CHAPTER 4.1 Hydrology

4.1.1 Introduction

This chapter describes the existing hydrologic conditions within the Fish Habitat Flows and Water Rights Project Area. Section 4.1.2, "Environmental Setting" describes the regional and project area environmental setting, including important water bodies and related infrastructure, surface and groundwater hydrology, geomorphology, and flooding. Section 4.1.3, "Regulatory Setting" details the federal, state, and local laws related to hydrology. Potential impacts to these resources resulting from the proposed project are analyzed in Section 4.1.4, "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.

Other impacts to related resources are addressed in other chapters as follows: impacts to water quality are addressed in Chapter 4.2, Water Quality; impacts to fish are addressed in Chapter 4.3, Fisheries Resources; and impacts to recreation are addressed in Chapter 4.5, Recreation.

4.1.2 Environmental Setting

The environmental setting for hydrology includes all areas that could be affected by activities associated with the Proposed Project. As stated in Chapter 3, Background and Project Description, the objective of the Fish Flow Project is to manage Lake Mendocino and Lake Sonoma water supply releases to provide instream flows that will improve habitat for threatened and endangered fish, while updating the Water Agency's existing water rights to reflect current conditions. The Water Agency would manage water supply releases from Lake Mendocino and Lake Sonoma to provide minimum instream flows in the Russian River and Dry Creek that would improve habitat for listed salmonids and meet the requirements of the Russian River Biological Opinion. Consequently, the environmental setting includes Lake Mendocino, the mainstem Russian River downstream of Coyote Valley Dam to the Pacific Ocean, tributaries entering the mainstem Russian River, Lake Sonoma, and Dry Creek downstream of Warm Springs Dam.

Physiography

North Coast Hydrologic Region

The California Water Plan (California Department of Water Resources [DWR] 2013) divides California into 10 hydrologic regions, based upon the state's major drainage basins. Each of these basins has distinct precipitation and runoff characteristics. The project area is within the North Coast Hydrologic Region. The region encompasses 19,390 square miles (mi^2) and is divided into the Klamath River and the North Coastal subbasins (DWR 2013). The North Coast Hydrologic Region includes all of Del Norte, Humboldt, Trinity, and Mendocino counties, major portions of Modoc, Siskiyou, and Sonoma counties, and portions of Glenn, Lake, and Marin counties. Characteristic topographic features are the California Coast Ranges, the Klamath

Mountains and the Modoc Plateau, with elevations averaging 6,000 feet along the eastern boundary and a few peaks greater than 8,000 feet (Mount Shasta is the tallest peak at 14,000 feet) to sea level along the western edge (DWR 2009). Climactic conditions transition from arid inland valleys that exceed 100°F in the summer and fall below freezing (32°F) in the winter, to coastal regions with summer (80°F) and winter (mid-30s, but rarely below freezing) temperatures moderated by the Pacific Ocean. The North Coast Hydrologic Region is the most water abundant in California, subject to heavy rainfall that yields 41 percent of the state's natural annual runoff (29 million acre-feet) (DWR 2009). Most of the precipitation is rainfall, which averages 50 inches per year, but ranges from 100 inches per year along the coast to 15 inches per year in dry inland regions. A small fraction falls as snow at elevations greater than 4,000 feet.

The North Coastal subbasin encompasses the entire project area and covers an area of approximately 8,560 mi^2 along the north-central California Coast (NCRWQCB 2011). The subbasin is bounded by the Pacific Ocean to the west; the Klamath and Trinity River Basins to the north; the Sacramento Valley, Clear Lake, Putah and Cache Creeks, and the Napa River Basin to the east; and the Marin-Sonoma county line to the south. The subbasin covers all of Mendocino County, major portions of Humboldt and Sonoma counties, about one-fifth of Trinity County, and small portions of Glenn, Lake and Marin counties. Most of the subbasin consists of rugged, forested coastal mountains dissected by six major river systems: Eel, Russian, Mad, Navarro, Gualala, and Noyo Rivers, and numerous smaller river systems. Soils are generally unstable and erodible, and rainfall is high (DWR 2013, North Coast Resource Partnership 2014).

Russian River Watershed

The Russian River drains 1,485 square miles (mi^2) from the Coast Ranges in northern California, flowing 110 miles (mi) from its origination point near the City of Ukiah to the Pacific Ocean near the town of Jenner (USACE 1986, Florsheim and Goodwin 1995) (Figure 3-1). The watershed is 80 mi long and 32 mi across at its widest point, and lies within a narrow valley between the Mendocino Range to the west, with elevations ranging from 1,500 to 3,000 feet, Mayacamas Mountains to the east, with elevations ranging from 3,000 to 4,000 feet, and Sonoma Mountains to the south (Ritter and Brown 1971, USACE 1986). Hills and valleys make up most of the watershed (85 percent), while the remainder lies within alluvial valleys (ENTRIX 2004). The highest points are Mount Saint Helena (4,344 feet) and Cobb Mountain (4,480 feet) (Ritter and Brown 1971, Florsheim and Goodwin 1995). From its source, the Russian River flows through several physiographically distinct sections beginning with an upper section comprised of a series of northwest trending alluvial valleys separated by bedrock constrictions that form the Ukiah, Hopland and Alexander valleys. The valleys occur along fault traces within extensional valleys formed by recent tectonic activity (Florsheim and Goodwin 1995). A middle section begins near the City of Healdsburg where the river turns abruptly west through a sinuous bedrock canyon, then south through an alluvial valley confined by a bedrock constriction near the Wohler Bridge. The lower portion flows west through an alluvial valley within a canyon cutting across the Coast Ranges to the Russian River estuary and the Pacific Ocean.

Vegetation and landcover reflect climate, and past and present land use. The climate is Mediterranean with cool wet, winters and warm, dry summers (Gasith and Resh 1999), but the watershed transitions from a dry interior portion dominated by hardwood forests, oak savannah, chaparral, and grasslands, to a fog-influenced portion near the coast characterized by conifer forest (ENTRIX 2004, Opperman et al. 2005). Early (circa 1800) land uses included cattle and horse ranching, leading to conversion from forest to grassland and general narrowing of the forested riparian corridor (ENTRIX 2004). The California Gold Rush of 1849 hastened the settlement of the watershed and increased demand for wood and agricultural products. Greater need for transportation and shipping routes led to gravel and sand extraction from the Russian River and its floodplains to build railroad corridors and wider, more accommodating roads and highways. Flood control practices further altered the river through channel straightening and levee construction. Current land use is dominated by agriculture (viticulture, orchards), sheep and cattle grazing, suburban and exurban development, and urban centers (Santa Rosa [population 160,000] and Windsor/Healdsburg [population 30,000]) (Opperman et al. 2005) and is guided by general plans approved by incorporated communities and the County of Sonoma.

Coyote Valley Dam controls 105 square miles (mi^2) of the upper watershed on the East Fork Russian River (approximately 7% of the entire Russian River basin), just upstream of the confluence with the Russian River. Details regarding the dimensions and purpose of Coyote Valley Dam may be found in Chapter 3, Background and Project Description. Upstream, the dam impounds water coming from the East Fork Russian River through Potter Valley into Lake Mendocino. This section of the East Fork Russian River also receives water from Pacific Gas and Electric Company's (PG&E) Potter Valley Hydroelectric Project (PVP), which transfers water from the Eel River through a tunnel and penstocks at the watershed divide between the Eel and the Russian rivers. Downstream of Coyote Valley Dam, the East Fork Russian River flows into the mainstem Russian River near Ukiah. The Russian River the flows through a series of alluvial valleys and an occasionally closed estuary before reaching the Pacific Ocean.

Several major tributaries (including the East Fork) enter the Russian River between Coyote Valley Dam and the Pacific Ocean (Table 4.1-1; USACE 1982). The East Fork Russian River enters the mainstem at River Mile (RM) 99, with Robinson Creek entering just downstream of Ukiah from the east, Feliz Creek entering from the west near Hopland, and Big Sulphur draining from the east near Cloverdale. Maacama Creek joins the mainstem upstream of Healdsburg. Dry Creek drains much of the western half of the Russian River watershed and enters downstream of Healdsburg. Mark West Creek enters the Russian River from the east at Mirabel Park near Forestville and drains approximately 254 mi^2. The Laguna de Santa Rosa (170 mi^2) empties into Mark West Creek approximately 2.5 miles upstream from its confluence with the Russian River and is a natural overflow basin for the Russian River. After flowing past Mark West Creek, the Russian River turns west and flows past Austin Creek into the Russian River estuary before entering the Pacific Ocean near Jenner.

Table 4.1-1. Major tributaries to the Russian River.

Tributary	Sub-watershed Drainage Area (mi^2)	Russian River River Mile (RM)
East Fork Russian River	101	99
Robinson Creek	25	96
Feliz Creek	42	76
Big Sulphur Creek	86	62
Maacama Creek	70	41
Dry Creek	217	31
Mark West Creek	254	21
Austin Creek	70	6
Russian River at mouth	1485	0

Source: USACE 1982

Dry Creek Watershed

The Dry Creek watershed drains 217 mi^2 from the interior Coast Ranges of northern Sonoma and southern Mendocino counties before entering the Russian River near the City of Healdsburg, 30 mi upstream of the Pacific Ocean (Harvey and Schumm 1985). The northwest-trending watershed is 32 miles long and 7 miles across at its widest point, with elevations ranging from 3,000 feet at the drainage divide to 70 feet near the confluence with the Russian River. Dry Creek is the second largest tributary by area within the Russian River watershed, but contributes the largest amount of annual runoff (USACE 1984). Current land use is dominated by agriculture (viticulture), but historical land use still influences the landscape. Past practices include forest clearing for grazing and agriculture, gravel and sand excavation, and channel straightening and levee construction for flood control (Harvey and Schumm 1985; Inter-Fluve 2010).

Warm Springs Dam bisects and controls the upper 131 mi^2, approximately 60% of the area, of the watershed (USACE 1984). The dam is located 14 miles upstream from the confluence of Dry Creek with the Russian River and is jointly operated by the USACE for flood control and by the Water Agency for water supply. Terrain upstream of the dam is steep and mountainous, with hillslopes exceeding 30 percent and channel slope ranging from 0.2 to 4 percent (Inter-Fluve 2010). Downstream of the dam, Dry Creek flows through a flat, relatively narrow alluvial valley with a channel slope ranging from 0.2 percent downstream near the Russian River to greater than 2 percent upstream near the dam (Inter-Fluve 2010). Major tributaries to Dry Creek upstream of the dam are Cherry and Warm Spring creeks. Similar to Coyote Valley Dam, construction of Warm Springs Dam altered watershed hydrology by reducing peak flows during wet periods and increasing baseflow during dry periods. Dam emplacement also interrupted sediment transport, leading to incision and bed coarsening in downstream reaches (USACE 1987).

Principal tributaries to Dry Creek below Warm Springs Dam are Fall, Dutcher, Peña, Grape, Crane, and Mill creeks (Table 4.1-2). Fall and Dutcher creeks enter Dry Creek approximately 1.5 mi downstream of Warm Springs Dam from the west and north respectively, and Peña Creek enters approximately 2.5 mi downstream from the west, but all are upstream of Yoakim Bridge. Grape and Crane creeks enter just upstream and downstream of Lambert Bridge from the southwest. Mill Creek is the largest tributary (by drainage area [22mi^2]), along with Peña Creek, and enters from the southwest near the confluence with the Russian River.

Table 4.1-2. Major tributaries to Dry Creek.

Tributary	Drainage Area (mi^2)	Dry Creek River Mile (RM)
Fall Creek	2	12
Dutcher Creek	3	12
Peña Creek	23	11
Grape Creek	3	7
Crane Creek	2	6
Mill Creek	22	1

Climate and Precipitation

Precipitation patterns within the Russian River watershed reflect a Mediterranean climate, with hot, dry summers and cool, wet winters. Mean daily summer temperatures range from 72-75 °F inland (with maximum temperatures in excess of 90 °F) to 61-64 °F near the coast, while mean winter temperatures range from 40 to 50 °F (PRISM 2015a, b, c). Most precipitation falls as rain from October through May, with 90 percent occurring from November through April and ranging from 28 to 80 inches across the watershed (USACE 1986, Opperman et al. 2005, PRISM 2013). These patterns are driven by Pacific frontal storms bringing warm subtropical moisture to produce intense, short bursts of rainfall (Mount 1995). The seasonal southerly migration of the Aleutian low pressure system forces westward moving storms over the Coast Ranges (USACE 1984), creating an orographic effect whereby water vapor cools and condenses as it rises, then rapidly precipitates. Rainfall tends to be heaviest at higher elevations near the coast, with average annual rainfall of 80 inches per year near Cazadero at the western edge of the watershed. In lower elevation valley areas, annual precipitation ranges from 22 inches per year near Santa Rosa to 41 inches per year at the City of Healdsburg (Inter-Fluve 2010, PRISM 2013).

Surface Water Hydrology

Surface water hydrology in the Russian River and its tributaries shows distinct patterns and trends associated with climate and regulation. To facilitate the description of potential effects, this analysis divided the project area into three reaches:

- Upper Russian River: the mainstem of the Russian River between the confluence of the east and west forks of the Russian River near Ukiah downstream to the confluence with Dry Creek near Healdsburg.
- Lower Russian River: the mainstem of the Russian River downstream of its confluence with Dry Creek to the Pacific Ocean.
- Dry Creek: Dry Creek and all of its tributaries between Warm Springs Dam to the confluence with the Russian River.

Seasonal Hydrology

Upper Russian River

There are nine United States Geological Survey (USGS) stream gages along the mainstem Russian River and two gages on tributaries entering the Upper Russian River, all with varying periods of record (Table 4.1-3). Focusing on the four gages with the longest periods of record and that encompass the Upper Russian River from just upstream of the confluence of the East Fork and the mainstem Russian River through Hopland to Healdsburg (Russian River near Ukiah, USGS gage No. 1146100; Russian River near Hopland, USGS gage No. 11462500; Russian River near Cloverdale, USGS gage No. 11463000; Russian River near Healdsburg, USGS gage No. 11464000), all show the same median monthly flow pattern with high flow in the winter and low flow in the summer (Figure 4.1-1). Under Baseline Conditions, mean monthly flow is greatest in February and lowest from June through October, reflecting the Mediterranean climate. Discharge at the Russian River near Ukiah stream gage is lowest across all months as it is the most upstream and has the least contributing area of all gages along the mainstem. The gage is also upstream of the confluence with the East Fork Russian River and is not affected by releases from Coyote Valley Dam. As such, this point is typically dry or nearly dry from late-summer to early-fall. Downstream of Ukiah, flow is nearly constant from June through October at the Hopland, Cloverdale, and Healdsburg gages owing to release flows from Coyote Valley Dam. Prior to the dam, the river experienced greater median monthly winter flows that peaked in January and lower, more variable summer flow (Figure 4.1-2). Regulation muted winter peak flows (compared to unregulated conditions) and stabilized flow from June through October, reflecting dam operation for flood control and water supply (see Surface Water Regulation for a description of dam operations).

Table 4.1-3. USGS flow gages along the Upper Russian River.

Gage name	Gage No.	Drainage area (mi^2)	Period of record
Russian River nr Ukiah	11461000	100	1911-present
Russian River nr Talmage	11462080	286	2009-present
Russian River nr Hopland	11462500	362	1939-present
Russian River nr Cloverdale	11463000	503	1951-present
Russian River nr Geyserville	11463500	655	1910-1913; 2013-present
Russian River at Jimtown	11463682	684	2009-present
Russian River at Digger Bend	11463980	791	1987-present
Russian River nr Healdsburg	11464000	793	1930-present
Russian River nr Windsor	11465390	1022	2009-present
Big Sulphur nr Cloverdale	11463200	86	1957-1972; 1989-present
Maacama nr Kellogg	11463900	44	1961-1981; 2013-present

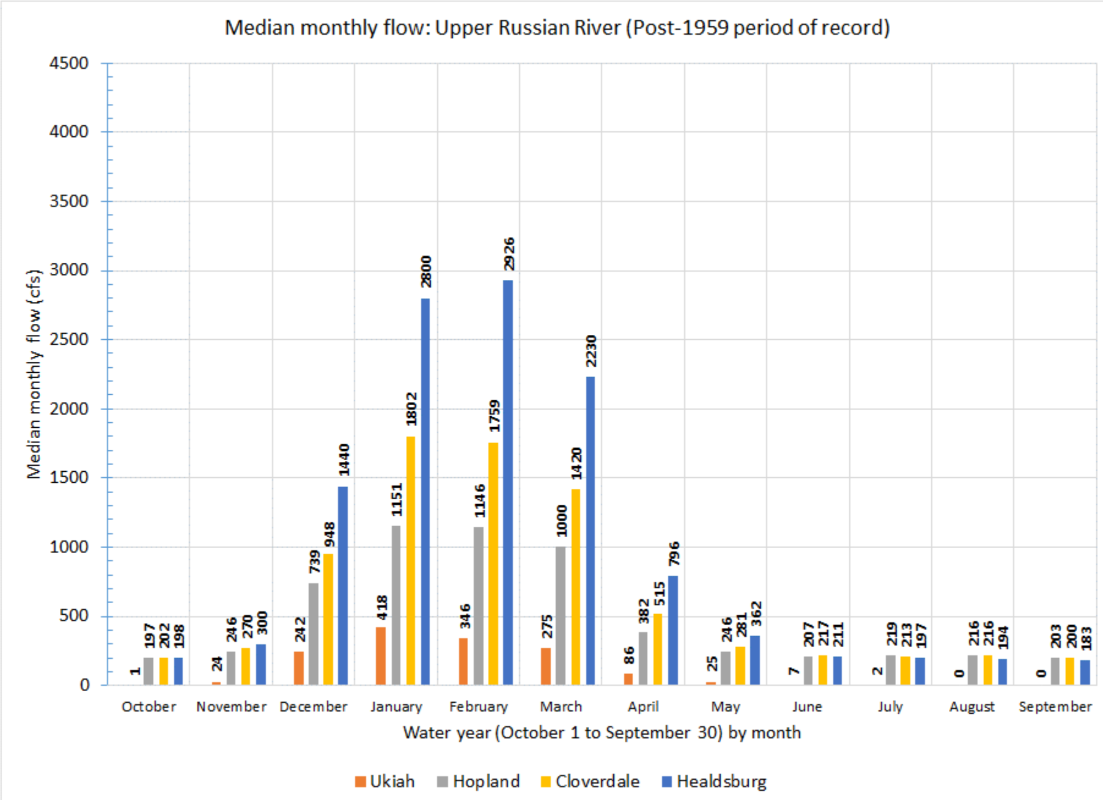

Figure 4.1-1. Post-Coyote Valley Dam median monthly flow in Upper Russian River

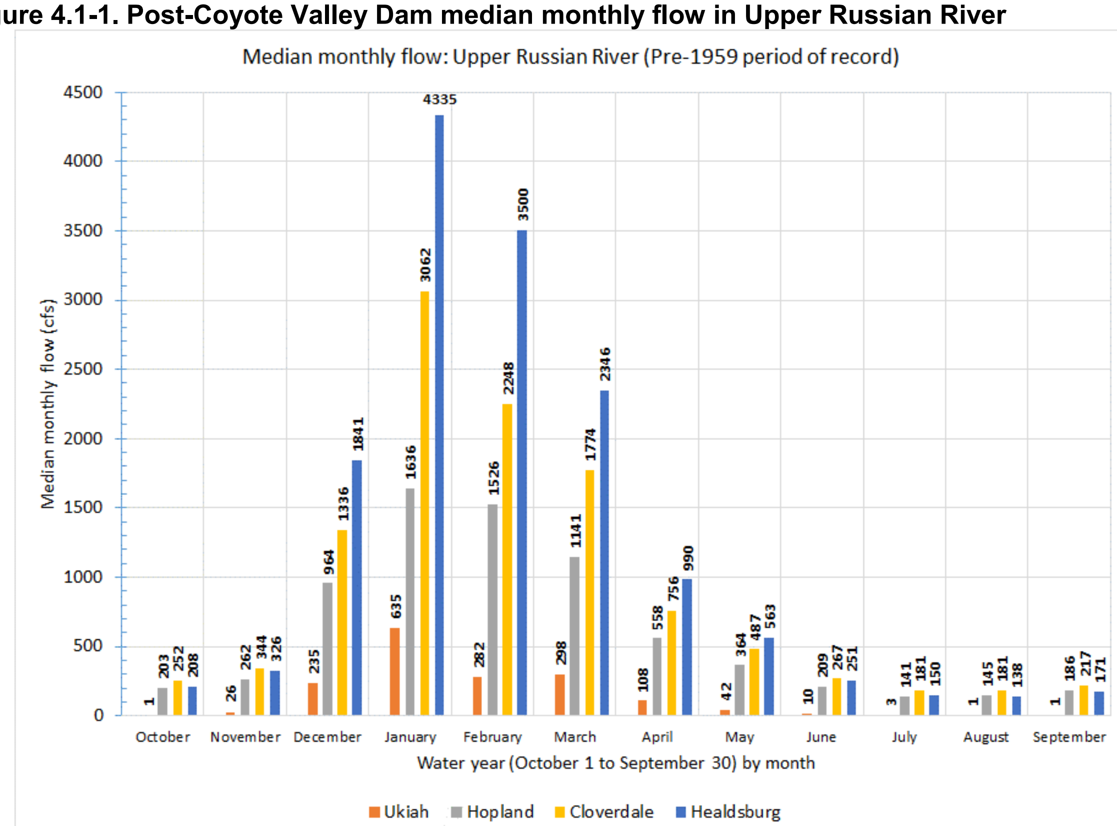

Figure 4.1-2. Pre-Coyote Valley Dam median monthly flow in Upper Russian River

Dry Creek

There are three gages along Dry Creek from Warm Springs Dam to the Russian River confluence with varying periods of record and seasonal operation (Table 4.1-4). Focusing on the gage with the longest period of record (Dry Creek near Geyserville, USGS Gage No. 11465200) median monthly flow shows similar characteristics as the Upper Russian River, following trends associated with the Mediterranean climate. Instream flow is greatest during late-fall and early winter and lowest from summer to early-fall (Figure 4.1-3). Under Baseline Conditions, the median mean monthly flow is greatest in March (approximately 390 cubic feet per second [cfs]) and lowest from May through October (approximately 100 cfs). This pattern is consistent with the Mediterranean climate and regulation by Warm Springs Dam. The period of record for the Dry Creek near Geyserville stream gage (October 1959 to present) encompasses pre- and post-dam hydrologic conditions. Before regulation (i.e., before the closure of Warm Springs Dam in 1984), surface flow in Dry Creek typically peaked in February (940 cfs median mean monthly flow) and nearly disappeared from June to October (0.5 to 20 cfs median monthly flow) (Figure 4.1-4). Dam operations muted peak flows (compared to unregulated conditions) and released a consistent summer flow, reflecting the flood control and water supply functions of Warm Springs Dam (see Surface Water Regulation for a description of dam operations). During the wet season (November through May), runoff from tributaries accounts for most of the flow in Dry Creek. During the dry season, most of the flow in Dry Creek consists of water released from Lake Sonoma.

Table 4.1-4. USGS flow gages along Dry Creek.

Gage name	Gage No.	Drainage area (mi^2)	Period of record
Dry Creek nr Geyserville	11465200	162	1959-present
Dry Creek nr Lambert Bridge	11462080	175	2011-present[1]
Dry Creek nr Healdsburg	11465350	217	1981-present

[1] discharge above 200 cfs not published

Lower Russian River

There is one USGS flow gage in the Lower Russian River at the Hacienda Bridge (Russian River near Guerneville, USGS Gage No. 11467000) and two gages near tributary junctions (Table 4.1-5). The Russian River near Guerneville gage shows similar seasonal trends as the Upper Russian River (Figure 4.1-1) and Dry Creek (Figure 4.1-3) with flows highest during winter and spring, and lowest during summer and fall (Figure 4.1-5). Instream flow is substantially higher in the winter and spring than the Upper Russian River or Dry Creek, due to a larger contributing area, but similar to the Upper Russian River in the summer and fall. The period of record for the Russian River near Guerneville gage encompasses pre- and post-regulation by Coyote Valley (before 1959) and Warm Springs (before 1984) dams. Gage records show that Coyote Valley Dam had a minor effect on winter median monthly flows as it controls only 7 percent of the total watershed area (the dam did have an effect on the duration and timing of flood peaks, see Flood Hydrology, below). Warm Springs Dam had a greater effect on winter median monthly flows as it controls a greater area (131 versus 105 mi^2) on a tributary (Dry Creek) that contributes the largest annual runoff to the Russian River (USACE 1984). Under pre- and post-Coyote Valley and Warm Springs dams regulation, median monthly flow was consistent, but low, during the summer and fall.

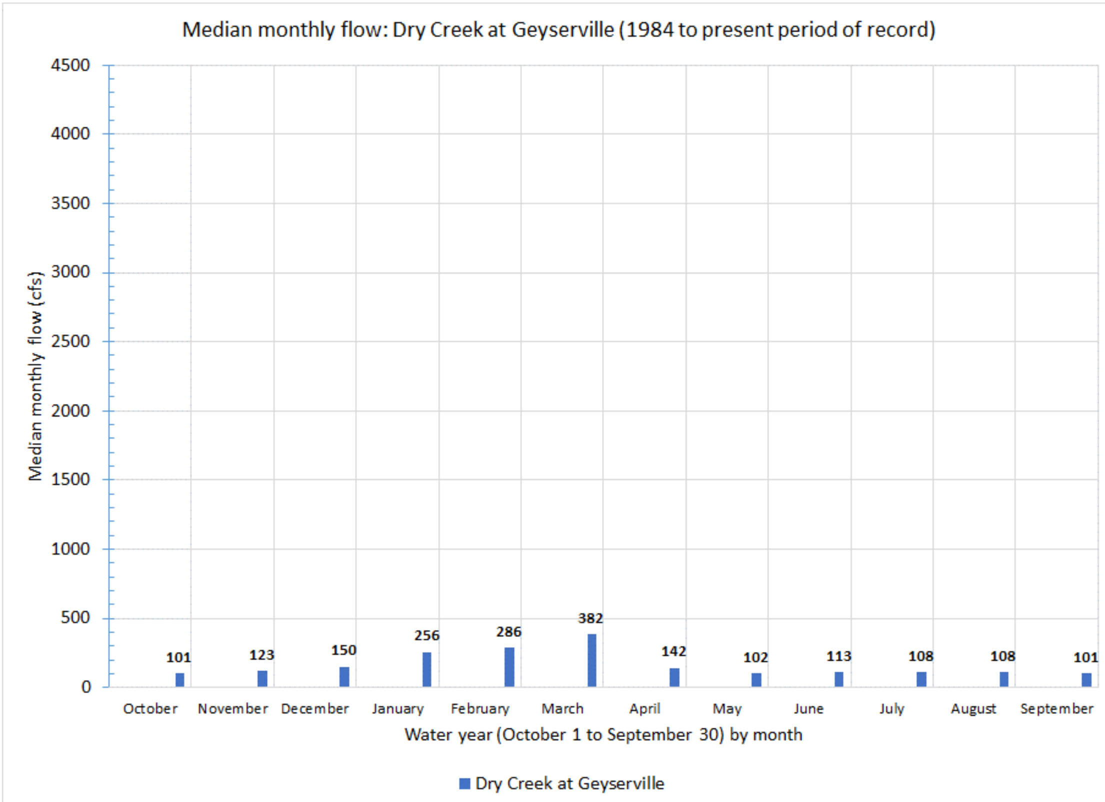

Figure 4.1-3. Post-Warm Springs Dam median monthly flows on Dry Creek.

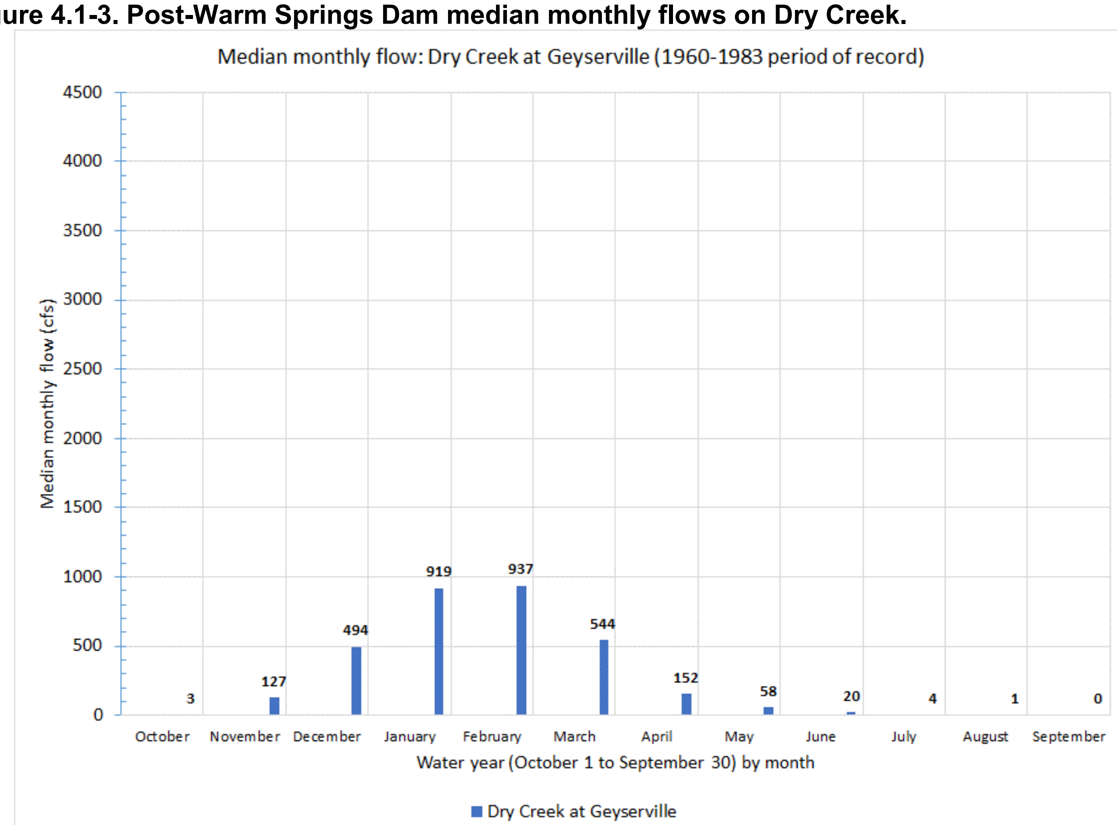

Figure 4.1-4. Pre-Warm Springs Dam median monthly flows on Dry Creek.

Table 4.1-5. USGS flow gages along the Lower Russian River

Gage name	Gage #	Drainage area (mi²)	Period of record
Russian River near Guerneville	11467000	1,338	1939-present
Mark West Creek nr Mirabel Hts	11466800	251	2005-present
Austin Creek near Cazadero	11467200	63	1959-present

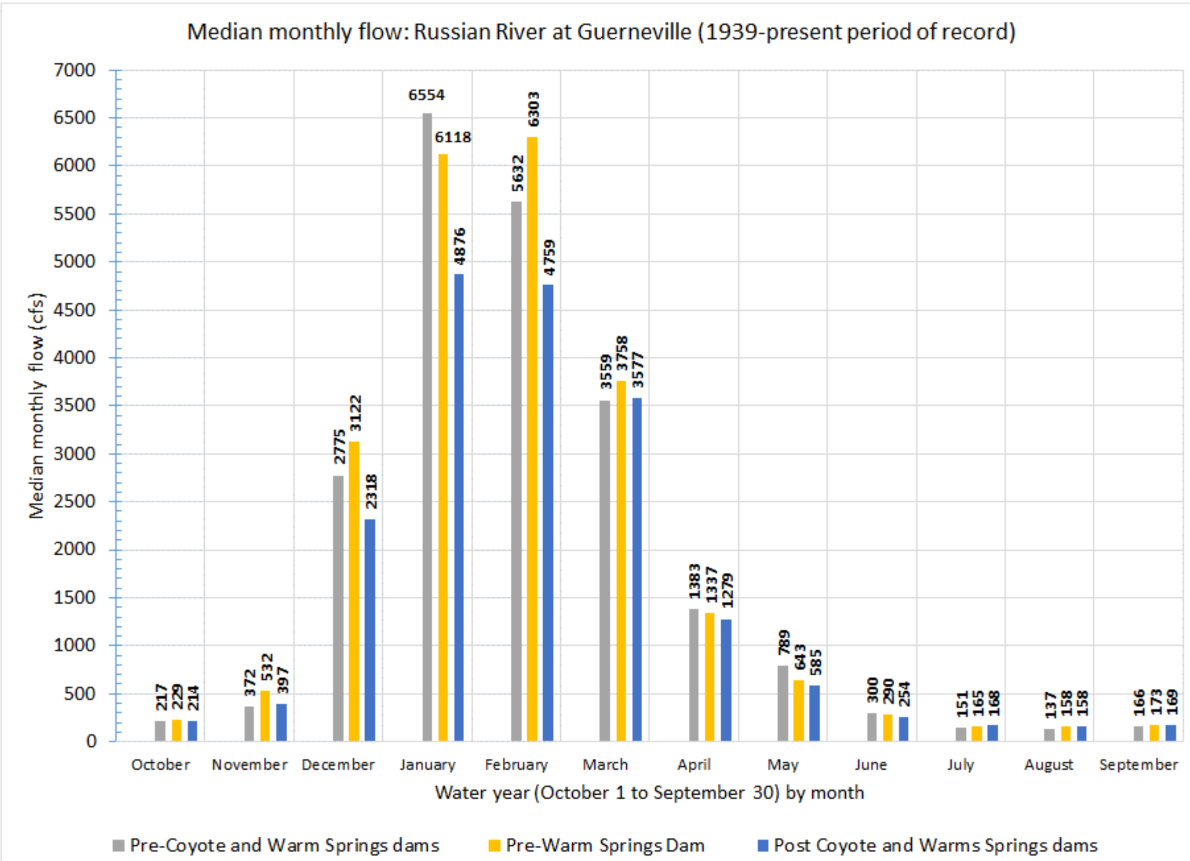

Figure 4.1-5. Before and after dam regulation median monthly flows on the Lower Russian River.

Flood Hydrology

Upper Russian River

Floods in the Russian River watershed are normally of short duration, lasting three to four days, developing within 24 to 48 hours after the beginning of a storm, but rapidly receding within 2 or 3 days (USACE 1984). Floods occur during the rainy season from November through April and larger storms can inundate the portions of the alluvial valleys (Ukiah, Hopland, and Alexander) adjacent to the river (USACE 1986). Since 1940, the highest peaks flows recorded at the Russian River near Hopland, Cloverdale, and Healdsburg USGS gage sites occurred in February 1940, January 1943, January 1954, December 1955, February 1958, December 1964, January 1974, February 1986, January 1995, and December 2005-January 2006 (Table 4.1-6). The USACE (1986) considers the 1955 and 1964 floods the two greatest floods of record. The

December 1955 flood included a small peak followed by a second larger peak that caused substantial flood damage. The 1964 flood included two smaller peaks before the main flood peak, and caused Coyote Valley Dam to spill for the first time since dam completion. The original Standard Project Flood[1] for Coyote Valley Dam was based upon the January 1943 flood, but USACE later updated this to the December 1955 flood, even though the December 1964 storm produced a higher discharge.

Table 4.1-6. Flood flows (cubic feet per second, cfs) on the Upper Russian River before and after Coyote Valley Dam.

Date[1]	**Russian River nr Hopland (cfs) (USGS gage no. 11462500) 1937-present 362 mi^2 drainage area**	**Russian River nr Cloverdale (cfs) (USGS gage no. 11463000) 1951-present 503 mi^2 drainage area**	**Russian River nr Healdsburg (cfs) (USGS gage no. 11464000) 1937-present 793 mi^2 drainage area**
February 1940	34,100	No record	67,000
January 1943	34,000	No record	53,330
January 1954	27,400	33,300	53,700
December 1955	45,000	53,000	65,400
February 1958	32,300	38,100	50,900
Pre dam median	**21,250**	**22,350**	**33,950**
December 1964	41,500	55,200	71,300
January 1974	39700	51,900	64,700
February 1986	35,600	40,700	71,100
January 1995	27,600	39,400	73,000
December 2005	35,600	50,700	58,900
Post-dam median	**14,550**	**18,200**	**32,050**

[1]Before Coyote Valley Dam: pre-1959; Post Coyote Valley Dam: post-1959

Regulation by Coyote Valley Dam reduced peak flows, increased the lag time between flood peaks entering and exiting Lake Mendocino, and increased the duration of high flow downstream. The median of instantaneous peak flows recorded at the Russian River at Hopland, Cloverdale, and Healdsburg gages decreased after dam closure in 1959, but since the structure only regulates 13 percent of the watershed above Healdsburg, and 7 percent of the total watershed, the decreases are minor (Table 4.1-6). In 1986, USACE found that the dam reduced flood peaks by 29 percent at Hopland, by 21 percent at Cloverdale, and by 11 percent at Healdsburg (USACE 1986). The greatest decreases occur upstream, closest to the dam and lessen downstream due to greater contributing area and unregulated tributary inputs. Florsheim and Goodwin (1995) examined the hydrographs upstream and downstream of Coyote Valley Dam for the December 1955 (pre-dam), December 1964 (post-dam), and February 1986 (post-dam) floods. In the case of the December 1955 floods, the analysis compared hydrographs upstream and downstream of the future dam location, and found the timing, magnitude, and duration of flood peaks similar between the two sites. Paired upstream and downstream flood hydrographs for the December 1964, February 1986, and December 2005 storms showed later,

1 The Standard Project Flood is defined as one that can be expected from the most severe combination of meteorologic and hydrologic conditions characteristic of the region, excluding extremely rare combinations.

lower magnitude, longer duration flood peaks downstream of the dam. Flood peaks arrived 4 to 7 days later, reduced in magnitude by approximately 50 percent below the dam, but the duration of flood flows lengthened by 3 to 4 days (Figure 4.1-6 shows December 2005 flood).

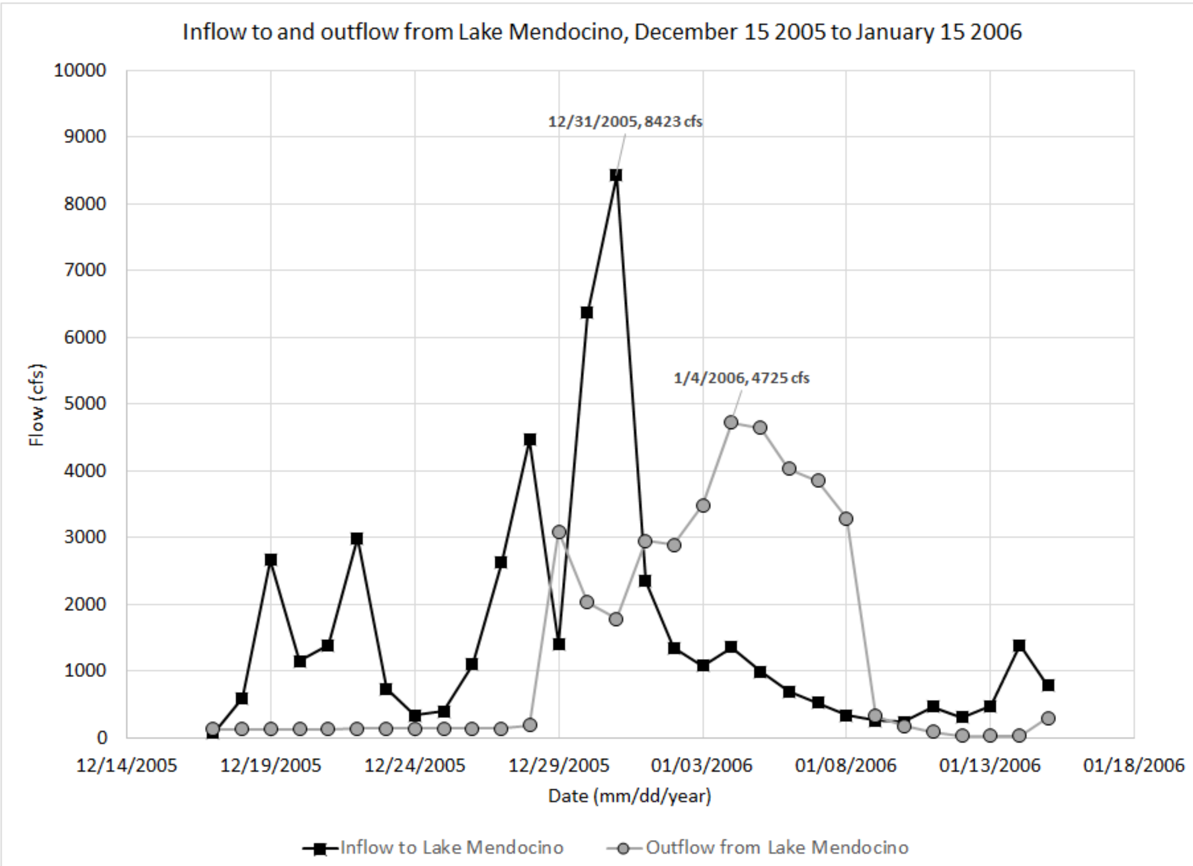

Figure 4.1-6. Inflow and outflow to Lake Mendocino during December 2005 storm.

Dry Creek

Tributaries, such as Dry Creek, can rise more rapidly than the mainstem Russian River, with flooding occurring as soon as four hours after heavy rainfall. Tributaries to Dry Creek also rise rapidly in response to storms, reaching their peak flow three to five hours after the heaviest rainfall. The greatest peak flows, as recorded by the Dry Creek near Cloverdale USGS stream gage (USGS gage No. 11464500; located on Dry Creek within the inundation area of Lake Sonoma [this gage is no longer operating]; period of record: October 1939 to September 1980) and the Dry Creek near Geyserville stream gage, occurred in December 1964, January 1963, and December 1955 (Table 4.1-7). The December 1955 storm was the “most severe multiple peaked storm of record,” and produced the greatest critical runoff volume into Dry Creek (USACE 1984). Consequently, the USACE used this storm as the Standard Project Flood on Dry Creek, applying the 144-hour, 30 in. recorded rainfall and 170,000 acre-feet watershed-wide runoff as the maximum flood controllable by Warm Springs Dam and Lake Sonoma. The December 1964 storm produced a higher peak flow, but was less intense and of shorter duration than the December 1955 storm. Consequently, USACE (1984) found the December

1955 flood produced the maximum runoff in the Lower Russian River, and used it as the Standard Project Flood for that portion of the watershed.

Table 4.1-7. Flood flows (cubic feet per second, cfs) on Dry Creek before Warm Springs Dam.

Date	Dry Creek near Cloverdale (USGS gage no. 1146500)[1] 1941-1980 88 mi^2 drainage area	Dry Creek near Geyserville (USGS gage no. 11465200) 1959-present 162 mi^2drainage area
January 1943	23,000	
December 1945	13,600	
December 1955	26,000	
February 1960	19,200	20,400
January 1963	25,000	32,400
December 1964	27,000	31,800
January 1970	N/A[2]	27,700
January 1974	N/A[2]	32,000

[1]Values taken from USACE (1984)
[2]Not reported in USACE (1984)

Regulation by Warm Springs Dam reduced peak flows by up to an order of magnitude. Prior to Warm Springs Dam, the Dry Creek near Geyserville stream gage showed a median annual peak flow of 16,600 cfs[2], with peak flows regularly exceeding 7,500 cfs (Figure 4.1-7; 20 out of 24 years from Water Year [WY] 1960 to WY 1983). After dam completion, median annual peak flow fell to 3,900 cfs and due to dam operations (see Surface Water Regulation and Releases, below) did not exceed 7,500 cfs from WY 1984 to WY 2013. Accordingly, regulation decreased flood magnitudes across a range of recurrence intervals (Table 4.1-8). The Federal Emergency Management Agency (FEMA) and USACE estimated post-dam peak discharges from downstream of Warm Springs Dam to just upstream of Peña Creek that were an order of magnitude lower than pre-dam flood magnitudes at Yoakim Bridge. The post-dam flood recurrence intervals show the effect of flood control operations just downstream of the dam as 10-, 50-, and 100-yr floods are all of similar magnitude (6,000 cfs). Current flood response comes largely from dam operation and tributary input.

Lower Russian River

The Lower Russian River receives flood flows from the Upper Russian River and Dry Creek and shows the highest magnitude peak flows. Since 1940, the highest flood peaks occurred in February 1940, January 1943, December 1955, February 1958, December 1964, January 1974, February 1986, January 1995, and December 2005-January 2006 (Table 4.1-9). The largest flood of record in the Lower Russian River occurred in February 1986 when a peak discharge of 102,000 cfs was recorded by the USGS near Guerneville. As with median monthly flows, Coyote Valley Dam showed little effect on instantaneous peak flows as measured at the

[2] The instantaneous peak flow differs from the mean monthly flow peak described above. The instantaneous peak flow is the maximum flow reached during a water year [WY; October 1 through September 30]. The mean monthly flow peak is the average daily flow over an entire month.

Russian River at Guerneville stream gage, with the median actually increasing after dam closure in 1959, although this is likely due to a limited pre-dam period of record (1940-1958) and

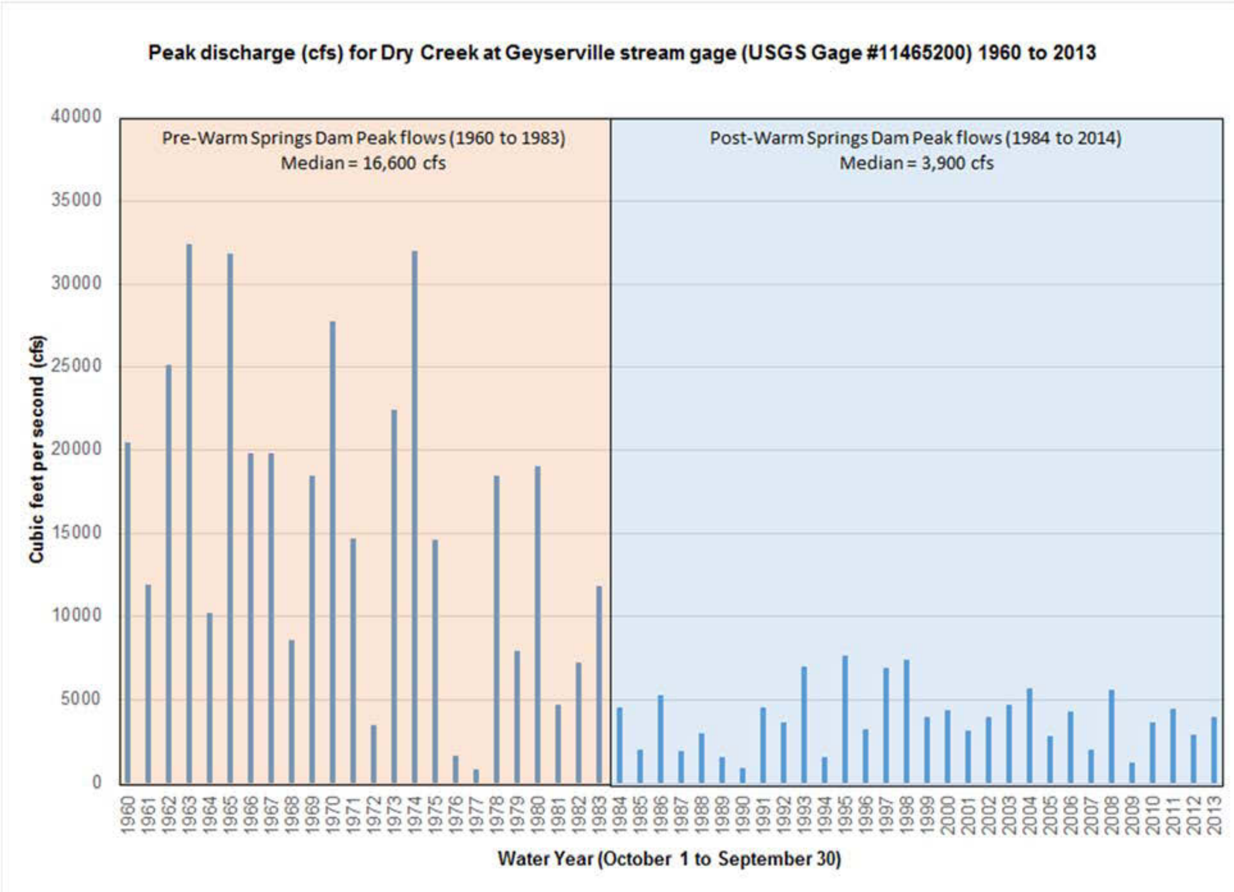

Figure 4.1-7. Pre- and post-Warm Springs Dam peak flows for Dry Creek at Geyserville stream gage (USGS gage no. 11465200) from 1960 to 2013.

Table 4.1-8. Flood recurrence intervals (cubic feet per second, cfs) on Dry Creek before and after Warm Springs Dam.

Flow event (recurrence interval)	Pre-Dam Dry Creek near Geyserville (USGS gage no. 11465200) (cfs)	Post-Dam Dry Creek below WSD (USGS gage no. 11465200) (cfs)	
		FEMA	USACE
2-yr	23,000	N/A[1]	4,000
5-yr	25,000	N/A[1]	4,500
10-yr	30,000	6,000	6,000
25-yr	35,000	N/A[1]	6,000
50-yr	38,000	6,000	6,000
100-yr	40,000	6,000	6,000

[1]FEMA did not estimate peak flows for these recurrence intervals

Table 4.1-9. Flood flows (cubic feet per second, cfs) on Lower Russian River before and after Coyote Valley and Warm Springs dams.

Date	Russian River nr Guerneville (cfs) (USGS gage no. 11467000) 1939-present 1,338 mi^2 drainage area
February 1940	88,400
January 1943	69,200
January 1954	59,900
December 1955	90,100
February 1958	68,700
Pre Coyote Valley and Warm Springs dam Median[1]	**48,100**
December 1964	93,400
January 1966	77,000
January 1970	72,900
January 1974	74,000
January 1983	71,900
Pre-Warm Springs Dam Median[2]	**62,800**
February 1986	102,000
January 1995	93,900
January 1997	82,100
January 2004	63,400
December 2005	86,000
Post Coyote Valley and Warm Springs dams median[3]	**37,850**

[1]1940 to1958 period of record
[2]1959 to 1983 period of record
[3]1984 to present period record

not an effect of regulation. After the closure of Warm Spring Dam, the median instantaneous peak flow decreased substantially from the pre-Coyote Valley and Warm Springs dam periods. The Laguna de Santa Rosa in the Lower Russian River acts as a flood retention basin and can reduce peak flows downstream on the mainstem Russian River near Mirabel Park.

Surface Water Regulation

Coyote Valley Dam and Lake Mendocino

Coyote Valley Dam is a multi-purpose facility constructed by the USACE from 1956 to 1959 for flood control, recreation, municipal and industrial water supply, irrigation and power production (USACE 1986). The 3,500 foot wide earth fill embankment extends 160 feet above the streambed and forms Lake Mendocino, which had an original gross capacity of 122,400 acre-feet at the spillway crest elevation (764.8 feet above mean sea level [msl]; crest elevation is 784 feet above msl). Recent bathymetric surveys show a reduction in gross capacity to 116,500 acre-feet due to sedimentation, which, as noted in Chapter 3, averages 143 acre-feet per year (AFY). The outlet works consist of a single concrete conduit located at 637 feet msl that leads toward a powerhouse downstream of the dam. A concrete tower within the lake houses three pairs of hydraulic slide gates that divert flow into the conduit and into the Coyote Valley powerhouse and valve chamber (USACE 1986). Water elevation in the lake varies by time of the year according to a water supply schedule directed by the Water Agency or a flood control schedule managed by USACE. Under water right permit 12947A, the Water Agency can collect into storage 122,500 acre-feet per year. USACE controls reservoir elevation above the winter water conservation pool (68,400 acre-feet), up to the spillway (approximately 48,000 acre-feet), for flood control from 15 October through 31 March and an additional 31,400 acre-feet available on April 1, as needed.

Warm Springs Dam and Lake Sonoma

Warm Springs Dam, which forms Lake Sonoma, is a multi-purpose facility constructed by the USCAE from 1970 to 1983 (litigation halted construction from 1974 to 1978) for flood control, recreation, and water supply (USACE 1984). The 2,600-foot wide earthfill embankment extends 319 feet above the streambed and forms Lake Sonoma. The lowest outlet gate at Warm Springs Dam is at elevation 221 mean sea level (msl), but the lake has a minimum pool level elevation, which is set at 292 feet msl to sustain a reservoir fishery. Except for emergencies, releases of water that result in the water elevation of the lake to drop below 292 feet msl is not authorized. Between water elevation 292 feet msl and 451 feet msl, the lake is in the water conservation pool. Above elevation 451 feet msl to the spillway crest at 495 feet msl (crest elevation is 521 feet msl), the lake is in the flood control pool. The reservoir originally had a gross capacity of 381,000 acre-feet at the spillway crest elevation, but is estimated to currently have 370,000 acre-feet from sedimentation since construction. Of the gross capacity, 130,000 acre-feet makes up the flood control pool and the Water Agency has the right to collect 245,000 acre-feet into storage (the water conservation pool), with the remainder making up the minimum pool.

Flood Management Operations

Coyote Valley Dam

The USACE operates Coyote Valley Dam for flood control. The primary water control objectives of Coyote Valley Dam are: to provide a high degree of flood protection to areas below the dam; to prevent flood flows on the East Fork Russian River from contributing to overbank flood stages on the Russian River below Coyote Valley Dam (as much as possible); to provide the maximum amount of water conservation storage without impairment of the flood control functions of the reservoir; to maintain a minimum continuous flow of 25 cfs immediately below Coyote Valley Dam; to maintain discharge of 150 cfs or inflow to the reservoir, whichever results in the lower reservoir release at the junction between the east and west forks of the Russian River; and to maintain a minimum discharge of 125 cfs at the Russian River near Guerneville (USACE 1986). Releases from Coyote Valley Dam are constrained such that the flow at Hopland does not exceed 8,000 cfs, when local flooding likely begins. Bank sloughing can occur during rapid flow decreases, as such changes in releases from Coyote Valley Dam are limited to 1,000 cfs per hour.

Lake Mendocino has distinct pools for water supply and flood control, determined by the season and elevation of the water surface. The Water Agency determines releases from the water supply pool. When the water level rises above the top of the water supply pool (seasonally between elevation [El.] 737.5 feet and El. 748 feet above msl]) and into the flood control pool, USACE determines releases. Flood control releases follow three schedules depending on storage within Lake Mendocino:1) 2,000 cfs up to a maximum of 4,000 cfs release between 72,300 and 87,400 ac-ft (737.7 feet msl water surface elevation [WSE]) from mid-October to mid-April); 2) 4,000 cfs release between 87,400 and 103,900 ac-ft (746 feet msl WSE and 755 feet msl WSE), and 3) 6,400 cfs release between 103,900 ac-ft and 134,500 acre-feet (755 feet msl WSE and 771 feet msl WSE). Flood gates may be used when the flood pool is above the spillway crest (764.8 feet msl) under Flood Schedule 3, but the sum of the release should not exceed 6,400 cfs, if possible. Regardless of schedule, releases are subject to three limitations:

1. Releases will not be increased or decreased at a rate greater than 1,000 cfs per hour.
2. When flow in the West Fork Russian River at Ukiah exceeds 2,500 cfs and is rising, releases from Lake Mendocino will be reduced to 25 cfs, insofar as possible.
3. Flood releases that contribute to flows greater than 8,000 cfs at Hopland will not be made, as possible.

Warm Springs Dam

The USACE operates Warms Springs Dam whenever the water surface elevation of the reservoir is within the flood control pool. The primary flood control objectives of Warm Springs Dam are to reduce peak discharges in Dry Creek and the Russian River downstream of Healdsburg, restrict discharge on the Russian River at Guerneville to 35,000 cfs, provide the maximum amount of conservation storage without impairing other project functions, and if possible, maintain a minimum pool WSE of 292 feet msl (20,000 acre-feet) to maintain operation of the fish hatchery (USACE 1984). Lake Sonoma contains a 130,000 acre-foot flood control pool, sufficient to accommodate a 144-hour, 30 in. Standard Project Flood (simulated from the December 1955 flood) through storage capacity and operational releases. The USACE determines flood control releases from Warm Springs Dam when water surface elevations of Lake Sonoma exceed 451.1 msl (245,000 acre-feet), the upper water surface elevation of the water supply pool. Flood control releases follow one of three schedules depending on storage capacity within Lake Sonoma: 1) 2,000 cfs release between 245,000 and 260,000 acre-feet (451.1–456.7 msl WSE); 2) 4,000 cfs release between 260,000 and 295,000 acre-feet (456.7–468.9 msl WSE); and 3) 6,000 cfs between 295,000 and 406,000 acre-feet (468.9–502.0 msl WSE). Above 502.0 msl WSE, flood control gates make emergency releases, beginning at 800 cfs (502.0–502.3 msl WSE) to a maximum of 7,900 cfs (505.0 msl WSE and above). Regardless of schedule, releases are subject to four limitations:

1. When the reservoir pool is at or below 502.0 msl WSE and inflow (to the reservoir) is at or above 5,000 cfs, no gate releases will be made.
2. When reservoir pool elevation is at or below 502.0, no releases will be made that will cause discharge on the Russian River at Guerneville to exceed 35,000 cfs.
3. When Quantitative Precipitation Forecasting (QPF) is >1 in. for 24 hours, or 0.6 in. for 6 hours, outflow from the reservoir will not exceed 2,000 cfs.
4. Changes in release rates will not exceed 1,000 cfs/hour to prevent bank failure and erosion along Dry Creek.

Water Supply Operations

As described in Chapter 3, Background and Project Description, the Water Agency is the local sponsor for Lake Mendocino and Lake Sonoma and manages water supply releases from both reservoirs in accordance with its water right permits issued by the State Water Resources Control Board (SWRCB) as those permits were amended by the SWRCB's Decision 1610. The Lake Mendocino water conservation pool ranges from 68,400 acre-feet (November to March) to 111,000 acre-feet (May to October), with transitions between these two levels from April through May and October through November (Figure 3-2 from Chapter 3, "Background and Project Description"). The Lake Sonoma conservation pool holds 245,000 acre-feet (Figure 3-3 from Chapter 3, "Background and Project Description") that constitutes the principal municipal, domestic, and industrial water supply for most of the Russian River, and parts of Sonoma and Marin counties (State Water Resources Control Board 1986; NMFS 2008). Whenever reservoir water surface elevations are within the water conservation pools, the Water Agency directs USACE releases from Lake Mendocino into the Russian River, and from Lake Sonoma into Dry Creek and downstream into the Russian River. The Water Agency sets release levels to maintain minimum instream flow requirements specified in its water rights permits and for downstream beneficial uses, including diversions for municipal, domestic, and industrial purposes.

Operation of Lake Mendocino and Lake Sonoma for water supply is conjunctively managed by the Water Agency according to the terms of its water rights permits. Releases from Lake Mendocino at Coyote Valley Dam primarily support demands and maintain instream flows in the upper reaches of the Russian River down to its confluence with Dry Creek. Downstream of the confluence and in Dry Creek, demands and maintenance of instream flows are supported by releases from Lake Sonoma at Warm Springs Dam. These operational protocols are dictated by the need to preserve the maximum amount of water in the Lake Mendocino water conservation pool due to its smaller capacity and greater susceptibility to dry conditions than Lake Sonoma. Since the 2008 issuance of the Biological Opinion, however, releases from both dams are subject to incidental take criteria as a result of the findings of jeopardy to endangered and threatened salmonids. These incidental take criteria have a more profound effect on limiting releases from Lake Sonoma than on limiting releases from Lake Mendocino. As a result, during the months of June through October, the Water Agency operational protocols have occasionally deviated from that described prior and additional releases from Coyote Valley Dam have been required to minimize the incidental take exceedances on Dry Creek.

Other Water Rights

As described in Chapter 3, Background and Project Description, other water rights permits holders may also use water from Lake Mendocino under certain conditions. The Mendocino County Russian River Flood Control and Water Conservation Improvement District (Mendocino District) holds water-right Permit 12947B authorizing re-diversion and use of up to 8,000 AFY of water released from Lake Mendocino. Refer to Chapter 3, Background and Project Description for further details regarding water rights permits.

Water rights Decision 1030 (SWRCB 1961) also reserved 10,000 acre-feet per year of water from Lake Mendocino for diversions for domestic and agricultural uses within the Russian River

Valley in Sonoma County. The 10,000-acre-feet per year reservation is administered by the SWRCB and available to qualifying appropriative water rights in Sonoma County.

Water Supply Agreements

The Water Agency has agreements with other entities to either supply water or to divert from the Russian River. Chapter 3, Background and Project Description, describes the Water Agency's water supply agreements with its retail contractors, Russian River customers, and other transmission system customers.

Minimum Instream Flow Requirements

As described in Chapter 3, Background and Project Description, the Water Agency is the local sponsor for Lake Mendocino and Lake Sonoma and manages water supply releases from both reservoirs in accordance with its water right permits as amended by the SWRCB's Decision 1610 adopted in 1986.

Decision 1610 established minimum instream flow requirements for the Russian River and Dry Creek, which are included as terms in the Water Agency's water right permits. Refer to Section 3.3.4 in Chapter 3, "Background and Project Description," for details regarding Decision 1610 minimum instream flow requirements. The minimum instream flows requirements were established for four reaches in the Russian River watershed: 1) East Fork Russian River from Coyote Valley Dam to the confluence with the Russian River; 2) the Russian River between the East Fork confluence and Dry Creek; 3) the Russian River between Dry Creek and the Pacific Ocean; and 4) Dry Creek downstream of Warm Springs Dam to the confluence with the Russian River.

Hydrologic Condition

Under the Water Agency's water right permits and Decision 1610, required minimum instream flows in the Russian River vary based upon a hydrologic index that sets water supply condition determined by the cumulative inflow to Lake Pillsbury (on the Eel River) on the first of each month between January and June from the previous October (referred to here as the "Decision 1610 Hydrologic Index"). The Decision 1610 Hydrologic Index has three schedules corresponding to the water supply condition (*Normal*, *Dry*, and *Critical*) and can change monthly until June 1 when the condition is set for the remainder of the year. As discussed in Chapter 3.3.4, two spring sub-conditions (*Normal Dry Spring 1* and *Normal Dry Spring 2*) can occur within the *Normal* condition on May 31 of each year if the total combined storage in Lake Mendocino and Lake Pillsbury is between 130,000 to 150,000 acre-feet, or 80-90 percent of the estimated total water supply storage of the reservoirs, whichever is less (*Dry-Spring 1*), or if the combined storage in Lake Pillsbury and Lake Mendocino is less than 130,000 acre-feet or less than 80 percent of the estimated total water supply storage of the reservoirs (*Normal-Dry Spring 2*). *Normal Dry-Spring 1* and *2* conditions result in lower minimum instream flow requirements in the Upper Russian River from 75 to 150 cfs. Hydrologic modeling (described in Appendix G) shows that under the Decision 1610 Hydrologic Index, *Normal* water supply conditions occurs in 75 percent of all years, and *Dry* and *Critical* occur 22 percent and 3 percent, respectively.

Water Supply Operations to Maintain Minimum Instream Flow

The Water Agency operates Lake Mendocino and Lake Sonoma to preserve water in each reservoir's water supply pool while complying with minimum instream flow requirements and meeting downstream demands. When rainfall and natural runoff are sufficient to meet minimum instream flow requirements at downstream gages (compliance points), the Water Agency limits water supply pool releases to amounts needed to meet the minimum instream flow requirement in the East Fork Russian River between Coyote Valley Dam and the West Fork of the Russian River (25 cfs at all times) and to meet the needs for the Don Clausen Fish Hatchery (a minimum of 70 cfs) (SCWA 2014). As natural runoff decreases through spring and into summer, the Water Agency increases releases to ensure minimum instream flows at compliance points all along the Russian River and Dry Creek. Typically, in the spring and early summer, when flow is higher downstream than upstream (Figure 4.1-1, Figure 4.1-3, and Figure 4.1-5), the compliance point is the most upstream point, either downstream of Coyote Valley Dam at the confluence of the East Fork and the West Fork Russian River (the Forks), downstream of Warm Springs Dam at the Dry Creek near Geyserville USGS gage site, or at the confluence of the Russian River and Dry Creek. During the dry season when flow is higher upstream than downstream due to declining tributary inputs and increased surface water losses to evaporation, diversions, and surface water/groundwater interaction losses, the compliance point moves downstream, gradually shifting to the most downstream point by late-summer and early-fall. The most downstream compliance points are the Healdsburg USGS gage site in the Upper Russian River, the Dry Creek mouth near Healdsburg USGS gage site in Dry Creek, and the Russian River near Guerneville USGS gage site in the Lower Russian River.

Hydroelectric Power

Coyote Valley and Warm Springs dams support hydroelectric power generation as part of their facilities. Chapter 3, "Background and Project Description," provides details about the Lake Mendocino Hydroelectric Facility, which is operated by the City of Ukiah under license 2841 from the Federal Energy Regulatory Commission (FERC). The Water Agency operates the Warm Springs Dam Hydroelectric Project under license 3351 from FERC. Chapter 3, "Background and Project Description," provides details about the Warm Springs Dam Hydroelectric Project. No releases from either Coyote Valley Dam or Warm Springs Dam are made solely for hydroelectric power generation.

Groundwater

Groundwater resources that could potentially be affected by the project (i.e., changes in releases from Lake Mendocino or Lake Sonoma) consist of aquifer systems that are in direct hydraulic communication with the surface water system affected by the reservoir releases. These include shallow unconfined aquifer systems occurring beneath and adjacent to the mainstem Russian River downstream of Coyote Valley Dam to the Pacific Ocean and beneath Dry Creek and adjacent to downstream of Warm Springs Dam. The following subsections describe (1) general concepts and characteristics of the interactions between groundwater and surface water and (2) the physical descriptions of the aquifer systems potentially affected by the project.

Surface Water and Groundwater Interaction General Concepts

In river and stream systems, surface water and groundwater are functionally inter-dependent and their interactions are controlled by the degree of hydraulic connection (Winter et al. 1998). In hydraulically connected systems, the groundwater table is in contact with the surface water of a river or stream. The exchange of water between groundwater and surface water is controlled by the relative elevations between the groundwater table and surface water level and the hydraulic conductivity of the streambed materials. Streams gain water when the groundwater table elevation is greater than surface water elevation, causing groundwater to flow into the stream ("gaining streams"). Streams lose water as the groundwater table elevation becomes lower than the adjacent surface water elevations causing surface water to flow out of a stream and into an aquifer ("losing streams"). In hydraulically disconnected systems, the groundwater table occurs beneath the bottom of the streambed and groundwater and surface water are not in physical contact. Disconnected rivers and streams typically lose water and may provide recharge to shallow unconfined aquifer systems. Hydraulically connected streams can be perennially gaining or losing or they can convert from gaining to losing over varying time-scales and reaches depending on the seasonal fluctuations of the groundwater table, the amount and timing of riparian evapotranspiration, and the amount, timing and location of any nearby groundwater pumping. Pumping of groundwater from wells can result in the depletion of streamflows. Factors that control the time response of streamflow depletion to groundwater pumping include the geologic structure, dimensions and hydraulic properties of the groundwater system; the locations and hydrologic conditions along the boundaries of the groundwater system, including streams; the horizontal and vertical distances of wells from the streams (Barlow and Leake 2012).

Description of Aquifer Systems in Project Area

Groundwater resources in the North Coast Hydrologic Region occur along the coast near major river mouths, on marine terraces, or inland river valleys and basins (DWR 2003). Reliability of these resources varies, but DWR (2003) delineated 63 groundwater basins (divided into 551 basin/sub-basins) in the region underlying approximately 1.022 million acres (1,600 mi^2). Along the coast, most groundwater comes from shallow wells in alluvium (sand and gravel) underlying the region's rivers.

The Russian River basin contains three general geologic formation assemblages differentiated by age and water bearing properties (Caldwell 1965). The oldest geologic formations (Jurassic and Cretaceous age) are rocks of the Franciscan, Great Valley and Coast Range Ophiolite, which occur as bedrock along the northern Coast Ranges and provide limited amounts of groundwater (through fracture flow) for primarily domestic use in mountain areas. Younger geologic formations of Pliocene and Pleistocene age (Sonoma volcanics, Wilson Grove [formerly Merced] formation, Glen Ellen formation) occur as occasional outcrops through the Russian River basin and can provide groundwater, but their geographic extent is limited. The youngest geologic formations are Quaternary and more recent alluvial deposits[3] (Caldwell 1965). Following the Wisconsin Glaciation, sea level rise caused the deposit of clay, sand, and

[3] Alluvial deposits are made up of alluvium, which is loose, unconsolidated sediment eroded by water and deposited in a non-marine environment.

gravel within the Russian River Valley. This unconsolidated sediment deposited as deltaic fans, floodplains, stream channels, and remains as terraces and other river landforms (Florsheim and Goodwin 1995). The Quaternary alluvial deposits, where sufficiently thick and saturated, comprise the most productive aquifer in the Project Area and are a high yield source for municipal, rural domestic and agricultural needs (Caldwell 1965, Florsheim and Goodwin 1995). In areas where the Quaternary alluvial deposits are relatively thin, such as near the margins of the valley, older formations, including the Glen Ellen Formation and Sonoma Volcanics (where present) are more commonly tapped by water wells (DWR 2003, USGS 2006).

The Project Area for groundwater resources encompasses several groundwater basins and subbasins as defined by Bulletin 118 of the California Department of Water Resources (Table 4.1-10) (DWR 2003). The Upper Russian River includes the Ukiah Valley (California groundwater basin #1-52), Sanel Valley (California groundwater basin #1-53), and Alexander Valley (California groundwater basin #1-54) groundwater basins. DWR (2003) further divides the Alexander Valley groundwater basin into the Alexander (#1-54.01) and Cloverdale (#1.54.02) sub-basins, which both occur in the Upper Russian River. The Healdsburg Area sub-basin (California groundwater sub-basin #1-55.02) of the Santa Rosa Valley basin (DWR 2003) straddles the Dry Creek Reach and southern end of the Upper Russian River. The Lower Russian River includes the Lower Russian River groundwater basin (California groundwater basin #1-60). The Santa Rosa Plain sub-basin (California groundwater sub-basin #1-55.01, part of the Santa Rosa Valley groundwater basin [#1-55]) is tributary to the Project area and aquifer systems within the Santa Rosa Plain are not considered to be in direct hydraulic communication with surface waters affected by the project.

Table 4.1-10. Groundwater basins found within the study area[1].

Groundwater basin (#)	Sub-basin	Acres
Ukiah Valley (1-52)	none	37,500
Sanel Valley (1-53)	none	5,570
Alexander Valley (1-54)	Alexander (1-54.01)	24,500
	Cloverdale (1-54.02)	6,500
Santa Rosa Valley (1-55)	Healdsburg (1-55.02)	15,400
Lower Russian River (1-60)	none	6,600

[1]Source: DWR. 2003. California's Groundwater: Bulletin 18. State of California, Sacramento, CA 2003.

The basins and sub-basins range in size from 5,570 to 37,500 acres and are utilized to varying degrees for water supply. Detailed groundwater budgets, an analysis of inflows and outflows useful for estimating storage change, have not been developed for most of the basins and sub-basins (Type C budget: not enough data to provide either an estimate of the basin's groundwater budget or groundwater extraction from the basin). The groundwater basins and subbasins are mapped based on the surficial distribution of alluvial geologic formations and represent areas with shallow alluvial aquifer systems that are most likely to exhibit direct hydraulic communication with surface water systems. Other aquifer systems that underlie the Project Area primarily occur within fractured bedrock of the Franciscan Complex, Great Valley Sequence and Coast Range Ophiolite and are more limited and sporadic in their occurrence and connection with the affected surface water systems, USGS (2006) also conducted a study of the hydrogeology and water chemistry of the Alexander Valley to address water-management issues, including potential increases in water demand and potential changes in flows in the Russian River to improve conditions for listed fish species under the State and Federal ESA. The estimated total water use for the Alexander Valley for 1999 was approximately 15,800 ac-ft. About 13,500 ac-ft of this amount was estimated to be for agricultural use, primarily vineyards, and about 2,300 ac-ft was for municipal/industrial use. Groundwater was reported to be the main source of water supply (estimated to meet 78% of the total water demands) in the basin, although the estimate may include some diversions made through wells under surface water rights (USGS, 2006).

In the Project Area, the principal inflows to groundwater are precipitation and surface water from rivers and streams (Caldwell 1965). Seasonal groundwater-level fluctuations vary from one to two feet (primarily along Dry Creek) to five to 10 feet in other areas. The seasonal high groundwater-levels generally correspond with high river and stream flows and indicate that groundwater within the alluvial aquifer is in close hydraulic communication with surface water. Groundwater-levels in the southern portion of the Healdsburg Area subbasin are also locally influenced by a series of quarry ponds which have been excavated along the middle reach of the Russian River. In general, during the rainy season with high river flows (typically late-fall through early spring (Figure 4.1-1, Figure 4.1-3, and Figure 4.1-5) surface water overtops banks and floodplains, infiltrating into and recharging unconfined aquifers. As flow and water surfaces decline to elevations lower than the adjacent groundwater table (typically late-spring to early summer), surface water is gained as aquifers discharge into rivers and stream channels, contributing baseflow to the rivers and streams. Through the summer and early-fall, the groundwater table elevation can gradually drop below surface water surface elevation along some reaches, and streamflow enters the aquifer. Additionally in areas where groundwater is pumped through wells located near the river, streamflow depletion can occur and locally result in losing river conditions.

Geomorphology

The current geomorphic condition of the Russian River and Dry Creek reflects the evolution and intensity of past and current land uses. Prior to European settlement in 1850, forests covered much of the Russian River and Dry Creek valleys, which were subject to dynamic fluvial interaction and characterized by large gravel bars, forested islands, side-channels and sloughs. These landforms became less prevalent, and watercourses less dynamic, as timber harvest, grazing, agriculture, gravel mining, and water storage and regulation increased. The Russian River and Dry Creek responded by incising into their alluvial valleys, changing the hydraulic environment from relatively wide and shallow to narrow and deep, and simplifying or eliminating fluvial landforms that provided habitat for aquatic and riparian biota.

Several sources (Harvey and Schumm 1985, Simons, Li and Associates 1991, Swanson 1992, Florsheim and Goodwin 1995) summarize a narrative history of land-use changes and river response, and examine recently collected survey data to describe and characterize the historical and current geomorphic condition of the Russian River from Coyote Valley Dam to the Pacific Ocean and Dry Creek. The narrative history and survey data show systemic changes through both basins from 1850 to present. Survey data were collected by different agencies

(USACE, DWR, FEMA) for various purposes. Consequently, the data occur at irregular spatial scales and time intervals. Nonetheless, the data show a pattern of channel incision and geomorphic change along the length of the Russian River and Dry Creek.

Prior to 1850, the wide alluvial portions of the Russian River meandered across adjacent floodplains while bedrock sections remained confined within narrow canyons. Shortly after European settlement, channel stabilization attempted to preserve and fix parcel boundaries surveyed from the centerline of the active channel to the land surface. Agricultural practices filled side-channels and sloughs and removed riparian vegetation to further increase land area. In 1908, the Potter Valley Project brought water from the Eel River into the Russian River, increasing flow during dry months. Florsheim and Goodwin (1995) note that this was the beginning of summer flow in the Russian River, prior to 1908 flow reduced to a trickle, but surface water remained in disconnected sloughs and side channels. Cultivation and agricultural activity increased through the 1940s when demand for aggregate and sand intensified, leading to gravel mining, and in-channel debris clearing to reduce flooding became practice. The completion of Coyote Valley Dam in 1959 altered the hydrograph and sediment transport from the East Fork Russian River to the mainstem Russian River.

Upper Russian River

Through the Upper Russian River, beginning in Mendocino County, aerial photographs show minimal change in channel width or sinuosity from the 1950s to the 1990s, but a comparison of longitudinal profiles and cross sections show substantial adjustment to land-use changes (Florsheim and Goodwin 1995). Long profiles from 1940 and 1979 showed that bed elevations lowered 10 to 18 feet just downstream of Coyote Valley Dam between River Miles 84 and 94, while later surveys (1979 and 1989) showed 5 feet of incision between Feliz Creek and the Highway 101 bridge crossing. Cross-sections collected in 1980, 1981, and 1982 at tributary junctions and bridge crossings show increases in channel area at Dooley Creek, Forsythe Creek, and Robinson Creek and in the Russian River at Highway 175 corresponding to incision and channel widening. Other field evidence of incision includes construction of grade control structures on Ackerman, Hensley, and Robinson creeks intended to prevent downcutting on bridge piers as tributary bed elevation lowered in response to coincident lowering on the Russian River.

Historical management, aerial photographs and maps indicate substantial planform change through the Alexander Valley and survey data show channel incision similar to upstream through Mendocino County. Levees constructed in the 1930s confined a portion of the river from the Cloverdale airport to Big Sulphur Creek, and USACE and the Water Agency began channel maintenance activities in 1959 after construction of Coyote Valley Dam (Florsheim and Goodwin 1995). In conjunction with the Coyote Valley Dam project, USACE constructed channel stabilization works from 1956 to 1963 that included channel clearing, pilot channels (conversion of a meander to a straight portion of river), bank protection works, including anchored steel jacks, wire mesh gravel revetments, and check dams (USACE 1997). Historical topographic maps and aerial photography show channel planform evolving from a sinuous channel surrounded by a wide riparian area to a straight channel surrounded by stabilization measures, agriculture, and gravel mining. Simons, Li and Associates (1991) monitored channel change through the Alexander Valley (and a portion of the Lower Russian River, upstream of Dry Creek, see below) using aerial photographs from 1981 to 1986 and observed localized bank failure that eroded riparian vegetation and surrounding undeveloped and cultivated lands. Simons, Li and Associates (1991) also noted meander migration within the active channel along a portion of the valley. Sequential longitudinal profiles from 1971 and 1991 by USACE and the Water Agency show 20 feet of channel degradation (incision) in the lower Alexander Valley, with some localized aggradation associated with channel widening (Florsheim and Goodwin 1995). Sequential cross-sections also indicate channel lowering and localized channel widening, likely related to flooding induced bank erosion.

Lower Russian River

The Lower Russian River flows generally south through a heavily modified alluvial section before entering a confined canyon cutting across the Coast Ranges that leads to the Russian River Estuary and the Pacific Ocean. In the alluvial section, aerial photographs from the 1940s and 1950s show intense floodplain and channel modification from gravel mining and flood control activities, while historical topographic maps document the river corridor evolving from a wide riparian area with a sinuous channel (1864) to a narrow, straight channel (1980) subject to bank stabilization and agricultural development (Florsheim and Goodwin 1995). Longitudinal profiles through this portion indicate channel incision of up to 20 feet, likely due to instream gravel mining. The primary gravel extraction method on the Russian River in the 1940s was deep dredging of the active channel, which occurred in the alluvial section of the Lower Russian River to depths of 30 to 60 feet (Swanson 1992). Regulations later limited gravel mining to bar skimming and floodplain excavation (gravel pits), but intensive gravel mining from the 1940s to the 1970s lowered bed elevation between Dry Creek and Wohler Bridge by up to 18 feet. As noted above, Dry Creek incised by up to 10 feet in response to lower bed elevations in the Russian River (Harvey and Schumm 1985). The canyon section of the Lower Russian River is relatively stable compared to upstream areas (including the Upper Russian River and Dry Creek), although Florsheim and Goodwin (1995) note approximately 12 feet of degradation at the Monte Rio Bridge since 1934, but little since 1973. The estuarine portion of the Lower Russian River extends 6 to 7 miles upstream from the mouth of the Russian River to upstream of Austin Creek, with bed elevations generally below sea level up to RM 12 (Florsheim and Goodwin 1995). A barrier beach occasionally forms across the mouth of the river during the dry season (and occasionally during winter), impounding water to form a lagoon (ENTRIX 2004). The sandbar opens naturally when hydraulic conditions in the Russian River and Pacific Ocean change, or when it is artificially breached. When the sandbar is open, the estuary is open to tidal mixing. Current water operations affect the estuary primarily in the low-flow months when minimum instream flow requirements result in a need for an artificial sandbar breaching program to prevent flooding of local property.

Dry Creek

The current geomorphic condition of Dry Creek is a reflection of the evolution and intensity of past and current land-use practices. Harvey and Schumm (1985) conducted a geomorphic assessment of Dry Creek that described cross-sectional and longitudinal response to changes in land-use since 1850, the beginning of European settlement. Prior to 1850, forests covered 50 percent of the Dry Creek basin (Ritter and Brown 1971). Settlers cleared up to 40 percent of these forests for grazing, resulting in increased surface and hillslope erosion and sediment delivery to the stream channel. This land-use change also increased stream discharge through decreases in infiltration and more efficient delivery of runoff from agricultural drainage systems. The channel responded by aggrading up to 3 feet, then degrading approximately 12 feet to reach an equilibrium base-level by 1900 (Figure 4.1-8). The onset of gravel mining from the channel and floodplains caused further channel degradation in response to base-level lowering in the Russian River, an increase in extraction rates in Dry Creek from the 1950s to 1960s, and record annual runoff (see Flood Hydrology, above). By 1964 the Dry Creek channel incised another 10 feet, resulting in channel instability and increased sediment yield to the Russian River. The rate of channel incision decreased by 1974, with Harvey and Schumm (1985) noting further degradation (2.4 feet) from the 1964 base-level. But, the systemic incision ceased just upstream of Lambert Bridge due to the presence of grade controlling Franciscan Foundation bedrock outcrops. By 1984, Dry Creek downstream of Lambert Bridge lowered another 2.0 feet, but appeared to reach a new equilibrium with the formation of a sinuous channel and adjacent gravel bars within the recently incised valleys.

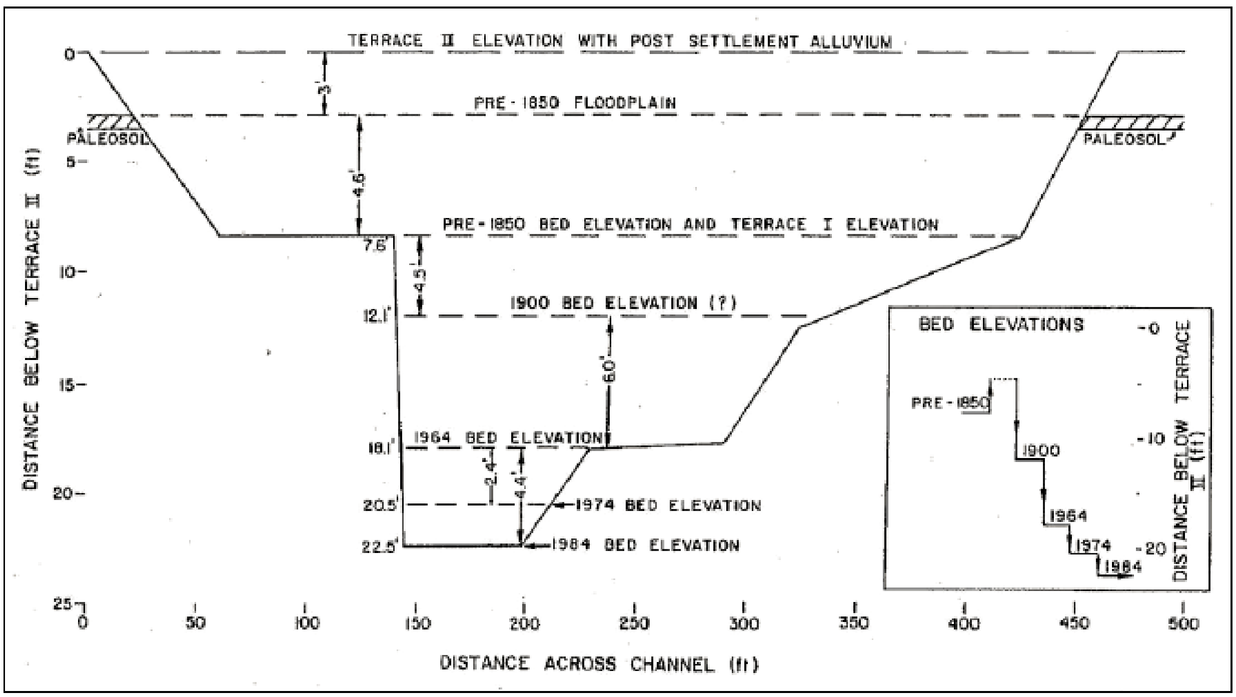

Figure 4.1-8. Historical incision through the Dry Creek Valley from 1850 to 1984 (Taken from Harvey and Schumm 1985).

As described above (see “Groundwater”) groundwater and surface water are functionally inter-dependent and the relative elevations of the groundwater table and surface water influence whether a stream is gaining or losing. Systemic channel incision through the Upper Russian River, Dry Creek, and the Lower Russian River also lowered surface water elevations relative to the groundwater table, possibly lowering the adjacent groundwater table. Substantially lower water surface elevations could potentially drain aquifers more rapidly than higher water surface elevations. In a Mediterranean climate, hydraulically-connected system, such as the Russian River, a lower surface water elevation could hasten the seasonal transition from surface water gaining to losing. Still, under unregulated conditions, the Russian River, Dry Creek, and tributaries underlain by alluvium likely went dry, became intermittent, or had very little flow in late-summer to early-fall as groundwater contributions waned and surface water infiltrated into aquifers. Any lowering of the groundwater table due to historical incision has likely stabilized as regulation and minimum instream flows maintain perennial surface flow and provide groundwater recharge throughout the year.

4.1.3 Regulatory Framework

State

State Water Resources Control Board

The SWRCB is responsible for approving any modification in water right permits or issuing new water right permits. The SWRCB has statutory authority over appropriative water rights in California. California water right permits contain terms, which among other things, specify the maximum authorized rates of direct diversion and re-diversion. “Direct diversion” refers to water diverted directly from stream flows. “Re-diversion” refers to water that is first collected to storage in a reservoir, then released from storage and diverted again (re-diverted) at a point downstream. In addition, the Division of Drinking Water within the SWRCB issues permits for public water supply systems.

As described in Section 3.3.6 of Chapter 3, “Background and Project Description,” the Water Agency manages water supply releases from Coyote Valley Dam and Warm Springs Dam under water right permits originally issued in accordance with SWRCB in Decision 1030, adopted on August 17, 1961, and then modified by Decision 1416, adopted on March 15, 1973; Order WR 74-30, adopted on October 17, 1974; Order WR 74-34, adopted on November 21, 1974; and Decision 1610, adopted on April 17, 1986.

California Department of Water Resources

The California Department of Water Resources (DWR) is the state agency responsible for managing California’s water resources, including conducting technical studies of surface water and groundwater in cooperation with local agencies, overseeing certain flood prevention and floodplain management programs, and developing and implementing water conservation and efficient water use strategies and programs in cooperation with local agencies. DWR is also responsible for building, operating, and maintaining the State Water Project, which supplies drinking water and agricultural irrigation water to various parts of the state (but not including Sonoma County). DWR has also has the responsibility for overseeing the preparation of Groundwater Management Plans (Department of Water Resources 2012).

Groundwater

The California Water Code (Section 10752) defines "groundwater" as all water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water which flows in known and definite channels.

California Statewide Groundwater Elevation Monitoring

Under the California 2009 Comprehensive Water Package, DWR implemented the California Statewide Groundwater Elevation Monitoring (CASGEM) program to establish rules for local agencies to develop and conduct groundwater level monitoring programs (DWR 2015). The water package required DWR to describe the degree of groundwater elevation monitoring within groundwater basins listed in DWR (2003; California's Groundwater, Bulletin 118, update 2003) to prioritize basins to identify, evaluate, and determine the need for additional groundwater level monitoring. DWR (2015; California's Groundwater, Update 2013, dated April 2015) used groundwater reliance as the leading indicator of basin priority to evaluate and categorize groundwater basins them into high, medium, low, and very low priority for water level monitoring. High or medium priority basins encompass 96 percent of annual groundwater use in California. The Ukiah Valley groundwater basin (1-52) is the only medium priority groundwater basin or subbasin that received a medium basin priority score within the project area. The other five groundwater basins and subbasins within the project area received a very low overall basin priority with low scores of groundwater use and groundwater reliance (DWR 2015). The Santa Rosa Plain groundwater sub-basin (#155.01), which is tributary to the project area, was designated as a medium basin priority basin.

Sustainable Groundwater Management Act

In September 2014, Governor Brown signed legislation requiring that California's critical groundwater resources be sustainably managed by local agencies. The Sustainable Groundwater Management Act (SGMA), which became effective on January 1, 2015, gives local public agencies that have water supply, water management or land use responsibilities the authority to form Groundwater Sustainability Agencies (GSAs), SGMA is required to be implemented for medium and high priority groundwater basins and GSA for these basins must be formed by June 30, 2017. GSAs are required to develop Groundwater Sustainability Plans (GSPs) which must describe how a groundwater basin will be sustainability managed within 20 years. The GSAs have discretionary authorities including conducting studies, regulating groundwater use, imposing fees, and constructing/operating projects to achieve groundwater sustainability. If a GSA is not formed or if it fails to meet the requirements of SGMA and achieve sustainability, the state can intervene and assume management of the groundwater basin. Currently, the Ukiah Valley is the only medium priority basin within the project area and is subject to the requirements of SGMA. As noted above, the Santa Rosa Plain, which is tributary to the project area, is also a medium priority basin and subject to the requirements of SGMA. Efforts are currently underway to form GSAs in these two basins by the deadline of June 2017. Once formed, the GSAs will be responsible for preparing GSPs for the two basins by January 2022, which must describe how the basins will be sustainably managed. Additionally, DWR will be reprioritizing basins in late 2016 or early 2017 with an added criteria that incorporates the potential for surface water and groundwater interaction and habitat impacts, which could potentially add additional medium or high priority basins in the project area.

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 4.1.5.

Mendocino County Water Action Plan

The Mendocino County Water Agency Action Plan (Mendocino County Water Agency 2015) is a plan to navigate regulatory, financial, water availability and legislative challenges and issues. The objectives and actions are a “road map” that the Mendocino County Water Agency will follow to adaptively move forward to achieve its mission of protecting and enhancing the reliability, availability, affordability and quality of water resources. The plan describes several action plan projects including monitoring for CASGEM in the Round Valley/Covelo, the Fort Bragg Terrace Area, Anderson Valley, and Sanel Valley groundwater basins. Mendocino County is coordinating the monitoring, which involves collecting well data from local agencies conducting the well monitoring and formatting and uploading the information to the State system.

Ukiah Valley Area Plan

The Ukiah Valley Area Plan (UVAP) is a comprehensive and long range inter-jurisdictional planning document that is an element of the Mendocino County General Plan governing land use and development on the unincorporated lands in the Ukiah Valley (Mendocino County 2011). The plan addresses water supply, distribution and quality through four water management goals and policies to achieve those goals:

- **Goal WM1** Promote efforts that protect and increase water supply storage and capacity
- **Goal WM2** Strike a balance between water supply infrastructure and new development.
- **Goal WM3** Promote reclamation and conservation of water.
- **Goal WM4** Protect water quality by improving storm and wastewater management practices.

Sonoma County Permit and Resource Management Department (PRMD)

The Sonoma County PRMD is responsible for issuing groundwater well permits in unincorporated areas of the County. The well permitting process varies depending on the availability of groundwater at the location of the proposed well. A four-tiered classification system is used to indicate general areas of groundwater availability:

- Class I includes Major Groundwater Basins;
- Class II includes the Major Natural Recharge Areas;
- Class III includes the Marginal Groundwater Availability Areas; and
- Class IV includes Areas with Low or High Variable Water Yield.

For proposed non-agricultural wells located in Class III and Class IV areas, applicants are required to provide proof of adequate groundwater yields to meet the proposed domestic or commercial uses by means of a geologic report. Provided they meet certain minimum County and state requirements for construction, agricultural well permits are granted, generally without further technical review, provided they meet certain minimum County and state requirements for construction.. However, agricultural well permits may be associated with other aspects of an agriculturally related project, such as processing or visitor-serving use. Such uses are typically subject to discretionary project review and permit approval process, including the review of the proposed well construction and operational details. Discretionary permits are not granted unless the geologic report establishes that groundwater supplies in the vicinity of the proposed well are adequate and will not be adversely impacted by anticipated future land uses and development.

Sonoma County General Plan

Parts of the Proposed Project are located within the jurisdiction of Sonoma County General Plan 2020 (PRMD 2008). The Sonoma County General Plan is discussed further in Section 4.1.5.

4.1.4 Impact Analysis

This section describes the impact analysis relating to hydrology 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.

Methodology

The hydrology impact assessment relies on a qualitative evaluation of potential changes to groundwater and surface water conditions (including erosion and flooding hazards) under the Fish Flow and Water Rights Project. The qualitative evaluation relied on a quantitative hydrologic model, the Russian River Reservoir System Simulation (Russian River ResSim) model, that used 104 years (1910 to 2013) of estimated unimpaired hydrology to analyze potential impacts (detailed in Appendix G). The assessment uses the model to analyze impacts between Baseline Conditions and the Proposed Project and No Project 1 and No Project 2 alternatives. The Russian River ResSim model simulates instream flow at nodes in each reach: in the Upper Russian River just downstream of Coyote Valley Dam, downstream of the junction of the East Fork and the mainstem Russian River, and at the Hopland, Cloverdale, and Healdsburg USGS gage sites; in the Lower Russian River at the junction of the Russian River and Dry Creek and the Guerneville gage site; and in Dry Creek just downstream of Warm Springs Dam, and at the Geyserville and Dry Creek mouth USGS gage sites. Nodes are meant to describe hydrologic trends at inflow sites (e.g., dam outlets), tributary junctions, or at the downstream ends of key reaches, and are independent of existing gage locations, although gage sites may be (and are) coincident with node location. Gages are often located in these same areas to describe similar patterns and trends. The Russian River ResSim model simulates instream flow over a longer period of record and across a wider range of hydrologic conditions (i.e., wet, normal, dry years) under current regulation and demands (with Coyote Valley and Warm Springs dams in place) than available from USGS gage records.

Russian River ResSim model simulations show that under Baseline Conditions median monthly flow is greatest at most nodes in all reaches in February (Figure 4.1-9, Figure 4.1-10, Figure 4.1-11), similar to post-Coyote Valley and Warm Spring dams trends observed at USGS gage sites in the Upper Russian River (Figure 4.1-1), Dry Creek (Figure 4.1-3), and the Lower Russian River (Figure 4.1-5) although at a lower magnitude, and a low but relatively constant flow from June through October. The model also illustrates longitudinal trends occurring under baseline regulation. Median monthly flows in all reaches follow a longitudinal trend that shifts seasonally. During fall and winter instream flows are lowest at the most upstream nodes (Coyote Valley Dam, Warm Springs Dam, and Russian River at Dry Creek Confluence) and increase downstream owing to flood retention in reservoirs (Lake Mendocino and Lake Sonoma) and tributary input between nodes. In spring, median monthly flows are still low at upstream nodes and successive tributary inputs still slightly increase flow downstream, but as summer progresses, tributary inputs decrease and dam releases increase to meet minimum instream flow requirements and water supply needs (see below). By May (Lower Russian River; Figure 4.1-11), June (Dry Creek, Figure 4.1-10), July (Upper Russian River, Figure 4.1-9) and through

September, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease.

Analysis of effects of the No Project 1 Alternative, the No Project 2 Alternative, and the Proposed Project on hydrology relied on instream flow estimated by the Russian River ResSim model at nodes along the Upper Russian River, Dry Creek, and the Lower Russian River. The model estimated daily flow for the 104 years of record, then calculated exceedance probability, which is the probability that an event (a particular flow, in this case) will be exceeded during a one-year period. Exceedance probabilities estimated by the model range from 0.99 to 0.01, where the lowest flow would be exceeded in 99 percent of all years (0.99 exceedance probability) and the highest flow would be exceeded in 1 percent of all years (0.01 exceedance probability). The analysis assigned modeled instream results to exceedance probabilities to describe flow occurring during different conditions, with 0.99 exceedance simulating a dry condition and 0.05 exceedance simulating the wettest condition (Table 4.1-11, Table 4.1-12, Table 4.1-13).

The model results were compared against stage-discharge rating curves to evaluate stage (water surface elevation) change along the Upper Russian River, Dry Creek, the Lower Russian River, and within Lake Mendocino and Lake Sonoma to analyze effects on groundwater levels and to determine potential effects on erosion by exposure of streambanks or shoreline. Estimates of stage came from the latest stage discharge rating curves at USGS gages within the project reaches (rating curves retrieved June 8, 2016 from USGS 2016a, b, c, d, e, and f):

- Upper Russian River
    - Russian River near Hopland (USGS gage # 11461000)
    - Russian River near Cloverdale (USGS gage # 11462080)
    - Russian River near Healdsburg (USGS gage # 11464000)
- Dry Creek
    - Dry Creek near Geyserville (USGS gage # 11465200)
    - Dry Creek near Healdsburg (Dry Creek mouth) (USGS gage # 11465350)
- Lower Russian River
    - Russian River near Guerneville (Hacienda Bridge) (USGS gage # 11467000)

The model calculated stage for a smaller set of nodes than for instream flow, which used unique points as well as selected USGS gage locations.

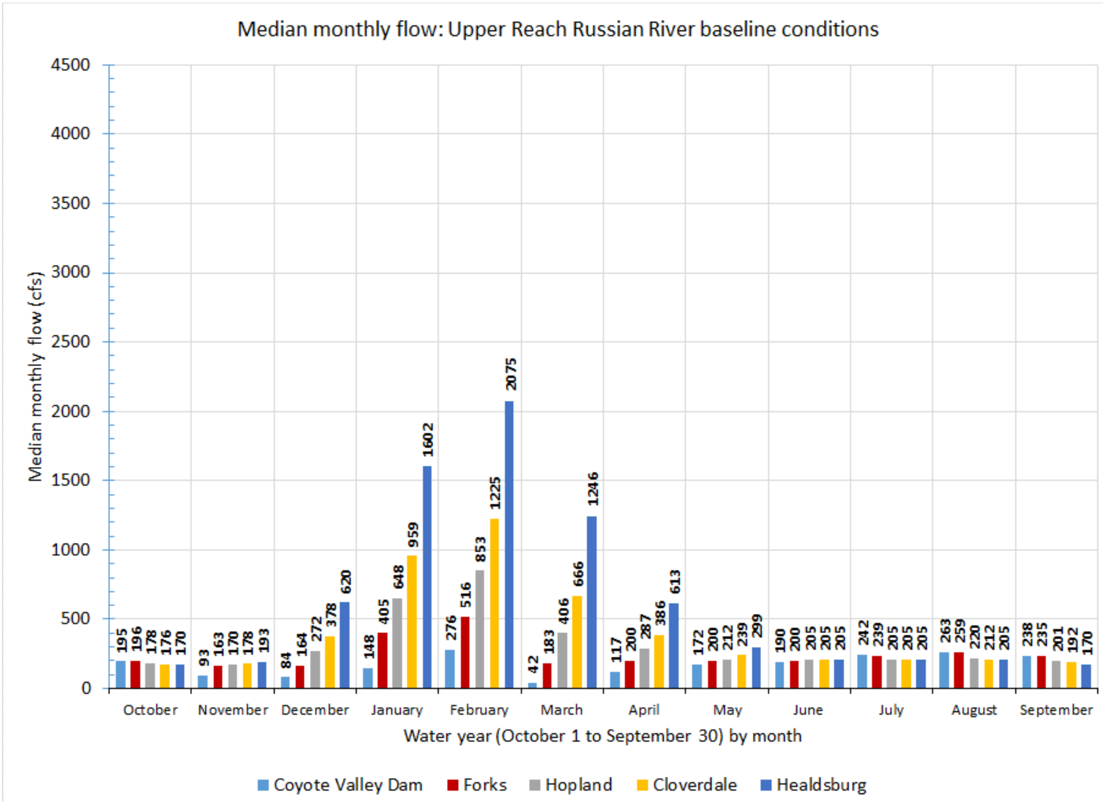

Figure 4.1-9. Median monthly flow, modeled Baseline Conditions, Upper Russian River.

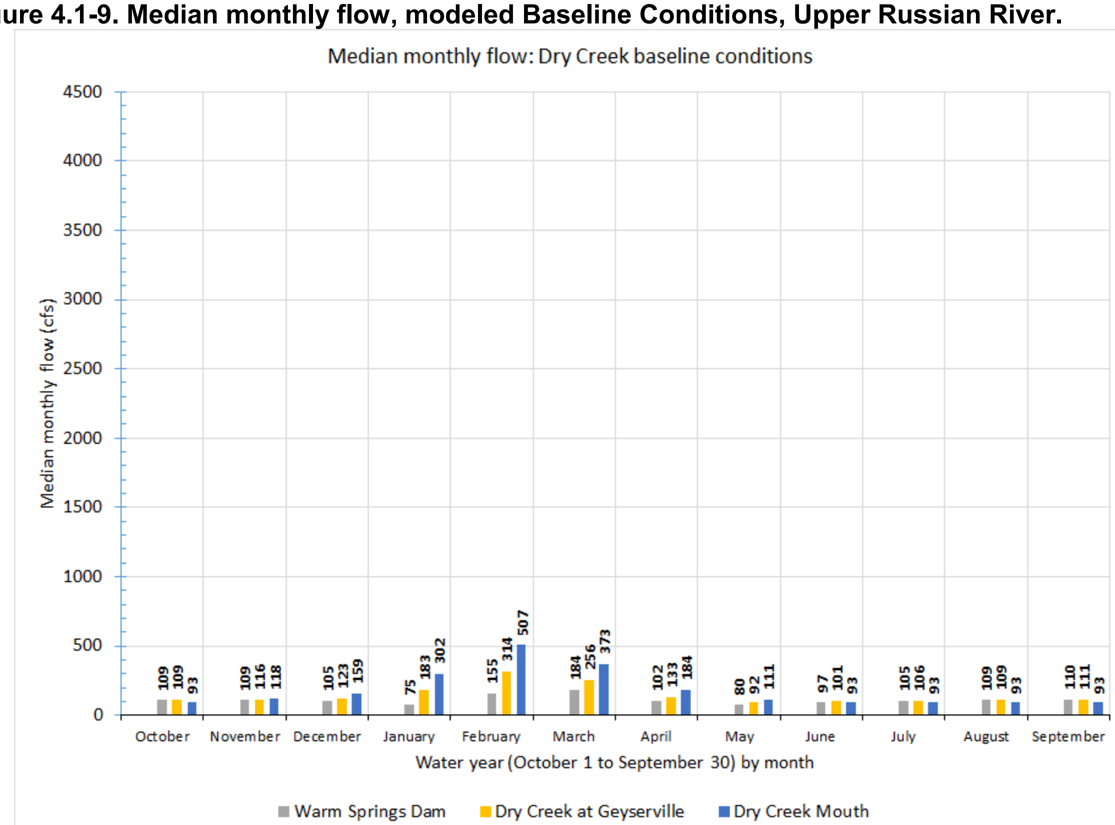

Figure 4.1-10. Median monthly flow, modeled Baseline Conditions, Dry Creek.

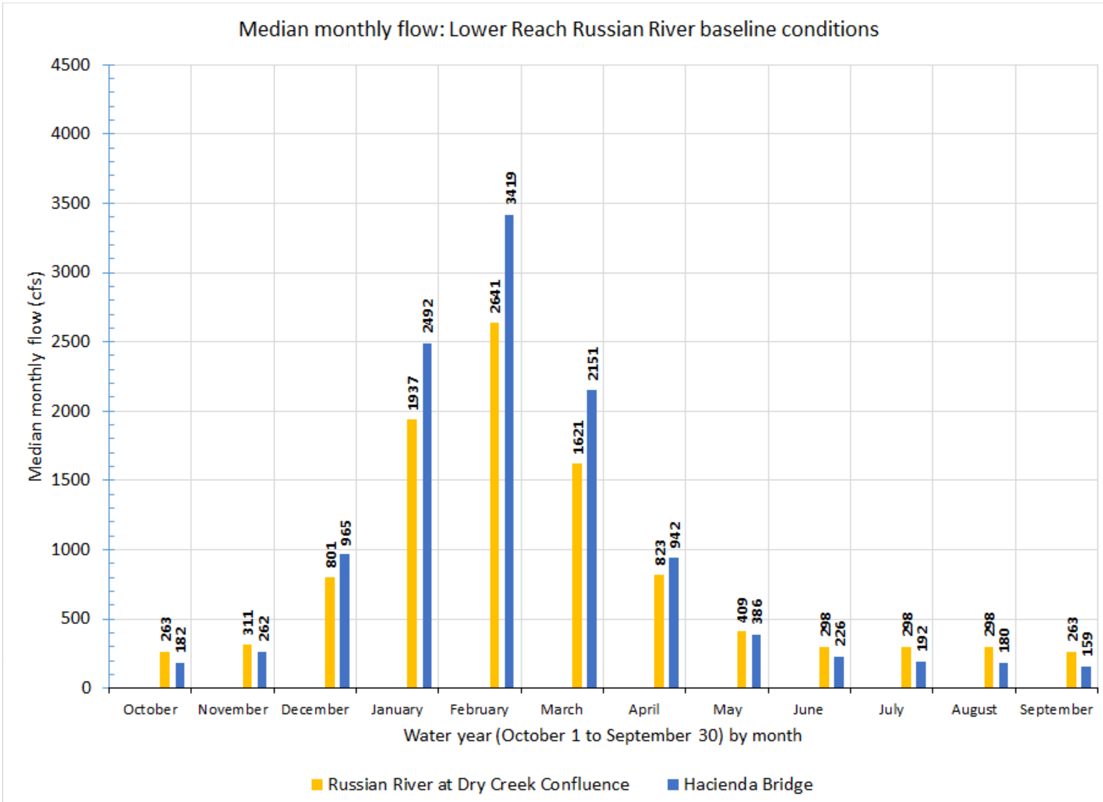

Figure 4.1-11. Median monthly flow, modeled Baseline Conditions, Lower Russian River.

Table 4.1-11. Estimated discharge (cfs) at various flow exceedances at nodes in the Upper Russian River under Baseline Conditions (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline Conditions	0.99	Coyote Valley Dam	28	26	26	26	26	26	27	27	69	118	116	30
		Forks	52	73	80	42	38	57	45	64	85	114	111	98
		Hopland	45	95	95	45	45	71	45	46	68	77	76	78
		Cloverdale	45	96	96	61	52	105	55	47	59	67	65	73
		Healdsburg	45	95	97	100	74	182	75	49	45	45	45	45
	0.95	Coyote Valley Dam	96	26	26	26	26	26	27	51	100	152	168	159
		Forks	106	80	80	93	81	99	80	86	103	148	163	156
		Hopland	95	95	95	100	138	178	111	95	95	113	123	126
		Cloverdale	96	98	102	144	195	225	149	104	95	107	115	117
		Healdsburg	95	98	111	192	307	347	230	125	95	95	95	95
	0.9	Coyote Valley Dam	111	26	26	26	26	26	27	77	116	162	174	172
		Forks	114	84	86	163	156	163	92	103	120	158	169	169
		Hopland	98	95	95	174	213	215	166	100	102	122	132	135
		Cloverdale	100	101	105	198	280	281	220	138	100	114	123	129
		Healdsburg	95	107	120	254	423	431	288	205	95	95	95	95
	0.75	Coyote Valley Dam	136	75	26	26	44	27	44	140	157	207	235	202
		Forks	136	92	125	163	285	163	200	200	164	206	229	200
		Hopland	114	95	170	252	426	269	237	205	170	175	191	170
		Cloverdale	110	106	184	334	576	390	292	215	170	172	182	174
		Healdsburg	95	122	211	509	931	670	413	243	170	170	170	170
	0.5	Coyote Valley Dam	196	93	84	148	276	42	117	173	190	242	263	238
		Forks	197	163	164	405	516	183	200	200	200	239	259	235
		Hopland	176	170	272	648	853	406	287	210	205	205	220	201
		Cloverdale	177	178	378	959	1225	666	386	237	205	205	212	192
		Healdsburg	170	193	620	1602	2075	1246	613	294	205	205	205	170
	0.05	Coyote Valley Dam	228	175	894	2001	2001	507	185	209	249	281	295	268
		Forks	227	578	2714	3667	3572	1794	513	219	252	278	290	265
		Hopland	200	1040	4474	6422	6313	3201	1150	335	227	236	249	227
		Cloverdale	197	1604	6297	9017	8620	4821	1829	488	258	230	237	214
		Healdsburg	198	2721	10014	13774	13702	7788	3383	830	345	221	205	170

Table 4.1-12. Estimated discharge (cfs) at various flow exceedances at nodes in Dry Creek under Baseline Conditions (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline Conditions	0.99	Warm Springs Dam	74	75	75	75	75	75	70	70	70	85	101	99
		Dry Cr at Geyserville	81	82	82	79	80	82	74	74	78	93	102	103
		Dry Creek Mouth	74	88	88	88	88	92	80	81	73	93	93	93
	0.95	Warm Springs Dam	80	76	75	75	75	75	70	70	80	94	104	104
		Dry Cr at Geyserville	98	88	88	81	83	86	79	78	91	99	104	105
		Dry Creek Mouth	93	88	117	88	92	104	90	89	93	93	93	93
	0.9	Warm Springs Dam	98	88	81	75	75	75	70	80	80	97	105	105
		Dry Cr at Geyserville	102	107	109	83	87	89	82	85	93	101	105	106
		Dry Creek Mouth	93	118	118	90	108	113	96	93	93	93	93	93
	0.75	Warm Springs Dam	105	105	105	75	75	75	75	80	88	102	106	108
		Dry Cr at Geyserville	106	113	113	89	133	125	89	87	97	104	107	108
		Dry Creek Mouth	93	118	118	112	191	180	113	98	93	93	93	93
	0.50	Warm Springs Dam	109	109	105	75	155	184	102	80	97	105	109	110
		Dry Cr at Geyserville	109	116	123	183	314	256	133	92	101	106	109	111
		Dry Creek Mouth	93	118	159	302	507	373	184	109	93	93	93	93
	0.05	Warm Springs Dam	160	118	1208	2000	4000	2000	586	184	162	181	194	186
		Dry Cr at Geyserville	162	225	2000	3279	4251	2421	758	238	164	182	194	187
		Dry Creek Mouth	149	460	2899	5100	5184	3204	1112	330	153	167	177	172

Table 4.1-13. Estimated discharge (cfs) at various flow exceedances at nodes in the Lower Russian River under Baseline Conditions (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline Conditions	0.99	Russian R at Dry C	144	183	197	191	162	281	155	150	157	172	181	174
		Hacienda Bridge	69	119	141	136	115	268	114	69	69	69	69	69
	0.95	Russian R at Dry C	188	206	227	282	411	455	322	208	199	211	224	217
		Hacienda Bridge	119	149	173	261	438	465	294	143	119	119	119	119
	0.90	Russian R at Dry C	202	223	238	347	529	553	387	298	212	226	235	229
		Hacienda Bridge	119	159	189	363	598	591	365	226	134	119	119	119
	0.75	Russian R at Dry C	233	239	331	627	1142	878	531	341	263	263	267	263
		Hacienda Bridge	159	189	312	725	1368	1030	556	282	176	159	159	159
	0.50	Russian R at Dry C	263	311	801	1937	2641	1621	823	402	298	298	298	263
		Hacienda Bridge	179	262	965	2492	3419	2151	942	374	226	192	180	159
	0.05	Russian R at Dry C	303	3107	12852	18081	18152	10802	4356	1168	456	314	298	277
		Hacienda Bridge	270	3842	14738	21766	22054	13820	6231	1401	446	237	207	181

Significance Criteria

Based on Appendix G of the California Environmental Quality Act (CEQA) Guidelines, project implementation would have significant impacts and environmental consequences on hydrology-related resources if it would result in any of the following:

1. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)

2. Substantially alter the existing drainage pattern of a site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or sedimentation on- or off-site, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

3. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

4. Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;

5. Place within a 100-year flood hazard area structures which would impede or redirect flood flows;

6. Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam; or

7. Contribute to inundation by seiche, tsunami, or mudflow.

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.

- Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;

- Place within a 100-year flood hazard area structures which would impede or redirect flood flows.

No Project 1, No Project 2, and the Proposed Project would not include actions or project elements that increase the amount or rate of surface runoff, such as an increase in the amount of impervious surfaces through addition of roads or structures, that would increase the rate or amount of surface runoff in a manner that would result in flooding on- or off-site. Nor would No Project 1, No Project 2, or the Proposed Project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.

Implementation of the Proposed Project would not involve any construction activities or new or changed facilities. There would be no impact from the Proposed Project or No Project 1 or No Project 2 alternatives that would place housing or structures within a 100-year flood hazard area.

Impacts and Mitigation Measures

The following section presents a detailed discussion of potential hydrology-related impacts associated with the project alternatives, including the Proposed Project, the No Project 1 Alternative, and the No Project 2 Alternative. 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.”

Impact 4.1-1. The Fish Flow Project could substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. (Less than Significant)

No Project 1 Alternative

Upper Russian River

Under the No Project 1 Alternative, minimum instream flows in the Upper Russian River would be identical to Baseline Conditions, which follow the minimum instream flow requirements included in the Water Agency’s water right permits and the Decision 1610 Hydrologic Index. Flows would be identical at all nodes in the Upper Russian River across the entire range of exceedances (Table 4.1-11). As instream flows are identical to Baseline Conditions, there would be No Impact to groundwater supplies.

Dry Creek

The No Project 1 Alternative follows minimum instream flow requirements included in the Water Agency’s water right permits and the Decision 1610 Hydrologic Index, but assumes that beneficial use of the existing 75,000 acre-feet of water authorized under water right Permits 12947A, 16596, 12949, and 12950 would be met by greater releases from Warm Springs Dam through Dry Creek and into the Russian River for diversion at the Water Agency’s Wohler and

Mirabel diversion facilities. Under the No Project 1 Alternative, instream flow along Dry Creek would be similar to Baseline Conditions during most months, except September during 0.75, 0.90, 0.95, and 0.99 exceedances (Table 4.1-14). During 0.05 and 0.50 exceedances instream flow in Dry Creek would be higher from June through October.

Under Baseline Conditions, median monthly flows along Dry Creek in spring are low at upstream nodes compared to downstream nodes as tributary inputs increase flow in the downstream direction. As summer progresses, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease (Figure 4.1-10). During this time, releases from Warm Springs Dam increase to maintain minimum instream flows, and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Releases from Warm Springs Dam, and resulting surface flows at nodes along Dry Creek would be similar or higher under the No Project 1 Alternative during losing months (June through October; Table 4.1-14). As such, potential contributions to groundwater would be similar or greater under the No Project 1 Alternative than under Baseline Conditions.

In hydraulically connected systems, such as Dry Creek, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at USGS gage sites along Dry Creek using estimated flows and the most recent rating curves (USGS 2016d,e) shows stage would be the same or higher under the No Project 1 Alternative during hydrologically losing months (June through October; Table 4.1-15). The greatest gains would occur during 0.05, 0.50, 0.75, 0.90 and 0.95 exceedances (up to 0.2 feet [3 inches]) but generally less than 0.1 feet (1 inch). This increase in stage may slightly increase the groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. Fluctuations will likely be greatest near the surface water connection with typical fluctuations from the wet season to the dry season in Dry Creek ranging from one to two feet. As these seasonal fluctuations exceed the potential stage change under the No Project 1 Alternative, and as described above, potential contributions to groundwater may be greater under the No Project 1 Alternative, this alternative would have no impact on the groundwater table elevation in Dry Creek.

Table 4.1-14. Percent difference in discharge (cfs) between Baseline Conditions and No Project 1 Alternative at nodes in Dry Creek. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 1	0.99	Warm Springs Dam	8%	0%	0%	0%	0%	0%	0%	0%	14%	1%	1%	5%
		Dry Creek Geyserville	3%	0%	0%	0%	0%	0%	2%	2%	14%	1%	1%	5%
		Dry Creek Mouth	25%	0%	0%	0%	0%	0%	7%	6%	25%	0%	0%	0%
	0.95	Warm Springs Dam	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	16%
		Dry Creek Geyserville	3%	1%	2%	0%	0%	0%	1%	5%	1%	0%	1%	16%
		Dry Creek Mouth	0%	14%	0%	0%	0%	0%	0%	5%	0%	0%	0%	14%
	0.90	Warm Springs Dam	3%	19%	-2%	0%	0%	0%	0%	0%	0%	0%	1%	20%
		Dry Creek Geyserville	3%	1%	0%	0%	0%	0%	0%	1%	0%	0%	1%	20%
		Dry Creek Mouth	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%
	0.75	Warm Springs Dam	2%	0%	0%	0%	0%	0%	0%	0%	1%	0%	2%	23%
		Dry Creek Geyserville	2%	0%	0%	0%	-7%	-4%	0%	0%	0%	1%	2%	23%
		Dry Creek Mouth	0%	0%	2%	0%	-3%	-3%	0%	1%	0%	0%	0%	26%
	0.50	Warm Springs Dam	3%	1%	0%	0%	-13%	-7%	-3%	0%	1%	4%	11%	27%
		Dry Creek Geyserville	4%	1%	2%	-2%	-4%	-2%	-2%	0%	1%	4%	10%	26%
		Dry Creek Mouth	7%	0%	0%	-2%	-2%	-2%	-2%	2%	0%	4%	13%	34%
	0.05	Warm Springs Dam	16%	14%	-28%	0%	-50%	0%	-3%	0%	20%	19%	16%	16%
		Dry Creek Geyserville	16%	0%	-8%	-5%	-19%	0%	0%	0%	20%	19%	16%	16%
		Dry Creek Mouth	17%	0%	-2%	0%	-1%	0%	0%	0%	21%	20%	18%	18%

Table 4.1-15. Estimated stage (feet) at various flow exceedances at gages in Dry Creek under Baseline Conditions (left panel of table) and difference under the No Project 1 Alternative (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					No Project 1				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Dry Creek at Geyserville	1.0	1.1	1.2	1.2	1.0	0.1	0.0	0.0	0.0	0.0
	Dry Creek Mouth	4.7	4.8	4.8	4.8	4.7	0.1	0.0	0.0	0.0	0.1
0.95	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.1	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.0	0.1	0.0
0.90	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.2	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.0	0.1	0.0
0.75	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.2	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.0	0.2	0.0
0.50	Dry Creek at Geyserville	1.2	1.2	1.3	1.3	1.3	0.0	0.0	0.1	0.2	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.1	0.2	0.0
0.05	Dry Creek at Geyserville	1.7	1.8	1.9	1.8	1.7	0.2	0.2	0.2	0.2	0.2
	Dry Creek Mouth	5.2	5.3	5.4	5.3	5.2	0.2	0.2	0.2	0.2	0.2

Lower Russian River

Under the No Project 1 Alternative, instream flow along the Lower Russian River would be similar or greater than Baseline Conditions during all months and all exceedances at the Russian River confluence with Dry Creek, with increases beginning in April during dry conditions (0.99 exceedance) and growing through September under increasingly wetter exceedances (Table 4.1-16). Downstream at Hacienda Bridge, instream flow would be similar or lower during all months and all exceedances, but increasingly lower from April through October through 0.05, 0.50, and 0.75 exceedances. This pattern reflects greater releases upstream of the Wohler and Mirabel diversion facilities, and diversion at the facilities to meet water supply demands.

Median instream flows decrease in the Lower Russian River between the Dry Creek Confluence and Hacienda Bridge from May through November (Figure 4.1-11). During this time, releases from Coyote Valley and Warm Springs dams increase along the Upper Russian River and Dry Creek to maintain minimum instream flow requirements, and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Decreases between the Russian River and Dry Creek confluence and the Hacienda Bridge result from diversion at Wohler and Mirabel, which varies with demand, and losses from evaporation, diversion, and infiltration into the alluvial aquifer. Under the No Project 1 Alternative, diversion from Wohler and Mirabel would increase to attain beneficial use of the existing 75,000 acre-feet of water authorized under the Water Agency’s water rights permits. As such, potential contributions to groundwater would be similar under the No Project 1 Alternative and Baseline Conditions. Further, the alluvial aquifer along the Russian River is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to the Russian River. Although the No Project 1 Alternative would reduce the volume of water flowing in the Lower Russian River during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems the groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at the Russian River at Guerneville (Hacienda Bridge) USGS gage using estimated flows and the most recent rating curve (USGS 2016f) shows stage would be the same or slightly lower under the No Project 1 Alternative during hydrologically losing months (June through October; Table 4.1-17). The greatest decreases would occur in July under 0.05 and 0.50 exceedances, up to 0.2 foot (3 inches), and would occur most frequently in June under 0.05, 0.50, 0.75, and 0.90 exceedances. These decreases in stage may decrease groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. Fluctuations would likely be greatest near the surface water connection with typical fluctuations in the Russian River from the wet season to the dry season ranging from 5 feet to 10 feet. As these seasonal fluctuations far exceed the potential stage change under the No Project 1 Alternative, and as described above, potential contributions to groundwater may be greater under No Project 1, this alternative would have a less than significant impact on the groundwater table elevation in the Lower Russian River.

Table 4.1-16. Percent difference in discharge (cfs) between Baseline Conditions and No Project 1 Alternative at nodes in the Lower Russian River. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 1	0.99	Russian River at Dry C	8%	8%	1%	2%	0%	0%	4%	21%	21%	14%	13%	8%
		Hacienda Bridge	0%	0%	-15%	-12%	-19%	-8%	-20%	0%	0%	0%	0%	0%
	0.95	Russian River at Dry C	11%	2%	3%	0%	0%	0%	0%	9%	15%	16%	15%	14%
		Hacienda Bridge	0%	-14%	-8%	-8%	-5%	-4%	-8%	-17%	0%	0%	0%	0%
	0.90	Russian River at Dry C	12%	5%	1%	0%	0%	0%	0%	0%	16%	16%	14%	15%
		Hacienda Bridge	0%	0%	-12%	-6%	-4%	-4%	-7%	-13%	-11%	0%	0%	0%
	0.75	Russian River at Dry C	11%	3%	0%	0%	0%	-1%	0%	0%	5%	9%	12%	8%
		Hacienda Bridge	0%	-11%	-7%	-3%	-3%	-3%	-5%	-11%	-10%	0%	0%	0%
	0.50	Russian River at Dry C	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%
		Hacienda Bridge	-11%	-9%	-2%	-1%	-1%	-1%	-3%	-8%	-14%	-17%	-12%	0%
	0.05	Russian River at Dry C	1%	0%	0%	0%	-1%	0%	0%	0%	0%	1%	5%	12%
		Hacienda Bridge	-9%	-1%	0%	0%	0%	0%	0%	-2%	-7%	-14%	-16%	-12%

Table 4.1-17. Estimated stage (feet) at various flow exceedances at gages in the Lower Russian River under Baseline Conditions (left panel of table) and difference under No Project 1 (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					No Project 1				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Hacienda Bridge	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
0.95	Hacienda Bridge	1.6	1.6	1.6	1.6	1.6	0.0	0.0	0.0	0.0	0.0
0.90	Hacienda Bridge	1.7	1.6	1.6	1.6	1.6	-0.1	0.0	0.0	0.0	0.0
0.75	Hacienda Bridge	2.0	1.9	1.9	1.9	1.9	-0.1	0.0	0.0	0.0	0.0
0.50	Hacienda Bridge	2.2	2.0	2.0	1.9	2.0	-0.2	-0.2	-0.1	0.0	-0.1
0.05	Hacienda Bridge	3.2	2.3	2.1	2.0	2.4	-0.1	-0.2	-0.2	-0.1	-0.1

No Project 2 Alternative

The No Project 2 Alternative would operate by the Decision 1610 Hydrologic Index and minimum instream flow requirements, but assumes temporary reductions in the minimum instream flow requirements from June to October as required by the Russian River Biological Opinion.

Upper Russian River

Under the No Project 2 Alternative, instream flow in the Upper Russian River would be less than Baseline Conditions from May through September during 0.05 and 0.75 exceedances and from May through October during median conditions (Table 4.1-18). During drier conditions (0.90, 0.95, and 0.99 exceedances), flow would be lower in May, June, and July, but generally the same or higher from August through October.

Under Baseline Conditions, median monthly flows along the Upper Russian River in spring are low at upstream nodes compared to downstream nodes as tributary inputs increase flow in the downstream direction. As summer progresses, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease. (Figure 4.1-9). During this time, releases from Coyote Valley Dam increase to maintain minimum instream flows, and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Although releases, and resulting surface flow, would be lower relative to Baseline Conditions, minimum instream flows would still maintain perennial surface flow and provide groundwater recharge throughout the year. As such, potential contributions to groundwater would be similar under the No Project 2 Alternative than under Baseline Conditions. The alluvial aquifer along the Russian River is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to the Russian River. Although the No Project 2 Alternative would reduce the volume of water flowing in the Upper Russian River during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, groundwater table elevation is related to, but not entirely dependent upon, adjacent surface water elevation. A comparison of stage at USGS gage sites along the Upper Russian River using estimated flows and the most recent rating curves (USGS 2016a, b, c), shows stage would be lower under the No Project 2 Alternative during hydrologically losing months (June through October; Table 4.1-19). The greatest differences would occur at Hopland and Cloverdale across 0.05, 0.50, and 0.75 exceedances, up to 0.4 feet (5 inches), but generally less than 0.2 feet (2 inches). This decrease in stage may slightly decrease groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. The amplitude of fluctuations would likely be greatest near the surface water connection with typical seasonal fluctuations in the Russian River ranging from 5 feet to10 feet. As these seasonal fluctuations far exceed the potential stage change under the No Project 2 Alternative, and as described above, potential contributions to groundwater may be slightly greater under the No Project 2 Alternative, the effect of the No Project 2 Alternative on the groundwater table elevation in the Upper Russian River would be less than significant.

Table 4.1-18. Percent difference in discharge (cfs) between Baseline Conditions and the No Project 2 Alternative in the Upper Russian River. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Coyote Valley Dam	0%	0%	0%	0%	0%	0%	0%	0%	-23%	1%	12%	302%
		Forks	8%	0%	0%	0%	0%	0%	0%	0%	0%	1%	12%	23%
		Hopland	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	15%	15%
		Cloverdale	10%	0%	0%	0%	0%	0%	0%	0%	0%	2%	15%	11%
		Healdsburg	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	0.95	Coyote Valley Dam	12%	0%	0%	0%	0%	0%	0%	-48%	-7%	-4%	0%	-1%
		Forks	7%	5%	5%	0%	4%	0%	0%	0%	2%	0%	0%	-1%
		Hopland	1%	0%	0%	0%	0%	-3%	0%	0%	0%	1%	0%	0%
		Cloverdale	4%	2%	2%	0%	1%	-2%	0%	0%	0%	0%	0%	0%
		Healdsburg	0%	9%	5%	0%	1%	-2%	0%	0%	0%	0%	0%	0%
	0.90	Coyote Valley Dam	12%	0%	0%	0%	0%	0%	0%	-34%	-10%	-4%	2%	-1%
		Forks	15%	10%	14%	-5%	0%	-5%	0%	0%	8%	-2%	3%	-1%
		Hopland	14%	0%	40%	-2%	-2%	-3%	0%	0%	5%	2%	2%	0%
		Cloverdale	7%	5%	66%	-3%	3%	-2%	-1%	-3%	2%	2%	1%	1%
		Healdsburg	0%	14%	53%	-2%	2%	-1%	-1%	-29%	0%	0%	0%	0%
	0.75	Coyote Valley Dam	16%	20%	121%	134%	180%	0%	-8%	-42%	-22%	-18%	-16%	-4%
		Forks	20%	68%	24%	15%	3%	-5%	-5%	-35%	-19%	-19%	-16%	-5%
		Hopland	30%	79%	0%	6%	2%	-3%	-4%	-35%	-21%	-24%	-21%	-6%
		Cloverdale	31%	63%	3%	6%	2%	-2%	-3%	-33%	-21%	-22%	-21%	-12%
		Healdsburg	41%	47%	7%	5%	1%	0%	-2%	-28%	-21%	-21%	-21%	-21%
	0.50	Coyote Valley Dam	-5%	68%	84%	33%	5%	-8%	-7%	-40%	-26%	-22%	-21%	-14%
		Forks	-6%	1%	30%	5%	4%	0%	-5%	-35%	-26%	-22%	-22%	-14%
		Hopland	-6%	0%	12%	3%	2%	-1%	-3%	-33%	-34%	-28%	-26%	-18%
		Cloverdale	-11%	2%	12%	2%	2%	0%	-2%	-29%	-32%	-30%	-28%	-19%
		Healdsburg	-21%	4%	6%	1%	0%	0%	-1%	-21%	-30%	-35%	-35%	-21%
	0.05	Coyote Valley Dam	254%	15%	47%	0%	0%	8%	-5%	-33%	-24%	-23%	-19%	-13%
		Forks	255%	5%	9%	2%	0%	2%	0%	-29%	-25%	-24%	-20%	-13%
		Hopland	288%	5%	4%	1%	0%	1%	0%	-14%	-27%	-29%	-24%	-16%
		Cloverdale	291%	7%	5%	0%	0%	0%	0%	-7%	-23%	-30%	-28%	-17%
		Healdsburg	284%	3%	3%	0%	0%	1%	0%	-3%	-18%	-32%	-35%	-21%

Table 4.1-19. Estimated stage (feet) at various flow exceedances at gages in the Upper Russian River under Baseline Conditions (left panel of table) and difference under the No Project 2 Alternative (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node[1]	Baseline					No Project 2				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Hopland	-0.2	-0.1	-0.1	-0.1	-0.4	0.0	0.0	0.1	0.1	0.0
	Cloverdale	1.9	2.0	2.2	2.2	2.2	0.0	0.0	-0.2	-0.1	-0.2
	Healdsburg	1.0	1.0	1.2	1.2	1.2	0.0	0.0	-0.2	-0.2	-0.2
0.95	Hopland	0.1	0.2	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0
	Cloverdale	2.2	2.3	2.4	2.4	2.2	0.0	0.0	0.0	0.0	0.0
	Healdsburg	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
0.90	Hopland	0.1	0.3	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.1
	Cloverdale	2.2	2.4	2.4	2.5	2.2	0.0	0.0	0.0	0.0	0.1
	Healdsburg	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
0.75	Hopland	0.6	0.6	0.7	0.6	0.2	-0.2	-0.3	-0.2	-0.1	0.2
	Cloverdale	2.7	2.8	2.8	2.8	2.3	-0.2	-0.2	-0.2	-0.1	0.2
	Healdsburg	1.4	1.4	1.4	1.4	1.2	-0.1	-0.1	-0.1	-0.1	0.1
0.50	Hopland	0.8	0.8	0.9	0.8	0.6	-0.4	-0.3	-0.3	-0.2	-0.1
	Cloverdale	2.9	2.9	2.9	2.8	2.8	-0.4	-0.3	-0.3	-0.2	-0.1
	Healdsburg	1.5	1.5	1.5	1.4	1.4	-0.1	-0.2	-0.2	-0.1	-0.1
0.05	Hopland	0.9	0.9	1.0	0.9	0.8	-0.4	-0.4	-0.3	-0.2	2.4
	Cloverdale	3.1	3.0	3.0	2.9	2.9	-0.2	-0.3	-0.3	-0.2	1.6
	Healdsburg	1.7	1.5	1.5	1.4	1.5	-0.1	-0.2	-0.2	-0.1	1.0

[1]The rating curve at the Hopland USGS gage begins at -1.5 feet. As such, application of the rating curve yields negative values at depths less than 1.5 feet. These negative values do not indicate or suggest drying of the Upper Russian River.

Dry Creek

Under the No Project 2 Alternative, instream flow in Dry Creek would be slightly greater than Baseline Conditions from July through October during 0.50 and 0.75 exceedances and from August through November during drier conditions (0.95 and 0.99 exceedances) (Table 4.1-20). Median flow would be less than Baseline Conditions from June through September and slightly higher in October and November.

Under Baseline Conditions, median monthly flows along Dry Creek in spring are low at upstream nodes compared to downstream nodes as tributary inputs increase flow in the downstream direction. As summer progresses, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease (Figure 4.1-10). Releases from Warm Springs Dam in late-summer and early-fall increase to maintain minimum instream flows and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Releases from Warm Springs Dam, and resulting surface flows at nodes along Dry Creek, would be higher or the same during 0.50 and 0.75 exceedances and drier conditions (0.90, 0.95, and 0.99 exceedances) under the No Project 2 Alternative (Table 4.1-20). Decreases would occur near 0.05 exceedance, from June through September, but still above minimum instream flows for those months (releases would not be required as unimpaired flow would be greater than minimum instream flow), and during wet years. As such, potential contributions to groundwater would be similar or greater under the No Project 2 Alternative. Depth to groundwater during summer conditions are not anticipated to change in Dry Creek as a result of the No Project 2 Alternative. The alluvial aquifer along Dry Creek is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to Dry Creek. Although the No Project 2 Alternative would reduce the volume of water flowing in Dry Creek during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, such as Dry Creek, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at USGS gage sites along Dry Creek using estimated flows and the most recent rating curves (USGS 2016d, e) from each gage shows stage would be the same or higher under the No Project 2 Alternative during hydrologically losing months (June through October; Table 4.1-21). The greatest changes would be increases occurring in October under wetter conditions (0.05 exceedance), up to 0.2 feet (2 inches), but slight gains also occur from June through October across all other exceedances. Stage would be slightly lower from June through September under wet condition (0.05 exceedance) with a saturated alluvial aquifer. These increases in stage may slightly increase groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. Fluctuations would likely be greatest near the surface water connection with typical seasonal fluctuations in Dry Creek ranging from 1 to 2 feet. As these seasonal fluctuations exceed the potential stage change under the No Project 2 Alternative, and as described above, potential contributions to groundwater may be similar under the No Project 2 Alternative. the No Project 2 Alternative would have no impact on the groundwater table elevation in Dry Creek.

Table 4.1-20. Percent difference in discharge (cfs) between Baseline Conditions and the No Project 2 Alternative at various flow exceedances at nodes in Dry Creek. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Warm Springs Dam	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	1%
		Dry Cr at Geyserville	3%	0%	0%	0%	0%	0%	2%	0%	-1%	0%	4%	1%
		Dry Creek Mouth	22%	0%	0%	0%	0%	0%	7%	-1%	-1%	0%	0%	0%
	0.95	Warm Springs Dam	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	2%
		Dry Cr at Geyserville	1%	1%	2%	0%	0%	0%	1%	0%	0%	0%	4%	2%
		Dry Creek Mouth	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	0.90	Warm Springs Dam	1%	19%	0%	0%	0%	0%	0%	0%	0%	0%	6%	3%
		Dry Cr at Geyserville	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	6%	3%
		Dry Creek Mouth	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
	0.75	Warm Springs Dam	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%	9%	4%
		Dry Cr at Geyserville	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%	9%	4%
		Dry Creek Mouth	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	11%	3%
	0.50	Warm Springs Dam	3%	1%	0%	0%	0%	0%	0%	0%	0%	5%	14%	7%
		Dry Cr at Geyserville	5%	0%	3%	-2%	0%	0%	0%	0%	0%	5%	13%	7%
		Dry Creek Mouth	8%	0%	3%	-1%	1%	0%	0%	1%	0%	5%	18%	11%
	0.05	Warm Springs Dam	13%	18%	-5%	0%	-50%	0%	-3%	0%	-13%	-12%	-13%	-14%
		Dry Cr at Geyserville	16%	0%	1%	-2%	-16%	0%	0%	0%	-13%	-12%	-13%	-14%
		Dry Creek Mouth	22%	0%	0%	0%	-1%	0%	0%	0%	-12%	-13%	-14%	-15%

Table 4.1-21. Estimated stage (feet) at various flow exceedances at gages in Dry Creek under Baseline Conditions (left panel of table) and difference under the No Project 2 Alternative (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					No Project 2				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Dry Creek at Geyserville	1.0	1.1	1.2	1.2	1.0	0.0	0.0	0.0	0.0	0.0
	Dry Creek Mouth	4.7	4.8	4.8	4.8	4.7	0.0	0.0	0.0	0.0	0.1
0.95	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.0	0.0	0.0
0.90	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.1	0.0	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.0	0.0	0.0
0.75	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	0.0	0.0	0.1	0.0	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.1	0.0	0.0
0.50	Dry Creek at Geyserville	1.2	1.2	1.3	1.3	1.3	0.0	0.0	0.1	0.1	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	0.0	0.0	0.1	0.1	0.0
0.05	Dry Creek at Geyserville	1.7	1.8	1.9	1.8	1.7	-0.1	-0.1	-0.2	-0.2	0.2
	Dry Creek Mouth	5.2	5.3	5.4	5.3	5.2	-0.1	-0.1	-0.1	-0.2	0.2

Lower Russian River

Under the No Project 2 Alternative, flow along the Lower Russian River would be less than Baseline Conditions from March through September or October across 0.05, 0.50, and 0.75 exceedances and the same or lower throughout most of the year during drier conditions (0.90, 0.95, 0.99 exceedances) at Hacienda Bridge (Table 4.1-22).

Median flows decrease in the Lower Russian River between the Dry Creek Confluence and Hacienda Bridge from May through November (Figure 4.1-11). During this time, releases from Coyote Valley and Warm Springs dams increase to maintain minimum instream flows, and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Differences between the Russian River and Dry Creek confluence and the Hacienda Bridge result from diversion at Wohler and Mirabel, which varies with demand, and losses from evaporation, diversion, and infiltration into the alluvial aquifer. Under the No Project 2 Alternative, diversion from Wohler and Mirabel would increase to attain beneficial use of the existing 75,000 acre-feet of water authorized under the Water Agency's water rights permits. As such, potential contributions to groundwater under the No Project 2 Alternative would be similar to Baseline Conditions.

Depth to groundwater (also referred as water table and aquifer) during summer conditions is not anticipated to change in the Lower Russian River as a result of the No Project 2 Alternative. The alluvial aquifer along the Russian River is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to the Russian River. Although the No Project 2 Alternative would reduce the volume of water flowing in the Lower Russian River during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, such as the Russian River, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at the Russian River at Guerneville (Hacienda Bridge) USGS gage using estimated flows and the most recent rating curve (USGS 2016f) shows stage would be the same or lower under the No Project 2 Alternative during hydrologically losing months (June through October; Table 4.1-23). The greatest decreases would occur in July and August under across 0.05 and 0.50 exceedances, up to 0.6 foot (7 inches), and would occur across all other conditions at generally less than 0.4 foot (5 inches). These decreases in stage may slightly decrease groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. Fluctuations would likely be greatest near the surface water connection with typical fluctuations in the Russian River from the wet season to the dry season ranging from 5 feet to 10 feet. As these seasonal fluctuations far exceed the potential stage change under the No Project 2 Alternative, and as described above, potential contributions to groundwater may be greater under the No Project 2 Alternative, this alternative would have a less than significant impact on the groundwater table elevation in the Lower Russian River.

Table 4.1-22. Percent difference in discharge (cfs) between Baseline Conditions and No Project 2 Alternative at nodes in the Lower Russian River. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Russian R at Dry C	18%	8%	1%	2%	0%	0%	4%	21%	17%	16%	16%	14%
		Hacienda Bridge	0%	0%	-15%	-12%	-19%	-8%	-20%	0%	0%	0%	0%	0%
	0.95	Russian R at Dry C	6%	2%	18%	0%	0%	-1%	0%	0%	-1%	0%	-1%	-2%
		Hacienda Bridge	-29%	-14%	12%	-8%	-5%	-5%	-9%	-22%	-29%	-29%	-29%	-29%
	0.90	Russian R at Dry C	4%	21%	27%	-1%	1%	-1%	-2%	-20%	-1%	0%	-3%	-1%
		Hacienda Bridge	-14%	21%	21%	-7%	-3%	-5%	-8%	-38%	-24%	-29%	-29%	-29%
	0.75	Russian R at Dry C	-3%	24%	5%	4%	1%	-1%	-1%	-20%	-14%	-14%	-12%	-13%
		Hacienda Bridge	-32%	13%	-2%	1%	0%	-2%	-6%	-34%	-39%	-36%	-36%	-36%
	0.50	Russian R at Dry C	2%	3%	4%	1%	1%	0%	-1%	-15%	-21%	-23%	-19%	-11%
		Hacienda Bridge	-30%	-4%	3%	0%	1%	-1%	-4%	-24%	-40%	-47%	-43%	-36%
	0.05	Russian R at Dry C	182%	7%	1%	0%	-1%	1%	0%	-4%	-13%	-20%	-15%	-9%
		Hacienda Bridge	184%	1%	1%	0%	0%	0%	0%	-3%	-19%	-44%	-50%	-42%

Table 4.1-23. Estimated stage (feet) at various flow exceedances at gages in the Lower Russian River under Baseline Conditions (left panel of table) and difference under the No Project 2 Alternative (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					No Project 2				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Hacienda Bridge	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
0.95	Hacienda Bridge	1.6	1.6	1.6	1.6	1.6	-0.3	-0.3	-0.3	-0.3	-0.3
0.90	Hacienda Bridge	1.7	1.6	1.6	1.6	1.6	-0.2	-0.3	-0.3	-0.3	-0.1
0.75	Hacienda Bridge	2.0	1.9	1.9	1.9	1.9	-0.4	-0.4	-0.4	-0.4	-0.3
0.50	Hacienda Bridge	2.2	2.0	2.0	1.9	2.0	-0.5	-0.6	-0.5	-0.4	-0.3
0.05	Hacienda Bridge	3.2	2.3	2.1	2.0	2.4	-0.3	-0.6	-0.6	-0.5	1.8

Proposed Project

The Proposed Project would follow the minimum instream flow schedule established by the Russian River Hydrologic index detailed in Chapter 3, Background and Project Description.

Upper Russian River

Under the Proposed Project, instream flow in the Upper Russian River would lower than Baseline Conditions from March, April, or May through September or October across 0.05 and 0.75 exceedances and drier conditions (0.90 and 0.95 exceedances) (Table 4.1-24). During the driest conditions (0.99 exceedance), flow in the Upper Russian River would be similar to slightly higher than Baseline Conditions from May through October (with the exception of June, November, and December).

Under Baseline Conditions, median monthly flows along the Upper Russian River in spring are low at upstream nodes compared to downstream nodes as tributary inputs increase flow in the downstream direction. As summer progresses, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease (Figure 4.1-9). Releases increase to maintain minimum instream flows and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Although releases and resulting surface flows would be lower under the Proposed Project relative to Baseline Conditions, minimum instream flows still maintain perennial surface flow and provide groundwater recharge throughout the year. As such, potential contributions to groundwater would be similar under the Proposed Project compared to Baseline Conditions. The alluvial aquifer along the Russian River is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to the Russian River. Although the Proposed Project would reduce the volume of water flowing in the Upper Russian River during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at USGS gage sites using estimated flows and the most recent rating curves (USGS 2016a, b, c) shows stage would be lower under the Proposed Project during hydrologically losing months (June through October; Table 4.1-25). The greatest differences would occur at Hopland and Cloverdale across 0.05, 0.50, and 0.75 exceedances, up to 0.6 foot (7 inches), but generally less than 0.4 foot (5 inches). This decrease in stage may slightly decrease groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. The amplitude of fluctuations would likely be greatest near the surface water connection with typical seasonal fluctuations in the Russian River ranging from 5 feet to 10 feet. As these seasonal fluctuations far exceed the potential stage change under the Proposed Project, and as described above, potential contributions to groundwater would be similar to Baseline Conditions under the Proposed Project, the effect of the Proposed Project on the groundwater table elevation in the Upper Russian River would be less than significant.

Table 4.1-24. Percent difference in discharge (cfs) between Baseline Conditions and the Proposed Project at nodes in the Upper Russian River. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Coyote Valley Dam	0%	0%	0%	0%	0%	0%	0%	0%	-42%	-8%	6%	269%
		Forks	32%	2%	-6%	79%	97%	30%	67%	-12%	-28%	-8%	6%	13%
		Hopland	20%	-17%	-17%	108%	92%	21%	76%	14%	-21%	-10%	1%	8%
		Cloverdale	22%	-17%	-17%	63%	114%	11%	54%	16%	-9%	-5%	3%	4%
		Healdsburg	0%	-17%	-16%	13%	84%	-3%	32%	10%	0%	0%	0%	0%
	0.95	Coyote Valley Dam	-8%	0%	0%	2%	1%	0%	0%	-48%	-25%	-18%	-15%	-18%
		Forks	-10%	5%	31%	14%	36%	11%	31%	-17%	-13%	-17%	-16%	-18%
		Hopland	-20%	-13%	16%	14%	9%	-19%	5%	-22%	-24%	-24%	-22%	-25%
		Cloverdale	-23%	-9%	17%	-11%	3%	-13%	-9%	-27%	-33%	-28%	-27%	-24%
		Healdsburg	-43%	8%	16%	-20%	1%	-10%	-20%	-33%	-43%	-43%	-43%	-43%
	0.90	Coyote Valley Dam	-4%	38%	0%	0%	153%	0%	0%	-56%	-26%	-18%	-9%	-14%
		Forks	1%	25%	28%	-32%	10%	-32%	20%	-13%	-18%	-16%	-10%	-14%
		Hopland	5%	20%	20%	-27%	14%	-19%	-23%	-6%	-17%	-18%	-14%	-17%
		Cloverdale	-2%	17%	19%	-22%	16%	-15%	-27%	-29%	-21%	-17%	-16%	-17%
		Healdsburg	-22%	12%	14%	-17%	12%	-8%	-18%	-43%	-22%	-22%	-22%	-22%
	0.75	Coyote Valley Dam	-3%	26%	199%	253%	363%	0%	-33%	-56%	-34%	-29%	-27%	-16%
		Forks	-2%	19%	-12%	33%	9%	-32%	-45%	-50%	-33%	-29%	-27%	-16%
		Hopland	1%	20%	-27%	15%	7%	-14%	-34%	-49%	-38%	-35%	-32%	-21%
		Cloverdale	6%	16%	-17%	11%	5%	-10%	-26%	-43%	-39%	-34%	-33%	-27%
		Healdsburg	20%	10%	-8%	7%	3%	-5%	-17%	-38%	-34%	-45%	-45%	-45%
	0.50	Coyote Valley Dam	-23%	17%	31%	63%	11%	-36%	-59%	-53%	-36%	-31%	-30%	-23%
		Forks	-24%	-30%	45%	14%	8%	0%	-45%	-45%	-36%	-32%	-31%	-24%
		Hopland	-27%	-22%	20%	8%	4%	-1%	-30%	-44%	-44%	-39%	-38%	-28%
		Cloverdale	-30%	-15%	16%	4%	4%	0%	-21%	-38%	-42%	-42%	-40%	-29%
		Healdsburg	-33%	-9%	8%	4%	1%	0%	-13%	-30%	-41%	-44%	-44%	-33%
	0.05	Coyote Valley Dam	257%	68%	101%	0%	0%	17%	-47%	-45%	-33%	-31%	-26%	-21%
		Forks	259%	32%	15%	4%	1%	9%	0%	-22%	-33%	-31%	-27%	-21%
		Hopland	295%	21%	12%	2%	1%	3%	0%	-13%	-31%	-37%	-33%	-25%
		Cloverdale	299%	15%	10%	1%	1%	2%	0%	-8%	-25%	-39%	-36%	-26%
		Healdsburg	292%	7%	7%	0%	0%	1%	0%	-2%	-19%	-41%	-44%	-33%

Table 4.1-25. Estimated stage (feet) at various flow exceedances at gages in the Upper Russian River under Baseline Conditions (left panel of table) and difference under Proposed Project (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node[1]	Baseline					Proposed Project				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Hopland	-0.2	-0.1	-0.1	-0.1	-0.4	-0.2	-0.1	0.0	0.0	0.1
	Cloverdale	1.9	2.0	2.2	2.2	2.2	-0.1	-0.1	-0.3	-0.2	-0.4
	Healdsburg	1.0	1.0	1.2	1.2	1.2	0.0	0.0	-0.2	-0.2	-0.2
0.95	Hopland	0.1	0.2	0.3	0.3	0.1	-0.2	-0.2	-0.2	-0.2	-0.2
	Cloverdale	2.2	2.3	2.4	2.4	2.2	-0.3	-0.3	-0.3	-0.3	-0.2
	Healdsburg	1.2	1.2	1.2	1.2	1.2	-0.2	-0.2	-0.2	-0.2	-0.2
0.90	Hopland	0.1	0.3	0.3	0.4	0.1	-0.1	-0.2	-0.1	-0.2	0.0
	Cloverdale	2.2	2.4	2.4	2.5	2.2	-0.2	-0.2	-0.2	-0.2	0.0
	Healdsburg	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1	-0.1	-0.1	-0.1
0.75	Hopland	0.6	0.6	0.7	0.6	0.2	-0.4	-0.4	-0.4	-0.2	0.0
	Cloverdale	2.7	2.8	2.8	2.8	2.3	-0.5	-0.4	-0.4	-0.3	0.0
	Healdsburg	1.4	1.4	1.4	1.4	1.2	-0.1	-0.2	-0.2	-0.2	0.1
0.50	Hopland	0.8	0.8	0.9	0.8	0.6	-0.6	-0.5	-0.5	-0.3	-0.3
	Cloverdale	2.9	2.9	2.9	2.8	2.8	-0.5	-0.5	-0.5	-0.3	-0.3
	Healdsburg	1.5	1.5	1.5	1.4	1.4	-0.2	-0.2	-0.2	-0.1	-0.1
0.05	Hopland	0.9	0.9	1.0	0.9	0.8	-0.4	-0.5	-0.4	-0.3	2.5
	Cloverdale	3.1	3.0	3.0	2.9	2.9	-0.3	-0.5	-0.4	-0.3	1.6
	Healdsburg	1.7	1.5	1.5	1.4	1.5	-0.1	-0.2	-0.2	-0.1	1.0

[1]The rating curve at the Hopland USGS gage begins at -1.5 feet. As such, application of the rating curve yields negative values at depths less than 1.5 feet. These negative values do not indicate or suggest drying of the Upper Russian River.

Dry Creek

Under the Proposed Project, flow in Dry Creek would be lower from May to June or July but greater from August through September or October across 0.50 and 0.75 exceedances and drier conditions (0.90 and 0.95 exceedances) (Table 4.1-26). Instream flow would be lower in all months, except April during very dry conditions (0.99 exceedance). In general, during all other months across most exceedances, flow would equal to or less than Baseline Conditions in Dry Creek under the Proposed Project.

Under Baseline Conditions, median monthly flows along Dry Creek in spring are low at upstream nodes compared to downstream nodes as tributary inputs increase flow in the downstream direction. As summer progresses, median monthly flows decrease in the downstream direction as tributary inputs decline and eventually cease (Figure 4.1-10). Releases increase to maintain minimum instream flows and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Although releases from Warm Springs Dam would be lower during most months, minimum instream flows still maintain perennial surface flow and provide groundwater recharge throughout the year. As such, potential contributions to groundwater would be similar under the Proposed Project compared to Baseline Conditions.

Depth to groundwater (also referred as water table and aquifer) during summer conditions are not anticipated to change in Dry Creek as a result of the Proposed Project. The alluvial aquifer along Dry Creek is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to Dry Creek. Although the Proposed Project would reduce the volume of water flowing in Dry Creek during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at USGS gage sites using estimated flows and the most recent rating curves (USGS 2016d, e) shows stage would be lower under the Proposed Project during hydrologically losing months (June through October; Table 4.1-27). The greatest differences would occur during June across all exceedances and during July under dry conditions (0.99 exceedance) up to 0.2 foot (2 inches). This decrease in stage may slightly decrease groundwater table elevation slightly, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. The amplitude of fluctuations would likely be greatest near the surface water connection with typical seasonal fluctuations in Dry Creek ranging from 1 to 2 feet. As these seasonal fluctuations exceed the potential stage change under the Proposed Project, and as described above, potential contributions to groundwater would be similar to Baseline Conditions under the Proposed Project, the effect of the Proposed Project on the groundwater table elevation in Dry Creek would be less than significant.

Table 4.1-26. Percent difference in discharge (cfs) between Baseline Conditions and the Proposed Project at nodes in Dry Creek. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Warm Springs Dam	-6%	0%	0%	0%	0%	0%	0%	0%	0%	-18%	-2%	-27%
		Dry Cr at Geyserville	-11%	-5%	-4%	-2%	-2%	-1%	2%	-1%	-6%	-19%	-1%	-24%
		Dry Creek Mouth	-23%	-7%	-7%	-7%	-7%	0%	5%	-2%	-15%	-26%	-6%	-12%
	0.95	Warm Springs Dam	2%	-1%	0%	0%	0%	0%	0%	0%	-13%	-24%	5%	0%
		Dry Cr at Geyserville	-10%	5%	2%	-2%	-2%	0%	1%	-3%	-19%	-20%	5%	0%
		Dry Creek Mouth	-21%	23%	-4%	-3%	0%	0%	1%	-6%	-28%	-21%	2%	-5%
	0.90	Warm Springs Dam	-7%	19%	-3%	0%	0%	0%	0%	-13%	-13%	-12%	8%	2%
		Dry Cr at Geyserville	-9%	0%	-1%	-2%	0%	0%	0%	-11%	-19%	-11%	8%	3%
		Dry Creek Mouth	-16%	-5%	-5%	1%	0%	0%	0%	-8%	-26%	-14%	7%	1%
	0.75	Warm Springs Dam	0%	0%	0%	0%	0%	0%	0%	-13%	-21%	1%	12%	6%
		Dry Cr at Geyserville	1%	-3%	-3%	0%	-1%	0%	0%	-11%	-20%	1%	12%	6%
		Dry Creek Mouth	-1%	-5%	-1%	0%	-1%	0%	0%	-7%	-21%	-2%	14%	6%
	0.5	Warm Springs Dam	15%	-4%	0%	0%	0%	0%	0%	-13%	-18%	10%	18%	11%
		Dry Cr at Geyserville	17%	-4%	1%	-2%	0%	0%	0%	-10%	-14%	9%	17%	10%
		Dry Creek Mouth	20%	-4%	0%	-1%	0%	0%	0%	-6%	-10%	11%	22%	16%
	0.05	Warm Springs Dam	-2%	1%	-11%	0%	-50%	0%	0%	3%	-7%	-8%	-9%	-9%
		Dry Cr at Geyserville	-2%	0%	-2%	0%	-14%	0%	0%	0%	-7%	-8%	-9%	-8%
		Dry Creek Mouth	0%	0%	0%	0%	-1%	0%	0%	0%	-8%	-8%	-9%	-9%

m

Table 4.1-27. Estimated stage (feet) at various flow exceedances at gages in Dry Creek under Baseline Conditions (left panel of table) and difference under Proposed Project (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					Proposed Project				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Dry Creek at Geyserville	1.0	1.1	1.2	1.2	1.0	0.0	-0.2	0.0	-0.2	-0.1
	Dry Creek Mouth	4.7	4.8	4.8	4.8	4.7	-0.1	-0.2	0.0	-0.1	-0.1
0.95	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	-0.2	-0.2	0.0	0.0	-0.1
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	-0.2	-0.1	0.0	0.0	-0.1
0.90	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	-0.2	-0.1	0.1	0.0	-0.1
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	-0.2	-0.1	0.0	0.0	-0.1
0.75	Dry Creek at Geyserville	1.1	1.2	1.2	1.2	1.2	-0.2	0.0	0.1	0.1	0.0
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	-0.1	0.0	0.1	0.0	0.0
0.50	Dry Creek at Geyserville	1.2	1.2	1.3	1.3	1.3	-0.1	0.1	0.2	0.1	0.1
	Dry Creek Mouth	4.8	4.8	4.8	4.8	4.8	-0.1	0.1	0.1	0.1	0.1
0.05	Dry Creek at Geyserville	1.7	1.8	1.9	1.8	1.7	-0.1	-0.1	-0.1	-0.1	0.0
	Dry Creek Mouth	5.2	5.3	5.4	5.3	5.2	-0.1	-0.1	-0.1	-0.1	0.0

Lower Russian River

Under the Proposed Project, instream flow along the Lower Russian River would be less than Baseline Conditions from April through September or October across 0.05, 0.50, and 0.75 exceedances and the same or lower throughout most of the year during drier conditions (0.90, 0.95, and 0.99 exceedances) at Hacienda Bridge (Table 4.1-28).

Median flows decrease in the Lower Russian River between the Dry Creek Confluence and Hacienda Bridge from May through November (Figure 4.1-11). During this time, releases from Coyote Valley and Warm Springs dams increase to maintain minimum instream flows, and to ensure surface water delivery to the Wohler and Mirabel diversion facilities. Differences between the Russian River and Dry Creek confluence and the Hacienda Bridge result from diversion at Wohler and Mirabel, which varies with demand, and losses from evaporation, diversion, and infiltration into the alluvial aquifer. Under the Proposed Project, diversion from Wohler and Mirabel would increase to attain beneficial use of the existing 75,000 acre-feet of water authorized under the Water Agency's water rights permits 12947A, 16596, 12949, and 12950. As such, potential contributions to groundwater would be similar under the Proposed Project than under Baseline Conditions.

The alluvial aquifer along the Russian River is in dynamic equilibrium with surface flows. In general, winter precipitation and surface runoff contributes to recharge of the alluvial aquifer. In addition, minimum instream flows maintain a continuous source of recharge to the alluvial aquifer that lies beneath and adjacent to the Russian River. Although the Proposed Project would reduce the volume of water flowing in the Lower Russian River during the dry season, surface water would be maintained throughout the entire system and the changes would not affect the shallow aquifer.

In hydraulically-connected systems, such as the Russian River, groundwater table elevation is related to adjacent surface water elevation. A comparison of stage at the Russian River at Guerneville (Hacienda Bridge) USGS gage using estimated flows and the most recent rating curve (USGS 2016f) shows stage would be the same or lower under the Proposed Project during hydrologically losing months (June through October; Table 4.1-29). The greatest decreases would occur in July and August across 0.05 and 0.50 exceedances, up to 0.6 foot (7 inches), and would occur under all but the driest conditions at generally less than 0.4 foot (5 inches). These decreases in stage may slightly decrease groundwater table elevation, but groundwater moves much more slowly through its medium than surface water, and groundwater elevation changes are more gradual than surface water changes. Fluctuations would likely be greatest near the surface water connection with typical fluctuations in the Russian River from the wet season to the dry season ranging from 5 feet to 10 feet. As these seasonal fluctuations far exceed the potential stage change under the Proposed Project, and as described above, potential contributions to groundwater may be greater under the Proposed Project, this alternative would have a less than significant impact on the groundwater table elevation in the Lower Russian River.

Table 4.1-28. Percent difference in discharge (cfs) between Baseline Conditions and the Proposed Project at nodes in the Lower Russian River. Positive percent indicates increase over Baseline Conditions (shaded blue); negative percent indicates decrease (shaded red); 0% indicates no change (no shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Russian R at Dry C	14%	-1%	-7%	5%	37%	-3%	17%	13%	9%	10%	10%	8%
		Hacienda Bridge	-7%	-17%	6%	10%	30%	-11%	-5%	-7%	-7%	-7%	-7%	-7%
	0.95	Russian R at Dry C	-2%	11%	6%	-15%	4%	-7%	-13%	-8%	-7%	-7%	-8%	-8%
		Hacienda Bridge	-29%	0%	-6%	-22%	-3%	-10%	-25%	-41%	-29%	-29%	-29%	-29%
	0.90	Russian R at Dry C	-6%	5%	5%	-13%	9%	-6%	-13%	-33%	-11%	-12%	-11%	-11%
		Hacienda Bridge	-29%	-6%	-6%	-17%	6%	-8%	-19%	-54%	-37%	-29%	-29%	-29%
	0.75	Russian R at Dry C	-15%	3%	-5%	7%	2%	-4%	-13%	-30%	-25%	-22%	-19%	-20%
		Hacienda Bridge	-47%	-11%	-10%	2%	0%	-4%	-16%	-46%	-52%	-47%	-47%	-47%
	0.50	Russian R at Dry C	-11%	-7%	6%	2%	2%	0%	-9%	-24%	-31%	-29%	-25%	-18%
		Hacienda Bridge	-17%	-12%	4%	0%	1%	-1%	-10%	-34%	-62%	-56%	-53%	-47%
	0.05	Russian R at Dry C	192%	8%	3%	0%	0%	1%	0%	-3%	-16%	-27%	-21%	-15%
		Hacienda Bridge	195%	3%	3%	0%	0%	0%	0%	-5%	-21%	-62%	-59%	-54%

Table 4.1-29. Estimated stage (feet) at various flow exceedances at gages in the Lower Russian River under Baseline Conditions (left panel of table) and difference under the Proposed Project (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Exceedance	Node	Baseline					Proposed Project				
		Jun	Jul	Aug	Sep	Oct	Jun	Jul	Aug	Sep	Oct
0.99	Hacienda Bridge	1.2	1.2	1.2	1.2	1.2	-0.1	-0.1	-0.1	-0.1	-0.1
0.95	Hacienda Bridge	1.6	1.6	1.6	1.6	1.6	-0.3	-0.3	-0.3	-0.3	-0.3
0.90	Hacienda Bridge	1.7	1.6	1.6	1.6	1.6	-0.4	-0.3	-0.3	-0.3	-0.3
0.75	Hacienda Bridge	2.0	1.9	1.9	1.9	1.9	-0.6	-0.5	-0.5	-0.5	-0.5
0.50	Hacienda Bridge	2.2	2.0	2.0	1.9	2.0	-0.9	-0.7	-0.6	-0.5	-0.2
0.05	Hacienda Bridge	3.2	2.3	2.1	2.0	2.4	-0.4	-0.9	-0.8	-0.6	1.9

Impact 4.1-2. The Fish Flow Project could substantially alter the existing drainage pattern of a site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or sedimentation on- or off-site. (Less than Significant)

Flow changes implemented by the Fish Flow Project could increase exposure of previously submerged shoreline along banks adjacent to the Russian River and Dry Creek. Increased exposure could lead to greater erosion from surface runoff during precipitation, thereby increasing sediment delivery to adjacent waterways. Substantial decreases in stage could also steepen the water surface slope from tributary streams, increasing erosive power at tributary junctions causing elevated sediment delivery to the Russian River and Dry Creek. Substantial increases in stage could lead to greater erosion from increased scour.

No Project 1 Alternative

Upper Russian River

Under the No Project 1 Alternative, instream flows in the Upper Russian River would be identical to Baseline Conditions, which follow minimum instream flow requirements in the Water Agency's water right permits and in the Decision 1610 Hydrologic Index. Instream flows would be identical at all nodes in the Upper Russian River across the entire range of exceedances (Table 4.1-11). As flows are identical to Baseline Conditions, there would be no impact to drainage patterns or erosion or sedimentation.

Dry Creek

Under the No Project 1 Alternative, the greatest stage changes at USGS gages along Dry Creek occur during across 0.50 and 0.05 exceedances (Table 4.1-30). Modeling data show that stage would be slightly greater from July through October under median flows and similar the remainder of the year, while during 0.05 exceedance stage would be greater from June through October and lower through the remainder of the year, with a low occurring in February. Increases in stage would occur during lower flows from June to July, with low velocity, and are not likely to cause increased erosion (Figure 4.1-12 and Figure 4.1-13). Further, since the changes would be relatively small compared to the overall stage height (1.0 to 1.5 feet), there would be little effect on water surface slope, and resulting erosion from or within tributaries. Potential stage change in February under 0.05 exceedance from 12.2 to 11 feet (Figure 4.1-13) would potentially expose 1.2 feet of streambank to erosion from runoff during precipitation. Still, this potential change would occur relatively infrequently during a single month (February). The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Table 4.1-30. Changes in stage (feet) compared to Baseline Conditions under the No Project 1 Alternative at USGS gages along Dry Creek by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 1	0.99	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
		Dry Creek Mouth	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	0.95	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Dry Creek Mouth	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	0.90	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	0.75	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	0.50	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2
		Dry Creek Mouth	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2
	0.05	Dry Cr at Geyserville	0.2	0.0	-0.4	-0.3	-1.4	0.0	0.0	0.0	0.2	0.2	0.2	0.2
		Dry Creek Mouth	0.2	0.0	-0.2	-0.1	-0.2	0.0	0.0	0.0	0.2	0.2	0.2	0.2

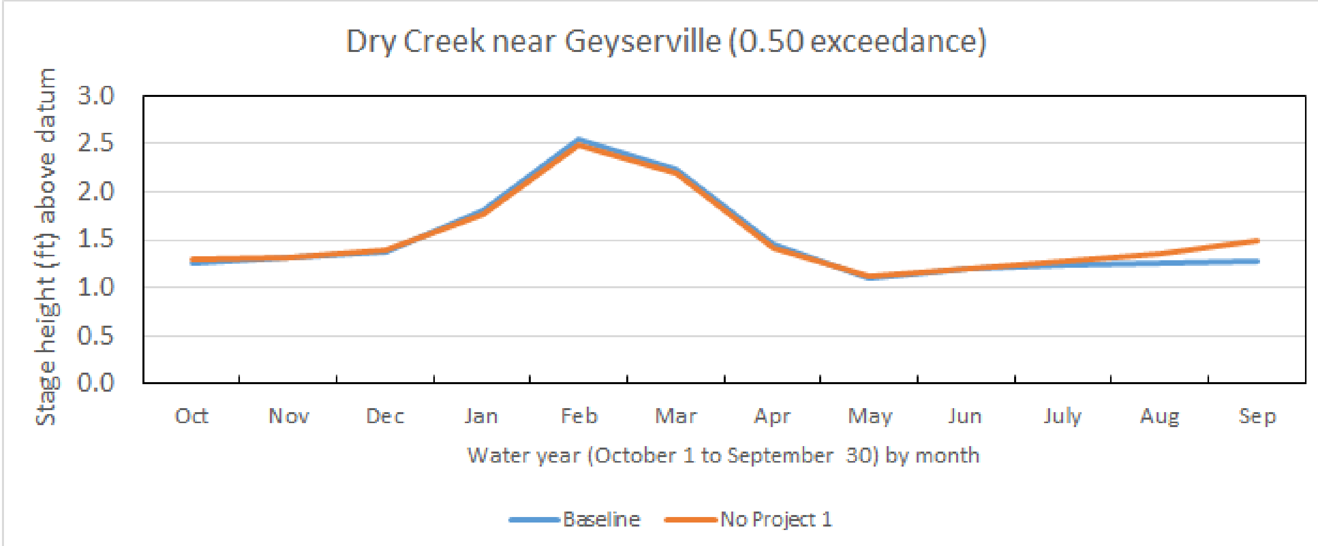

Figure 4.1-12. Stage height at the Dry Creek near Geyserville USGS gage under Baseline Conditions and the No Project 1 Alternative (0.50 exceedance).

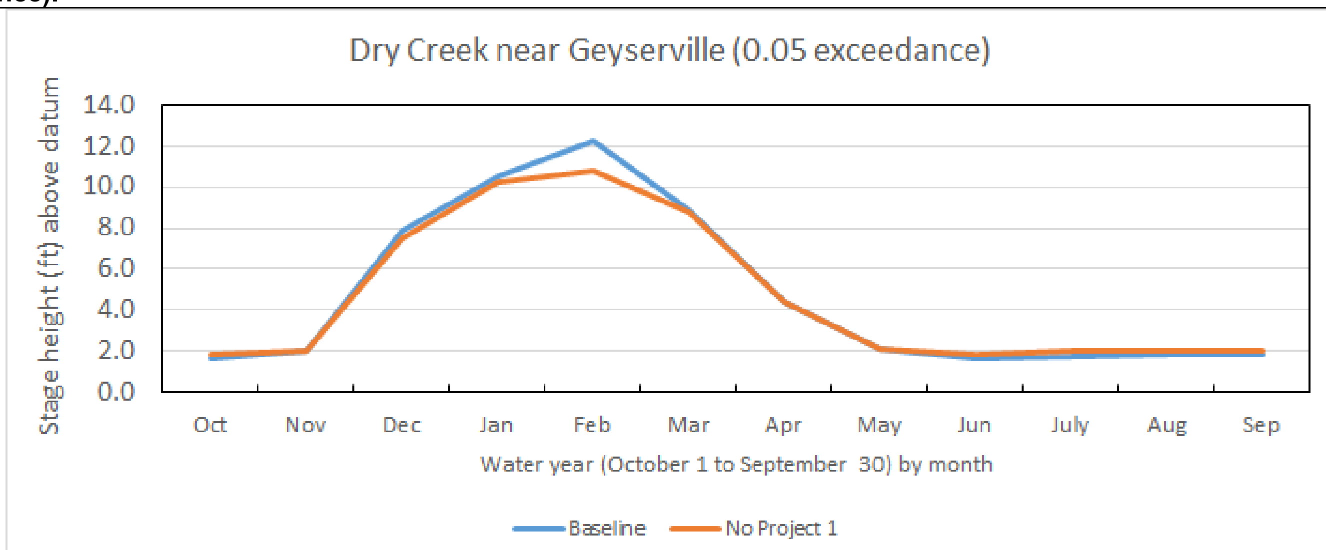

Figure 4.1-13. Stage height at the Dry Creek near Geyserville USGS gage under Baseline Conditions and the No Project 1 Alternative (0.05 exceedance).

Lower Russian River

Under the No Project 1 Alternative, the greatest stage changes at the Hacienda Bridge USGS gage in the Lower Russian River would occur during 0.50 and 0.05 exceedances (Table 4.1-31). Modeling data show that stage would lower from May through November under median flow and 0.05 exceedances and similar or slightly lower the remainder of the year. Some decreases in stage would occur during lower flows from June to November, with low velocity, and would not be likely to cause increased erosion (Figure 4.1-14 and Figure 4.1-15). Further, since the changes are relatively small (0.2 foot) compared to the overall stage heights (2.0 feet), there would be little effect on water surface slope, and resulting erosion from or within tributaries. During high flow, stage changes would be even smaller (0.2 foot) relative to overall stage heights (11 to 25 feet) (Figure 4.1-15) and the potential impact to drainage patterns and erosion and sedimentation would be less than significant.

No Project 2 Alternative

Upper Russian River

Under the No Project 2 Alternative, stage at USGS gages along the Upper Russian River would be less than Baseline Conditions from May through September across 0.05 and 0.75 exceedances and from May through October during median conditions (Table 4.1-32). During dry conditions (0.90, 0.95, and 0.99 exceedances), stage would be lower from August through October, but generally the same or higher through the year.

The stage decrease during May through September under median flow is 0.3 to 0.4 foot and would expose previously submerged streambank (Figure 4.1-14). The bank would be exposed during relatively dry months and would be unlikely to lead to greater erosion from surface runoff during precipitation or bank erosion from high water velocity. Further, the overall stage changes would be small and would likely have a minor effect on water surface slope, and resulting erosion from or within tributaries.

During wet conditions (0.05 exceedance), stage increases in October, likely in response to releases from Coyote Valley Dam to increase reservoir storage for flood control. The greatest changes would occur upstream near Coyote Valley Dam at the Hopland USGS gage in October (2.4 feet), but would also occur during periods of seasonal low flow (Figure 4.1-15). This could still cause bank erosion, but this potential change would occur relatively infrequently (0.05 exceedance [approximately one out of twenty years]) during a single month (October). Further, natural stage increases due to seasonal rainfall would exceed the magnitude and duration of this stage increase. Under No Project 2 and Baseline Condition during 0.05 exceedance, stage would increase above 3.1 feet (up to 13.0 feet) from November through April. The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Table 4.1-31. Changes in stage (feet) compared to Baseline Conditions under the No Project 1 Alternative at the Hacienda Bridge USGS gage along the Lower Russian River by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 1	0.99	Hacienda Br	0.0	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0
	0.95	Hacienda Br	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	0.0	0.0	0.0	0.0
	0.90	Hacienda Br	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	0.0	0.0	0.0
	0.75	Hacienda Br	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	0.0	0.0	0.0
	0.50	Hacienda Br	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.1	0.0
	0.05	Hacienda Br	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.1

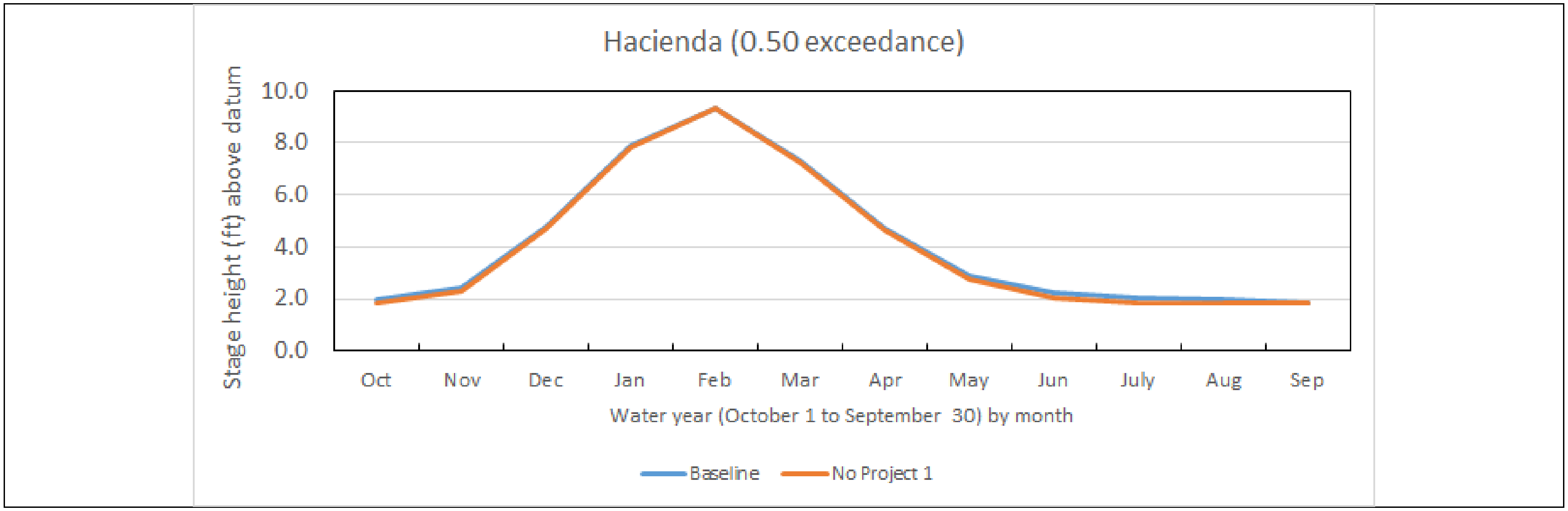

Figure 4.1-14. Stage height at the Hacienda Bridge USGS gage under Baseline Conditions and the No Project 1 Alternative (0.50 exceedance).

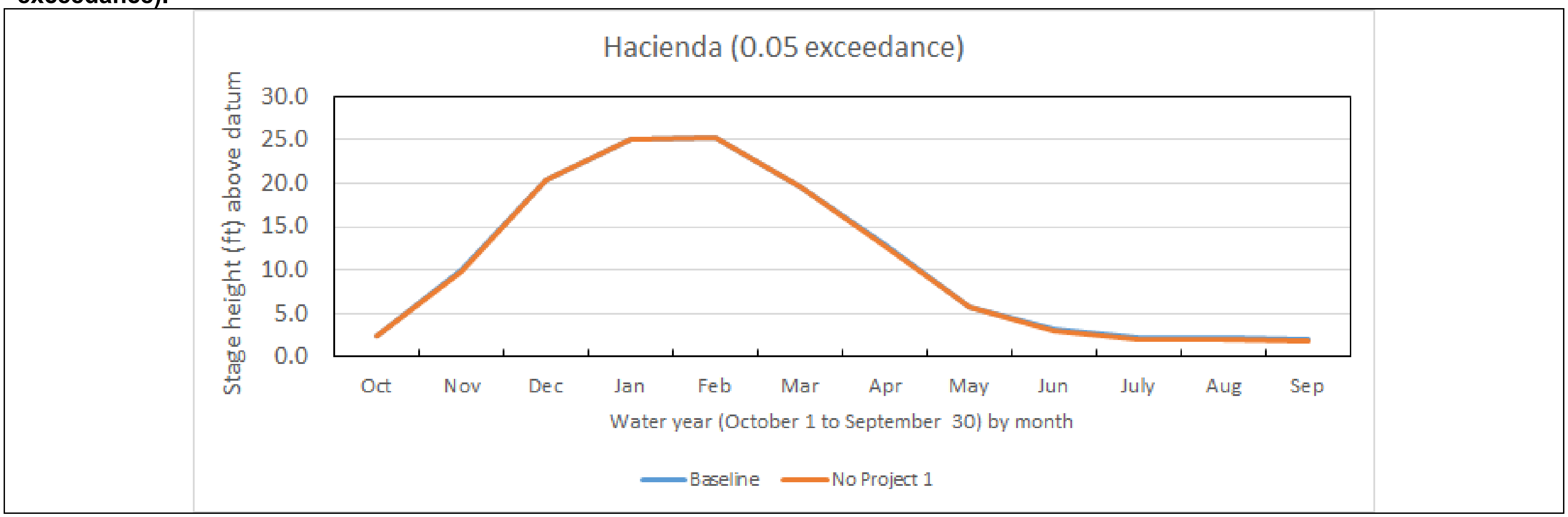

Figure 4.1-15. Stage height at the Hacienda Bridge USGS gage under Baseline Conditions and the No Project 1 Alternative (0.05 exceedance).

Table 4.1-32. Changes in stage (feet) compared to Baseline Conditions under the No Project 2 Alternative at USGS gages along the Upper Russian River by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Hopland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
		Cloverdale	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1
		Healdsburg	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
	0.95	Hopland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Cloverdale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Healdsburg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.90	Hopland	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Cloverdale	0.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Healdsburg	0.0	0.0	0.2	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
	0.75	Hopland	0.2	0.5	0.0	0.1	0.0	0.0	0.0	-0.4	-0.2	-0.3	-0.2	-0.1
		Cloverdale	0.2	0.5	0.0	0.1	0.0	0.0	0.0	-0.4	-0.2	-0.2	-0.2	-0.1
		Healdsburg	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	0.5	Hopland	-0.1	0.0	0.2	0.1	0.1	0.0	0.0	-0.4	-0.4	-0.3	-0.3	-0.2
		Cloverdale	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	-0.3	-0.4	-0.3	-0.3	-0.2
		Healdsburg	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.1
	0.05	Hopland	2.4	0.1	0.2	0.1	0.0	0.1	0.0	-0.2	-0.4	-0.4	-0.3	-0.2
		Cloverdale	1.6	0.2	0.2	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.3	-0.2
		Healdsburg	1.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.1

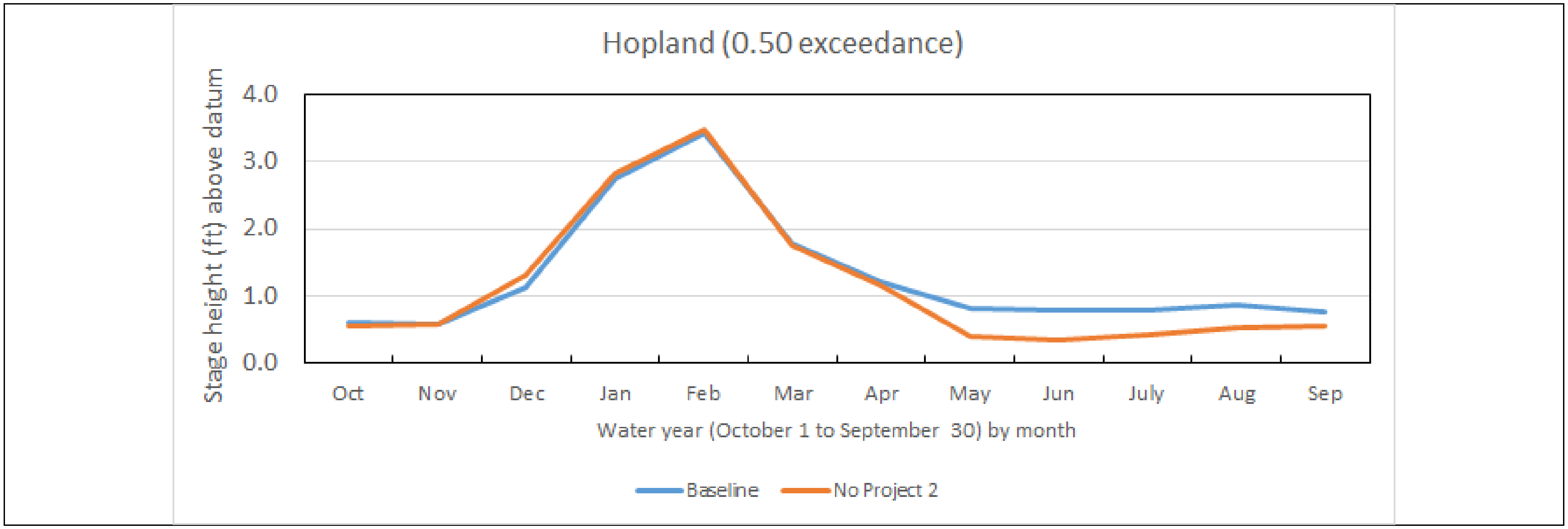

Figure 4.1-16. Stage height at the Hopland USGS gage under Baseline Conditions and the No Project 2 Alternative (0.50 exceedance).

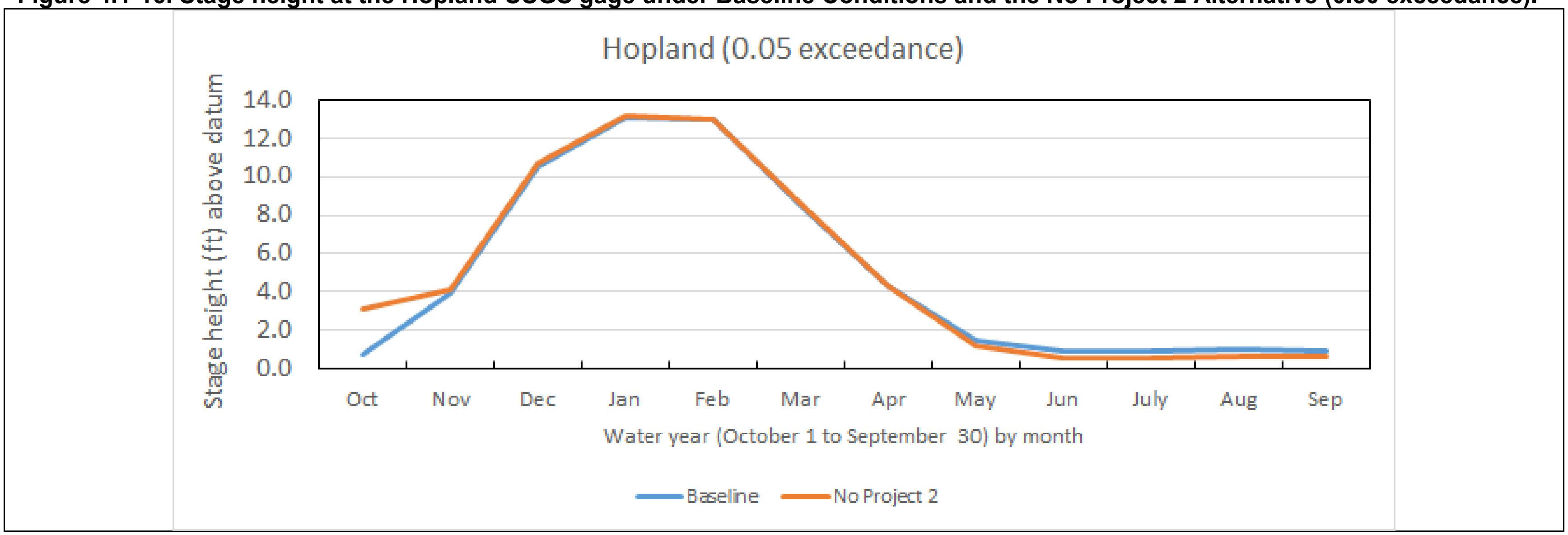

Figure 4.1-17. Stage height at the Hopland USGS gage under Baseline Conditions and the No Project 2 Alternative (0.05 exceedance).

Dry Creek

Under the No Project 2 Alternative, the greatest stage changes at USGS gages along Dry Creek occur during median and 0.05 occurrences (Table 4.1-33). Modeling data show that stage is similar or slightly greater across all months under median flows while during wetter conditions (0.05 exceedance) stage is less from June through September and higher in October and November, with the greatest difference occurring in February. Increases in stage would occur during lower flows from July through October, with low velocity, and are not likely to cause increased erosion during median flow conditions (Figure 4.1-18). Further, since the changes are relatively small (0.1 foot) compared to the overall stage height (1.0 to 1.5 feet), there would be little effect on water surface slope, and resulting erosion from or within tributaries. Potential stage change in February under wetter conditions (0.05 exceedance) from 12 feet to 11 feet (Figure 4.1-19) would potentially expose 1 feet of streambank to erosion from runoff during precipitation. Still, this potential change would occur relatively infrequently during a single month (February). The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Lower Russian River

Under the No Project 2 Alternative, the greatest stage changes at the Hacienda Bridge USGS gage in the Lower Russian River would occur from May through June under all but the driest flow conditions (0.99 exceedance) (Table 4.1-34). Modeling data show that stage is lower from April through October across 0.50 and 0.75 exceedances and similar or slightly lower the remainder of the year, while during wetter flow conditions (0.05 exceedance), stage is lower from May through September, but increases substantially in October, likely in response to releases from Coyote Valley Dam to increase storage for flood control. Decreases in stage would occur during lower flows from May to October, with low velocity, and are not likely to cause increased erosion (Figure 4.1-20 and Figure 4.1-21). Further, since the changes are relatively small (0.5 feet) compared to the overall stage heights (2.0 to 5.0 feet), there would be little effect on water surface slope, and resulting erosion from or within tributaries.

The increase in stage in October would be larger (1.8 feet) relative to overall stage height (5.0 feet), but would also occur during periods of seasonal low flow. This could still cause bank erosion, but this potential change would occur relatively infrequently (0.05 exceedance [approximately one out of twenty years]) during a single month (October). Further, natural stage increases due to seasonal rainfall would exceed the magnitude and duration of this stage increase. Under No Project 2 and Baseline Condition during 0.05 exceedance, stage would increase above 5.0 feet (up to 25.0 feet) from November through May. The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Table 4.1-33. Changes in stage (feet) compared to Baseline Conditions under the No Project 2 Alternative at USGS gages along Dry Creek by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	%	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dry Creek Mouth	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.95	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dry Creek Mouth	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.90	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.75	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	0.50	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	0.05	Dry Cr at Geyserville	0.2	0.0	0.0	-0.1	-1.2	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2
		Dry Creek Mouth	0.2	0.0	0.1	0.0	-0.2	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2

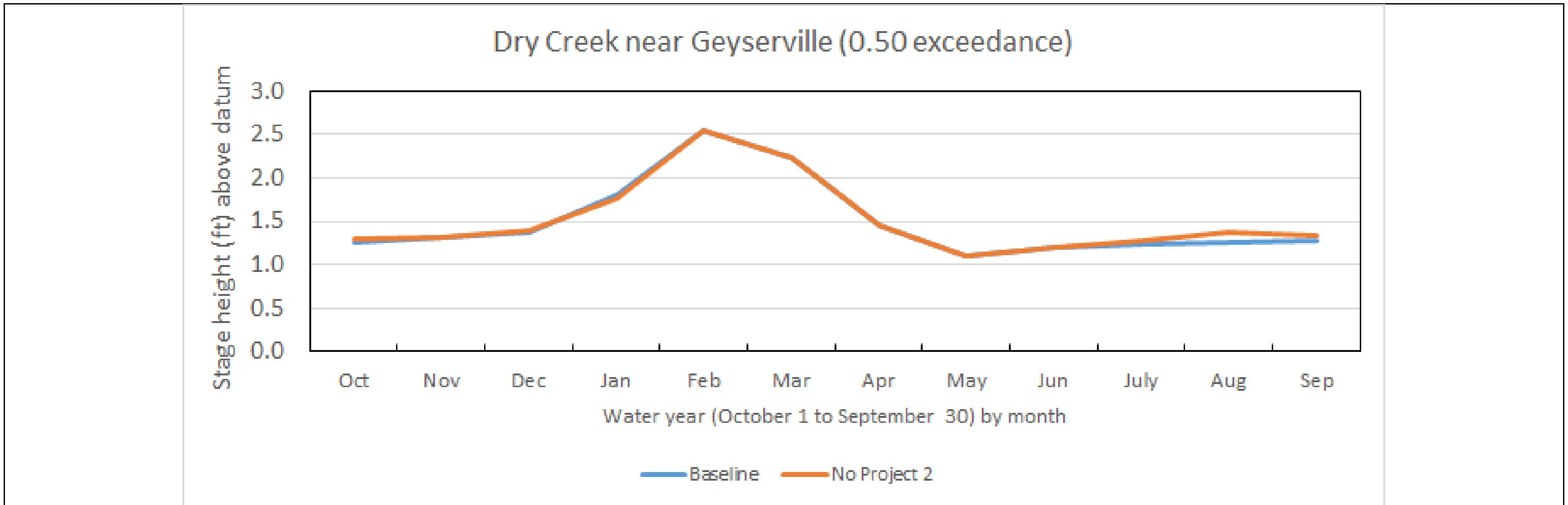

Figure 4.1-18. Stage height at the Dry Creek nr Geyserville USGS gage under Baseline Conditions and the No Project 2 Alternative (0.50 exceedance)

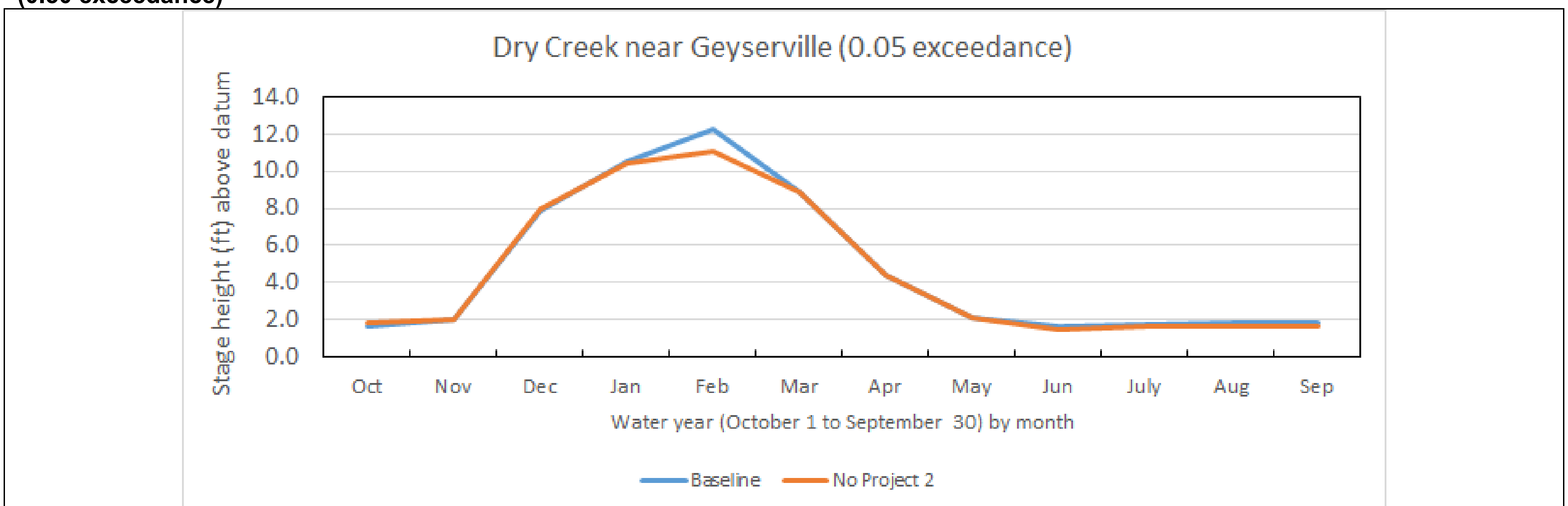

Figure 4.1-19. Stage height at the Dry Creek nr Geyserville USGS gage under Baseline Conditions and the No Project 2 Alternative (0.05 exceedance)

Table 4.1-34. Changes in stage (feet) compared to Baseline Conditions under the No Project 2 Alternative at USGS gages along Dry Creek by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Hacienda Br	0.0	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0
	0.95	Hacienda Br	-0.3	-0.1	0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3
	0.90	Hacienda Br	-0.1	0.2	0.2	-0.1	-0.1	-0.1	-0.1	-0.5	-0.2	-0.3	-0.3	-0.3
	0.75	Hacienda Br	-0.3	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.5	-0.4	-0.4	-0.4	-0.4
	0.50	Hacienda Br	-0.3	-0.1	0.1	0.0	0.0	0.0	-0.1	-0.4	-0.5	-0.6	-0.5	-0.4
	0.05	Hacienda Br	1.8	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.6	-0.6	-0.5

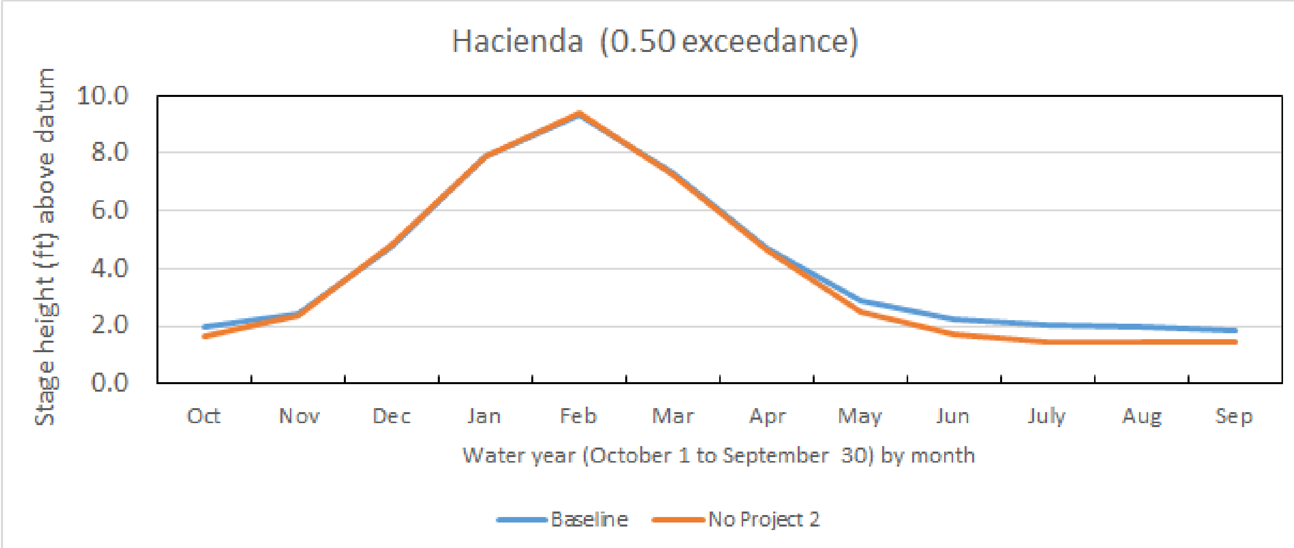

Figure 4.1-20. Stage height at the Hacienda Bridge USGS gage under Baseline Conditions and the No Project 2 Alternative (0.50 exceedance).

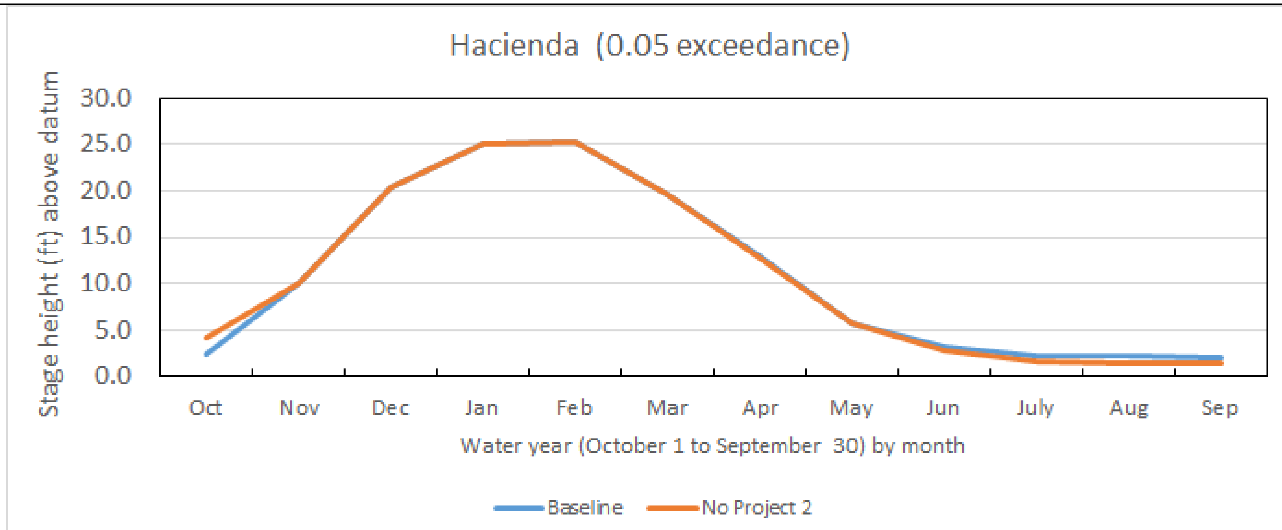

Figure 4.1-21. Stage height at the Hacienda Bridge USGS gage under Baseline Conditions and the No Project 2 Alternative (0.05 exceedance).

Proposed Project

Upper Russian River

Under the Proposed Project, stage at USGS gages along the Upper Russian River would be lower from March, April, or May through September or October across 0.50 and 0.75 exceedances and drier conditions (0.90 and 0.95 exceedances) (Table 4.1-35). During wetter conditions (0.05 exceedance), stage increases in October, likely in response to releases from Coyote Valley Dam to increase storage for flood control. The greatest changes would occur upstream near Coyote Valley Dam at the Hopland USGS gage. The stage decrease during May through September under median flows is 0.4 to 0.5 foot would expose previously submerged streambank (Figure 4.1-22). The bank would be exposed during relatively dry months and would be unlikely to lead to greater erosion from surface runoff during precipitation or be subject to bank erosion from high water velocity. Additionally, the overall stage changes are small and would likely have a minor effect on water surface slope, and resulting erosion from or within tributaries.

The increase in stage in October (2.4 feet) would occur during periods of seasonal low flow (Figure 4.1-23). This could still cause bank erosion, but this potential change would occur relatively infrequently during a single month (October). Further, natural stage increases due to seasonal rainfall would exceed the magnitude and duration of this stage increase. Under the Proposed Project and Baseline Condition during 0.05 exceedance, stage would increase above 4.0 feet (up to 13.0 feet) from November through April. The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Dry Creek

Under the Proposed Project, the greatest stage changes at USGS gages along Dry Creek occur across 0.50 and 0.05 exceedances (Table 4.1-36). Modeling data show that stage is greater from July through October under median flows, and similar or less throughout the remainder of the year. During wetter conditions (0.05 exceedance), stage is less from June through September and similar in October and November, with the greatest difference occurring in February. Increases in stage would occur during lower minimum flows from July through October, with low velocity, and would not be likely to cause increased erosion during 0.50 exceedance (Figure 4.1-24). Further, since the changes are relatively small (0.2 foot) compared to the overall stage height (1.2 to 1.5 feet), there would be little effect on water surface slope, and resulting erosion from or within tributaries. Potential stage change in February under 0.05 exceedance from 12 feet to 11 feet (Figure 4.1-25) would potentially expose 1 foot of streambank to erosion from runoff during precipitation. Still, this potential change would occur relatively infrequently during a single month (February). The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Table 4.1-35. Changes in stage (feet) compared to Baseline Conditions under the Proposed Project at USGS gages along the Upper Russian River by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alternative	%	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed	0.99	Hopland	0.1	-0.1	-0.1	0.5	0.4	0.1	0.4	0.1	-0.2	-0.1	0.0	0.0
		Cloverdale	-0.4	-0.2	-0.1	0.4	0.6	0.1	0.3	0.1	-0.1	-0.1	-0.3	-0.2
		Healdsburg	-0.2	-0.1	-0.1	0.0	0.2	0.0	0.1	0.0	0.0	0.0	-0.2	-0.2
	0.95	Hopland	-0.2	-0.1	0.1	0.1	0.1	-0.2	0.0	-0.2	-0.2	-0.2	-0.2	-0.2
		Cloverdale	-0.2	-0.1	0.1	-0.1	0.0	-0.1	-0.1	-0.3	-0.3	-0.3	-0.3	-0.3
		Healdsburg	-0.2	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
	0.90	Hopland	0.0	0.1	0.1	-0.3	0.1	-0.2	-0.2	0.0	-0.1	-0.2	-0.1	-0.2
		Cloverdale	0.0	0.1	0.2	-0.2	0.1	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2
		Healdsburg	-0.1	0.0	0.0	-0.1	0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1
	0.75	Hopland	0.0	0.1	-0.3	0.2	0.1	-0.2	-0.5	-0.7	-0.4	-0.4	-0.4	-0.2
		Cloverdale	0.0	0.1	-0.2	0.1	0.1	-0.1	-0.3	-0.5	-0.5	-0.4	-0.4	-0.3
		Healdsburg	0.1	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	-0.2	-0.2
	0.5	Hopland	-0.3	-0.2	0.3	0.2	0.1	0.0	-0.4	-0.6	-0.6	-0.5	-0.5	-0.3
		Cloverdale	-0.3	-0.2	0.2	0.1	0.1	0.0	-0.2	-0.4	-0.5	-0.5	-0.5	-0.3
		Healdsburg	-0.1	0.0	0.1	0.1	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1
	0.05	Hopland	2.5	0.6	0.7	0.2	0.1	0.2	0.0	-0.2	-0.4	-0.5	-0.4	-0.3
		Cloverdale	1.6	0.3	0.4	0.0	0.0	0.1	0.0	-0.1	-0.3	-0.5	-0.4	-0.3
		Healdsburg	1.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.1

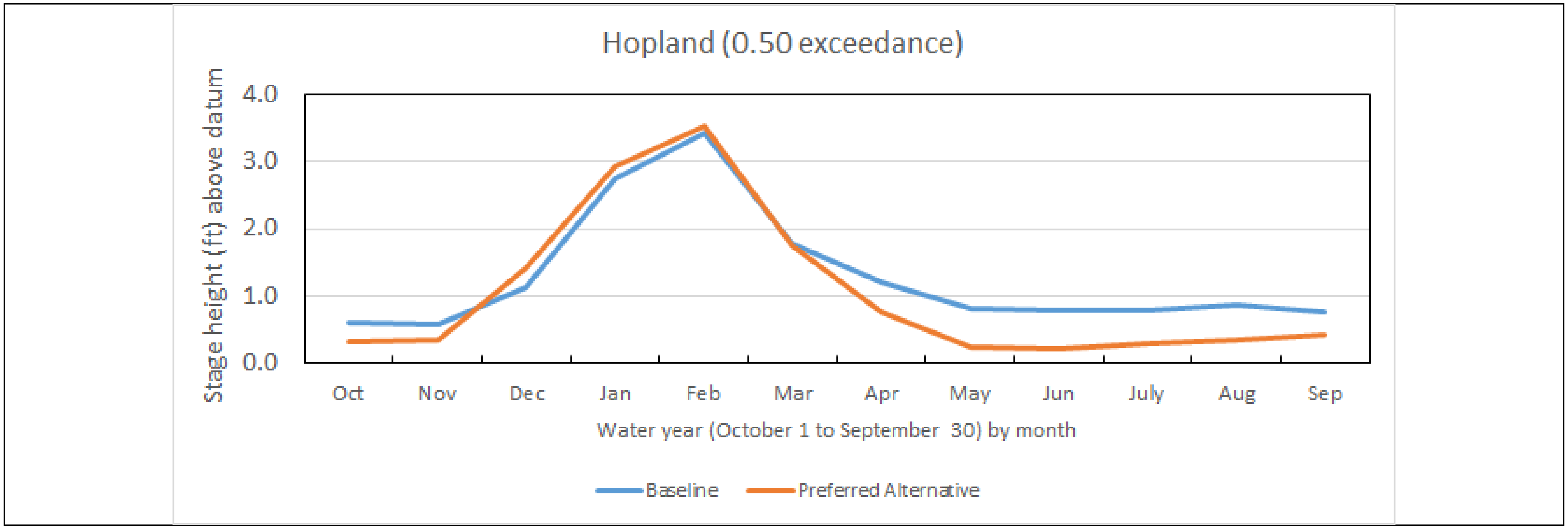

Figure 4.1-22. Stage height at the Hopland USGS gage under Baseline Conditions and the Proposed Project (0.50 exceedance).

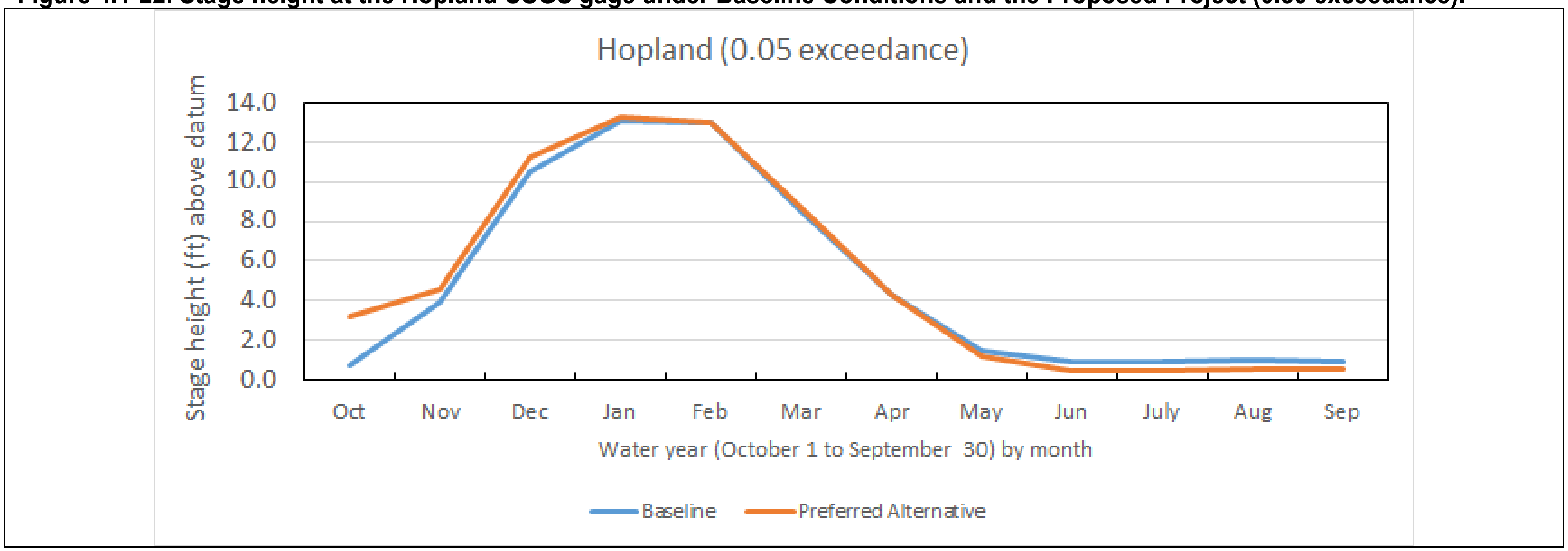

Figure 4.1-23. Stage height at the Hopland USGS gage under Baseline Conditions and the Proposed Project (0.05 exceedance).

Table 4.1-36. Changes in stage (feet) compared to Baseline Conditions under the Proposed Project at USGS gages along Dry Creek by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	%	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Dry Cr at Geyserville	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.2
		Dry Creek Mouth	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	-0.1
	0.95	Dry Cr at Geyserville	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	0.0	0.0
		Dry Creek Mouth	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
	0.90	Dry Cr at Geyserville	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.1	0.0
		Dry Creek Mouth	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
	0.75	Dry Cr at Geyserville	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.1	0.1
		Dry Creek Mouth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.1	0.0
	0.50	Dry Cr at Geyserville	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.2	0.1
		Dry Creek Mouth	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.1
	0.05	Dry Cr at Geyserville	0.0	0.0	-0.1	0.0	-1.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
		Dry Creek Mouth	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1

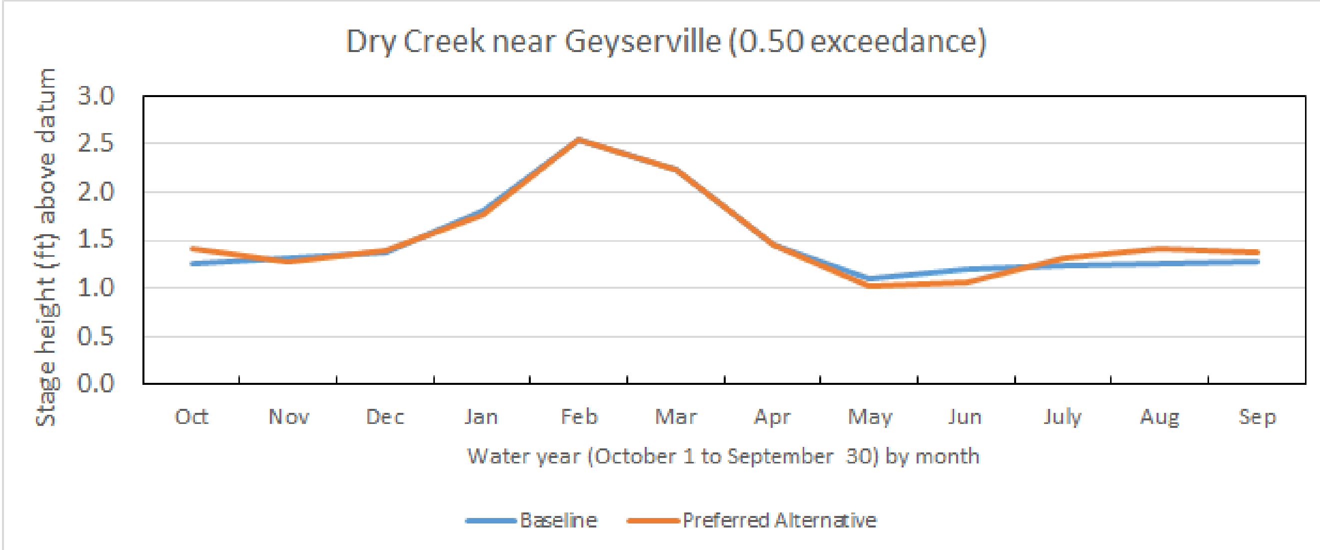

Figure 4.1-24. Stage height at Dry Creek near Geyserville USGS gage under Baseline Conditions and the Proposed Project (0.50 exceedance).

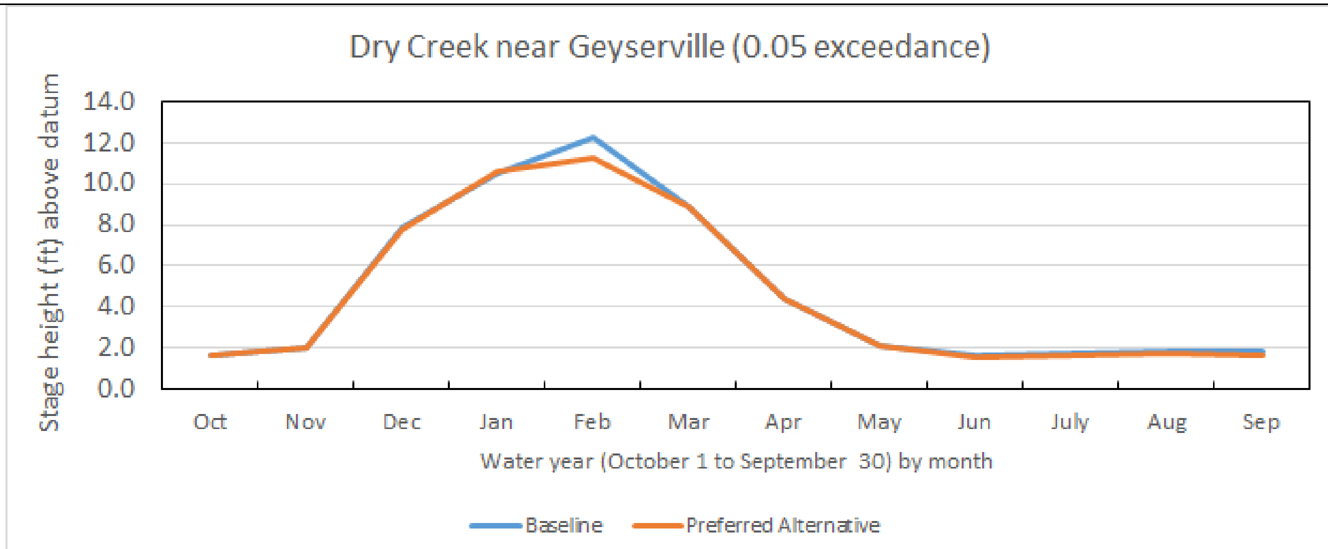

Figure 4.1-25. Stage height at Dry Creek near Geyserville USGS gage under Baseline Conditions and the Proposed Project (0.05 exceedance).

Lower Russian River

Under the Proposed Project, the greatest stage changes at the Hacienda Bridge USGS gage in the Lower Russian River would occur from May through October across all exceedances (Table 4.1-37). Modeling data show that stage is lower from May through October across 0.50 and 0.75 exceedances and similar or slightly lower the remainder of the year, while during wetter conditions (0.05 exceedance), stage is lower from May through September, but increases in October, likely in response to releases from Coyote Valley Dam to increase storage for flood control. Decreases in stage would occur across all other exceedances during lower minimum flows from May to October, with low velocity, and would not be likely to cause increased erosion (Figure 4.1-26 and Figure 4.1-27). The stage change during June through August under median flows would be 0.6 to 0.9 foot compared to the overall stage heights of 2.0 feet and would expose previously submerged streambank. This would occur during relatively dry months and would be unlikely to lead to greater erosion from surface runoff during precipitation.

The increase in stage in October would be large (1.9 feet) relative to overall stage height (5.0 feet), but would also occur during periods of seasonal low flow. This could still cause bank erosion, but this potential change would occur relatively infrequently (0.05 exceedance [approximately one out of twenty years]) during a single month (October). Further, natural stage increases due to seasonal rainfall would exceed the magnitude and duration of this stage increase. Under the Proposed Project and Baseline Condition during 0.05 exceedance, stage would increase above 5.0 feet (up to 25.0 feet) from November through May. The potential impact to drainage patterns and erosion and sedimentation would be less than significant.

Table 4.1-37. Changes in stage (feet) compared to Baseline Conditions under the Proposed Project at USGS gages along the Lower Russian River by month at various exceedance probabilities (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Hacienda Br	-0.1	-0.1	0.1	0.1	0.2	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	0.95	Hacienda Br	-0.3	0.0	-0.1	-0.3	0.0	-0.2	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3
	0.90	Hacienda Br	-0.3	-0.1	-0.1	-0.3	0.1	-0.2	-0.3	-0.7	-0.4	-0.3	-0.3	-0.3
	0.75	Hacienda Br	-0.5	-0.1	-0.1	0.0	0.0	-0.1	-0.3	-0.7	-0.6	-0.5	-0.5	-0.5
	0.50	Hacienda Br	-0.2	-0.2	0.1	0.0	0.1	0.0	-0.3	-0.6	-0.9	-0.7	-0.6	-0.5
	0.05	Hacienda Br	1.9	0.1	0.3	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.9	-0.8	-0.6

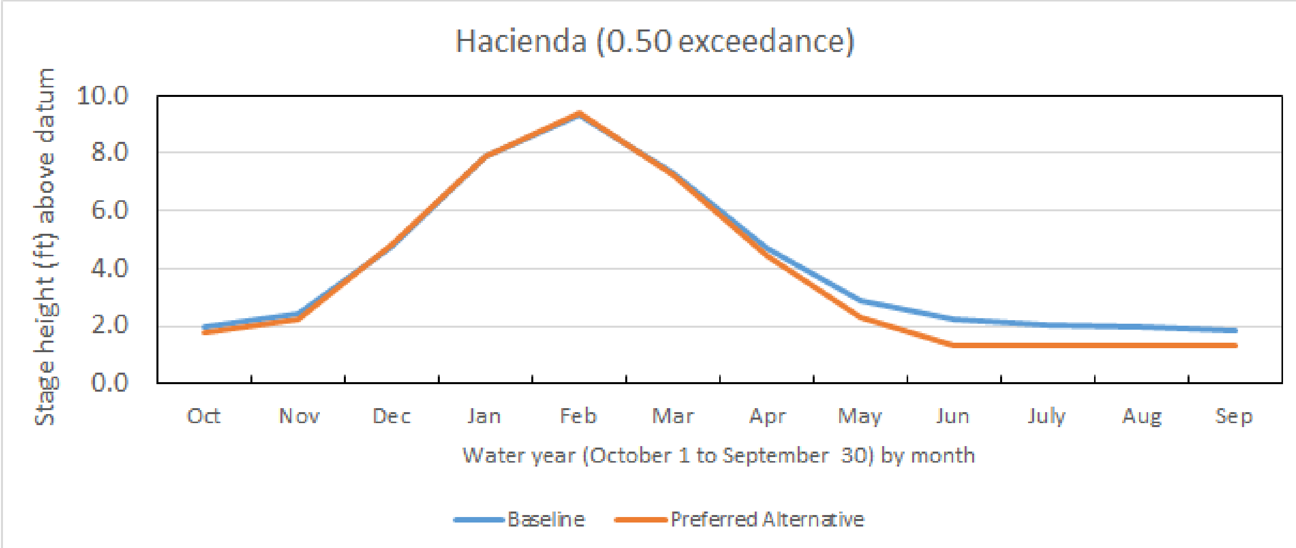

Figure 4.1-26. Stage height at the Hacienda Bridge USGS gage under Baseline Conditions and the Proposed Project (0.50 exceedance).

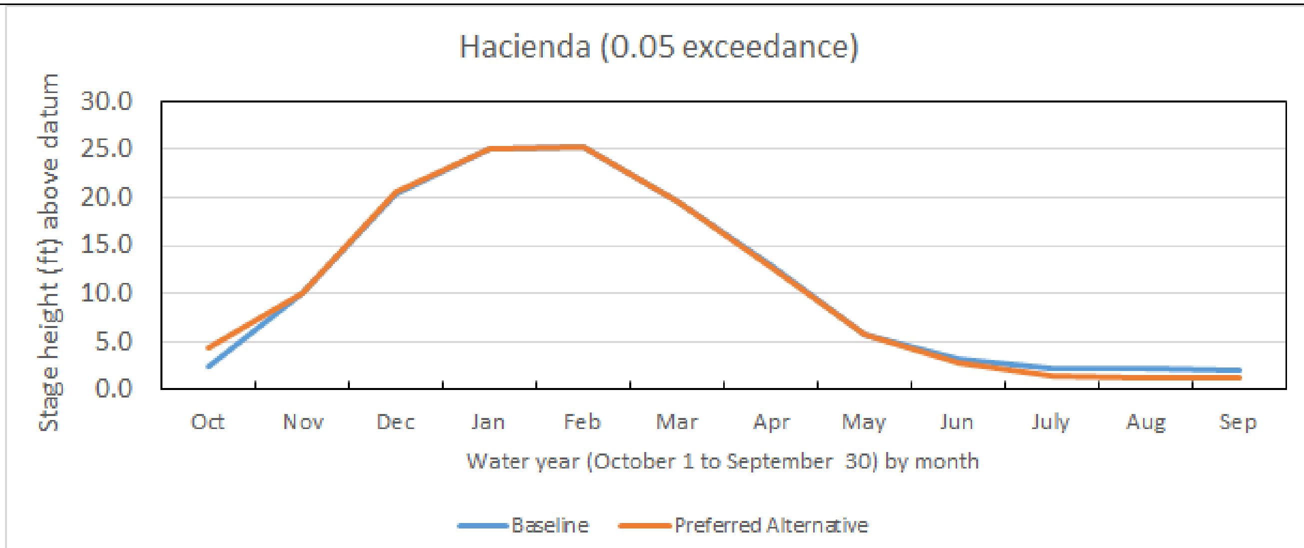

Figure 4.1-27. Stage height at the Hacienda Br USGS gage under Baseline Conditions and the Proposed Project (0.05 exceedance).

Impact 4.1-3. The Fish Flow Project could substantially alter the area of exposed shoreline within Lake Mendocino and Lake Sonoma in a manner which would result in substantial erosion or sedimentation on- or off-site. (Less than Significant)

Flow changes implemented by the Fish Flow Project could decrease water surface elevation within Coyote Valley and Warm Springs dams and expose previously submerged shoreline within Lake Mendocino and Lake Sonoma. Increased area of exposed shoreline could lead to greater erosion from surface runoff during precipitation, thereby increasing sediment delivery to the reservoirs.

No Project 1 Alternative

Lake Mendocino

Under the No Project 1 Alternative, instream flows in the Upper Russian River would be identical to Baseline Conditions, which follow minimum instream flow requirements in the Water Agency's water right permits and in the Decision 1610 Hydrologic Index. Releases from Coyote Valley Dam would be identical to Baseline Conditions across the entire range of exceedances (Table 4.1-11). As instream flows are identical to Baseline Conditions, there would be no impact to the area of exposed shoreline in Lake Mendocino.

Lake Sonoma

Under the No Project 1 Alternative, water surface elevation would decrease in Lake Sonoma in all months during across 0.75 to 0.99 exceedances, and from May through October during median flows (Table 4.1-38Error! Reference source not found.). Decreases in stage would be less than 4 feet in most cases under median flows and less than 7 feet in most cases during drier conditions. The area of exposed shoreline during median flows would be similar to Baseline Conditions with moderate increases from October through January (Figure 4.1-28**Error! Reference source not found.**). The area of exposed shoreline during drier conditions (0.90 exceedance) would be greater than Baseline Conditions, with increases throughout the year (Figure 4.1-29**Error! Reference source not found.**). While the additional area of exposed shoreline is greater, it would only be exposed infrequently during the driest years with little to no precipitation. The potential impact to areas of exposed shoreline would be less than significant.

Table 4.1-38. Estimated difference (feet) in water surface elevation at various flow exceedances in Lake Sonoma under the No Project 1 Alternative compared to Baseline Conditions (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 1	0.99	Sonoma	-6.7	-7.1	-7.2	-7.2	-9.4	-9.6	-6.0	-2.5	-3.7	-4.9	-6.1	-7.4
	0.95	Sonoma	-8.2	-8.4	-7.8	-5.5	-4.7	-2.1	-3.5	-4.0	-4.5	-4.9	-5.9	-6.9
	0.90	Sonoma	-6.6	-6.7	-6.8	-6.7	-3.1	-4.1	-3.4	-3.5	-4.4	-4.3	-4.7	-5.6
	0.75	Sonoma	-5.1	-4.1	-2.7	-2.3	-2.1	-0.3	-0.2	-0.2	-0.5	-1.4	-2.6	-4.1
	0.50	Sonoma	-1.6	-1.8	-1.7	-3.5	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.6	-1.3
	0.05	Sonoma	-0.7	-1.8	-0.5	-0.4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.2

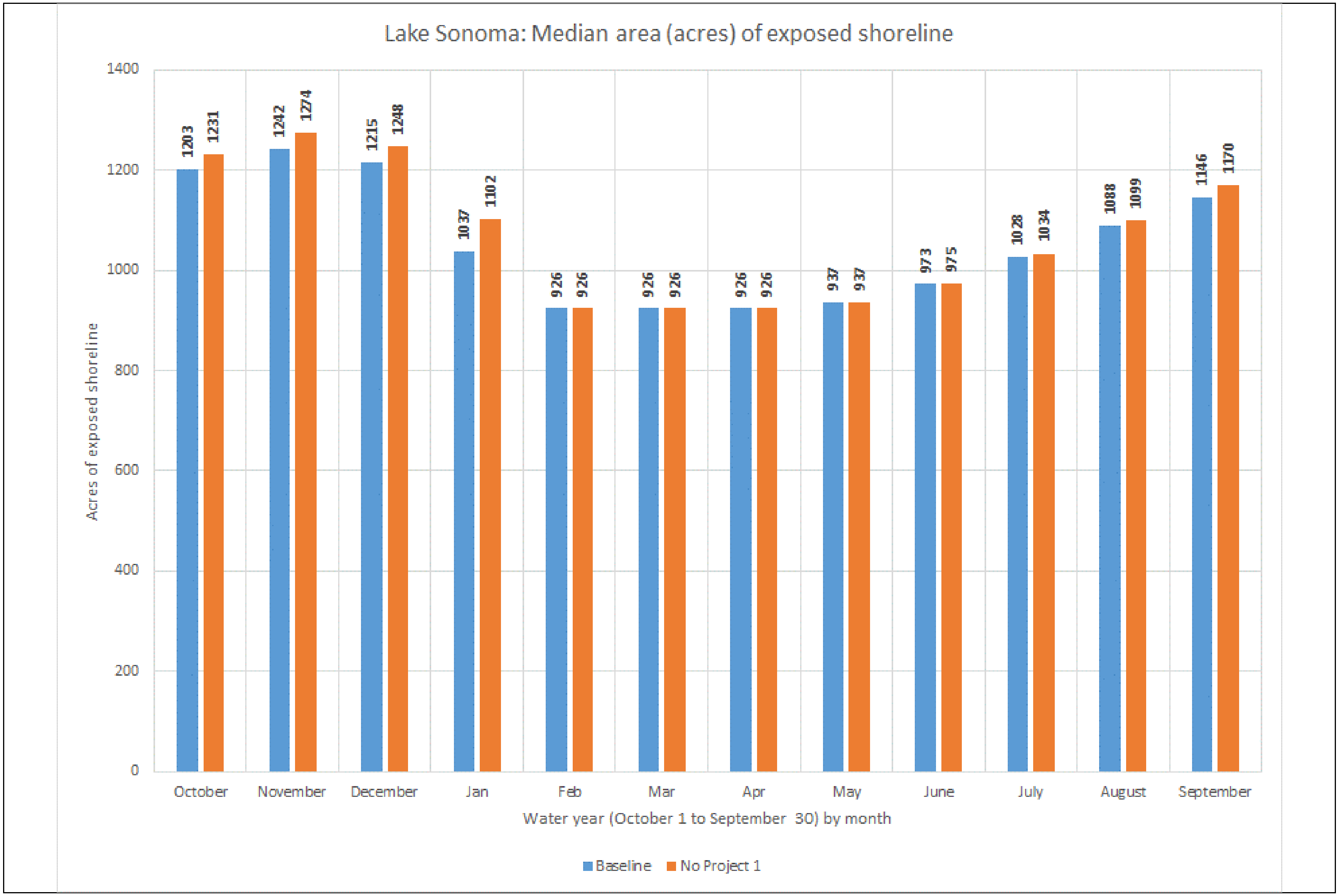

Figure 4.1-28. Area (acres) of exposed shoreline at Lake Sonoma under Baseline Conditions and the No Project 1 Alternative (0.50 exceedance).

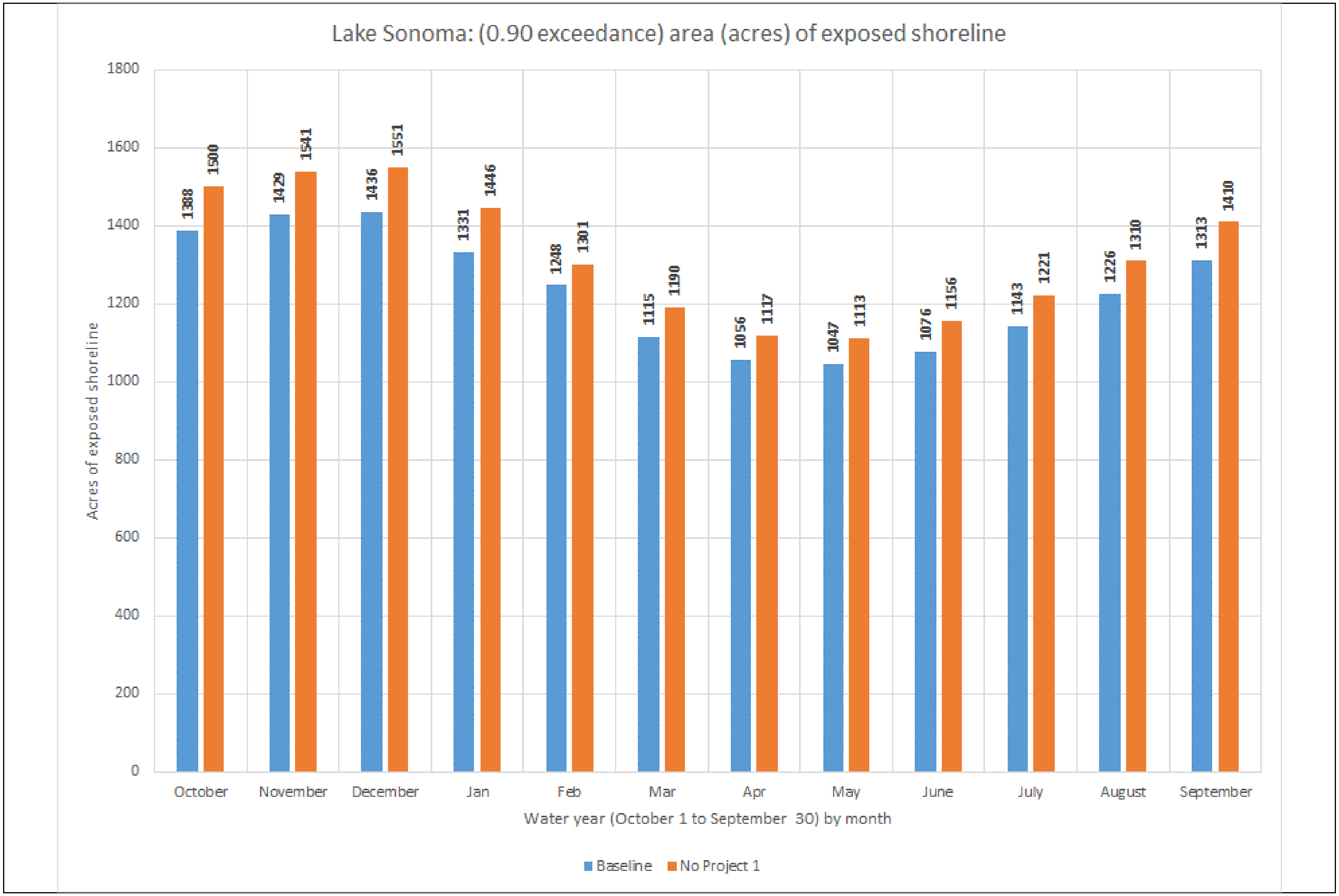

Figure 4.1-29. Area (acres) of exposed shoreline at Lake Sonoma under Baseline Conditions and the No Project 1 Alternative (0.90 exceedance).

No Project 2 Alternative

Lake Mendocino

Under the No Project 2 Alternative, water surface elevation would increase in Lake Mendocino in nearly all months across all exceedances (Table 4.1-39). The increase would inundate a greater area of shoreline compared to Baseline Conditions and would not expose shoreline to potential surface erosion. There would be no impact to the area of exposed shoreline in Lake Mendocino.

Lake Sonoma

Under the No Project 2 Alternative, water surface elevation in Lake Sonoma would be similar to Baseline Conditions across 0.50 to 0.90 exceedances during all months, with some slight increases or decreases (Table 4.1-40). Water surface elevation would increase during drier conditions (0.95 exceedance), leading to less exposed shoreline. The greatest decreases in water surface elevation, and potential increase in exposed shoreline would occur during the driest conditions (0.99 exceedance) during all months. But, precipitation during these conditions would likely be low compared to other conditions, and this increase would likely not lead to greater erosion from surface runoff during precipitation. The potential impact to areas of exposed shoreline would be less than significant.

Proposed Project

Lake Mendocino

Under the Proposed Project, water surface elevation would increase in Lake Mendocino in nearly all months across all exceedances (Table 4.1-41). The increase would inundate a greater area of shoreline compared to Baseline Conditions and would not expose shoreline to potential surface erosion. There would be no impact to the area of exposed shoreline in Lake Mendocino.

Lake Sonoma

Under the Proposed Project, water surface elevation in Lake Sonoma would be similar to Baseline Conditions across 0.05 to 0.90 exceedances during all months, with some slight increases or decreases (Table 4.1-42). Water surface elevation would increase during 0.95 exceedances leading to less exposed shoreline. The greatest decreases in water surface elevation, and potential increase in exposed shoreline would occur during the driest conditions (0.99 exceedance) during all months. But, precipitation during these conditions would likely be low compared to the other conditions, and this increase would likely not lead to greater erosion from surface runoff during precipitation. The potential impact to the area of exposed shoreline erosion in Lake Sonoma would be less than significant.

Table 4.1-39. Estimated difference (feet) in water surface elevation at various flow exceedances in Lake Mendocino under the No Project 2 Alternative compared to Baseline Conditions (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Mendocino	7.2	6.9	6.4	4.2	8.3	9.9	9.4	5.2	3.7	4.0	4.9	6.4
	0.95	Mendocino	5.3	5.6	4.0	7.1	4.8	5.3	3.9	2.7	3.3	3.5	4.1	5.1
	0.90	Mendocino	7.3	5.0	6.2	7.9	5.6	4.7	1.7	3.0	3.8	4.3	5.4	7.2
	0.75	Mendocino	9.8	7.9	7.8	6.4	2.2	0.4	1.7	2.6	3.9	4.7	6.2	7.9
	0.50	Mendocino	10.0	9.5	8.9	0.0	0.0	0.5	0.8	2.3	4.4	6.2	7.7	9.2
	0.05	Mendocino	9.5	0.2	0.3	0.2	0.0	0.3	0.1	1.1	3.1	4.9	7.5	9.4

Table 4.1-40. Estimated difference (feet) in water surface elevation at various flow exceedances in Lake Sonoma under the No Project 2 Alternative compared to Baseline Conditions. (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
No Project 2	0.99	Sonoma	-4.3	-1.6	-1.6	-1.6	-1.5	-1.7	-1.1	-1.1	-1.8	-2.9	-4.1	-5.3
	0.95	Sonoma	5.7	4.4	1.4	0.9	0.8	0.2	-0.8	-0.4	1.4	2.6	3.7	5.5
	0.90	Sonoma	1.7	1.2	1.0	-0.3	-0.5	0.7	3.3	1.6	0.9	0.7	0.9	1.4
	0.75	Sonoma	1.0	0.1	-0.6	-0.7	-0.7	0.0	0.0	0.0	0.1	0.2	0.5	1.0
	0.50	Sonoma	-0.8	-0.9	-0.5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.6
	0.05	Sonoma	-0.4	-0.7	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3

Table 4.1-41. Estimated difference (feet) in water surface elevation at various flow exceedances in Lake Mendocino under the Proposed Project compared to Baseline Conditions (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Mendocino	28.5	27.5	26.1	18.7	18.2	21.9	21.1	19.2	18.0	19.1	21.2	25.9
	0.95	Mendocino	21.0	22.4	18.6	19.1	17.6	11.6	8.3	9.1	11.9	14.0	16.0	18.8
	0.90	Mendocino	18.9	18.6	19.4	21.1	16.5	6.5	5.6	8.8	9.8	10.6	12.8	16.4
	0.75	Mendocino	19.3	19.3	19.8	14.2	2.2	1.1	4.2	6.2	8.6	10.5	13.2	16.0
	0.50	Mendocino	17.9	19.1	12.0	0.0	0.0	1.0	2.5	5.6	8.2	10.9	13.3	15.4
	0.05	Mendocino	10.8	0.2	2.0	0.5	0.3	0.4	0.4	1.8	3.1	5.8	9.0	11.5

Table 4.1-42. Estimated difference (feet) in water surface elevation at various flow exceedances in Lake Sonoma under the Proposed Project compared to Baseline Conditions (decreases in stage (feet) indicated by negative number and red shading; increases indicated by positive numbers and blue shading) (0.99 exceedance represents driest condition; 0.05 exceedance represents wettest condition).

Alt	Exceedance	Node	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Proposed Project	0.99	Sonoma	-4.2	-4.4	-4.3	-4.3	-2.4	-2.6	-0.4	-0.8	-1.8	-2.7	-3.7	-4.7
	0.95	Sonoma	2.1	0.8	0.2	3.7	1.4	0.4	-0.2	0.2	2.5	3.3	3.3	3.1
	0.90	Sonoma	1.1	1.4	1.6	0.2	0.0	1.3	2.5	1.6	0.9	0.4	0.5	0.8
	0.75	Sonoma	0.3	-0.2	-0.3	-0.5	-0.5	0.0	0.0	0.1	0.4	0.5	0.5	0.7
	0.50	Sonoma	-0.4	-0.5	-0.4	-0.8	0.0	0.0	0.0	0.1	0.4	0.5	0.1	-0.3
	0.05	Sonoma	0.3	-0.4	-0.1	-0.2	-0.2	0.0	0.0	0.0	0.1	0.5	0.6	0.3

Impact 4.1-4. The Fish Flow Project could expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam. (No Impact)

The Fish Flow Project would not expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam under the Proposed Project and No Project 1 and No Project 2 alternatives. As described in Chapter 3, Background and Project Description, the USACE manages water releases from Coyote Valley Dam and Lake Mendocino during flood management operations according to the *Coyote Valley Dam Master Water Control Manual, Appendix I* (CVD Water Control Manual; USACE 1986 and USACE 2004). The CVD Water Control Manual includes a reservoir guide curve that establishes the maximum seasonal limits for water supply storage in Lake Mendocino (Figure 3-2). The volume of the water supply pool decreases during the rainy season to increase available storage for flood management operations. The volume of the water supply pool increases in the dry season to increase water storage for water supply operations. The flood control pool is defined as the volume above the reservoir guide curve. When water storage in Lake Mendocino is above the reservoir guide curve and in the flood control pool, the USACE normally manages releases from Coyote Valley Dam. Under typical flood management operations, water is temporarily detained in the flood control pool until the risk of downstream flooding has diminished. The USACE will then release water from the reservoir to bring storage levels back down to the level defined by the reservoir guide curve. These releases are initiated in accordance with schedules established in the CVD Water Control Manual (Figure 3-2).

Chapter 3, "Background and Project Description," also describes USACE management of water releases from Warm Springs Dam and Lake Sonoma during flood management operations according to the *Warm Springs Dam and Lake Sonoma Water Control Manual, Appendix II* (WSD Water Control Manual; USACE 1984). The WSD Water Control Manual includes a reservoir guide curve that establishes the maximum limit for water supply storage in Lake Sonoma (Figure 3-3). The flood control pool is defined as the volume above the reservoir guide curve and below the top of the flood pool. When water storage in Lake Sonoma is above the reservoir guide curve and in the flood control pool, the USACE normally manages releases from Warm Springs Dam. Under typical flood management operations, water is temporarily detained in the flood control pool until the risk of downstream flooding has diminished. The USACE will then release water from the reservoir to bring storage levels down to the level defined by the reservoir guide curve. These releases are initiated in accordance with schedules established in the WSD Water Control Manual.

As noted in Impact 4.2-2, during wetter conditions (0.05 exceedance), modeling data estimated stage increases occurring in October in the Upper and Lower Russian River under the Proposed Project, likely in response to releases from Coyote Valley Dam to increase storage for flood control. The increases in stage in October may be large relative to overall stage height, but would also occur during periods of seasonal low flow (Figure 4.1-23, Figure 4.1-27). This potential change would occur relatively infrequently during a single month (October) and would be unlikely to cause erosion leading to levee failure. Natural stage increases due to seasonal rainfall would exceed the magnitude and duration of Proposed Project stage increases.

Naturally occurring flood stages are currently contained by existing levees, and would be far greater than any stage increases resulting from releases to create storage for flood control in Coyote Valley and Warm Spring dams.

The Proposed Project would not alter the flood management operations at Lake Mendocino or Lake Sonoma. Although overall reservoir water supply storage reliability is anticipated to improve under the Proposed Project, any water in storage above the reservoir guide curves would be released in accordance with the CVD and WSD water control manuals. The No Project 1 and No Project 2 alternatives would also operate under the flood management operations in accordance with the CVD and WSD water control manuals. The Proposed Project would not expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam, and there would be no impact.

Impact 4.1-5. The Fish Flow Project could contribute to inundation by seiche, tsunami, or mudflow. (Significant and Unavoidable)

A portion of the Lower Russian River in the Russian River Estuary, is located within a mapped tsunami hazard zone, and therefore could be inundated in the unlikely event of a tsunami (Figure 4.1-30). The Russian River Estuary may close throughout the year as a result of a barrier beach forming across the mouth of the Russian River. Although closures may occur at any time of the year, the mouth usually closes during the spring and fall. Closures result in ponding of the Russian River behind the barrier beach and, as water surface levels rise in the Estuary, flooding may occur. Natural breaching events occur when estuary water surface levels exceed the capability of the barrier beach to impound water, causing localized erosion of the barrier beach and creation of a tidal channel that reconnects the Russian River to the Pacific Ocean.

The Water Agency adaptively manages the Russian River Estuary with the objectives of enhancing summer rearing habitat for juvenile salmonids and managing estuary water levels to minimize flood hazard. The Fish Flow Project would not change the Water Agency's management of the Russian River Estuary.

If a tsunami occurred when the Russian River mouth is open, the Proposed Project, No Project 1 and No Project 2 alternatives would not contribute to inundation by tsunami compared to Baseline Conditions. The Fish Flow Project would not contribute to elevated water levels in the Estuary when the river mouth is open.

Potentially higher water elevations in the Estuary during a lagoon condition (when the river mouth is closed or an outlet channel is in place) could increase the risk to people or structures within this area to loss, injury, or death involving flooding in the event of a tsunami. Increased Estuary surface water levels (and, subsequently, decreased storage capacity) would result in somewhat higher inland tsunami elevations in the lower portion of the Estuary, should one occur during the lagoon management period. In essence, portions of the Estuary which would have retained a portion of the tsunami's flood volume during low Estuary water levels, would be filled with water as a result of the Estuary Management Project, so the overtopping volume from the tsunami may propagate further landward, although the exact extent of this probable effect is uncertain.

The No Project 1 and No Project 2 alternatives, and the Proposed Project would decrease flow in the Lower Russian River at Hacienda Bridge during portions of the lagoon management period across all flow exceedances, suggesting lower inflow into the Russian River Estuary. Under the No Project 1 Alternative, flow at Hacienda Bridge would be the same or increasingly lower than Baseline Conditions from May through October through 0.05, 0.50, 0.75, and 0.95 exceedances (Table 4.1-16). During the driest flow conditions (0.99 exceedance), flow at Hacienda Bridge would be the same as Baseline Conditions during the lagoon management period. Under the No Project 2 Alternative and the Proposed Project, flow at Hacienda Bridge would be lower than Baseline Conditions from May through October across 0.50, 0.75, 0.90, and 0.95 exceedances (Table 4.1-22, Table 4.1-28). During wetter flow conditions (0.05 exceedances), flow would be lower from May through September, but higher in October due to reservoir releases to increase pool storage for flood control. The Fish Flow Project would not increase probability of a tsunami (of any sort, including those of sufficient magnitude to cause damage) occurring concurrently with elevated Estuary water levels. Nonetheless, given lower inflow into the Russian River Estuary (relative to Baseline Conditions), the Fish Flow Project could further increase the duration of elevated estuary water levels, or increase the annual frequency of flow conditions that lead to a greater duration of elevated estuary water levels, thereby increasing the risk to people or structures within this area to loss, injury, or death involving flooding in the event of a tsunami. This impact would be significant and unavoidable.

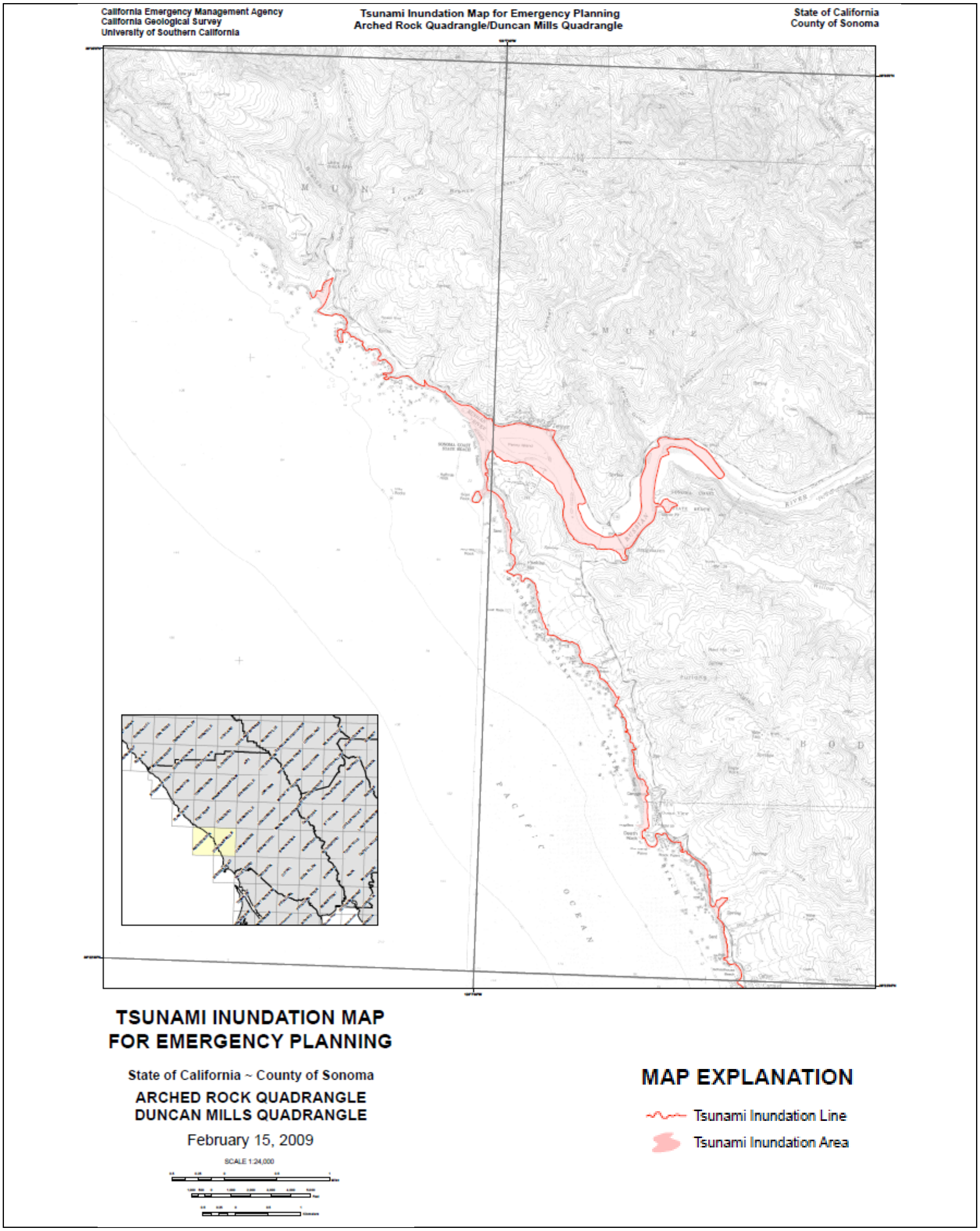

Figure 4.1-30. Tsunami inundation zone in the Lower Russian River (Source: California Emergency Management Agency [2009])

4.1.5 General Plans and Consistency

The project area includes portions of Mendocino and Sonoma counties. The following section lists goals, policies, and objectives related to hydrology from the general plans of these counties.

Mendocino County General Plan

The Mendocino County General Plan (Mendocino County 2009) sets forth the following goals, objectives, and policies related to water supplies, drainage, and floodplains that are applicable to the project.

Resource Management Goals

Goal RM-2 (Water Supply): Protection, enhancement, and management of the water resources of Mendocino County

Goal RM-4 (Ecosystems): Protection and enhancement of the county's natural ecosystems and valuable resources.

> Policy RM-6: Promote sustainable management and conservation of the county's water resources.
>
> Policy RM-10: Continue to seek and advocate for dependable water resources necessary to support all sectors of the economy and other beneficial uses.
>
> Policy RM-11: Work with local, state, and federal agencies and organizations to develop and protect water supplies in a manner that is consistent with adopted General Plan policies, recognizing sustainable yields and protections for the environment.
>
> Policy RM-12: Support the creation of a comprehensive plan for surface and groundwater resources in Mendocino County.
>
> Policy RM-15: Maximize the use of existing water supplies while proceeding with the development of new water supplies.

Sonoma County General Plan

The Sonoma County General Plan (PRMD 2008) sets forth the following goals, objectives, and policies related to water supplies, drainage, and floodplains that are applicable to the project.

Land Use (LU) element

Goal LU-8: Protect Sonoma County's water resources on a sustainable yield basis that avoids long term declines in available surface and groundwater resources or water quality.

> **Objective LU-8.1:** Protect, restore, and enhance the quality of surface and groundwater resources to meet the needs of all beneficial uses.

Objective LU-8.2: Coordinate with operators of public water systems to provide an adequate supply to meet long term needs consistent with adopted general plans and urban water management plans.

Objective LU-8.3: Increase the role of water conservation and re-use in meeting the water supply needs of both urban and rural users.

Policy LU-8d: Work with SCWA and other public water suppliers in the development and implementation of master facility plans, urban water management plans, and other long term plans for water supply, storage, and delivery necessary to meet water demands of existing urban and rural users and planned growth, consistent with the sustainable yield of water resources.

Policy LU-8f: Increase the role of water conservation, stormwater retention, and aquifer recharge for water supply purposes.

Policy LU-8h: Support use of a watershed management approach for water quality programs and water supply assessments and for other plans and studies where appropriate.

Policy LU-11d: Encourage methods of landscape design, landscape and park maintenance, and agriculture that reduce or eliminate the use of pesticide, herbicides, and synthetic fertilizers, and encourage the use of compost and conservation of water.

Policy LU-11f: Encourage conservation of undeveloped land, open space, and agricultural lands, protection of water and soil quality, restoration of ecosystems, and minimization or elimination of the disruption of existing natural ecosystems and flood plains.

Water Resources (WR) element

Goal WR-2: Manage groundwater as a valuable and limited shared resource.

Objective WR-2.3: Encourage new groundwater recharge opportunities and protect existing groundwater recharge areas.

Objective WR-2.5: Avoid additional land subsidence caused by groundwater extraction.

Policy WR-2e: Require proof of groundwater with a sufficient yield and quality to support proposed uses in Class II and IV water areas. Require test wells or the establishment of community water systems in Class IV water areas. Test wells may be required in Class III areas. Deny discretionary application in Class II and IV areas unless a hydrogeologic report establishes that groundwater quality and quantity are adequate and will not be adversely impacted by the cumulative amount of development and uses allowed in the area, so that the proposed use will not cause or exacerbate an overdraft condition in a groundwater basin or sub-basin. Procedures for proving adequate groundwater should consider groundwater overdraft, land subsidence, saltwater intrusion, and the expense of such study in relation to the water needs of the project.

Goal WR-3: Encourage public water systems and their sources to provide an adequate supply to meet long term needs that is consistent with adopted general plans and urban water management plans and that is provided in a manner that maintains water resources for other water users while protecting the natural environment.

Objective WR-3.1: Assist public water suppliers in the collection and dissemination of surface and groundwater data and the assessment of available water supplies and protection of water quality.

Objective WR-3.2: Work with public water suppliers in the development and implementation of long term plans for water supply, storage, and delivery necessary to first meet existing water demands and, secondly, to meet planned growth within the designated service areas, consistent with the sustainable yield of water resources.

Objective WR-3.3: Work with public water suppliers to balance reliance on groundwater and surface water to assure the sustainability of both resources.

Policy WR-3a: Work with public water suppliers in assessments of the sustainable yield of surface water, groundwater, recycled water and conserved water, including during possible drought periods. This work should include the exploration of potentially feasible alternative water supplies. Surface and groundwater supplies must remain sustainable and not exceed safe yields.

Policy WR-3b: Support to the extent feasible the actions and facilities needed by public water suppliers to supply water sufficient to meet the demands that are estimated in adopted master facilities plans, consistent with adopted general plans, urban water management plans and the sustainable yields of the available resources and in a manner protective of the natural environment.

Policy WR-3g: Assist public water suppliers in assuring that proposed water supplies and facilities are consistent with adopted general plans, that all planning jurisdictions are notified of and consider potential water supply deficiencies during the preparation of such plans, and that adopted general plans accurately reflect secure water sources.

Policy WR-3h: Help public water suppliers to disseminate and discuss information on the limits of available water supplies, how the supplies can be used efficiently, the possible effects of drought conditions, acceptable levels of risk of shortage for various water users, priorities for allocation of the available water supply, conditions for use of limited supplies, and limits of alternate sources that could be used or developed.

Policy WR-3q: Support cooperative inter-regional planning efforts by the public water suppliers, their contractors, other existing water users and Sonoma County to consider future demand projections concurrently with the availability of sustainable water supplies.

Policy WR-3r: Work with the SCWA in the following ways to provide an adequate water supply for its contractors consistent with this element:

Encourage SCWA to work cooperatively with Mendocino County interests to resolve water resource issues, including assessment of water resource projects, water supply alternatives, and use of recycled water.

Work with all water users along the Russian River and its tributaries to encourage
Work with all water users along the Russian River and its tributaries to encourage

GOAL WR-4: Increase the role of conservation and safe, beneficial reuse in meeting water supply needs of both urban and rural users.

Objective WR-4.2: Promote and encourage the efficient use of water by all water users.

GOAL WR-6: Improve understanding, valuation and sound management of the water resources in Sonoma County's diverse watersheds

Objective WR-6.1: Seek and secure funding for addressing water resource issues on a watershed basis.

The Fish Flow Project would be consistent with the goals, objectives, and policies of the Mendocino County General Plan and Sonoma County General Plan because it would conserve and enhance surface water resources and could enhance groundwater resources through continued maintenance of surface flows across a wide range of flow conditions.

4.1.6 References

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