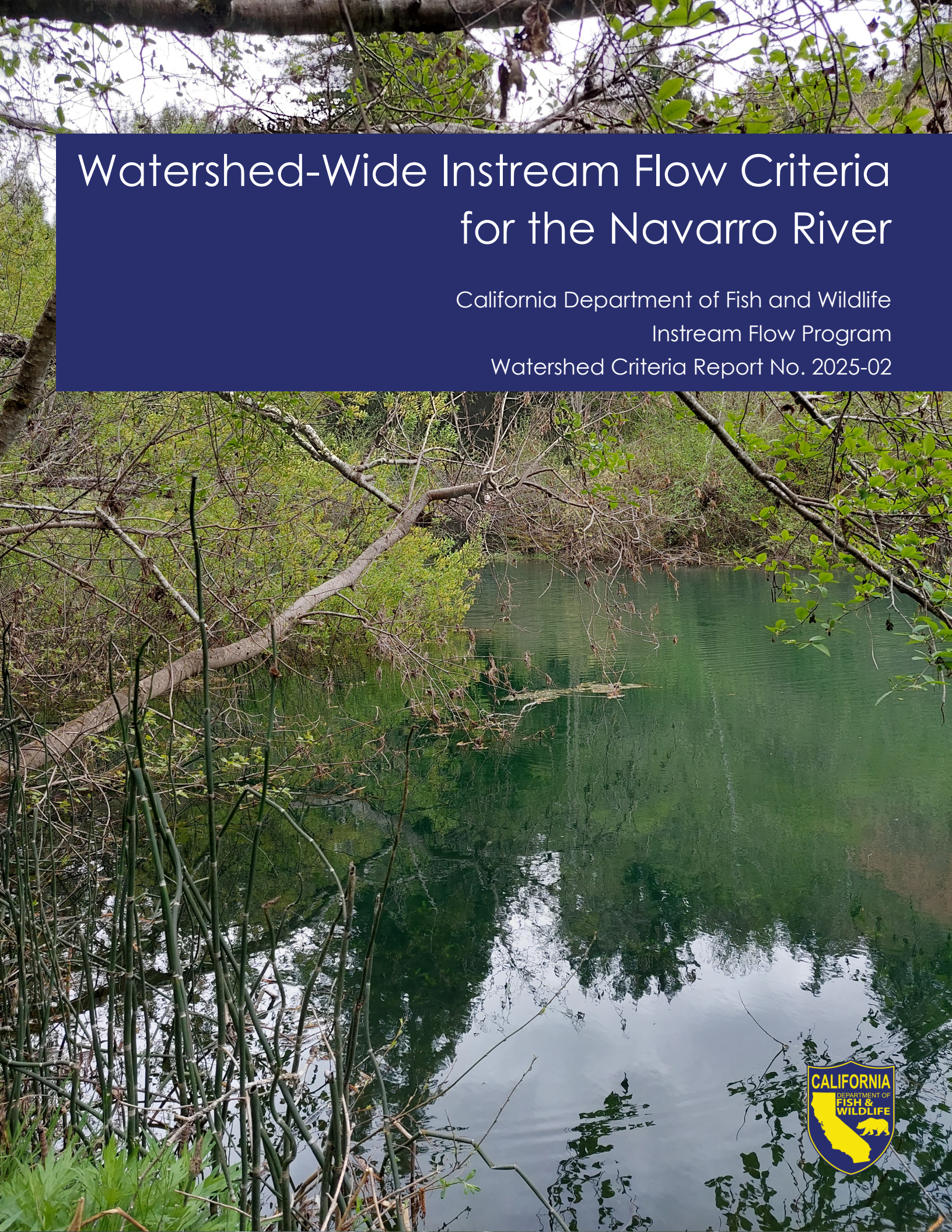

Watershed-Wide Instream Flow Criteria for the Navarro River

California Department of Fish and Wildlife
Instream Flow Program
Watershed Criteria Report No. 2025-02

California Department of Fish and Wildlife
Water Branch
Instream Flow Program
Watershed Criteria Report No. 2025-02

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Introduction

This *Watershed-Wide Instream Flow Criteria* report (Watershed Criteria Report) provides instream flow criteria for the Navarro 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 Navarro River was identified in the "California Salmon Strategy for a Hotter, Drier Future: Restoring Aquatic Ecosystems in the Age of Climate Change" as a priority stream for which the California Department of Fish and Wildlife (Department) must complete an instream flow analysis (Office of Governor Newsom 2024). This directive is consistent with the identification of the Navarro River as a watercourse for which minimum flow levels need to be established in order to ensure continued viability of stream-related fish and wildlife resources, in accordance with Public Resources Code section 10001.

This report presents stream assessments for 16 reaches. 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 *Overview of Watershed-Wide Instream Flow Criteria Report Methodology* (Overview) document (CDFW 2021). 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 2024).

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.

Navarro River

NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

Navarro River Watershed

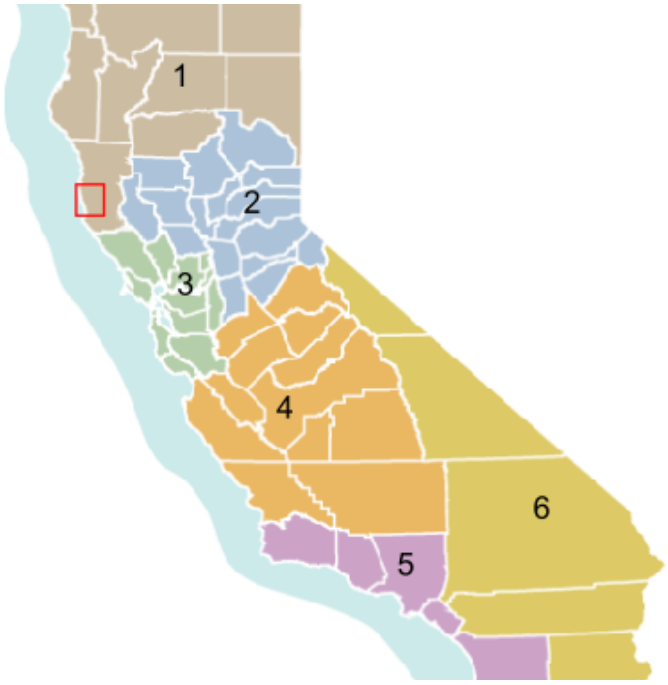
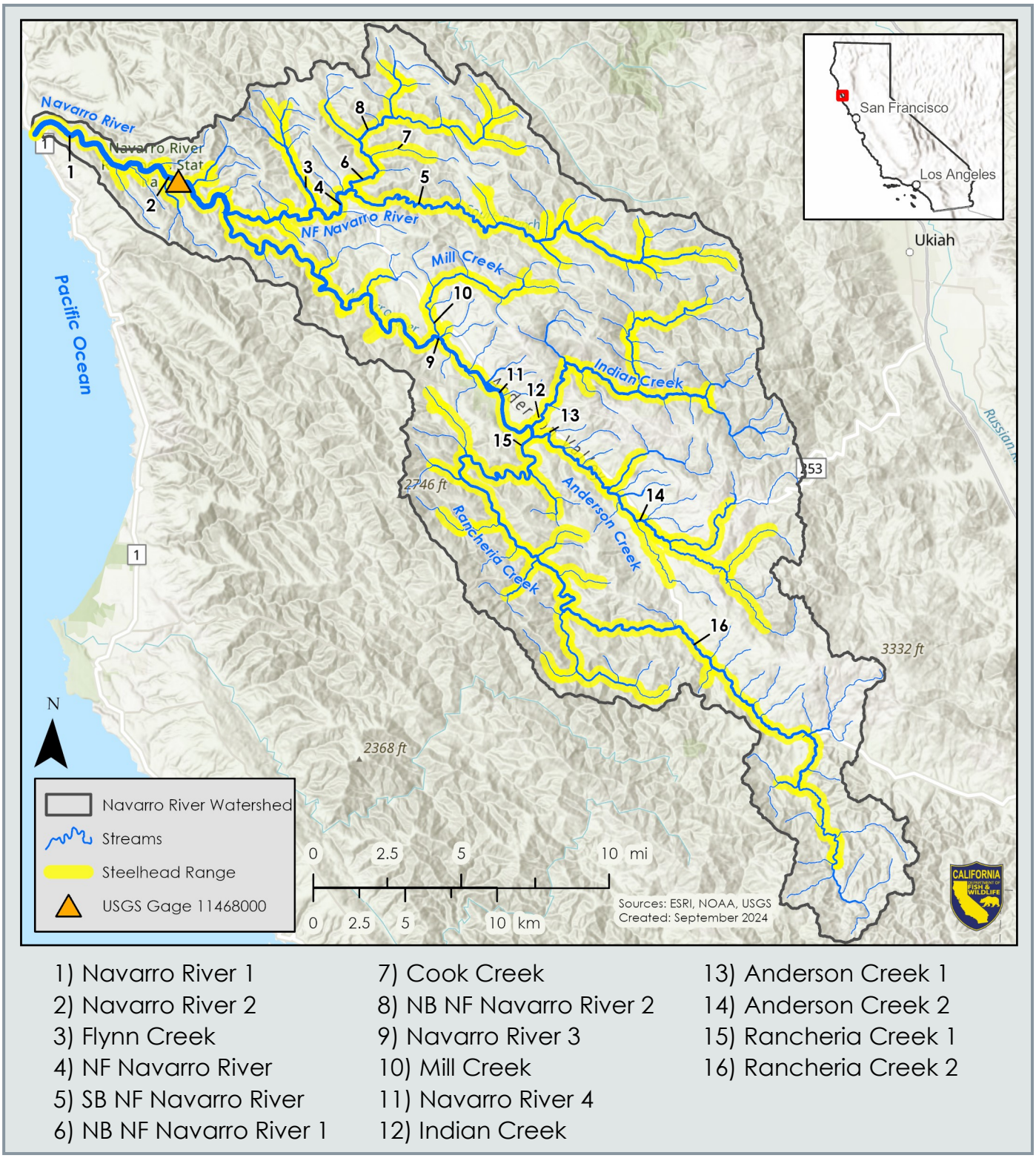


Figure 1. Map of the Department's Regions.

- Located in the Department's Region 1
- Within Mendocino county
- 315-square-mile (mi^2) drainage area
- Supports Coho Salmon, Chinook Salmon, and steelhead

Flynn Creek
NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

This report presents streamflow analyses for 16 stream reaches within the Navarro River watershed (Figure 2). Instream flow criteria were developed for two numbered reaches. The common identifiers (COMIDs) that correspond to the numbered reaches are listed in Appendix A.



1) Navarro River 1
2) Navarro River 2
3) Flynn Creek
4) NF Navarro River
5) SB NF Navarro River
6) NB NF Navarro River 1
7) Cook Creek
8) NB NF Navarro River 2
9) Navarro River 3
10) Mill Creek
11) Navarro River 4
12) Indian Creek
13) Anderson Creek 1
14) Anderson Creek 2
15) Rancheria Creek 1
16) Rancheria Creek 2

Figure 2. Navarro River watershed map. Yellow highlights indicate steelhead-bearing streams (Shannon and Christy 2012). The orange triangle is United States Geological Survey (USGS) gage 11468000.

This watershed criteria report includes five distinct analyses (Figure 3). For more details on each analysis see the Overview, which can be found through the Watershed-Wide Instream Flow Criteria webpage (CDFW 2024).

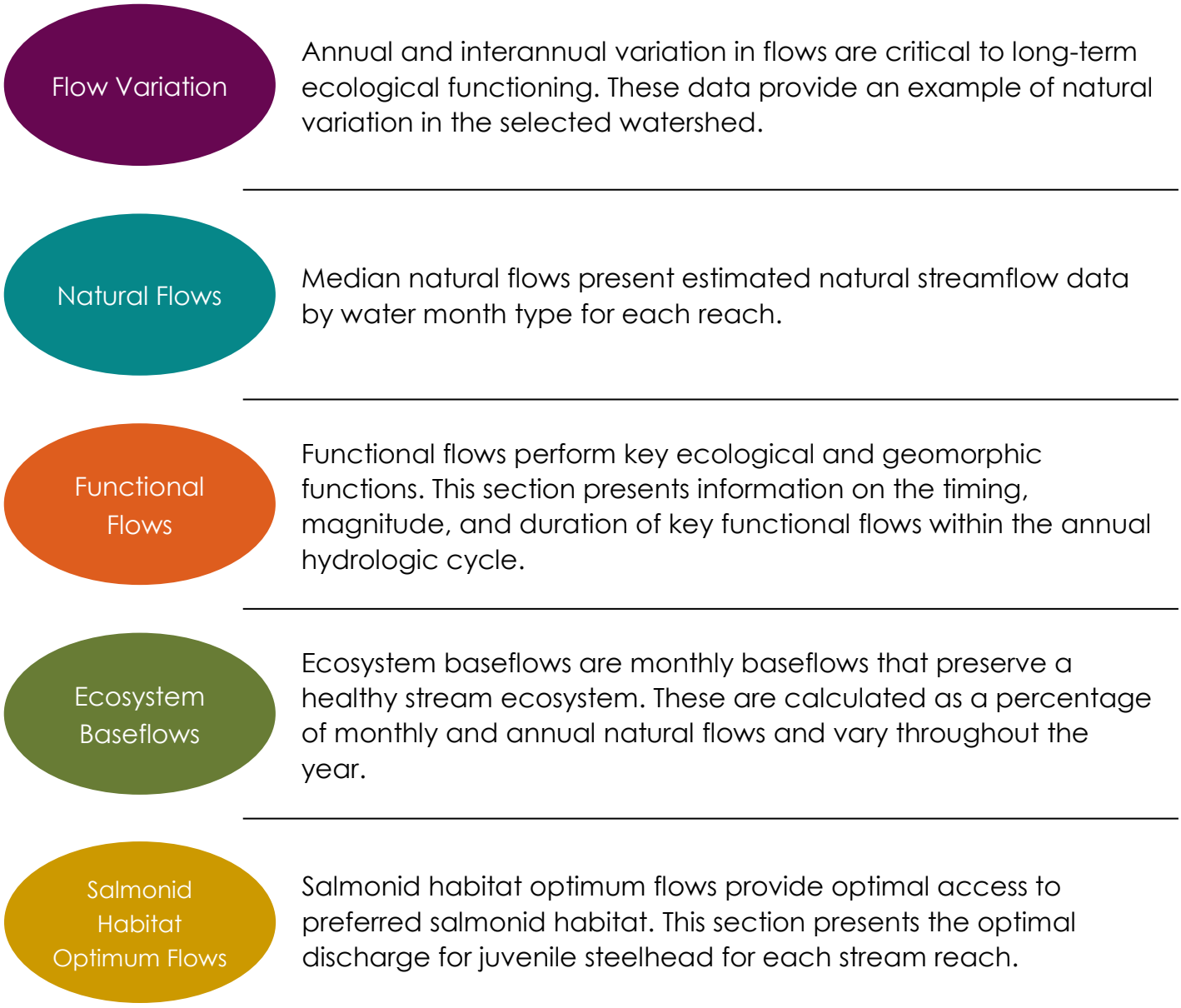


Figure 3. Watershed criteria analyses key.

Flow Variation

Flows in the Navarro River watershed are variable throughout the year and from year to year. The USGS gage used to visualize flow variation was selected because it is relatively unimpaired and is representative of hydrologic patterns in the Navarro River watershed (Figure 4).

The wet season in the Navarro 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.

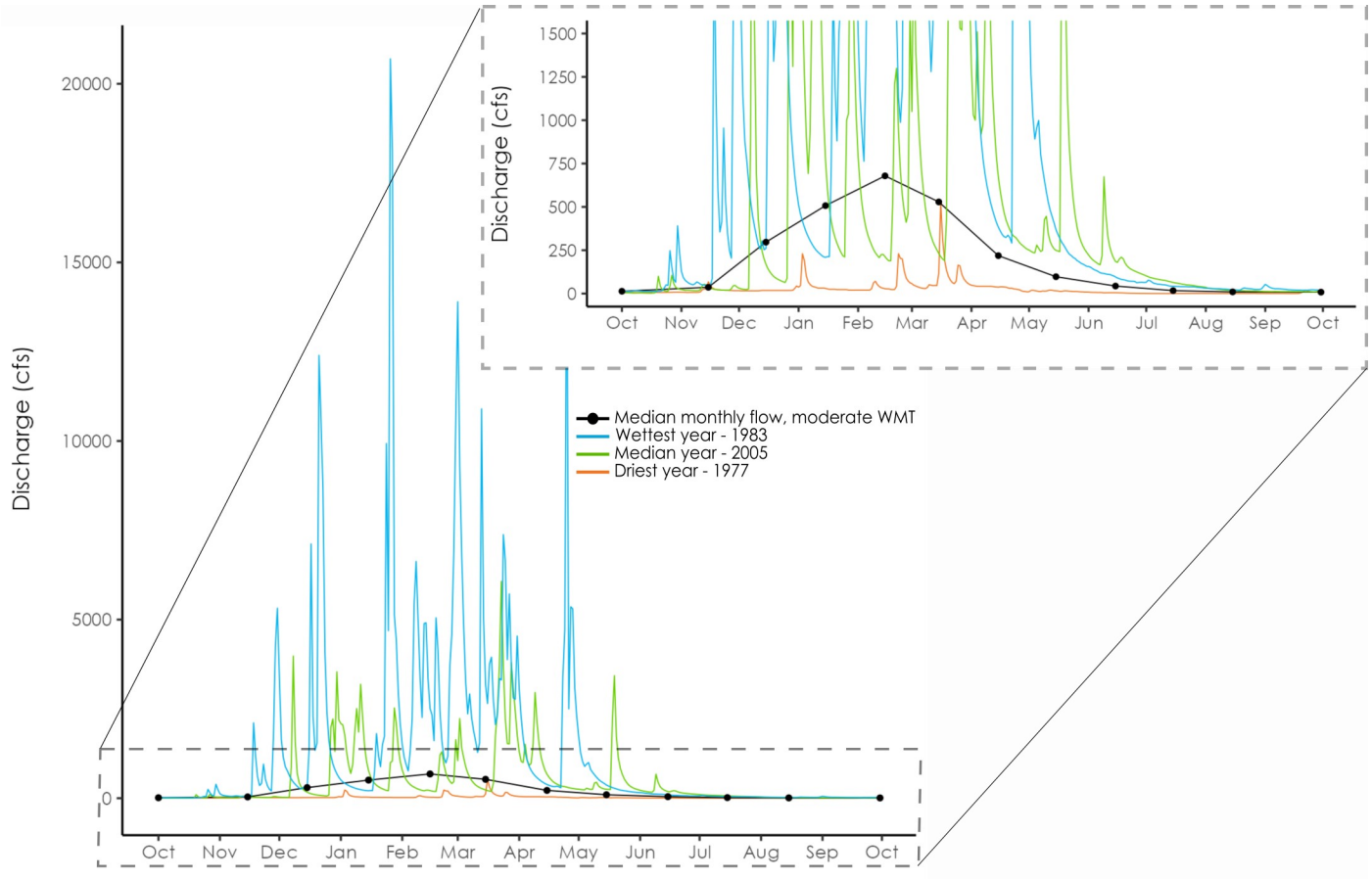


Figure 4. Variation in the Navarro River hydrograph. Mean daily Navarro River flows at the Navarro USGS gage 11468000, located in the lower Navarro River watershed, in the driest, median, and wettest water years on record between water years 1951 and 2013 (USGS 2024). Median monthly flow for a moderate water month type is also included.

Natural Flows

Natural flows are the stream flows (in cfs) that would be expected with no human influence (data from Zimmerman et al. 2023). This section presents median monthly natural flows for wet, moderate, and dry water month types for each Navarro River tributary and mainstem reach analyzed in this report (Table 1). The numbers next to each stream name correspond to the numbers found on the Navarro River watershed map (Figure 2).

Table 1. Median natural flows (cfs) by water month type (month type).

1) Navarro River 1 315.0 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1900	1611	1134	659	217	94	40	17	12	23	188	1049
Moderate	524	714	568	232	114	45	21	11	9	16	37	323
Dry	136	243	266	117	65	24	11	6	4	10	23	43

2) Navarro River 2 303.6 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1855	1531	1102	627	203	90	34	16	12	21	184	999
Moderate	507	679	529	219	97	43	17	10	8	13	36	297
Dry	126	230	229	102	52	22	9	4	4	8	21	40

3) Flynn Creek 7.5 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	35	36	26	16	6	3	1	1	1	1	5	21
Moderate	12	15	15	6	3	2	1	1	<1	1	1	8
Dry	4	7	8	4	2	1	1	<1	<1	<1	1	1

4) NF Navarro River 60.1 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	348	317	211	128	47	21	9	5	5	5	39	199
Moderate	91	140	114	50	23	11	5	3	4	3	7	60
Dry	31	54	56	30	14	7	3	2	3	2	5	9

5) South Branch NF Navarro River 29.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	168	154	112	70	26	12	6	3	2	3	19	97
Moderate	47	73	64	26	13	7	3	2	2	2	4	31
Dry	16	29	33	17	8	4	2	2	1	2	3	5

6) North Branch NF Navarro River 28.4 mi^2

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	141	144	96	57	21	9	4	2	2	2	18	90
Moderate	44	58	54	22	10	5	2	1	2	2	4	29
Dry	14	25	28	14	6	3	1	1	1	1	3	5

Table 1. Median natural flows (continued).

7) Cook Creek 3.3 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	16	15	9	6	2	1	1	<1	<1	<1	2	10
Moderate	5	6	5	2	1	1	<1	<1	<1	<1	1	3
Dry	2	3	2	1	1	1	<1	<1	<1	<1	1	1

8) North Branch NF Navarro River 2 23.3 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	121	117	79	48	18	8	3	2	2	2	15	71
Moderate	36	47	44	19	8	4	2	1	1	2	3	22
Dry	12	20	23	12	5	3	1	1	1	1	2	4

9) Navarro River 3 208.3 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1091	1010	778	440	160	69	31	12	8	15	135	591
Moderate	323	512	438	157	80	34	12	7	5	10	29	216
Dry	98	202	212	89	54	18	7	4	3	6	18	33

10) Mill Creek 12.2 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	56	59	37	24	9	5	2	1	1	1	6	31
Moderate	16	24	20	8	4	3	1	1	1	1	1	10
Dry	5	10	9	4	3	2	1	<1	<1	1	1	2

11) Navarro River 4 181.0 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	948	890	690	392	141	61	26	11	7	13	128	507
Moderate	290	491	385	138	68	29	11	6	5	9	28	197
Dry	90	208	190	80	41	16	8	4	3	6	18	33

12) Indian Creek 39.5 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	224	210	159	97	36	17	8	5	3	4	39	126
Moderate	66	110	90	35	19	9	5	4	3	3	10	47
Dry	23	47	41	23	12	6	4	3	2	2	7	10

13) Anderson Creek 1 46.0 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	259	194	185	99	37	12	5	3	2	4	27	132
Moderate	75	113	85	38	16	6	2	1	1	2	9	41
Dry	21	43	40	27	11	4	1	1	1	2	7	9

Table 1. Median natural flows (continued).

14) Anderson Creek 2 23.4 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	134	108	93	56	21	7	3	2	1	2	17	70
Moderate	42	62	45	20	9	3	1	1	<1	1	4	24
Dry	11	25	24	15	6	2	1	<1	<1	1	3	5

15) Rancheria Creek 1 92.5 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	477	468	370	205	73	34	16	7	4	7	64	247
Moderate	154	261	212	75	38	16	7	3	2	5	13	105
Dry	48	109	96	49	25	10	5	2	2	3	8	16

16) Rancheria Creek 2 41.6 mi²

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	255	214	167	105	34	11	5	2	2	3	36	129
Moderate	79	116	82	36	14	5	2	1	1	2	7	48
Dry	23	44	41	24	10	3	1	1	1	1	4	9

Flynn Creek
NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

Functional Flows

This section presents examples illustrating functional flows in the Navarro River watershed (data from Qiu et al. 2021 and CEFWG 2021). The functional flow metric data are representative of the mainstem Navarro River watershed as well as its tributaries (Figure 5 and Table 2–Table 3). Functional flow timing throughout the watershed is likely consistent, but magnitudes differ between reaches (Rodríguez-Iturbe and Valdés 1979).

Navarro River

NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

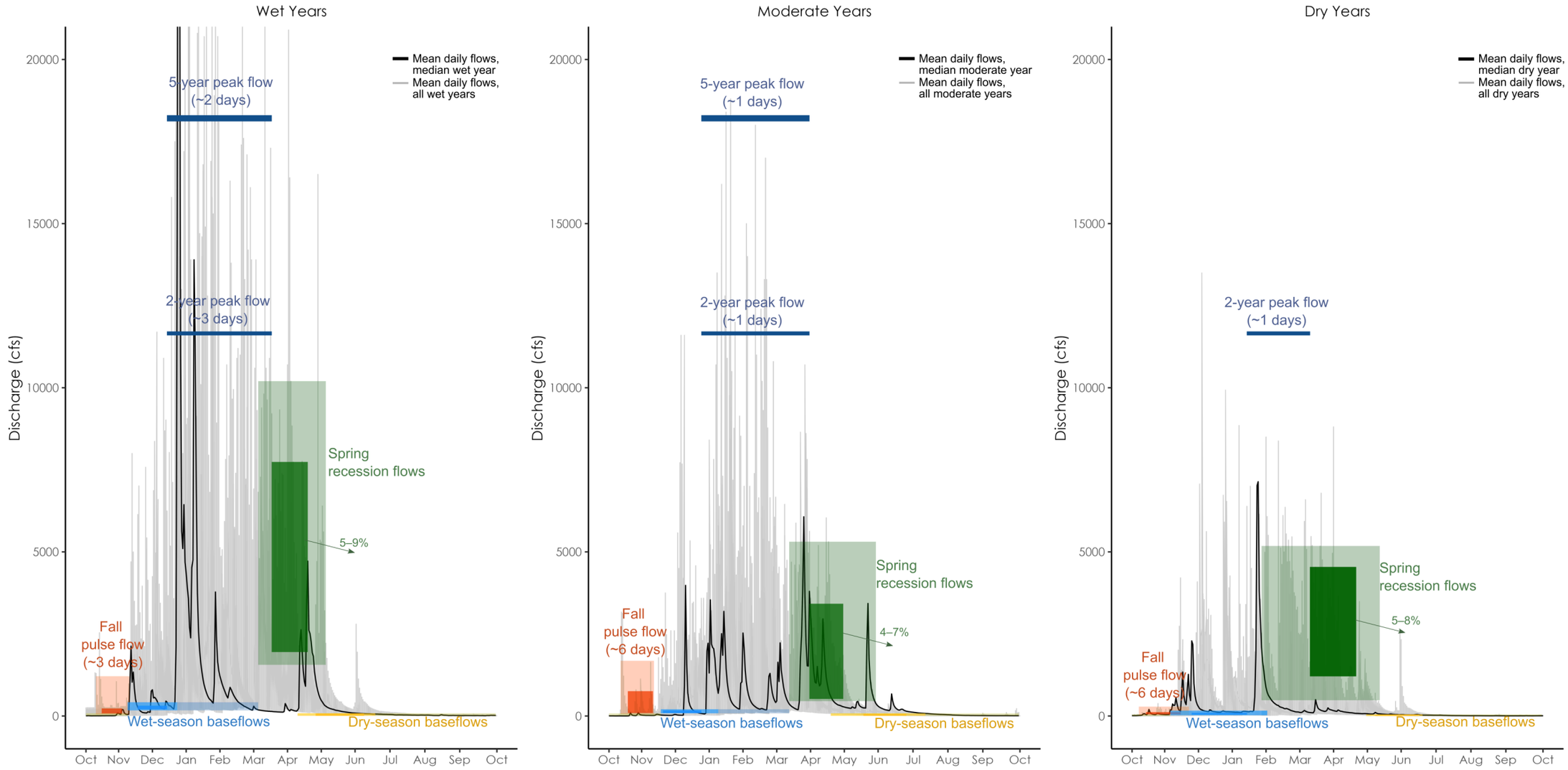


Figure 5. Timing and magnitude of the Navarro River (reach 2) functional flows by water year type (from left to right: wet, moderate, and dry years), based on water years 1951–2013 at the USGS gage 11468000, on the Navarro River near Navarro. The darkest colored boxes indicate the start timing and magnitude 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 (10th–90th percentile).

Table 2. Navarro River (reach 2) functional flow metric median values, 10th–90th percentile in parentheses. Metrics are based on the water years 1951–2013 at USGS gage 11468000 on the Navarro River and provided by water year type (i.e., wet, moderate, and dry).

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	96 (50–1,212)	306 (57–1,682)	79 (36–287)
Fall pulse flow duration (total days per year, when present)	3 (2–7)	6 (2–9)	6 (2–9)
Fall pulse flow start timing	Oct 24 (Oct 09–Nov 08)	Oct 27 (Oct 11–Nov 09)	Oct 30 (Oct 07–Nov 20)
Wet-season baseflow magnitude (cfs)	252 (173–418)	128 (83–206)	63 (23–164)
Median wet-season flow magnitude (cfs)	1,060 (600–1,780)	461 (327–802)	244 (98–617)
Wet-season duration (days)	124 (88–158)	131 (84–171)	94 (50–152)
Wet-season start timing	Dec 01 (Nov 07–Dec 21)	Nov 28 (Nov 16–Jan 06)	Dec 16 (Nov 04–Jan 29)
2-year peak flow magnitude (cfs)	11,600	11,600	11,600
2-year peak flow duration (total days per year, when present)	3 (1–5)	1 (1–2)	1
2-year peak flow frequency (events per year, when present)	2 (1–4)	1 (1–2)	1
5-year peak flow magnitude (cfs)	18,120	18,120	-
5-year peak flow duration (total days per year, when present)	2 (1–2)	1	-
5-year peak flow frequency (events per year, when present)	1 (1–2)	1	-
Spring recession flow magnitude (cfs)	5,020 (1,560–10,200)	1,250 (454–5,310)	2,670 (482–5,180)
Spring recession flow duration (days)	32 (24–92)	38 (19–85)	42 (31–143)
Spring recession flow start timing	Apr 04 (Mar 03–May 02)	Apr 15 (Mar 10–May 26)	Mar 29 (Jan 24–May 09)
Spring recession flow rate of change (%)	7 (5–9)	6 (4–7)	6 (5–8)
Dry-season baseflow magnitude (cfs)	20 (14–28)	18 (12–27)	9 (5–17)
Dry-season duration (days)	207 (145–255)	193 (148–252)	203 (171–236)
Dry-season start timing	May 13 (Apr 07–Jun 15)	May 26 (Apr 16–Jul 09)	May 26 (Apr 27–Jun 16)

Table 3. NF Navarro River (reach 4) functional flow metric median values, 10th–90th percentile in parentheses. Results are based on modeled functional flow metrics for the NF Navarro River and are provided by water year type (i.e., wet, moderate, and dry).

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	30 (11–112)	30 (11–105)	22 (8–61)
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 24 (Oct 10–Nov 06)	Oct 27 (Oct 08–Nov 13)	Oct 28 (Oct 09–Nov 13)
Wet-season baseflow magnitude (cfs)	48 (22–81)	24 (13–50)	14 (7–29)
Median wet-season flow magnitude (cfs)	197 (108–322)	99 (52–171)	51 (28–95)
Wet-season duration (days)	128 (92–159)	122 (82–154)	94 (63–144)
Wet-season start timing	Dec 02 (Nov 21–Dec 11)	Nov 22 (Nov 08–Dec 19)	Dec 26 (Nov 25–Jan 19)
2-year peak flow magnitude (cfs)	2,260 (1,840–3,380)	2,260 (1,840–3,380)	2,260 (1,840–3,380)
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)	4,360 (2,410–6,420)	4,360 (2,410–6,420)	4,360 (2,410–6,420)
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)	619 (214–1,860)	451 (122–1,180)	319 (92–894)
Spring recession flow duration (days)	35 (24–54)	46 (26–61)	41 (29–77)
Spring recession flow start timing	Apr 14 (Mar 27–Apr 27)	Mar 31 (Mar 11–Apr 25)	Mar 31 (Mar 13–Apr 29)
Spring recession flow rate of change (%)	6 (3–10)*	6 (3–10)*	6 (3–10)*
Dry-season baseflow magnitude (cfs)	5 (3–10)	4 (2–8)	3 (1–6)
Dry-season duration (days)	188 (159–229)	191 (150–229)	189 (145–235)
Dry-season start timing	May 14 (May 07–Jun 13)	Jun 02 (Apr 23–Jun 19)	Jun 06 (May 05–Jun 29)

* 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. 2023), meets or exceeds ecosystem baseflows (Tessmann 1980) for approximately 10 months of the water year for most reaches in the Navarro River watershed.

For the Navarro River (reach 2) in moderate water month types, median natural flows may exceed ecosystem baseflows for approximately three months of the water year (Figure 6). This pattern is similar for most reaches in the Navarro River watershed.

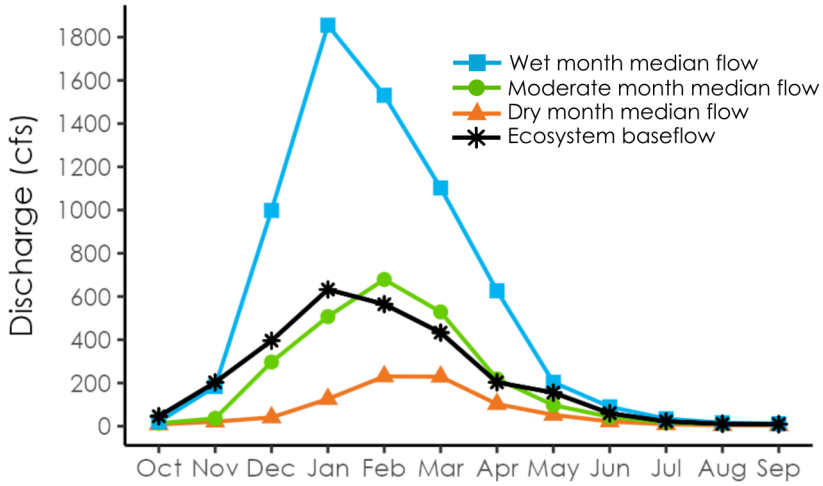


Figure 6. Ecosystem baseflows and median natural flows for wet, moderate, and dry water month types for the Navarro River (reach 2).

Navarro River

NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

Ecosystem baseflows are monthly flows unique to each Navarro River tributary and mainstem reach analyzed in this report (Table 4). The numbers next to each stream name correspond to the numbers found on the Navarro River watershed map (Figure 2).

Table 4. Ecosystem baseflows (cfs).

Stream	Drainage Area (mi^2)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1) Navarro River	315.0	664	591	455	214	168	63	26	12	10	48	214	419
2) Navarro River 2	303.6	632	564	433	203	155	60	22	11	9	46	203	396
3) Flynn Creek	7.5	15	12	10	5	5	2	1	1	<1	2	5	10
4) NF Navarro River	60.1	129	112	86	42	37	14	6	4	2	9	42	82
5) SB NF Navarro River	29.4	71	58	45	23	20	8	4	2	1	5	22	42
6) NB NF Navarro River 1	28.4	58	49	40	19	17	7	3	2	1	5	19	37
7) Cook Creek	3.3	6	5	4	2	2	1	<1	<1	<1	1	2	4
8) NB NF Navarro River 2	23.3	52	41	33	16	14	5	2	2	1	4	16	30
9) Navarro River 3	208.3	430	407	313	145	118	46	18	8	7	35	145	286
10) Mill Creek	12.2	22	20	16	7	6	3	1	1	<1	2	7	14
11) Navarro River 4	181.0	382	372	278	129	106	41	16	7	6	31	129	253
12) Indian Creek	39.5	88	81	63	31	27	14	6	3	4	10	31	62
13) Anderson Creek 1	46.0	89	87	65	34	27	9	3	2	2	8	30	57
14) Anderson Creek 2	23.4	49	48	35	19	15	5	2	1	1	4	17	31
15) Rancheria Creek 1	92.5	204	198	146	69	57	23	10	4	4	17	69	132
16) Rancheria Creek 2	41.6	92	91	63	34	27	8	3	2	1	9	31	60

Salmonid Habitat Optimum Flows

Salmonid habitat optimum flows (optimum flows) maximize usable habitat for juvenile steelhead (Hatfield and Bruce 2000). Each stream analyzed has one optimum flow value, and while these values may vary between streams, the overall patterns in the watershed are the same. Natural flows often meet or exceed optimum flows during the winter months in moderate and wet conditions, while natural flows typically remain below optimum flows during the summer and fall months across all water month types (Figure 7).

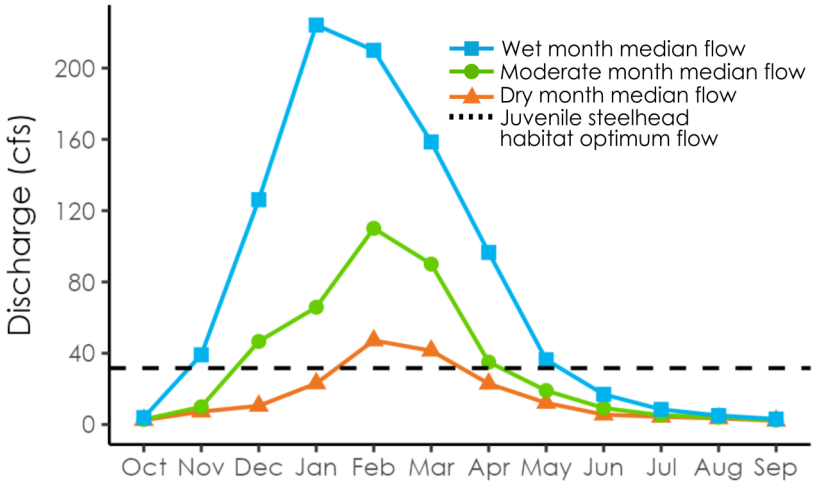


Figure 7. Juvenile steelhead optimum flows and median natural flows for wet, moderate, and dry water month types for Indian Creek (reach 12).

In drainages with altered flow, the time period when flows are below the juvenile steelhead optimum may be shorter or longer than shown here (Figure 7, Table 5).

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

Table 5. Juvenile steelhead optimum flows (by drainage area).

Small Streams

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
7) Cook Creek	3.3	6
3) Flynn Creek	7.5	11
10) Mill Creek	12.2	14
8) NB NF Navarro River 2	23.3	22
14) Anderson Creek 2	23.4	22
6) NB NF Navarro River 1	28.4	24
5) SB NF Navarro River	29.4	26

Mid-sized Streams

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
12) Indian Creek	39.5	32
16) Rancheria Creek 2	41.6	32
13) Anderson Creek 1	46.0	32
4) NF Navarro River	60.1	38
15) Rancheria Creek 1	92.5	51

Navarro River

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
11) Navarro River 4	181.0	74
9) Navarro River 3	208.3	80
2) Navarro River 2	303.6	98
1) Navarro River 1	315.0	101

Flow Criteria

Flow criteria provide a set of flow values that may be used to develop a flow regime prescription protective of fish, wildlife, and the habitats that support them 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 Navarro River 2 near Navarro USGS gage (11468000) and the NF Navarro River (Table 6–Table 7). While the flow criteria presented in this section were developed for specific locations within the Navarro 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 Navarro River and its tributaries based upon any new scientific information that may become available.

Flow criteria were developed for two locations within the Navarro River watershed for three water year types (i.e., wet, moderate, and dry) using functional flow results from Table 2–Table 3. These locations were selected based on priorities identified by the Department's Region 1. 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. 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 may vary by water year type.

Table 6. Flow criteria (in cfs) for the Navarro River (reach 2). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry). The length of the recession does not vary by water year type. The rate of change for wet years is 7% per day, while the rate of change in moderate and dry years is 6% per day

Water Year Type	**Wet Season** Nov-Apr	**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** Jun-Oct
Wet	252†	862	518	312	188	113	68	41	25	20‡
Moderate	128†	386	250	162	105	68	44	29	20	18‡
Dry	63†	204	132	86	56	36	23	15	10	9‡

† Approximately every two years, protect 1–2 peak flow events of 11,600 cfs as they occur. Approximately every five years, protect at least one peak flow event of 18,120 cfs as it occurs.

‡ In October–November, allow a fall pulse event of at least 92 cfs.

Table 7. Flow criteria (in cfs) for the NF Navarro River (reach 4). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry). The length of the recession varies by water year type. The recession lasts for eight weeks in wet years, seven weeks in moderate years, and six weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Water Year Type	**Wet Season** Nov-Apr	**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** Jun-Oct
Wet	48†	163	102	64	40	25	16	10	6	5‡
Moderate	24†	82	51	32	20	13	8	5	-	4‡
Dry	14†	42	26	17	10	7	4	-	-	3‡

† Approximately every two years, protect at least two peak flow events of 2,260 cfs as they occur. Approximately every five years, protect at least one peak flow event of 4,360 cfs as it occurs.

‡ In October–November, allow a fall pulse event of at least 26 cfs.

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 3. 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 6–Table 7. Additionally, 2- and 5-year peak flow events, respectively, should be allowed to pass through the watershed. Refer to Table 2–Table 3 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 or November. Specific magnitudes and durations by water year type for the fall pulse flows can be found in Table 2–Table 3. 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 6–Table 7 may be used to develop a flow regime. An example flow regime is presented to illustrate how criteria could be applied in a management context (Figure 8).

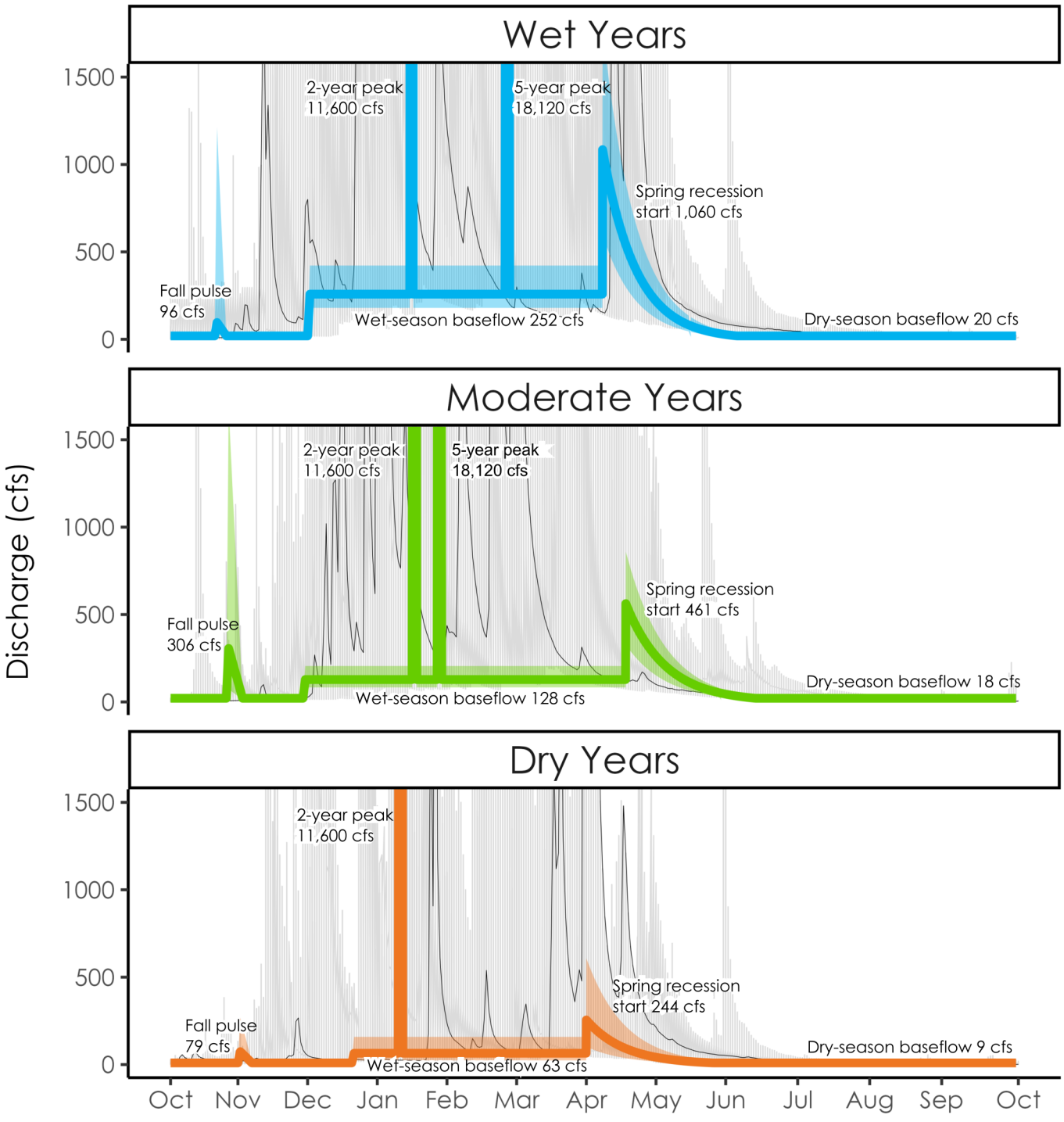


Figure 8. Example flow regimes for the Navarro River (reach 2) for wet, moderate, and dry water year types. Each line represents an example hydrograph using the flow criteria in Table 6. All years within a water year type are provided in gray, and the median year of each water year type is shown by the black line. The timing of peak flows has been inferred using observed data.

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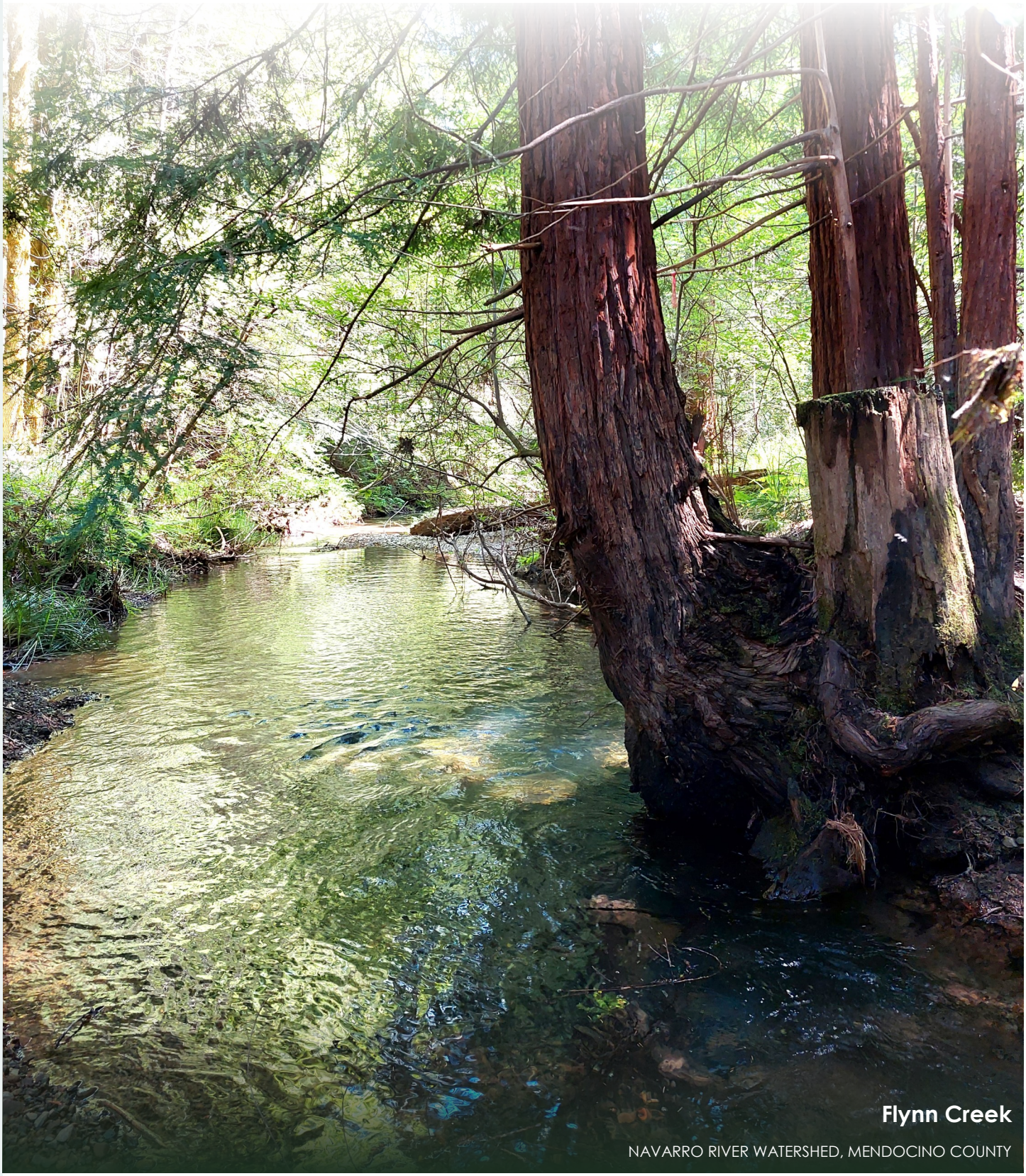

Flynn Creek

NAVARRO RIVER WATERSHED, MENDOCINO COUNTY

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All photos in this document were taken by Department staff. Cover photo is of the Navarro River (Navarro River watershed in Mendocino County).

Appendix A

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.[1] The COMIDs were used to identify and download natural flow estimates for each selected reach.

Table A-1. Reach delineation.

Stream	COMID
1) Navarro River 1	2665669
2) Navarro River 2	2665613
3) Flynn Creek	2664557
4) North Fork Navarro River	2664561
5) South Branch North Fork Navarro River	2665615
6) North Branch North Fork Navarro River 1	2664529
7) Cook Creek	2665609
8) North Branch North Fork Navarro River 2	2664487
9) Navarro River 3	2664799
10) Mill Creek	2664783
11) Navarro River 4	2664915
12) Indian Creek	2664961
13) Anderson Creek 1	2664985
14) Anderson Creek 2	2665143
15) Rancheria Creek 1	2665037
16) Rancheria Creek 2	2666075

[1] USEPA and USGS (2012). National Hydrography Dataset Plus (NHDPlus) medium resolution version 2. U.S. Environmental Protection Agency (USEPA) and the U.S. Geological Survey (USGS). Accessed: July 2020.