California Regional Water Quality Control Board
Central Coast Region

Total Maximum Daily Load for Fecal Coliform for the Lower Salinas River Watershed, Monterey County, California

Final Project Report

For the September 2, 2010 Water Board Meeting

Adopted by the
California Regional Water Quality Control Board
Central Coast Region
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List of Acronyms and Abbreviations

This report contains numerous acronyms and abbreviations. In general, staff wrote an acronym or abbreviation in parentheses following the first time a title or term was used. Staff wrote the acronym/abbreviation in place of that term from that point throughout this report. The following alphabetical list of acronyms/abbreviations used in this report is provided for the convenience of the reader:

BFI	Baseflow Index
CCAMP	Central Coast Ambient Monitoring Program
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CFU	Colony Forming Units
CWA	Clean Water Act
DAR	Drainage Area Ratio
DHS	California Department of Health Services
E. coli	Escherichia coli bacteria
FIB	Fecal Indicator Bacteria
LA	Load Allocation
MLVA	Multiple-Locus Variable-Number Tandem Repeat Analysis
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
MSW	Municipal Solid Waste
MTF	Multiple Tube Fermentation
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
OSDS	Onsite Waste Disposal System
ppt	Parts per thousand
RCD	Resources Conservation District
REC-1	Water Contact Recreation
REC-2	Non-contact Water Recreation
SWMP	Stormwater Management Plan
SWRCB	State Water Resources Control Board (State Board)
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Water Board	California Central Coast Regional Water Quality Control Board
WDR	Waste Discharge Requirements
WLA	Waste Load Allocation
WWTP	Waste Water Treatment Plant

1 PROJECT DEFINITION

1.1 Introduction

This Project addresses impairment of the Lower Salinas River (River) and several of its tributaries due to elevated density of fecal coliform. The following bodies of water were listed as impaired on Section 303(d) of the Clean Water Act due to elevated levels of fecal coliform:

1. Lower Salinas River (from Gonzales downstream to the Salinas River Lagoon[1],)
2. Old Salinas River
3. Tembladero Slough
4. Salinas Reclamation Canal[2]
5. Gabilan Creek
6. Alisal Creek
7. Natividad Creek
8. Santa Rita Creek
9. Quail Creek
10. Chualar Creek

In addition, two waterbodies in the project area are impaired for USEPA recommended criteria of *Escherichia coli*, which are used as an indicator for the presences of pathogens. The two additional waterbodies are the Salinas River Lagoon (north), and Towne Creek (see Table 3-4).

Fecal coliform and a subset of fecal coliform, *Escherichia coli* (*E. coli)*, are used as indicators for the presence of other pathogenic organisms. Fecal coliform and *E. coli* are referred to as indicator bacteria (or fecal indicator bacteria [FIB]) for the purposes of this report. Some fecal coliform and *E. coli* genera are pathogenic to humans, some are not pathogenic.

Note that the units of *density* and *concentration* are used synonymously in this report when referring to numbers of indicator bacteria in a stated volume of water.

[1] Salinas River Lagoon is the same waterbody as Salinas River Lagoon (North), as listed in the Water Quality Control Plan for the Central Coast Region (Basin Plan). The two names are used interchangeably throughout this report.
[2] The Salinas Reclamation Canal as listed in the Basin Plan, is the same waterbody as the Salinas Reclamation Ditch, a name used locally.

1.2 Project Area

The Project area for this TMDL includes the watershed area contributing flow to the Salinas River Lagoon and Old Salinas River, upstream to the Salinas River crossing at Gonzales Road near the city of Gonzales. Figure 1-1 illustrates the location of the Project Area.

Figure 1-1. TMDL Project Area.

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1.3 Beneficial Uses

Water quality objectives are in place to protect beneficial uses of the surface waters. Stated another way, in some cases numeric water quality objectives are in place to protect particular designated uses of water. In the case of this project, water contact recreation is the most sensitive water recreation use, i.e. more stringent numeric water quality objectives for fecal indicator bacteria.

Shellfish harvesting has a more stringent water quality standard than water recreation. Shellfish harvesting is a designated beneficial use of the Salinas River Lagoon, the Salinas River Estuary, and Tembladero Slough. At this time, staff is not proposing work related to the SHELL standard in the proposed Implementation Plan. The State Water Resources Control Board (SWRCB) is conducting a project to re-assess the areas designated for the shellfish harvesting beneficial use. As a result of this project SWRCB may potentially separate out the commercial from the other components of the shellfish definition. The current definition is broad, encompassing recreational harvesting for consumption, harvesting for bait, and commercial aquaculture. The breadth of the definition reduces flexibility to apply the most appropriate water quality standards to each of these applications.

Consequently, waterbodies designated with SHELL beneficial use in Project Area will be addressed in a separate SHELL TMDL and/or standards action pending the outcome of the work of the statewide task force involving the Ocean Planning Unit of the State Water Board, the California Department of Public Health, the USEPA, and the coastal Regional Water Boards whom are involved in re-assessing the SHELL standard.

During the environmental scoping and public participation meeting in June 2007, stakeholders expressed concern that some of the water bodies in the project area are designated to support the water contact recreation beneficial use. Stakeholders expressed concern that some of these water bodies can not support water contact recreation because:

- They occur on private lands used for purposes other than water contact recreation.
- Waters present during dry months of the year in some water bodies may not be natural flow, but rather ponded water resulting from irrigation on adjacent lands, or intermittent flow resulting from pumping ground water. Furthermore, these ponded areas might have high fecal indicator bacteria concentration not resulting from loading, but from bacteria growth in sediment and/or increasing concentration due to evaporation.
- Some water bodies designated to support water contact recreation could not be used for this purpose due to steep embankments, or mud substrate not suitable for wading.
- Natural sources of fecal indicator bacteria may exceed the numeric water quality objectives.

Staff will provide formal responses to public comment prior to the Water Board hearing to consider approval of the TMDL.

Table 1-1. shows the current beneficial use designations for major water bodies in the Project area.

Table 1-1. Beneficial uses in the Project area

	SALINAS RIVER	SALINAS RIVER	SALINAS RIVER LAGOON (NORTH)	OLD SALINAS RIVER ESTUARY	TEMBLADERO SLOUGH	SALINAS RECLAMATION DITCH	GABILAN CR.	ALISAL CR
	From Chualar to Sprecklés	Downstream of Spreckles						
MUN	X	X					X	X
AGR	X	X					X	X
PRO	X							
IND	X							
GWR	X						X	X
REC1	X		X	X	X	X	X	X
REC2	X	X	X	X	X	X	X	X
WILD	X	X	X	X	X	X	X	X
COLD	X	X	X	X				X
WARM	X	X	X	X	X	X	X	X
MIGR	X	X	X	X				
SPWN			X	X	X		X	X
BIOL			X	X				
RARE			X	X	X			
EST			X	X	X			
FRESH		X						
COMM	X	X	X	X	X	X	X	X
SHELL			X	X	X			

MUN: Municipal and domestic water supply.
AGR: Agricultural supply.
PRO: Industrial process supply.
IND: Industrial service supply
GWR: Ground water recharge.
REC1: Water contact recreation.
REC2: Non-Contact water recreation.
WILD: Wildlife habitat.
COLD: Cold fresh water habitat.
WARM: Warm fresh water habitat
MIGR: Migration of aquatic organisms.
SPWN: Spawning, reproduction, and/or early development.
BIOL: Preservation of biological habitats of special significance.
RARE: Rare, threatened, or endangered species
EST: Estuarine habitat
FRESH: Freshwater replenishment.
COMM: Commercial and sport fishing.
SHELL: Shellfish harvesting.

1.4 Water Quality Objectives

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to indicator bacteria (CCRWQCB, 1994, pg. III-3). These objectives are linked to specific beneficial uses and include:

1.4.1 Shellfish Harvesting (SHELL):

At all areas where shellfish may be harvested for human consumption, the median **total coliform** concentration throughout the water column for any 30-day period shall not exceed 70/100 ml, nor shall more than 10% of the samples collected during any 30-day period exceed 230/100 ml for a five-tube decimal dilution test or 330/100 ml when a three-tube decimal dilution test is used.

The California Department of Health Services (DHS) standards for the protection of the shell fishing beneficial use are:

i. The total coliform median or geometric mean MPN of the water does not exceed 70 per 100 mL and not more than 10 percent of the samples exceed a MPN of 230 per 100 mL for a five-tube decimal dilution test.

ii. The fecal coliform median or geometric mean MPN of the water does not exceed 14 per 100 mL and not more than 10 percent of the samples exceed a MPN of 43 for a five-tube decimal dilution test.

The DHS often uses the fecal coliform standard to classify growing areas (as opposed to total coliform).

Please note: At this time, we are not requiring work related to the SHELL standard in the proposed Implementation Plan. The State Water Resources Control Board (SWRCB) is conducting a project to re-assess the areas designated for the shellfish harvesting beneficial use. As a result of this project SWRCB may potentially separate out the commercial from the other components of the shellfish definition. The current definition is broad, encompassing recreational harvesting for consumption, harvesting for bait, and commercial aquaculture. The breadth of the definition reduces flexibility to apply the most appropriate water quality standards to each of these applications. Consequently, waterbodies designated with SHELL beneficial use in Project Area will be addressed in a separate SHELL TMDL and/or standards action pending the outcome of the work of the statewide task force involving the Ocean Planning Unit of the State Water Board, the California Department of Public Health, the USEPA, and the coastal Regional Water Boards whom are involved in re-assessing the SHELL standard.

1.4.2 Water Contact Recreation (REC-1):

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 per 100ml, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100ml.

1.4.3 Non-Contact Water Recreation (REC-2):

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 2000 per 100ml, nor shall more than 10% of samples collected during any 30-day period exceed 4000 per 100ml.

1.4.4 Controllable Water Quality conditions.

Controllable water quality must conform to the water quality objectives stated in the Basin Plan. The Basin Plan defines controllable water quality conditions as:

"Controllable water quality conditions are those actions or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled."

1.5 Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy)

The Listing Policy (California Water Quality Control Board, September 2004) provides guidance for interpreting data and information as they are compared to beneficial uses and existing numeric and narrative water quality objectives. In the absence of a site-specific exceedance frequency (e.g., five samples in a 30-day period), a water segment shall be placed on the section 303(d) list if bacteria water quality objectives are exceeded at the frequencies and sample sizes indicated in Table 1-2.

Table 1-2. Data required to assert impairment.

Sample Size	Number of Exceedances[1] needed to assert impairment
5-30	5
31-36	6
37-42	7
43-48	8
49-54	9
55-60	10
61-66	11
67-72	12
73-78	13
79-84	14
85-91	15
92-97	16

Sample Size	Number of Exceedances[1] needed to assert impairment
98-103	17
104-109	18
110-115	19
116-121	20

[1] Equal to or greater than 400 MPN/100 ml fecal coliform or 235 MPN/100 ml generic *E. coli*.

Exceedance criteria are equal to or greater than 400 MPN/100 ml for fecal coliform or 235 MPN/100 ml generic *E. coli*. Generic *E. coli* criteria are discussed in the following section.

Note from the table that at least five data and exceedances are required to assert impairment.

1.6 USEPA Recommended Water Quality Criteria

USEPA periodically updates and publishes water quality criteria recommendations. Table 1-3. summarizes USEPA recommended bacterial water quality criteria for the protection of human health in recreational waters.

Table 1-3. USEPA recommended criteria for *E. coli*.

Indicator	Risk Level	Geometric Mean Density (per 100 mL)	Single Sample Maximum Allowable Density (per 100 mL)[a]			
			Designated Beach Area (75th percentile)	Moderate Full Body Contact Recreation (82nd percentile)	Lightly Used Full Body Contact Recreation (90th percentile)	Infrequently Used Full Body Contact Recreation (95th percentile)
E. coli	8	126[b]	235	298	409	575

Source: U.S. EPA (1986).
a. Calculated using the following: single sample maximum = geometric mean * 10^(confidence level factor * log standard deviation), where the confidence level factor is: 75%: 0.675; 82%: 0.935; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.4 for fresh waters.
b. Calculated to nearest whole number using equation: geometric mean = antilog_{10} [(risk level + 11.74) / 9.40].

Note that the USEPA water quality criteria are in terms of *E. coli*, whereas the Central Coast Water Board water quality objectives for bacteria are in terms of fecal coliform.

According to USEPA guidance, the preferred criteria level is the geometric mean of 126 MPN/100mL; the single sample maximums are simply statistical extensions of the analysis used to determine the recommended geometric mean density (126 MPN/100mL).

USEPA gave staff guidance in using the recommended criteria to evaluate whether water bodies are impaired (Mary Adams, Central Coast Water Board, December 2007, personal communication). USEPA recommended having at least three samples in a 30-day period to apply the geometric mean criteria of

126 MPN/100mL. If three samples in a 30-day period were not available, USEPA recommended using the concentration of 235 MPN/100mL as a benchmark, with the number of exceedances of 235 MPN/100mL needed to assert impairment increasing with the number of available data. Table 1-2 (previous page) shows the number of data exceeding 235 MPN/100mL for generic *E. coli* needed to assert impairment. Note from the table that at least five data and exceedances are required to assert impairment.

2 WATERSHED DESCRIPTION

The proposed geographic scope of this TMDL (the project area) encompasses approximately 400 square miles of the Lower Salinas Valley in northern Monterey County, including the Lower Salinas River and its tributaries. The project area is bounded by the Gabilan Range to the east, by the Sierra De Salinas range to the west, and to the northwest (downstream) by Monterey Bay. The Salinas River Lagoon and the Old Salinas River are the two receiving water bodies at the downgradient terminus of the project area.

The project area is comprised of two major watersheds, identified here as the Reclamation Canal watershed, and the Lower Salinas River watershed. The Reclamation Canal watershed drains to the Old Salinas River and contains Tembladero Slough, and its tributaries: the Reclamation Canal. Espinosa Slough/Santa Rita Creek, Gabilan Creek, Natividad Creek, Alisal Creek, and Towne Creek. The Lower Salinas River watershed drains to the Salinas River Lagoon, and contains the Salinas River and its tributaries: Blanco Drain, Toro Creek, Quail Creek and Chualar Creek.

The Reclamation Canal and Lower Salinas River watersheds are essentially separate watersheds. Figure 2-1 illustrates the waterbodies and their connectivity. There is a limited hydrologic connection between the two Reclamation Canal watershed and the Lower Salinas River watershed where the Salinas River Lagoon (North) periodically drains into the Old Salinas River through a slide gate at the northwest end of the Salinas River Lagoon (North). In the winter, the slide gate is often closed to prevent flooding in low-lying agricultural lands surrounding the Old Salinas River, and the inflows into the Salinas Lagoon are typically discharged directly into Monterey Bay through a breached sand bar at the mouth of the lagoon. Table 2-1. shows the two downgradient receiving water bodies and the tributaries to these receiving water bodies.

Table 2-1. Receiving waterbodies and tributaries of Project area.

Receiving Water Body	
Salinas River Lagoon	**Old Salinas River**
Subwatersheds to the receiving water bodies	
Lower Salinas River	Tembladero Slough
El Toro Creek	Salinas Reclamation Canal
Blanco Drain	Santa Rita Creek
Quail Creek	Gabilan Creek
Chualar Creek	Alisal Creek

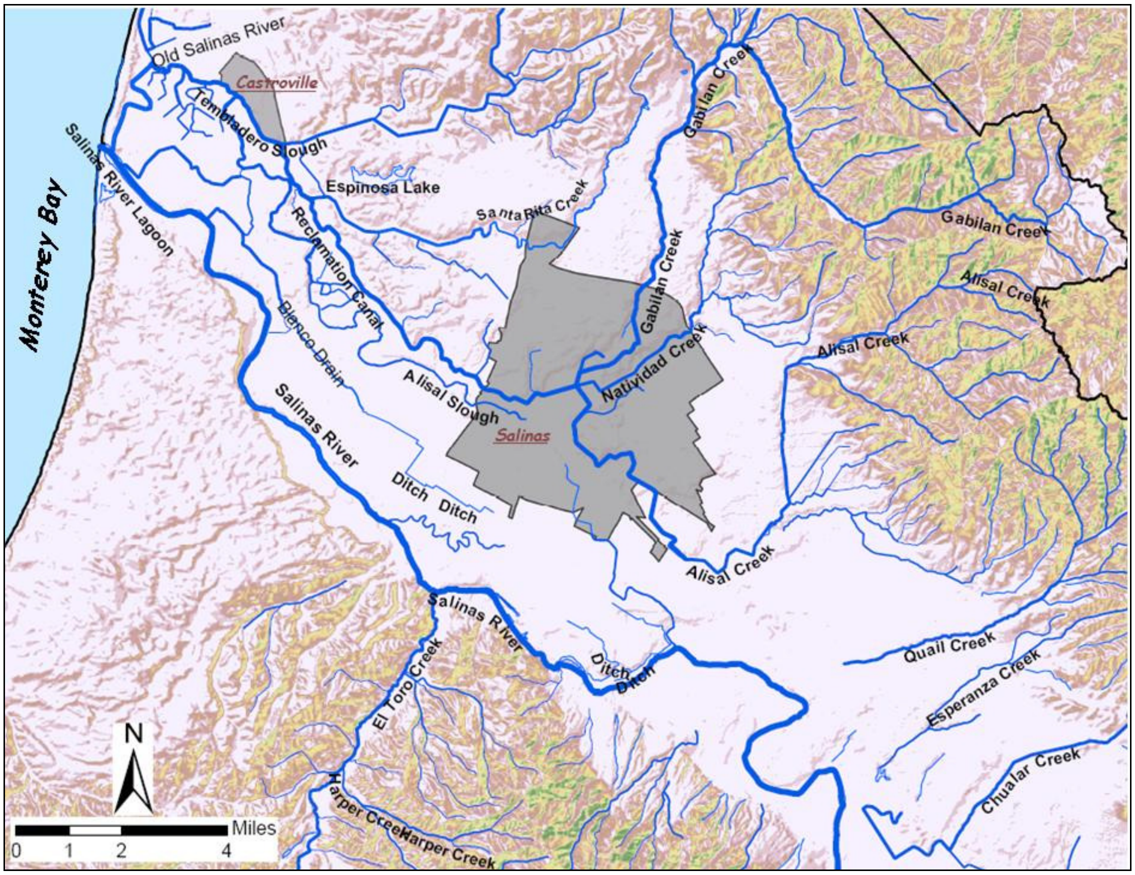

Figure 2-1. Waterbodies in the Lower Salinas River Watershed Project Area.

2.1 Land Use

Land uses within the project area were estimated using National Land Cover Data (NLCD). The NLCD was provided by the Multi-Resolution Land Characteristics Consortium that included the United States Geological Survey (USGS), the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Forest Service (USFS), the National Atmospheric and Space Administration (NASA), and the Bureau of Land Management (BLM). The NLCD was derived from images taken by Landsat's Thematic Mapper sensor. Staff aggregated the land use categories based on a level II classification scheme of the NLCD. Figure 2-2 shows the subwatersheds and the landuse/land cover of the Project Area. Relative landuse contribution is shown in Table 2-2.

Figure 2-2. Subwatersheds and Landuse/Landcover.

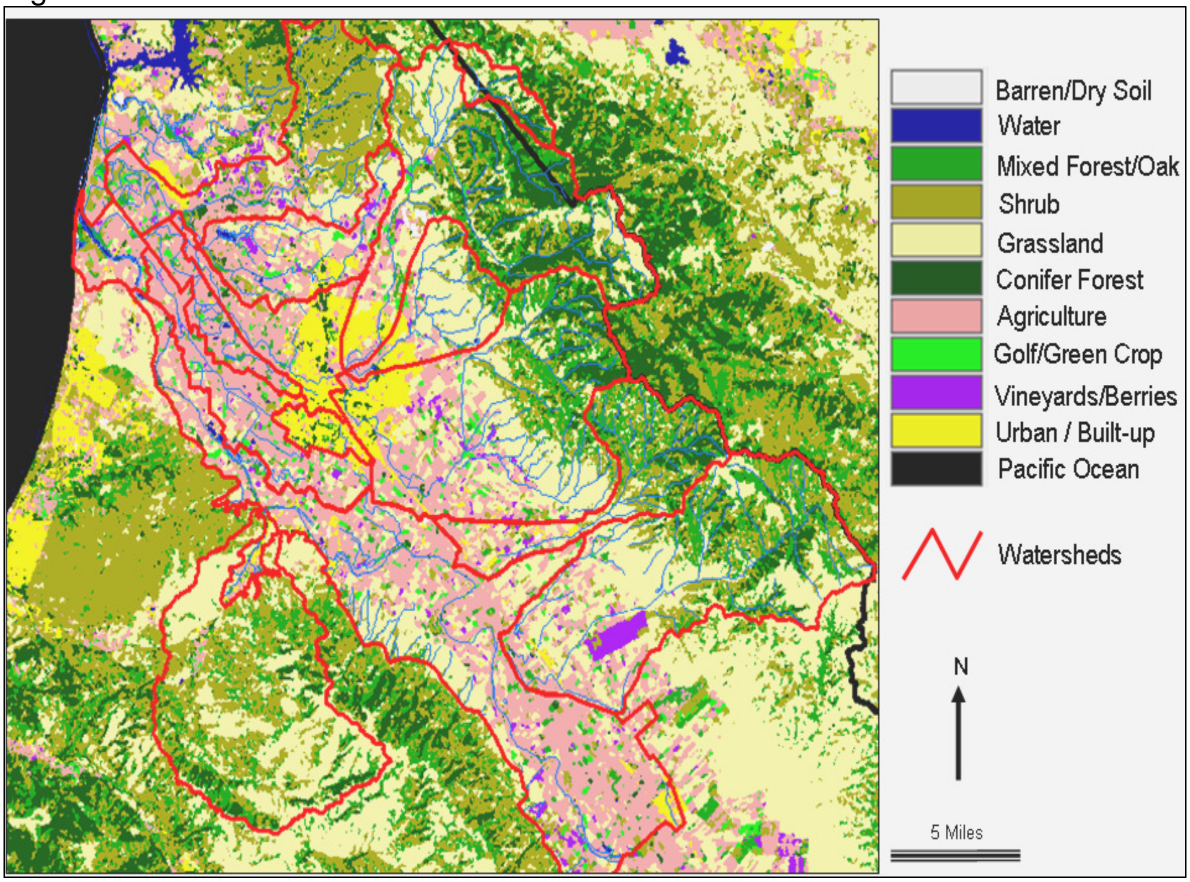

Table 2-2. Land uses of project area.

Land Use Type	Acres	Frequency (%)
Row Crops	71,121	32
Grassland/Herbaceous	47,974	21.6
Deciduous Shrubland	34,089	15.4
Evergreen Forest	17,572	7.9
Pasture/Hay	19,662	8.9
Mixed Forest	8,230	3.7
Low Intensity Residential	6,851	3.1
Bare Rock/Sand/Clay	3,959	1.8
Other Grasses (Urban/Rec; e.g. parks, lawns)	3,767	1.4
High Intensity Comml/Indl/Trans	3,276	1.5
High Intensity Residential	2,633	1.2
Deciduous Forest	1,773	0.8
Quarries/Strip Mines/Gravel Pits	419	0.2
Open Water	317	0.1
Emergent Herbaceous Wetlands	298	0.1
Other	93	0.1
Total	**222,034**	**100**

ESRI™ ArcMap® was used to create a land use layer for the Project area. The land use cover was used in conjunction with other information and data in the data analysis.

Figure 2-3 displays the separate subwatersheds that were included in the fecal coliform analysis. Table 2-3 shows the subwatershed numeric code as annotated on Figure 2-3 tied to the watershed name and size. Table 2-4 displays the landuses/landcover in the individual subwatersheds.

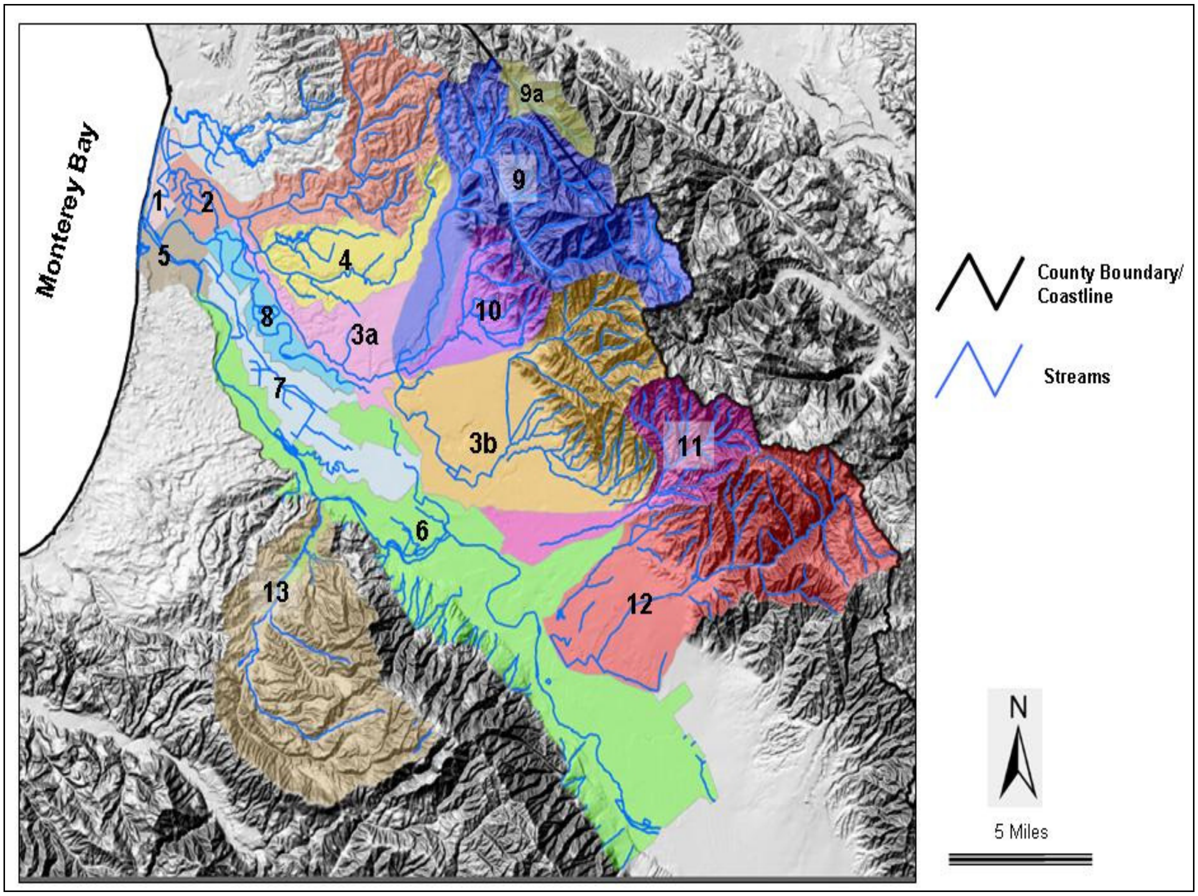

Figure 2-3. Map of Subwatersheds in Project Area.

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Table 2-3. Subwatersheds in project area.

Watershed Number	Watershed	Area (Acres)
1	Old Salinas River	1,463
2	Tembladero Slough/Merritt Lake	16,737
3a	Salinas Reclamation Canal, Lower	6,563
3b	Salinas Reclamation Canal, Upper/Alisal Creek	29,662
4	Santa Rita Creek	8,646
5	Salinas River Lagoon, North	3,058
6	Salinas River	40,595
7	Blanco Drain	8,300
8	Alisal Slough Remnant	3,703
9	Gabilan Creek (including Towne Creek – 9a)	27,713
10	Natividad Creek	7,405
11	Quail Creek	11,278
12	Chualar Creek	29,888
13	El Toro Creek	27,023
	Total Acreage	222,034

Table 2-4. Landuse/Land Cover of Subwatersheds in Project Area.

	Watershed	Total Watershed Acreage	% Agriculture	% Bare	% Developed	% Forest	% Grassland	% Quarries	% Shrub	% Water Feature/ Wetlands
1	Old Salinas River	1,463	81.7	2.7	4.3	0.0	0.7		9.9	0.7
2	Tembladero Slough	16,737	31.8	1.3	12.2	11.9	24.1	0.2	17.4	1.2
3a	Salinas Reclamation Canal, Lower	6,563	55.9	1.7	34.6	0.0	5.7		2.1	-
3b	Salinas Reclamation Canal, Upper/Alisal Creek	29,662	39.3	1.6	7.9	9.7	22.1		19.3	-
4	Santa Rita Cr	8,646	81.0	1.5	7.8	0.8	6.9		0.9	1.0
5	Salinas River Lagoon, North	3,058	70.6	10.0	3.4	0.4	4.1		6.5	4.8
6	Salinas River	40,595	58.2	2.7	6.5	1.4	26.7	0.2	3.9	0.3
7	Blanco Drain	8,300	92.8	1.0	4.7	0.0	0.8		0.6	-
8	Alisal Slough Remnant	3,703	94.9	1.4	3.4	0.0	0.2		0.1	-

	Watershed	Total Watershed Acreage	% Agriculture	% Bare	% Developed	% Forest	% Grassland	% Quarries	% Shrub	% Water Feature/ Wetlands
9	Gabilan Cr.	27,713	12.8	0.5	2.8	25.9	34.8	1.2	21.9	
10	Natividad Cr.	7,405	48.4	0.8	3.8	11.3	25.9	0.3	9.2	0.2
11	Quail Cr.	11,278	21.6	3.7	1.7	18.0	16.4		38.5	0.0
12	Chualar Cr.	29,888	26.6	1.2	0.5	16.3	33.6		21.8	0.0
13	El Toro Cr.	27,023	0.1	0	1.5	28.4	49.5	-	20.3	0
	Totals	**222,034**	**51%**	**2.3%**	**6.7%**	**8.7%**	**17.5%**	**0.4%**	**12.5%**	**1.0%**

2.2 Hydrology

The watershed area contributing to flow in the main stem of the Salinas River encompasses hundreds of square miles. Although much of the precipitation in the Salinas River Watershed was retained in reservoirs, flow reached over 1000 cubic feet per second during the rain season in the lower portions of the watershed.

There are four current, and one discontinued USGS flow gages in the Project Area (Figure 2-4). Current USGS flow gages include the Salinas River at Spreckles, the Salinas River at Chualar, Gabilan Creek, and the Reclamation Canal. Historic flow record (1961 through 2001) is available for El Toro Creek.

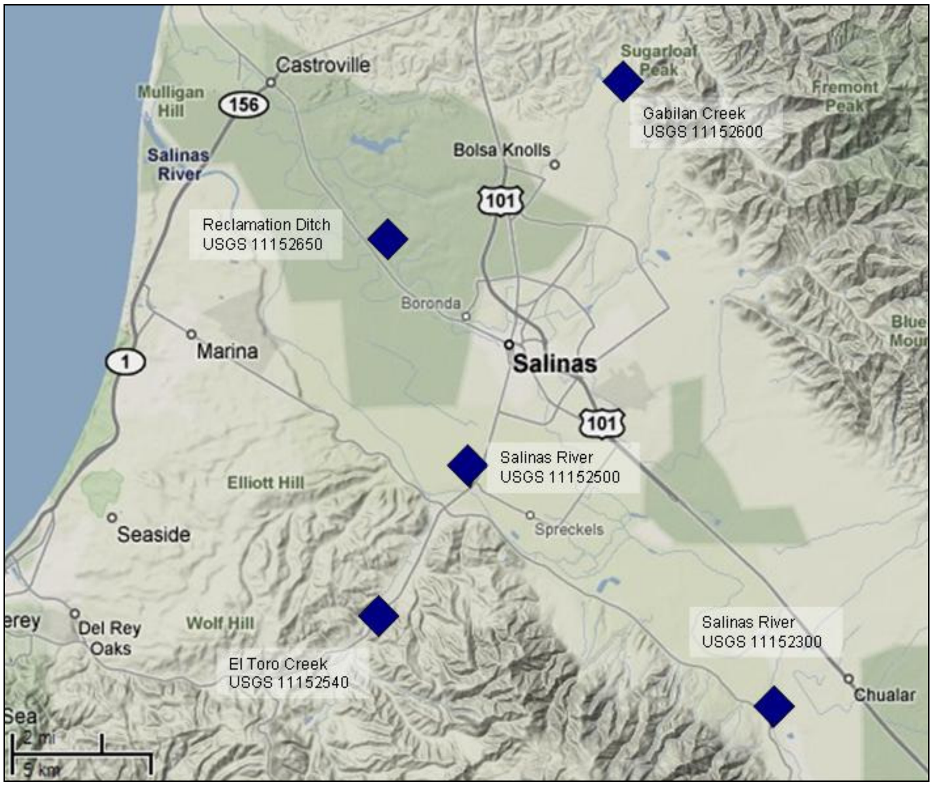


Figure 2-4. USGS Flow Gage Stations.

Sources of water in the surface waters included precipitation, releases from reservoirs, groundwater, and return flows from agricultural irrigation.

As noted previously, the project area is comprised broadly of two hydrologically separate drainages; the Salinas River watershed, and the Reclamation Canal watershed. Figure 2-5 illustrates mean monthly flow in the Salinas River near Spreckles (1990 to 2006) measured at USGS gage 11152500 at Spreckles, California, and mean monthly flow (1980-2008) in the Reclamation Canal at USGS gage 11152650 (partial flow record). Note that the highest flows occurred from January to March, indicating the influence of precipitation on mean flow.

Mean annual discharge from the Salinas River watershed, as measured at USGS 11152500, is 268,699 acre-feet/year (flow record 1942-2008; drainage area 4,156 square miles).

Mean annual discharge from the Reclamation Canal watershed, as measured at USGS 11152650, is 11,770 acre-feet/year (flow record 1971-2008; drainage area 53.2 square miles).

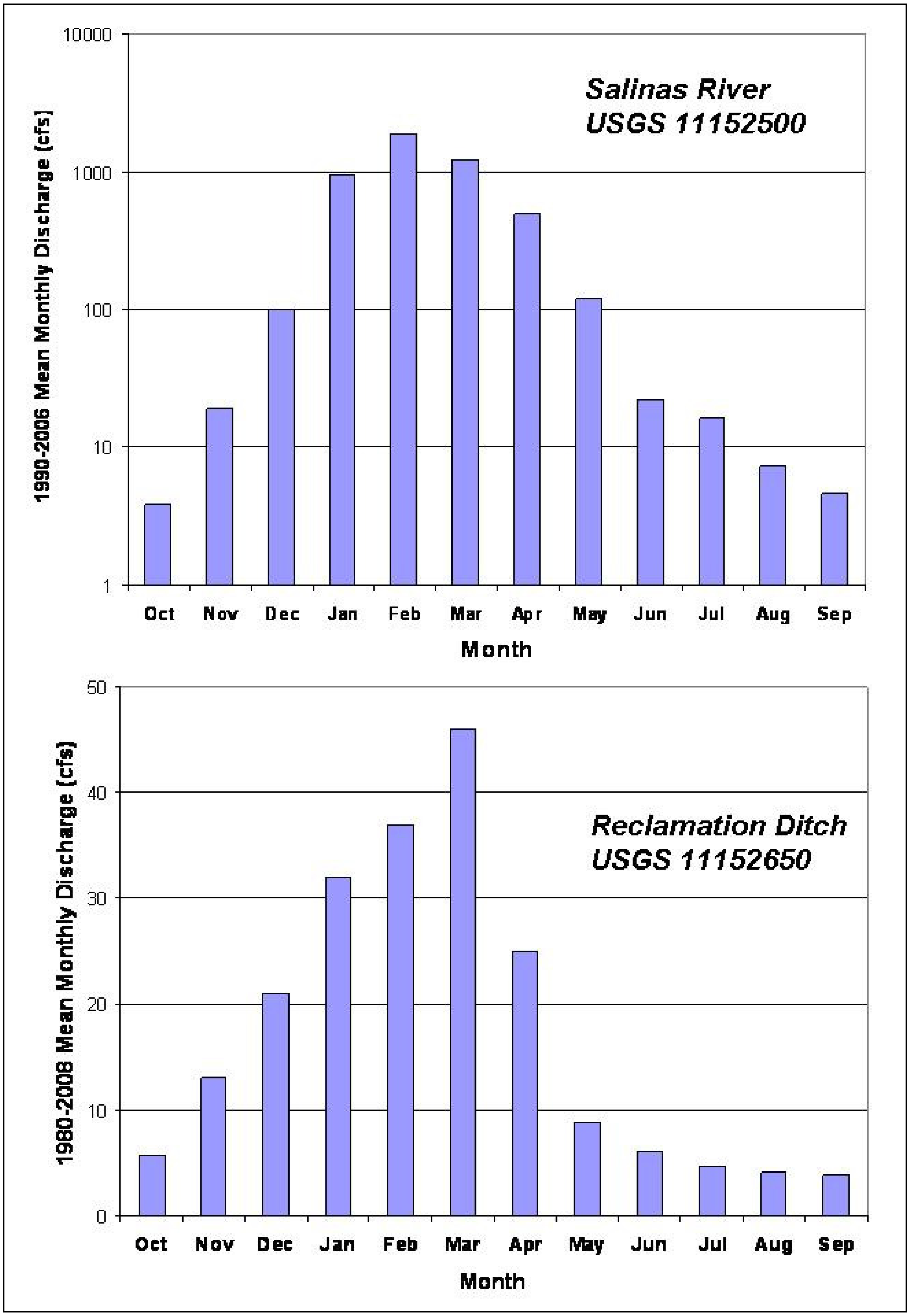


Figure 2-5. Mean monthly discharge at Salinas River near Spreckles, and Reclamation Canal near City of Salinas.

Low flow, baseflow conditions, or dry conditions in ephemeral drainages characterize stream reaches of the Project Area between rainy periods and throughout the dry season (May through October). Some of the surface waters in the watershed were perennial while some were ephemeral. The Lower Salinas River was dry during the late summer months upstream of Davis Road (near the City of Salinas). In contrast, the Salinas Reclamation Canal, Tembladero Slough, the Salinas River Lagoon, and the Old Salinas River were perennial; summer flows in these bodies of water were attributed to groundwater and irrigation sources. Two impervious layers separate groundwater aquifers in the valley of the Watershed. The upper clay layer lies from ten to twenty feet below the surface. The upper clay layer restricts percolating water from entering the deeper aquifer, thereby causing movement of water between the upper groundwater and surface waters, e.g. the Salinas River and its tributaries. As such, groundwater sources to area water bodies were probable. However, it was probable that much of the water percolating downward through the soil profile during summer months originated from agricultural irrigation.

Figure 2-6 broadly illustrates the nature of flow conditions throughout the Project Area, by depicting baseflow index in conjunction with stream flow observations. Baseflow Index (BFI) is the component of streamflow that can be attributed to groundwater discharges into streams. The BFI is the ratio of base flow to total flow. A higher BFI indicates a higher contribution of shallow, subsurface lateral flows into the stream reach, and consequently a higher likelihood of continuous or sustained flow through dry spells. The BFI grid shown on Figure 2-6 is a USGS raster dataset which is generated by interpolation from BFI point values estimated from USGS stream gages. The digital raster dataset is available from http://water.usgs.gov/GIS/metadata/usgswrd/XML/bfi48grd.xml#Identification_Information.

However, it should be noted that the USGS BFI raster is a broad approximation, interpolated from a few data points (i.e., stream gages), and the nature of perennial flows versus ephemeral flows throughout the Project Area will vary based on numerous factors. Also, BFI is really only a logical metric for perennial streams, and BFI ratios are not a quantitative metric to differentiate between ephemeral and intermittent streams. As such, also annotated on Figure 2-6 are point data from Project Area monitoring sites, which broadly indicate the nature of observed flow conditions, using stream gage data, instantaneous monthly flow measurements, or observational evidence (e.g., sites where water quality data was collected during the dry season, indicating at a minimum that intermittent flow exist at the monitoring site between May and October).

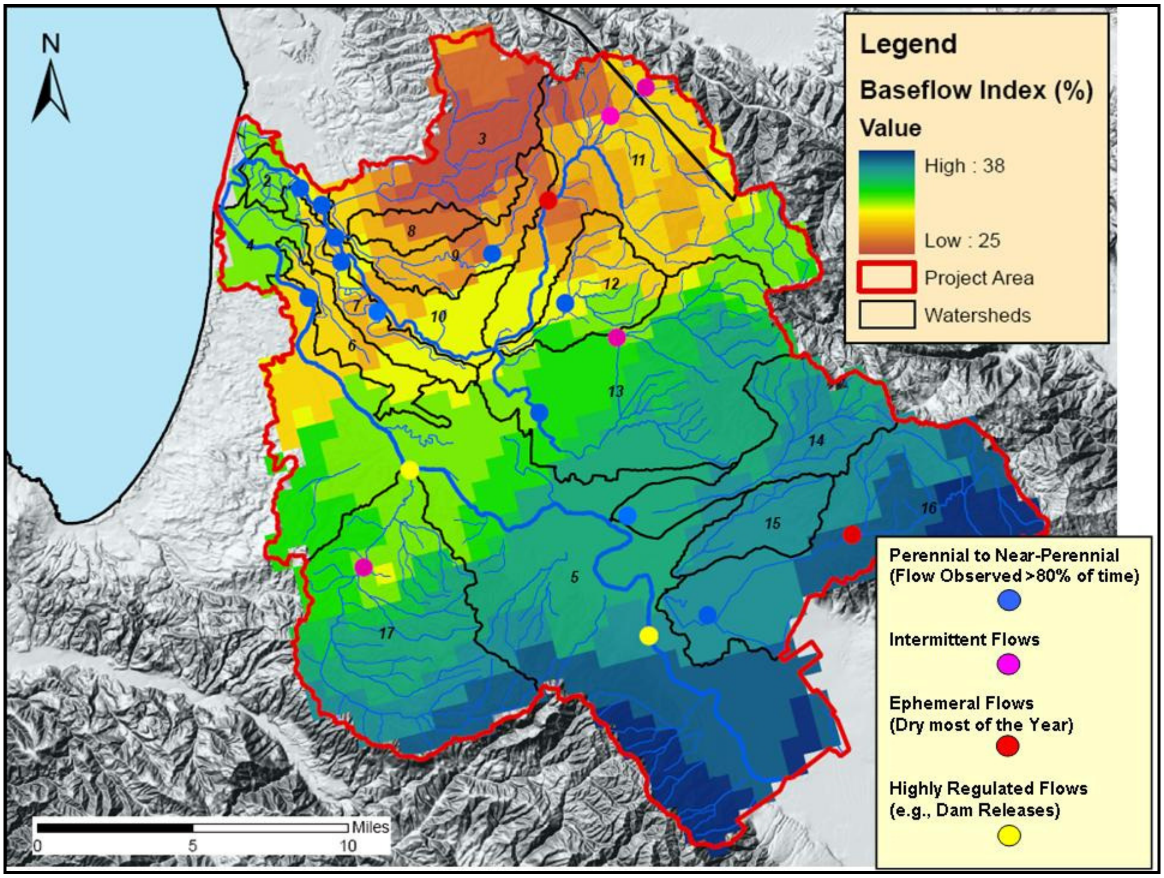


Figure 2-6. Baseflow Index Map for Project Area.

Broadly speaking, many of the low-gradient, valley floor stream reaches and coastal confluence water bodies have perennial or near-perennial (i.e., flow observed >80% of the time) flows. This is attributable to the fact that these stream reaches receive base flow and/or discharges of urban and agricultural runoff during the dry season. The Salinas Reclamation Canal, Tembladero Slough, the Salinas River Lagoon, and the Old Salinas River were perennial; summer flows in these bodies of water were attributed to groundwater and irrigation sources. Because the Salinas River is a highly regulated water body, and flows are to a some extent, tied to dam releases, the Lower Salinas River was dry during the late summer months upstream of Davis Road (near the City of Salinas). Flow records from the USGS gage at Spreckles and the USGS gage at Chualar Bridge, indicate that the Salinas River in these reaches, have measurable flow approximately 60% of the year.

In contrast, some stream reaches located higher up (topographically upgradient) on the alluvial plain or in lower order headwater reaches (where these is less flow contribution from urban or agricultural runoff), flows tend to be intermittent or ephemeral (e.g., reaches of Gabilan Creek upstream of Hebert Rd). Also, these stream reaches may typically be underlain by deep alluvial deposits or fractured bedrock having high permeability; consequently surface flows tend to percolate into the subsurface. Note however, that in some cases lower order Project Area headwater reaches appear to have flow that are intermittent, or near-perennial (e.g., Towne Creek) based on the observation that water quality data was collected throughout the year (including dry months) at monitoring sites associated with these reaches (see Appendix A, Water Quality dataset). These relatively more sustained headwater reach flows may potentially be due to baseflow, spring sources, and/or relatively impermeable bedrock (e.g., granitic bedrock in the Gabilan Range) which limit subsurface percolation of the surface flows.

2.3 Precipitation

Precipitation data in the project watershed is available from the National Oceanographic and Atmospheric Administration - Western Regional Climate Center (http://www.wrcc.dri.edu), and from California Department of Water Resources - California Irrigation Management Information Systems website (http://wwwcimis.water.ca.gov). The Lower Salinas Valley has a Mediterranean climate, with the vast majority of precipitation falling between November and April. Mean annual precipitation in the project area ranges from approximately 13 to 16 inches per year (See Figure 2-7 and Table 2-4).

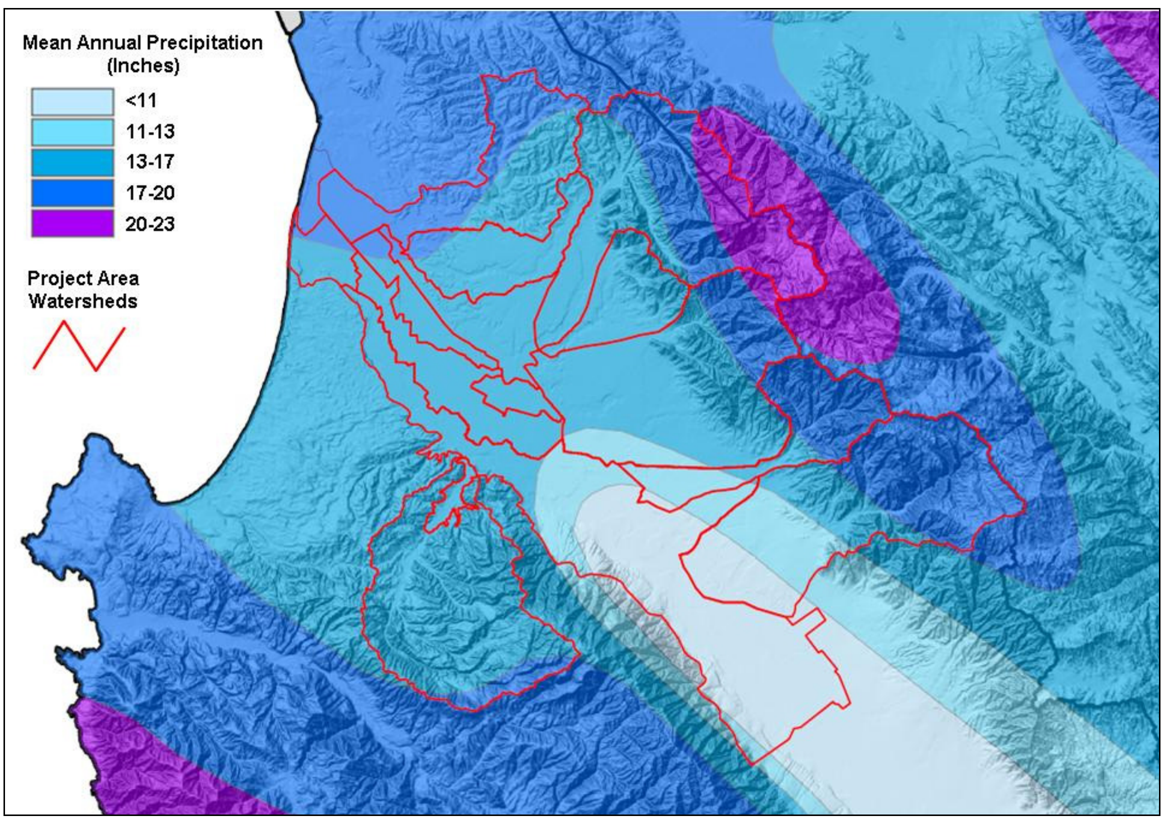


Figure 2-7. Mean Annual Precipitation Map (1900-1960).

Table 2-4. Precipitation Data

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Salinas Airport[A] (1930-2008)	Average Total Precipitation (in.)	2.66	2.41	2.14	1.12	0.32	0.09	0.03	0.05	0.13	0.58	1.39	2.38	**13.29**
Salinas 2[A] (1958-2008)	Average Total Precipitation (in.)	2.89	2.68	2.33	1.13	0.3	0.1	0.03	0.06	0.24	0.62	1.76	2.46	**14.58**
Spreckels[A] (1907-1988)	Average Total Precipitation (in.)	2.83	2.27	2.17	1.14	0.35	0.11	0.03	0.04	0.22	0.55	1.44	2.29	**13.45**
Fort Ord[A] (1968-1978)	Average Total Precipitation (in.)	0.91	2.7	2.28	1.4	0.12	0.09	0.06	0.13	0.13	0.68	2.06	2.33	**14.89**
Castroville #19[B] **(1983-2007)**	Average Total Precipitation (in.)	2.94	3.33	2.13	0.98	0.67	0.35	0.31	0.21	0.37	0.68	1.76	2.70	**16.26**

A: Western U.S. COOP weather station (Source: NOAA Western Regional Climate Center)
B: California Dept. of Water Resources CIMIS station (Source: Calif. DWR-Irrigation Management Information System)

3 DATA ANALYSIS

The Salinas River watershed is impaired on the basis of fecal coliforms. Microbial indicator organisms or fecal indicator bacteria (FIB) are monitored rather than pathogens because direct measurements of protozoa, bacteria, and viruses of public health significance are considered to be too slow, too difficult for routine analyses, and too expensive. Staff's assessment of ambient water quality for indicator bacteria for this Project relied principally on analysis for the presence of pathogens using fecal coliform and *E. coli* as indicators.

The total coliform group of bacteria is from the family *Enterobacteriaceae*, which includes over 40 genera of bacteria. The total coliform group includes bacteria of both fecal and non-fecal origin. Common habitats for the group include soil, groundwater, surface water, the intestinal tract of animals and humans, the surface of plants, algal-mats in pristine streams, wastes from the wood industry, and biofilms within drinking water distribution systems (Hurst, et al., 2002). Total coliforms can be divided into various groups based on common characteristics. Among these, the fecal coliforms are generally indicative of fecal sources, though not all members of the group are of fecal origin (Hager, et al, 2004, p. 6). The bacteria species, *Escherichia coli*, comprises a large percentage of coliform detected in human and animal feces. Since sewage contains many types of disease-causing organisms, fecal coliform, including *Escherichia coli*, are often used as an indictors of pathogens.

Although fecal bacteria have historically been the indicator organisms of choice, they have three primary shortcomings: 1) the presence of these indicators does not necessarily mean that human pathogens are present—only that they may be present; 2) bacterial indicators may not have the same levels of survival in the environment as the pathogens for which they are intended to serve as sentinels; and 3) these indicators are not human-specific, and therefore do not fully assess the health risk from human enteric viruses and other human-specific pathogens. The third limitation is of less importance than might be assumed, since fecal contamination from a wide range of non-human species—both domesticated and wild—often carry human pathogens (USEPA, 2004).

Additionally, there is substantial scientific uncertainty about whether FIB is an effective indicator of pathogen risk due to diffuse, or nonpoint sources, or what the environmental sources of FIB are. For example, it is conceivable that observed exceedances of water quality objectives in targeted watersheds are in part caused by seeding of the water column from stream sediments and other specific niches that allow indicator bacteria to persist and multiply.

Despite these shortcomings, there are limited practical alternatives to the use of fecal indicator bacteria currently available. Direct measurement of protozoa, viruses, and other pathogens are generally not feasible for routine and timely analysis. If in the future better indicator organisms or methods are identified and new standards are put into place, this TMDL may be modified accordingly. USEPA is in the process of updating its recreational criteria with a focus on the protection of human health at public swimming areas in coastal waters of the United States. USEPA also wants the revised/new criteria and methods to be applicable in different types of water bodies (Wuertz and Schriewer, 2009).

Some strains of *Escherichia coli* (*E. coli*) are pathogenic and some are not. *E. coli* O157:H7 is one of the hundreds of strains of the bacterium *E. coli*. Animal sources of *E. coli* O157:H7 include both domestic and wild animals. Known sources include cattle (beef and dairy), horses, pigs, birds, including waterfowl, flies, dogs, and more. Although most *E. coli* strains are harmless and reside naturally in the intestines of humans and animals, the *E. coli* O157:H7 strain produces a powerful toxin that can cause severe illness, even death. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many types of disease-causing organisms; therefore, the presence of *E. coli O157:H7* indicates not only that a pathogenic *E. coli* is present, but also indicates the potential presence of other pathogenic organisms.

Analysis of water samples to detect the *presence* of fecal coliform and *E. coli* (including O157:H7) is one way to determine the potential presence of pathogens. However, analytical methods for *quantifying* bacteria lack the precision common to many other laboratory methods for water quality analysis. For example, the Multiple Tube Fermentation (MTF) method results are an estimate of the most probable number (MPN) of bacteria. This number can vary considerably for a given result. For example, an MTF result of 1,600 MPN/100ml has a 95% confidence interval ranging from 600 to 5,300 MPN/100ml. The other common method, Membrane Filtration, also has limitations, particularly with highly turbid samples. The Colilert method also results in an MPN of total coliform as well as *E. coli*. The confidence interval is similar, and in some cases better, than the MTF method. Colilert has the advantage of being able to test for the presence of total coliform and *E. coli* in the same procedure and requires less time, relative to the MTF method.

E. coli O157:H7 can be identified using immunochemical and genetic methods. The methods used for isolating and identifying *E. coli* O157:H7 are more time-consuming and costly than the MTF and Colilert methods, but result in a positive identification of the bacterium. Polymerase chain reaction (PCR), culture, and Pathatrix methods for identifying *E. coli* O157:H7 were used for samples collected for this Project.

In spite of the limitations, testing for the presence fecal coliform, including *E. coli*, remains one of the best available methods for indication of potential fecal contamination (Ibid., p. 7), and therefore other pathogens. The MTF and Colilert methods, combined with methods of identifying the presence *E. coli O157:H7*, together provide strong indications of the presence and magnitude of pathogens, and therefore impairment of water quality.

3.1 Indicator Bacteria Data

The data used for this Project included five major groups including:

- TMDL Project dataset, including:
    - TMDL Program monitoring activities
    - United States Department of Agriculture (USDA)
- Central Coast Ambient Monitoring Program (CCAMP)
- Entities regulated by the Central Coast Water Board (City of Salinas Stormwater Program)
- Central Coast Watershed Studies (CCoWS) Team (affiliated with the Watershed Institute at California State University-Monterey Bay)
- Snap Shot Day monitoring program (Monterey Bay National Marine Sanctuary Citizen Watershed Monitoring Network)

The TMDL Project dataset ranged in time from November 2004 to October 2006. Staff and USDA technicians analyzed grab samples for *E. coli* using the Colilert-18 or Colilert-24 method. Over 400 data were analyzed from 27 monitoring sites in the Project area. Staff batched data according to season. All samples taken between 1-November through 30-April represented the wet season batch, and all samples taken between 1-May and 30-October represented the dry season batch. For the analysis of impairment, the geometric mean density was calculated for each batch and compared to the EPA recommended criteria of 126MPN/100mL. Seasonal data batching is an acceptable method for analysis of exceedance (L. Wilcut, USEPA, 2007, personal communication).

The CCAMP dataset used for this project ranged in time from February 1999 to October 2006. These samples were in terms of fecal coliform density that was analyzed by a contracted lab using the Multiple Tube Fermentation Method. A total of 317 data were used from 11 monitoring sites in the Project Area. Staff batched this data seasonally as well, and then determined the percent of data exceeding the 400 MPN/100mL water quality objective. Recall that not more than 10% of data should exceed 400 MPN/100mL to protect the REC-1 beneficial use.

Of the TMDL Project dataset, samples beginning in February 2005 were also analyzed by USDA for the presence of *E. coli* O157:H7 using two separate methods. USDA analyzed samples for the presence of O157:H7 from 31 monitoring sites in the Project area using Pathatrix recovery as well as an immunomagnetic separation method (IMS). In addition, staff placed Moore swabs in flowing waters for five days prior to collection and analysis at some monitoring sites. These samples were subsequently analyzed (by USDA) for the presence of *E. coli* O157:H7. There was a higher probability of detecting *E. coli* O157:H7 using Moore swabs, relative to grab samples, due to the extended length of time the swab was in the creek. Data were expressed in terms of presence of absence of *E. coli* O157:H7.

Additional data was available for Chualar Creek and Natividad Creek. The Central Coast Watershed Studies Team (CCoWS) from the California State University-Monterey Bay collected a suite of samples from Chualar Creek during the 2001/2002 monitoring period. The samples were analyzed for total coliform, fecal coliform, and *E. coli*.

Snapshot Day *E. coli* monitoring data for Natividad Creek was collected by the Monterey Bay National Marine Sanctuary Citizen Watershed Monitoring Network (Network). The Network provides guidance, training and equipment to support citizen monitoring groups. The Network also coordinates between citizen monitors and government agencies so that the data collected is useful. Information gathered by trained Snapshot Day volunteers are used to help resource managers focus attention on priority areas.

Finally, a suite of *E. coli* water quality data from Natividad Creek from the City of Salinas Stormwater Monitoring Program was used to supplement the Snapshot Day monitoring data (City of Salinas 2007-2008 Annual NPDES Report).

3.2 Spatial Data

Spatial data was prepared by staff using Geographic Information Systems (GIS) software. GIS layers used include the National Hydrologic Data (NHD) for streams, California Watershed Map (CALWATER version 2.2) for watershed boundaries, Geographic Data Technology for roads (DGT roads), and National

Land Cover Data (NLCD) for land use. Staff also developed hillshade layers from digital elevation models (DEM) in the Project area.

3.3 Water Quality Data

3.3.1 Indicator Bacteria Concentration and Presence

Samples were collected from the monitoring sites listed in Table 3-1. . The table provides locations of monitoring sites, associated waterbodies, as well as summary data for the CCAMP and TMDL Project datasets. The data summary in Table 3-1. represents all the data collected up to the date of this report preparation. Dry season data refers to data gathered from May through October. Wet season data refers to data gathered from November through April.

A map of the monitoring sites is provided in Figure 3-1. A summary of data sources are outlined in Section 3.3.1.1 to 3.3.1.3. The detailed water quality data is contained in Appendix A.

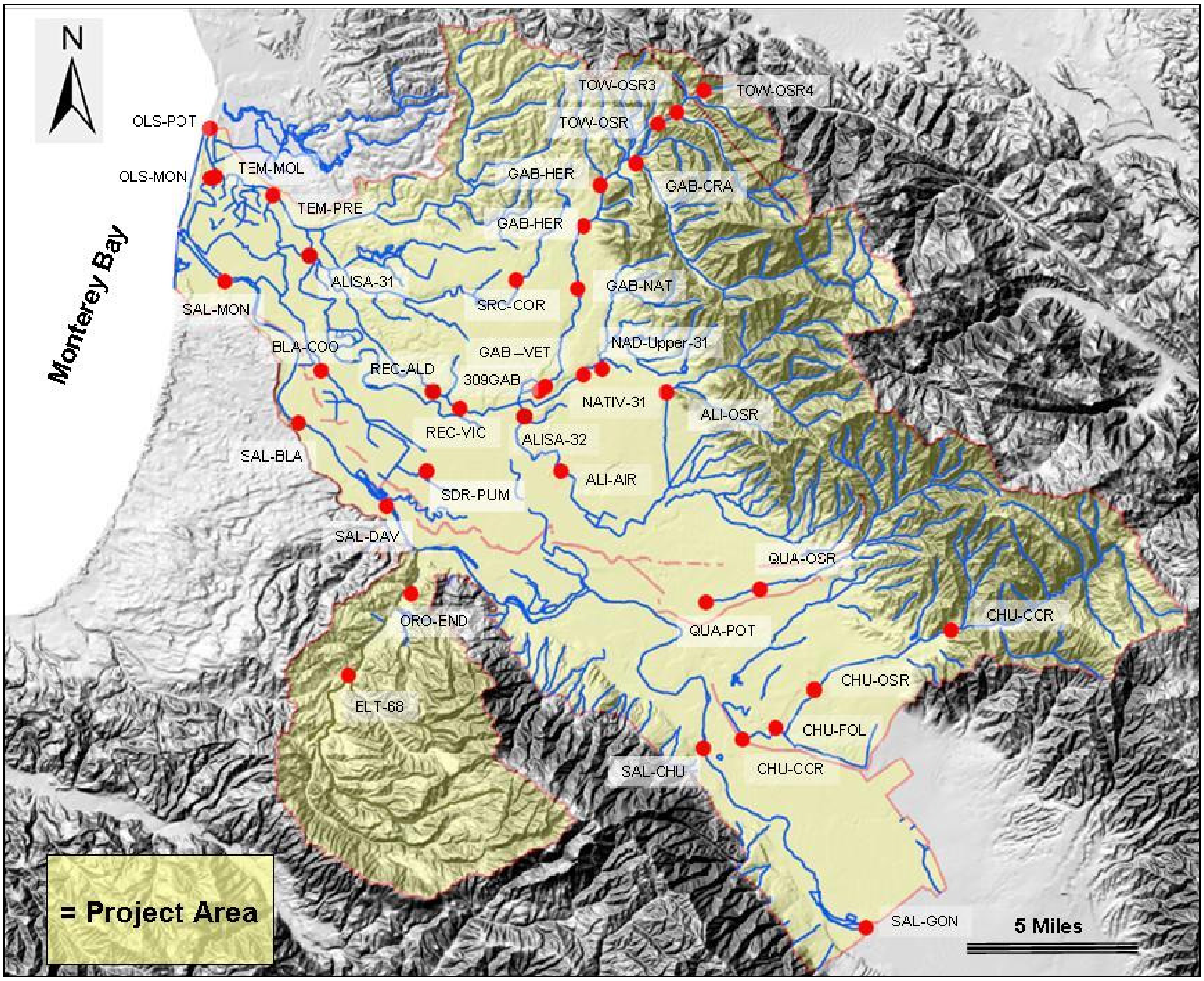


Figure 3-1. Map of monitoring site locations.

Table 3-1. Monitoring sites, locations, and summary data.

			Fecal Coliform Percent of data exceeding 400 MPN/100mL				Generic *E.coli* Geometric Mean				*E.coli* O157:H7		
Waterbody	Monitoring Site	Site Description	n[1]	wet season	n	dry season	n	wet season	n	dry season	number of positives	n	percent of positives
Salinas River	Gonzales to Spreckels												
	SAL-GON	Salinas River at Gonzales Road					8	57	7	84	1	16	6
	SAL-CHU	Salinas River at Chualar River Road	12	25	8	0	13	95	11	50	0	17	0
Salinas River	Spreckles to Lagoon												
	SAL-DAV	Salinas River at Davis Road	34	35	33	12	22	186	22	32	2	20	10
	SAL-BLA	Salinas River at Blanco Road					12	112	9	80	0	17	0
Salinas River Lagoon (north)	SAL-MON	Salinas River at Monte Road	12	17	9	0	10	146	9	37	0	9	0
Old Salinas River	OLS-MON	Old Salinas River at Monterey Dunes Colony	29	52	32	66	23	585	22	224	2	19	11
	OLS-POT	Old Salinas River at Potrero Road	5	60	4	0	5	1351	3	347	2	6	33
Tembladero Slough	TEM-PRE	Tembladero Slough at Preston Road in Castroville	9	67	9	78	18	841	15	223	5	21	24

			Fecal Coliform Percent of data exceeding 400 MPN/100mL				Generic *E.coli* Geometric Mean				*E.coli* O157:H7		
Waterbody	Monitoring Site	Site Description	n[1]	wet season	n	dry season	n	wet season	n	dry season	number of positives	n	percent of positives
	TEM-MOL	Tembladero Slough at Molera Road	24	58	28	50	23	820	22	106	3	21	14
Salinas Reclamation Canal	REC-VIC	Salinas Reclamation Canal at Victor Way					6	476	6	484	2	12	17
	REC-ALD	Salinas Reclamation Canal at Boranda Road	4	100	6	83							
Alisal Slough	ALISA-31	Alisal Slough at 1703 Hwy 187							1	310 (single sample)			
Alisal Creek	ALISA-32	Alisal Creek at Chavez Park and Madeira Ave							6	593			
	ALI-OSR	Alisal Creek at Old Stage Road	3	100	3	67	1	980					
	ALI-AIR	Alisal Slough at Airport Road	13	77	12	100	16	406	15	538	1	19	5
Gabilan Creek	309GAB	Gabilan Creek at Independence Road and E. Boranda Road.	9	100	3	67							
	GAB-OSR	Gabilan Creek at Old Stage Road					14	270	9	297	4	22	18
	GAB-CRA	Gabilan Creek at Crazy Horse road					14	786	9	779	8	21	38

			Fecal Coliform Percent of data exceeding 400 MPN/100mL				Generic *E.coli* Geometric Mean				*E.coli* O157:H7		
Waterbody	Monitoring Site	Site Description	n[1]	wet season	n	dry season	n	wet season	n	dry season	number of positives	n	percent of positives
	GAB-HER	Gabilan Creek at Herbert Road					14	708	9	600	6	23	26
	GAB-NAT	Gabilan Creek at Natividad Road					9	1852			4	11	36
	GAB-VET	Gabilan Creek at Veterans Park					13	284	9	71	2	21	10
Blanco Drain	BLA-COO	Blanco Drain at Cooper Road					10	80	9	87	0	17	0
Stormwater Drain	SDR-PUM	Storm Drain Pump off Hitchcock Road					11	1005	8	661	0	15	0
	309SDR	Storm Drain outlet near Davis Road					2	6797	6	195			
Santa Rita Creek	SRC-COR	Santa Rita Creek at Cornwall Street					8	545	8	323	0	19	0
Natividad Creek	NATIV-31	Natividad Creek at Las Casitas Road							4	414			
	Upper-31	Natividad Creek near E. Boranda Road							4	1664			

			Fecal Coliform Percent of data exceeding 400 MPN/100mL				Generic *E.coli* Geometric Mean				*E.coli* O157:H7		
Waterbody	Monitoring Site	Site Description	n[1]	wet season	n	dry season	n	wet season	n	dry season	number of positives	n	percent of positives
	309NAD	Natividad Creek near E. Boranda Road					3			1495			
Towne Creek	TOW-OSR	Towne Creek at Old Stage Road					14	1073	9	921	7	22	32
Arroyo Seco River	ARR-GOR	Arroyo Seco River at Gorge upstream of camp area					1	10	3	7	0	4	0
Quail Creek	QUA-OSR	Quail Creek at Old Stage Road	2	50									
	QUA-POT	Quail Creek at Potter Road	7	71	9	89	4	438	6	582			
Chualar Creek	CHU-CCR	Chualar Creek at Chualar Creek Road	3	100			1	30440			1	5	20
	CHU-FOL	Chualar Creek at Foletta Road	3	66	6	100							
	CHU-OSR	Chualar Creek at Old Stage Road	5	100	2	100							
	CHU-CRR	Chualar Creek at Chualar River Road	9	67	11	54	6	623	1	154	0	10	0
El Toro Creek	ELT-68	El Toro Creek at Hyw-68					2	2849	1	860	0	3	0
	ORO-END	Eastern entrance,					1	11780 (single sample)					

			Fecal Coliform Percent of data exceeding 400 MPN/100mL				Generic *E.coli* Geometric Mean				*E.coli* O157:H7		
Waterbody	Monitoring Site	Site Description	n[1]	wet season	n	dry season	n	wet season	n	dry season	number of positives	n	percent of positives
		Toro Regional Park											

n[1] Number of data available for analysis.

Note from Table 3-1. that most of the waterbodies had either 10% or more of fecal coliform data exceeding 400 MPN/100mL, or the *E. coli* geometric mean exceeded 126 MPN/100mL. Discussion of impairment is presented in subsequent sections of this report.

Table 3-2 summarizes the number and percent of samples that exceeded water quality criteria for fecal coliform and/or *E. coli*, by waterbody. Recall that USEPA recommends that impairment can be asserted if the number of exceedances is five or greater. Refer back to Section 1.6 for the State Board Listing Policy.

Table 3-2. Number and % of Samples Exceeding Water Quality Criteria by waterbody.

Waterbody	**Fecal Coliform Data**		***E. Coli* Data**	
	Number of Samples Exceeding 400 MPN/100mL	% of Samples Exceeding 400 MPN/100mL	Number of Samples Exceeding 235 MPN/100mL	% of Samples Exceeding 235 MPN/100mL
Towne Creek	-	-	40 of 42	95%
Tembladero Slough	41 of 70	58%	57 of 78	73%
Santa Rita Creek	-	-	15 of 33	45%
Salinas River	21 of 107	20%	29 of 133	22%
Reclamation Canal (Lower)	9 of 10	90%	9 of 12	75%
Quail Creek	14 of 18	78%	7 of 10	70%
Salinas Lagoon (North)	2 of 21	10%	5 of 22	23%
Old Salinas River	39 of 70	56%	32 of 53	60%
Gabilan Creek	10 of 12	83%	71 of 116	61%
El Toro Creek	-	-	4 of 4	100%
Chualar Creek	30 of 39	77%	11 of 22	50%
Blanco Drain	-	-	3 of 20	15%
Alisal Slough	-	-	1 of 1	Insufficient data
Alisal Creek/Upper Reclamation Canal	26 of 30	87%	28 of 39	72%
Natividad Creek	-	-	11 of 11	100%
Stormwater Outfalls	10 of 20	50%	18 of 27	67%

3.4 Flow Data

Flow data was not collected as part of this Project. Flow in the Salinas River can reach thousands of cubic feet per second rendering flow data collection for each sampling event beyond the resources of the Project. In addition, the TMDL and allocations in this report are described in terms of fecal indicator bacteria density, and not load. Flow data is, therefore, not necessary for TMDL and allocation calculations. However, Staff used USGS flow data, and estimated flow statistics to assess existing loading, assimilative capacity, and to derive daily load expressions for informational purposes in accordance with USEPA guidance, as outlined in Section 7 of this Project Report.

3.5 Rain Events

Staff collected samples from thirteen sites during and after two separate rain events. Neither of the rain events were first flush events, but rather occurred latter in the rain season. Figure 3-2. illustrates *E. coli* density during rain and non-rain sampling. The darker bars denote rain event sampling densities and hollow bars denote non-rain sampling. Note that the y-axis is log-scale, with non-rain event sampling often being an order of magnitude lower than rain event sampling.

The median *E. coli* density during rain events was 2,685 MPN/100mL, whereas the median density during non-rain sampling was 224 MPN/100mL. Staff conducted statistical analysis of median densities using paired samples. Using the Mann-Whitney analysis, staff found that median density during rain events was statistically greater, compared to non-rain medians occurring shortly after rain events ($p = 0.000$). Appendix B contains this statistical analysis.

Monitoring sites drain a variety of land uses, and all sites, excepting one, had greater *E. coli* density during rain event sampling. There may be several factors driving *E. coli* density higher during rain events. Potential factors included:

- Indicator bacteria loading from surface runoff throughout the watershed.
- Entrainment of indicator bacteria on soil particles and alluvium.

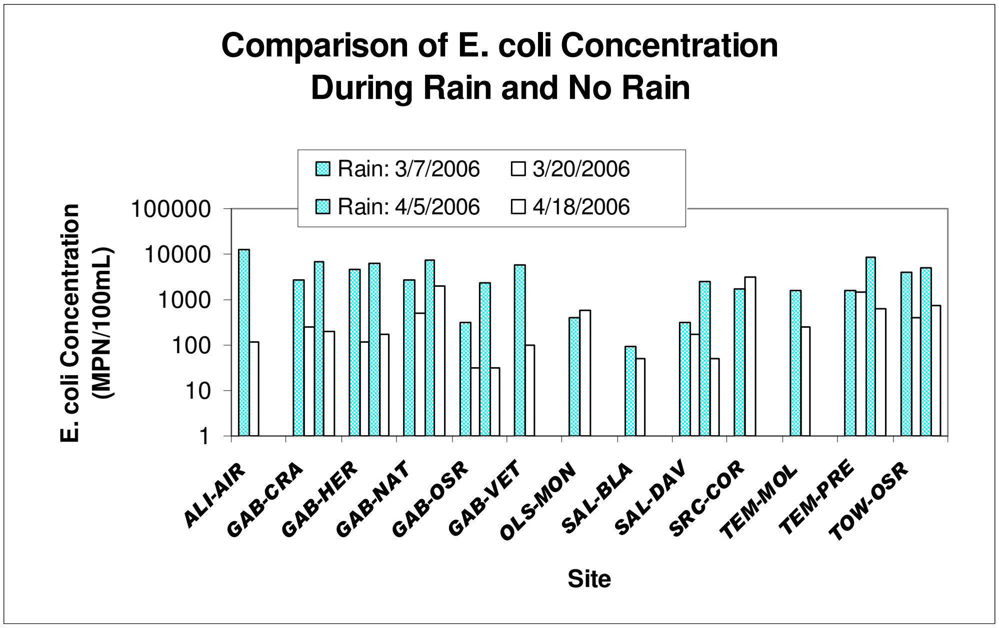


Figure 3-2. Comparing *E. coli* density during rain and non-rain event sampling.

3.6 Seasonal Indicator Bacteria Fluctuation

Section 3.5 discusses *E. coli* density differences during rain and non-rain event sampling. Another trend, perhaps in part related to rain event bacterial density, was seasonal fluctuation. There was a general trend of higher indicator bacteria (fecal coliform and *E. coli*) density during the rain season, relative to the drier summer months. In addition, there was a trend of increasing density during the summer, after a significant reduction in April and May after the rain season.

Figure 3-3. illustrates the monthly medians of the combined fecal coliform (CCAMP) dataset and *E. coli* (TMDL Project) dataset. Note the general trends of higher density in winter, as well as increasing density further into summer. Both of these trends were apparent in the fecal coliform and *E. coli* datasets.

The trend of higher density during the winter months could be explained by:

- Larger watershed area contributing to surface waters in wet weather, therefore increasing the potential for more source contributions.
- Higher indicator bacteria density during rain events resulting in surface runoff and entrainment of indicator bacteria.
- Differing land use practices between wet and dry weather.

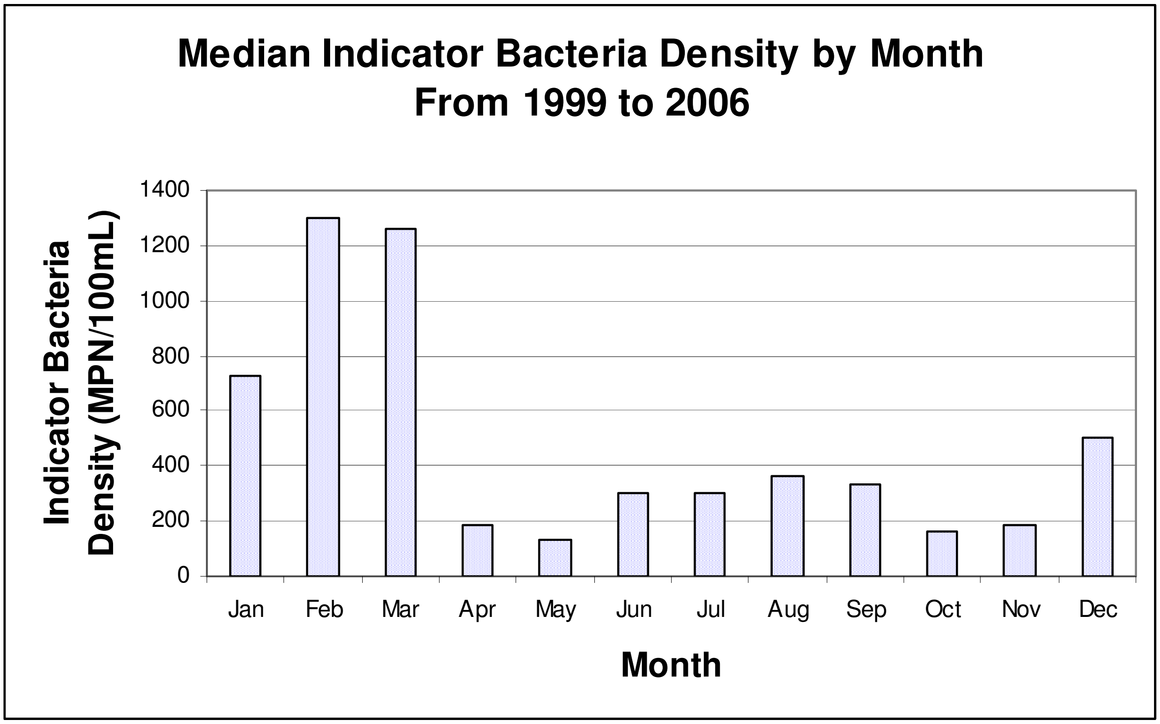


Figure 3-3. Project area combined *E. coli* and fecal coliform medians by month, from February 1999 to April 2006.

Figure 3-4. illustrates the geometric means of *E. coli* during the dry and wet seasons. Recall that dry season data refers to data gathered from May through October, and wet season data refers to data gathered from November through April. The illustration represents all the data collected up to the date of this document preparation.

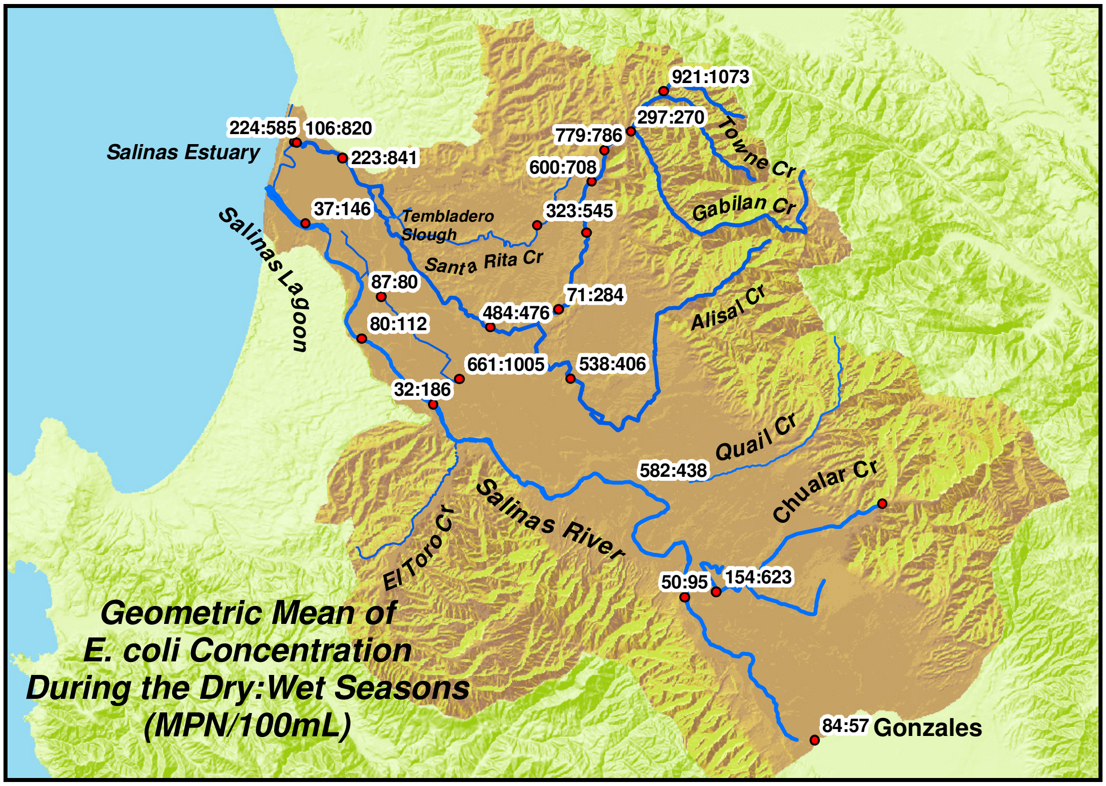


Figure 3-4. Geometric means during dry and wet seasons.

3.7 Presence of E. coli O157:H7

Staff reviewed the occurrence of *E. coli* O157:H7 as an indication of potential sources of *E. coli* O157:H7 as well as other pathogenic organisms. Figure 3-5. illustrates the number of samples at each site that had a positive identification for *E. coli* O157:H7. Note from the map that *E. coli* O157:H7 first occurred in the headwaters of the watershed. Figure 3-5. represents all the data collected up to the date of this document preparation.

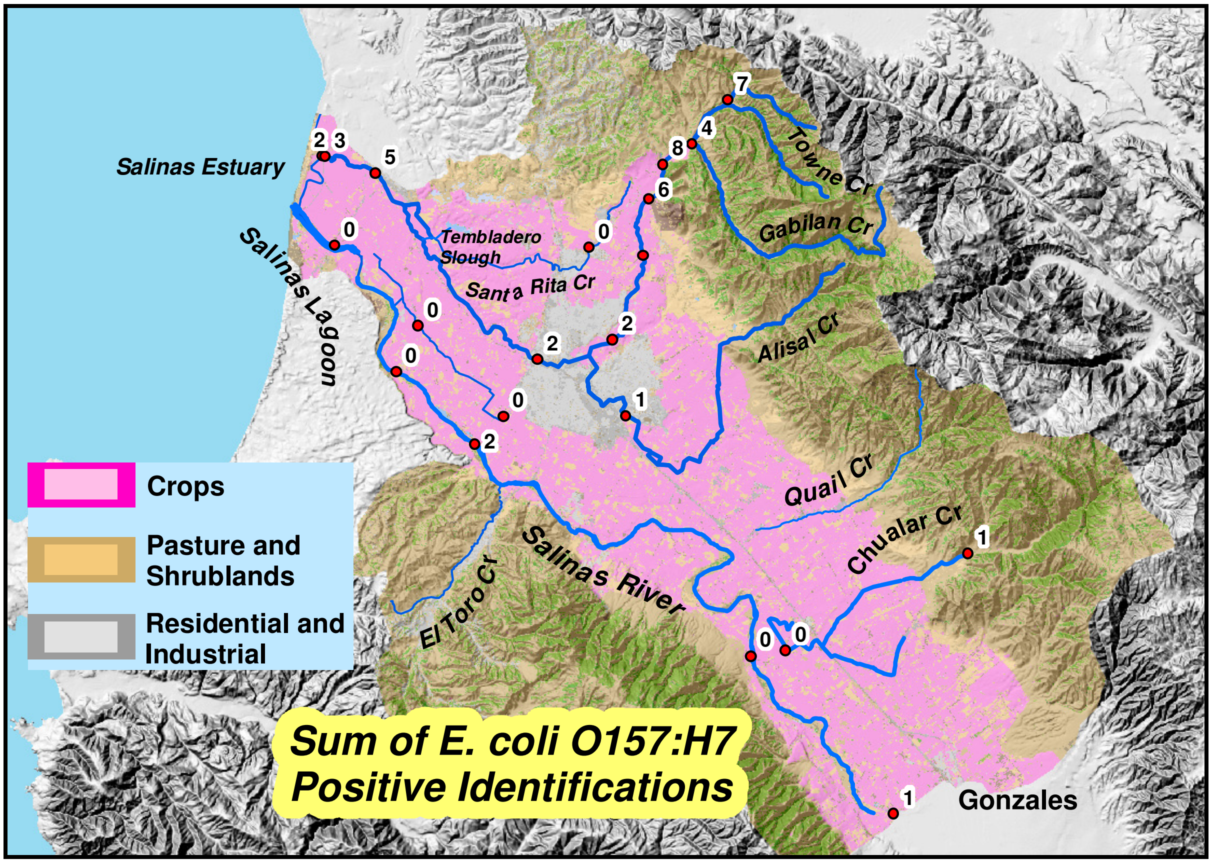


Figure 3-5. Sum of *E. coli* O157:H7 positives.

3.8 Dischager Data

The following are entities regulated for point discharges in the project area.

Table 3-3. Point Source Dischargers

FACILITY	ADDRESS	CITY	ORDER	NPDES	Discharges to
City of Salinas Industrial Wastewater Facility	Davis Road near Salinas River	Salinas	R3-2003-0008	-	Discharges to Land (wastewater pond system)
Cool Pacific Land Co.	Airport Blvd.	Salinas	01-119	CAG993001 (Rescinded) Permit Pending	Salinas Reclamation Canal, Upper/Alisal Creek
UNI-KOOL Salinas Facility	395 West Market Street	Salinas	01-119	CAG993001	Salinas Reclamation Canal, Upper/Alisal Creek
Uni-Kool Co. – Abbott Street	E. John St. & Abbot St (320 John Street)	Salinas	99-068	CA0005720	Salinas Reclamation Canal, Upper/Alisal Creek
Versacold Logistics	950 S. Sanborn Rd.	Salinas	01-119	CAG993001	Salinas Reclamation Canal, Upper/Alisal Creek

The Salinas Industrial Watewater Facility treats industrial wastewater from vegatable packers and processors, seafood processors, and other food commodity processors. The facility is prohibited by permit to discharge wastes to surface waters or to surface water drainage courses. As such, this facility is unlikely to contribute any significant pathogen loads to the Salinas River.

The NPDES-permitted entities in Table 3-3 are vegatable and fruit packing and cold storage facilities that discharge treated process wastewater, wash water, and/or cooling water to the Salinas Reclamation Canal via the City of Salinas storm drain system. The nature of their operation (vegatable and fruit packing and storage) does not necessarily suggest that these entities are significant contributors of indicator bacteria loads to the Reclamation Canal. However, we interviewed Water Board permitting staff, who indicated that there may have been some potential problems with rodents and their associated fecal material potentially being entrained in wash down water used at the facilities, as well as other lines of evidence indicating that monitoring was merited..

As such, the Executive Officer of the Central Coast Water Board required monitoring for indicator bacteria for discharges of process wastewater from these facilities via a California Water Code Section 13267 action, in a letter dated October 24, 2006. A review of the permit files (through 2008) indicated a few instances of subsequent bacteria monitoring at the above facilities, but the quantity and scope of the monitoring appears to be insufficient to conclude whether or not these entities are a significant source of indicator bacteria to the Reclamation Canal. Two sampling events in 2007 from the UNI-KOOL Salinas Facility included data for *E. coli* (7 and 68 MPN/100mL) and for total coliform (2419 and 20,459 MPN/100mL). One sampling event from the Versacold Facility in 2007 yielded a total coliorm result of 100 MPN/100mL. No other indicator bacteria data were identified from the files for these facilities. The UNI-KOOL facility on Abbot Street reported in a letter dated November 22, 2006 they do not currently process wastewater in any form.

More information will be obtained, if merited, during the implementation phase of the TMDL to further assess the level of FIB contribution from permitted points source discharge entities and to identify any actions if necessary to reduce loading. At a minimum, it should be verified that these facilities are complying with the indicator bacteria monitoring requirements, as outlined in the Central Coast Water Board's Executive Officer's 13267 letter dated October 24, 2006.

3.9 Data Analysis Summary

Figure 3-6. illustrates data and a corresponding graph showing the minimum, maximum, geometric mean, and number of data for each waterbody. Note that the data in Figure 3-6. is summary data only and was not meant to be compared with water quality objectives; the data was presented to give the reader a sense of relative concentrations of fecal indicator bacteria in the project area.

Waterbody	El Toro Cr	Towne Cr	Santa Rita Cr	Quail Cr	Chualar Cr	Rec. Canal	Alisal Cr
Maximimum	5040	11370	4570	2300	30440	3090	12590
Minimum	860	201	30	100	5	76	2
Geometric Mean	1911	1104	526	520	510	480	477
No. of data	3	39	19	10	7	12	32
Waterbody	Gabilan Cr	Temb. Slough	Sal. Lagoon	Blanco Drain	Salinas River	Arroyo Seco R	
Maximimum	7590	10000	5200	1120	2700	11	
Minimum	10	3	1	10	1	5	
Geometric Mean	454	360	264	83	78	7	
No. of data	100	78	72	19	104	4	

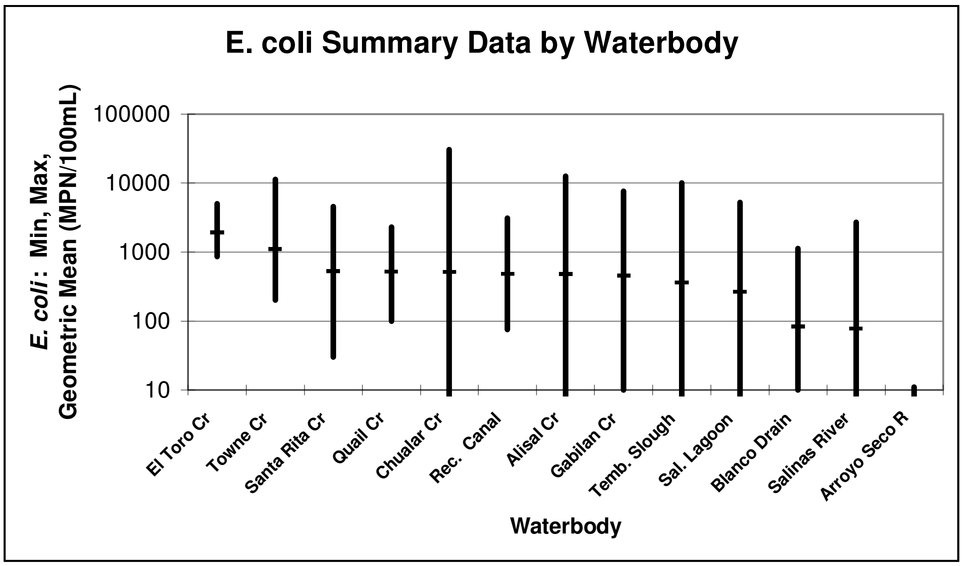


Figure 3-6. Summary data by water body.

Staff conducted a data analysis of all *E. coli* and fecal coliform data by water body. Staff assessed impairment using the numeric water quality objective for fecal coliform protecting water contact recreation (400 MPN/100mL.). For *E. coli* data, staff assessed impairment using the recommended USEPA criteria for *E. coli* (235 MPN/100mL). Staff batched data into dry and wet seasons for analysis (see Section 3 for discussion of dry and wet seasons).

3.9.1 Confirmed Impaired Waterbodies

Table 3-4. represents the impaired water bodies based on data available at the time of report. Note that all the water bodies that are currently listed as impaired on the 2006 303(d) list are confirmed to be impaired by the latest available data: the Lower Salinas River, Alisal Creek, Gabilan Creek, the Salinas Reclamation Canal, the Old Salinas River, and Tembladero Slough. These waterbodies are impaired due to exceedance of water quality objectives or recommended criteria protecting the water contact recreation beneficial use.

Staff also concluded that FIB water quality data indicate impairment of waterbodies that are proposed for addition to the updated 2008 303(d) list.

- Quail Creek
- Natividad Creek
- Chualar Creek
- Santa Rita Creek

Finally, Staff concluded that water quality data indicate impairment of waterbodies that are not on current or proposed 303(d) lists; these waterbodies are not meeting water quality objectives or recommended criteria:

- Salinas River Lagoon (North)
- Towne Creek

Table 3-4. Confirmed impaired waterbodies

Waterbody	Exceeding a water quality objective or recommended level?	Water quality objective or recommended level exceeded?		
		Fecal Coliform Objective	USEPA recommended *E. coli* level	Currently listed on 303(d) list?
Lower Salinas River	YES	YES	YES	YES
Old Salinas River	YES	YES	YES	YES
Tembladero Slough	YES	YES	YES	YES
Reclamation Canal	YES	YES	YES	YES
Alisal Creek	YES	YES	YES	YES
Gabilan Creek	YES	YES	YES	YES
Natividad Creek	YES	NO	YES	YES*
Salinas River Lagoon (north)	YES	NO	YES	NO
Santa Rita Creek	YES	NO	YES	YES*
Quail Creek	YES	YES	YES	YES*
Chualar Creek	YES	YES	YES	YES*
Towne Creek	YES	NO	YES	NO

* Water Board-approved additions to 2008 303(d) list – pending approval from USEPA

Staff made the following preliminary data analysis summary:

- All 303(d) listed waterbodies in the project area exceeded water quality objectives for indicator bacteria.
- Some waterbodies not currently listed also exceeded water quality objectives or USEPA recommended levels for indicator bacteria.
- The disease-causing strain of *E. coli* O157:H7 was isolated from samples drawn from several monitoring sites in the project area.
- *E. coli* O157:H7 was isolated more often from samples drawn in areas where livestock had access to surface waters, particularly in the Gabilan Creek

watershed.
- Maximum *E. coli* concentrations occurred predominantly during wet season months.
- There was a trend of higher median indicator bacteria concentration during winter months.
- Water quality objectives and USEPA recommended levels for indicator bacteria were exceeded in all land use categories, including rural areas upstream of urban and agricultural lands.
- Evidence suggested that the elevated concentrations in agricultural areas were the result of indicator bacteria loading from upstream waters.

3.9.2 Other Assessed Waterbodies

Waterbodies for which data did not indicate impairment, or for which data was insufficient to determine impairment status are summarized below:

<u>Blanco Drain – Not Impaired</u>
Blanco Drain is a valley-floor agricultural ditch, encompassing a drainage area of approximately 13 square miles. Land cover analysis indicates that approximately 90% of land in the watershed is used for cultivated crop. Twenty *E. coli* water quality samples were collected between 2005 and 2006. Three out of the twenty samples (3/20) exceeded the USEPA criteria for *E. coli* (235 MPN/100mL). The geometric mean of the suite of samples is 83 MPN/100mL. This water quality data indicates that Blanco Drain is not impaired by FIB, in accordance with the State listing policy (see Section 1.6).

<u>El Toro Creek – Insufficient Data</u>
El Toro Creek drains approximately 40 square miles of the western slope of the Sierra De Salinas range, ultimately discharging to the Salinas River downstream of the community of Spreckles. The watershed is predominantly characterized by grassland, shrub, and forest land cover. Several unincorporated urbanized communities parallel the creek upstream of the confluence with the Salinas River. Four *E. Coli* samples were collected from the creek in 2006 (monitoring sites ELT-69 and ORO-END). All samples (4/4) exceeded the USEPA criteria for *E. coli* (235 MPN/100mL). The geometric mean of the samples is 3011 MPN/100mL. The number of samples are not sufficient to assess the water body's impairment status, in accordance with the Listing Policy (see Section 1.6). However, the high levels of *E. Coli* observed in this suite of samples, indicates that another round of data collection to assess impairment status is merited.

<u>Alisal Slough – Insufficient Data</u>
Alisal Slough is a valley-floor agricultural ditch, encompassing a drainage area of approximately 6 square miles. Land cover analysis indicates that over 90% of land in the watershed is used for cultivated crop. Only one FIB water quality sample has been collected from the waterbody; an *E. coli* sample in 2003 (monitoring site ALISA-31). This single sample had an *E. coli* concentration of

310 MPN/100mL. As such, there is insufficient data to assess FIB impairment status for this waterbody. It is important to note that source analysis in this Project Report (see Section 4) indicates broadly that land use dominated by cultivated cropland does not appear to be a significant FIB source of controllable loads.

4 SOURCE ANALYSIS

Staff identified several sources of indicator bacteria through data analysis and information gathering. Staff based this source analysis on water quality and land use data, as well as genetic data used for other TMDL projects as discussed in the following sections. Staff also employed empirical load assessment methods and techniques that are recognized by USEPA or other Agencies to develop approved TMDLs. Staff additionally considered the following information:

- field observations,
- wastewater spill reports,
- permitted facilities within the watershed,
- monitoring efforts to isolate specific causes of high indicator bacteria loads,
- relationships between seasonal conditions, land use, and indicator bacteria levels,
- relationships between land use and indicator bacteria concentrations, and
- relationships between land use and genetic sources

Staff also obtained information from representatives of the USDA, Monterey County Department of Health, Monterey County Farm Bureaus, county Resource Conservation Districts, and from individuals who attended the CEQA Scoping meeting that was held June 20, 2007, in Salinas, California.

4.1 Inventory of Fecal Coliform Producers

Fecal coliforms are produced by all warm-blooded animals. The first step in this source analysis is to compile population estimates and fecal coliform produced by each animal type in the Project Area. Table 4-1 summarizes the inventory of major producers of fecal coliform in the project area. It is important to recognize there is uncertainty in these numbers; they are estimates based on census statistics and estimated wildlife population densities. Livestock numbers are taken from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service Census database, and from the Monterey County Agricultural Commissioner's 2007 Crop Report. The USDA database and the Ag Commissioner Report tabulate the number of livestock reported in Monterey County. At the time this project report was written, the most recent version of the USDA Agricultural Census available online was for 2002.

Livestock numbers were derived using a USEPA-recognized estimation method, which includes using U.S. Department of Agriculture county data on livestock, and land use information (USEPA, 2001). Per the USEPA-recognized methodology, it was assumed that livestock are evenly distributed throughout all rangeland/pasture/grassland in the county. To obtain an average animal geographic density, the number of livestock in Monterey County were obtained from the USDA Agricultural Census database, and divided by the amount of rangeland/pasture in Monterey County. This yielded an average county-wide animal density per acre. This average density/acre value was then multiplied by the acreage of rangeland/pasture/grassland in the project area, and also by the acreage amounts among the various subwatersheds to obtain the livestock numbers shown in Table 4-1.

The number of people in the watershed was estimated from block group data in the U.S. Census Bureau 2000 Decennial Census. The estimated number of people with Onsite Disposal Systems (OSDS, or septic tanks) is included from the 1990 Census. Unfortunately, household sewage disposal information was not included in the 2000 Census. Using data from 1990 may result in marginally underestimating the number of housing units/people using OSDS. In an attempt to make the 1990 OSDS census data more current, an upward adjustment was made to the 1990 Census numbers, assuming a 1% growth rate/year in the number of housing units with OSDS. The 1% growth rate/year comes from a Statewide OSDS survey conducted by Chico State University (2003). The number of people living in sewered households were simply the total number of people in the project area, minus the number of people with OSDS or other sewage disposal means. The number of unsheltered homeless was estimated from the Monterey County Homeless Census and Survey (2007).

Most communities do not have data on the number of households that own dogs, cats, or horses. Therefore the numbers of dogs, cats, and horses in the project area were estimated from the American Veterinary Medical Association's U.S. Pet Ownership and Demographics Sourcebook (AMVA, 2007), in conjunction with housing data from the U.S. Census Bureau. Staff used household-to-pet ratios reported by AMVA to estimate the number of pets in the Project Area and associated watersheds. For example, AMVA (2007) reports that 1.8% of households own horses. The average number of horses owned by these households is 3.5. Therefore, the number of horses can be estimated by the following calculation: number of horses = (total number of households in area of interest) x 0.018 (i.e., the ratio of households that own horses) x 3.5.

Wildlife populations are estimated from animal population densities available from California Department of Fish and Game and other Agency or scientific sources shown in Table 4-1. Using these numbers, a habitat density (animals/square mile or animals/acre) were derived, and it was assumed that the distribution of animals was spread uniformly across all suitable habitat. The distribution, habitat requirements, seasonality, and habitat ranges of wildlife shown in Table 4-1 were corroborated utilizing the California Department of Fish and Game's Wildlife Habitat Relation System.

Table 4-1. Inventory of Fecal Coliform Producers in Lower Salinas Valley Project Area.

Category	Sub-Category	Estimated Population	Source of Population Estimate	Fecal Coliform produced per Individual/day (cfu)[K]
Livestock	Cattle	8333	Monterey County Ag Commissioner Crop Report (2007)	1.0 E+11
	Horses	3295	AMVA Pet Ownership Statistics (2007)	4.20E+08
	Sheep	283	USDA Census of Agriculture (2002)[A]	1.2 E+10
	Hogs	207	USDA Census of Agriculture (2002)[A]	1.1 E+10
	Chicken	1228	USDA Census of Agriculture (2002)[A]	1.40E+08
Humans	Sewered	159267	US Census Bureau, 1990, 2000[B]	2.0 E+09
	OSDS	17003	US Census Bureau, 1990, 2000[B]	
	Unsheltered Homeless	321	Monterey County Homeless Census (2007)	
Pets	Dogs	35477	AMVA Pet Ownership Statistics (2007)	4.50E+08
	Cats	39987	AMVA Pet Ownership Statistics (2007)	4.50E+08
Wildlife	Deer	1869	California Dept. Fish and Game[C]	3.5 E+08
	Feral Pig	520	Calif. Dept. Fish and Game[D]	1.1 E+10
	Coyotes	159	Gese et al. (1989); Babb et al. (1989)	4.50E+08
	Raccoons	1573	Calif. Dept. Fish and Game[D]	5.0 E+07
	Opossum	1521	Kissell and Kennedy (1992)[E]	Assume equal to Raccoon
	Skunk	1624	Ontario Ministry of Natural Resources (1987)[F]	2.50E+07 Muskrat value, assume skunk=muskrat
	Wild Turkey	1548	Calif. Dept. Fish and Game[G]	9.3 E+07
	Pheasant	7200	Calif. Dept Water Resources-IEP[H]	Assume equal to turkey
	Duck (peak season)	1634	Estimated from Calif. Depart. of Fish and Game (2008)[I]	2.40E+09
	Geese (peak season)	165	Assume = approx. 10% of Duck population, based on Calif. DFG Waterfowl Hunt Results Report (2007), which indicates Geese harvest is typically around 10% of Duck harvest[J]	8.00E+08
	Other wildlife	Reliable estimates of numbers for other wildlife were not available. To attempt to account for the fecal coliform bacteria that would be produced by other wildlife, an equivalency to all deer in the project area was assumed.		Assume equivalency to all deer in project area.

Population Inventory and Habitat Sources
A: USDA, National Agricultural Statistics Service http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp
B: US Census Bureau website - http://factfinder.census.gov
C: California Dept. of Fish and Game - http://www.dfg.ca.gov/wildlife/hunting/deer/docs/habitatassessment/part4.pdf
D: California Dept. of Fish and Game - Game http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx
E: Kissel and Kennedy, 1992. Ecological Relationships of Co-occuring Populations of Opossums and Raccoons. Journal of Mammalogy, vol. 73, pp. 808-813.
F. Ontario Ministry of Natural Resources. Wildlife Research Service, 1987. Wildfurbearer Management and Conservation in North America, Chapter

45, Striped, Spotted, Hooded and Hog-Nosed Skunk.
G.: California Dept. of Fish and Game - http://www.dfg.ca.gov/wildlife/hunting/uplandgame/docs/turkplan_04.pdf
H: Interpreted from Cal. DWR Interagency Ecological Program - http://www.iep.ca.gov/suisun_eco_workgroup/workplan/report/wildlife/pheasant.html
I. California Dept. of Fish and Game, 2008 Waterfowl Breeding Population Survey. http://www.dfg.ca.gov/news/news08/08045.html
J. California Dept. of Fish and Game, Waterfowl Hunt Comparison Report. http://www.dfg.ca.gov/wildlife/waterfowl/shoot/ComparisonTables/docs/HT_CMP07.pdf
K. Literature references for Fecal Coliform production, see Appendix F, BSLC references sheet.

Note that staff recognizes that the pheasant population for the Project Area presented in the project report is likely overestimated; staff recognizes that indeed there may be few pheasants in the project area. Staff reviewed California Department of Fish and Game reports, which indicated that pheasants are concentrated in the central valley, but range through much of the state in scattered locations. As such, pheasant populations on the central coast reportedly are limited to scattered and isolated areas.

However, staff reasoned that pheasant populations should be included for Project Area wildlife estimates for two primary reasons: 1) California Department of Fish and Game habitat and range maps indicate that pheasant do indeed range in the Project Area; and 2) Due to the lack of fecal coliform production and population density information for other bird species, staff reasoned that including a pheasant population would serve as a plausible surrogate in an attempt to account for amounts of fecal coliform that would be produced by other bird species. Other state and USEPA approved TMDLs have also used species for which fecal coliform production is known (or can be reasonably presumed) as a surrogate to represent wildlife populations for which fecal coliform production or population density is unknown (for example, Minnesota TMDL program).

Figure 4-1 shows the relative proportions of fecal coliform produced by animal species in the project area. Figure 4-2 shows fecal coliform production by animal source group. It is important to note, that Figure 4-1 and Figure 4-2 represent the total amount of fecal coliform produced, not the amount delivered to surface waters. The estimates of the proportion of fecal coliforms potentially delivered to surface waters will be detailed in subsequent sections.

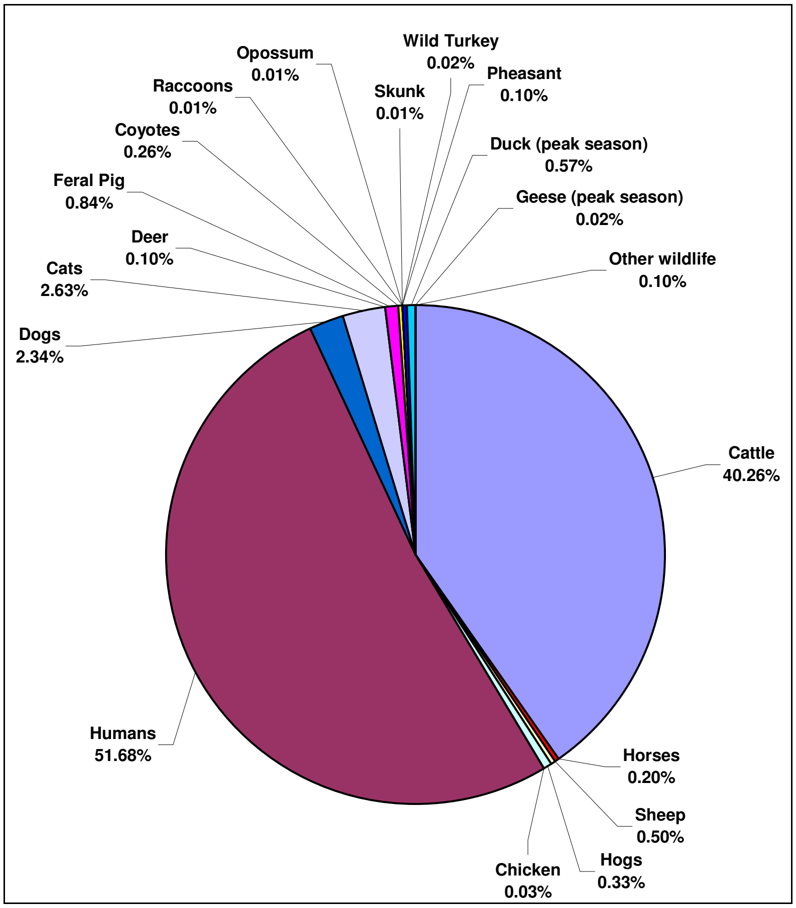


Figure 4-1. Estimated Fecal Coliform Produced by Animal Species in Project Area.

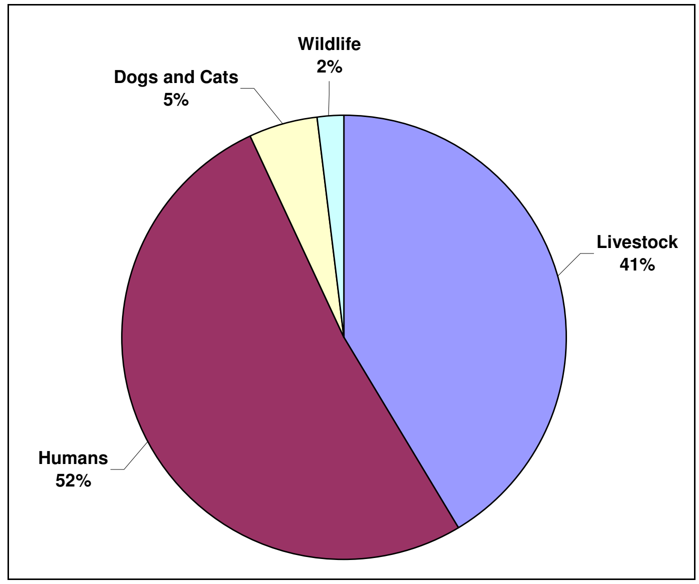


Figure 4-2. Estimated Fecal Coliform Produced by Source Group in Project Area.

4.2 Delivery Potential of Fecal Indicator Bacteria (FIB) to Surface Water

To estimate the relative proportion of FIB delivered to surface waters from the various fecal coliform sources in the project area, two spreadsheet tools, and some simplifying assumptions were used, to assess potential load contribution estimates.

For each of the subwatersheds in the Project Area, the relative load to land and load to stream contribution of fecal coliform nonpoint sources were estimated with the Bacteria Source Load Calculator (BSLC) spreadsheet, available from the Virginia Tech University Center for TMDL Studies. BSLC characterizes how bacterial loads are spatially and temporally distributed in the watershed from user input, and processes the source data to calculate 1) non-point source fecal coliform loads to land; and 2) fecal coliform loads to stream from direct in-stream deposition. The BSLC spreadsheet calculations and input parameters are included in Appendix F.

BSLC itself does not simulate die-off once bacteria reach the land surface. However, attenuation of bacteria prior to runoff into streams was incorporated by comparing the fecal coliform totals deposited on land, to reasonable area loading rates found in published literature (Horner, 1992 as reported in Shaver et al., 2007; New Jersey Dept. of Environmental Protection, 2008). Although these literature-based loading coefficients are gross approximations, and have not been estimated for the climate and conditions of the Project Area, Staff investigated the published loading coefficients in order to determine the most appropriate nonpoint source loading coefficients for use in the Project Area as described below.

Horner reported a range of fecal coliform loading potential (minimum, median, maximum) from various land uses in the Pacific Northwest. Since the Project Area of Monterey County is a relatively arid climate and precipitation is significantly less than the temperate Pacific Northwest climate, the low end (minimum) estimates of loading rates for forest and pasture/rangeland from Horner were used. Staff assumed loading from cropland was similar to forest, because manure application on cropland is rare in the Project Area, and most bacteria loading from cropland likely results from natural background and wildlife. Also, USEPA's Protocol for Developing Pathogen TMDLs (2001); reports that literature values for fecal coliform concentrations in cropland runoff and background runoff are within similar ranges. Therefore, Horner's loading rates used here for forest and cropland is 4.86E+08 cfu/acre/year; for grassland/pasture/rangeland the loading rate is 1.94E+09 cfu/acre/year.

Staff plotted a time-series of observed fecal coliform loads (Qua-Pot sampling site data) from Quail Creek - a watershed that is characterized by predominantly cropland, rangeland, and forest land use categories – and compared the *observed* daily loads to the *predicted* daily load (using the areal loading rates from Horner) (see Figure 4-3). The *predicted* load (in cfu/day) is 2.15 E+10. This predicted load falls within the range between the mean and median *observed* daily loads (shown on Figure 4-3). This indicates that the predicted loads using Horner's landuse-based loading rates appear to calibrate reasonably well with observed loads from water quality monitoring data.

Staff also evaluated the use of literature-based fecal coliform loading rates from other regions of California. The Central Valley Regional Water Quality Control Board also reported that *predicted* fecal coliform loads using Horner's loading rates appeared to comport reasonably well with *observed* fecal coliform stream loads at the subwatershed scale, in the lower Sacramento River area (USEPA and Central Valley RWQCB, 2007).

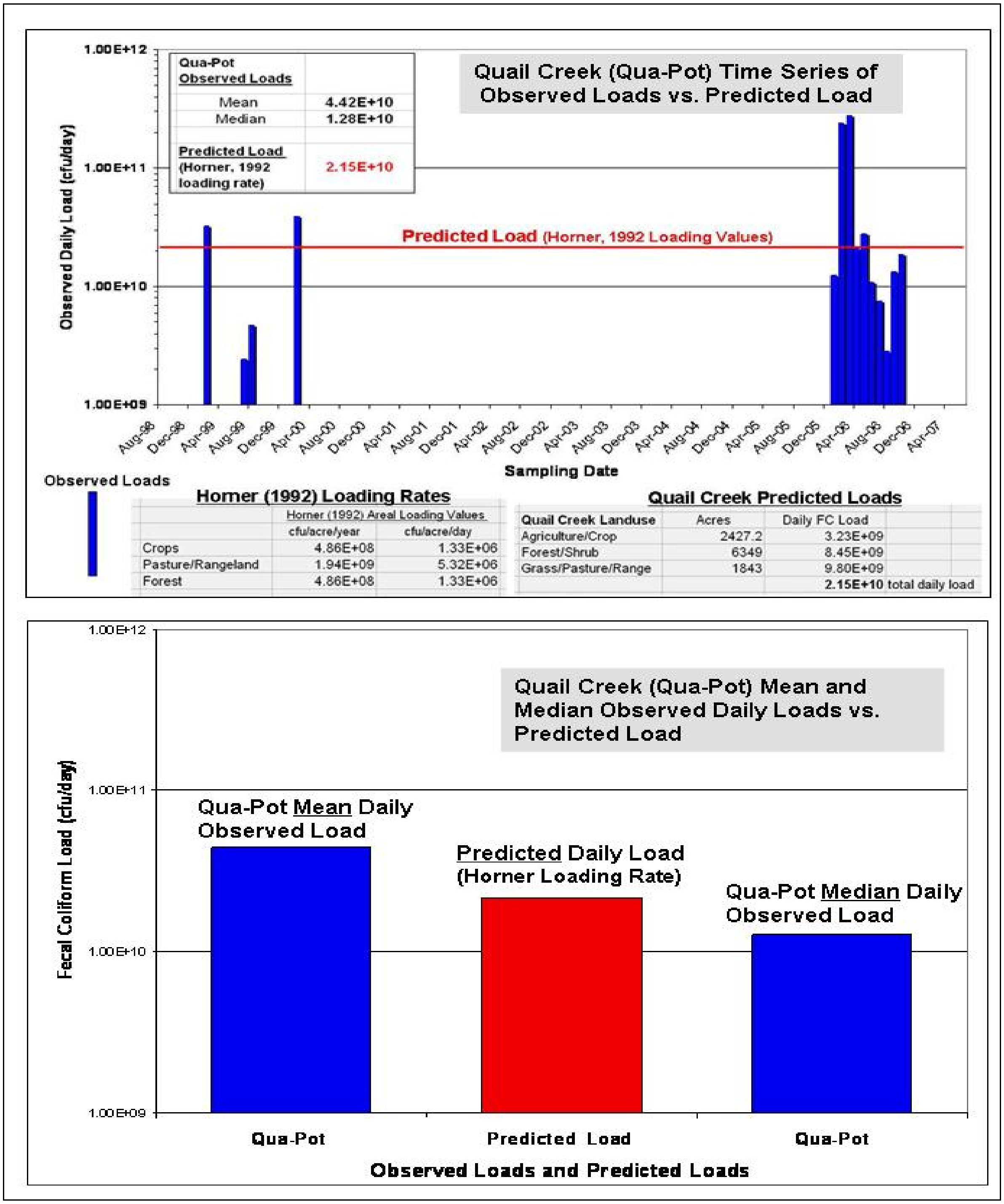


Figure 4-3. Evaluation of Predicted Fecal Coliform Load versus Observed Fecal Coliform Loads, Quail Creek.

Comparing the BSLC calculated fecal coliform loads deposited to land in conjunction with predicted runoff loads using the aforementioned literature loading rate values, allowed staff to approximate attenuation of fecal coliform prior to runoff to surface waters. This is identified as the delivery potential of fecal coliform in Table 4-2. Simply put the delivery potential is the percentage, or the fractional amount, of fecal coliform from a given source that might ultimately end up in a surface water. The fractional amount of fecal coliform produced and potentially delivered to surface water were estimated by multiplying the total fecal coliform produced from sources in the BSLC spreadsheets (Appendix F), by the estimated delivery potential (right hand column) in Table 4-2. The delivery potential itself is simply calculated as a percentage from the ratio of the predicted fecal coliform runoff load (using Horner's areal loading rates), to the total fecal coliform deposited to land from the BSLC spreadsheet calculations.

In contrast to delivery potentials for overland runoff, direct livestock/wildlife defecation into a stream channel was assumed to have a 100% delivery potential, because all fecal coliforms are discharged directly into the surface water, with no opportunity for attenuation.

The variation in delivery potential between different land use categories in Table 4-2, using the area loading values from Horner (1992), are not unexpected. Cropland typically has a significantly higher average surface runoff coefficient (i.e., more prone to runoff) than forest. And while pasture and forest typically tend to be closer to each other in literature-reported surface runoff coefficients, the majority of forest in the project area occurs in steeper topography (headwater reaches) and receives slightly more rainfall; simply put, the runoff or "delivery potential" for forest could reasonably be expected to be marginally higher in the project area than for pasture/rangeland. Additionally, the majority of the fecal coliform deposited on pasture or rangeland tends to be from domestic animals. Domestic animals tend to be constrained at least to some degree in their proximity or access to riparian areas, in a way that wildlife is not. Also, some domestic animals are not exposed to rainfall/runoff 100% of the time.

Further, the estimated delivery potentials in Table 4-2 appear to comport reasonably well with field-based studies which evaluated the fractional amount of total FIB generated by livestock that were ultimately transported to surface waters (Fenlon et al., 2000 and Vinten et al. 2004). These field studies reported that between 0.03% and up to 14% of *E. coli* generated by livestock on pasture land were ultimately entrained in drainage water or transported to streams.

Table 4-2. Delivery Potential of Fecal Coliform: Fraction (%) of Total Fecal Coliform Produced by Nonpoint Sources that is Available for Potential Runoff or Discharge to Surface Water.

	Total Acres In Project Area	**Total Fecal Coliform Produced** (MPN/year)*	**Estimated Fecal Coliform Runoff Load per acre** (MPN/acre/year) (from Horner, 1992)**	**Estimated Total Runoff Load Potential** (Runoff Load/acre) x (Total Acres) = MPN/year	**Delivery Potential:** % of Total Fecal Coliform Potentially Available for Runoff/Discharge to Surface Water***
Crops	113,165	1.04E+15	4.86E+08	5.50E+13	**5%**
Pasture Grassland Rangeland	66,568	1.40E+17	1.94E+09	1.29E+14	**0.1%**
Forest	19,305	1.27E+15	4.86E+08	9.37E+12	**0.7%**
Direct In-Stream Defecation	-	9.62E+14	-	-	**100%**

*from BSLC spreadsheet calculations: total amount of fecal coliform deposited to land or stream for all identified livestock and wildlife species.

** Horner (1992) as reported in Shaver et al., 2007.

*** Derived by dividing (Estimated Total Runoff Load Potential) by (Total Fecal Coliform Produced): for example, Forest Delivery Potential = (9.37E+12) / (1.27E+15) = 0.7%

Delivery potentials (i.e., the fractional amount of total fecal coliform produced that is available for potential runoff) have been used similarly in other State and USEPA-approved TMDLs. (Minnesota Pollution Control Agency, 2002; Minnesota State University, 2007). It is important to note that the delivery potentials identified in Table 4-2 come with a degree of uncertainty. The amount of fecal material delivered from any land use source will vary depending on numerous factors. The delivery potential ratios in Table 4-2 should be considered gross screening-level approximations of the “averaged” fractional amounts of fecal material potentially available for delivery to surface waters. This is an important distinction, because there remains substantial uncertainty about the exact relationship between FIB loads observed in overland runoff, and the water column FIB loads observed in streams. In many reported studies, it is not clear whether the monitored overland flow ultimately discharges to a waterway or simply infiltrates into the soil at some point down the hill slope. The uncertainty associated with delivery hinders quantification of the overland flow contribution to FIB loading of streams (Collins, et al. 2005).

Therefore, the goal of estimating the delivery potential of fecal coliform from identified sources in the Project Area, is to derive a reasonable estimate of the relative source contributions. This estimation is an empirically-driven way to estimate the relative importance and magnitude of various sources relative to each other. Once the proportionality of fecal coliform contribution from various sources to impaired surface waters are estimated, then the fractional contribution of each source can then be calibrated to *actual observed loads* (water quality monitoring data). Water quality monitoring data is a measure of actual stream loads that has none of the uncertainty pertaining to the assumptions about how overland runoff loads relate to actual stream loads.

By calibrating the estimated fractional proportions of source contributions developed in Section 4, to actual observed stream loads, it is possible to establish numeric load and allocation expressions. USEPA recognizes *existing loads* can be established through the calibration of *modeled or empirically estimated bacteria source contributions* to water quality monitoring data (USEPA, 2001).

Similarly, a screening level assessment of the amounts of fecal coliform from point sources (i.e., MS4 runoff, OSDS) that are *potentially* available for discharge to impaired surface waters were estimated using the Watershed Treatment Model, V.3.1 (WTM). WTM is a spreadsheet tool developed by the Center for Watershed Protection for the U.S. Environmental Protection Agency. It is primarily designed for rapid assessment of load parameters and treatment options appropriate for urban subwatersheds. WTM uses the Simple Method (Schueler, 1987), a USEPA-recognized empirical methodology of calculating loads from urban stormwater runoff. The WTM assessment establishes the potential proportional load contribution from each point source (i.e., the relative magnitude and importance of each source), and this information was subsequently calibrated to the observed loads to estimate source contributions to existing loads, and allocations as stated previously.

Delivery potentials were also assigned to point sources, to assess and quantify their relative source contributions (Table 4-3). It is reasonable to conclude that not all (100%) of FIB in effluent from failed OSDS which are proximal to surface waters, are ultimately discharged to the waterbody. Some of the FIB effluent loads simply infiltrates and attenuates into the soil at some point down gradient, prior to reaching a surface water. Staff assigned a delivery potential of 8% for effluent from failed OSDS located near surface waters; i.e. 8% of FIB in effluent from failed OSDS near surface waters are available to potentially discharge to surface water. The 8% delivery potential value comes from the Minnesota Pollution Control Agency (2002), and is reported to be based on best professional judgment of their staff and stakeholders. In contrast, the delivery potential of urban runoff was assumed to be 100%, since the effluent data comes from end-of-pipe storm outfall monitoring, and therefore presumably represents effluent concentration that is *directly* discharging into surface water.

Table 4-3. Delivery Potential of Fecal Coliform: Fraction (%) of Total Fecal Coliform Produced by Point Sources that is Available for Potential Runoff or Discharge to Surface Water.

	Estimated Mean Effluent Concentration	**Source of Effluent Concentration Estimate**	**Delivery Potential:** % of Total Fecal Coliform Potentially Available for Runoff/Discharge to Surface Water
Failing OSDS	10^6 MPN/100mL	Horsley and Witten (1996)*	**8%** **
Urban Runoff	1,242MPN/100mL	Salinas Stormwater Outfall Monitoring Data	**100%**

*Horsley and Witten, as reported in USEPA (2001)
**From: Minnesota Pollution Control Agency (2002)

4.3 Source Categories of Fecal Indicator Bacteria (FIB)

4.3.1 Point Sources

4.3.1.1 Storm Drain Discharges to Storm Sewer Systems (MS4-NPDES Permits)

Storm-water point sources are typically associated with urban and industrialized areas, and recent USEPA guidance includes permitted storm-water discharges as point source discharges and, therefore, part of the waste load allocation. There are two NPDES permitted urban stormwater entities in the project area: The City of Salinas, and the County of Monterey (Monterey Regional Stormwater Pollution Prevention Program).

Urban runoff as a potential contributor to water quality problems is well established. In 1986, USEPA published the “Results of the Nationwide Urban Runoff Program.” The study demonstrated high levels of indicator bacteria in urban runoff. The National Stormwater Quality Database contains 8,062 rain events from 104 cities throughout the United States, and again validating the ubiquitous nature of high levels of indicator bacteria measured in urban land use runoff. It is widely acknowledged that urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes; pollutants which include viruses and bacteria from pet waste, failing septic systems, and other sources including natural wildlife sources (USEPA Fact Sheet, 2003).

FIB deposited by pets and wildlife can enter storm drains through contact with stormwater during the wet season or dry weather flows originating from excessive landscape irrigation, car washing, or other types of wash water.

The following entities have stormwater discharges that are currently regulated with NPDES municipal stormwater permits:

1. Monterey County (Monterey Regional Group), which includes unincorporated areas of County jurisdiction which have been designated by the U.S. Census Bureau as being "Urbanized Areas" and which are within the County's legal jurisdictional boundary. This includes, but is not restricted to, the urbanized areas of:
    - i. City of Castroville
    - ii. El Toro area
    - iii. Census designated community of Spreckles.
    - iv. Census designated community of Boronda

2. City of Salinas

The towns of Gonzales and Chualar discharge stormwater to ditches that also receive discharges from irrigated agriculture. The discharges eventually reach the Salinas River. Discharge from Gonzales is first held in detention ponds located near the River before being discharged through a pump system. No data is available from either the town of Chualar or Gonzales. The Salinas River at Gonzalez and Chualar have not been identified as impaired due to FIB, so stormwater loads from these urbanized areas are not identified as sources contributing to FIB impairment in this Project Report.

Urban sources of indicator bacteria in areas along the central coast have been identified using DNA source tracking. Although DNA source tracking was not used for this Project, sources identified in areas adjacent to the Project area likely reflect sources in the Project area. Identified sources of indicator bacteria using DNA source tracking included (see Central Coast Water Board pathogen-related TMDL projects for Aptos Creek, San Lorenzo River, Soquel Creek, and Watsonville Slough):

1. Birds
2. Dogs
3. Cats
4. Horses
5. Rodents, and
6. Humans.

As previously stated, USEPA has acknowledged at the national level, and validated by genetic ribotyping studies in the Central Coast Region, that domestic pet waste contributes to fecal coliform loading in urbanized subwatersheds. Stormwater data at the National, State, Regional, and local levels routinely indicate high levels of fecal coliform concentrations in urban storm drain outfalls. Staff verified the domestic pet source (dog, cat) through personal communication with the City of Salinas staff. Wastewater crew for the city of Salinas has observed, on several occasions, citizens disposing pet waste into storm drains (wastewater crew City of Salinas, 2007, personal communication).

Staff observed pet and human waste adjacent to surface waters in the Project area. Staff also considered that during dry seasons pet waste reached storm drains if it was deposited on sidewalks, parking lots or other similar surfaces. These wastes could be transported via overland flow to surface waters from stormwater, car wash water, excess irrigation, or similar water source.

There are numerous storm drain outlets to surface waters in the watershed. Surface waters receiving urban storm water in the watershed include, but are not limited to:

- Lower Salinas River and all waters downstream (Estuary and Lagoon)
- Reclamation Canal upper/Alisal Creek (watershed 3b)
- Reclamation Canal lower (watershed 3a)
- Tembladero Slough
- Santa Rita Creek

Monitoring site SDR-PUM is a storm drain pump station located in the city of Salinas. Water flowing to the pump station is purely stormwater, which is discharged to the Salinas River upstream of Davis Road. Staff's review of data from this monitoring site shed light on the bacterial indicator density present in stormwater. Summary data of site SDR-PUM can be seen in Table 4-4.

Note that exceedance of the USEPA recommended criteria of 126 MPN/100mL was not uncommon. Based on staff's experience with data in the region, it is not uncommon for indicator bacteria levels in urban stormwater to exceed water quality objectives or USEPA recommended levels.

Sources of indicator bacteria in the urban source category included dogs, cats, rodents, humans, and wild animals. These sources are conveyed to surface waters through stormwater, direct discharge, and overland flow.

Table 4-4. Urban Stormwater Data.

Urban stormwater data	Monitoring Date	E. coli (MPN/100mL)
SDR-PUM	12/7/2004	2420
SDR-PUM	1/12/2005	>2149
SDR-PUM	2/16/2005	1300
SDR-PUM	3/23/2005	2419
SDR-PUM	4/20/2005	765
SDR-PUM	7/26/2005	>2419
SDR-PUM	8/16/2005	>2419
SDR-PUM	10/25/2005	199
SDR-PUM	11/15/2005	676
SDR-PUM	12/13/2005	630
SDR-PUM	1/17/2006	100
SDR-PUM	2/22/2006	41

Urban stormwater data	Monitoring Date	E. coli (MPN/100mL)
SDR-PUM	3/20/2006	14550
SDR-PUM	4/18/2006	3320
SDR-PUM	5/15/2006	100
SDR-PUM	6/19/2006	191
SDR-PUM	7/18/2006	1340
SDR-PUM	8/22/2006	630
SDR-PUM	10/10/2006	1950
Average/Max		**1980/14550**
Geometric Mean		**843**

Urban/residential loads to streams are most often associated with impervious surface flow. Impervious surfaces include roads, parking lots, driveways, asphalt, and any surface cover that precludes infiltration of water into the soil. Fecal materials deposited on impervious surfaces have the potential of being entrained by discharges of water for storm flows, routed to storm sewers, and potentially discharged to surface water bodies.

Figure 4-4 shows impervious cover (% imperviousness) from NLCD 2001 Impervious Surface data set, available from U.S. Geological Survey.

Only five identified impaired watersheds in the Project Area contain more than 5% developed land (refer back to Figure 2-4): Tembladero Slough; Reclamation Canal lower; Upper Reclamation Canal upper/Alisal Creek; Salinas River; and Santa Rita Creek. Urban fecal coliform loading is considered insignificant in other Project Area watersheds which have less than 5% developed land.

In addition, the impervious cover map (Figure 4-4) indicates that dense impervious cover is concentrated in the five aforementioned watersheds. Figure 4-5 indicates that areas with dense concentrations of impervious cover shown in Figure 4-4, fall within NPDES stormwater permit boundaries of MS4 entities in the Project Area

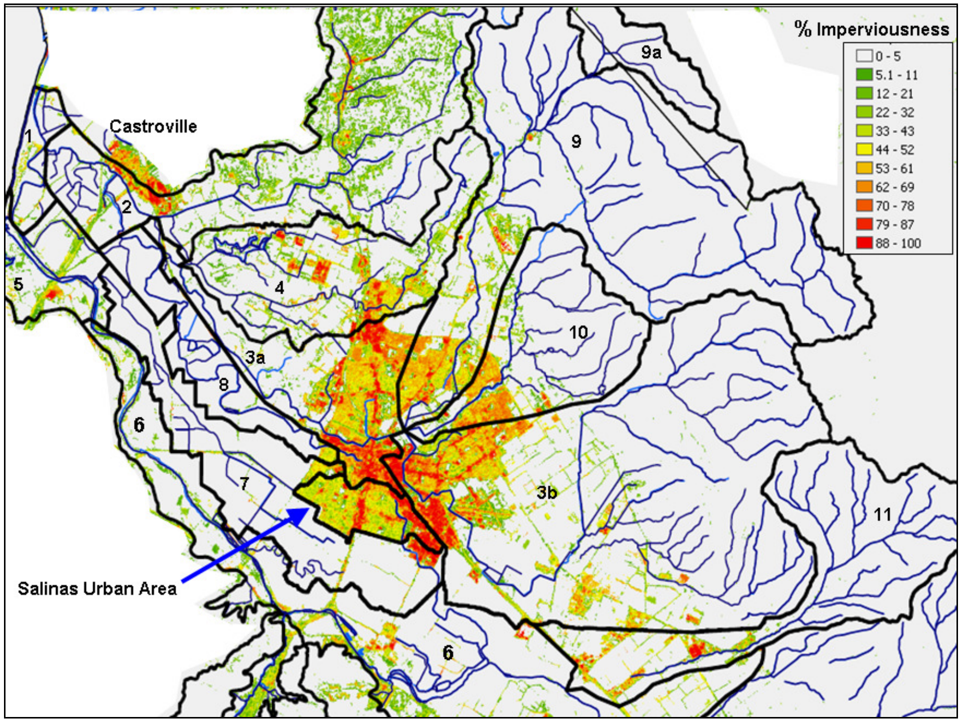


Figure 4-4. Distribution and Variation of Impervious Surface in Project Area.

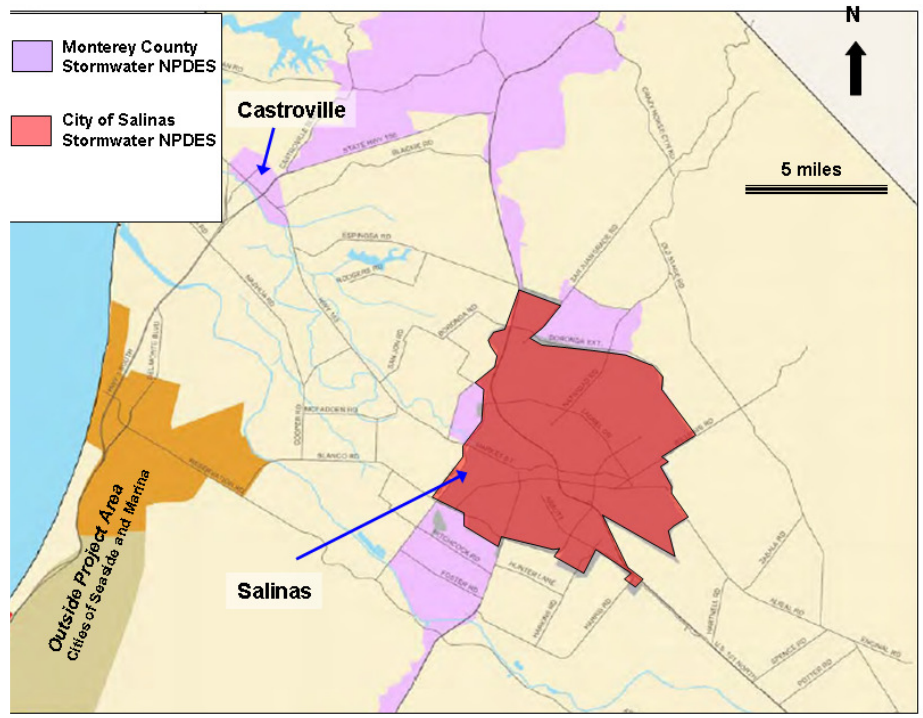


Figure 4-5. Stormwater Permit Boundaries in Project Area.

MS4 stormwater system discharge points in the Project Area are outlined below:

- Reclamation Canal Watershed: Stormwater is discharged from census-designated urbanized areas in and around the City of Salinas to the Reclamation Canal watersheds (watersheds 3a and 3b), and to the Reclamation Canal's upgradient tributaries: Gabilan Creek and Natividad Creek. Most of the stormwater runoff from the City of Salinas is conveyed westerly by the Reclamation Canal system to the Tembladero Slough and the Old Salinas River at Monterey Bay. For purposes of potential source load contribution, as outlined in Section 4.2, the urbanized area of Salinas that drains to the Reclamation Canal is estimated to be 10,140 acres (source: USGS Land Cover Analysis Tool, lcat.usgs.gov/lcat).

- Gabilan Creek: Urbanized areas of the City of Salinas and census-designated urbanized portions of Monterey County adjacent to the City of Salinas drain to Gabilan Creek. Because of urban growth on the northern boundary of the City of Salinas, more recent vintage GIS land cover data was evaluated (NLCD, 2001) to assess the amount of urbanized land. Using the more recent vintage NLCD data, Staff estimated that 1547 acres of developed land drained to Gabilan Creek from urbanized areas in and adjacent to the City of Salinas.

- Natividad Creek: Urbanized areas of the City of Salinas and census-designated urbanized portions of Monterey County adjacent to the City of Salinas drain to Natividad Creek. Because of moderate urban growth on the northern boundary of the City of Salinas, more recent vintage GIS land cover data was evaluated (NLCD, 2001) to assess the amount of urbanized land. Using the more recent vintage NLCD data, Staff estimated that 1360 acres of developed land drained to Natividad Creek from urbanized areas in and adjacent to the City of Salinas.

- Santa Rita Creek: Urbanized areas of the City of Salinas and census designated unincorporated urbanized areas of the County of Monterey drain to Santa Rita Creek. From land use data provided in Section 2, staff estimated that 674 acres of developed urban land drained to Santa Rita Creek, including parts of the City of Salinas and census-designated urbanized portions of Monterey County adjacent to the City of Salinas.

- Salinas River: Runoff from part of the southwestern portion of the City of Salinas is pumped south to the Salinas River. Staff determined that the urbanized area of Salinas that drains to the Salinas River is 2,025 acres, using the USGS Land Cover Analysis Tool.

- Tembladero Slough: The County of Monterey maintains stormwater outfalls in the City of Castroville, and is the MS4 permit entity for Castroville and census-designated urbanized part of the Tembladero Slough watershed. From land use data provided in Section 2, staff estimated that 2,042 acres of developed urban land drained to Tembladero Slough, including the City of Castroville.

A screening level assessment of the amount of fecal coliform available for potential discharge to impaired surface waters from MS4s was calculated by staff, as outlined in Section 4.2, with the Watershed Treatment Model spreadsheet tool. WTM uses the Simple Method, a USEPA-recognized empirical methodology of calculating loads from urban stormwater runoff.

The Simple Method requires a modest amount of information, including the subwatershed drainage area and impervious cover, stormwater runoff pollutant concentrations, and annual precipitation. For bacteria, the Simple Method equation is:

$$\mathbf{L = 1.03 * 10^{-3} * R * C * A}$$

Where:

L = Annual Load (Billion colonies)
R = Annual Runoff (inches)
C = Bacteria Concentration (#/100mL)
A = Area (acres)
$1.02 * 10^{-3}$ = Unit Conversion Factor.

Annual Runoff (R) is calculated in WTM as a product of annual rainfall and a runoff coefficient determined by land use.

$$\mathbf{R = P * Pj * Rv}$$

Where:

R = Annual Runoff (inches)
P = Annual Rainfall (inches)
Pj = Fraction of Annual Rainfall Events the Produce Runoff (typically 0.9)
Rv = Runoff Coefficient

The runoff coefficient (Rv) is calculated in WTM based on impervious cover in the subwatershed as:

$$\mathbf{Rv = 0.05 + 0.9 * Ia}$$

Where:

Ia = Fraction of Impervious Surface

The WTM input parameters and spreadsheets are shown in Appendix E.

Staff did not use the default WTM value for fecal coliform loading rate from urban land (20,000 mpn/100mL). WTM uses this default value which represents a national average urban runoff value as reported by USEPA. The national average value is not necessarily appropriate to use when local or regional information are available. Staff used stormwater data collected from the Project Area (see Table 4-4); this data is judged to be more representative of urban stormwater drain outfall in the Project Area. Unfortunately, stormwater data in Table 4-3 is in *E. Coli* counts. The WTM spreadsheet model only set up to calculate fecal coliform loads. To translate the *E. coli* geometric mean of 843 MPN/100mL shown in Table 4-3 to fecal coliform equivalents, staff used an *E. coli* to fecal coliform translator equation developed in Section 8.3.1 of this Project Report. Consequently, an estimated a geometric mean fecal coliform concentration in urban runoff of 1,242 MPN/100mL was calculated. As a result, 1,242 MPN/100 mL was then input to the WTM spreadsheet model to estimate the amount of fecal coliform potentially available for discharge to streams from urban stormwater.

Other required input for WTM included precipitation data and impervious land cover data. Precipitation data input is from Table 2-4. An area-weighted average impervious cover for the City of Salinas, and the City of Castroville was calculated from data taken from 2001 Impervious Land Cover data set available through the U.S. Geological Survey's Land Cover Analysis Tool. An area-weighted calculation accounts for variability in impervious cover throughout the area of interest.

The estimated annual amount of fecal coliform available for potential discharge to surface waters from MS4s are shown in Table 4-5.

Table 4-5. Estimated Average Annual Fecal Coliform from MS4s Discharged into Surface Waters.

Watershed	Acres of Developed Land Discharging to Water Body	Average Impervious Cover (%)	Mean Annual Precipitation (inches)	Mean Estimated Runoff Concentration (MPN/100mL)	Total Annual Fecal Coliform Available (MPN)
Tembladero Slough @ TEM-MOL	2042	45%[A]	16.26[C]	1,242	**2.45E+13**
Reclamation Canal @ REC-ALD	10141	47%[B]	14.58[D]	1,242	**1.22E+14**
Salinas River @ SAL-BLA	2025	47%[B]	14.58[D]	1,242	**2.43E+13**
Santa Rita Creek @SRC-COR	674	55%[B]	14.58[D]	1,242	**8.09E+12**
Gabilan Creek @ Carr Lake	1547*	40% [B]	14.58[D]	1,242	**1.86E+13**
Natividad Creek @ Carr Lake	1360*	38% [B]	14.58[D]	1,242	**1.63E+13**

A= Average area-weighted impervious cover for City of Castroville (determined from USGS LCAT lcat.usgs.gov/lcat
B = Average area-weighted impervious cover for City of Salinas (determined from USGS LCAT lcat.usgs.gov/lcat and 2001 MRLC Impervious Surface Grid
C = Castroville No. 19 California Dept. of Water Resources CIMIS weather station
D = Salinas No. 2 Western U.S. COOP weather station
* = Due to urban development in the Natvdidad and Gabilan watersheds in the Salinas area, a newer vintage of GIS land cover data was used to

Watershed	Acres of Developed Land Discharging to Water Body	Average Impervious Cover (%)	Mean Annual Precipitation (inches)	Mean Estimated Runoff Concentration (MPN/100mL)	Total Annual Fecal Coliform Available (MPN)
determine acres of developed land: the NLCD 2001 Land Cover raster grid. Land cover values given in Section 2.1 are from an older vintage of NLCD.					

In contrast to loads from NPDES-permitted stormwater runoff, nonpoint source stormwater loads from rural impervious cover (i.e., impervious cover in areas not subject to MS4 permits) appears to be negligible. For example the rural Quail Creek (watershed 11) is comprised of only about 2.7% impervious cover based on a screening-level analysis using the U.S. Geological Survey's Land Cover Analysis Tool (lcat.usgs.gov/lcat). This translates to about 300 acres of impervious surface in the Quail Creek watershed. Horner (1992) as reported in Shaver et al., (2007) provides fecal coliform loading rates for roads. Staff used Horner's minimum loading rate for roads (2.87E+7 cfu/acre/year) to be consistent with the assessments outlined in Section 4.2. Staff assumed the areal loading rate for roads is representative of rural impervious cover loads more broadly.

Therefore, the estimated annual load from rural impervious surface in the Quail Creek watershed is 8.6E+9 cfu (300 acres x 2.87E+7 cfu/acre). The mean *total* annual stream load to Quail creek is 4.86E+12 cfu (see Section 7), based on water quality monitoring data and estimated mean annual stream flows.

Even conservatively assuming a 100% delivery potential from rural impervious cover loads to surface water, this source would appear to constitute less than 0.18% of the total annual load to Quail Creek (8.7E+9 / 4.86E+12). Therefore, NPS loads from rural impervious cover were not identified as a significant source contributing to fecal coliform impairment of surface waters in the Project Area.

In summary, Staff concluded that the urban stormwater is a source of indicator bacteria causing exceedance of water quality objectives in the Project surface waters. The Implementation Plan recommends methods to minimize these sources.

4.3.1.2 Spills and Leaks from Sanitary Sewer Collection and Treatment Systems

There are several regulated entities treating domestic wastewater in the project area. The collection systems are also regulated. Treated wastewater is discharged to land in the Project Area, not to surface water.

However, spills and leaks from collection systems are a potential FIB load contribution to surface waters. Regulated dischargers are required to report sewage spills to the Central Coast Water Board. Along with other information, the volume of the spill and whether the spill reached surface waters is reported. If a spill occurs, spilled material is typically contained and disinfected as soon as possible. Appendix C summarizes the spills that have occurred since 2004.

Staff reviewed spill reports from 2004 to present. Based on the information available at the time of this report, staff concluded that incidental spills may have affected water quality in the Project area. The problem was not chronic, but episodic and infrequent. Where spills occurred, the response was typically immediate, minimizing further degradation to water quality. The identified spills that constituted a potential threat to surface water quality were in the City of Salinas, Castroville, and at the California Utilities Waste Water Treatment Plant (WWTP) in the El Toro area. The Monterey Regional Water Pollution Control Agency is responsible for the regional collection system, and this agency services Castroville and the City of Salinas. However, spills/leaks that occur in Salinas or Castroville fall under the jurisdiction of the City of Salinas and Castroville (Castroville Water District), respectively.

Additionally, the California Utilities Service Wastewater Treatment Plant, Salinas, California (WDR Order No. R3-2007-0008) is a private entity providing wastewater collection and treatment services to the communities and commercial areas in the Toro area along Highway 68 south of Reservations Road. Treated wastewater is discharged to land via spray irrigation area which is separated from the Salinas River channel by an earthen levee and dense riparian vegetation. Several spills from the collection system reportedly appear to have been a potential threat to El Toro Creek. El Toro Creek is in the Project Area, but is not currently identified as an impaired waterbody.

Because of the infrequent and episodic nature of the spills, and the fact that the majority of spills are recovered prior to discharge to surface water, Staff did not empirically assess the load contribution from this source category. Staff concludes that the overall load contribution of FIB from this source is very likely an extremely small fraction of total FIB stream load. Nonetheless, because untreated human waste is a relatively higher pathogenic risk, staff concluded that spills and leaks from sewage collection and treatment systems are a probable controllable source that contributes to pathogen loading in the Project Area.

Regulatory mechanisms are in place to address this potential source of indicator bacteria to surface waters. Modifications to existing regulatory mechanisms, if any, are discussed in the implementation plan of this report.

In summary, Staff concluded that spills and leaks from sewage collection and treatment systems are a source of indicator bacteria in the Project area, but regulatory mechanisms to address this source are in place. Water Board staff concluded it was likely that FIB from this source contributed to the impairment in surface waters of the lower Salinas River watershed. The Implementation Plan recommends methods to minimize this source.

4.3.1.3 Concentrated Animal Feeding Operations and Dairies

TMDL staff interviewed Water Board permitting staff and determined that there are no permitted concentrated animal feeding operations (CAFOs) that could contribute to FIB loading to surface water bodies in the Project Area.

The Gallo Cattle Company operates a large (~30,000 head) cattle feedlot near the community of Gonzalez, approximately 4.5 miles due northeast of the Salinas River. The Salinas River is not identified as impaired by indicator bacteria in this stream reach (near City of Gonzalez).

The feedlot is regulated under an NPDES permit (NPDES Permit No. CA0050601, Order No. R3-2003-0126). The facility is not adjacent or proximal to any identified FIB-impaired waterbodies. The facility is designed to discharge stormwater and waste water to land. A system of wastewater-holding ponds and storm water retention ponds collect contaminated runoff and stormwater runoff. The Discharger submitted a Report of Waste Discharge, dated August 19, 2008, and applied to renew its NPDES permit to discharge wastewater and contaminated stormwater onsite via spray irrigation to 64 acres of oat fields, which are regularly harvested for the exclusive use of feeding cattle onsite. Water Board permitting staff report that they are unaware of any record of problems with discharge of wastewater or manure to surface waters. Due to the magnitude of this CAFO's size, and proximity to the Project Area, Water Board staff should periodically review the permit conditions and operations of this facility during TMDL implementation.

Staff interviewed Water Board permitting staff to determine if permitted dairy operations are located within the Lower Salinas River watershed Project Area. Permitting staff reported that there are no permitted dairy operations in the Project Area. The nearest identified permitted dairy operation, the Moonglow Dairy, is on Dolan Road 1.2 miles east of Moss Landing, in the Moro Cojo Slough watershed outside the Project Area.

Based on the aforementioned information, confined animal feeding operations and dairies do not appear to be a source of indicator bacteria contributing to exceedances of surface water quality objectives in Project Area and are consequently not assigned a load allocation in this TMDL. More information will be obtained, if merited, during the implementation phase of the TMDL to further assess if there are smaller unpermitted dairy operations in the project area, and to identify any actions if necessary to reduce loading.

4.3.2 NonPoint Sources

4.3.2.1 Domestic Animal Discharges in Areas That Do Not Drain to MS4s

Livestock such as cattle, goats, and horses spend most of their time grazing on pasture or rangeland. It has been well established that grazing livestock can be a significant, diffuse source of fecal coliform loads to surface waters (Baxter-Potter and Gilliland, 1988; Rosen, 2000). Runoff from rainfall washes some of the manure deposited in the pastures into drainage features and nearby surface water bodies. Additionally, cattle and other animals are often allowed access to streams and ponds. Direct manure deposition may occur when cattle cross a stream, or through sporadic incursions into the stream channel for water or shade. Fecal material deposited directly into surface waterbodies may be a significant source of fecal coliform loads, in addition to the surface runoff from rangeland or pasture.

Many areas in the upper subwatersheds of the Project area support grazing lands and other activities involving domestic animals (livestock and farm animals). Staff began field reconnaissance of the Project area beginning in 2004. Staff observed livestock access to riparian areas, including direct access to surface waters. The livestock observed include dairy cattle, beef cattle, and horses. Livestock accessibility is particularly evident in the upper reaches of Towne Creek and Mudd Creek, as well as other tributaries to Gabilan Creek. In some areas, grazing has resulted in manure deposition along banks and channels of tributaries to the Salinas River Estuary. Staff, stakeholders, and investigators from other public agencies have also noted the presence of goat ranches, horse ranches, and other types of confined animal operations.

Consequently, there are a myriad of domestic animal operations and management practices in the Project Area. However, two broad types of domestic animal operations are indentified here:

1) Larger tracts of lands and open spaces that support grazing livestock operations, typically cattle (e.g. rangeland, grassland)
2) Domestic animal operations associated with smaller parcels of land with single-family homes which are used to raise farm animals, in many cases presumably for non-commercial use. Animals on these properties are typically confined (e.g., pasture, corral). These operations are typically located in rural residential areas where farm animals and livestock such as horses, cattle, chickens, goats, dogs, cats, and other farm animals are housed

Poorly managed or unpermitted confined animal operations, or lands containing confined animals (e.g., hobby ranches, properties with relatively dense unit-area concentrations of farm animals, etc) are typically a higher water quality risk for pathogen loads than lightly grazed rangeland, all other things being equal (e.g., proximity to surface water, runoff, access of animals to surface water drainage features, etc). At this time, due to the uncertainty surrounding the number of facilities, ranches, farms, etc. that will require implementation, staff do not have sufficient information to make distinct source assessments of the potential aggregate loading risk from open grazed rangeland versus properties containing confined animals.

Livestock are carriers of *E. coli* O157:H7. The United States Department of Agriculture, Agriculture Research Service (USDA ARS) estimates that as many as 100% of cattle lots could be infected with *E. coli* O157:H7 (AMI, 2004). A study of *E. coli* O157:H7 presence and persistence at county and state fairs in two states determined that 31 of the 32 fairs had livestock carrying *E. coli* O157:H7, with cattle having the greatest prevalence. In addition, *E. coli* O157:H7 persisted 10-11 months after the livestock were removed from the fairgrounds (Keen JE, et al, 2006). *E. coli* O157:H7 has also been isolated from the feces of horses, sheep, dogs, and deer (UW-M, 2006).

Cattle are known carriers of *E. coli* O157:H7, several samples drawn from the Gabilan Creek watershed were positive for this strain of *E. coli*. Multiple-Locus Variable-Number Tandem Repeat Analysis (MLVA) is a form of genetic typing of *E. coli*. The MLVA type of *E. coli* O157:H7 isolated from cattle feces collected from <u>land</u> in the Gabilan Creek watershed matched the MLVA type of *E. coli* O157:H7 isolated from water samples drawn from Gabilan Creek in 2006. *E. coli* O157:H7 was also isolated from five samples on the same day (February 16, 2005) from five separate monitoring sites separated by 16-miles (Cooley M. *et al*, 2007). The *E. coli* O157:H7 identified from the five samples all had identical MLVA types, and were first isolated from three upstream sites in the Gabilan subwatershed. The number of samples that were positive for *E. coli* O157:H7 in the Gabilan Creek subwatershed, relative to other subwatersheds, is illustrated in Figure 3-5. . It is important to note the prevalence of positive samples within the Gabilan Creek drainage system.

The presence of *E. coli* O157:H7 also indicates the presence other fecal indicator bacteria which are used as indicator organisms of pathogens. Beef and dairy cattle shed as many as 1.0×10^{11} fecal coliform each day (USEPA, 2001). Figure 3-4. illustrates seasonal geometric mean concentrations of generic *E. coli* in the Project area, including the Gabilan Creek subwatershed. *E. coli* concentrations in the Gabilan Creek system were typically in excess of the USEPA recommended concentrations, where livestock had access to surface waters and other land use activities were largely natural areas or scattered rural residential on large tracts of land.

A TMDL project has been approved by the Central Coast Water Board, State Board, and USEPA for the Watsonville Slough (see Central Coast Water Board order R3-2006-0025). Watsonville Slough is located approximately eight miles north of the northern edge of the Salinas River watershed. Staff utilized genetic analysis to fingerprint sources of *E. coli* for the Watsonville project. The genetic analysis was undertaken by the laboratory group led by Dr. Betty Olson at the University of California at Irvine. They analyzed 16 samples using the Toxin Gene Biomarker method. This method involves extracting DNA from *E. coli* colonies grown on agar plates from water samples. The DNA is then analyzed for the presence or absence of toxin genes specific to a host animal. In the Watsonville study, toxin genes searched for included those for rabbit, human, dog, bird, and cow. There was a significant difference in *E. coli* density attributed to cattle during the wet season compared to the dry season; dry season was 2 MPN/100 mL, wet season was 5267 MPN/100mL. These results indicated that:

1. Cattle sources of *E. coli* alone exceeded the water quality objectives in winter.
2. Cattle sources of *E. coli* may be seasonal.

Data associated with the current Project (Lower Salinas River Watershed) yielded similar findings. Monitoring site GAB-CRA is downstream of lands used for livestock activities. The three highest generic *E. coli* concentrations at monitoring site GAB-CRA occurred following rain events. In addition, USDA-ARS concluded from the Project *E. coli* O157:H7 data that the incidence of *E. coli* O157:H7 increased significantly when surface water flow increased due to rain events (Cooley M. *et al*, 2007).

The seasonality of the livestock fraction is a reasonable finding because:

1. Grazing practices vary by season due to seasonal changes in forage.
2. Some surface waters flow seasonally and may coincide with increased grazing rotation.
3. Overland flow from terrestrial areas can transport indicator bacteria from manure deposited near surface waters.

Figure 4-6 illustrates cattle access to a seasonal wetland area draining to Gabilan Creek immediately upstream from the monitoring site GAB-CRA.

Figure 4-6. Livestock access to wetland area flowing to Gabilan Creek near GAB-CRA.

Figure 4-7 illustrates cattle grazing in Alisal Creek. Although flow is not observed in the creek in this photo, the timeframe of the photo is December 2003, during the wet season. Also, *E. coli* bacteria or pathogens in manure deposited on grasses or in ephemeral stream beds may survive for weeks or months (Guan and Holley, 2003; Avery et al., 2004), potentially being mobilized in the water column by subsequent stream flows.

Figure 4-7. Cattle Grazing in Alisal Creek. (Fred Watson, Central Coast Watershed Studies, 2006)

In addition to large tracts of lands supporting grazing and livestock activities, some smaller parcels of land with single-family homes are used to raise farm animals, likely for non-commercial personal use. The Monterey County Department of Health conducted three creek walks along a two mile reach of Santa Rita Creek. County Health staff noted several incidences of farm animal access and/or animal waste adjacent to Santa Rita Creek, a tributary to Tembladero Slough, from single family homes. County Health staff was interviewed by Central Coast Water Board staff. One County Health staff gave a professional opinion that fecal indicator bacteria from farm animals were a significant threat to water quality. This opinion was based on field experience by the County Health staff (Monterey County Department of Health staff, 2006, personal communication).

Sources of fecal indicator bacteria from the creek walk included:

1. Horses in Santa Rita Creek.
2. Cattle in the Santa Rita Creek.
3. Horse manure adjacent to the Santa Rita Creek.
4. Pigs adjacent to Santa Rita Creek.
5. Sheep adjacent to Santa Rita Creek.
6. Goat feces adjacent to Santa Rita Creek.

These sources of fecal indicator bacteria occurred over two lineal miles of creek; there are hundreds of miles of creek system in the Project area.

Further, the California Department of Health Services (DHS) investigators reported runoff from a goat ranch located near Santa Rita Creek that drained into an agricultural drain ditch during the rainy season, ultimately discharging to Santa Rita Creek. DHS staff also noted numerous other places along Santa Rita Creek with horses and cows, and observed an area where horses had complete access to the creek. (California Dept. of Health Services, 2005).

Additionally, a USDA water quality monitoring project in the Lower Salinas River Watershed, reported seeing cattle and horses with stream access in Gabilan Creek and Towne Creek (USDA, 2006).

Based on the inventory of fecal coliform producers in the Project Area, outlined in Section 4.1, the estimated livestock inventory by impaired waterbody is shown in Table 4-6.

Table 4-6. Estimated Livestock Inventory by Watershed.

Subwatershed	Cattle	Chickens		Horses	Sheep	Hogs
		Layers	Broilers			
Old Salinas Riv Estuary	14	8	0	27	2	2
Tembladero Slough	633	76	3	244	21	15
Reclamation Canal (3a)	47	26	1	82	7	5
Rec Ditch/Alisal Creek (3b)	1119	146	7	469	40	29
Santa Rita Creek	62	48	2	152	13	10
Salinas Riv Lagoon	30	16	1	52	4	3
Salinas Riv	1136	221	10	707	61	44
Gabilan Creek	1435	118	5	378	33	24
Quail Creek	563	53	5	169	15	11
Towne Creek	129	9	0	28	2	2
Natividad Creek	237	38	5	122	10	8
Chualar Creek	1509	150	7	480	33	30

Using the BSLC spreadsheet tool, and delivery assumptions outlined in Section 4.2, the estimated annual load proportion is shown for each impaired stream reach in Table 4-7.

BSLC contains default literature-based values and assumptions for the amount of fecal coliform various livestock produce, the fraction of livestock that have access to streams and drainages, and the amount of time they spend daily or seasonally in riparian zones. Staff input to the BSLC spreadsheet model included project area-specific land use data, an assumption that up to 25% of cattle in the project area have some degree of access to streams, ditches, ephemeral drainage features, and/or riparian areas (personal communication, D. Marquis, Monterey

County Resource Conservation District, Dec. 2008), and additional data on livestock that the BSLC default model does not account for (i.e., hogs). The total amount of fecal coliform available for potential discharge is obtained by multiplying the total amount of livestock fecal coliform deposited to pasture/rangeland or stream (from BLSC spreadsheets), and multiplying it by the delivery potential (%) shown in Table 4-2.

Table 4-7. Estimated Annual Fecal Coliform from Domestic Animals Available for <u>Potential</u> Runoff or Discharge into Surface Waters.

	Domestic Animal Fecal Coliform Available for <u>Potential</u> Runoff/Dishcharge (MPN/year)		**Total Fecal Coliform Available**
Subwatershed	Pasture/Rangeland	Direct In-stream Defecation	
Old Salinas Riv Estuary	7.18E+11	2.89E+12	**3.60E+12**
Tembladero Slough	3.14E+13	1.31E+14	**1.62E+14**
Reclamation Canal (3a)	2.40E+12	9.69E+12	**1.21E+13**
Rec Ditch/Alisal Creek (3b)	5.55E+13	2.31E+14	**2.86E+14**
Santa Rita Creek	3.22E+12	1.28E+13	**1.60E+13**
Salinas Riv Lagoon	1.53E+12	6.19E+12	**7.71E+12**
Salinas Riv	5.66E+13	2.34E+14	**2.91E+14**
Gabilan Creek	7.10E+13	2.96E+14	**3.67E+14**
Quail Creek	2.79E+13	1.16E+14	**1.44E+14**
Towne Creek	5.81E+12	2.59E+13	**3.17E+13**
Natividad Creek	1.07E+13	4.76E+13	**5.83E+13**
Chualar Creek	6.77E+13	3.03E+14	**3.71E+14**

It is important to note that Staff acknowledges the work done by California Cattleman's Association, the Central Coast Rangeland Coalition, the Monterey County Cattlemen's Association, Conservation Districts, Natural Resource Conservation Districts, University of California Cooperative Extension, and rangeland managers within the Salinas River watershed. These entities have provided and attended educational courses, provided research and funding assistance to rangeland managers, and have reportedly implemented rangeland management practices to improve water quality. The California Cattlemen's Association has crafted a draft Nonpoint Source Grazing management strategy, containing information and strategies to manage pollutant loads from lands with domestic animals.

Given the information presented above, staff concluded that livestock and farm animals were source categories of indicator bacteria in surface waters of the Project area. Sources of indicator bacteria falling into these categories included cattle, horses, goats, pigs, sheep, and other commercial and non-commercially raised animals. Actions to control these sources are included in the Implementation Section.

4.3.2.2 Onsite Waste Disposal Systems (OSDS)

Many residents in county areas have onsite septic systems. Monterey County Department of Health regulates the issuance of new permits for septic systems and is responsible for investigating failing systems.

Staff interviewed a professional who installs and repairs septic systems (Ralph Sahagun, Tom's Septic Service, 2007, personal communication). Staff found that septic system failures in the Project area have periodically occurred. In some cases, the failing systems have resulted in sewage discharges to surface waters; the problem is not chronic, but episodic. System failures were often associated with:

- Clay soils
- High groundwater
- Older systems (40 years old and older).

Problem areas in the Project area included:

- Castroville Area (Tembladero Slough)
- Bolsa Knolls (Santa Rita Creek)
- Vista del Rio, off River Road (however, housing in this area is not adjacent to the Salinas River)

Of particular concern to staff was the Bolsa Knolls area just to the north of the City of Salinas. The Bolsa Knolls area is a 30-50 year old housing tract adjacent to the City of Salinas along Santa Rita Creek. The homes in this area are on individual septic systems. As can be seen in Figure 4-8, the highest density of OSDS in the project area occurs just to the north of the City of Salinas, in the census block group where Bolsa Knolls is located. Monterey County Department of Health staff (County staff) conducted a two mile creek walk along Santa Rita Creek, but did not find any failing septic systems; the County staff conducting the creek walk had extensive experience inspecting septic systems.

Some residents in the Bolsa Knowles area have experienced problems with their septic systems. Staff determined that the repairs to systems in this area were successful (Ralph Sahagun, Tom's Septic Service, 2007, personal communication).

The estimated number of housing units with Onsite Disposal Systems (OSDS, or septic tanks) may be obtained from the 1990 Census. Unfortunately, household sewage disposal information was not included in the 2000 Census. Data from the 1990 can result in marginally underestimating the number of housing units using OSDS. In an attempt to make the 1990 OSDS census data more current, an upward adjustment was made to the 1990 Census numbers, assuming a 1% growth rate/year in the number of housing units with OSDS. The 1% growth rate/year comes from a Statewide OSDS survey conducted by Chico State University (2003). Figure 4-8 shows the estimated OSDS density/acre, in census block groups in the project area. See Appendix E for Census Bureau septics data for Monterey County. Figure 4-8 indicates that the areas with the highest density of OSDS and that are associated with an identified FIB-impaired waterbody are in the Santa Rita Creek watershed, the Tembladero Slough Watershed, the Old Salinas River, and the Salinas River Lagoon. High OSDS density is observed in the El Toro Creek area; however there is currently insufficient data to determine if El Toro Creek in impaired by FIB.

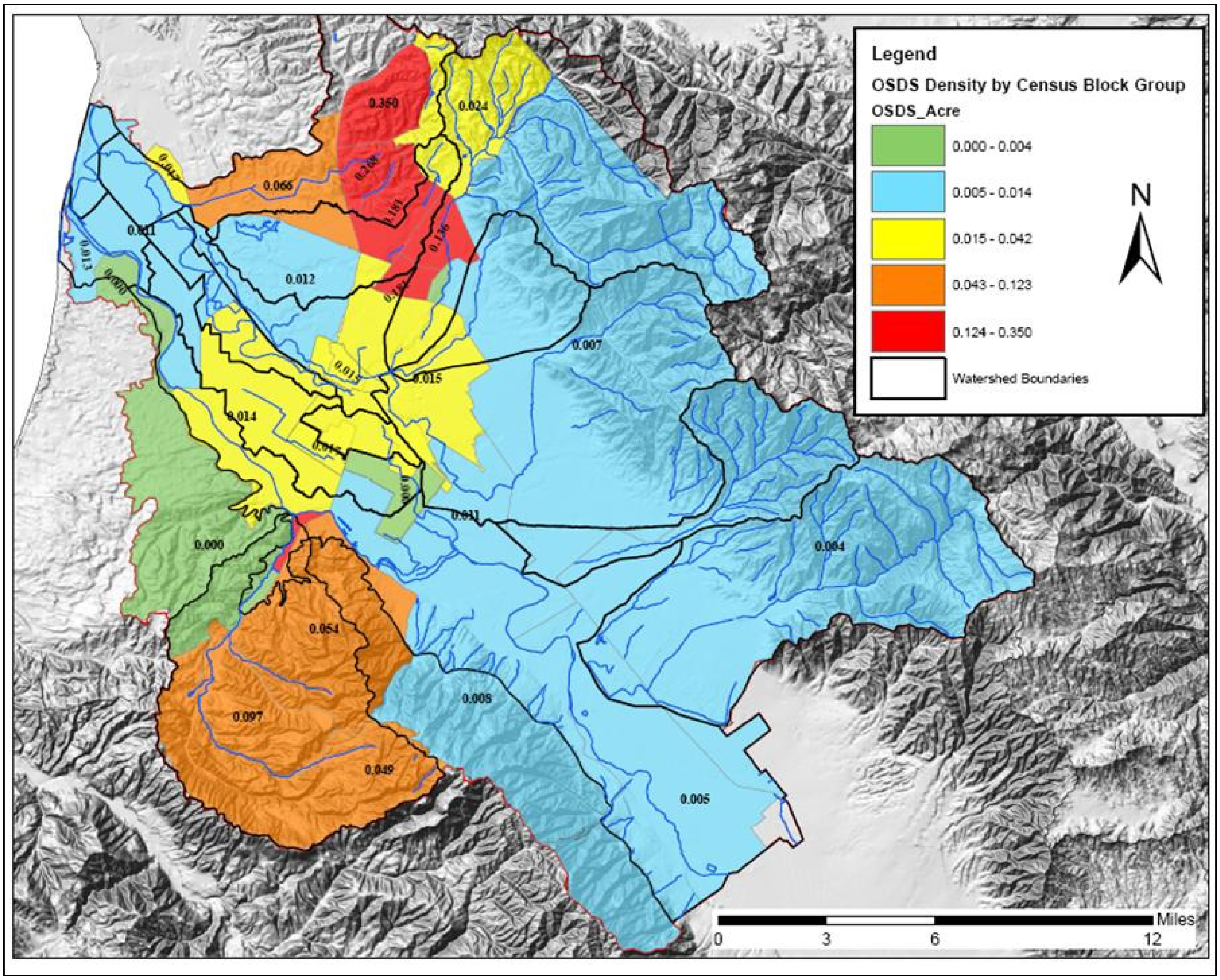


Figure 4-8. OSDS Estimated Density (number per acre) in Project Area.

State Water Resources Control Board recently estimated the number of existing OSDS found within 600 feet of 303(d) listed waterbodies in the Project Area (SWRCB, 2008). This estimate was based on the assumption that only homes and businesses within 600 feet of the impaired water bodies would have the potential to have an impact on surface waters. The counts were based on an investigation using multiple sources: The main sources for the investigation are TOPO! (a U.S. Geological Survey [USGS] map based program), Zillow.com, Realtor.com, and Google Maps. TOPO! were used to track water bodies through forest canopy, urban settings, and in some areas where the water body had few distinguishing features from the surrounding landforms. Zillow.com and Realtor.com were used to identify whether the area was connected to a public sewer system by identifying existing structures for sale in the area and determining, based on the property listing, whether it was served by an OWTS. In addition, Zillow.com and Google Maps were used to perform an actual rooftop estimate by either counting rooftops directly or assuming a density. (Density estimates were performed in areas with tree canopy or high density.) In all cases, only structures adjacent to the actual water body were included in the estimate.

The impaired water bodies, with the number of OSDS within 600 feet of them, are listed in Table 4-8.

Table 4-8. Estimated Locations and Numbers of OSDS Adjacent to Impaired Water Bodies in Project Area (source: SWRCB, 2008).

Impaired Water Body	**Estimated OSDS within 600 Feet of Impaired Water Body**
Alisal Creek	20
Santa Rita Creek/Espinosa Slough	20
Gabilan Creek	0
Old Salinas River	20
Salinas Reclamation Ditch	0
Salinas Lagoon (North)	1
Tembladero Slough	2

Only three impaired waterbodies in the Project Area appear to have a significant amount of OSDS located in near proximity to surface water: Alisal Creek, Santa Rita Creek, and the Old Salinas River.

Staff concluded that failing septic systems may be a small and episodic source of indicator bacteria in surface waters of the Project area, but there is no evidence to suggest the contribution is chronic or significant, unlike some other sources of fecal indicator bacteria, which may represent more continuous or uniform loading conditions.

Additionally, problems associated with failing OSDS appear to be typically quickly rectified by homeowners or addressed by the County Health Department. (e.g., previously mentioned repairs to problem OSDS in Bolsa Knowles area). Monterey County has an ordinance regulating sewage disposal (Monterey County Code, Title 15). Additionally, Monterey County Health Department staff reportedly periodically conduct creek walks in problem areas (e.g., Santa Rita Creek) to assess evidence for illegal pipe discharges, or illegal sewage discharge. County staff report they have seen little evidence of failing septics discharging to Santa

Rita Creek (personal communication, Susan Rimando, Monterey County Health Department, 29 March, 2007).

Based on the aforementioned information, OSDS appear to be a negligible source of FIB loading in the Project Area and are consequently not assigned to the load allocation in this TMDL. More information will be obtained, if merited, during the implementation phase of the TMDL to further assess the level of FIB contribution from OSDS, and to identify any actions if necessary to reduce loading.

4.3.2.3 Illegal Dumping

The Monterey County Department of Health conducted three two-mile creek walks along Santa Rita Creek. County Health staff noted and photographed eleven incidences of solid waste dumping along the two-mile reach investigated. Central Coast Water Board staff also encountered dumping sites along and in surface waters in the Watershed. On one occasion, staff observed soiled baby diapers dumped in Gabilan Creek.

City of Salinas staff witnessed owner/operators of motorized recreational vehicles discharging domestic sewage waste into surface waters (wastewater crew City of Salinas, 2007, personal communication). Other city staff corroborated this testimony. The City of Salinas 2007-2008 NPDES Annual Report documented Illicit Discharge Responses. Some of the illicit discharges included animal waste, illegal dumping of garbage, and other activities that have the potential to discharge FIB to land or surface water. The City of Salinas does have an active program to detect and respond to illicit discharges of waste. Illicit discharges that are detected and responded to by City employees are reportedly contained and abated.

Solid waste dumping along surface water areas appears to be prevalent in the Project area. Staff acknowledges that the City of Salinas and various volunteer efforts have been proactive in their efforts to control discharges from illegal dumping. Estimating the magnitude of illegal dumping comes with substantial uncertainties. However, Staff used FIB data on solid waste, and indirect evidence for making a screening-level estimate of the magnitude and water quality impact of illegal dumping that takes place in the Project Area. The information staff used were 1) Credible literature-estimates of the amount of municipal solid waste generated per capita; 2) Census Bureau population estimates; 3) Literature estimates of the FIB concentration in household garbage; 4) Indirect evidence of the magnitude of illegal dumping in the Project Area, 5) An assumption on the delivery potential to surface water of FIB from illegal dumping,

Estimates for FIB concentrations in household waste: Household waste contains more microorganisms with pathogenic potential for humans on average than medical waste (Rutala and Mayhall, 1992). Althaus et al., 1983 (as reported in Rutala and Mayhall, 1992) reported that household refuse contains an *E. coli* mean concentration of 1.3 x 10^5 MPN/gram. Household waste that may contribute to large numbers of microorganisms include facial tissues, dog and cat feces, soiled disposable diapers, and putrescible foods. The literature survey reported in Rutala and Mayhall (1992) do not include fecal coliform concentrations in household waste, therefore Staff used the Althaus et al. (1983) reported *E. Coli* value as a surrogate for fecal coliform concentrations. *E. Coli* bacteria are a subset of fecal coliform bacteria, and *E. Coli* water column concentrations broadly track fecal coliform water column concentrations in Project Area waterbodies (see Section 7.3.1)

<u>Estimates for amount of solid waste generated per capita in California</u>: California generates an estimated 1.5 tons of municipal solid waster per capita per year (Biocyle and the Earth Engineering Center of Columbia University, 2006). Staff assumed that the per capita rate of waste generation in California was representative of Monterey County, and the Project Area. As a result, in conjunction with Census Bureau population data, Staff assessed the total amount of municipal solid waste generated in the project area, as detailed below.

<u>Indirect evidence of the proportion of FIB-associated illegal waste disposal</u>: The City of Salinas reports the amount and nature of illicit discharges reported to the City (City of Salinas, 2007). Staff used this information to estimate the proportion of FIB-related refuse discharged to watersheds in the project area. Staff assumes that the City-reported illegal discharges are representative of the nature of illegal dumping throughout the Project Area. It is important to recognize that not all illegal discharges of waste contain FIB: chemicals, tires, used motor oil constitute a few examples. Of the 287 reported illicit discharges in Salinas between 2005-2007, 55 of those illicit discharges were comprised of materials that could conceivably contain indicator bacteria or pathogens: i.e., garbage/trash/debris/animal feces. Therefore, staff presumed that 19% (55/287) of all illegal discharges throughout the Project Area are comprised of refuse or municipal solid waste that potentially contain FIB.

<u>Indirect evidence of the magnitude of illegal dumping to riparian areas</u>: The City of Salinas Urban Watershed Management Program reports the amount (tons) of trash collected during watershed cleanups (City of Salinas, 2007). Clearly, not all illegal dumping occur in, or near streams and riparian areas. Therefore, Staff used the Watershed Trash Cleanup information reported by the City as an indirect indicator of the fractional proportion of illegally dumping that is *actually discharged <u>in or near</u> surface waters*. The City of Salinas reported that 11 tons of trash was removed in 2007 during volunteer watershed litter cleanups. Since not all "trash" contains FIB, staff used the aforementioned City illicit discharge reporting, and assumed that 19% of the 11 tons of "trash" collected were of a nature that could potentially contain FIB. Therefore, (11 tons of recovered "trash") x (0.19) = 2.1 tons of FIB-associated refuse (municipal solid waste, household garbage) were estimated to have been retrieved during watershed cleanup efforts.

Watershed cleanup efforts clearly do not retrieve all illegally discharged material Also some FIB associated with the discharged material could be leached or washed into surface water long before the clean up efforts commence. Therefore staff concluded that the 2.1 tons of FIB-associated trash recovered by volunteers is only a small fraction of the total FIB illicit discharge load. For screening-level assessment purposes, Staff assumed that the city volunteer cleanup efforts recover 5% of illegally-dumped material annually. Consequently, Staff estimates that 42 tons (2.1 tones x 20) of illegally discharged FIB-associated solid waste is disposed in riparian zones in the Salinas urban area annually.

The next step is to determine how the estimate of retrieved FIB-associated refuse (tons) compares to the *total* amount of solid waste generated annually in the Salinas area. Biocyle and the Earth Engineering Center of Columbia University (2006) data, in conjunction with Census Bureau County Division (CCD) population estimates, indicate that an estimated 244,395 tons of municipal solid waste is generated annually in the Salinas census division (1.5 tons per capita x 162,930 people in Salinas CCD). Therefore, 42 tons of <u>illegally discharged</u> waste equates to approximately 0.02% of <u>all</u> municipal solid waste (MSW) generated in the Salinas census division annually (42 tons/244,395 tons). Therefore, staff estimates that an annual average of 0.02% of all solid waste produced in the City of Salinas, and the Project Area more broadly, is illegally discharged in or near surface water bodies (See Table 4-9).

As a check on the reasonableness of Staff's estimate, a cursory review of professional literature on the magnitude of illegal dumping was conducted. Fullerton and Kinnaman (1996) estimated that 5.3% of households in Charlottesville, Virginia disposed of their household garbage illegally. It is important to recognize that illegal disposal can include incineration of refuse on private residential property, using commercial dumpsters, or littering. As such, clearly <u>only a small fraction</u> of the 5.3% illegal disposal rate reported by Fullerton and Kinnaman would constitute disposal that actually discharged *to or near a surface water body.* This literature-reported estimate of illegal dumping (5.3%) therefore does not appear to be qualitatively inconsistent with respect to Staff's estimate of the magnitude of illegal dumping (0.02% of total MSW) that is actually discharged to *riparian areas* in the Project Area.

<u>Delivery potential assumptions</u>: In section 4.2, Staff estimated the average delivery potential of various types of overland runoff, derived from literature sources and best professional judgment, ranging from 0.01% for rangeland to 8% for failing OSDS. Direct deposition into streams such as cattle defecation in streambed or stormwater outfalls were assumed to have a 100% delivery potential, because fecal coliform is deposited directly in the receiving waterbody with no opportunity for attenuation.

Unlike other nonpoint sources of FIB, which tend to be more uniformly deposited across various land uses, riparian areas are attractive locations for individuals who illegally dump: illegal disposal often occurs next to the banks of waterways, as they are less visible to the public (City of Salinas, 2007). In short, riparian areas are magnets for illegal dumping. As such, staff assumes that indicator bacteria associated with solid waste discharged in riparian areas have a relatively high delivery potential, especially in comparison to the overland runoff delivery potentials estimated in Section 4.2. Presumably, the delivery potential of fecal coliform from illegal solid waste disposal would be intermediate between the values of normal overland NPS runoff (i.e., 0.1% for pasture to 8% for OSDS), and the value for direct in-stream deposition from cattle or stormwater outfalls (100%). Therefore, Staff assumes that the delivery potential of FIB-associated solid waste illegally discharged to riparian areas is twice the estimate for effluent runoff from failing OSDS: a delivery potential of 16% is assigned to fecal coliform associated with illegal dumping in riparian areas.

The population estimates, total MSW estimates, and illegal discharge estimates are shown in Table 4-9.

Table 4-9. Project Area Population, Solid Waste Production (MSW), and Annual Illegal Discharge Estimates.

Census County Division (CCD) or Place (CDP)	Population	MSW Generated Per Person (tons/per capita/ year)*	Total MSW Generated In Census Area (tons/year)	Estimated Fraction Illegally Dumped in/near surface waters (%)**	Total MSW Illegally Discharged (tons/yr) –in/near surface waters
Salinas CCD	162,930	1.5	244,395	0.02%	42
Castroville CCD	18,259	1.5	27,389	0.02%	4.7
Gonzales CCD plus Spreckels CDP	11,352	1.5	16,301	0.02%	2.9
San Benito County Tract 2, Block Group 4 (Towne Creek)	755	1.5	1,132	0.02%	0.2

*Source: Biocyle and the Earth Engineering Center of Columbia University (2006).
** Inferred from indirect evidence: Reported amount of trash (tons) recovered in Salinas Urban Watershed cleanup efforts, in conjunction with estimates of the proportion of trash (fraction -%) that could be associated with FIB (City of Salinas, 2007). See Project Report narrative.

Based on the information presented above, the annual amount of FIB that is potentially available for discharge to surface water by Census County Division is shown in Table 4-10. These are intended to be broad approximations based on simplifying assumptions, of the annual averaged amount of estimated illegal dumping. Clearly, illegal dumping may vary temporally and spatially to an extent. To assess potential annual load contribution, Staff assumes that illegal dumping occurs uniformly in all Project Area waterbodies, therefore the amount of FIB available for discharge within each Census County Division (CCD) is assigned in equal proportion between the major stream reaches within the associated CCD. For example, total FIB available for discharge to the Tembladero Slough, Old Salinas River, and Salinas Lagoon is equivalent to the total source FIB available in the Castroville CCD divided by three stream reaches (8.79 E+10 / 3) = 2.93 E+10.

Because of the remote location, and small size of the Towne Creek drainage, solid waste disposal estimates were based on smaller-scale Census Bureau Block Group population data, rather than County Division data.

Table 4-10. Estimated Annual Fecal Coliform from Illegal Dumping for Potential Runoff or Discharge into Surface Waters

<table>
<tr><th>Census County Division (CCD)</th><th>Associated Watersheds</th><th>MSW Illegally Discharged (tons/yr) - in/near Surface Waters*</th><th>Mean. E. Coli Concentration in MSW (MPN/ton)**</th><th>Delivery Potential to Surface Water</th><th>Total MSW Fecal Coliform In Census Division (MPN/year)***</th><th>Total FC Available per Waterbody (MPN/year)</th></tr>
<tr><td rowspan="4">Salinas CCD</td><td>Reclamation Canal, Lower</td><td rowspan="4">42</td><td rowspan="4">1.18E+11</td><td rowspan="4">16%</td><td rowspan="4">7.93E+11</td><td>1.59E+11</td></tr>
<tr><td>Reclamation Canal Upper/Alisal Creek</td><td>1.59E+11</td></tr>
<tr><td>Natividad Creek</td><td>1.59E+11</td></tr>
<tr><td>Santa Rita Creek</td><td>1.59E+11</td></tr>
<tr><td rowspan="3">Castroville CCD</td><td>Tembladero Slough</td><td rowspan="3">4.7</td><td rowspan="3">1.18E+11</td><td rowspan="3">16%</td><td rowspan="3">8.79E+10</td><td>2.93E+10</td></tr>
<tr><td>Old Salinas River</td><td>2.93E+10</td></tr>
<tr><td>Salinas Lagoon</td><td>2.93E+10</td></tr>
<tr><td rowspan="3">Gonzales CCD plus Spreckels CDP</td><td>Salinas River</td><td rowspan="3">2.9</td><td rowspan="3">1.18E+11</td><td rowspan="3">16%</td><td rowspan="3">5.46E+10</td><td>1.82E+10</td></tr>
<tr><td>Quail Creek</td><td>1.82E+10</td></tr>
<tr><td>Chualar Creek</td><td>1.82E+10</td></tr>
<tr><td>San Benito County Tract 2, Block Group 4</td><td>Towne Creek</td><td>0.2</td><td>1.18E+11</td><td>16%</td><td>2.271E+10</td><td>3.63E+09</td></tr>
</table>

* From Table 4-9.
** Source: Althaus et al., 1983 (as reported in Rutala and Mayhall, 1992). Fecal Coliform concentrations were not reported; *E. Coli* is used here as a surrogate for fecal coliform.
*** Calculated as: (Tons MSW illegally discharged per year) x (Mean *E. Coli* conc. per ton MSW) x 0.16 (i.e., Delivery Potential)

In summary, Staff concluded that illegal dumping was a source category of indicator bacteria in surface waters of the Project area. Sources of indicator bacteria falling into this category included humans and pets. Actions to control these sources are included in the Implementation Section.

The estimated amount of fecal coliform from illegal dumping that is potentially available for discharge or runoff into surface water is relatively small compared to some other sources on an annualized basis. However, it is important to recognize that loads from illegal dumping, calculated on an annualized basis as above, may not reflect the water quality impact of this source on an episodic basis. Unlike some other nonpoint sources of fecal indicator bacteria, which may represent more continuous or uniform loading conditions, loads from illegal dumping may be episodic. As such, loads from illegal dumping may be more significant on smaller temporal scales. Also, illegal dumping potentially may contain human waste. Because of the relatively higher pathogenic risk associated with human waste, Staff concluded that illegal dumping should be identified as a distinct probable source of pathogen-loading in surface waters of the Project area.

4.3.2.4 Homeless Encampments

There was a homeless population in the project area. In some cases, homeless encampments were built along creek systems. Sanitary conditions among the homeless varied widely. In some cases, encampments were somewhat elaborate, with designated areas for bathroom activities. However, in other cases, surface waters were used for bathroom activities.

Staff obtained photographs of homeless encampments in the Project area, specifically along Natividad Creek, a tributary to Gabilan Creek. The photographs indicated that there was a significant population of people living along surface waters without bathroom facilities. The homeless encampment was semi-elaborate, with some homeless caring for pets and chickens.

Figure 4-9 illustrates a homeless encampment along Natividad Creek in 2003. Note the willow trees in the left, indicating the encampment was along a riparian area. Residents of the encampment were dispersed. However, after dispersal, homeless in the watershed typically set up another camp nearby because many are farm workers who work in the area.

Figure 4-9. Homeless encampment along Natividad Creek

Staff observed many signs of homeless activity while conducting field investigations. Human fecal matter was not uncommon along the banks of some waterways. Staff observed that in most cases, the likely pathway of indicator bacteria from human waste to surface waters was by overland flow. In a few cases, the pathway could have been through stormwater, but this pathway was not as prevalent as overland flow or direct discharge. Staff concluded that it was probable that the homeless population played a role in the contribution from human sources of indicator bacteria in the Project area.

Estimating the contribution of indicator bacteria from homeless encampments involves significant uncertainty. However, screening estimates can be made using the Monterey County Homeless Census and Survey (2007). The 2007 Homeless Survey estimates the fractional amount of homeless who are unsheltered (living in encampments, cars, or RVs), and how they are spatially distributed in the County (regionally and by Census Bureau Block Group). 266 unsheltered homeless were estimated to be living in the Salinas urban area, and 55 unsheltered homeless were estimated to be living in unincorporated areas of northern Monterey County. Spatial distributions of unsheltered homeless were also shown by the County by Census Bureau Block Groups, using density bubble maps (see Figure 4-10).

From these data, staff estimated that approximately 50% of the unsheltered homeless in the Salinas urban area were in the Reclamation Canal lower (3a) watershed, which corresponds to the highest mapped density of unsheltered. The County's bubble density map also shows up to 50 unsheltered homeless living in Census Bureau Block Group 106.6, which roughly corresponds to Natividad Creek. Because a large homeless encampment has been identified on Natividad Creek, staff estimated 50 unsheltered homeless living in the Natividad Creek watershed. The remainder of the Homeless Census numbers for the Salinas Urban area were assumed by staff to be evenly distributed through the other urban creeks of the City of Salinas: Gabilan Creek and Reclamation Canal upper/Alisal Creek (3b) – 28 people each. Staff estimated that rural project watersheds have an unsheltered homeless population of less than 10 people each, consistent with the County's Block Group bubble map (see Table 4-11).

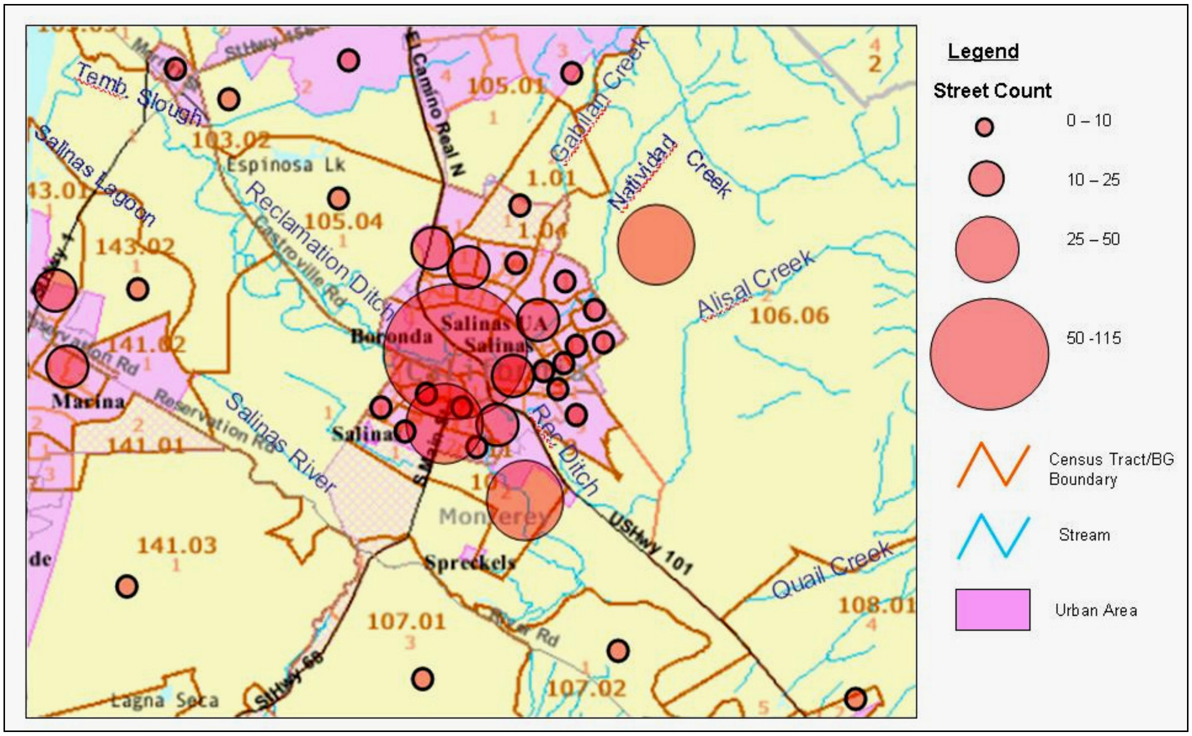


Figure 4-10. Unsheltered Homeless by Location (modified from Monterey County, 2007)

Table 4-11. Estimate of Unsheltered Homeless per Subwatershed.

Region	Unsheltered Homeless	Subwatershed	Unsheltered Homeless	% of Total Unsheltered Homeless
Salinas	266	Reclamation Canal, Lower	132	50%
		Reclamation Canal Upper/Alisal Creek	28	9%
		Natividad Creek	50	16%
		Gabilan Creek	28	9%
		Santa Rita Creek	28	9%
North County (Unincorporated areas)	55	Salinas River	<10	<1%
		Old Salinas River	<10	<1%
		Salinas River Lagoon (North)	<10	<1%
		Tembladero Slough	<10	<1%
		El Toro Creek	<10	<1%
		Towne Creek	<10	<1%
		Quail Creek	<10	<1%
		Chualar Creek	<10	<1%
Total	321			

= Impaired Waterbody

Because of the very small number of unsheltered homeless in the rural watersheds, only five watersheds in Table 4-11 were identified as having a fecal coliform load from unsheltered homeless to surface waters. These homeless populations are likely to be concentrated in or near the urban areas and urban fringes of the City of Salinas (in accordance with the County's street count bubble map), rather than the outlying rural portions of these watersheds. However, the exact location of all significant unsheltered homeless populations is uncertain to staff at this point. Table 4-12 shows the estimated annual load from unsheltered homeless to these impaired surface waters. Staff assumed that fecal coliforms produced by unsheltered homeless people would have a relatively low delivery potential to surface waters (i.e., the fractional amount of fecal coliform produced that is actually delivered to surface waters), because presumably some fraction of the unsheltered homeless have a degree of access to sanitary facilities. Therefore staff used the low-end delivery potential (0.1%) from Table 4-2.

Table 4-12. Estimated Annual Fecal Coliform from Unsheltered Homeless Available for Potential Runoff or Discharge into Surface Waters.

Subwatershed	Estimated Unsheltered Homeless	Fecal Coliform produced/person/year	FC Delivery potential	Total Fecal Coliform Available for Potential Discharge
Reclamation Canal, Lower	132	7.30E+11	0.1%	**9.64E+10**
Reclamation Canal Upper/Alisal Creek	28	7.30E+11	0.1%	**2.04E+10**
Natividad Creek	50	7.30E+11	0.1%	**3.65E+10**
Gabilan Creek	28	7.30E+11	0.1%	**2.04E+10**
Santa Rita Creek	28	7.30E+11	0.1%	**2.04E+10**

While the likely magnitude of annual loads from this source appear to be very small compared to other fecal coliform sources identified in this Section, staff concluded that the relatively higher pathogenic risk associated with untreated human waste merited including unsheltered homeless as a source category for impaired Project Area surface waters. Actions to control these sources are included in the Implementation Section.

4.3.2.5 Sediment Sources

Stream and lake sediments can serve as an environmental reservoir for fecal coliform and other indicator bacteria. Surviving fecal coliforms deposited in sediments and organic material at some time in the past, and which are not attributable to a recent pollution event, could be swept up into the water column due to a resuspension event. This may constitute a naturalized source of fecal coliform stream loads, referred to in this section as “bedloads”.

There is uncertainty about the scope and extent of this source in the project area, and the potential for propagation of microbial indicators deposited in sediment or organic matter in the watershed is largely unknown at present. Staff considers the fecal coliforms resulting from propagation and multiplication from controllable sources to be a naturalized source. Staff does consider these fecal coliforms controllable, insofar as the parent coliforms are from controllable sources. It is reasonable to presume that a substantial fraction of bedload bacteria originally came from controllable sources given that the overwhelming majority of fecal coliform production in the project area appears to be from anthropogenic activities and domestic animal operations (refer back to Figure 4-1).

Sediments can be resuspended when shear stress exerted on the stream bed exceeds the critical shear stress for incipient motion. This scouring results in stream sediment with associated indicator bacteria being resuspended, and thus contributing to the overlying water column concentrations of fecal coliform. Although these indicator bacteria loads are not external loads, they are included in the load allocation because all of the identified sources potentially contribute loads to the water column. Additionally, Staff has received guidance and comments from scientific peer reviewers (Wuertz and Schriewer, 2009) to include sediment resuspension of indicator bacteria as a distinct source load.

Sediment-associated bacteria are typically associated with fine, or cohesive sediment particles in aquatic environments (Gannon, et al., 1983; Wilkinson et al., 1995). Cohesive sediments are typically defined as sediment particles less than 60 microns in diameter; this generally includes silt-sized and clay-sized particles (NRCS, 1999). Typical flow velocities that cause streambed erosion of fine-grained sediments range from 3.0 feet/sec for silty loams to 5.0 feet/sec for colloidal clays and silts (City of Raleigh, 2003).

Therefore, staff presumed that areas in the Lower Salinas Valley comprised of ≥40% clay materials would constitute potential significant source areas of sediment-associated bacteria bedloads. As a result, it is possible to make broad empirical approximations of the potential magnitude of bedloads in the Project Area. Using soils data, staff identified impaired stream reaches in the project area that had potential for significant bed loading from sediment-associated bacterial water column resuspension, as described below. The data come from the Draft Lower Salinas Valley Pesticides TMDL (RWQCB, 2008 unpublished).

Soil characteristics are contained in the Monterey County Soil Survey, published by the Natural Resources Conservation Service, and the Soil Survey Geographic (SSURGO) database for soils. Staff used GIS soil analysis from the Draft TMDL for Pesticides in the Lower Salinas Valley (RWQCB, 2008 unpublished), to geographically locate regions characterized predominantly by fine soils (silt and clay) in project area watersheds (see Figure 4-11). To identify areas characterized by relatively high proportions of fines, staff used two soil characteristics to identify source areas: 1) soils where clay constitutes more than 40% of the surface layer; and 2) soil surface texture; the texture identified as “muck” in the soil survey data was also included in the source analysis because it consists of fine particles and organic matter.

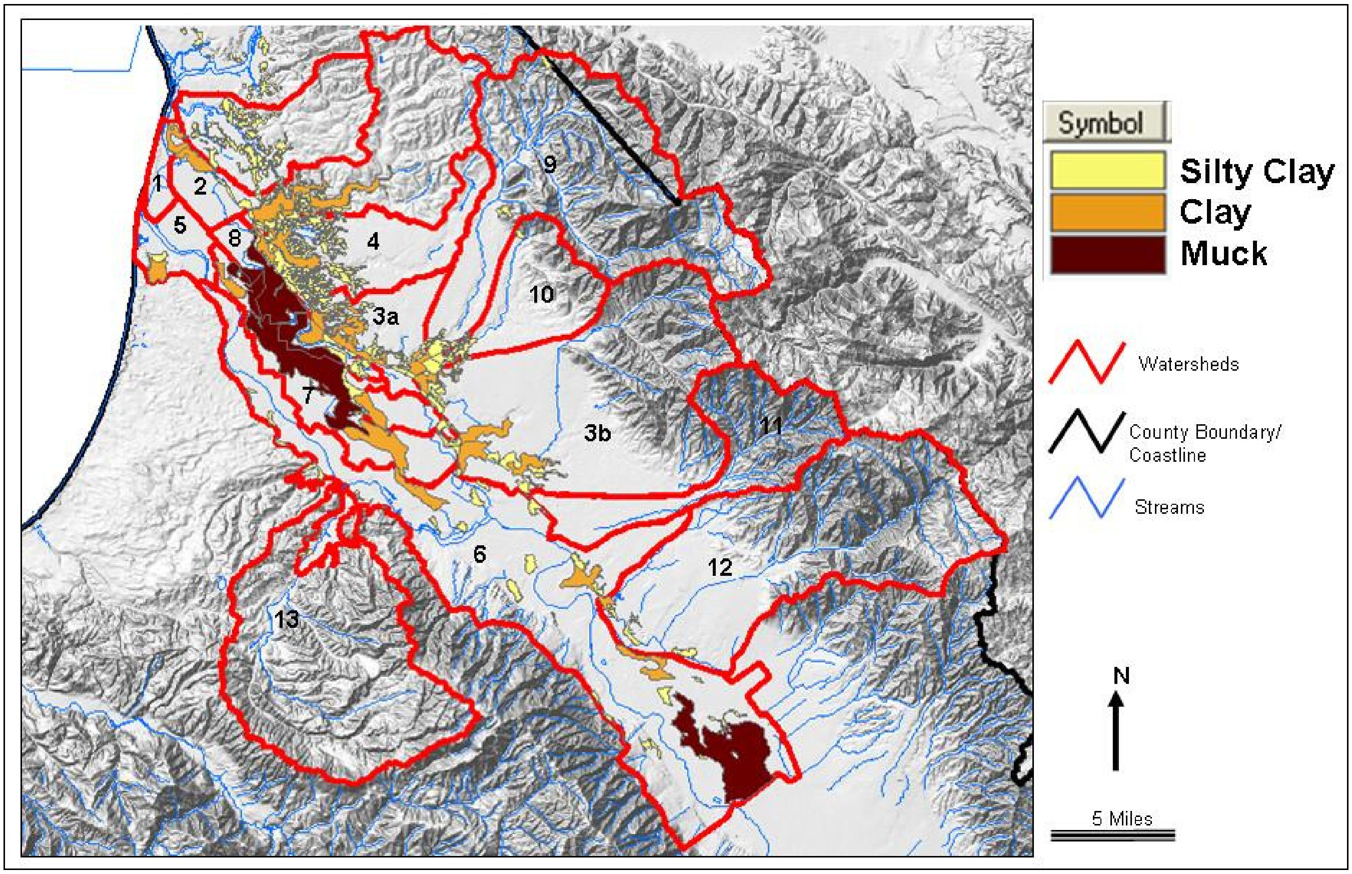


Figure 4-11. Fine Grained Soils Distribution in Project Area.

Staff identified Project Area impaired stream reaches that are characterized by significant amounts of these fine soils source areas (see Table 4-13). Staff presumed that project area subwatersheds which have any appreciable amount (more than 5%) of their areal extent characterized by fine soils source area could have the potential for significant bedload (sediment resuspension) contributions to water column bacteria loads.

Table 4-13. Percent of Subwatersheds Comprised of Fine Soils Source Area

Watershed No.	Watershed Name	Total Acres	Fine Soils Source Area (Acres)	Source Area as % of Watershed
1	Old Salinas River	1,462	198	13.5%
2	Tembladero Slough	16,737	1,992	11.9%
3a	Salinas Reclamation Canal, Lower	6,563	2,482	37.8%
3b	Salinas Reclamation Canal, Upper/Alisal Creek	29,601	1,976	6.7%
4	Santa Rita Creek/Espinosa Slough	8,646	1,953	22.6%
5	Salinas River Lagoon, North	3,058	286	9.4%

Watershed No.	Watershed Name	Total Acres	Fine Soils Source Area (Acres)	Source Area as % of Watershed
7	Salinas River	41,709	5,589	13.4%
7	Blanco Drain	8,300	3,754	45.2%
8	Alisal Slough Remnant (Rec Canal)	3,703	2,296	62.0%
9	Gabilan Creek	27,713	362	1.3%
9a	Towne Creek (in Gabilan Creek subwatershed)	2,560	0	0.0%
10	Natividad Creek	7,405	306	4.1%
11	Quail Creek	11,237	0	0.0%
12	Chualar Creek	29,888	955	3.2%

= Impaired Stream Reach

= Impaired Stream Reach with > 5% soil fines source area

Although Santa Rita Creek, and the Salinas River have more than 5% of the watershed characterized by fines, these watersheds were ruled out as having significant bacteria bed loads within the impaired reaches identified in the Project Area. This is because the observed loads from monitoring data on Santa Rita Creek, come from *the middle and upper part* of the subwatershed, which are *not* characterized by significant quantities of fine sediments. Therefore, bacteria from resuspended bedloads were considered to an inconsequential fraction of the observed loads in the monitoring data from Santa Rita Creek. Additionally, the reach of the Salinas River that is characterized by significant fines (i.e., the *upper reach* of Salinas River in the project area) is, in fact, *not* impaired by bacteria loads (for example monitoring data at SAL-GON).

Consequently, impaired stream reaches identified as having potentially significant bacteria bedloads are identified below:

- Old Salinas River;
- Salinas Lagoon (North);
- Tembladero Slough;
- Reclamation Canal, Lower (3a); and
- Reclamation Canal, Upper /Alisal Creek (3b).

Additional observations suggest that bacteria loads from fine grained sediment resuspension are not necessarily a widespread or ubiquitous load contribution throughout the entire project area. The fact that the watershed with one of the highest percentage of fines (Blanco Drain), is not currently impaired by bacteria, and the fact that stream reaches characterized largely by sandier soils are in contrast, significantly impaired (Gabilan Creek, Quail Creek, Towne Creek) suggests that the magnitude of loading from other non-point sources in the project area are likely much more significant than loading from sediment resuspension. However, bedloads were considered as a potential source in this project report, based on guidance and comments from scientific peer reviewers (Wuertz and Schriewer, 2009).

The loads associated with resuspension of sediment (bedloads) can be estimated using the Bacteria Load Estimation Spreadsheet (BLEST) tool, developed by the Texas Commission on Environmental Quality. The methodology for calculating bedloads with BLEST is detailed in Appendix G. By multiplying the occurrence of resuspension flows (i.e., storm events), FIB resuspension rates, estimates of the length of time the stream experiences critical shear conditions, and estimates of stream width and stream lengths, the fecal coliform bedloads were calculated as shown in Table 4-14. Because loading is a function of stream width and length, the streams with the largest stream surface area exposed to source bed sediment will consequently have the largest bed sediment contribution.

Table 4-14. Estimated Bacteria Bedloads.

Waterbody	**Ave. No. of Storm Events/Year***	**Median *E. Coli* Resuspension Rate (MPN m^{-2} sec^{-1})****	**MPN / Storm Event**	**Annual Bedload (MPN/yr)**
Alisal Creek @ALI-AIR	10	11,000	1.79E+11	**1.79E+12**
Reclamation Canal @ REC-VIC	10	11,000	2.02E+11	**2.02E+12**
Tembladero Slough @ TEM-MOL	10	11,000	5.71E+11	**5.71E+12**
Old Salinas River @ OLS-MON	10	11,000	5.71E+11	**5.71E+12**
Salinas Lagoon (North) @ SAL-MON	10	11,000	5.71E+11	**5.71E+12**

* Average number of annual precipitation events $\geq$ 0.5 inches in 24 hour period. (source: precipitation statistics from Salinas #2 NWS COOP Weather Station, available from NOAA/Western Regional Climate Center)

** Jamieson et al. (2005). *E. Coli* value. Fecal coliform resuspension rate was not reported. Staff use *E. Coli* here, as a surrogate for fecal coliform.

The Old Salinas River and the Salinas River lagoon are low gradient, coastal confluence receiving water bodies, and as such it is unknown whether these waterbodies generate sufficient flow velocities to resuspend fine grained cohesive sediments in any significant way. As noted previously, typical flow velocities that cause streambed erosion of cohesive fine-grained sediments range from 3.0 feet/sec for silty loams to 5.0 feet/sec for colloidal clays and silts. The lack of flow information for these coastal confluence waterbodies is complicated by tidal interactions from Moss Landing Harbor and Monterey Bay. Therefore, it was not possible to estimate in-situ bedloads for these two waterbodies. Rather, it is presumed here that the sediment-associated bacteria loads to the Old Salinas River and the Salinas Lagoon are derived from inflows from their upgradient tributary sources, rather than from resuspension of in-situ sources. In Table 4-14 it is assumed that bedload contributions in the Old Salinas River and the Salinas River Lagoon are equivalent to the estimated bedload in the Tembladero Slough. The Tembladero Slough is a direct upgradient tributary to coastal confluence receiving water bodies, and Tembladero Slough is the best hydrologic analog stream (low gradient, proximity, and water body size) to the Old Salinas River.

4.3.2.6 Irrigated Agriculture

The intensity of focus on irrigated agriculture since the *E. coli* O157:H7 outbreak associated with spinach led staff to carefully consider whether this land use activity could be a source of indicator bacteria. Probable sources of controllable FIB loads from cultivated croplands can potentially include: application of untreated or raw manure; improper management of manure; improper management of fecal waste from field workers.

Staff concluded that discharges from irrigated lands in the Project area did not cause an exceedance of water quality objectives related to indicator bacteria. Consider the following evidence.

Blanco Drain is surrounded by irrigated lands. Discharges to Blanco drain are almost entirely from overland flow or return waters from irrigated croplands. Land cover analysis indicates that approximately 90% of the land cover in the Blanco Drain watershed is cultivated cropland. Therefore, the Blanco Drain watershed can be singled out for source analysis with respect to irrigated cropland. The geometric mean of both wet and dry season *E. coli* concentration in Blanco drain were within the USEPA recommended concentration of 235 MPN/100mL. Figure 4-12. illustrates the dry and wet season geometric means at the Blanco Drain monitoring site. Note that the dry season and wet season geometric mean for *E. coli* was 87and 80 MPN/100mL, respectively.

Also note from Figure 4-12. that there are two monitoring sites along Tembladero Slough. The most upstream site is located in the City of Castroville, and the downstream site is near the confluence of Tembladero Slough and the Salinas River Estuary. Land use between these two monitoring sites is almost exclusively irrigated croplands, yet there was not an increase in the geometric mean of *E. coli* at the downstream site, neither during the wet nor dry season. Staff noted a similar pattern in other areas of the watershed.

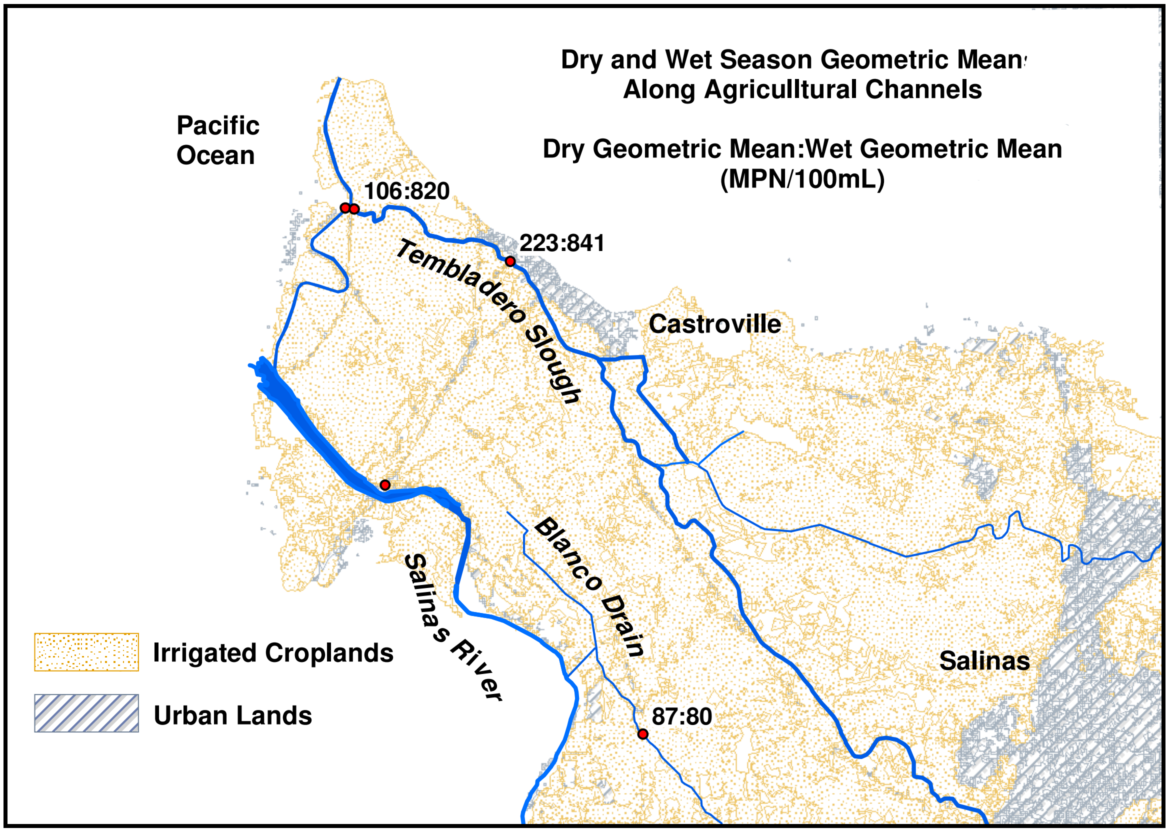


Figure 4-12. Dry and wet geometric mean of E. coli at Blanco Drain and Tembladero Slough.

Much of the water present in the lower Salinas River during the dry season was from irrigation return water of agricultural lands; there was a lack of connectivity between uplands, urbanized areas, and the irrigated lands in the lower portion of the watershed since the tributaries were dry. The water used to irrigate was predominantly from well water carrying very low levels of indicator bacteria. Therefore, during the summer months, when the irrigated agriculture return water source was the primary source of water in the system, review of concentration data in these waters would shed light on this land use as a source of indicator bacteria. Figure 4-13. illustrates geometric means of *E. coli* during the dry period. The boxes along the lower Salinas River indicate sites where the USEPA recommended criteria were **not** exceeded; these monitoring sites represent areas where irrigation return water was the primary source of water, yet these sites did not exceed the recommended concentration of 235 MPN/100mL.

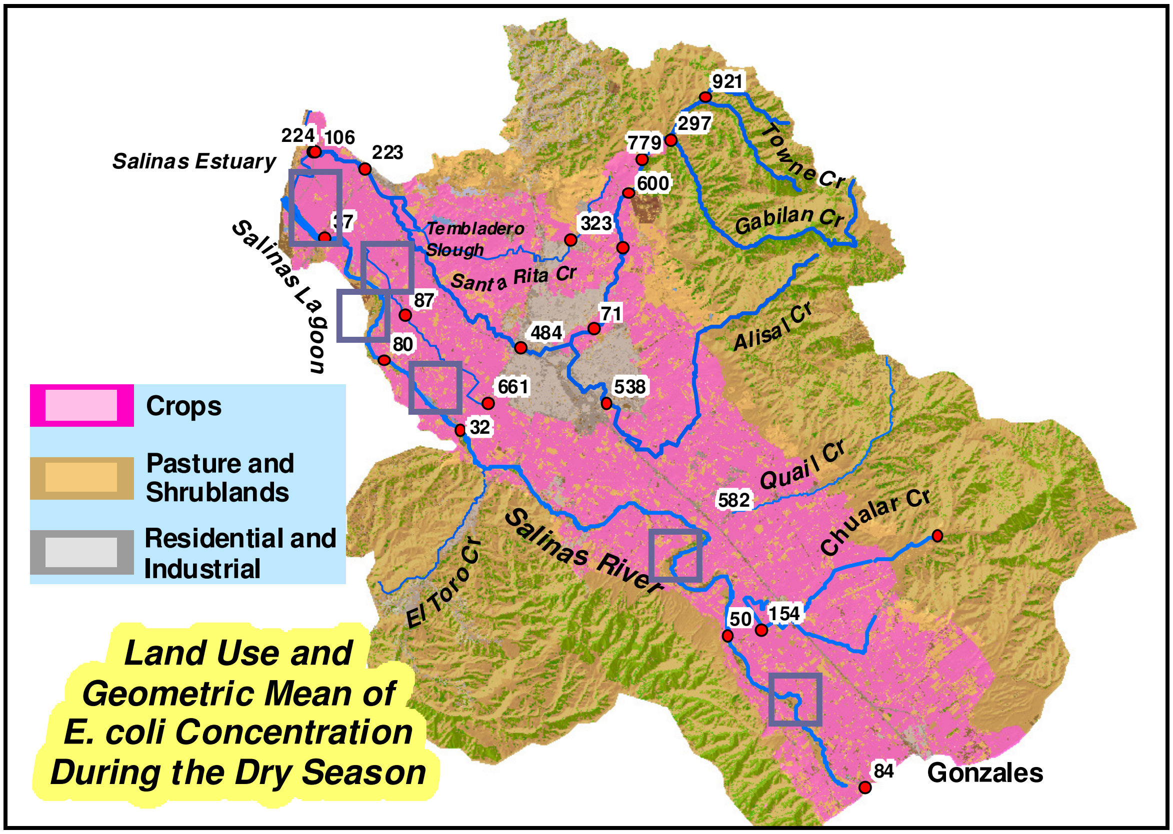


Figure 4-13. *E. coli* non-exceedance along agriculture channels during the dry season.

Note that grey boxes indicate no exceedance occurred at these monitoring sites.

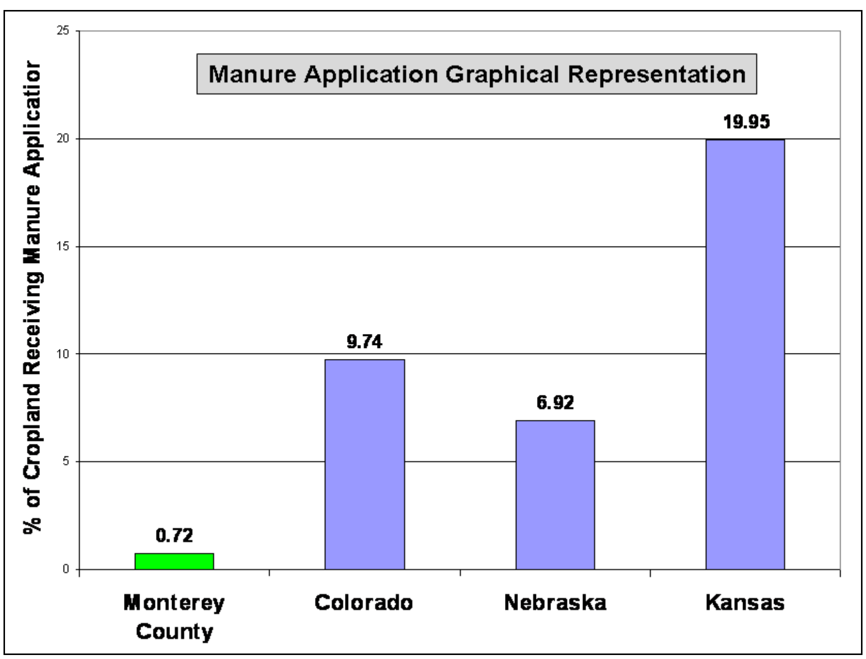
Additionally, it is widely accepted that a major risk of controllable pathogen loading from croplands is associated with application of raw or untreated manure, or the improper storage of manure (USEPA, 2001). The Resource Conservation District (RCD) of Monterey County reports that raw manure application in the Central Coast region has been largely phased out (Monterey County RCD, 2006).

To validate the RCD reporting, staff evaluated agricultural census data for Monterey County, available from the U.S. Department of Agriculture National Agricultural Statistics Service (NASS) database (www.nass.usda.gov). Staff presumed that reported manure application practices at the Monterey County scale is representative of manure application rates/practices within the project area of northernmost Monterey County. The NASS 2007 census data indicates that there are 602,631 acres of irrigated cropland in Monterey County. Only 0.7% of that cropland acreage received manure application (See Table 4-15). In fact, the overwhelming majority of farms in Monterey County with irrigated cropland used inorganic chemical fertilizers, lime, or soil conditioners (CalFERT, 2007; NASS 2007). For comparative purposes, staff evaluated NASS census data for manure application in three other agriculturally-important western states: Colorado, Nebraska, and Kansas. Manure application rates in these states were an order of magnitude or higher, relative to the manure application rate in Monterey County (Table 4-15). Although NASS doesn't report the exact nature or type of manure application, it is probable that most, or at least some fraction, of the acreage in Monterey County receiving manure application were with treated or composted manure, rather than raw manure (e.g., CalFERT, 2007). Treated or composted manure typically have negligible pathogen content, since the composting process involves the removal of the pathogenic fraction of the raw stock manure.

Collectively, the RCD reporting and the NASS data appear to indicate that raw or untreated manure application in Monterey County is relatively inconsequential.

Table 4-15. Manure Application Information.

	Location	Manure Applications (acres treated, 2007)	Total Land in Irrigated Cropland (acres, 2007)	% of Cropland Receiving Manure Application	Data Source
County	**Monterey**	4,357	602,631	**0.72%**	USDA, 2007
State	Colorado	279,420	2,867,957	**9.74%**	USDA, 2007
	Nebraska	592,016	8,558,559	**6.92%**	USDA, 2007
	Kansas	551,116	2,762,748	**19.95%**	USDA, 2007



Growers in the project area are highly aware of food safety issues; their livelihood depends on providing a crop that is safe for consumers. As such, growers practice methods that minimize the potential of crop contamination. One method is the use of well water and/or recycled water for irrigation purposes. Both well and recycled water carries very low (less than 10 MPN/100mL), or zero concentration, of indicator bacteria. Therefore, overland flow from irrigated lands to surface waters originates largely from well or recycled water. Any indicator bacteria discharged to surface waters from croplands, therefore, would likely originate from the land itself.

Growers carry the food safety concern to land and field practices. Staff conducted reconnaissance in the project area for a period of two years, and did not document land or field practices that would result in a controllable discharge of indicator bacteria to surface waters. Specifically:

- Staff noted that portable toilets were provided when field crews were present.
- Staff did not find evidence of manure applications on fields; the project area is dominated by inorganic farming.
- Staff did not see evidence of human waste along surface waters adjacent to agricultural lands; portable toilets were used.

Staff witnessed good agricultural practices in the project area, which in turn helped minimize loading of indicator bacteria in surface waters. Exceptions to the good agricultural practices could have occurred in the project area. However, based on staff's observations, exceptions, if any, were infrequent and not widespread.

In summary, based on the negligible amounts of manure application in the watershed, the monitoring data and land use analysis, and the operational practices pertaining to cropland field workers, staff concluded that irrigated agricultural operations are not a significant source of controllable fecal coliform loads contributing to exceedance of water quality objectives. Staff acknowledges that fecal material from natural wildlife sources is deposited on cropland, and potentially mobilized in runoff. Natural background has been identified as a source (see Section 4.3.2.6) and will be assigned a load allocation. It is important to note that non-controllable natural background loads are not subject to regulatory actions by the Water Board.

4.3.2.7 Non-controllable Natural Sources

Wildlife (mammals and birds) contribute a background level of fecal coliform bacteria to surface waters. Wastes from wildlife may be carried into nearby streams by runoff during rainfall. Animals can also defecate directly into streams. These constitute non-controllable natural sources not subject to regulation by the Water Board. Staff held an environmental scoping and public participation meeting in June 2007. As discussed in Section 1.3, stakeholders expressed concern that natural sources of indicator bacteria may exceed the target concentrations for this TMDL. Staff acknowledges that the concentration of indicator bacteria from natural sources may differ geographically and seasonally within the Project area.

Numerous wild animals are present in the Project area and are potential sources of indicator bacteria to surface waters. The animals that are likely contributors of indicator bacteria to surface waters in the project area include skunk, opossum, raccoon, deer, geese, turkey, egret, heron, as well as others.

Some uncertainty exists whether the non-controllable fraction of FIB alone is causing receiving water concentration of FIB to exceed the numeric target. The ability to differentiate between controllable and natural sources is an uncertainty in these TMDLs. This phenomenon represents an uncertainty that staff has attempted to address through an empirical analysis of land use data, sources of fecal coliform bacteria (humans, wildlife, livestock), hydrologic data, livestock and wildlife inventory data in this Project Report.

DNA fingerprinting analysis was performed on samples drawn from surface waters near the Project area, but not in the Project area. The DNA fingerprinting analysis from other surface waters suggested that the contribution from natural sources, particularly birds, could have exceeded water quality objectives. However, this occurred seasonally, and typically in the lower portions of the watershed where birds were attracted to calm waters. Contrastingly, staff evaluated data for other lagoons in the region (Waddell and Scotts Creeks) and found indicator bacteria concentrations met water quality objectives during most monitoring events.

Ultimately, it is useful to compare the estimated baseline conditions of the watersheds of the Lower Salinas Valley Project Area, with a nearby reference watershed that drains relatively undeveloped rural lands and which has similar climatic conditions. To further test whether current baseline conditions in Project Area streams (i.e., widespread and sustained exceedences of FIB water quality objectives) could be largely attributable to natural sources, staff evaluated FIB data from the Arroyo Seco River

The Arroyo Seco River is a tributary to the Salinas River located south of the Lower Salinas Valley Project Area, approximately 30 miles south of the City of Salinas. Climatic and precipitation conditions in the Arroyo Seco watershed are relatively similar to the inland streams in the Project Area. Water quality monitoring data from the headwaters of the Arroyo Seco contain minimally impacted areas that closely reflect natural *E. coli* densities in headwater areas in Project Area watersheds. .

Table 4-16 shows the data from the Arroyo Seco River monitoring site titled ARR-GOR. Note that the concentration of *E. coli* at this monitoring site was well below the USEPA recommended criteria of 235 MPN/100mL. Therefore, exceedances of water quality objectives that do occur in headwater areas are likely not caused by natural sources.

Table 4-16. *E. Coli* Data Upper Arroyo Seco River.

Site ARR-GOR	*E. coli* MPN/100mL	USEPA Criteria (MPN/100mL)
04/18/06	**15**	235
05/15/06	**11**	235
8/22/06	**5**	235
10/10/06	**5**	235

It is important to note that these headwater areas in the Arroyo Seco watershed do not likely reflect conditions with respect to the valley floor, agricultural and urban watersheds of the Project Areas watersheds. However, they may shed light on natural concentrations in other headwater areas of the Project area. Note that headwater reaches in the Project Area which have been sampled (i.e., six monitoring sites on Towne Creek, in the upper Gabilan watershed)) routinely show exceedances of *E. coli* bacteria water quality criteria. 40/42 (95%) of samples from six sites on Town Creek exceed the USEPA recommended criteria of 235 MPN/100mL for *E. Coli.* The geometric mean for *E. Coli* for all samples collected on Towne Creek is 670 MPN/100mL. Note that in contrast to the aforementioned Arroyo Seco sampling site (ARR-GOR), the Town Creek watershed is impacted by anthropomorphic activities to a larger extent, particularly livestock activities.

Also, staff has evaluated data for other lagoons in the region that are influenced predominantly by birds and not by other sources and found indicator bacteria concentrations did not exceed water quality objectives

The following narrative pertains to load assessment from non-controllable natural sources in the Project Area. Based on the inventory of fecal coliform producers in the Project Area, as outlined in Section 4.1, the estimated wildlife inventory by impaired water body in the Project Area is shown in Table 4-17.

Table 4-17. Estimated Wildlife Inventory by Watershed.

Watershed	Deer	Raccoons	Geese	Ducks	Wild Turkeys	Pheasant	Opossum	Skunk	Coyote	Feral Pig	"Other"
			Peak	Peak							
Old Sal Riv Estuary	13	11	11	109	2	50	11	11	0	4	*
Tem Slough	138	116	65	650	116	531	112	120	12	38	*
Rec Ditch lower	40	34	5	51	7	154	32	35	4	11	*
Rec Ditch upper/Alisal Creek	255	215	12	120	196	983	208	222	20	71	*
Santa Rita Creek	75	63	7	67	10	288	61	65	1	21	*
Sal Riv Lagoon	25	21	21	207	4	97	21	22	0	7	*
Sal Riv	349	294	23	226	169	1345	284	303	17	97	*
Gabilan Creek	252	212	4	37	297	972	205	219	30	70	*
Natividad Creek	67	56	3	33	45	259	55	58	4	19	*
Quail Creek	101	85	2	22	106	390	82	88	11	28	*
Chualar Creek	280	236	7	70	278	1079	228	243	28	78	*
Towne Creek	23	19	0	0	31	89	19	20	3	6	*

* "Other" wildlife in watershed assumed to produce an equivalent amount of fecal coliform to all deer in watershed.

Using the species-specific fecal coliform production shown in Section 4.1, the delivery potential assumptions outlined in Section 4.2, and the calculations from the BSLC spreadsheet tool, the annual amount of fecal coliform that is potentially available for runoff or discharge into surface waters is shown in Table 4-19. BSLC contains default literature-based values and assumptions for the amount of fecal coliform various wildlife produce, their habitat requirements, and the amount of time they spend daily or seasonally in streams and riparian zones. Staff input to the BSLC spreadsheet model included project area-specific land use data; and additional data on wildlife that the BSLC default model does not account for (i.e., coyote, feral pig, pheasants, opossum, skunk, and "other" wildlife, as shown in Table 4-2). The total amount of fecal coliform available for potential discharge is obtained by multiplying the total amount of wildlife fecal coliform deposited to land or stream (from BLSC spreadsheet), and multiplying it by the delivery potentials (%) shown in Table 4-2.

Table 4-18. Estimated Annual Fecal Coliform from Wildlife Available for Potential Runoff or Discharge into Surface Waters.

Watershed	Wildlife Fecal Coliform Available for Potential Runoff/Dishcharge (MPN/year)				Total Fecal Coliform Available
	Forest	Cropland	Pasture/Rangeland	Direct In-stream Defecation	
Old Sal Riv Estuary	3.86E+11	9.39E+11	2.42E+09	1.86E+13	**1.99E+13**
Tem Slough	2.51E+12	4.03E+12	1.03E+11	1.12E+14	**1.19E+14**
Rec Ditch lower	1.82E+11	2.64E+12	8.02E+09	9.25E+12	**1.21E+13**
Rec Ditch upper/Alisal Creek	7.45E+11	8.52E+12	1.82E+11	2.50E+13	**3.44E+13**
Santa Rita Creek	2.50E+11	5.16E+12	1.00E+10	1.26E+13	**1.80E+13**
Sal Riv Lagoon	7.31E+11	1.66E+12	4.71E+09	3.51E+13	**3.75E+13**
Sal Riv	9.12E+11	1.30E+13	2.63E+11	4.46E+13	**5.88E+13**
Gabilan Creek	9.04E+11	2.63E+12	2.35E+11	1.11E+13	**1.49E+13**
Natividad Creek	2.44E+11	2.66E+12	1.08E+11	3.91E+12	**6.92E+12**
Quail Creek	2.98E+11	1.78E+12	9.17E+10	5.63E+12	**7.80E+12**
Chualar Creek	1.38E+12	5.85E+12	6.84E+11	8.79E+12	**1.67E+13**
Towne Creek	1.03E+11	1.05E+09	2.04E+10	3.86E+11	**5.10E+11**

4.3.3 Analysis of FIB Data from Undeveloped Watersheds and Rangeland Watersheds

Stakeholders have expressed concerns about the ability to discriminate between water quality conditions in catchments draining grazed rangeland, versus natural background conditions in water quality which drain undeveloped forest lands (i.e., lands having no significant anthropomorphic inputs or domestic animal operations). The concern is essentially this: do drainages that are predominantly comprised of grazed rangelands and grasslands (i.e., grazing lands) exhibit substantially higher FIB concentrations in stream flows than in drainages comprised of predominantly undeveloped and forested land cover? What is the evidence that there is controllable water quality pollution in rangeland watersheds that are contributing to loads that substantially exceed background stream loads in undeveloped-forested drainages?

Consequently, staff conducted additional assessments of water quality conditions from monitoring sites in Monterey County which drain only grazing lands and/or forest- and undeveloped lands (i.e., monitoring sites where there are zero to negligible urban, residential or cropland inputs). The results are presented in Figures 4-14 and 4-15. .

Figure 4-14 illustrates the spatial extent of grazing land and forest/undeveloped lands in Monterey County with selected CCAMP water quality monitoring points annotated on the map. The land use spatial data depicted in Figure 4-14 come from the Farmland Mapping and Monitoring Program, 2005 (FMMP - California Dept. of Conservation). FMMP, in cooperation with the California Cattlemen's Association and others, developed digital mapping data depicting the location and extent of grazing lands. Bubble charts shown in Figure 4-14 depict the proportion of grazing lands versus forest/undeveloped lands in the catchments draining to each individual monitoring site. As the bubble charts show for this selected suite of monitoring sites, land uses/land cover draining to these monitoring sites are almost exclusively comprised of grazing lands and/or forest and undeveloped lands, per the FMMP digital data set. Table 4-19 summarizes the FMMP land use dataset for this suite of monitoring sites in tabular format.

The water quality data for this suite of monitoring sites come from this Project Report (see Appendix A-Water Quality Dataset), and the Central Coast Ambient Monitoring Program (http://www.ccamp.org/. The CCAMP bacteria dataset can be downloaded in Excel format from the State Water Resources Control Board website at:

http://www.swrcb.ca.gov/centralcoast/water_issues/programs/tmdl/303d/appendix_f2/table_of_contents.shtml

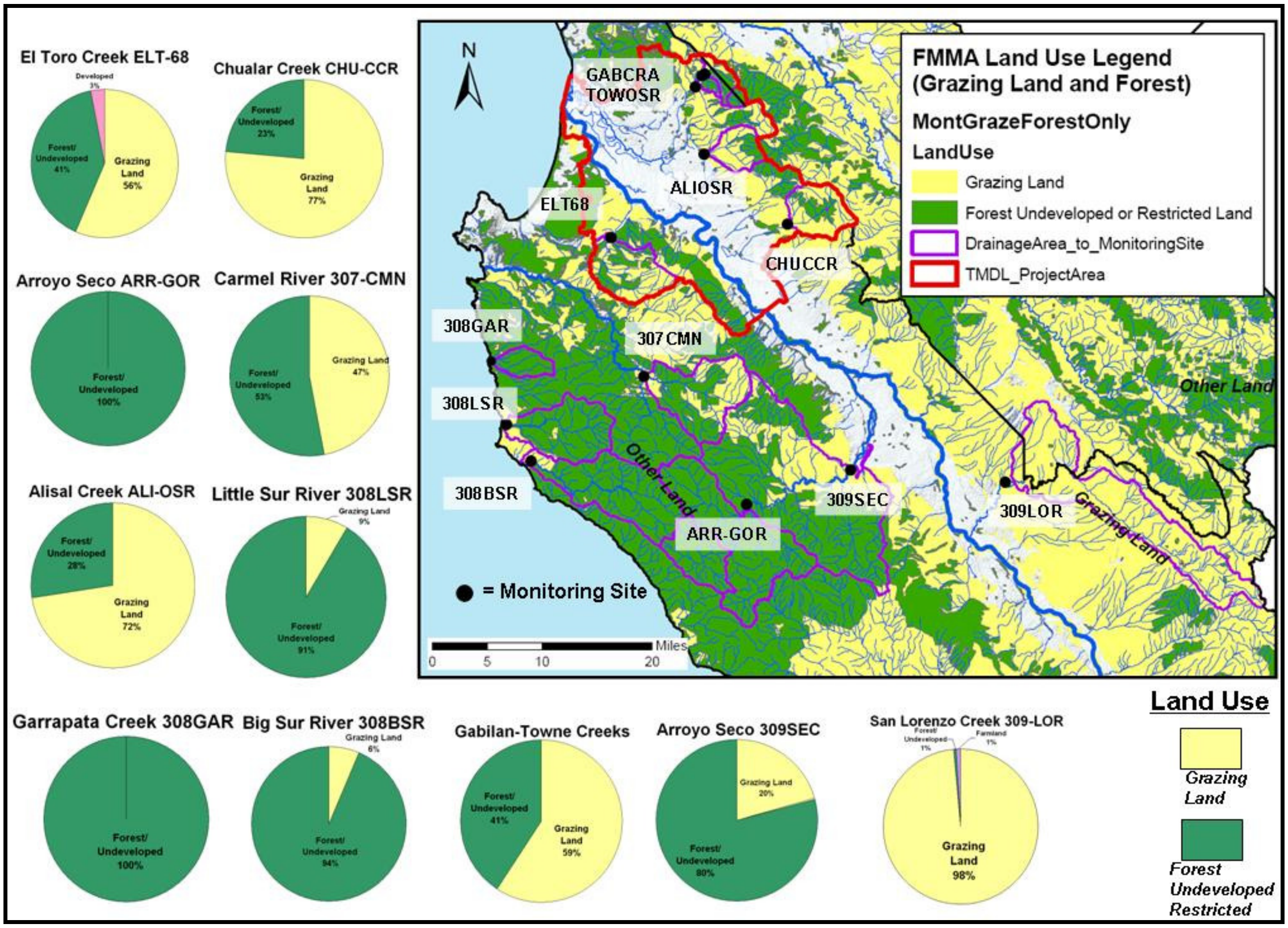


Figure 4-14. Selected CCAMP Monitoring Sites, and FMMP Grazing Land and Forest Distribution, Monterey County

Monitoring Site	Grazing Land	Forest/Undeveloped	Developed/Urban	Farmland
ARRGOR-Arroyo Seco River	0%	100%	0%	0%
309SEC-Arroyo Seco River	20%	80%	0%	0%
ELT68-El Toro Creek	56%	41%	3%	0%
ALIOSR-Alisal Creek	72%	28%	0%	0%
CHUCCR-Chualar Creek	76%	23%	0%	0%
308GAR-Garrapata Creek	0%	100%	0%	0%
307CMN-Carmel River	47%	53%	0%	1%
308LSR-Little Sur River	9%	91%	0%	0%
308BSR-Big Sur River	6%	94%	0%	0%
GABCRA-TOWOSR-Gabilan Creek	59%	40%	0%	1%

Table 4-19. FMMP Land Use Data for Selected Monitoring Sites

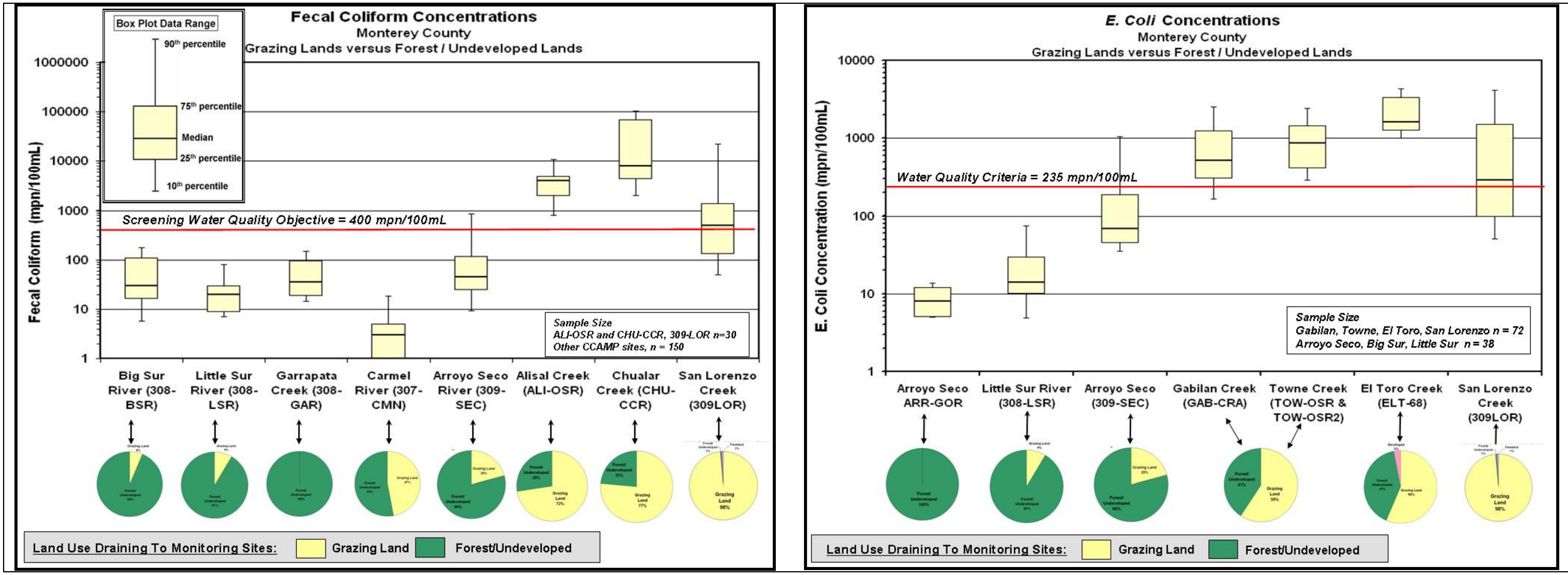


Figure 4-15. Box Plots of Fecal Coliform and *E. coli* Data, Monterey County, From Monitoring Sites Draining Exclusively Grazing and/or Forest Lands.

As shown in Figure 4-15, the range of water quality data from this suite of monitoring sites show that water quality samples from catchments draining all or mostly forest and undeveloped lands trend significantly lower than water quality samples from lands containing significant amounts of grazing lands. This appears to be consistent with conclusion in Section 4.3.2.1 of this Project Report that domestic animal operations and lands containing domestic animals contribute to exceedances of water quality standards, and are a probable controllable source of indicator bacteria loads to surface waters.

It is important to recognize that watersheds draining predominantly forested land in Monterey County are concentrated in the Santa Lucia Range. This area of the county typically receives higher amounts of rainfall and runoff than the Salinas Valley floor or the Gabilan Range watersheds in the Project Area. Consequently, Staff considered whether dilution could be invoked exclusively to account for lower observed concentrations in stream reaches draining predominantly forested land

Increased runoff and stream flow increases the assimilative capacity of a water body (i.e., the amount of FIB it can assimilate and still remain at levels that protect beneficial uses designated for that waterbody). However, load duration curve analysis indicates that both perennial and intermittent water bodies in the Project Area typically exhibit the largest *magnitude* of exceedances of water quality objectives during moderate to high flow regimes (see Section 7.3.3). This suggests that dilution, in and of itself, cannot be invoked exclusively to account for higher assimilative capacity and lower concentrations in Monterey County stream reaches. Simply put, the magnitude of exceedances of water quality objectives generally increase as flow increases in Project Area stream reaches. Increased flow and increased assimilative capacity do not appear to provide a dilution effect on FIB concentrations in Project Area stream reaches.

Staff considered additional data to assess if dilution (higher rainfall and runoff) exclusively could explain the lower concentrations of FIB noted from monitoring sites in monitoring sites from the forested drainages of the Santa Lucia range. Staff endeavored to identify CCAMP inland surface stream monitoring sites in Monterey County or within the Central Coast region, which drained predominantly forested/undeveloped land cover, *and* which represented similar climatic and hydrologic regimes as Project Area monitoring sites which drain predominantly grazing lands. The criteria staff used to identify these reference candidate monitoring sites are outlined below:

1) Similar climatic conditions (mean annual rainfall)
2) Similar physiography (inland surface streams, California Coastal Range Province USDA Ecogregion M262)
3) Similar hydrologic characteristics (very flashy flow regimes, intermittent flows or extremely low flows - <1cfs – during dry season
4) Drainage areas that are relatively comparable to Project Area grazing lands drainages (~ 100 square miles or less).

5) Drainage area to monitoring site is comprised predominantly (>75%) forest or undeveloped land per digital land cover mapping datasets.

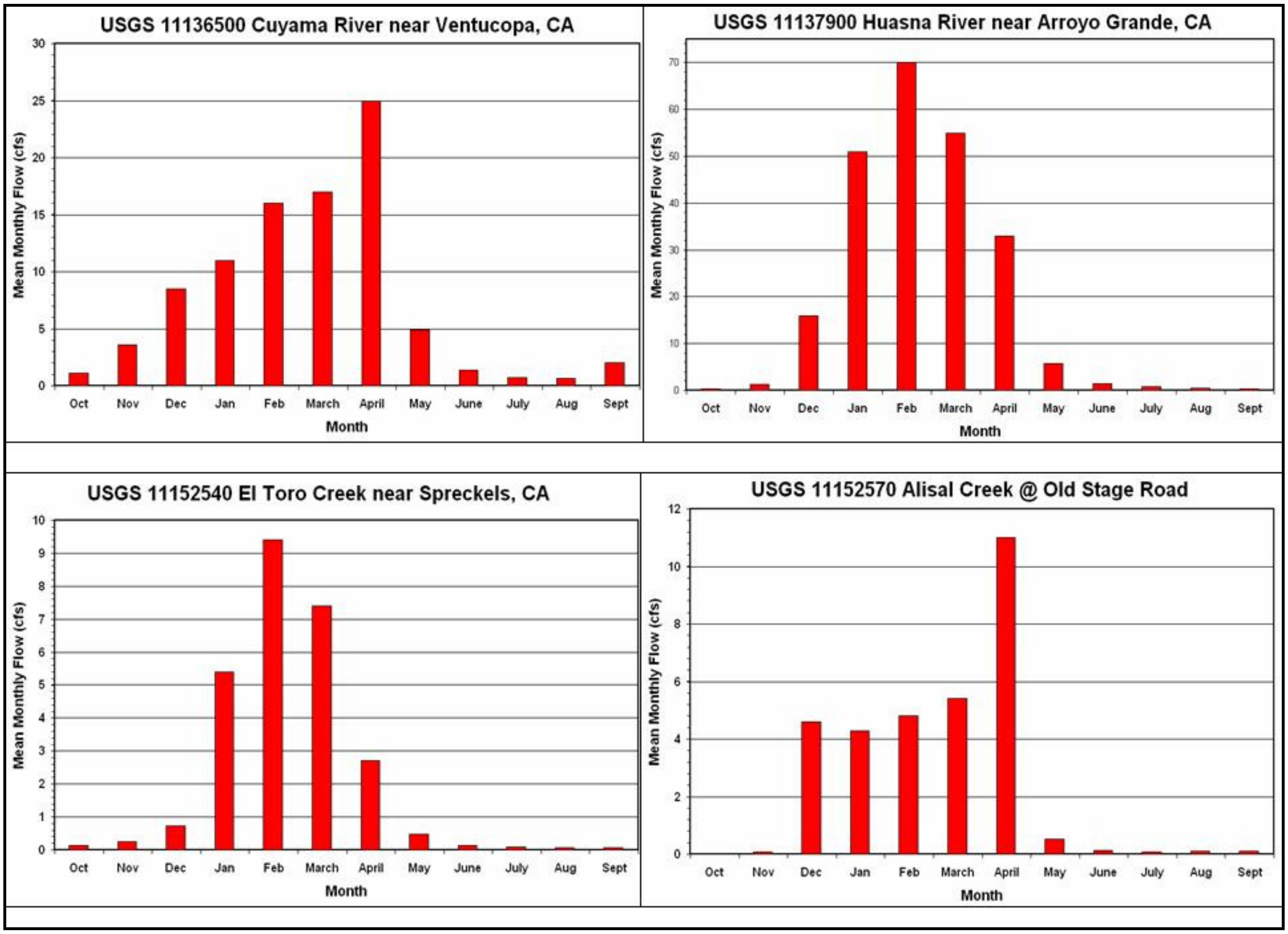
Although staff could not identify any CCAMP monitoring sites in Monterey County that fit these criteria, staff identified CCAMP sites from elsewhere in the Central Coast region meeting these criteria: monitoring sites 312CAV and 312HUA (Ventura and San Luis Obispo Counties, respectively) as shown in Table 4-20.

Table 4-20. Fecal Coliform Reference Sites and Monterey County Sites.

	Monitoring Site	Watershed	Drainage Area (mi^2)	Mean Annual Precipitation (inches)	USDA Ecogregion
Reference Sites	312 CAV	Cuyama River	89.9	11.53[A]	California Coastal Range Province
	312 HUA	Huasna River	103	13.97[B]	California Coastal Range Province
Project Area and Monterey County Sites	CHU-CCR	Chualar Creek	33	13.22[C]	California Coastal Range Province
	ALI-OSR	Alisal Creek	14.2	13.22[C]	California Coastal Range Province
	312 LOR	San Lorenzo Creek	101	11.21[D]	California Coastal Range Province

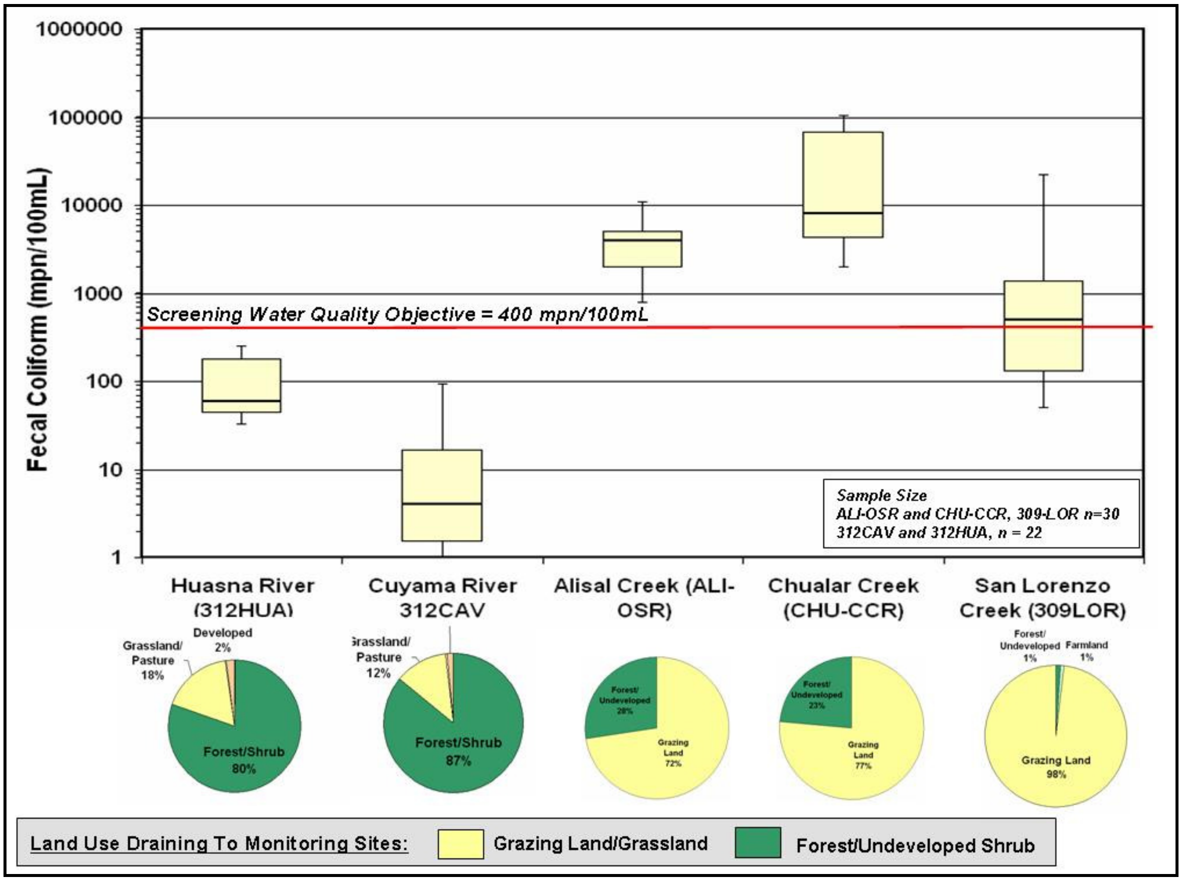
A – NOAA Western COOP weather station 046576
B - NOAA Western COOP weather station 04862
C - NOAA Western COOP weather station 047669
D - NOAA Western COOP weather station 044555

Figure 4-16 illustrates the mean monthly flows of the two reference monitoring sites (312CAV and 312HUA), compared to two project area monitoring sites which drain predominantly grazing land catchments (Alisal Creek-Old Stage Road, and El Toro Creek). Hydrologic flow regimes are comparable between these sites, as they are characterized by flashy wet season flows, and intermittent or very low flow conditions in the dry season (< 1cfs).



4-16. Mean Monthly Flows.

As shown in Figure 4-17, the range of water quality data from this suite of monitoring sites show that water quality samples from catchments draining predominantly forest and undeveloped lands trend significantly lower than water quality samples from lands containing significant amounts of grazing lands. In this illustration, a comparison was made between monitoring sites having relatively comparable climatic and hydrologic conditions. Again, as was illustrated previously in Figure 4-15, this appears to be consistent with conclusion in Section 4.3.2.1 of this Project Report that domestic animal operations and lands containing domestic animals contribute to exceedances of water quality standards, and are a probable controllable source of indicator bacteria loads to surface waters.



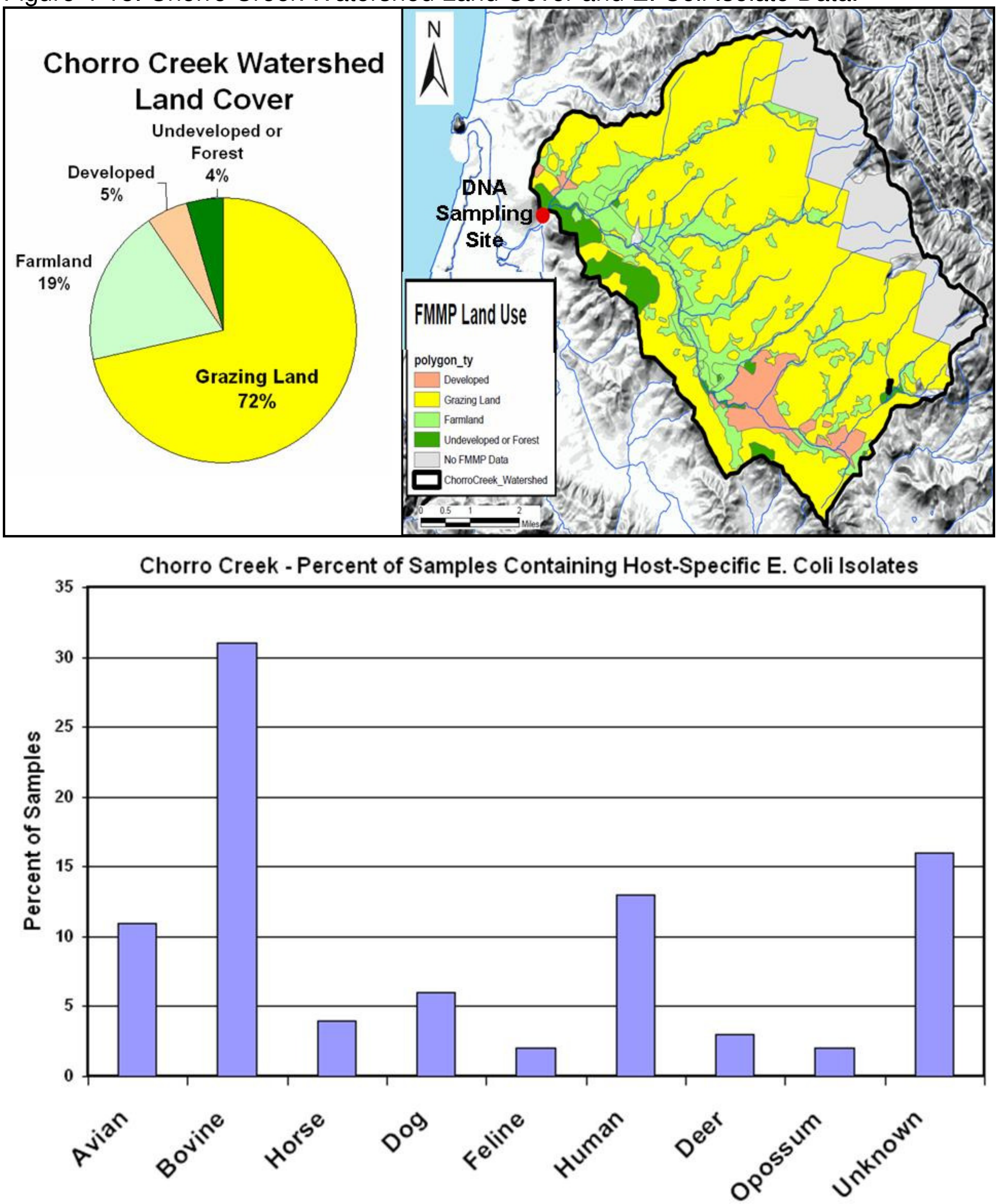
4-17. Box Plots of Central Coast Fecal Coliform Data From Monitoring Sites Draining Exclusively Grazing and/or Forest Lands, and Having Comparable Climatic and Hydrologic Conditions.

Finally, although DNA fingerprinting was not conducted for this TMDL project, DNA fingerprinting data has been collected and used in TMDL development throughout the Central Coast region. DNA fingerprinting is a type of analysis that can discriminate E. coli isolates that are associated with a specific animal host *E. coli* lives in the intestines of warmblooded animals. Different *E. coli* species are preferential to different animal hosts. Using this premise, a DNA fingerprint of a certain *E. coli* isolate found in a field sample (water, sediment, or oyster tissue) can be matched to *E. coli* known to inhabit a particular animal's intestines. . The method can provide insight into whether indicator bacteria loads are coming simply from natural background (wildlife), or if there is a component of controllable loads in the water sample (humans, domestic animals).

DNA ribotyping in the central coast region has widely demonstrated that observed indicator bacteria loads are associated with both non-controllable sources (e.g., wildlife) and controllable sources (human and domestic animals). A DNA site which represents a watershed that drains predominantly grazing lands (Chorro Creek), is reported in the Total Maximum Daily Load for Pathogens (Central Coast Water Board, 2002). The *E. coli* ribotypes from the Chorro Creek watershed matched to birds, domestic animals (cats and dogs), livestock (cows, horse, sheep and pigs), humans and wild animals (includes terrestrial and marine). Figure 4-18 illustrates the FMMP land cover for the Chorro Creek watershed and the *E. coli* ribotype data. Note that the FMMP digital land use data was compiled by the California Dept. of Conservation, in cooperation with the California Cattlemen's Association and others. Note that grazing lands comprises the large majority of the Chorro Creek watershed. Also note that 31% of the ribotypes matched to bovine, 13 % to human, 11% to avian, and other ribotypes matched to a variety of other wildlife and domestic animals. The Chorro Creek DNA data demonstrate that both controllable and non-controllable sources of indicator bacteria contribute loads in a watershed predominantly comprised of grazing lands.

While this analysis was not specific to Project Area watersheds, the data and observations presented in this report, along with regional DNA evidence which indicate that domestic animals on grazing lands can be a source of controllable loads to surface waters, collectively support the conclusion that domestic animal operations and lands containing domestic animals are a probable controllable source of indicator bacteria loads to surface waters in the Project Area.

Figure 4-18. Chorro Creek Watershed Land Cover and E. Coli Isolate Data.



4.4 Summary of Sources

Table 4-21 shows the summary of identified sources of indicator bacteria in the Project Area. Staff listed the sources by source category and the estimated proportional magnitude of FIB loads by watershed. The source loads are staff estimates based on the amounts of fecal coliforms that are available to *potentially* be discharged to surface waters from various sources.

The estimated magnitude of identified sources varies by watershed, as graphically shown in Figure 4-19. As noted previously, there are uncertainties associated with such estimates. The estimated population and/or densities of fecal coliform sources are approximations based on census data, scientific literature, or indirect evidence. The delivery potentials of fecal coliform used from section 4.2 are broad approximations, derived from literature values for loading rates or best professional judgment. The amount of fecal material delivered from any one source will vary depending on numerous factors. Because of this uncertainty, these are estimates only as the actual loading from each source is unknown. That said however, in making these estimates Staff employed methods and techniques that are recognized by USEPA or other Agencies to develop approved TMDLs.

Also, it is important to note that sources were identified in each individual subwatershed in an effort to ascertain the controllable sources occurring *within* that particular drainage. However, this does not preclude potential loading to a particular subwatershed, from upgradient sources outside the subwatershed's drainage boundaries. For example, there are no identified urban stormwater sources in the Old Salinas River watershed; however, this does not preclude the possibility that FIB from upstream urban stormwater discharges to the Reclamation Canal and Tembladero Slough ultimately reach and discharge into the Old Salinas River.

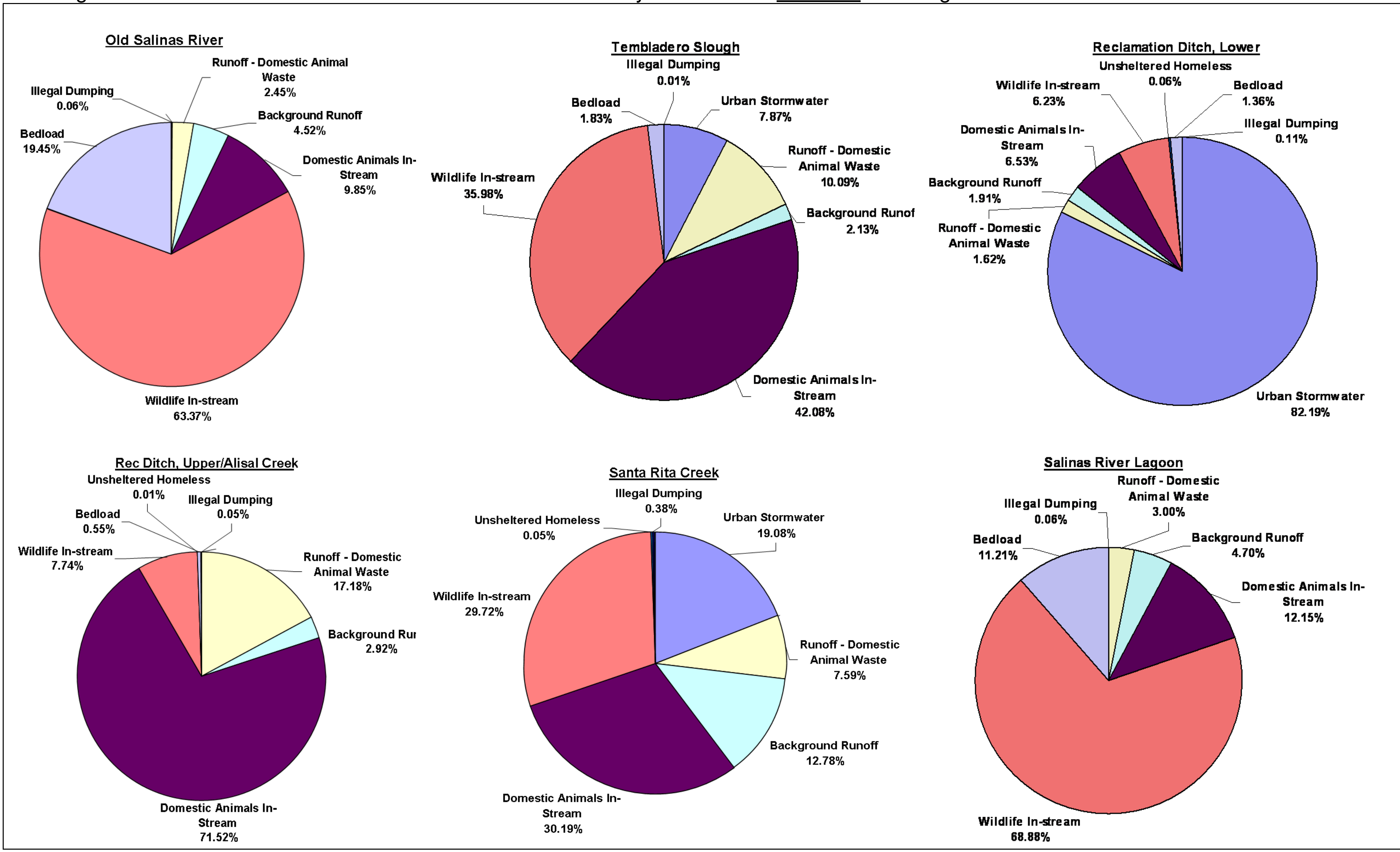
Staff did not assess the impact of loads from these upgradient sources because observed bacteria loads (water quality monitoring data) are typically only representative of the baseline conditions of a relatively small portion of drainage catchments upstream of the monitoring site. Simply put, observed FIB data is representative of conditions in the proximity of a sampling station (i.e., at the subwatershed scale). This is because bacteria flowing from the upper reaches of a large watershed (on the scale of hundreds of square miles) may have little impact on the waterbody downstream, due to die off and attenuation. When transport time frames of more than a few days are involved, die off make linkage of sources and concentrations difficult. Staff did not have sufficient have flow velocity, travel time, attenuation, and die off information to evaluate the water quality impact of upstream source loads coming from outside the individual subwatershed drainages.

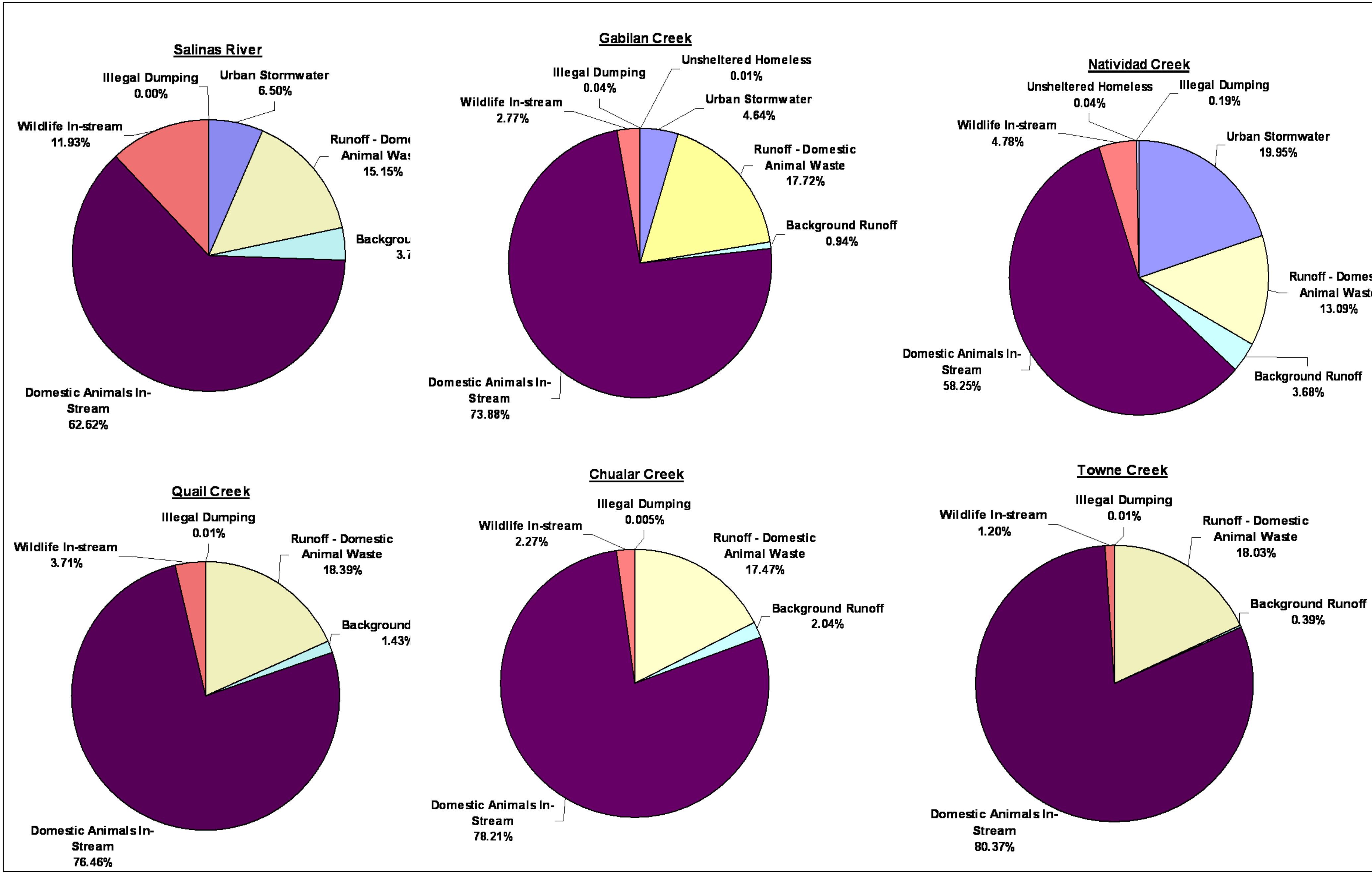
Finally, it is important to emphasize that the estimated relative magnitude of potential source contributions is calculated on an annualized basis. These represent annual loads from the entire watershed drainage. Loads that appear to be of a nominally small magnitude on an annualized basis (e.g., illegal dumping, homeless encampments) could be more consequential on different temporal scales or localized conditions.

Table 4-21. Summary Table of Estimated Annual Fecal Coliform from All Sources Available for Potential Runoff or Discharge into Surface Waters (MPN/year).

	Point Sources		NPS							
	Urban Stormwater	OSDS	Runoff - Domestic Animal Waste	Background Runoff	Domestic Animals In-Stream	Wildlife In-stream	Unsheltered Homeless	Bedload	Illegal Dumping	Total
Old Salinas Riv Estuary	0	0	7.18E+11	1.33E+12	2.89E+12	1.86E+13	0	5.71E+12	1.82E+10	2.93E+13
Tembladero Slough	2.45E+13	0	3.14E+13	6.64E+12	1.31E+14	1.12E+14	0	5.71E+12	2.93E+10	3.11E+14
Reclamation Canal (3a)	1.22E+14	0	2.4E+12	2.83E+12	9.69E+12	9.25E+12	9.64E+10	2.02E+12	1.59E+11	1.48E+14
Rec Ditch/Alisal Creek (3b)	0	0	5.55E+13	9.45E+12	2.31E+14	2.5E+13	2.04E+10	1.79E+12	1.59E+11	3.23E+14
Santa Rita Creek	8.09E+12	0	3.22E+12	5.42E+12	1.28E+13	1.26E+13	2.04E+10	0	1.59E+11	4.23E+13
Salinas Riv Lagoon	0	0	1.53E+12	2.40E+12	6.19E+12	3.51E+13	0	5.71E+12	2.93E+10	5.10E+13
Salinas Riv	2.43E+13	0	5.66E+13	1.42E+13	2.34E+14	4.46E+13	0	0	1.82E+10	3.74E+14
Gabilan Creek	1.86E+13	0	7.1E+13	3.77E+12	2.96E+14	1.11E+13	2.04E+10	0	1.59E+11	3.82E+14
Quail Creek	0	0	2.79E+13	2.17E+12	1.16E+14	5.63E+12	0	0	1.82E+10	1.52E+14
Towne Creek	0	0	5.81E+12	1.24E+11	2.59E+13	3.86E+11	0	0	3.63E+09	3.22E+13
Natividad Creek	1.63E+13	0	1.07E+13	3.01E+12	4.76E+13	3.91E+12	3.65E+10	0	1.59E+11	8.17E+13
Chualar Creek	0	0	6.77E+13	7.92E+12	3.03E+14	8.79E+12	0	0	1.82E+10	3.87E+14

Figure 4-19. Estimated Distribution of Fecal Coliform Annually Available for Potential Discharge/Runoff to Surface Waters




Salinas River
Illegal Dumping 0.00%
Urban Stormwater 6.50%
Wildlife In-stream 11.93%
Runoff - Dome
Animal Was
15.15%
Backgrou
3.7
Domestic Animals In-Stream 62.62%
Gabilan Creek
Illegal Dumping 0.04%
Unsheltered Homeless 0.01%
Wildlife In-stream 2.77%
Urban Stormwater 4.64%
Runoff - Domestic Animal Waste 17.72%
Background Runoff 0.94%
Domestic Animals In-Stream 73.88%
Natividad Creek
Unsheltered Homeless 0.04%
Illegal Dumping 0.19%
Wildlife In-stream 4.78%
Urban Stormwater 19.95%
Runoff - Domesti
Animal Waste 13.09%
Domestic Animals In-Stream 58.25%
Background Runoff 3.68%
Quail Creek
Illegal Dumping 0.01%
Wildlife In-stream 3.71%
Runoff - Domestic Animal Waste 18.39%
Background
1.43%
Domestic Animals In-Stream 76.46%
Chualar Creek
Illegal Dumping 0.005%
Wildlife In-stream 2.27%
Runoff - Domestic Animal Waste 17.47%
Background Runoff 2.04%
Domestic Animals In-Stream 78.21%
Towne Creek
Illegal Dumping 0.01%
Wildlife In-stream 1.20%
Runoff - Domestic Animal Waste 18.03%
Background Runoff 0.39%
Domestic Animals In-Stream 80.37%

5 NUMERIC TARGET

The Basin Plan contains fecal coliform water quality objectives. These water quality objectives are in place to protect the water contact recreational beneficial use.

The numeric target used to develop the TMDLs for Lower Salinas Watershed, including, Lower Salinas River, Old Salinas River, Tembladero Slough, Salinas Reclamation Canal, Alisal Creek, Gabilan Creek, Salinas River Lagoon (North), Santa Rita Creek, Quail Creek, and Towne Creek was:

> *Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN per 100 mL, nor shall more than 10 percent of samples collected during any 30-day period exceed 400 MPN per 100 mL.*

Natural non-controllable sources are a contributor of FIB in the Lower Salinas River watershed. Some uncertainty exists whether the non-controllable fraction of FIB alone is causing receiving water concentration of FIB to exceed the numeric target. However, there is evidence that non-controllable sources alone may not cause receiving water concentration to exceed the numeric target, i.e., that the numeric target can be achieved by managing controllable sources of FIB. For example, Waddell[3] and Scott's Creeks[4] are coastal streams with lagoons. Both Waddell and Scott's Creeks, as well as their lagoons, carry FIB concentrations that achieve the geometric mean value of the numeric target. Single samples from these water bodies have exceeded the numeric target, but again, the monthly geometric mean achieves the numeric target. Staff, therefore, concludes that the potential exists to achieve the numeric targets by managing the controllable fraction of FIB in the Lower Salinas River watershed. Staff acknowledges that waterbodies within the Project area are influenced by urban sources of FIB, whereas Waddell and Scott's Creek are much less developed with less human presence in their watersheds. Therefore, staff offers the above example as more of an indirect comparison, showing concentrations of FIB that more "natural" waterbodies may exhibit in this area, and not to show a direct comparison to other urban waterbodies that are achieving numeric targets.

Staff selected these numeric targets based on the fact that as this time, we are not requiring work related to the SHELL standard in the proposed Implementation Plan. The State Water Resources Control Board (SWRCB) is conducting a project to re-assess the areas designated for the shellfish harvesting beneficial

[3] Waddell Creek is located in the Redwood Belt of the Santa Cruz Mountains. The California Big Basin State Park occupies approximately 85% of the Waddell Creek watershed. The lower watershed is comprised of developed open space with a ranger/nature station at the bottom.

[4] Scott's Creek is also located in the Santa Cruz Mountains. The watershed is very rural with a small number of humans in residence. Low intensity timber harvesting, row-crop farming, and cattle ranching are practiced in a sustainable fashion.

use. As a result of this project SWRCB may potentially separate out the commercial from the other components of the shellfish definition. The current definition is broad, encompassing recreational harvesting for consumption, harvesting for bait, and commercial aquaculture. The breadth of the definition reduces flexibility to apply the most appropriate water quality standards to each of these applications. Consequently, waterbodies designated with SHELL beneficial use in Project Area will be addressed in a separate SHELL TMDL and/or standards action pending the outcome of the work of the statewide task force involving the Ocean Planning Unit of the State Water Board, the California Department of Public Health, the USEPA, and the coastal Regional Water Boards whom are involved in re-assessing the SHELL standard.

6 LINKAGE ANALYSIS

The goal of the linkage analysis is to establish a link between pollutant loads and water quality. This, in turn, supports that the loading capacity specified in the TMDLs will result in attaining the numeric target. For these TMDLs, this link is established because the numeric target concentrations are the same as the TMDLs, expressed as a concentration. Sources of pathogenic indicator organisms have been identified that cause the elevated concentrations of pathogenic indicator organisms in the receiving water bodies. Therefore, reductions in pathogenic indicator organism loading from these sources should cause a reduction in the pathogenic indicator organism concentrations measured. The numeric targets are protective of the recreational beneficial uses; hence the TMDLs define appropriate water quality.

7 TMDL DEVELOPMENT

7.1 Technical Approach and Methods

In Sections 7 through 10, we present the TMDLs and the following related analyses: assimilative capacity, margin of safety, seasonal variations and critical conditions, and daily load expressions.

TMDLs are "[t]he sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background. … TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure" in accordance with Code of Federal Regulations, Title 40, §130.2[i]).

We are establishing concentration-based TMDLs in accordance with this provision of the Clean Water Act.

However, based on USEPA guidance, we are also providing daily load expressions to supplement our concentration-based TMDLs and allocations

(Section 7.4.1). USEPA (2007) recommends that all TMDLs and associated load allocations (LAs) and wasteload allocations (WLAs) include a daily time increment in conjunction with other temporal or concentration-based expressions.

Staff used a load duration curve analysis approach to estimate existing loads and assimilative capacity for fecal coliform in the impaired stream segments in the project area. Load duration curves also allow for the calculation of flow-based daily load expressions. The load duration curve approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. Develop Flow Records for Key Water Quality Monitoring Stations. A flow duration curve for the impaired segment (or subsegments) is developed using the available flow data. This is done by generating a flow frequency record consisting of ranking all of the observed flows from the least observed flow to the greatest observed flow and plotting those points. Direct flow measurements are not available for all of the water quality monitoring stations addressed in this report. This information, however, is important to understanding the relationship between water quality and stream flow. Therefore, to characterize flow in some cases, synthetic flow records were derived from commonly used flow estimation methods. Flow data to support development of flow duration curves were derived for key water quality monitoring sites from USGS daily flow records generally in the following priority; however, the final methodology is subject to best professional judgment:

i) In cases where a USGS flow gage coincides with, or occurs within one-half mile upstream or downstream of a water quality monitoring station and simultaneous daily flow data matching the water quality sample dates are available, these flow measurements will be used. If flow measurements at a USGS flow gage are missing for some dates on which water quality samples were collected, gaps in the flow record will be filled, or the record extended, by estimating flow based on measured stream flows at a nearby gage. First, the most appropriate nearby stream gage is identified. The station with the strongest flow relationship, as indicated by the highest correlation coefficient (R), or based on similar land use and hydrologic factors, is selected as the index gage. Data from the flow gage with the partial flow record is then compared to the flow record from the index gage using regression analysis. The regression equation is then used to estimate flow at the gage to be filled/extended from flows at the index station. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression. This value was selected based on technical guidance for using regression analysis in estimating flows (USEPA 2007, and State of South Carolina DHEC, 2005). R-squared indicates the fraction of the variance in flow explained by the regression

ii) In cases where no USGS flow gage data is located within one-half mile upstream or downstream of a monitoring site, but instantaneous flow data is available at the monitoring site, mean daily discharge will be estimated by regressing the instantaneous flow measurements against mean daily values from the most appropriate nearby USGS flow gage. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression.

iii) In cases where no USGS flow gage data is available within one half mile upstream or downstream of a monitoring site, and no instantaneous flow data are available, but a USGS flow gage is located within the same stream reach (upstream or downstream) of the monitoring site, the Drainage Area Ratio method (see Section 7.2.2) with be used to estimate mean daily flow at the ungaged site using the USGS flow data that is located along the same stream reach.

iv) In drainages where there is no USGS flow gage or instantaneous flow data, mean daily flows will be estimated with the modified SWRCB proration drainage area method (see Section 7.2.2), using the mean daily flows from the most appropriate USGS flow gage record from a nearby drainage. The modified SWRCB proration drainage area method accounts for spatial variability in precipitation and runoff characteristics that might be expected between different drainages.

v) For monitoring sites in drainages where there is no USGS flow gage or instantaneous flow data, but a synthetic flow record has been created for a monitoring site within the same stream reach upstream or downstream of the ungaged site, flow statistics will be transferred to the ungaged site from the site with the synthetic flow record by using the Drainage Area Ratio method.

2. Develop Flow Duration Curves. Flow duration curves are graphical representations of the flow regime of a stream at a given site. Flow duration curves serve as the foundation for developing load duration curves. Flow duration curves are a type of cumulative distribution function. The flow duration curve represents the fraction of flow observations that exceed a given flow at the site of interest. The observed flow values are first ranked from highest to lowest, then, for each observation, the percentage of observations exceeding that flow is calculated. The lowest measured flow occurs at an exceedance frequency of 100 percent, indicating that flow has equaled or exceeded this value 100 percent of the time, while the highest measured flow is found at an exceedance frequency of 0 percent. The median flow occurs at a flow exceedance frequency of 50 percent. Flow duration curves can be subjectively divided into several hydrologic flow regime classes. These hydrologic classes facilitate the analytical uses of load duration curves, in terms of water quality response to flow and to pollutant loading conditions.

3. Develop Load Duration Curves. Load duration curves are based on flow duration curves. Load duration curves display the allowable loading capacity (based on the relevant water quality criterion) across the continuum of flow percentiles and also display historical pollutant load observations at the monitoring site. In lieu of flow, the y-axis is expressed in terms of a fecal coliform load (MPN/day). For this Project Report, the curve represents the instantaneous sample water quality criterion for fecal coliform (400 MPN/100 ml) expressed in terms of a load curve by multiplying each flow from the ranked flow record by the applicable water quality criterion and a conversion factor and plotting the resulting points.

4. Plot Observed Loads. Each pollutant data point from observed data is converted to a daily load by multiplying the concentration by the corresponding average daily flow on the day the sample was taken. The load is then plotted on the load duration curve graph. Points plotting above the curve represent exceedances of the water quality objective (i.e., the allowable load, or total maximum daily load). Those plotting below the curve represent compliance with water quality objective and therefore represent compliance with the maximum daily loads.

5. Use Load Duration Curve to Develop Daily Load Expressions. The load duration curve itself can be established as the TMDL. The TMDL would be dynamic and based on flow. Essentially, the loading capacity is the load corresponding to the flow selected along the curve. Alternatively, a static TMDL can be established based on the area beneath the TMDL curve, representing the loading capacity of the stream. The difference between this area and the area representing current loading conditions is the load that must be reduced to meet water quality standards. As noted previously, Staff are establishing concentration-based TMDLs in accordance with 40 CFR 122.45(f) of the Clean Water Act. However, USEPA recommends supplementing a concentration-based TMDL with a daily load expression, as indicated below:

> *"For TMDLs that are* ***<u>expressed as a concentration of a pollutant</u>****,* ***a possible approach would be to use a table and/or graph to express the TMDL as daily loads for a range of possible daily stream flows****. The in-stream water quality criterion multiplied by daily stream flow and the appropriate conversion factor would translate the applicable criterion into a daily target."**
>
> *-- USEPA, 2007 "Options for Expressing Daily Loads in TMDLs", Office of Wetlands, Oceans and Watersheds, June 22, 2007.*
>
> * emphasis added

7.2 Development of Flow Duration Curves

7.2.1 Flow Data

To develop flow duration curves, and ultimately conduct a load duration curve analysis, it is necessary to have a continuous flow record covering a broad range of flow conditions during times of water quality sampling in the impaired streams. Unfortunately, many of the identified impaired waterbodies in the project area do not have flow data. In those cases, flow can be estimated for the impaired waterbody based on nearby USGS gages draining creeks with similar watershed characteristics, or from instantaneous flow measurements and water budget analyses from literature sources.

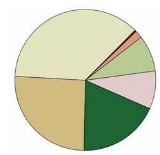
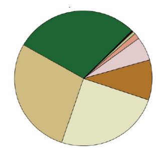
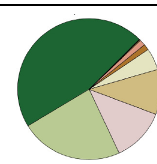
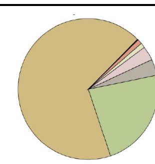
Based on knowledge of watershed characteristics and the overlap of water quality and flow data, El Toro Creek (USGS 11153540) was initially chosen as the surrogate flow gage for several of the ungaged impaired streams which drain mountainous headwater reaches in the project area. Additionally, the Reclamation Canal (USGS 11152650) was used as a surrogate flow gage for impaired waterbodies located in low-gradient, valley floor subwatersheds in the project area. However, the El Toro Creek Gage only has a partial flow record, and does not have flow data after October 2001. Much of the water quality data collected in the project area is subsequent to October 2001. To fill in this gap in flow data for the El Toro Creek gage, a reference stream approach was used. The reference stream approach involves evaluating flows from surrounding gages with similar watershed characteristics, for similarity to El Toro Creek flows. The flow data from a selected reference stream are then used to supplement the El Toro Creek partial flow record; i.e. to create a complete flow record. The complete El Toro Creek flow record can then be projected into the ungaged impaired streams in the project area.

Once several possible reference watersheds were selected, a correlation analysis was performed on the flow measurements of the reference stream gages and the target gage (El Toro Creek). Usually the reference gauge with the strongest correlation to the target gage is selected; however, the final decision is subject to best professional judgment. The reference stream gages selected were Corrilitos Creek (Santa Cruz County), Gabilan Creek (Monterey County), and Clear Creek (San Benito County).

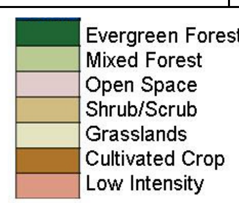
The reference stream correlation was performed by entering the flow measurement data from the target stream (El Toro Creek) into an Excel spreadsheet along with daily mean flow data from the reference streams candidates (Gabilan Creek, Corrilitos Creek, and Clear Creek). The Excel “Correlation” data analysis tool was then run to determine "R", or the Pearson's correlation coefficient, which can be used as an indication of the strength of the correlation. In this analysis absolute values of the Pearson's coefficient between 0 to 0.5 were regarded as indicating a very weak correlation, 0.5 to 0.7 as moderate and 0.7 to 1 as a strong correlation.

Table 7-1 highlights the target and reference watershed drainage area, physiography (USDA Ecoregion), land use, and correlation coefficients. Gabilan Creek was selected as the reference stream based on proximity, similar land use, similar drainage area size, and the highest correlation coefficient with El Toro Creek.

Table 7-1. Reference Stream Correlations with El Toro Creek.

	Watershed	USGS Gage	Drainage Area (mi^2)	USDA Ecoregion	Area Ratio	Land Use	Correlation Coefficient
Target Watershed	**El Toro Creek**	Partial Record 11153540	31.9	CCC	-		**-**
Potential Reference Streams	**Gabilan Creek**	11152600	36.7	CCC	1.15		**0.705**
	Corralitos Creek	11159200	27.8	CCC	0.87		**0.499**
	Clear Creek	11154700	14.1	CVCR	0.44		**0.612**

CCC=Calif. Central Coast Ecoregion
CVCR=Central Valley Coast Ranges Ecoregion



The flow regression for El Toro Creek and Gabilan Creek is shown in Figure 7-1. To complete the El Toro Creek flow record, daily flows from Gabilan Creek from October 2001 to December 2006 were adjusted by the regression equation in Figure 7-1, and added to the flow record gap in the partial El Toro Creek flow record. This effectively creates a complete flow record for the Toro Creek gage during the period in which all the monitoring data in the project area has been collected.

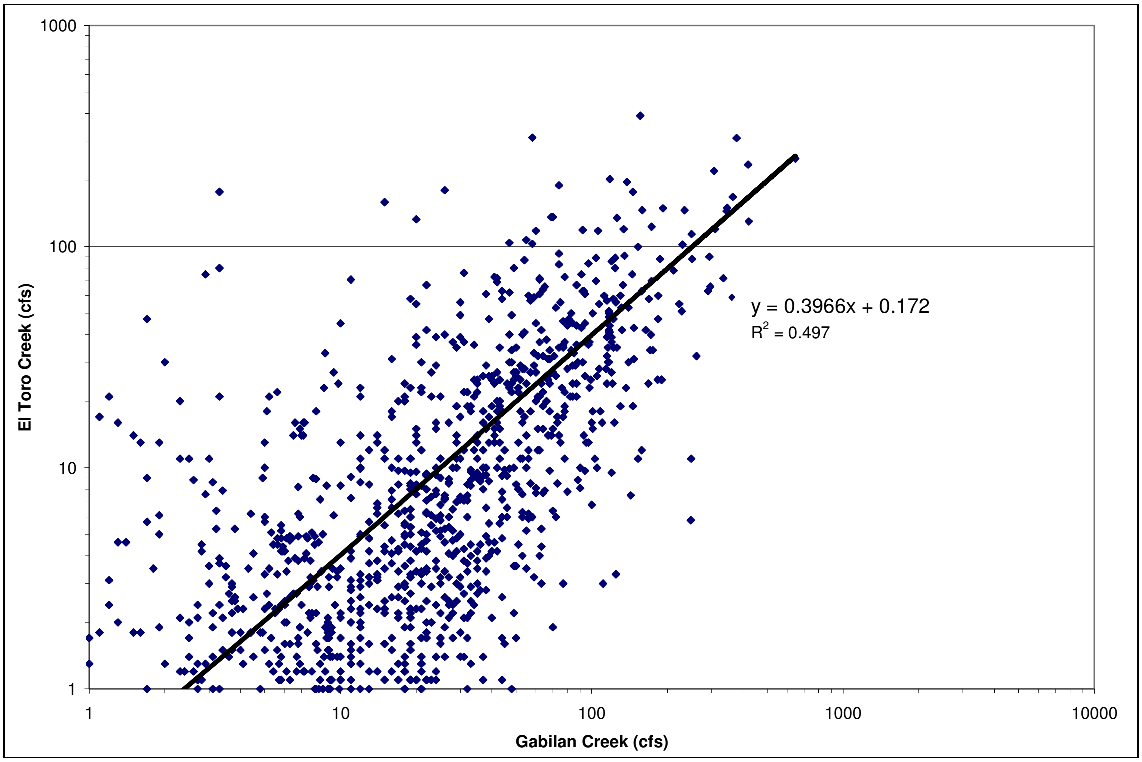


Figure 7-1 Flow Regression for El Toro Creek flow vs. Gabilan Creek flow.

7.2.2 Estimating Flow at Ungaged Streams

7.2.2.1 Flow Estimation using USGS Stream Gages

Several streams in the project area have USGS stream flow data (see Figure 2-3). However, as noted previously, not all watersheds in the project area have gaging stations or flow data available to develop flow duration curves and load duration curves. In such cases flow estimation techniques are needed. A simple and widely used analytical method to develop a flow record for ungaged watersheds, is the drainage area ratio method (DAR). The DAR method is a simple, widely used analytical approach for developing discharge for ungaged watersheds/sites using discharge data from gaged watersheds. DAR is recognized by USEPA as a standard flow estimation method for ungaged sites (USEPA, 2007(a) and 2007(b)). The DAR method is most reliable when land use characteristics of the ungaged and gaged watersheds are similar, and when the size ratio between the drainage areas of the ungaged site and the gaged site is between 0.3 and 1.5 (USGS, 2000). DAR assumes that flow at the ungaged stream is proportional to the ratio of the drainage areas between the ungaged stream, and the gaged stream. The DAR flow transfer method is calculated as:

$$Flow_{ungaged} = Flow_{gaged} \; x \; \frac{Area_{ungaged}}{Area_{gaged}}$$

Because DAR simply assumes that the streamflow at an ungaged site is the same per unit area as a nearby hydrologically similar stream gaged station, and the method does not account for spatial variations in precipitation and runoff, the DAR method is generally best used for transferring flows between sites within the same drainage basin.

To minimize uncertainty in flow estimates in this project report, a modified version of the State Water Resources Control Board DAR method (SWRCB, 2002) was used, making corrections for spatial variation in precipitation and in surface runoff characteristics. Unlike the standard DAR method, which simply transfers flows between gaged and ungaged sites by making a correction based on the drainage area ratio (i.e., ratio of ungaged watershed size to the gaged watershed size), the SWRCB DAR method incorporates a correction factor for spatial precipitation variations. The SWRCB method can be used to transfer flow statistics from one drainage basin to another basin (personal communication, Bill Cowen, SWRCB). The DAR equation used by the SWRCB to estimate streamflow statistics is:

$$Q_{ug} = Q_g \times \frac{A_{ug}}{A_g} \times \frac{I_{ug}}{I_g} \quad \text{(equation 1)}$$

Where

- Q_{ug} is the mean daily flow (cfs) at ungaged location.
- Q_g is the mean daily flow (cfs) at gaged location.
- A_{ug} is the watershed drainage area above the ungaged site (acres).
- A_g is the watershed drainage area above the gaged site (acres).
- I_{ug} is mean annual precipitation in the ungaged watershed.
- I_g is mean annual precipitation in the gaged watershed.

The SWRCB DAR method however, does not account for spatial variations in surface runoff characteristics. In an effort to further reduce uncertainty in the flow estimates, a correction factor was added to the SWRCB DAR equation. The correction factor accounts for spatial differences in land runoff characteristics by using area-weighted runoff coefficients for the various watersheds (a method used for example, in the State of Michigan Ecorse Creek *E. coli* TMDL, 2008). An area-weighted runoff coefficient is used where a drainage area is composed of subareas each having different runoff coefficients. The area-weighted runoff coefficient is in effect a composite coefficient for the total drainage area based on the percentage of different types of land surface in the drainage area. The area-weighted runoff coefficient is computed by dividing the summation of the products of the size of the subareas and their runoff coefficients, by the total area.

Therefore, the SWRCB DAR equation shown in Equation (1), was modified with a correction factor which accounts for differences surface runoff characteristics between the gaged and ungaged drainages, as below:

$$Q_{ug} = Q_g \times \frac{A_{ug}}{A_g} \times \frac{I_{ug}}{I_g} \times \frac{R_{ug}}{R_g} \qquad \text{(equation 2)}$$

Where:

R_{ug} is the area-weighted runoff coefficient in the ungaged watershed.
R_g is area-weighted runoff coefficient in the gaged watershed.

To use the modified SWRCB DAR method, three USGS reference flow gaged streams were used to estimate flows in ungaged streams in the project area. Reference stream gages are Reclamation Canal (USGS 11152650) and El Toro Creek (USGS 11153540) – see Figure 2-3. Clear Creek (USGS 11154700) in adjacent San Benito County was used as a reference flow gage for Towne Creek. The ungaged streams in the project area were compared and grouped with gaged streams based on similar land use and topography.

USGS 11152650 (Reclamation Canal) was used as a reference gage for Santa Rita Creek, Blanco Drain, and Alisal Slough (remnant). These subwatersheds are low-gradient valley floor waterbodies characterized by predominantly agricultural and urban land uses.

USGS 11153540 (El Toro Creek) was used as a reference gage for Alisal Creek, Natividad Creek, Quail Creek, and Chualar Creek. These streams are all characterized by flat to hilly topography (with significant proportions of the watersheds draining head water reaches in mountainous terrain), and are characterized predominantly by forest, grassland, or rangeland land use categories.

USGS 11154700 (Clear Creek in adjacent San Benito County to the east) was used as a reference gage for Towne Creek. Because of the small size of the Towne Creek drainage (4 mi^2), it was not appropriate to transfer flow statistics from project area gaged watersheds to Towne Creek, as the watershed size ratios were an order of magnitude in difference. The Clear Creek gage was the only nearby reference gage that represents a similar small drainage located in hilly, forested terrain.

7.2.2.2 Daily Flow Estimation from Instantaneous Flow Measurements

Tembladero Slough is not gaged but instantaneous flow data was collected by Harris et al. (2007) at Haro Road in Castroville, less than half a mile upstream of project area monitoring site TEM-PRE. Harris et al. used this data to estimate mean daily flow on Tembladero Slough by regressing their instantaneous flow measurements of the slough's discharge against mean daily discharge values reported at USGS 11152650 (Reclamation Canal). Therefore, in this project report, mean daily flow at TEM-PRE was estimated using the flow regression analysis for Tembladero Slough as given by Hager et al. (2007). Once a flow record was created for TEM-PRE, flow data was subsequently estimated at TEM-MOL (downstream of TEM-PRE, at the confluence of Tembladero Slough and the Old Salinas River) by simply using the drainage area ratio between TEM-PRE and TEM-MOL and adjusting estimated flows for TEM-MOL accordingly. The drainage area ratio between TEM-MOL and TEM-PRE was estimated to be 1.1, based on measurements of GIS shape files of USGS catchment drainage areas.

7.2.2.3 Flow Estimation for Coastal Confluence Water Bodies

It is not possible to estimate mean daily flow data for coastal confluence water bodies in the project area (Salinas River Lagoon; Old Salinas River). These are receiving waterbodies and are not typically characterized by measurable unidirectional flow, and flows are also complicated by tidal influences. However, available literature data is used here to estimate the mean annual and monthly water budget for these coastal waterbodies. Mean annual inflow to the Salinas River Lagoon is estimated from reporting by Monterey County Water Resources Agency (MCWRA, 2001). MCWRA (2001) estimates inflow into the Salinas Lagoon based on discharge measurements upgradient of the lagoon at USGS 11152500 (Salinas River at Spreckles). This method does not explicitly account for changes in water volume within the lagoon, but by basing the total fecal coliform load only upon the inflow into the Salinas River Lagoon, the estimated allowable load is conservatively calculated.

Outflow from the Old Salinas River is estimated from a water budget analysis of Watsonville Slough (Hager et al., 2004). Watsonville Slough is a nearby coastal confluence waterbody in Santa Cruz County. Watsonville Slough is similar to the Old Salinas River in landuse, size, and hydrologic characteristics. As such, outflow estimates from Watsonville Slough can be transferred to the Old Salinas River by proportionally adjusting outflows in accordance with the modified SWRCB DAR method described in Section 7.2.2.1. As a result, annual and monthly mean outflow for the Old Salinas River were estimated from the Watsonville Slough estimates, using the modified SWRCB DAR method (Equation 2), and the flow correction values as explained in section 7.2.2.4.

7.2.2.4 Area-Weighted Runoff Coefficients

As outlined in Section 7.2.2.1, flow statistics for ungaged sites were derived from a modified version of the SWRCB DAR method (Equation 2), utilizing spatial differences in runoff characteristics of the various watersheds. Table 7-2 shows the area-weighted runoff coefficients (RC) for the various watersheds in the project area. Both gaged and ungaged watersheds are evaluated in Table 7-2, so that an RC correction factor can be developed to transfer flow data from gaged sites to ungaged sites. Land use-specific runoff coefficients in Table 7-2 come from the Oregon Dept. of Transportation, Hydraulics Manual (2005). The Oregon Dept. of Transportation provides average runoff coefficients for various land uses, and associated topographies (flat, rolling, hilly) which are shown in Table 7-2.

Table 7-2. Area-Weighted Runoff Coefficients.

			Landuse (acres)						
	Topography	**Waterbody**	**Developed**	**Agriculture**	**Forest Shrub**	**Grassland Pasture**	**Barren Rock**	**Wetland**	**Area-weighted Runoff Coefficient**
Gaged Reference Watersheds	Coastal Confluence	**Watsonville Slough**	1601.2	4183.5	5713.1	1450.5	27.2	145.8	**0.262**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.5	
	Flat	**Reclamation Canal***	4608.9	15301	8721.8	6915.6	585.2	0	**0.319**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
	Rolling	**El Toro Creek**	387.9	25.9	12517.7	12828.0	1.0	0.0	**0.231**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	
	Hilly	**Clear Creek**	90.2	0	1698.3	37.9	283.8	0	**0.230**
		Runoff Coefficient	0.6	0.45	0.2	0.35	0.85	0.05	
Project Area Ungaged Watersheds	Coastal Confluence	**Old Salinas River**	62.9	1195.3	144.8	10.2	39.5	10.2	**0.383**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
		Salinas Lagoon	103.9	2158.2	210.9	125.3	305.7	146.7	**0.405**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
	Flat	**Tembladero Slough**	2041.9	5322.4	4903.9	4033.6	217.6	200.8	**0.290**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
		Santa Rita Creek	674.3	7002.5	147.0	596.5	129.7	86.5	**0.396**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
		Blanco Drain	390.1	7701.5	49.8	66.4	83.0	0	**0.406**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
		Alisal Slough (Remnant)	125.9	3515.1	3.7	7.4	0	0	**0.403**
		Runoff Coefficient	0.5	0.4	0.1	0.25	0.85	0.05	
	Rolling	**Alisal Creek**	2338.4	11632.8	8584	6541.6	473.6	0	**0.344**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	
		Natividad Creek	281.4	3583.5	1517.8	1917.6	59.2	14.8	**0.355**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	
		Quail Creek	191.0	2427.2	6348.9	1842.9	415.8	0.0	**0.272**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	
		Chualar Creek	149.5	7953.4	11391.9	10046.4	358.8	0	**0.291**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	
		Towne Creek	0	1.5	997.3	1417.1	0	0	**0.238**
		Runoff Coefficient	0.55	0.45	0.15	0.3	0.85	0.05	

The area-weighted runoff coefficients derived Table 7-2 were then used to adjust the SWRCB DAR equation to account for differences in runoff characteristics. For example, the Quail Creek flow values were increased by a factor of 1.18 (0.272/0.231), relative to the El Toro Creek reference gage flow record, due to the ratio in area-weighted runoff coefficients (see Section 7.2.2.5 and Table 7-3).

7.2.2.5 Precipitation, Drainage Area Ratios, and Flow Correction Factors

Mean annual precipitation estimates for project area watersheds were taken from Oregon State University's PRISM (Parameter-elevation Regressions on Independent Slopes Model) Climate Data Explorer (http://prism.oregonstate.edu/). PRISM provides searchable gridded precipitation data sets, which allow one to analyze time series and summary statistics for single spatial grid-points. Latitude-longitudes for project area monitoring points, and their associated subwatersheds, were entered into PRISM to obtain mean annual precipitation for each subwatershed. It was assumed that mean annual precipitation of the PRISM grid point in the subwatershed was representative of mean annual precipitation throughout the subwatershed.

With spatial differences in precipitation and surface runoff characteristics tabulated, the modified SWRCB DAR equation (Equation 2) can be used in conjunction with drainage area ratios, to transfer flow statistics from gaged watersheds to ungaged watersheds. Table 7-3 summarizes the drainage area ratios, precipitation ratios, and runoff coefficient correction factors used to estimate the flow at ungaged locations. Ungaged watersheds are grouped with their reference gaged watersheds based on similar landuse and topography, as previously outlined in Section 7.2.2.1. In most cases, the upstream drainage area of the ungaged stream is estimated relative to a monitoring point located at or near the lowest drainage point of the watershed, except where noted (SRC-COR).

Table 7-3. Drainage Areas, Drainage Area Ratios (DAR), Precipitation, and Landuse Correction Factors used to develop Discharge Data at Ungaged Locations.

Topography	Location	Drainage Area (sq. mi.)	DAR A_{ug}/A_g	Precipitation (inches)	Precipitation Ratio I_{ug}/I_g	Area Weighted Runoff Coef.	Runoff Coef. Ratio R_{ug}/R_g	Final Flow Adjustment Ratio
Coastal Confluence	Watsonville Slough[A]	20.5	-	21.6	-	0.262	-	-
	Old Salinas River*	41.7	2.03*	17.1	0.79	0.332	1.16	**2.04**
	Salinas Lagoon**	-	X	16.12	X	X	X	**N.A.**
Flat	Reclamation Canal @ USGS 11152650	56	-	15.44	-	0.319	-	**-**
	Tembladero Slough[B]	26.1	X	X	X	X	X	N.A.
	Santa Rita Creek @SRC-COR	9	0.16	16.39	1.06	0.396	1.24	**0.21**
	Blanco Drain	13	0.23	14.58	0.94	0.406	1.27	**0.28**
	Alisal Slough (Remnant)	5.7	0.10	14.58	0.94	0.403	1.26	**0.12**
Rolling	El Toro Creek @ USGS 11153540	31.9	-	17.1	-	0.231	-	**-**
	Alisal Creek	46	1.44	13.59	0.79	0.344	1.49	**1.71**
	Natividad Creek	11.5	0.36	16.28	0.95	0.355	1.54	**0.53**
	Quail Creek	17.5	0.55	14.59	0.85	0.272	1.18	**0.55**
	Chualar Creek	47	1.47	12.86	0.75	0.291	1.26	**1.40**
Hilly	Clear Creek @USGS 11154700	14.1	-	20.9	-	0.230	-	
Rolling	Towne Creek	4.0	0.28	23.6	1.13	0.238	1.03	**0.32**

Topography	Location	Drainage Area (sq. mi.)	DAR A_{ug}/A_g	Precipitation (inches)	Precipitation Ratio I_{ug}/I_g	Area Weighted Runoff Coef.	Runoff Coef. Ratio R_{ug}/R_g	Final Flow Adjustment Ratio

= Gaged Reference stream

A: No flow gage, outflow was estimated from Watsonville Slough Water Budget analysis by Questa Engineering (1995).
B. Mean daily flow was estimated from flow regression equation provided in Hager et al. (2007)

*Includes upgradient tributaries Reclamation Canal subwatershed (3a) and Tembladero Slough subwatershed. Runoff coefficient is composite area weighted runoff coefficient of all three subwatersheds

**Inflow values estimated from discharge measurements at upstream USGS 11152500, as reported in MCWRA (2001).

***Santa Rita Creek drainage area upstream of monitoring site SRC COR

Using the ratios and correction factors from Table 7-3 in conjunction with Equation 2, a final flow adjustment ratio was calculated in the right hand column of Table 7-3. Estimated flow records for ungaged streams were then derived from their respective reference stream gage records using this flow adjustment ratio. For example, the mean daily El Toro Creek flow record was adjusted by a factor of 1.71, to derive a synthetic flow record for Alisal Creek. Likewise, the mean daily Reclamation Canal flow record was adjusted by a factor of 0.21 to derive a synthetic flow record for Santa Rita Creek. Flow duration curves were constructed using the estimated flow records of ungaged streams using a spreadsheet tool developed by Bruce Cleland, USEPA. (See Section 7.2.3).

Additionally, daily flow records for steams with instantaneous flow data (Tembladero Slough) were estimated as previously outlined in Sections 7.2.2.2.

Lastly, outflow for coastal confluence waterbodies were estimated, as previously outlined in Section 7.2.2.3. Figure 7-2 shows the estimated outflows from the Old Salinas River as derived from the Watsonville Slough outflow water budget reported in Hager et al. (2004), by adjusting the Watsonville Slough flows by the correction factor shown in Table 7-3. Figure 7-3 shows estimated inflow into the Salinas River Lagoon based on discharge data at upstream USGS 11152500.

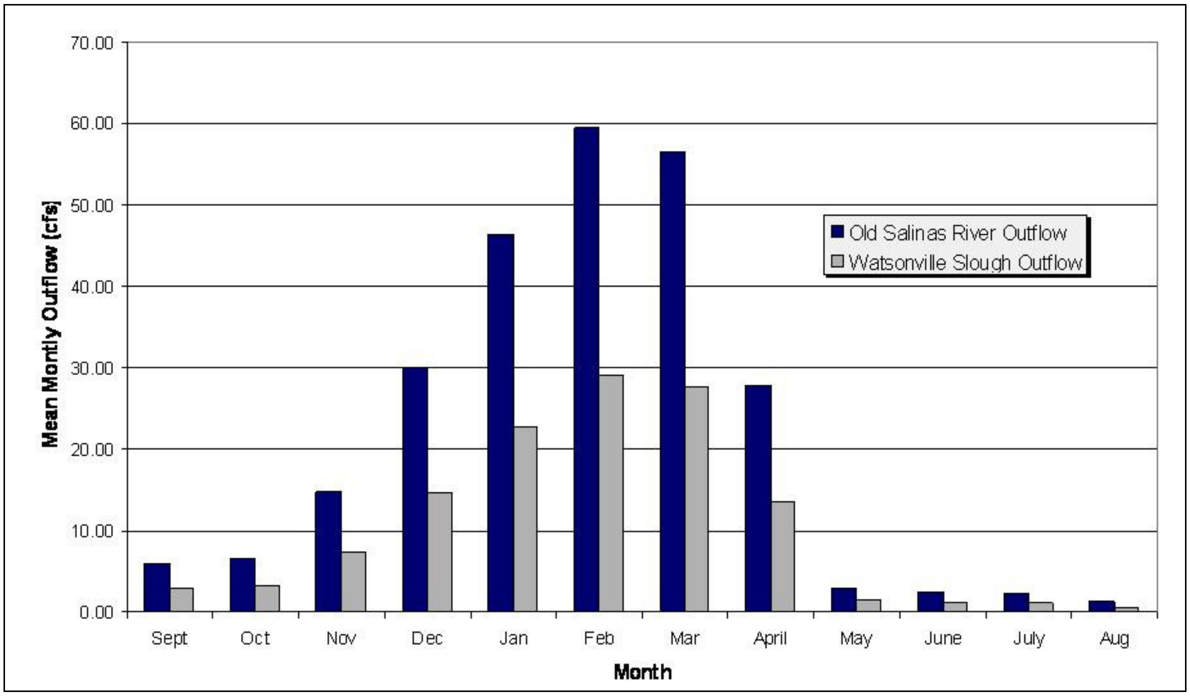


Figure 7-2. Estimated Outflow from Old Salinas River.

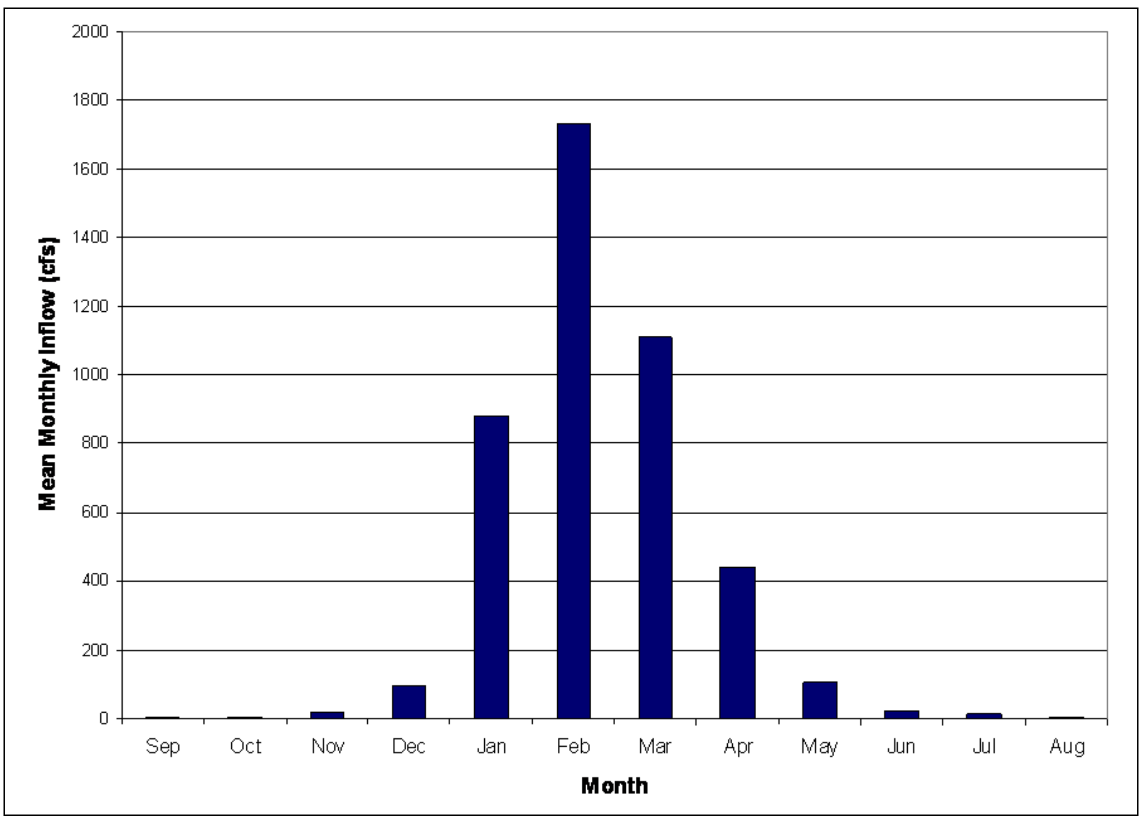


Figure 7-3. Estimated Salinas Lagoon Inflow.

7.2.2.6 Validation of Synthetic Flow Estimates

Finally, synthetic flow estimates derived in this Project Report were checked for reasonableness and consistency against historical discharge estimates from other published sources, and against instantaneous flow monitoring data and other metrics staff could identify.

In 1978, the Monterey County Water Resources Agency (MWRCA) estimated that the mean annual discharge from the Blanco Drain was 2,200 acre feet per year (reported in MCWRA, 2001). By comparison, flow estimates derived in this Project Report indicate that the mean annual discharge from Blanco Drain is 2,150 acre-feet/year (based on an estimated mean annual flow of 2.97 cfs). The Blanco Drain discharge estimate from data derived in this Project Report is therefore virtually identical to the MCWRA Blanco Drain discharge estimate.

Instantaneous flow field measurements for Natividad Creek have been reported by the Water Board (2008). These field data were collected monthly between January 2005 and December 2007 at monitoring site 309NAD. Staff assessed how the synthetic flow record for Natividad Creek derived in this Project Report compared to the reported field measurements of instantaneous flow. Using the Excel spreadsheet correlation tool, Staff calculated a correlation coefficient of 0.841 for the log normalized synthetic flow record and the instantaneous flow field measurements. The coefficient of determination (R^2), using the Excel trend analysis tool, ranges from 0.71 to 0.79 as shown in Figure 7-4. Therefore, it appears that the Natividad Creek estimated synthetic flow record comports reasonably well with instantaneous flow field measurements.

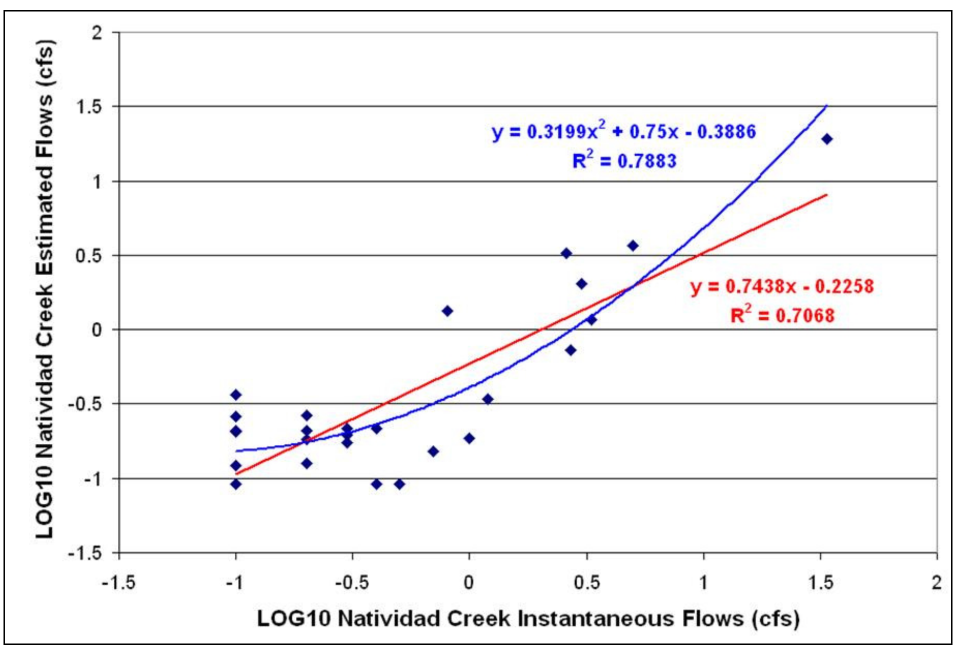


Figure 7-4. Natividad Creek, Estimated Synthetic Flows versus Instantaneous Flow Field Measurements.

Modeled discharge data for the Old Salinas River near its confluence with Moss Landing Harbor has been reported by Flow Science Inc. (2005). The modeled discharge data was calibrated to match temperature data. Modeled flow was calculated only over ebbing tidal periods, during which time the Old Salinas River discharges into Moss Landing Harbor, ultimately discharging through Elkhorn into Monterey Bay. As a result, Flow Science Inc. reported an ebb tidal discharge from the Old Salinas River as 10 m^3/sec (353 cfs) over the period April 16-April 22, 2003.

It is important to recognize that ebb tides only occur for several hours a day, Broenkow and Breaker (2005) reported that Elkhorn Slough is an ebb tidal current dominated system, with flood tides lasting almost twice as long as ebb tides. Tidal current measurements of the semidiurnal cycle, as shown in Broenkow and Breaker (2005), indicate that ebb tide cycles appear to occur for about a total of 4 hours during a 24 hour cycle (Figure 7-5). During ebb tides, the Old Salinas River discharges into the southern end of Moss Landing Harbor (Chapin et al., 2004). During slack tides, or flood tides there should be little to no discharge from the Old Salinas River to Moss Landing Harbor.

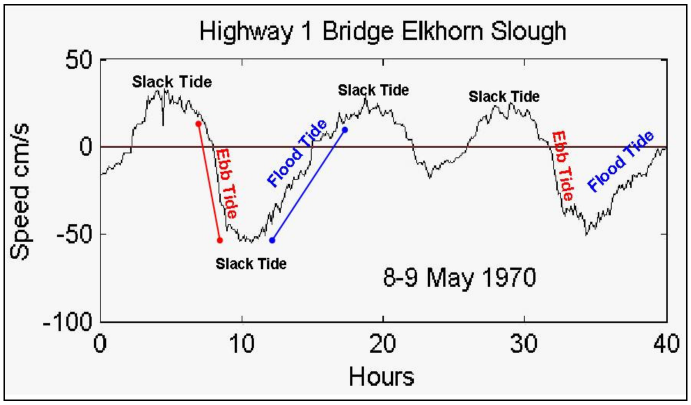


Figure 7-5. Elkhorn Slough Tidal Current Velocity and Cycle (modified from Broenkow and Breaker 2005).

As such, the reported Old Salinas River ebb tide discharges reported by Flow Science Inc, translated to a mean *daily* basis, should be in the range of 59 cfs mean daily outflow, assuming a temporal duration of 4 hours of ebb tide per day. In contrast, synthetic flow record estimates derived in this Project Report indicate that the mean April discharge from the Old Salinas River at OLS-MON is 28 cfs. This is significantly less that the estimated 59 cfs estimate derived from ebb tide flows modeled by Flow Science Incorporated. However, a review of precipitation records indicates that rainfall in April 2003 (the period the Flow Science Inc. ebb tide discharge was modeled) was between 118% to 137% above normal (NOAA Salinas #2 COOP, and CIMS Castroville #19 weathers stations, respectively). All other things being equal, and increasing the Project Report synthetic mean April monthly flow by 118 to 137% in accordance with the precipitation correction factor as used in equation (2), the April 2003 monthly discharge for the Old Salinas River would be expected to be around 61 to 66 cfs. These values appear to comport reasonably well with the Flow Science Inc. modeled mean daily discharge estimate of ~59 cfs.

Lastly, the potential affects of water rights diversions to the calculated synthetic flows were evaluated. Flow transfer statistics using drainage area ratio methods do not explicitly account for water diversions due to anthropomorphic activities in the ungaged streams. If the magnitude of water diversions are large or significant in an ungaged stream, it may introduce significant uncertainty or error to the transferred flow statistics from a nearby gaged stream.

The State Water Resources Control Board (SWRCB) evaluated the impact of water diversions on the SWRCB DAR flow estimation method in the North Coast region of the state. SWRCB concluded that the magnitude of diversions were too small to introduce any significant error to transferred flow statistics from gaged streams to ungaged streams (personal communication, Bill Cowen, SWRCB). Simply put, trying to quantify and remove the flow diversions from the DAR estimated flow statistics was deemed to be not worth the effort by SWRCB, because the effect of diversions on seasonal flow were so small.

In an effort to evaluate if this was likewise the case in the Lower Salinas Valley, water rights diversion data for the project area was obtained from the SWRCB's web-based GIS water rights mapping system- eWRIMS (waterrightsmaps.waterboards.ca.gov/ewrims). Table 7-4 shows the magnitude of water rights diversions on project area streams, as identified from eWRIMS. The magnitude of flow diversions appears to be insignificant and small enough relative to annual discharges, that the impact of flow diversions relative to the estimated synthetic stream flow statistics is presumed to be inconsequential.

Table 7-4. Project Area Water Diversions.

	Water Rights Diversions (annual acre feet)	Ave. Annual Flow (cfs)	Ave. Annual Discharge acre feet/year	**% of flow diverted annually**
Gabilan Creek @ USGS 11152600	129.1	4.86	3518.5	**3.67%**
Alisal Creek (synthetic flow record)	42	4.22	3055.2	**1.37%**
Natividad Creek (synthetic flow record)	8.7	1.31	948.4	**0.92%**

In summary, the synthetic flow estimates derived in this project report appear to be reasonable and consistent with respect to discharge estimates from other published sources, with continuous flow monitoring data, and with water rights stream flow diversion information.

7.2.3 Flow Duration Curves

Figure 7-6 shows an example of a flow duration curve developed for this project report. The horizontal axis is essentially a flow frequency distribution, depicting the percentage of times a certain flow is exceeded on a daily basis. As such, highest flows are represented on the extreme left side of the horizontal axis, lowest flows recorded are represented the extreme right side of the axis.

For perennial streams, with sustained and broad flow conditions, the flow frequency is often split into 5 flow regimes, from highest to lowest flows. Central Coast streams in contrast, tend to be flashy, or have intermittent flows, with short durations of high flows following precipitation events, followed by long, extended periods of low or no flows. Because of the lack of sustained and broadly varying flow conditions, the flow frequencies developed for project area streams were limited to three flow regimes: high, moderate, and low (see Table 7-5).

Table 7-5. Hydrologic Flow Regime Classes.

Flow Duration Interval	Hydrologic Flow Regime Class
0-10%	High Flows
10-40%	Moderate Flows
40-100%	Low Flows (or Dry)

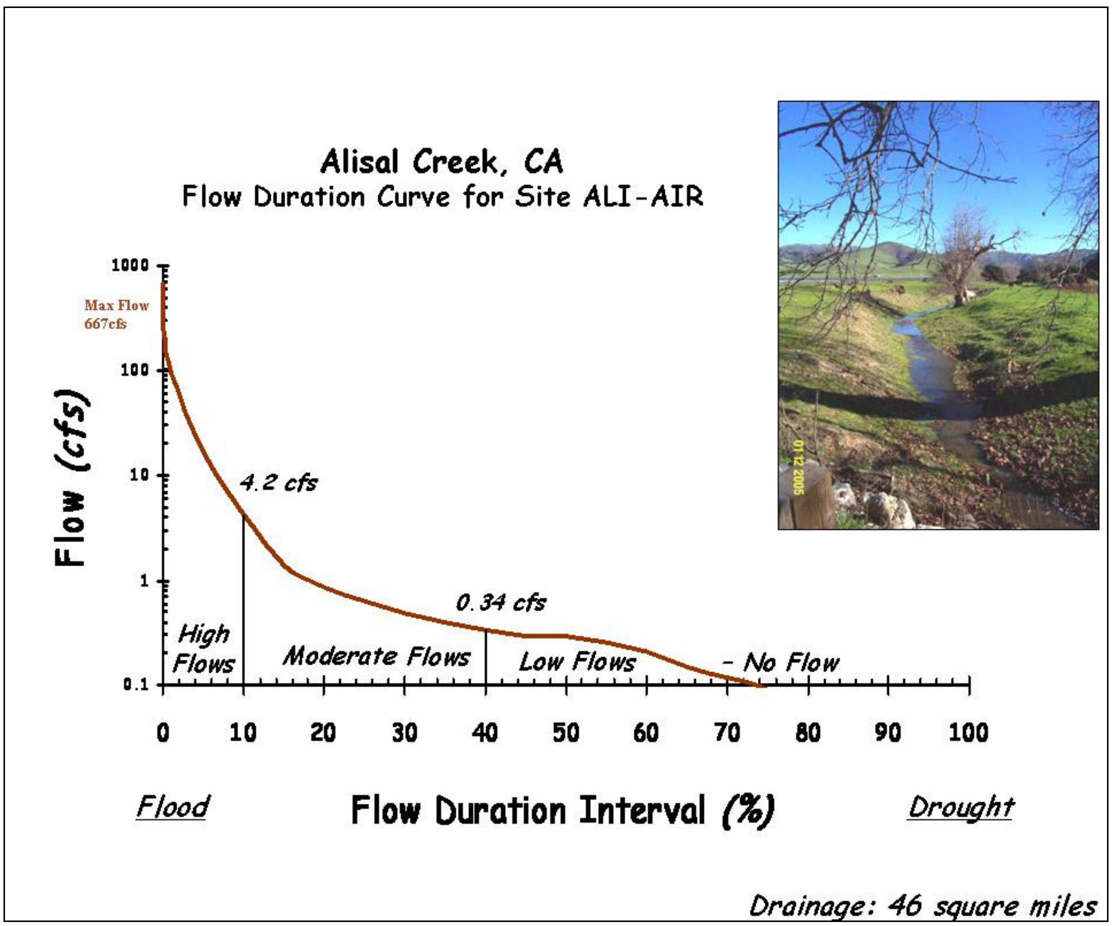


Figure 7-6. Flow Duration Curve for Alisal Creek.

The remainder of the flow duration curves developed for waterbodies in the project area are presented in Appendix H.

7.3 Load Duration Curves

A load duration curve is the allowable loading capacity of a pollutant, as a function of flow. The flow duration curve is transformed into a load duration curve by multiplying the flow by the water quality objective and a conversion factor. The water quality objective that staff selected to calculate the load duration curve was the instantaneous fecal coliform Basin Plan criterion 400 MPN/100 mL. The load duration curve is thus calculated by multiplying the flow at the given flow exceedance percentile, by the instantaneous fecal coliform criteria and unit conversion factors; therefore the loading capacity is:

$$\text{Loading Capacity (MPN/day)} = \overset{\text{Water Quality Criterion}}{400\ \text{MPN/100mL}} * \overset{\text{Flow}}{Q\ (\text{cfs})} * \overbrace{283.2\ \text{100mL/ft}^3 * 86400\ \text{sec/day}}^{\text{Unit Conversion Factors}}$$

The load duration method essentially uses an entire stream flow record to provide insight into the flow conditions under which exceedances of the water quality objective occur. Exceedances that occur under low flow conditions are generally attributed to loads delivered directly to the stream such as straight pipes, domestic animals or wildlife with access to the stream, or some other form of direct discharge. Exceedances that occur under high flow conditions are typically attributed to loads that are delivered to the stream in stormwater runoff. Exceedances occurring under during normal flows can be attributed to a combination of runoff and direct deposits.

The load duration curve is derived from the flow duration curves and water quality monitoring data, as outlined in Section 7.1. Points plotting above the curve represent loads deviating from the water quality objective (the allowable load). Those plotting below the curve represent compliance with standards and represent loads below the maximum loading capacity. A generic example of a fecal coliform load duration curve is shown in Figure 7-7. Points above the curve on the left side of the figure are indicative of fecal coliform exceedances during wet weather conditions (higher flows) and when data points plot above the curve to the right side it indicates fecal coliform exceedances during dry weather conditions (lower flows).

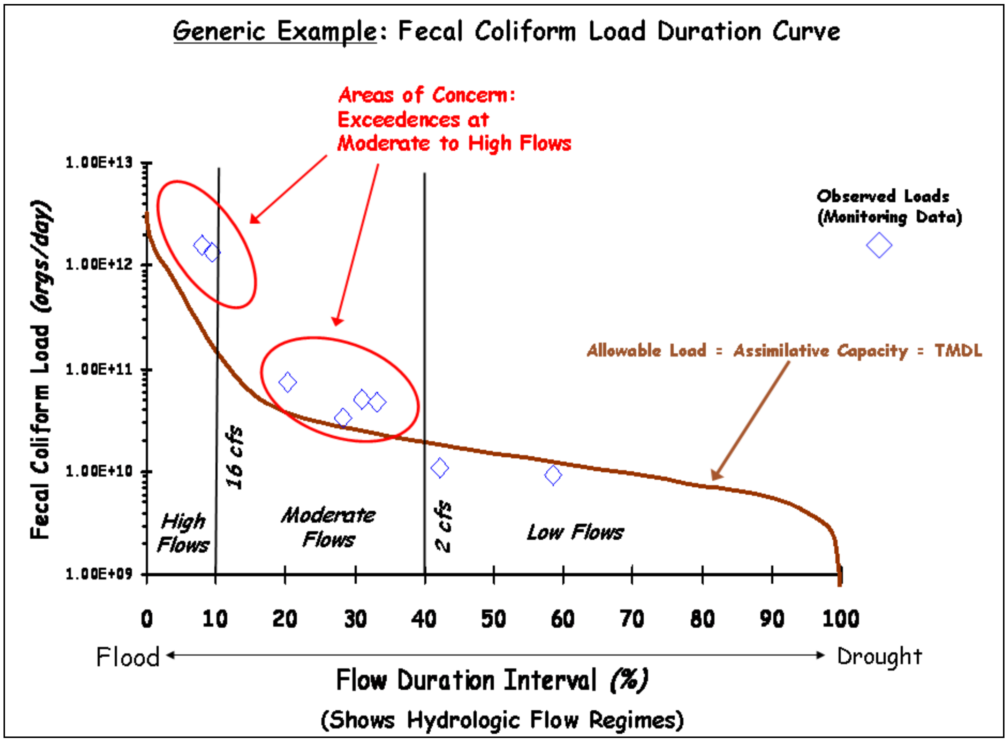


Figure 7-7. Generic Example of Fecal Coliform Load Duration Curve.

A load duration curve (LDC) considers how flow conditions relate to a variety of pollutant sources, and therefore load duration curves can be useful in differentiating between loading from point and nonpoint sources (see Table 7-6). For example, In the generic LDC example in Figure 7-7, excursions above the water quality objective at high to moderate flows appear to suggest that non-point sources and stormwater flows are potential sources.

Table 7-6. Potential Relationship Between Load Duration Curve and Contributing Sources

Contributing Source	**Flow Regime-Load Duration Curve**		
	High Flow	**Moderate Flow**	**Low Flow**
Direct Point Sources (pipe discharge, etc)			*H*
Direct Delivery (livestock in-stream, wildlife, pets, illegal dumping)		*M*	*H*
Failing OSDS		*M*	*H*
Sediment Resuspension	*H*	*M*	
Stormwater: Impervious areas	*H*	*H*	
Combined sewer overflows	*H*	*H*	
Overland flow/Bank erosion	*H*	*M*	

-Note: Color Shading = Potential relative importance of source area to contribute loads under given hydrologic condition **(H=High; M=Medium)**
-Figure adapted from USEPA, Bruce Cleland, and Oregon Dept. of Environmental Quality

The load duration curve itself can be established as the TMDL. The TMDL would be dynamic and based on flow. Essentially, the loading capacity is the load corresponding to the flow selected along the curve. Alternatively, a static TMDL can be established based on the area beneath the TMDL curve, representing the loading capacity of the stream. The difference between this area and the area representing current loading conditions is the load that must be reduced to meet water quality standards.

7.3.1 Developing Load Duration Curves Using the E. Coli Data

Several stream bodies in the project area have been identified as impaired due to *E. coli* indicator bacteria (Santa Rita Creek, Towne Creek, Natividad Creek). The Basin Plan however does not contain enforceable water quality objectives for *E. Coli*; the Basin Plan bacteria water quality standard is based on fecal coliform bacteria. Fecal coliform bacteria are a subset of total coliform bacteria, and *E. coli* is a subset of fecal coliform. Theoretically, a regression relationship between fecal coliform bacteria and *E. coli* in Project Area waterbodies could be used to convert the *E. coli* values to their equivalent fecal coliform counts. Therefore, in order to plot existing *E. coli* data against the Basin Plan fecal coliform water quality objective (i.e., the allowable load) it is necessary to translate the *E. coli* data from these impaired streams to fecal coliform-equivalents.

Using *E. coli* data to predict in stream fecal coliform counts (or vice versa) is recognized by several State and Federal regulatory agencies. U.S. Geological Survey has reported that concentrations of *E. Coli* correlate well fecal coliform concentrations, and that *E. Coli* concentrations can be predicted, with a relatively high level of confidence from fecal coliform concentrations (USGS, 1993). Further, the Santa Cruz County Health Services Agency has reported that fecal coliform levels correlate very well with *E. Coli* levels (County of Santa Cruz, 2008). This *E. Coli*-fecal coliform correlative relationship has been used by regulatory authorities as a predictive tool of bacteria-equivalent counts. For example, USEPA and the Virginia Department of Environmental Quality agreed to apply a regression-based translator equation which transforms in stream fecal coliform data to equivalent *E. Coli* counts, as the State transitioned from a fecal coliform-based water quality standard to an *E. Coli*-based water quality standard (Commonwealth of Virginia, 2003). In an Alaska TMDL USEPA translated *E. Coli* data to fecal coliform-equivalents using a literature-reported regression equation, due to the fact that the State of Alaska had a fecal coliform-based water quality standard (USEPA, 2000). Likewise, the State of Oregon Department of Environmental Quality has used a regression-based translator equation to convert *E. Coli* data to fecal coliform-equivalent concentrations in TMDL development (Oregon DEQ, 2005). Also, the State of Iowa Department of Natural Resources (State of Iowa, 2006) evaluated the correlation of *E.coli* to fecal coliform, and found that using fecal coliform data to calculate *E. Coli*-equivalent concentrations in order to assess current conditions and develop percentage reduction targets may be appropriate.

Based on the above information from other public regulatory agencies, Staff concluded that translating Project Area *E. Coli* data to fecal coliform-equivalents would be technically reasonable in order to evaluate existing FIB loads relative to the Basin Plan's fecal coliform water quality objective. Translation of *E. Coli* data to fecal coliform-equivalent data was achieved by using a translator equation developed from a regression analysis of 493 paired fecal coliform/*E. coli* data sets from the Water Board's regional monitoring data. The paired data sets are from three geographically contiguous watersheds: the lower Salinas Valley (i.e., current project area); the Pajaro River Watershed; and the Watsonville Slough Watershed. A relatively high correlation coefficient of the raw *E. Coli* (EC) and fecal coliform (FC) data was calculated (r = 0.875). This correlation coefficient comports reasonably well to EC-FC correlation coefficients reported by the previously mentioned public agencies: County of Santa Cruz (2008) reported an EC-FC correlation coefficient of 0.9; USGS (1993) reported EC-FC correlation coefficients ranging from 0.929 to 0.984. Consequently, staff concluded that the EC-FC correlation from the central coast regional data was strong enough, to allow for a robust regression analysis using the log-transformed EC-FC paired data (see Figure 7-8). The translator equation resulting from the regression analysis is shown below:

$$LOG_{10}\ FC = 0.8344 * (LOG_{10}\ EC) + 0.6527 \qquad \text{(equation 3)}$$

The regression relationship can be simplified by taking the anti-log of both sides of equation (3). The result is expressed as:

$$\text{Fecal Coliform} = (\textit{E. Coli})\ \hat{}\ 0.8344 * 4.4947 \qquad \text{(equation 4)}$$

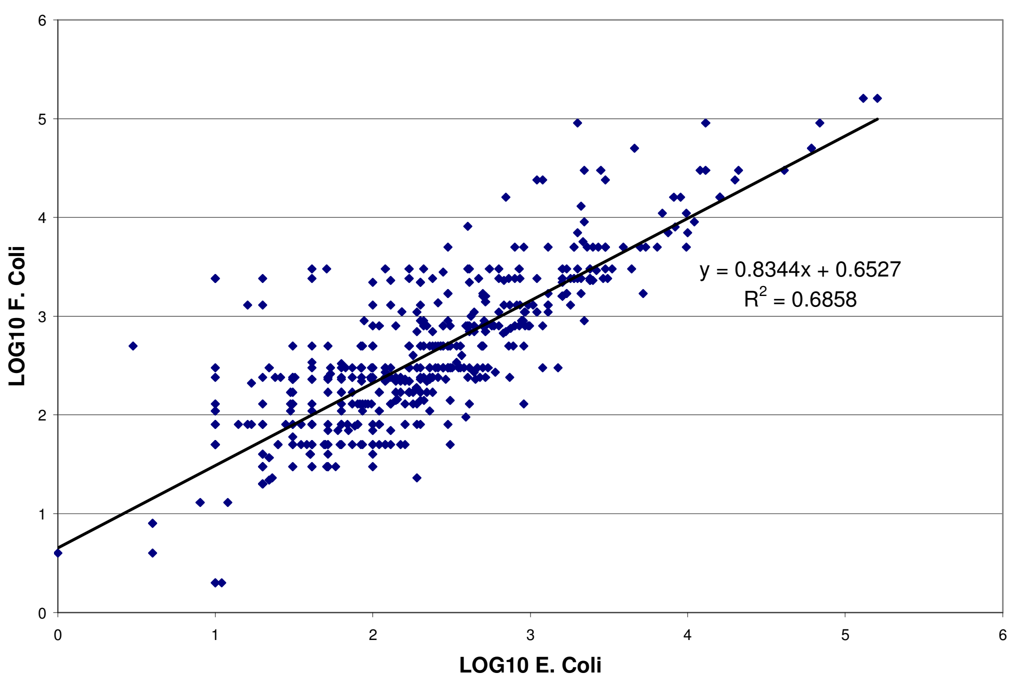


Figure 7-8. *E. Coli* and Fecal Coliform Regression Analysis.

By translating the existing EC data into estimated FC loads and plotting these estimated loads on the load-duration curve, against the FC water quality objective (the allowable load), the number and pattern of exceedances of the water quality objective can be analyzed. It is important to note, that the LDCs here are used for or informational purposes to allow for analysis of water quality response, identify assimilative capacity, to estimate load reductions necessary to meet the water quality objective, and to provide a mechanism to incorporate daily load expressions, per USEPA guidance. As noted earlier, compliance with the TMDL will be implemented as a concentration based TMDL. The translation of *E. Coli* counts to fecal coliform equivalents for relevant monitoring sites are shown in Appendix A.

7.3.2 Percent Reduction Goals

Load duration analysis included a "percent reduction" that was calculated for informational purposes only, to illustrate the difference between existing conditions and the loading capacity at the time the streams were sampled. The percent reduction for each impaired segment is provided in section 7.3.3.

A TMDL provides a foundation for identifying, planning, and implementing water quality-based controls to reduce both point and nonpoint source pollution. Though the data used to calculate the percent reductions may be considered "historical", it provides a representation of the existing FIB loads in the waterbodies over a range of hydrologic conditions. Therefore, the percent reduction *<u>should not be viewed as the TMDL</u>* but rather a goal to work towards in the implementation phase of the TMDL process with the ultimate goal being the restoration and maintenance of in-stream water quality so that beneficial uses are met. The percent reduction can be calculated as:

Percent reduction = [(existing load) - (allowable load)/(existing load)] *100

7.3.3 Determination of Loading Capacity and Existing Load

This section presents the load duration curves and estimates of existing loading for impaired waterbodies in the project area. Also presented for each impaired reach are tables displaying the likely major sources of bacterial loading to that waterbody. Based on the source analysis in Section 4, the estimated relative contribution of each source category is qualified as follows: categories with >20% potential load contribution are defined as a High Contributor; 5%-20% a Moderate Contributor; <5% a Low Contributor.

In accordance with USEPA guidance (USEPA, 2007), and given that the instantaneous fecal coliform criterion states that no more than 10 percent of samples should exceed 400 MPN/100 ml, it is appropriate to evaluate existing loading as the 90th percentile of observed fecal coliform concentrations.

Staff used guidance from USEPA (2007) in using load duration curves to assess existing loads and flow-based assimilative capacity. Therefore, existing loading is conservatively calculated as the 90th percentile of measured fecal coliform concentrations under each hydrologic flow regime class multiplied by the flow at the middle of the flow exceedance percentile. The 90 percentile of measure loads is a more conservative estimate than using the median. For example, in calculating the existing loading under high flow conditions (flow exceedance percentiles = 0-10% percent), the 5th percentile exceedance flow is multiplied by the 90th percentile of fecal coliform concentrations measured within the 0-10th percentile flow class. Similarly, the middle percentile (25%) of the moderate flow regime was used, to assess existing loads at moderate flow (10-40th percentile flow class). Low flows were handled a little differently. Many project area streams are ephemeral, and flow is not observed 100% of the time. In addition, water quality data is rarely available for the 80 to 100th percentile flows, which correspond either to dry stream bed conditions, or extremely limited flows. Therefore, the existing loading at low flow conditions is multiplied by the flow at the 60th percentile flow.

For a graphical example of how existing loads and flow-based assimilative capacities (TMDLs) are determined, refer to Figure 7-9.

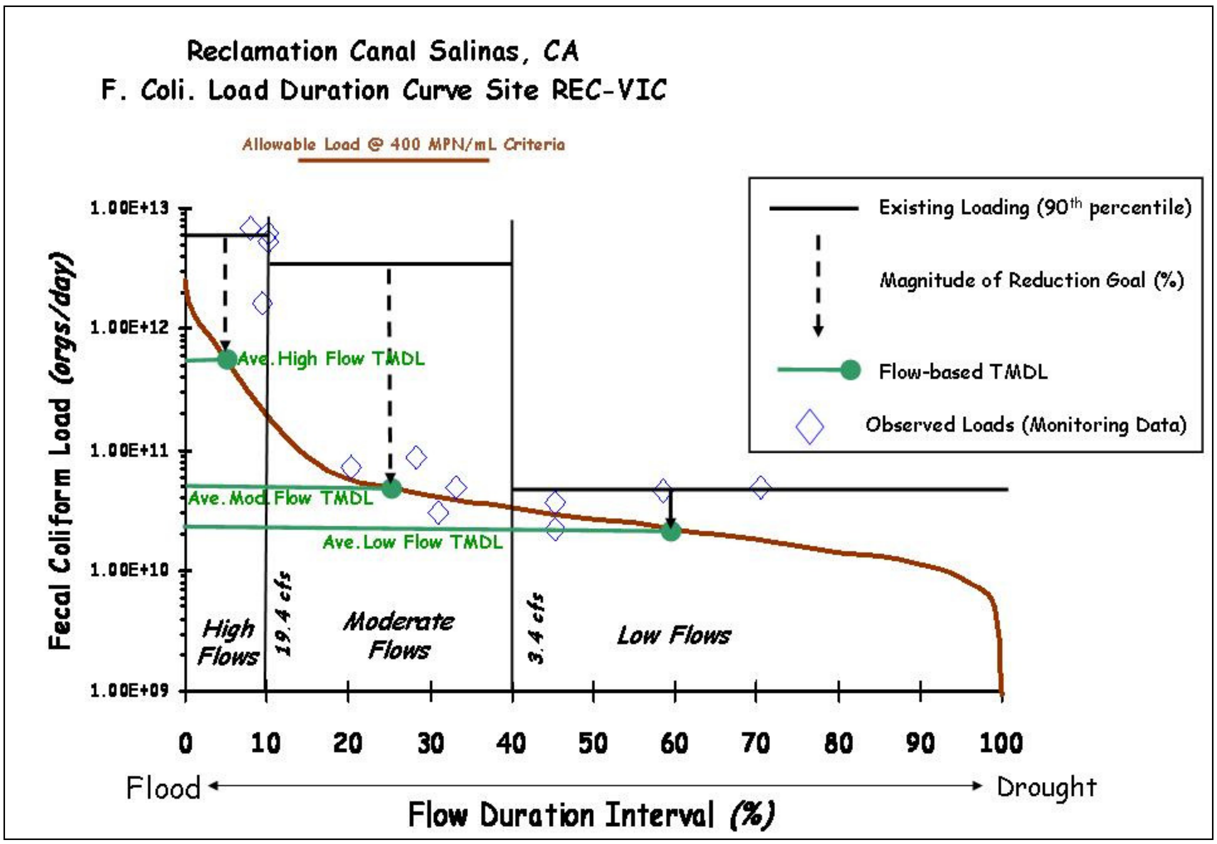


Figure 7-9. Example Assessment of Existing Load, Percent Reduction Goal, and Flow-based TMDLs.

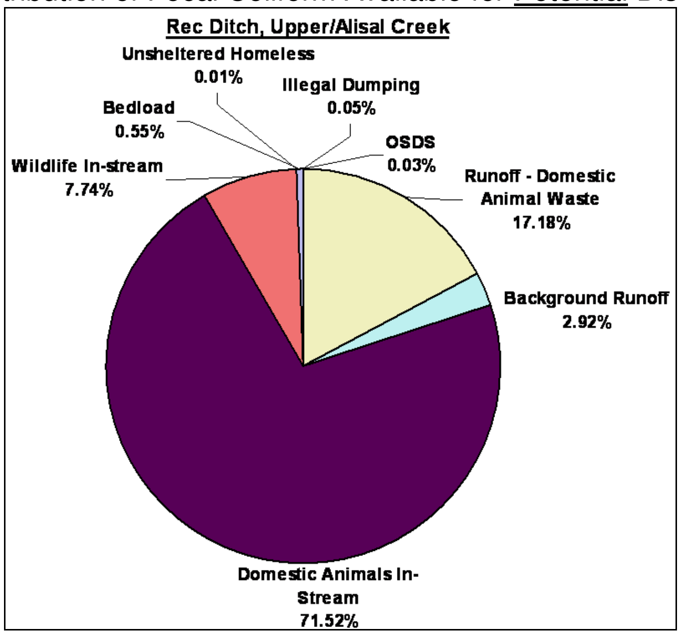
The load duration curves, and assessment of existing loads and flow based TMDLs for each impaired waterbody in the Project Area are presented in Sections 7.3.3.1 through 7.3.3.12. The load duration curves are constructed for monitoring points located closest to the downstream confluence, or river mouth of the associated waterbody. This ensures that the loading capacity of the waterbody, and that all or most source contributions in the watershed drainage are potentially represented.

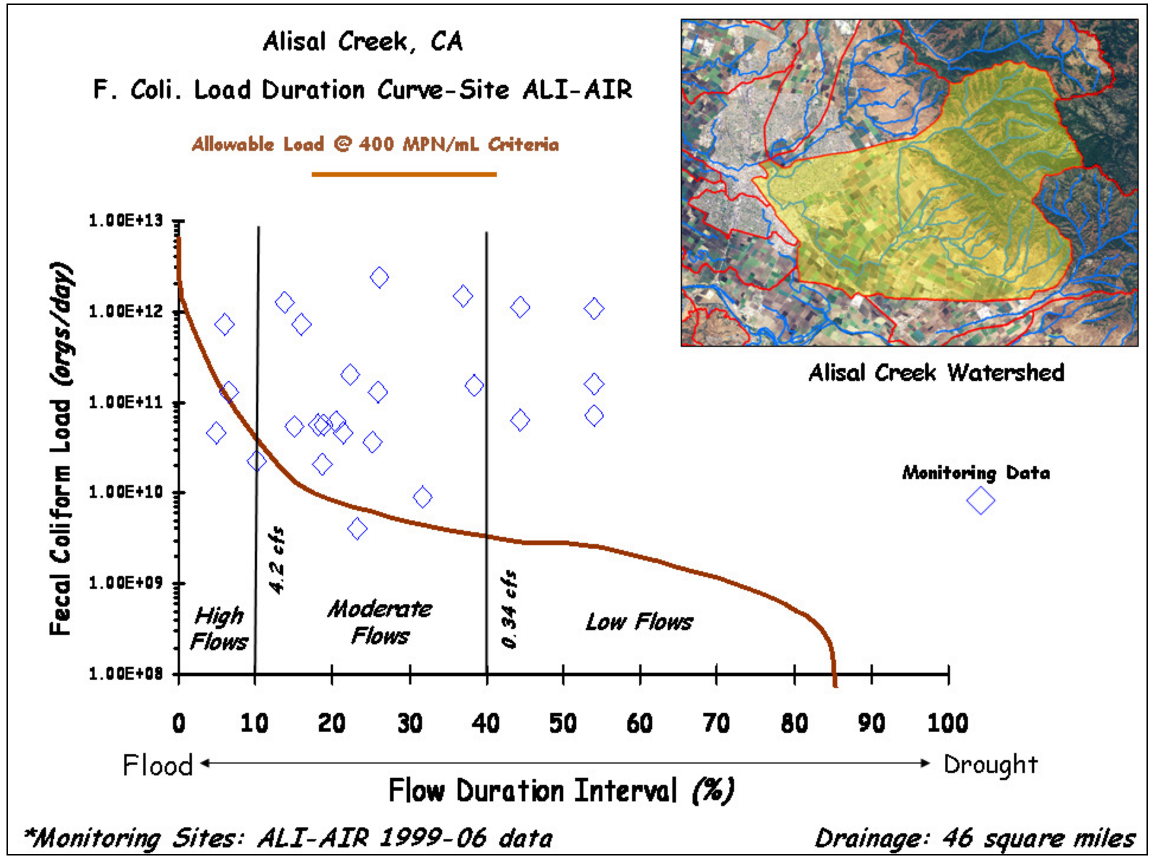
Alternatively, for Project Area coastal confluence waterbodies for which daily flow information is not available and cannot be estimated (Salinas River Lagoon, and Old Salinas River), a temporal/seasonal-based TMDL is provided, rather than a flow-based load expression.

7.3.3.1 Alisal Creek/Reclamation Canal, Upper

The load duration curve method was used to determine the percent reduction necessary in the current load for Alisal Creek to meet the 400 MPN/100mL bacteria criterion Exceedences of the allowable loading capacity at Alisal Creek occur over all flow conditions, suggesting a combination of fecal coliform nonpoint load sources during wet weather conditions (higher flows) and point sources or direct instream deposition during dry weather conditions (lower flows). See Table 7-6.

-Monitoring Site: ALI-AIR
-Drainage Area 46 square miles
-Impaired Reach Length: 16 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife	
	Unsheltered Homeless	
	Bedload	
	Illegal Dumping	

Low Contributor
Moderate Contributor
High Contributor

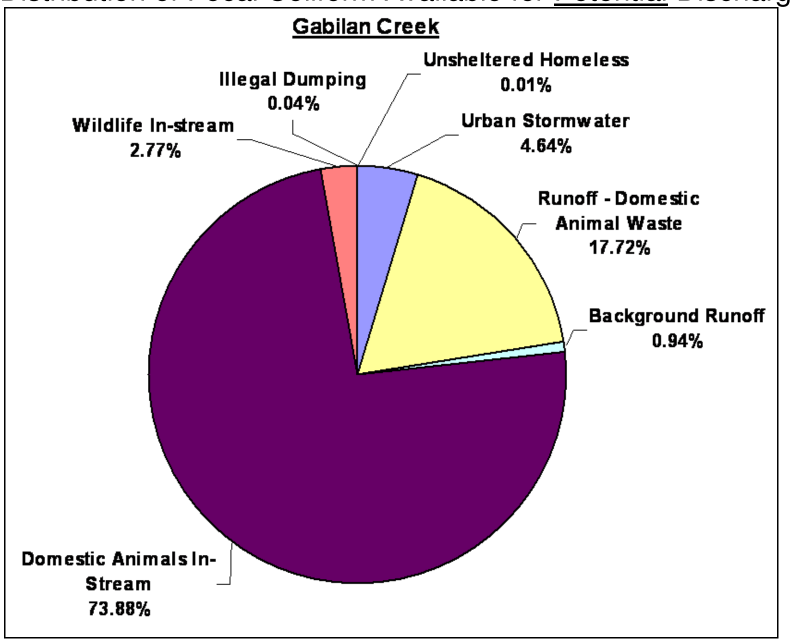
Estimated Existing Fecal Coliform Loading for ALI-AIR with Critical Conditions Highlighted

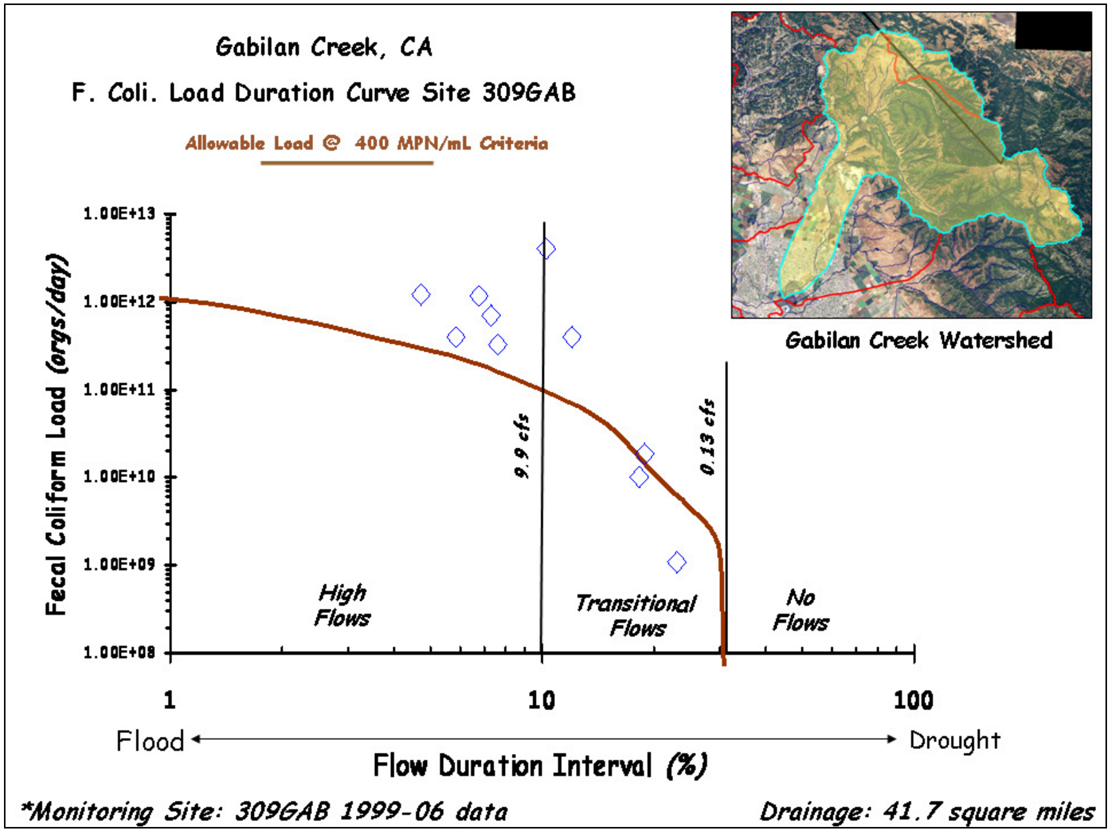
Flow Regime	Allowable Load	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	1.62E+11	5.52E+11	71%
Moderate Flows	6.19E+09	1.37E+12	99%
Low Flows	2.01E+09	1.10E+12	99%

7.3.3.2 Gabilan Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Gabilan Creek to meet the 400 MPN/100mL bacteria criterion. Gabilan Creek only has recorded flow 31% of the year at USGS 11152600. Exceedences of the allowable loading capacity at Gabilan Creek occur over high and transitional flow conditions, suggesting that non-point sources are significant load contributors. See Table 7-6.

-Monitoring Site: 309GAB
-Drainage Area: 41.7 square miles
-Impaired Reach Length: 15 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	
Nonpoint Sources	Domestic Animals	
	Wildlife	
	Unsheltered Homeless	
	Illegal Dumping	

Low Contributor	
Moderate Contributor	
High Contributor	

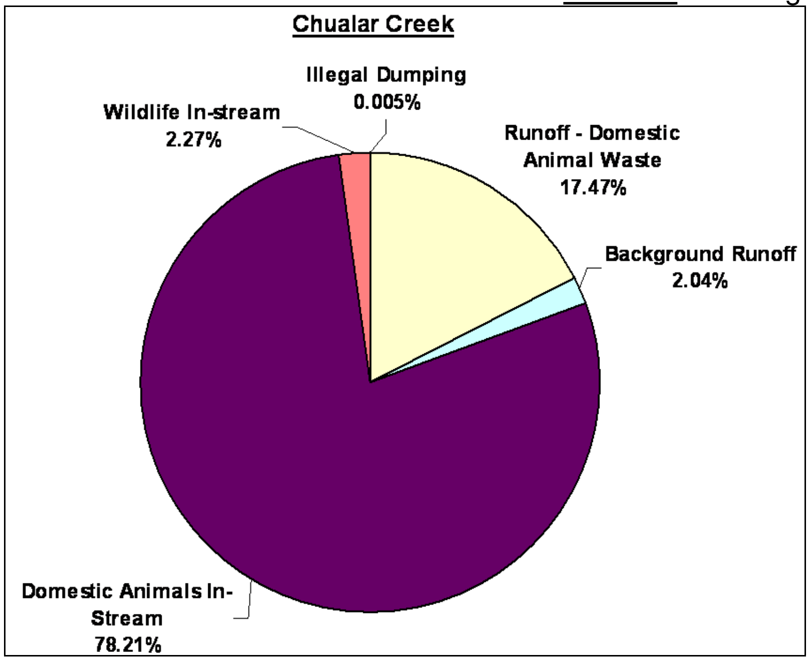
Estimated Existing Fecal Coliform Loading for 309GAB with Critical Conditions Highlighted

Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	2.80E+11	2.62E+12	89%
Transitional Flows	1.08E+10	2.79E+11	96%
No Flow	N.A.	N.A.	N.A.

7.3.3.3 Chualar Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Chualar Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Gabilan Creek occur over all flow conditions, suggesting that non-point sources and direct instream discharges are both significant load contributors. See Table 7-6.

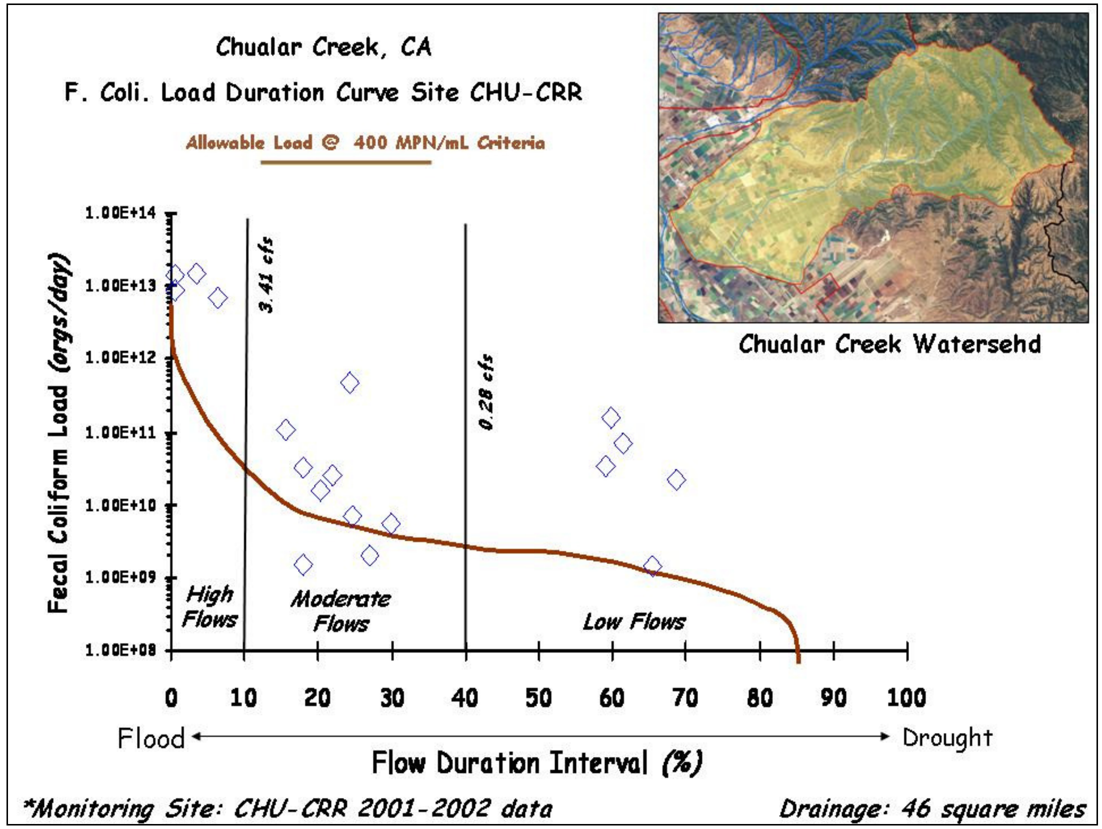
-Monitoring Site: CHU-CRR
-Drainage Area: 46 square miles
-Impaired Reach Length: 15 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife	
	Illegal Dumping	

Low Contributor	
Moderate Contributor	
High Contributor	



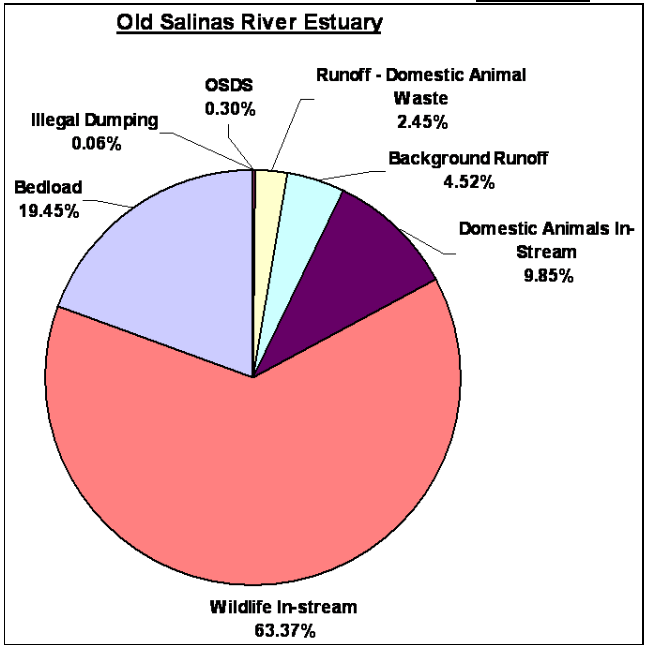
Estimated Existing Fecal Coliform Loading for CHU-CRR with Critical Conditions Highlightec

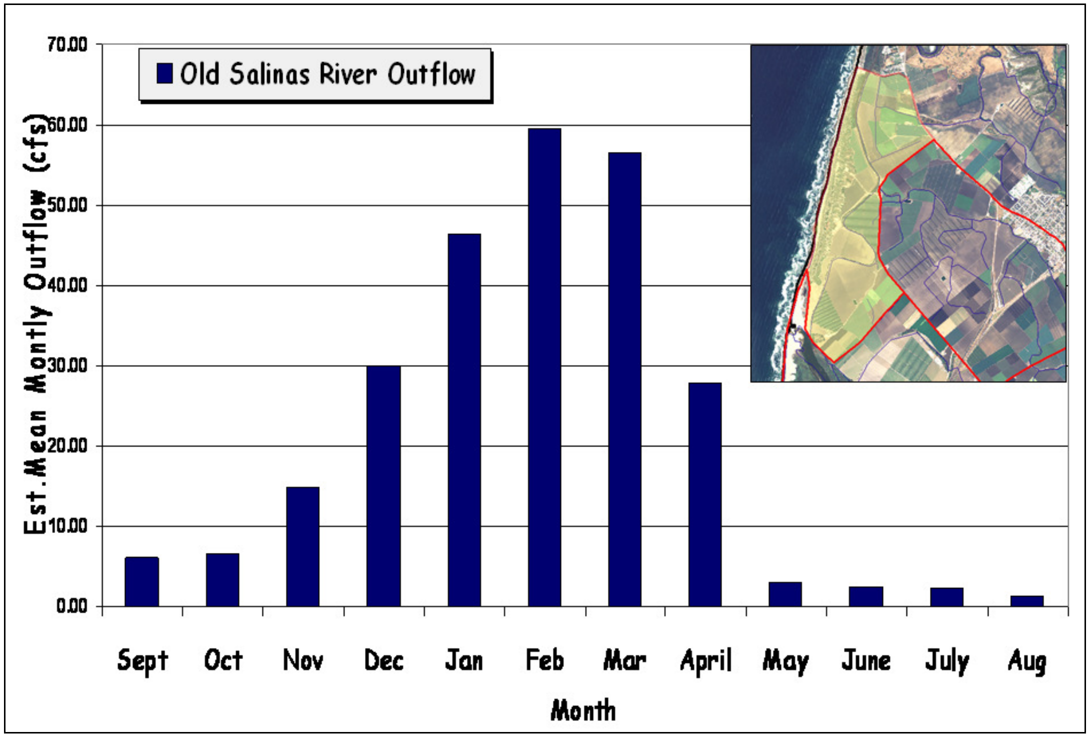
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Go
High Flows	1.33E+11	6.89E+14	99%
Moderate Flows	5.07E+09	1.82E+11	97%
Low Flows	1.64E+09	9.53E+10	98%

7.3.3.4 Old Salinas River

Daily flow information is not available for the Old Salinas River. As such, a temporal/seasonal daily load expression is calculated rather than a flow-based expression. The percent reduction was determined conservatively by using the 90th percentile of the OLS-MON water quality samples, and calculating the percent reduction necessary to meet the 90 percentile instantaneous criterion (400 MPN/100mL). Percent reductions in the Old Salinas River Estuary ranged from 93 to 98%. Dry season exceedence magnitudes are a critical condition, suggesting continuous instream deposition or point sources are significant contributors to impairment. See Table 7-6.

-Monitoring Site: OLS-MON
-Drainage Area: 2.3 square miles
-Impaired Reach Length: 3.8 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife	
	Bedload	
	Illegal Dumping	

Low Contributor	
Moderate Contributor	
High Contributor	

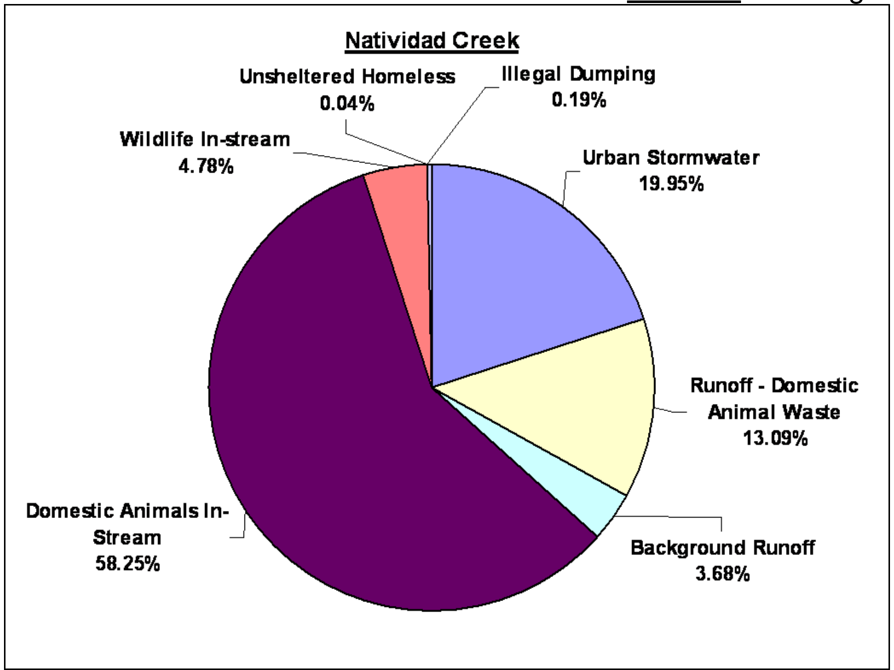
Estimated Existing Fecal Coliform Loading for OLS-MON with Critical Condition Highlighted

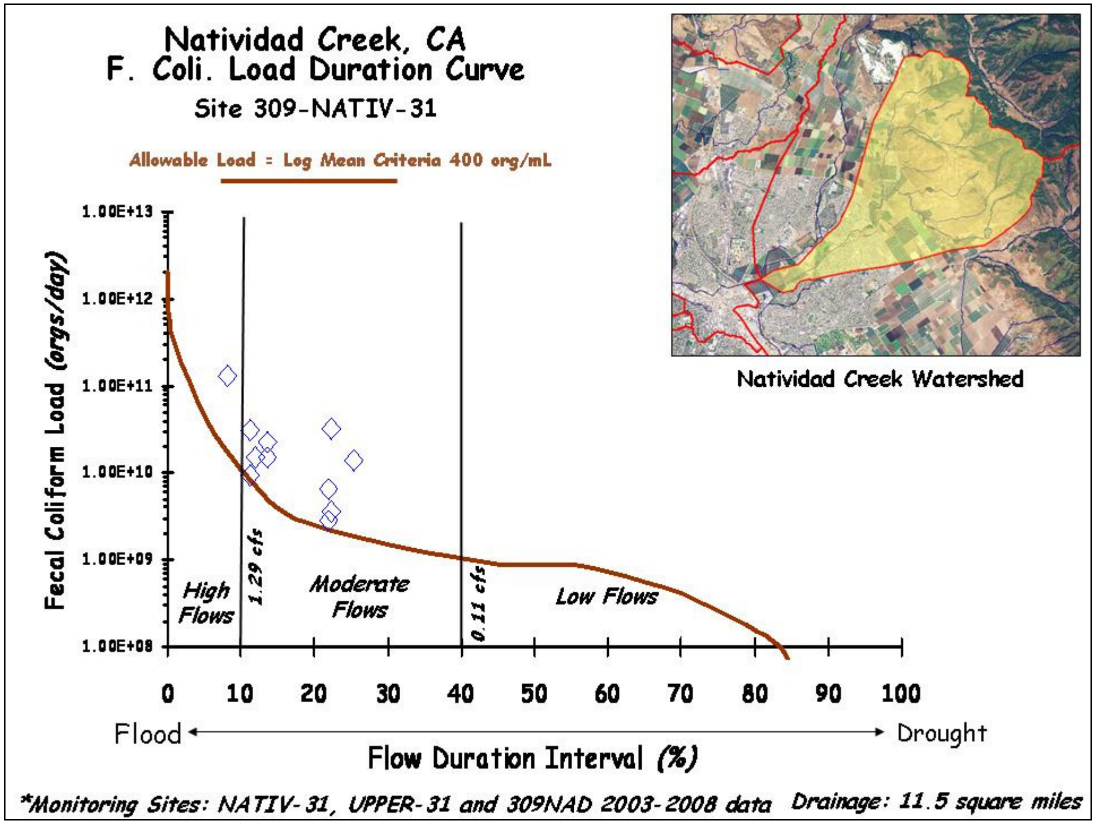
Season	Sample Geomean (MPN/100mL)	90th percentile (MPN/100mL)	Percent Reduction Goal
Wet (Nov through Apr)	487	6200	93%
Dry (May through Oct)	1107	16000	98%

7.3.3.5 Natividad Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Natividad Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Natividad Creek occur over moderate flow conditions; there is currently insufficient data to assess water quality response to either high flow or low flow conditions. An estimated load reduction goal of 93% from existing loads was calculated on the basis of the existing quality data.

-Monitoring Site: NATIV-31
-Drainage Area: 11.5 square miles
-Impaired Reach Length: 6 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	High
Nonpoint Sources	Domestic Animals	High
	Wildlife/Background	Moderate
	Unsheltered Homeless	Low
	Illegal Dumping	Low

Low Contributor	(green)
Moderate Contributor	(yellow)
High Contributor	(orange)

Estimated Existing Fecal Coliform Loading for NATIV-31 with Critical Condition Highlighted

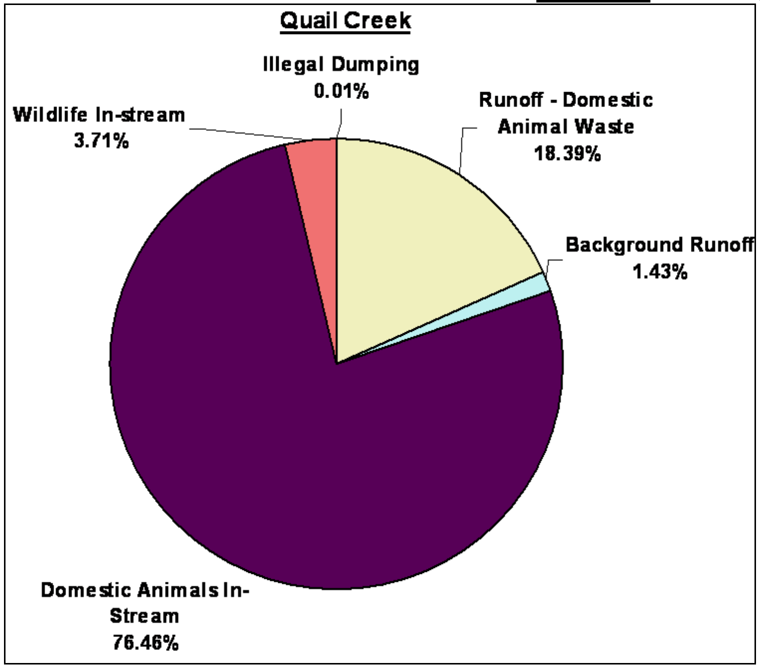
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	4.41E+10	*	*
Moderate Flows	1.90E+09	3.16E+10	93%
Low Flows	7.26E+08	*	*

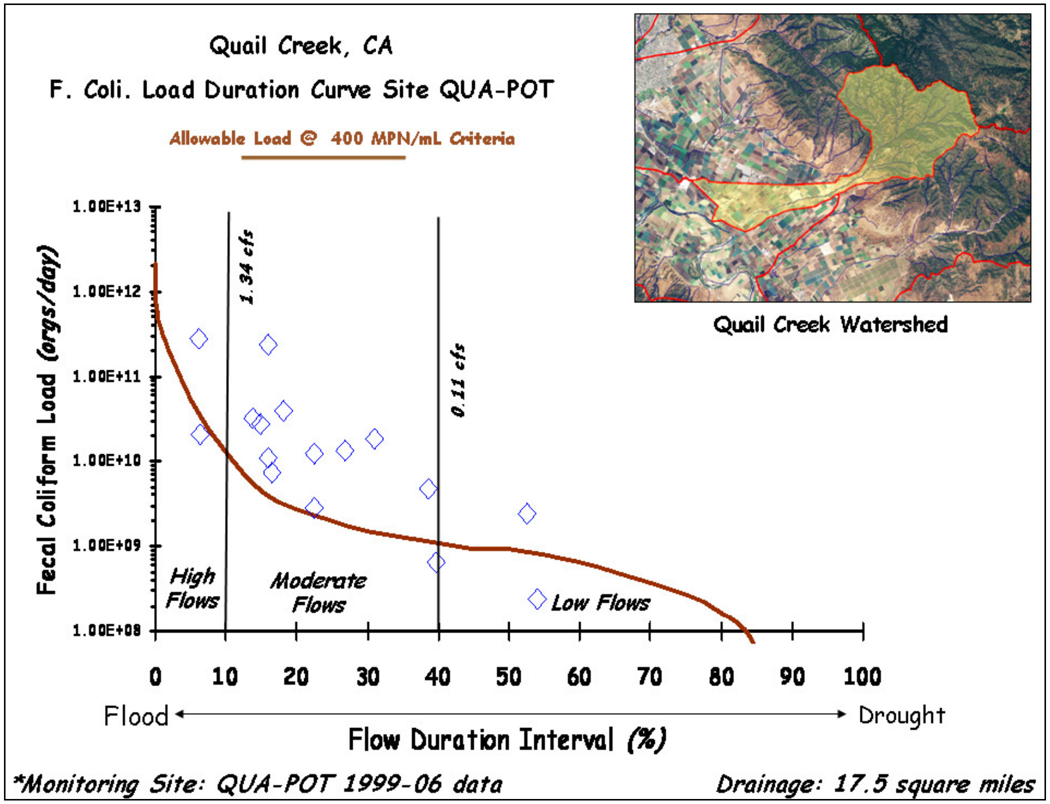
* = Insufficient Data

7.3.3.6 Quail Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Quail Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Quail Creek occur over all flow conditions, suggesting a combination of fecal coliform nonpoint load sources during wet weather conditions (higher flows) and point sources or direct instream deposition during dry weather conditions (lower flows). See Table 7-6.

-Monitoring Site: QUA-POT
-Drainage Area: 17.5 square miles
-Impaired Reach Length: 9 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	Moderate Contributor
	Illegal Dumping	Low Contributor

Low Contributor	green
Moderate Contributor	yellow
High Contributor	orange

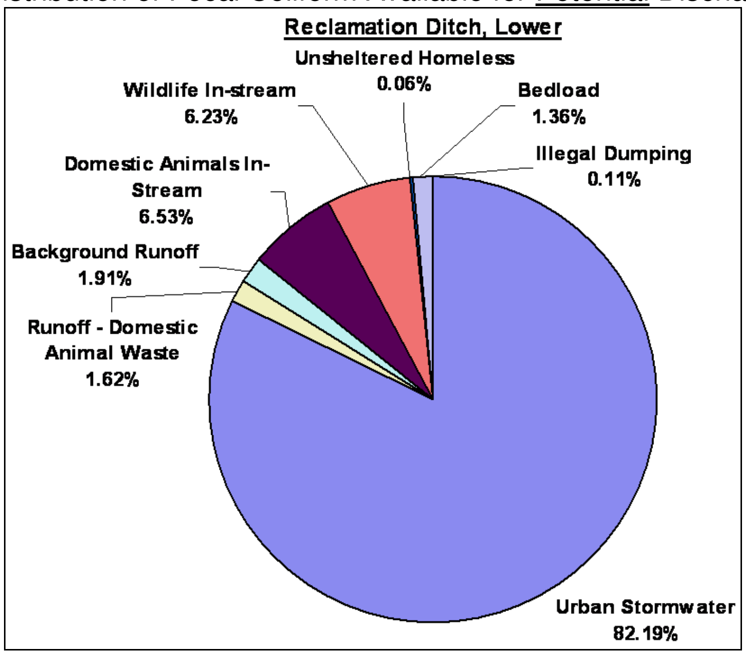
Estimated Existing Fecal Coliform Loading for QUA-POT with Critical Condition Highlighted

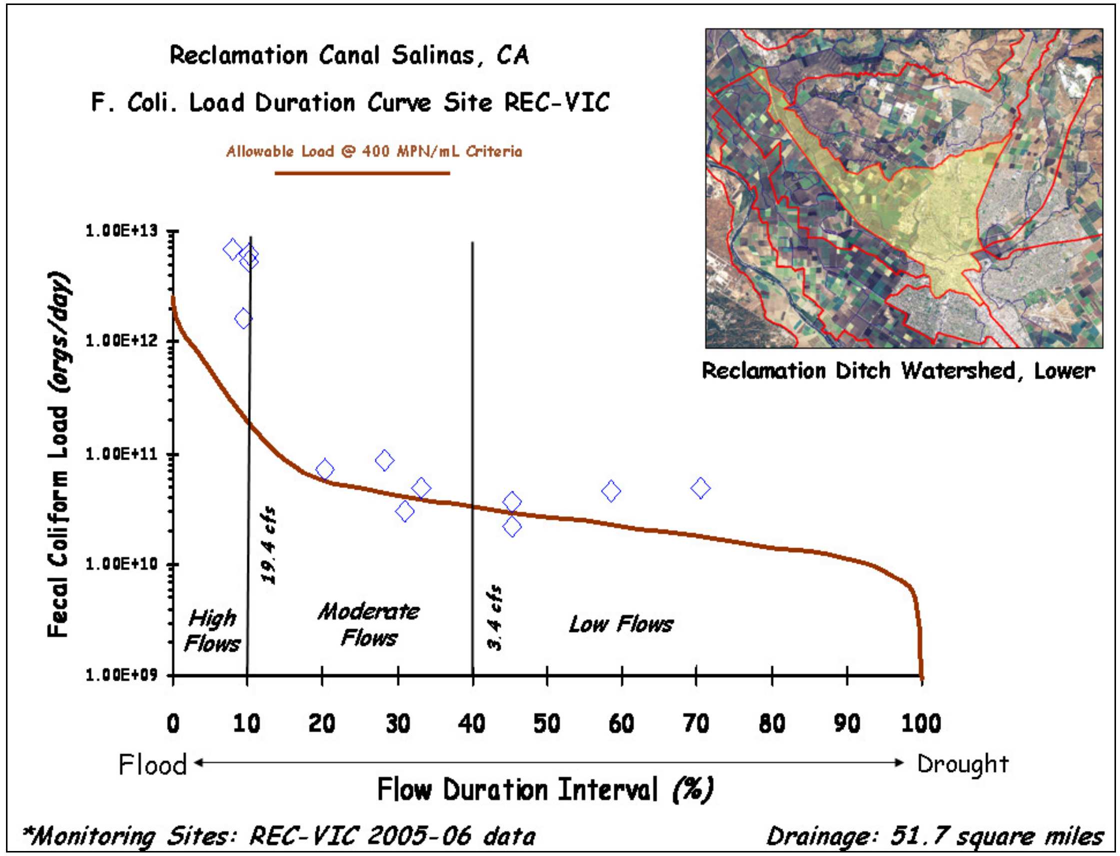
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	5.22E+10	2.53E+11	79%
Moderate Flows	1.96E+09	3.85E+10	95%
Low Flows	6.85E+08	2.20E+09	68%

7.3.3.7 Reclamation Canal, Lower

The load duration curve method was used to determine the percent reduction necessary in the current load for lower Reclamation Canal to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Reclamation Ditch occur over all flow conditions, suggesting a combination of fecal coliform nonpoint load sources during wet weather conditions (higher flows) and point sources or direct instream deposition during dry weather conditions (lower flows). See Table 7-6.

-Monitoring Site: REC-VIC
-Drainage Area: 10.2 Square Miles
-Impaired Reach Length: 8.6 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	
	Unsheltered Homeless	
	Bedload	
	Illegal Dumping	

Low Contributor	
Moderate Contributor	
High Contributor	

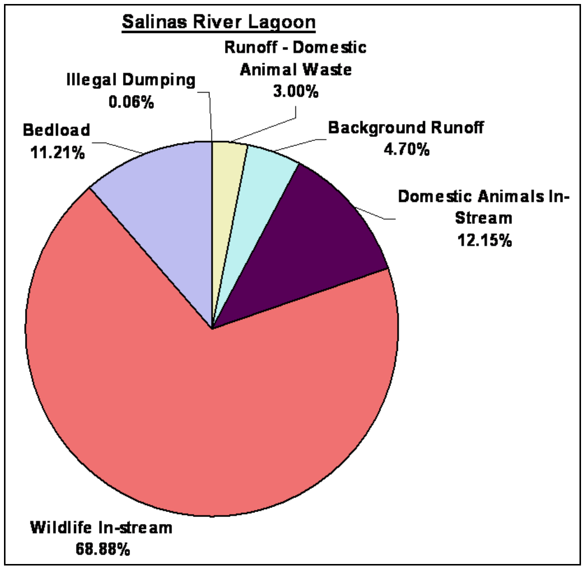
Estimated Existing Fecal Coliform Loading for REC-VIC with Critical Conditions Highlighted

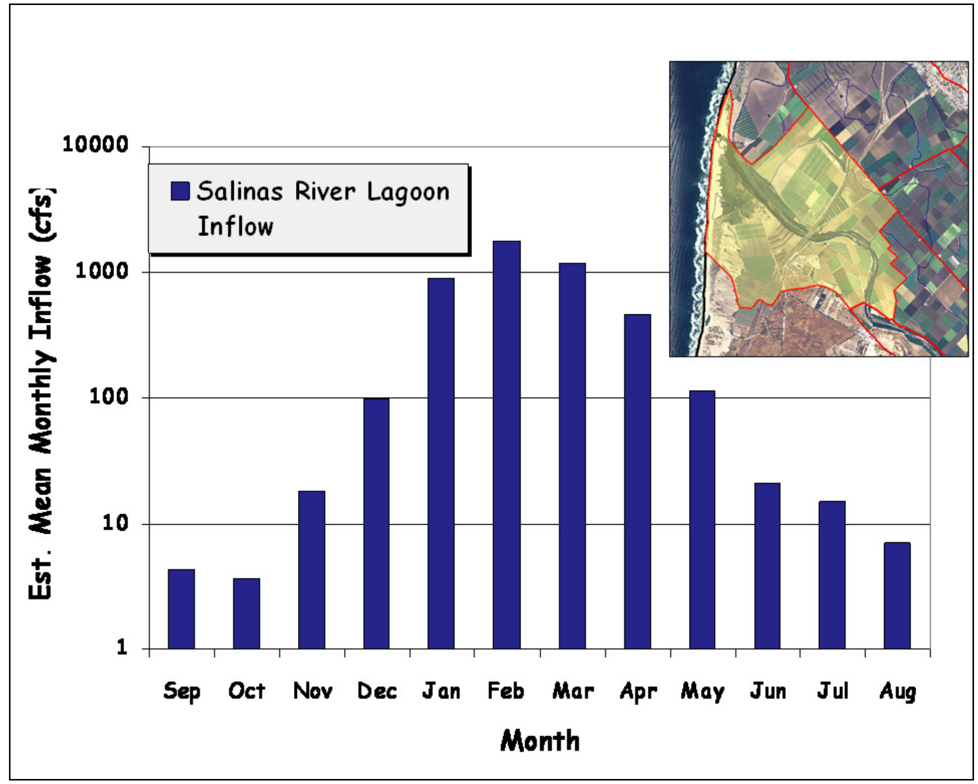
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	5.50E+11	6.70E+12	92%
Moderate Flows	4.84E+10	3.17E+12	98%
Low Flows	2.18E+10	4.83E+10	55%

7.3.3.8 Salinas River Lagoon (North)

Daily flow information is not available for the Salinas River Lagoon. As such, a temporal/seasonal daily load expression is calculated rather than a flow-based expression. The lagoon was identified as impaired due to *E. Coli* FIB data. Fecal coliform data is insufficient to establish impairment. Therefore percent reduction goals are based on the USEPA *E. Coli* 235MPN/100mL criterion. The percent reductions are provided for informational and planning purposes only. The percent reduction was determined conservatively by using the 90th percentile of the SAL-MON water quality samples, and calculating the percent reduction necessary to meet the 235 MPN/100mL criterion. Percent reductions in the Salinas River Lagoon ranged from 7 to 77%. Wet season exceedances are a critical condition, suggesting nonpoint sources are a major contributor to impairment. See Table 7-6.

-Monitoring Site: SAL-MON
-Drainage Area: 4.8 square miles
-Impaired Reach Length: 3.4 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife	
	Bedload	
	Illegal Dumping	

Low Contributor
Moderate Contributor
High Contributor

Estimated Existing Fecal Coliform Loading for SAL-MON with Critical Condition Highlighte

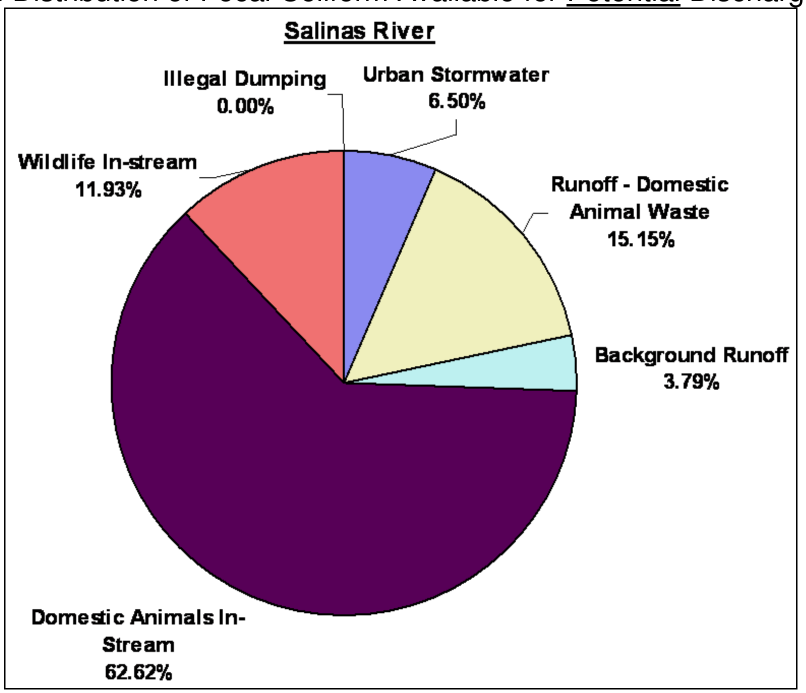
Season	Sample Mean (MPN/100mL)*	90th percentile (MPN/100mL)	Percent Reduction G
Wet (Nov through Apr)	436	1023	77%
Dry (May through Oct)	106	254	7%

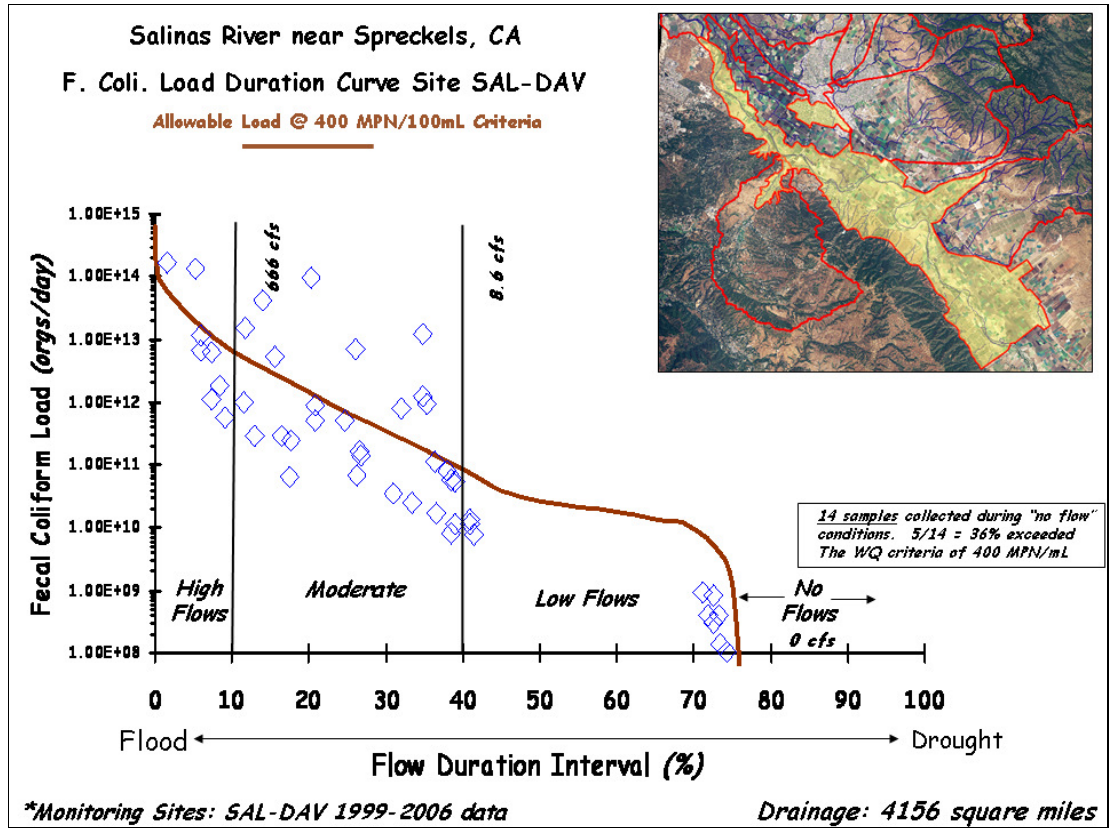
* Because the data set had several ND values, calculating the geomean was not possible. And arithmetic mea calculated instead.

7.3.3.9 Salinas River

The load duration curve method was used to determine the percent reduction necessary in the current load for Salinas River to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Quail Creek occur over high and moderate flow conditions. It was not possible to determine existing loads at low flows due to Inadequate data at the 40 to 100% flow percentile ranges.

-Monitoring Site: SAL-DAV
-Drainage Area: 51 square miles (in Project Area)
-Impaired Reach Length: 39 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	Moderate Contributor
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	Moderate Contributor
	Illegal Dumping	Low Contributor

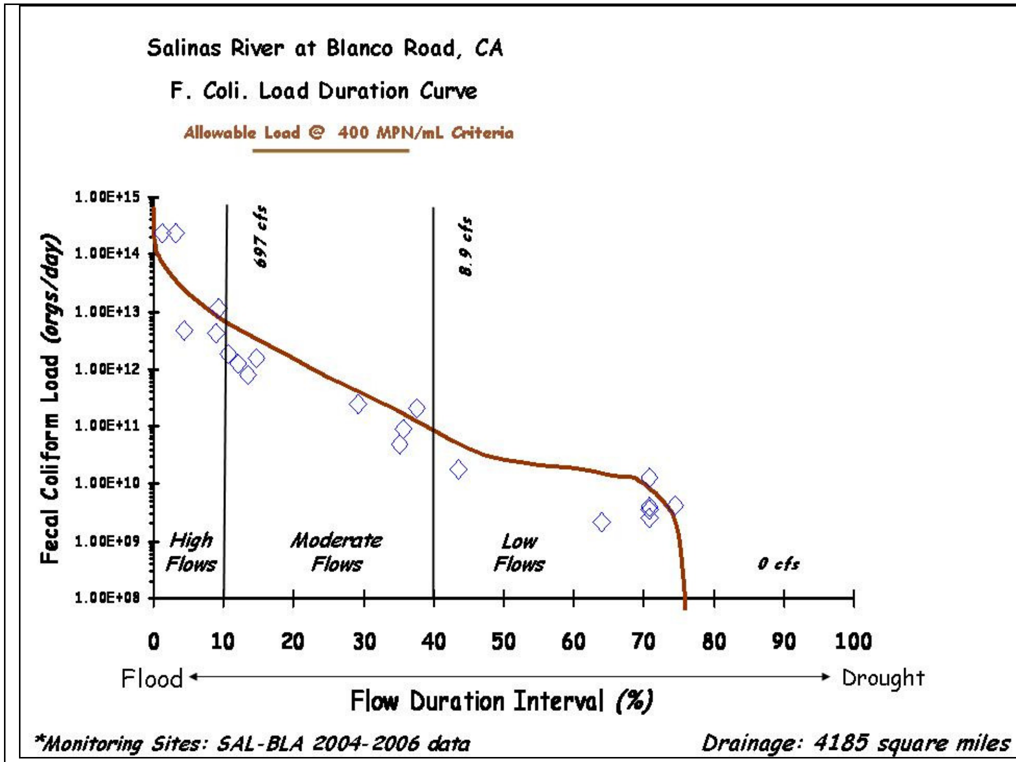
Low Contributor (green)
Moderate Contributor (yellow)
High Contributor (orange)

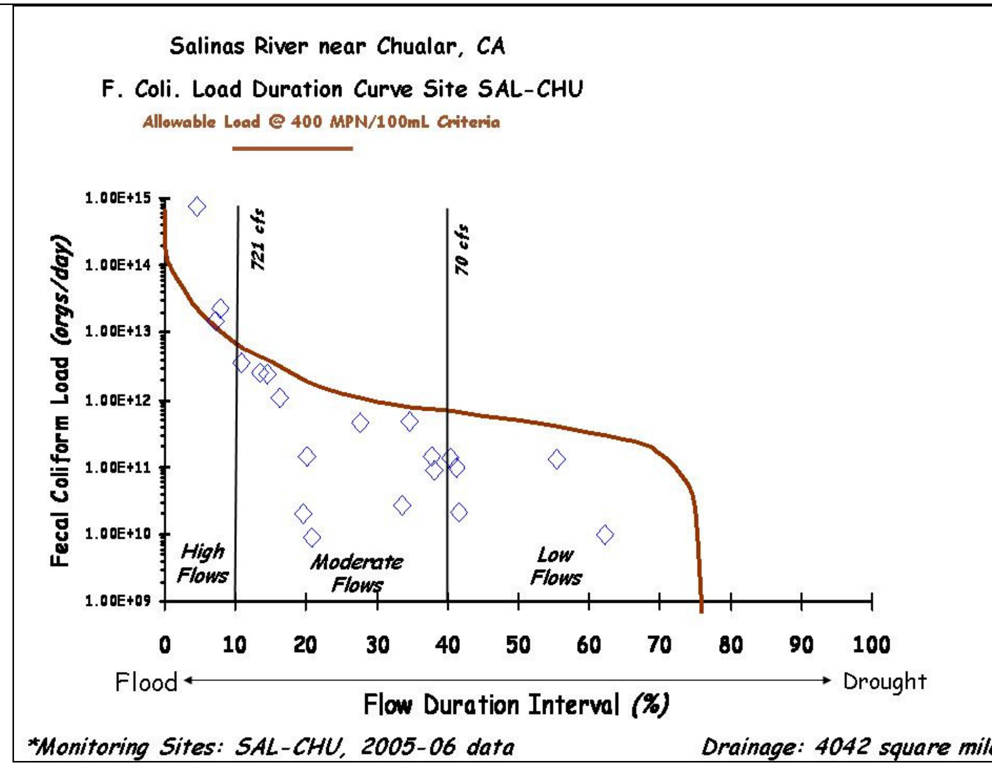
Estimated Existing Fecal Coliform Loading for SAL-DAV with Critical Conditions Highlighted

Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	1.97E+13`	1.47E+14	87%
Moderate Flows	6.85E+11	1.30E+13	95%
Low Flows	1.76E+10	*	*

* SAL-DAV monitoring data collected during dry season conditions is available for times when USGS 11152500 reports "no flow". This is likely because USGS 11152500 is located several thousand feet upstream of SAL-DAV, and discharges from City of Salinas can occur in dry season downstream of 11152500.

Salinas River (continued)





Estimated Existing Fecal Coliform Loading for SAL-BLA with Critical Conditions Highlighted

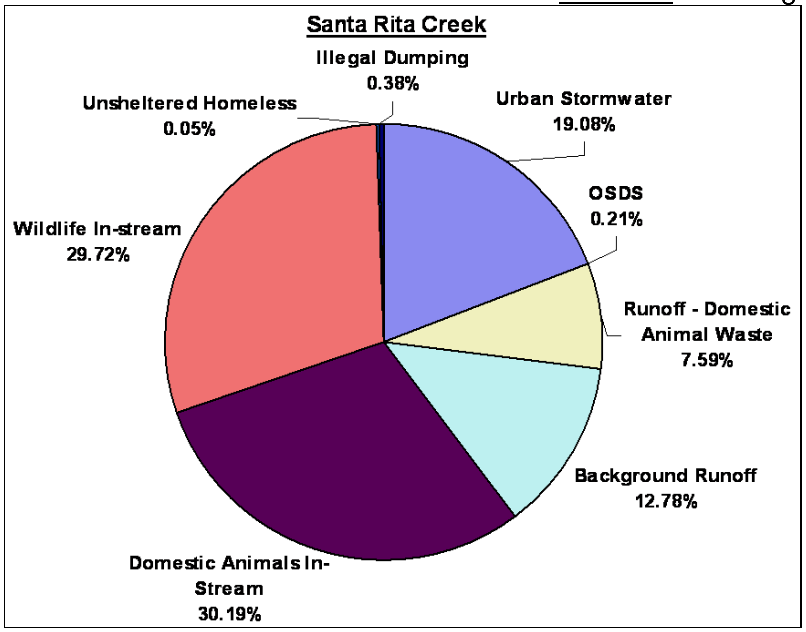
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	2.07E+13	2.37E+14	91%
Moderate Flows	1.52E+12	1.64E+12	7%
Low Flows	1.44E+10	1.52E+10	5%

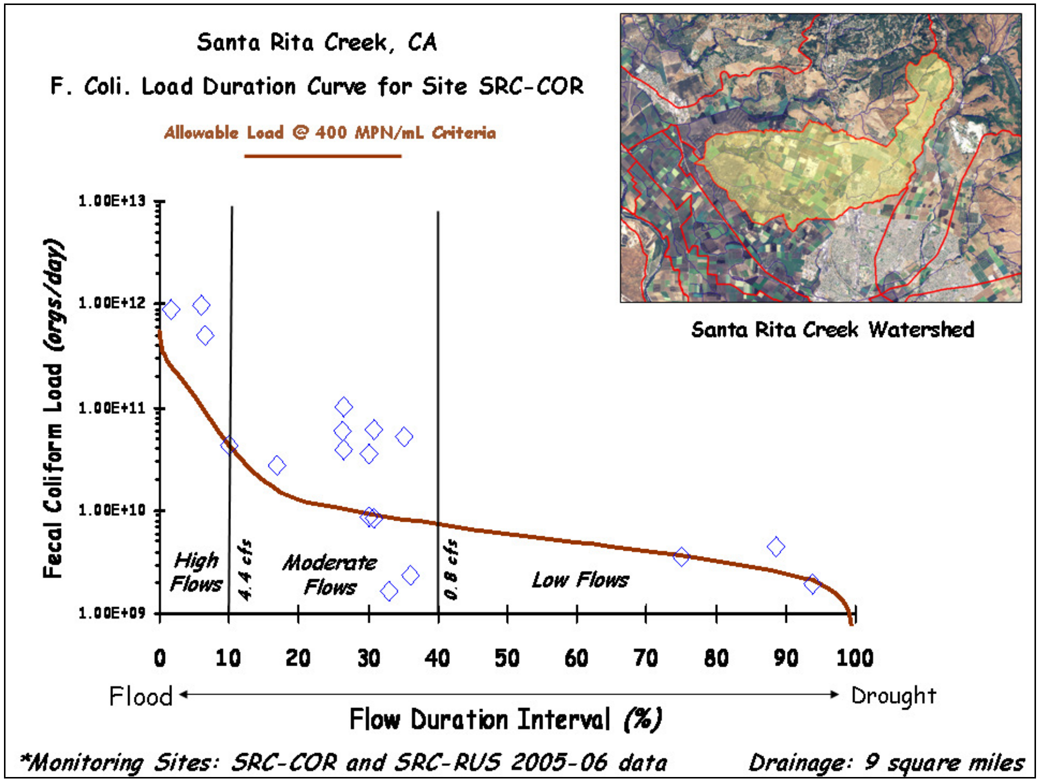
Current Impairment Status for Salinas River at SAL-CHU
Not Impaired

7.3.3.10 Santa Rita Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Santa Rita Creek to meet the 400 MPN/100mL bacteria criterion. Existing loading was calculated as describe in Section 8.3.3, except at low flow. Existing load at low flow was calculated at the 75th percentile flow. The highest magnitude of exceedences occur at high flows, suggesting nonpoint sources and urban runoff are major contributors to FIB loads. See Table 7-6.

-Monitoring Site: SRC-COR
-Drainage Area: 9 square miles
-Impaired Reach Length: 10.5 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	Moderate Contributor
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	High Contributor
	Unsheltered Homeless	Low Contributor
	Illegal Dumping	Low Contributor

Low Contributor
Moderate Contributor
High Contributor

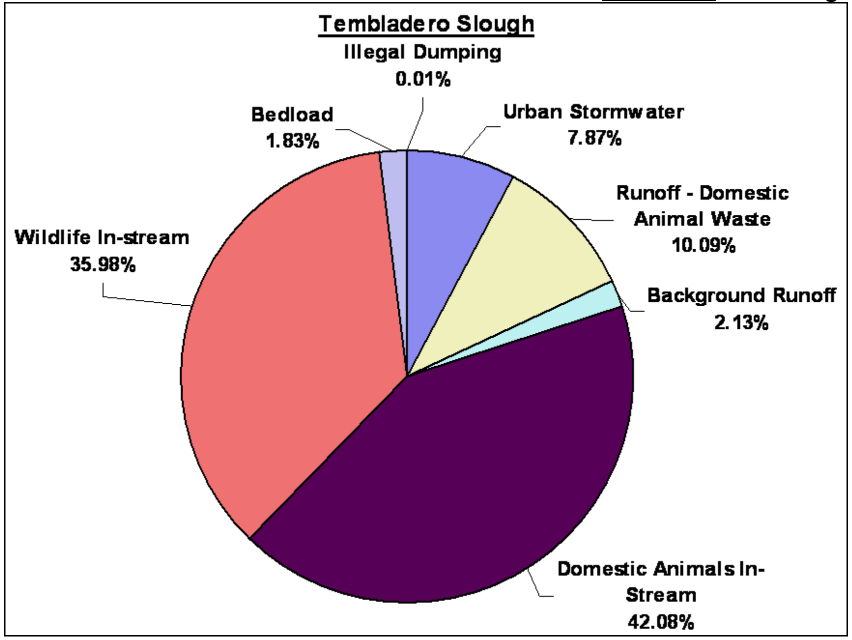
Estimated Existing Fecal Coliform Loading for SRC-COR with Critical Conditions Highlighted

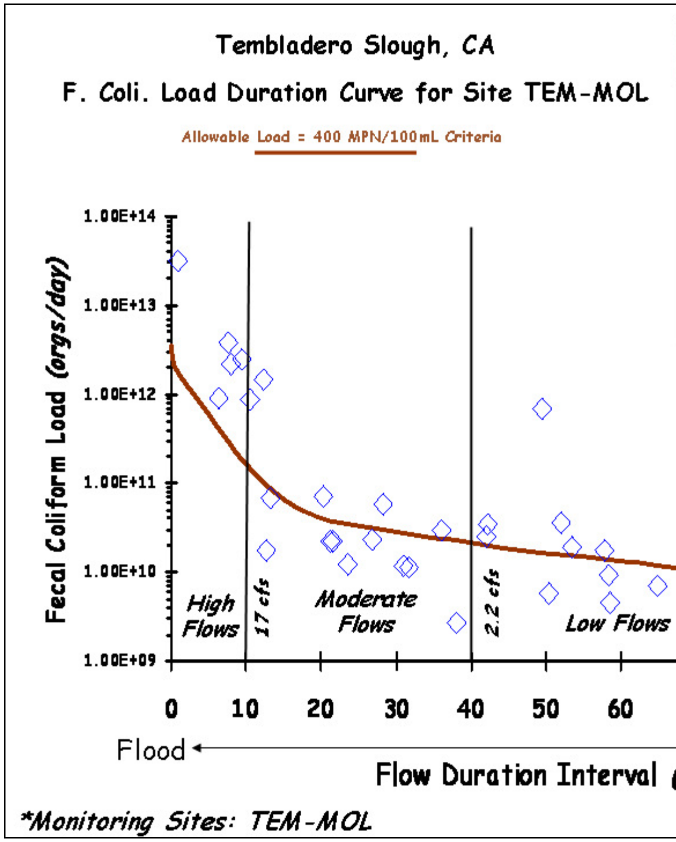
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	1.25E+11	9.41E+11	87%
Moderate Flows	1.09E+10	6.13E+10	82%
Low Flows	3.70E+09	4.22E+09	12%

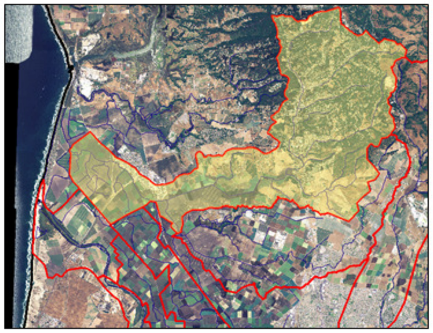
7.3.3.11 Tembladero Slough

The load duration curve method was used to determine the percent reduction necessary in the current load for Tembladero Slough to meet the 400 MPN/100mL bacteria criterion Existing loading was calculated as describe in Section 8.3.3, except at low flow. Existing load at low flow was calculated at the 75th percentile flow.

-Monitoring Site: TEM-MOL
-Drainage Area: 26 square miles
-Impaired Reach Length: 5 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:







Tembladero Slough Watershed

Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	MS4 Storm Sewer System	Moderate Contributor
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	High Contributor
	Bedload	Low Contributor
	Illegal Dumping	Low Contributor

Low Contributor
Moderate Contributor
High Contributor

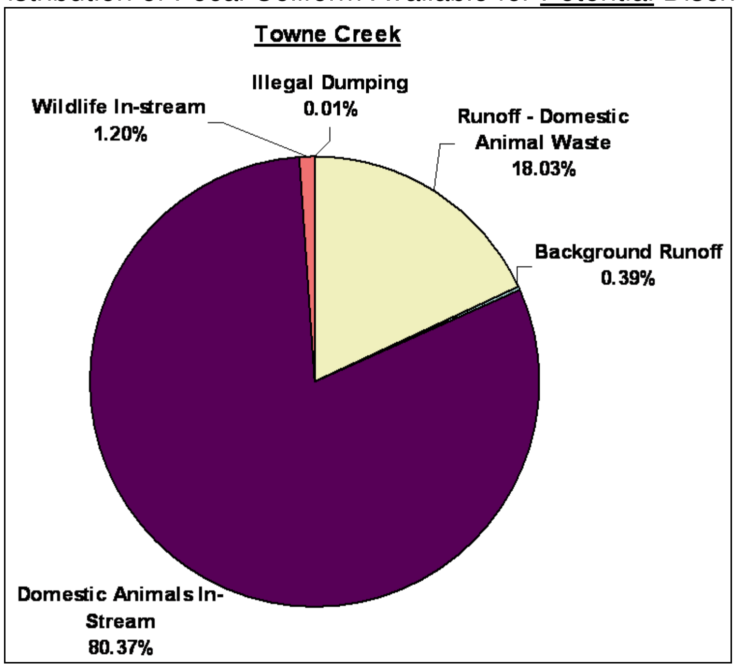
Estimated Existing Fecal Coliform Loading for TEM-MOL with Critical Condition Highlighted

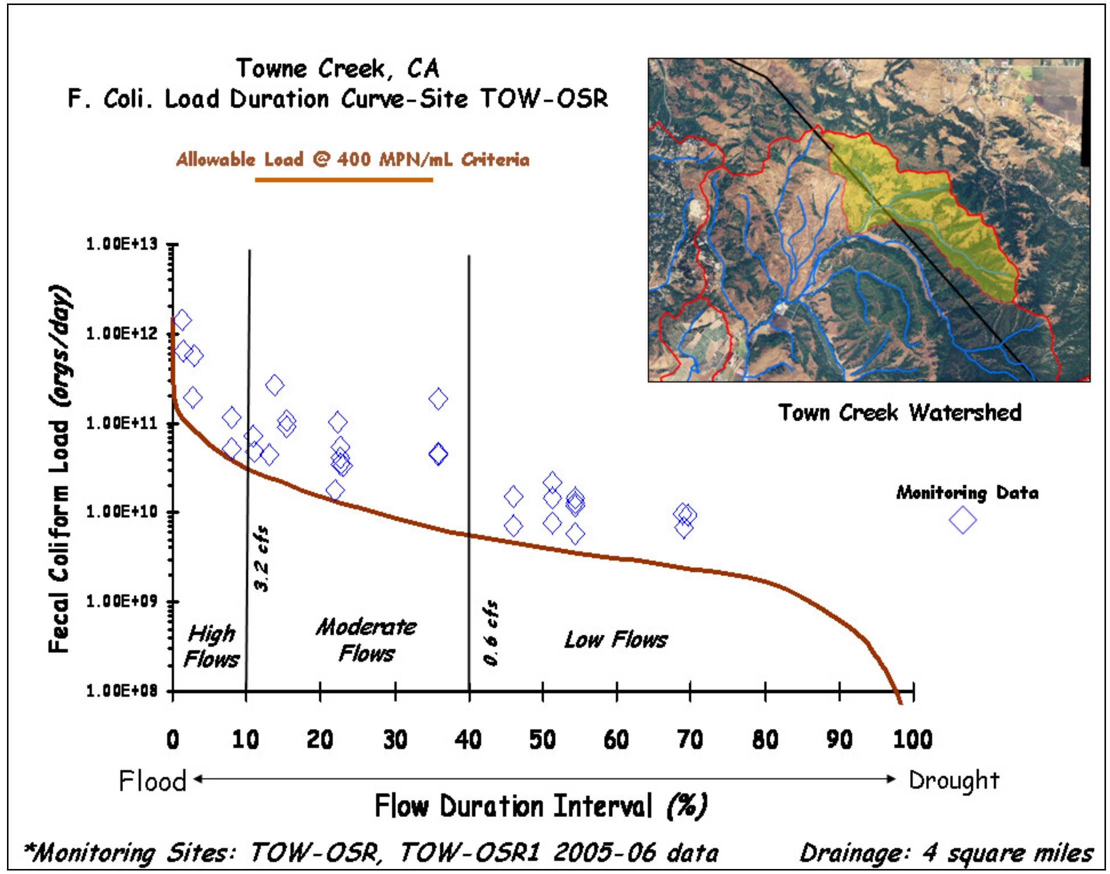
Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	5.82E+11	2.03E+13	97%
Moderate Flows	3.34E+10	6.26E+11	95%
Low Flows	9.17E+09	3.51E+10	74%

7.3.3.12 Towne Creek

The load duration curve method was used to determine the percent reduction necessary in the current load for Towne Creek to meet the 400 MPN/100mL bacteria criterion Exceedences of the allowable loading capacity at Towne Creek occur over all flow conditions, suggesting a combination of fecal coliform nonpoint load sources during wet weather conditions (higher flows) and point sources or direct instream deposition during dry weather conditions (lower flows). See Table 7-6.

-Monitoring Site: TOW-OSR
-Drainage Area: 4 square miles
-Impaired Reach Length: 3.5 miles
-Est. Distribution of Fecal Coliform Available for Potential Discharge:





Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	
	Illegal Dumping	

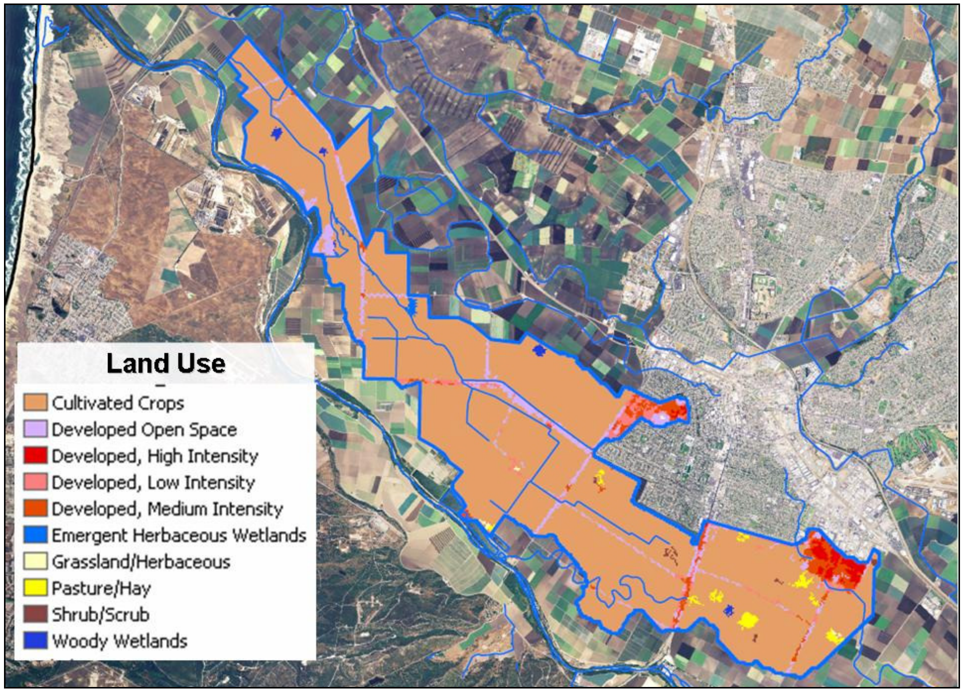
Low Contributor	
Moderate Contributor	
High Contributor	

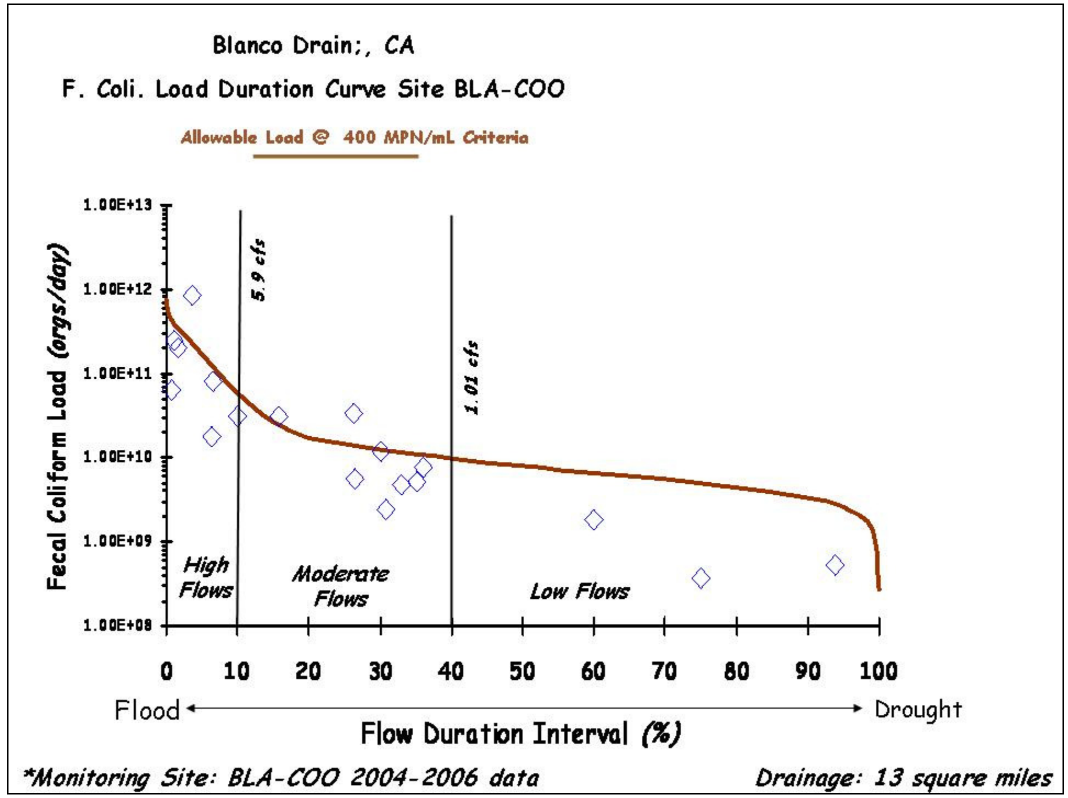
Estimated Existing Fecal Coliform Loading for TOW-OSR with Critical Conditions Highlighted

Flow Regime	Loading Capacity	Estimated Existing Load (90th percentile)	Percent Reduction Goal
High Flows	5.64E+10	1.03E+12	94%
Moderate Flows	1.13E+10	1.55E+11	92%
Low Flows	3.10E+09	1.49E+10	79%

7.3.3.13 Blanco Drain

Blanco Drain is currently not impaired by FIB. A load duration curve for Blanco Drain is provided for comparative purposes to the impaired water bodies.





Current Impairment Status for Blanco Drain
Not Impaired

7.4 Total Maximum Daily Load

A TMDL is the pollutant loading capacity that a water body can accept while protecting beneficial uses. Usually, TMDLs are expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), but in the case of fecal coliform, it is more logical for TMDLs to be based on concentration. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure [40 CFR §130.2(I)]. Concentration based TMDLs make more sense in this situation because the public health risks associated with recreating in contaminated waters scales with organism concentration, and fecal coliform is not readily controlled on a mass basis.

7.4.1 Concentration-based TMDL

Staff proposes the TMDLs as the same set of concentrations as staff proposed in the numeric targets section. Therefore, the concentration-based TMDLs for fecal coliform for all impaired waters in the lower Salinas River Watershed, which is the watershed area downstream of the Lower Salinas River (beginning at, and downstream from, the bridge at Gonzales Road) including:

The following waterbodies currently listed on the 303(d) list:
1. Lower Salinas River (from the crossing at Chualar River Road, downstream to the Salinas River Lagoon)
2. Old Salinas River (the entire Estuary) from the tide gate at the Salinas River lagoon to the downstream confluence with Moss Landing Harbor.
3. Tembladero Slough from the confluence with the Salinas Reclamation Canal to the confluence with the Old Salinas River.
4. Salinas Reclamation Canal (the entire Reclamation Canal)) from the uppermost reach of the waterbody to the confluence with Tembladero Slough.
5. Alisal Creek (the entire Creek) from the uppermost reach of the waterbody to the confluence with the Reclamation Canal.
6. Gabilan Creek (the entire Creek) from the uppermost reach of the waterbody to the confluence with the Reclamation Canal.

And for the following water bodies that are impaired for fecal coliform but not currently listed on the 303(d) List:
1. Salinas River Lagoon (the entire lagoon), from Monterey Bay to the Highway One Bridge.
2. Santa Rita Creek (the entire creek) from the uppermost reach of the waterbody to the confluence with the Reclamation Canal.
3. Quail Creek (the entire creek) from the uppermost reach of the waterbody to the confluence with the Salinas River.
4. Towne Creek (the entire creek) from the uppermost reach of the waterbody to the confluence with the Mud Creek.

5. Natividad Creek (the entire creek) from the uppermost reach of the waterbody to the confluence with the Reclamation Canal.
6. Chualar Creek, from the uppermost reach of the waterbody to the confluence with the Salinas River.

And for all tributaries to the above-named waterbodies, as well as herein un-named waterbodies situated in the lower Salinas River Watershed are concentration-based TMDLs applicable to each day of all seasons and are equal to the following:

Discharges may not cause receiving water concentration of fecal coliform to exceed the following:

Fecal coliform concentration , based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100mL.

7.4.2 Daily Load Expressions

Staff provides the following daily load expressions in light of a recent court decision and draft USEPA guidance, despite the fact that this is a concentration-based TMDL and a daily or average daily TMDL is not appropriate for this TMDL project. The District of Columbia (D.C.) Circuit Court of Appeals issued a decision in *Friends of the Earth, Inc. v. EPA, et al.*, No. 05-5015 (D.C. Cir. 2006), in which the D.C. Circuit held that two TMDLs for the Anacostia River did not comply with the Clean Water Act because they were not expressed as *daily* loads.

As a result of the decision, USEPA issued a memorandum entitled *Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA et. al., No. 05-5015* (April 25, 2006) and Implications for NPDES Permits in November 2006 that recommends that all TMDLs and associated load allocations (LAs) and wasteload allocations (WLAs) include a daily time increment in conjunction with other temporal expressions (e.g., annual, seasonal) that may be necessary to implement the relevant water quality standards.

The 2006 USEPA draft guidance for establishing Total Maximum Daily Loads includes the following statements:

> *"If technically appropriate and consistent with the applicable water quality standard, it may also be appropriate for the TMDL and associated load allocations and wasteload allocations to be expressed in terms of <u>differing maximum daily values depending on the season of the year, stream flow</u> (e.g., wet v. dry weather conditions) or other factors. In situations where pollutant loads, water body flows, or other environmental factors are highly dynamic, it may be appropriate for TMDLs and associated allocations <u>to be expressed as functions of controlling factors such as</u>*

> *water body flow. For example, a load-duration curve approach to expressing a TMDL and associated allocations might be appropriate, provided it clearly identifies the allowable daily pollutant load for any given day as a function of the flow occurring that day. Using the load-duration curve approach also has the advantage of addressing seasonal variations as required by the statute and the regulations."*
>
> *"For TMDLs that are expressed* ***as a concentration of a pollutant****, a possible approach would be to use a table and/or graph to* ***express the TMDL as daily loads for a range of possible daily stream flows****. The in-stream water quality criterion multiplied by daily stream flow and the appropriate conversion factor would translate the applicable criterion into a daily target."**
>
> * emphasis added

A daily or average daily TMDL is inappropriate for the proposed allocations and TMDLs due to both (1) the temporal component embedded in the applicable water quality objective for bacteria; and (2) the episodic and highly variable nature of FIB transport and loading in streams make daily fecal coliform loads inappropriate for this TMDL project.

U.S. EPA noted in this guidance document that "for pollutants where the [water quality standard] has a longer than daily duration (e.g., monthly or seasonal average), individual values that are greater than the daily expression do not necessarily constitute an exceedance of the applicable standard." This is the case with this TMDL project, which is in response to elevated FIB concentrations in project area waterbodies, and a water quality objective that has an embedded monthly temporal component.

Staff, nonetheless, provide the following interpretations of our concentration-based allocations and TMDLs as a daily load expression in MPN/per day in accordance with the draft U.S. EPA guidance. However, we intend to implement the concentration-based TMDLs and allocations.

A TMDL is allocated into waste load allocations (WLAs) for point sources (NPDES permits; general permits), load allocations (LAs) for nonpoint sources (including background loads), and the margin of safety (MOS). The TMDL is the sum of the individual WLAs for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly within the WLA or LA, or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \Sigma\text{WLA} + \Sigma\text{LA} + \text{MOS}$$

The allowable fecal coliform loads are presented under a variety of flow conditions, each of which assures attainment of the targets. An exceedance flow is a statistically determined flow that is exceeded a specific percentage of time. For example, the 75% exceedance flow represents a flow expected to be exceeded 75% of the time and, therefore, represents low flow conditions. A 5% exceedance flow would be expected to be exceeded only 5% of the time and, therefore, represents high flow conditions.

7.4.2.1 Waste Load Allocation (WLA)

Storm-water point sources are typically associated with urban and industrialized areas, and USEPA guidance includes permitted storm-water discharges as point source discharges and, therefore, part of the WLA (USEPA, 2002). Point sources covered under a general permit involving a pipe discharge can also get a WLA. Thus, the ΣWLA for includes two subcategories: entities subject to MS4 NPDES permit requirements; and spills and leaks from sanitary sewer collection and treatment systems. Per guidance from SWRCB, discharges of human fecal material (such as sanitary sewer spills and leaks) involve a relatively higher pathogenic risk, and consequently the allocation for OSDS is zero – no discharge allowed (personal communication. Rick Rasmussen TMDL Section Chief and Office of Chief Counsel, SWRCB, Oct. 8, 2008). As a result, the WLA for spills and leaks from sanitary sewer collection and treatment systems is set at zero.

7.4.2.2 Load Allocation (LA)

The load allocation is the portion of the TMDL assigned to natural background loadings as well as non-point sources such as illegal dumping, bedload, nonpoint sources of human fecal material discharge, and domestic animal discharges. While the relative magnitude of various nonpoint sources were estimated in this project report, LAs were not allocated to separate, discrete nonpoint sources due to the lack of sufficient source characterization data. This is consistent with 40 CFR 130.2(g), which states: *"load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading*. Consequently, the ΣLA was set equal to the TMDL minus the ΣWLA minus the MOS. Note that since an implicit margin of safety is used, the MOS is set at zero. The ΣLA is reported here as two categories: 1) Nonpoint Sources (collectively: domestic animal waste discharges, bedload, illegal dumping, and natural sources); and 2) Discharges of Human Fecal Material (i.e., homeless encampments, illegal discharges). As noted previously, discharges of human fecal material are given an allocation of zero, so human FIB has an LA of zero.

7.4.2.3 Daily Load Allocation Scheme

Estimates of FIB loads from MS4 urbanized entities are constrained by Project Area-specific data on precipitation, impervious cover, and storm water outfall monitoring data, used in conjunction with a USEPA-recognized methodology for estimated urban storm water loads. MS4 WLAs are therefore calculated by taking the MS4's proportion (%) of the estimated total existing annual load (Source Analysis, Section 4.4) and multiplying this fraction by the allowable load (total maximum daily load), resulting in a daily waste load allocation. As noted previously, once the WLA is established, the ΣLA was set equal to the TMDL minus the ΣWLA minus the MOS. Note that since an implicit margin of safety is used, the MOS is set at zero. This allocation scheme is consistent with USEPA guidance, which recognizes an "equal percentage overall removal" allocation scheme for point and nonpoint source loads (USEPA, 1991 and www.epa.gov/waterscience/models/allocation/def.htm).

In summary, using the load duration curves, which are a representation of the total maximum daily load across all flow conditions; using the information developed in Section 8.3; and applying the allocation scheme outlined above staff provide the following daily load expressions shown in Table 7-7

Table 7-7. TMDL and Allocations Summary for Daily Load Expressions (*See Footnote A)

Impaired Inland Stream Reaches	Flow Regime	Flow Exceedence Percentile	Flow (cfs)	Estimated Existing Load	Flow-based Total Maximum Daily Load	Percent Reduction Goal*	WLA	Load Allocation		MOS
							Municipal MS4s	NPS	Human FIB	
Reclamation Canal upper/Alisal Creek	High	5%	16.6	5.52E+11	1.62E+11	71%	N.A.	1.62E+11	0	Implicit
	Moderate	25%	0.6	1.37E+12	6.19E+09	99%		6.19E+09		
	Low	60%	0.2	1.10E+12	2.01E+09	99%		2.01E+09		
Gabilan Creek	High	5%	26	2.62E+12	2.80E+11	89%	1.31E+11	2.49E+12	0	Implicit
	Transitional	20%	1	2.79E+11	1.08E+10	96%	1.40E+10	2.65E+11		
	Dry	N.A.	0	N.A.	N.A.	N.A.	N.A.	N.A.		
Quail Creek	High	5%	5.3	2.53E+11	5.22E+10	79%	N.A.	5.22E+10	0	Implicit
	Moderate	25%	0.2	3.85E+10	1.96E+09	95%		1.96E+09		
	Low	60%	0.07	2.20E+09	6.85E+08	68%		6.85E+08		
Reclamation Canal, lower	High	5%	56.2	6.70E+12	5.50E+11	92%	4.51E+11	9.90E+10	0	Implicit
	Moderate	25%	4.9	3.17E+12	4.84E+10	98%	3.97E+10	8.71E+09		
	Low	60%	2.2	4.83E+10	2.18E+10	55%	1.79E+10	3.92E+09		
Salinas River	High	5%	2014	1.47E+14	1.97E+13	87%	1.38E+12	1.83E+13	0	Implicit
	Moderate	25%	70	1.30E+13	6.85E+11	95%	4.80E+10	6.37E+11		
	Low	60%	1.8	D	1.76E+10	D	1.23E+09	1.64E+10		
Santa Rita Creek	High	5%	12.8	9.41E+11	1.25E+11	87%	2.39E+10	1.01E+11	0	Implicit
	Moderate	25%	1.1	6.13E+10	1.09E+10	82%	2.09E+09	8.79E+09		
	Low	75%	0.4	4.22E+09	3.70E+09	12%	7.09E+08	2.98E+09		
Tembladero Slough	High	5%	59.4	2.03E+13	5.82E+11	97%	4.60E+10	5.36E+11	0	Implicit
	Moderate	25%	3.4	6.26E+11	3.34E+10	95%	2.64E+09	3.08E+10		
	Low	60%	1.3	3.51E+10	9.17E+09	74%	7.24E+08	8.45E+09		
Towne Creek	High	5%	5.8	1.03E+12	5.64E+10	94%	N. A.	5.64E+10	0	Implicit
	Moderate	25%	1.2	1.55E+11	1.13E+10	92%		1.13E+10		
	Low	60%	0.3	1.49E+10	3.10E+09	79%		3.10E+09		
Natividad Creek	High	5%	4.5	D	4.41E+10	D	8.82E+09	3.53E+10	0	Implicit
	Moderate	25%	0.2	3.16E+10	1.90E+09	93%	3.80E+08	1.52E+09		
	Low	60%	0.07	D	7.26E+08	D	1.45E+08	5.81E+08		
Chualar Creek	High	5%	13.6	6.89E+14	1.33E+11	99%	N. A.	1.33E+11	0	Implicit
	Moderate	25%	0.5	1.82E+11	5.07E+09	97%		5.07E+09		
	Low	60%	0.17	9.53E+10	1.64E+09	98%		1.64E+09		

Coastal Confluence Impaired Waters	Season	Mean Outflow-Inflow (cfs)	Estimated Existing Load	Seasonal Total Maximum Daily Load	WLA	Load Allocation		MOS
					Municipal MS4s	NPS	Human FIB	
Old Salinas River	Wet (Nov-Apr)	39.2 outflow	D	3.83E+11	N.A.	3.83E+11	0	Implicit
	Dry (May-Oct)	3.6 outflow	D	3.53E+10		3.53E+10		
Salinas River Lagoon	Wet (Nov-Apr)	739 inflow	D	7.24E+12	N.A.	7.24E+12	0	Implicit
	Dry (May-Oct)	27 inflow	D	2.66E+11		2.66E+11		

D = Insufficient Data
N.A. = Not Applicable
* = Informational only. Not a regulatory criteria.

A: Mass-based daily load expressions are provided to comply with USEPA technical and legal guidance, as described in Section 7.4.2. However, we intend to implement the concentration-based TMDLs and allocations. As such, daily load expressions presented in this section represent an alternative way to express concentration-based allocations, but the mass-based daily load expressions do NOT formally constitute the TMDL or the allocations.

8 MARGIN OF SAFETY

The TMDL requires a margin of safety component that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). For fecal coliform in Lower Salinas River watershed a margin of safety has been established implicitly through the use of protective numeric targets, which are equal to the water quality objectives for the Lower Salinas River watershed's beneficial uses.

The fecal coliform TMDLs for the Lower Salinas River watershed are the Basin Plan water quality objective for fecal coliform for water contact recreation. The Basin Plan states that, "controllable water quality shall conform to the water quality objectives..." When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality" (Basin Plan, p. III-2). Because the allocation for controllable sources is set at the water quality objective, if achieved, these allocations will by definition contribute as much as possible to achieving the water quality objectives in the receiving water. Thus, in these TMDLs there is no uncertainty that controlling the load from controlled sources will positively affect water quality by reducing the pathogen indicator organism contribution.

However, in certain locations there is a possibility that non-controllable, or natural sources, will themselves occur at levels exceeding water quality objectives. And while it is controllable water quality conditions ("actions or circumstances resulting from man's activities" (Basin Plan, p. III-2)) that must conform to water quality objectives, receiving water quality will contain discharge from both controllable and natural sources.

9 CRITICAL CONDITIONS AND SEASONAL VARIATION

This section discusses factors affecting impairment, critical conditions, and seasonal FIB variations.

9.1 Critical Conditions and Uncertainties

A critical condition is the combination of environmental factors resulting in the water quality objective "just" being achieved, i.e., that a slight change in one of the environmental factors could result in exceedance of the water quality objective (USEPA, 2001). However, the occurrence of this condition has a low frequency.

Staff concluded that there is not a critical condition in the impaired waters. Staff made this determination based on the consistent and high magnitude of exceedance of fecal coliform water quality objectives. Please refer to Table 3-1 for a summary of exceedances in the project area. Note the data suggests that no critical conditions, as described above, occur in the project area.

Staff concluded there are uncertainties regarding the TMDLs and associated allocations. Stream flows in the Mediterranean climate may serve to either increase or dilute FIB concentrations. Environmental conditions, e.g. stagnant or slow moving water with fine sediment, may be areas where FIB concentrations increase due to cell-propagation, which could be entrained during rain events. Although staff has made an attempt to estimate loading from these sources and conditions, environmental conditions can fluctuate from year to year, creating an uncertainty regarding our estimates. Additionally, staff has used documented and calculated stream flows, which are in part driven by historic rain events. There are assumptions and therefore uncertainties inherent in the approach.

10 TMDL ALLOCATIONS

Table 10-1 shows wasteload and load allocations to responsible parties associated with the waterbodies and sources of indicator bacteria identified. All the allocations are equal to the TMDLs, which are expressed as receiving water concentrations. As noted previously, staff proposes to implement a concentration-based TMDL, equal to the numeric targets for fecal coliform. Discharges of human fecal material are assigned an allocation of zero because of the higher pathogenic risk associated with human waste.

All responsible parties for sources of fecal coliform to the Lower Salinas River watershed will be accountable to attain these allocations. The parties responsible for the allocations to non-natural (controllable) sources are not responsible for the allocation to natural (uncontrollable) sources.

Table 10-1. Wasteload and Load allocations.

WASTE LOAD ALLOCATIONS		
Waterbody	**Party Responsible for Allocation (Source) NPDES/WDR number**	**Receiving Water Fecal Coliform (MPN/100mL)**
Gabilan Creek[1] , Santa Rita Creek[3], Salinas Reclamation Canal[4], Natividad Creek[5], Lower Salinas River[6]	City of Salinas (Storm drain discharges to MS4s) Storm Water Permit NPDES No. CA00049981	Allocation-1
Gabilan Creek[1], Alisal Creek.[2], Santa Rita Creek.[3], Salinas Reclamation Canal[4], Natividad Creek[5], Lower Salinas River[6], Tembladero Slough[7], Old Salinas River[9], Salinas River Lagoon[10]	County of Monterey (Storm drain discharges to MS4s) Storm Water General Permit NPDES No. CAS000004	Allocation-1
Gabilan Creek[1] , Santa Rita Creek[3], Salinas Reclamation Canal[4], Natividad Creek[5]	City of Salinas (Sanitary sewer collection system spills and leaks) Statewide General WDR for Sanitary Sewer Systems WQO No. 2006-0003	Allocation-2
Tembladero Slough[7]	Castroville Community Services District (Sanitary sewer collection system spills and leaks) Statewide General WDR for Sanitary Sewer Systems WQO No. 2006-0003	Allocation-2

LOAD ALLOCATIONS		
Waterbody	**Responsible Party (Source)**	**Receiving Water Fecal Coliform (MPN/100mL)**
All twelve impaired water bodies[a]	Owners/operators of land used for/containing domestic animals/livestock (Domestic animals/livestock waste not draining to MS4s))	Allocation-1
Salinas Reclamation Canal, Alisal Creek, Santa Rita Creek, Gabilan Creek, Natividad Creek	Owners and/or Operators of Land that have Homeless Persons/Encampments (Discharges From Homeless Persons/Encampments Not Regulated by a Permit for Storm Water Discharges)	Allocation-2
All twelve impaired water bodies[a]	Owners/operators of land used for/containing illegal dumping (Discharges from illegal dumping Not Regulated by a Permit for Storm Water Discharges)	Allocation-1
All twelve impaired water bodies[a]	No responsible party (Natural sources)	Allocation-1
Wasteload/Load Allocation 1 (Equal to the TMDL):Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400 MPN/100 mL. Wasteload/Load Allocation 2: Allocation of zero; no fecal coliform bacteria load originating from human sources of fecal material is allowed.		

[a] All twelve impaired water bodies:: Lower Salinas River, Old Salinas River, Tembladero Slough, Salinas Reclamation Canal, Alisal Creek, Gabilan Creek , Natividad Creek, Salinas River Lagoon (north), Chualar Creek, Santa Rita Creek, Quail Creek, Towne Creek.

[1] Gabilan Creek: all reaches and its tributaries, which includes from the confluence with Carr Lake to the uppermost reaches of the waterbody, including but not limited to Towne Creek[12], Mudd Creek, and un-named creeks tributary to these.
[2] Alisal Creek: all reaches and its tributaries, which includes from the confluence with the Salinas Reclamation Canal to the uppermost reach of the waterbody.
[3]Santa Rita Creek: all reaches and its tributaries, which includes from the confluence with the Salinas Reclamation Canal to the uppermost reach of the waterbody.
[4]Salinas Reclmation Canal: all reaches and tributaries, which includes from confluence with Tembladero Slough, to upstream confluence with Carr Lake and Alisal Creek.
[5]Natividad Creek: all reaches and its tributaries, which includes from the confluence with Carr Lake to the uppermost reach of the waterbody.
[6]Lower Salinas River: all reaches and tributaries from Salinas River at Chualar River Road downstream to its confluence with the Salinas River Lagoon at Monte Road.
[7]Tembladero Slough: which includes all reaches and tributaries from the confluence with the Salinas Reclamation Canal downstream to its confluence with the Old Salinas River.
[8]Quail Creek: which includes all reaches and its tributaries, from the confluence with the Salinas River to the uppermost reach of the waterbody.
[9]Old Salinas River: all reaches and tributaries from the slide gate at the head of the Old Salinas River adjacent to Mulligan Hill, downstream to Potrero Road.
[10]Salinas River Lagoon (North): From Monte Road downstream to its confluence with Monterey Bay.
[11]Chualar Creek: which includes all reaches and its tributaries, from the confluence with the Salinas River to the uppermost reach of the waterbody.
[12]Towne Creek: all reaches and tributaries.

The parties responsible for the allocations to controllable sources are not responsible for the allocation to natural sources.

The TMDLs are considered achieved when the allocations assigned to all individual responsible parties are met, or when the numeric targets are consistently met.

Should all control measures be in place, pathogen indicator organism concentrations remain high, and a TMDL not be met, staff may investigate (e.g., genetic studies to isolate sources or other appropriate monitoring) to determine if the high level of indicator organisms is due to uncontrollable sources. Responsible parties may demonstrate that controllable sources of pathogen indicator organisms are not contributing to exceedance of water quality objectives in receiving waters. If this is the case, staff may consider re-evaluating the numeric targets and allocations. For example, staff may propose a site-specific objective to be approved by the Central Coast Water Board. The site-specific objective may be based on evidence that natural or background sources alone were the cause of exceedances of a TMDL.

11 PUBLIC PARTICIPATION

Staff conducted stakeholder outreach efforts throughout the Project inception. Staff worked with county, state, and federal agencies during the data collection and data analysis phases. Results of coordinated efforts were publicized in newspapers and television media.

Staff made several presentations and engaged with stakeholders during the development of the TMDL. Attendees of the presentations included representatives from the following:

- United Fresh Fruit and Vegetable Association
- Monterey County Department of Environmental Health
- State of California Department of Health Services
- United States Department of Agriculture
- United States Food and Drug Administration
- Monterey County Cattlemen's Association
- The City of Salinas
- Commercial Ranches
- Commercial Farms
- Monterey County Water Resources Agency
- Monterey Bay National Marine Sanctuary
- Monterey County Farm Bureau
- Monterey County Agricultural Commissioner's Office
- Resource Conservation District of Monterey County
- Central Coast Agricultural Task Force

- California State University Monterey Bay, Watershed Institute
- Central Coast Agricultural Water Quality Coalition

Staff conducted a California Environmental Quality Act (CEQA) stakeholder scoping meeting on June 20, 2007. Staff addressed questions and comments from attendees.

Staff held another stakeholder meeting on August 18, 2009, prior to the formal public comment period preceding the Central Coast Water Board public hearing to consider adoption of the TMDL. Staff responded orally to public comments and questions at the stakeholder meeting.

Central Coast Water Board staff solicited written public comment prior to the Central Coast Water Board public hearing considering adoption of the Lower Salinas River Watershed Fecal Coliform TMDL. The Central Coast Water Board accepted public comments and provided written response at the Water Board public hearing.

12 IMPLEMENTATION AND MONITORING

12.1 Overview

The purpose of the Implementation Plan is to describe the steps necessary to reduce pathogen loads and to achieve these TMDLs. The Implementation Plan identifies the following: 1) actions expected to reduce pathogen loading; 2) parties responsible for taking these actions; 3) regulatory mechanisms by which the Central Coast Water Board will assure these actions are taken; 4) reporting and evaluation requirements that will indicate progress toward completing the actions; 5) and a timeline for completion of implementation actions.

The Implementation Plan also addresses economic considerations to achieve compliance. A monitoring plan designed to measure progress toward water quality goals is included in the following section.

The overall intent of this implementation plan is to restore and protect beneficial uses of the waterbodies of the Lower Salinas River Watershed by reducing pathogen loading. Potential pathogen sources in the watershed include: municipal storm drain discharges, domestic animal/livestock discharges, illegal dumping, discharges from homeless persons/encampments, sanitary sewer collection system spills and leaks, wildlife, and sediment bedload resuspension. The Central Coast Water Board recognizes the technical, institutional, and monetary challenges that each source category may face in designing and implementing measures to reduce their respective loading. As such, we are trying to be as flexible as possible in the implementation approach for reducing pathogen loading. We anticipate that enforcement mechanisms will only be needed where individuals have chosen not to assess and reduce their potential to impact water quality.

Water Board staff also recognize many implementation activities are already underway in the watershed. The Central Coast Water Board strongly supports these activities and recommends that these efforts be continued. Existing and ongoing implementation activities to control pathogen loading are encouraged, as this may preclude the need for implementation of additional management measures for those sources.

Implementation actions and monitoring requirements proposed here rely on existing and proposed regulatory mechanisms. The Implementation Plan incorporates requirements that currently exist pursuant to an existing regulatory mechanism (e.g. permit or prohibition). The Water Board's Executive Officer is authorized to take the proposed steps to insure implementation of appropriate actions to reduce fecal coliform loading according to the requirements that currently exist. Other proposed actions establish new requirements that must be approved by the Central Coast Water Board, State Water Resources Control Board and California's Office of Administrative Law. These new requirements include the following prohibitions:

Add the following watershed to the end of the bulleted list of applicable areas of the Domestic Animal Waste Discharge Prohibition:
Discharges containing fecal material from domestic animals to the waters of the State that cause or contribute to exceedance of water quality objectives in the areas listed below are prohibited. Examples of domestic animals include, but are not limited to, horses, cattle, goats, sheep, dogs, cats or any other animal(s) in the care of any persons(s).

- Lower Salinas River Watershed (the watershed area of the Salinas River from Gonzales Road downstream to its confluence with Moss Landing Harbor)

Add the following watershed to the end of the bulleted list of applicable areas of the Human Fecal Material Discharge Prohibition:
Discharges containing fecal material from humans to the waters of the State in the areas listed below are prohibited. Exceptions to this prohibition include discharges in accordance with Waste Discharge Requirements or other provisions of the California

- Lower Salinas River Watershed (the watershed area of the Salinas River from Gonzales Road downstream to its confluence with Moss Landing Harbor)

These prohibitions are discussed in the following sections where domestic animal waste and human waste is a source. Staff will work with landowners and/or cooperating entities to develop documentation details for such a program during outreach. These prohibitions, and the associated actions are in compliance with the Nonpoint Source Implementation and Enforcement Policy discussed below.

The *Nonpoint Source Implementation and Enforcement Policy*, adopted as state law in August 2004, requires the Regional Water Boards to regulate all nonpoint sources (NPS) of pollution using the administrative permitting authorities provided by the Porter-Cologne Act. Nonpoint source dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan Prohibitions by participating in the development and implementation of Nonpoint Source Pollution Control Implementation Programs. NPS dischargers can comply either individually or collectively as participants in third-party coalitions. (The “third-party” Programs are restricted to entities that are not actual discharges under Regional Water Board permitting and enforcement jurisdiction. These may include Non-Governmental Organizations, citizen groups, industry groups, Watershed coalitions, government agencies, or any mix of the above.) All Programs must meet the requirements of the following five key elements described in the NPS Implementation and Enforcement Policy. Each Program must be endorsed or approved by the Regional Water Board or the Executive Officer (where the Regional Water Board has delegated authority to the Executive Officer).

Key Element 1: A Nonpoint Source Pollution Control Implementation Program’s ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.

Key Element 2: The Program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.

Key Element 3: The Program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.

Key Element 4: The Program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required (See Section 12, Monitoring Program).

Key Element 5: Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve a Program’*s* objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

Water Board staff held a CEQA meeting to identify environmental impacts and provide project status in June 2007. In general, the management measures that will be implemented will not adversely impact beneficial uses. Staff included documentation of environmental impacts and alternatives.

Water Board staff recognized numerous existing efforts and regulatory mechanisms aimed at reducing fecal coliform loading. These included, but are not limited to the following: ranchers implementing irrigation and grazing management measures, rural landowners maintaining individual sewage disposal systems and implementing management measures to control domestic animal wastes, owners and operators of irrigated agricultural lands providing sanitary facilities, measures to control human waste, and municipalities implementing storm water management measures. Staff identified possible implementation actions or alternatives for all sources (e.g. storm water, domestic animal waste) that may be contributing to the impairment. Actions that address fecal coliform reductions from nonpoint sources must be consistent with the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (SWRCB, 2004).

Staff discusses regulatory actions be developed or modified as part of TMDL implementation to address fecal coliform loading in the following section.

12.2 Implementation Actions

Staff discusses the proposed actions necessary for the Lower Salinas River watershed surface waters to attain fecal coliform water quality standards in this section. The actions are presented with the sources of fecal coliform to the Lower Salinas River watershed.

12.2.1 Urban Sources: Storm Drain Discharges to Municipally Owned and Operated Storm Sewer Systems (MS4s)

The Central Coast Water Board will address fecal indicator bacteria (FIB), i.e., fecal coliform and/or other indicators of pathogens, discharged from the City of Salinas's and the County of Monterey's municipal separate storm sewer systems (MS4s) by regulating the MS4 entities under the provisions of an individual municipal stormwater permit, or the State Water Resource Control Board's General Permit for the Discharges of Storm Water from Small Municipal Separate Storm Sewer Systems (General Permit). As enrollees under the an individual municipal stormwater permit or the General Permit, they must develop and implement a Storm Water Management Plan (SWMP) that controls urban runoff discharges into and from their MS4s. To address the MS4 TMDL wasteload allocations, the Central Coast Water Board will require the enrollees to specifically target FIB in urban runoff through incorporation of a Wasteload Allocation Attainment Program in their SWMPs.

The Central Coast Water Board will require the Wasteload Allocation Attainment Program to include descriptions of the actions that will be taken by the MS4 entity to attain the TMDL wasteload allocations, and specifically address:

1. Development of an implementation and assessment strategy;
2. Source identification and prioritization;
3. Best management practice identification, prioritization, implementation schedule, analysis, and effectiveness assessment;
4. Monitoring program development and implementation;
5. Reporting; including evaluation whether current best management practices are progressing towards achieving the wasteload allocations within thirteen years of the date that the TMDLs are approved by the Office of Administrative Law;
6. Coordination with stakeholders; and
7. Other pertinent factors.

The Wasteload Allocation Attainment Program will be required by the Central Coast Water Board to address each of these TMDLs that occur within the MS4 entities' jurisdictions.

The Central Coast Water Board will require the Wasteload Allocation Attainment Program to be submitted at one of the following milestones, whichever occurs first:

1. Within one year of approval of the TMDLs by the Office of Administrative Law;
2. When required by any other Water Board-issued storm water requirements (e.g., when the Phase II Municipal Storm Water Permit is renewed).

For MS4 entities that are enrolled under an individual municipal stormwater permit or the General Permit at the time of Wasteload Allocation Attainment Program submittal, the Wasteload Allocation Attainment Program must be incorporated into the SWMPs when they are submitted. For an MS4 that is not enrolled under the General Permit at the time of Wasteload Allocation Attainment Program submittal, the Wasteload Allocation Attainment Program must be incorporated into the SWMP when the SWMP is approved by the Central Coast Water Board.

The Executive Officer, pursuant to delegated authority, or the Central Coast Water Board will require information that demonstrates implementation of the actions described above, pursuant to applicable sections of the California Water Code and/or pursuant to authorities provided in the General Permit for storm water discharges.

12.2.2 Domestic Animal Waste Discharges

Owners and/or operators of lands containing domestic animals (including pets, farm animals, and livestock) in the Lower Salinas River watershed must comply with the Domestic Animal Waste Discharge Prohibition; compliance with the Domestic Animal Waste Discharge Prohibition is intended to result in compliance with the load allocation for these TMDLs.

Within three years of approval of these TMDLs by the Office of Administrative Law, the Executive Officer will notify owners and/or operators of lands used for/containing domestic animals of the requirement to comply with the Domestic Animal Waste Discharge Prohibition. In the notification, the Executive Officer will describe the options that owners/operators of lands containing domestic animals have for demonstrating compliance with the Domestic Animal Waste Discharge Prohibition. Within six months of notification by the Executive Officer pursuant to California Water Code section 13261 or 13267, owners/operators of lands containing domestic animals will be required to submit one the following to the Water Board:

1) Sufficient evidence to demonstrate that the owner/operator of lands containing domestic animals is and will continue to be in compliance with the Domestic Animal Waste Discharge Prohibition; Such evidence could include documentation submitted by the owner/operator to the Executive Officer that the owner/operator is not causing waste to be discharged to the Creek resulting in violations of the Prohibition, or
2) A plan for compliance with the Domestic Animal Waste Discharge Prohibition. Such a plan must include a list of specific management practices that will be implemented to control discharges containing fecal material from domestic animals. The plan must also describe how implementing the identified management practices are likely to progressively achieve the load allocations to domestic animals, with the ultimate goal achieving the load allocations no later than thirteen years after Office of Administrative Law approval of these TMDLs. The plan must include monitoring and reporting to the Central Coast Water Board, demonstrating the progressive progress toward achieving load allocations for discharges from domestic animals, and a self-assessment of this progress. The plan may be developed by an individual discharger or by or for a coalition of dischargers in cooperation with a third-party representative, organization, or government agency acting as the agents of owners/operators of lands containing domestic animals, or
3) A Report of Waste Discharge pursuant to California Water Code Section 13260 (as an application for waste discharge requirements).

12.2.3 Homeless Encampments

Owners of land that contain homeless persons and/or homeless encampments in the Lower Salinas River watershed must comply with the Human Fecal Material Discharge Prohibition.

Owners of land with homeless persons must demonstrate to the satisfaction of the Executive Officer or the Water Board that they are in compliance with the Human Fecal Material Discharge Prohibition; compliance with the Human Fecal Material Discharge Prohibition implies compliance with the load allocation for these TMDLs.

Within three years of approval of these TMDLs by the Office of Administrative Law, the Executive Officer will notify owners of lands containing homeless persons of the requirement to comply with the Human Fecal Material Discharge Prohibition. In his notification, the Executive Officer will also describe owners' options for demonstrating compliance with the Human Fecal Material Discharge Prohibition; pursuant to California Water Code 13267 and within six months of the notification by the Executive Officer, owners will be required to submit the following for approval by the Executive Officer or the Water Board:

1) Clear evidence that the owner/operator is and will continue to be in compliance with the Human Fecal Material Discharge Prohibition; clear evidence could be documentation submitted by the owner to the Executive Officer validating current and continued compliance with the Prohibition, or
2) A plan for compliance with the Human Fecal Material Discharge Prohibition. Such a plan must include a list of specific management practices that will be implemented to control discharges containing fecal material from homeless persons. The Plan must also describe how implementing the identified management practices is likely to progressively achieve the load allocation for homeless persons, with the ultimate goal achieving the load allocation no later than three years from the date of the Executive Officer's notification to the owner requiring compliance. The plan must include monitoring and reporting to the Central Coast Water Board, demonstrating the progress towards achieving load allocations for discharges from homeless persons, and self-assessment of this progress, or
3) Submittal of a Report of Waste Discharge pursuant to California Water Code Section 13260 (as an application for waste discharge requirements).

12.2.4 Illegal Dumping

Owners of lands where illegal dumping occurs are ultimately responsible for achieving the allocation for pathogen loading resulting from illegal dumping. However, the County of Monterey and the City of Salinas currently have programs and ordinances to address illegal dumping, and have been proactive in their effort to control these discharges. Illegal dumping is a violation of California Law and Monterey County Code (California Penal Code 374.3(A) and Monterey County Code, Chapter 10.41.040(A), respectively). The County of Monterey Health Department responds to illegal dumping complaints, prepares reports of investigation for the District Attorney's Office, engages in public outreach and education, and participates in programs that focus on minimizing illegal dumping. The County of Monterey and the City of Salinas actively prosecute individuals who are caught illegally dumping. The City of Salinas has devoted resources to watershed cleanup efforts to remove litter from City creeks. Both the City and the County have reportedly established telephone hotlines for citizens to report illegal dumping and they provide financial rewards for reporting parties.

The Executive Officer anticipates that existing programs and ordinances will achieve the allocation; therefore, no new regulatory mechanisms are warranted. Compliance with the allocation may be demonstrated through effective and proactive implementation and enforcement of existing regulatory authorities. The Executive Officer will assess progress and make changes if necessary during TMDL implementation tracking to achieve allocations for pathogen loading from illegal dumping.

12.2.5 Sanitary Sewer Collection System Leaks

Entities with jurisdiction over sewer collection systems can demonstrate compliance with these TMDL load allocations through waste discharge requirements and/or NPDES permits.

The City of Salinas, the Castroville Community Services District, and the California Utilities Service Wastewater Treatment Plant must continue to implement their Collection System Management Plans as required by waste discharge requirements.

In addition, the City of Salinas, the Castroville Community Services District, and the California Utilities Service Wastewater Treatment Plant (herein referred to as sanitary collection system jurisdictions) are required to improve maintenance of their sewage collection systems, including identification, correction, and prevention of sewage leaks in portions of the collection systems that run through, or adjacent to, impaired surface waters or their tributaries within the Lower Salinas River Watershed.

To this end, within six months following approval of these TMDLs by the Office of Administrative Law, the Executive Officer will issue letters to sanitary collection system jurisdictions pursuant to Section 13267 of the California Water Code requiring: 1) submittal within one year of approval of these TMDLs by the Office of Administrative Law a technical report that describes how and when the sanitary collection system jurisdictions will conduct improved collection system maintenance in portions of the collection system most likely to affect impaired surface water bodies, with the end result being compliance with its TMDL allocation, 2) stream monitoring for fecal coliform or another fecal indicator bacteria and reporting of these monitoring activities, and 3) annual reporting of self-assessment as to whether the sanitary collection system jurisdictions are in compliance with the TMDL allocation.

12.2.6 Other Implementation Actions for NPDES and WDR Point Source Dischargers

In Section 3.8 of this Project Report, staff outlined the permitted point sources that have discharges of industrial wastewater and wash water to surface waters of the Project Area, via the City of Salinas storm sewer system. These dischargers have not been identified at present as a significant contributor of controllable indicator bacteria loads to impaired water bodies, and as such are not identified as Responsible Parties requiring waste load allocations.

However, these dischargers were provided a California Water Code 13267 letter from the Central Coast Water Board's Executive Officer (dated October 24, 2006) outlining the reporting requirements for indicator bacteria that these discharge must provide. These dischargers are listed below:

- Cool Pacific Land Co., Salinas, CA. NPDES CAG993001 (since rescinded, permit pending)
- UNI-KOOL Salinas Facility, Salinas, CA. NPDES CAG993001
- UNI-KOOL Abbot Street Facility, Salinas, CA. NPDES CA0005720.
- Versacold Logistics, Salinas, CA. NPDES CAG993001.

At a minimum, staff will verify that the above facilities are complying with the indicator bacteria monitoring requirements, as outlined in the Central Coast Water Board's Executive Officer's 13267 letter dated October 24, 2006. More information will be obtained, if merited, during the implementation phase of the TMDL to further assess the level of FIB contribution from NPDES-permitted points source discharge entities and to identify any actions if necessary to reduce loading.

- California Utilities Service Wastewater Treatment Plant, Salinas, CA.
  WDR Order No. R3-2007-0008

The California Utilities WWTP must continue to implement its Collection System Management Plan, as required by Waste Discharge Requirements (WDRs) (Order No. R3-2007-0009). This Discharger has not been identified at present as a significant contributor of controllable indicator bacteria loads to impaired water bodies, and as such is not currently identified as Responsible Party requiring waste load allocations. The facility has had several discharges which were reportedly a potential threat to El Toro Creek. Should additional monitoring indicate impairment of El Toro Creek by indicator bacteria, California Utilities WWTP may be assigned a TMDL load allocation and may be required to demonstrate compliance with load allocations, in accordance with the Implementation Plan for Sanitary Sewer Collection System Leaks.

12.3 Evaluation of Implementation Progress

It is important to monitor water quality progress, track TMDL implementation, and modify TMDLs and implementation plans as necessary, in order to assess trends in water quality to ensure that improvement is being made; oversee TMDL implementation to ensure that implementation measures are being carried out; address any uncertainty in various aspects of TMDL development; and ensure that the TMDL remains effective, given changes that may occur in the watershed after TMDL development.

The primary measure of success for this TMDL is attainment or continuous progress toward attainment of the TMDL targets and load allocations. However, in evaluating successful implementation of this TMDL, attainment of trackable implementation actions will also be heavily relied upon. Therefore, we propose two types of monitoring for this TMDL: 1) water quality monitoring, and 2) monitoring of implementation of actions.

Every three years, beginning three years after the Office of Administrative Law approves the TMDLs, the Central Coast Water Board will perform a review of implementation actions, monitoring results, and evaluations submitted by responsible parties of their progress towards achieving their allocations. The Central Coast Water Board will use annual reports, nonpoint source pollution control implementation programs, evaluations submitted by responsible parties, and other available information to determine progress toward implementing required actions and achieving the allocations and the numeric target.

Responsible parties will continue monitoring and reporting according to this plan for at least three years, at which time the Central Coast Water Board will determine the need for continuing or otherwise modifying the monitoring requirements. Responsible parties may also demonstrate that although water quality objectives are not being achieved in receiving waters, controllable sources of pathogens are not contributing to the exceedance. If this is the case, the Central Coast Water Board may re-evaluate the numeric target and allocations. For example, the Central Coast Water Board may pursue and approve a site-specific objective. The site-specific objective would be based on evidence that natural, or background sources alone were the cause of exceedances of the Basin Plan water quality objective for fecal indicator bacteria.

Three-year reviews will continue until the water quality objectives are achieved. The compliance schedule for achieving the allocations and numeric target required under these TMDLs is 13 years after the date of approval by the Office of Administrative Law.

12.4 Timeline and Milestones

Staff anticipates that the allocations, and therefore the TMDL, will be achieved thirteen years from the date the TMDL becomes effective (which is upon approval by the California Office Administrative Law). This estimation is in part based on the amount of time necessary to identifying responsible parties of the nonpoint source prohibition. The estimation is also based on the uncertainty of the time required for in-stream water quality improvements resulting from management practices to be realized. Staff anticipates that the full in-stream positive effect of all the management measures will be realized gradually.

Stormwater permits or nonpoint source implementation programs may include additional provisions that the Central Coast Water Board determines are necessary to control pollutants (CWA section 402(p)(3)(B)(iii)). The Central Coast Water Board will consider additional requirements if implementation of management practices do not result in achievement of water quality objectives.

12.5 Economic Considerations

Porter-Cologne requires that the Central Coast Water Board take economic considerations, into account when requiring pollution control requirements (Public Resources Code, Section 21159 (a)(3)(c)). The Central Coast Water Board must analyze what methods are available to achieve compliance and the costs of those methods.

Staff identified a variety of costs associated with implementation of these TMDLs. Costs fall into four broad categories: 1) planning or program development actions (e.g., establishing nonpoint source implementation programs, conducting assessments, etc.); 2) implementation of management practices for permanent to semi-permanent features; and 3) TMDL inspections/monitoring; and 4) reporting costs.

Anticipating costs with any accuracy is challenging for staff for several reasons. Many of the actions, such as review and revision 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 nonpoint source implementation programs and establishing assessment workplans carry discrete costs. Cost estimates are further complicated by the fact that some implementation actions are necessitated by other regulatory requirements (e.g., Phase II Stormwater) or are actions anticipated regardless of TMDL adoption. Therefore assigning all of these costs to TMDL implementation would be inaccurate.

12.5.1 Cost Estimate Storm Drain Discharges

The State Water Resources Control Board adopted an NPDES General Permit for stormwater discharge. The General Permit requires the MS4 Entities to develop and implement a Stormwater Management Plan (SWMP). The Monterey Regional Water Pollution Control Agency (MRWPCA), the County of Monterey, and the City of Salinas have approved SWMPs and NPDES permit coverage.

Planning or Program Development Actions: The MS4 entities approved SWMPs and permit coverage, there Central Coast Water Board staff estimate no significant costs beyond the local agency program budget.
Implementation: To implement the requirements of the TMDL, the Central Coast Water Board may ask local agencies to develop additional management measures for fecal coliform reduction; identify measurable goals and time schedules for implementation; develop a monitoring program; and assign responsibility for each task. The specifics of the stormwater program efforts will not be known until Central Coast Water Board adoption of the SWMP occurs. An estimate of the stormwater program efforts and their associated costs are provided below.

The University of Southern California conducted a survey of NPDES Phase I Stormwater Costs in 2005 (Center for Sustainable Cities, University of Southern California, 2005). They determined the annual cost per California household ranged from $18 to $46. However, these costs were just to keep the existing plan running and did not include start-up costs which may increase the total cost per household. According to Central Coast Water Board Stormwater Unit staff, recently approved Phase II SWMPs in Region 3 ranged from $21 to $130 per household. Stormwater Unit staff reported that the wide range of costs in both cases was based on many factors including the amount of revenue generated by the municipality, the size of the area covered by the SWMP, and because some municipalities did not include the cost of programs such as street sweeping that are already accounted for in other program budgets, while other municipalities did include this cost.

It was difficult for staff to estimate the cost of a SWMP for the above reasons. To get a rough idea of how much a SWMP program would cost in the Lower Salinas River River watershed, staff calculated an average annual cost from the range of costs for recently approved Phase II SWMPs in Region 3 ($21 in Seaside to $130 in the City of Monterey). Staff calculated an average annual cost of $77 per household. Staff used this cost per household to estimate the cost per year of SWMP implementation in the Lower Salinas River watershed, based on an estimate of the population residing within census designated entities that meet the criteria for requiring coverage under the NPDES General Permit for MS4s. Areas that typically may require coverage under an MS4 include cities, unincorporated areas, and census designated places with high population density (greater than 1,000 residents per square mile) (SWRCB, 2003). Staff tabulated housing and population estimates for Census-designated urbanized areas, urbanized clusters, and census-designated places that fall within MS4 NPDES permit boundaries, and meet the high population density criteria. Table 12-1 shows the estimated cost per year of SWMP implementation in these areas:

Table 12-1. Estimated Annual Cost for SWMP Implementation.

Census Defined Areas with > 1,000 residents per Sq. mile in Project Area, and within SWMP Permit Boundaries		**Population**	**Housing units**	**Density per square mile of land area**		**Total Cost per Household ($77 per housing unit)**
				Population density	**Housing unit density**	
Castroville CDP[A]		6,724	1,462	6,656.1	1,447.2	$112,574
Chualar CDP[A]		1,444	286	2,392.9	473.9	$22,022
Gonzales UC[A]		7,525	1,754	5,429.4	1,243.9	$135,058
Salinas UA[B]	City of Salinas	140,499	42,602	7,948.4	2,086.8	$3,280,354
	Remainder of Salinas UA (e.g., Boronda, El Toro Area, Bolsa Knolls)	26,792	8,093			$623,161
Spreckels CDP[A]		485	176	3,629.3	1,317.0	$13,552
Total			**52,911**			**$4,186,721**

UA=Urbanized Area; UC=Urbanized Cluster; CDP=Census Designated Place

A: Data is from Decennial Census 2000. More recent vintage data on housing units is generally only available at the City, County and National level, not at the smaller-scale CCD or CDP level.
B: Data is from 2007 American Community Survey, U.S. Census Bureau

It is important to emphasize that SWMP implementation *is required, with or without the incremental costs associated with an FIB control program*. Therefore, the costs noted in Table 12-1 are incurred regardless of the implementation requirements in this project report. Additional implementation measures or management programs may be needed for fecal coliform reductions. Staff does not know the specific measures 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*, June 14, 2006, Marin County estimated additional pathogen-specific measures would result in a two to 15 percent increase to their annual SWMP program budget. Therefore staff estimates a range of incremental costs of implementing SWMP bacteria-control measures, between a two percent annual increase (minimum) and a 15% annual increase (maximum), shown in Table 12-2.

Table 12-2. Estimated Range of Incremental Costs to SWMP Program Associated with Implementing Bacteria Control Measures.

Census Defined Areas with > 1,000 residents per Sq. mile in Project Area, and within SWMP Permit Boundaries		**Population**	**Housing units**	**Total Cost per Household ($77 per housing unit)**	**<u>2% Incremental Cost Increase</u> Associated with FIB-Control Program**	**<u>15% Incremental Cost Increase</u> Associated with FIB-Control Program**
Castroville CDP		6,724	1,462	$112,574	$2,251	$16,886
Chualar CDP		1,444	286	$22,022	$440	$3,303
Gonzales UC		7,525	1,754	$135,058	$2,701	$20,259
Salinas UA	City of Salinas	140,499	42,602	$3,280,354	$65,607	$492,053
	Remainder of Salinas UA (e.g., Boronda, El Toro Area, Bolsa Knolls)	26,792	8,093	$623,161	$12,463	$93,474
Spreckels CDP		485	176	$13,552	$271	$2,033
<u>Subtotal for City of Salinas</u>- Estimated Range of Incremental Costs					**$83,734**	**$628,008**
<u>Subtotal for Unincorporated Portion of County of Monterey</u> in Project Areas that are within SWMP Permit Boundaries					**$18,127**	**$135,955**
Range of <u>Total</u> (City plus County) Estimated Incremental Costs in Project Area					**$101,862**	**$763,963**

Inspections/Monitoring: Central Coast Water Board staff is proposing that MS4 Entities monitor storm drains. The purpose of the monitoring is to determine the effectiveness of management measures. (The Central Coast Water Board will not impose targets/allocations as effluent limits on the County.)

Central Coast Water Board staff estimated monitoring will cost the County approximately $5,600 per year. According to John Ricker County of Santa Cruz Environmental Health Services, the cost of sampling is $40 for sample collection and field analysis plus $20 for each bacterial per sample (personal communication, September 18, 2007), for a total of $60 per sample. Staff proposed the County sample each storm drain 10 times per year. Staff also estimated approximately 6 sample sites will be analyzed per year. Therefore, staff estimated the total water sampling cost per year at approximately $3,600 ($60/sample x 10 samples x 6 sites). Water Board staff also assumed County staff resources will cost $200 per sampling day. Therefore total sampling costs per year including staff resources would cost approximately $5,600 ($3,600 + ($200/sampling day x 10 sampling days/year)). Based on this information, staff estimates the cost of $5,600 for the three MS4 Entities will total $16,800.

Reporting: The MS4 Entities are required to report independent of the TMDL under Phase II of the municipal stormwater program. Therefore, no costs have been estimated for reporting.

12.5.2 Cost Estimate Domestic Animal Discharges

Staff has endeavored to evaluate and provide a range of cost estimates associated with rangeland and grazing animal management practices. Cost estimates shown here were tabulated from sources provided by the National Resources Conservation Service, U.S. Environmental Protection Agency, U.S. Department of Agriculture, and other sources.

While it is possible to identify a discrete range of costs associated with implementing management practices, there is substantial uncertainty in calculating total costs associated with future measures. This is in part, due to the uncertainty surrounding the number of facilities, ranches, farms, etc. that will require implementation. Also, it is important to note that the Water Board cannot mandate or designate the specific types of on-site actions necessary to reduce indicator bacteria loading, or to meet allocations by the various responsible parties. Specific actions or management measure that are described or identified in the project report can only be suggestions or examples of actions that are known to be effective at reducing loading.

Planning or Program Development Actions: The cost to develop FIB control measures at these facilities will vary from site to site depending upon constraints present at each site. Central Coast Water Board staff estimate approximately eight hours is necessary for planning control actions.

Implementation: Staff concluded there are a variety of methods owners of domestic animals can use to help control wastes. Some methods include installing livestock exclusion barriers, stables for horses, corrals, and manure bunkers at locations that prevent runoff from entering surface waters.

1. Livestock Exclusion Barriers: According to the U.S. EPA, the cost of permanently excluding livestock from areas where animal waste can impact surface waters ranges from $2,474/mi to $4,015/mi (*Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. 840-B-92-002,* United States Environmental Protection Agency, January 1993).

2. Horse Stables: Horses can be boarded at stables. According to the American Miniature Horse Association, miniature horses can be boarded in a professional stable for $50 to $150 per month per horse and full size horses can be boarded for $200 to $550 per month per horse. The cost depends on the facilities, pasture, and riding opportunities (http://www.amha.com/MarketTools/Profitibility.html).

3. Corral Cost: According to a Progressive Farmer website, a corral (excluding the head gate) can cost less than $7,000. Gates cost (at the most) between $3,000 and $4,000 (http://www.progressivefarmer.com/farmer/animals/article/0,24672,1113452,00.html)

4. Manure Bunker Costs: Ecology Action has worked with landowners to install manure bunkers. Manure bunkers help prevent stormwater from infiltrating the manure thereby causing runoff of pollutants from the manure. According to Ecology Action, the average cost for constructing a manure bunker on properties in the Aptos Creek watershed was approximately $4,000. (Each bunker was constructed on an existing cement slab, or a new one was poured and employed some type of cover - either a permanent roof or a tarp.) The cost of bunker construction varies greatly depending on the size and materials choice. When looking at bunkers for the entire program, costs ranged from $3,000 to $15,000 (Reference: E-mail dated 5-1-2007 from Jennifer Harrison of Ecology Action).

Inspections/Monitoring: The landowner cost for inspections/monitoring will vary depending upon the elements of the Nonpoint Source Implementation Program. The cost could be low for frequent periodic property inspections to assess and prevent discharges. Costs are higher if a landowner performs water quality monitoring.

Reporting: Central Coast Water Board staff estimated it would take approximately eight hours of land owner time to prepare a report to the Water Board. This report is required every three years.

Tabulated Example Costs: Costs associated with on-site management practices for rangeland, grazing animals, and domestic farm animal operations, are tabulated in Table 12-3.

Table 12-3. Example Costs for Grazing Animal Management Practices.

Practices	Cost (Maximum, unless otherwise noted)	Practices	Cost (Maximum, unless otherwise noted)
Access Road (repair)	$5/ft.	Pond (repair)	$10,000 ea.
Attend Training Sessions	Usually <$40 (transportation/registration fess)**	Range Seeding:	
Brush Mgt.	$10/ac.	Native species	$250/ac.
Channel Vegetation	$600/ac.	Introduced species	$100/ac.
Clearing and Snagging	$10/ft.	Riparian Buffer Strip	$600/ac.
Conservation Tillage	$20/ac.	Roads*	
Cover/Green Manure Crop:		Culverts and Water Bars	$150/mile
Native species	$250/ac.	Road Repairs	$1,500/mile
Introduced species	$100/ac.	Spring Development	$1,000/ea.
Critical Area Planting	$1,000/ac.	Streambank Protection:	
Fence (upland)	$2/ft.	mechanical	$100/ft.
Fence (riparian)	$2/ft.	Vegetative	$12.50/ft.
Fence, Electric (upland)	$1.25/ft.	Tank	$2,500 ea.
Fence, Electric (riparian)	$1.25/ft.	Tree Planting w/ irrigation	$600/ac.
Grade Stabilizer	$20,000 ea.	Tree Planting w/o irrigation	$300/ac.
Grassed Waterways	$20/ft.	Trough (w/ concrete pad)	$1,000 ea.
Grazing Management:		Trough (w/o concrete pad)	$800/ea.
Hardened Stream Crossings	$2,000 to $6,000**	Trough (small wildlife)	$500/ea.
Prescribed Grazing	$6.95/ac. (median)**	Upland Wildlife Habitat Mgt.	$400/ac.
Provide Shade away from riparian area	$500/accommodate 5-6 cows**(moveable shading structures)	Vegetative Buffer Strip:	
Remote waterers in pastures	$4,500 to $8,200 to install (could be <$1,000 if water piped from existing well)**	Native Species	$200/ac.
Rotational Grazing	$30 to $70/acre	Introduced Species.	$75/ac.
Streamside livestock exclusion	(see fence est.) Funding may be available through local conservation office**	Wildlife Watering Facility	$4,000/ea.
Pipeline	$1.25/ft.		

Source: NRCS Templeton Service Center Environmental Quality Improvement Program Practices Information (as reported in CCRWQCB Watsonville Slough Pathogen TMDL Project Report, 2005)
* Estimate provided by Cal Poly State Univ. for Chumash Creek Watershed road improvements.
** U.S. Dept. of Agriculture and South Dakota State Univ., 2008. Reicks et al., “Better Management Practices for Improved Profitability and Water Quality” : SDSU publication FS994

12.5.3 Cost Estimate Homeless Encampments

Planning or Program Development Actions: The approaches used to control homeless encampment waste can range from a land owner 1) installing barriers to 2) participating with local agencies to develop a comprehensive Watershed-wide solution. Water Board staff estimate the planning cost for an approach such as installing barriers may require approximately eight hours of land owner time.

Landowners may devote more time to comprehensive Watershed-wide approaches.

Homeless Person/Encampment Waste Plan Implementation: The Water Board will identify possible properties with homeless encampments. The methods used to control these wastes will be developed by landowners as part of their Nonpoint Source Management Plan. However, a few possibilities include hiring security to patrol areas used by homeless, utilizing portable toilets, and fencing. The web site http://www.security-ess.com/DesignDetail.html indicates the cost of security guards range from $25 - $40 per hour. This service provides guards for a six hour minimum per guard per day. Staff contacted a service that provides portable toilets. This service provides a portable toilet for $95 per month (personal communication with Ace Portable Services, Santa Cruz, CA, January 23, 2007). Staff also contacted a service that provides security fences. The cost of a six foot chain link fence with 3 strands of barbed wire on the top is $1,800 per 100 feet or $15,000 per 1000 feet (personal communication with Affordable Fence Company, Santa Cruz, CA, January 23, 2007.)

Inspections/Monitoring: Land owners could utilize various approaches to inspect lands for homeless encampments. Again, the approach is dependant upon whether the land owner uses an approach in which the land owner is responsible for inspecting the property or local agencies are able to provide inspection services. The cost for security guards, mentioned above, is one means to estimate this cost.

Reporting: The Water Board will identify possible properties with homeless encampments. All land owners are required to submit triennial reports to the Water Board. All land owners shall submit a report documenting that measures are in place and effectively minimizing discharges or demonstrating that no discharge is occurring from homeless encampments. Water Board staff estimate this report will require approximately eight hours of land owner time.

12.5.4 Cost Estimate for Sanitary Sewer Collection and Treatment Systems Spills and Leaks

Implementation: All sanitary sewer activities specified in the Basin Plan amendment are currently required under the existing Water Board permits and requirements. No new costs are anticipated as a result of these TMDLs.

Inspections/Monitoring: These costs are currently required by Central Coast Water Board permits.

Reporting: These costs are currently required by Central Coast Water Board permits.

13 MONITORING PLAN

13.1 Introduction

The Monitoring Plan outlines the monitoring sites, frequency of monitoring, and parties responsible for monitoring. The monitoring proposed below for complying with the TMDLs is the minimum staff finds is necessary. However, if a change in these requirements is warranted after the TMDLs are approved; the Executive Officer and/or the Central Coast Water Board will require such changes.

13.2 Monitoring Sites, Frequency, and Responsible Parties

The following monitoring plan proposes specific monitoring sites, frequency, and indicators to be monitored. *Water Board Staff will work with parties responsible for monitoring when the implementation and monitoring phase of the project commences, and will make revisions, if appropriate, to the monitoring plan outlined below.*

Central Coast Water Board will require the responsible parties to perform fecal coliform monitoring in receiving waters. Staff identified 14 receiving water monitoring locations that would allow the Central Coast Water Board to evaluate attainment of the TMDL and allocations (Table 13-1). The Central Coast Water Board will require the responsible parties to perform fecal coliform monitoring in receiving waters

Staff also proposes fecal coliform monitoring for urban stormwater outfall discharges (Table 13-2). The purpose of storm drain sampling is to assess the effectiveness of management measures. *Storm drain samples will not be used to determine if the TMDL is attained. The Central Coast Water Board will use receiving water samples to determine compliance.* Monterey County and the City of Salinas will identify which of their MS4 stormwater outfalls they will monitor, based on the outfalls' representativeness and relative discharge (loading potential) to impaired receiving waters, among other factors.

Monitoring activities will commence as directed by the Executive Officer of the Central Coast Water Board. Each party responsible for monitoring will be required to provide the data to the Central Coast Water Board.

Staff proposes fecal coliform monitoring in receiving waters at the following sites:

Table 13-1. Proposed Monitoring Locations.

Site Code	Waterbody	Site Location	Latitude -	Longitude
309-SDD[A]	Salinas River	Salinas River near Davis Road d/s of City Outfall	36.64325	-121.69900
309-ALD[B]	Reclamation Canal	Reclamation Canal at Boronda Road	36.69021	-121.680567
SAL-MON[B]	Salinas River Lagoon (north)	Salinas River at Monte Road	36.731117	-121.745283

Site Code	Waterbody	Site Location	Latitude -	Longitude
OLS-MON[B]	Old Salinas River	Old Salinas River @ Monterey Dunes Way	36.771683	-121.789667
309-UAL[A]	Alisal Creek	Alisal Creek @ Alisal Road	36.645417	-121.577033
GAB-NAT[C]	Gabilan Creek	Gabilan Creek @ Natividad Road	36.731483	-121.61245
GAB-CRA[C]	Gabilan Creek	Gabilan Creek @ Crazy Horse Road	36.771383	-121.602267
GAB-VET[C]	Gabilan Creek	Gabilan Creek @ Veteran's Park	36.693917	-121.627283
TOW-OSR[C]	Towne Creek	Towne Creek @ Old Stage Road	36.79557	-121.57503
NAT-LAS[C]	Natividad Creek	Natividad Creek at Las Casitas Dr.	36.69823	-121.60905
309-SRITA-36[D]	Santa Rita Creek	Santa Rita Creek at North Main St. and E. Bolivar Street	36.725486	-121.658422
TEM-PRE[B]	Tembladero Slough	Tembladero Slough at Preston Road in Castroville	36.765	-121.759517
QUA-POT[B]	Quail Creek	Quail Creek @ Potter Road	36.611267	-121.548383
CHU-CRR[B]	Chualar Creek	Chualar Creek at Chualar River Road	36.5583	-121.5296

[A] City of Salinas Site Code
[B] Central Coast Ambient Monitoring Program (CCAMP) Site Code
[C] Central Coast Watershed Studies (CCoWS) Site Code
[D] CleanStreams Site Code

Tables 13-2 and 13-3 identify the monitoring required for the Lower Salinas River Watershed Fecal Coliform TMDL.

Table 13-2. Proposed Receiving Waters Monitoring Requirements.

RECEIVING WATER MONITORING					
Monitoring Location(s)	**Constituent**	**Sampling Entities/Responsible Parties**	**Controllable Sources**	**Sampling Frequency**	
Salinas River near Davis Road d/s of City Outfall	Fecal Coliform	City of Salinas County of Monterey Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Reclamation Canal @ Boronda Road	Fecal Coliform	City of Salinas Salinas Industrial WWTP Owners/Operators of Lands w/Domestic Animals Owners/Operators of Lands	MS4 Stormwater Spills and Leaks (Collection System) Domestic Animal Fecal Material	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)

RECEIVING WATER MONITORING						
Monitoring Location(s)		**Constituent**	**Sampling Entities/Responsible Parties**	**Controllable Sources**	**Sampling Frequency**	
			w/Homeless Encampments Owners/operators of land used for illegal dumping	Human Fecal Material Illegal Dumping	Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Salinas River Lagoon (north) @ Monte Rd.		Fecal Coliform	County of Monterey Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
					Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Old Salinas River @ Monterey Dunes Way		Fecal Coliform	County of Monterey Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
					Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Alisal Creek @ Alisal Road		Fecal Coliform	Owners/Operators of Lands w/Domestic Animals Owners/Operators of Lands w/Homeless Encampments Owners/operators of land used for illegal dumping	Domestic Animal Fecal Material Human Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
					Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Gabilan Creek	@ Natividad Road	Fecal Coliform	Owners/Operators of Lands w/Domestic Animals Owners/Operators of Lands w/Homeless Encampments Owners/operators of land used for illegal dumping	Domestic Animal Fecal Material Human Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
	@ Crazy Horse Road				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May through September)
	@ Veteran's Park	Fecal Coliform	City of Salinas Owners/operators of land used for illegal dumping	MS4 Stormwater Spills and Leaks (Collection System) Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
					Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)

RECEIVING WATER MONITORING					
Monitoring Location(s)	**Constituent**	**Sampling Entities/Responsible Parties**	**Controllable Sources**	**Sampling Frequency**	
Towne Creek @ Old Stage Road	Fecal Coliform	Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Natividad Creek @ Las Casitas Dr.	Fecal Coliform	City of Salinas Owners/Operators of Lands w/Domestic Animals Owners/Operators of Lands w/Homeless Encampments Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Human Fecal Material Spills and Leaks (Collection System) Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Santa Rita Creek @ North Main St. and E. Bolivar Street	Fecal Coliform	County of Monterey City of Salinas Owners/Operators of Lands w/Domestic Animals Owners/Operators of Lands w/Homeless Encampments Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Human Fecal Material Spills and Leaks (Collection System) Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Tembladero Slough @ Preston Road	Fecal Coliform	County of Monterey Castroville Water District Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	MS4 Stormwater Domestic Animal Fecal Material Spills and Leaks (Collection System) Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)
Quail Creek @ Potter Rd.	Fecal Coliform	Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)

RECEIVING WATER MONITORING					
Monitoring Location(s)	**Constituent**	**Sampling Entities/Responsible Parties**	**Controllable Sources**	**Sampling Frequency**	
Chualar Creek @ Chualar River Road	Fecal Coliform	Owners/Operators of Lands w/Domestic Animals Owners/operators of land used for illegal dumping	Domestic Animal Fecal Material Illegal Dumping	Wet Season (Jan.-March)	Five samples collected over one 30-day period in each wet season (January 1 through March 31)
				Dry Season (May-Sept.)	Five samples collected over one 30-day period in each dry season (May 1 through September 30)

Table 13-3. Proposed Storm Drain Monitoring Requirements.

STORM DRAIN MONITORING				
Monitoring Location(s)[1]	**Constituent**	**Sampling Entities/Responsible Parties**	**Controllable Sources**	**Sampling Frequency**
City of Salinas Storm Drain that empties to Salinas River near Davis Road (for example, City of Salinas Outfall Site 309-SDD)	Fecal Coliform	City of Salinas	MS4 Storm Water	-Event-Based (Wet Weather) Outfall Monitoring, To Be Determined -Non-storm (Dry Weather) Outfall Monitoring, To Be Determined
City of Salinas Storm Drain that empties to Reclamation Ditch (for example, City of Salinas Outfall Site 309-U52)	Fecal Coliform	City of Salinas	MS4 Storm Water	-Event-Based (Wet Weather) Outfall Monitoring, To Be Determined -Non-storm (Dry Weather) Outfall Monitoring, To Be Determined
County of Monterey Storm Drain that empties to Tembladero Slough from Castroville (for example, County Outfall MC-2 or MC-3)	Fecal Coliform	County of Monterey Regional Group	MS4 Storm Water	-Event-Based (Wet Weather) Outfall Monitoring, To Be Determined -Non-storm (Dry Weather) Outfall Monitoring, To Be Determined
County of Monterey Storm Drain or Drainage Ditch, To Be Determined	Fecal Coliform	County of Monterey Regional Group	MS4 Storm Water	-Event-Based (Wet Weather) Outfall Monitoring, To Be Determined -Non-storm (Dry Weather) Outfall Monitoring, To Be Determined
County of Monterey Storm Drain or Drainage Ditch, To Be Determined	Fecal Coliform	County of Monterey Regional Group	MS4 Storm Water	-Event-Based (Wet Weather) Outfall Monitoring, To Be Determined -Non-storm (Dry Weather) Outfall Monitoring, To Be Determined
[1] To be determined by the City and County and approved by the Executive Officer of the Central Coast Water Board				

The above monitoring may be done in concert with the Water Board's CCAMP existing five-year rotational monitoring in the project area. The next CCAMP monitoring rotation in the Lower Salinas Watershed is anticipated 2011-12.

As shown in Table 13-2 most waterbodies have more than one responsible party indicated for monitoring sites. This reflects the fact that multiple parties are known to be probable or, potential sources of controllable pathogen loads and thus share responsibility for monitoring. Therefore responsible parties could collaborate in monitoring at these locations.

The monitoring frequency at all receiving water sites satisfies the minimum number of samples needed to evaluate compliance with the Basin Plan water quality objective for indicator organisms in REC-1 waters (five samples must be drawn in a 30-day period). As shown in Table 13-2, responsible parties will monitor receiving waters according to the following schedule:

Receiving Waters – Five samples from each of fourteen monitoring sites collected over one 30-day period in each of the following seasons:

- ✓ Wet Season: January 1 – March 31
- ✓ Dry Season: May 1 – September 30

The wet season time frame of January 1 to March 31 was identified because water quality monitoring data show that project area median indicator bacteria concentrations are particularly elevated from January through March (see Figure 3-3).

In addition to the receiving water locations, staff also proposes fecal coliform monitoring in storm water drain discharges, as shown above in Table 13-3. Staff will coordinate with MS4 Entities to determine the appropriate number and locations of sampling sites to characterize the severity and extent of fecal coliform concentrations in urban runoff. Staff provisionally proposes that samples should be taken during three storm events and during two dry season flows (when present).

Stormwater Outfalls – Storm-event sampling in wet season; and representative non-storm discharges in dry season (when flow present):

- ✓ Wet Season: October 15 – April 30
- ✓ Dry Season: May 1 – October 14

Where landowners need to demonstrate their activity is not passing fecal material into waters, landowner monitoring for pathogen indicator organisms may provide evidence of complying with load allocations. Landowners have the option of performing individual monitoring or participating in a cooperative monitoring program. Individual landowner monitoring can comprise either water quality monitoring or other forms of monitoring (such as a report documenting visual site inspections supported by site photos). Central Coast Water Board staff will review data every three years to determine compliance with the TMDL. If the Executive Officer determines additional monitoring is needed, the Executive Officer shall request it pursuant to applicable sections of the California Water Code.

13.3 Reporting

The parties responsible for implementation and monitoring will incorporate the results of monitoring efforts in reports filed pursuant to the NPDES permit, Small MS4 Stormwater Permit, Nonpoint Source Implementation Program, or other correspondence as requested by the Central Coast Water Board pursuant to California Water Code Section 13267 or 13383.

If reporting changes become necessary based on staff's assessment of the TMDL implementation progress, the Executive Officer of the Central Coast Water Board will require such changes. At a minimum, the Central Coast Water Board will evaluate monitoring reporting data and implementation reporting information every three years.

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