Staff Report

for the

Action Plan
for the
Russian River Watershed
Pathogen Total Maximum Daily Load

May 2019
California Regional Water Quality Control Board
North Coast Region

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Adopted by the
California Regional Water Quality Control Board
North Coast Region
on ____________, 201x

Approved by the
State Water Resources Control Board
on ____________, 201x
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on ______________. 201x

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LIST OF ACRONYMS & SHORT HAND NAMES

APMP	Advanced Protection Management Plan
Basin Plan	Water Quality Control Plan for the North Coast Region
BLRP	Bacteria Load Reduction Plan
BMP	Best Management Practice
BAV	Beach Action Value
CAFO	Confined Animal Feeding Operation
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CDHCD	California Department of Housing and Community Development
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CEQA	California Environmental Quality Act
CIWQS	California Integrated Water Quality System
cfu	colony forming units
CSD	Community Service District
CWA	Clean Water Act
CWC	California Water Code
DNA	Deoxyribonucleic acid
EIR	Environmental Impact Report
EL	Effluent Limitation
I/I	inflow and infiltration
Impaired Waters Policy	California Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options
gpd	gallons per day
LA	Load Allocation
mgd	million gallons per day
MPN	Most Probably Number
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NGI	Near Gastrointestinal Illness (includes diarrhea without the requirement of a fever)
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source
NRCS	Natural Resources Conservation Service
OWTS	Onsite Wastewater Treatment Systems
qPCR	Quantitative Polymerase Chain Reaction
QA/QC	Quality Assurance / Quality Control
REC-1	Water Contact Recreation Beneficial Use
REC-2	Non-Contact Water Recreation Beneficial Use
Regional Water Board	North Coast Regional Water Quality Control Board
RCD	Resource Conservation District
rRNA	Ribosomal Ribonucleic Acid

ROWD .... Report of Waste Discharge
SSO .... Sanitary Sewer Overflow
State Water Board.................. State Water Resources Control Board
STV... Statistical Threshold Value or 90th percentile
TMDL.. Total Maximum Daily Load
U.S. EPA...................................... United States Environmental Protection Agency
USFS.. United States Forest Service
USFWS .... United States Fish and Wildlife Service
Waiver .... Waiver of Waste Discharge Requirements
WDRs .... Waste Discharge Requirements
WLA... Wasteload Allocation
WWTP... Wastewater Treatment Plant

CHAPTER 1
INTRODUCTION

1.1 PROJECT PURPOSE

The purpose of this 2019 Staff Report is to present the information and analyses that support the *Action Plan for the Russian River Watershed Pathogen Total Maximum Daily Load* (Action Plan~~)~~), which includes both the Russian River Watershed Pathogen Total Maximum Daily Load (Russian River Pathogen TMDL) and a program of implementation, as required under state law. The Action Plan will be proposed to the Regional Water Board for adoption as an amendment to the *Water Quality Control Plan for the North Coast Region* (Basin Plan~~.~~). The Action Plan with support from this Staff Report includes all of the elements required by U.S. EPA for approval as a TMDL. It also includes the nine key elements of a watershed plan, as required by U.S. EPA to support 319(h) grant solicitations.

The North Coast Regional Water Quality Control Board (Regional Water Board) is undertaking this action under its authority in the state Porter-Cologne Water Quality Control Act~~.~~ (Porter Cologne). Under state law, the Regional Water Board may establish a program of implementation to address water quality problems~~,~~ (i.e., pollution, as described in Porter Cologne), including waters identified in the development of the TMDL that are not yet listed on the Clean Water Act Section 303(d) list~~.~~ of impaired waters (303(d) List). Porter Cologne defines the term “pollution” to mean an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either of the following: (A) The waters for beneficial uses or (B) facilities which serve these beneficial uses. Analysis of the multiple lines of evidence indicate that the water contact recreation (REC-1) beneficial use is not supported in the Russian River Watershed~~.~~ in all locations. The proposed program of implementation described in the Action Plan includes a prohibition against the discharge of fecal waste to the surface waters of the Russian River Watershed to be implemented through existing and newly proposed waste discharge requirements (WDRs) or waivers of WDRs. Any reference or use of Clean Water Act terms and concepts in the development of this program of implementation ~~program~~ does not limit the Regional Water Board’s authority under state law to address the ~~water quality issues~~pollution identified.

The Action Plan will be presented to the ~~North Coast~~ Regional Water ~~Quality Control~~ Board ~~(Regional Water Board)~~ in a public hearing as a proposed amendment to the ~~*Water Quality Control Plan for the North Coast Region*, which is also known as the~~ Basin Plan. Because the basin planning process is certified as an exempt regulatory program, meeting the requirements of Public Resources Code section 21080.5 (Cal. Code Regs., tit.14, § 15251), the Regional Water Board is not required to prepare an initial study, a Negative Declaration, or an Environmental Impact Report. Instead, the basin planning process uses substitute environmental documentation (SED). This Staff Report and its ~~attachment~~attachments fulfill the requirements of an SED.

Should the Regional Water Board adopt the Action Plan, the State Water Resources Control Board (State Water Board) will hold a hearing to consider approval of the decision. Basin Plan amendments are not effective until they are approved by the State Water Board and the regulatory provisions are approved by the California Office of Administrative Law. The U.S. EPA reviews and approves only the technical elements of the TMDL, not the program of implementation.

1.2 PROJECT HISTORY

In January 2015, a *Peer Review Draft Staff Report for the Action Plan for the Russian River Watershed Pathogen Indicator Bacteria Total Maximum Daily Load* (Peer Review Draft Staff Report)[1] was submitted to two external scientific peers to conduct a review of the scientific basis for the Action Plan for the Russian River Pathogen TMDL. The statutory mandate for external scientific review (Health and Safety Code Section 57004) states that it is the reviewer's responsibility to determine whether the scientific work product is "based upon sound scientific knowledge, methods, and practices." The Cal/EPA Scientific Peer Review Program manager identified two external scientific peers who conducted the review:

Patricia A. Holden
Professor, Bren School of Environmental Science & Management
University of California, Santa Barbara

Nicholas J. Ashbolt
Professor, School of Public Health
University of Alberta, Edmonton

Staff summarized Professors Holden's and Ashbolt's comments and provided written responses in a Response to Peer Review Comments document[2]. The Staff Report was revised to accommodate the scientific peers' recommendations in August 2015 and the revised report was released for public review as the *Draft Staff Report for the Action Plan for the Russian River Watershed Pathogen Indicator Bacteria Total Maximum Daily Load* (2015 Staff Report), which was accompanied by a draft Action Plan~~.~~ (2015 draft Action Plan).

The 2015 Staff Report and 2015 draft Action Plan were released for a 45-day public review period, during which three staff-led workshops were also held. The written public comment period closed on October 8, 2015.

Workshop 1 - September 22, 2015

[1] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150116_StaffReport_PeerReviewDraft.pdf

[2] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/pdf/150821/150827_Peer_Review_Response_to_Comments_MSJ.pdf

Monte Rio Middle School
20700 Foothill Drive, Monte Rio, CA

Workshop 2 - September 23, 2015
University of California Cooperative Extension - Mendocino County
890 N. Bush Street Ukiah, CA

Workshop 3 - September 24, 2015
North Coast Regional Water Quality Control Board
5550 Skylane Blvd. Suite A, Santa Rosa, CA

A Public Hearing before the Regional Water Board was scheduled for November 19, 2015 to consider adoption of the 2015 draft Action Plan as an amendment to the Basin Plan. But, the number and content of the written public comments indicated the need to revisit the proposed program of implementation described in the 2015 draft Action Plan and consider significant revisions.

Since that time, staff has coordinated with both Sonoma County and Mendocino County on multiple issues, including the local regulation of Onsite Waste Treatment Systems (OWTS), which was a point of specific concern in the 2015 draft Action Plan. A Memorandum of Understanding (MOU) has been signed between the Regional Water Board and Sonoma County, delineating roles and responsibilities. Multiple meetings have been held to familiarize county staff with state funding sources potentially useful for local planning and infrastructure improvements. The 2015 draft Action Plan ~~has been~~was significantly revised in 2017 to address major concerns, particularly with respect to OWTS. For example, the 2017 draft Action Plan ~~now defines~~included revisions to define the boundaries of the Advanced Protection Management Plan (APMP) area, which is the area within which special requirements for OWTS owners will apply, as described in the State Water Board's 2012 Onsite Waste Treatment System Policy. Accompanying the 2017 draft Action Plan was a revised 2017 draft Staff Report, which modified the presentation of the technical analysis for clarity and transparency, but did not significantly revise it. Significant revisions to the 2015 draft Staff Report included in the 2017 draft Staff Report were primarily associated with the program of implementation and its description in the staff report.

The full ~~Similarly, the~~ 2017 draft Staff Report ~~has also been significantly revised to address public comments. However, the majority of revisions of the Staff Report are to improve clarity~~ and ~~transparency. Little has been revised with respect to the technical analyses that form the basis for~~2017 draft Action Plan~~, as the technical analysis is deemed complete.~~ were noticed~~Staff Report and Action Plan will be renoticed~~ for a 53-day public comment period, ~~and will include~~including a public ~~workshops~~workshop, to be followed by an adoption hearing that was scheduled for December 13, 2017. However, in light of devastating impacts to the Russian River community related to the October 2017 fires, the hearing was postponed.

During the intervening period, the State Water Board has adopted statewide bacteria water quality objectives and implementation options to protect water contact recreational users from the effects of pathogens in California water bodies.

The 2018 adoption of statewide bacteria objectives led Regional Water Board staff to re-analyze *E. coli* bacteria data in the Russian River watershed through the lens of the new Statewide Bacteria Provisions, as well as enterococci data in the lower river based on the salinity threshold associated with the statewide objectives. This re-analysis included the elimination of consideration of fecal coliform data and the use of a six-week rolling geometric mean (GM) and the statistical threshold value (STV) for *E. coli* bacteria data (in freshwater) and enterococci data (in waters meeting the salinity threshold established by the State Water Board). Further, staff have applied the *Water Quality Control Policy For Developing California's Clean Water Act Section 303(d) List* (2015) (303(d) Listing Policy) exceedance frequency recommendations to guide the assessment of pollution and impairment to ensure harmony with the upcoming update to the 303(d) list, which will also be presented to the Regional Water Board in 2019. These changes to staff's approach are consistent with public comment received during 2017 and have led to refinement of both Chapter 3 *Bacteria Standards and Other Indicators of Pathogen Pollution* and Chapter 4 *Evidence of Pollution* of the 2019 Staff Report. Further, alterations to the area of the Russian River Watershed defined as impaired and polluted has affected the geographic scope of the APMP area.

A response to public comments document has been produced, which addresses each of the significant comments submitted during the 2015 and 2017 public review periods. The response to comments document also includes a summary of the changes to the staff report that have been made in each iteration of the project since 2015.

This ~~.~~2019 Staff Report and associated Action Plan will be the subject of a public hearing to be scheduled before the Regional Water Board. A public notice to this effect will be published for ~~3~~three days in the Press Democrat, distributed to interested stakeholders via a lyris email list[3], posted in the Monte Rio and Guerneville Post Offices (as per public request), and posted on the Regional Water Board's website.

1.3 REGULATORY FRAMEWORK

Several laws and regulations govern the development and implementation of TMDLs, most notably the federal Clean Water Act (CWA) and the state Porter-Cologne Water Quality Control Act. This section describes the framework and context of these laws and regulations with respect to the Action Plan.

1.3.1 SECTION 303(D) LISTING

Section 303(d) of the CWA requires states to develop a list of waterbodies where required pollution control mechanisms are not sufficient or stringent enough to meet water quality

[3] http://www.waterboards.ca.gov/resources/email_subscriptions/reg1_subscribe.shtml

standards applicable to such waters (known as the Clean Water Act Section 303(d) list or 303(d) List). Per state policy the ~~Section~~ 303(d) List applicable to a given region of the State is updated once every 6 years.

The 2012 update to the 303(d) List included multiple watershed reaches within the Russian River Watershed, which were identified as impaired due to fecal indicator bacteria. ~~The Action Plan addresses~~These waterbodies included: an unnamed tributary on Fitch Mountain, the ~~indicator~~mainstem Laguna de Santa Rosa, tributaries to the Laguna de Santa Rosa, the mainstem Santa Rosa Creek, tributaries to Santa Rosa Creek, the mainstem Russian River at Veterans Memorial beach from the Railroad Bridge to Highway 101, the mainstem Russian River from Fife Creek to Dutch Bill Creek, the mainsteam Butch Bill Creek, and the Green Valley Creek Watershed.

The 2012 303(d) List relied on fecal coliform data, as well as evidence generated through the TMDL. The 303(d) List will be updated in 2019 using the new statewide bacteria ~~impairment and refers to the impairment generally as "pathogens". Exposure to illness-causing pathogens impairs the water contact recreational beneficial use (REC-1) of water.~~objectives. As described ~~in greater~~above, the data reanalysis conducted in support of the 2019 Action Plan and described in this Staff Report is consistent with the data analysis conducted to support the 2019 303(d) List update to be released later this year. The analysis for both proposed actions relies on *E. coli* and enterococci in a manner consistent with statewide bacteria objectives as well as enterococci in freshwaters, where combined with other lines of evidence of pollution (e.g., beach closures) as described in more detail in Chapter 4 ~~10, the presence of illness-causing pathogens is determined by analyzing water samples for fecal indicator bacteria (FIB). The presence of FIB in the water column suggests the presence of fecal waste, which is a carrier of illness-causing pathogens~~.

The Basin Plan delineates waterbodies, including the Russian River, utilizing Hydrologic Subareas (HSA's) and designates the beneficial uses associated with those HSA's. The 2012 303(d) List of pathogen-impaired waters is based upon HSAs identified in the Basin Plan. For the purposes of this TMDL, water quality data assessed to determine evidence of pollution have been reevaluated within sub-watershed areas known as Hydrological Unit 12 (HUC-12). This realignment of information results in finer scale delineations and allows more precise impairment/pollution classification. The crosswalk between these two spatial delineation methods is listed in Table 1.1 ~~shows those waterbodies identified on the Section 303(d) List in 2012[4] as impaired due to indicator bacteria/pathogens, as measured by the exceedance of fecal indicator bacteria above thresholds established to protect REC-1.~~ and illustrated in Figure 1. 1. ~~2 maps the reaches of the watershed listed for indicator bacteria/pathogens on the 303(d) list in 2012.~~

[4] ~~The 2012 Section 303(d) has been adopted by the Regional Water Board and State Water Resources Control Board, and on July 30, 2015 it was approved by U.S. EPA (it was partially approved on Jun 26, 2015).~~

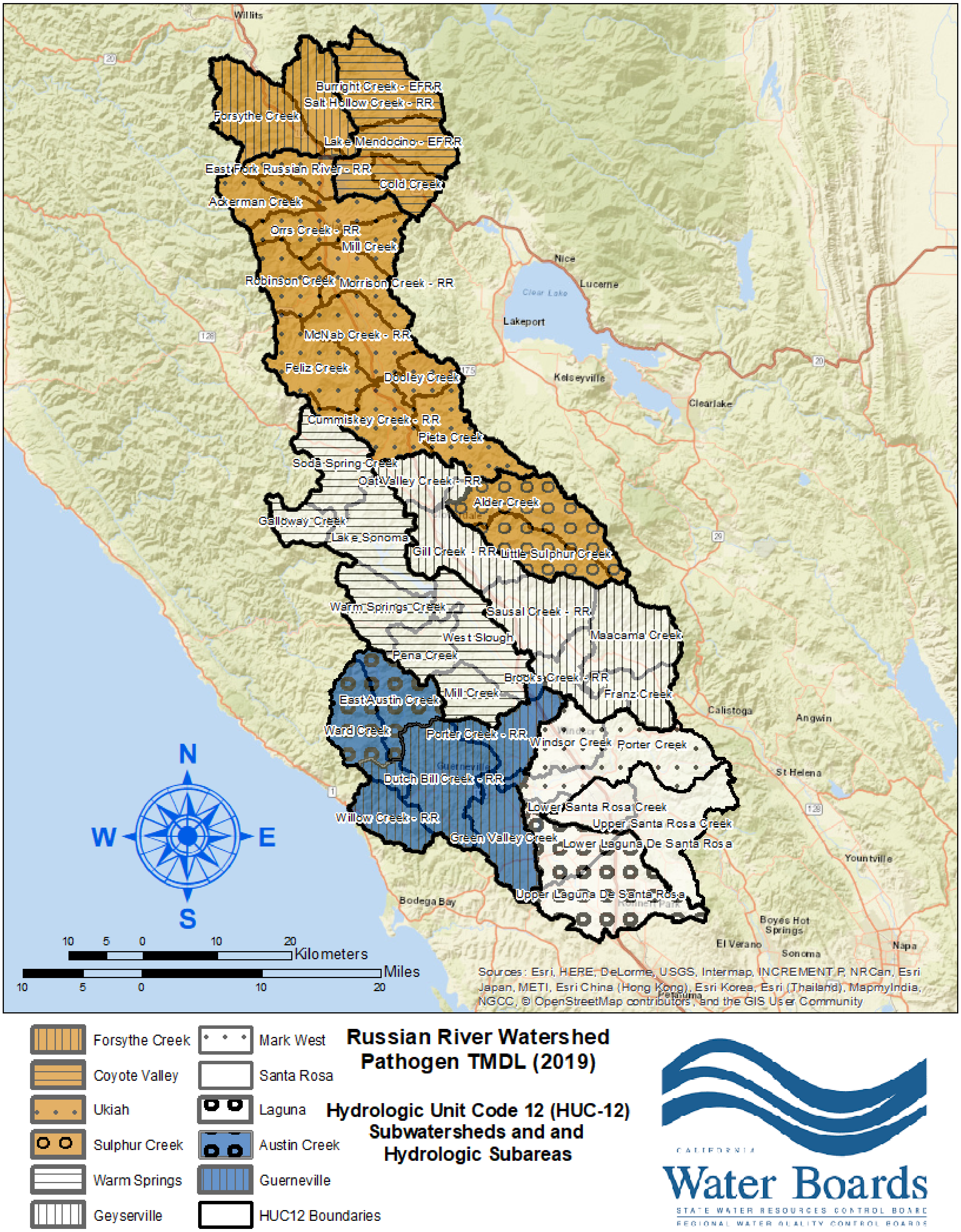

Figure 1.1: Hydrologic Unit 12 (Huc12) Overlain Hydrologic Subarea

Table 1.1 Hydrologic Subarea and Hydrologic Unit 12 (Huc12) Crosswalk

Hydrologic Area Name	Hydrologic Sub Area	Hydrologic Unit 12
Upper Russian River	Coyote Valley	Lake Mendocino-East Fork Russian River
		Burright Creek
		Cold Creek
	Forsythe Creek	Salt Hollow Creek-Russian River
		Forsythe Creek
	Ukiah	East Fork Russian River
		Ackerman Creek
		Orrs Creek
		Mill Creek
		Robinsons Creek
		Morrisons Creek
		McNab Creek
		Feliz Creek
		Cooley Creek
		Cummiskey Creek
		Pieta Creek
Middle Russian River	Warm Springs	Soda Spring Creek
		Galloway Creek
		Lake Sonoma
		Warm Springs Creek
		West Slough
		Pena Creek
		Mill Creek
	Geyserville	Oat Valley Creek-Russian River
		Gill Creek
		Sausal Creek
		Maacama Creek
		Brooks Creek
		Franz Creek
	Santa Rosa	Upper Santa Rosa Creek
	Laguna	Upper Laguna de Santa Rosa

Table 1.1 Hydrologic Subarea and Hydrologic Unit 12 (Huc12) Crosswalk

		Lower Laguna De Santa Rosa
	Mark West	Porter Creek-Mark West Creek
		Windsor Creek
Lower Russian River	Austin Creek	East Austin Creek
		Ward Creek
	Guerneville	Porter Creek
		Green Valley Creek
		Dutch Bill Creek
		Willow Creek

Water quality monitoring conducted to support the development of the 2019 Action Plan~~,~~ ~~Table 1.1 also reports the pollution status of reaches within the Russian River Watershed not yet listed as impaired on the 303(d) list. In summary, Table 1.1 shows that there is~~ confirms evidence of fecal waste ~~throughout the whole of~~discharge within the Russian River Watershed, with the potential for exposure to illness-causing pathogens through water contact recreation. Details of the water quality monitoring conducted to support the ~~Action Plan can be found in Chapter 9 and in technical memoranda and monitoring reports found on the Regional Water Board's website.[5]~~ 2019 Action Plan can be found in Chapter 4.[6] Chapter 4 reports the pollution status of HUC-12 areas within the Russian River Watershed, including those not yet listed as impaired on the 303(d) List. Due to the reassessment of data using the HUC-12 boundaries rather than HSAs, the areal extent of confirmed fecal waste pollution identified within the Russian River Watershed is greatly reduced from the area described in the 2017 draft Staff Report and 2017 draft Action Plan. This refinement results in commensurate modifications of the boundaries of the APMP area listed in the 2019 Action Plan.

1.3.2 TOTAL MAXIMUM DAILY LOAD (TMDL)

A total maximum daily load (TMDL) is a numerical calculation of the amount of a pollutant that a waterbody can assimilate and still meet water quality objectives. The TMDL equation is the sum of waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background and must include a margin of safety. An allocation can be expressed as a concentration rather than a load. For pathogens, TMDLs are generally expressed as the concentration of a fecal indicator bacteria, which indicates the potential presence of illness-causing pathogens. This staff report includes all the information necessary to be approved as a TMDL under the Clean Water Act.

~~[5] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/~~

[6] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

1.3.3 ACTION PLAN

An Action Plan is adopted by the Regional Water Board as an amendment to the Basin Plan. An Action Plan summarizes the findings of the TMDL analysis, indicating numeric targets, the TMDL calculation, and TMDL allocations, approves the TMDL, and establishes a program of implementation by which to attain water quality objectives, restore beneficial uses, and protect public health.

An Action Plan amended into the Basin Plan is appropriate for the Russian River Watershed because control of existing direct and indirect discharges of fecal waste, monitoring of progress towards REC-1 protection, and attainment of water quality objectives will require multiple implementation actions. The California Administrative Procedures Act and the State's *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options* (Impaired Waters Policy) require the use of a Basin Plan amendment to tie together numerous actions by the Regional Water Board to ensure that persons subject to regulations have the opportunity to provide review and comment.

The purpose of the Action Plan is to:

1. Improve the bacteriological quality of the surface waters in the Russian River Watershed so that public health is protected and water quality objectives are attained. The public health risk of most concern results from water contact recreation (REC-1) and incidental ingestion of water polluted by fecal waste, when and where such conditions exist or threaten to exist.

2. Set limits on the amount of fecal waste discharge to the surface waters of the Russian River Watershed from controllable sources[7] that are necessary to protect water contact recreational beneficial uses (REC-1) by establishing the Russian River Pathogen TMDL.

3. Describe the program of implementation necessary to identify and control controllable discharges of fecal waste, reduce concentrations of fecal indicator bacteria, and reduce the potential for pathogen exposure in the Russian River Watershed to levels that protect public health and meet water quality objectives.

4. Describe the monitoring activities necessary to ensure that the program of implementation results in attainment of water quality objectives and protection of beneficial uses, or to support the revision of the program of implementation, as appropriate.

This staff report includes all the information necessary to support the Regional Water Board's consideration of the Action Plan as an amendment to the Basin Plan.

[7] As examples, the controllable sources of concern to the Russian River Watershed include but are not limited to leaking septic systems, leaking sewer lines, leaking or undersized manure holding ponds, and direct disposal (or indirect disposal via storm water runoff) of human or domestic animal fecal waste into the Russian River and its tributaries.

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CHAPTER 2
WATERSHED SETTING

2.1 LOCATION

The Russian River Watershed is a large watershed in the southern portion of the North Coast Region. The North Coast Region is a relatively rural region; but, the Russian River Watershed houses one of its largest population centers. It spans two counties, Mendocino County in its northern reaches and Sonoma County to the south. The City of Santa Rosa is the most populous of the watershed's cities with nearly 172,000 people, followed in order of size by Rohnert Park, Windsor, Ukiah, and Healdsburg. The remaining towns and cities have fewer than 10,000 people. Nonetheless, the Russian River Watershed, like the region it sits in, is quite rural with considerable agriculture, timber and open space. As such, it provides a vibrant tourist trade, with wine tasting, restaurants, and outdoor activities, especially during the summer months. Recreational opportunities along the Russian River Watershed include, but are not limited to, swimming, wading, and kayaking/boating. Notable in the Russian River Watershed are several dams that control river flow from several of the river's tributaries and are important to efforts to restore habitat for threatened and endangered aquatic species. A large array of local, state, and federal agencies; private entities; and nonprofit organizations are fully engaged in multiple efforts to study and restore a functioning Russian River Watershed system.

The Russian River Watershed encompasses 1,484 square miles (949,982 acres) in Sonoma and Mendocino counties, California (Figure 2.1). Major municipalities within the watershed include Santa Rosa, Rohnert Park, Windsor, Healdsburg, Sebastopol, Cloverdale, and Ukiah. The watershed also includes numerous unincorporated communities such as, Forestville, Guerneville, Monte Rio, Hopland, and Calpella.

The Russian River Watershed has been divided into eleven (11) Hydrologic Subareas ~~which are shown in Figure 2.2 and listed Table 2.1.~~ (HSA), which are shown in Figure 2.2 and listed in Table 2.1. The HSA delineation is an adequate basis for dividing the watershed for the purpose of general description. See Table 1.1 for a crosswalk between HSAs and HUC-12s. HUC-12 delineation is used for the purpose of assessing water quality data, defining the area of impairment/pollution, and defining the APMP boundary, only.

Figure 2.1: Russian River Watershed Overview Map

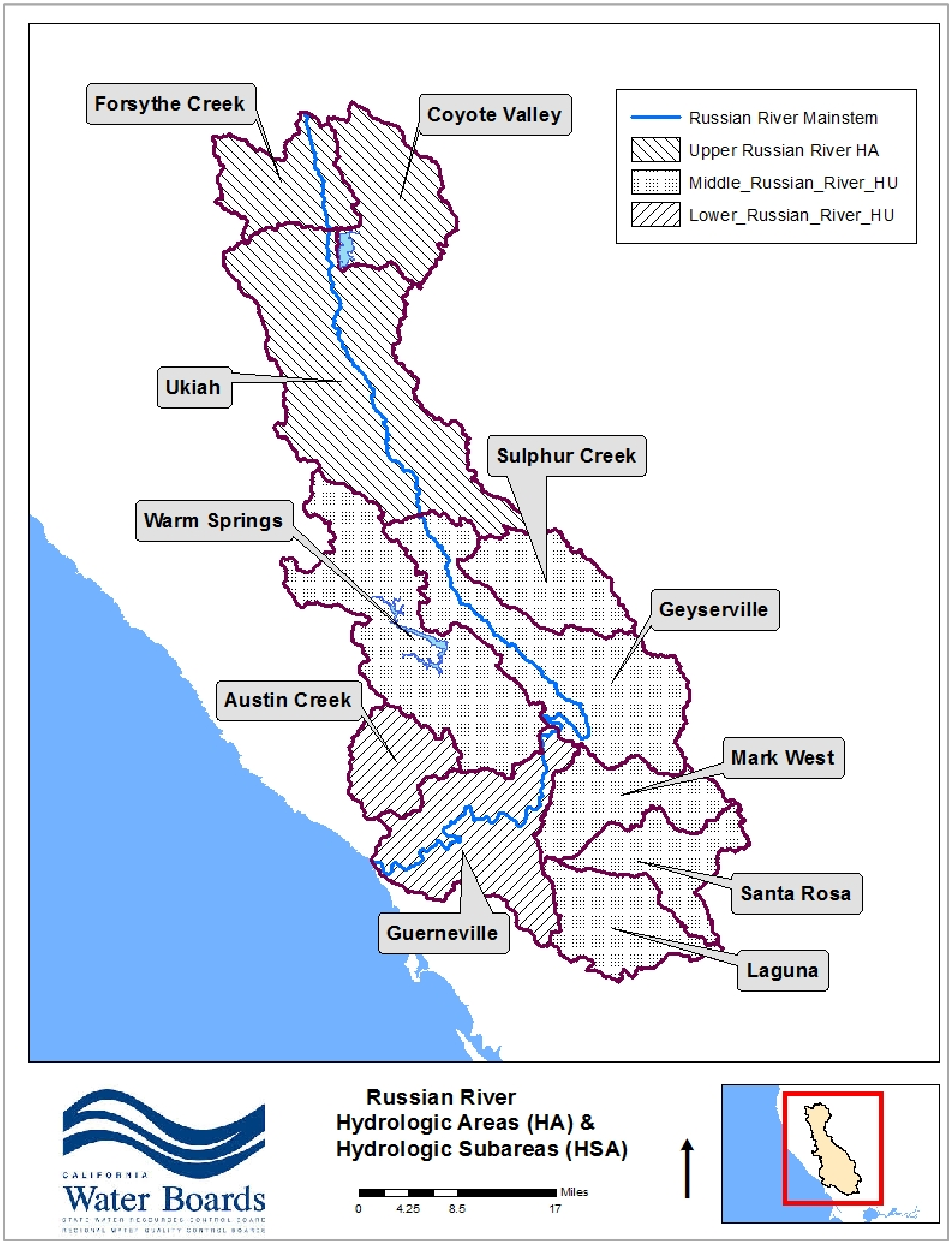

Figure 2.2: Hydrologic Subareas Of The Russian River Watershed

Table 2.1 Hydrologic Areas and Subareas of the Russian River			
Hydrologic Area Name	**Hydrologic Subarea Name**	**Acres**	**Relative Area (%)**
Upper Russian River	Coyote Valley	67,011	7%
	Forsythe Creek	53,965	6%
	Ukiah	200,235	21%
Middle Russian River	Sulphur Creek	52,655	6%
	Warm Springs	139,536	15%
	Geyserville	133,007	14%
	Laguna	56,644	6%
	Santa Rosa	49,511	5%
	Mark West	55,248	6%
Lower Russian River	Guerneville	102,303	11%
	Austin Creek	39,867	4%
Russian River Watershed		**949,982**	**100%**

2.2 HYDROLOGY

The Russian River Watershed is hydrologically and geomorphologically diverse, containing 238 streams, 23 named springs, 14 natural lakes, 15 named reservoirs, all or portions of 10 groundwater basins, steep ridges, ephemeral streams, rolling hills, and wide alluvial valleys. The Russian River, in conjunction with Lake Mendocino and Lake Sonoma, serves as the primary water source for more than 500,000 residents in Mendocino, Sonoma and Marin counties, and for agricultural production in Mendocino and Sonoma counties. Lake Mendocino, located on the East Fork of the Russian River, has a capacity of 118,900 acre-feet and captures a drainage area of about 105 square miles. Lake Sonoma, located at the confluence of Warm Springs Creek and Dry Creek, about 14 miles northwest of the city of Healdsburg, has a capacity of 381,000 acre-feet and captures a drainage area of about 130 square miles. Neither of these reservoirs were monitored for fecal indicator bacteria as part of this TMDL.

The Russian River Watershed includes all of the tributaries to the river and is affected by the interactions between the hillslopes, the channel, and its floodplain. Sediment produced in the headwaters of the Russian River Watershed is stored in the channel or in reservoirs, extracted as aggregate, or transported toward the Pacific Ocean. The main channel of the Russian River flows through a series of wide alluvial valleys separated by relatively narrow bedrock constrictions. These bedrock constrictions act as geologic controls such that each alluvial valley is relatively independent with respect to adjustments in slope, width and depth (Florsheim and Goodwin 1995).

The 110-mile mainstem channel of the Russian River originates in the Redwood Valley of central Mendocino County about 15 miles north of Ukiah. From its origin, the Russian River flows in a south to southeast direction to the Wohler Bridge area, where it changes to a southwest direction, crosses the Coast Range, and empties into the Pacific Ocean near the town of Jenner 20 miles west of Santa Rosa. Elevations range from zero at the Pacific Ocean to 4,343 feet at Mount St. Helena in the Mayacamas Mountains. Eleven hydrologic subareas containing fifty-seven valleys comprise the watershed.

The Russian River originates upstream of the Ukiah Valley and passes through the alluvial valley until the valley constricts at the Hopland Gage. The river again passes through another alluvial valley that contains the Town of Hopland before again being constricted in the Frog Woman Rock region. Downstream of Ukiah and Hopland, in the Alexander Valley reach, the river enters a mountainous area east of Healdsburg known as the Fitch Mountain Constriction where it is confined by steep bedrock banks. The section of the river in the Healdsburg Valley downstream to Wohler Bridge, where another bedrock constriction occurs, is known as the middle reach. The middle reach contains several permanent in-stream structures including the Healdsburg Dam, two bridges in Healdsburg, Wohler Bridge, and Highway 101. The lower reach is a narrow alluvial valley that terminates at the Pacific Ocean, near the town of Jenner.

~~The Potter Valley Project, an project, delivers water from the basin to the headwaters of the . The main facilities~~
There are two ~~dams on the Eel River, a diversion tunnel and . The project derives water from above Scott Dam and approximately 50 square miles between Scott Dam and Cape Horn Dam, where water is diverted to the Russian River.~~

~~Three~~ major reservoir projects that provide water supply for ~~Lake Pillsbury on~~ the ~~Eel~~Russian River~~,~~ watershed: Lake Mendocino on the East Fork of the Russian River~~,~~ and Lake Sonoma on Dry Creek. ~~Under agreements with the US~~Lake Mendocino and Lake Sonoma are dual-purpose reservoirs in that they provide flood protection (managed by the U.S. Army Corps of Engineers~~,~~) and water supply storage (releases managed by the Sonoma County Water Agency ~~manages the stored~~). The Water Agency, as local sponsor, controls and coordinates water supply ~~in~~releases from Lake Mendocino and Lake Sonoma ~~to provide water for agriculture, municipal, and industrial uses~~ in accordance with its water~~-right permit. In addition, the Sonoma County Water Agency also releases water from these reservoirs to contribute the minimum stream flow requirements in the Russian River and Dry Creek established in 1986 by the~~ rights permits and the requirements of the State Water Resources Control Board's Decision 1610. ~~These minimum stream flows provide water for recreation and fish passage for salmon and steelhead in~~Decision 1610 establishes minimum instream flow requirements for the mainstem Russian River and Dry Creek. The ~~Sonoma County~~ Water Agency ~~also operates an inflatable dam on the Russian River in the Wohler Bridge area to increase water production capacity during peak demand months. The dam is inflated in the early spring to create pool conditions in the river. In the fall, the dam is deflated to provide passage for fish migration. Operation of the inflatable dam~~

~~increases water production capacity in two important ways. First, surface water immediately behind the dam can be diverted to a series of infiltration ponds that are constructed adjacent to the three Mirabel collector wells. Second, infiltration to the underlying aquifer behind the dam is significantly improved by increasing the recharge area from the river.~~makes releases to meet downstream demands from agricultural, commercial, and residential individual water uses and other public water systems and to maintain minimum instream flow requirements for beneficial uses, including recreation and fish habitat.

The Potter Valley Project, owned and operated by Pacific Gas and Electric (PG&E), is a hydroelectric project that provides an interbasin water transfer from the Eel River to the East Fork of the Russian River. Its operations are not coordinated with the operation of Coyote Valley Dam at Lake Mendocino. PG&E releases water from Lake Pillsbury to meet minimum instream flow requirements on the Eel River and to divert water through the Potter Valley Project to generate electricity and maintain minimum instream flow requirements in the East Fork Russian River. The water diverted through the Potter Valley Project flows into the East Fork of the Russian River. The Potter Valley Irrigation District diverts a portion of the released water for irrigation, with the remaining eventually flowing to Lake Mendocino.

2.3 LAND USES

Based on Landsat satellite imagery (Fry et al. 2006), primary land uses in the Russian River Watershed include urban, rural, agricultural, and undeveloped lands as shown in Table 2.2 and Figure 2.3. Most of the land in the watershed is privately owned (89.78%), with federal (5.41%), state (2.59%), local (2.15%), and tribal lands (0.08%) making up the remaining ownership. Land cover is primarily open space with fifty-one percent of the watershed having less than one housing unit per 160 acres (WCW 2007). Almost 300,000 people live in ~~municipalities~~incorporated cities and towns of the Russian River Watershed (Table 2.3).

Urban, rural, and agricultural lands each host their own unique problems with respect to pathogens and fecal waste discharge. Chapter 6 elaborates on these sources in detail.

Table 2.2 Land Cover in the Russian River Watershed

Land Cover Category	Acres	Percent of Watershed Area
Shrub/Scrub	260,269	27.4%
Evergreen Forest	231,347	24.4%
Grassland/Herbaceous	163,358	17.2%
Mixed Forest	104,836	11.0%

Table 2.2 Land Cover in the Russian River Watershed		
Land Cover Category	**Acres**	**Percent of Watershed Area**
Developed, Open Space	57,173	6.0%
Cultivated Crops	55,813	5.9%
Deciduous Forest	23,096	2.4%
Developed, Low Intensity	22,233	2.3%
Developed, Medium Intensity	16,312	1.7%
Open Water	7,130	0.8%
Woody Wetlands	2,564	0.3%
Developed, High Intensity	1,948	0.2%
Pasture/Hay	1,719	0.2%
Barren Land	1,469	0.2%
Herbaceous Wetlands	343	<0.1%
Total	949,611	100%

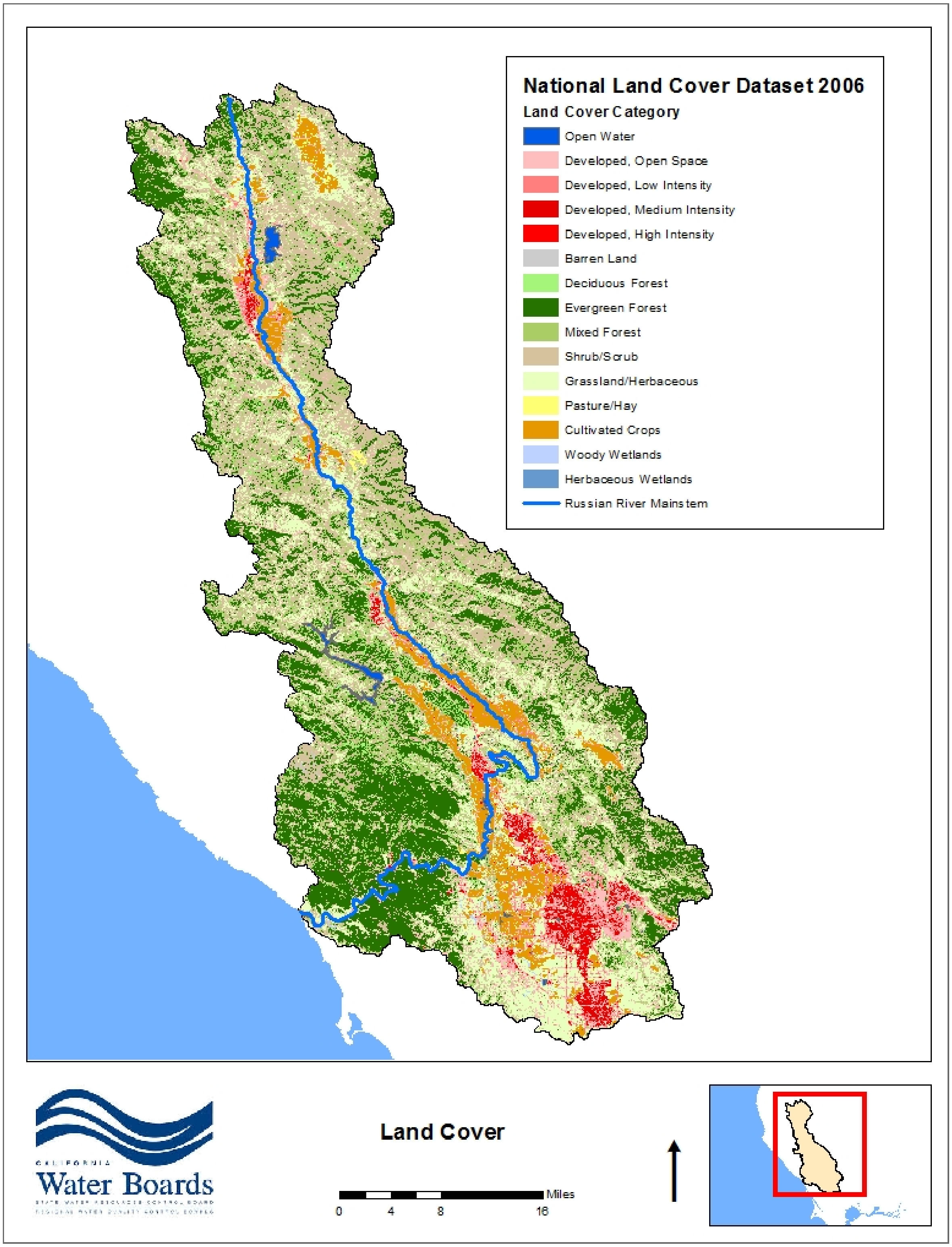

Figure 2.3: Land Cover In The Russian River Watershed

Table 2.3 Population of Cities in the Russian River Watershed

City or Town	Population[1]	Percent of Municipal Population
Cloverdale	8,801	3%
Cotati	7,455	3%
Healdsburg	11,827	4%
Rohnert Park	42,622	14%
Santa Rosa	175,155	59%
Sebastopol	7,678	3%
Ukiah	15,882	5%
Windsor	27,555	9%
Total City Population	296,975	100%

[1] Per U.S. Census Bureau 2016

2.4 RECREATIONAL USES

The Russian River and tributary creeks are enjoyed by many swimmers, waders, canoers, kayakers, fishermen, and enthusiasts that partake in water contact and non-contact water recreation. The Russian River is one of the most intensively used rivers for recreation in the North Coast Region. On holiday weekends in the summer, beach visitors along the river number in the thousands. Several of the most popular beaches are listed in Table 2.4 and shown in Figure 2.4. The greatest number of popular swimming beaches are located in the Guerneville HSA, in the lower part of the Russian River Watershed.

Table 2.4 Popular Swimming Beaches along the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Upper Russian River	Coyote Valley	Mill Creek Park	Potter Valley
	Forsythe Creek	Mariposa Swimming Hole	Redwood Valley
	Ukiah	Vichy Springs Park	Ukiah
		Mill Creek Park	Ukiah
Middle Russian River	Geyserville	Cloverdale River Park	Cloverdale
		Alexander Valley Campground	Healdsburg
Lower Russian River	Guerneville	Veteran Memorial Beach	Healdsburg
		Riverfront Park	Windsor
		Mirabel Park Campground	Forestville
		Steelhead Beach	Forestville
		River Access Beach	Forestville
		Sunset Beach	Forestville
		Johnson's Beach	Guerneville
		Monte Rio Beach	Monte Rio
		Casini Ranch Campground	Duncans Mills

Figure 2.4: Popular Swimming Beaches On The Russian River

2.5 CLIMATE

The Russian River Watershed has a Mediterranean climate with hot, dry summers and wet winters. Average precipitation varies across the watershed with generally wetter conditions in the north and west. Summer temperatures can reach over 100° F in inland valleys for weeks at a time, with coastal conditions cool and moist. Drought and severe storms occur periodically but mostly unpredictably; El Niño/ La Niña Southern Oscillation climatic conditions can exacerbate climatic extremes.

Precipitation in the Russian River Watershed is distinctly seasonal; about 80 percent of the total occurs during five months, November through March. The bulk of the precipitation occurs during moderately intense general storms of several days' duration. Snow falls in modest amounts at altitudes above 2,000 feet, but it seldom remains on the ground for more than a few days. Mean annual precipitation varies from about 30 inches in the flat valley lands north of Santa Rosa to more than 80 inches in parts of the mountains. Summers are dry, with total rainfall from June through August averaging less than 0.5 inch (Zhang and Johnson 2010).

Table 2.5 Average Annual Precipitation

Hydrologic Area Name	Hydrologic Subarea Name	Mean Precipitation (inches/year)
Upper Russian River	Coyote Valley	41.1
	Forsythe Creek	46.0
	Ukiah	43.1
Middle Russian River	Sulphur Creek	51.4
	Warm Springs	48.6
	Geyserville	41.6
	Laguna	31.3
	Santa Rosa	38.5
	Mark West	39.0
Lower Russian River	Guerneville	45.1
	Austin Creek	65.5
Russian River Watershed Mean		44.2

The spatial distribution of mean annual rainfall in the Russian River Watershed is shown in Figure 2.5. These precipitation zones were derived statewide by the California Department of Forestry and Fire Protection for the period 1900-1960. Table 2.5 presents the area weighted precipitation for each Hydrologic Subarea in the Russian River.

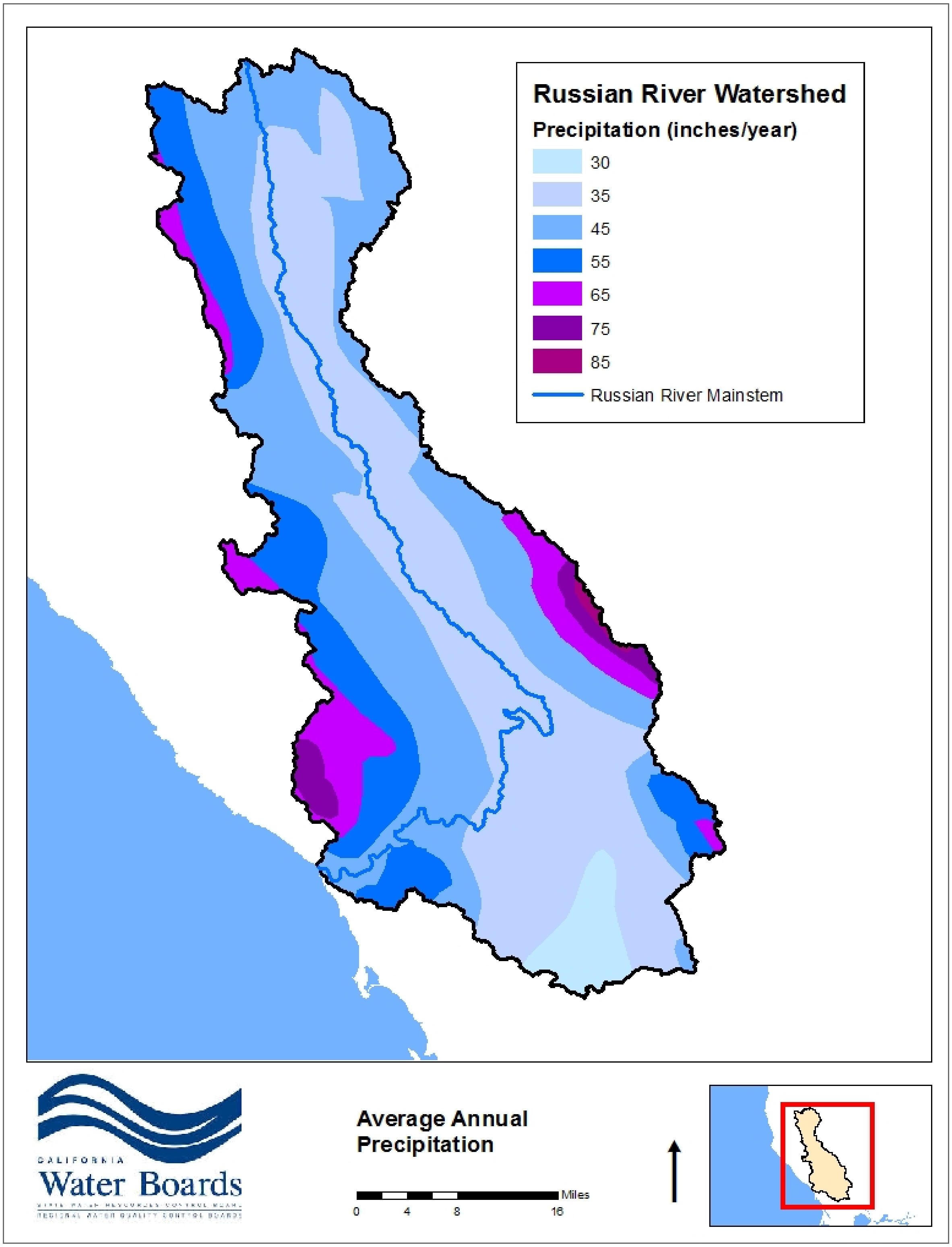

Figure 2.5: Average Annual Precipitation Patterns In The Russian River Watershed

2.6 GEOLOGY AND SOILS

The Russian River Watershed is underlain predominantly by the Franciscan Assemblage, which is a highly erodible mélange that formed during the Jurassic-Cretaceous age. The Franciscan Assemblage forms the bulk of the coast range; the sediment consists of muddy sandstones and cherts jumbled together and layered with basalt lava flow. This lithology is very unstable with landslides common throughout the mountainous regions of the basin. Many of the streams within the basin, including the upper mainstem Russian River, follow the northwest to southeast orientation of geologic faults. The Rodgers Creek Fault enters Sonoma County at San Pablo Bay and extends northward through the City of Santa Rosa, where it meets up with the Healdsburg Fault, which continues northward passing east of the Town of Windsor. The Mayacama Fault lies to the east of the Healdsburg Fault and continues northward, passing east of the City of Cloverdale.

The Russian River flows through a series of broad alluvial valleys and narrow bedrock constrictions. For a more in-depth understanding of watershed form and function, a conceptual model of the hydrology, surface and groundwater interactions, and stream ecology of Russian River Watershed has been completed by an Independent Science Review Panel since the first drafting of this report and is available online.[8] Historic photographs show that the historic river channel once meandered across a broad natural floodplain and that the elevation of the active channel was once close to the elevation of the floodplain. Traces of the channel remained on the irregular floodplain as a series of "sloughs" or side channels. Subsequent land use changes in the Russian River Basin have leveled the floodplain, filled the side channels, and constrained the river channel into a narrow and straighter course (Florsheim and Goodwin 1995).

The Russian River Watershed contains a large number of different soils types (NRCS 2013). Identification of hydrologic soil groups is based on comparison of the characteristics of soil profiles, which include hydraulic conductivity, texture, bulk density, structure, strength, clay mineralogy, and organic matter content. Four hydrologic soil groups are categorized in Table 2.6 and shown on Figure 2.6 (NRCS 2007). Hydrologic soil characteristics influence the delivery of bacteria to surface waters. Soils with a greater potential to runoff also have a greater potential to deliver bacteria with the soil particles. Impervious lands, such as urban paved areas, deliver storm water and associated bacteria directly to the river and its tributaries.

[8] http://www.russianriverisrp.org/index.html

Table 2.6 Hydrologic Soil Characteristics of the Russian River Watershed			
Hydrologic Soil Group	**Runoff Potential**	**Acres**	**Relative Watershed Area (%)**
A	Low when thoroughly wet. Water is transmitted freely through the soil.	1,756	0.2%
B	Moderately low when thoroughly wet. Water transmission through the soil is unimpeded.	477,416	50%
C	Moderately high when thoroughly wet. Water transmission through the soil is somewhat restricted.	218,774	23%
D	High when thoroughly wet. Water movement through the soil is restricted or very restricted.	251,664	27%
	Total	949,611	100%

The Russian River Watershed is a very important watershed in the North Coast Region. Dependent on the water supplies provided by the Russian River, it contains one of the largest population centers in the region. The river provides broad recreational value, attracting a large tourist population. The Russian River Watershed supports multiple thriving ~~landuses~~land uses, which produce a variety of anthropogenic influences, stemming both from urban and rural living. The Mediterranean climate causes most of the precipitation in the Russian River Watershed falls during the winter season. This, coupled with the steep slopes of the watershed, results in significant storm water runoff during the wet season. The broad valleys foster significant agricultural production within the river corridor.

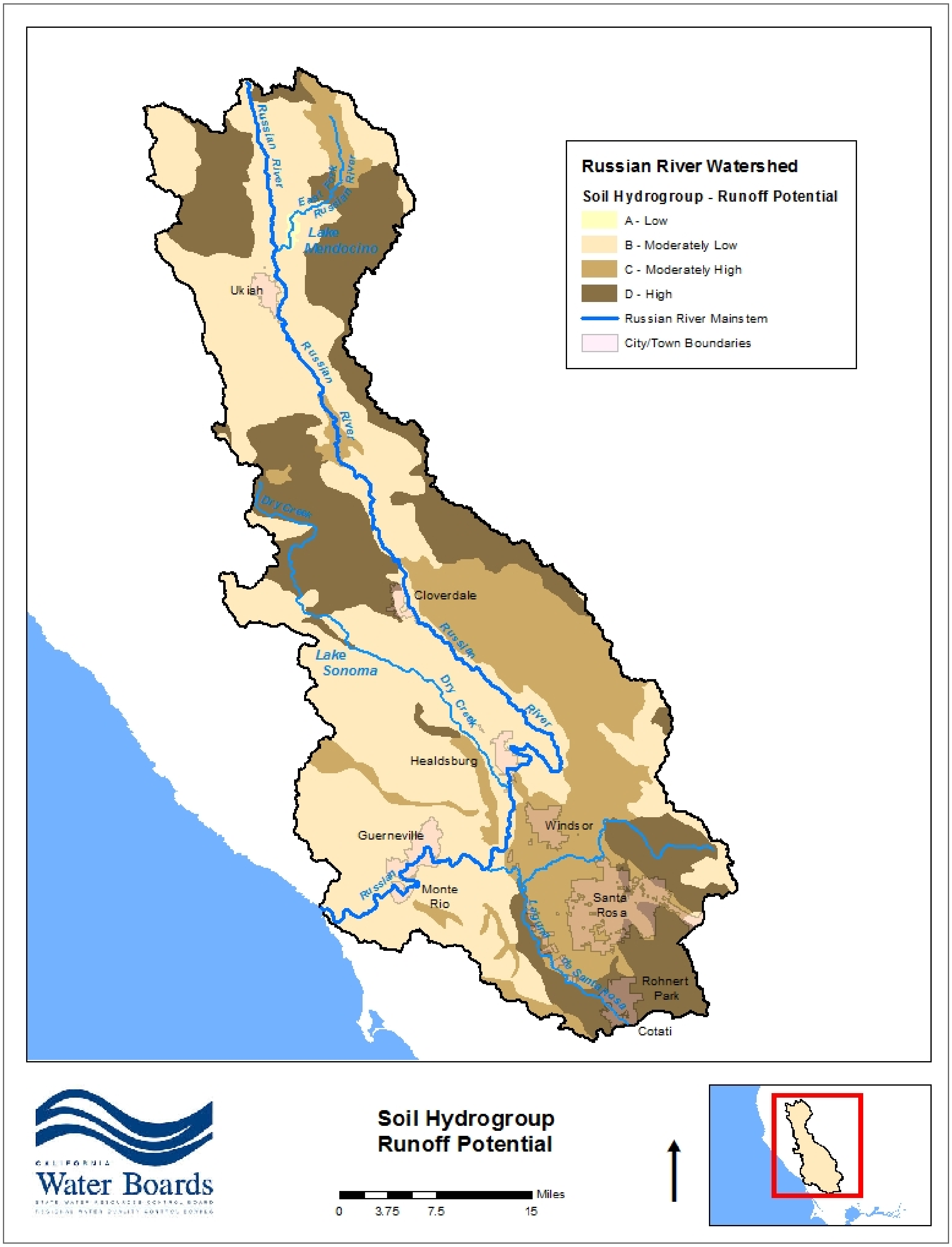

Figure 2.6: Hydrologic Soil Characteristics Of The Russian River Watershed

2.7 SUMMARY

The watershed setting is important to understanding the potential sources of pathogens in the Russian River Watershed, the conditions that result in fecal waste discharge, and the effect on water quality, water contact recreation, and public health. In short, the Russian River Watershed has densely populated urban centers, which rely on municipal services such as sewage collection, centralized wastewater treatment, and storm water collection systems. The collection and treatment facilities require adequate maintenance and repair, if they are to consistently transport, treat and dispose of fecal waste properly. The Russian River Watershed also has considerable rural development, where residents generally rely on onsite wastewater treatment systems (OWTS) to treat and dispose of fecal waste. Many reaches of the Russian River and its tributaries are within steep canyons with little soil to support adequate OWTS or were developed long before modern OWTS regulations were in place. As such, there are likely to be numerous old, failing, or inadequately sited OWTS in need of replacement or upgrade. Further, the Russian River Watershed is home to multiple kinds of agriculture, including small and large animal operations such as horse farms, goat farms and dairies, each with the potential for fecal waste discharge. The watershed experiences a long summer drought, with precipitation occurring primarily from October through April, which is important with respect to storm water runoff as a carrier of fecal waste. It is also a very popular tourist destination, particularly in the summer months, which is important with respect to the potential for pathogen exposure.

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CHAPTER 3
BACTERIA STANDARDS AND OTHER INDICATORS OF PATHOGEN POLLUTION

The Russian River Pathogen TMDL uses a number of different analytical approaches to assess water quality conditions in the Russian River Watershed and the potential for human exposure to illness-causing pathogens. The science associated with assessment of pathogens has evolved over time, with the development of new methods, metrics, and criteria. The purpose of the chapter is to describe the standards and indicators used in the Russian River Pathogen TMDL.

3.1 WATER QUALITY STANDARDS FOR BACTERIA

Water quality standards are established in the Basin Plan. Water quality standards consist of three basic elements: beneficial uses, the water quality objectives minimally required to protect the beneficial uses, and an antidegradation policy. Resolution No. 68-16 was adopted by the State Water Board to protect the state's high quality waters and is incorporated into the Basin Plan as the antidegradation policy.

3.1.1 BENEFICIAL USES

The beneficial use at issue in this TMDL is water contact recreation. Water contact recreation (REC-1) is defined in the Basin Plan as "the uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white-water activities, fishing, or use of natural hot springs." All of the beneficial uses designated in the Russian River Watershed are identified in Table 3.1. Beneficial uses designated in a downstream waterbody are generally applicable upstream.

Table 3.1 Beneficial Uses Designated for Protection in Surface Waters of the Russian River Watershed

HYDROLOGIC AREAS (HA)		Upper Russian River			Middle Russian River						Lower Russian River	
HYDROLOGIC SUB AREAS (HSA)		Coyote Valley	Forsythe Creek	Ukiah	Sulphur Creek	Warm Springs	Geyserville	Laguna	Santa Rosa	Mark West	Guerneville	Austin Creek
MUN	Municipal and Domestic Supply	X	X	X	X	X	X	X	X	X	X	X
AGR	Agricultural Supply	X	X	X	X	X	X	X	X	X	X	X
IND	Industrial Service Supply	X	X	X	X	X	X	X	X	X	X	X
PRO	Industrial Process Supply	X	X	X	X	X	X	X	X	X	X	X
GWR	Groundwater Recharge	X	X	X	X	X	X	X	X	X	X	X
FRSH	Freshwater Replenishment	X		X		X	X	X		X	X	
NAV	Navigation	X	X	X	X	X	X	X	X	X	X	X
POW	Hydropower Generation	X	X	X	X	X	X	X	X	X	X	X
REC-1	Water Contact Recreation	X	X	X	X	X	X	X	X	X	X	X
REC-2	Non-Contact Water Recreation	X	X	X	X	X	X	X	X	X	X	X
COMM	Commercial and Sport Fishing	X	X	X	X	X	X	X	X	X	X	X
WARM	Warm Freshwater Habitat	X	X	X	X	X	X	X	X	X	X	X
COLD	Cold Freshwater Habitat	X	X	X	X	X	X	X	X	X	X	X
WILD	Wildlife Habitat	X	X	X	X	X	X	X	X	X	X	X
RARE	Rare, Threatened, or Endangered Species	X	X	X	X	X	X	X	X	X	X	X
MIGR	Migration of Aquatic Organisms	X	X	X	X	X	X	X	X	X	X	X
SPWN	Spawning, Reproduction, and/or Early Development	X	X	X	X	X	X	X	X	X	X	X
SHELL	Shellfish Harvesting			X			X	X	X	X	X	
EST	Estuarine Habitat										X	
AQUA	Aquaculture	X	X	X	X	X	X	X	X	X	X	X

The Basin Plan delineates waterbodies, including the Russian River, utilizing Hydrologic Subareas (HSA's) and designates the beneficial uses associated with those HSA's. For the purposes of this TMDL, the data have been evaluated within each Hydrological Unit 12 (HUC-12) subwatershed resulting in finer scale delineations and allowing more precise impairment/pollution classification. The crosswalk between these two spatial delineation methods is listed in Table 1.1 and illustrated in Figure 1.1.

3.1.2 WATER QUALITY OBJECTIVES

The water quality objective for bacteria ~~currently~~ contained in the Basin Plan reads as follows. ~~It will be superseded by the statewide bacteria objective for REC-1 protection to be adopted by the State Water Resources Control Board, as described below.~~

Regional Bacteria Water Quality Objective

The bacteriological quality of waters of the North Coast Region shall not be degraded beyond natural background levels. In no case shall coliform concentrations in waters of the North Coast Region exceed the following:

In waters designated for contact recreation (REC-1), the median fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed 50/100 mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 mL (State Department of Health Services).

At all areas where shellfish may be harvested for human consumption (SHELL), the fecal coliform concentration throughout the water column shall not exceed 43/100 ml for a 5-tube decimal dilution test or 49/100 ml when a three-tube decimal dilution test is used (National Shellfish Sanitation Program, Manual of Operation).

~~As noted, the objective has three parts requiring:~~

1. ~~Consistency with natural background conditions;~~
2. ~~Protection of water contact recreation; and~~
3. ~~Protection of human consumption of shellfish.~~

~~The Regional Water Board is conducting a study of reference streams to determine the expected fecal indicator bacteria concentrations from relatively undisturbed waterbodies. The reference study will provide additional information with which to reasonably assess compliance in the Russian River Watershed with the first element of the bacteria objective, the natural background requirement.~~

~~Similarly, additional information is necessary to reasonably assess compliance with the third element of the bacteria objective, the SHELL requirements. This is because updated science no longer recognizes fecal coliform as an appropriate metric for measuring~~

~~potential risk to shellfish and no alternative criteria are readily available. Regional Water Board staff assessed the extent of the SHELL use in the watershed. A limited staff survey of resource agency professionals, non-governmental organizations, and recreation sport fishing suppliers found no evidence of existing or historical harvesting of freshwater shellfish from the Russian River Watershed. Conversely, a U.C. Davis survey of Native American tribal use found anecdotal evidence of historic traditional use of mussels from the river (Butkus 2015). Regional Water Board staff assessed the extent of SHELL in the watershed and documented evidence of shellfish in several areas (Butkus 2015). Freshwater mussels (*Anodonata* spp., *Margaritifera falcate*, and other unidentified species) were observed in the mainstem Russian River, East Fork, Mark West Creek, and Green Valley Creek. Although staff was unable to document current use of freshwater shellfish, there remains the potential for any individual to use shellfish from the Russian River and its tributaries for human consumption.~~

~~The Russian River Pathogen TMDL does not establish wasteload and load allocations to implement the narrative portion of the existing bacteria objective nor the fecal coliform objective for protection of SHELL. Staff envision that the Action Plan will result in the control of fecal waste discharge in a manner that protects all relevant beneficial uses. Ongoing monitoring and implementation of an adaptive management strategy will allow for future revision and update as necessary to accommodate any new information.~~

Only the second part of the bacteria objective is ~~relevant to~~ the ~~protection~~subject of ~~REC-1 and~~the Russian River Pathogen TMDL. It is important to note that the objective was adopted by the Regional Water Board in 1975 when fecal coliform was a common measure of bacterial contamination. In 1984, the U.S. EPA promulgated national criteria for the protection of recreation, which are based on *E. coli* and enterococci bacteria. In 2012, U.S. EPA released revised national criteria for the protection of recreation, also based on *E. coli* and enterococci bacteria. The State Water Board ~~is currently in the process of developing~~ adopted statewide bacteria objectives in August of 2018, which are based on U.S. EPA's 2012 national criteria~~, which will be proposed for statewide applicability.~~. The statewide bacteria objective~~, once adopted by the State Water Board will supersede~~ supersedes REC-1 standards contained in Basin Plans. ~~Draft documents have been released~~The statewide bacteria objective adopted by the State Water Board ~~for public review and~~ can be found on the State Water Board website.[9] ~~The draft documents propose that the statewide bacteria objective for the~~The adopted language includes protection of REC-1 in freshwaters ~~be~~ based on the national criteria for *E. coli* using 32 gastrointestinal ~~illness~~illnesses per 1,000 recreators as the threshold and in saline waters based on the national criteria for enterococci also using 32 gastrointestinal illnesses per 1, 000 recreators as the threshold. (See further discussion below).

As such, the Russian River Pathogen TMDL is based on the ~~draft~~ statewide *E. coli* objective ~~now out~~ for ~~public review.~~freshwater and enterococci objective for saline water adopted in August 2018. Wasteload allocations and load allocations are also based on the ~~draft~~

[9] http://www.waterboards.ca.gov/bacterialobjectives/

statewide *E. coli* and enterococci objectives. (See further discussion in Chapter 7). The ~~draft~~ statewide *E. coli* objectives for the protection of REC-1 is ~~as follows:~~reproduced in Table 3.2

<table>
<tr><th colspan="4">Table 3.2 Statewide Bacteria Objectives for the Protection of REC-1</th></tr>
<tr><td rowspan="3">Applicable Waters</td><td rowspan="3">Objective Elements</td><td colspan="2">Estimated Illness Rate (NGI): 32 per 1,000 water contact recreators</td></tr>
<tr><td colspan="2">Magnitude</td></tr>
<tr><td>GM (cfu/100 mL)</td><td>STV (cfu/100/mL)</td></tr>
<tr><td>All the waters where salinity is equal to or less than 1 ppth 95 percent of more of the time</td><td>E. coli</td><td>100</td><td>320</td></tr>
<tr><td>All the waters where salinity is greater than 1 ppth more than 5 percent of the time</td><td>Enterococci</td><td>30</td><td>110</td></tr>
<tr><td colspan="4">The waterbody GM shall not be greater than the applicable GM magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a CALENDAR MONTH, calculated in a static manner.

NGI = National Epidemiological and Environmental Assessment of Recreational Water gastrointestinal illness rate
GM = geometric mean
STV = statistical threshold value
cfu = colony forming units
mL = milliliters
ppth = parts per thousand</td></tr>
</table>

~~A six-week rolling GEOMETRIC MEAN of *Escherichia coli (E. coli)* not to exceed 100 colony forming units per 100 milliliters (cfu/100 mL), calculated weekly, and a STATISTICAL THRESHOLD VALUE (STV) of 320 cfu/100 mL not to be exceeded more than 10 percent of the time, calculated monthly.~~

~~A decision of the State Water Board is currently scheduled for December 2017, a week prior to the Regional Water Board's scheduled hearing on the Russian River Pathogen TMDL Action Plan.~~

3.1.3 ANTIDEGRADATION POLICY

The federal antidegradation policy described in 40 C.F.R. section 131.12 and state Antidegradation Policy contained in State Water Board Resolution No. 68-16 obligate the Regional Water Board to protect the quality of waters, and to make appropriate findings when any lowering of water quality is authorized. Under the state Antidegradation Policy, which incorporates the requirements of the federal policy, waters that exceed minimum water quality objectives are described as high-quality waters. In those locations and during those times of year when the quality of water in the Russian River Watershed can be described with respect to pathogens as high quality, the Regional Water Board must maintain that high quality unless certain findings are made. Chapter 13 of the staff report more fully describes the Regional Water Board's antidegradation analysis for the Russian River Pathogen TMDL.

3.2 OTHER INDICATORS OF PATHOGEN POLLUTION

Though the Russian River Pathogen TMDL is based on *E. coli* as the bacteria objective for protection of REC-1 in freshwater and enterococci for saline waters, there are numerous other analytical methods useful to the assessment of fecal waste discharge and pathogen exposure. This section describes some of the other metrics staff have used to assess pollution in the Russian River Watershed.

Pathogens most commonly identified and associated with waterborne diseases can be grouped into three general categories: bacteria, protozoans, and viruses (Table 3.~~2~~3). Bacteria are microscopic unicellular organisms that are ubiquitous in nature, including the intestinal tract of animals. Many types of harmless bacteria colonize the human intestinal tract and are routinely shed in feces. However, pathogenic (disease-causing) bacteria are present in the feces of infected humans and animals and can contaminate surface water and groundwater as a result of inadequate waste treatment or disposal methods. Protozoans are unicellular organisms that are present primarily in the aquatic environment. Of the 35,000 known species of protozoans, almost 30 percent are pathogenic. Pathogenic protozoans can occur in humans and animals where they multiply in the intestinal tract of the infected individual or animal and are later excreted in feces as cysts. Viruses are obligate intracellular parasites, incapable of replication outside of a specific host organism. Viruses that are of a public health concern are viruses that replicate in the intestinal tract of humans, and are referred to as human enteric viruses (U.S. EPA 2001).

Table 3.3 Pathogenic Bacteria, Protozoan, and Virus of Concern to Water Quality

Pathogen Type	Disease	Effects
Bacteria		
Escherichia coli	Gastroenteritis	Vomiting, diarrhea
Salmonella typhi	Typhoid fever	High fever, diarrhea, ulceration of the small intestine
Salmonella	Salmonellosis	Diarrhea, dehydration
Shigella	Shigellosis	Bacillary dysentery
Vibrio cholera	Cholera	Extremely heavy diarrhea, dehydration
Yersinia enterolitica	Yersinosis	Diarrhea
Protozoan		
Balantidium coli	Balantidiasis	Diarrhea, dysentery
Cryptosporidium	Cryptosporidiosis	Diarrhea, death in susceptible populations
Entamoeba histolytica	Amebiasis (ameobic dysentery)	Prolonged diarrhea with bleeding, abscesses of the liver and small intestine
Giardia lamblia	Giardiasis	Mild to severe diarrhea, nausea, indigestion
Virus		

Table 3.3 Pathogenic Bacteria, Protozoan, and Virus of Concern to Water Quality

Pathogen Type	Disease	Effects
Bacteria		
Adenovirus	Respiratory disease, gastroenteritis	Various effects
Enterovirus	Gastroenteritis, heart anomalies, meningitis	Various effects
Hepatitus A	Infectious hepatitis	Jaundice, fever
Reovirus	Gastroenteritis	Vomiting, diarrhea
Rotavirus	Gastroenteritis	Vomiting, diarrhea
Calicivirus	Gastroenteritis	Vomiting, diarrhea
Astrovirus	Gastroenteritis	Vomiting, diarrhea

Adapted from Metcalf & Eddy 1991 and Fout 2000; as cited in U.S. EPA 2001

3.2.1 FECAL INDICATOR BACTERIA (FIB)

Several groups of intestinal bacteria are used as indicators that a waterbody has been contaminated with fecal waste and that pathogens are present. Most strains of fecal indicator bacteria (FIB) do not directly pose a health risk to swimmers and those recreating in the water; but, indicator bacteria often co-occur with human pathogens and are easier to measure than the actual pathogens that may pose the risk of illness. Not only is it impractical to directly measure the wide range of fecal-borne pathogens (bacteria, viruses, and protozoans), but the methods to detect human pathogens are characteristically expensive and inefficient, or may ~~be~~ not be available. The following are descriptions of various methods of using indicators to determine fecal waste contamination in a waterbody.

3.2.1.1 FECAL COLIFORM

Fecal coliform bacteria are a subgroup of total coliform bacteria found mainly in the intestinal tracts of warm-blooded animals, and thus, are considered a more specific indicator of fecal waste pollution than the total coliform group. Fecal coliform bacteria concentration criteria were initially recommended by U.S. EPA (1976) for assessing support of recreational use. However, since 1976, several key epidemiological studies were conducted to evaluate the criteria for effectiveness at protecting public health related to water contact recreation (Cabelli et al. 1982; Cabelli et al. 1983; Dufour 1983; Favero 1985; Seyfried et al. 1985a, Seyfreid et al. 1985b). These studies concluded that the 1976 U.S. EPA recommended fecal coliform bacteria criteria were not protective of public health from incidental ingestion associated with swimming recreation. As a result, the U.S. EPA changed the criteria recommendation in 1986 to use the fecal indicator bacteria *E. coli* and enterococci bacteria. ~~At least one of the potential issues with the use of fecal coliform bacteria as an indicator of fecal waste is that this bacteria group contains a genus, *Klebsiella*, with species that are not necessarily fecal in origin. *Klebsiella* bacteria are commonly associated with soils and the surfaces of plants, so that areas with organic debris may show high levels of fecal coliform bacteria that do not have a fecal-specific bacteria~~

~~source.~~ The State Water Board has since adopted objectives based on the U.S. EPA's recommendations that now supersede any fecal coliform objectives. This TMDL no longer relies upon fecal coliform bacteria data for assessment of impairment or pollution.

3.2.1.2 E. COLI BACTERIA AND ENTEROCOCCI BACTERIA

E. coli is a species of fecal coliform bacteria that is found in the fecal material of humans and other animals. U.S. EPA (2012) compiled numerous epidemiological studies and concluded that *E. coli* bacteria are a good indicator of human health risk from water contact in recreational freshwaters. National criteria are established for both the geometric mean and the statistical threshold value (STV~~) (Table 3.3~~). To assess impairment of REC-1, the geometric mean criterion is compared to the logarithmic average of the bacteria concentration distribution. In addition, the STV criterion is compared to the 90th percentile of the bacteria concentration distribution. The State Water Board's ~~draft~~ bacteria objective for freshwater is based on *E. coli* and is consistent with the national criteria. This TMDL identifies impaired HUC-12 units based on exceedances of the statewide objective for *E. coli* is freshwaters.

Enterococci is a genera of fecal indicator bacteria that is also found in the fecal material of humans and other animals. U.S. EPA (2012) compiled numerous epidemiological studies and concluded that enterococci bacteria are a good indicator of human health risk from water contact in recreational marine and freshwaters. National criteria are established for both the geometric mean and the statistical threshold value (STV~~) (Table 3.4~~). The geometric mean criterion is compared to the logarithmic average of the bacteria concentration distribution. In addition, the STV criterion is compared to the 90th percentile of the bacteria concentration distribution. The State Water Board ~~has not proposed for its draft bacteria objective, the development of~~ adopted objectives for enterococci ~~bacteria in freshwater. Instead, the draft bacteria objectives include enterococci objectives for the protection of REC-1 in marine~~, which are consistent with the national criteria, but applicable to saline waters, only. The statewide objective for enterococci apply to waters with a salinity threshold of 1 part per thousand more than 5 percent during the calendar year. However, the scientific peer reviewers for the Russian River Pathogen TMDL recommended the use of enterococci bacteria in freshwater ~~as an indicator of potential exposure to fecal-borne pathogens in the Russian River Watershed~~, too as an indicator of potential exposure to fecal-borne pathogens in the Russian River Watershed. This TMDL identifies impaired HUC-12 units based on exceedances of the statewide objective for enterococci in waters with a salinity threshold that exceeds 1 ppth more than 5 percent of time in a calendar year. This TMDL also identifies impaired HUC-12 units based on exceedances of the national criteria for enterococci in freshwaters, when coupled with another line of evidence of pollution (e.g., beach closure). This approach is consistent the statewide bacteria objectives, the national bacteria criteria, and the results of the scientific peer review process.

U.S. EPA published *E. coli* and enterococci bacteria criteria for two different levels of illness risk. The first level of risk (36 estimated illnesses per 1,000 recreators) is the same risk level applied with the previous recreational criteria (i.e., U.S. EPA 1986). The 1986 U.S. EPA criteria correspond to the level of risk associated with an estimated illness rate of the number of highly credible gastrointestinal illnesses (HCGI) per 1,000 primary contact recreators. The information developed for the 2012 U.S. EPA criteria uses a more comprehensive definition of GI illness, referred to as NEEAR-GI (NGI), which includes diarrhea without the requirement of a fever. Because NGI is broader than HCGI, more illness cases were reported and associated with recreation using the NGI definition of illness, at the same level of water quality observed using the previous illness definition (i.e., HCGI). The U.S. EPA (2012) also recommends criteria that correspond to an illness rate of 32 NGI per 1,000 primary contact recreators to "encourage an incremental improvement in water quality." The statewide bacteria objectives are based on 32 NGI per 1,000 primary contact recreators, as is this TMDL.

~~The 2012 U.S. EPA criteria are expressed as colony-forming units per sample volume (cfu/100mL) based on membrane filtration methods (U.S. EPA 2002a; U.S. EPA 2002b). Many laboratories, including the Regional Water Board Microbiology Laboratory, use a different analysis method to measure *E. coli* (and enterococci) bacteria concentrations (IDEXX 2001). These methods, (Colilert® and Enterolert® Quanti-Tray/2000) have been shown to produce equivalent results as the membrane filtration methods (Budnick et al. 1996; Yakub et al. 2002) and have been approved by the U.S. EPA in the Code of Federal Regulations (40 C.F.R. 136.3). Both methods are based on culturing the bacteria in the sample on nutrient media.~~

~~In addition to the 2012 U.S. EPA criteria, U.S. EPA suggests the use of the Beach Action Value (BAV) as a conservative, precautionary tool for making beach notification decisions. The BAV is not a component of U.S. EPA's recommended criteria, but a tool that states may choose to use, without adopting it into their water quality standards as a "do not exceed value" for beach notification purposes. The BAV is applied to single sample measurements: any single sample above the BAV could trigger a beach notification until another sample below the BAV is collected. States also may choose a quantitative polymerase chain reaction-based (qPCR) BAV for beach notification purposes.~~
~~This Pathogen TMDL includes numeric targets based on the U.S. EPA (2012) fecal indicator bacteria criteria for both *E. coli* and enterococci bacteria. Inclusion of both U.S. EPA recommended criteria is consistent with the scientific peer review comments on the Peer Review Draft Staff Report, which strongly recommended inclusion of enterococci bacteria criteria for the Russian River Pathogen TMDL. The scientific peer reviewer explained that the dose-response relationship between enterococci bacteria concentration and gastrointestinal illness establishes it as a good indicator of human health protection. The scientific peer reviewer explained that while *E. coli* is also a reasonable fecal indicator bacteria, U.S. EPA retained *E. coli* in the 2012 REC-1 criteria document so as to provide consistency with the previous approach.~~

3.2.1.3 BACTEROIDES BACTERIA

Bacteroides bacteria are another group of fecal indicator bacteria that are used to measure fecal waste in water. *Bacteroides* is the genus name of the bacteria from the phylum

Bacteroidetes and order Bacteroidales. *Bacteroides* bacteria are anaerobic (i.e., they do not live or grow in the presence of oxygen) and make up a substantial portion of the gastrointestinal flora of mammals (Wexler 2007). However, some species of *Bacteroides* bacteria can come from non-enteric sources (Niemi et al. 2012).

Due to their anaerobic-nature, *Bacteroides* bacteria have a low potential for survival and regrowth in the environment. In addition, water temperature has been shown to affect the persistence of *Bacteroides* in surface water. For water temperatures typically observed in the Russian River during the summer period (20-25°C or 68-77°F), *Bacteroides* bacteria survive one to two days. In cooler temperatures, *Bacteroides* bacteria likely survive for a week or more. Because of this short life span, *Bacteroides* bacteria concentrations are often used to indicate recent introduction of fecal waste to surface waters.

Bacteroides bacteria are especially useful as a tool to identify fecal waste from specific animal sources. The percentage of the *Bacteroides* bacteria population that originates from specific animal hosts can be determined using real-time quantitative polymerase chain reaction (qPCR) methods, which amplify specific DNA sequences of the 16S rRNA gene marker (Molina 2007). *Bacteroides* bacteria assay primers have been developed for most domestic animal hosts including cattle, swine, chicken, dog, and horse (Griffith et al. 2013). Commercial laboratories are available that conduct these animal host analyses. Some animal host assays are non-quantitative and produce only presence/absence results. Water samples analyzed for the Russian River Pathogen TMDL project were analyzed for both human-specific and bovine- specific *Bacteroides* bacteria.

According to the few epidemiological studies currently available for human *Bacteroides*, there is link between the bacteria and illness rates. Wade et al. (2010) estimated the probability of gastrointestinal illness due to increasing concentrations of *Bacteroides* bacteria, and found that a geometric mean of 60 gene copies/~~100mL~~100 mL corresponded to about 30 gastrointestinal illnesses per 1,000 swimmers. Ashbolt et al. (2010) compared human-specific *Bacteroides* bacteria concentration to *Norovirus* concentrations. From these estimates, a concentration of 860 gene copies/~~100mL~~100 mL corresponded to about 30 gastrointestinal illnesses per 1,000 swimmers. Soller et al. (2010a) identified *Norovirus* as the pathogen most responsible for a majority of gastrointestinal illness. Bohem et al. (2015) found a linear relationship between the risk of GI illness associated with swimming and concentrations of human *Bacteroides* bacteria concentration.

For the purposes of this TMDL, *Bacteroides* data were used as a triad of information with *E. coli* and enterococci from which to assess the potential presence of illness causing pathogens. The detection of human or bovine-sourced *Bacteroides* was taken as an indication of the potential of recent discharge of fecal waste. Elevated *Bacteroides* concentrations was taken as an indication of the potential for significant recent discharge of fecal waste. In no case was a pollution or impairment determination made based on *Bacteroides* findings, alone.

3.2.1.4 DNA MARKER SENSITIVITY AND SPECIFICITY

Bernhard and Field (2000a) first identified species composition differences in *Bacteroides* bacteria populations by screening 16S rDNA from human and cow feces. Conventional host-specific PCR assays were then developed to detect these genetic markers in environmental samples (Bernhard and Field 2000b). Further technical advancements have allowed for the relative quantification of animal host-specific genetic markers. There have been more than a dozen human-specific genetic markers developed over the last decade (Griffith et al. 2013). Studies have evaluated these genetic markers for sensitivity (does the marker detect human material when it is present in the sample) and specificity (does the marker cross-react with other animal sources).

Shilling et al. (2009) recommended use of the HuBac genetic marker of human-specific *Bacteroides* bacteria and the BoBac marker for bovine-specific *Bacteroides* bacteria for concentration measurements to support the Russian River Pathogen TMDL. Layton et al. (2006) found the HuBac genetic marker assay had 100% sensitivity, but it also had a 32% false-positive rate with potential for cross-sensitivity with swine feces. Shanks et al. (2010a) found the HuBac marker showed cross-sensitivity with feces from other animal hosts, most prominently with cats, dogs, and chickens. This leads staff to conclude that the HuBac marker was highly likely to correctly detect human waste material in samples from the watershed, but could have also counted other animal fecal waste in the total concentration value.

In regards to bovine host markers, Layton et al. (2006) found the BoBac genetic marker assay was specific for bovine fecal samples with 100% sensitivity and 0% cross-sensitivity with the other animal hosts evaluated. Shanks et al. (2010b) found that the BoBac genetic marker showed cross-sensitivity with feces from many other animal hosts, most prominently with sheep and pig feces. The bovine-specific genetic markers, CowM2 and CowM3, both showed 100% specificity with no detection of other animal host fecal wastes.

The use of the HF183 and HumM2 markers is recommended for future human-specific *Bacteroides* analyses and CowM2 and Rum2Bac markers for bovine-specific analyses, until such time that better technology becomes available. These recommendations are based on the research and review by Griffith et al. (2013) of studies on human-specific and bovine-specific genetic markers. Griffith et al. concluded that the HF183 and HumM2 markers should be used for measuring human fecal waste in environmental samples because they provide the best combination of sensitivity and specificity. Griffith et al. also suggests that bovine-specific assays use both the CowM2 and the Rum2Bac genetic markers if non-cow ruminants are present in the watershed. ~~Additionally, the U.S. EPA is in the process of approving the CowM2 method.~~

3.2.2 DIRECT MEASUREMENT OF PATHOGENS

Pathogenic bacteria, protozoans, and viruses are occasionally measured directly without relying on indicator bacteria species, and the ability to do so is increasing with continuing advances in DNA technology. No direct measurements of viruses were made in support of this TMDL project. But, direct measurements of specific bacteria and protozoans were available, as described below.

3.2.2.1 BACTERIA COMMUNITY

Analytical measurement technology has advanced to a point where entire bacterial communities are quantified instead of just specific fecal indicator bacteria groups or species. High-throughput DNA sequence analysis can potentially identify all sources of microbial contaminants in a single test by measuring the total diversity of microbial communities. The PhyloChip™ (Second Genome, San Bruno CA) is a phylogenetic DNA microarray that has 16S rRNA gene probes that can quantify 59,316 different bacterial taxa in a single water sample. Analyzing the comprehensive suite of bacteria in a sample can help identify specific disease-causing bacteria species, as well as the major sources of fecal waste pollution from which such disease-causing bacteria may be emanating (Hazen et al. 2010).

Analysis of the bacteria with the PhyloChip™ reveals strong differences in community composition among fecal wastes from human, birds, pinnipeds, and livestock. Differences in the diversity among fecal wastes reveal hundreds of unique taxa that are specific to human, bird, and livestock feces (Dubinsky et al. 2012). Actinobacteria, Bacilli, and many Gammaproteobacteria taxa discriminate birds from mammalian sources. Families within the Clostridia and Bacteroidetes taxa discriminate between humans, livestock, and pinniped animal sources. Comprehensive interrogation of microbial communities for these diverse identifier taxa can assist in fecal waste source identification. Phylogenetic microarrays are an effective tool for rapidly measuring the full assortment of microbial taxa that discriminate sources of fecal contamination in surface waters. Similarly, phylogenetic microarrays are an effective tool for identifying the presence of specific potential human pathogens.

For the purpose of this TMDL, PhyloChip™ data was used in a manner like that of *Bacteroides* data. That is, PhyloChip™ data indicating the significant[10] presence of human or bovine fecal waste was used as a line of evidence with which to interpret *E. coli* and enterococci findings. No pollution or impairment determinations were made on the basis of PhyloChip™ data, alone.

3.2.2.2 CRYPTOSPORIDIUM AND GIARDIA PROTOZOA

Protozoans are unicellular organisms that are present primarily in the aquatic environment. Of the 35,000 known species of protozoans, almost 30 percent are pathogenic. Pathogenic protozoans can occur in humans and animals where they multiply in the intestinal tract of the infected individual or animal and are later excreted in feces as cysts. Protozoan cysts do not reproduce in the environment, but are capable of surviving

[10] A 20% gene match or higher was used as the threshold to determine whether human or grazer-sourced pathogens were potentially significant at a given site (Dubinsky and Anderson, 2014).

dormant in the soil and surface water for extended periods of time, which makes them a prominent public health concern.

Two waterborne protozoans of major public health concern are *Giardia lamblia* and *Cryptosporidium parvum*. The *Giardia* organism inhabits the digestive tract of a wide variety of domestic and wild animal species, as well as humans. Once shed in feces, *Giardia* cysts are frequently found in rivers and lakes. Infection by *Giardia* can result in giardiasis in humans, which is characterized by gastroenteritis, particularly among the young and elderly. *Giardia* is considered nonpathogenic in cattle because it is usually found in animals that have normal feces and no sign of disease. However, among the human population, giardiasis affects approximately 200 million people worldwide and is one of the most prevalent waterborne diseases in the United States. *Cryptosporidium* species are a group of parasitic protozoa that are recognized as pathogens of domesticated livestock, poultry, and wildlife and are readily transmitted to humans. *Cryptosporidium* oocysts are about 4-6 µm in diameter, slightly larger than bacteria, and relatively unaffected by conventional methods of wastewater disinfection, such as chlorination. Infection by *Cryptosporidium* can cause cryptosporidiosis, whose symptoms include loss of appetite, nausea, and abdominal pain followed by acute or persistent diarrhea. Although *Cryptosporidium* infections are usually of short duration and self-limiting in individuals with an intact immune system, there is no specific treatment available and the infection can be life threatening in patients with profound impairment of immune function.

For the purpose of this TMDL, the direct measurement of protozoa was included in the Staff Report for general interest. No pollution or impairment determinations were made using direct measurement of protozoa, alone.

3.3 SUMMARY

The ~~Basin Plan contains a~~fecal coliform bacteria objective for ~~the protection of REC-1, which currently~~ REC-1 protection currently described in the Basin Plan is replaced by the statewide bacteria objective for *E. coli* in freshwater and enterococci in saline water. This TMDL is based on ~~fecal coliform, a metric that is no longer recognized as appropriate~~the statewide bacteria objectives. The 2019 Staff Report and Action Plan have been updated from previous versions to ~~measure~~ eliminate consideration of fecal coliform data.

There are numerous other metrics with which to assess the potential for human exposure to illness-causing pathogens~~. Since its adoption in 1975, there have been enormous advancements in the development of methods, metrics, and criteria with which to assess fecal waste pollution and potential for pathogen exposure. Many of these methods and metrics have been used in development of the Russian River Pathogen TMDL and are described in this chapter.~~, including other fecal indicator bacteria, as well as direct measures of specific pathogens.

~~U.S. EPA (2012) has established national criteria based on *E. coli* and enterococci bacteria for the protection of REC-1.~~ The Regional Water Board's scientific peer reviewers strongly recommended the use of enterococci bacteria as a good indicator of human health

~~protection. This Pathogen TMDL includes numeric targets for both *E. coli* and enterococci bacteria.~~exposure to pathogens in freshwaters. To conform to the results of the legally mandated scientific peer review process, national criteria for enterococci in freshwaters were also used to assess impairment, but only in combination with other evidence that considered by itself would constitute evidence of impairment and the potential for human exposure to illness-causing pathogens. It should be noted that evidence of beach closures alone is sufficient to identify a give reach as impaired or polluted. Use of enterococci data, too, strengthens the finding.

CHAPTER 4
EVIDENCE OF POLLUTION

4.1 OVERVIEW

The development of a TMDL includes monitoring studies, analyses and assessments to help determine the geographic extent of the noted pollution and the sources of the pollution that need additional management and control. The Action Plan is designed to address both exceedances of water quality objectives for bacteria (e.g., as required of a TMDL under federal law) and evidence of pollution as demonstrated using other relevant and reliable metrics (e.g., under the authority of state law). As described in Chapter 3, using multiple lines of evidence to assess fecal waste pollution, beneficial use impairment, and the potential for exposure to illness-causing pathogens is reasonable and appropriate given the nature of pathogens and the evolving field of pathogen measurement and assessment. Individual metrics for the measurement of pathogens respond to environmental factors in different ways, indicating the efficacy of using multiple lines of evidence to ensure full public health protection. To ensure clarity with respect to requirements specific to TMDLs, under federal law, evidence of exceedance of bacteria objectives for protection of REC-1 (i.e., impairment) are particularly noted. However, all the lines of evidence of fecal waste pollution is taken as a whole~~,~~ when describing an appropriate Program of Implementation to be implemented under state law.

The 2012 Section 303(d) List of Impaired Waters was approved by U.S. EPA on July 30, 2015.[11] ~~The List identifies~~ There are six (6) waterbody-pollutant pairs in the Russian River Watershed identified in the 2012 Section 303(d) List as impaired for fecal indicator bacteria due to the failure to fully attain the ~~existing~~ Basin Plan bacteria water quality objective. The data analysis necessary to produce the 2019 Section 303(d) List of Impaired Waters is currently underway and ~~therefore, not supporting the REC-1 beneficial use. These waterbodies are~~ is following an approach for assessment of pathogen data in the Russian River ~~at Veterans Memorial Beach, Russian River between the confluences of Fife Creek in Guerneville and Dutch Bill Creek in Monte Rio, an unnamed stream near Healdsburg at Fitch Mountain, Laguna de Santa Rosa, Santa Rosa Creek, Green Valley Creek, and Dutch Bill Creek (Table 1.1 and Figure 1.1).~~ that is consistent with that which is reported here. The ~~assessment of data that resulted in the 2012 Section 303(d) List provides a line of~~ evidence of ~~fecal waste~~ pollution ~~in the Russian River Watershed and the potential for exposure to illness-causing pathogens.~~ described in this chapter updates the findings of the 2012 Section 303(d) List of Impaired Waters.
For the purposes of this TMDL, ~~that assessment was completed, additional data have been collected, criteria have been updated, and assessment methods have improved.~~ Regional Water Board staff have conducted ~~the following additional~~ multiple monitoring studies to assess the geographic extent of fecal waste discharge in the Russian River Watershed and the potential for human exposure to pathogens.

[11] The list was partially approved by U.S. EPA on June 26, 2015.

- ~~Pilot Studies and Monitoring Design Project (September 2009)~~
- ~~Lower Russian River Bacteria Monitoring (May 2012)~~
- ~~Upper Russian River Bacteria Monitoring (Nov 2013)~~
- ~~Onsite Wastewater Treatment System Impact Study (July 2013)~~
- ~~Recreation Impact Study (Nov 2013)~~

~~Phylochip Microbial Community Analysis (May 2014)~~

This chapter summarizes the evidence of fecal waste pollution and beneficial use impairment in the Russian River and its tributaries ~~resulting from these studies. Technical memoranda describing each of the studies in more detail can be found on the Regional Water Board's website.~~[12]. The multiple lines of evidence of fecal waste pollution ~~provided by these studies~~and beneficial use impairment allows for robust, conservative conclusions regarding the geographic extent and sources of fecal waste pollution, as is appropriate for public health protection. Following the State Water Board's adoption in August 2018 of statewide REC-1 bacteria objectives, staff reanalyzed all the data collected as part of this TMDL to compare against the new standards. The data were aggregated by HUC-12 geographic unit[13]. Data in each HUC-12 was separated by data type (e.g., *E. coli*, enterococci, *Bacteroides*, etc.). The rolling 6-week geomean and statistical threshold value (STV) were calculated for *E. coli* in freshwater and enterococci in saline water and the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy) guidelines[14] were applied to assess impairment. Enterococci data for freshwater was aggregated by HUC-12; but, the static geomeans reported in the 2015 Staff Report and 2017 Staff Report were retained. Determination of impairment was based on the following conditions:

- Any HUC-12 in which there was sufficient *E. coli* data in freshwater or enterococci data in saline water to determine impairment under the Listing Policy was assessed for impairment and the results described.
- Any HUC-12 in which there was sufficient enterococci data in freshwater to determine impairment under the Listing Policy was only identified as impaired if enterococci exceeded the national criteria for enterococci and there were public health advisories for recreational beaches within the HUC-12.

This chapter describes the data, analyses, and results. In summary, the multiple lines of evidence indicate that surface waters throughout much of the Russian River Watershed experience fecal waste pollution, as demonstrated by water samples with measured pathogen indicator bacteria concentrations that exceed the ~~draft~~ statewide bacteria objectives to ~~protection~~protect REC-1, the U.S. EPA (2012) bacteria criteria for protection of recreation, and as corroborated by *Bacteroides* bacteria data, DNA analyses, and other

~~[12]http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/~~
[13] The U.S. Geological Survey (USGS) has defined hydrologic unit codes (HUC) for nested subwatershed units. The HUC-12 is a subwatershed unit within a larger watershed (e.g., Russian River Watershed) that represents individual tributaries, subwatersheds and subunits of the mainstem.
[14] https://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/ffed_303d_listingpolicy093004.pdf

analytical methods. Though, it is recognized that the greatest public use of the Russian River occurs during the summer months, water contact recreation is a beneficial use of the Russian River Watershed throughout the year. The beneficial use impairment is based on data collected in both the wet and dry season, with the following general findings:

1. Concentrations of fecal coliform bacteria measured in several recreational beaches and streams in the watershed ~~indicate~~were used to assess impairment prior to the adoption of statewide bacteria objectives for *E. coli* and enterococci. Those data indicated a potential risk of illness during water contact recreation~~. These data also demonstrate~~, including periodic exceedances of the fecal coliform bacteria objective for the protection of REC-1 ~~currently~~ contained in the Basin Plan. These data are no longer included in this TMDL and are not used to define the extent of pollution/impairment.

2. Concentrations of *E. coli* bacteria measured in numerous recreational beaches and streams in the watershed indicate a potential risk of illness during water contact recreation. These data also demonstrate periodic exceedances of the ~~draft~~statewide bacteria objective for the protection of REC-1 ~~proposed as a statewide objective, which will superseded the existing fecal coliform bacteria objective contained in the Basin Plan, if adopted by the State Water Resources Control Board~~.

3. Concentrations of enterococci bacteria measured in numerous recreational beaches and streams in the watershed indicate a potential risk of illness during water contact recreation. These data also demonstrate periodic exceedances of the statewide REC-1 objective for saline waters and national REC-1 criteria recommended by the U.S. EPA (2012~~).~~) for freshwaters. One of the scientific reviewers of this project specifically supported use of the U.S. EPA 2012 enterococci bacteria criteria as an important line of evidence relative to public health protection~~.~~ in freshwaters.

4. Human-specific and bovine-specific *Bacteroides* bacteria are found in almost all sampling locations in the watershed. Detections of human and bovine *Bacteroides* bacteria in association with *E. coli* and/or enterococci bacteria confirm the likelihood that any exceedances of the ~~draft~~ statewide *E. coli* and enterococci bacteria objectives or the U.S. EPA 2012 enterococci criteria are related to fecal waste pollution and not other environmental causes.

5. Microbiological source identification using ~~PhyloChipTM~~PhyloChip™ phylogenetic DNA microarray associate specific animal sources with elevated concentrations of fecal indicator bacteria. These data confirm the presence of fecal waste in the water column.

6. Bacteria species that are potential human pathogens are found at numerous locations in the watershed. These data confirm the potential for exposure to illness-causing pathogens via water contact.

7. The 2012 Section 303(d) List of Impaired Waters identifies several reaches of the mainstem Russian River and several tributaries as impaired for indicator bacteria. The listings are based on data collected prior to August 2010.

8. Public health advisories warning of potential risk of illness from recreational water contact have been posted at mainstem Russian River beaches and along Santa Rosa Creek.

Sampling locations were established at multiple places throughout the watershed, as described in Table 4.1 and depicted in Figure 4.1.

Table 4.1 Sample Locations

Hydrologic Area Name	Hydrologic Sub Area	Hydrologic Unit 12 (HUC-12)	Sample Location
Upper Russian River	Coyote Valley	Lake Mendocino-East Fork Russian River	Russian River, East Fork at East Road
		Burright Creek	--
		Cold Creek	--
	Forsythe Creek	Salt Hollow Creek-Russian River	Russian River at East School Way
		Forsythe Creek	--
	Ukiah	East Fork Russian River	Russian River at Mendocino Drive
		Ackerman Creek	--
		Orrs Creek	Russian River at Talmage Road
			Russian River at Vichy Springs Road
		Mill Creek	Palmer Creek at Palmer Creek Road
		Robinsons Creek	--
		Morrisons Creek	--
		McNab Creek	--
		Feliz Creek	--
		Cooley Creek	--
		Cummiskey Creek	--
		Pieta Creek	--
Middle Russian River	Warm Springs	Soda Spring Creek	--
		Galloway Creek	--
		Lake Sonoma	--
		Warm Springs Creek	--
		West Slough	Unnamed Tributary at West Dry Creek Road
			Foss Creek at Matheson Street
			Unnamed Tributary at Lambert Bridge Road
		Pena Creek	--
		Mill Creek	--
	Geyserville	Oat Valley Creek-Russian River	Russian River at Cloverdale River Park
		Gill Creek	Russian River at Crocker Road
		Sausal Creek	Unnamed Tributary at Fredson Road
			Unnamed Tributary at Alexander Valley Road

Table 4.1 Sample Locations

Hydrologic Area Name	Hydrologic Sub Area	Hydrologic Unit 12 (HUC-12)	Sample Location
			Russian River at Alexander Valley
			Russian River at Highway 128
		Maacama Creek	--
		Brooks Creek	Unnamed Tributary at Redwood Drive
			Unnamed Tributary at Fitch Mountain Road
			Russian River at Healdsburg Veterans Memorial Beach
			Russian River at Camp Rose
			Russian River at Diggers Bend
		Franz Creek	--
	Santa Rosa	Upper Santa Rosa Creek	Santa Rosa Creek at Los Alamos Road
			Piner Creek at Fulton Road
			Santa Rosa Creek at Railroad Street
			Unnamed Tributary at River Road
			Abramson Creek at Willowside Road Levy
	Laguna	Upper Laguna de Santa Rosa	Blucher Creek at Lone Pine Road
			Copeland Creek at Commerce Drive
			Crane Creek at Snyder Lane
			Gossage Creek at Gilmore Avenue
			Unnamed Tributary at Turner and Daywalt Road
		Lower Laguna De Santa Rosa	Laguna de Santa Rosa at Guerneville Road
			Laguna de Santa Rosa at Sebastopol Community Center
			Unnamed Tributary at Sanford Road
	Mark West	Porter Creek-Mark West Creek	Mark West Creek at Trenton-Healdsburg Road
			Van Buren Creek at St. Helena Road
		Windsor Creek	--
Lower Russian River	Austin Creek	East Austin Creek	--
		Ward Creek	--
	Guerneville	Porter Creek	Unnamed Tributary at Trenton Road
			Russian River at Steelhead Beach
			Russian River at Riverfront Park
			Unnamed tributary at Old Redwood Highway
		Green Valley Creek	Atascadero Creek at Green Valley Road
			Green Valley Creek at Martinelli Road
		Dutch Bill Creek	Unnamed Tributary at River Road near Duncan Road
			Unnamed tributary at Diver Drive
			Unnamed Tributary at Old Monte Rio Road
			Unnamed Tributary at Main Street
			Unnamed Tributary at River Road near Rio Nido
			Unnamed Tributary at Foot Hill Drive
			Unnamed Tributary at Market Street

Table 4.1 Sample Locations

Hydrologic Area Name	Hydrologic Sub Area	Hydrologic Unit 12 (HUC-12)	Sample Location
			Dutch Bill Creek at Fir Road
			Unnamed Tributary at Del Rio Court
			Russian River at Monte Rio Beach
			Russian River at Johnsons Beach
			Russian River at Forestville Access Beach
			Mays Creek at Neeley Road
			Russian River at Hacienda Bridge
		Willow Creek	Unnamed Tributary at Moscow Road
			Russian River at Jenner Boat Ramp
			Russian River at Bridgehaven
			Russian River at Casini Ranch
			Russian River at Duncans Mills

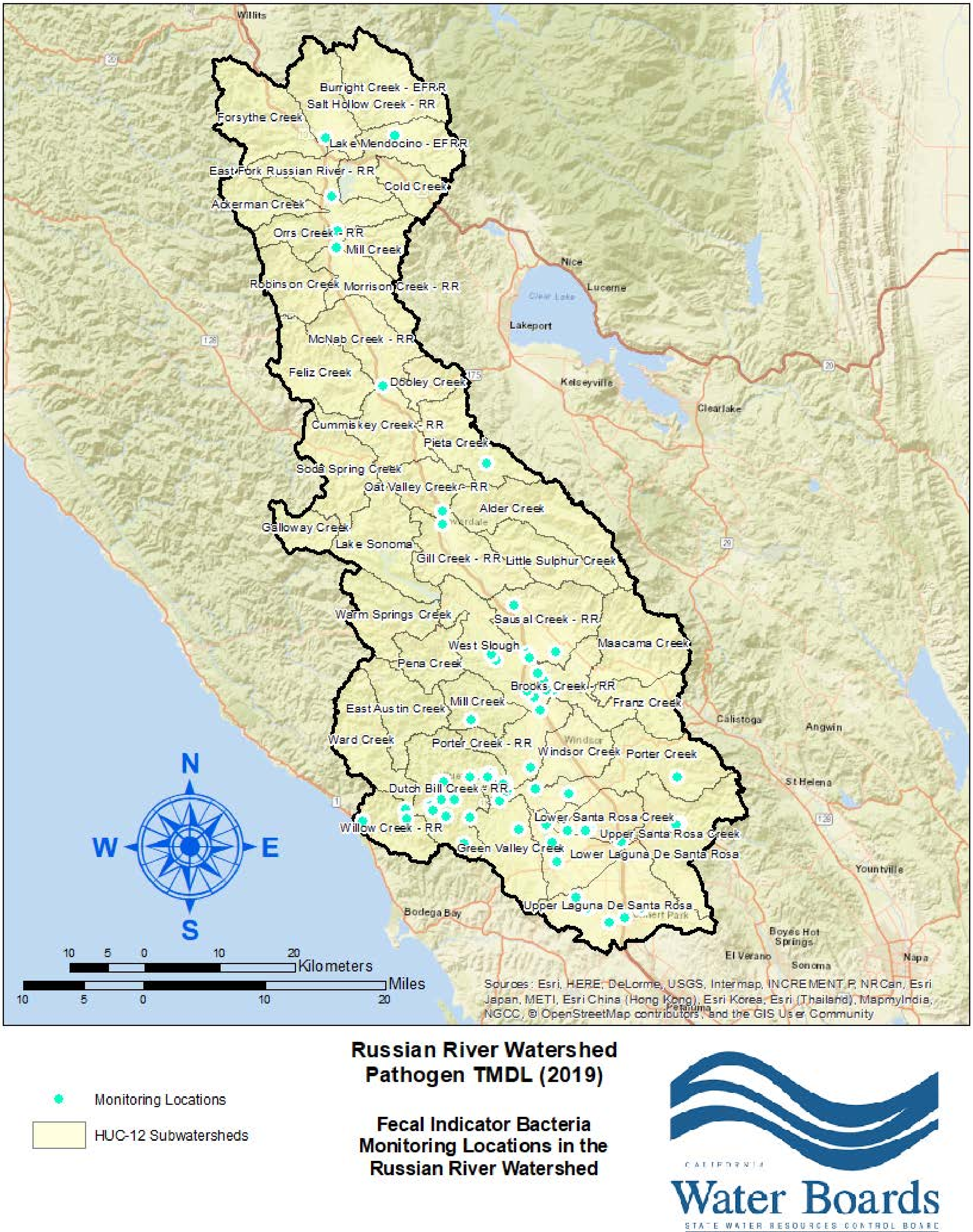

Figure 4.1 Fecal Indicator Bacteria Monitoring Locations

~~What follows is a summary of the findings from each of the assessment methods. The technical memoranda and monitoring reports detailing the methods and results of these studies can be found on the Regional Water Board website.~~

~~4.2 ASSESSMENT OF FECAL COLIFORM BACTERIA CONCENTRATIONS~~

~~As described in Chapter 3, the existing bacteria objective for the protection of REC-1 contained in the Basin Plan is based on fecal coliform and was established in 1975. Measured fecal coliform bacteria concentrations were used to assess whether the waterbody is supporting recreational (i.e., REC-1) beneficial use, based on the existing REC-1 bacteria objective. Regional Water Board staff has collected water samples to measure fecal coliform bacteria concentrations at several beaches and streams in the Russian River Watershed since 1980. Measured fecal coliform bacteria concentrations were compiled from four (4) recreation beaches on the Russian River (i.e., Camp Rose Beach, Healdsburg Veteran's Memorial Beach, Johnsons Beach, and Monte Rio Beach) and one tributary stream along a public park (i.e., Santa Rosa Creek at Railroad Street along the Prince Memorial Greenway).~~

~~Regional Water Board staff compared the compiled fecal coliform concentrations to the numeric Basin Plan water quality objectives (WQOs) (Butkus 2013c). Only 15 percent of the 30-day periods within the data record have an adequate number of fecal coliform concentration measurements for application of the two-part Basin Plan water quality objective (i.e., median and 90th percentile from a 30-day period), since the objective requires 5 samples collected within a 30-day period. Water samples were simply not collected frequently enough to provide a complete assessment of impairment to REC-1 using the Basin Plan WQO. For example, adequate water samples were not collected in Santa Rosa Creek to assess exceedance of the Basin Plan WQO. Nonetheless, based on those available data as shown in Table 4.1, all four beaches assessed showed at least one 30-day period that exceeded the water quality objective[15], with 37% of the measurements overall exceeding the water quality objective (Butkus 2013c).~~

~~Fecal coliform bacteria storm water samples are collected as a requirement of the Municipal Separate Storm Sewer Systems (MS4) permit for the City of Santa Rosa, County of Sonoma, and Sonoma County Water Agency. Single storm water samples were collected from Santa Rosa Creek upstream and downstream of the urban area. These single samples cannot be directly assessed with the Basin Plan Water Quality Objective for fecal coliform bacteria, which requires 5 samples collected in a 30-day period. However, the fecal coliform concentrations measured in Santa Rosa Creek during storm events range from 170 – 5,000,000 MPN/100mL. These very high concentrations supplement other evidence~~

~~[15] From the Basin Plan, the bacteria objectives reads "In waters designated for contact recreation (REC-1), the median fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed 50/100 ml, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 ml (State Department of Health Services)."~~

~~that Santa Rosa Creek is impaired due to high bacterial loads, especially during wet weather.~~

4.2 ASSESSMENT OF E. COLI BACTERIA CONCENTRATIONS

E. coli bacteria data from the Russian River Watershed were compiled from three agencies: the Regional Water Board, the Sonoma County Water Agency, and the University of California (UC) Davis Aquatic Ecosystems Analysis Laboratory. Sample locations are representative of the range of streams and rivers in the watershed. Water samples were collected at ~~29~~64 locations from 2001 to ~~2013~~2017 for analysis of *E. coli* bacteria concentrations (NCRWQCB 2012, 2013a, 2013b).

Water samples were analyzed by IDEXX Colilert and were either undiluted or serially diluted 1:10, resulting in a minimum reporting limit of 1 or 10 MPN/~~100mL~~100 mL and a maximum reporting limit of 2,419 or 24,196 MPN/100 mL. Sample measurements below and above analytical reporting limits are called censored data. When bacteria concentration results were beyond any of these limits, the reporting limit was substituted for censored data. ~~100mL.~~Originally, data were assessed using discrete 30-day periods ~~were~~ defined based on the Julian calendar date of each year (i.e., 30-day period 1 for Julian days 1-30; 30-day period 2 for Julian days 31-60, etc~~.).~~

~~Fecal waste pollution was determined using *E. coli* bacteria concentrations measured at each specific sampling location as compared to the draft~~ .), only. The statewide ~~*E. coli*~~ bacteria objective ~~for protection of REC-1. The draft statewide bacteria objective is~~ , however, specifies a rolling 6-week period to calculate the geometric mean ~~of 100 cfu/100mL and a statistical threshold value of 320 cfu/100mL, based on a public health outcome of now more than 32 illnesses per 1000 recreators and is more fully discussed in Chapter 3.~~. The ~~results of the assessment for *E. coli* bacteria concentrations for discrete 30-day averaging periods are presented in Figure 4.1 and Table 4.2.~~ *E. coli* data was reanalyzed applying the calculation method specified in the statewide objective. Findings were made based on geographic areas defined by HUC-12 boundaries and the exceedance frequency recommendations of the 303(d) Listing Policy.

The results of the assessment for *E. coli* bacteria concentrations are presented per HUC-12 in Table 4.2 and Figure 4.2. Table 4.2 shows the number of exceedances over the total number of data (or calculations) for both the geomean and the STV.

Table 4.2 *E. coli* Bacteria Data—Comparison of Results to Water Quality Objectives

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	6-week Rolling Geometric Mean[1]	30-day Statistical Threshold Value[1]
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-
		Cold Creek	-	-

Table 4.2 *E. coli* Bacteria Data—Comparison of Results to Water Quality Objectives

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	6-week Rolling Geometric Mean[1]	30-day Statistical Threshold Value[1]
		Lake Mendocino-East Fork Russian River	0/0	1/1
	Forsythe Creek Ukiah	Forsythe Creek	-	-
		Salt Hollow Creek-Russian River	0/0	0/1
		East Fork Russian River-Russian River	0/0	1/1
	Sulphur Creek	Little Sulphur Creek	-	-
		Alder Creek-Big Sulphur Creek	-	-
	Ukiah	Ackerman Creek	-	-
		Mill Creek	-	-
		Orrs Creek-Russian River	0/0	0/2
		Robinson Creek	-	-
		Morrison Creek-Russian River	-	-
		Dooley Creek	-	-
		McNab Creek-Russian River	-	-
		Feliz Creek	-	-
		Pieta Creek	-	-
		Cummisky Creek-Russian River	0/70	1/24
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	0/40	0/15
		Gill Creek-Russian River	0/13	0/3
		Sausal Creek-Russian River	0/91	5/38
		Franz Creek	-	-
		Maacama Creek	-	-
		Brooks Creek-Russian River	0/284	6/110
	Warm Springs	Galloway Creek	-	-
		Soda Spring Creek-Dry Creek	-	-
		Warm Springs Creek	-	-
		Lake Sonoma-Dry Creek	-	-
		Pena Creek	-	-
		Mill Creek	0/0	1/4
		West Slough-Dry Creek	0/0	**5/8**
	Laguna	**Upper Laguna de Santa Rosa**	0/0	**14/21**
		Lower Laguna de Santa Rosa	**7/17**	**7/10**
	Santa Rosa	**Upper Santa Rosa Creek**	0/0	**8/49**
		Lower Santa Rosa Creek	**55/57**	**50/93**
	Mark West	Windsor Creek	-	-
		Porter Creek-Mark West Creek	**4/6- Summer**	1/7
Lower Russian River	Guerneville	East Austin Creek	-	-
		Ward Creek-Austin Creek	-	-
		Green Valley Creek	**8/19**	**10/17**
		Porter Creek-Russian River	**6/6 – Winter**	**7/59**
		Dutch Bill Creek-Russian River	1/369	**8/18 - Winter**
		Willow Creek-Russian River[2]	0/0	1/1

* Locations that exceed the ~~draft statewide bacteria~~water quality objectives are shown in **Bold** font.
[1] The ratio shown represents the number of calculations that exceed either the geometric mean (100 cfu/100 mL) or the statistical threshold value (320 cfu/100 mL) over the total number of geomeans or STVs that were

calculated. A minimum of 5 samples are required to calculate year round or winter impairment and a minimum of 3 samples to calculate summer impairment.
[2] As per the statewide bacteria objective, saline waters are those in which salinity exceeds 1 part per thousand more than 5% of the time during the calendar year. The Jenner Boat Launch meets this salinity threshold; the statewide enterococci objective is applied in the Willow Creek-Russian River HUC-12.

The data show that of the 43 HUC-12s within the Russian River Watershed, *E. coli* concentrations were measured in 20 of them. Only 14 of the HUC-12s had a sufficient number of data, as per the 303(d) Listing Policy, to calculate exceedances. Nine of these exceeded the water quality objective at a frequency consistent with the 303(d) Listing Policy so as to be identified as impaired. These 9 impaired HUC-12s include: West Slough-Dry Creek, Upper Laguna de Santa Rosa, Lower Laguna de Santa Rosa, Upper Santa Rosa Creek, Lower Santa Rosa Creek, Porter Creek-Mark West Creek, Green Valley Creek, Porter Creek-Russian River, and Dutch Bill Creek-Russian River.

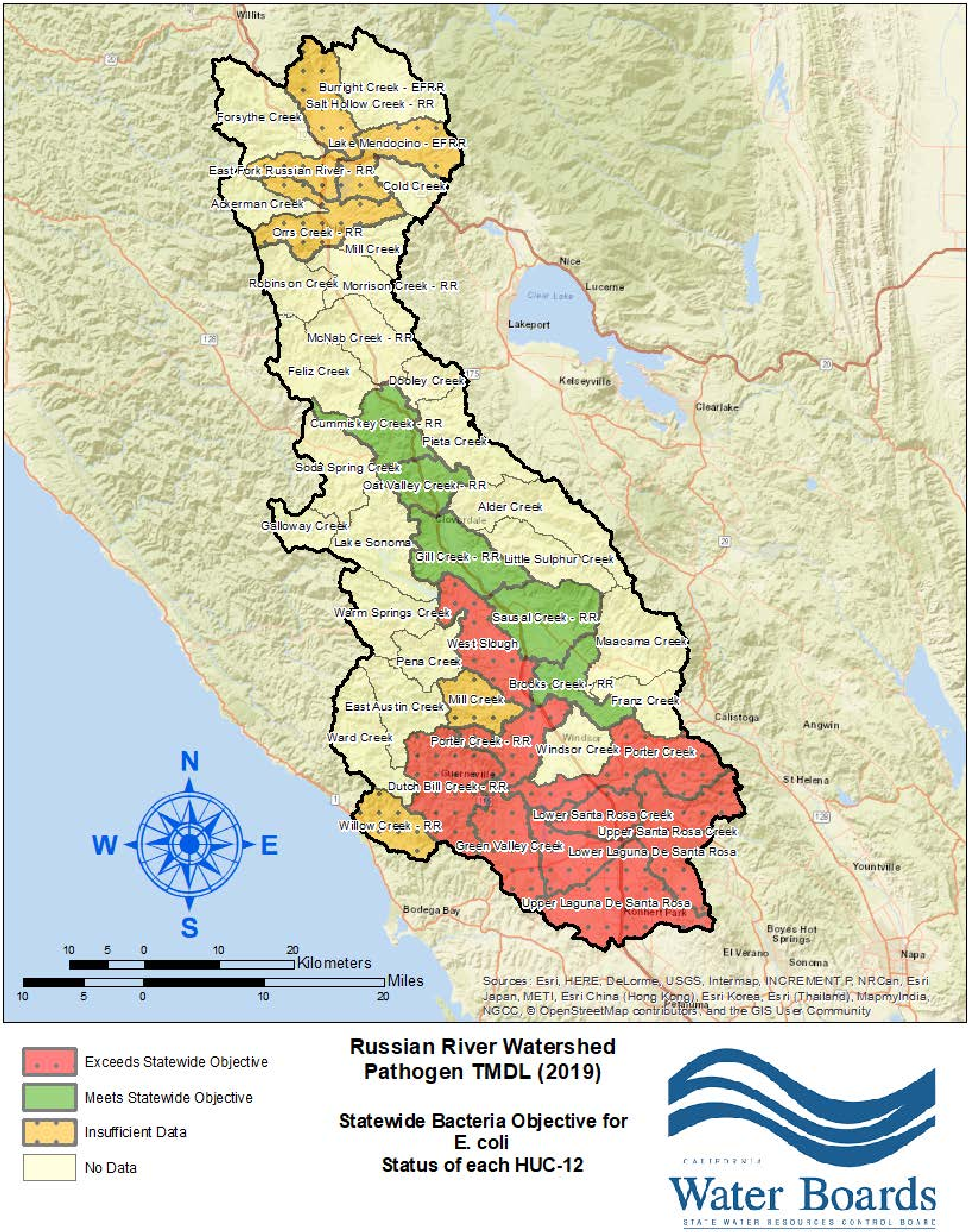

Figure 4.2: Exceedances Of Bacteria Objectives For E. Coli

4.~~4~~3 ASSESSMENT OF ENTEROCOCCI BACTERIA CONCENTRATIONS

Enterococci bacteria data from the Russian River Watershed were compiled from three agencies: the Regional Water Board, the Sonoma County Water Agency, and the University of California (UC) Davis Aquatic Ecosystems Analysis Laboratory. Sample locations are representative of the range of streams and rivers in the watershed. Water samples were collected at 29 locations from 2001 to 2013 for analysis of enterococci bacteria concentrations (NCRWQCB 2012, 2013a, 2013b).

Water samples were analyzed by IDEXX Enterolert and were either undiluted or serially diluted 1:10, resulting in a minimum reporting limit of 1 or 10 MPN/~~100mL~~100 mL and a maximum reporting limit of 2,419 or 24,196 MPN/100 mL. Sample measurements below and above analytical reporting limits are called censored data. When bacteria concentration results were beyond any of these limits, the reporting limit was substituted for censored data. ~~100mL.~~For the most part, data were assessed using a static/discrete 30-day averaging approach~~ (Butkus 2013b).~~. Discrete 30-day periods were defined based on the Julian calendar date of each year (i.e., 30-day period 1 for Julian days 1-30; 30-day period 2 for Julian days 31-60, etc.). For enterococci data collected from locations meeting the salinity threshold of the statewide bacteria objective for saline waters, the geometric mean was calculated as a rolling 6-week average, as specified by the State Water Board. Data in the Willow Creek HUC-12 (i.e., the estuary) were treated this way. The national criteria for enterococci are set as a geometric mean (30 cfu/100 mL) or the statistical threshold value (110 cfu/100 mL) to ensure no more than 32 illnesses per 1000 recreators, as defined by U.S. EPA (2012).

~~Enterococci bacteria concentrations measured at each specific sampling location were assessed using the enterococci criteria of the geometric mean (30 cfu/100mL) or the statistical threshold value (110 cfu/100mL) for 32 illnesses per 1000 recreators. These criteria are taken from U.S. EPA (2012), which establishes fecal indicator bacteria criteria based on *E. coli* and enterococci bacteria for the protection of public health in freshwater streams. While the draft statewide bacteria objective is based on the *E. coli* criteria established in U.S. EPA (2012), only~~While the statewide bacteria objective for freshwater is based on *E. coli*, one of the scientific peer reviewers of this project strongly recommended use of U.S. EPA (2012) enterococci bacteria criteria in freshwater because of the strength of the epidemiological relationships. For this TMDL, any findings of pollution/impairment derived from assessment of enterococci data in freshwaters required a second line of evidence of potential pathogen exposure, namely public health advisories for recreational beaches. Use of enterococci bacteria in freshwater as a line of evidence in this project affirms the importance of scientific peer review, strengthens the conclusions regarding fecal waste pollution, and is allowed under state law. Though, record of a public health advisory for a recreational beach alone would be sufficient evidence of beneficial use impairment. The results of the assessment for enterococci bacteria concentrations are presented in Figure 4.~~2~~3 and Table 4.3~~ for discrete 30-day averaging periods~~.

Of the 43 HUC-12s in the Russian River Watershed, enterococci concentrations were measured in 20 of them. Of these, 14 HUC-12s had sufficient data, as per the 303(d) Listing Policy, to calculate exceedances. All 14 showed rates of exceedance above the exceedance frequencies recommended in the 303(d) Listing Policy. These include: Cummisky Creek-Russian River, Oat Valley Creek-Russian River, Sausal Creek-Russian River, Brooks Creek-Russian River, West Slough-Dry Creek, Upper Laguna de Santa Rosa, Lower Laguna de Santa Rosa, Upper Santa Rosa Creek, Lower Santa Rosa Creek, Porter Creek-Mark West Creek, Green Valley Creek, Porter Creek-Russian River, Dutch Bill Creek-Russian River, and Willow Creek-Russian River. The Willow Creek HUC-12 data was compared to the statewide objective for enterococci due to its applicability based on salinity data, thereby apply the 6 week rolling average geomean.

Table 4.3 Enterococci Bacteria Data in the Russian River

Enterococcus results for freshwaters are compared to U.S. EPA Criteria

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	4 week Static Geometric Mean[1]	30-day Statistical Threshold Value[1]
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-
		Cold Creek	-	-
		Lake Mendocino-East Fork Russian River	0/0	1/1
	Forsythe Creek Ukiah	Forsythe Creek	-	-
		Salt Hollow Creek-Russian River	1/1	0/1
		East Fork Russian River-Russian River	0/0	1/1
	Sulphur Creek	Little Sulphur Creek	-	-
		Alder Creek-Big Sulphur Creek	-	-
	Ukiah	Ackerman Creek	-	-
		Mill Creek	-	-
		Orrs Creek-Russian River	0/2	0/2
		Robinson Creek	-	-
		Morrison Creek-Russian River	-	-
		Dooley Creek	-	-
		McNab Creek-Russian River	-	-
		Feliz Creek	-	-
		Pieta Creek	-	-
		Cummisky Creek-Russian River	**14/27**	**6/27**
Middle Russian River	Geyserville	**Oat Valley Creek-Russian River**	**7/17**	2/17
		Gill Creek-Russian River	1/3	2/3
		Sausal Creek-Russian River	**18/42**	**14/42**
		Franz Creek	-	-
		Maacama Creek	-	-
		Brooks Creek-Russian River	**19/87**	**10/87**
	Warm Springs	Galloway Creek	-	-
		Soda Spring Creek-Dry Creek	-	-
		Warm Springs Creek	-	-
		Lake Sonoma-Dry Creek	-	-
		Pena Creek	-	-
		Mill Creek	4/4	2/4

Table 4.3 Enterococci Bacteria Data in the Russian River

Enterococcus results for freshwaters are compared to U.S. EPA Criteria

		West Slough-Dry Creek	**17/18**	**15/18**
	Laguna	**Upper Laguna de Santa Rosa**	**19/20**	**16/20**
		Lower Laguna de Santa Rosa	**14/17**	**13/17**
	Santa Rosa	**Upper Santa Rosa Creek**	**10/11**	**9/11**
		Lower Santa Rosa Creek	**37/42**	**29/42**
	Mark West	Windsor Creek	-	-
		Porter Creek-Mark West Creek	**5/7**	3/7
Lower Russian River	Guerneville	East Austin Creek	-	-
		Ward Creek-Austin Creek	-	-
		Green Valley Creek	**13/18**	**14/18**
		Porter Creek-Russian River	**14/50**	**9/50**
		Dutch Bill Creek-Russian River	**42/137**	**36/137**
		Willow Creek-Russian River	5/66	**7/32**

* Locations that exceed the water quality standards are shown in **Bold** font
[1] The ratio shown represents the number of calculations that exceed either the geometric mean (100 cfu/100 mL) or the statistical threshold value (320 cfu/100 mL) over the total number of geomeans or STVs that were calculated. A minimum of 5 samples are required to calculate year round or winter impairment and a minimum of 3 samples to calculate summer impairment.
[2] The statewide bacteria objective includes a geomean and STV for enterococci, which applies to saline waters. Saline waters are those in which salinity exceeds 1 part per thousand more than 5% of the time during the calendar year. The Jenner Boat Launch meets this salinity threshold; the enterococci objective (e.g., geomean calculated on a 6 week rolling basis) is applied in the Willow Creek-Russian River HUC-12.

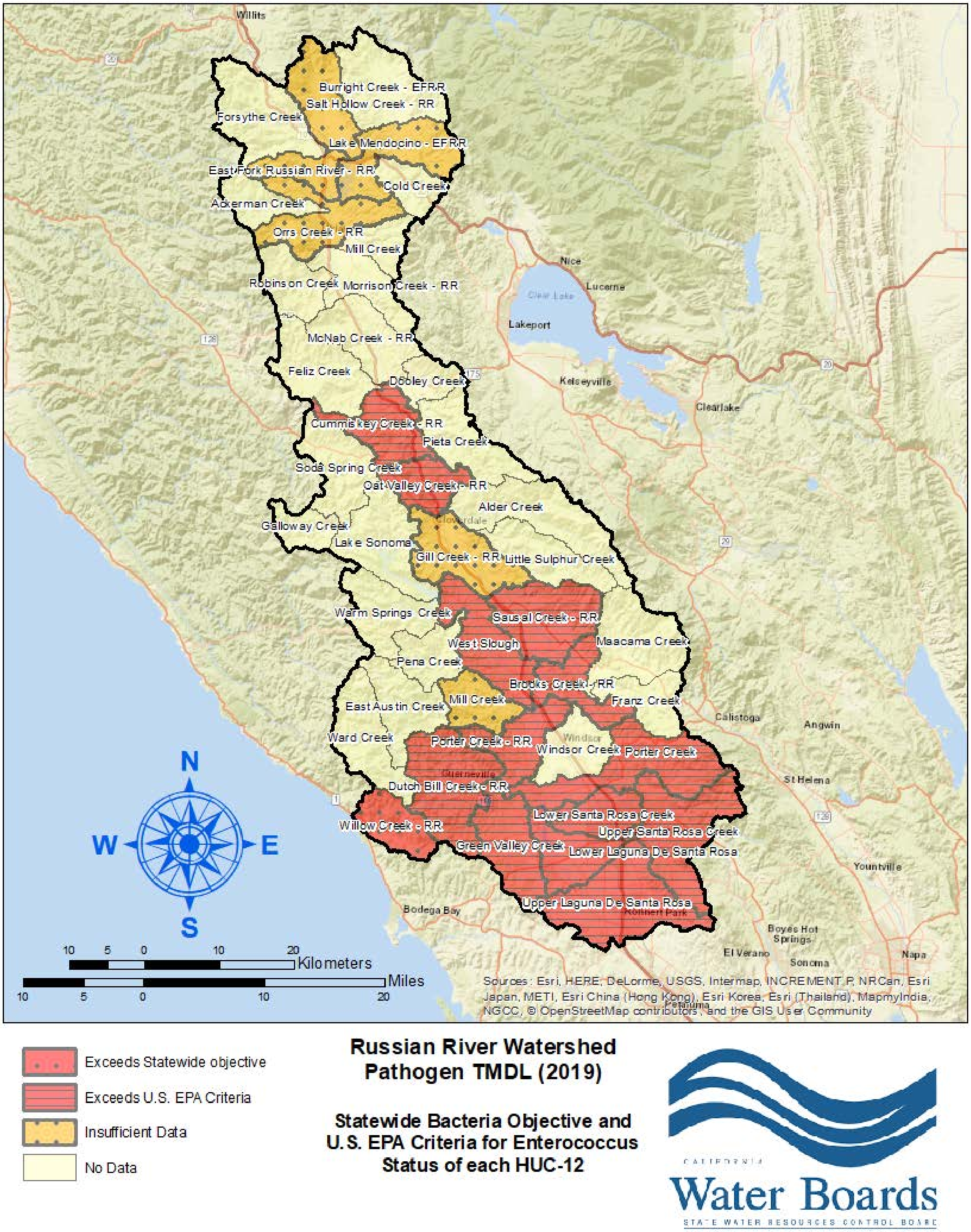

Figure 4.3: Exceedances Of Bacteria Objectives For Enterococcus

4.4 ASSESSMENT OF BACTEROIDES BACTERIA CONCENTRATIONS

Regional Water Board staff collected water samples for measurement of human-specific and bovine-specific *Bacteroides* bacteria at numerous locations in the Russian River Watershed from 2011 to 2013 (NCRWQCB 2012; NCRWQCB 2013a; NCRWQCB 2013b). Sample locations represent the range of streams and rivers in the watershed. Staff collected samples from waterbodies during both wet and dry periods and from a range of flows. Sample sites were located in waterbodies that drain the wide range of land uses (from urban to undeveloped) and geomorphic features (from bedrock to alluvial landscapes) in the watershed.

Bacteroides bacteria are a suitable indicator of a waterbody's bacteriological quality since the bacteria come from the gastrointestinal systems of mammals, they degrade rapidly outside of the body, and technology is available to trace the bacteria back to specific types of animals, including humans and domestic animals.

Human-specific and bovine-specific *Bacteroides* bacteria data were compared to the current laboratory reporting limit of 60 gene copies/~~100mL~~100 mL for human-specific *Bacteroides* and 30 gene copies/~~100mL~~100 mL for bovine-specific *Bacteroides*. Any measurements above the reporting limit indicate a~~ high~~ likelihood that fecal waste material is present and the bacteriological quality of the water has been degraded. Human-specific *Bacteroides* were analyzed with the HuBac genetic marker and the Bovine-specific *Bacteroides* were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B. ~~The median concentrations of human-specific Bacteroides measured at each location in the Russian River Watershed are shown in Figure 4.3 and listed in Table 4.4 for the Russian River mainstem and Table 4.5 for Russian River tributaries. The median concentrations of bovine-specific *Bacteriodes* measured at each location in the Russian River Watershed are shown in Figure 4.4 and listed in Table 4.6 for the Russian River mainstem and Table 4.7 for Russian River tributaries~~Staff were unable to identify a well-accepted threshold for *Bacteroides* that relates to public health protection. For reporting purposes the median concentrations of human-specific and bovine-specific *Bacteroides* measured at each location in the mainstem Russian River Watershed and tributaries are shown in Figures 4.4 and 4.5 and listed in Tables 4.4 and 4.5, respectively. The HUC-12s generally can be stratified based on the order of magnitude of median *Bacteroides* concentration with the lowest concentrations (e.g., 10-100 gene copies/100 mL) indicating weak evidence and the highest concentrations (>10,000 gene copies/100 mL) indicating very strong evidence of water quality degradation. As a general recommendation, those HUC-12s with the highest median *Bacteroides* concentrations should be considered for additional monitoring, as necessary. High concentrations of human-specific *Bacteroides* bacteria indicate the presence in the respective HUC-12 of human fecal sources requiring control. High concentrations of bovine-specific *Bacteroides* bacteria indicate the presence in the respective HUC-12 of bovine fecal sources requiring control.

Assessment of the human-specific *Bacteroides* bacteria data shows that bacteria from human waste are widespread throughout the Russian River Watershed. Human-specific *Bacteroides* bacteria are present at levels that exceed the current laboratory reporting limit (60 gene copies/100mL for human-specific *Bacteroides*) in all 17 mainstem locations, and in all but one of the 35 tributary locations sampled by Regional Water Board staff. Of the 179 samples collected in these 52 sites, 95% of the samples exceed the analytical reporting limit, meaning that 95% of the samples contain detectable levels of human~~waste.~~ -source *Bacteroides* bacteria. Of the 43 HUC-12 subwatersheds in the Russian River watershed, human-specific *Bacteroides* bacteria data were collected in 17 of them. All HUC-12 median values (e.g., 17 of 17) exceeded 500 gene copies/100 mL. 15 of 17 HUC-12 median values exceeded 1,000 gene copies/100 mL. 4 of 17 HUC-12 median values exceeded 10,000 gene copies/100 ml. Table 4.4 and Figure 4.4 summarize these results.

Table 4.4 Human-specific *Bacteroides* in the Russian River

Human-specific *Bacteroides* were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Median Human-specific *Bacteroides* (gene copies/100 mL)[1]	Number of *Bacteroides* measurements
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-
		Cold Creek	-	-
		Lake Mendocino-East Fork Russian River	5,949	3
	Forsythe Creek Ukiah	Forsythe Creek	-	-
		Salt Hollow Creek-Russian River	979	3
		East Fork Russian River-Russian River	3,275	3
	Sulphur Creek	Little Sulphur Creek	-	-
		Alder Creek-Big Sulphur Creek	-	-
	Ukiah	Ackerman Creek	-	-
		Mill Creek	-	-
		Orrs Creek-Russian River	**10,548**	**6**
		Robinson Creek	-	-
		Morrison Creek-Russian River	-	-
		Dooley Creek	-	-
		McNab Creek-Russian River	-	-
		Feliz Creek	-	-
		Pieta Creek	-	-
		Cummisky Creek-Russian River	1,898	5
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	1087	2
		Gill Creek-Russian River	573	3
		Sausal Creek-Russian River	5,560	17
		Franz Creek	-	-
		Maacama Creek	-	-
		Brooks Creek-Russian River	8,053	25
	Warm Springs	Galloway Creek	-	-
		Soda Spring Creek-Dry Creek	-	-
		Warm Springs Creek	-	-
		Lake Sonoma-Dry Creek	-	-

Table 4.4 Human-specific *Bacteroides* in the Russian River

Human-specific *Bacteroides* were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Median Human-specific *Bacteroides* (gene copies/100 mL)[1]	Number of *Bacteroides* measurements
		Pena Creek	-	-
		Mill Creek	-	-
		West Slough-Dry Creek	4,040	5
	Laguna	Upper Laguna de Santa Rosa	-	-
		Lower Laguna de Santa Rosa	7,469	2
	Santa Rosa	Upper Santa Rosa Creek	2,727	2
		Lower Santa Rosa Creek	**32,909**	**2**
	Mark West	Windsor Creek	-	-
		Porter Creek-Mark West Creek	-	-
Lower Russian River	Guerneville	East Austin Creek	-	-
		Ward Creek-Austin Creek	-	-
		Green Valley Creek	**17,016**	**2**
		Porter Creek-Russian River	**48,200**	**7**
		Dutch Bill Creek-Russian River	4,750	59
		Willow Creek-Russian River	3,781	3

[1] HUC-12 subwatersheds, where the median number of gene copies of human-specific *Bacteroides* per 100 mL exceed a threshold of 10,000 are highlighted in **bold** font. These are HUC-12 subwatersheds with strong evidence of the presence of human fecal waste in surface waters.

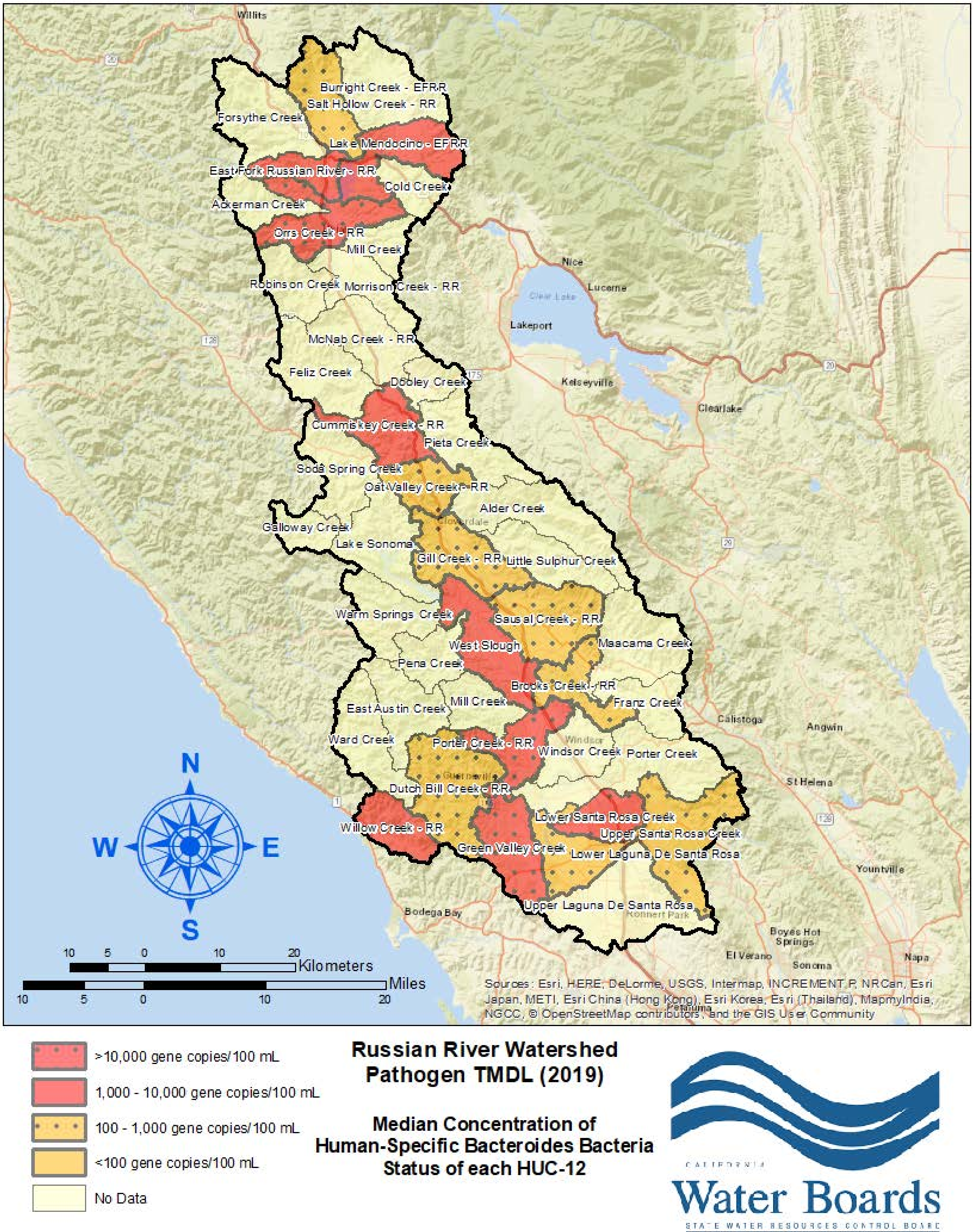

Figure 4.4: Median Concentration Of Human-Specific Bacteroides

For bovine-specific *Bacteroides* bacteria, quantifiable levels were found in all 11 mainstem locations, and in all but one of the 19 tributary locations sampled. Of the 83 samples collected, 95% of the samples also exceed the analytical reporting limit (30 gene copies/100mL for bovine-specific *Bacteroides*), meaning that 95% of the samples contain detectable levels of bovine ~~waste~~source *Bacteroides* bacteria.

Of the 43 HUC-12 subwatersheds, 11 HUC-12s were sampled for bovine-specific *Bacteroides* bacteria. All but Green Valley Creek HUC-12 showed median concentrations exceeding 100 gene copies/100 mL. 4 of the 11 HUC-12 subwatersheds sampled showed median concentrations exceeding 1,000 gene copies/100 mL, and Porter Creek-Russian River HUC-12 showed median concentrations of 23,684 gene copies/100 mL. The higher the median concentration of bovine-specific *Bacteroides* bacteria, the greater the certainty that discharges of bovine fecal waste occur within the identified HUC-12 subwatershed. Table 4.5 and Figure 4.5 summarize these data.

Table 4.5 Bovine-specific *Bacteroides* in the Russian River

Bovine-specific *Bacteroides* were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Median Bovine-specific *Bacteroides* (gene copies/100 mL)[1]	Number of *Bacteroides* measurements
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-
		Cold Creek	-	-
		Lake Mendocino-East Fork Russian River	-	-
	Forsythe Creek Ukiah	Forsythe Creek	-	-
		Salt Hollow Creek-Russian River	-	-
		East Fork Russian River-Russian River	-	-
	Sulphur Creek	Little Sulphur Creek	-	-
		Alder Creek-Big Sulphur Creek	-	-
	Ukiah	Ackerman Creek	-	-
		Mill Creek	-	-
		Orrs Creek-Russian River	-	-
		Robinson Creek	-	-
		Morrison Creek-Russian River	-	-
		Dooley Creek	-	-
		McNab Creek-Russian River	-	-
		Feliz Creek	-	-
		Pieta Creek	-	-
		Cummisky Creek-Russian River	5,413	2
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	710	2
		Gill Creek-Russian River	-	-
		Sausal Creek-Russian River	175	4
		Franz Creek	-	-
		Maacama Creek	-	-
		Brooks Creek-Russian River	286	4
	Warm Springs	Galloway Creek	-	-

Table 4.5 Bovine-specific *Bacteroides* in the Russian River

Bovine-specific *Bacteroides* were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Median Bovine-specific *Bacteroides* (gene copies/100 mL)[1]	Number of *Bacteroides* measurements
		Soda Spring Creek-Dry Creek	-	-
		Warm Springs Creek	-	-
		Lake Sonoma-Dry Creek	-	-
		Pena Creek	-	-
		Mill Creek	-	-
		West Slough-Dry Creek	-	-
	Laguna	Upper Laguna de Santa Rosa	-	-
		Lower Laguna de Santa Rosa	272	2
	Santa Rosa	Upper Santa Rosa Creek	181	2
		Lower Santa Rosa Creek	7,765	2
	Mark West	Windsor Creek	-	-
		Porter Creek-Mark West Creek	-	-
Lower Russian River	Guerneville	East Austin Creek	-	-
		Ward Creek-Austin Creek	-	-
		Green Valley Creek	72	2
		Porter Creek-Russian River	**23,684**	**2**
		Dutch Bill Creek-Russian River	133	24
		Willow Creek-Russian River	2,682	2

[1] HUC-12 subwatersheds, where the median number of gene copies of bovine-specific *Bacteroides* per 100 mL exceed a threshold of 10,000 are highlighted in **bold** font. These are HUC-12 subwatersheds with good evidence that bovine fecal waste has been discharged.

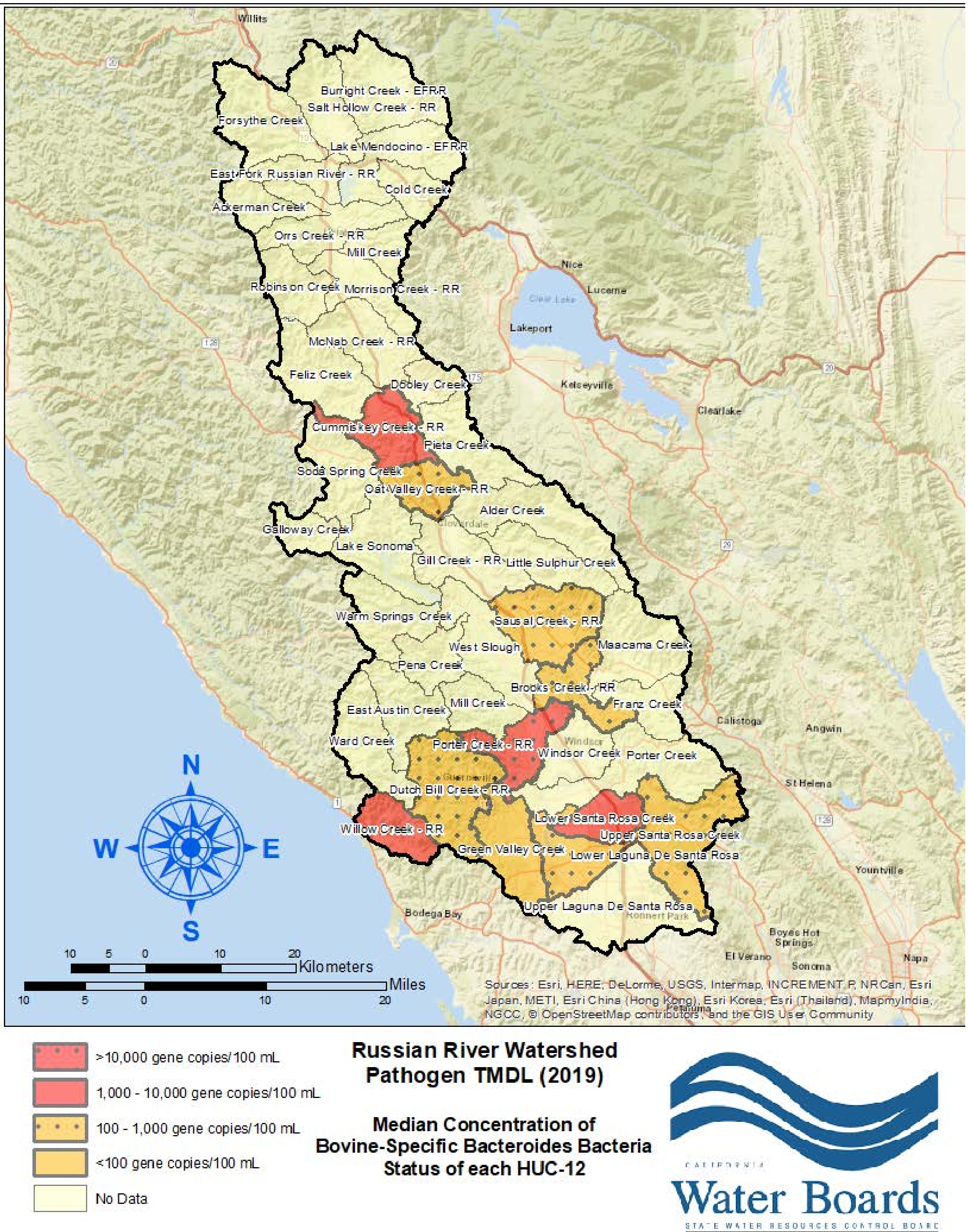

Figure 4.5: Median Concentration Of Bovine-Specific Bacteroides

4.5 MICROBIOLOGICAL SOURCE IDENTIFICATION

Regional Water Board staff conducted a monitoring study to attribute the animal sources of fecal waste to elevated fecal indicator bacteria concentrations in surface waters of the Russian River Watershed from 2011 to 2013 (NCRWQCB 2012, 2013a, 2013b, 2013c). The monitoring study included microbiological source identification in the watershed. Over one hundred samples were analyzed during this study by the Lawrence Berkeley National Laboratory using the PhyloChip™ phylogenetic DNA microarray in order to estimate the percentages of bacteria in water samples that matched DNA profiles for reference fecal waste sources. The analysis methods and results (Dubinsky and Anderson 2014) are summarized in this section and ~~in a memo to the file record (Butkus 2014a), which~~ can be found on the Regional Water Board website. Dubinsky and Anderson (2014) recommend a threshold of 20% DNA match as significant. The results of the study help to determine whether human or grazer fecal waste is the likely source of exceedances of the ~~draft~~ statewide *E. coli* objective or U.S. EPA (2012) enterococci criteria, at those locations where exceedances were measured. Also, the results provide another line of evidence of fecal waste pollution, distinguishing between anthropogenic and natural sources of fecal waste.

4.5.1 METHODS

The Lawrence Berkeley National Laboratory collected, composited, and cataloged specific DNA profiles of fecal waste from humans, grazing mammals, and birds. This library of DNA profiles included human waste samples from raw sewage, septic waste, and feces. The DNA profile for grazing mammals included samples of droppings from cows, horses, deer, and elk. The profile for birds included samples of droppings from gulls and pelicans. Water samples from the Russian River Watershed were then compared to the library of DNA profiles from known human, grazer, and bird wastes to determine the percentage of bacteria DNA gene sequences that matched the known profiles.

Regional Water Board staff collected multiple water samples from monitoring locations in the Russian River Watershed during both wet and dry seasons in order to analyze for *E. coli*, enterococci, and *Bacteroides* bacteria, as well as DNA profiles. Sets of all samples were analyzed for E. c*oli*, enterococci, and *Bacteroides* bacteria. However, due to cost, not all water samples were immediately analyzed to assess for fecal DNA profile. Instead, a set of each water sample collected was frozen to be analyzed later using the phylogenetic DNA microarray. Frozen water samples were later thawed and analyzed using the phylogenetic DNA microarray when any of the other fecal bacteria measurements were shown to be elevated.

4.5.2 RESULTS

~~There is a wide range~~Presented in Tables 4.6, 4.7, and 4.8 below are summaries of ~~human fecal waste DNA matches found in~~ the ~~Russian River and its tributaries.~~ PhyloChip™ results for human, grazer, and bird fecal waste sources, respectively. These summary tables present the maximum and median gene sequence percent match per HUC-12 subwatershed. Sample locations where the gene sequence percent match exceeds 20% represent locations where a source of fecal waste ~~are mapped in Figure 4.5, based on percent~~ requires control. HUC-12 subwatersheds where the median gene sequence percent match exceeds 20% represents a subwatershed where relevant activities require control. Please note that only 15 of the 43 HUC-12 subwatersheds were measured using the PhyloChip™ DNA microarray technique.

Of the 15 HUC-12 subwatersheds monitored using the PhyloChip™ DNA ~~match. The ten locations with the highest~~ microarray technique, 4 contained locations where the median human gene sequence percent match exceeds 20%, indicating sources of human fecal waste ~~measured are shown in Table 4.7. The highest percent matches are found in the~~ that require control. These include Upper Laguna de Santa Rosa ~~and the Guerneville Hydrologic Subareas in the lower~~, Lower Santa Rosa Creek, Porter Creek-Russian River, and Dutch Bill Creek-Russian River. ~~For example, in water samples collected in an unnamed stream in Monte Rio at Foothill Drive, 89% of the measured~~ Similarly, these same HUC-12 subwatersheds contained locations with evidence that grazer fecal waste requires control. Of these, Lower Santa Rosa Creek and Porter Creek-Russian River HUC-12 subwatersheds also contain bovine-specific *Bacteroides* bacteria ~~DNA gene~~ concentrations at levels that indicate that bovine species are the source of the grazer fecal waste requiring control. Further, the PhyloChip™ data indicates that the Upper Laguna de Santa Rosa HUC-12 as a whole requires efforts to control grazer fecal waste discharge.

Exceedances of *E. coli* bacteria objectives can sometimes be caused by high concentrations of bird fecal waste. To assess this possible source as a cause of *E. coli* exceedances, the PhyloChip™ assessment included measurement of bird gene sequences ~~match known human waste~~. None of the HUC-12 subwatersheds measured showed bird gene sequences~~.~~ exceeding the 20% threshold, though the Lower Santa Rosa Creek HUC-12 contained a sample location measuring 19% bird fecal waste match.

Table 4.6 Bacteria DNA sequences – Human Fecal Waste

Human fecal waste were analyzed using PhyloChip

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Max of Gene Sequence Percent Match[1]	Median of Gene Sequence Percent Match	Number of Gene Sequence Measurements
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-	-
		Cold Creek	-	-	-
		Lake Mendocino-East Fork Russian River	-	-	-
	Forsythe Creek Ukiah	Forsythe Creek	-	-	-
		Salt Hollow Creek-Russian River	-	-	-
		East Fork Russian River-Russian River	-	-	-
	Sulphur Creek	Little Sulphur Creek	-	-	-
		Alder Creek-Big Sulphur Creek	-	-	-
	Ukiah	Ackerman Creek	-	-	-
		Mill Creek	-	-	-

Table 4.6 Bacteria DNA sequences – Human Fecal Waste

Human fecal waste were analyzed using PhyloChip

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Max of Gene Sequence Percent Match[1]	Median of Gene Sequence Percent Match	Number of Gene Sequence Measurements
		Orrs Creek-Russian River	-	-	-
		Robinson Creek	-	-	-
		Morrison Creek-Russian River	-	-	-
		Dooley Creek	-	-	-
		McNab Creek-Russian River	-	-	-
		Feliz Creek	-	-	-
		Pieta Creek	-	-	-
		Cummisky Creek-Russian River	1	0.5	2
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	1	1	2
		Gill Creek-Russian River	-	-	-
		Sausal Creek-Russian River	5	2	8
		Franz Creek	-	-	-
		Maacama Creek	-	-	-
		Brooks Creek-Russian River	10	2	8
	Warm Springs	Galloway Creek	-	-	-
		Soda Spring Creek-Dry Creek	-	-	-
		Warm Springs Creek	-	-	-
		Lake Sonoma-Dry Creek	-	-	-
		Pena Creek	-	-	-
		Mill Creek	6	4	2
		West Slough-Dry Creek	16	5	5
	Laguna	**Upper Laguna de Santa Rosa**	**24**	10	10
		Lower Laguna de Santa Rosa	9	1	4
	Santa Rosa	Upper Santa Rosa Creek	5	3	2
		Lower Santa Rosa Creek	**32**	6	8
	Mark West	Windsor Creek	-	-	-
		Porter Creek-Mark West Creek	5	3	2
Lower Russian River	Guerneville	East Austin Creek	-	-	-
		Ward Creek-Austin Creek	-	-	-
		Green Valley Creek	1	1	2
		Porter Creek-Russian River	**54**	7	7
		Dutch Bill Creek-Russian River	**89**	2	36
		Willow Creek-Russian River	16	2	3

[1] HUC-12 subwatersheds, where the percent gene sequence match of a sample to a known source of fecal waste exceeds 20% are highlighted in **bold** font. These are HUC-12 subwatersheds with good evidence that human fecal waste has been discharged in amounts requiring further monitoring and/or control.

Table 4.7 Bacteria DNA sequences – Grazer Fecal Waste

Grazer fecal waste were analyzed using PhyloChip

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Max of Gene Sequence Percent Match[1]	Median of Gene Sequence Percent Match	Number of Gene Sequence Measurements
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-	-
		Cold Creek	-	-	-
		Lake Mendocino-East Fork Russian River	-	-	-
	Forsythe Creek Ukiah	Forsythe Creek	-	-	-
		Salt Hollow Creek-Russian River	-	-	-
		East Fork Russian River-Russian River	-	-	-
	Sulphur Creek	Little Sulphur Creek	-	-	-
		Alder Creek-Big Sulphur Creek	-	-	-
	Ukiah	Ackerman Creek	-	-	-
		Mill Creek	-	-	-
		Orrs Creek-Russian River	-	-	-
		Robinson Creek	-	-	-
		Morrison Creek-Russian River	-	-	-
		Dooley Creek	-	-	-
		McNab Creek-Russian River	-	-	-
		Feliz Creek	-	-	-
		Pieta Creek	-	-	-
		Cummisky Creek-Russian River	3	2	2
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	2	1	2
		Gill Creek-Russian River	-	-	-
		Sausal Creek-Russian River	14	2	8
		Franz Creek	-	-	-
		Maacama Creek	-	-	-
		Brooks Creek-Russian River	7	2	8
	Warm Springs	Galloway Creek	-	-	-
		Soda Spring Creek-Dry Creek	-	-	-
		Warm Springs Creek	-	-	-
		Lake Sonoma-Dry Creek	-	-	-
		Pena Creek	-	-	-
		Mill Creek	8	8	2
		West Slough-Dry Creek	6	3	5
	Laguna	**Upper Laguna de Santa Rosa**	**34**	**22**	10
		Lower Laguna de Santa Rosa	17	2	4
	Santa Rosa	Upper Santa Rosa Creek	6	3	2
		Lower Santa Rosa Creek	**36**	6	8
	Mark West	Windsor Creek	-	-	-
		Porter Creek-Mark West Creek	4	3	2
Lower Russian River	Guerneville	East Austin Creek	-	-	-
		Ward Creek-Austin Creek	-	-	-
		Green Valley Creek	5	3	2
		Porter Creek-Russian River	**20**	2	7
		Dutch Bill Creek-Russian River	**23**	2	36
		Willow Creek-Russian River	4	3	3

[1] HUC-12 subwatersheds, where the percent gene sequence match of a sample to a known source of fecal waste exceeds 20% are highlighted in **bold** font. These are HUC-12 subwatersheds with good evidence that grazer fecal waste has been discharged in amounts requiring further monitoring and/or control.

Table 4.8 Bacteria DNA sequences – Bird Fecal Waste

Bird fecal waste were analyzed using PhyloChip

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Max of Gene Sequence Percent Match	Median of Gene Sequence Percent Match	Number of Gene Sequence Measurements
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-	-
		Cold Creek	-	-	-
		Lake Mendocino-East Fork Russian River	-	-	-
	Forsythe Creek Ukiah	Forsythe Creek	-	-	-
		Salt Hollow Creek-Russian River	-	-	-
		East Fork Russian River-Russian River	-	-	-
	Sulphur Creek	Little Sulphur Creek	-	-	-
		Alder Creek-Big Sulphur Creek	-	-	-
	Ukiah	Ackerman Creek	-	-	-
		Mill Creek	-	-	-
		Orrs Creek-Russian River	-	-	-
		Robinson Creek	-	-	-
		Morrison Creek-Russian River	-	-	-
		Dooley Creek	-	-	-
		McNab Creek-Russian River	-	-	-
		Feliz Creek	-	-	-
		Pieta Creek	-	-	-
		Cummisky Creek-Russian River	3	3	1
Middle Russian River	Geyserville	Oat Valley Creek-Russian River	3	3	1
		Gill Creek-Russian River	-	-	-
		Sausal Creek-Russian River	-	-	-
		Franz Creek	-	-	-
		Maacama Creek	-	-	-
		Brooks Creek-Russian River	8	4	4
	Warm Springs	Galloway Creek	-	-	-
		Soda Spring Creek-Dry Creek	-	-	-
		Warm Springs Creek	-	-	-
		Lake Sonoma-Dry Creek	-	-	-
		Pena Creek	-	-	-
		Mill Creek	12	12	1
		West Slough-Dry Creek	11	6	3
	Laguna	Upper Laguna de Santa Rosa	10	8	5
		Lower Laguna de Santa Rosa	7	6	2
	Santa Rosa	Upper Santa Rosa Creek	7	7	1
		Lower Santa Rosa Creek	19	12	4
	Mark West	Windsor Creek	-	-	-
		Porter Creek-Mark West Creek	6	6	1
	Guerneville	East Austin Creek	-	-	-

Table 4.8 Bacteria DNA sequences – Bird Fecal Waste

Bird fecal waste were analyzed using PhyloChip

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	Max of Gene Sequence Percent Match	Median of Gene Sequence Percent Match	Number of Gene Sequence Measurements
Lower Russian River		Ward Creek-Austin Creek	-	-	-
		Green Valley Creek	-	-	-
		Porter Creek-Russian River	11	9	3
		Dutch Bill Creek-Russian River	10	6	13
		Willow Creek-Russian River	4	3	2

[1] HUC-12 subwatersheds, where the percent gene sequence match of a sample to a known source of fecal waste exceeds 20% are highlighted in **bold** font. These are HUC-12 subwatersheds with good evidence that bird fecal waste has been discharged in amounts requiring further monitoring and/or control.

4.6 ASSESSMENT OF PATHOGENIC SPECIES

Pathogenic bacteria and protozoans are occasionally measured directly without relying on indicator bacteria species, and the ability to do so is increasing with continuing advances in DNA technology. This section describes detections of pathogenic organisms and provides additional evidence of fecal waste pollution.

4.6.1 PATHOGENIC BACTERIA DETECTIONS

Regional Water Board staff collected water samples from 2011 to 2013 (NCRWQCB 2012, 2013a, 2013b). This monitoring focused on microbiological source identification in the middle and lower Russian River Watershed. As described above, over one hundred samples were analyzed by the Lawrence Berkeley National Laboratory using the PhyloChip™ phylogenetic DNA microarray, which evaluates 16S rRNA gene sequences to identify different bacteria taxa. Taxa were identified, but not quantified. The analysis results (Dubinsky and Anderson 2014) are summarized in this section and in a memo to the file record (Butkus 2014a).

Over 10,000 different bacteria taxa were identified in the samples from the Russian River Watershed. Most of the taxa detected are in the Actinobacteria phylum, Flavobacteria order, and Proteobacteria phylum of bacteria, which are naturally abundant in freshwater and soil, and do not likely originate from human or animal fecal waste sources. However, a substantial number of taxa in the Bacteroidia class, Clostridia class, Bacilli class, and Verrucomicrobia phylum of bacteria were also found in the samples. These taxa likely originate from fecal waste sources and individual pathogenic species are found within these taxa groups.

The human health risk associated with the presence of pathogenic bacteria is unknown since detection of a pathogenic species does not necessarily indicate that illness will occur. Some pathogenic bacteria are only pathogenic under certain circumstances, such as contact with an open wound. Additionally, there can be more than one strain of a particular bacterium species, and not all strains are pathogenic. The results of the PhyloChip™ analysis, as presented in Table 4.~~8~~9, show a list of bacteria species found in the Russian River Watershed that have the potential to be human pathogens and cause illness.

Table 4.9 Potential Human Pathogens Detected in the Russian River Watershed

Pathogenic Bacteria Species	Health Impact	Number of Locations with Detected Species		Percent of Samples with Detected Bacteria
		Mainstem	Tributaries	
Proteus mirabili	Urinary Tract Infections	1	10	11%
Salmonella enterica	Gastroenteritis	1	9	10%
Serratia marcescens	Infections, Pneumonia, Meningitis	3	27	41%
Shigella flexneri	Gastroenteritis	0	15	16%
Staphylococcus epidermidis	Infections	3	13	22%
Staphylococcus haemolyticus	Infections	2	0	2%
Yersinia sp.	Plague	4	7	15%

4.6.2 CRYPTOSPORIDIUM AND GIARDIA DETECTIONS

The Sonoma County Water Agency (SCWA) conducted monitoring for *Cryptosporidium* and *Giardia* oocysts in the Russian River near Wohler Bridge from 2004 through 2006 as part of their Sanitary Survey as shown in Table 4.~~9~~10 (Palencia & Archibald 2013). The SCWA found three *Giardia* cysts and five *Cryptosporidium* oocysts out of 660 L of water from 48 samples. *Giardia lamblia* and *Cryptosporidium parvum* are pathogens that can cause gastrointestinal illness. The low number of *Cryptosporidum* oocysts detected meant no additional treatment is needed for the drinking water collected from the Russian River near Wohler Road (71 FR 775).

Table 4.10 Cryptosporidium and Giardia Detections in the Russian river near Wohler Bridge
(data from Palencia and Archibald, 2013)

Collection Date	*Cryptosporidium* (oocysts/L)	*Giardia* (cysts/L)
3/9/2004	0.1	-
5/18/2004	-	0.1

Table 4.10 Cryptosporidium and Giardia Detections in the Russian river near Wohler Bridge
(data from Palencia and Archibald, 2013)

Collection Date	*Cryptosporidium* (oocysts/L)	*Giardia* (cysts/L)
12/26/2004	0.2	-
3/2/2005	0.1	0.1
3/23/2005	0.1	-
8/8/2005	0.1	0.1
1/10/2006	-	0.1

~~4.7 SECTION 303(D) IMPAIRED WATER LISTINGS~~

~~The 2012 Section 303(d) List of Impaired Waters was approved by the Regional Water Board on August 14, 2014 and State Water Board on April 8, 2015. The list was approved by U.S. EPA on July 30, 2015.[16] The List identifies six waterbody-pollutant pairs in the Russian River Watershed as not attaining the Bacteria Water Quality Objective and therefore, not supporting the REC-1 beneficial use. In order to determine whether a waterbody should be listed as impaired on the 2012 Section 303(d) List, instream measurements of *E. coli* and fecal coliform bacteria concentrations collected and submitted prior to August 2010 were assessed. The data used in the listing decisions is available online at . The data assessment supporting the listings provides a line of evidence of fecal waste pollution and pathogen impairment in the Russian River Watershed. The listed waterbodies include the Russian River at Veterans Memorial Beach, Russian River reach between the confluences of Fife Creek in Guerneville and Dutch Bill Creek in Monte Rio, an unnamed stream near Healdsburg at Fitch Mountain, Laguna de Santa Rosa and tributaries, Santa Rosa Creek and tributaries, Green Valley Creek and tributaries, and mainstem Dutch Bill Creek (Table 1.1 and Figure 1.1).~~

~~For the Section 303(d) List assessment, *E. coli* data were compared against the draft California Department of Health Services (CDHS 2006) guidance for posting advisories at fresh water beaches. The draft guidance identifies a single sample concentration level of 235 MPN/100 mL as a threshold for posting a beach advisory to inform swimmers of potential risk. The draft guidance also recommends a 30-day average value of 126 MPN/100 mL applied on a rolling basis.~~

~~State Water Board staff determined that the 2012 U.S. EPA Recreational Water Quality Criteria (U.S. EPA 2012) would not be applied to data submitted for the 2012 Integrated~~

~~[16] The list was partially approved by U.S. EPA on June 26, 2015.~~

~~Report cycle, as the data had already been assessed and lines of evidence developed by the time the criteria were finalized. In the interest of expedience, State Water Board staff directed the Regional Water Boards to move forward with the existing lines of evidence and to utilize the 2012 U.S. EPA criteria for the next Integrated Report cycle. Thus, the evaluation guideline for *E. coli* utilized to interpret the Basin Plan objective is cited from the "California Department of Health Services Draft Guidance for Fresh Water Beaches" (CADHS 2011), which is the same as that recommended in the U.S. EPA document "Ambient Water Quality Criteria for Bacteria-1986" (U.S. EPA 1986).~~

~~*E. coli* data used in the listing process were also used to inform the TMDL Action Plan. Since that assessment was completed, additional data have been collected, criteria have been updated, and assessment methods have improved. Data were reassessed in accordance with improved criteria and methods, and the results are described in this chapter. Data collected both before and after 2010 were assessed and utilized in the development of the TMDL Action Plan.~~

~~Detailed information on listing decisions and respective lines of evidence can be found at: .~~

4.7 PUBLIC HEALTH ADVISORIES

Local agencies use information on fecal indicator bacteria concentrations to post streams with public health advisories that warn against swimming and water recreation. The City of Santa Rosa posts a permanent advisory for swimming in Santa Rosa Creek at Prince Memorial Greenway. This advisory is based on ~~FIB~~fecal indicator bacteria concentrations measured in the stream near the Railroad Street Bridge. The Sonoma County Department of Health Services uses ~~FIB~~fecal indicator bacteria data to temporarily post Russian River beaches when concentrations exceed the California Department of Health thresholds during the summer recreation season. Table 4.~~10~~11 lists the number of days with posted advisories each year since 2001 (Tyler 2013; SCDHS 2014). Between 2001 and ~~2014~~2018, Russian River beaches were posted with advisories on ~~157~~175 days.

E. coli bacteria concentration data used by the City of Santa Rosa and the County of Sonoma for posting advisories were assessed and utilized in the development of the Action Plan, and the results are described in this chapter.

Table 4.11 Russian River Beach Advisories Issued by the Sonoma Co. Department of Health Services		
Year	**Number of Beaches Sampled**	**Number of Posted Advisories (Days)**
2001	6	0
2002	6	1
2003	6	1
2004	6	0
2005	6	0
2006	6	1
2007	6	3
2008	6	11
2009	10	80
2010	6	5
2011	7	7
Total Days Posted 2001-2011		109
2012	9	36
2013	8	9
2014	9	3
2015	12	6
2016	10	2
2017	10	8
2018	10	2
Total Days Posted Since 2012		66

4.8 SUMMARY

This chapter presents ~~eight~~multiple lines of evidence that human and domestic animal fecal waste discharge is widespread throughout the Russian River Watershed, with the potential to impact the REC-1 beneficial use through human exposure to illness-causing pathogens~~.~~ ~~Fecal coliform data are compared to the bacteria objective for REC-1 protection in the Basin Plan to assess exceedance of standards. Similarly~~ (Table 4.12). *E. coli* data are compared to the ~~draft~~ statewide bacteria ~~objective~~objectives for freshwater to determine ~~exceedance of superseding standards.~~exceedances. Enterococci data ~~(~~are compared to statewide bacteria objectives for saline waters and U.S. EPA (2012) criteria~~)~~, for freshwater. Direct measurement of pathogenic species~~,~~ and the history of public health advisories are used to assess the evidence of a risk to public health. ~~Finally,~~ *Bacteroides* bacteria data and PhyloChip™ phylogenetic DNA microarray results are used to confirm a relationship between indicator bacteria exceedances and human and domestic animal fecal waste discharge~~, so as to confirm the veracity of standards and public health criteria exceedances.~~ . Finally, direct measurement of pathogenic species provides evidence that exposure to pathogens is a real risk to human health.

Table 4.12 and Figure 4.6 present a summary of the relevant data.

Table 4.12 Weight of Evidence Summary Table

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	*E. coli*[1]	Public Health Advisory[2]	Enterococcus[3]	Human *Bacteroides*[4]	Bovine *Bacteroides*[4]	Human DNA[5]	Grazer DNA[5]
Upper Russian River	Coyote Valley	Burright Creek-East Fork Russian River	-	-	-	-	-	-	-
		Cold Creek	-	-	-	-	-	-	-
		Lake Mendocino-East Fork Russian River	×	-	×	×	-	-	-
	Forsythe Creek Ukiah	Forsythe Creek	-	-	-	-	-	-	-
		Salt Hollow Creek-Russian River	×	-	×	×	-	-	-
		East Fork Russian River-Russian River	×	-	×	×	-	-	-
	Sulphur Creek	Little Sulphur Creek	-	-	-	-	-	-	-
		Alder Creek-Big Sulphur Creek	-	-	-	-	-	-	-
	Ukiah	Ackerman Creek	-	-	-	-	-	-	-
		Mill Creek	-	-	-	-	-	-	-
		Orrs Creek-Russian River	×	-	×	X	-	-	-
		Robinson Creek	-	-	-	-	-	-	-
		Morrison Creek-Russian River	-	-	-	-	-	-	-
		Dooley Creek	-	-	-	-	-	-	-
		McNab Creek-Russian River	-	-	-	-	-	-	-
		Feliz Creek	-	-	-	-	-	-	-
		Pieta Creek	-	-	-	-	-	-	-
		Cummisky Creek-Russian River	×	-	⊠	×	×	×	×
Middle Russian River	Geyserville	**Oat Valley Creek-Russian River**	×	⊗	⊠	×	×	×	×
		Gill Creek-Russian River	×	⊗	×	×	×	-	-
		Sausal Creek-Russian River	×	⊗	⊠	×	×	×	×
		Franz Creek	-	-	-	-	-	-	-
		Maacama Creek	-	-	-	-	-	-	-
		Brooks Creek-Russian River	×	⊗	⊠	×	×	×	×
	Warm Springs	Galloway Creek	-	-	-	-	-	-	-
		Soda Spring Creek-Dry Creek	-	-	-	-	-	-	-
		Warm Springs Creek	-	-	-	-	-	-	-
		Lake Sonoma-Dry Creek	-	-	-	-	-	-	-
		Pena Creek	-	-	-	-	-	-	-
		Mill Creek	×	-	×	-	-	×	×
		West Slough-Dry Creek	⊗	-	⊠	×	×	×	×
	Laguna	**Upper Laguna de Santa Rosa**	⊗	-	⊠	-	-	X	X
		Lower Laguna de Santa Rosa	⊗	-	⊠	X	×	×	×
	Santa Rosa	**Upper Santa Rosa Creek**	⊗	⊗	⊠	×	×	×	×
		Lower Santa Rosa Creek	⊗	⊗	⊠	×	×	X	X
	Mark West	Windsor Creek	-	-	-	-	-	-	-
		Porter Creek-Mark West Creek	⊗	-	⊠	-	-	×	
Lower Russian River	Guerneville	East Austin Creek	-	-	-	-	-	-	-
		Ward Creek-Austin Creek	-	-	-	-	-	-	-
		Green Valley Creek	⊗	-	⊠	X	×	×	×
		Porter Creek-Russian River	⊗	⊗	⊠	X	×	X	X
		Dutch Bill Creek-Russian River	⊗	⊗	⊠	×	×	X	X

Table 4.12 Weight of Evidence Summary Table

Hydrologic Area	Hydrologic Sub Area	Hydrologic Unit 12	*E. coli*[1]	Public Health Advisory[2]	Enterococcus[3]	Human *Bacteroides*[4]	Bovine *Bacteroides*[4]	Human DNA[5]	Grazer DNA[5]
		Willow Creek-Russian River[6]	×	-	⊗	×	×	×	×

* The parameters collected in each HUC-12 subwatershed are indicated with an "x" in the relevant parameter column. HUC-12 subwatersheds with parameters represented as "⊗" are locations where data exceeds either the statewide bacteria objective *E. coli* in freshwater or enterococci in saline waters or the REC-1 beneficial use is impacted due to public health advisories associated with recreational beaches. HUC-12 subwatersheds with exceedances of the national criteria for enterococci in freshwater are represented by the symbol "⊠". *Bacteroides* and PhyloChip™ data that exceed the respective assessment thresholds are represented by a capital X. HUC-12 subwatersheds that are identified as impaired/polluted are shown in **bold** font.

[1] The statewide objective for *E. coli* bacteria in freshwater was used to assess impairment/pollution, applying the exceedance thresholds identified in the 303(d) Listing Policy.

[2] Any public health advisory posted since 2012 for a recreational beach in the Russian River watershed represents an impact to the recreational beneficial use. Only if these data were accompanied by exceedances of the national criteria for enterococci in freshwater were they used as the basis of an impairment/pollution finding.

[3] The statewide objective for enterococci bacteria in saline water was used to assess impairment/pollution, applying the exceedance thresholds contained in the 303(d) Listing Policy. The national criteria for enterococci bacteria in freshwater was used to assess impairment/pollution, applying the exceedance thresholds contained in the 303(d) Listing Policy and requiring the additional evidence of public health advisories.

[4] *Bacteroides* bacteria data indicate the presence of relatively fresh fecal waste from the gut of its host (e.g., human, bovine). A threshold of at least 10,000 gene copies/100 mL was used as strong evidence of the presence of host fecal waste. These data were used for informational purposes, only.

[5] PhyloChip™ data indicate the percent of a sample that matches known gene sequences of specific source animals. A threshold of 20% gene sequence match with a known fecal waste source (e.g., human, grazer) was used as evidence of the presence of host fecal waste. These data were used for informational purposes, only.

[6] Salinity at the Jenner Boat Ramp in the Willow Creek HUC-12 meets the statewide bacteria objective's threshold for saline waters. The statewide objectives for enterococci apply in this HUC-12.

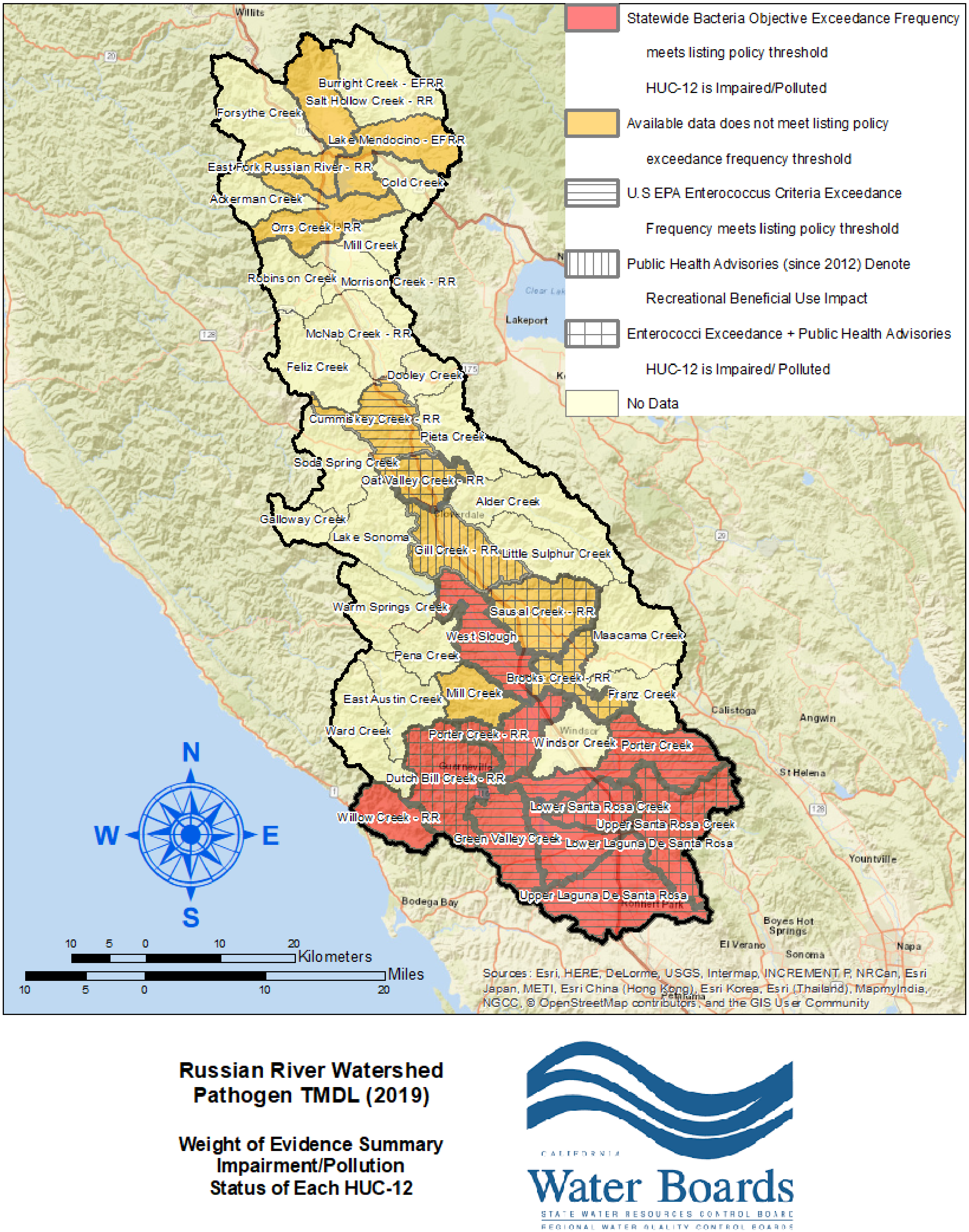

Figure 4.6: Weight Of Evidence Summary

From these data, two specific findings can be made: 1) The E. coli, enterococci, and public health advisory data provide a rational basis for identifying the HUC-12 subwatersheds that are impaired/polluted and require specific attention with respect to source control and public health protection; 2) The body of data provides a rational basis for identifying areas deserving additional monitoring. Table 4.12 provides a summary of all the ambient water quality data collected. From these data, the following HUC-12 subwatersheds are identified as impaired/polluted:

- Oat Valley Creek-Russian River
- Sausal Creek-Russian River
- Brooks Creek-Russian River
- West Slough-Dry Creek
- Upper Laguna de Santa Rosa
- Lower Laguna de Santa Rosa
- Upper Santa Rosa Creek
- Lower Santa Rosa Creek
- Porter Creek-Mark West Creek
- Green Valley Creek
- Porter Creek-Russian River
- Dutch Bill Creek-Russian River
- Willow Creek-Russian River

From these data, the following HUC-12 subwatersheds are highlighted because though the data is too limited to draw impairment/pollution conclusions, there is nonetheless evidence of potential concern, which requires additional monitoring:

- Lake Mendocino-East Fork Russian River
- East Fork Russian River-Russian River
- Orrs Creek-Russian River
- Cummisky Creek-Russian River
- Gill Creek-Russian River

From this data summary, the following HUC-12 subwatersheds are highlighted because there is no recent data from which to draw clear conclusions:

- Burright Creek-East Fork Russian River
- Cold Creek
- Forsythe Creek
- Little Sulphur Creek
- Alder Creek-Big Sulphur Creek
- Ackerman Creek
- Mill Creek (Ukiah Hydrologic Subarea)

- Robinson Creek
- Morrison Creek-Russian River
- Dooley Creek
- McNab Creek-Russian River
- Feliz Creek
- Pieta Creek
- Franz Creek
- Maacama Creek
- Galloway Creek
- Soda Spring Creek-Dry Creek
- Warm Springs Creek
- Lake Sonoma-Dry Creek
- Pena Creek
- Windsor Creek
- East Austin Creek
- Ward Creek-Austin Creek

Chapter 6 describes the results of the source assessment conducted for this TMDL project, including an assessment of land cover types and their respective association with *E. coli*, enterococci, and *Bacteroides* bacteria. The *Bacteroides* bacteria concentration data and PhyloChip™ DNA microarray data point to both human and bovine sources of fecal waste as significant in much of the Russian River watershed.

CHAPTER 5
NUMERIC TARGETS

5.1 OVERVIEW

It is sometimes necessary as part of a TMDL to establish indicators and numeric targets by which to measure progress towards attainment of the water quality objectives ~~at issue in~~applicable to the TMDL. The water quality objectives at issue in this pathogen TMDL are the ~~draft~~ statewide fecal indicator bacteria objectives based on *E. coli* in freshwater and enterococci in saline waters. For each of these fecal indicator bacteria, the statewide objectives establish a rolling 6-week geometric mean limitation and a monthly statistical threshold value, as described in Chapter 3 and summarized here. ~~The water quality objective has significance within the context of a TMDL because it~~Direct measurement of the statewide bacteria objectives themselves is ~~the regulatory endpoint upon which the TMDL is calculated. But with pathogens, the water quality objective also has significance within the context of public health protection. This chapter describes the use~~an adequate means of ~~two separate instream indicators and numeric targets as appropriate when assessing~~tracking progress towards attainment of the ~~draft~~limitations. There are no numeric targets other than the statewide bacteria ~~objective~~objectives proposed for ~~*E. coli* and protection of public health.~~this pathogen TMDL.

~~5.2 E. COLI BACTERIA~~

~~As described in Chapter 3, the Regional Water Board adopted in 1975 a Basin Plan objective to protect REC-1, which was based on fecal coliform bacteria. At that time, fecal coliform was the standard indicator of fecal waste discharge and risk of pathogen exposure. Since that time, other, more reliable indicators have been developed. As such, fecal coliform is no longer recommended as the most effective indicator for REC-1 protection. The Basin Plan fecal coliform objective for the protection of REC-1 soon will be superseded by a statewide objective for bacteria based on more contemporary science. A draft statewide bacteria objective based on *E. coli* is now out for public review. For the purpose of this TMDL, the draft statewide *E. coli* objectives is used as the water quality objective endpoint. The draft statewide *E. coli* objectives are given as a geometric mean and a statistical threshold value, based on the number of colony forming units (cfu) per 100 mL of sample. These concentration-based objectives 1) are derived from epidemiological studies that relate known concentrations of *E. coli* to rates of gastrointestinal illness and 2) are set based on a rate of illness deemed acceptable for the protection of public health. *E. coli* concentrations are easily measured and require no surrogate to ensure their attainment. As such, the draft statewide *E. coli* objectives are proposed as numeric targets, as well, as shown in Table 5.1.~~

~~5.3 ENTEROCOCCI BACTERIA~~

~~The draft statewide *E. coli* objectives are derived from the most recent U.S. EPA REC-1 criteria document (USEPA 2012). U.S. EPA (2012) reviews the epidemiological evidence associated with both *E. coli* bacteria and enterococci bacteria in freshwater. One of the scientific peer reviewers of this TMDL project finds the epidemiological evidence relating health outcomes and enterococci concentrations particularly compelling. He strongly recommends use of U.S. EPA (2012) enterococci criteria for the protection of REC-1 uses in this TMDL. While measurement of enterococci bacteria cannot be used to assess compliance with the draft statewide *E. coli* objective, it can be said to 1) provide further evidence of public health protection and 2) provide a margin of safety against any uncertainty associated with *E. coli* measurements, alone. It is important to note that measured concentrations of both *E. coli* bacteria and enterococci bacteria are influenced by environmental conditions, sometimes resulting in false positives (that is erroneous quantification of concentrations exceeding the threshold value) or false negatives (that is erroneous quantification of concentrations below the threshold value). As such, monitoring, which indicates *E. coli* geometric means or statistical threshold values lower than the objective cannot be said with certainty to represent acceptable public health protection, depending on other environmental factors. As with this TMDL project generally, multiple lines of evidence are necessary to reduce uncertainties and ensure the best protection of public health. To this end, enterococci bacteria concentrations based on U.S. EPA (2012) and 32 gastrointestinal illnesses per 1000 recreators are included as a second numeric target.~~

5.2 PROPOSED NUMERIC TARGETS

Table 5.1 outlines the proposed numeric targets for *E. coli* and enterococci bacteria~~. The geometric mean is to be based on a rolling 6-week period, calculated weekly. A statistically relevant number of samples must be included, generally a minimum of 5 samples in a 6-week period. The Statistical Threshold Value (STV) is not to be exceeded any more than 10% of the time, calculated monthly. The *E. coli* targets are~~, identical to the ~~draft~~ statewide bacteria objectives. ~~The enterococci targets are identical to the REC-1 criteria identified by U.S. EPA (2012), using illness rates identical to that used to establish the *E. coli* targets.~~

Table 5.1 Fecal Indicator Bacteria and Target Conditions			
Applicable Waters	**Objective Elements**	**Estimated Illness Rate (NGI):** 32 per 1,000 water contact recreators	
		Magnitude	
		GM (cfu/100 mL)	STV (cfu/100/mL)
All the waters where salinity is equal to or less than 1 ppth 95 percent of more of the time	*E. coli*	100	320
All the waters where salinity is greater than 1 ppth more than 5 percent of the time	Enterococci	30	110
The waterbody GM shall not be greater than the applicable GM magnitude in any six-week interval, calculated weekly. The applicable STV shall not be exceeded by more than 10 percent of the samples collected in a CALENDAR MONTH, calculated in a static manner. NGI = National Epidemiological and Environmental Assessment of Recreational Water gastrointestinal illness rate GM = geometric mean STV = statistical threshold value cfu = colony forming units mL = milliliters ppth = parts per thousand			

~~Cfu = colony forming units; mL = milliliters~~

5.3 SUMMARY

~~Out of an abundance of caution and as a margin of safety, targets for two fecal indicator bacteria are proposed. The indicators and targets are selected because of the epidemiological evidence that links their measurement to health outcomes, as described in U.S. EPA (2012). These two indicators measure different bacteria, but under different scenarios are linked to similar health outcomes and are identically scaled to result in no more than 32 gastrointestinal illnesses per 1000 recreators. Should environmental factors cause measurement of either of the indicators to result in a false positive, than the results of the other will allow for better assessment and response. Such a margin of safety ensures greater certainty when assessing attainment of the water quality objective and protection of public health.~~

Attainment of the statewide bacteria objectives for the protection of REC-1 is best determined by measurement of the fecal indicator bacteria for which statewide objectives have been established. In the Russian River Watershed, the REC-1 beneficial use is designated as a year-round use and applies to all waters.

CHAPTER 6
SOURCE ANALYSIS

6.1 OVERVIEW

A TMDL source analysis typically identifies the amount, timing, and point of origin of pollutants of concern, measured or estimated as loads or loading rates (e.g., pounds/acre or tons/mi^2/year). The pollutant loading is then translated into load and waste load allocations, which together with a margin of safety represent the total maximum daily loading that will meet objectives.

This typical approach is somewhat modified when the pollutant of concern is bacteria. A modification is necessary for many reasons. 1) The water quality issue of concern with respect to fecal indicator bacteria is a public health concern related to the risk of exposure to pathogens. 2) The risk of exposure to pathogens is estimated by the presence of fecal indicator bacteria. 3) A given concentration of specific fecal indicator bacteria is associated with a number of illnesses per ~~1000~~1,000 recreators that is acceptable as defined by policy. 4) The presence of fecal indicator bacteria is an indication of fecal waste discharge. 5) Any discharge of human and/or domestic animal fecal waste increases the risk of pathogen exposure to recreators. 6) As a matter of general public health protection, there is no allowable load of fecal waste discharge that can ~~be considered to be~~is without any risk. 7) An obvious public health principle is to eliminate the discharge of fecal waste to waterbodies that support recreation and other human contact.

Given that any load of fecal waste discharge can pose a risk to human health, pathogen TMDLs generally take another approach. Pathogen TMDLs generally apply fecal indicator bacteria *concentrations* as the load and waste load allocations. Through the use of concentrations, policy makers assert the allowable number of illnesses per ~~1000~~1,000 recreators that constitute an acceptable public health risk. With respect to the development of a program of implementation, this approach serves to narrow the needs of a source analysis. Unlike mass-based load and wasteload allocations, where the mass of pollutant from each source adds up to the total allocation, concentration-based allocations do not add up to equal the TMDL. Rather, in order to achieve the concentration-based TMDL, each source must meet the concentration-based allocation. Under this approach, a source analysis simply needs to identify the categories of sources of fecal waste discharge, the places on the landscape where they exist, and the places where there is a high risk of fecal waste discharge such that its control is a high priority.

This chapter evaluates all potential sources of fecal waste discharge and identifies the major sources of fecal waste contributing to elevated concentrations of fecal indicator bacteria found in the surface waters of Russian River Watershed. Where there are geographic delineations made in this chapter, they are based on Hydrologic Subarea (HSA). Please see Chapter 1 for a cross-walk between HSAs and HUC-12, as necessary.

The source analysis is composed of two parts:

1. An assessment of elevated fecal indicator bacteria concentrations associated with different land cover categories.

2. An inventory of the types of point source and nonpoint source facilities and activities that discharge or have the potential to discharge fecal waste to surface waters.

The land cover assessment serves two purposes. 1) It helps to extend the evidence of pollution findings in Chapter 4 by associating FIB sampling results with land cover categories. 2) By establishing the land cover categories that are associated with evidence of pollution, it helps to confirm whether or not the inventory of potential sources is reasonably complete. The inventory of point and nonpoint source facilities and activities with the potential to discharge fecal waste represent all the known potential sources of fecal waste in the watershed. Section 6.6 Source Analysis Conclusions provides a summary of the sources requiring further control, which are associated with land cover types showing evidence of pollution. The program of implementation is designed to ensure additional assessment of individual facilities and activities, where the development of a new source control program may be necessary or existing programs may need updating.

6.2 SOURCES BY LAND COVER TYPE

Fecal indicator bacteria results described in Chapter 4 showed exceedance of ~~U.S. EPA (2012) recommended criteria for~~ statewide bacteria objectives for both *E. coli* in freshwater and enterococci in saline water during both wet and dry weather periods in multiple HUC-12s in the ~~mainstem~~ Russian River ~~and most tributaries sampled in the watershed.~~[17]Watershed. Similarly, exceedance of national criteria for enterococci in freshwater, coupled with other evidence of pollution, established several additional HUC-12s as impaired. Regional Water Board staff conducted studies to investigate the relationship between land cover types and fecal indicator bacteria in the surface waters of the Russian River Watershed. Regional Water Board staff assessed the relative contributions, magnitude, and variability of fecal indicator bacteria in the Russian River Watershed based on different land cover types during both dry and wet weather periods. Methods and sample concentration results are documented in a monitoring report by Regional Water Board staff (NCRWQCB 2012). An assessment of the data, including a statistical analysis, is documented in a memorandum (Butkus 2013a) on our website.[18] This section of the staff report summarizes the findings.

6.2.1 METHODS

Regional Water Board staff collected water samples from streams within the study area that drain subwatersheds primarily composed of one type of land use only, as a way of isolating the influence of different land uses on fecal indicator bacteria concentrations[19].

~~[17] The U.S. EPA (2012) criteria for *E. coli*, which represents no more than 32 gastrointestinal illnesses per 1000 recreators, is identical to the draft statewide objective.~~

[18] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

[19] All the sampling locations drained watersheds with 50% or more of their area in one type of land cover category, except for sampling locations representing the developed non-sewered category. There was a

Five land cover categories were selected. These land cover categories were based on the National Land Cover Dataset (Fry et al. 2011) and Urban Service Areas (PRMD 2010). The land cover categories were defined through remote sensing by Anderson et al. (1976), and are summarized as follows:

- **Forest Land** – Areas with a 10 percent or more tree-crown areal density (crown closure percentage).
- **Shrubland** – Areas where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs. Anderson et al. (1976) previously defined this land cover as "Rangeland." These areas do not include animal pastures or dry croplands.
- **Agriculture** – Areas were defined by visual indications of agricultural activity through distinctive geometric field or road patterns and the traces produced by livestock or mechanized equipment.
- **Developed Sewered** - Urban and residential areas identified by Fry et al. (2011) where much of the land is covered by structures including cities, towns, villages, strip developments along highways, transportation, power, and communications facilities. Residential land uses range from low density (where houses are on lots of more than an acre) to high density, multiple-unit structures. The boundaries of the Urban Service Areas (PRMD 2010) were used to identify those urban and residential areas that are sewered to receive domestic wastewater treatment.
- **Developed Non-Sewered** – Residential land uses identified by Fry et al. (2011) where the houses are outside of the boundaries of the Urban Service Areas (PRMD, 2010) and assumed to use individual onsite wastewater treatment systems (OWTS), cesspools, or direct discharges for disposal of domestic waste.

For each of the five land cover categories, six water samples were collected at three different locations during both wet and dry periods. Samples were analyzed for *E. coli*, enterococci, human-specific *Bacteroides*, and bovine-specific *Bacteroides* bacteria. Visual comparison and statistical hypothesis tests were made between different data groupings. More information on the assessment methods is available in Butkus (2013a).

<u>The assessment of data was conducted prior to the adoption in August 2018 of statewide bacteria objectives for *E. coli* and enterococci. As such, the *E. coli* and enterococci data evaluated as part of the Land Cover Study were assessed using the national criteria for these indicators, choosing the criteria representing 32 gastrointestinal illnesses per 1,000 recreators. Importantly, the exceedance of the geometric mean criteria was calculated in a static manner, rather than a rolling manner as is now required by the new statewide objectives. The results of the Land Cover Study as first published in Butkus (2013a) and summarized in the 2015 draft Staff Report and again in the 2017 draft Staff Report have not been altered. Staff assert that the differences between the two methods of calculation though real are insignificant with respect to the purpose of the study. The numeric</u>

relatively low percentage of land in this category as developed non-sewered areas are interspersed with other categories, especially agricultural lands.

thresholds for both the national criteria reported here and the statewide bacteria objectives are identical.

6.2.2 RESULTS

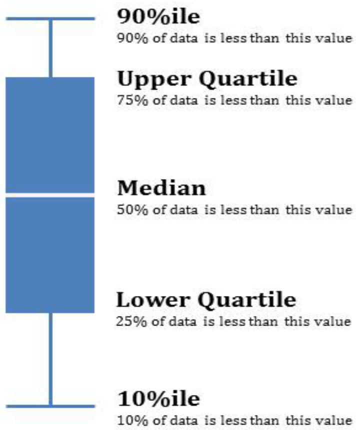

Figure 6.1 Data Example: Reading A Box And Whisker Plot

The results of the land cover analysis are presented in box-and-whisker plots in Figures 6.2 through 6.5. A separate box and whisker plot is produced for each land cover type, each sampling season, and for each FIB. Figure 6.1 provides a visual explanation of how to read a box and whisker plot.

One of the key findings of the land cover assessment is that there is evidence of fecal waste discharge from all of the land cover categories evaluated. This is consistent with the findings reported in ~~Evidence of Pollution,~~ Chapter 4. Also consistent with the findings in Chapter 4, the concentrations of FIB measured in surface waters is higher during the wet season than during the dry season. While all land cover categories are associated with FIB, the concentrations measured in association with the Forestland cover type are significantly less than those measured in association with the other land cover types. Importantly, elevated public health risks, as measured by *E. coli* bacteria, appear to be most strongly associated with unsewered developed areas and shrubland[20] during both the dry and wet seasons. This finding points to onsite wastewater treatment systems (OWTS) as a potential year-round source of human fecal waste. Similarly, *E. coli* data is strongly associated with sewered and unsewered developed areas during the wet season, suggesting that there are connections between sources of human fecal waste and storm water collection systems.

A stable isotope analysis, which measures oxygen and nitrogen in the water sample, was also conducted on samples from different land use categories to help identify the source of the water associated with the bacteria in samples. The results show that most of the nitrate measured in the samples was from soil, which was likely carried into the water column through rainfall-induced erosion. The results also show that several of the samples collected during wet weather in both sewered and unsewered (OWTS) developed areas were likely derived from domestic wastewater, which suggests that storm events may be transporting untreated domestic wastewater from sanitary sewer overflows and exfiltration, failing sanitary sewer pipelines and sewer laterals, and failing septic systems into streams. Sampling under this study was conducted in such a manner as to prevent capture of permitted surface water discharges from municipal wastewater treatment facilities, by collecting samples upstream of treated effluent discharge locations.

Summary of Findings of the Land Cover Assessment~~:~~ (Butkus 2013):

[20] Shrubland does not include animal pastures or dry cropland. But, it likely includes rural residential sites.

- ~~Human-source *Bacteroides* bacteria are present in all locations and in all land use categories, demonstrating pervasive discharge of human fecal waste to surface waters of the Russian River Watershed.~~
- *E. coli*, enterococci, and *Bacteroide*s bacteria concentrations in wet periods have statistically-significant higher concentrations than dry periods, indicating that fecal waste discharge is strongly influenced by storm water runoff patterns.
- Runoff from forest lands has statistically-significant lower concentrations of fecal indicator bacteria than runoff in all other assessed land cover categories. This suggests that inventorying potential sources of fecal waste from forestlands is relatively unimportant to the goal of reducing human fecal waste discharge.
- Runoff from shrublands, agricultural areas, and forested areas have statistically-significant lower *E. coli*~~,~~ and enterococci~~, and *Bacteroides* bacteria~~ concentrations than runoff from developed areas (both sewered and non-sewered areas). This suggests that inventorying potential sources of fecal waste in developed areas is relatively important to the goal of reducing human fecal waste discharge.
- *Bacteroides* bacteria concentrations are statistically the same for wet and dry period runoff draining from developed sewered areas, developed areas with OWTS, agricultural areas and shrublands. This suggests that ~~there pervasive sources of~~ fecal ~~waste~~indicator bacteria may recognize the human signature associated with ~~the potential to enter the surface waters of the Russian River Watershed during all times of the year~~managed land cover types.
- *E. coli,* enterococci, and Bacteroides bacteria concentrations are statistically the same for wet and dry period runoff draining from developed sewered areas and developed areas with OWTS. This suggests that ~~there are~~certain common features such as leaking septic system/sewer lines may be pervasive~~ sources of fecal waste in developed areas, which have the potential to impact public health during all times of the year~~.

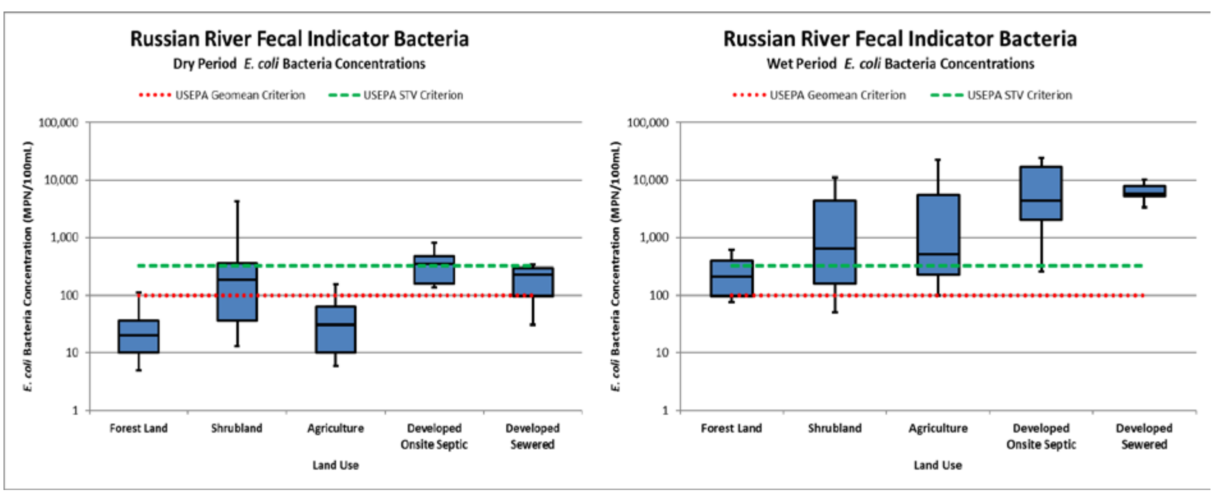

Figure 6.2: E. Coli Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

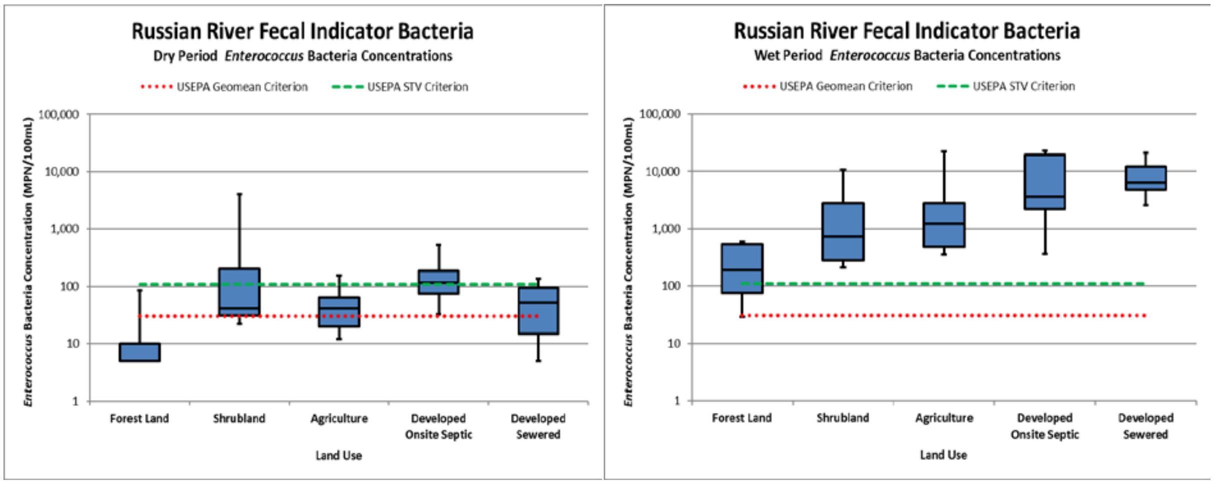

Figure 6.3: Enterococci Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

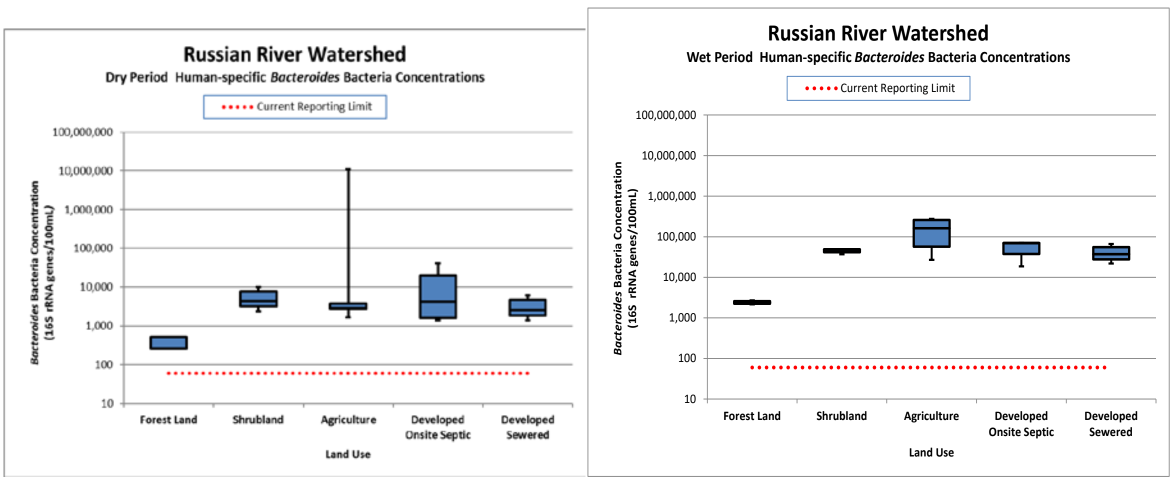

Figure 6.4: Human-Specific Bacteroides Bacteria Concentrations Measured In The Russian River Watershed By Land Cover Category.

Human-specific Bacteroides were analyzed with the HuBac genetic marker following U.S. EPA (2010) Method B.

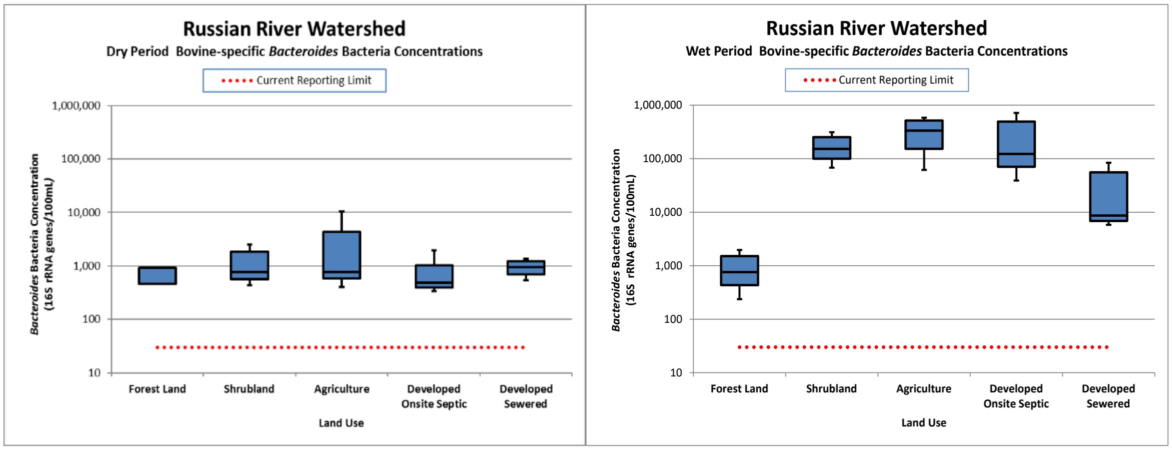

Figure 6.5~~.~~: Bovine-Specific Bacteroides Bacteria Concentrations Measured In The Russian River Watershed During Dry Periods By Land Cover Category.

Bovine-specific Bacteroides were analyzed with the BoBac genetic marker following U.S. EPA (2010) Method B.

6.2.3 CONCLUSIONS

These data indicate that the inventory of potential sources of fecal waste must thoroughly consider all potential sources in developed areas, both sewered and unsewered. It is the developed areas where fecal waste appears to be reaching surface waters of the Russian River Watershed during all times of the year, though in significantly higher concentrations during the wet season. It is also in the developed areas where the predominant fecal waste signature is from human sources, representing a higher potential for elevating exposure to illness-causing pathogens to those who recreate in the Russian River.

Storm water runoff appears to be a major pathway by which fecal waste enters surface waters of the Russian. Sources of fecal waste that have the potential to enter storm water collection systems will be important to inventory and evaluate. Similarly, sources of fecal waste in agricultural areas and shrublands, which have the potential to runoff the landscape during storms, are also important to inventory and evaluate. Conversely, inventorying fecal waste sources on forestlands is relatively unimportant to the overall goals.

6.3 POINT SOURCE FACILITIES AND ACTIVITIES

This section describes potential point sources of pathogens in the Russian River Watershed. Clean Water Act section 402 addresses direct discharges of waste into navigable waters. "Point source", as defined in the Clean Water Act, means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft. This term does not include agricultural storm water discharges and return flows from irrigated agriculture. (33 U.S.C. §1362). Point source discharges to waters of the United States are regulated under the federal National Pollutant Discharge Elimination System (NPDES) program, through NPDES permits. Point source discharges to waters of the state are regulated in accordance with the Porter-Cologne Water Quality Control Act through waste discharge requirements (WDRs) that also serve as NPDES permits.

The point sources described in this section were identified by querying the California Integrated Water Quality System (CIWQS) database for existing facilities regulated by a NPDES permit.

6.3.1 WASTEWATER DISCHARGES TO SURFACE WATERS

Wastewater discharges to surfaces waters in the Russian River Watershed occur from both direct permitted discharges of treated effluent and from unpermitted spills and leaks. The following sections identify potential sources in the watershed.

6.3.1.1 MUNICIPAL WASTEWATER DISCHARGES TO SURFACE WATERS

The watershed contains nine municipal wastewater treatment facilities authorized under NPDES permits to discharge treated domestic wastewater into surface waters. Table 6.1 summarizes these facilities (per information obtained from CIWQS in Nov. 2013) and describes their level of treatment. Figure 6.6 shows the locations of these facilities in the watershed. All facilities in the watershed treat to secondary or tertiary levels. Secondary treatment refers to physical, chemical, and biological unit processes used to meet federal standards in 40 C.F.R. §133.102 for biochemical oxygen demand (BOD), total suspended solids (TSS), and pH. Tertiary treatment is generally defined as treatment beyond secondary levels to achieve a higher level of BOD or TSS removal or to remove constituents of concern such as nutrients or toxic compounds.

To achieve water quality objectives, protect beneficial uses, protect public health, and prevent nuisance, surface water discharges within the Russian River are prohibited from May 15 through September 30. During the remainder of the year, discharges are limited to one percent of the flow volume in the receiving water unless specifically exempted in the NPDES permit. For authorized discharges of wastewater to the Russian River and its tributaries during October 1 through May 14, the Basin Plan requires that discharges of municipal waste "*shall be of advanced treated wastewater in accordance with effluent limitations contained in NPDES permits for each affected discharger, and shall meet a median coliform level of 2.2 MPN/100 mL.*" The Regional Water Board has defined advanced wastewater treatment in individual permits as treated effluent meeting, in part, disinfection standards, including total coliform thresholds, consistent with tertiary treated recycled water requirements set forth in title 22 of the California Code of Regulations.

Disinfection standards in existing municipal NPDES permits consist of effluent limitations for total coliform bacteria and other process requirements to ensure adequate effluent disinfection. For surface water discharges, municipal NPDES permits are prescribed uniform effluent limitations for total coliform bacteria that require:

- The 7-day median concentration not exceed an MPN of 2.2 per 100 mL;
- The number of coliform bacteria not exceed an MPN of 23 per 100 mL in more than one sample in any 30-day period; and
- No single sample exceed an MPN of 240 total coliform bacteria per 100 mL.

In addition to effluent limitations for total coliform bacteria, existing municipal NPDES permits also require compliance with disinfection process requirements depending on the permitted facility's method of disinfection. For wastewater treatment facilities that employ an ultraviolet (UV) disinfection process, permittees are required to ensure a minimum UV dose, maintain a minimum UV transmittance, and perform appropriate operation and maintenance activities specified by Division of Drinking Water of the State Water Resources Control Board.

For wastewater treatment facilities that utilize chlorine as a means of disinfection, permittees must demonstrate a continuous chlorine residual after treatment or provide a minimum CT (the product of total chlorine residual and modal contact time) value of not less than 450 mg-min/L at all times.

Regional Water Board staff used discharger-specific effluent monitoring data from self-monitoring reports to assess total coliform bacteria concentrations in the effluent from these facilities. Table 6.1 shows that disinfection methods are highly effective at meeting effluent limitations for total coliform bacteria. Consequently, direct discharges to surface water of treated municipal wastewater that meet effluent limitations for bacteria and discharge specifications for disinfection are not considered a significant source of bacteria. See Section 6.3.1.2 for discussion of the potential for bacterial contamination from discharges from holding ponds.

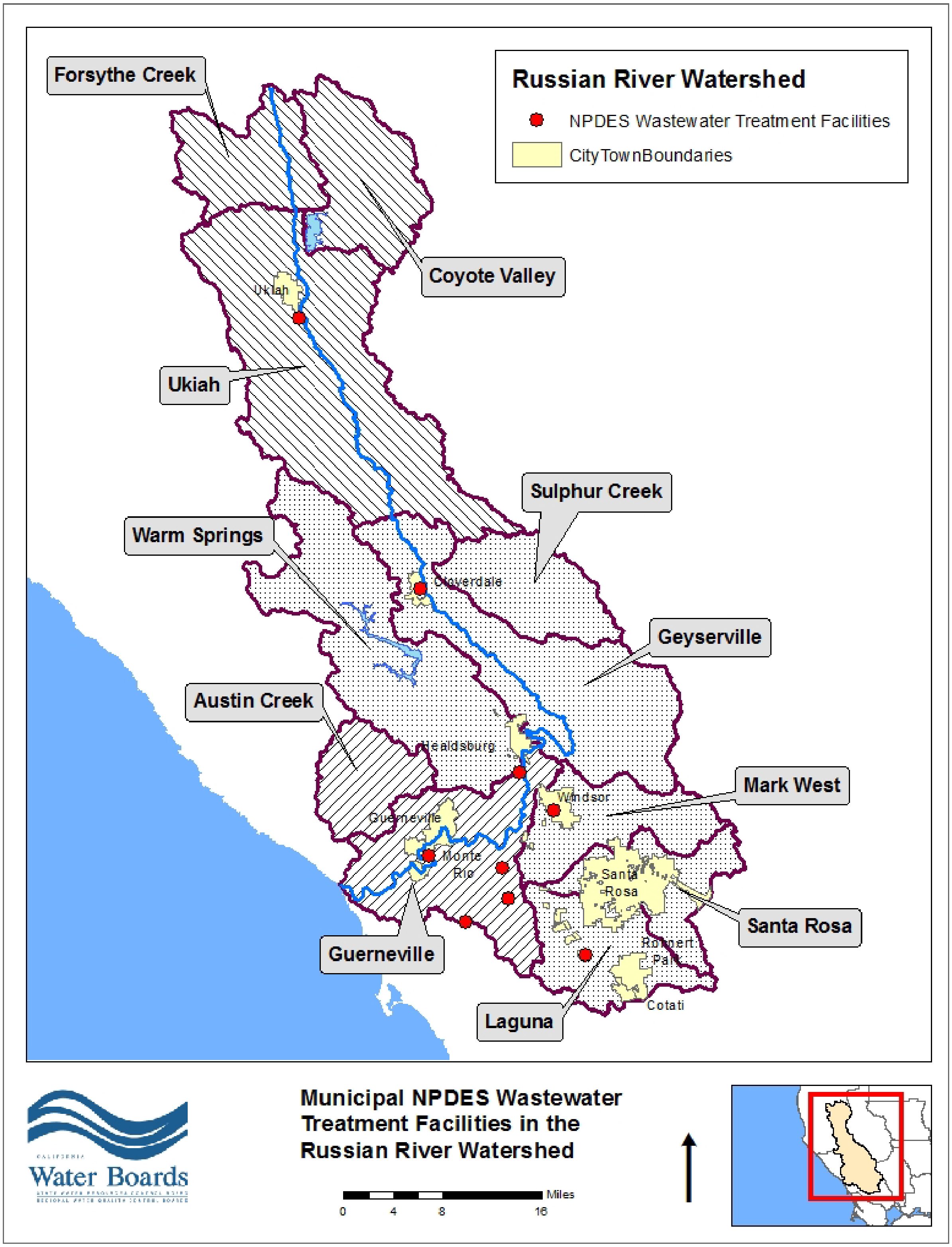

Figure 6.6: Municipal NPDES Wastewater Treatment Facilities In The Russian River Watershed

6.3.1.2 RECYCLED WATER HOLDING PONDS

The beneficial reuse of treated wastewater, which is also known as recycled water, is common in the Russian River Watershed as a means to conserve scarce potable water supply and to comply with stringent discharge requirements imposed in NPDES permits in the watershed, including the Basin Plan's prohibition against summertime discharges of waste to the Russian River and its tributaries. For these and other reasons, storage ponds for many wastewater treatment facilities serve a dual purpose: 1) to temporarily store recycled water in large holding ponds for later distribution to recycled water users or 2) to temporarily store treated wastewater until conditions are suitable and permitted for discharge to surface waters. It is the experience of Regional Water Board staff that discharges from holding ponds to surface waters outside of the prescribed discharge season or as a result of rain-induced pond overflows are rare, and are not considered a significant source of fecal bacteria in the Russian River Watershed.

Although advanced wastewater treatment systems in the Russian River Watershed are operated to produce recycled water that is essentially pathogen-free and suitable for water recycling, compliance with effluent limitations for bacteria has been historically measured at municipal treatment plants at a point immediately after completion of the disinfection process. The point at which disinfection is complete, for example, at the end of a chorine contact chamber, may be separated from the surface water discharge by both distance and time. As a result, this same recycled water, when stored in open-air holding ponds, may become contaminated as a result of regrowth of bacteria or through contribution of fecal waste from wildlife, particularly birds that frequent the storage ponds. Thus, the original bacterial water quality of the recycled water demonstrated immediately after disinfection cannot be guaranteed during storage.

Many studies document the occurrence of fecal indicator bacteria and other opportunistic pathogens in open-air reservoirs, but the public health risk associated with pathogens in recycled water storage ponds has not been well-documented. Regional Water Board staff evaluated monitoring data for treated effluent discharges from the open-air, recycled water storage ponds at Vintage Greens used by the Town of Windsor. Monitoring results from the Town of Windsor for the period 2007-2011 indicate ~~measureable~~measurable concentrations of *E. coli* recycled water storage ponds after completion of disinfection. These results are shown in Figure 6.7.

In the Russian River Watershed, municipal wastewater treatment facilities that discharge to surface waters directly or indirectly after storage employ either chlorine or ultraviolet light as a means of wastewater disinfection. Research assessing the regrowth or photoreactivation of bacteria or pathogens in storage ponds is sparse; most recent work has focused on photoreactivation after exposure to ultraviolet light. One study reviewed by Regional Water Board staff used biochemical fingerprinting to show that the fecal contamination in a golf course pond supplied with chlorine-disinfected recycled water was not related to the recycled water and that the fecal indicator bacteria did not regrow in the ponds (Casanovas-Massana 2012). Another case study (Basu 2007) of fecal coliform bacteria regrowth in a full-scale operating wastewater treatment facility using ultraviolet disinfection concluded that bacterial regrowth in recycled water systems is a concern, but that exceedances of effluent limitations for fecal coliform in this study could be attributed to poor effectiveness of the ultraviolet disinfection system. The report also summarized recent research on the topic, indicating that photoreactivation of bacteria diminishes drastically after exposure to dosages of ultraviolet radiation above 50 MJ/cm^2.

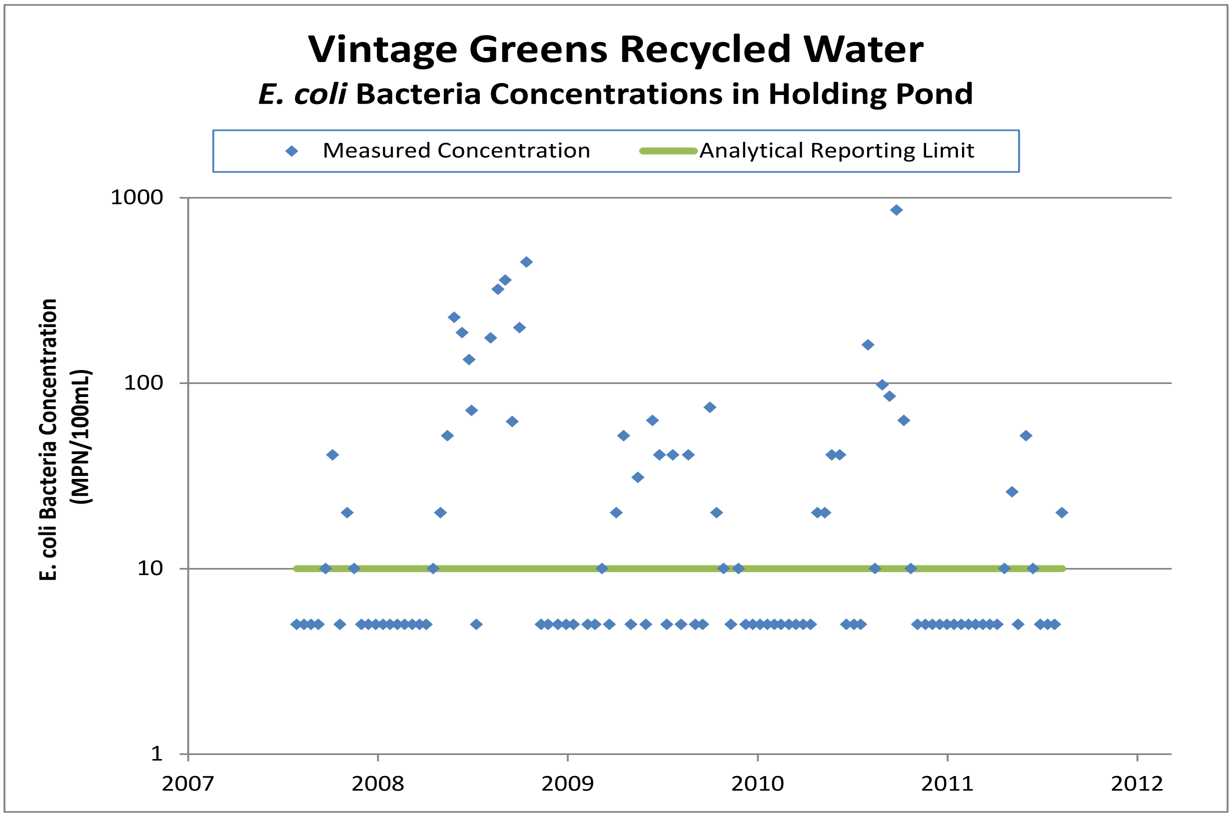

Figure 6.7: E. Coli Bacteria Concentrations In A Recycled Water Holding Pond At Vintage Greens In Windsor.

Table 6.1 Municipal NPDES Wastewater Treatment Facilities in the Russian River Watershed and Percent Compliance with Total Coliform Effluent Limitations

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type	Percent Compliance		
						Daily Max.	7-Day Median	Monthly Max.
Upper Russian River	Ukiah	City of Ukiah Wastewater Treatment Plant	CA0022888	3.01	Tertiary	100.0 %	93.9%	100.0%
Middle Russian River	Geyserville	City of Cloverdale Wastewater Treatment Plant	CA0022977	1.0	Secondary	100.0 %	100.0%	100.0%
	Warm Springs	City of Healdsburg Water Reclamation Facility	CA0025135	1.4	Tertiary	100.0 %	98.4%	100.0%
	Santa Rosa, Laguna, Mark West	Santa Rosa Subregional Water Reclamation System	CA0022764	21.34	Tertiary	99.9 %	100.0%	99.9%
	Mark West	Town of Windsor Wastewater Treatment, Reclamation, and Disposal Facility	CA0023345	1.9	Tertiary	100.0 %	96.1%	100.0%
Lower Russian River	Guerneville	Graton Community Services District Wastewater Treatment, Reclamation, and Disposal Facility	CA0023639	0.397	Tertiary	100.0 %	100.0%	100.0%
		Forestville Water District Wastewater Treatment, Reclamation, and Disposal Facility	CA0023043	0.130	Tertiary	99.9 %	83.6%	99.7%
		Russian River County Sanitation District Wastewater Treatment Facility	CA0024058	0.71	Tertiary	100.0 %	100.0%	100.0%
		Occidental County Sanitation District Wastewater Treatment Facility	CA0023051	0.05	Secondary	100.0 %	97.6%	100.0%

Based on these studies reviewed by Regional Water Board staff, discharges of treated wastewater from recycled water holding ponds may contain *E. coli* and in concentrations above the TMDL targets~~.~~ (i.e., National criteria or statewide objectives). However, the studies indicate that the sources of detected *E. coli* bacteria in recycled water storage ponds are not necessarily of human origin and therefore may not pose a more significant threat to public health or be relevant to protection of the REC-1 beneficial use. More site-specific information is necessary to determine the sources of *E. coli* or other fecal indicator bacteria in recycled water storage ponds and whether the discharge from a recycled water storage pond contains ~~human~~ pathogens that risk human illness before the holding pond can be eliminated as a pathogen source.

6.3.1.3 SANITARY SEWER SYSTEMS

Sanitary sewer systems collect and transport municipal wastewater from private residences, commercial buildings, industrial facilities, and institutional buildings to a wastewater treatment facility for treatment and disposal and/or reuse. Some sanitary sewer systems also convey storm water and groundwater that may inadvertently enter the system. Sanitary sewer infrastructure is comprised of some or all of the following components: service laterals, collector sewers, connections between laterals and collector sewers, interceptor sewers, manholes and cleanouts, pump stations, and force mains. Typically a public entity (e.g., municipality or county sanitation district) owns and is responsible for maintaining all components of the system except the service laterals, which connect the individual building to the sewer system and are located on private property. Where sewers are installed on private property such as a mobile home park or apartment complex, ownership and maintenance responsibility, including the connection point, is the responsibility of the property owners unless there are subdivision covenants or written agreements and easements which clearly indicate otherwise.

There are nineteen ~~publically~~publicly-owned sanitary sewer systems within the Russian River Watershed, as shown in Table 6.2 and based on the most recent Questionnaire data.

Table 6.2 Sanitary Sewer Systems in the Russian River Watershed							
Hydrologic Area Name	**Hydrologic Subarea Name**	**Sanitary Sewer System**	**Population Served**	**Number of Service Connections**	**Miles of Force Main**	**Miles of Gravity Sewer**	**Miles of Publicly-owned Laterals**
Upper Russian River	Ukiah	Calpella County Water District	450	110	0.3	2.9	1
		Hopland Public Utility District	1,200	288	0.6	4.4	6
		Ukiah Valley Sanitation District	5,000	4,971	1	43	44
		City of Ukiah	16,500	5,642	0	44	44
Middle Russian River	Geyserville	City of Cloverdale	8,500	3,200	0.1	32.3	21
		City of Healdsburg	11,564	4689	2.9	54	90
		Geyserville Sanitation Zone	782	267	1	4.3	1.3
	Laguna	City of Cotati	7,265	2,300	1	32	26.6
		City of Rohnert Park	40,794	8,427	7.5	77	71.8
		City of Sebastopol	7,507	2,800	2.7	25.6	53
		Sonoma State University	10,000	19	0	2.5	1.2
		South Park County Sanitation District	10,400	1,717	0	18.4	16
	Santa Rosa	City of Santa Rosa	165,267	47,801	6.4	562	434
	Mark West	Airport/Larkfield/Wikiup Sanitation Zone	9,306	1,937	1	10	9.2
		Town of Windsor	26,950	8,250	1	92	60
Lower Russian River	Guerneville	Forestville Water District	865	438	1.5	6	3.4
		Graton Community Services District	1,815	445	0.3	6.5	4
		Occidental County Sanitation District	610	71	1.5	1	0.3
		Russian River County Sanitation District	7,377	2,467	5	35	11.7
		Totals	333,226	96,543	33	1,070	899

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Overflows of wastewater from the sanitary sewer can be caused by grease blockages, root blockages, sewer line flood damage, pump station power or mechanical failures, and surcharged pipe conditions from excessive storm water or groundwater inflow and infiltration (I/I). Releases of wastewater from the sanitary sewer can also occur as a result of poor sewer design, pipe or material failures, construction-related damage, or lack of a preventive maintenance program, which includes sufficient planning for system rehabilitation and replacement. Private building laterals can crack, become disjointed or displaced, and blocked with roots or other debris and result in an overflow. Untreated sewage from sanitary sewer system releases can contain high levels of pathogenic microorganisms and other pollutants.

All federal and state agencies, municipalities, counties, districts and other public entities that own or operate sanitary sewer systems greater than one mile in length that collect and/or convey untreated or partially treated wastewater to a wastewater treatment facilities are required to enroll for coverage under General Waste Discharge Requirements for Sanitary Sewer Systems, Water Quality Order No. 2006-0003-DWQ (General Order). The General Order establishes minimum requirements to prevent sanitary sewer overflows (SSOs). Reporting requirements are included to ensure adequate and timely notifications are made to appropriate local, state, and federal authorities in the event of SSOs from publicly-owned sewer infrastructure. Table 6.3 lists the details for SSOs reported to the CIWQS SSO database since 2007, resulted in a discharge to a drainage channel and/or surface waters, or discharged to a storm drain and were not fully captured and returned to the sanitary sewer system. These data are based on information retrieved from CIWQS in July 2017. Though any SSO is a violation of permit conditions, the reported levels shown in Table 6.3 indicate that SSOs from publicly-owned sewer infrastructure are not a large source of bacterial contamination of the Russian River Watershed. However, SSO reporting from small communities is inconsistent, which may result in under reporting of SSOs.

Private sewer laterals are owned and maintained by the property owner. Private sewer laterals are not regulated under the General Order and, therefore, owners of private laterals are not required by permit to report SSOs that occur as a result of a failure or blockage in the lateral. Because of the sheer number of private laterals connected to a municipal sewer system and the limited jurisdiction that municipalities have over sewer laterals on private property, SSOs from private sewer laterals often go unreported and corrective actions to stop the SSO may be delayed. Most municipalities have established local ordinances that require property owners connected to the municipal system to design and install new laterals in accordance with local standards and maintain existing service laterals and cleanouts in good working order at the owner's expense. Local ordinances that require property owners to inspect their private service laterals at a property transfer, in response to chronic SSOs, or changes in use are rare in the Russian River Watershed. At least two public sanitation districts within the Russian River Watershed offer a program that enables eligible ratepayers to replace leaking or deteriorating service laterals at the expense of the municipality.

The available information indicates that the volume of SSOs from publicly-owned sewer systems that reach surface waters within the Russian River Watershed is relatively low, with the exception of a few SSOs caused by excessive inflow and infiltration or major pipeline failure. Because of the lack of consistent and complete reporting of SSOs from private sewer laterals, private lateral SSOs are potentially a significant source of pathogens as measured by fecal indicator bacteria in surface waters within the Russian River Watershed.

Table 6.3 Sanitary Sewer Overflows in the Russian River Watershed from 2007 to July 2017

Hydrologic Area Name	Hydrologic Subarea Name	Responsible Agency	Number of SSOs	Volume of SSO (gallons)	Volume that Reached Surface Water (gallons)	% that Reached Surface Water
Upper Russian River	Ukiah	Calpella County Water District	2	2,250	1000	44%
		Hopland Public Utility District	3	295	0	0%
		City of Ukiah	31	4,247	1,688	40%
		Ukiah Valley Sanitation District	4	1,800	1,100	61%
Middle Russian River	Geyserville	City of Cloverdale	0	0	0	NA
		City of Healdsburg	74	45,465	27,575	61%
		Geyserville Sanitation Zone	1	200	0	0%
	Laguna	City of Cotati	12	2,012	98	5%
		City of Rohnert Park	10	1268	341	27%
		City of Sebastopol	32	210,369	198,029	94%
		Sonoma State University	6	22,867	0	0%
		South Park County Sanitation District	5	7,753	0	0%
	Santa Rosa	City of Santa Rosa	42	69,567	49,272	71%
	Mark West	Airport/Larkfield/Wikiup Sanitation Zone	3	510	50	10%
		Town of Windsor	19	15,090	4,317	29%
Lower Russian River	Guerneville	Forestville Water District	5	397	70	18%
		Graton Community Services District	3	850	200	24%
		Occidental County Sanitation District	4	506	216	43%
		Russian River County Sanitation District	19	1,448,554	1445969	100%
		Total SSOs since 2007	275	1834000	1729925	94%

6.3.1.4 SANITARY SEWER EXFILTRATION

Exfiltration is different from SSOs. Sanitary sewer overflows from small diameter pipelines are usually caused by pipe blockages. In larger diameter pipelines, excessive infiltration and inflow (I/I) can lead to surcharged pipe conditions. These conditions can result in direct overflows to surface water or land or cause sewer backups into residential or commercial buildings. In contrast, exfiltration is generally described as a sewer leaking from its inside to its surrounding outside and occurs primarily at defective joints and cracks in service laterals, local mains and trunk sewer lines. Factors that contribute to exfiltration include: size and length of sewer lines, age of sewer lines, construction materials, and depth of flow in the sewer. Geological and climatic conditions that contribute to exfiltration include groundwater depth, soil type, faults, and rainfall.

Compliance with requirements for proper operation and maintenance of public sanitary sewer systems set forth in the Sanitary Sewer Systems General Order may help reduce or eliminate exfiltration over time. The occurrence of exfiltration is thought to be limited to those areas where sewer elevations lie above the groundwater table. Since groundwater elevations near surface waterbodies are typically near the ground surface, sewers near surface waterbodies generally are below the groundwater table and infiltration (rather than exfiltration) might be expected to dominate the mode of sewer leakage in these areas.

Where conditions and other factors are present that could result in exfiltration of untreated wastewater from sanitary sewer system, sanitary sewers systems are potential sources of pathogens, measured as fecal indicator bacteria to surfaces waters in the Russian River Watershed.

6.3.1.5 OTHER NPDES FACILITIES

<u>Fish Hatcheries</u>
There is one fish hatchery within the Russian River Watershed: Warm Springs Dam Fish Hatchery. The facility is owned by the U.S. Army Corps of Engineers and is operated by the California Department of Fish and Wildlife located at the base of Warm Springs Dam in Healdsburg. The facility is regulated under Waste Discharge Requirements Order No. 97-61 (NPDES Permit No. CA0024350).

The facility is designed to raise approximately 161,000 pounds (800,000 fish) per year for release to the Russian River, and it feeds up to 40,000 pounds of feed during the month of maximum feeding. Influent to the facility comes from Warm Springs Dam (Lake Sonoma) and, if necessary, from a series of wells adjacent to Dry Creek. Influent flow is aerated and routed to twenty ponds/raceways, which discharge to a single pollution control pond with a minimum detention time of 2.5 hours. Treated wastewater from the pollution control pond is discharged to Dry Creek, which is tributary to the Russian River, and also is used for landscape irrigation on less than five acres at an adjacent visitor center and day use area.

Waste Discharge Requirements Order No. 97-61 contains effluent limitations and monitoring requirements for effluent flow, suspended solids, settleable solids, and chloride. Fish intestines have been shown to contain *E. coli* bacteria, but the bacteria comes from ingestion of the bacteria from other sources and are not produced within the fish. A study of the role of fish as contributors of *E. coli* bacteria showed that the source of the *E. coli* in fish feces were likely from ingested bacteria from sediments, Canada geese, mallard ducks, and wastewater. Fish simply serve as a transport vehicle for *E. coli* bacteria transmission from other sources (Hansen et al. 2008). The fish themselves are not a direct source of bacteria. Therefore, fish hatcheries are not considered a source of *E. coli* bacteria for this TMDL.

<u>Other Permittees</u>
There are a number of other permittees in the Russian River Watershed that are regulated under NPDES permits for waste discharges to surface waters, but do not receive, treat or discharge domestic wastewater under conditions of the permit (Table 6.4). Domestic wastewater from the Sonoma West Holdings Food Processing Facility is treated in a lined aerated pond, then filtered and disinfected before application to land. Treated discharges are required to meet effluent limitations for total coliform bacteria as a condition of discharge. Discharges permitted under the aquatic herbicide and aquatic pesticide general NPDES permits and for JDS Uniphase, which is covered under an individual NPDES permit, are not expected to contain human or animal waste, and are therefore not probable sources of fecal bacteria. Utility structures may contain pathogens as measured by fecal indicator bacteria from natural sources or as a result of pass-through from municipal separate storm sewer systems. Even though there is a potential for bacteria to be present in these discharge, these permitted discharges are not expected to be an original source of pathogens that contribute to the pathogen impairment in the watershed.

Table 6.4 Other NPDES Facilities in the Russian River Watershed

Hydrologic Area Name	**Hydrologic Subarea Name**	**Permittee Name**	**Permit No.**	**Facility Type**
Upper Russian River	Coyote Valley	Potter Valley Irrigation District	CAG990005	Aquatic Herbicide
	Ukiah	Mendocino Forest Products Ukiah Sawmill	CA0005843 (terminated)	Sawmill
Middle Russian River	Laguna	Sonoma West Holdings Plant #2 Facility	CA0023655	Food Processing
		JDS Uniphase	CAG911001	Laboratory
Upper, Middle and Lower Russian River	Multiple HSAs	AT&T Statewide Cable System	CAG990002	Utility Structure
		Pacific Bell (AT&T)	CAG990002	Utility Structure
		Pacific Gas & Electric Company	CAG990002	Utility Structure
		Sprint	CAG990002	Utility Structure
		Verizon California	CAG990002	Utility Structure

Table 6.4 Other NPDES Facilities in the Russian River Watershed				
		Sonoma County Water Agency	CAG990005	Aquatic Herbicide
		Marin/Sonoma Mosquito and Vector Control District	CAG990004	Pesticide/Vector Control
		City of Santa Rosa	CAG990005	Aquatic Herbicide
		Sonoma County Regional Parks	CAG990005	Aquatic Herbicide

6.3.2 STORM WATER

The NPDES Storm Water Program regulates storm water discharges from municipal separate storm sewer systems (MS4s), construction activities, industrial facilities, and state highways. Permitted facilities in the watershed are listed in Table 6.5. Most storm water discharges are considered point sources, and operators of these sources may be required to receive an NPDES permit before they can discharge. In 1987, the U.S. Congress broadened the definition of "point source" to include construction and industrial storm water discharges and municipal separate storm sewer systems (CWA §402(p)). As described below, storm water discharges to the Russian River Watershed are considered an important source of fecal waste in the watershed.

Table 6.5 Permitted Storm Water Facilities in the Russian River Watershed

Program	Number of Enrollees
Municipal Phase I MS4	10
Municipal Phase II MS4	1
Municipal Phase II MS4 (Small Non-Traditional)	1
Storm Water Construction	83
Storm Water Industrial	169
Caltrans	1
Total	265

6.3.2.1 MUNICIPAL STORM WATER

The 1987 amendments to the Clean Water Act required the U.S. EPA to address storm water runoff in two phases. Phase I of the NPDES Storm Water Program began in 1990 and applied to large (serving 250,000 people or more) and medium (serving between 100,000 and 250,000 people) municipal separate storm sewer systems (MS4) and eleven industrial categories including construction sites disturbing five acres of land or more. Phase II of the NPDES Storm Water Program began in 2003 and applies to small MS4s (serving less than 100,000 people) including non-traditional small MS4s, which are facilities such as military bases, public campuses, prison and hospital complexes and construction sites disturbing from one up to five acres of land. The CWA requires that MS4 permits must "require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP), including management practices, control techniques and systems, design engineering methods and such other provisions as the [U.S. EPA] Administrator or the State determines appropriate for the control of such pollutants." (33 U.S.C. 1342(p)(3)(B)(iii).).

A MS4 is defined in 40 CFR 122.26(b)(8) as a conveyance or system of conveyances (including roads w/drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is:

1. Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges into waters of the United States.
2. Designed or used for collecting or conveying storm water.
3. Which is not a combined sewer.
4. Which is not part of a Publicly Owned Treatment Works (POTW), as defined in 40 CFR 122.2.

The current Phase I MS4 Permit, Order No. R1-2015-0030 (NPDES Permit No. CA0025054), names the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency[21], City of Ukiah, Town of Windsor as co-permittees. Portions of Unincorporated Mendocino County within the Russian River Watershed are enrolled as Traditional MS4s under the Phase II Small MS4 Permit (Order No. 2013-0001- DWQ effective July 1, 2013). Sonoma State University is regulated under the Phase II Permit as a Non-Traditional Small MS4.

Under terms of the Phase I MS4 Permit, permittees are required to possess the legal authority to prohibit discharges of non-storm water to the MS4 from dumping and disposal of materials such as litter, household refuse, and other materials that have the potential to impact water quality, including sources of pathogens as measured by fecal indicator bacteria. Phase I permittees are also required to implement, in coordination with other public entities, as appropriate, a Public Information and Participation Program (PIPP) that includes education materials to inform the public on the proper disposal and storage of animal wastes.

The Phase II MS4 Permit specifies actions needed by the permittee to reduce the discharge of pollutants in storm water to the maximum extent practicable to achieve compliance with water quality standards and objectives. Like the Phase I MS4 Permit, the Phase II Permit prohibits non-storm water discharges into municipal storm drain systems and

[21] The Sonoma County Water Agency does not have land use authority and can only control activities conducted by Sonoma County Water Agency staff or conducted on its own property. Therefore, not all requirements in the Phase I MS4 Permit are applicable to the Sonoma County Water Agency

watercourses within the permittees' jurisdiction. The Phase II MS4 Permit also identifies special provisions for non-traditional MS4 permittees to comply with including the requirement for an Education and Outreach Program, an Illicit Discharge Detection and Elimination Program, and a Pollution Prevention and Good Housekeeping Program.

Except for Sonoma State University, there are currently no other Phase II Small MS4 permittees in the Russian River Watershed designated as Non-traditional MS4s. However, other regional water boards have identified special districts that own and/or operate within transportation corridors as non-traditional MS4s needing coverage under the Phase II MS4 Permit, in recognition that these are sources of trash and human waste from homeless encampments entering MS4s and watercourses. Examples of special districts regulated as non-traditional MS4s include, AMTRAK, Bay Area Rapid Transit (BART), and CalTrain.

Pathogens in Urban Storm Water Systems was prepared by Urban Water Resources Research Council (UWRRC 2014). The report describes potential sources of fecal bacteria in urbanized areas (areas within MS4 boundaries) to include SSOs, illicit discharges to storm sewer systems (e.g., power washing), failing OWTS, wastewater treatment plants, urban wildlife, domestic pets, and agriculture. Further, the report found fecal indicator bacteria concentrations in wet weather discharges from urban MS4s orders of magnitude above primary contact recreation standards. Storm water samples are collected as a requirement of the MS4 permit for the City of Santa Rosa, County of Sonoma, and Sonoma County Water Agency. Single storm water samples were collected from Santa Rosa Creek upstream and downstream of the urban area. These single samples cannot be directly assessed with the Basin Plan water quality objective for fecal coliform bacteria which requires 5 samples collected in a 30-day period. However, the fecal coliform concentrations measured in Santa Rosa Creek during storm events range from 170 – 5,000,000 MPN/~~100mL~~100 mL. These very high concentrations supplement other evidence that Santa Rosa Creek is impaired due to high bacterial loads, especially during wet weather.

Additionally, the wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from developed and sewered areas described in Section 6.2 were much higher than the U.S. EPA (2012) criteria and the ~~draft~~ state water quality objectives. *E. coli* bacteria concentration measurements showed a geometric mean of 5,372 MPN/~~100mL~~100 mL, as compared to the numeric target of 100 MPN/~~100mL~~100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 6,860 MPN/~~100mL~~100 mL, as compared to the numeric target of 30 MPN/~~100mL~~100 mL. These results confirm that municipal storm water draining from developed and sewered areas is an existing source of pathogens as measured by fecal indicator bacteria.

6.3.2.1.1 PET WASTE

Domesticated pets can be a major source of pathogens as measured by fecal indicator bacteria, especially dogs and cats. Domesticated dogs can be a significant source of fecal waste based on their population density, high defecation rate, and pathogen infection rates

(Schueler 2000). A single gram of dog feces contains 23 million fecal coliform bacteria (van der Wel 1995). Dogs have been found to be significant hosts for *Giardia, Salmonella*, and *Pseudomonas* bacteria (Pitt 1998). Lim and Oliveri (1982) concluded that dog feces were the single greatest source contributing fecal coliform and fecal streptococcus bacteria in urbanized Baltimore catchments. Trial et al. (1993) reported that cats and dogs were the primary source of fecal coliform bacteria in urban catchments in the Seattle area.

Improper pet waste disposal has the potential to deliver pathogens to surface waters through storm water discharges. ~~Since~~Because storm drains do not normally connect to treatment facilities, untreated animal feces often end up in surface waters.

Most pet waste management programs focus on increasing public awareness. Many communities implement pet waste management programs by posting signs in parks or other pet-frequented areas, by mass mailings, and by broadcasting public service announcements. Sign posting is one of the most common outreach strategies. Signs can designate areas where dog walking is prohibited, where waste must be recovered, or where dogs can roam freely. A "pooper-scooper" ordinance may be an effective solution. Many communities have pooper-scooper laws that mandate pet waste cleanup. Because pet waste management is focused on individual pet owners, the program is dependent on the participation and cooperation of all pet owners, and pet waste management programs must be enforced. With an increase in public knowledge of storm water regulations, proper disposal of pet wastes can lead to a significant reduction of bacteria discharged in storm water.

The monitoring and source assessment completed for the Russian River Watershed did not explicitly evaluate the contribution of pet waste to bacteria concentrations in surface waters. However, given the human population density in the watershed, it is assumed that pet waste is a source of indicator bacteria in the watershed. Because the pathogen load from pet waste is presumed to be closely associated with storm water discharges, pet waste management within the Russian River Watershed is being implemented by the NPDES MS4 co-permittees through work plans (i.e. Pathogen Reduction Plans).

6.3.2.2 INDUSTRIAL STORM WATER

The most common pollutants of concern in industrial storm water are suspended solids, oxygen-demanding substances (BOD), nutrients, and heavy metals. Most industrial categories are related to heavy industry and certain light industrial facilities and are unlikely to discharge a significant level of bacteria or other pathogens found in human domestic waste. However, some facilities that require coverage under a storm water permit, such as solid waste transfer stations, sewage treatment plants, and composting operations, are potential sources of pathogens and other public health-related pollutants.

Storm water discharges associated with industrial activities, unless otherwise excluded, are regulated under NPDES Industrial General Permit (Order 2014-0057-DWQ, NPDES No. CAS000001). Beginning on July 1, 2015, storm water discharges associated with industrial activities, unless otherwise excluded, are regulated under the NPDES Industrial General Permit (Order 2014-0057-DWQ). Industrial facilities obtain permit coverage based on whether or not their Standard Industrial Classification (SIC) code is included in those specific categories. The Industrial General Permit requires the implementation of Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges.

Compliance with requirements in the General Permit will ensure that storm water discharges from industrial sites are not a significant source of pathogens as measured by fecal indicator bacteria.

6.3.2.3 CONSTRUCTION STORM WATER

Construction activities that result in a land disturbance equal to or greater than one acre are required to have coverage under the Construction General Permit (Order 2009-0009-DWQ, as amended by Order 2010-0014-DWQ and Order 2012-006-DWQ). The objective of the Construction General Permit is to prevent or minimize the discharge of construction-related pollutants from sites during and after construction.

The primary potential sources of pathogens at construction sites are temporary sanitary facilities on sites that are poorly designed or maintained and thus are a potential source ~~of~~pathogens as measured by fecal indicator bacteria. Operators of construction sites where there are no permanent sanitary facilities or where permanent facilities are too far from the construction site will provide sanitary facilities for construction personnel in one or more locations throughout the site. A well-designed and maintained site will include BMPs for portable sanitary facilities that include setbacks from waterbodies, storm drains, and gutters, location of toilets on surface areas that will absorb spills instead of transporting contamination to surface waters, and provisions to prevent vandalism and toppling of the enclosures due to exposure to high winds. Recommended maintenance activities include establishment of an appropriate cleaning and maintenance schedule, and inspection schedules to detect damage, leaks, and spills, and disposal for rinse water from cleaning activities into a sanitary sewer system.

Compliance with requirements in the Construction General Permit will ensure that storm water discharges from construction sites are not a significant source of pathogens as measured by fecal indicator bacteria.

6.3.2.4 CALTRANS STORM WATER

The California Department of Transportation (Caltrans) is responsible for the design, construction, management, and maintenance of the state highway system, including freeways, bridges, tunnels, and associated properties. Major state highways in the Russian River Watershed include Highways 101, 116, 128, and 12.

Caltrans is subject to the storm water permitting requirements of Clean Water Act section 402(p). Caltrans is currently operating under a statewide storm water permit (Order 2012-011-DWQ) that regulates all storm water and non-storm water discharges from Caltrans MS4s and maintenance facilities. Caltrans' Storm Water Management Plan, which is updated annually, describes the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters. Construction activities associated with Caltrans projects are covered by Order 2009-0009-DWQ, as amended.

The State Water Board adopted Order 2014-0077-DWQ as an amendment to the Caltrans permit to add requirements related to completed TMDLs. Under the statewide permit and TMDL amendment, Caltrans is required to prioritize reaches across the state and then to implement best management practices and control measures to achieve 1,650 Compliance Units each year in the highest priority reaches. One Compliance Unit is equal to one acre of Caltrans right-of-way from which runoff is retained, treated, or otherwise controlled prior to discharge to the relevant reach. Caltrans is encouraged to establish cooperative implementation agreements with other parties that have responsibility to attain a TMDL.

Also under the statewide storm water permit, Caltrans is required to prepare a TMDL Status Review Report to be submitted with each Annual Report. The TMDL Status Review Report includes (1) a summary of the effectiveness of the control measures installed for each reach that has been addressed, as a result of BMP effectiveness assessment, (2) a determination as to whether the control measures have been or will be sufficient to achieve WLAs and other performance standards by the final compliance deadlines, (3) where the control measures are determined not to be sufficient to achieve WLAs or other performance standards by the final compliance deadlines, a proposal for improved control measures to address the relevant pollutants, and (4) a summary of the estimated amount of pollutants that were prevented from entering into the receiving waters.

Homeless encampments within the Caltrans right-of-way are a source of both trash and pollutants in waterways. As described in a 2013 study for the Contra Costa County Flood Control and Water Conservation District, larger, well-established encampments usually have a designated "toilet area," but it is likely that occupants also use the water to dispose of waste (DeVuono-Powell 2013). Where the disposal of urine and human fecal waste in water occurs, there is a high potential that this is a source of pathogens as measured by fecal indicator bacteria. In areas within Caltrans rights-of-way that do not contain bacteria-generating sources such as homeless encampments, restroom facilities, garbage binds, etc., Caltrans finds that the contribution of fecal bacteria to waterbodies is not believed to be a significant source of pathogens that present a human health risk (Caltrans 2012).

6.3.3 POINT SOURCE CONCLUSIONS

Direct discharges to surface water from treated municipal wastewater that meet effluent limitations for bacteria and discharge specifications for disinfection, fish hatcheries and other NPDES covered activities in the watershed are not expected to be significant sources of pathogens that contribute to the impairment in the watershed. Similarly, requirements in the industrial and construction General Permits are designed to ensure that storm water discharges from industrial and construction sites are not a significant source of fecal indicator bacteria and pathogens. As discussed below, monitoring data of storm water discharges from MS4s demonstrate that these areas can be a significant source of pathogens as measured by fecal indicator bacteria. The reported levels and frequencies indicate that SSOs from publicly-owned sewer infrastructure are not a large source of bacterial contamination of the Russian River Watershed.

More site-specific information is necessary, however, to determine the sources of *E. coli* or other fecal indicator bacteria in recycled water storage ponds and whether the discharge from a recycled water storage pond contains ~~human~~illness-causing pathogens before the holding pond can be eliminated as a pathogen source. Where conditions and other factors are present that could result in exfiltration of untreated wastewater from sanitary sewer system, sanitary sewers systems are potential sources of pathogens, measured as fecal indicator bacteria to surfaces waters in the Russian River Watershed.

Untreated sewage from sanitary sewer system releases can contain high levels of pathogenic microorganisms and other pollutants. SSOs from private sewer laterals are potentially a significant source of pathogens as measured by fecal indicator bacteria in surface waters within the Russian River Watershed. Homeless encampments within the Caltrans right-of-way are a source of both trash and pollutants in waterways. In areas within Caltrans rights-of-way that do not contain bacteria-generating sources such as homeless encampments, restroom facilities, garbage bins, etc., Caltrans finds that the contribution of fecal bacteria to waterbodies is not believed to be a significant source of pathogens that present a human health risk (Caltrans 2012).

Additionally, the wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from developed and sewered areas described in Section 6.2 were much higher than the statewide objective for *E. coli* and U.S. EPA (2012) criteria~~.~~ for enterococci. *E. coli* bacteria concentration measurements showed a geometric mean of 5,372 MPN/~~100mL~~100 mL, as compared to the numeric target of 100 MPN/~~100mL~~100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 6,860 MPN/~~100mL~~100 mL, as compared to the numeric target of 30 MPN/~~100mL~~100 mL. These results confirm that municipal storm water is an existing source of pathogens as measured by fecal indicator bacteria.

In summary, the Russian River Watershed has widespread point sources throughout the watershed that have the potential to deliver pathogens to surface waters. Assessment of potential fecal waste sources and fecal bacteria do not inform relative ~~load~~ contributions between the point sources (waste loads) and/or nonpoint sources~~.~~ (loads). All identified potential point sources of fecal waste to surface waters provide an elevated risk of pathogen discharge and impairment of REC-1 beneficial uses. As such, all identified potential point sources of fecal waste to surface waters require a program of implementation and monitoring to prevent and assure that fecal waste and potential pathogens are not discharged to surface waters. *Chapter 9 – Implementation* describes the implementation and Chapter 10 – Watershed Monitoring describes the monitoring program designed to assure the TMDL ~~targets~~waste load and load allocations are achieved.

6.4 WASTE DISCHARGES TO LAND

The following sections identify known waste discharges to land in the Russian River Watershed and discuss the likelihood that these discharges are sources of fecal waste and pathogens to the Russian River and its tributaries via indirect discharge. This TMDL treats these potential sources as nonpoint sources because direct discharges to the Russian River and its tributaries from these facilities are not authorized in accordance with an NPDES permit.

6.4.1 MUNICIPAL WASTEWATER DISCHARGES TO LAND

The Russian River Watershed contains five municipal wastewater treatment facilities that are authorized under WDRs to discharge treated domestic wastewater to land (Figure 6.8). Table 6.6 summarizes these facilities (based on information obtained from CIWQS in November 2013) and describes their treatment capabilities and methods of effluent disposal or reuse.

Municipal wastewater treatment facilities discharging to land in the watershed rely primarily on aerobic pond systems for waste treatment to achieve the effluent quality necessary to protect groundwater quality. Disinfection using chlorine is commonly used to comply with an average monthly effluent limitation for total coliform of 23 MPN/100 mL. Final disposal of treated effluent is through percolation or irrigation to pasture land. The eventual receiving water for these discharges is groundwater. Through adequate treatment and disposal system design, which includes disinfection units and separation of the disposal area from streams, lakes, and reservoirs, the risk of transport of pathogens to surface waters is low.

Municipal wastewater disposed through surface irrigation from facilities that are operating properly, irrigating at agronomic rates, and ~~whose discharge conforms~~conforming to conditions prescribed in waste discharge requirements is not expected to cause ~~bacterial~~pathogenic contamination of groundwater or surface waters. Municipal wastewater discharged to percolation ponds that are proximate to surface waters have the potential to contribute to ~~bacterial~~pathogenic loading in surface waters via shallow groundwater connection to surface water as do unpermitted releases, depending on site specific conditions. Importantly, groundwater monitoring data to assess the water quality impact of wastewater discharges to land in the Russian River Watershed is currently lacking and should be addressed in future permit updates.

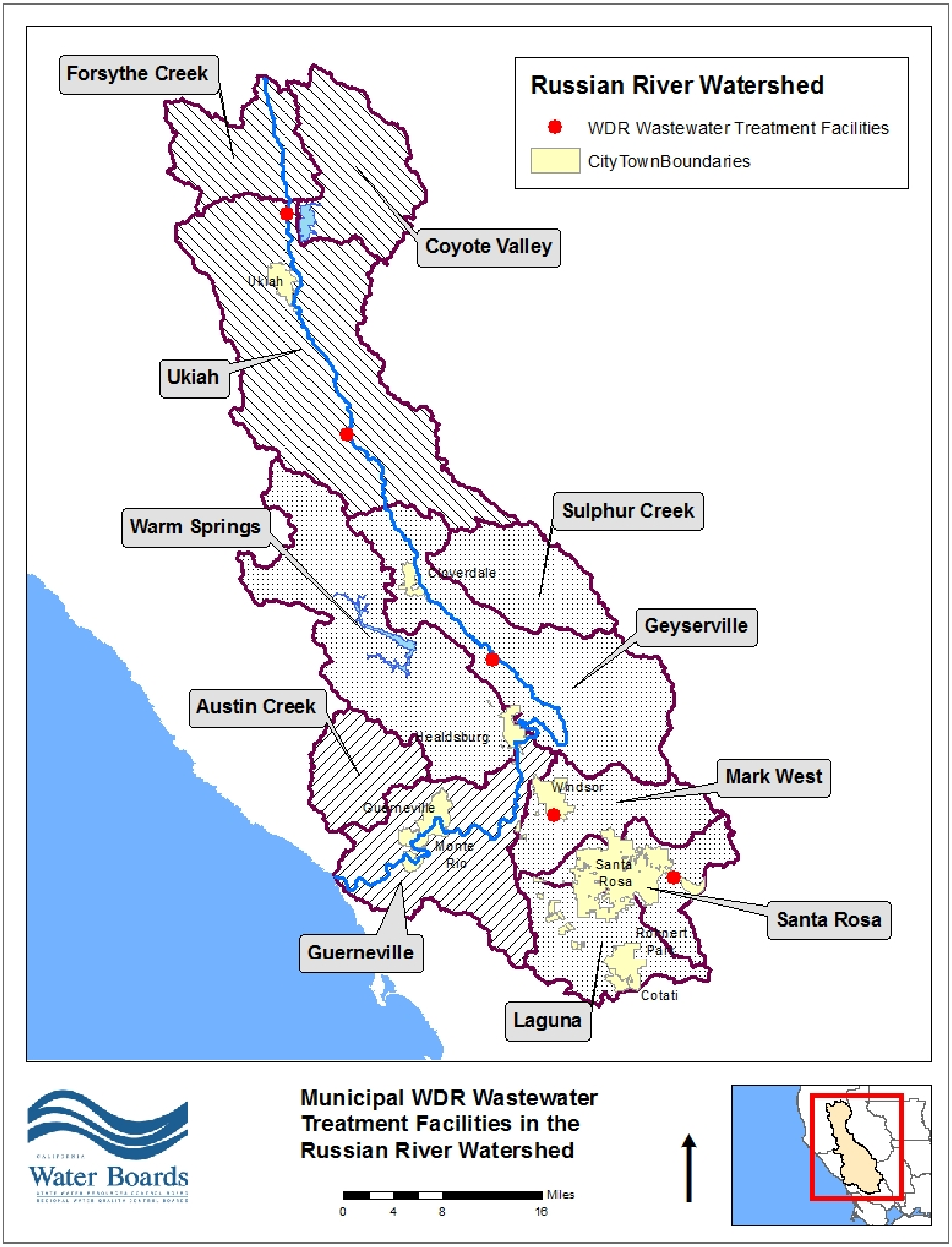

Figure 6.8: Municipal WDR Wastewater Treatment Facilities In The Russian River Watershed

Table 6.6 Municipal WDR Wastewater Treatment Facilities in the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name	Permit No.	Capacity (mgd)	Treatment Type/Disposal Method
Upper Russian River	Ukiah	Calpella County Water District	86-16	0.04	Aerated pond treatment, disinfection and percolation disposal
		Hopland Public Utility District	R1-2008-0003	0.09	Aerated pond treatment, disinfection, and percolation disposal
Middle Russian River	Geyserville	Geyserville Sanitation Zone	97-67	0.092	Aerated pond treatment, disinfection, and percolation disposal
	Mark West	Airport-Larkfield-Wikiup Sanitation Zone	R1-2001-0069	0.9	Aerated pond treatment, microfiltration, disinfection, and spray irrigation disposal

6.4.2 LAND APPLICATION OF MUNICIPAL BIOSOLIDS

Both Class A (Exceptional Quality) and Class B municipal biosolids contain pathogens, including bacteria, parasites, and viruses. Exposure to these pathogens may occur through direct contact with biosolids, through inhalation, ingestion of food that has come into contact with biosolids or through contact with vectors (flies, mosquitos, birds, rodents, etc.) that can transport pathogens from biosolids to humans. Federal regulations establish minimum standards for the regulation of biosolids using various risk assessment methodologies. (40 C.F.R. part 503.) Compliance with these regulations will minimize the human health risk associated with the land application of municipal biosolids.

In July 2004, the State Water Board adopted General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities, Water Quality Order No. 2004-12-DWQ (General Order). The General Order incorporates the minimum standards established by the Part 503 Rule and expands upon them to fulfill requirements of the California Water Code.

When biosolids are applied to ground surfaces where there is an increased risk that biosolids may migrate off the application site, the Regional Water Board Executive Officer may require an Erosion Control Plan to assure containment of biosolids on the application site. Site specific conditions that may require submission of an Erosion Control Plan include, but are not limited to~~:~~, sites where ground slopes are greater than 10 percent and areas with minimal riparian buffer between the biosolids application area and surface waters.

The City of Santa Rosa is the only public or private entity that is permitted to apply municipal biosolids to land in the Russian River Watershed. The City of Santa Rosa currently land applies Class B biosolids at three city-owned properties: Alpha Farm, Brown Farm, and Stone Farm, all of which are located within the Laguna Hydrologic Subarea. There is no available evidence that biosolids applied to land by the City of Santa Rosa have migrated outside the authorized application areas and entered surface waters. However, mobilization pathways may present a risk of pathogen discharge where biosolids are applied on sites near waterbodies with erosion potential.

6.4.3 RECYCLED WATER DISCHARGES FROM LANDSCAPE IRRIGATION

Although advanced wastewater treatment systems in the Russian River Watershed are operated to produce recycled water that is essentially pathogen-free and suitable for water recycling, this same recycled water, when stored in open-air holding ponds, may become contaminated as a result of regrowth of bacteria or through contribution of fecal waste from wildlife, particularly birds that frequent the storage ponds.

Most major municipalities in the watershed are either actively participating in water recycling programs or are contemplating becoming involved. The largest water recycling program in the region, the Santa Rosa Subregional Water Reclamation System, accepts and treats municipal wastewater from the communities of Santa Rosa, Cotati, Rohnert Park, and Sebastopol for use as recycled water for urban and agricultural irrigation on over 6,400 acres of land. Other communities, such as the Town of Windsor, Guerneville, and the Airport-Larkfield-Wikiup communities also use recycled water for local irrigation projects. In Mendocino County, the City of Ukiah is developing a project that would use recycled water for landscape irrigation within the Russian River Watershed. Recycled water producers in the North Coast Region are regulated under General Waste Discharge Requirements (Order 2014-0090-DWQ) or individual waste discharge requirements.

In addition, the Santa Rosa non-storm water Discharge Best Management Practices (BMP) Plan was required by NPDES MS4 Permit Order No. R1-2015-0030 and sets forth approved protective measures that are required of all applicable recycled water uses in order to minimize or prevent the effects of non-storm water discharges (City of Santa Rosa 2013). The BMP Plan describes runoff control measures to be implemented for both landscape irrigation in urban settings and agricultural irrigation in rural settings. By controlling runoff from recycled water use areas, these BMPs will also help reduce human-source bacteria entering receiving waters.

Although local recycled water programs are well-managed, unintentional spills of recycled water occur periodically. Large volume spills are rare and usually the result of broken recycled water lines in rural properties. Large volume spills of recycled water have the potential to adversely impact water quality~~,~~ but are a low risk to contribute pathogens as measured by fecal indicator bacteria because the recycled water has been disinfected to meet tertiary treatment standards prior to entering the recycled water distribution system. Small volume spills occur more frequently, though not common, as a result of unintentional overspray, mechanical breaks, vandalism, or other unforeseen conditions. The contribution of ~~fecal bacteria~~pathogens from small volume spills and other incidental runoff events is de minimus and not expected to be a source of ~~pathogens~~fecal indicator bacteria in amounts that contribute to ~~the pathogen impairment in the watershed~~exceedances of water quality standards.

6.4.4 PRIVATE DOMESTIC WASTEWATER DISCHARGES TO LAND (WITH FLOW GREATER THAN 10,000 GALLONS PER DAY)

Discharges of domestic wastewater or combined industrial/domestic wastewater systems to the ground surface and discharges to the subsurface where the projected wastewater flow is greater than 10,000 gallons per day (gpd) are regulated under state-issued WDRs or individual waste discharge requirements. Discharges of domestic wastewater to the subsurface under 10,000 gpd may be authorized by a local agency under a Local Agency Management Plan (LAMP) approved by the Regional Water Board in accordance with the *Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems* (OWTS Policy).

There are nineteen large and medium-sized private domestic wastewater treatment facilities in the Russian River Watershed currently regulated under WDRs that discharge to land through conventional septic tank/leachfield systems, subsurface drip irrigation systems, percolation ponds, or spray irrigation. Table 6.7 summarizes these facilities and describes their treatment capabilities and methods of disposal.

WDRs for large wastewater discharges include effluent limitations, discharge prohibitions, and other conditions established to protect water quality and beneficial uses. Septic systems are designed in accordance with minimum standards for siting, design, and operation contained in the Basin Plan and other requirements set forth by the applicable local regulatory agency. Minimum standards that are critical to effective onsite treatment and disposal of waste include adequate separation to groundwater and drinking water sources, favorable soil characteristics and geology to maximize soil treatment, and suitable waste application rates. Land disposal systems conforming to prescribed minimum standards and operating properly are not expected to cause bacterial contamination of groundwater and surface waters. But, land disposal through percolation ponds that are proximate to surface waters have the potential to contribute to bacterial loading in surface waters, depending on site specific conditions, and require site-specific evaluation. Importantly, groundwater monitoring data to assess the water quality impact of wastewater discharges to land in the Russian River Watershed is currently lacking and should be addressed in future permit updates.

Table 6.7 Private Domestic WDR Wastewater Treatment Facilities in the Russian River Watershed (with flow greater than 1,500 gallons per day)					
Hydrologic Area Name	**Hydrologic Subarea Name**	**Facility Name (Location)**	**Permit No.**	**Capacity (gpd)**	**Treatment Type/ Disposal Method**
Upper Russian River	Ukiah	Camp Wente (Ukiah)	97-10-DWQ	10,875	Conventional septic tank/leachfield system
		City of Ten Thousand Buddhas (Talmage)	WQ 2014-0153-DWQ	33,271	Subsurface flow wetland treatment followed by subsurface disposal to leachfield system
Middle Russian River	Warm Springs	EJ Gallo Winery (Healdsburg)	R1-2012-0099 (waiver)	3,060	Conventional septic tank/leachfield system
	Geyserville	Coppola Winery (Geyserville)	97-10-DWQ	12,000	Aerobic pretreatment, disinfection, and subsurface drip irrigation
		Jordan Vineyard and Winery (Healdsburg)	97-10-DWQ	3,500	Aerobic pretreatment and mound disposal
		Old Crocker Inn (Cloverdale)	97-10-DWQ	1,875	Conventional septic tank/leachfield system
		Rio Lindo Academy (Healdsburg)	87-094	75,000	Solids separation with evaporation/percolation disposal
		Salvation Army-Lytton Springs Rehabilitation Facility (Healdsburg)	97-10-DWQ	11,000	Aerated pond treatment, disinfection, and spray irrigation disposal
	Mark West	Camp Newman (Santa Rosa)	97-10-DWQ	20,000	Aerobic pretreatment with subsurface drip irrigation
		Humane Society of Sonoma County	R1-2003-0068	2,423	Aerobic pretreatment and mound disposal
		Kendall-Jackson Wine Center (Fulton)	97-10-DWQ	5,850	Aerobic pretreatment with subsurface drip irrigation
		Mayacamas Golf Club (Santa Rosa)	R1-2003-0029	4,900	Aerated pond, microfiltration, disinfection, spray irrigation
		Sonoma-Cutrer Vineyards (Santa Rosa)	97-10-DWQ	1,800	Aerobic pretreatment with subsurface drip irrigation
		Vintner's Inn (Santa Rosa)	R1-2002-0087	32,000	Activated sludge system with surface drip irrigation

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name (Location)	Permit No.	Capacity (gpd)	Treatment Type/ Disposal Method
Lower Russian River	Guerneville	Bohemian Grove (Monte Rio)	R1-2006-0053	2,250,000	Aerated pond treatment, disinfection, and spray irrigation disposal
		Gurdjieff Foundation (Guerneville)	97-10-DWQ	2,490	Aerobic pretreatment with subsurface drip irrigation and at-grade disposal system
		Odd Fellows Recreation Club (Forestville)	98-125	45,000	Clustered, conventional septic tank/leachfield system
		Rodney Strong Vineyard (Healdsburg)	88-064	60,000	Aerated pond treatment, disinfection, and percolation disposal
		The Farmhouse Inn (Forestville)	97-10-DWQ	3,285	Aerobic pretreatment and subsurface drip irrigation
	Austin Creek	Camp Royaneh (Cazadero)	97-10-DWQ	16,600	Aerated pond treatment and percolation disposal

6.4.5 WINE, BEVERAGE AND FOOD PROCESSORS

Wine, beverage, and food (WBF) processing facilities located within the Russian River Watershed include, but are not limited to alcoholic (e.g., wineries, breweries, cider houses) and non-alcoholic beverage producers, fruit and vegetable processors, meat wrapping, and dairy product manufacturers. These facilities range in size from small in-home operated, non-commercial establishments to large, industrial or commercial establishments. ~~The Regional Water Board currently regulates~~In 2016, the Regional Water Board adopted General Waste Discharge Requirements for Discharges of Wine, Beverage and Food Processor Waste to Land, Order No. R1-2016-0002, and Conditional Waiver of Waste Discharge Requirements for Discharges of Wine, Beverage and Food Processor Waste to Land, Order No. R1-2016-0003, to regulate discharges to land from WBF processing facilities that could affect the quality of waters of the state~~ through~~. A small number of WBF processors in the ~~issuance of~~ Watershed are regulated under facility-specific WDRs~~,~~ ~~enrollment under~~ because they are not eligible for coverage under either general order or because permit coverage has not yet been transferred to a general ~~WDR for wineries, or issuances of conditional waivers of WDRs.~~order.

Process wastewater from these facilities is not expected to contain ~~human~~illness-causing pathogens as measured by fecal indicator bacteria, and not considered a source of fecal ~~indicator bacteria~~waste in this TMDL. Domestic, human waste is commonly disposed of in individual onsite wastewater treatment systems (OWTS) separate from the process wastewater disposal systems and regulated by the local regulatory agency or by the Regional Water under WDRs. WBF processing facilities that combine process and domestic wastewater streams and dispose of the effluent through land application are potential sources of ~~fecal bacteria~~pathogens in surface waters unless permit conditions contain disinfection requirements or disposal requirements to prevent the migration of pathogenic organisms in the effluent to groundwater and surface water.

There are five food processing facilities in the Watershed that discharge process wastewater to land and are regulated under individual WDRs or a waiver of WDRs (Table 6.8). These facilities were identified as a result of a query of the CIWQS database in November 2013. None of these permits contain effluent limitations. Other food processing facilities in the watershed have been identified by Regional Water Board staff. It is expected many of these facilities will enroll under general WDRs or waiver of WDRs for WBF processors.

Generally, Good Manufacturing Practices (GMPs) and Sanitation Standard Operating Procedures (SSOPs) are the foundations for food safety programs for food processors. GMP regulations are designed to control the risk of contaminating foods with chemicals and microbes during their manufacture~~,~~ and include practices for the cleaning and sterilization of equipment, pest control, and quality assurance assessment. SSOPs are specific, written procedures necessary to ensure sanitary conditions in the facility. SSOPs are required in all meat and poultry processing plants, in accordance with C.F.R. title 9 Part 416. Compliance with these practices and procedures will prevent contamination or adulteration of food products and will minimize the bacterial load discharged from the facility.

The concentration of bacteria associated with process wastewater effluent from food processors is not currently known. However, proper and appropriate sanitation safeguards implemented during food processing will ensure that bacterial contaminants do not enter the waste stream from the food processing stream. Domestic waste discharges related to the operation of food processing facilities are separate from the process wastewater stream and treated in domestic waste treatment system permitted by the State or authorized by local permits or programs. Consequently, Regional Water Board staff has determined that these facilities are not expected to be a source of pathogens that contributes to the pathogen impairment in the watershed.

Table 6.8 Private Food Processors Individual WDR Wastewater Treatment Facilities in the Russian River Watershed

Hydrologic Area Name	Hydrologic Subarea Name	Facility Name (Location)	Permit No.	Design or Permitted Flow	Treatment Type/ Disposal Method
Middle Russian River	Warm Springs	Timber Crest Farms (Healdsburg)	No. 80-047	10,000 gpd	Discharges wash water from the five individual wineries and one food processor renting space from the former dehydrated fruit processing facility to a spray irrigation system during the processing season (June-September).
	Laguna	Olive Leaf Press (Sebastopol)	R1-2012-0116 (Waiver)	120,000 gallons storage capacity	Organic farm that produces olive oil from Sonoma County-grown olives. The facility is used for both the pressing of olives and grapes along with the manufacturing of olive oil. The facility is covered by the categorical waiver policy as an agricultural commodity. Wash water is stored in tanks and land applied to 50 acres of agricultural land.
		Santa Rosa Meat and Poultry Company (Santa Rosa)	No. 79-019	1,000 gpd	Specialty meat shop where industrial and domestic wastewater flows through a septic tank, one tank for industrial waste and one tank for domestic waste, the flows are then combined and chlorinated before disposal into an evaporation/percolation pond.
		Sonoma West Holdings-South (Sebastopol)	No. 88-071	50,000 gpd	Multi-tenant food and beverage processing facility that generates wash water. During dry weather, wash water is spray irrigated on 2.6 acres. Runoff from the spray fields is collected and re-irrigated, discharged to percolation beds, and/or retained in storage tanks. During wet weather, all wash water is directed to the percolation ponds and/or to storage tanks. Domestic wastewater is disposed of through an OWTS.
Lower Russian River	Guerneville	Manzana Products Company (Graton)	No. 85-079	25,000 gpd	Apple processing and canning plant that discharges wash water to a spray irrigation system during seasonal operations.

6.4.6 MOBILE HOMES PARKS AND CAMPGROUNDS

There are 133 mobile home and special occupancy (RV) parks in the Russian River Watershed (CDHCD 2014). About two-thirds of these mobile home parks, RV Parks, and campgrounds are located within municipal sewer districts and discharge domestic wastewater to treatment facilities. However, forty-one of these parks are located outside of sewered areas and consequently dispose of domestic waste onsite via individual septic systems. Figure 6.9 shows the locations of these facilities and provides an estimate of their wastewater flow volume based on the assumption that 250 gallons per day of wastewater is produced per mobile home or campground space (U.S. DHEW 1972). Septic systems associated with mobile home parks and campgrounds are commonly large capacity, located adjacent to surface waterbodies, and often poorly maintained or overloaded. Consequently, Regional Water Board staff determined that these facilities, when poorly sited, inadequately operated or maintained, are a probable source of pathogens as measured by fecal indicator bacteria in surface waters in the Russian River Watershed.

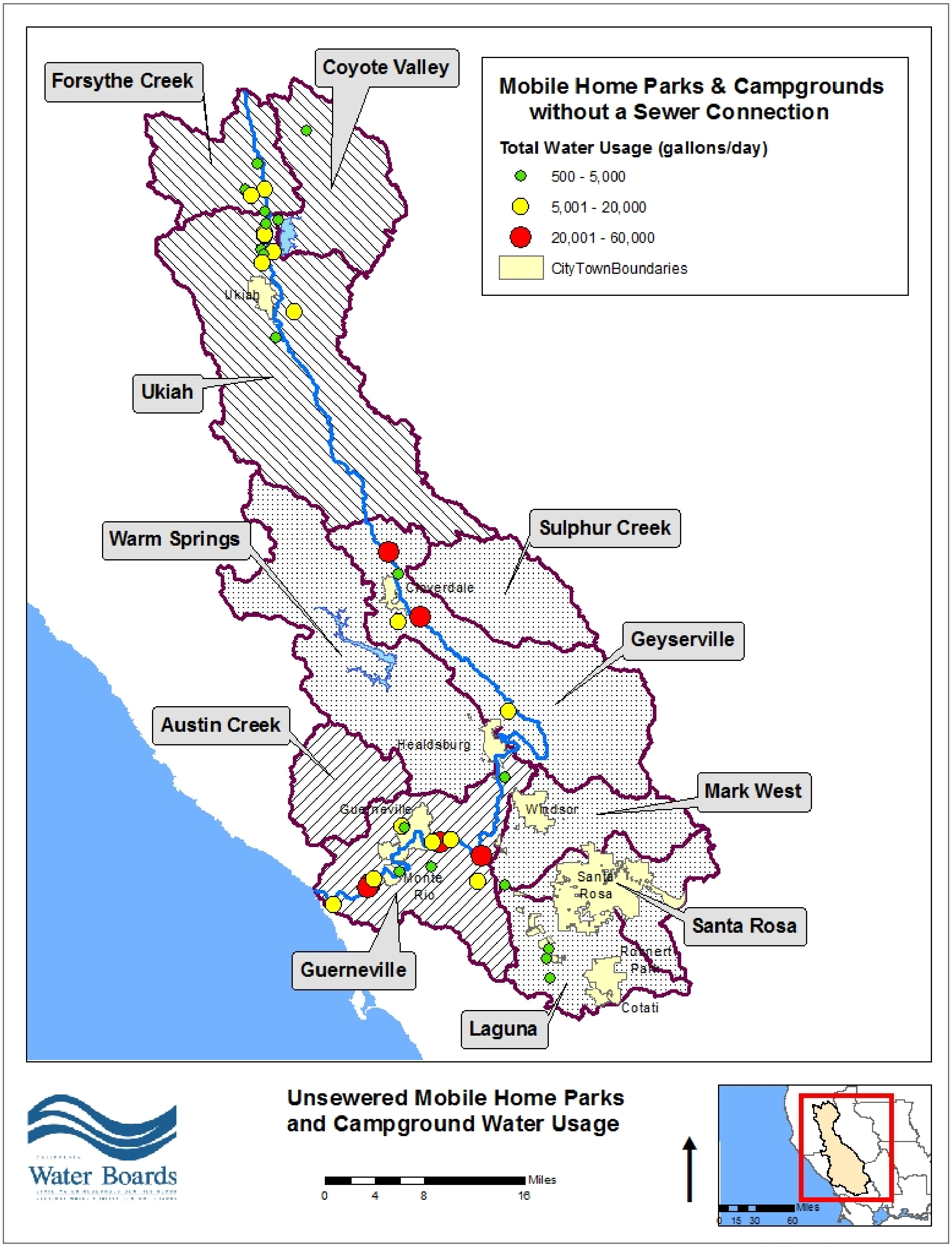

Figure 6.9: Unsewered Mobile Home Parks And Campgrounds

~~bacteria.~~

6.4.7 ONSITE WASTEWATER TREATMENT SYSTEMS

For the purposes of this TMDL, OWTS are identified as a ~~nonpoint source~~waste discharge to land since treated wastewater disperses through a leachfield with no intentional outlet to a surface waterbody. About one-fourth of all American households rely on onsite wastewater treatment systems (OWTS) to dispose of their wastewater, which translates to about 20 million individual systems nationwide (Wilhelm et al. 1994). Table 6.9 presents estimates of the houses and population that are connected to sanitary sewers in the Russian River Watershed. The estimates show that about 31% of the houses in the watershed are not connected to a sanitary sewer and are assumed to use OWTS for treatment of domestic waste. The estimates were made from the 2010 U.S. Census.

Table 6.9 Estimates of Houses, Population & Acres of Sewered and Non-Sewered Areas in the Russian River Watershed

Areas	Houses		Population		Acres	
	Count	Percent	Count	Percent	Count	Percent
Sewered	113,631	69%	288,225	72%	83,644	9%
Non-sewered	51,537	31%	111,147	28%	866,608	91%
Total within Russian River Watershed	165,168	100%	399,372	100%	950,252	100%

Conventional OWTS operate simply: after solids are trapped in a septic tank, typically a 1,000 to 1,500-gallon concrete or fiberglass tank, wastewater is distributed to a subsurface drain field and allowed to percolate through the soil. Bacteria in the wastewater are effectively removed by filtering and straining water through the soil profile. Viruses are not effectively filtered in soil because of their small size. Instead viruses are removed through adsorption to soil particles and by inactivation in the soil.

Effective pathogen removal in OWTS is dependent on proper siting and installation of the OWTS components, proper maintenance, and operation of the system within design specifications. ~~Pathogen~~Pathogens may enter the groundwater and surface water from OWTS when wastewater rises to the ground surface, is intercepted by high groundwater, or passes through the soil profile without adequate treatment.

Regional Water Board staff conducted a focused study on the potential influence of OWTS on the ~~discharges~~discharge of pathogens, as measured by fecal indicator bacteria concentrations in receiving surface waters. The sampling methods, results, and an analysis of the data are presented in the "Onsite Wastewater Treatment System Impact Study Report" (NCRWQCB 2013a). In this study, Regional Water Board staff selected catchments for monitoring based on the risk of FIB transport to surface waters and parcel density. Parcel density was determined using parcel data from the Sonoma County Assessor. Risk of FIB transport was determined using an in-house geospatial model developed based on risk factors derived from the Regional Water Board's "Policy on the Control of Water

Quality with Respect to On-Site Waste Treatment and Disposal Practices" in the Basin Plan (NCRWQB 2011). Three sample locations were selected to represent catchments draining each of the following four categories, for a total of twelve sites:

- High parcel density with a high risk of FIB transport from OWTS
- High parcel density with a low risk of FIB transport from OWTS
- Low parcel density with a high risk of FIB transport from OWTS
- Low parcel density with a low risk of FIB transport from OWTS

Three additional ~~samples~~sample locations were selected to represent catchments that drain areas served by OWTS that have high parcel density and are near a stream. Locations were selected from the Fitch Mountain area near Healdsburg, downtown Monte Rio, and Camp Meeker.

Water quality data was collected from each location five times during the study period, measuring for *E. coli*, enterococci, and *Bacteroides* bacteria. Statistical analyses were conducted to determine any correlations between the water quality data and catchment characteristics. Multiple potential characteristics were evaluated, including the modeled FIB transport risk, catchment size and parcel density. Of these characteristics, parcel density showed a positive correlation with water quality data. That is, when parcel densities were higher, so were downstream concentrations of FIB.

Figure 6.10 shows the distribution of these concentrations by parcel densities. High parcel densities range from 0.8 to 4 parcels per acre (0.2 to 1.3 acres/parcel). Low parcel densities ranged <0.1 parcels per acre (9 to 100 acres/parcel).

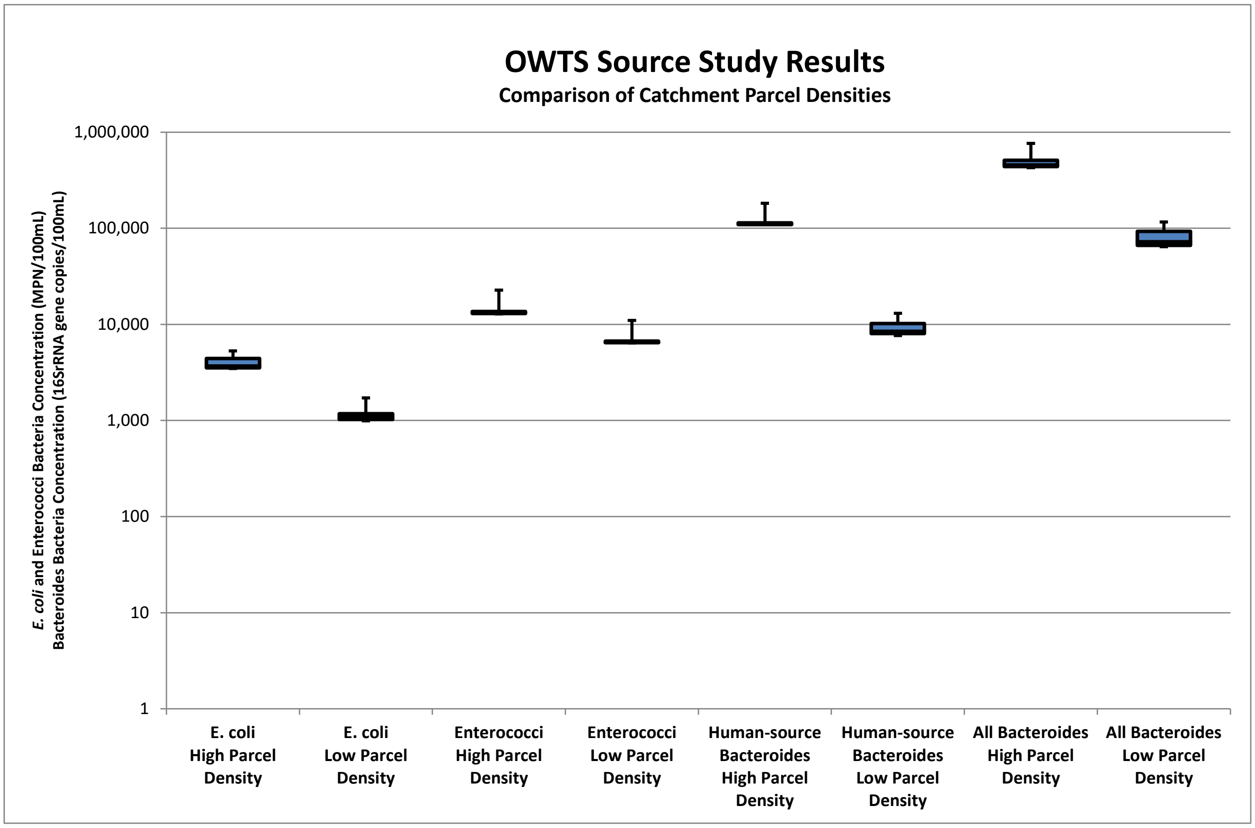

Figure 6.10: Comparison Of The Distribution Of E. Coli, Enterococci And Bacteroides Bacteria Concentrations By Parcel Densities.

Bacteroides bacteria were analyzed with the AllBac and HuBac genetic marker following U.S. EPA (2010) Method B.

These findings confirm that OWTS are a source of FIB, particularly from high parcel density areas. The findings indicate the need to consider parcel density when developing an Advanced Protection Management Program to evaluate and control discharges from OWTS in the Russian River Watershed.

6.4.8 DISCHARGES TO LAND SOURCE CONCLUSIONS

The Russian River Watershed has numerous land discharge sources throughout the watershed, some of which have the potential to deliver pathogens to surface waters. Discharges from some of these land discharge categories are already controlled under a program of implementation that are working well to prevent pollution. Other identified land discharge sources of fecal waste either require a program of implementation and monitoring to prevent and assure that fecal waste and potential pathogens are not discharged to surface waters or require update. *Chapter 9 – Implementation* describes the implementation and monitoring program designed to assure the waste load and load allocations are achieved.

6.5 NONPOINT SOURCES

The term "nonpoint source" is defined as any source of water pollution that is not from a discernible, confined, and discrete conveyance. Per definitions in the Clean Water Act, agricultural discharges are also considered nonpoint sources even when conveyed through a pipe. Nonpoint source pollution typically comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, depositing them into streams and other waters.

This section primarily focuses on controllable nonpoint sources in developed areas and agricultural areas, since the runoff from these areas show the highest concentrations of fecal indicator bacteria.

6.5.1 RECREATION AT PUBLIC BEACHES

There are many public swimming beaches along the mainstem Russian River. Several of the most popular beaches are shown in Table 6.10 and Figure 6.11. Swimming and other water contact recreation in the river can be a source of bacteria and other pathogens through direct human urination or defecation in the water or along the shore. Pathogens may also be washed off the body during immersion.

Regional Water Board staff conducted a focused study on the potential influence of intensive recreation on fecal indicator bacteria concentrations at public beaches (NCRWQCB 2013b; Appendix B). Water samples were collected for analysis of *E. coli*, enterococci, and human-source *Bacteroides* bacteria at Veterans Memorial Beach and Monte Rio Beach during the week of the Independence Day holiday in 2013.

Table 6.10 Popular Swimming Beaches along the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Upper Russian River	Coyote Valley	Mill Creek Park	Potter Valley
	Forsythe Creek	Mariposa Swimming Hole	Redwood Valley
	Ukiah	Vichy Springs Park	Ukiah
		Mill Creek Park	Ukiah
Middle Russian River	Geyserville	Cloverdale River Park	Cloverdale
		Alexander Valley Campground	Healdsburg
	Guerneville	Veteran Memorial Beach	Healdsburg

Table 6.10 Popular Swimming Beaches along the Russian River

Hydrologic Area Name	Hydrologic Subarea Name	Recreational Beach Name	Location
Lower Russian River		Riverfront Park	Windsor
		Mirabel Park Campground	Forestville
		Steelhead Beach	Forestville
		River Access Beach	Forestville
		Sunset Beach	Forestville
		Johnson's Beach	Guerneville
		Monte Rio Beach	Monte Rio
		Casini Ranch Campground	Duncans Mills

Figure 6.11: Popular Swimming Beaches Along The Russian River

Water samples were collected during the afternoon when human recreational use was the highest. Sonoma County Park staff counted recreators on the beach and in the water at Veterans Memorial Beach each day at 14:00 hours (Figure 6.12). Recreator counts were not available for Monte Rio Beach.

Relationships between these variables were investigated using the Spearman's rank correlation coefficient (ρ) (Helsel and Hirsch 2002). Spearman's rank correlation coefficient is a nonparametric statistical measure of the dependence between two variables. Spearman correlation coefficients approach either plus one (ρ~+1.0) or minus one (ρ~−1.0), as the relationship become stronger. A small correlation coefficient (between -0.5 and 0.5) indicates a weak relationship between the variables.

The study found that the percentage of human-specific *Bacteroides* showed a relatively strong positive correlation (Spearman Correlation Coefficient = 0.72) with swimming recreation, with the higher percentages of human-specific *Bacteroides* observed on days with a larger number of people swimming. Moderately positive correlations were found for *E. coli* bacteria concentrations (Spearman Correlation Coefficient = 0.55) and enterococci bacteria concentrations (Spearman Correlation Coefficient = 0.51) with swimming recreation. The results indicate that intensive human contact recreation at public beaches on the most popular hot summer days contributes to *E. coli,* enterococci and *Bacteroides* bacteria concentrations in surface waters. The less intensive recreation periods that is more common during summer weekdays and throughout the non-summer season results in lower *E. coli,* enterococci and *Bacteroides* indicator bacteria concentrations compared with the times of high intensity use.

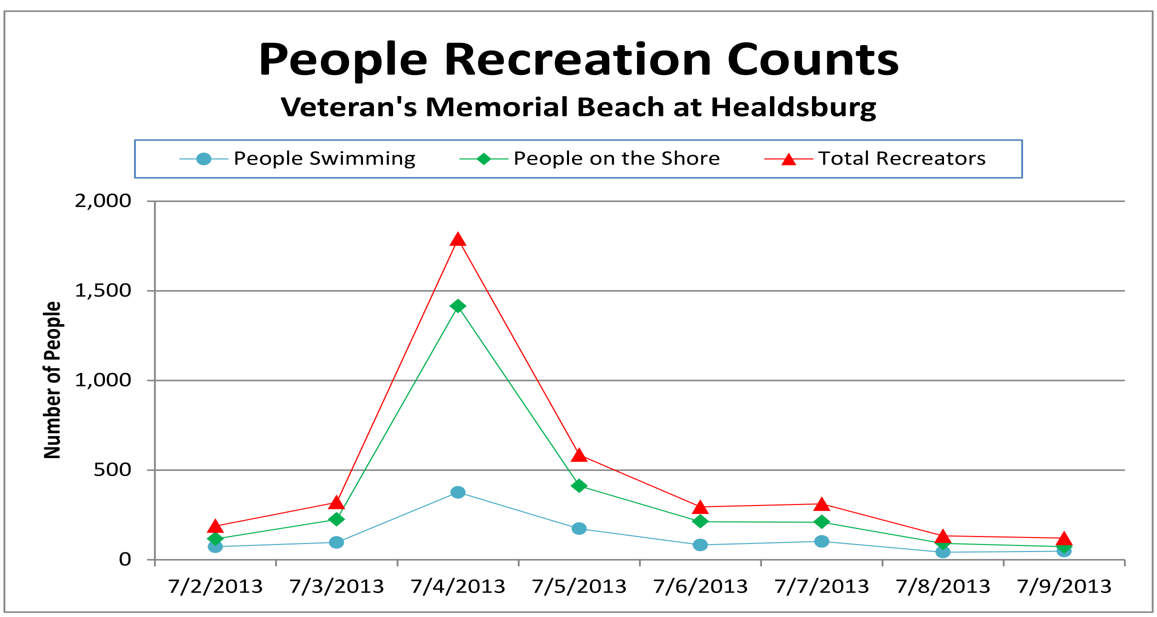

Figure 6.12: Counts Of People Recreating At Veterans Memorial Beach In Healdsburg.

6.5.2 HOMELESS ENCAMPMENTS

Homeless encampments and sites of other illegal camping are potential sources of ~~bacteria~~pathogens. Many riparian areas within the Russian River Watershed attract homeless people and these areas most often do not have sanitary disposal facilities. The discharge of untreated human waste directly to surface waters within these riparian corridors from homeless encampments could be one of the causes of the presence of ~~human-source~~fecal indicator bacteria found in undeveloped areas.

The Russian River Watershed covers large areas of Mendocino and Sonoma counties. Applied Survey Research (2005) estimates that 5,335 people were homeless in Mendocino County in 2005 and 78% of those were unsheltered. This represents 6% of the overall population of 90,816 people in Mendocino County. Applied Survey Research also estimates that 9,749 people were homeless in Sonoma County in 2005 and 77% of those were unsheltered. This represents 2% of the overall population of 484,102 people in Sonoma County.

The source analysis for this Pathogen TMDL did not attempt to assess the potential of pathogen contamination specifically associated with homeless encampments or sites of other illegal camping. However, monitoring results for Santa Rosa Creek downstream of known homeless encampments routinely indicate high levels of fecal indicator bacteria ~~and~~. Further, anecdotal reports of poor waste disposal practices by the occupants of the encampments lead Regional Water Board staff to conclude that homeless encampments are a likely potential source of ~~human-source indication bacteria in surface waters~~pathogens in surface waters as measured by fecal indicator bacteria. The same potential applies to sites of other illegal camping, in close proximity to surface water and without adequate sanitation facilities.

6.5.3 LIVESTOCK WASTE

A large number of ~~bacterial~~ pathogens found in manure from livestock have the potential to cause illness in humans. These organisms include, but are not limited to, *Salmonella, Campylobacter, E. coli, Leptospira,* and *Clostridium* bacteria (U.S. EPA 2009). Human-infectious pathogens relevant to livestock sources in the Russian River Watershed also include *Giardia* (cattle), *Campylobacter jejuni* (chickens), and hepatitis E serogroup C (hogs). Several viruses found in livestock waste have the potential to cross from animals to humans, and thus have the potential to cause disease in humans (Mattison et al. 2007; McAllister and Topp 2012). Pathogens can be discharged directly to watercourses when livestock have access to streams. They can also be carried to surface waters in storm water runoff or in runoff resulting from over-application of liquefied manure to pasture land. The estimated number of different types of animals in Sonoma and Mendocino counties is shown in Table 6.11. The Russian River Watershed covers large areas of both counties. Data presented in this table were obtained from several sources, as described below. Discussion of categories of livestock animals as potential sources of fecal waste to the Russian River Watershed is provided in greater detail in the following sections.

Table 6.11 Inventory of Livestock Animals in Mendocino and Sonoma Counties				
Animal Type	**Mendocino County**		**Sonoma County**	
	Number of Animals	**Citation**	**Number of Animals**	**Citation**
Laying Hens and Pullets	8,973	USDA (2007)	5,764,700	Linegar (2013)
Cows	18,800	Morse (2012)	68,762	Linegar (2013)
Horses	2,509	USDA (2007)	17,794	Benito (2005)
Sheep and lambs	9,200	Morse (2012)	22,543	Linegar (2013)
Goats	1,454	USDA (2007)	2,146	Linegar (2013)
Hogs	1,450	Morse (2012)	1,029	Linegar (2013)

6.5.4 DAIRIES, MANURE HOLDING PONDS, & LANDSCAPE APPLICATIONS OF MANURE

Any release of manure to surface waters from holding ponds from confined animal facilities has a significant potential to impact bacterial water quality due to the large amount stored and the high concentration of bacteria in raw manure (up to 100 million fecal coliform per gram). Most commercial dairies in the Russian River Watershed store manure in large lagoons that can hold millions of gallons of liquid manure. Waste lagoons can break, spill, leak, or fail. Lagoon linings can crack and allow liquefied manure to seep into surface waters or shallow groundwater. Pipes and hoses connecting to lagoons or spray fields may fail or leak (Marks 2001). In addition, many dairies spread or spray liquefied manure on pasture land. When liquid waste is over-applied or inappropriately applied to farm fields through irrigation, runoff of manure to surface waters can result.

The Regional Water Board implements the Water Quality Compliance Program for Cow Dairies and Concentrated Animal Feeding Operations (CAFOs). Initiated in 2012, this program currently includes a NPDES permit for CAFOs that discharge directly to surface waters, a General WDR permit for dairies that do not meet minimum standards for the protection of surface water and groundwater, and a Conditional Waiver for dairies that meet minimum standards in title 27 of the California Code of Regulations for confined animal facilities. These regulatory tools require management of process water, manure, and other organic materials at dairy operations including holding ponds and the application of such materials to cropland. The General WDR is being revised in 2019. The Regional Water Board currently has no enrollees in the NPDES permit for CAFOs.

The dairy permits require retention ponds and manured areas at confined animal facilities in operation on or after November 27, 1984, to be protected from inundation or washout by overflow from any stream channel during 20-year peak stream flows. Retention ponds are required to be lined with, or underlain by, soils which contain at least 10 percent clay and not more than 10 percent gravel or artificial materials of equivalent impermeability. Manure ponds constructed after January 19, 2012, must include a pond liner that does not exceed a unit seepage rate of $1X\ 10^{-6}$ centimeters per second. While these permit requirements protect against manure discharges from holding ponds, discharges can occur when streams exceed the 20-year peak stream flow rate. The dairy permits (Order No. R1-2012-0002 and Order No. R1-2012-0003) specify that waste storage facilities constructed after January 19, 2012 shall be located outside of 100-year floodplains, unless site restrictions require location within a floodplain, in which case, the waste storage facility shall be protected from inundation or damage from a 100-year flood event. The dairy permits also authorize the application of manure and process waters to land only if such application is at rates that are reasonable for the crop, soil, climate, special local situations management systems, and type of manure.

As described in Section 6.2, wet weather measurements of *E. coli* and enterococci bacteria concentrations draining from agricultural areas were much higher than the statewide objective and U.S. EPA (2012) criteria~~.~~, respectively. *E. coli* bacteria concentration measurements showed a geometric mean of 880 MPN/~~100mL~~100 mL, as compared to the numeric target of 100 MPN/~~100mL~~100 mL. Enterococci bacteria concentrations measurements showed a geometric mean of 1,556 MPN/~~100mL~~100 mL, as compared to the numeric target of 30 MPN/~~100mL~~100 mL. These results confirm that runoff from agricultural areas is an existing source of bacteria. Additionally, the results for grazer fecal waste are included in Chapter 4, Evidence of Pollution~~. They are mapped in Figure 4.6. The ten locations with the highest grazer fecal waste measured are shown in~~, Table 4.~~8. The majority of the sites with highest percent matches are in the~~7. Sites in the Upper Laguna de Santa Rosa ~~Watershed~~and Lower Santa Rosa Creek HUC-12 subwatersheds showed strong evidence of grazer fecal waste pollution. The Upper Laguna de Santa Rosa HUC-12 subwatershed as a whole showed strong evidence of grazer fecal waste pollution.

Figure 6.13 shows the results of the Bovine-source *Bacteroides* bacteria concentration measurements and the locations of dairies in the Middle Russian River Hydrologic Area. Visual comparison shows that higher concentrations of Bovine-source *Bacteroides* bacteria are near or downstream of the dairies. Figure 6.14 shows the results of the grazer fecal waste gene sequence measurements (the percentage of the grazer fecal waste gene sequences are shown) and the locations of dairies in the Middle Russian River Hydrologic Area. Visual comparison shows that higher levels of grazer fecal waste gene sequence measurements are near or downstream of the dairies. This source analysis approach does not distinguish between the various types of grazers, and in particular between cattle and dairy cows. However, based on an assessment of the data and the known distribution of cattle versus dairy operations, general assumptions regarding the relative contribution from cattle versus dairy cows are appropriate and Regional Board staff conclude that dairy operations are a probable source of pathogens.

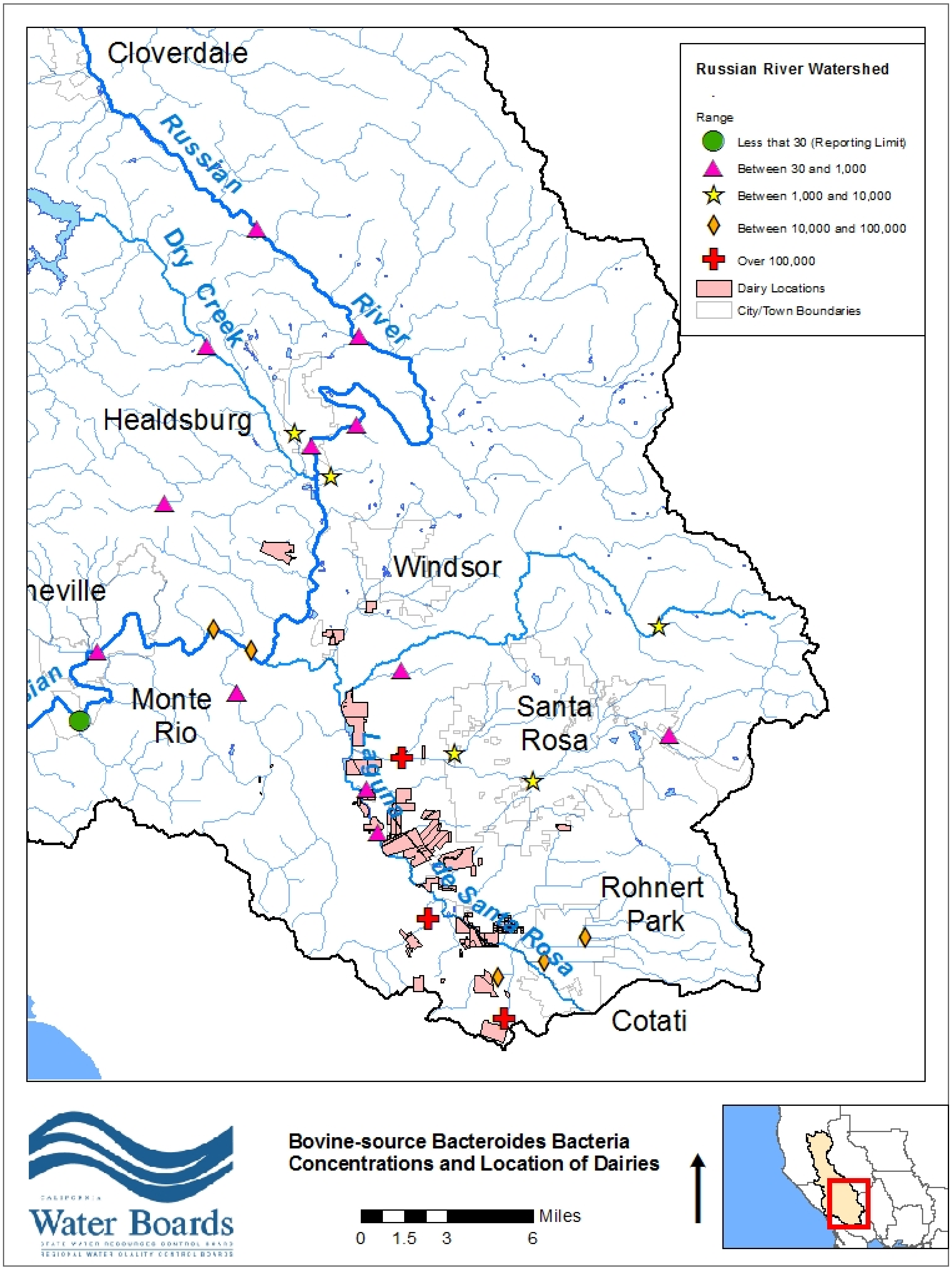

Figure 6.13: Locations Of The Bovine-Source Bacteroides Results And Dairies In The Middle Russian River Watershed.

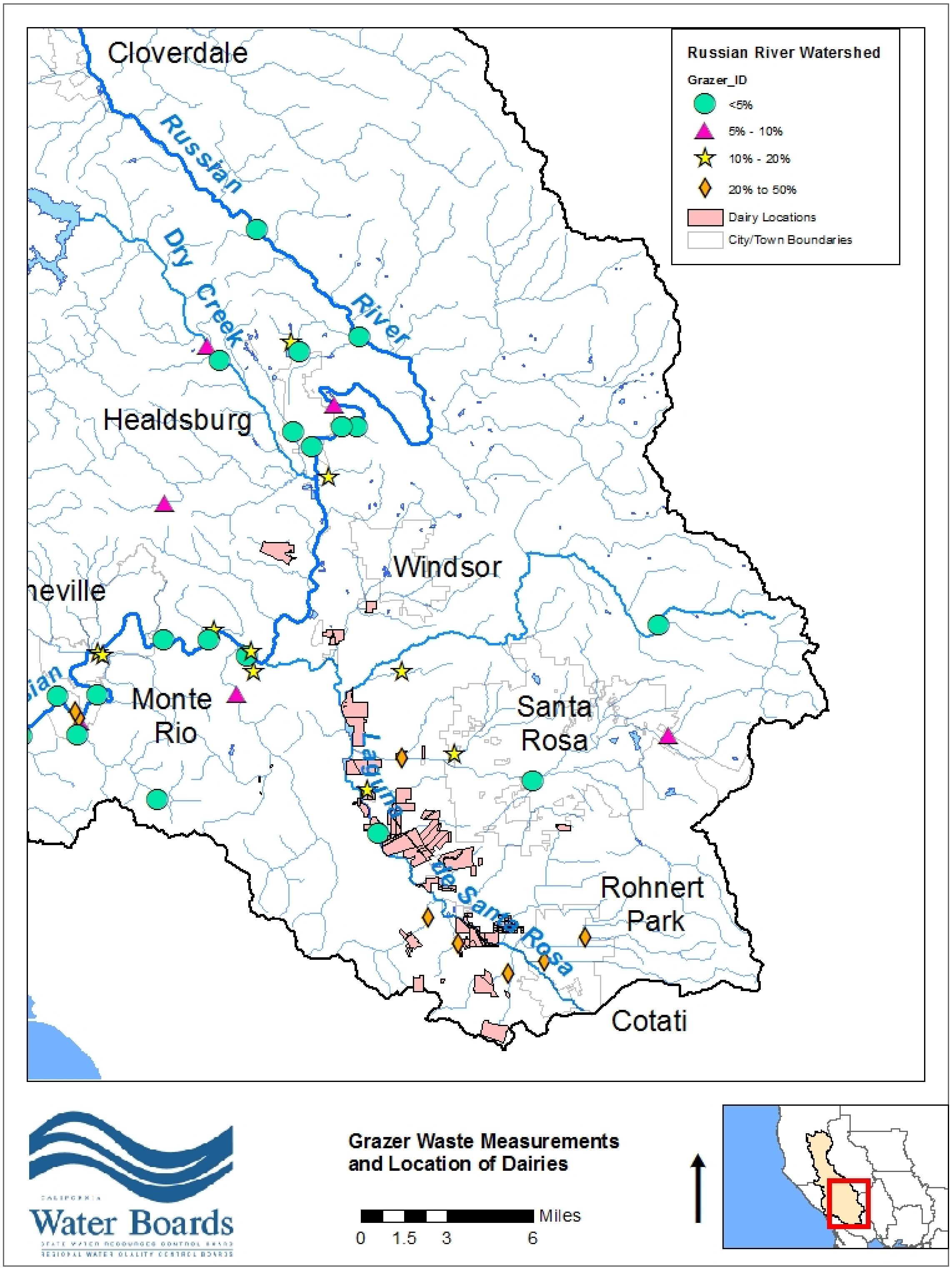

Figure 6.14: Locations Of The Grazer Waste Results And Dairies In The Middle Russian River Watershed.

6.5.5 NONPOINT SOURCE CONCLUSIONS

The Russian River Watershed has widespread nonpoint sources throughout the watershed that have the potential to deliver pathogens to surface waters. Assessment of potential fecal waste sources and fecal indicator bacteria do not inform relative load contributions between the point sources and/or nonpoint sources~~.~~, including runoff from facilities that discharge waste to land. All identified potential nonpoint sources of fecal waste to surface waters provide an elevated risk of pathogen discharge and impairment of REC-1 beneficial uses. The primary nonpoint sources of fecal waste include ~~OWTS,~~ homeless encampments, recreational water uses and users, and manure from dairies and non-dairy livestock. As such, all identified potential nonpoint sources of fecal waste to surface waters require a program of implementation and monitoring to prevent and assure that fecal waste and potential pathogens are not discharged to surface waters. *Chapter 9 – Implementation* describes the implementation and *Chapter 10 – Watershed Monitoring* describes the monitoring program designed to assure the ~~TMDL targets~~waste load and load allocations are achieved.

6.6 SOURCE ANALYSIS CONCLUSIONS

Potential sources of fecal waste within the Russian River Watershed are many and widespread. A significant number of potential sources are already covered under an individual or general permit and are controlled through use of treatment or best management practices.

In summary, staff analyzed sources of fecal waste with the potential to enter the Russian River or its tributaries in two different ways:

- By assessing fecal indicator bacteria concentrations associated with different types of land uses; and
- By identifying the types of point source, discharge to land, and nonpoint source facilities and activities that discharge or have the potential to discharge fecal waste to surface waters.

The source analysis does not estimate the volume of fecal waste entering the Russian River Watershed from any given potential source, nor does it stratify the sources based on order of magnitude. But, the multiple lines of evidence provide an understanding of the locations within the watershed with greatest risk from fecal waste, the land uses of most concern, and the point and nonpoint sources deserving further evaluation~~.~~ and/or control. For the purposes of this TMDL, the facilities/activities that discharge waste to land are considered nonpoint sources.

There is evidence of human and bovine fecal waste entering the waters of the Russian River Watershed during all times of the year, though higher during wet weather. Sewered and non-sewered developed areas are associated with exceedances of ~~numeric targets~~statewide objectives for *E. coli* and national criteria enterococci bacteria, indicating a threat to recreational use. Similarly, agricultural areas are also associated with exceedances of ~~numeric targets for *E. coli* and enterococci bacteria~~the same objectives/criteria.

From these multiple lines of inquiry, it is possible to conclude that the following source categories have potential to discharge pathogens to surface waters in the Russian River Watershed:

Sources of Human Fecal Waste Material

- Treated Municipal Wastewater to Surface Waters including discharges from holding ponds;
- Untreated Sewage from Sanitary Sewer Systems;
- Wastewater from Percolation Ponds and through Spray Irrigation;
- Runoff from Land Application of Municipal Biosolids and Biosolids Storage Areas;
- Runoff from Water Recycling Projects;
- Onsite Wastewater Treatment Systems, including individual systems and large or multi-user systems;
- Recreational Water Uses and Users;
- Homeless and Illegal Camping; and
- Storm Water to Municipal Separate Storm Sewer System (MS4s) and Areas Outside MS4 Boundaries, including CalTrans stormwater runoff.

Sources of Domestic Animal and Farm Animal Waste

- Pet Waste;
- Manure from Non-Dairy Livestock and Farm Animals; and
- Manure from Dairy Cows

Chapter 9 ~~(- *Implementation*)~~ describes the program of implementation by which these sources of fecal waste material are to be controlled, including completion of site specific studies/surveys~~ will be completed~~, development and implementation of new or upgraded management plans ~~developed~~ and ~~implemented, including the existing and new~~ applicable regulatory mechanisms~~ applicable to each source category.~~

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CHAPTER 7
TMDL CALCULATIONS AND ALLOCATIONS

7.1 OVERVIEW

A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality objectives. The TMDL equals the loading capacity of the waterbody for the pollutant plus a margin of safety (MOS) to account for any uncertainties. The MOS can be implicit by virtue of conservative assumptions or explicit, given as a measured or estimated term. The loads are allocated among the various sources of the pollutant. Anthropogenic pollutant sources are characterized as either point sources that receive a wasteload allocation (WLA) or nonpoint sources that receive a load allocation (LA). The natural background load is included in the load allocation, unless estimated separately.

TMDL = Σ WLAs + LAs + MOS

TMDLs can be expressed in terms of mass per time, toxicity or other appropriate measure. The TMDL must be set at a level not to exceed the loading capacity of the waterbody and at a level resulting in attainment of the water quality objective. It must be adjusted to account for seasonal variation, if appropriate.

7.2 LOADING CAPACITY, TMDL AND MARGIN OF SAFETY

~~Because the current~~ The fecal coliform objective ~~applicable~~contained in the ~~North Coast Region~~Basin Plan for protection of REC-1 is ~~soon to be~~ superseded by a statewide bacteria objective~~, the~~ for *E. coli* in freshwater and enterococci in saline waters, adopted by the State Water Board in August 2018. As such, the loading capacity, and by extension the TMDL, are based on the ~~draft~~ statewide ~~*E. coli* bacteria objective proposed by the State Water Board for~~ standard for the protection of REC-1~~ in freshwaters. The draft statewide bacteria objective itself is based on U.S. EPA national criteria (2012), which assessed the applicability of two *E. coli* criteria, each derived from a different number of acceptable illnesses per 1,000 recreators. The draft~~. The statewide bacteria objective is based on the lower of the two acceptable illness rates identified by U.S. EPA (2012) (i.e., 32 gastrointestinal illnesses versus 36). As such, the TMDL~~, based on the draft statewide bacteria objective,~~ includes an implicit margin of safety as represented by the lower of two acceptable illness rates. ~~The TMDL and loading capacity are defined in Table 7.1.~~

~~As an added margin of safety, thresholds for two fecal indicator bacteria are proposed as numeric targets (see Chapter 5). The indicators and targets are selected because of the epidemiological evidence that links their measurement to health outcomes, as described in U.S. EPA (2012). These two indicators measure different bacteria, but under different scenarios, are linked to similar health outcomes, and are identically scaled to result in no more than 32 gastrointestinal illnesses per 1,000 recreators. Should environmental factors~~

~~cause measurement of either of the indicators to result in a false positive, then the results of the other will allow for better assessment and response. Such a margin of safety ensures greater certainty when assessing attainment of the water quality objective and protection of public health.~~

7.3 WASTELOAD AND LOAD ALLOCATIONS

The loading capacity of the Russian River Watershed for ~~fecal waste~~pathogens is equivalent to the water quality objective, given as a concentration of the fecal indicator bacteria *E. ~~coli.~~coli* in freshwaters and enterococci in saline waters, as per the statewide objectives adopted by the State Water Board in August 2018. To attain ~~this~~these water quality ~~objective~~objectives, the wasteload (WLA) and load allocations (LA) are also equivalent to the water quality objective and given as the same concentration of *E. ~~coli.~~coli* in freshwater and enterococci in saline waters, as described in Table 7.1. Natural background concentrations of *E. coli* and enterococci have not been estimated. ~~As described in Chapter 3, Regional Water Board staff are conducting a reference study to estimate fecal indicator bacteria concentrations in minimally disturbed subwatersheds representing multiple different landscapes found within the Russian River Watershed and region as a whole.~~ For the purpose of this TMDL, natural background concentrations are not represented by a separate term~~,~~ but included in the load allocation. ~~The wasteload and load allocations are defined in Table 7.1.~~

Table 7.1

Source Category	**Type of Allocation**	**Allocation**
Municipal wastewater discharge to surface water (NPDES)	WLA	GM and STV for *E. coli* or enterococci depending on salinity
Municipal wastewater discharge to land (WDR)	WLA/LA	0
Sanitary Sewer Systems	LA	0
Land Application of Biosolids	LA	0
Recycled Water Irrigation Runoff	LA	0
Municipal Stormwater (NPDES)	WLA	GM and STV for *E. coli* or enterococci depending on salinity
CalTrans Stormwater (NPDES)	WLA	GM and STV for *E. coli* or enterococci depending on salinity
Large OWTS	LA	0
Individual OWTS	LA	0
Recreational Water Use and Users	LA	0
Homeless Encampments and Illegal Camping	LA	0
Non-dairy Livestock and Farm Animal Waste	LA	GM and STV for *E. coli* or enterococci depending on salinity
Dairies and CAFOs subject to NPDES permit	WLA	GM and STV for *E. coli* or enterococci depending on salinity
Dairies and CAFOs not subject to NPDES permit	LA	GM and STV for *E. coli* or enterococci depending on salinity

The sampling frequency and period of sampling is important to proper interpretation of monitoring results. The ~~draft~~ statewide *E. coli* objective for freshwater and enterococci objective for saline water requires that the geometric mean be calculated weekly based on a rolling 6 week period using a statistically relevant number of samples, generally a minimum of 5 within 6 weeks. The Statistical Threshold Value (STV) is to be exceeded no more than 10% of the time, calculated monthly. To remain consistent with the ~~draft~~ statewide *E. coli* objectives, the same sampling frequency and calculation approach are required here.

7.4 SEASONAL VARIATION

When establishing wasteload and load allocations, it is important to consider the seasonality of the discharge and beneficial use. A point source waste discharge prohibition applies in the Russian River Watershed, which limits point source discharge to the wet season, only. The existing waste discharge prohibition does not apply to nonpoint sources of waste. Chapters 4 and 6 provide evidence of fecal waste discharge during all times of the year, largely from developed areas, both sewered and nonsewered, though measured concentrations of ~~FIB~~fecal indicator bacteria are highest in the wet season.

The beneficial use of concern to this TMDL is REC-1, which is designated as a year round use. REC-1 includes multiple forms of water contact recreation and is based on the potential to ingest water incidental to the recreational activity. While the use is designated as a year round use, and there is no restricted access to rivers and streams during the winter; nonetheless, full body contact is most prevalent during the dry season months when the Russian River Watershed swimming beaches are more commonly enjoyed.

Because fecal waste discharge and REC-1 occur during all times of the year, and the TMDL is based on concentrations of *E. coli* for freshwater and enterococci for saline water, regardless of river flow, there is no seasonal variation required for this TMDL. The use of concentration limits as the waste load and load allocation intrinsically accounts for seasonality. The TMDL is based on the maximum allowable concentration of *E.* ~~*coli*~~*coli* in freshwater and enterococci in saline water to protect public health during all times of the year.

7.5 REQUIRED REDUCTIONS

An estimate of the reductions necessary to achieve the TMDL are useful for implementation planning and required as one of the nine elements of a watershed plan, to be eligible for 319(h) grant funding. Regional Water Board staff estimated the reductions in *E. coli* that would be necessary to achieve the TMDL, as reported in Butkus (2013d). [22] Staff evaluated historic *E. coli* data from 2002 to 2012 at numerous locations throughout the watershed, with a minimum of 5 samples required for the analysis. A statistical rollback method was applied to use the statistical characteristics of a bacteria concentration distribution to

[22] http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

estimate future concentrations after abatement processes are applied to sources. The percent reductions necessary to achieve both the geometric mean and statistical threshold value established by the ~~draft~~ statewide *E. coli* objective were estimated at each location where sufficient historic *E. coli* data was available. The required reductions range from 49-99% and are particularly important in the tributaries.

7.6 TMDL SCHEDULE

Attainment of a TMDL and its wasteload and load allocations is generally required on the quickest schedule that can reasonably be applied. Chapter 9 describes the implementation actions that are necessary to identify and control individual fecal waste sources. The Action Plan establishes the time frame for achieving each of the elements of the program of implementation. Completion of all action and attainment of the TMDL are anticipated to occur within 20 years of Action Plan adoption and approval.

CHAPTER 8
LINKAGE ANALYSIS

The purpose of this chapter is to establish the link between 1) the sources of fecal waste on the landscape, 2) evidence of fecal waste discharge to the Russian River and its tributaries, 3) the risk of contact with human and domestic animal fecal waste when recreating in and around the Russian River and its tributaries, 4) the increased risk of illness that could potentially result from contact with pathogen-contaminated waters, and 5) the reduction in risk of pathogen contact and illness that will result from the control of fecal waste discharge in a manner described in the proposed Program of Implementation.

8.1 SOURCES OF FECAL WASTE ON THE LANDSCAPE

Chapter 6 presents an inventory of all of the known sources of fecal waste on the landscape within the Russian River Watershed. Though the inventory does not quantify the relative contribution from each of the sources or establish their actual potential to discharge~~.~~ ~~Instead~~ from specific locations, it identifies each of the sources of fecal waste discharge within the Russian River Watershed.

8.2 EVIDENCE OF FECAL WASTE DISCHARGE

Chapter 4 provides evidence of human and bovine fecal waste discharge by describing the results of monitoring for *E. coli*, enterococci, and *Bacteroides* bacteria, among other measures of impact. *Bacteroides* bacteria ~~that~~ are specific to their animal host. Ambient water quality samples were collected throughout the watershed: upper, middle and lower reaches. The results indicate the widespread presence of human-specific and bovine-specific *Bacteroides* bacteria throughout the watershed~~. These~~ and exceedances of 1) statewide bacteria objectives and 2) national criteria for enterococci plus public health advisories in HUC-12s through the middle and lower reaches of the watershed. *Bacteroides* bacteria can only have entered the Russian River having first originated in the gut of their animal host~~.~~ and are a good measure of recent discharge. The *Bacteroides* analyses do not directly associate any of the known sources of fecal waste with evidence of discharge, except to the degree that it distinguishes between human sources and bovine sources.

Chapter 4 also provides evidence of human and grazer fecal waste discharge through the use of PhyloChip ™ DNA tracing. Water samples were analyzed for the presence of gene sequences that can be matched to a library of known animal fecal waste gene sequences. These data establish that human and grazer fecal waste are entering the Russian River Watershed at locations throughout the middle and lower portions of the watershed. The PhyloChip ™ study indicates that the most significant fecal waste discharge of concern in the Laguna de Santa Rosa subwatershed may be from dairies, while the most significant problem in the Guerneville subwatershed is from humans. The PhyloChip ™ study does not directly associate any of the known sources of fecal waste with evidence of discharge, except to the degree that it distinguishes between human sources and grazer sources. But, Chapter 4 provides clear evidence that investigation of the potential for discharge from the identified sources is warranted.

Chapter 6 confirms evidence of the discharge of human and bovine sources of fecal waste being associated with specific land cover types. Human-specific and bovine-specific *Bacteroides* and the other FIBs were associated with every landcover type during both dry and wet weather, but at levels nearly an order of magnitude higher during wet weather. The exception is with forestland, which has similar concentrations of both human-specific and bovine-specific *Bacteroides* and other FIBs during both dry and wet conditions. Non-sewered developed lands are identified as having the highest concentrations of fecal indicator bacteria during the dry season, while sewered developed lands had the highest during the wet season. Agricultural lands showed the largest concentrations of both human and bovine fecal waste sources during the wet season.

8.3 RISK OF CONTACT WITH FECAL WASTE

One of the general findings of the TMDL study is that the most significant discharge of fecal waste to the Russian River Watershed occurs as a result of storm water discharges. Another general finding is that the most significant recreational use of the Russian River Watershed is during the summer months when swimming, boating, and other water contact recreational activities are most common. With respect to public health protection, these findings are very good news: the most significant human health risk occurs during times of the year when the fewest people are in contact with water in the Russian River Watershed. It is important to keep in mind, however, that recreational use of the Russian River Watershed is allowed and occurs during all times of the year. Further, the Regional Water Board has designated the water contact recreational beneficial use as a year round use, thereby obligating it to ensure protection during all months of the year. In other regions of the State, a seasonal recreational beneficial use is sometimes applied and requires structures (e.g., fences) that prevent the public from making use of the waterbody during dangerous time of the year. This is not the case in the Russian River Watershed.

Chapter 6 describes the results of a focused study of the effect of onsite waste treatment systems (OWTS) on water quality conditions. In the study staff collected water quality samples in locations in surface water determined to have a high density of OWTS upgradient. Samples were analyzed for human-specific *Bacteroides*, *E. coli* and ~~enterococcus~~enterococci. The results of this sampling was compared to the results of identical sampling at locations determined to have a low density of OWTS upgradient. Specific to assessing the risk of human contact with fecal waste, the study showed that higher OWTS density is directly associated with higher concentrations of FIBs, including human-specific *Bacteroides*.

Further, Chapter 6 describes the relationship between the number of summer time swimmers and evidence of human-specific fecal waste. Water samples were collected and analyzed for *E. coli*, enterococci, and human-source *Bacteroides* bacteria. Samples were collected at Veterans Memorial Beach and Monte Rio Beach during the week of the Independence Day holiday in 2013. The study found that the percentage of *Bacteroides* bacteria that were human-source showed a relatively strong positive correlation with swimming recreation, with the higher percentages of human-specific *Bacteroides* observed on days with a larger number of people swimming. These data provide compelling evidence that summer recreational use of the Russian River Watershed does present a risk of contact with fecal waste, particularly at recreational beaches and during holidays when a larger number of people are present.

Finally, Chapter 6 relates various land cover categories with ambient water quality results for *E. coli*, enterococci, and *Bacteroides* bacteria. The Land Cover Study confirms the potential for developed areas (both urban and rural) and agricultural areas to be associated with elevated FIBs, including evidence of human and bovine-specific bacteria.

These studies effectively extend the area of concern to include urban areas, areas with a high density of OWTS, and areas such as shrubland, agricultural lands, and rural residential lands that include cows.

8.4 RISK OF PATHOGEN-RELATED ILLNESS

The primary mechanism by which the Action Plan assesses the potential for pathogen-related illness is through ambient water quality sampling for *E. coli* and enterococci using ~~draft~~ statewide bacteria objectives and U.S. EPA (2012) recommended criteria, respectively, as thresholds of concern. The TMDL assessment applied the specific thresholds that represent a risk to no more than 32 illnesses per 1000 recreators. Chapter 4 describes the results of the *E. coli* analyses in freshwater and enterococci analyses in saline water, with exceedances of the ~~draft~~ statewide bacteria objective at ~~16 of the 31~~numerous locations sampled. These locations ~~include: a number of reaches in the Russian River mainstem within the Geyserville and Guerneville~~are contained in the following HUC-12 subwatersheds~~, the~~: West-Slough-Dry Creek, Sausal Creek-Russian River, Upper Laguna de Santa Rosa, Upper Santa Rosa Creek, Lower Santa Rosa Creek, Lower Laguna de Santa Rosa, Porter Creek-Mark West Creek, ~~Atascadero Creek, and~~ Green Valley Creek~~. Chapter 4~~, Porter Creek-Russian River, Dutch Bill Creek-Russian River, and Willow Creek-Russian River HUC-12 subwatersheds also ~~describes the results of the enterococci analyses, with~~ were identified as impaired/polluted based on exceedances of ~~the U.S. EPA (2012) recommended~~national criteria ~~at 27 of the 31 locations sampled. Only four locations on the Russian River were free of~~for enterococci ~~exceedances, including the Russian River at: Vichy Springs Road, Talmadge Road, River Access Road,~~in freshwater coupled with public health advisories. Oat Valley-Russian River and ~~Hacienda Bridge Road.~~Brooks Creek-Russian River HUC-12 subwatersheds are identified as impaired/polluted on this basis.

These data were augmented by an analysis using PhyloChip™ phylogenetic DNA microarray. From the PhyloChip™ analysis, the genetic sequence of seven pathogenic bacteria species with the potential to cause human illness were identified at locations in the middle and lower Russian River Watershed. As many as 27 tributary locations and four mainstem locations showed evidence of contamination with *proteus mirabili, salmonella enterica, serratia marcescens, shigella flexneri, Staphylococcus epidermidis, Staphylococcus haemolyticus, and Yersinia sp*. Up to 41% of the samples collected showed the presence of one or more of these pathogenic bacteria, with potential to cause illnesses ranging from urinary tract infection, skin infections, gastroenteristis, pneumonia, meningitis, and the plague.

~~Finally~~As above, local agencies have on occasion been compelled to close public beaches within the Russian River Watershed because of exceedances of public health criteria. The City of Santa Rosa posts a permanent advisory against swimming in Santa Rosa Creek at Prince Memorial Greenway. In addition, an advisory against swimming has been posted on at least one of the public beaches in Sonoma County in all but 3 of the years between 2001 and ~~2014~~2018, with the largest number of posted days in 2008 (11 days), 2009 (80 days), 2011 (7), 2012 (36), ~~and~~ 2013 (9~~).~~), 2015(6), and 2017(8)..

To ensure a clear linkage of fecal waste discharge to fecal indicator bacteria concentrations, all the ambient water samples, which were analyzed for *E. coli* and enterococci, were also analyzed for human-source and bovine-source *Bacteroides* bacteria. The results provide evidence of human and bovine fecal waste discharge at all of the locations where *E. coli* or enterococci bacteria exceeded ~~draft~~ statewide bacteria objectives~~ and U.S. EPA (2012) recommended criteria, respectively,~~ confirming the linkage of fecal waste discharge to fecal indicator bacteria concentrations.

8.5 ATTAINMENT OF WATER QUALITY OBJECTIVE

~~The current water quality objective related to protection of water contact recreation from pathogens is established in the Basin Plan as a numeric fecal coliform objective. The fecal coliform objective is no longer deemed the best metric to assess risk of pathogenic illness, soon to be superseded by a statewide bacteria objective to be adopted by the State Water Board. The draft statewide objective currently out for public review is based on U.S. EPA (2012) and is an *E. coli* bacteria objective ensuring no more than 32 gastrointestinal illnesses per 1,000 recreators. Numeric targets are based on measurement of *E. coli* and enterococci bacteria with thresholds based on U.S. EPA (2012) that represent a risk of no more than 32 illnesses per 1,000 recreators. Measurement of these metrics~~Numeric targets to measure attainment of statewide water quality objectives are based on the statewide water quality objectives, themselves. Measurement of these metrics (i.e., *E. coli* in freshwater and enterococci in saline water) will allow assessment of the progress being made toward reducing fecal waste discharge and reducing potential public exposure to illness-causing pathogens. Similarly, attainment of the statewide bacteria objective will ensure protection of the REC-1 beneficial use and public health.

8.6 CONCLUSION

Fecal waste from animals and humans can contain pathogens. Indicator bacteria are associated with the presence of fecal waste and are routinely used as an indicator of pathogens. Ambient water quality samples were collected throughout the watershed: upper, middle and lower reaches. Monitoring data indicate that the Russian River watershed is impacted by fecal indicator bacteria in multiple reaches during both dry and wet weather. Chapter 4 and Chapter 6~~ of the staff report~~ provides evidence of human and bovine fecal waste discharge throughout the watershed, indicating high concentrations of pathogen indicator bacteria in the watershed, and multiple fecal waste sources within the Russian River Watershed, respectively.

The loading capacity is defined in terms of fecal indicator bacterial ~~indicator~~ concentrations and is equivalent to the numeric targets. The numeric targets correspond to an acceptable level of human illness in recreational waters, use indicators that correlate with controllable sources of pathogens, and are indicators that are associated with gastrointestinal illness rates. The numeric targets are associated with a human health risk that will protect the REC-1 beneficial use, and therefore effectively measure progress toward attainment of the water quality standards.

Reductions in ~~*E. coli* and enterococci bacteria concentrations~~fecal waste discharge from the identified sources ~~should~~are expected to result in a reduction in the discharge of pathogens and therefore a reduction of receiving water column concentrations~~,~~ of *E. coli* in freshwater and enterococci in saline water. These reductions are expected to correlate with a decrease in illness rate~~,~~ and support of the REC-1 use. The numeric targets are identical to the statewide bacteria objectives and protective of recreational beneficial uses; hence the TMDLs define appropriate water quality conditions. Therefore, the loading capacity, waste load and load allocations, and proposed actions to reduce the ~~pollutants~~ discharge of fecal waste and therefore pathogens will result in attainment of the numeric targets and thus achieve water quality standards.

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CHAPTER 9
PROGRAM OF IMPLEMENTATION

The purpose of the Program of Implementation is to describe the actions necessary to reduce and eliminate fecal waste discharges and attain water quality objectives. The Regional Water Board has discretion in how it implements the Program of Implementation described in this chapter. The Program of Implementation is incorporated into ~~a~~an Action Plan, to be proposed to the Regional Water Board for adoption as an amendment to the Basin Plan (Basin Plan Amendment). ~~Then~~The Action Plan is included as Appendix A. The Program of Implementation identifies:

1. Actions that staff expect will reduce and eliminate fecal waste discharges and associated pathogens;
2. Implementing parties for these actions;
3. Regulatory mechanisms by which the Regional Water Board will ensure that these actions are taken; and
4. A timeline for completion of actions.

9.1 WASTE DISCHARGE PROHIBITIONS

Discharges of fecal material from humans or from domestic animals to waters of the state are controllable water quality factors that shall conform to the bacteria water quality objective and be treated and managed in such a way as to ensure ambient fecal indicator bacteria concentrations are protective of REC-1. Controllable water quality factors are those actions, conditions, or circumstances resulting from human's activities that may influence the quality of waters of the state and that may be reasonably controlled.

In accordance with Water Code section 13243 and in order to achieve the bacteria water quality objective, to protect present and future beneficial uses of water, to protect public health, and to prevent nuisance, the Action Plan sets forth the following discharge prohibition:

> *Discharges of waste containing fecal ~~waste~~ material from humans or domestic animals[23] to waters of the state within the Russian River Watershed ~~that cause or contribute to an exceedance of the bacteria water quality objectives not otherwise authorized by waste discharge requirements or other order or action of the Regional or state Water Board~~ are prohibited. Compliance with this prohibition can be achieved in the following manner.*

[23] Examples of domestic animals include, but are not limited to, cows, horses, cattle, goats, sheep, swine, poultry, dogs, cats, or any other animal(s) in the care of any person(s).

1. *Implement adequate treatment and best management practices to prevent the discharge of fecal waste material from humans or domestic animals from entering a water of the state either directly, or indirectly as a result of stormwater runoff.*
2. *Comply with all fecal waste/pathogen-related provisions of an applicable NPDES permit.*
3. *Comply with all fecal waste/pathogen-related provisions of an applicable WDR.*
4. *Comply with all fecal waste/pathogen-related provisions of an applicable general WDR or waiver of WDRs.*
5. ~~1.~~ *Implement the terms of the Memorandum of Understanding between the North Coast Regional Water Quality Control Board and relevant local agencies to address fecal waste from homeless encampments and recreational water use.*
6. *For non-dairy livestock, implement best management practices to achieve the assigned load allocation within 2 years of the effective date of this TMDL and, if required by the Executive Officer, develop and implement a Ranch Management Plan. Once adopted by the North Coast Regional Water Quality Control Board, non-dairy livestock operations comply with the prohibition if dischargers are in compliance with all fecal waste/pathogen-related provisions of an applicable WDR or waiver of WDRs.*

Examples of domestic animals include, but are not limited to, cows, horses, cattle, goats, sheep, swine, poultry, dogs, cats, or any other animal(s) in the care of any person(s).

9.2 IMPLEMENTATION ACTIONS

Water quality assessment and monitoring results indicate the following source categories have potential to discharge pathogens to surface waters in the Russian River Watershed:

Sources of Human Fecal Waste Material

- Treated Municipal Wastewater to Surface Waters~~;~~, including discharges from holding ponds
- Untreated Sewage from Sanitary Sewer Systems~~;~~
- Wastewater from Percolation Ponds and through Spray Irrigation~~;~~
- Runoff from Land Application of Municipal Biosolids and Biosolids Storage Areas~~;~~
- Runoff from Water Recycling Projects~~;~~
- Runoff from sites that receive discharges of waste to land
- Onsite Wastewater Treatment Systems, both large and small, commercial and domestic;
- Recreational Water Uses and Users~~;~~
- Homeless and Illegal Camping~~; and~~
- Storm Water to Municipal Separate Storm Sewer System (MS4s) and Areas Outside MS4 Boundaries.

Sources of Domestic Animal and Farm Animal Waste

- Pet Waste~~;~~
- Manure from Non-Dairy Livestock and Farm Animals~~; and~~
- Manure from Dairy Cows

The implementation actions included in the Action Plan address the control of fecal waste discharge and associated pathogens from specific controllable pathogen sources (as identified in Source Analysis, Chapter 6), including humans and domesticated animals. Each probable source, it's implementing party(s), its applicable wasteload allocation (WLA) or load allocation (LA), and, where applicable, its implementation actions are described in the following sections. They include:

- Municipal wastewater discharges to surface waters
- Wastewater holding pond discharges to surface waters
- Percolation ponds and disposal by irrigation
- Sanitary sewer systems
- ~~Storage and use~~Land application of treated municipal sewage sludge (biosolids)
- Recycled water irrigation runoff
- Individual onsite wastewater treatment systems
- ~~Recreation~~
- Large onsite wastewater treatment systems
- Recreational water uses and users
- Homeless encampments and illegal camping
- ~~Urban~~Municipal storm water runoff
- Caltrans storm water runoff
- Non-dairy livestock and farm animals
- Dairies and CAFOs

9.2.1 MUNICIPAL WASTEWATER DISCHARGES TO SURFACE WATERS

There are municipal wastewater treatment facilities in the Russian River Watershed that are authorized pursuant to a National Pollutant Discharge Elimination System (NPDES) permit to collect, treat, disinfect and discharge fully-treated wastewater directly to the Russian River or its tributaries during the wet season up to certain percent of the river flow. These facilities are operated by:

- City of Ukiah
- City of Healdsburg
- City of Santa Rosa
- Russian River County Sanitation District
- Occidental County Sanitation District
- City of Cloverdale

The waste discharges are regulated under existing NPDES permits that include effluent limitations and disinfection specifications to ensure treatment processes achieve effective and reliable pathogen reduction. Disinfection requirements in these permits are derived from standards for tertiary-treated recycled water contained in title 22 of the California Code of Regulations. The Basin Plan describes discharge requirements for advanced treated wastewater~~ for discharges~~. When a disinfection system operates properly and attains the effluent limitations for total coliform bacteria, it will also attain the wasteload allocation for *E. coli* in freshwater and enterococci in saline water that is described in the

Action Plan. As a general matter, direct discharges of properly disinfected, treated wastewater to surface waters are not expected to contribute to an exceedance of fecal indicator bacteria concentration limits that are protective of REC-1.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, ~~dischargers~~discharges of wastewater from municipal treatment facilities directly to the Russian River or its tributaries shall attain the following effluent limitations in their NPDES permits and/or the wasteload allocation, whichever is most stringent:

1. The median concentration of total coliform bacteria shall not exceed 2.2 MPN/ 100 mL, using the daily bacteriological results of the last 7 days for which analyses have been completed; and
2. The number of total coliform bacteria shall not exceed 23 MPN/ 100 mL in more than one daily result in any 30-day period~~; and~~.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each entity shall maintain compliance with applicable waste discharge requirements for its wastewater treatment facility. To demonstrate compliance with limitations, ~~direct dischargers~~discharges of treated wastewater directly to the Russian River and its tributaries shall comply with existing monitoring and reporting requirements, including daily effluent monitoring at a location or locations where a representative sample of the effluent can be collected. ~~Direct~~ Dischargers shall provide to the Regional Water Board monthly discharge monitoring reports and other reports, as necessary, to demonstrate compliance with effluent limitations and wasteload allocations.

9.2.2 WASTEWATER HOLDING POND DISCHARGES TO SURFACE WATERS

There are five municipal wastewater treatment facilities in the Russian River Watershed that collect, treat, dispose, or recycle municipal wastewater and discharge treated effluent from a wastewater holding pond to the Russian River or its tributaries. These facilities are operated by:

- Town of Windsor
- City of Santa Rosa[24]
- Forestville Water District
- Graton Community Services District
- Russian River County Sanitation ~~District[1]~~District[18]

All municipal wastewater treatment facilities discharging directly to surface waters in the Russian River Watershed are regulated under NPDES permits that include effluent limitations and disinfection specifications to achieve pathogen reduction in the effluent, and the regulated dischargers listed in Section 9.2.1 above maintain reasonably consistent compliance with these limitations and specifications. However, wastewater discharged

[24] The City of Santa Rosa and the Russian River County Sanitation District also have the capability of discharging treated wastewater effluent directly to the Russian River or its tributaries.

from municipal wastewater holding ponds, although previously disinfected, is not routinely monitored after prolonged storage and prior to discharge to surface water to detect the presence of fecal indicator bacteria. Consequently, the discharge, upon entering the surface water, may not meet waste load allocations.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, ~~each entity~~NPDES permits adopted after the effective date of the Action Plan for entities authorized to discharge treated wastewater from holding ponds to the Russian River or its tributaries ~~shall maintain compliance with the wasteload~~must include 1) requirements for the entity to collect and ~~load allocations as follows, using the~~analyze bacteriological ~~results of~~samples from holding pond effluent ~~samples collected at least weekly for the calendar month for which analyses have been completed:~~

~~The geometric mean concentration~~and other pertinent information related to the discharge to determine whether discharges from the holding pond are attaining WLAs, and 2) effluent limitations that implement WLAs if it is determined that an entity's discharge causes or has the reasonable potential to cause an exceedance of ~~*E. coli* bacteria shall not exceed 100 MPN/ 100 mL, and~~WLAs. An entity's effluent monitoring requirements must include samples of a sufficient number and frequency to fully characterize the discharge from the holding pond to surface water.

~~1. The Statistical Threshold Value (STV) for *E. coli* bacteria shall not exceed 320 MPN/ 100 mL.~~

Within ~~five~~seven years from the effective date[25] of the Action Plan, the Regional Water Board will begin to conduct reasonable potential analyses (RPAs) for entities authorized to discharge treated wastewater from holding ponds to the Russian River or its tributaries and, where reasonable potential is determined, establish the ~~aforementioned~~ effluent limitations that implement WLAs in ~~each~~an entity's NPDES permit. The Regional Water Board shall complete the RPAs and establish appropriate effluent limitations when each individual NPDES permit is scheduled for revision.

Based on an entity's request and demonstration that it is infeasible for the entity to achieve immediate compliance with ~~these~~adopted effluent limitations, the Regional Water Board may authorize a schedule of compliance in the NPDES permit. A schedule of compliance shall include a series of required actions to be undertaken by the discharger for the purpose of achieving adopted effluent limitations ~~established pursuant to the Action Plan~~. These actions shall demonstrate reasonable progress toward the attainment of effluent limitations. The compliance schedule shall reflect a realistic assessment of the shortest practicable time to perform each task. The compliance schedule shall contain a final compliance date based on the shortest practicable time required to achieve compliance, but

[25] Federal law requires that TMDLs be incorporated into a Regional Water Boards water quality control plan (Basin Plan). The Basin Plan is a legal document that describes how a Regional Water Board would manage water quality. The TMDLs must be formally incorporated into the Basin Plan to be part of the basis for Regional Water Board actions. Basin Plan amendments are adopted through a public process that requires approval of the TMDLs by a Regional Water Board, the State Water Board, the Office of Administrative Law, and USEPA Region 9. The effective date of a TMDL Action Plan is date on which the US E.P.A. approves the Basin Plan amendment.

in no case exceed ten years from the effective date of the ~~TMDL.~~adopted NPDES permit. The deadlines for each action in the compliance schedule shall be specified in the NPDES permit and may be accompanied by interim requirements, such as, interim effluent limitations and pollutant minimization measures. If the final compliance date extends beyond the term of the NPDES permit, the final compliance date and supporting explanation shall be included in the permit findings.

9.2.3 PERCOLATION PONDS AND DISPOSAL BY IRRIGATION

There are six municipal wastewater treatment facilities and five privately-owned wastewater treatment facilities in the Russian River Watershed that collect, treat, and dispose of or recycle treated effluent to land via percolation ponds or by irrigation. These facilities are operated by:

- Bohemian Grove (private)
- Calpella County Water District (public)
- Camp Royaneh (private)
- City of Cloverdale (public)
- City of Ukiah (public)
- Geyserville County Sanitation Zone (public)
- Hopland County Water District (public)
- Rio Lindo Academy (private)
- Russian River County Sanitation District (public)
- Rodney Strong Vineyards (private)
- (Former) Salvation Army Lytton Springs Rehabilitation Facility (private)

The discharge of wastewater to surface water from percolation ponds and as a result of irrigation runoff is prohibited.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each entity shall maintain compliance with applicable waste discharge requirements for its wastewater treatment facility.

9.2.4 SANITARY SEWER SYSTEMS

There are ~~eighteen~~nineteen publicly-owned sanitary sewer systems in the Russian River Watershed that collect and convey domestic wastewater to wastewater treatment facilities for treatment, and disposal or recycling. These facilities are operated by:

- Airport/Larkfield/Wikiup Sanitation Zone
- Calpella County Water District
- City of Cloverdale
- City of Cotati
- City of Healdsburg
- City of Rohnert Park
- City of Santa Rosa

- City of Sebastopol
- City of Ukiah
- Forestville Water District
- Geyserville County Sanitation Zone
- Graton Community Services District
- Hopland County Water District
- Occidental County Sanitation District
- Russian River County Sanitation District
- Sonoma State University
- South Park County Sanitation District
- Town of Windsor
- Ukiah Valley Sanitation District

Publicly-owned sanitary sewer systems greater than one mile in length are regulated under General Waste Discharge Requirements for Sanitary Sewer System, Water Quality Order No. 2006-0003-DWQ (Sanitary Sewer General Order) and Monitoring and Reporting Program WQ 2013-0058-EXEC. The Sanitary Sewer ~~System~~ General Order prohibits the discharge of untreated or partially-treated wastewater from sanitary sewer systems to waters of the United States, including the Russian River and its tributaries.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each municipality and district shall maintain compliance with the Sanitary Sewer General Order and all amendments and subsequent updates to the Sanitary Sewer General Order.

9.2.5 LAND APPLICATION OF TREATED MUNICIPAL SEWAGE SLUDGE (BIOSOLIDS)

Currently, the City of Santa Rosa is the only public entity permitted for the land application of biosolids as a soil amendment in the Russian River Watershed. The City of Santa Rosa's biosolids application discharges are regulated under General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities, Water Quality Order No. 2004-12-DWQ (Biosolids General Order), which prohibits the discharge of biosolids to surfaces water and includes biosolids management practices to reduce the risk to public health and the environment.

In order to comply with the Action Plan, the City of Santa Rosa and any proponent of a future project involving the land application of municipal biosolids shall maintain coverage for its biosolids land application projects under the Biosolids General Order, or individual waste discharge requirements adopted to regulate the discharge of biosolids to land.

9.2.6 RECYCLED WATER IRRIGATION RUNOFF

There are ~~twelve~~thirteen municipalities and special districts, three private entities, and one university in the Russian River Watershed that use recycled water for landscape irrigation, crop irrigation and other approved non-potable uses. These facilities are:

- Airport/Larkfield/Wikiup Sanitation Zone
- City of Cotati
- City of Healdsburg
- City of Rohnert Park
- City of Santa Rosa
- City of Sebastopol
- City of Ukiah
- Forestville Water District
- Graton Community Services District
- Occidental County Sanitation District
- Russian River County Sanitation District
- Sonoma State University
- Town of Windsor
- Mayacamas Golf Club (private)
- Vintner's Inn (private)
- Virginia Dare Winery (private)

Recycled water projects that beneficially reuse treated wastewater for landscape irrigation, agricultural irrigation, or other use allowable under California Code of Regulations, title 22, chapter 3, article 3, section 60303 through 60307 are regulated under water recycling requirements in State Water Resources Control Board Order WQ 2016-0068-DWQ, Water Reclamation Requirements for Recycled Water Use (Recycled Water General Order) or Regional Water Board-issued waste discharge requirements. To prevent and/or minimize overspray, spills, and incidental runoff of recycled water that could reach surface waters, these projects rely on best management practices (BMPs). Water recycling BMPs are set forth in Regional Water Board-issued waste discharge requirements as water recycling specifications. For recycled water projects regulated under the Recycled Water General Order, water recycling BMPs are described by a discharger in its Notice of Intent and implemented immediately upon permit issuance, in accordance with an Operations and Management Plan. Where the water recycling entity is also regulated under the Phase I Municipal Separate Storm Sewer Systems (MS4) Permit, recycled water BMPs are implemented in accordance with a non-storm water BMP Plan approved by the Regional Water Board Executive Officer.

Title 22 prohibits the escape of recycled water from recycled water use areas as surface water flow that would enter surface waters. Accordingly, recycled water permits prohibit discharges of recycled water to surface water, except for when the runoff is deemed incidental. Incidental runoff is unintended amounts of runoff that are typically infrequent, low volume, not due to a pattern of neglect or lack of oversight, and are promptly addressed.

In order to ensure ambient fecal indicator bacteria concentrations are protective of REC-1, each municipality and district or other entity that is permitted to beneficially reuse treated wastewater for landscape irrigation, agricultural irrigation, or other use shall maintain compliance with its applicable water recycling requirements and shall develop and implement a Recycled Water BMP Plan, or equivalent BMP plan.

The Recycled Water BMP Plan shall include, at a minimum:

- BMPs to prevent overspray, spills, and incidental runoff;
- Setbacks from recycled water points of use to waterbodies, curbs, pavement and storm water inlets; and
- A compliance program that includes public outreach and progressive enforcement.

All permit applications for recycled water projects within the Russian River Watershed proposed after the effective date of the Action Plan shall submit a Recycled Water BMP Plan, or equivalent BMP plan, with the permit application. For Recycled Water BMP Plans being implemented prior to the effective date of the Action Plan, the implementing party shall submit written certification that their existing Recycled Water BMP Plan adequately prevents and/or minimizes overspray, spills, and incidental runoff. This certification shall be submitted to the Regional Water Board Executive Officer within ~~one month of~~three months after the effective date of the Action Plan. Any entity currently recycling water, but without a Recycled Water BMP Plan or an equivalent BMP plan, shall develop and implement a Recycled Water BMP Plan within two years after the effective date of the Action Plan. Where the entity is the producer and user of recycled water, the entity shall also submit to the Regional Water Board Executive Officer a Title 22 Engineering Report approved by the State Water Board Division of Drinking Water.

Where necessary, the Regional Water Board will require the submission of a Recycled Water BMP Plan and/or Title 22 Engineering Report under authority of section 13267 subdivision (b) of the Water Code.

9.2.7 INDIVIDUAL ONSITE WASTEWATER TREATMENT SYSTEMS

9.2.7.1 ONSITE WASTEWATER TREATMENT SYSTEMS (OWTS) POLICY

On June 19, 2012, the State Water Resources Control Board (State Water Board) adopted the OWTS Policy. The OWTS Policy took effect on May 13, 2013. The Regional Water Board, in accordance with the statewide OWTS Policy, amended the Basin Plan on June 18, 2015, to incorporate requirements of the OWTS Policy into the Basin Plan for the North Coast Region. The Basin Plan amendment was approved by the Office of Administrative Law on July 18, 2016.

Section 3.2 of the OWTS Policy allows the Regional Water Board to approve individual Local Agency Management ~~Plans (LAMP~~Programs (LAMPs) for local agencies that want to provide alternative minimum standards than those specified in the OWTS Policy for OWTS that pose the lowest threat to water quality and public health. Individual OWTS within the Russian River Watershed are regulated by the Sonoma County Permit and Resource Management Department in Sonoma County (Permit Sonoma) and by the County of Mendocino Health & Human Services Agency – Department of Environmental Health in

Mendocino County~~.~~ (DEH). These local agencies review development proposals that rely on individual OWTS for domestic waste treatment and disposal. Local agency staff also review permit applications and project plans for OWTS repairs and upgrades and issue repair permits as necessary in accordance with local policies. To ensure compliance with local regulations and technical standards for OWTS, local agency staff also conducts inspections at the time of OWTS construction and in response to complaints and reports of OWTS failures. For OWTS utilizing supplemental treatment components or enhanced effluent dispersal systems, both Permit Sonoma~~ County PRMD~~ and Mendocino County DEH implement permit programs that include periodic inspections of the OWTS by County staff and/or a service provider and self-monitoring requirements imposed on OWTS owners.

9.2.7.2 ADVANCED PROTECTION MANAGEMENT PROGRAM

An Advanced Protection Management Program (APMP) is a management program that establishes standards for OWTS near impaired waterbodies. The standards for an OWTS in an APMP may be established by the following:

- A TMDL implementation plan adopted by a Regional Water Board~~.~~;
- An approved LAMP with special provisions for OWTS that are near impaired waterbodies listed in Attachment 2 of the OWTS Policy; and
- The default APMP requirements prescribed by section 10.0 of the OWTS Policy.

The Action Plan establishes minimum requirements for all OWTS within the designated APMP area for the Russian River Watershed. Owners of existing, new and replacement OWTS whose OTWS are located entirely outside the boundaries of the APMP are not subject to the APMP requirements, but must still comply with relevant requirements of the OWTS Policy and any approved Local Agency Management Program (LAMP), and if applicable, individual/general waste discharge requirements or waiver of waste discharge requirements.

Section 10.1 of the OWTS Policy states that an APMP must specify its geographic area and the OWTS requirements that apply within that area.

9.2.7.3 THE GEOGRAPHIC AREA OF THE APMP

Given their proximity to surface waterbodies, OWTS discharging to the subsurface near a waterbody may contribute pathogens to surface waters by direct discharge (i.e., surfacing effluent from an improperly designed or located OWTS) or through contamination of groundwater in the vicinity of the OWTS as a result of incomplete soil treatment of the OWTS effluent and the migration of the contaminated groundwater to surface water. The likelihood that surface water will be adversely impacted by OWTS is increased significantly in areas with highly permeable soils and inadequate separation to groundwater, which are conditions that can result in incomplete removal of pathogenic organisms from the waste stream, and in areas where there is a high density of OWTS, particularly those areas with small parcel sizes and where there is a high percentage of existing OWTS that predate adopted local standards for the design and siting of OWTS. A Regional Water Board study (NCRWQCB 2013) confirmed that areas where OTWS are in close proximity, fecal indicator bacteria concentrations in surface water downstream of the OWTS are higher than for areas where the OWTS are widely spaced.

To establish the geographic area of the APMP, Regional Water Board staff applied the conclusions from TMDL monitoring and the identification of HUC-12 sub-watersheds (as described in Chapter 4 of this Staff Report) for which there is substantial evidence of pollution attributable to fecal waste discharges to establish an area of influence within which it can be expected that an OWTS ~~will~~could contribute to the impairment of a waterbody if the OWTS is failing or malfunctioning to the extent that the OWST requires major repair. Consistent with the Tier 3 of the OWTS Policy for areas near impaired waterbodies, ~~if an OWTS is within 600 feet of a waterbody, it is assumed to be contributing wastewater effluent to that waterbody. In addition, because Regional Water Board monitoring found that areas with OWTS situated in close proximity to each other adversely impacted downstream water quality, the geographic area of the APMP includes a density component, whereby OWTS located in areas with OWTS density greater than a threshold density of 50 parcels per square mile are also included in the APMP. The parcel density threshold of 50 parcels per square mile is a Regional Water Board staff decision to identify OWTS that posed the highest threat to contribute fecal contamination to surface waters~~The Action Plan establishes a 600-foot zone of influence for OWTS adjacent to perennial streams, which for the purposes of the Action Plan are blueline streams that are depicted on the USGS 1:100,00 scale topographic map, and a 200-foot zone of influence for lower class streams that are derived using a LIDAR dataset. The 600-foot distance is based on a microbial contamination zone that was recommended by the California Department of Public Heath (CDPH, 1999) to protect water supply from viral, microbial and direct chemical contamination. In the 1999 guidance document, CDPH found that for porous media aquifers, 600 feet is the recommended minimum distance for protection of water supply wells from microbial contaminants as well as chemical contaminants such as nitrate. This distance is believed to be sufficiently protective to protect public health from microbiological contaminants. The 600-foot zone of influence is consistent with State Water Resources Control Board's recommended distance when it established its Tier 3 default zone of influence in the statewide OWTS Policy for OWTS near impaired water bodies. For intermittent and ephemeral streams, Regional Water Board staff established the smaller, 200-foot zone of influence because contributions of wastewater from OWTS to these nonperennial streams are less likely to impair REC-1 beneficial uses in downstream waterbodies and the 200-foot distance is consistent with the minimum horizontal setback from a low risk OWTS to a spring or flowing surface water body required in Tier 1 of the OWTS Policy (section 7.5.4), plus a factor of safety.

Accordingly, the Action Plan defines the Russian River Watershed APMP boundary[26] to include both: 1) ~~areas~~parcels that are at least partially within 600 linear feet in the horizontal (map) direction on either side of the ~~entire mainstem~~centerline of ~~each waterbody~~blueline streams depicted on the ~~2012 303(d) list~~USGS 1:100,000 scale

[26] A map of the Russian River APMP Boundary is provided on the Regional Water Board website at http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

topographic map for ~~pathogens, which includes the Russian River, Santa Rosa Creek, Green Valley Creek, Dutch Bill Creek, and the Laguna de Santa Rosa~~impaired HUC-12 sub-watersheds, and 2) ~~areas~~parcels that are at least partially within ~~600~~200 linear feet on either side of the centerline of any ~~mapped stream~~waterway derived using LIDAR datasets in ~~sub-watersheds where parcel densities are greater than 50 parcels per square mile. Watersheds, defined as Hydrologic Units Code 12 basin names, with parcel densities greater than 50 parcels per square mile~~HUC-12 sub-watersheds that have evidence of pollution attributable to fecal waste discharges. Affected HUC-12 sub-watersheds include the following: Brooks Creek~~,~~ (Russian River), Sausal Creek (Russian River), Dutch Bill Creek~~, East Fork~~ (Russian River~~,~~), Green Valley Creek, Lower Laguna De Santa Rosa, Upper Laguna de Santa Rosa, Lower Santa Rosa Creek, Upper Santa Rosa Creek, Porter Creek (Mark West Creek~~,~~), Porter Creek~~, Salt Hollow~~ (Russian River), West Slough (Dry Creek~~, Upper Laguna de Santa Rosa, Upper Santa Rosa~~), Willow Creek~~, Ward~~ (Russian River),and Oat Valley Creek~~-Austin Creek, and Windsor Creek~~ (Russian River).

Any OWTS located on a parcel within the APMP boundary is subject to the requirements of the APMP. As described below, some APMP requirements will vary for individual OWTS based on the distance of the OWTS to the mapped stream.

9.2.7.4 OPERATION AND MAINTENANCE REQUIREMENTS

Proper operation and maintenance is essential to the long-term performance of any OWTS. Routine inspections and service visits can provide early detection of problems that could result in malfunction of OWTS and allows for timely repair before an OWTS becomes a public health hazard. Section 2.5 of the OWTS Policy requires that owners of OWTS maintain their OWTS in good working condition, including inspections and pumping of solids, as necessary, or as required by local ordinances, to maintain proper function and assure adequate treatment.

The Action Plan establishes an implementation action for owners of existing, new and replacement OWTS within the boundaries of the APMP to obtain a basic operational inspection of their septic tank, effluent dispersal area(s), and related appurtenances of the OWTS by a qualified professional once every five years. The objective of this requirement is to implement the OWTS Policy and to facilitate timely identification and resolution of maintenance and operational issues. To minimize the financial burden of routine inspection on owners of OWTS, the Action Plan allows that operational inspections can be scheduled by the OWTS owner to occur in conjunction with pumping of the septic tank, a property transaction, issuance of a local building permit, an in-field performance verification performed by a Service Provider certified by an OWTS manufacturer, or an inspection otherwise required by the local agency or Regional Water Board. So the Regional Water Board and the local agency are made aware of the results of the inspection for potential follow up actions, the OWTS owner ~~may~~will be required to submit a report of the inspection to the Regional Water Board and/or local agency within 30 days after completion of the inspection.

The appropriate frequency of monitoring and maintenance is related to the complexity of the OWTS, its age, location, site constraints, approved variances, repair history, past monitoring and inspection results, peak hydraulic loading, and other factors. However, in general, OWTS consist of a treatment component, which for a conventional OWTS is typically a septic tank, and an effluent dispersal component. At a minimum, a basic operational inspection should evaluate whether both the treatment and effluent dispersal components are functioning adequately to minimize the threat to water quality and public health. To provide direction to OWTS owners, the Action Plan specifies minimum requirements that must be included in an OWTS inspection. For conventional OWTS that use a standard septic tank and leachfield effluent dispersal field, the following are the minimum requirements that must be included in an OWTS inspection:

a. Septic Tank and Pump Systems
   i. Observations to detect leaks, cracks, excessive corrosion, root intrusion, odors
   ii. Presence and proper operation of liquid high-level alarm
   iii. Assessment of liquid levels in relation to tank outlet
   iv. Evidence of lack of water tightness
   v. Evidence of problems in downstream OWTS components, where they have been installed (e.g., distribution box, effluent filter, dosing tank)
   vi. Proper settings and operation of pumping system(s), where they have been installed

b. Effluent Dispersal Area(s)
   i. Evidence of odors or surfacing effluent (e.g., excessive vegetation)
   ii. Evidence of unequal effluent distribution
   iii. Observations of inspection ports

The requirement for owners and operators of OWTS to obtain a basic inspection will be required pursuant to Water Code section 13267 by the Regional Water Board Executive Officer. For OWTS utilizing supplemental treatment components and/or enhanced effluent distribution systems, the minimum requirements of a basic inspection will depend on the type of individual OWTS and will be specified in the investigative order.

9.2.7.5 CORRECTIVE ACTION REQUIREMENTS

Section 11.0 of the OWTS Policy requires that any OWTS that is failing or fails at any time while the Policy is in effect must be replaced, repaired, or modified to return the OWTS to proper function and comply with applicable local requirements. The OWTS Policy also prohibits the use of cesspools for new and replacement OWTS and OWTS subject to major repair.

To ensure that ambient fecal indicator bacteria concentrations are protective of REC-1, the Action Plan requires corrective action for cesspools and other OWTS within the boundaries of the APMP that do not include a septic tank and effluent dispersal system~~.~~ that complies with the OWTS Policy. The Action Plan also requires corrective action for OWTS that are routinely operated under conditions of hydraulic overloading, a condition that could result in overflows and solids carry-over to and clogging of the effluent dispersal field.

The Action Plan requires property owners with OWTS within the boundaries of the APMP that do not meet minimum requirements established in the Action Plan to repair or replace the OWTS. Where alternatives to repairs or replacement of an individual OWTS are available, the owner of the OWTS will be offered an opportunity to participate in the planning and completion of a community wastewater treatment and disposal system or equivalent alternative. Property owners that are required to upgrade, repair, or replace an existing OWTS or acquire a new OWTS must obtain the appropriate county permit in accordance with county ordinances and policies, or must obtain from the Regional Water Board waste discharge requirements or a waiver of waste discharge requirements. In accordance with a Memorandum of Understanding (MOU) between the Regional Water Board, the County of Sonoma, and the Sonoma County Community Development Commission, ~~the Sonoma County Permit and Resource Management Division of the Department of Public Works~~Permit Sonoma will be the lead organization for plan review, local permit issuance, construction inspection and monitoring of new OWTS and upgrades, and repairs or replacement of existing OWTS. Regional Water Board staff continue to work with Mendocino County to develop a similar agreement.

~~Section V.B.1.3.1 of~~ The Action Plan establishes minimum requirements for corrective action for new and replacement OWTS and for existing seepage pits within the boundaries of the APMP and conditions under which the requirements apply. To ensure that fecal indicator bacteria concentrations downstream of the OWTS are protective of REC-1, the Action Plan requires supplemental treatment components and/or enhanced effluent dispersal systems that provide sufficient pretreatment of the wastewater for the following conditions:

a. New[27] OWTS

  i. When ~~a new or replacement~~ the OWTS has ~~its~~an effluent dispersal system within ~~100~~600 feet from the top of the bank of any mapped stream within the APMP boundary~~;~~

b. Replacement[28] OWTS and OWTS Requiring Major Repair[29]

[27] New OWTS means an OWTS permitted or approved after the effective date of the TMDL Action Plan

[28] OWTS Policy (2013), section 1.0, defines replacement OWTS to mean an OWTS that has its treatment capacity expanded, or its dispersal system replaced or added to.

[29] OWTS Policy (2013), section 1.0, defines major repair to mean either: (1) for a dispersal system, repairs required for an OWTS dispersal system due to surfacing wastewater effluent from the dispersal field and/or wastewater backed up into plumbing fixtures because the dispersal system is not able to percolate the design flow of wastewater

i. When ~~a replacement~~the OWTS is designed to treat or dispose of a wastewater flow greater than the OWTS being replaced~~; or~~

~~.~~ When ~~a new or replacement~~the OWTS has a projected ~~wastewater~~ flow of 3,500 gallons per day or greater~~.~~

ii. ~~The Action Plan provides flexibility for the local agency to authorize~~, where the ~~authorization will not individually or collectively result in pollution or nuisance, replacement OWTS without supplemental treatment components or an enhanced effluent dispersal system if the replacement OWTS~~projected flow is ~~required for reconstruction due to a catastrophic natural event (e.g., fire, flood, tree falls). The local agency may also authorize a replacement OWTS without supplemental treatment components or~~the amount of wastewater flow into the OWTS as determined in accordance with an ~~enhanced effluent dispersal system when the replacement OWTS is proposed as a voluntary OWTS upgrade or repair initiated by the owner in response to a failing or marginally functional OWTS, provided that the replacement OWTS is not otherwise required to include pretreatment or an enhanced effluent dispersal system by the Action Plan.~~ approved LAMP

iii. When the OWTS is for a developed parcel permitted by the local agency for replacement of an existing OWTS that has been unutilized for five consecutive years or more prior to receipt of a building permit application by the local agency

iv. When OWTS is less than or equal to 600 feet from the top of the bank of any mapped stream within the APMP boundary, except when the replacement OWTS meets the conditions in Table 9.1

c. Seepage Pits

i. Seepage pits permitted or for which a construction permit by a local agency has been issued after May 13, 2016 are prohibited.

ii. Seepage pits permitted or for which a construction permit has been issued by a local agency prior to May 13, 2016 are prohibited unless the seepage pit includes supplemental treatment components to remove pathogens.

iii. Seepage pits may be authorized as replacement OWTS for existing cesspools only if the other options to comply with the Action Plan are infeasible.

Table 9.1 Site Conditions Requiring Supplemental Treatment and/or Enhanced Effluent Dispersal System for OWTS

OWTS Distance from Waterbody	Minimum Separation to Groundwater	Acceptable Percolation Rate	Acceptable Wastewater Application Rate

associated with the structure served, or (2) for a septic tank, repairs required to the tank for a compartment baffle failure or tank structural integrity failure such that either wastewater is exfiltrating or groundwater is infiltrating.

< 200 feet	36 inches	30-120 minutes per inch	Not to exceed application rate set forth in Table 3 OWTS Policy for determined percolation rate
200-600 feet	24 inches	30-120 minutes per inch	
> 600 feet	In accordance with Tier 2 requirements of on approved LAMP or, if there is no approved LAMP, Tier 1 of the OWTS Policy		

Where a local agency establishes more restrictive requirements, the more restrictive standards shall govern.

The Action Plan requires that, within the boundaries of the APMP and except for OWTS that are required to include pretreatment or an enhanced effluent dispersal system by the Action Plan or by local agency requirements, new OWTS must meet all local agency requirements for soils and setbacks for 1) an undeveloped parcel permitted by the local agency after ~~May 13, 2013~~the effective date of the Action Plan, and 2) for replacement of an existing OWTS that has been unutilized for five consecutive years or more prior to receipt of a building permit application by the local agency.

9.2.7.6 ~~INITIAL~~ OWTS ASSESSMENT

Consistent with the principle that proper operation and maintenance and routine inspections are essential to the long-term performance of any OWTS, the Action Plan establishes a program to assess whether each OWTS within the boundaries of the APMP is failing and/or in need of corrective action. The program will be carried out by the Regional Water Board and/or its agents and the local agencies and consists of an ~~initial~~ assessment process to evaluate the operational status of existing OWTS and a routine inspection process that is described in section 9.2.7.4~~ of the Program of Implementation~~.

~~As set forth in the Action Plan, for the initial~~ The assessment ~~process, The Regional Water Board and/or its agents will notify all~~ to identify the type of OWTS ~~within the boundaries of the APMP of the need to submit information that will be used to determine whether the OWTS is failing and/or in need of corrective action. The assessment~~ may include a desktop ~~assessment~~ or local record review, results of a sanitary survey, public survey, questionnaire, or~~, upon determination of the Regional Water Board,~~ a physical site inspection or evaluation. Information that may be used to ascertain the performance of an existing OWTS includes, but is not limited to, the OWTS type, age, approved variances, repair history, monitoring and inspection results, septic tank pumping records, maintenance records, peak hydraulic loading, and record of complaints received. As set forth in the Action Plan, for the OWTS assessment process, will notify all OWTS within the boundaries of the APMP of the need to submit information that will be used to determine whether the OWTS is failing and/or in need of corrective action. Upon conclusion of the assessment for an individual OWTS or group of OWTS, at the discretion of the Regional Water Board, the Regional Water Board will notify each property owner whether the OWTS is in need of corrective action to comply with the Action Plan. When a physical site inspection is conducted to provide information about the OWTS type and the inspection includes the minimum requirements for a basic operational inspection described in section 9.2.7.4, the inspection will satisfy the first five-year inspection requirement in the APMP.

The Regional Water Board will begin the process of notifying owners and operators of OWTS of the need to submit information within six months of the effective date of the TMDL Action Plan, under authority of section 13267 subdivision (b) of the Water Code. The schedule for notifications and the deadlines for submission of OWTS assessments will be developed in consultation with the local agencies and citizen advisory groups and will be based on the OWTS type, age, threat to water quality, approval date by the local agency, level of function, and other factors as required.

9.2.7.7 PLANNING FOR COMMUNITY-BASED SYSTEMS

The objective of the Regional Water Board's ~~initial~~ OWTS assessment is to identify ~~OWTS that are~~ failing OWTS, OWTS prohibited by the OWTS Policy (such as, cesspools), and~~/~~ OWTS that by their design or ~~in need of corrective action.~~ operation are a high threat to contribute pathogens and other pollutants to the Russian River or its tributaries. In areas within the APMP where there are significant numbers of existing OWTS that do not meet the minimum standards defined in the Action Plan, and where repairs or ~~upgrades~~replacement of individual OWTS to meet minimum standards are infeasible or cost prohibitive, the development of a community-based OWTS management plan ~~or Onsite Wastewater Management Authority, where authorized by a local agency,~~ may be appropriate. For development of a community-based management plan to be orderly, fair, and provide a path to compliance, coordination between the Regional Water Board ~~encourages the development of community advisory groups to assist the Regional Water Board and~~ , local agencies ~~in the development~~, affected homeowners, and ~~implementation of community-based solutions. It~~other stakeholders is ~~the intent of the Regional Water Board to provide adequate time for owners of failing and substandard OWTS to comply with the Action Plan and to seek and obtain financial and technical assistance for the planning and construction of community-based wastewater treatment and disposal systems, as necessary.~~ crucial.

As a pilot project to develop a framework for a public participation process, Regional Water Board staff is participating with Sonoma County and representatives from the communities of Monte Rio and Villa Grande to pursue public funding to investigate community wastewater solutions that would enable OWTS owners in the project area to comply with APMP requirements. An important component of this pilot project is a commitment by local agencies to coordinate and cooperate to identify technical and regulatory solutions to wastewater planning, to investigate funding options, and to secure public and private funding assistance for local actions to resolve wastewater disposal challenges and implement the TMDL Action Plan. To support this commitment, the Regional Water Board, the County of Sonoma, and the Sonoma County Community Development Commission have entered into a Memorandum of Understanding (MOU) that acknowledges the necessity of cooperation between the agencies to provide funding and facilitate community outreach for affected communities. Approved in December 2016, this MOU establishes the mutual understandings of the parties with respect to their joint efforts and responsibilities to implement the Action Plan as it relates to OWTS.

A second, vital component of the project is the formation of a community advisory group whose purpose is to provide input to the implementing agencies on the planning process and conduct meaningful outreach to homeowners and others affected by the requirements of the Action Plan. The Monte Rio/Villa Grande Community Advisory Group has met monthly since June 2018 and has made significant contributions to a Planning Scope of Work that is part of an application for funding by Clean Water State Revolving Fund Program. If successful, this pilot project will serve as a model for public outreach programs for infrastructure improvements and for establishing other community advisory groups in the Russian River Watershed where replacement of OWTS may be infeasible.

9.2.8 LARGE ONSITE WASTEWATER TREATMENT SYSTEMS

For the purpose of the Action Plan, a large OWTS means any OWTS with a projected flow greater than 10,000 gpd, any facility, such as a campground or ~~any~~mobile home park, with multiple OWTS whose combined projected flows are greater than 10,000 gpd, or any individual or combined OWTS with projected flow greater than that specified in an approved LAMP. In the North Coast Region, large OWTS are commonly used for domestic wastewater disposal for mobile home parks and campgrounds.

Discharges of untreated or partially-treated wastewater to surface water from large OWTS are prohibited. Accordingly, the ~~wasteload allocation for these facilities is zero~~load allocations described in Chapter 7 apply to this source.

Owners of large OWTS in the Russian River Watershed not regulated by WDRs or a Waiver of WDRs on the adoption date of the Action Plan shall notify the Regional Water Board by submitting a report of waste discharge containing information about their OWTS. The report of waste discharge shall be submitted to the Regional Water Board no later than three months after the effective date of the Action Plan. Based on the report of waste discharge, the Regional Water Board may issue WDRs or Waivers of WDRs for the OWTS.

9.2.9 RECREATIONAL WATER USES AND USERS

Discharges of human waste to surface water ~~in excess of water quality objectives~~ from individuals engaged in recreational water use are prohibited. Accordingly, the load allocations described in Chapter 7 apply to this source.

However, the Regional Water Board recognizes that the most effective strategy to reduce contamination from recreational water users will focus not on demanding compliance with a prohibition, but instead, through public outreach and education to increase the awareness of the connection between unhygienic activities and the impairment of the recreational use of the Russian River and its tributaries. To this end, the County of Sonoma and the Sonoma County Community Development Commission have entered into a Memorandum of Understanding (MOU) with the Regional Water Board that outlines a Joint

Policy for addressing water quality impacts relative to recreational water use. The Joint Policy includes a concerted effort to engage private landowners, other public agencies, and river users through educational or regulatory activities designed to reduce pathogen load from recreational activities. The Regional Water Board will coordinate with Mendocino County to develop a MOU or equivalent agreement to address water quality impacts from recreational water use in Mendocino County.

Potential joint implementation actions in both counties could include:

- Installing temporary or permanent restroom facilities and pet waste disposal stations near the recreation use areas and signage to effectively direct recreators to restroom facilities;
- Establishing interagency agreements with local sanitation districts to provide maintenance and waste disposal for temporary restroom facilities;
- Developing and distributing educational and outreach materials (fliers, brochures) to inform river recreators about proper waste disposal and sanitation at beaches and access points along the Russian River and tributaries;
- Conducting outreach to private recreational beach operators and commercial river outfitters to improve beach housekeeping and provide adequate sanitation facilities for customers;
- Publicizing locations of public restroom facilities on the county website and at recreational outfitters' headquarters; and
- Improving restroom facilities at popular private beaches.

9.2.10 HOMELESS ENCAMPMENTS AND ILLEGAL CAMPING

Discharges of human waste to surface water in excess of water quality objectives is prohibited. Accordingly, the load allocations described in Chapter 7 apply to this source.

However, addressing homelessness and its associated impacts to water quality is complex. Both Sonoma and Mendocino counties are developing and implementing strategies to engage unsheltered homeless people living near waterways in an effort to mitigate the impacts of homelessness, with the long-term goal of ending homelessness within their jurisdictions. The County of Sonoma and the Sonoma County Community Development Commission have entered into a Memorandum of Understanding (MOU) with the Regional Water Board that outlines a Joint Protocol for addressing water quality impacts relative to homeless encampments. The Joint Protocol includes sharing of information and technical assistance as necessary to support the County's actions, and quarterly meetings between responsible public and private entities to discuss activities addressing homeless issues in the Russian River area. The Regional Water Board will coordinate with Mendocino County to develop a MOU or equivalent agreement to address water quality impacts from homeless encampments in Mendocino County.

Where suitable housing for homeless persons exists or is planned, and the housing unit is served by an individual septic system, community septic system, or other approved waste treatment and disposal system, the design, installation, and operation of the system shall comply with the Action Plan and the LAMP for the local agency with jurisdiction over individual OWTS or requirements set forth in WDRs or waivers of WDRs. Throughout implementation of the Action Plan, the Regional Water Board will prioritize permitting for homeless-dedicated and affordable housing projects in the Russian River area for which Regional Water Board permits are required.

9.2.11 ~~URBAN~~MUNICIPAL STORM WATER RUNOFF

Within the Russian River Watershed's urban boundaries, storm water runoff and non-storm water runoff is regulated under a Phase I Municipal Separate Storm Sewer Systems (MS4) Permit. The current Phase I MS4 Permit, Order No. R1-2015-0030 (NPDES Permit No. CA0025054) became effective on January 6, 2016~~,~~ and continues in force until a new permit is issued. Traditional Small MS4s within the watershed are enrolled under Water Quality Order No. 2013-0001-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004, Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (Phase II MS4 General Permit). The County of Mendocino is currently enrolled under the Phase II MS4 General Permit. Sonoma State University is enrolled under the Phase II General Permit as a Non-Traditional Small MS4 permittee.

~~The County of Mendocino is the only entity within the Russian River Watershed enrolled under the Phase II MS4 General Permit.~~ Permittees currently named under the Phase I MS4 Permit are:

- City of Santa Rosa
- County of Sonoma
- City of Cloverdale
- City of Cotati
- City of Rohnert Park
- City of Healdsburg
- City of Sebastopol
- Sonoma County Water Agency
- City of Ukiah
- Town of Windsor

~~The County~~Under terms of ~~Sonoma and~~the current Phase I MS4 Permit, only the City of Santa Rosa ~~have~~and the County of Sonoma are required to prepare work plans (i.e. Pathogen Reduction Plans) to reduce pathogens in storm water runoff. As of 2019, the City of Santa Rosa has submitted a pathogen work plan that has been approved by the Executive Officer of the Water Board~~ to reduce pathogens in storm water runoff.~~. The scope of work includes the implementation of BMPs to reduce the levels of pathogens in the discharge to surface water. Implementation of the plans will be evaluated through adaptive management, with future modification potentially necessary, as supported by monitoring. The ~~remaining~~County of Sonoma has submitted a work plan that is currently undergoing revision by County staff for resubmission to the Regional Water Board.

For Phase I and II MS4 Permittees ~~in the Russian River Watershed must develop and implement a similar scope of work (i.e.~~ without approved Pathogen Reduction Plans on the effective date of the TMDL Action Plan~~) for Executive Officer approval.~~ (excluding the Sonoma County Water Agency, who does not have land use authority), the Regional Water Board will require submission of the Pathogen Reduction Plans under authority of section 13267 subdivision (b) of the Water Code. The ~~work~~Pathogen Reduction Plan shall include, at a minimum:

1. An inventory of fecal waste sources from human and domestic animals;
2. Proposed BMPs to reduce the levels of pathogens in the discharge to receiving water;
3. A proposal to conduct field monitoring, investigation, or research to confirm the source(s) identified as significantly impacting water quality;
4. A monitoring proposal to verify BMP effectiveness; and
5. A proposed implementation schedule.

~~For Phase I MS4 Permittees without approved Pathogen Reduction Plans on the effective date of the TMDL Action Plan, the Regional Water Board will require submission of the Pathogen Reduction Plans under authority of section 13267 subdivision (b) of the Water Code. For Phase II MS4 Permittees, the requirement to develop and implement a Pathogen Reduction Plan will be incorporated in the renewal of the Phase II MS4 Permit. Compliance with the TMDL~~Compliance with the TMDL for Phase I and Phase II MS4 Permittees requires attainment of the wasteload allocations described in Chapter 7.

9.2.12 CALTRANS STORM WATER RUNOFF

The California Department of Transportation (Caltrans) is regulated under General Storm Water Permit (NPDES Permit No. CAS000003), Waste Discharge Requirements Order No. 2012-0011-DWQ as amended by Order 2014-0077-DWQ, which includes TMDL-specific permit implementation requirements. The statewide permit regulates storm water and non-storm water discharges from Caltrans's properties and facilities, and discharges associated with operation and maintenance of the state highway system. In order to comply with the Action Plan, storm water and non-storm water discharges from Caltrans' facilities and properties in the Russian River Watershed shall attain the waste load allocations described in Chapter 7.

Upon renewal of the statewide storm water permit or as soon as is practicable, Regional Water Board staff will work with the State Water Board to ~~include~~establish the ~~requirements of the Action Plan in the~~ means by which Caltrans can achieve compliance with TMDL requirements~~ of the permit to ensure compliance with the given wasteload allocations.~~. Permit renewal is anticipated in ~~2017 or 2018~~2020.

9.2.13 NON-DAIRY LIVESTOCK AND FARM ANIMALS

Owners and operators of animal facilities, including animal husbandry, livestock production, other similar agriculture operations, and commercial animal boarding facilities, shall implement BMPs for control of fecal wastes~~.~~ within two years after the adoption of the Action Plan. The BMPs ~~shall~~may be included in a ranch management plan, or equivalent, and may be required by the Executive Officer. A ranch management plan may be designed to contain, stabilize, and reuse or dispose of waste in order to prevent discharge of fecal waste. Guidance on appropriate best management practices to properly contain and dispose of waste and prevent potential water quality impacts resulting from surface runoff of animal waste can be found in the University of California Davis Ranch Water Quality Planning Short Course materials. Management practices may include:

- Regular cleanup of fecal waste and soiled bedding in animal habitation areas;
- Use of covered impermeable surfaces for storage of fecal waste;
- Siting of fecal waste storage areas away from water courses and off slopes;
- Use of onsite composting to stabilize and reuse fecal waste;
- Preventing storm water runoff from contact with fecal waste storage areas and compost;
- Minimization and reduction of storm water contacting paddocks, and kennel areas;
- Use of vegetated buffers to provide a barrier to offsite migration of fecal waste; and
- Limiting of animals' access to waterways.

Discharges of fecal waste from animal husbandry operations, livestock production, other similar agriculture operations, and commercial animal boarding facilities must comply with the fecal waste discharge prohibition. Accordingly, the load allocation as described in Chapter 7 applies to these sources.

~~Pursuant~~The Regional Water Board intends to develop general WDRs or a waiver of WDRs as the ~~Action Plan,~~primary regulatory mechanism for compliance with the ~~requirement of owners and operators of~~ fecal waste discharge prohibition for non-dairy confined animal facilities ~~to submit a report of waste discharge for discharges from these~~and grazing operations. It is ~~waived for animal facilities~~anticipated that ~~implement these or similar best management practices that achieve~~ Regional Water Board adoption of the ~~same purpose, which is to protect water quality and public health.~~ future general WDRs or waiver will take a number of years to complete. Until this time, owners and operators of animal facilities ~~found to be in violation of the prohibition may be subject to enforcement action for the unpermitted discharge,~~and grazing operators should implement BMPs listed above, or similar BMPs, that are feasible and ~~may be required to submit a report of waste discharge for the possible establishment of waste discharges requirements for the discharge~~appropriate to their operation.

9.2.14 DAIRIES AND CAFOS

Each cow dairy and Confined Animal Feeding Operation (CAFO) in the Russian River Watershed is required to maintain compliance with a Conditional Waiver of WDRs, WDRs, or NPDES Permit, as applicable. ~~Under conditions set forth~~The General WDR for dairies is being revised in ~~Conditional Waivers of WDRs and WDRs,~~2019 Point source discharge of ~~wastewater from~~ dairy waste to waters of the ~~production area of cow dairies to surface water~~United States that is subject to an NPDES permit is prohibited~~.~~ in the revised General WDR.

~~Under an NPDES permit, discharge of process wastewater is prohibited from a CAFO except that portion of wastewater which overflows from a facility designed, constructed, operated and maintained to contain all process generated wastewater plus the runoff from a 25-year, 24-hour rainfall event. During a 25-year, 24-hour or greater rainfall event, discharges of fecal waste from CAFOs in the Russian River Watershed shall comply with the wasteload allocations described in Chapter 7. At all other times, the wasteload allocation for CAFOs shall be zero.~~

Within two years after the effective date of the Action Plan, in order to prevent discharges of fecal waste from dairies to surface water, each ~~enrollee~~dairy within the Russian River Watershed enrolled under the ~~Conditional Waiver of WDRs (Order No. R1-2012-0003) or~~General WDR ~~(Order No. R1-2012-0002)~~for Dairies or subsequent dairy Orders shall update required management plans (i.e., Water Quality Plan (WQP) or Waste Management Plan or comparable plans) to address sources of fecal waste. The updated actions to be taken to address fecal waste shall be in addition to those currently required under the ~~respective~~ order.

At a minimum, the ~~permit-required~~ management plans shall be updated to:

- Prevent or minimize animal access to water courses;
- Provide a vegetated buffer along water courses; and
- ~~Include a surface water monitoring plan for routine monitoring of fecal indicator bacteria sufficient in scope to demonstrate attainment of numeric targets and WLAs or LAs. Coordination between dairies and CAFOs, including but not limited to group monitoring, is encouraged; and~~
- Include an implementation schedule, with a commencement date not exceeding two years from the effective date of the Action Plan.

Monitoring of surface water will be required to provide information regarding the effectiveness of the required management plans, and other requirements of the Action Plan including: 1) compliance with the Fecal Waste Discharge Prohibition; 2) achievement of LAs; 3) attainment of the numeric targets; and 4) attainment of bacteria objectives and protection of beneficial uses.

The Regional Water Board will incorporate these requirements to address sources of fecal waste into ~~renewed Conditional Waiver of WDRs, WDRs, or NPDES permits when these orders come up for renewal, and into new dairy Waivers and WDRs as they are proposed and adopted. WLAs for CAFOs will be incorporated into the NPDES permit as effluent limitations upon renewal~~revised General WDRs when the order is renewed.

CHAPTER 10
WATERSHED MONITORING

10.1 OVERVIEW

As described in Chapter 2, the Russian River Watershed is a large watershed, which spans two counties and includes numerous towns and cities, the City of Santa Rosa being the largest at nearly 172,000 people. The watershed, nonetheless, maintains an essential rural character and covers an area of about 1,484 square miles. There is a large array of local, state, and federal agencies; private entities; and nonprofit organizations that are fully engaged in multiple efforts to study and restore a functioning Russian River Watershed system. The Program of Implementation described in Chapter 9 of this staff report to restore bacteriological health to the watershed, is only one of many stewardship efforts. As such, the watershed monitoring program designed to assess the success of the Action Plan, should be well coordinated with other similar efforts.

10.2 MONITORING PURPOSE

Chapter 9 describes multiple implementation actions by which individual entities will assess and control discharges of fecal waste to the Russian River Watershed. The Program of Implementation relies both on existing regulatory mechanisms and the development of new or updated voluntary and regulatory mechanisms by which to promote and ensure control of fecal waste discharge and protection of public health from pathogen exposure. The Regional Water Board intends to adaptively manage implementation of this TMDL by assessing the success over time of implementation actions with respect to the goal of reducing concentrations of fecal indicator bacteria in the Russian River and its tributaries. To this end, adaptive management of this TMDL requires a robust and thoughtful monitoring plan that is keyed to answering specific management questions, such as:

- Are individual implementation actions being correctly implemented and implemented on schedule?
- Are ambient water quality conditions improving from sewered developed areas, non-sewered developed areas, agricultural areas, and ~~undeveloped areas?~~other impacted areas (e.g., areas with homeless encampments)?
- Are ambient water quality conditions improving at key locations, such as recreational beaches and in popular boating reaches?
- Are ambient water quality conditions meeting water quality standards and 303(d) delisting requirements?
- Is there evidence of fecal waste sources not yet identified or addressed by the Action Plan?
- Is there evidence that individual implementation actions should be adapted to better address fecal waste pollution?

These key questions, and others as developed with stakeholders, will be answered through monitoring and reporting requirements associated with permitted waste discharges and coordinated ambient water quality monitoring, including public health monitoring.

10.3 RUSSIAN RIVER REGIONAL MONITORING PROGRAM

The concept of a Russian River Regional Monitoring Program (R3MP) has been established, engaging multiple interested parties. The purpose of the R3MP is ~~many fold,~~broadly defined but is consistent with the goals and purpose of the Russian River Pathogen TMDL. ~~The Russian River Watershed Association (RRWA) has acquired grant funding to develop~~ The R3MP~~, which~~ will ~~help to~~ coordinate the monitoring efforts of its member agencies, including cities, towns, Sonoma and Mendocino Counties~~. Similarly, the Regional~~, and Sonoma Water ~~Board has acquired discretionary contract money to assist in the effort by developing a governing structure. The R3MP is still~~. The Program is currently under development~~. But, it will be~~ , but has to date formed a Steering Committee of local agencies, adopted initial management questions, a Charter, and is in the process of evaluating funding models. The R3MP is modeled ~~on~~after established regional monitoring programs, including those in the Klamath Basin ~~Monitoring Program~~ and San ~~Francisco~~Francisco's Bay ~~Regional Water Board's Regional Monitoring Program~~and Delta. Coordination will likely include:

- Ambient ~~sampling~~conditions monitoring;
- Compliance monitoring;
- Status and trends monitoring;
- Standardized sampling methods, protocols, and Quality Assurance/Quality Control;
- Data sharing and ~~compilation~~visualization;
- Data assessment and interpretation;
- ~~Information~~Special studies;
- Peer-reviewed publications and watershed health reporting ~~and sharing with~~ to stakeholders and the public~~;~~, and;
- Regular public meetings to share and discuss implementation activities, ~~data~~analytical results, research, and other information critical to water quality and the health of the Russian River Watershed.

The R3MP is being developed to accommodate growth to include multiple members with multiple purposes related to the restoration of the water quality and ecological health of the Russian River Watershed. Entities responsible for implementation under the Action Plan ~~should~~ are encouraged to participate in the R3MP once it is fully established~~,~~ to ensure the best possible coordination ~~amongst~~among monitoring partners. The Regional Water Board will be an active member of the R3MP and represent its own monitoring resources available through the State's Surface Water Ambient Monitoring Program (SWAMP).

10.4 INDIVIDUAL MONITORING & REPORTING REQUIREMENTS

As described in Chapter 9, dischargers and parties responsible for potential sources of fecal waste discharge will be required to assess and control sources of fecal waste and pathogens as measured by fecal indicator bacteria. Dischargers operating under existing, new or revised NPDES permits or WDRs will be required to monitor, assess, and report on the implementation of their assigned actions, including compliance with the implementation requirements and their effectiveness. For some identified pathogen sources, implementation actions are conducted in accordance with a memorandum of agreement or some other agreement between the Regional Water Board and a local agency, or in accordance with requirements in a Local Agency Management Plan (LAMP).

Generally speaking, a point source discharge must be sampled at its point of entry to any surface water of the State to confirm source control effectiveness and compliance with wasteload allocations. Similarly, ambient water quality conditions must be sampled in receiving waters at reasonably close locations above and below the point of discharge to confirm water quality improvements and compliance with the fecal waste discharge prohibition.

A nonpoint source discharge is generally assessed by 1) inspection of best management practices (BMP) to confirm that they are properly installed and functioning, 2) photographic evidence of BMP performance and ambient conditions, and 3) ambient water quality monitoring at multiple locations above, associated with, and below a nonpoint source. Nonpoint source monitoring is necessary to confirm source control effectiveness, and compliance with the load allocations. Ambient water quality conditions are also sampled to confirm water quality improvements and compliance with the fecal waste discharge prohibition.

Discharges of waste to land must meet the discharge requirements specified in the applicable permit or order, to ensure proper treatment, disinfection, and disposal. Discharges of waste to land with the potential to result in impacts to groundwater or surface water via subsurface migration may be required to conduct site specific monitoring, including the installation of groundwater monitoring wells to characterize such potential impact or migration.

Leaks and spills with the potential to discharge directly to surface water, discharge indirectly to surface water via subsurface migration, or impact groundwater may also be required to conduct site specific monitoring, including the installation of groundwater monitoring wells to characterize such potential discharge, migration, or impact.

10.5 MONITORING RECREATIONAL USE

The Sonoma County Department of Health Services, Environmental Health and Safety Section currently conducts monitoring at several of the beaches with the authority to issue public warnings or close beaches, as conditions ~~warrant it~~indicate. The Regional Water Board works in coordination with the County on this and other such issues of public health protection. Such coordination is critical to the successful implementation of the Action Plan, including the collection of data necessary to assess that success. Regional Water Board staff anticipate continued coordination with the County on beach monitoring and assessment.

10.6 ~~AMBEINT~~AMBIENT WATER QUALITY MONITORING

There are multiple approaches to successful ambient water quality monitoring, which the R3MP should be central to designing and implementing. With respect to the Regional Water Board's specific interest in correcting the problem of fecal waste pollution and public health protection, there are a few key parameters that should be part of any ambient water quality monitoring, whether performed for effectiveness, water quality ~~trend~~trends, compliance, or public health protection purposes.

The statewide bacteria objectives for the protection of REC-1 establish *E. coli* limitations for freshwater and enterococci limitation for saline water. Compliance with water quality standards for REC-1 protection will be determined based on attainment of these objectives. 303(d) delisting of impaired reaches will be based on the guidance contained in the 303(d) Listing Policy. As described in this staff report, fecal indicator bacteria each have their own particular sensitivities with respect to environmental influences, however. As such, a weight of evidence approach is ~~necessary~~appropriate to ensure full and complete protection of water quality, beneficial uses, and public health. In the case of the Russian River Watershed, the fecal indicator bacteria that are most relevant and valuable are: *E. coli* ~~and~~, enterococci, and *Bacteroides* in freshwater and enterococci and *Bacteroides* in saline water as described in Chapter ~~5 regarding numeric targets.~~3, Bacteria Standards and Other Indicators of Pathogen Pollution. At a minimum, ambient water quality monitoring should include these metrics. *E. coli* ~~and~~, enterococci, and *Bacteroides* results indicate whether or not there is evidence that there is a risk to REC-1 of unacceptable human exposure to illness causing pathogens.

There are multiple other lines of evidence that could provide important assessment information, however.~~ For example, human and bovine *Bacteroides* data were used in the Russian River Pathogen TMDL to confirm that exceedances of the statewide *E. coli* objective or national enterococci criteria were related to fecal waste discharge, rather than a result of environmental influences.~~ Many other potential lines of evidence are described below for use in an ambient water quality monitoring program, including: individual or general monitoring and reporting requirements, the R3MP, SWAMP, and public health monitoring.

The ambient water quality monitoring conducted to support development of this TMDL did not include monitoring in every HUC-12 within the Russian River Watershed; nor did it include collection of every parameter within each HUC-12 subwatershed. The following are HUC-12 subwatersheds in which the limited data collected suggests the need for additional data collection to assessment impairment/pollution status: Orrs Creek-Russian River, Cummiskey Creek-Russian River, and Gill Creek-Russian River. In addition, it is a high priority to collect ambient water quality data in Windsor Creek for which there currently is none.

10.6.1 BACTEROIDES BACTERIA

Because of the short life span, *Bacteroides* bacteria concentrations are often used to indicate recent fecal contamination of surface waters. *Bacteroides* bacteria are a suitable indicator of a waterbody's bacteriological quality since the bacteria come from the gastrointestinal systems of animals, they degrade rapidly outside of the body, and technology is available to trace the bacteria back to specific types of animals, including humans and domestic animals. Host-specific *Bacteroides* bacteria can be used to help assess the natural background of pathogenic indicator bacteria in minimally disturbed waterbodies. Current recommended genetic markers and protocols for *Bacteroides* bacteria analysis are described by Griffith et al. (2013). Additional markers may also be appropriate in the future as technology advances to improve assay sensitivity and performance. As above, *Bacteroides* is recommended as part of a triad of metrics to assess the presence of fecal waste and the potential for exposure to illness-causing pathogens above water quality standards.

10.6.2 BACTERIOPHAGES

Measurement of *Bacteroides* bacteriophages may provide additional information on animal hosts. *Bacteroides* bacteria are rapidly inactivated by environmental oxygen levels, but *Bacteroides* bacteriophages are resistant to degradation. One group of phages that specifically uses *B. fragilis* strain HSP40 as host is found only in human feces and not in feces of other animals.

10.6.3 VIRUSES

Several analytic methods detect viruses excreted in feces and/or urine with high specificity to human waste and almost no cross-reactivity with other sources. Among the virus methods, markers for DNA viruses, such as human adenovirus and human polyomavirus, are among the more sensitive and robust. These viruses are fairly widespread among humans, and a sizable portion of the population sheds polyomaviruses passively. In addition, the DNA genomes of these viruses are less labile than those of common human enteric viruses with RNA genomes, which may make them more resistant to environmental degradation and therefore easier to detect.

10.6.4 CHEMICAL SOURCE TRACKING

Chemicals found in wastewater might be useful for independently confirming human waste in ambient surface waters. Measurement of chemicals that could include optical brighteners used in laundry detergents, caffeine, fecal sterols (metabolic byproducts of human digestion processes), and metabolite of nicotine (cotinine) excreted by tobacco users.

The collection of any water quality data must be in accordance with an approve QA/QC Plan. *E. coli* and enterococci data should be collected on a weekly basis to ensure an adequate number of samples to assess compliance with the targets. These data will be important for determining public health risk related to REC-1 impairment. Similarly, storm water monitoring also will be important to assessing the effectiveness of the Action Plan. A storm water monitoring plan should consider monitoring locations that allow assessment of: 1) the impact of known fecal waste discharges, 2) the location of unknown fecal waste discharges, 3) the water quality trends associated with specific areas (e.g., sewered and unsewered developed areas, agricultural areas) and 4) the water quality trends in waters contained within the Advanced Protection Management Program (APMP) area.

10.7 SPECIAL STUDIES

The Sonoma County Water Agency mechanically breaches the sand bar that forms at the mouth of the Russian River in the spring/summer months if there is threat of flooding of low lying housing in the estuary. However, the National Marine Fisheries Service (NMFS) has concluded that the freshwater lagoon conditions that form behind the sand bar are beneficial to the growth of young steelhead and should be preserved, as possible. The TMDL analyses did not specifically include assessment of the degree to which the presence of the sand bar and freshwater lagoon at the mouth of the river affect upstream ambient water quality conditions. But, the Environmental Impact Report for NMFS's Biological Opinion concluded that there might be water quality impacts that are not mitigatable. Further assessment of the effects of these phenomena on water quality conditions and implementation of the pathogen TMDL is warranted.

10.8 REPORTING AND ASSESSMENT

Regional Water Board staff will review and assess the monitoring results provided under individual or general monitoring and reporting requirements, the R3MP, SWAMP, and public health monitoring. Staff anticipates periodically compiling data and data assessments into a stewardship report, which is produced in collaboration with partners and public feedback, as a basis for adaptive management. For example, monitoring approaches may be revised, if data are inadequate to assess program effectiveness. Similarly, implementation requirements may be revised if data indicate that the assigned actions show no effect.

Continued and ~~coordinate~~coordinated monitoring of the Russian River Watershed may lead to the inclusion of new reaches of the Russian River Watershed on the 303(d) List of Impaired Waters. Similarly, such monitoring may lead to delisting other reaches, as water quality conditions improve, overtime.

CHAPTER 11
CEQA SUBSTITUTE ENVIRONMENTAL ANALYSIS

The Regional Water Board is the lead agency for evaluating the environmental impacts of a Basin Plan amendment pursuant to the California Environmental Quality Act (CEQA). The Regional Water Board basin planning process is certified by the Secretary for Natural Resources as "functionally equivalent" to CEQA, and therefore exempt from the requirement for preparation of an environmental impact report or negative declaration and initial study[30]. Basin Plan amendments proposed for board approval must include or be accompanied by a Substitute Environmental Documentation (SED)[31] which shall include, at a minimum, all of the following:

1. A brief description of the proposed project (Section 11.1; Details described in Chapters 1-10).
2. An identification of any significant or potentially significant adverse environmental impacts of the proposed project. (Section 11.4)
3. An analysis of the reasonably foreseeable alternatives to the proposed project. (Section 11.2)
4. An analysis of mitigation measures to avoid or reduce any significant or potentially significant adverse environmental impacts of the proposed project. (Section 11.4)
5. An environmental analysis of the ~~reasonable~~reasonably foreseeable methods of compliance. (Chapters 9 and Section 11.4)

The SED shall contain an environmental analysis of reasonably foreseeable methods of compliance (compliance measures) for the project that include the following components:[32]

1. An identification of the reasonably foreseeable methods of compliance with the project. The reasonably foreseeable methods of compliance (hereinafter compliance measures) are the potential actions that responsible parties may employ to comply with the TMDL load allocations, numeric targets and the implementation measures in the Action Plan. (Chapter 11.4)
2. An analysis of any reasonably foreseeable significant adverse environmental impacts associated with the reasonably foreseeable methods of compliance.

[30] Cal. Code Regs., tit. 14, § 15251(g); Cal. Code Regs., tit. 23, § 3775.
[31] Cal. Code Regs., tit. 23, § 3777.
[32] Cal. Code Regs., tit. 23 § 3777(b)(4); Cal. Code Regs., tit. 14 § 15187(c); Cal. Pub. Resources Code, § 21159 (c).

3. An analysis of any reasonably foreseeable alternative methods of compliance that would have less significant adverse environmental impacts. (Chapter 11.2)

4. An analysis of the reasonably foreseeable mitigation measures that would minimize any unavoidable significant adverse environmental impacts (Chapter 11.4)

The SED must take into account a reasonable range of:[33]

1. Environmental, economic, and technical factors. (Chapters 1-12)

2. Population and geographic areas. (Chapters 1 & 2 &11)

3. Specific sites (Chapters 9 & 11)

While the regulations require consideration of a "reasonable range" of the factors listed above, an examination of every site is not required.[34] The statute specifically states that the agency shall not be required to conduct a "project-level analysis."[35] Rather, in most circumstances, the site-specific analysis will be performed by the responsible party or the agency with jurisdiction when an activity is conducted in conformance with the Basin Plan amendments.

Notably, the Regional Water Board is prohibited from specifying the manner of compliance with requirements in waste discharge requirements or other Order,[36] and accordingly, the actual environmental impacts will necessarily depend upon the compliance strategy selected by the responsible party.

This Staff Report ~~*for the Action Plan for the Russian River Watershed Pathogen TMDL* (2017 Staff Report),~~ includes the CEQA checklist, along with the Action Plan. Following public review and comment, a response to comments document will be produced and modifications to the Action Plan, as necessary. The proposed Action Plan, resolution adopting the Action Plan, and public comments and response to public comments will be available prior to the public hearing. These materials fulfill the requirements of California Code of Regulations, title 23, section 3777, and the Regional Water Board's substantive CEQA obligations.

Any potential environmental impacts associated with implementation of the Action Plan depend upon the specific compliance projects selected by the responsible parties, many of whom are public agencies subject to their own CEQA obligations[37]. Consistent with CEQA, the SED does not engage in speculation or conjecture but rather considers the reasonably

[33] Cal. Code Regs., tit. 23 § 3777(c); Cal. Code Regs., tit. 14 § 15187(d); ~~Cal.~~ Pub. Resources Code, § 21159 (c).
[34] Cal. Code Regs., tit. 23 § 3777(c);
[35] Cal. Code Regs., tit. 23 § 3777(c); Public Resources Code § 21159(d)
[36] ~~Cal. Water~~ Wat. Code § 13360
[37] Public Resources Code § 21159.2

foreseeable feasible mitigation measures, and the reasonably foreseeable methods of compliance, which would avoid, or minimize the identified impacts.

The Regional Water Board recognizes that there may be project-level impacts that the local public agencies determine cannot be avoided or minimized to have less than significant adverse impacts. To the extent there are unavoidable adverse environmental effects, the necessity of implementing the federally required TMDL via the Action Plan, improving public health by reducing pathogens and associated waterborne illnesses, and removing the water quality impairment from the Russian River Watershed (an action required to achieve the national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects. The potential significant impacts associated with the Basin Plan amendment are outweighed by the benefit of restoration and enhancement of beneficial uses, and reduction of pathogens in the Russian River watershed.[38]

In making this statement of overriding considerations, the Regional Water Board has balanced the economic, legal, social, technological, and other benefits of this proposed TMDL against the unavoidable environmental effects in determining whether to recommend approval of this project. Upon review of the environmental information generated for this project and in view of the entire record supporting the TMDL, the Regional Water Board has determined that the specific economic, legal, social, technological, and other benefits of this proposed bacteria TMDL outweigh the unavoidable adverse environmental effects, and that such adverse environmental effects are acceptable under the circumstances.

11.1 SUMMARY OF PROPOSED ACTION PLAN

Regional Water Board staff developed a proposed *Action Plan for the Russian River Watershed Pathogen TMDL* (proposed Action Plan) for amendment into the Basin Plan. The Action Plan consists of a description of the TMDL fecal indicator bacteria-related load allocations, numeric targets, and implementation actions necessary to comply with the TMDL. The Action Plan also includes the following prohibition:

> *Discharges of waste containing fecal ~~waste~~ material from humans or domestic animals[39] to waters of the state within the Russian River Watershed ~~that cause or contribute to an exceedance of the bacteria water quality objectives not otherwise authorized by waste discharge requirements or other order or action of the Regional or state Water Board~~*

[38] California Code of Regulations title 23, section 3777 (d) requires the Regional Water Board to make findings consistent with California Code of Regulations title 14 section 15093 when the SED identifies potentially unavoidable adverse environmental effects.
[39] Examples of domestic animals include, but are not limited to, cows, horses, cattle, goats, sheep, swine, poultry, dogs, cats, or any other animal(s) in the care of any person(s).

are prohibited. *Compliance with this prohibition can be achieved in the following manner.*

7. *Implement adequate treatment and best management practices to prevent the discharge of fecal waste material from humans or domestic animals from entering a water of the state either directly, or indirectly as a result of stormwater runoff.*
8. *Comply with all fecal waste/pathogen-related provisions of an applicable NPDES permit.*
9. *Comply with all fecal waste/pathogen-related provisions of an applicable WDR.*
10. *Comply with all fecal waste/pathogen-related provisions of an applicable general WDR or waiver of WDRs.*

~~2.~~11. *Implement the terms of the Memorandum of Understanding between the North Coast Regional Water Quality Control Board and relevant local agencies to address fecal waste from homeless encampments and recreational water use.*

12. *For non-dairy livestock, implement best management practices to achieve the assigned load allocation within 2 years of the effective date of this TMDL and, if required by the Executive Officer, develop and implement a Ranch Management Plan. Once adopted by the North Coast Regional Water Quality Control Board, non-dairy livestock operations comply with the prohibition if dischargers are in compliance with all fecal waste/pathogen-related provisions of an applicable WDR or waiver of WDRs.*

The Action Plan is necessary to comply with existing federal and State laws, regulations, plans and policies. Technical information supporting the Action Plan is described in detail in Chapters 1-10 of this staff report. In summary, the Action Plan is proposed to include the following elements:

1. An analysis of the sources of ~~fecal bacteria~~pathogens within the Russian River Watershed
2. The Total Maximum Daily Load (TMDL) of fecal ~~waste~~indicator bacteria that can be discharged to the Russian River Watershed and still attain water quality objectives
3. Waste load and load allocations for *E. coli* bacteria for freshwaters and enterococci bacteria for saline waters applicable to all controllable sources identified within the Russian River Watershed
4. A new Waste Discharge Prohibition specific to unauthorized fecal waste discharges within the Russian River Watershed
5. Existing and prospective interagency agreements to cooperatively implement actions for OWTS, homeless encampments, and recreational water users
6. A discussion of permitting, implementation of the prohibition, and enforcement.
7. A discussion of monitoring and adaptive management
8. Requirements~~,~~ for responsible parties to develop, update, and implement the following for the reduction of fecal bacteria loads:
    a. A *Recycled Water BMP Plan*, or equivalent BMP Plan, for recycled water projects;
    b. *A Water Quality Management Plan, Waste Management Plan, or Nutrient Management Plan* for dairies;
    c. *Report of Waste Discharge* for unpermitted large private OWTS, OWTS not meeting

conditions of the OWTS Policy's Conditional Waiver of Waste Discharge Requirements.

d. A *Pathogen Reduction Plan* for MS4 general permit enrollees.

11.2 ALTERNATIVES ANALYSIS

Regional Water Board staff has identified two approaches (or alternatives) to address the ~~fecal indicator bacteria~~pathogen impairment in the Russian River Watershed. The following sections discuss the two alternatives: 1) Adoption of the Action Plan (adoption of the proposed Basin Plan amendment), and 2) No Action.

11.2.1 ALTERNATIVE 1 - ADOPTION OF THE ACTION PLAN (PREFERRED ALTERNATIVE)

The Preferred Alternative is adoption of the Action Plan, including establishment of the human and domestic animal fecal waste discharge prohibition for the Russian River Watershed. The Action Plan includes the source assessment, waste load allocations and load allocations for each of the identified sources, and an implementation program describing the actions likely necessary to achieve the TMDL allocations and numeric targets. Regional Water Board staff will conduct reviews to evaluate the success of implementation actions aimed at reducing loading to achieve the allocations. Individual monitoring and reporting requirements will provide data and information about whether the implementation actions are working and if the TMDL is being achieved. A coordinated monitoring program will help improve the consistency and cost-effectiveness of monitoring actions. The Action Plan requirements will be implemented through updates to existing permits, local agency MOUs, and through existing Regional Water Board authorities. Staff have determined that this alternative is the most likely to result in attainment of water quality standards in a reasonable period of time and that most of the impacts resulting from this action are generally less than significant or can be mitigated. Therefore, this is the preferred alternative.

11.2.2 ALTERNATIVE 2 - NO ACTION

Under the No Action alternative, no amendment to the Basin Plan would occur (no Action Plan adopted) and staff would continue to implement existing Regional and State Water Board programs and permits. The Regional Water Board would not adopt a TMDL for the Russian River Watershed and would not require specific load reductions from each source and the proposed prohibition would not be enacted.

Under this scenario, all existing onsite wastewater treatment systems (OWTS) in the Russian River Watershed would continue to be required to comply with the Basin Plan requirements for OWTS. If the Regional Water Board does not adopt a TMDL within two years of the TMDL completion date specified in Attachment 2 of the statewide OWTS Policy (i.e., by the end of ~~2018),~~2020)[40], coverage under the OWTS Policy's conditional waiver of WDRs will expire for any OWTS that has any part of its dispersal system within 600 feet of the waterbodies listed in Attachment 2 for pathogens. ~~These~~In conformance with the findings of the 2012 303(d) list of impaired waters, there reaches include:

- Lower Russian HA, Guerneville ~~HAS~~HSA, mainstem Russian River from Fife Creek to Dutch Bill Creek
- Lower Russian HA, Guerneville ~~HAS~~HSA, Green Valley Creek Watershed
- Middle Russian River HA, Geyserville HAS, mainstem Russian River at Healdsburg memorial beach and unnamed tributary at Fitch mountain
- Middle Russian River HA, Mainstem Laguna de Santa Rosa
- Middle Russian River HA, Mainstem Santa Rosa Creek

Beginning in ~~2019~~2021, for all existing OWTS within these geographic areas, the Regional Water Board would have to issue WDRs, waivers of WDRs, or require corrective action to comply with siting, design, or operational standards that would be protective of bacteria water quality objectives. New and replacement OWTS within 600 feet of the waterbodies listed in Attachment 2 would have to meet applicable specific Tier 3 requirements of Basin Plan OWTS Policy adopted by the Regional Water Board on June 19, 2014, or other special provisions established for these waterbodies.

Additionally, opportunities for owners of OWTS to obtain public funding assistance for required upgrades to their OWTS may be reduced because ~~standards~~standard federal and state implementation grants and other funding sources are typically only available for projects located in watersheds that have an approved Action Plan or some other effective watershed-scale management plan in place.

The Regional Water Board is required under the *Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program*[41] (NPS Policy) to implement a WDR, waiver of WDR, or waste discharge prohibition to address sources of nonpoint source pollution. In the absence of the fecal waste discharge prohibition included in Alternative 1, the Regional Water Board would have to develop a WDR or waiver of WDRs for any sources of fecal waste to the Russian River Watershed, which are not addressed through an existing WDR or waiver to conform to the requirements of the policy.

This no action alternative will likely result in some improvement in water quality, but it does not provide a framework for watershed-wide implementation and monitoring efforts, a timeline by which implementation must occur, and reasonable assurance that water

[40] The statewide OWTS Policy was revised by Resolution No. 2018-0019 on April 17, 2018. Attachment 1 of the resolution was revised to update the proposed adoption date for the Russian River Pathogen TMDL from 2017 to 2018.
[41] https://www.waterboards.ca.gov/water_issues/programs/nps/docs/plans_policies/nps_iepolicy.pdf

quality objectives will be attained within the shortest, reasonable period of time. Further, the no action alternative does not conform to the NPS Policy.

11.3 REASONABLY FORESEEABLE MEANS OF COMPLIANCE

This section presents an analysis of the potential environmental impacts associated with reasonably foreseeable methods of compliance with the proposed Action Plan (preferred alternative). Regional Water Board staff solicited public input to help identify reasonably foreseeable compliance measures. Many of the measures listed below were identified by members of the public and agency staff during the CEQA scoping process. Current elevated fecal indicator bacteria densities exceed water quality objectives and are detrimental to the beneficial uses within the Russian River Watershed. The Action Plan provides a program addressing the adverse impacts of non-compliance with water quality objectives through progressive reduction in loading of fecal waste and pathogens (as measured by fecal indicator bacteria) to the Russian River Watershed using a schedule that is reasonable and as short as practicable.

The compliance measures and pollution controls necessary to comply with the Action Plan will depend on a number of site-specific conditions and factors. The following examples are not meant to be exhaustive of the suitable suite of compliance measures, but rather provide a reasonable range of measures that may be implemented. Many of the compliance measures listed below are often interchangeable as mitigation measures for potentially adverse environmental impacts associated with specific project activities. Additionally, though not listed below, public commenters encouraged the use of Low Impact Development (LID), including the construction of smaller homes, as possible mitigation measures.

11.3.1 NON-STRUCTURAL CONTROLS

Non-structural controls are typically aimed at controlling sources of a pollutant and do not involve construction or other earth moving/landscape manipulations. Non-structural controls are those activities that are primarily planning or outreach in nature. Most of the non-structural controls identified are unlikely to have an environmental impact because they are not physical in nature; however, where they were found to have less than significant impacts or where they could be mitigated to less than significant, they are discussed in Section 11.4. No potentially significant impacts on the environment were identified for these controls. Some of the possible non-structural controls that could be implemented as a method of compliance include:

- Education and Outreach: Conduct education and outreach about proper maintenance and upkeep for OWTS, water conservation, recycled water and graywater use, preventing illegal camping along waterbodies, proper human and domestic animal waste disposal and sanitation, and the effects of improper pet waste disposal. Publicize the locations of restrooms found at recreational beaches along the mainstem Russian River.

- Inspection and Maintenance: Require preventative maintenance and upkeep of OWTS. Inspect and perform routine maintenance of sewer laterals. Perform inspections and routine maintenance of sanitary sewer infrastructure and existing public restroom facilities at beaches along the Russian River. Perform regular beach clean-up to dispose of waste left on beaches. Manage irrigation to minimize leaks and ensure that overwatering and runoff do not occur.
- Municipal Wastewater Program Establishment, Evaluation, and Enforcement: Revise design standards for new and replacement sewer systems to add enhanced protection against overflows and exfiltration. Establish procedures and standards for the use of off-site easements, which include conditions, covenants, and deed restrictions, to facilitate properly designed and constructed OWTS serving multiple dwellings. Establish a local ordinance to require property owners to inspect their private sewer lateral upon property transfer, in response to chronic sanitary sewer overflows, or prior to change in property use. Establish a program and funding assistance for homeowners to promote voluntary inspections and repairs of private laterals. Develop an OWTS management program. Provide and/or improve options for shelters and transitional housing or other homeless services. Establish a hotline for reporting homeless/illegal encampments and facilitate their removal along stream corridors. Evaluate and if necessary improve management practices to prevent recycled water overspray, spills, and runoff. Implement programs to discourage or prevent illegal dumping. Explore expanding recycled water use to prevent discharge into surface waters. Enforce permit conditions, including water recycling requirements.
- Water Quality Plans: Require Best Management Practices (BMPs) for manure handling through the development or update of Water Quality Plans. BMPs for manure handling could include regular cleanup of manure and soiled bedding in animal habitation areas, locating manure storage areas away from water courses and off slopes (i.e., prevent storm water discharge), practicing onsite composting and reuse of manure, and storing manure on impermeable surfaces (i.e., prevent groundwater discharge).

11.3.2 STRUCTURAL CONTROLS

Structural controls for non-point sources divert, store, treat, and/or infiltrate storm water to prevent the discharge of waste material to the river as a result of runoff. Structural controls for point sources can also be implemented to treat waste before discharge and/or prevent the direct discharge of waste into a waterbody. Structural controls can involve activities that create potentially significant environmental impacts. Structural controls that were found to have impacts, both potentially significant and less than significant, are discussed in Section 11.4.

The following is a list of potential structural controls:

- Straw Waddles: Use straw waddles inoculated with mushrooms (i.e. mycofiltration), as appropriate, to filter bacteria from runoff.
- Buffer Strips, Vegetated Swales, and Bioretention: Construct and maintain vegetative

buffers along roadsides and next to waterbodies to slow runoff velocity, increase filtration of pollutants, and increase storm water infiltration. Construct and maintain bioretention BMPs to provide onsite removal of pollutants, including fecal waste, from storm water runoff through landscaping features.

- Green Roofs and Rain Gardens: Replace existing roofs and gardens with “green” infrastructure such as green roofs and rain gardens to prevent or reduce clean storm water from coming into contact with fecal wastes.
- Exclusion: Construct fencing, hedgerows, livestock trails, and walkways to exclude animals from streams and riparian areas to prevent direct deposition of feces into surface waters. Construct fencing, shrubs, or other barriers to prevent camping & habitation under bridges and overpasses and in other rights-of-way.
- Waste Storage and Disposal: Install pet waste collection systems, which provide plastic bags to be used in the collection of domestic pet waste, throughout the watershed. Provide garbage cans, recycling bins, and diaper changing stations at public beaches.
- Municipal Composting of Biosolids: Ensure the elimination of pathogens from biosolids by upgrading treatment through the use of composting.
- Waterless Waste Treatment: Utilize waterless technology such as composting and incinerating toilets.
- Restroom Facilities: Provide and/or upgrade permanent or temporary restroom facilities at recreation beaches and at locations frequented by homeless and transient people.
- Sewer Lateral Replacement: Fix or replace private sewer laterals that have inflow and infiltration issues.
- Increase Wastewater Storage Capacity: Enlarge wastewater holding ponds to prevent discharge to the Russian River and its tributaries.
- Wastewater Treatment Plant Expansion and/or New Treatment Plant Construction: Expand or construct wastewater treatment plants to allow for new connections.
- Connect OWTS to a Centralized Wastewater Treatment Plant or Decentralized Community System: Connect individual wastewater treatment and disposal systems to a centralized treatment plant or decentralized community wastewater treatment system and discontinue use of individual OWTS.
- Treatment Plant Wastewater Disinfection: Upgrade treatment plant wastewater disinfection systems and disinfect holding pond effluent through the use of ozone, heat sterilization or ultrafiltration.
- OWTS Supplemental Treatment: Utilize supplemental treatment such as ultraviolet (UV) light disinfection or chlorine to ensure adequate treatment of effluent from OWTS.
- MS4 Sand Filters: Install and maintain sand filters, which are effective for pollutant removal from storm water. Sand filters may be a good option in densely developed urban areas with little pervious surface since the filters occupy minimal space.
- Replacement and/or Improvement of OWTS: Replace/upgrade leaking and poorly sited

OWTS with OWTS that are correctly designed, sited, constructed, installed, operated and maintained. System status to be determined through site inspection.

11.4 ENVIRONMENTAL CHECKLIST

As stated previously, the environmental analysis must include an evaluation of the reasonably foreseeable environmental impacts of the methods of compliance and the reasonably foreseeable mitigation measures relating to those impacts. This section, consisting of the CEQA checklist and answers to the questions in the checklist, discusses the reasonably foreseeable compliance measures and alternatives and mitigation measures of those compliance methods.

In formulating the checklist answers, the impacts of implementing the non-structural and structural controls were evaluated. At this time, the exact compliance measures that might be implemented to comply with the Action Plan are unknown, and therefore this analysis considers a range of non-structural and structural measures that might be used. When specific measures are selected for implementation, a project-level/site-specific CEQA analysis will be performed by the responsible party, as necessary.

This evaluation considers whether the construction or implementation of the reasonably foreseeable compliance measures has the potential to cause a substantial, adverse change in any of the physical conditions within the area affected by the project. In addition, the evaluation considers environmental effects in proportion to their severity and probability of occurrence. In this analysis, the level of significance is based on the existing conditions of both the physical environment and regulatory baseline requirements. A significant effect on the environment is defined in regulation as “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance. An economic or social change by itself shall not be considered a significant effect on the environment. An economic or social change related to a physical change may be considered in determining whether the physical change is significant.” (14 Cal. Code regs, tit.14, § 15382.).

Potential reasonably foreseeable impacts of the reasonably foreseeable compliance measures were evaluated with respect to each of the factors on the checklist. Additionally, mandatory findings of significance regarding short-term, long-term, cumulative and substantial impacts were evaluated. In this analysis, the level of significance was based on baseline conditions (i.e., current conditions). Based on this review, it has been concluded that there may be some potentially significant impacts associated with certain reasonably foreseeable methods of compliance with the Action Plan. Reasonably foreseeable structural and non-structural controls that were found to have impacts, both potentially significant and less than significant, or that require mitigation are discussed in detail below.

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
I. AESTHETICS -- Would the project:				
a) Have a substantial adverse effect on a scenic vista?			✓	
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?		✓		
c) Substantially degrade the existing visual character or quality of the site and its surroundings?		✓		
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?		✓		
II. AGRICULTURE AND FOREST RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and forest carbon measurement methodology				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	✓			
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	✓			
c) Conflict with existing zoning for, or cause rezoning or, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?				✓
d) Result in the loss of forest land or conversion of forest land to non-forest use?				✓

Table 11.1 Environmental Checklist

	Potentially Significant Impact	Less Than Significant With Mitigation	Less Than Significant Impact	No Impact
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	✓			
III. AIR QUALITY: Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. -- Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?				✓
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?			✓	
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				✓
d) Expose sensitive receptors to substantial pollutant concentrations?				✓
e) Create objectionable odors affecting a substantial number of people?		✓		
IV. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?		✓		
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service?		✓		
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?		✓		

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?		✓		
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?		✓		
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?		✓		
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?		✓		
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?		✓		
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?		✓		
d) Disturb any human remains, including those interred outside of formal cemeteries?		✓		
e)Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or		✓		

Table 11.1 Environmental Checklist

	Potentially Significant Impact	Less Than Significant With Mitigation	Less Than Significant Impact	No Impact
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.		✓		
VI. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist- Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.		✓		
ii) Strong seismic ground shaking?		✓		
iii) Seismic-related ground failure, including liquefaction?		✓		
iv) Landslides?		✓		
b) Result in substantial soil erosion or the loss of topsoil?		✓		
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?		✓		
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?		✓		
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste- water disposal systems where sewers are not available for the disposal of waste water?		✓		

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
VII. GREENHOUSE GAS EMISSIONS -- Would the project:				
a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?		✓		
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?				✓
VIII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?		✓		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?		✓		
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?		✓		
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?		✓		
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?		✓		
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?		✓		
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				✓
h) Expose people or structures to a significant risk of loss injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				✓

Table 11.1 Environmental Checklist

	Potentially Significant Impact	Less Than Significant With Mitigation	Less Than Significant Impact	No Impact
IX. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?		✓		
b) Substantially deplete ground water supplies or interfere substantially with ground water recharge such that there would be a net deficit in aquifer volume or a lowering of the local ground water 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)?				✓
c) Substantially alter the existing drainage pattern of the 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 siltation on- or off-site?		✓		
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?		✓		
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?		✓		
f) Otherwise substantially degrade water quality?		✓		
g) 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?				✓
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?		✓		
i) 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?				✓
j) Inundation by seiche, tsunami, or mudflow?				✓

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
X. LAND USE AND PLANNING -- Would the project:				
a) Physically divide an established community?				✓
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				✓
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				✓
XI. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				✓
b) Result in the loss of availability of a locally – important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				✓
XII. NOISE -- Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?		✓		
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				✓
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	✓			
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?		✓		
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				✓
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				✓

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
XIII. POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	✓			
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?		✓		
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?		✓		
XIV. PUBLIC SERVICES				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?				✓
Police protection?				✓
Schools?				✓
Parks?				✓
Other public facilities?				✓
XV. RECREATION				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be			✓	
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				✓

Table 11.1 Environmental Checklist

	Potentially Significant Impact	Less Than Significant With Mitigation	Less Than Significant Impact	No Impact
XVI. TRANSPORTATION/TRAFFIC -- Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?			✓	
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				✓
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				✓
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				✓
e) Result in inadequate emergency access?				✓
f) Result in inadequate parking capacity?			✓	
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?			✓	
XVII. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				✓
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	✓			
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?			✓	
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				✓

Table 11.1 Environmental Checklist				
	Potentially Significant Impact	**Less Than Significant With Mitigation**	**Less Than Significant Impact**	**No Impact**
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	✓			
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				✓
g) Comply with federal, state, and local statute and regulations related to solid waste?				✓
XVIII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		✓		
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	✓			
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	✓			

i. AESTHETICS

Would the project:

(a) – Have a substantial adverse effect on a scenic vista?
Answer: Less than significant.[42]

The creation of buffer strips and vegetated swales may include planting of trees and shrubs. The addition of these types of vegetation to the landscape is generally regarded as having positive aesthetic effects. In some cases the planting or retention of large woody vegetation could reduce visibility of an adjacent waterbody or of the surrounding landscape and therefore could alter the scenic vista. Although the creation of buffer strips and vegetated swales will modify the appearance of an area, the aesthetic effects are expected to be positive and will not likely result in a substantial adverse effect on the scenic vista and are considered less than significant.

(b) – Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?
(c) – Substantially degrade the existing visual character or quality of the site and its surroundings?
(d) – Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?
Answer: Less than significant with mitigation.

The changes to the visual character of a site due to the construction of wastewater treatment ponds and buildings associated with significantly expanded or new centralized or decentralized wastewater treatment facilities can be mitigated by building facility structures to house equipment and fences to provide a visual screen for equipment and materials used in the everyday operations of the facility. Planting vegetation such as native trees, grasses, and wildflowers can provide a vegetative screen and result in an aesthetic that more closely reflects the surrounding landscape. Strategic siting of the facility structures on the landscape can also allow for the structures to be placed in locations that will have the least possible effect on the existing visual character of the surrounding area and allow them to avoid damaging scenic resources. Additionally, where scenic resources are identified at a site along a scenic highway, the use of standard construction techniques and sediment and erosion control practices would require revegetation and would not result in permanent alteration to the vegetation of scenic resources. The potential glare that could result from the construction of new wastewater treatment and effluent storage ponds could be mitigated by proper siting and the planting of vegetation screens around the ponds.

The construction of new restroom facilities at public beaches or other locations throughout the watershed could result in adverse aesthetic affects to the visual quality of the surroundings; however this effect can be mitigated through strategic siting of the restroom facility in a location that minimizes the effect on the visual character of the surrounding

[42]

site. Additionally, the planting of trees, shrubs, and native plants can be used to screen the restroom from view and result in an aesthetic that more closely reflects the surrounding landscape. For restrooms constructed in urban locations, the selection of materials used to construct the exterior of the restroom should reflect the aesthetic and character of the surrounding location, which will allow it to blend it better with neighboring structures.

Increasing wastewater storage capacity, adding supplemental treatment to OWTS, composting biosolids, and installing pet waste collection systems, and garbage and recycling cans would result in less than significant impacts to the visual character and quality of the site and its surroundings. The enlarging of wastewater holding ponds would result in minimal changes from the existing baseline and therefore will have a less than significant impact on the visual character surrounding site. The composting of biosolids and addition of supplemental treatment to OWTS would result in minimal changes to the visual landscape as they can be housed in existing structures and the mechanisms to house supplemental treatment could even be placed underground with a cover for access. Pet waste collection systems are small and can be painted to blend with the surrounding environment. The presence of garbage and recycling cans will not substantially degrade the surrounding area and is expected to improve the aesthetics of the surroundings by preventing trash from being deposited on the ground.

ii. AGRICULTURE AND FOREST RESOURCES

Would the project:

(a) – Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?
(b) – Conflict with existing zoning for agricultural use, or a Williamson Act contract?
(e) – Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to nonforest use?
Answer: Potentially significant.

The creation of riparian buffers and exclusion of animals from riparian zones could cause incidental loss of agricultural use. These losses would affect only a very narrow band of land on either side of a watercourse. Additionally, some agricultural areas that are mapped as prime, unique or important may already have riparian buffers or exclusion fencing in place. Although there are many factors that affect this determination, it can be assumed that agricultural lands with a potential to discharge waste that contains pathogenic microorganisms to waters of the state and that implement riparian protection actions or compliance measures to comply with the Action Plan could be taking land out of production. While avoidance and minimization measures can be used to lessen impacts, and experience suggests that some modified management of riparian zones is often appropriate, there is no mitigation for loss of land where that occurs. Therefore, this is a potentially significant and unavoidable impact that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?
(d) Result in the loss of forest land or conversion of forest land to non-forest use?
Answer: No Impact.

None of the reasonably foreseeable structural or non-structural compliance measures will rezone or force the rezoning of Timberlands Production or result in the conversion of forested land to non-forested land. Therefore, there will be no impact on the classification or conversion of timberlands.

iii. AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations.

Would the project:
(a) – Conflict with or obstruct implementation of the applicable air quality plan?
(c) – Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is not attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?
(d) – Expose sensitive receptors to substantial pollutant concentrations?
Answer: No impact.

None of the structural or non-structural compliance measures would result in a violation of air quality plans, result in a cumulatively considerable increase in criteria pollutants, or expose sensitive receptors to substantial pollutant concentrations.

(b) – Violate any air quality standard or contribute substantially to an existing or projected air quality violation?
Answer: Less than significant impact.

Construction activities can generate dust and combustion exhaust emissions that will be emitted into the atmosphere from construction equipment associated with wastewater treatment plant expansion and/or construction, treatment plant wastewater disinfection system upgrades, connecting OWTS to a centralized or decentralized wastewater treatment plant, adding supplemental treatment to OWTS, replacing or upgrading existing OWTS, increasing wastewater storage capacity, construction of new restroom facilities, creation of sand filters for storm water, sewer lateral replacement, and creation of green roofs and rain gardens. Air pollutants will be emitted from construction worker commutes. However, because of the temporary nature of construction activities, the proposed project is not likely to result in construction-related emissions that will result in significant impacts or require mitigation for any of the regionally significant pollutants.

(e) – Create objectionable odors affecting a substantial number of people?
Answer: Less than significant with mitigation.
The repair and replacement of sewer laterals and upgrade, maintenance, and/or replacement of OWTS will decrease the potential for illicit discharges which would result in objectionable odors. Therefore, there would be no impact from those activities. The composting of biosolids can result in objectionable odors, however through the use of indoor composting or the thoughtful siting and design of composting locations odors can be minimized. Other mechanisms that could be considered to mitigate composting odors include use of aeration and biofiltration, mixing with coarse dry bulking agents, and placing an aerobic biofilter layer over the biosolids. Therefore, the application of mitigation measures will result in less than significant impacts to air quality.

iv. BIOLOGICAL RESOURCES

Would the project:
(a) – Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?
(b) – Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?
(c) – Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?
(d) – Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?
(e) – Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?
(f) – Conflict with the provision of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?
Answer: Less than significant impact with mitigation.

There are numerous aquatic and terrestrial Federal and State listed endangered and threatened animals which are known to be present in the Russian River Watershed. Such species could potentially be adversely impacted by measures implemented to comply with the proposed Action Plan, if only temporarily. The location of sensitive species and habitat must be assessed on a project by project basis. When installing structural compliance measures that involve substantial earth moving or riparian restoration activities that have the potential to affect candidate, sensitive, or special status species, project proponents are required to consult with federal, state and local agencies, including but not limited to, the county, CDFW, Regional Water Board, and USFWS. Project proponents must ensure project actions avoid, minimize and/or mitigate for impacts to rare, threatened or endangered species.

Actions to limit the input of fecal indicator bacteria into water ways, such as riparian buffers, the use of straw waddles, and exclusion from riparian areas may conflict with the habitat requirements of certain flora or fauna and some could impede migration. Specific examples include non-native species out competing natives in constructed riparian buffers. Mitigation measures to reduce this potential impact include use of certified weed-free grass and project specific seed mixes to prevent the introduction of non-native or invasive species. Fencing can be selected that won't ensnare animals and migration corridors can be left to allow movement of fauna. Alternatively, rotational grazing practices and hotwire fences could be used where exclusionary fencing has the potential to affect wildlife and impede migration. The netting used in some straw waddles may ensnare small terrestrial fauna, and can be mitigated by the use of biodegradable, natural fiber netting. In most cases, impacts could be avoided by adjusting the timing and/or location of the actions to take into account candidate, sensitive, or special status species or their habitats. The process for designing, permitting, and implementing mitigation measures includes collaboration between Regional Water Board staff and CDFW and USFWS staff to reach agreement on the most appropriate approach to protecting sensitive beneficial uses.

Construction activities may have a potential impact upon species identified as a candidate, sensitive, or special status, may conflict with a local policies or ordinances protecting biological resources, may fill federally protected wetlands as defined by Section 404 of the Clean Water Act, and may conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP) or other approved local, regional, or state habitat conservation plan. Construction has the potential to cause adverse effects in several ways: filling of federally protected wetlands, short-term habitat destruction during construction, permanent displacement of sensitive species due to new structures, and, "take" of endangered species. It is likely that when an entity is choosing possible locations for the construction of a new centralized or decentralized wastewater treatment plant, new restroom, new sewer lines, or significant expansion of a wastewater treatment plant they would give preference to sites that did not fill federally protected wetlands or adversely affect biological resources. If a site containing endangered or threatened species was selected for new construction, the entity would be required to consult with federal, state, and local agencies to mitigate potential impacts. If a site were selected that would result in the fill of federally protected wetlands, the responsible party would be required to obtain a Clean Water Act (CWA) Section 404 permit from the Army Corps of Engineers and a CWA Section 401 Water Quality Certification from the Regional Water Board. If a direct fill of a stream or wetland is absolutely necessary, then adequate compensatory mitigation in accordance with federal and state regulatory programs will be required to replace the loss of functions and values in compliance with the State's No Net Loss Policy[43].

During project level construction activities to implement compliance measures, both structural and non-structural mitigation measures can be implemented to avoid, minimize or mitigate potentially significant impacts to sensitive species. Once a project plan is prepared and construction areas are delineated, measures must be implemented prior to and during construction to avoid, minimize, and mitigate impacts to sensitive animals and their habitat, and vegetation communities such as wetlands. For example, wetlands within 100 feet of any ground disturbance and construction-related activities (including staging and access roads) would be clearly marked and/or fenced to avoid impacts from construction equipment and vehicles. If new or temporary access roads are required, grading would be conducted such that existing hydrology would be maintained. In addition, water pollution control measures such as erosion control, sediment control, and waste management would be implemented to avoid and minimize potential water quality impacts from polluted storm water runoff to streams, wetlands and riparian areas. Other potential mitigation measures could include only constructing during the time of year where the species are not present or are at less vulnerable life stages, or fencing off areas that contain sensitive species or their habitat so that they are not disturbed during construction.

Based on the information provided above and the variety of avoidance, minimization and mitigation measures available, the impacts to Biological Resources from compliance measures to address fecal indicator bacteria impairment are less than significant with mitigation incorporated.

v. CULTURAL RESOURCES

Would the project:

(a) – Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?
(b) – Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?
(c) – Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?
(d) – Disturb any human remains, including those interred outside of formal cemeteries?
(e) - Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:
(i)Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or

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ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.
Answer: Less than significant with mitigation.

For the majority of potential compliance measures, it is unlikely that their implementation will cause a substantial adverse change to cultural resources. Most of the reasonably foreseeable compliance measures will take place in areas that are already disturbed and are in highly urbanized areas, contain sewer laterals, septic systems, and/or other pipes. Implementation strategies that involve digging of a hole, such as for a fence post to contain livestock, may disturb previously unexcavated soil; however, the volume of soil excavated for post-holes is not significant and, therefore, does not pose a significant threat to cultural resources. Additionally, it is more probable that livestock owners will choose methods of compliance that are less costly than fencing a great length of ground, e.g. moving food and water sources away from riparian areas, which of course results in minimal excavation, if any. In the event cultural resources are discovered, implementation is not expected to have substantial adverse change in significance of the resources, destruction of unique cultural resources or sites with cultural value, or the disturbance of human remains. The digging of new fence post holes is a small-scale operation and the fence post could be relocated if cultural resources are found.

The Project is not expected to have a substantial adverse change in significance of tribal cultural resources. Strategic siting of facility structures or facility improvements on the landscape can allow for the structures to be placed in locations that will have the least possible effect on tribal cultural resources. Avoidance and preservation of the resource in place would minimize significant adverse impacts.

In cases where the installation of compliance measures may involve large scale excavations or earth disturbing activities, such as centralized or decentralized wastewater treatment plant construction, restroom construction, placing new sewer lines, or expanding a wastewater treatment plant or pond, a cultural resources investigation should be conducted before any substantial disturbance. The cultural resources investigation will include, at a minimum, a records search for previously identified cultural resources, including sites, features, places, cultural landscapes, sacred places, and objects with cultural value pursuant to the California Register of Historical Resources or included in a local register of historical resources. Additionally, the lead agency will consider the impact of the project on tribal cultural resources and follow consultation requirements pursuant to Public Resources Code sections 21080.3.1, 21080.3.2, and 21082.3. Previously conducted cultural resources investigations of the project parcel and vicinity will also be identified and utilized.

All future actions must comply with the CEQA process and investigate, evaluate, and treat impacted significant cultural resources. A record search should be conducted that also includes contacting the appropriate information center of the California Historical Resources Information System, operated under the auspices of the California Office of Historic Preservation, and the relevant Regional Archaeological Information Center. In coordination with the information center or a qualified archaeologist, a determination regarding whether identified cultural resources will be affected by the proposed project must be made and if investigations were performed to satisfy the requirements of CEQA. If not, a cultural resources survey may need to be conducted. The purpose of this investigation would be to identify resources before they are affected by a proposed project and avoid the impact. If resources are identified, site-specific implementation will minimize impacts. This can include actions such as avoidance through relocation, changes in design, site capping and protection through barriers, fencing, and covering of the cultural resources. Taking into account tribal cultural values and meaning of the resource, other mitigation measures could include protecting the confidentiality of the resource, protecting the cultural character and integrity of the resource, and its traditional use.

In addition, in the event that the ground disturbances uncover previously undiscovered or documented resources, California law protects Native American burials, skeletal remains, and associated grave goods regardless of the antiquity and provides for the sensitive treatment and disposition of those remains. (Health & Safety Code, Section 7050.5; Public Resource Code, Section 5097.9 et seq).

vi. GEOLOGY AND SOILS

Would the project:

(a) – Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.
ii. Strong seismic ground shaking
iii. Seismic-related ground failure, including liquefaction?
iv. Landslides?
(b) – Result in substantial soil erosion or the loss of topsoil?
(c) – Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?
(d) – Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?
(e) – Have soils incapable of adequately supporting the use of septic tanks or alternative waste-water disposal systems where sewers are not available for the disposal of waste water?
Answer: Less than significant with mitigation.

It is possible that some soils in areas of the Russian River Watershed considered for the construction of new structures, including centralized or decentralized wastewater treatment facilities, community OWTS, and restrooms, could be unstable, be located on expansive soil, or result in ruptured faults, seismic ground shaking, liquefaction, or landslides if construction were to occur on certain sites. The first step in preventing this possibility is to properly site such construction so as to avoid these potential outcomes.

If it were determined that construction would take place on a site with areas of unstable or expansive soils or in areas with fault zones, seismic shaking, or where liquefaction could occur it would be up to the project proponents to offer mitigation measures to reduce the impact to less than significant. Mitigation measures could include abstaining from constructing in areas with unsuitable or unstable geology, minimizing the disturbance of the areas of concern, anchoring the soils, adding structural piles, building a thicker foundation, deepening the footings of the foundation, and ensuring proper drainage so that rain-induced landslides do not occur. A site-specific CEQA evaluation would need to be completed for the project to outline any potential environmental effects. Additionally, a site-specific work plan and health and safety plan would be developed by a licensed geologist or engineer prior to implementation of the project. Such plans ensure conditions are assessed and impacts appropriately avoided prior to initiation of the project. The site manager must also be made aware of potential risks and management measures associated with any structures, soil instability, expansive soils, or other features associated with the unique nature of the project setting, with specific attention to potential risks to life or property and appropriate protections.

Construction activities may result in soil erosion of disturbed topsoil. Implementation of compliance measures such as expansion of restroom facilities, construction of centralized or decentralized wastewater treatment systems, green roofing, or wastewater storage ponds will result in temporary ground disturbances. These activities could result in erosion and sedimentation. However, construction related erosion impacts will be temporary and should cease with the cessation of construction activities. Standard best management practices (BMPs) to address erosion, sediment, and pollution prevention should be used during small and large scale construction activities to mitigate potential erosion issues. Facility pollution prevention plans should be developed to ensure that the correct BMPs are selected for the construction of wastewater treatment facilities, wastewater storage ponds, and of other treatment measures. For example, excavated soil should be covered or seeded prior to precipitation and replanted as soon as practicable to avoid contaminating storm water runoff and to prevent soil erosion. For construction activities that are greater than one acre, enrollment under the National Pollutant Discharge Elimination System (NPDES) construction storm water general permit will be necessary and the development of a storm water pollution prevention plan (SWPPP) required.

The proper implementation of mitigation measures, including those discussed above, will result in a less than significant impact to soil stability and erosion.

vii. GREENHOUSE GAS EMMISSIONS

Would the project:

(a) Generate Greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?
Answer: Less than significant with mitigation.

Implementation of compliance measures at the project level could result in a temporary increase in greenhouse gases related to exhaust from equipment and vehicles used during construction activities. However, these emissions will be limited to a finite period of time and would result in less than significant impacts overall.

Greenhouse gases may be generated from wastewater treatment plant alterations or new construction, installation of new sewer lines, replacement of OWTS, and improvements, repair, and maintenance of OWTS, sewer laterals, and wastewater treatment facilities, as compared to the current baseline.

The daily operations of a new centralized or decentralized wastewater treatment plant, or significantly expanded plant, could result in increased greenhouse gas emissions as a result of greater power needs at the plant itself, as well as at lift stations to move a larger volume of waste. Possible mitigation measures include the use of ecofriendly power, including wind and solar power, and implementation of water and power conservation measures. Impacts associated with individual projects implemented to comply with the Action Plan will be evaluated for their potential to increase greenhouse gases by the parties responsible for implementing the compliance measures and appropriate mitigation implemented to reduce that potential.

(b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?
Answer: No Impact

All structural or non-structural implementation measures would need to be implemented in a manner consistent with plans, policies or regulations to reduce greenhouse gas emissions including those mentioned here. Any water quality control effort must be consistent with the State Water Board Resolution No. 2008-0030 which directs Water Board staffs to "require…climate change considerations, in all future policies, guidelines, and regulatory actions." Also, the proposed project is intended to be implemented in a manner which conforms with the goals of Assembly Bill (AB) 32 (States, 2005, ch 488). AB 32 requires that greenhouse gas emissions be reduced to 1990 levels by 2020. This requirement relates to anthropogenic sources of greenhouse gases.

viii. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

(a) – Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?
(b) – Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?
(c) – Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?
(d) – Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?
(e) – For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?
(f) – For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?
Answer: Less than significant with mitigation.

The existing regulatory baseline includes numerous federal, state and local laws regarding the designation, handling, transportation and disposal of hazardous substance. Nothing in the proposed TMDL Basin Plan amendment alters this existing regulatory baseline. However, the manner in which hazardous materials are handled and controlled can have environmental impacts as highlighted here.

Specifically, in any action involving chemicals or toxic pollutants, there is a potential for release of pollutants due to an accident or upset condition. The potential for such releases can be greatly reduced by proper planning. Measures to prevent releases of pollutants include such things as pollution prevention technology (e.g., automatic sensors and shut-off valves, pressure and vacuum relief valves, secondary containment, air pollution control devices, double walled tanks and piping), access restrictions, fire controls, emergency power supplies, contingency planning for potential spills and releases, pollution prevention training and other types of mitigation measures. Before implementing structural compliance measures, it is important to consider site geology, hydrology, surrounding land uses and potential receptors, costs, and air quality control plans (including monitoring and contingency plans) if necessary.

Fuels, lubricating oils, and other petroleum products will be used during construction activities. Well established techniques for controlling spills, leaks, and drips should be incorporated in work plans, remedial action plans, treatment plans and site health and safety plans to assure the control of petroleum products and any other chemicals used during the cleanup activity. In order to mitigate the potential adverse effects, pollution prevention plans and waste management BMPs should be used in conjunction with the implementation of compliance measures.

Existing regulations require the proper storage, handling and use of these types of materials. In the event of an accident, responsible parties must comply with the requirements of the California Emergency Management Agency (CalEMA) Hazardous Materials Spill reporting process. Any significant release or threatened release of a hazardous material requires immediate reporting by the responsible person to the Cal EMA State Warning Center (800) 852-7550 and the Certified Unified Program Agency (CUPA) or 911.

The mitigation measures discussed above will likely reduce impacts to a less than significant level.

(g) – Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?
(h)– Expose people or structures to a significant risk of loss injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?
Answer: No Impact

Much of the Russian River valley includes rural residential dwellings and a loosely-defined urban/wildland boundary. The California Department of Forestry and Fire Protection (CalFire) has identified at least 3 communities in the Russian River valley as existing in a Very High Fire Hazard Severity Zone, including: Cloverdale, Santa Rosa, Ukiah. The proposed structural and non-structural compliance measures will not hinder emergency response plans or expose people or structures to wildfires above and beyond that which already exists as the baseline.

IX. HYDROLOGY AND WATER QUALITY

Would the project:
(a) – Violate any water quality standards or waste discharge requirements?
(c) – Substantially alter the existing drainage pattern of the 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 siltation on- or off-site?
(d) – Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?
(e) – Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?
(f) – Otherwise substantially degrade water quality?
(h) – Place within a 100-year flood hazard area structures which would impede or redirect flood flows?

Answer: Less than significant impact with mitigation.

When replacing or repairing private sewer laterals and OWTS, and operating a centralized or decentralized wastewater treatment plant, it is possible that sewage could be released to surface waters and violate water quality standards and degrade water quality. Mitigation measures such as containment structures and absorption materials are available to reduce transfer of these substances to surface waters. Fuels, lubricating oils, and other petroleum products will be used during construction activities and could be accidentally discharged to surface waters. Well established techniques for controlling spills, leaks, and drips should be incorporated in work plans, remedial action plans, treatment plans and site health and safety plans to assure the control of petroleum products and any other chemicals used during the activity. In order to mitigate the potential adverse effects, pollution prevention plans and waste management BMPs should be used in conjunction with the implementation of permit compliance measures. Mitigation measures such as containment structures, absorption materials, and drip pans are available to reduce the transfer of these substances to surface waters. The possibility that composted biosolids could reach surface waters can be mitigated by siting compost piles away from water courses, covering the piles during storm events, using straw waddles around the piles to filter runoff, build storm water containment, and placing the piles indoors. Pet waste collection systems which provide plastic bags for pet waste cleanup, may cause violations of water quality standards if they are improperly discarded and enter waterbodies. This can be mitigated by providing waste receptacles near the pet waste collection systems to provide a location for people to place the used and unused bags.

Compliance measures related to construction activities could potentially cause an alteration of the existing drainage pattern of a site. In most cases however, these compliance measures would be installed with appropriately designed mitigation measures so as to limit any alteration of the existing drainage pattern, unless beneficial to the environment. In general, compliance measures could be constructed or installed without resulting in substantial erosion of siltation on- or offsite. For example, implementing BMPs such as using straw mulch and hydroseed on exposed areas, placing silt fencing and straw waddle to filter runoff, drip protection and vehicle cleaning for construction equipment, maintenance and site inspections are all methods that can be employed. Entities are commonly required to install and maintain erosion control measures (e.g. mulch, straw waddles, silt fencing) to prevent discharge of excess sediment from soil disturbing activities.

Construction of a new centralized or decentralized wastewater treatment plant, restroom ~~facility~~facilities, or significant expansion of a wastewater treatment plant, may increase the amount of impervious surface and therefore could result in flooding or polluted runoff. Additionally, these structures may be placed within the 100-year flood hazard area. The possibility of flooding and polluted runoff can be mitigated through the use of Low Impact Development (LID). LID is utilized to infiltrate storm water and reduce changes in drainage patterns due to impervious surfaces and to filter storm water runoff. LID strategies integrate green space, native landscaping, natural hydrologic functions, and various other techniques to generate less runoff from developed land. Examples of LID that could be used are bio swales, green roofs, rain gardens, and sand filters.

(b) – Substantially deplete ground water supplies or interfere substantially with ground water recharge such that there would be a net deficit in aquifer volume or a lowering of the local ground water 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)?
(g) – 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?
(i) – 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?
(j) – Inundation by seiche, tsunami, or mudflow?
Answer: No impact.

The structural and non-structural reasonably foreseeable compliance measure identified would not deplete groundwater supplies and should not substantially increase the chances of risk of loss, injury, or death involving flooding, or increase the chance of tsunami or mudflow. No housing development is proposed as a result of this proposed Basin Plan amendment and therefore none will be placed within a 100-year flood hazard area or place housing in the 100-year flood plain.

X. LAND USE PLANNING

Would the project:
(a) – Physically divide an established community?
(b) – Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?
(c) – Conflict with any applicable habitat conservation plan or natural community conservation plan?
Answer: No impact.

The reasonable foreseeable structural and non-structural compliance measures should not divide a community, conflict with land use, policy, or regulation of an agency with jurisdiction over the project, adopted for mitigation purposes, or conflict with any applicable habitat conservation plan or natural community conservation plan. All compliance measures would have to work within the existing regulatory baseline and comply with existing plans, policies, and regulations.

XI. MINERAL RESOURCES

Would the project:

(a) – Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?
(b) – Result in the loss of availability of a locally –important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?
Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures would result in the loss of availability of a known mineral resource. Based upon a search of the internet in July 2015, including the California Geologic Survey website, water board staff did not find any evidence of current mineral mining practices taking place in the Russian River Watershed. Furthermore, reasonable foreseeable structural and non-structural compliance measures should not preclude the mining of mineral resources.

XII. NOISE

Would the project result in:
(a) – Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?
Answer: Less than significant with mitigation.

Temporary increases in noise levels would likely be associated with construction activities, including construction of structural compliance measures. Activities might include the use of heavy machinery and the movement of earth and debris, both of which can create noise and ground vibrations. Mitigation measures include the use of standard construction BMPs and operation of equipment according to a time schedule to prevent cumulative noise impacts resulting in further increased noise levels. The majority of the activities that would produce noise are not typically expected to exceed existing standards. Therefore, the temporary noise impacts from construction activities are considered less than significant with mitigation.

(b) – Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?
(e) – For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?
(f) – For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?
Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures would result in excessive noise levels. Groundborne vibration from construction would be at an extremely low level would be temporary and would not be notable above the existing baseline.

(c) – A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?
Answer: Potentially significant.

The every-day running of a new centralized or decentralized wastewater treatment plant may result in increased ambient noise levels above baseline levels for those within the project vicinity. To a large extent, these increases in noise may be mitigated by housing motors, pumps, generators, and other mechanisms that may make noise indoors. Additionally, sound walls and other sound barriers can be constructed if necessary to lessen the noise impacts of the running of the facility. A similar impact may result from ~~implementation~~operation of supplemental treatment units for individual OWTS, where those prove necessary. Given that it may be impossible to minimize to less than significant all ambient noise impacts associated with the running of a wastewater treatment plant or supplemental treatment units for OWTS, the substantial permanent increase in ambient noise levels in the project vicinity may be a potentially significant impact~~.~~ that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(d) – A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?
Answer: Less than significant with mitigation.

During construction activities there may be a brief period when the noise level is increased due to earth moving or construction machinery. Noise may also increase as a result of an increase in traffic due to installation of, or work on collection system lines under roadways. Temporary impacts can be mitigated to a less than significant level by implementing noise abatement procedures, for example, standard construction techniques such as sound barriers, mufflers, and restricted hours of operation. Appropriate mitigation measures should be evaluated on a case-by-case basis when specific projects are determined.

XIII. POPULATION AND HOUSING

Would the project:

(a) – Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?
Answer: Potentially significant.

The construction of a new centralized or decentralized wastewater treatment plant, or significant expansion of an existing plant, may have a potentially significant impact on population growth in the project area, as people who were considering constructing new homes but were not able to install OWTS due to space, soil, other limitations would potentially be able to connect their homes to the wastewater treatment plant. It is acknowledged that other services and infrastructure would need to be established before new development could occur, such as electric lines and roads, and therefore construction or expansion of a wastewater treatment plant would be one of several factors that may indirectly influence population growth. It is also possible that a new wastewater treatment plant or plant expansion could be done so it only served the existing population. All things considered, there may be potentially significant impacts from population growth associated with the construction or significant expansion of a wastewater treatment plant. <u>These potentially significant impacts cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.</u>

(b) – Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?
Answer: Less than significant with mitigation.

Displacement of people from existing housing due to failing OWTS could be mitigated by connecting to a centralized or decentralized wastewater treatment plant, upgrading the OWTS to meet standards, or other efforts that would remedy the effects of the failing OWTS. A very limited number of systems may not be able to remedy their failing OWTS but the number is expected to be very low, will not necessitate the construction of replacement housing, and therefore does not rise to the level of significance.

(c) – Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?
Answer: Less than significant with mitigation

There is the potential that some properties will not have the site characteristics necessary to replace or repair failing OWTS with the risk of displacing people from those homes. There are a number of alternatives, however, to mitigate the risk including seeking a permit from the county for an alternative system, connection to a new or existing wastewater treatment system, connection to a new or existing community OWTS, or installation of other alternatives such as composting toilets and greywater systems. A very limited number of people may not be able to remedy their failing OWTS but the number is expected to be very low, will not necessitate the construction of replacement housing, and therefore does not rise to the level of significance.

XIV. PUBLIC SERVICES

(a) – Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

- Fire protection?
- Police protection?
- Schools?
- Parks?
- Other public facilities?

Answer: No impact.

There are no reasonably foreseeable compliance measures that would cause environmental impacts, impeding acceptable service ratios and response times. Limiting parking near areas of the river without adequate restroom facilities would cause a negligible need for increased parking enforcement as compared to the existing baseline as the existing parking capacity at many areas along the river is already highly limited or is located on private property. Reasonably foreseeable compliance measures should not impede services. If roadway access is restricted due to construction equipment associated with the building of a restroom facility or if a roadway must be excavated for collection system maintenance, for example, access to and through that roadway for emergency vehicles should be maintained. Fences, if installed, will likely be constructed in areas that are not currently used as access for fire or police protection or that are not part of a park or school. If a fence is constructed at a park, it would likely surround the park and not impede its use as a park. Therefore, there would be no impact in terms of Public Services.

XV. RECREATION

(a) – Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?
Answer: Less than significant.

Publicizing the location of public beaches with restroom facilities and limiting parking near areas of the river without adequate restrooms would have a minimal impact on the existing public beaches and facilities compared to the existing baseline. The Russian River Watershed is currently a highly recreated area and the small increase in users at particular public beaches is not expected to cause substantial physical deterioration of the restroom facilities at those locations. Therefore, there would be a less than significant impact.

(b) – Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?
Answer: No impact.

Reasonably foreseeable compliance measures do not include the construction of recreational facilities. Thus, there will be no impact in terms of recreation.

XVI. TRANSPORTATION/TRAFFIC

Would the project:

(a) – Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?
(f) – Result in inadequate parking capacity?

(g) – Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?
Answer: Less than significant impact.

During construction-related activities, there may be a brief period when traffic congestion will increase due to the presence of earth moving equipment and other construction equipment. Potential impacts would be temporary and less than significant because potential impacts could be reduced by limiting or restricting hours of construction so as to avoid peak traffic times and by providing temporary traffic signals and flagging to facilitate traffic movement. Additionally, a parking lot, street parking, or the alternate transportation infrastructure could potentially be temporarily blocked due to compliance measures that involve construction, particularly construction occurring in roadways and in urban areas. However, the blockage would be temporary and is likely negligible as compared to the existing traffic baseline. Therefore, these impacts would be less than significant.

(b) – Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?
(c) – Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?
(d) – Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?
(e) – Result in inadequate emergency access?
Answer: No impact.

None of the reasonably foreseeable structural or non-structural compliance measures will affect a level of service standard, air traffic patterns, increase hazards, or result in inadequate emergency access. Changes in traffic due to construction-related activities to install compliance measures should not exceed the service standard level established by the county as these types of activities currently occur, are part of the baseline, and the County's level of service standard should allow for the activities. There should be no change in air traffic patterns due to the reasonably foreseeable compliance measures. This is because the compliance measures in no way increase or decrease air traffic; and, structures should not be tall enough to have an effect on the flight of an airplane. Traffic hazards will not substantially increase, as the reasonably foreseeable compliance measures do not require redesign of roads or incompatible uses. Reasonably foreseeable compliance measures should not impede emergency access and if roadways must be excavated for new sewer line installation or collection system maintenance, access to and through that roadway for emergency vehicles should be maintained. Fences will likely be constructed in areas that are not currently used as access for fire or police protection or that are not part of a park or school.

XVII. UTILITIES AND SERVICE SYSTEMS

Would the project:

(a) – Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?
Answer: No impact.

Any reasonably foreseeable compliance measure requiring compliance with wastewater treatment requirements of the North Coast Regional Water Board, will be controlled via a permit adopted through a public process by the North Coast Regional Water Board, and will include appropriate controls, limitations, and compliance schedules.

(b) – Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?
(e) – Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?
Answer: Potentially significant.

The proposed Basin Plan Amendment could result in an existing wastewater treatment plant determining it doesn’t have the capacity to serve the projects projected demand and thus result in the construction of a new centralized or community wastewater treatment plant or expansion of an existing plant or new, upgraded or replaced individual or community OWTS, as reasonably foreseeable compliance measures. The environmental effects associated with this type of construction, and of construction in general, have been discussed throughout this checklist, as appropriate. Potentially significant effects were identified and discussed in sections XI. Noise (c) and XII. Population and Housing (a). Any potentially significant adverse impacts that may result cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) – Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?
Answer: Less than significant.

Storm water infrastructure is already in place and it is not anticipated that large-scale construction will occur (such as a new subdivision). The expansion or construction of a new centralized or decentralized wastewater treatment facility will not result in significant environmental effects related to storm water drainage as storm water discharges from a wastewater treatment facility may be subject to NPDES industrial storm water general permit requirements that require protection of water quality and prevention of nuisance. Therefore, the effect will be less than significant.

(d) – Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?
(f) – Be served by a landfill with sufficient permitted capacity to accommodate the ~~proejct's~~project's sold waste disposal needs?
(g) – Comply with federal, state, and local statutes and regulations related to solid waste?
Answer: No impact.

Reasonably foreseeable compliance measures should not require an increase in water supply. The solid waste from a new wastewater treatment plant, construction activities, or pet waste from collection receptacles is not expected to have any impact on landfills over current baseline conditions. Any actions related to solid waste must be in compliance with all existing federal, state, and local statutes and regulations related to solid waste. None of the reasonably foreseeable compliance measures would violate existing statutes and regulations.

XVIII. MANDATORY FINDINGS OF SIGNIFICANCE

(a) – Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?
Answer: Less than significant with mitigation.

Reasonably foreseeable non-structural compliance measures will not result in the substantial degradation of the environment for fish, wildlife, and threatened/rare plant and animal species because none of the measures would introduce any new physical effects above the baseline that could impact these characteristics.

Some of the reasonably foreseeable structural compliance measures, however, do have the potential to cause significant degradation of the environment for fish, wildlife, and threatened/rare plant and animal species if not mitigated. As discussed in section IV above, plant and animal species could potentially be adversely affected by construction related activities, creation of riparian buffers, installation of straw waddles, and by exclusion fencing. The mitigation measures discussed in that section, as well as others, could be implemented to ensure that unique, rare or endangered plant and/or animal species and their habitats are not taken or destroyed. When specific projects are developed and sites identified, a focused protocol plant and/or animal survey and/or a search of the California Natural Diversity Database should be performed to confirm that any potentially sensitive or special status plant and/or animal species in the site area are properly identified and protected as necessary. If sensitive plant and/or animal species occur on the project site, mitigation is required in accordance with the Endangered Species Act. Mitigation measures should be developed in consultation with CDFW and USFWS.

The adoption of the proposed Basin Plan amendment should result in improved surface water quality in the Russian River Watershed and will have a significant beneficial effect on the environment over the long-term. However, it should be noted that some of the structural compliance measures do have the potential to adversely impact the environment. In many cases, the impacts of the installation of the structural compliance measures will be temporary, and many of the effects caused by permanent structures can be avoided by adjusting the timing and/or location so as to take into account any candidate, sensitive, or special status species or their habitats. Therefore, with correctly implemented mitigation measures these impacts are considered less than significant.

(b) – Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?
Answer: Potentially significant.

Cumulative impacts, defined in section 15355 of the California Code of Regulations, refer to two or more individual effects, that when considered together, are considerable or increase other environmental impacts. Cumulative impact assessment must consider not only the impacts of the proposed Basin Plan amendment, but also the impacts from other Basin Plan amendments, municipal and private projects which have occurred in the past, are presently occurring, and may occur in the future in the watershed during the period of implementation.

Impacts associated with implementation of the non-structural measures and most of the structural measures will be short-term, temporary, amenable to mitigation, and spatially distributed across the watershed, and will not contribute to significant adverse effects or cumulative impacts on the environment. However, structural compliance measures that involve substantial earth movement could have potentially significant cumulative impacts to traffic, greenhouse gas emissions, and noise when considered in conjunction with other past, present, and future construction; including but not limited to construction and repair of infrastructure (such as roads), housing construction, commercial construction activities, and restoration projects involving earth moving and construction equipment. Regional Water Board staff's oversight of construction activities though permits, regulatory programs, and other authorities will provide an opportunity to limit the potential for cumulative impacts by ensuring that multiple projects proposing various compliance measures and implementation of BMPs with the potential to cause short-term impacts are phased appropriately to limit potential cumulative impacts.

Based on a review of the available information, and as a result of implementing various compliance measures including creating riparian buffers, exclusion fencing, construction and daily operations of a new wastewater treatment plant and expansion of an existing wastewater treatment plant, it has been determined that significant and unavoidable impacts to the environment have the potential to occur. Cumulative impacts are especially significant in areas that are already listed as impaired or otherwise degraded since the system or species has already lost resilience to external stressors. Due to the fact that many streams in the region are impaired and several rare, threatened and endangered are present throughout the region any adverse impact that has the potential to occur in multiple instances could be considered significant and unavoidable. Many of the potential impacts discussed throughout this CEQA analysis can be reduced through proper implementation of mitigation measures; however, cumulatively these impacts do have the potential for significant adverse effects on the environment~~.~~ that cannot be reduced to a less than significant level with mitigation. The impact is overridden by project benefits as set forth in the SED.

(c) – Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?
Answer: Potentially significant.

The purpose of the proposed Action Plan is to improve water quality conditions to protect human health as well as aquatic ecosystem health. Most of the potentially significant impacts to human beings, such as air quality, aesthetics, biological resources, greenhouse gas emissions, etc., are either short-term in nature, or can be mitigated to less than significant levels as previously discussed. However, some impacts were identified as being potentially significant including impacts to agricultural resources, noise levels, population growth, and utilities as detailed in those sections above. It is possible that when implemented at the project level, some of the reasonably foreseeable compliance measures identified as having potentially significant impacts could be mitigated so as to reduce the impacts to less than significant or that proposed projects could identify additional compliance measures that have less than significant impacts or impacts that can be mitigated. The overall effects of implementing the proposed Action Plan will be to improve water quality conditions and therefore are seen as a benefit for human beings and the environment. Any potentially significant environmental impacts that cannot be reduced to a less than significant level with mitigation are overridden by project benefits as set forth in the SED.

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CHAPTER 12
ECONOMIC CONSIDERATIONS

12.1 OVERVIEW

This chapter describes the economic considerations associated with implementation of the Russian River Watershed Pathogen TMDL Action Plan (Action Plan). The triggers for Regional Water Board consideration of economics or costs in basin planning include:

- Establishing water quality objectives that ensure the reasonable protection of beneficial uses.
- Compliance with the California Environmental Quality Act (CEQA)[44] when Regional Water Boards amend their basin plans. CEQA, and the regulations implementing CEQA, require that the Boards identify the reasonably foreseeable methods of compliance with draft performance standards and treatment requirements.[45] This process must include discussion of economic factors.

Chapter 11 of this staff report (CEQA Substitute Environmental Analysis) discusses the potential environmental impacts, as required under CEQA, associated with adopting an amendment to the Water Quality Control Plan for the North Coast Region (Basin Plan) to include a Program of Implementation for the Russian River Watershed Pathogen TMDL, known as an Action Plan. Chapter 11 identifies the reasonably foreseeable compliance measures necessary to achieve compliance with the Action Plan. Compliance measures include treatment technologies and management practices most likely to be implemented to achieve compliance with load allocations, waste load allocations, numeric targets, and the water quality objectives for bacteria. There are no new water quality objectives proposed for adoption as part of the proposed Action Plan.

This chapter considers the potential costs of implementing the reasonably foreseeable compliance measures without considering whether compliance measures are currently part of the existing regulatory baseline. The costs are generally given as a range~~,~~ and are dependent on the specific characteristics of the land or operation to which given management practices are applied. A list of potential funding sources is also presented below.

For CEQA purposes, the economic and social impacts of the draft proposed project are considered to determine if they will cause or contribute to an adverse environmental impact, not whether the costs of the measures themselves are significant or will cause an economic hardship. Although the Regional Water Board is required to consider economics during the Basin Plan amendment (Action Plan) process, it is not obligated to consider the balance of costs and benefits associated with implementation of the amendment.

[44] Pub. Resources Code § ~~21000 *et seq.*~~21159
[45] Cal.Code Regs., tit., 23 § 3777 subdivision (b).

Anticipating costs with precision is challenging for several reasons. Many of the actions, such as review, revision, and development of policies and ordinances by a governmental agency, could incur no significant costs beyond the program budgets of those agencies. However, other actions, such as establishing an ordinance to require property owners to inspect and repair their private sewer laterals carries discrete costs. Cost estimates are further complicated by the fact that some implementation actions are currently part of the baseline condition as they are already required by other regulatory requirements (e.g., NPDES Storm Water) or are actions anticipated regardless of Action Plan adoption. Therefore, assigning all ~~of~~ these costs to implementation of the proposed Action Plan would be inaccurate.

While the below text discusses the cost of various control measures aimed at improving water quality, it does not discuss the effects (costs) of *not* improving water quality such as impacts to public health.

12.2 ESTIMATED COST OF COMPLIANCE

The majority of costs identified in this chapter were derived from the following sources of information:

- U.S. Environmental Protection Agency (USEPA) Technology Fact Sheets http://water.epa.gov/scitech/wastetech/mtbfact.cfm
- Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010. http://ndwrcdp.werf.org/documents/DEC2R08/DEC2R08web.pdf
- San Francisco Bay Regional Water Quality Control Board, Staff Report for Pathogens in the Napa River Watershed Total Maximum Daily Load (TMDL). http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/napapathogens/item8napapathsappb.pdf
- Federal Remediation Technologies Roundtable Screening Matrix and Reference Guide (FRTR) http://www.frtr.gov/default.htm;
- Natural Resource Conservation Service (NRCS) Field Office Technical Guide (FOTG) http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/;
- CDFW Coho Salmon Recovery Strategy http://www.dfg.ca.gov/fish/Resources/Coho/CohoRecovery.asp; and
- California Department of Transportation (Caltrans) 2013 contract proposal award information http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/.

The cost information provided in the U.S. EPA guidance are available to assist the public and publicly owned treatment works, referred to here as wastewater treatment facilities (WWTFs), in understanding the necessary components and costs involved with implementing particular technologies. Many of the cost breakdowns are based on a variety of example sites throughout the county over the last two decades. Therefore, it can be generally assumed that these costs have increased with inflation, although some compliance measures have become more affordable as improvements in technologies are made. Generally, it can be assumed that labor rates will increase at a long-term average of three percent and capital cost inflation. The assumed potential cost ranges for compliance measures listed in the following tables will be at the long-term annual inflation rate of three percent assumed by the Engineering News Record (ENR) Construction Cost Index (CCI).

Cost ranges for construction and Operation and Maintenance (O&M) unit costs provided in the following tables are national averages and may not reflect actual construction costs for Sonoma County. Factors affecting the cost of construction in different areas of the county include: cost of transporting material and equipment to the project site, state and local taxes, construction wage requirements, labor supply, compliance with local codes, and managing local conditions such as weather and unusual soils. Cost indices to update old data and area modification factors to account for nationwide composite cost data are published by R.S. Means, Craftsman Book Company, and ENR, and others. Based on the 2015 National Building Cost Manual (Craftsman Book Company), the area modification factor for estimating total project costs for residential, commercial, industrial public, agricultural, and military buildings for the Santa Rosa area is six percent. Thus, a factor of 1.06 can be applied to each of the capital and O&M cost ranges in the tables below where a non-local figure is used. A detailed cost estimate for compliance measures is beyond the scope of this staff report.

The cost information provided in the NRCS FOTG is a national dataset to assist local NRCS Districts in setting cost shares for implementing conservation practices. Cost estimates are provided at the county level and the data used for this analysis are specific to Northern California as described in their Fiscal Year 2014 Payment Schedule. The FOTG represents the NRCS estimate of costs to implement such practices.

The costs included in the CDFG Manual are described as upslope erosion inventory and sediment control guidance. The numbers are based on estimates provided by Pacific Watershed Associates, a consulting firm specializing in erosion control work. Actual costs can vary considerably depending on operator skill and experience, equipment types, local site conditions, and regional location.

12.2.1 POTENTIAL COSTS FOR TREATMENT PLANT UPGRADES AT EXISTING WWTFS

2.2.1.1 DISINFECTION IMPROVEMENTS

All municipal wastewater treatment facilities within the Russian River Watershed are required to comply with effluent disinfection requirements contained in waste discharge requirements. No new capital costs are anticipated as a result of implementing the proposed Action Plan for WWTFs that are in compliance with effluent limitations for bacteria and disinfection requirements in their waste discharge permits. Permitted wastewater treatment facilities will incur increased costs associated with additional effluent and receiving water bacteria monitoring~~, so as~~ to demonstrate compliance with the proposed Action Plan. In particular, those facilities that discharge treated and disinfected effluent to a holding pond prior to discharge to a surface water, will be required to conduct a reasonable potential analysis during the process of renewing their NPDES permit to demonstrate that ~~any regrowth of *e. coli* or~~ discharges of treated wastewater from holding ponds are not causing or contributing to an exceedance of the bacteria water quality objectives of the Russian River and its tributaries. The reasonable potential analysis may include an investigation to determine the concentrations of *E. coli*, total coliform bacteria ~~in the~~ , or other fecal indicator discharged from the holding pond ~~(including bacteria contributions from bird life) does not otherwise indicate the presence of human pathogens. But~~, the sources of these ~~costs are not included here as an economic consideration associated~~contaminants (i.e., whether the sources are humans, domestic animals, or other), and whether the microbial contaminants discharged from the holding ponds pose a public health threat or impair the REC-1 beneficial use. The cost to conduct a reasonable potential analysis to assess compliance with ~~implementation~~the bacterial water quality objectives will vary depending on the scope of the investigation but may be expected to be in the hundreds of thousands of dollars for a detailed investigation involving microbial source tracking techniques.

In cases where a municipal wastewater treatment facility does not consistently meet bacteria effluent limitations in its waste discharge permit or cannot demonstrate that discharges from wastewater holding ponds are in compliance with wasteload allocations (WLAs), the municipality or special district may have to improve the reliability or upgrade its existing treatment facilities. It is anticipated that treatment systems consistent with disinfected tertiary treated water, as defined in title 22 of the California Code of Regulations, are the minimum acceptable processes that are capable of ensuring compliance with effluent limitations for bacteria, excluding consideration of the potential for bacterial regrowth in holding ponds. The costs for complying with effluent limitations for bacteria through improvements in wastewater disinfection systems include capital costs and cost for routine operations and maintenance and are presented in Table 12.1.

Table 12.1 Estimated Cost Range for Centralized Wastewater Treatment Compliance Measures Advanced Treatment and Disinfection

Compliance Measures	Capital Costs	Annual O&M Costs	Cost Source
Membrane Bioreactors	\$7.00-\$20.00 / gpd capacity	\$1.00-\$2.00 /gallons treated	USEPA[1], GWRMN
Chlorine Disinfection	1-2.5 mgd = \$1.1 to \$1.3 million 10-20 mgd = \$3.1 to \$4 million 100-175 mgd = \$14.3 to \$1.3 million	1-2.5 mgd = \$49K to \$76K 10-20 mgd = \$158K to \$380K 100-175 mgd = \$660K to \$1.3 million	USEPA[1]
Dechlorination	\$6,500 to \$383,000	\$9,900 to \$17,500 \$0.10 to \$10.00/1,000 gallons treated	USEPA[1]
Ultraviolet Light	Lamps 1-5 mgd =\$400-\$1,375	\$19,200	USEPA[1] WRF

Table 12.1 Estimated Cost Range for Centralized Wastewater Treatment Compliance Measures Advanced Treatment and Disinfection

Compliance Measures	Capital Costs	Annual O&M Costs	Cost Source
Disinfection	5-10 mgd = $345-$595 19-100 mgd = $275-$590 Systems 0.1 MGD (Design Flow) = $300,000 1.0 MGD = $250,000 10 MGD = $1,000,000 100 MGD = $7,000,000	0.1 MGD (Design Flow) = $50,000 1.0 MGD = $36,500 10 MGD = $182,000 100 MGD = $365,000	
Ozone Disinfection	Oxygen gas /compressor= $245K Contact vessel (500 gpm)= $4,000 - $5,000 <u>Destruct unit:</u> Small (around 30 cfm)= $800 Large (around 120)= $1,000-1,200 Non-component costs= $35,000 Engineering=$12,000-15,000 Contingencies= 30%	Labor= $12,000 Power= 90 kW Other (filter replacements, compressor oil, spare dielectric, etc.)= $6,500	USEPA[1]
Reverse Osmosis	$776k to $81 million / 1.0 to 200 mgd		USEPA[1]
Wetland Treatment Systems	$155,000 to $260,00 /100,000 gpd $359,000 to $1,015,009 /acre of wetland treatment system Operations and maintenance costs	$5,00 to $8,323 /acre per year $0.45 to $1.36 /1,000 gallons over 10 to 30 year timeframe	FRTR, USEPA[3]
Advanced Ecologically Engineered Systems	40K gpd = $985K to $1.2 million 80K gpd = $1.5 to $1.9 million 1 million gpd = $8.5 to $10.5 million		USEPA[1]

gpm – gallons per minute / mgd – million gallons per day / gpd – gallons per day/ cy – cubic yard / ft^2 – square foot / lb – pound / ft- feet
OWTS – Onsite Wastewater Treatment System
SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final SED June 19, 2012
FRTR – Federal Remediation Technologies Roundtable
GWRTAC – Groundwater Remediation Technologies Analysis Center, Technology Overview Report TO-97-03
U.S. EPA 1 – US Environmental Protection Agency Technology Fact Sheets http://water.epa.gov/scitech/wastetech/mtbfact.cfm
U.S. EPA 2 – US Environmental Protection Agency Technologies and Cost for Removal of Arsenic from Drinking Water
U.S. EPA 3 – US Environmental Protection Agency Technology Fact Sheet Free Surface Water Wetland & Constructed Wetland Treatment of Municipal Wastewaters
GWRMN- Groundwater Remediation and Management for Nitrate Report – Addressing Nitrate in California's Drinking Water AFCEE –
EN- Eco-Nomic Septic System design Page http://www.eco-nomic.com/indexsdd.htm#Industrial or Non-Residential Wastewater
Water Research Foundation (WRF) – Fact Sheet: Advanced Treatment-Ultraviolet Disinfection.
http://www.waterrf.org/knowledge/advanced-treatment/FactSheets/advanced-treatment_UV_factSheet.pdf

12.2.1.2 EXPANSION OF COLLECTION, TREATMENT, AND DISPOSAL OR RECYCLED WATER SYSTEMS

To accommodate new connections, WWTFs may need to evaluate whether flow from new customers will require expansion of its wastewater collection, treatment and disposal systems. Wastewater collection costs are generally the largest component of costs for expansion of the complete system, but the cost of land purchase is often significant when land suitable for waste management functions is scarce and expensive. Cost estimates for expanding the wastewater collection system for new connections are highly variable depending on terrain and other site constraints, method of collection, and design flow. As part of a 2007 assessment by the City of Los Altos Hills in Santa Clara County, for example, it was estimated that a proposed extension of an existing municipal sewer line to 40 nearby residences would cost approximately $1.5 million or $37,500 per residence (Moody Sewer Extension), and another proposed extension to 57 residences would cost approximately $1.01 million ~~(Robleda Sewer Extension). Both proposed extension were rejected by City staff as too expensive to residents in the targeted subdivisions~~or $17,720 per residence (Robleda Sewer Extension). In Sonoma County, the Sonoma County Water Agency (Sonoma Water) is developing a project for Larkfield Estates that would extend and make sewer service available to property owners that were impacted by a destructive wildfire in 2017. The affected parcels are located within an existing municipal sewer boundary but are currently served by individual OWTS. Sonoma Water estimated that construction costs for the sewer connections, including service laterals to the property line, will cost approximately $45,000 per parcel. Connection fees for individual property owners, which would be due upon connection, would cost $12,023 and the annual service charge is expected to be approximately $900. These cost estimates for Larkfield Estates are based on extension of sewer to an area within an existing sewer district and reflect costs for a construction project that poses few technical challenges. Sewer extension to residential areas where there are technical challenges to traditional construction practices and options will likely cost considerably more.

Unit costs for expansion of baseline capacity for treatment unit processes to accommodate additional flow from new customers outside an established service area are highly variable and dependent on many factors and estimating the cost for such an expansion would require a project level evaluation beyond the scope of this staff report. Consequently, estimating the cost for possible construction costs for WWTF expansion scenarios would be speculative and inaccurate. The average operation and maintenance costs for wastewater treatment are generally lower for a facility that increases design volume. This is a result of an economy of scale for secondary and tertiary wastewater treatment systems.

In cases where a municipality or special district choses to comply with Action Plan by expanding effluent storage so that the need to discharge to surface water is eliminated, the capital cost may include costs for land acquisition, permitting, pond excavation and earthwork, pond liner, pumping and pumping appurtenances, and electrical systems. The total cost of construction or expansion of effluent storage will vary greatly depending on site constraints, land availability, and level of public support. Two recent examples illustrate the range of costs: In 1999, the Russian River County Sanitation District (Guerneville, CA) evaluated a project to construct a 5.7 million gallon equalization basin to increase wastewater treatment capacity at its Guerneville Treatment Plant. Although the project was never completed, the estimated cost of the expansion was $1.5 million. More recently, the Sonoma Valley County Sanitation District (Sonoma, CA) is proposing to construct a 37-million gallon recycled water storage reservoir to reduce its discharge to Shell Slough and San Pablo Bay and provide recycled water for irrigation purposes.

Construction of the reservoir is expected to cost approximately $2.3 million. Where discharge to a pond is designed to use percolation to groundwater as the method of disposal, costs associated with ongoing operation and maintenance, as well as groundwater monitoring will also apply.

~~In order~~ To avoid Action Plan implementation requirements for storage pond discharges to surface waters, municipalities and special districts that treat municipal wastewater may also expand existing or implement new water recycling programs. Total capital costs will vary depending on site conditions, land acquisition requirements, and public support. As part of the 1999 WWTF evaluations, the Russian River County Sanitation District considered expansion of its treated wastewater disposal capacity. Among the alternatives evaluated was expansion of spray irrigation on the Burch Property, which is located adjacent to the Guerneville Treatment Plant and a portion of which is already leased for spray irrigation of treated wastewater. This alternative was estimated to cost approximately $4.0 million (including purchase of the Burch Property). Other alternatives for this project included extension of the pipelines and spray irrigation to Green Valley and to the Guerneville and Westside Road areas. These projects were estimated from $6.5 to $12 million and $3 ~~to12~~to $12.5 million, respectively. Annual operation and maintenance costs for the Green Valley alternative was estimated from $50,000 to $350,000. Proper operation and maintenance ~~includes~~include the cost of monitoring to ensure proper application. These projects were designed to use vegetative uptake as the primary mechanism for wastewater removal, depending on agronomic rates of wastewater application and may be considered typical for similar projects, for the purpose of this analysis.

12.2.2 POTENTIAL COST FOR SANITARY SEWER SYSTEMS

Sanitary sewer systems greater than one mile in length within the Russian River Watershed are required under the existing General Permit for Sanitary Sewer Systems to be designed, operated, and maintained in such a way as to prevent or minimize sanitary sewer overflows. No new costs to prevent sanitary sewer overflows are anticipated as a result of the Action Plan. In the event that public entities which own sanitary sewer systems enact new ordinances or programs to require or promote private property owners to inspect their private sewer laterals, costs to develop the ordinances or programs will be incurred. The cost of developing and implementing a program will depend on the nature and complexity of the local program and are not estimated here.

12.2.3 POTENTIAL COSTS FOR INDIVIDUAL AND DECENTRALIZED ONSITE WASTEWATER TREATMENT SYSTEMS

12.2.3.1 INDIVIDUAL OWTS COST CONSIDERATIONS

As outlined in the Action Plan, certain existing, new, and replacement OWTS in the Russian River Watershed may be required to utilize supplemental treatment to achieve load allocations for fecal indicator bacteria. The necessary supplemental treatment components ~~necessary to comply with performance requirements~~ will vary depending on type and age of the existing OWTS, site conditions and constraints, the availability of and proximity to the individual OWTS to community sewer systems, and the availability of financial assistance to private property owners to fund OWTS upgrades. Cost estimates for new OWTS and for supplemental treatment components for new and replacement OWTS are presented in Table 12.2. Permit and design fees are an additional cost to construct an individual new or replacement OWTS and may add $5,000 to $15,000 to the capital and O&M costs, or more for complicated designs. Other site preparation costs, such as tree removal, are site specific, but can increase costs significantly.

In the absence of a TMDL, existing OWTS that do not meet requirements in the statewide Conditional Waiver of Waste Discharge Requirements or the conditions and requirements set forth in an approved LAMP may be required to submit a report of waste discharge, obtain waste discharge requirements, and pay an annual fee for their OWTS. The cost of preparing a complete report of waste discharge will vary depending on whether the report will be prepared by the property owner or a qualified professional, how much information is available to characterize the discharge and site conditions, site conditions and constraints, and the proposed supplemental treatment~~ system to be used to meet performance requirements.~~. The cost for a general site evaluation to obtain local agency approvals for a new or replacement OWTS is approximately $1,000. The cost for preparation of a report of waste discharge by a qualified professional could range from $2,000 to $6,000 (Ted Walker, personal communication). The application fee and first annual fee submitted to the Regional Water Board for waste discharge requirements is currently $2,~~088~~286 (Fiscal Year ~~2016-17~~2018-19).

Table 12.2 Estimated Cost Range for Wastewater Treatment Compliance Measures Individual OWTS

Compliance Measures	Capital Costs	O&M Costs	Cost Source
Septic System for single home	Tank replacement: $2,500 - $4,500 Leachfield replacement: $3,300 - $7,400	$44-$400/yr	USEPA[1], EN[2], SWRCB[3]
	Whole new standard gravity OWTS: $5,600-$10,000		
	With supplemental treatment: $17,600 - $45,000 [4]		
Septic System for a Restaurant (approximately 200 meals per day)	Tank replacement: $4,500 - $13,800 Leachfield replacement: $29,500 - $66,000	$44-$400/yr	USEPA, EN, SWRCB
	Whole new OWTS: $34,000-$80,000		
	With supplemental treatment: $104,000 - $151,000		
Septic System for a School (Approximately	Tank replacement: $4,500 - $13,000 Leachfield replacement: $50,000 - $200,000	$44-$400/yr	USEPA, EN, SWRCB

Table 12.2 Estimated Cost Range for Wastewater Treatment Compliance Measures Individual OWTS

Compliance Measures	Capital Costs	O&M Costs	Cost Source
700 students)	Whole new OWTS $55,600-$212,000 With supplemental treatment: $104,000 - $151,000		
Aerobic Pretreatment	500–1,500 gallon per day = $2,500 to $9,000	$350/yr	USEPA
Chlorine Disinfection	$325 - $4,200 /unit	Tablets $69-$280 (45lb. pail)	USEPA
UV Disinfection	$2,500 – 4,700/unit	Lamp Replacement: $40-$80 Power: 200-300 kWh/yr	USEPA Levernze[5]
Control Panels	$1,500 - $3,000 /unit	-0-	USEPA
Septic Tank Effluent Screen	$70 - $300 per unit, not including installation	Minimal	USEPA
Sand/Gravel Filters	Range: $4,000 - $15,000 1,500-gallon single compartment septic/pump tank @ $0.57/gallon: $850 ISF complete equipment package (includes dual simplex panel, pump pkg., tank risers, lids, liner, lateral kit, orifice shields, etc.): $3,200 Non-component costs: $750 Engineering (soil evaluation, siting, design, and construction): $2,000	Labor @ $65/hr. (2 hrs./yr.)= $130/yr Power @10 cents/kWh Sludge disposal=$25/yr	USEPA, EN
Low Pressure Pipe System	$1,500 - $5,000	Distribution line and filter flushing: $0 Power: Variable depending on pumping rate, volume per dose pumped, and pump wattage.	USEPA, EN
Pressure Systems	$4,000 - $6,500	Distribution line and filter flushing: $0 Power: Variable depending on pumping rate, volume per dose pumped, and pump wattage.	USEPA, EN
Mound Systems	$12,000 to $20,000	$100/yr	USEPA, EN
Granular Activated Carbon Absorption	$0.80 - $6.30 /1,000 gallons treated	Carbon $0.50 to $1.20 /lb	USEPA

Table 12.2 Estimated Cost Range for Wastewater Treatment Compliance Measures Individual OWTS			
Compliance Measures	**Capital Costs**	**O&M Costs**	**Cost Source**
Replace/Upgrade Sewer laterals	Burst Pipe: $40-$80 per linear foot Sliplining: $80-$170 per linear foot Cured In Place Pipe: $25-$65 per linear foot Modified Cross Section: $18-$50 per linear foot		USEPA
Composting Toilets	Household of four: $1,200 - $6,000 Seasonal Usage: $700 - $1,500 Large Capacity/ Public Facility: $20,000	Electric (fan): 120 Wh/day Leachate disposal: variable Bulking agents: variable Compost Disposal: variable	USEPA
Incinerating Toilet	Electric: $2,300 - $2,700 Propane: $2,550	Electric: $2,748/yr Propane: $383.60/yr	

~~gpm – gallons per minute / mgd – million gallons per day / gpd – gallons per day/ cy – cubic yard / ft² – square foot / lb – pound / ft- feet~~
~~SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final Substitute Environmental Document June 19, 2012~~

[1] U.S. EPA 1 – US Environmental Protection Agency Technology Fact Sheets http://water.epa.gov/scitech/wastetech/mtbfact.cfm, https://www.epa.gov/septic/decentralized-wastewater-systems-technology-fact-sheets, https://www.epa.gov/septic/water-efficiency-technology-fact-sheets

[2] EN- Eco-Nomic Septic System design Page http://www.eco-nomic.com/indexsdd.htm#Industrial or Non-Residential Wastewater

[3] SWRCB 1 – State Water Resources Control Board Onsite Wastewater Treatment System Policy Final Substitute Environmental Document June 19, 2012

[4] Total costs for OWTS with supplemental treatment components and pressure-distributed effluent dispersal systems to mitigate for difficult sites can be considerably higher that this cost range.

[5] Leverenz, Harold, J. Darby, and G. Tchobanoglous, 2006. Evaluation of Disinfection Units for Onsite Wastewater Treatment Systems. http://www.waterboards.ca.gov/water_issues/programs/owts/docs/disinfection.pdf

12.2.3.2 DECENTRALIZED OWTS COST CONSIDERATIONS

An alternative for some small communities, where neither individual OWTS nor connection to an existing centralized municipal sewer system work well, is the establishment of a decentralized onsite waste treatment and disposal system. There is a range of available collection, treatment, and effluent dispersal technologies for a community-owned decentralized OWTS that may be used individually or in combination. Cost estimates for individual property owners to connect to a community-owned decentralized OWTS via a local sewer system (not including connection fees or other related costs) are presented in Table 12.3. Table 12.4 presents estimates for the cost of operating a decentralized OWTS, based on common technologies for waste flows ranging from 5,000 to 50,000 gpd.

Table 12.3 Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS- Cost to Property Owner

Compliance Measures	Capital Costs for building sewer and connection to sewer main	Annual O&M Costs	Cost Source
Private Laterals	$20-$30/ft (excluding surface restoration) $50-$100/ft (for paved streets)	Electricity: $0 O&M: $0	CCCSD[1]
Gravity Sewer Systems	Materials and Installation: $1,800 - $2,700	Electricity: $0 O&M: $16 - $24	WERF[2]
Pressure Sewer Systems	Materials and Installation: $4,800 - $7,200	Electricity: $44 - $66 O&M: $120 - $240	WERF
Effluent (STEP) Sewer Systems	Materials and Installation: $3,000 - $5,000	Electricity: $24 - $36 O&M: $56 - $84	WERF

[1] Central Contra Costa County Sanitary District (CCCSD) website: http://www.centralsan.org/index.cfm?navid=27

[2] Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.

Table 12.4 Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Wastewater Utility

Compliance Measures	Cost Factors	Wastewater Volume (gpd)		
		5,000 gpd (or 20 homes)	10,000 gpd (or 40 homes)	50,000 gpd (or 200 homes)
Gravity Sewers	Materials and Installation Annual O&M	$210,000-$315,000 $6,400-$9,600	$419,000-$629,000 $12,800-$19,200	$2,182,000-$3,273,000 $65,000-$97,000
Pressure Sewers	Materials and Installation Annual O&M	$33,000-$49,000 $6,400-$9,600	$65,000-$98,000 $13,000-$19,000	$344,000-$516,000 $56,000-$84,000
Effluent Sewers	Materials and Installation Annual O&M	$32,000-$48,000 $6,000-$9,000	$65,000-$97,000 $12,000-$18,000	$340,000-$510,000 $61,000-$91,000
Extended Aeration	Materials and Installation Annual Electrical Annual O&M	$100,000-$150,000 $900-$1,400 $5,300-$8,000	$148,000-$223,000 $1,800-$2,700 $9,000-$13,000	$410,000-$616,000 $9,000-$14,000 $34,000-$51,000
Fixed-growth Media Filter	Materials and Installation Annual Electrical Annual O&M	$30,000-$46,000 $350-$500 $4,100-$6,000	$98,000-$147,000 $900-$1,400 $7,300-$11,000	$287,000-$431,000 $4,600-$6,900 $30,000-$44,000
Wastewater Lagoons	Materials and Installation Annual Electrical Annual O&M	$314,000-$471,000 -0- $2,400-$3,500	$628,000-$942,000 -0- $4,700-$7,100	$3,141,000-$4,711,000 -0- $24,000-$35,000
Chlorine Disinfection	Materials and Installation Annual Electrical Annual O&M	$3,100-$5,400 $40-$50 $900-$1,400	$3,100-$5,400 $50-$80 $1,700-$2,500	$3,100-$5,400 $3,100-$4,700 $7,900-$12,000

Table 12.4 Estimated Cost Range for Wastewater Treatment Compliance Measures Decentralized OWTS – Cost to Wastewater Utility

Compliance Measures	Cost Factors	Wastewater Volume (gpd)		
		5,000 gpd (or 20 homes)	10,000 gpd (or 40 homes)	50,000 gpd (or 200 homes)
UV Disinfection	Materials and Installation Annual Electrical Annual O&M	$1,700-$2,500 $14-$20 $480-$720	$2,300-$3,400 $28-$40 $700-$1,100	$5,200-$7,800 $130-$190 $2,600-$3,900
Gravity Distribution	Materials and Installation Annual Electrical Annual O&M	$54,000-$81,000 $80-$120 $2,300-$3,400	$105,000-$158,000 $160-$230 $4,400-$6,600	$517,000-$776,000 $750-$1,100 $21,000-$31,500
Drip Distribution	Materials and Installation Annual Electrical Annual O&M	$37,000-$56,000 $240-$360 $3,300-$5,000	$85,000-$127,000 $480-$720 $6,900-$10,000	#329,000-$494,000 $2,400-$3,600 $31,000-$47,000
Spray Distribution	Materials and Installation Annual Electrical Annual O&M	$138,000-$206,000 $240-$360 $2,200-$3,400	$265,000-$397,000 $460-$690 $4,300-$6,500	$1,260,000-1,890,000 $2,300-$3,500 $21,000-$31,000

[1]Water Environment Research Foundation (WERF). Performance & Cost of Decentralized Unit Processes. Final Report, 2010.

12.3.2.3 LOCAL OVERSIGHT AGENCY COSTS

As described in Chapter 6 (Source Analysis), Section 6.5.1 (Onsite Waste Treatment Systems), effective pathogen removal in OWTS is dependent on proper siting and installation of the OWTS components, proper maintenance, and operation of the system within design specifications. Local agencies have been performing OWTS design review and approval for decades. According to the well and septic fees adopted by Sonoma County for the 2015/2016 fiscal year, inspections and field clearance reports range from $400-$1,100 per inspection/plan check. For existing OWTS requiring certification, the cost of a qualified contractor to perform the inspection and generate a report could range from $350 to $1,500.

As a general rule, the local agencies that issue a building permit are often the same entities that oversee the installation and construction of most of the OWTS, as well. In many cases, local agencies have worked with their respective regional water boards to integrate the necessary OWTS-related requirements into the building permit process, allowing one permitting and inspection agency to oversee both programs. Estimating the cost associated complying with the OWTS-related requirements of a building permit, is difficult and speculative, given the combined requirements.

Tier 2 of the Basin Plan's OWTS Policy is written to allow variability in local programs while retaining comparable standards to maintain the function of OWTS for the purpose of protecting the environment and human health through institutional controls and management. This is achieved by requiring Regional Water Board approval of a Local Agency Management Plan (LAMP) developed under Tier 2 of the Basin Plan's OWTS Policy. Conceptually, Tier 2 Programs (approved LAMPs) will include varying degrees of change to the local programs and practices currently in place. An OWTS managed under an approved LAMP may be allowed a variety of technological designs for both the wastewater treatment and effluent dispersal system. The selection of the technology would be made to accommodate site constraints, in order to ensure that the design provides adequate protection given the site's slope, groundwater level, soil conditions, topographic location, and other natural barriers to effective treatment.

There may be additional cost to the local agencies for developing and administering a local agency management program (LAMP). ~~But, that~~Additional costs will depend on the extent to which the existing programs and practices require upgrading to meet the goals and requirements of the Basin Plan's OWTS policy. It is expected that some or all of any such additional costs will be passed on to the owners of OWTS in the form of permit fees.

Tier 3 of the Basin Plan's OWTS Policy applies to existing, new, and replacement OWTS that are near waterbodies listed as impaired for pathogens or nitrogen on the CWA 303(d) list and where it is likely that operating OWTS will be determined to be a contributing source of the impairment. Tier 3 OWTS are regulated in accordance with an Advanced Protection Management Program (APMP) when a TMDL Implementation Plan (Action Plan) addressing the impairment(s) has been adopted by the Regional Water Board. The cost to a local agency for implementing requirements in an adopted Action Plan will depend on the extent to which the local agency assumes responsibility for implementation actions for existing OWTS.

Tier 4 of the Basin Plan's OWTS Policy requires that OWTS owners replace their failing OWTS (e.g. collapsed septic tank, overflowing leachfield) with a new component that will operate correctly and in compliance with conditions and requirements of the OWTS Policy. Replacement components (e.g. septic tank or drainfield) may have to be upgraded consistent with the Action Plan and the repair policy of the local agency. (See Tables 12.2 and 12.3 for costs associated with individual OWTS)

12.2.4 POTENTIAL COSTS OF ADDRESSING HOMELESS AND FARMWORKER ENCAMPMENTS, AND RECREATIONAL WATER USE

12.2.4.1 HOMELESS ENCAMPMENTS AND ILLEGAL CAMPING

In accordance with a Memorandum of Understanding (MOU), Sonoma County, the Sonoma County Community Development Commission and the Regional Water Board will implement a Joint Protocol to address water quality impacts associated to homeless encampments. It is anticipated that for the control of waste discharges from homeless and farmworker encampments the signatories to the MOU will employ a combination of non-structural and structural BMPs. Non-structural BMPs include community outreach and public information to reduce the homeless population within the Russian River Watershed, thereby reducing the need for the formation of encampments. Many of these efforts are voluntary and are already in development or underway in both Mendocino County and Sonoma County. Cost estimates for these initiatives are not considered as part of this staff report. Structural BMPs could include construction of permanent restroom facilities or installation of temporary mobile restroom facilities that are accessible to homeless individuals.

Cost estimates for the construction of public restroom facilities is presented in Table 12.5~~,~~ and are based on nationwide case studies in conjunction with a local project in the community Guerneville in Sonoma County. These costs also apply to the construction of public restroom facilities at recreational beaches and trailheads in close proximity to the Russian River and its tributaries. ~~Maintenance costs for public restroom facilities will vary by location, restroom type, level of use, and other factors.~~Other costs associated with the operation of public toilets include costs for cleaning, maintenance, security, insurance, and other operating costs such as repair costs for graffiti and vandalism. Annual cleaning and maintenance costs for one popular, low-maintenance restroom model, the Portland Loo, which must connect to public sewer, run approximately $21,000 per station. Cost may be considerably higher for other models depending on restroom type, location, level of use, and desired level of cleanliness. For models where a daily attendant is required, annual costs per station may be as high as $100,000.

12.2.4.2 RECREATIONAL WATER USE

In accordance with a Memorandum of Understanding, Sonoma County, the Sonoma County CDC, and the Regional Water Board will work with local entities and private parties along the Russian River to address water quality impacts relative to recreational water uses, and to promote the installation and location of sanitary facilities along the Russian River for use by recreational water users. It is anticipated that increasing the availability and access to restroom facilities at places of significant recreational use will result in a significant reduction in pathogen waste entering surface waters from recreational water use.

Table 12.5 provides estimates of the cost for construction of restroom facilities. In addition, cities, counties, and special districts may limit the availability of public parking near places of recreational water use, so as to accommodate only as many recreational water users as the facilities can safely support. Estimating costs for these site-specific measures are difficult to determine with the existing baseline of parking and trespassing enforcement during the peak tourism season. Additionally, minor cost may be incurred for posting additional signage informing recreators of such facility limits.

Table 12.5 Estimated Cost for Construction of Public Restroom Facilities

Location/Manufacturer	(1) Room	(2) Room	(4) Room	(6) Room	Source
Salt Lake City 1700 South River Park	N/A	N/A	158,264	N/A	1

Table 12.5 Estimated Cost for Construction of Public Restroom Facilities

Location/Manufacturer	(1) Room	(2) Room	(4) Room	(6) Room	Source
Roseburg, OR ROMTEC, Inc.	82,571	N/A	149,293	204,523	1
Spokane, WA CXT Concrete Buildings	78,614	N/A	199,370	127,030	1
LeGrange, KY Hunter Knepshield Co.	93,702	N/A	181,266	222,047	1
Reno, NV Restroom Facilities Ltd	148,460	N/A	351,483	491,646	1
Reno, NV Public Restroom Co.	117,281	N/A	205,111	247,378	1
Portland, OR Portland Loo	156,000	N/A	N/A	N/A	1
Salt Lake City American Ready Kontainer	N/A	N/A	217,750	N/A	1
Guerneville, CA	N/A	250,000	N/A	N/A	
Durham, NC	N/A	165-200,000	N/A	N/A	2
Range	$78-156,000	$165-250,000	$150-351,000	$127-492,000	

N/A – Not Available
[1] Staff report to City Council, Salt Lake City, "Cost of Building Public Restrooms."(Jan 15, 2013)
[2] "Going Public: An Assessment of Restroom Facilities in City of Durham Parks" (Jan 15, 2014)

12.2.5 POTENTIAL COSTS TO CONTROL URBAN STORM WATER RUNOFF

12.2.5.1 LOCAL AGENCY PROGRAM COSTS

As described in Chapter ~~5~~6 (Source Analysis) Section ~~5~~6.3.2 (Storm Water), urban storm water runoff and non-storm water runoff from MS4s[46] located in urban areas within the Russian River Watershed are regulated under conditions in the Phase I MS4 Permit for the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency, City of Ukiah, and the Town of Windsor. Under terms of the Phase I MS4 Permit, permittees are required to develop and implement a Storm Water Management Plan and Monitoring Program that identifies tasks and programs to reduce the discharge of pollutants in storm water to the maximum extent practicable in a manner designed to achieve compliance with water quality standards and objectives. The Storm Water Management Plan and Monitoring Program includes ongoing costs for operations and maintenance, inspections, enforcement, staff training, public education and outreach, illicit connections and discharges response and abatement, and effectiveness monitoring. The costs for implementing the Storm Water Management Plan and Monitoring Program are baseline program costs~~,~~ and will be

[46] Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances owned by a public entity and designed for collecting and conveying storm water, including roads, drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.

incurred by MS4 Permittees with or without additional, incremental costs associated with a specific program to control fecal indicator bacteria.

The Program of Implementation for the control of urban storm water and non-storm water runoff requires the MS4 Permittees to develop and implement BMPs to reduce the levels of pathogens in storm water discharged to surface waters. It is anticipated that MS4 Permittees will develop specific structural and/or nonstructural BMPs to control the sources of bacteria within the MS4 boundary. Potential control measures are unknown at this time. However, in the California Regional Water Quality Control Board, San Francisco Bay Region's *Pathogens in the Napa River Watershed Total Maximum Daily Load*, it was estimated that additional pathogen-specific measures for Napa County would result in a two to 15 percent increase to the annual MS4 program budget based on information for a similar MS4 program in Marin County. Using this estimate, staff estimates a range of incremental costs of implementing MS4 bacteria-control measures between a two percent annual increase (minimum) and a 15 percent annual increase (maximum). As an example of potential added costs for two MS4 Permittees in the Russian River Watershed, the cost calculations for the City of Santa Rosa and the County of Sonoma are shown in Table 12.6. Staff expects that MS4 Permittees that are already addressing fecal indicator bacteria issues would fall at the low end of incremental cost increases.

Other structural controls, including exclusionary structures to discourage uncontrolled public access and the formation of homeless encampments are also potential costs for MS4s or other entities where limiting public access is a feasible implementation action. The cost for exclusionary fencing for bridge abutments for MS4 Permittees is expected to be similar to costs estimates for Caltrans discussed in section 12.2.5.2. Potential costs for purchasing and installing exclusionary or safety fencing for operators of transportation corridors are likely much higher, depending on the type and length of fence needed.

Table 12.6 Estimated Cost Range for Incremental Costs for Bacteria Control Measures Municipal Separate Storm Sewer Systems (MS4s)

	Annual Program Cost	2% Incremental Cost Increase associated with Bacteria Control Program	15% Incremental Cost Increase associated with Bacteria Control Program
Santa Rosa (FY 13/14)[1]	$1,983,913	$39,678	$297,587
Santa Rosa (FY 14/15,est.)[1]	$2,251,609	$45,032	$337,741
Sonoma County (FY 13/14)[2]	$775,949	$15,519	$116,392

1 City of Santa Rosa, December 2014. City of Santa Rosa's 2013-2014 Annual Report of Compliance with Order No. R1-2009-0050

2 County of Sonoma, December 2014. NPDES Phase I Annual Report: July 1, 2013 – June 30, 2014, Term 3, Year Five

12.2.5.2 COSTS FOR STORM WATER CONTROLS FOR CALTRANS

In the North Coast Region (Caltrans District 4), BMPs installed to comply with Caltrans' statewide NPDES Permit conditions currently are focused on activities to prevent and minimize erosion and sediment discharges from Caltrans right-of-way. Effective erosion control will reduce the migration of pollutants, including human pathogens and fecal indicator bacteria, to surface waters.

Proactive bridge design is a cost-effective method to prevent the creation of tempting encampment sites for homeless persons. For retrofitting existing bridge underpasses, security fencing and other exclusionary structures are effective BMP to discourage the formation of homeless encampments under bridges within the Caltrans right-of-way. As an example of potential costs, in 2014, the City of Santa Rosa installed exclusion structures designed to exclude access to flat areas at the base of old bridge abutments that have been used for camping at three road crossings within the Russian River Watershed. The cost estimate for the project was $38,960, plus $1,170 for inspection of the three sites. In Pennsylvania, the Pennsylvania Department of Transportation spent an average of $24,000 per location to fences bridges and highway ramps to deter homeless. Based on available information, the cost estimate per location for exclusionary fencing is from $13,000 to $24,000, depending on site conditions.

12.2.5.3 GENERAL STORM WATER COMPLIANCE MEASURES COSTS

Structural controls for nonpoint sources divert, store, treat, and/or infiltrate storm water to prevent the discharge of waste material to the river with storm water runoff. Structural controls for point sources can be implemented to treat waste before discharge and/or prevent the direct discharge of waste into a waterbody, as highlighted in Table 12.7.

Table 12.7 Estimated Costs of Reasonably Foreseeable Compliance Measures Associated with Storm Water Control

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Sediment/Bacteria Controls	Fiber roll / Straw Wattle	$1.20- 20.00/Lft	Home Depot/ Caltrans 2013
Sediment/Bacteria Controls	Sand Filters	$6,000 -$18,500 /acre	U.S. EPA
Bioretention	Green Roofs, Rain Gardens, vegetated strips, and bioswales	$500-$7,000/per unit	U.S. EPA

12.2.6 POTENTIAL COSTS FOR OWNERS OF NON-DAIRY LIVESTOCK AND FARM ANIMALS

Activities associated with raising, feeding, and maintaining non-dairy livestock and farm animals occur throughout the North Coast Region both on private and public lands. Best management practices are recommended to prevent the migration of animal waste to surface waters. Estimates of potential cost to the grazing community are derived from NRCS Fiscal Year 2013 Payment Schedule, as depicted in Table 12.8.

Table 12.8 Estimated Cost Range for Incremental Costs for Bacteria Control Measures Owners of Non-dairy Livestock and Farm Animals

Reasonably Foreseeable Compliance Measure	Practice Name	Range of Practice Costs	NRCS Practice Code or Source
Use Exclusion	Forage exclusion	$0.64-$1.32/ft	#472
Vegetated filter strips	Filter strip	$210-$448/acre	#393
Stream buffer areas/Field borders	Field Borders: Riparian tree & shrub establishment; Non-native or native seedbed preparation	$211-$1,617/acre	#386
Fencing	NA	$3-$12/ft	CDFW Coho Recovery Plan

Owners of non-dairy livestock and farm animals who fail to implement these or substantially similar best management practices within two years after the effective date of the Action Plan will be ~~required to submit a report~~in violation of the fecal waste discharge ~~for possible establishment of waste discharge requirements for the discharge~~prohibition. The Executive Officer may require of ~~waste.~~individual non-dairy livestock operations the development and implementation of a ranch management plan. The cost for preparing a ~~report of waste discharge, or Notice of Intent,~~ranch management plan will vary depending whether the ~~report~~plan will be prepared by the property owner or a qualified professional, the size of the operation, how much information is available to characterize the discharge and site conditions, and site conditions and constraints. ~~The application fee and first annual fee for waste discharge requirements for small-scale animal operations is prescribed in California Code of Regulations, title 23, division 3, chapter 9, article 1, section 2200 (Annual Fee Schedules).~~

12.2.7 POTENTIAL COSTS FOR PET WASTE MANAGEMENT PROGRAMS

A successful pet waste management program is dependent of the participation and cooperation of individual pet owners. The cost of a public education program depends on the type of materials produced and the method of distribution. Implementation of a pet waste management program is an existing program under the MS4 permit for the County of Sonoma, City of Cloverdale, City of Cotati, City of Healdsburg, City of Rohnert Park, City of Santa Rosa, City of Sebastopol, Sonoma County Water Agency, City of Ukiah, and the Town of Windsor. No new costs are anticipated to continue implementing this program beyond the installation of new trash receptacles and pet waste bag dispensers. The cost of a bag dispenser is approximately $60 (Washington State Department of Ecology).

12.2.8 POTENTIAL COSTS FOR DAIRIES

The structural BMPs to reduce and prevent discharges of animal waste associated with the operation of cow dairies are similar to practices identified in section 12.~~1~~2.6 for non-dairy livestock and farm animals. Cost estimates for bacteria control measures for these BMPs are presented in Table 12.8. Where the structural BMP involves the construction of a new manure storage pond or enlargement of an existing manure storage pond, costs depend on the required design storm and the resulting required pond volume. Average national installation costs for livestock ponds is 2.2 cents per gallon for ponds with a capacity less than 1 million gallons, 1.8 cents per gallon for capacities from 1 million to 3 million gallons, and 1.5 cents per gallon for capacities greater than 3 million gallons (USDA)[47]. Increasing capacity in existing ponds by raising the levels of pond berms would cost considerably less.

12.2.9 POTENTIAL COSTS FOR BIOSOLIDS APPLICATION

Current options for managing wastewater biosolids include both beneficial reuse technologies (such as land application, landfilling with biogas recovery, and energy recovery through incineration) and non-reuse options, including landfilling. While implementing some type of beneficial reuse is the preferred method for managing wastewater biosolids, this is not always practical. For example, land acquisition constraints or poor material quality may limit beneficial reuse options. Composting is one of several methods for treating biosolids to create a marketable end product that is easy to handle, store, and use.

Recycling biosolids through land application serves several purposes. It improves soil properties, such as texture and water holding capacity, which make conditions more favorable for root growth and increases the drought tolerance of vegetation. Biosolids application also supplies nutrients essential for plant growth, including nitrogen and phosphorous, as well as some essential micronutrients such as nickel, zinc, and copper. Biosolids can also serve as an alternative or substitute for expensive chemical fertilizers.

Implementation of BMPs to prevent the migration of biosolids, and associated fecal pathogens, from land application areas is an existing requirement of the State Water Board's Water Quality Order No. 2004-0012-DWQ, General Waste Discharge Requirements for the Discharge of Biosolids for use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities (Biosolids General Order) and a common requirement in individual WDRs or Waivers of WDRs that authorize land application of biosolids. The Action Plan requires that each discharger that land applies biosolids comply

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[47] **USDA Natural Resources Conservation Service (Rhode Island). Comprehensive Nutrient Management Plans (CNMP): Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans -** Part I—Nutrient Management, Land Treatment, Manure and Wastewater Handling and Storage, and Recordkeeping. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ri/technical/dma/?cid=nrcs143_014041

with its applicable permit. No new costs are anticipated as a result of this Program of Implementation.

12.2.10 POTENTIAL COSTS FOR PUBLIC OUTREACH AND EDUCATION PROGRAMS

Public education and community outreach are integral parts of any public program. Public education provides information to the public about where, when, why, and how a program will be implemented. If provided early and continued through the life a program, public education can also help create and maintain public support for a program and to ultimately meet the goals of the program.

Creating and implementing a successful education and outreach program requires a significant long-term financial commitment. The cost for implementing a public education and community outreach program depends on the scope of the public information effort. As an example, the Texas Water Development Board estimates in its *Best Management Practices for Municipal Water Users*[48] guide, that the costs for a public utility for administration and materials to implement a comprehensive water conservation program would range in cost from $0.25 per customer per year to several dollars per year, depending on the budget and size of the public utility. The Sonoma County Water Agency estimates that the costs to implement the public outreach and education components of its water programs range from $100,000 to $500,000 per year.

12.3 SOURCES OF FUNDING

Potential sources of funding include monies from private and public sources. Public financing includes, but is not limited to: grant funds, as described below; single-purpose appropriations from federal, state, and/or local legislative bodies; and bond indebtedness and loans from government institutions.

12.3.1 SUMMARY OF PERTINENT STATE FUNDING PROGRAMS

There are several potential sources of public financing through grant and loan funding programs administered, at least in part, by the Regional Water Board and the State Water Board. The Division of Financial Assistance (DFA) administers the implementation of the State Water Board financial assistance programs that include loan and grant funding for project planning, construction of municipal sewage and water recycling facilities, remediation for underground storage tank releases, watershed protection projects, and nonpoint source pollution control projects.

The resources available through these programs vary over time depending upon federal and state budgets and ballot propositions approved by voters. State funding programs pertinent to the proposed Action Plan are summarized and described below. Additional

[48] Texas Water Development Board. *Best Management Practices for Municipal Water Users*. November 2013. http://www.twdb.texas.gov/conservation/BMPs/Mun/doc/MunMiniGuide.pdf?d=1530657069210

information can be found on the State Water Resources Control Board webpage. (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/).

12.3.1.1 CLEAN WATER STATE REVOLVING FUND

The Federal Water Pollution Control Act (Clean Water Act or CWA), as amended in 1987, provides for establishment of a Clean Water State Revolving Fund (CWSRF) program. The program is funded by federal grants, State funds, and Revenue Bonds. The purpose of the CWSRF program is to implement the CWA and various State laws by providing financial assistance for the construction of facilities or implementation of measures necessary to address water quality problems and to prevent pollution of the waters of the State, including federal waters.

In 2014, California voters passed the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1; Prop 1), which authorized $7.545 billion in general obligation bonds for water projects including surface and groundwater storage, ecosystem and watershed protection and restoration, and drinking water protection. The State Water Board administers Proposition 1 for five programs: Small Community Wastewater, Water Recycling, Drinking Water, Storm Water, and Groundwater Sustainability. For small community wastewater projects, Proposition 1 allocates $260 million to the CWSRF Small Community Grant (SCG) Fund. The State Water Board has an annual SCG appropriation of $8 million dollars, which is administered consistent with the CWSRF Intended Use Plan (IUP), and the CWSRF Policy. Administering these funds as a part of the CWSRF Program allows grant funds to be easily leveraged with low-interest financing available through the CWSRF Program. CWSRF applications are accepted on a continuous basis, and eligible projects are funded as applications are completed and approved.

In addition to capital projects, up to 15 percent of the funds available from Prop 1 is allocated to a multi-disciplinary technical assistance (TA) program. The Prop 1 TA Funding Plan (Plan) was adopted by the State Water Board on November 4, 2015. The Plan outlines the general process to administer Prop 1 TA funds. The TA efforts are focused on helping small disadvantaged communities develop, fund, and implement capital improvement projects. This is a multi-disciplinary approach, intended to address small disadvantaged communities' drinking water, wastewater, groundwater quality, and storm water needs under one program.

Including the currently authorized and forecasted future revenue bond sales, the CWSRF's estimated cumulative uncommitted cash through June 30, 2023, available for financing new projects is approximately $711 million.

Additional information can be found on the State Water Resources Control Board webpage http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/

12.3.1.2 INTEGRATED REGIONAL WATER MANAGEMENT GRANTS

Proposition 1 also authorized $510 million to Integrated Regional Water Management (IRWM) funding, with funding allocated to hydrologic region-based Funding Areas. The Proposition 1 IRWM Grant Program, administered by the California Department of Water Resources (DWR), is designed to provide funding for projects that help meet the long-term water needs of the state, with particular attention to communities that are economically disadvantaged. The IRWM program is a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. In the North Coast Region, the North Coast Regional Partnership, a coalition of local and Tribal governments, water and wastewater service providers, non-governmental organizations, watershed groups, resource conservation districts, and interested stakeholders from Tribes and the North Coast counties, has been instrumental in obtaining IRWM) project implementation funding for communities, with $53 million of that funding over the last 10 years substantially contributing towards drinking water and water quality improvement projects in disadvantaged communities.

DWR has a number of IRWM grant program funding opportunities. Current IRWM grant programs include: planning, implementation, and storm water flood management. The IRWM Grant Programs are managed within DWR's Division of IRWM by the Financial Assistance Branch with assistance from the Regional Planning Branch and regional offices.

On October 5, 2018 DWR released the 2018 Proposition 1 - Round 1 IRWM Implementation Grant Draft Proposal Solicitation Package and Draft 2018 Guidelines for public review. DWR is proposing that approximately $194 million be made available for implementation projects with approximately $18 million designated for projects that provide benefits to Disadvantaged Communities.

Additional information can be found on the State Department of Water Resources webpage. https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs

The North Coast Partnership

The North Coast Resource Partnership (NCRP) is a long term, innovative and successful collaboration among local governments, watershed groups, Northern California Tribes, and other interested stakeholders that identifies, evaluates, and selects for funding water quality projects, which include projects for water and wastewater infrastructure, water recycling, storm water capture, and groundwater management. The NCRP region covers over 19,000 square miles – 12% of the California landscape – and includes the Tribal lands and the counties of Del Norte, Humboldt, Trinity, Siskiyou, Modoc, Mendocino and Sonoma.

Since 2004, the partnership has engaged in collaborative, integrated planning and project implementation, investing over $67 million of local, state, and federal funding in hundreds of projects that benefit the North Coast Region's communities and watersheds. The NCRP has been active in securing funding for failing water and wastewater infrastructure, and for projects that promote community health and safety.

Additional information about NCRP can be found on its webpage. http://northcoastresourcepartnership.org/

~~12.3.1.3 LINKED DEPOSIT PROGRAM~~

~~In a linked deposit program, a local public agency typically applies to the State Water Board to establish "linked deposit loans" to address a specific water quality problem in its area. The State Water Board arranges with local banks to provide loans to individual property owners for the specific water quality projects or actions. The CWSRF agrees to buy a Certificate of Deposit (CD) at below market rate. In exchange, the bank agrees to provide reduced interest rate loans to private property owners for eligible projects that were reviewed and approved by the local public agency.~~

~~12.3.1.4 SAFE DRINKING WATER STATE REVOLVING FUND~~

~~The Safe Drinking Water Act, as amended in 1996, established the Drinking Water State Revolving Fund (DWSRF) to make funds available to drinking water systems to finance infrastructure improvements. A noted priority of the program is to provide funds to small and disadvantaged communities and to programs that encourage pollution prevention as a tool for ensuring safe drinking water. The fund provides low interest loans, grants, and other assistance to public water systems for the purpose of infrastructure improvements to correct system deficiencies and improve water quality. Detailed information on the program can be found in the annual Intended Use Plan.~~

~~12.3.1.5 PROPOSITION 50~~

~~, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Water Code Section 79500, et seq.) was passed by California voters in the November 2002 general election. DDW is responsible for portions of the Act that deal with water security, safe drinking water, and treatment technology. DDW currently has funding available for projects designed to remove contaminants from drinking water supplies and/or install UV or ozone disinfection.~~

~~12.3.1.6 PROPOSITION 84~~

~~, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006 (Public Resources Code Section 75001, et seq.), was passed by California voters in the November 2006 general election. DDW is responsible for portions of the Act that deal with safe drinking water supplies, including emergency and urgent funding, infrastructure improvements, and groundwater quality. The Integrated Regional Water Management program from DWR has funding available under Proposition 84 for~~

~~projects that address critical drinking water supply or water quality needs for Disadvantaged Communities. Funding is also available for Urban Water Suppliers implementing leak detection and repair and installation of water meters as Best Management Practices.~~

~~12.3.1.7 PROPOSITION 84 STORM WATER GRANT PROGRAM~~

~~The Public Resources Code (PRC) requires that the Proposition 84 Storm Water Grant Program (SWGP) funds be used to provide matching grants to local public agencies for the reduction and prevention of storm water contamination of rivers, lakes, and streams. The Legislature may enact legislation to further define this grant program.~~

~~AB 739 requires the development of project selection and evaluation guidelines for the Proposition 84 SWGP, and provides additional information regarding types of projects eligible for funding. AB 739 also requires creation of a Storm Water Advisory Task Force that will provide advice to the State Water Board on its Storm Water Management Program that may include program priorities, funding criteria, project selection, and interagency coordination of State programs that address storm water management.~~
~~12.3.1.8~~

12.3.1.3 EMERGENCY SOLUTIONS GRANTS PROGRAM

The Emergency Solutions Grants program (ESG) provides funds for a variety of activities to address homelessness as authorized under the federal HEARTH Act of 2009 and State program requirements. The State of California Department of Housing and Community Development (HCD) administers the ESG program with funding received from the U.S. Department of Housing and Urban Development (HUD).

The federal ESG program provides grant funding to 1) engage homeless individuals and families living on the street; (2) rapidly re-house homeless individuals and families (2) help operate and provide essential services in emergency shelters for homeless individuals and families; (4) prevent individuals and families from becoming homeless.

Additional information can be found on the HCD webpage
~~http://hcd.ca.gov/financial-assistance/emergency-solutions-grant-program/index.html~~
https://www.hudexchange.info/programs/esg/

12.3.1.4 CLEAN BEACHES INITIATIVE GRANT PROGRAM

The Clean Beaches Initiative (CBI) Grant Program provides funding for projects that restore and protect the water quality and the environment of coastal waters, estuaries, bays, and near shore waters. The CBI Grant Program was initiated in response to the poor water quality and significant exceedances of bacterial indicators revealed by Assembly Bill (AB) 411 (Stats. 1997, Ch. 765) monitoring at California's beaches. Scientific studies have shown that water with high bacteria levels can cause infections rashes, and gastrointestinal and respiratory illnesses.

The CBI Grant Program has provided about $100 million from voter-approved bonds for approximately 100 projects since it was started under the 2001 Budget Act. Typical projects include the construction of disinfecting facilities, diversions that prevent polluted storm water from reaching the beach, and scientific research that will enable early notification of unhealthy swimming conditions. Round 2 Implementation includes $90 million that will become available in the Summer 2019.

Additional information about the CBI Grant Program can be found on the State Water Board website.
https://www.waterboards.ca.gov/water_issues/programs/beaches/cbi_projects/

~~12.3.1.10 AGRICULTURAL DRAINAGE PROGRAM~~

~~The was created by the Water Conservation and Water Quality Bond Act of 1986 to address treatment, storage, conveyance, or disposal of agricultural drainage water that threatens waters of the State. Loan repayments are for a period of up to 20 years. Eligible applicants include any city, county, district, joint powers authority or other political subdivision of the State involved with water management. Projects must address treatment, storage, conveyance or disposal of agricultural drainage that threaten waters of the State.~~

12.2.1.5 Cleanup & Abatement Account

The State Water Board's Cleanup and Abatement Account (CAA) was created by Water Code Sections 13440-13443 to provide grants for the cleanup or abatement of a condition of pollution when there are no viable responsible parties available to undertake the work. The CAA is supported by court judgments and administrative civil liabilities assessed by the State Water Board and the Regional Water Boards. Eligible entities include:

- Public agencies, including Regional Water Boards.
- Tribal government on the California Tribal Consultation List maintained by the Native American Heritage Commission and is a disadvantaged community (DAC).
- Not-for-profit organizations serving a DAC; or
- Community water systems serving a DAC.

Available funding varies for this program.

https://www.waterboards.ca.gov/water_issues/programs/grants_loans/caa/cleanup_and_abatement.html

12.3.2 SUMMARY OF PERTINENT FEDERAL FUNDING PROGRAMS

Several federal agencies, including but not limited to the U.S. EPA, NOAA Fisheries, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service also provide grants and other funding opportunities. Table 12.9 presented below provides a summary of the pertinent federal funding programs. Not all of the programs are currently available. but they are listed for educational purposes and in the case that they become available in the future.

The U.S. EPA provides access through its webpage to a catalog of federal funding opportunities: http://water.epa.gov/grants_funding/shedfund/databases.cfm

12.3.2.1 (USDA) NATURAL RESOURCES CONSERVATION SERVICE

~~The USDA has a wide variety of financial support programs that provide assistance to agricultural producers to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition to agriculture-related assistance, USDA also provides low interest loans to very low income homeowners to finance vital improvements necessary to make their homes decent, safe, and sanitary and provides grants to elderly very low income homeowners to remove health and safety hazards. USDA Multi-Family Housing Programs offer Rural Rental Housing Loans to provide affordable multi-family rental housing for very low-, low-, and moderate-income families; the elderly; and persons with disabilities. In addition, rental assistance is available to eligible families.~~

The United States Department of Agriculture Rural Development has more than 40 programs to support investments in infrastructure, housing, and economic and community development projects throughout rural California. USDA's loan and grant programs work in partnership with state and local sources to help build stronger rural communities. Eligible applicants include: public agencies, special districts, nonprofit corporations and federally recognized tribes. Funding available in the Water and Environmental (WEP) programs include water and wastewater loan and grant, emergency community water assistance grants, Native American grants and Special Evaluation Assistance for Rural Communities and Households (SEARCH) grants. WEP also provides funding to organizations that provide technical assistance and training to rural communities in relation to their water and waste activities. Some examples of eligible projects include: water, waste treatment and disposal, and constructed wetlands.

Additional information can be found on the USDA webpage

~~Additional information regarding housing assistance for rural communities can be found~~ at:
https://www.rd.usda.gov/

12.3.3 SUMMARY OF PERTINENT PRIVATE FUNDING PROGRAMS

In addition to the range of government entities that offer financial resources to advance environmental projects, there are a number of private funding programs that can be used to finance public infrastructure projects. Private funding organizations often provide funds through non-profit corporations.

12.3.3.1 (IBANK) INFRASTRUCTURE STATE REVOLVING FUND PROGRAM

The California Infrastructure and Economic Development Bank (IBank) provides funding to finance public infrastructure and private development that promote a healthy climate for jobs, contribute to a strong economy and improve the quality of life in California communities. The Infrastructure State Revolving Fund (ISRF) program provides financing to public agencies and non-profit corporations, sponsored by public agencies, for a wide variety of infrastructure and economic development projects (excluding housing). ISRF funding is available in amounts ranging from $50,000 to $25 million with loan terms for the useful life of the project up to a maximum of 30 years. Some examples of eligible projects include: water, sewage, flood control, waste disposal, streets, highways, public transit, public safety, educational, cultural, social, parks and recreation facilities, ports and goods movement.

Additional information can be found on the IBank webpage at:
http://www.ibank.ca.gov/about-us/

Table 12.9 Summary of Federal Funding Programs

Funding Program	Programs Description	2019 Funding
Agency : U.S. Department of Agriculture		
Sustainable Agriculture Research and Education	The Sustainable Agriculture Research and Education (SARE) program of the U.S. Department of Agriculture National Institute of Food and Agriculture (NIFA) works to advance farming systems that are productive, profitable, environmentally sound and good for communities through a regional grants program. SARE funds research and extension activities to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems in areas that possess various soil, climatic, and physical characteristics; to study farms that are managed using farm practices that optimize on-farm resources and conservation practices; and to promote partnerships among farmers, nonprofit organizations, agribusiness, and public and private research and extension institutions. Click on program name and check the link in the Primary Internet box for more information about grant opportunities and program results. https://www.sare.org/Grants	$22.7 million

Table 12.9 Summary of Federal Funding Programs		
Funding Program	**Programs Description**	**2019 Funding**
	https://www.westernsare.org/Professional-Development-Program/State-and-Protectorate-Pages/California	
Environmental Quality Incentives Program	The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for agricultural producers to address significant natural resource needs and objectives. Through a competitive process, EQIP offers financial assistance contracts with a maximum term of ten years, to help implement eligible conservation practices. Persons or legal entities, who are owners of land under agricultural production or who are engaged in livestock or agricultural production on eligible land, including private non-industrial forest land, or Indian Tribes may participate in EQIP. Conservation practices implemented through EQIP are subject to NRCS technical standards adapted for local conditions. NRCS or Technical Service Providers (TSPs) help applications develop a plan of operations which identifies practices needed to address natural resource concerns and support the EQIP contract. EQIP-related programs include Conservation Innovation Grants (CIG), Resource Conservation Partnership Program (RCPP), and the National Water Quality Initiative (NWQI). https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/	$981.7 million Estimate (Cost Share)
National Integrated Water Quality Program (NIWQP)	The National Integrated Water Quality Program (NIWQP) provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight "themes" that are being promoted in research, education and extension. The eight themes are (1) Animal manure and waste management (2) Drinking water and human health (3) Environmental restoration (4) Nutrient and pesticide management (5) Pollution assessment and prevention (6) Watershed management (7) Water conservation and agricultural water management (8) Water policy and economics. Awards are made in four program areas - National Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education and Extension Projects. Please note that funding is only available to universities. https://nifa.usda.gov/national-integrated-water-quality-program-frequently-asked-questions	Not currently available
Agency : U.S. Department of Housing and Urban Development		
Community Development Block Grants/Entitlement Grants	The objective of this program is to develop viable urban communities, by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for persons of low and moderate income. Recipients may undertake a wide range of activities directed toward neighborhood revitalization, economic development and provision of improved community facilities and services. https://www.hudexchange.info/programs/cdbg/	$1.95 billion (est.)

Table 12.9 Summary of Federal Funding Programs

Funding Program	Programs Description	2019 Funding
Agency : U.S. Environmental Protection Agency		
Source Reduction Assistance Grant Program	The Source Reduction Assistance Grant Program provides grants and cooperative agreements to fund pollution prevention (source reduction and resource conservation) activities. Specifically, the Agency is interested in funding projects that help reduce hazardous substances, pollutants, or contaminants entering waste streams or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, disposal or energy recovery activities. https://www.epa.gov/p2/fy-2018-and-fy-2019-request-proposals-source-reduction-assistance-grant-program	$2.0 million (est.)
Clean Water State Revolving Fund	The EPA's Clean Water State Revolving Fund (CWSRF) program provides a permanent source of low-cost financing for a wide range of water quality infrastructure projects. These projects include traditional wastewater treatment and collection, nonpoint source pollution controls, and estuary management. Funds to capitalize the program are provided annually through federal grants and state matching funds (equal to 20 percent of federal grants). Monies are loaned to assistance recipients at below-market rates. In addition, states also have the ability to customize loan terms to benefit small and disadvantaged communities. Loan repayments are recycled back into the programs to fund additional projects. Since its inception, the CWSRF has provided over $95.4 billion in assistance to eligible borrowers, including communities of all sizes, farmers, small businesses, and nonprofit organizations. More information on the CWSRF program can be obtained at https://www.epa.gov/cwsrf	$1.1 billion (est.) Estimated 70 million in Grants for California
Nonpoint Source Implementation Grants (319 Program)	Through its 319 program, U.S. EPA provides formula grants to the states, territories and tribes to implement nonpoint source programs and projects and programs in accordance with section 319 of the Clean Water Act (CWA). Nonpoint source pollution projects can be used for a wide range of activities including agriculture, forestry, construction, and urban challenges. When set as priorities within a state's Nonpoint source management program, projects may also be used to protect source water areas and high quality waters. Examples of previously funded projects include installation of best management practices (BMPs) for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; and basin-wide landowner education programs. Most states provide opportunities for 3rd parties to apply for funds under a state request for proposal. https://www.waterboards.ca.gov/water_issues/programs/nps/319grants.html	$4 million **E**stimated for California
Urban Waters Small Grants	EPA's Urban Waters Program protects and restores America's urban waterways. EPA's funding priority is to achieve the goals and commitments established in the Agency's Urban Waters Strategic Framework (www2.epa.gov/urbanwaters/urban-waters-strategic-	$2.08 (est.)

Table 12.9 Summary of Federal Funding Programs

Funding Program	Programs Description	2019 Funding
	framework). This program has an emphasis on engaging communities with environmental justice concerns. The objective of the Urban Waters Small Grants is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. In particular, the Urban Waters Small Grants seek to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways. https://www.epa.gov/urbanwaters/urban-waters-small-grants	Currently not available
Pollution Prevention Grant Program	The Pollution Prevention Grant Program provides grants and cooperative agreements to state agencies, instrumentalities of a state and federally recognized tribes to implement pollution prevention projects that provide technical assistance to businesses. The program requires applicants to work towards reducing pollution, conserving energy and water, and saving dollars through P2 efforts; as identified in EPA's Strategic Plan under Goal 4: Ensuring Safety of Chemicals and Preventing Pollution, Objective 4.2: Promote Pollution Prevention. https://www.epa.gov/p2/grant-programs-pollution-prevention	$4.69 million (est.)
Five-Star Restoration Program	The U.S. EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference will be given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments. Each project would ideally involve at least five partners who are expected to contribute funding, land, technical assistance, workforce support, or other in-kind services that are equivalent to the federal contribution. https://www.nfwf.org/fivestar/Pages/2018rfp.aspx	TBD

https://ofmpub.epa.gov/apex/watershedfunding/f?p=109:1:0::NO:RP::#search_results

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CHAPTER 13
ANTIDEGRADATION ANALYSIS

13.1 OVERVIEW

This chapter analyzes whether approval of the amendment would be consistent with the federal and state antidegradation policies.

13.2 STATE AND FEDERAL ANTIDEGRADATION POLICIES

The federal antidegradation policy, described in 40 CFR § 131.12, requires that existing instream designated uses and the level of water quality necessary to protect the existing uses be maintained and protected. Where, however, the quality of the water exceeds levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and out of the water, that quality must be maintained and protected unless the state finds that:

1. Such activity is necessary to accommodate important economic or social development in the area in which the waters are located;
2. Water quality is adequate to protect existing beneficial uses fully; and
3. The highest statutory and regulatory requirements for all new and existing point source discharges and all cost-effective and reasonable best management practices for nonpoint source control are achieved.

In addition, the federal antidegradation policy requires that where high quality waters constitute an outstanding National resource that water quality shall be maintained and protected.

The state antidegradation policy incorporates the federal Antidegradation Policy ~~(see State Water Board Order No. WQ 2001-16, p. 19, fn 83).~~.[49] (The state Antidegradation Policy applies to high quality waters.[50] The state policy establishes several conditions that must be met before the quality of high quality waters may be lowered by waste discharges. ("Statement of Policy With Respect to Maintaining High Quality Waters in California", State Water Board Resolution No. 68-16; See also Basin Plan pages 3-2.00 to 3-3.00). The state must determine that lowering the quality of high quality waters:

1. Will be consistent with the maximum benefit to the people of the state,
2. Will not unreasonably affect present and anticipated beneficial uses of such water, and
3. Will not result in water quality less than that prescribed (e.g., by water quality objectives).

[49] See State Water Board Order No. WQ 2001-16, fn 83).
[50] Baseline water quality for the purposes of the antidegradation analysis is the best quality of water measured since 1968, considering the state antidegradation policy, or 1975, considering the federal antidegradation policy, unless a subsequent lowering of water quality was allowed consistent with state and federal antidegradation policies.

In addition, before any degradation of water quality is permitted, it must be shown that the discharge will be required to meet waste discharge requirements that result in best practicable treatment or control of the discharge necessary to assure that:

1. Pollution or nuisance will not occur;
2. The highest water quality consistent with maximum benefit to the people of the State is maintained.

13.3 APPLICABILITY TO THE RUSSIAN RIVER WATERSHED PATHOGEN INDICATOR TMDL ACTION PLAN AND WASTE DISCHARGE PROHIBITION

The Action Plan is based in part on the principles contained in the state and federal antidegradation policies. High concentrations of fecal indicator bacteria in ambient waters infer the presence of human and animal fecal waste and associated disease-causing microorganisms that pose a risk to human health. The water quality of the Russian River does not support the recreational beneficial use~~.~~.[51] The Action Plan is designed to improve water quality conditions and protect uses of water for recreational activities such as wading, swimming, fishing and rafting. ~~The Action Plan is expected to result in an increase in water quality and will maintain and protect beneficial uses.~~The Action Plan is expected to result in an improvement in water quality compared to existing conditions and will promote attainment of water quality standards and protection of beneficial uses pursuant to the schedule established in the Action Plan. While not a specific component of an antidegradation analysis or required for compliance with state or federal antidegradation requirements, the Action Plan incorporates monitoring requirements to provide feedback on whether the actions that parties must implement are effective in improving water quality and avoiding further degradation. Both individual and comprehensive monitoring programs will help determine areas where site-specific management measures and further monitoring are necessary to achieve water quality goals.

It is important to note that the proposed Action Plan includes a prohibition of the discharge of fecal waste materials that cause or contribute to an exceedance of bacteria water quality objectives not authorized by action of the Regional or State Water Board. The Action Plan identifies a wide range of factors affecting the fate and transport of pathogens and the appropriate choice of compliance measures that will help attain water quality standards. The Action Plan also allows measures tailored to a particular site and includes iterative planning based on monitoring feedback (e.g., advanced protection management plan for OWTS, sanitary sewer management plans, etc.).

While the Action Plan directs the Regional Water Board staff to incorporate pathogen protection measures into its point source and nonpoint source permitting actions, it does not itself authorize or permit any activity that will discharge waste into high quality waters. An antidegradation analysis is appropriate at the time of permit development, with the proper findings made by the Regional Water Board prior to adoption~~.~~, including findings

that where any lowering of water quality is authorized that the discharges will ensure water quality objectives are not exceeded, are to the maximum benefit to the people of the state, and are subject to best practicable treatment and control methods.
The proposed Action Plan complies with antidegradation policies by ensuring the protection of contact recreation use, and by implementing a program to achieve bacteria source reduction and to reach attainment of water quality objectives if discharges are to occur. The waste load allocations and load allocations are set at a level that ~~would~~are expected to improve conditions in the Russian River Watershed. Additionally, the prohibition of the discharge of fecal waste materials that cause or contribute to an exceedance of bacteria water quality objectives will help to ensure the attainment of standards. This amendment is consistent with the State Antidegradation Policy (State Water Board Resolution No. 68-16), and the federal Antidegradation Policy (40 CFR § 131.12), in that it does not allow degradation of water quality, but requires restoration of water quality and attainment of water quality standards.

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CHAPTER 14
PUBLIC PARTICIPATION SUMMARY

This chapter describes the opportunities for the public to participate in the development of the Russian River Watershed Pathogen TMDL and Program of Implementation.

14.1 STAKEHOLDER AND PUBLIC OUTREACH

Regional Water Board staff has held numerous meetings to update and inform key stakeholders and the public throughout the Russian River Watershed TMDL assessment and Action Plan development process. The outreach meetings related to this project have included both public meetings and meetings targeted to small groups of individuals and local agency representatives who were identified by Regional Water Board staff as key stakeholders in the Russian River Watershed. A list of the stakeholder and public meetings that have been held regarding the Pathogen TMDL and Action Plan is presented in Table 14.1. Meetings before the Regional Water Board are identified in **bold.**

Table 14.1 Stakeholder and Public Meetings for the Russian River Watershed Pathogen TMDL and Action Plan

Subject	Date	Participants
Update on Regulatory and TMDL Efforts	**January 27, 2011**	**Regional Water Board meeting, all interested stakeholders**
Early TMDL Implementation and Monitoring	**November 3, 2011**	**Regional Water Board meeting, all interested stakeholders**
Update on Russian River Watershed TMDL	**August 23, 2012**	**Regional Water Board meeting, all interested stakeholders**
Monte Rio Community Forum	October 20, 2012	Public Meeting in Monte Rio
Public Outreach	May 28, 2013	Fitch Mountain Neighborhood Association Sonoma County Supervisor Mike McGuire
Implementation Plan Outreach	August 21, 2013	Sonoma County Community Development Agency
Russian River Biological Opinion, Fish Habitat and Water Rights Project and Pathogen TMDL	**August 22, 2013**	**Regional Water Board meeting, all interested stakeholders**
Update on Russian River Watershed TMDL	**March 13, 2014**	**Regional Water Board meeting, all interested stakeholders**
Implementation Brainstorming Session 1	May 20, 2014	Sonoma County Water Coalition Russian Riverkeepers Green Valley Watershed Committee
Implementation Brainstorming Session 2	June 5, 2014	Sonoma County Continuum of Care
Implementation Brainstorming Session 3	June 5, 2014	Sonoma County Water Agency Sonoma County Permit and Resource Management Department (PRMD) Sonoma County Community Development Agency Board Members Bill Massey and David Noren

Table 14.1 Stakeholder and Public Meetings for the Russian River Watershed Pathogen TMDL and Action Plan

Subject	Date	Participants
Implementation Brainstorming Session 4	July 1, 2014	Sonoma County Water Agency Sonoma County PRMD City of Santa Rosa City of Sebastopol City of Cotati City of Rohnert Park Town of Windsor City of Ukiah Sonoma County Agricultural Commissioner
Implementation Brainstorming Session 5	July 3, 2014	Sonoma County Department of Health Services
Implementation Brainstorming Session 6	July 9, 2014	Sonoma Resource Conservation District Gold Ridge Resource Conservation District Mendocino Resource Conservation District Sonoma County Agricultural Commissioner
Implementation Plan Update	August 15, 2014	Summer Home Park Monte Rio Villa Grande Russian River Redevelopment Oversight Committee (Fitch Mountain) Sonoma County Supervisor Efren Carrillo Sonoma County Water Agency Sonoma County PRMD Board Members Bill Massey and David Noren
Implementation Plan Outreach	August 28, 2014	Public Meeting in Santa Rosa
Stakeholder Outreach Meeting	January 9, 2015	North Bay Association of Realtors in Santa Rosa
Russian River Watershed Pathogen TMDL Technical Group Meeting	January 30, 2015	Representatives from the Communities of: Guerneville Occidental Monte Rio Villa Grande Fitch Mountain Northwood Property Owners
Public Workshops on draft TMDL and Action Plan	September 22, 2015 September 23, 2015 September 24, 2015	Staff-led workshop, Lower River stakeholders Staff-led workshop, Upper River stakeholders Staff-led workshop, Middle River stakeholders
Regional Water Board Information Item	**November 19, 2015**	**Regional Water Board meeting, all interested stakeholders**
Regional Water Board Information Item	**August 11, 2016**	**Regional Water Board meeting, all interested stakeholders**
Fitch Mountain Community Meeting	November 19, 2016	Fitch Mountain Community
Regional Water Board Public Workshop	**December 15, 2016**	**Regional Water Board meeting, all interested stakeholders**

Table 14.1 Stakeholder and Public Meetings for the Russian River Watershed Pathogen TMDL and Action Plan

Subject	Date	Participants
Program of Implementation Update for Lower Russian River OWTS Owners Group	January 20, 2017	Sonoma County PRMD, Sonoma County Supervisors Lynda Hopkins and James Gore, Regional Water Board Member David Noren, private individuals residing in lower Russian River area
Program of Implementation Update for LUAP Subcommittee	March 16, 2017	Sonoma County PRMD, Sonoma County LUAP subcommittee members
Program of Implementation Update for Lower Russian River OWTS Owners Group	May 20, 2017	Sonoma County PRMD, Sonoma County Supervisors Lynda Hopkins and James Gore, private individuals residing in lower Russian River area
Program of Implementation Update for Lower Russian River OWTS Owners Group	June 5, 2017	Sonoma County PRMD, Sonoma County Supervisor Lynda Hopkins, private individuals residing in lower Russian River area
Program of Implementation Update for Lower Russian River OWTS Owners Group	June 21, 2017	Sonoma County PRMD, Sonoma County Supervisor Lynda Hopkins, private individuals residing in lower Russian River area
Revisions to Program of Implementation	May 5, 2018	Lower Russian River stakeholders
Revisions to Sonoma County OWTS Manual and APMP Requirements	May 14, 2018	Sonoma County Supervisor Lynda Hopkins
Executive Officer's Report article on status of TMDL project	**July 11, 2018**	**Regional Water Board, all interested stakeholders**
Monte Rio Tour	July 17, 2018	Sonoma County Supervisor Lynda Hopkins, Sonoma County Water Agency, CAG Members
Sonoma County OWTS Manual and APMP Requirements	August 15, 2018	Sonoma County Supervisor Lynda Hopkins, Sonoma County Supervisor James Gore, Permit Sonoma, Regional Water Board Member David Noren
Sonoma County OWTS Manual Community Workshop (Monte Rio)	September 29, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual Community Workshop (Healdsburg)	October 10, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual Community Workshop (Santa Rosa)	October 11, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual Community Workshop (Guerneville)	October 17, 2018	Permit Sonoma, Interested Public
Sonoma County OWTS Manual and APMP Requirements	October 26, 2018	Sonoma County Supervisor Lynda Hopkins, Permit Sonoma
Executive Officer's Report article on status of TMDL project	**November 14, 2018**	**Regional Water Board, all interested stakeholders**

14.1.1 COMMUNITY AND INTERAGENCY GROUPS

Owners of OWTS within the boundaries of the APMP may be required to implement corrective actions when their OWTS are not in compliance with the minimum standards set forth in the TMDL Action Plan. In some cases, upgrades to individual OWTS to meet the APMP minimum standards may be infeasible or cost prohibitive. To foster community-based solutions to area-wide wastewater treatment and disposal challenges, Regional Water Board staff, in coordination the Sonoma County Water Agency, representatives of Sonoma County's 5th Supervisory District, Permit Sonoma, the Gold Ridge Resource Conservation District (RCD), and the Sonoma RCD formed an Interagency Committee to guide a pilot project that would explore community alternatives, public funding options for local projects, and to encourage community engagement for a community solution. This Interagency Committee meets quarterly, or more frequently as needed.

To facilitate community involvement, build consensus on potential solutions, and secure funding for the planning, development and implementation of sustainable solutions to address the failing septic systems located in disadvantaged Russian River communities, the Interagency Committee encouraged the formation of a Community Advisory Group (CAG). In January 2018, the Sonoma County Board of Supervisors provided notice of the need for the formation of a CAG and requested that members of the lower Russian River communities of Monte Rio, Northwood, Villa Grande, and Camp Meeker whom were interested in participating in the CAG submit a letter of interest. The Interagency Committee selected 12 applicants from an applicant pool of 23 applicants. The first monthly meeting of the CAG occurred in June 2018. The CAG is expected to continue in its advisory role for a term of approximately two years. Meetings of both the CAG and the Interagency Committee are listed in Table 14.2.

Table 14.2 Interagency Committee and Community Advisory Group – Monte Rio and Villa Grande Wastewater Treatment Project Meetings

Subject	Date	Participants
Interagency Committee Meeting	March 28, 2018	County of Sonoma, Sonoma RCD, Gold Ridge RCD, Rural California Assistance Corporation (RCAC)
Community Advisory Group Kick-off Meeting	June 5, 2018	CAG Members
Interagency Committee Meeting	July 12, 2018	County of Sonoma, Sonoma RCD, Gold Ridge RCD, RCAC
Community Advisory Group	July 23, 2018	CAG Members
Community Advisory Group	August 21, 2018	CAG Members
Community Advisory Group	September 18, 2018	CAG Members, Interested Public
Interagency Committee Meeting	October 9, 2018	County of Sonoma, Sonoma RCD, Gold Ridge RCD, RCAC
Interagency Committee Meeting	October 24, 2018	County of Sonoma, Sonoma RCD, Gold Ridge RCD
Community Advisory Group	October 25, 2018	CAG Members, Interested Public
Community Advisory Group	November 29, 2018	CAG Members
Interagency Committee Meeting	December 10, 2018	County of Sonoma, RCD, Gold Ridge RCD
Community Advisory Group	December 27, 2018	CAG Members, Interested Public

Table 14.2 Interagency Committee and Community Advisory Group – Monte Rio and Villa Grande Wastewater Treatment Project Meetings

Subject	Date	Participants
Interagency Committee Meeting	January 10, 2019	County of Sonoma
Community Advisory Group	January 24, 2019	CAG Members, Interested Public
Interagency Committee Meeting	February 14, 2019	County of Sonoma
Interagency Committee Meeting, Project Flow Chart Planning	February 21, 2019	County of Sonoma, CAG Subcommittee
Interagency Committee Meeting	March 14, 2019	County of Sonoma
Community Advisory Group	March 28, 2019	CAG Members, Interested Public
Interagency Committee Meeting	January 10, 2019	County of Sonoma, CAG Subcommittee
Community Advisory Group	April 25, 2019	CAG Members, Interested Public

14.1.2 CEQA SCOPING MEETING

The purpose of the California Environmental Quality Act (CEQA) Scoping Meeting was to solicit public comments to help staff assess the potential environmental scope of the environmental analysis. Holding a scoping meeting is a requirement of the CEQA. The CEQA scoping meeting for the Russian River Watershed TMDL was held on January 30, 2015, in Santa Rosa, CA. The comments received at the CEQA scoping meeting that concerned the scope of the environmental review are summarized in Chapter 11. These comments, and others, helped to shape the scope of the environmental review and specific aspects of the analysis.

14.1.3 RUSSIAN RIVER WATERSHED TMDL WEBPAGE

In addition to holding public meetings, Regional Water Board staff has maintained a webpage on the North Coast Regional Water Quality Control Board's website where the latest, up-to-date information on the Russian River TMDL development process can be found. The webpage also includes a map of the watershed, a description of the current Clean Water Act Section 303(d) listing, project documents, quality assurance plans, technical memoranda, and board presentations. The website also includes the public comment letters received on both the 2015 draft Staff Report and Action Plan and the 2017 draft Staff Report and Action Plan. The website can be accessed at: http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river/

14.2 PRESENTATIONS TO THE REGIONAL WATER BOARD

Periodically, Regional Water Board staff has presented updates and status reports to the Regional Water Board and interested members of the public on the Russian River Watershed Pathogen TMDL. The presentations were opportunities for the public and Board members to hear status updates and background information regarding progress and emerging issues related to the TMDL development process. At each of these meetings, the public also had the opportunity to give comment before the Board. All such comments are part of the public record. Table 14.1 includes in **bold** a complete list of the presentations given to the Regional Water Board.

14.3 PRESENTATIONS TO COUNTY SUPERVISORS

In order to keep local agencies informed of the details of the Russian River Watershed TMDL, Regional Water Board staff met with County Supervisors from Sonoma County and Mendocino County. A list of these presentations is available in Table 14.~~2~~3. Regional Water Board staff also met with Sonoma County supervisors, administration staff, legal counsel, and staff from the Sonoma County Community Development Commission to develop a Memorandum of Understanding (MOU) between the agencies that would establish the roles and responsibilities of the parties with respect to the parties' joint efforts to implement the Action Plan for the Russian River Watershed Pathogen TMDL. These coordination meetings occurred on March 17, 2016 and August 9, 2016. The MOU was signed by the Sonoma County Administrative Officer and the Regional Water Board Executive Officer and made final on December 13, 2016.

Table 14.3 Presentations to County Supervisors

Subject	Date	Venue
Russian River TMDL	January 22, 2015	Sonoma County Board Supervisors Efren Carrillo and James Gore
Russian River TMDL	February 6, 2015	Sonoma County Board Supervisor Shirlee Zane
Russian River TMDL	February 9, 2015	Sonoma County Board Supervisor David Babbitt
Russian River TMDL	February 18, 2015	Sonoma County Board Supervisor Susan Gorin
Russian River TMDL	April 6, 2015	Sonoma County Board Supervisors Efren Carrillo and James Gore

14.4 PEER REVIEW

Prior to development of the Public Review Draft of the Russian River Watershed TMDL Staff Report, a peer- review draft report was reviewed by the following two professors as part of a formal state-mandated peer-review process:

- Dr. Nicholas J. Ashbolt, Alberta Innovates Translational Research Chair in Water, School of Public Health, at the University of Alberta, Canada;
- Dr. Patricia A. Holden, Professor of Bren School, Director of UCSB Natural Reserve System at the University of California, Santa Barbara

14.5 ~~AUGUST 2015~~ PUBLIC REVIEW ~~DRAFT~~DRAFTS

A draft Staff Report and the Action Plan were posted and available for public review and comment beginning on August 21, 2015 with the public review period closing on October 8,

2015. Numerous, detailed comments were submitted requiring consideration and revision to the Program of Implementation. Revisions to the 2015 Staff Report were also required as a result of public comment, but the basic tenets of the technical analysis ~~have~~ remained the same. Due to the extent of public comments, the item scheduled for the November 19, 2015 Board Meeting was changed from an adoption hearing to an Information Item.

Staff ~~have~~ reviewed public comments received in 2015 and revised the Staff Report and Action Plan, accordingly. ~~The 2017~~A revised Draft Staff Report and Action Plan ~~are out for public review until September 30, 2017, providing~~ was prepared and made available in August 2017 for a 45-day public review period ~~and accounting for holidays.~~. An adoption hearing ~~will~~was scheduled to be held before the Regional Water Board at its December 12-13, 2017 meeting, ~~after public comments have been appropriately considered~~ but was postponed as a result of the wildfires in October 2017 and ~~final~~in order to accommodate changes to the statewide bacteria objectives. In January 2018, the State Water Board posted for public review statewide bacteria objectives to supersede Basin Plan bacteria objectives to protect REC-1. The adoption hearing was held in August 2018, at which time the State Water Board adopted statewide bacteria objectives. Regional Water Board staff postponed bringing the Russian River Pathogen TMDL and Action Plan to the Regional Water Board for adoption until the State Water Board acted on the statewide objective.

Following the August 2018 adoption of statewide bacteria objectives, staff made revisions to the ~~draft Action Plan proposed.~~TMDL staff report and Action Plan to account for the new statewide objectives. The statewide bacteria objective specified a six-week rolling method for calculating compliance with the geometric mean, which differed from the static calculation method used to assess data in the Russian River. Staff recompiled all of the ambient water quality data collected in the Russian River Watershed and conducted a reassessment to bring the conclusions of the TMDL up to date with respect to the new statewide objective.

Throughout the Basin Plan amendment process, there are opportunities for public participation and comment, including at the CEQA scoping meetings, Regional Water Board workshops, Regional Water Board adoption hearing, and the State Water Board approval process. Interested parties are advised to check the Regional Water Board website for announcements regarding Regional Water Board meetings, updates to the Russian River Watershed TMDL project, and to sign up for the Russian River TMDL lyris list.

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CHAPTER 15
NINE KEY ELEMENTS

15.1 OVERVIEW

The California Nonpoint Source Grant Program allocates Clean Water Act section 319(h) funding from the U.S. EPA to support projects that implement watershed plans to address water quality problems in surface water and groundwater resulting from nonpoint source pollution. Before receiving 319 grants for projects, the project proponent/grantee must demonstrate that a watershed plan is in place and includes the ~~USEPA's~~U.S. EPA's nine key elements. The purpose of this chapter is to explicitly explain how the nine key elements are included in this TMDL and described in this Staff Report.

In California, wide ranges of plans are used to comply with the nine key elements, often in combination with each other. Examples of other plans include bacteria load reduction plans, erosion control plans, local watershed plans, coordinated resource management plans, comprehensive conservation and management plans, and Regional Water Quality Control Plans (Basin Plans). Applicants that need assistance may work with their Regional Water Boards to verify that the combination of plans has the nine elements. More information about the nine key elements can be found in U.S. EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (U.S. EPA 2008).

The following describes how the nine key elements are included in this TMDL Staff Report.

ELEMENT 1: IDENTIFICATION OF CAUSES & SOURCES

Element 1 includes the identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified geographically along with estimates of the extent to which they are present in the watershed.

Chapter 6 (Source Analysis) describes the geographic distribution of pathogenic indicator bacteria by type (i.e., human, grazer, and bird) and by land cover (i.e., forest, shrubland, agriculture, developed sewered, developed non-sewered) throughout the watershed. Chapter 6 also identifies individual nonpoint sources, including onsite wastewater treatment systems, recreation, runoff from homeless encampments, recycled water discharges from landscape irrigation, pet waste, livestock waste, and runoff from dairies and land application of manure.

ELEMENT 2: LOAD REDUCTIONS EXPECTED FROM MANAGEMENT MEASURES

An estimate of the load reductions expected from management measures. Estimates for loading reductions should be provided at the same level as that required in the scale and scope component in Element 1.

Chapter 7 (TMDL Calculations and Allocations) describes the point source waste load allocations and nonpoint source load allocations that will attain water quality standards. These allocations are expressed as concentrations of *E. coli* and enterococci bacteria in surface waters and in discharges. Chapter 7 also provides estimates of the reductions that will be needed to achieve the concentration-based load allocations at numerous locations in the watershed. These load reductions are expected to be attained upon the completion of the management measures, which are also known as implementation actions, described in Chapter 9.

ELEMENT 3: DESCRIPTION OF NONPOINT SOURCE MANAGEMENT MEASURES

Element 3 includes the nonpoint source management measures that will need to be implemented to achieve the load reductions in Element 2, and a description of the critical areas in which those measures will be needed~~.~~ to implement this plan. Management measures are groups or categories of cost-effective management practices that are implemented to achieve comprehensive goals.

Chapter 9 (Implementation) describes the nonpoint source management measures that satisfy Element 3. The management measures are better known as implementation actions. They are specific to each type of source of pathogenic indicator bacteria. Within the source category, the management measures/implementation actions are specific to individual facilities and/or areas which are critical for achieving the TMDL and water quality standards.

ELEMENT 4: TECHNICAL AND FINANCIAL ASSISTANCE NEEDED, COSTS, SOURCES OF FUNDING, AND IMPLEMENTATION AUTHORITY

Element 4 includes an estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed plan. Available federal, state, local, and private funds and resources should be considered and shortfalls between needs and actuals should be identified.

Chapter 12 estimates the costs for implementing the management measures, for both point and nonpoint sources. Chapter 12 also identifies potential sources of funding from public and private sources. Chapter 1 describes the Regional Water Board's authority to require the implementation of management measures.

Technical assistance will be necessary for many responsible parties as they implement the required management measures. The amount will vary depending on their technical capability and knowledge. Some responsible parties will be able to fully implement on their own, while others will need assistance with funding, project design, permitting, implementation, monitoring, reporting, and maintenance. There are several entities throughout the watershed and across the state that can help provide technical assistance, including:

- Sonoma Resource Conservation District

- Gold Ridge Resource Conservation District
- Mendocino County Resource Conservation District
- University of California Cooperative Extension
- Sonoma County Permit and Resource Management Department
- Mendocino County Planning and Building Services
- Natural Resource Conservation Service's District Conservationists

ELEMENT 5: INFORMATION AND EDUCATION

Element 5 includes an information and education component used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.

Chapter 14 (Public Participation Summary) describes the meetings held and efforts made to update, inform, and solicit input from key stakeholders and the public throughout the TMDL development process, including the public review process. In addition, the Regional Water Board is collaborating with the Russian River Watershed Association to establish a Russian River Regional Monitoring Program through which substantial education and outreach will occur.

Information on individual implementation projects (e.g., grant-funded projects on an individual property) may require additional outreach and education to neighbors and the public. Such project-specific information should be included in a project-specific plan. Russian River Watershed

ELEMENT 6: SCHEDULE

Element 6 includes a schedule for implementing the nonpoint source management measures that ~~is~~ are identified in the plan and are reasonably expeditious.

9 (Implementation) describes specific compliance dates for required management measures/implementation actions.

ELEMENT 7: INTERIM MEASUREABLE MILESTONES

Element 7 includes interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

Chapter 9 (Implementation) describes the steps necessary to fully implement appropriate controls for each of the sources areas of concern. Milestones are given as deadlines, deliverables, and concentration trends.

ELEMENT 8: BENCHMARKS FOR TRACKING PROGRESS

Element 8 includes criteria or benchmarks that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards. Interim benchmarks can be direct measurements (e.g., *E. coli* concentrations) or indirect indicators of load reductions (e.g., number of beach caution postings). This element also includes how plans will be revised if interim targets are not met.

Chapter 5 (Numeric Targets) and Chapter 8 (Linkage Analysis) describe the targets or benchmarks proposed to measure protection of beneficial uses and their linkage to the existing water quality objective. Chapter 10 (Watershed Monitoring) describes the procedures for attainment and non-attainment of the target concentrations/loading capacities.

ELEMENT 9: MONITORING

Element 9 includes a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the benchmarks established in Element 8. Watershed-scale monitoring can be used to measure the effects of multiple programs, projects, and trends over time. Instream monitoring does not have to be conducted for individual management practices unless that type of monitoring is relevant and appropriate.

Chapter 10 (Watershed Monitoring) describes requirements and responsible parties for monitoring, assessment, and adaptive management. It also provides an umbrella stewardship approach for cooperation and collaboration in regards to monitoring: the Russian River Regional Monitoring Program.

15.2 SUMMARY

This TMDL Staff Report contains all of the nine key elements of a watershed plan that are needed to qualify for 319(h) nonpoint source grants. Additional, project-level detail may be required to supplement the broader management measures described in this Staff Report. Bacteria load reduction plans, erosion control plans, watershed plans, and other planning documents may be useful when identifying the nine key elements and requesting grants for funding.

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CHAPTER 16
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