Class I Stream Aquatic Habitat Trends Monitoring

2017 Annual Report

June 30, 2018

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 Condition (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 synthesizes and simplifies presentation of habitat status by taking a pass/fail approach to the APFC target criteria, resulting in habitat composite scores for each WAU. A brief summary of results follows:

In 2017, for the Freshwater Creek WAU, there were improvements in habitat composite scores for pool characteristics. However, composite scores for bed surface particle size and LWD piece frequency were both lower than the 2014 and baseline records. 2017 mid-channel canopy cover and water temperature composite scores remained even with the 2014 records, each scoring higher than their respective baseline records.

In the Elk River WAU, there were improvements in habitat composite scores for pool characteristics and mid-channel canopy cover. However, composite scores for bed surface particle size and LWD piece frequency were lower than both 2014 and baseline records. Water temperature composite scores for both 2014 and 2017 achieved perfect scores (1.00), each scoring higher than their respective baseline records.

In the Lower Eel River WAU, for Bear Creek, there were improvements in habitat composite scores for mid-channel canopy cover. However, the composite scores for bed surface particle size and water temperature were both lower than the 2016 and baseline records. 2017 pool characteristics and LWD piece frequency composite scores remained consistent with the 2016 records.

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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. 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, Figure 1). 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 WAUs. 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 great 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 lists the active monitoring stations, organized by WAU and arranged by drainage area. Currently, there are 44 habitat monitoring sites and 49 temperature monitoring sites.

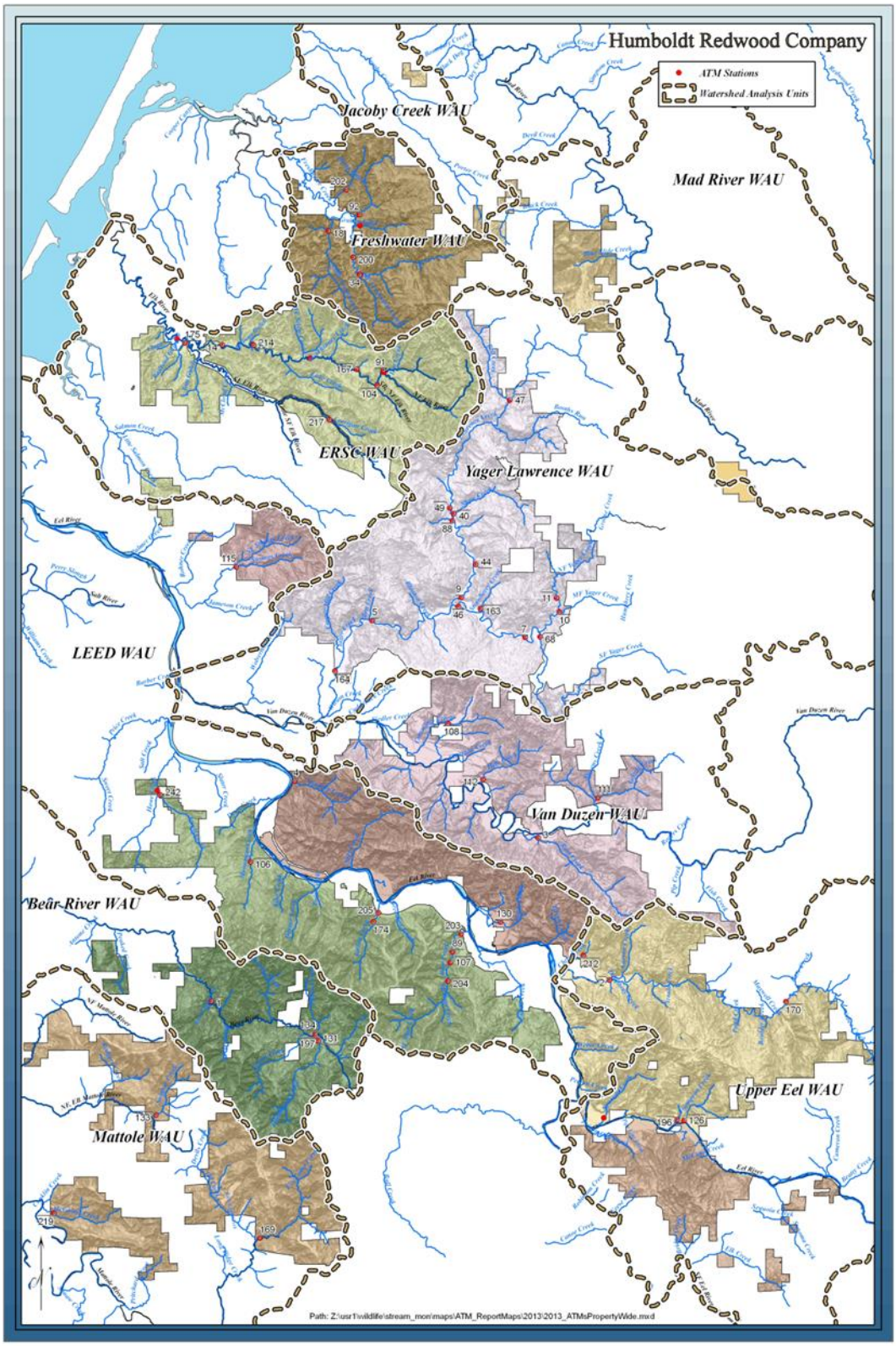


Figure 2. Location map of HRC ATM sites

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		
									2017	2018	2016
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 = 2022)				
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*		
									2017	2018	2016
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, with the exception of 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 [CDFW]). 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 of these flood and precipitation events were exceeded in Freshwater and Elk River in December 2002 and have not been observed since.

Sampling Methods

Each ATM site consists of a stream reach that is at least 30 channel widths long. 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 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_{85})	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 parameters (D_5, D_{16}, D_{85}). 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.

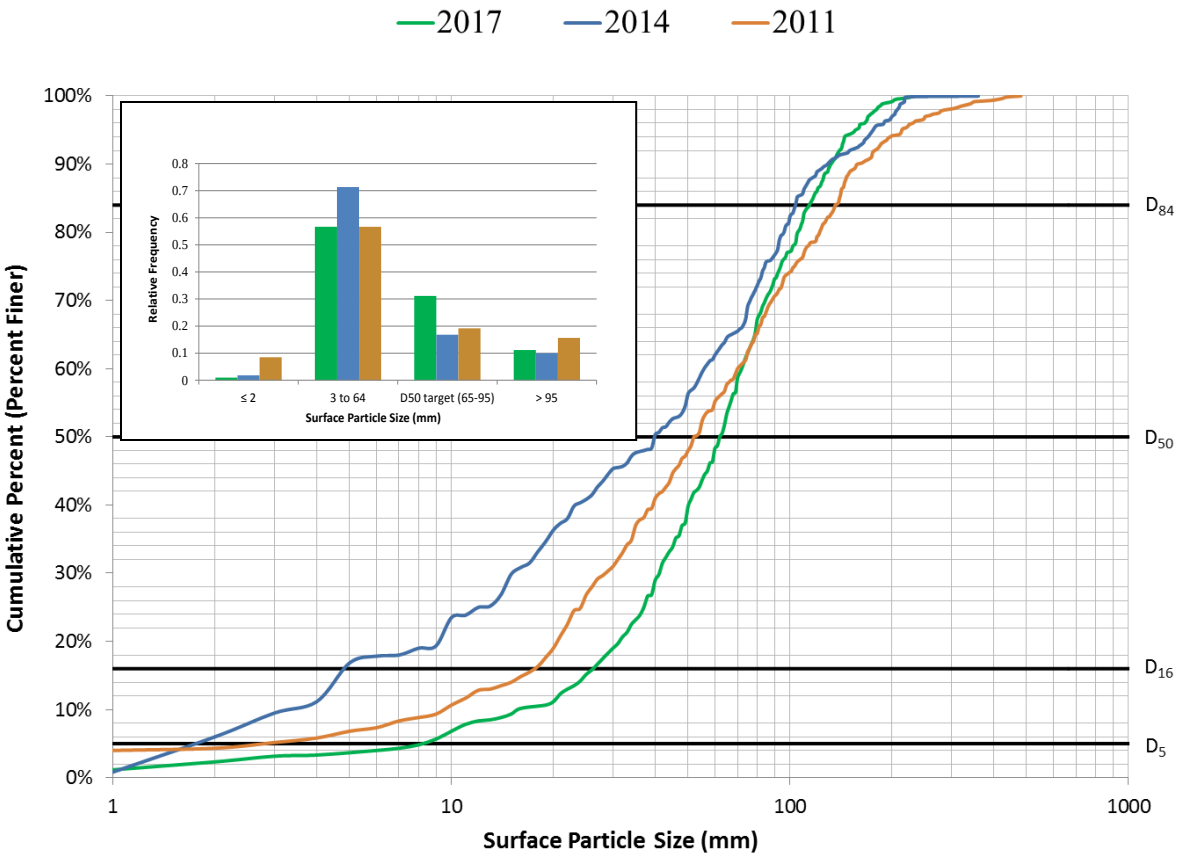


Figure 4. Example of a cumulative frequency (percent finer) plot of the mean surface particle sizes (mm) of three riffles measured within an ATM survey reach

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 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 as reference for the three-dimensional sampling grid encompassing the monitoring reach.

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).

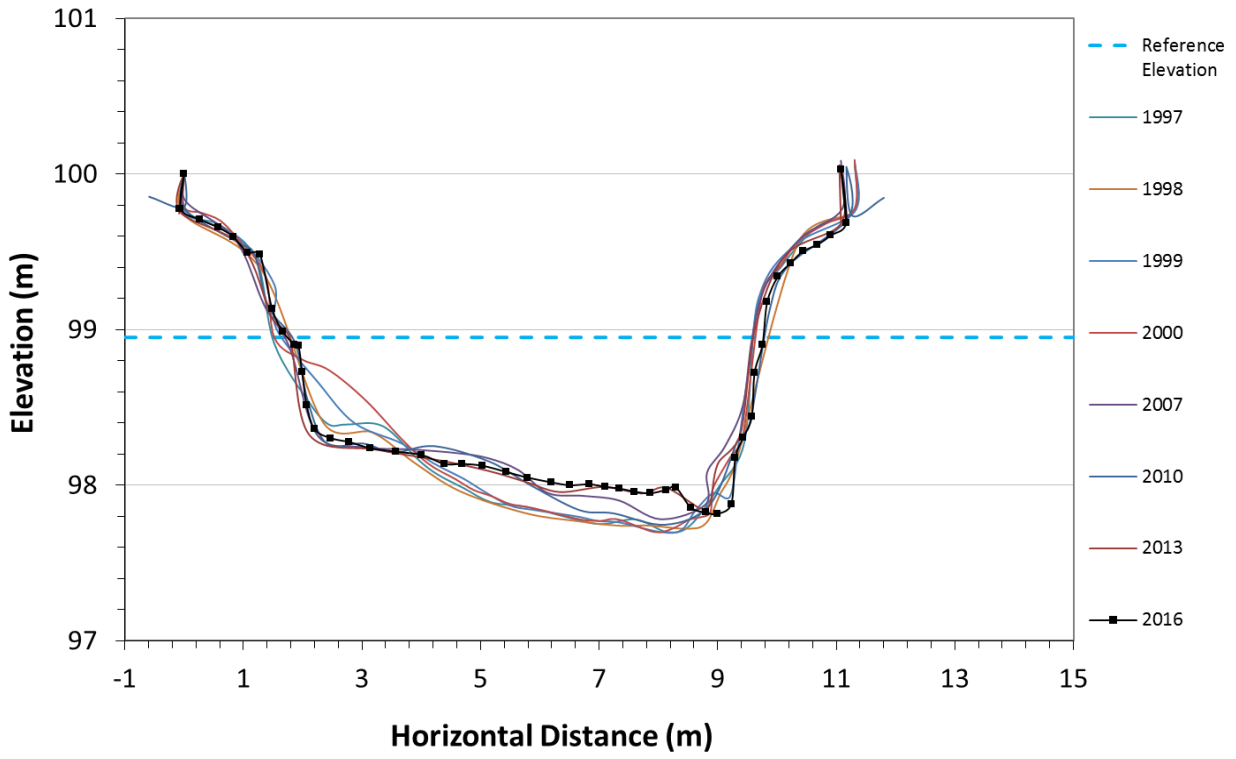


Figure 5. Example of a typical cross-sectional profile within an ATM survey reach

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

Figure 8. Stream temperature logger with protective PVC case

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.

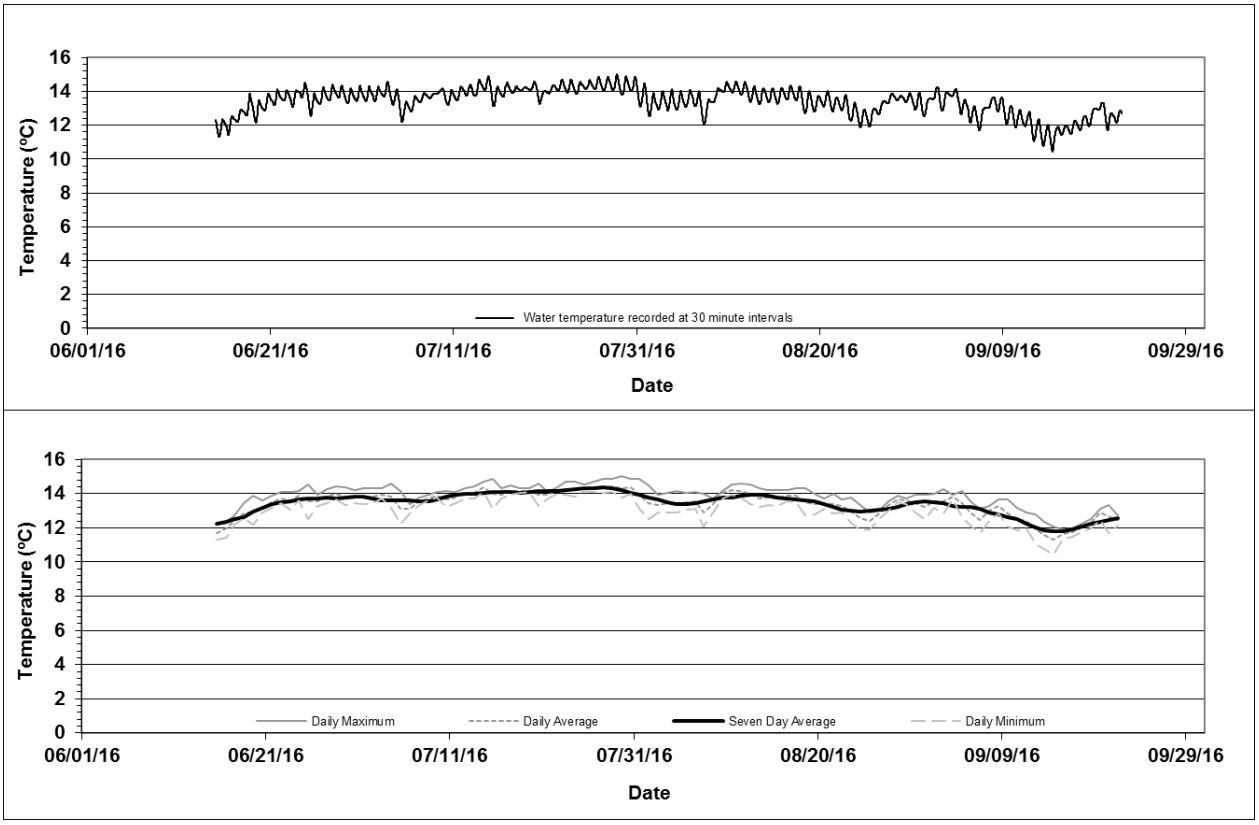


Figure 9. Example of a stream temperature profile generated from a continuously-recording temperature data logger deployed at most ATM stations annually

PROGRAM IMPLEMENTATION - 2017

In this section, we report on program implementation, including field and laboratory 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 2017 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, and Lower Eel River drainages. Temperature instruments were deployed at 49 sites property-wide. All fieldwork was completed within the scheduled time period. All data collection occurred prior to any major storm events.

Table 3. 2017 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	3
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**	**49**

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_{85}). 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% 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 with the exception of 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 2022.

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 2017 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 109 of this document.

PRESENTATION OF RESULTS

Current data derived from long-term stream habitat monitoring stations is 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 will not be 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 measured in 2017. Previous measurements from WAUs not measured in 2017 can be found in previously submitted ATM annual reports.

Table 4. Example watershed report card

2017	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 there 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 ultimate 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 of 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 2017

Precipitation is calculated by the "hydrologic year" that runs from October 1 through September 30th 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 39.28 inches[1] with roughly 90% of the annual precipitation falling as rain during the months of October through May. Generally speaking, rainfall amounts in hydrologic year 2017 (October 1, 2016 to September 30, 2017) were substantially greater 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 63.79 inches, approximately 62% greater than the long-term average. Maximum daily rainfall was 2.31 inches, suggesting that peak flows may have been moderate to large in certain 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 HY2017 was 76.50 inches, which is approximately 61% greater than the long-term average for this station. The maximum peak flow measured at the gaging station at the Eel River near Scotia equaled 264,000 cubic feet per second (cfs), with a corresponding maximum daily mean of 213,000 cfs occurring on January 11, 2017. 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 shown in Figure 10.

Annual peak flows (cms) 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)

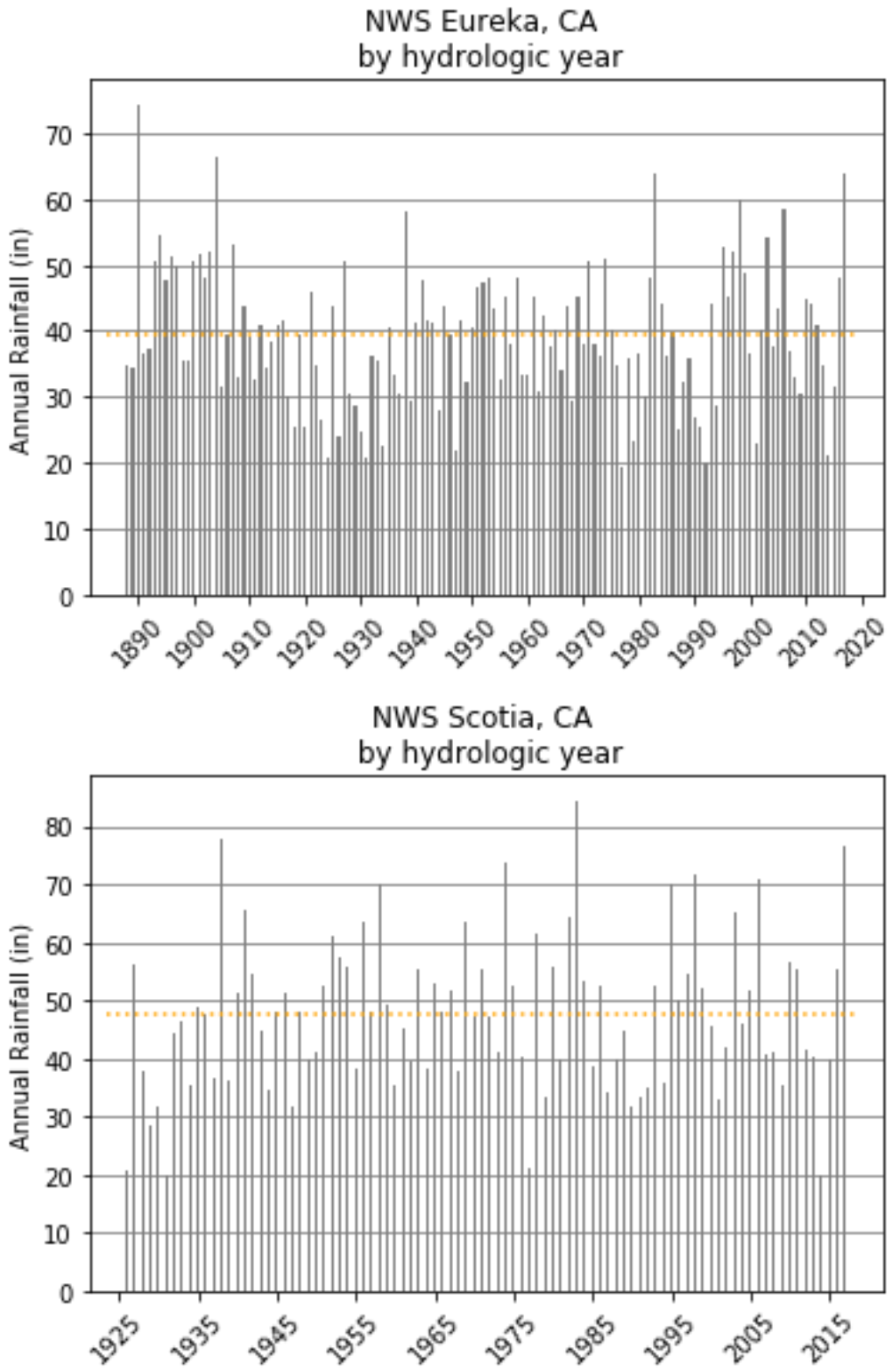


Figure 10. Annual rainfall by hydrologic year at Eureka and Scotia, CA. Dotted lines represent the running averages over all years

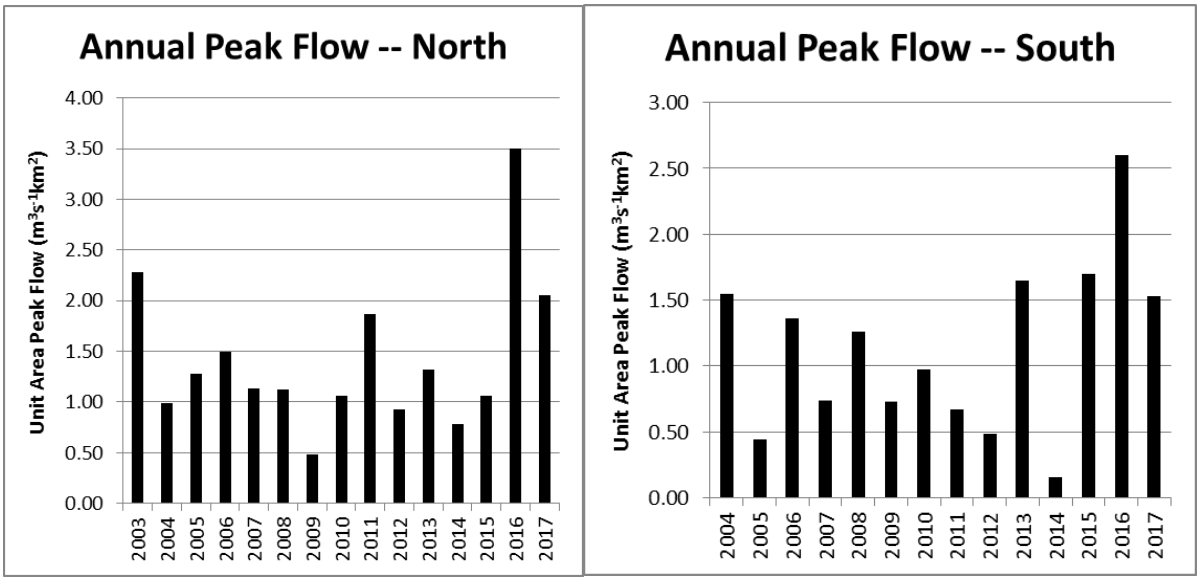


Figure 11. Reference streamflow sites are represented by Graham Gulch (site 505) in Freshwater Creek (north) and by Bear Creek (site 530) in the south

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 2017 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	2015	2016	2017
Freshwater Creek 015, 018, 019, 034, 092, 202, 200			X
Elk River **104** **162, 214, 175, 166, 167, 217**			X
Yager /Lawrence 049, 040, 009, 007, 046, 005, 164	X		
Van Duzen 003, 108, 111, 112		X	
Upper Eel (Larabee, tribs to mainstem Eel River from Newman Cr south) 002, 122, 126, 170, 212			X
Lower Eel and Eel Delta (tribs to mainstem Eel River north of Perrot Cr) **203, 107, 204** **106, 174, 205, 130, 242**	X	X	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. Freshwater Creek drains to the northern end of Humboldt Bay near Eureka, CA. The Freshwater watershed contains three major geologic terrains: Wildcat Group, Yager, and Franciscan Central Belt. Figure 12 Figure 12 shows the location of the seven Freshwater Creek WAU ATM sites. These sites were measured in 2017, and typical conditions are illustrated in Figure 13. There are currently seven habitat monitoring sites in Freshwater Creek.

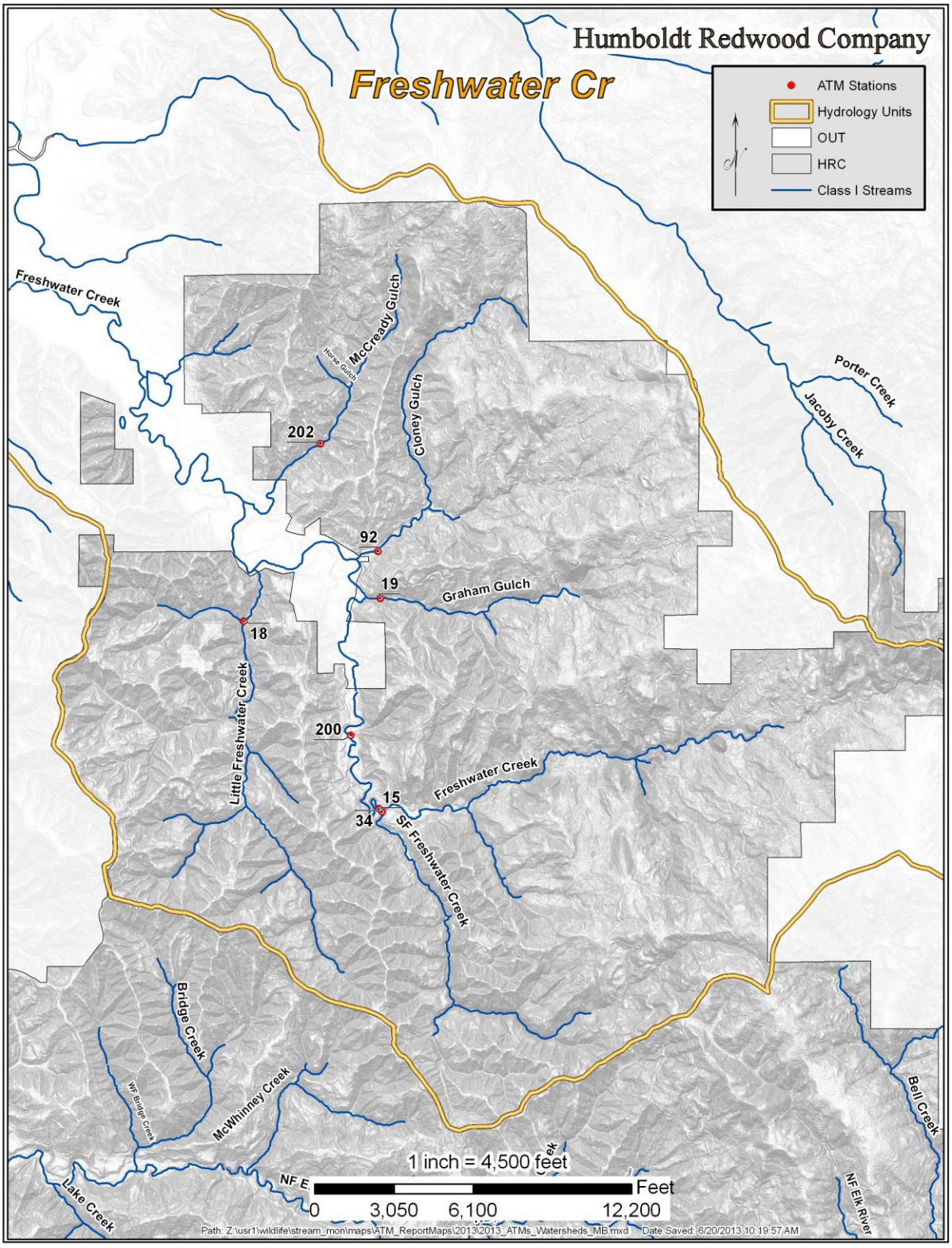


Figure 12. Location map of ATM stations in the Freshwater Creek WAU

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 not met at this site in 2017, though the data suggest a coarsening of the substrate across all particle sizes since 2014 (Figure 14). Pool measures suggest a slight improvement since 2014 with an increase in the percentage of pools associated with LWD, while residual pool depth failed to meet the target criterion. Total LWD pieces remained static, as total LWD piece frequency placed short of the target for the seventh time since 2003. Water temperature met the target for the third consecutive year since 2015, though mid-channel canopy cover placed short of the target for the sixth straight year.

Survey data from Mid Freshwater Creek indicate little change since 2014 at all five sites, in each case related to small changes occurring across the channel bed (Appendix A). Cross sectional areas at sites 1 – 3 increased less than 5% due to channel scour spread across the channel bed. Cross sectional areas at sites 4 and 5 decreased by 3 and 2%, respectively, due to small amounts of deposition spread across the channel bed

A snorkel survey conducted on 6/8/2017 identified steelhead and cutthroat trout of various size classes in each of the 5 pools sampled. Juvenile coho salmon were observed in every pool, although no juvenile Chinook salmon or any other aquatic species were identified.

Table 6. Individual site report card for ATM station 034, Mainstem Freshwater Creek

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

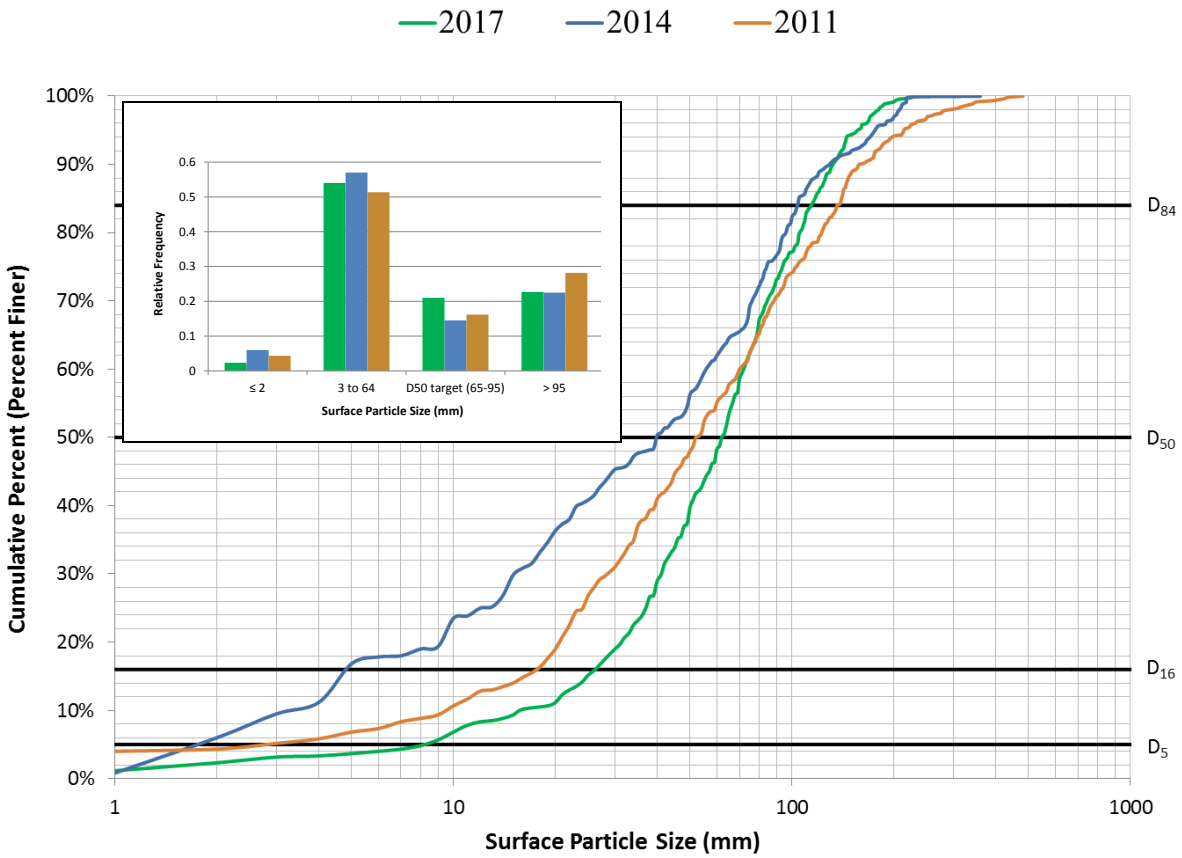


Figure 14. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Mainstem Freshwater Creek ATM 034 survey reach

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 2017, though the data suggests a coarsening of most of the particle size classes since 2014 (Figure 15). Pool measures indicate a general decline in habitat quality, with pool area (%) and pools associated with wood (%) meeting their respective targets. The total piece frequency within the surveyed reach fell short of the APFC target, with total LWD pieces decreasing by 39% since 2014. Water temperature met the target goal for the fifteenth consecutive year on record, and mid-channel canopy cover met the target for the fourth time in the last six survey years.

Survey data from South Fork Freshwater indicate little change within the lower reach, but some aggradation in the upper reaches between 2014 and 2017 (Appendix A). At site 1 both banks scoured while the central channel remained relatively unchanged from the 2014 survey. The site 1 cross section needed to be reestablished in 2011. Site 2 remained unchanged from the 2014 survey. Site 3 continued fill across the entire channel bed and is now 45% small than the 2005 cross section. Site 4 continued to fill, and is still smaller than the 2008 cross section (-5%), but fill rate has slowed. Site 5 is now experiencing deposition in the channel center, and the cross sectional area decreased by about 11% since 2014.

A snorkel survey conducted on 6/8/2017 identified trout of various size classes in each of the 5 pools sampled. Juvenile coho salmon were observed in every pool, although no juvenile Chinook salmon were identified. Also identified was one Pacific brook lamprey (*Lampetra richardsoni*).

Table 7. Individual site report card for ATM station 015, SF Freshwater Creek

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
Bed Surface	D_{84} (mm)	#	29	77	93			68			85			82			68
	D_{50} (mm)	65-95	16	27	28			28			43			31			40
	D_{16} (mm)	#	5	5	4			3			16			6			20
	D_{5} (mm)	#	1	1	3			1			6			2			11
Pool Characteristics	Pool Area (%)	≥25	46	51	44			52			44			64			54
	Pool Spacing (CW/pool)	≤6.0	6.5	8.0	3.0			3.2			5.6			4.3			7.5
	Residual Pool Depth (m)	≥0.91	0.81	0.90	0.63			0.59			0.66			0.5			0.81
	Pools Assoc. w/wood (%)	≥50	100	100	56			60			100			71			75
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥10.40	14.69	14.57	7.16			7.63			7.44			13.46			9.70
	Total Piece Count	#	93	103	75			44			53			93			67
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
Riparian Overstory	Canopy Over Stream (%)	≥92	92	93				84			94			81			93
	Canopy of Rip Forest (%)	≥85	85	96							92			95			

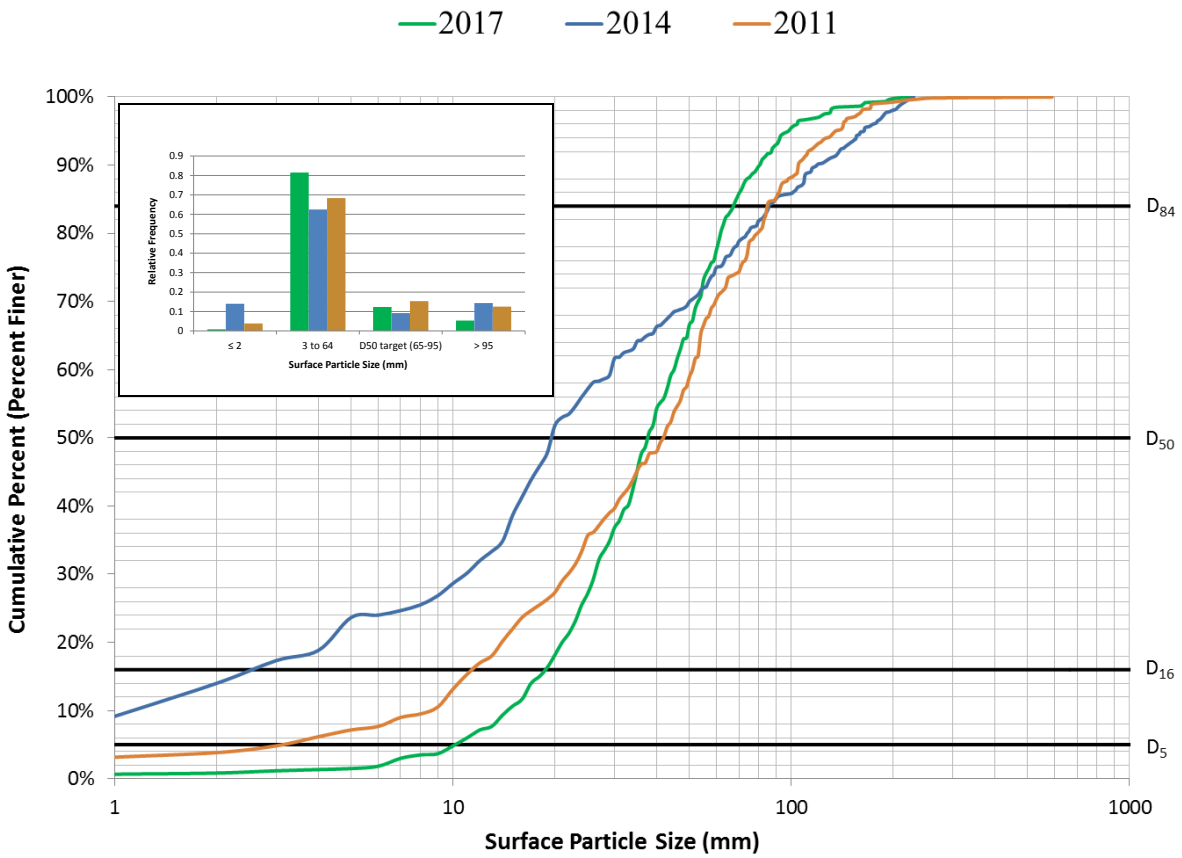


Figure 15. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Freshwater Creek ATM 015 survey reach

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 not met in 2017, though the data suggest a coarsening of the substrate across most particle size classes (Figure 16). Pool measures remained static since 2014, with residual pool depth failing to meet the target for the second year straight. The total piece frequency within the surveyed reach failed to meet the APFC target, and total LWD pieces decreased by 17% since 2014. Water temperature and mid-channel canopy cover each met the target goal for another consecutive survey year since 2005.

Survey data from Freshwater Creek indicate relatively little change in cross sections between 2014 and 2017 (Appendix A). Sites 1, 3, and 4 had less than a 1% net change in area since 2014 and similar bed cross sections, although the thalweg at site 3 has continued to move toward the left bank. These sites have slightly smaller cross sectional areas than the starting areas in 2005 (4%, 7%, and 7% smaller, respectively). Site 2 also had less than a 1% net change in area and the thalweg has shifted toward the right bank, but this cross section remains slightly larger (1%) than the area measured in 2005. Deposition in the thalweg at site 5 has decreased the channel area by 4% since 2014, but overall channel area remains slightly larger (by 2%) than the 2005 area. The trend at this site since 2008 has been continued deposition.

A snorkel survey conducted on 6/8/2017 identified steelhead and cutthroat trout of various size classes in all 5 pools sampled. Juvenile coho salmon were observed in 4 of the pools and juvenile Chinook salmon were observed in 1 of the pools. Also identified were threespine sticklebacks (*Gasterosteus aculeatus*).

Table 8. Individual site report card for ATM station 200, SF Freshwater Creek

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

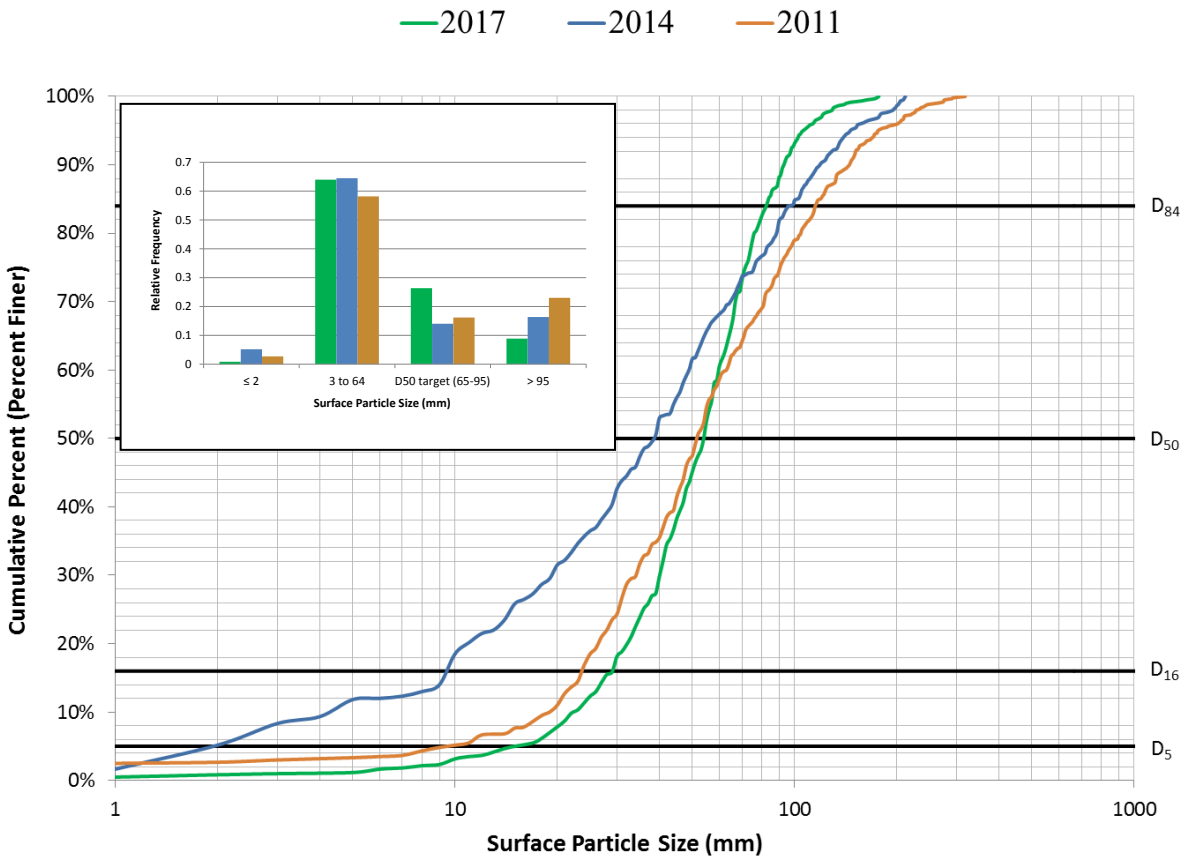


Figure 16. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Mainstem Freshwater Creek ATM 200 survey reach

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 2017, though the data suggest a coarsening of the substrate across all particle size classes (Figure 17). Pool measures indicate a slight improvement in habitat quality, with only residual pool depth failing to meet the target for the seventh consecutive survey year. The total piece frequency within the surveyed reach remained short of the APFC target, while total LWD pieces increased 19% since 2014. Water temperature met the target for the fifteenth consecutive year, and mid-channel canopy cover met the target for the third consecutive year.

Survey data from Graham Gulch indicate relatively small changes since 2014 at all sites except site 2, which experienced major scour (Appendix A). There was a small amount of deposition at site 1, which decreased the cross sectional area by 2% since 2014. At site 2, scour concentrated on the left bank increased the cross sectional area by about 35% since 2014 and shifted the thalweg toward the left bank. Deposition at site 4 decreased the cross sectional area by about 7% since 2014 and there were no changes at site 5 since 2014.

A snorkel survey conducted on 6/6/2017 identified trout of various size classes in all 5 pools sampled. A single juvenile coho salmon was observed, but no juvenile Chinook salmon were identified. No other aquatic organisms were observed.

Table 9. Individual site report card for ATM station 019, Graham Gulch

Site 019 Graham Gulch	**Parameter**	**Target Value** (# no target)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	54	64	67			109			91			60			78
	D_{50} (mm)	65-95	21	27	27			45			46			26			55
	D_{16} (mm)	#	1	6	1			7			18			10			33
	D_{5} (mm)	#	1	1	1			1			2			4			20
Pool Characteristics	Pool Area (%)	≥25	49	43	47			40			47			49			44
	Pool Spacing (CW/pool)	≤6.0	4.1	6.3	3.6			4.9			3.6			3.3			3.8
	Residual Pool Depth (m)	≥0.91	0.61	0.53	0.66			0.44			0.48			0.41			0.52
	Pools Assoc. w/wood (%)	≥50	100	100	100			100			90			41			88
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥8.90	11.17	6.99	4.09			2.97			3.85			4.68			5.50
	Total Piece Count	#	93	53	35			22			30			37			44
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
Riparian Overstory	Canopy Over Stream (%)	≥92	89	95				84			94			95			97
	Canopy of Rip Forest (%)	≥85	94	100							92			95			

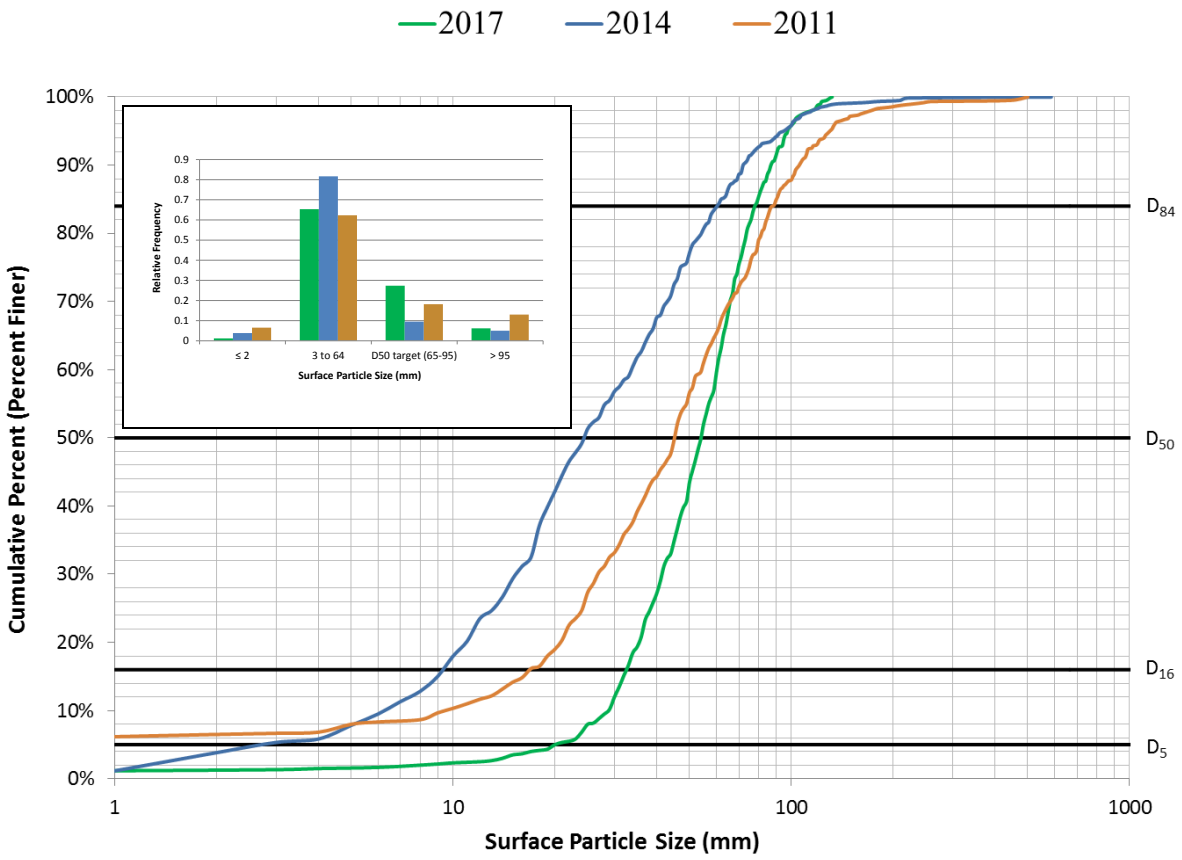


Figure 17. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Graham Gulch ATM 019 survey reach

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 2017, though the data suggest a coarsening of the substrate across all particle size classes since 2014 (Figure 18). Pool measures indicate a slight increase in habitat quality, though residual pool depth failed to meet the target for the fourth consecutive year. The total piece frequency within the surveyed reach failed to meet the APFC target, while total LWD pieces increased 37% since 2014. Water temperature met the target for the twelfth consecutive survey year, and mid-channel canopy cover met the target for the third consecutive survey year.

Survey data from Cloney Gulch indicate small amounts of scour (<=5%) since 2014 at all sites except site 2, which had a negligible amount of fill since 2014 and otherwise scoured since 2005 (Appendix A). The scour that occurred at Site 1 continued since 2008, and in recent years was focused on deepening the thalweg along the left bank. At site 3, some deposition occurred in the channel center, with scour occurring towards the left bank of the main channel, resulting in 3% overall increase in channel cross sectional area since 2014. Scour at site 4 increased channel cross sectional area by 2% since 2014. Scour at site 5 was focused on the left bank, where the thalweg deepened; the right side of the channel remained unchanged. Cross sectional areas at all sites remain greater than the beginning cross sectional areas (1998 for sites 1 and 2; 2005 for sites 3-5).

A snorkel survey conducted on 6/6/2017 identified steelhead & cutthroat trout of various size classes and juvenile coho salmon in all 5 pools sampled. No juvenile Chinook salmon were observed. Also identified were threespine sticklebacks.

Table 10. Individual site report card for ATM station 092, Cloney Gulch

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

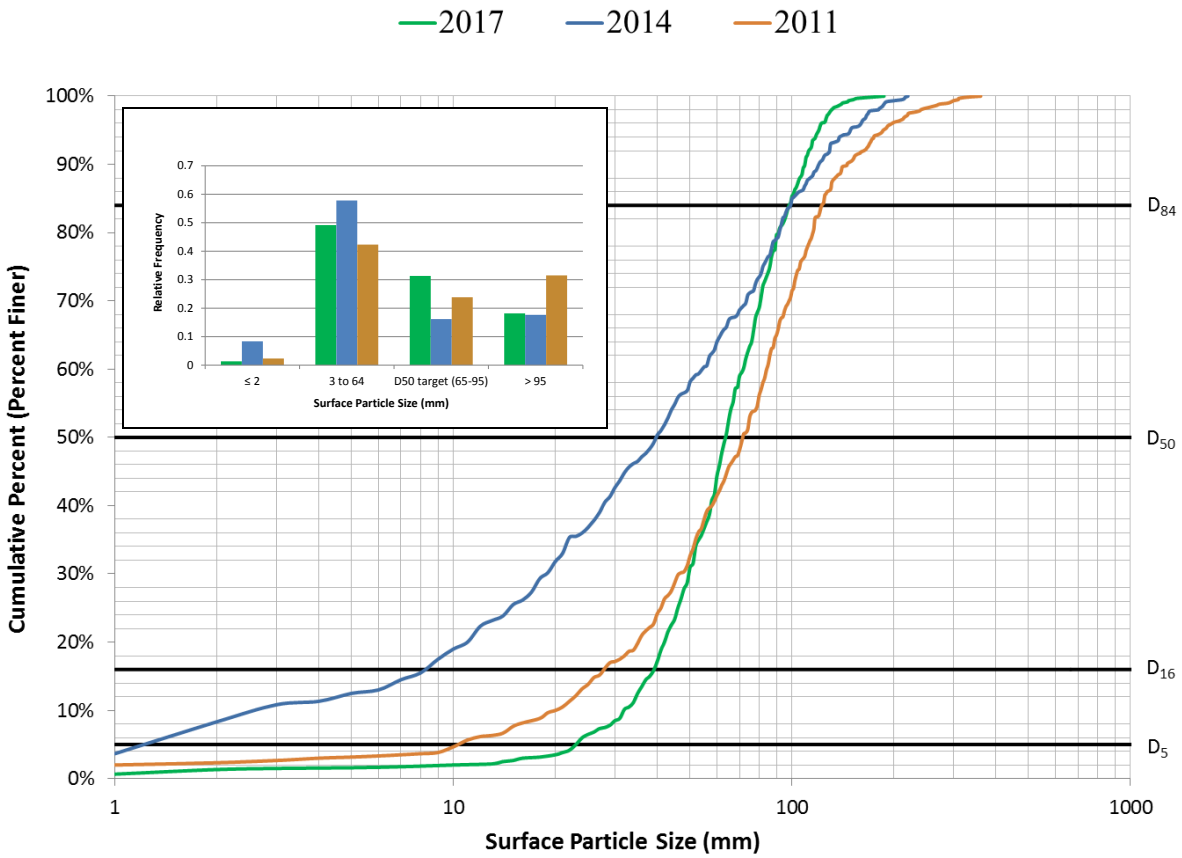


Figure 18. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Cloney Gulch ATM 092 survey reach

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 2017, though the data suggest a coarsening of the substrate across all particle size classes (Figure 19). Pool measures indicate a slight decline in habitat quality, with pool spacing and residual pool depth failing to meet their respective targets. The total piece frequency within the surveyed reach did not meet the APFC target, and total LWD pieces decreased 86% since 2014. Water temperature met the target for the thirteenth consecutive year, and mid-channel canopy cover met the target for the third consecutive survey year.

Survey data from McCready Gulch indicate both scour and fill at cross sections within the ATM site (Appendix A). Scouring at sites 1, 2, and 4 has increased channel area since 2014 by 5%, 7%, and 13%, respectively. A general scouring trend continues at sites 1 and 2. Deposition at site 4 occurred between 2005 and 2014, but the scour since 2014 has now increased the channel area beyond its original size (+10% since 2005). Deposition at sites 2 and 5 has decreased channel area since 2014 by 3% and 12%, respectively. Deposition at site 5 occurred across the channel bottom, but the current cross section remains 4% larger than the area surveyed in 2005.

A snorkel survey conducted on 6/8/2017 identified steelhead & cutthroat trout of various size classes and juvenile coho salmon in all 5 pools sampled. No juvenile Chinook salmon or any other aquatic organisms were identified.

Table 11. Individual site report card for ATM station 202, McCready Gulch

Site 202 McCready Gulch	**Parameter**	**Target Value** (# no target)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	64			61			65			44			65
	D_{50} (mm)	65-95	23			18			28			14			34
	D_{16} (mm)	#	1			3			11			4			16
	D_{5} (mm)	#	1			1			2			2			6
Pool Characteristics	Pool Area (%)	≥25	45			47			38			35			30
	Pool Spacing (CW/pool)	≤6.0	2.4			4.6			6.2			5.0			6.1
	Residual Pool Depth (m)	≥0.91	0.46			0.45			0.48			0.42			0.47
	Pools Assoc. w/wood (%)	≥50	100			100			83			100			80
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥13.70	15.76			7.82			6.25			9.94			5.30
	Total Piece Count	#	192			86			42			52			28
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
Riparian Overstory	Canopy Over Stream (%)	≥93				85			96			96			96
	Canopy of Rip Forest (%)	≥85							94			98			

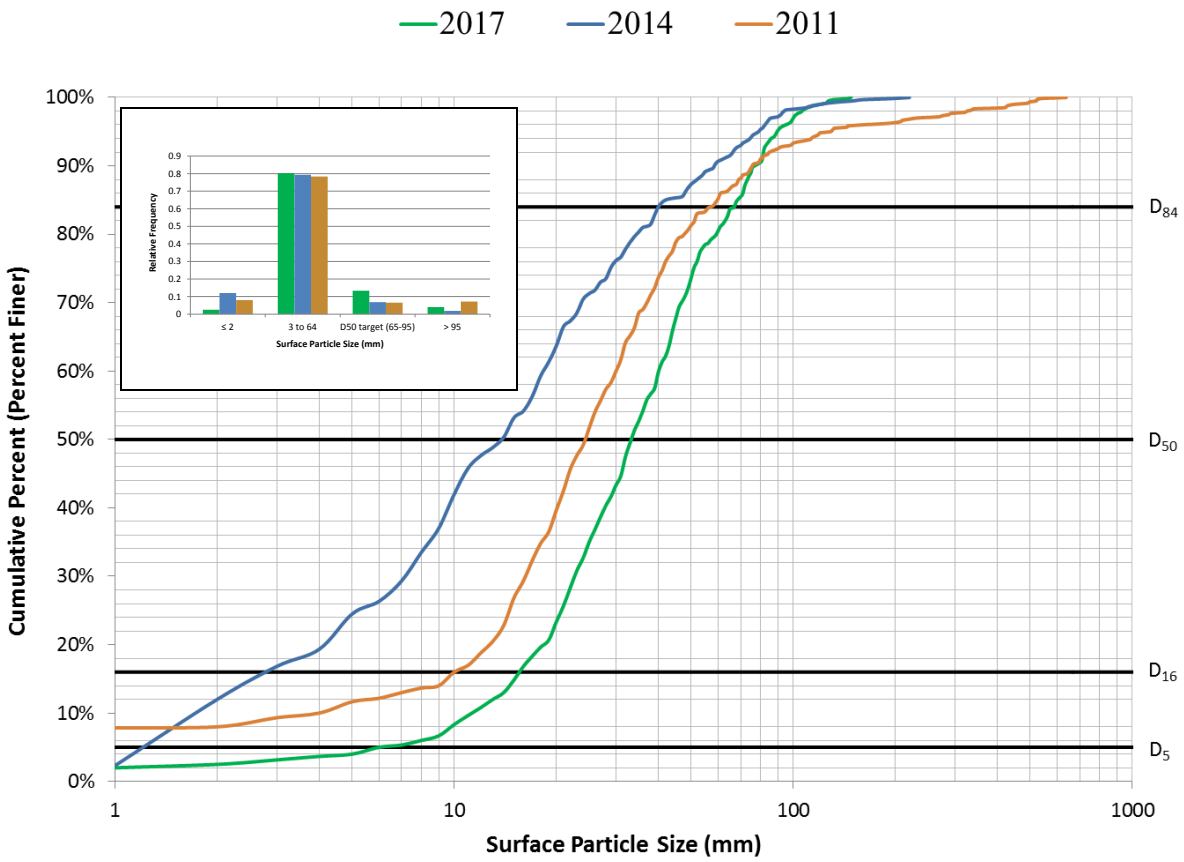


Figure 19. Cumulative frequency plot of the mean surface particle size of three riffles measured within the McCready Gulch ATM 202 survey reach

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 met for the first time in 2017, as the data suggest a coarsening of the substrate across all particle size classes (Figure 20). Pool measures indicate a general improvement in habitat quality, though residual pool depth fell short of the target for the seventh consecutive survey year. The total LWD piece frequency within the surveyed reach failed to meet the APFC target, although total LWD pieces increased 38% since 2014. Water temperature met the target for the fifteenth consecutive year, and mid-channel canopy cover met the target for the third consecutive survey year.

Survey data from Little Freshwater Creek indicate little to no change throughout the monitoring reach between 2014 and 2017 (Appendix A). Sites 1 and 2 experienced small amounts of scour since 2014 (<5%) and have cross sections that remain larger than their original (2008) cross sections. Sites 3 and 5 experienced small amounts of fill since 2014 (<5%) and have cross sections that are smaller than their original (2008) cross sections (-6% and -1%, respectively). The site 4 cross section location and area did not change between 2014 and 2017.

A snorkel survey conducted on 6/6/2017 identified steelhead & cutthroat trout of various size classes in 4 of the 5 pools sampled. Juvenile coho salmon were observed in all 5 pools, but no juvenile Chinook salmon were observed. Also identified were threespine sticklebacks and one brook lamprey.

Table 12. Individual site report card for ATM station 018, Little Freshwater Creek

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
Bed Surface	D_{84} (mm)	#	89	83	84			100			98			61			89
	D_{50} (mm)	65-95	53	42	39			48			56			20			65
	D_{16} (mm)	#	14	2	5			10			27			5			42
	D_5 (mm)	#	1	1	1			1			13			2			31
Pool Characteristics	Pool Area (%)	≥25	71	72	61			53			68			35			84
	Pool Spacing (CW/pool)	≤6.0	4.9	5.0	3.0			5.2			6.2			7.5			3.9
	Residual Pool Depth (m)	≥0.91	0.51	0.53	0.59			0.53			0.53			0.46			0.44
	Pools Assoc. w/wood (%)	≥50	100	100	100			71			100			46			88
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥11.90	6.83	4.98	6.30			2.27			3.29			3.74			4.90
	Total Piece Count	#	43	33	52			18			21			24			33
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
Riparian Overstory	Canopy Over Stream (%)	≥92	85	94				84			90			96			94
	Canopy of Rip Forest (%)	≥85	89	96							89			97			

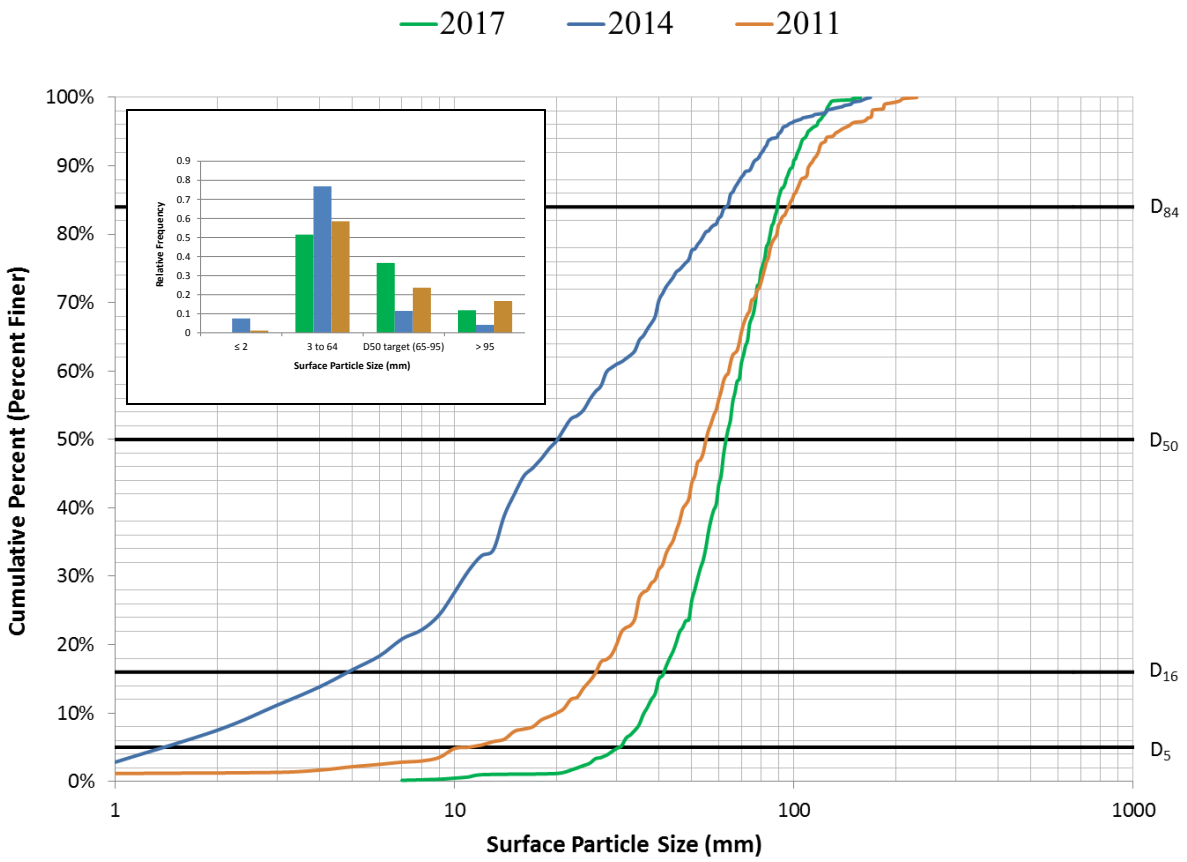


Figure 20. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Little Freshwater Creek ATM 018 survey reach

Summary of ATM Trends in the Freshwater Creek WAU

A summary of the Freshwater Creek habitat characteristics from 2017 is provided in and APFC report card (Table 13). Results of habitat composite scores from 2017 and 2014 are compared to baseline (2003) data (Figure 21). Overall, the greatest improvements in habitat composite scores were observed in pool characteristics. All other habitat characteristics either remained static or were in decline.

The bed surface composite score in 2017 was lower than both 2014 and the baseline records. The 2017 composite score for pool characteristics was higher (+19%) than 2014 and higher (+11%) than the baseline record. The 2017 LWD composite score for LWD was lower than both the 2014 and the baseline records. The 2017 mid-channel canopy cover composite score was the same in 2014, but higher

(+34%) than the baseline record. The 2017 water temperature composite score was the same in 2014, but higher (+16%) than the baseline record.

Table 13. The most recent habitat measures for the Freshwater Creek WAU

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)	#	113	68	81	78	98	65	89
	D_{50} (mm)	65-95	62	40	56	55	64	34	65
	D_{16} (mm)	#	27	20	30	33	39	16	42
	D_5 (mm)	#	5	11	16	20	23	6	31
Pool Characteristics	Pool Area (%)	≥25	51	54	84	44	59	30	84
	Pool Spacing (CW/pool)	≤6	4.0	7.5	3.8	3.8	4.4	6.1	3.9
	Residual Pool Depth (m)	≥0.91	0.56	0.81	0.81	0.52	0.71	0.47	0.44
	Pools Assoc. w/wood (%)	≥50	75	75	63	88	86	80	88
Large Woody Debris	Total Piece Frequency (#/100 ft)	f(CW)	3.10	9.70	1.00	5.50	6.20	5.30	4.90
	Total Piece Count	#	35	67	12	44	52	28	33
Water Temperature	MWAT (°C)	≤16.8	16.8	15.9	16.4	15.3	14.9	15.2	15.6
Riparian Overstory	Canopy Over Stream (%)	f(CW)	87	93	98	97	97	96	94
	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

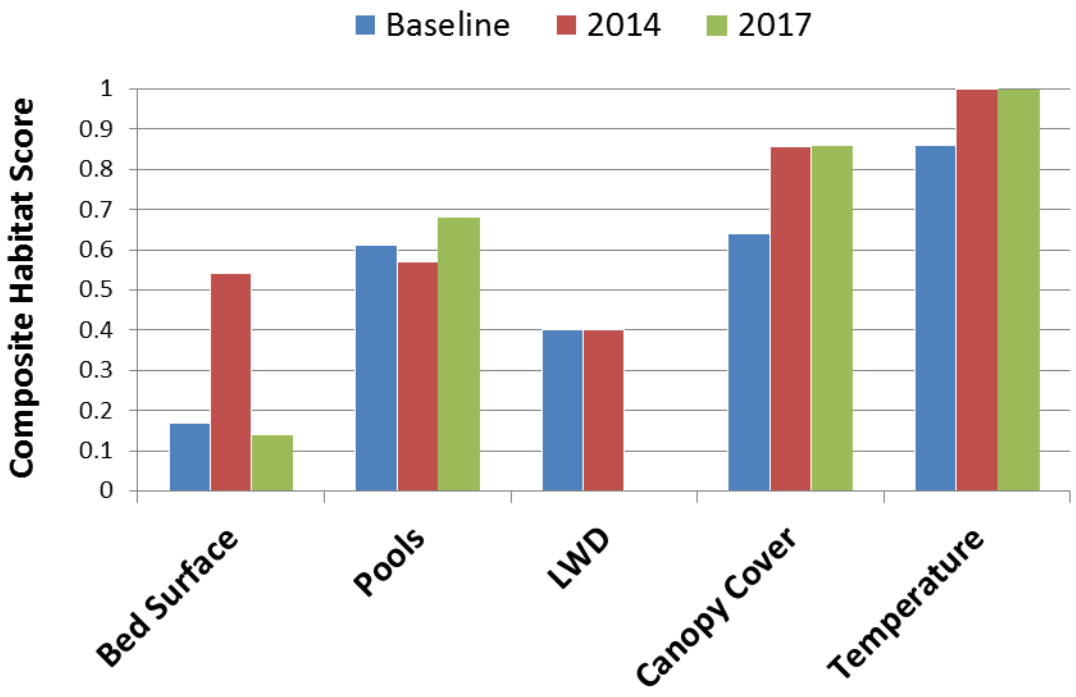


Figure 21. The composite scores for habitat characteristics in the Freshwater Creek WAU in 2017 and 2014 relative to baseline (2003) data

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.

A known area of active deposition exists in Elk River, demarcated by the Tom's Gulch confluence South Fork Elk River, and the Dunlap and Brown's confluences on the North Fork. These low (<0.2%) reaches tend to be undergoing varying rates of bed aggradation as evident from annual section data.

Figure 22 shows the location of the 7 active ATM stations in Elk River. Figure 23 shows typical site conditions at each of the seven stations surveyed in 2017. 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.

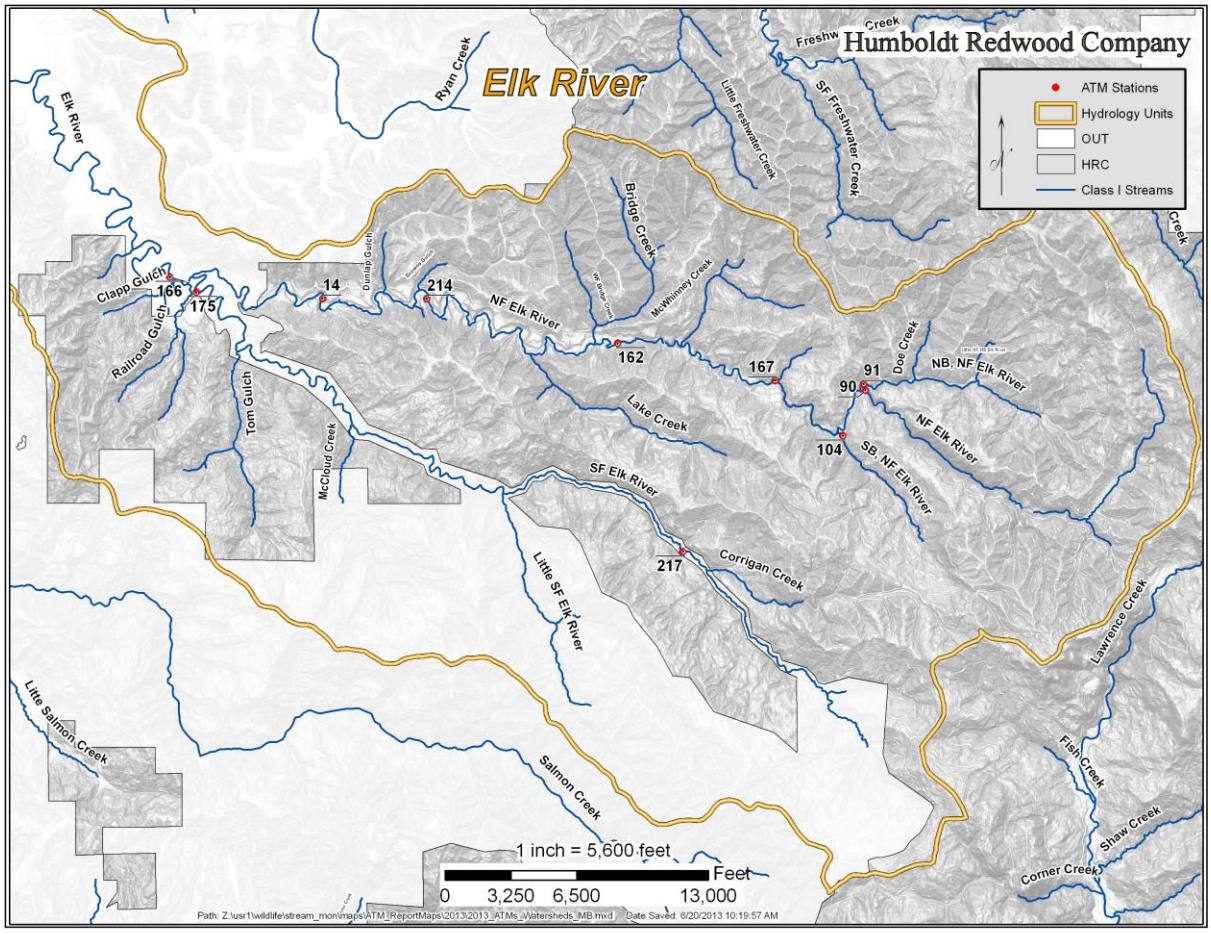
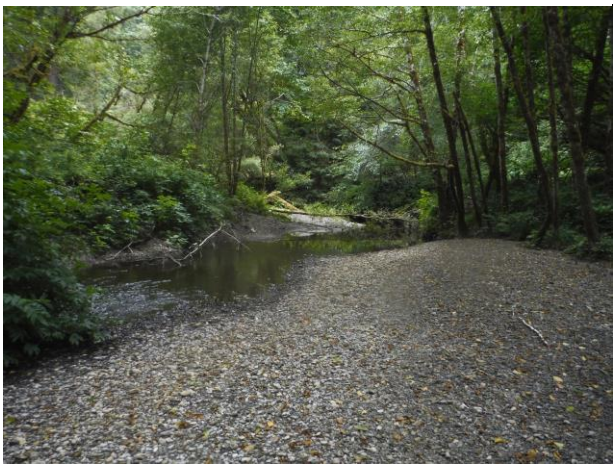


Figure 22. Location map of ATM stations in the Elk River WAU

NF Elk River 167

NF Elk River 162



NF Elk River 214

SF Elk River 217

SF Elk River 175

Elk River 166

Figure 23. ATM stations within the Elk River WAU

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

Data for all ATM parameters at site 167 (Figure 23) are summarized in the APFC report card found in Table 14. The bed surface target was not met in 2017, though the data suggest a slight coarsening of the D_{50} and D_{16} substrate particle size classes (Figure 24). Pool characteristics indicate generally static habitat conditions, though residual pool depth did not reach its target for the thirteenth consecutive survey year. The total LWD piece frequency within the surveyed reach met the APFC target, as total LWD pieces increased 14% since 2014. Water temperature met the target for the twelfth consecutive year, and mid-channel canopy cover met its target the fifth consecutive survey year since 2010.

Survey data from the Upper North Fork Elk River indicate little to no change at the lower sites (sites 1-2), some fill at the middle site (site 3) and some scour at the upper sites (sites 4-5) (Appendix A). Deposition at site 3 decreased channel area by 4% since 2014, which was focused towards the right bank, with no change to the thalweg depth. Scour at site 4 increase channel area by 34%, which was distributed across the bed. Scour at site 5 was minimal (2% increase in area) and was distributed across the bed.

A snorkel survey conducted on 6/30/2017 identified steelhead trout of various size classes and juvenile coho salmon in all 5 pools sampled. Juvenile Chinook salmon were not observed. One Coastal giant salamander (*Dicamptodon tenebrosus*) was also identified in one of the sampled pools.

Table 14. Individual site report card for ATM station 167, NF Elk River

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**
Bed Surface	D_{84} (mm)	#	251	218	189	148	216	150	262	146	181	247		126	103			89
	D_{50} (mm)	65-95	69	67	45	42	38	22	44	25	68	65		51	44			47
	D_{16} (mm)	#	14	10	11	11	3	3	1	6	9	17		4	14			18
	D_5 (mm)	#	4	1	1	4	1	1	1	2	3	3		1	4			4
Pool Characteristics	Pool Area (%)	≥25	46	40	27	44	22	30	15	52	37	23		20	32			37
	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
	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
	Pools Assoc. w/wood (%)	≥50	71	88	87	69	50	100	67	58	63	89		83	80			70
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
	Total Piece Count	#	62	137	140	119	70	91	50	75	76	66		85	72			82
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
Riparian Overstory	Canopy Over Stream (%)	≥89	89	89	88	73	81	73	88	81	89	90		92	91			95
	Canopy of Rip Forest (%)	≥85	94	96	99	100	98					95		97	93			

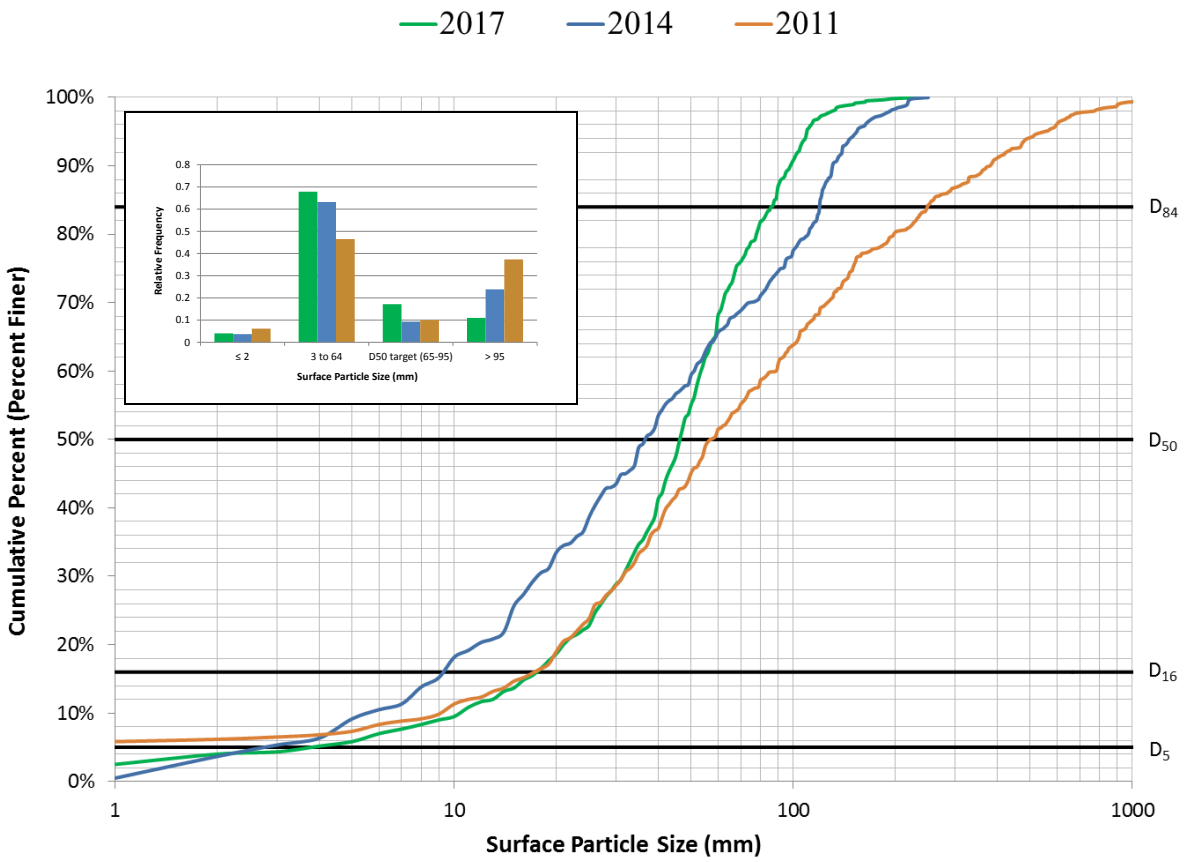


Figure 24. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 167 survey reach

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

Data for all ATM parameters at site 162 (Figure 23) are summarized in the APFC report card found in Table 15. The bed surface target was not met in 2017, though the data suggests a coarsening of the substrate across most particle size classes (Figure 25). Pool measures indicate a slight increase in habitat quality, though residual pool depth did not reach its target for the sixth consecutive year since 2009. The total piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 68% since 2014. Water temperature met the target for the fourth consecutive year since 2014, and mid-channel canopy cover met its target the first time since 2011.

Survey data from the Middle North Fork Elk River indicate little net change at all cross sections and minor areas of scour and fill (Appendix A). Scour at site 1 has increased the channel area by 2% since 2014 and has shifted the thalweg towards the left bank, while some limited deposition has occurred towards the right bank. Scour at sites 2-4 was minimal since 2014 (<2%), resulting in little to no change in the channel bed at those sites. Site 5 saw little net change since 2014; deposition that resulted in a small decrease in channel area (-2%) was near the right bank and not in the active channel.

A snorkel survey conducted on 6/30/2017 identified steelhead trout of various size classes and juvenile coho salmon in all 5 pools sampled. Juvenile Chinook salmon were not observed. Also identified were threespine sticklebacks in 3 of the pools sampled.

Table 15. Individual site report card for ATM station 162, NF Elk River

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**
Bed Surface	D_{84} (mm)	#	144	122	104	132	133	147	131	87	116		105	113			102
	D_{50} (mm)	65-95	72	40	41	46	44	62	59	44	53		49	41			62
	D_{16} (mm)	#	27	4	7	3	3	7	19	23	26		13	11			27
	D_5 (mm)	#	6	1	1	1	1	1	7	9	11		2	4			6
Pool Characteristics	Pool Area (%)	≥25	38	36	31	25	31	27	70	42	53		24	37			51
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	60	75	67	67	67	44	60	63		50	80			64
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
	Total Piece Count	#	70	80	50	20	45	35	65	83	54		74	74			44
Water Temperature	MWAT (°C)	≤16.8							16.3	15.4	16.1	15.3	17.6	16.8	16.1	16.3	16.5
Riparian Overstory	Canopy Over Stream (%)	≥90	81	88	86	82	62	85	91	71	90		85	88			93
	Canopy of Rip Forest (%)	≥85	92	96							97		93	95			

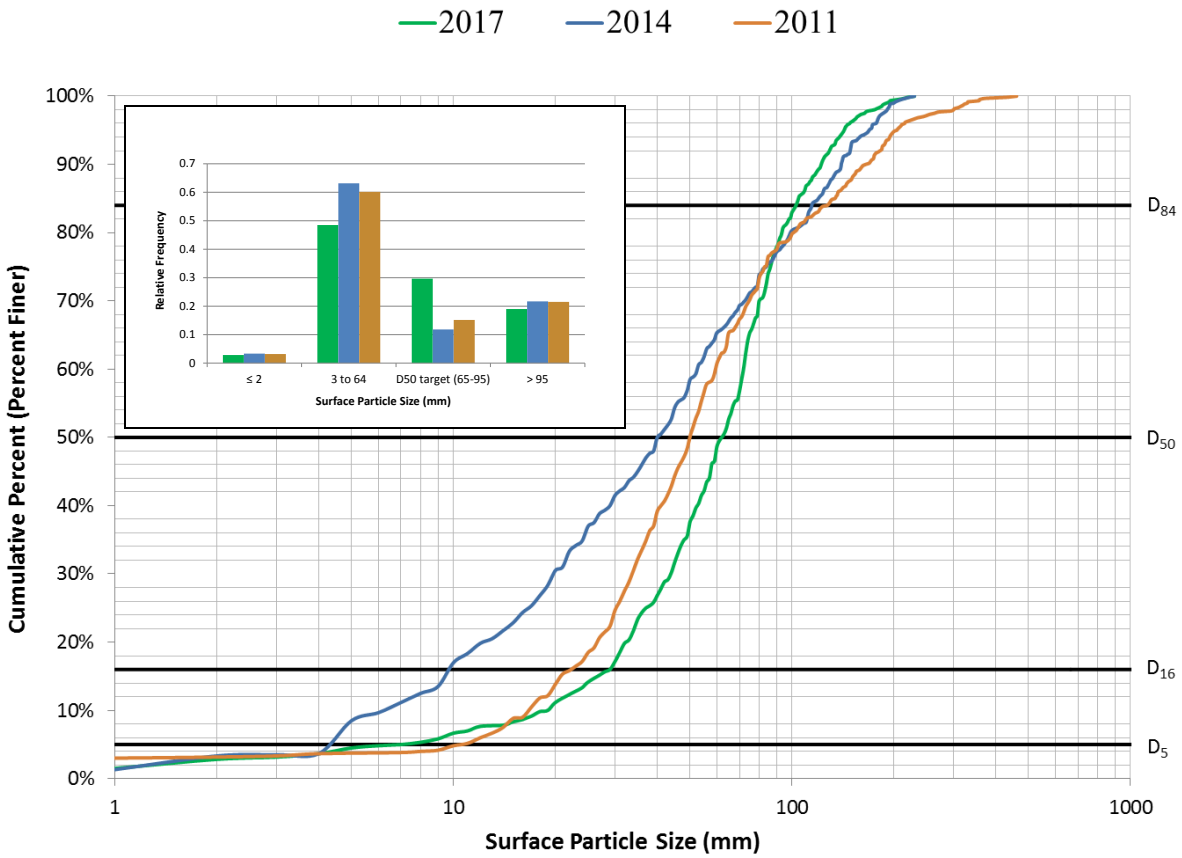


Figure 25. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 162 survey reach

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

Data for all ATM parameters at site 214 (Figure 23) are summarized in the APFC report card found in Table 16. The bed surface APFC target was not met in 2017, though the data suggest a coarsening of the substrate across all particle size classes (Figure 26). Pool measures indicate favorable habitat conditions, scoring successes across all four measurable characteristics. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 19% since 2014. Water temperature met the target for the ninth consecutive survey year since 2008, and mid-channel canopy cover met its target for the first time since 2008.

Survey data from Lower North Fork Elk River indicate very large changes in channel cross sections between 2014 and 2017 at sites 1, 2, and 5 (Appendix A). Scour at site 1 increased net channel area by 16% and a shift in the channel thalweg eroded a large portion of the right bank while depositing sediment along the left side of the channel. Scour at site 2 increased net channel area by 14% since 2016. The channel reoccupied and deepened the buried 2005 thalweg and deposited over a meter of sediment toward the right side of the channel. Changes at site 3 were less notable, with deposition decreasing the channel are by 3% since 2014. Scour at site 5 increased net channel area by 4%, again with a significant channel shift that included deposition of sediment towards the left bank and erosion of a new main channel towards the right bank.

A snorkel survey conducted on 6/30/2017 identified steelhead trout of various size classes and juvenile coho salmon in all 5 pools sampled. Juvenile Chinook salmon were not observed. Also identified were threespine sticklebacks in 4 of the pools sampled.

Table 16. Individual site report card for ATM station 214, NF Elk River

Site 214 North Fork Elk River	**Parameter**	**Target Value** (# no target)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	38	36	39	33	43	53	52		30	30			52
	D_{50} (mm)	65-95	19	16	19	15	22	30	33		14	15			38
	D_{16} (mm)	#	1	3	6	3	9	12	16		6	6			21
	D_5 (mm)	#	1	1	1	1	3	3	6		3	3			12
Pool Characteristics	Pool Area (%)	≥25	82	41	83	67	84	54	85		46	37			85
	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
	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
	Pools Assoc. w/wood (%)	≥50	86	80	86	100	100	80	100		100	100			89
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
	Total Piece Count	#	54	30	45	26	39	20	20		72	80			67
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
Riparian Overstory	Canopy Over Stream (%)	≥90	60	73	58	92	74	74	88		75	82			92
	Canopy of Rip Forest (%)	≥85							97		97	93			

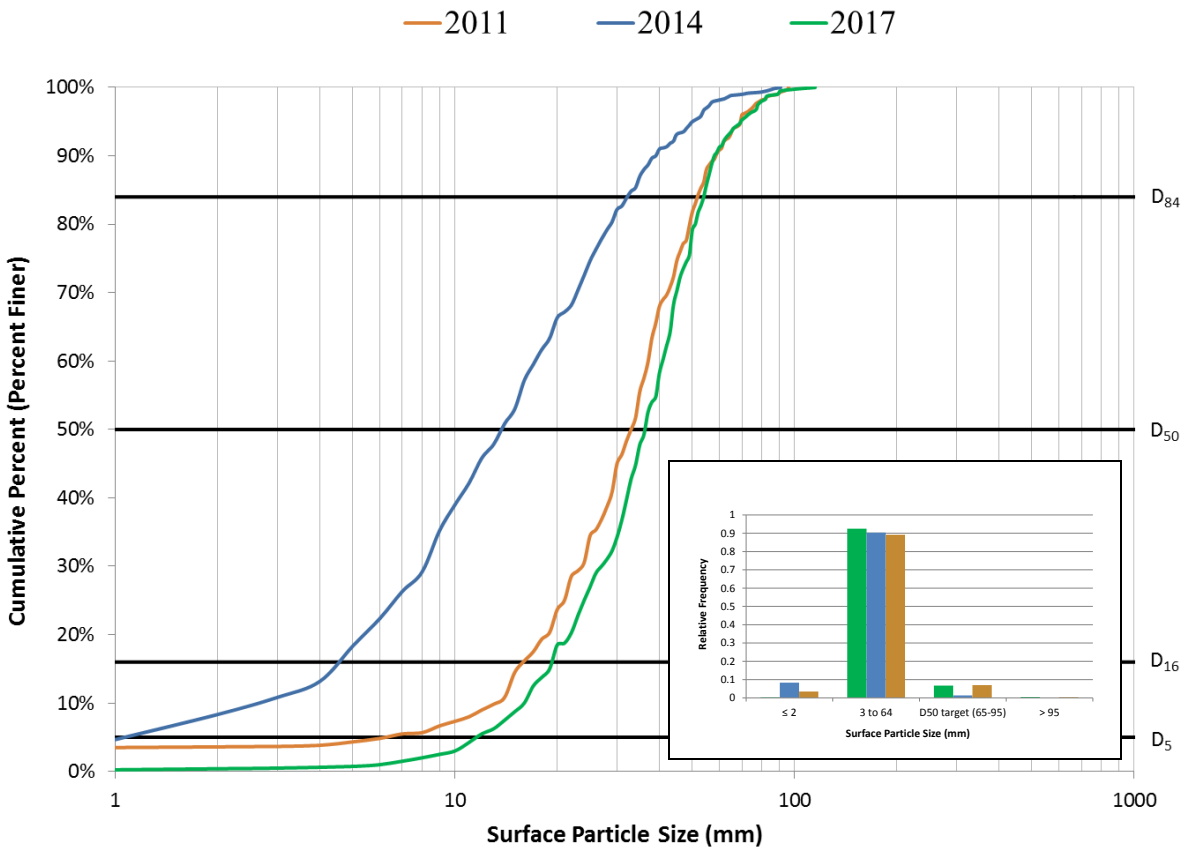


Figure 26. Cumulative frequency plot of the mean surface particle size of three riffles measured within the NF Elk River ATM 214 survey reach

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

Data for all ATM parameters at site 217 (Figure 23) are summarized in the APFC report card found in Table 17. The bed surface APFC target was not met in 2017, though the data suggest a coarsening of the substrate across most particle size classes (Figure 27). Pool measures indicate generally static habitat conditions, though residual pool depth did not reach its target for the sixth consecutive year since 2009. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 24% since 2014. Water temperature met the target for the thirteenth consecutive year, and mid-channel canopy cover met the target for the ninth consecutive survey year since 2006.

Survey data from the Upper South Fork Elk River indicate very minor changes since 2014 at all sites (Appendix A). Scour at site 1 produced the biggest change, which was a 6% increase in channel area, but this was distributed as small changes across the channel. Deposition at sites 2 and 3 decreased channel area by 2% in each case. Site 4 saw no change and scour at site 5 resulted in a very small increase in channel area (1%).

A snorkel survey conducted on 6/30/2017 identified steelhead trout of various size classes. Neither juvenile coho nor Chinook salmon were observed in all 5 pools sampled. Also identified were threespine sticklebacks in 1 of the pools sampled.

Table 17. Individual site report card for ATM station 217, SF Elk River

Site 217 South Fork Elk River	**Parameter**	**Target Value** (# no target)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	121	147	141	159	110	144	185		120	132			100
	D_{50} (mm)	65-95	38	51	50	48	35	66	59		56	49			60
	D_{16} (mm)	#	7	6	10	2	10	17	17		13	12			34
	D_5 (mm)	#	1	2	1	1	3	4	1		10	4			15
Pool Characteristics	Pool Area (%)	≥25	42	39	45	46	56	41	51		55	55			60
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	100	100	86	80	100	83		67	71			78
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
	Total Piece Count	#	123	52	89	41	61	73	36		51	57			46
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
Riparian Overstory	Canopy Over Stream (%)	≥90		100	91	99	99	91	98		98	94			98
	Canopy of Rip Forest (%)	≥85	99	98					99		99	96			

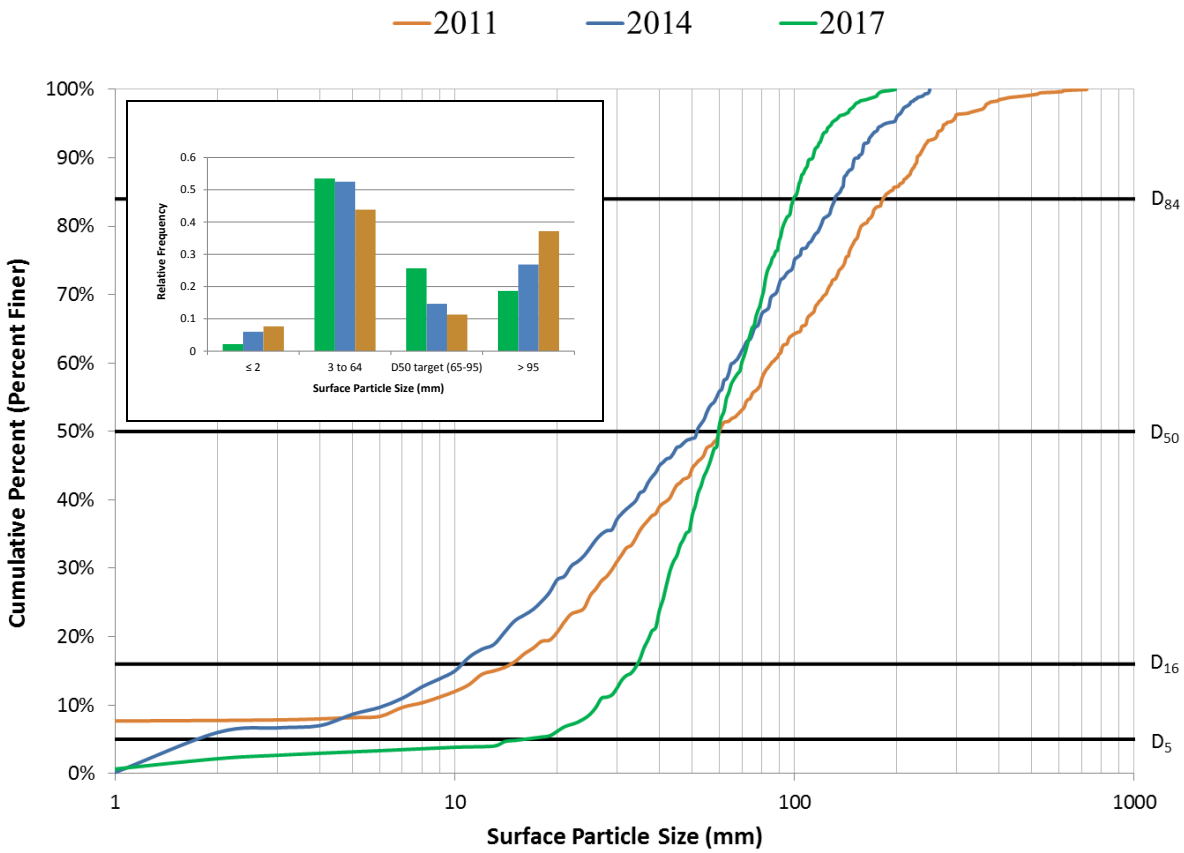


Figure 27. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Elk River ATM 217 survey reach

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

Data for all ATM parameters at site 175 (Figure 23) are summarized in the APFC report card found in Table 18. The bed surface APFC target was not met in 2017, though the data suggest a slight coarsening of the substrate across most particle size classes (Figure 28). Pool measures indicate a slight decline in habitat quality, although 100% of measured pools were associated with LWD. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 61% since 2014. Water temperature met the target for the ninth consecutive year since 2008, and mid-channel canopy cover met the target for eleventh consecutive survey year since 2004.

Survey data from Lower South Fork Elk River indicate decreases in cross sectional area at some sites (sites 1, 3, 4) and little to no net change at others (sites 2, 5) (Appendix A). Deposition at site 1 has decreased channel area by 3% since 2014. Deposition has generally continued since 2009 except for a small amount of scour that occurred in 2013. There was essentially no net change in area at site 2, but the channel has transitioned from two flow paths to one since 2014. The main channel is now wider while maintaining the depth of the old thalweg and in general, this site has been scouring since 2009. Deposition at site 3 has decreased channel area by 13% since 2014. No changes in depth were measured, but the channel has narrowed due to deposition along the right bank. Deposition at site 4 has decreased channel area by 16% since 2014, with about half a meter of deposition measured throughout the channel bed. Little net change was measured at site 5, which has maintained a similar cross section as measured in 2014.

A snorkel survey conducted on 6/30/2017 identified steelhead trout of various size classes and juvenile coho salmon in all 5 pools sampled. Juvenile Chinook salmon were not observed. Also identified were threespine sticklebacks in all 5 of the sampled pools.

Table 18. Individual site report card for ATM station 175, SF Elk River

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**
Bed Surface	D_{84} (mm)	#	1	6	6	5	6	8	6	6	9		2	5			12
	D_{50} (mm)	65-95	1	2	1	1	2	2	2	3	2		1	1			7
	D_{16} (mm)	#	1	1	1	1	1	1	1	1	1		1	1			2
	D_{5} (mm)	#	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
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	80	67	80	100	75	80	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
	Total Piece Count	#	150	58	20	53	62	45	46	52	44		47	45			28
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
Riparian Overstory	Canopy Over Stream (%)	≥90	85	98	97	98	100	99	98	95	93		96	93			97
	Canopy of Rip Forest (%)	≥85	85	98	76	97					93		97	95			

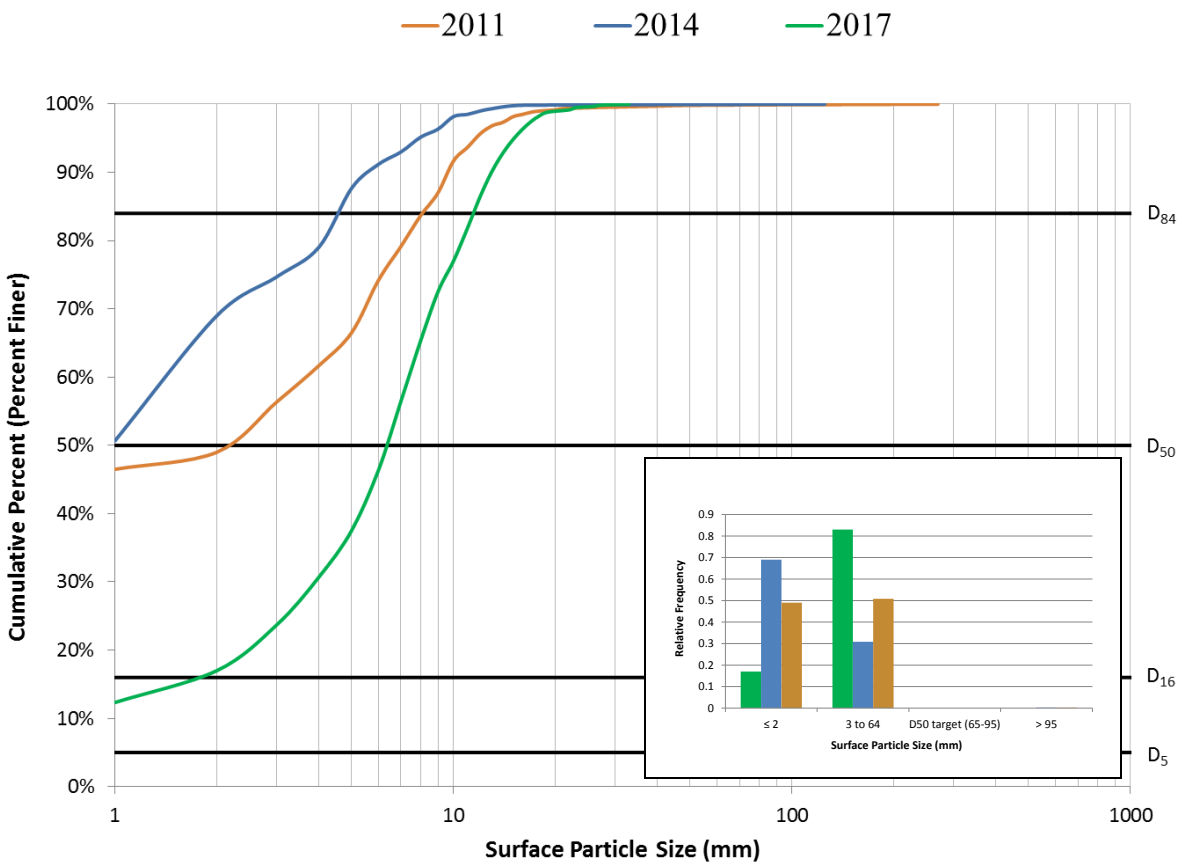


Figure 28. Cumulative frequency plot of the mean surface particle size of three riffles measured within the SF Elk River ATM 175 survey reach

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

Data for all ATM parameters at site 166 (Figure 23) are summarized in the APFC report card found in Table 19. The bed surface APFC target was not met in 2017, though the data suggest a slight coarsening of the substrate across all particle size classes (Figure 29). Pool measures indicate a slight improvement in habitat quality since 2014, with all pool characteristics meeting their respective targets. The total LWD piece frequency within the surveyed reach did not meet the target, as the total number of pieces increased by only 8% since 2014. Water temperature met the target for the ninth consecutive survey year since 2008, although mid-channel canopy cover fell short of the target the first time in the last four survey years.

Survey data from Mainstem Elk River indicate continued, but moderate, deposition at the lower cross sections and some scour at the upper cross sections (Appendix A). Deposition at site 1 decreased channel area by 3% since 2013 and overall channel area is 9% less than the starting area in 1998. Deposition at site 2 has decreased channel area by 7% since 2013, resulting mostly from narrowing due to bank deposition and some bed deposition; channel area is 16% smaller than 1998. Site 3 has seen relatively little net change since 2013; some channel scour occurred, but deposition on the left bank narrowed the overall width. The channel area is 22% less than what was measured in 1998. Site 4 also saw relatively little net change since 2013. The channel bed deepened by 0.2 m on the right bank side, but filled in toward the left bank. Overall channel area is 14% less than the area measured in 2002. Scour at site 5 has increased channel area by 11% since 2013, mostly due to deepening across the channel.

A snorkel survey could not be accurately conducted due to poor visibility; however juvenile coho salmon were observed occupying riffles and shallow pool habitats.

Table 19. Individual site report card for ATM station 166, Mainstem Elk River

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**
Bed Surface	D_{84} (mm)	#	7	5	7	6	11	9	7	7	7		3	6			10
	D_{50} (mm)	65-95	1	1	2	2	4	3	3	4	3		1	2			6
	D_{16} (mm)	#	1	1	1	1	1	1	1	1	1		1	1			2
	D_5 (mm)	#	1	1	1	1	1	1	1	1	1		1	1			2
Pool Characteristics	Pool Area (%)	≥25	73	75	61	41	68	68	80	33	72		36	78			70
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	100	67	100	100	100	80	100	89		100	80			100
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
	Total Piece Count	#	108	58	20	38	42	31	28	27	37		50	64			69
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
Riparian Overstory	Canopy Over Stream (%)	≥90	84	87	83	73	78	80	84	82	92		98	92			88
	Canopy of Rip Forest (%)	≥85	82	95	99	95					94		99	88			

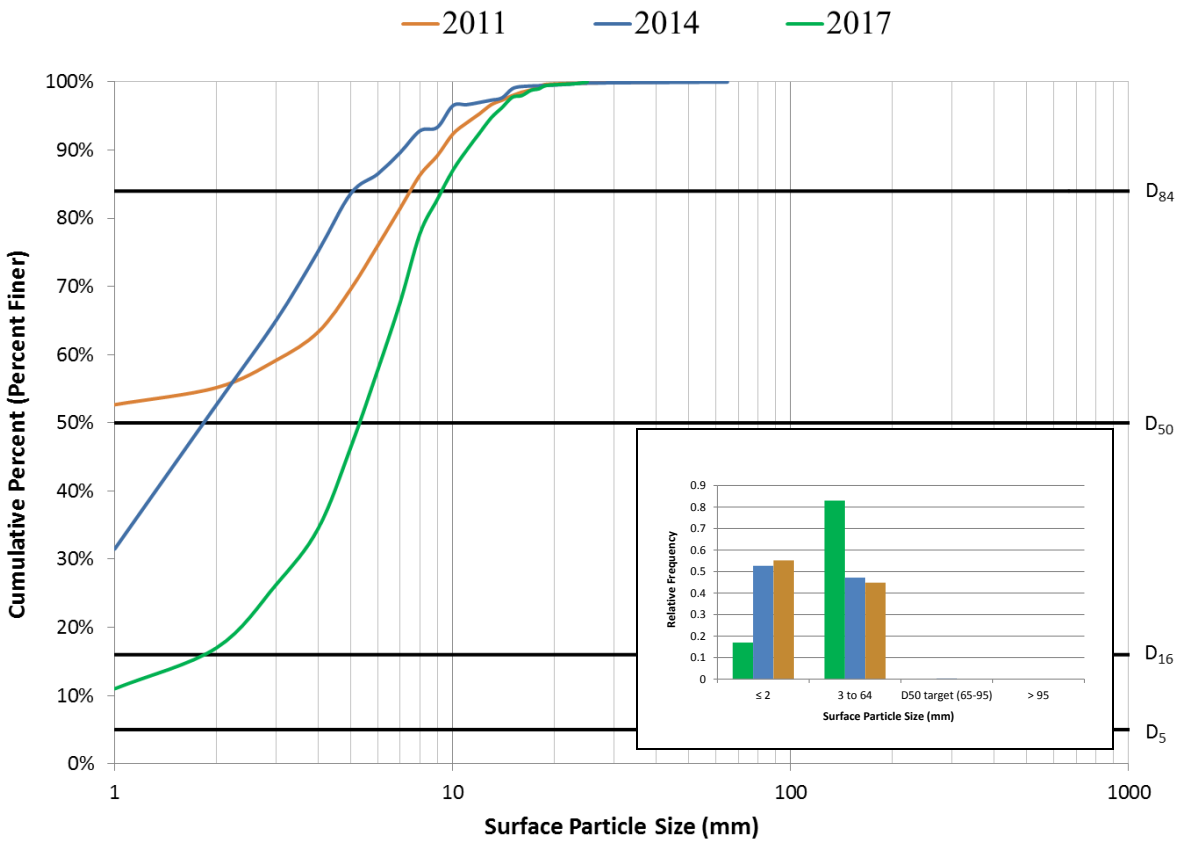


Figure 29. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Mainstem Elk River ATM 166 survey reach

Summary of ATM Trends in the Elk River WAU

A summary of the Elk River habitat characteristics from 2017 is provided in and APFC report card (Table 20). Results of habitat composite scores from 2017 and 2014 are compared to baseline (2003) data (Figure 30). Overall, the greatest improvements in habitat composite scores were observed in pool characteristics and mid-channel canopy cover.

The bed surface composite score in 2017 was lower than both 2014 and the baseline record with none of the ATM stations meeting the D_{50} target. The 2017 composite score for pool characteristics was higher than both 2014 and the baseline record (+16%, +22%, respectively). The 2017 LWD composite score for LWD was lower than both the 2014 and baseline record (-100%, -71% respectively). The 2017 mid-channel canopy cover composite score was higher (+5%) than 2014 and also higher (+32%) than the

baseline record. The 2017 water temperature composite score was equal to 2014 and higher (+33%) than the 2003 baseline record.

Table 20. The most recent habitat measures for the Elk River WAU

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)	#	89	102	52		100	12	10
	D_{50} (mm)	65-95	47	62	38		60	7	6
	D_{16} (mm)	#	18	27	21		34	2	2
	D_5 (mm)	#	4	6	12		15	1	2
Pool Characteristics	Pool Area (%)	≥25	37	51	85		60	40	70
	Pool Spacing (CW/pool)	≤6	3.0	2.8	3.5		3.5	7.4	5.0
	Residual Pool Depth (m)	≥0.91	0.54	0.62	1.13		0.65	0.77	0.92
	Pools Assoc. w/wood (%)	≥50	70	64	89		78	100	100
Large Woody Debris	Total Piece Frequency (#/100 ft)	f(CW)	5.70	3.10	4.40		5.10	2.90	4.60
	Total Piece Count	#	82	44	67		46	28	69
Water Temperature	MWAT (°C)	≤16.8	16.2	16.5	16.8		15.9	16.6	15.7
Riparian Overstory	Canopy Over Stream (%)	f(CW)	95	93	92		98	97	88
	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

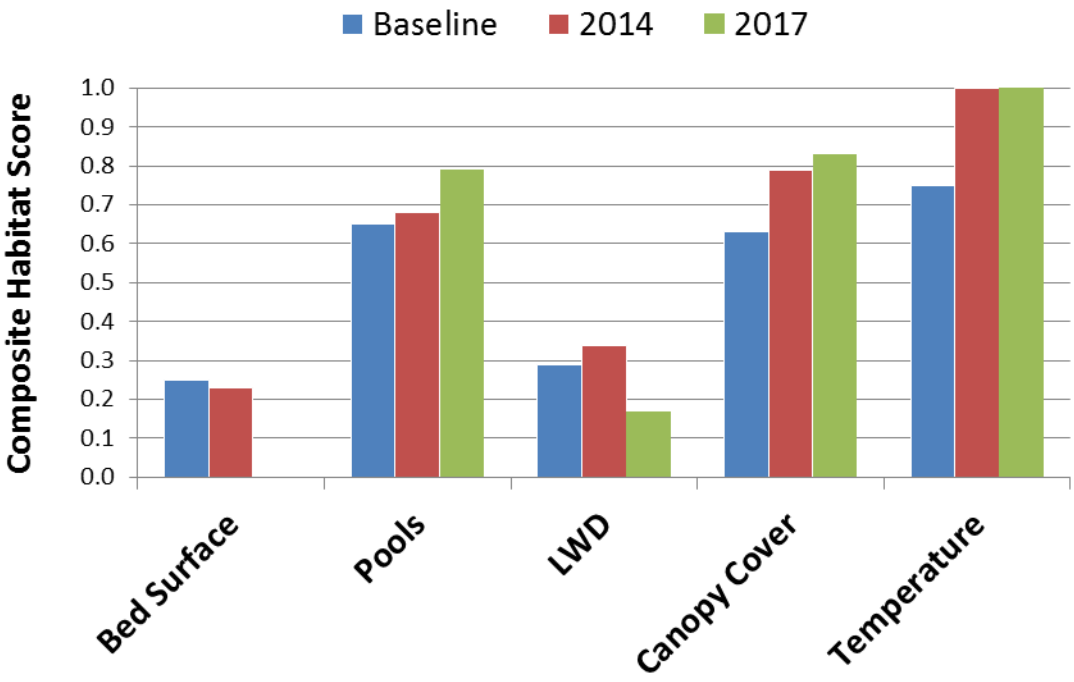


Figure 30. The composite scores for habitat characteristics in the Elk River WAU in 2017 and 2014 relative to baseline (2003) data

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 5 ATM habitat monitoring sites in the Upper Eel WAU. Two are located on the mainstem of Larabee Creek, and 3 are on tributaries to Larabee and the Middle Eel River. Figures 31 and 32 show the locations of ATM sites within the WAU. Typical site conditions are shown in Figure 33.

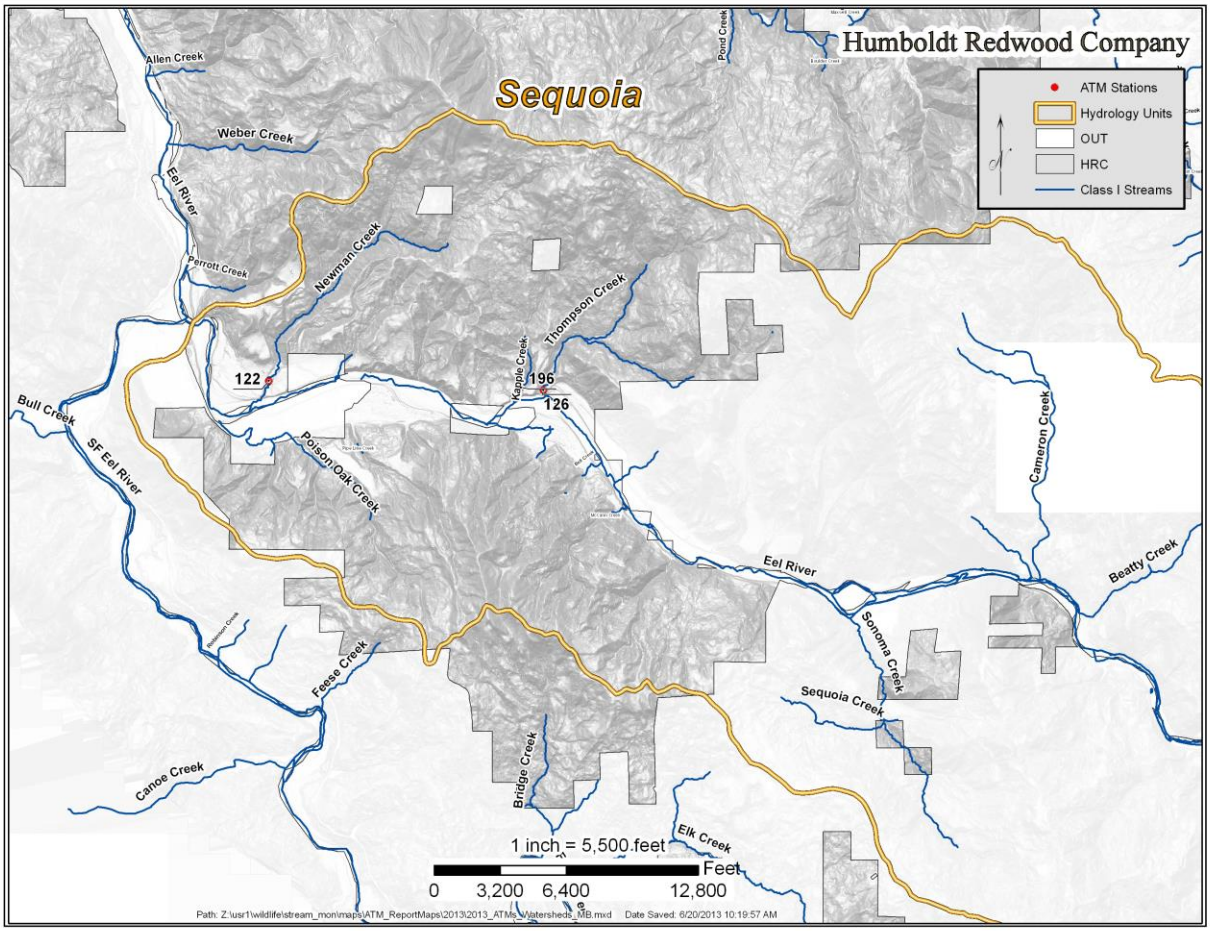


Figure 31. Location map of ATM sites in the Upper Eel WAU

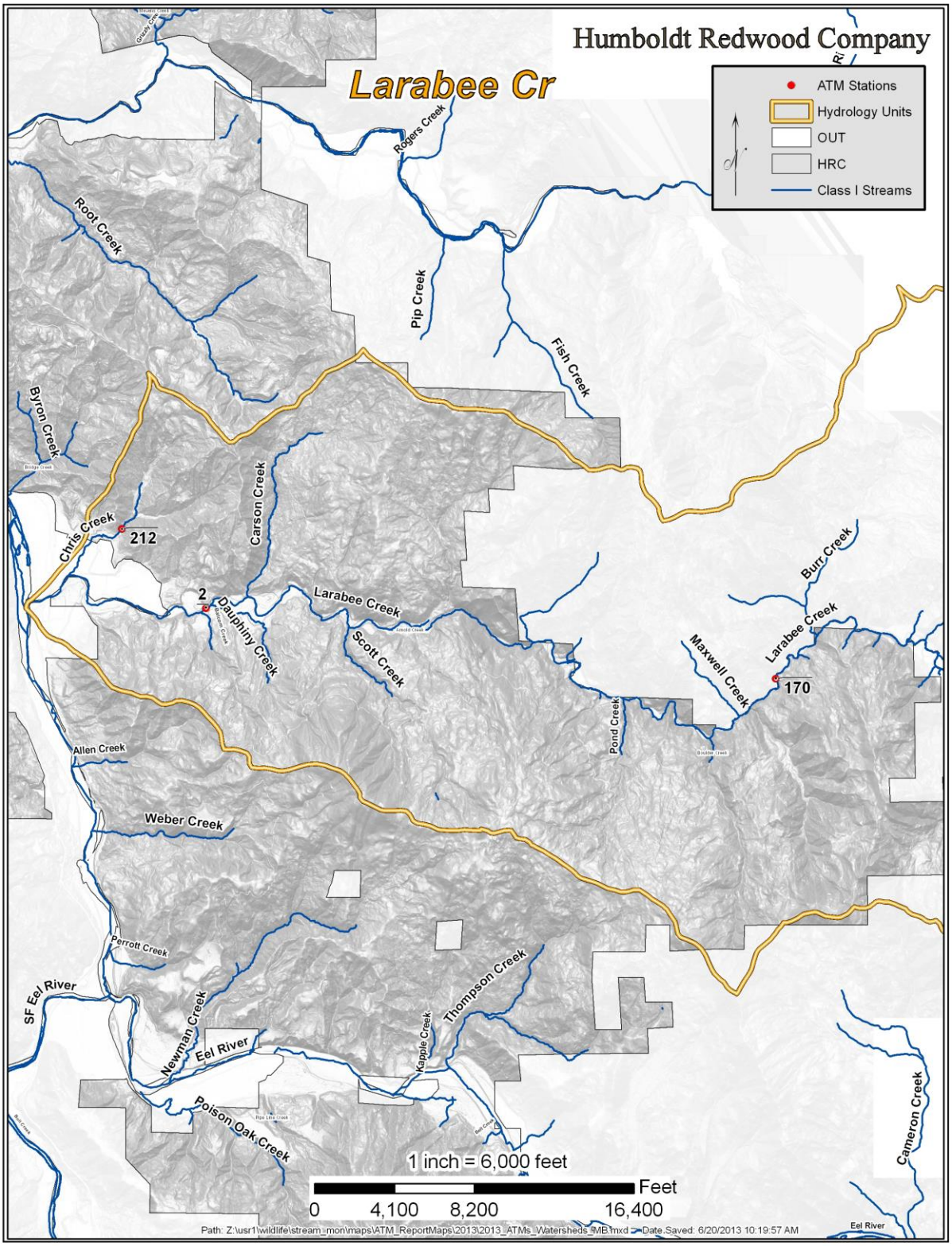


Figure 32. Location map of ATM sites in Larabee Creek /Upper Eel WAU

Thompson Creek 126

Newman Creek 122

Larabee Creek 002

Chris Creek 212

Larabee Creek 170

Figure 33. 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 33) are summarized in the APFC report card found in Table 21. The bed surface APFC target was met in 2017, as the data suggest a coarsening of the substrate across all particle size classes (Figure 34). Pool measures indicate an overall improvement in habitat quality, though residual pool depth did not meet the target for the seventh consecutive survey year. The total LWD piece frequency within the surveyed reach did not meet the APFC target, although total LWD pieces increased (+213%) since 2014. Water temperature did not meet the target in 2017, although mid-channel canopy cover met its target for the fourth time since 2008.

Survey data from Thompson Creek indicate substation scour at all sites, resulting in increases in channel cross sectional areas between 2014 and 2017 (Appendix A). Scour at site 1 increased channel area by 77% and deepened the thalweg by about half a meter, also widening the left bank. Scour at site 2 increased channel area by 75% and deepened the bed by about half a meter across the width of the channel. The net area increase of 35% at site 3 was associated more with significant left bank change than channel scour. Mass movement on the left bank appears to have increased the channel area below the reference elevation, but also deposited some material in the active channel. Scour at site 4 increased channel area by 8%, but was focused on both banks and did not change channel bed elevations. Scour at site 5 increased channel area by 35%, primarily by deepening the left bank side of the channel.

A snorkel survey conducted on 7/17/2017 identified steelhead trout of various size classes in all 5 pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. No other aquatic organisms were identified.

Table 21. Individual site report card for ATM station 126, Thompson Creek

Site 126 Thompson Creek	**Parameter**	**Target Value** (# no target)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	112	155	206			219			231			76			111
	D_{50} (mm)	65-95	26	28	40			59			81			17			66
	D_{16} (mm)	#	1	3	7			10			13			4			32
	D_{5} (mm)	#	1	1	1			1			3			2			6
Pool Characteristics	Pool Area (%)	≥25	17	19	21			17			26			18			38
	Pool Spacing (CW/pool)	≤6.0	9.3	5.0	3.2			8.7			4.3			7.5			4.5
	Residual Pool Depth (m)	≥0.91	0.24	0.43	0.45			0.51			0.41			0.45			0.33
	Pools Assoc. w/wood (%)	≥50	100	100	100			60			50			50			57
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥12.95	4.19	5.18	8.07			1.13			1.85			1.38			4.10
	Total Piece Count	#	28	32	82			11			13			8			25
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
Riparian Overstory	Canopy Over Stream (%)	≥90	88	94	92			100			100			100			94
	Canopy of Rip Forest (%)	≥85	77	79							94			97			

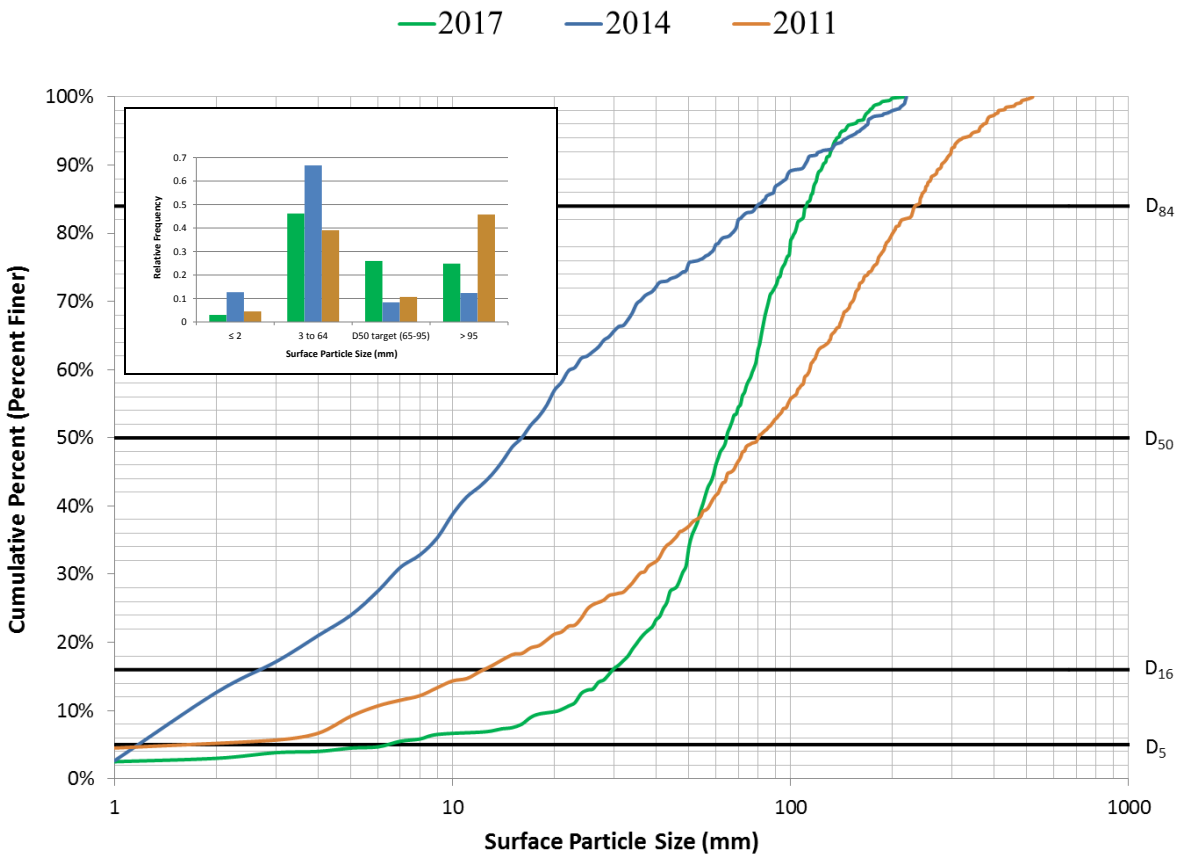


Figure 34. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Thompson Creek ATM 126 survey reach

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

Data for all ATM parameters at site 122 (Figure 33) are summarized in the APFC report card found in Table 22. The bed surface APFC target was not met in 2017, though the data suggests a coarsening of the substrate across most particle size classes (Figure 35). Pool measures indicate a slight increase in habitat quality, although residual pool depth did not meet the target for the seventh consecutive survey year. The total LWD piece frequency within the surveyed reach did not meet the APFC target, although the total number of pieces increased 67% since 2014. Water temperature did not meet the target in 2017, although mid-channel canopy met its target for the sixth consecutive survey year since 2004.

Survey data from Newman Creek indicate channel scour at all sites, with some accompanying deposition at sites 3, 5, and 6 (Appendix A). After years of deposition between 2011 and 2014, scour at site 1 increased the cross sectional area by 38% since 2014, with most change occurring towards the right side of the channel. Scour at site 2 was distributed uniformly across the bed, resulting in a net increase of 9% in cross sectional area since 2014. Site 3 experienced some minor fill and scour, resulting in little net change and a flatter channel bed. Net change at site 4 only increased cross sectional area by 5%, but fill and scour flipped the thalweg from channel right to channel left. Net cross sectional area at both sites 5 and 6 decreased (2 and 2.5%, respectively), but in both cases the channel thalweg also deepened.

A snorkel survey conducted on 7/17/2017 identified steelhead trout of various size classes in all 5 pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. No other aquatic organisms were identified.

Table 22. Individual site report card for ATM station 122, Newman Creek

Site 122 Newman Creek	**Parameter**	**Target Value** (# no target)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	80	34	104			96			111			98			93
	D_{50} (mm)	65-95	47	19	36			46			54			41			59
	D_{16} (mm)	#	13	3	5			6			21			11			35
	D_{5} (mm)	#	2	1	1			1			3			3			14
Pool Characteristics	Pool Area (%)	≥25	33	45	41			20			36			31			38
	Pool Spacing (CW/pool)	≤6.0	6.0	5.7	2.5			8.5			5.0			10.1			5.1
	Residual Pool Depth (m)	≥0.91	0.52	0.49	0.52			0.50			0.45			0.55			0.48
	Pools Assoc. w/wood (%)	≥50	67	100	100			100			71			100			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
	Total Piece Count	#	30	50	50			12			24			21			35
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
Riparian Overstory	Canopy Over Stream (%)	≥90	89	100	100			100			100			100			99
	Canopy of Rip Forest (%)	≥85	99	100							99			99			

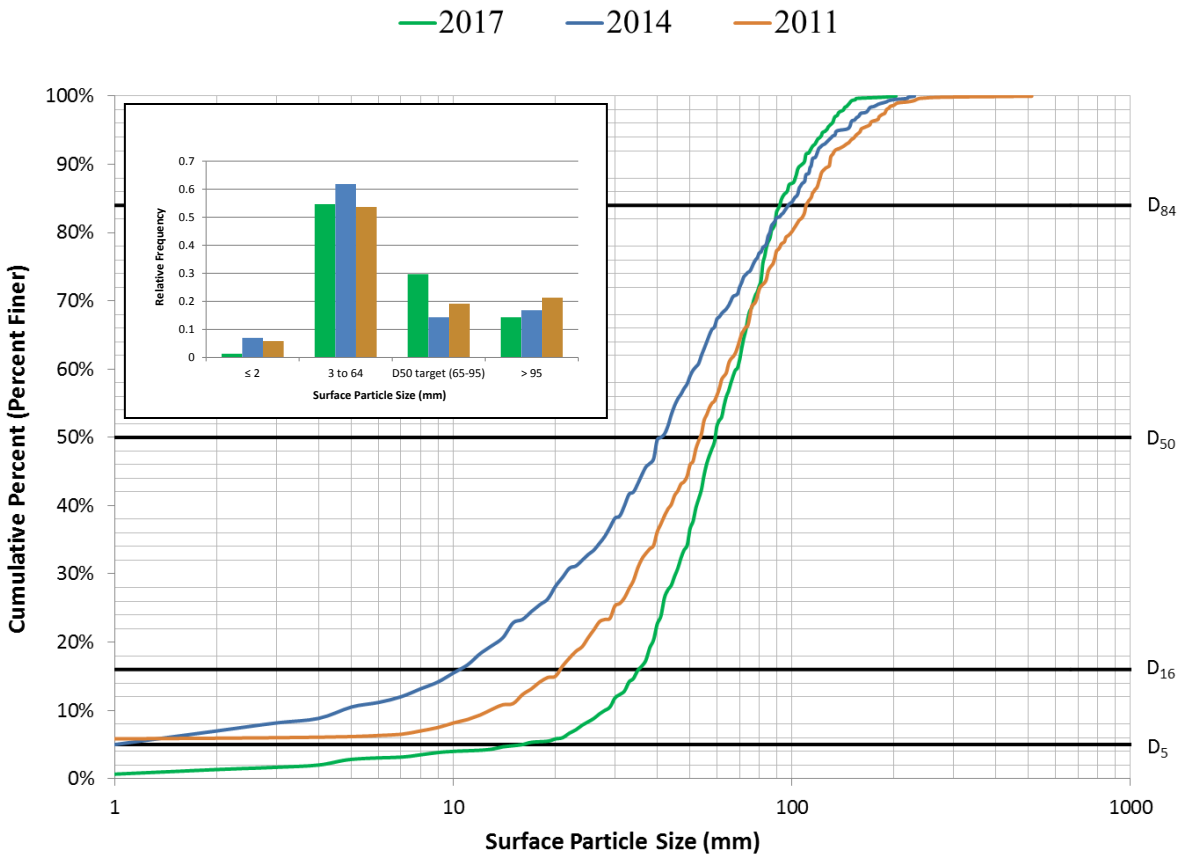


Figure 35. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Newman Creek ATM 122 survey reach

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 33) are summarized in the APFC report card found in Table 23. The bed surface APFC target was met in 2017, as the data suggest a coarsening of the substrate across most particle size classes (Figure 36). Pool measures indicate a slight decline in habitat quality, with pool spacing falling short of the target for the first time on record. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as total LWD pieces decreased 6% since 2014. Water temperature did not meet the target for the fifth time since 2012, as both mid-channel and riparian forest canopy cover placed well-short of their targets once again.

Survey data from Lower Larabee indicate a combination of scour and fill between 2014 and 2017 depending on location (Appendix A). Deposition at site 1 filled in on the left and right banks, shifting the thalweg to the center of the channel and slightly decreasing its depth and decreasing channel area by 10%. Deposition at site 2 filled in the old left bank thalweg and scour has eroded the right bank. The thalweg has shifted from the left to right bank and net channel area decreased by 21%. Scour at site 3 was focused in the channel center and deepened the thalweg; overall net channel area decreased by 4%. Deposition at site 4 filled in the thalweg and decreased channel area by 18% since 2014. Site 5 was not surveyed because the site was completely blown out due to landslides on both banks.

A snorkel survey conducted on 7/17/2017 identified steelhead trout of various size classes in all 5 pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were speckled dace (*Rhinichthys osculus*) and California roach (*Lavinia symmetricus*).

Table 23. Individual site report card for ATM station 002, Lower Larabee Creek

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**
Bed Surface	D_{84} (mm)	#	267	190				246			246			160			141
	D_{50} (mm)	65-95	86	64				111			113			74			81
	D_{16} (mm)	#	18	17				13			28			22			42
	D_{5} (mm)	#	1	7				1			1			6			21
Pool Characteristics	Pool Area (%)	≥25	6	63				61			45			58			40
	Pool Spacing (CW/pool)	≤6.0	4.9	3.3				4.0			5.2			4.3			6.4
	Residual Pool Depth (m)	≥0.91	0.96	1.32				1.34			1.31			1.56			1.46
	Pools Assoc. w/wood (%)	≥50	67	67				50			33			57			60
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥2.08	2.10	2.17				1.31			1.59			1.34			1.20
	Total Piece Count	#	28	36				20			42			36			34
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
Riparian Overstory	Canopy Over Stream (%)	≥90	13	13				14			20			9			20
	Canopy of Rip Forest (%)	≥85	11	35							30			27			63

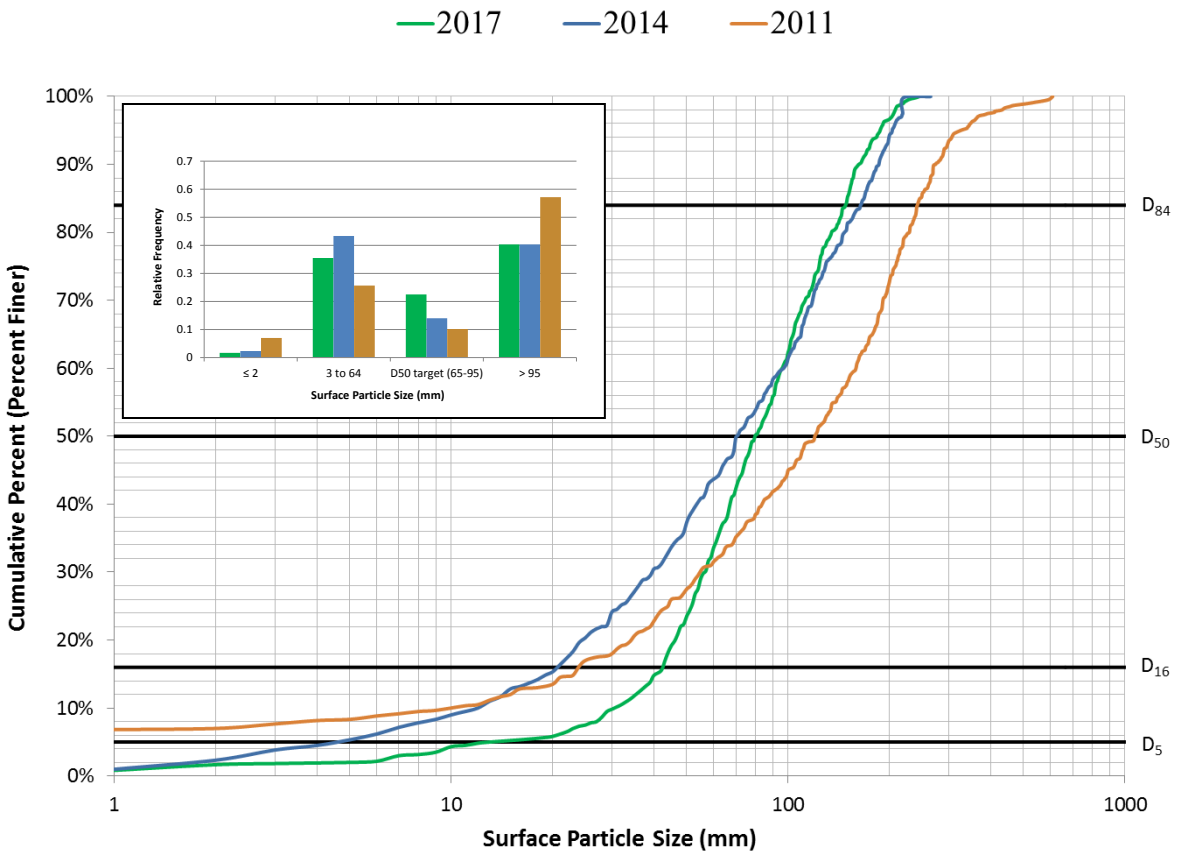


Figure 36. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Lower Larabee Creek ATM 002 survey reach

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

Data for all ATM parameters at site 212 (Figure 33) are summarized in the APFC report card found in Table 24. The bed surface APFC target was not met in 2017, although the data suggest a coarsening of the substrate across all particle size classes (Figure 37). Pool measures indicate generally static habitat conditions, though pool spacing and residual pool depth continued to place short of their respective targets. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as the total number of pieces decreased 178% since 2014. Water temperature met the target for the twelfth time since 2005, as mid-channel canopy cover met its target for the fifth time since 2005.

Survey data from Chris Creek indicate scour has increased channel area at all sites, with major channel changes occurring at sites 1-3, and minor changes occurring at sites 4 and 5 (Appendix A). Scour at site 1 resulted in net channel area increase of 1% and the thalweg deepened by 0.1-0.2m. Scour at sites 2 and 3 increased channel area by 27% and 39%, respectively, while deepening the thalweg by more than half a meter in each case. Scour at site 4 was less pronounced, resulting in a 7% net increase in channel area. Scour at site 5 was even less, resulting in a 3% channel area increase and a slight deepening of the channel thalweg.

A snorkel survey conducted on 8/6/2017 did not identify trout, coho, or Chinook in all 5 pools sampled. Two adult foothill yellow-legged frogs (*Rana boylii*) were observed leaping from the banks into 2 of the sampled pools. No other aquatic organisms were identified.

Table 24. Individual site report card for ATM station 212, Chris Creek

Site 212 Chris Creek	**Parameter**	**Target Value** (# no target)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	49			51			72						75
	D_{50} (mm)	65-95	20			7			36						49
	D_{16} (mm)	#	1			1			6						25
	D_5 (mm)	#	1			1			1						5
Pool Characteristics	Pool Area (%)	≥25	52			35			75						72
	Pool Spacing (CW/pool)	≤6.0	2.7			13.5			8.6						6.4
	Residual Pool Depth (m)	≥0.91	0.58			0.72			0.65						0.46
	Pools Assoc. w/wood (%)	≥50	83			100			89						60
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥29.56	3.63			2.63			3.78						3.20
	Total Piece Count	#	23			14			25						9
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
Riparian Overstory	Canopy Over Stream (%)	≥90	99			100			99			100			100
	Canopy of Rip Forest (%)	≥85							99			100			

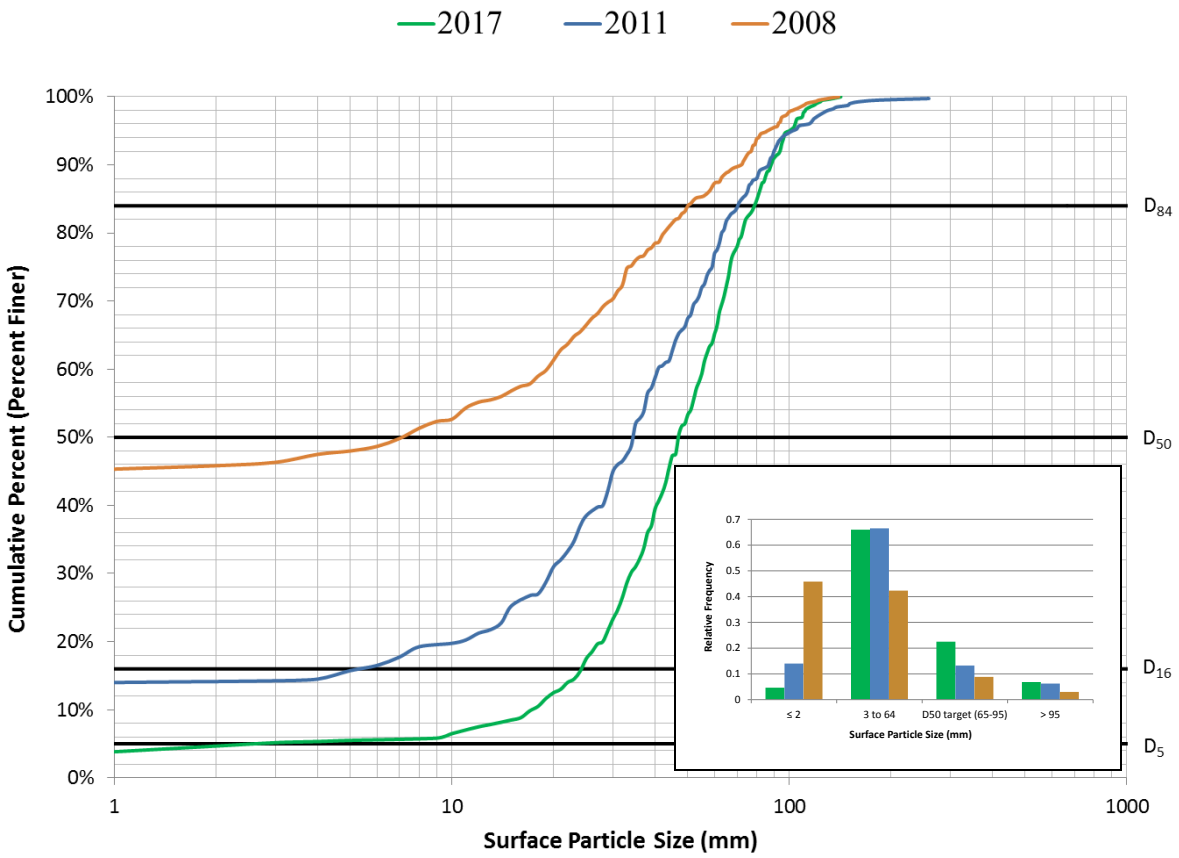


Figure 37. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Chris Creek ATM 212 survey reach

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 33) are summarized in the APFC report card found in Table 25. The bed surface APFC target was not met in 2017, although the data suggest a coarsening of the substrate across all particle size classes (Figure 38). Pool measures indicate a slight increase in habitat quality since 2014, with all characteristics meeting their respective targets. The total LWD piece frequency within the surveyed reach did not meet the APFC target, as the total number of pieces decreased 21% since 2014. Water temperature did not meet the target for the eleventh consecutive survey year. Mid-channel canopy cover placed well short of the target in 2017, although riparian forest canopy easily met its target and will not be necessary to measure during the next habitat survey rotation year.

Survey data from Larabee Creek indicate moderate deposition at all sites since 2014 and continued fill since 2011 at all sites, except site 5 (Appendix A). Deposition at site 1 has decreased channel area by 3%, focused mainly within the channel thalweg, but some scour has occurred on the upper left bank. Deposition at site 2 has decreased channel area by 4% since 2014, focused on the lower left channel bank, which has decreased the active channel width. Deposition at site 3 decreased the channel area by 8% since 2014, primarily along the shallow sloping right bank and the steeper left bank, resulting in narrowing of the active channel. Deposition along the majority of the channel bed at site 4 decreased channel area by 12% since 2014. Deposition at site 5 was less pronounced, but decreased channel area by 4% since 2014.

A snorkel survey conducted on 7/20/2017 identified steelhead trout of various size classes in 3 of the 5 pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were California roach (*Lavinia symmetricus*) in 1 of the sampled pools. No other aquatic organisms were identified.

Table 25. Individual site report card for ATM station 170, Upper Larabee Creek

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**
Bed Surface	D_{84} (mm)	#	78	62				58			62			63			79
	D_{50} (mm)	65-95	41	28				28			34			27			56
	D_{16} (mm)	#	16	11				5			18			6			37
	D_5 (mm)	#	1	2				1			7			2			24
Pool Characteristics	Pool Area (%)	≥25	61	74				61			59			61			62
	Pool Spacing (CW/pool)	≤6.0	3.3	4.7				3.5			4.0			2.2			3.4
	Residual Pool Depth (m)	≥0.91	1.66	1.19				1.32			1.33			1.02			1.22
	Pools Assoc. w/wood (%)	≥50	20	33				40			63			28			78
Large Woody Debris	Total Piece Frequency (#/100 ft)	≥2.07	0.07	0.26				0.14			0.50			0.99			0.80
	Total Piece Count	#	8	4				2			12			23			19
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
Riparian Overstory	Canopy Over Stream (%)	≥90	29	38				19			59			38			69
	Canopy of Rip Forest (%)	≥85	97	95							86			69			91

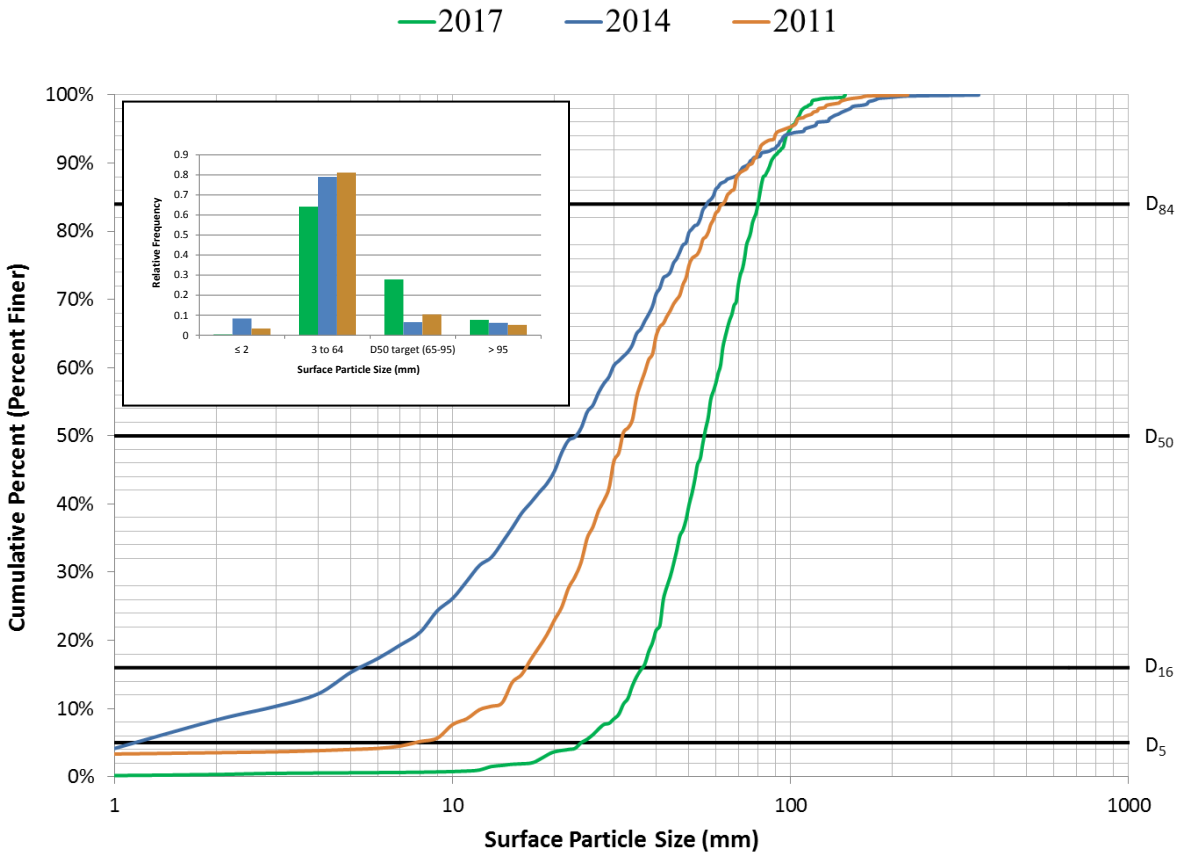


Figure 38. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Upper Larabee Creek ATM 170 survey reach

Summary of ATM Trends in the Upper Eel River WAU

A summary of the Upper Eel River WAU habitat characteristics from 2017 is provided in and APFC report card (Table 26). Results of habitat composite scores from 2017 and 2014 are compared to baseline (2003) data (Figure 39). Overall, the greatest improvements in habitat composite scores were observed in pool characteristics, although bed surface, LWD piece frequency, canopy cover and water temperature all scored lower than the 2014 records.

The bed surface composite score in 2017 was lower (-38%) than 2014 but still greater (+43%) than the baseline record. The 2017 composite score for pool characteristics was higher (+34%) than both the 2014 and baseline records. The 2017 composite score for LWD was zero, lower than both the 2014 and

baseline records. The 2017 mid-channel canopy cover composite score was lower (-5%) than 2014 and also lower (-5%) than the baseline record. The 2017 water temperature composite score was lower (-235%) than 2014 and lower (-180%) than the baseline record.

Table 26. The most recent habitat measures for the Upper Eel River WAU

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)	#	79	141	75	111	93
	D_{50} (mm)	65-95	56	81	49	66	59
	D_{16} (mm)	#	37	42	25	32	35
	D_5 (mm)	#	24	21	5	6	14
Pool Characteristics	Pool Area (%)	≥25	62	40	72	38	38
	Pool Spacing (CW/pool)	≤6	3.4	6.4	6.4	4.5	5.1
	Residual Pool Depth (m)	≥0.91	1.22	1.46	0.46	0.33	0.48
	Pools Assoc. w/wood (%)	≥50	78	60	60	57	83
Large Woody Debris	Total Piece Frequency (#/100 ft)	f(CW)	0.80	1.20	3.20	4.10	6.00
	Total Piece Count	#	19	34	9	25	35
Water Temperature	MWAT (°C)	≤16.8	20.0	22.4	15.3	17.7	17.5
Riparian Overstory	Canopy Over Stream (%)	f(CW)	69	20	100	94	99
	Canopy of Rip Forest (%)	≥85	91	63			
Watershed Area	Upstream Acreage	#	39709	53634	835	2463	1878
Reach Gradient	Reach Gradient (%)	#	0.4	0.9	0.9	4.1	2.3

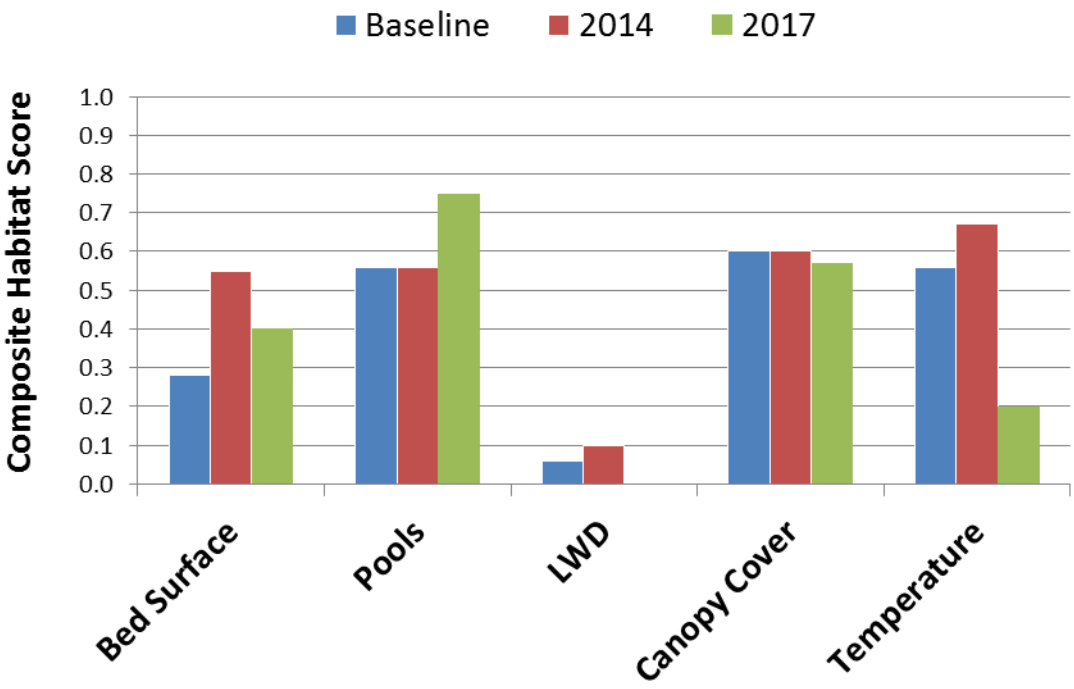


Figure 39. The composite scores for habitat characteristics in the Upper Eel River WAU in 2017 and 2014 relative to baseline (2003) data

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 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 40). 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 41.

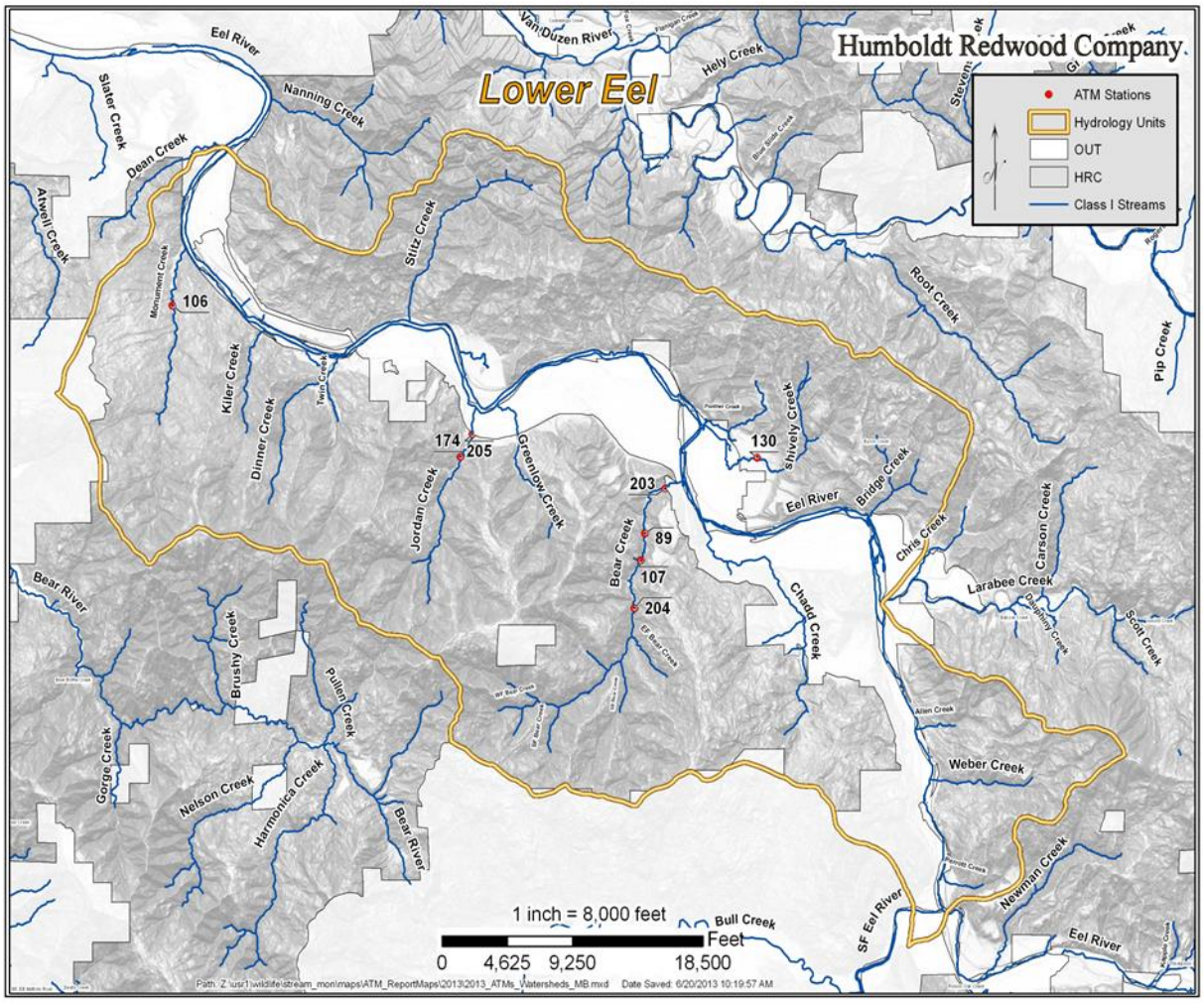


Figure 40. Location map of ATM stations in the Lower Eel River WAU

Bear Creek Station 203

Bear Creek Station 107

Bear Creek Station 204

Figure 41. Bear Creek 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 41) are summarized in the APFC report card found in Table 27. The bed surface APFC target was not met in 2017, as the data reflect a fining of the substrate across all particle size classes (Figure 42). Most pool characteristics remained generally static, while residual pool depth once again failed to meet the target criterion. Total LWD piece frequency met the APFC target for the sixth consecutive year since 2012, although the total number of pieces decreased by 65% since 2016. Water temperature did not meet the target in 2017 as mid-channel canopy cover also placed short of the target.

Survey data from Lower Bear Creek indicate significant scour and associated increases in cross sectional area at upper sites 2-5 and some deposition and associated decrease in cross sectional area at the lower site 1. The cross sectional area at site 1 is 13% smaller than in 2016, due to almost a meter of deposition in the previous right bank active channel. Scour towards the right bank created a new thalweg on that side of the channel; current cross sectional area remains larger than the 2004 start area. Scour at site 2 increased channel area by 15%. Scour at sites 3, 4, and 5 increased channel areas by 9%, 25%, and 32%, respectively, since 2016, deepening the channel at each site to the maximum extent since 2004. Channel areas are 1.5, 2, and 2.25, times larger than original areas at sites 3, 4, and 5, respectively.

A snorkel survey conducted on 8/3/2017 identified steelhead trout of various size classes in all 5 of the pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were 2 rough skinned newts (*Taricha granulosa*), 1 adult foothill yellow legged frog, and a single Sacramento pike minnow (*Ptychocheilus grandis*). No other aquatic organisms were identified.

Table 27. Individual site report card for ATM station 203, Bear Creek

Site 203 Bear Creek	**Parameter**	**Target Value** (# no target)	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	66	88	98	98	114	110	94	126	93	77	83	45	110	94
	D_{50} (mm)	65-95	30	38	28	42	46	56	39	68	65	31	33	19	66	48
	D_{16} (mm)	#	12	8	2	6	4	20	12	25	9	6	7	6	38	14
	D_{5} (mm)	#	8	1	1	1	1	4	3	4	2	1	2	2	19	2
Pool Characteristics	Pool Area (%)	≥25	22	61	32	32	26	35	47	37	26	11	13	17	32	30
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	100	100	100	100	100	85	88	100	100	100	100	100	82
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
	Total Piece Count	#	148	145	71	72	65	87	57	46	70	85	112	128	178	108
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
Riparian Overstory	Canopy Over Stream (%)	≥90	24	38	35	26	57	40	97	80	77	83	83	70	87	85
	Canopy of Rip Forest (%)	≥85	90	96	97	85				96	99	96	91			

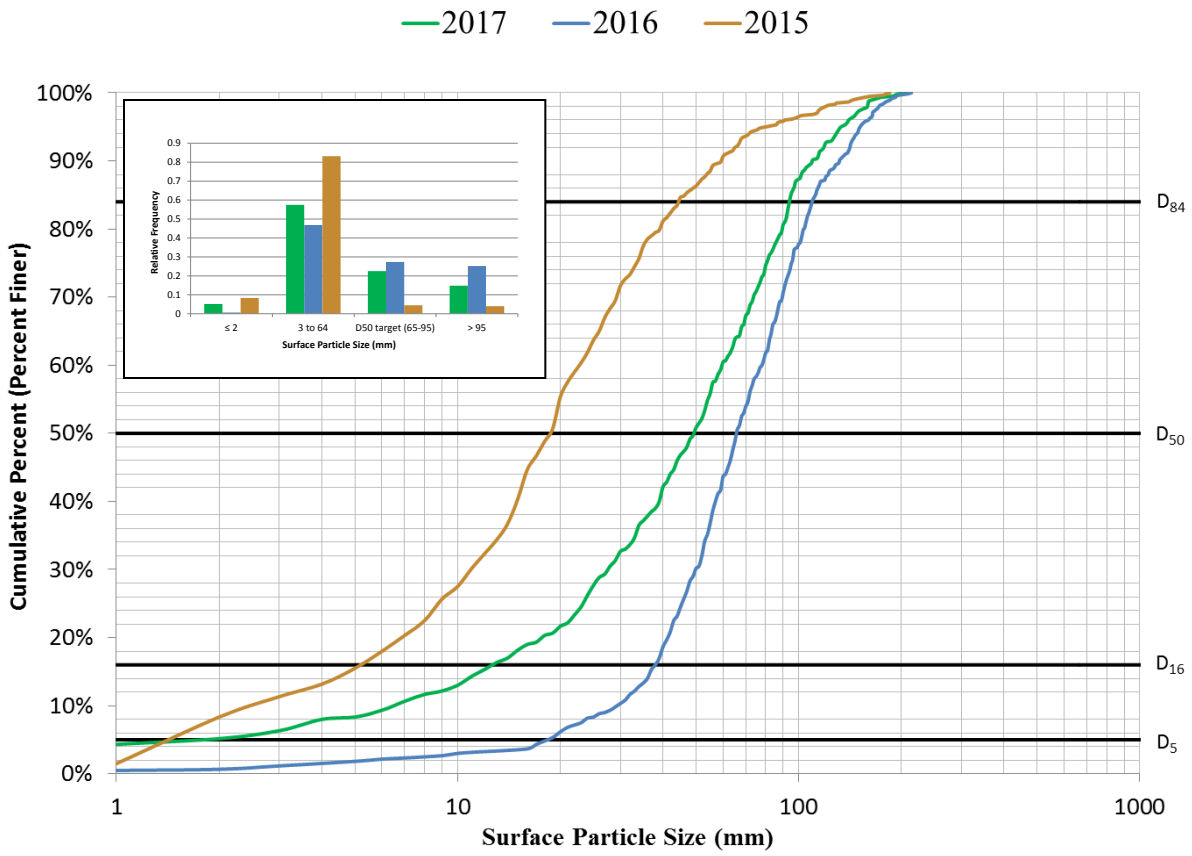


Figure 42. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 203 survey reach

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

Data for all ATM parameters at site 204 (Figure 41) are summarized in the APFC report card found in Table 28. The bed surface APFC target was met in 2017, even as the data reflect a fining of the substrate across all particle size classes (Figure 43). Pool characteristics remained generally static, while residual pool depth once again failed to meet the target for fourteen years straight. Total LWD piece frequency met the target for the third year straight since 2015, even though the total number of pieces decreased by 130% since 2016. Water temperature met the target for the second time on record at this site, as mid-channel canopy cover met its target for the first time on record since 2004.

Survey data from Upper Bear Creek indicate moderate scour at sites 1 through 4 and limited fill at site 5 (Appendix A). Scour at sites 1, 2, and 3, has increased channel area since 2016 by 7%, 5%, and 8%, respectively. This scouring trend has continued at those sites since 2015. Scour at site 4 increased channel area by 10%, with erosion focused on the mid-channel bar that separates two active channels. Some deposition has occurred within the 2016 thalweg, which has shifted the thalweg towards the left bank. Deposition at site 5 has decreased channel area by 3%, continuing a general trend of deposition that began in 2008.

A snorkel survey conducted on 8/3/2017 identified steelhead trout of various size classes in all 5 pools sampled. 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

Site 204 Bear Creek	**Parameter**	**Target Value** (# no target)	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	118	135	108	143	161	133	128	170	173	123	120	101	116	142
	D_{50} (mm)	65-95	37	51	24	53	54	62	51	76	64	52	47	45	69	66
	D_{16} (mm)	#	4	14	2	8	7	17	13	28	14	15	11	11	35	15
	D_{5} (mm)	#	1	1	1	3	1	5	4	11	3	1	2	3	16	5
Pool Characteristics	Pool Area (%)	≥25	23	39	21	38	22	16	28	38	27	21	36	14	28	31
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	100	100	100	100	100	83	100	83	86	75	67	88	80
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
	Total Piece Count	#	105	158	151	124	71	62	130	33	63	85	49	78	170	74
Water Temperature	MWAT (℃)	≤16.8						17.3							15.1	16.3
Riparian Overstory	Canopy Over Stream (%)	≥90	7	10	34	11	23	53	73	79	51	75	63	64	85	90
	Canopy of Rip Forest (%)	≥85	79	77	90	85				96	93	94	90	96		

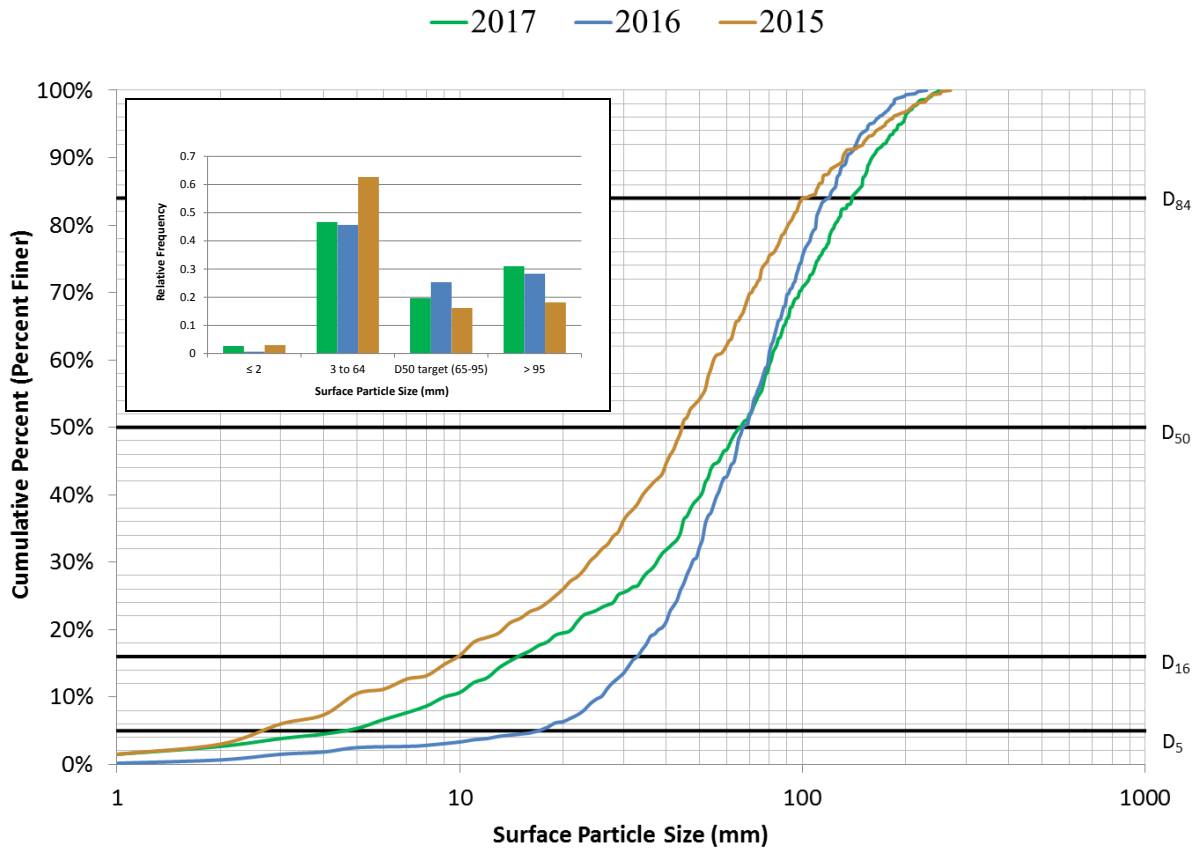


Figure 43. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 204 survey reach

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

Data for all ATM parameters at site 107 (Figure 41) are summarized in the APFC report card found in Table 29. The bed surface APFC target was met in 2017, even as the data reflect a fining of the substrate across most particle size classes (Figure 44). Pool measures reflect overall static habitat conditions, with residual pool depth once again failing to meet the target criterion in 2017. Total LWD piece frequency met the target, although the total number of pieces decreased by 6% since 2016. Water temperature did not meet the target for the first time since 2009 at this site, as mid-channel canopy cover placed short of the target for the sixth consecutive year since 2012.

Survey data from Middle Bear Creek indicate substantial channel change at all cross sections between 2016 and 2017 (Appendix A). Moderate scour at site 1 increased the cross sectional area by 6% since 2016, with most change concentrated towards the right side of the channel. Scour at site 2 increased the cross sectional area by 14%, mostly related to deepening across the active channel. Site 3 experienced deposition in the 2016 thalweg and scour into the left side of the channel, with an overall increase in cross sectional area of 13%. The channel thalweg at site 3 jumped from right to left bank in 2013 and scour has progressed since then. Scour at site 4 was distributed across the channel and resulted in a 6% increase in cross sectional area. Net cross sectional area change at site 5 was essentially zero, but left bank deposition and right bank scour caused the thalweg to completely shift locations within the channel. Scour at site 6 increased the cross sectional area by 14%, focused mainly on widening and deepening of the thalweg near the left bank.

A snorkel survey conducted on 8/3/2017 identified steelhead trout of various size classes in all 5 pools sampled. Neither juvenile coho nor juvenile Chinook salmon were observed. Also identified were 3 adult foothill yellow legged frogs. No other aquatic organisms were identified.

Table 29. Individual site report card for ATM station 107, Bear Creek

Site 107 Bear Creek	**Parameter**	**Target Value** (# no target)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Bed Surface	D_{84} (mm)	#	113	110	100	110	109	160	129	124	154	131	116	104	79	116	123
	D_{50} (mm)	65-95	46	44	42	30	36	67	62	57	69	37	43	43	34	68	66
	D_{16} (mm)	#	9	10	8	3	7	14	22	19	16	5	11	7	10	36	24
	D_5 (mm)	#	1	1	1	1	1	1	5	3	2	1	2	2	3	14	7
Pool Characteristics	Pool Area (%)	≥25	9	23	50	19	14	22	16	20	25	45	19	27	7	28	29
	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
	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
	Pools Assoc. w/wood (%)	≥50	100	100	100	100	100	100	100	100	100	89	67	86	100	100	89
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
	Total Piece Count	#	129	213	179	94	119	76	75	115	49	95	85	83	55	129	122
Water Temperature	MWAT (°C)	≤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
Riparian Overstory	Canopy Over Stream (%)	≥90	31	42	31	26	28	56	53	97	90	83	79	77	54	78	88
	Canopy of Rip Forest (%)	≥85	73	86	90	73	81				98	99	90	89			

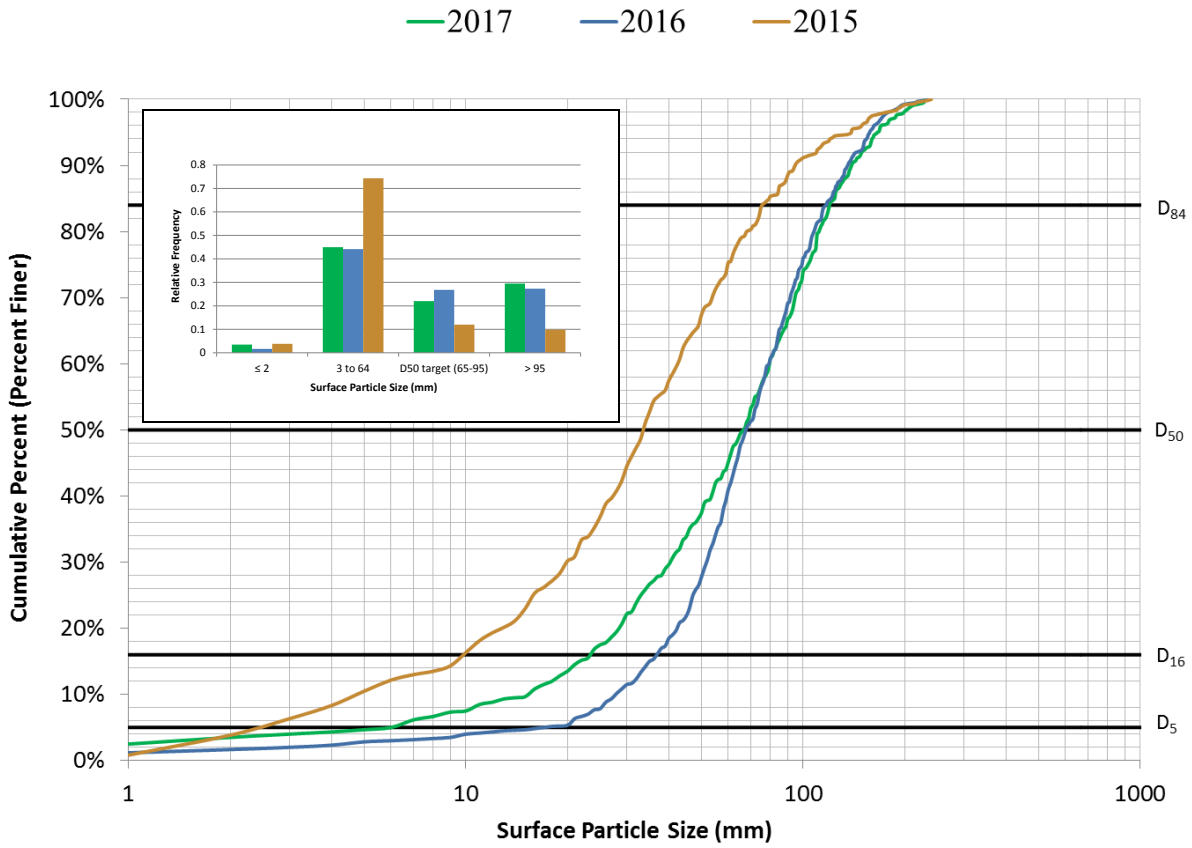


Figure 44. Cumulative frequency plot of the mean surface particle size of three riffles measured within the Bear Creek ATM 107 survey reach

Summary of ATM Trends in the Lower Eel River WAU

A summary of the Lower Eel River WAU habitat characteristics from 2017 is provided in and APFC report card (Table 30). The results of habitat composite scores from 2017 and 2016 are compared to baseline (2004) records (Figure 45). The greatest improvement since 2016 was observed in mid-channel canopy cover. Pool characteristics and total LWD piece frequency both remained static since 2016, while the habitat composite score for bed surface decreased by 49% and the temperature composite score decreased by 203%.

Table 30. Most recent habitat measures for the Lower Eel River WAU

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)	#	94	123	142
	D_{50} (mm)	65-95	48	66	66
	D_{16} (mm)	#	14	24	15
	D_5 (mm)	#	2	7	5
Pool Characteristics	Pool Area (%)	≥25	30	29	31
	Pool Spacing (CW/pool)	≤6	2.7	3.4	3.0
	Residual Pool Depth (m)	≥0.91	0.61	0.63	0.49
	Pools Assoc. w/wood (%)	≥50	82	89	80
Large Woody Debris	Total Piece Frequency (#/100 ft)	f(CW)	6.8	7.7	5.3
	Total Piece Count	#	108	122	74
Water Temperature	MWAT (°C)	≤16.8	17.6	16.9	16.3
Riparian Overstory	Canopy Over Stream (%)	f(CW)	85	88	90
	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

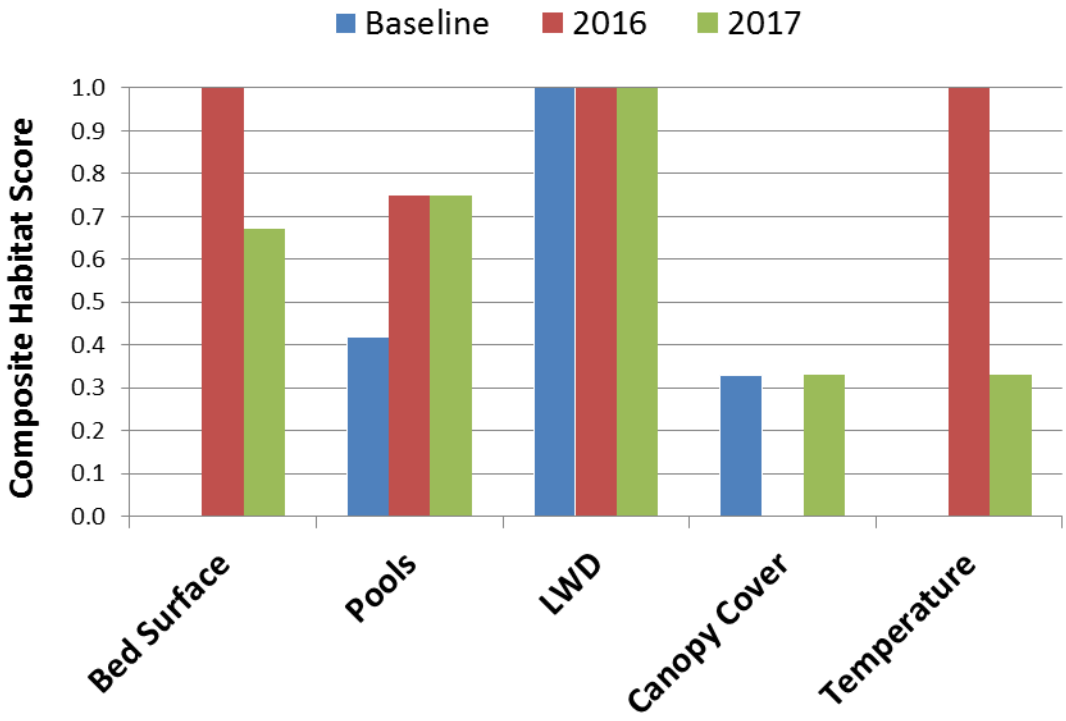


Figure 45. The composite scores for habitat characteristics in Bear Creek (Lower Eel River WAU) in 2016 and 2017 relative to baseline (2004) data

QUALITY ASSURANCE / QUALITY CONTROL

Three of the twelve (3/21) ATM sites measured in 2017 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 2017. 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 2017 QA/QC are shown in Table 31.

Initial vs. QA/QC surface sediment measurements were relatively constant at site 015 (within 2.5%), but identical at sites 217 and 203. Pool characteristic comparisons were consistent at all three sites, resulting in identical pass/fail scores across all pool habitat parameters. LWD counts also resulted in identical pass/fail scores despite the variance of initial vs. QA/QC counts (up to 17% difference). Mid-channel canopy was re-measured at all three sites and reflects consistent results utilizing the current data

collection methods and highlights the flexibility of the pass/fail approach to the APFC score card rating system currently utilized in this report.

Table 31. QA/QC data collection measures for three (3) ATM stations in 2017

2017 QA/QC	Parameter	Target Value (# no target)	015 SF Freshwater	015.1 SF Freshwater	217 NF Elk River	217.1 NF Elk River	203 Bear Creek	203.1 Bear Creek
Bed Surface	D_{84} (mm)	#	68	71	100	100	94	98
	D_{50} (mm)	65-95	40	41	60	60	48	48
	D_{16} (mm)	#	20	23	34	32	14	13
	D_5 (mm)	#	11	11	15	15	2	3
Pool Characteristics	Pool Area (%)	≥25	54	61	60	53	30	36
	Pool Spacing (CW/pool)	≤6.0	7.5	7.5	3.5	4.0	2.7	2.2
	Residual Pool Depth (m)	≥0.91	0.81	0.75	0.65	0.72	0.61	0.52
	Pools Assoc. w/wood (%)	≥50	75	100	78	75	82	100
Large Woody Debris	Total Piece Frequency (#/100 ft)	f(CW)	9.70	9.70	5.10	5.80	6.80	7.70
	Total Piece Count	#	67	67	46	54	108	122
Water Temperature	MWAT (°C)	≤16.8	15.9		15.9		17.6	
Riparian Overstory	Canopy Over Stream (%)	f(CW)	93	94	98	99	85	86
	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 also 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. This change was made to the monitoring program and is discussed in the ATM methods revised section of this document.

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 measurement 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 at ATM locations have been formally added to standard ATM protocol in consultation with HCP signatory agencies (2014).

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 on an annual basis)

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APPENDICES

Appendix A Cross-section Plots (on CD)