Watershed-Wide Instream Flow Criteria for the South Fork Eel River

California Department of Fish and Wildlife
Instream Flow Program

November 2021

Watershed Criteria Report No. 2021–02

California Department of Fish and Wildlife
Water Branch
Instream Flow Program
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The California Department of Fish & Wildlife
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FLOW PROGRAM

Suggested citation:

CDFW (2021). Watershed-wide instream flow criteria for the South Fork Eel River. California Department of Fish and Wildlife, Instream Flow Program (CDFW), West Sacramento, CA. Watershed Criteria Report No. 2021–02.

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Introduction

This *Watershed-Wide Instream Flow Criteria* report (Watershed Criteria Report) provides instream flow criteria for the South Fork Eel River (SF Eel River) watershed, based on the best available scientific information, existing and new datasets, analysis, and fieldwork. Its intended audience includes agencies, water managers, non-governmental organizations, and the public.

The SF Eel River was identified as a priority stream in the California Water Action Plan (CNRA et al. 2016). Accordingly, the California Department of Fish and Wildlife (Department) initiated studies in Redwood Creek, a tributary to the SF Eel River, as described in the *Habitat and Instream Flow Evaluation for Anadromous Salmonids in the South Fork Eel River and Tributaries, Humboldt and Mendocino Counties* study plan (CDFW 2016). This Watershed Criteria Report presents a portion of the results from this study. An additional report, *Instream Flow Evaluation: Juvenile Steelhead and Coho Salmon Rearing in Redwood Creek, Humboldt County* (Maher et al. 2021), provides site-specific information for Redwood Creek.

This report presents stream assessments for 55 reaches and 13 site-specific field surveys. An overview of the analyses used to create instream flow regime criteria contained in this document, as well as examples of potential criteria applications, are found in the Department's *Methodology Overview for Watershed-Wide Instream Flow Criteria Reports* (Overview) document (CDFW 2021a). Reviewing and understanding the information contained in the Overview document is essential to understanding flow criteria contained in this report. Complete background files for this report are maintained in the Department's Headquarters office. This document and the Overview may be found on the Watershed-Wide Instream Flow Criteria webpage (CDFW 2021b).

The Department provides this document as a tool for consideration in water management planning. It presents an analytical approach that can be implemented, if appropriate, under the specific circumstances of a watershed, stream, or informational need. This report and the Overview, in and of themselves, should not be considered to provide binding guidelines.

South Fork Eel River
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

South Fork Eel River Watershed

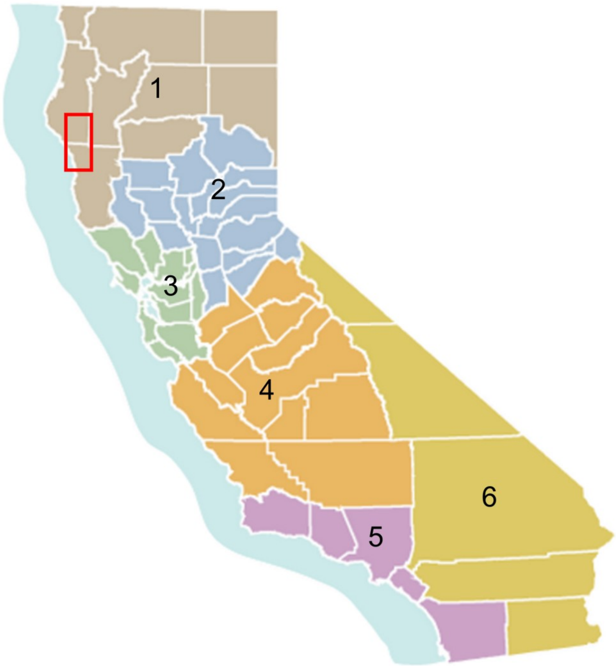

Figure 1. Map of the Department's Regions.

- Located in the Department's Region 1
- Spans Humboldt and Mendocino counties
- 689-square-mile (mi^2) drainage area
- Supports Coho Salmon, Chinook Salmon, and steelhead

Cow Creek

SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

In this map (Figure 2), yellow indicates steelhead-bearing streams (Shannon and Christy 2012) and the orange shapes are United States Geological Survey (USGS) gages. Criteria were developed for each numbered reach. The common identifiers (COMIDs) that correspond to the numbered reaches are listed in Appendix A. Maps for each subwatershed (i.e., lower, middle, upper) are presented in Figure 3–Figure 5.

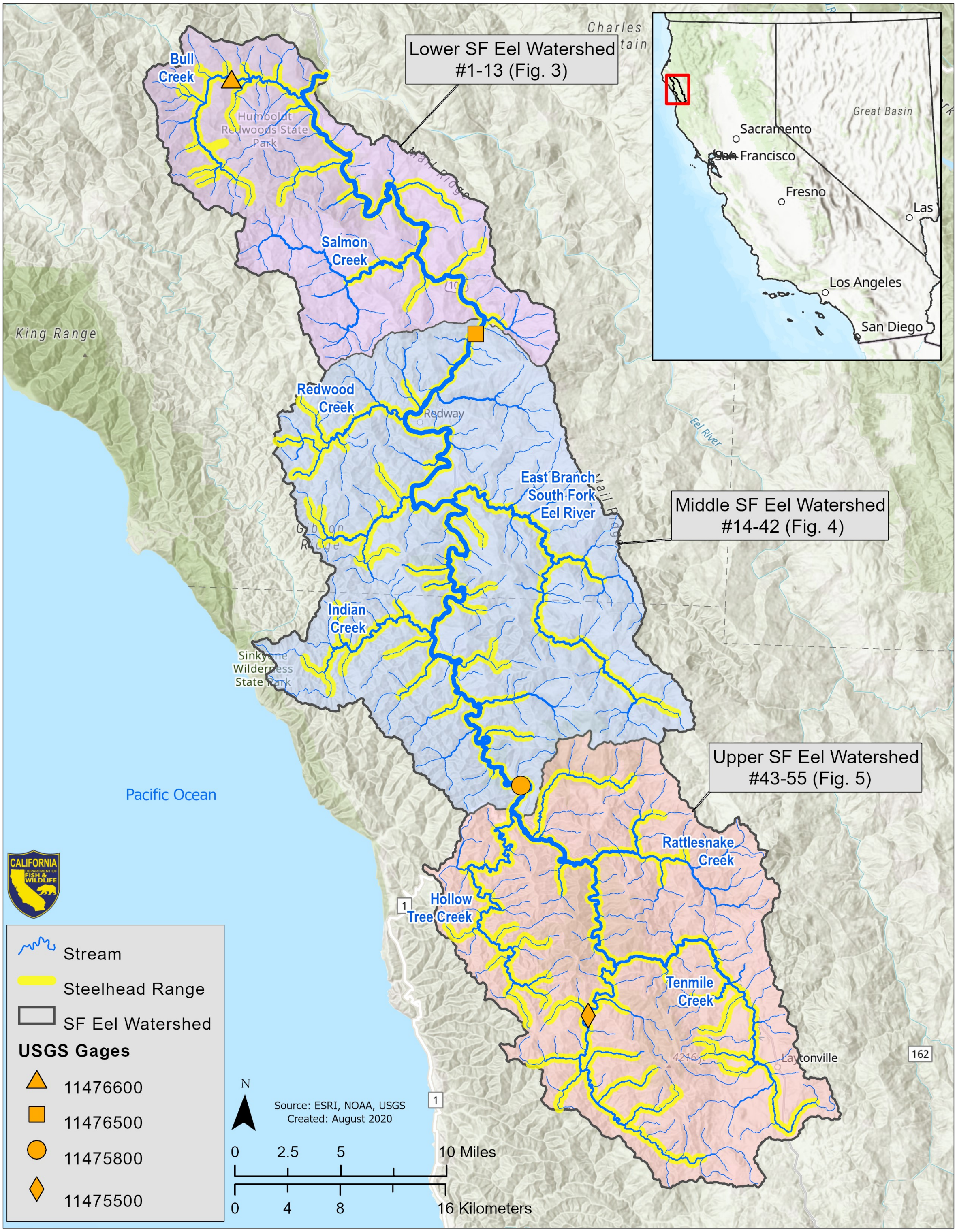

Figure 2. SF Eel River watershed overview map.

The following maps display the SF Eel River subwatersheds (Figure 3–Figure 5). On each map, yellow indicates steelhead-bearing streams and the orange shapes are USGS gages. The black numbers indicate reaches that were analyzed in this report. Both tributary and mainstem reaches were included.

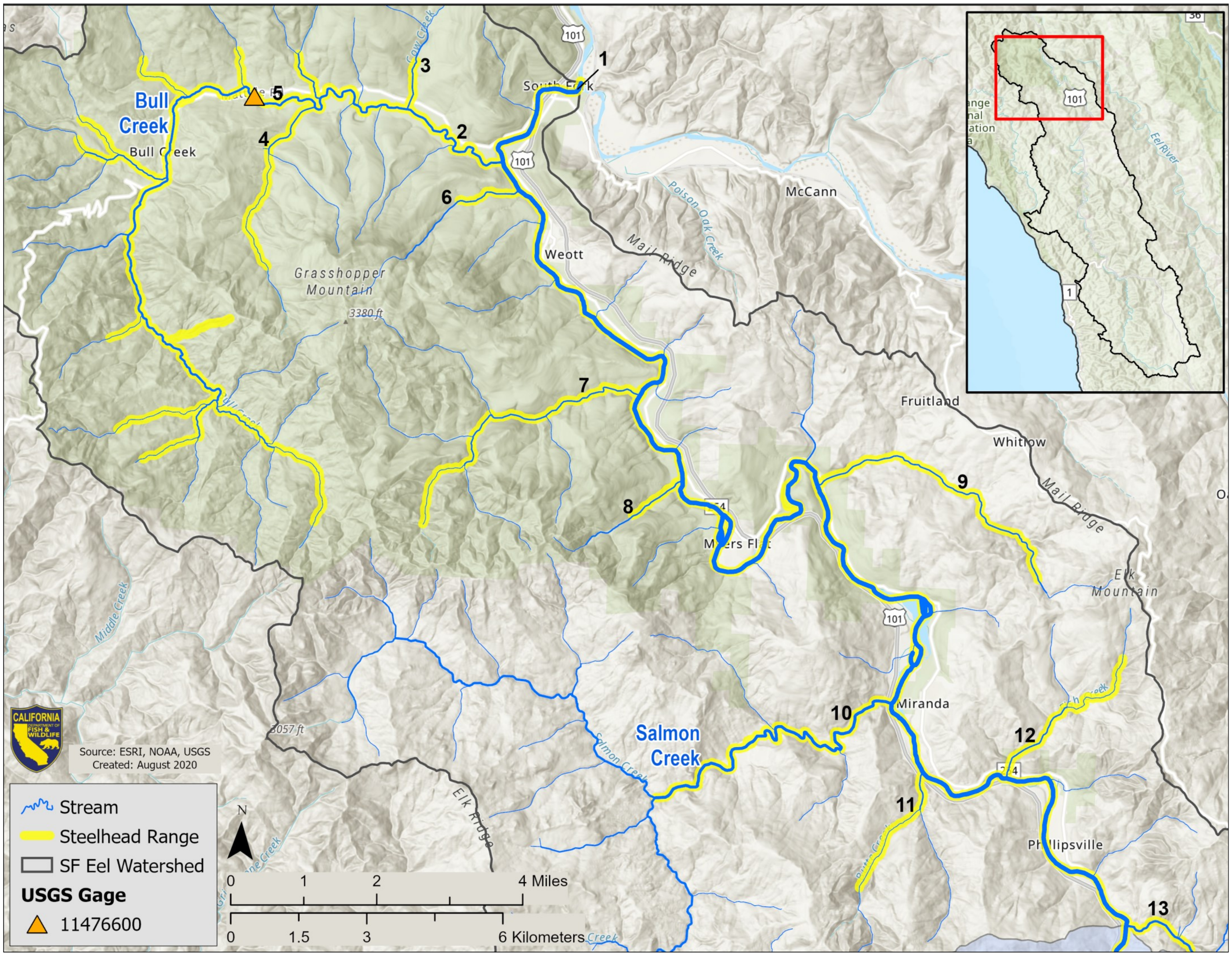

Figure 3. Lower SF Eel River subwatershed map.

1) SF Eel River 1
2) Bull Creek 1
3) Cow Creek
4) Squaw Creek
5) Bull Creek 2
6) Decker Creek
7) Canoe Creek
8) Coon Creek
9) Elk Creek
10) Salmon Creek
11) Butte Creek
12) Fish Creek 1
13) Ohman Creek

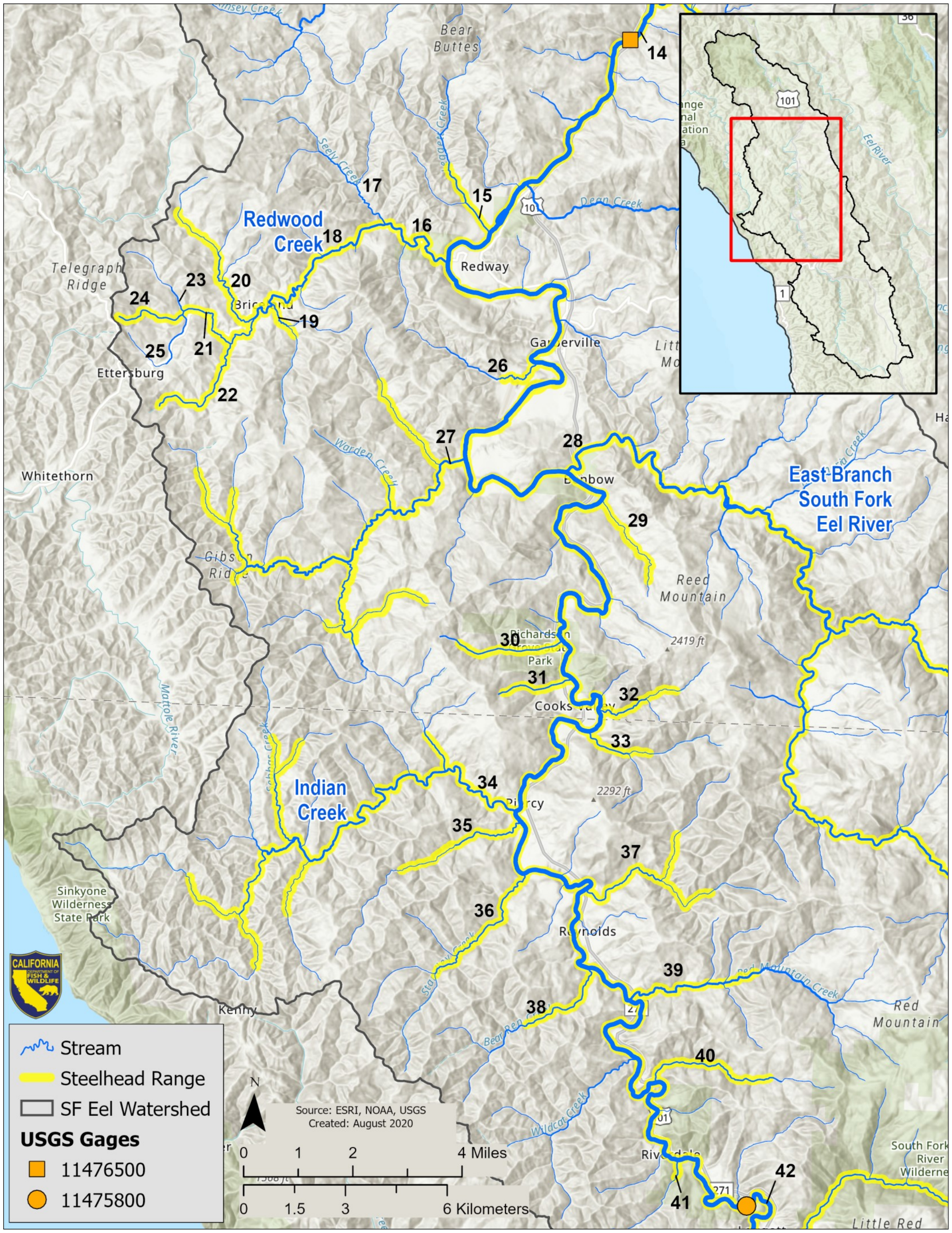

Figure 4. Middle SF Eel River subwatershed map.

14) SF Eel River 2
15) Leggett Creek
16) Lower Redwood Creek
17) Seely Creek
18) Middle Redwood Creek
19) Somerville Creek
20) Miller Creek
21) Lower China Creek
22) Upper Redwood Creek
23) NF China Creek
24) Upper China Creek
25) Dinner Creek
26) Connick Creek
27) Sproul Creek
28) East Branch SF Eel River
29) Fish Creek 2
30) Durphy Creek
31) Hartsook Creek
32) Milk Ranch Creek
33) Lower Gap Creek 1
34) Indian Creek
35) Piercy Creek
36) Standley Creek
37) McCoy Creek
38) Bear Pen Creek
39) Red Mountain Creek
40) Bridges Creek
41) Mill Creek
42) SF Eel River 3

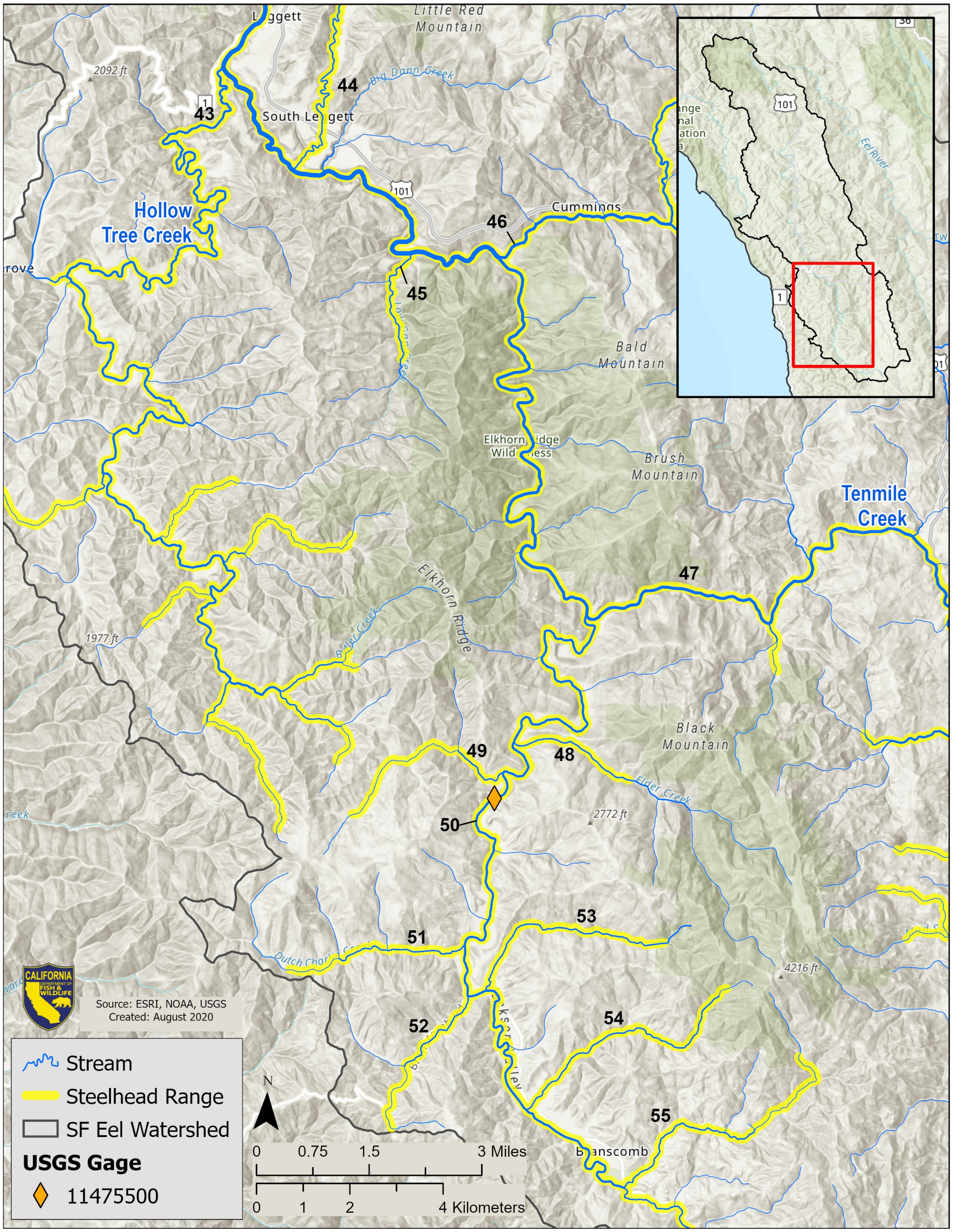

Figure 5. Upper SF Eel River subwatershed map.

43) Hollow Tree Creek
44) Cedar Creek
45) Lower Gap Creek 2
46) Rattlesnake Creek
47) Tenmile Creek
48) Elder Creek
49) Jack of Hearts Creek
50) SF Eel River 4
51) Dutch Charlie Creek
52) Redwood Creek 2
53) Rock Creek
54) Kenny Creek
55) Mud Creek

The summaries in Figure 6 provide an overview of analyses presented in this Watershed Criteria Report. For more details on each analysis see the Overview, which can be found through the Watershed-Wide Instream Flow Criteria webpage (CDFW 2021).

Flow Variation

Annual and interannual variation in flows is critical to long-term ecological functioning. These data provide an example of natural variation in the selected watershed.

Median Natural Flows

Median natural flows present estimated natural streamflow data by water month type for each reach.

Functional Flows

Functional flows perform key ecological and geomorphic functions. This section presents information on the timing, magnitude, and duration of key functional flows within the annual hydrologic cycle.

Ecosystem Baseflows

Ecosystem baseflows are monthly baseflows that preserve a healthy stream ecosystem. These are calculated as a percentage of monthly and annual natural flows and vary throughout the year.

Salmonid Habitat Optimum Flows

Salmonid habitat optimum flows provide optimal access to preferred salmonid habitat. This section presents the optimal discharge for select salmonid life stages for each stream reach.

Sensitive Period Indicators

Sensitive period indicator flows can be used to identify the sensitive low-flow period. During this period, fish and wildlife may be particularly sensitive to flow reductions. These flows can be determined using a field-based analysis.

Salmonid Passage Flows

Salmonid passage flows provide enough water for salmonids to cross riffles, which are typically the shallowest part of a channel. These flows are determined using a field-based analysis.

Figure 6. Watershed Criteria Analysis Key.

Flow Variation

Flows in the SF Eel River watershed are variable throughout the year and from year to year. The gage presented below (Figure 7) was selected because it is relatively unimpaired and represents hydrologic patterns in the SF Eel River watershed. However, it is important to note that the SF Eel River watershed has experienced decades of anthropogenic impacts, including land use changes and water diversions, which have resulted in changes in hydrologic patterns (CDFW 2014).

The wet season in the SF Eel River watershed is predicted to become shorter, more intense, and more variable as climate change impacts intensify (Grantham 2018). These shifts, combined with ongoing surface and groundwater extractions, may result in higher stress to ecosystems and reduced water availability. Understanding natural variability and projected future changes to flow patterns can help water users and managers create a flow regime and plan for changes in water availability.

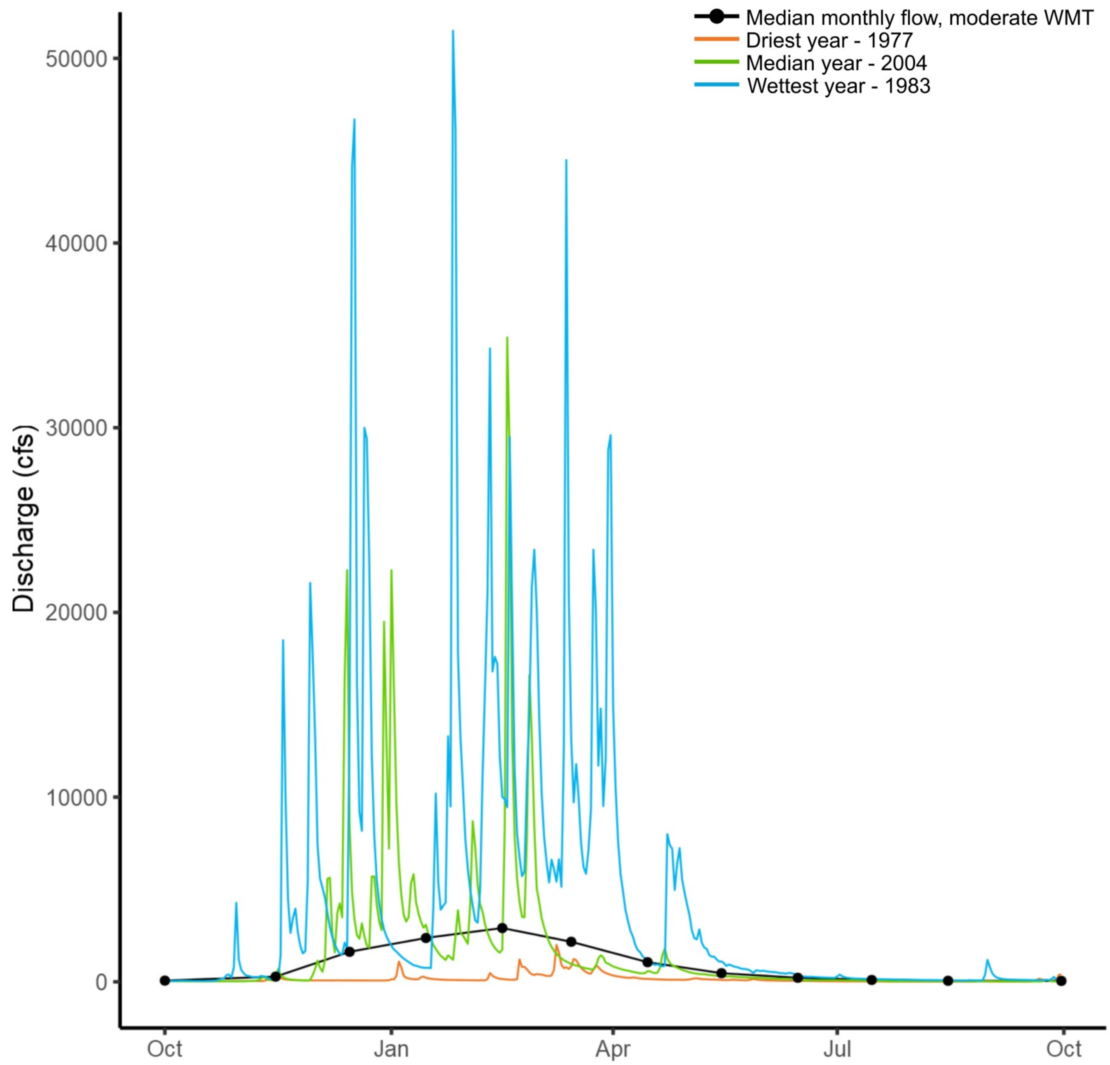

Figure 7. Variation in mean daily SF Eel River flows at the Miranda USGS gage 11476500, located in the lower SF Eel River watershed, in extreme and median conditions (i.e., the driest, median, and wettest year) between water years 1940 and 2019 (USGS 2020). Median monthly flow for a moderate water month type (WMT) is also included.

Median Natural Flows

Natural Flows are the stream flows (in cfs) that would be expected with no human influence (data from Zimmerman et al. 2020). Table 1 presents monthly median natural flows by month for wet, moderate, and dry water month types for each SF Eel River tributary and mainstem reach analyzed in this report. It also presents the drainage area in mi^2. The numbers next to each stream name correspond to the numbers found on the SF Eel River watershed maps (Figure 2–Figure 5).

Table 1. Median natural flows.

1) SF Eel River 1 689.2 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	7,321	5,831	4,898	2,938	1,285	557	208	94	67	115	1,416	6,908
Moderate	3,106	3,935	2,992	1,354	618	274	130	70	56	81	399	2,032
Dry	981	1,519	1,737	803	368	168	82	52	42	50	119	295

2) Bull Creek 1 41.6 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	485	380	276	215	92	37	13	6	3	7	74	366
Moderate	206	242	186	93	46	19	8	4	3	5	27	143
Dry	74	103	114	60	27	13	6	3	2	2	9	28

3) Cow Creek 2.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	23	18	13	11	4	2	1	<1	<1	<1	4	17
Moderate	9	10	8	5	2	1	<1	<1	<1	<1	1	6
Dry	3	5	6	3	2	1	<1	<1	<1	<1	1	1

4) Squaw Creek 4.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	51	39	27	22	9	4	1	1	<1	1	8	36
Moderate	21	25	19	10	5	2	1	1	<1	<1	3	15
Dry	8	11	12	6	3	1	1	<1	<1	<1	1	3

5) Bull Creek 2 27.9 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	368	315	251	165	64	26	9	4	3	5	65	322
Moderate	181	187	157	67	31	13	6	3	2	3	17	115
Dry	48	77	81	41	19	9	4	2	1	2	6	21

6) Decker Creek 2.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	25	18	14	11	4	2	1	<1	<1	<1	3	17
Moderate	9	11	8	5	2	1	<1	<1	<1	<1	1	6
Dry	4	5	6	3	2	1	<1	<1	<1	<1	<1	1

Table 1. Median natural flows (continued).

7) Canoe Creek 10.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	127	93	68	50	21	8	3	2	1	2	17	80
Moderate	50	59	42	22	11	5	2	1	1	1	6	32
Dry	16	25	27	13	7	3	2	1	<1	1	2	7

8) Coon Creek 1.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	17	13	9	7	3	1	<1	<1	<1	<1	2	11
Moderate	6	8	5	3	1	1	<1	<1	<1	<1	1	4
Dry	2	3	4	2	1	<1	<1	<1	<1	<1	<1	1

9) Elk Creek 6.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	58	45	34	26	10	4	2	1	1	1	8	38
Moderate	21	25	20	11	6	3	1	1	<1	1	2	13
Dry	6	12	14	7	4	2	1	<1	<1	1	1	3

10) Salmon Creek 36.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	362	279	225	153	64	24	10	4	3	6	55	272
Moderate	138	175	136	65	31	12	6	3	3	3	19	91
Dry	46	83	86	42	20	9	4	2	2	2	6	20

11) Butte Creek 4.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	41	33	23	17	7	3	1	1	<1	1	6	29
Moderate	14	18	14	7	4	2	1	<1	<1	<1	2	10
Dry	5	9	9	5	3	1	1	<1	<1	<1	1	2

12) Fish Creek 1 4.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	38	32	23	17	7	3	1	1	<1	1	6	29
Moderate	14	18	14	7	4	2	1	<1	<1	1	2	9
Dry	5	8	9	5	3	1	1	<1	<1	<1	1	2

13) Ohman Creek 7.2 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	68	56	46	31	12	5	2	1	1	1	10	65
Moderate	27	39	27	12	6	2	1	<1	1	1	3	17
Dry	9	15	17	8	3	1	1	<1	<1	<1	1	4

Table 1. Median natural flows (continued).

14) SF Eel River 2 537.3 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	5,874	4,379	3,773	2,251	1,020	447	156	75	58	91	1,229	5,313
Moderate	2,374	2,911	2,168	1,061	467	218	101	56	49	66	281	1,625
Dry	775	1,115	1,264	581	281	133	66	42	37	43	89	230

15) Leggett Creek 5.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	43	36	27	19	8	3	1	1	1	1	7	32
Moderate	16	21	16	8	4	2	1	<1	<1	<1	2	10
Dry	5	10	11	5	3	1	1	<1	<1	<1	1	2

16) Lower Redwood Creek 26.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	244	202	149	117	44	18	8	4	3	5	38	168
Moderate	90	119	89	45	21	11	4	2	2	2	10	57
Dry	26	54	58	30	14	8	3	2	2	2	4	12

17) Seely Creek 5.8 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	52	43	32	23	10	4	2	1	1	1	8	37
Moderate	20	25	19	9	5	2	1	<1	<1	1	2	13
Dry	6	12	13	6	3	1	1	<1	<1	<1	1	3

18) Middle Redwood Creek 17.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	154	138	104	81	30	13	5	3	2	3	25	128
Moderate	66	90	63	31	15	8	3	2	2	2	7	40
Dry	19	37	40	21	10	6	2	2	1	1	3	9

19) Somerville Creek 3.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	29	25	20	16	6	2	1	1	<1	1	5	25
Moderate	12	16	12	6	3	1	1	<1	<1	<1	1	7
Dry	4	6	7	4	2	1	<1	<1	<1	<1	1	1

20) Miller Creek 3.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	33	29	22	17	7	3	1	1	<1	1	5	27
Moderate	14	18	13	7	3	2	1	<1	<1	<1	1	8
Dry	4	8	8	5	2	1	1	<1	<1	<1	1	2

Table 1. Median natural flows (continued).

21) Lower China Creek 3.9 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	38	32	25	19	7	3	1	1	<1	1	6	32
Moderate	16	21	15	8	3	2	1	<1	<1	<1	2	10
Dry	5	9	9	5	2	1	1	<1	<1	<1	1	2

22) Upper Redwood Creek 2.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	24	21	17	13	5	2	1	1	<1	1	4	23
Moderate	11	14	10	5	2	1	<1	<1	<1	<1	1	6
Dry	3	6	6	3	2	1	<1	<1	<1	<1	1	1

23) NF China Creek 1.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	11	9	7	5	2	1	<1	<1	<1	<1	2	9
Moderate	4	6	4	2	1	<1	<1	<1	<1	<1	<1	3
Dry	1	2	3	1	1	<1	<1	<1	<1	<1	<1	1

24) Upper China Creek 0.7 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	7	6	4	3	1	1	<1	<1	<1	<1	1	6
Moderate	3	4	3	1	1	<1	<1	<1	<1	<1	<1	2
Dry	1	2	2	1	<1	<1	<1	<1	<1	<1	<1	<1

25) Dinner Creek 1.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	13	11	9	7	3	1	<1	<1	<1	<1	2	13
Moderate	6	8	6	3	1	1	<1	<1	<1	<1	1	4
Dry	2	3	4	2	1	<1	<1	<1	<1	<1	<1	1

26) Connick Creek 2.8 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	23	21	16	11	4	2	1	<1	<1	1	5	17
Moderate	10	12	9	5	2	1	<1	<1	<1	<1	1	6
Dry	3	5	6	3	2	1	<1	<1	<1	<1	<1	1

27) Sproul Creek 24.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	217	190	159	115	46	17	8	4	3	5	40	227
Moderate	97	129	94	44	22	10	4	3	2	3	11	58
Dry	31	47	58	30	14	7	3	2	2	2	4	11

Table 1. Median natural flows (continued).

28) East Branch SF Eel River 76.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	946	719	562	400	151	70	24	9	8	15	210	769
Moderate	351	426	336	165	73	33	15	7	7	10	56	250
Dry	117	163	198	94	43	21	10	5	5	7	15	51

29) Fish Creek 2 2.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	23	19	15	10	4	2	1	<1	<1	<1	5	19
Moderate	9	12	9	4	2	1	<1	<1	<1	<1	1	6
Dry	3	4	5	3	1	1	<1	<1	<1	<1	<1	1

30) Durphy Creek 2.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	22	20	17	12	5	2	1	<1	<1	1	4	23
Moderate	10	14	10	5	2	1	1	<1	<1	<1	1	6
Dry	3	5	6	3	1	1	<1	<1	<1	<1	<1	1

31) Hartsook Creek 1.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	10	9	7	5	2	1	<1	<1	<1	<1	2	10
Moderate	4	6	4	2	1	<1	<1	<1	<1	<1	1	3
Dry	1	2	3	1	1	<1	<1	<1	<1	<1	<1	1

32) Milk Ranch Creek 2.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	24	23	17	12	5	2	1	<1	<1	1	6	22
Moderate	11	15	11	5	2	1	1	<1	<1	<1	1	7
Dry	4	5	6	3	2	1	<1	<1	<1	<1	<1	1

33) Lower Gap Creek 1 3.6 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	37	34	26	19	7	3	1	1	<1	1	8	34
Moderate	17	22	16	8	4	2	1	1	<1	<1	2	10
Dry	5	8	9	5	2	1	1	<1	<1	<1	1	2

34) Indian Creek 27.2 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	257	227	197	141	52	22	9	4	3	6	50	263
Moderate	114	151	120	54	25	12	5	3	3	3	15	73
Dry	38	58	71	36	17	8	4	3	2	2	5	15

Table 1. Median natural flows (continued).

35) Piercy Creek 3.6 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	38	31	26	18	7	3	1	1	<1	1	7	35
Moderate	16	20	16	7	3	2	1	<1	<1	<1	2	10
Dry	5	8	9	5	2	1	1	<1	<1	<1	1	2

36) Standley Creek 7.3 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	73	62	51	35	14	6	2	1	1	2	16	69
Moderate	31	41	31	13	7	3	2	1	1	1	4	20
Dry	10	16	18	9	4	2	1	1	1	1	1	4

37) McCoy Creek 7.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	70	67	51	36	14	6	2	1	1	2	17	66
Moderate	31	43	30	14	7	3	2	1	1	1	4	20
Dry	11	15	18	10	4	2	1	1	1	1	1	4

38) Bear Pen Creek 5.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	52	44	34	24	10	4	2	1	1	1	11	48
Moderate	24	29	21	9	5	2	1	1	<1	1	2	14
Dry	7	11	12	6	3	2	1	1	<1	<1	1	2

39) Red Mountain Creek 12.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	168	137	92	76	26	12	4	2	2	3	42	124
Moderate	60	80	63	34	14	6	3	1	1	2	10	49
Dry	22	30	33	17	8	4	2	1	1	1	4	12

40) Bridges Creek 3.3 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	41	34	24	19	7	3	1	1	<1	1	10	33
Moderate	16	21	15	8	4	2	1	<1	<1	<1	2	11
Dry	5	8	8	5	2	1	1	<1	<1	<1	1	3

41) Mill Creek 2.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	26	21	16	11	5	2	1	<1	<1	1	5	23
Moderate	11	13	10	4	2	1	1	<1	<1	<1	1	7
Dry	4	5	6	3	1	1	<1	<1	<1	<1	<1	1

Table 1. Median natural flows (continued).

42) SF Eel River 3 248.0 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	3,091	2,196	1,837	1,182	480	204	75	37	27	48	591	2,477
Moderate	1,191	1,297	1,043	517	236	102	48	27	23	31	129	784
Dry	345	524	572	288	129	62	30	18	16	20	51	155

43) Hollow Tree Creek 41.8 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	505	377	307	202	90	40	14	7	5	8	102	435
Moderate	207	239	176	81	41	19	9	5	4	5	22	126
Dry	64	89	101	52	26	13	7	4	3	4	6	19

44) Cedar Creek 15.2 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	202	163	122	99	37	18	5	2	2	4	49	167
Moderate	79	97	81	47	20	9	3	2	2	2	14	57
Dry	28	39	45	25	11	5	2	1	1	2	5	15

45) Lower Gap Creek 2 4.0 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	54	40	28	20	9	4	1	1	<1	1	10	42
Moderate	20	24	17	9	4	2	1	1	<1	1	2	13
Dry	7	9	10	5	2	1	1	<1	<1	<1	1	3

46) Rattlesnake Creek 38.1 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	479	359	290	209	78	32	9	5	4	7	108	362
Moderate	186	217	180	91	37	16	6	4	3	4	27	136
Dry	59	82	99	47	19	10	4	2	2	2	8	29

47) Tenmile Creek 65.4 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	803	508	447	341	136	53	19	8	7	11	136	612
Moderate	290	341	269	132	66	30	12	6	5	7	34	190
Dry	98	142	163	81	34	19	8	4	4	5	13	29

48) Elder Creek 6.5 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	86	71	63	43	17	8	3	2	1	1	28	82
Moderate	40	40	38	21	9	4	2	1	1	1	6	32
Dry	16	22	23	10	5	3	1	1	1	1	2	7

Table 1. Median natural flows (continued).

49) Jack of Hearts Creek 3.9 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	53	37	32	23	9	4	1	1	<1	1	11	43
Moderate	21	24	17	9	4	2	1	<1	<1	1	3	14
Dry	7	10	11	5	2	1	1	<1	<1	<1	1	2

50) SF Eel River 4 44.2 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	560	381	360	218	88	37	14	6	4	7	116	486
Moderate	227	255	192	90	42	18	8	4	3	6	25	169
Dry	69	99	115	51	24	12	5	3	3	4	9	21

51) Dutch Charlie Creek 4.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	59	37	35	26	10	4	1	1	<1	1	12	47
Moderate	23	25	19	10	5	2	1	1	<1	1	3	17
Dry	8	10	11	6	3	2	1	<1	<1	<1	1	2

52) Redwood Creek 2 3.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	43	28	25	18	7	3	1	1	<1	1	9	33
Moderate	17	19	14	6	3	2	1	<1	<1	1	2	12
Dry	6	7	8	4	2	1	<1	<1	<1	<1	1	2

53) Rock Creek 3.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	42	32	29	19	7	4	1	1	<1	1	12	36
Moderate	19	20	16	9	4	2	1	<1	<1	1	2	13
Dry	8	10	10	5	2	1	1	<1	<1	<1	1	3

54) Kenny Creek 3.6 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	49	36	31	22	8	4	1	1	<1	1	11	41
Moderate	22	24	18	10	4	2	1	1	<1	1	3	15
Dry	7	11	11	5	2	1	1	<1	<1	<1	1	3

55) Mud Creek 5.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	69	50	47	31	12	5	2	1	1	1	19	61
Moderate	33	33	27	14	6	3	1	1	1	1	4	22
Dry	11	16	16	8	3	2	1	<1	<1	1	1	4

Functional Flows

This section presents examples illustrating functional flows in the SF Eel River watershed (data from Lane et al. 2020). Figure 8 and Table 2–Table 4 are representative of the mainstem SF Eel River watershed, as well as its tributaries. Functional flow timing throughout the watershed is likely consistent, but magnitudes differ (Rodríguez-Iturbe and Valdés 1979).

Cow Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

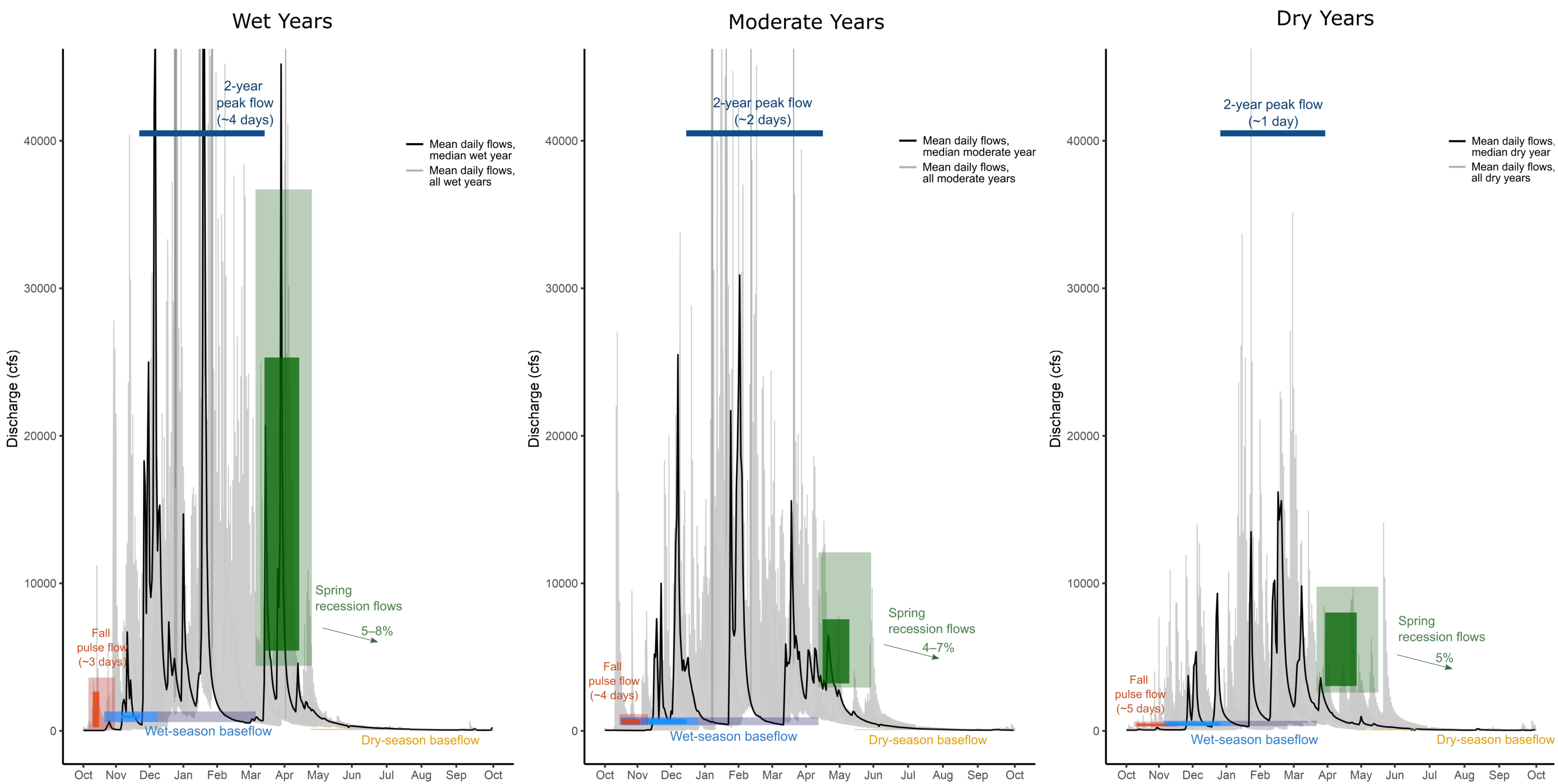

Figure 8. Timing and magnitude of SF Eel River functional flows by water year type (from left to right, wet, moderate, dry years), based on water years 1951–1981 at the USGS gage 11476500, on the SF Eel River at Miranda. The darkest colored boxes indicate the start timing and magnitude in 50% of years (25th–75th percentile values) for each functional flow component. The medium-colored boxes represent start timing and magnitude in 80% of years (10th–90th percentile). The light-blue and light-yellow boxes link wet season start and dry season start to the next functional flow season. The arrow indicates the spring recession rate. Note, 5- and 10-year peak flows are not displayed on this plot. Refer to Table 2 for specific 5- and 10-year peak flow magnitude, duration, and frequency metrics.

Table 2. SF Eel River functional flow metric median values, 10th–90th percentile in parentheses. Metrics based on the water years 1951–1981 at USGS gage 11476500 on the SF Eel River at Miranda, and are provided by water year type (wet, moderate, dry).

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	534 (150–3,600)	490 (423–948)	402 (269–609)
Fall pulse flow duration (total days per year, when present)	3 (2–6)	4 (2–6)	5 (3–6)
Fall pulse flow start timing	Oct 11 (Oct 5–Oct 29)	Oct 23 (Oct 13–Nov 8)	Oct 18 (Oct 7–Nov 15)
Wet-season baseflow magnitude (cfs)	1,004 (604–1,309)	654 (401–916)	414 (331–672)
Median wet-season flow magnitude (cfs)	3,725 (2,394–5,722)	2,290 (1,360–2,650)	1,300 (913–1,804)
Wet-season duration (days)	135 (102–164)	153 (119–187)	131 (113–164)
Wet-season start timing	Nov 16 (Oct 19–Dec 5)	Nov 21 (Oct 15–Dec 23)	Nov 22 (Nov 3–Jan 1)
2-year peak flow magnitude (cfs)	40,300	40,300	40,300
2-year peak flow duration (total days per year, when present)	4 (1–6)	2 (1–2)	1
2-year peak flow frequency (events per year, when present)	2 (1–3)	1 (1–2)	1
5-year peak flow magnitude (cfs)	70,000	70,000	–
5-year peak flow duration (total days per year, when present)	2 (1–3)	1	–
5-year peak flow frequency (events per year, when present)	1 (1–2)	1	–
Spring recession flow magnitude (cfs)	8,430 (4,424–36,690)	4,680 (2,940–12,100)	4,870 (2,602–9,770)
Spring recession flow duration (days)	34 (28–73)	40 (26–49)	39 (30–54)
Spring recession flow start timing	Mar 29 (Mar 3–Apr 22)	Apr 17 (Apr 9–May 26)	Apr 3 (Mar 19–May 13)
Spring recession flow rate of change (%)	6 (5–8)	5 (4–7)	5
Dry-season baseflow magnitude (cfs)	92 (68–122)	93 (63–110)	69 (59–97)
Dry-season duration (days)	218 (183–240)	165 (139–178)	190 (150–226)
Dry-season start timing	May 9 (Apr 21–May 31)	Jun 1 (May 11–Jun 24)	May 14 (Apr 23–Jun 18)

Table 3. Salmon Creek functional flow metric median values, 10th–90th percentile in parentheses. Results provided by water year type (wet, moderate, dry). Results are based on modeled functional flows for reach 10) Salmon Creek.

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	44 (17–167)	33 (12–86)	27 (9–81)
Fall pulse flow duration (total days per year, when present)	3 (2–6)*	3 (2–6)*	3 (2–6)*
Fall pulse flow start timing	Oct 18 (Oct 6–Oct 29)	Oct 19 (Oct 8–Nov 7)	Oct 22 (Oct 8–Oct 30)
Wet-season baseflow magnitude (cfs)	63 (31–115)	48 (23–89)	24 (11–48)
Median wet-season flow magnitude (cfs)	189 (123–342)	133 (82–241)	71 (34–134)
Wet-season duration (days)	151 (119–181)	143 (96–179)	129 (81–180)
Wet-season start timing	Nov 21 (Nov 4–Dec 6)	Nov 25 (Nov 9–Dec 13)	Nov 29 (Nov 11–Jan 5)
2-year peak flow magnitude (cfs)	2,750 (1,890–2,760)	2,750 (1,890–2,760)	2,750 (1,890–2,760)
2-year peak flow duration (total days per year, when present)	3 (1–19)*	3 (1–19)*	3 (1–19)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	3,810 (2,350–4,780)	3,810 (2,350–4,780)	3,810 (2,350–4,780)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	481 (193–1,360)	361 (130–1,080)	318 (74–822)
Spring recession flow duration (days)	39 (25–65)	41 (26–60)	45 (26–81)
Spring recession flow start timing	Apr 17 (Mar 27–May 7)	Apr 15 (Mar 20–May 6)	Apr 3 (Mar 15–May 14)
Spring recession flow rate of change (%)	6 (3-10)*	6 (3-10)*	6 (3-10)*
Dry-season baseflow magnitude (cfs)	6 (3–10)	5 (2–9)	4 (2–8)
Dry-season duration (days)	178 (142–229)	172 (138–227)	180 (129–230)
Dry-season start timing	May 26 (May 5–Jun 22)	Jun 2 (May 7–Jun 23)	Jun 5 (Apr 28–Jul 4)

* indicates a metric with inferred ranges that was not modeled by water year type

Table 4. Tenmile Creek functional flow metric median values, 10th–90th percentile in parentheses. Results provided by water year type (wet, moderate, dry). Results are based on modeled functional flows for reach 47) Tenmile Creek.

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	85 (33–297)	81 (26–255)	54 (18–190)
Fall pulse flow duration (total days per year, when present)	3 (2–6)*	3 (2–6)*	3 (2–6)*
Fall pulse flow start timing	Oct 23 (Oct 9–Oct 31)	Oct 23 (Oct 6–Nov 9)	Oct 15 (Oct 6–Oct 29)
Wet-season baseflow magnitude (cfs)	101 (51–178)	77 (38–131)	41 (22–83)
Median wet-season flow magnitude (cfs)	429 (252–666)	253 (153–411)	145 (90–250)
Wet-season duration (days)	149 (106–178)	145 (107–184)	129 (88–165)
Wet-season start timing	Nov 20 (Nov 11–Dec 6)	Nov 15 (Nov 4–Dec 3)	Nov 28 (Nov 16–Dec 14)
2-year peak flow magnitude (cfs)	3,370 (2,000–6,020)	3,370 (2,000–6,020)	3,370 (2,000–6,020)
2-year peak flow duration (total days per year, when present)	3 (1–19)*	3 (1–19)*	3 (1–19)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	5,690 (3,850–10,100)	5,690 (3,850–10,100)	5,690 (3,850–10,100)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	992 (349–3,400)	508 (203–1,650)	584 (166–1,410)
Spring recession flow duration (days)	40 (28–83)	42 (31–81)	43 (30–91)
Spring recession flow start timing	Apr 13 (Mar 26–May 3)	Apr 17 (Mar 22–May 14)	Apr 2 (Mar 17–May 7)
Spring recession flow rate of change (%)	6 (3–10)*	6 (3–10)*	6 (3–10)*
Dry-season baseflow magnitude (cfs)	11 (5–21)	9 (3–20)	8 (2–16)
Dry-season duration (days)	177 (140–222)	170 (137–220)	185 (136–223)
Dry-season start timing	May 22 (May 10–Jun 22)	Jun 6 (May 11–Jun 23)	May 20 (Apr 25–Jun 26)

* indicates a metric with inferred ranges that was not modeled by water year type

Ecosystem Baseflows

In wet water month types, median monthly discharge (MMD), derived using Natural Flows (data from Zimmerman et al. 2020), meets or exceeds ecosystem baseflows (Tessmann 1980) for approximately nine months of the water year for most reaches in the SF Eel River watershed.

For moderate month types, median natural flows may exceed ecosystem baseflows for approximately seven months of the water year (Figure 9). This pattern is similar for most reaches in the SF Eel River watershed.

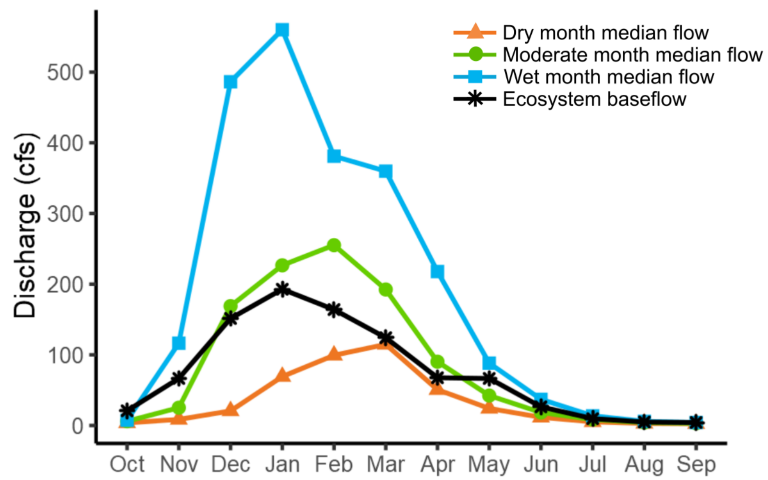

Figure 9. Ecosystem baseflows (SF Eel River 4).

Squaw Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

Ecosystem baseflows and drainage area are provided in Table 5 for each SF Eel River tributary and mainstem reach analyzed in this report. There is one ecosystem baseflow value per month, which applies across all years. The numbers next to each stream name correspond to the numbers found on the SF Eel River watershed maps (Figure 2–Figure 5).

Table 5. Ecosystem baseflows.

Stream	Drainage Area (mi^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1) SF Eel River 1	689.2	2,689	2,356	1,826	963	949	390	140	77	66	321	957	2,201
2) Bull Creek 1	41.6	160	143	112	64	59	27	10	5	4	18	59	132
3) Cow Creek	2.4	7	7	5	3	3	2	1	<1	<1	1	3	6
4) Squaw Creek	4.7	17	14	12	7	6	3	1	1	<1	2	6	13
5) Bull Creek 2	27.9	123	112	88	46	44	19	7	3	3	13	45	100
6) Decker Creek	2.4	8	7	5	3	3	1	1	<1	<1	1	3	6
7) Canoe Creek	10.5	38	34	27	15	14	7	2	1	1	5	14	31
8) Coon Creek	1.5	6	5	4	2	2	1	<1	<1	<1	1	2	4
9) Elk Creek	6.7	21	17	14	8	7	3	1	1	1	2	7	15
10) Salmon Creek	36.7	121	107	86	49	43	20	7	4	3	15	43	88
11) Butte Creek	4.5	14	12	10	5	5	2	1	1	<1	1	5	10
12) Fish Creek 1	4.5	14	12	9	5	5	2	1	<1	<1	1	5	10
13) Ohman Creek	7.2	22	23	18	9	9	4	1	1	<1	3	9	19
14) SF Eel River 2	537.3	2,126	1,862	1,422	756	728	302	112	61	60	253	750	1,698
15) Leggett Creek	5.0	16	14	11	6	5	2	1	1	<1	2	5	11
16) Lower Redwood Creek	26.0	86	76	60	33	30	13	5	3	2	10	30	64
17) Seely Creek	5.8	18	16	13	7	6	3	1	1	<1	2	6	13
18) Middle Redwood Creek	17.1	57	53	42	23	21	10	4	2	2	7	21	45
19) Somerville Creek	3.0	10	10	8	4	4	2	1	<1	<1	1	4	8

Table 5. Ecosystem baseflows (continued).

Stream	Drainage Area (mi^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20) Miller Creek	3.7	12	11	9	5	4	2	1	<1	<1	1	4	9
21) Lower China Creek	3.9	14	13	10	5	5	2	1	1	<1	2	5	11
22) Upper Redwood Creek	2.7	9	8	7	4	3	2	1	<1	<1	1	3	7
23) NF China Creek	1.1	4	3	3	1	1	1	<1	<1	<1	<1	1	3
24) Upper China Creek	0.7	2	2	2	1	1	<1	<1	<1	<1	<1	1	2
25) Dinner Creek	1.5	5	5	4	2	2	1	<1	<1	<1	1	2	4
26) Connick Creek	2.8	9	8	6	4	3	1	1	<1	<1	1	3	7
27) Sproul Creek	24.0	80	74	60	33	30	14	5	3	3	10	30	65
28) East Branch SF Eel River	76.1	312	276	211	119	112	51	16	9	7	41	112	253
29) Fish Creek 2	2.0	8	7	6	3	3	1	<1	<1	<1	1	3	6
30) Durphy Creek	2.4	8	8	6	3	3	1	1	<1	<1	1	3	7
31) Hartsook Creek	1.1	4	4	3	2	1	1	<1	<1	<1	<1	1	3
32) Milk Ranch Creek	2.4	9	9	7	4	3	2	1	<1	<1	1	3	7
33) Lower Gap Creek 1	3.6	13	13	10	6	5	2	1	1	1	2	5	11
34) Indian Creek	27.2	95	90	71	38	36	18	6	4	3	12	36	79

Hollow Tree Creek
SOUTH FORK EEL RIVER WATERSHED, MENDOCINO COUNTY

Table 5. Ecosystem baseflows (continued).

Stream	Drainage Area (mi²)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
35) Piercy Creek	3.6	13	12	10	5	5	2	1	<1	<1	2	5	11
36) Standley Creek	7.3	27	25	19	10	10	5	2	1	1	3	10	22
37) McCoy Creek	7.0	25	25	19	10	10	5	2	1	1	3	10	21
38) Bear Pen Creek	5.0	19	17	13	7	7	3	1	1	1	2	7	16
39) Red Mountain Creek	12.1	53	49	37	20	19	9	3	2	2	7	19	43
40) Bridges Creek	3.3	13	12	9	5	5	2	1	1	<1	2	5	11
41) Mill Creek	2.4	9	8	6	3	3	2	1	<1	<1	1	3	8
42) SF Eel River 3	248.0	977	852	662	359	347	144	54	29	27	108	347	781
43) Hollow Tree Creek	41.8	166	148	115	61	60	27	11	5	4	19	60	138
44) Cedar Creek	15.2	64	60	46	28	24	12	4	2	2	9	24	52
45) Lower Gap Creek 2	4.0	16	15	11	6	6	3	1	1	<1	2	6	13
46) Rattlesnake Creek	38.1	157	144	108	60	57	25	7	4	3	18	57	128
47) Tenmile Creek	65.4	250	216	168	90	88	36	13	7	6	27	88	201
48) Elder Creek	6.5	31	25	22	13	11	6	2	1	1	4	11	25
49) Jack of Hearts	3.9	17	15	12	6	6	3	1	1	<1	2	6	14

Miller Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

Table 5. Ecosystem baseflows (continued).

Stream	Drainage Area (mi^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50) SF Eel River 4	44.2	193	164	124	68	67	26	10	5	4	21	67	151
51) Dutch Charlie Creek	4.4	18	16	12	7	7	3	1	1	<1	2	7	15
52) Redwood Creek 2	3.1	13	12	9	5	5	2	1	<1	<1	1	5	11
53) Rock Creek	3.1	15	12	10	6	5	2	1	<1	<1	2	5	11
54) Kenny Creek	3.6	16	14	11	6	6	3	1	1	<1	2	6	13
55) Mud Creek	5.1	24	20	16	9	9	4	1	1	1	3	9	19

South Fork Eel River

SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

Salmonid Habitat Optimum Flows
By Monthly Duration

Figure 10 displays flows that maximize usable habitat for juvenile steelhead (Hatfield and Bruce 2000) along with median natural flows (Zimmerman et al. 2020). The information is sorted by drainage size category (i.e., headwater, small, mid-sized, and the SF Eel River). In drainages with altered flow, the period of flow below the juvenile steelhead habitat optimum flows may have a longer or shorter duration than shown here.

Headwater Streams: 0.7–1.5 mi²

Natural flows for a moderate water month type are typically above the Optimum Flow for **1 month** of the year.

Small Streams: 2.0–10.5 mi²

Natural flows for a moderate water month type are typically above the Optimum Flow for **3–5 months** of the year.

Mid-sized Streams: 12.1–76.1 mi²

Natural flows for a moderate water month type are typically above the Optimum Flow for **5–6 months** of the year.

SF Eel River: 248.0–689.2 mi²

Natural flows for a moderate water month type are typically above the Optimum Flow for **6–8 months** of the year.

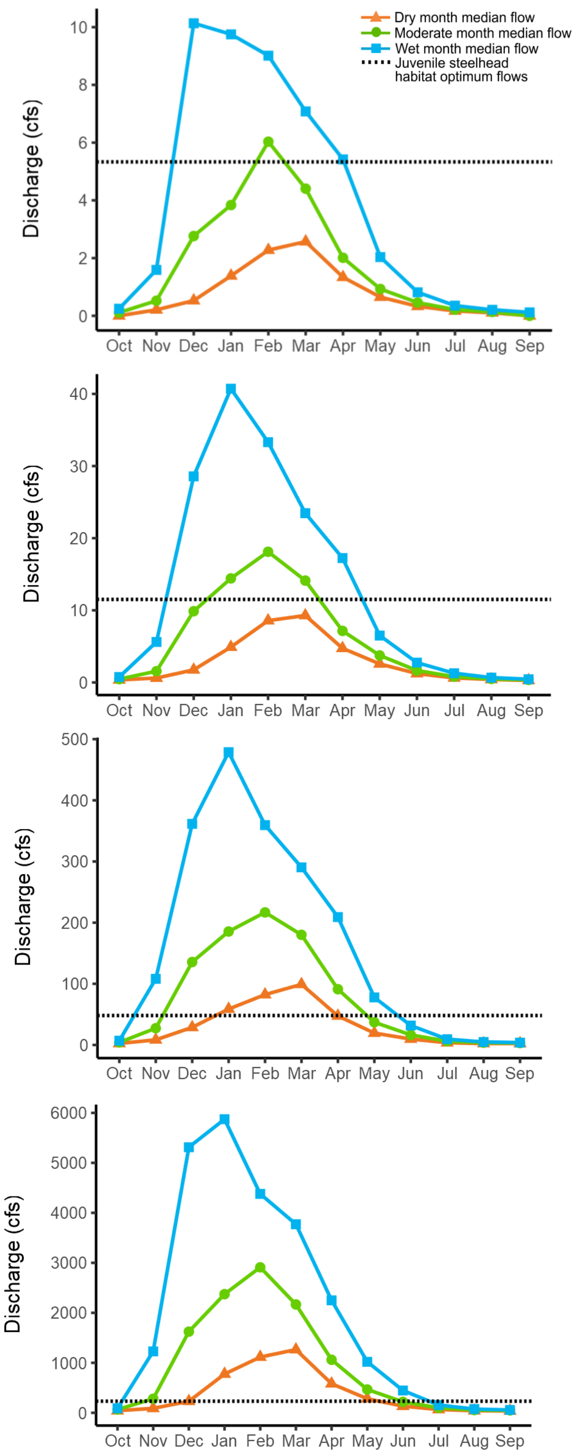

Figure 10. Juvenile steelhead optimum flows.

Salmonid Habitat Optimum Flows
By Drainage Area

Generally, the surface flow required to meet the steelhead optimum flows increases as the drainage area increases. Table 6 groups steelhead optimum flows by drainage size category (i.e., headwater streams, small streams, mid-sized streams, and the SF Eel River). The numbers next to each stream name correspond to the numbers found on the SF Eel River watershed maps (Figure 2–Figure 5).

Table 6. Juvenile steelhead optimum flows (by drainage area).

Headwater Streams

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
24) Upper China Creek	0.7	4
23) NF China Creek	1.1	5
31) Hartsook Creek	1.1	5
25) Dinner Creek	1.5	6
8) Coon Creek	1.5	7

Hollow Tree Creek
SOUTH FORK EEL RIVER WATERSHED, MENDOCINO COUNTY

Table 6. Juvenile steelhead optimum flows (by drainage area) (continued).

Small Streams

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
29) Fish Creek 2	2.0	8
3) Cow Creek	2.4	8
6) Decker Creek	2.4	8
30) Durphy Creek	2.4	9
32) Milk Ranch Creek	2.4	9
41) Mill Creek	2.4	9
22) Upper Redwood Creek	2.7	9
26) Connick Creek	2.8	9
19) Somerville Creek	3.0	10
52) Redwood Creek 2	3.1	11
53) Rock Creek	3.1	11
40) Bridges Creek	3.3	11
35) Piercy Creek	3.6	11
33) Lower Gap Creek 1	3.6	12
54) Kenny Creek	3.6	12
20) Miller Creek	3.7	11
21) Lower China Creek	3.9	12
49) Jack of Hearts Creek	3.9	13
45) Lower Gap Creek 2	4.0	13
51) Dutch Charlie Creek	4.4	13
11) Butte Creek	4.5	11
12) Fish Creek 1	4.5	11
4) Squaw Creek	4.7	13
15) Leggett Creek	5.0	12
38) Bear Pen Creek	5.0	14
55) Mud Creek	5.1	15
17) Seely Creek	5.8	13
48) Elder Creek	6.5	18
9) Elk Creek	6.7	14
37) McCoy Creek	7.0	17
13) Ohman Creek	7.2	16
36) Standley Creek	7.3	17
7) Canoe Creek	10.5	21

Table 6. Juvenile steelhead optimum flows (by drainage area) (continued).

Mid-sized Streams

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
39) Red Mountain Creek	12.1	26
44) Cedar Creek	15.2	29
18) Middle Redwood Creek	17.1	27
27) Sproul Creek	24.0	33
16) Lower Redwood Creek	26.0	34
34) Indian Creek	27.2	37
5) Bull Creek 2	27.9	43
10) Salmon Creek	36.7	42
46) Rattlesnake Creek	38.1	48
2) Bull Creek 1	41.6	51
43) Hollow Tree Creek	41.8	50
50) SF Eel River 4	44.2	52
47) Tenmile Creek	65.4	62
28) East Branch SF Eel River	76.1	73

South Fork Eel River

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
42) SF Eel River 3	248.0	141
14) SF Eel River 2	537.3	227
1) SF Eel River 1	689.2	265

Cuneo Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

Sensitive Period Indicators

Sensitive period indicator flows derived using the wetted perimeter method (CDFW 2020a) are provided in Table 7 for SF Eel River tributary streams with site-specific field data. When the sensitive period indicator flows are not met, the ecosystem is likely to be particularly sensitive to additional flow reductions and other stressors (CDFW 2017).

In Table 7, there is one value for each reach, which applies across all months and years. The numbers next to each stream name correspond to the numbers on the SF Eel River watershed maps (Figure 2–Figure 5). Results presented here are the mean of results for all sites within a reach. The third column indicates the number of transects that were used to estimate the sensitive period indicator for that stream (see Appendix B for additional information about transect selection). For small tributaries (<4 mi^2) within the Redwood Creek subwatershed with limited field data (i.e., Somerville, Miller, Lower China, NF China, and Dinner Creeks), the mean sensitive period indicator flow was calculated and applied to each of those tributaries. The cross-channel transect profiles and wetted perimeter-discharge curves used in the analysis for each site are located in Appendix B.

Table 7. Sensitive Period Indicators (by drainage area).

Stream	Drainage Area (mi^2)	Number of Sites	Sensitive Period Indicators (cfs)
24) Upper China Creek	0.7	3	3
23) NF China Creek	1.1	1	3
25) Dinner Creek	1.5	3	3
3) Cow Creek	2.4	1	2
19) Somerville Creek	3	1	3
20) Miller Creek	3.7	2	3
21) Lower China Creek	3.9	2	3
4) Squaw Creek	4.7	2	6
17) Seely Creek	5.8	2	3
18) Middle Redwood Creek	17.1	2	4
16) Lower Redwood Creek	26	2	7
34) Indian Creek	27.2	2	6
43) Hollow Tree Creek	41.8	2	20

Salmonid Passage Flows

Juvenile steelhead passage flows are displayed in Table 8. These passage flows provide connectivity between mesohabitat units for juvenile steelhead. The numbers next to each stream name correspond to the numbers found on the SF Eel River watershed maps (Figure 2–Figure 5). The third column indicates the number of transects that were used to estimate the passage flow for that stream (see Appendix B for additional information about transect selection). The cross-channel transect profiles used in the analysis for each site are located in Appendix B.

Table 8. Juvenile steelhead passage flows (by drainage area).

Stream	Drainage Area (mi^2)	Number of Sites	Juvenile Steelhead Passage Flows (cfs)
24) Upper China Creek	0.7	3	6
34) Indian Creek	27.2	2	22
43) Hollow Tree Creek	41.8	2	23

Upper China Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

Flow Criteria

Flow criteria provide a set of flow values that may be used to develop a flow regime for a location within a watershed. Using results from the functional flows section of this Watershed Criteria Report, flow criteria have been developed for the SF Eel River at the Miranda USGS gage (11476500), Salmon Creek, and Tenmile Creek. While the flow criteria presented in this section were developed for specific locations within the SF Eel River watershed, patterns and timings of flows throughout the watershed are consistent, and a similar process to the one outlined below could be followed to develop criteria for other locations within the watershed. Flow criteria presented below are provided as a tool for consideration in water management planning. While criteria are not formal flow recommendations, they may be used to develop flow recommendations. These criteria should not be relied upon for legal compliance and do not ensure project success. The Department may revise instream flow criteria for the SF Eel River and its tributaries based upon any new scientific information that may become available.

Flow criteria were developed for three locations within the SF Eel River watershed for three water year types (i.e., wet, moderate, dry) using functional flow results from Table 2–Table 4. These locations were selected based on CDFW Region 1 priorities. In each case, criteria represent median functional flow metric values by water year type. Median values are commonly used to represent water availability in other instream flow methods, such as habitat duration time series analysis. Median flows would be met or exceeded in 50% of years under natural conditions, and represent a useful potential long-term management target. While medians were used to establish criteria, in the driest years, flows may be closer to 10th percentile functional flow values, and in the wettest years may be closer to the 90th percentile values. In Table 9–Table 11, criteria are presented for each season corresponding to functional flow metrics, with additional detail provided during the spring to more specifically capture changes in flows during the transition period between the wet season and dry season. Note, the length of the spring recession varies by water year type.

Table 9. Flow criteria (in cfs) for the SF Eel River at Miranda. Criteria are provided for each functional flow season and are stratified by water year type.

Water Year Type	Wet Season Nov-Mar	Spring Recession Week 1	Spring Recession Week 2	Spring Recession Week 3	Spring Recession Week 4	Spring Recession Week 5	Spring Recession Week 6	Spring Recession Week 7	Spring Recession Week 8	Spring Recession Week 9	Spring Recession Week 10	Dry Season May-Oct
Wet	1,004†	3,118	2,022	1,311	850	551	358	232	150	97	-	92‡
Moderate	654†	1,974	1,378	963	672	469	328	229	160	112	78	93‡
Dry	414†	1,120	782	546	382	266	186	130	91	-	-	69‡

† Approximately every two years, allow 1–2 peak flow events of 40,300 cfs. Approximately every five years, allow one peak flow event of 70,000 cfs.

‡ In October, allow fall pulse events of 534 cfs in wet years, 490 cfs in moderate years, and 402 cfs in dry years.

- The length of the recession varies by water year type. In wet years, the recession lasts for nine weeks, in moderate years, the recession lasts for 10 weeks, and in dry years, it lasts for eight weeks. The rate of change varies from 6% per day in wet years to 5% per day in moderate and dry years.

Table 10. Flow criteria (in cfs) for Salmon Creek. Criteria are provided for each functional flow season and are stratified by water year type.

Water Year Type	Wet Season Nov-Mar	Spring Recession Week 1	Spring Recession Week 2	Spring Recession Week 3	Spring Recession Week 4	Spring Recession Week 5	Spring Recession Week 6	Spring Recession Week 7	Spring Recession Week 8	Dry Season May-Oct
Wet	63†	156	98	61	39	24	15	10	7	6‡
Moderate	48†	110	69	43	27	17	11	7	-	5‡
Dry	24†	59	37	23	14	9	6	4	-	4‡

† Approximately every two years, allow 1–5 peak flow events of 2,750 cfs. Approximately every five years, allow one peak flow event of 3,810 cfs.

‡ In October, allow fall pulse events of 44 cfs in wet years, 33 cfs in moderate years, and 27 cfs in dry years.

- The length of the recession varies by water year type. In wet years, the recession lasts for eight weeks, and in moderate and dry years the recession lasts for seven weeks.

Table 11. Flow criteria (in cfs) for Tenmile Creek. Criteria are provided for each functional flow season and are stratified by water year type.

Water Year Type	Wet Season Nov-Mar	Spring Recession Week 1	Spring Recession Week 2	Spring Recession Week 3	Spring Recession Week 4	Spring Recession Week 5	Spring Recession Week 6	Spring Recession Week 7	Spring Recession Week 8	Dry Season May-Oct
Wet	101†	354	222	140	88	55	34	22	14	11‡
Moderate	77†	209	131	82	52	32	20	13	9	9‡
Dry	41†	120	75	47	30	19	12	9	-	8‡

† Approximately every two years, allow 1–3 peak flow events of 3,370 cfs. Approximately every five years, allow 1–2 peak flow events of 5,690 cfs.

‡ In October, allow fall pulse events of 85 cfs in wet years, 81 cfs in moderate years, and 54 cfs in dry years.

- The length of the recession varies by water year type. In wet and moderate years, the recession lasts for eight weeks, and in dry years, it lasts for seven weeks.

The timing of the wet season was approximated using the median start dates for each water year type (i.e., wet, moderate, dry) using functional flow results from Table 2–Table 4. The wet-season baseflow magnitudes represent flows between storm events; however, following peak flow events (e.g., winter storms), flows should be much higher than the criteria presented in Table 9–Table 11. Additionally, 2- and 5-year peak flow events, respectively, should be allowed to pass through the watershed. Refer to Table 2–Table 4 for specific recommended frequencies and durations of these peak events for each water year type. The end of the wet season for each water year type was determined by the median start date of the spring recession.

The median wet-season flow magnitude was used to represent spring high flows that immediately precede the recession period. This metric represents an elevated flow relative to baseflows occurring early in the wet season, as storm events saturate the system by the spring. The median spring recession rate for each water year type was used to calculate a daily decrease in flows, which were then averaged by week for the duration of the recession. The duration of the recession was determined by applying a daily rate of change in flows until the median dry-season baseflow magnitude was reached. The length of the recession varies across water year types due to differences in start magnitudes, rates of change, and the magnitude of dry-season baseflows.

The dry-season baseflow magnitude was used to establish flow criteria for the dry season. Baseflows will likely be higher at the beginning of the dry season than at the end of the dry season, but the median flow over the entire dry season should match the listed criteria. Additionally, fall pulse events should occur annually in October. Specific magnitudes and durations by water year type for the fall pulse flows can be found in Table 2–Table 4. The end of the dry season for each water year type was determined by the median start date of the wet season.

Flow criteria provided in Table 9–Table 11 may be used to develop a flow regime. An example flow regime is presented in Figure 11 to illustrate how criteria could be applied in a management context. In Figure 11, the blue, green, and orange lines represent an example hydrograph for each water year type using the flow criteria outlined above. For reference, flows for all years within a water year type are provided in gray, and the median year of each water year type is provided as a black line. The timing of peak flows has been inferred using observed data.

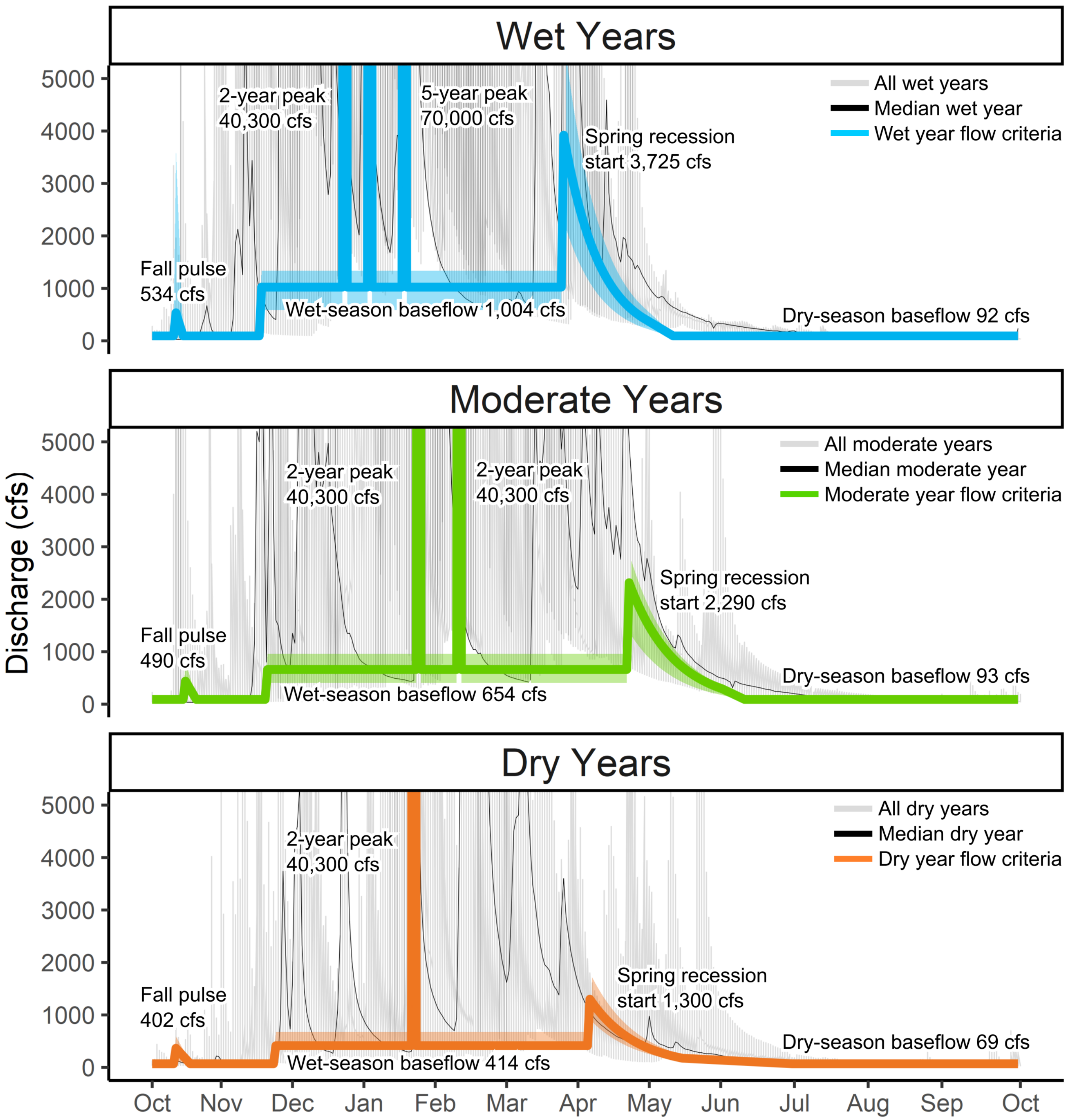

Figure 11. Example flow regimes for the SF Eel River at Miranda, for three water year types (i.e., wet, moderate, dry).

Acknowledgements

Thank you to the following Department Water Branch staff for their assistance with this report: Hanna Casares, Brionna Drescher, Nicole Gephart, Bronwen Stanford, and Sean Windell.

The data used in this report were collected with assistance from the following Department Water Branch staff: James Allen, Todd Carlin, Hanna Casares, Brionna Drescher, Danielle Elledge, Diane Haas, Mike Hancock, Michael Maher, Bronwen Stanford, David Strunk, and Paige Uttley.

Upper China Creek
SOUTH FORK EEL RIVER WATERSHED, HUMBOLDT COUNTY

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All photos in this document were taken by Department Staff. Cover photos from left to right are SF Eel River (SF Eel River watershed, Humboldt County), Cow Creek (SF Eel River watershed, Humboldt County), and Seely Creek (SF Eel River watershed, Mendocino County).

Appendix A
Reach Definition

Table A-1 presents each reach analyzed in this report with the associated NHDPlus COMIDs. The stream reaches were delineated using NHDPlus Version 2 medium-resolution mapping (USEPA and USGS 2012). The COMIDs were used to identify and download Natural Flow estimates for each selected reach.

Table A-1. Reach delineation.

Stream	COMID
1) SF Eel River 1	8284766
2) Bull Creek 1	8286600
3) Cow Creek	8284780
4) Squaw Creek	8284792
5) Bull Creek 2	8284190
6) Decker Creek	8284816
7) Canoe Creek	8284864
8) Coon Creek	8284928
9) Elk Creek	8284942
10) Salmon Creek	8285008
11) Butte Creek	8285046
12) Fish Creek 1	8285026
13) Ohman Creek	8285080
14) SF Eel River 2	8285120
15) Leggett Creek	8285218
16) Lower Redwood Creek	8285238
17) Seely Creek	8285210
18) Middle Redwood Creek	8285234
19) Somerville Creek	8285288
20) Miller Creek	8285280
21) Lower China Creek	8285306
22) Upper Redwood Creek	8285332
23) NF China Creek	8285274
24) Upper China Creek	8285284
25) Dinner Creek	8285312
26) Connick Creek	8285316
27) Sproul Creek	8285360
28) East Branch SF Eel River	8286756

Stream	COMID
29) Fish Creek 2	8286762
30) Durphy Creek	8285506
31) Hartsook Creek	8285538
32) Milk Ranch Creek	8285556
33) Lower Gap Creek 1	8286982
34) Indian Creek	8287014
35) Piercy Creek	8287032
36) Standley Creek	8287102
37) McCoy Creek	8287074
38) Bear Pen Creek	8287178
39) Red Mountain Creek	8288610
40) Bridges Creek	8288612
41) Mill Creek	8287228
42) SF Eel River 3	8287256
43) Hollow Tree Creek	8287274
44) Cedar Creek	8287286
45) Lower Gap Creek 2	8287358
46) Rattlesnake Creek	8287348
47) Tenmile Creek	8287534
48) Elder Creek	8287590
49) Jack of Hearts Creek	8287586
50) SF Eel River 4	8287608
51) Dutch Charlie Creek	8287662
52) Redwood Creek 2	8287698
53) Rock Creek	8287682
54) Kenny Creek	8287704
55) Mud Creek	8287730

Appendix B
Supplemental Information

This appendix provides additional details on data used to generate results included in the Watershed-Wide Instream Flow Criteria for the South Fork Eel River report (Watershed Criteria Report). Field data collected in the SF Eel River watershed were used to develop sensitive period indicator flows, using the wetted perimeter method, and steelhead passage flows, using the habitat retention method. Data collection procedures are described in the Standard Operating Procedure for the Wetted Perimeter Method in California (CDFW 2020a) and the Standard Operating Procedure for the Habitat Retention Method in California (CDFW 2018).

To develop sensitive period indicator flows, data were collected at 25 transects in the SF Eel River watershed. For 12 of these sites, data were collected at hydraulic control transects following the standard wetted perimeter method (CDFW 2020a).

To develop sensitive period indicator flows for the 13 remaining transects, all within Redwood Creek watershed, riffle transects were surveyed using a slightly different method as part of the 1D modeling study described in Maher et al. (2021). Water surface slope was not collected in the field for these 13 sites, so a geographic information system (GIS) was used to approximate the slope. Using the Spatial Analyst hydrology toolbox in ArcGIS, flow direction and flow accumulation rasters were created using a five-meter digital terrain model (DTM) raster. A high-resolution USGS National Hydrography Dataset (NHD) stream layer was then overlaid with the DTM and flow accumulation rasters and split at each study transect. To determine the slope, the lowest DTM elevation point along the NHD stream line was located 500 ft upstream and downstream of each transect. In almost all cases, these points coincided with the flow accumulation raster as expected. While these elevations represent the streambed, they are used here as a surrogate for the study site slope calculations.

Seven transects within the SF Eel River watershed were used to develop steelhead passage flows using the habitat retention method (CDFW 2018).

Data were collected for some additional sites but were omitted from analysis either because they were outside the modelable range, were located on a non-representative transect, or because the survey did not capture bankfull stage. Sites omitted and the rationale for each omission are documented in the Quality Assurance and Quality Control log stored at the Department Headquarters office. Table B-1 lists the sites included the sensitive period indicators and steelhead passage flows analyses.

Table B-1. Summary of sites included in the final analysis. X indicates the site was included in the analysis; - indicates sites removed from analysis, * indicates sites were not evaluated for method.

Stream	Riffle Transect	Sensitive Period Indicator	Juvenile Steelhead Passage
3) Cow Creek	HRM1	X	-
4) Squaw Creek	HRM4	X	-
4) Squaw Creek	HRM5	X	-
16) Lower Redwood Creek	LRT16	X	*
16) Lower Redwood Creek	LRT88	X	*
17) Seely Creek	ST29	X	*
17) Seely Creek	ST33	X	*
18) Middle Redwood Creek	MRT129	X	*
18) Middle Redwood Creek	MRT178	X	*
19) Somerville Creek	SCT88	X	*
20) Miller Creek	HRM1	X	-
20) Miller Creek	MCT17	X	*
20) Miller Creek	MCT137	X	*
21) Lower China Creek	LCT32	X	*
21) Lower China Creek	LCT140	X	*
23) NF China Creek	NFCT16	X	*
24) Upper China Creek	Unit 14	X	X
24) Upper China Creek	Unit 22	X	X
24) Upper China Creek	Unit 73	X	X
25) Dinner Creek	Unit 1	X	-
25) Dinner Creek	Unit 5	X	-
25) Dinner Creek	DT7	X	*
34) Indian Creek	HRM3	X	X
34) Indian Creek	HRM4	X	X
43) Hollow Tree Creek	HRM2	X	X
43) Hollow Tree Creek	HRM4	X	X

Table B-2 presents the hydraulic model calibration results for transects included in the analysis. Differences between measured and modeled water surface elevation (WSEL) estimates for all sites were within the USFWS (1994) physical habitat simulation guidelines of 0.10 ft.

Table B-2. Hydraulic model calibration results by transect.

Stream	Riffle Transect	Survey Flow Calibration Measurement (cfs)	Field Measured WSEL (ft)	HydroCalc Predicted WSEL (ft)	Difference (+/-)
3) Cow Creek	HRM1	17.8	98.993	99.009	0.02
4) Squaw Creek	HRM4	2.8	98.303	98.316	0.01
4) Squaw Creek	HRM5	2.7	97.443	97.456	0.01
16) Lower Redwood Creek	LRT16	9.5	94.91	94.91	0.00
16) Lower Redwood Creek	LRT88	2.6	96.39	96.39	0.00
17) Seely Creek	ST29	1.2	96.04	96.04	0.00
17) Seely Creek	ST33	2.5	97.31	97.27	0.04
18) Middle Redwood Creek	MRT129	2.3	96.05	96.05	0.00
18) Middle Redwood Creek	MRT178	6.0	97.15	97.15	0.00
19) Somerville Creek	SCT88	2.0	98.37	98.37	0.00
20) Miller Creek	HRM1	45.3	99.670	99.682	0.01
20) Miller Creek	MCT17	1.2	97.48	97.48	0.00
20) Miller Creek	MCT137	1.1	95.89	95.89	0.00
21) Lower China Creek	LCT32	1.6	97.46	97.46	0.00
21) Lower China Creek	LCT140	2.7	97.72	97.76	0.04
23) NF China Creek	NFCT16	1.8	97.19	97.19	0.00
24) Upper China Creek	Unit 14	10.9	98.817	98.837	0.02
24) Upper China Creek	Unit 22	10.9	96.813	96.876	0.06
24) Upper China Creek	Unit 73	10.9	96.867	96.893	0.03
25) Dinner Creek	Unit 1	26.3	100.290	100.297	0.01
25) Dinner Creek	Unit 5	26.3	98.480	98.518	0.04
25) Dinner Creek	DT7	2.4	98.73	98.73	0.00
34) Indian Creek	HRM3	13.1	99.593	99.592	0.00
34) Indian Creek	HRM4	13.1	96.417	96.420	0.00
43) Hollow Tree Creek	HRM2	25.4	91.440	91.447	0.01
43) Hollow Tree Creek	HRM4	21.8	98.743	98.754	0.01

The wetted perimeter method requires generation of a graphical plot showing the relationship between wetted perimeter and discharge. The breakpoint is identified where the greatest change in slope occurs in the channel cross section. The sensitive period indicator for each transect is determined by 1) visually identifying the lowest discharge associated with a breakpoint on the plot and 2) estimating the discharge at which a specified percentage of the bankfull channel perimeter is wetted (Annear et al. 2004; CDFW 2020b). The sensitive period indicator is the larger of these two discharges. For streams up to 50 ft wide, 50% of the bankfull channel perimeter must be wetted; for streams wider than 50 ft, 60% of the bankfull channel perimeter must be wetted.

The habitat retention method identifies flows that permit salmonid passage across constriction points in the stream channel. Both species- and life-stage-specific mean depth criteria and either velocity or wetted perimeter criteria must be met. Transect cross sections with the sensitive period indicator and steelhead passage flow WSELs and wetted perimeter-discharge curves are provided in Figures B-1 to B-52.

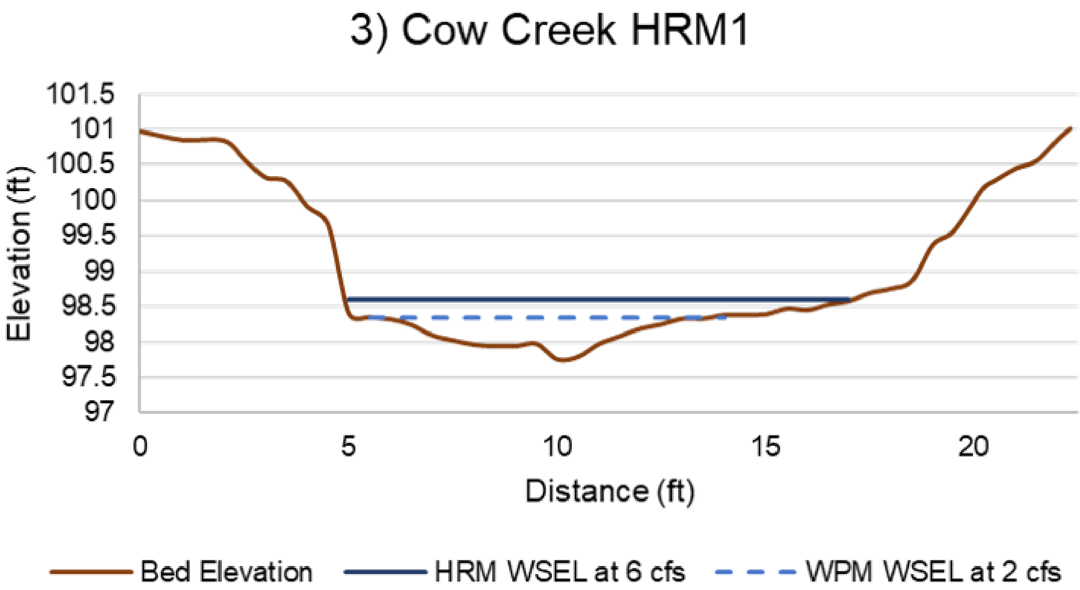

Figure B-1. Cow Creek HRM1 transect cross section with bed elevation, HRM WSEL, and WPM WSEL.

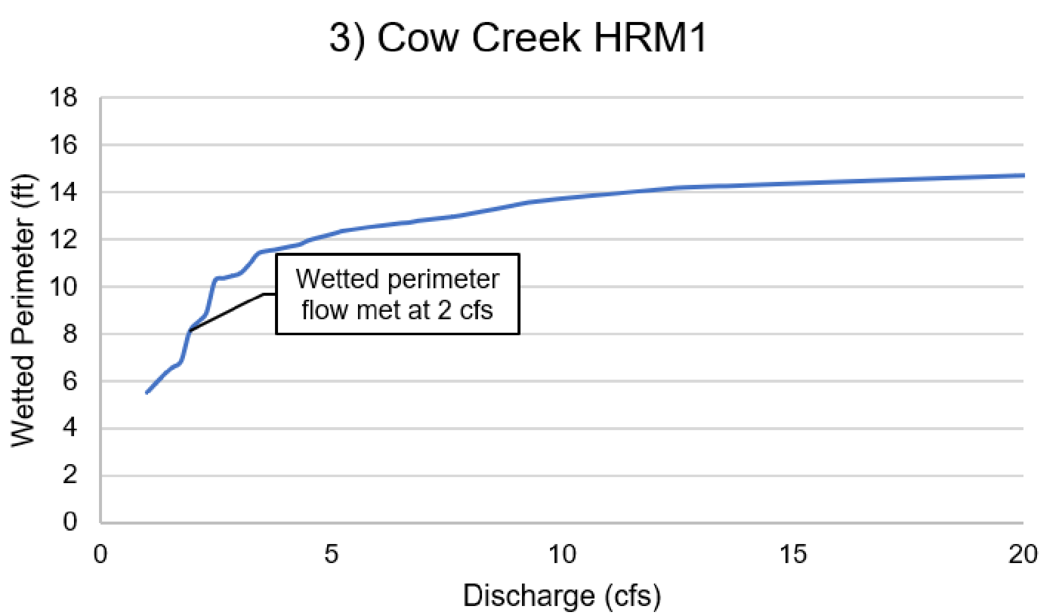

Figure B-2. Cow Creek HRM1 transect wetted perimeter-discharge curve.

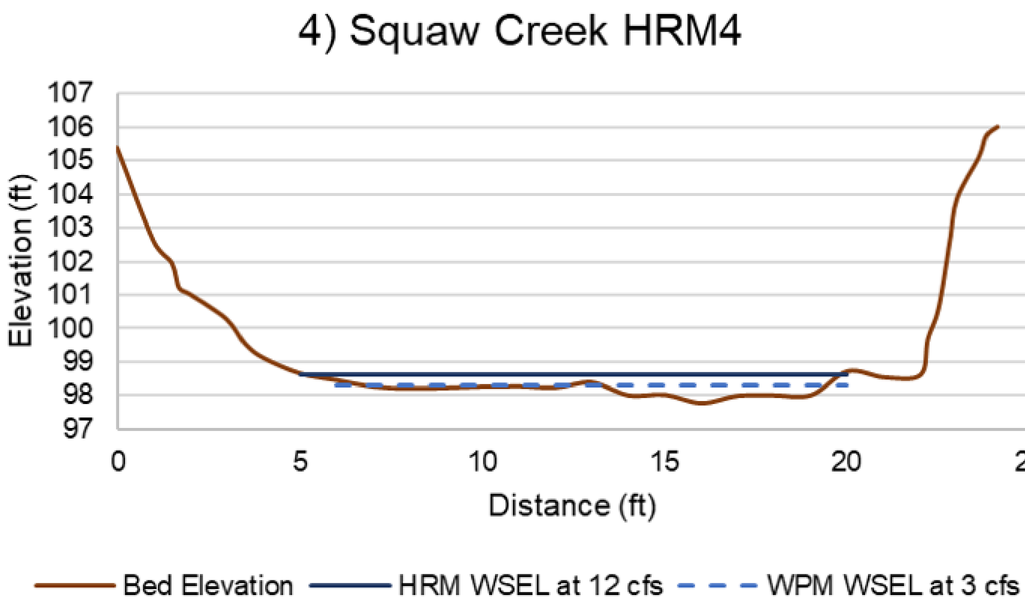

Figure B-3. Squaw Creek HRM4 transect cross section with bed elevation, HRM WSEL, and WPM WSEL.

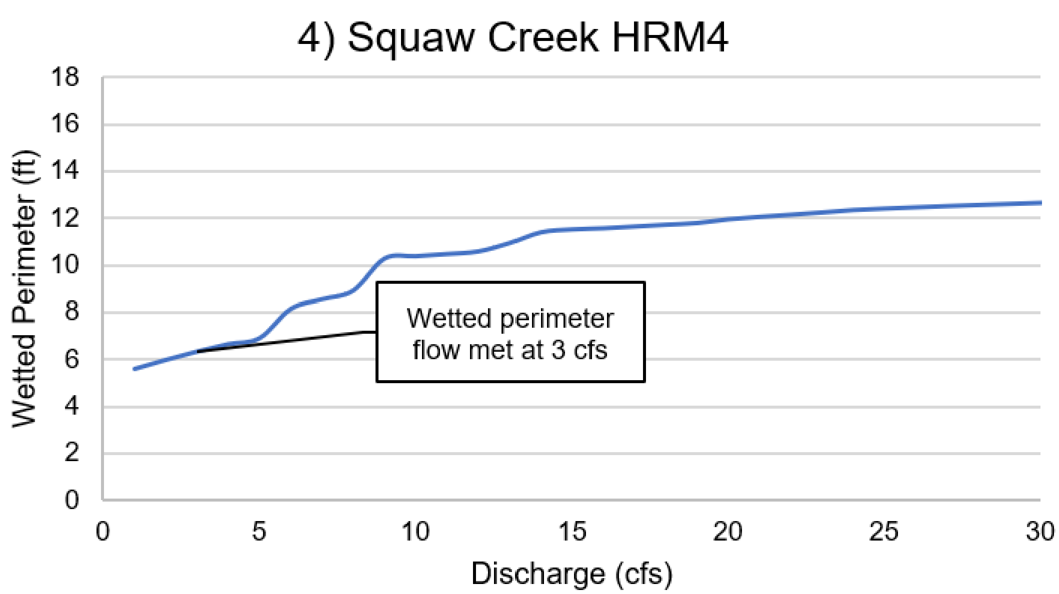

Figure B-4. Squaw Creek HRM4 transect wetted perimeter-discharge curve.

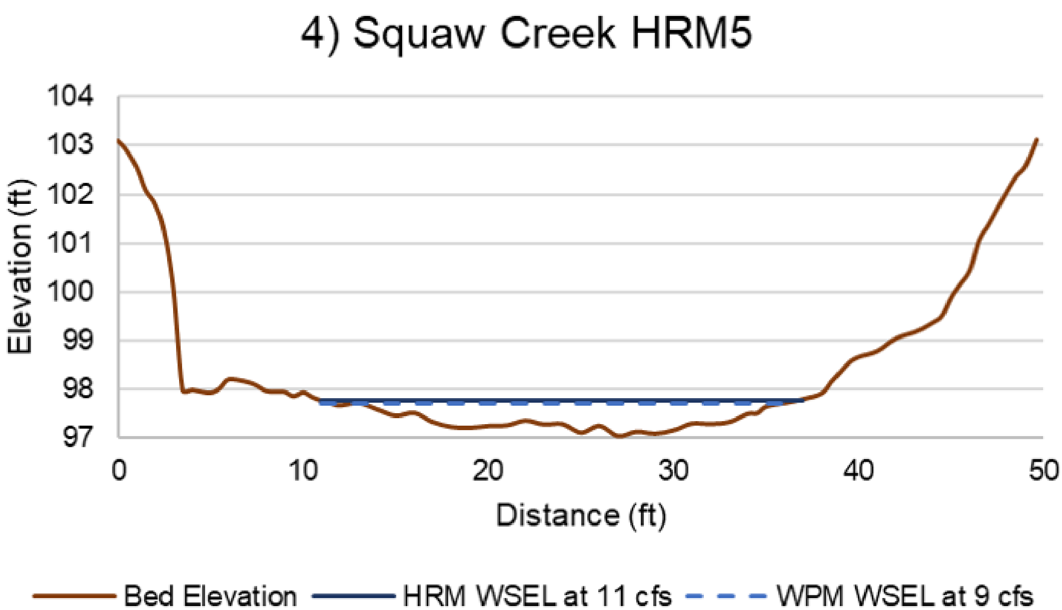

Figure B-5. Squaw Creek HRM5 transect cross section with bed elevation, HRM WSEL, and WPM WSEL.

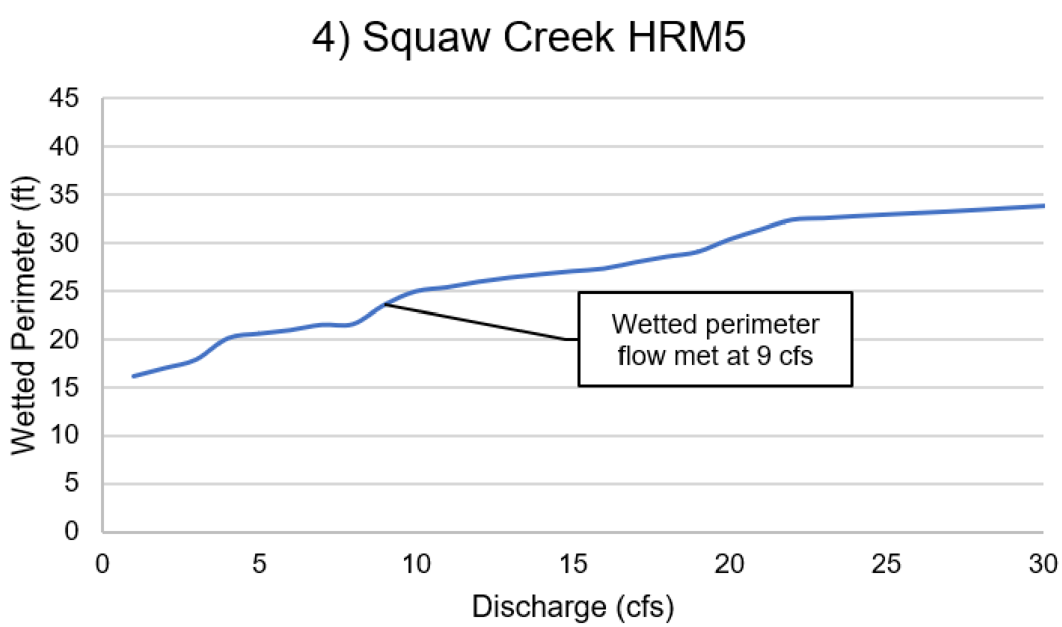

Figure B-6. Squaw Creek HRM5 transect wetted perimeter-discharge curve.

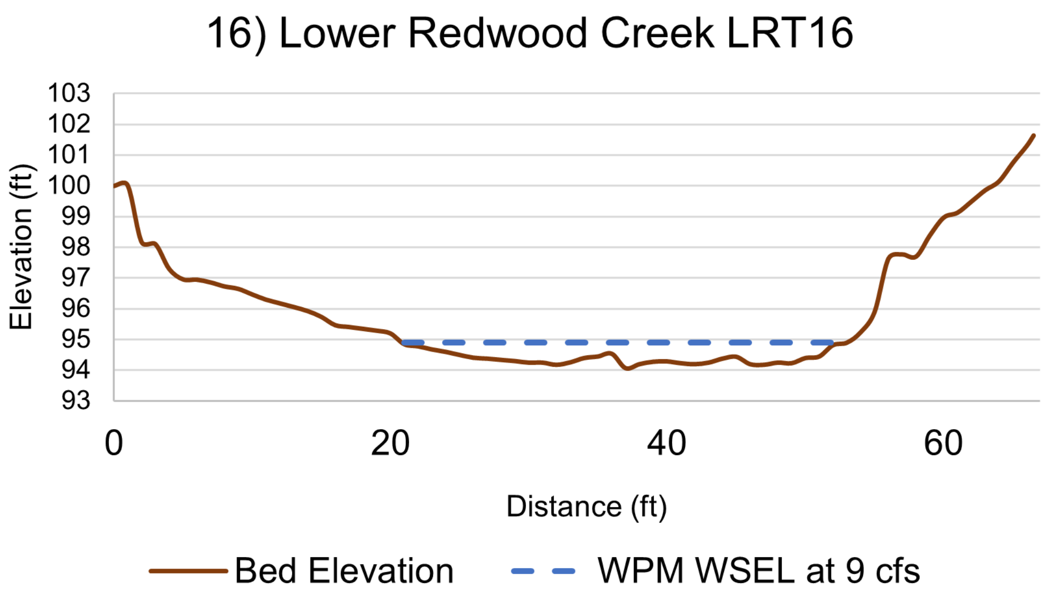

Figure B-7. Lower Redwood Creek LRT16 transect cross section with bed elevation and WPM WSEL.

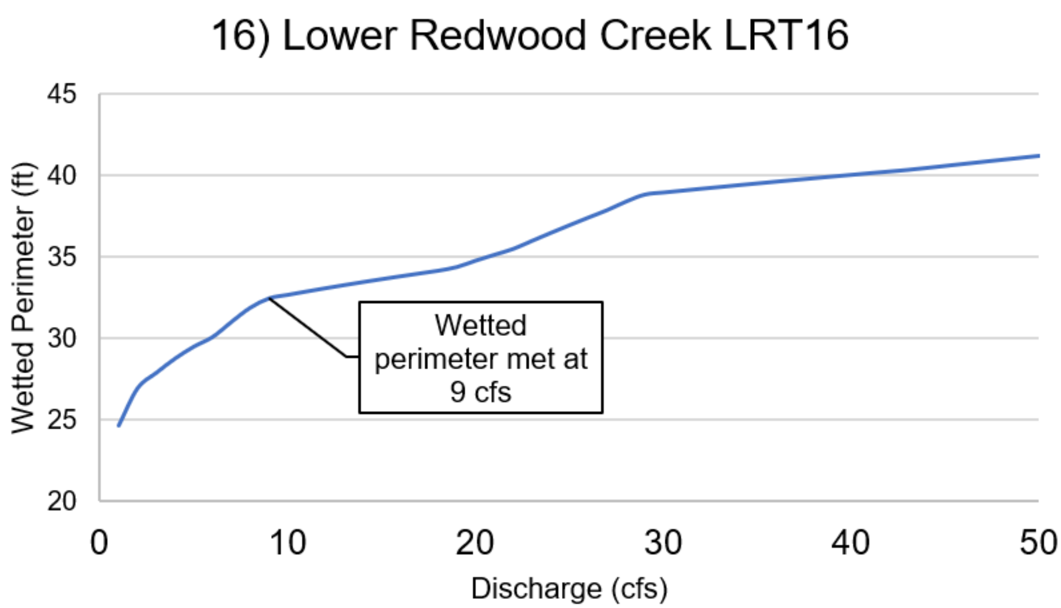

Figure B-8. Lower Redwood Creek LRT16 transect wetted perimeter-discharge curve.

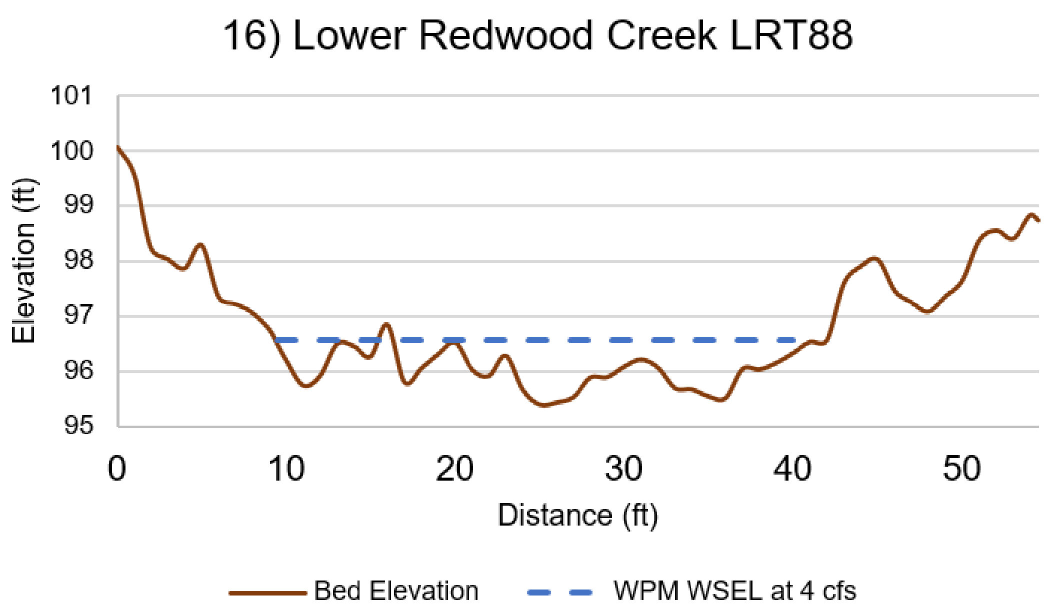

Figure B-9. Lower Redwood Creek LRT88 transect cross section with bed elevation and WPM WSEL.

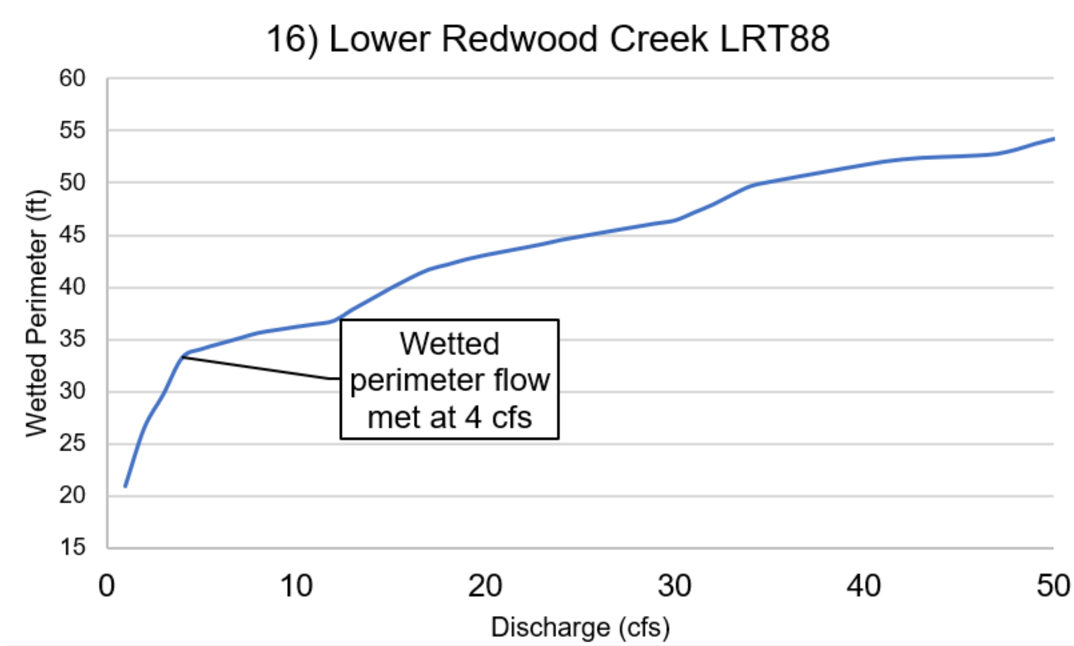

Figure B-10. Lower Redwood Creek LRT88 transect wetted perimeter-discharge curve.

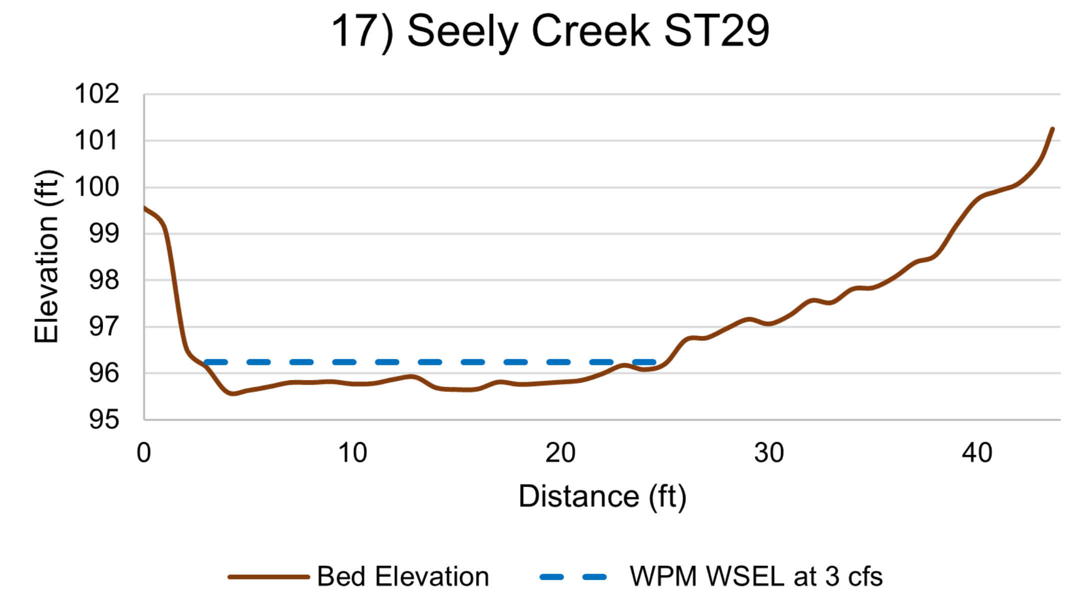

Figure B-11. Seely Creek ST29 transect cross section with bed elevation and WPM WSEL.

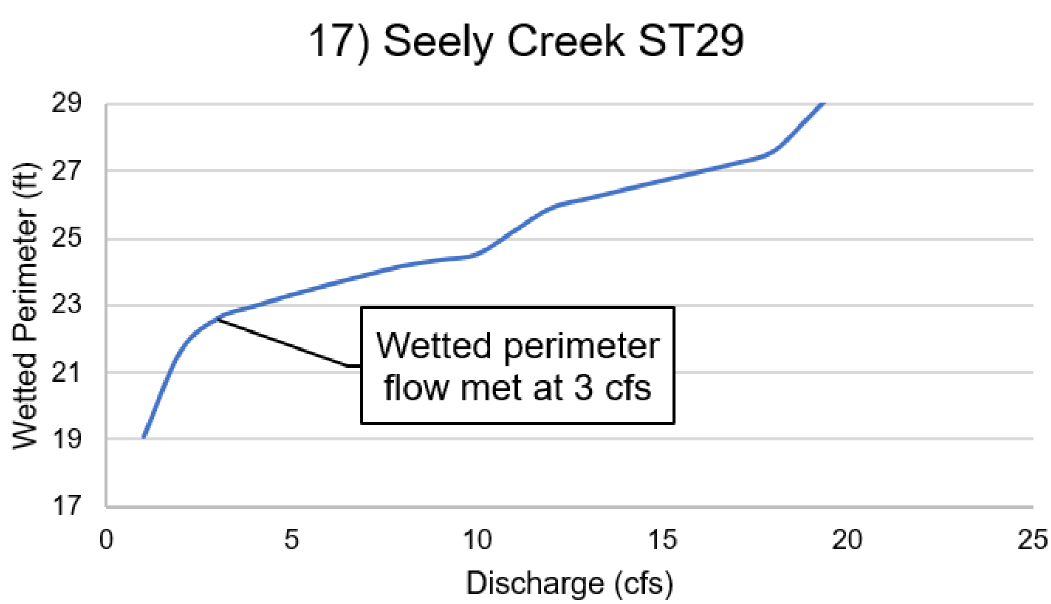

Figure B-12. Seely Creek ST29 transect wetted perimeter-discharge curve.

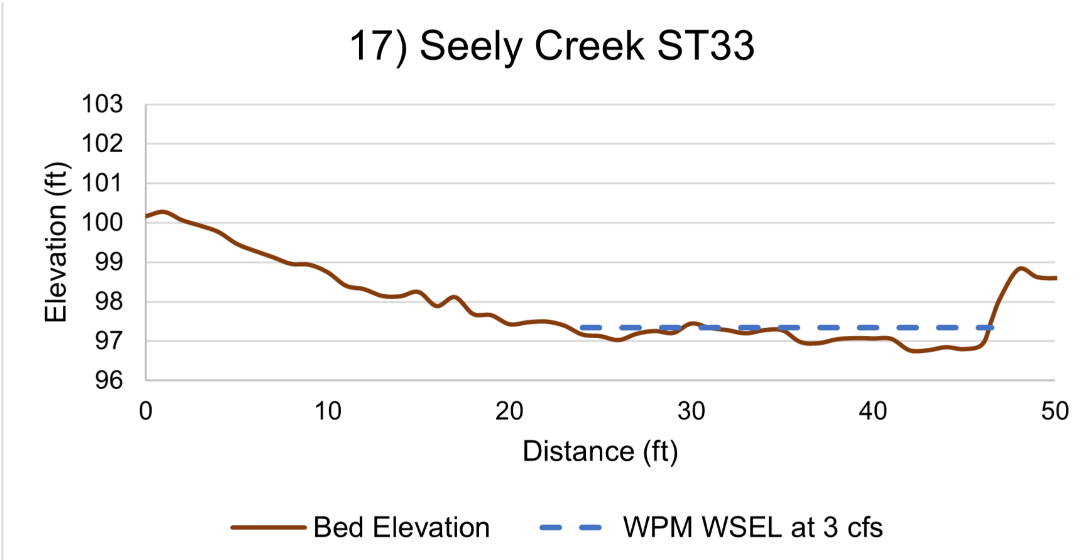

Figure B-13. Seely Creek ST33 transect cross section with bed elevation and WPM WSEL.

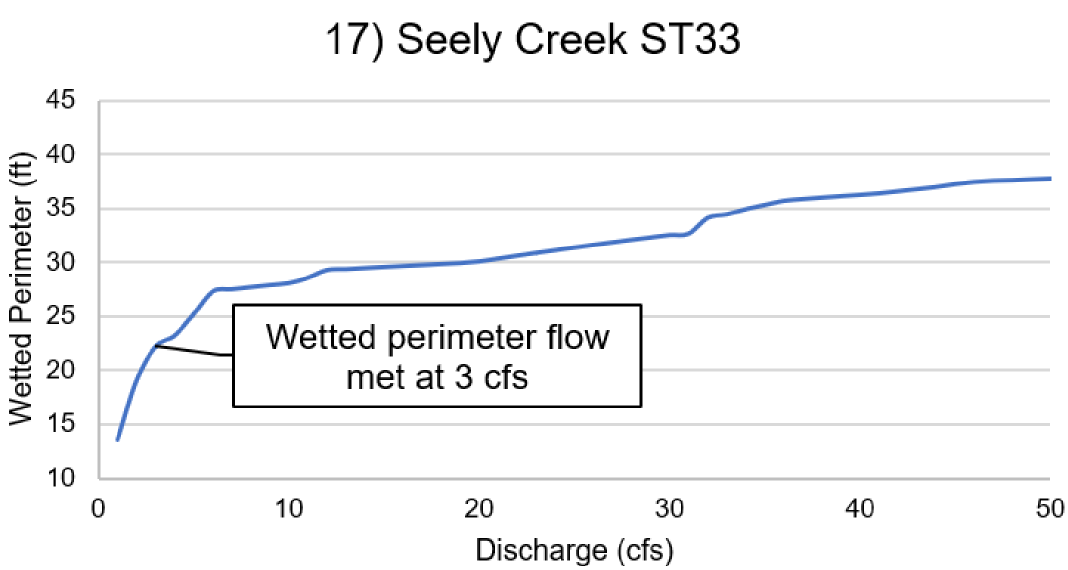

Figure B-14. Seely Creek ST33 transect wetted perimeter-discharge curve.

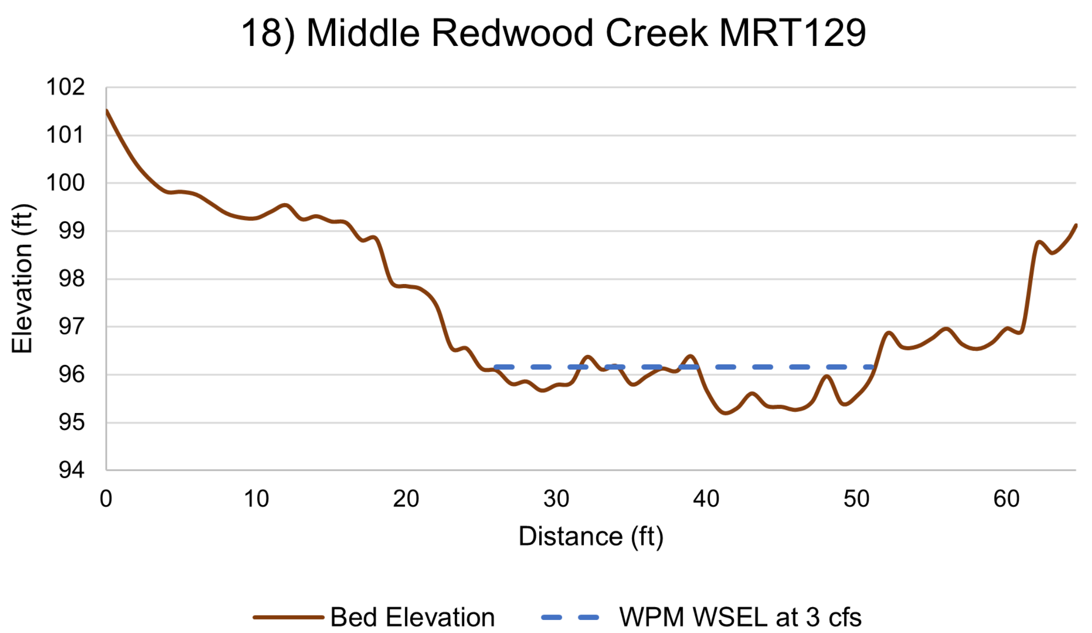

Figure B-15. Middle Redwood Creek MRT129 transect cross section with bed elevation and WPM WSEL.

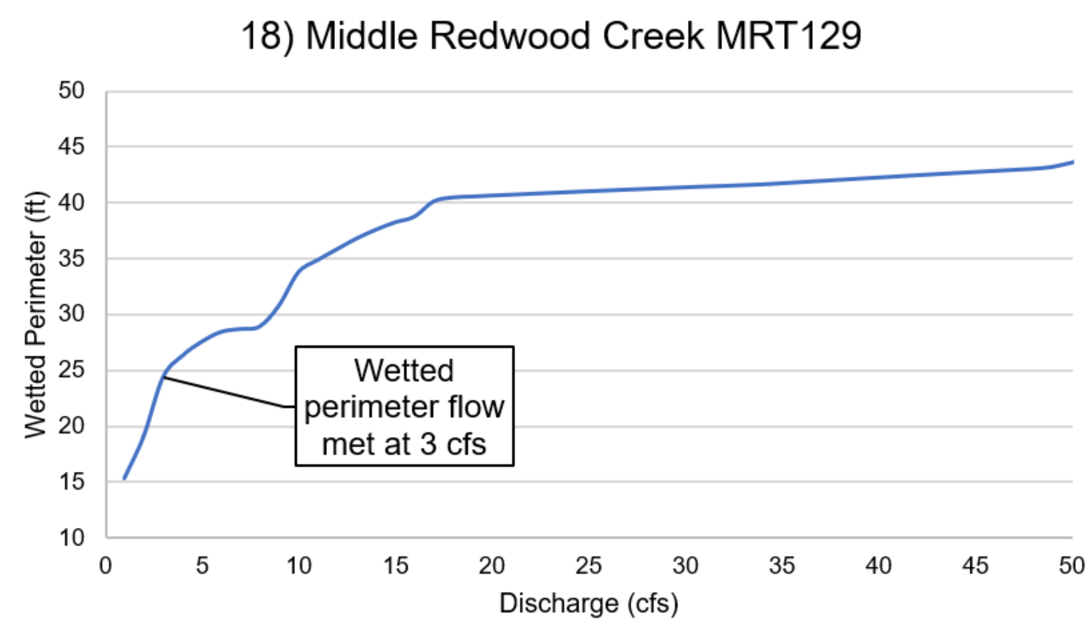

Figure B-16. Middle Redwood Creek MRT129 transect wetted perimeter-discharge curve.

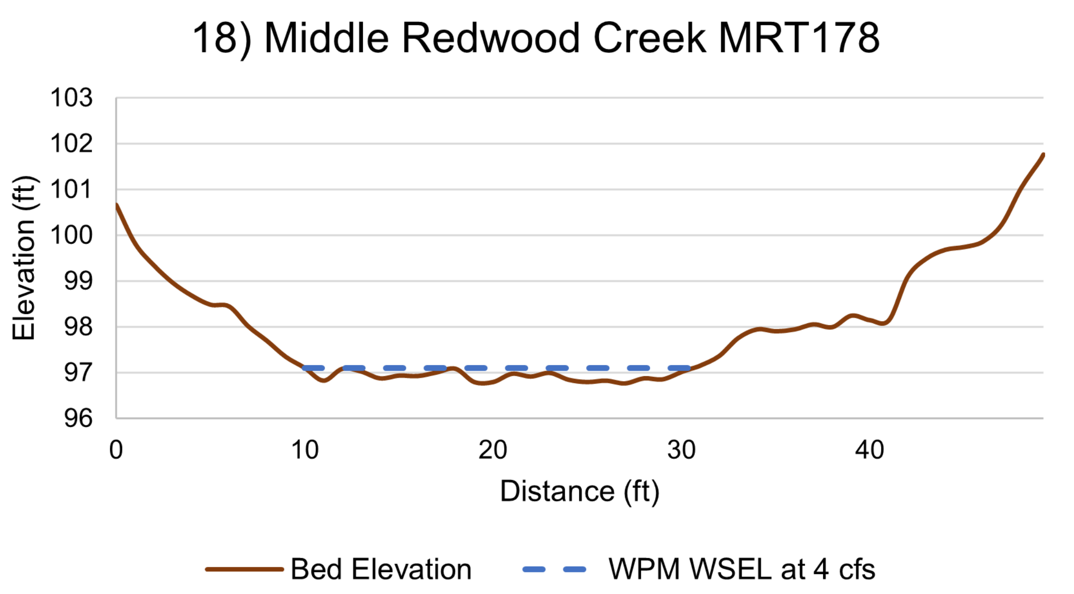

Figure B-17. Middle Redwood Creek MRT178 transect cross section with bed elevation and WPM WSEL.

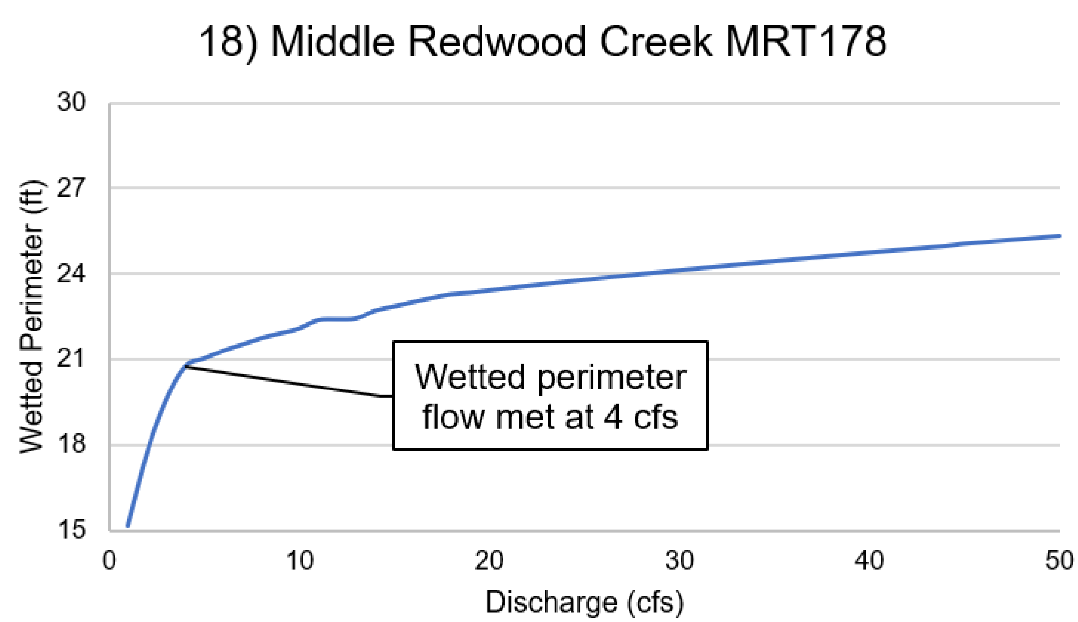

Figure B-18. Middle Redwood Creek MRT178 transect wetted perimeter-discharge curve.

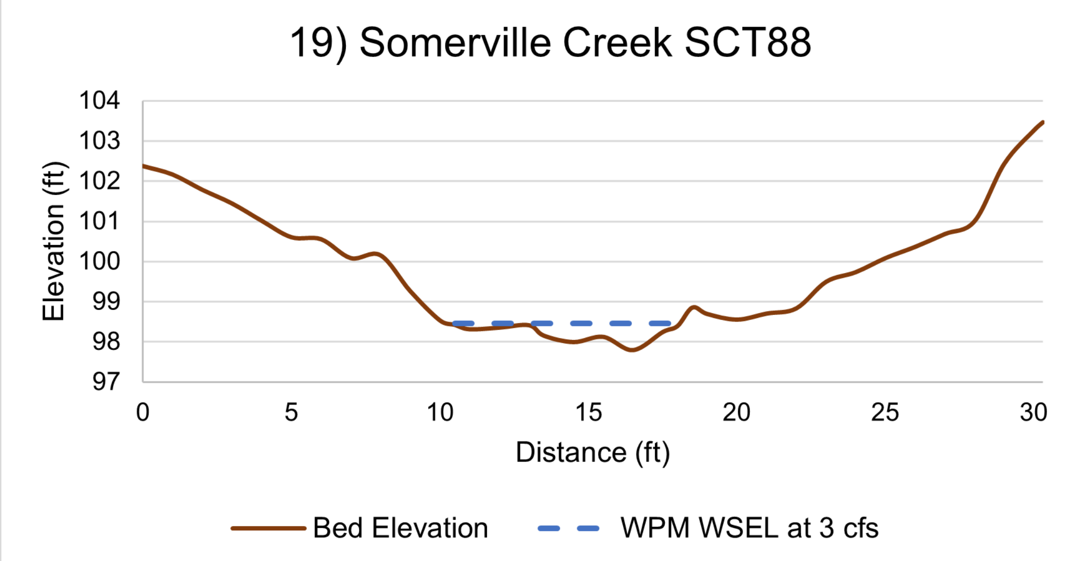

Figure B-19. Somerville Creek SCT88 transect cross section with bed elevation and WPM WSEL.

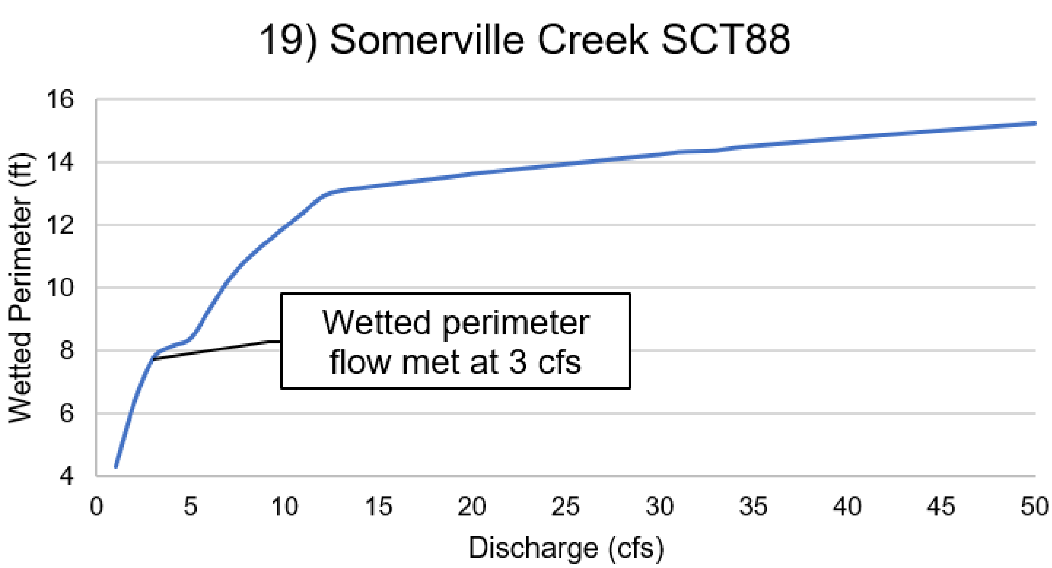

Figure B-20. Somerville Creek SCT88 transect wetted perimeter-discharge curve.

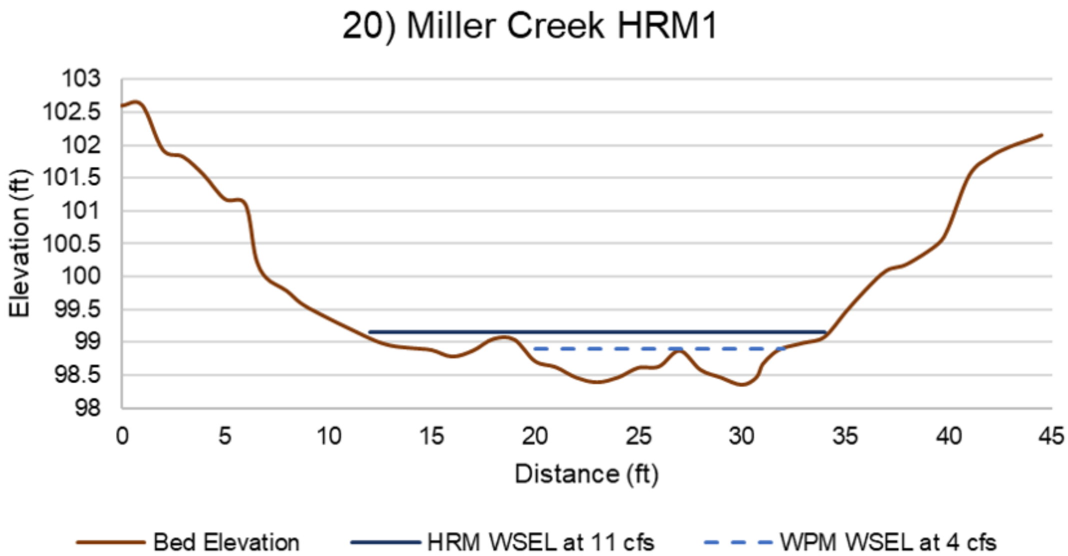

Figure B-21. Miller Creek HRM1 transect cross section with bed elevation and WPM WSEL.

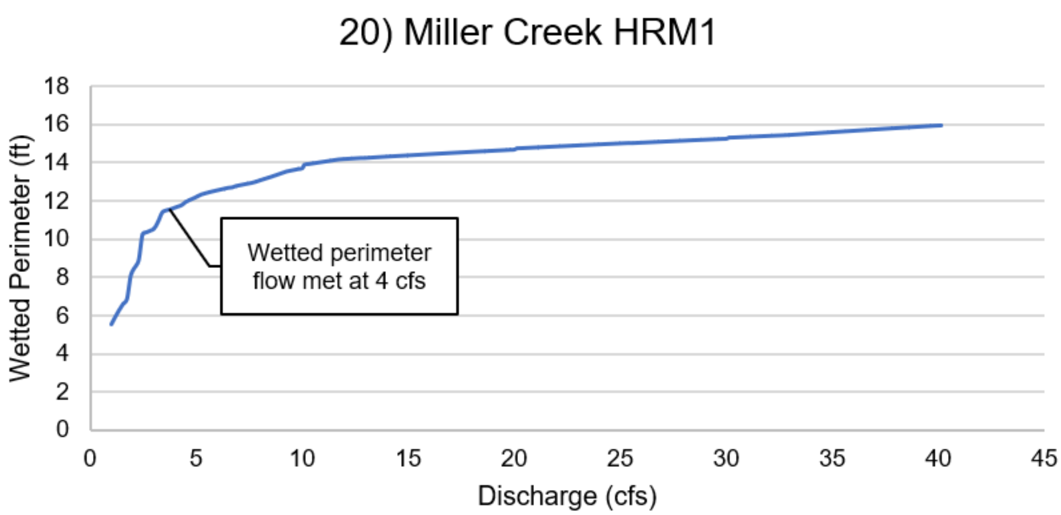

Figure B-22. Miller Creek HRM1 transect wetted perimeter-discharge curve.

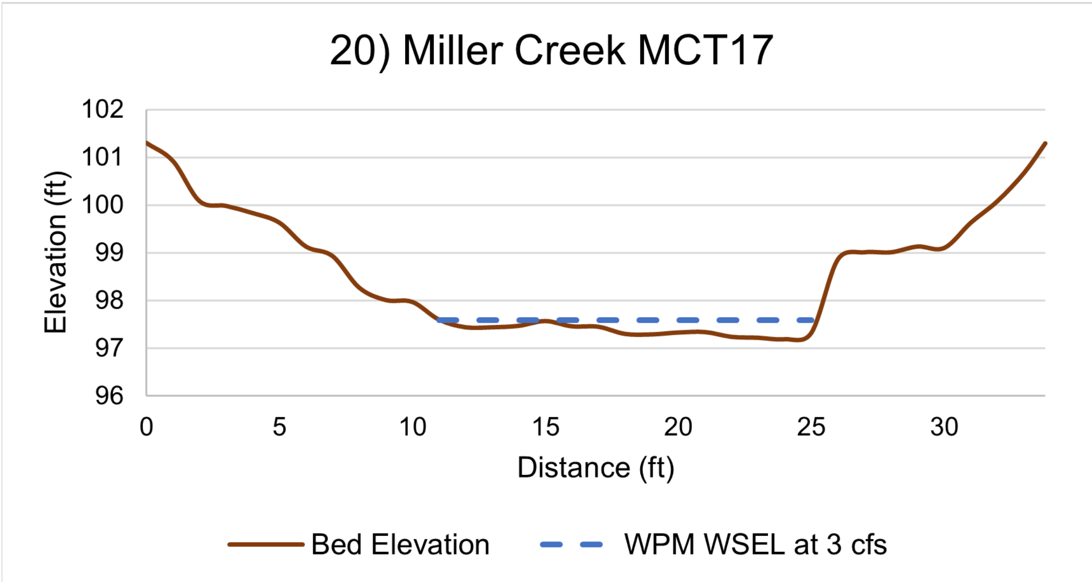

Figure B-23. Miller Creek MCT17 transect cross section with bed elevation and WPM WSEL.

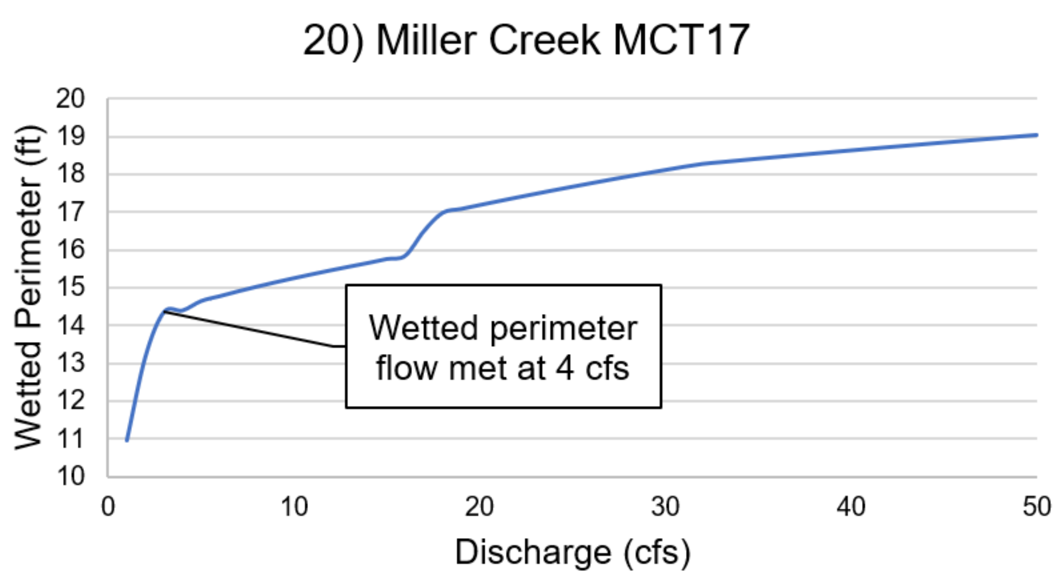

Figure B-24. Miller Creek MCT17 transect wetted perimeter-discharge curve.

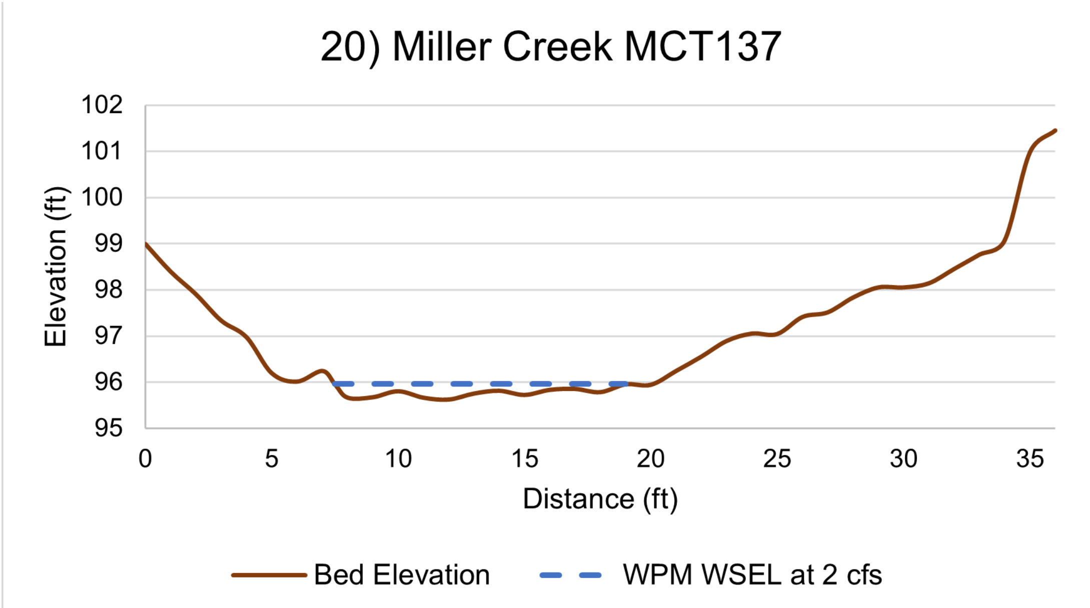

Figure B-25. Miller Creek MCT137 transect cross section with bed elevation and WPM WSEL.

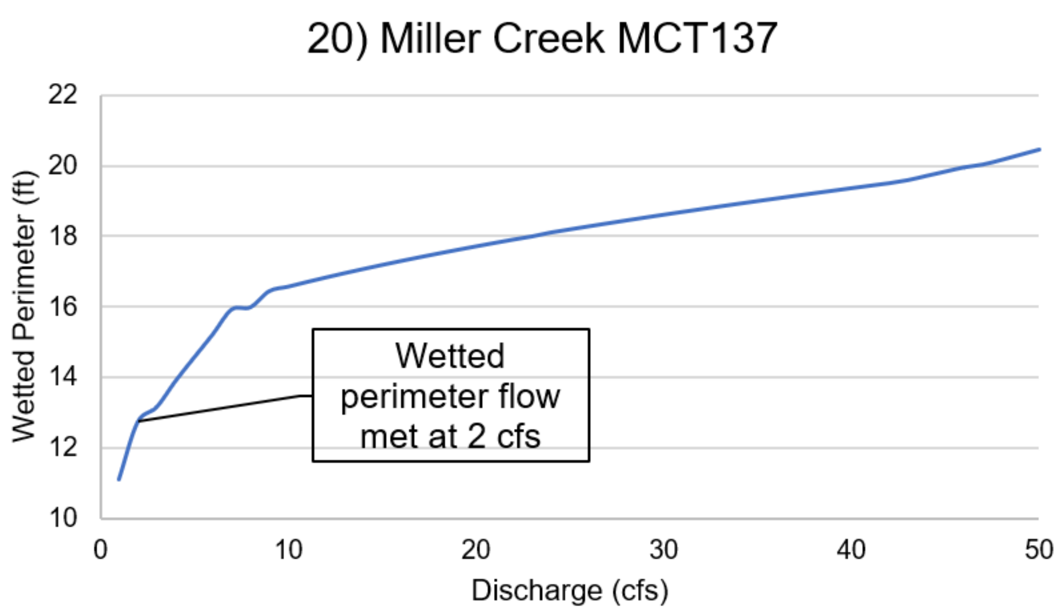

Figure B-26. Miller Creek MCT137 transect wetted perimeter-discharge curve.

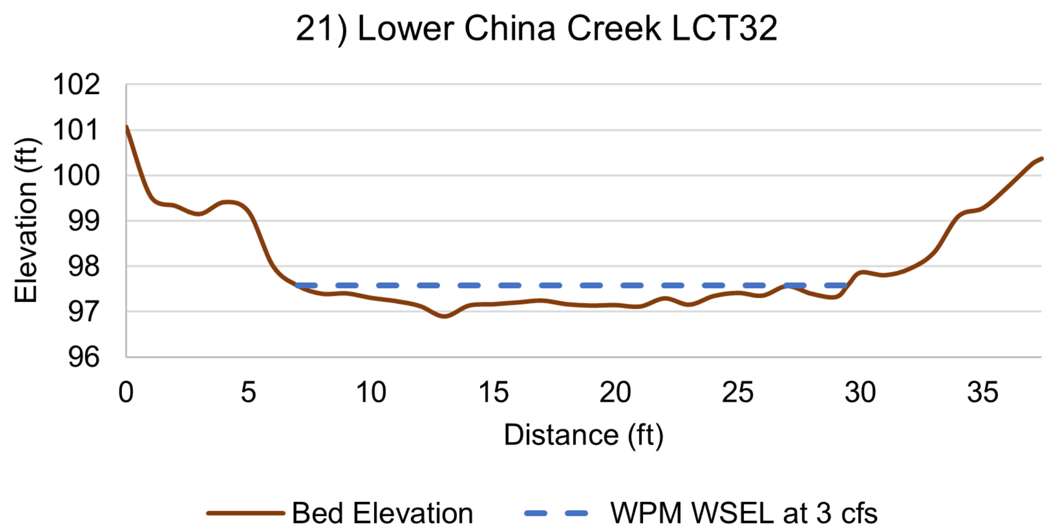

Figure B-27. Lower China Creek LCT32 cross section with bed elevation and WPM WSEL.

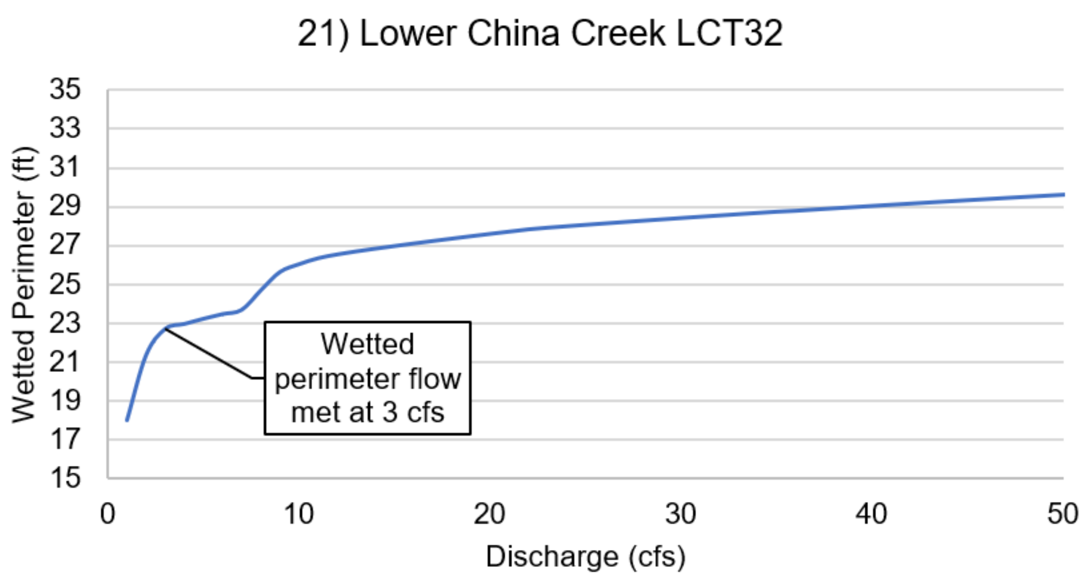

Figure B-28. Lower China Creek LCT32 transect wetted perimeter-discharge curve.

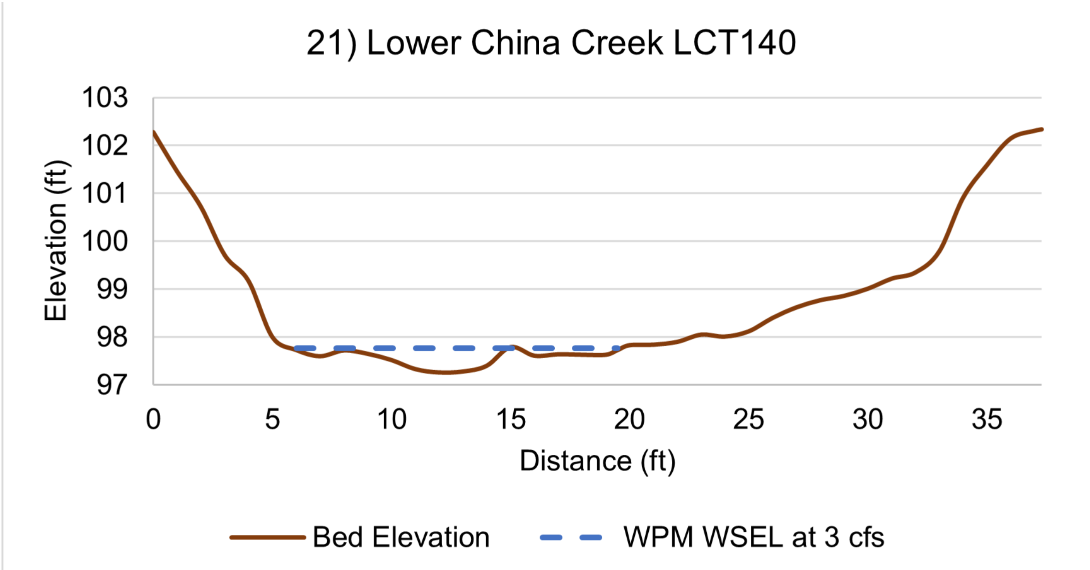

Figure B-29. Lower China Creek LCT140 cross section with bed elevation and WPM WSEL.

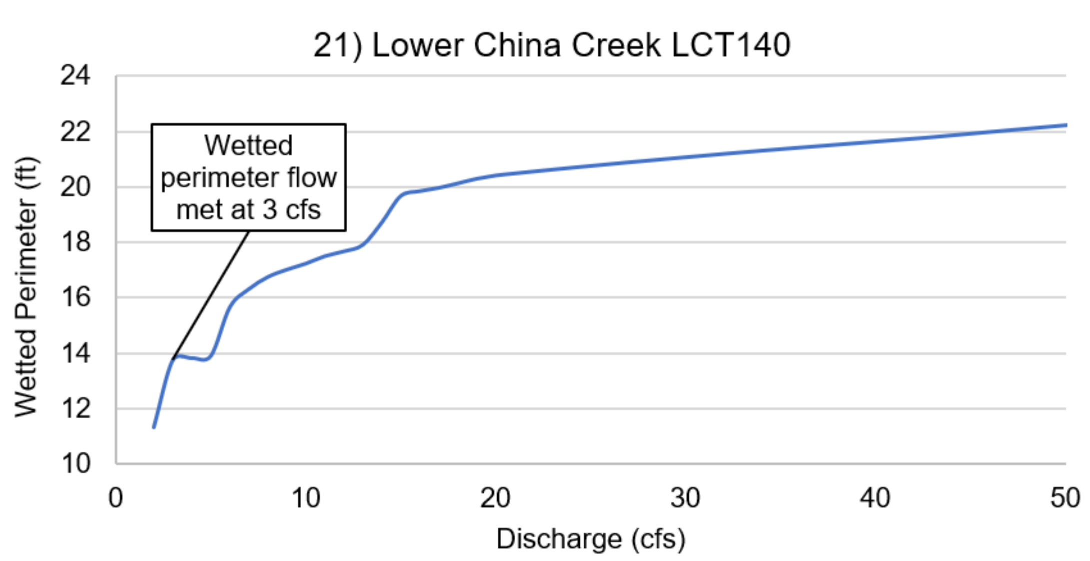

Figure B-30. Lower China Creek LCT140 transect wetted perimeter-discharge curve.

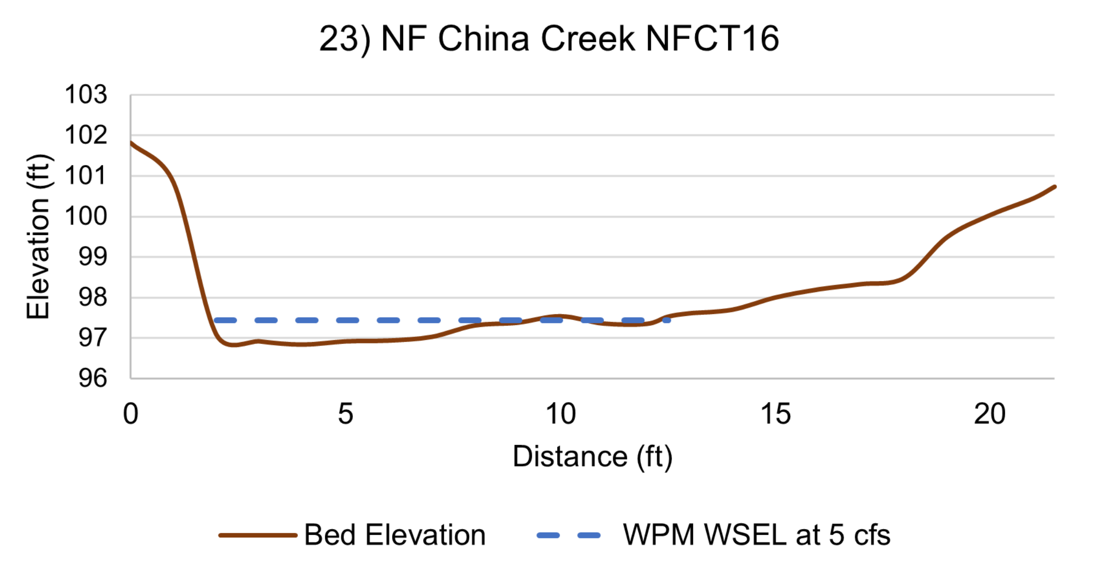

Figure B-31. NF China Creek NFCT16 cross section with bed elevation and WPM WSEL.

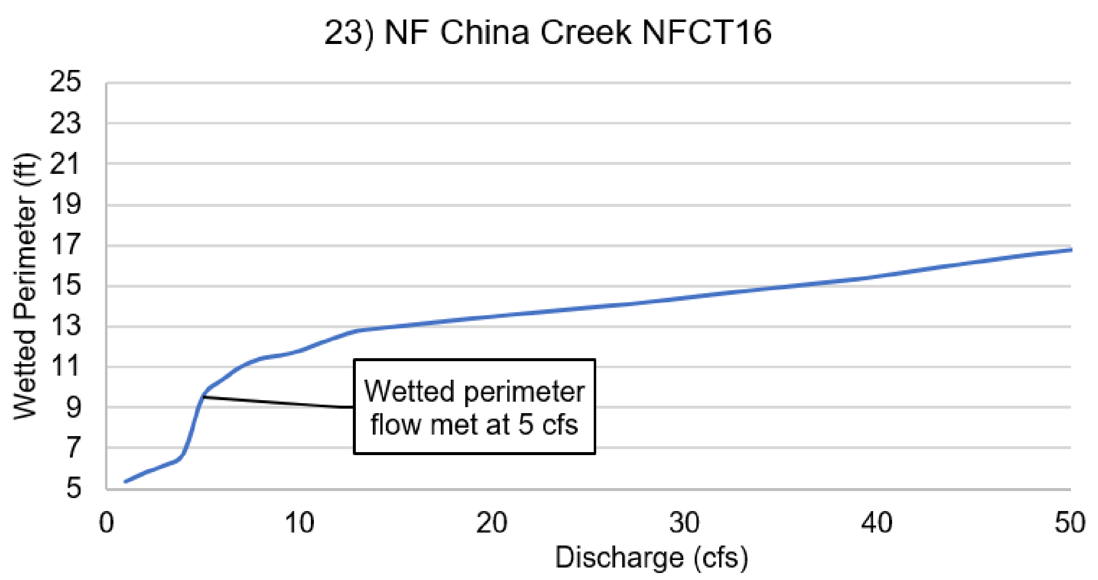

Figure B-32. NF China Creek NFCT16 transect wetted perimeter-discharge curve.

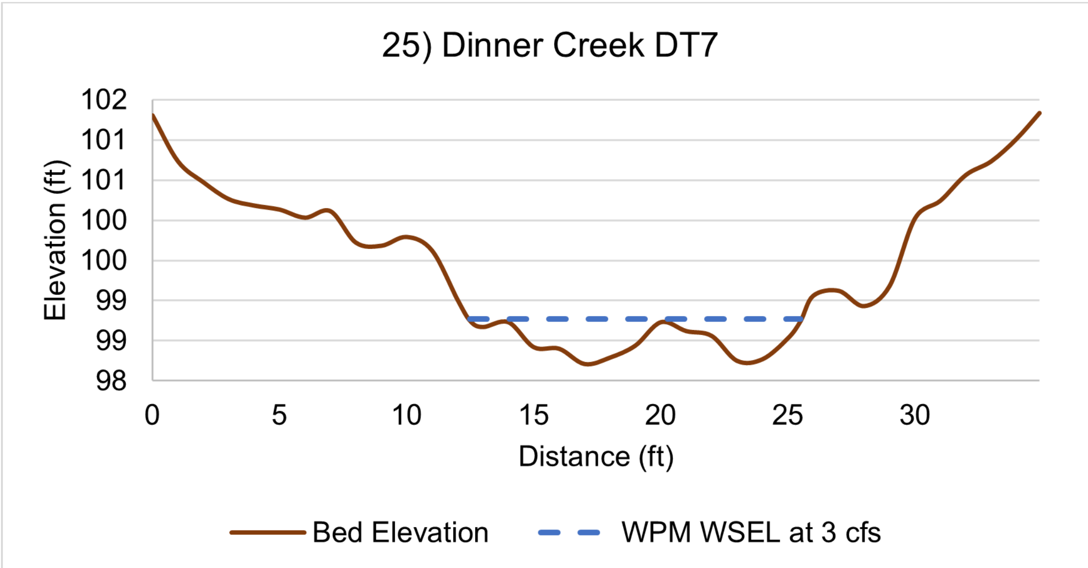

Figure B-33. Dinner Creek DT7 cross section with bed elevation and WPM WSEL.

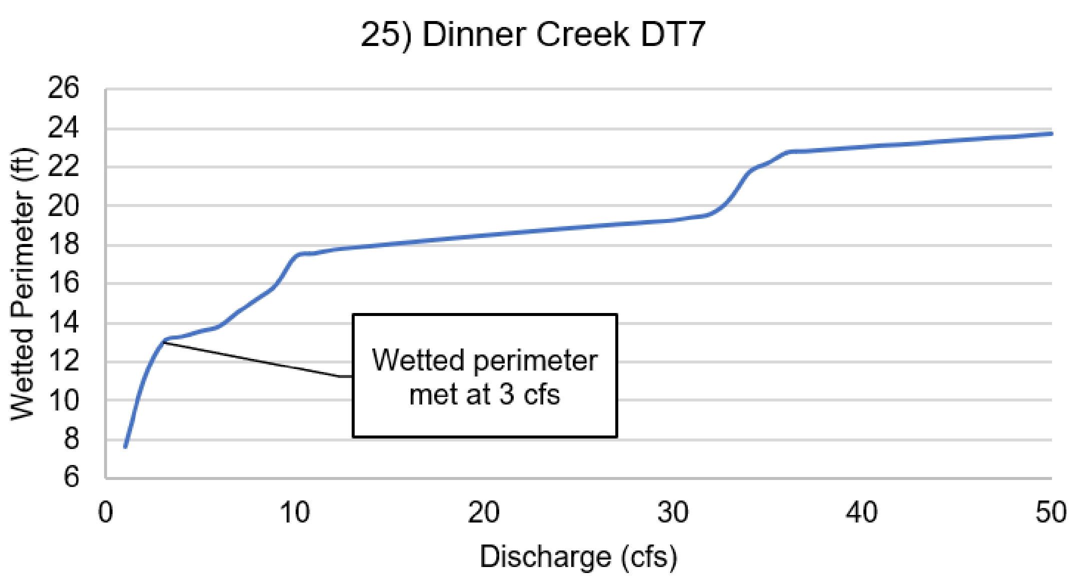

Figure B-34. Dinner Creek DT7 transect wetted perimeter-discharge curve.

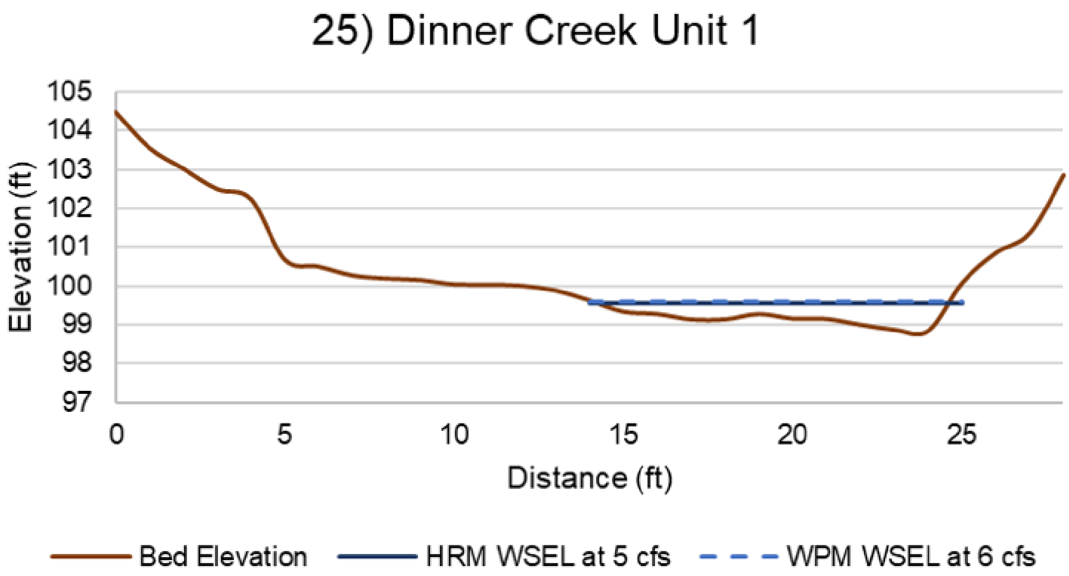

Figure B-35. Dinner Creek Unit 1 transect cross section with bed elevation, WPM WSEL, and HRM WSEL.

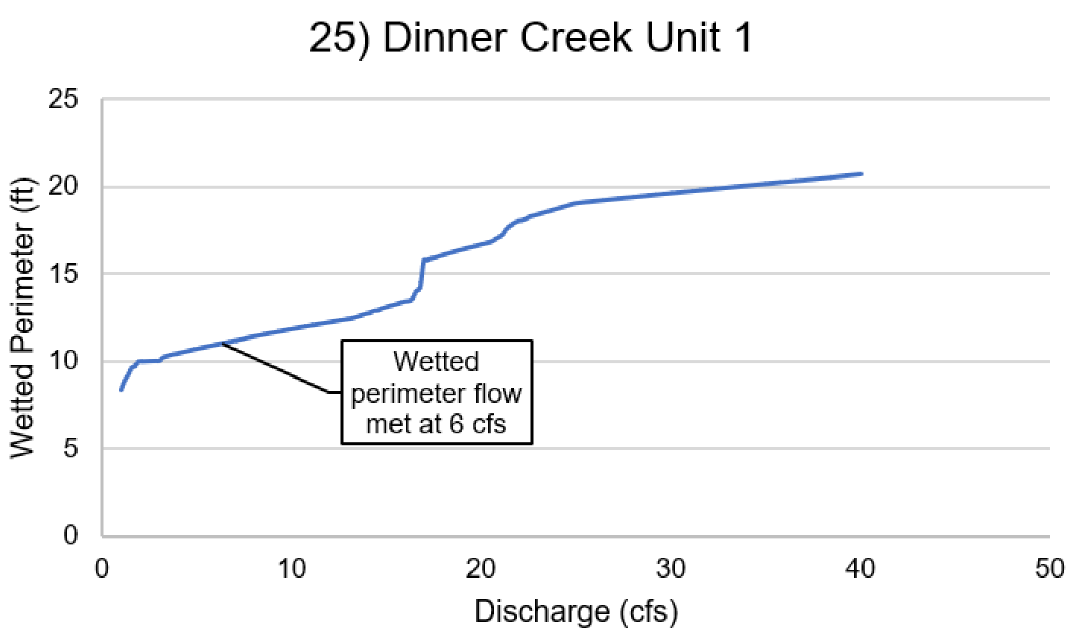

Figure B-36. Dinner Creek Unit 1 transect wetted perimeter-discharge curve.

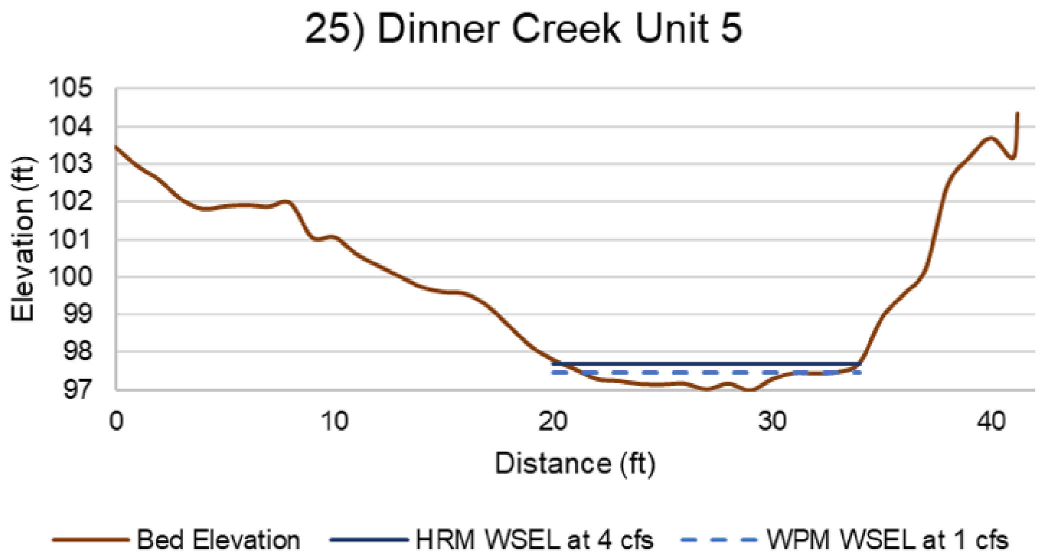

Figure B-37. Dinner Creek Unit 5 transect cross section with bed elevation, WPM WSEL, and HRM WSEL.

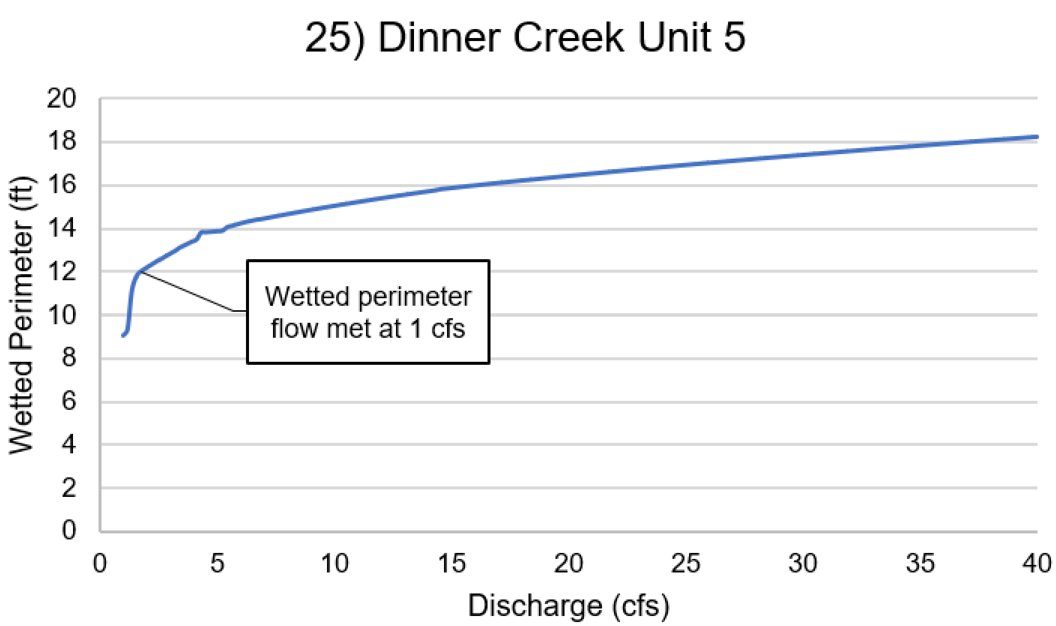

Figure B-38. Dinner Creek Unit 5 transect wetted perimeter-discharge curve.

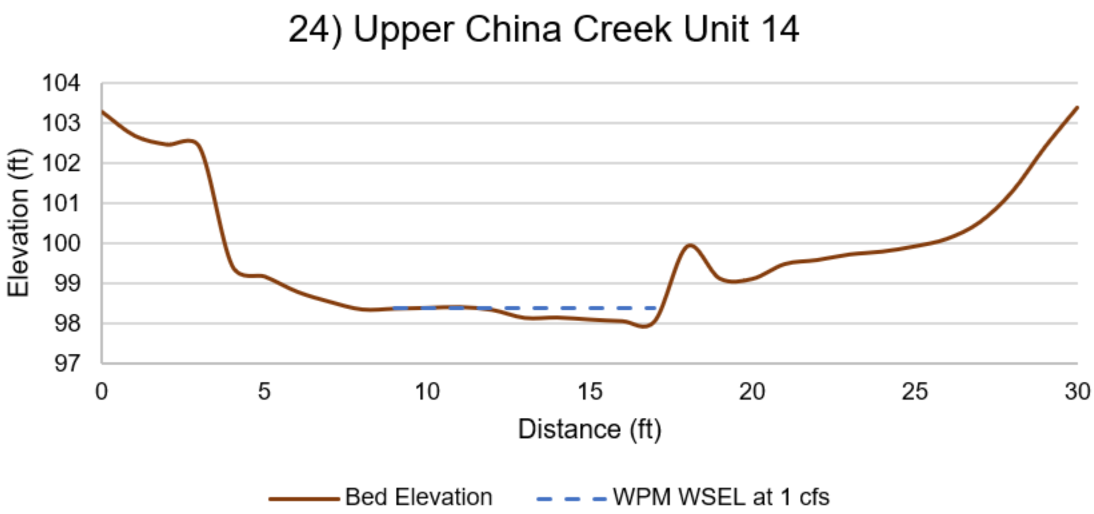

Figure B-39. Upper China Creek Unit 14 transect cross section with bed elevation and WPM WSEL.

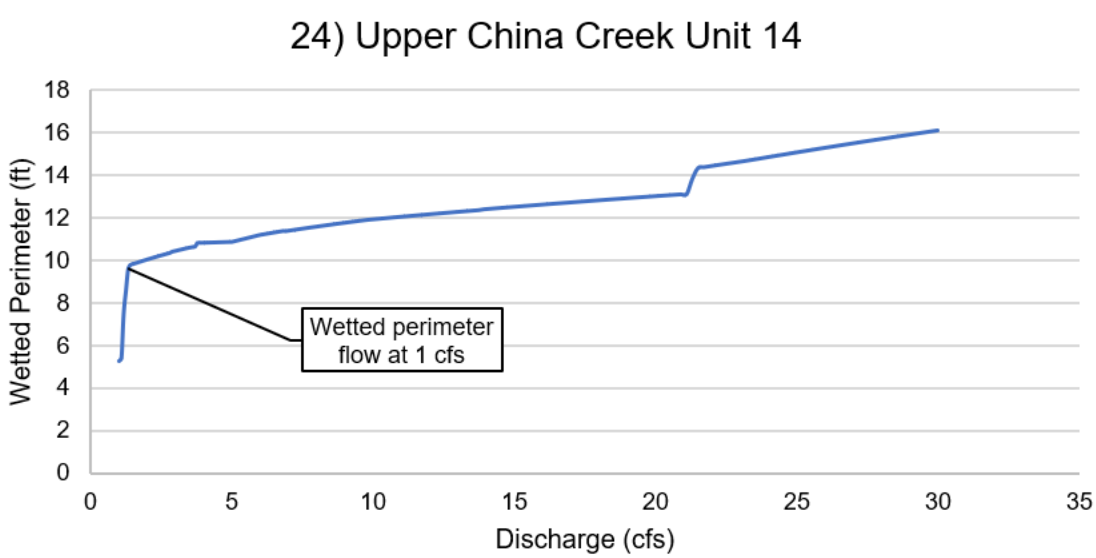

Figure B-40. Upper China Creek Unit 14 transect wetted perimeter-discharge curve.

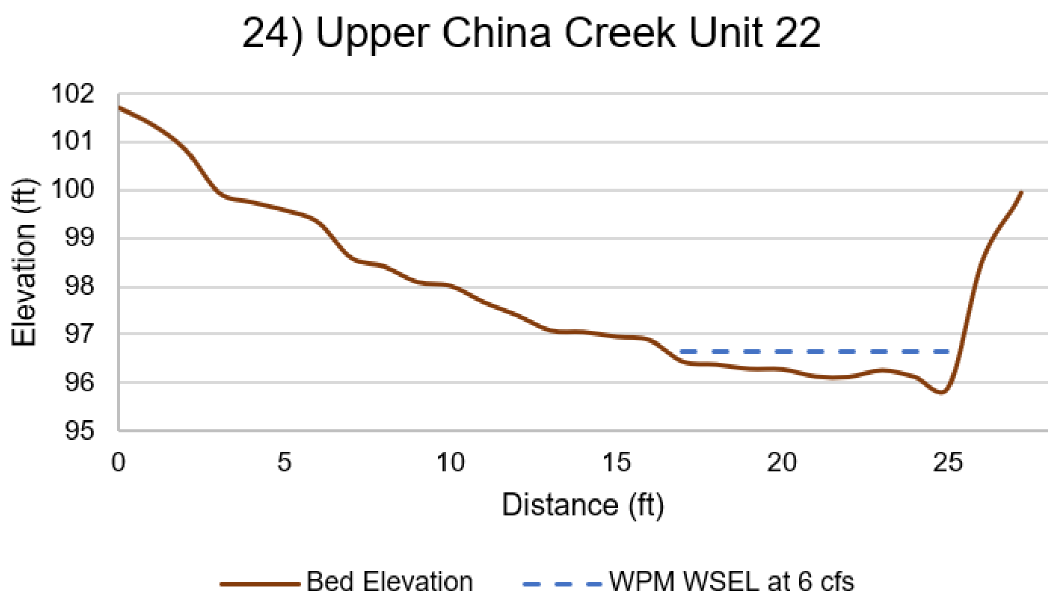

Figure B-41. Upper China Creek Unit 22 transect cross section with bed elevation and WPM WSEL.

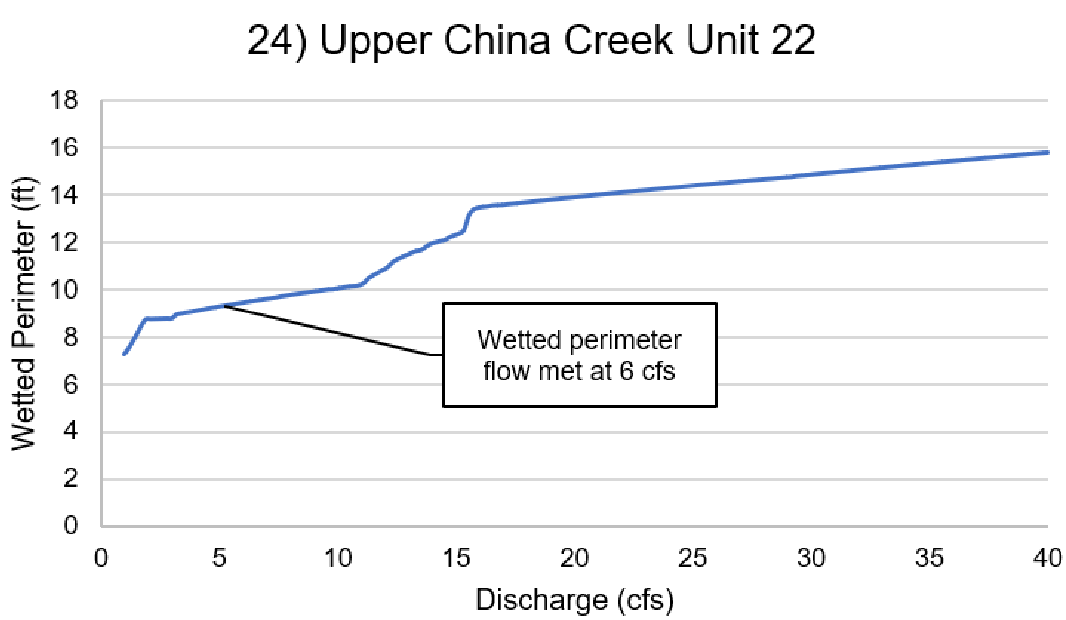

Figure B-42. Upper China Creek Unit 22 transect wetted perimeter-discharge curve.

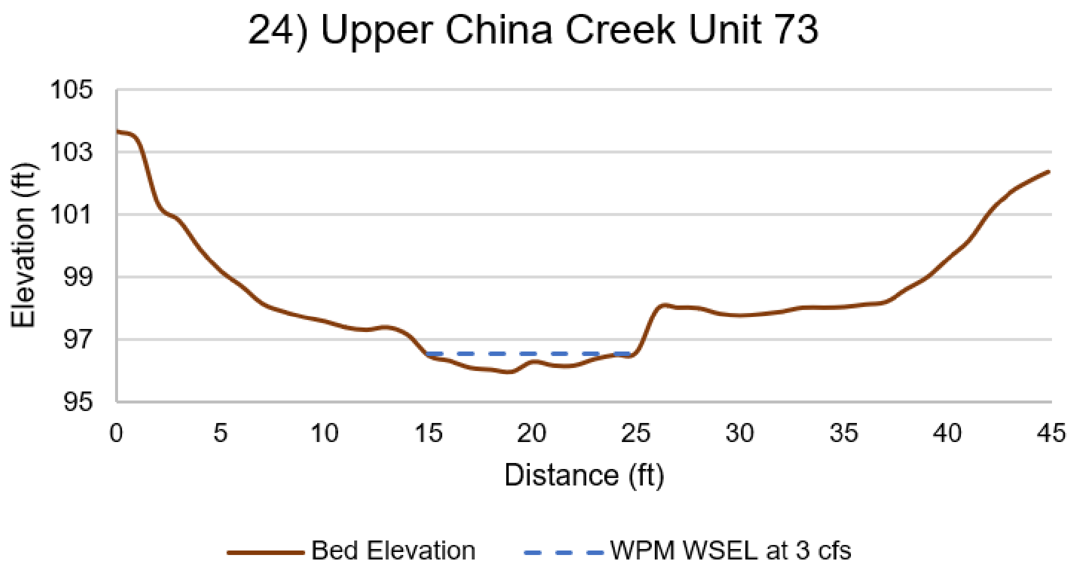

Figure B-43. Upper China Creek Unit 73 transect cross section with bed elevation and WPM WSEL.

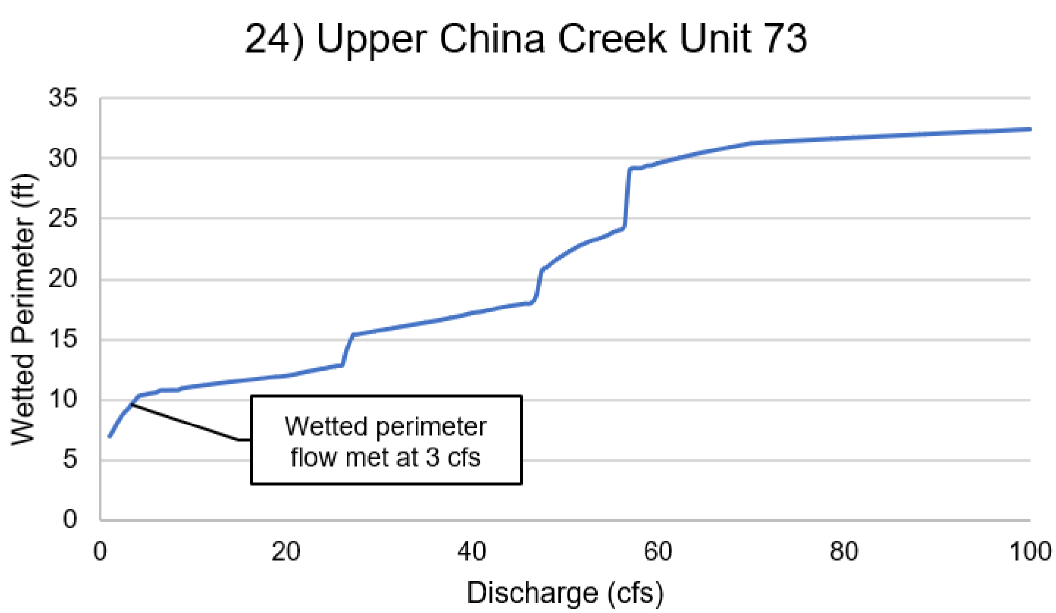

Figure B-44. Upper China Creek Unit 73 transect wetted perimeter-discharge curve.

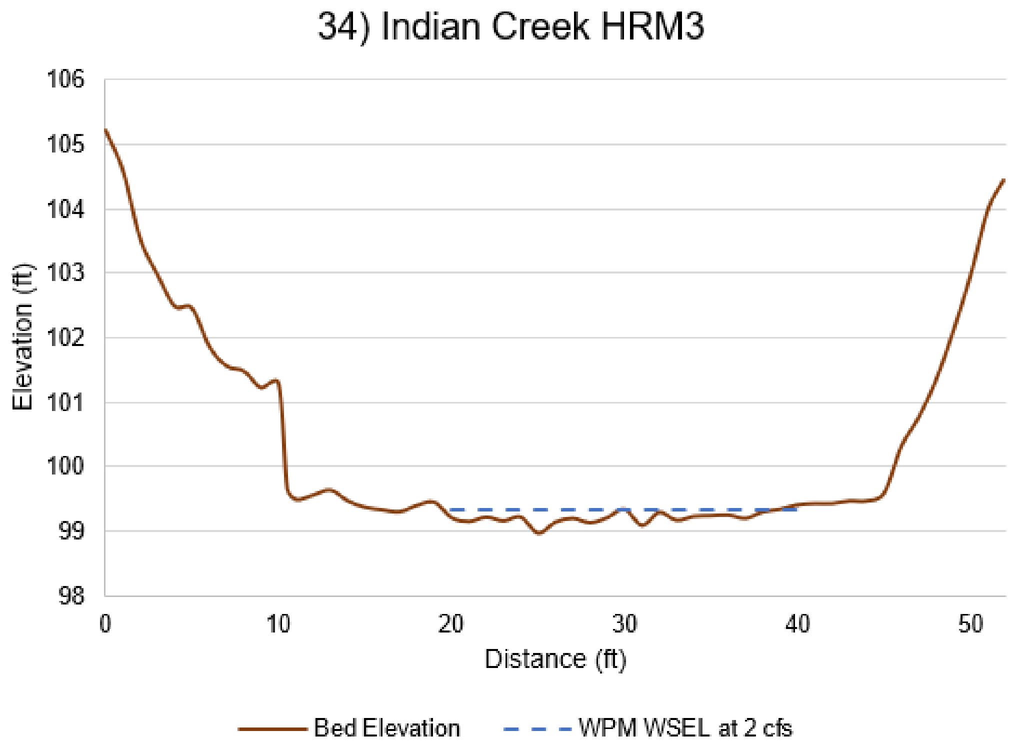

Figure B-45. Indian Creek HRM3 transect cross section with bed elevation and WPM WSEL.

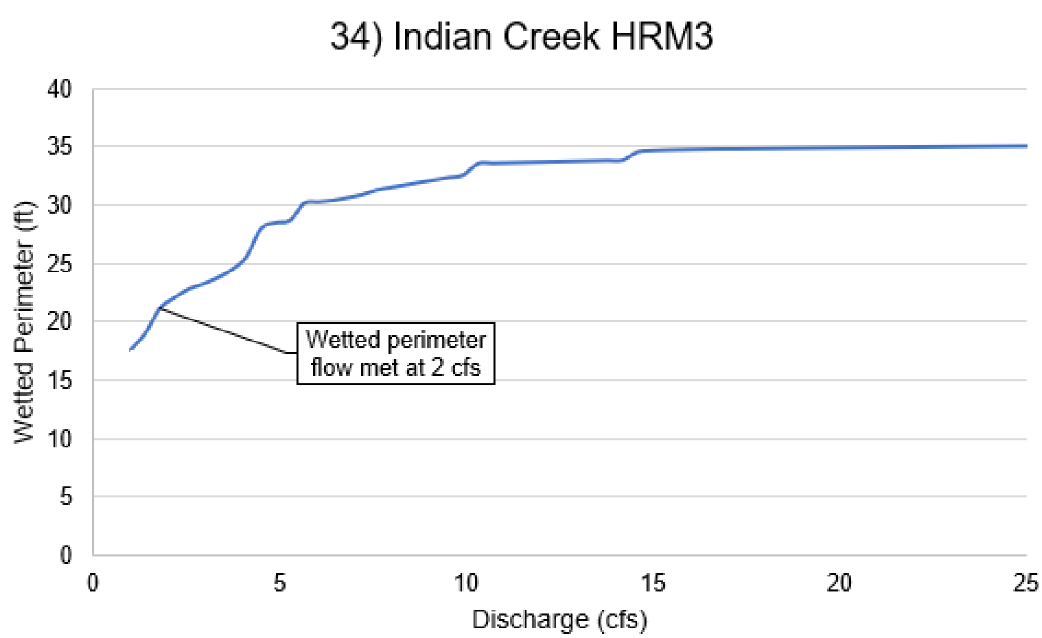

Figure B-46. Indian Creek HRM3 transect wetted perimeter-discharge curve.

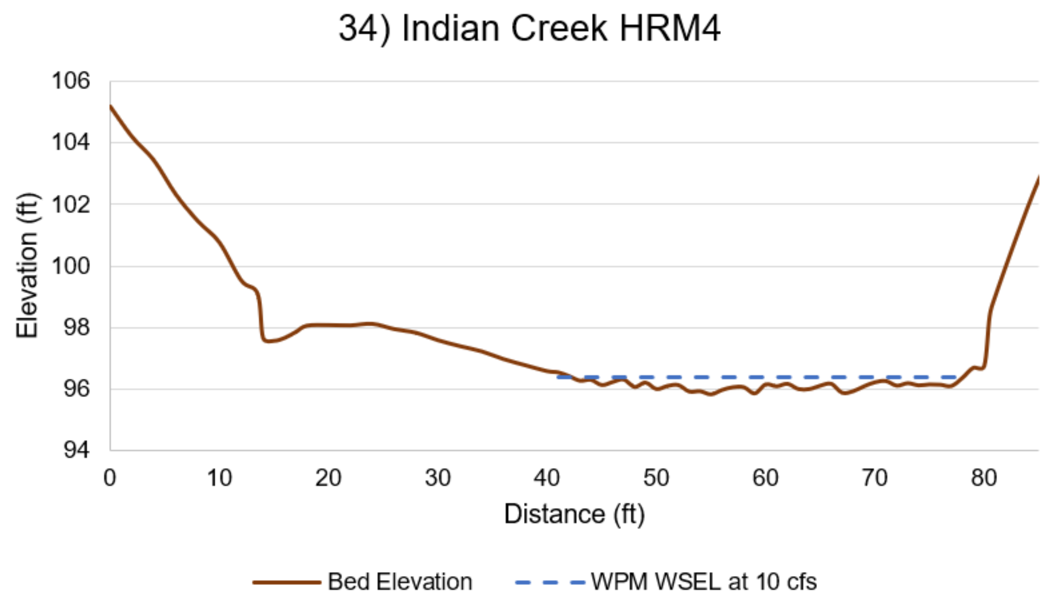

Figure B-47. Indian Creek HRM4 transect cross section with bed elevation and WPM WSEL.

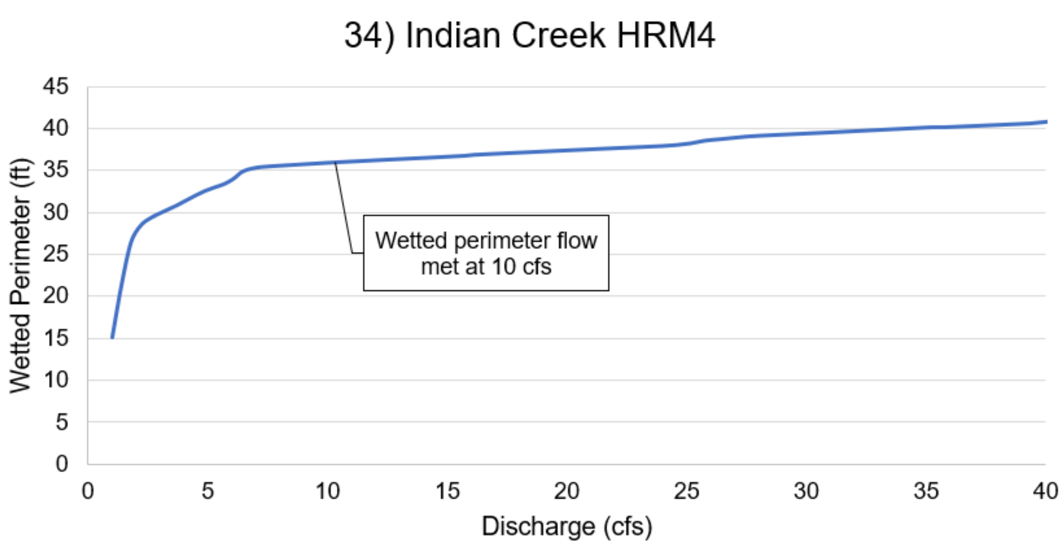

Figure B-48. Indian Creek HRM4 transect wetted perimeter-discharge curve.

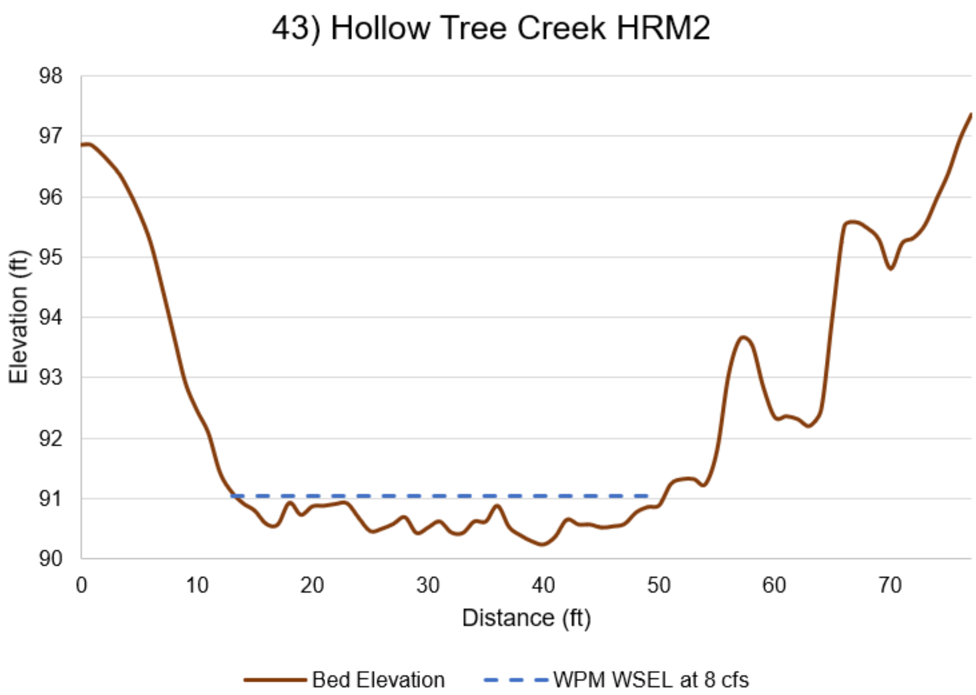

Figure B-49. Hollow Tree Creek HRM2 transect cross section with bed elevation and WPM WSEL.

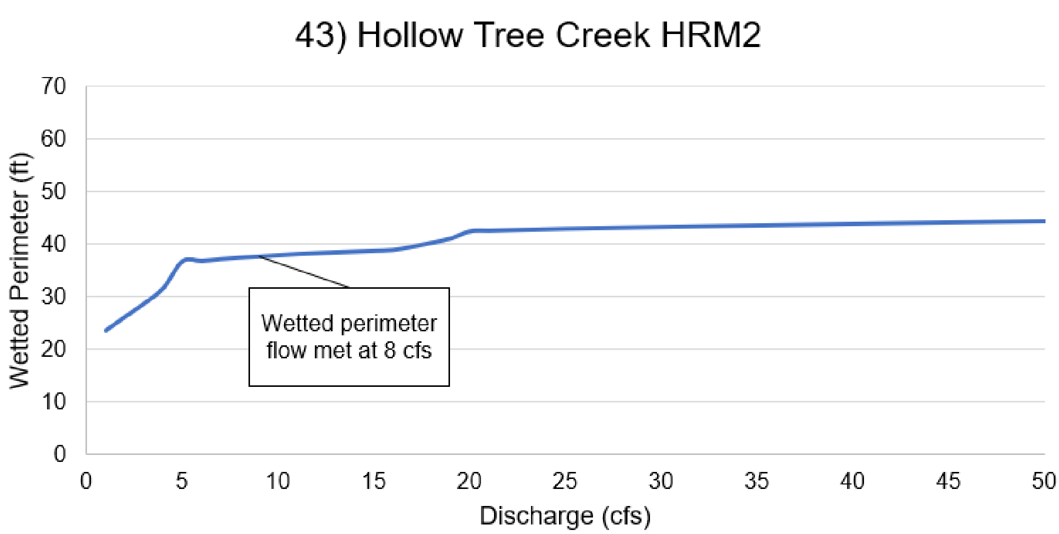

Figure B-50. Hollow Tree Creek HRM2 transect wetted perimeter-discharge curve.

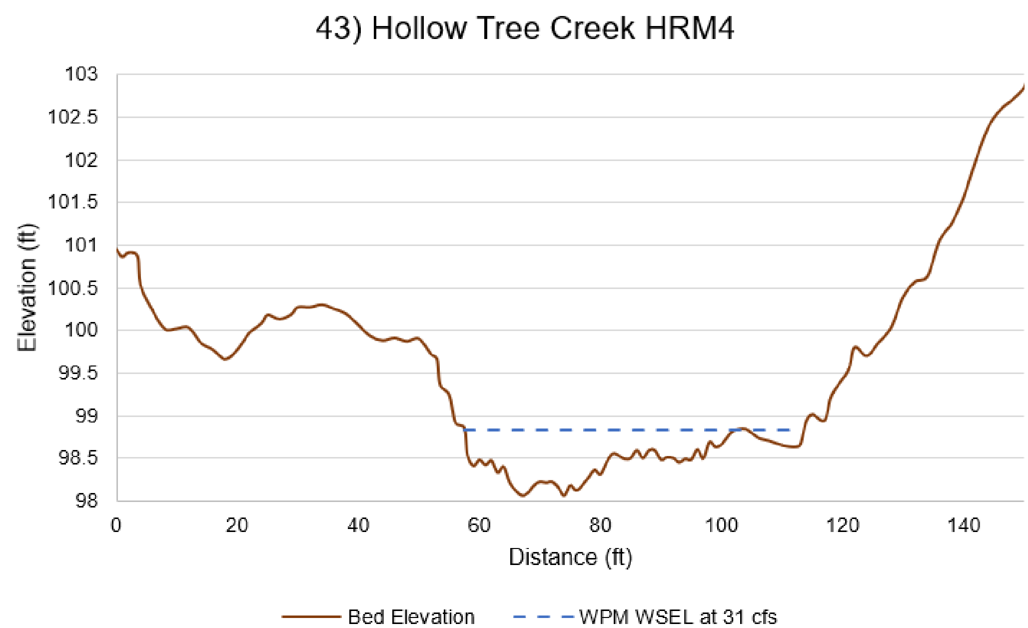

Figure B-51. Hollow Tree Creek HRM4 transect cross section with bed elevation and WPM WSEL.

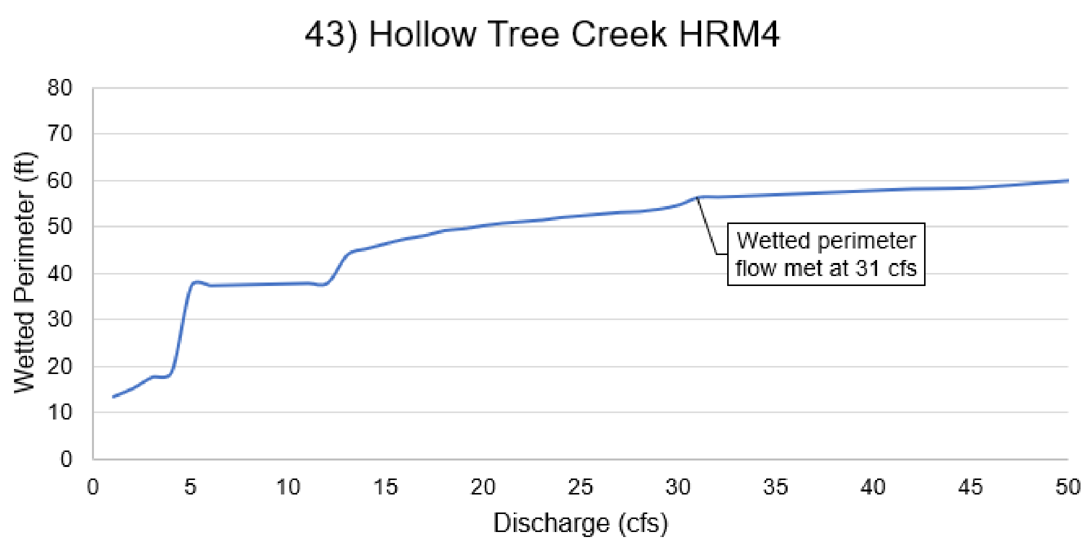

Figure B-52. Hollow Tree Creek HRM4 transect wetted perimeter-discharge curve.