4.3 Water Quality

This section analyzes the potential water quality impacts of the Estuary Management Project in the Russian River Estuary (Estuary). As previously noted in **Chapter 2.0, Project Description,** the Estuary Study Area comprises the Russian River Estuary (Estuary), which extends approximately seven miles from the mouth of the Russian River upstream to Duncans Mills just beyond the confluence of Austin Creek. Under certain closed conditions, the Estuary may backwater to Monte Rio, and as far upstream as Vacation Beach. Although this condition may periodically occur, potential impacts related to water quality are generally thought to be limited to the seven mile area downstream of Austin Creek. Where appropriate, discussion of water quality impacts within the Estuary Study Area and the larger maximum backwater area, which extends upstream past Austin Creek to approximately Vacation Beach, is provided (Please refer to **Figure 2-3** in **Chapter 2.0, Project Description**. Potential impacts relating to flooding and drainage conditions are presented in **Section 4.2, Hydrology and Flooding**. Potential impacts to fisheries and biological resources are discussed in **Section 4.4, Biological Resources,** and **Section 4.5, Fisheries**, respectively.

4.3.1 Setting

Regional Setting

Russian River Watershed

The Russian River drains an area of 1,485 square miles that is approximately 110 miles long and from 12 to 32 miles wide. From its source, about 15 miles north of Ukiah, the river flows southward for 90 miles through Redwood, Ukiah, Hopland, and Alexander Valleys, and through the northwestern part of the Santa Rosa Plain. The river then turns abruptly westward at Mirabel Park and flows for 22 miles through a canyon in the mountains before entering the Pacific Ocean at Jenner.[1]

The Estuary overlies the Lower Russian River Valley Groundwater Basin No. 1-60 (DWR, 2003) located in the Mendocino Range within west-central Sonoma County. The valley begins over two miles east of Mirabel Heights and extends west and southwest for approximately 23 (river) miles until it exits into the Pacific Ocean near Jenner with an average width of about 0.25 miles. The valley is defined by the areal extent of alluvial and river-channel (fluvial) deposits that are bounded predominantly by bedrock of the Franciscan Complex. The deposits consist of unconsolidated and semi-consolidated alluvial and river (fluvial) sediments ranging in size from boulders to clay (Blake et al., 2002) but consist largely of sand and gravel with minor amounts of silt and clay (DWR, 2003). The Franciscan Complex that underlies the lower Russian River Valley is considered predominantly non-water-bearing and therefore, does not yield significant quantities of water to wells (DWR, 2003). With respect to groundwater beneficial uses identified in the North Coast RWQCB Basin Plan, the Estuary portion of the Lower Russian River Basin

1 The Russian River Interactive Information System, Watershed Background, Hydrology, http://www.russianriverwatershed.net/Content/10065/Hydrology.html

identified Municipal and Domestic Water Supply (MUN) as a “potential” beneficial use, and does not identify Groundwater Recharge (GWR) as a beneficial use.

Surface water quality in the Russian River is influenced primarily by the various inflows or inputs in the river and is a function of the season, the surrounding land use, and the tributaries flowing into the river. During the wet season (November through May) stormwater runoff accounts for most of the flow in the Russian River. Treated wastewater discharges from various cities and communities in the Russian River watershed also account for a small portion of the flows. During the dry season (June through October), most of the flow in the Russian River consists of water released from Lake Mendocino or Lake Sonoma. Implementation of the proposed project would occur during the dry season from May 15 through October 15.

Stream channelization, road construction along stream margins, bank stabilization, and water diversions in tributaries have significantly degraded stream habitats throughout the watershed by simplifying stream channels, isolating them from their floodplains, greatly increasing sedimentation, blocking fish migrations, and reducing or eliminating flow and cover (USACE, 2008). Water quality priorities within the watershed include the need for control of nonpoint source runoff from logging, rural roads, agriculture, and urban areas. As such, sediment, temperature, and nutrients are the items of primary focus for the North Coast Regional Water Quality Control Board (RWQCB; see Section 4.3.2 for details). For a discussion on sediment, please see **Section 4.2, Hydrology and Flooding**.

Consequently, the RWQCB has listed the entire Russian River on the 2006 Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments (RWQCB, 2007a) for sedimentation/siltation and temperature impairments. Several hydrologic sub-areas within the Russian River watershed are also listed for impairments including specific conductivity, pH, low dissolved oxygen, nutrients, indicator bacteria, and mercury. The 303(d) impairments identified for the lower section of the Russian River where the project site is located are discussed in **Section 4.3.2**.

Estuary Water Quality

Surface water quality in the Estuary is a function of various sources of inflows into the Russian River (also discussed above under the Regional Setting) and conditions within the Estuary such as tidal influence and stratification of temperature and salinity. As noted in **Chapter 3.0, Project Background and Environmental Setting**, the Water Agency has conducted long-term water quality monitoring, under various sampling programs, within the Russian River Estuary since 1996 to establish baseline information and gain a better understanding of the longitudinal and vertical water quality profile of the Estuary during the ebb and flow of the tide, as well as to track changes that may occur during periods of barrier beach closure and reopening. The data from these sampling reports are used to discuss different parameters that characterize the water quality conditions in the Estuary.

Sampling Program Summary

The Water Agency conducted water quality monitoring from April or May of each year through the spring, summer, and fall (SCWA, 1996; 1997; 1998; 1999; 2005). Current water quality monitoring efforts include data collection at six stations in the Estuary (refer to **Figure 4.3-1**): the Mouth of the Russian River at Goat Rock State Beach (Mouth Station); Patty's Rock upstream from Penny Island (Patty's Rock Station); Bridgehaven just downstream from the Highway 1 bridge (Bridgehaven Station); in the pool downstream of Sheephouse Creek (Sheephouse Creek Station); a pool next to an area known as Heron Rookery approximately halfway between Sheephouse and Freezeout creeks (Heron Rookery Station); and downstream of Freezeout Creek (Freezeout Creek Station).

Multi-parameter, continuously-recording water quality meters (sondes) were deployed during mid-April to mid-May and were retrieved prior to the onset of winter rains. Hourly data was collected on water temperature, dissolved oxygen (DO), salinity, pH, and specific conductance in 2005, 2006, 2007, 2008, and 2009 (SCWA, 2009).

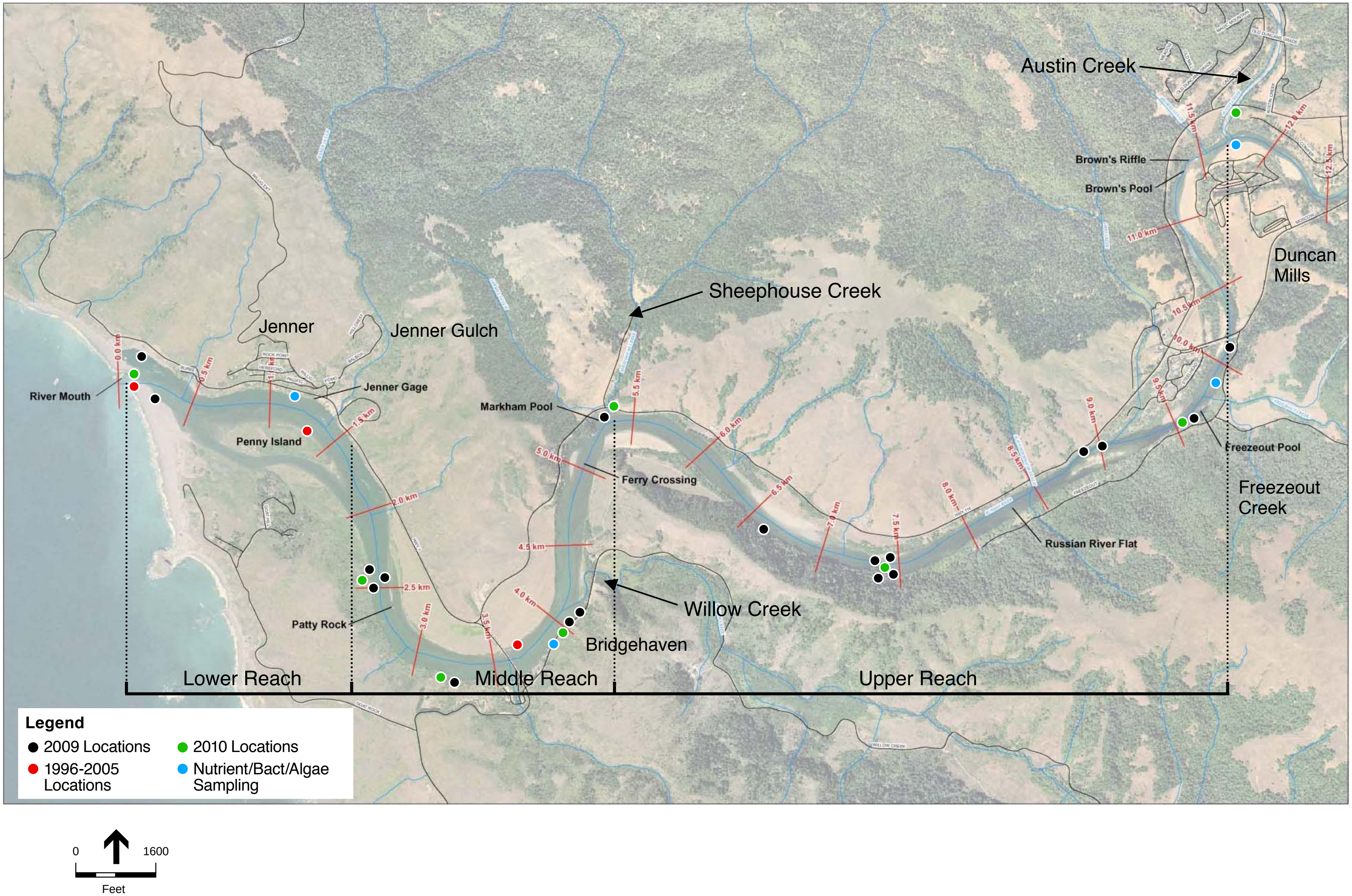
In 2009, the Water Agency contracted with Bodega Marine Laboratory (U.C. Davis) to provide a view of circulation, stratification, residence and salinity in the Russian River Estuary over summer and fall months of 2009. An extended barrier beach closure period lasting 29 days from September 7 through October 5 allowed for a study of prolonged closure conditions in the Estuary at high temporal and spatial resolution, along with two subsequent shorter closures (October 14-17 and October 22-27). This information is reported in *Hydrography of the Russian River Estuary Summer-Fall 2009* (Behrens and Largier, 2010) and a discussion of salinity, dissolved oxygen and temperature data is presented in **Chapter 3.0, Project Background and Environmental Setting, Section 3.7 Extended Closure – 2009 Data Report**.

In addition to the above sampling programs, the U.S. Geological Survey (USGS) prepared a report (Anders et al., 2006) in cooperation with the Water Agency to establish baseline water quality data during summer flows in the Russian River. In the Lower Russian River Basin, the Estuary monitoring sites (Jenner and Willow Creek Marsh) were sampled in summer 2004 for inorganic and organic constituents, nutrients, trace elements, organic carbon, and mercury (Anders et al., 2006).

The Water Agency conducted nutrient and indicator bacteria sampling in the Estuary in 2009 and expanded sampling in 2010 to include areas upstream of the Estuary, including a station at Monte Rio. Sampling conducted by the Water Agency in June through October, 2010, included testing for nutrients such as total organic nitrogen, ammonia, total kjeldahl nitrogen (TKN), nitrates, nitrites, total phosphorus and indicator bacteria. A discussion of these constituents is presented below.

Constituents

In addition to the physical parameters described in **Chapter 3.0, Project Background and Environmental Setting, Section 3.7, Extended Closure – 2009 Data Report** (salinity, DO, and temperature), the concentrations of inorganic and organic constituents, including nutrients,



SOURCE: Behrens and Largier, 2009; SCWA, 2005; ESA, 2010

Russian River Estuary Management Project . 207734.01

Figure 4.3-1
Estuary Study Area : Biological and Water Quality Sampling Locations

chlorophyll *a* (an indicator of algal growth and organics tied to the presence of nutrients), and indicator bacteria, help in assessing the overall ecological health of the Estuary in terms of water quality and the protected beneficial uses such as biological habitat and recreation (see also **Table 4.3-1**). For a discussion on sediment, please see **Section 4.2, Hydrology and Flooding**.

High levels of nutrients (i.e., nitrogen and phosphorus) and lower DO from internal nutrient cycling primarily in the reservoirs within the watershed are a concern in the middle section of the Russian River (RWQCB, 2007a). However, the mainstem of the Russian River, including the Estuary, is not listed as impaired for these constituents. Therefore, the background concentrations of these constituents in the Estuary are considered indicators of the current conditions of the Estuary that support the beneficial uses identified in the RWQCB Basin Plan for the Lower Russian River, including aquatic habitat and recreation (see **Table 4.3-1** in **Section 4.3.2** below).

Nutrients

Nutrients such as nitrogen and phosphorus are essential for life processes in aquatic organisms including algal growth. Through a process called photosynthesis, algae utilize solar energy to convert simple inorganic nutrients into complex organic molecules. The organic matter in turn serves as energy source for other organisms (Deas and Orlob, 1999). Increased cellular processes such as photosynthesis and respiration result in greater algal growth and accumulation of organic matter especially in waters that have lower DO levels and high temperatures, which in turn affect the overall health of the water body. The rates of such processes vary with the nature of the water bodies. The Estuary has a typical estuarine environment with varying levels of nutrients from the Russian River mouth to upstream areas.

The most recent monitoring in the Estuary conducted by the Water Agency (June to October, 2010) included testing for nutrients such as total organic nitrogen, ammonia, TKN, nitrates, nitrites, and total phosphorus. Samples were collected from five stations (Jenner, Bridgehaven, Duncans Mills, Casini Ranch, and Monte Rio). The USEPA has established section 304(a) nutrient criteria across 14 major ‘ecoregions’ of the United States. USEPA’s section 304(a) criteria are intended to provide for the protection and propagation of aquatic life and recreation (USEPA, 2002). The Russian River was designated as occurring in Aggregate Ecoregion III. The following discussion of nutrients compares sampling results to these USEPA criteria. However, it is important to note that these criteria are established for freshwater systems, and as such, are only applicable to the freshwater portions of the Estuary. Currently, there are no numeric nutrient criteria established for estuaries.

The USEPA’s desired goal for total nitrogen in Aggregate Ecoregion III is 0.38 milligrams per liter (mg/L) for rivers and streams not discharging into lakes or reservoirs. Calculating total nitrogen values requires the summation of the different components of total nitrogen; organic and ammoniacal nitrogen (together referred to as total kjeldahl nitrogen or TKN), and nitrate and nitrite nitrogen. Total nitrogen concentrations in the upper estuary, including Monte Rio, were predominantly below the USEPA criteria of 0.38 mg/L, with a few exceptions. Concentrations of approximately 0.4 mg/L were recorded at all three upper stations in June when spring flows were still high from an above average rainfall season. Total nitrogen concentrations of 0.83 mg/L were recorded on single occasions at the Monte Rio and Duncans Mills stations in October at a time when there were several barrier beach closures and breaches occurring. The lower estuary, as represented by the Bridgehaven and Jenner stations, had more frequent exceedances of the USEPA criteria of 0.38 mg/L, including a high value of 0.58 mg/L recorded at the Bridgehaven station and 0.75 mg/L recorded at the Jenner station. However, it is important to note that three of the five exceedances at Jenner occurred during June and July when spring flows were still elevated above normal levels, and another exceedance occurred in October following the breaching of the barrier beach. Elevated levels of total nitrogen were observed to occur during both open and closed conditions in the Estuary.

The USEPA's desired goal for total phosphates as phosphorus in Aggregate Ecoregion III has been established as 21.88 micrograms per liter (µg/L), or approximately 0.022 mg/L, for rivers and streams not discharging into lakes or reservoirs. Total phosphorus concentrations exceeded the USEPA criteria a majority of the time during both open and closed conditions at all stations in the Estuary, including the Monte Rio station. Detectable levels of total phosphorus ranged between 0.021 and 0.077 mg/L during the sampling period of June to October (SCWA, 2010). Total phosphorus concentrations were generally higher in June and July at all stations, when late springs flows were still elevated, and tended to decrease, but remain above USEPA criteria, through the rest of the season into October. There were a couple of exceptions, most notably at the Bridgehaven station, where the 0.077 mg/L value was recorded in October following the breaching of the barrier beach. (SCWA, 2010).

In the process of photosynthesis, *chlorophyll a* - a green pigment in plants -absorbs sunlight and combines carbon dioxide and water to produce sugar and oxygen. Chlorophyll *a* can therefore serve as a measureable parameter of algal growth. Qualitative assessment of primary production on water quality can be based on chlorophyll *a* concentrations. A University of California, Davis report on the Klamath River (1999) assessing potential water quality and quantity regulations for restoration and protection of anadromous fish in the Klamath River includes a discussion of chlorophyll *a* and how it can affect water quality. The report characterizes the effects of chlorophyll *a* in terms of different levels of discoloration (e.g., no discoloration to some, deep, or very deep discoloration). The report indicated that less than 10 µg/L (or 0.01 mg/L) of chlorophyll *a* exhibits no discoloration (Deas and Orlob, 1999). Additionally, the USEPA criteria for chlorophyll *a* in Aggregate Ecoregion III is 1.78 µg/L, or approximately 0.0018 mg/L for rivers and streams not discharging into lakes or reservoirs. Chlorophyll *a* levels in the Estuary were generally lower in the upper estuary, including Monte Rio, and higher in the lower estuary, especially around the Bridgehaven station. Higher concentrations were typically observed early in the season during higher late spring flows and also late in the season during or following barrier beach closure and breaching. Chlorophyll *a* ranged from 0.0001 to 0.0037 mg/L at all stations other than Bridgehaven, with the majority of values below the USEPA criteria. The Bridgehaven station had the most exceedances by far and concentrations ranged from 0.0002 mg/L to 0.0083 mg/L. Higher values at Bridgehaven may be attributable to the location of the station at the mouth of Willow Creek, an area that may provide conditions beneficial to the production of algae, including chlorophyll *a*.

Indicator Bacteria

The following information on the current understanding of human-related bacteriological issues can be found on the North Coast Regional Water Quality Control Board's webpage on Bacteriological Water Quality Sampling.[2]

The RWQCB's Water Quality Control Plan for the North Coast Region (Basin Plan) contains a fecal coliform bacteria freshwater water quality objective for the protection of waters designated with the contact recreation beneficial use (REC-1). Water quality objectives present in the Basin Plan were developed in the 1970s and based on recommendations provided by the California Department of Public Health (CDPH) (formerly California Department of Health Services or DHS) at that time. However, since the 1970s, the U.S. Environmental Protection Agency (USEPA) and the CDPH have recommended standards that differ from the current Basin Plan freshwater bacteria objective.

In 2006, the California Department of Public Health (CDPH) developed the "Draft Guidance for Fresh Water Beaches", which describes bacteria levels that, if exceeded, may require posted warning signs in order to protect public health. The CDPH draft guideline for total coliform is 10,000 most probable number (MPN) per 100 milliliters (ml). The MPN for *Enterococcus* is 61 per 100 ml, and the MPN for *E. coli* is 235 per 100 ml. However, it must be emphasized that these are draft guidelines, not adopted standards, and are therefore both subject to change (if it is determined that the guidelines are not accurate indicators) and are not currently enforceable. In addition, these draft guidelines were established for and are only applicable to fresh water beaches. Currently, there are no numeric guidelines that have been developed for estuarine areas.

Sources of these bacteria include the natural environment (soils and decaying vegetation), stormwater, urban runoff, animal wastes (both wildlife and domestic animals), and human sewage. Analysis for coliform, *Enteroccoccus,* and *E. coli* bacteria are widely used as an indicator test. Coliform is a heading that describes a type of bacteria, which includes *E. coli*. It is found within the intestines of warm-blooded animals, though most water contamination comes from cattle and people. *Enterococcus* is much like coliform bacteria, but is known to have a greater correlation with swimming-associated illnesses and is less likely to die-off in highly saline water. While these bacteria normally occur at low levels in the environment, high levels can indicate contamination (but do not cause illness) and the presence of other harmful pathogens.

Analysis for levels of Total Coliform, *Enterococcus,* and *Escherichia coli* are of primary concern. However, other measurements are taken in the field that can provide an indication of whether conditions of concern exist at the time of sampling including dissolved oxygen content, pH (hydrogen ion activity), conductivity (ionized or dissolved minerals in the water), water temperature, and turbidity (clarity). For example, a lower than normal dissolved oxygen reading can indicate the presence of decaying matter; a higher than normal turbidity could indicate a recent discharge of sediment; or a higher than normal conductivity reading could indicate the presence of a nonpoint source runoff of animal wastes (which are high in ionized salts).

2 http://www.swrcb.ca.gov/northcoast/water_issues/programs/water_quality_sampling

Sampling events in 2009 and 2010 indicate there is a large variation in indicator bacteria levels observed through the different sections of the Estuary. These variations were observed to occur under both open and closed mouth conditions and may be seasonal as well. In 2009, total coliform counts were observed to be higher during open conditions in mid-summer than during closed conditions, including the 29-day extended closure at the end of the management season. All three stations sampled in 2009 had at least one total coliform value above the draft guidance for freshwater beach posting of 10,000 MPN/100ml during open conditions, with the highest value of 24,196 MPN/100 ml occurring at the Jenner station. *Enterococcus* and *E. coli* counts were generally low, but were observed to occasionally exceed recommended values in both open and closed conditions. It is important to note that the draft guidance for beach postings applies only to freshwater beaches.

However, in 2010, total coliform counts were not significantly elevated during mid-summer open conditions (except at the Bridgehaven Station) and instead were observed to be significantly elevated during closed conditions at the end of the management season and were accompanied by high counts of *Enterococci* and E. coli, as well. These higher counts in 2010 may be attributable to increased inputs of flow into the Estuary at the end of September into early October. Indicator bacteria levels were observed to increase at all stations at the end of September and during the repeated closures in early October.

Local Groundwater Conditions

The approximately two-mile long portion of the groundwater basin underlying the Estuary from the Pacific Ocean upstream to approximately Willow Creek is described as an area with a low or highly variable water yield (Sonoma County, 2010). The area from Willow Creek upstream to the Santa Rosa Plain, east of the project area is described as part of a major groundwater basin (the Lower Russian River Valley Basin). Much of the Russian River, its floodplain, and areas immediately within the river valley are also cited as a groundwater recharge area, indicating that river water is the primary source of groundwater in the local aquifer (Sonoma County, 2010). The immediate portions of the Russian River valley downstream of Willow Creek to the Pacific Ocean could also reasonably be assumed to provide groundwater recharge.

Limited information is available regarding groundwater conditions in the project area. The approximately two-mile portion of the underlying groundwater basin under the Estuary from the Pacific Ocean upstream to approximately Willow Creek is identified as an area with a low or highly variable groundwater yield (SCWA, 2010). Information regarding the exchange between groundwater and surface water of the Russian River within the Estuary Study Area is limited. Based on studies of surface water and groundwater interaction in upstream reaches of the Russian River, it is anticipated that the exchange between surface water and groundwater will vary based, in part, on distance from the river, amount of localized groundwater pumping and seasonal variations in river stage. For example, when the stage of the Russian River is higher than groundwater levels in the alluvial aquifer, surface water from the Russian River recharges groundwater and, conversely, when the stage of the Russian River is lower than groundwater levels in the alluvial aquifer, groundwater will discharge to the Russian River.

Sources available through the California Department of Water Resources and the California Department of Public Health indicate that groundwater production from the Russian River alluvial aquifer is primarily limited to private domestic wells[3] within the Estuary Study Area (DWR, 2003). The nearest municipal supply wells completed within the Russian River alluvial aquifer is located in the vicinity of Monte Rio and serves the Sweetwater Springs Water District. Water supply wells completed within the Russian River alluvial aquifer serving small water systems (e.g., public restaurants and campgrounds) were identified in the vicinity of Duncans Mills. Drinking water for other communities in the area is provided by combinations of surface water from tributaries of the Russian River, and groundwater and spring sources from bedrock areas located outside the alluvial aquifer.

The Water Agency has acquired limited additional information regarding water wells in and near the Estuary, including Duncans Mills, Monte Rio, the Goat Rock area south of Jenner (SCWA, 2010). Review of the available information for wells located in the project area identified 20 known private water supply wells completed within the Russian River alluvial aquifer within the Estuary Study Area. Eight additional wells were identified between Austin Creek and Vacation Beach. It is likely that more wells exist within the project area that that do not have Well Completion Forms on file with the Department of Water Resources (DWR) or the Sonoma County Permit and Resource Management Department. The lithology[4] recorded on the well logs for the 28 identified wells all describe predominantly sands and gravels consistent with the alluvium in and along the margins of the Russian River (see **Figure 4.1-1 in Section 4.1, Geology**).

Anecdotal comments from local residents suggest that water in wells located close to the river in the Estuary area becomes brackish (from salt water intrusion) during certain times of the year and remains that way until the rainy season begins or there are changes in the condition of the Estuary. This would indicate that tidally-influenced ocean water periodically flows upstream, partially mixing with freshwater, and enters the aquifer that supplies the local water wells, resulting in seasonally brackish conditions. Brackish conditions are a mix between freshwater and ocean water conditions. This is consistent with the findings of previous studies that brackish water is found in wells extending from the river mouth up to Duncans Mills (USGS, 1965 and DWR, 2003).

Limited local domestic well water quality data is available in a 1965 United States Geologic Survey (USGS) water supply paper on groundwater along the Russian River and other connected areas (USGS, 1965). One-time water quality tests from the 1950s were compiled from groundwater samples collected from four domestic water supply wells pumping water from alluvium along the margins of the Russian River within the project area. **Table 4.3-1** below summarizes the chloride data, a conservative indicator of salt water intrusion up the Estuary, along with the sample dates and the relative qualitative distance from the river. The wells are listed in order of relative lateral distance (the only description provided) from the river to highlight the decreasing chloride concentrations.

[3] There are limited public water supply systems.
[4] Lithology is defined as the physical character and composition of a bedrock of types of rock comprising a substrate in terms of its geologic structure, color, mineral composition, grain size, formation, etcetera.

TABLE 4.3-1
SUMMARY OF WELL DATA FOR ADJACENT DOMESTIC WELLS

Well Number	Sample Date	Chloride Concentration in Parts per Million	Distance Upstream from River Mouth in Kilometers	Relative Lateral Distance from River Margin
7/11-15P1	12-September-1951	3,580	~8 (along Russian River Flat)	Closest
7/11-17J1	22-July-1954	2,920	~5.3 (near Markham Pool)	Next closest
7/11-20L1	21-August-1954	774	~3.5 (across from Bridgehaven)	Farther
7/11-14E1	12-September-1951	14	~9.9 (Duncans Mills)	Farthest

NOTES:
Well numbering scheme is township/range-section followed by well number
Upstream distance based on Plate 1 in USGS 1548 and Figure 2-3 in the USGS report
Relative lateral distance based on text in USGS 1548; all wells appear to be in or along the river floodplain

The limited 1950s data is consistent with the more recent anecdotal information of brackish water intrusion into domestic wells drawing water from within and near the floodplain as much as five miles upstream from the river mouth. However, unverified anecdotal information suggests it may be as far as 6.2 miles (10 km) upstream. Although no numerically-measured lateral distances from the river to the sampled wells were available, the relative qualitative distances suggest that the brackish water intrusion attenuates with increased lateral distance from the river.

Limited chemical testing data is available for two wells in the Duncans Mills area, collected in 1997 and 2000. The chloride concentrations in samples collected from these two locations ranged from 9 to 11.9 milligrams per liter (equivalent to parts per million). This data further suggests that brackish water conditions attenuate with distance from the ocean and from the margins of the Estuary.

4.3.2 Regulatory Framework

Federal

Clean Water Act

Under the Clean Water Act (CWA) of 1977, the U.S. Environmental Protection Agency (USEPA) seeks to restore and maintain the chemical, physical, and biological integrity on the nation's waters. The CWA authorizes the USEPA to implement water quality regulations. The National Pollutant Discharge Elimination System (NPDES) permit program under Section 402(p) of the CWA controls water pollution by regulating point sources that discharge pollutants into waters of the U.S. California has an approved state NPDES program. The USEPA has delegated authority of issuing NPDES permits to the California State Water Resources Control Board (SWRCB), which has nine regional boards. The North Coast Regional Water Quality Control Board (RWQCB) regulates water quality in the project area.

Total Maximum Daily Load

Section 303(d) of the CWA requires that each state identify water bodies or segments of water bodies that are "impaired" (i.e., do not meet one or more of the water quality standards established by the state). These waters are identified in the Section 303(d) list as waters that are polluted and need further attention to support their beneficial uses. Once the water body or segment is listed, the state is required to establish Total Maximum Daily Load or TMDL for the pollutant, which is causing the conditions of impairment. TMDL is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Typically, TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The intent of the 303(d) list is to identify water bodies that require future development of a TMDL to maintain water quality. See regional regulatory framework below for water bodies in the project area that are listed for TMDLs.

State

Porter-Cologne Water Quality Act

The Porter-Cologne Water Quality Control Act allows the SWRCB to adopt statewide water quality control plans. The purpose of the plans is to establish water quality objectives for specific water bodies. The act also authorizes the NPDES program under the CWA, which establishes effluent limitations and water quality requirements for discharges to waters of the state. Under the NPDES program, the North Coast RWQCB has established requirements for water quality in the project area. See **Section 4.2, Hydrology and Flooding**, for details.

Regional

North Coast Basin Plan

The North Coast RWQCB prepared the *North Coast Water Quality Control Plan* (Basin Plan) (2007b) that contains descriptions of the legal, technical, and programmatic basis for water quality regulation in the region. The Basin Plan describes beneficial uses of major surface waters and their tributaries. **Table 4.3-2** below lists the beneficial uses for the Austin Creek and Guerneville Hydrologic Subareas that are part of the Lower Russian River where the project site is located.

The North Coast RWQCB is responsible for issuing permits to ensure the protection of beneficial uses. **Table 4.3-3** lists the water quality objectives (WQOs) for freshwater and estuarine bodies that were established to protect these beneficial uses. Freshwater objectives apply to waters that have salinity of equal to or less than 1 part per thousand (ppt) 95 percent of the time, and estuarine objectives apply in brackish to saline water. Additionally, some objectives apply to different target organisms (aquatic life or humans) or different periods of exposure (e.g., 1-hour average or 4-day average for aquatic life and 30-day average for human health). In evaluating existing water quality conditions in the Estuary, the 4-day average criteria for aquatic life (which are lower than the 1-hour average) and 30-day average human health criteria based on consumption of "organisms only" would apply. These criteria are applicable as data collected are typically indicative of conditions that persist greater than a day (SCWA, 2006).

TABLE 4.3-2
BENEFICIAL USES OF LOWER RUSSIAN RIVER HYDROLOGIC AREA

	Lower Russian River Hydrologic Area		
Beneficial Uses	**Austin Creek Hydrologic Subarea**	**Guerneville Hydrologic Subarea**	**Estuaries**
Municipal and Domestic Supply (MUN)	E	E	P
Agricultural Supply (AGR)	E	E	P
Industrial Service Supply (IND)	E	E	P
Industrial Process Supply (PRO)	P	P	P
Groundwater Recharge (GWR)	E	E	
Freshwater Replenishment (FRSH)		E	P
Navigation (NAV)	E	E	E
Hydropower Generation (POW)	P	P	P
Water Contact Recreation (REC1)	E	E	E
Non-Contact Water Recreation (REC2)	E	E	E
Commercial and Sport Fishing (COMM)	E	E	P
Warm Freshwater habitat (WARM)	E	E	P
Cold Freshwater habitat (COLD)	E	E	E
Wildlife Habitat (WILD)	E	E	E
Rare, Threatened, or Endangered Species (RARE)	E	E	P
Fish Migration (MIGR)	E	E	E
Fish Spawning (SPWN)	E	E	E
Shellfish Harvesting (SHELL)		P	E
Estuarine Habitat (EST)		E	E
Aquaculture (AQUA)	P	P	P
Native American Culture (CUL)			P

E = Existing Beneficial Use
P = Potential Beneficial Use
EST use applies only to the estuarine portion of the waterbody.

SOURCE: RWQCB, 2007b

As previously noted with respect to nutrients, the USEPA has established section 304(a) nutrient criteria to provide for the protection and propagation of aquatic life and recreation (USEPA, 2002) and the Russian River is in Aggregate Ecoregion III. These criteria are also identified in **Table 4.3-3**. However, it is important to note that these criteria are established for freshwater systems, and as such, are only applicable to the freshwater portions of the Estuary. Currently, there are no numeric nutrient criteria established for estuaries.

As previously noted with respect to indicator bacteria, the CDPH's "Draft Guidance for Fresh Water Beaches" describes bacteria levels that, if exceeded, may require posted warning signs in order to protect public health. The CDPH draft guideline for total coliform is 10,000 most probable number (MPN) per 100 milliliters (ml). The MPN for *Enterococcus* is 61 per 100ml, and the MPN for *E. coli* is 235 per 100ml. However, it must be emphasized that these are draft

TABLE 4.3-3
BASIN PLAN WATER QUALITY OBJECTIVES FOR APPLICABLE BENEFICIAL USES

Parameter/ Constituent	Water Quality Objectives	Applicable Beneficial Use or Designation[5]
Temperature	Not to exceed 5ºF () above naturally receiving water temperature	Cold and warm freshwater habitat
Bacteria (shall not degrade beyond the natural background levels) Fecal Coliform	Median fecal coliform concentrations based on a minimum of not less than 5 samples for any 30-day period shall not exceed 50/100 milliliter (ml) of sample Nor shall more than 10% of total samples during any 30-day period exceed 400/100 ml	Water contact recreation
Dissolved Oxygen (Russian River Hydrologic Unit)	Minimum – 7 mg/L 90% Lower Limit (1) – 7.5 mg/L 50% Lower Limit (2) – 10 mg/L	Cold and Warm freshwater habitat
Biostimulatory substances (nitrogen, phosphorus) Algal productivity (see below)	Waters shall not contain in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.	Water contact recreation
Additional Non-Basin Plan Criteria		
USEPA – Total Nitrogen (3)	0.38 mg/L	Recommended Criteria for aquatic life and recreation
USEPA – Total Phosphates (3)	0.022 mg/L	Recommended Criteria for aquatic life and recreation
USEPA – Chlorophyll *a* (3)	0.0018 mg/L	Recommended Criteria for aquatic life and recreation
CDPH – Total Coliform (4)	10,000 MPN/100 milliliters	Draft Guidance for Freshwater Beaches
CDPH – Enterococcus (4)	61 MPN/100 milliliters	Draft Guidance for Freshwater Beaches
CDPH – E. Coli (4)	235 MPN/100 milliliters	Draft Guidance for Freshwater Beaches

1) 90% lower limits represent the 90 percentile values for a calendar year. 90% or more of the values must be greater than or equal to a lower limit.
2) 50% lower limits represent the 50 percentile values of the monthly means for a calendar year. 50% or more of the monthly means must be greater than or equal to a lower limit.
3) USEPA 304(a) (2002): Applicable to freshwater areas; no numeric criteria for Estuaries currently available.
4) California Department of Public Health (2006) Draft Guidance for Freshwater Beaches.
5) These are Beneficial Uses applicable within the Estuary Study Area and do not represent all Beneficial Uses protected by these standards that may apply outside the Estuary Study Area.

SOURCE: RWQCB, 2007b;

guidelines, not adopted standards, and are therefore both subject to change (if it is determined that the guidelines are not accurate indicators) and are not currently enforceable.

Groundwater

The North Coast Basin Plan (RWQCB, 2007b) defines groundwater as subsurface water in soils and geologic formations that are fully saturated all or part of the year. Groundwater is any subsurface body of water which is or can be beneficially used or usable. Existing and potential beneficial uses applicable to groundwater in the North Coast Region include municipal, domestic, industrial and process, and agricultural water supply and freshwater replenishment to surface waters, among others. Occasionally, groundwater is used for other purposes (e.g., groundwater pumped for use in aquaculture operations). The water quality objectives in the Basin Plan (**Table 4.3-2** above) typically apply to groundwater that is used for such beneficial purposes. There is limited information (some of it anecdotal) available on the current groundwater usage in Jenner and near the Estuary. The available information suggests that groundwater in the project area is used for domestic water supply; other potential uses listed above are undocumented.

TMDL Implementation Under Clean Water Act

In accordance with Section 303(d) of the Clean Water Act, the NCRWQCB has identified impaired water bodies within its jurisdiction, and the pollutant or stressor responsible for impairing the water quality (see **Table 4.3-4**). The entire Russian River watershed, including the estuary, is impaired for sediment and temperature. Additionally, the NCRWQCB has identified the reach between Fife Creek in Guerneville and Dutch Bill Creek in Monte Rio as impaired for pathogens. This impaired reach is upstream of the Estuary Study Area, but portions are within the maximum backwater area, which extends upstream past Monte Rio to Vacation Beach.

4.3.3 Environmental Impacts and Mitigation Measures

This section describes the potential water quality impacts resulting from the implementation of the proposed project (i.e., continuation of the historic breaching practice for seven months [October 16 – May 14] and lagoon adaptive management from May 15 through October 15). The evaluation considered project plans, current conditions at the project site, and applicable regulations and guidelines. Potential impacts to hydrology, flooding, and drainage conditions, are presented in **Section 4.2, Hydrology and Flooding**, and impacts to fisheries are discussed in **Section 4.5, Fisheries**.

Significance Criteria

Based on Appendix G the CEQA Guidelines, a potential water quality impact would be considered significant if the proposed project results in any of the following:

1. Significant adverse effects on water quality; or
2. Exceed the water quality threshold.

Approach to Analysis

As noted in **Chapter 2.0, Project Description**, the Water Agency would continue its current practice of artificial breaching outside of the lagoon management period of May 15 through October 15. Timing, implementation, access, sensitivity to pinniped haulout, personnel, equipment and general procedures would be equivalent to current practices, as described in **Section 2.2.2**. No change to existing artificial breaching outside of the lagoon management period would occur under the Estuary Management Project.

TABLE 4.3-4
LOWER RUSSIAN RIVER WATER QUALITY IMPAIRMENTS

Lower Russian River Hydrologic subarea	Impairment/ Constituent	Purpose/ Source of the Impairment
Austin Creek	Sedimentation/siltation	1. Silviculture 2. Construction/Land Development 3. Disturbed Sites (Land Development) 4. Dam Construction 5. Flow Regulation/Modification 6. Erosion/Siltation
	Temperature	1. Hydromodification 2. Flow Regulation/Modification 3. Habitat Modification 4. Removal of Riparian Vegetation 5. Nonpoint Source
Guerneville	Sedimentation/siltation	1. Agriculture 2. Irrigated Crop Production 3. Specialty Crop Production 4. Agriculture-storm runoff 5. Agriculture-grazing 6. Silviculture 7. Construction/Land Development 8. Highway/Road/Bridge Construction 9. Land Development 10. Hydromodification 11. Channelization 12. Dam Construction 13. Upstream Impoundment 14. Flow Regulation/Modification 15. Habitat Modification 16. Removal of Riparian Vegetation 17. Stream bank Modification/Destabilization 18. Drainage/Filling Of Wetlands 19. Channel Erosion 20. Erosion/Siltation
	Temperature	1. Hydromodification 2. Upstream Impoundment 3. Flow Regulation/Modification 4. Habitat Modification 5. Removal of Riparian Vegetation 6. Stream bank Modification/Destabilization 7. Nonpoint Source
	Pathogens	1. Nonpoint source/ point source

SOURCE: RWQCB, 2007a

Surface Water Quality

The background / current measurements and concentrations of various physical parameters, inorganic and organic constituents, and microbiological parameters in the Estuary (SCWA, 2010; Anders et. al., 2006) are considered the indicators of the current conditions of the Estuary supporting beneficial uses such as aquatic habitat and recreation. The proposed project would result in a significant water quality impact if it would result in a substantial change in the current conditions that would:

1) Create a nuisance,
2) Significantly adversely affect the beneficial uses of the Estuary, or
3) Exceed the applicable water quality standards and recommendations discussed in Sections 4.3.1 and 4.3.2.

Groundwater

Water quality thresholds would apply to groundwater that is usable or has a beneficial use or purpose such as water supply. As described in the Setting, groundwater production is limited to domestic wells and no municipal groundwater systems are documented in the Estuary Study Area. The domestic usage appears to include small businesses and campgrounds. As noted in **Section 4.3.2, Regulatory Framework**, there is limited data available on the groundwater usage in Jenner, Duncans Mills, and near the Estuary. It is assumed that groundwater in the project area is used for domestic purpose. For the purpose of this analysis, the Project is considered to result in a significant effect on groundwater conditions if the project would substantially adversely affect the background or current groundwater conditions compared to the existing conditions.

The Estuary provides a tidal environment with seasonal variations in salinity, DO, and temperature as described in **Section 4.3.1 Setting**. The project objectives are to provide flood management and enhance freshwater habitat for rearing salmonids. The impact analysis below is based upon the net changes that may occur to the water quality in the Estuary during the lagoon adaptive management activities. There would be no changes in the current activities outside of the lagoon management period.

Impacts Analysis

Impacts are summarized and categorized as either “no impact,” “less than significant,” “less than significant with mitigation,” or “significant and unavoidable.”

Impact 4.3.1: The action of creating the outlet channel during the lagoon management period could adversely affect the water quality in the Estuary. (Less than Significant)

Creation and maintenance of the outlet channel would involve the use of one or two pieces of heavy equipment such as an excavator or a bulldozer, consistent with current artificial breaching activities. As noted in **Chapter 2.0, Project Description**, the frequency of equipment operation on the barrier during the lagoon management period may be incrementally increased compared to existing conditions, and could include up to 18 maintenance activities over the course of the lagoon management period, depending upon the performance of the outlet channel. Operation of mechanized equipment would include the use of chemicals such as fuel, oil, and grease. Although these chemicals would not be stored onsite, inadvertent spills or release of these materials could occur during maintenance of the outlet channel. However, the Water Agency has standard operating procedures in place that help control and manage handling and usage of chemicals during such operations (please refer to **Section 4.13, Hazards and Hazardous Materials**, for details). Procedures such as assigning an onsite contact for emergency response and/or rescue procedures and to perform site control during heavy equipment operation, would continue to be implemented during the outlet channel formation to avoid or control any such spills. The impact would be less than significant.

Impact Significance. Less than Significant; no mitigation required.

Impact 4.3.2: The change in the barrier beach breaching operations during the lagoon management period could adversely affect salinity, dissolved oxygen and temperature levels in the Estuary. (Less than Significant)

The primary beneficial uses of the lower Russian River, including the Estuary, include water supply, freshwater replenishment, freshwater habitat, estuarine habitat, and recreation (see **Table 4.3-1**). The purpose of the project is to comply with NMFS' Russian River Biological Opinion (see **Chapter 2, Project Description**, for details) and maintain rearing habitat for steelhead by providing freshwater lagoon-type conditions. Protection of such beneficial uses is a function of levels of constituents such as salinity, DO, and temperature (see **Section 4.3.2** and **Table 4.3-2**). The following discussion, therefore presents the potential impacts associated with the proposed project in terms of any changes that may occur in the levels of such constituents (e.g., increase in temperature or reduction in DO) that may adversely affect RWQCB Basin Plan beneficial uses, create a nuisance, or exceed the significance thresholds discussed above.

Salinity

The Estuary exhibits conditions typical of estuarine environments with varying salinity levels. Salinity steadily increases from low levels (0-5 parts per thousand [ppt]) at the freshwater/Estuary interface in the upper reach, to moderate levels in the middle reach (approximately 15 ppt), to the highly saline tidal zone near the ocean (30-35 ppt) (Day et al., 1989). Salinity in the lower Estuary up to Sheephouse Creek (30 to 35 ppt) generally reflects tidal conditions. The Estuary becomes brackish upstream of Sheephouse Creek and transitions to a predominantly freshwater system in the Duncans Mills area. The saline influence from the ocean would be reduced as the barrier beach develops and closes the inlet. Salinity patterns observed during the shorter barrier beach closures (October 14-17 and October 22-27, 2009) were similar to that of the prolonged barrier beach closure from September 7 to October 5, 2009 (Behrens and Largier, 2010).

The extended closed barrier beach conditions would change the local distribution of salinity levels in the Estuary as fresh/saltwater stratification occurs. This would reduce salinity levels within some areas of the Estuary, and may increase it within other areas of the Estuary. With extended barrier beach closures, salinity conditions would be expected to follow the trends observed during the 29-day closure in 2009. Data collected during that closure showed development of stratified conditions, with a downward movement of the denser, more saline water (25-35 ppt) and the development of an increased freshwater surface layer up to 6 feet in depth **(see Figure 3-6, in Section 3.7, Extended Closure Conditions -2009**). Depending upon the hydrologic year type, and the timing of closure, the distribution and depth of this stratification would be variable; however, based on observed conditions, closure would increase the freshwater lagoon conditions in the upper layers of the estuarine water column. If these conditions are replicable, the proposed project could result in a beneficial impact in terms of enhancing the freshwater lagoon conditions and salmonid rearing habitat as a beneficial use of the Estuary (See **Section 4.5, Fisheries**).

As previously discussed, high salinity levels of greater than 30 ppt have been observed to persist in some of the deeper pools of the Estuary under both open and closed conditions. As conditions become stratified, migration of saline waters upstream in the lower part of the water column has also been observed during several monitoring years, especially during closed estuary conditions. The most upstream location exhibiting increased salinity during summer months is below Austin Creek. Depending upon the performance of the outlet channel and the duration of closure, these conditions could extend further upstream towards Monte Rio. Although the distribution of these higher saline conditions may be changed under the proposed project, conditions are not anticipated to exceed salinities generally experienced within the Estuary Study Area. Therefore, potential impacts are considered less than significant. Please refer to **Impact 4.3.4** below for further discussion of potential secondary effects to groundwater quality.

Dissolved Oxygen

The extended closed barrier beach conditions would change the distribution of DO levels in the Estuary as fresh/saltwater stratification occurs. As observed during previous monitoring efforts in the Russian River (see **Section 4.3.1**), DO levels are generally above 5 mg/L when the barrier beach is open and below 5 mg/L when the barrier beach is closed. In addition, DO levels in the lower Estuary are generally observed to be higher at the surface, followed by the mid-depth and then the bottom layers (SCWA, 2006). When the Estuary is open, DO typically ranges from approximately 7 -10 mg/l in the surface layers, and varies, on average, from 4 to 9 mg/l in bottom areas of estuary pools (NMFS, 2008). When the bar closes, salinity stratification results in pronounced DO stratification in the closed lagoon. Supersaturation, hypoxic, and anoxic events were observed, with prolonged hypoxic (2 mg/L) and/or anoxic events occurring at the bottom of the deeper portions of the estuary through the duration of Estuary closure. Decreasing DO concentrations were also observed in the middle layers of the water column during barrier beach closures. However, DO levels at the surface in the Estuary did not appear to be negatively impacted by Estuary closure and remained similar to pre-closure conditions, or increased in some instances (SCWA, 2006). DO concentrations near the surface remain similar to those found when the Estuary is open (7 to 10 mg/l). Similar stratified conditions were also observed when the barrier beach was open during neap tides or low river flows, indicating that the deeper portions of the Estuary may not be subject to mixing even during open tidal conditions.

With extended barrier beach closures, salinity stratification that can affect DO levels would be expected to follow the trends observed during the 29-day closure in 2009. DO levels are anticipated to be higher and conducive for habitat in the upper six to nine feet of the water column where freshwater lagoon conditions are expected to persist. As shown in **Figure 3-7 of Section 3.7. Extended Closure Data Report**, by the end of the barrier beach closure period on October 5, the halocline boundary between fresh and saline water had become nearly horizontal, leaving a uniform, nine foot thick layer of freshwater with higher DO levels (10 mg/L) at the surface. As previously noted in the discussion of DO in **Section 3.6.2, Current Estuary Management and Fish Habitat**, hypoxic and anoxic conditions currently occur within the saline layers in the deeper parts of the Estuary; these conditions appear to persist under both open channel and closed barrier beach conditions, and are likely influenced by several factors that affect Estuary mixing. Although these conditions are not consistent with DO objectives identified in the Basin Plan, they are considered a naturally occurring condition within the deeper holes of the Estuary. The proposed project is not expected to substantially change the occurrence of hypoxic and anoxic conditions within the deepest portions of the Estuary. However, stratified conditions during outlet channel operations would likely contribute to longer periods of hypoxic to anoxic conditions in the saline layers in the deeper parts of the Estuary during the lagoon management period. After opening the barrier beach at the end of the lagoon management period, these conditions would revert to either mixed Estuary conditions or predominantly freshwater conditions with the onset of rains and increased inflow into the Estuary.

Temperature

The extended closed barrier beach conditions would change the distribution of temperature in the Estuary as fresh/saltwater stratification occurs. During the 29-day closure observed in 2009, a vertical temperature gradient was formed after the closure with initial temperatures of above 20ºC at the surface in early September and then decreasing to between 16 to 18ºC at the surface by early October (**see Figure 3-8, Section 3.7, Extended Closure Data Report - 2009**). A vertical gradient was formed (stratification), which continued through the closure period, and development of a three layer system was observed, with a cooler saline to brackish bottom layer that is below the effects of solar heating, a warmer mid-depth layer of saline to brackish water subject to the effects of solar heating, and a relatively warm freshwater layer on the surface. The temperature profiles resulting from barrier beach closures do not indicate any exceedances or major deviations from natural or existing conditions (i.e., within 5ºF increase in natural temperatures as listed in the Basin Plan and shown in Table 4.3-3). Further, any change in the temperatures would be consistent with existing conditions and would remain only during the course of the lagoon management period each year.

Summary

As described in **Chapter 4.0, Introduction and CEQA Requirements,** the Estuary is a complex environment subject to changing environmental conditions on daily, seasonal, and annual timeframes. Therefore, it may not be possible to precisely predict the effects of the proposed

Estuary Management Project to the degree typically provided for under CEQA. Implementation of the Estuary Management Plan would increase the frequency and duration of closed freshwater lagoon conditions, and would therefore alter water quality parameters within the Estuary. The duration and geographic extent of these water quality parameters would also be altered, and more saline conditions in the lower parts of the water column could be extended upstream past Austin Creek towards Monte Rio. These conditions would be limited to the five month lagoon management period, and would revert back to fresh water conditions with the onset of rains.

Freshwater lagoon conditions and stratification observed within the Estuary, in combination with the proposed Estuary Management Project, could result in physical processes and water quality conditions that could have a temporary, adverse effect on aquatic ecology. These conditions include breakdown of stratified conditions and upwelling of hypoxic or anoxic (low dissolved oxygen) water or other dynamic physical processes that could affect water quality. The potential for dynamic physical processes to adversely affect water quality currently exists within the Estuary, and their occurrence is considered part of the physical ecological regime of the Estuary. The Estuary Management Project is proposed in order to provide a more natural set of habitat conditions for juvenile salmonids. However, adverse water quality conditions have occurred as part of the natural physical processes of the Russian River Estuary under existing conditions, and may occur in the future both with, and without, implementation of the Estuary Management Project. Similarly, natural physical processes have contributed to temporary adverse water quality conditions in other estuaries on the West Coast, including those that are managed for salmonid habitat, such as Pescadero Creek.

It is anticipated that conditions would remain within the naturally occurring range of water quality parameters observed within the Estuary, based upon monitoring conducted by the Water Agency and others, and that conditions would be consistent with those observed in other estuary systems. Additionally, alterations in water quality are not anticipated to conflict with parameters established in the RWQCB Basin Plan to be protective of beneficial uses. Additional monitoring and continual updating of the Adaptive Management Plan with the best information available is a key element of the Estuary Management Project. Therefore, potential impacts associated with changes to salinity, dissolved oxygen and temperature levels as a result of implementation of the Estuary Management Plan are considered less than significant.

Impact Significance: Less than Significant; no mitigation required.

Impact 4.3.3: The change in the barrier beach breaching operations during the lagoon management period could adversely affect the water quality due to increased nutrient or indicator bacteria levels in the Estuary. (Significant and Unavoidable)

Nutrients and Indicator Bacteria

In 2010, the Water Agency collected water quality samples as part of the Temporary Urgency Change Petition Water Quality Plan for 2010 to review whether summer time water quality exhibited high nutrient loads. Total nitrogen concentrations in the upper estuary, including monitoring at Monte Rio, were predominantly below the USEPA criteria of 0.38 mg/L, with a few exceptions. Concentrations of approximately 0.4 mg/L were recorded at Monte Rio, Austin Creek, and Freezeout Creek in June, when spring flows were still high from an above average rainfall season. Total nitrogen concentrations of 0.83 mg/L were recorded on single occasions at the Monte Rio and Duncans Mills stations in October, at a time when barrier beach closures and natural breach events were occurring. The lower estuary, as represented by the Bridgehaven and Jenner stations, had more frequent occurrences above of the USEPA criteria of 0.38 mg/L, including a high value of 0.58 mg/L recorded at the Bridgehaven station and 0.75 mg/L recorded at the Jenner station. However, it is important to note that three of the five occurrences above the USEPA criteria at Jenner were during June and July when spring flows were still elevated above normal levels and the barrier beach was open, and another occurred in October following the breaching of the barrier beach.

Total phosphorus concentrations were above the USEPA criteria a majority of the time at all stations in the estuary, including the Monte Rio station. Detectable levels of total phosphorus ranged between 0.021 and 0.077 mg/L during the sampling period of June to October (SCWA, 2010). Total phosphorus concentrations were generally higher in June and July at all stations, when late springs flows were still elevated, and tended to decrease through the rest of the season into October. There were a couple of exceptions, most notably at the Bridgehaven station, where the 0.077 mg/L value was recorded in October following the breaching of the barrier beach (SCWA, 2010).

Chlorophyll *a* levels in the Estuary were generally lower in the upper estuary, including Monte Rio, and higher in the lower estuary, especially around the Bridgehaven station. Higher concentrations were typically observed early in the season during higher late spring flows and also late in the season during or following barrier beach closure and breaching. Chlorophyll *a* ranged from 0.0001 to 0.0037 mg/L at all stations other than Bridgehaven, with the majority of values below the USEPA criteria. The Bridgehaven station had the most occurrences above the USEPA criteria, and concentrations ranged from 0.0002 mg/L to 0.0083 mg/L. Higher values at Bridgehaven may be attributable to the location of the station at the mouth of Willow Creek, an area that may provide conditions beneficial to the production of algae, including chlorophyll *a*.

The primary sources of indictor bacteria for surface waters typically consist of point sources such as wastewater discharges and nonpoint sources such as septic systems and leach fields, agricultural uses, and storm drains. Although the CDPH draft guidelines were established for and are only applicable to fresh water beaches, they are being used in the context of potential public health issues when discussing observed Estuary values. Currently, there are no numeric criteria developed for estuarine areas.

Sampling events in 2009 and 2010 indicate there is a large variation in indicator bacteria levels observed through the different sections of the Estuary. These variations were observed to occur under both open and closed mouth conditions and may be seasonal as well. In 2009, total coliform counts were observed to be higher during open conditions in mid-summer than during closed conditions, including the 29-day extended closure at the end of the management season. All three stations sampled in 2009 had at least one total coliform value above the draft guidance for freshwater beach posting of 10,000 MPN/100ml during open conditions, with the highest value of 24,196 MPN/100 ml occurring at the Jenner station. Total coliform values were relatively elevated during closed conditions, but not as high as during open mid-summer conditions, and the draft guidance was not exceeded at any station. *Enterococcus* and *E. coli* counts were generally low, but were observed to occasionally exceed recommended values in both open and closed conditions.

However, in 2010, total coliform counts were not significantly elevated during mid-summer open conditions (except at the Bridgehaven Station) and instead were observed to be significantly elevated during closed conditions at the end of the management season and were accompanied by high counts of *Enterococci* and *E. coli*. During preliminary sampling events in June and July 2010, the total coliform counts in the Estuary ranged from a low of 30 MPN/100ml at the Monte Rio station to an estimated value of greater than 1600 MPN/100 ml at the Bridgehaven station. However, variability in total coliform counts were observed at all stations including Monte Rio, which had a high count of 900 MPN/100ml, and Jenner, which had a low count of 110 MPN/100ml during this same time period. As such, variability was also observed with *Enterococcus* and *E. coli* counts (SCWA, 2010). Although there was no clear pattern of potential lagoon management influences on indicator bacteria levels early in the season, as there were elevated levels observed at various stations during both open and closed conditions, indicator bacteria levels were observed to increase and exceed the recommended guidance values at all stations during and following increased freshwater inflows related to upstream dam removals at the end of September, and during the repeated barrier beach closures in early October. At this time, it is not known what role increased inflows have on the elevated indicator bacteria levels observed during these closures and whether or not these increases would occur, or persist, without these inflows.

During the 2009 extended closure event, water temperatures increased and reached a peak in the middle of the water column at a depth where sunlight heats the water column, but freshwater/salinity stratification prevents mixing to allow cooling. Peak observed temperatures during the 2009 extended closure, which provide an indication of potential outlet channel conditions, was considerably less than 30ºC, which is lower than the optimal temperatures for growth of 37ºC for coliforms and other bacteria such as *Clostridium* species. Therefore, Estuary temperatures are not expected to be a significant contributor to increases in indicator bacteria production.

Under existing conditions, the residence time of water within the Estuary varies depending upon barrier beach conditions. Residence time is a function of river flows into the Estuary, discharge at the river mouth, seepage through the barrier beach, and other losses, such as evaporation and groundwater infiltration. Under current conditions, the estimated residence time in the Estuary ranges from approximately one day, during open tidal conditions, to approximately 27 days, under full closure conditions. With artificial breaching under existing conditions, the actual residence time within the Estuary during closure events is the time period between barrier beach formation and mouth closure, and the implementation of artificial breaching by the Water Agency. This time period is typically between five and 14 days. During this timeframe, standing water conditions exist, as there is no outlet channel through the barrier beach, although seepage through the barrier beach still occurs.

Under the Estuary Management Project, the proposed outlet channel would convey water from the Estuary to the ocean, supporting a flow-through freshwater lagoon system that will function at a “steady-state” in terms of storage, maintaining lagoon water levels in a perched state that is also below flood stage. That is to say, inflow to the estuary would be matched primarily by outflow conveyed by the channel and seepage through the barrier beach. Other natural loses, such as evaporation, would provide additional, but minor losses. Therefore, establishment of the outlet channel would include flow through the Estuary towards the outlet channel, as opposed to full closure conditions, which limits output to seepage through the barrier beach.

As noted in **Chapter 3.0**, observed closure conditions in 2009 included establishment of stratified conditions, with a freshwater layer on top of a saline layer. Similar stratified layers are expected for the proposed outlet channel. Under stratified conditions, most flow through the Estuary would occur in the upper freshwater layer. Because the freshwater layer is also exposed to sunlight and is well-oxygenated, it is the layer most susceptible to nutrient and bacteria- related water quality impacts.

Based upon the lowest observed flows of 70-85 cfs, and stratified conditions observed during the 2009 closure, residence time for the proposed project is estimated to range between 14 days and 22 days, depending upon the depth of the freshwater layer that is established. This represents an increase in estimated residence time of approximately one week, compared to the typical residence time of between five and 14 days associated with artificial breaching under existing conditions. It should be noted that during the extended closure in October 2009, residence time was extended to the duration of the 29-day closure. During that time period, no nuisance conditions were observed.

The bottom saline layer would have higher residence times than the freshwater layer, since flow through this layer would be limited to mixing with the surface freshwater layer and seepage through the barrier beach. Estimates of flow exchanges in the bottom layer are not available. However, if flow is assumed to be negligible, then the residence time would be based upon the duration of the closure period. However, the bottom layer in the deeper portions of the estuary receive minimal sunlight and would likely be hypoxic to anoxic, so nutrient-induced algal growth or bacteria production are expected to be negligible in this deep layer.

Project implementation would not alter water quality inputs for bacteria or nutrients into the Estuary. Therefore, implementation is not anticipated to adversely affect nutrient or bacteria levels within the Estuary, as closed Estuary conditions would still include flow through processes. However, based on the information presented above, particularly the limited nature of nutrient and bacteria data collection during varying closure conditions, there is insufficient information to definitively conclude whether the adaptive management program would result in an increase, decrease, or no substantial adverse effect on nutrient or bacteria levels within the Estuary.

However, there is evidence to suggest that water quality conditions in the Estuary could be reduced following late summer or early fall increases in flow inputs into the Estuary, and that residence time within the Estuary would be increased compared to existing conditions experienced.

As discussed in **Chapter 4.0, Introduction and CEQA Requirements,** the precise response of the Estuary to the Estuary Management Project cannot be predicted with certainty. Localized water quality may be improved in some areas of the Estuary and diminished in others. Freshwater lagoon conditions and stratification observed within the Estuary, in combination with the proposed Estuary Management Project, could result in physical processes and water quality conditions that could have a temporary, adverse affect on aquatic ecology. These conditions include potential algal blooms associated with nutrient loading, or other dynamic physical processes that could affect water quality. The potential for dynamic physical processes to adversely affect water quality currently exists within the Estuary, and their occurrence is considered part of the physical ecological regime of the Estuary. The Estuary Management Project is proposed in order to provide a more natural set of habitat conditions for juvenile salmonids. However, adverse water quality conditions have occurred as part of the natural physical processes of the Russian River Estuary under existing conditions, and may occur in the future both with, and without, implementation of the Estuary Management Project. Similarly, natural physical processes have contributed to temporary adverse water quality conditions in other estuaries on the West Coast, including those that are managed for salmonid habitat, such as Pescadero Creek. However, it is anticipated that conditions would remain within the range of those experienced within the Estuary over the past 15 years, although the duration of those conditions during the lagoon management period would likely be increased. Additional monitoring and continual updating of the Adaptive Management Plan with the best information available would be required. Therefore, in the absence of technical certainty, this EIR concludes that the proposed project would have the potential to result in significant and unavoidable impacts to water quality related to bacterial and nutrient levels in the Estuary.

It should be noted that the Estuary Management Project's Adaptive Management Plan includes provisions for breaching in the event that flooding conditions, water quality conditions, or biological resource conditions warrant it, after consultation with the National Marine Fisheries Service and California Department of Fish and Game. Therefore, no additional mitigation measures are required or available relative to the occurrence of this impact.

Impact Significance: Significant and Unavoidable.

Impact 4.3.4: The change in the barrier beach breaching operations during the lagoon management period (i.e., May through October) could change the duration and/or geographic extent of saline conditions in the Estuary. This could extend the period of time groundwater wells experience brackish water intrusion. (Significant and Unavoidable)

As previously discussed, limited well water quality data (USGS, 1965; SCWA, 2010) along with anecdotal evidence suggests that groundwater in some wells near the Russian River Estuary become brackish during certain times of the year, especially the summer and fall. Reportedly, the brackish taste in the water dissipates after the rainy season begins. Although there is insufficient information to positively demonstrate that the reported temporary increase of brackish water in wells is associated with closure of the barrier beach, for purposes of this analysis, it is assumed that the seasonal variations of salinity in the groundwater would continue to occur during the lagoon management period proposed by the project. This analysis focuses on the effects the proposed project could have on the quality of groundwater in wells that may be influenced by surface water in the Estuary.

Tidally-influenced ocean water enters the Russian River Estuary, flows upstream and becomes stratified below fresh water. The influence of salt water can extend from the mouth of the Russian River upstream to the Heron Rookery (9.0 km mark on Figure 2-3) in most cases, and under certain conditions, Moscow Road Bridge (10.5 km mark on Figure 2-3) (Behrens and Largier, 2010).[5] As discussed in detail in **Section 4.3.1, Setting**, salinity monitoring showed that alignment and orientation of flow gradient contours within the river may respond to breaching and closure events. During periods that the barrier beach was closed (Behrens and Largier, 2010), the gradients were somewhat horizontal with higher salinity water at deeper reaches extending upstream to about Heron Rookery and lower salinity waters extending upstream to Moscow Road Bridge. Once in the Estuary, brackish water enters the estuarine groundwater system that supplies the local groundwater wells located along the Estuary margin; wells are screened at depth, and could more directly extract more highly saline water that occurs in the deeper areas of the Estuary. With the proposed project, the freshwater-saline stratification is not expected to be remarkably different; however, more fresh water may accumulate over the salt water in response to barrier beach closure prior to implementation of the outlet channel.

The reported brackish water intrusion in local groundwater wells is considered an existing condition and there is no evidence to indicate it would change under the proposed project. However, because the Estuary Management Project would maintain water levels of at least 7 feet during the lagoon management period, brackish conditions in the Estuary may adjust and might possibly extend the period of time that water in the wells remains brackish. The potential adjustment in brackish conditions could be caused by the increased fresh water that would overlie the brackish water or the amount of time brackish water remains in the deeper reaches of the Estuary. Any such resulting salinity in the groundwater wells would likely be a seasonal condition and would diminish after the lagoon management period ends October 15. Currently, anecdotal information indicates salinity decreases when the rains start, around the same time.

The proposed project could possibly extend the amount of time that some groundwater wells experience higher salinity during certain times of the year. It could also increase the geographic area of salinity intrusion, given longer migration time. This would not be considered a significant effect of the project because salt water influence has reportedly already been a recurring condition in wells located along the Estuary since at least the 1950s, based upon historical well logs. The

5 Saline conditions exist in the deeper reaches of the river because salt water is denser than fresh water.

portion of Russian River from the mouth to two miles upstream is considered an area with a low or highly variable groundwater water yield. The wells that could be affected are not part of a municipal water system nor are there municipal groundwater supply wells in the area; municipal water is supplied, for the most part, by surface water sources or water sources located away from the river floodplain.

While this analysis has focused on the assumption that seasonal brackish conditions would continue to affect the groundwater and wells, it should also be noted that that the project could have a reverse effect on salinity in the Estuary. Depending upon timing and performance, the adaptive management of the barrier beach could ultimately reduce the inflow of seawater while increasing the accumulation of freshwater to such a degree that salinity could decrease in the wells previously affected by temporary brackish conditions. However, the depth of the Estuary and observed stratified conditions may limit the potential for freshwater lagoon conditions to directly influence groundwater.

As discussed in **Chapter 4.0, Introduction and CEQA Requirements,** the precise response of the Estuary to the Estuary Management Project cannot be predicted with certainty. Localized water quality, and subsequently, groundwater quality, may be improved in some areas of the Estuary and diminished in others. However, it is anticipated that conditions would remain within the range of those experienced within the Estuary over the past 15 years, although the duration of those conditions during the lagoon management period would likely be increased. Additional monitoring and continual updating of the Adaptive Management Plan with the best information available would be required. Therefore, in the absence of technical certainty, this EIR concludes that the proposed project would have the potential to result in significant and unavoidable secondary impacts to groundwater quality.

Impact Significance: Significant and Unavoidable.

4.3.4 References

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