CHAPTER 4.3 Fisheries Resources

4.3.1 Introduction

This chapter describes the existing fisheries resources within the area of the Proposed Project. Section 4.3.2, “Environmental Setting” describes the regional and project area environmental setting as it relates to fisheries resources. Section 4.3.3, “Regulatory Framework” details the federal, state, and local laws related to fisheries resources. Potential impacts to fisheries resources resulting from the Proposed Project are analyzed in Section 4.3.4, “Impact Analysis” in accordance with the California Environmental Quality Act (CEQA) significance criteria (CEQA Guidelines, Appendix G) and mitigation measures are proposed that could reduce, eliminate, or avoid such impacts, if feasible.

Other impacts related to fisheries resources addressed in other chapters as follows: impacts to hydrology are addressed in Chapter 4.1, “Hydrology,” impacts to water quality are addressed in Chapter 4.2, “Water Quality,” and impacts to recreation are addressed in Chapter 4.5, “Recreation.”

4.3.2 Environmental Setting

Russian River Watershed

The Russian River measures slightly over 100 miles in length and the watershed drains roughly 1,485 square miles in Sonoma and Mendocino Counties. The watershed consists of a series of valleys surrounded by two mountainous ranges, the Mendocino Highlands to the West and the Mayacamas Mountains to the east. The Santa Rosa Plain, Alexander Valley, Hopland Valley, Ukiah Valley, Redwood Valley, Potter Valley and other small valleys comprise about 15 percent of the watershed. The remainder of the watershed area is hilly to mountainous. Principal tributaries of the Russian River include the East Fork Russian River, Big Sulphur Creek, Maacama Creek, Dry Creek, Mark West Creek, and Austin Creek.

Rainfall in the Russian River is typical of a Mediterranean climate where rain is concentrated during the winter months (November through March). Significantly, for fish, the watershed experiences long periods when little to no rain falls (typically mid-May through mid-October). Rainfall is heaviest in the mountains near the coast, which receive an average of 50 to 80 inches per year. Mountainous areas away from the coast receive an average of 40 to 60 inches a year, while the lower valley areas receive 25 to 45 inches per year.

Russian River

Historically, the Russian River was an alluvial river that meandered across a wide floodplain (Florsheim and Goodwin 1993). Over the course of its meandering, the river left an ever-changing series of side channels, sloughs, and oxbow lakes. Land use practices including dam construction, agriculture, gravel mining, levee construction, and timber harvest altered the Russian River from a dynamic meandering river to the existing straightened, incised channel. A

consequence of the physical changes to the river was the reduction of pool habitat and the increase in shallow run habitat.

Streamflow in the Russian River has been enhanced with construction of, and import of water from, the Potter Valley Project (PVP). The PVP began the era of persistent summertime flows in the Russian River. Prior to this point, summertime flows in the main channel were described as “a small trickle,” with sloughs and deep pools providing habitat for fish and other aquatic organisms (Florsheim and Goodwin 1995). Streamflows in the Russian River and Dry Creek were further enhanced with the completion of Lake Mendocino in 1958 and Lake Sonoma in 1983. The overall affect is that streamflows in the Russian River have been augmented and largely stabilized compared to pre-1900 (“pre-water development”) flows.

During the low flow season, water temperatures in the Russian River and Dry Creek are influenced by atmospheric conditions and releases from Coyote Valley Dam and Warm Springs Dam. Figure 4.3-1 presents the average daily temperature for each month at six modeled junctions on the mainstem Russian River (the water quality model used to develop Figure 4.3-1 is discussed in Section 4.3.4, Methodology). Overlaying the graph is a color gradient representing temperature preference for rearing steelhead (dark blue equates to optimal conditions passing through suitable (light blue) tolerable (green) stressful (yellow) to potentially lethal (red). Releases from Coyote Valley Dam heavily influenced water temperatures in the Upper Russian River, while atmospheric conditions control temperatures near Healdsburg. Dry Creek enters the mainstem Russian River at river mile 30 and cools the mainstem by up to 5.5° F. The river then warms again as it flows downstream towards the Russian River Estuary.

Peak water temperatures in the Russian River occur in July, and are a response to atmospheric conditions. Upstream of Cloverdale, summer temperatures are modified by releases from Coyote Valley Dam. However, as the coldwater pool in Lake Mendocino is exhausted, temperatures ramp up quickly in August and September, with peak water temperatures in the Russian River occurring in September in response to reservoir turnover and isothermal conditions in Lake Mendocino. This is described further in Chapter 4.2, “Water Quality.”

Based on fish sampling conducted by the Water Agency and results from the water quality model, the Russian River provides suitable temperatures for migrating salmonids during the late fall through spring timeframe. However, rearing salmonids, primarily steelhead, are limited by high temperatures in the river above approximately Cloverdale during the summer.

Dry Creek

Dry Creek is a major tributary to the Russian River. Dry Creek originates in the coastal hills above Hopland, California, and flows 32 miles to its confluence with the Russian River. The lower 13.9 miles of Dry Creek (downstream of Warm Springs Dam) flows through the relatively low gradient Dry Creek Valley. The natural configuration of the stream channel in Lower Dry Creek has been altered over the past 150 years in response to land clearing, agricultural development, historic gravel mining practices, and the construction of Warm Springs Dam (see Inter-Fluve 2013 for a detailed description of lower Dry Creek). Historically, summer flows in Dry Creek were intermittent with long stretches of creek bed with no flow.

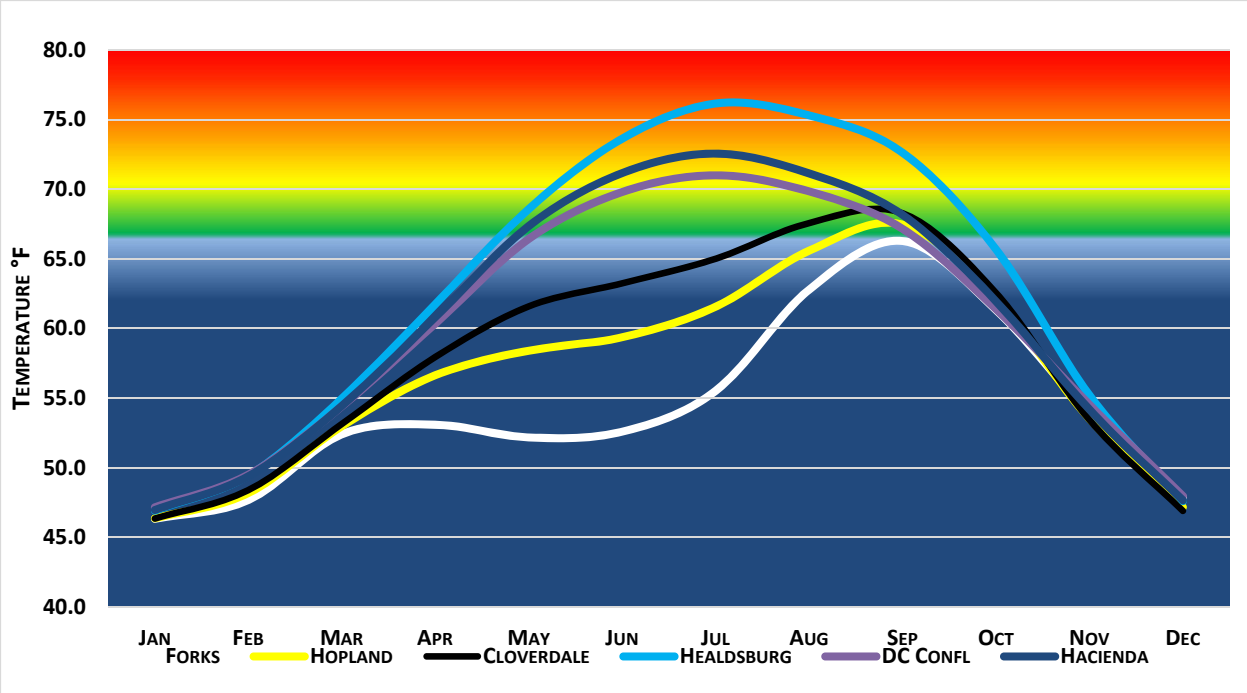


Figure 4.3-1. Average summertime water temperatures at selected locations along the Russian River under Baseline Conditions. Dark Blue <64.0° F; optimal temperatures for rearing steelhead. Light blue 64 – 68° F; suitable temperatures. Green 68 – 71.5° F; tolerable but stressful temperatures. Yellow/orange (71.6 – 74.9° F); very stressful temperatures, and red equals potentially lethal temperatures (>75° F).

The construction of Warm Springs Dam and Lake Sonoma and subsequent releases for water supply results in elevated streamflows in Dry Creek during the summer period.

Dams (Permanent and Temporary)

There are two permanent dams and four permitted temporary dams in the Russian River watershed. In addition, there are an unknown number of temporary dams constructed on smaller tributaries. The two principal permanent dams are Coyote Valley Dam (Lake Mendocino) on the East Fork Russian River, and Warm Springs Dam (Lake Sonoma) on Dry Creek. These reservoirs are operated by the USACE for flood control and by the Water Agency for water supply. The four temporary summer dams include the Healdsburg Memorial Dam, the Water Agency's Mirabel Inflatable Dam near Forestville, and the Johnson's and Vacation Beach dams near Guerneville. The dams at Memorial, Johnson's, and Vacation beaches provide recreational opportunities, while the Water Agency's Mirabel Inflatable Dam is a water supply facility. The time of year that the temporary dams (excluding the Mirabel Inflatable Dam) may be erected is limited to June 15 through September 30 to minimize impacts to migrating salmonids. Each of the temporary dams is equipped with a fish ladder to allow for the passage of salmon and steelhead (late or early arriving fish that enter the river outside of the normal run timing) as well as native warm water species. The Mirabel Inflatable Dam can be operated at any time of the year. Fish passage at this facility has been monitored since 2000 to insure that it does not inhibit the upstream or downstream migration of salmonids. Currently, the fish ladder on the west side of the river is being replaced with a modern design fish ladder to improve the

passage of all species past the Mirabel Inflatable Dam. The project is expected to be completed in 2016.

Don Clausen Fish Hatchery and the Coyote Valley Egg Collection Facility

The Don Clausen Fish Hatchery (Hatchery) is located below Warm Springs Dam, with its satellite facility located at the base of Coyote Valley Dam, the Coyote Valley Egg Collection Facility. The Hatchery facilities were built to mitigate for the loss of salmonid spawning habitat above Warm Springs and Coyote Valley dams. Steelhead produced at the Hatchery continue to support a popular recreational fishery in the Russian River.

Adult steelhead typically return to the Hatchery facilities from January through March. The eggs from both facilities and the resulting young are reared for approximately one year at the Don Clausen Fish Hatchery. Because of the high growth rates associated with a hatchery setting, the juvenile steelhead are generally ready to smolt after one year, compared to wild fish that typically require two years to advance to the smolt stage. The progeny of fish spawned at the Don Clausen Fish Hatchery are released into Dry Creek during the following spring (March and April). The progeny of fish from the Coyote Valley Egg Collection Facility are released into Russian River below Coyote Valley Dam.

In 2001, the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) was initiated to enhance wild coho populations in the watershed, and to reintroduce coho back to streams where local populations had been extirpated. Wild juvenile coho salmon were collected and reared to maturity at the Hatchery and used as broodstock. The resultant offspring are reared for a short time before being released into streams that historically supported coho salmon. The goal of this program is to reinvigorate and/or reestablish sustainable wild coho salmon populations in several tributaries of the Russian River watershed.

Aquatic Resources

Species Composition

A conservative total of 47 different species of fish have been reportedly captured in the Russian River watershed. However, based on sampling conducted by the Water Agency, the total currently inhabiting the river is closer to 35, with 16 of those native to the mainstem Russian River upstream of the estuary (Table 4.3-1). In addition, pink salmon were reported spawning in the Russian River during the early 1950s, but have rarely been observed since this time and are believed to be extirpated from the watershed.

The Russian River fish assemblage has several species in common with the Sacramento River, suggesting a connection between the two basins in the recent (geologic) past (Snyder 1907; Hopkirk 1973; Moyle 2002). Seven of the shared species are intolerant of salt water, and could have only been transferred between basins via a freshwater connection. Species that likely transferred from the Sacramento River to the Russian River are; Sacramento sucker,

Table 4.3-1. Common and scientific names of fish species reported in the Russian River watershed since 2000, including their origin, life history strategy, and regulatory status.

Common Name	Scientific Name	Origin	Resident - Anadromous
Steelhead	*Oncorhynchus mykiss*	Native	Anadromous
Chinook salmon	*Oncorhynchus tshawytscha*	Native	Anadromous
Coho salmon	*Oncorhynchus kisutch*	Native	Anadromous
Pink salmon [1]	*Oncorhynchus gorbuscha*	Native	Anadromous
Tule perch	*Hysterocarpus traski*	Native	Resident
Pacific lamprey	*Entosphenus tridentatus*	Native	Anadromous
Pacific brook lamprey	*Lampetra c.f. richardsoni*	Native	Resident
Prickly sculpin	*Cottus asper*	Native	Resident
Riffle sculpin	*Cottus c.f. gulosus*	Native	Resident
Coastrange sculpin	*Cottus aleuticus*	Native	Resident
Sacramento sucker	*Catostomus occidentalis*	Native	Resident
Threespine stickleback	*Gasterosteus aculeatus*	Native	Resident
California roach	*Lavinia symmetricus*	Native	Resident
Hardhead	*Mylopharodon conocephalus*	Native	Resident
Sacramento blackfish	*Orthodon microlepidotus*	Native	Resident
Hitch	*Lavinia exilicauda*	Native	Resident
Sacramento pikeminnow	*Ptychocheilus grandis*	Native	Resident
Fathead minnow	*Pimephales promelas*	Introduced	Resident
Golden shiner	*Notemigonus crysoleucas*	Introduced	Resident
Common carp	*Cyprinus carpio*	Introduced	Resident
Goldfish	*Carassius auratus*	Introduced	Resident
Bluegill	*Lepomis macrochirus*	Introduced	Resident
Green sunfish	*Lepomis cyanellus*	Introduced	Resident
Redear sunfish	*Lepomis microlophus*	Introduced	Resident
Black crappie	*Pomoxis nigromaculatus*	Introduced	Resident
White crappie	*Pomoxis annularis*	Introduced	Resident
Smallmouth bass	*Micropterus dolomieu*	Introduced	Resident
Largemouth bass	*Micropterus salmoides*	Introduced	Resident
Channel catfish	*Ictalurus punctatus*	Introduced	Resident
White catfish	*Ameiurus catus*	Introduced	Resident
Black bullhead	*Ameiurus melas*	Introduced	Resident
Mosquitofish	*Gambusia affinis*	Introduced	Resident
Striped bass	*Morone saxitalis*	Introduced	Anadromous
American shad	*Alosa sapidissima*	Introduced	Anadromous
Threadfin shad	*Dorosoma petenense*	Introduced	Resident
Inland silverside	*Menidia beryllina*	Introduced	Resident

[1] Believed to be extirpated from the Russian River Watershed

Sacramento pikeminnow, hardhead, California roach, tule perch, hitch[1], and Sacramento blackfish[1]. The other species native to the Russian River are either anadromous or saltwater tolerant, and could have invaded the Russian River through entry from the ocean as well as through a freshwater route.

There are two generally accepted pathways whereby obligate freshwater fish species inhabiting the Sacramento River Basin could have gained access to the Russian River (Hopkirk 1973; Moyle and Nichols 1973; Moyle 2002). Both rely on the capture of a tributary from Sacramento River watershed into the Russian River watershed. During the Pleistocene epoch, a well-documented lava flow blocked the outlet of Clear Lake (Cache Creek). Over time, the lake back filled until it spilled over into the Russian River. The blockage eventually gave way and Clear Lake returned to draining through Cache Creek and into the Sacramento River. The second pathway was through stream capture between the Petaluma River and Copeland Creek, which are separated by a very low divides. During these stream capture events, fish inhabiting the Sacramento Basin could have disbursed into the Russian River.

Species of Uncertain Status

The Russian River fish community has expanded over time through natural and anthropogenic additions. In addition, some members have been poorly studied, and their taxonomic designation is in question. As a result, a few species do not easily fit into pre-defined categories:

California roach in the Russian River are considered a sub-species by Moyle, et al. (2015), which they call the “Russian River roach.” For the sake of ease, the commonly used “California roach” is used when referring to this species in this report.

Recent genetics work conducted by Baumsteiger (2013) has determined that the “riffle sculpin” in the Russian River is a separate, as, yet undescribed, species. While the taxonomy of this species is updated, the name “riffle sculpin” will be used when referring to this species. The status of lampreys in the Russian River (family Petromyzontidae) is particularly complex. The “western brook lamprey” found in the Russian River (as well as other watersheds) is going through taxonomic revision as a separate species (Reid pers. Comm. 2015).

According to Reid (pers. comm. 2015), this species should be referred to as “Pacific brook lamprey” (*Lampetra c.f. pacifica*) until its taxonomy is completed. To further confuse this issue, true western brook lamprey, *L. richardsoni*, that have been found in the East Fork Russian River are genetically identical to those in the Eel River (S. Reid, pers. comm. 2015). These lamprey are believed to have entered the Russian River through the PVP which connects the Eel River and Russian River watersheds. However, the current range of this species is outside of the project area. In addition, river lamprey were once thought to inhabit the Russian River; however, Reid (pers. comm. 2015) has identified all such specimens collected to date as species other than river lamprey. Based on Reid’s work, two species of lamprey are currently

[1] There is debate as to whether hitch and Sacramento blackfish are native to the Russian River. However, there are not sufficient data to warrant excluding them from the native fish community.

recognized as inhabiting the project area (Russian River Watershed downstream of Coyote Valley Dam) Pacific lamprey (*Entosphenus tridentatus*) and Pacific brook lamprey. The distribution of western brook lamprey in the Russian River watershed is uncertain.

Pink salmon, *Oncorhynchus gorbuscha*, are thought to be extirpated from the Russian River. However, in 2002, seven adult pink salmon were observed at the Water Agency's Mirabel Dam Video Monitoring Station. These individuals were believed to be strays from other, more northern coastal rivers.

Species Distribution

Fish communities in the Russian River watershed form analogous assemblages to those described by (Moyle 2002; Hopkirk 1973; Moyle and Nichols 1973). Fish populations change in response to habitat conditions. Two important factors affecting the distribution of fish are water temperature and stream gradient. The Russian River fish community forms at least four separate fish assemblages based on position in the watershed; a "Headwater assemblage", a "Valley Floor assemblage," a "Mainstem assemblage," and an "Estuary assemblage." The borders between fish assemblages are not distinct zones, but form a gradually shifting continuum from one fish assemblage to another in response to changes in habitat. The upstream most assemblage begins in the headwaters of most streams and is typified by having relatively high gradient and cool well-oxygenated water. The assemblages in headwater streams are characterized by having low species diversity and are typically dominated by juvenile steelhead, often with riffle and or prickly sculpin as a co-dominate species. Downstream of the Headwater Zone stream gradients decrease and water temperatures increase. As tributaries progress across the valley floor, juvenile steelhead abundance decreases and California roach increase and eventually dominate the fish community (in terms of numbers). Other species found in the "Valley Floor" assemblage include prickly and riffle sculpin, Sacramento sucker (*Catostomus occidentalis*), threespine stickleback (*Gasterosteus aculeatus*) and juvenile lamprey (called ammocoetes). At least in Santa Rosa and Mark West creeks, the upstream portions of the valley floor habitat supports relatively large numbers of juvenile steelhead, which are gradually replaced by warmer water species such as tule perch at the lower end of this habitat type. The Mainstem Fish Assemblage is dominated by native species such as Sacramento suckers, hardhead, tule perch and Sacramento pikeminnow. In addition, introduced smallmouth bass are prevalent in portions of the mainstem. These species are adapted to relatively slow moving, warm water habitats, typical of the lower and middle reaches of the Russian River. A fourth zone, the Estuary Fish Assemblage, is composed of a diverse fish assemblage ranging from freshwater species in the upper estuary, through brackish to primarily saltwater fish in the lower estuary.

Anthropogenic impacts can shift the location of the zones along the continuum. Habitat disturbances that increase stream temperatures can shift fish assemblages upstream. For example, the downstream extent of steelhead rearing habitat may shift upstream in response to ecosystem disturbances. However, the presence of non-salmonid species does not necessarily equate to a degraded ecosystem.

Within the project area, fish assemblages include a modified “headwater” zone where cold water released from project reservoirs provide suitable thermal conditions for salmonids. This zone includes the Russian River from Coyote Valley Dam downstream to approximately Cloverdale and Dry Creek below Warm Springs Dam to the confluence with the mainstem Russian River. Sacramento pikeminnow, Sacramento sucker, hardhead, and Russian River tule perch, along with the non-native smallmouth bass, dominate fish assemblages in the Russian River downstream of Cloverdale to the Estuary.

Historical Fish Surveys

Russian River

The Russian River fish community was surveyed on several occasions between 1897 and 1993 (Snyder 1907; Johnson 1954; Johnson 1955; Pintler and Johnson 1956; Johnson 1957; Hopkirk and Northen 1980; Cox 1984; Goodwin et al. 1993). These surveys have generally been conducted during the summer (July through August) period. Sampling techniques were generally limited to beach seining and a fish toxicant (Rotenone). It is important to note that beach seines are biased towards capturing smaller individuals, and are limited to sampling relatively shallow habitats that have smooth, unobstructed substrates, with moderately sloped contours. Beach seines are not effective at capturing species that are found in heavy cover (e.g., adult smallmouth bass), or fast swimming species (e.g. adult pikeminnow). However, Rotenone affectively kills all species of fish inhabiting the treated stream reach.

During historical surveys native resident fish (Sacramento suckers and Sacramento pikeminnow), introduced sunfish (smallmouth bass and green sunfish), and juvenile American shad dominated the catch. Pintler and Johnson (1956) provide anecdotal information on the distribution and relative abundance of several species of fish collected after the application of Rotenone to the Russian River. In the 1950’s, CDFW conducted an experiment to determine if steelhead populations could be increased by reducing populations of non-salmonids. The hypothesis was that non-salmonids competed with and/or preyed on steelhead. The perceived competition and predation by these species was thought to be reducing the steelhead population. By reducing the numbers of “rough fish” in the Russian River watershed, steelhead populations would respond by increasing in abundance. Although steelhead population showed an initial positive response to the removal of the “rough fish,” the increases were short lived, the non-salmonid populations quickly recovered, and the program was abandoned. According to Pintler and Johnson (1956), Sacramento suckers were the most abundant species collected, and were noted as being very abundant throughout the river. Juvenile lamprey and tule perch were also noted as abundant throughout the river. Sacramento pikeminnow and hardhead were found in low numbers. Smallmouth bass comprised 0.5 percent of the fish collected. Juvenile steelhead were collected in low numbers throughout the Russian River.

Summertime water temperatures are believed to limit steelhead habitat in the Lower Russian River. During a 1954 study, four juvenile steelhead were captured at one site below Northwood (water temperature 75.0° F), ranging in length from 4 to 7 inches (Johnson 1954). All steelhead captured were infected with external parasites. Three additional steelhead were captured below Austin Creek. No juvenile steelhead were observed or captured during a 1984 CDFW study

(Cox 1984). However, in one study (Johnson 1955), 153 juvenile steelhead less than a year old ("young-of-the-year") were captured in the Lower Russian River at 30 sampling stations (generally one beach seine haul per site).

Dry Creek

In the early 1950's, Dry Creek downstream of the present Warm Springs Dam was a moderately warm (based on fish assemblage) creek that was intermittent to dry in its lower reaches (Pintler and Johnson 1956). According to Pintler and Johnson (1956) the fish assemblage was dominated by California roach, Sacramento sucker, Sacramento pikeminnow and tule perch. Juvenile steelhead were reported to be locally abundant, but scarce overall.

Recent Fish Surveys

The Water Agency began conducting fisheries studies in the Russian River in 1999 (e.g., (Cook et al. 2010; Chase et al. 2005; Martini-Lamb and Manning 2014); SCWA unpublished data). Sampling techniques include boat electrofishing, operation of screw traps for downstream migrant trapping, video counts, and snorkel surveys. Fisheries surveys conducted in Dry Creek include spawning surveys (Cook 2008; Water Agency (A) Unpublished Data), backpack electrofishing surveys and downstream migrant trapping (Martini-Lamb and Manning 2014).

Upper Russian River

Snorkel surveys were conducted in the Upper Russian River (from the Confluence of the West and East Forks of the Russian River and the Dry Creek confluence) in 2002 (Cook 2003). Surveys were conducted during July and August to assess the summertime fish assemblage in the Upper Russian River. Similar to the results of the CDFW reports in the 1950s, minnows (primarily California roach along with hardhead and Sacramento pikeminnow) and Sacramento suckers dominated the fish community. Subdominant species included Russian River tule perch and smallmouth bass. Juvenile steelhead were observed in most reaches, but were relatively abundant only between Cloverdale and Hopland. Very few juvenile steelhead were observed downstream of Cloverdale.

Chinook salmon spawn in the Russian River, primarily above Healdsburg (Cook 2008). Juvenile Chinook salmon rear for a short time in the Russian River before emigrating to the Pacific Ocean, generally by their fourth month of life.

Lower Russian River

The mainstem Russian River below the confluence with Dry Creek falls within the Pikeminnow-Hardhead-Sucker Zone as described by Moyle (2002). A total of 25 species of fish were captured during eleven years of Water Agency study from the confluence of Dry Creek to the Mirabel Inflatable Dam (Chase et al. 2005), (Water Agency (B), Unpublished Data; Martini-Lamb and Manning 2016) (Table 4.3-2). Smallmouth bass and Sacramento sucker dominated the

Table 4.3-2. Species composition (by percentage) captured during August boat electrofishing surveys above and below the Mirabel Inflatable Dam, Russian River. Population level surveys were conducted from 1999 to 2004, 2006. Limited surveys targeting large predatory fish were conducted in 2005 and from 2007 through 2013.

Species	Below Dam[1]	Wohler Pool[2]	Above Pool[3]
Wild steelhead	0.0	0.6	3.3
Hatchery steelhead	0.0	0.3	0.0
Chinook salmon	<0.1	0.0	0.0
Sacramento sucker	36.2	25.6	45.3
Sacramento pikeminnow	1.0	3.4	2.2
Hardhead	3.4	13.9	5.1
Hitch	0.4	0.4	0.0
Sacramento blackfish	2.5	0.2	0.2
Tule Perch	13.1	12.6	10.2
California roach	0.3	4.2	10.9
Threespine stickleback	0.0	<0.1	0.0
Prickly sculpin	0.1	0.2	0.4
Riffle sculpin	<0.1	<0.1	<0.1
American Shad	1.7	4.2	10.9
Smallmouth bass	20.4	31.0	6.7
Largemouth bass	2.5	0.2	0.0
Green sunfish	5.1	1.0	1.8
Bluegill	8.3	0.9	1.6
Redear sunfish	0.8	0.2	0.0
Black crappie	0.6	<0.1	0.0
White Crappie	<0.1	<0.1	<0.1
Carp	3.5	1.0	1.1
Channel catfish	<0.1	<0.1	<0.1
White catfish	0.3	0.2	0.2
Black bullhead	0.2	0.1	0.0
Striped bass	0.0	<0.1	<0.1

[1] Sampling conducted in a single large pool (approximately 1800 ft. in length) adjacent to Steelhead Beach Regional Park.
[2] Sampling conducted in the 5.1 km impoundment behind the Inflatable Dam.
[3] Sampling conducted in approximately the first 1,000 m of river above the influence of Wohler Pool.

catch when all years and sites are combined (28.5 and 27.9 percent of the catch, respectively). Tule perch and hardhead ranked third (12.6 percent of the catch) and fourth (12.0 percent of the catch) in abundance, respectively. Although juvenile American shad were the fifth most abundant species captured overall, the majority were caught during the 2003 sampling event. The high numbers of juvenile American shad in 2003 were likely tied to the high flow conditions present in the Russian River during the spring, which likely improved spawning conditions for this species upstream of the Mirabel Inflatable Dam. Pikeminnow were the seventh most abundant species captured during six years of sampling, accounting for 3.0 percent of the total catch. Largemouth bass comprised 0.5 percent of the fish captured during the study. Juvenile steelhead were captured in low numbers in the Russian River downstream of the confluence with Dry Creek. Dry Creek has a moderating effect on water temperature in the mainstem Russian that continues downstream through the Wohler Pool (Chase et al. 2005).

The Water Agency has conducted downstream migrant trapping since 2000 in the Russian River below the Mirabel Inflatable Dam. In all, 28 species of fish were captured. Chinook salmon were the most abundant species, excluding larval suckers and cyprinids, captured during spring trapping (49.2 percent of all fish captured) (Table 4.3-3), followed by threespine stickleback (14.5 percent of the 2000-2013 combined catch).

Young-of-the-year steelhead (12.7 percent) and juvenile Pacific lamprey (ammocoetes) (7.7 percent) ranked third and fourth, respectively. Wild steelhead smolts accounted for 0.8 percent of the combined catch. The numbers of wild and hatchery-produced coho salmon have increased in recent years.

Dry Creek

Dry Creek has been substantially altered from its pre-Warm Springs Dam conditions. Flows in Dry Creek are maintained well above historical summertime levels through releases from Warm Springs Dam. In addition, the releases originate from deep within Lake Sonoma, so that the water temperatures are maintained artificially cold. These changes have likely had a mixed impact on the fish community in the creek. Prior to the construction of Warm Springs Dam, flows in Dry Creek were intermittent during the summer and the fish community was dominated by a mixture of a native and introduced warm water fish (Pintler and Johnson 1956). Results of downstream migrant trapping and backpack electrofishing conducted by the Water Agency (2009 to present) demonstrated that the Dry Creek fish community is dominated by juvenile Chinook salmon (early March through July) and juvenile steelhead.

Special-status Species

Special-status species are either (1) protected, or proposed for protection, under the Federal Endangered Species Act; (2) protected, or proposed for protection, under the California Endangered Species Act; (3) managed as part of a Federal Fishery Management Plan under the Magnuson-Stevens Fishery Conservation and Management Act; or (4) considered a species of concern by US Fish and Wildlife Service (USFWS) and/or CDFW. Special-status species potentially inhabiting the project area are discussed in Table 4.3-4.

Table 4.3-3. Species composition (by percentage) captured during spring downstream migrant trapping surveys below the Mirabel Inflatable Dam, Russian River, 2000-2013, combined.[1]

Species	Percentage
Chinook salmon	49.2
Threespine stickleback	14.5
Steelhead	11.4
Lamprey *sp.* (Pacific and Pacific brook)	6.1
Largemouth bass	5.1
Sacramento pikeminnow	3.1
Sculpin *sp.* (prickly and riffle)	3.0
Hardhead	1.8
Sacramento sucker	1.4
Smallmouth bass	0.9
Bluegill	0.9
California roach	0.6
Russian River tule perch	0.5
White catfish	0.2
American shad	0.2
Coho salmon	0.2
Green sunfish	0.2
Sacramento blackfish	0.2
Black crappie	0.2
Common carp	0.1
Fathead minnow	0.1
Hitch	0.1
Golden shiner	0.1
Black bullhead	<0.1
White crappie	<0.1
Channel catfish	<0.1
Mosquitofish	<0.1
Redear sunfish	<0.1
Goldfish	<0.1
Striped bass	<0.1

[1] Excludes larval suckers and minnows

Table 4.3-4. Special-Status Fish Species with Potential to Occur in the Russian River Watershed

Scientific Name	Common Name	Status	Anadromous/ Resident	Regulatory Status	Habitat	Potential to Occur in project area
Spirinchus thaleichthys	Longfin smelt	Native	Anadromous	CT	Utilize freshwater rivers to spawn. Adults occur in estuaries, bays, and coastal areas.	Unlikely. Use of Russian River Estuary appears very low. Status of population in the Russian River uncertain.
Oncorhynchus mykiss	steelhead	Native	Anadromous	FT	Associated with migratory and rearing habitat in Dry Creek and mainstem Russian River. Utilize Upper Russian River and tributaries for spawning.	High. Suitable rearing and spawning habitat present in Upper Russian River and Dry Creek; regularly observed in fisheries monitoring surveys.
Oncorhynchus kisutch	Coho salmon	Native	Anadromous	FE/CE	Associated with migratory habitat in Dry Creek and the Russian River. Spawning and rearing occurs in select streams with cold water, deep pools, and submerged large woody cover.	High. Suitable rearing and spawning habitat (Dry Creek) present in project area; regularly observed in fisheries monitoring surveys.
Oncorhynchus tshawytscha	Chinook salmon	Native	Anadromous	FT	Associated with migratory and rearing habitat in Estuary and mainstem Russian River. Spawning habitat in mainstem Russian River and larger tributaries.	High. Suitable rearing and spawning habitat present in project area; regularly observed in fisheries monitoring surveys.
Oncorhynchus gorbuscha	Pink salmon	Native/Stray	Anadromous	Extirpated[a]	Historically spawned in Lower Russian River near Duncans Mills. Juveniles emigrate to estuaries shortly after emergence.	Unlikely. Pink salmon believed extirpated from the Russian River sometime after 1955.
Lampetra tridentatus	Pacific lamprey	Native	Anadromous	FSC	Associated with migratory and rearing habitat in Russian River and Dry Creek. Spawns in Russian River and tributaries. Young use backwater and other low velocity habitats.	High. Suitable rearing and migratory habitat present in project area; commonly observed in the Russian River and Dry Creek monitoring surveys.

Table 4.3-4 (Continued). Special-Status Species Observed in the Russian River Watershed

Scientific Name	Common Name	Status	Anadromous/ Resident	Regulatory Status	Habitat	Potential to Occur
Hysterocarpus traskii pomo	Russian River tule perch	Native	Resident	CSC	Associated with mainstem Russian River and the lower reaches of larger tributaries with abundant cover elements.	High. Suitable habitat present in project area. Commonly observed in Russian River.
Acipenser medirostris	green sturgeon	Native/visitor	Anadromous	FT	Utilize large rivers to spawn in deep, fast water. Early life stage may rear in freshwater up to 2 years.	Unlikely. The Russian River is not recorded as providing spawning or rearing habitat and none have been found during Water Agency fish studies.
Lavinia symmetricus	California roach (Russian River roach subspecies)	Native	Resident	CSC	Utilize warm low gradient rivers. Can occupy large pools as well as shallow water habitats.	High. Roach are routinely observed in the Russian River and Dry Creek.
Mylopharodon conocephalus	hardhead	Native	Resident	CSC	Utilize low- to mid-elevation well-oxygenated streams with deep pools and low-velocity run habitat. Often absent from streams where introduced sunfish predominate.	High. Routinely observed during fisheries monitoring surveys in the Russian River.

[a] Pink salmon are thought to be extinct in the Russian River. However, small numbers of this species were observed during video monitoring conducted by the Water Agency in 2003; however, these were thought to be strays from other watersheds.

Regulatory Status Definitions:

FT = Federal Threatened CE = California Endangered
FE = Federal Endangered CT = California Threatened
FSC = Federal Species of Concern CSC = California Species of Special Concern

Potential to Occur:

Unlikely = Habitat not present in the project area and/or species is not known to occur in the project area based on fisheries monitoring surveys or species distribution information.
Low = Habitat not present in the project area and/or few occurrences in the project area observed.
Moderate = Marginal habitat present in the project area and/or some occurrences in the project area observed.
High = Suitable habitat present in the project area and nearby occurrences observed or species is known to occur in the project area based on fisheries monitoring surveys.

SOURCES: Moyle, 2002; Chase et al. 2005; Chase et al. 2007; Cook et al. 2010; NMFS, 2008

Special-status Species Life Histories

Generalized Salmonid Life History

All three salmonids (Chinook salmon, coho salmon, and steelhead) inhabiting the Russian River exhibit a similar life history strategy known as anadromy. With an anadromous life style, juveniles rear in freshwater before migrating to the ocean where they grow and mature; finally returning as adults to freshwater to lay their eggs and begin the lifecycle anew. Although there are specific differences between salmonids, they all share several life history traits. After growing and maturing in the ocean, the adults of all three species return (generally) to the stream where they were born. The eggs are laid in a nest, called a redd. The female selects a site, usually in the tailout of a pool or in a riffle. The characteristics (depth, velocity, and substrate size) of the redd depend on the size of the fish. The female digs the redd by sweeping her tail rapidly back and forth to dislodge gravel, creating a pit. The eggs are deposited in the pit and fertilized, and are subsequently buried with gravel by the female. The eggs remain in the gravel for several weeks before hatching. The resulting sac fry remain in the gravel for an additional 3 to 6 more weeks (depending on the species and water temperature) before emerging from the gravel. The freshwater residency is highly variable between the three species, but is marked by rapid growth followed by a physiological change known as smoltification. A salmonid undergoing this change is called a smolt. The smolting process is necessary for salmon to convert from a physiology adapted to living in freshwater to one adapted to living in salt water.

Chinook salmon: Based on run timing, Chinook salmon inhabiting the Russian River are considered “fall-run.” Chinook salmon occupy the Upper and Lower Russian River seasonally from the estuary upstream into the West Fork Russian River, as well as Dry Creek. Chinook salmon have been documented to spawn in selected tributaries to the Russian River, but usage of tributaries appears to be limited, as well as outside of the project area. Chinook salmon spawn in the Russian River, primarily upstream of Healdsburg. Although historical estimates of salmonid populations abound in the Russian River literature, virtually all are based on anecdotal information and not on quantitative counts of fish (Chase et al. 2007). The accuracy of the anecdotal estimates cannot be assessed. The only quantitative estimate of a salmonid population in the Russian River are the video counts of Chinook salmon migrating past the Mirabel Fish Ladders conducted by the Water Agency between 2000 and 2013 (Chase et al. 2007; Martini-Lamb and Manning 2014).

Fisheries data from Sonoma County prior to 1900 are sparse. The few references to the fisheries of Sonoma County, although lacking in specific details, do provide a glimpse into historical fish populations. The earliest record of a salmon fishery found for Sonoma County was from 1888 (USFCC 1892). The USFCC (1892) described a commercial fishery consisting of 19 men gillnetting “winter salmon” from the Russian River (salmonids were not identified to species). In 1888, 33,597 pounds of salmon were captured by commercial fisherman and shipped to San Francisco. In addition, local consumption of fish (multiple species) was

estimated at 150,000 pounds. The report observed that the commercial fishery of the Russian River had become “rather unimportant” by 1888, but had been noted for its abundance of salmon. Overfishing was cited as the reason for the decline.

Although Chinook salmon were listed as native to the Russian River (Snyder 1908), reports from the 1940’s and 1950’s indicate that the population was never very large (e.g. reviews by (Winzler and Kelly. 1978; Steiner Environmental Consulting 1996). CDFW memos from the 1940’s and 1950’s stated that few, if any, Chinook salmon inhabited the river (although a few sources did suggest Chinook salmon were observed in the Russian River). Rich et al. (1944) does not mention Chinook salmon in a report discussing the fishery of the Russian River for 1941. An internal memo reported that CDFW hatchery Chinook salmon released into the Russian River resulted in a minor fishery, but that the fish were unable to reproduce successfully (Jensen 1973). Steiner (1996) concluded that very few Chinook were presently in the Russian River basin.

Similar to the 1940’s, the general consensus among fishery biologist in 1999 was that few Chinook salmon inhabited the river. However, a juvenile trapping program and the operation of underwater video cameras between 1999 and 2013 documented a fairly robust, self-sustaining Chinook salmon population. Counts of adult Chinook salmon passing through the fish ladders at Mirabel ranged from approximately 1,400 to 6,700 (Martini-Lamb and Manning 2014).

Adult Chinook salmon have been observed at the Mirabel fish counting station as early as the last week in August through at least early February; however, the adult upstream migration consistently peaks in October and November (Chase et al. 2007; Martini-Lamb and Manning 2014). Chinook salmon are limited naturally in the basin to waters with sufficient flow to allow upstream migration and spawning during the fall/early winter timeframe. Spawning habitat is primarily located in the mainstem Russian River, upstream of Healdsburg, and in Dry Creek (Cook 2003); Martini-Lamb and Manning 2014). Spawning begins in November (Cook 2008), and likely continues through at least early February. Chinook salmon spawn in pool tailouts, riffles and runs. Chinook salmon, like all salmonids, require relatively silt free substrate for successful spawning and egg incubation. Optimally-sized spawning substrate range from 2.0 to 10.6 cm (0.8 to 4.2 inches in diameter) (Raleigh et al. 1984); fines should be less than 6 percent. Survival of developing embryos should be high when water temperature is <55.0° F and dissolved oxygen (DO) levels are ≥8.0 mg/l.

Juvenile Chinook emigrate through the project area from approximately late-February through July, with peak emigration from mid-April through mid-May. The extended migration period in the Russian River is likely related to the anomalous conditions created in Dry Creek. The cold water released from Lake Sonoma masks the seasonal cues that occur over the rest of the watershed. While water temperatures exceed 68º F by mid-May in the Russian River above Healdsburg, water temperatures in Dry Creek remain at ≤56º F. Chinook salmon in the Russian River emigrate through the Wohler Pool at about 90 millimeters (mm) fork length (FL) (range 32 to 140 mm). Factors that stimulate downstream migration are not well known (Healey 1998); however, streamflow likely plays a role.

Juvenile Chinook salmon feed on small invertebrates (Cladocera, diptera, Copepoda, and Homoptera) in the Sacramento-San Joaquin Delta (Kjelson et al. 1982, cited by Healey 1998). Growth appears to be quite rapid in the Russian River. The average length of juvenile Chinook salmon captured in the downstream migrant fish trap operated below the Mirabel Inflatable Dam during a 5-year study increased from 39 to 81 mm fork length (FL) between the first week of March and mid-April (Chase et al. 2005). Growth of juvenile Chinook continues during their freshwater residency. By late June, the juveniles average greater than 100 mm FL.

Coho Salmon: Coho salmon primarily occupy a small set of streams in the Russian River watershed, primarily from Maacama Creek sub watershed downstream). Coho salmon do not spawn or rear in the mainstem Russian, but use it seasonally as a migration corridor. Within the project area, coho salmon migrate through the Lower Russian River upstream to Maacama Creek. Coho spawning and rearing within the project area is limited to Dry Creek.

References to coho salmon abundances in the Russian River in the historical literature are limited. (Rich et al. 1944) stated that the coho salmon abundance in the Russian River was “small and sporadic,” while Shapovalov (1947) reported “appreciable” numbers of coho salmon in tributaries to the Russian River near Duncans Mills. Although there are no historical quantitative estimates for coho salmon, a few qualitative estimates have been reported in the literature. Lee and Baker (1975) cite CDFW (1965) estimating 7,000 coho salmon in the Russian River with an annual harvest of 2,000 fish. CDFW (1965) provides no supporting data for this estimate. The lack of quantitative data prevents making an assessment of the historical coho population in the Russian River. Surveys conducted in the early 2000’s found few juvenile coho salmon, and the general consensus among local biologists was that the total run of adult coho salmon returning to the Russian River number at most in the tens of fish. Against this backdrop, several entities (University of California Cooperative Extension, CDFW, NMFS, USACE and the Water Agency) established a Captive Broodstock Program designed to reintroduce coho salmon back into the streams that historically supported them. Juvenile coho salmon were removed from the wild and reared at a special facility at the Don Clausen Fish Hatchery. After the coho salmon reach maturity, they were spawned and the subsequent juveniles were reared for a time in the hatchery to increase survival. The juveniles were released into streams that historically supported coho salmon with the expectation that they would complete their life cycle and return and spawn in those streams; thus, reestablishing a viable populations in the Russian River Basin. Recent sightings of hatchery and wild adult coho salmon spawning in the Russian River Basin, along with the production of natural produced juveniles, indicate that the program is working. While a definitive count of retuning adult coho salmon is not available, there is evidence that adult coho escapement between 2010 and 2015 ranged from approximately 122 to 540 (Martini-Lamb and Manning 2014) (Sonoma Count Water Agency and University of Calfornia Cooperative Extension 2015), (UCCE website).

Coho salmon have the most restricted habitat requirements of the three salmonid species inhabiting the Russian River. Coho salmon prefer cold (≤61° F); low gradient stream reaches that typically include dense riparian canopy. Since coho salmon are restricted to a relatively small number of streams, they are at a greater risk from localized disturbances compared to other salmonids. Coho salmon primarily inhabit streams in the Lower Russian River watershed,

including, Austin, Willow, Dutch Bill, Mark West, and Green Valley creeks, and in selected tributaries to Dry Creek. In addition, at least historically, populations of coho were also documented in the Maacamas and Forsythe creek watersheds.

Coho salmon have a fairly rigid life history, where they spend approximately one year in freshwater and two years in the ocean, although juveniles occasionally spend two years in freshwater, and a few adults return after one year in the ocean (mostly male fish).

In other streams in California, coho migrate upstream in November and December, and spawning occurs primarily between December and January (Shapovalov and Taft 1954), (UCCE website). Since coho spawn in relatively small tributaries, they are dependent on rain to provide sufficient streamflow to allow for passage and spawning. Spawning typically occurs in the tailouts of pools. Coho prefer proportionally slower water velocities, shallower depths, and smaller substrates compared to the larger Chinook salmon. Redds are generally built in depths greater than 6 inches with velocities between 0.7 to 2.3 feet per second (ft./sec) (McMahon 1983). Spawning substrates generally consist of gravel and small cobble (McMahon 1983).

Juvenile coho salmon tend to occupy pools during the summer months. Juvenile coho salmon feed on aquatic and terrestrial invertebrates, but will consume small fish (including coho fry and other salmonids) when available. Smolts emigrate March through May, with the peak occurring during the first two weeks of May.

Steelhead: Based on run timing, steelhead in the Russian River are considered “winter run.” Steelhead are the most widely distributed salmonid in the Russian River watershed, inhabiting most permanent tributary streams. Steelhead also utilize the mainstem Russian River as spawning and rearing habitat. Spawning habitat overlaps with Chinook salmon (mainly above Cloverdale). Limited steelhead rearing occurs in the mainstem Russian River with peak abundances recorded in the Canyon Reach located between Cloverdale and Hopland and near Ukiah (Cook 2003). Limited rearing has also been observed in the mainstem below Dry Creek (Chase et al. 2005). Steelhead have also been documented rearing in the Lower Russian River near the confluence with Austin Creek and in the Estuary (Martini-Lamb and Manning 2014) (SCWA unpublished data). Although steelhead are widely distributed in the basin, the overall population is likely depressed compared to historical levels.

There are no quantitative estimates of the Russian River steelhead population. Although historical steelhead abundance “estimates” in the Russian River range from 50,000 to 57,000 fish (Evans 1959, Hinton 1963, Vestal and Lassen 1969, Anderson 1972), these figures are based on anecdotal information (Evans 1959, CDFW 1963), or no supporting data (Vestal and Lassen 1969). The most cited “estimate of the historical steelhead sports catch” is similarly flawed. A Press Democrat reporter interviewed anglers and “estimated” that 25,000 steelhead were caught in 1957 (Christensen 1957). Rather than representing a typical sports harvest as is generally reported, the article raised concern that a significant portion of the spawning population was being removed and that lower runs might result in following years (Christensen 1957). Thus, the 1957 sports catch, regardless of its true size, was not representative of an average years catch, but may have demonstrated a level where over-fishing was occurring. Still, the popularity of the steelhead fishery provides evidence of a large historical population.

Steelhead are flexible in their life history strategies and habitat requirements. In California, spawning steelhead usually return between December and March, with peak returns occurring in January and February (Moyle 2002). Adult steelhead enter the Russian River from at least November through May, although based on hatchery returns peak migration occurs in January through March. Steelhead spawn in the upper mainstem river as well as most tributaries throughout the basin. Eggs require 3 to 4 weeks to hatch, and the young emerge from the gravel two to three weeks later (Moyle 2002). Steelhead smolt primarily as two year old fish (Chase et al. 2005) although one-year-old smolts are apparently common in Dry Creek (SCWA unpublished data).

Adult steelhead migrate through the project area primarily during the winter (December through March). Steelhead smolts emigrate through the project area primarily during the spring (March through early June). Steelhead smolts emigrate through the Wohler Pool at an average size of approximately 175 mm FL (range 83 to 259 mm). Young-of-the-year steelhead have been captured below the dam during the spring trapping season, measuring between approximately 30 to 130 mm FL, depending on the time of year (Chase et al. 2005).

Pink salmon: Pink salmon were observed spawning in the Lower Russian River during the late 1940's and early 1950's (Wilson 1954; Hallock and Fry 1967). In addition, seven adult male pink salmon were observed during video monitoring at the Mirabel Dam.[2] No other mention of this species in the literature before or after this date. Based on the data collected to date, pink salmon are believed to be extirpated in the Russian River.

Species of concern

Tule perch. Tule perch in the Russian River inhabit the mainstem and the lower reaches of the larger tributaries (Cook et al. 2010). Tule perch are often found in pools, although they can forage in relatively fast water habitats. When found, they are often associated with areas of heavy cover, including aquatic plants, large woody debris, overhanging vegetation and riprap (Moyle 2002). Tule perch feed on small invertebrates picked off the substrate or off plants. Important food items for tule perch include the larvae of midges and mayflies (Moyle 2002).

Tule perch abundance in the Russian River has been reported to be low (Phelps 1989; Moyle 2002). Phelps (1989) found tule perch throughout the Russian River from Monte Rio to Ukiah, but this species was abundant only in the section of river between Cloverdale and Hopland. However, fish sampling techniques were limited to beach seining which is inefficient in areas with large amounts of cover favored by tule perch. In addition, tule perch populations were likely reduced to low levels during a 1950's poisoning project conducted by CDFW. Tule perch have a relatively low fecundity, and this species may have been slow to recover from the poisoning project.

[2] Mature male pink salmon develop a distinctive "hump" behind their head, thus earning them the nickname humpback salmon. Females do not develop this secondary trait. If female pink salmon migrated past the fish counting station in 2003, they were miss identified as likely Chinook salmon.

Tule perch were observed throughout the Russian River from Steelhead Beach to Ukiah (Chase *et al*. 2005; Cook *et al*. 2010). Tule perch comprised between 3 and 9 percent of the fish community in four reaches of the Russian River (located between Healdsburg and Ukiah) during a snorkel survey (Cook 2003), and have been captured as far downstream as Duncans Mills (Cox 1984; Cook *et al*. 2010).

Tule perch in the Russian River seldom live longer than 2 years (Cook *et al*. 2010). Tule perch averaged 73 mm FL during August of their first year, 116 mm FL during August of their second year, and 174 mm FL during August of their third year (Chase *et al*. 2005; Cook *et al*. 2010).

Tule perch are viviparous, meaning that it gives birth to live young (as opposed to laying eggs). Tule perch give birth in May and June (Cook *et al*. 2010). The earliest capture of a YOY tule perch in the Russian River screw traps at Mirabel was May 19. Presumably pregnant tule perch (observed with severely distended sides) have been captured in the rotary screw trap operated at the Mirabel Inflatable Dam and fyke netting conducted in the Lower Russian River from during May (Chase *et al*. 2005; Cook *et al*. 2010). Young-of-the-year tule perch that have been captured starting during the last week in May ranged in length from 26 to 34 mm FL.

Pacific lamprey. Pacific lamprey are anadromous with a lifecycle similar to steelhead. In California, Pacific lamprey have been reported to migrate upstream and spawn during the winter and spring (January through March (Chase 2001), March through late June (Moyle 2002), and the fall in the Trinity River (Moffett and Smith 1950, cited by (Moyle 2002)) and the Napa River (Wang 1986). Pacific lamprey spawn in freshwater in riffles with gravel/cobble substrates. Lamprey, with males and females working together, build a nest (redd) by latching onto rocks with their sucking disc (mouth) and swimming backwards, pulling the rocks downstream. Once a pit is constructed, spawning takes place, and then the redd is covered with gravel.

The young, called ammocoetes, emerge from the pit after approximately three weeks, and drift downstream to suitable rearing habitat (backwater areas with unconsolidated gavels, soft sand/silt substrates). Ammocoetes burrow tail first into the substrate, where they feed on detritus. Ammocoetes are found in the mainstem Russian River, as well in the lower and middle reaches of tributaries such as Dry, Austin, Mark West and Santa Rosa creeks.

Ammocoetes do not possess eyes or a developed oral sucking disc, and spend three to seven years in freshwater before undergoing a physical transformation that allows them to survive in the ocean. During this metamorphosis, Pacific lamprey ammocoetes develop large eyes and a fully functional oral sucking disc. The body coloration also changes from brown to silvery, with a darker bluish color on the back. The transforming ammocoetes (called marcopthalmia) pass through a smolting phase similar to salmonids, which allow them to take up a marine residence. Metamorphosing Pacific lampreys have been captured in Mark West and Santa Rosa creeks during September and October sampling events (personal observations of the author). Marcopthalmia emigrate to the ocean during the winter, usually moving on the first few large storm events, although they have been captured in the mainstem Russian River during the spring sampling period.

California roach. Multiple subspecies of roach, including the "Russian River roach" (Moyle *et al*. 2015) exist. Roach are a highly adaptable species, inhabiting environments ranging from cold headwater streams, to warm, low gradient rivers. However, roach are generally not abundant in the presence of large numbers of other species (Moyle 2002). When found alone, roach occupy open waters of large pools. In the presence of predatory fish such as pikeminnow, roach occupy shallow water habitats along the shoreline on in riffles. Roach also appear to be particularly vulnerable to competition by green sunfish. Roach are omnivores, feeding primarily on algae, aquatic insects, and small crustaceans.

Roach are a small, relatively short-lived species, seldom living longer than 3 years. Using the length at age data provided in Moyle (2002), in combination with the length-frequency data collected in August in the Russian River (Chase *et al*. 2005), Age 1+ roach average 63 mm FL; Age 2+ roach average 113 mm FL (range 100 to 125 mm FL), and Age 3+ roach average 135 mm FL (range 130 – 140 mm FL).

Native Predators

Sacramento pikeminnow: The Sacramento pikeminnow is the largest member of the minnow family (Cyprinidae) inhabiting the Russian River. Pikeminnow are native to the Russian River, Sacramento-San Joaquin river systems, and the Pajaro and Salinas rivers (Moyle 2002). Prior to the introduction of other predators, pikeminnow were the dominant piscivore ("fish eater") in the Russian River. Site-specific information is limited, and most of what is known about their biology and life history comes from studies conducted in other river systems, primarily in the Sacramento and San Joaquin. In addition, a considerable amount of work has been conducted on the closely related northern pikeminnow (*P. oregonensis*) predation on salmonid smolts in the Columbia River Basin.

Historical observations of Sacramento pikeminnow in the Russian River are limited to (Taft and Murphy 1950) and a few CDFW reports, primarily during the 1950s chemical treatment (rotenone) projects. Pikeminnow occupy pools throughout the Russian River and the lower reaches of the larger tributaries. Large pikeminnow are apparently widespread above the Wohler Pool, and were observed in most large pools sampled during a snorkel survey in 2002 (Cook 2003).

Sacramento pikeminnow prefer warm streams with abundant pools and cover (Taft and Murphy 1950), (Moyle and Nichols 1973). Adults tend to be sedentary during daylight hours (Smith 1982**,** cited in Brown 1990). Juveniles (70 to 120 mm SL) were found in riffles and runs. Sacramento pikeminnow prefer relatively low velocity habitat (<0.5 fps), except when foraging or moving from one pool to another, moderate depths (1.5 to 4.5 feet), and a substrate of gravel to boulder (Knight 1985).

Sacramento pikeminnow prefer warm water compared to salmonids, are seldom abundant where water temperature does not exceed 59.0˚ F (Moyle 1976), and show a preference for a water temperature of 78.8˚ F (Knight 1985). The critical thermal maxima temperatures were 82.9˚ F for Sacramento pikeminnow acclimated at 50.0˚ F, and 99.0˚ F when acclimated to 77.0˚ F (Knight 1985). Sacramento pikeminnow survived temperatures of 86.0˚ F, but died when

temperature was rapidly increased to 95.0˚ F (Cech, et al. 1990). Sacramento pikeminnow tolerate low dissolved oxygen levels, and do not show a metabolic response to hypoxic conditions (dissolved oxygen levels at 25 percent of saturation for each temperature tested) at temperatures up to 77.0˚ F (Cech *et al*. 1990).

Adults feed primarily at dawn, dusk and at night ((Brown 1990)). Sacramento pikeminnow feed on aquatic insects as juveniles, switching to a diet primarily of fish as they grow (Moyle 2002). Taft and Murphy (1950) examined the stomach contents of 36 juveniles (ranging in length from 3.3 to 17.8 cm FL) captured in the Russian River near Cloverdale. The diet of these fish consisted entirely of aquatic insects. Mertz and Vanicek (1996) compared the diets of juvenile Sacramento pikeminnow with steelhead and Chinook salmon in the lower American River. They concluded that juveniles fed primarily on corixids (water boatmen) and chironomids (larval gnats), and that their diet did not overlap with either steelhead or Chinook salmon. Sacramento pikeminnow have been reported to begin preying on fish and crayfish at 230-250 mm FL (data cited in Brown and Moyle 1981), and greater than 165 mm FL (Buchanan *et al*. 1981). Buchanan *et al.* (1981) reported that 75 percent of the salmonids consumed were eaten by northern pikeminnow greater than 300 mm FL.

Adult Sacramento and northern pikeminnow are known to eat salmon and steelhead smolts (Moyle 2002, (Poe 1991; Shively *et al*. 1996; Zimmerman 1999). Northern pikeminnow can be a significant predator on juvenile salmonids below large dams when smolts become disoriented or injured by passage past dams, and below hatcheries following large releases of smolts (Shively *et al*. 1996). Buchanan *et al.* (1981) examined northern pikeminnow diets in free flowing sections of the Willamette River basin in Oregon. Although the fish in this study were collected during spring smolt emigration period, they fed primarily on insects, crayfish, and sculpin. Juvenile salmonids were found in 2 percent of the 1,127 pikeminnow stomachs examined.

Both Buchanan *et al*. (1980) and Thompson (1959 cited in Brown and Moyle 1981) found that pikeminnow were opportunistic, and fed on whatever prey source was most abundant. This may explain why they are such active predators of salmonids below dams and after hatchery releases.

In Central Valley streams, the presence of adult pikeminnow can result in a shift in habitat used by other (prey) species (Brown and Moyle 1991, Brown and Brasher 1995, Gard 1994). Juvenile rainbow trout and Sacramento suckers shifted to shallower, higher velocity (riffle) habitat, and threespine stickleback and juvenile California roach shifted to near shore, shallow water habitat in the presence of pikeminnow. Pikeminnow are seldom abundant where sunfish are common (Moyle and Nichols 1973; Gard 1994).

In the Russian River, spawning takes place in April and May (Taft and Murphy 1950). Eggs are adhesive and are attached to rocks or gravel. Pikeminnow inhabiting large rivers and reservoirs migrate into tributary streams to spawn during high flows (Moyle 2002, Mulligan 1975, Harvey and Nakamoto 1999). Sacramento pikeminnow migrated anywhere from 2 to 92 km during spawning migration. Eggs hatch in 4 to 7 days at 64.4° F. In the Russian River, larvae were first captured in screw traps in mid to late June in 2000 and 2002.

Recreationally Important Species

Recreationally important fisheries occur in the mainstem as well as in both Lake Mendocino and Lake Sonoma. In the mainstem Russian River, hatchery steelhead are the primary sports fish (fishing for Chinook and coho salmon, as well as for wild steelhead, is illegal). American shad and smallmouth bass are actively pursued during the spring and summer. Other species, including white and channel catfish, bluegill, and striped bass comprise a minor fishery. Project reservoirs support popular fisheries for largemouth bass, redear sunfish, bluegill, black crappie, channel catfish, and (in Lake Sonoma) resident rainbow trout ("landlocked steelhead").

Conversely, the sports fish listed above (excluding American shad) are at least partially, if not primarily, piscivorous, and can negatively impact juvenile salmonids and other native fish through competition and predation. Excluding steelhead, these species are not native to the Russian River, and any predation by these species would constitute a negative impact to listed species. Thus, improving populations of these species in the Russian River can be beneficial for recreation while negatively impacting listed salmonids.

American shad are an anadromous species that is native to the Atlantic coast from northern Florida into Canada. Upstream migration in the Russian River begins in April and may continue into early August; however, peak observations were made in May through mid-June (Barraco and Jones 1971). In the Sacramento River, American shad begin migrating when temperatures exceed 57º F, and peak when temperatures ranging from 62.5 to 75º F. American shad are broadcast spawners, and developing embryos remain suspended in the current, drifting downstream as the young shad develop. Time to hatching is positively related to water temperature, and takes 8-12 days at temperatures ranging from 52-59º F, 6-8 days at 62.5 ºF, and 3 days at 75º F (Moyle 2002). However, survival is lower at higher temperatures. Young American shad feed on plankton, eventually including a variety of insects in their diets. American shad slowly move downstream and enter the ocean in the September to November timeframe. Site-specific information for the Russian River is sparse. Barraco and Jones (1971) reported that American shad were not hindered by flows greater than 162 cfs (measured at Hacienda). American shad are smaller than Chinook salmon, thus, it is reasonable to assume that they can migrate upstream at comparable (or lower) streamflows (approximately 135 through the Lower Russian River and 110 cfs through the Upper Russian River). In addition to flows suitable for upstream migration, American shad eggs need to be suspended in the current for 3 to 12 days. Flows sufficient to maintain this state of buoyancy is unknown.

Smallmouth bass are native to the eastern half of the United States and southern Canada (Carlander 1977). Smallmouth bass, first stocked in the Russian River in 1878 (Dill and Cordone 1997), are widespread throughout the mainstem.

Optimal water temperatures for growth range from 78.8 to 84.2˚ F, and preferred temperatures overall range from 70.0 to 80.5˚ F (Edwards *et al.* 1983). Growth is inhibited at temperatures below 50.0 to 57.2˚ F. Smallmouth bass seek cover when temperatures drop to 59.0˚ F, and become inactive at approximately 50.0˚ F (Edwards *et al.* 1983). Smallmouth bass prefer DO levels in excess of 6.0 mg/l.

Smallmouth bass will consume a wide variety of food items, including fish, crayfish, insects, and amphibians (Moyle 2002). Juvenile salmonids can constitute a significant portion of their diet during the outmigration period (Fayram and Sibley 2000). Sub-yearling Chinook salmon comprised 59 percent of the diet of smallmouth bass in one Columbia River study (Tabor 1993). However, in another study, sub-yearling Chinook accounted for only 4 percent of smallmouth bass prey items (Poe 1991). Sub-yearling Chinook salmon accounted for 12.4 to 25.8 percent of the diet of smallmouth bass collected in three sections of the Columbia River during a seven-year study (Zimmerman 1999). In another study, smallmouth bass consumed approximately 4 percent of the hatchery production in a given year. However, hatchery reared Chinook salmon are larger than their wild counterparts, and predation on wild fish was likely higher (Fritts and Pearson 2004).

Smallmouth bass are spring spawners, and spawning is generally initiated after water temperature increases to 55.0 to 59.9° F (range 39.9 to 70.0° F) (Emig 1966). Preferred spawning substrate is gravel, but silt and sand can be utilized. Nests are generally built at depths between 0.3 to 0.9 m (Edwards *et al*. 1983). Spawning generally occurs in quiet backwater areas of streams.

Largemouth Bass: Largemouth bass are native east of the Rocky Mountains from southern Quebec through the Mississippi River Basin to the Gulf of Mexico, east into the Carolinas and Florida (Carlander 1977). Largemouth bass thrive in low velocity, warm water habitats. Moyle and Nichols (1973) described habitat supporting largemouth bass in Sierra foothill streams as being warm, turbid pools with aquatic and floating vegetation. In rivers, largemouth bass prefer low velocity habitats with aquatic vegetation (Stuber *et al*. 1982; Carlander 1977).Substrate in these pools was typically sand or mud. Optimal temperatures for growth of juvenile and adult largemouth bass range from 75.2 to 96.8° F (Stuber *et al*. 1982). Little growth occurs below 59.0° F (Mohler 1966, cited by (Stuber *et al*. 1982).

Largemouth bass feed primarily on fish and crayfish after reaching a size of approximately 5 to 6 inches FL. Largemouth bass have the well-earned reputation for being able to consume any animal that it can fit in its mouth, including small mammals, waterfowl, frogs, and fish.

Few data are available on the abundance and distribution of largemouth bass in the Russian River. They are apparently confined to the lower sections of the river, but form a small proportion of fish captured during recent surveys (Chase, et al. 2005).

Largemouth bass form a significant component of the Lake Mendocino and Lake Sonoma fisheries. Largemouth bass life history characteristics are discussed in more detail in the Methodology section.

4.3.3 Regulatory Framework

Federal

Federal Endangered Species Act

The USFWS and the National Marine Fisheries Service (NMFS) administer and enforce the federal Endangered Species Act of 1973 (16 USC Section 1531 *et seq*.). The USFWS administers the ESA for all terrestrial species and some inland aquatic species. NMFS administers the ESA for marine fish species, including anadromous salmonids. Threatened and Endangered Species on the Federal list (50 CFR Section 17.11, 17.12) are protected from take, defined as direct or indirect harm unless a Section 10(a) Incidental Take Permit or a Biological Opinion with incidental take provisions is issued.

Pursuant to the requirements of the ESA, a federal agency reviewing a Proposed Project within its jurisdiction must determine whether any federally listed species may be present in the project area and determine whether the Proposed Project would have a potentially significant impact upon such species. Under the ESA, habitat loss is considered an impact to the species. In addition, the agency is required to determine whether the project is likely to jeopardize the continued existence of any species that is proposed for listing under the ESA or to result in the destruction or adverse modification of critical habitat proposed to be designated for such species (16 USC 1536[3], [4]). Therefore, project-related impacts to these species or their habitats would be considered significant and would require mitigation.

Procedures for addressing federally listed species follow two principal pathways, both of which require consultation with USFWS and/or NMFS. The first pathway (ESA Section 10(a) Incidental Take Permit) is set up for situations where a non-federal government entity (or where no federal nexus exists) must resolve potential adverse impacts to species protected under the ESA. The second pathway (ESA Section 7 Consultation) involves projects with a federal connection or requirement (e.g. requiring a federal permit or receiving federal funding).

Critical Habitat and Essential Fish Habitat

Both Critical Habitat and Essential Fish Habitat (EFH) are designated within the project area for various special-status species. Both of these habitat types are important components in considering potential project-related impacts as part of this assessment. The federal ESA defines critical habitat as “the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary to be essential for the conservation of the species.” EFH is defined in the MSA as “those waters or substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”

State

California Endangered Species Act

The California Endangered Species Act (CESA [California Fish and Game Code Section 2080]) is similar to the ESA, but is limited to state-listed threatened and endangered species. CESA prohibits the take of state-listed threatened and endangered species. Additionally, the CDFW maintains a list of species of special concern, which serves as a "watch list." Under CESA, agencies are required to consult with the CDFW when preparing CEQA documents. Consultation ensures that Proposed Projects or actions do not have a negative effect on state-listed species or state species of special concern. During consultation, CDFW determines whether take would occur and identifies "reasonable and prudent alternatives" for the project and conservation of wildlife species. CDFW can authorize take if the applicant "obtains from the Secretary of the Interior or the Secretary of Commerce an incidental take statement pursuant to Section 1536 of Title 16 of the United States Code or an incidental take permit pursuant to Section 1539 of Title 16 of the United States Code that authorizes the taking of an endangered species or a threatened species that is listed pursuant to Section 1533 of Title 16 of the United States Code." No permit can be issued if its issuance would "jeopardize the continued existence of the species," and impacts of the authorized take must be minimized and fully mitigated.

CEQA Guidelines Section 15380

Although threatened and endangered species are protected by specific federal and state statutes, CEQA Guidelines Section 15380(d) provides that a species not listed on the federal or state list of protected species may be considered rare or endangered if the species can be shown to meet specified criteria. These criteria have been modeled after the definition in the ESA and the section of the California Fish and Game Code defining rare or endangered plants and animals. Section 15380(d) allows a public agency to undertake a review to determine if a significant effect on species that have not yet been listed by either the USFWS or CDFW (i.e., candidate species) would occur. Thus, CEQA provides an agency with the ability to protect a species from a project's potential impacts until the respective government agencies have an opportunity to designate the species as protected.

Local

Mendocino County General Plan

Parts of the Proposed Project are located within the jurisdiction of the Mendocino County General Plan (Mendocino County 2009). The Mendocino County General Plan is discussed further in Section 4.3.5.

Sonoma County General Plan

Parts of the Proposed Project are located within the jurisdiction of Sonoma County General Plan 2020 (PRMD 2012). The Sonoma County General Plan is discussed further in Section 4.4.5.

4.3.4 Impact Analysis

This section describes the impact analysis relating to fisheries resources for the Proposed Project. It describes the methods used to determine the impacts of the project and lists the thresholds used to conclude whether an impact would be significant. Measures to mitigate potentially significant impacts accompany each impact discussion, where applicable.

Potential impacts are evaluated for multiple species and life stages. Habitat utilized by these species/life stages varies spatially and temporarily. To account for the spatial and temporal distribution, evaluation criteria were modeled in Lakes Mendocino and Sonoma, as well as at multiple locations along the Russian River and Dry Creek (Figure 4.3-2). Evaluation criteria were developed for each species/life stage at the appropriate location and time of year. The Russian River was subdivided into the Upper Russian River between the East Fork Russian River and Dry Creek, the Lower Russian River from the Russian River confluence with Dry Creek to the Pacific Ocean, and Dry Creek from Warm Springs Dam to its confluence with the Russian River.

Significance Criteria

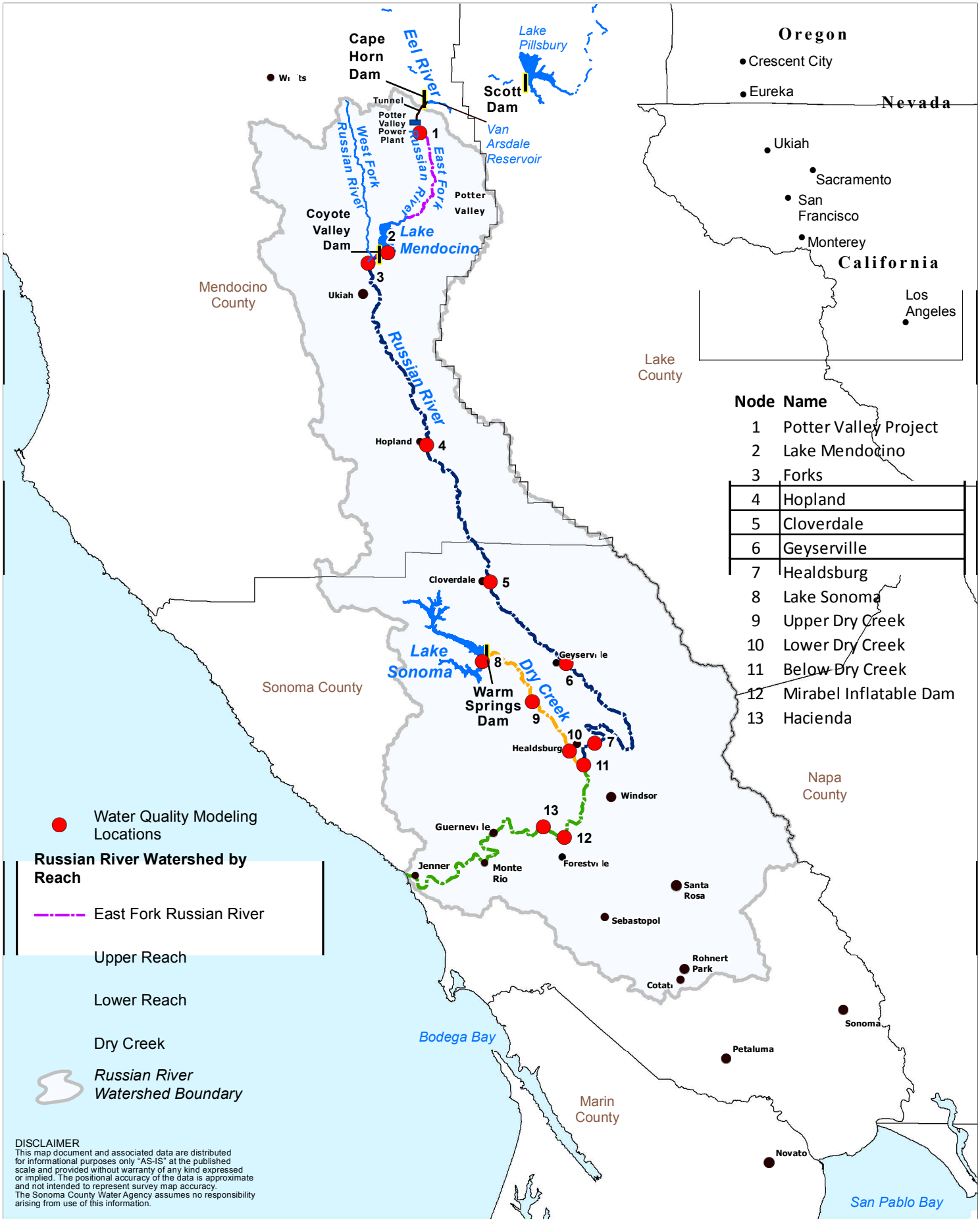
Based on the Appendix G of the CEQA Guidelines, project implementation would have significant impacts and environmental consequences on fisheries resources if it would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, regulations, or by the California Department of Fish & Game or U.S. Fish and Wildlife Service.
- Interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery site.
- Conflict with any local policies or ordinances protecting biological resources, such as tree preservation policy or ordinance.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

The impact analysis for wetland and biological resources such as riparian habitat are discussed in Chapter 4.4, “Vegetation and Wildlife.”

Based on the nature and function of the Proposed Project, the following criteria included in Appendix G of the CEQA Guidelines do not apply to this analysis and are not discussed further, as explained below.

- Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved plan.



Fish Habitat Flows and Water Rights Project

Water Quality Modeling Locations

Figure 4.3-2

There are no adopted habitat conservation plans, natural community conservation plans, or other approved plan for the project area and, therefore, impacts related to conflicts with such a plan are not applicable and are not further discussed. Please see Section 4.3.5 for general plan consistency and local policies or ordinances. Plans related to vegetation and wildlife resources are discussed in Chapter 4.4, “Vegetation and Wildlife.”

Methodology

The impact analysis below compares the elements of the Proposed Project and alternatives with the baseline or existing conditions within the project area. As described in Chapter 4.0, “Environmental Settings, Impacts and Mitigation Measures,” Baseline Conditions consists of minimum instream flow requirements included in the Water Agency’s water right permits as established by the State Water Resources Control Board’s Decision 1610 and the Russian River Estuary Management Project with a target water elevation in the Estuary of 7 feet (range 4.5 to 9 feet) from May 15 to October 15. Flow throughout the Russian River, Estuary, and Dry Creek during the rainy season from November to April is largely influenced by rainfall and tributary inflows. Proposed Project instream flows are most relevant during the dry season (May to October) when releases from Lake Mendocino and Lake Sonoma contribute a large portion of the flows to the Russian River and Dry Creek.

Changes in instream flow in the Russian River and Dry Creek, as well as fluctuations in Lake Mendocino and Lake Sonoma, could affect migratory or resident fish depending on the timing and degree of change in flow, and are unique to the species assessed. Impacts on biological resources are evaluated based on the likelihood that special-status animal species, wildlife corridors and nursery sites, and other protected biological resources are present within the project area (as discussed in Section 4.3.2, Environmental Setting), and the likely effects that changes in lake levels and stream flows may have on these resources.

The analysis of the effects of the project alternatives on fisheries resources emphasizes impacts on special-status aquatic species and habitats as wells as the movement of any resident or migratory fish species, or the use of fisheries rearing site, which were assessed by determining changes in Lake Mendocino and Lake Sonoma water surface elevations and changes in Russian River and Dry Creek flows. Modeling using historic hydrology data was used to simulate surface elevations in the two reservoirs and flows downstream of the reservoirs and the corresponding changes under project conditions. Projected changes in reservoir surface elevations and stream flow were then compared against Baseline Conditions to determine potential impacts, including changes in habitat accessible to special-status species. Please see Chapter 3, “Background and Project Description,” and Chapter 4.1, “Hydrology,” for modeling results and for a detailed description of Baseline Conditions.

Analyzing the potential impacts to the seven special-status species with potential to occur in the project area would likely cover impacts to the remaining species as well. A potentially confusing aspect to the impact analysis is that a project impact could be considered both positive and negative to the aquatic ecosystem overall. If a project component enhances the smallmouth bass population, this would constitute a benefit for recreation. However, smallmouth bass are predatory, and an increase in their population could potentially increase predation on salmonid

and other species of concern: a negative impact. A hierarchical approach will be used to assess impacts to the aquatic ecosystem. Highest priority will be given to impacts to ESA listed species; secondly to species of concern and other native species; and last to non-native species. Using this approach, any predation by non-native species will be considered a negative impact. Conversely, predation by a native species would only be considered a negative impact if the rate of predation is perceived to be enhanced by a project component. The rational for this is that species such as pikeminnow inhabit the Russian River independent of the human intervention, and would be a predator on salmonids under natural conditions.

Russian River Model

Water Quality

A water quality model of the Russian River (RMA 2007) was developed using HEC 5Q to simulate how changes in flow affect water temperature and dissolved oxygen in Lakes Mendocino and Sonoma, Dry Creek, and the Russian River downstream of Warm Springs and Coyote Valley dams. Simulated flow for Baseline Conditions, No Project 1 Alternative, No Project 2 Alternative, and the Proposed Project were generated using the Russian River Reservoir Simulation Model (Russian River ResSim – please see Appendix G for details) and used as input into the water quality model. Meteorological conditions were based upon California Irrigation Management Information System (CIMIS) data from stations at Hopland and Santa Rosa for 1989 to 2013. The model was calibrated using water quality field observations from 1990 to 2005. Further validation of the model was completed in 2015 using data from 2000 to 2013. The HEC 5Q water quality model is described in further detail in Appendix G. Water temperature and DO levels were modeled at the Russian River ResSim nodes (Figure 4.3-2) as well as 2 miles and 4 miles downstream from the confluence of the east and west forks of the Russian River, at Geyserville, and at Lambert Bridge (Dry Creek) to assess the potential for the Proposed Project to affect these parameters (Figure 4.3-2).

Water surface elevations

The Russian River ResSim Model was used to estimate changes in water level elevations at Lakes Mendocino and Sonoma that would result from the Proposed Projects and Baseline. The Baseline Condition was used to estimate lake levels under existing conditions and these levels are compared to those modeled to occur under the No Project 1, No Project 2, and Proposed Project.

Summer Rearing Habitat

To analyze the how changes in minimum instream flows may alter the quantity of summer rearing habitat a two dimensional hydraulic model (Russian River River2D) was employed. The Russian River River2D model assessed project-related impacts to steelhead and Chinook salmon fry and juvenile rearing habitat in the Russian River upstream of Cloverdale (Sonoma County Water Agency 2016). The Russian River River2D modeled habitat over a range of flows encompassed by the proposed releases from the three project alternatives and Baseline Conditions (Sonoma County Water Agency 2016). The model estimated depths and velocities within reaches of the river over a range of simulated flows. These predicted depths and velocities were then linked to a Habitat Suitability Index (HSI) for different salmonid species and

life stages to quantitatively estimate the quantity and quality of habitat in each reach. The quantity of habitat is often expressed as Weighted Usable Area (WUA), the amount of habitat (measured in square meters) in a reach adjusted, or "weighted," by habitat quality. The amount of WUA can be compared at different simulated flows to estimate how a range of flows effect salmonid habitat in a modeled reach. Project releases dominate flow during the summer months. River flow is dominated by reservoir releases earlier in the summer nearer to the dams. In the Upper Russian River from the forks down to Hopland (in some years) reservoir releases often dominate flow from May through October. Downstream of Hopland significant amounts of unimpaired flow can increase flows above that which is released from the reservoir well into July. This period coincides with the spring and summer rearing life stages for Chinook salmon and steelhead. Flows modeled for River2D where those expected to present in the mainstem Russian River during the summer rearing period under Baseline Conditions and under a range of alternatives.

Steelhead

Juveniles

Data collected in 2013 for the Russian River River2D study show that there is little change in velocity WUA (WUA that includes only the suitability of estimated velocity, but excludes the suitability of estimated depths or cover) for juvenile steelhead at the Hopland, Comminsky Station, and Cloverdale study sites across the range of modeled flows (25 to 260 cfs). At the Ukiah study site, velocity WUA would increase from 25 to 105 cfs, then steadily decreased from 105 to 310 cfs. Nonetheless, there is an improvement WUA as a percent of wetted area as flows decrease at all reaches. Since a reduction in releases from CVD could lead to a reduction in wetted area it is important to consider both metrics.

The relationship between velocity, depth, and cover suitability also should be considered since changes in releases from CVD affect velocity, depth, and cover and change the total amount of juvenile steelhead rearing habitat in a reach. Depth, velocity, and cover availability form the mainstay of salmonid (physical) habitat. Juvenile salmonids actively select a range of depths and velocities that maximize individual fitness and survival. The preferred range of depths and velocity (and cover types) change as the animal grows, generally shifting from shallow, low velocity habitat for fry, to deeper faster water for larger juveniles. Physical habitat quality and quantity will change in response to flow.

The Russian River River2D model estimated the amount of WUA based on monthly median flows (predicted by the Russian River ResSim model) under different project alternatives. The estimates provided data to analyze impacts to juvenile rearing habitat. Model results show that steelhead juvenile WUA would increase with minimum instream flows from approximately 25 cfs to approximately 100 cfs at all sites. From approximately 100 cfs to 250 cfs, a slight increase occurs. The WUA for steelhead juveniles range from 2,167 m^2 to 7,791 m^2 depending on flow and the reach modeled (Figure 4.3-3). Under Baseline Conditions, monthly median flow in the Upper Russian River (estimated by Russian River ResSim at the forks of the Russian River near Ukiah, Hopland, and Cloverdale) range from 163 to 259 cfs May through November. The amount of WUA for Juvenile steelhead that occurs for the median flow from May through

November range from 3,498 m^2 to 7,795 m^2 and varies by the flow and reach modeled (Table 4.3- 5). For Baseline Conditions, the total amount of steelhead juvenile WUA combining all River2D reaches range from 23,832 m^2 to 23,949 m^2 depending on the month (Table 4.3- 6).

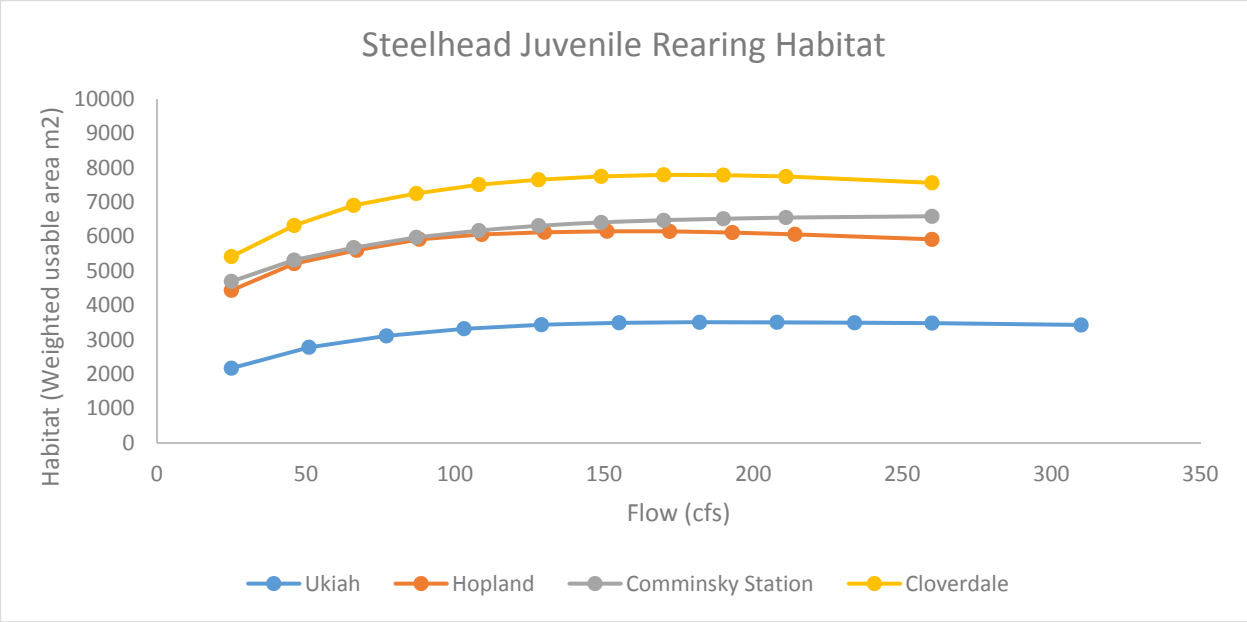


Figure 4.3-3. The estimated habitat (weighted usable area, WUA, in square meters) for steelhead juveniles at Ukiah, Hopland, Comminsky station, and at Cloverdale based on River2D. Flow is the flow that occurred in each reach.

Table 4.3-5. The estimated amount of weighted usable area (WUA) for steelhead and Chinook fry and juveniles in River2D reaches using the monthly median flow (from the nearest node) from Russian River ResSim under Baseline Conditions. Dashes indicate that this life stage would not be present in the Upper Russian River for these months.

species	life stage	WUA% change from baseline at River2D Reach	May	Jun	Jul	Aug	Sep	Oct	Nov
Steelhead	Juveniles	Ukiah	3,512	3,512	3,506	3,497	3,508	3,512	3,491
		Hopland	6,066	6,080	6,080	6,035	6,091	6,140	6,146
		Comminsky	6,581	6,548	6,548	6,556	6,528	6,498	6,498
		Cloverdale	7,673	7,773	7,773	7,755	7,795	7,800	7,800
	Fry	Ukiah	1,066	1,066	-	-	-	-	-
		Hopland	1,459	1,452	-	-	-	-	-
		Comminsky	1,415	1,485	-	-	-	-	-
		Cloverdale	1,052	1,108	-	-	-	-	-
Chinook	Juveniles	Ukiah	1,609	-	-	-	-	-	-
		Hopland	4,170	-	-	-	-	-	-
		Comminsky	5,029	-	-	-	-	-	-
		Cloverdale	4,696	-	-	-	-	-	-
	Fry	Ukiah	1,133	-	-	-	-	-	-
		Hopland	2,177	-	-	-	-	-	-
		Comminsky	2,313	-	-	-	-	-	-
		Cloverdale	1,732	-	-	-	-	-	-

Table 4.3-6. The total estimated amount of weighted usable area (WUA) for steelhead and Chinook fry and juveniles when combining all River2D reaches under Baseline Conditions monthly median flows. Dashes indicate that this life stage would not be present in the Upper Russian River for these months.

Species	Life stage	May	Jun	Jul	Aug	Sep	Oct	Nov
steelhead	Juvenile	23,832	23,913	23,907	23,843	23,921	23,949	23,936
	fry	4,993	5,111	-	-	-	-	-
Chinook	Juvenile	15,504	-	-	-	-	-	-
	Fry	7,354	-	-	-	-	-	-

Fry

The River2D model results show that steelhead fry habitat would change at all sites with a change in minimum instream flow. At the Ukiah reach, model results indicate that steelhead fry WUA would increase with minimum instream flows from approximately 25 cfs to approximately 250 cfs. At Hopland, model results indicate that the WUA would decrease from 25 cfs to approximately 100 cfs then slightly increase as flow increased to 250 cfs. As flows increased, model projections for the WUA at the Comminsky Station reach would gradually decrease over the range of flows modeled. At Cloverdale, the model projections for the WUA would sharply decrease as flow increased from 25 cfs to 250 cfs. The WUA for steelhead fry range from 967 m^2 to 2,337 m^2 depending on flow and the reach modeled (Figure 4.3- 4). For Baseline Conditions, the median flow in the Upper Russian River ranges from 200-237 (estimated at the forks of the Russian River near Ukiah, Hopland, and Cloverdale) during May through June. The modeled amount of steelhead fry habitat available for the monthly median flows for May through June range from 1,052 m^2 to 1,485 m^2 and varied by reach (Table 4.3- 5). However for comparison purposes it is important to consider the total amount WUA would be available when combining all River2D reaches. For Baseline Conditions, the total amount of steelhead fry WUA when combining all River2D reaches range from 4,993 m^2 to 5,111 m^2 depending on the month (Table 4.3- 6).

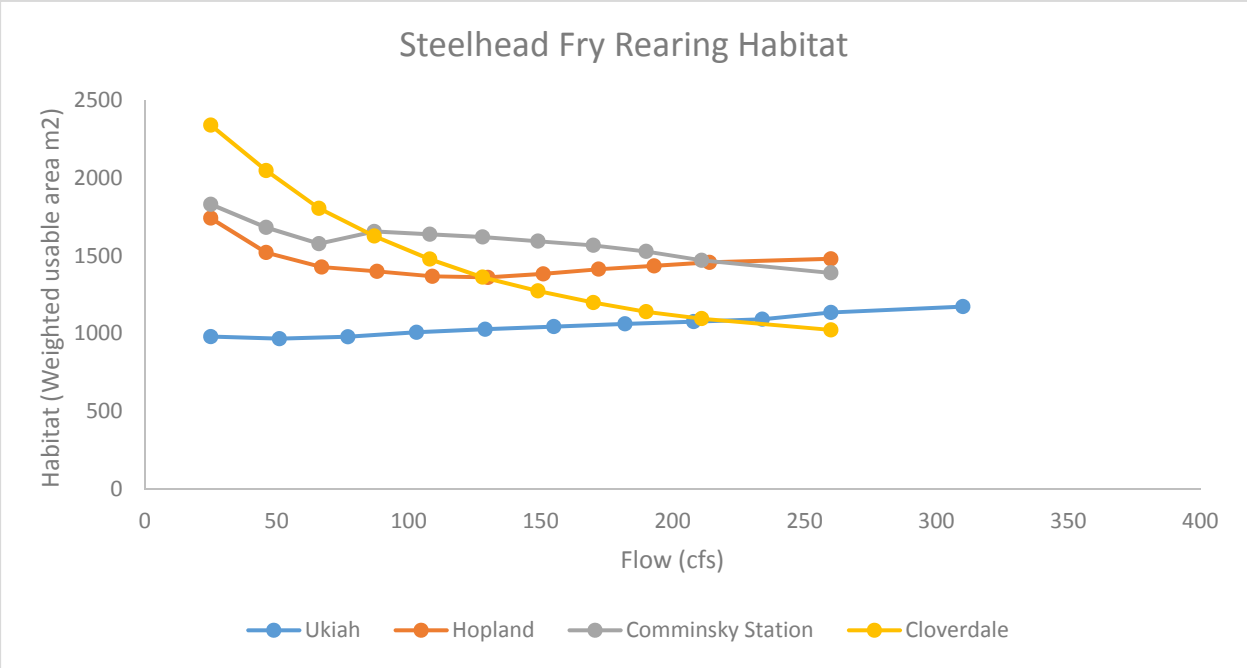


Figure 4.3-4. The estimated habitat (weighted usable area (WUA) in square meters for steelhead fry at Ukiah, Hopland, Comminsky station, and at Cloverdale based on River2D. Flow is the flow that occurred in each reach.

Chinook salmon

Fry

The River2D model results show that Chinook salmon fry habitat would change at all sites with a change in minimum instream flow. At the Ukiah reach, modeled results indicate that Chinook salmon fry WUA would slightly increase with flow from approximately 25 cfs to 250 cfs. At the other reaches, the model result indicate that habitat would decrease with an increase in flow. The WUA for Chinook salmon fry range from 1,072 m^2 to 3,316 m^2 depending on the flow rate and the reach modeled (Figure 4.3- 5). Under Baseline Conditions, median flow in the Upper Russian River (estimated at the forks of the Russian River near Ukiah, Hopland, and Cloverdale) range from 200 to 237 cfs during May, depending on the reach. The River2D model results indicate that the amount of habitat in the Ukiah, Hopland, Comminsky station, and Cloverdale reaches under the median flows during May range from 1,133 m^2 to 2,313 m^2 and varied by reach (Table 4.3- 5). For Baseline Conditions, the total amount of Chinook salmon fry WUA combining all River2D reaches is 7,354 m^2 (Table 4.3- 6).

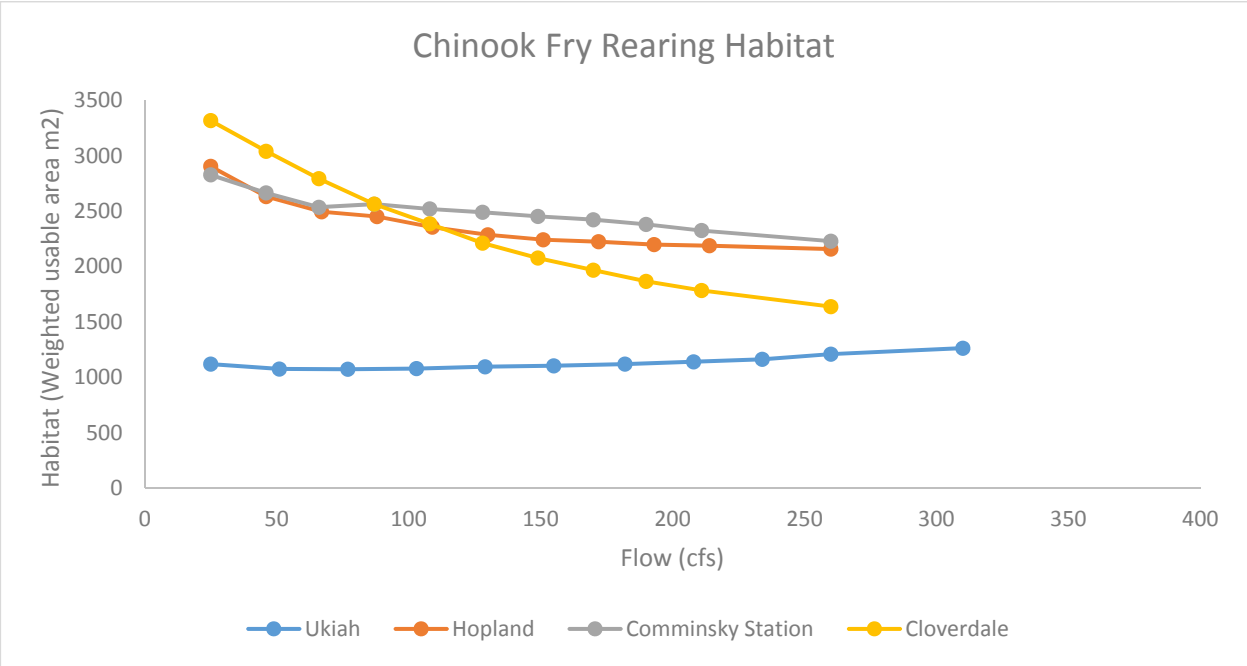


Figure 4.3-5. The estimated habitat (weighted usable area, WUA, in square meters) for steelhead juveniles at Ukiah, Hopland, Comminsky station, and at Cloverdale based on River2D. Flow is the flow that occurred in each reach.

Juveniles

The River2D model results show that WUA for Chinook salmon juveniles would increase with instream flow from approximately 25 cfs to 70 cfs at all sites. From approximately 70 cfs to approximately 250 cfs, a slight decrease occurs. The WUA for Chinook salmon juveniles range from 1,331 m^2 to 5,358 m^2 depending on flow and the reach modeled (Figure 4.3- 6). For Baseline Conditions, modeled monthly median flows in the Upper Russian River (estimated at the Forks of the Russian River near Ukiah, Hopland, and Cloverdale) during May range from 200 cfs to 237 cfs depending on the reach. The modeled results for the amount of WUA that

occur range from 1,609 m^2 to 5,029 m^2 and vary by reach (Table 4.3- 5). For Baseline Conditions, the total amount of Chinook salmon juvenile WUA combining all River2D reaches is 15,504 m^2 (Table 4.3- 6).

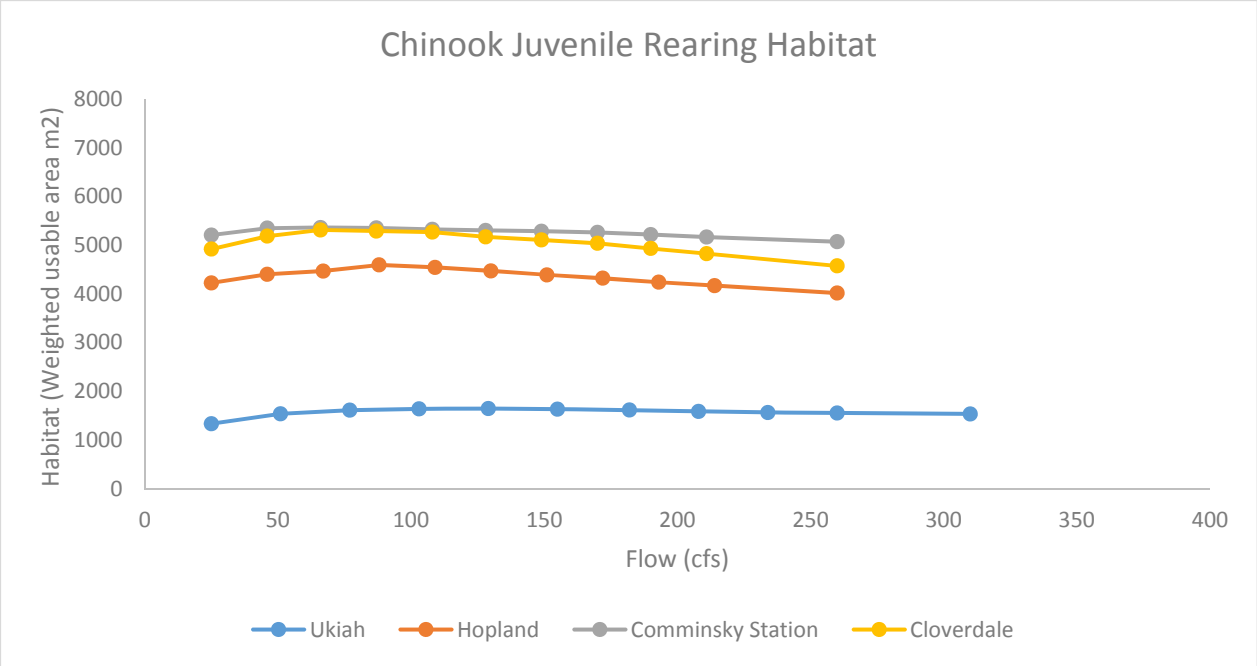


Figure 4.3-6. The estimated habitat weighted usable area (WUA) in square meters, for steelhead juveniles at Ukiah, Hopland, Comminsky station, and at Cloverdale based on River2D. Flow is the flow that occurred in each reach.

Coho salmon

Coho salmon habitat does not occur in the mainstem of the Russian River. As discussed in the life history section of this chapter, coho salmon habitat is limited to the selected tributaries located primarily in the Lower Russian River, including Dry Creek and a few of its tributaries. The Water Agency is implementing 6 miles of habitat enhancements in Dry Creek that are intended to improve habitat for coho salmon and steelhead. However these enhancements were built recently and are not part of Baseline Conditions.

Dry Creek

Instream flows in Dry Creek are managed by reservoir releases from Warm Springs Dam. Under Baseline Conditions monthly median flows range from 93 cfs to 118 cfs from May through November (Table 4.3 -7).

Table 4.3-7. The monthly median flows (cfs) estimated by Russian River ResSim for the mouth of Dry Creek for Baseline Conditions.

Alternative	May	Jun	Jul	Aug	Sep	Oct	Nov
Baseline	109	93	93	93	93	93	118

Dry Creek is used by Chinook salmon and steelhead for rearing habitat, but under Baseline Conditions provides almost no coho habitat. ENTRIX (2003) found that Dry Creek provided minimal habitat for coho salmon. For Baseline Conditions and at the time of ENTRIX (2003) conducted their study, the minimum instream flows in Dry Creek were in accordance with the Water Agency's water right permits and the SWRCB's Decision 1610 adopted in 1986.

The National Marine Fisheries Service (NMFS) issued its *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River Watershed* (Russian River Biological Opinion) on September 24, 2008 (see Chapter 3, "Background and Project Description," for additional information on the Russian River Biological Opinion). NMFS concluded that the continued operations of Coyote Valley Dam and Warm Springs Dam by the USACE and the Water Agency in a manner similar to recent historic practices are likely to jeopardize and adversely modify critical habitat for endangered Central California Coast coho salmon and threatened Central California Coast steelhead (NMFS 2008, 14).

Since the issuance of the Biological Opinion, the Water Agency has conducted annual electrofishing surveys in Dry Creek. Each year multiple sites are visited, and as often as three times a year. Combining all surveys up to 2015, 18,118 steelhead and 117 coho have been captured during these surveys.

Salmonid Upstream Migration and Spawning

Adult passage

Adult salmon require a particular stream depth suitable to access their spawning grounds and successfully spawn. In the Russian River, adult Chinook spawn on riffles primarily in the Upper Russian River and in Dry Creek. Coho salmon spawn in tributaries to the Russian River and Dry Creek the bulk of which are located downstream of Healdsburg. Steelhead spawn in the tributaries to the Russian River and Dry Creek as well as in the upper mainstem Russian river, and in Dry Creek (see "Environmental setting" in Fisheries Chapter). Minimum depths that allow for adult salmonid passage is not well defined in the literature and will be discussed further in this section. Depths in rivers are largely a function of flow. The lowest flow that still creates depths suitable for fish passage is often referred to as a "passage flow." The Water Agency used three lines of evidence to identify passage flows in the Russian River by 1) surveying the depths of shallow riffles in the Russian River; and 2) verifying that adult salmonids could pass these sections of river by operating an underwater video camera upstream of these riffles; and 3) conducting Chinook salmon spawning surveys during periods of low flow to confirm that salmonids successfully accessed their spawning grounds.

Minimum stream depths at which adult salmonids are able to successfully migrate have received little attention in the literature. The criterion most commonly cited is from “Determining Stream Flow for Fish Life” (Thompson 1972). This was a presentation at a symposium, and represented the Oregon Department of Fish and Wildlife’s (formerly the Oregon State Game Commission) criterion for a depth that provides suitable passage conditions for Chinook salmon (0.8 feet). Thompson (1972) suggests that passage is unimpeded when the shallowest riffle in a river has a riffle crest that is at least 0.8 feet deep. However, this does not provide insight into depths where migration is impeded or prevented. Thompson's criterion was based on measurements of fish morphology and not observations of fish behavior. Thompson (1972) states that to his knowledge this criteria has never been tested in the field. Salmonids have been observed moving upstream at shallower depths (SWRCB 2013; Mosely 1982; USGS 2005). A study in the Eel River found that Chinook could access spawning grounds above rifles with a maximum riffle crest depth of 0.6 feet (VTN 1982). The USGS (2005) and Sutton et al. (2006) concluded that the Thompson criterion was too restrictive and opted to follow Scott et al. (1981) and selected 0.6 feet as a minimum depth suitable for Chinook salmon passage. They noted that Chinook salmon have been observed migrating through water as shallow as 0.2 feet deep (USGS 2005). The Water Agency has documented Chinook salmon upstream of riffles that failed to meet the Thompson Criterion as well. In the Russian River, shallow areas (less than 0.8 feet deep) tend to be very short in linear distances, and would not require a significant effort by an adult Chinook salmon to traverse to deeper water.

In the Russian River and Dry Creek there has been limited data collected on the depths required for adult salmonids to access their spawning grounds or the flows that may provide these necessary depths. However, some data was collected in 2013 during a drought which required lower minimum instream flows to preserve water supply in Lake Mendocino through a dry period. In order to conserve water supply in Lake Mendocino throughout the 2013 drought the Water Agency petitioned the SWRCB to reduce minimum instream flows in the Russian River in April of 2013. From May 1, through October 28, 2013 minimum instream flows were reduced from 185 cfs in the Upper Russian River to 75 cfs and from 125 cfs in the Lower Russian River to 85 cfs. After October 28, 2013 the SWRCB’s temporary urgency change order expired and minimum instream flows specified in D1610 went into effect. The storage in Lake Mendocino at that time of year was such that minimum instream flows for a dry spring 2 condition was specified by D1610. During a dry spring 2, minimum flows in the Upper Russian River are 75 cfs and minimum instream flows in the Lower Russian River are the same as during a normal year, which is 125 cfs (SWRCB 2013). A second temporary urgency change petition was submitted to the SWRCB in December to reduce minimum instream flows and the SWRCB issued a new temporary urgency change order. Under the new order, minimum instream flows in the Upper Russian River were reduced as low as 25 cfs during the beginning of 2014, although tributary inflow often resulted in much higher flows (SWRCB 2013). There was some uncertainty as to whether Chinook could access their spawning grounds and successfully spawn during the 2013 drought because flows were historically low.

To address these concerns the Water Agency conducted surveys to investigate the spawning success of adult salmonids in 2013 (Smith 2013). In total 18.5 river miles (RM) of stream were surveyed to identify and measure shallow riffles that may delay or prevent upstream migration

by Chinook salmon in 2013-14. The entire Lower Russian River from Mirabel to Cassini Ranch was surveyed from a kayak in order to identify the shallowest riffles downstream of Mirabel. In addition to kayak based surveys, the water agency conducted adult Chinook counts at the Mirabel fish ladders, located at RM 25, and used these observations to provide an estimate of river flow needed for Chinook to reach the ladders. The Water Agency used spawner surveys upstream of the Mirabel fish ladders to confirm that Chinook reached spawning sites. At a subset of these spawning sites, the Water Agency collected additional depth and velocity information to describe the conditions that fish were experiencing. The Water Agency focused on Chinook salmon because they are, on average, the largest salmonid in the river and would require the greatest depth for migration.

Over 20 riffles were measured for these surveys and the Water Agency found that many shallow riffles (max depth less than 1 foot) occur over the range of flows observed during the surveys (75-115 cfs measured at the nearest USGS stream gage). Of the riffles surveyed the four shallowest riffles were located at Casini Ranch near Duncans Mills, at Monte Rio, at Badger Park near Healdsburg, and Geyserville (near Hwy 128). Maximum depths were 0.6 feet for Cassini Ranch, 1.1 feet for Monte Rio when the river mouth was closed, 0.8 feet for Monte Rio when the river mouth was open, 0.6 feet for Badger Park, 0.7 at Geyserville (near Hwy 128) at 114 cfs and 0.6 feet at Geyserville (near Hwy 128) at 48 cfs (gaged at the USGS stream gage at Hacienda (USGS gage number 11467000) (SCWA 2014)). In 2015, a shallow riffle was measured in the lower Alexander Valley reach which was not surveyed in 2013. The deepest part of the riffle crest was 0.7 feet deep when measured on September 15, 2015 at a flow of 83 cfs (measured at the USGS Jimtown gage (USGS gage number 11463682), Table 4.3- 8).

Table 4.3-8. The location and maximum depth at the riffle crest of the shallowest riffles measured during shallow riffle survey in the Russian River. The flow measured at the nearest USGS stream gage is also show.

Location	Max Depth (ft.)	Stream Gage	flow	Comments
Cassini Ranch	0.6	Hacienda	90	
Monte Rio	1.1	Hacienda	75	River mouth closed
Monte Rio	0.8	Hacienda	90	River mouth open
Badger park	0.6	Diggers Bend	80	
Geyserville	0.7	Cloverdale	114	
Geyserville	0.6	Cloverdale	48	
Alexander Valley	0.7	Jimtown	83	

A flow of 130 cfs in the Lower Russian River, when measured at the USGS stream gage at Hacienda (USGS gage number 11467000) provides depths suitable for salmonid passage. Relatively few Chinook salmon were observed at the Mirabel fish ladder at a flows less than 125 cfs at the USGS stream gage at Hacienda, although since the Chinook run was first monitored in 2000 flows below 125 cfs at the USGS stream gage at Hacienda (USGS gage number 11467000) occur infrequently during the Chinook migration season. However, large numbers (up to 213 and 589 in a day) of Chinook salmon have been observed at Mirabel when flow at

the USGS stream gage at Hacienda (USGS gage number 11467000) was 130 to 135 cfs (Figure 4.3- 7). At this flow riffles downstream of Mirabel would be at least 0.6 ft. deep (Table 4.3- 8). These observations suggest that a flow of 130 cfs when measured at USGS stream gage at Hacienda (USGS gage number 11467000) provides sufficient depths to allow salmonid passage through the Lower Russian River.

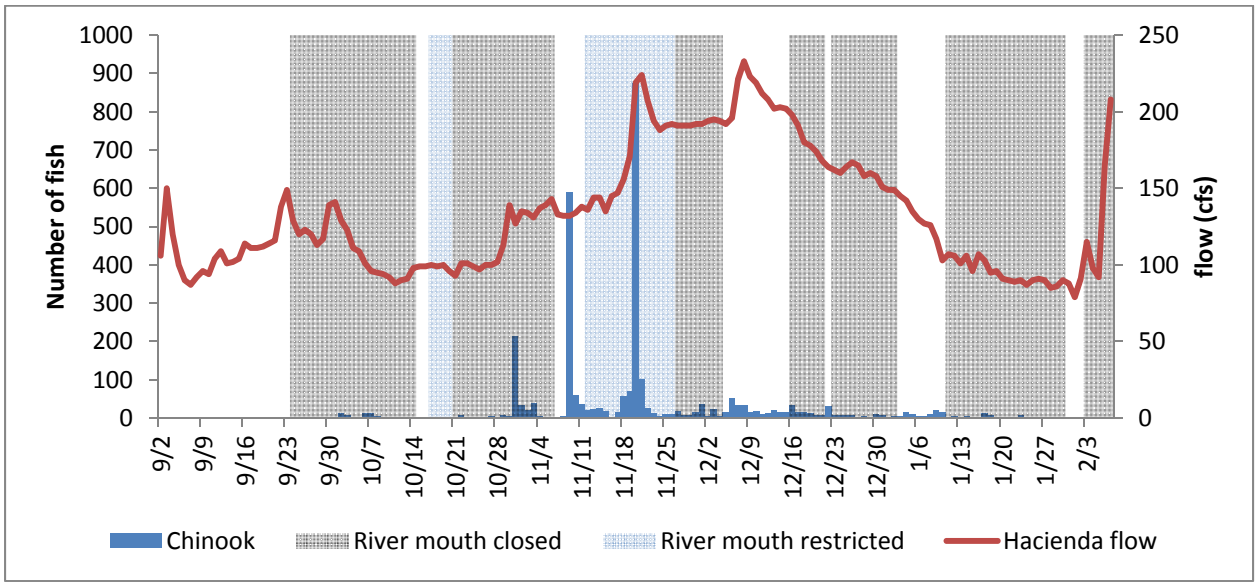


Figure 4.3-7. The number of adult Chinook observed in the Russian River at Mirabel in 2013-14. Also, shown are average daily river flow at Hacienda and barrier beach closures at the river mouth which limit Chinook from entering the Russian River.

The Water Agency conducted spawner surveys in the Upper Russian River and noted that a flow of 110 cfs measured at the USGS stream gage at Healdsburg (USGS gage number 11464000) provides depths sufficient for salmonid passage in this section of river. Chinook were observed as far upstream as Hopland during a period of time when flow had not exceeded 110 cfs at the USGS stream gage at Healdsburg for over 75 days. Furthermore, Chinook accessed Alexander Valley, and Hopland reaches when flow at USGS Healdsburg gage (USGS gage number 11464000) never exceeded 110 cfs from September 1, 2013 to the date surveys observed Chinook in the Upper Russian River on November 12 and November 14, 2013 (Smith 2013). These observations suggest that depths are sufficient for salmonid passage in the Upper Russian River when flow is 110 cfs measured at USGS stream gage at Healdsburg (USGS gage number 11464000).

Riffle depths were not measured in Dry Creek, but Kayak based Chinook redd surveys have shown that adult Chinook can access Dry Creek spawning areas when flow is at least as low as 98 cfs measured at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350). At this flow riffle depths are sufficient to allow for salmonid passage. In 2014 kayak based adult Chinook spawner surveys were conducted in Dry Creek from Warm Springs Dam to the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350. The first survey occurred on October 22, 2014 when flow at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350) was 82 cfs. During this survey 2 Chinook redds and no

adult Chinook salmon were observed. Additional surveys were conducted on November 5, November 19, and November 25, 2014. During this 34 day period (October 23 through November 25, 2014) flow ranged from 59 to 98 cfs at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350), 74 cfs to 91 cfs at the USGS Dry Creek gage near Geyserville (USGS gage number 11465240) and 77 cfs to 89 cfs at the Warm Springs Dam. In total 128 Chinook redds and 11 adult Chinook salmon were observed during these 3 surveys. Of the 128 Chinook redds observed during these surveys, 78 were observed in the upper 1/2 of Dry Creek (upstream of Lambert Bridge, Table 4.3- 9). This indicates that adult Chinook salmon can migrate through Dry Creek in flows of approximately 90 cfs.

Table 4.3-9. The total number of Chinook salmon redds observed during redd surveys that occurred in Dry Creek in 2014 shown by survey date.

Survey Date	Lower Dry Creek	Upper Dry Creek	Total
10/22/2014	1	1	2
11/5/2014	5	5	10
11/19/2014	22	34	56
11/25/2014	23	39	62
Total	51	79	130

In summary, field studies conducted in previous years have gathered data that can be used to identify flows that provide stream depths suitable for salmonid passage (Smith 2013, Martini-Lamb and Manning 2014). Based on these studies a flow of 110 cfs when measured at the USGS stream gage at Healdsburg (USGS gage number 11464000) was considered to provide sufficient depths in the Upper Russian River for salmonid passage. Field studies have shown that fish can traverse the section of river between Healdsburg and Cloverdale when flow is 110 cfs measured at the USGS stream gage at Healdsburg (USGS gage number 11464000). It is likely that fish would also be able to access the remainder of the Upper Russian River at a flow of 110 cfs as some Chinook have been observed as far upstream as Hopland when flow was 110 at Healdsburg (USGS gage number 11464000). Water Agency studies found that depths are sufficient for salmonid passage in the Lower Russian River at a flow of 135 cfs at the USGS stream gage at Hacienda (USGS gage number 11467000). High numbers of Chinook salmon were observed at Mirabel when flow was 135 cfs when measured at the USGS stream gage at Hacienda (USGS gage number 11467000) further supports that this flow is adequate for salmonid passage in the Lower Russian River. Surveys observed Chinook salmon spawning throughout Dry Creek indicate a flow of 90 cfs measured at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350) is adequate to provide Chinook passage through Dry Creek (Table 4.3- 10).

Table 4.3-10. Flows that provide salmonid passage in the Russian River

Reach	Stream gage	Passage flow (cfs)
Upper Russian River	Healdsburg	110
Lower Russian River	Hacienda	135
Dry Creek	Mouth of Dry Creek	90

Under Baseline Conditions adult Chinook passage flows occur frequently. Chinook salmon enter the Russian River and begin staging in the estuary in October, but in most years the bulk of the upstream migration occurs from October 15, through December (Figure 4.3- 8). Chinook spawning habitat is located in the Upper Russian River and in Dry Creek, but Chinook must also traverse the Lower Russian River to access these spawning areas. Under Baseline Conditions, flows are sufficient for Chinook upstream migration for 65% to 100% of the time varying both temporally and spatially (Table 4.3- 11).

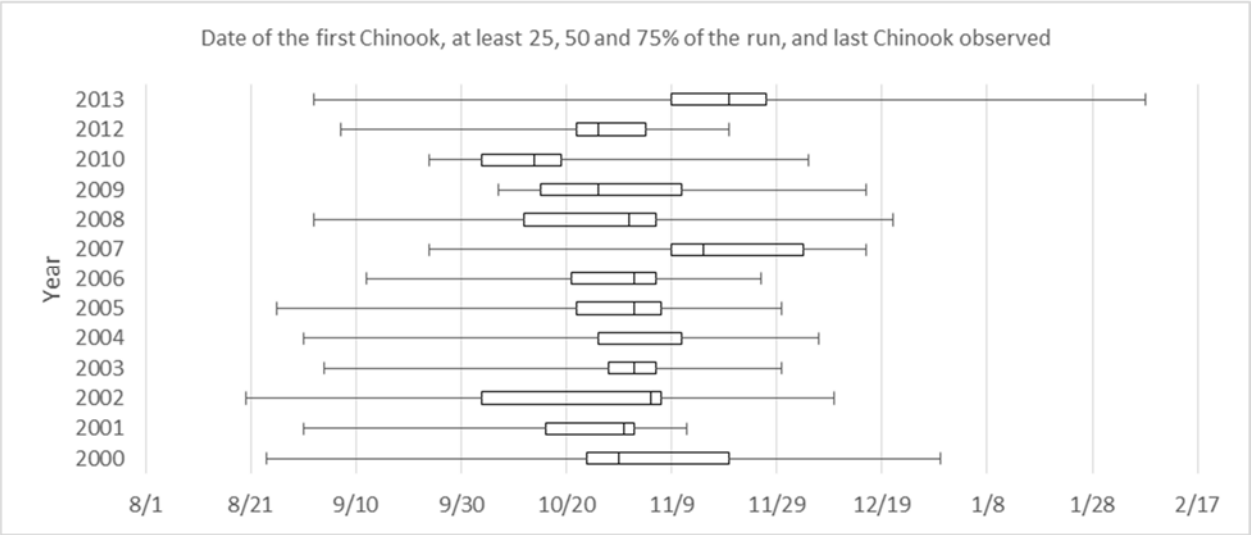


Figure 4.3-8. The date that the first and last Chinook were observed on video cameras at the Mirabel fish ladders shown as whiskers, and the date that at least 25%, 50%, and 75% of the run were observed which are shown as boxes. In most years the video cameras were installed on September 1. The video cameras were removed during the onset of the first major storm each year. This often coincides with the date the last fish was observed.

Table 4.3-11. The percent occurrence that passage flows occur for Chinook salmon under Baseline Conditions.

Reach	Gage	Passage flow (cfs)	Oct 15-31	Nov	Dec
Upper Russian River	Healdsburg	110	65%	87%	96%
Lower Russian River	Hacienda	135	90%	97%	100%
Dry Creek	Mouth of Dry Creek	90	95%	95%	97%

Coho passage flows occur frequently under Baseline Conditions. Coho spawning habitat is mainly located in tributaries to the Lower Russian River and tributaries to Dry Creek, although some spawning may occur in mainstem Dry Creek. Upstream of Healdsburg, there is limited spawning habitat in a few tributaries to the Russian River. While most of the coho spawning habitat is located outside of the project area coho must traverse the Lower Russian River and

Dry Creek, and to a lesser extent the Upper Russian River in order to access their spawning habitat. The while coho may stage in the Russian River estuary as early as October, the coho migration period is from November to February. Under Baseline Conditions flows are sufficient for coho upstream migration for 87% to 100% of the time. The percent of time that coho can migrate upstream varies temporally and spatially (Table 4.3- 12).

Table 4.3-12. The percent occurrence that passage flows occur for coho salmon.

Reach	Gage	Passage flow (cfs)	Nov	Dec	Jan	Feb
Upper Russian River	Healdsburg	110	87%	96%	98%	98%
Lower Russian River	Hacienda	135	97%	100%	100%	99%
Dry Creek	Mouth of Dry Creek	90	95%	97%	90%	96%

Under Baseline Conditions steelhead are able to access their spawning grounds relatively frequently. Most of the steelhead spawning habitat is located outside of the project area in the tributaries to the Russian River and in tributaries to Dry Creek. Some steelhead spawn in the Upper Russian River near Hopland and in the Mainstem of Dry Creek. In order to access these habitats steelhead must be able to move upstream through the Lower Russian River, the Upper Russian River, and through Dry Creek. The steelhead migration period is from December through March. The percent of the time that upstream migration flows are sufficient for steelhead varies by month and by location, but in general steelhead can access their spawning grounds 90% to 100% of the time under Baseline Conditions (Table 4.3- 13).

Table 4.3-13. The percent occurrence that passage flows occur for steelhead.

Reach	Gage	Passage flow (cfs)	Dec	Jan	Feb	Mar
Upper Russian River	Healdsburg	110	96%	98%	98%	100%
Lower Russian River	Hacienda	135	100%	100%	99%	100%
Dry Creek	Mouth of Dry Creek	90	97%	90%	96%	100%

Spawning

The Water Agency used a two-dimensional hydraulic mode for habitat modeling and Chinook spawning surveys to identify flows of 130 cfs in the Upper Russian River (gaged at the USGS gage station at Healdsburg (USGS gage number 11464000) and 90 cfs in Dry Creek (gaged at the USGS gage station at the mouth of Dry Creek (USGS gage number 11465350) that provide suitable spawning habitat for salmonids. Adult salmonids require adequate depth and velocity to construct viable redds. Depth and velocity are reliant on the quantity of flow in a river. The Water Agency used a two dimensional habitat model of depths and velocities in the Upper Russian River and related these to Chinook and steelhead preferences in order to estimate the quantity of spawning habitat in the Upper Russian River at different flows. The Water Agency also conducted salmonid spawning surveys in the Upper Russian River and in Dry Creek to document the success of adult salmon spawning.

Based on habitat modeling Chinook and steelhead spawning habitat is present in sufficient quantities when flow in the Russian River is approximately 130 cfs (gaged at the USGS gage station at Healdsburg (USGS gage number 11464000)). The Water Agency used a two

dimensional model to estimate hydrologic conditions (depth and velocity) suitable for Chinook and steelhead spawning. Adult salmon spawning habitat suitability criteria have not been constructed for the Russian River; however Chinook and steelhead spawning habitat suitability criteria from other rivers (e.g., Clear Creek, Gard 2011) (Table 4.3- 14) are available in the literature. The Water Agency collected bathometric data at Ukiah, Hopland, Commisky station, and Cloverdale for a complementary study (Sonoma County Water Agency 2016). In past years the Hopland, Commisky station, and Cloverdale reaches were not used (or used very infrequently) by adult Chinook and steelhead for spawning (Cook 2008; Martini-Lamb and Manning 2014), therefore these reaches were excluded from the analysis of adult spawning habitat. In general, habitat modeling at the Ukiah reach indicated that the amount (Weighted Usable Area (WUA)) of Chinook and steelhead spawning habitat increased with an increase in flow up to approximately 130 cfs (gaged at the USGS gage station at Healdsburg (USGS gage number 11464000)) after which little additional Chinook or steelhead spawning habitat became available with an increase of flow (Figure 4.3- 7, and Figure 4.3- 9 and Figure 4.3-10). Observations from spawning surveys in the Upper Russian River support the model results, that a flow of 130 cfs (gaged at the USGS gage station at Healdsburg (USGS gage number 11464000)) provides depth and velocity conditions which are suitable for Chinook salmon spawning.

Table 4.3-14. Chinook and steelhead spawning habitat suitability criteria (from Gard 2011).

Chinook

Water Velocity (ft/s)	SI Value
0	0
0.09	0
0.1	0.06
0.15	0.08
0.22	0.1
0.29	0.12
0.36	0.14
0.43	0.17
0.5	0.21
0.57	0.24
0.64	0.29
0.71	0.33
0.78	0.38
0.85	0.43
0.92	0.48
0.95	0.5
0.99	0.53
1.06	0.59
1.13	0.64
1.2	0.7
1.27	0.75
1.34	0.8
1.41	0.84
1.48	0.88
1.55	0.92
1.62	0.95
1.69	0.97
1.76	0.99
1.83	1
1.97	1
2.04	0.99
4.15	0.5
6.31	0

Water Depth (ft)	SI Value
0	0
0.4	0
0.5	0.39
0.6	0.59
0.7	0.76
0.8	0.88
0.9	0.95
1	0.99
1.1	1
6.7	0
100	0

Steelhead

Water Velocity (ft/s)	SI Value
0	0
0.6	0
0.61	0.08
0.7	0.14
0.8	0.25
0.9	0.38
1	0.53
1.1	0.66
1.2	0.78
1.3	0.87
1.4	0.94
1.5	0.98
1.6	1
1.7	1
1.8	0.99
1.9	0.97
2	0.95
2.1	0.93
2.2	0.9
2.3	0.87
2.4	0.85
2.5	0.82
2.6	0.8
2.7	0.78
2.8	0.76
2.9	0.73
3	0.7
3.1	0.66
3.2	0.61
3.3	0.56
3.4	0.49
3.5	0.41
3.6	0.33
3.7	0.25
3.8	0.17
3.89	0.11
3.9	0
100	0

Water Depth (ft)	SI Value
0	0
0.3	0
0.4	0.16
0.5	0.26
0.6	0.38
0.7	0.51
0.8	0.64
0.9	0.75
1	0.85
1.1	0.92
1.2	0.96
1.3	0.99
1.4	1
1.5	1
28.6	0
100	0

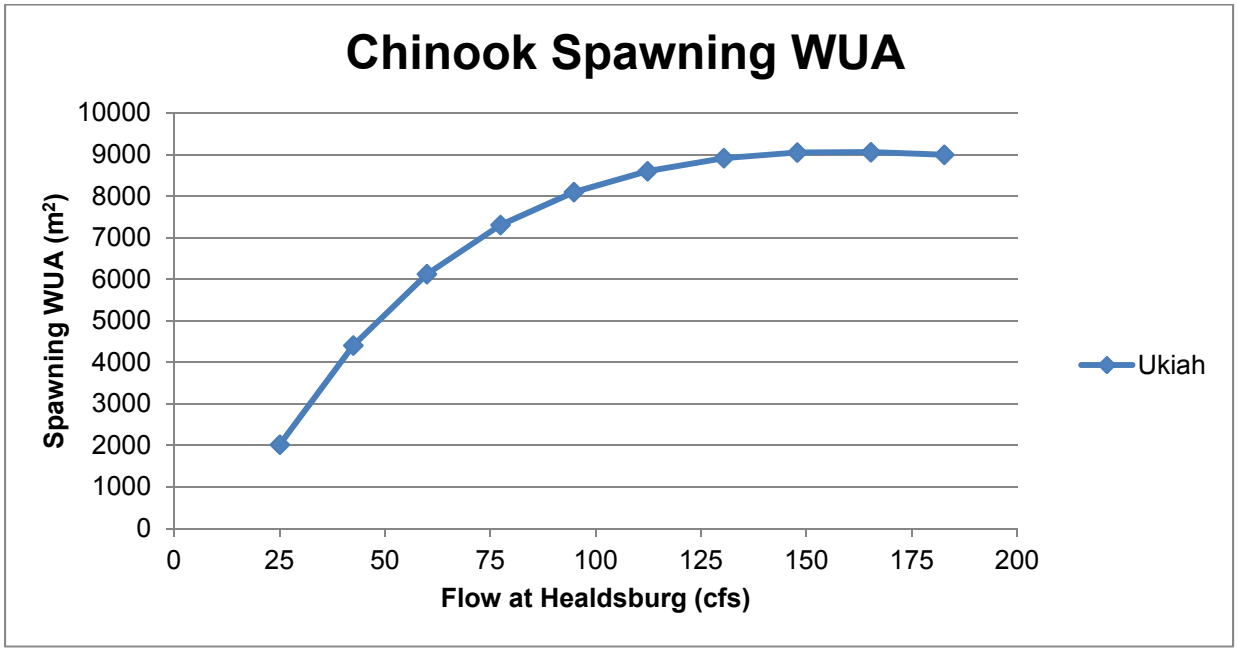


Figure 4.3-9. The weighted useable area for Chinook spawning shown in square meters for the Ukiah modeling reach (SCWA unpublished data). Habitat is modeled using flow from within the modeled reach, but is related to and reported using the flow that occurred at Healdsburg during the same time.

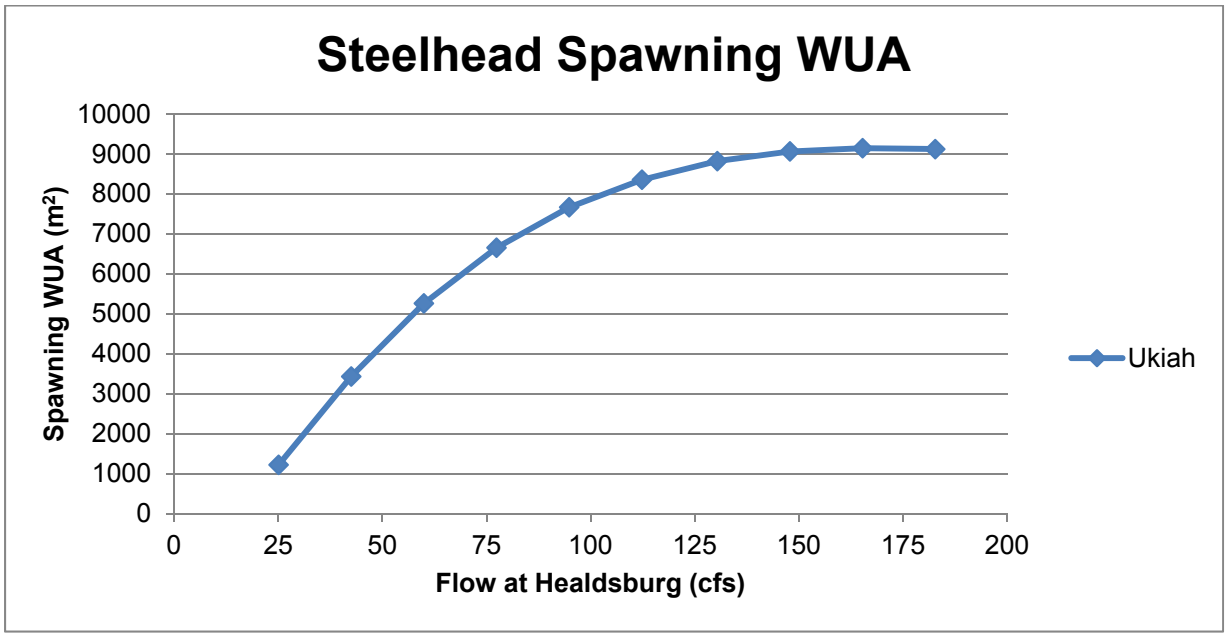


Figure 4.3-10. The weighted useable area for steelhead spawning shown in square meters for the Ukiah Modeling reach (SCWA unpublished data). Habitat is modeled using flow from within the modeled reach, but is related to and reported using the flow that occurred at Healdsburg during the same time.

Based on spawning surveys, depths and velocities suitable for Chinook spawning are present in the Upper Russian River at a flow of 130 cfs (gaged at the USGS gage station at Healdsburg (USGS gage number 11464000)). Chinook salmon were observed spawning in the Upper Russian River during a single pass redd survey (362 redds over 75 river miles (SCWA unpublished data)) when flow was approximately 130 cfs in the upper Russian River. Flow from September 1, 2013 to when surveys were completed on December 10, 2013 was 134 cfs or less when gaged at Healdsburg (USGS gage number 11464000), and 137 cfs or less when gaged at Hopland (USGS gage number 11462500). Unused spawning habitat was available in Geyserville at 115 cfs (gaged at the USGS gage station at Geyserville (USGS gage number 11463500), based on measured areas of suitable depth and velocity in riffles used for spawning in previous years (Smith 2013). Therefore it is likely that a flow of 130 cfs when gaged at Healdsburg (USGS gage number 11464000) provides adequate Chinook spawning conditions (suitable depths and velocities) in the Upper Russian River.

In Dry Creek a flow of 90 cfs when gaged at the USGS gage at the mouth of Dry Creek (USGS gage number 11465350) is likely more than adequate to provide suitable depths and velocities for Chinook spawning. Surveys in 2014 found Chinook could access and spawn in Dry Creek at flows ranging from 91-98 cfs at USGS gage at the mouth of Dry Creek (USGS gage number 11465350), although lower flows may provide spawning habitat as well (for more details see the description of Dry Creek spawner surveys in the “Adult Passage” section of this chapter). Therefore a flow of 90 cfs when measured at the USGS gage at the mouth of Dry Creek (USGS gage number 11465350) is likely more than sufficient to provide suitable depths and velocities for Chinook salmon spawning.

In summary, studies conducted in the Russian River and Dry Creek have identified flows that provide spawning habitat conditions (depth and velocity) for adult Chinook salmon. Based on habitat modeling and spawner surveys a flow of approximately 130 cfs when measured at the USGS stream gage at Healdsburg (USGS gage number 11464000) provides spawning habitat throughout the Upper Russian River and a flow of 90 cfs measured at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350) provides spawning habitat in Dry Creek. These flows are likely conservative and Chinook may spawn at lower flows. Since steelhead are smaller than Chinook and spawn in smaller substrate flows of 130 cfs when measured at the USGS stream gage at Healdsburg (USGS gage number 11464000) should be more than adequate to provide spawning habitat in the Upper Russian River and flows of 90 cfs measured at the USGS stream gage at the mouth of Dry Creek (USGS gage number 11465350) should be more than adequate to provide spawning habitat in Dry Creek. Coho are also smaller than Chinook and would be able to spawn at similar flows, but coho spawning habitat within the project area is limited to Dry Creek (Table 4.3- 15).

Table 4.3-15. Flows that provide suitable spawning conditions for Chinook and steelhead in the Upper Russian River and for Chinook, steelhead, and coho in Dry Creek.

Reach	Stream gage	Spawning flow (cfs)
Upper Russian River	Healdsburg	130
Dry Creek	Mouth of Dry Creek	90

Under Baseline Conditions flows that allow for suitable spawning conditions occur frequently. Chinook salmon spawn in the Upper Russian River and in Dry Creek. The Chinook salmon spawning season begins in November and continues through February. Flows are sufficient for spawning 72% to 98% of the time and vary temporally and spatially (Table 4.9- 16). Within the project area (Lake Mendocino, Lake Sonoma, mainstem Russian River from Coyote Valley Dam to the Pacific Ocean and Dry Creek from Warm Springs Dam to the Russian River) coho spawning habitat is limited to Dry Creek. Coho spawning occurs from December through February. During this time the frequency that spawning flows occur in Dry Creek ranges from 83% to 97% of the time and varies by month (Table 4.3- 16). Steelhead spawning habitat within the Project area is limited to the Upper Russian River near Hopland and in Dry Creek. The steelhead spawning season occurs between December and March. During this time flows are sufficient for steelhead spawning 72% to 100% of the time based on Russian River ResSim modeling results (Table 4.3- 17).

Table 4.3-16. The percent occurrence that flows which have been shown to provide Chinook spawning habitat occur in the Russian River and in Dry Creek based on Russian River ResSim modeling results.

Reach	Gage	Spawning flow (cfs)	Nov	Dec	Jan	Feb
Upper Russian River	Healdsburg	130	72%	88%	97%	98%
Dry Creek	Mouth of Dry Creek	90	95%	97%	90%	96%

Table 4.3-17. The percent occurrence that flows which provide steelhead spawning habitat occur in the Russian River and in Dry Creek based on Russian River ResSim modeling results. Coho spawning occurs during this time range, but is limited to Dry Creek.

Reach	Gage	Spawning flow (cfs)	Dec	Jan	Feb	Mar
Upper Russian River	Healdsburg	130	88%	97%	98%	100%
Dry Creek	Mouth of Dry Creek	90	97%	90%	96%	100%

Water Temperature and Dissolved Oxygen Requirements

Water temperature directly affects an organism's ability to survive, grow, and reproduce. Within a species-specific tolerance range, as water temperature increases, growth rate and other metabolic activities also increase. Water temperatures above or below this range may result in an increased susceptibility to disease and predation, a reduction in swimming performance, and a reduction in growth rates. Ultimately, excessively low or high temperatures can result in direct mortality (excessively low temperatures do not occur in Russian River and will not be discussed). Factors such as dissolved oxygen levels, food availability, and exposure to

predation and diseases, influence the effects of temperature on fish growth and survival. The effects of water temperature vary by life stage (e.g., embryos are less tolerant of high temperatures than juveniles) and by the ecological variable being considered (e.g., disease resistance versus maximum growth rates). The significance of this is clear when considering the potential impacts associated with different ecological variables impinging on a population. Impacts associated with diseases are reduced at very cold temperatures. Conversely, growth is maximized at relatively warm temperatures. Larger fish are more competitive with smaller conspecifics, are better able to avoid predation, and have higher overall survival rates. Thus, maximizing temperature for one variable (e.g., resistance to disease) may decrease the suitability of another variable (e.g., growth).

Under natural conditions, water temperatures vary on a daily and seasonal basis, and are seldom within the optimal range for a particular species for extended periods of time. This is particularly true for the Russian River which is located near the southern edge of the range for coastal salmonids. Further, habitat conditions vary depending on position in the watershed. The significance of this fact on the distribution of fish communities within a river system is that some reaches of the Russian River would not provide suitable summer rearing habitat for salmonids under natural conditions. This is borne out by the fact that several warm water species (e.g. hardhead, Sacramento pikeminnow, and Sacramento sucker) thrived in the Russian River prior to water management activities in the watershed (e.g., USFCC 1892; Snyder 1908).

Critical temperatures that limit production and survival of salmonids vary widely in the literature. Verhille et al. (in Press) found that steelhead living in the lower Tuolumne River maintained 95% of peak aerobic scope between 64 and 76° F. Their results suggested that the Tuolumne River population may be locally adjusted to its river system, and that it may not be appropriate to apply criteria developed from geographically disparate systems. Although thermal criteria developed from more northern (and often from snowmelt driven systems) was used out of necessity, it is possible that salmonids in the Russian River, like those in the Tuolumne River, may tolerate warmer temperatures compared to salmonids from colder climes where much of the water temperature data were developed. For example, McCullough *et al.* (2001) site data suggesting that the ability of steelhead to smolt is impaired at temperatures between 53.5 and 55.5° F while other studies reported that steelhead smolts were negatively affected at temperatures above 59.0° F. However, in 2016, the daily average water temperature recorded at the USGS stream gauge at Hacienda exceeded 55.5° F on March 25 at a flow of 5,400 cfs, and exceeded 59° F on April 3 at a flow of 1,700 cfs (well above required minimum instream flows, and likely unaffected by released from Project reservoirs). This suggest that Russian River steelhead are either able to complete the smolting process at higher temperatures, or that they complete the smolting process in tributaries and are able to travel to the Pacific Ocean before suffering ill effects of warm water.

Much of the literature analyzing the effects of temperature on fish is focused on determining “optimal” or lethal levels. However, even in pristine environments, fish often spend the majority of their time exposed to “suboptimal” conditions. Fish are able to survive, grow, and reproduce at temperatures above their theoretical “optimum.” Sullivan et al. (2000) modified Brett (1956)

generalized concept of the effects of temperature on salmonid. They used four categories (zones) with five physiological responses to relate the effects of temperature on growth and survival (Figure 4.3-11). There are two response within the "Zone of Preference;" "optimal" conditions where survival is maximized and growth occurs at all but starvation rations; and "suitable" temperatures where survival is high and growth occurs proportional to food availability. Within the "Zone of Tolerance," fish are becoming stressed; while mortality does not increase, growth may be compromised based on the length of exposure. Within the Zone of Resistance, fish are highly stressed. Survival and growth are decreased proportional to exposure. At the upper critical lethal limit, death occurs rapidly.

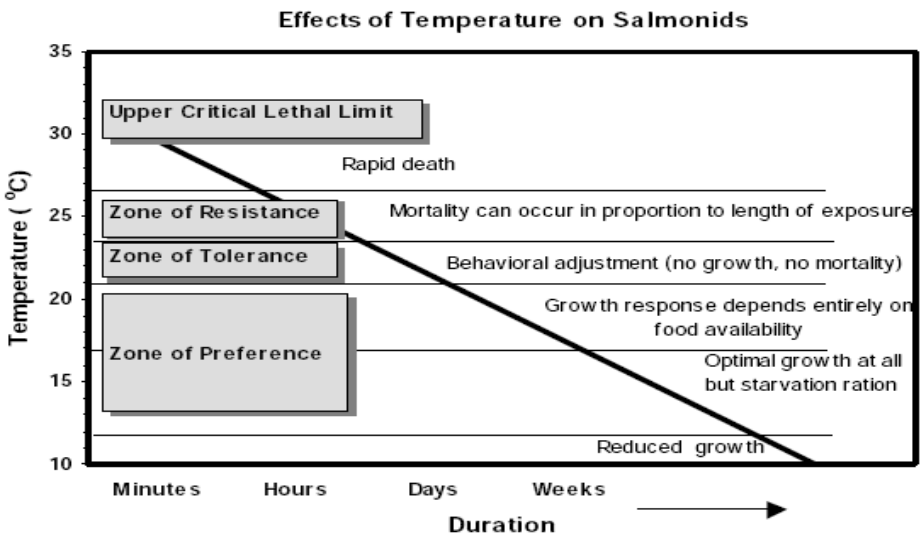


Figure 4.3- 11. General environmental effects of temperature on rearing salmonids in relation to duration and magnitude of temperature from (Sullivan, et al. 2000), page 2-2).

A key point in understanding thermal related impacts on fish is that they form a continuum that is influenced by both the actual temperature and the length of exposure. Exposure to very high temperatures for short periods of time can increase the rate of mortality; conversely, exposure to moderate warm temperatures for an extended period of time can result in negative impacts to growth and survival as well.

Temperature Assessment Criteria

Definitive criteria to assess the effects of temperature on fish are not available in the literature. Further, the effects of temperature on some life stages of each of the three listed species have been poorly studied, requiring the use of data from related species to "fill in" the gaps." All of this presents a dilemma for assessing the effects of modifying minimum instream flow requirements and its resultant effect on temperature on fish. Analyzing the average temperature between alternatives is instructive to assess the overall effect of changing flows; however, in some cases, small changes in temperature can have profound impacts to fish. Developing such a metric is complicated by the interactions of multiple variables (e.g., life stage, food availability, DO, disease, etc.) over the range of temperatures that fish can survive. In addition, recent

studies suggest that fish may become adapted to local conditions and may tolerate much wider range of temperatures than generally reported in the literature (e.g., Verhille et al. 2015). In addition, the influence of water temperature occurs over a continuum, with the effects ranging from "ideal" slowly degrading to lethal.

The potential for changes in water temperature to affect listed salmonids for each life stage will be assessed using three metrics.

1. Monthly mean[3] temperatures (mean daily temperatures averaged by month over the 104 year period of record) will be presented to provide an overview of thermal conditions under each alternative (No Project 1, No Project 2, and Proposed Project).

2. An "assessment criteria" (discussed below) will be used to put the overall suitability of the thermal regime for each species/life stage into perspective. The assessment criteria uses exceedance values (that is, the percentage of time that a value is exceeded during the 104 year period of record).

3. The change in the frequency of occurrence of stressful water temperatures (the percentage of time that water temperature exceeds selected values) will be used to assess the potential for high temperatures to affect salmonids.

Assessment Criteria Defined

Based on a review of the pertinent literature (cited in Tables 4.3-5 through 4.3-28), an ordinal scale ranging from 5 (optimal or "no impacts") to 0 (lethal) with "significant impacts" potentially occurring below a score of 3, was used to compare the effects of water temperature between the different alternatives with Baseline Conditions. Scoring criteria for each of 4 life stages for the 3 ESA listed salmonids in the Russian River watershed were developed:

- Optimal (score of 5): For each life stage, temperatures within this range maximize survival and fitness for the population. No temperature-related impacts occur within this range.
- Suitable (score 4.75 to 4.0): Temperature may exert some stress on individuals, but growth and survival of the population is not negatively impacted. No significant temperature-related impacts are expected within this range.
- Tolerance (score of 3.75 to 2.0): The tolerance zone transitions from "good" to "stressful" conditions. Temperatures within this range exert physiological stress on fish, and may reduce survival and fitness of individuals, depending on duration. However, fish generally do not display behavioral changes such as seeking out coldwater refugia. Short-term exposure to temperatures generally do not result in significant negative impacts. However, long-term exposure, particularly to the warmer end of this range, can result in significant impacts. The cooler half of this zone scores from 3.9 to 3.0 – fish are becoming stressed, growth may be reduced, but survival and overall fitness of the population is not significantly compromised. The lower scores (2.75 – 2.0) reflect the potential for the warmer half of the

[3] *Monthly mean is the mean of daily average values for each month in 104 years of model simulation. The Russian River ResSim models hydrology based on the historical hydrology from 1910 to 2013.*

transitional zone to increase physiological stress (e.g., decrease in growth rates and an increase in susceptibility to predation and diseases). Significant, negative impacts can occur within this range depending on duration of exposure.

- Resistance (score 1.75 – 0.25): Fish alter their normal behavior to cope with heat related stress. Behavioral changes include a reduction in feeding, increased or decreased agonistic behavior, and/or actively seeking coldwater refugia. Significant impacts occur proportional to the length of exposure. Short-term exposure may result in a minimal loss to the population. However, as exposure time increases, growth rates are reduced and mortality rates increase.
- Lethal (score of 0): Death may occur rapidly because of heat related stress. Significant impacts occur within a short period.

Species Specific Temperature Criteria

Although observational data are available for Chinook salmon, coho salmon, and steelhead in the Russian River, and continuous water temperatures measurements have been collected on the Russian River: there have been no site-specific water temperature studies on salmonids conducted in this watershed. The following temperature criteria was based on a review of the literature, in combination with observations of salmonids in the Russian River watershed.

Chinook Salmon

Adult migration: Chinook salmon are the first anadromous species to return to the Russian River each fall. Although some individual Chinook salmon enter the river as early as late August, the run typically peaks between mid-October and mid-November, with spawning typically beginning in mid-November, and continues through December. As a consequence of their early arrival in the river, adult Chinook may encounter relatively warm water during the beginning of the upstream migration. Fall Chinook salmon have been reported in the literature migrating at temperatures ranging from 43 to 67° F, with an optimal temperature of 43 to 60° F. In the Russian River, adult Chinook salmon have been observed migrating past the Mirabel Dam at temperatures up to 72.7° F; however, the majority of adult Chinook salmon are counted at the Mirabel Dam once temperatures have decreased below 60º F. Upstream migration by adult Chinook salmon in the San Joaquin River was reportedly halted when temperatures exceeded 70.0° F, but resumed when temperatures declined below 65° F. In the Klamath River, upstream migration was inhibited when water temperatures exceeded 73.5º F. (please see Table 4.3-18 for citations and Table 4.3-19 for the assessment criteria).

Embryonic development: Although adult Chinook salmon can withstand relatively high temperatures, multiple studies have demonstrated detrimental effects to spawning success when adults with eggs are exposed to temperatures lower than temperatures that impact adult fish. High temperatures affected not only egg development, but also reduce subsequent fry development and survival. High survival rates (hatching through fry stages) have been reported to occur at temperatures ranging from approximately 39 to 59° F. Eggs reared at temperatures above approximately 60° F have been reported to experience increasingly higher rates of mortality. Temperatures above approximately 65° F are reportedly lethal to developing

eggs/newly hatched Chinook (please see Table 4.3-20 for citations and Table 4.3-21 for the assessment criteria).

Rearing: Chinook begin to emerge during mid-February, and rear in the Russian River for approximately 2 to 4 months before emigrating to the ocean. Late migrating fish may encounter elevated water temperatures. Optimal temperatures for rearing Chinook salmon appears to be a tradeoff between cooler temperatures that reduce mortality from factors such as diseases and predation, and warmer temperatures that promote better growth and increase survival upon entry into the ocean. The preferred temperature range for juvenile Chinook salmon has been reported to range from 50 to 60˚ F; however, growth is maximized at temperatures ranging between approximately 60 and 69˚ F. Chinook reared at fluctuating temperatures between 62.6 and 68.0˚ F grew at rates similar to Chinook smolts reared at 55.4 to 60.8˚ F. Juvenile Chinook survived and grew at temperatures up to 75˚ F at ration levels found in the wild. However, the growth rates decreased for fish reared at temperatures above 71.5˚ F (please see Table 4.3-22 for citations and Table 4.3-23 for the assessment criteria).

Smolts: Chinook smolts migrate through the Lower Russian River primarily during April and May, but the run extends through July in some years. Chinook salmon are able to smolt at the highest temperatures of the three Russian River salmonids. Optimal temperatures for smolting range from 50 to around 63° F. Temperatures ranging between 63 and 68° F are marginal for smolting; However, smolts reared at temperatures within this range successfully adapted to saltwater, and did not experience a statistically significant increase in mortality during acute seawater test when compared to fish reared at 55.4 to 60.8° F. Water temperatures above 70.0° F have been reported to stop downstream migration of Chinook salmon smolts. In the Russian River, Chinook salmon have been captured in downstream migrant traps (presumed migrating) at a daily average temperatures of 71.8° F. However, the fate of these fish is unknown (please see Table 4.3-24 for citations and Table 4.3-25 for the assessment criteria).

Table 4.3- 18. Literature review of water temperatures and their effect on Chinook salmon: adult migrants.

Temperature (°F)	Effect	Citation
45 - 60	Preferred temperatures for upstream migration	Becker 1973[1]; Burrows 1963[1]
43 - 57	"Optimal" range for migration and pre-spawning broodstock survival	Marine 1992[1]
>60	Poor survival for adults held in hatcheries	Boles et al. 1988
57 – 67	Suitable temperature range for migration	NOAA 1997[1]
59 – 60	Optimal temperatures for adults with maturing eggs	NOAA 2000[1]
<64	Suitable for migrating adults	NMFS 2009[1]
64.5	Risk of disease increases	EPA 2003[1]
63.5 – 66	Embryonic mortality and abnormalities occur	Berman 1990[1]
62.5 – 68.0	Lethal limit for pre-spawning adults "probably falls" with the range	Marine 1992[1]
70	Upstream migration halted in the San Joaquin River (low DO levels may have been a contributing factor)	Hallock et al. 1970
73.4	Adult migration in the Klamath River was halted	Strange 2010
75.0	Lethal	Brett 1952

[1]Cited in Bratovich *et al*. 2004

Table 4.3-19. Water temperature assessment criteria for upstream migrating Chinook salmon.

Upstream migration: October 1 – November 15; Dry Creek and the Russian River			
Temperature (°F)	**Score**	**Descriptive rating**	**Significance**
≤60.0	5	Optimal	No impacts anticipated
60.1 – 64.0	4.75 – 4.00	Suitable	No significant impacts anticipated
64.1 – 67.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposure – Impacts tend to be less than significant Long term exposure – Impacts can be significant
67.1 – 74.9	1.75 – 0.25	Resistance	Significant impacts occur proportional to exposure
75.0	0.00	Lethal	Significant impacts occur over a short period of time

Table 4.3-20. Literature review of water temperatures and their effect on Chinook salmon: embryonic development

Temperature (°F)	Effect	Citation
35.5	100% mortality	Beacham and Murray 1989[1]
50	Preferred temperature for spawning anadromous salmonids	ISG (1996)[4]
39 - 53.5	Survival of eggs and alevins maximized (Central Valley stocks)	Myrick and Cech (2001)
53 - 57.5	Highest survival for Sacramento River stocks	Boles et al. (1988)
40 - 55	High survival of all life stages	Seymour (1956)[2]
55 - 57.5	<50% survival from eggs to sac-fry	Seymour (1956)[2]
53 - 58	Preferred temperatures (Central Valley stocks)	NOAA 2002b[1]
35 - 58	Recommended temperatures for egg incubation	Yoshiyama et al. 1998[1]
39 - 59	Survival to hatching ranged from 88 to 99.4 percent	Beacham and Murray 1989[1]
>60.0	Upper threshold for Chinook salmon eggs in Washington stressful conditions for anadromous salmonids Survival to yolk sac stage was zero Low survival for eggs incubated at temperatures	Combs and Burrows 1957[3] ISG (1996)[4] Seymour 1956[1] Johnson and Brice (1953)[2] Boles et al. (1988)
53 - 61	Survival was similar for eggs initially fertilized within the temperature range and then incubated at normal seasonal temperatures (43-54° F).	Olson and Foster (1957)[3]
60 - 62.5	Survival to sac fry was zero	Seymour 1956[2]
62 – 64	Physiologically limiting for Sacramento River stocks	USFWS 1999[1]
>65	Survival for eggs incubated at temperatures was zero	Johnson and Brice (1953)[3] Seymour (1956)[2]
70 - 79	Lethal temperature for spawning anadromous salmonids	ISG (1996)[4] Baker 1995 Brett 1952

[1]Cited in Bratovich *et al*. 2004
[2]Cited in Raleigh *et al*. 1984
[3]Cited in Boles *et al.* 1988
[4]Cited in Sauter *et al.* 2001

Table 4.3-21. Water temperature assessment criteria for spawning Chinook salmon and egg incubation.

Spawning/embryo development: November 15 – January 31; Dry Creek and the Upper Russian River			
Temperature (° F)	**Score**	**Descriptive rating**	**Significance**
53.5	5.00	Optimal	No impacts anticipated
53.5 – 58.0	4.75 – 4.00	Suitable	No significant impacts anticipated
58.1 - 60	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposure – Impacts tend to be less than significant Long term exposure – Impacts can be significant
60.1 – 64.0	1.75 – 0.25	Resistance	Significant impacts occur proportional to exposure
>64.0	0.00	Lethal limit	Significant impacts occur over a short period of time

Table 4.3-22. Literature review of water temperatures and their effect on juvenile Chinook salmon rearing.

Temperature (°F)	Effect	Citation
53.5 - 57	Preferred	Brett 1952
59	Mortality from columnaris increased	Bratovich *et al.* 2004
50 - 60	Balanced fish growth with potential for temperature related mortality	(McCullough *et al*. 1999
60	Disease infection rates increase	Bratovich *et al.* 2004
54.5 – 61.0 62.6 - 68.0 70 - 75	Compared with juvenile Chinook reared between 54.5 and 61.0° F, fish reared between 62.6 and 68° F grew at similar rates, but had more variable rates of predation. Fish reared between 70 and 75° F grew slowly, and suffered higher mortality rates.	Marine and Cech 2004
53 – 64	Optimal for growth and survival	Raleigh 1984[1]
65	Columnaris infection rates and mortality rates increase	Johnson et al. 1953[1]
59 - 66	Excellent growth occurred at test temperatures	Brett 1972
66.4	Mortality rate equal to growth rate	McCullough 1991
67 - 68	Optimum food conversion	Brett et al. 1982
<68	No significant reductions in growth rates when food was adequate; growth slowed at higher temperatures	Marine and Cech 2004
59.5 - 69	Growth maximized when food was not limiting	Myrick and Cech (2000)

[1]Cited in Bratovich et al. 2004

Table 4.3-22 (Continued). Literature review of water temperatures and their effect on juvenile Chinook salmon rearing.

Temperature (°F)	Effect	Citation
66.0 - 69	Growth maximized when food was not limiting	Brett et al. 1972
46.5 - 71.5	Number of salmon consumed by northern pikeminnow increased 14-fold between these temperatures	Vigg and Burley (1991)[5]
71.6	Prefer temperatures below this level	Myers et al. 1998[1]
75	Survived and grew at levels found in the wild	Marine and Cech 2004
74 - 79	Upper lethal limit (depending on acclimation temperature)	Brett 1952 Boles et al. 1988 Bell 1991 McCullough 1999 Myrick and Cech 2000

[1]Cited in Bratovich et al. 2004

Table 4.3-23. Water temperature assessment criteria for juvenile Chinook salmon rearing.

Pre-smolts (rearing): March 1 – June 1; Upper Russian River; March 1 – July 15; Dry Creek and Lower Russian River			
Temperature (° F)	**Score**	**Descriptive rating**	**Significance**
62.5	5.00	Optimal	No impacts anticipated
62.6 – 64.0	4.75 – 4.00	Suitable	No significant impacts anticipated
64.1 – 68.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposure - Impacts tend to be less than significant Long term exposure - can result in significant impacts
68.1 – 74.9	1.75 – 0.25	Resistance	Significant impacts occur proportional to exposure
≥75.0	0.00	Lethal Limit	Significant impacts occur over a short period of time

[2]Cited in Raleigh *et al*. 1984
[3]Cited in Boles *et al*. 1988
[4]Cited in Sauter *et al.* 2001

Table 4.3-24. Literature review of temperatures and emigrating Chinook salmon smolts.

Temperature	Results	Citation
<53.5	Maximum temperature to maintain migratory response and seawater adaption	Wedemeyer et al. 1980
55.5 - 61.0 62.5 - 68.0 70 - 75	Compared with juvenile Chinook reared between 54.5 and 61.0° F, fish reared between 62.5 and 68° F had more variable smoltification indices. Fish reared between 70 and 75° F exhibited impaired smoltification indices. Although mortality was higher in seawater challenges, the difference was not significant.	Marine and Cech 2004
50 - 62.5	Optimal for smolting	Zedonis and Newcomb 1997
50 - 63.5	Optimal for smolting	Myrick and Cech 2001
<64	Temperatures below this level are required for smolting	NMFS 2009
68	Successfully smolted (upper limit)	Marine 1997
62.5 - 68	Marginal for smolting	Zedonis and Newcomb 1997
70	Emigration halted	Boles et al. 1988

Table 4.3-25. Water temperature assessment criteria for emigrating Chinook salmon smolts.

Smolts: April 1 – June; Dry Creek and Lower Russian River			
Temperature	**Score**	**Descriptive rating**	**Impact severity**
≤62.5	5.00	Optimal	No temperature related impacts
61.1 - 64.0	4.75 – 4.00	Suitable	No impacts anticipated
63.6 - 68.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposure - impacts tend to be less than significant; Long term exposure - can result in significant impacts
68.1 - 74.9	1.75 – 0.25	Resistance	Significant impacts occur proportional to exposure
≥75.0	0.00	Lethal limit	Significant impacts occur over a short period of time

Coho Salmon

Adult migration: Spawning coho enter the Russian River primarily December through January, avoiding warm temperatures encountered by Chinook salmon (UCCE and SCWA unpublished data). Like Chinook salmon, the adults can withstand relatively warm temperatures; however, the fitness of their eggs and developing fry can be compromised by relatively low temperatures. Little information has been found assessing the impacts of water temperature and migrating adult coho salmon. Adults migrating through 62° F water apparently did not negatively affect egg development; however, water temperatures of 68° F negatively affected egg development. The lack of information for this life stage prevented the development of a species-specific assessment criteria. Based on run timing overlap, the assessment criteria for steelhead adult migration was applied to coho salmon (please see Table 4.3-26 for citations and Table 4.3-27 for the assessment criteria).

Embryonic development: Although eggs were not adversely affected when adults were exposed to temperatures of 62° F, a rapid deterioration in egg viability was observed when adults were exposed to temperatures warmer than 68° F. Temperatures of 40 to 53° F are considered suitable for spawning. Multiple studies have demonstrated that coho salmon embryo survival from fertilization to hatching was high between 41 and 53° F, but was markedly less at 35.5 and 57° F. In another study, mortality was 100 percent at test temperatures between 57 to 58° F (please see Table 4.3-28 for citations and Table 4.3-29 for the assessment criteria).

Rearing: The upper lethal level for juvenile coho salmon is relatively high (73.2 to 84.6), overall they have the most restrictive temperature requirements of the three listed species in the Russian River. Juvenile coho salmon reportedly rear at temperatures between 37.9 and 69.1° F, but prefer water temperatures between 50 and 59° F. In the Mattole River Basin the warmest tributaries supporting coho salmon had a mean week average temperature of 62° F. Juvenile coho seek out cooler water when temperatures exceed 71.5° F. Juvenile growth is maximized at temperatures between 52 and 62.5° F. Growth apparently stops at temperatures above 68.5° F. Physiological performance is maximized at temperatures above reported optimal conditions, for example, the maximum sustained swimming speed occurs at 68.0° F (please see Table 4.3-30 for citations and Table 4.3-31 for the assessment criteria).

Smolting: Little information was found in the literature regarding the effects of temperature on coho smolts. Smolting is apparently optimized at 57° F, impaired at 59° F, and reversed at 62.5 (please see Table 4.3-32 for citations and Table 4.3-33 for the assessment criteria). Criteria for smolting steelhead and Chinook salmon were used to fill in the gaps and complete the assessment criteria.

Table 4.3- 26. Summary of selective water temperatures and their effect on upstream migrating coho salmon.

Temperature (°F)	Results	Citation
62	No apparent adverse effects to eggs in utero caused by prolonged exposure	Bouck et al. (1970)[6]
68	Adults migrating through waters warmer than 68° F experienced reduced quality and more rapid deterioration of eggs.	Flett et al. (1996)[4]
69.8	Lethal temperature for spawning anadromous salmonids	ISG (1996) [4]

[4]Cited by Sauter *et al.* 2001
[6]Cited by WDOE 2002

Table 4.3- 27. Water temperature assessment criteria for upstream migrating coho salmon

Life stage: upstream migration (December - March; Mainstem and Dry Creek)			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤52.0	5.00	Optimal	No Impacts
52.1– 59.0	4.75 – 4.00	Suitable	No impacts anticipated
59.1 – 70.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
70.1 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
≥75.0	0.00	Lethal	Significant impacts occur over a short period of time

Table 4.3-28. Summary of selective water temperatures and their effect on spawning coho salmon and egg incubation.

Temperature (°F)	Results	Citation
50	Preferred temperature for spawning anadromous salmonids	ISG (1996)[4]
46.5 to 50	Optimal temperatures for spawning fish	WDOE 2002
41-53	Embryo survival from fertilization to hatching was high	Murray and McPhail 1988[6]
54.5	Alevin mortalities of 51-59%	Dong 1981[1]
57	Coho alevin survival was lower than at the other (41 – 53° F) incubation temperatures.	Murray and McPhail 1988[6]
57 - 58	100% mortality	Dong, 1981[6]

[4]Cited by Sauter *et al.* 2001
[6]Cited by WDOE 2002

Table 4.3-29. Water temperature assessment criteria for spawning coho salmon and egg incubation.

Spawning migration: December 1 – March; Dry Creek and Lower Russian River			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤50	5.00	Optimal	
50.1 – 53.0	4.75 – 4.00	Suitable	No impacts anticipated
53.1 – 54.5	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposure - impacts tend to be less than significant; Long term exposure - can result in significant impacts
54.6 – 57.0	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
>57.1	0.00	Lethal limit	Significant impacts occur over a short period of time

Table 4.3-30. Summary of selective water temperatures and their effect on juvenile coho salmon rearing.

Temperature (°F)	Results	Citation
49	No mortality from exposure to bacterial infection	Holt et al. 1975
50 – 59	Preferred range	Hassler 1987; Bell (1986)
49 - 57	selectively preferred	Piper et al. 1982[6]
57	Proposed that August-September stream temperatures should fluctuate between 52 – 62.5° F (mean 57° F) for optimal growth.	Averett 1969[6]
49	Preferred temperature for coho from parental stock originating from cold ground water supplied streams preferred 9.6°C (range 43 – 61° F),	Konecki, *et al.* 1995
53	Preferred temperature for coho from parental stock originating from warmer streams (range 44.5 - 70° F)	Konecki, *et al.* 1995
61.7	MWMT that minimizes loss of growth	Sullivan et al 2000
62	MWAT for coho bearing streams in the Mattole River Watershed	Welch et al. 2001
62.5	Growth maximized	Shelbourn 1980[6]
64	Mean Weekly Average Temperature (MWAT)	EPA 1977
64.4	Mean weekly maximum temperature (MWMT) for coho bearing streams in the Mattole River Watershed	Welch et al. 2001
66	Juvenile coho began utilizing cool water refuge	Sutton and Soto 2010
68	Physiological performance is maximized	Griffiths and Alderdice 1972
69	For coho exposed to bacteria, survival was zero	Holt et al. 1975
37.9 – 69.1	Reported rearing temperatures	Bell 1986
70	Coho had positive growth and showed no stress response. They were similar to cohorts reared at 61. Growth should not be impaired if there is access to thermal refugia when temperatures are ≥ 73.4	Foot et al., 2014
70 – 73.5	Absent when daily maximum temperatures exceed this range	Frissell et al. 1992[6]
71.6	Coho juveniles begin moving to cold water refuge	Bisson et al. 1988
73.2 – 84.6	Upper lethal limit depending on acclimation history	Brett 1952; Bell 1986, Konecki et al, 1995.

[6]WDOE 2002

Table 4.3-31. Water temperature assessment criteria for juvenile coho salmon rearing

Rearing: year around; Dry Creek			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤57.0	5.00	Optimal	
≤62.5	4.75 – 4.00	Suitable	No impacts anticipated
62.5 – 64.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
64.1 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
≥75.0	0.00	Lethal	Significant impacts occur over a short period of time

Table 4.3-32. Summary of selective water temperatures and their effect on coho salmon life stage: smolting

Temperature (°F)	Results	Citation
43 - 50	Optimal	Zedonis and Newcomb 1997
53.5	Impairment of smolting process	Wedemeyer et al. 1980
57	Smolting is optimized	Shelbourn 1980[6]
59	Impairment of smolting process	Zaugg and McClain 1976 McCullough et al. 2001
59	Tolerated for short periods of time	Zedonis and Newcomb 1997
62.5	Reverse the smoltification process	Zedonis and Newcomb 1997
50 - 68	ATPase activity and the associated parr-smolt transformation were accelerated in fish at 50 and 59° F whereas animals at 68° F experienced at best only a transitory elevation in activity.	Zaugg and Mclain 1976

[6]WDOE 2002

Table 4.3- 33. Water temperature assessment criteria for emigrating coho salmon smolts.

Smolt: March 1 – May 31; Lower Russian River; Dry Creek			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤50	5.00	Optimal	
50.1 – 57.0	4.75 – 4.00	Suitable	No impacts anticipated
57 – 62.5	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
62.6 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
≥75.0	0.00	Lethal	Significant impacts occur over a short period of time

Steelhead

The effects of water temperature on this steelhead vary greatly in the literature, which is not surprising for a species that occupies a geographic area ranging from (at least historically) Baja California to Alaska. For example, the upper lethal water temperature for steelhead has been reported to be 75.0° F; however, juvenile steelhead in the Eel River were observed feeding in surface waters with ambient temperatures up to 75.2° F (Nielsen et al. 1994).

Adult migration: Steelhead spawning migration occurs primarily from December through March in the Russian River. As a result, water temperature is rarely an issue for this life stage. Steelhead use essentially the entire watershed. Adult steelhead reportedly prefer temperatures between 46 and 52° F, with suitable ("preferred") condition ranging up to 59° F. Upstream migration reportedly stops at temperatures above 70 - 75° F. Temperatures above 70° F are stressful to adult steelhead (please see Table 4.3-34 for citations and Table 4.3-35 for the assessment criteria).

Embryonic development: Egg development occurs primarily from December through April in the Russian River watershed. Optimal temperatures for developing embryos range from 42 to 52° F. Embryonic survival was 96% at temperatures below 53.5° F, decreasing to 85% at 59° F in a separate study. Emerging alevins reared at 53.6° F were larger than those reared at 61° F (please see Table 4.3-36 for citations and Table 4.3-37 for the assessment criteria).

Rearing: Optimal water temperatures for juvenile steelhead range between 50 and 62.6˚ F. However, in the Eel River, juvenile steelhead were observed in relatively high densities where the maximum weekly average temperatures ranged between 68.0-71.6° F. Like coho, physiological performance is maximized at temperatures above "optimal" levels. Growth rates increase as temperature increases to a point, then rapidly decreases. Growth rate was higher at 66.2˚ F compared to fish reared at 52 – 59 ° F, suggesting improved food conversion efficiency at the higher temperature. For rainbow trout fed to satiation, an increase in temperature led to an increase in the maximum consumption rates. The high feeding rates decreased the negative effects of increased water temperatures, up to 72.5˚ F. However, above 72.5˚ F, feeding rates decreased, possibly due to temperature related stress. Growth and the size of the territory defended by dominant steelhead was reduced in the presence of juvenile pikeminnow at temperatures between 68.0-73.4° F, but growth was not reduced when the two species were held in treatment water ranging between 59.0 and 64.4° F.

In the Navarro River, significant increases in the heat shock protein (hsp) 72 was detected in wild steelhead parr when the short and long term daily average temperatures were 64.4 to 66.2˚ F, and daily maximum temperatures were 68.0 to 72.5˚ F. Although this study did not report on the ecological consequences of juvenile steelhead rearing at temperatures above 64.4˚ F (e.g., reduced growth, survival, etc.), the presence of hsp indicate that the fish were undergoing a response to an outside stressor (presumed to be temperature in this case), implying a physiological cost to the fish. Steelhead begin utilizing thermally stratified pools at temperatures above 71.6˚ F (please see Table 4.3-38 for citations and Table 4.3-39 for assessment criteria).

Table 4.3-34. Summary of selective water temperatures and their effect on steelhead upstream migration.

Temperature (°F)	Results	Citation
46 – 52	Preferred	NMFS 2000 McEwan and Jackson 1996 Stillwater 2006
50	Preferred temperature for spawning anadromous salmonids	ISG 1996[4]
50 – 59	Preferred for holding in freshwater	Moyle *et al.* 1995
60.0	Stressful conditions for anadromous salmonids	ISG 1996[4]
69.8	Lethal temperature for spawning anadromous salmonids	ISG 1996[4]
70	Upstream migration inhibited/chronic stress	Strickland (1967, cited by McCullough *et al.* 2001) Stillwater 2006
71.0 - 75	Upstream migration inhibited	Fish and Hanavan (1948)

Table 4.3-35. Water temperature assessment criteria for upstream migrating steelhead.

Life stage: upstream migration (December - March; Mainstem and Dry Creek)			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤52.0	5.00	Optimal	No Impacts
52.1– 59.0	4.75 – 4.00	Suitable	No impacts anticipated
59.1 – 70.0	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
70.1 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
≥75.0	0.00	Lethal	Significant impacts occur over a short period of time

Table 4.3-36. Summary of selective water temperatures and their effect on spawning steelhead and egg incubation.

Temperature (°F)	Results	Citation
42 – 52	Optimal for egg survival	Fuss 1988 Stillwater 2006
43 – 53.5	Embryonic mortality <4%	Rombough 1988 (cited by McCullough et al. 2001)
55	Stressful	Stillwater 2006
59	Embryonic mortality = 15%	Rombough 1988 (cited by McCullough et al. (2001)
53.6 – 61.0	Emerging alevin reared at 53.6° F were larger compared to those reared at 61° F	Redding and Schreck (1979) (cited by McCullough et al. 2001)

Table 4.3- 37. Water temperature assessment criteria for spawning steelhead and egg incubation.

Life stage: spawning (December - April; mainstem above Cloverdale and Dry Creek)			
Temperature	**Score**	**Descriptive rating**	**Impact severity**
≤52.0	5.00	Optimal	No Impacts
52.1 – 59.0	4.75 – 4.00	Suitable	No impacts anticipated
59.1 - 60	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
60.1 – 64.0	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
>64.0	0.00	Lethal	Significant impacts occur over a short period of time

Table 4.3-38. Summary of selective water temperatures and their effect on steelhead rearing.

Temperature (°F)	Results	Citation
50 – 59	Optimal range	Bell 1984, Bovee 1978 Barnhart 1986
62.6	Preferred temperature for steelhead wild Feather River steelhead.	Myrick and Cech 2000
59 – 64	Growth and size of territory are not affected by the presence of juvenile pikeminnow.	Reese and Harvey 2002
<65	Optimal	Stillwater 2006
64.5 – 66	Heat shock proteins detected in wild steelhead parr in the Navarro River, indicating the fish were experiencing stress.	Werner et al. 2005
66.2	Food conversion and growth maximized compared to fish reared between 52 - 59.	Myrick and Cech 2000
65 – 68	Suboptimal	Stillwater 2006
>68	Acute stress	Stillwater 2006
68 – 71.5	Eel River steelhead found in relatively high densities	Harvey et al. 2002
68.9	Upper threshold for the 7-day maximum temperature to minimize growth loss.	Sullivan et al. 2000
71.5	Steelhead seek out cool water refuges at tempeartures above 71.5	Nielsen et al. 1994
72.5	High feeding rates decrease the negative effects of increased water temperature. Above this point, feeding decreases.	Wurtsbaugh 1977
68 – 73.5	Growth and size of territory defended were reduced in the presence of juvenile pikeminnow.	Reese and Harvey 2002
63.3 – 76.5	Active in southern California streams	Spina 2006
64.0 – 76.3	Maintained aneropic scope at 95% of maximum	Verhille et al. 2015.
>71.5	Aggressive behavior increased and foraging decreased	Nielsen et al. 1994
>73.4	Steelhead began utilizing thermally stratified pools	Nielsen et al. 1994
75	Upper lethal limit	Bell 1986

[1]Cited by WDOE 2002
[2]Cited by Sauter et al. 2001

Table 4.3-39. Water temperature assessment criteria for juvenile steelhead rearing.

Life stage: juvenile rearing (April - November; mainstem above Cloverdale and Dry Creek)			
Temperature	**Score**	**Descriptive rating**	**Impact severity**
≤62.5	5.00	Optimal	No Impacts
62.5– 66.0	4.75 – 4.00	Suitable	No impacts anticipated
66.1 – 71.4	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant. Long term exposure – impacts may be significant
71.5 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
≥75.0	0.00	Lethal	Significant impacts occur over a short period of time

Smolting: Like all life stages for this species, the optimal and critical temperature ranges vary significantly in the literature. For example, significant impacts were reported in one study at temperatures above 53.5 to 55.5° F, and successful smolting was reported to occur at temperatures up to 59° F in another study. Steelhead require the coldest water temperatures for smolting of the three salmon species in the Russian River. Water temperatures in the Russian River are naturally warm compared to many steelhead streams. For example, a daily minimum and maximum water temperature of 56.5 and 60.3° F, respectively, were recorded at the USGS Hacienda streamflow gauge on May 1, 2010, at an average daily streamflow of 2,090 cubic feet per second (cfs). At this flow, water temperatures are controlled by atmospheric conditions. To cope with their restrictive temperature requirements, steelhead likely migrate earlier in the year compared to other salmonids in the basin. Presumed migrating smolts have been detected leaving basin tributaries between December and mid-May. In addition, the Russian River is a relatively short river compared to many steelhead streams, and emigrating smolts would be able to pass through the river in a short amount of time, possible reaching the ocean before experiencing thermal related stress (please see Table 4.3-40 for citations and Table 4.3-41 for the assessment criteria).

Temperature Requirements of Native and Recreationally Important Species

In contrast to salmonids, most of the other native fish species in the Russian River watershed prefer warmer temperatures (Table 4.3-42). Evaluating water temperature impacts on fish must be made in relation to the habitat assessed. Relatively warm temperatures in the lower sections of tributaries and in the mainstem Russian River during the summer are not necessarily indicative of a negative impact to these species. Conversely, activities that increase temperature in the Headwater Zone may result in a negative impact. A single temperature criteria cannot be made that encompasses all of the native and recreationally important species inhabiting the Russian River. A generalization that can be made is that over the range of temperatures commonly found in the Russian River, increasing temperatures are beneficial for all species inhabiting the Russian River below the confluence with Dry Creek, excluding tule perch. For this analysis, warmer temperatures between 70 and 80° F are considered beneficial for native and recreational species, while temperatures over 77.0° F would constitute a significant impact for tule perch.

Table 4.3-40. Summary of selective water temperatures and their effect on steelhead smolts.

Temperature (°F)	Results	Citation
≤52	Optimal for smolting	Adams *et al.* 1975 Myrick and Cech 2001; Yuba EIR
≤55.4	Optimal temperature for smolting	Zedonis and Newcomb 1997; Hoar 1988.
53.5 – 55.5	Temperatures in this range negatively affected the smoltification process	Studies cited by McCullough et al. 2001
50 – 52.3	Steelhead able to smolt, but the seawater survival was decreased compared to 43° F.	Adams et al. 1975
59	Marginal conditions for smolting	Zedonis and Newcomb 1997
>59	Adaption to seawater impaired	Myrick and Cech 2001
>59	Smolting inhibited	Adams et al. 1973

Table 4.3-41. Water temperature assessment criteria for emigrating steelhead smolts.

Life stage: smolt (March – May) mainstem and Dry Creek)			
Temperature (°F)	**Score**	**Descriptive rating**	**Impact severity**
≤52.0	5.00	Optimal	No impacts
52.1 – 55.0	4.75 – 4.00	Suitable	No impacts anticipated
55.1 – 59	3.75 – 3.00 2.75 – 2.00	Tolerance	Short term exposures - impacts tend to be less than significant Long term exposure – impacts may be significant
59.1 – 74.9	1.75 – 0.25	Resistance	Impacts occur proportional to exposure (potentially significant)
75.0	0.00	Lethal limit	Significant impacts occur over a short period of time

Table 4.3-42. Water temperature ranges for common (non-salmonid) fish species in the Russian River (from Moyle 2002).

Common Name	Scientific Name	Preferred temperature ranges
Hitch	*Lavinia exilicauda*	Temperature preference 80.0-84.0˚ F
California roach	*Lavinia symmetricus*	Can tolerate temperatures up to 86-95˚ F
Sacramento blackfish	*Orthodon microlepidotus*	Optimal temperatures 71.5-82.5˚ F;
Hardhead	*Mylopharodon conocephalus*	Preferred range of 69.0˚ F, perform well at temperatures ranging from 61 to 77˚ F (Thompson et al. 2012)
Sacramento pikeminnow	*Ptychocheilus grandis*	Prefer temperatures ranging from 64.5 to 82.5˚ F
Sacramento suckers	*Catostomus occidentalis*	Preferred temps around 68-77˚ F
Tule perch	*Hysterocarpus traski*	Prefer water below 71.5˚ F, rarely found in water above 77˚ F.
Smallmouth bass	*Micropterus dolomieu*	Preferred temps around 70.0-80.5˚ F

Dissolved Oxygen Criteria

Salmonids: Temperature influences an organism's metabolism which in turn influences the dissolved oxygen (DO) demand placed on that organism. As water warms, salmonids requirements for DO also increases. Dissolved oxygen levels ≥8.0 are required for Chinook salmon (Bratovich, et al. 2004). A review summarized several studies and concluded that food conversion was impaired at DO concentrations less than 5.0 mg/l and that salmonids were not impaired when DO concentrations exceeded 8 mg/l (Bjornn and Reiser 1991). Coho salmon avoid waters with D.O. concentrations less than 4.5 mg/l (data cited in (McMahon 1983) Chinook salmon reportedly avoid DO concentrations below 5.0 mg/l (Hallock *et al*. 1970). For all three salmonids in the Russian River, the lower lethal limit for DO is around 1.0 – 3.0 mg/l depending on temperature (Doudoroff and Shumway 1970).

Dissolved oxygen in excess of 6.3 mg/l are recommended for upstream migrating salmonids (Davis 1975). Survival and emergence of fry was high at DO levels in excesses of 8.0 mg/l. Conversely, embryo survival was significantly reduced at DO levels below 6.5 mg/l (data cited in (McMahon 1983). Adult Chinook salmon avoided DO levels below 4.2 mg/l. Migration resumed when DO increased above 5.0 mg/l (Hallock et al. 1970).

Defining DO criteria for fish is complicated by the interaction between temperature and DO. Colder water has a higher saturation level (holds more oxygen). Although some sources reviewed suggest that optimal DO levels for salmonids is 12 ppm (Raleigh et al. 1984), this level may not be appropriate for the Russian River. In general, the "amount" of oxygen that can be

dissolved into water is controlled by temperature (water can become “supersaturated” under turbulent conditions or at high levels of plant respiration). Water at 100% oxygen saturated reaches 12 ppm at a temperature of 44.5° F. Since water in the Russian River rarely, if ever, cools to that level, achieving a 12.0 ppm DO level in the Russian River may not be possible. While this may be the case, higher (than 8.0 ppm) DO levels are beneficial to salmonids. Accordingly, the scoring criteria reflects this fact by setting “optimal” DO levels at 12.0 ppm, and suitable at 8.0 ppm. Dissolved oxygen assessment criteria for salmonids are presented in Table 4.3-43.

Native non-salmonids: Although DO criteria for native non-salmonid species in the Russian River are poorly known, they are tolerant of lower DO levels compared to salmonids. Still, their habitat is often referred to as “well-oxygenated” (Moyle et al. 2015). Because of the lack of information on these species, DO-requirements for smallmouth bass were used since their habitat overlaps the native species complex in the Russian River (Table 4.3-44).

Table 4.3-43. Dissolved oxygen criteria used to assess conditions for salmonids in the Russian River and Dry Creek.

Descriptive rating	DO range (mg/l)
Optimal - no Impacts	≥12
Suitable - no significant impacts anticipated	8.0 - 11.9
Tolerance - short term exposures, impacts tend to be less than significant long term exposure, impacts may be significant	5.0 – 7.9
Resistance - impacts proportional to exposure	3.0 – 4.9
Potentially lethal depending on temperature - significant impacts occur over a short period of time	≤ 2.9

Table 4.3-44. Dissolved oxygen criteria used to assess conditions for native and recreationally important species in the Russian River.

Descriptive rating	DO range (mg/l)
Optimal (No Impacts)	≥ 6.0
Suitable (No significant impacts anticipated)	4.0 – 5.9
Tolerance (potentially stressful depending on temperature)	1.0 – 3.9
Lethal (Significant impacts occur over a short period of time)	≤1.0

Aquatic Resources of Lake Mendocino and Lake Sonoma

Lake Mendocino fish populations has been sampled on two occasions by the Water Agency. Lake Sonoma fish populations have been sampled with electrofishing gear on several occasions from 1987 to 1992 (Cox 1992), and in 2007 and 2013 CDFW and the Water Agency (unpublished data). The fish community in lakes Sonoma and Mendocino are dominated by

non-native warm water species such as largemouth bass and redear sunfish, with lesser numbers of smallmouth bass, green sunfish, bluegill, and channel catfish being caught. A few native species still inhabit each lake, including Sacramento suckers, Sacramento pikeminnow, and rainbow trout - landlocked steelhead in Lake Sonoma.

The Proposed Projects have the potential to alter the rate and the magnitude of reservoir drawdown. Rapidly decreasing water surface elevations may disrupt spawning by largemouth bass and sunfish (collectively referred to as “sunfish”). In addition, depending on the magnitude of the drawdown, the coldwater pool that supports the rainbow trout population may be depleted during critically dry years, impacting this species.

Sunfish Spawning Requirements

Site-specific data on sunfish spawning requirements from lakes Mendocino and Sonoma were not available. However, their spawning requirements have been well documented in other settings. Sunfish typically spawn during the spring and early summer, (April through June) depending on water temperature and other species-specific requirements. Sunfish typically spawn in relatively shallow water over a variety of substrates, including gravel, sand, roots, and aquatic vegetation. Nests are often constructed near rocks, submerged logs, or other structure providing protection to the nest.

Water Surface Elevation Fluctuations at Lake Mendocino and Lake Sonoma

Sunfish Spawning

Potential impacts to sunfish (family Centrarchidae) spawning success is based on a comparison of the rate of change in water surface elevations between project scenarios and depths and the amount of time needed for successful spawning by sunfish. Changes in water surface elevation are inherent in the operation of the reservoir, and all scenarios could impact spawning habitat to some degree in some years. The question is how the potential impacts of the change in water surface elevation changes between the scenarios. The changes in water surface elevation were modeled over the 104-year period of record used for the hydraulic model. Changes in water surface elevations were assessed on a 21-day running average (the approximately amount of time required for sunfish eggs to hatch and for the resultant fry to become mobile) for each month between March and June. The largest such decrease in any month was recorded in the appropriate category (described below). Where the 21-day time period straddled two months, any impacts were ascribed back to the month when the first day of the 21-day period occurred. For example, if the time frame analyzed ranged from June 20 to July 10, any impacts were recorded as having occurred in June.

A caveat to the analysis is that during wet years, water surface elevations would occasionally rise into the flood control pool and would be quickly lowered through releases. While these events triggered the model to record an impact (a rapid drop in water surface elevation), these events were generally limited to March, and are characterized by cold conditions. Sunfish likely

do not spawn under these conditions; thus, these events were unlikely to result in an impact to spawning sunfish. Subsequently, these events were excluded from the analysis.

Relating the potential impact of fluctuating water surface elevations on sunfish spawning success is difficult because the actual impact would vary depending on the depths selected for spawning by the majority of fish. Another complicating factor is water temperature. As water temperature increases, the rate of larval development increases. Thus, the length of time over which water surface elevations are compared is important. A conservative estimate for successful spawning of 21 days. For early spawning fish, this timeframe is likely reasonable. For later spawning fish, embryo development to the free swimming stage is likely accelerated because of the warmer water temperatures, and thus the 21-day timeframe may overstate the potential impact to spawning success.

A descriptive rating system was developed based on a review of the literature regarding depths and the length of time needed for successful spawning by sunfish (Table 4.3-45). Categories describing potential impacts reflect the largest negative change in water surface elevation over a 21-day period recorded for each month modeled during the 104-year hydrologic record.

Table 4.3-45. Descriptive rating for the potential impacts to sunfish spawning success associated with a decrease in water surface elevations (WSE) in Lake Mendocino and Lake Sonoma.

Change in WSE	Descriptive rating of the severity of potential impacts to spawning sunfish based on the maximum rate of change in reservoir drawdown over a 21 day period, March through July
≤-0.5	No impact
-0.6 to -3.5	Less-than-significant impact
>-3.6	Significant impact

Largemouth bass

Largemouth bass typically spawn in April and May after the water warms to approximately 57 to 61° F (Emig 1966). Largemouth bass spawn at depths ranging from 0.5 to 24.5 feet in depth (Stuber *et al.* 1982). However, the average depth which bass spawn is generally at the shallower end of this range. Largemouth bass nest were constructed at depths of 0.5 to 2.5 feet, 3.9 to 5.9 feet, and 0.5 to 6.5 feet with an average of 2.0 feet, in three studies cited by (Carlander 1977); between 1.0 and 3.0 feet (Stuber et al. 1982); and 3.3 to 6.5 feet (Moyle 1976). In a California reservoir, largemouth bass were more likely to spawn at a depth of 2.5 feet than at 1.5 feet (Carlander 1977). In Lake Millerton, also in California, largemouth bass spawned at an average depth of 3.9 feet, with a range of 2.0 to 8.2 feet (Mitchell 1982). Based on these data, largemouth bass spawning habitat was defined as the lake area ranging in depth from 0.5 to 6.5 feet.

Incubation (to hatching) of largemouth bass eggs is largely influenced by water temperature, and ranges from approximately 13 days at 50° F, to 1.5 days at 86° F (data cited by (arlander (1977). Water temperatures in Lake Sonoma range from approximately 60° F to 70° F in April and June (USACE 1993). At this temperature range, the incubation period for largemouth bass would last for approximately three to seven days. After hatching, the young bass remain in the

nest for a period of time before becoming free swimming. Based on the length of time required for nest construction and embryo and larval development cited by Carlander (1977), largemouth bass larvae would be expected to be free swimming approximately 13 to 21 days after the onset of nest construction.

Sunfish

Site-specific data on sunfish (e.g., redear sunfish, black crappie, and bluegill) spawning requirements from lakes Sonoma and Mendocino were not available. Information on the spawning requirements of sunfish has been synthesized by Calhoun (1966), Moyle (2002) and Carlander (1977). Like largemouth bass, the onset of spawning is largely controlled by temperature, with black crappie spawning at the lowest temperatures (approximately 57.0 to 62.5 ° F), and redear sunfish spawning at the warmest temperatures (approximately 71.5 to 75.0 ° F). The sunfish spawning season is expected to begin in late March, and extend into June, and possibly early July for redear sunfish.

Sunfish typically spawn at depths less than six feet deep, but have been reported to spawn at depths up to 20 feet. The depths at which sunfish spawn appear to be flexible within a species specific range, and have been reported to vary depending up on local conditions. Black crappie have been reported to spawn at depths ranging from three to eight feet (Calhoun 1966) and less than three feet (Moyle 1976). Bluegill have been reported to spawn at depths ranging between two and six feet (Calhoun 1966) and between 0.5 and four feet, (Carlander 1977). Redear sunfish tend to spawn at deeper depths than other sunfish, with a preferred range of six to ten feet (Moyle 1976). Since sunfish spawning depths overlap closely with largemouth bass, spawning criteria for the two groups were combined. The potential impacts to spawning sunfish will be analyzed for the months of March through June for each water year for the period of record.

Estuary

The estuary is a marine influenced section of the Russian River, and provides habitat for both marine and freshwater fish including salmonids. The Russian River estuary is located near the town of Jenner. The estuary is approximately 7 miles long and extends from the Pacific Ocean to the mouth of Austin Creek near Duncans Mills, CA. The lower estuary from the Pacific Ocean to the upstream end of Penny Island (approximately river mile (RM 1)) and the middle estuary from upstream end of Penny Island to Sheephouse Creek (RM 3) are heavily influenced by the marine environment. The water column of the lower and middle reaches of the estuary are typically stratified with more dense seawater near the bottom and a layer of less dense freshwater near the surface. The upper estuary, from Sheephouse Creek to the mouth of Austin Creek is predominantly a freshwater environment. Large ocean waves can form a barrier beach and effectively close the mouth of the river. This typically happens in the spring and in the fall, although closures can occur at any time of the year. Under closed mouth conditions the water surface elevation (WSE) and freshwater habitat will increase in the estuary as river inflows fill the estuary. This causes a backwatering effect that can increase stage as far upstream as vacation beach. The area from the mouth of Austin Creek to Vacation beach is referred to as the maximum backwater area and when combined with the tidally influenced portion of the

estuary it is approximately 13 miles long. Historically the Water Agency breached the barrier beach when WSE were 4.5 to 7 feet in order to protect low lying properties form inundation (NMFS 2008). In 2008 NMFS issued the Russian River Biological Opinion which requires the Water Agency to manage the estuary as a freshwater lagoon from May 15 through October 15 to improve summer rearing steelhead habitat. The Biological Opinion recommends constructing an outlet channel across the barrier beach and managing water surface elevations of at least 7 feet (NMFS 2008).

In general the lower and middle reaches of the estuary are heavily influenced by the marine environment. These sections of the estuary typically have a layer of highly saline water (35 parts per thousand (ppt)) near the stream bottom that is overlaid with a layer of nearly freshwater at the surface. The quantity of the saline and freshwater portions of the estuary vary as do the water quality conditions within these portions of the estuary (Largier and Behrens 2011).

During open river mouth conditions habitat in the lower and middle estuary are dynamic. Seawater flows into and out of the estuary following ocean tides. As a result of tidal action the depth of the lower and middle estuary varies throughout the day during open mouth conditions. High incoming tides transport large amounts of cold highly saline seawater into the estuary while outgoing tides transport large amounts of both seawater and freshwater out of the estuary.

Following a river mouth closure the quantity of marine habitat decreases and the quantity of freshwater habitat accessible to salmonids increases in the lower and middle estuary. When a barrier beach forms at the mouth of the estuary, tidal exchange with the ocean no longer occurs. Seawater is no longer transported into and out of the estuary via tidal action. After the estuary closes, the remaining saltwater begins to warm and dissolved oxygen levels decrease which restricts salmonids to the freshwater layer near the surface (Martini-Lamb and Manning 2011). The freshwater surface layer deepens as river flow enters the estuary at a higher rate than flow exits the estuary. Some water, both saline and fresh infiltrates through the barrier beach and leaves the estuary during a closure, but not all saline water is exported from the estuary (Largier and Behrens 2011). Largier and Behrens (2011) observed saline water in the Russian River estuary five weeks after a closure event. Recent two dimensional modeling results suggest that salt may persist in the lower portions of the water column for over two months and will likely remain in the deeper pools during extended closures (Bombardelli, et al. 2014). However, due to freshwater river inflow (Figure 4.3- 12) the freshwater layer of the lower estuary significantly deepens (figure 4.3- 13) and inundates previously dry shoreline.

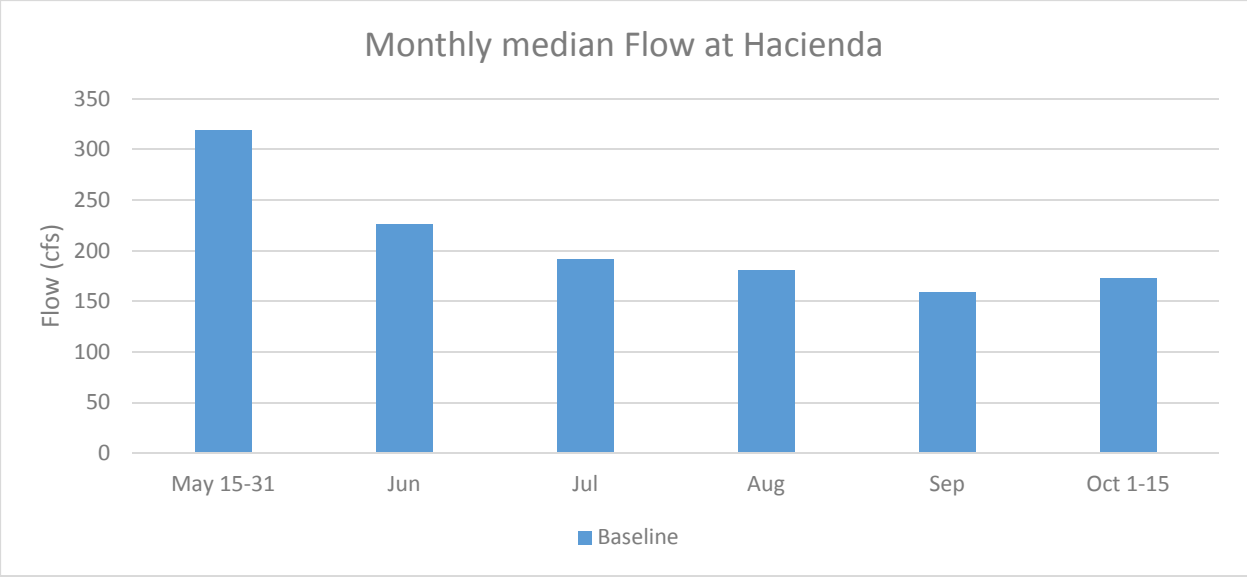


Figure 4.3-12. Monthly median flow at USGS Hacienda gage from May 15 to October 15. The Hacienda Gage is the closes stream gage to the Russian River estuary and can be used to estimate inflow into the estuary.

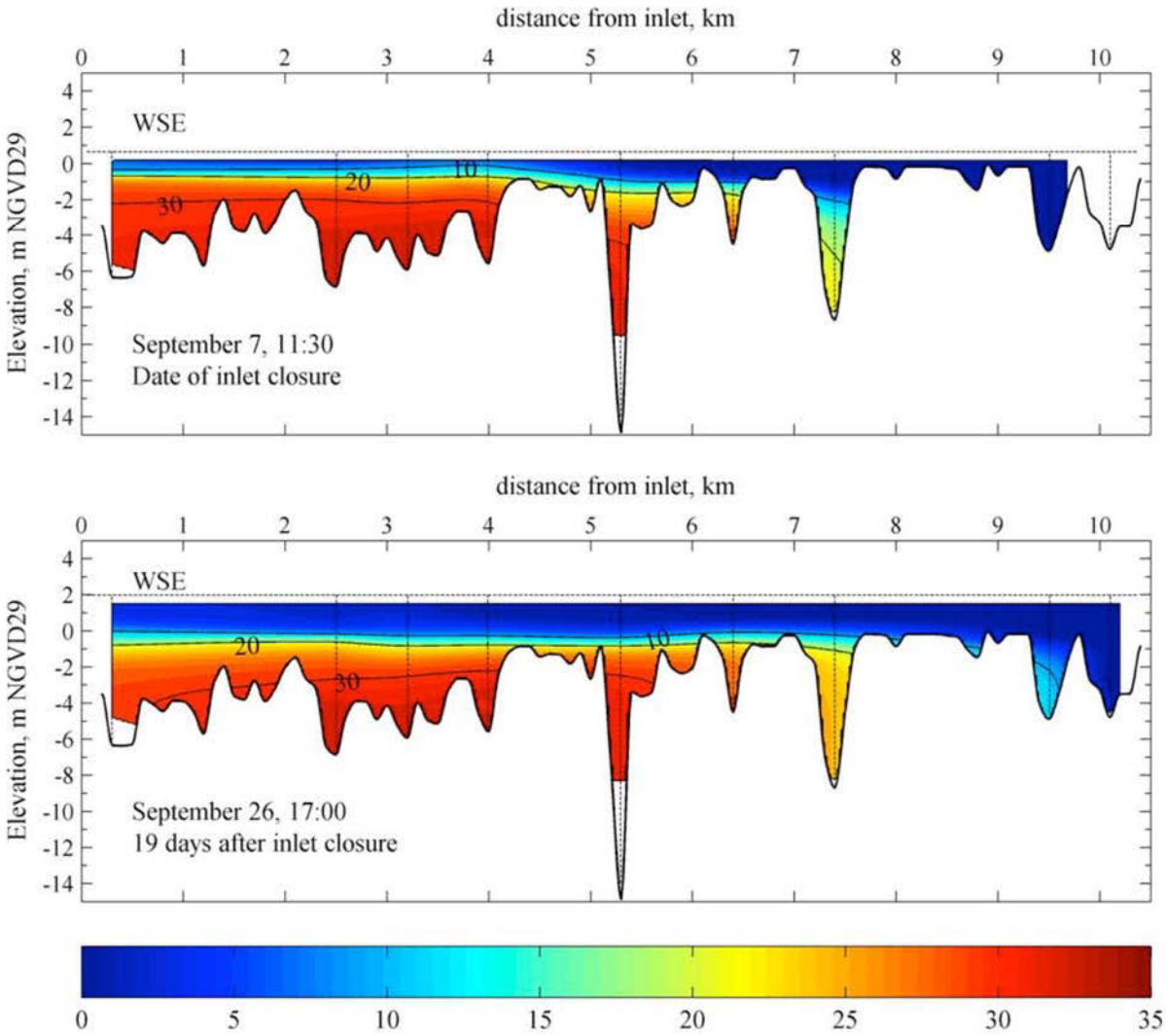


Figure 4.3-13. The change in salinity over the period of 19 days during a closure in 2009. The upper panel shows salinity distribution at time of closure. The lower panel shows the distribution of salinity 19 days after closure. Shown in practical salinity units. From Largier and Behrens (2011).

The estuary is important habitat for salmonids. Salmonids migrate through the estuary as adults from September through March with the bulk of adults migrating through the estuary after October 15. Salmonid smolts migrate through the estuary from January through June. Juvenile steelhead rear in the estuary from as early as May to as late as October (Martini-Lamb and Manning 2011). The Water Agency conducts seining surveys in the estuary to document the use of the estuary by juvenile steelhead. A subset of steelhead captured during the surveys are tagged with a passive integrated transponder (PIT) tags. Growth rates can be calculated for PIT tagged steelhead that are recaptured during a later seining survey. The Water Agency has observed high growth rates (as high a 1 mm per day) for juvenile steelhead in the estuary under open mouth conditions (Martini-Lamb and Manning 2016).

Recent acoustic telemetry of steelhead in the Russian River estuary provides information on habitat use during open and closed river mouth conditions. Juvenile steelhead were tagged and detected throughout the summer of 2015 under different estuarine and lagoon conditions using acoustic tags that reported a unique identification number and the temperature of the fish (Matsubu, et al. 2015). Matsubu *et al*. (2015) noted that radio tagged steelhead occupied newly inundated habitat during a closure in 2015. Steelhead occupied habitat with similar dissolved oxygen levels when the river mouth was open and closed. Matsubu *et al*. (2015) found that during open conditions steelhead occupied both cold saline water and warm fresh water habitat, but during closed conditions fish occupied less saline habitat. During a closure steelhead used thermal refugia in Austin and Willow creeks that were unavailable at lower water levels during times with an open river mouth. Based on energetics model built off of work by Seghesio (2011); Matsubu *et al*. (2015) suggests that there could be an increase in growth in the upper estuary when steelhead have access to thermal refugia in Austin Creek during a river mouth closure.

A study of prey availability and salmonid diets in the Russian River found that prey availability and modeled steelhead growth rates were favorable during a closure. Seghesio (2011) compared prey availability as well as steelhead and Chinook diets between estuarine reaches, and open and closed river mouth conditions. Seghesio (2011) found that most of the common diet species of steelhead and Chinook in the Russian River estuary were freshwater or euryhaline species, and that the loss of marine invertebrate species during a closure event would likely not impact these species. Seghesio (2011) found that epibenthic invertebrates moved into newly flooded habitat within a day of closure and suggested that the habitat created by a closure in the estuary would increase the carrying capacity of the system. She also modeled growth rates for steelhead using temperatures from closures in the fall of 2009 and summer of 2010. Modeled steelhead growth was positive at temperatures ranging from 60 °F to 72.5 °F (Seghesio 2011).

In summary, observations during recent closures note that some saline water persists for as long as five weeks in the estuary (Largier and Behrens 2011). Two dimensional modeling results suggest that salt may persist in the lower portions of the water column for over two months and will likely remain in the deeper pools during extended closures (Bombardelli, et al. 2014). Dissolved oxygen becomes depressed in the bottom of the water column and temperature increases in the saline water during a closure (Martini-Lamb and Manning 2014). This leads to

poor quality salmonid habitat in the lower portion of the water column. However the freshwater layer on the surface thickens and inundates dry shoreline making new habitat available for salmonid use (Seghesio 2011). Radio tagged steelhead were observed making use of newly inundated habitat during recent closures (Matsubu *et al*. 2015). Based on this information habitat is likely favorable for summer rearing steelhead during closure events even when the estuary does not fully convert to a freshwater lagoon.

Impacts and Mitigation Measures

The following section presents a detailed discussion of potential fisheries impacts associated with the implementation of the Proposed Project. Each project component is analyzed separately and impacts associated with each component are described below. Each impact discussion includes an analysis of the impact, a summary statement of the impact and its significance, and proposed mitigation measures where applicable. Impacts are summarized and categorized as either “no impact,” less than significant,“ “less than significant with mitigation,” “significant and unavoidable,” or “beneficial.”

Rearing Habitat

Impacts to juvenile and fry rearing habitat are analyzed by comparing the change of WUA over Baseline Conditions. For this impact analysis, the amount of available habitat for steelhead fry during the months of May and June were considered. Based on length data collected by the Water Agency, by the end of June most young-of-the-year Chinook salmon and steelhead have grown to 60 mm or larger, and are considered juveniles. For juvenile steelhead, the analysis was limited to May through November because this is the “summer low flow” rearing season for steelhead, which is most affected by changes in reservoir releases. Chinook salmon fry, and Chinook salmon juvenile habitat will be analyzed for the month of May. After May these fish have emigrated from the Upper Russian River.

As described above in the Environmental Setting section, the Russian River River2D model was developed to assess project-related impacts to steelhead and Chinook salmon fry and juvenile rearing habitat in the Russian River upstream of Cloverdale. The Russian River River2D model was calibrated to model habitat over a range of flows encompassed by the proposed releases from the three project alternatives and releases under Baseline Conditions for the summer rearing period (Sonoma County Water Agency 2016). For the analysis it is important to consider the total amount WUA that is available when combining all River2D reaches and months analyzed for comparison purposes. Depending on the River2D reach, the WUA can either increase or decrease with a change in flow. This variability of how individual reaches react to flow changes can be overcome by combining all River2D reaches for each alternative. By doing so, the effect of the alternative as a whole can be considered rather than the variable effect it may have on individual reaches for different months.

Mainstem Russian River

Impact 4.3-1. Changes in minimum instream flow could substantially affect the quantity of rearing habitat for steelhead fry in the Upper Russian River. (Beneficial)

Proposed Project: Instream flows in the Upper Russian River would decrease from May through June and an increase in the amount of rearing habitat for steelhead fry would occur. Under Baseline Conditions, there is a total of 4,993 m^2 to 5, 111 m^2 of WUA for steelhead fry when combining all River2D reaches depending on the month analyzed. Under the Proposed Project there would be a total of 5,268 m^2 to 5,444 m^2 of WUA for steelhead fry when combining all River2D reaches depending on the month analyzed. Overall there would be a 6 to 7 percent increase in the amount of steelhead fry rearing habitat when considering all River2D reaches (Table 4.3- 46).The Proposed Project would increase the quantity of rearing habitat for steelhead fry and provide a benefit in the Upper Russian River.

No Project 1 Alternative: Monthly median flows in the Upper Russian River would be the same as Baseline Conditions; therefore, no impacts to the quantity of rearing habitat for steelhead fry would occur (Table 4.3- 46).

***No Project 2 Alternative*:** Minimum instream flows in the Upper Russian River would decrease from May through June and an increase in the amount of rearing habitat for steelhead fry would occur. Under Baseline Conditions, there is a total of 4,993 m^2 to 5,111 m^2 of WUA for steelhead fry when combining all River2D reaches depending on the month analyzed. Under the No Project 2 Alternative, there is a total of 5,175 m^2 to 5,338 m^2 of WUA for steelhead fry when combining all River2D reaches depending on the month analyzed. Overall there will be a 4% increase in the amount of steelhead fry rearing habitat when considering all months and River2D reaches (Table 4.3- 46). The No Project 2 Alternative would increase the quantity of rearing habitat for steelhead and provide a benefit in the Upper Russian River.

Table 4.3-46 The percent change from Baseline Conditions of the total amount of weighted usable area (velocity, depth, and cover suitability) when combined for all River2D reaches analyzed for each species and life stage under each alternative (Proposed Project, No Project 1 and No Project 2). These data are shown by month. Dashes indicate that the life stage is not present in the Upper Russian River during that month.

Species	Life stage	Alternative	May	June	July	Aug	Sep	Oct	Nov
Steelhead	Juveniles	Proposed Project	-1%	-2%	-2%	-1%	-1%	-2%	-1%
		No Project 1	0%	0%	0%	0%	0%	0%	0%
		No Project 2	0%	-1%	-1%	0%	0%	0%	0%
	Fry	Proposed Project	6%	7%	-	-	-	-	-
		No Project 1	0%	0%	-	-	-	-	-
		No Project 2	4%	4%	-	-	-	-	-
Chinook	Juveniles	Proposed Project	7%	-	-	-	-	-	-
		No Project 1	0%	-	-	-	-	-	-
		No Project 2	5%	-	-	-	-	-	-
	Fry	Proposed Project	8%	-	-	-	-	-	-
		No Project 1	0%	-	-	-	-	-	-
		No Project 2	5%	-	-	-	-	-	-

Impact 4.3-2. Changes in minimum instream flow could substantially affect the quantity of habitat for rearing juvenile steelhead in the Upper Russian River (No Impact).

Proposed Project: Under the Proposed Project minimum instream flows in the Upper Russian River would decrease from May through November, creating lower velocities in the Upper Russian River. Coyote Valley Dam monthly median release flows from May through November range from 93 cfs to 263 cfs under Baseline Conditions, and from 80 cfs to 185 cfs under the Proposed Project. When compared to Baseline Conditions releases from Coyote Valley Dam would decrease under the Proposed Project by 93 cfs, 69 cfs, 76 cfs, 79 cfs, and 55 cfs in May, June, July, August, and September, respectively. Releases from Coyote Valley Dam increase by 16 cfs under the Proposed Project in November. As discussed above ("Methodology"), there would be little change in velocity WUA (WUA that includes only the suitability of estimated velocity, but excludes the suitability of estimated depths or cover) at the Hopland, Comminsky Station, and Cloverdale study sites across the range of modeled flows (25 to 260 cfs). At the Ukiah study site, velocity WUA would increase from 25 to 100 cfs, then steadily decrease from 100 to 300 cfs. However, there would be an increase in the amount of velocity WUA as percentage of wetted area with a reduction in flow for all reaches. The Proposed Project would reduce instream flow from Baseline Conditions in 5 of the 6 months (May through November) as a result there would be an improvement in the amount of velocity WUA as a percentage of

wetted area. In most reaches the total amount of velocity WUA does not substantially change except in the Ukiah study reach where the total amount of velocity WUA increases with less flow down to 103 cfs. There would be an improvement in velocity WUA in the months of May, June, July, August, and September, since the Proposed Project would reduce releases from Coyote Valley Dam in these months when compared to Baseline Conditions.

It is important to consider the interaction between velocity WUA, depth WUA, and cover WUA as instream flow change. Minimum instream flows in the Upper Russian River would decrease from May through November and a slight decrease in the total amount rearing habitat for steelhead juvenile would occur. Under Baseline Conditions there is a total of 23,832 m^2 to 23,949 m^2 of total WUA (the product of velocity, depth, and cover suitability) for steelhead juveniles when combining all River2D reaches depending on the month analyzed. Under the Proposed Project there would be a total of 23,334 m^2 to 23,692 m^2 of WUA for steelhead juveniles when combining all River2D reaches depending on the month analyzed. Overall there would be a 1 to 2 percent decrease in the amount of steelhead juvenile rearing habitat (when considering velocity, depth, and cover suitability) for the River2D reaches (Table 4.3- 46).

When considering the amount of velocity WUA scaled by the wetted area there is an increase in the percent of the wetted area that has high quality velocities for rearing juvenile steelhead. When considering only the amount of velocity WUA the Ukiah reach shows an increase in the amount of velocity WUA as flows are decreased from approximately 300 cfs to approximately 100 cfs, for the remaining reaches there is little change in the amount of velocity WUA over the range of flows modeled by Russian River River2D. A decrease of 1 to 2 percent of steelhead rearing WUA (the product of depth, velocity, and cover) in the Upper Russian River would not be an impact to the population of steelhead because this decrease in habitat would be similar to natural variation in physical habitat. The 1 to 2 percent decrease in WUA related to the Proposed Project is within the natural variability of habitat in the Upper Russian River. Under Baseline Conditions and under the Proposed Project and No Project 1 and No Project 2 alternatives, variability in tributary inflow, diversions for agriculture, and in evapotranspiration lead to variability in summer instream flow, which in turn leads to variability in steelhead WUA. Furthermore, large winter storm events cause the mobilization of stream bed substrate which overtime leads to variability in bed topography and variability in the quantity of WUA. Because the 1 percent to 2 percent decrease in WUA under the Proposed Project is within the natural variability of habitat there would be no impact to the quantity of juvenile steelhead rearing habitat.

No Project 1 Alternative: Monthly median flows in the Upper Russian River would be the same as Baseline Conditions; therefore, no impacts to the quantity of rearing habitat for steelhead juveniles would occur (Table 4.3- 46).

No Project 2 Alternative: Minimum instream flows in the Upper Russian River would decrease from May through November and a slight decrease in the amount rearing habitat for steelhead juveniles would occur. Under Baseline Conditions there is a total of 23,832 m^2 to 23,949 m^2 of WUA for steelhead juveniles when combining all River2D reaches depending on the month analyzed. For the No Project 2 Alternative, there would be a total of 23,684 m^2 to 23,948 m^2 of

WUA for steelhead juveniles when combining all River2D reaches depending on the month analyzed. Overall there would be a 1 percent decrease in the amount of steelhead juvenile rearing habitat when considering all months and River2D reaches (Table 4.3- 46). This amount of habitat decrease is small when considering the natural variation of steelhead habitat in the Russian River. A decrease of 1 percent of steelhead rearing habitat in the Upper Russian River would not be an impact to the population of steelhead because this decrease in habitat would be similar to natural variation in physical habitat. The 1 percent decrease in habitat related to the No Project 2 Alternative is within the natural variability of habitat in the Upper Russian River. Under Baseline Conditions and under the Proposed Project and No Project 1 and No Project 2 alternatives, variability in tributary inflow, diversions for agriculture, and in evapotranspiration lead to variability in summer flow which in turn can lead to variability in steelhead WUA. Furthermore, large winter storm events cause the mobilization of stream bed substrate which overtime leads to variability in bed topography and variability in the quantity of WUA. Because the 1 percent decrease in WUA under the Proposed Project is within the natural variability of habitat there would be no impact to juvenile steelhead rearing habitat.

Impact 4.3-3. Changes in minimum instream flow could substantially affect the quantity of habitat for rearing Chinook salmon fry in the Upper Russian River. (Beneficial).

Proposed Project: Minimum instream flows in the Upper Russian River would decrease in May and provide an increase in the amount of rearing habitat for Chinook salmon fry. Under Baseline Conditions, there is a total of 7,354 m^2 of WUA for Chinook salmon fry when combining all River2D reaches. Under the Proposed Project there would be a total of 7,972 m^2 of WUA for Chinook salmon fry when combining all River2D reaches. Overall there would be an 8% increase in the amount of Chinook salmon fry rearing habitat when considering all months and River2D reaches under the Proposed Project (Table 4.3- 46). The Proposed Project would increase the quantity of rearing habitat and provide a benefit for Chinook salmon fry in the Upper Russian River.

No Project 1 Alternative: Monthly median flows in the Upper Russian River would be the same as Baseline Conditions, therefore, no impacts to the quantity of rearing habitat for Chinook salmon fry would occur (Table 4.3- 46).

No Project 2 Alternative: Minimum instream flows in the Upper Russian River would decrease during May and a slight increase in the amount of rearing habitat for Chinook salmon fry would occur. Under Baseline Conditions there is a total of 7,354 m^2 of WUA for Chinook salmon fry when combining all River2D reaches. Under the No Project 2 Alternative, there would be a total of 7,755 m^2 of WUA for Chinook salmon fry when combining all River2D reaches. Overall there will be a 5 percent increase in the amount of Chinook salmon fry rearing habitat when considering all months and River2D reaches (Table 4.3- 46).The No Project 2 Alternative would increase the quantity of rearing habitat and provide a benefit for Chinook salmon fry in the Upper Russian River.

Impact 4.3-4. Changes in minimum instream flow could substantially affect the quantity of habitat in the Upper Russian River rearing juvenile Chinook salmon. (Beneficial).

Proposed Project: Minimum instream flows in the Upper Russian River would decrease during May and an increase in the amount of rearing habitat for Chinook salmon juveniles would occur. Under Baseline Conditions, there is a total of 15,504 m^2 of WUA for Chinook salmon juvenile when combining all River2D reaches. For the Proposed Project there would be a total of 16,561 m^2 of WUA for Chinook salmon juveniles when combining all River2D reaches. Overall there would be a 7% increase in the amount of Chinook salmon juvenile rearing habitat when considering all months and River2D reaches (Table 4.3- 46). The Proposed Project would increase the quantity of rearing habitat and provide a benefit for Chinook salmon juveniles in the Upper Russian River.

No Project 1 Alternative: Monthly median flows in the Upper Russian River would be the same as Baseline Conditions, therefore, no impacts to the quantity of rearing habitat for Chinook salmon juveniles would occur (Table 4.3- 46).

No Project 2 Alternative: Minimum instream flows in the Upper Russian River would decrease during May and an increase in the amount of rearing habitat for Chinook salmon juvenile would occur. Under Baseline Conditions, there is a total of 15,504 m^2 of WUA for Chinook salmon juvenile when combining all River2D reaches. For the No Project 2 Alternative, there would be a total of 16,357 m^2 of WUA for Chinook salmon juveniles when combining all River2D reaches. Overall there would be a 5 percent increase in the amount of Chinook salmon juvenile rearing habitat when considering all months and River2D reaches (Table 4.3- 46). The No Project 2 Alternative would increase the quantity of rearing habitat and provide a benefit for Chinook salmon juveniles in the Upper Russian River.

Dry Creek

Impact 4.3-5. Changes in minimum instream flow could substantially affect the quantity of habitat for rearing steelhead, Coho, and Chinook salmon in Dry Creek. (No Impact).

Changes in minimum instream flows from implementation of either the Proposed Project or the No Project alternatives are not expected to decrease the amount of rearing habitat for steelhead, Chinook salmon or coho salmon. Baseline instream flows in Dry Creek are fairly similar for the Proposed Project and the No Project alternatives. The monthly median flows for Baseline Conditions range from 93 cfs to 507 cfs depending on the month, while the monthly median flows for the Proposed Project and the No Project alternatives range from 84 to 509 cfs. From May through November flows are mainly determined by reservoir releases, monthly median flows range from 93 to 118 cfs under Baseline Conditions. Monthly median flows would range from 84 cfs to 118 cfs under the Proposed Project, or the No Project alternatives (Table 4.3-47). The slight changes in instream flows would not substantially impact the quantity of

rearing habitat for steelhead, Chinook salmon or coho salmon and therefore, no impacts would occur.

Table 4.3-47. The monthly Median flows estimated by Russian River ResSim for the mouth of Dry Creek for Baseline Conditions, No Project 1, No Project 2 and, the Proposed Project. Flows are measured in cubic feet per second.

Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline	302	507	373	184	109	93	93	93	93	93	118	159
Proposed Project	302	508	374	184	103	84	103	113	107	112	113	160
No Project 1	296	495	365	181	111	93	96	105	125	99	118	159
No Project 2	300	509	374	184	110	93	98	110	103	101	118	163

Adult passage

Salmonid passage was analyzed by comparing the percentage of time that flows sufficient to allow for the upstream passage of adult salmonids are modeled to occur during the upstream migration period for each of the three species under each of the three alternatives when compared to Baseline. Passage flows for the Lower Russian River are 135 cfs at Hacienda. For the Upper Russian River, passage flows are 110 cfs at Healdsburg. In Dry Creek passage flows are 90 cfs at the mouth of Dry Creek. The adult migration period for Chinook salmon is October 15, through December 31. For coho salmon the adult migration period is November through February. The adult migration period for steelhead is December through March.

Impact 4.3-6. Changes in minimum instream flow could substantially interfere with the movement salmonids in the Upper Russian River. (Beneficial).

Proposed Project: Compared to Baseline Conditions, there is no change to a slight improvement for migration flows from implementation of the Proposed Project. The Proposed Project provides a marked improvement for the months of October and November and remains relatively similar to Baseline Condition for the months December through March (Table 4.3- 48). The Proposed Project increases flows during the months of adult migration and provides a benefit for salmonids in the Upper Russian River.

No Project 1 Alternative: The Russian River ResSim model uses the same minimum instream flows, the Hydrologic index, and Upper Russian River demands when modeling Baseline Conditions and the No Project 1 Alternative. Therefore modeled flows in the Upper Russian River are the same between the No Project 1 alternative and Baseline Conditions. The No Project 1 Alternative would have the same Upper Russian River flows as Baseline conditions and would not alter adult salmonid migration conditions in the Upper Russian River when compared to Baseline Conditions, therefore no impacts would occur.

No Project 2 Alternative: There is a slight increase for passage flows in the months of October and November and the conditions remain relatively the same from December through March. The No Project 2 Alternative increases flows during the months of adult migration and provides a benefit for salmonids in the Upper Russian River. (Table 4.3- 48).

Table 4.3- 48. The percent occurrence that flow provides suitable conditions for upstream migration in the Upper Russian River when gaged at Healdsburg. Green shading indicates that the frequency of passage flows occur more often under the alternative than under Baseline. No shading indicates that there is no change from Baseline.

Alternative	Passage flow (cfs)	Oct 15-31	Nov	Dec	Jan	Feb	Mar
Baseline	110	65%	87%	96%	98%	98%	100%
Proposed Project	110	87%	96%	99%	100%	100%	100%
No Project 1	110	65%	87%	96%	98%	98%	100%
No Project 2	110	83%	94%	98%	98%	98%	100%

Impact 4.3-7. Changes in minimum instream flow could substantially interfere with the movement of salmonids in the Lower Russian River. (No impact).

Compared to Baseline Conditions, salmonids passage flows remain relatively similar for the Proposed Project or the No Project alternatives. For the Proposed Project, there would be an increase for the months of October and November and the instream conditions remain relatively the same for the months December through March. For the No Project alternatives, a slight decrease in passage flow (1 to 2 percent) would occur (Table 4.3- 49). This decrease in passage flow under the No Project Alternatives is a result of the Russian River ResSim model taking into account the higher water demands needed to utilize the full water rights of 75,000 acre feet. This decrease is small (1 to 2 percent). Therefore, implementation of either the Proposed Project or the No Project alternatives would not substantially interfere with the movement or migration of salmonids in the Lower Russian River and no impacts would occur.

Table 4.3-49. The percent occurrence that flow provides suitable conditions for upstream migration in the Lower Russian River. Green shading indicates that the frequency of passage flows occur more often under the alternative than under Baseline, while orange shading indicates that the frequency occurs less often. No shading indicates that there is no change from Baseline.

Alternative	Passage flow (cfs)	Oct 15-31	Nov	Dec	Jan	Feb	Mar
Baseline	135	90%	97%	100%	100%	99%	100%
Proposed Project	135	96%	98%	100%	100%	100%	100%
No Project 1	135	89%	95%	98%	99%	98%	100%
No Project 2	135	90%	95%	98%	99%	98%	100%

Impact 4.3-8. Changes in minimum instream flow could substantially interference with the movement salmonids in Dry Creek. (Beneficial).

Compared to Baseline Conditions, passage flows in Dry Creek would be improved with implementation of the Proposed Project or the No Project alternatives. The Russian River ResSim model uses the municipal water demands from 2015 for modeling Baseline Conditions. When modeling the Proposed Project and the No Project alternatives the Russian River ResSim model considers the projected future municipal demands to account for projected future

demographics in the Water Agency's service area. As a result, additional water is released from the reservoirs to meet this demand. Because more water is release from Lake Sonoma to meet municipal water demands, instream flows are more frequently above 90 cfs and are sufficient for adult salmonid passage in Dry Creek. The Proposed Project or the No Project alternatives increase the frequency of passage flows and would provide a benefit to the movement or migration of salmonids Dry Creek (Table 4.3-50).

Table 4.3-50. The percent occurrence that flow provides suitable conditions for upstream migration in Dry Creek. Green shading indicates that the frequency of passage flows occur more often under the alternative than under Baseline. No shading indicates that there is no change from Baseline.

Alternative	Passage flow (cfs)	Oct 15-31	Nov	Dec	Jan	Feb	Mar
Baseline	90	95%	95%	97%	90%	96%	100%
Proposed Project	90	99%	96%	97%	92%	96%	100%
No Project 1	90	99%	97%	98%	92%	96%	100%
No Project 2	90	99%	97%	98%	92%	96%	100%

Spawning Habitat

Upper Russian River

The quantity of Upper Russian River spawning habitat is analyzed by comparing the percentage of time that flows sufficient to allow for salmonid spawning are modeled to occur during the spawning period for each species under each of the three alternatives compared to Baseline Conditions. Flows suitable for spawning in the Upper Russia River are 130 cfs at Healdsburg. The spawning period for Chinook salmon is from November through January. For coho salmon the spawning period is from December through February. The spawning period for steelhead is from December through March.

Impact 4.3-9. Changes in minimum instream flow could substantially affect the quantity of spawning habitat for salmonids in the Russian River. (Beneficial)

The Proposed Project and the No Project 2 Alternative would increase the frequency of passage flows and improve the suitable conditions required by salmonids for spawning habitat in the Upper Russian River (Table 4.3- 51) over Baseline Conditions. The Proposed Project and the No Project 2 Alternative would provide a benefit for spawning conditions.

For the No Project 1 Alternative, flows remain the same as Baseline Conditions. Therefore, no impacts would occur.

Table 4.3- 51. The percent occurrence that flow provides suitable conditions for spawning in the Upper Russian River near Healdsburg. Green shading indicates that the frequency of passage flows occur more often under the alternative than under Baseline. No shading indicates that there is no change from Baseline.

Alternative	Spawning flow (cfs)	Nov	Dec	Jan	Feb	Mar
Baseline	130	72%	88%	97%	98%	100%
Proposed Project	130	81%	96%	98%	100%	100%
No Project 1	130	72%	88%	97%	98%	100%
No Project 2	130	90%	94%	97%	98%	100%

Dry Creek

The quantity of Dry Creek spawning habitat is analyzed by comparing the percentage of time that flows sufficient to allow for salmonid spawning are modeled to occur during the spawning period for each species under each of the three alternatives compared to Baseline Conditions. Dry Creek flows suitable for spawning are 90 cfs at the mouth of Dry Creek. The spawning period for Chinook salmon is from November through January. For coho salmon the spawning period is from December through February. The spawning period for steelhead is from December through March.

Impact 4.3-10. Changes in minimum instream flow could substantially affect the quantity of spawning habitat for salmonids in Dry Creek. (No Impact)

Compared to Baseline Conditions, the suitable conditions needed by salmonids for spawning habitat remains relatively the same in Dry Creek (Table 4.3- 52) from implementation of either the Proposed Project or the No Project alternatives. The Proposed Project and the No Project alternatives would provide a slight benefit for spawning conditions during November and remain relatively similar to Baseline Conditions during the rest of spawning months, thus no impacts to the quantity of spawning habitat for salmonids would occur.

Table 4.3-52. The percent occurrence that flow provides suitable conditions for spawning in Dry Creek. Green shading indicates that the frequency of passage flows occur more often under the alternative than under Baseline. No shading indicates that there is no change from Baseline.

Alternative	Spawning flow (cfs)	Nov	Dec	Jan	Feb	Mar
Baseline	90	95%	97%	90%	96%	100%
Proposed Project	90	96%	97%	92%	96%	100%
No Project 1	90	97%	98%	92%	96%	100%
No Project 2	90	97%	98%	92%	96%	100%

Water Temperature

Chinook Salmon

Within the project area, Chinook salmon spawn in the Upper Russian River upstream of Healdsburg and in Dry Creek. Chinook salmon migrate upstream to their spawning grounds from October through December (primarily mid-October through mid-November). Spawning begins in mid-November and likely extends into January in normal years. The subsequent egg incubation period extends through March. Juvenile Chinook salmon rear in the Russian River and Dry Creek from March through June. Chinook salmon in the Russian River smolt during the first few months of their lives, and downstream migrating Chinook salmon are routinely captured in the downstream migrant trap operated at the Mirabel Inflatable Dam during this time (March through June). As described in the Methodology above, the Russian River ResSim model (Appendix G) uses selected points along Dry Creek and the Russian River to assess the potential for the Proposed Project to affect water quality over Baseline Conditions.

> **Impact 4.3-11. Changes in minimum instream flow could substantially affect the upstream migration of Chinook salmon through elevated water temperatures in the months October through December in the Russian River and in Dry Creek. (No Impact).**

Proposed Project: Under the Proposed Project, mean monthly water temperatures in the Upper Russian River were modeled to be approximately 1.0° F lower during the second half of October compared to Baseline Conditions (Figure 4.3.1-14; Table 4.3-53). During November and December, water released from Lake Mendocino (measured at the Forks) was up to 0.9° F warmer under the Proposed Project, but this difference decreased to 0.6° F at Hopland, and the difference between the Proposed Project and Baseline Conditions further decreased with distance downstream. Water temperatures varied by less than 0.2° F in Dry Creek between the Proposed Project and Baseline Conditions. Temperature assessment scores rate higher under the Proposed Project during the second half of October throughout the Russian River, and essentially identical during November and December (although temperatures would be slightly higher in the Upper Russian River under the Proposed Project, temperatures would be generally optimal for the Proposed Project during these months) (Table 4.3-54). Both Baseline Conditions and the Proposed Project support suitable water temperature conditions in Dry Creek during the Chinook salmon upstream migration period. The Proposed Project would provide a reduction in the frequency of occurrence of stressful water temperatures during October (prior to the peak of the run) (Table 4.3-55). From November and December, stressful water temperatures would rarely occur for the Proposed Project. The Proposed Project would not negatively affect the upstream migration for Chinook salmon through elevated water temperatures from October through December in the Russian River or in Dry Creek and therefore, no impacts would occur.

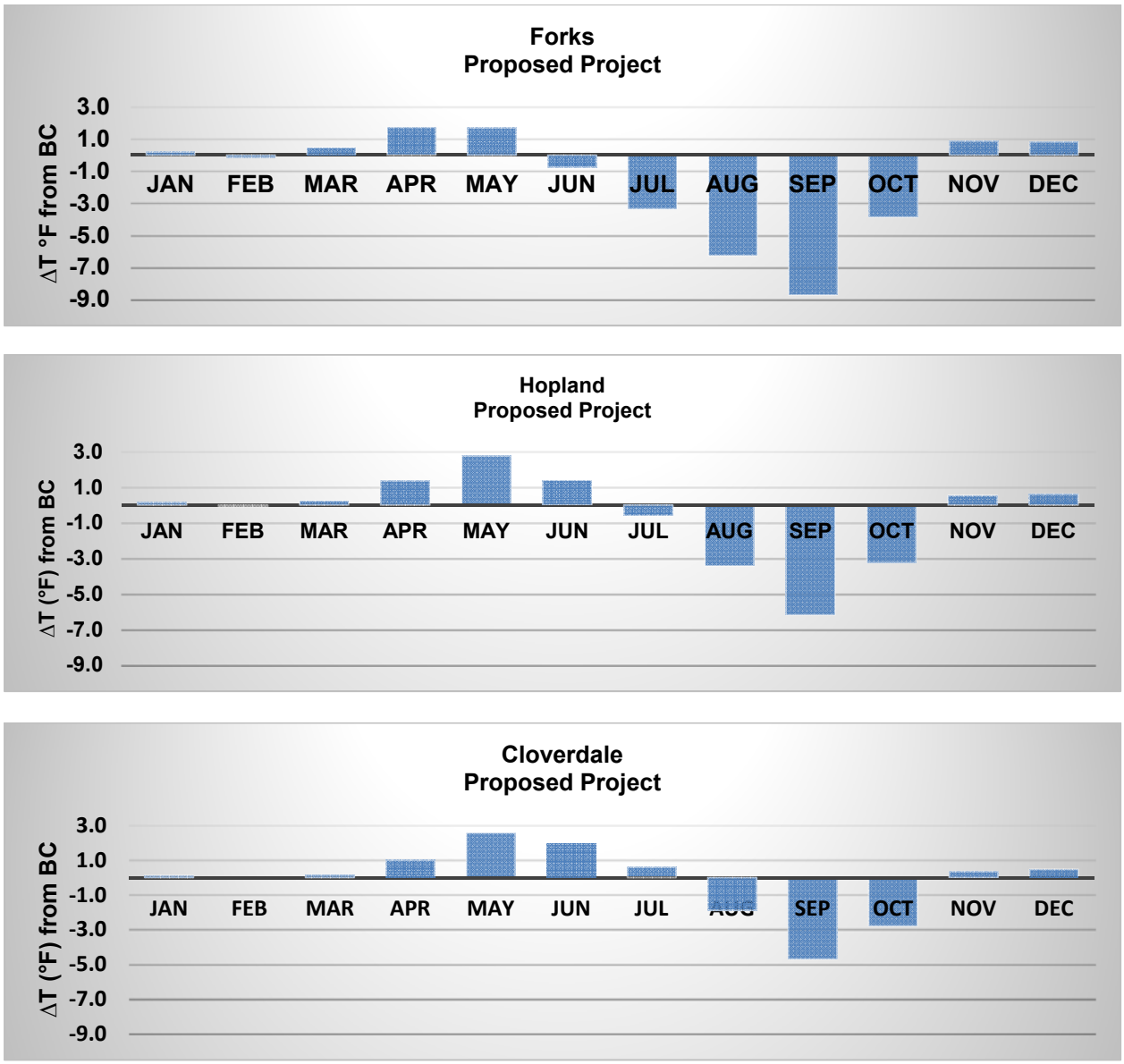
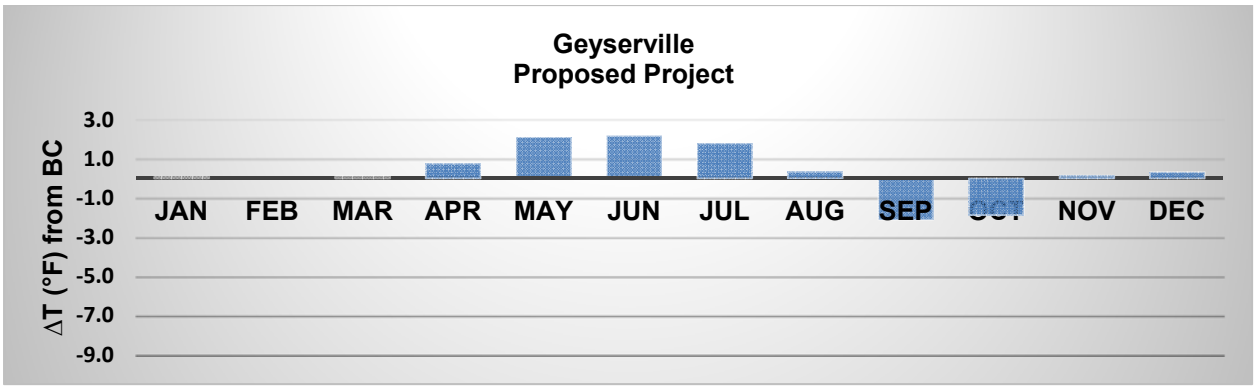


Figure 4.3-14 (continued.). Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, Proposed Project relative to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the Proposed Project would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the Proposed Project would result in a decrease in the monthly mean water temperature.



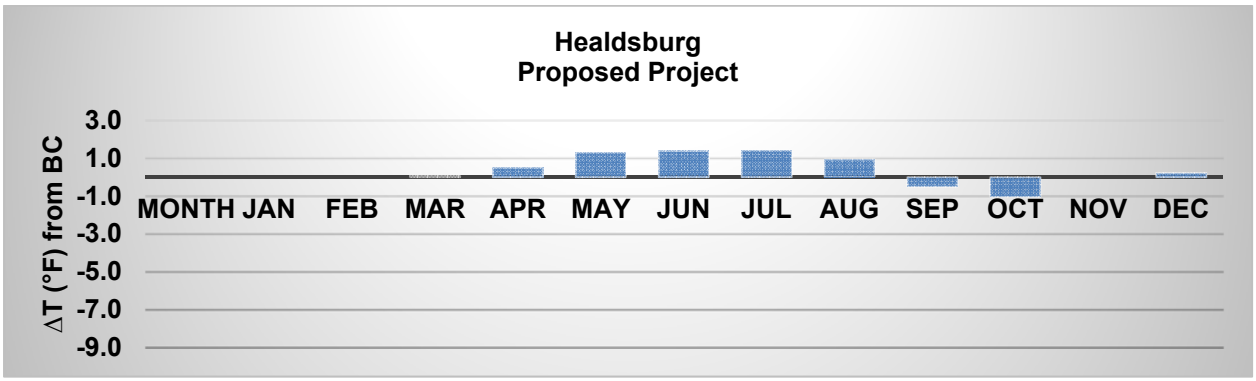
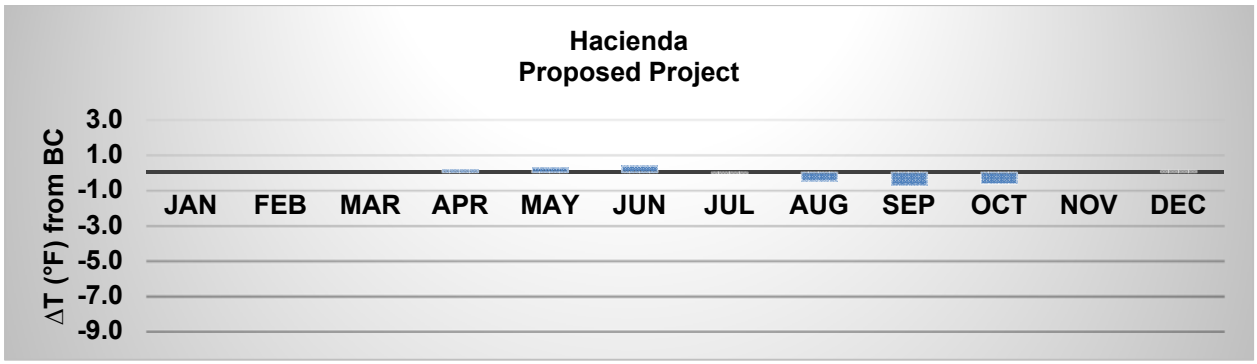
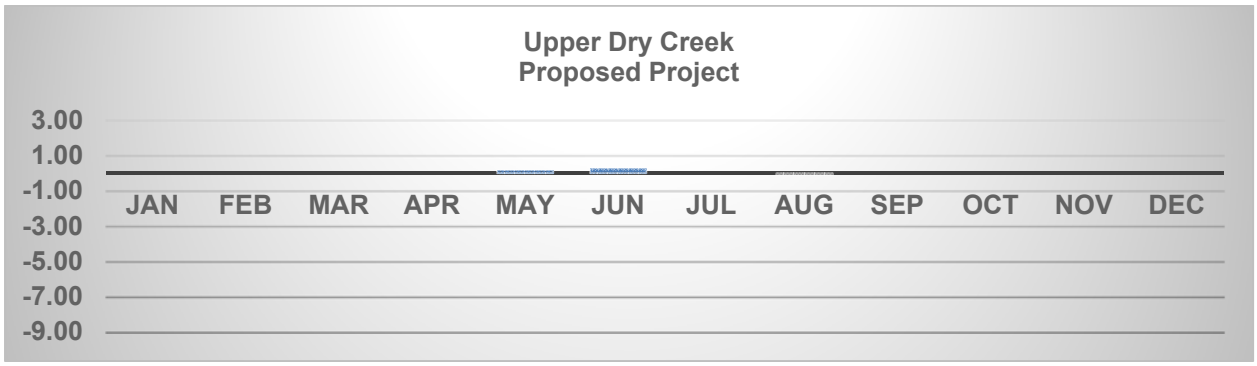


Figure 4.3-14 (continued). Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, Proposed Project relative to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the Proposed Project would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the Proposed Project would result in a decrease in the monthly mean water temperature.





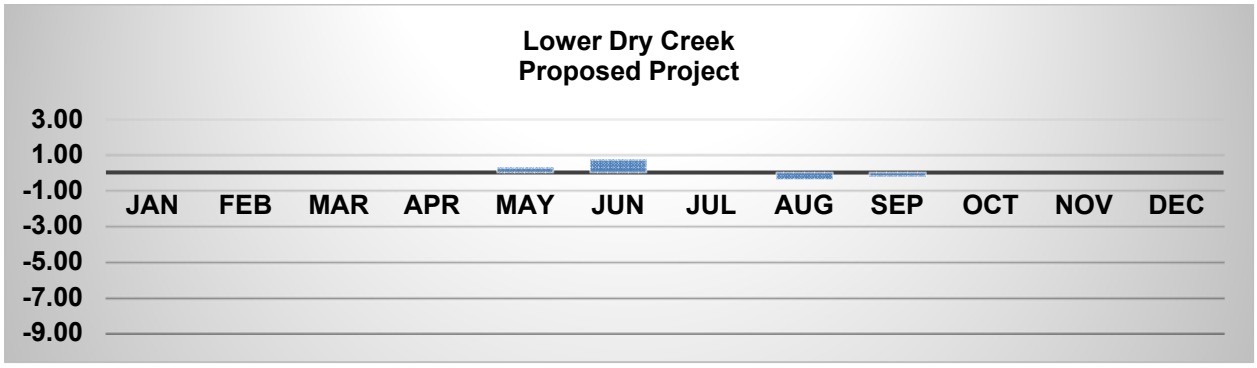


Figure 4.3-14 (continued). Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, Proposed Project relative to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the Proposed Project would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the Proposed Project would result in a decrease in the monthly mean water temperature.

Table 4.3-53. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek from October through December, under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	October 1-15		October 16-31		November		December	
		BC	PP	BC	PP	BC	PP	BC	PP
Upper River	Forks	66.7	59.8	64.8	63.9	57.4	58.3	48.8	49.6
	Hopland	66.3	60.9	64.0	62.8	56.3	56.9	48.2	48.8
	Cloverdale	66.2	61.8	63.5	62.3	55.7	56.0	47.9	48.4
	Geyserville	67.2	64.7	64.0	62.8	56.2	56.3	48.4	48.7
	Healdsburg	68.0	66.8	64.4	63.4	56.6	56.6	48.7	48.9
Lower Russian River	Below Dry Creek	63.4	62.4	60.8	60.0	55.3	55.4	49.1	49.3
	Hacienda	63.8	63.1	60.7	60.1	54.7	54.7	48.5	48.6
Dry Creek	Upper	54.0	54.0	53.8	53.8	53.3	53.3	50.7	50.7
	Lower	57.4	57.6	56.2	56.0	53.8	53.8	50.2	50.1

Table 4.3-54: Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the October through December Chinook salmon upstream migration season under Baseline Condition (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	October 1-15		October 16-31		November		December	
		BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	2.23	4.45	3.14	3.44	4.79	4.74	5.00	5.00
	Hopland	2.46	4.31	3.47	3.90	4.87	4.86	5.00	5.00
	Cloverdale	2.54	4.17	3.65	4.10	4.90	4.91	5.00	5.00
	Geyserville	2.19	3.17	3.42	3.88	4.84	4.85	5.00	5.00
	Healdsburg	1.86	2.32	3.32	3.72	4.84	4.86	5.00	5.00
Lower Russian River	Below Dry Creek	2.83	3.47	3.73	4.11	4.53	4.71	4.97	4.97
	Hacienda	2.54	2.97	3.68	3.95	4.58	4.74	4.99	4.98
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.84	4.85	4.93	4.92	4.99	4.99	5.00	5.00

Table 4.3-55. Frequency occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to upstream migrating Chinook salmon, October through December, under Baseline Condition (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

October 1 - 15										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Russian River	Forks	17.31	0.76	59.35	1.07	0.00	0.00	76.66	1.83	-74.83
	Hopland	20.18	5.02	45.86	2.23	0.24	0.00	66.28	7.25	-59.03
	Cloverdale	20.79	6.47	41.89	3.30	0.26	0.00	62.94	9.77	-53.17
	Geyserville	17.38	15.58	50.81	25.28	1.34	0.21	69.53	41.07	-28.46
	Healdsburg	18.83	20.79	62.57	47.39	0.86	0.28	82.27	68.46	-13.81
Lower Russian River	Below Dry Creek	12.36	7.98	8.37	2.80	0.00	0.00	20.73	10.78	-9.95
	Hacienda	11.99	7.09	4.39	1.65	0.00	0.00	16.38	8.74	-7.64
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	-0.02
October 16 - 31										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	27.73	21.66	14.34	8.94	0.00	0.00	42.07	30.62	-11.45
	Hopland	18.19	10.10	11.17	4.32	0.06	0.00	29.41	14.42	-14.99
	Cloverdale	15.20	7.07	8.30	2.12	0.03	0.00	23.53	9.19	-14.34
	Geyserville	15.20	9.34	17.31	8.50	0.08	0.00	32.58	17.84	-14.74
	Healdsburg	18.40	13.06	16.69	8.56	0.05	0.00	35.13	21.62	-13.52
Lower Russian River	Below Dry Creek	2.08	0.49	0.32	0.03	0.00	0.00	2.40	0.52	-1.88
	Hacienda	12.0	7.4	4.4	1.7	0.00	0.00	16.4	9.1	-7.2
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-55. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to upstream migrating Chinook salmon, October through December, under Baseline Condition (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

November										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.15	0.33	0.00	0.00	0.00	0.00	0.15	0.33	0.18
	Hopland	0.27	0.19	0.00	0.00	0.00	0.00	0.27	0.19	-0.07
	Cloverdale	0.06	0.03	0.00	0.00	0.00	0.00	0.06	0.03	-0.03
	Geyserville	0.89	0.77	0.30	0.19	0.00	0.00	1.19	0.96	-0.23
	Healdsburg	0.75	0.40	0.12	0.08	0.00	0.00	0.87	0.48	-0.39
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 1 Alternative*:* The change in monthly mean water temperatures between Baseline Conditions and the No Project 1 Alternative during the October through December Chinook salmon upstream migration period were modeled to be within ± 0.2 degrees Fahrenheit (°F) in the Russian River and Dry Creek (Figure 4.3-15; Table 4.3-56). For Baseline Conditions and the No Project 1 Alternative, water temperatures would be poor in the Upper Russian River during the first half of October (temperature assessment scores 1.86 to 2.54, respectively), but improve significantly beginning mid-October (temperature assessment scores ranged from 3.14 to 3.65). Temperature assessment scores from November and December rate near optimal (Table 4.3-57). Temperature assessment scores in Dry Creek would be high (>4.9 Baseline Conditions and the No Project 1 Alternative) from October through December. During the Chinook salmon upstream migration period, the No Project 1 Alternative would not increase the occurrence of stressful water temperatures relative to Baseline Conditions (Table 4.3-58). The No Project 1 Alternative would not affect the upstream migration for Chinook salmon through elevated water temperatures from October through December in the Russian River or in Dry Creek and therefore, no impacts would occur.

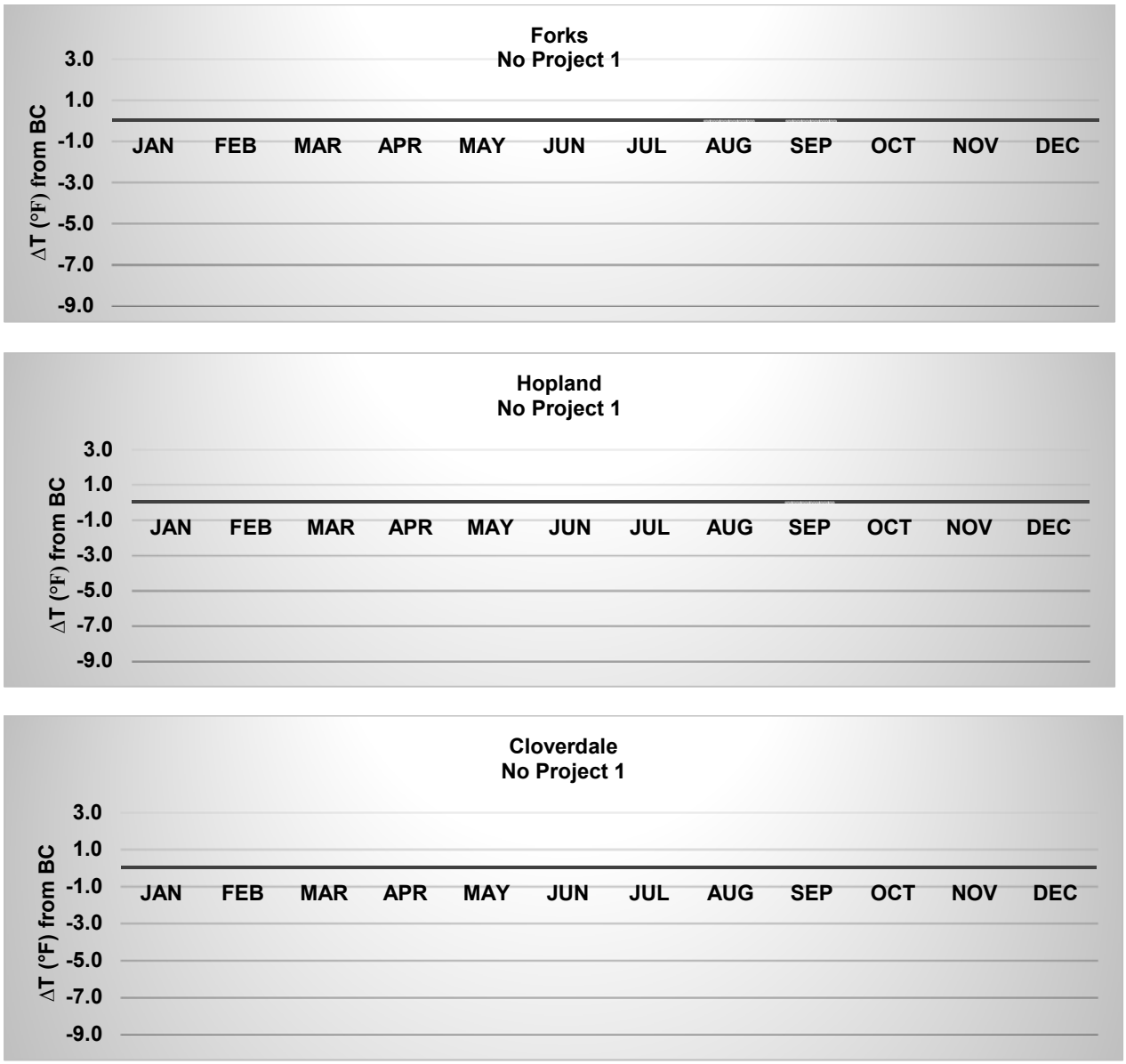
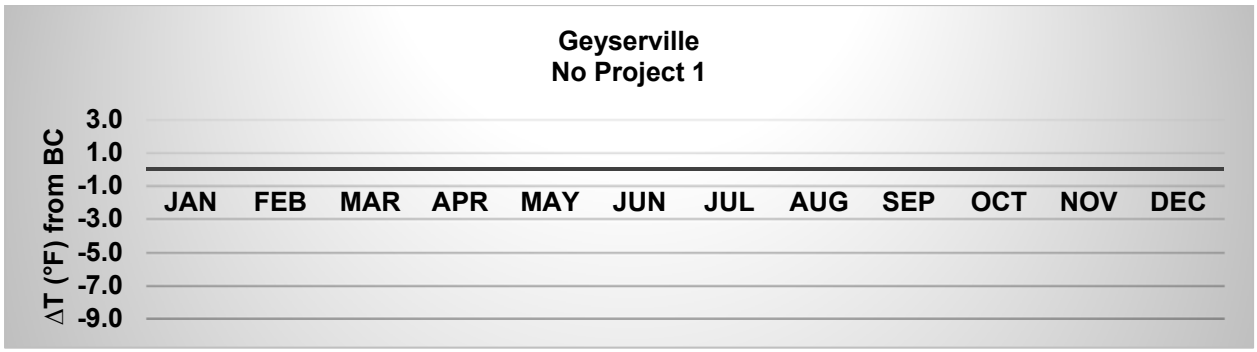
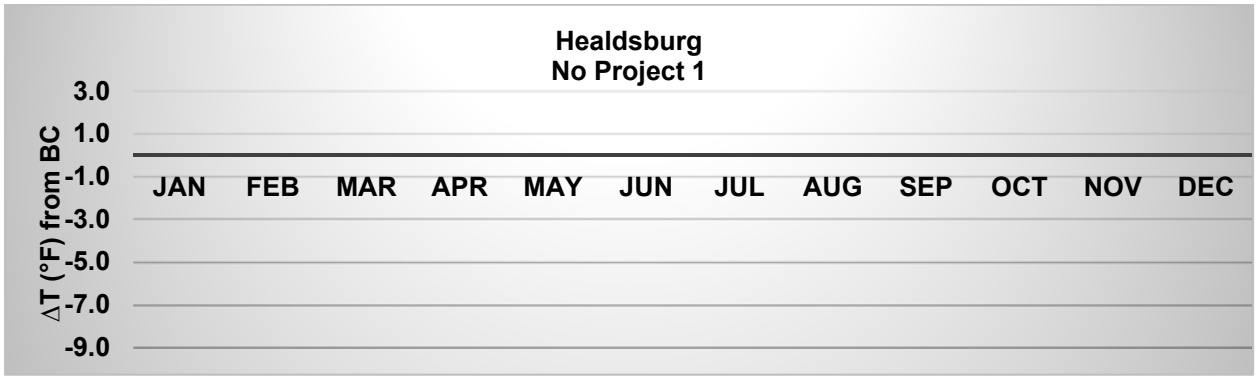


Figure 4.3-15. The change in the monthly mean water temperature (ΔT) between Baseline Conditions (BC) and the No Project 1 Alternative (NP1) in the mainstem Russian River and Dry Creek. In comparison to Baseline Conditions, positive numbers indicate that the No Project 1 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers mean the No Project 1 Alternative would result in a decrease in the monthly mean water temperature. In some cases, modeled water temperatures were unchanged between the project and Baseline Conditions. In these cases, no bars would be presented on the graph.





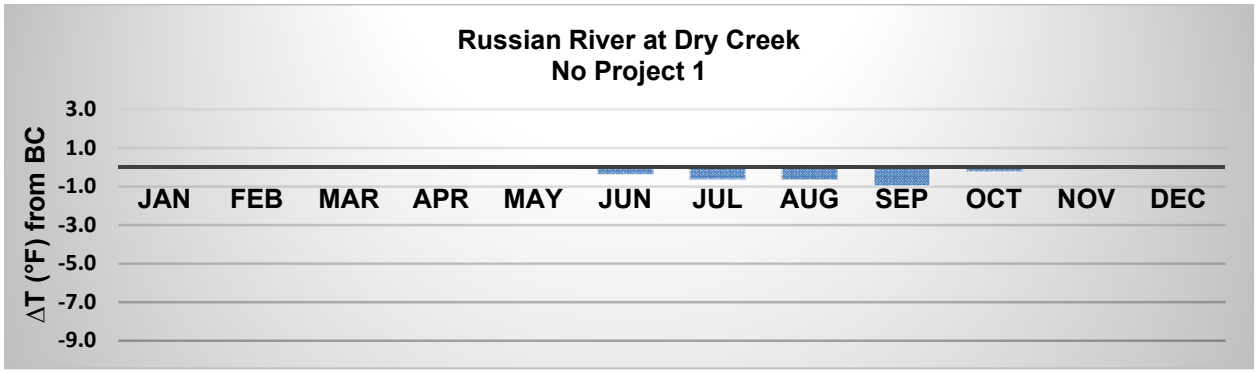
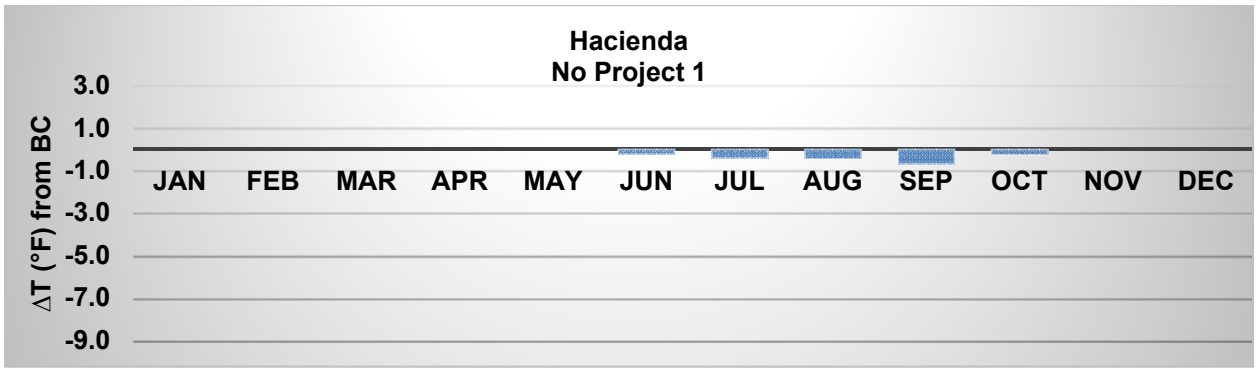
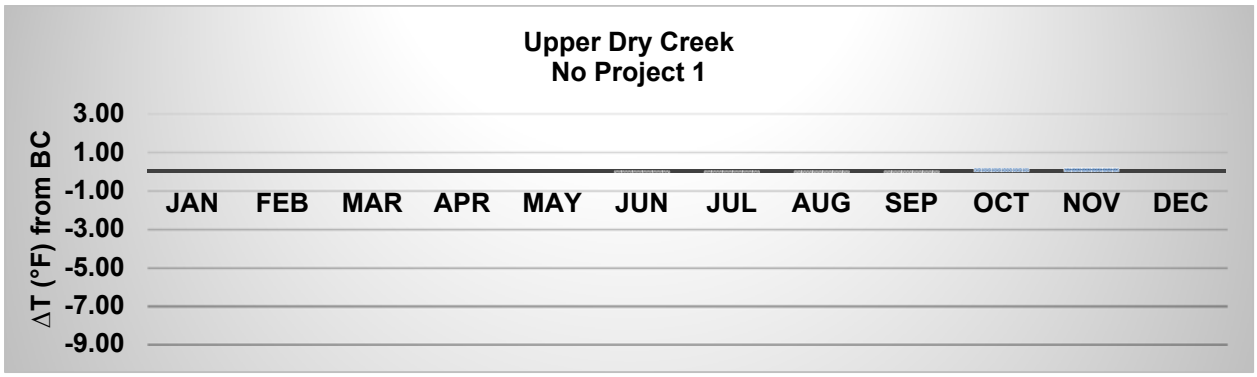
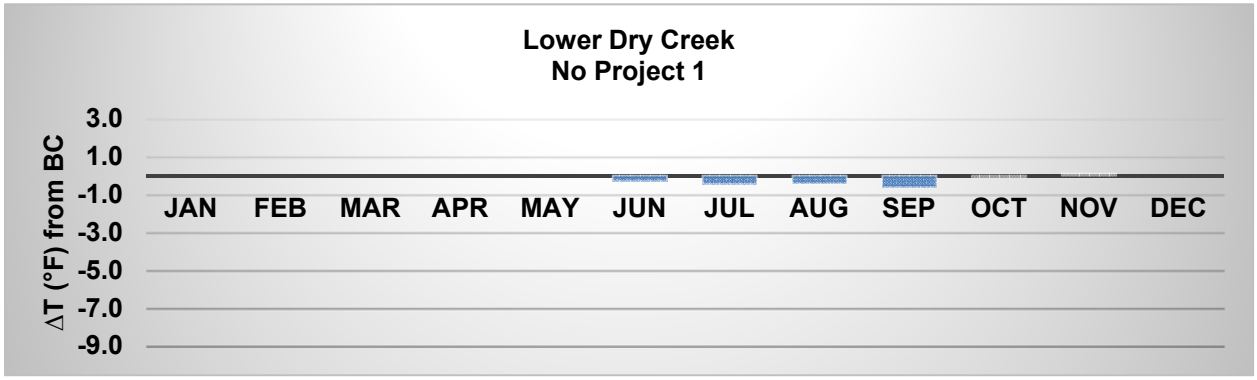


Figure 4.3-15 (continued.). The change in the monthly mean water temperature (ΔT) between Baseline Conditions (BC) and the No Project 1 Alternative (NP1) in the mainstem Russian River and Dry Creek. In comparison to Baseline Conditions, positive numbers indicate that the No Project 1 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers mean the No Project 1 Alternative would result in a decrease in the monthly mean water temperature. In some cases, modeled water temperatures were unchanged between the project and Baseline Conditions. In these cases, no bars would be presented on the graph.







4.3-15 (continued). The change in the monthly mean water temperature (ΔT) between Baseline Conditions (BC) and the No Project 1 Alternative (NP1) in the mainstem Russian River and Dry Creek. In comparison to Baseline Conditions, positive numbers indicate that the No Project 1 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers mean the No Project 1 Alternative would result in a decrease in the monthly mean water temperature.

Table 4.3-56. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek from October through December under Baseline Conditions and the No Project 1 Alternative (NP1).

Reach	Location	October 1–15		October 16–31		November		December	
		BC	NP1	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	66.7	66.7	64.8	64.8	57.4	57.5	48.8	48.8
	Hopland	66.3	66.3	64.0	64.0	56.3	56.3	48.2	48.2
	Cloverdale	66.2	66.2	63.5	63.5	55.7	55.7	47.9	47.9
	Geyserville	67.2	67.2	64.0	64.0	56.2	56.2	48.4	48.4
	Healdsburg	68.0	68.0	64.4	64.4	56.6	56.6	48.7	48.7
Lower Russian River	Below DC	63.4	63.0	60.8	60.7	55.3	55.4	49.1	49.2
	Hacienda	63.8	63.5	60.7	60.5	54.7	54.6	48.5	48.5
Dry Creek	Upper	54.0	54.1	53.8	54.0	53.3	53.4	50.7	50.7
	Lower	57.4	57.2	56.2	56.2	53.8	53.9	50.2	50.2

Table 4.3-57: Temperature assessment scores evaluating water temperatures in the Russian River and Dry Creek during the October through December Chinook salmon upstream migration season under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	October 1–15		October 16–31		November		December	
		BC	NP1	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	2.23	2.23	3.14	3.14	4.79	4.75	5.00	5.00
	Hopland	2.46	2.46	3.47	3.47	4.87	4.87	5.00	5.00
	Cloverdale	2.54	2.54	3.65	3.65	4.90	4.90	5.00	5.00
	Geyserville	2.19	2.19	3.42	3.42	4.84	4.84	5.00	5.00
	Healdsburg	1.86	1.86	3.32	3.32	4.84	4.84	5.00	5.00
Lower Russian River	Below DC	2.83	3.20	3.73	3.87	4.97	4.97	5.00	5.00
	Hacienda	3.68	3.82	4.58	4.61	4.99	4.99	5.00	5.00
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.90	4.90	5.00	5.00	5.00	5.00	5.00	5.00

Table 4.3-58. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to upstream migrating Chinook salmon, October through December, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would result in a decrease in the occurrence of stressful temperatures.

October 1 - 15										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	17.31	17.28	59.35	59.42	0.00	0.00	76.67	76.70	0.03
	Hopland	20.18	20.13	45.86	45.94	0.24	0.24	66.28	66.31	0.03
	Cloverdale	20.79	20.81	41.89	41.88	0.26	0.26	62.94	62.94	0.00
	Geyserville	17.38	17.39	50.81	50.81	1.34	1.34	69.53	69.55	0.02
	Healdsburg	18.83	18.83	62.57	62.57	0.86	0.86	82.27	82.27	0.00
Lower Russian River	Below DC	19.85	20.13	31.41	19.72	0.00	0.00	51.26	39.85	-11.41
	Hacienda	32.00	31.80	33.00	20.20	0.00	0.00	65.00	52.00	-13.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
October 16 - 31										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	27.73	27.76	14.34	14.32	0.15	0.15	42.21	42.23	0.02
	Hopland	18.19	18.22	11.17	11.15	0.06	0.06	29.41	29.43	0.02
	Cloverdale	15.20	15.22	8.30	8.30	0.03	0.03	23.53	23.54	0.02
	Geyserville	15.20	15.20	17.31	17.31	0.08	0.08	32.58	32.58	0.00
	Healdsburg	18.40	18.40	16.69	16.69	0.05	0.05	35.13	35.13	0.00
Lower Russian River	Below DC	12.36	10.92	8.37	5.70	0.00	0.00	20.73	16.62	-4.11
	Hacienda	12.00	9.30	4.40	2.70	0.00	0.00	16.40	12.00	-4.40
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00

Table 4.3-58. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to upstream migrating Chinook salmon, October through December, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would result in a decrease in the occurrence of stressful temperatures.

November										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10	0.00
	Hopland	0.30	0.30	0.00	0.00	0.00	0.00	0.30	0.30	0.00
	Cloverdale	0.06	0.06	0.00	0.00	0.00	0.00	0.06	0.06	0.00
	Geyserville	0.89	0.90	0.30	0.30	0.00	0.00	1.19	1.19	0.01
	Healdsburg	0.75	0.75	0.12	0.12	0.00	0.00	0.87	0.87	0.00
Lower Russian River	Below DC	2.08	2.02	0.32	0.33	0.00	0.00	2.40	2.35	-0.05
	Hacienda	0.61	0.56	0.00	0.00	0.00	0.00	0.61	0.56	-0.05
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 2 Alternative: Under the No Project 2 Alternative, mean monthly water temperatures in the Upper Russian River would be cooler during October (0.5 to 1.9° F) and slightly (≤0.5° F) warmer from November through December, compared to Baseline Conditions (Figure 4.3-16; Table 4.3-59). In the Lower Russian River, modeled mean monthly water temperatures would be within ± 0.4° F for the No Project 2 Alternative and under Baseline Conditions. Modeled mean monthly water temperatures in Dry Creek would be generally suitable to optimal for upstream migrating Chinook salmon. Suitability criteria in the Upper Russian River would be poor for upstream migrating Chinook salmon during October for the No Project 2 Alternative and under Baseline Conditions (Table 4.3-60). Although modeled temperatures would be slightly warmer during November under the No Project 2 Alternative compared to Baseline Conditions, the difference was slight, and modeled temperatures would be generally suitable to optimal for upstream migrating Chinook salmon under the No Project 2 Alternative. The No Project 2 Alternative would provide suitable water temperatures in the Lower Russian River during the Chinook salmon upstream migration period. The No Project 2 Alternative would provide a significant reduction in the frequency of occurrence of stressful water temperatures (>65.5° F) during the first half of October (prior to the peak of the run). During the second half of October, stressful thermal conditions would be reduced by 0.4 (Hacienda) to 8.0 percent (Healdsburg) in the Russian River. From November through December, stressful water temperatures rarely occur for the No Project 2 Alternative and under Baseline Conditions (Table 4.3-61). The No Project 2 Alternative would not negatively affect the upstream migration for Chinook salmon through elevated water temperatures from October through December in the Russian River or in Dry Creek and therefore, no impacts would occur.

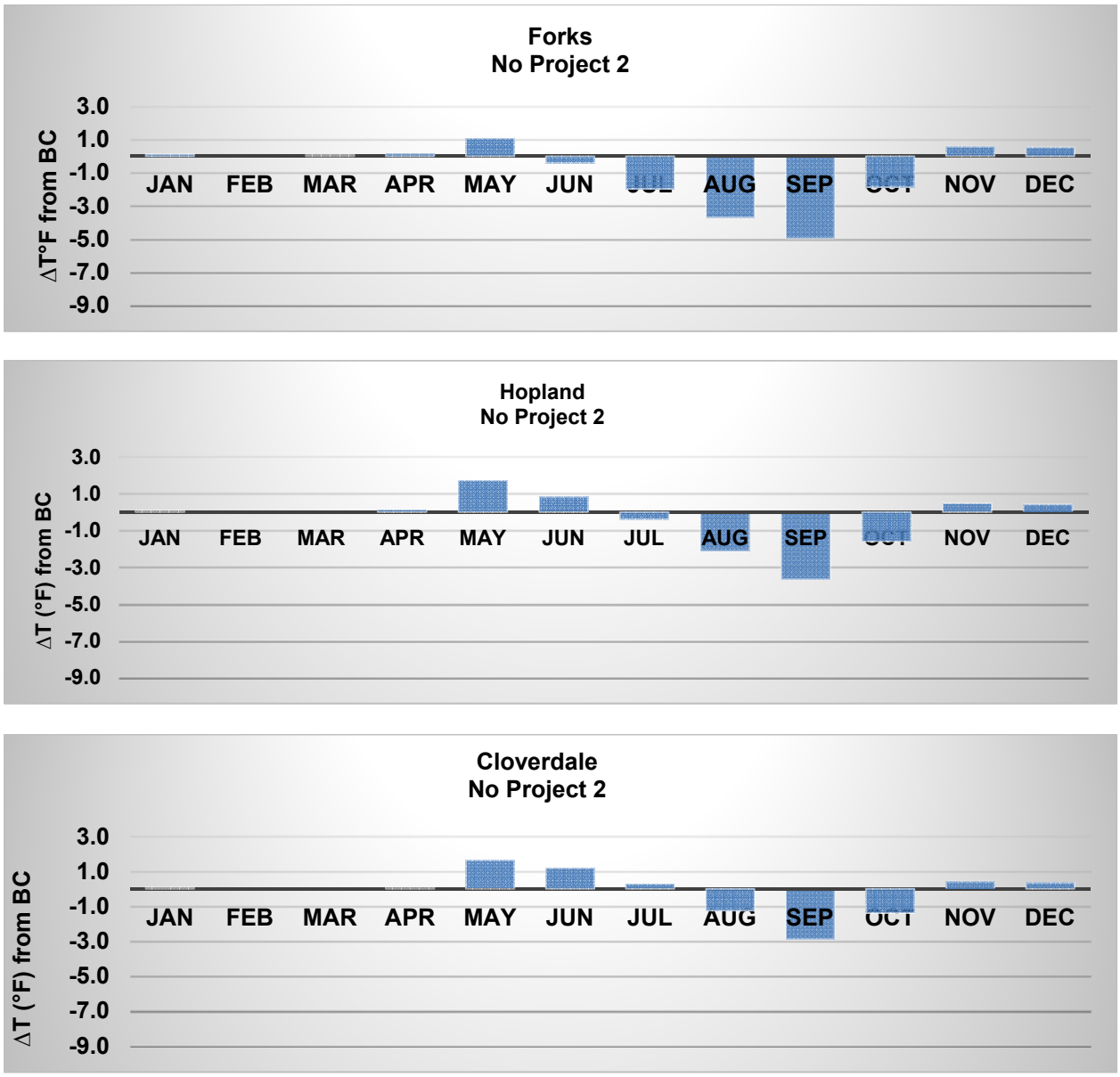
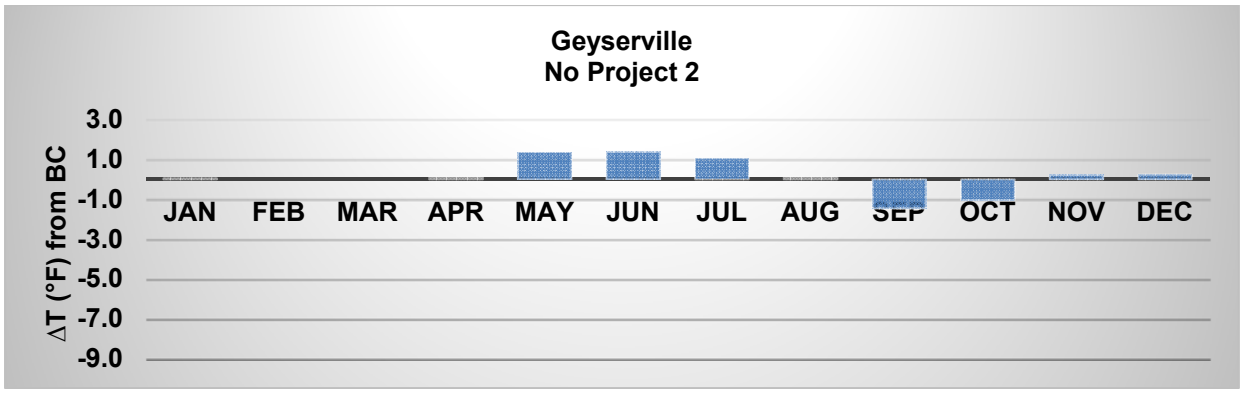
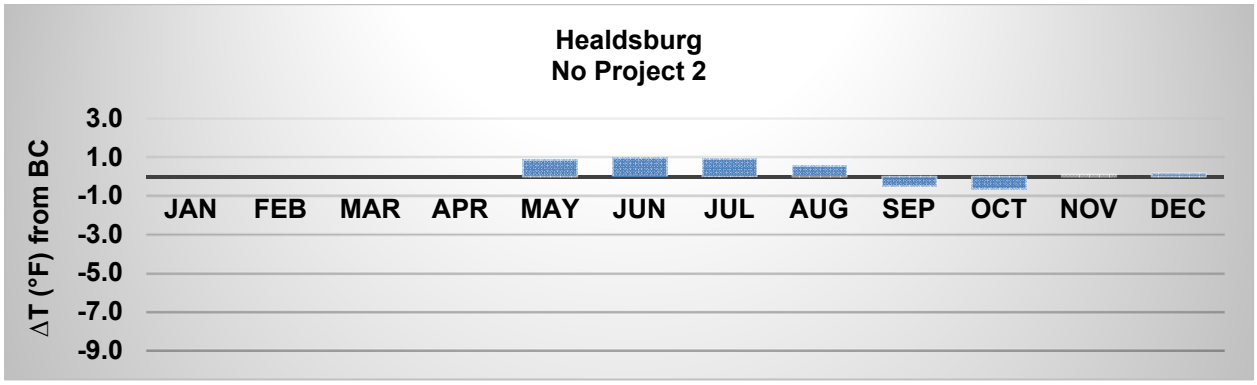


Figure 4.3-16. Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, No Project 2 Alternative (NP2) compared to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the No Project 2 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the No Project 2 Alternative would result in a decrease in the monthly mean water temperature.





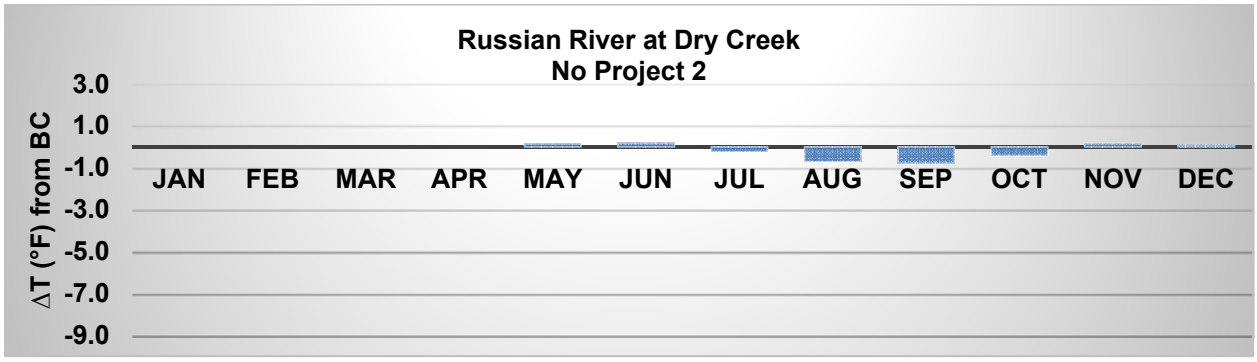
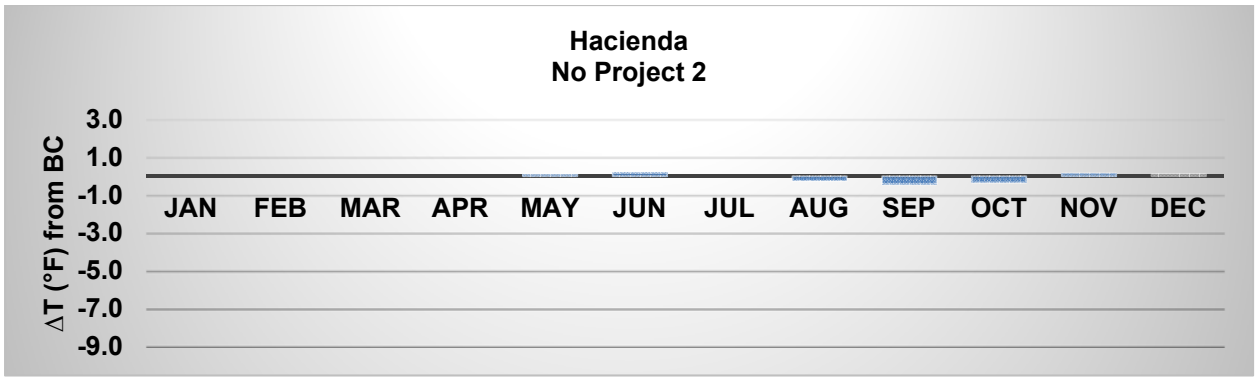
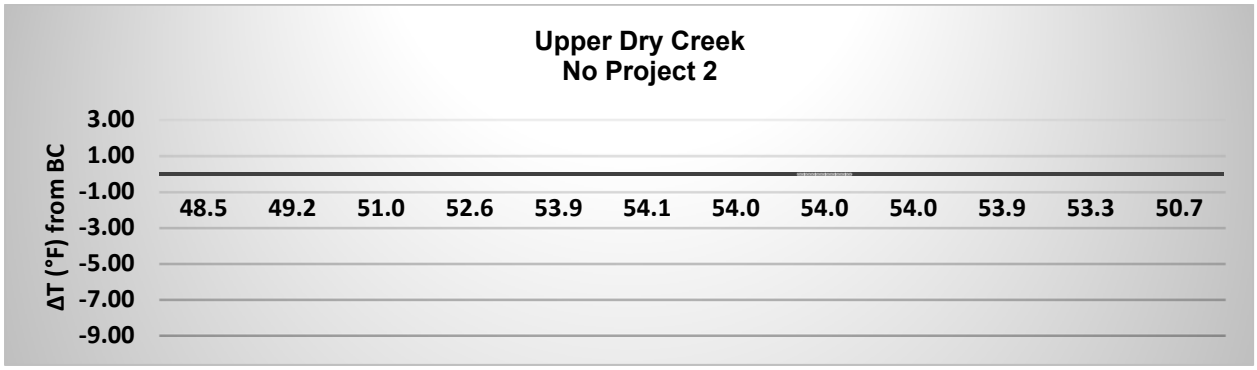


Figure 4.3-16 (continued): Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, No Project 2 Alternative (NP2) compared to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the No Project 2 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the No Project 2 Alternative would result in a decrease in the monthly mean water temperature.





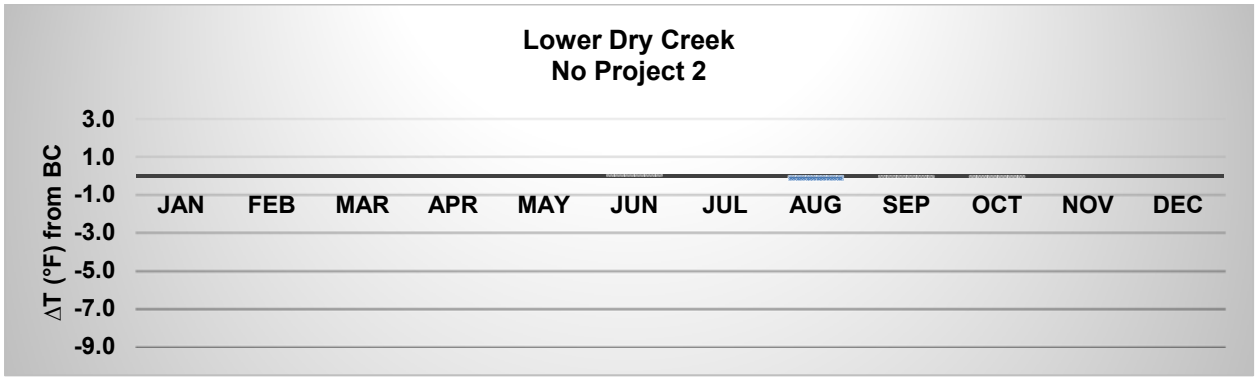


Figure 4.3-16 (continued). Change in the monthly mean water temperature (ΔT) at selected sites along the Russian River and in Dry Creek, No Project 2 Alternative (NP2) compared to Baseline Conditions (BC). In comparison to Baseline Conditions, positive numbers indicate that the No Project 2 Alternative would result in an increase in the monthly mean water temperature. Conversely, negative numbers indicate that the No Project 2 Alternative would result in a decrease in the monthly mean water temperature.

Table 4.3-59. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek from October through December, under Baseline Conditions and under the No Project 2 Alternative (NP2).

		October 1-15		October 16 - 31		November		December	
Reach	Location	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	66.7	63.2	64.8	64.5	57.4	58.0	48.8	49.3
	Hopland	66.3	63.5	64.0	63.6	56.3	56.8	48.2	48.7
	Cloverdale	66.2	63.8	63.5	63.1	55.7	56.1	47.9	48.3
	Geyserville	67.2	65.8	64.0	63.4	56.2	56.4	48.4	48.6
	Healdsburg	68.0	67.2	64.4	63.8	56.6	56.7	48.7	48.9
Lower Russian River	Below DC	63.4	62.8	60.8	60.6	55.3	55.5	49.1	49.2
	Hacienda	63.8	63.4	60.7	60.4	54.7	54.8	48.5	48.6
Dry Creek	Upper	54.0	54.0	53.8	54.8	53.3	53.3	50.7	50.7
	Lower	57.4	57.4	56.2	56.0	53.8	53.8	50.2	50.1

Table 4.3-60: Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the October through December Chinook salmon upstream migration season under Baseline Conditions and the No Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		October 1-15		October 16 - 31		November		December	
Reach		**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	2.23	3.30	3.14	3.23	4.79	4.75	5.00	5.00
	Hopland	2.46	3.41	3.47	3.62	4.87	4.85	5.00	5.00
	Cloverdale	2.54	3.40	3.65	3.82	4.90	4.89	5.00	5.00
	Geyserville	2.19	2.77	3.42	3.66	4.84	4.84	5.00	5.00
	Healdsburg	1.86	2.15	3.32	3.56	4.84	4.86	5.00	5.00
Lower Russian River	Below DC	3.73	3.98	4.53	4.61	4.97	4.97	5.00	5.00
	Hacienda	3.68	3.85	4.58	4.67	4.99	4.98	5.00	5.00
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.93	4.93	4.99	4.99	5.00	5.00	5.00	5.00

Table 4.3-61. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating Chinook salmon in the Russian River and Dry Creek, October through December, under Baseline Condition (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease the occurrence of stressful water temperatures.

October 1 - 15										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	17.31	16.07	59.35	28.93	0.00	0.00	76.67	45.00	-31.67
	Hopland	20.20	15.90	45.90	22.10	0.20	0.00	66.30	38.00	-28.30
	Cloverdale	20.79	16.31	41.89	20.89	0.26	0.00	62.94	37.20	-25.74
	Geyserville	17.38	14.60	50.81	36.70	1.34	0.65	69.53	51.94	-17.59
	Healdsburg	18.83	20.74	62.57	51.78	0.86	0.42	82.27	72.94	-9.32
Lower Russian River	Below Dry Creek	12.36	9.77	8.37	4.32	0.00	0.00	20.73	14.09	-6.63
	Hacienda	11.99	8.87	4.39	2.73	0.00	0.00	16.38	11.60	-4.77
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
October 16 – 31										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	27.73	25.86	14.34	13.18	0.00	0.00	42.07	39.05	-3.02
	Hopland	18.19	14.90	11.17	8.89	0.06	0.00	29.41	23.79	-5.63
	Cloverdale	15.20	12.01	8.30	6.07	0.03	0.00	23.53	18.08	-5.45
	Geyserville	15.20	13.08	17.31	12.12	0.08	0.03	32.58	25.23	-7.36
	Healdsburg	18.40	15.56	16.69	11.54	0.05	0.00	35.13	27.11	-8.02
Lower Russian River	Below Dry Creek	2.08	1.02	0.32	0.15	0.00	0.00	2.40	1.17	-1.23
	Hacienda	0.61	0.20	0.00	0.00	0.00	0.00	0.61	0.20	-0.41
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-61. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to upstream migrating Chinook salmon October through December, under Baseline Condition and the Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures

November										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	0.10	0.50	0.00	0.00	0.00	0.00	0.10	0.50	0.40
	Hopland	0.30	0.30	0.00	0.00	0.00	0.00	0.30	0.30	0.00
	Cloverdale	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10	0.00
	Geyserville	0.90	0.90	0.30	0.20	0.00	0.00	1.20	1.10	-0.10
	Healdsburg	0.80	0.60	0.10	0.10	0.00	0.00	0.90	0.70	-0.20
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Impact 4.3-12: Changes in minimum instream flow could substantially affect the quality of spawning habitat and egg incubation for Chinook salmon through elevated water temperatures from November 15 through March in the Russian River and in Dry Creek. (No Impact).

***Proposed Project*:** Under the Proposed Project, modeled monthly mean water temperatures from November 15 through March range from 0.1 to 0.8º F higher in the Upper Russian River (Figure 4.3-14 Table 4.3-62). Modeled temperature assessment scores would be slightly lower under the Proposed Project compared to Baseline Conditions during the November 16th to 30th timeframe, but overall, scores for the Proposed Project and Baseline provide suitable to optimal conditions for Chinook salmon spawning and egg incubation (Table 4.3-63). Modeled stressful water temperatures occur slightly more often at the Forks (7.51 percent) under the Proposed Project compared to Baseline Conditions during the second half of November; but would be similar (change of ≤1.82%) for all other locations in the Upper Russian River (Table 4.3-64). In Dry Creek, monthly mean temperatures, temperature assessment scores, and the frequency of occurrence of stressful water temperatures would be essentially the same as Baseline Conditions. While the temperature assessment rating is slightly lower, during the November 16th to 30th timeframe and modeled stressful water temperatures occur slightly more often at the Forks, the conditions would be within the suitable to optimal range. Therefore, the Proposed Project would not substantially affect the quality of water by elevated water temperatures from November 15 through March to Chinook salmon spawning and egg incubation and would be considered no impact.

***No Project 1 Alternative*:** Modeled monthly mean water temperatures under the No Project 1 Alternative from November 15 through March would be within ± 0.1° F of Baseline Conditions (Figure 4.3-15; Table 4.3-65). Baseline Conditions and the No Project 1 Alternative provide suitable to optimal water temperatures for spawning Chinook salmon (Table 4.3-66), and the No Project 1 Alternative would not increase the frequency of occurrence of stressful water temperatures relative to Baseline Conditions (Table 4.3-67). Therefore, there are no potential impacts to Chinook salmon spawning and egg incubation under the No Project 1 Alternative.

Table 4.3-62. Monthly mean water temperatures (°F) modeled to occur in the Russian River, November 16 through March, under Baseline Conditions (BC) and under the Proposed Project 2 Alternative (NP2).

		November 16- 30		December		January		February		March	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	Forks	54.8	55.9	48.8	49.6	46.2	46.4	48.0	47.9	53.0	53.5
	Hopland	53.7	54.5	48.2	48.8	46.3	46.5	48.7	48.6	53.6	53.8
	Cloverdale	53.1	53.6	47.9	48.4	46.4	46.5	48.9	48.9	53.7	53.9
	Geyserville	53.5	53.8	48.4	48.7	46.9	47.0	49.7	49.6	54.9	55.0
Dry Creek	Upper	53.0	52.9	50.7	50.7	48.5	48.5	49.2	49.2	51.0	50.9
	Lower	53.0	53.0	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-63. Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the November 16 to March Chinook salmon spawning and egg incubation period under Baseline Conditions (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		November 16- 30		December		January		February		March	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	Forks	4.29	3.98	4.98	4.97	5.00	5.00	5.00	5.00	4.72	4.63
	Hopland	4.55	4.43	4.99	4.98	5.00	5.00	4.99	5.00	4.63	4.56
	Cloverdale	4.66	4.60	4.99	4.99	5.00	5.00	4.99	4.99	4.61	4.56
	Geyserville	4.54	4.51	4.98	4.98	5.00	5.00	4.96	4.97	4.27	4.23
Dry Creek	Upper	4.89	4.89	4.97	4.97	5.00	5.00	5.00	5.00	4.98	4.98
	Lower	4.84	4.84	4.97	4.97	5.00	5.00	4.98	4.98	4.79	4.79

Table 4.3-64. Frequency occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Condition and the Proposed Project. In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

November 16 - 30										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	6.16	9.40	3.38	7.65	0.00	0.00	9.54	17.05	7.51
	Hopland	2.66	3.61	1.54	2.41	0.00	0.00	4.20	6.02	1.82
	Cloverdale	1.74	2.14	0.86	1.09	0.00	0.00	2.60	3.23	0.64
	Geyserville	2.72	2.87	3.08	3.31	0.06	0.06	5.86	6.23	0.38
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.08	0.00	0.00	0.00	0.00	0.02	0.08	0.06
December										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-64. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Condition and the Proposed Project. In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

January										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.12	0.09	0.17	0.09	0.02	0.02	0.31	0.20	-0.11
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.12	0.09	0.17	0.09	0.02	0.02	0.31	0.20	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-64. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Condition and the Proposed Project. In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	1.49	2.29	0.72	1.47	0.02	0.09	2.24	3.85	1.61
	Hopland	1.93	2.49	1.69	2.53	0.08	0.13	3.69	5.15	1.46
	Cloverdale	2.04	2.39	1.79	2.42	0.09	0.13	3.92	4.95	1.03
	Geyserville	4.37	4.65	6.42	7.25	0.53	0.79	11.32	12.69	1.38
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.07	1.09	0.43	0.43	0.00	0.00	1.50	1.52	0.02

Table 4.3-65. Monthly mean water temperatures (°F) modeled to occur in the Upper Russian River and Dry Creek, November 16 through March, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		November-16 to 30		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	54.8	54.8	48.8	48.8	46.2	46.2	48.0	48.1	53.0	53.0
	Hopland	53.7	53.7	48.2	48.2	46.3	46.4	48.7	48.7	53.6	53.6
	Cloverdale	53.1	53.1	47.9	47.9	46.4	46.4	48.9	48.9	53.7	53.8
	Geyserville	53.5	53.5	48.4	48.4	46.9	46.9	49.7	49.7	54.9	54.9
Dry Creek	Upper	53.0	53.0	50.7	50.7	48.5	48.5	49.2	49.2	51.0	51.0
	Lower	53.0	53.1	50.2	50.2	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-66: Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the November 16 through March Chinook salmon spawning and egg incubation season under Baseline Condition (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		November-16		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	4.29	4.29	4.98	4.98	5.00	5.00	5.00	5.00	4.72	4.72
	Hopland	4.63	4.63	4.55	4.55	4.99	4.99	5.00	5.00	4.99	4.99
	Cloverdale	4.66	4.66	4.99	4.99	5.00	5.00	4.99	4.99	4.61	4.60
	Geyserville	4.54	4.54	4.98	4.98	5.00	5.00	4.96	4.96	4.27	4.27
Dry Creek	Upper	4.98	4.98	4.89	4.87	4.97	4.96	5.00	5.00	5.00	5.00
	Lower	4.84	4.83	4.97	4.96	5.00	5.00	4.98	4.98	4.79	4.78

Table 4.3-67. Percent occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Condition (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

November 16 - 30										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	6.16	6.16	3.38	3.38	0.00	0.00	9.54	9.54	0.00
	Hopland	2.66	2.66	1.54	1.54	0.00	0.00	4.20	4.20	0.00
	Cloverdale	1.74	1.74	0.86	0.86	0.00	0.00	2.60	2.60	0.00
	Geyserville	2.72	2.72	3.08	3.08	0.00	0.00	0.06	0.06	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.06	0.00	0.00	0.00	0.00	0.02	0.06	0.05
December										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	6.16	6.16	3.38	3.38	0.00	0.00	9.54	9.54	0.00
	Hopland	2.66	2.66	1.54	1.54	0.00	0.00	4.20	4.20	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.06	0.00	0.02	0.00	0.00	0.02	0.08	0.06

Table 4.3-67. Percent occurrence of water temperatures modeled to exceed criteria deemed stressful to Chinook salmon spawning and egg incubation period in the Upper Russian River and Dry Creek under Baseline Condition (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

January										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-67. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Condition (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Russian River	Forks	1.49	1.49	0.72	0.72	0.02	0.02	2.24	2.24	0.00
	Hopland	1.93	1.93	1.69	1.70	0.08	0.08	3.69	3.71	0.02
	Cloverdale	2.04	2.04	1.79	1.80	0.09	0.09	3.92	3.92	0.01
	Geyserville	4.37	4.36	6.42	6.41	0.53	0.54	11.32	11.31	-0.01
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.07	1.15	0.43	0.50	0.00	0.00	1.50	1.65	0.15

No Project 2 Alternative: Under the No Project 2 Alternative, monthly mean water temperatures from November 15 to March range from 0.1 to 0.5º F higher in the Upper Russian River (Figure 4.3-16; Table 4.3-68). The No Project 2 Alternative would result in slightly lower temperature assessment scores compared to Baseline Conditions during the November 16th to 30th timeframe, but assessment scores for the No Project 2 Alternative would be similar to Baseline Conditions from December through March (Table 4.3-69). Overall, scores for the No Project 2 Alternative would be suitable for Chinook salmon spawning and incubation. The frequency of occurrence of stressful water temperatures in the Upper Russian River was slightly higher (approximately 1.0 to 4.4 percent) under the No Project 2 Alternative during the second half of November (Table 4.3-70). In Dry Creek, monthly mean temperatures, temperature assessment scores, and occurrence of stressful water temperatures would be essentially the same as Baseline Conditions. While the temperature assessment rating is slightly lower, during the November 16th to 30th timeframe and modeled stressful water temperatures occur slightly more often at the Forks, the conditions would be within the suitable to optimal range. Therefore, the Proposed Project would not substantially affect the quality of water by elevated water temperatures from November 15 through March to Chinook salmon spawning and egg incubation and would be considered no impact.

Table 4.3-68. Monthly mean water temperatures (°F) modeled to occur in the Russian River, November 16 through March, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		November-16		December		January		February		March	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	54.8	55.5	48.8	49.3	46.2	46.4	48.0	48.0	53.0	53.1
	Hopland	53.7	54.3	48.2	48.7	46.3	46.4	48.7	48.7	53.6	53.7
	Cloverdale	53.1	53.6	47.9	48.3	46.4	46.5	48.9	48.9	53.7	53.8
	Geyserville	53.5	53.8	48.4	48.6	46.9	47.0	49.7	49.7	54.9	54.9
Dry Creek	Upper	53.0	53.0	50.7	50.7	48.5	48.5	49.2	49.2	51.0	50.9
	Lower	53.0	53.0	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-69. Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the November 16 through March Chinook salmon spawning and egg incubation season under Baseline Condition (BC) and the Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		November-16		December		January		February		March	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	4.29	4.10	4.98	4.98	5.00	5.00	5.00	5.00	4.72	4.71
	Hopland	4.55	4.44	4.99	4.99	5.00	5.00	4.99	4.99	4.63	4.61
	Cloverdale	4.66	4.58	4.99	4.99	5.00	5.00	4.99	4.99	4.61	4.60
	Geyserville	4.54	4.49	4.98	4.98	5.00	5.00	4.96	4.96	4.27	4.27
Dry Creek	Upper	4.89	4.89	4.97	4.96	5.00	5.00	5.00	5.00	4.98	4.98
	Lower	4.84	4.84	4.97	4.97	5.00	5.00	4.98	4.98	4.79	4.79

Table 4.3-70. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November through March, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

November 16 - 30										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	6.16	8.10	3.38	5.80	0.00	0.00	9.54	13.90	4.36
	Hopland	2.66	3.64	1.54	2.41	0.00	0.00	4.20	6.05	1.86
	Cloverdale	1.74	2.25	0.86	1.28	0.00	0.00	2.60	3.53	0.94
	Geyserville	2.72	3.08	3.08	3.35	0.06	0.05	5.86	6.47	0.62
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	-0.01
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-70. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.12	0.12	0.17	0.17	0.02	0.02	0.31	0.31	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-70. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon spawning and egg incubation, November 16 through March, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Russian River	Forks	1.49	1.62	0.72	0.82	0.02	0.02	2.24	2.46	0.22
	Hopland	1.93	2.05	1.69	1.79	0.08	0.09	3.69	3.93	0.24
	Cloverdale	2.04	1.97	1.79	1.94	0.09	0.10	3.92	4.01	0.09
	Geyserville	4.37	4.42	6.42	6.54	0.53	0.58	11.32	11.54	0.23
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.07	1.06	0.43	0.43	0.00	0.00	1.50	1.48	-0.02

Impact 4.3-13: Changes in minimum instream flow could substantially affect the quality of habitat for rearing Chinook juveniles by elevated water temperatures from April through June in the Russian River and in Dry Creek. (Less than significant).

Proposed Project: In the Russian River above Geyserville, modeled monthly mean water temperatures from April through June were approximately 0.8 to 2.8° F higher under the Proposed Project compared to Baseline Conditions (Figure 4.3-14; Table 4.3-71). Modeled water temperature increase to stressful levels between Geyserville and Healdsburg for the Proposed Project and under Baseline Conditions, particularly in June. Temperature assessment scores declined below 3.0 at Healdsburg during May, and declined further during June to 1.15 and 0.75 for Baseline Conditions and the Proposed Project (Table 4.3-72). The frequency of occurrence of stressful conditions would be higher at Geyserville and Healdsburg for the Proposed Project from May through June (increase in the frequency of occurrence of 13 to 18 percent in May and 13 to 15 percent in June) (Table 4.3-73). In the Lower Russian River, Dry Creek moderated water temperatures, and the increase in frequency of stressful temperatures is <4.0 percent. As stated above, rearing juvenile Chinook salmon are in the process of migrating to the Lower Russian River where Dry Creek moderates the temperatures. Based on the results from the Water Agency's annual downstream migrant trapping in the Russian River, most juvenile Chinook salmon have migrated downstream of Healdsburg by the end of May. Therefore, the small increase in water temperatures would not substantially affect the habitat quality for rearing Chinook juveniles from April through June and is considered a less-than-significant impact.

Table 4.3-71. Monthly mean water temperatures (°F) modeled to occur in the Russian River, April through June, under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	April		May		June	
		BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	54.0	55.7	52.8	54.5	52.7	51.9
	Hopland	57.4	58.7	58.8	61.6	59.9	61.3
	Cloverdale	58.6	59.6	61.6	64.2	63.6	65.6
	Geyserville	60.8	64.6	65.7	67.8	69.7	71.8
	Healdsburg	62.3	62.8	68.3	69.6	73.2	74.6
Lower Russian River	Below Dry Creek	61.0	61.2	65.9	66.2	68.9	68.9
	Hacienda	61.2	61.3	66.5	66.8	70.2	70.5
Dry Creek	Upper	52.7	52.6	53.9	54.1	54.1	54.4
	Lower	56.6	56.6	59.8	60.1	61.4	62.2

Table 4.3-72. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the April through June juvenile Chinook salmon rearing period under Baseline Conditions (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	April		May		June	
		BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	5.00	4.98	4.99	4.97	4.98	5.00
	Hopland	4.97	4.92	4.88	4.62	4.78	4.62
	Cloverdale	4.93	4.87	4.65	4.16	4.28	3.75
	Geyserville	4.68	4.55	3.67	3.00	2.40	1.68
	Healdsburg	4.47	4.34	2.85	2.38	1.15	0.75
Lower Russian River	Below Dry Creek	4.70	4.66	3.67	3.55	2.64	2.51
	Hacienda	4.73	4.70	3.52	3.43	2.20	2.06
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.98	4.98	4.84	4.81	4.61	4.48

Table 4.3-73. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to rearing juvenile Chinook salmon, April through June, under Baseline Conditions (BC) and the Proposed Project (PP).

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.05	0.15	0.00	0.00	0.00	0.00	0.05	0.15	0.10
	Cloverdale	0.22	0.37	0.00	0.00	0.00	0.00	0.22	0.37	0.14
	Geyserville	3.26	5.84	0.50	0.89	0.10	0.08	3.86	6.81	2.95
	Healdsburg	6.46	9.33	0.83	1.54	0.06	0.07	7.35	10.94	3.59
Lower Russian River	Below Dry Creek	2.67	3.53	0.10	0.15	0.00	0.00	2.76	3.68	0.91
	Hacienda	1.11	1.53	0.01	0.00	0.00	0.00	1.12	1.53	0.42
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.09	0.23	0.02	0.02	0.00	0.00	0.10	0.25	0.15
	Hopland	1.03	3.82	0.10	0.42	0.00	0.00	1.13	4.24	3.11
	Cloverdale	3.05	11.27	0.39	1.38	0.02	0.07	3.46	12.72	9.26
	Geyserville	18.80	25.30	7.32	14.45	2.04	6.38	28.16	46.13	17.97
	Healdsburg	31.99	32.97	15.91	23.55	4.12	8.71	52.02	65.23	13.21
Lower Russian River	Below Dry Creek	21.58	23.63	5.36	7.11	0.23	0.33	27.17	31.07	3.90
	Hacienda	27.75	29.65	2.24	3.30	0.06	0.12	30.05	33.07	3.02
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.49	0.03	0.03	0.00	0.00	0.258	0.52	0.24

Table 4.3-73. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to rearing juvenile Chinook salmon, April through June, under Baseline Conditions (BC) and the Proposed Project (PP).

June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.19	0.02	0.15	0.00	0.02	0.00	0.36	0.02	-0.34
	Hopland	1.83	4.10	0.41	0.60	0.18	0.02	2.42	4.72	2.30
	Cloverdale	8.09	19.23	1.75	4.09	0.42	0.50	10.27	23.82	13.55
	Geyserville	28.66	25.34	20.82	26.32	12.63	26.00	62.11	77.66	15.55
	Healdsburg	24.60	15.34	36.67	34.34	31.33	46.88	92.60	96.56	3.96
Lower Russian River	Below Dry Creek	36.78	34.03	19.95	22.12	3.24	5.97	59.97	62.12	2.15
	Hacienda	56.02	50.95	26.67	31.95	1.29	2.44	83.98	85.34	1.36
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.92	6.96	0.14	0.19	0.00	0.02	3.06	7.17	4.11

No Project 1 Alternative: During the juvenile Chinook salmon rearing period, minimum instream flow requirements are similar to Baseline Conditions. Consequently, modeled water temperatures in the Upper Russian River during this time period would be within ± 0.04° F in the Russian River and in Dry Creek (Figure 4.3-15; Table 4.3-74). Temperature assessment scores are also similar and the No Project 1 Alternative would not result in an increase in stressful water temperatures (Table 4.3-75). Although minimum instream flows are similar between Baseline Conditions and the No Project 1 Alternative, the increase in municipal water demands modeled under the No Project 1 Alternative would result in higher releases from Lake Sonoma and a slight reduction in water temperature in the Lower Russian River and in Dry Creek during June (± 0.4° F). Temperature assessment scores were similar to Baseline Conditions and would not result in an increase in the frequency of occurrence of stressful water temperatures (Table 4.3-76). For the No Project 1 Alternative, suitable water temperatures would be present for rearing Chinook salmon during April throughout the project area. Rearing conditions decline downstream of Cloverdale during May, and become stressful at Healdsburg during June (suitability score of 1.15 under the No Project 1 Alternative and Baseline Conditions). Downstream of Dry Creek, water temperatures are generally suitable during April and May, but become degraded in June. Temperature assessment scores at Hacienda range from 2.20 to 2.28 under Baseline Conditions and the No Project 1 Alternative, respectively. Water temperatures remain suitable to optimal in Dry Creek during the April through June juvenile Chinook salmon rearing period. Overall, the occurrence of stressful water temperatures remained approximately equal compared to Baseline Conditions, therefore, no impacts would occur.

Table 4.3-74. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, April through June, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach		April		May		June	
	Location	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	54.0	54.0	52.8	52.8	52.7	52.7
	Hopland	57.4	57.4	58.8	58.8	59.9	59.9
	Cloverdale	58.6	58.6	61.6	61.6	63.6	63.6
	Geyserville	60.8	60.8	65.7	65.7	69.7	69.7
	Healdsburg	62.3	62.3	68.3	68.3	73.2	73.2
Lower Russian River	Below DC	61.0	61.0	65.9	65.8	68.9	68.5
	Hacienda	61.2	61.2	66.5	66.5	70.2	69.9
Dry Creek	Upper	52.6	52.6	53.9	53.8	54.1	54.0
	Lower	56.6	56.6	59.8	59.8	61.4	61.2

Table 4.3-75. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during April through June juvenile Chinook salmon rearing period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		April		May		June	
	Location	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	5.00	5.00	4.99	4.99	4.98	4.98
	Hopland	4.97	4.96	4.88	4.88	4.78	4.78
	Cloverdale	4.93	4.93	4.65	4.65	4.28	4.28
	Geyserville	4.68	4.68	3.67	3.67	2.40	2.40
	Healdsburg	4.47	4.47	2.85	2.85	1.15	1.15
Lower Russian River	Below DC	4.70	4.70	3.67	3.69	2.64	2.76
	Hacienda	4.73	4.73	3.52	3.54	2.20	2.28
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.98	4.98	4.84	4.84	4.61	4.64

Table 4.3-76. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to rearing juvenile Chinook salmon, April through June, under Baseline Condition and the Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.22	0.22	0.00	0.00	0.00	0.00	0.22	0.22	0.00
	Geyserville	3.26	3.27	0.50	0.50	0.10	0.10	3.87	3.87	0.00
	Healdsburg	6.46	6.46	0.83	0.83	0.06	0.06	7.35	7.35	0.00
Lower Russian River	Below DC	2.70	2.70	0.10	0.10	0.00	0.00	2.80	2.80	0.00
	Hacienda	1.10	1.10	0.00	0.00	0.00	0.00	1.10	1.10	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.09	0.09	0.02	0.02	0.00	0.00	0.10	0.10	0.00
	Hopland	1.03	1.03	0.10	0.10	0.00	0.00	1.13	1.13	0.00
	Cloverdale	3.05	3.06	0.39	0.39	0.02	0.02	3.46	3.48	0.02
	Geyserville	18.80	18.79	7.32	7.37	2.04	2.04	28.16	28.20	0.04
	Healdsburg	31.99	32.00	20.03	20.05	4.12	4.12	56.14	56.17	0.04
Lower Russian River	Below DC	21.58	21.30	5.36	5.16	0.23	0.21	27.17	26.67	-0.50
	Hacienda	27.75	27.32	2.24	2.13	0.06	0.05	30.05	29.49	-0.56
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.22	0.00	0.00	0.00	0.00	0.25	0.22	-0.02

Table 4.3-76. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to rearing juvenile Chinook salmon rearing period, April through June, under Baseline Condition and the Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

June										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.19	0.19	0.15	0.15	0.02	0.02	0.36	0.36	0.00
	Hopland	1.83	1.83	0.41	0.41	0.18	0.18	2.42	2.42	0.00
	Cloverdale	8.09	8.10	1.75	1.76	0.42	0.42	10.27	10.29	0.02
	Geyserville	28.66	28.60	20.82	20.85	12.63	12.67	62.11	62.12	0.01
	Healdsburg	24.60	24.52	36.67	36.75	31.33	31.34	92.60	92.61	0.01
Lower Russian River	Below DC	36.78	35.50	19.95	18.57	3.24	2.78	60.0	56.9	-3.12
	Hacienda	56.02	55.34	26.67	24.34	1.29	1.19	84.0	80.9	-3.10
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.00
	Lower	2.92	2.51	0.14	0.13	0.00	0.00	3.1	2.6	-0.42

No Project 2 Alternative: Monthly mean water temperatures are essentially the same during April, and 0.8 to 1.7° F warmer in the Upper Russian River during May and June under the No Project 2 Alternative as Baseline Conditions (Figure 4.3-15; Table 4.3-77). In the Lower Russian River, modeled water temperatures for Baseline Conditions and No Project 2 Alternative would be within 0.2° F. Modeled water temperatures in Dry Creek are within 0.2° F between Baseline Conditions and the No Project 2 Alternative. In the Russian River (upper and lower), water temperature suitability ranged from near optimal to highly suitable during April, but become degraded during May and June between Geyserville and the Dry Creek confluence (Table 4.3-78). The No Project 2 Alternative would result in a slight increase in the occurrence of stressful conditions compared to Baseline Conditions (Table 4.3-79).

Monthly mean water temperatures at Healdsburg approach lethal levels by June under Baseline Conditions and the No Project 2 Alternative (73.2 and 74.6° F). Since Chinook salmon emigrate to the ocean during their first year of life, their tendency is to continually migrate downstream as they grow. Water temperature assessment scores were similar between Baseline Conditions and the No Project 2 Alternative in the Lower Russian River, although again, the No Project 2 Alternative scored slightly lower overall. Rearing conditions for juvenile Chinook salmon in Dry Creek rated suitable to optimal under both the No Project 2 Alternative and Baseline Conditions. In the Russian River, stressful water temperatures rarely occur during April, but were modeled to occur approximately 52 and 61 percent of the time during May at Healdsburg under Baseline Conditions and the No Project 2 Alternative, respectively (Table 4.3-79). Under the No Project 2 Alternative, the frequency of occurrence of stressful water temperatures during May were modeled to increase by 12.1 and 9.2 percent of the time at Geyserville and Healdsburg. However, the inflow from Dry Creek moderated temperatures, the occurrence of stressful water temperatures were within 2.0 percent between Baseline Conditions and the No Project 2 Alternative. Although the No Project 2 Alternative increases temperatures in the Upper Russian River (mainly between Geyserville and Healdsburg), rearing juvenile Chinook salmon are in the process of migrating to the Lower Russian River where Dry Creek moderates the temperatures between Baseline Conditions and the No Project 2 Alternative. Based on the results from the Water Agency's annual downstream migrant trapping in the Russian River, most juvenile Chinook salmon have migrated downstream of Healdsburg by the end of May. Therefore, the small increase in water temperatures would not substantially affect the habitat quality for rearing Chinook juveniles from April through June and is considered a less-than-significant impact.

Table 4.3-77. Monthly mean water temperatures (° F) modeled to occur in the Russian River and Dry Creek from April through June, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	April		May		June	
		BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	54.0	54.1	52.8	53.8	52.7	52.2
	Hopland	57.4	57.5	58.8	60.6	59.9	60.8
	Cloverdale	58.6	58.7	61.6	63.2	63.6	64.8
	Geyserville	60.8	60.9	65.7	67.1	69.7	71.0
	Healdsburg	62.3	62.4	68.3	69.2	73.2	74.2
Lower Russian River	Below DC	61.0	61.0	65.9	66.0	68.9	69.1
	Hacienda	61.2	61.2	66.5	66.6	70.2	70.3
Dry Creek	Upper	52.6	52.6	53.9	53.9	54.1	54.1
	Lower	56.6	56.6	59.8	59.8	61.4	61.6

Table 4.3-78. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during April through June juvenile Chinook salmon rearing period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	April		May		June	
		BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	5.00	5.00	4.99	4.98	4.98	5.00
	Hopland	4.97	4.96	4.88	4.75	4.78	4.71
	Cloverdale	4.93	4.93	4.65	4.38	4.28	4.01
	Geyserville	4.68	4.67	3.67	3.24	2.40	1.93
	Healdsburg	4.47	4.46	2.85	2.54	1.15	0.85
Lower Russian River	Below DC	4.70	4.70	3.67	3.62	2.64	2.57
	Hacienda	4.73	4.73	3.52	3.48	2.20	2.12
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.98	4.98	4.84	4.84	4.61	4.60

Table 4.3-79. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to juvenile Chinook salmon rearing, April through June, under Baseline Conditions (BC) and the Project 2 Alternative (NP2).

April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.22	0.17	0.00	0.00	0.00	0.00	0.22	0.17	-0.05
	Geyserville	3.26	3.48	0.50	0.50	0.10	0.10	3.86	4.08	0.22
	Healdsburg	6.46	6.75	0.83	0.85	0.06	0.06	7.35	7.67	0.32
Lower Russian River	Below DC	2.67	2.79	0.10	0.08	0.00	0.00	2.76	2.81	0.10
	Hacienda	1.11	1.14	0.01	0.00	0.00	0.00	1.12	1.14	0.02
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	1.03	1.85	0.10	0.18	0.00	0.00	1.13	2.02	0.89
	Cloverdale	3.05	6.98	0.39	0.39	0.02	0.02	3.46	7.73	4.27
	Geyserville	18.80	24.23	7.32	11.80	2.04	4.24	28.16	40.27	12.10
	Healdsburg	31.99	33.10	15.91	21.08	4.12	7.04	52.02	61.22	9.20
Lower Russian River	Below DC	21.58	22.53	5.36	6.11	0.23	0.21	27.17	28.90	1.73
	Hacienda	27.75	28.55	2.24	2.13	0.06	0.09	30.05	31.37	1.32
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.28	0.03	0.02	0.00	0.00	0.28	0.30	0.02

Table 4.3-79. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to juvenile Chinook salmon rearing, April through June, under Baseline Conditions (BC) and the Project 2 Alternative (NP2).

June										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	% Change
Upper Russian River	Forks	0.19	0.02	0.15	0.00	0.02	0.00	0.36	0.02	-0.34
	Hopland	1.83	2.80	0.41	0.26	0.18	0.02	2.42	3.08	0.67
	Cloverdale	8.09	13.86	1.75	2.54	0.42	0.27	10.27	16.67	6.40
	Geyserville	28.66	27.84	20.82	24.71	12.63	20.30	62.11	72.84	10.74
	Healdsburg	24.60	18.46	36.67	35.99	31.33	41.56	92.60	96.01	3.41
Lower Russian River	Below DC	36.78	36.58	19.95	21.26	3.24	3.61	59.97	61.45	1.48
	Hacienda	56.02	54.38	26.67	29.47	1.29	1.72	83.98	85.58	1.59
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.92	2.95	0.14	0.14	0.00	0.00	3.06	3.08	0.02

Impact 4.3-14: Changes in minimum instream flow could substantially affect the quality of habitat for Chinook salmon smolts by elevated water temperatures from April through July 15 in the Russian River and in Dry Creek. (No Impact).

Juvenile Chinook salmon rear in freshwater for 2 to 4 months before entering the ocean. The rearing and smolting phases are intertwined, and "rearing" juveniles slowly morph into "smolts." Under the assumption that "smolting" fish are more inclined to migrate downstream, the Lower Russian River is emphasized when assessing potential impacts to smolts. This assumption is supported by limited downstream migrant trapping in the Upper Russian River near Healdsburg in 2016, where numbers of juvenile Chinook salmon rapidly declined after May 31. Secondly, the Upper Russian River becomes inhospitable to rearing/smolting Chinook salmon in June under Baseline Conditions (see discussion below).

An additional factor to consider is the effect of Dry Creek on the presence of juvenile/smolt Chinook salmon in the Lower Russian River during June and July. Coldwater releases from Warm Springs Dam maintain artificially cold (and stable) temperatures in Dry Creek. This likely results in some Chinook juveniles delaying the onset of emigration. Chinook salmon smolts are captured in a downstream migrant trap in Dry Creek in June, with very low numbers (generally <2%) being captured into July.

Proposed Project: Modeled water temperatures in the Lower Russian River increase by ≤0.4° F under the Proposed Project relative to Baseline Conditions (Figure 4.3-14; Table 4.3-80). For the Proposed Project, suitable water temperatures for emigrating Chinook salmon smolts during April would be throughout the project area. Water temperature assessment scores under the Proposed Project are similar to Baseline during April, but would be slightly lower during May and June (Table 4.3-81). Overall, stressful water temperatures in the Lower Russian River modeled to occur approximately 50 to 95 percent of the time under both Baseline Conditions and the Proposed Project during May and June; however, difference in the occurrence of stressful temperatures between Baseline Conditions and the Proposed Project was ≤4.2 percent (Table 4.3-82). The timing of these slight differences in temperature would not substantially affect the emigrating Chinook salmon smolts from April through July 15 in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 1 Alternative: During the Chinook salmon smolting period, minimum instream flow releases are slightly higher in Dry Creek under the No Project 1 Alternative. Consequently, mean month water temperatures in the Lower Russian River during this time are modeled to be within 0.1 to 0.4° F cooler downstream of Dry Creek compared to Baseline Conditions (Figure 4.3-15; Table 4.3-83). Temperature assessment scores would be similar to Baseline Conditions (Table 4.3-84) would not result in an increase in frequency of stressful water temperatures (Table 4.3-85). There would be no potential for impacts to emigrating Chinook salmon smolts under the No Project 1 Alternative.

Table 4.3-80. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, April through June, under Baseline Conditions (BC) and the Proposed Project.

Reach		April		May		June	
	Location	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	54.0	55.7	52.8	54.5	52.7	51.9
	Hopland	57.4	58.7	58.8	61.6	59.9	61.3
	Cloverdale	58.6	59.6	61.6	64.2	63.6	65.6
	Geyserville	60.8	61.6	65.8	67.8	69.7	71.8
	Healdsburg	62.3	62.8	68.3	69.6	73.2	74.6
Lower Russian River	Below Dry Creek	61.0	61.2	65.9	66.2	68.9	68.9
	Hacienda	61.2	61.3	66.5	66.8	70.2	70.5
Dry Creek	Upper	52.6	52.6	53.9	54.1	54.1	54.4
	Lower	56.6	56.6	59.8	59.8	61.4	61.2

Table 4.3-81. Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the Chinook salmon smolt emigration period, April through June, under Baseline Conditions (BC) and the Proposed Project. Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		April		May		June	
	Location	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	4.99	4.97	4.99	4.96	4.97	4.99
	Hopland	4.94	4.85	4.79	4.36	4.65	4.38
	Cloverdale	4.88	4.77	4.41	3.66	3.87	3.14
	Geyserville	4.49	4.28	3.08	2.34	1.72	1.09
	Healdsburg	4.15	3.97	2.09	1.65	0.63	0.39
Lower Russian River	Below Dry Creek	4.50	4.43	3.00	2.86	1.84	1.71
	Hacienda	4.53	4.48	2.72	2.61	1.28	1.17
Dry Creek	Upper	5.00	5.00	5.00	5.00	5.00	5.00
	Lower	4.96	4.96	4.71	4.66	4.34	4.16

Table 4.3-82. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to Chinook salmon smolts (April – June) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	Hopland	0.50	1.21	0.05	0.15	0.00	0.00	0.55	1.36	0.81
	Cloverdale	0.82	2.10	0.22	0.37	0.00	0.00	1.04	2.47	1.43
	Geyserville	5.42	8.11	3.77	6.73	0.10	0.08	9.28	14.92	5.64
	Healdsburg	9.87	11.20	7.28	10.85	0.06	0.07	17.22	22.12	4.93
Lower Russian River	Below Dry Creek	5.85	6.69	2.76	3.68	0.00	0.00	8.61	10.37	1.77
	Hacienda	5.29	6.35	1.12	1.53	0.00	0.00	6.41	7.88	1.47
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.17	0.11	0.00	0.00	0.00	0.00	0.17	0.11	-0.06
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Forks	0.11	0.36	0.10	0.25	0.00	0.00	0.21	0.61	0.40
	Hopland	1.83	7.02	1.13	4.24	0.00	0.0	2.96	11.26	8.30
	Cloverdale	6.47	16.08	3.44	12.65	0.02	0.07	9.93	28.80	18.87
	Geyserville	16.48	17.06	26.12	39.75	2.04	6.38	44.64	63.19	18.55
	Healdsburg	19.70	15.90	47.90	56.52	4.12	8.71	71.72	81.13	9.41
Lower Russian River	Below Dry Creek	20.28	20.59	26.94	30.74	0.23	0.33	47.46	51.66	4.20
	Hacienda	27.85	28.49	29.99	32.94	0.06	0.12	57.90	61.54	3.65
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	3.23	4.28	0.28	0.52	0.00	0.00	3.51	4.80	1.30

Table 4.3-82 (continued). Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to Chinook salmon smolts (April – June) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

June										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.18	0.03	0.34	0.02	0.02	0.00	0.54	0.06	-0.48
	Hopland	3.33	7.19	2.24	4.70	0.18	0.02	5.75	11.91	6.16
	Cloverdale	12.93	21.10	9.85	23.33	0.42	0.50	23.21	44.93	21.72
	Geyserville	15.09	12.43	49.48	51.67	12.63	26.00	77.20	90.10	12.90
	Healdsburg	5.18	2.41	61.27	49.69	31.33	46.88	97.78	98.94	1.16
Lower Russian River	Below Dry Creek	18.83	17.67	56.73	56.15	3.24	5.97	78.80	79.79	0.99
	Hacienda	11.92	10.85	82.69	82.89	1.29	2.48	95.91	96.22	0.31
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	11.36	11.20	3.06	7.12	0.00	0.02	14.42	18.34	3.92

Table 4.3-83. Monthly mean water temperatures (°F) modeled to occur in the Russian River, April through June, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

	April		May		June	
	BC	NP1	BC	NP1	BC	NP1
Forks	54.0	54.0	52.8	52.8	52.7	52.7
Hopland	57.4	57.4	58.8	58.9	59.9	60.0
Cloverdale	58.6	58.7	61.7	61.7	63.6	63.7
Geyserville	60.9	60.9	65.8	65.8	69.7	69.8
Healdsburg	62.4	62.4	68.4	68.4	73.3	73.3
Below Dry Creek	61.1	61.1	66.0	65.9	68.9	68.5
Hacienda	61.3	61.3	66.6	66.6	70.2	70.0
Geyserville	52.6	52.6	53.9	53.8	54.1	54.0
Confluence	56.7	56.7	59.8	59.8	61.4	61.2

Table 4.3-84. Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the April through June Chinook salmon smolt emigration period, April through June, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

	April		May		June	
	BC	NP1	BC	NP1	BC	NP1
Forks	4.99	4.99	4.99	4.99	4.97	4.97
Hopland	4.94	4.94	4.79	4.79	4.65	4.65
Cloverdale	4.88	4.88	4.41	4.41	3.87	3.86
Geyserville	4.49	4.49	3.08	3.08	1.72	1.72
Healdsburg	4.15	4.15	2.09	2.09	0.63	0.63
Below Dry Creek	4.50	4.49	3.00	3.02	1.84	1.84
Hacienda	4.53	4.53	2.72	2.72	1.28	1.36
Geyserville	5.00	5.00	5.00	5.00	5.00	5.00
Confluence	4.96	4.96	4.71	4.72	4.34	4.40

Table 4.3-85. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon smolts, April through June, under Baseline Conditions (BC) and the Project 2 Alternative (NP1). In the "% Change" column, a positive number indicates that the Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.50	0.50	0.05	0.05	0.00	0.00	0.55	0.55	0.00
	Cloverdale	0.82	0.82	0.22	0.22	0.00	0.00	1.04	1.04	0.00
	Geyserville	5.42	5.41	3.77	3.77	0.10	0.10	9.28	9.27	-0.01
	Healdsburg	9.87	9.90	7.28	7.28	0.06	0.06	17.22	17.25	0.03
Lower Russian River	Below Dry Creek	5.85	5.87	2.76	2.81	0.00	0.00	8.61	8.68	0.07
	Hacienda	5.29	5.29	1.12	1.12	0.00	0.00	6.41	6.41	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.11	0.11	0.10	0.10	0.00	0.00	0.21	0.21	0.00
	Hopland	1.83	1.85	1.13	1.13	0.00	0.00	2.96	2.98	0.02
	Cloverdale	6.47	6.50	3.44	3.45	0.02	0.02	9.93	9.97	0.04
	Geyserville	16.48	16.48	26.12	26.16	2.04	2.04	44.64	44.68	0.04
	Healdsburg	19.70	19.68	47.90	47.94	4.12	4.12	71.72	71.74	0.02
Lower Russian River	Below Dry Creek	20.28	20.14	26.94	26.46	0.23	0.21	47.46	46.81	-0.65
	Hacienda	27.85	27.83	29.99	29.44	0.06	0.05	57.90	57.32	-0.58
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	3.23	2.96	0.28	0.23	0.00	0.00	3.51	3.19	-0.32

Table 4.3-85. Frequency of occurrence of modeled water temperatures in the Russian River and Dry Creek deemed stressful to Chinook salmon smolts, April thought June, under Baseline Conditions (BC) and the Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

June										
		Tolerance		Resistance		Lethal		Total		
Reach	Location		NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Forks	0.18	0.18	0.34	0.34	0.02	0.02	0.54	0.54	0.00
	Hopland	3.33	3.35	2.24	2.24	0.18	0.18	5.75	5.77	0.02
	Cloverdale	12.93	13.02	9.85	9.86	0.42	0.42	23.21	23.30	0.10
	Geyserville BC	15.09	15.09	49.48	49.45	12.63	12.67	77.20	77.21	0.01
	Healdsburg	5.18	5.18	61.27	61.27	31.33	31.34	97.78	97.79	0.01
Lower Russian River	Below Dry Creek	18.83	18.57	56.73	54.07	3.24	2.78	78.80	75.42	-3.38
	Hacienda	11.92	13.96	82.69	79.69	1.29	1.19	95.91	94.84	-1.07
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	11.36	10.08	3.06	2.64	0.00	0.00	14.42	12.72	-1.70

No Project 2 Alternative: Modeled monthly mean water temperatures in the Lower Russian River increase by ≤0.2° F under the No Project 2 Alternative relative to Baseline Conditions (Figure 4.3-16; Table 4.3-86). For the No Project 2 Alternative suitable water temperatures for rearing Chinook salmon smolts during April would be throughout the Lower Russian River. Modeled temperature assessment scores would be slightly lower under the No Project 2 Alternative during May and June (Table 4.3-87). Overall, stressful water temperatures in the Lower Russian River are modeled to occur approximately 50 to 95 percent of the time for Baseline Conditions and the No Project 2 Alternative during May and June; however, difference in the occurrence of stressful temperatures between Baseline Conditions and the No Project 2 Alternative was <2.0 percent (Table 4.3-88). The slight differences in temperature would not substantially affect the emigrating Chinook salmon smolts from April through July 15 in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-86. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, April through June, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	April		May		June	
		BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	54.0	54.1	52.8	53.8	52.7	52.2
	Hopland	57.4	57.6	58.8	60.6	59.9	60.8
	Cloverdale	58.6	58.8	61.7	63.3	63.6	64.8
	Geyserville	60.9	61.0	65.8	67.2	69.7	71.1
	Healdsburg	62.4	62.5	68.4	69.3	73.3	74.2
Lower Russian River	Below Dry Creek	61.1	61.1	66.0	66.1	68.9	69.1
	Hacienda	61.3	61.3	66.6	66.6	70.2	70.0
Dry Creek	Geyserville	52.6	54.3	53.9	56.5	54.1	57.2
	Confluence	56.7	56.7	59.8	59.8	61.4	61.6

Table 4.3-87. Temperature assessment scores evaluating water temperature suitability in the Upper Russian River and Dry Creek during the Chinook salmon smolt emigration period, April through June, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	April		May		June	
		BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	4.99	4.99	4.99	4.97	4.97	4.99
	Hopland	4.94	4.94	4.79	4.57	4.65	4.52
	Cloverdale	4.88	4.88	4.41	3.97	3.87	3.45
	Geyserville	4.49	4.49	3.08	2.59	1.72	1.28
	Healdsburg	4.15	4.13	2.09	1.79	0.63	0.44
Lower Russian River	Below Dry Creek	4.50	4.49	3.00	2.94	1.84	1.77
	Hacienda	4.53	4.52	2.72	2.67	1.28	1.22
Dry Creek	Geyserville	5.00	5.00	5.00	5.00	5.00	5.00
	Confluence	4.96	4.96	4.71	4.71	4.34	4.32

Table 4.3-88. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to Chinook salmon smolts (April – June) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

April										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Russian River	Forks	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.02
	Hopland	0.50	0.50	0.05	0.03	0.00	0.00	0.55	0.53	-0.04
	Cloverdale	0.82	0.89	0.22	0.17	0.00	0.00	1.04	1.06	-0.04
	Geyserville	5.42	5.74	3.77	3.98	0.10	0.10	9.28	9.82	0.75
	Healdsburg	9.87	10.14	7.28	7.60	0.06	0.06	17.22	17.80	0.90
	Below Dry Creek	5.85	5.99	2.76	2.87	0.00	0.00	8.61	8.86	0.35
	Hacienda	5.29	5.44	1.12	1.14	0.00	0.00	6.41	6.58	0.19
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Russian River	Forks	0.11	0.31	0.10	0.18	0.00	0.00	0.21	0.49	0.28
	Hopland	1.83	4.75	1.13	2.02	0.00	0.00	2.96	6.77	3.81
	Cloverdale	6.47	12.40	3.44	7.72	0.02	0.02	9.93	20.14	10.21
	Geyserville	16.48	16.79	26.12	36.03	2.04	4.24	44.64	57.06	12.42
	Healdsburg	19.70	16.80	47.90	54.17	4.12	7.04	71.72	78.01	6.29
	Below Dry Creek	20.28	20.40	26.94	28.65	0.23	0.03	47.46	49.08	1.62
	Hacienda	27.85	28.02	29.99	31.28	0.06	0.09	57.90	59.39	1.49
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	3.23	3.12	0.28	0.30	0.00	0.00	3.51	3.42	-0.09

Table 4.3-88. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to Chinook salmon smolts (April – June) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Russian River	Forks	0.18	0.08	0.34	0.02	0.02	0.00	0.5	0.1	-0.44
	Hopland	3.33	5.11	2.24	3.07	0.18	0.02	5.7	8.2	2.45
	Cloverdale	12.93	17.92	9.85	16.40	0.42	0.27	23.2	34.6	11.38
	Geyserville	15.09	13.49	49.48	52.55	12.63	20.30	77.2	86.3	9.14
	Healdsburg	5.18	2.91	61.27	54.45	31.33	41.56	97.8	98.9	1.14
	Below Dry Creek	18.83	18.65	56.73	57.84	3.24	3.61	78.8	80.1	1.30
	Hacienda	11.92	10.95	82.69	83.85	1.29	1.72	95.9	96.5	0.61
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.00
	Confluence	11.36	11.67	3.06	3.08	0.00	0.00	14.4	14.8	0.33

Coho salmon

Coho salmon inhabit selected streams from the Maacama Creek (near Healdsburg) downstream to Willow Creek near the Russian River estuary. Coho salmon do not spawn or rear in the mainstem Russian River. Adults migrate upstream to from December through February, and spawning takes place shortly after the adults migrate. Juveniles rear in their natal streams for approximately one year before emigrating as smolts from March through May, with peak emigration occurring during the first two weeks of May.

> **Impact 4.3-15: Changes in minimum instream flow could substantially affect the upstream migration of coho salmon through elevated water temperatures in the months November through February in the Lower Russian River and in Dry Creek. (No Impact).**

Proposed Project: Modeled water temperatures in the Lower Russian River and in Dry Creek are almost identical to Baseline Conditions during the November through February coho salmon upstream migration period (±0.2° F) (Figure 4.3-14; Table 4.3-89). Modeled water temperatures remain below 59° F in Dry Creek throughout the coho salmon upstream migration period. In the Lower Russian River, modeled water temperatures remain below 59° F during November and January, and only exceed 59° F under the warmest conditions during February (maximum temperature of 59.9° F) under the Proposed Project. Consequently, temperature assessment scores rate near optimal for all months (Table 4.3-90). Stressful conditions would not occur under the Proposed Project during the coho salmon upstream migration period (Table 4.3-91). Overall, temperature assessment scores for this life stage range between 4.9 and 5.0. The Proposed Project would not affect the upstream migration through elevated water temperatures during the months October through December to upstream migrating Chinook salmon. Therefore, there are no potential impacts to upstream migrating coho salmon under the Proposed Project.

Table 4.3-89. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, November through February, under Baseline Conditions (BC) and the Proposed Project (PP).

Reach		November		December		January		February	
	Location	BC	PP	BC	PP	BC	PP	BC	PP
Russian River	Healdsburg	56.6	56.6	48.7	48.9	47.3	47.3	50.2	50.2
	Below Dry Creek	53.3	55.4	49.1	49.3	47.5	47.6	50.2	50.1
	Hacienda	54.7	54.7	48.5	48.6	47.2	47.3	49.9	49.9
Dry Creek	Upper	53.3	53.3	50.6	50.6	48.5	48.5	49.3	49.3
	Lower	53.8	53.8	50.2	50.1	48.2	48.2	49.8	49.8

Table 4.3-90. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the November through February coho salmon upstream migration period under Baseline Conditions (BC) and the Proposed Project. Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		November		December		January		February	
	Location	BC	PP	BC	PP	BC	PP	BC	PP
Russian River	Healdsburg	4.18	4.19	4.96	4.96	5.00	5.00	4.92	4.92
	Below Dry Creek	4.38	4.38	4.95	4.95	5.00	5.00	4.93	4.93
	Hacienda	4.46	4.46	4.98	4.98	5.00	5.00	4.95	4.95
Dry Creek	Upper	4.70	4.70	4.89	4.9	4.99	4.99	4.99	4.99
	Lower	4.61	4.61	4.91	4.91	4.99	4.99	4.96	4.96

Table 4.3-91. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration (November – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

November										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Russian River	Healdsburg	0.75	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	PP	BC	PP	BC	PP	BC	PP	
Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-91. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration (December – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

January										
Location	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 1 Alternative: Modeled water temperatures in the Lower Russian River (including Healdsburg) and in Dry Creek would be similar to Baseline Conditions from November through February (Figure 4.3-15; Table 4.3-92). Modeled water temperatures remain below 59° F in Dry Creek 100 percent of the time. For coho salmon in the Lower Russian River, modeled water temperatures at Hacienda remain below 59° F during December and January, and only exceed 59° F under the warmest conditions during February (maximum temperature of 59.9° F) under the No Project 1 Alternative. Modeled water temperatures in the Russian River near Dry Creek and at Healdsburg exceed 59° F less than one percent of the time in December through February for the No Project 1 Alternative. Consequently, temperature assessment scores rate near optimal during the upstream migration period (Table 4.3-93). Modeled stressful conditions (water temperatures above 65.5° F) would not occur under the No Project 1 Alternative during the coho salmon upstream migration period (Table 4.3-94). Overall, temperature assessment scores for this life stage range between 4.9 and 5.0 (essentially optimal). Therefore, there would be no potential impacts to upstream migrating coho salmon under the No Project 1 Alternative.

No Project 2 Alternative: Modeled water temperatures in the Lower Russian River and Dry Creek would be nearly identical to Baseline Conditions during the November through February coho salmon upstream migration period (±0.2º F) (Figure 4.3-16; Table 4.3-95). Consequently, temperature assessment scores rate near optimal (>4.89) at all sites during this time (Table 4.3-96). Modeled water temperatures remain below levels stressful to upstream migrating coho salmon in the Lower Russian River and in Dry Creek under the No Project 2 Alternative from November through February (Table 4.3-97). Therefore, there would be no potential impacts to upstream migrating coho salmon under the No Project 2 Alternative.

Table 4.3-92. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, November through February, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	November		December		January		February	
		BC	NP1	BC	NP1	BC	NP1	BC	NP1
Russian River	Healdsburg	56.6	56.6	48.7	48.7	47.3	47.3	50.2	50.2
	Below Dry Creek	55.3	55.4	49.1	49.2	47.5	47.5	50.2	50.2
	Hacienda	54.7	54.6	48.5	48.5	47.2	47.2	49.9	49.9
Dry Creek	Upper	53.3	53.4	50.6	50.6	48.5	48.5	49.3	49.3
	Lower	53.8	53.9	50.2	50.2	48.2	48.2	49.8	49.8

Table 4.3-93. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the November through February coho salmon upstream migration period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	November		December		January		February	
		BC	NP1	BC	NP1	BC	NP1	BC	NP1
Russian River	Healdsburg	4.18	4.18	4.96	4.96	5.00	5.00	4.92	4.92
	Below Dry Creek	4.38	4.38	4.95	4.95	5.00	5.00	4.93	4.93
	Hacienda	4.46	4.47	4.98	4.98	5.00	5.00	4.95	4.95
Dry Creek	Geyserville	4.99	4.99	4.89	4.88	4.99	4.99	4.99	4.99
	Confluence	4.61	4.60	4.91	4.91	4.99	4.99	4.96	4.96

Table 4.3-94. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration period (November – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease the occurrence of stressful water temperatures.

November										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Upper Russian River	Healdsburg	0.75	0.75	0.12	0.12	0.00	0.00	0.87	0.87	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-94. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration period (December – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease the occurrence of stressful water temperatures.

January										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-95. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, November through February, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	November		December		January		February	
		BC	NP2	BC	NP2	BC	NP2	BC	NP2
Russian River	Healdsburg	56.60	56.60	48.70	48.90	47.30	47.30	50.20	50.20
	Below Dry Creek	55.30	55.40	49.10	49.20	47.50	47.60	50.20	50.20
	Hacienda	54.70	54.60	48.50	48.50	47.20	47.20	49.90	49.90
Dry Creek	Upper	53.30	53.40	50.60	50.50	48.50	48.80	49.30	49.70
	Lower	53.80	53.90	50.20	50.10	48.20	48.20	49.80	48.20

Table 4.3-96. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the November through February coho salmon upstream migration period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	November		December		January		February	
		BC	NP2	BC	NP2	BC	NP2	BC	NP1
Russian River	Healdsburg	4.18	4.17	4.96	4.96	5.00	5.00	4.92	4.92
	Below Dry Creek	4.38	4.36	4.95	4.95	5.00	5.00	4.93	4.93
	Hacienda	4.46	4.44	4.98	4.98	5.00	5.00	4.95	4.95
Dry Creek	Upper	4.70	4.70	4.89	4.89	4.99	4.99	4.99	4.99
	Lower	4.61	4.60	4.91	4.91	4.99	4.99	4.96	4.96

Table 4.3-97. Frequency occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration (November – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

November										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	
Russian River	Healdsburg	0.75	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December										
Reach	**Location**	**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
		BC	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	
Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-97. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon upstream migration (November – February) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

January										
Reach	Location	Tolerance		Resistance		Lethal		Total		Difference
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Confluence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Impact 4.3-16: Changes in minimum instream flow could substantially affect the spawning and egg incubation of coho salmon through elevated water temperatures in the months December through May in Dry Creek. (No Impact)

Proposed Project: Modeled water temperatures in Dry Creek during the coho salmon spawning and egg incubation period would be essentially identical to Baseline Conditions (Figure 4.3-14; Table 4.3-98). Overall, temperature assessment scores in lower Dry Creek range from 4.90 in January to 3.28 in March (Table 4.3-99). Stressful water temperatures (>53.75° F) rarely occur during January and February (less than 8.5% of the time), but occur approximately 32 percent of the time during March for the Proposed Project and under Baseline Conditions (table 4.3-100). In upper Dry Creek reach, temperature assessment scores range from 4.91 in January to 4.32 in December. Overall, the change in the occurrence of stressful water temperatures between Baseline Conditions and the Proposed Project are modeled to be ± 0.22% (Table 4.3-100). Water temperatures potentially lethal to developing coho salmon embryos are modeled to occur under the warmest conditions in upper Dry Creek during December and March (0.02% of the time) and in lower Dry Creek during December, February and March (0.06 to 6.40% of the time) under both Baseline Conditions and the Proposed Project. However, these events occurred essentially equally between both Baseline Conditions and the Proposed Project. There would be no increase in elevated water temperatures during the months December through March in Dry Creek. Therefore, the Proposed Project would not affect the spawning and egg incubation of coho salmon and no impacts would occur.

No Project 1 Alternative: Modeled water temperatures in Dry Creek during the coho salmon spawning and egg incubation period (December through March) would be nearly identical to Baseline Conditions (Figure 4.3-15; Table 4.3-101). Overall, temperature assessment scores in lower Dry Creek range from 4.90 in January to 3.28 in March (Table 4.3-102). In Upper Dry Creek, temperature assessment scores range from 4.91 in January to 4.32 in December (Table 4.3-102). Stressful conditions (temperature above 53.75° F) rarely occur during January and February, but do occur up to approximately 8.4% of the time during December and 32.3 percent of the time in lower Dry Creek during March under Baseline Conditions and the No Project 1 Alternative (Table 4.3-103). The change in the occurrence of stressful water temperatures between Baseline Conditions and the No Project 1 Alternative modeled to be less than 2 percent in March. The slight increase from Baseline Conditions during March would not affect the spawning and egg incubation of coho salmon in Dry Creek and would be considered no impact.

Table 4.3-98. Monthly mean water temperatures (°F) modeled to occur in Dry Creek, from December through March, under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	December		January		February		March	
		BC	PP	BC	PP	BC	PP	BC	PP
Dry Creek	Upper	50.6	50.6	48.5	48.5	49.3	49.3	51.1	51.1
	Lower	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-99. Temperature assessment scores evaluating water temperature suitability in Dry Creek during the December through March coho salmon spawning and egg incubation period under Baseline Conditions (BC) and the Proposed Project. Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	December		January		February		March	
		BC	PP	BC	PP	BC	PP	BC	PP
Dry Creek	Upper	4.32	4.32	4.91	4.91	4.89	4.89	4.45	4.45
	Lower	4.42	4.42	4.90	4.90	4.67	4.67	3.28	3.28

Table 4.3-100. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon spawning and egg incubation (December – March) in Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	5.00	4.93	3.37	3.46	0.02	0.01	8.39	8.40	0.01
	Lower	4.10	4.02	4.07	4.11	0.06	0.11	8.24	8.24	0.00
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.23	0.25	0.08	0.07	0.00	0.00	0.31	0.32	0.01
	Lower	0.62	0.63	0.18	0.17	0.00	0.00	0.80	0.81	0.01
February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.16	0.17	0.09	0.10	0.00	0.00	0.26	0.27	0.02
	Lower	1.72	1.69	1.91	1.92	0.14	0.15	3.76	3.76	0.00
March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	2.56	2.56	1.89	1.86	0.02	0.02	4.47	4.43	-0.04
	Lower	8.92	8.96	16.97	16.90	6.40	6.39	32.28	32.25	-0.03

Table 4.3-101. Monthly mean water temperatures (°F) modeled to occur in Dry Creek, December through March, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1)

		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Dry Creek	**Upper**	50.6	50.6	48.5	48.5	49.3	49.3	51.1	51.1
	Lower	50.2	50.2	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-102. Temperature assessment scores evaluating water temperature suitability in the Dry Creek during the December through March coho salmon spawning and egg incubation period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Dry Creek	**Upper**	4.32	4.27	4.91	4.90	4.89	4.89	4.45	4.43
	Lower	4.42	4.38	4.90	4.89	4.67	4.67	3.28	3.26

No Project 2 Alternative: Modeled water temperatures in Dry Creek during the coho salmon spawning and egg incubation period would be nearly identical to Baseline Conditions (Figure 4.3-16; Table 4.3-104).Temperature assessment scores in lower Dry Creek range from 4.90 in January to 3.28 in March for Baseline Conditions and the No Project 2 Alternative (Table 4.3-105). In Upper Dry Creek, temperature assessment scores range from approximately 4.91 in January to 4.32 in December for Baseline Conditions and the No Project 2 Alternative. Stressful water temperatures (>53.75° F) rarely occur during January and February (less than 9.0% of the time), but occur up to 32.3 percent of the time during March for Baseline Conditions and the No Project 2 Alternative (Table 4.3-106). The change in the occurrence of stressful water temperatures between Baseline Conditions and the No Project 2 Alternative would to be within approximately 0.3%. The slight differences in temperature would not substantially affect the spawning and egg incubation of coho salmon through elevated water temperatures in the months December through May in Dry Creek and therefore, no impacts would occur.

Table 4.3- 103. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon spawning and egg incubation (December through March) in Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	5.00	5.58	3.37	4.54	0.02	0.09	8.38	10.20	1.82
	Lower	4.10	4.58	4.07	4.75	0.06	0.16	8.24	9.50	1.26
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.23	0.25	0.08	0.09	0.00	0.00	0.31	0.34	0.02
	Lower	0.62	0.63	0.18	0.22	0.00	0.00	0.80	0.85	0.05
February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.16	0.15	0.09	0.10	0.00	0.00	0.26	0.26	0.00
	Lower	1.72	1.71	1.91	1.92	0.14	0.14	3.76	3.77	0.01
March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	2.56	2.72	1.89	2.21	0.02	0.02	4.47	4.95	0.48
	Lower	8.92	8.90	16.97	17.20	6.40	6.53	32.28	32.63	0.34

Table 4.3- 104. Monthly mean water temperatures (°F) modeled to occur in Dry Creek from December through March, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach		December		January		February		March	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Dry Creek	Upper	50.6	50.5	48.5	48.5	49.3	49.5	51.1	50.9
	Lower	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3- 105. Temperature assessment scores comparing water temperature suitability in Dry Creek during the coho salmon spawning and egg incubation period (December - March) under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		December		January		February		March	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Dry Creek	Upper	4.32	4.31	4.91	4.91	4.89	4.89	4.45	4.45
	Lower	4.42	4.42	4.90	4.89	4.67	4.67	3.28	3.28

Table 4.3- 106. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon spawning and egg incubation (December through March) in Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	5.00	5.19	3.37	3.47	0.02	0.02	8.4	8.7	0.3
	Lower	4.10	4.25	4.07	4.08	0.06	0.06	8.2	8.4	0.2
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.23	0.23	0.08	0.08	0.00	0.00	0.31	0.31	0.00
	Lower	0.62	0.64	0.18	0.16	0.00	0.00	0.80	0.81	0.01
February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.16	0.17	0.09	0.09	0.00	0.00	0.3	0.3	0.0
	Lower	1.7	1.7	1.9	1.9	0.1	0.1	3.8	3.7	0.0
March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	2.56	2.58	1.89	1.87	0.02	0.02	4.5	4.5	0.0
	Lower	8.92	8.95	16.97	16.90	6.40	6.39	32.3	32.2	0.0

Impact 4.3-17: Changes in minimum instream flow could substantially affect the quality of habitat for rearing coho salmon juveniles by elevated water temperatures from April through November in Dry Creek. (No Impact).

Proposed Project: Modeled water temperatures in lower Dry Creek would be slightly warmer in June (0.7° F) and slightly cooler in August (0.4 °F) compared to Baseline Conditions (Figure 4.3-14; Table 4.3-107). In Upper Dry Creek, modeled water temperatures between Baseline Conditions and the Proposed Project are within ±0.3° F. Temperature assessment scores for rearing coho salmon in upper Dry Creek range from 4.97 to 5.0, April through November (Table 4.3-108). In lower Dry Creek, scores would be similar between Baseline Conditions and the No Project 1, although scores are below 4.0 in June and July. Stressful water temperatures (>64.0° F) would not occur in upper Dry Creek during the juvenile coho salmon rearing period (Table 4.3-109). In lower Dry Creek, the Proposed Project would increase the occurrence of stressful water temperatures slightly in June, and decrease their occurrence slightly in August. Lethal temperatures do not occur in Dry Creek under Baseline Conditions or the Proposed Project. The Proposed Project would not affect the quality of habitat for rearing coho salmon juveniles by elevated water temperatures from April through November in Dry Creek, therefore no impacts would occur.

Table 4.3-107. Monthly mean water temperatures (°F) modeled to occur in Dry Creek from April through November under Baseline Conditions (BC) and the Proposed Project (PP).

Reach		April		May		June		July		August		September		October		November	
	Location	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Dry Creek	Upper	52.6	52.6	53.9	54.1	54.1	54.4	54.0	54.0	54.0	53.9	54.0	54.0	53.9	53.9	53.3	53.3
	Lower	56.6	56.6	59.8	60.1	61.4	62.2	61.2	61.2	60.2	59.8	58.8	58.6	56.8	56.8	53.8	53.8

Table 4.3-108. Temperature assessment scores evaluating water temperature suitability in Dry Creek from April through November during the juvenile coho salmon rearing period under Baseline Conditions (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		April		May		June		July		August		September		October		November	
	Location	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Dry Creek	Upper	5.00	5.00	4.97	4.97	4.96	4.94	4.97	4.97	4.98	4.99	4.99	4.99	5.00	5.00	5.00	5.00
	Lower	4.72	4.72	4.16	4.09	3.70	3.49	3.76	3.75	4.05	4.17	4.45	4.51	4.79	4.79	4.98	4.98

Table 4.3-109. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile coho salmon rearing period (April – November) in Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.30	1.35	0.17	0.11	0.00	0.00	1.47	1.46	0.01
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	9.49	9.83	3.51	4.80	0.00	0.00	13.00	14.63	1.63
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	11.77	13.93	14.42	18.32	0.00	0.02	26.19	32.27	6.08
July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	12.16	13.41	12.72	11.77	0.00	0.00	24.89	25.18	0.29

Table 4.3-109. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile coho salmon rearing period (April -November) in Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	30.67	26.75	6.92	3.56	0.00	0.00	37.59	29.31	-8.28
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	8.66	8.82	0.32	0.17	0.00	0.00	8.98	8.59	-0.39
October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.04	0.17	0.01	0.01	0.00	0.00	0.06	0.18	0.12
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 1 Alternative: For juvenile coho salmon rearing in Dry Creek, modeled water temperatures remain essentially unchanged compared to Baseline Conditions (± 0.6º F) (Figure 4.3-15; Table 4.3-110). Temperature assessment scores rate similar in upper Dry Creek, and slightly higher at the confluence compared to Baseline Conditions. Overall, temperature assessment scores in upper Dry Creek rate optimal (>4.96) (Table 4.3-111). Although temperature assessment scores in lower Dry Creek drop below 4.0 (suitable) from June through July for Baseline Conditions, they would be slightly higher for the No Project 1 Alternative. Modeled water temperatures remain below levels (>64.0° F) stressful to rearing juvenile coho salmon in upper Dry Creek under the No Project 1 Alternative. In lower Dry Creek, stressful water temperatures are modeled to occur up to 37.6% of the time during August for Baseline Conditions and 29.2% of the time under the No Project 1 Alternative (Table 4.3-112). Overall, stressful conditions are reduced under the No Project Alternative. Lethal temperatures do not occur in Dry Creek under Baseline Conditions or the No Project 1 (Table 4.3-112). The No Project 1 Alternative would not affect the quality of habitat for rearing coho salmon juveniles by elevated water temperatures from April through November in Dry Creek, therefore no impacts would occur.

No Project 2 Alternative: In Dry Creek, modeled water temperatures remain essentially unchanged compared to Baseline Conditions (± 0.3º F) (Figure 4.3-16; Table 4.3-113). Temperature assessment scores would be similar in upper Dry Creek, and slightly higher at the confluence (Table 4.3-114). Overall, temperature assessment scores in Upper Dry Creek rate optimal (>4.96). Although temperature assessment scores at the mouth dropped below 4.0 (suitable) during June and July, they would be essentially equal to Baseline Conditions. Modeled water temperatures remain below levels (>64.0° F) stressful to rearing juvenile coho salmon in upper Dry creek for Baseline Conditions and the No Project 2 Alternative. In Lower Dry Creek, stressful water temperatures are modeled to occur up to 37.6% of the time during August for Baseline Conditions and 33.1% of the time under the No Project 2 Alternative (Table 4.3-115). Overall, stressful conditions are reduced under the No Project 2 Alternative. Lethal temperatures do not occur in Dry Creek for Baseline Conditions and the No Project 1 Alternative (Table 4.3-115). The No Project 2 Alternative would not affect the quality of habitat for rearing coho salmon juveniles by elevated water temperatures from April through November in Dry Creek, therefore no impacts would occur.

Table 4.3-110. Monthly mean water temperatures (°F) modeled to occur in Dry creek, April through November under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach		April		May		June		July		August		September		October		November	
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1
Dry Creek	Upper	52.7	52.7	53.9	53.9	54.1	54.0	54.0	53.9	54.0	54.0	54.0	53.9	53.9	54.0	53.2	53.3
	Lower	56.6	56.6	59.8	59.8	61.4	61.2	61.2	60.8	60.2	59.8	58.8	58.2	56.8	56.7	53.8	53.9

Table 4.3-111. Temperature assessment scores evaluating water temperature suitability in Dry Creek during the April through November juvenile coho salmon rearing period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		April		May		June		July		August		September		October		November	
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1
Dry Creek	Upper	5.00	5.00	4.97	4.98	4.96	4.97	4.97	4.98	4.98	4.99	4.99	5.00	5.00	5.00	5.00	5.00
	Lower	4.82	4.72	4.16	4.17	3.70	3.77	3.76	3.87	4.05	4.16	4.45	4.58	4.79	4.81	4.98	4.98

Table 4.3-112. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile coho salmon from April through November in Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.30	1.39	0.17	0.12	0.00	0.00	1.5	1.5	0.0
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	9.49	9.24	3.51	3.19	0.00	0.00	13.0	12.4	-0.6
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	11.8	11.5	14.4	12.7	0.00	0.00	26.2	24.2	-2.0
July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	12.16	11.37	12.72	10.19	0.00	0.00	24.9	21.6	-3.3

Table 4.3-112. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile coho salmon from April through November in Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	30.67	23.76	6.92	5.49	0.00	0.00	37.6	29.2	-8.3
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	8.66	2.52	0.32	0.10	0.00	0.00	9.0	2.6	-6.4
October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.04	0.00	0.01	0.01	0.00	0.00	0.1	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-113. Monthly mean water temperatures (°F) modeled to occur in Dry Creek from April through November under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

	April		May		June		July		August		September		October		November	
Location	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper	52.7	52.7	53.9	53.9	54.1	54.0	54.0	53.9	54.0	54.0	54.0	53.9	53.9	54.0	53.2	53.3
Lower	56.6	56.6	59.8	59.8	61.4	61.2	61.2	60.8	60.2	59.8	58.8	58.2	56.8	56.7	53.8	53.9

Table 4.3-114. Temperature assessment scores evaluating water temperature suitability in Dry Creek from April through November during juvenile coho salmon rearing period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

	April		May		June		July		August		September		October		November	
Location	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper	5.00	5.00	4.97	4.97	4.96	4.96	4.97	4.97	4.98	4.99	4.99	4.99	5.00	5.00	5.00	5.00
Lower	4.72	4.72	4.16	4.16	3.70	3.67	3.76	3.77	4.05	4.13	4.45	4.49	4.79	4.80	4.98	4.98

Table 4.3-115. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile coho salmon rearing period from April through November in Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	1.30	1.34	0.17	0.11	0.00	0.00	1.47	1.45	0.02
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	9.49	9.44	3.51	3.42	0.00	0.00	13.00	12.86	-0.14
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	11.77	12.50	14.42	14.76	0.00	0.00	26.2	27.3	1.10
July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	12.16	13.63	12.72	11.33	0.00	0.00	24.9	25.0	0.10

Table 4.3-115. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile coho salmon rearing period from April through November in Dry Creek under Baseline Conditions (BC) and the No Project Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	30.67	28.95	6.92	4.13	0.00	0.00	37.6	33.1	-4.5
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	8.66	5.78	0.32	0.21	0.00	0.00	9.0	6.00	-3.00
October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.04	0.02	0.01	0.01	0.00	0.00	0.1	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Impact 4.3-18: Changes in minimum instream flow could substantially affect emigrating coho salmon through elevated water temperatures in the months March through May in the Russian River and in Dry Creek. (Less-than-significant)

Proposed Project: Modeled monthly mean water temperatures in the Lower Russian River would be equal during March, and within 0.3° F in April and May compared to Baseline Conditions (Figure 4.3-14; and Table 4.3-116). In Dry Creek, water temperatures were modeled to be within 0.25° F between March and May. Monthly mean water temperatures modeled to occur at Healdsburg under would be the same as Baseline Conditions during March, and 0.5 to 1.3° F warmer during April and May. Temperature assessment scores rate suitable during March, stressful during April, and highly stressful during May for Baseline Conditions and the Proposed Project (Table 4.3-117). The difference in the frequency of occurrence of stressful water temperatures was less than 4 percent per month at all sites, and in the Lower Russian River (Hacienda) was less than 2 percent over all months (Table 4.3-118). One exception is the increase in potentially lethal conditions at Healdsburg in May. Potentially lethal conditions increased from 4.12 percent to 8.71 percent under the Proposed Project (Table 4.3-118).

Additional analysis was conducted in the Russian River between Healdsburg and the confluence with Dry Creek in response to the increased water temperatures modeled under the Proposed Project (Table 4.3-118). Coho salmon emigration generally peaks during the first two weeks of May, then quickly declines thereafter. During the first two weeks of May, modeled stressful water temperatures (primarily in the Resistance or “very stressful” category) occur 97.13 to 98.51 percent of the time under Baseline Conditions and the Proposed Project, respectively (Table 4.3-118). Modeled potentially lethal conditions occur 1.12 and 2.68 percent of the time for Baseline Conditions and the Proposed Project during the first two weeks of May. After mid-May, water temperatures modeled to increase at a higher rate under the Proposed Project. However, the increase in potentially lethal conditions is less than 5% (1.5% during the peak of the run); it affects a small portion of the coho salmon smolts (fish leaving the Maacama system); occurs late in the season after the majority of smolts have emigrated to the Lower Russian River; and affects a very short stretch of river (Maacama downstream to Dry Creek). While these elevated water temperatures potentially could affect late emigrating coho smolts from the Maacama system, for the above reasons this impact is less-than-significant.

Table 4.3-116. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, March through May, under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	March		April		May	
		BC	PP	BC	PP	BC	PP
Upper	Healdsburg	55.7	55.7	62.3	62.8	68.3	69.6
Lower Russian River	Below Dry Creek	55.1	55.1	61.0	61.2	65.9	66.2
	Hacienda	54.9	54.9	61.2	61.3	66.5	66.8
Dry Creek	Upper	51.0	50.9	52.6	52.6	53.9	54.1
	Lower	52.9	52.9	56.6	56.6	59.8	60.1

Table 4.3-117. Temperature assessment scores evaluating water temperature suitability in the Lower Russian River and Dry Creek during the March through May coho salmon smolt emigration period under Baseline Conditions (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach		March		April		May	
	Location	BC	PP	BC	PP	BC	PP
Upper	Healdsburg	4.54	4.51	2.52	2.37	0.94	0.74
Lower Russian River	Below Dry Creek	4.68	4.67	2.96	2.89	1.42	1.35
	Hacienda	4.76	4.76	2.84	2.79	1.24	1.19
Dry Creek	Upper	5.00	5.00	4.99	4.99	4.95	4.95
	Lower	4.95	4.95	4.39	4.39	3.40	3.30

Table 4.3-118. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to emigrating coho salmon smolts, March through May, in Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Healdsburg	4.57	4.98	2.81	3.23	0.00	0.00	7.38	8.21	0.83
Lower Russian River	Below Dry Creek	2.92	3.16	1.21	1.28	0.00	0.00	4.13	4.44	0.31
	Hacienda	1.55	1.62	0.10	0.12	0.00	0.00	1.65	1.74	0.09
Dry Creek	Upper	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
	Lower	0.19	0.20	0.00	0.00	0.00	0.00	0.19	0.20	0.01
April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Healdsburg	17.27	16.18	46.59	51.37	0.06	0.07	63.92	67.62	3.70
Lower Russian River	Below Dry Creek	17.64	17.05	32.86	35.68	0.00	0.00	50.50	52.73	2.23
	Hacienda	20.51	19.70	34.82	37.04	0.00	0.00	55.33	56.74	1.41
Dry Creek	Upper	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
	Lower	6.58	6.59	4.59	4.57	0.00	0.00	11.17	11.16	-0.01
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Healdsburg	4.19	2.49	89.98	87.94	4.12	8.71	98.29	99.14	0.85
Lower Russian River	Below Dry Creek	10.43	9.46	83.07	84.77	0.23	0.33	93.73	94.56	0.83
	Hacienda	5.05	4.41	93.17	94.03	0.06	0.12	98.28	98.56	0.28
Dry Creek	Upper	0.03	0.04	0.00	0.00	0.00	0.00	0.03	0.04	0.01
	Lower	14.98	15.44	22.34	24.60	0.00	0.00	37.32	40.04	2.72

Table 4.3-118. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to emigrating coho salmon smolts, May 1 – 15 and May 16 – 30, in the Russian River between Healdsburg and the Dry Creek Confluence under Baseline Conditions (BC) and the Proposed Project (PP). In the "% Change" column, a positive number indicates that the Proposed Project would increase the occurrence of stressful temperatures. A negative number indicates that the Proposed Project would decrease in the occurrence of stressful water temperatures.

May 1 – 16										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Healdsburg	6.80	4.25	89.21	91.58	1.12	2.68	97.13	98.51	1.38
May 15 – 30										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	% Change
Upper Russian River	Healdsburg	1.77	0.86	90.94	85.03	6.65	13.84	99.35	99.73	0.38

No Project 1: Water temperatures would be essentially equal (< 0.1° F) in the Russian River downstream of Healdsburg and in Dry Creek (Figure 4.3-15; Table 4.3-119) compared to Baseline Conditions. Temperature assessment scores rate suitable to optimal in Dry Creek, but generally poor in the Russian River, particularly in April and May (Table 4.3-120). During April, thermal conditions in the Russian River would be stressful (>60.75° F) approximately 50 to 64% of the time for Baseline Conditions and the No Project 1 Alternative, and over 90% of the time during May (Table 4.3-121). However, these thermally-degraded conditions exists under Baseline Conditions. For the No Project 1 Alternative, there would be no change over Baseline Conditions to emigrating coho smolts.

No Project 2 Modeled water temperatures in Dry Creek and the Russian River from Healdsburg downstream during the March through May coho salmon smolt emigration period would be essentially unchanged compared to Baseline Conditions (Figure 4.3-16; Table 4.3-122). Correspondingly, temperature assessment scores rate nearly identical (Table 4.3-123). Overall, temperature assessment scores rate near optimal in Dry Creek, but range from poor to very stressful for Baseline Conditions and the No Project 2 Alternative in the Russian River downstream of Healdsburg. Although conditions for coho salmon smolts are poor, the net change in stressful conditions (>60.3° F) is ± 0.6 percent between Baseline Conditions and the No Project Alternative 2 (Table 4.3-124). One exception is the increase in potentially lethal conditions at Healdsburg during May. Potentially lethal conditions increased from 4.12 percent for Baseline Conditions to 7.04 percent under the No Project 2 Alternative (Table 4.3-124. However, the increase in potentially lethal conditions is less than 3 percent; it affects a small portion of the coho salmon smolt habitat (smolts migrating out of the Maacama system); and occurs late in the season after the majority of smolts have likely emigrated (after mid-May) to the Lower Russian River or out to the ocean. While these elevated water temperatures potentially could affect emigrating smolts from the Maacama system, for the above reasons the impact is less-than-significant.

Table 4.3-119. Monthly mean water temperatures modeled to occur in the Russian River and Dry Creek, March through May, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	March		April		May	
		BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Healdsburg	55.7	55.7	62.3	62.3	68.3	68.3
Lower Russian River	Below Dry Creek	55.1	55.1	61.0	61.0	65.9	65.8
	Hacienda	54.9	54.9	61.2	61.2	66.5	66.5
Dry Creek	Upper	51.0	51.0	52.6	52.6	53.9	53.8
	Lower	52.9	52.9	56.6	56.6	59.8	59.8

Table 4.3-120. Temperature assessment scores evaluating water temperature suitability in the Lower Russian River and Dry Creek during the April through May coho salmon smolt emigration period under Baseline Conditions (BC) and the Proposed Project (PP). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

Reach	Location	March		April		May	
		BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Healdsburg	4.54	4.54	2.52	2.51	0.94	0.94
Lower Russian River	Below Dry Creek	4.68	4.68	2.96	2.96	1.42	1.43
	Hacienda	4.76	4.76	2.84	2.84	1.24	1.25
Dry Creek	Upper	5.00	4.00	4.99	4.99	4.95	4.96
	Lower	4.95	4.95	4.39	4.38	3.40	3.42

Table 4.3-121. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile coho salmon rearing period (March – May) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). In the "% Change" column, a positive number indicates that the No Project 1 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 1 Alternative would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Healdsburg	4.57	4.58	2.81	2.81	0.00	0.00	7.38	7.39	0.01
Lower Russian River	Below Dry Creek	2.92	2.96	1.21	1.28	0.00	0.00	4.13	4.24	0.11
	Hacienda	1.55	1.62	0.10	0.10	0.00	0.00	1.65	1.72	0.07
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.19	0.21	0.00	0.00	0.00	0.00	0.19	0.21	0.02
April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Healdsburg	17.27	17.24	46.59	46.63	0.06	0.06	63.92	63.93	0.01
Lower Russian River	Below Dry Creek	17.64	17.52	32.86	33.04	0.00	0.00	50.50	50.56	0.06
	Hacienda	20.51	20.50	34.82	34.83	0.00	0.00	55.33	55.33	0.00
Dry Creek	Upper	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
	Lower	6.58	6.75	4.59	4.58	0.00	0.00	11.17	11.33	0.16
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	% Change
Upper Russian River	Healdsburg	4.19	4.20	89.98	89.98	4.12	4.12	98.29	98.30	0.01
Lower Russian River	Below Dry Creek	10.43	10.33	83.07	82.8	0.23	0.21	93.73	93.34	-0.39
	Hacienda	5.05	5.10	93.17	93.09	0.06	0.05	98.28	98.24	-0.04
Dry Creek	Upper	0.03	0.02	0.00	0.00	0.00	0.00	0.03	0.02	-0.01
	Lower	14.98	14.63	22.34	21.91	0.00	0.00	37.32	36.54	-0.78

Table 4.3-122. Monthly mean water temperatures (°F) modeled to occur in the Lower Russian River and Dry Creek, March through May, under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		March		April		May	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Healdsburg	55.7	55.7	62.3	62.4	68.3	69.2
Lower Russian River	Below Dry Creek	55.1	55.1	61.0	61.0	65.9	66.0
	Hacienda	54.9	54.9	61.2	61.2	66.5	66.6
Dry Creek	Upper	51.0	50.9	52.6	52.6	53.9	53.9
	Lower	52.9	52.9	56.6	56.6	59.8	59.8

Table 4.3-123. Temperature assessment scores evaluating water temperature suitability in the Lower Russian River and Dry Creek during the March – May coho salmon smolting period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		March		April		May	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Healdsburg	4.54	4.54	2.52	2.50	0.94	0.80
Lower Russian River	Below Dry Creek	4.68	4.68	2.96	2.95	1.42	1.39
	Hacienda	4.76	4.76	2.84	2.83	1.24	1.22
Dry Creek	Upper	5.00	5.00	4.99	4.99	4.95	4.95
	Lower	4.95	4.95	4.39	4.39	3.40	3.40

Table 4.3-124. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to coho salmon smolting period from March through May in the Lower Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2). In the "% Change" column, a positive number indicates that the No Project 2 Alternative would increase the occurrence of stressful temperatures. A negative number indicates that the No Project 2 Alternative would decrease in the occurrence of stressful water temperatures.

March										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Healdsburg	4.57	4.62	2.81	2.89	0.00	0.00	7.38	7.51	0.13
Lower Russian River	Below Dry Creek	2.92	2.95	1.21	1.24	0.00	0.00	4.13	4.19	0.06
	Hacienda	1.55	1.54	0.1	0.1	0.00	0.00	1.65	1.64	-0.01
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.19	0.19	0.00	0.00	0.00	0.00	0.19	0.19	0.00
April										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Healdsburg	17.27	17.22	46.59	47.24	0.06	0.06	63.92	64.52	0.60
Lower Russian River	Below Dry Creek	17.64	17.50	32.86	33.23	0.00	0.00	50.50	50.73	0.23
	Hacienda	20.51	20.46	34.82	35.08	0.00	0.00	55.33	55.54	0.21
Dry Creek	Upper	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
	Lower	6.58	6.62	4.59	4.54	0.00	0.00	11.17	11.16	-0.01
May										
		Tolerance		Resistance		Lethal		Total		
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	% Change
Upper Russian River	Healdsburg	4.19	3.06	89.98	88.72	4.12	7.04	98.29	98.82	0.53
Lower Russian River	Below Dry Creek	10.43	9.88	83.07	83.97	0.23	0.26	93.73	94.11	0.38
	Hacienda	5.05	4.70	93.17	93.60	0.06	0.09	98.28	98.39	0.11
Dry Creek	Upper	0.03	0.04	0.00	0.00	0.00	0.00	0.03	0.04	0.01
	Lower	14.98	14.93	22.34	22.23	0.00	0.00	37.32	37.16	-0.16

Steelhead

Steelhead are the most widely distributed salmonid in the Russian River watershed. Adults migrate upstream primarily from December through March and spawn in the mainstem Russian as well as a multitude of tributaries, including Dry Creek. Although no steelhead spawning surveys have been conducted in the mainstem Russian River, spawning habitat is assumed to coincide with available juvenile rearing habitat (upstream of Cloverdale). Spawning begins shortly after the adult migration begins, and likely continues through March, with egg incubation lasting through April for late spawning fish. Juvenile rearing habitat in the mainstem is limited by water temperature to the river above Cloverdale. Smolts emigrate from approximately March through May.

Impact 4.3-19: Changes in minimum instream flow could substantially affect the upstream migration of steelhead through elevated water temperatures in the months December through March in the Russian River and in Dry Creek. (No Impact).

Proposed Project: Modeled monthly mean water temperatures in the Upper Russian River would be slightly warmer in December (up to 0.8° F), and nearly identical during the remainder of the steelhead upstream migration period (Figure 4.3-14; Table 4.3-125) compared to Baseline Conditions. Temperature assessment scores rate near optimal December through February, and suitable during March (Table 4.3-126). Based on model results, stressful water temperatures would not occur during December through February, and rarely (<0.40% of the time) during March (Table 4.3-127). Water temperatures in Dry Creek would be similar to Baseline Conditions with temperature assessment scores near optimal throughout the steelhead upstream migration period. There would be no potential impacts to upstream migrating steelhead from elevated water temperatures under the Proposed Project.

No Project 1 Alternative: Modeled monthly mean water temperatures would be similar to Baseline Conditions during the steelhead upstream migration period (Figure 4.3-15; Table 4.3-128). Temperature assessment scores are near optimal December through February, and rated suitable during March (Table 4.3-129). Based on model results, stressful water temperatures would not occur December through February, and rarely (<0.30% of the time) during March (Table 4.3-130). Water temperatures in Dry Creek would be similar to Baseline Conditions with temperature assessment scores near optimal throughout the steelhead upstream migration period. There would be no potential impacts to upstream migrating steelhead from elevated water temperatures under the No Project 1 Alternative.

Table 4.3-125. Monthly mean water temperatures (°F) modeled to occur during the steelhead upstream migration period in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

Reach		December		January		February		March	
	Location	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	48.8	49.6	46.2	46.4	48.0	47.9	53.0	53.5
	Hopland	48.2	48.8	46.3	46.5	48.7	48.6	53.6	53.8
	Cloverdale	47.9	48.4	46.4	46.5	48.9	48.9	53.7	53.9
	Geyserville	48.4	48.7	46.9	47.0	49.7	49.6	54.9	55.0
	Healdsburg	48.7	48.9	47.3	47.3	50.2	50.2	55.7	55.7
Lower Russian River	Below Dry Creek	49.1	49.3	47.5	47.6	50.2	50.1	55.1	55.1
	Hacienda	48.5	48.6	47.2	47.3	49.9	49.9	54.9	54.9
Dry Creek	Upper	50.7	50.6	48.5	48.5	49.2	49.2	51.0	50.9
	Lower	50.2	50.2	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-126. Suitability scores comparing water temperature for upstream migrating steelhead (October – December) modeled to occur in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

Reach		December		January		February		March	
	Location	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71
	Hopland	4.97	4.96	5.00	5.00	4.98	4.99	4.61	4.58
	Cloverdale	4.98	4.97	5.00	5.00	4.98	4.98	4.59	4.57
	Geyserville	4.96	4.96	5.00	5.00	4.94	4.95	4.44	4.42
	Healdsburg	4.96	4.96	5.00	5.00	4.92	4.92	4.33	4.32
Lower Russian River	Below Dry Creek	4.95	4.95	5.00	5.00	4.93	4.93	4.42	4.42
	Hacienda	4.98	4.98	5.00	5.00	4.95	4.95	4.45	4.45
Dry Creek	Upper	4.89	4.90	4.99	4.99	4.99	4.99	4.93	4.93
	Lower	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71

Table 4.3-127. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead (October – December) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-127. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead (October – December) in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

February										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.02	0.05	0.00	0.01	0.00	0.00	0.0	0.06	0.0
	Cloverdale	0.02	0.04	0.00	0.00	0.00	0.00	0.02	0.04	0.02
	Geyserville	0.16	0.19	0.03	0.08	0.00	0.00	0.19	0.27	0.08
	Healdsburg	0.17	0.29	0.05	0.06	0.00	0.00	0.23	0.35	0.12
Lower Russian River	Below Dry Creek	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.05	0.02
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-128. Monthly mean water temperatures (°F) modeled to occur in the Russian River and Dry Creek, December through March, under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	48.8	48.8	46.2	46.2	48.0	48.1	53.0	53.0
	Hopland	48.2	48.2	46.3	46.4	48.7	48.7	53.6	53.6
	Cloverdale	47.9	47.9	46.4	46.4	48.9	48.9	53.7	53.8
	Geyserville	48.4	48.4	46.9	46.9	49.7	49.7	54.9	54.9
	Healdsburg	48.7	48.7	47.3	47.3	50.2	50.2	55.7	55.7
Lower Russian River	Below Dry Creek	49.1	49.2	47.5	47.5	50.2	50.2	55.1	55.1
	Hacienda	48.5	48.5	47.2	47.2	49.9	49.9	54.9	54.9
Dry Creek	Upper	50.7	50.7	48.5	48.6	49.2	49.2	51.0	51.0
	Lower	50.2	50.2	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-129. Temperature assessment scores evaluating water temperature suitability in the Russian River and Dry Creek during the December through March steelhead upstream migration period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1). Scores near 5.0 are optimal for the completion of this life stage, while scores below 3.0 become increasingly stressful. Scores near 0 are potentially lethal.

		December		January		February		March	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71
	Hopland	4.97	4.97	5.00	5.00	4.98	4.98	4.61	4.61
	Cloverdale	4.98	4.98	5.00	5.00	4.98	4.98	4.59	4.59
	Geyserville	4.96	4.96	5.00	5.00	4.94	4.94	4.44	4.44
	Healdsburg	4.96	4.96	5.00	5.00	4.92	4.92	4.33	4.33
Lower Russian River	Below Dry Creek	4.95	4.95	5.00	5.00	4.93	4.93	4.42	4.42
	Hacienda	4.98	4.98	5.00	5.00	4.95	4.95	4.45	4.45
Dry Creek	Upper	4.89	4.88	4.99	4.99	4.99	4.99	4.93	4.93
	Lower	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71

Table 4.3-130. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead (December – March) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

December										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
January										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-130. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead (December – March) in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

February										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March										
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Cloverdale	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Geyserville	0.16	0.16	0.03	0.03	0.00	0.00	0.19	0.19	0.00
	Healdsburg	0.17	0.17	0.05	0.05	0.00	0.00	0.23	0.23	0.00
Lower Russian River	Below Dry Creek	0.04	0.04	0.00	0.00	0.00	0.00	0.04	0.04	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 2 Alternative: Modeled monthly mean water temperatures in the Upper Russian River would be slightly warmer in December (up to 0.4° F), and nearly identical during the remainder of the steelhead upstream migration period (Figure 4.3-16; Table 4.3-131) compared to Baseline Conditions. Temperature assessment scores rate near optimal December through February, and suitable during March (Table 4.3-132). Based on model results, stressful water temperatures would not occur December through February, and rarely (<0.30% of the time) during March (Table 4.3-133). Water temperatures in Dry Creek would be similar to Baseline Conditions with temperature assessment scores near optimal throughout the steelhead upstream migration period. There would be no potential impacts to upstream migrating steelhead from elevated water temperatures under the No Project 2 Alternative.

Table 4.3-131. Monthly mean water temperatures (°F) modeled to occur during the steelhead upstream migration period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach		December		January		February		March	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	48.8	49.3	46.2	46.4	48.0	48.0	53.0	53.1
	Hopland	48.1	48.5	46.3	46.4	48.7	48.7	53.6	53.7
	Cloverdale	47.4	48.2	46.4	46.5	53.7	53.8	53.7	53.8
	Geyserville	46.7	48.5	46.9	47.0	49.7	49.7	54.9	54.9
	Healdsburg	46.0	48.6	47.3	47.3	50.2	50.2	55.7	55.7
Lower Russian River	Below Dry Creek	45.3	49.1	47.5	47.6	50.2	50.2	55.1	55.1
	Hacienda	44.6	48.5	47.2	47.2	49.9	49.9	54.9	54.9
Dry Creek	Upper	43.9	50.6	48.5	48.6	49.2	49.5	51.0	51.8
	Lower	52.2	52.1	48.2	48.2	49.8	49.8	52.9	52.9

Table 4.3-132. Suitability scores comparing water temperature for upstream migrating steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach		December		January		February		March	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71
	Hopland	4.97	4.96	5.00	5.00	4.98	4.98	4.61	4.60
	Cloverdale	4.98	4.97	5.00	5.00	4.98	4.98	4.59	4.59
	Geyserville	4.96	4.96	5.00	5.00	4.94	4.94	4.44	4.44
	Healdsburg	4.96	4.96	5.00	5.00	4.92	4.92	4.33	4.33
Lower Russian River	Below Dry Creek	4.95	4.95	5.00	5.00	4.93	4.93	4.42	4.42
	Hacienda	4.98	4.98	5.00	5.00	4.95	4.95	4.45	4.45
Dry Creek	Upper	4.89	4.89	4.99	4.99	4.99	4.99	4.93	4.93
	Lower	4.91	4.91	4.99	4.99	4.96	4.96	4.71	4.71

Table 4.3- 133. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-133. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to upstream migrating steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below Dry Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach		BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.01
	Cloverdale	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Geyserville	0.16	0.14	0.03	0.04	0.00	0.00	0.19	0.18	-0.01
	Healdsburg	0.17	0.18	0.05	0.06	0.00	0.00	0.23	0.24	0.02
Lower Russian River	Below Dry Creek	0.04	0.05	0.00	0.00	0.0	0.00	0.04	0.05	0.01
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Impact 4.3-20: Changes in minimum instream flow could substantially affect the spawning and egg incubation of steelhead through elevated water temperatures in the months December through May in the Russian River (above Cloverdale) and in Dry Creek. (Less-than-significant).

Proposed Project: Modeled monthly mean water temperatures in the Russian River upstream of Cloverdale, would be 0.5 to 0.8° F warmer during December, ±0.2° F in January through March, and 1.0 to 1.7° F warmer during April (Figure 4.3-14; Table 4.3-134) compared to Baseline Conditions. Temperature assessment scores rate near optimal to suitable December through March for Baseline Conditions and the Proposed Project, but declined to stressful levels during April (Table 4.3-135). Stressful water temperatures would not occur during the peak spawning months from December through February, and modeled to occur ≤3.7% of the time during March. During April, water temperature suitability deteriorated for Baseline Conditions and the Proposed Project (stressful levels would occur approximately 38 to 50 percent of the time under Baseline Conditions and the Proposed Project, respectively) (Table 4.3-136). Overall, stressful water temperatures would occur 8 to 16% more often and potentially lethal levels modeled to occur 4 to 5% more often as a result of the Proposed Project. Modeled stressful water temperatures during the first two weeks of April would occur approximately 16.5 to 27.5 percent of the time for Baseline Conditions and the Proposed Project, respectively, and potentially lethal water temperatures modeled to occur less than 2% of the time for Baseline Conditions and the Proposed Project. Modeled water temperatures in Dry Creek would be near optimal expect during April in the lower reach where water temperatures deteriorate for Baseline Conditions and the Proposed Project (stressful conditions occur approximately 18.5% of the time under both Baseline Conditions and the Proposed Project (Table 4.3-136)). Modeled elevated water temperatures occur primarily during the last two weeks of April at the end of the steelhead egg incubation period, and thus would only affect a small proportion of the spawning population. The thermal conditions under Baseline Conditions deteriorate in April and this time period is generally unfavorable for egg incubation. In addition, the analysis of applying results from modeled surface waters to assess the potential effects of elevated water temperatures to developing eggs presents limitations and as discussed in the methodology section, the model does not take into account for the intra-gravel water temperatures which tend to be cooler than surface temperatures (Magneson 2016). Thus, the Proposed Project would not substantially affect the spawning and egg incubation of steelhead through elevated water temperatures in the months December through May in the Russian River and in Dry Creek and therefore is considered less-than-significant.

Table 4.3-134. Suitability scores modeled to occur during the steelhead spawning and egg incubation period in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	December		January		February		March		April	
		BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	48.8	49.6	46.2	46.4	48.0	47.9	53.0	53.5	54.0	55.7
	Hopland	48.2	48.8	46.3	46.5	48.7	48.6	53.6	53.8	57.4	58.7
	Cloverdale	47.9	48.4	46.4	46.5	48.9	48.9	53.7	53.9	58.6	59.6
Dry Creek	Lower	50.7	50.7	48.5	48.5	49.2	49.2	51.0	50.9	52.6	52.6
	Upper	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9	56.6	56.6

Table 4.3-135. Suitability scores modeled to occur during the steelhead spawning and egg incubation period in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	December		January		February		March		April	
		BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	4.96	4.93	5.00	5.00	4.99	5.00	4.65	4.57	4.42	3.99
	Hopland	4.97	4.96	5.00	5.00	4.98	4.99	4.55	4.50	3.52	2.91
	Cloverdale	4.98	4.97	5.00	5.00	4.98	4.98	4.53	4.50	3.03	2.51
Dry Creek	Lower	4.89	4.90	4.99	4.99	4.99	4.99	4.93	4.93	4.76	4.76
	Upper	4.89	4.90	4.99	4.99	4.99	4.99	4.70	4.70	3.77	3.78

Table 4.3-136. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead during the spawning and egg incubation period (December through March) in the Russian River and Dry Creek under Baseline Condition and Proposed Project.

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
January										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-136. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead during the spawning and egg incubation period (November 15 - March) in the Russian River and Dry Creek under Baseline Condition and Proposed Project (concluded).

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.69	0.99	0.72	1.45	0.02	0.08	1.44	2.52	1.08
	Hopland	0.75	1.06	1.69	2.49	0.08	0.13	2.52	3.69	1.17
	Cloverdale	0.91	0.99	1.79	2.42	0.09	0.13	2.79	3.54	0.75
Dry Creek	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Upper	0.36	0.37	0.43	0.43	0.00	0.00	0.78	0.79	0.01
April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	1.59	2.76	4.77	10.97	0.28	0.99	6.63	14.71	8.08
	Hopland	4.49	5.43	17.82	29.13	2.40	6.13	24.71	40.69	15.98
	Cloverdale	5.28	5.37	27.44	35.43	4.54	9.67	37.26	50.47	13.21
Dry Creek	Lower	0.06	0.02	0.01	0.02	0.00	0.00	0.06	0.03	-0.03
	Upper	3.12	3.15	14.04	13.94	1.47	1.46	18.62	18.55	-0.07

No Project 1 Alternative: Modeled monthly mean water temperatures would be similar during the steelhead spawning and egg incubation period (Figure 4.3-15; Table 4.3-137) compared to Baseline Conditions. Temperature assessment scores rate near optimal December through February, and suitable during March (Table 4.3-138). However, scores rate near stressful in the Cloverdale reach during April. Based on model results, stressful water temperatures would not occur during December through February, and rarely (<3.0 percent of the time) during March. However, during April, stressful conditions occur approximately 37 percent of the time for Baseline Conditions and the No Project 1 Alternative (Table 4.3-139). Modeled water temperatures in Dry Creek would be similar to Baseline Conditions with temperature assessment scores near optimal throughout the steelhead egg incubation period. The No Project 1 Alternative would not affect the spawning and egg incubation of steelhead through elevated water temperatures in the months December through May in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 2 Alternative: Modeled monthly mean water temperatures would be up to 0.5° F warmer in the Upper Russian River (above Cloverdale) compared to Baseline Conditions during the steelhead spawning and egg incubation period (Figure 4.3-16; Table 4.3-140). Temperature assessment scores rate near optimal December through February, and suitable during March (Table 4.3-141). However, scores rated near stressful in the Cloverdale reach during April (3.03) for Baseline Conditions and the No Project 2 Alternative. Based on model results, stressful water temperatures do not occur during December through February, and rarely (<3.0 percent of the time) during March for Baseline Conditions and the No Project 2 Alternative (Table 4.3-142. However, in April, stressful water conditions were modeled to occur approximately 38 percent of the time for Baseline Conditions and the No Project 2 Alternative. Water temperatures in Dry Creek would be similar to Baseline Conditions with temperature assessment scores near optimal throughout the steelhead upstream migration period. The No Project Alternative 2 would not affect the spawning and egg incubation of steelhead through elevated water temperatures in the months December through May in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-137. Monthly mean water temperatures (°F) modeled to occur during the steelhead spawning and egg incubation period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	December		January		February		March		April	
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	48.8	48.8	46.2	46.2	48.0	48.1	53.0	53.0	54.0	54.0
	Hopland	48.2	48.2	46.3	46.4	48.7	48.7	53.6	53.6	57.4	57.4
	Cloverdale	47.9	47.9	46.4	46.4	48.9	48.9	53.7	53.8	58.6	58.6
Dry Creek	Upper	50.7	50.7	48.5	48.5	49.2	49.2	51.0	51.0	52.6	52.6
	Lower	50.2	50.2	48.2	48.2	49.8	49.8	52.9	52.9	56.6	56.6

Table 4.3-138. Suitability scores comparing water temperature modeled to occur during the steelhead spawning and egg incubation period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	December		January		February		March		April	
			NP1	BC	NP1	BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	4.96	4.96	5.00	5.00	4.99	4.99	4.65	4.65	4.42	4.41
	Hopland	4.97	4.97	5.00	5.00	4.98	4.98	4.55	4.55	3.52	3.52
	Cloverdale BC	4.98	4.98	5.00	5.00	4.98	4.98	4.53	4.53	3.03	3.03
Dry Creek	Upper	4.89	4.88	4.99	4.99	4.99	4.99	4.93	4.93	4.76	4.76
	Lower	4.89	4.88	4.99	4.99	4.99	4.99	4.70	4.69	3.77	3.77

Table 4.3-139. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to spawning steelhead and egg incubation, December through March, in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

January										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-139. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to spawning steelhead and egg incubation, December through March, in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

March										
Reach		**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
	Location	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Russian River	Forks	0.69	0.69	0.72	0.72	0.02	0.02	1.44	1.44	0.00
	Hopland	0.75	0.75	1.69	1.70	0.08	0.08	2.52	2.53	0.01
	Cloverdale	0.91	0.90	1.79	1.80	0.09	0.09	2.79	2.79	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.36	0.44	0.43	0.50	0.00	0.00	0.78	0.93	0.15
April										
Reach		**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
	Location	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	
Russian River	Forks	1.59	1.59	4.77	4.77	0.28	0.28	6.63	6.63	0.00
	Hopland	4.49	4.50	17.82	17.86	2.40	2.40	24.71	24.76	0.05
	Cloverdale	5.28	5.26	27.44	27.49	4.54	4.56	37.26	37.32	0.06
Dry Creek	Upper	0.06	0.02	0.01	0.01	0.00	0.00	0.06	0.03	-0.03
	Lower	3.12	3.11	14.04	14.16	1.47	1.51	18.62	18.77	0.15

Table 4.3-140. Monthly mean water temperatures (°F) modeled to occur during the steelhead spawning and egg incubation period in Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach		December		January		February		March		April	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Russian River	Forks	48.8	49.3	46.2	46.4	48.0	48.0	53.0	53.1	54.0	54.1
	Hopland	48.2	48.7	46.3	46.4	48.7	48.7	53.6	53.7	57.4	57.5
	Cloverdale	47.9	48.3	46.4	46.5	48.9	48.9	53.7	53.8	58.6	58.7
Dry Creek	Upper	50.7	50.6	48.5	48.6	49.2	49.5	51.0	51.8	52.6	52.6
	Lower	50.2	50.1	48.2	48.2	49.8	49.8	52.9	52.9	56.6	56.6

Table 4.3-141. Suitability scores comparing water temperature for steelhead spawning and egg incubation period modeled to occur in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project Alternative (NP2).

Reach		December		January		February		March		April	
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Russian River	Forks	4.96	4.94	5.00	5.00	4.99	4.99	4.65	4.64	4.42	4.38
	Hopland	4.97	4.96	5.00	5.00	4.98	4.98	4.55	4.55	3.52	3.47
	Cloverdale	4.98	4.97	5.00	5.00	4.98	4.98	4.53	4.53	3.03	2.97
Dry Creek	Upper	4.89	4.89	4.99	4.99	4.99	4.99	4.93	4.93	4.76	4.76
	Lower	4.89	4.89	4.99	4.99	4.99	4.99	4.70	4.70	3.77	3.77

Table 4.3-142. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead spawning and egg incubation in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

December										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
January										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-142. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead spawning and egg incubation in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

March										
Reach		**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
	Location	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP1**	
Russian River	Forks	0.69	0.69	0.72	0.72	0.02	0.02	1.44	1.44	0.00
	Hopland	0.75	0.80	1.69	1.79	0.08	0.09	2.52	2.68	0.16
	Cloverdale	0.91	0.93	1.79	1.94	0.09	0.10	2.79	2.97	0.18
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.36	0.37	0.43	0.43	0.00	0.00	0.78	0.79	0.01
April										
Reach		**Tolerance**		**Resistance**		**Lethal**		**Total**		**% Change**
	Location	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP1**	
Russian River	Forks	1.59	1.59	4.77	5.18	0.28	0.30	6.63	7.08	0.45
	Hopland	4.49	4.50	17.82	19.01	2.40	2.47	24.71	25.97	1.26
	Cloverdale	5.28	5.40	27.44	28.57	4.54	4.89	37.26	38.85	1.59
Dry Creek	Upper	0.06	0.02	0.01	0.01	0.00	0.00	0.06	0.03	-0.03
	Lower	3.12	3.12	14.04	14.05	1.47	1.45	18.62	18.61	-0.01

Impact 4.3-21: Changes in minimum instream flow could substantially affect the rearing habitat for juvenile steelhead through elevated water temperatures in the months April through November in the Russian River (above Cloverdale) and in Dry Creek. (Beneficial)

***Proposed Project*:** Modeled water temperatures in the Russian River between the Forks and Cloverdale would be approximately 1 to 3° F higher April through June, and approximately 2 to 9° F cooler August through October (Figure 4.3-14; Table 4.3-143) compared to Baseline Conditions. Although temperatures would be warmer under the Proposed Project during the April through June timeframe, temperature assessment scores exceed 4.0 ("suitable") except during June at Cloverdale (3.78) (Table 4.3-144). However, during the August through October timeframe, temperature assessment scores rate higher compared to Baseline Conditions. The minimum suitability score for Baseline Conditions rate 3.07 (Cloverdale) compared to 3.78 in June under the Proposed Project. The occurrence of stressful water temperatures would be rare upstream of Hopland, but modeled to increase under the Proposed Project by 9 to 13 percent in May and June, but declined by up to 40 to 45 percent in September, compared to Baseline Conditions (Table 4.3-145). In Dry Creek, modeled water temperatures would be near optimal throughout the juvenile steelhead rearing period. The primary difference between Baseline Conditions and the Proposed Project; peak temperatures would be delayed approximately one month and cooler under the Proposed Project. This would result in an improvement in habitat conditions for rearing juvenile steelhead in the Russian River and Dry Creek and therefore the Proposed Project would provide a habitat benefit upstream of Cloverdale in the months April through November**.**

Table 4.3-143. Monthly mean water temperatures (°F) modeled to occur during the juvenile steelhead rearing period in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	Forks	54.0	55.7	52.8	54.5	52.7	51.9	54.9	51.6	59.8	53.5	65.8	57.0	65.7	61.9	57.4	58.3
	Hopland	57.4	58.7	58.8	61.6	59.9	61.3	61.2	60.6	63.6	60.1	66.9	60.7	65.1	61.9	56.3	56.9
	Cloverdale	58.6	59.6	61.6	64.2	63.6	65.6	64.8	65.4	65.9	64.0	67.6	62.9	64.8	62.0	55.7	56.0
Dry Creek	Upper	52.7	52.7	53.9	53.9	54.1	54.0	54.0	53.9	54.0	54.0	54.0	53.9	53.9	54.0	53.2	53.3
	Lower	56.6	56.6	59.8	59.8	61.4	61.2	61.2	60.8	60.2	59.8	58.8	58.2	56.8	56.7	53.8	53.9

Table 4.3-144. Suitability scores comparing water temperature suitability in the Russian River and Dry Creek during the juvenile steelhead period under Baseline Conditions (BC) and the Proposed Project (PP).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	Forks	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.73	5.00	3.46	4.97	3.71	4.51	4.95	4.94
	Hopland	4.97	4.92	4.88	4.62	4.78	4.62	4.64	4.75	4.18	4.83	3.24	4.77	3.90	4.63	4.97	4.97
	Cloverdale	4.93	4.87	4.65	4.16	4.28	3.78	4.01	3.87	3.65	4.29	3.07	4.51	3.99	4.66	4.98	4.99
Dry Creek	Upper	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98
	Lower	4.98	4.98	4.84	4.81	4.61	4.48	4.65	4.64	4.80	4.85	4.94	4.96	4.96	4.96	4.96	4.96

Table 4.3-145. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Condition and the Proposed Project.

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.05	0.15	0.00	0.00	0.00	0.00	0.05	0.15	0.10
	Cloverdale	0.22	0.37	0.00	0.00	0.00	0.00	0.22	0.37	0.14
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.09	0.23	0.02	0.02	0.00	0.00	0.10	0.25	0.15
	Hopland	1.03	3.82	0.10	0.42	0.00	0.00	1.13	4.20	3.11
	Cloverdale	3.05	11.25	0.39	1.40	0.02	0.07	3.46	12.71	9.25
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.49	0.03	0.03	0.00	0.00	0.28	0.52	0.24
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.19	0.02	0.15	0.00	0.02	0.00	0.36	0.02	-0.34
	Hopland	1.83	4.10	0.41	0.60	0.18	0.02	2.42	4.72	2.30
	Cloverdale	8.09	18.74	1.75	3.93	0.42	0.48	10.27	23.15	12.88
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.92	6.96	0.14	0.19	0.00	0.02	3.06	7.17	4.11

Table 4.3-145. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Condition and the Proposed Project.

July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.03	0.00	0.63	0.00	0.66	0.00	-0.66
	Hopland	2.82	1.70	0.33	0.10	0.58	0.01	3.73	1.81	-1.93
	Cloverdale	13.76	17.12	1.94	1.84	0.69	0.09	16.39	19.06	2.67
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.05	3.23	0.02	0.04	0.00	0.00	2.08	3.27	1.19
August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	2.33	0.00	0.21	0.00	0.00	0.00	2.54	0.00	-2.54
	Hopland	11.99	0.62	1.75	0.00	0.18	0.00	13.92	0.62	-13.30
	Cloverdale	23.39	7.14	4.00	0.41	0.39	0.00	27.78	7.56	-20.22
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.18	0.14	0.00	0.00	0.00	0.00	0.18	0.14	-0.04
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	39.34	0.00	3.58	0.00	0.00	0.00	42.92	0.00	-42.92
	Hopland	36.03	0.76	9.88	0.03	0.44	0.00	46.35	0.79	-45.56
	Cloverdale	39.11	3.54	11.72	0.17	0.53	0.00	51.35	3.71	-47.65
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.01

Table 4.3-145. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Condition and the Proposed Project.

October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	20.94	1.90	1.23	0.00	0.00	0.00	22.17	1.59	-20.58
	Hopland	16.21	1.22	1.72	0.02	0.15	0.00	18.08	1.24	-16.84
	Cloverdale	13.58	1.35	1.64	0.01	0.14	0.00	15.37	1.36	-14.01
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

No Project 1 Alternative: Modeled monthly mean water temperatures between the Forks and Cloverdale would be essentially the same as Baseline Conditions during the juvenile steelhead rearing period (April through November) (Figure 4.3-15; Table 4.3-146). Temperature assessment scores rate suitable to optimal through July, with lower scores occurring between August and October for Baseline Conditions and the No Project 1 Alternative (Table 4.3-147). Minimum scores occur during September (3.07) at Cloverdale. Modeled stressful water temperatures rarely occur prior to August for Baseline Conditions and the No Project 1 Alternative, but occur (equally) up to 40 to 50 percent of the time between the Forks and Cloverdale during September (Table 4.3-148). In Dry Creek, temperatures assessment scores rate near optimal throughout the juvenile steelhead juvenile period. The No Project 1 Alternative would not affect the rearing habitat for juvenile steelhead through elevated water temperatures in the months April through November in the Russian River (above Cloverdale) and in Dry Creek and therefore, no impacts would occur.

No Project 2 Alternative: Modeled monthly mean water temperatures in the Russian River between the Forks and Cloverdale would be approximately 1.7° F higher April through June, and approximately 1 to 5° F cooler August through October (Figure 4.3-16; Table 4.3-149) compared to Baseline Conditions. Although temperatures would be warmer during the April through June timeframe, temperature assessment scores exceed 4.0 (“suitable”) under the No Project 2 Alternative except during June at Cloverdale (3.96). However, during the August through October timeframe, temperature assessment scores under the No Project 2 Alternative rate higher compared to Baseline Conditions. Temperature assessment scores decline to 3.07 at Cloverdale, while the lowest score modeled to occur under the No Project 2 Alternative was 3.96 (Table 4.3-150). The occurrence of stressful water temperatures would increase under the No Project 2 Alternative by 4 to 6 percent May through June, but declined by up to 32 to 35 percent in September (Table 4.3-151). In Dry Creek, water temperatures were modeled to be near optimal and temperature assessment scores exceed suitable throughout the juvenile steelhead juvenile period. The No Project 2 Alternative improves habitat conditions in the months April through November in the Russian River for juvenile steelhead rearing in the Upper Russian River above Cloverdale and would not affect the rearing habitat for juvenile steelhead through elevated water temperatures in Dry Creek and therefore, no impacts would occur.

Table 4.3-146. Monthly mean water temperatures (°F) modeled to occur during the steelhead juvenile rearing period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	54.0	54.0	52.8	52.8	52.7	52.7	54.9	54.9	59.8	59.7	65.8	65.7	65.7	65.7	57.4	57.5
	Hopland	57.4	57.4	58.8	58.8	59.9	59.9	61.2	61.3	63.6	63.5	66.9	66.8	65.1	65.1	56.3	56.3
	Cloverdale	58.6	58.6	61.6	61.6	63.6	63.6	64.8	64.8	65.9	65.9	67.6	67.6	64.8	64.8	55.7	55.7
Dry Creek	Upper	52.6	52.6	53.9	53.8	54.1	54.0	54.0	53.9	54.0	54.0	54.0	53.9	53.9	54.0	53.2	53.3
	Lower	56.7	56.7	59.8	59.8	61.4	61.2	61.2	60.8	60.2	59.8	58.8	58.2	56.8	56.7	53.8	53.9

Table 4.3-147. Suitability scores comparing water temperature modeled to occur during the steelhead juvenile rearing period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	Forks	5.00	5.00	4.99	4.99	4.98	4.98	4.97	4.97	4.73	4.73	3.46	3.46	3.71	3.71	4.95	4.95
	Hopland	4.97	4.96	4.88	4.88	4.78	4.78	4.64	4.64	4.18	4.18	3.24	3.24	3.90	3.90	4.97	4.97
	Cloverdale	4.93	4.93	4.65	4.65	4.28	4.28	4.01	4.00	3.65	3.65	3.07	3.07	3.99	3.99	4.98	4.98
Dry Creek	Upper	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98
	Lower	4.98	4.98	4.84	4.84	4.61	4.64	4.65	4.70	4.80	4.84	4.94	4.98	4.98	4.98	4.98	4.98

Table 4.3-148. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	April									
	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.05	0.05	0.00	0.00	0.00	0.00	0.05	0.05	0.00
	Cloverdale	0.22	0.22	0.00	0.00	0.00	0.00	0.22	0.22	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	May									
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.09	0.09	0.02	0.02	0.00	0.00	0.1	0.11	0.00
	Hopland	1.03	1.03	0.10	0.10	0.00	0.00	1.13	1.13	0.00
	Cloverdale	3.05	3.06	0.39	0.39	0.02	0.02	3.46	3.48	0.02
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.22	0.03	0.01	0.00	0.00	0.28	0.23	-0.05
	June									
Reach	Location	Tolerance		Resistance		Lethal		Total		% Change
		BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.19	0.19	0.15	0.15	0.02	0.02	0.36	0.36	0.00
	Hopland	1.83	1.83	0.41	0.41	0.18	0.18	2.42	2.42	0.00
	Cloverdale	8.09	8.10	1.75	1.76	0.42	0.42	10.27	10.27	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.29	2.51	0.14	0.13	0.00	0.00	3.06	2.64	-0.42

Table 4.3-148. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.03	0.03	0.63	0.63	0.66	0.766	0.00
	Hopland	2.82	2.83	0.33	0.33	0.58	0.58	3.74	3.74	0.01
	Cloverdale	13.76	13.82	1.94	1.94	0.69	0.69	16.39	16.46	0.07
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.05	1.90	0.02	0.01	0.00	0.00	2.08	1.91	-0.17
August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	2.33	2.33	0.21	0.21	0.00	0.00	2.54	2.54	0.00
	Hopland	11.99	12.02	1.75	1.75	0.18	0.18	13.92	13.94	0.02
	Cloverdale	23.39	23.42	4.00	4.00	0.39	0.39	27.78	27.81	0.03
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.18	0.16	6.92	5.49	0.00	0.00	7.10	5.65	-1.45
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	39.34	39.32	3.58	3.58	0.00	0.00	42.92	42.90	0.02
	Hopland	36.03	36.05	9.88	9.88	0.44	0.45	46.35	46.38	0.00
	Cloverdale	39.11	39.12	11.72	11.71	0.53	0.53	51.35	51.35	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.01

Table 4.3-148. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

October										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	20.94	20.94	1.23	1.23	0.00	0.00	22.17	22.17	0.00
	Hopland	16.21	16.20	1.72	1.73	0.15	0.15	18.08	18.08	0.00
	Cloverdale	13.58	13.61	1.64	1.64	0.14	0.14	15.37	15.39	0.02
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.04	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
November										
Reach		Tolerance		Resistance		Lethal		Total		% Change
	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-149. Monthly mean water temperatures (°F) modeled to occur in Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	April		May		June		July		August		September		October		November	
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	54.0	54.1	52.8	53.8	52.7	52.2	54.9	53.0	59.8	56.1	65.8	60.8	65.7	63.9	57.4	58.0
	Hopland	57.4	57.5	58.8	60.6	59.9	60.8	61.2	60.8	63.6	61.5	66.9	63.2	65.1	63.6	56.3	56.8
	Cloverdale	58.6	58.7	61.6	63.2	63.6	64.8	64.8	65.1	65.9	64.6	67.6	64.7	64.8	63.4	55.7	56.1
Dry Creek	Upper	52.7	52.7	53.9	56.6	54.1	57.2	54.0	53.9	54.0	54.0	54.0	53.9	53.9	54.0	53.2	53.3
	Lower	56.6	56.6	59.8	59.8	61.4	61.6	61.2	60.8	60.2	59.8	58.8	58.2	56.8	56.7	53.8	53.9

Table 4.3-150. Suitability scores comparing water temperature for juvenile steelhead rearing period modeled to occur in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project Alternative (NP2).

Reach	Location	April		May		June		July		August		September		October		November	
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Upper Russian River	Forks	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.73	4.95	3.46	4.48	3.71	4.10	4.95	4.94
	Hopland	5.00	5.00	4.88	4.75	4.78	4.71	4.64	4.72	4.18	4.63	3.24	4.21	3.90	4.26	4.97	4.97
	Cloverdale	4.93	4.93	4.65	4.38	4.28	4.01	4.01	3.96	3.65	4.09	3.07	3.97	3.99	4.33	4.98	4.98
Dry Creek	Upper	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98	4.98
	Lower	4.98	4.98	4.84	4.84	4.61	4.60	4.65	4.66	4.80	4.83	4.94	4.96	4.96	4.96	4.96	4.96

Table 4.3-151. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.09	0.16	0.02	0.02	0.00	0.00	0.10	0.18	0.08
	Hopland	1.03	1.85	0.10	0.18	0.00	0.00	1.13	2.02	0.89
	Cloverdale	3.05	6.98	0.39	0.74	0.02	0.02	3.46	7.73	4.27
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.25	0.28	0.03	0.02	0.00	0.00	0.28	0.30	0.02
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.19	0.02	0.15	0.00	0.02	0.00	0.36	0.02	-0.34
	Hopland	1.83	2.80	0.41	0.26	0.18	0.02	2.42	3.08	0.67
	Cloverdale	8.09	13.86	1.75	2.54	0.42	0.27	10.27	16.67	6.40
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.92	2.95	0.14	0.14	0.00	0.00	3.06	3.08	0.02

Table 4.3-151. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative

July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Upper Russian River	Forks	0.00	0.00	0.03	0.00	0.63	0.00	0.66	0.00	-0.66
	Hopland	2.82	1.89	0.33	0.26	0.58	0.01	3.73	2.16	-1.57
	Cloverdale	13.76	14.7	1.94	1.63	0.69	0.15	16.39	16.50	0.12
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	2.05	1.85	0.02	0.02	0.0	0.00	2.08	1.87	-0.20
August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Upper Russian River	Forks	2.33	0.64	0.21	0.00	0.00	0.00	2.54	0.64	-1.90
	Hopland	11.99	3.57	1.75	0.51	0.18	0.03	13.92	4.11	-9.81
	Cloverdale	23.39	11.79	4.00	1.53	0.39	0.11	27.78	13.43	-14.35
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP1	
Upper Russian River	Forks	39.34	6.08	3.58	1.22	0.00	0.00	42.92	7.31	-35.61
	Hopland	36.03	11.81	9.88	1.98	0.44	0.08	46.35	13.88	-32.48
	Cloverdale	39.11	16.53	11.72	2.51	0.53	0.07	51.35	19.11	-32.24
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.18	0.13	0.00	0.00	0.00	0.00	0.18	0.13	-0.05

Table 4.3-151. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	20.94	8.35	1.23	0.46	0.00	0.00	22.17	8.82	-13.3
	Hopland	16.21	8.01	1.72	0.49	0.1	0.00	18.08	8.50	-9.58%
	Cloverdale	13.58	6.66	1.64	0.45	0.14	0.00	15.37	7.12	-8.25
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Impact 4.3-22: Changes in minimum instream flow could substantially affect the emigrating steelhead smolts through elevated water temperatures in the months March through May in the Russian River and in Dry Creek. (No Impact)

Proposed Project: Modeled monthly mean water temperatures in the Upper Russian River would be up to 2.8° F warmer in May compared to Baseline Conditions (Figure 4.3-14; Table 4.3-152). However, downstream of the confluence of Dry Creek, water temperatures are within 0.3° F between Baseline Conditions and the Proposed Project. Temperature assessment scores range from over 4.0 (suitable) upstream of Cloverdale in March to 0.51 at Healdsburg in May (Table 4.3-153). In the Lower Russian River (below the confluence with Dry Creek), temperature assessment scores range from 3.74 at Hacienda during March, to 0.84 during May for Baseline Conditions and the Proposed Project. Modeled stressful water temperatures at Hacienda occur from 24.10 (March) to 99.98 (May) percent of the time under both Baseline Conditions and the Proposed Project (Table 4.3-154). Although the Proposed Project would increase the occurrence of stressful water temperatures in the Upper Russian River in May, the occurrence of stressful water temperatures was essentially unchanged in the Lower Russian River. In upper Dry Creek, temperature assessment scores rate near optimal for emigrating steelhead smolts; however, in the lower reach of Dry Creek, temperature assessment scores decline from suitable in March to stressful in May under Baseline Conditions and the Proposed Project. The Proposed Project would not affect the emigrating steelhead smolts through elevated water temperatures in the months March through May in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 1 Alternative: Modeled monthly mean water temperatures would be similar to Baseline Conditions during the March through May steelhead smolt emigration season (Figure 4.3-15; Table 4.3-155). Temperature assessment scores for emigrating steelhead smolts range from over 4.0 (suitable) upstream of Cloverdale in March to 0.65 at Healdsburg in May for Baseline Conditions and the No Project 1 Alternative (Table 4.3-156). In the Lower Russian River (below the confluence with Dry Creek), temperature assessment scores range from 3.74 at Hacienda in March, to 0.88 in May. Modeled stressful water temperatures at Hacienda occur from approximately 24.10 (March) to 99.97 (May) percent of the time for Baseline Conditions and the No Project 1 Alternative (Table 4.3-157). Overall, the No Project 1 Alternative would increase the occurrence of stressful water temperatures in the Lower Russian River by ± 0.11 percent relative to Baseline Conditions. In upper Dry Creek, temperature assessment scores rate suitable to near optimal for emigrating steelhead smolts; however, in the lower reach of Dry Creek, temperature assessment scores decline from suitable in March to stressful in May under both Baseline Conditions and the No Project 1 Alternative. The No Project 1 Alternative would not affect the emigrating steelhead smolts through elevated water temperatures in the months March through May in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-152. Monthly mean water temperatures (°F) during the steelhead smolt emigration period in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project.

Reach	Location	March		April		May	
		BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	53.0	53.5	54.0	55.7	52.8	54.5
	Hopland	53.6	53.8	57.4	58.7	58.8	61.6
	Cloverdale	53.7	53.9	58.6	59.6	61.6	64.2
	Geyserville	54.9	55.0	60.8	64.6	65.7	67.8
	Healdsburg	55.7	55.7	62.3	62.8	68.3	69.6
Lower Russian River	Below Dry Creek	55.1	55.1	61.0	61.2	65.9	66.2
	Hacienda	54.9	54.9	61.2	61.3	66.5	66.8
Dry Creek	Upper	51.0	50.9	52.7	52.7	53.9	54.1
	Lower	52.9	52.9	56.6	56.6	59.8	60.1

Table 4.3-153. Suitability scores comparing water temperature suitability in the Russian River and Dry Creek during the steelhead smolt emigration period (April through May) under Baseline Conditions (BC) and the Proposed Project.

Reach	Location	March		April		May	
		BC	PP	BC	PP	BC	PP
Upper Russian River	Forks	4.31	4.16	4.03	3.45	4.45	3.91
	Hopland	4.15	4.06	2.88	2.44	2.44	1.72
	Cloverdale	4.11	4.05	2.46	2.19	1.68	1.22
	Geyserville	3.74	3.70	1.91	1.76	1.02	0.74
	Healdsburg	3.47	3.45	1.59	1.51	0.65	0.51
Lower Russian River	Below Dry Creek	3.68	3.67	1.86	1.82	0.97	0.92
	Hacienda	3.74	3.73	1.79	1.76	0.87	0.84
Dry Creek	Upper	4.90	4.90	4.56	4.56	4.16	4.09
	Lower	4.42	4.42	3.17	3.17	2.12	2.06

Table 4.3-154. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing steelhead smolts in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project.

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	6.93	7.31	2.24	2.46	0.00	0.00	9.17	9.77	0.60
	Hopland	9.04	9.23	3.69	3.93	0.00	0.00	12.73	13.16	0.43
	Cloverdale	9.83	10.10	3.92	4.01	0.00	0.00	13.75	14.11	0.36
	Geyserville	13.63	13.73	11.32	11.54	0.00	0.00	24.95	25.27	0.33
	Healdsburg	16.88	16.86	16.69	16.90	0.00	0.00	33.57	33.76	0.19
Lower Russian River	Below Dry Creek	14.79	14.77	11.63	11.74	0.00	0.00	26.42	26.51	0.09
	Hacienda	15.88	15.78	8.33	8.34	0.00	0.00	24.21	24.12	-0.09
Dry Creek	Upper	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Lower	4.90	4.90	1.50	1.48	0.00	0.00	6.40	6.39	-0.01
April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	9.43	9.60	8.26	8.85	0.00	0.00	17.69	18.45	0.76
	Hopland	22.73	23.34	29.32	30.81	0.00	0.00	52.05	54.15	2.10
	Cloverdale	23.96	23.73	43.24	45.01	0.00	0.00	67.20	68.73	1.54
	Geyserville	18.15	17.72	65.71	66.51	0.00	0.00	83.86	84.24	0.38
	Healdsburg	12.53	12.28	79.07	79.40	0.00	0.00	91.60	91.68	0.08
Lower Russian River	Below Dry Creek	16.41	16.26	69.50	69.71	0.00	0.00	85.91	85.97	0.06
	Hacienda	13.81	13.70	75.03	75.11	0.00	0.00	88.85	88.81	-0.03
Dry Creek	Upper	1.51	1.48	0.11	0.08	0.00	0.00	1.63	1.56	-0.06
	Lower	18.82	18.84	22.25	22.26	0.00	0.00	41.07	41.10	0.02

Table 4.3-154. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to rearing steelhead smolts in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project.

May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	Forks	3.30	7.09	4.86	8.21	0.00	0.00	8.16	15.30	7.14
	Hopland	22.36	17.63	45.52	65.80	0.00	0.00	67.88	83.43	15.55
	Cloverdale	14.82	7.21	77.30	90.35	0.02	0.02	92.13	97.58	5.45
	Geyserville	3.27	1.40	94.12	94.14	2.04	4.24	99.43	99.78	0.35
	Healdsburg	0.23	0.16	95.65	92.79	4.12	7.04	100.0	100.0	0.00
Lower Russian River	Below Dry Creek	1.35	1.37	98.23	98.18	0.23	0.26	99.81	99.80	-0.02
	Hacienda	0.19	0.19	99.71	99.70	0.06	0.09	99.97	99.98	0.01
Dry Creek	Upper	8.24	8.24	0.40	0.37	0.00	0.00	8.64	8.61	-0.03
	Lower	20.81	20.96	56.60	56.41	0.00	0.00	77.41	77.37	-0.05

Table 4.3-155. Monthly mean water temperatures (°F) modeled to occur during the emigrating steelhead smolt season in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	March		April		May	
		BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	53.0	53.0	54.0	54.1	52.8	52.9
	Hopland	53.6	53.6	57.4	57.4	58.8	58.9
	Cloverdale	53.7	53.8	58.6	58.6	61.7	61.7
	Geyserville	54.9	54.9	60.8	60.8	65.7	65.7
	Healdsburg	55.7	55.7	62.3	62.3	68.3	68.3
Lower Russian River	Below Dry Creek	55.1	55.1	55.1	61.0	65.9	65.8
	Hacienda	54.9	54.9	61.2	61.2	66.5	66.5
Dry Creek	Upper	51.0	51.0	52.6	52.6	53.9	53.8
	Lower	52.9	52.9	56.7	56.7	59.8	59.8

Table 4.3-156. Suitability scores comparing water temperature modeled to occur during the steelhead juvenile rearing period in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

Reach	Location	March		April		May	
		BC	NP1	BC	NP1	BC	NP1
Upper Russian River	Forks	4.31	4.31	4.03	4.03	4.45	4.44
	Hopland	4.15	4.14	2.88	2.87	2.44	2.43
	Cloverdale	4.11	4.11	2.46	2.46	1.68	1.68
	Geyserville	3.74	3.74	1.91	1.91	1.02	1.02
	Healdsburg	3.47	3.47	1.59	1.59	0.65	0.65
Lower Russian River	Below Dry Creek	3.68	3.67	1.86	1.86	0.97	0.98
	Hacienda	3.74	3.74	1.79	1.79	0.87	0.88
Dry Creek	Upper	4.90	4.89	4.56	4.56	4.16	4.17
	Lower	4.42	4.41	3.17	3.17	2.12	2.14

Table 4.3-157. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to emigrating steelhead smolts in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	6.93	6.96	2.24	2.24	0.00	0.00	9.17	9.19	0.02
	Hopland	9.04	9.03	3.69	3.71	0.00	0.00	12.73	12.74	0.01
	Cloverdale	9.83	9.85	3.92	3.92	0.00	0.00	13.75	13.78	0.03
	Geyserville	9.83	9.85	3.92	3.92	0.00	0.00	13.75	13.78	0.03
	Healdsburg	16.88	16.90	16.69	16.69	0.00	0.00	33.57	33.58	0.01
Lower Russian River	Below Dry Creek	14.79	14.77	11.63	11.76	0.00	0.00	26.42	26.53	0.11
	Hacienda	15.88	15.61	8.33	8.49	0.00	0.00	24.21	24.10	-0.11
Dry Creek	Upper	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Lower	4.90	4.88	1.50	1.65	0.00	0.00	6.40	6.53	0.13
April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	9.43	9.51	8.26	8.26	0.00	0.00	17.69	17.77	0.08
	Hopland	22.73	22.76	29.32	29.45	0.00	0.00	52.05	52.21	0.16
	Cloverdale	23.96	24.04	43.24	43.28	0.00	0.00	67.20	67.32	0.12
	Geyserville	23.96	24.04	43.24	43.28	0.00	0.00	67.20	67.32	0.12
	Healdsburg	12.53	12.50	79.07	79.11	0.00	0.00	91.60	91.61	0.01
Lower Russian River	Below Dry Creek	16.41	16.41	69.50	69.55	0.00	0.00	85.91	85.96	0.05
	Hacienda	13.81	13.82	75.03	74.99	0.00	0.00	88.85	88.81	-0.03
Dry Creek	Upper	1.51	1.51	0.11	0.08	0.00	0.00	1.63	1.59	-0.04
	Lower	18.82	19.04	22.25	22.32	0.00	0.00	41.07	41.36	0.29

Table 4.3-157 (cont.). Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to emigrating steelhead smolts in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	Forks	3.30	3.27	4.86	4.91	0.00	0.00	8.16	8.18	0.02
	Hopland	22.36	22.42	45.52	45.63	0.00	0.00	67.88	68.06	0.18
	Cloverdale	14.82	14.77	77.30	77.40	0.02	0.10	92.13	92.20	0.06
	Geyserville	18.15	18.15	65.71	65.74	0.02	0.10	83.96	93.98	0.02
	Healdsburg	0.23	0.23	95.65	95.65	4.12	4.12	100.00	100.00	0.00
Lower Russian River	Below Dry Creek	1.35	1.52	98.23	98.08	0.23	0.21	99.81	99.81	0.00
	Hacienda	0.19	0.21	99.71	99.71	0.06	0.05	99.97	99.97	0.00
Dry Creek	Upper	8.24	7.93	0.40	0.36	0.40	0.36	9.04	8.64	-0.40
	Lower	20.81	20.76	56.60	56.22	0.00	0.00	77.41	76.99	-0.43

No Project 2 Alternative: Modeled monthly mean water temperatures in the Upper Russian River would be similar during March and April, but between 0.9 and 1.7° F warmer in May compared to Baseline Conditions (Figure 4.3-16; Table 4.3-158). In the Lower Russian River, modeled water temperatures between Baseline Conditions and the No Project 2 Alternative are within 0.2° F. Temperature assessment scores for emigrating steelhead smolts range from over 4.0 (suitable) upstream of Cloverdale in March to 0.55 at Healdsburg in May (Table 4.3-159). In the Lower Russian River, temperature assessment scores range from 3.74 at Hacienda in March, to 0.86 in May for Baseline Conditions and the No Project 2 Alternative. Modeled stressful water temperatures at Hacienda occur from approximately 24.10 (March) to 99.98 (May) percent of the time for Baseline Conditions and the No Project 2 Alternative (Table 4.3-160). Overall, the No Project 2 Alternative would increase the occurrence of stressful water temperatures by less than 0.10 percent relative to Baseline Conditions. In upper Dry Creek, temperature assessment scores rated suitable to near optimal for emigrating steelhead smolts; however, in the lower reach of Dry Creek, temperature assessment scores decline from suitable in March to stressful in May under Baseline Conditions and the No Project 2 Alternative. The No Project 2 Alternative would not affect the emigrating steelhead smolts through elevated water temperatures in the months March through May in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-158. Monthly mean water temperatures (°F) modeled to occur during the steelhead smolting period in Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		March		May		June	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	53.0	53.1	54.0	54.1	52.8	53.8
	Hopland	53.6	53.7	57.4	57.6	58.8	60.6
	Cloverdale	53.7	53.8	58.6	58.8	61.7	63.3
	Geyserville	54.9	54.9	60.8	60.9	65.7	67.1
	Healdsburg	55.7	55.7	62.3	62.4	68.3	69.2
Lower Russian River	Below Dry Creek	55.1	55.1	61.0	61.0	65.9	66.0
	Hacienda	54.9	54.9	61.2	61.2	66.5	66.6
Dry Creek	Upper	51.0	51.8	52.7	52.7	53.9	56.6
	Lower	52.9	52.9	56.6	56.6	59.8	59.8

Table 4.3-159. Suitability scores comparing water temperature for the steelhead smolting period modeled to occur in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project Alternative (NP2).

		March		April		May	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	Forks	4.31	4.28	4.03	4.00	4.45	4.13
	Hopland	4.15	4.13	2.88	2.82	2.44	1.95
	Cloverdale	4.11	4.10	2.46	2.43	1.68	1.38
	Geyserville	3.74	3.73	1.91	1.89	1.02	0.83
	Healdsburg	3.47	3.46	1.59	1.58	0.65	0.55
Lower Russian River	Below Dry Creek	3.68	3.68	1.86	1.85	0.97	0.95
	Hacienda	3.74	3.74	1.79	1.78	0.87	0.86
Dry Creek	Upper	4.90	4.90	4.56	4.56	4.16	4.16
	Lower	4.42	4.42	3.17	3.17	2.12	2.12

Table 4.3-160. Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead smolts in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2)

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	6.93	7.31	2.24	2.46	0.00	0.00	9.17	9.77	0.60
	Hopland	9.04	9.23	3.69	3.93	0.00	0.00	12.73	13.16	0.43
	Cloverdale	9.83	10.10	3.92	4.01	0.00	0.00	13.75	14.11	0.36
	Geyserville	13.63	13.73	11.32	11.54	0.00	0.00	24.95	25.27	0.33
	Healdsburg	16.88	16.86	16.69	16.90	0.00	0.00	33.57	33.76	0.19
Lower Russian River	Below Dry Creek	14.79	14.77	11.63	11.74	0.00	0.00	26.42	26.51	0.09
	Hacienda	15.88	15.78	8.33	8.34	0.00	0.00	24.2	24.1	-0.09
Dry Creek	Upper	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.00
	Lower	4.90	4.90	1.50	1.48	0.00	0.00	6.40	6.39	0.00
April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	9.43	9.60	8.26	8.85	0.00	0.00	17.69	18.45	0.76
	Hopland	22.73	23.34	29.32	30.81	0.00	0.00	52.05	54.15	2.10
	Cloverdale	23.96	23.73	43.24	45.01	0.00	0.00	67.20	68.73	1.54
	Geyserville	18.15	17.72	65.71	66.51	0.00	0.00	83.86	84.24	0.38
	Healdsburg	12.53	12.28	79.07	79.40	0.00	0.00	91.60	91.68	0.08
Lower Russian River	Below Dry Creek	16.41	16.26	69.50	69.71	0.00	0.00	85.91	85.97	0.06
	Hacienda	13.81	13.70	75.03	75.11	0.00	0.00	88.85	88.81	-0.03
Dry Creek	Upper	1.51	1.48	0.11	0.08	0.00	0.00	1.63	1.56	-0.06
	Lower	18.82	18.84	22.25	22.26	0.00	0.00	41.07	41.10	0.02

Table 4.3-160 (continued). Frequency of occurrence of water temperatures modeled to exceed criteria deemed stressful to steelhead smolts in the Upper Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2)

May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	Forks	3.30	7.09	4.86	8.21	0.00	0.00	8.16	15.30	7.14
	Hopland	22.36	17.63	45.52	65.80	0.00	0.00	67.88	83.43	15.55
	Cloverdale	14.82	7.21	77.30	90.35	0.02	0.02	92.13	97.58	5.45
	Geyserville	3.27	1.40	94.12	94.14	2.04	4.24	99.43	99.78	0.35
	Healdsburg	0.23	0.16	95.65	92.79	4.12	7.04	100.00	100.00	0.00
Lower Russian River	Below Dry Creek	1.35	1.37	98.23	98.18	0.23	0.26	99.81	99.80	-0.02
	Hacienda	0.19	0.19	99.71	99.70	0.06	0.09	99.97	99.98	0.01
Dry Creek	Upper	8.24	8.24	0.40	0.37	0.00	0.00	8.64	8.61	-0.03
	Lower	20.81	20.96	56.60	56.41	0.00	0.00	77.41	77.37	-0.05

Dissolved Oxygen Discussion

Reservoir stratification

Releases from Lake Mendocino and Lake Sonoma can have a profound effect on water temperature and dissolved oxygen (DO) levels in the Russian River below Lake Mendocino and in Dry Creek below Lake Sonoma. Understanding the influence of reservoir releases on these two constituents requires an understanding of the process of “thermal stratification” within a lake. A fascinating property of water is how its density changes with temperature. As water cools, its density increases. This relationship continues until water cools to about 39° F at which point the density of water decreases with further cooling (this explains why ice floats). Solar radiation disproportionately warms water near the surface of a lake. As the surface water warms, it becomes less dense and “floats” on top of the colder, denser layer below. With just a few degrees of warming, the density difference can become strong enough to prevent mixing between the surface and bottom layers. In essence, lakes stratify into three layers: a warm surface layer (called the epilimnion), a narrow middle layer where the temperature rapidly declines, called the metalimnion (sometimes referred to as the thermocline); and a cold bottom layer (called the hypolimnion, which is commonly referred to in reservoirs as the “coldwater pool”). During the fall, atmospheric temperatures decline, cooling the surface waters of the reservoirs. The decrease in temperature in the surface waters reduces the density gradient between the epilimnion and hypolimnion, allowing the two layers to mix (often referred to as the lake “turning over.” During the mixing of the upper and lower layers, the bottom layer becomes re-oxygenated, and the overall temperature of the lake decreases, depending on the size of the remaining coldwater pool.

The density barrier that restricts mixing between the upper and lower layers affects water quality. The epilimnion remains in contact with the atmosphere and remains well oxygenated. However, the hypolimnion is isolated, and overtime, biological and chemical processes slowly deplete the oxygen within this layer. Thus, the reservoirs stratify into a warm, oxygenated surface layer and a cold bottom layer where the DO declines over time, potentially becoming anoxic. This has immense consequences to fish living downstream of the reservoirs. Depending on the depth of the release outlet in relation to the “coldwater pool,” water released from a reservoir may range from warm to cold and oxygenated to anoxic.

The size of the reservoir significantly affects downstream water quality as well. Larger reservoirs, such as Lake Sonoma, support a large coldwater pool. The available cold water is substantially less in smaller reservoirs such as Lake Mendocino. Consequently, the coldwater pool is only depleted under extreme conditions in Lake Sonoma, but the coldwater pool in Lake Mendocino can be depleted on a regular basis.

Once released from the reservoir, the natural process of water flowing over riffles mixes the water with the atmosphere, re-oxygenating the water (this is an oversimplification of the process, but in a river immediately below a dam this is the primary source of introducing oxygen back into a river). The greater the turbulence (e.g., riffles and cascades) the quicker the re-

oxygenation process occurs. Colder water has both a higher saturation point ("holds more oxygen") compared to warmer water, and a greater solubility (oxygen dissolves into cold water more readily than it does in warm water).

Overview of dissolved oxygen levels in the Russian River and in Dry Creek

Upper Russian River: During the late fall, winter, and early spring, water stored in Lake Mendocino remains well mixed, and water released from the reservoir is well oxygenated. In addition, atmospheric conditions and tributary input help to maintain DO levels at or near saturation. However, beginning in May of most years, DO levels in the water released below the reservoir begins to decrease under Baseline Conditions and the No Project 1 Alternative, No Project 2 Alternative, and the Proposed Project (Figure 4.3-17). This continues through the summer and early fall until the lake "turns over" and the process starts anew. The general pattern follows the development and depletion of the coldwater pool in Lake Mendocino. Minimum DO levels are present at the outlet of the reservoir, but increase with distance downstream, as water entrains oxygen as it tumbles over downstream riffles. In general, DO levels are higher under the No Project 2 Alternative and the Proposed Project during July and August, and lower during October compared to Baseline Conditions and the No Project 1 Alternative. The potential for low DO levels released from Lake Mendocino occurs during the summer through early fall, thus, its potential to influence fish populations is limited to species present during this timeframe.

Lower Russian River: Dissolved oxygen levels in the Lower Russian River are minimally influence by releases from the two project reservoirs. Releases from Warm Springs Dam have adequate DO levels, and water released from Coyote Valley Dam has flowed approximately 70 miles and has had adequate time to become fully re-oxygenated. In general, DO levels were modeled to be suitable for all species of fish in the river (8.0 ppm or higher) under each alternative for each month of the year (Figure 4.3-18). Modeled DO levels were similar under Baseline Conditions, the No Project 1 Alternative, the No Project 2 Alternative, and the Proposed Project; thus, there are no project related impacts associated with DO levels in the Lower Russian River.

Dry Creek: Lake Sonoma, with its large coldwater pool, maintains coldwater releases under the driest conditions modeled (1977 water year). Water released from Lake Sonoma flows over a large weir (cascade) immediately after release from the reservoir, and the relatively high gradient of Dry Creek (compared to the Russian River) results in a high energy system where water is rapidly, and repeatedly, mixed with air. As a result, dissolved oxygen levels in Dry Creek under all four flow scenarios modeled remain above 8 ppm (suitable to near optimal levels) throughout the year as well as during the driest conditions modeled (Figure 4.3-19). Thus there are no DO related impacts in Dry Creek.

Based on the water quality model, potential impacts related to low DO levels are limited to the first few miles of the Russian River downstream of Coyote Valley Dam. Because low DO levels are limited spatially and temporally, the species potentially impacted by low DO are upstream migrating Chinook salmon, rearing juvenile steelhead, and native warm water species inhabiting

the Upper Russian River. Table 4.3-161 presents the rationale for the inclusion or exclusion of species and life stages from the analysis.

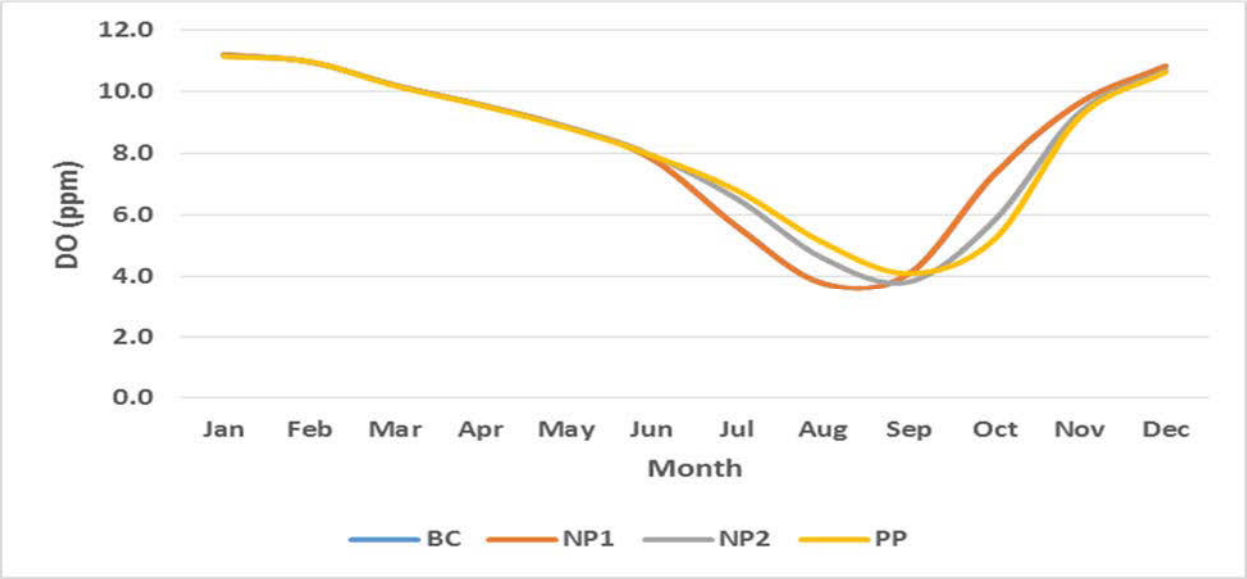


Figure 4.3-17: Monthly mean dissolved oxygen (DO) levels modeled to occur at the Forks in the Upper Russian River under Baseline Conditions (BC), the No Project 1 Alternative (NP1), the No Project 2 Alternative (NP2), and the Proposed Project (PP).

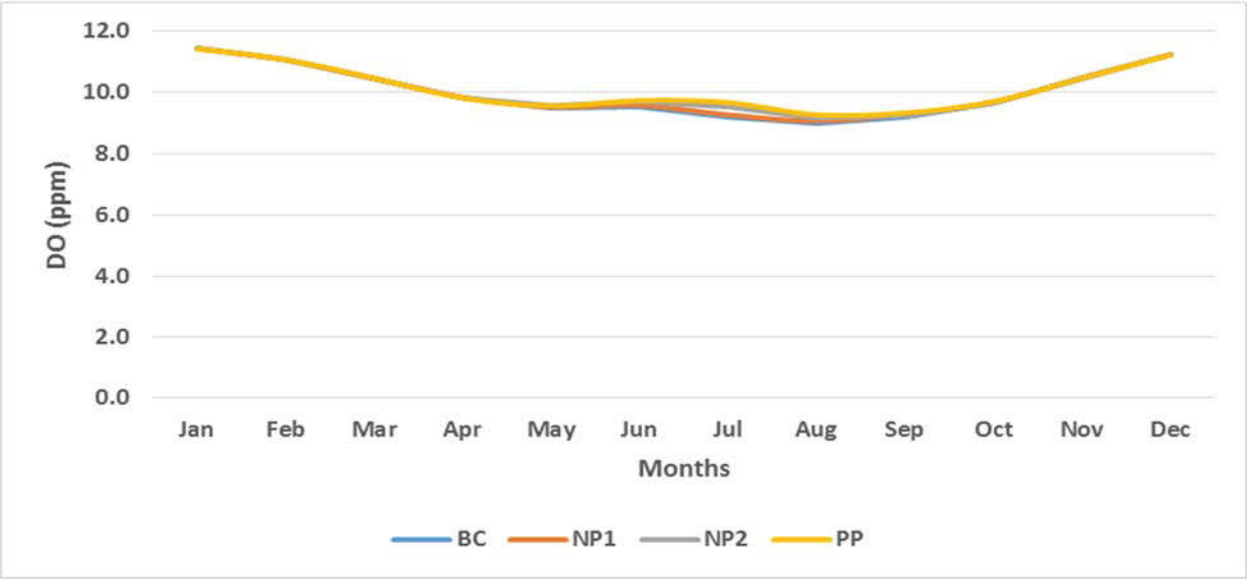


Figure 4.3-18: Monthly mean dissolved oxygen (DO) levels modeled to occur at Hacienda in the Lower Russian River under Baseline Conditions (BC), the No Project 1 Alternative (NP1), No Project 2 Alternative (NP2), and Proposed Project (PP).

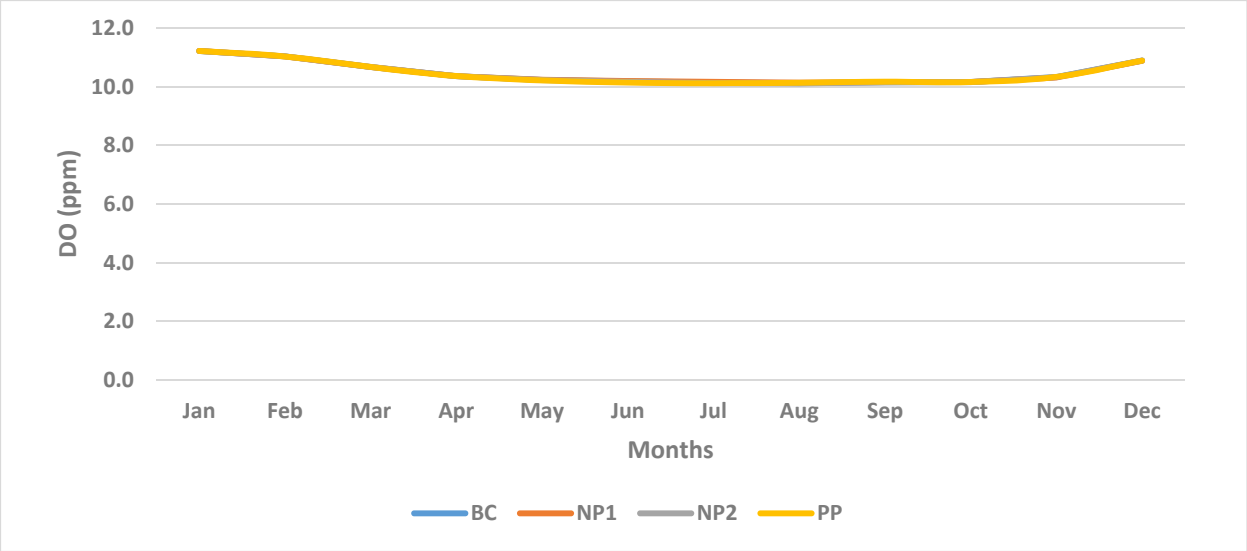


Figure 4.3-19. Monthly mean dissolved oxygen (DO) levels modeled to occur in lower Dry Creek under Baseline Conditions (BC), the No Project 1 Alternative (NP1), No Project 2 Alternative (NP2), and Proposed Project (PP).

Table 4.3-161. Potential for each species and life stage to be negatively impacted by low dissolved oxygen (DO) levels in the Russian River and Dry Creek.

Species	Life stage	Susceptibility to low DO levels	Rationale
Chinook	Upstream migration	Potential Impact	Early (October) arriving adults may encounter stressful DO levels in the Upper Russian River. Potential impacts are discussed below.
Chinook	Spawning and incubation	None	Modeled DO levels are suitable under all flow scenarios throughout the Chinook salmon spawning and incubation period.
Chinook	Rearing	None	Modeled DO levels are suitable under all flow scenarios in areas occupied by rearing juvenile Chinook salmon throughout the rearing season
Chinook	Smolt	None	Chinook salmon smolts have emigrated to the ocean prior to the onset of low DO levels in the Upper Russian River.
Coho	Upstream migration	None	Coho salmon do no occupy areas modeled to experience stressful DO levels.
Coho	Spawning and incubation	None	Coho salmon do no occupy areas modeled to experience stressful DO levels.
Coho	Rearing	None	Coho salmon do no occupy areas modeled to experience stressful DO levels.
Coho	Smolt	None	Coho salmon do no occupy areas modeled to experience stressful DO levels.
Steelhead	Upstream migration	None	Modeled DO levels are suitable throughout the upstream migration period.
Steelhead	Spawning and incubation	None	Modeled DO levels are suitable throughout the spawning and incubation period.
Steelhead	Rearing	Potential Impact	Juvenile steelhead rear in the Upper Russian River when DO levels were modeled to be stressful. Potential impacts are discussed below.
Steelhead	Smolt	None	Smolts have immigrated to the ocean prior to the onset of stressful DO levels in the Upper Russian River.
Native warmwater	Rearing	Potential Impact	Native species rearing the Upper Russian River when DO levels were modeled to be stressful. Potential impacts are discussed below.

Impact 4.3-23: Changes in minimum instream flow could substantially affect the upstream migration of Chinook salmon through reduced dissolved oxygen levels in the months October through December in the Russian River and in Dry Creek. (No Impact).

Proposed Project: The modeled mean DO levels during the second half of October in the water released from Lake Mendocino would be 5.1 ppm for the Proposed Project and 7.8 ppm (Table 4.3-162) for Baseline Conditions. Suitability assessment scores during this timeframe for October would be 2.84 under the Proposed Project and 3.64 for Baseline Conditions (Table 4.3-163). The reductions in DO levels begin at Coyote Valley Dam and extends to approximately two miles downstream. After that point, the modeled mean DO levels increase approximately 8.8 under Baseline Conditions and approximately 7.5 ppm for the Proposed Project. The suitability assessment scores also increase to 4.06 for Baseline Conditions and 3.64 under the Proposed Project. The percentage occurrence for stressful DO levels would increase by approximately 29 percent at the Forks under the Proposed Project, however this difference drops to approximately 10 percent 2 miles downstream of CVD (Table 4.3-164). Below this point, DO levels are suitable for upstream migrating Chinook salmon for Baseline Conditions and the Proposed Project. Although the reduced DO levels could affect upstream migrating Chinook salmon, the occurrence would be short-term in nature and this timeframe is prior to when the majority of fish would have accessed the Upper Russian River. This area represents approximately 2 percent of the Russian River and the bulk of the Chinook salmon spawn downstream of this area, thus few fish would have the potential to be affected by the low DO levels that could occur below Coyote Valley Dam. By November, model results show that DO levels increase for both Baseline Conditions and the Proposed Project and would provide adequate conditions for upstream migrating Chinook salmon throughout the river. For the Proposed Project, dissolved oxygen levels in Dry Creek would remain above levels (>8.0 ppm) suitable for upstream migrating Chinooks salmon throughout the migration period (Tables 4.3-162 through 4.3-164). Since Dry Creek DO levels would be suitable for the entire migration period and the reduced DO levels in the Upper Russian River would only occur for a short timeframe and when the majority of fish would not have accessed the two-mile section area, the Proposed Project would not affect the upstream migration of Chinook salmon through reduced dissolved oxygen levels in the months October through December in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 1 Alternative: The Modeled mean daily DO levels during the second half of October in water released from Lake Mendocino would be similar to Baseline Conditions. DO levels range from 7.8 ppm at the Coyote Valley Dam to 8.3 ppm at the Forks (Table 4.3-165). Downstream of the Forks, modeled mean daily DO levels remain above 8.0 ppm. During the remainder of the Chinook salmon upstream migration period, DO levels would be suitable for upstream migrating Chinook salmon (>8.0 ppm) (Table 4.3-166). For Baseline Conditions and the No Project 1 Alternative, modeled stressful DO levels occur approximately 3 percent of the time at Coyote Valley Dam to 0.1 percent of the time two miles downstream (Table 4.3-167. Dissolved Oxygen level in Dry Creek remain above 8.0 ppm throughout the Chinook salmon

upstream migration period. No Project 1 Alternative modeled dissolved oxygen levels would be identical to Baseline Conditions. The No Project 1 Alternative would not affect the upstream migration of Chinook salmon through reduced dissolved oxygen levels in the months October through December in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 2 Alternative: Under the No Project 2 Alternative, a reduction in DO levels would be present during the second half of October in the water released from Coyote Valley Dam with a marked reduction occurring within the first two miles and would begin to improve and recover approximately after four miles. However, for the remainder of the Chinook salmon upstream migration period, modeled DO levels would be similar to Baseline Conditions. The driving force behind this occurrence appears to be the timing of when Lake Mendocino "turns over," that is, the temperature related density barrier between the upper and lower layers breaks down and the reservoir's warm upper layer and the cold bottom layer mix. Based on model results, Lake Mendocino turns over earlier for Baseline Conditions. Dissolved oxygen levels in the release from Lake Mendocino reach a seasonal minimum during August and September, and begin to rebound in October. For the No Project 2 Alternative, Lake Mendocino turns over in October and thereafter DO levels improve rapidly (average DO levels in the first two weeks of October are 2.9 ppm compared to 6.5 ppm averaged over the last two weeks of October) (Table 4.3-168). Suitability assessment scores at the Forks modeled 3.81 for Baseline Conditions and 3.29 under the No Project 2 Alternative (Table 4.3-169). The reduction occurs at least a couple of miles downstream of Coyote Valley Dam. Two miles downstream of Coyote Valley Dam, monthly mean DO levels during the last two weeks of October are optimal and are 8.8 ppm for Baseline Conditions and 7.4 ppm under the No Project 2 Alternative. Suitability assessment scores also increase to 4.06 for Baseline Conditions and to 3.82 under the No Project 2 Alternative. The occurrence of stressful DO levels increase by approximately 13.5 percent at the Forks, however 2 miles downstream of Coyote Valley Dam the DO levels recover and this difference drops to approximately 6.3 percent (Table 4.3-170). Below this point, DO levels would be similar to Baseline Conditions and stressful conditions occur less than 1 percent of the time. Although the reduced DO levels could affect upstream migrating Chinook salmon, the occurrence would be short-term in nature and this timeframe is prior to when the majority of fish would have accessed the Upper Russian River. This area represents approximately 2 percent of the Russian River and the bulk of the Chinook salmon spawn downstream of this area, thus few fish would have the potential to be affected by the low DO levels that could occur below Coyote Valley Dam. By November, model results show that DO levels would increase for both Baseline Conditions and the No Project 2 Alternative and would provide adequate conditions for upstream migrating Chinook salmon throughout the river. For the No Project 2 Alternative, dissolved oxygen levels in Dry Creek would remain above levels (>8.0 ppm) suitable for upstream migrating Chinooks salmon throughout the migration period (Tables 4.3-168 through 4.3-170). Since Dry Creek DO levels would be suitable for the entire migration period and the reduced DO levels in the Upper Russian River would only occur for a short timeframe and when the majority of fish would not have accessed the two-mile section area, the No Project 2 Alternative would not affect the upstream migration of Chinook salmon through reduced

dissolved oxygen levels in the months October through December in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-162. Monthly mean Dissolved oxygen levels modeled to occur in the Russian River and Dry Creek, during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the Proposed Project (PP).

		October 16-31		November		December	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	CVD	7.8	5.1	9.2	8.5	10.6	10.6
	Forks	8.3	6.2	9.7	9.2	10.8	10.8
	2 mile[1]	8.8	7.5	9.9	9.6	11.0	11.0
	4 mile	9.1	8.4	10.1	9.9	11.1	11.1
	Hopland	9.5	9.5	10.4	10.3	11.4	11.3
	Cloverdale	9.4	9.5	10.4	10.3	11.3	11.2
	Geyserville	9.4	9.5	10.3	10.3	11.3	11.3
	Healdsburg	9.4	9.4	10.3	10.3	11.3	11.3
Lower Russian River	Below Dry Creek	9.7	9.7	10.3	10.3	11.2	11.2
	Hacienda	9.8	9.9	10.5	10.5	11.2	11.2
Dry Creek	Upper	9.7	9.7	9.8	9.8	10.6	10.6
	Lower	10.2	10.1	10.3	10.3	10.9	10.9

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-163. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the Chinook salmon upstream migration period (mid-October through December) under Baseline Conditions (BC) and the Proposed Project (PP).

		October 16 - 31		November		December	
Reach	**Location**	**BC**	**PP**	**BC**	**PP**	**BC**	**PP**
Upper Russian River	CVD	3.64	2.28	4.17	3.98	4.52	4.44
	Forks	3.81	2.88	4.29	4.17	4.58	4.53
	2 mile[1]	4.06	3.64	4.36	4.28	4.64	4.59
	4 mile	4.07	3.94	4.40	4.36	4.67	4.63
	Hopland	4.26	4.24	4.47	4.45	4.47	4.45
	Cloverdale	4.26	4.26	4.46	4.45	4.70	4.69
	Geyserville	4.22	4.24	4.45	4.45	4.72	4.71
	Healdsburg	4.21	4.22	4.44	4.44	4.71	4.70
Lower Russian River	Below Dry Creek	4.31	4.32	4.46	4.46	4.68	4.68
	Hacienda	4.32	4.33	4.50	4.50	4.70	4.69
Dry Creek	Upper	4.29	4.28	4.31	4.31	4.52	4.52
	Lower	4.44	4.44	4.49	4.49	4.61	4.61

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-164. Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to upstream migrating Chinook salmon in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

October 16 - 31										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	3.13	15.55	2.46	11.53	4.78	25.03	10.37	52.43	41.16
	Forks	2.64	12.47	4.73	15.56	0.00	8.48	7.37	36.51	29.14
	2 miles	0.14	8.80	0.00	1.41	0.00	0.00	0.14	10.21	10.21
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.27	0.27
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-164. Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to upstream migrating Chinook salmon in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-165. Monthly mean dissolved oxygen levels modeled to occur in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		October 16 - 31		November		December	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	CVD	7.8	7.8	9.2	9.2	10.6	10.6
	Forks	8.3	8.3	9.7	9.7	10.8	10.8
	2 mile[1]	8.8	8.8	9.9	9.9	11.0	11.0
	4 mile	9.1	9.1	10.1	10.1	11.1	11.1
	6 mile	9.2	9.2	10.2	10.2	11.2	11.2
	Hopland	9.5	9.5	10.4	10.4	11.4	11.4
	Cloverdale	9.5	9.5	10.4	10.4	11.3	11.3
	Geyserville	9.4	9.4	10.3	10.3	11.3	11.3
	Healdsburg	9.4	9.4	10.3	10.3	11.3	11.3
Lower Russian River	Below Dry Creek	9.7	9.7	10.3	10.3	11.2	11.2
	Hacienda	9.8	9.8	10.5	10.5	11.2	11.2
Dry Creek	Upper	9.7	9.7	9.8	9.8	10.6	10.6
	Lower	10.2	10.2	10.3	10.3	10.9	10.9

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-166. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the Chinook salmon upstream migration period (mid-October through December) under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		October 16 - 31		November		December	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper River	CVD	3.64	3.64	4.17	4.17	4.52	4.52
	Forks	3.81	3.81	4.29	4.29	4.58	4.58
	2 mile[1]	4.06	4.06	4.36	4.36	4.64	4.64
	4 mile	4.07	4.07	4.40	4.40	4.67	4.67
	Hopland	4.26	4.26	4.46	4.46	4.70	4.70
	Cloverdale	4.26	4.26	4.45	4.45	4.72	4.72
	Geyserville	4.22	4.22	4.44	4.44	4.71	4.71
	Healdsburg	4.21	4.21	4.46	4.46	4.68	4.68
	Below Dry Creek	4.31	4.31	4.50	4.50	4.70	4.69
Lower River	Hacienda	4.32	4.33	4.31	4.31	4.52	4.52
	Upper	4.29	4.28	4.49	4.49	4.61	4.61
Dry Creek	Lower	4.44	4.44	4.49	4.49	4.61	4.61

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-167. Frequency of occurrence of stressful dissolved oxygen conditions modeled to occur in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

October 16 - 31										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	3.13	3.14	2.46	2.46	4.78	4.78	10.37	10.38	0.01
	Forks	2.64	2.64	4.73	4.73	0.00	0.00	7.37	7.37	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River (“Forks”).

Table 4.3-167. Frequency of occurrence of stressful dissolved oxygen conditions modeled to occur in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River (“Forks”).

Table 4.3-168. Monthly mean dissolved oxygen levels modeled to in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		October 16-31		November		December	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	CVD	7.8	6.5	9.2	8.8	10.6	10.4
	Forks	8.3	7.2	9.7	9.4	10.8	10.7
	2 mile[1]	8.8	8.0	9.9	9.7	11.0	10.9
	4 mile	9.1	8.7	10.1	10.0	11.1	11.1
	Hopland	9.5	9.4	10.4	10.3	11.4	11.3
	Cloverdale	9.4	9.5	10.4	10.3	11.3	11.2
	Geyserville	9.4	9.4	10.3	10.3	11.3	11.3
	Healdsburg	9.4	9.4	10.3	10.3	11.3	11.3
Lower Russian River	Below Dry Creek	9.7	9.7	10.3	10.3	11.2	11.2
	Hacienda	9.8	9.8	10.5	10.5	11.2	11.2
Dry Creek	Upper	9.7	9.7	9.8	9.8	10.6	10.6
	Lower	10.2	10.2	10.3	10.3	10.9	10.9

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-169. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the Chinook salmon upstream migration period (mid-October through December) under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		October 16 - 31		November		December	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	CVD	3.64	3.01	4.17	4.17	4.52	4.52
	Forks	3.81	3.29	4.29	4.22	4.58	4.55
	2 mile[1]	4.06	3.82	4.36	4.31	4.64	4.61
	4 mile	4.07	3.97	4.40	4.37	4.67	4.64
	Hopland	4.26	4.24	4.47	4.45	4.72	4.70
	Cloverdale	4.26	4.25	4.46	4.45	4.70	4.69
	Geyserville	4.22	4.22	4.45	4.45	4.72	4.71
	Healdsburg	4.21	4.22	4.44	4.44	4.71	4.71
Lower Russian River	Below Dry Creek	4.31	4.29	4.46	4.46	4.68	4.68
	Hacienda	4.32	4.33	4.50	4.50	4.70	4.69
Dry Creek	Upper	4.29	4.29	4.31	4.31	4.52	4.52
	Lower	4.44	4.45	4.49	4.49	4.61	4.61

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-170. Frequency of occurrence of stressful dissolved oxygen conditions modeled to occur in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

October 16 - 31										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	3.13	8.27	2.46	6.23	4.78	14.02	10.36	28.52	18.16
	Forks	2.64	6.60	4.73	8.83	0.00	5.63	7.30	21.06	13.68
	2 miles[1]	0.14	5.90	0.00	0.49	0.00	0.00	0.14	6.39	6.25
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-170 (continued). Frequency of occurrence of stressful dissolved oxygen conditions modeled to occur in the Russian River and Dry Creek during the Chinook salmon upstream migration period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

December										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Geyserville	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Healdsburg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Russian River	Below DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hacienda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks")

Impact 4.3-24: Changes in minimum instream flow could substantially affect the habitat for rearing juvenile steelhead through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek. No Impact.

Proposed Project: The modeled monthly mean DO levels in the water released from Coyote Valley Dam would be similar to Baseline Conditions April through June with an increase during July and August, (Table 4.3-171), however DO levels would begin to decline in October, but recover slightly during November compared to Baseline Conditions. Modeled dissolved oxygen levels 4 miles downstream of Coyote Valley Dam to Cloverdale would be above 8.0 ppm for the Proposed Project and Baseline Conditions, thus suitability assessment scores would improve similarly (Table 4.3-172), and stressful levels would not occur within this reach of the river. However, in the upper 2+ miles, DO levels would range from stressful to potentially lethal levels from August through October for the Proposed Project and Baseline Conditions (Table 4.3-173). The Proposed Project would have the same minimum monthly mean DO level (1.9 ppm) as Baseline Conditions, but the minimums would occur one month apart for the Proposed Project. Two miles downstream of Lake Mendocino, DO levels would increase to approximately 6.6 ppm, which is a slight improvement compared to Baseline Conditions of 6.2 ppm. The modeled occurrence of stressful DO levels two miles downstream of the dam during August and September would be approximately 22 to 30 percent lower under the Proposed Project, compared to Baseline Conditions. During October, the modeled occurrence of stressful conditions would increase by <5 percent. The reduced DO levels in this timeframe would occur in the two-mile section of the Upper Russian River for the Proposed Project and Baseline Conditions. In Dry Creek DO is favorable for salmonids under Baseline Conditions and under the Proposed Project. In Dry Creek DO levels, DO assessment scores and the frequency of stressful DO conditions are similar under Baseline conditions and under the Proposed Project (Tables 4.3-171 through 4.3-173). The Proposed Project would not affect the habitat for rearing juvenile steelhead through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 1 Alternative: The modeled monthly mean DO levels in the water released from Coyote Valley Dam would be the same as Baseline Conditions. Model results show that low DO levels occur in releases at Lake Mendocino and begin in July and continue through October (Table 4.3-174). However, low DO levels would be restricted to the first 2+ miles downstream of Coyote Valley Dam, and by mile 4, DO levels would recover to approximately 8.0 ppm. For the No Project 1 Alternative, modeled monthly mean DO levels would increase from 1.9 ppm in August, to 7.8 ppm 4 miles downstream. Although stressful condition would occur approximately 30 percent of the time during August and September at Mile 2, this occurs under Baseline Conditions (Table 4.3-175 and 4.3-176). In Dry Creek DO is favorable for salmonids under Baseline Conditions and under the No Project 1 Alternative. In Dry Creek DO levels, DO assessment scores and the frequency of stressful DO conditions are similar under Baseline conditions and under the No Project 1 Alternative (Tables 4.3-174 through 4.3-176). There would be no change from Baseline Conditions as a result of the No Project 1 Alternative to the

habitat for rearing juvenile steelhead through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek and therefore, no impacts would occur.

No Project 2 Alternative: The modeled monthly mean DO levels in the first two miles downstream of the water released from Coyote Valley Dam would be slightly higher under the No Project 2 Alternative during July and August, and slightly lower in September and October, compared to Baseline Conditions. Approximately 4 miles downstream, modeled DO levels would be similar and remain above 8.0 ppm for the No Project 2 Alternative compared to Baseline Conditions. Model result show that stressful levels would not occur within this reach of the river (Tables 4.3-177). However, in the upper 2+ miles, DO levels would range from stressful to potentially lethal levels from August through October for the No Project 2 Alternative and during Baseline Conditions (Table 4.3-177). Both Baseline Conditions and the No Project 2 Alternative modeled to have the same minimum monthly mean DO level (1.9 ppm), but the minimums were modeled to occur one month apart for the No Project 2 Alternative. Two miles downstream of Lake Mendocino, modeled DO levels increase to approximately 6.2 ppm for Baseline Conditions and the No Project 2 Alternative, and suitability assessment scores improved similarly (Table 4.3-178). The occurrence of stressful DO levels two miles downstream of the dam would be approximately 22 to 30 percent lower from August through September under the No Project 2 Alternative, compared to Baseline Conditions. During October, the occurrence of stressful conditions in the two-mile section of the Upper Russian River would increase by <2 percent for the No Project 2 Alternative and occurs under Baseline Conditions (Table 4.3-179). In Dry Creek DO is favorable for salmonids under Baseline Conditions and under the No Project 2 Alternative. In Dry Creek DO levels, DO assessment scores and the frequency of stressful DO conditions are similar under Baseline conditions and under the No Project 2 Alternative (Tables 4.3-177 through 4.3-179). The slight change in the minimum DO levels modeled to occur one month apart from Baseline Conditions would not be a substantial affect to the habitat for rearing juvenile steelhead through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek and therefore, no impacts would occur.

Table 4.3-171. Monthly mean dissolved oxygen levels modeled to occur in the Russian River and Dry Creek during the juvenile steelhead rearing period under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	April		May		June		July		August		September		October		November	
		BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	CVD	8.9	8.7	8.0	7.5	6.7	6.5	4.0	5.2	1.9	3.2	2.4	1.9	6.6	3.4	9.2	8.5
	Forks	9.6	9.6	8.9	8.8	7.8	7.9	5.6	6.8	3.7	5.1	4.1	4.1	7.4	5.2	9.7	9.2
	2 mile[1]	9.9	9.9	9.6	9.6	9.0	9.2	7.5	8.5	6.2	7.3	6.2	6.6	8.2	7.0	9.9	9.6
	4 mile	10.1	10.0	10.0	9.9	9.8	9.9	8.8	8.9	7.8	8.9	7.7	8.3	8.8	8.3	10.1	9.9
	Hopland	10.3	10.1	10.2	9.9	10.2	10.1	9.9	10.1	9.5	10	9.2	9.9	9.4	9.6	10.4	10.3
	Cloverdale	10.0	9.9	9.9	9.6	9.9	9.7	9.7	9.7	9.4	9.7	9.1	9.7	9.4	9.6	10.4	10.3
Dry Creek	Upper	10.5	10.5	10.4	10.4	10.4	10.4	10.2	10.2	10.1	10.1	9.9	9.9	9.8	9.8	9.8	9.8
	Lower	10.4	10.4	10.2	10.2	10.2	10.1	10.1	10.1	10.0	10.1	10.1	10.2	10.2	10.2	10.3	10.3

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-172. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the juvenile steelhead rearing period under Baseline Conditions (BC) and the Proposed Project (PP).

Reach	Location	April		May		June		July		August		September		October		November	
		BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP	BC	PP
Upper Russian River	CVD	4.11	4.05	3.85	3.69	3.42	3.37	1.62	2.73	0.26	0.90	0.49	0.11	3.04	1.21	4.17	3.98
	Forks	4.27	4.26	4.08	4.08	3.82	3.85	2.54	3.47	0.70	2.33	1.04	1.13	3.31	2.07	4.29	4.17
	2 mile	4.36	4.33	4.26	4.25	4.14	4.18	3.69	3.98	3.26	3.64	3.27	3.38	3.89	3.50	4.36	4.28
	4 mile	4.42	4.38	4.39	4.37	4.29	4.35	4.07	4.25	3.81	4.11	3.76	3.96	4.17	3.96	4.40	4.36
	Hopland	4.45	4.40	4.43	4.36	4.43	4.40	4.35	4.41	4.27	4.39	4.16	4.35	4.23	4.28	4.47	4.45
	Cloverdale	4.38	4.34	4.35	4.28	4.36	4.30	4.28	4.28	4.22	4.29	4.14	4.30	4.23	4.28	4.46	4.45
	Geyserville	4.35	4.33	4.26	4.24	4.24	4.19	4.15	4.12	4.11	4.11	4.11	4.16	4.19	4.23	4.45	4.45
	Healdsburg	4.31	4.30	4.20	4.17	4.12	4.07	3.99	3.95	3.98	3.95	4.04	4.07	4.18	4.18	4.44	4.44
Lower River	RR_DC	4.34	4.34	4.26	4.26	4.24	4.21	4.17	4.18	4.15	4.17	4.17	4.23	4.28	4.31	4.46	4.46
	Hacienda	4.32	4.32	4.25	4.26	4.25	4.31	4.17	4.29	4.13	4.18	4.16	4.19	4.29	4.29	4.50	4.50
Dry Creek	Upper	4.49	4.49	4.47	4.47	4.47	4.47	4.45	4.45	4.42	4.42	4.36	4.36	4.30	4.30	4.31	4.31
	Lower	4.49	4.49	4.45	4.44	4.43	4.41	4.42	4.42	4.40	4.41	4.40	4.41	4.42	4.42	4.49	4.49

Table 4.3-173. Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-173 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	8.08	8.30	1.95	0.06	0.02	0.00	10.05	8.36	-1.68
	Forks	0.79	0.00	0.00	0.00	0.00	0.00	0.79	0.00	-0.79
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	24.14	59.00	20.04	12.92	33.30	1.22	77.48	73.14	-4.34
	Forks	19.39	5.69	30.09	.26	0.00	0.00	49.48	5.95	-43.53
	2 miles	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	-0.03
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-173 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	6.11	20.04	7.12	35.79	85.91	44.06	99.14	99.89	0.75
	Forks	7.26	28.81	83.26	35.42	1.76	0.00	92.28	64.23	-28.05
	2 miles[1]	30.64	0.00	0.00	0.00	0.00	0.00	30.64	0.00	-30.64
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	6.20	0.57	12.50	12.50	74.77	86.57	93.47	100.00	6.53
	Forks	12.68	15.69	75.08	80.32	0.01	0.00	87.77	96.01	8.24
	2 miles	29.24	0.00	0.00	0.00	0.00	0.00	29.24	0.00	-29.24
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-173 (cont.). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to rearing juvenile steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the Proposed Project (PP).

October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	6.47	8.28	4.43	6.84	16.43	60.31	27.33	75.43	48.10
	Forks	4.92	10.36	15.75	49.01	0.00	6.67	20.68	66.04	45.36
	2 miles[1]	2.21	7.02	0.00	0.70	0.00	0.00	2.21	7.73	5.52
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	PP	BC	PP	BC	PP	BC	PP	
Upper Russian River	CVD	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-174. Monthly mean dissolved oxygen levels modeled to occur in the Russian River and Dry Creek, during the juvenile steelhead rearing period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	CVD	8.9	8.9	8.0	8.0	6.7	6.7	4.0	4.0	1.9	1.9	2.4	2.4	6.6	6.6	9.2	9.2
	Forks	9.6	9.6	8.9	8.9	7.8	7.8	5.6	5.6	3.7	3.7	4.1	4.1	7.4	7.4	9.7	9.7
	2 miles	9.9	9.9	9.6	9.6	9.0	9.0	7.5	7.5	6.2	6.2	6.2	6.2	8.2	8.2	9.9	9.9
	4 miles	10.1	10.1	10.0	10.0	9.8	9.8	8.8	8.8	7.8	7.8	7.7	7.7	8.8	8.8	10.1	10.1
	Hopland	10.3	10.3	10.2	10.2	10.2	10.2	9.9	9.9	9.5	9.5	9.2	9.2	9.4	9.4	10.4	10.4
	Cloverdale	10.0	10.0	9.9	9.9	9.9	9.9	9.7	9.7	9.4	9.4	9.1	9.1	9.4	9.4	10.4	10.4
Lower Russian River	Below Dry Creek	9.9	9.9	9.5	9.5	9.4	9.5	9.2	9.2	9.1	9.2	9.3	9.4	9.6	9.6	10.3	10.3
	Hacienda	9.8	9.8	9.5	9.5	9.5	.6	9.2	9.3	9.0	9.1	9.2	9.3	9.7	9.7	10.5	10.5
Dry Creek	Upper	10.5	10.5	10.4	10.4	10.4	10.4	10.2	10.2	10.1	10.1	9.9	9.9	9.8	9.7	9.8	9.8
	Lower	10.4	10.4	10.2	10.2	10.2	10.2	10.1	10.2	10.0	10.1	10.1	10.2	10.2	10.2	10.3	10.3

Table 4.3- 175. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the juvenile steelhead rearing period under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**	**BC**	**NP1**
Upper Russian River	CVD	4.11	4.11	3.85	3.85	3.42	3.42	1.62	1.62	0.26	0.26	0.49	0.49	3.04	3.04	4.17	4.17
	Forks	4.27	4.27	4.08	4.09	3.82	3.82	2.54	2.54	0.70	0.70	1.04	1.04	3.31	3.31	4.29	4.29
	2 mile	4.36	4.36	4.26	4.26	4.14	4.14	3.69	3.69	3.26	3.26	3.27	3.27	3.89	3.89	4.36	4.36
	4 mile	4.42	4.42	4.39	4.39	4.29	4.29	4.07	4.07	3.81	3.81	3.76	3.76	4.17	4.17	4.40	4.40
	Hopland	4.45	4.45	4.43	4.43	4.43	4.43	4.35	4.35	4.27	4.27	4.16	4.16	4.23	4.23	4.46	4.46
	Cloverdale	4.38	4.38	4.35	4.35	4.36	4.36	4.28	4.28	4.22	4.22	4.14	4.14	4.23	4.23	4.45	4.45
Dry Creek	Upper	4.49	4.49	4.47	4.47	4.47	4.47	4.45	4.45	4.42	4.42	4.36	4.36	4.30	4.29	4.49	4.49
	Lower	4.49	4.49	4.45	4.45	4.43	4.44	4.42	4.43	4.40	4.42	4.40	4.40	4.42	4.43	4.49	4.49

Table 4.3-176. Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

March										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-176 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	8.08	8.08	1.95	1.96	0.02	0.02	10.05	10.06	0.02
	Forks	0.79	0.78	0.00	0.00	0.00	0.00	0.79	0.78	-0.01
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-176 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	24.14	24.13	20.04	20.06	33.30	33.30	77.48	77.50	0.02
	Forks	19.39	19.41	30.09	30.10	0.00	0.00	49.48	49.51	0.02
	2 miles[1]	0.03	0.03	0.00	0.00	0.00	0.00	0.03	0.03	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	6.11	6.11	7.12	7.09	85.91	85.93	99.14	99.14	0.00
	Forks	7.26	7.25	83.26	83.27	1.76	1.76	92.28	92.28	0.00
	2 miles[1]	30.64	30.63	0.00	0.00	0.00	0.00	30.64	30.63	-0.01
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-176 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	6.20	6.21	12.50	12.48	74.77	74.79	93.47	93.47	0.00
	Forks	12.68	12.70	75.08	75.07	0.01	0.01	87.77	87.78	0.02
	2 miles[1]		29.27	0.00	0.00	0.00	0.00	29.24	29.27	0.03
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	6.47	6.51	4.43	4.43	16.43	16.42	27.33	27.36	0.04
	Forks	4.92	4.92	15.75	15.75	0.00	0.00	20.68	20.67	-0.01
	2 miles	2.21	2.20	0.00	0.00	0.00	0.00	2.21	2.20	-0.01
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-176 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to rearing juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 1 Alternative (NP1).

November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP1	BC	NP1	BC	NP1	BC	NP1	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-177. Monthly mean dissolved oxygen levels modeled to occur in the Russian River and Dry Creek, during the juvenile steelhead rearing period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

Reach	Location	April		May		June		July		August		September		October		November	
		BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2	BC	NP2
Upper Russian River	CVD	8.9	8.9	8.0	7.7	6.7	6.6	4.0	4.8	1.9	2.6	2.4	1.9	6.6	4.7	9.2	8.8
	Forks	9.6	9.6	8.9	8.9	7.8	7.9	5.6	6.3	3.7	4.5	4.1	3.9	7.4	5.8	9.7	9.4
	2 mile[1]	9.9	9.9	9.6	9.6	9.0	9.1	7.5	8.1	6.2	6.8	6.2	6.3	8.2	7.4	9.9	9.7
	4 mile	10.1	10.1	10.0	10.0	9.8	9.9	8.8	9.3	7.8	8.4	7.7	8.0	8.8	8.4	10.1	10.0
	Hopland	10.3	10.2	10.2	10.0	10.2	10.1	9.9	10.0	9.5	9.8	9.2	9.6	9.4	9.5	10.4	10.3
	Cloverdale	10.0	10.0	9.9	9.7	9.9	9.8	9.7	9.7	9.4	9.6	9.1	9.4	9.4	9.5	10.4	10.3
Dry Creek	Upper	10.5	10.5	10.4	10.4	10.4	10.4	10.2	10.2	10.1	10.1	9.9	9.9	9.8	9.8	9.8	9.8
	Lower	10.4	10.4	10.2	10.2	10.2	10.2	10.1	10.1	10.0	10.1	10.1	10.2	10.2	10.2	10.3	10.3

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-178. Suitability scores comparing dissolved oxygen suitability in the Russian River and Dry Creek during the juvenile steelhead rearing period under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

		April		May		June		July		August		September		October		November	
Reach	**Location**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**	**BC**	**NP2**
Upper Russian River	CVD	4.11	4.11	3.85	3.85	3.42	3.42	1.62	1.62	0.26	0.26	0.49	0.49	3.04	3.04	4.17	4.17
	Forks	4.27	4.26	4.08	4.09	3.82	3.85	2.54	3.18	0.70	1.51	1.04	0.78	3.31	2.48	4.29	4.22
	2 mile	4.36	4.36	4.26	4.25	4.14	4.17	3.69	3.87	3.26	3.48	3.27	3.31	3.89	3.64	4.36	4.31
	4 mile	4.42	4.41	4.39	4.38	4.29	4.33	4.07	4.19	3.81	3.99	3.76	3.86	4.17	4.03	4.40	4.37
	Hopland	4.45	4.44	4.43	4.38	4.43	4.42	4.35	4.39	4.27	4.34	4.16	4.29	4.23	4.26	4.47	4.45
	Cloverdale	4.38	4.38	4.35	4.30	4.36	4.33	4.28	4.28	4.22	4.27	4.14	4.24	4.23	4.25	4.46	4.45
	Geyserville	4.35	4.35	4.26	4.25	4.24	4.21	4.15	4.13	4.11	4.11	4.11	4.14	4.19	4.21	4.45	4.45
	Healdsburg	4.31	4.31	4.20	4.18	4.12	4.09	3.99	3.97	3.98	3.97	4.04	4.06	4.18	4.18	4.44	4.44
Lower River	Below Dry Creek	4.34	4.34	4.26	4.26	4.24	4.22	4.17	4.17	4.15	4.15	4.17	4.19	4.28	4.29	4.46	4.46
	Hacienda	4.32	4.32	4.25	4.26	4.25	4.29	4.17	4.23	4.13	4.15	4.16	4.17	4.29	4.29	4.50	4.50
Dry Creek	Upper	4.49	4.49	4.47	4.47	4.47	4.47	4.45	4.45	4.42	4.42	4.36	4.36	4.30	4.30	4.31	4.31
	Lower	4.49	4.49	4.45	4.45	4.43	4.43	4.42	4.42	4.40	4.41	4.40	4.40	4.42	4.42	4.49	4.49

Table 4.3-179. Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

April										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3-179 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

June										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	8.08	5.84	1.95	0.67	0.02	0.04	10.05	6.55	-3.49
	Forks	0.79	0.17	0.00	0.00	0.00	0.00	0.79	0.17	-0.62
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	24.14	40.37	20.04	18.12	33.30	13.74	77.48	72.24	-5.23
	Forks	19.39	15.24	30.09	9.98	0.00	0.00	49.48	25.22	-24.26
	2 miles	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	-0.03
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-179 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

August										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	6.11	15.31	7.12	18.78	85.91	65.64	99.14	99.73	0.60
	Forks	7.26	16.04	83.26	61.93	1.76	0.00	92.28	77.98	-14.30
	2 miles[1]	30.64	0.68	0.00	0.00	0.00	0.00	30.64	0.68	-29.96
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	6.20	1.55	12.50	9.50	74.77	87.69	93.47	98.75	5.28
	Forks	12.68	10.42	75.08	84.65	0.01	0.00	87.77	95.07	7.31
	2 miles	29.24	7.21	0.00	0.00	0.00	0.00	29.24	7.21	-22.03
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Table 4.3-179 (continued). Frequency of occurrence of dissolved oxygen levels modeled to exceed criteria deemed stressful to juvenile steelhead rearing in the Russian River and Dry Creek under Baseline Conditions (BC) and the No Project 2 Alternative (NP2).

October										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	6.47	7.44	4.43	6.75	16.43	41.09	27.33	55.28	27.95
	Forks	4.92	7.88	15.75	35.88	0.00	3.76	20.68	47.52	26.84
	2 miles	2.21	3.99	0.00	0.00	0.00	0.00	2.21	3.99	1.79
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November										
		Tolerance		Resistance		Lethal		Total		% Change
Reach	Location	BC	NP2	BC	NP2	BC	NP2	BC	NP2	
Upper Russian River	CVD	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 miles[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4 miles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hopland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cloverdale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dry Creek	Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[1]Miles downstream from the confluence with the East and West Forks of the Russian River ("Forks").

Impact 4.3-25: Changes in minimum instream flow could substantially affect the habitat for native warmwater species through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek. (No Impact).

Although the Russian River Biological Opinion focuses on the management of juvenile steelhead in the Russian River above Cloverdale, rearing by native warmwater fish would continue to occur in the Upper Russian River downstream from Coyote Valley Dam. Although low numbers of warmwater fish inhabit Dry Creek, the year-around release of coldwater inhibit the development of large populations of these species. The mainly cool water releases from Lake Mendocino also impinge on the development of a warmwater fish community in the Upper Russian River, but to a lesser degree compared to Dry Creek. Fish inhabiting the Upper Russian River in the first two miles downstream from Coyote Valley Dam would be subject to fluctuating DO levels as described for upstream migrating Chinook salmon and rearing juvenile steelhead impact analysis section. As described in the Setting section, warmwater adapted fish can tolerate lower DO levels compared to salmonids. Dissolved oxygen levels above 6 ppm are generally optimal, and stressful conditions do not begin until DO levels drop below 4 ppm. Based on the water quality model results, DO levels generally exceed 4.0 ppm (suitable levels) within two miles of Coyote Valley Dam. Therefore, the impact analysis is limited to the first two miles of the Russian River downstream from Coyote Valley Dam.

The modeled monthly mean DO levels for the Proposed Project and the No Project alternatives are similar to Baseline Conditions (Figure 4.3-20). Although the timing that DO reaches its lowest point varies by approximately one month (as discussed in the rearing juvenile steelhead and upstream migrating Chinook salmon) from Baseline Conditions, the overall effects to native warmwater fish is similar. Although DO levels approach lethal levels at the outlet to Coyote Valley Dam, DO levels recover and approach 4.0 ppm (suitable) near the Forks. Based on the modeled DO levels, and the similarities in the average daily DO modeled that would occur for the Proposed Project and the No Project alternatives compared to Baseline Conditions, there would be no affects to the habitat for native warmwater species through reduced dissolved oxygen levels in the months April through November in the Russian River and in Dry Creek and therefore, no impacts would occur.

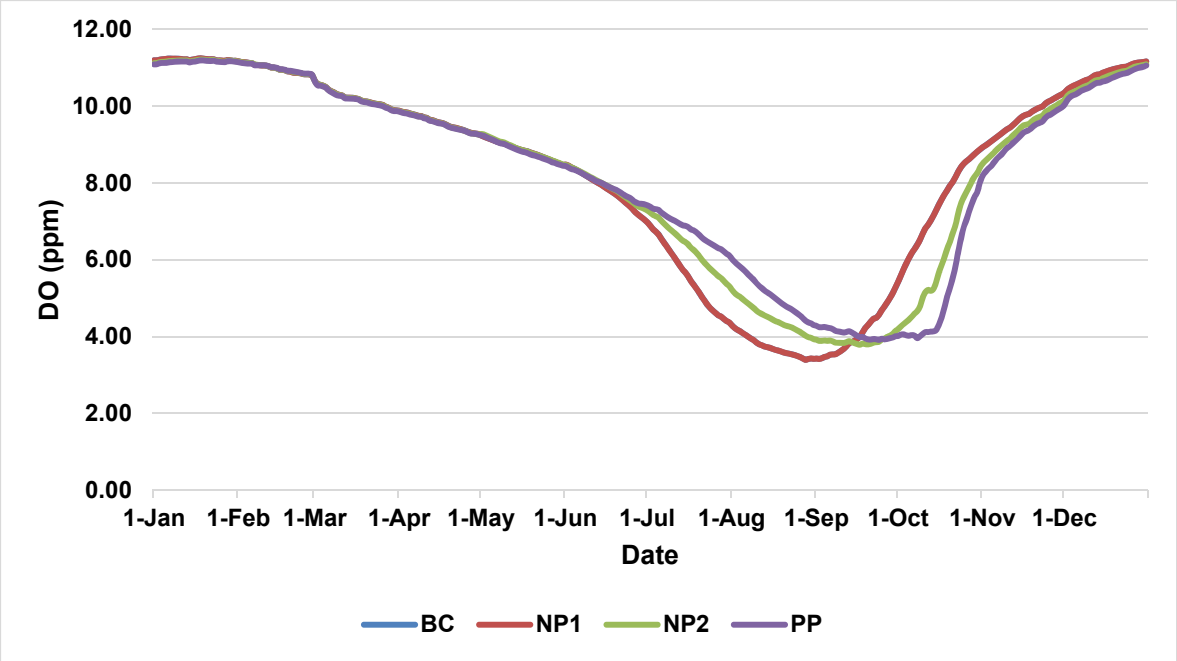


Figure 4.3-20. Average daily dissolved oxygen levels modeled to occur at the Forks for Baseline Conditions (BC), the No Project 1 Alternative (NP1), the No Project 2 Alternative (NP2), and the Proposed Project (PP). Note that the DO levels are identical under both BC and the No Project 1 Alternative.

Impact 4.3-26: Changes in minimum instream flow could substantially affect quantity and quality of habitat for resident, rare or endangered species in the Upper Russian River under 1977 Drought Conditions. (No Impact).

The drought of 1977 is the most critical year in terms of water supply/flow in the Russian River. Although the calendar year of 2013 was drier than 1977, the previous year's leading into 1977 and 2013 were vastly different in terms of water supply. 1976 was also a dry year, thus water supply levels were already stressed leading into 1977. In comparison, over 12 inches of rain fell in Sonoma County in the December of 2012, thus water supply was much better starting off the 2013 drought.

The 1977 Drought presents unique challenge to analyzing how changes in flow impact water quality constitutes such as temperature and DO. Based on model results, under Baseline Conditions as well as the No Project 1 and 2 Alternatives, water surface elevations in Lake Mendocino would fall below the outlet structure, preventing the release of water from the reservoir during 1977. Although there would be residual pools remaining in the Russian River below Lake Mendocino under Baseline Condition and the No Project 1 and 2 alternatives, the water quality model was unable to estimate temperatures and DO levels under the no flow condition. However, under the Proposed Project, sufficient storage would remain to allow for releases throughout 1977. Water quality conditions under 1977 water supply conditions would indicate that the Proposed Project would have a negative impact on salmonids in the Upper Russian River, while the lack of results for the other three flow scenarios would not be recorded as an impact (that is, the model cannot estimate temperature and DO when flow is zero, thus

there would be no results to report). In order to present an accurate comparison between the different projects scenarios, water quality results from 1977 were removed, but only during the period that Lake Mendocino was modeled "to go dry" (a misnomer since a residual pool would remain behind the dam, providing some habitat for aquatic, lake dwelling species). Results from 1977 were included in the analysis discussed above for all times that water was modeled to be released from Lake Mendocino.

Proposed Project: The reduced flows modeled under the Proposed Project would maintain adequate storage in the Lake Mendocino so that it does not go "dry" under 1977 drought like conditions. Water temperature and DO levels would likely result in a severe reduction in habitat quality of rearing habitat for upstream migrating Chinook salmon and rearing juvenile steelhead under a 1977 drought scenario. However, the Proposed Project would provide some improvement to water supply and would not cause a substantial effect to the quantity and quality of habitat for resident, rare or endangered species in the Upper Russian River under 1977 drought conditions over Baseline Conditions and therefore, no impact.

No Project 1 and No Project 2 Alternatives: For the No Project 1 Alternative, the water surface elevation in Lake Mendocino would fall below the reservoir outlet structure on July 21, and continuing through November 20 when a large storm restored flow to the river. Under the No Project 2 Alternative, the water surface elevation in the reservoir would drop below the outlet structure on November 7. For Baseline Conditions, the modeled fluctuations are similar. The No Project alternatives would not cause an increase in substantial effects to the quantity and quality of habitat for resident, rare or endangered species in the Upper Russian River under 1977 drought conditions over Baseline Conditions and therefore, no impact

Impacts to Fish in Lake Sonoma and Lake Mendocino

Impact 4.3-27: Changes in minimum instream flow could substantially affect the habitat for spawning sunfish through increased reservoir releases at Lake Mendocino. (Beneficial).

As discussed in the setting section, sunfish are spring spawners. Sunfish spawn primarily in relatively shallow water (approximately 0.5 to 6.0 feet, depending on species). Embryo development is controlled by water temperature, and may take up to 21 days from egg deposition to the point where the resultant young fish are able to actively swim. During the spring, water surface elevation within a reservoir will rise or fall depending on the amount of inflow or outflow (releases from the reservoir). The rate at which the water surface is drawn down may impact sunfish spawning success if the nest become dewatered prior to the eggs hatching and the young fish developing to the point where they are able to actively swim.

Proposed Project: Under the Proposed Project, the number of years with no change in water surface elevation does not exceed 0.5 ft./21 days. An improvement in March by 34 years, 69 years in April, and in May by 57 years over Baseline Conditions (Table 4.3-180. In June, the number of years where the water surface elevation declined between 0.5 and 3.5 feet and improved 58 times; however, neither scenario was modeled to provide optimal conditions for spawning sunfish. Overall, changes in minimum instream flow would reduce water surface

fluctuations in the spring and would provide a benefit to spawning sunfish in Lake Mendocino under the Proposed Project. Beneficial

No Project 1 Alternative: The fluctuation of water surface drawdown is identical (in terms of its potential effects on spawning sunfish) under the No Project 1 Alternative compared to Baseline Conditions. As a result, conditions for spawning sunfish in Lake Mendocino would not change (Table 4.3-180). Based on modeled water surface elevation fluctuations at Lake Mendocino, would be similar to Baseline Conditions and would not substantially affect the habitat for spawning sunfish through increased reservoir releases and therefore, no impacts would occur.

No Project 2 Alternative: Under the No Project 2 Alternative, the number of years with no change in water surface elevation would not exceed 0.5 ft. over any 21 day period. An improvement in April by 33 years and in May by 34 years over Baseline Conditions. In June, the number of years in which the water surface elevation would decrease between 0.5 and 3.5 feet over a 21 day period decreased 57 times however, neither Baseline Conditions nor the No Project 2 Alternative modeled to provide optimal conditions for spawning sunfish (Table 4.3.0-180). Overall, changes to minimum instream flow requirements in the summer months under No Project 2 would reduce water surface fluctuations in the spring; and would provide a benefit to spawning conditions for sunfish.

Impact 4.3-28: Changes in minimum instream flow could substantially affect the habitat for spawning sunfish through increased reservoir releases at Lake Sonoma. (Beneficial).

Proposed Project: Fluctuations in water surface elevation are the same as Baseline Conditions (Table 4.3-181). The change in water surface elevation would not exceed 0.5 ft. over a 21 day period and was modeled to occur in 12 fewer years in May, and seven fewer years in June compared to Baseline Conditions. Therefore, the Proposed Project would provide a slight benefit for spawning sunfish.

No Project 1 Alternative: Releases from Lake Sonoma are slightly elevated under the No Project 1 Alternative compared to Baseline Conditions, thus water surface drawdown is slightly elevated under the No Project 1 Alternative (Table 4.3-181). Years with optimal sunfish spawning conditions (based on reservoir drawdown) would be reduced by 1 in March, 5 in April, and 3 in May. Slight to moderately stressful conditions in June occur in 14 fewer years with a corresponding increase in moderately to stressful conditions under the No Project 1 Alternative. Although the increase in water surface elevations could result in effects to spawning success for sunfish in some years, it would not cause a substantial impact to the sunfish populations. Therefore, it is considered a less than significant impact.

No Project 2 Alternative: Water surface fluctuations during the sunfish spawning period in Lake Sonoma are nearly identical between Baseline Condition and the No Project 2 Alternative. There would be no change over Baseline Conditions and therefore, no impact would occur

Table 4.3-180. Model Results for the maximum 21-Day change in water surface elevations by month during the sunfish spawning Season in Lake Mendocino (March through June) for the 104-year hydrologic record

March				
Decrease in water surface elevation (ft.)	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	59	59	62	93
>-0.6 and ≤-3.5	41	41	38	7
>-3.6 and ≤-6.5	2	2	2	2
>-6.5	2	2	2	2
Total	**104**	**104**	**104**	**104**
April				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	30	30	64	99
>-0.6 and ≤-3.5	74	74	40	5
>-3.6 and ≤-6.5	0	0	0	0
>-6.5	0	0	0	0
Total	**104**	**104**	**104**	**104**
May				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	4	4	40	61
>-0.6 and ≤-3.5	98	98	64	43
>-3.6 and ≤-6.5	2	2	0	0
>-6.5	0	0	0	0
Total	**104**	**104**	**104**	**104**
June				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	0	0	0	0
>-0.6 and ≤-3.5	45	45	102	103
>-3.6 and ≤-6.5	58	58	2	1
>-6.5	1	1	0	0
Total	**104**	**104**	**104**	**104**

Table 4.3-181. Model Results for the Maximum 21-Day Change in Water Surface Elevations by Month during the Sunfish Spawning Season in Lake Sonoma (March through June) for the 104-Year Hydrologic Record

March				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	66	69	66	67
>-0.6 and ≤-3.5	32	29	32	31
>-3.6 and ≤-6.5	6	6	6	6
>-6.5	0		0	0
Total	**104**	**104**	**104**	**104**
April				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	31	30	30	39
>-0.6 and ≤-3.5	69	70	70	14
>-3.6 and ≤-6.5	4	4	4	0
>-6.5	0	0	0	0
Total	**104**	**104**	**104**	**104**
May				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	4	4	4	63
>-0.6 and ≤-3.5	99	98	98	40
>-3.6 and ≤-6.5	1	2	2	1
>-6.5	0	0	0	0
Total	**104**	**104**	**104**	**104**
June				
Decrease in water surface elevation	**Baseline**	**No Project 1**	**No Project 2**	**Proposed Project**
≤-0.5	0	0	0	13
>-0.6 and ≤-3.5	103	89	103	90
>-3.6 and ≤-6.5	1	15	1	1
>-6.5	0	0	0	0
Total	**104**	**104**	**104**	**104**

Don Clausen and the Coyote Valley Dam Egg Collection Facility

The Don Clausen Fish Hatchery and Coyote Valley Dam Egg Collection facilities are discussed in Chapter 3 “Background and Project Description.” Coho salmon and steelhead are spawned and reared at the Don Clausen Fish Hatchery. The eggs of steelhead returning to the Coyote Valley Dam Egg Collection Facility are collected and fertilized then transported to the Don Clausen Fish Hatchery at Lake Sonoma to be raised. After a year, young steelhead are returned to the facility located at the base of Coyote Valley Dam the following January and housed for a period of time to imprint the fish to the site. The steelhead are volitionally released into the Russian River in February and March. Chinook salmon are not spawned or raised at either facility.

Analyzing potential impacts to fish reared in these two facilities is simplified (compared to assessing impacts to wild fish) by the nature of hatcheries. Hatchery staff maximize factors such as dissolved oxygen levels and food availability while suppressing the potential for outbreaks of disease, fungal and bacterial infections. In addition, flow releases required to maintain hatchery facilities in good condition are crucial elements of Baseline Conditions as well as the three proposed alternatives. However, water temperature cannot be easily managed. The temperature of water released from Lake Mendocino and Lake Sonoma depends on the conservation of the coldwater pool. During critically dry years, water temperature released from the reservoirs may result in stressful conditions for hatchery-reared fish.

Coyote Valley Egg Taking Station

Impact 4.3-29: Changes in minimum instream flow could substantially affect the quality of habitat for spawning steelhead by elevated water temperatures from January through mid-April at the Coyote Valley Egg Taking Station. (No Impact).

Steelhead eggs are collected at the Coyote Valley Egg Taking Station from January through mid-April. During the steelhead spawning period, temperatures of water released from Lake Mendocino to this facility are suitable 100 percent of the time under Baseline Conditions and the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative (Table 4.3-182). Therefore, no impacts to spawning steelhead by elevated water temperatures from January through mid-April at the Coyote Valley Egg Taking Station would occur

Impact 4.3-30: Changes in minimum instream flow could substantially affect the quality of habitat for steelhead smolts by elevated water temperatures from March through April at the Coyote Valley Egg Taking Station. (No Impact).

Steelhead smolts are transported from the Don Clausen Fish Hatchery to the Coyote Valley Egg Taking Station in January and held for approximately one to two months before being released into the Russian River. Water temperatures were suitable 100 percent of the time during January through March under Baseline Condition, the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative (Table 4.3-183). Therefore, no impacts to steelhead smolts by elevated water temperatures from March through April at the Coyote Valley Egg Taking Station would occur.

Table 4.3-182. Percentage of the time that water temperatures released from Lake Mendocino are suitable (≤59.0° F) during the January through mid-April steelhead spawning and egg incubation period under Baseline Conditions, the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
January	100	100	100	100
February	100	100	100	100
March	100	100	100	100
April	100	100	100	100

Table 4.3-183. Percentage of the time that water temperatures released from Lake Mendocino are suitable (≤55.0° F) when steelhead smolts are held at the Coyote Valley Egg Taking Facility (March and April) under Baseline Conditions and the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
March	100	100	100	100
April	99	100	99	100

Don Clausen Fish Hatchery

Impact 4.3-31: Changes in minimum instream flow could substantially affect the quality of habitat for spawning steelhead and egg incubation by elevated water temperatures from January through mid-April at the Don Clauson Fish Hatchery. (No Impact).

Steelhead eggs are collected January through mid-April at the Don Clausen Fish Hatchery. Suitable temperatures for upstream migrating and spawning steelhead are ≤59.0° F. During the steelhead spawning period, temperatures of water released from Lake Sonoma to the hatchery facility are suitable 100 percent of the time under Baseline Conditions, the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative (Table 4.3-184). Therefore, no impacts to spawning steelhead and egg incubation by elevated water temperatures from January through mid-April at the Don Clauson Fish Hatchery.

Table 4.3-184. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤59.0° F) during the January through mid-April steelhead spawning period under Baseline Conditions and the Proposed Project, the No Project 1 alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
January	100	100	100	100
February	100	100	100	100
March	100	100	100	100
April	100	100	100	100

Impact 4.3-32: Changes in minimum instream flow could substantially affect the quality of habitat for juvenile steelhead rearing at the Don Clauson Fish Hatchery by elevated water temperatures from April through November. (No Impact).

Water released from Lake Sonoma remained below 66.0° F (suitable levels) for rearing juvenile steelhead under Baseline Conditions, the Proposed Project, and the No Project 2 Alternative (Table 4.3-185). Water temperatures would exceed 66.0° F under the No Project 1 during October and November. However, this event would occur less than one percent of the time, and the temperatures modeled to occur (67.3 and 66.3 in October and November of 1977, respectively) and would not substantially affect the quality of habitat for juvenile steelhead. Therefore, no impacts to juvenile steelhead rearing by elevated water temperatures from April through November at the Don Clauson Fish Hatchery.

Table 4.3-185. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤66.0° F) during the April through November juvenile steelhead rearing period under Baseline Conditions and the Proposed Project, the No Project 1 alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
April	100	100	100	100
May	100	100	100	100
June	100	100	100	100
July	100	100	100	100
August	100	100	100	100
September	100	99	100	100
October	100	99	100	100
November	100	100	100	100

Impact 4.3-33: Changes in minimum instream flow could substantially affect the quality of habitat for steelhead smolts by elevated water temperatures from March through April at the Don Clauson Fish Hatchery. (No Impact).

Water temperatures were suitable 100 percent of the time during March under Baseline Condition, the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative (Table 4.3-186). In April, water temperatures are suitable for smolting steelhead over 99 percent of the time under the Proposed Project and the No Project 2 Alternative, and 99 percent of the time under Baseline Conditions and the No Project 1 Alternative. Temperatures exceeding suitable levels occurs less than one percent of the time and occurs equally between Baseline Conditions and the three proposed alternatives. Therefore, no impacts to steelhead smolts by elevated water temperatures from March through April at the Don Clauson Fish Hatchery would occur.

Table 4.3-186. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤55.0° F) when steelhead smolts are held at the Don Clausen Fish Hatchery (March and April) under Baseline Conditions and the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
March	100	100	100	100
April	99	99	99	99

Impact 4.3-34: Changes in minimum instream flow could substantially affect the quality of habitat for spawning coho salmon and egg incubation by elevated water temperatures from April through November at the Don Clauson Fish Hatchery. (No Impact).

Water released from Lake Sonoma meet water temperature criteria for coho salmon spawning and egg incubation 99 percent of the time under Baseline Conditions, as well as the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative, with one exception. During December, temperatures exceed levels considered suitable for spawning coho salmon 27 to 30 percent of the time. Overall, Baseline Conditions, the Proposed Project, and the No Project alternatives all perform well, with few difference between them (Table 4.3- 187 Therefore, no impacts to spawning coho salmon and egg incubation by elevated water temperatures from April through November at the Don Clauson Fish Hatchery would occur.

Table 4.3-187. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤59.0° F) during the December through March coho salmon spawning and egg incubation period under Baseline Conditions, the Proposed Project, the No Project 1 alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
December	72	73	70	72
January	99	99	99	99
February	99	99	99	99
March	99	99	99	99

Impact 4.3-35: Changes in minimum instream flow could substantially affect the quality of habitat for spawning coho salmon and egg incubation by elevated water temperatures from April through November at the Don Clauson Fish Hatchery. (No Impact).

Water released from Lake Sonoma meet water temperature criteria (≤62.5° F) for juvenile coho salmon rearing at the Don Clausen Fish Hatchery 99 to 100 percent of the time (Table 4.3-188). Suitable conditions would only be exceeded during the most severe drought conditions modeled. Overall, there was no differences between Baseline Conditions, the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative. Therefore, no impacts to

spawning coho salmon and egg incubation by elevated water temperatures from April through November at the Don Clauson Fish Hatchery would occur.

Table 4.3-188. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤62.5° F) during the April through November juvenile coho salmon rearing period under Baseline Conditions and the Proposed Project, the No Project 1 alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
April	100	100	100	100
May	100	100	100	100
June	100	100	100	100
July	100	100	100	100
August	100	100	100	100
September	100	100	100	100
October	99	99	99	99
November	99	99	99	99

Impact 4.3-36: Changes in minimum instream flow could substantially affect the quality of habitat for coho salmon smolts by elevated water temperatures from April through November at the Don Clauson Fish Hatchery. (No Impact).

Water released from Lake Sonoma meet water temperature criteria (≤57.0° F) for coho salmon smolts at the Don Clausen Fish Hatchery 100 percent of the time (Table 4.3-189). No impacts to coho salmon smolts by elevated water temperatures from April through November at the Don Clauson Fish Hatchery would occur.

Table 4.3-189. Percentage of the time that water temperatures released from Lake Sonoma are suitable (≤57.0° F) during the March through May coho salmon smolting period under Baseline Conditions and the Proposed Project, the No Project 1 alternative, and the No Project 2 Alternative.

	Water Supply Alternative			
Month	**Baseline Conditions**	**Proposed Project**	**No Project 1**	**No Project 2**
March	100	100	100	100
April	100	100	100	100
May	100	100	100	100

Native Warm Water Fish Complex

Impact 4.3-37: Changes in minimum instream flow could substantially affect the habitat for native warmwater species in the Russian River. (No Impact).

Native warm water species complex

Most native warmwater tolerant fish (Sacramento suckers, hardhead, Sacramento pikeminnow, Russian River tule perch, etc.) inhabiting the Russian River prefer large pools and deep runs with temperatures in the upper 60s to high 70s (or higher). Based on the temperature and DO levels modeled to be in the Russian River between Cloverdale and the Estuary, all of the flow scenarios provide suitable habitat for this complex of fish. Although reductions in flows could reduce the quantity of habitat, the pools and deep run habitat favored by these species would be minimally affected by the changes in flows modeled to occur under the three alternatives. Historically, these species tolerated flows in the river decreasing to a relative trickle during the summer months (prior to the construction of the Potter Valley Project), that would have restricted fish to the remaining pool habitat. Therefore, changes in minimum instream flow under the Proposed Project or the No Project alternatives would not substantially affect habitat for the warm water fish complex and no impacts would occur.

Sacramento pikeminnow

A native predator that are known to include salmonids in their diet where their habitat overlaps. However, Sacramento pikeminnow prefer warmer water than salmonids, and their preferred habitat (large pools) often naturally segregates them from salmonids. While the proposed alternatives are not expected to negatively impact this species, the reduction in flows would not lead to an increase in available habitat, or a foreseeable expansion of their populations above what is currently living in the river. Therefore, changes in minimum instream flow would not increase Sacramento pikeminnow populations or expand their range, and thus no impacts would occur.

Pacific lamprey

An ancient anadromous aquatic organism (although they are not truly a “fish,” they are generally referred to as such for convenience). Little is known about Pacific lamprey in the Russian River. Sampling conducted by the Water Agency has documented populations in many “steelhead bearing” streams. Pacific lamprey ammocoetes (juvenile lamprey) have also been captured above the Mirabel Dam near Forestville, and near Ukiah (SCWA unpublished data). Lamprey spawning habitat and timing overlaps with steelhead. Pacific lamprey “smolts,” called macropthalmia, migrate to the ocean during the first few high winter flows. Because of the timing of their upstream migration (fall through spring) and their perceived tolerance for warmer water (based on observations made by Water Agency biologists) there would be no affects to the habitat for Pacific lamprey in the Russian River as a result of the either the Proposed Project or the No Project alternatives and therefore, no impacts would occur.

Non-Native Sports Fish

Impact 4.3-38: Changes in minimum instream flow could substantially affect the habitat for spawning American shad in the Russian River. (Less-than-significant).

American shad

A non-native species popular as a sports fish. Shad migrate and spawn in the Russian River April through August, with peak upstream migration occurring in early to mid-May (Baracco and Jones (1971)). American shad spawn over a wide range of temperatures (62 to 75° F). American shad spawn in the Russian River at least as far upstream as Healdsburg. Water temperatures and DO levels during the spring fall within suitable ranges during the spring spawning period for this species. One potential factor affecting American shad in the Russian River is flow. Although there are no studies analyzing streamflow requirements for spawning American shad in the Russian River, a reduced flow was assumed to have an effect to their habitat. The significance would depend on exact timing of spawning. At least in 1971, peak upstream migration was noted as occurring in early to mid-May. Daily flows at Hacienda over 162 cfs (the lowest flow observed during their study) were described by Baracco and Jones (1971) as being sufficient to pass upstream migrating American shad. In addition, because much larger Chinook salmon are capable of migrating upstream through the lower Russian River, the smaller American shad were assumed to be able to complete their upstream migration as well. However, the minimum flow necessary for American shad to complete egg incubation in the Russian River is unknown. Streamflows during April and May appear to be suitable for spawning American shad in the Russian River; however, minimum instream flows are significantly lower June through August for the Proposed Project and the No Project alternatives compared to Baseline Conditions (Table 4.3-190). Based on Baracco and Jones (1971), American shad would be able to successfully spawn during April and May (peak timing); however, reduced flows in the Lower Russian River June through August could have effects to the habitat for American shad. Since the timing of the reduced flows from either the Proposed Project or the No Project alternatives would occur after the peak of the spawning period, the potential to substantially affect the habitat for spawning American shad in the Russian River would be less than significant.

Table 4.3-190. Monthly median flows at Healdsburg and Hacienda under the four flow scenarios during the April – August shad upstream migration and spawning period.

Healdsburg					
	Month				
Alternative	**April**	**May**	**June**	**July**	**August**
Baseline	613	294	205	205	205
Proposed Project	536	207	121	114	114
No Project 1	613	294	205	205	205
No Project 2	604	232	143	134	134
Hacienda					
	April	**May**	**June**	**July**	**August**
Baseline	942	374	226	192	180
Proposed Project	848	246	87	84	84
No Project 1	914	342	193	159	159
No Project 2	908	284	134	102	102

Impact 4.3-39: Changes in minimum instream flow could substantially affect the habitat for smallmouth bass in the Russian River. (No Impact).

Smallmouth Bass

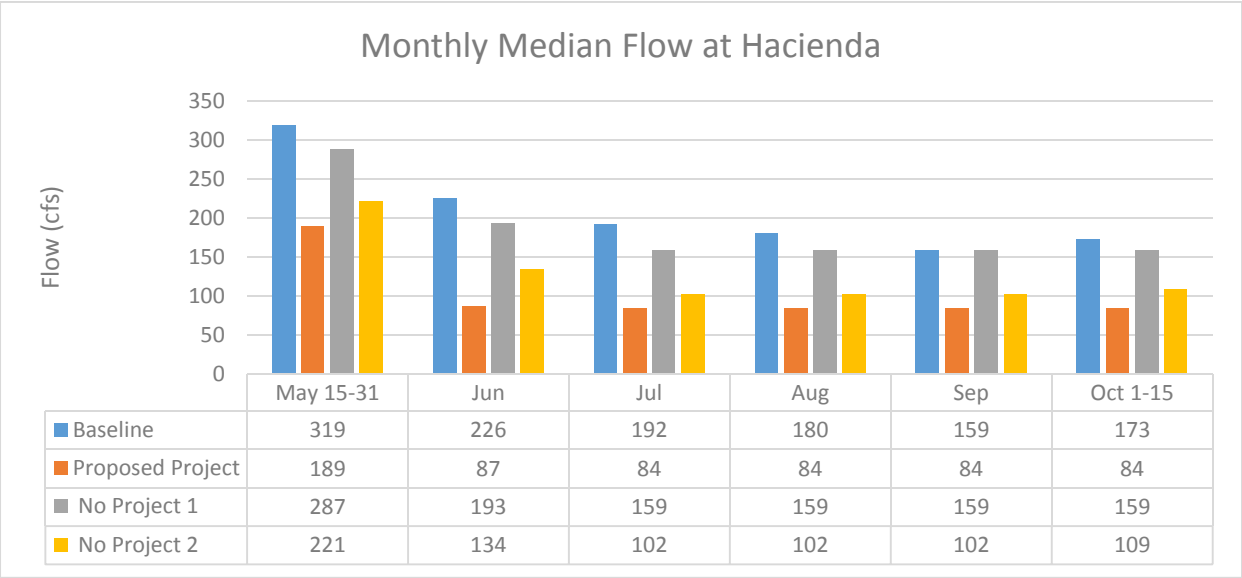
From a fisheries management perspective, the presences of smallmouth bass constitute a negative impact to native species. Smallmouth bass are an aggressive, non-native predator that has been implicated in the reduction of native fish throughout California (although it is this aggressive nature that makes them popular with anglers). Smallmouth bass habitat likely overlaps with the warm water native complex (large pools and deep runs from Cloverdale downstream to the estuary). Water temperatures were modeled to change very little in this reach of the river, and DO levels were modeled to exceed 6.0 ppm throughout the year. Because this species occupies pools and deep runs, the changes in flow modeled to occur Proposed Project or the No Project alternatives would marginally affected these habitats; thus there would be no potential to affect the habitat for smallmouth bass in the Russian River and no impacts would occur.

Estuary Habitat

The Fish Flow and Water Rights Project is not intended to improve habitat in the Russian River estuary and is not anticipated to change the frequency that the barrier beach forms or water quality conditions within the estuary (see Water Quality chapter). However, lowering minimum instream flows in the mainstem Russian River will result in lower inflows into the estuary. During the lagoon management season lower inflows may decrease the frequency that the estuary reaches elevations that would cause the estuary to naturally self-breach or require the Water Agency to breach the barrier beach in order to protect low-lying properties from inundation.

Impact 4.3-40. Changes in minimum instream flow could affect the frequency Estuary closures which could substantially interfere with the movement of adult salmonid (No Impact).

The Proposed Project or the No Project alternatives are not anticipated to change the quantity or quality of habitat in the Estuary. Based on the Russian River ResSim model No Project 1 would have monthly median flows during September 1 through October 15 (the portion of the lagoon management period that overlaps with the adult migration period) that are 0 to 14 cfs lower than Baseline, No Project 2 would have monthly median flows that are 57 to 64 cfs lower than Baseline, and the Proposed Project would have monthly median flows 75 to 89 cfs lower than Baseline (Figure 4.3-21). Lower inflows into the estuary may prolong the duration of closures which may delay adult migration in the early part of the migration period. Adult salmonids may be delayed from entering the estuary if closures last for longer periods of time, however this would take place outside of the period of time that the bulk of adult salmonid migration takes place. In general thermal conditions are unsuitable for adult salmonids in the Russian River before mid-October (for more details see the section of this chapter that discusses stream temperature). Adult Chinook have been observed at Mirabel in early September, but in relatively low numbers.



	May 15-31	Jun	Jul	Aug	Sep	Oct 1-15
Baseline	319	226	192	180	159	173
Proposed Project	189	87	84	84	84	84
No Project 1	287	193	159	159	159	159
No Project 2	221	134	102	102	102	109

Figure 4.3-21. The monthly median flows at Hacienda during the lagoon management period for Baseline, the Proposed Project, No Project 1, and No Project 2 based on Russian River ResSim model results.

The peak of the Chinook run takes place after October 13. During a normal water year from October 16 through April minimum instream flows in the Lower Russian River are the same for No Project alternatives as Baseline, and 10 cfs higher under the Proposed Project. This time period corresponds with when the bulk of the adult salmonid migration occurs. During this time period, flows would be similar to Baseline Condition because during most years the unimpaired stream flow would be higher than minimum instream flows. As a result it is unlikely that river mouth closures would last longer. However, minimum instream flows are 55 cfs lower under the

Proposed Project and under No Project 2 from May 1 through October 15. Therefore inflows into the estuary would likely be lower during the beginning of the Chinook migration period, specifically from September 1 through October 15. If the duration of closures were longer from September 1 to October 15 due to lower inflows into the estuary some adult Chinook may be delayed from entering the river. However water temperatures in the Lower Russian River are relatively warm before October 15 and delaying adult fish from entering the Russian River could be slightly beneficial. Therefore, no impacts would occur.

Impact 4.3-41. Changes in minimum instream flow could affect the frequency Estuary closures which could substantially interfere with the movement of salmonid smolts. (No Impact)

Salmonid smolts migrate through the estuary in the spring. In most years unimpaired flows in the months of November through April would be higher than minimum instream flows and similar to baseline under the Proposed Project or the No Project alternatives. In May and June lower inflows into the estuary could prolong the duration of closures during a time that salmonid smolts are migrating through the estuary. However this would not significantly affect salmonid smolts, because the Sonoma County Water Agency would implement an outlet channel across the barrier beach as recommended by the Biological Opinion (NMFS 2008). The outlet channel would allow salmonid smolts to enter the ocean and therefore, no impacts would occur.

Impact 4.3-42. Changes in minimum instream flow could affect the frequency of Estuary closures which could substantially affect the quantity and quality of juvenile steelhead habitat and steelhead could become more susceptible to avian predation. (No Impact)

No Project 1, No Project 2, and the Proposed Project are not anticipated to change the quantity or quality of habitat in the Estuary. However, lower inflows into the Russian River estuary may prolong the length of closures. Observations of recent prolonged closures & recent modeling results suggest that the estuary may not fully convert to a freshwater lagoon (Largier and Behrens 2011 and Bombardelli *et al*. 2014). Recent fisheries monitoring and two dimensional hydraulic modeling results suggests that a stratified lagoon provides ample rearing habitat as the fresh water surface layer thickens and inundates previously dry shoreline (Seghesio 2011, Matsubu, et al. 2015). Avian predation would not likely increase from Baseline Conditions. This is because the duration of closures may increase which would lead to a thicker freshwater lens in the estuary that would provide juvenile steelhead with more fresh water depth to avoid avian predation. There would be no negative effects to the quantity and quality of juvenile steelhead habitat that could make juvenile steelhead more susceptible to avian predation. Therefore, no impacts would occur.

4.3.5 General Plan Consistency

The Proposed Project appears to be consistent with Sonoma County General Plan 2020 goals, objectives, and policies. The Proposed Project does not involve construction of new facilities, which could impact vegetation and wildlife. Also, the Proposed Project would have less than significant impact on riparian and wetland habitats, sensitive plant and wildlife species, and riparian corridors (see Impacts 4.4.1, 4.4.3 and 4.4.4) and, therefore, would be consistent with Goals OSRC-7 and 8 described above.

Also, the Proposed Project would not involve any prohibited activity under Articles 65 (Riparian Corridor Combining Zone), 66 (Biotic Habitat Combining Zone) of the Sonoma County zoning code, which restrict certain construction activities that could impact riparian corridors or protected trees.

Mendocino County General Plan

The Mendocino County General Plan (Mendocino County 2009) sets forth the following goals, policies, and actions related to vegetation and wildlife that are applicable to the Proposed Project.

Resource Management Goals, Policies, and Actions

Goal RM-7 (Biological Resources): Protection, enhancement and management of the biological resources of Mendocino County and the resources upon which they depend in a sustainable manner.

> **Policy RM-71:** Promote land uses and management practices that protect biological diversity and productivity.
>
> **Policy RM-75:** Protection of existing sensitive resources is the highest priority. Onsite replacement or offsite replacement, protection or enhancement is less desirable.
>
> **Policy RM-77:** Maintain resource diversity and integrity by protecting and enhancing continuous resource corridors compatible with adjacent uses through project design.
>
> **Policy RM-78:** Conserve native vegetation, critical habitats and soil resources through education, technical and financial assistance, cooperative endeavors, best management practices, and soils and vegetation management plans for development and resource uses.
>
> **Policy RM-79:** Encourage farmers, land owners and property managers to protect sensitive environments, and minimize the effects of recreation, tourism, agriculture and development on these resources. Promote techniques and features such as:
>
> - Habitat contiguity,
> - Wildlife corridors,
> - Maintaining compatibility with adjacent uses,
> - Maintaining habitat for sensitive plant and animal species.

Action Item RM-79.1: Work with agencies and organizations to educate the public about effective ways to protect listed plant and animal species and preserve sensitive habitats.

Policy RM-89: Conserve and enhance watercourses to protect habitat, fisheries, soils, and water quality.

The Proposed Project appears to be consistent with Mendocino County General Plan goals, objectives, and policies. The Proposed Project does not involve construction of new facilities, which could impact vegetation and wildlife. Also, the Proposed Project would have less than significant impact on riparian and wetland habitats, sensitive plant and wildlife species, wildlife corridors, and riparian corridors (see Impacts 4.4.1, 4.4.3 and 4.4.4) and, therefore, would be consistent with goals, policies, and actions listed above.

Sonoma County General Plan

The project area is located within portions Sonoma County. The following section lists goals, policies and objectives related to the Proposed Project's vegetation and wildlife resources from Sonoma County General Plan 2020 (PRMD 2012) and ends with a brief analysis discussing consistency with this plan.

Goal OSRC-7: Protect and enhance the County's natural habitats and diverse plant and animal communities.

Objective OSRC-7.1: Identify and protect native vegetation and wildlife, particularly occurrences of special status species, wetlands, sensitive natural communities, woodlands, and areas of essential habitat connectivity.

Objective OSRC-7.4: Where appropriate, support regulatory efforts by other agencies to protect biotic habitat.

Objective OSRC-7.5: Maintain connectivity between natural habitat areas.

GOAL OSRC-8: Protect and enhance Riparian Corridors and functions along streams, balancing the need for agricultural production, urban development, timber and mining operations, and other land uses with the preservation of riparian vegetation, protection of water resources, flood control, bank stabilization, and other riparian functions and values.

Objective OSRC-8.1: Designate all streams shown on USGS 7.5 minute quadrangle topographic maps as of March 18, 2003, as Riparian Corridors and establish streamside conservation areas along these designated corridors.

Objective OSRC-8.2: Provide standards for land use and development in streamside conservation areas that protect riparian vegetation, water resources and habitat values while considering the needs of residents, agriculture, businesses and other land users.

Objective OSRC-8.3: Recognize and protect riparian functions and values of undesignated streams during review of discretionary projects. The following policies shall be used to achieve these objectives:

Policy OSRC-8a: Classify “Riparian Corridors” designated in the Open Space and Resource Conservation Element as follows:

(1) “Russian River Riparian Corridor” is the corridor adjacent to the main stem of the Russian River, excluding lands located within the Urban Residential, Commercial, Industrial, or Public-Quasi Public land use categories or within the jurisdiction of a city.

(2) “Flatland Riparian Corridors” are the corridors adjacent to designated streams in the 1989 General Plan that flow through predominantly flat or very gently sloping land, generally with alluvial soil. This classification excludes areas located within the “Russian River Riparian Corridor” or within the Urban Residential, Commercial, Industrial, or Public/Quasi-Public land use categories.

(3) “Other Riparian Corridors” are the corridors adjacent to all designated streams not Policy OSRC-8b: Establish streamside conservation areas along both sides of designated Riparian Corridors as follows, measured from the top of the higher bank on each side of the stream as determined by PRMD: (1) Russian River Riparian Corridor: 200' (2) Flatland Riparian Corridors: 100' (3) Other Riparian Corridors: 50'* Policy OSRC-8c: Continue to utilize the Biotic Resources combining district for all lands within the designated streamside conservation areas. Develop and adopt regulations establishing standards applicable to Riparian Corridors along designated streams consistent with Policies OSRC-8d and OSRC-8e. Until the regulations are adopted, require that land use and development comply with Policies OSRC-8d and OSRC-8e.*

Policy OSRC-8f: Develop and/or adopt, where appropriate, revised streamside specific standards, guidelines, and/or best management practices that provide for protection of Riparian Corridors by watershed, stream, or other geographic areas. Once adopted, the revised standards would replace the standards that are in effect at the time.

Policy OSRC-8h: Where additional Riparian Corridors are designated in Area Plans, revise such plans and guidelines as needed to provide protection of riparian corridors equivalent to or better than the protection provided by the General Plan.

Policy OSRC-8i: As part of the environmental review process, refer discretionary permit applications near streams to CDFG and other agencies responsible for natural resource protection.

Policy OSRC-8j: Notify permit applicants of possible Federal and State permit requirements in areas near streams and notify landowners whose property overlaps or touches a designated Riparian Corridor regarding the public hearings on the proposed regulations affecting them.

Policy OSRC-8n: Work with the Sonoma County Water Agency and other entities to identify all streams with “bed-and-bank” channels and consider Riparian Corridor designation for all such streams.

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