consecutive survey year since 2010.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 4 (-0.57$m^2$). The greatest degree of channel scour occurred at cross-section 5 where the channel area increased +0.46$m^2$.

A snorkel survey conducted on 6/12/2020 identified juvenile coho salmon and steelhead trout of various size classes in each of the five pools sampled (Figure 32). No other aquatic organisms were identified in the reach.

**Table 14. Individual site report card for ATM station 167, NF Elk River (2002-2020)**

| **Site 167 North Fork Elk River** | **Parameter** | **Target Value** (# no target) | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 251 | 218 | 189 | 148 | 216 | 150 | 262 | 146 | 181 | 247 | | 126 | 103 | | | 89 | | | 99 |
| | $D_{50}$ (mm) | 65-95 | 69 | 67 | 45 | 42 | 38 | 22 | 44 | 25 | 68 | 65 | | 51 | 44 | | | 47 | | | 52 |
| | $D_{16}$ (mm) | # | 14 | 10 | 11 | 11 | 3 | 3 | 1 | 6 | 9 | 17 | | 4 | 14 | | | 18 | | | 16 |
| | $D_{5}$ (mm) | # | 4 | 1 | 1 | 4 | 1 | 1 | 1 | 2 | 3 | 3 | | 1 | 4 | | | 4 | | | 4 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 46 | 40 | 27 | 44 | 22 | 30 | 15 | 52 | 37 | 23 | | 20 | 32 | | | 37 | | | 28 |
| | Pool Spacing (CW/pool) | ≤6.0 | 3.7 | 3.4 | 2.0 | 1.5 | 3.8 | 3.5 | 6.9 | 1.7 | 5.9 | 3.4 | | 5.0 | 3.0 | | | 3.0 | | | 3.0 |
| | Residual Pool Depth (m) | ≥0.91 | 0.47 | 0.66 | 0.54 | 0.44 | 0.65 | 0.68 | 0.59 | 0.49 | 0.50 | 0.57 | | 0.59 | 0.50 | | | 0.54 | | | 0.45 |
| | Pools Assoc. w/wood (%) | ≥50 | 71 | 88 | 87 | 69 | 50 | 100 | 67 | 58 | 63 | 89 | | 83 | 80 | | | 70 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥3.60 | 2.19 | 11.17 | 9.50 | 15.55 | 6.23 | 8.50 | 2.68 | 6.76 | 7.59 | 4.55 | | 5.90 | 5.00 | | | 5.70 | | | 2.85 |
| | Total Piece Count | # | 62 | 137 | 140 | 119 | 70 | 91 | 50 | 75 | 76 | 66 | | 85 | 72 | | | 82 | | | 41 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | | | | | 15.9 | 16.2 | 15.0 | 15.0 | 14.0 | 14.2 | 14.2 | 15.9 | 15.5 | 16.2 | 15.0 | 16.2 | 15.4 | | 15.6 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥89 | 89 | 89 | 88 | 73 | 81 | 73 | 88 | 81 | 89 | 90 | | 92 | 91 | | | 95 | | | 97 |
| | Canopy of Rip Forest (%) | ≥85 | 94 | 96 | 99 | 100 | 98 | | | | | 95 | | 97 | 93 | | | | | | |

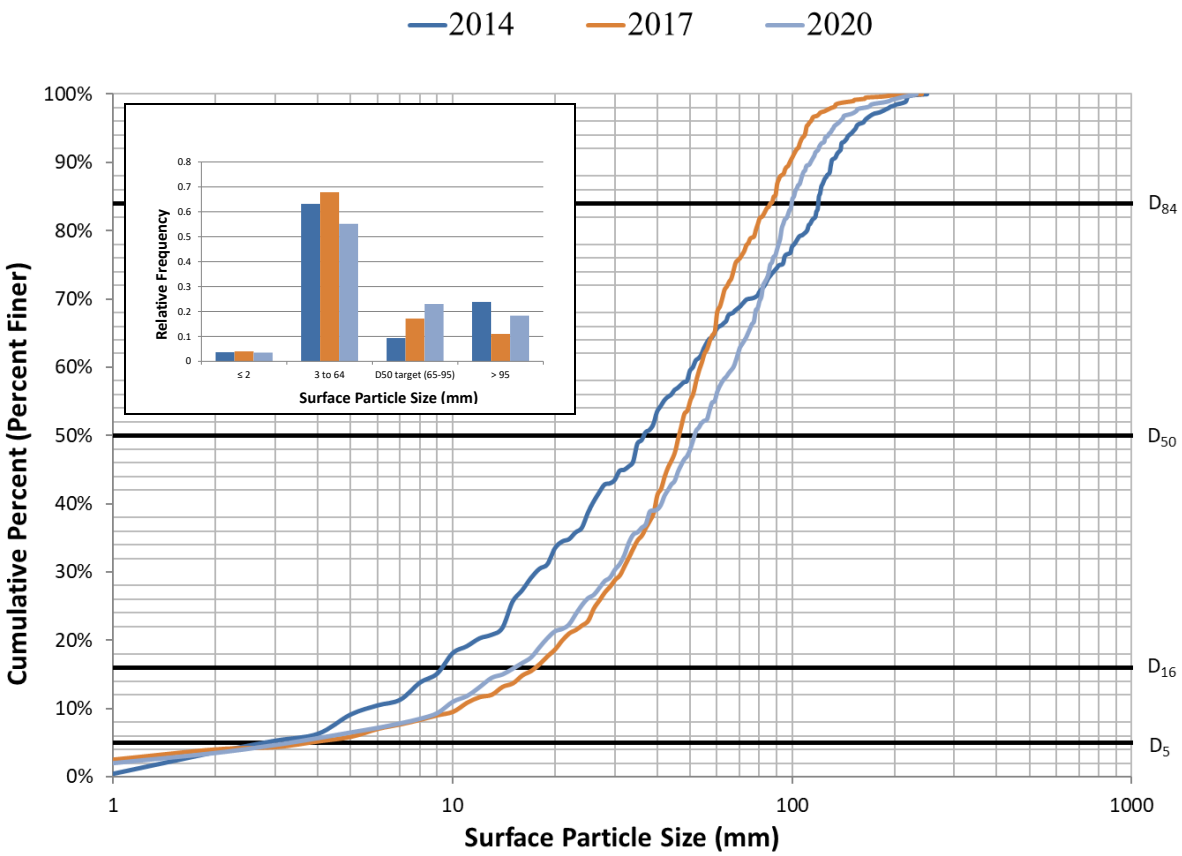



**Figure 31. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 167 survey reach (2014-2020)**

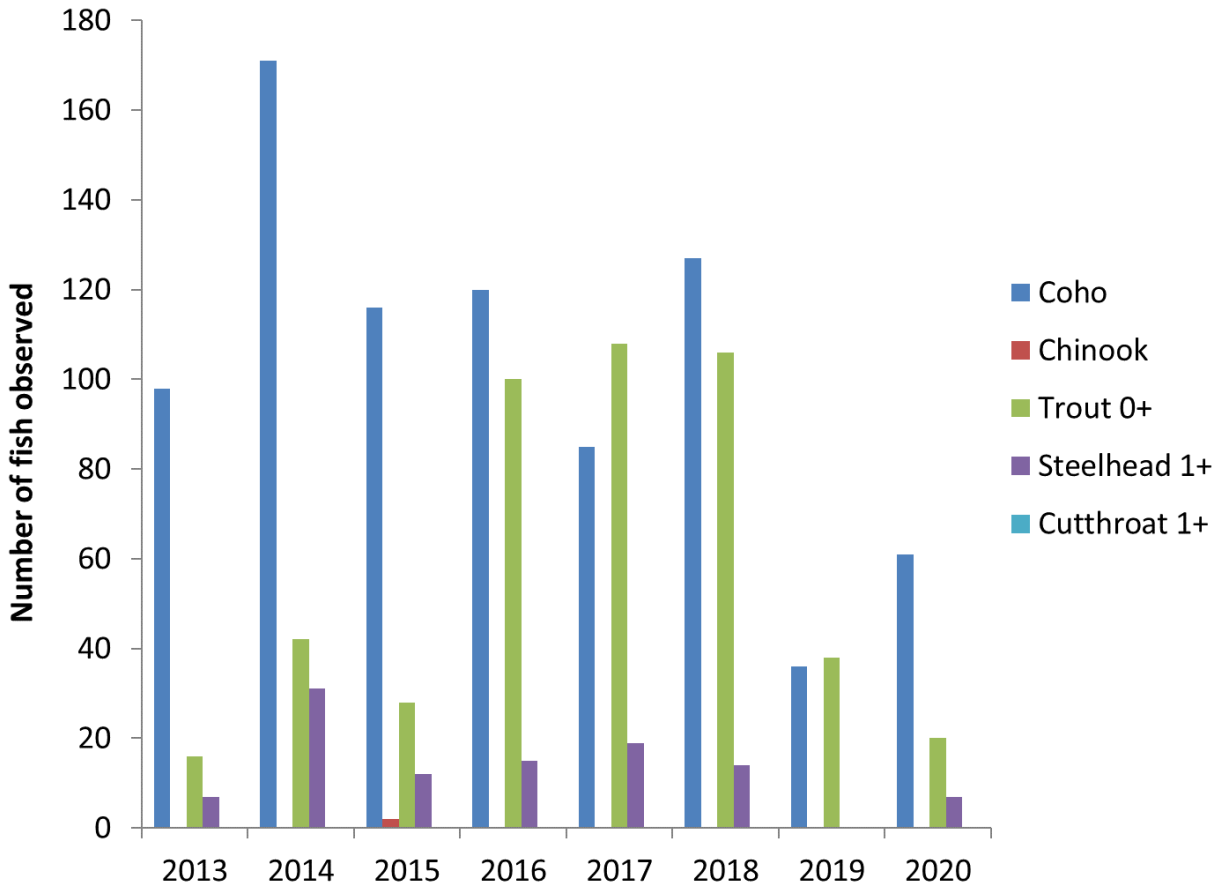



**Figure 32. Results of annual snorkel survey fish counts of the first 5 pools within the NF Elk River ATM 167 monitoring reach (2013-2020)**

## ATM Station 162 – NF Elk River [Underlying Geology: Yager Terrane / Wildcat Group]

Data for all ATM parameters at site 162 (Figure 30) are summarized in the APFC report card found in Table 15. The bed surface target was met in 2020 for the first time since 2003, as the data suggest a coarsening of the substrate across all particle size classes (Figure 33). Pool characteristics suggest stable habitat conditions despite residual pool depth failing to reach its target for the seventh consecutive survey year. Total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 144% since 2017. Water temperature met the target for the seventh consecutive year, as mid-channel canopy cover met its target for the second straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1998 (see appendix). Aggradation was observed at 4/6 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 4 (-0.61$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +1.82$m^2$.

A snorkel survey conducted on 6/12/2020 identified juvenile coho salmon and steelhead trout of various size classes in most of the five pools sampled (Figure 34). Also identified in the reach were foothill yellow-legged frogs.

**Table 15. Individual site report card for ATM station 162, NF Elk River (2003-2020)**

| **Site 162 North Fork Elk River** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 144 | 122 | 104 | 132 | 133 | 147 | 131 | 87 | 116 | | 105 | 113 | | | 102 | | | 104 |
| | $D_{50}$ (mm) | 65-95 | 72 | 40 | 41 | 46 | 44 | 62 | 59 | 44 | 53 | | 49 | 41 | | | 62 | | | 65 |
| | $D_{16}$ (mm) | # | 27 | 4 | 7 | 3 | 3 | 7 | 19 | 23 | 26 | | 13 | 11 | | | 27 | | | 30 |
| | $D_5$ (mm) | # | 6 | 1 | 1 | 1 | 1 | 1 | 7 | 9 | 11 | | 2 | 4 | | | 6 | | | 14 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 38 | 36 | 31 | 25 | 31 | 27 | 70 | 42 | 53 | | 24 | 37 | | | 51 | | | 43 |
| | Pool Spacing (CW/pool) | ≤6.0 | 7.1 | 5.6 | 7.0 | 8.4 | 7.1 | 7.7 | 2.9 | 2.0 | 3.8 | | 7.3 | 6.0 | | | 2.8 | | | 3.3 |
| | Residual Pool Depth (m) | ≥0.91 | 0.63 | 0.63 | 0.59 | 0.75 | 0.92 | 0.93 | 0.61 | 0.61 | 0.67 | | 0.86 | 0.58 | | | 0.62 | | | 0.61 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 60 | 75 | 67 | 67 | 67 | 44 | 60 | 63 | | 50 | 80 | | | 64 | | | 89 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥5.44 | 5.85 | 6.53 | 4.52 | 2.25 | 5.30 | 3.80 | 6.40 | 9.60 | 3.80 | | 5.40 | 5.40 | | | 3.10 | | | 1.31 |
| | Total Piece Count | # | 70 | 80 | 50 | 20 | 45 | 35 | 65 | 83 | 54 | | 74 | 74 | | | 44 | | | 18 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | | | | | | | 16.3 | 15.4 | 16.1 | 15.3 | 17.6 | 16.8 | 16.1 | 16.3 | 16.5 | 15.8 | 16.5 | 16.0 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 81 | 88 | 86 | 82 | 62 | 85 | 91 | 71 | 90 | | 85 | 88 | | | 93 | | | 94 |
| | Canopy of Rip Forest (%) | ≥85 | 92 | 96 | | | | | | | 97 | | 93 | 95 | | | | | | |

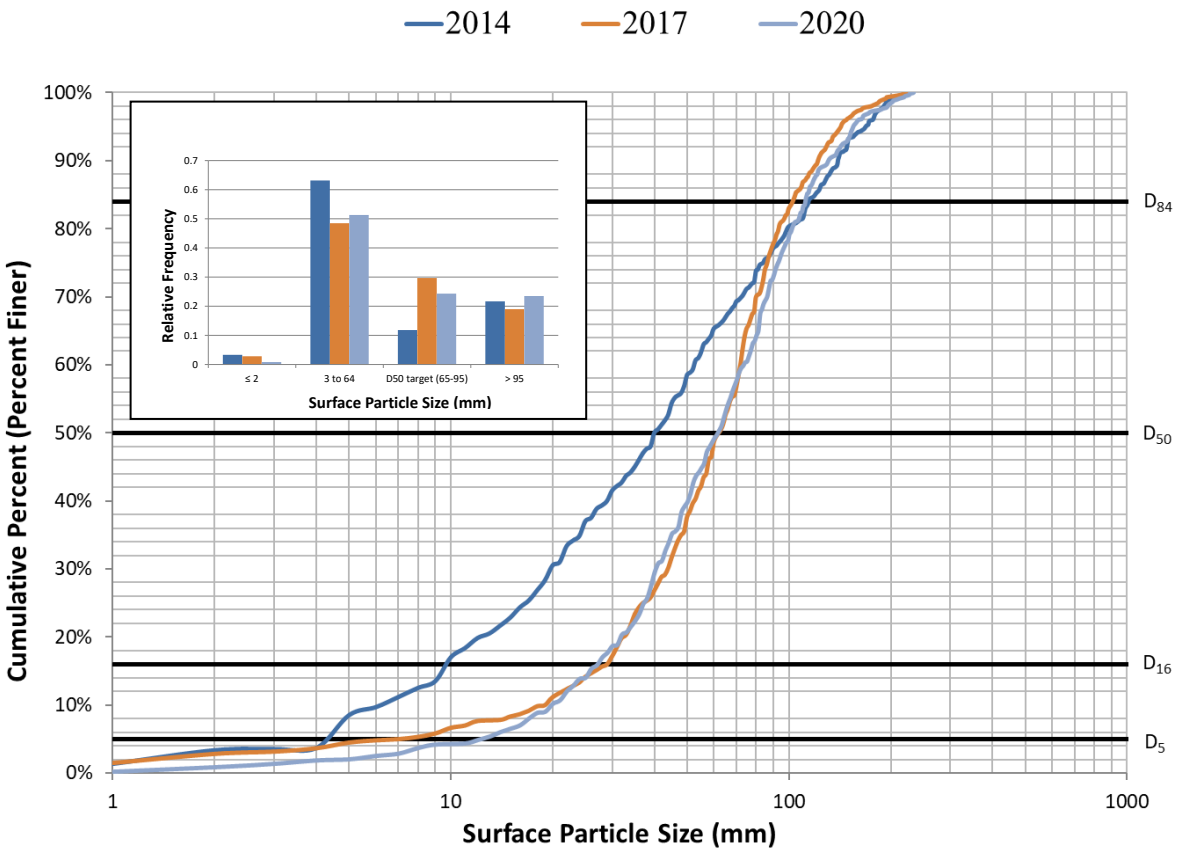



**Figure 33. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 162 survey reach (2014-2020)**

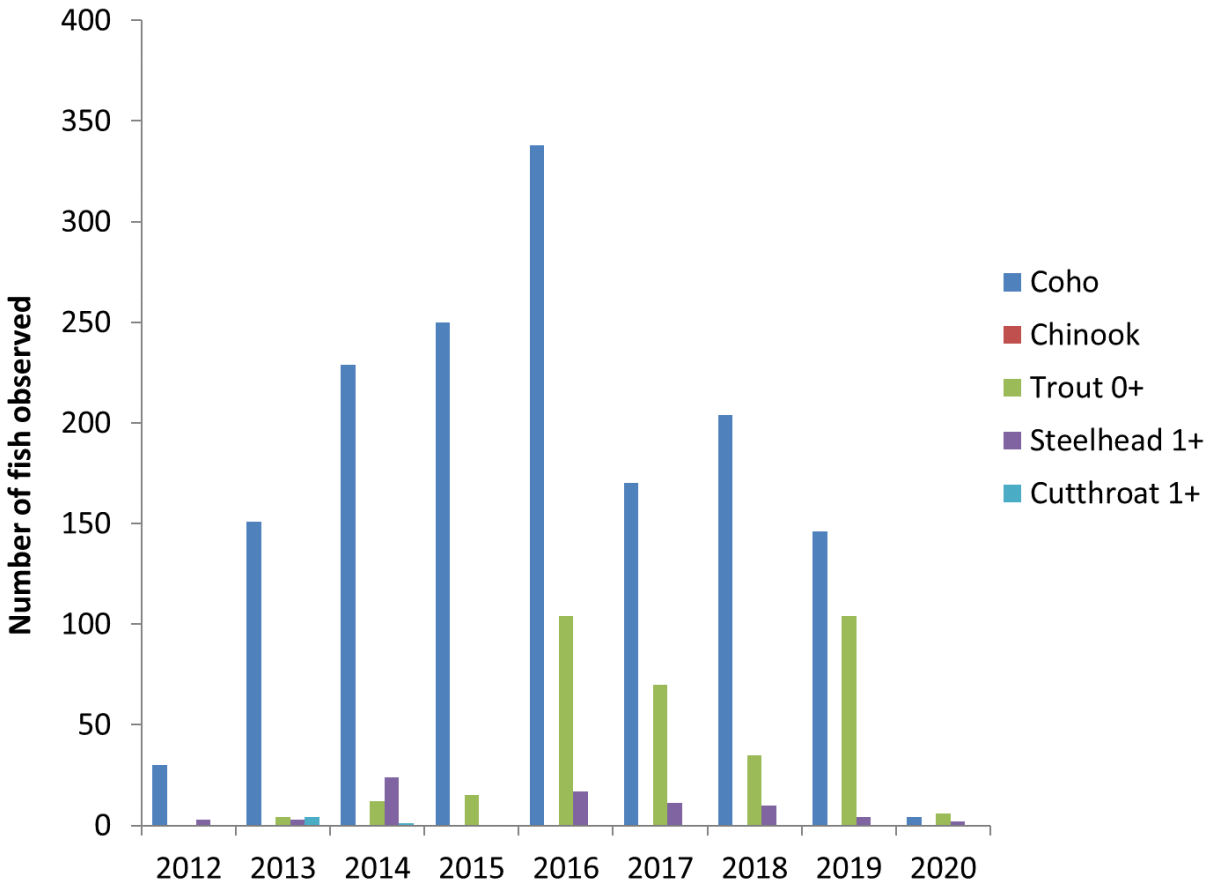



**Figure 34. Results of annual snorkel survey fish counts of the first 5 pools within the NF Elk River ATM 167 monitoring reach (2012-2020)**

## ATM Station 214 – NF Elk River [Underlying Geology: Wildcat Group]

Data for all ATM parameters at site 214 (Figure 30) are summarized in the APFC report card found in Table 16. The bed surface APFC target was not met in 2020, as the data suggest a fining of the substrate across most particle size classes (Figure 35). Pool characteristics suggest favorable habitat conditions, scoring successes across all four measured parameters. Total LWD piece frequency within the survey reach did not meet the APFC target, as total LWD pieces decreased 131% since 2017. Water temperature met the target after not meeting the target in 2019, as mid-channel canopy cover met its target for the second straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 3/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 5 (-1.25$m^2$). The greatest degree of channel scour occurred at cross-section 2 where the channel area increased +4.37$m^2$.

A snorkel survey conducted on 6/11/2020 identified juvenile coho salmon and steelhead trout of various size classes in each of the five pools sampled (Figure 36). Also identified in the reach were threespine stickleback and foothill yellow-legged frogs.

**Table 16. Individual site report card for ATM station 214, NF Elk River (2005-2020)**

| **Site 214 North Fork Elk River** | **Parameter** | **Target Value** (# no target) | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 38 | 36 | 39 | 33 | 43 | 53 | 52 | | 30 | 30 | | | 52 | | | 53 |
| | $D_{50}$ (mm) | 65-95 | 19 | 16 | 19 | 15 | 22 | 30 | 33 | | 14 | 15 | | | 38 | | | 33 |
| | $D_{16}$ (mm) | # | 1 | 3 | 6 | 3 | 9 | 12 | 16 | | 6 | 6 | | | 21 | | | 13 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | 1 | 3 | 3 | 6 | | 3 | 3 | | | 12 | | | 6 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 82 | 41 | 83 | 67 | 84 | 54 | 85 | | 46 | 37 | | | 85 | | | 81 |
| | Pool Spacing (CW/pool) | ≤6.0 | 3.7 | 5.4 | 3.0 | 6.3 | 5.2 | 7.4 | 5.1 | | 4.8 | 6.0 | | | 3.5 | | | 4.5 |
| | Residual Pool Depth (m) | ≥0.91 | 0.59 | 0.90 | 0.86 | 1.06 | 1.04 | 0.71 | 0.83 | | 0.96 | 0.90 | | | 1.13 | | | 1.08 |
| | Pools Assoc. w/wood (%) | ≥50 | 86 | 80 | 86 | 100 | 100 | 80 | 100 | | 100 | 100 | | | 89 | | | 86 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥4.74 | 5.30 | 2.52 | 4.00 | 2.30 | 4.70 | 1.70 | 1.90 | | 6.10 | 5.40 | | | 4.40 | | | 1.96 |
| | Total Piece Count | # | 54 | 30 | 45 | 26 | 39 | 20 | 20 | | 72 | 80 | | | 67 | | | 29 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 16.7 | 17.6 | 18.6 | 16.3 | 15.9 | 16.1 | 15.8 | 15.4 | | 16.0 | 16.3 | 15.8 | 16.8 | 16.4 | 17.3 | 16.1 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 60 | 73 | 58 | 92 | 74 | 74 | 88 | | 75 | 82 | | | 92 | | | 92 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | | 97 | | 97 | 93 | | | | | | |

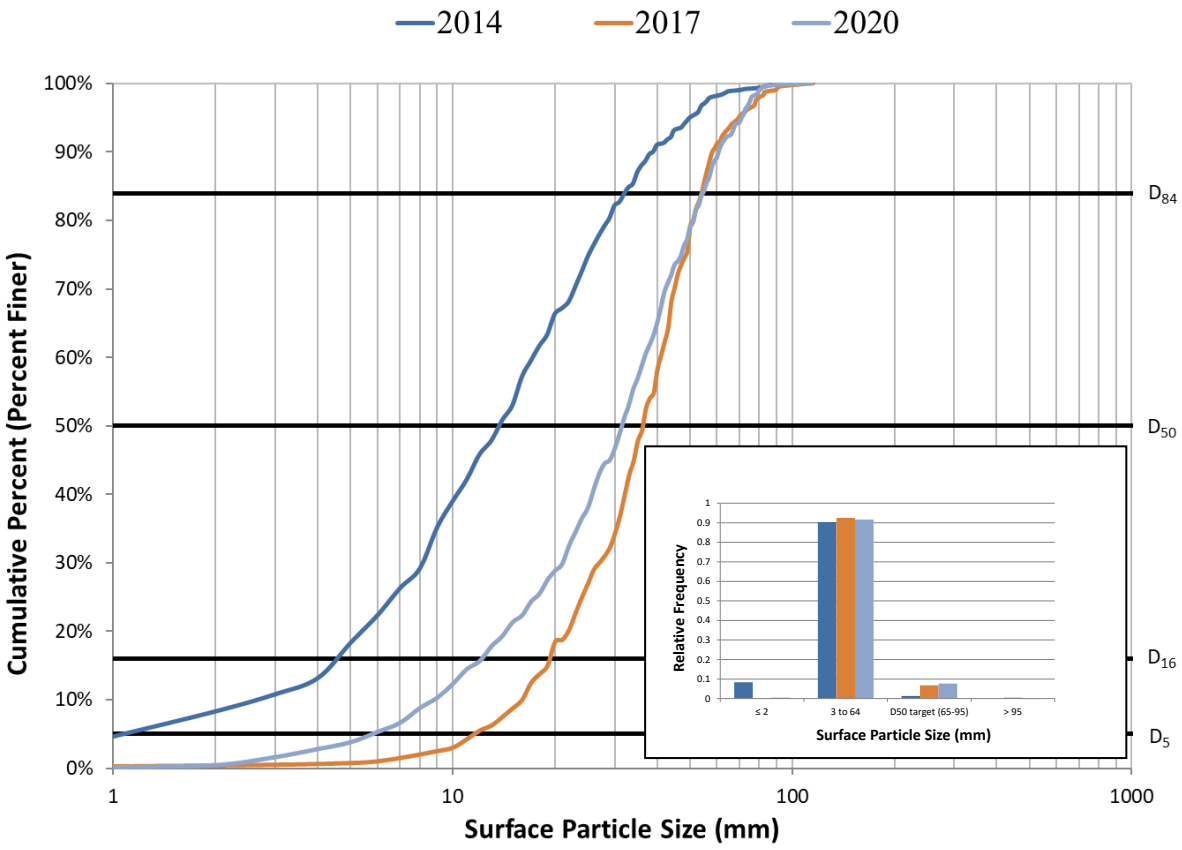



**Figure 35. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 214 survey reach (2014-2020)**

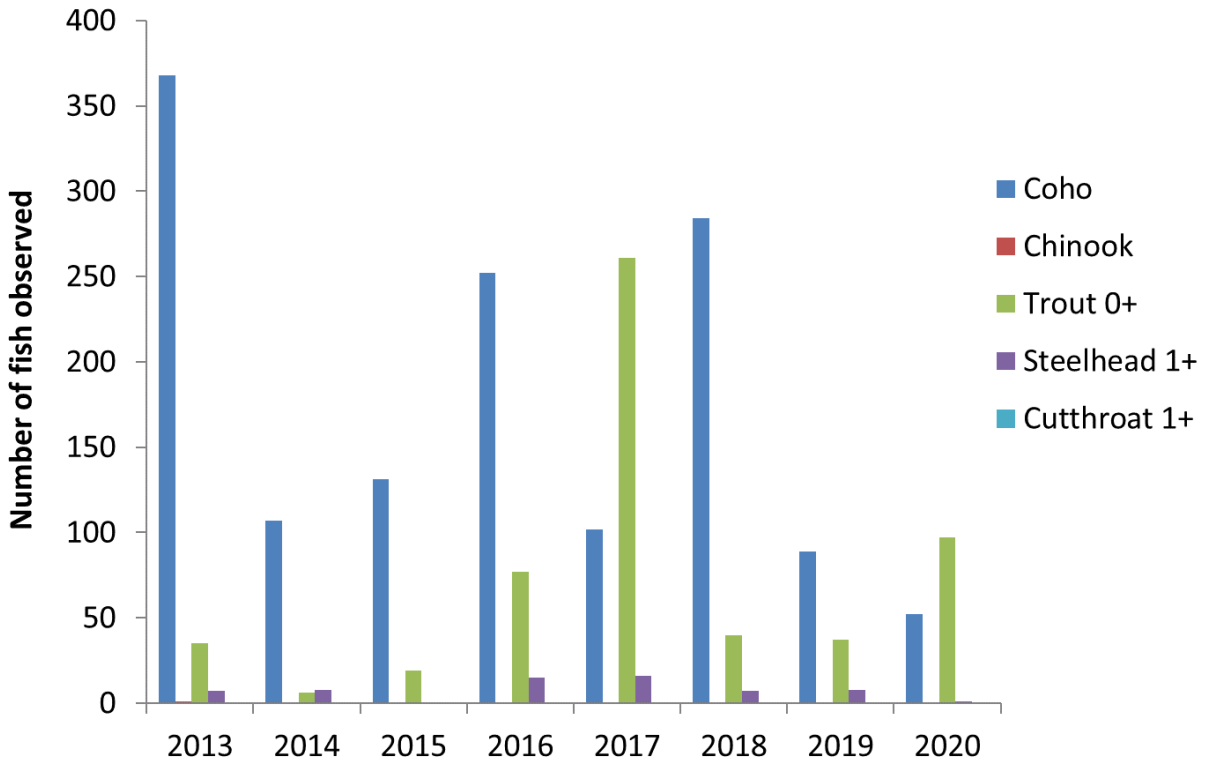



**Figure 36. Results of annual snorkel survey fish counts of the first 5 pools within the NF Elk River ATM 214 monitoring reach (2013-2020)**

## ATM Station 217 – SF Elk River [Underlying Geology: Yager Terrane]

Data for all ATM parameters at site 217 (Figure 30) are summarized in the APFC report card found in Table 17. The bed surface APFC target was met in 2020, as the data suggest a coarsening of the $D_{50}$ and $D_{84}$ substrate particle size classes (Figure 37). Pool characteristics suggest stable habitat conditions despite residual pool depth remaining below its target for the seventh consecutive survey year. Total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 39% since 2017. Water temperature met the target for the sixteenth consecutive year, as mid-channel canopy cover met the target for the tenth consecutive survey year since 2006.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 3 (-0.36$m^2$). The greatest degree of channel scour occurred at cross-section 2 where the channel area increased +0.67$m^2$.

A snorkel survey conducted on 6/16/2020 identified juvenile trout (Figure 38). Neither juvenile coho salmon nor age 1+ steelhead trout were observed in any of the five pools sampled. Also identified were pacific giant salamanders and tailed frogs.

**Table 17. Individual site report card for ATM station 217, SF Elk River (2005-2020)**

| **Site 217 South Fork Elk River** | **Parameter** | **Target Value** (# no target) | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 121 | 147 | 141 | 159 | 110 | 144 | 185 | | 120 | 132 | | | 100 | | | 116 |
| | $D_{50}$ (mm) | 65-95 | 38 | 51 | 50 | 48 | 35 | 66 | 59 | | 56 | 49 | | | 60 | | | 66 |
| | $D_{16}$ (mm) | # | 7 | 6 | 10 | 2 | 10 | 17 | 17 | | 13 | 12 | | | 34 | | | 30 |
| | $D_5$ (mm) | # | 1 | 2 | 1 | 1 | 3 | 4 | 1 | | 10 | 4 | | | 15 | | | 14 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 42 | 39 | 45 | 46 | 56 | 41 | 51 | | 55 | 55 | | | 60 | | | 55 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.2 | 6.2 | 4.9 | 6.3 | 3.7 | 4.3 | 5.1 | | 4.6 | 4.3 | | | 3.5 | | | 3.9 |
| | Residual Pool Depth (m) | ≥0.91 | 0.81 | 0.98 | 0.93 | 0.94 | 0.79 | 0.76 | 0.89 | | 0.81 | 0.87 | | | 0.65 | | | 0.69 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | 86 | 80 | 100 | 83 | | 67 | 71 | | | 78 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥7.15 | 10.68 | 4.72 | 8.70 | 4.00 | 5.40 | 6.70 | 4.60 | | 5.80 | 6.50 | | | 5.10 | | | 3.77 |
| | Total Piece Count | # | 123 | 52 | 89 | 41 | 61 | 73 | 36 | | 51 | 57 | | | 46 | | | 33 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 15.3 | 16.3 | 14.1 | 14.0 | 13.7 | 14.5 | 13.2 | 13.1 | 14.7 | 14.2 | 15.3 | 13.8 | 15.9 | 14.1 | 15.0 | 15.0 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | | 100 | 91 | 99 | 99 | 91 | 98 | | 98 | 94 | | | 98 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | 99 | 98 | | | | | 99 | | 99 | 96 | | | | | | |

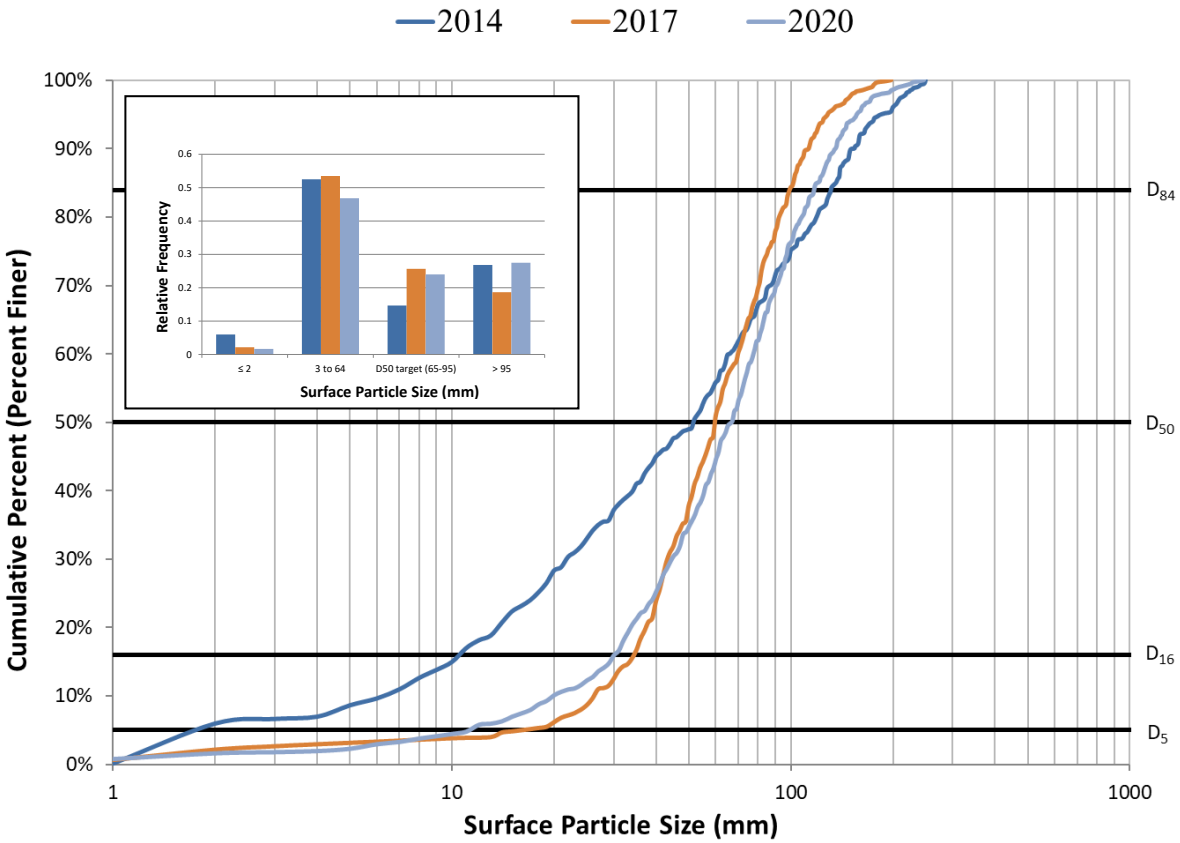



**Figure 37. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Elk River ATM 217 survey reach (2014-2020)**

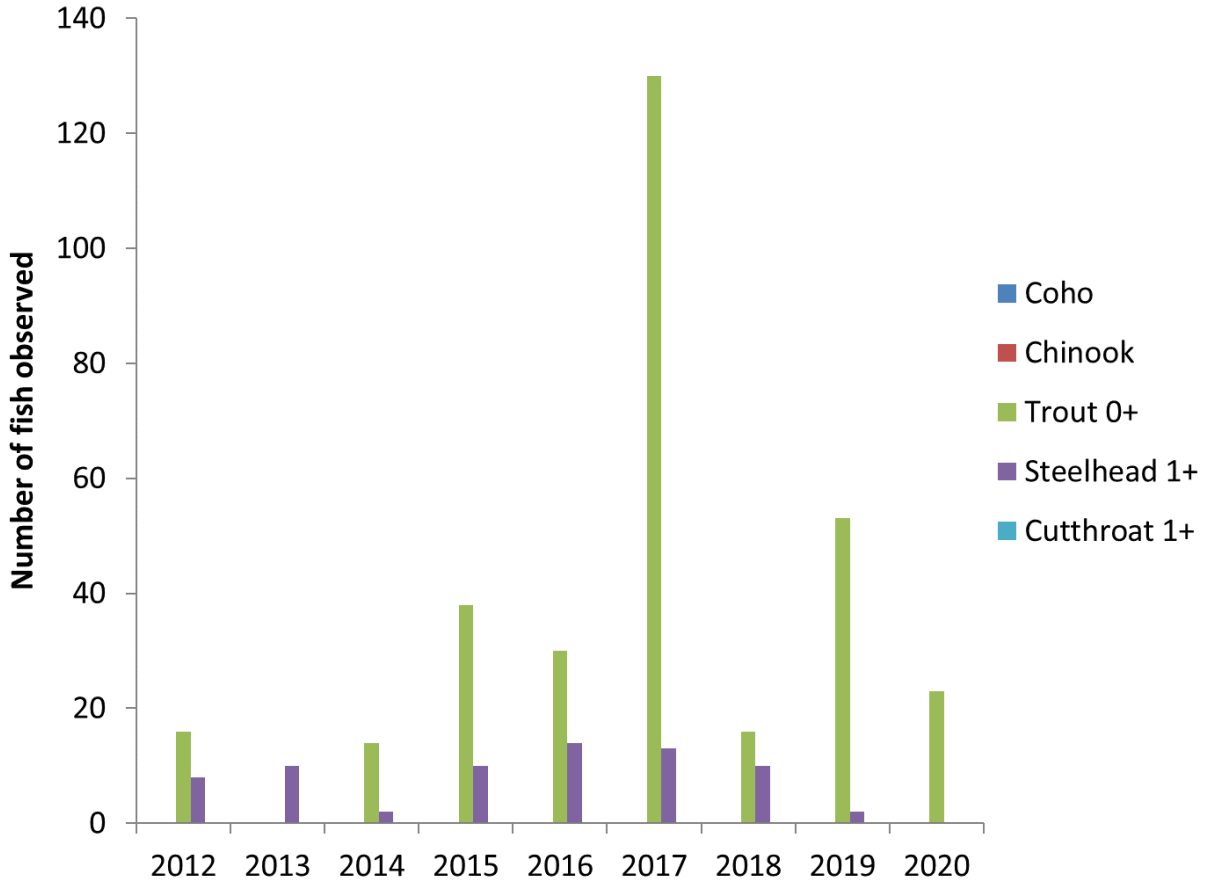



**Figure 38. Results of annual snorkel survey fish counts of the first 5 pools within the NF Elk River ATM 217 monitoring reach (2012-2020)**

## ATM Station 175 – SF Elk River [Underlying Geology: Holocene Alluvium / Wildcat Group]

Data for all ATM parameters at site 175 (Figure 30) are summarized in the APFC report card found in Table 18. The bed surface APFC target was not met in 2020, as the data suggest a slight fining of the substrate across most particle size classes (Figure 39). Pool characteristics suggest a slight improvement in habitat conditions, although pool spacing remained below the target for a second straight year. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 22% since 2017. Water temperature met the target in 2020, and mid-channel canopy cover has met the target for twelfth consecutive survey year since 2004.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2000 (see appendix). Aggradation was observed at 3/6 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 2 (-1.02$m^2$). The greatest degree of channel scour occurred at cross-section 4 where the channel area increased +4.1$m^2$.

A snorkel survey was attempted on 6/11/2020 but was determined infeasible due to high tannin levels. Although a formal survey was not conducted, juvenile coho salmon and other unidentified fish were observed in the shallow fringe water within the survey reach. 2014 and 2017 were the only recent survey years when conditions were suitable for snorkel counts (Figure 40).

**Table 18. Individual site report card for ATM station 175, SF Elk River (2003-2020)**

| **Site 175 South Fork Elk River** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 1 | 6 | 6 | 5 | 6 | 8 | 6 | 6 | 9 | | 2 | 5 | | | 12 | | | 10 |
| | $D_{50}$ (mm) | 65-95 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | | 1 | 1 | | | 7 | | | 6 |
| | $D_{16}$ (mm) | # | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | | 2 | | | 3 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | | 1 | | | 1 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 73 | 72 | 50 | 55 | 73 | 67 | 80 | 43 | 79 | | 42 | 66 | | | 40 | | | 46 |
| | Pool Spacing (CW/pool) | ≤6.0 | 8.2 | 6.2 | 6.2 | 5.6 | 4.4 | 7.2 | 4.9 | 11.2 | 5.4 | | 5.7 | 5.0 | | | 7.4 | | | 7.6 |
| | Residual Pool Depth (m) | ≥0.91 | 0.75 | 0.66 | 0.61 | 0.62 | 0.94 | 0.86 | 0.83 | 0.95 | 0.95 | | 0.81 | 0.81 | | | 0.77 | | | 1.10 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 80 | 67 | 80 | 100 | 75 | 80 | 100 | 100 | | 100 | 100 | | | 100 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥7.15 | 9.14 | 5.03 | 2.97 | 7.38 | 8.30 | 6.20 | 4.80 | 7.70 | 6.10 | | 6.40 | 4.60 | | | 2.90 | | | 2.36 |
| | Total Piece Count | # | 150 | 58 | 20 | 53 | 62 | 45 | 46 | 52 | 44 | | 47 | 45 | | | 28 | | | 23 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 17.1 | 16.0 | 16.4 | 16.3 | 17.8 | 15.7 | 15.4 | 14.9 | 15.1 | | 16.6 | 15.1 | 16.1 | 15.5 | 16.6 | 15.5 | 16.9 | 15.7 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 85 | 98 | 97 | 98 | 100 | 99 | 98 | 95 | 93 | | 96 | 93 | | | 97 | | | 99 |
| | Canopy of Rip Forest (%) | ≥85 | 85 | 98 | 76 | 97 | | | | | 93 | | 97 | 95 | | | | | | |

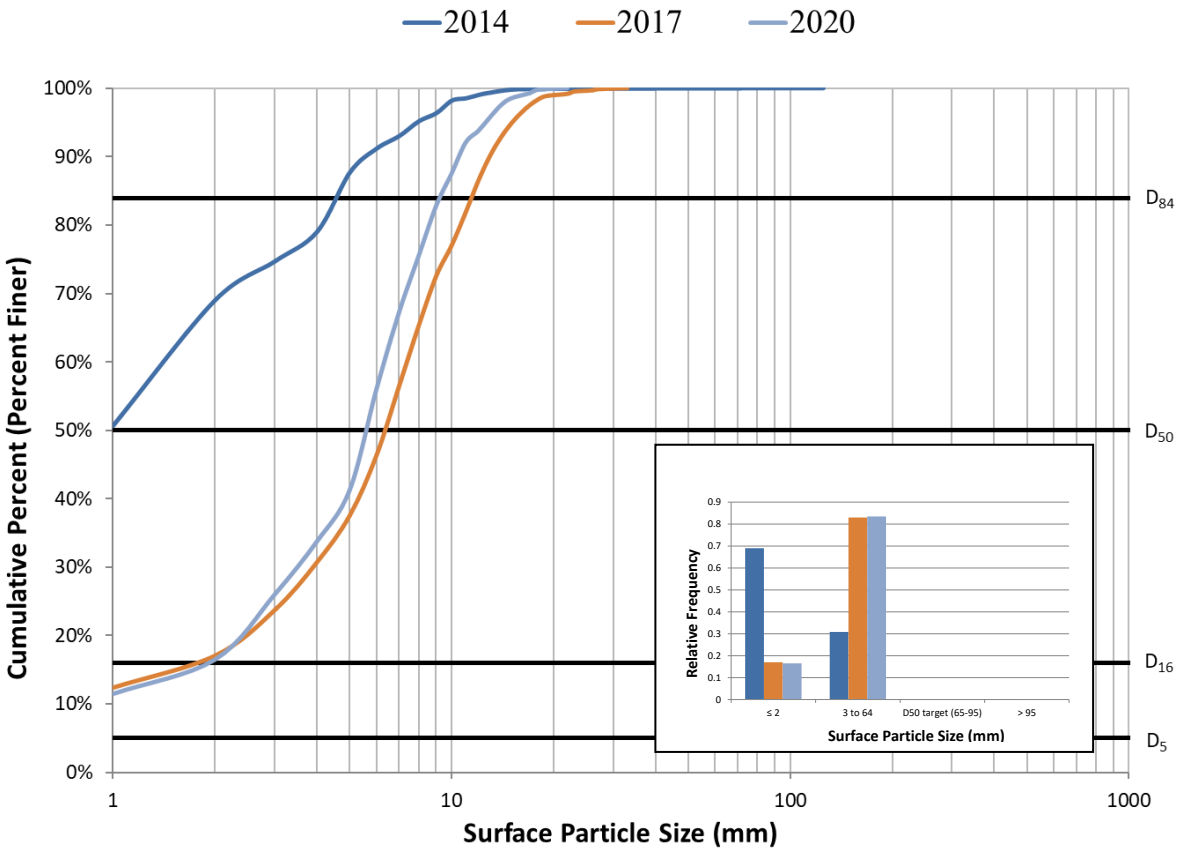



**Figure 39. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Elk River ATM 175 survey reach (2014-2020)**

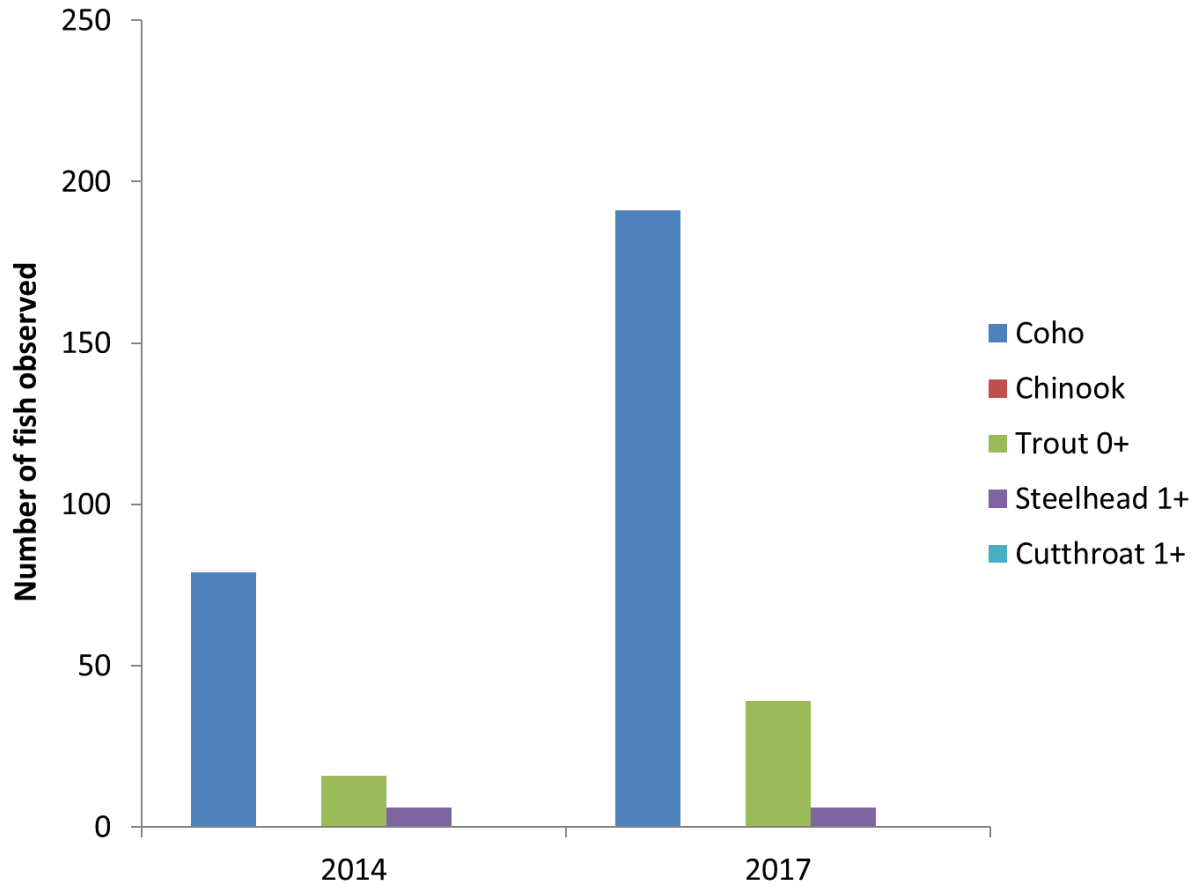



**Figure 40. Results of snorkel survey fish counts (when conditions allowed) of the first 5 pools within the NF Elk River ATM 175 monitoring reach (2014 & 2017)**

## ATM Station 166 – Mainstem Elk River [Underlying Geology: Holocene Alluvium / Wildcat Group]

Data for all ATM parameters at site 166 (Figure 30) are summarized in the APFC report card found in Table 19. The bed surface APFC target was not met in 2020, though the data suggest a slight coarsening of the substrate across most particle size classes (Figure 41). Pool characteristics suggest favorable habitat conditions, scoring successes across all four measured parameters. Total LWD piece frequency within the survey reach did not meet the target, as the total number of pieces decreased by 50% since 2017. Water temperature met the target for the twelfth consecutive survey year since 2008, as mid-channel canopy met the target after falling below the target in 2019.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1998 (see appendix). Aggradation was observed at 3/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 4 (-0.93$m^2$). The greatest degree of channel scour occurred at cross-section 2 where the channel area increased +4.58$m^2$.

A snorkel survey was attempted on 6/11/2020 but was determined infeasible due to high water tannin levels. Although a formal survey was not conducted, juvenile coho salmon and other unidentified fish were observed in the shallow fringe water within the survey reach. 2013, 2014, and 2018 were the only recent survey years when conditions were suitable for snorkel counts (Figure 42).

**Table 19. Individual site report card for ATM station 166, Mainstem Elk River (2003-2020)**

| **Site 166 Elk River Mainstem** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 7 | 5 | 7 | 6 | 11 | 9 | 7 | 7 | 7 | | 3 | 6 | | | 10 | | | 13 |
| | $D_{50}$ (mm) | 65-95 | 1 | 1 | 2 | 2 | 4 | 3 | 3 | 4 | 3 | | 1 | 2 | | | 6 | | | 7 |
| | $D_{16}$ (mm) | # | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | | 2 | | | 3 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | | 2 | | | 1 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 73 | 75 | 61 | 41 | 68 | 68 | 80 | 33 | 72 | | 36 | 78 | | | 70 | | | 71 |
| | Pool Spacing (CW/pool) | ≤6.0 | 9.5 | 10.0 | 5.7 | 7.6 | 5.3 | 4.4 | 3.4 | 8.6 | 4.5 | | 5.0 | 6.0 | | | 5.0 | | | 3.5 |
| | Residual Pool Depth (m) | ≥0.91 | 0.97 | 0.88 | 0.94 | 0.63 | 0.86 | 0.78 | 0.64 | 0.82 | 0.66 | | 0.70 | 0.95 | | | 0.92 | | | 1.00 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 67 | 100 | 100 | 100 | 80 | 100 | 89 | | 100 | 80 | | | 100 | | | 83 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥6.22 | 5.64 | 5.03 | 2.97 | 5.98 | 7.10 | 5.30 | 4.80 | 4.50 | 3.50 | | 6.80 | 4.30 | | | 4.60 | | | 3.12 |
| | Total Piece Count | # | 108 | 58 | 20 | 38 | 42 | 31 | 28 | 27 | 37 | | 50 | 64 | | | 69 | | | 46 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 16.8 | 17.1 | 16.7 | 16.2 | 18.1 | 15.7 | 15.5 | 14.9 | 15.2 | | 16.7 | 15.3 | 15.8 | 15.6 | 15.7 | 15.0 | 16.7 | 15.0 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 84 | 87 | 83 | 73 | 78 | 80 | 84 | 82 | 92 | | 98 | 92 | | | 88 | | | 95 |
| | Canopy of Rip Forest (%) | ≥85 | 82 | 95 | 99 | 95 | | | | | 94 | | 99 | 88 | | | | | | |

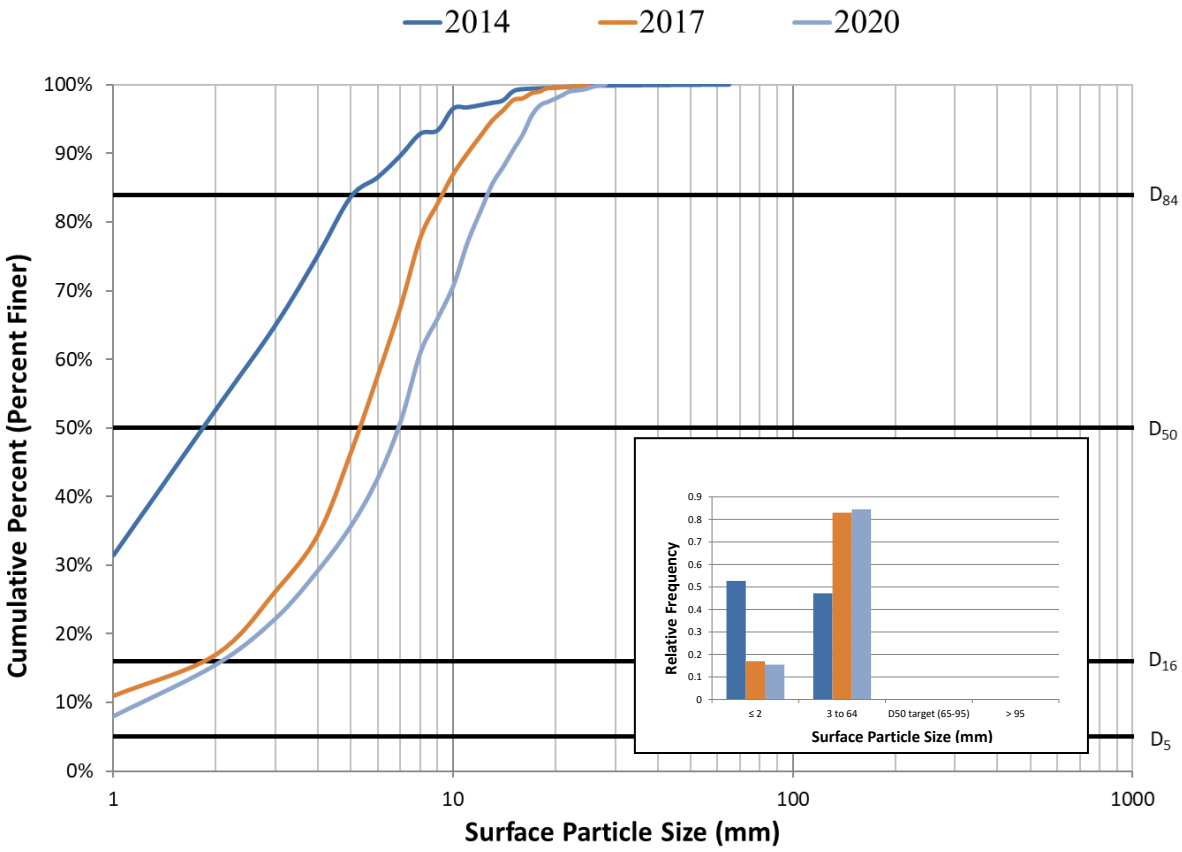



**Figure 41. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Mainstem Elk River ATM 166 survey reach (2014-2020)**

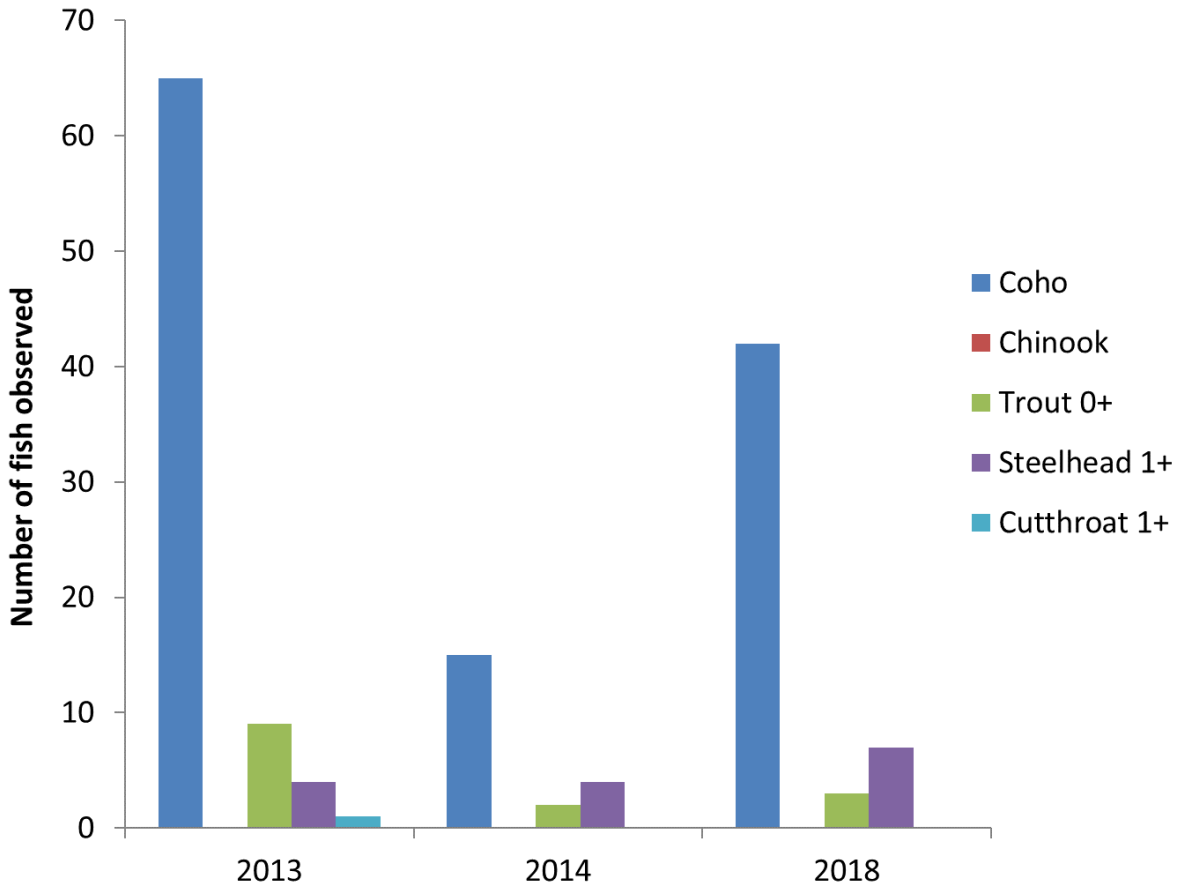



**Figure 42. Results of snorkel survey fish counts (when conditions allowed) of the first 5 pools within the NF Elk River ATM 166 monitoring reach (2013, 2014, & 2018)**

## Summary of ATM Trends in the Elk River WAU

A summary of the Elk River habitat characteristics from 2020 is provided in and APFC report card (Table 20). Results of habitat composite scores from 2020 and 2017 are compared to baseline (2003) data (Figure 43). Overall, the greatest improvements in habitat composite scores were observed in bed surface pool characteristics and mid-channel canopy cover. The LWD composite score remained at zero, while the stream temperature composite score remained at 1.0 for the second straight survey year.

**Table 20. The most recent habitat measures for the Elk River WAU (2020)**

| Current Status | Parameter | Target Value (# no target) | 167 North Fork Elk River | 162 North Fork Elk River | 214 North Fork Elk River | 104 SB N. Fork Elk River | 217 South Fork Elk River | 175 South Fork Elk River | 166 Mainstem Elk River |
|---|---|---|---|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 99 | 104 | 53 | | 116 | 10 | 13 |
| | $D_{50}$ (mm) | 65-95 | 52 | 65 | 33 | | 66 | 6 | 7 |
| | $D_{16}$ (mm) | # | 16 | 30 | 13 | | 30 | 3 | 3 |
| | $D_5$ (mm) | # | 4 | 14 | 6 | | 14 | 1 | 1 |
| Pool Characteristics | Pool Area (%) | ≥25 | 28 | 43 | 81 | | 55 | 46 | 71 |
| | Pool Spacing (CW/pool) | ≤6 | 3.0 | 3.3 | 4.5 | | 3.9 | 7.6 | 3.5 |
| | Residual Pool Depth (m) | ≥0.91 | 0.45 | 0.61 | 1.08 | | 0.69 | 1.10 | 1.00 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 89 | 86 | | 100 | 100 | 83 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | f(CW) | 2.85 | 1.31 | 1.96 | | 3.77 | 2.36 | 3.12 |
| | Total Piece Count | # | 41 | 18 | 29 | | 33 | 23 | 46 |
| Water Temperature | MWAT (°C) | ≤16.8 | 15.6 | 16.0 | 16.1 | 14.5 | 15.0 | 15.7 | 15.0 |
| Riparian Overstory | Canopy Over Stream (%) | f(CW) | 97 | 94 | 92 | | 98 | 99 | 95 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | | |
| Watershed Area | Upstream Acreage | # | 7230 | 8738 | 12302 | 1206 | 4030 | 12200 | 26393 |
| Reach Gradient | Reach Gradient (%) | # | 2.1 | 0.6 | 0.2 | 2.88 | 1.6 | 0 | 0.1 |

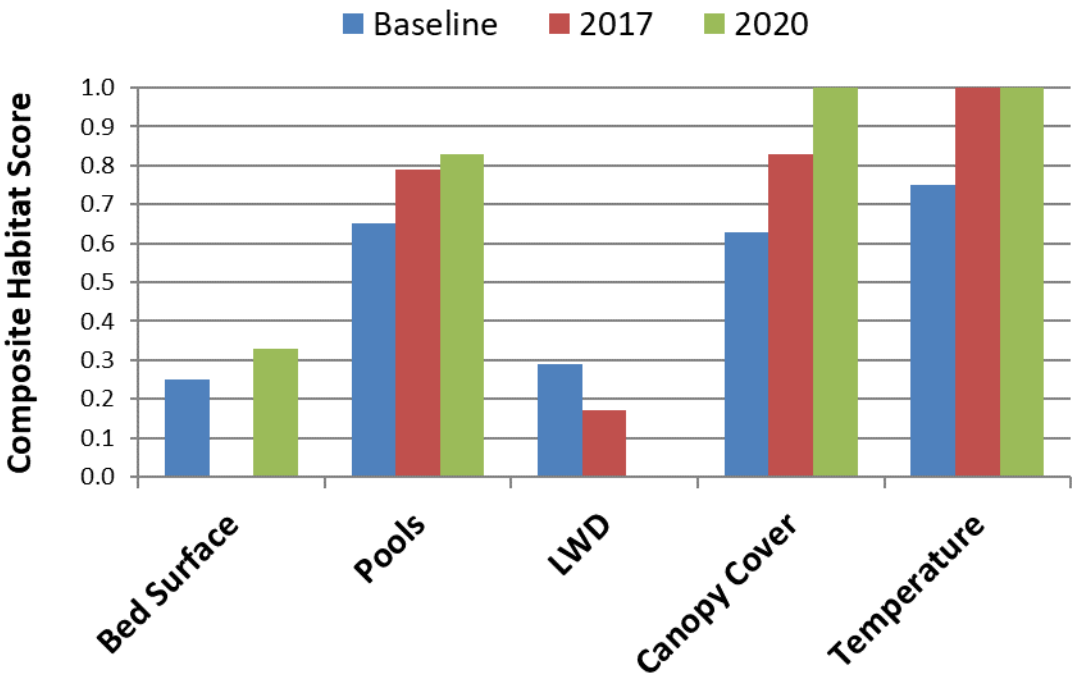



**Figure 43. The composite scores for habitat characteristics in the Elk River WAU in 2020 and 2017 relative to baseline (2003) data**

## Upper Eel River WAU

HRC has subdivided the Eel River WAU for purposes of Watershed Analysis. The Upper Eel WAU includes Larabee Creek and tributaries that drain directly to the Eel River upstream (south) of the confluence with Larabee Creek. Tributaries draining to the mainstem Eel River north of this location are included with the Lower Eel River and Eel River Delta WAU. There are five ATM habitat monitoring sites in the Upper Eel WAU. Two are located on the mainstem of Larabee Creek, and three are on tributaries to Larabee and the Middle Eel River. Figures 44 and 45 show the locations of ATM sites within the WAU. Typical site conditions are shown in Figure 46.

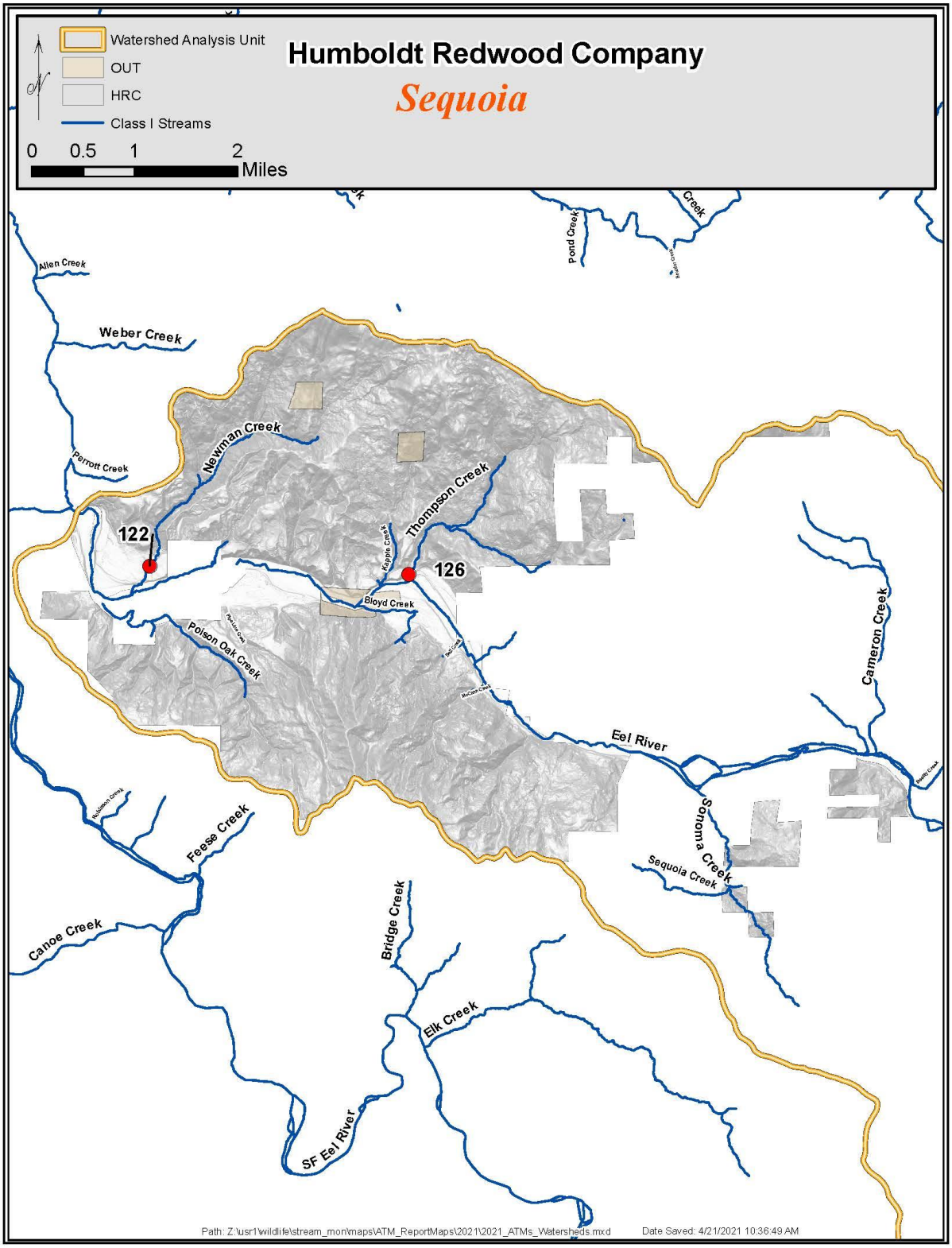



**Figure 44. Location map of ATM sites in the Upper Eel WAU**

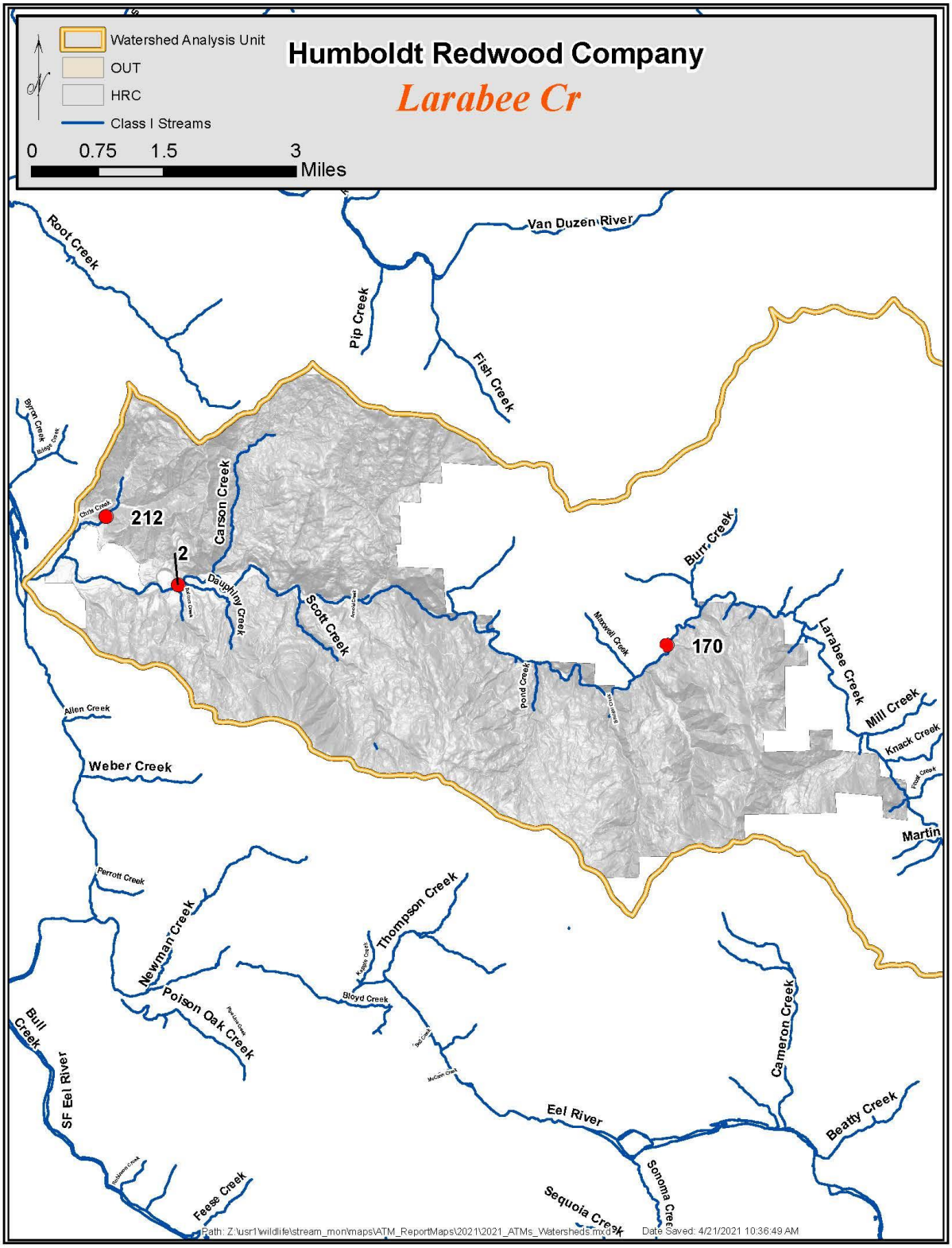



**Figure 45. Location map of ATM sites in Larabee Creek /Upper Eel WAU**

**Thompson Creek 126**

**Newman Creek 122**

**Larabee Creek 002**

**Chris Creek 212**

**Larabee Creek 170**

**Figure 46. ATM stations within the Upper Eel River WAU**

## ATM Station 126 –Thompson Creek [Underlying Geology: Pleistocene to Miocene age Undifferentiated Wildcat Group (QTwu)]

Data for all ATM parameters at site 126 (Figure 44) are summarized in the APFC report card found in Table 21. The bed surface APFC target was met in 2020, as the data suggest a coarsening of the substrate across most particle size classes (Figure 47). Pool characteristics suggest stable habitat conditions despite residual pool depth failing to meet the target for the eighth consecutive survey year. Total LWD piece frequency within the surveyed reach did not meet the APFC target for the eighth consecutive survey year, as total LWD pieces decreased 257% since 2017. Water temperature did not meet the target in 2020, while mid-channel canopy cover met its target for the fifth consecutive survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2000 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 2 (-0.67$m^2$). The greatest degree of channel scour occurred at cross-section 3 where the channel area increased +1.45$m^2$.

A snorkel survey conducted on 7/24/20 identified steelhead trout of various size classes in each of the five pools sampled (Figure 48). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were rough-skinned newts and foothill yellow-legged frogs.

**Table 21. Individual site report card for ATM station 126, Thompson Creek (2003-2020)**

| **Site 126 Thompson Creek** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 112 | 155 | 206 | | | 219 | | | 231 | | | 76 | | | 111 | | | 113 |
| | $D_{50}$ (mm) | 65-95 | 26 | 28 | 40 | | | 59 | | | 81 | | | 17 | | | 66 | | | 65 |
| | $D_{16}$ (mm) | # | 1 | 3 | 7 | | | 10 | | | 13 | | | 4 | | | 32 | | | 28 |
| | $D_5$ (mm) | # | 1 | 1 | 1 | | | 1 | | | 3 | | | 2 | | | 6 | | | 8 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 17 | 19 | 21 | | | 17 | | | 26 | | | 18 | | | 38 | | | 35 |
| | Pool Spacing (CW/pool) | ≤6.0 | 9.3 | 5.0 | 3.2 | | | 8.7 | | | 4.3 | | | 7.5 | | | 4.5 | | | 5.1 |
| | Residual Pool Depth (m) | ≥0.91 | 0.24 | 0.43 | 0.45 | | | 0.51 | | | 0.41 | | | 0.45 | | | 0.33 | | | 0.56 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | | | 60 | | | 50 | | | 50 | | | 57 | | | 50 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥12.95 | 4.19 | 5.18 | 8.07 | | | 1.13 | | | 1.85 | | | 1.38 | | | 4.10 | | | 1.22 |
| | Total Piece Count | # | 28 | 32 | 82 | | | 11 | | | 13 | | | 8 | | | 25 | | | 7 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 17.1 | 17.6 | 16.8 | 17.7 | 16.3 | 16.2 | 16.2 | 15.1 | 15.4 | 16.0 | | 16.8 | 17.8 | 16.6 | 17.7 | 16.5 | 17.0 | 17.3 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 88 | 94 | 92 | | | 100 | | | 100 | | | 100 | | | 94 | | | 95 |
| | Canopy of Rip Forest (%) | ≥85 | 77 | 79 | | | | | | | 94 | | | 97 | | | | | | |

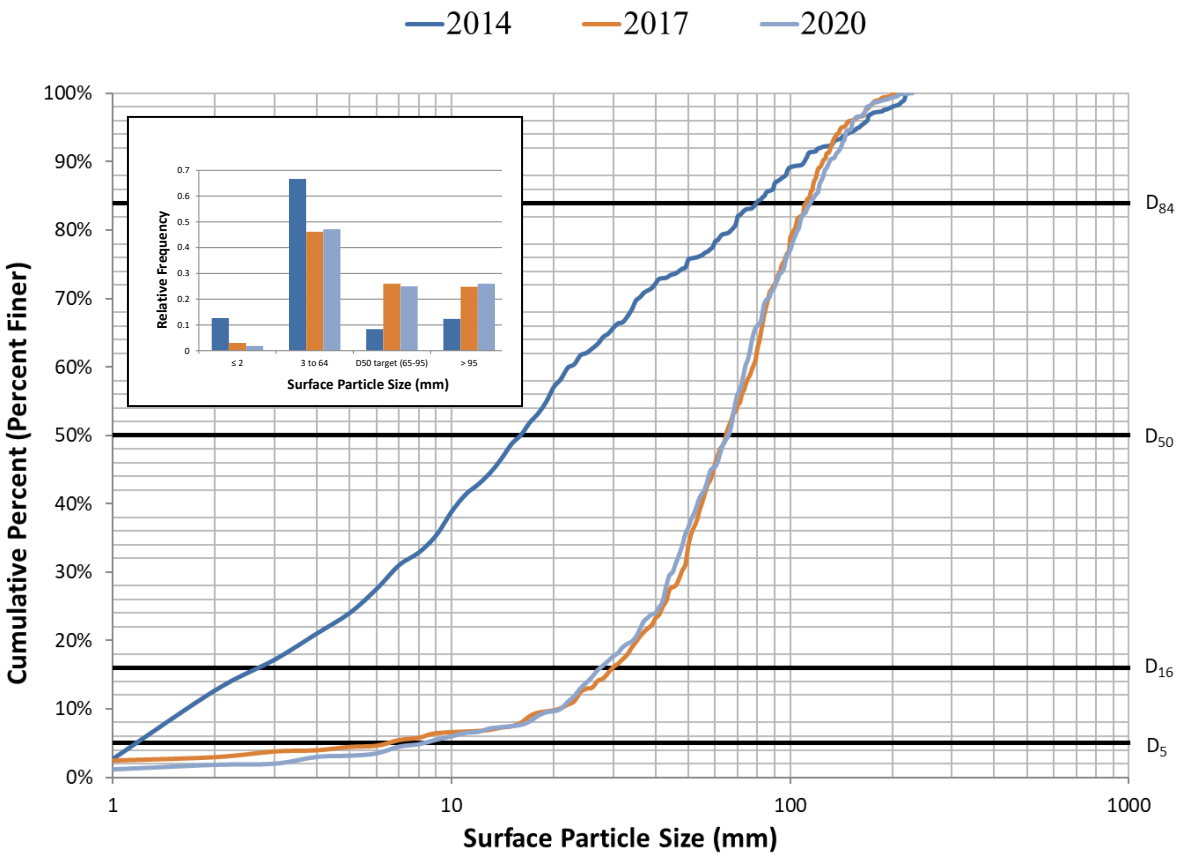



**Figure 47. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Thompson Creek ATM 126 survey reach (2014-2020)**

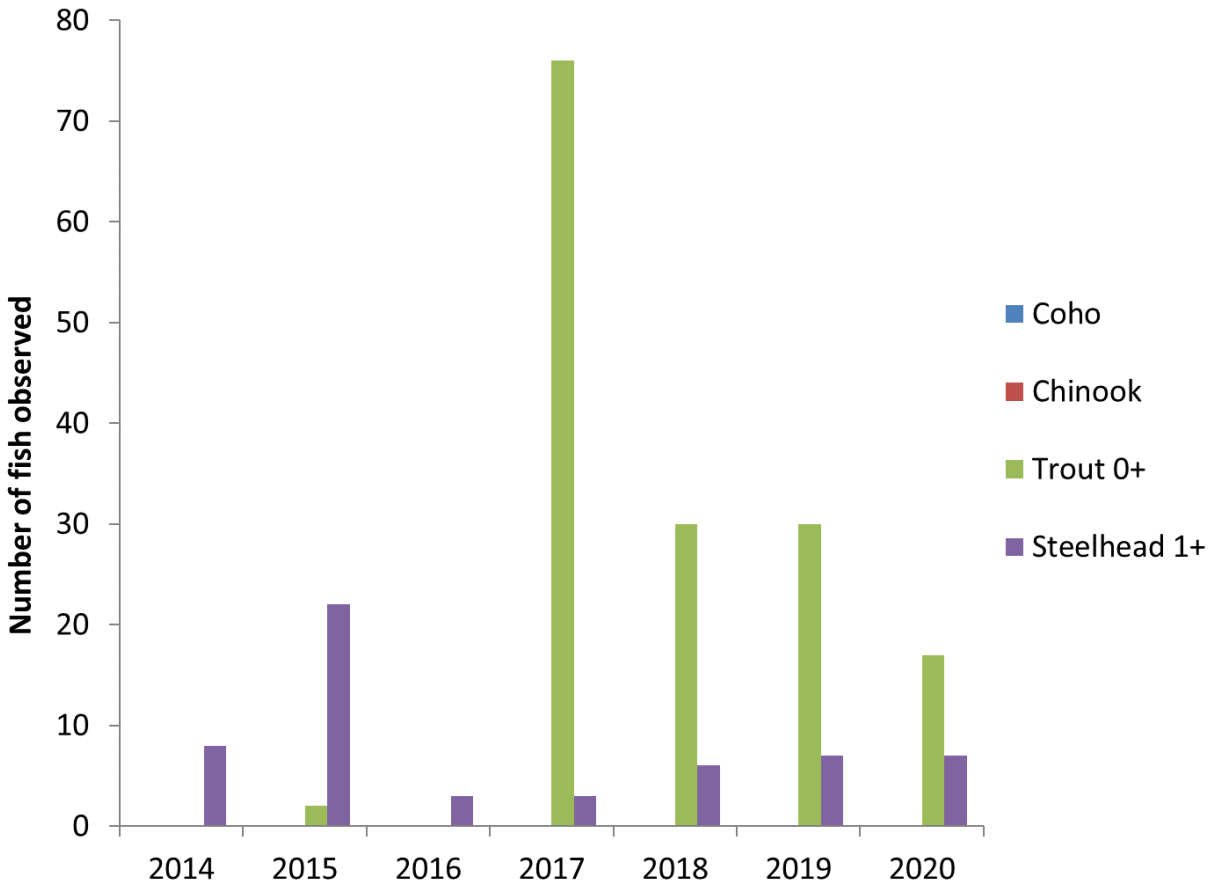



**Figure 48. Results of annual snorkel survey fish counts of the first 5 pools within the Thompson Creek ATM 126 monitoring reach (2014-2020)**

## ATM Station 122 –Newman Creek [Underlying Geology: Pleistocene to Miocene age Undifferentiated Wildcat Group (QTwu)]

Data for all ATM parameters at site 122 (Figure 46) are summarized in the APFC report card found in Table 22. The bed surface APFC target was not met in 2020, though the data suggest a coarsening of the substrate across most particle size classes (Figure 49). Pool characteristics suggest stable habitat conditions despite residual pool depth failing to meet the target for the eighth consecutive survey year. Total LWD piece frequency within the survey reach did not meet the APFC target, as the total number of pieces decreased 13% since 2017. Water temperature did not meet the target in 2020, though mid-channel canopy met its target for the seventh consecutive survey year since 2004.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was not observed at any of the 6 cross-sections between survey years 2017 and 2020. Channel scour was observed at all cross sections, the greatest degree of which occurred at cross-section 5 where the channel area increased $+0.71m^2$.

A snorkel survey conducted on 7/22/2020 identified steelhead trout in 3/5 pools sampled (Figure 50). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were pacific giant salamanders and foothill yellow-legged frogs.

**Table 22. Individual site report card for ATM station 122, Newman Creek (2003-2020)**

| **Site 122 Newman Creek** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 80 | 34 | 104 | | | 96 | | | 111 | | | 98 | | | 93 | | | 102 |
| | $D_{50}$ (mm) | 65-95 | 47 | 19 | 36 | | | 46 | | | 54 | | | 41 | | | 59 | | | 61 |
| | $D_{16}$ (mm) | # | 13 | 3 | 5 | | | 6 | | | 21 | | | 11 | | | 35 | | | 33 |
| | $D_5$ (mm) | # | 2 | 1 | 1 | | | 1 | | | 3 | | | 3 | | | 14 | | | 18 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 33 | 45 | 41 | | | 20 | | | 36 | | | 31 | | | 38 | | | 47 |
| | Pool Spacing (CW/pool) | ≤6.0 | 6.0 | 5.7 | 2.5 | | | 8.5 | | | 5.0 | | | 10.1 | | | 5.1 | | | 5.1 |
| | Residual Pool Depth (m) | ≥0.91 | 0.52 | 0.49 | 0.52 | | | 0.50 | | | 0.45 | | | 0.55 | | | 0.48 | | | 0.54 |
| | Pools Assoc. w/wood (%) | ≥50 | 67 | 100 | 100 | | | 100 | | | 71 | | | 100 | | | 83 | | | 83 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥12.29 | 4.83 | 7.37 | 7.25 | | | 2.30 | | | 3.53 | | | 3.66 | | | 6.00 | | | 5.43 |
| | Total Piece Count | # | 30 | 50 | 50 | | | 12 | | | 24 | | | 21 | | | 35 | | | 31 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 16.6 | 17.3 | 16.6 | 17.4 | 16.3 | 16.2 | 16.1 | 15.2 | 15.3 | 15.7 | 14.9 | 16.9 | 17.5 | 16.0 | 17.5 | 16.2 | 16.7 | 17.1 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 89 | 100 | 100 | | | 100 | | | 100 | | | 100 | | | 99 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | 99 | 100 | | | | | | | 99 | | | 99 | | | | | | |

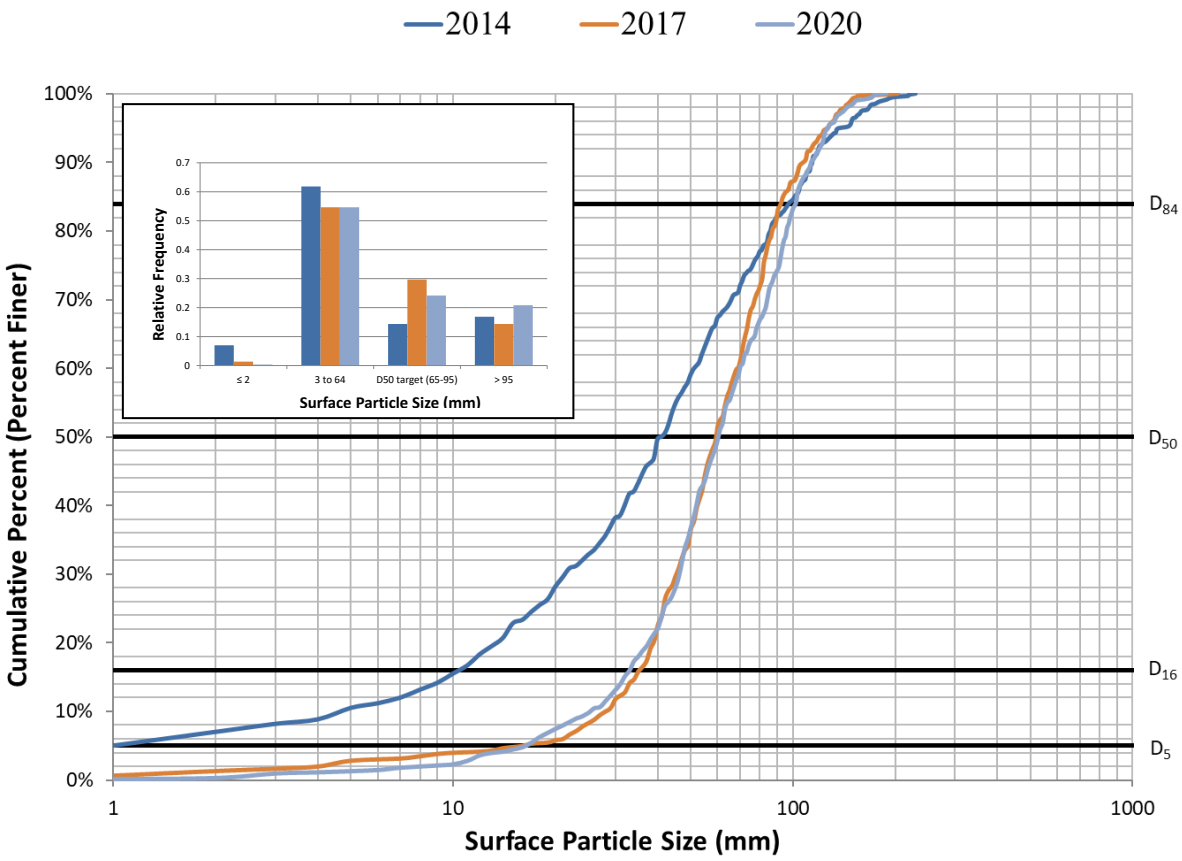



**Figure 49. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Newman Creek ATM 122 survey reach (2014-2020)**

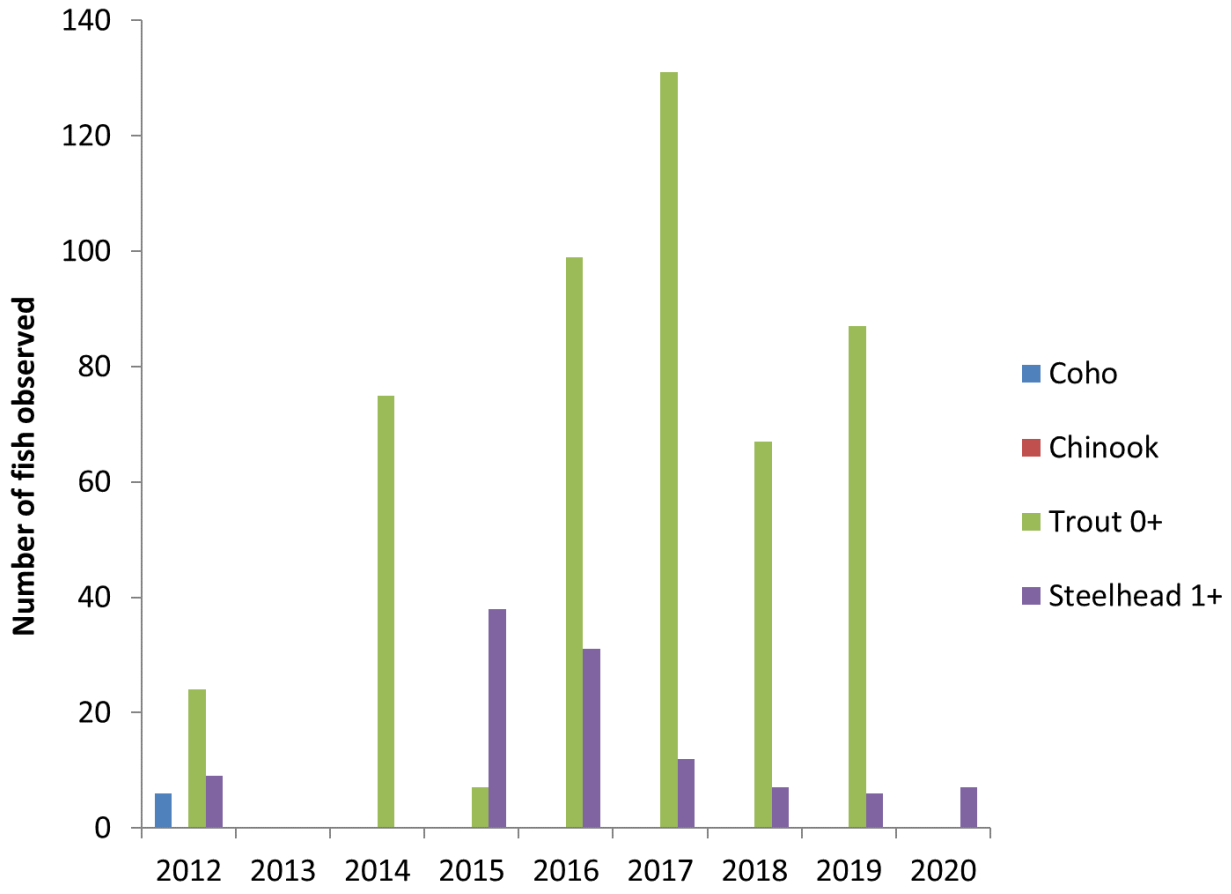



**Figure 50. Results of annual snorkel survey fish counts of the first 5 pools within the Newman Creek ATM 122 monitoring reach (2012, 2014-2020)**

## ATM Station 002 –Lower Larabee Creek [Underlying Geology: Pleistocene to Pliocene age Scotia Bluffs formation (Qsb)]

Data for all ATM parameters at site 002 (Figure 46) are summarized in the APFC report card found in Table 23. The bed surface APFC target was met in 2020, though the data suggest a fining of the substrate across all particle size classes (Figure 51). Pool characteristics suggest stable habitat conditions, although pool spacing remaining below the target for the second straight survey year. Total LWD piece frequency within the survey reach did not meet the APFC target, as total LWD pieces decreased 36% since 2017. Water temperature did not meet the target for the eighth consecutive year since 2013, as both mid-channel and riparian forest canopy cover placed well-below their respective targets.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2008 (see appendix). Cross-sections 3, 4, and 5 were lost during high flow events between 2017 and 2020 that eroded the stream banks beyond the benchmark pins. These cross sections were reestablished in 2020 but will not be available for comparison until 2023. Cross-sections 1 and 2 remained intact but will be referred to as cross-sections 4 and 5 from this point forward. Aggradation was observed at cross-section 5 between survey years 2017 and 2020 (-2.62$m^2$) and channel scour occurred at cross-section 4 where the channel area increased +0.98$m^2$.

A snorkel survey conducted on 7/8/2020 identified steelhead trout of various size classes in each of the five pools sampled (Figure 52). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were speckled dace (*Rhinichthys osculus*), Sacramento pike minnow, foothill yellow-legged frogs, western pond turtles, and garter snakes (*Thamnophis sirtalis*).

**Table 23. Individual site report card for ATM station 002, Lower Larabee Creek (2003-2020)**

| **Site 002 Lower Larabee Creek** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 267 | 190 | | | | 246 | | | 246 | | | 160 | | | 141 | | | 134 |
| | $D_{50}$ (mm) | 65-95 | 86 | 64 | | | | 111 | | | 113 | | | 74 | | | 81 | | | 68 |
| | $D_{16}$ (mm) | # | 18 | 17 | | | | 13 | | | 28 | | | 22 | | | 42 | | | 28 |
| | $D_5$ (mm) | # | 1 | 7 | | | | 1 | | | 1 | | | 6 | | | 21 | | | 7 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 6 | 63 | | | | 61 | | | 45 | | | 58 | | | 40 | | | 43 |
| | Pool Spacing (CW/pool) | ≤6.0 | 4.9 | 3.3 | | | | 4.0 | | | 5.2 | | | 4.3 | | | 6.4 | | | 7.8 |
| | Residual Pool Depth (m) | ≥0.91 | 0.96 | 1.32 | | | | 1.34 | | | 1.31 | | | 1.56 | | | 1.46 | | | 1.45 |
| | Pools Assoc. w/wood (%) | ≥50 | 67 | 67 | | | | 50 | | | 33 | | | 57 | | | 60 | | | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥2.08 | 2.10 | 2.17 | | | | 1.31 | | | 1.59 | | | 1.34 | | | 1.20 | | | 0.93 |
| | Total Piece Count | # | 28 | 36 | | | | 20 | | | 42 | | | 36 | | | 34 | | | 25 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 20.2 | 23.0 | 21.5 | 22.8 | 21.1 | 21.4 | 21.8 | 20.4 | 20.5 | 16.5 | 17.3 | 17.7 | 22.6 | 21.7 | 22.4 | 21.9 | 21.4 | 22.0 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 13 | 13 | | | | 14 | | | 20 | | | 9 | | | 20 | | | 15 |
| | Canopy of Rip Forest (%) | ≥85 | 11 | 35 | | | | | | | 30 | | | 27 | | | 63 | | | 42 |

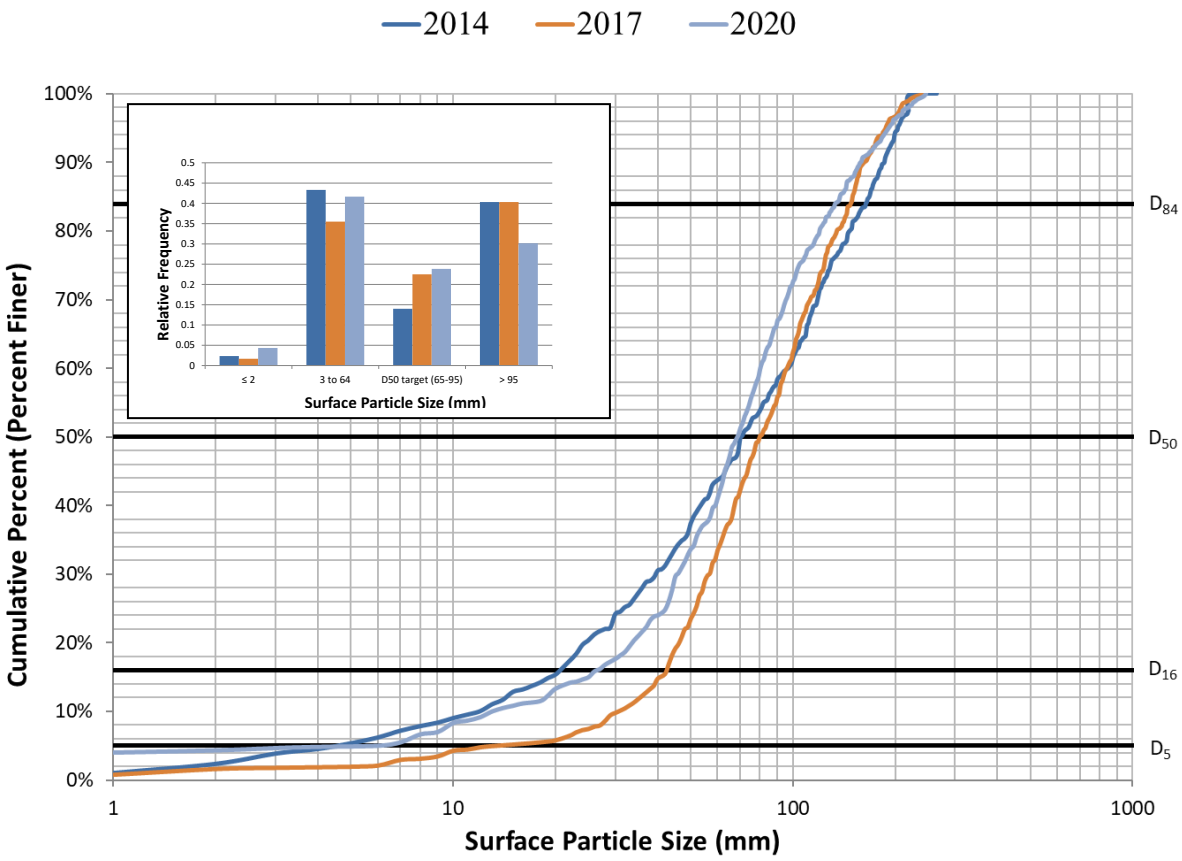



**Figure 51. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Lower Larabee Creek ATM 002 survey reach (2014-2020)**

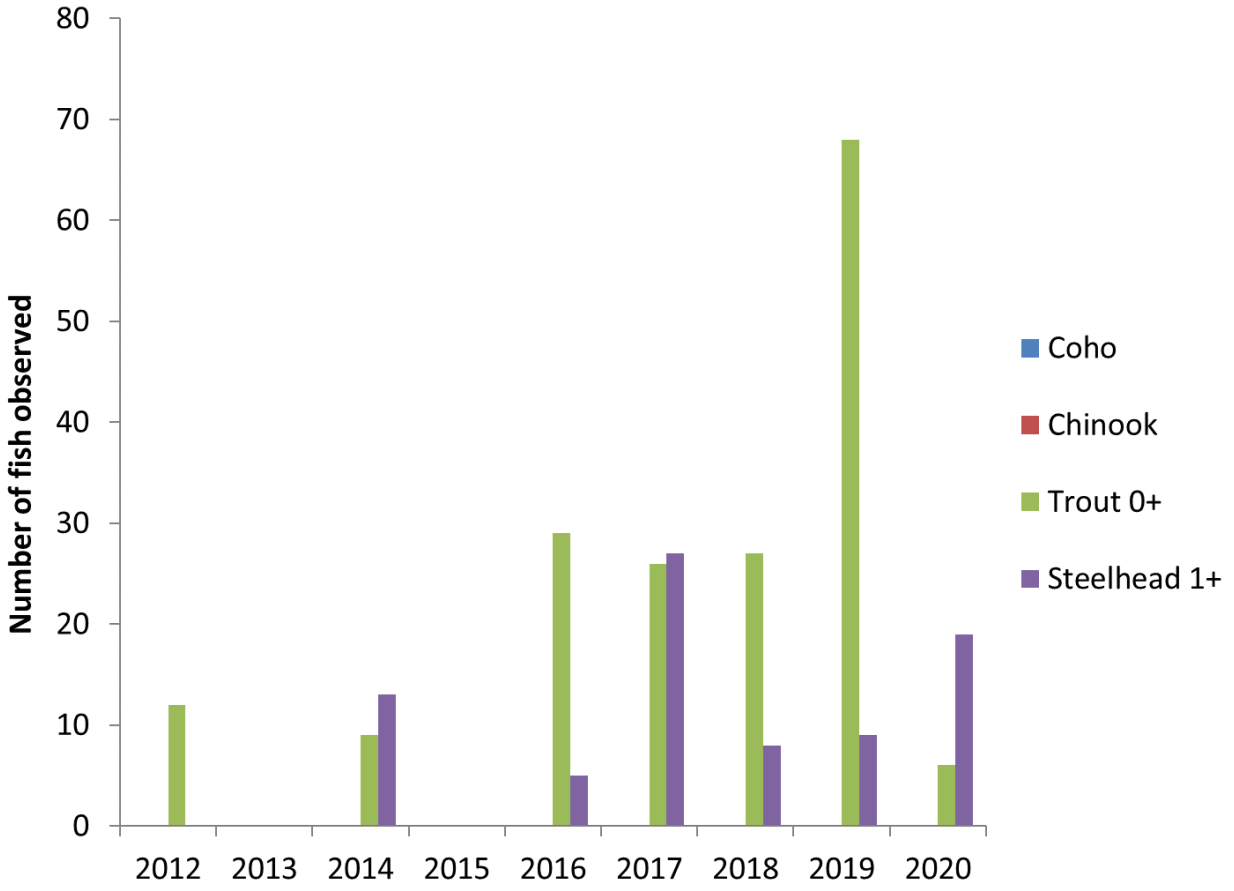



**Figure 52. Results of annual snorkel survey fish counts of the first 5 pools within the lower Larabee Creek ATM 002 monitoring reach (2012, 2014-2020)**

## ATM Station 212 –Chris Creek [Underlying Geology: Pleistocene to Pliocene age Scotia Bluffs formation (Qsb)]

Data for all ATM parameters at site 212 (Figure 46) are summarized in the APFC report card found in Table 24. The bed surface APFC target was not met in 2020, as the data suggest a fining of the substrate across most particle size classes (Figure 53). Pool characteristics suggest a slight improvement in habitat conditions despite residual pool depth remaining below the target for the fifth consecutive survey year. Total LWD piece frequency within the surveyed reach did not meet the APFC target, though the total number of pieces increased 22% since 2017. Water temperature met the target for the fifteenth consecutive survey year, as mid-channel canopy cover met its target for the sixth time since 2005.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2005 (see appendix). Aggradation was not observed at any of the 5 cross-sections between survey years 2017 and 2020. Scour was observed at all cross-sections, the greatest degree of which occurred at cross-section 4 where the channel area increased $+0.42m^2$.

A snorkel survey conducted on 7/12/2020 did not identify fish in any of the five pools sampled. Surveys were initiated in 2012 and fish have not been detected in this watercourse on any occasion. Identified in the survey reach were foothill yellow-legged frogs, tree frogs (*Pseudacris regilla*), and pacific giant salamanders.

**Table 24. Individual site report card for ATM station 212, Chris Creek (2005-2020)**

| **Site 212 Chris Creek** | **Parameter** | **Target Value** (# no target) | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 49 | | | 51 | | | 72 | | | | | | 75 | | | 65 |
| | $D_{50}$ (mm) | 65-95 | 20 | | | 7 | | | 36 | | | | | | 49 | | | 38 |
| | $D_{16}$ (mm) | # | 1 | | | 1 | | | 6 | | | | | | 25 | | | 20 |
| | $D_5$ (mm) | # | 1 | | | 1 | | | 1 | | | | | | 5 | | | 11 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 52 | | | 35 | | | 75 | | | | | | 72 | | | 86 |
| | Pool Spacing (CW/pool) | ≤6.0 | 2.7 | | | 13.5 | | | 8.6 | | | | | | 6.4 | | | 4.4 |
| | Residual Pool Depth (m) | ≥0.91 | 0.58 | | | 0.72 | | | 0.65 | | | | | | 0.46 | | | 0.40 |
| | Pools Assoc. w/wood (%) | ≥50 | 83 | | | 100 | | | 89 | | | | | | 60 | | | 71 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥29.56 | 3.63 | | | 2.63 | | | 3.78 | | | | | | 3.20 | | | 4.14 |
| | Total Piece Count | # | 23 | | | 14 | | | 25 | | | | | | 9 | | | 11 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 15.6 | 15.8 | 15.7 | 15.5 | 15.2 | 14.0 | 14.8 | 14.31 | 15.6 | 14.5 | | 14.7 | 15.3 | 13.9 | 15.2 | 14.5 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 99 | | | 100 | | | 99 | | | 100 | | | 100 | | | 98 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | | 99 | | | 100 | | | | | | |

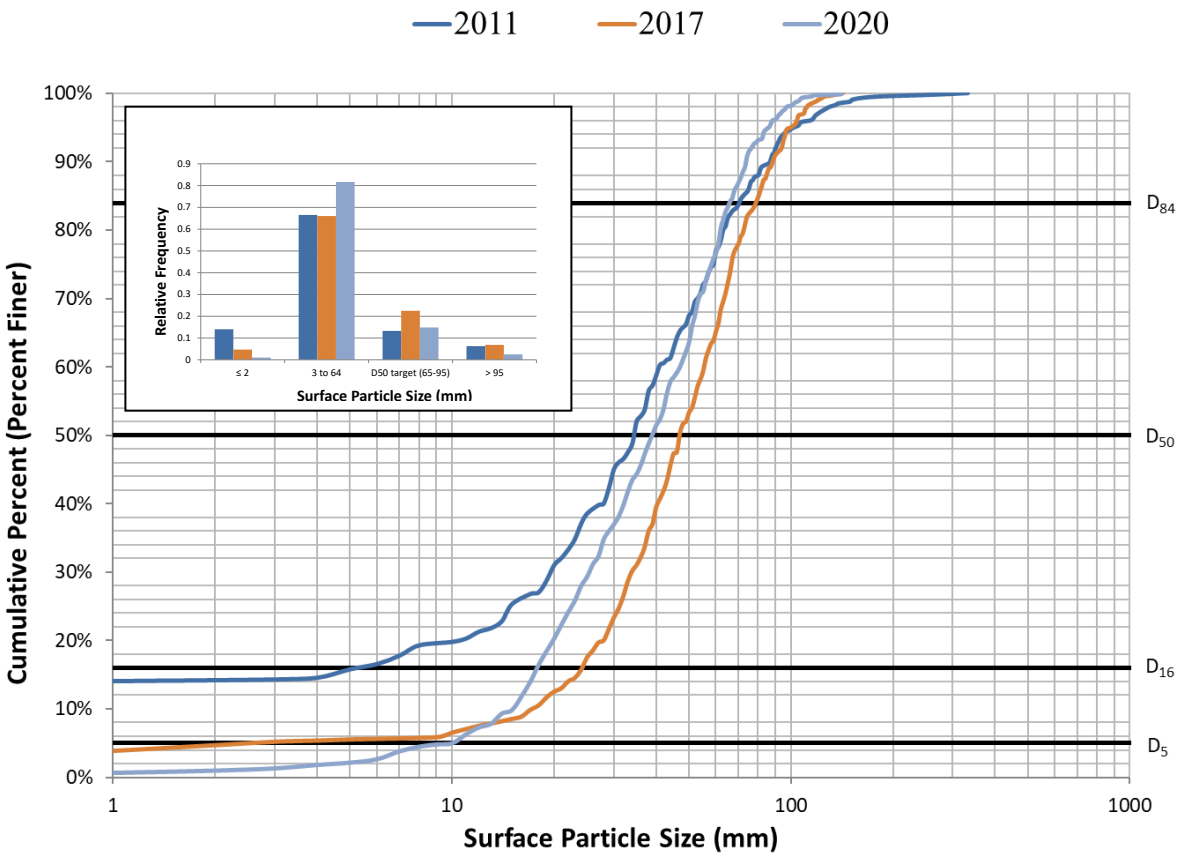



**Figure 53. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Chris Creek ATM 212 survey reach (2011-2020)**

### ATM Station 170 – Upper Larabee Creek [Underlying Geology: Cretaceous/ Jurassic age Central Belt of the Franciscan Complex (sedimentary rocks) (KJfs); Middle Miocene to Late Pliocene age Wildcat Group (lower unit) (Twl)]

Data for all ATM parameters at site 170 (Figure 46) are summarized in the APFC report card found in Table 25. The bed surface APFC target was not met in 2020, as the data suggest a fining of the substrate across all particle size classes (Figure 54). Pool characteristics suggest a downturn in habitat conditions since 2017, as the percentage of pools associated with LWD experienced a sharp decline. Total LWD piece frequency within the survey reach did not meet the APFC target, as the total number of pieces decreased 36% since 2017. Water temperature did not meet the target for the fourteenth consecutive survey year, as mid-channel canopy cover placed below the target for the seventh consecutive survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2008 (see appendix). Aggradation was observed at 3/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 5 (-1.52$m^2$). The greatest degree of channel scour occurred at cross-section 4 where the channel area increased +1.77$m^2$.

A snorkel survey conducted on 8/4/2020 identified steelhead trout of various size classes in each of the five pools sampled (Figure 55). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were California roach (*Lavinia symmetricus*), foothill yellow-legged frogs, and garter snakes.

**Table 25. Individual site report card for ATM station 170, Upper Larabee Creek (2003-2020)**

| **Site 170 Upper Larabee Creek** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 78 | 62 | | | | 58 | | | 62 | | | 63 | | | 79 | | | 77 |
| | $D_{50}$ (mm) | 65-95 | 41 | 28 | | | | 28 | | | 34 | | | 27 | | | 56 | | | 54 |
| | $D_{16}$ (mm) | # | 16 | 11 | | | | 5 | | | 18 | | | 6 | | | 37 | | | 34 |
| | $D_5$ (mm) | # | 1 | 2 | | | | 1 | | | 7 | | | 2 | | | 24 | | | 17 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 61 | 74 | | | | 61 | | | 59 | | | 61 | | | 62 | | | 63 |
| | Pool Spacing (CW/pool) | ≤6.0 | 3.3 | 4.7 | | | | 3.5 | | | 4.0 | | | 2.2 | | | 3.4 | | | 3.0 |
| | Residual Pool Depth (m) | ≥0.91 | 1.66 | 1.19 | | | | 1.32 | | | 1.33 | | | 1.02 | | | 1.22 | | | 1.18 |
| | Pools Assoc. w/wood (%) | ≥50 | 20 | 33 | | | | 40 | | | 63 | | | 28 | | | 78 | | | 10 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥2.07 | 0.07 | 0.26 | | | | 0.14 | | | 0.50 | | | 0.99 | | | 0.80 | | | 0.61 |
| | Total Piece Count | # | 8 | 4 | | | | 2 | | | 12 | | | 23 | | | 19 | | | 14 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | 22.3 | 22.7 | 21.7 | 23.8 | 21.0 | 20.9 | | 20.0 | 20.1 | 20.8 | | | | 21.4 | 20.0 | 21.7 | 20.4 | 21.1 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 29 | 38 | | | | 19 | | | 59 | | | 38 | | | 69 | | | 68 |
| | Canopy of Rip Forest (%) | ≥85 | 97 | 95 | | | | | | | 86 | | | 69 | | | 91 | | | |

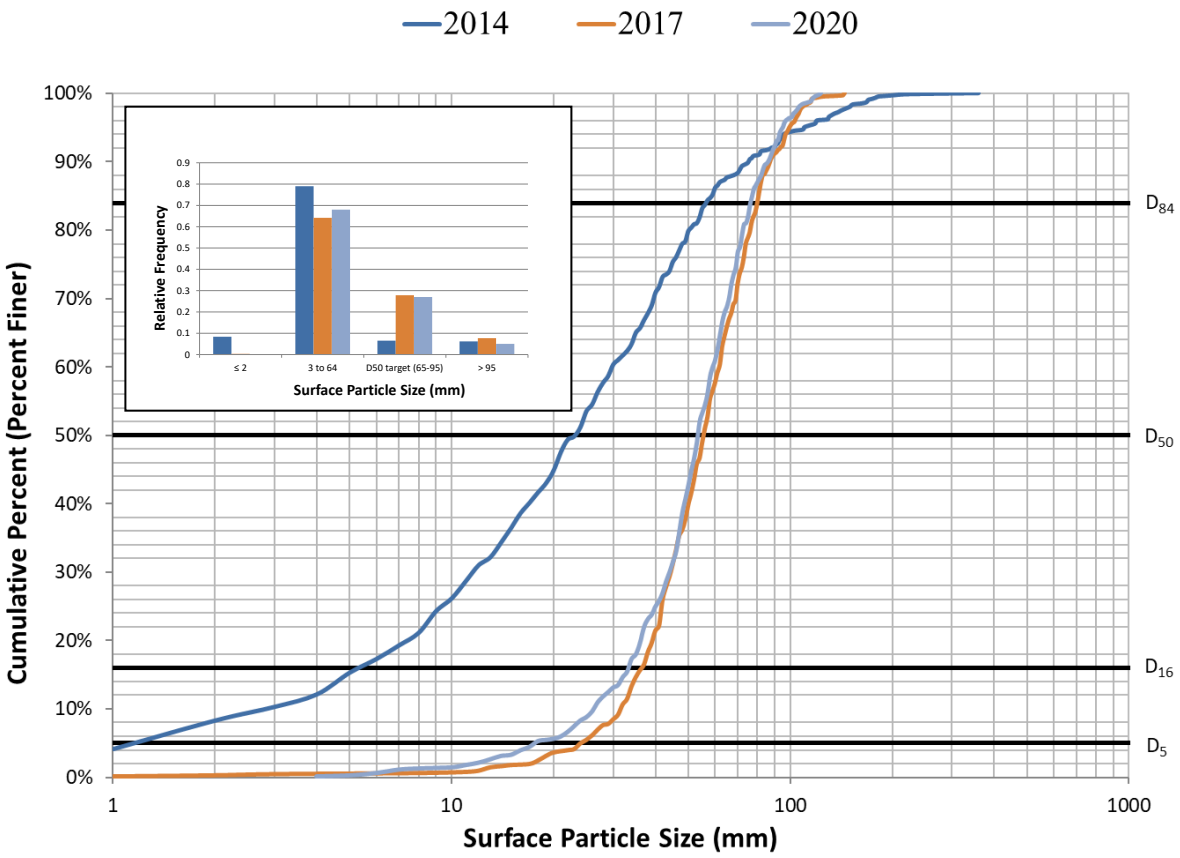



**Figure 54. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Upper Larabee Creek ATM 170 survey reach (2014-2020)**

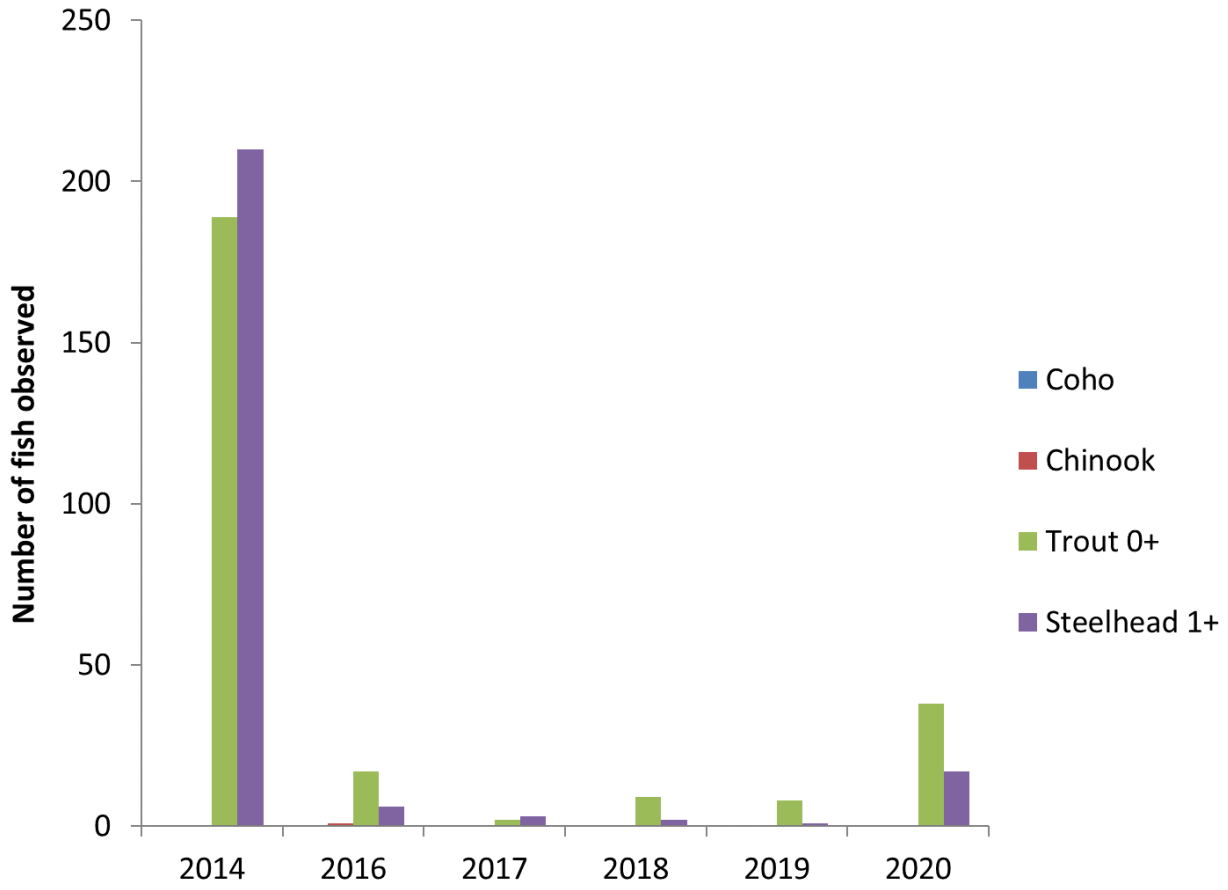



**Figure 55. Results of annual snorkel survey fish counts of the first 5 pools within the upper Larabee Creek ATM 170 monitoring reach (2014, 2016-2020)**

## Summary of ATM Trends in the Upper Eel River WAU

A summary of the Upper Eel River WAU habitat characteristics from 2020 is provided in and APFC report card (Table 26). Results of habitat composite scores from 2020 and 2017 are compared to baseline (2003) data (Figure 56). Overall, the greatest examples of stability in habitat composite scores were observed in bed surface, pool characteristics, and water temperature. LWD and mid-channel canopy cover both scored below the baseline records in 2020.

**Table 26. The most recent habitat measures for the Upper Eel River WAU (2020)**

| Current Status | Parameter | Target Value (# no target) | 170 Upper Larabee Cr | 002 Lower Larabee Cr | 212 Chris Cr | 126 Thompson Cr | 122 Newman Cr |
|---|---|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 77 | 134 | 65 | 113 | 102 |
| | $D_{50}$ (mm) | 65-95 | 54 | 68 | 38 | 65 | 61 |
| | $D_{16}$ (mm) | # | 34 | 28 | 20 | 28 | 33 |
| | $D_5$ (mm) | # | 17 | 7 | 11 | 8 | 18 |
| Pool Characteristics | Pool Area (%) | ≥25 | 63 | 43 | 86 | 35 | 47 |
| | Pool Spacing (CW/pool) | ≤6 | 3.0 | 7.8 | 4.4 | 5.1 | 5.1 |
| | Residual Pool Depth (m) | ≥0.91 | 1.18 | 1.45 | 0.40 | 0.56 | 0.54 |
| | Pools Assoc. w/wood (%) | ≥50 | 10 | 100 | 71 | 50 | 83 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | f(CW) | 0.61 | 0.93 | 4.14 | 1.22 | 5.43 |
| | Total Piece Count | # | 14 | 25 | 11 | 7 | 31 |
| Water Temperature | MWAT (°C) | ≤16.8 | 21.1 | 22.0 | 14.5 | 17.3 | 17.1 |
| Riparian Overstory | Canopy Over Stream (%) | f(CW) | 68 | 15 | 98 | 95 | 98 |
| | Canopy of Rip Forest (%) | ≥85 | | 42 | | | |
| Watershed Area | Upstream Acreage | # | 39709 | 53634 | 835 | 2463 | 1878 |
| Reach Gradient | Reach Gradient (%) | # | 0.4 | 0.9 | 0.9 | 4.1 | 2.3 |

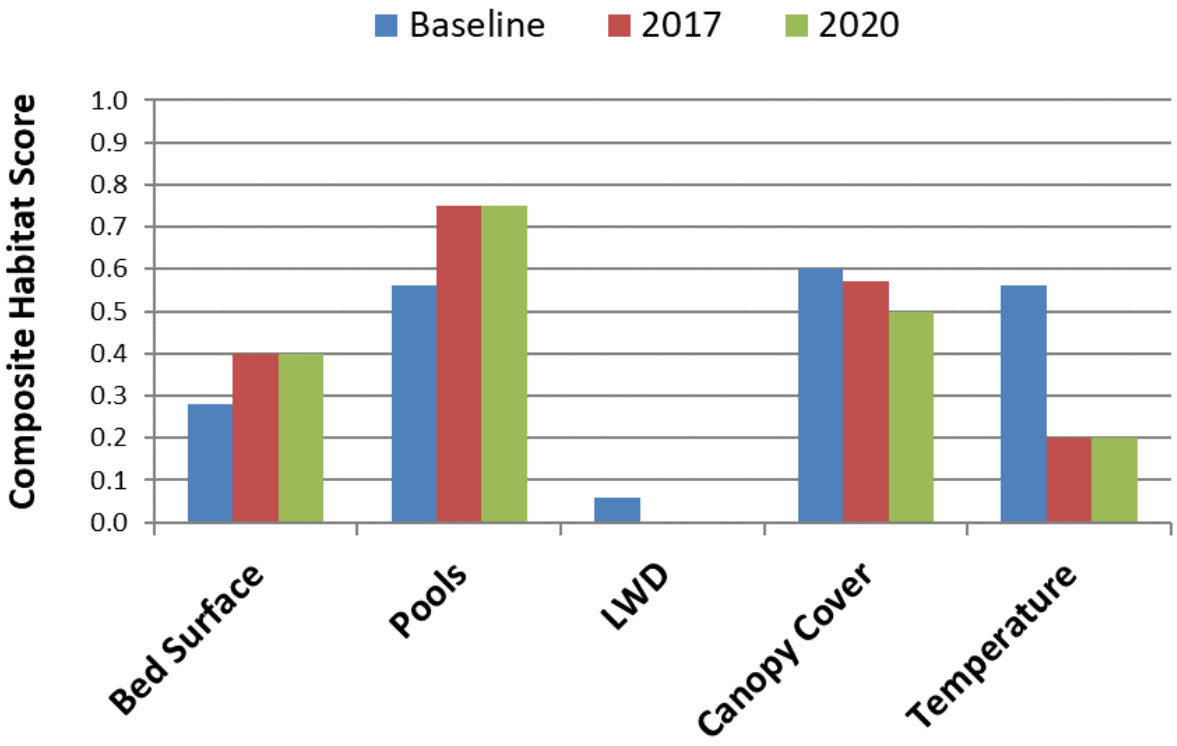



**Figure 56. The composite scores for habitat characteristics in the Upper Eel River WAU in 2020 and 2017 relative to baseline (2003) data**

## LOWER EEL RIVER AND LOWER EEL DELTA WAU

HRC has ownership within both major and smaller tributaries that drain to the Eel River from near its confluence with the Pacific Ocean to about 40 miles upstream above the confluence with Devil's Elbow Creek. In total, HRC owns about 17% of the watershed area within this reach. The area is divided into the Lower and Upper Eel River WAUs for Watershed Analysis. The Lower Eel River WAU includes HRC ownership within tributaries to the Eel River south of the Van Duzen River to Perrott Creek and includes both Jordan and Bear Creek. This WAU also includes a region termed the Eel River Delta, which contains several tributaries that drain to the Eel River nearer to its confluence with the Pacific Ocean.

There are nine (9) ATM sites in the Lower Eel WAU, including three in Bear Creek, two in Jordan Creek, and one each in Monument Creek, Stitz Creek, Shively Creek, and Atwell Creek (Figure 57). Habitat characteristics at the Bear Creek sites are measured annually at the request of the NCRWQCB. Habitats at all other sites are measured every three years. Typical site conditions are shown in Figure 58.

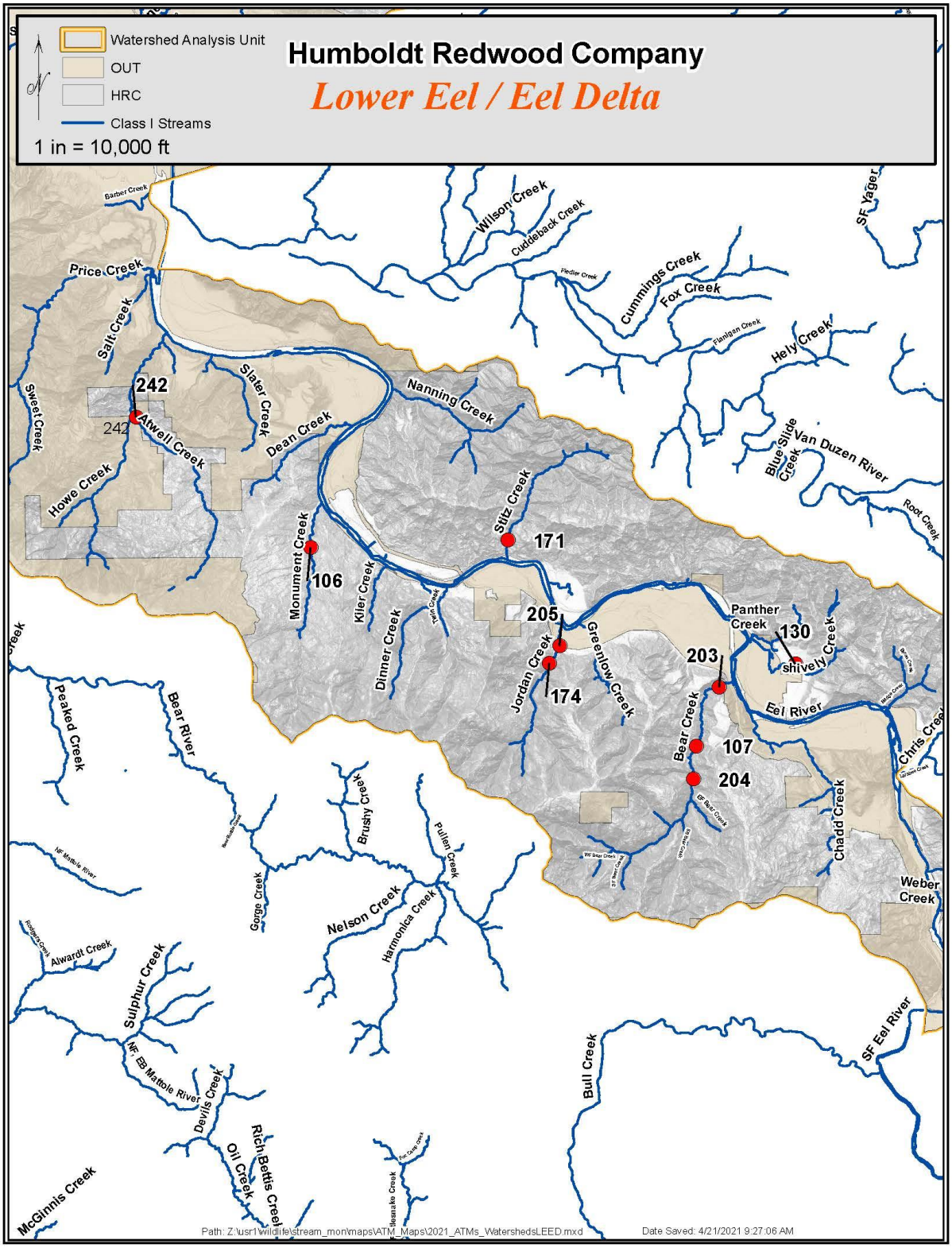



**Figure 57. Location map of ATM stations in the Lower Eel River WAU**

**Bear Creek Station 203**

**Bear Creek Station 107**

**Bear Creek Station 204**

**Figure 58. ATM Stations within Bear Creek in the Lower Eel River WAU**

## ATM Station 203 – Lower Bear Creek [Underlying Geology: Alluvium (Qal) underlain by Undifferentiated Wildcat Group (Qtw)]

Data for all ATM parameters at site 203 (Figure 58) are summarized in the APFC report card found in Table 27. The bed surface APFC target was met in 2020, as the data suggest a coarsening of the substrate across most particle size classes (Figure 59). Pool habitat characteristics remained stable, though residual pool depth placed below the target for the seventeenth consecutive year. Total LWD piece frequency did not meet the APFC target, as the total number of pieces decreased by 31% since 2019. Water temperature did not meet the target in 2020, as mid-channel canopy cover also placed below the target for the fourth straight year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (see appendix). Aggradation was observed at 2/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 4 (-17.47$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +1.03$m^2$.

A snorkel survey conducted on 6/26/2020 identified steelhead trout of various size classes in each of the five pools sampled (Figure 60). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were foothill yellow legged frogs.

**Table 27. Individual site report card for ATM station 203, Bear Creek (2004-2020)**

| **Site 203 Bear Creek** | **Parameter** | **Target Value** (# no target) | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 66 | 88 | 98 | 98 | 114 | 110 | 94 | 126 | 93 | 77 | 83 | 45 | 110 | 94 | 110 | 108 | 109 |
| | $D_{50}$ (mm) | 65-95 | 30 | 38 | 28 | 42 | 46 | 56 | 39 | 68 | 65 | 31 | 33 | 19 | 66 | 48 | 66 | 66 | 65 |
| | $D_{16}$ (mm) | # | 12 | 8 | 2 | 6 | 4 | 20 | 12 | 25 | 9 | 6 | 7 | 6 | 38 | 14 | 40 | 29 | 33 |
| | $D_{5}$ (mm) | # | 8 | 1 | 1 | 1 | 1 | 4 | 3 | 4 | 2 | 1 | 2 | 2 | 19 | 2 | 27 | 12 | 14 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 22 | 61 | 32 | 32 | 26 | 35 | 47 | 37 | 26 | 11 | 13 | 17 | 32 | 30 | 25 | 40 | 34 |
| | Pool Spacing (CW/pool) | ≤6.0 | 5.0 | 5.5 | 3.3 | 2.6 | 4.8 | 3.2 | 2.6 | 4.1 | 3.9 | 7.3 | 7.5 | 3.3 | 3.0 | 2.7 | 3.1 | 1.9 | 2.4 |
| | Residual Pool Depth (m) | ≥0.91 | 0.42 | 0.61 | 0.60 | 0.57 | 0.67 | 0.57 | 0.49 | 0.52 | 0.62 | 0.53 | 0.60 | 0.42 | 0.55 | 0.61 | 0.56 | 0.52 | 0.54 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | 100 | 100 | 100 | 85 | 88 | 100 | 100 | 100 | 100 | 100 | 82 | 100 | 100 | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥5.1 | 12.9 | 12.7 | 6.2 | 6.3 | 5.6 | 7.3 | 4.7 | 4.7 | 8.6 | 7.4 | 7.1 | 8.1 | 11.3 | 6.8 | 6.4 | 5.8 | 4.44 |
| | Total Piece Count | # | 148 | 145 | 71 | 72 | 65 | 87 | 57 | 46 | 70 | 85 | 112 | 128 | 178 | 108 | 102 | 92 | 70 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | | 17.9 | 19.5 | 18.7 | 18.1 | 17.9 | 15.9 | 15.5 | 15.5 | 17.2 | 17.2 | 17.7 | 16.8 | 17.6 | 17.1 | 17.1 | 18.4 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 24 | 38 | 35 | 26 | 57 | 40 | 97 | 80 | 77 | 83 | 83 | 70 | 87 | 85 | 79 | 83 | 91 |
| | Canopy of Rip Forest (%) | ≥85 | 90 | 96 | 97 | 85 | | | | 96 | 99 | 96 | 91 | | | | | | |

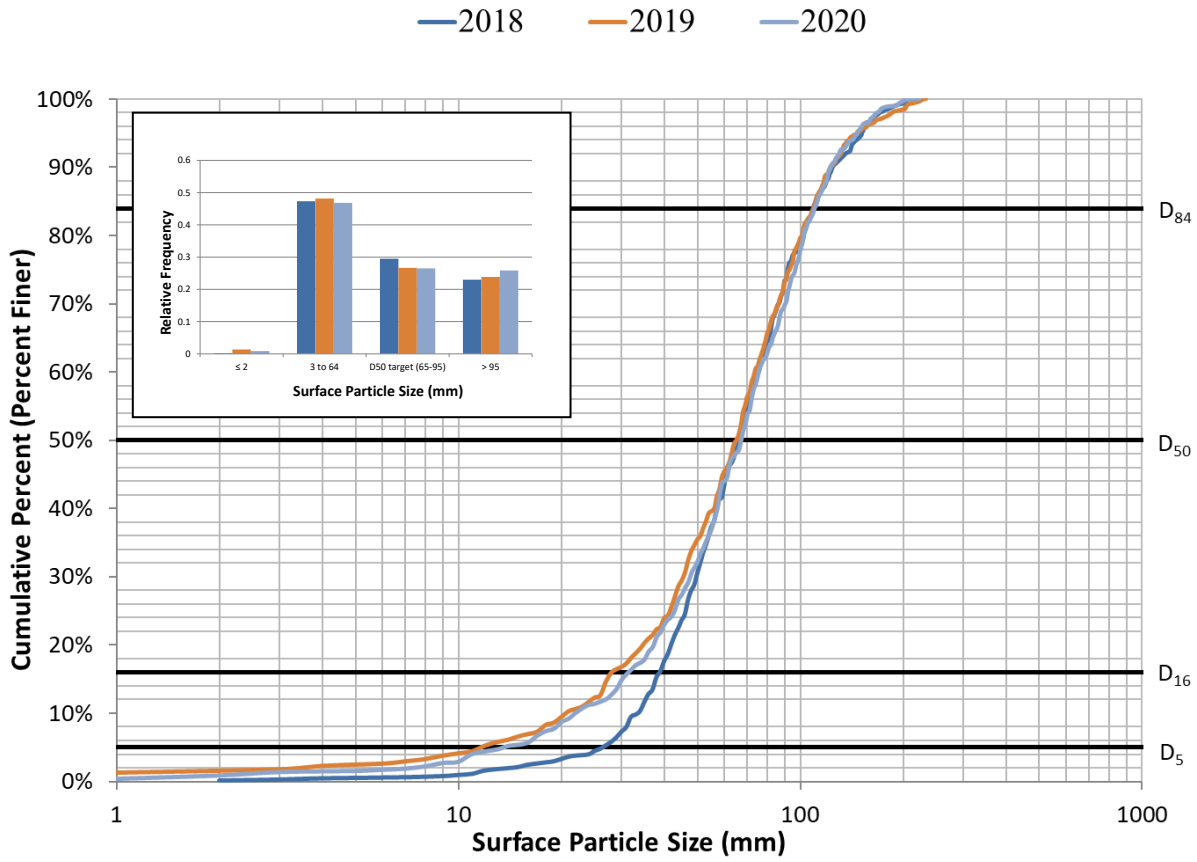



**Figure 59. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 203 survey reach (2018-2020)**

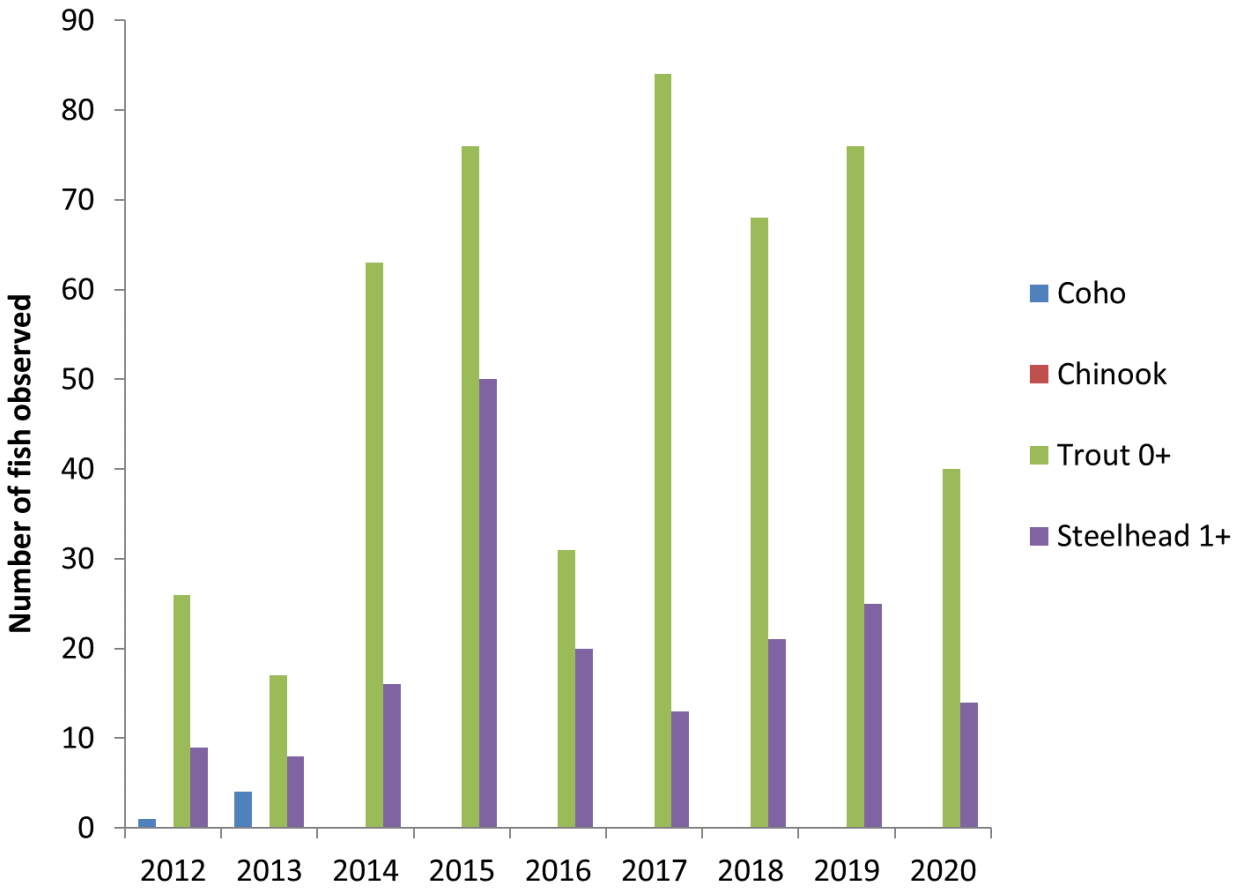



**Figure 60. Results of annual snorkel survey fish counts of the first 5 pools within the Bear Creek ATM 203 monitoring reach (2012-2020)**

## ATM Station 204 – Mid-Upper Bear Creek [Underlying Geology: Coastal Belt: Coastal Terrane (TKfs)]

Data for all ATM parameters at site 204 (Figure 58) are summarized in the APFC report card found in Table 28. The bed surface APFC target was not met in 2020, as the data reflect a fining of the substrate across most particle size classes (Figure 61). Pool characteristics suggest stable habitat conditions despite residual pool depth remaining below the target for the seventeenth consecutive year. Total LWD piece frequency met the target for the sixth year straight since 2015, despite the total number of pieces decreasing by 71% since 2019. Water temperature met the target for the fifth consecutive year, as mid-channel canopy cover met its target for the second year on record since 2004.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (see appendix). Aggradation was observed at 4/5 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 4 (-2.45$m^2$). The only observation of channel scour occurred at cross-section 2 where the channel area increased +0.34$m^2$.

A snorkel survey conducted on 7/10/2020 identified steelhead trout of various size classes in each of the five pools sampled (Figure 62). Neither juvenile coho nor juvenile Chinook salmon were observed. No other aquatic organisms were identified.

**Table 28. Individual site report card for ATM station 204, Bear Creek (2004-2020)**

| **Site 204 Bear Creek** | **Parameter** | **Target Value** (# no target) | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 118 | 135 | 108 | 143 | 161 | 133 | 128 | 170 | 173 | 123 | 120 | 101 | 116 | 142 | 142 | 115 | 117 |
| | $D_{50}$ (mm) | 65-95 | 37 | 51 | 24 | 53 | 54 | 62 | 51 | 76 | 64 | 52 | 47 | 45 | 69 | 66 | 80 | 67 | 61 |
| | $D_{16}$ (mm) | # | 4 | 14 | 2 | 8 | 7 | 17 | 13 | 28 | 14 | 15 | 11 | 11 | 35 | 15 | 32 | 35 | 25 |
| | $D_{5}$ (mm) | # | 1 | 1 | 1 | 3 | 1 | 5 | 4 | 11 | 3 | 1 | 2 | 3 | 16 | 5 | 14 | 11 | 10 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 23 | 39 | 21 | 38 | 22 | 16 | 28 | 38 | 27 | 21 | 36 | 14 | 28 | 31 | 28 | 34 | 34 |
| | Pool Spacing (CW/pool) | ≤6.0 | 7.7 | 9.9 | 3.1 | 2.7 | 6.7 | 5.1 | 10.8 | 4.4 | 3.9 | 4.1 | 3.8 | 4.9 | 3.8 | 3.0 | 3.1 | 3.4 | 2.7 |
| | Residual Pool Depth (m) | ≥0.91 | 0.39 | 0.39 | 0.67 | 0.70 | 0.66 | 0.45 | 0.47 | 0.61 | 0.62 | 0.61 | 0.58 | 0.44 | 0.53 | 0.49 | 0.46 | 0.54 | 0.49 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | 100 | 100 | 100 | 83 | 100 | 83 | 86 | 75 | 67 | 88 | 80 | 100 | 100 | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥4.4 | 7.6 | 11.4 | 10.9 | 9.0 | 3.4 | 7.1 | 9.4 | 3.3 | 5.8 | 6.5 | 3.5 | 5.6 | 12.1 | 5.3 | 5.4 | 8.1 | 4.8 |
| | Total Piece Count | # | 105 | 158 | 151 | 124 | 71 | 62 | 130 | 33 | 63 | 85 | 49 | 78 | 170 | 74 | 77 | 113 | 66 |
| **Water Temperature** | MWAT (°C) | ≤16.8 | | | | | | 17.3 | | | | | | | 15.1 | 16.3 | 15.2 | 15.5 | 15.6 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 7 | 10 | 34 | 11 | 23 | 53 | 73 | 79 | 51 | 75 | 63 | 64 | 85 | 90 | 79 | 80 | 93 |
| | Canopy of Rip Forest (%) | ≥85 | 79 | 77 | 90 | 85 | | | | 96 | 93 | 94 | 90 | 96 | | | | | |

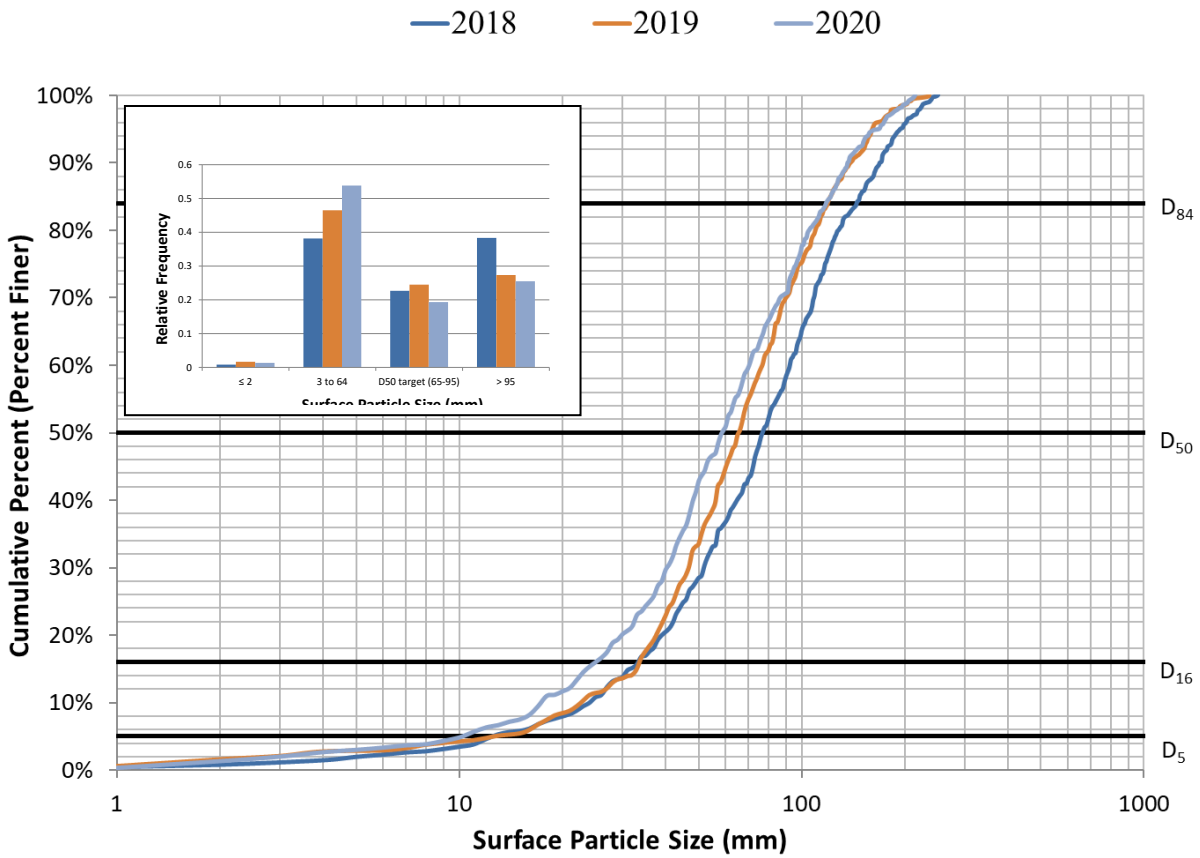



**Figure 61. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 204 survey reach (2018-2020)**

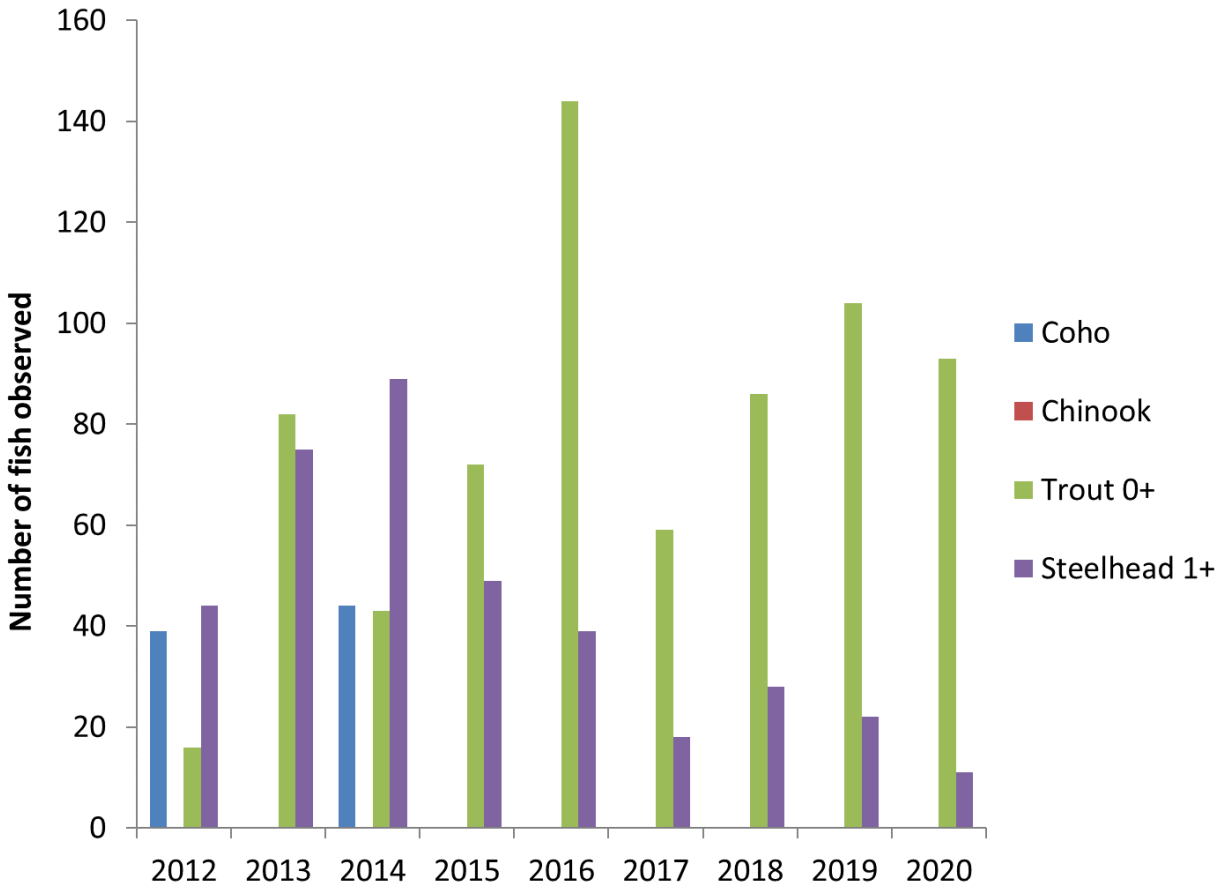



**Figure 62. Results of annual snorkel survey fish counts of the first 5 pools within the Bear Creek ATM 204 monitoring reach (2012-2020)**

## ATM Station 107 – Middle Bear Creek [Underlying Geology: Coastal Belt: Coastal Terrane (TKfs)]

Data for all ATM parameters at site 107 (Figure 58) are summarized in the APFC report card found in Table 29. The bed surface APFC target was met in 2020, as the data reflect a coarsening of the substrate across the $D_{50}$ and $D_{84}$ particle size classes (Figure 63). Pool characteristics suggest stable habitat conditions despite residual pool depth remaining below the target for the eighteenth consecutive year. Total LWD piece frequency did not meet the target, as the total number of pieces decreased by 63% since 2019. Water temperature met the target for the third straight year, as mid-channel canopy cover met the target for the first time since 2011.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1998 (see appendix). Aggradation was observed at 2/6 cross-sections between survey years 2017 and 2020, the greatest degree of which occurred at cross-section 6 (-3.32$m^2$). The greatest degree of channel scour occurred at cross-section 1 where the channel area increased +1.11$m^2$.

A snorkel survey conducted on 6/30/2020 identified steelhead trout of various size classes in each of the five pools sampled (Figure 64). Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were foothill yellow legged frogs, rough-skinned newts, and garter snakes.

**Table 29. Individual site report card for ATM station 107, Bear Creek (2003-2020)**

| **Site 107 Bear Creek** | **Parameter** | **Target Value** (# no target) | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bed Surface** | $D_{84}$ (mm) | # | 113 | 110 | 100 | 110 | 109 | 160 | 129 | 124 | 154 | 131 | 116 | 104 | 79 | 116 | 123 | 127 | 116 | 130 |
| | $D_{50}$ (mm) | 65-95 | 46 | 44 | 42 | 30 | 36 | 67 | 62 | 57 | 69 | 37 | 43 | 43 | 34 | 68 | 66 | 73 | 66 | 68 |
| | $D_{16}$ (mm) | # | 9 | 10 | 8 | 3 | 7 | 14 | 22 | 19 | 16 | 5 | 11 | 7 | 10 | 36 | 24 | 37 | 28 | 27 |
| | $D_{5}$ (mm) | # | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 3 | 2 | 1 | 2 | 2 | 3 | 14 | 7 | 20 | 11 | 11 |
| **Pool Characteristics** | Pool Area (%) | ≥25 | 9 | 23 | 50 | 19 | 14 | 22 | 16 | 20 | 25 | 45 | 19 | 27 | 7 | 28 | 29 | 28 | 35 | 43 |
| | Pool Spacing (CW/pool) | ≤6.0 | 11.3 | 3.8 | 7.9 | 4.1 | 4.4 | 4.6 | 5.1 | 4.5 | 4.9 | 2.6 | 7.4 | 4.3 | 10 | 3.4 | 3.4 | 3.0 | 2.7 | 2.2 |
| | Residual Pool Depth (m) | ≥0.91 | 0.72 | 0.54 | 0.50 | 0.52 | 0.45 | 0.48 | 0.45 | 0.33 | 0.61 | 0.56 | 0.56 | 0.45 | 0.39 | 0.42 | 0.63 | 0.61 | 0.51 | 0.49 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 89 | 67 | 86 | 100 | 100 | 89 | 100 | 100 | 100 |
| **Large Woody Debris** | Total Piece Frequency (#/100 ft) | ≥5.1 | 9.2 | 15.2 | 12.8 | 6.7 | 8.5 | 3.2 | 7.1 | 11.3 | 15.1 | 8.9 | 6.1 | 5.9 | 3.9 | 9.2 | 7.7 | 7.5 | 7.1 | 4.36 |
| | Total Piece Count | # | 129 | 213 | 179 | 94 | 119 | 76 | 75 | 115 | 49 | 95 | 85 | 83 | 55 | 129 | 122 | 106 | 99 | 61 |
| **Water Temperature** | MWAT (ºC) | ≤16.8 | 18.7 | 19.6 | 17.5 | 18.8 | 18.0 | 17.9 | 17.3 | 15.2 | 15.1 | 14.8 | 16.6 | 16.8 | | 16.2 | 16.9 | 16.1 | 16.1 | 16.3 |
| **Riparian Overstory** | Canopy Over Stream (%) | ≥90 | 31 | 42 | 31 | 26 | 28 | 56 | 53 | 97 | 90 | 83 | 79 | 77 | 54 | 78 | 88 | 65 | 76 | 91 |
| | Canopy of Rip Forest (%) | ≥85 | 73 | 86 | 90 | 73 | 81 | | | | 98 | 99 | 90 | 89 | | | | | | |

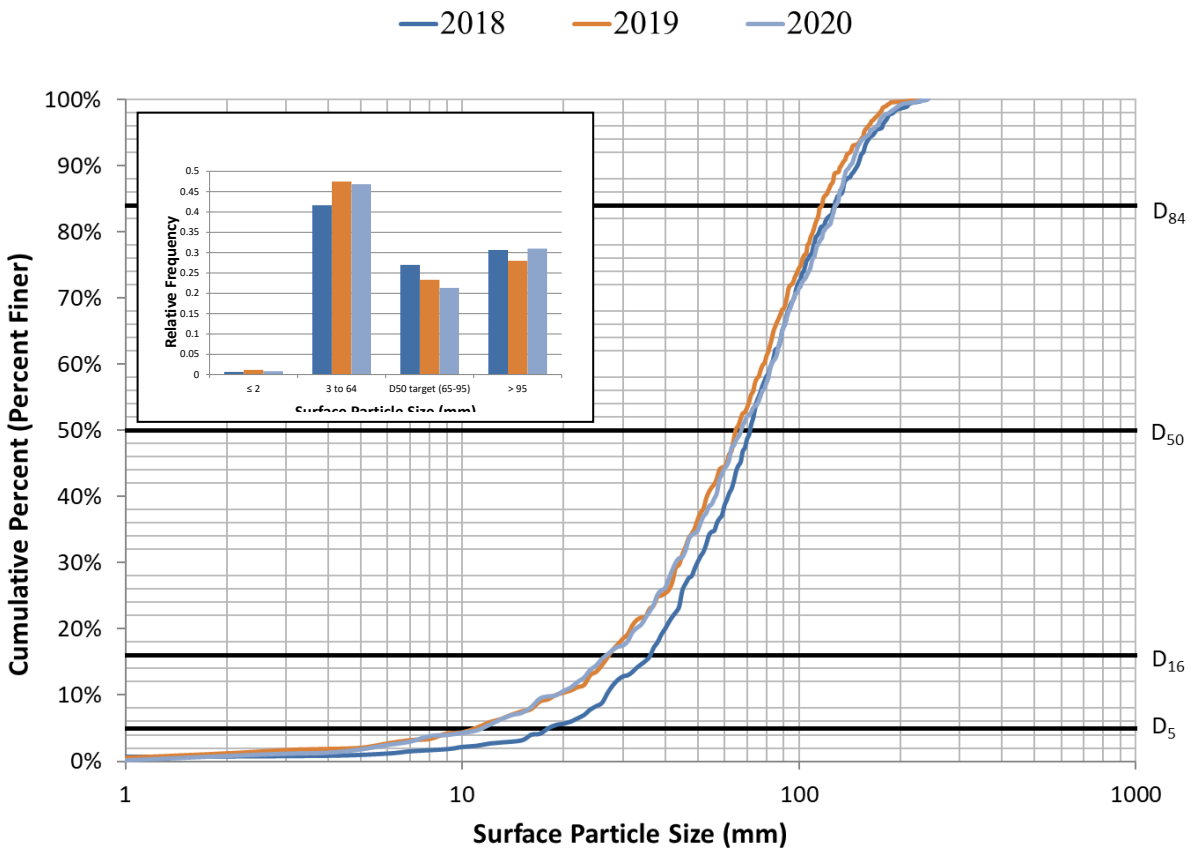



**Figure 63. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 107 survey reach (2018-2020)**

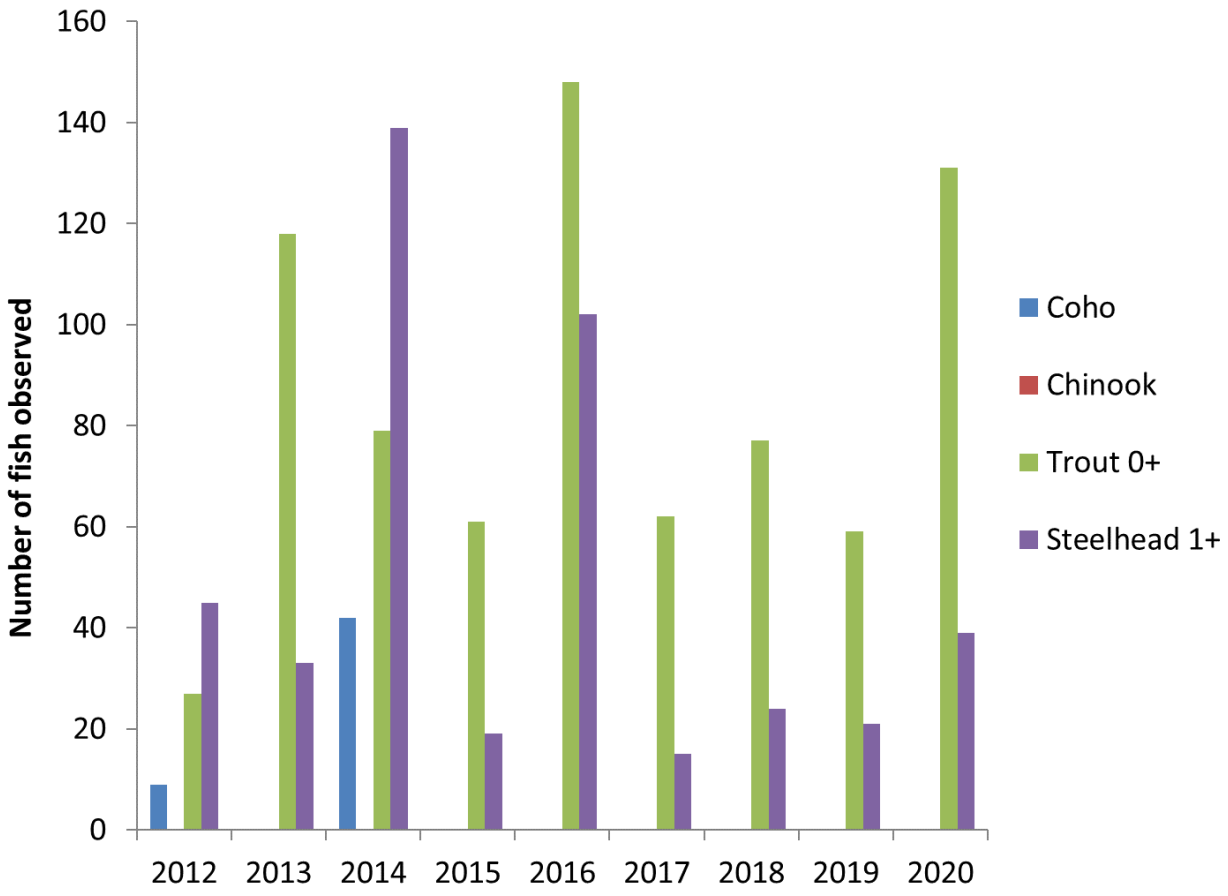



**Figure 64. Results of annual snorkel survey fish counts of the first 5 pools within the Bear Creek ATM 107 monitoring reach (2012-2020)**

## Summary of ATM Trends in the Lower Eel River WAU

A summary of the Lower Eel River WAU habitat characteristics from 2020 is provided in and APFC report card (Table 30). The results of habitat composite scores from 2020 and 2019 are compared to baseline (2004) records (Figure 65). The greatest improvement since 2020 was observed in mid-channel canopy cover. Pool characteristics and water temperature both remained stable since 2019, while the habitat composite scores for bed surface and LWD piece frequency declined in 2020.

**Table 30. Most recent habitat measures for the Lower Eel River WAU (2020)**

| Current Status | Parameter | Target Value (# no target) | 203 Lower Bear Cr | 107 Mid-Bear Cr | 204 Mid-Upper Bear Cr |
|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 109 | 130 | 117 |
| | $D_{50}$ (mm) | 65-95 | 65 | 68 | 61 |
| | $D_{16}$ (mm) | # | 33 | 27 | 25 |
| | $D_5$ (mm) | # | 14 | 11 | 10 |
| Pool Characteristics | Pool Area (%) | ≥25 | 34 | 43 | 34 |
| | Pool Spacing (CW/pool) | ≤6.0 | 2.4 | 2.2 | 2.7 |
| | Residual Pool Depth (m) | ≥0.91 | 0.54 | 0.49 | 0.49 |
| | Pools Assoc. w/wood (%) | ≥50 | 100 | 100 | 100 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | f(CW) | 4.44 | 4.36 | 4.76 |
| | Total Piece Count | # | 70 | 61 | 66 |
| Water Temperature | MWAT (°C) | ≤16.8 | 18.4 | 16.3 | 15.6 |
| Riparian Overstory | Canopy Over Stream (%) | f(CW) | 91 | 91 | 93 |
| | Canopy of Rip Forest (%) | ≥85 | | | |
| Watershed Area | Upstream Acreage | # | 5,449 | 5,026 | 4,302 |
| Reach Gradient | Reach Gradient (%) | # | 1.6 | 1.8 | 3.8 |

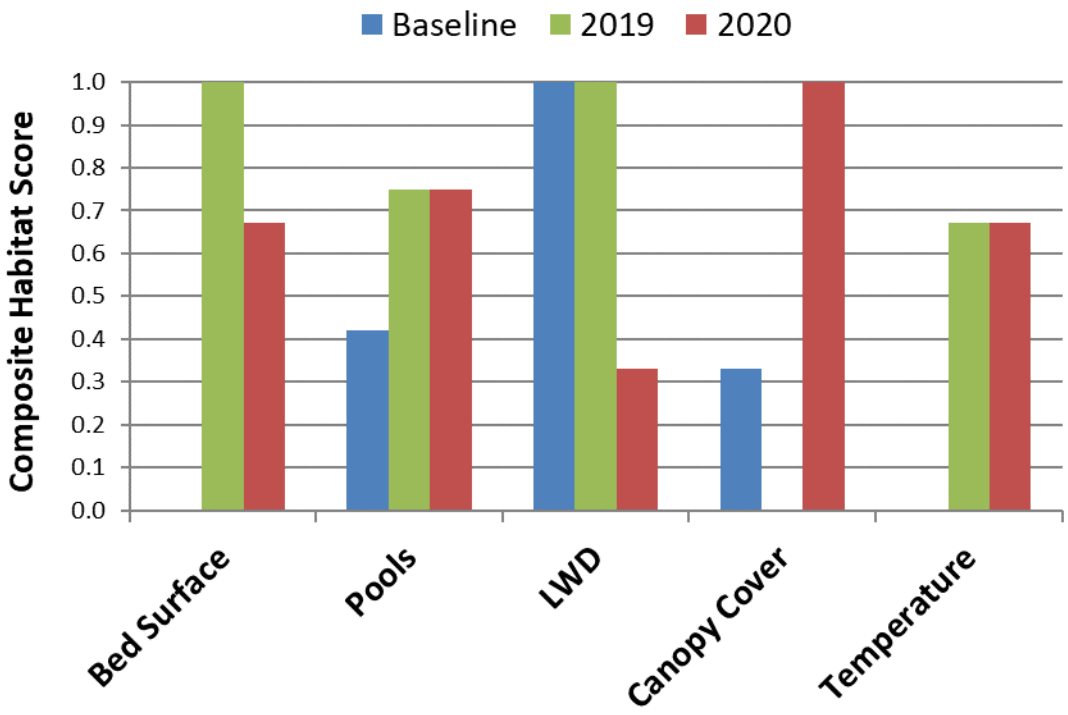



**Figure 65. The composite scores for habitat characteristics in Bear Creek (Lower Eel River WAU) in 2019 and 2020 relative to baseline (2004) data**

## QUALITY ASSURANCE / QUALITY CONTROL

Three of the twenty-one (3/21) ATM sites measured in 2020 were re-measured to assess the quality and reproducibility of ATM data collection. Data collection at all sites, including QA/QC, was conducted by the same two-person field crew in 2020. QA/QC sites were re-measured within three weeks of the initial measurement. The number of pools surveyed during the QA/QC visit at each site also remained consistent with the original survey and surface sediment (pebble count) re-measurement took place at the same locations at each site. Results of the 2020 QA/QC are shown in Table 31.

Initial vs. QA/QC surface substrate measurements were relatively consistent at all three sites, resulting in identical pass/fail scores. Pool characteristic comparisons were also consistent at all three sites, resulting in nearly identical pass/fail scores across all pool habitat parameters except at Chris Creek, where pool area (%) was replicated within 4% of the original survey. LWD counts also resulted in nearly identical

pass/fail scores despite the variance of 2% at Newman Creek. Mid-channel canopy reflected consistent results except for Bear Creek, where a variance of 5% was observed.

**Table 31. QA/QC data collection measures for three (3) ATM stations in 2020**

| 2020 QA/QC | Parameter | Target Value (# no target) | Newman Creek 122 | Newman Creek 122.1 | Bear Creek 203 | Bear Creek 203.1 | Chris Creek 212 | Chris Creek 212.1 |
|---|---|---|---|---|---|---|---|---|
| Bed Surface | $D_{84}$ (mm) | # | 102 | 94 | 109 | 115 | 65 | 63 |
| | $D_{50}$ (mm) | 65-95 | 61 | 59 | 65 | 67 | 38 | 36 |
| | $D_{16}$ (mm) | # | 33 | 33 | 33 | 36 | 20 | 17 |
| | $D_5$ (mm) | # | 18 | 16 | 14 | 17 | 11 | 10 |
| Pool Characteristics | Pool Area (%) | ≥25 | 47 | 48 | 34 | 35 | 86 | 83 |
| | Pool Spacing (CW/pool) | ≤6.0 | 5.1 | 5.2 | 2.4 | 2.3 | 4.4 | 5.0 |
| | Residual Pool Depth (m) | ≥0.91 | 0.54 | 0.51 | 0.54 | 0.49 | 0.40 | 0.42 |
| | Pools Assoc. w/wood (%) | ≥50 | 83 | 83 | 100 | 92 | 71 | 67 |
| Large Woody Debris | Total Piece Frequency (#/100 ft) | f(CW) | 5.43 | 5.3 | 4.44 | 5.7 | 4.14 | 4.89 |
| | Total Piece Count | # | 31 | 30 | 70 | 90 | 11 | 13 |
| Water Temperature | MWAT (°C) | ≤16.8 | 17.1 | | 18.4 | | 14.5 | |
| Riparian Overstory | Canopy Over Stream (%) | f(CW) | 98 | 99 | 91 | 87 | 98 | 99 |
| | Canopy of Rip Forest (%) | ≥85 | | | | | | |

## ATM METHODS REVISITED

Bed Surface

Analyses of the QA/QC measures indicate adjustment to protocols is warranted to achieve greater consistency and confidence in measurements. Bed surface surveys include the measurement of 600 pebbles in three riffles using a systematic approach. Refinements to sampling protocol include exclusion of boulders (> 254mm), systematic sampling that includes a grid process for measuring an entire riffle, and minimum spacing based on the largest particle size. These specified procedures allow for more consistent implementation of methods.

Bed Subsurface

Bed subsurface measurement is conducted by collecting three pool tail-out bulk sediment samples with a shovel. Difficulties with consistent measurement of the subsurface are due to 1) limitations in the ability to sample large substrate with a shovel, 2) heterogeneity of sediment distribution in pool tail-outs, and 3) a relatively small sample size collected from each site. Due to the inherent variability of this measure, HRC has discontinued the collection and processing of bulk sediment samples. This change was made in consultation with the HCP Agencies (2014).

Pool Habitat Delineation

HRC added criteria for consistent delineation of pools in 2013. Current pool criteria require a pool to have a minimum surface area of 3 $m^2$ for streams with a wetted width of < 3 m and must be at least one half the wetted channel widths. For streams with a wetted width of > 3 m, a pool must have a minimum surface area of 6 $m^2$ and a width of at least one half the wetted channel widths. This change reduces subjectivity (surveyor bias) when considering determination of marginal pool habitat in favor of established minimum criteria.

In-stream Large Wood

APFC targets for LWD are based on a bank-full width, as measurement of LWD is limited to the bank-full channel. These measurement limits require all field observers to consistently identify bank full as they move through each stream reach. This identification can be complicated in areas with braided channels (i.e., ATM 174, Jordan Creek), or areas where the bank-full width cannot be observed from the thalweg (i.e., ATM 164, Yager Creek). Previous LWD sampling techniques highlighted the challenges in evaluating trends for wood in streams. New methods for LWD data collection minimized these

challenges by reducing the effects of observer bias such as the inconsistent identification of bank-full boundaries.

Bank-full width is used to calculate APFC targets for length, diameter, and total LWD volume. Previous inconsistencies were identified within the ATM dataset due to bank-full widths being collected on an annual basis at different locations. For example, bank-full widths collected during habitat delineation on an annual basis varied as much as ±75% for the same ATM reaches from year to year. This variation in bank-full width was the result of measurement errors and changes in measurement locations, as previous methods called for measurements to be taken at standard distances and not at locations that are representative of average channel conditions.

To increase consistency, a standard bank-full width was calculated for each ATM reach using a combination of permanent cross-sections and habitat measurements. Standardized bank-full widths do not include areas outside the active main channel (i.e., braided reaches). The standard bank-full width was then applied to LWD data collected since 2005 and wood loading characteristics subsequently re-calculated for consistent comparison over time. The standard bank-full width for each ATM reach will be revisited periodically and adjusted if significant changes in stream channel warrant.

Beginning in 2015, LWD pieces were counted, and distances were recorded as to the location of each piece. Measurements of diameter, length, volume, and determination of number of key pieces were discontinued except during extended wood surveys which are to be conducted once every 6 years. Designation of extended wood survey reaches were determined during watershed analysis revisit and limited to reaches where wood is critical in habitat development. This change was made in consultation with the HCP Agencies (2014).

Riparian Canopy

Also beginning in 2015, riparian forest canopy closure measurements were limited to ATM riparian stands where less than 85% canopy closure was recorded in the prior ATM survey. No riparian canopy closure measurements were required in stands with 85% or more riparian canopy closure documented in the prior ATM survey unless a significant disturbance has occurred since last surveyed (e.g., harvest, blow-down, landslide, fire, disease, or insect mortality). This change was made in consultation with the HCP Agencies (2014).

Juvenile Salmonid Surveys

Occupancy surveys have been conducted at ATM locations since 2012 and later formally added to the standard ATM protocol in 2014 after consultation with the HCP signatory agencies. These surveys may provide anecdotal insight to the spawning success during the previous winter and may provide insight as to the rate of colonization by non-native, invasive aquatic species in watercourses within HRC's ownership. It is anticipated that the long-term findings from these surveys will help to corroborate the results from the habitat monitoring portion of the ATM program.

Elk River ATM Stations

Changes specific to ATM monitoring in Elk River were submitted as part of the Elk River Watershed Analysis Revisit and implemented in consultation with HCP signatory agencies (2014). These changes include:

1. A reduction in ATM stations from ten (10) to seven (7)

2. A reduction in ATM site visit rotation from an annual to a three-year cycle (stream temperature and juvenile salmonid surveys will continue annually)

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# APPENDICES

# CROSS-SECTION PLOTS (ON CD)