MENDOCINO • HUMBOLDT
Redwood Companies

Class I Stream Aquatic Habitat Trends Monitoring

2022 Annual Report

June 30, 2023

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 50 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 using an easily read, color-coded report card for each individual ATM station. Those ATM data can also be grouped to get a broader understanding of the watershed as a whole, resulting in habitat composite scores for each WAU. Lastly, the complete record of data points can be plotted to show long term trends and detect direction and magnitude of change over time. Those charts are currently presented in the Watershed Analysis Revisit reports due to the high number of graphics and scope of information they provide. For this annual ATM report, long-term trends results are concisely summarized in a chart that uses color-coded arrows for easy interpretation (Table 1). The following is a brief summary of survey results in 2022:

In the Van Duzen River WAU, the greatest improvements in habitat composite scores were observed in LWD piece frequency, mid-channel canopy cover, and stream temperature. Pool characteristics scored equally as well as in 2019, while bed surface scored substantially less than in years prior.

In the Lower Eel River WAU, for Bear Creek, the greatest improvement in habitat composite score was observed in bed surface. Pool Characteristics, LWD, canopy cover, and stream temperature remained stable between 2021 and 2022.

For the remaining ATM stations in the Lower Eel River WAU, the greatest improvements in habitat composite scores were observed in bed surface, pool characteristics, and LWD. Canopy cover and stream temperature scores remained stable from 2019.

Table 1. Long-term ATM trends summary chart relative to APFC targets (2003-2022).

Stream Station	Particle Size/Avg D_{50} (mm)	Pool Area (%)	Pool Spacing (CW/pool)	Residual Pool Depth (m)	Pools Assoc. with LWD (%)	Total LWD Piece Frequency (#/100 feet)	MWAT (°C)	Overstream Canopy cover (%)	Riparian Canopy Cover (%)
ATM Station 203 (Bear Creek)	→	–	→	–	–	←	→	→	→
ATM Station 107 (Bear Creek)	→	→	→	–	–	←	→	→	→
ATM Station 204 (Bear Creek)	→	→	→	–	–	←	→	→	→
ATM Station 205 (Jordan Creek)	→	→	→	→	→	→	→	→	→
ATM Station 174 (Jordan Creek)	→	→	→	←	→	←	→	→	→
ATM Station 242 (Atwell Creek)	→	→	→	–	–	←	–	–	←
ATM Station 106 (Monument Creek)	←	←	←	←	←	←	–	←	←
ATM Station 130 (Shively Creek)	→	→	→	←	←	←	–	→	←
ATM Station 171 (Stitz Creek) *	N/A	N/A	N/A	N/A	N/A	N/A	–	N/A	N/A
ATM Station 108 (Cummings Creek)	→	←	←	–	←	←	–	→	←
ATM Station 111 (Grizzly Creek)	→	–	→	←	–	–	→	→	→
ATM Station 112 (Hely Creek)	→	←	←	–	–	←	–	←	→
ATM Station 003 (Root Creek)	→	→	→	←	–	→	–	←	–

→ **Toward APFC Target**
← **Away From APFC Target**
– **Static**
* **Habitat Monitoring Discontinued**

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INTRODUCTION

HRC manages approximately 211,000 acres of redwood and Douglas-fir forests in Humboldt County, California for long-term production of forest products. 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 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 (Class I) streams. All monitored 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.

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. HRC owns most of the area in some watersheds while company ownership is a small portion of others. To facilitate analyses of this extensive property, HRC has divided its ownership into eight Watershed Analyses Units (WAUs). Watershed analyses are a comprehensive synthesis of all forestry management related information available, typically recurring on a 10-year rotation. Watershed analyses have 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 detailed description of the locations, physical characteristics, major watercourses, and dominant vegetation within each WAU 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 1, organized by WAU, and arranged by drainage area.

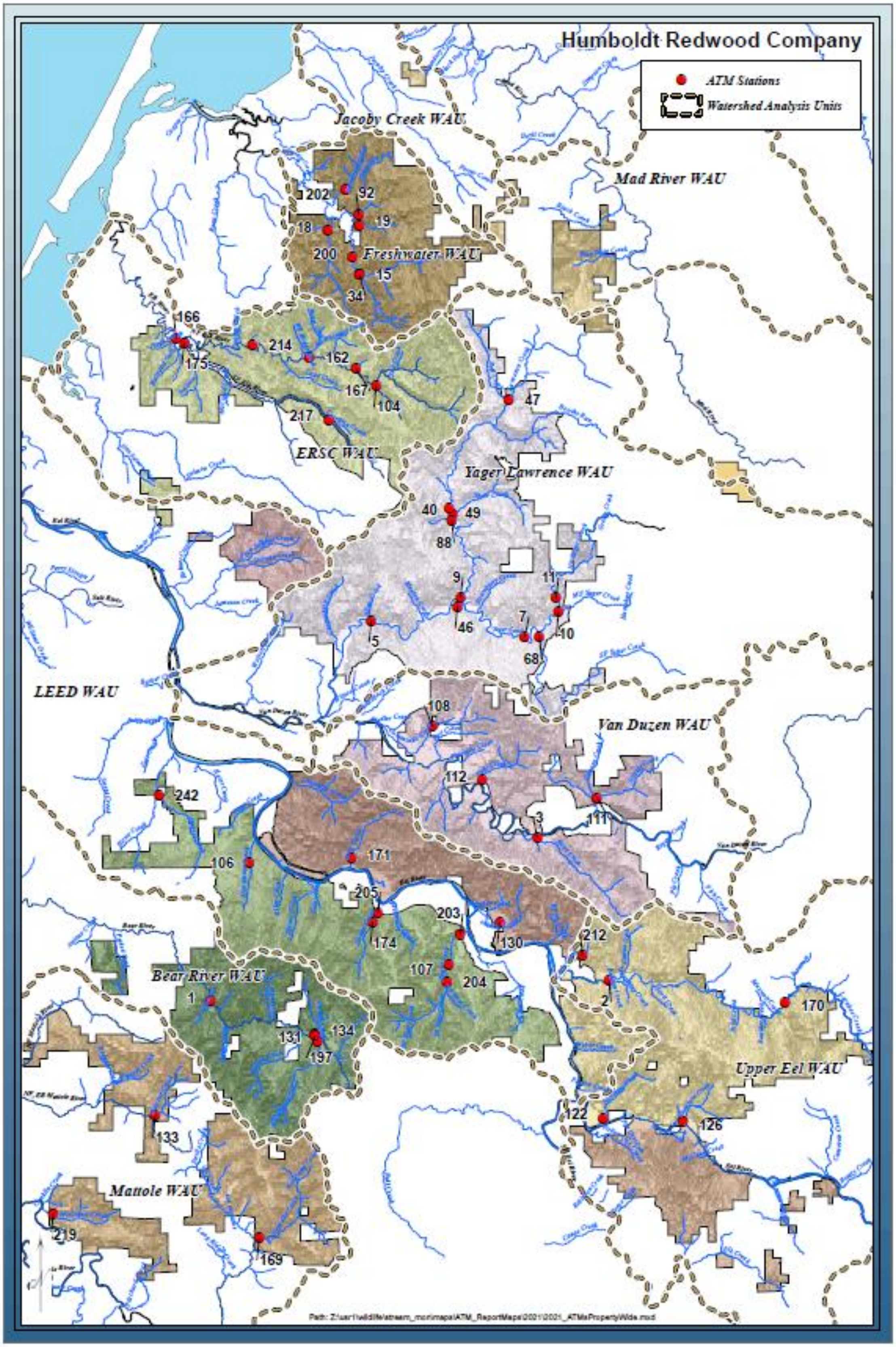


Figure 1. Map showing all currently active ATM sites property wide.

Table 2. 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		
									2022	2023	2024
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 10 years (next = 2023)			X	
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		
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	

Table 2 (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*		
									2022	2023	2024
	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
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 2 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 3 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 3. Parameters measured in the HRC ATM monitoring program.

Characteristic	Measurement Parameters	Standard Operating Protocol
Channel dimensions	Channel gradient Channel width Cross-sectional area	SOP-15: *Aquatic trends monitoring site selection, monumenting and documentation* 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 Pool spacing Residual pool depth % Pools associated with wood	SOP-14: *Stream Habitat Typing*
LWD frequency and distribution	Frequency (# pieces/100 ft.) 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) % 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 substrate measurements 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.

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. 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 1), 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.

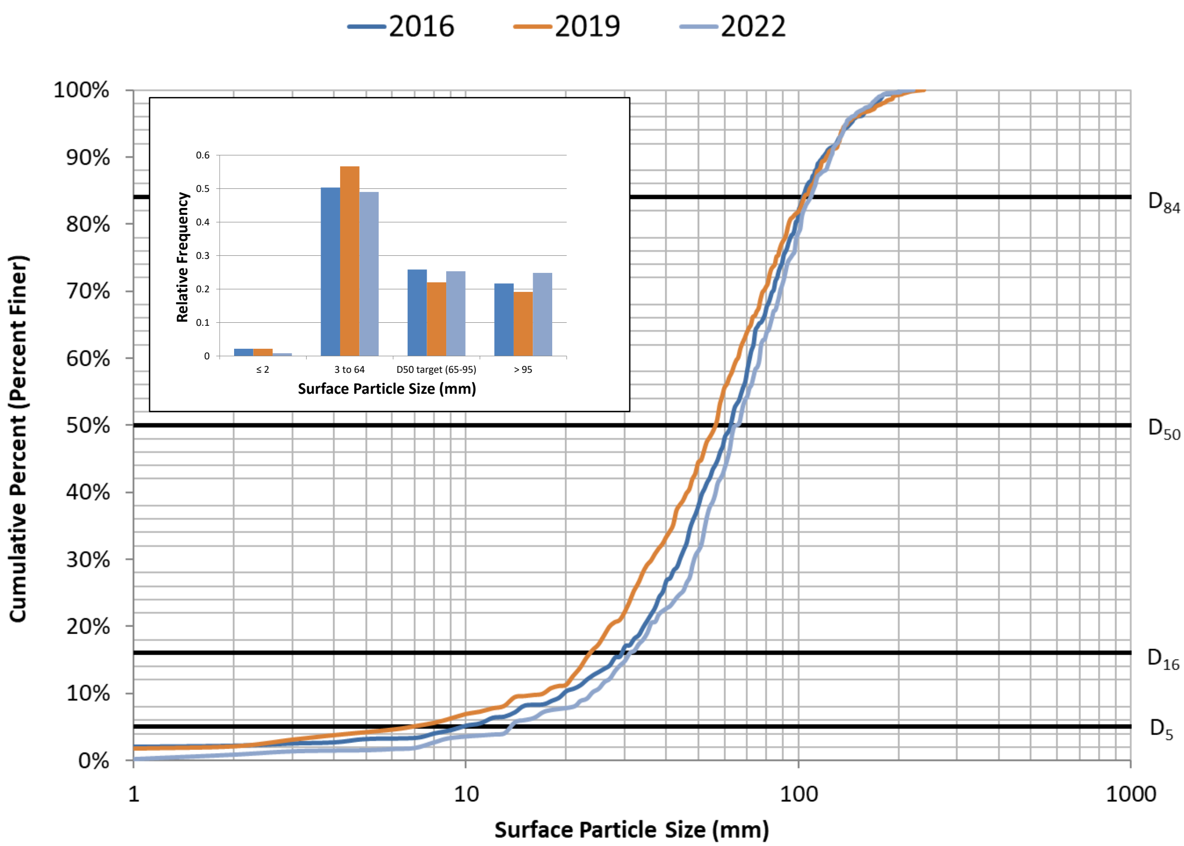


Figure 2. Example of a cumulative frequency (percent finer) plot of the mean surface particle sizes (mm) of three riffles measured within an ATM survey reach.

Channel Dimensions

Cross-sectional streambed surveys are conducted to determine streambed elevation and area changes over time (Figure 2). 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).

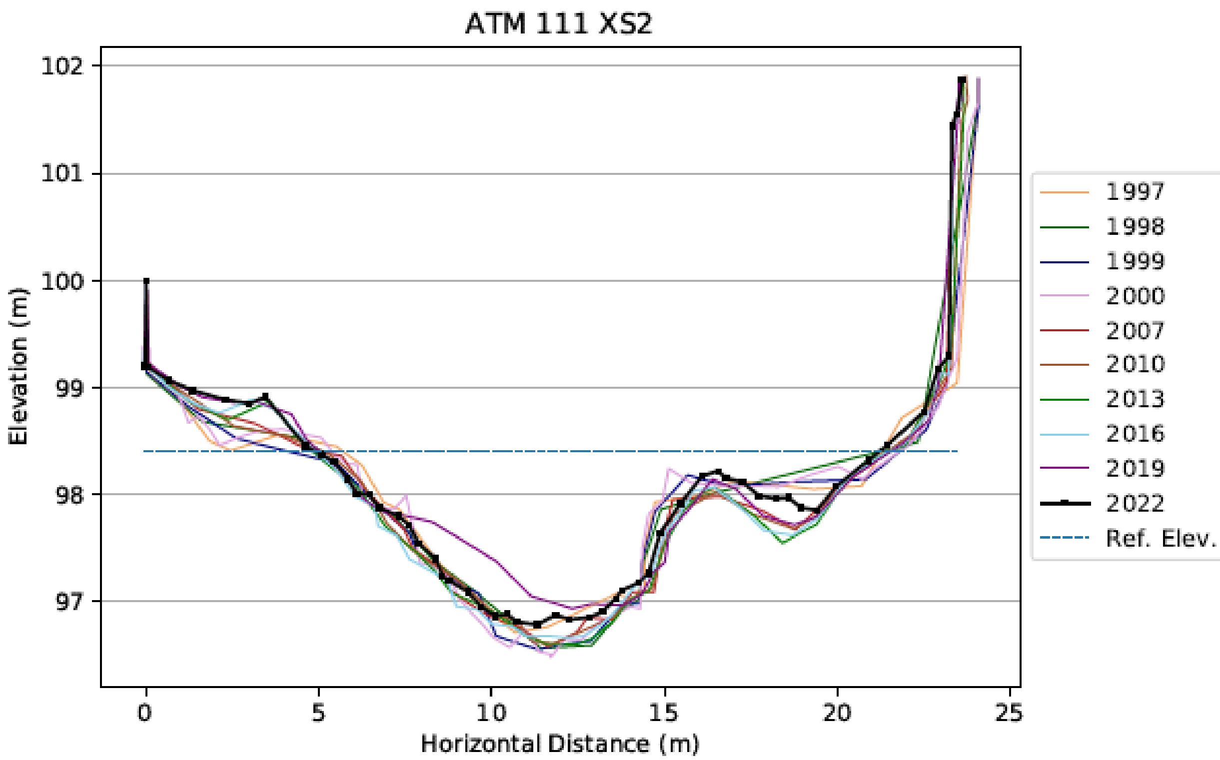


Figure 3. Example of a typical cross-sectional profile within an ATM survey reach.

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 percentage of pools associated with LWD parameter will continue to be collected as part of pool habitat measurements.

Pools, Riffles, and Flatwater

HRC conducts habitat typing on stream reaches to assess the frequency (i.e., the percentage of channel length composed of pools, riffles, and flatwater), length, width, and depth. Measurements are taken of each distinct habitat unit in the sampling reach, broken out at distinguishable transitions such as riffle crests and heads of pools. After basic physical measurements such as length, width and residual depth are measured, observations of LWD influence are recorded whether the pools were formed by LWD or merely associated with LWD in some other way.

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. The residual pool depth is equal to the difference between maximum depth and pool tail crest depth.

Riparian Overstory

Canopy cover measurements (percent overstory) 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 and within the riparian forest. 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). Overstory canopy closure data in the riparian forest adjacent to the stream channel are 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 perforated PVC cases 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 3 illustrates a typical temperature profile as measured at ATM stations property wide.

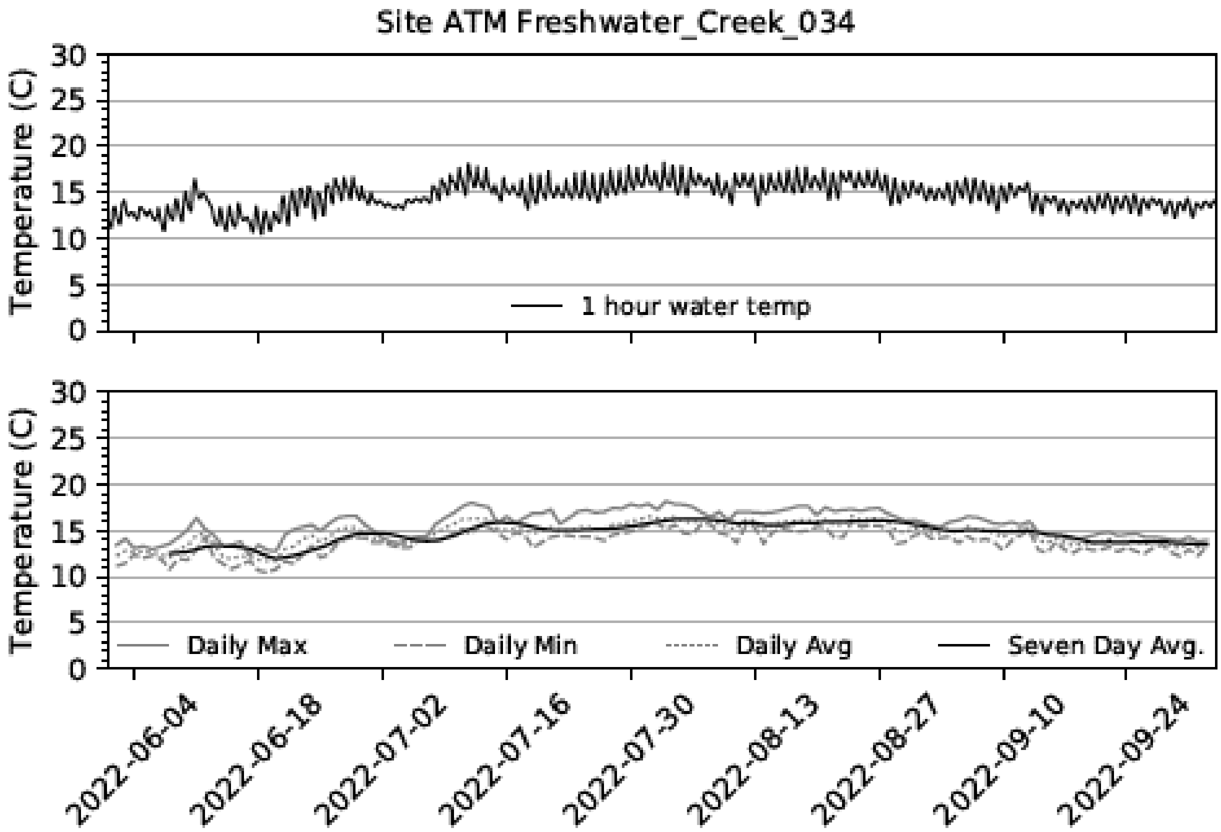


Figure 4. Example of a stream temperature profile generated from a continuously-recording temperature data logger deployed annually at most ATM stations.

PROGRAM IMPLEMENTATION – 2022

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 the HCP Signatory Agencies, NCRWQCB, and make them publicly available.
- Provide habitat and channel morphology information to the HRC Watershed Analysis Process and THP cumulative effects analyses.

LOCATIONS OF FIELD MEASUREMENTS

Table 4 lists the field activities scheduled for 2022 and accomplishments against this plan. Pebble count, canopy closure, habitat typing, LWD counts, and streambed surveys were conducted at 12 stations in the Van Duzen River and lower Eel River drainages. Stream temperature loggers were deployed at 50 sites property wide. All fieldwork was completed within the scheduled time period and all habitat data collection occurred prior to any major storm events.

Table 4. 2022 scheduled activity in the HRC ATM Program.

Watershed	Habitat		Temperature	
	Scheduled	Completed	Scheduled	Completed
Freshwater Creek	0	0	7	7
Elk River	0	0	7	7
Yager Creek	0	0	6	6
Lawrence Creek	0	0	5	5
Van Duzen River	4	4	4	4
Eel River Delta	2	2	2	2
Lower Eel Tributaries	3	3	3	3
Bear Creek	3	3	3	3
Upper Eel Tributaries	0	0	2	2
Larabee Creek	0	0	3	3
Mattole River	0	0	3	3
Bear River	0	0	4	4
Mad River	0	0	1	1
TOTAL	**12**	**12**	**50**	**50**

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 intend 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 2022 for QA/QC purposes (Appendix E). Ideally, the QAQC survey reaches are replicated by the same two-person crew that had conducted the initial survey. However, due to staffing constraints in 2022, a third surveyor had participated in the measurements of at least one revisited ATM station, resulting in greater variance in survey results in 2022.

Long-term QA/QC records generally reflect a high degree of reproducibility with increasing precision. This is demonstrated in the stable or decreasing level of variance through time (Appendix E)

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 36 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 5. 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. Previous measurements from WAUs not monitored in 2022 can be found in previously submitted ATM annual reports.

Table 5. Example watershed report card.

2022	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			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	16.3	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		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 there are nine (9) parameters and 10 stations, there are 90 opportunities for success. Note that in Table 5 there are two (2) stations that do not have total LWD piece frequency values 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 5, there are 46 successes, yielding a watershed composite habitat score of 0.55 (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 5) 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.

WATERSHED HABITAT RESULTS

WEATHER IN 2022

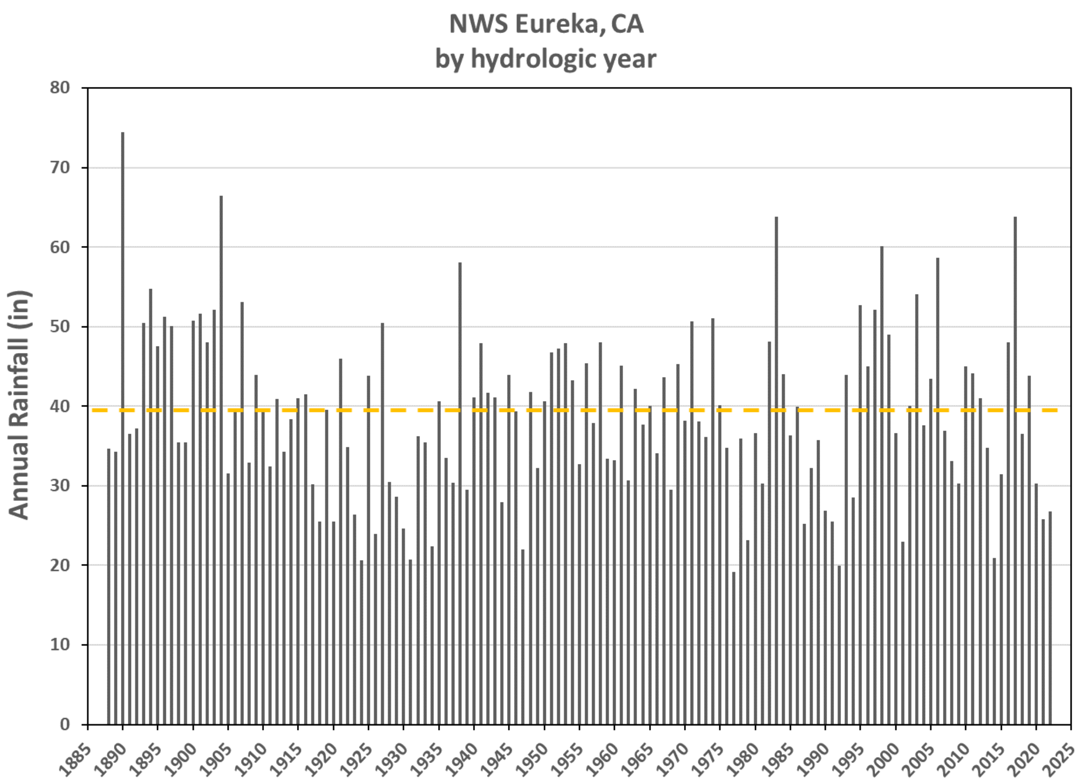
Precipitation is calculated by the "hydrologic year" that runs from October 1 through September 30 and is numbered for the year in which it ends. Rainfall data collected at the Woodley Island National Weather Station (NWS) in Eureka, CA, indicate an average total annual rainfall of 39.06 inches[1] with roughly 90% of the annual precipitation falling as rain during the months of October through May. Rainfall amounts in hydrologic year 2022 (October 1, 2021, through September 30, 2022) were substantially 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 in HY2022 was 26.80 inches, approximately 46% lower than the long-term average. Maximum daily rainfall was 1.01 inches, suggesting that peak flows were 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 HY2022 was 30.72 inches, which is approximately 53% lower than the long-term average for this station. The maximum peak flow measured at the gaging station at the Eel River near Scotia was 55,200 cubic feet per second (cfs), with a corresponding maximum daily mean of 44,100 cfs occurring on December 24, 2021. 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 4.

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 5). 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)



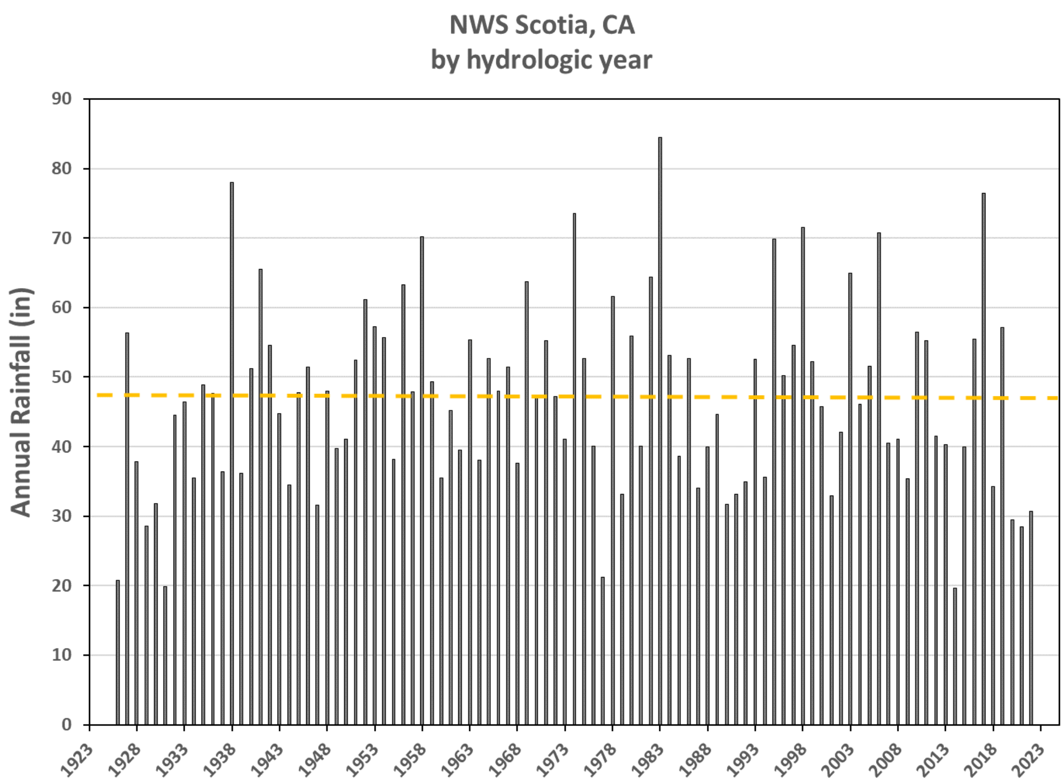
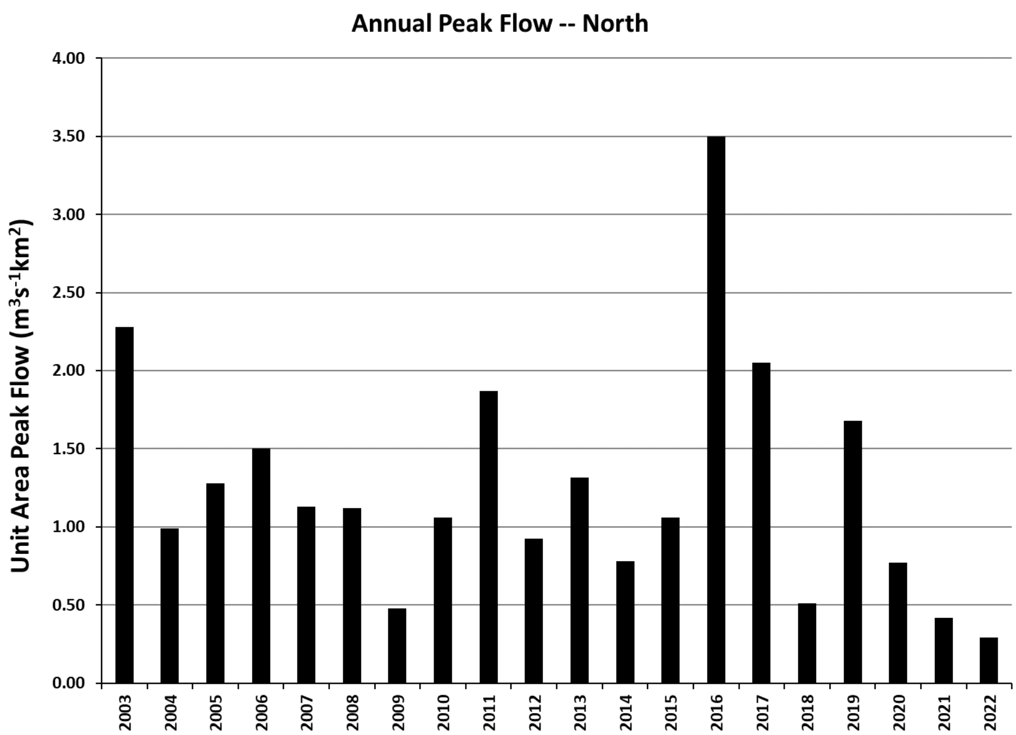


Figure 5. Annual rainfall by hydrologic year at Eureka and Scotia, CA. Dotted lines represent the running averages (all years).



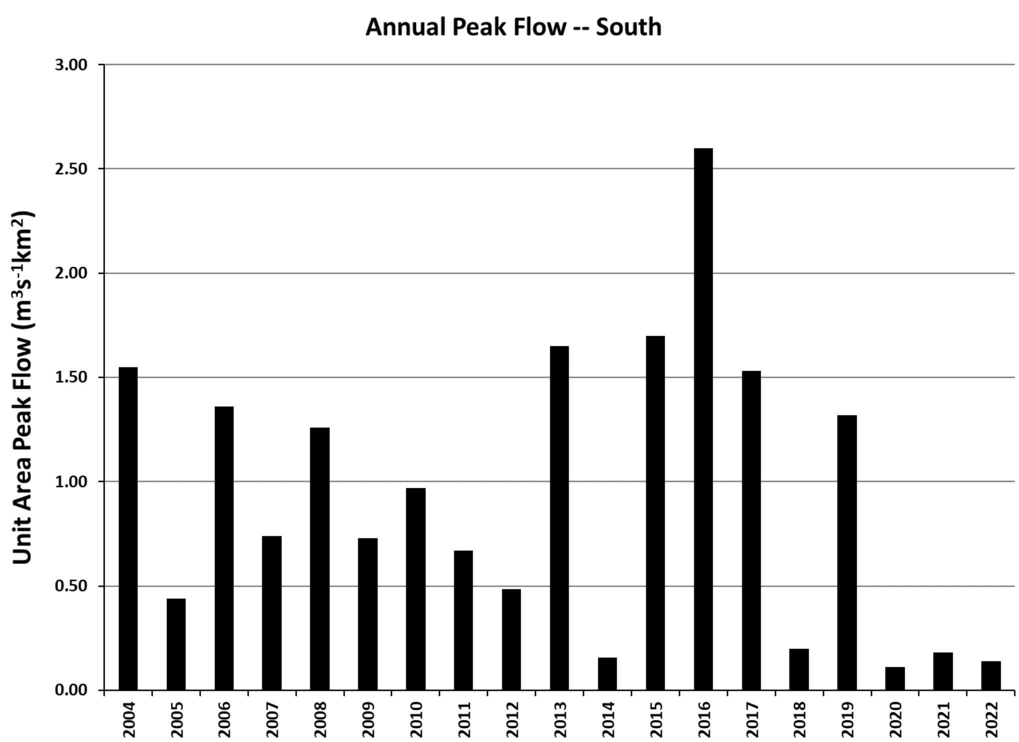


Figure 6. Reference streamflow sites are represented by Graham Gulch (site 505) in Freshwater Creek (north) and by Bear Creek (site 530) in the south.

VAN DUZEN WAU

The Van Duzen WAU is centrally located within HRC's ownership, encompassing the lower three miles of Yager Creek and the Van Duzen River watershed excluding the headwaters. Approximately 45 percent of this area is located within HRC ownership.

Anadromous salmonids utilize all tributaries within the WAU. Steelhead trout are currently the most abundant species, followed by Chinook and coho salmon. Coastal cutthroat trout have been documented in Fox Creek, which enters the Van Duzen River just upstream of Cummings Creek. Although no coastal cutthroat trout have been documented by HRC biologists during annual snorkel surveys, a portion of the WAU still encompasses some of the southeasternmost range of the species. Invasive Sacramento pike minnows are currently thriving in the mainstem Van Duzen River but are yet to be observed in the four stream reaches monitored by HRC during the ATM surveys.

Figure 7 shows the location of the four Van Duzen WAU ATM sites: Cummings Creek, Hely Creek, Root Creek, and Grizzly Creek. Habitat, snorkel, and cross-section surveys were conducted at these locations in 2022, and typical conditions are shown in Figure 8.

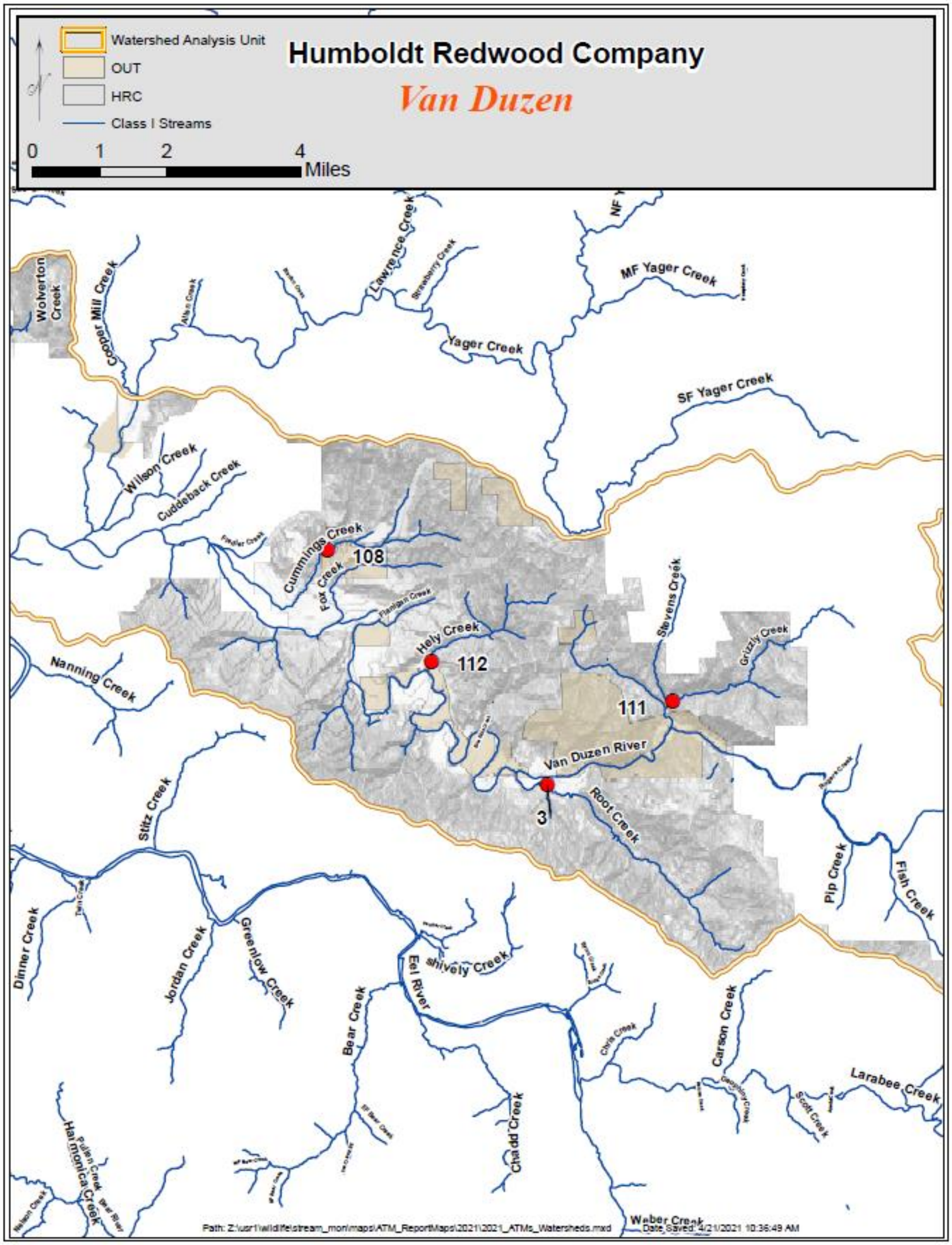


Figure 7. Map showing the four ATM station locations within the Van Duzen WAU.

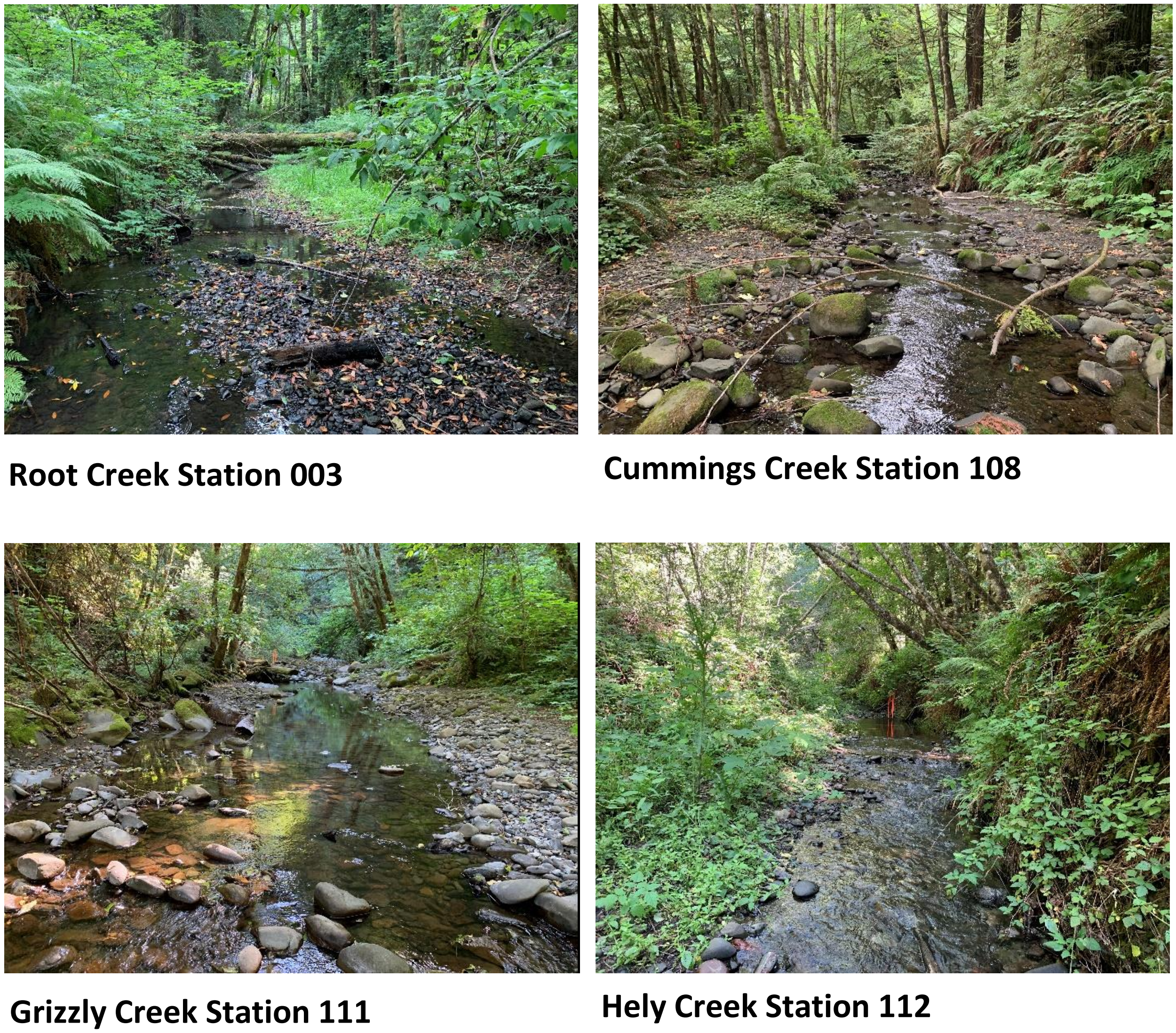


Figure 8. Typical site conditions of the four ATM stations within the Van Duzen River WAU.

ATM Station 003 – Root Creek [Underlying Geology: Quaternary age Alluvium (basement rock = Cretaceous to Pliocene age Coastal belt of the Franciscan Complex, specifically the Coastal terrane)]

Data for all ATM parameters at site 003 (Figure 8) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met at this site in 2022, although the data suggest a coarsening of substrate particles within all size classes (Appendix B). Pool characteristics remained generally static since 2004, with residual pool depth staying consistently short of its target. Total LWD pieces increased by 50% since 2019, as total LWD piece frequency met the APFC target by a margin of 2.3 pieces per 100 feet of stream channel. Water temperature met the target five years straight since 2018, as mid-channel canopy met the target after failing only once in 2016.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (Appendix C). Aggradation was observed at 5/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 2 (-1.47m^2).

A snorkel survey conducted on 8/26/2022 found no fish in any of the 5 pools sampled (Appendix D). Multiple foothill yellow-legged frogs (*Rana boylii*) were observed occupying the stream reach. Juvenile coho salmon have not been detected in this ATM reach since 2013.

ATM Station 108 – Cummings Creek [Underlying Geology: Miocene to Late Pliocene age Wildcat Group]

Data for all ATM parameters at site 108 (Figure 8) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met at this site in 2022, as the data suggest a fining of most substrate size classes (Appendix B). Pool characteristics suggest a general decline in habitat quality since 2010, although 100% of pools surveyed were either formed by or associated with LWD. The total LWD piece frequency within the surveyed reach remained short of the APFC target by a margin of 4.4 pieces per 100 feet of stream channel, as total LWD increased by a mere 1 piece since 2019. Water temperature met the target for the 20th consecutive year on record, and mid-channel canopy cover met the target for the 5th straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2007 (Appendix C). Aggradation was observed at 3/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 3 (-0.21m^2). The greatest degree of channel scour occurred at cross-section 5 where the channel area increased +0.21m^2.

A snorkel survey conducted on 8/26/2022 identified trout of various size classes in each of the 5 pools sampled (Appendix D). Also identified was one rough-skinned newt (*Taricha granulosa*). Juvenile coho salmon have yet to be detected in this ATM reach.

ATM Station 111 – Grizzly Creek [Underlying Geology: Cretaceous to Pliocene age Coastal belt of the Franciscan Complex (specifically the Yager terrane)]

Data for all ATM parameters at site 111 (Figure 8) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the data suggest a coarsening of the substrate across most particle size classes (Appendix B). Pool characteristics remained generally static since 2013, with residual pool depth consistently failing to meet the target. The total LWD piece frequency within the surveyed reach met the APFC target as total LWD pieces increased by 45% since 2019. Water temperature exceeded the target by 0.2 °C while mid-channel canopy cover met the target goal for the 5^{th} consecutive survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (Appendix C). Aggradation was observed at 3/6 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 1 (-0.71m^2). The greatest degree of channel scour occurred at cross-section 3 where the channel area increased +1.93m^2.

A snorkel survey conducted on 8/26/2022 identified trout of various size classes in all 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed in the reach in 2022. Chinook salmon have not been seen since 2013 and juvenile coho salmon have yet to be detected in this ATM reach.

ATM Station 112 – Hely Creek [Underlying Geology: Quaternary age Alluvium (basement rock = Miocene to Late Pliocene age Wildcat Group)]

Data for all ATM parameters at site 112 (Figure 8) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met in 2022, as the data suggest a fining of the substrate across all particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth and pool area consistently short of their targets. The total LWD piece frequency within the surveyed reach did not meet the target in 2022, as total LWD pieces decreased by 23% since 2019. Water temperature met the target for the 19^{th} consecutive year, as mid-channel canopy cover met the target after falling short two consecutive survey years in 2016 and 2019.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2007 (Appendix C). Channel scour was observed at 2/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 3 (+0.19m^2). The greatest degree of aggradation occurred at cross-section 1 (-0.75m^2).

A snorkel survey conducted on 8/26/2022 identified juvenile trout in all 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed occupying the stream reach. Juvenile coho salmon were detected in this ATM reach in 2022, the first time since 2013.

Summary of ATM Trends in the Van Duzen WAU

A summary of the Van Duzen habitat characteristics from 2022 is provided in an APFC report card (Appendix A). Results of habitat composite scores from 2022 and 2019 are compared to baseline (2003) data (Appendix A). Overall, the greatest improvements in habitat composite scores were observed in LWD piece frequency, mid-channel canopy cover, and stream temperature. Pool characteristics scored equally as well as in 2019, while bed surface scored substantially less than years prior.

LOWER EEL RIVER AND LOWER EEL DELTA WAU

HRC has ownership within both major and minor 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 Analyses. 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.

Anadromous salmonids utilize all tributaries within the WAU. Steelhead trout are currently the most abundant species, followed by Chinook and coho salmon. Resident coastal cutthroat trout have been documented in Stitz Creek, currently the southernmost extent of the species known range, entering the Eel River between Dinner and Jordan Creeks. Coastal cutthroat trout have been consistently documented by HRC biologists during annual snorkel surveys in Stitz Creek upstream of the 12-foot-high drop beneath the Shively Road culvert, a known barrier to anadromous fish passage. Invasive Sacramento pike minnows are currently thriving in the mainstem Eel River and have been observed in Bear and Jordan Creeks by HRC biologists during the ATM surveys.

There are eight (8) ATM sites in the Lower Eel WAU, including three in Bear Creek, two in Jordan Creek, and one each in Monument Creek, Shively Creek, and Atwell Creek (Figure 9). 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. Habitat, snorkel, and cross-section surveys were conducted at these locations in 2022, and typical conditions are shown in Figures 10 and 11.

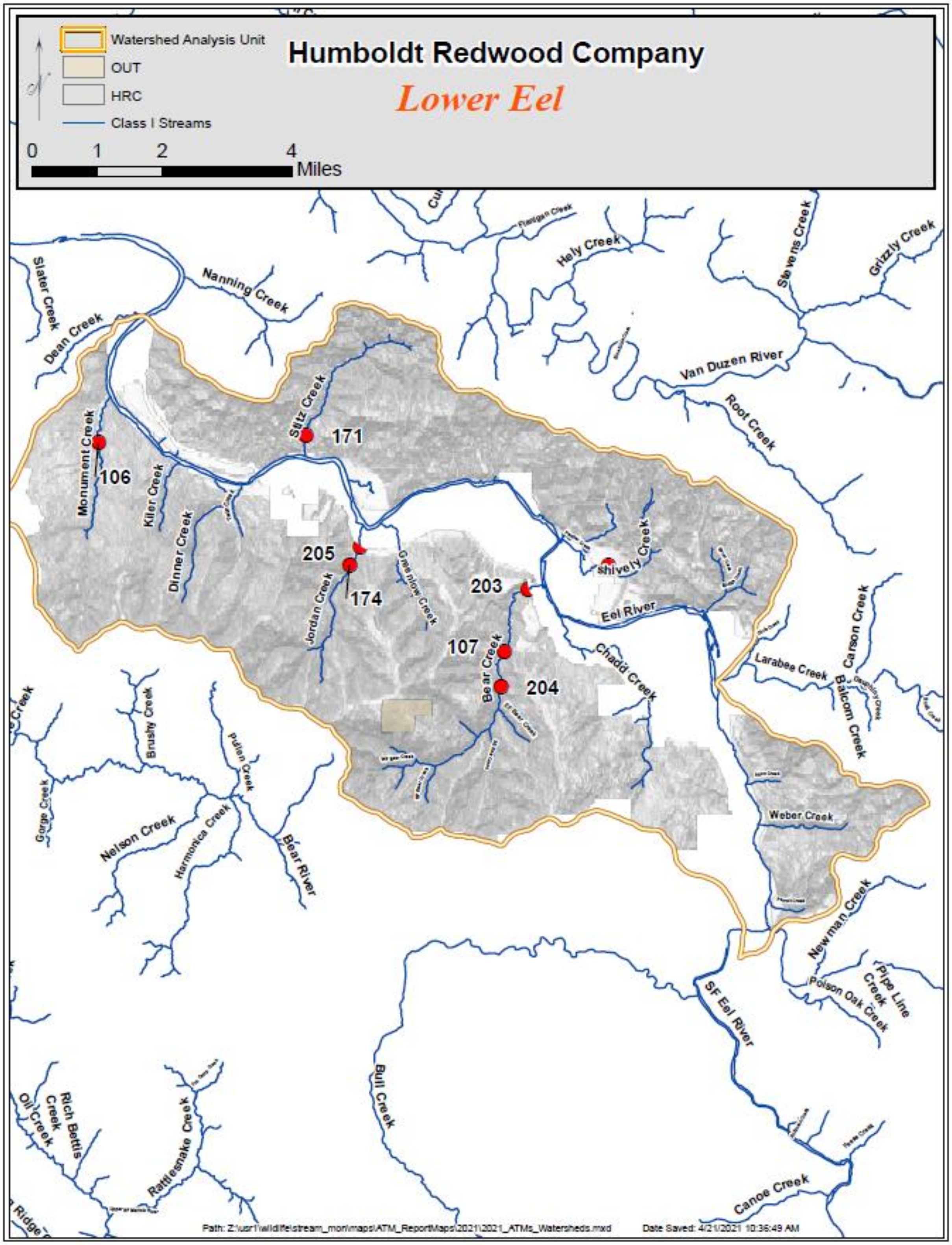


Figure 9. Map showing the locations of the eight ATM stations in the Lower Eel River WAU.

Bear Creek Station 203

Bear Creek Station 204

Bear Creek Station 107

Figure 10. Typical site conditions of the Bear Creek ATM stations within the Lower Eel River WAU.

Jordan Creek Station 205

Jordan Creek Station 174

Monument Creek Station 106

Shively Creek Station 130

Atwell Creek Station 242

Figure 11. Typical site conditions of the remaining ATM stations within 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 10) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the data reflect a coarsening of the substrate across all particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth consistently short of its target. LWD piece frequency met the APFC target, even as total LWD pieces decreased (-33%) since 2021. Water temperature met the target, as mid-channel canopy cover also met its target for the 3rd consecutive year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (Appendix C). Aggradation was observed at 4/5 cross-sections between survey years 2021 and 2022, the greatest degree of which occurred at cross-section 5 (-0.83m^2). Scour occurred at cross-section 1 where the channel area increased +0.56m^2.

A snorkel survey conducted on 8/30/2022 identified trout of various size classes in all 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed occupying the stream reach. Juvenile coho salmon were last detected in this ATM reach in 2021.

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

Data for all ATM parameters at site 107 (Figure 10) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the data reflect a coarsening of the substrate across most particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth consistently short of its target. LWD piece frequency met the APFC target, as total LWD pieces increased (+8%) since 2021. Water temperature met the target for the 5th year straight, as mid-channel canopy cover met its APFC target for the 3rd consecutive year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1998 (Appendix C). Aggradation was observed at 5/6 cross-sections between survey years 2021 and 2022, the greatest degree of which occurred at cross-section 2 (-0.97m^2). Scour occurred at cross-section 5 where the channel area increased +0.29m^2.

A snorkel survey conducted on 8/30/2022 identified trout of various size classes in all 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed occupying the stream reach. Juvenile coho salmon have not been detected in this ATM reach since 2014.

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

Data for all ATM parameters at site 204 (Figure 10) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met in 2022, as the data suggest a fining of the substrate in half of the particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth consistently short of its target. LWD piece frequency met the APFC target for the 8th straight year, even as total LWD pieces decreased (-24%) since 2021. Water temperature met the target for the 7th year in a row, as mid-channel canopy cover met the APFC target for the 3rd straight year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (Appendix C). Aggradation was observed at 5/5 cross-sections between survey years 2021 and 2022, the greatest degree of which occurred at cross-section 4 (-2.14m^2).

A snorkel survey conducted on 8/11/2022 identified trout of various size classes in all 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed occupying the stream reach. Juvenile coho salmon were last detected in this ATM reach in 2021.

ATM Station 205 – Jordan Creek [Underlying Geology: Quaternary age Alluvium (basement rock = Cretaceous to Pliocene age Coastal belt of the Franciscan Complex, specifically the Coastal terrane)]

Data for all ATM parameters at site 205 (Figure 11) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met in 2022, as the data reflect a fining of the substrate in half of the particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth and pool area consistently short of the target criteria. LWD piece frequency met the APFC target for the 4th straight survey year, as total LWD pieces increased (+16%) since 2019. Water temperature has not been measured at this site since 2015 due to repeated vandalism, although water temperatures have generally been below (cooler than) the target threshold in years measured. Mid-channel canopy cover met the APFC target for the 3rd straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (Appendix C). Aggradation was observed at 5/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 2 (-1.13m^2).

A snorkel survey conducted on 8/30/2022 identified juvenile trout in all 5 pools sampled (Appendix D). No other aquatic species were identified. Juvenile coho salmon were last detected in this ATM reach in 2021.

ATM Station 174 – Jordan Creek [Underlying Geology: Cretaceous to Pliocene age Coastal belt of the Franciscan Complex (specifically the Coastal terrane)]

Data for all ATM parameters at site 174 (Figure 11) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the data reflect a coarsening of the substrate across all particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth consistently short of its target. LWD piece frequency met the target by a margin of 0.88 pieces per 100 feet of stream channel. Water temperature met the target for the 18^{th} consecutive year and mid-channel canopy cover met the APFC target for the 5^{th} survey year in a row.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2004 (Appendix C). Aggradation was observed at 2/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 4 ($-1.16m^2$). The greatest degree of channel scour occurred at cross-section 5 where the channel area increased $+14.59m^2$.

A snorkel survey conducted on 8/30/2022 identified a single juvenile trout between all 5 pools sampled (Appendix D). No other aquatic species were identified. Juvenile coho salmon have not been detected in this ATM reach since 2018.

ATM Station 106 – Monument Creek [Underlying Geology: Cretaceous to Pliocene age Coastal belt of the Franciscan Complex (specifically the Coastal terrane)]

Data for all ATM parameters at site 106 (Figure 11) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the pebble count data reflect a coarsening of the substrate across all particle size classes (Appendix B). Pool characteristics suggest improvements in habitat quality, with pool area, pool spacing, and pools associated with LWD meeting their respective targets in 2022. LWD piece frequency met the target in 2022 by a margin of 1.02 pieces per 100 feet of stream channel as total LWD pieces increased (+49%) since 2019. Water temperature met the APFC target for the 5^{th} straight year as mid-channel canopy cover met the target goal for the 5^{th} straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 1997 (Appendix C). Aggradation was observed at 3/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 5 (-0.7m^2). The greatest degree of channel scour occurred at cross-section 3 where the channel area increased +0.07m^2.

Snorkel surveys have been suspended since 2017 (Appendix D) due to unsuitable diving conditions associated with livestock entering the stream channel monitoring reach. Snorkel surveys will resume once this matter has been addressed and water quality conditions have improved. Juvenile coho salmon have yet to be detected in this ATM reach.

ATM Station 130 – Shively Creek [Underlying Geology: Quaternary age Alluvium (basement rock = Cretaceous to Pliocene age Coastal belt of the Franciscan Complex, specifically the Coastal terrane)]

Data for all ATM parameters at site 130 (Figure 11) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was not met in 2019, even as the data reflect a coarsening of the substrate across all particle size classes (Appendix B). Pool characteristics remained generally static since 2016, with residual pool depth consistently short of its target. LWD piece frequency did not meet the APFC target in 2022, even as total LWD pieces increased substantially (+144%) since 2019. Water temperature met the APFC target for the 6th survey year, as mid-channel canopy cover met the target goal for the 4th straight survey year.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2007 (Appendix C). Aggradation was observed at 2/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 5 (-0.31m^2). The greatest degree of channel scour occurred at cross-section 3 where the channel area increased +0.17m^2.

A snorkel survey conducted on 8/25/2022 did not find any fish in the 5 pools sampled (Appendix D). Juvenile coho salmon have not been detected in this ATM reach since 2016.

ATM Station 242 – Atwell Creek [Underlying Geology: Miocene to Late Pliocene age Wildcat Group]

Data for all ATM parameters at site 242 (Figure 11) are summarized in the APFC report card provided in Appendix A. The bed surface APFC target was met in 2022, as the pebble count data reflect stability of the D_{50} particle size class (Appendix B). Pool characteristics reflect a slight improvement in habitat quality since 2019, as residual pool depth remained short of its target. LWD piece frequency has not met the APFC target in the last five survey years, even as total LWD pieces increased 62% since 2019. Water temperature has consistently met the APFC target and mid-channel canopy cover met the APFC target the last five survey years straight.

Cross-section data suggest varying degrees of channel aggradation and scour since surveys were instituted in 2007 (Appendix C). Aggradation was observed at 2/5 cross-sections between survey years 2019 and 2022, the greatest degree of which occurred at cross-section 3 (-0.13m^2). The greatest degree of channel scour occurred at cross-section 4 where the channel area increased +0.43m^2.

A snorkel survey conducted on 8/23/2022 did not find fish in any of the 5 pools sampled (Appendix D). Foothill yellow-legged frogs were observed occupying the stream reach. Juvenile coho salmon have not been detected in this ATM reach since 2018.

Summary of ATM Trends in the Lower Eel River WAU

A summary of the Lower Eel River habitat characteristics from 2022 is provided in the APFC report card Appendix A.

For Bear Creek, results of habitat composite scores from 2022 and 2021 are compared to baseline (2004) records (Appendix A). Pool characteristics, LWD, canopy cover, and stream temperature scores remained stable from the previous year in 2021. Bed surface scores in the Bear Creek watershed showed the greatest improvements in 2022.

For the remaining ATM stations in the Lower Eel River WAU, results of habitat composite scores from 2022 and 2019 are compared to baseline (2004) records (Appendix A). Canopy cover and stream temperature scores remained stable from 2019. Bed surface, pool characteristics, and LWD scores all showed improvements in 2022.

QUALITY ASSURANCE / QUALITY CONTROL

Three of the twelve (3/12) ATM sites measured in 2022 were re-measured to assess the quality and reproducibility of ATM data collection. Normally, data collection is conducted by a two-person field crew through the entire season. However, due to staffing constraints in 2022, the field work was spread between three surveyors on rotation in 2022. This appears to have affected the QA/QC results by increasing the variance beyond what is usually observed. QA/QC sites were re-measured within 4 weeks of the initial measurement. The number of pools surveyed during the QA/QC visit at each site remained consistent with the original survey and bed surface (pebble count) re-measurement took place at the same locations at each site. Results of the 2022 QA/QC are provided in Appendix E.

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APPENDICES

Appendix A: Individual 2022 ATM habitat report cards and WAU composite score charts

Appendix B: ATM bed surface substrate cumulative frequency and relative frequency charts

Appendix C: 2022 ATM cross-section profiles, data, and summary statistics

Appendix D: ATM snorkel survey results (2012-2022)

Appendix E: 2022 ATM QA/QC results and long-term QA/QC trend results